SEA LAMPREY CONTROL IN THE GREAT LAKES 2018

ANNUAL REPORT TO
THE GREAT LAKES FISHERY COMMISSION

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Cover: Tim Granger (U.S. Fish and Wildlife Service) searches for larval Sea Lamprey while patrolling a granular Bayluscide plot in the Detroit River. Photo: Dave Keffer, USFWS).

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EXECUTIVE SUMMARY

This report summarizes Sea Lamprey control operations conducted by the United States Fish and Wildlife Service and Fisheries and Oceans Canada in the Great Lakes during 2018, 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 102 tributaries and 20 lentic areas. Larval assessment crews surveyed 450 Great Lakes tributaries and 68 lentic areas to assess control effectiveness, plan future TFM treatments, and establish production capacity of streams. 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 58,478 (95% CI; 45,248 – 71,708), which was greater than the target of 12,112. In Lake Michigan, the index of adult abundance was estimated to be 26,999 (95% CI; 22,968 – 31,031), which was less than the target of 38,703. In Lake Huron, the index of adult abundance was estimated to be 39,178 (95% CI: 36,781 – 41,575), which is greater than the index target of 35,999. In Lake Erie, the index of adult abundance was estimated to be 4,149 (95% CI; 3,027 – 5,270), which was less than the target of 4,435. In Lake Ontario, the index of adult abundance was estimated to be 11,666 (95% CI; 9,921 – 13,412), which is less than the target of 15,502.

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 establish and maintain self-sustaining stocks of Lake Trout and other salmonines by minimizing Sea Lamprey impacts on these stocks. The lake committees have agreed to Sea Lamprey abundance indices and Lake Trout marking targets for each of the lakes. This report outlines the program conducted by the control agents and the Commission in 2018 to meet these targets.

FISH-COMMUNITY OBJECTIVES

Each lake committee has identified qualitative goals for Sea Lamprey control which are published in their fish- community objectives. During 2004, the lake committees 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 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 contrasting lake-specific adult Sea Lamprey index estimates and Lake Trout marking rates with prescribed targets. Adult Sea Lamprey abundance indices are estimated by the Service and Department by summing mark-recapture estimates from a sub-set of streams that were selected based on a consistent trapping history and significant 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 12,112 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 2018, the index of adult abundance in Lake Superior was estimated to be 58,478 (95% CI; 45,248 – 71,708), which is greater than the index target. The Sea Lamprey marking rate on Lake Trout is currently at 6.1 A1-A3 marks per 100 Lake Trout >532mm, which is greater than the target of 5 marks per 100 fish.

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 38,703 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 2018, the index of adult abundance in Lake Michigan was estimated to be 26,999 (95% CI; 22,968 – 31,031), which is less than the index target. The Sea Lamprey marking rate on Lake Trout is currently at 3.9 A1-A3 marks per 100 Lake Trout >532mm, which is less than the target of 5 marks per 100 fish.

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 35,999 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 2018, the index of adult abundance in Lake Huron was estimated to be 39,178 (95% CI: 36,781 – 41,575), which is greater than the index target. The Sea Lamprey marking rate on Lake Trout is currently 8.6 A1-A3 marks per 100 Lake Trout >532 mm which is greater than the target of 5 marks per 100 fish.

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 4,435 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 2018, the index of adult abundance in Lake Erie was estimated to be 4,149 (95% CI; 3,027 – 5,270), which is less than the index target. The Sea Lamprey marking rate on Lake Trout is currently 9.7 A1-A3 marks per 100 Lake Trout >532mm, which is greater than the target of 5 marks per 100 fish.

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 15,502 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 2018, the index of adult abundance in Lake Ontario was estimated to be 11,666 (95% CI; 9,921 – 13,412), which is less than the index target. The Sea Lamprey marking rate on Lake Trout is currently 0.6 A1 marks per 100 Lake Trout >431mm, which is less than the target of 2 marks per 100 fish.

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 2018 is presented in the LCTF section of this report.

During 2018, lampricide treatments were conducted on 102 tributaries and 20 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 2018.

Lake	Number of Streams	Number of Lentic Areas	Discharge (m^3/s)	Distance Treated (km)	TFM (kg) [1,2]	Bayluscide (kg) [1,3]
Superior	40	13	124	593	11,308	556
Michigan	9	1	17	178	4,222	23
Huron	34	5	252	1,230	44,607	1,971
Erie	3	0	11	182	2,466	0.3
Ontario	16	1	93	319	6,049	159
Total	**102**	**20**	**497**	**2,502**	**68,652**	**2,709**

[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.

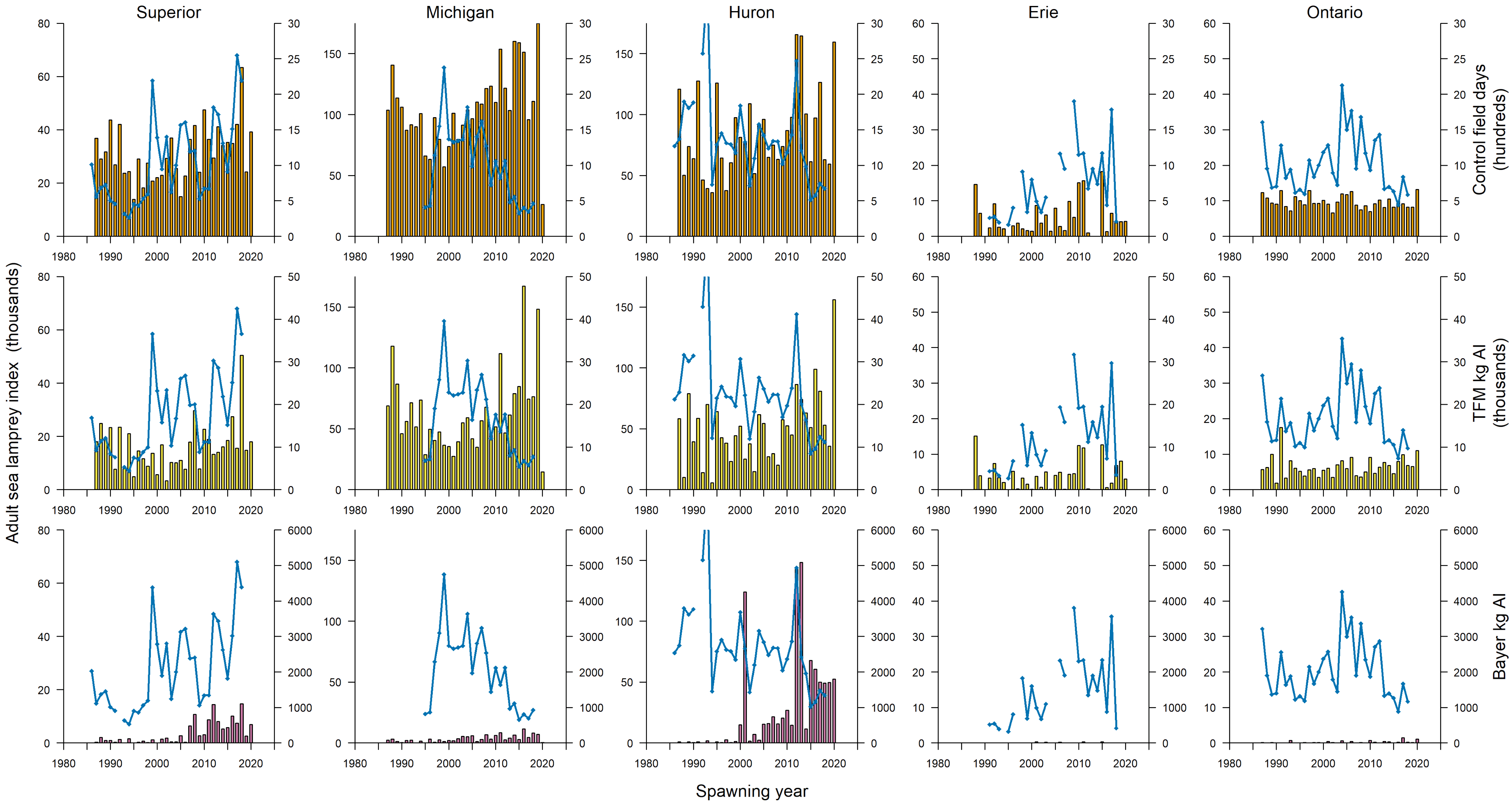

Figure 1. Row 1: Number of control field days (orange bars). Row 2: TFM used (kg active ingredient, yellow bars). Row 3: Bayluscide used (kg active ingredient, purple bars). All rows: Index of adult Sea Lamprey is shown with blue lines. All metrics plotted against the Sea Lamprey spawning year. Control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

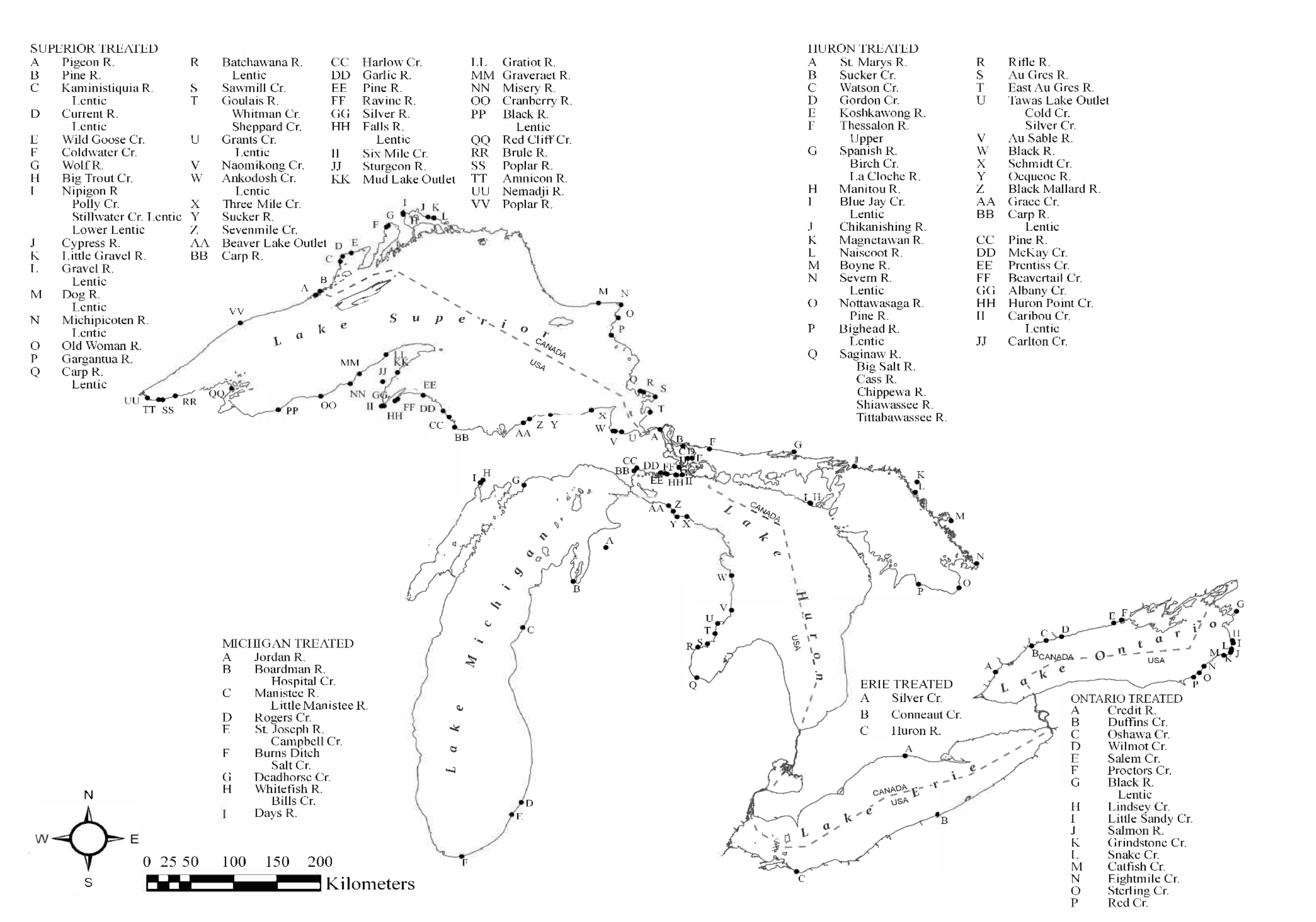

Figure 2. Location of tributaries treated with lampricide in 2018.

Lake Superior

Lake Superior has 1,566 tributaries (833 Canada, 733 U.S.). One hundred sixty-five tributaries (58 Canada, 107 U.S.) have historical records of larval Sea Lamprey production. Of these, 121 tributaries (45 Canada, 76 U.S.) have been treated with lampricides at least once during 2009-2018. Fifty-four tributaries (20 Canada, 34 U.S.) are treated every 4-6 years. Details on lampricide applications to Lake Superior tributaries and lentic areas during 2018 and tributary locations are found in Table 2 and Figure 2.

- Lampricide treatments were completed in 40 tributaries (14 Canada, 26 U.S.) and in 13 lentic areas (9 Canada, 4 U.S.).

- Trask Creek (Brule River) and Seven Mile Creek (U.S.) and Wild Goose Creek (Canada) were treated for the first time in 2018.

- Lampricide treatments were completed in several tributaries that had not been treated in over 40 years: Mud Lake Outlet (1973), Poplar (1977) and Pine rivers (1973), Six Mile (1963), Three Mile (1963), and Naomikong creeks (1962).

- The Amnicon and Sturgeon rivers were treated under unusually high discharge conditions.

- Lampricide treatments in Seven Mile Creek and the Beaver Lake system were challenging due to remote access in Pictured Rocks National Lakeshore. Lampricide and equipment were packed in several miles to access the recommended application points.

- The Black River was treated to prevent escapement of young-of-the-year (age 0) Sea Lamprey minimizing the potential for colonization of a lentic population and will be scheduled as an annual treatment.

- Completion of the Nemadji River lampricide treatment was challenging due to multiple rain events that occurred during the scheduled treatment period.

- The Carp River was rescheduled from late June to late August due to high discharge. The Cleveland Cliffs drawdown of Deer Lake to perform repairs and maintenance on the Deer Lake Dam contributed to unseasonably high discharge in the Carp River. High water levels were further compounded by a significant rain event that occurred just prior to the scheduled treatment.

- The required flows for the Michipicoten River could not be provided until later in September or October, coinciding with a large salmon run. The TFM treatment was deferred until 2019 to minimize impacts on non-target species. The lentic treatment was completed in early September.

Table 2. Details on the application of lampricides to tributaries and lentic areas of Lake Superior during 2018 (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								
Pigeon R. (A)	Jul-12	9.8	5.0	495.4	---	---	6.5	---
Pine R. (B)	Jul-13	2.0	4.3	268.2	0.8			---
Kaministiquia R. (C)								
Lentic	Sep-15	---	---	---	---	---	---	20.8
Current R. (D)								
Lentic	Sep-15	---	---	---	---	---	---	58.2
Wild Goose Cr. (E)	Jul-19	0.1	0.3	4.6	---	---	---	---
Coldwater Cr. (F)	Jul-16	0.8	20.9	431.9	---	---	---	0.0
Wolf R. (G)	Jul-20	3.5	4.4	458.3	---	---	5.5	0.0
Big Trout Cr. (H)	Jul-16	0.1	15.8	33.7	---	---	---	0.0
Nipigon R (I)								
Polly Cr.	Jul-20	0.1	2.0	8.2	---	---	---	0.0
Stillwater Cr. Lentic	Sep-11	---	---	---	---	---	---	35.5
Lower Lentic	Sep-09	---	---	---	---	---	---	49.0
Cypress R. (J)	Jul-24	0.6	6.0	30.2	---	---	---	0.0
Little Gravel R. (K)	Jul-21	0.1	5.8	10.3	---	---	---	0.0
Gravel R. (L)								
Lentic	Sep-12	---	---	---	---	---	---	179.4
Dog R. (M)								
Lentic	Jun-16	---	---	---	---	---	---	0.9
Michipicoten R. (N)								
Lentic	Sep-06	---	---	---	---	---	---	26.9
Michipicoten R. (N)								
Lentic	Sep-06	---	---	---	---	---	---	26.9
Old Woman R. (O)	Jul-21	1.5	15.9	94.2	---		---	0.0
Gargantua R. (P)	Sep-11	0.5	1.4	31.5	0.1	---	---	---
Carp R. (Q)								
Lentic	Jul-31	---	---	---	---	---	---	30.0
Batchawana R. (R)	Jul-25	6.5	12.5	480.9	2.7	---	---	0.1
Lentic	Aug-01	---	---	---	---	---	---	86.3
Sawmill Cr. (S)	Aug-23	0.1	0.5	1.0	---	---	---	---

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]
Goulais R. (T)								
Whitman Cr.	Aug-22	0.3	4.8	21.6	0.2	---	---	0.0
Sheppard Cr.	Sep-18	0.3	14.3	38.8	0.0	---	---	0.0
Total (Canada)		**26.3**	**113.9**	**2,408.8**	**3.8**	**0.0**	**12.0**	**487.1**
United States								
Grants Cr. (U)								
Lentic	Jul-25	---	---	---	---	---	---	3.7
Naomikong Cr. (V)	Jul-26	0.3	1.4	39.9	0.8	---	---	---
Ankodosh Cr. (W)								
Lentic	Jul-25	---	---	---	---	---	---	10.4
Three Mile Cr. (X)	Jul-27	0.0	2.3	1.5	---	---	---	---
Sucker R. (Y)	Jul-28	2.4	13.8	317.6	---	---	---	---
Sevenmile Cr. (Z)	Jul-29	0.6	2.4	77.7	---	---	---	---
Beaver Lake Outlet (AA)	Jul-30	1.3	4.0	211.6	2.1	---	---	---
Carp R. (BB)	Aug-22	1.0	8.5	253.3	0.6	---	---	---
Harlow Cr. (CC)	Jun-28	0.7	8.9	107.7	---	---	---	---
Garlic R. (DD)	Jun-27	1.2	12.6	139.1	1.3	---	---	---
Pine R. (EE)	Jun-27	1.4	3.5	87.9	---	---	---	---
Ravine R. (FF)	Aug-26	0.3	12.4	68.8	0.2	---	---	---
Silver R. (GG)	Aug-24	0.5	6.4	60.1	0.4	---	---	---
Falls R. (HH)	Aug-22	1.4	0.5	227.1	---	---	---	---
Lentic	Jun-24	---	---	---	---	---	---	13.5
Six Mile Cr. (II)	Sep-11	0.6	2.4	75.7	---	---	---	---
Sturgeon R. (JJ)	Oct-6	34.0	77.3	1,678.1	2.7	4.8	14.8	---
Mud Lake Outlet (KK)	Sep-12	0.4	3.7	13.1	---	---	---	---
Gratiot R. (LL)	Sep-9	0.4	2.9	48.5	---	---	---	---
Graveraet R. (MM)	Sep-7	0.9	10.9	143.1	0.4	---	---	---
Misery R. (NN)	Aug-25	1.1	2.9	183.1	---	---	---	---
Cranberry R. (OO)	Sep-6	0.3	27.5	85.5	1.1	---	---	---
Black R. (PP)	Sep-11	3.1	0.8	364.8	---	---	---	---
Lentic	Sep-12	---	---	---	---	---	---	9.8
Red Cliff Cr. (QQ)	Jun-1	0.3	3.7	39.2	1.3	---	---	---
Brule R. (RR)	Jun-30	8.7	24.8	956.6	---	---	---	---

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]
Poplar R. (SS)	Jun-5	2.3	25.1	217.5	0.8	---	---	---
Amnicon R. (TT)	Jul-2	14.2	17.2	855.6	1.7	---	---	---
Nemadji R. (UU)	Sep-22	19.0	202.2	2,523.1	9.7	---	---	---
Poplar R. (VV)	Jun-28	1.4	0.8	96.4	---	---	---	---
Total (United States)		**97.8**	**478.9**	**8,872.6**	**23.1**	**4.8**	**14.8**	**37.4**
Total for Lake		**124.1**	**592.8**	**11,281.4**	**26.9**	**4.8**	**26.8**	**524.5**

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

Lake Michigan

Lake Michigan has 511 tributaries. One hundred twenty-eight tributaries have historical records of larval Sea Lamprey production, and of these, 85 tributaries have been treated with lampricides at least once during 2009-2018. Thirty-one tributaries are treated every 3-5 years. Details on lampricide applications to Lake Michigan tributaries and lentic areas during 2018 and tributary locations are found in Table 3 and Figure 2.

- Lampricide applications were conducted in 9 tributaries and 1 lentic area (Table 1).

- Rogers Creek was successfully treated after being deferred in 2017.

- Campbell Creek (St. Joseph River) was treated after large larvae were collected during 2018 evaluation surveys.

Table 3. Details on the application of lampricides to tributaries and lentic areas of Lake Michigan during 2018 (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]
Jordan R. (A)	Aug-27	7.9	44.3	1,895.1	19.6	---	9.0	13.9
Boardman R. (B)								
Hospital Cr.	Jul-12	0.3	6.4	85.3	---	---	---	---
Manistee R. (C)								
Little Manistee R.	Jul-15	5.4	90.9	1,581.2	21.4	---	---	---
Rogers Cr. (D)	May-04	1.2	5.0	79.4	1.2	---	---	---
St. Joseph R. (E)								
Campbell Cr.	Oct-5	0.3	2.3	74.5	---	---	---	---
Burns Ditch (F)								
Salt Cr.	May-05	1.4	10.3	299.2	---	---	---	---
Deadhorse Cr. (G)	Aug-25	0.1	2.7	11.6	---	---	---	---
Whitefish R. (H)								
Bills Cr.	Aug-26	0.3	9.2	40.1	1.9	---	---	---
Total for Lake		**17.4**	**178.0**	**4,177.1**	**44.8**	**0.0**	**9.0**	**13.9**

[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 historical records of larval Sea Lamprey production. Of these, 86 tributaries (39 Canada, 47 U.S.) have been treated with lampricide at least once during 2009-2018. Forty-four tributaries (22 Canada, 22 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Huron tributaries and lentic areas during 2018 and tributary locations are found in Table 4 and Figure 2.

- Lampricide applications were completed in 34 tributaries (14 Canada, 20 U.S.), 5 lentic areas (3 Canada, 2 U.S.), and 336 ha of the St. Marys River (Table 1). Six St. Marys River plots were re-ranked based on an estimated 75% treatment efficacy and were retreated to target residual larval Sea Lamprey expected to survive the first treatment.

- Caribou and Huron Point creeks were treated under historically high discharge.

- The treatments of Beavertail and Carlton creeks were postponed from early May to July and October, respectively, due to high discharge.

- A portion of the Pine River was postponed from the original treatment period in May due to heavy rain during treatment. The remaining portion was treated in July.

- The Shiawassee River (Saginaw River) was rescheduled from its original treatment period in May to early June due to high discharge.

- Minimum lethal concentration was not achieved in the lower end of Prentiss Creek and is scheduled to be treated again during 2019.

- Significant non-target mortality occurred in the North Branch Carp River following a lampricide spill. The Michigan Department of Environmental Quality and U.S. Environmental Protection Agency were notified of the incident.

- The Tittabawassee River (Saginaw River) was treated for the first time.

- The Pine River (Saginaw River) was deferred due to continuous malfunctions of the St. Louis Dam throughout the spring.

- The Black Mallard River, upstream of Black Mallard Lake, was deferred due to extremely low water conditions.

- The Root, Garden, Echo (Bar/Iron Creek), and Mississagi rivers, and the Echo River lentic plot were deferred and have been rescheduled for 2019 pending further discussion with First Nation communities.

- Shebeshekong River, scheduled for treatment based on one age class of large larvae, was deferred due to low flows and will be assessed prior to rescheduling to confirm that sea lampreys remain in the river.

- The Boyne River was treated after large larvae were collected during 2018 ranking and distribution surveys.

- Sucker Creek and Boyne River were treated from a point further upstream than in previous treatments. Larval distribution in Sucker Creek was above historical limits. Distribution in the Boyne River was further upstream than in recent years.

- The treatment of La Cloche Creek (Spanish River) was washed out due to heavy rain. Post-treatment assessment during 2019 will determine whether La Cloche Creek requires retreatment.

- Lentic areas of the Severn and Bighead rivers were treated for the first time.

Table 4. Details on the application of lampricides to tributaries and lentic areas of Lake Huron during 2018 (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-10	---	---	---	---	---	---	1,572.0
Sucker Cr. (B)	May-16	0.1	2.7	31.5	0.2	---	---	0.0
Watson Cr. (C)	May-15	0.2	1.6	9.5	---	---	---	0.1
Gordon Cr. (D)	May-16	0.1	1.4	3.3	---	---	---	---
Koshkawong R. (E)	May-15	0.8	1.6	67.5	---	---	---	---
Thessalon R. (F)								
Upper	Sep-21	1.3	39.6	136.7	1.3	---	---	0.1
Spanish R. (G)								
Birch Cr.	Jun-05	0.9	16.9	124.9	1.0	---	---	0.1
La Cloche R.	Oct-10	2.3	15.3	288.1	---	---	---	---
Manitou R. (H)	Sep-05	1.1	1.2	222.4	---	---	---	---
Blue Jay Cr. (I)	Sep-07	0.6	11.2	137.3	1.0	---	---	0.0
Lentic	Jun-19	---	---	---	---	---	---	89.4
Chikanishing R. (J)	Jun-19	0.5	1.6	12.8	---	---	---	---
Magnetawan R. (K)	Jun-21	23.0	6.9	909.5	0.4	---	---	0.0
Naiscoot R. (L)	May-24	9.7	17.8	259.3	0.8	---	---	0.1
Boyne R. (M)	Sep-06	2.9	7.9	144.0	---	---	---	---
Severn R. (N)								
Lentic	Aug-08	---	---	---	---	---	---	26.3
Nottawasaga R. (O)								
Pine R.	Jun-25	2.6	49.1	860.1	---	---	---	0.1
Bighead R. (P)	Aug-15	0.6	50.8	392.3	3.8	---	---	0.2
Lentic	Jun-20	---	---	---	---	---	---	27.6
Total (Canada)		**46.7**	**225.6**	**3,599.2**	**8.5**	**0.0**	**0.0**	**1,716.0**
United States								
Saginaw R. (Q)								
Big Salt R.	May-21	5.2	30.9	1,733.0	0.7	---	---	---
Cass R.	Jun-21	3.4	70.7	2,317.0	---	---	---	---
Chippewa R.	May-17	39.6	114.1	8,867.2	---	---	10.6	17.9
Shiawassee R.	Jun-04	9.9	88.7	4,580.8	---	---	---	---
Tittabawassee R.	Jun-5	66.5	33.2	9,120.9	---	---	74.0	---
Rifle R. (R)	Aug-9	5.4	166.2	2,097.5	6.6	---	9.7	---
Au Gres R. (S)	Sep-10	4.8	25.9	925.1	---	---	---	---

Table 4. *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]
East Au Gres R. (T)	Jun-15	1.8	31.1	554.8	---	---	---	---
Tawas Lake Outlet (U)								
Cold Cr.	Aug-23	0.2	1.3	44.1	---	---	---	---
Silver Cr.	Aug-25	1.1	9.7	316.5	---	---	---	---
Au Sable R. (V)	Aug-28	48.1	24.9	5,983.3	6.2	---	75.4	---
Black R. (W)	Jun-15	1.4	34.6	358.7	1.9	---	---	0.6
Schmidt Cr. (X)	Jun-29	0.1	1.8	11.9	---	---	---	---
Ocqueoc R. (Y)	Sept-24	2.0	34.9	671.9	3.7	---	---	---
Black Mallard R. (Z)	Jul-2	0.3	3.1	63.3	---	---	---	0.2
Grace Cr. (AA)	Oct-7	0.3	1.3	16.4	---	---	---	---
Carp R. (BB)	Jul-13	2.3	96.6	788.6	5.2	---	---	---
Lentic	Jul-18	---	---	---	---	---	---	36.1
Pine R. (CC)	Jul-14	6.2	207.9	1,867.0	7.1	---	---	---
McKay Cr. (DD)	May-7	1.8	7.2	201.6	---	---	---	---
Prentiss Cr. (EE)	May-9	0.6	4.0	118.2	2.9	---	---	---
Beavertail Cr. (FF)	Jul-29	0.3	12.4	56.0	1.5	---	---	---
Albany Cr. (GG)	May-6	1.3	1.0	95.0	---	---	---	---
Huron Point Cr. (HH)	May-4	0.9	0.8	63.5	---	---	---	---
Caribou Cr. (JJ)	May-5	1.4	1.0	89.1	---	---	---	---
Lentic	Aug-1	---	---	---	---	---	---	30.0
Carlton Cr. (II)	Oct-2	0.1	1.3	22.1	---	---	---	---
Total (United States)		**205.0**	**1,004.6**	**40,963.4**	**35.8**	**0.0**	**169.7**	**84.8**
Total for Lake		**251.7**	**1,230.2**	**44,562.6**	**44.3**	**0.0**	**169.7**	**1,800.8**

[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 historical records of larval Sea Lamprey production. Of these, 18 tributaries (7 Canada, 11 U.S.) have been treated with lampricides at least once during 2009-2018. Eight tributaries (2 Canada, 6 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Erie tributaries and lentic areas during 2018 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 3 tributaries (1 Canada, 2 U.S.).

- Silver Creek was treated from a point further upstream than in previous treatments.

- The Huron River was treated for the first time in 2018.

Table 5. Details on the application of lampricides to tributaries and lentic areas of Lake Erie during 2018 (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]
<u>Canada</u>								
Silver Cr. (A)	May-01	0.5	8.3	128.8	---	---	---	0.3
Total (Canada)		**0.5**	**8.3**	**128.8**	**---**	**---**	**---**	**0.3**
<u>United States</u>								
Conneaut Cr. (B)	Apr-24	4.0	154.7	740.4	8.3	---	---	---
Huron R. (C)	May-07	6.2	19.0	1,587.9	0.2	---	---	---
Total (United States)		**10.2**	**173.7**	**2,328.3**	**8.5**	---	---	---
Total for Lake		**10.7**	**182.0**	**2,457.1**	**8.5**	**0.0**	**0.0**	**0.3**

[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 2009-2018. 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 2018 and tributary locations are found in Table 6 and Figure 2.

- Lampricide applications were conducted in 16 tributaries (6 Canada, 10 U.S.) and 1 lentic area (0 Canada, 1 U.S.).

- Salmon River and Lindsey Creek were treated in 2018 due to the presence of residual Sea Lamprey remaining after the 2017 treatments.

- The Salmon River was treated from the Lighthouse Hill Dam in Altmar, New York for the first time since 1978 because Sea Lamprey larvae were collected immediately downstream of the Salmon River Fish Hatchery application site in 2017. In addition, lampricide was applied to large backwater areas harboring numerous residual Sea lampreys.

- Little Sandy and Lindsey creeks were rescheduled from late spring to October due to low discharge.

Table 6. Details on the application of lampricides to tributaries of Lake Ontario during 2018 (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								
Credit R. (A)	May-27	7.0	40.3	1,556.4	3.1	---	18.2	0.2
Duffins Cr. (B)	Jun-05	2.4	38.9	723.7	---	---	---	0.1
Oshawa Cr. (C)	Jun-03	1.1	21.7	296.5	---	---	---	0.1
Wilmot Cr. (D)	Jun-01	0.8	17.4	292.4	---	---	---	0.0
Salem Cr. (E)	Apr-29	0.4	2.2	97.5	---	---	---	0.1
Proctors Cr. (F)	Apr-29	0.8	4.1	173.8	---	---	---	0.1
Total (Canada)		**12.5**	**124.6**	**3,140.3**	**3.1**	**0.0**	**18.2**	**0.6**
United States								
Black R. (G)	Aug-10	43.1	9.3	2,703.5	---	12.7	19.2	---
Lentic	Aug-11	---	---	---	---	---	---	106.6
Lindsey Cr. (H)	Oct-19	0.2	14.2	49.6	4.2	---	---	0.1
Little Sandy Cr. (I)	Oct-21	0.5	16.7	79.4	0.8	---	---	0.1
Salmon R. (J)	May-25	28.9	52.0	1,904.7	5.1	---	---	0.5
Grindstone Cr. (K)	Apr-23	2.1	44.0	270.3	1.5	---	---	0.3
Snake Cr. (L)	Apr-20	0.3	13.6	109.4	---	---	---	---
Catfish Cr. (M)	Apr-20	2.8	1.2	187.6	---	---	---	---
Eightmile Cr. (N)	Apr-26	0.6	4.5	85.0	---	---	---	0.1
Sterling Cr. (O)	May-28	0.9	28.0	394.3	4.8	---	---	0.2
Red Cr. (P)	Apr-27	1.1	11.1	247.3	1.7	---	---	0.0
Total (United States)		**80.5**	**194.6**	**6,031.1**	**18.1**	**12.7**	**19.2**	**107.9**
Total for Lake		**93.0**	**319.2**	**9,171.4**	**21.2**	**12.7**	**37.4**	**108.5**

[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 2018, 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 2018 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.

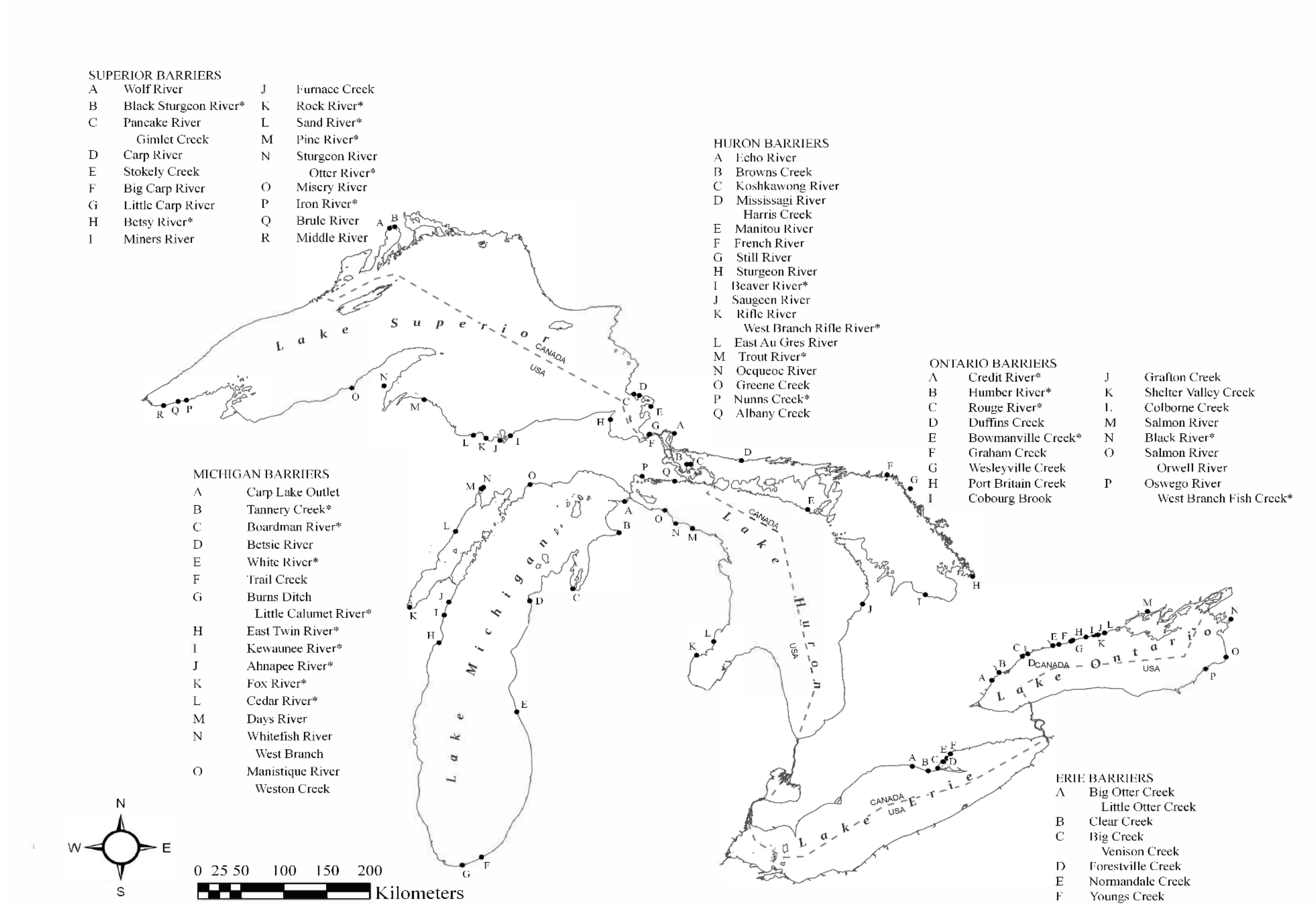

Figure 3. Locations of tributaries with Sea Lamprey barriers. Structures that have been modified or constructed by others that prevent the upstream migration of Sea Lamprey are indicated by an asterisk.

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 47 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 17 barriers (6 Canada, 11 U.S.).

- Fish community assessment surveys (28) were conducted in the Black Sturgeon watershed upstream of the Black Sturgeon Dam (Camp 43) to the Camp 1 Site at the outlet of Eskwanonwatin Lake to d document fish communities within this reach. In addition to electrofishing surveys, 1 lake (Nip-22) was also sampled using trap nets.

Ensure Blockage to Sea Lamprey Migration

- 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.

- Partner agencies were consulted to ensure blockage at barriers at 12 sites in 8 tributaries during 2018 (Table 7).

Table 7. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Superior tributaries during 2018.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Two Islands R.	Fredenberg Cr.	CCCD[1]	LTV Railroad culvert	Proposed	Ineffective Barrier
Two Islands R.	Fredenberg Cr.	CCCD[1]	Ash Cell Road culvert	Proposed	Ineffective Barrier
Two Islands R.	Fredenberg Cr.	CCCD[1]	County Road 1 culvert	Proposed	Ineffective Barrier
Bad R.	Fred’s Cr.	SRWA[2]	Fred’s Cr. culvert	Proposed	Ineffective Barrier
Bad R.	Trib. to Trout Br.	SRWA[2]	Hoeppner Road culvert	Proposed	Ineffective Barrier
Sturgeon R.	Gristmill Cr.	KBIC[3]	Gristmill Road culvert	Proposed	Ineffective Barrier
Sturgeon R.	Gristmill Cr.	KBIC[3]	Varline Road culvert	Proposed	Ineffective Barrier
Eagle R.	Central Cr.	KCRC[4]	Gratiot Lake Road culvert	Concur	Upstream of First Blocker
Section 34 Trib. #4		COS[5]	Moccasin Mike Road culvert #1	Proposed	Ineffective Barrier
Section 34 Trib. #3		COS[5]	Moccasin Mike Road culvert #2	Proposed	Ineffective Barrier
Bad R.	Denomie Cr.	BRB[6]	Denomie Cr. culvert	Proposed	Ineffective Barrier
Graveyard Cr.		BRB[6]	Graveyard Cr. culvert	Proposed	Negative Stream

[1]Cook County Soil and Water Conservation District
[2]Superior Rivers Watershed Association
[3]Keweenaw Bay Indian Community
[4]Keweenaw County Road Commission
[5]City of Superior, [6]Bad River Band of Lake Superior Chippewa Tribe

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 size needed and potential backwater effects. Service personnel attended a public meeting in 2018 to discuss additional alternative control technologies including seasonal and velocity barriers.

- 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 when Sea Lamprey are not migrating. Service personnel attended a public meeting hosted by USFS during 2018 in Kenton, MI to discuss the project with local stakeholders.

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 46 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 16 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 former Union Street Dam. 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 expected to be finalized this year with construction beginning late 2020 or early 2021.

- 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 2018, Service staff deployed portable assessment traps and fyke nets at 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 494 adult Sea Lamprey, resulting in a stream population estimate of 1,350 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 stoplogs needed to maintain an 18” vertical separation between the barrier crest and tailwater during the Sea Lamprey spawning migration.

- Whitefish River – Service staff reconfigured road gates and placed quarry stones and no trespassing signs along the road right-of-way to address landowner concerns with trespassing.

- Barrier removals/modification – Partner agencies were consulted to ensure blockage at barriers at 21 sites in 7 tributaries (Table 8).

Table 8. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Michigan tributaries during 2018.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Milwaukee R.		OC[1]	Thiensville Dam	Concur	Repair
Carp Lake R.		CRA[2]	Gill Road culvert	Proposed	Upstream of First Blocker
Carp Lake R.		CRA[2]	Munger Road culvert	Proposed	Upstream of First Blocker
Carp Lake R.		CRA[2]	Reed Road culvert	Proposed	Upstream of First Blocker
Grand R.	Trib. to Grand R.	OCP[3]	Riverside Park culvert #1	Concur	Ineffective Barrier
Grand R.	Trib. to Grand R.	OCP[3]	Riverside Park culvert #2	Concur	Ineffective Barrier
Grand R.		GRW[4]	Beautification Dam 1	Proposed	Ineffective Barrier
Grand R.		GRW[4]	Beautification Dam 2	Proposed	Ineffective Barrier
Grand R.		GRW[4]	Beautification Dam 3	Proposed	Ineffective Barrier
Grand R.		GRW[4]	Beautification Dam 4	Proposed	Ineffective Barrier
Grand R.	Trib. to Maple R.	CCD[5]	Island Road culvert	Proposed	Upstream of First Blocker
Manistee R.	Hinton Cr.	TU[6]	Hinton Cr. culvert	Proposed	Upstream of First Blocker
Manistee R.	Peterson Cr.	TU[6]	Peterson Cr. culvert	Proposed	Upstream of First Blocker
Manistee R.	Big Devil Cr.	TU[6]	Big Devil Cr. culvert	Proposed	Upstream of First Blocker
Manistee R.	Perkins Cr.	TU[6]	Perkins Cr. culvert	Proposed	Upstream of First Blocker
Platte R.		HP[7]	Skinner Road culvert	Proposed	Ineffective Barrier
Platte R.	Trib. to Little Platte R.	HP[7]	Saffron Road culvert	Proposed	Ineffective Barrier
Platte R.	Kinney Cr.	HP[7]	North Carmean Road culvert	Proposed	Ineffective Barrier
Pere Marquette R.	Blood Cr.	HP[7]	72nd Street culvert	Proposed	Ineffective Barrier
Pere Marquette R.	Blood Cr.	HP[7]	Broadway Avenue culvert	Proposed	Ineffective Barrier
Boardman R.	Hospital Cr.	WCGTB[8]	Kids Creek culvert	Proposed	Ineffective Barrier

[1]Ozaukee County
[2]Conservation Resource Alliance
[3]Ottawa County Parks
[4]Grand Rapids Whitewater
[5]Clinton Conservation District
[6]Trout Unlimited
[7]Huron Pines
[8]The Watershed Center Grand Traverse Bay

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 2021.

- 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 Preliminary Restoration Plan and feasibility study have been completed for the barrier and trap project. The project would include improvements to the weir structure and construction of permanent traps. Next steps involve 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 5 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 11 barriers (5 Canada, 6 U.S.).

- Repairs or improvements were conducted on one Canadian barrier:

    - Echo River – Replacement of the existing Sea Lamprey trap to improve function and safety is underway at the Echo River barrier. Construction is expected to be completed by April 2019.

- The combination low-head/electrical barrier in the Ocqueoc River was electrified during March 29-30 and April 22-May 15 when water levels inundated the low-head barrier. Water level monitoring occurred from March 23 to August 31 during the entire Sea Lamprey spawning migration.

- Fish community assessment surveys (19) were conducted in the upper Nottawasaga River watershed. This work is being completed as a monitoring component of the Nicolston Dam Rehabilitation Project.

- Fish community assessment surveys (12) were conducted in the Lower Saugeen River watershed. This work is being 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 and research agents 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" using Great Lakes Fishery and Ecosystem Restoration (GLFER) funding through the USACE.

- A total of 3,500 sterilized male Sea Lamprey were released upstream of the Cheboygan Dam during 2018 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 2018. Four unmarked lamprey were captured in the Pigeon, one in the Sturgeon, and zero in the Maple. Fin clipped sterile males were also released in these rivers: 1,338 in the Pigeon, 1,350 in the Sturgeon, and 812 in the Maple. Fyke nets recaptured sterile males at the following rates: 32% recapture rate in Pigeon, 19% in Sturgeon, and 25% in Maple River. These results are consistent with previous netting efforts between 2013 – 2017 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 and there are no plans to mitigate the removal with alternative controls. The sterile male evaluation study is expected to take place during 2017-2020.

- Saugeen River – The rehabilitation of Denny's Dam was completed in 2018.

- 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 2019.

- Partner agencies were consulted to ensure blockage at barriers for 11 sites in 4 tributaries during 2018 (Table 9).

Table 9. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Huron tributaries during 2018.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Pine R.	Trout Br.	USFS[1]	Trout Br. Pond Dam	Concur	Minimal Upstream Potential
Cheboygan R.	Van Cr.	LTBB[2]	Reed Road culvert	Proposed	Ineffective Barrier
Cheboygan R.	Van Cr.	LTBB[2]	Pet-Mack Trail culvert	Proposed	Ineffective Barrier
Cheboygan R.	Van Cr.	LTBB[2]	Van Road culvert	Proposed	Ineffective Barrier
Cheboygan R.	Pigeon R.	HP[3]	Ford Lake Road culvert	Proposed	Ineffective Barrier
Au Sable R.	Lost Cr.	TU[4]	Lost Cr. culvert	Proposed	Upstream of First Blocker
Thunder Bay R.	Gilchrist Cr.	HP[3]	Carter Road culvert	Proposed	Upstream of First Blocker
Thunder Bay R.		HP[3]	Hall Road culvert	Proposed	Upstream of First Blocker
Thunder Bay R.	Gilchrist Cr.	HP[3]	Greasy Cr. Road culvert	Proposed	Upstream of First Blocker
Thunder Bay R.	Gilchrist Cr.	HP[3]	Harwood Road culvert	Proposed	Upstream of First Blocker
Thunder Bay R.	Hunt Cr.	HP[3]	Schmallers Road culvert	Proposed	Upstream of First Blocker

[1]United States Forest Service
[2]Little Traverse Bay Band of Odawa Indians
[3]Huron Pines
[4]Trout Unlimited

New Construction

- Pine River (Nottawasaga River) – Barrier design was completed during 2018. After review, the proposed location was considered inappropriate and the project has been discontinued.

Experimental barriers

- A next generation low voltage electrical fish barrier was deployed seasonally (March – August) near the mouth of Black Mallard Creek during 2016-2018 to block adult Sea

Lamprey and eliminate the need for the next scheduled treatment. Although no adult Sea Lamprey were captured or observed upstream of the barrier during its operation, Sea Lamprey larvae from several year classes were found suggesting that escapement occurred during each year. The stream will be treated during 2019 on its normal schedule.

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)

- Field crews visited one structure on a Lake Erie tributary 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 11 barriers (7 Canada, 4 U.S.).

- Repairs or improvements were conducted on three Canadian barriers:

    - Big Creek – The trap on Big Creek was refitted with lighter trap inserts and the land surrounding the barrier on Venison Creek, a tributary to Big Creek, was stabilized to prevent passage. Obermeyer Hydro Incorporated has been contracted to refit the inflatable crest barrier and replace the control system scheduled for completion during 2019.

    - Little Otter Creek – The barrier-integrated trap was replaced to improve function and safety.

    - Fish community assessment surveys were conducted on Big (Venison) (10), Big Otter (Little Otter) (11), Clear (10), and Forestville (4) creeks to monitor fish communities in tributaries where purpose-built Sea Lamprey barriers are present.

Ensure Blockage to Sea Lamprey Migration

- 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. Construction is targeted for 2021 following the Sea Lamprey spawning run.

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

New Construction

- 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, and Ashtabula County. Design of the barrier allows for an 18-inch separation between the barrier crest and tailwater elevation as well as velocities capable of preventing Sea Lamprey passage during flooding events. Construction of the dam has begun and will be completed during 2019.

Table 10. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Erie tributaries during 2018.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Clinton R.		CRWC[1]	Yates Mill Dam (Utica Milling Co.)	Concur	Repair
Chagrin R.	Beecher's Br.	CM[2]	Beecher's Br. culvert	Proposed	Negative System
Cuttle Cr.		MIDNR[3]	Cuttle Cr. culvert	Proposed	Negative System
Bunce Cr.		MIDNR[3]	Bunce Cr. barrier	Proposed	Negative System
Huron R.		HRWC[4]	Flat Rock Hydro Dam	Proposed	Fish Passage Modification

[1]Clinton River Watershed Council
[2]Cleveland Metroparks
[3]Michigan Department of Natural Resources
[4]Huron River Watershed Council

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.).

- Fish community assessment surveys were conducted on the Orwell Brook (15), tributary to Salmon River, to monitor the fish community.

Ensure Blockage to Sea Lamprey Migration

- No requests for barrier removals on Lake Ontario were put forward by partner agencies during 2018.

Juvenile Trapping

- No trapping for out-migrating Sea Lamprey juveniles was conducted in 2018.

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 2018, the mean embryo viability from 9 nests was 72% (Figure 4).

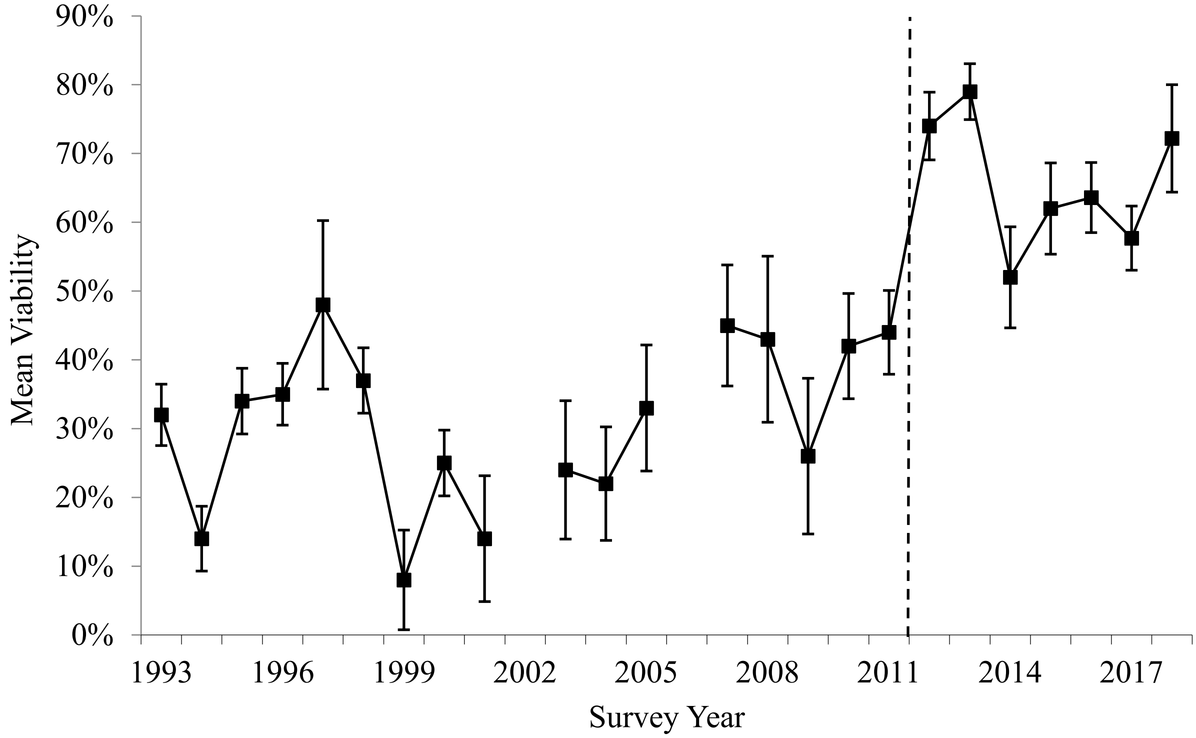

Figure 4. Mean annual embryo viability in the St. Marys River rapids during and after application of the sterile-male release technique (SMRT). The error bars represent SEs (not calculated for 2002 because only one sample was obtained). The vertical dashed line shows when SMRT application was discontinued 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 2018 are presented in the LATF and TTF sections of this report.

Larval Assessment

Tributaries considered for lampricide treatment during 2019 were assessed during 2018 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 146 tributaries (64 Canada, 82 U.S.) and 34 lentic areas (22 Canada, 12 U.S.). The status of larval Sea Lamprey populations in historically infested Lake Superior tributaries and lentic areas is presented in Tables 11 and 12.

- Surveys to estimate larval abundance were conducted in 54 tributaries (24 Canada, 30 U.S.) and in lentic areas offshore of 20 tributaries (13 Canada, 7 U.S.).

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 31 tributaries (19 Canada, 12 U.S.). A new population of larvae was discovered in Hungarian Creek (Houghton County, MI).

- Post-treatment assessments were conducted in 24 tributaries (7 Canada, 17 U.S.) and 3 lentic areas (2 Canada, 1 U.S.) to determine the effectiveness of lampricide treatments conducted during 2017 and 2018. Stillwater Creek (Nipigon River), Furnace River, Huron River and the lentic areas of Chippewa River, Jackpine River, and Dead River are scheduled for treatment in 2019 based on the presence of residual Sea Lamprey.

- Surveys to evaluate barrier effectiveness were conducted in 27 tributaries (5 Canada, 22 U.S.). All barriers were found to be effective in limiting Sea Lamprey infestations.

- Biological collections for research or training purposes were conducted in three U.S. tributaries. A total of 23,648 Sea Lamprey larvae were collected for research purposes from the Brule and Dead rivers, and Harlow Creek.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 71.07 kg active ingredient of 3.2% gB (43.55 kg Canada, 27.52 kg U.S.; Table 13).

Table 11. Status of larval Sea Lamprey in Lake Superior tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2018.

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Canada							
East Davignon Cr.	May-72	May-18	---	No	---	---	Unknown
West Davignon Cr.	Jun-14	May-18	No	No	---	---	Unknown
Little Carp R.	May-16	May-17	No	No	---	---	Unknown
Big Carp R.	Sep-07	May-17	No	No	---	---	Unknown
Cranberry Cr.	May-17	Sep-18	No	Yes	---	---	Unknown
Goulais R.	Oct-16	Jul-18	Yes	Yes	1,526,082	5,983	***2019***
Boston's Cr.	Never	Jun-17	---	No	---	---	Unknown
Horseshoe Cr.	Never	Aug-15	---	No	---	---	Unknown
Havilland Cr.	Jul-13	Jun-18	No	Yes	3,883	568	***2019***
Stokely Cr.	Jun-08	May-18	No	No	---	---	Unknown
Tier Cr.	Never	Jul-16	---	No	---	---	Unknown
Harmony R.	Jun-14	Jul-18	No	Yes	197	0	Unknown
Sawmill Cr.	Aug-18	Oct-18	No	No	---	---	Unknown
Jones Landing Cr.	Never	Jul-17	---	No	---	---	Unknown
Tiny Cr.	Never	Sep-15	---	No	---	---	Unknown
Chippewa R.	Jun-16	Jul-18	Yes	Yes	64,136	3,063	***2019***
Unamed (S-1009)	Never	May-18	---	Yes	90	75	***2019***
Unger Cr.	Jul-10	May-18	No	Yes	---	---	Unknown
Batchawana R.	Jul-18	Aug-17	Yes	Yes	---	---	
Digby Cr.	Jun-13	Jul-17	No	Yes	---	---	Unknown
Carp R.	Jun-16	Jul-18	No	Yes	23,664	0	2020
Pancake R.	Jul-16	Sep-18	Yes	Yes	31,180	0	***2019***
Westman Cr.	Jun-16	May-18	No	No	---	---	Unknown
Agawa R.	Jun-16	Jun-18	Yes	Yes	75,970	5,426	***2019***
Sand R.	Sep-71	Jun-18	No	Yes	---	---	Unknown
Baldhead R.	Never	Jul-17	---	No	---	---	Unknown
Gargantua R.	Sep-18	Oct-18	No	No	---	---	2022
Old Woman R.	Jul-18	Jul-18	No	No	---	---	Unknown
Michipicoten R.	Aug-16	Jun-18	Yes	Yes	---	---	***2019***
Dog R.	Aug-63	Jul-18	---	Yes	---	---	Unknown
White R.	Jul-16	Jul-18	No	No	---	---	2021
Pic R.	Jul-13	Jul-18	No	Yes	---	---	***2019***[1]
Nama Cr.	Aug-14	Jul-18	No	Yes	---	---	***2019***[1]
Little Pic R.	Jul-16	Jul-17	No	---	---	---	Unknown
Prairie R.	Jul-94	Jul-18	No	Yes	14,169	4,386	***2019***
Steel R.	Jul-16	Jul-18	Yes	Yes	28,535	2,038	***2019***
Pays Plat R.	Jul-15	Aug-18	Yes	Yes	---	---	***2019***[1]
Little Pays Plat Cr.	Jul-15	Aug-18	No	Yes	21,808	727	***2019***
Gravel R.	Aug-16	Aug-18	Yes	Yes	38,290	5,470	***2019***
Little Gravel R.	Jul-18	Aug-18	Yes	Yes	12,433	0	2020
Little Cypress	Aug-14	Aug-17	No	Yes	---	---	Unknown
Cypress R.	Jul-18	Aug-18	Yes	---	334	0	Unknown
Jackpine R.	Never	Aug-18	---	Yes	---	---	Unknown
Jackfish R.	Oct-16	Aug-18	Yes	Yes	22,599	706	***2019***

Table 11. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment)		Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
			Residuals Present	Recruitment Evident			
Nipigon R.							
Upper Nipigon R.	Aug-16	Aug-18	Yes	Yes	136,949	0	***2019***
Lower Nipigon R.	Aug-06	Aug-18	---	Yes	---	---	Unknown
Cash Cr.	Oct-15	Aug-18	Yes	Yes	40,164	0	2020
Polly Cr.	Jul-18	Aug-17	---	---	---	---	Unknown
Stillwater Cr.	Jun-17	Jun-18	Yes	Yes	818	327	***2019***
Big Trout Cr.	Jul-18	Jul-18	---	---	---	---	Unknown
Otter Cove Cr.	Aug-71	Jun-12	No	No	---	---	Unknown
Black Sturgeon R.	Aug-16	Aug-18	No	Yes	6,163	0	2020
Big Squaw Cr.	Jun-72	Aug-18	No	No	---	---	Unknown
Wolf R.	Jul-18	Aug-18	No	No	---	---	2022
Coldwater Cr.	Jul-18	Aug-18	No	---	---	---	Unknown
Pearl R.	Jul-15	Aug-18	Yes	Yes	7,512	1,594	***2019***
D'Arcy Cr.	Jul-10	Aug-18	No	Yes	325	325	***2019***
Blende Cr.	Jun-17	Aug-18	No	Yes	32,240	0	2020
MacKenzie R.	Aug-16	Aug-17	No	Yes	---	---	Unknown
Wild Goose Cr.	Jul-18	Aug-18	No	---	---	---	Unknown
Neebing-McIntyre FW	Jun-17	Aug-17	No	Yes	---	---	2021
Kaministiquia R.	Sep-16	Aug-17	Yes	No	---	---	***2019***[1]
Corbett Cr.	Jul-16	Aug-18	No	Yes	---	---	***2019***[1]
Whitefish R.	Aug-16	Aug-18	No	Yes	---	---	***2019***[1]
Oliver Cr.	Jul-16	Aug-18	No	Yes	---	---	***2019***[1]
Jarvis R.	Jun-17	Aug-17	No	No	---	---	Unknown
Cloud R.	Jun-17	Aug-17	No	Yes	---	---	2021
Pine R.	Jul-18	Aug-16	No	---	---	---	Unknown
Pigeon R.	Jul-18	Aug-17	---	---	---	---	Unknown
<u>United States</u>							
Waiska R.	Never	Jun-18	---	Yes	---	---	Unknown
West Branch	Jun-16	Jun-16	---	---	---	---	Unknown
Sec. 11SW Cr.	Never	Jun-17	---	Yes	---	---	Unknown
Pendills Cr.	Jul-12	May-18	---	Yes	---	---	Unknown
Grants Cr.	Aug-15	Jul-17	No	No	---	---	Unknown
Halfaday Cr.	Jul-12	Aug-17	---	Yes	---	---	Unknown
Naomikong Cr.	Jul-18	Jun-18	---	---	---	---	Unknown
Ankodosh Cr.	Sep-16	May-18	Yes	Yes	310	155	***2019***[1]
Roxbury Cr.	Jul-17	Sep-17	No	---	---	---	Unknown
Galloway Cr.	Aug-15	Jun-18	Yes	Yes	5,852	0	***2019***[1]
Tahquamenon R.	Oct-15	Jun-18	Yes	Yes	---	---	***2019***[1]
Betsy R.	Jul-17	May-18	No	---	---	---	Unknown
Three Mile Cr.	Jul-18	Aug-17	---	---	---	--	Unknown
Little Two Hearted R.	Aug-16	Jul-18	No	Yes	18,872	---	Unknown
Two Hearted R.	Aug-16	Sep-18	Yes	Yes	102,575	653	***2019***[1]
Dead Sucker R.	Aug-13	Sep-16	No	No	---	---	Unknown
Sucker R.	Jul-18	Sep-18	No	---	---	---	2022[1]
Chipmunk Cr.	Oct-61	Jun-15	---	No	---	---	Unknown
Carpenter Cr.	Aug-15	May-17	No	No	---	---	Unknown

Table 11. *continued*.

			Status of Larval Lamprey Population (surveys since last treatment)				
Tributary	Last Treated	Last Surveyed	Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Sable Cr.	Sep-89	Sep-18	---	Yes	226	---	Unknown
Hurricane R.	Never	Sep-18	---	Yes	---	---	Unknown
Sullivans Cr.	Jul-15	Sep-18	Yes	Yes	1,551	123	***2019***
Seven Mile Cr.	Jul-18	Sep-18	No	---	---	---	Unknown
Beaver Lake Cr.							
Beaver Lk Outlet	Jul-18	Sep-18	No	---	---	---	Unknown
Lowney Cr.	Jul-18	Sep-18	Yes	---	---	---	Unknown
Little Beaver Cr.	Jul-18	Sep-18	No	---	---	---	Unknown
Mosquito R.	Jun-73	Sep-18	---	No	---	---	Unknown
Miners R.							
Barrier downstream	Jul-16	Sep-18	No	Yes	9,645	134	***2019***
Barrier upstream	Jul-13	Sep-18	No	No	---	---	Unknown
Munising Falls Cr.	Sep-64	Sep-17	---	Yes	---	---	Unknown
Anna R.	Jul-13	Sep-18	No	Yes	3,247	0	***2019***[1]
Tourist Park Cr.	Never	Jul-16	---	Yes	---	---	Unknown
Furnace Cr.							
Lower	May-17	May-18	Yes	Yes	2,055	151	***2019***
Upper	Sep-10	Sep-18	---	No	---	---	Unknown
Five Mile Cr.	Jul-16	May-18	No	Yes	---	---	Unknown
Au Train R.					---	---	
Lower	Sep-16	Oct-18	No	Yes	56,456	0	***2019***[1]
Upper	Sep-16	Sep-18	Yes	Yes	25,273	0	***2019***[1]
Rock R.	Jul-02	Sep-18	---	No	---	---	Unknown
Deer Lake Cr.	Aug-70	Sep-17	---	No	---	---	Unknown
Laughing Whitefish R.	Jul-17	Sep-17	Yes	---	---	---	Unknown
Sand R.					---	---	
Below Dam	Jul-15	Sep-18	No	Yes	9,905	150	***2019***
Above Dam	Jul-15	Aug-17	Yes	No	---	---	Unknown
Chocolay R.	Jul-16	Oct-18	Yes	Yes	432,958	3,673	***2019***[1]
Carp R.	Aug-18	Aug-17	---	---	---	---	Unknown
Dead R.	Aug-14	Aug-18	Yes	Yes	64,998	6,132	***2019***[1]
Compeau Cr.	Never	Jun-16	---	Yes	---	---	Unknown
Harlow Cr.	Jun-18	Nov-18	Yes	---	1,416	145	***2019***
Little Garlic R.	May-17	Oct-18	No	Yes	13,316	---	2021[1]
Garlic R.	Jun-18	Oct-18	Yes	---	---	---	2021[1]
Iron R.	Jun-16	Sep-18	Yes	Yes	10,664	2,133	***2019***[1]
Salmon Trout R. (Marquette Co.)	Jul-16	Sep-18	Yes	Yes	1,640,120	18,709	***2019***[1]
Pine R.	Jun-18	Sep-17	---	---	---	---	Unknown
Huron R.	Aug-17	Aug-18	Yes	Yes	4,706	523	***2019***[1]
Ravine R.	Aug-18	Jul-18	---	---	---	---	***2019***[1]
Slate R.	Sep-13	Jun-17	Yes	Yes	---	---	Unknown
Silver R.	Aug-18	Jul-18	---	---	---	---	***2019***[1]
Falls R.	Aug-18	Sep-17	No	---	---	---	***2019***[1]
Six Mile Cr.	Sep-18	Aug-18	---	---	---	---	***Unknown***
Little Carp R.	May-16	Aug-18	No	Yes	20,062	0	***2019***[1]
Kelsey Cr.	Never	Aug-18	---	Yes	---	---	***Unknown***

Table 11. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Sturgeon R.	Oct-18	Aug-18	---	---	---	---	2021[1]
Pilgrim R.	Aug-62	Jun-17	---	Yes	---	---	Unknown
Trap Rock R.	Jun-17	Aug-18	No	Yes	133,566	---	***2019[1]***
McCallum Cr.	Aug-63	May-15	---	No	---	---	Unknown
Little Gratiot R.	Jun-16	Aug-17	No	No	---	---	Unknown
Eliza Cr.	Aug-15	Aug-18	Yes	Yes	428	0	***2019[1]***
Gratiot R.	Sep-18	Aug-17	---	---	---	---	Unknown
Smiths Cr.	May-64	Aug-17	---	No	---	---	Unknown
Boston-Lily Cr.	Jun-16	Aug-18	Yes	Yes	42,251	0	Unknown
Schlotz Cr.	Jul-16	Sep-16	No	---	---	---	Unknown
Salmon Trout R. (Houghton Co.)	Jun-16	Aug-18	No	Yes	---	---	Unknown
Mud Lake Outlet	Sep-18	Aug-17	---	---	---	---	Unknown
Hungarian Creek	Never	Aug-18	---	Yes	3,426	1,557	***2019***
Graveraet R.	Sep-18	Aug-17	---	---	---	---	Unknown
Elm R.	Aug-16	May-17	No	---	---	---	Unknown
Misery R.					---	---	Unknown
Barrier Downstream	Aug-18	May-17	---	---	---	---	2021[1]
Barrier upstream	Aug-00	Aug-18	---	No	---	---	Unknown
East Sleeping R.	Jun-16	Jul-18	Yes	Yes	80,415	21,575	***2019[1]***
West Sleeping R.	Jun-16	Sep-18	Yes	Yes	43,430	653	***2019[1]***
Firesteel R.	Jul-16	Sep-18	Yes	Yes	266,625	1,165	***2019[1]***
Flintsteel R.	Sep-17	Jul-18	No	---	---	---	Unknown
Ontonagon R.	Oct-16	Oct-18	Yes	Yes	267,245	6,527	***2019[1]***
Potato R.	Sep-17	Jul-18	No	---	---	---	2020[1]
Floodwood R.	Never	Jul-18	---	Yes	---	---	Unknown
Cranberry R. (Ontonagon Co.)	Sep-18	Oct-17	---	---	---	---	2021[1]
Mineral R.	Sep-17	Jul-18	No	Yes	---	---	Unknown
Big Iron R.	Never	Jun-17	---	Yes	---	---	Unknown
Little Iron R.	Sep-75	Jun-17	---	Yes	---	---	Unknown
Union R.	May-64	Jun-17	---	No	---	---	Unknown
Black R.	Sep-18	Jul-17	---	---	---	---	***2019[1]***
Montreal R.	Jul-75	Aug-18	---	Yes	---	---	Unknown
Washington Cr.	Jun-80	Jul-12	--	No	---	---	Unknown
Bad R.	Sep-17	Aug-18	Yes	Yes	---	---	2020[1]
Marengo River	May-16	Aug-18	No	Yes	---	---	2020[1]
Fish Cr. (Eileen Twp)	Jun-15	Aug-18	No	Yes	---	---	Unknown
Sioux R.	Sep-14	Aug-18	No	Yes	5,596	2,798	***2019[1]***
Pikes Cr.	May-16	Aug-18	Yes	No	---	---	Unknown
Red Cliff Cr.	Jun-18	Aug-17	---	---	---	---	Unknown
Raspberry R.	May-16	Sep-16	No	No	---	---	Unknown
Sand R.	Jul-16	Sep-16	No	---	---	---	Unknown
Cranberry R. (Bayfield Co.)	Jun-17	Aug-18	No	No	---	---	Unknown
Iron R.							
Barrier downstream	Aug-16	Jul-17	Yes	---	---	---	Unknown
Barrier upstream	Oct-64	Aug-16	---	No	---	---	Unknown

Table 11. *continued*.

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Reefer Cr.	Oct-64	Aug-18	---	Yes	---	---	Unknown
Fish Cr. (Orienta Twp)	Oct-64	Sep-16	---	No	---	---	Unknown
Brule R.					---	---	Unknown
Barrier downstream	Jun-18	Aug-18	Yes	---	---	---	2021[1]
Barrier upstream	Jun-86	Jul-18	---	No	---	---	Unknown
Poplar R.	Jun-18	Aug-18	No	---	---	---	Unknown
Middle R.					---	---	Unknown
Barrier downstream	Jun-17	Aug-17	No	---	---	---	Unknown
Barrier upstream	Jun-02	Jul-18	---	No	---	---	Unknown
Amnicon R.	Jul-18	Aug-18	No	---	---	---	2021[1]
Nemadji R.	Sep-18	Aug-17	---	---	---	---	Unknown
St. Louis R.	Sep-87	Aug-17	---	Yes	---	---	Unknown
Sucker R. (St. Louis Co.)	Never	Aug-17	---	Yes			Unknown
Gooseberry R.	Aug-76	Aug-17	---	Yes	---	---	Unknown
Splitrock R.	Aug-76	Aug-17	---	Yes	---	---	Unknown
Poplar R.	Jun-18	Aug-18	No	---	---	---	Unknown
Arrowhead R.	Jun-09	Aug_18	---	Yes	13,506	3,972	***2019***

[1] Stream being treated based on stream-specific knowledge of sea lamprey recruitment and growth.

Table 12. Status of larval Sea Lamprey in historically infested lentic areas of Lake Superior during 2018.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Canada				
Goulais R.	Goulais Bay	Jul-18	Jul-18	Oct-16
Havilland Cr.	Havilland Bay	Jul-17	Jul-14	Jun-15
Stokely Cr.	Havilland Bay	Jul-17	Jul-09	Aug-11
Harmony R.	Batchawana Bay	Aug-17	Aug-17	Aug-14
Chippewa R.	Batchawana Bay	Aug-18	Aug-18	Oct-17
Batchawana R.	Batchawana Bay	Jul-17	Jul-17	Aug-18
Carp R.	Batchawana Bay	Sep-16	Sep-16	Jul-18
Pancake R.	Pancake Bay	Jul-18	Jul-18	Never
Agawa R.	Agawa Bay	Jul-18	Jul-14	Aug-10
Michipicoten R. (Lower)	Marina Area	Aug-16	Aug-12	Sep-18
Pays Plat R.	Pays Plat Bay	Aug-18	Aug-17	Never
Gravel R.	Mountain Bay	Aug-17	Aug-17	Sep-18
Little Gravel R.	Mountain Bay	Aug-17	Aug-17	Aug-16
Little Cypress R.	Cypress Bay	Aug-15	Aug-15	Aug-16
Cypress R.	Cypress Bay	Aug-18	Aug-18	Aug-15
Jackpine R.	Nipigon Bay	Aug-18	Aug-18	Jun-17
Jackfish R.	Nipigon Bay	Aug-14	Aug-05	Never
Nipigon R.				
Poly Cr.	Poly Lake	Aug-17	Jul-90	Jul-87
Cash Cr.	Lake Helen	Aug-17	Aug-15	Sep-16
Nipigon R.	Lake Helen	Aug-18	Aug-18	Aug-16
Nipigon R (Lower).	Nipigon Bay	Aug-18	Aug-18	Sep-18
Stillwater Cr.	Nipigon Bay	Aug-17	Aug-17	Sep-18
Big Trout Cr.	Nipigon Bay	Aug-18	Aug-18	Oct-11
Black Sturgeon R.	Black Bay	Aug-11	Jul-04	Never
Wolf R.	Black Bay	Aug-18	Aug-16	Aug-15
Coldwater Cr.	Black Bay	Aug-18	Aug-18	Never
D'Arcy Cr.	Black Bay	Aug-17	Aug-16	Jun-17
MacKenzie R.	MacKenzie Bay	Aug-18	Aug-18	Aug-16
Current R.	Thunder Bay	Aug-17	Aug-17	Aug-14[1]
Neebing-McIntyre Floodway	Thunder Bay	Aug-14	Jul-90	Never
Kaministiquia R. (Lower)	Thunder Bay	Aug-17	Aug-17	Sep-18
Pigeon R.	Pigeon Bay	Aug-15	Aug-15	Aug-10[2]
United States				
Pendills Cr.	Tahquamenon Bay	Jul-17	Jul-12	Never[2]
Grants Cr.	Tahquamenon Bay	Jul-17	Jul-17	Never[1]
Halfaday Cr.	Tahquamenon Bay	Jul-12	Jul-12	Never[2]
Ankodosh Cr.	Tahquamenon Bay	Jul-17	Jul-17	Sep-16[1]
Roxbury Cr	Tahquamenon Bay	Aug-15	Aug-15	Never[2]
Galloway Cr.	Tahquamenon Bay	Jun-13	Jul-88	Never
Sucker R.	Grand Marais Harbor	Sep-09	Aug-90	Never
Carpenter Cr.	West Bay	Sep-16	Sep-16	Aug-15
Beaver Lake Cr.	Beaver Lake	Aug-17	Aug-17	Never[2]
	Little Beaver Lake	Aug-17	Aug-17	Never[2]
Anna R.	Munising Bay	Jun-17	Jun-17	Aug-11
Miners R.	Miners Lake	Sep-13	Sep-13	Jun-11

Table 12. *continued.*

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Furnace Cr.	Furnace Bay	Jun-17	Jun-17	Jul-17
	Furnace Lake – Offshore Hanson Cr.	Jul-17	Aug-09	Never[2]
	Furnace Lake – Offshore Gongeau Cr.	Jul-17	Aug-09	Never[2]
Five Mile Cr.	Offshore mouth	Jul-16	Jul-16	Never[2]
Carp R.	Offshore mouth	Jun-17	Jun-17	Jun-15
Dead R.	Presque Isle Harbor	Aug-18	Aug-18	Jul-17[1]
Harlow Cr.	Harlow Lake –			
	Offshore Bismark Cr.	Jun-17	Jun-17	Never[2]
	Offshore Outlet	Jun-12	Jun-12	Never
Little Garlic R.	Offshore mouth	Jun-17	Aug-11	Jul-12
Garlic R.	Offshore mouth	Jul-12	Sep-05	Never[2]
	Saux Head Lake	Jul-17	Jul-17	Jun-15
Ravine R.	Huron Bay	Sep-17	Sep-17	Sep-15
Slate R.	Huron Bay	Jun-18	Jun-18	Sep-15[1]
Silver R.	Huron Bay	Sep-17	Sep-17	Aug-16
Falls R.	L'anse Bay	Sep-17	Sep-17	Jun-18
Six Mile Creek	L'anse Bay	Jul-18	Jul-18	Never[2]
Trap Rock R.	Torch Lake	Aug-18	Aug-18	Jun-17[1]
Eliza Cr.	Eagle Harbor	Aug-18	Aug-18	Never[1]
Mineral R.	Offshore mouth	Sep-11	Sep-11	Never[2]
Black R.	Black River Harbor	Jul-17	Jul-17	Sep-18[1]
Fish Cr. (Eileen Twp.)	Chequamegon Bay	Aug-15	Aug-06	Never[2]
Red Cliff Cr.	Buffalo Bay	Aug-11	Aug-03	Never
Sand R. (Bayfield Twp.)	Sand Bay	Aug-15	Aug-15	Aug-10[2]

[1] Scheduled for treatment during 2018.
[2] Low-density larval population monitored with 3.2% granular Bayluscide surveys.

Table 13. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Superior for larval assessment purposes during 2018.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
Goulais R. (Lentic)	1.68	0.3
Unnamed (S-35)	0.56	0.1
Chippewa R. (Lentic)	1.96	0.35
Chippewa R.	1.68	0.3
Pancake R. (Lentic)	1.68	0.3
Montreal R. (Lentic)	0.56	0.1
Montreal R.	0.56	0.1
Agawa R. (Lentic)	0.864	0.2
Sand R. (Lentic)	0.56	0.1
Sand R.	0.28	0.05
Old Woman R. (Lentic)	0.84	0.15
Dog R.	1.05	0.19
White R.	1.68	0.3
Pic R.	0.84	0.15
Prairie R.	0.84	0.15
Steel R. (Lentic)	0.56	0.1
Pays Plat R. (Lentic)	0.56	0.1
Little Cypress R. (Lentic)	0.84	0.15
Cypress R. (Lentic)	1.68	0.3
Jackpine R. (Lentic)	0.84	0.15
Jackpine R.	0.48	0.085
Jackfish R.	1.68	0.3
Nipigon R. (Lentic)	1.68	0.3
Nipigon R. (Lake Helen)	1.68	0.3
Nipigon R.	4.48	0.8
Nipigon R. (Stillwater Cr.)	0.56	0.1
Big Trout Creek (Lentic)	1.68	0.3
Black Sturgeon R.	1.68	0.3
Wolf R. (Lentic)	1.68	0.3
Coldwater Cr. (Lentic)	0.84	0.15
Pearl R.	1.68	0.3
D'Arcy Cr.	0.28	0.05
Blende Cr. (Lentic)	0.84	0.15
MacKenzie R. (Lentic)	1.68	0.3
McVicar Cr. (Lentic)	0.84	0.15
Pine R. (Lentic)	1.12	0.2
Little Pine R. (Lentic)	0.56	0.1
Total (Canada)	**43.55**	**7.82**
United States		
Waiska R. (Lotic)	1.68	0.36
Tahquamenon R. (Lotic)	1.92	0.41
Sucker Cr. (Lentic)	1.92	0.41
Carpenter Cr. (Lentic)	1.92	0.41
Anna R. (Lentic)	2.88	0.62
Chocolay R. (Lentic)	1.92	0.41
Dead R. (Lentic)	1.44	0.31

Table 13. *continued*

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Huron R. (Lentic)	0.96	0.21
Slate R. (Lentic)	2.16	0.47
Six Mile Cr. (Lentic)	1.92	0.41
Trap Rock (Lentic)	1.92	0.41
Traverse R. (Lentic)	0.96	0.21
Eliza Cr. (Lentic)	0.96	0.21
Flintsteel R. (Lotic)	0.31	0.07
Ontonagon R. (Lotic)	1.26	0.27
Cranberry R. (Bayfiled Co.) (Lotic)	0.48	0.1
Reefer Cr. (Lotic)	0.03	0.12
Amnicon R. (Lentic)	2.88	0.62
Total (United States)	**27.52**	**6.03**
Total for Lake	**71.07**	**13.85**

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

Lake Michigan

- Larval assessments were conducted in 86 tributaries and 15 lentic areas. The status of larval Sea Lamprey populations in historically infested Lake Michigan tributaries and lentic areas is presented in Tables 14 and 15.

- Surveys to estimate larval abundance were conducted in 26 tributaries.

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 13 tributaries. No new infestations were identified..

- Post-treatment assessments were conducted in 24 tributaries to determine the effectiveness of lampricide treatments conducted during 2017 and 2018. Hudson Creek, Crow River, Platte River, Betsie River and Muskegon River are scheduled for treatment in 2019 based on the presence of residual Sea Lamprey.

- Surveys to evaluate barrier effectiveness were conducted in 21 tributaries. All barriers were found to be effective in limiting Sea Lamprey infestations.

- Larval assessment surveys were conducted in 19 non-wadable lentic and lotic areas using 32.76 kg active ingredient of 3.2% gB (Table 16).

Table 14. Status of larval Sea Lamprey in Lake Michigan tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2018.

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Brevort R.							
Upper	Jun-17	Sep-17	No	No	---	---	Unknown
Lower	Jun-17	Sep-17	No	No	---	---	Unknown
Paquin Cr.	Oct-87	Sept-18	No	Yes	659	494	*2019*
Davenport Cr.	Sep-13	Jun-16	No	No	---	---	Unknown
Hog Island Cr.	Jun-17	Aug-17	No	Yes	---	---	2021[1]
Sucker R.	Jun-61	Sep-17	No	Yes	---	---	Unknown
Black R.	Jun-17	Aug-17	No	No	---	---	Unknown
Mattix Cr.	Aug-15	Jun-18	No	---	---	---	Unknown
Mile Cr.	May-17	May-17	---	---	---	---	Unknown
Millecoquins R.	Jun-17	Jul-18	No	Yes	---	---	2020[1]
Rock R.	Sep-13	Jun-18	Yes	Yes	2,678	956	*2019*
Crow R.	Aug-17	Sep-18	Yes	Yes	7,851	7,680	*2019*
Cataract R.	Sep-13	Aug-18	Yes	Yes	9,943	1,213	*2019*
Pt. Patterson Cr.	Jul-13	Aug-18	No	No	---	---	Unknown
Hudson Cr.	Aug-17	May-17	Yes	Yes	543	181	*2019*
Swan Cr.	Jul-13	Jun-18	No	No	---	---	Unknown
Seiners Cr.	Aug-17	May-17	No	No	---	---	Unknown
Milakokia R.	Oct-16	Sep-18	No	---	---	---	Unknown
Bulldog Cr.	Jun-13	Jun-18	Yes	Yes	---	---	Unknown
Gulliver Lake Outlet	Sep-13	Aug-18	No	Yes	1,474	1,105	*2019*
Marblehead Cr.	May-16	Jul-17	Yes	Yes	23,656	710	*2019*
Manistique R.	Sep-16	Jul-18	Yes	Yes	247,079	155,527	*2019*
Southtown Cr.	Jul-13	May-17	No	No	---	---	Unknown
Thompson Cr.	Never	Aug-17	---	Yes	---	---	Unknown
Johnson Cr.	Jun-13	Jul-16	No	No	---	---	Unknown
Deadhorse Cr.	Aug-18	Jun-18	---	---	---	---	Unknown
Gierke Cr.	Never	Jun-18	---	Yes	---	---	Unknown
Bursaw Cr.	Aug-17	Jun-18	Yes	Yes	---	---	Unknown
Parent Cr.	Aug-17	Jun-18	No	Yes	---	---	Unknown
Poodle Pete Cr.	Aug-17	Jun-16	No	Yes	---	---	Unknown
Valentine Cr.	Aug-17	Jul-17	No	---	---	---	Unknown
Little Fishdam R.	May-01	Aug-18	---	No	---	---	Unknown
Big Fishdam R.	Aug-16	May-17	No	---	---	---	Unknown
Sturgeon R.	Aug-15	Aug-18	No	Yes	---	---	*2019*[1]
Ogontz R.	Jun-16	Aug-17	Yes	Yes	---	---	2020[1]
Squaw Cr.	Aug-17	Aug-18	No	No	---	---	Unknown
Hock Cr.	May-17	Aug-17	No	No	---	---	Unknown
Whitefish R.	May-16	Aug-17	Yes	Yes	---	---	*2019*[1]
Bills Creek	Aug-18	Aug-17	Yes	Yes	---	---	*2019*[1]
Rapid R.	May-17	Aug-18	Yes	Yes	---	---	2021[1]
Tacoosh R.	Oct-14	Aug-17	No	No	---	---	Unknown
Days R.							
Barrier downstream	Aug-18	Jun-18	---	---	---	---	*2019*[1]
Barrier upstream	Aug-17	Aug-17	No	No	---	---	Unknown

Table 14. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Escanaba R.	Never	Jun-15	---	No	---	---	Unknown
Portage Cr.	May-17	Aug-17	Yes	No	---	---	Unknown
Ford R.	May-17	Aug-18	Yes	Yes	---	---	20201
Sunnybrook Cr.	May-71	May-16	---	No	---	---	Unknown
Bark R.	May-17	Aug-18	No	No	---	---	Unknown
Cedar R.	Jun-17	Aug-18	Yes	Yes	---	---	20201
Sugar Cr.	May-08	Aug-18	---	Yes	---	---	Unknown
Arthur Bay Cr.	Jun-10	Aug-18	---	Yes	---	---	Unknown
Rochereau Cr.	Apr-63	Aug-17	---	No	---	---	Unknown
Johnson Cr.	Apr-17	Aug-17	No	No	---	---	Unknown
Bailey Cr.	Apr-15	Aug-18	Yes	Yes	1,950	150	2019
Beattie Cr.	Apr-15	Aug-18	No	Yes	1,092	624	2019
Springer Cr.	Apr-13	Jun-17	No	Yes	1.899	237	2019
Menominee R.	Jul-16	Aug-17	Yes	No	---	---	Unknown
Little R.	Aug-77	Aug-18	---	No	---	---	Unknown
Peshtigo R.	Oct-15	Aug-18	No	Yes	---	---	20191
Oconto R.	Oct-17	Aug-17	No	No	---	---	Unknown
Pensaukee R.	Nov-77	Aug-17	---	No	---	---	Unknown
Suamico R.	Never	Jun-15	---	No	---	---	Unknown
Ephraim Cr.	Apr-63	Sep-16	---	No	---	---	Unknown
Hibbards Cr.	May-07	Jul-17	---	Yes	---	---	Unknown
Whitefish Bay Cr.	May-16	Sep-16	No	No	---	---	Unknown
Shivering Sands Cr.	Apr-12	Jun-18	Yes	No	---	---	Unknown
Lilly Bay Cr.	Apr-63	Jul-15	---	No	---	---	Unknown
Bear Cr.	May-75	Jun-18	---	No	---	---	Unknown
Door Co. 23 Cr.	May-07	Jun-18	---	Yes	209	183	2019
Silver Creek	Never	Jul-18	---	Yes	---	---	Unknown
Ahnapee R.	Apr-64	Jul-17	---	No	---	---	Unknown
Three Mile Cr.	Apr-17	Jul-17	No	---	---	---	Unknown
Kewaunee R.							
Barrier downstream	May-75	Jul-17	---	Yes	---	---	Unknown
Barrier upstream	May-75	Jul-17	---	Yes	---	---	Unknown
Casco Cr.	May-14	Jul-17	Yes	No	---	---	Unknown
Scarboro Cr.	May-75	Jul-17	---	Yes	---	---	Unknown
East Twin R.	Apr-17	Jul-18	No	No	---	---	Unknown
Fischer Cr.	May-87	Jul-15	---	No	---	---	Unknown
French Farm Cr.	Never	Jun-17	---	No	---	---	Unknown
Carp Lake Outlet	Jun-17	Sept-17	No	No	---	---	Unknown
Big Stone Cr.	Sep-13	Jun-18	---	No	---	---	Unknown
Big Sucker R.	Sep-13	Sep-18	---	No	---	---	Unknown
Wycamp Lake Outlet	Jul-17	Sep-18	No	No	---	---	Unknown
Bear R.	Never	Aug-16	---	No	---	---	Unknown
Horton Cr.	Jun-17	Jul-18	Yes	Yes	---	---	Unknown
Boyne R.	Jul-18	Sep-17	---	---	---	---	2021[1]
Porter Cr.	Sep-13	Jul-17	No	No	---	---	Unknown
Jordan R.	Jul-18	May-18	---	---	---	---	2022[1]

Table 14. *continued.*

			Status of Larval Lamprey Population (surveys since last treatment)				
Tributary	Last Treated	Last Surveyed	Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Monroe Cr.	Aug-13	Aug-16	No	No	---	---	Unknown
Loeb Cr.	Aug-13	Jun-17	No	No	---	---	Unknown
McGeach Cr.	Oct-99	May-15	---	---	---	---	Unknown
Elk Lake Outlet	Jun-17	Sep-17	No	No	---	---	Unknown
Yuba Cr.	May-06	Jun-14	---	---	---	---	Unknown
Acme Cr.	Aug-63	Aug-18	---	No	---	---	Unknown
Mitchell Cr.	Jul-17	Aug-18	No	No	---	---	Unknown
Boardman R. (lower)	Aug-15	Sep-16	No	No	---	---	Unknown
Boardman R. (mid.)	Aug-15	Jun-16	No	No	---	---	Unknown
Hospital Creek	Jul-18	Jun-17	---	---	---	---	2021[1]
Leo Cr.	Never	Sep-16	---	No	---	---	Unknown
Leland River	Never	Jul-17	---	No	---	---	Unknown
Good Harbor Cr.	Jul-10	Sep-16	---	No	---	---	Unknown
Crystal R.	Nov-11	Sep-18	---	Yes	1,873	1,873	*2019*
Platte R. (upper)	Jun-17	Sep-18	Yes	Yes	389,976	9,643	*2019*
Platte R. (middle)	Jun-17	Sep-18	No	No	---	---	*2019*
Platte R. (lower)	Jun-17	Sep-18	Yes	Yes	---	---	*2019*
Betsie R.	Jun-17	Oct-18	Yes	Yes	37,213	4,751	*2019*
Bowen Cr.	Jun-09	Jul-18	---	No	---	---	Unknown
Big Manistee R.	Aug-16	Jun-18	Yes	Yes	---	---	*2019*
Bear Cr.	Aug-16	Jun-18	Yes	Yes	---	---	*2019*
L. Manistee R.	Jul-18	Jun-18	---	---	---	---	2021[1]
Gurney Cr.	Jun-16	Jul-17	No	No	---	---	Unknown
Cooper Cr.	Jul-08	Jul-18	---	No	---	---	Unknown
Lincoln R.	Jul-17	Jul-17	No	No	---	---	2021[1]
Pere Marquette R.	Jul-17	Nov-18	Yes	Yes	---	---	2020[1]
Bass Lake Outlet	Aug-78	Jun-18	---	No	---	---	Unknown
Pentwater R. (N. Br.)	Jul-16	Jun-18	No	Yes	---	---	2019[1]
South Branch	Never	Aug-17	---	No	---	---	Unknown
Lambricks Cr.	Sep-84	Aug-17	---	No	---	---	Unknown
Stony Cr.	Jul-17	Jun-18	Yes	No	---	---	Unknown
Flower Cr.	Jul-17	Jun-18	No	No	---	---	Unknown
White R.	Aug-17	Oct-18	No	Yes	---	---	2020[1]
Duck Cr.	Jul-84	May-15	---	No	---	---	Unknown
Muskegon R.	Sep-17	Aug-18	Yes	Yes	315,840	57,363	*2019*
Brooks Cr.	Sep-17	Aug-18	Yes	Yes	---	---	*2019*
Cedar Cr.	Sep-17	Aug-18	No	No	---	---	*2019*
Bridgeton Cr.	Sep-17	Aug-18	No	No	---	---	*2019*
Minnie Cr.	Sep-17	Aug-18	No	No	---	---	*2019*
Bigelow Cr.	Sep-17	Aug-18	Yes	Yes	---	---	*2019*
Big Bear Cr.	Aug-70	May-15	---	No	---	---	Unknown
Mosquito Cr.	Sep-68	Aug-14	---	No	---	---	Unknown
Black Cr.	Aug-08	Sep-16	---	No	---	---	Unknown
Grand River	Never	Aug-15	---	No	---	---	Unknown
Norris Cr.	Jun-17	Jul-18	No	No	---	---	Unknown
Lowell Cr	Sep-65	Jun-13	---	No	---	---	Unknown

Table 14. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Mosquito Cr.	Sep-68	Aug-14	---	No	---	---	Unknown
Black Cr.	Aug-08	Sep-16	---	No	---	---	Unknown
Grand River	Never	Aug-15	---	No	---	---	Unknown
Norris Cr.	Jun-17	Jul-18	No	No	---	---	Unknown
Lowell Cr	Sep-65	Jun-13	---	No	---	---	Unknown
Buck Cr.	Sep-65	Jul-18	---	No	---	---	Unknown
Rush Cr.	Sep-65	Jul-18	---	No	---	---	Unknown
Sand Cr.	Jun-07	Jul-18	---	No	---	---	Unknown
Crockery Cr.	Jun-17	Jul-18	No	No	---	---	2020[1]
Bass R.	Aug-04	Jul-18	---	No	---	---	Unknown
Rogue R.	Sep-09	Jul-18	---	No	---	---	Unknown
Pigeon R.	Oct-64	Jun-16	---	No	---	---	Unknown
Pine Cr.	Oct-64	Jun-16	---	No	---	---	Unknown
Gibson Cr.	Jul-84	Jun-16	---	No	---	---	Unknown
Kalamazoo R.	Oct-65	Jul-12	---	No	---	---	Unknown
Bear Cr.	Jul-14	Sep-18	No	Yes	538	98	*2019*
Sand Cr.	Sep-10	Sep-18	---	Yes	---	---	Unknown
Mann Cr.	Jul-16	Sep-18	No	No	---	---	Unknown
Rabbit R.	Sep-15	May-17	No	No	---	---	Unknown
Swan Cr.	Jul-13	May-17	No	No	---	---	Unknown
Allegan 3 Cr.	Sep-65	Jun-16	---	No	---	---	Unknown
Allegan 4 Cr.	Oct-78	Sep-18	---	Yes	---	---	Unknown
Allegan 5 Cr.	Sep-15	Sep-18	No	No	---	---	Unknown
Black R.							
North Branch	Jun-77	May-15	---	No	---	---	Unknown
Middle Branch	May-17	Oct-17	Yes	Yes	---	---	Unknown
South Branch	May-17	Oct-17	No	No	---	---	Unknown
Brandywine Cr.	Aug-85	May-17	---	No	---	---	Unknown
Rogers Cr.	May-18	Sep-18	No	No	---	---	Unknown
St. Joseph R.	Never	Jul-10	---	No	---	---	Unknown
Lemon Cr.	Oct-65	Sep-11	---	No	---	---	Unknown
Pipestone Cr.	May-14	Oct-14	No	No	---	---	Unknown
Meadow Dr.	Oct-65	Sep-11	---	No	---	---	Unknown
Hickory Cr.	Jul-15	Aug-15	No	No	---	---	Unknown
Paw Paw R.	Sep-17	Sep-17	No	No	---	---	Unknown
Blue Cr.	Sep-15	Jul-17	No	No	---	---	Unknown
Mill Cr.	Sep-17	Jul-17	No	No	---	---	Unknown
Brandywine Cr.	Sep-17	Sep-18	No	No	---	---	Unknown
Brush Cr.	Sep-15	Jul-17	No	No	---	---	Unknown
Hayden Cr.	Sep-17	Sep-18	No	Yes	---	---	Unknown
Campbell Cr.	Sep-18	Oct-18	No	No	---	---	Unknown
Ritter Cr.	Sep-17	Sep-18	No	No	---	---	Unknown
Galien R. (N. Br.)	Jun-16	Jul-17	No	No	---	---	2020[1]
E. Br. & Dowling Cr.	Oct-10	May-16	---	No	---	---	2020[1]
S. Br. & Galina Cr.	Jun-16	Sep-18	No	Yes	---	---	2020[1]
Spring Cr.	Jun-16	Jul-17	No	No	---	---	2020[1]

Table 14. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
S. Br. Spring Cr.	Jun-16	Jul-17	No	No	---	---	2020[1]
State Cr.	Apr-14	May-16	No	No	---	---	Unknown
Trail Cr.	Apr-14	Sep-17	No	No	---	---	Unknown
Donns Cr.	May-66	Sep-17	---	No	---	---	Unknown
Burns Ditch	Jun-15	Sep-17	Yes	Yes	---	---	Unknown
Salt Creek	May-18	Sep-18	No	No	---	---	Unknown

[1] Stream being treated based on stream-specific knowledge of sea lamprey recruitment and growth.

Table 15. Status of larval Sea Lamprey in historically infested lentic areas of Lake Michigan during 2018.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Brevort R.	Brevort Lake (Silver Cr. – Offshore)	Jun-16	Jul-08	Never[2]
	Brevort Lake (L. Brevort R. – Offshore)	Jun-16	Aug-74	Never
Paquin Cr.	Paquin Cr. (Offshore)	Sep-18	Sep-18	Never[2]
Hog Island Cr.	Hog Island Cr. (Offshore)	Jul-18	Jul-18	Jun-07[2]
Black R.	Black R. (Offshore)	Jun-18	Aug-11	Jun-76[2]
Mile Cr.	Mile Cr. (Offshore)	Jun-18	Jun-08	Aug-68[2]
Millecoquins R.	Millecoquins Lake (Cold Cr. – Offshore)	Jun-16	Sep-10	Never[2]
Milakokia R.	Seul Choix Bay	Jun-14	Aug-80	Never
Manistique R.	Manistique R. (Offshore)	Jul-18	Jul-18	Sep-16[1]
Deadhorse Cr.	Deadhorse Cr. (Offshore)	Jul-11	Oct-64	Never
Bursaw Cr.	Bursaw Cr. (Offshore)	Jul-11	Jul-11	Never[2]
Valentine Cr.	Big Bay De Noc (Offshore)	Sep-11	Aug-94	Never
Ogontz R.	Big Bay De Noc (Offshore)	Aug-17	Jul-15	Sep-14
Whitefish R.	Little Bay De Noc	Aug-18	Jul-11	Jun-83[2]
Rapid R.	Little Bay De Noc	Aug-18	Jul-16	May-15
Days R.	Little Bay De Noc	Aug-17	Aug-13	Aug-14
Escanaba R.	Little Bay De Noc	Jun-15	Jul-06	Never[2]
Portage Cr.	Portage Bay	Aug-17	Aug-82	Never
Ford R.	Green Bay	Aug-17	Jul-16	Oct-14
Sunny Br.	Green Bay	Sep-82	Aug-81	Never
Bark R.	Green Bay	Jul-16	Sep-98	Never
Cedar R.	Green Bay	Jul-16	Jul-16	May-10
Bailey Cr.	Green Bay	Aug-18	Aug-18	Never
Beattie Cr.	Green Bay	Aug-18	Jul-85	Never
Menominee R.	Green Bay	Aug-17	Sep-15	Jul-16[2]

Table 15. *continued*

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Peshtigo R.	Green Bay	Sep-15	Aug-14	Never
Bear R.	Little Traverse Bay	Aug-16	Jun-08	May-07
Horton Cr.	Horton Bay (Lake Charlevoix)	Jul-18	Jul-18	Jul-17[1]
Boyne R.	Boyne Harbor (Lake Charlevoix)	Jul-18	Jun-14	Jul-17
Porter Cr.	Lake Charlevoix	Jun-14	Jun-14	Sep-13
Jordan R.	Lake Charlevoix	Jun-18	Jun-14	Sep-18[2]
Monroe Cr.	Lake Charlevoix	Aug-16	Jun-13	Aug-13
Mitchell Cr.	Grand Traverse Bay (East Arm)	May-04	May-04	Never
Boardman R.	Grand Traverse Bay (West Arm)	Aug-18	Jun-16	Jun-17
Leland R.	Leland R. (Offshore)	Jun-17	Jun-13	Never
Platte R.	Loon Lake	Sep-17	Sep-17	Never[2]
	Platte Lake	Sep-16	Jul-03	Never
Betsie R.	Betsie Lake	Sep-16	Aug-83	Never
Big Manistee R.	Manistee Lake (Big Manistee - Offshore)	Jul-15	Jul-08	Never
	Manistee Lake (Little Manistee – Offshore)	Jul-18	Jul-08	Jul-08

[1] Scheduled for treatment during 2019.

[2] Low-density larval population monitored with 3.2% granular Bayluscide surveys.

Table 16. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Michigan for larval assessment purposes during 2018.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Paquin Creek (Lentic)	1.74	0.31
Hog Island Creek (Lentic)	2.32	0.41
Black River (Lentic)	2.32	0.41
Mile Creek (Lentic)	1.74	0.31
Rock River (Lentic)	0.87	0.15
Whitefish River (Lentic)	2.90	0.52
Rapid River (Lentic)	3.48	0.62
Bailey Creek (Lentic)	1.74	0.31
Beattie Creek (Lentic)	1.74	0.31
Oconto River (Lentic)	1.74	0.31
Oconto River (Lotic)	1.16	0.21
West Twin River (Lotic)	1.16	0.21
Sheboygan River (Lotic)	1.74	0.31
Horton Creek (Lentic)	1.74	0.31
Boyne River (Lentic)	0.87	0.15
Jordan River (Lentic)	2.32	0.41
Boardman River (Lentic)	1.16	0.21
Manistee River (Lotic)	0.28	0.05
Little Manistee River (Lentic)	1.74	0.31
Total for Lake	**32.76**	**5.83**

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

Lake Huron

- Larval assessments were conducted in 93 tributaries (54 Canada; 39 U.S.) and 11 lentic areas (6 Canada; 5 U.S.). The status of larval Sea Lamprey populations in historically infested Lake Huron tributaries and lentic areas is presented in Tables 17 and 18.

- Surveys to estimate larval abundance were conducted in 10 tributaries (7 Canada; 3 U.S.) and 3 lentic areas (2 Canada; 1 U.S.).

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 36 tributaries (32 Canada; 4 U.S.). No new infestations were identified.

- Post-treatment assessments were conducted in 18 tributaries (3 Canada; 15 U.S.) and in 1 lentic area (0 Canada; 1 U.S.) to determine the effectiveness of lampricide treatments conducted during 2017 and 2018. Prentiss Creek is scheduled for treatment during 2019 based on the presence of residual Sea Lamprey.

- Surveys to evaluate barrier effectiveness were conducted in 9 tributaries (4 Canada, 5 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 2018. With the use of deepwater 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 1,100,000 (95% CI; 730,000 – 1,500,000).

- Larval assessments were conducted in non-wadable lentic and lotic areas using 27.4 kg active ingredient of 3.2% gB (7.84 kg Canada; 19.53 kg U.S.; Table 19).

Table 17. Status of larval Sea Lamprey in Lake Huron tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2018.

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of)verall Larval Population	Abundance Estimate of Larvae >100mm	xpected Year of Next Treatment
Canada							
St. Marys R.	Sept-18	Oct-18	Yes	Yes	1,100,000	---	***2019***
Whitefish Ch.	Jul-16	Sep-15	---	---	---	---	2020
Root R.	May-16	Oct-17	Yes	Yes	---	---	***2019***[1]
Garden R.	Jul-14	Aug-15	Yes	Yes	1,162,720	148,490	***2019***
Maud &Driving	May-15	May-15	---	---	---	---	***2019***
Echo R.							
Main	Jul-11	Jun-17	---	No	---	---	Unknown
Bar & Iron Cr.	Jun-15	Sep-17	Yes	Yes	32,781	9,548	***2019***
Bar R.	Oct-11	Sep-17	---	No	---	---	Unknown
Sucker Cr.	May-18	Jul-18	No	No			Unknown
Two Tree R.	May-15	Sept-18	No	No	---	---	Unknown
Richardson Cr.	Sep-16	Jun-17	No	No	---	---	2021
Watson Cr.	May-18	Jun-18	No	No	---	---	2021
Gordon Cr.	May-18	Jul-18	No	No	---	---	2021
Browns Cr.	May-16	Jul-18	Yes	Yes	1,261	244	***2019***

Table 17. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Koshkawong R.	May-18	Jul-17	No	No	---	---	
No Name (H-65)	Jun-13	Sep-17	No	No	---	---	
No Name (H-68)	Sep-75	Jul-18	No	Yes	179	28	***2019***
MacBeth Cr.	Jun-67	Sep-18	No	Yes	1,220	1,220	***2019***
Thessalon R.							
Upper	Sept-18	Sep-17	---	Yes	---	---	
Patten Lake Cr.	Jul-17	Sep-16	---	---			2021
Lower	Jul-17	Sep-17	No	No	---	---	2021
Livingstone Cr.	Jun-13	May-17	No	No	---	---	Unknown
Mississagi R.	Aug-13	Aug-16	No	Yes	---	---	***2019***
Harris/Bolton	Jul-12	Aug-16	---	Yes	---	---	***2019***
Blind R.	May-84	Jun-16	---	No	---	---	Unknown
Lauzon R.	Jun-15	Sep-18	No	Yes	4,635	1,012	***2019***
Spragge Cr.	Oct-95	May-18	No	No	---	---	Unknown
No Name (H-114)	Jun-15	Sep-18	Yes	Yes	232	131	***2019***
Marcellus Cr.	Jun-13	May-17	No	No	---	---	Unknown
Serpent R.							
Main	Jun-16	Aug-16	No	---	16,608	0	2020
Grassy Cr.	Jun-16	Aug-16	Yes	No	---	---	***2019***
Spanish R.							
Main	Sep-15	Jun-17	No	No	---	---	2020
LaCloche Cr.	Oct-18	Sep-17	---	---	---	---	2023
Birch Cr.	Jun-18	Jun-17	---	---	---	---	2022
Aux Sables R.	Sep-15	Jun-17	No	No	---	---	2020
Kagawong R.	Aug-67	May-18	No	No	---	---	Unknown
Unnamed (H-267)	Apr-17	Sep-17	No	No	---	---	2021
Silver Cr.	May-17	Sep-17	No	Yes	---	---	2021
Sand Cr.	Oct-17	Jun-17	---	---	---	---	2022
Mindemoya R.	May-17	Sep-17	No	No	---	---	2021
Timber Bay Cr.	Apr-17	Sep-17	No	Yes	---	---	2021
Hughson Cr.	Apr-17	Sep-17	No	Yes	---	---	2021
Manitou R.	Sep-18	Sep-17	---	---	---	---	2021
Blue Jay Cr.	Sep-18	Sep-17	---	---	---	---	2021
Kaboni Cr.	Oct-78	May-18	No	No	---	---	Unknown
Chikanishing R.	Jun-18	May-17	---	---	---	---	Unknown
French R. System					---	---	
O.V. Channel	Jun-12	Jun-17	---	No	---	---	Unknown
Wanapitei R.	Jun-11	Jun-17	---	No	---	---	Unknown
Key R. (Nesbit Cr.)	Sep-72	May-15	---	No	---	---	Unknown
Still R.	Jul-17	Sep-17	No	No	---	---	Unknown
Magnetawan R.	Jun-18	Sep-17	No	Yes	---	---	2021
Naiscoot R.	May-18	Aug-17	---	---	---	---	2021
Shebeshekong R.	Never	Aug-17	---	Yes	---	---	Unknown
Boyne R.	Sep-18	May-18	---	---	---	---	2021
Musquash R.	Aug-13	Jun-17	No	Yes	---	---	Unknown
Simcoe/Severn	Never	Aug-17	---	Yes	---	---	Unknown

Table 17. *continued*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Sturgeon R.	Apr-12	May-17	No	No	---	---	Unknown
Hog Cr.	Sep-78	Aug-17	No	No	---	---	Unknown
Lafontaine Cr.	Jun-68	May-18	No	No	---	---	Unknown
Nottawasaga R.							
Main	Jun-17	Aug-17	Yes	Yes	---	---	2021
Boyne R.	Jun-17	Aug-17	No	No	---	---	2021
Bear Cr.	Jun-13	May-16	No	No	---	---	Unknown
Pine R.	Jun-18	Aug-17	---	---	---	---	2021
Marl Cr.	Apr-13	May-16	No	No	---	---	Unknown
Pretty R.	May-72	May-18	No	No	---	---	Unknown
Silver Cr.	Sep-82	May-18	---	No	---	---	Unknown
Bighead R.	Aug-18	May-18	---	---	---	---	2021
Bothwells Cr.	Jun-79	May-18	No	No	---	---	Unknown
Sydenham R.	Jun-72	May-18	No	No	---	---	Unknown
Sauble R.	Jun-04	May-18	No	Yes	---	---	Unknown
Saugeen R.	Jun-71	May-17	No	No	---	---	Unknown
Bayfield R.	Jun-70	May-17	No	No	---	---	Unknown
United States							
Mission Cr.	Never	May-16	---	No	---	---	Unknown
Frenchette Cr.	Never	May-16	---	No	---	---	Unknown
Ermatinger Cr.	Never	May-16	---	No	---	---	Unknown
Charlotte R.	Oct-11	Jun-17	---	No	---	---	Unknown
Little Munuscong R.	Jul-16	May-17	No	No	---	---	Unknown
Big Munuscong R.	Jun-99	May-16	---	No	---	---	Unknown
Taylor Cr.	Jul-15	May-17	No	No	---	---	Unknown
Gogomain River	Jul-16	Jun-18	Yes	No	---	---	Unknown
Carlton Cr.	Oct-18	Sep-17	---	---	---	---	Unknown
Canoe Lake Outlet	May-70	Apr-13	---	No	---	---	Unknown
Caribou Cr.	May-18	Sep-18	---	No	---	---	Unknown
Bear Lake Outlet	Sep-16	Jun-17	Yes	No	---	---	Unknown
Carr Cr.	Jun-13	Sep-16	Yes	No	---	---	Unknown
Joe Straw Cr.	Jun-13	Jun-17	No	No	---	---	Unknown
Saddle Cr.	Never	Sep-16	---	No	---	---	Unknown
Huron Point Cr.	May-18	Sep-18	Yes	No	---	---	Unknown
Albany Cr.							
Barrier downstream	May-18	Sep-18	Yes	No	---	---	Unknown
Barrier upstream	Sep-01	Aug-15	---	No	---	---	Unknown
Trout Cr.	Jul-15	Jun-17	No	Yes	---	---	Unknown
Beavertail Cr.	Jul-18	Sep-18	---	---	---	---	Unknown
Prentiss Cr.	May-18	Sep-18	Yes	No	3,574	1,751	***2019***
McKay Cr.	May-18	Sep-18	Yes	Yes	---	---	Unknown
Flowers Cr.	Jun-13	Jul-18	No	No	---	---	Unknown

Table 17. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Ceville Cr.	Jul-16	May-17	No	---	---	---	Unknown
Hessel Cr.	Jul-15	Sep-18	No	Yes	1,909	---	Unknown
Steeles Cr.	Sep-16	May-17	No	---	---	---	Unknown
Nunns Cr.							
Barrier downstream	Jul-16	Sep-16	No	---	---	---	Unknown
Barrier upstream	Jul-16	Sep-16	No	---	---	---	Unknown
Pine R.	Jun-18	Sep-18	Yes	Yes	---	---	2020[1]
McCloud Cr.	Jul-15	May-17	No	Yes	---	---	Unknown
Carp R.	Jul-18	Sep-18	Yes	Yes	---	---	2020[1]
Martineau Cr.	Jul-16	May-17	Yes	---	---	---	Unknown
Hoban Cr.	Jun-12	May-17	---	No	---	---	Unknown
266-20 Cr.	Aug-76	Jun-18	---	No	---	---	Unknown
Beaugrand Cr.	Jun-16	Jun-18	No	No	---	---	Unknown
Little Black R.	May-67	May-14	---	No	---	---	Unknown
Cheboygan R.	Oct-83	Jun-18	---	Yes	---	---	Unknown
Laperell Cr.	May-00	Sep-18	---	No	---	---	Unknown
Meyers Cr.	Jul-17	Sep-18	No	No	---	---	Unknown
Maple R.	Aug-16	Sep-18	Yes	No	---	---	Unknown
Pigeon R.	Sep-16	Sep-18	Yes	Yes	---	---	Unknown
Little Pigeon R.	Aug-12	Sep-18	---	No	---	---	Unknown
Sturgeon R.	Aug-16	Sep-18	Yes	Yes	---	---	Unknown
Elliot Cr.	Jul-17	Jun-18	Yes	Yes	---	---	2020
Greene Cr.							
Barrier downstream	Jul-12	Jun-18	---	No	---	---	Unknown
Barrier upstream	Jun-07	Jun-18	---	No	---	---	Unknown
Grass Cr.	May-78	Jun-18	---	No	---	---	Unknown
Mulligan Cr.	Jun-16	Jun-18	No	Yes	271	135	***2019***
Grace Cr.	Oct-18	Sep-18	---	---	---	---	Unknown
Black Mallard Cr.							
(Lower)	Jun-18	Aug-18	No	---	---	---	2021[1]
(Upper)	May-15	Jun-18	No	Yes	---	---	***2019***
Seventeen Cr.	Jul-12	Aug-16	---	No	---	---	Unknown
Ocqueoc R.							
Barrier upstream	Sep-18	Aug-18	---	---	---	---	Unknown
Barrier downstream	Jul-16	Sep-18	No	Yes	---	---	2020[1]
Johnny Cr.	Sep-70	Aug-16	---	No	---	---	Unknown
Schmidt Cr.							
Lower	Jun-18	Jun-17	---	---	---	---	Unknown
Upper	May-08	Jun-17	---	No	---	---	Unknown
Nagels Cr.	Never	Aug-18	---	No	---	---	Unknown
Trout R.							
Barrier downstream	Jul-16	Sept-18	Yes	Yes	---	---	2020[1]
Barrier upstream	Oct-07	Jul-17	---	No	---	---	Unknown

Table 17. *continued.*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Swan R.	Jun-10	Jul-17	---	No	---	---	Unknown
Grand Lake Outlet	Never	Jun-17	---	No	---	---	Unknown
Middle Lake Outlet	Jun-67	Aug-18	---	No	---	---	Unknown
Long Lake Outlet	Jun-16	Jul-17	No	No	---	---	Unknown
Squaw Cr.	Jun-13	Aug-18	---	No	---	---	Unknown
Devils R.	Oct-14	Aug-18	---	No	---	---	Unknown
Black R.	Jun-18	Aug-18	No	Yes	---	---	2021
Mill Cr.	Never	Aug-18	---	No	---	---	Unknown
Au Sable R.	Aug-18	Sep-18	No	---	---	---	2021[1]
Pine R.	May-87	Jun-16	---	No	---	---	Unknown
Tawas Lake Outlet	Jun-15	May-17	---	No	---	---	Unknown
Cold Cr.	Aug-18	Jul-18	---	---	---	---	Unknown
Sims Cr.	Jul-09	May-17	---	No	---	---	Unknown
Grays Cr.	Sep-05	May-18	---	No	---	---	Unknown
Silver Cr.	Sep-18	Sep-17	---	---	---	---	2021
East AuGres R.	Jun-18	May-18	---	---	---	---	2021
AuGres R.	Sep-18	Jul-18	---	---	---	---	2021
Rifle R.	Aug-18	Jul-18	---	---	---	---	2022[1]
Saginaw R.							
Shiawassee R.	May-18	Sep-18	No	Yes	---	---	2021
Cass R.	Jun-18	Jul-18	Yes	---	---	---	2021
Flint River	Never	Sep-18	---	No	---	---	Unknown
Armstrong Cr.	May-15	Sep-17	No	No	---	---	Unknown
Tittabawassee R.	Jun-18	Aug-18	No	---	---	---	Unknown
Chippewa R.	May-18	Jul-18	No	Yes	---	---	2020[1]
Pine R.	May-16	Oct-18	No	Yes	---	---	***2019***
Carroll Cr.	May-17	Jul-18	No	No	---	---	2021
Big Salt R.	Jun-18	Jul-18	No	---	---	---	2021
Rock Falls Cr.	Never	Jul-14	---	No	---	---	Unknown
Sucker Cr.	Never	May-17	---	No	---	---	Unknown
Cherry Cr.	Never	Aug-12	---	No	---	---	Unknown
Mill Cr.	May-85	Sep-13	---	No	---	---	Unknown

[1] Stream being treated based on stream-specific knowledge of recruitment and growth.

Table 18. Status of larval Sea Lamprey in historically infested lentic areas of Lake Huron during 2018.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Canada				
Echo R.	Echo Lake	Sep-17	Sep-17	Jun-15
	Solar Lake	Jul-06	May-90	Jul-87
	Stuart Lake	May-90	May-90	Jul-80
Sucker Cr.	Desjardins Bay	Sep-16	Jun-13	Jul-84
Two Tree R.	North Channel	Aug-81	Aug-81	Never
Gordon Cr.	Tenby Bay	Jul-18	Aug-91	Jul-84
Brown’s Cr.	Tenby Bay	Jul-18	Aug-91	Aug-87
Koshkawong R.	North Channel	Jul-17	Aug-91	Never
Unnamed (H-68)	North Channel	Apr-12	May-95	Never
Mississagi R.	North Channel	Aug-16	Aug-16	Jul-16
Lauzon R.	North Channel	Sep-18	Sep-18	Jun-15
Unnamed (H-114)	North Channel	Sep-18	Sep-14	Jun-15
Kagawong R.	Mudge Bay	Aug-16	Aug-16	Aug-87
Mindemoya R.	Providence Bay	May-12	Jul-88	Jul-81
Manitou R.	Michael's Bay	Sep-17	Sep-17	Jun-18
Blue Jay Cr.	Michael's Bay	Sep-17	Sep-17	Jun-18
Still R.	Byng Inlet	Sep-17	Aug-16	Jun-12
Boyne R.	Georgian Bay	Aug-17	May-16	Never
Severn R.	Georgian Bay	Aug-17	Aug-17	Aug-18
Sturgeon R.	Sturgeon Bay	May-14	June-99	Never
Bighead R.	Georgian Bay	Aug-17	Aug-17	Aug-18
United States				
Caribou Cr.	Caribou Cr. (Offshore)	Sep-18	Jul-17	May-18
Albany Cr.	Albany Bay (Offshore)	Sep-18	Jul-16	May-18
Trout Cr.	Trout Cr. (Offshore)	Jul-14	Jul-11	Never[1]
McKay Cr.	McKay Bay	Sep-18	Jul-11	May-18
Flowers Cr.	Flowers Bay	Jun-12	Jul-80	Never
Nunns Cr.	St. Martin Bay	Aug-14	Aug-87	Never
Pine R.	St. Martin Bay	Sep-18	Jul-17	May-18
McCloud Cr.	St. Martin Bay	Aug-15	Aug-15	Never
Carp R.	St. Martin Bay	Jun-16	Jun-16	Jul-14
Martineau Cr.	Horseshoe Bay	Aug-15	Sep-14	Never[1]
Cheboygan R.	Straits of Mackinac	Sep-15	Aug-93	Never
Sturgeon R.	Burt Lake	Jun-18	Jun-18	Aug-16
Elliot Cr.	Duncan Bay	Aug-16	Jul-12	Never
Mulligan Cr.	Mulligan Cr. (Offshore)	Aug-16	Aug-16	Never
Black Mallard R.	Black Mallard Lake	Jul-12	Jun-10	Never
Hammond Bay Cr.	Hammond Bay	Sep-17	Sep-17	Never
Ocqueoc R.	Hammond Bay	Sep-12	Sep-86	Never
Devils R.	Thunder Bay	Jun-09	Aug-76	Never
Au Sable R.	Au Sable R. (Offshore)	Aug-17	Sep-14	Aug-15
East Au Gres R.	East Au Gres R.	Aug-15	Jun-86	Never

[1] Low-density larval population monitored with Bayluscide 3.2% Granular Sea Lamprey Larvicide surveys.

Table 19. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Huron for larval assessment purposes during 2018.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
Watson Cr. (Lentic)	0.28	0.05
Gordon Cr. (Lentic)	0.28	0.05
Browns Cr. (Lentic)	0.28	0.05
Lauzon R. (Lentic)	1.68	0.3
Unnamed H-114 (Lentic)	1.12	0.2
Serpent R.	1.68	0.3
Indian R. (Lentic)	0.84	0.15
Sauble R.	1.68	0.3
Total (Canada)	**7.84**	**1.4**
United States		
Albany Cr. (Lentic)	1.16	0.2
Caribou Cr. (Lentic)	1.16	0.2
Gogomain R.	0.29	0.05
Pine R. (Lentic)	1.16	0.2
McKay Cr. (Lentic)	2.32	0.4
Cheboygan R. (Lentic)	6.72	1.2
Ausable R.	1.68	0.30
Saginaw R.	5.04	0.90
Total (United States)	**19.53**	**3.45**
Total for Lake	**27.37**	**4.85**

[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 67 tributaries (20 Canada, 47 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 Tables 20 and 21.

- Surveys to detect the presence of new larval populations were conducted in 37 tributaries (7 Canada, 30 U.S.). No new Sea Lamprey infestations were discovered.

- Post-treatment assessments were conducted in 3 tributaries (1 Canada, 2 U.S.) to determine the effectiveness of lampricide treatments conducted during 2017 and 2018.

- Surveys to evaluate barrier effectiveness were conducted in 5 tributaries (2 Canada, 3 U.S.). All barriers were found to be effective in limiting Sea Lamprey infestations.

- A total of 2.5 ha of the St. Clair River were surveyed with gB, including the upper river and the three main delta channels. Eighty-two Sea Lamprey larvae were captured throughout the river. Service staff sampled the Detroit River in June 2018. Native lamprey (*Ichthyomyzon spp*.) were found, but no Sea Lamprey were detected.

- Larval assessments were conducted in non-wadable lentic and lotic areas including the St. Clair River, using 17.36 kg active ingredient of 3.2% gB (6.16 kg Canada, 11.2 U.S. kg; Table 22).

Table 20. Status of larval Sea Lamprey in Lake Erie tributaries with a history of Sea Lamprey production, and estimates of abundance from tributaries surveyed during 2018 using a quantitative method.

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Canada							
East Cr.	Jun-87	May-17	---	No	---	---	Unknown
Catfish Cr.	Apr-16	May-18	No	No	---	---	Unknown
Bradley Cr.	Apr-16	May-18	No	No	---	---	Unknown
Silver Cr.	May-18	May-18	No	No	---	---	Unknown
Big Otter Cr.	Jun-17	Sept-17	No	No	---	---	2020
South Otter Cr.	Aug-10	May-17	---	No	---	---	Unknown
Clear Cr.	May-91	May-18	---	No	---	---	Unknown
Big Cr.	Jun-17	Sept-17	No	No	---	---	2020
Forestville Cr.	Aug-13	May-18	No	No	---	---	Unknown
Normandale Cr.	Jun-87	May-18	---	No	---	---	Unknown
Fishers Cr.	Jun-87	May-17	---	No	---	---	Unknown
Young's Cr.	Aug-13	May-17	No	No	---	---	Unknown
United States							
Buffalo R.	Never	Jul-18	---	No	---	---	Unknown
Buffalo Cr.	Jun-13	Jul-18	---	Yes	---	---	***2019*[1]**
Cayuga Cr.	Never	Jul-18	---	Yes	---	---	***2019*[1]**
Cazenovia Cr.	Sept-13	Jul-18	No	Yes	---	---	***2019*[1]**
Big Sister Cr.	Apr-15	Jul-18	No	No	---	---	Unknown
Delaware Cr.	Jun-13	Jul-18	---	No	---	---	Unknown
Cattaraugus Cr.	May-16	Jul-18	Yes	Yes	---	---	***2019*[1]**
Halfway Br.	Oct-86	Jul-18	---	No	---	---	Unknown
Canadaway Cr.	May-16	Jul-18	No	No	---	---	Unknown
Chautauqua Cr.	Never	Jun-18	---	No	---	---	Unknown
Crooked Cr.	Apr-17	Jun-18	Yes	Yes	---	---	***2019*[1]**
Raccoon Cr.	May-15	Jun-18	No	No	---	---	Unknown
Conneaut Cr.	Apr-18	Jul-18	Yes	No	---	---	***2019***
Wheeler Cr.	Never	Aug-15	---	No	---	---	Unknown
Grand R.	Apr-17	Jun-18	No	Yes	---	---	2020
Chagrin R.	Never	Jul-18	---	Yes	---	---	Unknown
Huron R.	May-18	Jul-18	No	No	---	---	Unknown
Lake St. Clair							
St. Clair R.	Never	Jun-18	---	Yes	---	---	Unknown
Black R.	Never	Jun-17	---	No	---	---	Unknown
Mill Cr.	Never	Jun-17	---	No	---	---	Unknown
Pine R.	Apr-88	Jun-18	---	No	---	---	Unknown
Belle R.	Never	Jun-17	---	No	---	---	Unknown
Clinton R.	Never	Jun-18	---	No	---	---	Unknown
Paint Cr.	May-15	Jun-18	No	No	---	---	Unknown
Thames R.	Never	May-16	---	No	---	---	Unknown
Komoka Cr.	Aug-15	May-18	No	No	---	---	Unknown

Table 21. Status of larval Sea Lamprey in historically infested lentic areas of Lake Erie during 2018.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
United States				
Cattaraugus Cr.	Sunset Bay	Jul-17	Aug-12	Never[1]
Conneaut Cr.	Conneaut Harbor	Jul-16	Jul-06	Never[1]
Grand R.	Fairport Harbor	Aug-15	Jun-87	Never[1]

[1] Low-density larval population monitored with 3.2% granular Bayluscide surveys.

Table 22. Details on application of granular Bayluscide to tributaries and lentic and lotic areas of Lake Erie for larval assessment purposes during 2018.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
St. Clair R.	6.16	1.1
Total (Canada)	**6.16**	**1.1**
United States		
Detroit R.	3.36	0.6
St. Clair R.	7.84	1.4
Total (United States)	**11.2**	**2.0**
Total for Lake	**17.36**	**3.1**

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

Lake Ontario

- Larval assessments were conducted in 58 tributaries (32 Canada, 26 U.S.) and offshore of 6 (0 Canada, 6 U.S.). The status of larval Sea Lampreys in historically infested Lake Ontario tributaries and lentic areas is presented in Tables 23 and 24.

- Surveys to estimate larval abundance were conducted in 10 tributaries (6 Canada, 4 U.S.).

- Surveys to detect new larval Sea Lamprey populations were conducted in 10 tributaries (7 Canada, 3 U.S.). No new infestations were identified.

- Post-treatment assessments were conducted in 13 tributaries (6 Canada, 7 U.S.) to determine the effectiveness of lampricide treatments conducted during 2017 and 2018. Surveys on the Salmon River (NY) found many residuals, resulting in the retreatment of backwater areas during 2018.

- Surveys to evaluate barrier effectiveness were conducted in 28 tributaries (25 Canada, 3 U.S.). Due to high spring lake levels in 2017, several dams were inundated enabling sea lampreys to migrate further upstream. Graham Creek is scheduled for treatment upstream of the purpose-built barrier during 2019.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 10.4 kg active ingredient of 3.2% gB (0 kg Canada, 10.4 kg U.S.; Table 25).

- Surveys were completed on the Credit River during 2017 and 2018 to evaluate the production potential of sea lamprey upstream of the Norval Dam by quantitatively assessing larval habitat as well as native lamprey abundance and distribution as a surrogate for sea lampreys. The larval population estimate of American brook lamprey (*Lethenteron appendix)* upstream of the Norval Dam to the Forks is 855,888 individuals.

Table 23. Status of larval Sea Lamprey in Lake Ontario tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2018 using a quantitative method.

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
Canada							
Niagara R.	Never	Jun-17	---	No	---	---	Unknown
Ancaster Cr.	May-03	Jun-17	---	No	---	---	Unknown
Grindstone Cr.	Never	Jun-18	---	No	---	---	Unknown
Bronte Cr.	Apr-16	Jun-18	Yes	Yes	---	---	2019[1]
Sixteen Mile Cr.	Jun-82	Jun-18	---	No	---	---	Unknown
Credit R.	May-18	Jun-18	No	No	---	---	***2020***
Humber R.	Never	Jun-17	---	No	---	---	Unknown
Rouge R.	Jun-11	Jun-18	---	No	---	---	Unknown
Little Rouge. R.	Jun-15	Jun-18	---	No	---	---	Unknown
Petticoat Cr.	Sep-04	Jun-18	---	No	---	---	Unknown
Duffins Cr.	Jun-18	Jul-18	No	No	---	---	***2021[1]***
Carruthers Cr.	Sep-76	Jun-18	---	No	---	---	Unknown
Lynde Cr.	Jun-15	Jun-18	Yes	No	---	---	Unknown
Oshawa Cr.	Jun-18	Jun-18	No	No	---	---	***2021[1]***
Farewell Cr.	Jun-15	Jun-18	No	Yes	---	---	Unknown
Bowmanville Cr.	May-17	Jun-18	Yes	Yes	---	---	2020[1]
Wilmot Cr.	Jun-18	Jun-18	No	No	---	---	***2021[1]***
Graham Cr.	May-96	Jun-18	---	Yes	42,839	329	2019
Wesleyville Cr.	Oct-02	Jun-18	---	No	---	---	Unknown
Port Britain Cr.	Apr-16	Jun-18	No	Yes	238	119	2019
Gage Cr.	May-71	Jun-16	---	No	---	---	Unknown
Cobourg Br.	Oct-96	Jul-18	---	Yes	---	---	Unknown
Covert Cr.	Apr-16	Jul-18	Yes	Yes	3,119	1,637	2019
Grafton Cr.	Jun-17	Ju1-18	No	No	---	---	Unknown
Shelter Valley Cr.	Apr-16	Jul-18	No	Yes	316,578	---	2020
Colborne Cr.	Jun-17	Jul-18	No	Yes	178	25	2019
Salem Cr.	Apr-18	Jul-18	No	No	---	---	***2021[1]***
Proctor Cr.	Apr-18	Jul-18	No	No	---	---	Unknown
Smithfield Cr.	Sep-86	Jul-17	---	No	---	---	Unknown
Trent R. (Canal)	Sep-11	Jul-17	---	No	---	---	Unknown
Mayhew Cr.	Jun-15	Jul-18	No	Yes	1,205	295	2019
Moira R.	Jun-15	Jul-17	Yes	No	---	---	Unknown
Salmon R.	Jun-16	Jul-18	No	---	---	---	Unknown
Napanee R.	Never	Jul-17	---	No	---	---	Unknown
Black R.	Aug-15	Aug-18	Yes	Yes	---	---	***2021[1]***
Stony Cr.	Sep-82	Aug-17	---	No	---	---	Unknown
United States							
Sandy Cr.	Never	Aug-18	---	No	---	---	Unknown

Table 23. *Continued*

Tributary	Last Treated	Last Surveyed	Status of Larval Lamprey Population (surveys since last treatment) Residuals Present	Recruitment Evident	Estimate of Overall Larval Population	Abundance Estimate of Larvae >100mm	Expected Year of Next Treatment
South Sandy Cr.	Jun-17	Aug-18	Yes	No	---	---	2020[1]
Skinner Cr.	Apr-05	Aug-17	---	No	---	---	Unknown
Lindsey Cr.	Oct-18	Aug-18	---	---			***2021***
Blind Cr.	May-76	Aug-17	---	No	---	---	Unknown
Little Sandy Cr.	Oct-18	Aug-17	---	---	---	---	2022
Deer Cr.	Apr-04	Aug-18	---	No	---	---	Unknown
Salmon R.	Jun-18	Aug-18	Yes	Yes	---	---	***2021***
Orwell Brook	May-17	Aug-17	No	No	---	---	Unknown
Trout Brook	Jun-18	Aug-18	Yes	Yes	---	---	***2021***
Altmar Cr.	Jun-18	Aug-18	No	No	---	---	***2021***
Grindstone Cr.	Apr-18	Aug-18	Yes	No	---	---	2021[1]
Snake Cr.	Apr-18	Aug-18	No	No	---	---	***2021[1]***
Sage Cr.	May-78	Jul-16	---	No	---	---	Unknown
Little Salmon R.	May-17	Aug-18	No	Yes	---	---	2020[1]
Butterfly Cr.	May-72	Jul-16	---	No	---	---	Unknown
Catfish Cr.	Apr-18	Aug-18	No	No	---	---	***2021[1]***
Oswego R.							
Black Cr.	May-81	Aug-17	---	No	---	---	Unknown
Big Bay Cr.	Sep-93	Aug-15	---	No	---	---	Unknown
Scriba Cr.	Jun-10	Aug-18	---	Yes	641	42	2019
Fish Cr.	May-16	Aug-18	No	Yes	---	---	2019[1]
Carpenter Br.	May-94	Jul-16	---	No	---	---	Unknown
Putnam Br./ Coldsprings Cr.	May-96	Aug-16	---	No	---	---	Unknown
Hall Br.	Never	Aug-15	---	No	---	---	Unknown
Crane Br.	Never	Aug-16	---	No	---	---	Unknown
Skaneateles Cr.	Never	Aug-16	---	No	---	---	Unknown
Owasco Outlet	Oct-15	Aug-18	No	Yes	3,489	1,480	2019
Rice Cr.	May-72	Aug-18	---	No	---	---	Unknown
Eight Mile Cr.	Apr-18	Aug-18	No	No	---	---	Unknown
Nine Mile Cr.	May-17	Aug-17	No	No	---	---	Unknown
Sterling Cr.	May-18	Aug-18	Yes	No	---	---	***2019***
Unnamed Cr.	May-18	Aug-18	Yes	No	823	323	***2019***
Blind Sodus Cr.	May-78	Aug-16	---	No	---	---	Unknown
Red Cr.	Apr-18	Jul-18	No	No	---	---	Unknown
Wolcott Cr.	May-79	Aug-17	---	No	---	---	Unknown
Sodus Cr.	Apr-15	Aug-17	No	No	---	---	Unknown
Forest Lawn Cr.	Never	Jul-18	---	Yes	728	48	Unknown
Irondequoit Cr.	Never	Jul-18	---	No	---	---	Unknown
Larkin Cr.	Never	Jul-18	---	No	---	---	Unknown
Northrup Cr.	Never	Jul-18	---	No	---	---	Unknown
Salmon Cr.	Apr-05	Aug-17	---	Yes	---	---	Unknown
Sandy Cr.	Apr-14	Aug-17	---	No	---	---	Unknown
Oak Orchard Cr.							
Marsh Cr.	Apr-14	Jul-18	---	No	---	---	Unknown
Johnson Cr.	Apr-10	Jul-18	---	No	---	---	Unknown
Third Cr.	May-72	Aug-17	---	No	---	---	Unknown
First Cr.	May-95	Jul-18	---	No	---	---	Unknown

Table 24. Status of larval Sea Lamprey in historically infested lentic areas of Lake Ontario during 2018.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Canada				
Duffins Cr.	Duffins Cr. - lentic	Aug-15	Aug-12	Never[1]
Oshawa Cr.	Oshawa Cr. - lentic	Jul-13	Oct–81	Never[1]
Wilmot Cr.	Wilmot Cr. - lentic	Aug-11	Aug-11	Never[1]
United States				
Black R.	Black River Bay	Aug-18	Aug-18	Aug-18

[1] Low-density larval population monitored with 3.2% granular Bayluscide surveys.

Table 25. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Ontario for larval assessment purposes during 2018.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
United States		
Black R. (lentic)	2.0	0.36
Black R. (lotic)	1.68	0.3
South Sandy Cr. (lentic)	1.12	0.20
South Sandy Cr. (lotic)	0.56	0.1
Lindsey Cr. (lentic)	1.12	0.20
Little Sandy Cr. (lentic)	1.12	0.2
Salmon R. (lentic)	1.68	0.3
Catfish Cr. (lentic)	0.56	0.1
Catfish Cr. (lotic)	0.56	0.1
Total (United States)	**10.4**	**1.86**
Total for Lake	**10.4**	**1.86**

[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, Wisconsin Department of Natural Resources (WDNR), 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 2018 was 6.1 A1-A3 marks per 100 Lake Trout >532mm, which is greater than the target of 5 marks per 100 fish (Figure 5).
- The MIDNR provided data on the frequency of juvenile Sea Lamprey attached to fishes caught by sport charter fishers.
    - A total of 48 juvenile Sea Lamprey were collected from 8 management districts: all were attached to Lake Trout. Attachment rates during 2018 were 0.79 per 100 Lake Trout (n=6,070) and 0.00 per 100 Chinook Salmon (n=95), which was lower than the 0.90 attachment rate on Lake Trout and the same as the attachment rate for Chinook Salmon during 2017.

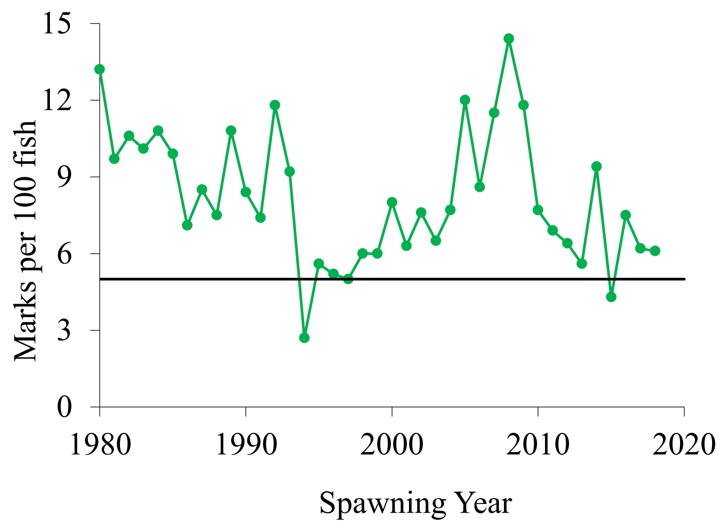

Figure 5. Average number of A1-A3 marks per 100 Lake Trout >532 mm caught during April-June assessments in Lake Superior 1980 – 2018. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout.

Lake Michigan

- Lake Trout marking data for Lake Michigan are provided by MIDNR, WDNR, 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 2018 was 3.9 A1-A3 marks per 100 Lake Trout >532mm, which is less than the target of 5 marks per 100 fish (Figure 6).
- The MIDNR and WDNR provided data on the frequency of juvenile Sea Lamprey attached to fish caught by sport charter fishers.
    - A total of 286 juvenile Sea Lamprey were collected from 14 management districts: 135 were attached to Lake Trout and 151 were attached to Chinook Salmon. Attachment rates during 2018 were 0.18 per 100 Lake Trout (n=75,508) and 0.29 per 100 Chinook Salmon (n=51,981), which was equal to the attachment rate on Lake Trout and lower than the attachment rate on Chinook Salmon during 2017 (0.18 and 0.46, respectively).

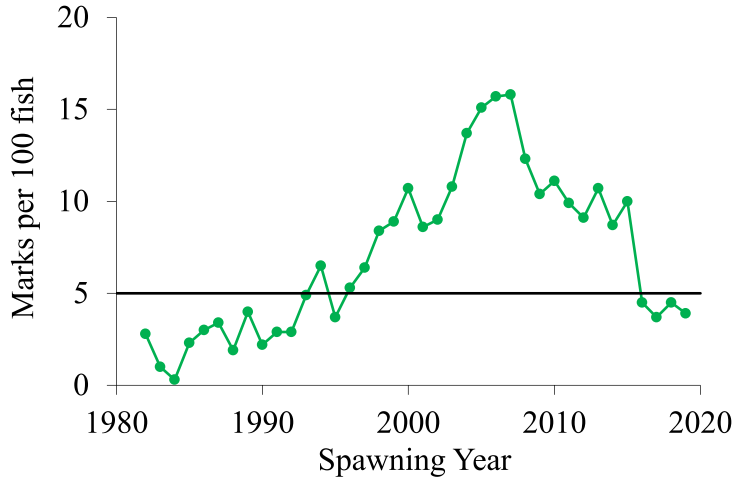

Figure 6. Average number of A1-A3 marks per 100 Lake Trout >532 mm from standardized fall assessments in Lake Michigan 1982 – 2018. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout. The spawning year is used rather than the survey year (shifted by one year) to provide a comparison 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 2018 was 8.6 A1-A3 marks per 100 Lake Trout >532 mm, which is greater than the target of 5 marks per 100 fish (Figure 7).

- Marking rates on Lake Whitefish and Ciscoes have been increasing and these fish may be important initial hosts for juvenile Sea Lamprey.

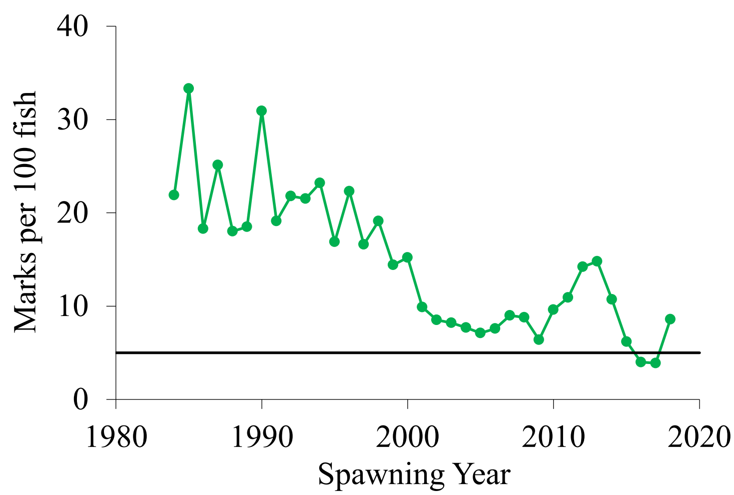

Figure 7. Average number of A1-A3 marks per 100 Lake Trout >532 mm caught in U.S. waters during spring assessments in Lake Huron 1984-2018. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout. The spawning year is used rather than the survey year (shifted by one year) to provide a comparison with the adult index.

- Canadian commercial fisheries in northern Lake Huron continued to provide parasitic juvenile Sea Lamprey in 2018, 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 2018 is not yet available; the CPUE value for 2017 was slightly higher than 2016 (Figure 8).

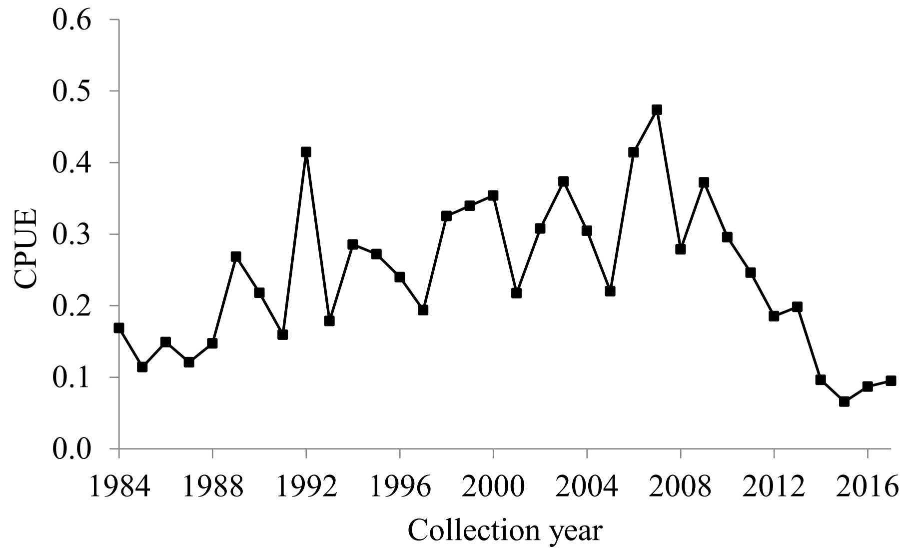

Figure 8. Northern Lake Huron commercial fisheries index showing CPUE (number of parasitic juvenile Sea Lamprey per km of gillnet per night) for 1984-2017.

- Since 1998, standardized trapping for out-migrating juveniles has been conducted in the St. Marys River as an index of Sea Lamprey production in this system. Eleven floating fyke nets are deployed each October and November in the Munuscong, Sailor’s Encampment, and Middle Neebish channels. In 2018, fyke nets were fished for a total of 407 net days, capturing 42 out-migrating juveniles (0.10 juveniles per net day. (Figure 9).

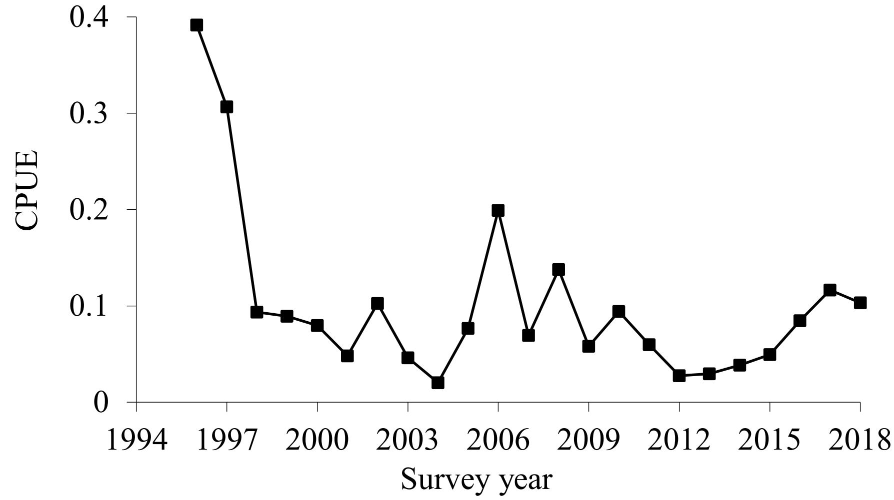

Figure 9. CPUE (number of out-migrating juvenile Sea Lamprey per net day) of fall fyke netting in the St. Marys River during 1996-2018.

- The MIDNR provided data on the frequency of juvenile Sea Lamprey attached to fishes caught by sport charter fishers.
    - A total of 574 juvenile Sea Lamprey were collected from 6 management districts: 346 were attached to Lake Trout and 228 were attached to Chinook Salmon. Attachment rates during 2018 were 3.67 per 100 Lake Trout (n=9,438) and 21.35 per 100 Chinook Salmon (n=1,068), which were higher than the attachment rates on Lake Trout and Chinook Salmon during 2017 (1.03and 5.85, respectively).

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 2018 was 9.7 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).

- In cooperation with Walpole Island First Nation, the Commission and partners completed the fourth year of an annual index for out-migrating juvenile Sea Lampreys in the St. Clair River. Eight floating fyke nets were deployed on November 14, 2018. Due to United States Coast Guard concerns regarding ice flow and proper function of aids to navigation, the nets were retrieved on December 15. Over the collection period, 20 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.

- No data are collected in Lake Erie to determine the frequency of feeding juvenile Sea Lamprey attached to fish caught by sport charter fishers.

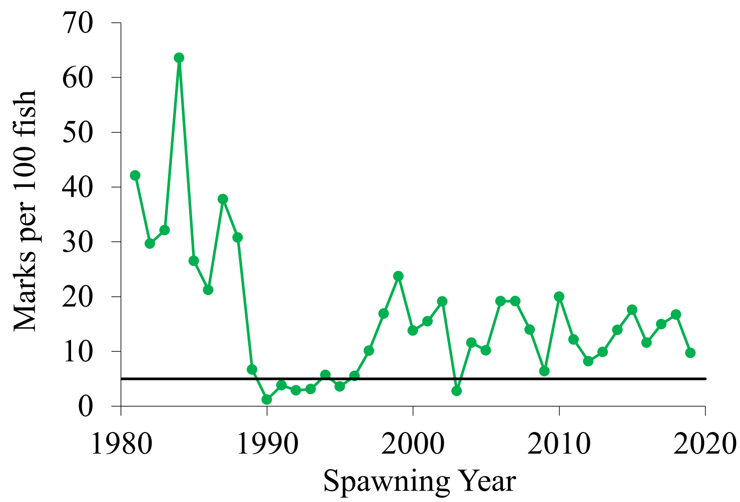

Figure 10. Average number of A1-A3 marks per 100 Lake Trout >532 mm from standardized fall assessments. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout 1985-2018. The spawning year is used rather than the survey year (shifted by one year) to provide a comparison with the adult index.

Lake Ontario

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

- Based on standardized fall assessment data, the marking rate during 2018 was 0.06 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).

- The NYDEC provided data on the frequency of juvenile Sea Lamprey attached to fish caught by sport charter fishers during April 15 – September 30, 2018.

    - An estimated 5,327 juvenile Sea Lampreys were observed by anglers. Sea Lampreys were attached to Chinook Salmon (71.68%), Rainbow Trout (3.09%), Brown Trout (22.12%), and Lake Trout (0.88%). Attachment rates were 1.98 per 100 trout and salmon in the west region, 1.98 in the west central region, 2.17 in the east central region, and 2.40 in the east region. In comparison to 2017, attachment rates were greater in all regions (1.02, 1.92, 1.79 and 1.44 respectively).

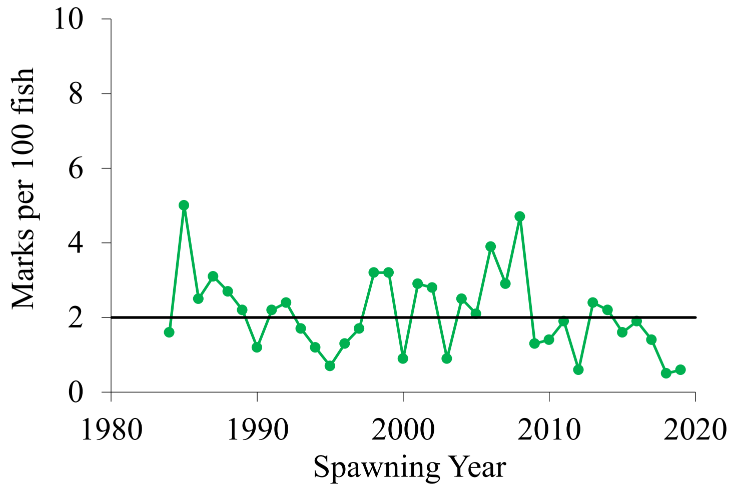

Figure 11. Number of A1 marks per 100 Lake Trout >431 mm from standardized fall assessments in Lake Ontario 1983-2018. The horizontal line represents the target of 2 A1 marks per 100 Lake Trout. The spawning year is used rather than the survey year (shifted by one year) to provide a comparison with the adult index.

Adult Assessment

An annual index of adult Sea Lamprey abundance is derived by summing individual population estimates from traps operated in a specific suite of streams (index streams) during spring and early summer. The index approach was first used during 2015, replacing regression model estimates of lake-wide abundance that were derived from multiple variables. During 2018, the SLCP discontinued use of the Schaefer method in favor of the simpler Petersen method to calculate population estimates from mark-recapture data. The estimates were updated for all index streams from 1980 to 2018. Mark-recapture estimates are attempted in each index stream; however, in the absence of an estimate due to an insufficient number of marked or recaptured Sea Lamprey, abundance is estimated using the annual pattern of adult abundance observed in all streams and years, and adjusted to the stream-specific average abundance estimate in the time series. 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 6,067 Sea Lampreys were captured in 11 tributaries during 2018, 7 of which are index locations. Adult population estimates based on mark-recapture were obtained from 6 of the 7 index locations; the Middle River was estimated using the relative annual pattern of abundance (Table 26, Figure 22).

- The index of adult Sea Lamprey abundance was 58,478 (95% CI; 45,248 – 71,708), which was higher than the target of 12,112 (Figure 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.

- The configuration of the Brule River fishway downstream from the lamprey trap was modified to enhance trapping of Sea Lampreys and facilitate improved fish passage. The fish ladder was operated as a vertical slot instead of a pool and weir fishway up to the Sea Lamprey trap jumping pool to enhance trapping and facilitate improved fish passage. This configuration was adopted in 2017 and continued during 2018. Fieldwork for a two-year Technical Assistance Project (TAP) began in 2018 and an experimental bottom-oriented Sea Lamprey trap was installed in the fishway downstream of the barrier. This research will investigate Sea Lamprey capture and finfish passage under a range of hydraulic conditions. Sea Lamprey and other fishes were PIT tagged and their movements were tracked by fixed PIT antennas installed throughout the fishway.

- Service staff have been evaluating whether the accuracy and precision of mark-recapture abundance estimates differ when using weekly batch marks or unique individual marks as part of a 2-year TAP study on the Brule and Middle rivers. Data analysis is ongoing; a completion report will be submitted in February 2019 and a manuscript will be submitted for publication during spring 2019.

Table 26. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Superior during 2018 (letter in parentheses corresponds to streams 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									
Neebing R. (A)	134	1,284	10	13	46	481	411	233	169
Big Carp R. [3] (B)	7	---	---	5	20	502	450	254	303
Total or Mean (Canada)	**141**	---	---	**18**	**39**	**484**	**434**	**236**	**209**
United States									
Tahquamenon R. (C)	950	3,974	24	80	71	454	440	211	211
Betsy R. (D)	273	1,097	25	51	53	444	457	191	227
Rock R. (E)	494	1,152	43	101	50	439	442	194	203
Silver R.[3] (F)	22	---	---	---	---	---	---	---	---
Misery R. [3] (G)	74	---	---	25	60	423	418	192	198
Firesteel R. [3] (H)	152	1,716	8	11	73	416	447	185	217
Bad R. (I)	710	11,301	6	15	27	447	435	309	245
Brule R. (J)	3,247	36,558	9	48	69	482	477	249	245
Middle R. (K)	4	3,113	0	---	---	---	---	---	---
Total or Mean (U.S.)	**5,926**	---	---	**331**	**59**	**449**	**446**	**210**	**216**
Total or Mean (for lake)	**6,067**	---	---	**349**	**58**	**451**	**445**	**211**	**216**

[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.

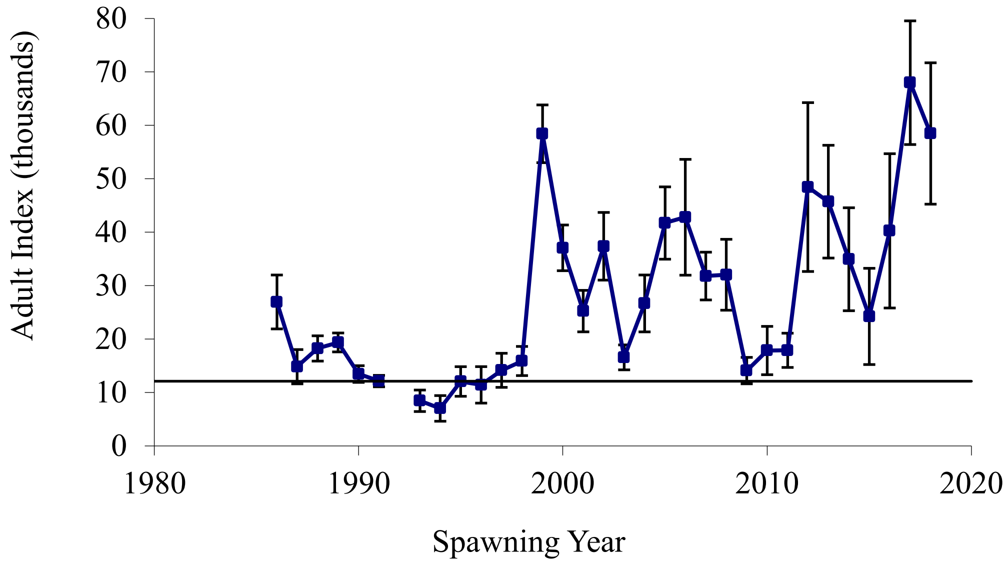

Figure 12. Index estimates with 95% confidence interval (vertical bars) of adult Sea Lamprey in Lake Superior. The adult index in 2018 was 58,478 (95% confidence interval 45,248 – 71,708). The point estimate was greater than the target of 12,112 (black horizontal line). The index target was estimated as the mean of indices during a period with acceptable marking rates (1994-1998).

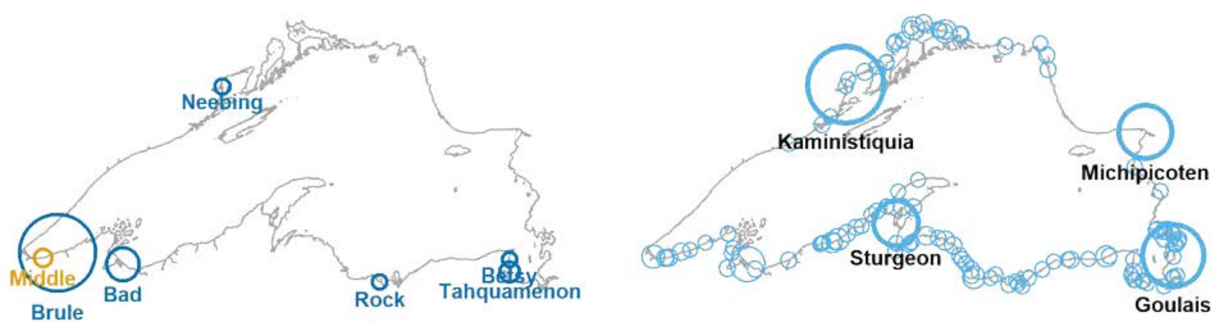

Figure 13. LEFT: Estimated index of adult Sea Lamprey in Lake Superior during the spring spawning migration, 2018. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). RIGHT: Maximum estimated number of larval Sea Lamprey in each stream 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 11,491 Sea Lampreys were captured at 9 tributaries during 2018, 6 of which are index locations. Adult population estimates based on mark-recapture were obtained for each index location (Table 27, Figure 22).
- The index of adult Sea Lamprey abundance was 26,999 (95% CI; 22,968 – 31,031), which was less than the target of 38,703 (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.

Table 27. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Michigan during 2018 (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)	1,770	2,322	54	153	52	479	487	241	248
Boardman R. [3] (B)	144	465	30	58	66	498	492	248	257
Betsie R. (C)	1,002	1,654	61	124	62	507	496	287	288
Big Manistee R. (D)	454	7,219	6	19	63	496	517	288	296
Grand R. [3] (E)	494	1,350	36	169	45	522	515	302	301
St. Joseph R. (F)	680	3,528	19	31	29	477	492	247	273
Trail Cr. [3] (G)	119	---	---	---	---	---	---	---	---
Peshtigo R. (H)	1,249	1,857	67	77	44	518	511	279	296
Manistique R. (I)	5,579	10,420	54	249	51	504	507	273	288
Total or Mean (for lake)	**11,491**	**---**	**---**	**880**	**51**	**505**	**504**	**274**	**283**

[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.

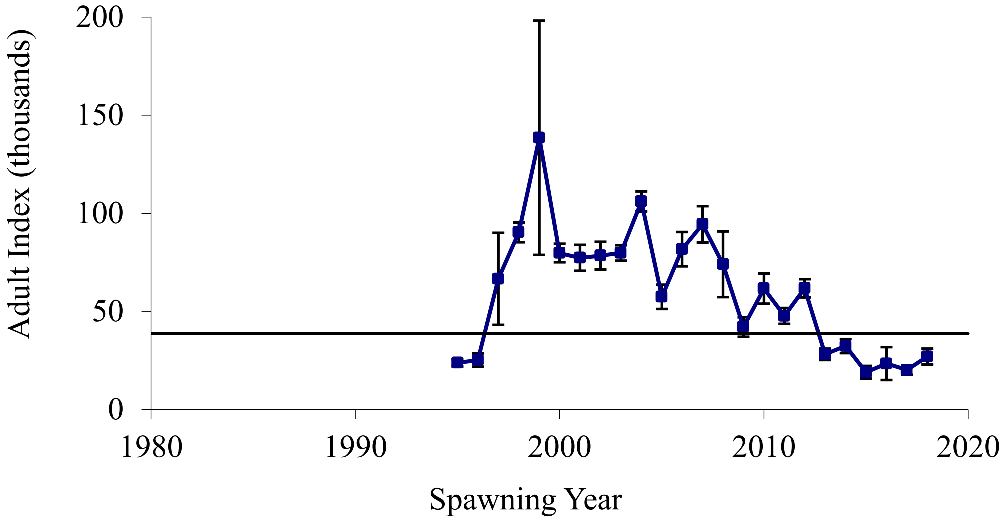

Figure 14. Index estimates with 95% confidence intervals (vertical bars) of adult Sea Lamprey in Lake Michigan. The adult index in 2018 was 26,999 (95% confidence interval 22,968 – 31,031). The point estimate is less than the target of 38,703 (black horizontal line). The index target was estimated as 5/8.9 times the mean of indices (1995-1999).

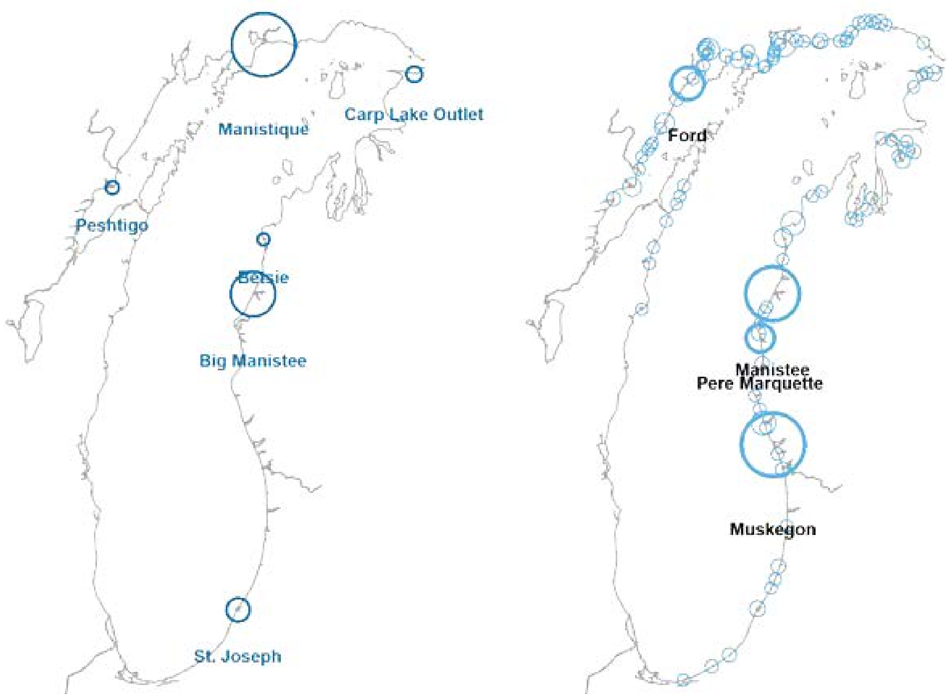

Figure 15. LEFT: Estimated index of adult Sea Lamprey in Lake Michigan during the spring spawning migration, 2018. Circle size corresponds to estimated number of adults from mark-recapture studies. RIGHT: Maximum estimated number of larval Sea Lamprey in each stream surveyed during 1995-2012. Tributaries 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 21,710 Sea Lampreys were trapped in 6 tributaries during 2018, all of which are index locations. Adult population estimates based on mark-recapture were obtained from each index location (Table 28, Figure 22).

- The index of adult Sea Lamprey abundance was 39,178 (95% CI: 36,781 – 41,575), which is higher than the index target of 35,999 (Figure 16-17).

- A total of 3,569 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 10,312 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 28. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Huron during 2018 (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
<u>Canada</u>									
St. Marys R. (A)	3,569	10,312	34	95	64	499	502	271	278
Echo R. (B)	638	1,994	30	---	---	---	---	---	---
Thessalon R. (C)									
Bridgeland Cr.	2,866	3,353	85	229	60	484	482	238	240
Total or Mean (Canada)	**7,073**	---	---	**324**	**62**	**489**	**487**	**248**	**251**
<u>United States</u>									
East Au Gres R. (D)	424	2,124	27	40	63	462	468	216	241
Ocqueoc R. (E)	3,084	4,813	70	160	44	477	479	232	234
Cheboygan R. (F)	11,129	16,683	82	533	55	485	489	238	247
St. Marys R. (A)	See Canada	See Canada	See Canada	48	71	488	505	284	319
Total or Mean (U.S.)	**14.637**	---	---	**781**	**58**	**482**	**486**	**239**	**247**
Total or Mean (for Lake)	**21,710**	---	---	**1,105**	**55**	**484**	**486**	**242**	**248**

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

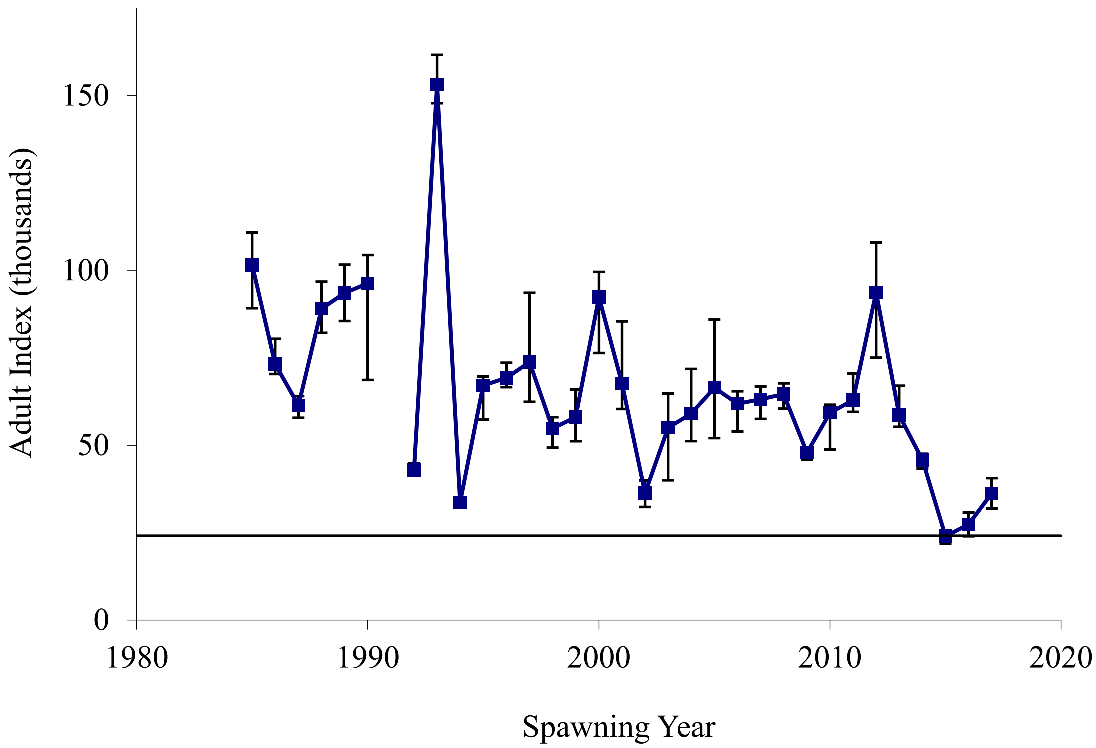

Figure 16. Index estimates with 95% confidence intervals (vertical bars) of adult Sea Lampreys in Lake Huron. The adult index in 2018 was 39,178 (95% confidence interval 36,781 – 41,575). The point estimate is greater than the target of 35,999 (black horizontal line). The index target was estimated as 0.25 times the mean of indices between 1989 and 1993.

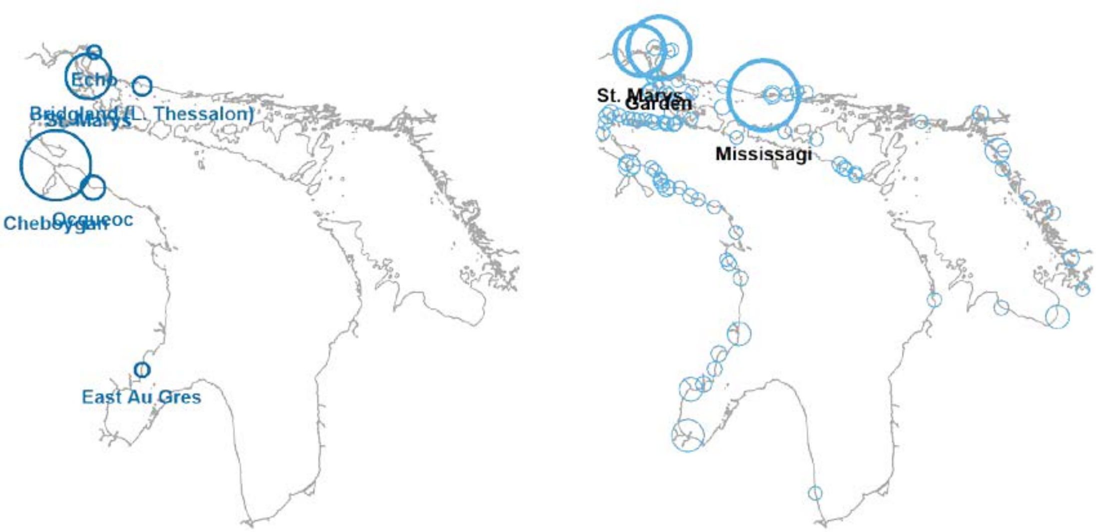

Figure 17. LEFT: Estimated index of adult Sea Lampreys in Lake Huron during the spring spawning migration, 2018. Circle size corresponds to estimated number of adults from mark-recapture studies. RIGHT: Maximum estimated number of larval Sea Lampreys in each stream surveyed during 1995-2012. Tributaries 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 913 Sea Lampreys were trapped in 5 tributaries during 2018, all of which are index locations. Adult population estimates based on mark-recapture were obtained from 3 of the 5 index locations; the Cattaraugus Creek and Grand River were estimated using the relative annual pattern of abundance (Table 39, Figure 22).

- The index of adult Sea Lamprey abundance was 4,149 (95% CI; 3,027 – 5,270), which was less than the target of 4,435 (Figure 18-19).

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

Table 29. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Erie during 2018 (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									
Big Otter Cr. (A)	---	---	---	---	---	---	---	---	---
Little Otter Cr.	49	454	8	4	0	---	470	---	238
Big Cr. (B)	550	1,256	43	55	64	508	498	261	267
Young's Cr. (C)	70	171	40	26	81	500	479	249	228
Total or Mean (Canada)	**669**	**---**	**---**	**85**	**48**	**504**	**482**	**255**	**244**
United States									
Cattaraugus Cr. (D)	158	1,637	10	0	---	---	---	---	---
Grand R. (E)	86	618	14	1	100	430	---	217	---
Total or Mean (U.S.)	**244**	**---**	**---**	**1**	**100**	**430**	---	**217**	---
Total or Mean (for Lake)	**913**	**---**	**---**	**86**	**70**	**511**	**495**	**274**	**277**

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

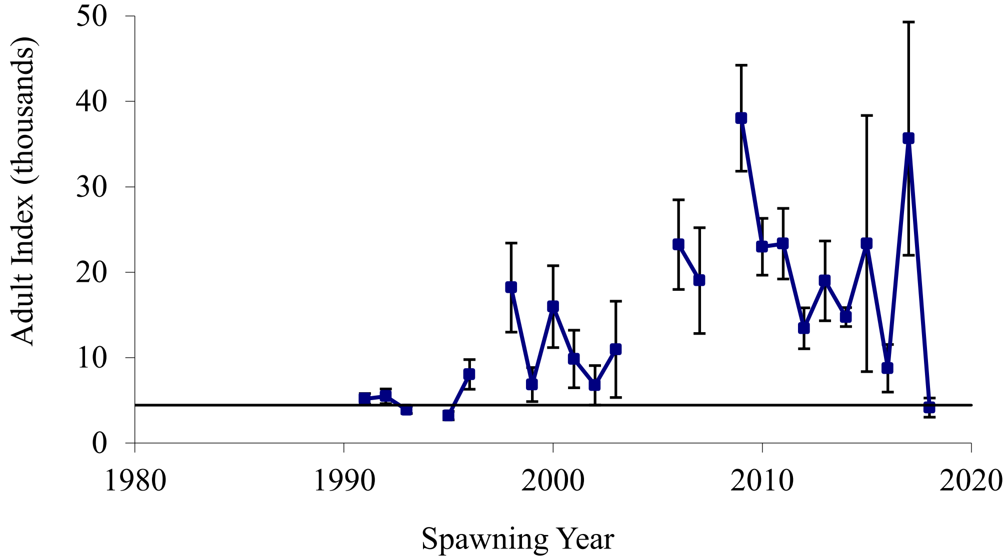

Figure 18. Index estimates with 95% confidence intervals (vertical bars) of adult Sea Lampreys in Lake Erie. The adult index in 2018 was 4,149 with 95% confidence interval (3,027 – 5,270). The point estimate met the target of 4,435 (horizontal line). The index target was estimated as the mean of indices during a period with acceptable marking rates (1991-1995).

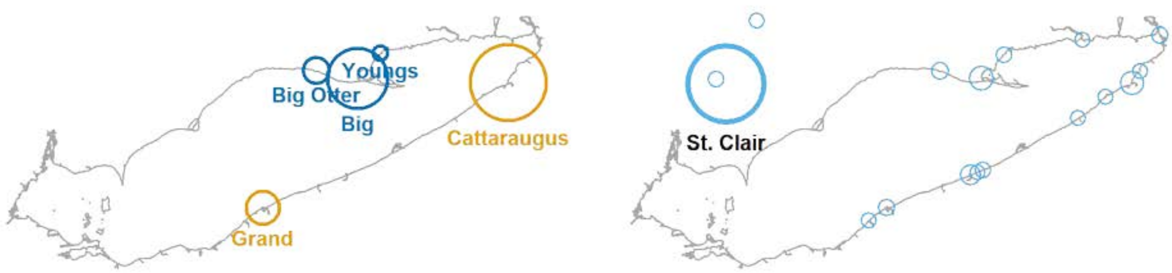

Figure 19. LEFT: Estimated index of adult Sea Lampreys in Lake Erie during the spring spawning migration 2018. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). RIGHT: Maximum estimated number of larval Sea Lampreys in each stream 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 5,428 Sea Lampreys were trapped in 8 tributaries during 2018, 5 of which are index locations. Adult population estimates based on mark-recapture were obtained from each index location (Table 30, Figure 22).

- The index of adult Sea Lamprey abundance was 11,666 (95% CI; 9,921 – 13,412), which is less than the target of 15,502 (Figures 20-21).

Table 30. Information regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Ontario during 2018 (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)	3,230	4,702	68	221	59	501	501	280	286
Duffins Cr. (B)	346	1,041	32	22	54	512	498	302	317
Bowmanville Cr. (C)	290	765	38	92	66	500	518	279	312
Cobourg Cr.[3] (D)	273	458	59	154	54	480	483	243	251
Salmon R.[3] (E)	4	---	---	---	---	---	---	---	---
Total or Mean (Canada)	**4,143**	---	---	**489**	**59**	**495**	**497**	**270**	**279**
United States									
Black R. (F)	993	2,291	18	131	68	503	490	282	281
Salmon R.(G)									
Orwell Br.[3]	31	331	9	2	0	---	490	---	293
Sterling Cr. (H)	261	2,868	21	16	69	459	429	314	288
Total or Mean (U.S.)	**1,285**	---	---	**149**	**67**	**498**	**484**	**285**	**282**
Total or Mean (for lake)	**5,428**	---	---	**638**	**61**	**496**	**495**	**274**	**280**

[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.

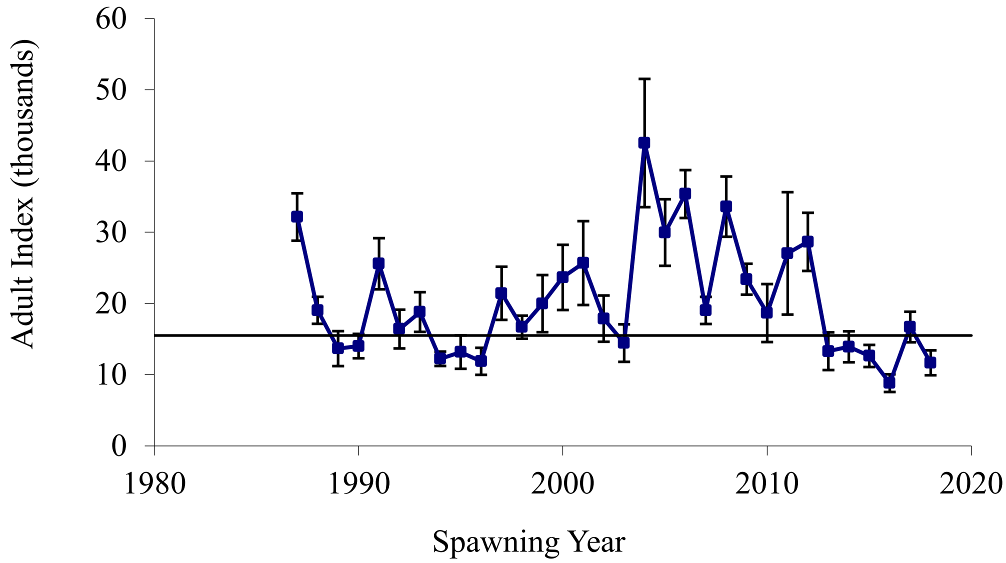

Figure 20. Index estimates with 95% confidence intervals (vertical bars) of adult Sea Lampreys in Lake Ontario. The adult index in 2018 was 11,666 (95% confidence interval 9,921 – 13,412). The point estimate is less than the target of 15,502 (black horizontal line). The index target was estimated as the mean of indices during a period with acceptable marking rates (1993-1997).

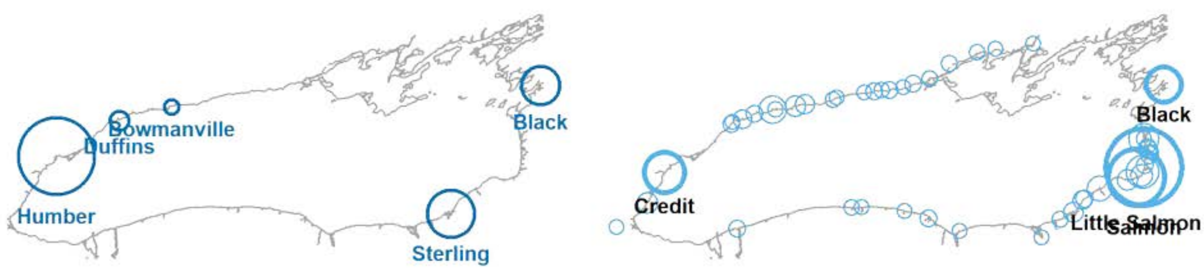

Figure 21. LEFT: Estimated index of adult Sea Lampreys in Lake Ontario during the spring spawning migration 2018. Circle size corresponds to estimated number of adults from mark-recapture studies. RIGHT: Maximum estimated number of larval Sea Lampreys in each stream surveyed during 1995-2012. Tributaries 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).

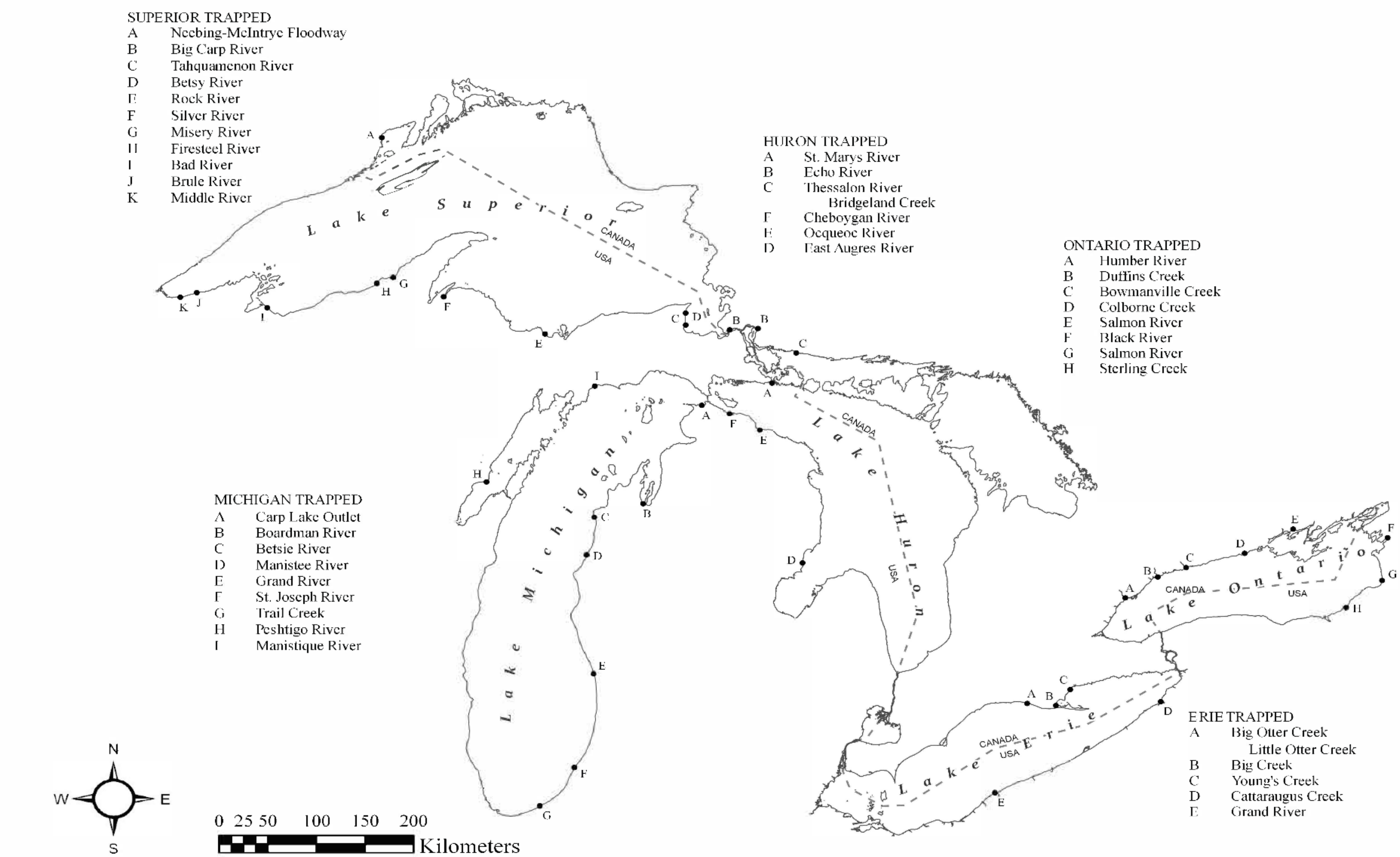

Figure 22. Locations of tributaries where assessment traps were operated during 2018.

RISK MANAGEMENT

Risk management addresses environmental and non-target issues related to the implementation of the SLCP in the United States. This involves coordination with many federal, 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 proposed lampricide applications, assess the potential risk of these applications to federally listed species, and develop procedures to protect and avoid disturbance for each listed species.

During 2018, 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:

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

Programmatic Review

Because of the broad scope of the SLCP, consultation under Section 7 of the ESA involves several states, many listed species, and hundreds of streams. 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 2018, 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 Department of Environmental Protection

Studies and Fieldwork

Non-target Surveys

Conneaut Creek (Lake Erie): The Risk Management Team (RMT) participated with partner agencies and local community volunteers to conduct non-target surveys in Ohio waters of Conneaut Creek during the April lampricide treatment.

Huron River (Lake Erie): The RMT participated with partner agencies to conduct non-target surveys in the Huron River during the May lampricide treatment. This was the first time a treatment was conducted on this stream.

Freshwater Mussel Toxicity Tests

Tests were conducted in situ (Middle Channel of the St. Clair River, Lake Michigan) to determine the toxicity of niclosamide [5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide] to the Eastern lampmussel (*Lampsilis radiata*) and Eastern pondmussel (*Ligumia nasuta*) when exposed to a gB application.

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 2018.*
- *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 2018*.

A total of 120 federal and state listed species, 3 critical habitats and the de-listed bald eagle (*Haliaeetus leucocephalus*) were identified in the 2018 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 2018, NEPA was required for cooperative agreements for the following actions:

Trapping for adult Sea Lamprey on the following streams:

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

Treatment for larval Sea Lamprey on the following streams:

- Red Cliff Creek (Lake Superior)

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 31).

Table 31. Summary of 6(a)(2) reports submitted for incidents of non-target mortality during 2018 lampricide treatments.

Lake	Stream	Mortality	Freq	Comments
Superior	Lowney Creek[1]	Trout-perch (*Percopsis omiscomaycus*)	76	Sensitive, possibly spawning
Huron	Carp River[1]	Longnose dace (*Rhinichthys cataractae*)	60	Accidental spill
	Rifle River[2]	Stonecat (*Noturus flavus*)	62	Sensitive species
	Watson Creek[1]	White sucker (*Catostomus commersonii*)	450+	Possibly spawning
		Common shiner (*Luxilus cornutus*)	75+	Possibly spawning
	Ocqueoc River[1]	Logperch (*Percina caprodes*)	83	Sensitive species
Erie	Conneaut Creek[1]	Stonecat (*Noturus flavus*)	1,272	Sensitive species
		Mudpuppy (*Percina maculata*)	165	Sensitive species
		White sucker (*Catostomus commersoni*)	100	Sensitive species
		Rainbow darter (*Eteostoma caeruleum*)	62	
	Huron River[1]	Stonecat (*Noturus flavus*)	1,768	Sensitive species
		Bigeye chub (*Hybopsis amblops*)	844	
		Central stoneroller (*Campostoma anomalum*)	202	
		Rainbow darter (Etheostoma caeruleum)	70	
Champlain	Great Chazy River[1]	Stonecat (*Noturus flavus*)	257	Sensitive species
		Pumpkinseed (*Lepomis gibbosus*)	64	AP, incomplete mix
		Mudpuppy (*Necturus maculosus*)	60	Sensitive species
	Ausable River[1]	Banded killifish (*Fundulus diaphanus*)	142	
	Saranac River[2]	Stonecat (*Noturus flavus*)	80	Sensitive species

[1]TFM treatment

[2]TFM/niclosamide treatment

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.

2018 Membership

Lori Criger (Chair), Cheryl Kaye, Chris Gagnon, Tim Sullivan, Jenna Tews (Service); Bruce Morrison, Shawn Robertson, Fraser Neave (Department); Jean Adams (USGS/GLFC); Steve Lantz, 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.

2018 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 survival and/or escapement in these refugia areas. Lampricide concentrations were targeted to be greater than 10% above theoretical values due to some uncertainty with the 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 in order treat more streams in the spring (when conditions are generally optimal) and to augment treatment effort on complex, labor 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.

3. Crews from both Service and Department worked together to complete the St. Marys River granular Bayluscide treatment plots.
4. Treatments of the Garden, Mississagi, Echo, and Root rivers (Lake Huron) and two plots in the St. Marys River were deferred due to lack of concurrence from First Nations, and the upper Black Mallard, Shebeshekong, and Au Gres rivers (Lake Huron) were not treated due to insufficient discharge. Additionally, the Michipicoten River treatment was deferred due to construction on the power dam as well as insufficient discharge and the Pine River (Saginaw River) treatment was deferred due to inconsistent output from the St. Louis Dam. However, the Boyne River (Lake Huron – Canada) and Campbell Creek (Paw Paw River) were added to the treatment schedule based on larval assessments conducted during the 2018 field season. Likewise, three alternate plots on the St. Marys River were treated in place of the two that were deferred.

2019 Objectives:

1. Treat all streams listed on the 2019 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 2019.
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 later in the season.
4. Develop an optimized schedule jointly between the agents to realize efficiencies in travel and effectively utilize Department staff conducting or assisting with treatments in Michigan.
5. To increase treatment effectiveness of St. Marys River granular Bayluscide applications, both spray boats will be employed to ensure treatments are completed before aquatic vegetation becomes problematic.
6. Support and provide input into research that may lead to new control strategies and minimize effects on non-target species by investigating sea lamprey sensitivity and effects on non-target organisms.

    a. Upper Midwest Environmental Science Center (UMESC) and RMT will continue conducting toxicity tests to determine the toxicity and sub-lethal effects of granular Bayluscide to freshwater mussels
    b. RMT will participate in the partner-led effort to collect young-of-the-year lake sturgeon before/during/after lampricide treatments of the Manistee and Muskegon rivers
    c. The LCTF continues 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.

2018 Outcomes:

1. Lampricide analysis and water chemistry data from streams treated in 2018 were reviewed to identify potential areas that did not receive theoretical lethal TFM concentrations. Information was provided to larval assessment to help guide treatment evaluation survey effort and recommend re-treatment.

2019 Objectives:

1. Review past treatment history and larval assessment information for streams ranked for treatment in 2019 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. Assist UMESC in field studies in support of the development of a more effective TFM bar/pellets and a new formulation of liquid niclosamide. Treatment personnel will assist with field trials of the new products as they become available.

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.

2018 Outcomes:

1. Implemented the large-scale treatment strategy targeting large producers in Lake Huron.
2. At the direction of the SLCB, LCTF and LATF considered various lampricide control strategies and larval abundance targets in the St. Marys River. The SLCP will continue to target 300 ha of infested habitat for treatment with Bayluscide each year.

2019 Objectives:

1. Optimize stream treatment schedules to facilitate the implementation of the next the large-scale treatment strategy targeting Lake Superior in 2019.
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 Michigan targeted treatment strategy to occur in 2020.

<u>Barrier Task Force</u>

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.

2018Membership
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.

2018 Outcomes:

1. Planning continued on 14 barrier construction projects to prevent Sea Lamprey from accessing spawning habitat.
2. Rebuild of Denny's Dam on the Saugeen River (Lake Huron) was completed.
3. Routine maintenance at all purpose-built Sea Lamprey barriers was completed to ensure adult Sea Lamprey do not have access to spawning habitat.
4. Inspection of approximately 130 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.
5. Review of twenty-five fish passage projects was initiated or completed to determine the effect of fish passage and dam or culvert removals to Sea Lamprey control operations.
6. Completed electrofishing surveys and habitat assessments conducted upstream of barriers of concern in the Credit and Thunder Bay rivers to quantify potential infestation risk; barrier inspections were also completed to verify historical information and at locations not currently represented in the barrier database.

2019 Objectives:

1. Initiate construction of the Manistique River (Lake Michigan) Sea Lamprey barrier.
2. Initiate construction of the Grand River (Lake Erie) Sea Lamprey barrier in Harpersfield, OH. Plan for construction in FY19 to ensure that Sea Lampreys remain blocked at the Harpersfield Dam.
3. Complete rebuild of Nicolston Dam on the Nottawasaga River (Lake Huron).
4. Members remain engaged in the process to reach a decision point regarding the Black Sturgeon River (Lake Superior) Camp 43 dam.
5. Members remain engaged in the analysis and review of options at the 6th Street Dam on the Grand River (Lake Michigan) to assess risk of adult Sea Lampreys migrating upstream of the proposed structure that will create a whitewater rapids area in downtown Grand Rapids, MI.
6. 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.

7. Investigate use of existing surrogate species data and geographic information systems (GIS) data to predict infestation risk upstream of blocking barriers.
8. 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.

2018 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. Four unmarked adult lampreys were captured during 2018 in the upper Cheboygan. Approximately 3,500 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 are planned for this fall.
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 3 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.

2019 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. Submit proposal to field test a combination of alternative strategies (pheromone, alarm cue, NEMO, etc.) to block Sea Lamprey from accessing spawning habitat.
4. Participate in technical assistance proposal evaluations of NEMO as a seasonal barrier to block a natural sea lamprey run in the Black Mallard River over three years with the goal of eliminating the need for lampricide treatment.
5. The Cheboygan Work Group (CWG) will continue to assess the upper Cheboygan River population during 2018 to confirm that adult populations upstream of the Cheboygan Lock and Dam complex are small. The CWG developed a proposal (to

Sea Lamprey Research Board) to apply SMRT in the upper river in 2017-2019 following the 2016 lampricide treatment.

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.

2018 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 Lamprey.

2018 Outcomes:

1. Distribution surveys were conducted during 2018 in tributaries scheduled for treatment in 2019.
2. On three Lake Ontario tributaries, high water levels in spring 2017 resulted in recruitment above previously effective barriers. Graham Creek ranked for treatment in 2019. Cobourg Creek and Shelter Valley Creek will be ranked for potential treatment in 2020.
3. Recruitment was detected in Hungarian Creek, Lake Superior, and will be treated in 2019.

2019 Objectives:

1. Conduct detection surveys as required. When new infestations are found, rank for treatment as size structure dictates.
2. Conduct distribution surveys for all 2020 treatments, including the Lake Michigan Targeted Treatment Strategy streams.

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

2018 Outcomes:

1. Post-treatment assessments were conducted on streams treated during 2017 and early 2018. All streams with large larvae were re-ranked for treatment.

2019 Objectives:

1. Continue to conduct post-treatment assessments on all treated streams and rank streams where large residual Sea Lamprey are recovered.

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.

2018 Outcomes:

1. Larval habitat identification and quantification training for full-time and some seasonal assessment staff was held in a joint DFO-USFWS session in Cheboygan in spring 2018.
2. The LATF continued to research the potential incorporation of environmental DNA detection into its assessment approach. After extensive testing, it was determined that some new e-DNA surveillance equipment provided to USFWS was not yet ready for field implementation. Further research is required before adopting this technology.
3. Assessment biologists have observed that large (>100mm) Sea Lamprey larvae are less common in surveys over the last two years, and this has reduced the number of streams that can be used when prioritizing treatments during the standard annual ranking procedure. In 2018 larval assessment biologists pro-actively sampled additional streams to enable the potential use of a smaller larvae (80mm rather than 100mm) length cut-off in the ranking process. This reduced cut-off length was ultimately not used in developing the ranked portion of the list, but almost all streams with Sea Lamprey larvae greater than 100mm were treated. This indicated that this more aggressive stream sampling will likely be required in the future.
4. To address stream selection issues and other items as directed by the LATF, the Larval Assessment Workgroup will meet in association with SLAWs meetings.

2019 Objectives:

1. Implement a more aggressive strategy when selecting streams to rank for treatment. This will be initiated due to our ability to target larvae of a younger age and will ensure the generation of a complete stream treatment list in 2020. All regular producing streams with larvae of one year old or older will be sampled for potential inclusion in the 2020 rank list. The length cut-off used to develop the rank list will be determined in September 2019, and will depend on survey results.
2. Continue to revise larval assessment protocols and operating procedures as necessary, particularly with regard to any changes to the more aggressive stream sampling strategy.

3. Continue implementation of electronic field data collection by US agents and work out any outstanding issues. DFO will test electronic field data collection for the first time.

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

2018 Outcomes:

1. Year three of the 2016-2018 Targeted Treatment Strategy was completed. This basin-wide approach focused on Lake Huron tributaries in 2018.
2. The next Targeted Treatment Strategy (2019-2021) was developed, and will be similar to the previous strategy. It will again focus on the three upper Great Lakes, targeting Lake Superior in 2019, Lake Michigan in 2020, and Lake Huron in 2021.
3. Ranking and distribution surveys were conducted in preparation for the 2019 Lake Superior Targeted effort.

2019 Objectives:

1. Refine the Lake Michigan Targeted Treatment Strategy stream list for 2020, based on 2019 larval assessment survey data.
2. Begin to assemble a preliminary stream list for the Lake Huron Targeted Treatment Strategy for 2021.

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.

2018 Membership

Gale Bravener (Chair) and Mike Steeves (Department), Peter Hrodey, Greg Klingler and 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.

2018 Outcomes:

1. A total of 29 index locations were trapped throughout the Great Lakes in 2018, and mark recapture population estimates were obtained from 26 index locations. Adult indices for each lake were generated.
2. The transition was made from modified Schaefer to pooled Petersen as the estimator for stream level mark-recapture data, beginning in 2018. Historical estimates, targets and conversion factors were all re-calculated.

2019 Objectives:

1. Operate and maintain 37 trap sites throughout the Great Lakes. These include the 29 index streams, for which populations will be estimated using mark-recapture, and another 8 non-index streams.
2. Continue monitoring results from recent and ongoing research projects, and be prepared to implement effective new technologies and methods into the Sea Lamprey control program when they become available.

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

2018 Outcomes:

1. Considered collection of transformers for control in several tributaries in 2018. Most of these were subsequently treated, could not be collected on due to high water, or were deemed to have small populations.
2. Monitored several recent and ongoing research projects aimed at improving the capture efficiency of adults and transformers for control purposes. No new methods to increase capture of adults or juveniles were deployed in 2018.

2019 Objectives:

1. Continue trapping juveniles for control in newly discovered or deferred streams to decrease escapement to the lakes.
2. Continue monitoring results from recent and ongoing research projects, and be prepared to implement new technologies and methods into SLCP. Continue to evaluate trapping for control options, including a model of adult trapping at the lake level (SLaMSE model), and using supplemental controls in streams where TFM is not effective.

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.

2018 Outcomes:

1. The Li Lab (MSU) has identified new putative pheromone compounds, some of which were tested for biological activity in the field. In total, they have identified 14 new compounds from mature male washing and 7 new compounds from larval washings. However, no pheromone combinations tested were as effective at attracting or retaining ovulating females as washings from spermiated males.
2. Many control agents from USFWS and DFO helped conduct year 2 of 2 of a research project led by Nick Johnson (USGS) to optimize 3kPZS application to barrier-integrated traps. This is a follow-up to the management scale field trials of 2009-2011. The objective was to determine the concentration of 3kPZS required to maximize increases in trap efficiency and what environmental conditions 3kPZS may work best in.
3. The Wagner Lab (MSU), with Nick Johnson and James Hanson (Seton Hall), published a standard method for the deployment of attractant pheromones in trapping operations using inexpensive controlled-release polymer emitters.

2019 Objectives:

1. Continue to identify the structure and function of Sea Lamprey pheromone components, and attempt to unequivocally confirm the pheromone function of at least one novel compound.
2. Report final results of 3kPZS dose response project. Make recommendation to TTF on when and where it is useful to apply to traps.

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

2018 Outcomes:

1. The Wagner and Nair Labs (MSU) screened 15 compounds isolated and identified from the Sea Lamprey alarm cue, and a further 22 sub-fractions (mixtures of compounds), for behavioral repellency in laboratory raceways. Three compounds and nine sub-fractions produced significant repellency.
2. The Wagner Lab completed fieldwork to test the application of the alarm cue in a two-channel pass-and-trap model fishway. Sea lamprey may be effectively repelled from the passage channel, and guided into a trap channel equipped with an eel ladder trap. A native fish that co-migrates with lamprey (White Sucker) did not respond to the alarm cue.
3. The Li Lab has made significant progress identifying and testing pheromone antagonists.
   Antagonists are showing promise not only for nullifying nest approaching (3kPZS) but mate finding and nest building (DkPES, PAMS-24, Spermidine). At the right concentration, a cocktail of PZS and tri-sulfated PZS is effective at repelling mature females from spermiated male washings.

2019 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.

2018 Outcomes:

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

2019 Objectives:

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

COMMUNICATIONS AND OUTREACH

The GLFC and its partners, the United States Fish and Wildlife Service (USFWS), the Department of Fisheries and Oceans Canada (DFO), and United States Geological Survey-Hammond Bay Biological Station (USGS), conducts a comprehensive education and outreach program. The following is an update about recent outreach and educational activities.

Outreach and Education Events

As part of the outreach and education program to inform the public about the Commission's programs, the health of the Great Lakes, and the importance of the fisheries to the region, the following major shows and events were conducted by the GLFC, USFWS, DFO, and USGS during the 2018 season.

2018 Shows, events, and programs:

Ultimate Fishing Show, Detroit, MI.
Greater Niagara Fishing and Outdoor Expo, Niagara Falls, NY.
Chicagoland Fishing Travel & Outdoor Expo, Schaumburg, IL.
Cranbrook Institute of Science, Girl Scouts in Science
Duluth Boat and Sport Show, Duluth, MN.
Spring Fishing & Boat Show, Mississauga, ON.
Ottawa Boat & Sportsmen's Show, Ottawa, ON.
Place Based Education Workshop – Northern Michigan University
OFAH-Invasive Species Awareness Week, Peterborough, ON.
Northeast Wisconsin Sport Fishin' Show, Oshkosh, WI.
Cabelas' Captain's Weekend, Hammond, IN.
Ultimate Sport Show, Grand Rapids, MI.
Bothwell STEM Fair, Bothwell Middle School
Spring into Science Event, Cranbrook Inst. of Science, Bloomfield Hills, MI.
Sudbury Sportsmen Show, Sudbury, ON.
Washtenaw Community College Earth Day, Ypsilanti, MI.
Cheboygan Earth Week Plus Expo, Cheboygan, MI.
Michigan State University Science Festival, Belle Isle, MI.
Rouge River Water Festival, Dearborn, MI.
Marine Advanced Technology Education (MATE) ROV Comp. Alpena, MI.
Washtenaw Elementary Science Olympiad, Ann Arbor, MI.
Chequamegon Birding Festival, Ashland, WI.
Clinton River Water Festival, Oakland University, Rochester, MI.
Flint River GREEN, Kettering University, Flint, MI.
Bay Cliff Health Camp, Big Bay, MI.
Blue Water Sturgeon Festival, Port Huron, MI.
Michigan Out of Doors Summer Camp, Chelsea,MI.
DNR Free-Fishing Weekend & Kids Fishing Tournament, Cheboygan, MI.
River Fish 4 Kids, Detroit, MI.
Hooked for Life Kids Fishing Clinic and Derby, Alpena, MI.
P.H. Hoeft State Park, Rogers City, MI.
Maple Dam Removal Open House, Pellston, MI.
Lumberman's Monument Visitor Center program, Oscoda Twp, MI.

2018 Shows, events, and programs (*continued*).

Brown Trout Festival, Alpena, MI.
4-H Camp at the Ocqueoc Outdoor Center, Millersburg, MI.
Rogers City Fishing Tournament, Rogers City, MI.
Harrisville State Park, Harrisville, MI.
Tawas State Park, East Tawas, MI.
Invasive Species Week, Van Riper State Park, Champion, MI.
Great Lakes and Natural Resources 4-H camp, Presque Isle, MI.
U.P. State Fair, Escanaba, MI.
Owen Sound Salmon Spectacular, Owen Sound, ON .
Lions Perch Festival, Marblehead, OH.
Agri-palooza, MSU-U.P. Research and Extension Center, Chatham, MI.
Rouge River Water Festival, Cranbrook Institute of Science
Sea Lamprey in Michigan Education, Teachers workshop, Beulah, MI.

The Commission relies on the greater Great Lakes community to assist in conducting outreach around the basin. Partners, advisors, commissioners, agents, and others, help advance the messages of healthy fisheries and the Sea Lamprey control program, while adding relevant, local, regional, and national information. A special thanks to the following advisors, agents, and friends who participated in, or who have committed to, events during 2018: Don Arcuri, Gale Bravener, Sasha Bozimowski, Kevin Butterfield, Chris Eilers, John Ewalt, Bob Frank, Joe Genovese, Stephanie Grand, Peter Grey, Thom Gulash, Justin Hart, Mary Henson, Julie Hinderer, Bob Kahl, Lynn Kanieski, Jerome Keen, Dave Keffer, Dan Kochanski, Jason Krebill, Paul Kyostia, Joe Lachowsky, Kevin Letson, Shawn Lewandoski, Matt Lipps, Kevin Mann, Jeff McAulay, Dan McGarry, Commissioner Jim McKane, Ken Merckel, Andy Mikos, Jen Nalbone, Tiffany Olpaka-Myers, Judy Ogden, Barb Ollila, Dale Ollila, Alan Rowlinson, Sara Ruiter, Michael Ryan, Titus Seilheimer, Chris Siersputowski, Paul Sullivan, Tim Sullivan, Matt Symbol, Jenna Tews, Pat Wick.

PERMANENT EMPLOYEES OF THE SEA LAMPREY CONTROL PROGRAM

FISHERIES AND OCEANS CANADA

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

Paul Sullivan, Division Manager

Section Head, Control: Bruce Morrison

Lampricide Control Biologists:

Shawn Robertson: Supervisor
Alan Rowlinson: Supervisor
Barry Scotland: Assistant Supervisor
Tonia Van Kempen: Environmental Supervisor

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

Lampricide Analysis Technicians:

Stefanie Grand	Joe Lachowsky
Jerome Keen	Richard Middaugh

Lampricide Application Technicians:

Zach Allan	Adam Loubert
Sarah Daniher	Matt McAulay
Kevin Finlayson	Sean Nickle
Kathy Hansen	Chris Sierzputowski
Paul Kyostia	Mike Sim
Dean Lamming	Clinton Wilson
Melissa Leonard	

Barriers:

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

Section Head, Assessment: Mike Steeves

Assessment Biologists:
Gale Bravener: Adult Supervisor
Fraser Neave: Larval Supervisor (Upper Lakes)
Kevin Tallon: Larval Supervisor (Lower Lakes)

Assessment Technicians:

Ryan Booth	Trevor Plumley
Jennifer Hallett	Jeff Rantamaki
Sarah Larden	Chad Ritsema
Sean Morrison	Chris Robinson
Andrea Phippen	Thomas Voigt

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

Maintenance:
Brian Greene: Supervisor

Environmental Assessment Technician:
Nathan Coombs

UNITED STATES FISH AND WILDLIFE SERVICE

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Administrative Support:
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Jenna Tews, Treatment Supervisor
Christopher Eilers
Daniel McGarry
Lauren Freitas

Lampricide Control Lead Physical Science Technician:
Vacant

Lampricide Control Physical Science Technicians:
Kevin Butterfield
Jeffrey Sartor
Barry Shier

Lampricide Control Biological Science Technicians:

Ben Molitor (CS)	Paul Seckora (CS)
Lisa Dennis (CS)	Bobbie Halchishak (CS)

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

Larval Assessment Biological Science Technicians:

John Ewalt	Timothy Granger (CS)
Jason Krebill	Stephanie Shaw (CS)
Gordon Simon (CS)	Mark Martin (CS)

Maintenance Worker:
Thomas McVay

Marquette Biological Station – Marquette, Michigan

Jessica Barber, Field Supervisor

Administrative Support:
- Tracy Demeny, Administrative Officer
- Michael LeMay
- Barbara Poirier
- Alana Kiple (CS)
- Vacant

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

Risk Management:
- Cheryl Kaye, Risk Management Supervisor
- Mary Henson (Fish Biologist)
- Chad Anderson (Biological Science Technician)

Chemist:
- Benson Solomon

Maintenance Worker:
- John Gilkenson

Unit Supervisor (Adult): Vacant

Fish Biologists:
- Pete Hrodey: Barrier and Trapping Supervisor
- Vacant
- Sean Lewandoski
- Kevin Mann

Barrier and Trapping Biological Science Technicians:

Dennis Smith	Tiffany Opalka-Myers (CS)
Kevin Letson	Nicholas Scripps (CS)
	Jason Pynnonen (CS)

Unit Supervisor (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)	Janet McConnell (CS)
Silas Hart (CS)	Randy Parker (CS)
Stephan Healy (CS)	Cory Racine (CS)
Kevin Hensiak (CS)	Dan Suhonen (CS)

Larval Assessment Biologists:
- Robert Frank, Larval Assessment Supervisor
- Rebecca Philipps
- Matthew Symbal

Larval Assessment Biological Science Technicians:

Nikolas Rewald	Nicholas Chartier (CS)
Vacant	Matt Elva (CS)
Jarvis Applekamp (CS)	Alex Larson (CS)
Mark Bash (CS)	

(CS) Career Seasonal