SEA LAMPREY CONTROL IN THE GREAT LAKES 2019

ANNUAL REPORT TO
THE GREAT LAKES FISHERY COMMISSION

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Cover: Sea Lamprey in live tank at Sea Lamprey Control Outreach booth at the Duluth Boat, Sports, Travel and RV Show in Duluth, MN, 2019. (Photo: Stefanie Grand, DFO)

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SEA LAMPREY CONTROL IN THE GREAT LAKES 2019

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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 2019, 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 96 tributaries and 21 lentic areas. A total of 73 barriers, (48 purpose-built, 25 modified to serve as a Sea Lamprey barrier) were operated to block Sea Lamprey migration and serve as an alternative control to the use of lampricides. Larval assessment crews surveyed 512 Great Lakes tributaries and 71 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 39 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 13,133 (95% CI; 8,518 – 17,749), which was greater than the target of 10,421. In Lake Michigan, the index of adult abundance was estimated to be 16,844 (95% CI; 12,942 – 20,746), which was less than the target of 34,982. In Lake Huron, the index of adult abundance was estimated to be 32,268 (95% CI: 28,641 – 35,895), which was greater than the index target of 31,274. In Lake Erie, the index of adult abundance was estimated to be 1,587 (95% CI; 1,105 – 2,070), which was less than the target of 3,263. In Lake Ontario, the index of adult abundance was estimated to be 11,844 (95% CI; 9,459 – 14,229), which is less 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 Lamprey 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 are killed by 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 salmonines by minimizing Sea Lamprey impacts on these stocks. This report outlines the program's efforts in 2019 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 five-year period when Sea Lamprey marking rates resulted in 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 a five-year period when marking rates were closest to 5 A1-3 marks per 100 Lake Trout >532 mm. Similarly, a target was developed for Lake Ontario from the estimated average 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 and range was calculated as 25% of the estimated average during the five-year period 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 indexes 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.*

The adult index target for Lake Superior of 10,421 Sea Lamprey was calculated from the average abundance estimated for 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). During 2019, the index of adult abundance in Lake Superior was estimated to be 13,133 (95% CI; 8,518 – 17,749), which is greater than the index target. The number of A1-A3 marks on Lake Trout from spring assessments in 2019 was 5.7 marks per 100 Lake Trout >532mm.

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 calculated from the average abundance estimated for 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. During 2019, the index of adult abundance in Lake Michigan was estimated to be 16,844 (95% CI; 12,942 – 20,746), which is less than the index target. The number of A1-A3 marks on Lake Trout from fall assessments in 2019 was 2.3 marks per 100 Lake Trout >532mm.

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 calculated as 25% of the average abundance estimated 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 explicit target was not based on observed marking rates that resulted in a tolerable annual Lake Trout mortality rate. During 2019, the index of adult abundance in Lake Huron was estimated to be 32,268 (95% CI: 28,641 – 35,895), which is more than the index target. The number of A1-A3 marks on Lake Trout from spring assessments in 2019 was 6.3 marks per 100 Lake Trout >532mm.

Lake Erie

The *Fish Community Goals and Objectives for Lake Erie* does not include a specific Sea Lamprey objective; however, it does acknowledge that effective Sea Lamprey control is needed to support the fish community objectives for Lake Erie, especially those related to Lake Trout restoration:

- *Eastern basin – provide sustainable harvests of Walleye, Smallmouth Bass, Yellow Perch, Whitefish, Rainbow Smelt, Lake Trout, Rainbow Trout, and other salmonines; restore a self-sustaining population of Lake Trout to historical levels of abundance.*

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 calculated from the average abundance estimated for 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). During 2019, the index of adult abundance in Lake Erie was estimated to be 1,587 (95% CI; 1,105 – 2,070), which is less than the index target. The number of A1-A3 marks on Lake Trout from fall assessments in 2019 was 5.2 marks per 100 Lake Trout >532mm.

Lake Ontario

The Lake Ontario Committee established the following goal for Sea Lamprey control in Lake Ontario:

- *Suppression of Sea Lamprey populations to early-1990s levels.*

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 target 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 calculated from the average abundance estimated for 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). During 2019, the index of adult abundance in Lake Ontario was estimated to be 11,844 (95% CI; 9,459 – 14,229), which is less than the index target. The number of A1 marks on Lake Trout from fall assessments in 2019 was 0.6 marks per 100 Lake Trout >431mm.

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 (70% wettable powder or 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 2019 is presented in the LCTF section of this report.

During 2019, lampricide treatments were conducted on 96 tributaries and 21 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 2019.

Lake	Number of Streams	Number of Lentic Areas	Discharge (m^3/s)	Distance Treated (km)	TFM (kg) [1,2]	Bayluscide (kg) [1,3]
Superior	45	16	274	1,071	29,019	493
Michigan	22	2	223	1,122	34,253	85
Huron	13	3	84	142	6,182	1,611
Erie	6	0	42	139	8,109	1
Ontario	10	0	33	146	7,055	1
Total	**96**	**21**	**656**	**2,620**	**84,618**	**2,191**

[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.

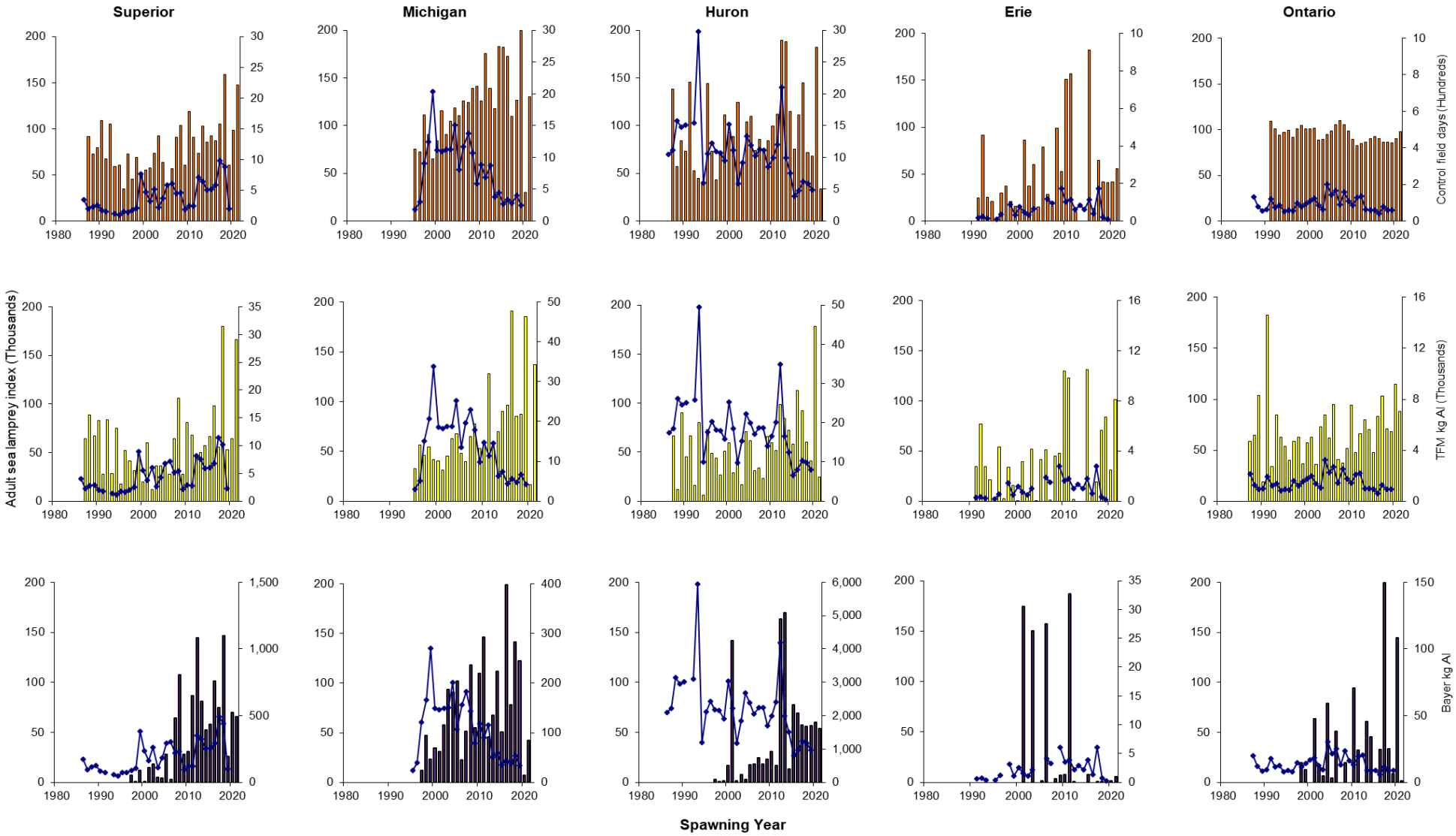

Figure 1. Row 1: Number of control field days (orange bars). Row 2: TFM used (kg active ingredient, yellow bars). Row 3: Bayluscide used (kg active ingredient, purple bars). All rows: Index of adult Sea Lamprey is shown with blue lines. All metrics plotted against the Sea Lamprey spawning year. Control 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.

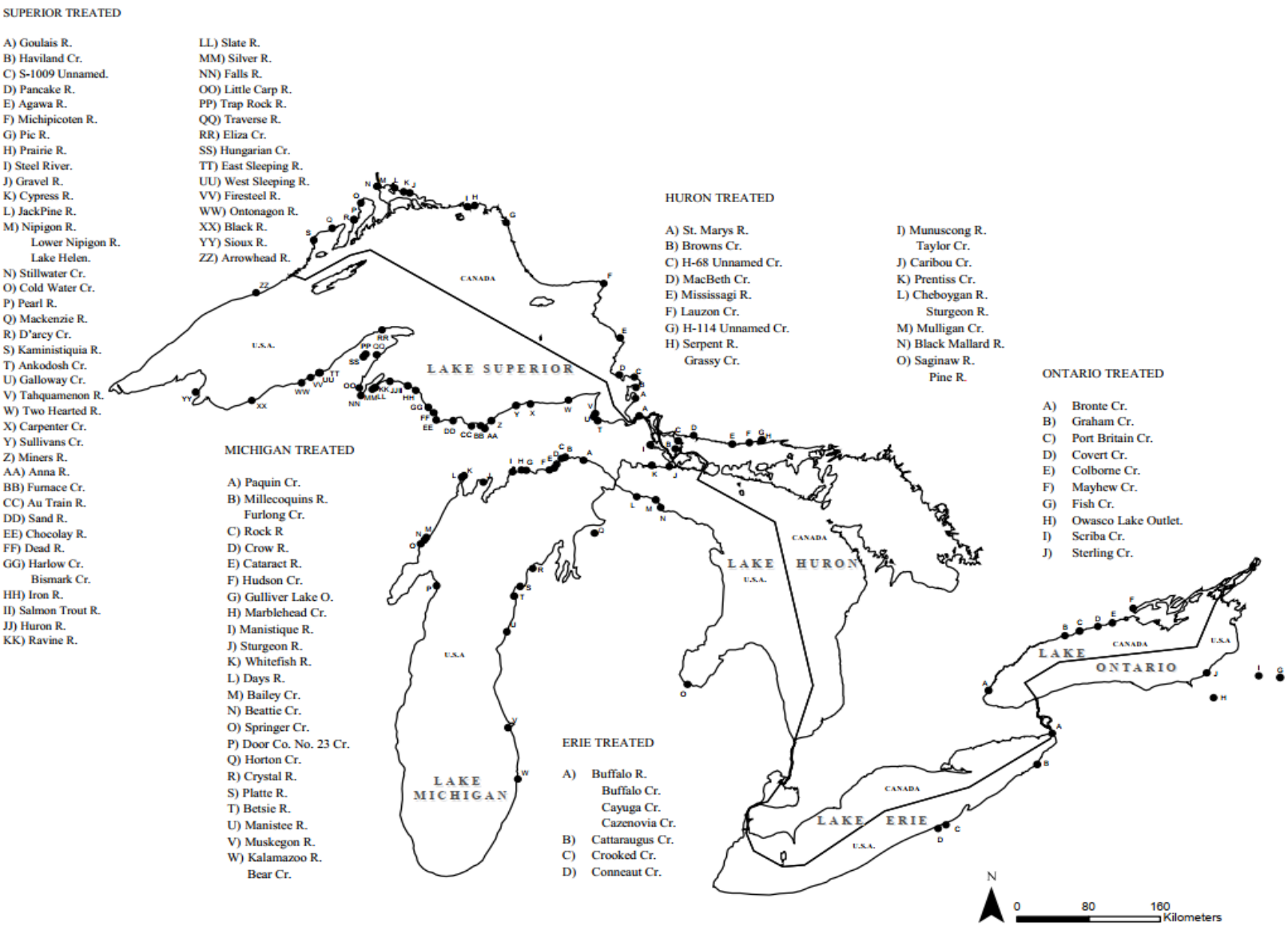

Figure 2. Location of tributaries treated with lampricide in 2019.

Lake Superior

Lake Superior has 1,566 tributaries (833 Canada, 733 U.S.). One hundred sixty-eight tributaries (58 Canada, 110 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 2010-2019. Fifty-six tributaries (20 Canada, 36 U.S.) are treated every 4-6 years. Details on lampricide applications to Lake Superior tributaries and lentic areas during 2019 and tributary locations are found in Table 2 and Figure 2.

- Lampricide treatments were completed in 45 tributaries (14 Canada, 31 U.S.) and in 16 lentic areas (8 Canada, 8 U.S.).

- Hungarian Creek and the lentic area associated with Eliza Creek were treated for the first time.

- The Ontonagon and East Sleeping rivers were treated under unusually high discharge conditions.

- Multiple rain events occurred during treatments of the Two Hearted and Traverse rivers. Excessive runoff can provide refuge for larvae and increase the potential for survival. Post treatment surveys will be conducted in the upcoming 2020 field season to determine treatment effectiveness.

- The required flows for the Michipicoten River could not be provided due to equipment failure with a generator at the Scott Falls Generating Station. The river was deferred for treatment until 2020.

- Treatments of the Chippewa, Pays Plat, Little Pays Plat and Jackfish rivers were deferred due to environmental conditions impacting water levels.

Table 2. Details on the application of lampricides to tributaries and lentic areas of Lake Superior during 2019 (letter in parentheses corresponds to location of stream in Figure 2).

Tributary	Date	Discharge (m^3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg) [1]	Emulsifiable Concentrate Bayluscide (kg) [1]	Granular Bayluscide (kg)[1]
Canada								
Goulais R. (A)	Jul-03	25.1	115.1	1,426.3	4.0	---	---	0.3
Haviland Cr. (B)	Oct-23	0.6	4.8	45.0	0.6	---	---	0.1
S-1009 Unnamed (C)	Oct-17	0.1	0.4	3.3	---	---	---	---
Pancake R. (D)	Jun-26	3.7	11.6	167.2	0.4	---	---	0.1
Lentic	Jun-27	---	---	---	---	---	---	26.9
Agawa R. (E)	Jul-10	6.5	12.3	338.6	---	---	---	---
Michipicoten R. (F)								
Lentic	Aug-12	---	---	---	---	---	---	18.4
Pic R. (G)	Jul-14	21.9	118.8	3,437.6	2.5	---	52.7	0.6
Prairie R. (H)	Jul-21	0.9	3.9	210.6	---	---	---	0.1
Steel R. (I)	Aug-14	4.2	10.6	850.0	0.2	---	---	0.1
Gravel R. (J)	Aug-18	0.8	12.7	337.7	---	---	---	0.1
Cypress R. (K)								
Lentic	Jul-24	---	---	---	---	---	---	38.0
Jackpine R. (L)								
Lentic	Aug-14	---	---	---	---	---	---	22.0
Nipigon R. (M)	Aug-23	87.1	11.6	6,543.2	2.1	---	70.8	0.3
Lower Nipigon Lentic	Aug-19	---	---	---	---	---	---	104.1
Lake Helen Lentic	Aug-24	---	---	---	---	---	---	58.2
Stillwater Cr. (N)	Aug-21	0.1	1.2	15.0	0.5	---	---	0.1
Coldwater Cr. (O)								
Lentic	Aug-15	---	---	---	---	---	---	25.7
Pearl R. (P)	Jul-11	0.4	4.5	121.3	0.4	---	---	---
Mackenzie R. (Q)								
Lentic	Aug-17	---	---	---	---	---	---	60.0
D'Arcy Cr. (R)	Jul-11	0.1	0.9	20.1	---	---	---	---
Kaministiquia R. (S)	Jul-13	35.1	111.6	2,904.0	3.5	---	22.3	0.6
Total (Canada)		**186.4**	**420.0**	**16,419.9**	**14.2**	**0.0**	**145.8**	**355.7**
United States								
Ankodosh Cr. (T)	Aug-25	0.2	1.0	38.2	---	---	---	---
Galloway Cr. (U)	Aug-26	0.1	3.7	22.0	0.4	---	---	---
Tahquamenon R. (V)	Aug-23	7.4	23.7	1,636.4	10.1	---	---	---

Table 2. *continued*

Tributary	Date	Discharge (m3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg)[1]	Emulsifiable Concentrate Bayluscide (kg)[1]	Granular Bayluscide (kg)[1]
Two Hearted R. (W)	Aug-23	4.7	84.5	753.7	0.5	---	---	---
Carpenter Cr. (X)								
Lentic	Aug-26	---	---	---	---	---	---	19.6
Sullivans Cr. (Y)	Jul-02	0.1	1.9	16.8	---	---	---	---
Miners R. (Z)	Jul-25	0.5	1.8	141.8	---	---	---	---
Anna R. (AA)	Jul-13	1.3	11.7	241.8	10.7	---	---	---
Lentic	Jul-24	---	---	---	---	---	---	8.6
Furnace Cr. (BB)	Jul-17	0.3	0.8	47.8	---	---	---	---
Lentic	Jul-18	---	---	---	---	---	---	0.6
Au Train R. (CC)	Jul-12	9.9	32.5	2,247.1	0.4	---	---	---
Sand R. (DD)	Jul-17	0.1	2.1	5.9	---	---	---	---
Chocolay R. (EE)	Jul-25	3.8	44.7	648.9	1.7	---	---	---
Dead R. (FF)	Jul-17	4.5	1.8	428.3	---	---	---	---
Lentic	Jul-28	---	---	---	---	---	---	52.0
Harlow Cr. (GG)								
Bismark Cr.	Sep-10	0.2	2.3	40.3	1.3	---	---	---
Iron R. (HH)	Sep-09	1.6	4.8	163.9	---	---	---	---
Salmon Trout R. (II)	Jul-30	1.2	12.6	176.6	1.5	---	---	---
Huron R. (JJ)	Aug-12	0.4	11.1	76.3	0.1	---	---	---
Ravine R. (KK)	Aug-09	0.1	9.3	16.1	0.1	---	---	---
Slate R. (LL)								
Lentic	Jun-11	---	---	---	---	---	---	33.7
Silver R. (MM)	Aug-11	0.4	12.9	66.8	0.4	---	---	---
Falls R. (NN)	Aug-07	1.4	0.8	237.2	---	---	---	---
Little Carp R. (OO)	May-17	0.2	6.6	16.9	1.5	---	---	---
Trap Rock R. (PP)	Jul-13	0.6	13.8	74.2	1.7	---	---	---
Lentic	Jul-16	---	---	---	---	---	---	1.8
Traverse R. (QQ)	May-18	1.8	17.1	132.3	1.1	---	---	---
Eliza Cr. (RR)	Jul-11	0.0	1.1	1.5	---	---	---	---
Lentic	Jul-15	---	---	---	---	---	---	9.8
Hungarian Cr. (SS)	Jul-15	0.0	0.6	0.7	---	---	---	---
East Sleeping R. (TT)	May-17	1.2	31.2	402.4	2.3	---	---	---
West Sleeping R. (UU)	Jun-15	0.2	6.6	19.8	0.6	---	---	---
Firesteel R. (VV)	Jun-15	1.4	67.6	305.2	0.4	---	---	---

Table 2. *continued*

Tributary	Date	Discharge (m^3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg) [1]	Emulsifiable Concentrate Bayluscide (kg) [1]	Granular Bayluscide (kg)[1]
Ontonagon R. (WW)	Oct-04	37.7	225.3	3,877.6	13.7	---	---	---
Black R. (XX)	Sep-05	1.7	1.1	352.7	---	---	---	---
Lentic	Sep-07	---	---	---	---	---	---	11.0
Sioux R. (YY)	Jul-13	1.1	15.1	133.3	0.4	---	---	---
Arrowhead R. (ZZ)	Jul-11	3.5	0.6	213.4	---	---	---	---
Total (United States)		**87.7**	**650.7**	**12,536.0**	**48.9**	**0.0**	**0.0**	**137.2**
Total for Lake		**274.1**	**1070.7**	**28,955.9**	**63.1**	**0.0**	**145.8**	**492.9**

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

Lake Michigan

Lake Michigan has 511 tributaries. One hundred twenty-eight tributaries have records of larval Sea Lamprey production, and of these, 86 tributaries have been treated with lampricides at least once during 2010-2019. Thirty-two tributaries are treated every 3-5 years. Details on lampricide applications to Lake Michigan tributaries and lentic areas during 2019 and tributary locations are found in Table 3 and Figure 2.

- Lampricide applications were conducted in 22 tributaries and 2 lentic areas.

- An experimental liquid formulation of Bayluscide was evaluated during lampricide treatments of the Betsie and Manistique rivers.

- The Manistique River was treated under unusually high discharge, resulting in increased lampricide usage.

- The Peshtigo River was not treated due to extremely high water levels and inconsistent flow at the Wisconsin Public Service hydropower dam. The treatment is rescheduled for September 2020.

- Furlong Creek (Millecoquins River) was added to the treatment schedule based on large larvae found during 2019 assessment surveys.

Table 3. Details on the application of lampricides to tributaries and lentic areas of Lake Michigan during 2019 (letter in parentheses corresponds to location of stream in Figure 2).

Tributary	Date	Discharge (m^3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg)[1]	Emulsifiable Concentrate Bayluscide (kg)[1]	Granular Bayluscide (kg)[1]
Paquin Cr. (A)	Jun-29	0.3	2.9	115.4	0.6	---	---	---
Millecoquins R. (B)								
Furlong Cr.	Sep-24	0.9	12.9	176.9	1.9	---	---	---
Rock R. (C)	Jun-28	0.3	4.0	59.5	---	---	---	---
Crow R. (D)	Jun-30	0.3	1.0	72.7	---	---	---	---
Cataract R. (E)	Sep-26	0.4	3.2	39.6	0.4	---	---	---
Hudson Cr. (F)	Aug-27	0.0	3.2	5.1	---	---	---	---
Gulliver Lake O. (G)	Sep-20	0.2	3.1	36.7	---	---	---	---
Marblehead Cr. (H)	Jun-30	0.3	7.9	61.0	0.4	---	---	---
Manistique R. (I)	Sep-20	76.5	563.8	5,994.1	12.0	---	25.2	---
Lentic	Oct-16	---	---	---	---	---	---	76.5
Sturgeon R. (J)	Jul-26	3.0	87.7	864.1	7.1	---	---	---
Whitefish R. (K)	May-03	17.5	115.9	3,155.8	9.0	7.2	---	---
Days R. (L)	Sep-05	0.3	6.8	90.3	1.5	---	---	---
Bailey Cr. (M)	May-04	0.7	2.1	96.3	---	---	---	---
Beattie Cr. (N)	May-03	1.2	4.3	190.3	---	---	---	---
Springer Cr. (O)	May-06	0.4	1.8	70.5	0.6	---	---	---
Door Co. No. 23 Cr. (P)	May-02	0.3	1.3	55.8	0.2	---	---	---
Horton Cr. (Q)								
Lentic	Jun-26	---	---	---	---	---	---	7.4
Crystal R. (R)	Apr-19	1.7	9.5	367.4	---	---	---	---
Platte R. (S)	May-30	17.0	22.5	3,469.1	11.8	---	25.1	---
Betsie R. (T)	Jun-04	10.3	20.4	1,768.0	6.5	---	18.9	---
Manistee R. (U)	Aug-09	49.8	97.8	9,449.8	17.7	---	92.3	1.0
Muskegon R. (V)	Sep-06	41.1	145.8	7,768.6	26.0	---	86.5	0.3
Kalamazoo R. (W)								
Bear Cr.	Apr-19	0.7	3.9	242.5	7.9	---	---	---
Total for Lake		**223.0**	**1,121.8**	**34,149.7**	**103.7**	**7.2**	**248.0**	**85.2**

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

Lake Huron

Lake Huron has 1,761 tributaries (1,334 Canada, 427 U.S.). One hundred twenty-seven tributaries (59 Canada, 68 U.S.) have records of larval Sea Lamprey production. Of these, 86 tributaries (39 Canada, 47 U.S.) have been treated with lampricide at least once during 2010-2019. Forty-six tributaries (22 Canada, 24 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Huron tributaries and lentic areas during 2019 and tributary locations are found in Table 4 and Figure 2.

- Lampricide applications were completed in 13 tributaries (7 Canada, 6 U.S.), 3 lentic areas (2 Canada, 1 U.S.), and 330.02 ha of the St. Marys River. Six St. Marys River plots were retreated to target residual larval Sea Lamprey expected to survive the first treatment.

- Taylor Creek (Munuscong River) was added to the treatment schedule based on large larvae found during 2019 assessment surveys.

- Caribou Creek was added to the treatment schedule after 2019 treatment evaluations revealed several large residuals from the 2018 treatment.

- The Pine River (Saginaw River) and upper Black Mallard River were treated after being deferred in 2018.

- The Root River, Garden River, and Bar/Iron Creek (Echo River) and one lentic plot in the St. Marys River and another on Echo Lake were deferred for treatment due to concerns about lampricides from the Garden River First Nation community. These rivers are scheduled for treatment during 2020.

- H-68 (St. Joseph's Island), and McBeth Creek were treated for the first time since 1975 and 1967, respectively.

Table 4. Details on the application of lampricides to tributaries and lentic areas of Lake Huron during 2019 (letter in parentheses corresponds to location of stream in Figure 2).

Tributary	Date	Discharge (m^3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg)[1]	Emulsifiable Concentrate Bayluscide (kg)[1]	Granular Bayluscide (kg)[1]
Canada								
St. Marys R. (A)	Jul-09	---	---	---	---	---	---	1,556.6
Browns Cr. (B)	May-08	0.2	0.9	12.9	---	---	---	---
H-68 Unnamed Cr. (C)	Jun-05	0.1	0.8	15.7	---	---	---	0.1
McBeth Cr. (D)	Jun-06	0.2	2.9	13.8	0.8	---	---	0.1
Mississagi R. (E)	Aug-07	65.0	49.3	3,244.8	0.5	---	37.4	---
Lauzon Cr. (F)	Jun-18	2.9	0.9	110.4	---	---	---	---
Lentic	Jun-18	---	---	---	---	---	---	26.9
H-114 Unnamed Cr. (G)	Jun-18	0.2	0.5	5.5	---	---	---	0.1
Serpent R. (H)								
Grassy Cr.	Jun-05	0.2	3.3	7.7	---	---	---	---
Total (Canada)		**68.8**	**58.6**	**3410.8**	**1.3**	**0.0**	**37.4**	**1,583.8**
United States								
Munuscong R. (I)								
Taylor Cr.	Jun-20	1.2	11.7	203.0	0.2	---	---	0.1
Caribou Cr. (J)	Oct-05	0.1	1.0	11.0	---	---	---	---
Prentiss Cr. (K)	Oct-06	0.4	6.3	102.8	---	---	---	---
Cheboygan R. (L)								
Sturgeon R. lentic	Jun-27	---	---	---	---	---	---	27.1
Mulligan Cr. (M)	May-17	0.2	1.1	11.0	---	---	---	---
Black Mallard R. (N)	May-16	0.8	10.1	116.8	1.5	---	---	---
Saginaw R. (O)								
Pine R.	May-19	12.0	53.6	2,322.0	---	---	19.0	---
Total (United States)		**14.7**	**83.8**	**2,766.6**	**1.7**	**0.0**	**19.0**	**27.2**
Total for Lake		**83.5**	**142.4**	**6,178.7**	**3.0**	**0.0**	**56.4**	**1,611.0**

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

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 2010-2019. 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 2019 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.); Paint Creek (Clinton River) was treated in 2015.

- Lampricide treatments were completed in 6 tributaries (0 Canada, 6 U.S.).
- Silver Creek was treated from a location further upstream than in previous treatments.
- Cayuga Creek (Buffalo River) was treated for the first time in 2019.
- The West Branch of Conneaut Creek was treated in 2019 after surveys confirmed the presence of Sea Lampreys upstream of the 2018 treated area.

Table 5. Details on the application of lampricides to tributaries and lentic areas of Lake Erie during 2019 (letter in parentheses corresponds to location of stream in Figure 2).

Tributary	Date	Discharge (m^3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg)[1]	Emulsifiable Concentrate Bayluscide (kg)[1]	Granular Bayluscide (kg)[1]
United States								
Buffalo R. (A)								
Buffalo Cr.	May-27	1.9	9.5	687.3	---	---	---	0.0
Cayuga Cr.	May-24	1.5	16.6	443.0	---	---	---	---
Cazenovia Cr.	May-28	2.4	7.2	657.4	---	---	---	0.0
Cattaraugus Cr. (B)	Jun-15	31.6	90.6	5,906.5	0.6	---	---	---
Crooked Cr. (C)	May-01	2.9	12.1	314.5	---	---	---	---
Conneaut Cr. (D)	May-05	1.7	2.9	99.9	---	---	---	---
Total (United States)		**41.9**	**138.9**	**8,108.6**	**0.6**	**0.0**	**0.0**	**0.1**
Total for Lake		**41.9**	**138.9**	**8,108.6**	**0.6**	**0.0**	**0.0**	**0.1**

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

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 (18 Canada, 18 U.S.) have been treated with lampricides at least once during 2010-2019. Twenty-nine tributaries (15 Canada, 14 U.S.) are treated on a regular 3-5 year cycle. Details on lampricide applications to Lake Ontario tributaries and lentic areas during 2019 and tributary locations are found in Table 6 and Figure 2.

- Lampricide applications were conducted in 10 tributaries (6 Canada, 4 U.S.). No lentic treatments were conducted in Lake Ontario during 2019.

- Graham Creek was treated for the first time since 1996. Record high water levels in 2017 enabled Sea Lamprey were able to access spawning habitats above the inundated barrier.

Table 6. Details on the application of lampricides to tributaries of Lake Ontario during 2019 (letter in parentheses corresponds to location of stream in Figure 2).

Tributary	Date	Discharge (m^3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg)[1]	Emulsifiable Concentrate Bayluscide (kg)[1]	Granular Bayluscide (kg)[1]
Canada								
Bronte Cr. (A)	May-05	5.2	37.9	2,313.0	---	---	---	0.2
Graham Cr. (B)	Apr-29	1.7	15.5	464.2	---	---	---	0.1
Port Britain Cr. (C)	Apr-28	1.0	1.4	224.5	---	---	---	0.1
Covert Cr. (D)	May-02	0.3	4.6	79.2	0.6	---	---	0.1
Colborne Cr. (E)	Apr-28	1.0	1.0	214.8	---	---	---	0.1
Mayhew Cr. (F)	May-24	0.7	2.5	134.9	---	---	---	---
Total (Canada)		**9.9**	**62.9**	**3,430.6**	**0.6**	**0.0**	**0.0**	**0.6**
United States								
Fish Cr. (G)	Aug-16	12.0	56.1	1,336.5	---	---	---	0.7
Owasco Lake Outlet (H)	May-31	7.4	21.6	2,084.0	---	---	---	0.2
Scriba Cr. (I)	May-26	3.7	0.8	147.3	---	---	---	0.1
Sterling Cr. (J) tributary	May-24	0.2	4.6	56.4	0.1	---	---	0.1
Total (United States)		**23.2**	**83.1**	**3,624.2**	**0.1**	**0.0**	**0.0**	**1.1**
Total for Lake		**33.1**	**146.0**	**7,054.8**	**0.7**	**0.0**	**0.0**	**1.7**

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

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 2019, barriers were the only operational alternative control method. Juvenile trapping and nest destruction were explored as potential alternative methods. Other methods that are currently being investigated include the use of 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 non-SLCP barrier sites.
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; and
    d. 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 2019 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, 48 were purpose-built as Sea Lamprey barriers and 25 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.

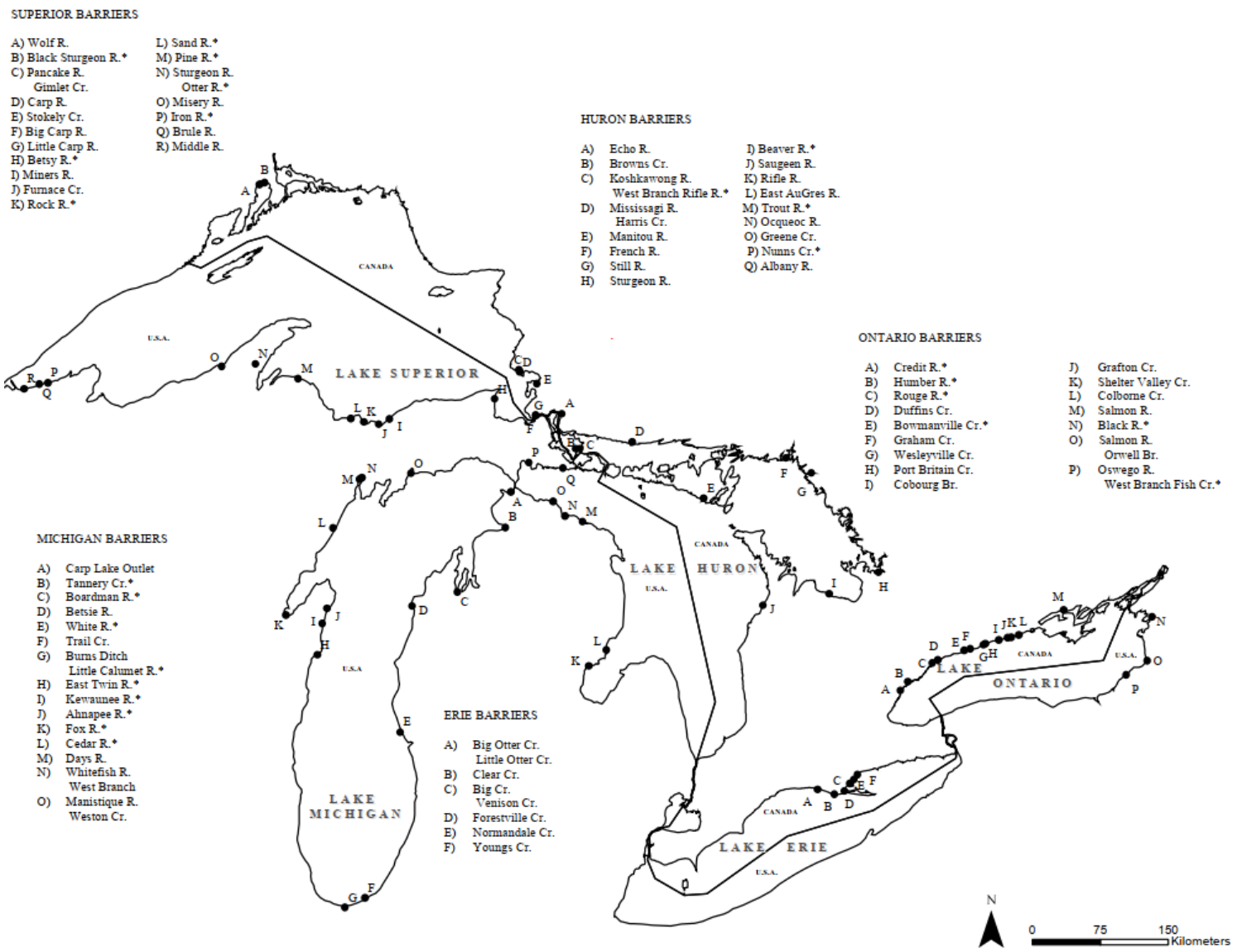

Figure 3. Locations of tributaries with Sea Lamprey barriers. Structures that have been modified or constructed by others that prevent the upstream migration of Sea Lamprey are indicated by an asterisk.

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)

- Field crews visited 3 structures on tributaries to Lake Superior to assess Sea Lamprey blocking potential and to improve the information in the BIPSS database.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 20 barriers (6 Canada, 14 U.S.).

- Fish community assessment surveys (31) were conducted in the Black Sturgeon watershed. Sample sites began downstream of Camp 1 at the outlet to Eskwanonwatin Lake and concluded at Highway 17 below the Black Sturgeon dam (Camp 43).

- As a barrier monitoring component, fish community assessment surveys were completed on Big Carp River (N=11), Carp River (N=8), Little Carp River (N=5), Pancake River (N=4), Stokely Creek (N=8) and Wolf River (N=8).

Ensure Blockage to Sea Lamprey Migration

- Brule River – Portions of the fishway walls were resurfaced with concrete during late 2016 to determine if the patch material would withstand winter conditions. These test patches did not function well. Other patching alternatives are being considered.

- Black Sturgeon River – The Ontario Ministry of Natural Resources and Forestry (OMNRF) initiated an Environmental Assessment (EA) during 2012 for a proposal to decommission the Camp 43 Dam and construct a new Sea Lamprey barrier 50 km upstream. Results of the EA are pending.

- Partner agencies were consulted to ensure blockage at barriers at 9 sites in 7 tributaries during 2019 (Table 7).

New Construction

- Bad River – The U.S. Army Corps of Engineers (USACE) is the lead agency administering a project to construct a Sea Lamprey barrier in the Bad River under the Great Lakes Fishery Ecosystem Restoration (GLFER) program. The USACE completed hydrologic modeling to site a new barrier and trap near the railroad trestle downstream of the Potato River junction. The topography at this location is not conducive for constructing a Sea Lamprey barrier due to height needed and potential backwater effects. Service personnel attended a public meeting in 2018 to discuss additional alternative control technologies including seasonal and velocity barriers. This project has been reclassified as a feasibility study until full support from the Bad River Tribe for a barrier can be obtained. USACE feasibility study efforts

remain on hold pending input and direction from the Tribe and Service. During 2019, Service staff met with the Bad River Natural Resources Department to discuss barrier location options.

- Ontonagon River – The Service is working with the U.S. Forest Service (USFS) to investigate construction of an adjustable-crest, seasonal barrier several miles downstream of the Lower Dam on the East Branch Ontonagon River, with the Lower Dam being removed as part of the project. Sites visits were conducted during 2017 and a water surface elevation logger was installed at one location. Considerable savings in treatment cost would be realized from a barrier built at either of the two preferred locations; several miles of habitat would be accessible to fish when Sea Lamprey are not migrating. During 2019, Service staff met with the USFS to identify potential locations and conduct site visits for a Sea Lamprey barrier. Field data collected during site visits determined that the selected sites were not feasible for barrier construction; however, installing a seasonal barrier at the Lower Dam remains an option.

Table 7. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Superior tributaries during 2019.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Sucker R.	Baker Cr.	ACD[1]	Baker Cr. culvert	Proposed	Minimal Upstream Potential
Au Train R.	Slapneck Cr.	ACD[1]	Slapneck Cr. culvert	Proposed	Upstream of First Blocker
Huron R.	Chinks Cr.	SWP[2]	Culvert 213	Concur	Upstream of First Blocker
Huron R.	Chinks Cr.	SWP[2]	Culvert 217	Concur	Upstream of First Blocker
Trap Rock R.	Slaughterhouse Cr.	CT[3]	Calumet Lions Park Dam	Proposed	Repair
Brule R.	Nebagamon Cr.	WIDNR[4]	Nebagamon Cr. Railroad culvert	Concur	Upstream of First Blocker
Talmadge R.		SSWCD[5]	Duluth Retriever Club Dam	Proposed	Does not support Sea Lamprey
Baptism R.	Hockamin Cr.	LCSCD[6]	Breezy Lane culvert	Proposed	Upstream of First Blocker
Baptism R.	Hockamin Cr.	LCSCD[6]	Heffelfinger Road culvert	Proposed	Upstream of First Blocker

[1] Alger Conservation District, [2] Superior Watershed Partnership, [3] Calumet Township, [4] Wisconsin Department of Natural Resources, [5] South St. Louis Soil & Water Conservation District, [6] Lake County Soil and Conservation District

Lake Michigan

The Commission has invested in 15 barriers on Lake Michigan (Figure 3). Of these, 7 were purpose-built as Sea Lamprey control barriers and 8 were constructed for other purposes, but have been modified to block Sea Lamprey migrations.

Barrier Inventory and Project Selection System (BIPSS)

- Field crews visited 168 structures on tributaries to Lake Michigan to assess Sea Lamprey blocking potential and to improve the information in the BIPSS database.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on seven barriers.

Ensure Blockage to Sea Lamprey Migration

- Boardman River – Removal of the Sabin Dam was completed during 2018 and was contingent on Union Street Dam continuing to perform as a blocking structure to Sea Lamprey. The Commission has partnered with the City of Traverse City, Grand Traverse County, Grand Traverse Band of Ottawa and Chippewa Indians, Michigan Department of Natural Resources (MIDNR) and several other State, Federal, academic and NGO partners to develop fish passage technologies on-site to pass desirable fishes while blocking Sea Lamprey. A selective, bi-directional fish passage experimental research facility (FishPass) is being constructed at the Union Street Dam location. One of the main objectives is to test elective sorting techniques to provide selective passage for desired species and continued blockage of invasive species. The FishPass project design is nearing completion and construction could begin as early as spring 2020. Larval assessment data collected for the upper Boardman River is currently being analyzed to determine the Sea Lamprey production potential for this area should escapement occur.

- Grand River – The City of Grand Rapids along with several citizens groups have proposed removal of the 6th Street Dam on the Grand River to provide more varied use of the downtown rapids area. The current plan calls for removal of the existing structure and the creation of an artificial rapids complex that can be used by kayakers and anglers. A new inflatable crest structure is proposed approximately one mile upstream of the current location. During 2019, Service staff deployed portable assessment traps and fyke nets at the 6th Street Dam as well as within historically positive tributaries of the Grand River to evaluate the abundance of spawning Sea Lampreys within the Grand River. Crews were able to capture 114 adult Sea Lampreys, resulting in a stream population estimate of 1,297 Sea Lamprey. To ensure blockage of the Sea Lamprey migration in the Grand River, the Service and DFO are engaged in the review of the proposed structure and will continue to participate in various levels of project coordination.

- Platte River – Service staff are working with the MIDNR to review weir operation and sediment management practices at the Platte River State Fish Hatchery. A level logger was installed to monitor water levels to determine the appropriate number of stop logs needed to maintain an 18” vertical separation between the barrier crest and tail-water during the Sea Lamprey spawning migration. Analysis of the data collected during 2018-2019 has yet to be completed.

- Barrier removals/modification – Partner agencies were consulted to ensure blockage at barriers at 19 sites in 10 tributaries (Table 8).

Table 8. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Michigan tributaries during 2019.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Black R.		MCRC[1]	Black R. Road culvert	Proposed	Ineffective Barrier
Gulliver Lake Outlet		SC[2]	Gulliver Lake Dam	Proposed	Repair
Menominee R.	Michigamme R.	MRBA[3]	Republic Dam	Proposed	Upstream of First Blocker
Sheboygan R.	Willow Cr.	SCF[9]	Willow Cr. culvert #1	Proposed	Ineffective Barrier
Sheboygan R.	Willow Cr.	SCF[9]	Willow Cr. culvert #2	Proposed	Ineffective Barrier
Boardman R.	North Branch Boardman	CRA[4]	Broomhead Road culvert	Proposed	Ineffective Barrier
Platte R.	Trib. to Little Platte R.	CRA[4]	Saffron Road culvert	Proposed	Ineffective Barrier
Platte R.	Kinney Cr.	CRA[4]	North Carmean Road culvert	Proposed	Ineffective Barrier
Big Manistee R.	Bowsell Cr.	TU[5]	Brewer Road culvert	Proposed	Upstream of First Blocker
Big Manistee R.	Hinton Cr.	TU[5]	Hinton Cr. culvert	Proposed	Upstream of First Blocker
Big Manistee R.	Peterson Cr.	TU[5]	Peterson Cr. culvert	Proposed	Upstream of First Blocker
Big Manistee R.	Big Devil Cr.	TU[5]	Big Devil Cr. culvert	Proposed	Upstream of First Blocker
Big Manistee R.	Perkins Cr.	TU[5]	Perkins Cr. culvert	Proposed	Ineffective Barrier
Pere Marquette R.	Blood Cr.	CRA[4]	72nd Street culvert	Proposed	Ineffective Barrier
Pere Marquette R.	Blood Cr.	CRA[4]	Broadway Avenue culvert	Proposed	Ineffective Barrier
Muskegon R.	Middle Branch R.	VM6	Marion Dam	Proposed	Upstream of First Blocker
Muskegon R.	Bigelow Cr.	TU[5]	Walnut Road culvert	Proposed	Ineffective Barrier
Kalamazoo R.	Portage Cr.	CK[7]	Milham Park Dam	Proposed	Upstream of First Blocker
Kalamazoo R.		MIDNR[8]	Trowbridge Dam	Concur	Upstream

[1]Mackinac County Road Commission, [2]Schoolcraft County, [3] Michigamme R. Basin Authority, [4]Conservation Resource Alliance , [5]Trout Unlimited
[6]Village of Marion, MI, [7]City of Kalamazoo, MI, [8]Michigan Department of Natural Resources, [9] Stantec Consulting Firm

New Construction

- Manistique River – The USACE is the lead agency administering a project to construct a Sea Lamprey barrier to replace a deteriorated structure in the Manistique River. Project partners include the Commission, Service, MIDNR, City of Manistique, and Manistique Papers, Inc. The existing Manistique Paper Inc. Dam was identified as the most feasible site for a new barrier. The feasibility study was approved in July 2018 and the Project Partnership Agreement was signed in October 2018. Final design and implementation are currently underway, with MIDNR assisting with real estate actions. Project permitting will occur after review and approval of final design drawings. The timeline for project completion is 2023.

- Little Manistee River – The Service has been working with MIDNR and USACE staff to improve the blocking capability of the Little Manistee River weir and egg take facility during concurrent facility upgrade work that is being conducted by the State of Michigan. The project

would include improvements to the weir structure and construction of permanent traps. The Service continues provide guidance for placing the permanent trap within the new structure. The Preliminary Restoration Plan is complete for the project. A draft feasibility study was finished and public comments were minimal. The next steps involve generating a detailed design, pending funding availability.

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)

- Field crews visited 29 structures on tributaries to Lake Huron to assess Sea Lamprey blocking potential and to improve the information in the BIPSS database.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 26 barriers (5 Canada, 21 U.S.).

- Replacement of the existing Sea Lamprey trap at the Echo River barrier site was completed in 2019.

- The combination low-head/electrical barrier in the Ocqueoc River was electrified during five time periods during 2019; March 30-April 30, May 1-5, May 9-14, May 25-31, and June 10-19, when water levels inundated the low-head barrier. Water level monitoring occurred from March 30th through August 22nd during the entire Sea Lamprey spawning migration.

- Fish community assessment surveys (18) were conducted in the upper Nottawasaga River watershed. This work was completed as a monitoring component of the Nicolston Dam Rehabilitation Project.

- Fish community assessment surveys (13) were conducted in the Lower Saugeen River watershed in collaboration with the Saugeen Ojibway Nation. This work was completed as a monitoring component of the Denny's Dam Rehabilitation Project.

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:

    - Control agents and researchers continued discussion with the USACE and the Michigan Department of Natural Resources (MIDNR) regarding alternatives for preventing Sea Lamprey passage at the Cheboygan River lock. The MIDNR is pursuing a refurbishment of the aging structure and the federal partners are interested in making the lock "lamprey

proof". The MIDNR has allocated funding to update and refurbish the Cheboygan River lock and dam complex. GEI Consultants Inc. (GEI) was awarded the contract and have begun collecting data for the project design. The Service will be involved with the MIDNR and GEI to incorporate Sea Lamprey control measures into the design.

- A total of 1,900 sterilized male Sea Lamprey were released upstream of the Cheboygan Dam during 2019 as part of a research project being conducted by the U.S. Geological Survey testing an eradication hypothesis using the Sterile Male Release Technique.

- Fyke nets were deployed in the Pigeon, Sturgeon, and Maple rivers during 2019. One unmarked Sea Lamprey was captured in the Pigeon, six in the Sturgeon, and none in the Maple. Sterile male Sea Lampreys were released in these rivers: Pigeon (360); Sturgeon (908); Maple (628). Fyke nets recaptured sterile males at the following rates: 20% recapture rate in Pigeon, 18% in Sturgeon, and 7% in Maple River. Results are consistent with previous netting efforts between 2013 – 2018 suggesting the abundance of adult Sea Lamprey in the streams is very low (less than 50). The Lake Kathleen Dam on the Maple River was removed during fall 2018. Currently, there are no plans to mitigate the removal with alternative controls. The Service is conducting annual monitoring to document changes in native and Sea Lamprey populations throughout the Maple River due to the removal.

- Nottawasaga River – Reconstruction of Nicolston Dam began during 2017 under the Canadian Federal Infrastructure Initiative. The auxiliary spillway was completed in 2018 and the main spillway will be completed in 2020.

- Partner agencies were consulted to ensure blockage at barriers for 10 sites in 5 tributaries during 2019 (Table 9).

Table 9. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Huron tributaries during 2019.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Munuscong R.	Trib to Munuscong R.	MCRC[1]	Rutledge Road culvert	Proposed	Minimal Upstream Potential
Munuscong R.	Trib to Munuscong R.	MCRC[1]	Blair Road culvert	Proposed	Minimal Upstream Potential
Cheboygan R.	Cornwall Cr.	HP[2]	Cornwall Cr. Dam	Proposed	Repair
Cheboygan R.	Van Cr.	CRA[3]	Pet-Mack Trail culvert	Proposed	Ineffective Barrier
Cheboygan R.	Van Cr.	CRA[3]	Van Road culvert	Proposed	Ineffective Barrier
Cheboygan R.	Cold Cr.	CRA[3]	Ely Road culvert	Proposed	Ineffective Barrier
Trout R.		PICD[4]	Trout Cr. Dam	Proposed	Repair
Au Sable R.	Lost Cr.	TU[5]	Lost Cr. Culvert	Proposed	Upstream of First Blocker
Au Sable R.	North Branch Au Sable R.	OC[6]	Otsego Lake Outlet	Proposed	Repair
Saginaw R.	Mission Cr.	CMP[7]	Mission Cr. Dam	Proposed	Ineffective Barrier

[1]Mackinac County Road Commission, [2]Huron Pines, [3]Conservation Resource Alliance, [4]Presque Isle Conservation District, [5]Trout Unlimited, [6]Otsego County, [7]City of Mount Pleasant

Experimental barriers

- A next generation low voltage electrical fish barrier was deployed seasonally (March – August) near the mouth of Black Mallard Creek during 2016-2019 to block adult Sea Lamprey and eliminate the need for the next scheduled treatment. The Service will monitor upstream of the electrical barrier for Sea Lamprey recruitment in 2020.

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)

- No structures on Lake Erie tributaries were assessed in 2019. Assessments are conducted on a 4-year rotation and will be completed in 2021.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 12 barriers (7 Canada, 5 U.S.).

- Big Creek – The Big Creek inflatable crest barrier control system was replaced with a new system in 2019.

- Fish community assessment surveys (4) were conducted on the Young's Creek watershed. This work was completed as part of a barrier monitoring component.

Ensure Blockage to Sea Lamprey Migration

- Black River – The MIDNR and USFWS-Alpena FWCO funded a feasibility study for the removal of Wingford Dam. The study was completed in January and it provides three conceptual alternatives including basic dam removal, dam removal with substantial upstream river restoration, and dam removal with targeted restoration and river stabilization. Project partners are currently working to find a mutually beneficial solution to allow fish passage while preventing Sea Lamprey escapement upstream.

- Clinton River – The MIDNR, Clinton River Watershed Council, the City of Rochester Hills are currently collaborating with Service staff to block a natural bypass around the Yates Mill Dam. The bypass developed in a low-lying area during periods of high flow and has allowed Sea Lamprey escapement in the past. During 2019, the bypass channel was assessed to determine if it could be temporarily blocked to prevent Sea Lamprey escapement. Communications have begun between the City of Rochester Hills and a private landowner to obtain an access easement to the area.

- Partner agencies were consulted to ensure blockage at barriers for 5 sites in 4 tributaries (Table 10).

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. The Project Partnership Agreement was signed in August 2017 between USACE, NYDEC, and Erie County, and the study team has moved forward with the engineering and design phase of this project. The selected plan will decrease the existing spillway height from 38 to 13.5 feet to function as a Sea Lamprey barrier. Requests from the National Historic Registry will be fulfilled by preserving a portion of the original spillway on both banks to show the original structure. A Denil fishway with a seasonal trap and sort operation is also included in the design. The Service has worked closely with the NYDEC and USACE to design a Sea Lamprey trap at the entrance of the fishway. Construction is targeted for 2021 following the Sea Lamprey spawning run.

- Grand River – The USACE is the lead agency administering a project at the Harpersfield Dam to construct a Sea Lamprey barrier to replace the deteriorated structure in the Grand River. Project partners include the Commission, Service, Ohio Department of Natural Resources (OHDNR), and Ashtabula County. Design of the barrier allows for an 18-inch separation between the barrier crest and tail water elevation as well as velocities capable of preventing Sea Lamprey passage during flooding events. Construction of the dam began in summer 2019 and will be completed by mid-summer 2020.

- Conneaut Creek – The Pennsylvania Fish and Boat Commission and OHDNR have expressed interest in constructing a new barrier on Conneaut Creek in either Ohio or Pennsylvania. The goal of the project is to reduce the amount of stream miles exposed to lampricide application and thus protect sensitive, native species. A meeting was held in August 2019 to discuss project goals and visit potential barrier sites

Table 10. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Erie tributaries during 2019.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Chagrin R.	Trib to Silver Cr.	GPD[1]	Westwood Park Dam	Proposed	Minimal Upstream Potential
River Raisin		CD[2]	Dundee Mill Dam	Proposed	Fish Passage Modification
River Raisin	South Branch R. Raisin	LCDC[3]	Tecumseh Dam	Concur	First Blocker
Huron R.		HRWC[4]	Flat Rock Hydro Dam	Proposed	Feasibility Study
River Rouge	Seeley Drain	ECT[5]	San Marino Golf Club Dam	Proposed	Low Chance of Infestation

[1]Geauga Park District, [2]City of Dundee, [3]Lenawee County Drain Commission, [4]Huron River Watershed Council, [5]Environmental Consulting & Technology

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.

Operation and Maintenance

- Routine maintenance, spring start-up, and safety inspections were performed on 13 barriers (10 Canada, 3 U.S.). Among these, two barriers (1 Canada, 1 U.S.) were seasonally operated.

Ensure Blockage to Sea Lamprey Migration

- No requests for barrier removals on Lake Ontario were put forward by partner agencies during 2019.

Juvenile Trapping

- A lentic population of Sea Lampreys was discovered at the mouth of the Garlic River in Saux Head Lake. Treatment of this population is difficult because aquatic vegetation restricts efficacy of granular Bayluscide application. Fyke nets were set downstream of the outlet of Saux Head Lake near the mouth of the Garlic River in an attempt to collect juvenile Sea Lampreys during their outmigration. Nets were fished from late October to mid-November and collected seven juvenile Sea Lampreys resulting in a catch rate of 0.058 juveniles per net per night.

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 the time of stage 12 of development) continues to provide insight into the effectiveness of SMRT.

- In 2019, the mean embryo viability from 12 nests was 75% (Figure 4).

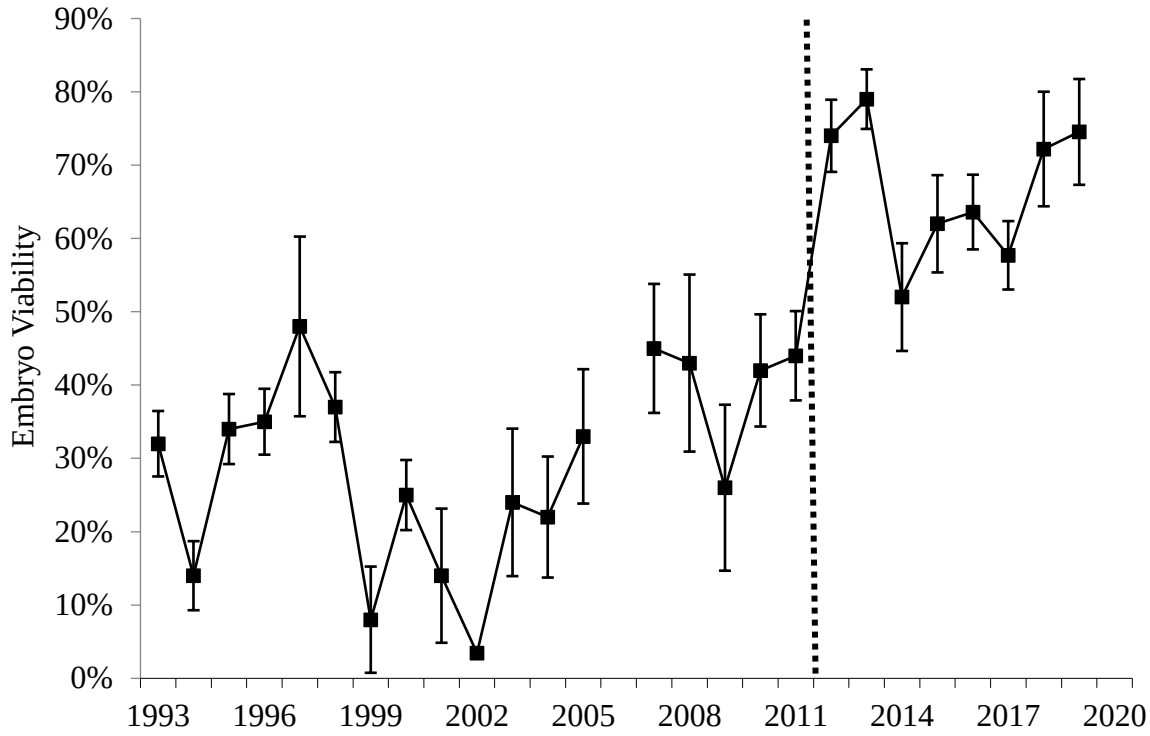

Figure 4. Mean annual embryo viability in the St. Marys River rapids during and after application of the sterile-male release technique (SMRT). The error bars represent SEs (not calculated for 2002 because only one sample was obtained). The vertical dashed line shows when SMRT application was discontinued after 2011.

ASSESSMENT

The SLCP has three assessment metrics:

1. 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.

2. 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.

3. 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 2019 are presented in the LATF and TTF sections of this report.

Larval Assessment

Tributaries considered for lampricide treatment during 2020 were assessed during 2019 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, evaluate lampricide treatments, and to establish the sites for lampricide application.

Lake Superior

- Larval assessments were conducted in 190 tributaries (97 Canada, 93 U.S.) and 25 lentic areas (6 Canada, 19 U.S.). The status of larval Sea Lamprey populations in historically infested Lake Superior tributaries and lentic areas is presented in Table 11.

- Surveys to estimate larval abundance were conducted in 48 tributaries (16 Canada, 32 U.S.) and in lentic areas offshore of 14 tributaries (1 Canada, 13 U.S.).

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 85 tributaries (70 Canada, 15 U.S.). A new population of larvae was discovered in Mill Creek (Chippewa County, MI).

- Post-treatment assessments were conducted in 43 tributaries (7 Canada, 36 U.S.) and 12 lentic areas (3 Canada, 9 U.S.) to determine the effectiveness of lampricide treatments conducted during 2018 and 2019. Batchawana River, Hungarian Creek, Eliza Creek lentic, Trap Rock River lentic, and Carp River are scheduled for treatment in 2020 based on the presence of residual Sea Lamprey.

- Surveys to evaluate barrier effectiveness were conducted in 4 tributaries (4 Canada, 0 U.S.). All barriers were found to be effective in limiting Sea Lamprey infestations.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 67.10 kg active ingredient of 3.2% gB (17.51 kg Canada, 49.59 kg U.S.; Table 12).

Table 11. 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	May-18	May -72
West Davignon Cr.	Jun-14	May-18	June-16
Little Carp R.	May-16	Jun-19	Jun-19
Big Carp R.	Sep-07	Jul-19	Aug-08
Cranberry Cr.	May-17	Sep-18	Sep-18
Goulais R.	Jun-19	Jul-19	Jul-19
Goulais Bay	Oct-16	Jul-18	Jul-18
Boston's Cr.	Never	Jun-17	Jun-94
Horseshoe Cr.	Never	Aug-15	Aug-59
Havilland Cr.	Oct-19	Jun-18	Jun-19
Havilland Bay	Jun-15	Jul-17	Jul-14
Stokely Cr.	Jun-08	May-18	Sep-17
Havilland Bay	Aug-11	Jul-17	Jul-09
Tier Cr.	Never	Jul-19	Jun-61
Harmony R.	Jun-14	Jul-19	Jul-19
Batchawana Bay	Aug-14	Aug-17	Aug-17
Sawmill Cr.	Aug-18	Oct-18	Aug-17
Jones Landing Cr.	Never	Jul-17	Jun-66
Tiny Cr.	Never	Aug-19	Aug-19
Chippewa R.	Jun-16	Jul-18	Jul-18
Batchawana Bay	Oct-17	Aug-18	Aug-18
Unamed (S-1009)	Oct-19	May-18	May-18
Unger Cr.	Jul-10	May-18	May-18
Batchawana R.	Jul-18	Jul-19	Jul-19
Batchawana Bay	Aug-18	Jul-19	Jul-19
Digby Cr.	Jun-13	Aug-19	Jul-19
Carp R.	Jun-16	Jul-19	Jul-19
Batchawana Bay	Jul-18	Jul-19	Jul-17
Pancake R.	Jun-19	Jun-19	Sep-18
Pancake Bay	Jun-19	Jul-18	Jul-18
Westman Cr.	Jun-16	May-18	Jul-15
Agawa R.	Jul-19	Jun-18	Jun-18
Agawa Bay	Aug-10	Jul-18	Aug-12
Sand R.	Sep-71	Jun-18	Jun-18
Baldhead R.	Never	Jul-17	Sep-01
Gargantua R.	Sep-18	Oct-18	Jul-15
Old Woman R.	Jul-18	Jul-18	Jul-17
Michipicoten R.	Aug-16	Jul-19	Jul-19
Michipicoten R. (Lower) lentic	Aug-19	Aug-16	Aug-12
Dog R.	Aug-63	Jul-18	Jul-17
White R.	Jul-16	Jul-18	Jul-15
Pic R.	Jul-19	Jul-18	Jul-18
Nama Cr.	Jul-19	Jul-18	Jul-18
Little Pic R.	Jul-16	Jul-19	Jul-19
Prairie R.	Jul-19	Jul-18	Jun-18
Steel R.	Aug-19	Jul-18	Jul-18
Pays Plat R.	Jul-15	Aug-18	Aug-18

Table 11. *continued.*

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

Table 11. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Oliver Cr.	Jul-16	Aug-18	Aug-18
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.	Jul-18	Aug-19	Aug-17
Pigeon Bay	Aug-10	Aug-15	Aug-15
United States			
Waiska R.	Jul-07	Jul-19	Jun-18
West Branch	Jun-16	Jul-19	Jul-19
Sec. 11SW Cr.	Never	Jun-17	Jun-12
Pendills Cr.	Jul-12	May-18	May-16
Tahquamenon Bay	Never	Jul-17	Jul-12
Grants Cr.	Aug-15	Jul-19	Jul-19
Tahquamenon Bay	Jul-18	Jul-19	Jul-19
Halfaday Cr.	Jul-12	Jul-19	Jul-19
Tahquamenon Bay	Never	Jul-12	Jul-12
Naomikong Cr.	Jul-18	Jul-19	Jun-17
Ankodosh Cr.	Aug-19	July-19	Jul-19
Tahquamenon Bay	Jul-18	Jul-19	Jul-17
Roxbury Cr.	Jul-17	Aug-19	Aug-19
Tahquamenon Bay	Never	Jul-19	Jul-19
Galloway Cr.	Aug-19	Jun-18	Jun-18
Tahquamenon Bay	Never	Jun-13	Jul-88
Tahquamenon R.	Aug-19	Aug-19	Jul-18
Betsy R.	Jul-17	Jul-19	Jul-19
Three Mile Cr.	Jul-18	Jun-19	Aug-17
Little Two Hearted R.	Aug-16	Aug-19	Aug-19
Two Hearted R.	Aug-19	Aug-19	Jul-19
Dead Sucker R.	Aug-13	May-19	May-19
Sucker R.	Jul-18	Oct-19	Jun-18
Grand Marais Harbor	Never	Sep-18	Sep-18
Chipmunk Cr.	Sep-62	May 19	Sep-61
Carpenter Cr.	Aug-15	May-19	Aug-14
West Bay	Aug-19	Sep-18	Sep-18
Sable Cr.	Sep-89	Jun-19	Jun-19
Hurricane R.	Never	Sep-18	Aug-08
Sullivans Cr.	Jul-19	Oct-19	Oct-19
Seven Mile Cr.	Jul-18	Sep-18	Sep-17
Beaver Lake Cr.			
Beaver Lk Outlet	Jul-18	Sep-18	Aug-17
Lowney Cr.	Jul-18	Jun-19	Jun-19
Little Beaver Cr.	Jul-18	Jun-19	Aug-17
Beaver Lake	Never	Aug-17	Jun-19
Little Beaver Lake	Never	Jun-19	Jun-19
Mosquito R.	Jun-73	Sep-18	Oct-72
Miners R.			
Barrier downstream	Jul-16	Jul-19	Sep-18
Barrier upstream	Jul-13	Aug-18	May-12

Table 11. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Miners Lake Lentic	Jun-11	Sep-13	Sep-13
Munising Falls Cr.	Sep-64	Sep-17	Jun-14
Anna R.	Jul-19	Oct-19	May-19
Munising Bay	Jul-19	Sep-19	Sep-19
Tourist Park Cr.	Never	Jul-19	Jul-10
Furnace Cr.			
Lower	Jul-19	Sep-19	Sep-19
Upper	Sep-10	Sep-18	Aug-09
Furnace Bay	Jul-17	Jul-19	Jul-19
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	Sep-19	Sep-19
Five Mile Cr. Lentic	Never	Jul-16	Jul-16
Au Train R.			
Lower	Jul-19	Sep-19	May-19
Upper	Jul-19	Sep-19	May-19
Au Train Lake	Never	Jun-17	Jun-17
Rock R.	Jul-02	Sep-18	Aug-97
Deer Lake Cr.	Aug-70	Sep-17	Aug-78
Laughing Whitefish R.	Jul-17	Oct-19	Oct-19
Sand R.			
Below Dam	Jul-19	Sep-19	Sep-18
Above Dam	Jul-15	Aug-17	Aug-17
Chocolay R.	Jul-19	Oct-19	Oct-19
Carp R.	Aug-18	Oct-19	Oct-19
Carp R. lentic	Jun-15	Oct-19	Jul-19
Dead R.	Jul-19	Sep-19	Jul-19
Presque Isle Harbor	Jul-19	Sep-19	Aug-18
Compeau Cr.	Never	Jul-19	Jun-12
Harlow Cr.	Sep-19	Nov-18	Nov-18
Harlow Lake – offshore Bismark Cr.	Never	Jun-17	Jun-17
Little Garlic R.	May-17	Aug-19	Aug-19
Little Garlic R. lentic	Jun-12	Jun-17	Aug-11
Garlic R.	Jul-18	Oct-19	Oct-19
Garlic R. lentic	Never	Jul-12	Sep-05
Saux Head Lake	Jul-17	Jun-19	Jun-19
Iron R.	Sep-19	Sep-18	Sep-18
Salmon Trout R.	Jul-19	Oct-19	Jun-19
Pine R. (Marquette Co.)	Jun-18	Jun-19	Sep-17
Huron R.	Aug-19	Jul-19	Jun-19
Ravine R.	Aug-19	Sep-19	Sep-19
Huron Bay	Sep-15	Sep-19	Sep-19
Slate R.	Jun-19	Sep-19	Aug-16
Huron Bay	Aug-17	Sep-19	Sep-19
Silver R.	Aug-19	Sep-19	Jun-19
Huron Bay	Aug-17	Sep-19	Sep-17
Falls R.	Aug-19	Sep-19	Jun-06
L'anse Bay	Jun-18	Sep-19	Sep-19
Six Mile Cr.	Sep-18	Jul-19	Jun-17

Table 11. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
L'anse Bay	Never	Jun-18	Jun-18
Little Carp R.	May-19	Oct-19	Aug-18
Kelsey Cr.	Never	Aug-18	Aug-16
Sturgeon R.	Oct-18	Sep-19	Sep-19
Pilgrim R.	Aug-62	May-19	May-19
Trap Rock R.	Jul-19	Oct-19	Sep-19
Torch Lake	Jul-19	Sep-19	Sep-19
McCallum Cr.	Aug-63	May-15	May-94
Traverse River	May-19	Oct-19	Oct-19
Little Gratiot R.	Jun-16	May-19	May-15
Eliza Cr.	Jul-19	Oct-19	Aug-18
Eagle Harbor	Jul-19	Sep-19	Sep-19
Gratiot R.	Sep-18	May-19	Aug-17
Smiths Cr.	May-64	Aug-17	May-64
Boston-Lily Cr.	Jun-16	Sept-19	Sep-19
Schlotz Cr.	Jul-16	May-19	May-19
Salmon Trout R. (Houghton Co.)	Jun-16	Aug-18	Aug-18
Mud Lake Outlet	Sep-18	May-19	May-19
Hungarian Creek	Jul-19	Oct-19	Oct-19
Torch Lake	Never	Sep-19	Sep-19
Graveraet R.	Sep-18	May-19	May-19
Elm R.	Aug-16	May-19	Aug-15
Misery R.			
Barrier Downstream	Aug-18	Aug-19	Aug-19
Barrier upstream	Aug-00	Aug-18	Sep-08
East Sleeping R.	May-19	Aug-19	Aug-19
West Sleeping R.	May-19	Aug-19	Aug-19
Firesteel R.	Jun-19	Sep-19	Aug-19
Flintsteel R.	Sep-17	Sep-19	Sep-19
Ontonagon R.	Oct-19	Aug-19	Aug-19
Potato R.	Sep-17	Sep-19	Sep-19
Floodwood R.	Never	Jul-18	Aug-85
Cranberry R. (Ontonagon Co.)	Sep-18	Oct-19	Aug-19
Mineral R.	Sep-17	Sep-19	Jul-18
Mineral R. lentic	Never	Aug-19	Sep-11
Big Iron R.	Never	Aug-19	Jul-15
Little Iron R.	Sep-75	Aug-19	Sep-13
Union R.	May-64	Jun-17	Aug-62
Black R.	Sep-19	Jul-19	Jul-17
Black River Harbor	Sep-19	Jul-19	Jul-19
Montreal R.	Jul-75	Aug-18	Jul-10
Washington Cr.	Jun-80	Jul-12	Sep-82
Bad R.	Sep-17	Sep-19	Sep-19
Fish Cr. (Eileen Twp)	Jun-15	Sep-19	Sep-19
Chequamegon Bay	Never	Aug-15	Aug-06
Sioux R.	Jul-19	Sep-19	Aug-18
Pikes Cr.	May-16	Aug-18	Aug-18
Red Cliff Cr.	Jun-18	Jul-19	Jul-19
Buffalo Bay	Never	Aug-11	Aug-03

Table 11. *continued.*

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

Table 12. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Superior for larval assessment purposes during 2019.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
Goulais River	1.42	0.3
Batchawana River	1.42	0.3
Batchawana River	0.71	0.15
Carp River	0.71	0.15
Little Pic River	1.42	0.3
Nipigon R.	0.95	0.2
Nipigon R.	1.89	0.4
Otter Cove Cr.	0.24	0.05
Otter Cove Cr.	0.95	0.2
Black Sturgeon R.	2.13	0.45
Current R.	1.42	0.3
Kaministiquia R.	3.07	0.65
Cloud R.	0.47	0.1
Pigeon R.	0.71	0.15
Total (Canada)	**17.51**	**3.70**
United States		
Grants Creek (Lentic)	1.95	0.41
Ankodosh Creek (Lentic)	0.98	0.21
Roxbury Creek (Lentic)	1.95	0.41
Beaver Lake Creek (Lentic)	2.45	0.52
Beaver Lake Creek (Lowney Cr) (Lentic)	1.46	0.31
Anna R. (Lentic)	1.95	0.41
Furnace Creek (Lentic)	1.95	0.41
Au Train River	0.49	0.10
Carp River (Lentic)	1.95	0.41
Dead River (Lentic)	1.95	0.41
Dead River (Lotic)	0.98	0.21
Garlic River –Saux Head Lake (Lentic)	1.46	0.32
Ravine River (Lentic)	3.92	0.83
Slate River (Lentic)	1.95	0.41
Silver River (Lentic)	3.92	0.83
Falls River (Lentic)	1.95	0.41
Sturgeon River (Lentic)	2.45	0.52
Trap Rock River (Lentic)	1.95	0.41
Eliza Creek (Lentic)	0.98	0.21
Hungarian Creek (Lentic)	1.95	0.41
Firesteel Creek (Lotic)	0.73	0.16
Black River (Lentic)	2.45	0.52
Sioux River (Lentic)	0.24	0.05
Iron River (Bayfield) (Lotic)	1.95	0.41
St. Louis River (Lotic)	5.63	1.19
Total (United States)	**49.59**	**10.49**
Total for Lake	**67.10**	**14.19**

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

Lake Michigan

- Larval assessments were conducted in 122 tributaries and 25 lentic areas. The status of larval Sea Lamprey populations in historically infested Lake Michigan tributaries and lentic areas is presented in Table 13.

- Surveys to estimate larval abundance were conducted in 38 tributaries.

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 11 tributaries. No new infestations were identified.

- Post-treatment assessments were conducted in 15 tributaries to determine the effectiveness of lampricide treatments conducted during 2018 and 2019. The Big Manistee River is scheduled for treatment during 2020 based on the presence of residual Sea Lamprey.

- Surveys to evaluate barrier effectiveness were conducted in 14 tributaries. All barriers were found to be effective in limiting Sea Lamprey infestations.

- Larval assessment surveys were conducted in 28 non-wadable lentic and lotic areas using 38.12kg active ingredient of 3.2% gB (Table 14).

Table 13. 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	Jun-17	Aug-19	Aug-19
Lower	Jun-17	Aug-19	Aug-19
Brevort Lake	May-12	Jun-19	Jun-19
Paquin Cr.	Jun-19	Sept-18	Sep-18
Paquin Cr. Lentic	Never	Sep-18	Sep-18
Davenport Cr.	Sep-13	Aug-19	Aug-11
Hog Island Cr.	Jun-17	Aug-19	Aug-19
Hog Island Cr. Lentic	Jun-07	Jul-18	Jul-18
Sucker R.	Jun-61	Sep-17	May-07
Black R.	Jun-17	Aug-19	Aug-19
Black R. lentic	Jun-76	Aug-11	Aug-11
Mattix Cr.	Aug-15	Jun-18	Jun-14
Mile Cr.	May-17	Aug-19	Jun-19
Mile Cr. Lentic	Aug-68	Jun-18	Jun-08
Millecoquins R.	Jun-17	Aug-19	Jul-19
Furlong Creek	Sep-19	Jun-19	Sep-19
Millecoquins Lake	Never	Jun-19	Jun-14
Rock R.	Jun-19	May-19	Jun-18
Crow R.	Jun-19	Jun-19	Jun-18
Cataract R.	Sep-19	Aug-18	Sep-18
Cataract R. lentic	Never	Jul-19	Jul-19
Pt. Patterson Cr.	Jul-13	Aug-18	Sep-12

Table 13. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Hudson Cr.	Aug-19	May-19	Aug-18
Swan Cr.	Jul-13	Jul-19	Jul-19
Seiners Cr.	Aug-17	Jul-19	Jul-19
Milakokia R.	Oct-16	Jul-19	Jul-19
Seul Choix Bay	Never	Aug-80	Jul-19
Bulldog Cr.	Jun-13	Jun-18	Sep-13
Gulliver Lake Outlet	Sep-19	Sep-18	Sep-18
Marblehead Cr.	Jun-19	May-19	May-19
Manistique R.	Sep-19	Sep-19	Sep-19
Inside Breakwalls	Jun-19	Jun-19	Oct-19
Outside Breakwalls	Jul-18	Jul-18	Oct-19
Southtown Cr.	Jul-13	Jul-19	Aug-12
Thompson Cr.	Never	Jul-19	Jul-19
Johnson Cr.	Jun-13	Jul-19	Sep-12
Deadhorse Cr.	Aug-18	Jul-19	Jul-19
Deadhorse Cr. Lentic	Never	Jul-11	Oct-64
Gierke Cr.	Never	Jul-19	Jun-04
Bursaw Cr.	Aug-17	Jul-19	Jul-19
Bursaw Cr. Lentic	Never	Jul-11	Jul-11
Parent Cr.	Aug-17	Jul-19	Jul-19
Poodle Pete Cr.	Aug-17	Jul-19	Jul-19
Valentine Cr.	Aug-17	Jul-19	Jul-19
Big Bay de Noc	Never	Sep-11	Aug-94
Little Fishdam R.	May-01	Jul-19	Jul-04
Big Fishdam R.	Aug-16	Jul-19	Jul-19
Sturgeon R.	Jul-19	Jun-19	Jun-19
Big Bay de Noc	Never	Aug-19	Aug-15
Ogontz R.	Jun-16	Oct-19	Oct-19
Big Bay de Noc	Sep-14	Aug-17	Jul-15
Squaw Cr.	Aug-17	Jul-19	May-16
Hock Cr.	May-17	Jul-19	May-16
Whitefish R.	Jun-19	Oct-19	Oct-19
Little Bay de Noc	Jun-83	Aug-18	Jul-11
Rapid R.	May-17	Oct-19	Oct-19
Little Bay de Noc	May-15	Aug-18	Jul-16
Tacoosh R.	Oct-14	Jul-19	Jul-14
Days R.			
Barrier downstream	Sep-19	Jun-19	Aug-18
Barrier upstream	Aug-17	Jul-19	Aug-17
Little Bay de Noc	Aug-14	Aug-17	Aug-13
Escanaba R.	Never	Jun-15	Jul-06
Portage Cr.	May-17	Aug-19	Aug-17
Portage Bay	Never	Aug-17	Aug-82
Ford R.	May-17	Sep-19	Sep-19
Green Bay	Oct-14	Aug-19	Aug-19
Sunnybrook Cr.	May-71	Aug-19	Sep-90
Bark R.	May-17	Jul-19	Aug-16
Green Bay	Never	Jul-16	Sep-98

Table 13. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Cedar R.	Jun-17	Aug-19	Aug-19
Green Bay	May-10	Aug-19	Jul-16
Sugar Cr.	May-08	Jul-19	Jul-19
Arthur Bay Cr.	Jun-10	Jul-19	Jul-19
Rochereau Cr.	Apr-63	Jul-19	Jul-62
Johnson Cr.	Apr-17	Jul-19	Jul-19
Bailey Cr.	May-19	Jul-19	Jul-19
Green Bay	Never	Aug-18	Aug-18
Beattie Cr.	May-19	Jul-19	Aug-18
Springer Cr.	May-19	Jul-19	Jul-19
Menominee R.	Jul-16	Jun-19	Jun-19
Green Bay	Jul-16	Aug-17	Sep-15
Little R.	Aug-77	Aug-18	Aug-77
Peshtigo R.	Oct-15	Aug-18	Sep-16
Oconto R.	Oct-17	Jul-19	Aug-17
Pensaukee R.	Nov-77	Aug-17	Sep-85
Suamico R.	Never	Aug-17	May-67
Ephraim Cr.	Apr-63	Jun-19	Apr-61
Hibbards Cr.	May-07	Jun-19	Oct-09
Whitefish Bay Cr.	May-16	Jun-19	Jun-15
Shivering Sands Cr.	Apr-12	Jun-19	May-14
Lily Bay Cr.	Apr-63	Jun-18	May-63
Bear Cr.	May-75	Jun-19	May-75
Door Co. 23 Cr.	May-19	Jun-19	Jun-18
Silver Creek	Never	Jul-18	Jul-15
Ahnapee R.	Apr-64	Jun-18	Apr-64
Three Mile Cr.	Apr-17	Jun-19	Jun-19
Kewaunee R.			
Barrier downstream	May-75	Jun-19	May-98
Barrier upstream	May-75	Jul-17	Aug-13
Casco Cr.	May-14	Jun-19	Aug-14
East Twin R.	Apr-17	Jun-19	Jun-19
Fischer Cr.	May-87	Jun-19	May-87
French Farm Cr.	Never	Jul-19	Jun-10
Carp Lake Outlet	Jun-17	Jun-19	May-15
Big Stone Cr.	Sep-13	Jun-19	Aug-10
Big Sucker R.	Sep-13	Jul-19	Sep-13
Wycamp Lake Outlet	Jul-17	Jun-19	Aug-16
Bear R.	Never	Jun-19	Never
Bear R. Lentic	Jun-07	Jun-08	Jun-08
Horton Cr.	Jun-17	Aug-19	Oct-19
Horton Cr. Lentic	Jun-19	Aug-19	Aug-19
Boyne R.	Jul-18	Jun-19	Jun-19
Boyne R. Lentic	Jun-17	Jun-19	Jun-14
Porter Cr.	Sep-13	Jun-19	Jun-19
Porter Cr. Lentic	Sep-13	Jun-19	Jun-19
Jordan R.	Jul-18	Jun-19	May-18
Jordan R. Lentic	Jul-18	Jun-19	Jun-14
Monroe Cr.	Aug-13	Jun-19	Jun-13

Table 13. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Loeb Cr.	Aug-13	Jun-19	Aug-11
McGeach Cr.	Oct-99	May-15	Jun-98
Elk Lake Outlet	Jun-17	Aug-19	Jun-16
Yuba Cr.	May-06	Sep-16	Aug-05
Acme Cr.	Aug-63	Aug-18	Jul-73
Mitchell Cr.	Jul-17	Sep-19	Sep-19
Boardman R. (lower)	Aug-15	Jul-19	Jun-14
Boardman R. (mid.)	Aug-15	Jul-19	Sep-14
Boardman R. Lentic	Jun-17	Jul-19	Jun-16
Hospital Creek	Jul-18	Aug-19	Jun-17
Leo Cr.	Never	Aug-19	Jul-95
Leland River Lentic	Never	Jul-19	Jun-13
Good Harbor Cr.	Jul-10	Aug-19	Sep-09
Crystal R.	Apr-19	Aug-19	Sep-18
Platte R. (upper)	May-19	Aug-19	May-19
Platte R. (middle)	May-19	Aug-19	Sep-19
Loon Lk. Lentic	May-19	Sep-19	Sep-19
Platte R. (lower)	May-19	Aug-19	Sep-18
Betsie R.	May-19	Aug-19	May-19
Bowen Cr.	Jun-09	Aug-19	Oct-19
Big Manistee R.	Aug-19	Oct-19	Oct-19
Bear Cr.	Aug-19	Jul-19	Jul-19
L. Manistee R.	Jul-18	Aug-19	Aug-19
L. Manistee R. Lentic	Jul-11	Jul-18	Sep-05
Gurney Cr.	Jun-16	Aug-19	Jul-15
Cooper Cr.	Jul-08	Aug-19	Sep-07
Lincoln R.	Jul-17	Aug-19	Aug-19
Pere Marquette R.	Jul-17	Aug-19	Jul-19
Bass Lake Outlet	Aug-78	Jun-18	Aug-75
Pentwater R. (N. Br.)	Jul-16	Aug-19	Jun-18
South Branch	Never	Aug-17	Jun-83
Lambricks Cr.	Sep-84	Aug-17	Sep-84
Stony Cr.	Jul-17	Aug-19	Aug-19
Flower Cr.	Jul-17	Jul-19	May-17
White R.	Aug-17	Jul-19	Jul-19
Duck Cr.	Jul-84	Jul-19	Aug-95
Muskegon R.	Sep-19	Jul-19	Aug-18
Brooks Cr.	Sep-19	Jul-19	Aug-18
Cedar Cr.	Sep-19	Jul-19	Sep-16
Bridgeton Cr.	Sep-19	Jul-19	May-17
Minnie Cr.	Sep-19	Jul-19	Jul-19
Bigelow Cr.	Sep-19	Jul-19	Aug-18
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 River	Never	Aug-15	Never
Norris Cr.	Jun-17	Jul-19	Sep-16
Lowell Cr	Sep-65	Sep-19	Jun-65
Buck Cr.	Sep-65	Jul-18	Sep-65

Table 13. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Rush Cr.	Sep-65	Jul-18	Sep-62
Sand Cr.	Jun-07	Jul-18	Jun-07
Crockery Cr.	Jun-17	Sep-19	Sep-16
Bass R.	Aug-04	Jul-18	Sep-03
Rogue R.	Sep-09	Apr-19	Sep-08
Pigeon R.	Oct-64	Sep-19	May-62
Pine Cr.	Oct-64	Sep-19	May-62
Gibson Cr.	Jul-84	Sep-19	Jun-83
Kalamazoo R.	Oct-65	Jul-17	Never
Bear Cr.	Apr-19	Aug-19	Aug-19
Sand Cr.	Sep-10	Aug-19	May-17
Mann Cr.	Jul-16	Aug-19	Sep-15
Rabbit R.	Sep-15	Aug-19	Jul-14
Swan Cr.	Jul-13	Aug-19	Aug-19
Allegan 3 Cr.	Sep-65	Sep-19	Jun-62
Allegan 4 Cr.	Oct-78	Sep-19	Sep-19
Allegan 5 Cr.	Sep-15	Sep-19	Jul-14
Black R.			
North Branch	Jun-77	Sep-19	Sep-19
Middle Branch	May-17	Sep-19	Sep-19
South Branch	May-17	Aug-19	May-17
Brandywine Cr.	Aug-85	May-17	Jul-02
Rogers Cr.	May-18	Sep-19	Jun-16
St. Joseph R.	Never	Jul-19	Never
Lemon Cr.	Oct-65	Sep-19	Jun-65
Pipestone Cr.	May-14	Sep-19	Sep-19
Meadow Dr.	Oct-65	Oct-19	Apr-62
Hickory Cr.	Jul-15	Sep-19	Sep-19
Farmers Creek	Never	Sep-19	Oct-19
Paw Paw R.	Sep-17	Sep-19	Sep-19
Blue Cr.	Sep-15	Sep-19	Jun-15
Mill Cr.	Sep-17	Sep-19	Jun-17
Brandywine Cr.	Sep-17	Sep-19	Jul-17
Brush Cr.	Sep-15	Sep-19	Jun-15
Hayden Cr.	Sep-17	Sep-19	Sep-18
Campbell Cr.	Sep-18	Sep-19	Sep-18
Ritter Cr.	Sep-17	Sep-19	Oct-16
Galien R. (N. Br.)	Jun-16	Sep-19	Sep-15
E. Br. & Dowling Cr.	Oct-10	Sep-19	Sep-09
S. Br. & Galina Cr.	Jun-16	Sep-19	Sep-18
Spring Cr.	Jun-16	Sep-19	May-16
S. Br. Spring Cr.	Jun-16	Sep-19	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	Sep-17	Oct-98
Salt Creek	May-18	Oct-19	Jun-19

Table 14. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Michigan for larval assessment purposes during 2019.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
United States		
Brevort River – Brevort Lake	1.94	0.41
Brevort River (Lentic)	1.47	0.31
Cataract River (Lentic)	1.47	0.31
Crow River – Amadon Pond	0.47	0.10
Millecoquins River – Millecoquins Lake	3.45	0.73
Millecoquins River (Lentic)	1.47	0.31
Milakokia River (Lentic)	1.47	0.31
Sturgeon River (Lentic)	1.47	0.31
Whitefish River – Trout Lake	0.47	0.10
Ford River (Lentic)	1.94	0.41
Cedar River (Lentic)	1.94	0.41
Springer Creek (Lentic)	1.47	0.31
Sugar Creek (Lentic)	1.47	0.31
Shivering Sands Creek (Lentic)	1.47	0.31
Door Co No 23 Creek (Lentic)	1.47	0.31
Carp River (Lentic)	0.95	0.21
Bear River (Lentic)	0.95	0.21
Horton Creek (Lentic)	1.42	0.30
Boyne River (Lentic)	1.42	0.30
Porter Creek (Lentic)	0.95	0.21
Jordan River (Lentic)	1.89	0.40
Monroe Creek (Lentic)	0.71	0.15
Loeb Creek (Lentic)	0.47	0.10
Elk Lake Outlet (Lentic)	0.71	0.15
Boardman River (Lentic)	1.42	0.30
Leland River (Lentic)	0.95	0.21
Platte River (Loon Lk. Lentic)	2.84	0.60
Total for Lake	**38.12**	**8.09**

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

Lake Huron

- Larval assessments were conducted in 111 tributaries (55 Canada; 56 U.S.) and 19 lentic areas (13 Canada; 6 U.S.). The status of larval Sea Lamprey populations in historically infested Lake Huron tributaries and lentic areas is presented in Table 15.

- Surveys to estimate larval abundance were conducted in 36 tributaries (22 Canada; 14 U.S.) and 7 lentic areas (2 Canada; 5 U.S.).

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 27 tributaries (17 Canada; 10 U.S.). No new infestations were identified.

- Post-treatment assessments were conducted in 21 tributaries (11 Canada; 10 U.S.) and in 2 lentic areas (0 Canada; 2 U.S.) to determine the effectiveness of lampricide treatments

conducted during 2018 and 2019. Munuscong River (Taylor Creek) is scheduled for treatment during 2020 based on the presence of residual Sea Lamprey.

- Surveys to evaluate barrier effectiveness were conducted in 7 tributaries (0 Canada, 7 U.S.). All barriers were found to be effective in limiting Sea Lamprey infestations.

- Monitoring of larval Sea Lamprey in the St. Marys River continued during 2019. With the use of deep-water electrofishers, 868 geo-referenced sites were sampled. Surveys were conducted according to a stratified, systematic sampling design. The larval Sea Lamprey population in the St. Marys River was estimated to be 1.14 million (95% CI; 0.66 to 1.6 million).

- Larval assessments were conducted in non-wadable lentic and lotic areas using 39.36 kg active ingredient of 3.2% gB (18.78 kg Canada; 20.58 kg U.S.; Table 16).

Table 15. 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.	Oct-19	Oct-19	Oct-19
Whitefish Ch.	Jul-16	Nov-19	Nov-19
Root R.	May-16	Oct-19	Aug-19
Garden R.	Jul-14	Sep-19	Sep-19
Maud &Driving Cr.	May-15	May-15	Jul-14
Echo R.			
Main	Jul-11	Oct-19	Oct-19
Bar & Iron Cr.	Jun-15	Oct-17	Oct-17
Echo Lake	Jun-15[1]	Sep-17	Sep-17
Solar Lake	Jul-87	Jul-06	May-90
Stuart Lake	Jul-80	May-90	May-90
Bar R.	Oct-11	Jul-19	Jul-10
Sucker Cr.	May-18	Jul-19	Sep-17
Desjardins Bay	Jul-84	Sep-16	Jun-13
Two Tree R.	May-15	Sept-18	Jul-14
North Channel	Never	Aug-81	Aug-81
Richardson Cr.	Sep-16	Jul-19	Jul-16
Watson Cr.	May-18	Jul-19	Jul-19
Gordon Cr.	May-18	Jul-19	Jul-19
Tenby Bay	Jul-84	Jul-18	Aug-91
Browns Cr.	May-16	Jul-18	Jul-18
Tenby Bay	Aug-87	Jul-18	Aug-91
Koshkawong R.	May-18	Jul-19	Jul-19
North Channel	Never	Jul-17	Aug-91
No Name (H-65)	Jun-13	Sep-17	Jun-15
No Name (H-68)	Jun-19	Jul-18	Jul-18
North Channel	Never	Apr-12	May-95
MacBeth Cr.	Jun-19	Sep-18	Jun-18

Table 15. *continued.*

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

Table 15. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Musquash R.	Aug-13	Jun-19	Jun-19
Simcoe/Severn System	Never	May-19	May-19
Georgian Bay	Aug-18	May-19	May-19
Sturgeon R.	Apr-12	May-19	Sep-09
Sturgeon Bay	Never	May-14	Jun-99
Hog Cr.	Sep-78	Aug-17	Aug-78
Lafontaine Cr.	Jun-68	May-18	May-67
Nottawasaga R.			
Main	Jun-17	May-19	May-19
Boyne R.	Jun-17	May-19	May-19
Bear Cr.	Jun-13	May-19	April-11
Pine R.	Jun-18	May-19	May-19
Marl Cr.	Apr-13	May-19	May-11
Pretty R.	May-72	May-18	May-72
Silver Cr.	Sep-82	May-18	Sep-82
Bighead R.	Aug-18	May-19	May-19
Georgian Bay	Aug-18	Aug-17	Aug-17
Bothwells Cr.	Jun-79	May-18	Aug-83
Sydenham R.	Jun-72	May-18	Jul-71
Sauble R.	Jun-04	May-18	May-18
Saugeen R.	Jun-71	May-17	May-95
Bayfield R.	Jun-70	May-17	Sep-73
United States			
Mission Cr.	Never	May-16	Aug-04
Frechette Cr.	Never	May-16	Jul-81
Ermatinger Cr.	Never	May-16	Jun-12
Charlotte R.	Oct-11	Jun-17	Jun-17
Little Munuscong R.	Jul-16	Jul-19	Jul-19
Big Munuscong R.	Jun-99	May-16	Jul-97
Taylor Cr.	May-19	Aug-19	Aug-19
Gogomain River	Jul-16	Jun-18	Jun-18
Carlton Cr.	Oct-18	Aug-19	Aug-19
Canoe Lake Outlet	May-70	Apr-13	May-69
Caribou Cr.	Oct-19	Aug-19	Aug-19
Caribou Cr. Lentic	May-18	Sep-18	Jul-17
Bear Lake Outlet	Sep-16	Aug-19	Aug-19
Carr Cr.	Jun-13	Aug-19	Jun-15
Joe Straw Cr.	Jun-13	May-19	Oct-12
Saddle Cr.	Never	May-19	May-02
Huron Point Cr.	May-18	Aug-19	Aug-19
Albany Cr.			
Barrier downstream	May-18	Aug-19	Aug-19
Barrier upstream	Sep-01	Aug-15	May-03
Albany Bay	May-18	Sep-18	Jul-16
Trout Cr.	Jul-15	Aug-19	Aug-19
Trout Cr. Lentic	Never	Jul-14	Jul-11
Beavertail Cr.	Jul-18	Aug-19	Jul-17
Prentiss Cr.	Oct-19	Sep-18	May-19

Table 15. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
McKay Cr.	May-18	Aug-19	Aug-19
McKay Bay	Never	Sep-18	Jul-11
Flowers Cr.	Jun-13	May-19	May-11
Flowers Bay	Never	Jun-12	Jul-80
Ceville Cr.	Jul-16	May-19	Jul-15
Hessel Cr.	Jul-15	Aug-19	Aug-19
Steeles Cr.	Sep-16	Aug-19	Aug-19
Nunns Cr.			
Barrier downstream	Jul-16	Aug-19	May-14
Barrier upstream	Jul-16	May-19	Jun-15
St. Martin Bay	Never	Aug-14	Aug-87
Pine R.	Jun-18	Aug-19	Sep-18
St. Martin Bay	May-18	Sep-18	Jul-17
McCloud Cr.	Jul-15	Aug-19	Aug-15
St. Martin Bay	Never	Aug-15	Aug-15
Carp R.	Jul-18	Aug-19	Sep-18
St. Martin Bay	Jul-18	Aug-19	Aug-19
Martineau Cr.	Jul-16	Aug-19	May-17
Horseshoe Bay	Never	Aug-19	Sep-14
Hoban Cr.	Jun-12	May-17	May-11
266-20 Cr.	Aug-76	Jun-18	Sep-94
Beaugrand Cr.	Jun-16	Jun-18	Jul-15
Little Black R.	May-67	May-14	May-07
Cheboygan R.	Oct-83	Jun-19	Jun-19
Cheboygan R. lentic	Never	Jun-19	Aug-93
Laperell Cr.	May-00	Sep-18	Aug-99
Meyers Cr.	Jul-17	Sep-18	Jun-16
Maple R.	Aug-16	Aug-19	Aug-19
Pigeon R.	Sep-16	Sep-19	Sep-19
Little Pigeon R.	Aug-12	Sep-19	Jun-10
Sturgeon R.	Aug-16	Aug-19	Aug-19
Sturgeon R. lentic	Jun-19	Aug-19	Aug-18
Elliot Cr.	Jul-17	Aug-19	Aug-19
Duncan Bay	Never	Aug-16	Jul-12
Greene Cr.			
Barrier downstream	Jul-12	Jun-18	Sep-10
Barrier upstream	Jun-07	Aug-19	Jun-13
Grass Cr.	May-78	Jun-19	Jun-19
Mulligan Cr.	Jun-16	Jul-19	Jun-18
Mulligan Cr. lentic	Never	Aug-16	Aug-16
Grace Cr.	Oct-18	May-19	May-19
Black Mallard Cr.			
(Lower)	Jun-18	Jul-19	Jul-19
Black Mallard Lake	Never	Jul-12	Jun-10
(Upper)	May-15	Jun-18	Sep-19
Seventeen Cr.	Jul-12	Jun-19	Jul-12

Table 15. *continued.*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Ocqueoc R.			
Hammond Bay lentic	Never	Sep-12	Sep-86
Barrier upstream	Sep-18	Jun-19	Jun-19
Barrier downstream	Jul-16	Jul-19	Jul-19
Johnny Cr.	Sep-70	Jun-19	Jun-19
Hammond Bay Cr. lentic	Never	Sep-17	Sep-17
Schmidt Cr.			
Lower	Jun-18	Jun-19	Jun-17
Upper	May-08	Jun-17	May-08
Nagels Cr.	Never	Aug-18	Jun-09
Trout R.			
Barrier downstream	Jul-16	Jul-19	Jul-19
Barrier upstream	Oct-07	Jun-19	Jun-07
Swan R.	Jun-10	Jul-17	Jun-10
Grand Lake Outlet	Never	Jun-17	May-03
Middle Lake Outlet	Jun-67	Aug-18	Aug-66
Long Lake Outlet	Jun-16	Jul-19	Jul-19
Squaw Cr.	Jun-13	Aug-18	Oct-11
Devils R.	Oct-14	Aug-18	Aug-13
Thunder Bay	Never	Jun-09	Aug-76
Black R.	Jun-18	Aug-18	Aug-18
Mill Cr.	Never	Aug-18	May-98
Au Sable R.	Aug-18	Jul-19	Jul-19
Au Sable. R lentic	Aug-15	Aug-17	Sep-14
Pine R.	May-87	Sep-19	Sep-94
Tawas Lake Outlet	Jun-15	Jul-19	Jun-14
Cold Cr.	Aug-18	Aug-19	May-17
Sims Cr.	Jul-09	Aug-19	Aug-08
Grays Cr.	Sep-05	May-18	Jul-04
Silver Cr.	Sep-18	Aug-19	Sep-17
East AuGres R.	Jun-18	May-18	Jul-19
East AuGres R. lentic	Never	Aug-15	Jun-86
AuGres R.	Sep-18	Jul-18	Jun-19
Rifle R.	Aug-18	Jul-18	Jul-18
Saginaw R.			
Shiawassee R.	May-18	Jun-19	Jun-19
Cass R.	Jun-18	Jun-19	Jul-18
Flint River	Never	Jul-19	Jul-14
Armstrong Cr.	May-15	Sep-17	Jul-14
Tittabawassee R.	Jun-18	Sep-19	Sep-19
Chippewa R.	May-18	Sep-19	Sep-19
Chippewa gravel pits	May-18	Sep-19	Sep-19
Pine R.	May-19	Sep-19	Sep-19
Carroll Cr.	May-17	Oct-19	Jul-16
Big Salt R.	Jun-18	Oct-19	Oct-19
Rock Falls Cr.	Never	Jun-19	Jun-69
Cherry Cr.	Never	Jun-16	Jul-77
Mill Cr.	May-85	Jun-19	Jun-12

Table 16. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Huron for larval assessment purposes during 2019.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
St. Marys R.	2.84	0.6
MacBeth Cr.	0.71	0.15
Thessalon River	1.42	0.3
Mississagi R. (Lentic)	2.13	0.45
Mississagi R.	2.36	0.5
Blind R.	0.71	0.15
Serpent R.	1.42	0.3
Kagawong R.	0.71	0.15
Francis Brook	0.47	0.1
French R. System	0.35	0.075
Still R. (Lentic)	0.47	0.1
Still R.	0.95	0.2
Magnetawan R.	1.42	0.3
Seguin R.	0.47	0.1
Musquash R.	0.95	0.2
Simcoe/Severn System (Lentic)	0.47	0.1
Simcoe/Severn System	0.95	0.2
Total (Canada)	**18.78**	**3.98**
United States		
Beavertail Cr. (Lentic)	1.42	0.3
Carp R. (Lentic)	1.89	0.4
Martineau Cr. (Lentic)	1.89	0.4
Pine R. (Lentic)	1.42	0.3
Trout Cr. (Lentic)	1.89	0.4
Cheboygan R. (Lentic)	1.42	0.3
Cheboygan R. (Lotic)	2.37	0.5
Sturgeon R. (Lentic – Burt Lake)	1.18	0.25
Pigeon R. (Lentic – Mullett Lake)	0.95	0.2
Black R. (Lotic)	1.42	0.3
Saginaw R. (Chippewa R. Gravel Pits)	4.73	1.0
Total (United States)	**20.58**	**4.35**
Total for Lake	**39.36**	**8.33**

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

Lake Erie

The control agents continue to delineate the distribution and abundance of the larval Sea Lamprey population in the St. Clair River, a potential source of parasitic juveniles in Lake Erie. Results of these efforts form the basis for further actions and strategies for Sea Lamprey control in this important interconnecting waterway.

- Larval assessments were conducted in 43 tributaries (9 Canada, 34 U.S.) and offshore of 2 U.S. tributaries. The status of larval Sea Lampreys in historically infested Lake Erie tributaries and lentic areas is presented in Table 17.

- Surveys to detect the presence of new larval populations were conducted in 16 tributaries (0 Canada, 16 U.S.). No new Sea Lamprey infestations were discovered.

- Post-treatment assessments were conducted in 4 tributaries (0 Canada, 4 U.S.) to determine the effectiveness of lampricide treatments conducted during 2018 and 2019.

- Surveys to evaluate barrier effectiveness were conducted in 12 tributaries (4 Canada, 8 U.S.). Surveys indicated an infestation of Sea Lamprey upstream of the barrier on Venison Creek (tributary to Big Creek).

- A total of 1.3 ha of the St. Clair River were surveyed with gB, in the three main delta channels. A total of Six Sea Lamprey larvae were captured throughout the lower river.

- Larval assessments were conducted in non-wadable lentic and lotic areas including the St. Clair River, using 8.04 kg active ingredient of 3.2% gB (0 kg Canada, 8.04 kg U.S.; Table 18).

Table 17. 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	May-19	Jun-13
Catfish Cr.	Apr-16	May-19	Apr-15
Bradley Cr.	Apr-16	May-19	Oct-15
Silver Cr.	May-18	May-19	Jun-17
Big Otter Cr.	Jun-17	May-19	May-19
South Otter Cr.	Aug-10	May-19	Aug-09
Clear Cr.	May-91	May-19	May-91
Big Cr.	Jun-17	May-19	May -19
Forestville Cr.	Aug-13	May-19	Jun-13
Normandale Cr.	Jun-87	May-18	Apr-08
Fishers Cr.	Jun-87	May-19	May-04
Young's Cr.	Aug-13	May-19	Jul-12
Ussher's Cr.	Never	Jun-17	Jun-17
United States			
Buffalo R.			
Buffalo Cr.	Apr-19	Jul-19	Jul-18
Cayuga Cr.	Apr-19	Jul-19	Jul-18
Cazenovia Cr.	Apr-19	Jul-19	Jul-18
Big Sister Cr.	Apr-15	Jul-19	Jun-14
Delaware Cr.	Jun-13	Jul-18	Jul-12
Cattaraugus Cr.	Apr-19	Jul-19	Jul-19
Lentic Lake Erie	Never	Jul-17	Aug-12
Halfway Br.	Oct-86	Jul-18	Jul-85
Canadaway Cr.	May-16	Jul-19	May-16
Chautauqua Cr.	Never	Jul-19	Jul-12
Crooked Cr.	Apr-19	Jun-19	Jun-18
Raccoon Cr.	May-15	Aug-19	Aug-19
Conneaut Cr.	Apr-19	Jun-19	Jun-18
Conneaut Harbour	Never	Sep-19	Jul-16
Wheeler Cr.	Never	Jul-19	Oct-87

Table 17. *continued*

Tributary	Last Treated	Last Surveyed	Last Survey Showing Infestation
Grand R.	Apr-17	Jun-19	Jun-19
Fairport Harbour	Never	Sep-19	Jun-87
Chagrin R.	Never	Jul-19	Jul-18
Huron R.	May-18	Aug-19	May-18
Lake St. Clair			
St. Clair R.	Never	Jun-19	Jun-19
Black R.	Never	Jun-19	Jul-07
Pine R.	Apr-88	Sep-19	Jun-16
Belle R.	Never	Sep-19	May-96
Clinton R.	Never	Sep-19	May-17
Paint Cr.	May-15	Sep-19	May-14
Thames R.	Never	May-16	Never
Komoka Cr.	Aug-15	May-19	May-17

Table 18. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Erie for larval assessment purposes during 2019.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
St. Clair R.	0.00	0.00
Total (Canada)	**0.00**	**0.00**
United States		
Conneaut Cr.	1.42	0.30
Grand R.	0.47	0.10
St. Clair R.	6.15	1.3
Total (United States)	**8.04**	**1.7**
Total for Lake	**8.04**	**1.7**

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

Lake Ontario

- Larval assessments were conducted in 46 tributaries (24 Canada, 22 U.S.) and no lentic areas were assessed. The status of larval Sea Lampreys in historically infested Lake Ontario tributaries and lentic areas is presented in Table 19.

- Surveys to estimate larval abundance were conducted in 20 tributaries (10 Canada, 10 U.S.).

- Surveys to detect new larval Sea Lamprey populations were conducted in one Canadian tributary. No new infestations were identified.

- Post-treatment assessments were conducted in 8 tributaries (6 Canada, 2 U.S.) to determine the effectiveness of lampricide treatments conducted during 2018 and 2019.

- Surveys to evaluate barrier effectiveness were conducted in 12 tributaries (6 Canada, 6 U.S.). Due to high spring lake levels in recent years, several dams were inundated enabling Sea

Lampreys to migrate further upstream. Shelter Valley Creek is scheduled for treatment upstream of the purpose-built barrier during 2020.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 3.79 kg active ingredient of 3.2% gB (2.84 kg Canada, 0.95 kg U.S.; Table 20).

Table 19. 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	Jun-17	Jun-14
Ancaster Cr.	May-03	May-19	Jun-15
Grindstone Cr.	Never	Jun-18	Jun-14
Bronte Cr.	Jun-19	Jun-19	Jun-19
Sixteen Mile Cr.	Jun-82	Jun-18	May-05
Credit R.	May-18	Jun-19	Jun-19
Humber R.	Never	Jun-17	Never
Rouge R.	Jun-11	Jun-19	Jun-19
Little Rouge. R.	Jun-15	Jun-19	Aug-14
Petticoat Cr.	Sep-04	Jun-18	Jun-16
Duffins Cr.	Jun-18	Jul-19	Jul-19
Duffins Cr. - lentic	Never	Aug-15	Aug-15
Carruthers Cr.	Sep-76	Jun-18	Jul-78
Lynde Cr.	Jun-15	Jun-19	Jun-19
Oshawa Cr.	Jun-18	Jun-19	Jun-19
Oshawa Cr. - lentic	Never	Jul-13	Oct-81
Farewell Cr.	Jun-15	Jun-19	Jun-19
Bowmanville Cr.	May-17	Jun-19	Jun-19
Wilmot Cr.	Jun-18	Jun-19	Jun-19
Wilmot Cr. - lentic	Never	Aug-11	Aug-11
Graham Cr.	Apr-19	Jul-19	Jun-18
Wesleyville Cr.	Oct-02	Jun-18	May-04
Port Britain Cr.	Apr-19	Jul-19	Jun-18
Gage Cr.	May-71	Jul-19	Apr-71
Cobourg Br.	Oct-96	Jul-18	Jul-18
Covert Cr.	May-19	Jul-19	Jul-19
Grafton Cr.	Jun-17	Ju1-19	Jun-16
Shelter Valley Cr.	Apr-16	Jul-19	Jul-19
Colborne Cr.	Apr-19	Jul-19	Jul-18
Salem Cr.	Apr-18	Jul-19	Jul-19
Proctor Cr.	Apr-18	Jul-19	Jul-19
Smithfield Cr.	Sep-86	Jul-19	May-86
Trent R. (Canal)	Sep-11	Jul-17	Jul-17
Mayhew Cr.	May-19	Jul-19	Jul-18
Moira R.	Jun-15	Jul-19	Jul-19
Salmon R.	Jun-16	Jul-19	Jul-19
Napanee R.	Never	Jul-17	Jul-15
United States			
Black R.	Aug-15	Aug-18	Aug-18
Black R. (lentic)	Aug-18	Aug-18	Aug-18

Table 19. *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-17	Aug-19	Aug-19
Skinner Cr.	Apr-05	Aug-19	Apr-06
Lindsey Cr.	Oct-18	Aug-19	Aug-19
Blind Cr.	May-76	Aug-17	Oct-75
Little Sandy Cr.	Oct-18	Aug-19	Aug-19
Little Sandy Cr. (lentic)	Never	Aug-18	Aug-18
Deer Cr.	Apr-04	Aug-18	Sep-06
Salmon R.	Jun-18	Aug-19	Aug-19
Orwell Brook	May-17	Aug-19	Apr-14
Trout Brook	Jun-18	Aug-19	Aug-19
Altmar Cr.	Jun-18	Aug-19	Aug-19
Grindstone Cr.	Apr-18	Aug-19	Aug-19
Snake Cr.	Apr-18	Aug-19	Aug-19
Sage Cr.	May-78	Aug-19	May-88
Little Salmon R.	May-17	Aug-19	Aug-19
Butterfly Cr.	May-72	Jul-19	Jun-70
Catfish Cr.	Apr-18	Aug-19	Aug-19
Oswego R.			
Black Cr.	May-81	Aug-17	Jun-04
Big Bay Cr.	Sep-93	Aug-15	Aug-94
Scriba Cr.	May-19	Aug-18	Aug-18
Fish Cr.	Aug-19	Aug-18	Aug-18
Carpenter Br.	May-94	Jul-16	Apr-94
Putnam Br./			
Coldsprings Cr.	May-96	Jul-19	Apr-05
Hall Br.	Never	Aug-15	Aug-77
Crane Br.	Never	Aug-16	Jun-81
Owasco Outlet	Jun-19	Jul-19	Jul-18
Rice Cr.	May-72	Aug-18	Jun-70
Eight Mile Cr.	Apr-18	Aug-19	Aug-19
Nine Mile Cr.	May-17	Jul-19	Jul-19
Sterling Cr.	May-18	Aug-19	Aug-19
Unnamed Cr.	May-19	Aug-19	Aug-19
Blind Sodus Cr.	May-78	Jul-19	May-78
Red Cr.	Apr-18	Jul-19	Aug-17
Wolcott Cr.	May-79	Aug-19	Aug-78
Sodus Cr.	Apr-15	Aug-19	Aug-19
Forest Lawn Cr.	Never	Aug-19	Aug-19
Irondequoit Cr.	Never	Jul-18	Apr-09
Larkin Cr.	Never	Jul-18	May-07
Northrup Cr.	Never	Jul-18	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	Jul-18	Aug-14
Johnson Cr.	Apr-10	Jul-18	Jun-09
Third Cr.	May-72	Aug-17	Sep-72
First Cr.	May-95	Jul-18	Sep-94

Table 20. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Ontario for larval assessment purposes during 2019.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
Moira R.	1.42	0.3
Salmon R.	1.42	0.3
Total (Canada)	**2.84**	**0.6**
United States		
Catfish Cr.	0.95	0.2
Total (United States)	**0.95**	**0.2**
Total for Lake	**3.79**	**0.8**

[1] Lampricide quantities are reported in kg of 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 targets 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, (WIDNR), GLIFWC, Chippewa-Ottawa Resource Authority (CORA), Keweenaw Bay Indian Community, Grand Portage Band of Lake Superior Chippewa Indians, and the OMNRF, and analyzed by the Service's GBFWCO.

Based on standardized spring assessment data, the marking rate during 2019 was 5.7 A1-A3 marks per 100 Lake Trout >532mm, which is greater than the target of 5 marks per 100 fish (Figure 5).

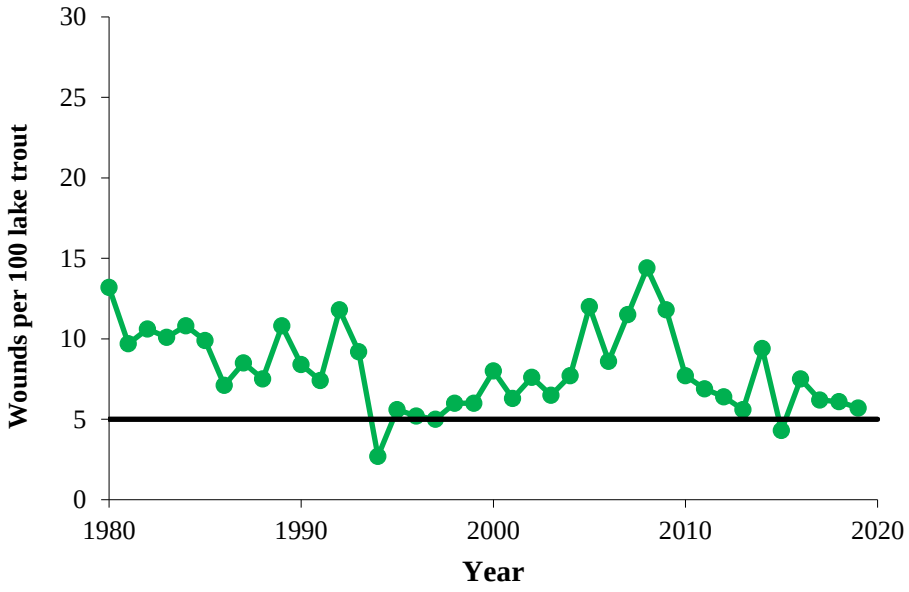

Figure 5. Average number of A1-A3 marks per 100 Lake Trout >532 mm caught during April-June assessments in Lake Superior 1980 – 2019. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout.

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 the United States Geological Survey (USGS), and analyzed by the Service's GBFWCO.
- Based on standardized fall assessment data, the marking rate during 2019 was 2.3 A1-A3 marks per 100 Lake Trout >532mm, which is less than the target of 5 marks per 100 fish (Figure 6).

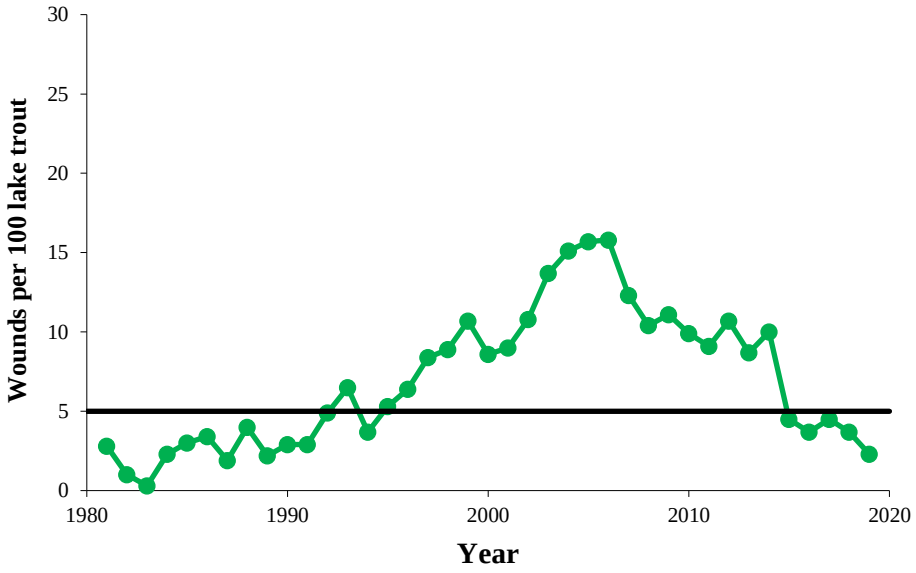

Figure 6. Average number of A1-A3 marks per 100 Lake Trout >532 mm from standardized fall assessments in Lake Michigan 1982 – 2019. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout. The spawning year is used rather than the survey year (shifted by one year) to provide a comparison with the adult index.

Lake Huron

- Lake Trout marking data for Lake Huron are provided by the MIDNR, CORA, USGS, and OMNRF. The data was analyzed by the Service's GBFWCO.

- Based on standardized spring assessment data, the marking rate during 2019 was 6.3 A1-A3 marks per 100 Lake Trout >532 mm, which is greater than the target of 5 marks per 100 fish (Figure 7).

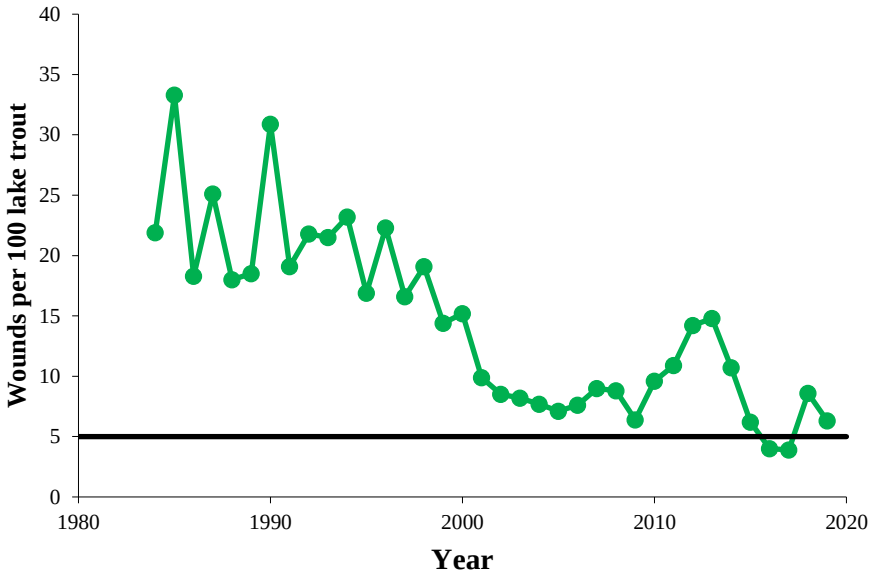

Figure 7. Average number of A1-A3 marks per 100 Lake Trout >532 mm caught in U.S. waters during spring assessments in Lake Huron 1984-2019. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout. The spawning year is used rather than the survey year (shifted by one year) to provide a comparison with the adult index.

- Canadian commercial fisheries in northern Lake Huron continued to provide parasitic juvenile Sea Lamprey in 2019, 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 the OMNRF, is used as an index of juvenile Sea Lamprey abundance in northern Lake Huron. The data for 2019 are not yet available; the CPUE value for 2018 was slightly higher than 2017 (Figure 8).

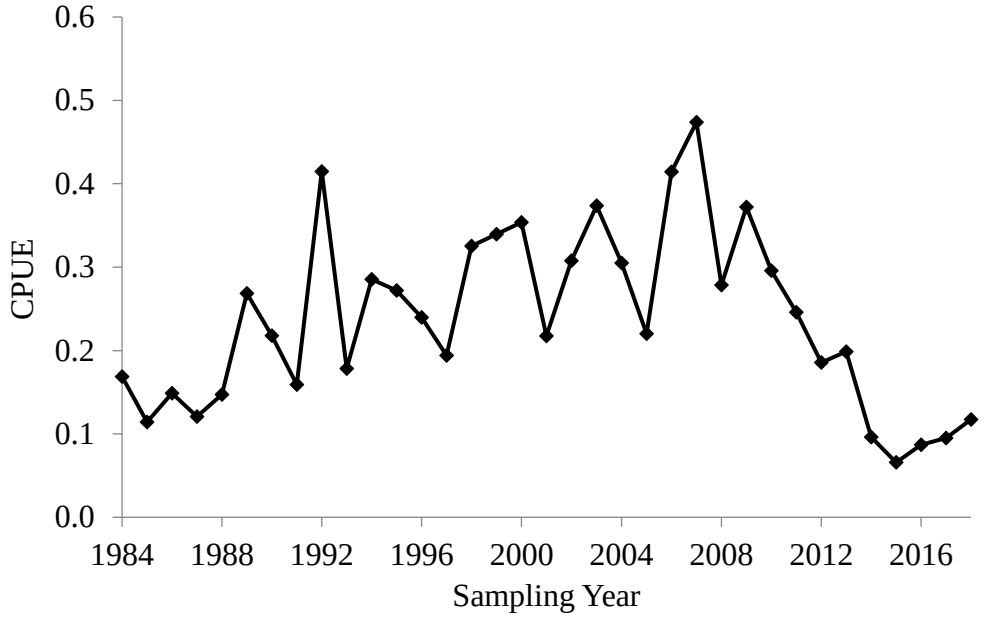

Figure 8. Northern Lake Huron commercial fisheries index showing CPUE (number of parasitic juvenile Sea Lamprey per km of gillnet per night) for 1984-2018.

- Since 1998, standardized trapping for out-migrating juveniles has been conducted in the St. Marys River as an index of Sea Lamprey production. Eleven floating fyke nets are deployed each October and November in the Munuscong, Sailor's Encampment, and Middle Neebish channels. The CPUE value for 2019 is lower than the previous 3 years (Figure 9).

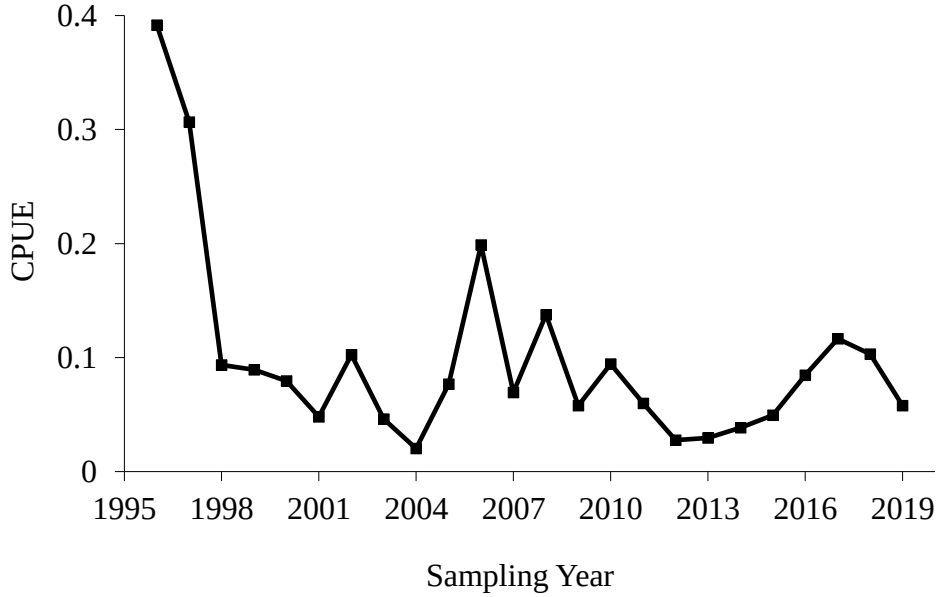

Figure 9. CPUE (number of out-migrating juvenile Sea Lamprey per net day) of fall fyke netting in the St. Marys River during 1996-2019.

Lake Erie

- Lake Trout marking data for Lake Erie are provided by the NYDEC, the Pennsylvania Fish and Boat Commission, USGS, and OMNRF, and analyzed by the Service's GBFWCO.

- Based on standardized fall assessment data, the marking rate during 2019 was 5.2 A1-A3 marks per 100 Lake Trout >532 mm. The marking rate has been greater than the target for the last 16 years (Figure 10).

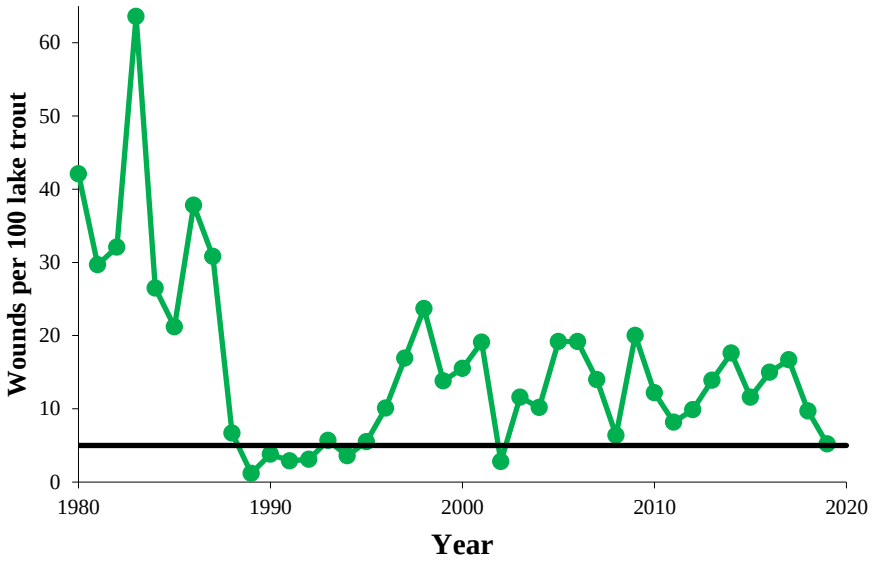

Figure 10. Average number of A1-A3 marks per 100 Lake Trout >532 mm from standardized fall assessments in Lake Erie. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout 1985-2019. The spawning year is used rather than the survey year (shifted by one year) to provide a comparison with the adult index.

- In cooperation with Walpole Island First Nation, the Commission and partners completed the fifth year of an annual index for out-migrating juvenile Sea Lampreys in the St. Clair River. Eight floating fyke nets were deployed on December 4, 2019. Due to Canadian Coast Guard concerns regarding ice flow and proper function of aids to navigation, the nets were retrieved on January 17, 2020. Over the collection period, 8 juvenile Sea Lampreys were captured. Despite attempts to standardize annual sampling effort, net numbers, location, and duration of collection have varied depending on conditions in the river.

Lake Ontario

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

- Based on standardized fall assessment data, the marking rate during 2019 was 0.6 A1 marks per 100 Lake Trout >431 mm which is less than the target of 2 A1 marks per 100 Lake Trout target (Figure 11).

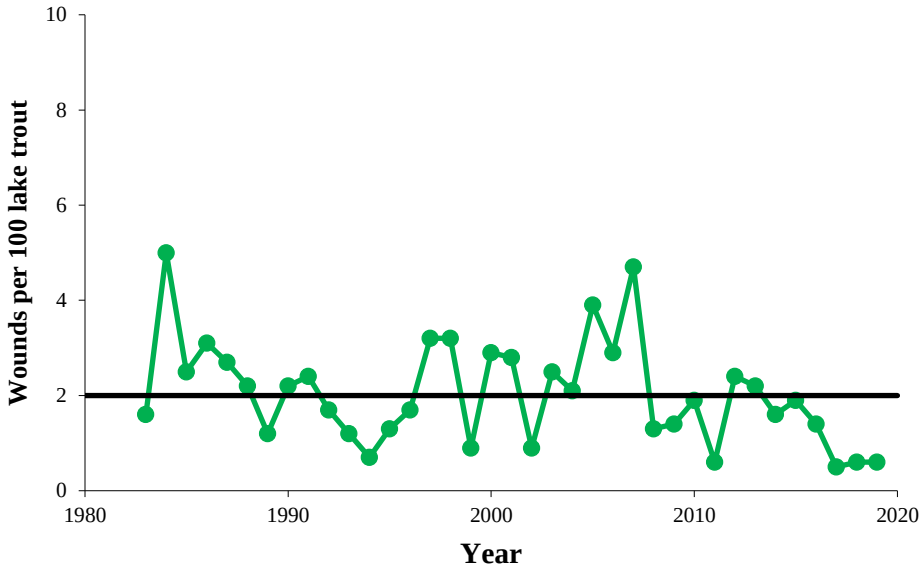

Figure 11. Number of A1 marks per 100 Lake Trout >431 mm from standardized fall assessments in Lake Ontario 1983-2019. The horizontal line represents the target of 2 A1 marks per 100 Lake Trout.

Adult Assessment

An annual index of adult Sea Lamprey abundance is derived for each lake by summing individual abundance estimates from traps operated in a specific suite of streams (index streams) during spring and early summer. Abundance estimates are derived using simple Petersen mark-recapture in each index stream. In the absence of a stream-specific estimate due to an insufficient number of marked or recaptured Sea Lamprey, abundance 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.

Lake Superior

- A total of 1,517 Sea Lampreys were captured in 11 tributaries during 2019, 7 of which are index locations. Adult population estimates based on mark-recapture were obtained from 6 of the 7 index locations; the Neebing River index was estimated using the relative annual pattern of abundance (Table 21, Figure 22).

- The index of adult Sea Lamprey abundance was 13,133 *(95% CI; 8,518 – 17,749)*, which was higher than the target of 10,421 (Figures 12,13).

- Adult Sea Lamprey migrations were monitored in the Middle, Bad, Misery, and Silver rivers through cooperative agreements with the GLIFWC and in the Brule River with the WDNR.

- Fieldwork continued on the Brule River fishway to evaluate the effectiveness of an experimental bottom-oriented Sea Lamprey trap, as well as determine the catchability of Sea Lamprey and finfish during varied hydraulic conditions.

Table 21. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Superior during 2019 (letter in parentheses corresponds to streams in Figure 22).

						Mean Length (mm)		Mean Weight (g)	
Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Males	Females	Males	Females
Canada									
Neebing R. (A)	15	---	---	0	---	---	---	---	---
Big Carp R.[3] (B)	2	---	---	0	---	---	---	---	---
Total or Mean (Canada)	**17**	---	---	**0**	---	---	---	---	---
United States									
Tahquamenon R. (C)	249	1531	16	20	85	442	411	192	160
Betsy R. (D)	199	615	32	56	59	437	396	188	150
Rock R. (E)	194	340	57	49	49	423	411	169	161
Silver R.[3] (F)	25	---	---	1	100	417	---	180	---
Misery R.[3] (G)	16	50	32	4	75	451	382	198	147
Firesteel R.[3] (H)	17	---	---	1	0	---	478	---	241
Bad R. (I)	318	4333	7	7	57	442	454	210	194
Brule R. (J)	130	770	17	1	100	410	---	115	---

Table 21. *continued.*

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
Middle R. (K)	352	5307	7	11	36	416	416	164	153
Total or Mean (U.S.)	**1,500**	---	---	**150**	**58**	**429**	**402**	**180**	**156**
Total or Mean (for lake)	**1,517**	---	---	**150**	**58**	**429**	**402**	**180**	**156**

[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.

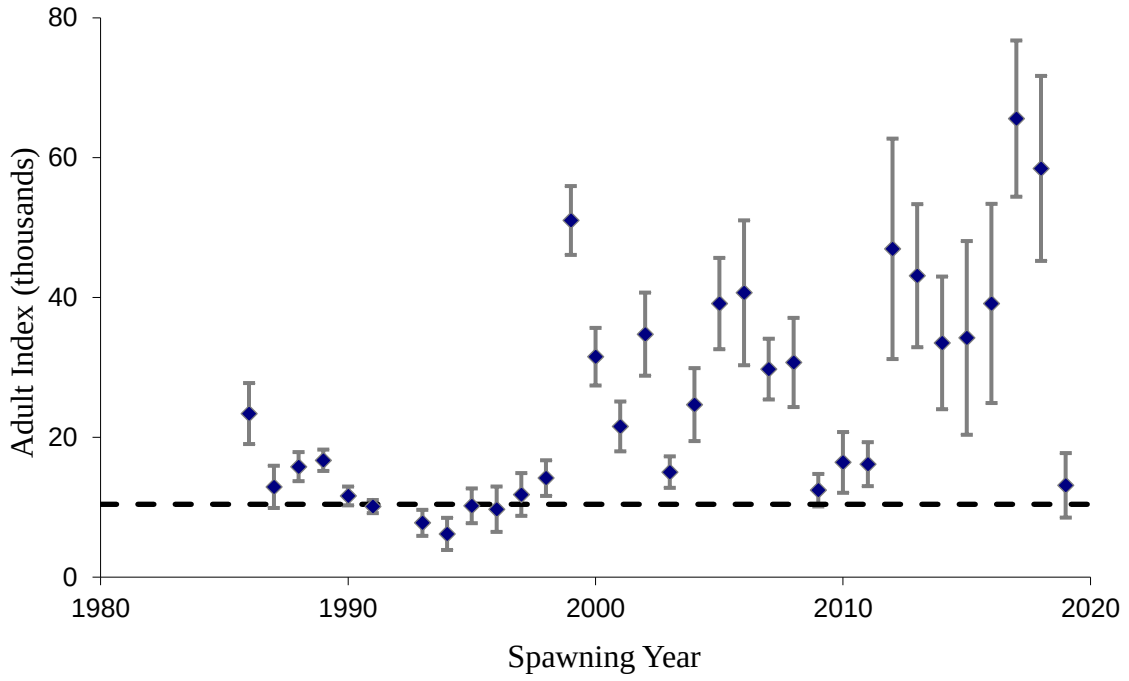

Figure 12. Index estimates with 95% confidence intervals of adult Sea Lampreys in Lake Superior. The target of 10,421 is represented by the dotted horizontal line. The index target was estimated as the mean of indices during a period with acceptable marking rates (1994-1998).

Figure 13. LEFT: Estimated index of adult Sea Lamprey in Lake Superior during the spring spawning migration, 2019. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). RIGHT: Maximum estimated number of larval Sea Lamprey in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (Kaministiquia 6,600,000; Goulais 5,000,000; Michipicoten 4,100,000; Sturgeon 3,300,000).

Lake Michigan

- A total of 5,633 Sea Lampreys were captured at 9 tributaries during 2019, 6 of which are index locations. Adult population estimates based on mark-recapture were obtained for each index location (Table 22, Figure 22).

- The index of adult Sea Lamprey abundance was 16,844 *(95% CI; 12,942 – 20,746),* which was lower than the target of 34,982 (Figures 14,15).

- Adult Sea Lamprey migrations were monitored in the Boardman and Betsie rivers through a cooperative agreement with the Grand Traverse Band of Ottawa and Chippewa Indians.

- Service staff fished portable assessment traps and fyke nets at 6th Street Dam, as well as within historically positive tributaries of the Grand River during 2019. Crews were able to capture 114 adult Sea Lamprey during the effort, down from 494 captured in 2018. A synthesized sex pheromone (3kPZS) was added to traps within the 6th Street Dam fishway and PIT tagged fish were released to track their movements.

Table 22. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Michigan during 2019 (letter in parentheses corresponds to stream in Figure 22).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
Carp Lake Outlet (A)	935	1764	53	61	44	476	469	219	231
Boardman R. [3] (B)	144	460	31	15	53	492	474	276	242
Betsie R. (C)	217	561	39	16	56	508	510	277	301
Big Manistee R. (D)	195	4607	4	7	14	530	505	353	293
Grand R. [3] (E)	114	1297	9	7	29	518	483	288	251
St. Joseph R. (F)	197	1501	13	11	27	509	486	289	256
Trail Cr. [3] (G)	42	---	---	0	---	---	---	---	---
Peshtigo R. (H)	728	2106	35	32	59	488	490	242	250
Manistique R. (I)	3061	6305	49	147	46	499	494	260	266
Total or Mean (for lake)	**5,633**	**---**	**---**	**296**	**46**	**495**	**488**	**255**	**258**

[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.

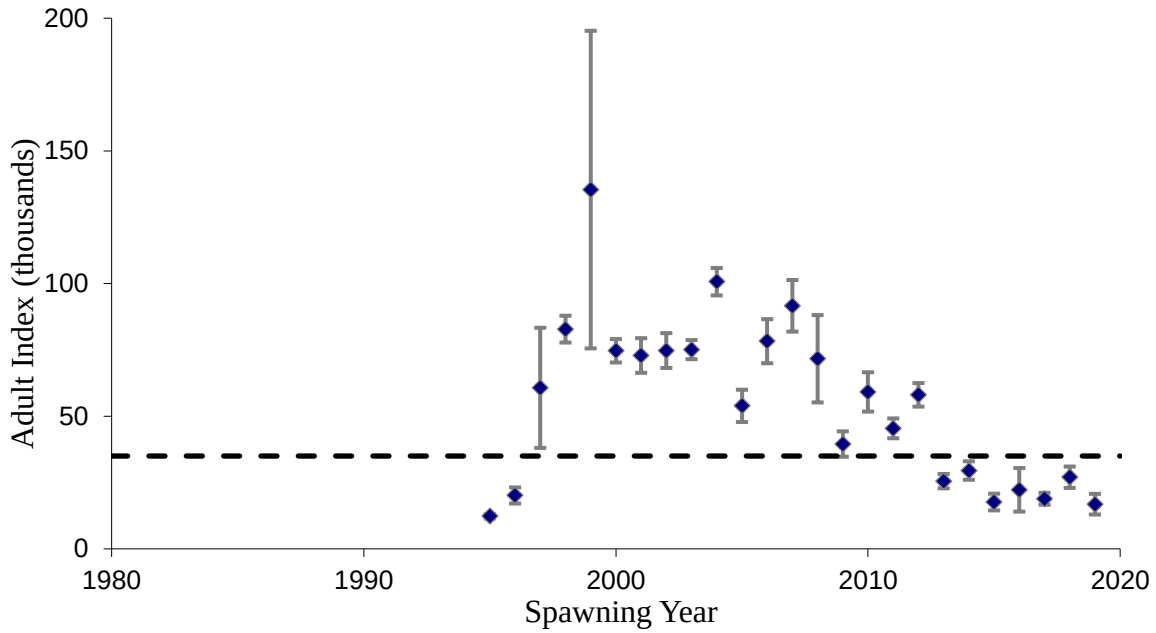

Figure 14. Index estimates with 95% confidence intervals of adult Sea Lampreys in Lake Michigan. The target of 34,982 is represented by the dotted horizontal line. The index target was estimated as 5/8.9 times the mean of indices (1995-1999).

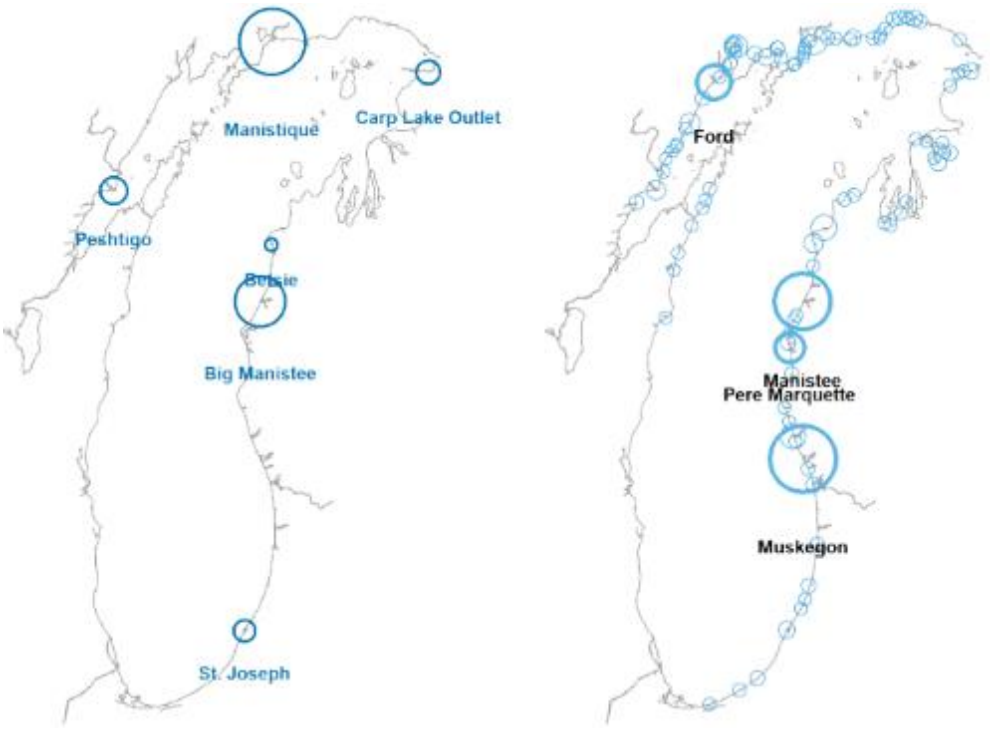

Figure 15. LEFT: Estimated index of adult Sea Lamprey in Lake Michigan during the spring spawning migration, 2019. Circle size corresponds to estimated number of adults from mark-recapture studies. RIGHT: Maximum estimated number of larval Sea Lamprey in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (Muskegon 4,500,000; Manistee 3,600,000; Ford 1,800,000; Pere Marquette 1,400,000).

Lake Huron

- A total of 12,380 Sea Lampreys were trapped in 6 tributaries during 2019, all of which are index locations. Adult population estimates based on mark-recapture were obtained from each index location (Table 23, Figure 22).

- The index of adult Sea Lamprey abundance was 32,268 *(95% CI: 28,641 – 35,895)*, which was higher than the target of 31,274 (Figures 16,17).

- A total of 2,042 adult Sea Lampreys were captured in traps operated in the St. Marys River at the Clergue Generating Station in Canada, and the USACE and Cloverland Electric plants and compensating gates in the U.S. The estimated population in the river was 5,888 adult Sea Lampreys and trapping efficiency was 34%.

- The USACE continued planning for trap improvement projects at the St. Marys, Au Sable, and East Au Gres rivers using GLFER program funding.

Table 23. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Huron during 2019 (letter in parentheses corresponds to stream in Figure 22).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
Canada									
St. Marys R. (A)	2,042	6,346	32	52	67	467	468	230	238
Echo R. (B)	360	2,210	16	5	80	480	450	231	199
Thessalon R. (C)									
Bridgeland Cr.	2,164	2,647	82	173	55	457	468	203	217
Total or Mean (Canada)	**4,566**	---	---	**230**	**58**	**460**	**468**	**210**	**221**
United States									
East Au Gres R. (D)	104	1,456	7	3	33	450	490	196	232
Ocqueoc R. (E)	3,405	9,066	38	101	48	447	463	200	218
Cheboygan R. (F)	4,305	1,0543	41	177	37	465	470	203	221
St. Marys R. (A)	(see Canada)	(see Canada)	(see Canada)	7	71	469	489	237	214
Total or Mean (U.S.)	**7,814**	---	---	**288**	**42**	**459**	**468**	**203**	**220**
Total or Mean (for Lake)	**12,380**	---	---	**518**	**49**	**459**	**468**	**206**	**221**

[1] The number of Sea Lamprey used to determine percent males, mean length, and mean weight.
[2] Gender was determined using external characteristics.

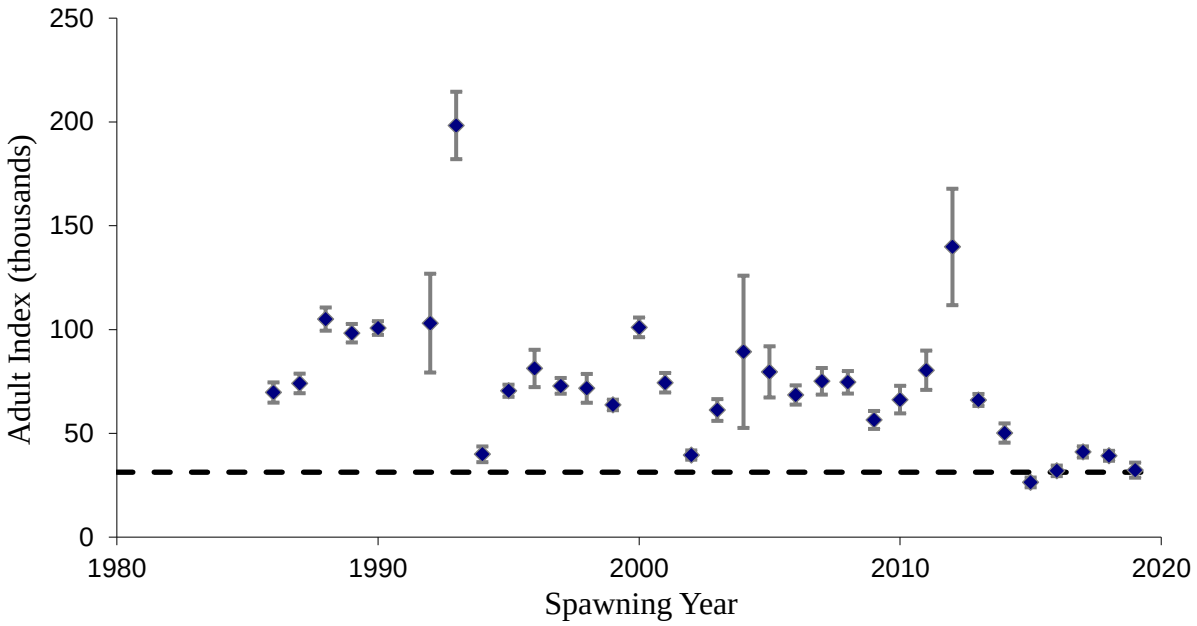

Figure 16. Index estimates with 95% confidence intervals of adult Sea Lampreys in Lake Huron. The index target of 31,274 is represented by the horizontal dotted line. The index target was estimated as 0.25 times the mean of indices between 1989 and 1993.

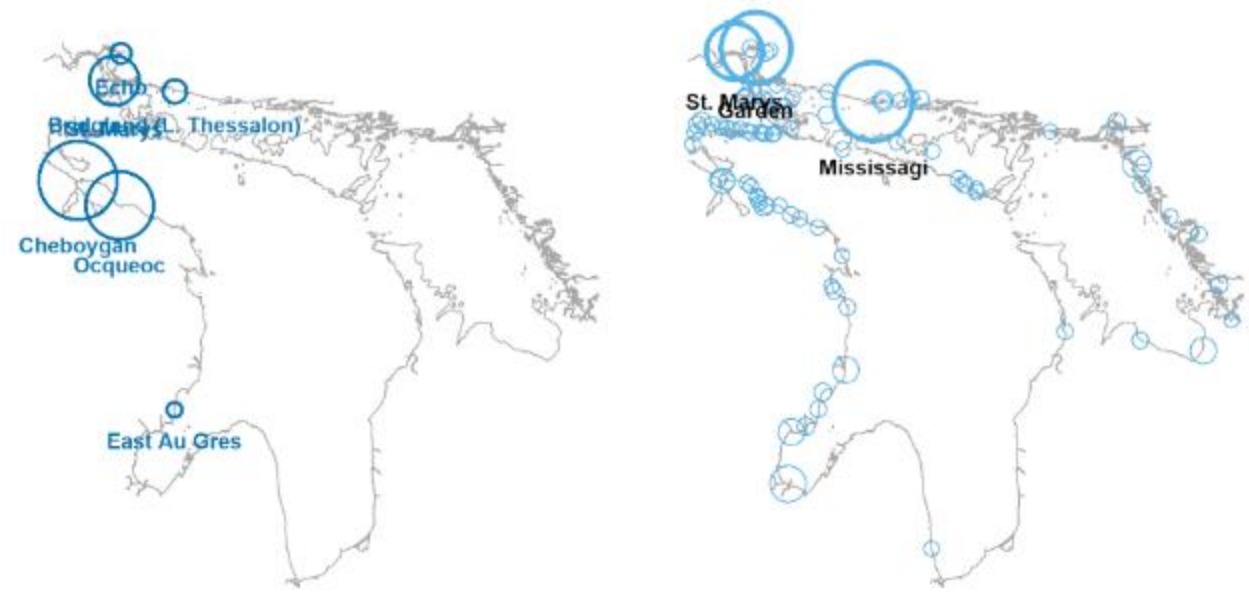

Figure 17. LEFT: Estimated index of adult Sea Lampreys in Lake Huron during the spring spawning migration, 2019. Circle size corresponds to estimated number of adults from mark-recapture studies. RIGHT: Maximum estimated number of larval Sea Lampreys in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (Mississagi 8,100,000; Garden 7,000,000; St. Marys 5,200,000).

Lake Erie

- A total of 361 Sea Lampreys were trapped in 5 tributaries during 2019, all of which are index locations. Adult population estimates based on mark-recapture were obtained from 2 of the 5 index locations; Little Otter Creek, Cattaraugus River and Grand River were estimated using the relative annual pattern of abundance (Table 24, Figure 22).

- The index of adult Sea Lamprey abundance was 1,587 *(95% CI; 1,105 – 2,070)* in 2019, which was lower than the target of 3,263 (Figures 18,19).

- The adult Sea Lamprey migration in Cattaraugus Creek was monitored through a cooperative agreement with the Seneca Nation of Indians.

Table 24. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Erie during 2019 (letter in parentheses corresponds to stream in Figure 22).

			Trap			Mean Length (mm)		Mean Weight (g)	
Tributary	Number Caught	Adult Estimate	Efficiency (%)	Number Sampled[1]	Percent Males[2]	Males	Females	Males	Females
Canada									
Big Otter Cr. (A) Little Otter Cr.	2	---	---	---	---	---	---	---	---
Big Cr. (B)	317	469	68	47	68	508	498	261	267
Young's Cr. (C)	20	60	33	6	17	500	479	249	228
Total or Mean (Canada)	**339**	**---**	**---**	**53**	**62**	**503**	**496**	**255**	**240**

Table 24. *continued.*

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
United States									
Cattaraugus Cr. (D)	7	---	---	---	---	---	---	---	---
Grand R. (E)	15	---	---	---	---	---	---	---	---
Total or Mean (U.S.)	**22**	---	---	---	---	---	---	---	---
Total or Mean (for Lake)	**361**	---	---	**53**	**62**	**503**	**496**	**255**	**240**

[1]The number of Sea Lamprey used to determine percent males, mean length, and mean weight.
[2]Gender was determined using external characteristics.

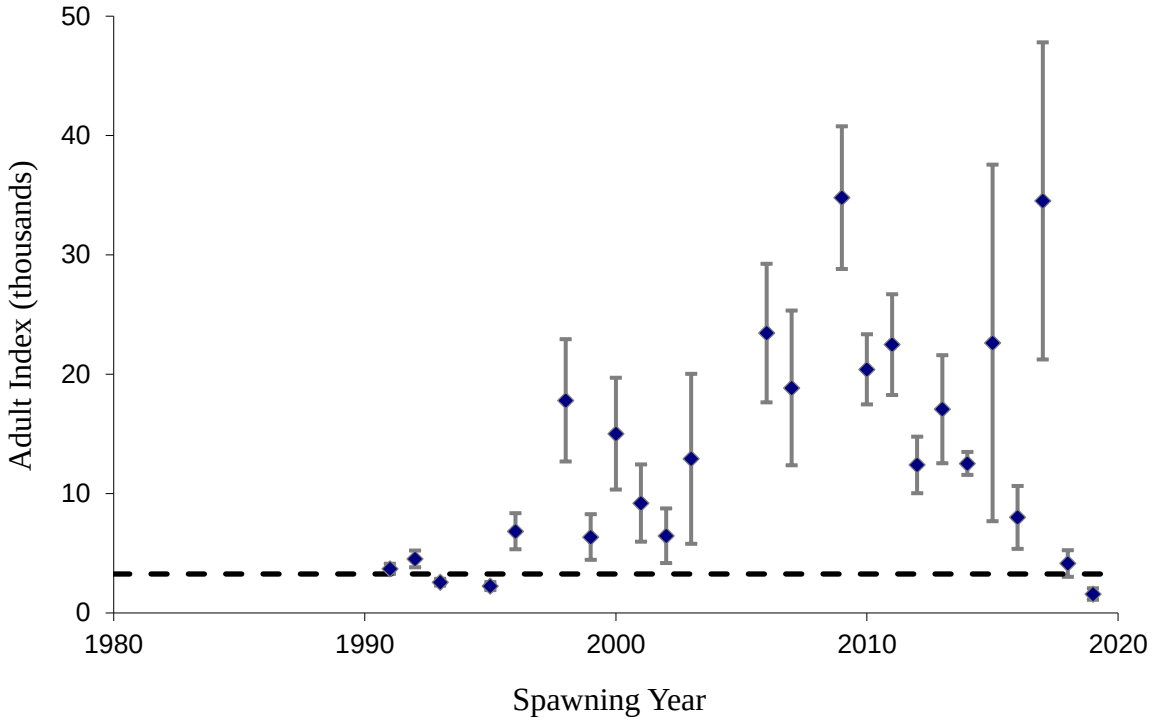

Figure 18. Index estimates with 95% confidence intervals of adult Sea Lampreys in Lake Erie. The index target of 3,263 is represented by the dotted horizontal line. The index target was estimated as the mean of indices during a period with acceptable marking rates (1991-1995).

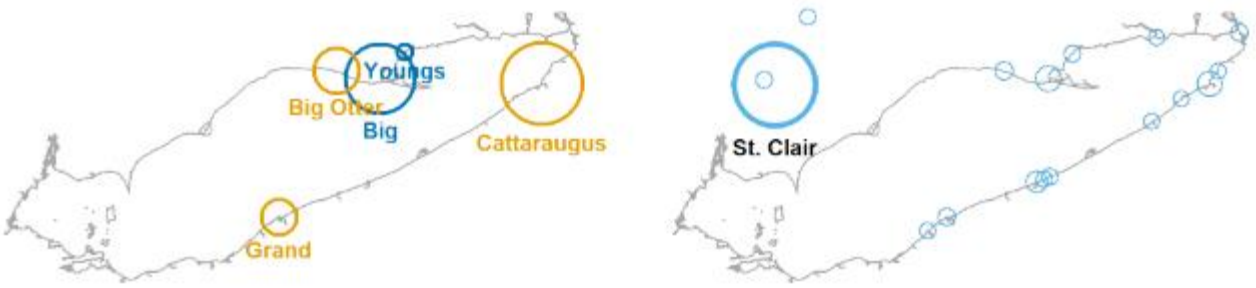

Figure 19. LEFT: Estimated index of adult Sea Lampreys in Lake Erie during the spring spawning migration 2019. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). RIGHT: Maximum estimated number of larval Sea Lampreys in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (St. Clair 920,000).

Lake Ontario

- A total of 4,301 Sea Lampreys were trapped in 8 tributaries during 2019, 5 of which are index locations. Adult population estimates based on mark-recapture were obtained from each index location (Table 25, Figure 22).

- The index of adult Sea Lamprey abundance was 11,844 *(95% CI; 9,459 – 14,229)* in 2019, which was lower than the target of 14,065 (Figures 20,21).

Table 25. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Ontario during 2019 (letter in parentheses corresponds to stream in Figure 22).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
Canada									
Humber R. (A)	2,922	5,736	51	147	63	495	486	268	262
Duffins Cr. (B)	99	463	21	3	100	529	---	306	---
Bowmanville Cr. (C)	434	851	51	92	62	508	506	288	288
Cobourg Cr.[3] (D)	315	---	---	164	41	482	478	255	253
Salmon R.[3] (E)	0	---	---	0	---	---	---	---	---
Total or Mean (Canada)	**3,770**	---	---	**406**	**54**	**493**	**484**	**268**	**262**
United States									
Black R. (F)	315	3,234	10	13	69	476	506	251	291
Salmon R.(G) Orwell Br.[3]	21	---	---	---	---	---	---	---	---
Sterling Cr. (H)	195	1,560	13	14	71	492	503	358	402
Total or Mean (U.S.)	**531**	---	---	**27**	**70**	**484**	**504**	**306**	**349**
Total or Mean (for lake)	**4,301**	---	---	**433**	**55**	**492**	**485**	**270**	**268**

[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.

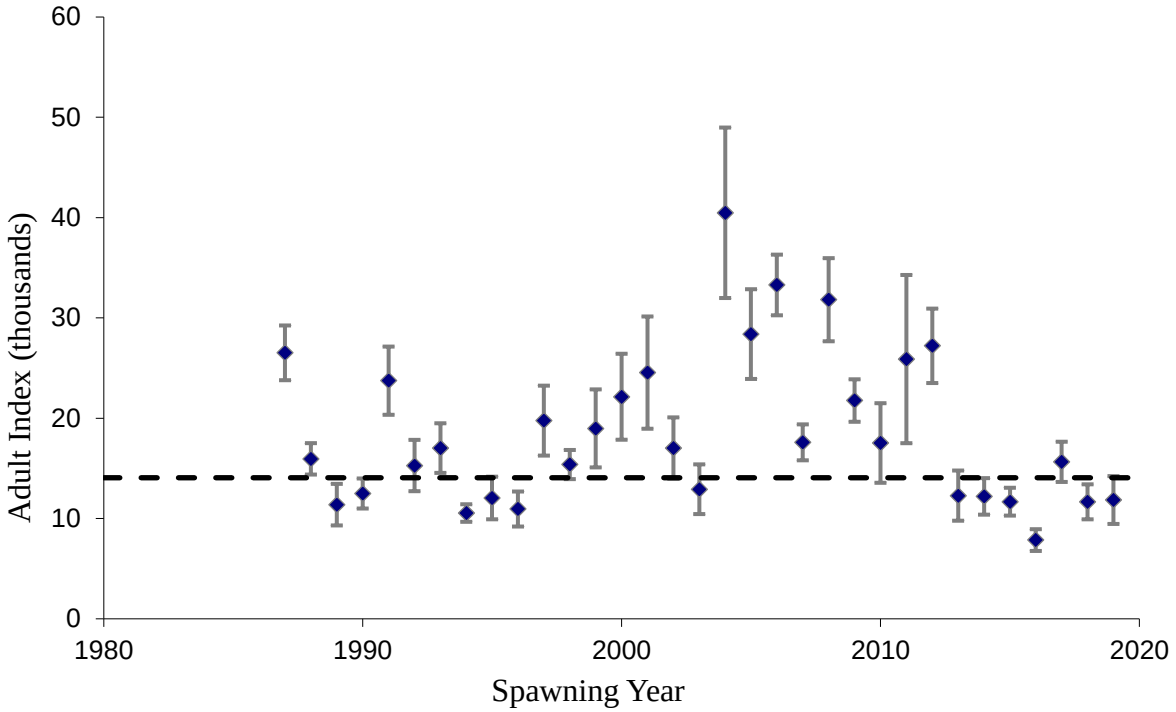

Figure 20. Index estimates with 95% confidence intervals of adult Sea Lamprey in Lake Ontario. The index target of 14,065 is represented by the dotted horizontal line. The index target was estimated as the mean of indices during a period with acceptable marking rates (1993-1997).

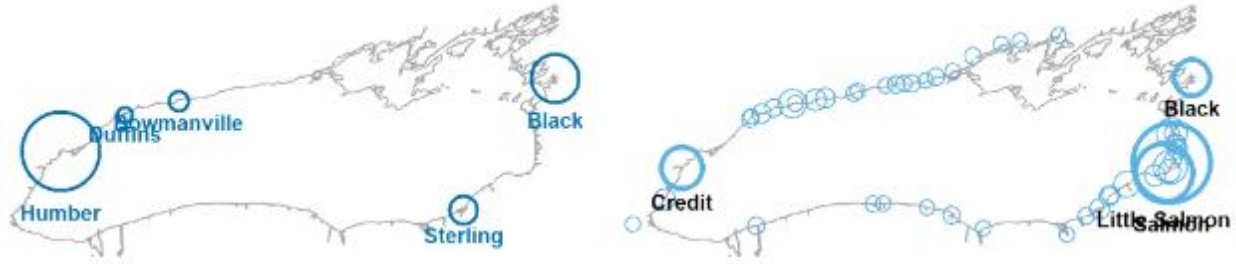

Figure 21. LEFT: Estimated index of adult Sea Lampreys in Lake Ontario during the spring spawning migration 2019. Circle size corresponds to estimated number of adults from mark-recapture studies. RIGHT: Maximum estimated number of larval Sea Lampreys in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (Salmon 1,400,000; Little Salmon 970,000; Credit 590,000; Black 470,000).

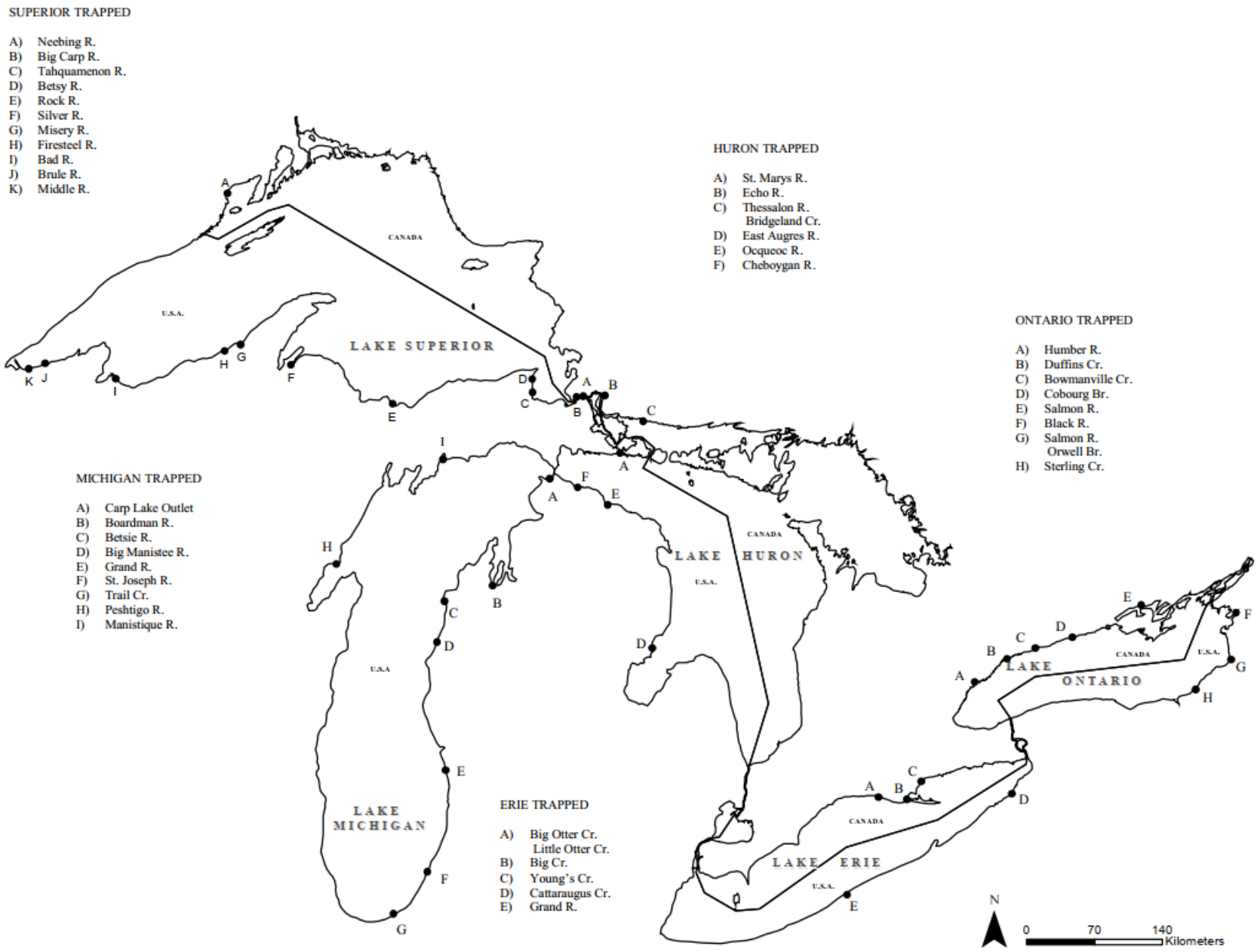

Figure 22. Locations of tributaries where assessment traps were operated during 2019.

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 agencies, and working with others to minimize risk to non-target organisms.

Species at Risk Act

The goal of the Species at Risk Act (SARA) is to protect endangered or threatened organisms and their habitats. Conducting activities that are prohibited under Sections 32, 33 and 58(1) of SARA require approval from DFO. SARA permits are sought where lampricide applications overlap with the known occurrence and critical habitat of federally listed threatened and endangered species. Permits are annually issued by DFO under section 73 of SARA.

Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires 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 (endangered, threatened, and candidate) species or adversely modify designated critical habitat.

Annual Reviews

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

During 2019, the following ES offices reviewed the effect of scheduled lampricide applications on endangered 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
- Bloomington Ecological Services Field Office
- Ohio Ecological Services Field Office
- Pennsylvania Department of Conservation and Natural Resources
- New York Field Office

Programmatic Review

Due to the broad scope of the SLCP, consultation under Section 7 of the ESA involves several states, many listed species and hundreds of streams. In an effort to streamline the consultation process and to 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 (endangered, threatened, and special concern) species, and develop procedures that protect and avoid disturbance for each listed species.

During 2019, the following state regulatory offices reviewed endangered species within their jurisdiction and issued permits to conduct lampricide applications:

- Michigan Department of Natural Resources
- Wisconsin Department of Natural Resources
- Minnesota Department of Natural Resources
- Indiana Department of Natural Resources
- Ohio Department of Environmental Protection
- Pennsylvania Department of Environmental Protection
- New York State Department of Environmental Conservation

Studies and Fieldwork

Non-target Surveys

Manistee River: The Risk Management Team (RMT) participated in the partner-led effort to collect young-of-the-year lake sturgeon (YOY-LAS: *Acipenser fulvescens*) before (3 days), during (1 day), and after (2 days) the treatment of the Manistee River (August 10).

Muskegon River: The RMT participated in the partner-led effort to collect YOY-LAS before (6 days), during (1 day), and after (1 day) the treatment of the Muskegon River (September 9).

Freshwater Mussel Toxicity Tests

Tests were conducted in the RMT portable bioassay laboratory during June 11-20 on the St. Clair River (Michigan) with the Eastern lampmussel (*Lampsilis radiata*). Mussels were exposed to the equivalent of gB applied in the field (FAR: Field Application Rate), ¼FAR, ½FAR, 2FAR, and 4FAR.

Field Protocols

Field protocols are developed annually for field personnel so they can help protect and avoid disturbance to federal and state listed species located near scheduled SLCP activities. The protocols provides 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 2019.

- 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 *granular Bayluscide* assessments in the United States during 2019.

A total of 99 federal and state listed species, 3 critical habitats, multiple bat hibernacula, and the de-listed bald eagle (*Haliaeetus leucocephalus*) were identified in the 2019 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 2019, NEPA was required for cooperative agreements for the following actions:

Trapping for adult Sea Lamprey on the following streams:

- Bad River (Lake Superior)
- Red Cliff Creek (Lake Superior)
- Cattaraugus Creek (Lake Erie)
- Clear Creek (Lake Erie)
- Boardman River (Lake Michigan)
- St. Marys River (Lake Huron)

Federal Insecticide, Fungicide and Rodenticide Act

Reports were 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 is the registrant for lampricides and 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 endangered, threatened or candidate species, and with observed mortalities of greater than 50 non-schooling or 1,000 schooling fish of any non-target species or taxa during a lampricide application (Table 26).

Table 26. Summary of 6(a)(2) reports submitted for incidents of non-target mortality during 2019 lampricide treatments.

Lake	Stream	Mortality	Freq	Comments
Superior	MacKenzie Bay[2]	Slimy Sculpin (*Cottus cognatus*)	128	
		Mottled Sculpin (*Cottus bairdii*)	50	
Michigan	Slate River[2]	Logperch (*Percina caprodes*)	500	Sensitive species
Erie	Cayuga Creek[1]	Stonecat (*Noturus flavus*)	100	Sensitive species
Ontario	Mad River[1]	Brown Bullhead (*Ameiurus nebulosus*)	400	pH suppression
	Fish Creek	Stonecat (*Noturus flavus*)	500	Sensitive species
		Mudpuppy (*Necturus maculosus*)	500	
		Madtom sp. (*Noturus sp.*)	200	
		Logperch (*Percina caprodes*)	200	pH suppression
	Owasco Lk. Outlet[1]	White Sucker (*Catostomus commersonii*)	103	
	Seneca River	Shortnose Redhorse (*Moxostoma macrolepidotum*)	105	
		Common Shiner (*Luxilus cornutus*)	50	
Champlain	Mt. Hope Brook[1]	Chain Pickerel (*Esox niger*)	61	pH suppression Most < 20 cm
	Hoisington Brook[1]	Brown Bullhead	53	pH suppression Most < 6 cm

[1] TFM, [2] Bayluscide 3.2% Granular

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.

2019 Membership
Lori Criger (Chair), Cheryl Kaye, Chris Gagnon, Tim Sullivan, Jenna Tews, Benson Solomon (Service); Bruce Morrison, Shawn Robertson, Al Rowlinson, Fraser Neave (Department); Jean Adams (USGS/GLFC); Jim Luoma, Mike Boogaard, Karen Slaght (USGS); Michael Wilkie (Wilfred Laurier University); Dale Burkett, Mike Siefkes, Chris Freiburger (Commission Secretariat).

Progress towards goals described in the GLFC 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.

2019 Outcomes:

1. 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 that did not otherwise receive lethal doses of lampricide were treated in conjunction with the main application to prevent escapement in these refugia areas. Lampricide concentrations were targeted to be greater than 10% above theoretical values due to some uncertainty with the predictive chart levels. With the exception of outside agency (i.e. state, provincial, hydro generation) or endangered species constraints, streams were scheduled for treatment in the optimal time of year to ensure favorable discharge.
2. Personnel within the program were deployed to the control units to treat more streams in the spring (when conditions are generally optimal) and to augment treatment effort on complex, labour intensive systems later in the season. Where practical, the Department conducted lampricide treatments in the US that were geographically closer to its headquarters to reduce travel time. Service and Department personnel cooperated to successfully treat the Muskegon and Manistique rivers.

3. Service and Department personnel worked together to complete the St. Marys River granular Bayluscide treatments.
4. Treatments of the Garden, Echo, and Root rivers and one plot in each of the St. Mary's River and Echo River were deferred due to delayed concurrence from First Nations. Treatments of the Michipicoten and Peshtigo rivers were deferred due to mechanical issues at Scott Falls generating station and extremely high and inconsistent discharge at the We Energies hydro dam, respectively. Otter Cove, Taylor, Caribou, and Furlong creeks were added to the treatment schedule after large larvae were found in them during 2019 surveys. Two alternate plots on the St. Marys River were treated in place of the two that were deferred.
5. In anticipation of a potential granular Bayluscide treatment in the HEC, UMESC and the Service RMT continued conducting toxicity tests to determine the toxicity and sub-lethal effects of granular Bayluscide to freshwater mussels. During June 2019, toxicity tests were conducted on the Eastern lampmussel streamside the St. Clair River.
6. The final draft of the biological assessment concluding that application of the mixture of TFM:1% niclosamide is not likely to adversely affect the federally endangered piping plover was accepted by Ecological Services allowing use of the mixture during the 2019 lampricide treatment of the Platte River.
7. The Service RMT participated in the partner-led effort to collect young-of-the-year lake sturgeon before/during/after lampricide treatments of the Manistee and Muskegon rivers.

2020 Objectives:

1. Treat all streams listed on the 2020 treatment schedule.
2. Review past treatment results and larval assessment data to direct implementation of strategies to achieve improved efficacy of lampricide treatments scheduled during 2020.
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 optimal. Additionally, treatment supervisors will request additional personnel to augment treatment effort on complex, labor-intensive systems scheduled in the fall.
4. Develop an optimized schedule jointly between the agents to realize efficiencies in travel and maximize treatment efficacy.
5. To increase treatment effectiveness of St. Marys River granular Bayluscide applications, both spray boats will again be employed to ensure treatments are completed before aquatic vegetation becomes problematic.
6. Support and provide input into 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.
    a. The Service RMT will participate in the partner-led effort to collect young-of-the-year lake sturgeon before/during/after the Manistee River lampricide treatment.
    b. UMESC and Service personnel will cooperate to conduct bioassays prior the Manistee River treatment to minimize the potential for residuals and reduce the risk to young lake sturgeon.
    c. The LCTF will continue to support and provide feedback on research evaluating the effects of lampricide on young lake sturgeon

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

2019 Outcomes:

1. Lampricide analysis and water chemistry data from streams treated in 2019 were reviewed to identify potential areas that did not receive lethal TFM concentrations. Information was provided to larval assessment to help guide treatment evaluation survey effort and recommend re-treatment.
2. UMESC personnel examined dissolution rates and heat stress of several prototypes of TFM bars and pellets in support of developing a more effective solid formulation of TFM.
3. UMESC continues to investigate a greener liquid formulation of niclosamide. Service field staff assisted with field trials of an experimental liquid formulation during the Betsie and Manistique river lampricide treatments.

2020 Objectives:

1. Review past treatment history and larval assessment information for streams scheduled for treatment in 2020 to identify impediments to effectiveness and develop strategies to increase efficacy.
2. Work with other task forces to plan work that will measure effectiveness of lampricide applications. LCTF will continue to assist LATF with evaluating the success of prior large-scale treatment strategies. Treatment supervisors will review results of treatment evaluation surveys to identify problem areas and improve success of future treatments.
3. Treatment personnel will assist UMESC with field trials that support the development of a more effective solid formulation of TFM.

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

Strategy 4: Implement integrated strategies for Sea Lamprey control for each lake and evaluate their effectiveness.

2019 Outcomes:

1. Implemented the targeted treatment strategy focusing on Sea Lamprey producing tributaries to Lake Superior. All streams included in the strategy were successfully treated.
2. Provided input and calculated treatment costs for streams selected for treatment in 2020.
3. As directed by the SLCB, the LCTF continues to assist the LATF to consider possible control strategies in the Huron-Erie Corridor.

2020 Objectives:

1. Optimize stream treatment schedules to facilitate the implementation of the targeted treatment strategy focusing on tributaries to Lake Michigan.

2. The LCTF will 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 Huron targeted treatment strategy to occur in 2021.

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.

2019 Membership

Pete Hrodey (Chair), Kevin Mann, Jessica Barber, Cheryl Kaye, and Rob Elliott (Service); Bruce Morrison, Tonia Van Kempen, Bhuwani Paudel, and Tom Pratt (Department); Amanda Meyer and Carl Platz (USACE); Gary Whelan (MIDNR); David Gonder (OMNRF); Nicholas Johnson and Dan Zielinski (USGS); Rob McLaughlin (University of Guelph); Dale Burkett, Michael Siefkes, and Chris Freiburger (Commission Secretariat).

Progress towards goals described in the GLFC 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.

2019 Outcomes:

1. Planning continued on 17 barrier construction projects to prevent Sea Lamprey from accessing spawning habitat.
2. Construction of the Grand River (Lake Erie) Sea Lamprey barrier was initiated.
3. Rebuild of Big Creek inflatable Sea Lamprey barrier on Big Creek (Lake Erie) was completed.
4. Routine maintenance at all purpose-built Sea Lamprey barriers was completed to ensure adult Sea Lamprey do not have access to spawning habitat.
5. Inspection of approximately 180 existing barriers in the Great Lakes was 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.
6. Review of twenty fish passage projects was initiated or completed to determine the effect of fish passage and dam or culvert removals to Sea Lamprey control operations.
7. Completed electrofishing surveys and habitat assessments conducted upstream of barriers of concern in the Fox River to quantify potential infestation risk; barrier inspections were also completed to verify historical information and at locations not currently represented in the barrier database.

2020 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. Complete construction of the Grand River (Lake Erie) Sea Lamprey barrier in Harpersfield, OH.
4. Complete rebuild of Nicolston Dam on the Nottawasaga River (Lake Huron).
5. Members remain engaged in the process to reach a decision point regarding the Black Sturgeon River (Lake Superior) Camp 43 dam.
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 white water rapids area in downtown Grand Rapids, MI.
7. Continue working on priority GLFER barrier projects with the USACE: Bad (Lake Superior) and Little Manistee rivers (Lake Michigan) to limit Sea Lamprey access to spawning habitat.
8. Investigate use of existing surrogate species data and geographic information systems (GIS) data to predict infestation risk upstream of blocking barriers.
9. Deliver barrier program of operation and maintenance to limit Sea Lamprey access to spawning habitat.

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.

2019 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.
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. Seven unmarked adult lampreys were captured during 2019 in the upper Cheboygan. Approximately 1,896 sterilized male Sea Lampreys were also released into Sturgeon, Pigeon, and Maple rivers. Nest surveys were conducted and no viable eggs were observed. Further larval assessment surveys were planned for fall 2019.
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 electrical barrier was operated for 4 spawning seasons. Based on trap catches, it blocked >99% of the adults each year. Nevertheless, larvae were found above the barrier. There were some short periods when the barrier was off due to electrical outages. There were also some very early and very late arrivals of adult lamprey in the stream which needs to be investigated further.

2020 Objectives:

1. Remain involved in barrier research regarding use of chemo-sensory techniques to block or guide Sea Lampreys to increase capture of adult Sea Lamprey at barrier/trap complexes.
2. Participate in research trials 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. Barrier Task Force members and participants and control agents will develop an adaptive research plan for field testing supplemental control strategies (SMRT, pheromone, alarm cue, NEMO, etc.) on difficult to treat streams.
4. The Cheboygan Work Group (CWG) will continue to assess the upper Cheboygan River population during 2020 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.

Larval Assessment Task Force

The task force was established in 2012 and combined some objectives from the Assessment Task Force and the Larval Assessment Work Group.

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

2019 Membership
Fraser Neave (Chair), Mike Steeves and Kevin Tallon (Department); Lori Criger, Bob Frank and Aaron Jubar, (Service); Jean Adams and Chris Holbrook (USGS); Travis Brenden (Quantitative Fisheries Center, MSU); Dale Burkett, Chris Freiburger, and Mike Siefkes (Commission Secretariat).

Progress towards goals described in the GLFC 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.

2019 Outcomes:

1. All distribution surveys and detection surveys were scheduled and conducted in accordance with larval protocols.
2. Recruitment was detected in one new stream tributary to Lake Huron. Mill Creek will be ranked for potential treatment as required. Recruitment was also detected in Otter Cove Creek, a Lake Superior tributary which had not been infested since 1971. The assessment was expanded such that the entire small infested area was effectively treated.
3. The process by which streams are selected to survey for ranking purposes was modified somewhat in 2018, and again in 2019. In 2018 larval assessment biologists

ranked additional streams to enable the use of a smaller (80mm rather than 100mm) larval length cut-off. This change was implemented to ensure sufficient sampling data was obtained to generate a full treatment list for 2019. Subsequent to the 2018 field season, an exercise was undertaken to estimate the survey requirements for 2019, and it was determined that the sampling scope need to be widened even further. Hence in 2019, ranking surveys were conducted to target all streams that were predicted to have recruitment in 2018, i.e. one year old larvae. Ultimately, the 2020 rank list was calculated using larvae 100mm.

2020 Objectives:

1. Conduct detection surveys as possible given higher priority survey needs. When new infestations are found, rank for treatment as size structure dictates.
2. Conduct distribution surveys on all streams scheduled for treatment during 2021.
3. Continue to refine the ranking survey approach as required such that a full treatment list can be established for 2021.

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

2019 Outcomes:

1. Post-treatment assessments were conducted on all streams treated during 2018 and early 2019. The presence of large larvae in a number of streams resulted in recommendations for a re-treatment. These streams were Prentiss Cr., Furlong Cr., Taylor Cr., Caribou Cr. and Little Sandy Creek.

2020 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.

2019 Outcomes:

1. Larval habitat identification and quantification training for staff was completed in the respective offices of Marquette, Ludington and Sault Ste. Marie.
2. To address stream selection issues and other items as directed by the LATF, the Larval Assessment Workgroup met in conjunction with the January 2020 Sea Lamprey Annual Workshop.

2020 Objectives:

1. Conduct larval habitat identification training in spring 2020.
2. Continue to edit larval assessment protocols and operating procedures as necessary.
3. Currently St. Marys River treatment plots are ranked for a second within year treatment based on anticipated residual populations (using a set treatment efficacy value). This approach has been successful on the St. Marys River and it was suggested that a similar approach could be adopted for some lentic areas of concern to better direct our treatment effort in these areas. This approach will be considered at future meetings based on further analysis of residual populations in lentic areas.
4. Concern was brought up that some of the growth rates used in the ESTR model may need to be updated, and that to better rank streams we should consider improving/updating this part of the lamprey ranking model. Hence the LATF will continue investigations into updating growth parameters.

Strategy 4: Develop integrated strategies for Sea Lamprey control for each lake and evaluate their effectiveness.

2019 Outcomes:

1. Year one of the 2019-2021 Targeted Effort treatment strategy was implemented. This basin-wide approach focused on Lake Superior tributaries in 2019. The next Targeted Effort strategy will focus on Lake Michigan in 2020, and Lake Huron in 2021.
2. Ranking surveys, distribution surveys, and where required, habitat assessment were conducted to establish the list of streams for the 2020 Targeted Treatment strategy in Lake Michigan.

2020 Objectives:

1. Continue to work with the Trapping Task Force to identify and target streams for trapping out-migrating juveniles for control.
2. Initiate the Lake Huron Targeted Effort stream treatment list selection process for 2021, continuing with the approach used in the 2020 Lake Michigan process.

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.

2019 Membership
Gale Bravener (Chair) and Mike Steeves (Department), Peter Hrodey, Sean Lewandoski (Service), Jean Adams, Scott Miehls, Kim Fredricks, Alex Haro (USGS); Weiming Li, Michael Wagner (Michigan State University), Heather Dawson (University of Michigan), Rob McLaughlin (University of Guelph), Michael Siefkes, Dale Burkett, Chris Freiburger (Commission Secretariat).

Progress towards goals described in the GLFC Vision:

Goal 1: Suppress Sea Lamprey populations to target levels.

Strategy 4: Quantify the relationship between the abundance of adult Sea Lampreys, lake trout abundance, and marking rates on lake trout.

2019 Outcomes:

1. A total of 29 index streams were trapped throughout the Great Lakes in 2019, and mark recapture population estimates were obtained from 25. Adult indices for each lake were generated.

2020 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. Continue monitoring results from recent and ongoing research projects, and be prepared to implement new technologies/methods when they become available.

Strategy 6: Deploy trapping methods to increase capture of adult and recently metamorphosed Sea Lampreys.

2019 Outcomes:

1. Collection via screw traps, fyke nets, or electrofishing were considered in several tributaries with potential for recently metamorphosed (transformers) in fall 2018 and spring 2019. Most of these were subsequently treated, could not be collected on due to high water, or were deemed to have very few transformers.
2. There are several recent and ongoing research projects aimed at improving the capture of adults (pheromone attractants, alarm cue repellants, antagonist disruptors, etc.) and transformers (guidance via light, alarm cues) for control purposes. No new methods were deployed in 2019.
3. Heather Dawson's lab proceeded with updating the SLaMSE model to evaluate lake-wide trapping for control potential while taking into account expert judgement treatment cycles (ie. no delay in treatment frequency).
4. Members of the TTF have been involved with evaluating supplemental control (SupCon) methods by providing suggestions and advice to core group on study design and deployment options for each study stream.

2020 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. Continue monitoring results from recent and ongoing research projects, and be prepared to implement new technologies/methods when they become available.
3. Finish updating the SLaMSE model to evaluate lake-wide trapping for control potential while taking into account expert judgement treatment cycles.
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 maximize reductions in 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.

2019 Outcomes:

1. The focus of the Li lab (MSU) was less on mating pheromones released by males, and focused more on the effects of milt compounds and compounds released by females. Milt pheromone was partially identified and was tested in the field for the first time. Compounds released by ovulated females were isolated and tested with EOG and maze tests. Analyses ongoing.
2. TTF considered final results of 3kPZS dose response project. The capture of 10-20% more adult Sea Lamprey in 3kPZS-baited traps will likely not result in meaningful or consistent reductions in the production of Sea Lamprey larvae due to density independent stock recruitment variability. Therefore, 3kPZS should not be considered a standalone Sea Lamprey control tool, but rather a tool that integrated with other tools could be helpful (e.g. SupCon).

2020 Objectives:

1. Continue monitoring results from recent and ongoing pheromone research projects, and be prepared to implement new methods into the Sea Lamprey control field program when they become available.

Strategy 2: Evaluate a repellent-based method to deter Sea Lampreys from spawning areas.

2019 Outcomes:

1. The Wagner and Nair Labs (MSU) made progress on identifying the alarm cue. As expected it is a mixture of fraction that work synergistically. Reception is not only in the nose. Next steps are identification, and testing combinations in the field.
2. A new project began to develop criteria for siting traps in open river channels, integrating PIT and acoustic telemetry, bathymetric and habitat mapping, and push-application of the repellant alarm cue. Site selection is underway and tagging studies will begin in 2020.
3. Work continued on defeating the response attenuation (habituation) to alarm cue release in streams. When exposure is sporadic, there is no attenuation by the adult Sea Lamprey. Pulse modulation was tested in Hammond Bay raceways. Next step is to take into account mixing of alarm cue within streams at various distances.
4. Antagonists (3sPZS and PZS) were more rigorously tested in the field. Several movements and behaviors were quantified in response to antagonists, both alone and in combination.

2020 Objectives:

1. Continue to monitor results from alarm cue identification research.
2. Continue to monitor results from trap siting / push-pull research.

3. Continue to monitor results from alarm cue application research.
4. Continue to monitor results from antagonist research aimed at determining an effective formula of antagonists and the efficacy in halting reproduction in natural spawning populations.

Strategy 4: Implement integrated Sea Lamprey control strategies for each lake and evaluate their effectiveness.

2019 Outcomes:

1. Worked with LATF members to identify and target streams for trapping transformers 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.

2020 Objectives:

1. Continue to work with LATF to identify and target streams for trapping transformers for control.
2. Continue to evaluate the effect of integrated control strategies that have been implemented by developing adult Sea Lamprey abundance estimates.

2020 Objectives:

1. Continue work to isolate and identify the chemical structure of the Sea Lamprey alarm cue (Wagner Lab and Nair Lab, MSU).
2. The Wagner Lab will begin new research to develop criteria for siting traps and/or counting devices in open river channels to extend trap-based assessment and control options to rivers without barriers, to discover the best combination of site attributes and alarm cue applications to maximize encounter with the trap device.
3. Future directions for antagonist work include 1) determining an effective formula of antagonists, 2) determining the efficacy in halting reproduction in natural spawning populations, and 3) determining the mechanism of interaction with pheromone receptors.
4. The Wagner Lab will begin new research to develop application practices for the repellent alarm cue to defeat diminished response to the cue during full-night application. Previous research has demonstrated that Sea Lamprey will habituate to the alarm cue after 2-4 h of continuous exposure. This project will develop practices for modulating the cue release (e.g. pulsing high and low concentrations across time) for use in control operations.

Strategy 4: Implement integrated strategies for Sea Lamprey control for each lake and evaluate their effectiveness.

2019 Outcomes:

1. Worked with LATF to identify and target streams for trapping transformers for control.

2. Evaluated the effects of integrated control strategies that have been implemented (e.g. large-scale treatment strategies) by developing adult Sea Lamprey abundance estimates.

2020 Objectives:

1. Continue to work with LATF to identify and target streams for trapping transformers 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 GLFC and its partners, the United States Fish and Wildlife Service (USFWS), Fisheries and Oceans Canada (DFO), and United States Geological Survey-Hammond Bay Biological Station (USGS), conduct a comprehensive education and outreach program. The following is an update about recent outreach and educational activities.

OUTREACH AND EDUCATION EVENTS, 2019:

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 major shows and events were conducted by the GLFC, USFWS, DFO, and USGS during the 2019 season.

2019 Shows, events, and programs:

Ultimate Fishing Show, Detroit, MI—January 10-13 (USFWS – Lud)
Greater Niagara Fishing & Outdoor Expo, Niagara Falls, NY—January 18-20 (USFWS – Lud)
Chicagoland Fishing, Schaumburg, IL—January 24-27 (USFWS – Lud)
Duluth Boat, Sports, Travel show, Duluth, MN—February 13-17 (USFWS – Marq.)
Spring Fishing & Boat Show, Mississauga, ON—February 15-18 (SOO)
Ottawa Boat & Sportsmen's Show, Ottawa, ON—February 21-24 (SOO)
Outdoor Adventure Center Invasive Species Event, Detroit, MI – February 23 (GLFC)
Ontario Chapter of AFS Annual Meeting, Orillia, ON—March 1-2 (GLFC)
Northeast Wisconsin Sport Fishin' Show, Oshkosh, WI—March 1-3 (USFWS – Marq.)
Ultimate Sport Show, Grand Rapids, MI—March 14-17 (USFWS – Lud)
Keweenaw Bay Ojibwa Community College Job Fair, L'Anse, MI
Open House of the Bad River Natural Resources Dept., Odanah, WI—March 27 (USFWS – Marq)
Cranbrook Institute: Spring Into Science, Bloomfield Hills, MI—April 1-5 (GLFC)
6th Street Dam Community Meeting, Grand Rapids, MI—April 8 (GLFC)
MSU Science Festival, Belle Isle, MI—April 14 (GLFC)
Sault Ste. Marie Science Festival, Sault Ste. Marie, ON—April 27(SOO)
Rouge River Water Festival, Dearborn, MI—May 2 (GLFC)
St. Clair Water Festival, Detroit, MI—May 14 (GLFC)
Clinton River Water Festival, Rochester, MI—May 17 (GLFC)
Blue Water Anglers Kids Training Day, Sarnia, ON—May 25 (GLFC)
Blue Water Sturgeon Festival, Port Huron, MI—May 30 – June 1 (GLFC/HBBS)
Conference on the Environment, Michigan City, IN—June 7 (GLFC)
Kid's Fishing Day, Detroit, MI — June 8 (GLFC)
Grovefest, Fremont, OH — June 22 (GLFC)
Tall Ships Challenge, Toronto, ON—June 29 - July 1 (GLFC)
Tall Ships Challenge, Buffalo, NY—July 4-7 (GLFC)
Tall Ships Challenge, Cleveland, OH—July 11-14 (GLFC/USFWS-Lud)
Tall Ships Challenge, Bay City, MI—July 18-21 (GLFC)
Tall Ships Challenge, Kenosha, ON—August 1-4 (HBBS)
Tall Ships Challenge, Midland, ON—August 9-11 (GLFC)
Tall Ships Challenge, Sarnia, ON—August 9-11 (HBBS)
Western Michigan Fair, Ludington, MI—August 5-11 (USFWS-Lud)
U.P. State Fair, Escanaba, MI—August 12-18 (USFWS-Marq)
Tall Ships Challenge, Kingsville, ON—August 16-18 (GLFC)
Tall Ships Challenge, Erie, PA—August 22-26 (GLFC/USFWS-Lud)
Owen Sound Salmon Spectacular, Owen Sound, ON—August 23-Sept 1 (GLFC/SOO)
Tall Ships Challenge, Brockville, ON—August 30-Sept 2 (GLFC)
Cranbrook Institute: Rouge River Water Festival, Bloomfield Hills, MI—September 13 (GLFC)
Flint River Sturgeon Release, Flint, MI—September 21 (GLFC)
Maumee River Sturgeon Release, Toledo, OH—October 6 (GLFC)

PERMANENT EMPLOYEES OF THE SEA LAMPREY CONTROL PROGRAM

FISHERIES AND OCEANS CANADA

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

Mike Steeves, Program Manager

Team Leader, Control: Bruce Morrison

Lampricide Control Biologists:
Shawn Robertson: Supervisor
Alan Rowlinson: Supervisor
Barry Scotland: Assistant Supervisor
Clint Wilson: A/Assistant Supervisor
Ryan Booth: A/Environmental Supervisor

Lampricide Application Coordinators:
Peter Grey: Supervisor
Jamie Storozuk: Supervisor

Lampricide Analysis Technicians:
Stefanie Grand
Jerome Keen
Joe Lachowsky
Richard Middaugh

Lampricide Application Technicians:
Zach Allan
Justin Colbourne
Kevin Finlayson
Paul Kyostia
Melissa Leonard
Adam Loubert
Matt McAulay
Sean Nickle
Troy Pine
Chris Sierzputowski
Mike Sim
Kevin Sullivan
Brandon Trotter
Ryan Whitaker

Barriers:
Bhuwani Paudel: Barrier Engineering Coordinator
Joe Hodgson: Barrier Engineering Technician
Chad Hill: Technician

Team Leader, Assessment: Tonia Van Kempen

Assessment Biologists:
Gale Bravener: Adult Supervisor
Fraser Neave: Larval Supervisor (Upper Lakes)
Kevin Tallon: Larval Supervisor (On Assignment)
Sean Morrison: A/Larval Supervisor (Lower Lakes)

Assessment Technicians:
Ryan Booth
Jennifer Hallett
Sarah Larden
Sean Morrison
Andrea Phippen
Trevor Plumley
Jeff Rantamaki
Thomas Voigt
Agata Kolodziejczyk

Administrative Support:
Lisa Vine: Finance and Administrative Officer
Melanie McCaig: Administrative Clerk
Christine Reid: Field Administrative Clerk

Maintenance:
Brian Greene: Supervisor

Environmental Technician:
Nathan Coombs

UNITED STATES FISH AND WILDLIFE SERVICE

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

Ludington Biological Station – Manistee, Michigan

Scott Grunder, Station Supervisor

Administrative Support:
Danya Sanders
Vacant (CS)

Database Management and IT Support:
Daniel McGarry

Lampricide Control Fish Biologists:
Jenna Tews, Treatment Supervisor
Christopher Eilers
Daniel McGarry
Lauren Freitas

Lampricide Control Lead Physical Science Technician:
Barry Shier

Lampricide Control Physical Science Technicians:
Jeffrey Sartor
Vacant

Lampricide Control Biological Science Technicians:
Christina Carter (CS)
Bobbie Halchishak (CS)
Ben Molitor (CS
Paul Seckora (CS)
Chelsey Taylor (CS)
Barrett Warmbein (CS)

Larval Assessment Fish Biologists:
Aaron Jubar, Larval Assessment Supervisor
David Keffer
Matthew Lipp

Larval Assessment Biological Science Technicians:
John Ewalt
Todd Gerardot
Timothy Granger (CS)
Callie Kopp (CS)

Maintenance Worker:
Thomas McVay

Marquette Biological Station – Marquette, Michigan

Jessica Barber, Field Supervisor

Administrative Support:
Tracy Demeny, Administrative Officer
Lisa Dennis
Karla Godin

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
Mary Henson (Fish Biologist)
Chad Andresen (Biological Science Technician)

Chemist:
Benson Solomon

Maintenance Worker:
John Gilkenson

Unit Supervisor (Adult): Pete Hrodey

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

Barrier and Trapping Biological Science Technicians:
Kevin Letson
Dennis Smith
Tiffany Opalka-Myers
Jason Pynnonen (CS)
Nicholas Scripps (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:
Ross Gay (CS)
Stephen Healy (CS)
Kevin Hensiak (CS)
Janet McConnell (CS)
Randy Parker (CS)
Cory Racine (CS)
Dan Suhonen (CS)

Larval Assessment Biologists:
Robert Frank, Larval Assessment Supervisor
Rebecca Philipps
Vacant

Larval Assessment Biological Science Technicians:
Nikolas Rewald
Mark Bash (CS)
Matt Elya (CS)
Alex Larson (CS)

(CS) Career Seasonal