SEA LAMPREY CONTROL IN THE GREAT LAKES 2016

ANNUAL REPORT TO
THE GREAT LAKES FISHERY COMMISSION

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Cover: Larval Sea Lampreys being captured by USFWS Larval Assessment personnel with the use of backpack electroshocking units to determine population densities, age structure and larval distribution. (Photo USFWS)

Patrick Wick (Physical Science Technician, USFWS) preparing a TFM application site on Stony Creek, a tributary to the East Branch Ontonagon River, during the Ontonagon River lampricide treatment in October 2016 (Photo by Chris Gagnon, USFWS).

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EXECUTIVE SUMMARY

This report summarizes Sea Lamprey control activities conducted by the United States Fish and Wildlife Service and Fisheries and Oceans Canada in the Great Lakes during 2016. These activities are consistent with the actions identified in the Great Lakes Sea Lamprey Control Plan to achieve Sea Lamprey abundance and marking targets that was adopted by the Great Lakes Fishery Commission in 2011. Lampricide treatments were conducted on 101 tributaries and 17 lentic areas. Larval assessment crews surveyed 438 Great Lakes tributaries and 58 lentic areas to assess control effectiveness, plan future TFM treatments, and establish production capacity of streams. Assessment traps were operated in 29 tributaries across the Great Lakes to estimate the index of adult Sea Lamprey abundance in each Great Lake.

Indices of adult Sea Lamprey abundance were evaluated relative to fish-community objectives for each of the lakes. In Lake Superior, the index of adult abundance was estimated to be 20,857 (95% CI; 13,442 – 28,271), which was higher than the index target of 9,664. In Lake Michigan, the index of adult abundance was estimated to be 16,125 (95% CI; 11,112-21,138), which was less than the index target of 24,874. In Lake Huron, the index of adult abundance was estimated to be 27,383 (95% CI: 23,978 – 30,788), which was higher than the index target of 24,113. In Lake Erie, the index of adult abundance was estimated to be 4,788 (95% CI; 2,716 – 6,860), which was higher than the index target of 3,039. In Lake Ontario, the index of adult abundance was estimated to be 7,191 (95% CI; 4,310 – 10,072), which is lower than the index target of 11,368.

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 affect efforts to restore and rehabilitate the fish-community. Sea Lampreys subsist on the blood and body fluids of large-bodied fish. It is estimated that about half of Sea Lamprey attacks result in the death of their prey and on average, 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 index and Lake Trout marking targets for each of the lakes. This report outlines the program conducted by the control agents and the Commission in 2016 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 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 estimated average 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. The index approach was first used during 2015, replacing regression model estimates of lake-wide abundance that were derived from multiple variables. 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 9,664 Sea Lampreys 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 2016, the index of adult abundance was 20,857 (95% CI; 13,442-28,271), which was greater than the index target. The Sea Lamprey marking rate on Lake Trout is currently at 7.5 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 has the most direct effect on achieving 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 24,874 Sea Lampreys was calculated from the average abundance estimated for the 5-year period, 1988-1992, when marking rates were closest to 5 marks per 100 Lake Trout >532 mm (4.7 A1-3 marks per 100 fish >532mm). During 2016, the index of adult abundance was 16,125

(95% CI; 11,112-21,138), which was less than the target of 24,874. The Sea Lamprey marking rate on Lake Trout is currently at 3.7 A1-A3 marks per 100 Lake Trout >532mm which represents the lowest marking rate since 1995.

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.*

This 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 24,113 Sea Lampreys was calculated as 25% of the average abundance estimated during the 5-year period 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 2016, the index of adult abundance in Lake Huron was estimated to be 27,383 (95% CI: 23,978 – 30,978), which was higher than the index target. The Sea Lamprey marking rate on Lake Trout is currently 4.0 A1-A3 marks per 100 Lake Trout >532 mm. This represents the first time in the time series that the marking rate has been less 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 Lampreys.

The adult index target for Lake Erie of 3,039 Sea Lampreys 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 2016, the index of adult Sea Lamprey abundance was 4,788 (95% CI; 2,716-6,860), which was greater than the index target. The Sea Lamprey marking rate on Lake Trout is currently 11.6 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 Lampreys is necessary for Lake Trout rehabilitation and stated a specific objective for Sea Lampreys:

- *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 was first calculated using the same marking statistics as the other lakes (A1-A3 marks). During 2006, the target and range were revised using A1 marks exclusively, which have been more consistently recorded on Lake Ontario. Also, 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 11,368 Sea Lampreys 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 2016, the index of adult Sea Lamprey abundance was 7,191 (95% CI; 4,310-10,072), which was less than the index target. The Sea Lamprey marking rate on Lake Trout is currently 1.4 A1 marks per 100 Lake Trout >431mm.

LAMPRICIDE CONTROL

Tributaries harboring larval Sea Lampreys are treated periodically with lampricides to eliminate or reduce larval populations before they recruit to the lake as feeding juveniles. During stream treatments, Service and Department 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 95% 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 Lampreys 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. The task force's progress on SLCB charges during 2016 is presented in the LCTF section of this report.

During 2016, lampricide treatments were conducted on 101 tributaries and 17 lentic areas of the Great Lakes (Table 1). Historical control efforts compared to 2016 control efforts are presented in Figure 1.

Table 1. Summary of lampricide applications in tributaries of the Great Lakes in 2016.

Lake	Number of Streams	Number of Lentic	Discharge (m^3/s)	Distance Treated (km)	TFM (kg) [1,2]	Bayluscide (kg) [1,3]
Superior	50	12	340.1	1117.0	31,610.2	1,018.3
Michigan	14	2	145.5	985.5	21,798.2	269.5
Huron	24	3	84.2	452.0	15,104.2	1,681.8
Erie	3	0	15.6	128.8	5,656.6	0.0
Ontario	10	0	31.5	220.0	5,667.7	23.6
Total	**101**	**17**	**616.9**	**2,903.3**	**79,836.9**	**2,993.2**

[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.

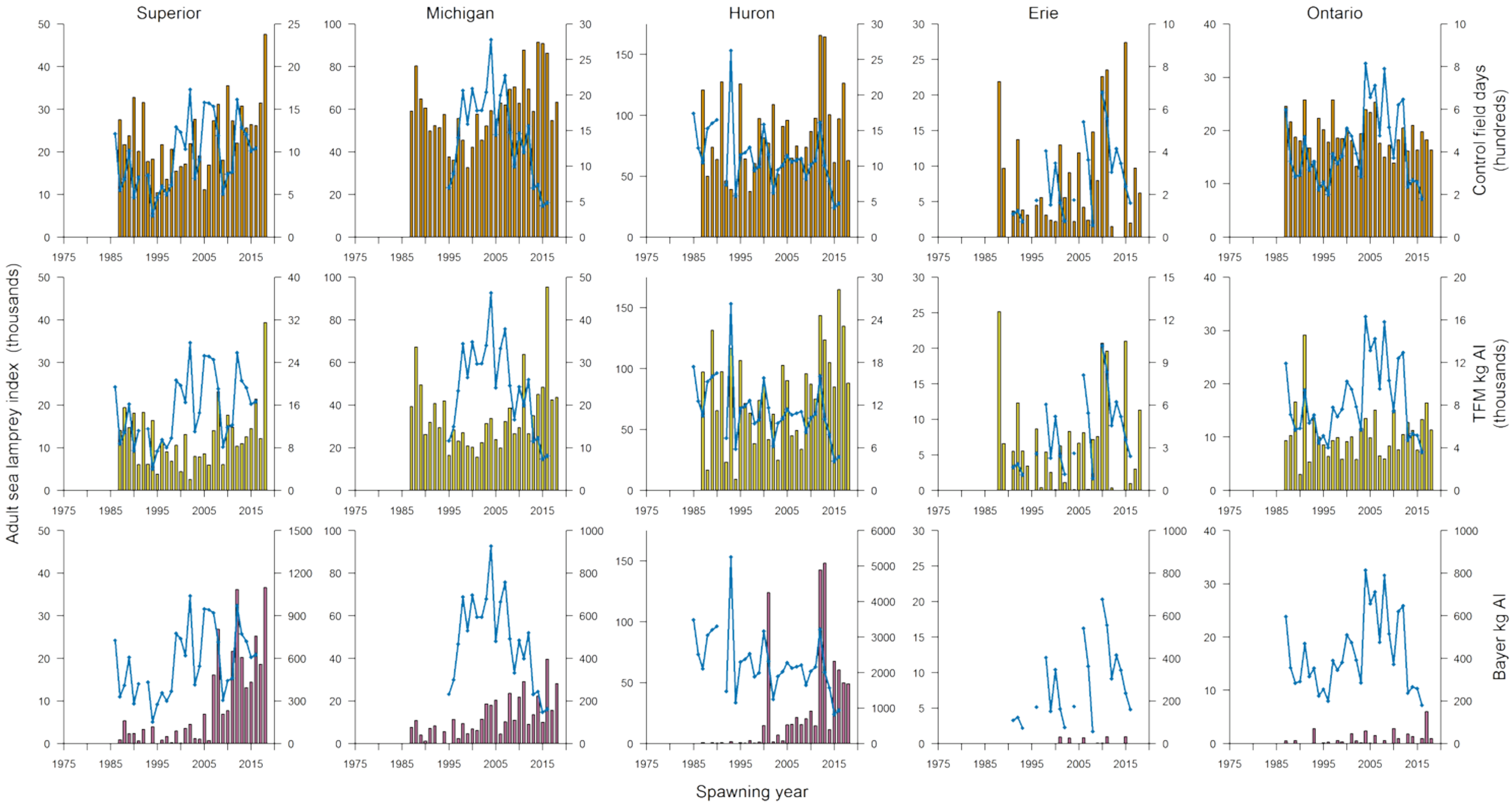


Figure 1. Row 1: Number of control field days (orange bars). Row 2: TFM used (kg active ingredient, yellow bars). Row 3: Bayluscide used (kg active ingredient, purple bars). All rows: Index of adult Sea Lampreys is shown with blue lines. All metrics plotted against the Sea Lamprey spawning year. Control metrics are offset by 2 years, e.g., control applied during 2006 is plotted on the 2008 spawning year - the year the treatment effect would first be observed in the adult Sea Lamprey population.

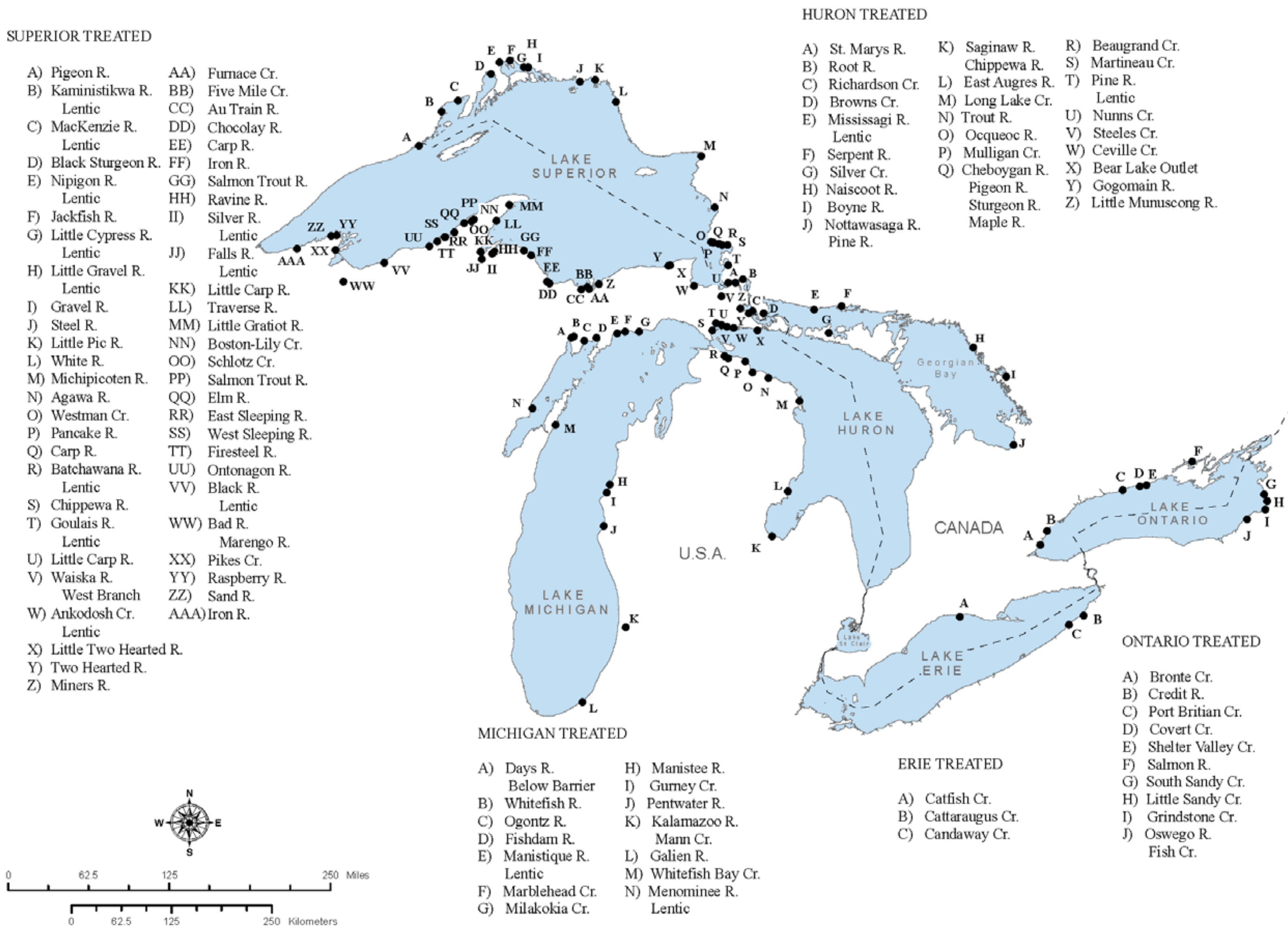


Figure 2. Location of tributaries treated with lampricide in 2016.

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, 119 tributaries (43 Canada, 76 U.S.) have been treated with lampricides at least once during 2007–2016. Fifty-three tributaries (19 Canada, 34 U.S.) are treated every 4–6 years. Details on lampricide applications to Lake Superior tributaries and lentic areas during 2016 are found in Table 2 and Figure 2.

- Lampricide treatments were completed in 50 tributaries (19 Canada, 31 U.S.) and in 12 lentic areas (9 Canada, 3 U.S.).

- This was the first year of a three-year targeted strategy to treat significant larval sea lamprey producers in each of the upper Great Lakes in consecutive years beginning with Lake Superior.

- Pikes Creek (Bayfield County) and Schlotz Creek (Houghton County) were treated for the first time.

- Raspberry River (Bayfield County) was treated for the first time since 1963. Staff from the Red Cliff Band of Lake Superior Tribe of Chippewa Indians provided support during the treatment.

- Unseasonably high stream discharge facilitated effective treatments in the Ravine, Silver, Ontonagon, Little Carp, and Traverse rivers which have historically produced residual Sea Lampreys. High densities of residual Sea Lampreys were observed during the Little Carp River treatment which was last treated in 2015 during low water conditions.

- Roland Lake Outlet (Ravine River tributary) was treated for the first time during the Ravine River treatment. Four year classes of larval Sea Lampreys were observed and the tributary was likely contributing to the residual population of Sea Lampreys in the system.

- A larger than historical lentic area was treated with gB off the mouth of the MacKenzie River, which had been treated with TFM on the previous day. Non-target mortality was greater than expected, triggering an immediate investigation by Department field staff and initiation of the GLFC Communications Protocol. The majority of fish collected belonged to four species, Common White Sucker, Trout-perch (*Percopsis omiscomaycus*), Longnose Dace (*Rhinichthys cataractae*), and Lake Chub (*Couesius plumbeus*). The exact causes of non-target mortality are unknown, however; exposure to sub-lethal concentrations of TFM prior to and during the gB treatment, warm water temperatures, and the pattern of application may have acted individually or in combination to increase the susceptibility on non-target species. A 6(a)2 report was filed with the United States Environmental Protection Agency.

- The Pays Plat River was removed from the schedule based on larval assessment data collected during 2016.

- The Jarvis River was scheduled to be treated for the first time; however, the treatment was deferred until 2017 due to low stream discharge.

Table 2. Details on the application of lampricides to tributaries and lentic areas of Lake Superior during 2016 (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)	Aug-17	9.3	4.9	440.3	---	---	5.3	---
Kaministiquia R. (B)	Jul-22	40.2	122.3	3,491.8	6.9	---	30.6	0.5
Lentic	Aug-21	---	---	---	---	---	---	47.8
Mackenzie R. (C)	Aug-22	0.9	0.6	88.0	---	---	---	0.1
Lentic	Aug-22	---	---	---	---	---	---	156.2
Black Sturgeon R.(D)	Aug-19	14.3	16.9	1,197.6	0.6	---	16.4	0.1
Nipigon R. (E)	Aug-16	82.2	11.6	6,345.5	7.3	80.3	29.4	0.5
Lentic	Aug-13	---	---	---	---	---	---	73.5
Cash Cr. lentic	Sep-25	---	---	---	---	---	---	23.3
Lake Helen lentic	Aug-17	---	---	---	---	---	---	63.7
Jackfish R.(F)	Oct-2	3.8	10.9	211.7	---	---	---	0.1
Little Cypress R.(G)								
Lentic	Aug-11	---	---	---	---	---	---	18.4
Little Gravel R. (H)								
Lentic	Aug-11	---	---	---	---	---	---	14.7
Gravel R. (I)	Aug-10	1.4	14.0	231.5	1.2	---	---	0.1
Lentic	Aug-12	---	---	---	---	---	---	175.1
Steel R. (J)	Jul-27	7.5	6.7	820.8	---	---	0.6	---
Little Pic R. (K)	Jul-18	6.7	33.4	1,661.0	9.8	---	---	0.6
White R. (L)	Jul-15	24.3	5.3	2,571.5	0.8	---	29.4	0.1
Michipicoten R. (M)	Aug-11	43.3	22.2	2,726.4	---	---	32.3	0.1
Lentic	Aug-11	---	---	---	---	---	---	26.9
Agawa R. (N)	Jun-22	10.5	12.3	471.7	---	---	---	0.6
Westman Cr. (O)	Jun-29	0.1	0.8	1.5	0.1	---	---	0.1
Pancake R. (P)	Jun-21	0.7	12.3	53.2	0.3	---	---	0.1
Carp R. (Q)	Jun-28	0.5	8.2	30.3	---	---	---	0.1
Batchawana R. (R)	Jun-22	7.6	12.5	462.4	0.6	---	4.7	0.2
Lentic	Jun-23	---	---	---	---	---	---	91.9
Chippewa R. (S)	Jun-28	2.7	3.0	187.0	---	---	---	---
Goulais R. (T)	Jun-29	23.2	119.6	2,042.7	7.5	---	---	0.6
Lentic	Oct-20	---	---	---	---	---	---	21.4
Little Carp R. (U)	May-12	0.2	2.6	9.5	---	---	---	0.1
Total (Canada)		**279.6**	**420.1**	**23,044.4**	**35.1**	**80.3**	**148.7**	**716.9**

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]
United States								
Waiska R. (V)	Jun-07	0.5	18.7	47.8	1.0	---	---	---
Ankodosh Cr. (W)								
Lentic	Sep-22	---	---	---	---	---	---	6.5
Little Two Hearted R. (X)	Aug-15	0.5	22.5	122.9	---	---	---	---
Two Hearted R. (Y)	Aug-12	4.1	104.8	616.2	2.3	---	---	---
Miners R. (Z)	Jul-06	0.8	3.2	176.4	---	---	---	---
Furnace Cr. (AA)	Jul-06	0.3	0.8	46.3	---	---	---	---
Five Mile Cr. (BB)	Jul-07	0.1	1.0	0.7	---	---	---	---
AuTrain R. (CC)	Sep-08	5.5	30.6	1,006.6	---	---	5.6	0.1
Chocolay R. (DD)	Jul-15	5.1	45.7	636.0	0.6	---	---	---
Carp R. (EE)	Jul-20	2.5	8.1	377.8	0.2	---	---	---
Iron R. (FF)	Jun-22	1.8	4.8	158.0	---	---	---	---
Salmon- Trout R. (GG)	Jul-13	1.1	12.9	141.8	1.7	---	---	---
Ravine R. (HH)	Aug-26	0.8	12.1	50.0	0.6	---	---	---
Silver R. (II)	Aug-29	1.4	5.5	153.6	0.4	---	---	---
Lentic	Jun-16	---	---	---	---	---	---	121.9
Falls R. (JJ)	Aug-28	1.9	0.5	236.6	---	---	---	---
Little Carp R. (KK)	May-19	0.1	6.6	10.3	0.6	---	---	---
Traverse R. (LL)	May-21	0.5	16.7	35.3	1.3	---	---	---
Little Gratiot R. (MM)	Jun-29	0.6	0.8	33.8	0.8	---	---	---
Boston-Lily Cr. (NN)	Jun-30	0.3	7.7	25.0	0.4	---	---	---
Schlotz Cr. (OO)	Jul-07	0.2	2.1	26.5	0.2	---	---	---
Salmon- Trout R. (PP)	Jun-29	1.3	0.6	77.2	---	---	---	---
Elm R. (QQ)	Aug-25	0.5	1.3	63.9	1.0	---	---	---
East Sleeping R. (RR)	Jun-19	0.4	31.2	138.1	0.6	---	---	---
West Sleeping R. (SS)	Jun-16	0.3	10.3	26.1	0.4	---	---	---
Firesteel R. (TT)	Jul-28	1.0	74.1	292.5	2.5	---	---	---
Ontonagon R. (UU)	Oct-07	21.8	228.6	2,991.1	15.8	---	---	0.2
Black R. (VV)	Jun-28	2.8	1.6	345.4	---	---	---	---
Lentic	Jun-15	---	---	---	---	---	---	18.4
Bad R. (WW)								
Marengo R.	May-05	1.8	25.8	174.2	0.4	---	---	---
Pikes Ck. (XX)	May-10	0.5	1.8	52.9	0.2	---	---	---
Raspberry R. (YY)	May-08	0.1	3.1	13.2	0.2	---	---	---

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]
Sand R. (ZZ)	Jul-28	0.3	10.3	60.3	---	---	---	---
Iron R. (AAA)	Aug-01	1.6	3.1	363.0	---	---	---	---
Total (United States)		**60.5**	**696.9**	**8,499.5**	**31.2**	**0.0**	**5.6**	**147.1**
Total for Lake		**340.1**	**1117.0**	**31,543.9**	**66.3**	**80.3**	**154.3**	**864.0**

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, 92 tributaries have been treated with lampricides at least once during 2007–2016. Twenty-nine tributaries are treated every 3–5 years. Details on lampricide applications to Lake Michigan tributaries and lentic areas during 2016 are found in Table 3 and Figure 2.

- Lampricide applications were conducted in 14 streams and 2 lentic areas.

- Marblehead Creek, which was deferred in 2015 due to low stream discharge, was successfully treated and contained high densities of Sea Lamprey larvae.

- Whitefish Bay Creek was treated for the first time since 1987.

- The Manistique River was treated during extremely high stream discharge that, while challenging, contributed to an effective treatment.

- The Manistee River treatment was highly successful with an estimated 98% treatment efficiency.

Table 3. Details on the application of lampricides to tributaries and lentic areas of Lake Michigan during 2016 (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]
Days R. (A)	Sep-13	0.8	6.9	195.6	---	---	---	---
Whitefish R. (B)	Jun-05	14.7	122.4	2,562.9	11.9	4.8	---	---
Ogontz R. (C)	Jun-17	0.5	16.9	49.4	0.8	---	---	---
Fishdam R. (D)	Aug-01	0.7	29.9	146.9	0.8	---	---	---
Manistique R. (E)	Sep-21	73.7	547.1	6,492.3	18.3	8.0	17.9	---
Lentic	Sep-28	---	---	---	---	---	---	76.6
Marblehead Cr. (F)	May-23	0.1	4.2	21.2	---	---	---	---
Milikokia R. (G)	Oct-08	2.4	23.5	681.7	2.5	---	---	---
Manistee R. (H)	Aug-25	46.4	120.9	9,167.3	9.3	---	90.2	0.9
Gurney Cr. (I)	Jul-07	0.3	4.8	59.7	---	---	---	---
Pentwater R. (J)	Jul-18	1.6	50.7	563.5	1.2	---	---	---
Kalamazoo R. (K)								
Mann Cr.	Jul-07	0.1	1.6	23.3	---	---	---	---
Galien R. (L)	Jun-04	3.8	53.4	1,679.0	8.7	---	---	---
Whitefish Bay Cr. (M)	May-19	0.4	3.2	101.9	---	---	---	---
Menominee R. (N)								
Lentic	Jul-05	---	---	---	---	---	---	83.9
Total for Lake		**145.5**	**985.5**	**21,744.7**	**53.5**	**12.8**	**108.1**	**161.4**

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, 84 tributaries (37 Canada, 47 U.S.) have been treated with lampricide at least once during 2007– 2016. Forty-five tributaries (21 Canada, 24 U.S.) are treated every 3–5 years. Details on lampricide applications to Lake Huron tributaries and lentic areas during 2016 are found in Table 4 and Figure 2.

- Lampricide applications were completed in 24 tributaries (9 Canada, 15 U.S.), 3 lentic area (1 Canada, 2 U.S.) and 328 hectares of the St. Marys River (see Table 1). Five St. Marys River plots were re-ranked based on an expected 75% reduction during the first treatment and were re-treated to remove residual larvae.

- The Chippewa and Pine rivers (Saginaw River) were successfully treated together, thereby maintaining minimum lethal concentrations to the mouth of the Chippewa River for the first time.

- Beaugrand Creek was treated for the first time.

- Boyne River and Richardson Creek were added to the treatment schedule due to the presence of large larvae found during 2016 surveys.

- The Garden River treatment was deferred.

- Silver Creek will be re-treated in 2017 due to the presence of residual lamprey from the 2016 treatment.

- Sturgeon River lentic was added to the treatment schedule after larval assessment discovered a sizeable larval population during survey efforts.

Table 4. Details on the application of lampricides to tributaries and lentic areas of Lake Huron during 2016 (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>								
St. Marys R. (A)	Jun-20	---	---	---	---	---	---	1,523.5
Whitefish Ch.	Jul-17	0.4	0.7	39.6	---	---	---	0.1
Root R. (B)	May-10	1.6	33.0	139.7	2.3	---	---	0.2
Richardson Cr. (C)	Aug-8	0.3	4.9	129.6	---	---	---	---
Brown's Cr. (D)	May-12	0.1	0.9	5.6	---	---	---	---
Mississagi R. (E)	Jul-26							
Lentic		---	---	---	---	---	---	53.3
Serpent R. (F)	Jun-3	13.6	10.3	498.5	0.2	---	---	0.1
Silver Cr. (G)	Jun-6	0.4	5.1	85.4	---	---	---	---
Naiscoot R. (H)	May-26	6.3	17.8	209.2	0.4	---	---	0.1
Boyne R. (I)	Jun-8	1.9	7.2	99.0	---	---	---	---
Nottawasaga R. (J)								
Pine R.	May-31	3.3	50.8	1,088.7	---	---	---	0.1
Total (Canada)		**27.9**	**130.7**	**2,295.3**	**2.9**	**0.0**	**0.0**	**1,577.4**
<u>United States</u>								
Saginaw R. (K)								
Chippewa R.	May-20	36.8	143.6	8,124.3	1.9	5.1	14.7	---
East Augres R. (L)	Jun-29	1.6	21.7	463.7	---	---	---	---
Long Lake Cr. (M)	Jun-29	0.5	3.9	139.1	---	---	---	---
Trout R. (N)	Jul-14	0.1	2.3	14.6	---	---	---	---
Ocqueoc R. (O)	Jul-15	1.7	5.8	502.3	10.1	---	---	---
Mulligan Cr. (P)	Jun-17	0.1	1.6	8.0	---	---	---	---
Cheboygan R. (Q)								
Pigeon R.	Sep-12	4.5	56.8	1,421.5	4.4	---	---	---
Sturgeon R.	Aug-15	7.6	32.5	1,238.3	6.9	---	16.9	22.0
Maple R.	Aug-13	2.1	12.2	644.3	5.6	---	---	---
Beaugrand R. (R)	Jun-16	0.1	1.4	---	---	---	---	---

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]
Martineau Cr. (S)	Oct-06	0.2	4.2	49.1	0.4	---	---	---
Pine R. (T)								
Lentic	Sep-21	---	---	---	---	---	---	50.8
Nunns Cr. (U)	Jul-29	0.1	3.9	43.2	---	---	---	---
Steeles Cr. (V)	Sep-09	0.1	1.4	21.8	---	---	---	---
Ceville Cr. (W)	Jul-19	0.1	3.1	4.4	---	---	---	---
Bear Lake Outlet (X)	Sep-08	0.1	1.3	0.7	1.3	---	---	---
Gogomain R. (Y)	Jul-20	0.2	4.0	29.5	---	---	---	---
Little Munuscong R. (Z)	Jul-12	0.4	21.6	69.1	1.5	---	---	---
Total (United States)		**56.3**	**321.3**	**12,773.9**	**32.1**	**5.1**	**31.6**	**72.8**
Total for Lake		**84.2**	**452.0**	**15,069.2**	**35.0**	**5.1**	**31.6**	**1,650.2**

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

Lake Erie

Lake Erie has 842 tributaries (525 Canada, 317 U.S.). Twenty-nine tributaries (11 Canada, 18 U.S.) have historical records of larval Sea Lamprey production. Of these, 17 tributaries (7 Canada, 10 U.S.) have been treated with lampricides at least once during 2007-2016. Eight tributaries (3 Canada, 5 U.S.) are treated every 3-5 years. Details on lampricide applications to Lake Erie tributaries and lentic areas during 2016 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 (one Canada, one U.S.), one of which required treatment during 2007-2016.

- Lampricide treatments were completed in 3 tributaries (1 Canada, 2 U.S.).

- The main branch of Catfish Creek was treated for the first time.

- Favorable conditions in early May resulted in a highly successful treatment of Cattaraugus Creek and its tributaries.

- The Grand River was deferred twice due to both high and low stream discharge and is scheduled for treatment during spring 2017.

Table 5. Details on the application of lampricides to tributaries and lentic areas of Lake Erie during 2016 (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								
Catfish Cr. (A)	Apr-26	2.7	26.4	650.1	---	---	---	0.1
Total (Canada)		**2.7**	**26.4**	**650.1**	**---**	**---**	**---**	**0.1**
United States								
Cattaraugus Cr. (B)	May-03	11.6	96.8	4,753.4	---	---	---	---
Canadaway Cr. (C)	May-05	1.3	5.6	253.1	---	---	---	---
Total (USA)		**12.9**	**102.4**	**5,006.5**	**---**	**---**	**---**	**---**
Total for Lake		**15.6**	**128.8**	**5,656.6**	**---**	**---**	**---**	**0.1**

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

Lake Ontario

Lake Ontario has 659 tributaries (405 Canada, 254 U.S.). Sixty-six tributaries (31 Canada, 35 U.S.) have historical records of larval Sea Lamprey production, and of these, 36 tributaries (18 Canada, 18 U.S.) have been treated with lampricides at least once during 2007-2016. Twenty-eight tributaries (14 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 2016 are found in Table 6 and Figure 2.

- Lampricide applications were conducted in 10 streams (6 Canada, 4 U.S.).

- Levi and Heritage creeks (Credit River tributaries) were treated for the first time.

Table 6. Details on the application of lampricides to tributaries of Lake Ontario during 2016 (letter in parentheses corresponds to location of stream in Figure 2).

Tributary	Date	Discharge (m^3/s)	Distance Treated (km)	Liquid TFM (kg)[1]	Solid TFM (kg)[1]	Wettable Powder Bayluscide (kg)[1]	Emulsifiable Concentrate Bayluscide (kg)[1]	Granular Bayluscide (kg)[1]
Canada								
Bronte Cr. (A)	Apr 22	3.5	41.4	1,624.8	---	---	---	0.1
Credit R. (B)	Jun 04	9.0	52.3	1,564.9	---	---	18.4	0.5
Port Britain Cr. (C)	Apr 18	0.4	1.4	111.3	---	---	---	0.1
Covert Cr. (D)	Apr 19	0.2	5.0	58.9	---	---	---	0.1
Shelter Valley Br. (E)	Apr 20	1.0	0.6	247.9	---	---	---	---
Salmon R. (F)	Jun 01	2.5	3.6	252.6	---	---	3.1	---
Total (Canada)		**16.6**	**104.3**	**3,860.4**	**0**	**0**	**21.5**	**0.8**
United States								
South Sandy Cr. (G)	Apr 20	3.8	12.0	512.1	0.2	2.1	---	0.1
Little Sandy Cr. (H)	May 27	0.5	13.1	74.5	---	---	---	0.1
Grindstone Cr. (I)	Apr 14	1.6	60.2	328.0	4.4	---	---	0.3
Oswego River. (J)								
Fish Cr.	May 29	9.0	30.4	887.8	0.3	---	---	0.1
Total (United States)		**14.9**	**115.7**	**1,802.4**	**4.9**	**2.1**	**0**	**0.6**
Total for Lake		**31.5**	**220.0**	**5,662.8**	**4.9**	**2.1**	**21.5**	**1.4**

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 Lampreys. During 2016, 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 USACE on the construction, operation, and maintenance of Sea Lamprey barriers. The task force's progress on SLCB charges during 2016 is presented in the BTF section of this report.

During 2016, there were 73 Sea Lamprey barriers in the Great Lakes basin that were either purpose-built to block Sea Lampreys (48), or constructed for other purposes (25), but modified to serve a Sea Lamprey control function (Figure 3).

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) and may be used to select barrier projects, monitor inspection frequency, schedule upstream larval assessments, assess the effects of barrier removal or modifications on Sea Lamprey populations, or identify structures that are important in controlling Sea Lampreys.

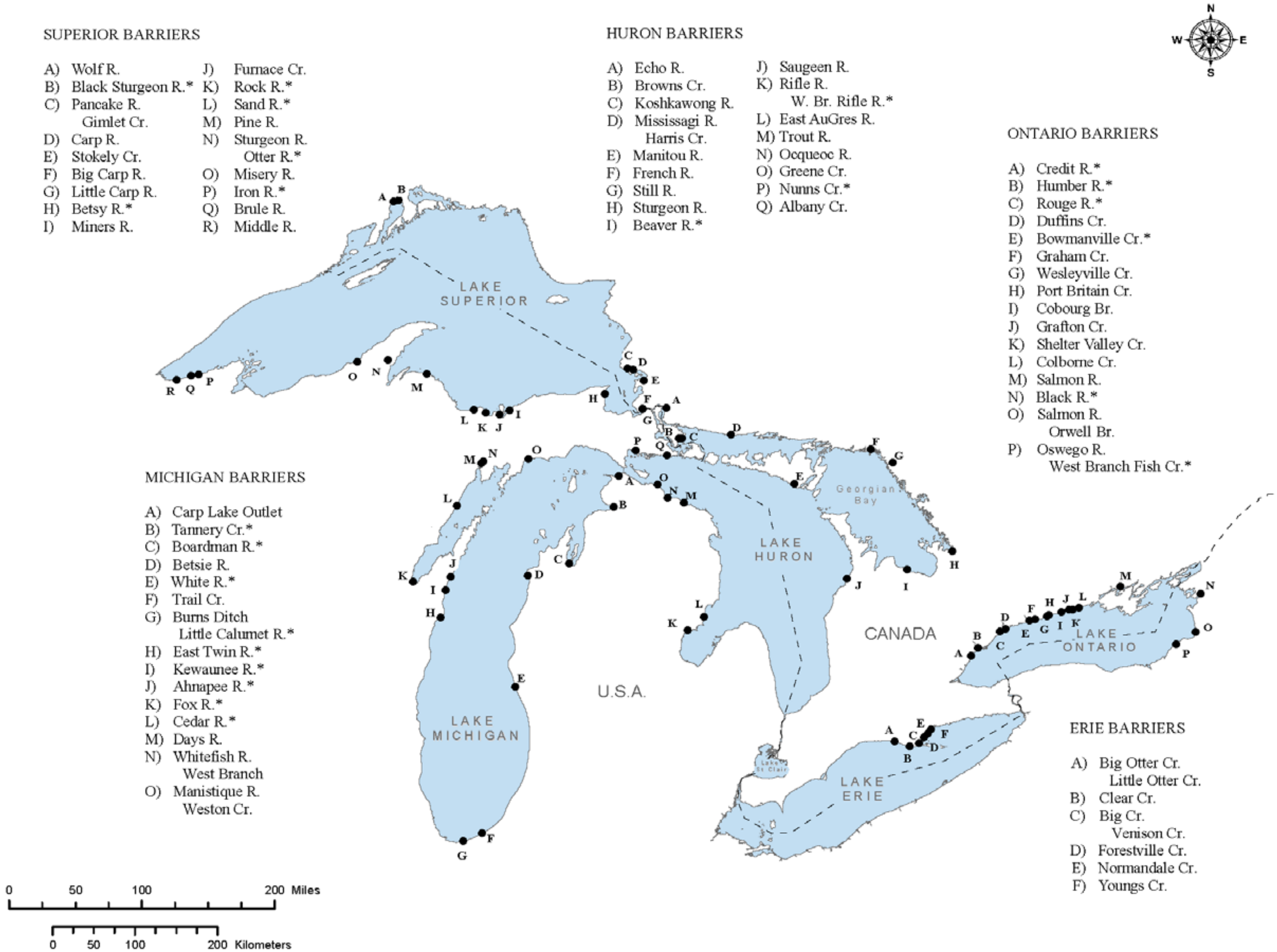


Figure 3. Locations of tributaries with Sea Lamprey barriers. Structures that have been modified or constructed by others that prevent the upstream migration of Sea Lampreys are indicated by an asterisk.

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 eight 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 16 barriers (6 Canada, 10 U.S.).

- Repairs or improvements were conducted on one Canadian and one U.S. barrier.

  - Gimlet Creek (Pancake River tributary) – Larval assessments indicated upstream escapement of adult Sea Lampreys, resulting in the establishment of one age class of larvae in either 2010 or 2011. During the spring of 2016, a stop log was added to raise the crest height to improve the sea lamprey control function of the barrier.

  - Middle River – A portion of the access road to the barrier site was resurfaced and graded and a second culvert was installed during the fall of 2016 to aid in diverting runoff.

Ensure Blockage to Sea Lamprey Migration

- Black Sturgeon River – The Ontario Ministry of Natural Resources and Forestry (OMNRF) initiated an Environmental Assessment (EA) of the proposed decommissioning of the Camp 43 Dam and construction of a new Sea Lamprey barrier 50 km upstream during 2012. The OMNRF has contracted the class EA to the KGS Group and a draft Environmental Study Report (ESR) has been released for public comment.

- Consultations to ensure blockage at barriers at seven sites in three streams were conducted with partner agencies (Table 7).

Table 7. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Superior tributaries during 2016.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Bad R.	Trib. to Brunsweiler R.	NFWF[1]	County Hwy C culvert	Concur	Ineffective barrier
Bad R.	Trib. to Krause Cr.	NFWF[1]	Gilgen Rd. culvert	Concur	Ineffective barrier
Bad R.	Four Corners Store Cr.	NFWF[1]	Four Corners Rd. culvert	Concur	Ineffective barrier
Bad R.	Sec. 33 Trib. to Marengo R.	NFWF[1]	Beckman Rd. culvert	Concur	Ineffective barrier
Bad R.	Marengo R.	NFWF[1]	Marengo Lake Rd. culvert	Concur	Ineffective barrier
St. Louis R.	Trib. to St. Louis R.	USFWS[2]	Overlie Rd. culvert	Concur	Ineffective barrier
Huron Lake Outlet		USFWS[2]	Waterfront Park Dam	Concur	Limited potential

[1]National Fish and Wildlife Foundation.
[2]U.S. Fish and Wildlife Service, Fish and Wildlife Conservation Office (Ashland).

New Construction

- Bad River – The 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 the feasibility study to site a new barrier and trap downstream from the Potato River junction (the location supported by the Bad River Tribe). The study indicated that the topography at this location would require a structure much larger than anticipated to block Sea Lampreys and would result in potential backwater effects. Personnel from the Service, the Natural Resources Department of the Bad River Band of Lake Superior Chippewa Indians (NRD), and the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) met to discuss alternate locations. The NRD is supportive of investigating the feasibility of barrier construction on the smaller high production tributaries to the Bad River. Permission to survey potential barrier locations in the Marengo River was requested during 2016.

- Whitefish River – Hydraulic analysis at the proposed barrier site was completed in 2014. However, construction of new barriers requires OMNRF authorization under the Federal-Provincial Agreement on Sea Lamprey Barrier Dams (1983). Previously, the province authorized new construction under the Lakes and Rivers Improvement Act, but it has since been determined that this provincial legislation is not binding to Canadian federal agencies. Because of uncertainty regarding authorization, the Canada-Ontario Fisheries Advisory Board (CONFAB) has recommended the establishment of a Federal-Provincial Sea Lamprey Barrier Working Group to review and revise, as necessary, the existing federal-provincial agreement and address other issues related to structures that serve a Sea Lamprey control function in Ontario. A committee comprised of OMNRF and Department personnel met in December 2016 and progress will be reported at the May 2017 CONFAB meeting. New sea lamprey barrier construction in Ontario streams is pending the results of this process.

- Fish community assessments were conducted in Big Trout Creek, a relatively new producer of Sea Lampreys that has been identified by the Department as a barrier candidate stream.

Lake Michigan

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

Barrier Inventory and Project Selection System (BIPSS)

- Field crews visited 70 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 37 barriers.

Ensure Blockage to Sea Lamprey Migration

- Boardman River – Removal of the Boardman Dam and construction of the Cass Road Bridge is scheduled to begin during 2017. Removal of Sabin Dam will occur during 2018 contingent upon Union Street Dam continuing to perform as a blocking structure to Sea Lampreys. The lower Boardman River was treated during August 2015. Treatment evaluation surveys during June 2016 found no Sea Lampreys.

- Indian River (Manistique River tributary) – Deteriorated stop logs were replaced and an additional row of new stop logs were added to the Intake Park Dam on the Indian River. No larval Sea Lampreys were detected upstream from this barrier, but they have been found immediately downstream of the structure.

- Grand River – The City of Grand Rapids along with several citizens groups are considering removing the 6th Street Dam on the Grand River to provide for 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 fishermen. A new inflatable crest structure that will theoretically act as a velocity barrier under high flows is proposed approximately one mile upstream of the current location. The USACE Engineer Research and Development Center performed an independent review of the current design plans and modeling components at Service request. The Service and DFO remain engaged and continue to coordinate on the project.

- Cedar River – Repairs to the Powers Dam were completed by Powers Township after the dam was breached during spring 2014. No larval Sea Lampreys were found upstream of the dam during August surveys.

- Little Manistee River - The Service is collaborating with the Michigan Department of Natural Resources (MIDNR) to develop operational procedures to reduce the length of time stop logs are removed in the fall/winter to reduce the transport of sand deposited upstream of the barrier.

- The Service provided field support to Michigan State University researcher, Dr. Michael Wagner, to conduct U.S. Environmental Protection Agency funded Sea Lamprey alarm substance field trials on the Carp Lake River Outlet. Alarm cue tests were conducted to determine whether trap efficacy could be increased by incorporating a naturally derived repellent (Sea Lamprey "alarm cue") alongside a synthesized partial sex pheromone (3kPZS) during the spawning migration. Initial results suggest that application of the repellent may be effective in moving migrants into the vicinity of trap entrances when traps are sited at barriers.

- Barrier removals/modification – Consultations to ensure blockage at barriers were conducted with partner agencies at 21 sites in 10 streams (Table 8).

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 project remained on hold while the USACE completed additional survey work and flood mapping to refine the list of affected landowners for Michigan Department of Environmental Quality permit requirements.

- Little Manistee River – The USACE is the lead agency on a project to replace the current dam at the MIDNR egg taking facility on the Little Manistee River. The current barrier height is insufficient to prevent Sea Lampreys from migrating upstream. The Preliminary Restoration Plan has been completed and includes an increase in barrier height and permanent traps. MIDNR has acquired state funding to upgrade the weir structure; close coordination between agencies will ensure a cost-effective project.

Table 8. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Michigan tributaries during 2016.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Big Sucker Cr.		MIDNR[1]	O'Neal Lake Dam	Concur	Modification
Grand R.	Lamberton Cr.	NFWF[2]	Veterans Park Dam	Concur	Upstream of blocking barrier
Jordan R.		NFWF[2]	Old State Rd. culvert	Concur	Ineffective barrier
Manistee R.	Dutchman Cr.	USFWS[3]	Dutchman Creek Dam	Concur	Ineffective barrier
Manistee R.	Trib. to Soper Cr.	USFWS[3]	Soper (Brooke) Fish Farm Dam	Concur	Upstream of blocking barrier
Manitowoc R.		WDNR[4]	Clark's Mills Dam	Do not concur	First blocking
Milwaukee R.		NFWF[2]	Kletzsch Park Dam	Concur	Ineffective barrier
Milwaukee R.		NFWF[2]	Estabrook Dam	Concur	Ineffective barrier
Muskegon R.	Bigelow Cr.	NFWF[2]	40th St. culvert	Concur	Ineffective barrier
Muskegon R.	West Br. Twinwood Cr.	NFWF[2]	40th St. culvert	Pending	Not funded
Muskegon R.	Bigelow Cr.	NFWF[2]	58th St. culvert	Pending	Not funded
Muskegon R.	Spruce Cr.	NFWF[2]	Spruce Rd. culvert	Concur	Ineffective barrier
Muskegon R.	Spruce Cr.	NFWF[2]	40th St. culvert	Concur	Ineffective barrier
Muskegon R.	Bigelow Cr.	NFWF[2]	Croton Dam Rd. culvert	Pending	Not funded
Muskegon R.	West Br. Twinwood Cr.	NFWF[2]	Walnut Rd. culvert	Pending	Not funded
Pere Marquette R.	Sanborn Cr.	USFWS[3]	Queens Hwy. culvert	Concur	Ineffective barrier
Pere Marquette R.	Sanborn Cr.	USFWS[3]	Spruce Rd. culvert	Concur	Ineffective barrier
Pere Marquette R.	Sanborn Cr.	USFWS[3]	Broadway Rd. culvert	Concur	Ineffective barrier
Pere Marquette R.	Sanborn Cr.	USFWS[3]	Foreman Rd. culvert	Concur	Ineffective barrier
St. Joseph R.	Portage R.	MIDNR[1]	Parkerville Dam	Concur	Upstream of blocking barrier

[1]Michigan Department of Natural Resources
[2]National Fish and Wildlife Foundation
[3]U.S. Fish and Wildlife Service, Fish and Wildlife Conservation Office (Green Bay).
[4]Wisconsin Department of Natural Resources.

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 10 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 12 barriers (5 Canada, 7 U.S.).

- Repairs or improvements were conducted on two Canadian barriers:

    - Still River – A log jam downstream from the barrier was removed to ensure proper function of the barrier.

    - Echo River – Design drawings were completed to facilitate replacement of the existing Sea Lamprey trap and construction is planned for 2017.

- The electrical field of the combination low-head/electrical barrier in the Ocqueoc River was active from March 7 until August 23. The barrier was electrified for most of March and April when water levels inundated the low-head barrier.

- Fish community assessments were conducted on the Echo, Koshkawong River, and the lower Saugeen rivers, and Brown's and Harris (Mississagi River tributary) creeks to evaluate the condition of fish communities in these streams where purpose built Sea Lamprey Barriers exist.

Ensure Blockage to Sea Lamprey Migration

- Cheboygan River – Plans to block adult Sea Lampreys at the Cheboygan lock and dam complex and to eradicate lampreys from the upper river continued:

    - Control and research agents continued discussion with the USACE and 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 GLFER funding through the USACE.

    - A study continued in the upper Cheboygan River to seek evidence of a landlocked Sea Lamprey population and to inform lock refurbishment plans. Between 2013 and 2016, fyke nets were set in three tributaries in the upper Cheboygan River to capture landlocked Sea Lampreys prior to lock operation (March – May). During 2016, no unmarked adult Sea Lampreys were captured in nets and the estimated adult population upstream of the lock is small (n<50). On July 11, the lower river trap was re-deployed to capture late run Sea Lampreys; the trap was fished for two weeks and one immature male was captured. Adult Sea Lamprey assessment in the Cheboygan River will continue during 2017 as described with the installation of a resistance weir and integrated trap in the Pigeon River.

- Saugeen River – The Saugeen Ojibway Nation (SON) and the Commission entered into an agreement to rehabilitate Denny's Dam to maintain its Sea Lamprey control function. Commission staff participated in a SON community meeting in July to discuss the proposed rehabilitation project. An engineering plan review and site visit was conducted in October. Several cultural and ecological studies are ongoing to determine the impacts of the project. Assuming successful completion of these studies and detailed design, specifications and construction drawings, the tendering process will be undertaken in the spring, with construction beginning in the summer.

- Nottawasaga River – Structural deterioration is evident at the Nicolston Dam near Alliston, Ontario, increasing the risk of Sea Lamprey escapement. Restoration of the dam will be conducted under new Government of Canada infrastructure initiative funding. A detailed engineering study, including geotechnical investigation and hydraulic analysis, is in progress. Detailed design, specifications and construction drawings, and tendering of construction is anticipated during 2017.

- Consultations to ensure blockage at barriers in five tributaries were completed with partner agencies at 14 sites in nine streams (Table 9).

New Construction

- Bighead River - Construction of a Sea Lamprey barrier has been proposed for Bighead River and a potential site has been identified on private land near Meaford, Ontario. However, construction of new barriers requires OMNRF authorization under the Federal-Provincial Agreement on Sea Lamprey Barrier Dams (1983). Previously, the province authorized new construction under the Lakes and Rivers Improvement Act, but it has since been determined that this provincial legislation is not binding to Canadian federal agencies. Because of uncertainty regarding authorization, the CONFAB has recommended the establishment of a Federal-Provincial Sea Lamprey Barrier Working Group to review and revise, as necessary, the existing federal-provincial agreement and address other issues related to structures that serve a Sea Lamprey control function in Ontario. A committee comprised of OMNRF and Department personnel met in December 2016 and progress will be reported at the May 2017 CONFAB meeting. New sea lamprey barrier construction in Ontario streams is pending the results of this process.

- Pine River (Nottawasaga River tributary) - A potential site has been identified within Canadian Forces Base Borden, near Angus, Ontario A field study, which included geotechnical investigation and a topographical survey, has been completed. An engineering consulting firm was contracted under Canadian Federal Infrastructure Initiative funding to prepare detailed design, specifications and construction drawings.

Experimental Barriers

- A portable electrical barrier was deployed in the Black Mallard River near Hammond Bay Biological Station during 2016 to block adult Sea Lampreys from migrating upstream. Results indicated that no adult Sea Lampreys migrated upstream of the barrier Further larval assessment work is required to confirm results. The seasonally operated barrier will be deployed prior to the start of the 2017 Sea Lamprey spawning run.

Table 9. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Huron tributaries during 2016.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Au Sable R.	South Br. Pine R.	USFWS[1]	Buhl Dam	Concur	Upstream of blocking barrier
Au Sable R.	Middle Br. Big Cr.	MIDNR[2]	Big Creek Dam	Concur	Upstream of blocking barrier
Black R.	South Br. Black R.	NFWF[3]	Lavergne Rd. culvert	Concur	Ineffective barrier
Cheboygan R.	Minnehaha Cr.	NFWF[3]	Maxwell Rd. culvert	Concur	Ineffective barrier
Cheboygan R.	Minnehaha Cr.	NFWF[3]	Pickerel Lake Rd. culvert	Concur	Ineffective barrier
Elliot Cr.		NFWF[3]	Alpena State Rd. culvert	Concur	Ineffective barrier
Elliot Cr.		NFWF[3]	Seffren Rd. culvert	Concur	Ineffective barrier
Pine Cr.	Sweiger Cr.	NFWF[3]	Truck Tr. culvert	Concur	Ineffective barrier
Pine Cr.	Vaughn Cr.	NFWF[3]	Heath Rd. culvert	Concur	Ineffective barrier
Rifle R.	Houghton Cr.	NFWF[3]	Heath Rd. culvert	Concur	Ineffective barrier
Rifle R.	Houghton Cr.	NFWF[3]	Beechwood Rd. culvert	Concur	Ineffective barrier
Saginaw R.	Shiawassee R.	MIDNR[2]	Corunna Dam	Concur	Ineffective barrier
Saugeen R.		DFO-FPP[4]	Truax Dam	Concur	Upstream of blocking barrier
Maitland R.		DFO-FPP[4]	Howson Dam	Concur	Limited potential

[1]U.S. Fish and Wildlife Service, Fish and Wildlife Conservation Office (Alpena).
[2]Michigan Department of Natural Resources.
[3]National Fish and Wildlife Foundation.
[4] Fisheries and Oceans Canada, Fisheries Protection Program.

Lake Erie

The Commission has invested in seven barriers on Lake Erie (Figure 3), all of which were purpose-built as Sea Lamprey barriers.

Barrier Inventory and Project Selection System (BIPSS)

- Field crews visited 15 structures on tributaries to Lake Erie 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 two Canadian barriers:

    - Big Otter Creek – Removal of the Rock's Mill Dam, which previously served as the first blocking structure in Big Otter Creek, has increased the area of infestation by Sea Lampreys by 30 km. The next upstream blocking structure, the Otterville Dam, was constructed in the 1800's and is in a state of disrepair. The Department has proposed the rehabilitation of the Black Bridge Dam located near Tillsonburg, Ontario approximately 10 km downstream of the Rock's Mill Dam site, as a Sea Lamprey barrier under Canada's federal Infrastructure Initiative. An engineering firm has been contracted to conduct engineering studies, and provide detailed design, specifications and construction drawings.

Once these are finalized, the Department intends to solicit bids for construction. Assuming a favorable bid is received, construction is planned for 2017.

- Big Creek – The computerized control system for the inflatable crest barrier failed during 2016 leading to operational issues related to crest height. As an alternative, a steel beam was placed across the stream so that the crest could be maintained in its fully-elevated position during the Sea Lamprey spawning run. Since 2012, elevation of the crest has been advanced to mid-March from early April in response to earlier warming of stream temperature, which presumably impacts the onset of the Sea Lamprey spawning migration. Larval assessments conducted since the last treatment in 2013 indicate that this strategy has been successful in preventing the upstream escapement of Sea Lampreys at the barrier, dramatically reducing the area of larval infestation and the length of stream requiring treatment. The lampricide application scheduled for 2017 will mark the first time that treatment will be confined to the area downstream from the barrier since its construction during 1996.

Ensure Blockage to Sea Lamprey Migration

- Cattaraugus Creek – The USACE, along with project partners Erie County and New York State Department of Environmental Conservation (NYSDEC) have approved the selected plan for the Springville Dam Ecosystem Restoration Project, restoring connectivity to approximately 113 km of Cattaraugus Creek upstream of the Springville Dam. The selected plan will lower a portion of the existing spillway, but the structure will still serve as a Sea Lamprey barrier. A rock riffle ramp with seasonal trapping and sorting operation is also included in the design. Construction is targeted for 2018.

- East Branch Chagrin River – Larval and habitat surveys were conducted above the Kirtland Country Club Dam during July 2016 to determine the production potential for sea lampreys in areas upstream of the dam, which has been proposed for removal.

- Consultation to ensure blockage at barriers were conducted with partner agencies at eight sites in five streams (Table 10).

New Construction

- Grand River – The USACE is the lead agency administering a project to construct a Sea Lamprey barrier to replace the deteriorated structure in the Grand River. Project partners include the Commission, Service, Ashtabula County MetroParks, and Ohio Department of Natural Resources. The USACE has selected an onsite rebuild as the preferred alternative and barrier design is currently under review. Construction is targeted to begin during 2018.

Table 10. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Erie tributaries during 2016.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Chagrin R.	East Br. Chagrin R.	ECT[1]	Kirtland Country Club Dam	Conditional	First blocking
Cuyahoga R.		OSMP[2]	Gorge Plant Dam	Conditional	First blocking
Cuyahoga R.		OEPA[3]	Brecksville Dam	Concur	Ineffective barrier
River Rouge		MIDNR[4]	Ford Estate Dam	Concur	Ineffective barrier
Rocky R.	Baldwin R.	RRWC[5]	Webster Rd. Dam	Concur	Ineffective barrier
Rocky R.	Baldwin R.	RRWC[5]	Lucerne Rd. Dam	Concur	Ineffective barrier
Rocky R.	Baldwin R.	RRWC[5]	Dam #4	Concur	Ineffective barrier
Grand R. (ON)	Middle Cr. Speed R.	DFO-FPP[6]	Dam	Concur	Upstream of blocking structure

[1]Environmental Consulting and Technology, Inc.
[2]Ohio Summit Metro Parks.
[3]Ohio Environmental Protection Agency.
[4]Michigan Department of Natural Resources.
[5]Rocky River Watershed Council.
[6]Fisheries and Oceans Canada, Fisheries Protection Program.

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 six were constructed for other purposes, but have been modified to block Sea Lamprey migrations.

Barrier Inventory and Project Selection System (BIPSS)

- Field crews visited 34 structures on tributaries to Lake Ontario 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 21 barriers (9 Canada, 12 U.S.).

Ensure Blockage to Sea Lamprey Migration

- Bowmanville Creek – A new fishway at the Goodyear Dam was constructed in 2014. Since then, there has been escapement of spawning phase Sea Lampreys in successive years, leading to the establishment of a larval population in upstream areas of the watershed. Department staff is communicating with the dam owner to identify potential routes of escapement and evaluate and implement remedial measures.

- Credit River – Escapement of Sea Lamprey at the Streetsville Dam has continued since it was rehabilitated to block Sea Lampreys in the mid-2000s. Improvements, including installation of an overhanging lip, were completed during 2013-2015. Data loggers were installed in fall of 2015 to monitor the hydraulic conditions at the barrier. A fall 2016 site meeting of Department and OMNRF representatives was convened to determine possible remediation. One potential avenue of escapement that was identified in a previous pit-tagging study is through the fishway that OMNRF and its partners operate. Remedial measures, including modification of the fishway and changes to operating procedures, are planned in cooperation with OMNRF prior to the spring 2017 migration.

- Consultations to ensure blockage were conducted with partner agencies at four sites in four streams (Table 11).

New Construction

- Rouge River – The Toronto Regional Conservation Authority (TRCA) has completed a draft Fisheries Management Plan (FMP), which included the recommendation of a Sea Lamprey barrier feasibility study. The FMP is consistent with the 2007 Rouge River Watershed Management Plan, which identifies the evaluation of the installation or maintenance of barriers to partition species or to exclude invasive species as a priority for the watershed. Portions of the watershed that were formerly under TRCA jurisdiction will be incorporated into an Urban National Park under Parks Canada (PC). Parks Canada has been apprised of the Department's barrier feasibility studies, and further discussion between the Department and PC is planned in spring 2017.

Table 11. Status of concurrence requests for barrier removals, replacements, or fish passage projects in Lake Ontario tributaries during 2016.

Mainstream	Tributary	Lead Agency	Project	SLCP Position	Comments
Genesee R.	Ludington Run	PCCD[1]	Ludington Run culvert	Concur	Ineffective barrier
Oswego R.	West Br. Onodaga Cr.	OEI[2]	Red Mill Rd. culvert	Concur	Ineffective barrier
Tonawanda Cr.	Crow Cr.	BNR[3]	Krotz Rd. culvert	Concur	Ineffective barrier
Humber R.	Albion Pond	DFO-FPP[4]	Dam removal	Concur	Upstream of blocking barrier

[1]Potter County Conservation District.
[2]Onodaga Environmental Institue.
[3]Buffalo Niagra River Keeper.
[4]Fisheries and Oceans Canada, Fisheries Protection Program.

Juvenile Trapping

- Trapping and depletion electrofishing for out-migrating Sea Lamprey juveniles was considered for the Potato River (Bad River tributary) beginning in early October 2016, but site access due to the summer flooding prohibited the efforts.

Sterile Male Release Technique

The Commission discontinued the Sterile Male Release Technique (SMRT) in the St. Marys River in 2012. Long-term monitoring of egg viability and larval populations are used to assess changes that may be attributable to termination of the SMRT.

- In 2016, the mean egg viability from 11 nests was 64%. The mean post-SMRT (2012-2016) egg viabilities (66%) are significantly higher than mean viabilities (32%) when SMRT was applied (1993-2011).

- The annual proportion of age-1 larvae (≤47mm) captured in the St. Marys River by deep-water electrofishing also provides an indication of recruitment. The proportion in 2016 was 69%. The mean proportion during post-SMRT years (73%) was higher than the mean proportion during SMRT years (42%).

ASSESSMENT

The SLCP has three assessment components and include the following:

1. Larval assessment 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 evaluates the lake-specific rate of Lake Trout marking inflicted by Sea Lampreys. 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 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. The task force's progress on SLCB charges during 2016 are presented in the LATF and TTF sections of this report (pages 97-103).

<u>Larval Assessment</u>

Tributaries considered for lampricide treatment during 2017 were assessed during 2016 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 Lampreys within a stream, detect new populations, evaluate lampricide treatments, and to establish the sites for lampricide application.

Lake Superior

- Larval assessments were conducted on 134 tributaries (53 Canada, 81 U.S.) and 22 lentic areas (10 Canada, 12 U.S.). The status of larval Sea Lamprey populations in historically infested Lake Superior tributaries and lentic areas is listed in Tables 12 and 13.

- Surveys to estimate larval abundance were conducted in 40 tributaries (13 Canada, 27 U.S.) and in lentic areas offshore of 11 tributaries (6 Canada, 5 U.S.).

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 32 tributaries (17 Canada, 15 U.S.). A new population was found in Flintsteel River, near Ontonagon, Michigan, and is scheduled for treatment in 2017. Additionally, a new population was found in Wild Goose Creek near Thunder Bay, Ontario. It did not rank for treatment but will be surveyed again in 2017.

- Post-treatment assessments were conducted in 45 tributaries (12 Canada, 33 U.S.) and 10 lentic areas (2 Canada, 8 U.S.) to determine the effectiveness of lampricide treatments conducted during 2015 and 2016. The Betsy and Huron rivers and Roxbury Creek are scheduled for 2017 treatments based on the presence of residual Sea Lampreys.

- Surveys to evaluate barrier effectiveness were conducted in 12 tributaries (2 Canada, 10 U.S.). No larval Sea Lampreys were detected upstream of these structures.

- Biological collections for research or training purposes were conducted in five U.S. tributaries. A total of 8,046 Sea Lamprey larvae were collected for research purposes from the Bad, Little Carp, Little Garlic, Salmon Trout, and West Sleeping rivers.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 58.87 kg active ingredient of gB (21.42 kg Canada, 37.45 U.S.; Table 14).

Table 12. Status of larval Sea Lampreys in Lake Superior tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2016.

			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
Canada							
East Davignon Cr.	May-72	Jul-15	---	No	---	---	Unknown
West Davignon Cr.	Jun-14	Jun-16	Yes	No	---	---	Unknown
Little Carp R.	May-16	Sep-15	---	---	---	---	Unknown
Big Carp R.	Sep-07	Jul-15	---	No	---	---	Unknown
Cranberry Cr.	May-11	Sep-16	---	Yes	12,400	1,908	***2017***
Goulais R.	Oct-16	Sep-16	---	---	---	---	2020[1]
Boston's Cr.	Never	Jun-14	---	No	---	---	Unknown
Horseshoe Cr.	Never	Aug-15	---	No	---	---	Unknown
Havilland Cr.	Jul-13	Jul-16	No	No	---	---	Unknown
Stokely Cr.	Jun-08	Jun-16	---	No	---	---	Unknown
Tier Cr.	Never	Jul-16	---	No	---	---	Unknown
Harmony R.	Jun-14	Jun-16	No	No	---	---	Unknown
Sawmill Cr.	Jul-11	Jul-16	---	Yes	---	---	Unknown
Jones Landing Cr.	Never	Jul-13	---	No	---	---	Unknown
Tiny Cr.	Never	Sep-15	---	No	---	---	Unknown
Chippewa R.	Jun-16	Aug-15	---	---	---	---	Unknown
Unger Cr.	Jul-10	Jul-16	---	No	---	---	Unknown
Batchawana R.	Jun-16	Jul-14	---	---	---	---	2020[1]
Digby Cr.	Jun-13	Aug-16	Yes	Yes	110	83	Unknown
Carp R.	Jun-16	Sep-16	No	No	---	---	2020[1]
Pancake R.	Jul-16	Sep-16	Yes	---	---	---	2020[1]
Westman Cr.	Jun-16	Sep-16	No	No	---	---	Unknown
Agawa R.	Jun-16	Jul-16	Yes	No	---	---	Unknown
Sand R.	Sep-71	Jul-15	---	Yes	---	---	Unknown
Baldhead R.	Never	Jul-15	---	No	---	---	Unknown
Gargantua R.	Aug-13	Jul-15	No	Yes	---	---	2018[1]
Old Woman R.	Jul-12	Jul-16	Yes	Yes	1,815	1,452	Unknown
Michipicoten R.	Aug-16	Aug-16	---	---	---	---	2020[1]
Dog R.	Aug-63	Jul-15	---	Yes	---	---	Unknown
White R.	Jul-16	Jul-15	---	---	---	---	Unknown
Pic R.	Jul-13	Jul-14	No	No	---	---	2019[1]
Nama Cr.	Aug-14	Jul-11	---	---			2019[1]
Little Pic R.	Jul-16	Jul-15	---	---	---	---	Unknown
Prairie R.	Jul-94	Jul-16	---	No	---	---	Unknown
Steel R.	Jul-16	Aug-16	No	---	---	---	2020[1]
Pays Plat R.	Jul-15	Jun-16	No	Yes	---	---	2020[1]
Little Pays Plat Cr.	Jul-15	Aug-15	No	---	---	---	Unknown
Gravel R.	Aug-16	Aug-16	No	---	---	---	2020[1]
Little Gravel R.	Jul-13	Aug-16	Yes	Yes	9,354	0	Unknown
Little Cypress	Aug-14	Aug-16	No	No	---	---	Unknown
Cypress R.	Jul-15	Aug-15	Yes	---	---	---	2019[1]
Jackpine R.	Never	Aug-16	---	Yes	---	---	Unknown
Jackfish R.	Oct-16	Aug-15	---	---	---	---	2020[1]
Nipigon R.							
Upper Nipigon R.	Aug-16	Aug-12	---	---	---	---	2020[1]

Table 12. *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
Lower Nipigon R.	Aug-06	Aug-16	---	Yes	---	---	Unknown
Cash Cr.	Oct-15	Aug-16	Yes	---	---	---	Unknown
Polly Cr.	Jul-87	Aug-16	---	Yes	---	---	Unknown
Stillwater Cr.	Aug-13	Aug-16	Yes	Yes	---	---	***2017***[1]
Big Trout Cr.	Jul-15	Aug-15	No	---	---	---	Unknown
Otter Cove Cr.	Aug-71	Jun-12	---	No	---	---	Unknown
Black Sturgeon R.	Aug-16	Aug-15	---	---	---	---	Unknown
Big Squaw Cr.	Jun-72	Aug-14	---	No	---	---	Unknown
Wolf R.	Jul-15	Aug-15	Yes	---	---	---	2019[1]
Coldwater Cr.	Jul-12	Aug-15	No	No	---	---	Unknown
Pearl R.	Jul-15	Aug-15	No	---	---	---	Unknown
D’Arcy Cr.	Jul-10	Aug-16	---	Yes	---	---	Unknown
Blende Cr.	Jul-13	Aug-16	Yes	Yes	25,084	4,502	***2017***
MacKenzie R.	Aug-16	Aug-16	---	---	---	---	Unknown
Wild Goose Cr.	Never	Aug-16	---	Yes	1,645	383	Unknown
Neebing-McIntyre FW	Jul-13	Sep-16	Yes	Yes	243,130	16,490	***2017***
Kaministiquia R.	Sep-16	Aug-16	---	---	---	---	2019[1]
Corbett Cr.	Jul-16	Aug-15	---	---	---	---	2019[1]
Whitefish R.	Aug-16	Aug-15	---	---	---	---	2019[1]
Oliver Cr.	Jul-16	Aug-15	---	---	---	---	2019[1]
Jarvis R.	Never	Aug-15	---	Yes	6,910	2,764	***2017***
Cloud R.	Jul-12	Aug-16	Yes	Yes	74,998	31,578	***2017***
Pine R.	Jul-73	Aug-16	---	Yes	854	366	Unknown
Pigeon R.	Aug-16	Aug-15	---	---	---	---	Unknown
United States							
Waiska R.		Jul-14	No	No	---	---	Unknown
West Branch	Jun-16	Jun-16	---	---	---	---	Unknown
Sec 11SW Cr.	Never	Jul-13	---	Yes	---	---	Unknown
Pendills Cr.	Jul-12	Sep-16	No	Yes	---	---	Unknown
Grants Cr.	Aug-15	May-16	No	---	---	---	Unknown
Halfaday Cr.	Jul-12	Jul-14	Yes	Yes	---	---	Unknown
Naomikong Cr.	Jul-63	Jul-14	---	Yes	---	---	Unknown
Ankodosh Cr.	Aug-15	May-16	Yes	---	474	474	Unknown
Roxbury Cr.	Aug-15	Sep-16	Yes	No	2,186	1,856	***2017***
Galloway Cr.	Aug-15	May-16	Yes	---	104	104	Unknown
Tahquamenon R.	Oct-15	Sep-16	Yes	Yes	---	---	2019[1]
Betsy R.	Aug-15	May-16	Yes	---	5,400	5,400	***2017***
Three Mile Cr.	Jun-62	Sep-16	---	Yes	735	0	Unknown
Little Two Hearted R.	Aug-16	Jun-15	---	---	---	---	Unknown
Two Hearted R.	Aug-16	Jun-16	---	---	---	---	2020[1]
Dead Sucker R.	Aug-13	Sep-16	No	No	---	---	Unknown
Sucker R.	Jul-14	Sep-16	Yes	Yes	37,590	0	2018[1]
Chipmunk Cr.	Oct-61	Jun-15	---	No	---	---	Unknown
Carpenter Cr.	Aug-15	Oct-15	No	---	---	---	Unknown
Sable Cr.	Sep-89	Sep-16	---	Yes	---	---	Unknown
Hurricane R.	Never	Jun-15	---	No	---	---	Unknown
Sullivans Cr.	Jul-15	Oct-15	No	Yes	---	---	Unknown

Table 12. *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			
Seven Mile Cr.	Jul-67	Jun-15	---	Yes	---	---	Unknown
Beaver Lake Cr.							
Lowney Cr.	Aug-15	Jun-16	Yes	---	583	291	Unknown
Little Beaver Cr.	Sep-87	Sep-16	---	Yes	142	0	Unknown
Mosquito R.	Jun-73	Jul-14	---	No	---	---	Unknown
Miners R.							
Barrier downstream	Jul-16	Sep-16	No	Yes	---	---	2020[1]
Barrier upstream	Jul-13	Jul-15	No	No	---	---	Unknown
Munising Falls Cr.	Sep-64	Jun-14	---	No	---	---	Unknown
Anna R.	Jul-13	Jul-15	Yes	Yes	---	---	Unknown
Tourist Park Cr.	Never	Jul-16	---	Yes	---	---	Unknown
Furnace Cr.							
Lower	Sep-10	Oct-16	Yes	Yes	435	198	***2017***
Upper	Sep-10	Oct-16	---	No	---	---	Unknown
Five Mile Cr.	Jul-16	Jul-15	---	---	---	---	Unknown
Au Train R.					---	---	
Upper	Sep-16	Aug-16	---	---	---	---	Unknown
Lower	Sep-16	Aug-16	---	---	---	---	Unknown
Rock R.	Jul-02	Jun-14	---	No	---	---	Unknown
Deer Lake Cr.	Aug-70	Oct-16	---	No	---	---	Unknown
Laughing Whitefish R.	Jul-14	Aug-16	Yes	Yes	27,975	9,957	***2017***
Sand R.					---	---	
Below Dam	Jul-15	Oct-15	No	---	---	---	Unknown
Above Dam	Jul-15	Sep-15	No	---	---	---	Unknown
Chocolay R.	Jul-16	Oct-16	No	---	---	---	2020[1]
Carp R.	Jul-16	Oct-16	Yes	---	---	---	Unknown
Compeau Cr.	Never	Jun-16	---	Yes	---	---	Unknown
Dead R.	Aug-14	Jun-15	---	No	---	---	Unknown
Harlow Cr.	Jul-15	Aug-16	No	Yes	---	---	Unknown
Little Garlic R.	Aug-14	Aug-16	Yes	Yes	7,275	1,532	***2017***
Garlic R.	Jun-15	Jun-16	Yes	Yes	---	---	2019[1]
Iron R.	Jun-16	Oct-16	No	Yes	---	---	2020[1]
Salmon Trout R. (Marquette Co.)	Jul-16	Oct-16	No	Yes	---	---	2020[1]
Pine R.	Jun-15	Sep-15	No	Yes	---	---	Unknown
Huron R.	Sep-15	Jun-16	Yes	---	7,054	2,016	***2017***
Ravine R.	Aug-16	Jul-16	---	---	530	240	***2017***[1]
Slate R.	Sep-13	Aug-16	Yes	Yes	62	46	Unknown
Silver R.	Aug-16	May-16	---	---	---	---	***2017***[1]
Falls R.	Aug-16	Jul-13	---	---	---	---	***2017***[1]
Six Mile Cr.	May-63	Jul-14	---	Yes	---	---	Unknown
Little Carp R.	May-16	Aug-16	No	No	---	---	Unknown
Kelsey Cr.	Never	Aug-16	---	Yes	---	---	Unknown
Sturgeon R.	Sep-15	Jul-16	Yes	---	---	---	2019[1]
Pilgrim R.	Aug-62	Jun-15	---	Yes	---	---	Unknown
Trap Rock R.	Aug-15	Aug-16	Yes	Yes	7,920	2,160	***2017***
McCallum Cr.	Aug-63	May-15	---	No	---	---	Unknown
Traverse R.	May-16	Sep-16	No	No	---	---	2019[1]
Little Gratiot R.	Jun-16	Jun-16	---	---	---	---	Unknown

Table 12. *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			
Eliza Cr.	Aug-15	Aug-16	Yes	No	28	0	Unknown
Gratiot R.	Jul-15	Aug-16	Yes	Yes	3,927	0	Unknown
Smith's Cr.	May-64	Jun-14	---	No	---	---	Unknown
Boston-Lily Cr.	Jun-16	Aug-16	Yes	Yes	---	---	Unknown
Schlotz Cr.	Jul-16	Sep-16	No	---	---	---	Unknown
Salmon Trout R.	Jun-16	Sep-16	No	---	---	---	Unknown
Mud Lake Outlet	Oct-73	Sep-15	---	Yes	---	---	Unknown
Graveraet R.	Aug-15	Sep-16	Yes	Yes	1,516	350	Unknown
Elm R.	Aug-16	Aug-15	---	---	---	---	Unknown
Misery R.					---	---	Unknown
Barrier downstream	Jul-15	May-16	No	---	---	---	2018[1]
Barrier upstream	Aug-00	Jul-16	---	No	---	---	Unknown
East Sleeping R.	Jun-16	Sep-16	No	---	1,163	0	2019[1]
West Sleeping R.	Jun-16	Sep-16	Yes	---	3,316	0	Unknown
Firesteel R.	Jul-16	May-16	---	---	---	---	2020[1]
Flintsteel R.	Never	Aug-16	---	Yes	18,908	13,751	***2017***
Ontonagon R.	Oct-16	Aug-16	---	---	---	---	2020[1]
Potato R.	Jun-14	Aug-16	Yes	Yes	32,806	16,516	***2017***[1]
Floodwood R.	Never	Jul-14	---	No	---	---	Unknown
Cranberry R.	Jun-14	Aug-16	Yes	Yes	207,433	74,568	***2017***[1]
Mineral R.	Jun-14	Aug-16	Yes	Yes	19,267	8,299	***2017***
Big Iron R.	Never	Aug-15	---	Yes	---	---	Unknown
Little Iron R.	Sep-75	Aug-15	---	Yes	---	---	Unknown
Union R.	May-64	Jul-13	---	No	---	---	Unknown
Black R.	Jun-16	Jul-15	---	---	---	---	Unknown
Montreal R.	Jul-75	Aug-13	---	Yes	---	---	Unknown
Washington Cr.	Jun-80	Jul-12	---	No	---	---	Unknown
Bad R.	Oct-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Marengo River	May-16	Sep-16	No	No	---	---	***2017***[1]
Fish Cr. (Eileen Twp)	Jun-15	Sep-15	No	---	---	---	Unknown
Sioux R.	Sep-14	Jul-15	No	No	---	---	Unknown
Pikes Cr.	May-16	Aug-16	No	No	---	---	Unknown
Red Cliff Cr.	Jun-15	Aug-15	No	Yes	---	---	Unknown
Raspberry R.	May-16	Sep-16	No	No	---	---	Unknown
Sand R.	Jul-16	Sep-16	No	---	---	---	Unknown
Cranberry R. (Bayfield	Jul-13	Sep-16	No	Yes	3,926	2,748	***2017***[1]
Iron R.							
Barrier downstream	Aug-16	Jul-15	---	---	---	---	Unknown
Barrier upstream	Oct-64	Aug-16	---	No	---	---	Unknown
Reefer Cr.	Oct-64	Sep-16	---	Yes	---	---	Unknown
Fish Cr. (Orienta Twp)	Oct-64	Sep-16	---	No	---	---	Unknown
Brule R.					---	---	Unknown
Barrier downstream	Jun-15	Sep-15	Yes	---	---	---	2019[1]
Barrier upstream	Jun-86	Jul-16	---	No	---	---	Unknown
Poplar R.	Jun-15	Sep-15	Yes	---	---	---	Unknown
Middle R.					---	---	Unknown
Barrier downstream	Jul-13	Sep-16	No	Yes	7,740	2,996	***2017***

Table 12. *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
Barrier upstream	Jun-02	Aug-16	---	No	---	---	Unknown
Amnicon R.	Jun-15	Sep-15	Yes	---	---	---	2018[1]
Nemadji R.	Oct-14	Sep-16	Yes	Yes	21,047	4,079	Unknown
St. Louis R.	Sep-87	Aug-14	---	No	---	---	Unknown
Sucker R. (St. Louis Co.)	Never	Jun-14	---	No	---	---	Unknown
Gooseberry R.	Aug-76	Jul-15	---	No	---	---	Unknown
Splitrock R.	Aug-76	Jun-14	---	No	---	---	Unknown
Poplar R.	Jul-77	Jul-15	---	No	---	---	Unknown
Arrowhead R.	Jun-09	Aug_16	---	Yes	3,180	374	Unknown

[1] Stream being treated based on expert judgment

Table 13. Status of larval Sea Lampreys in historically infested lentic areas of Lake Superior during 2016.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Canada				
Goulais R.	Goulais Bay	Sep-16	Jul-15	Oct-16
Havilland Cr.	Havilland Bay	Jul-14	Jul-14	Jun-15
Stokely Cr.	Havilland Bay	Jun-13	Jul-09	Aug-11
Harmony R.	Batchawana Bay	Sep-16	Sep-16	Aug-14
Chippewa R.	Batchawana Bay	Jul-14	Jul-14	Jun-15
Batchawana R.	Batchawana Bay	Sep-14	Jul-14	Jun-16
Carp R.	Batchawana Bay	Sep-16	Sep-16	Aug-07
Pancake R.	Pancake Bay	Jun-14	Jun-14	Never
Agawa R.	Agawa Bay	Jul-14	Jul-14	Aug-10
Michipicoten R. (Lower)	Marina Area	Jul-15	Aug-12	Aug-16
Pays Plat R.	Pays Plat Bay	Aug-16	Aug-16	Never
Gravel R.	Mountain Bay	Aug-15	Aug-15	Aug-16
Little Gravel R.	Mountain Bay	Aug-15	Aug-15	Aug-16
Little Cypress R.	Cypress Bay	Aug-15	Aug-15	Aug-16
Cypress R.	Cypress Bay	Aug-16	Aug-16	Aug-15
Jackpine R.	Nipigon Bay	Aug-16	Aug-16	Never[1]
Jackfish R.	Nipigon Bay	Aug-14	Aug-05	Never
Nipigon R.				
Poly Cr.	Poly Lake	Jun-12	Jul-90	Jul-87
Cash Cr.	Lake Helen	Aug-15	Aug-15	Sep-16
Nipigon R.	Lake Helen	Aug-15	Aug-15	Aug-16
Nipigon R (Lower).	Nipigon Bay	Aug-16	Aug-16	Aug-16
Stillwater Cr.	Nipigon Bay	Aug-13	Aug-13	Aug-13
Big Trout Cr.	Nipigon Bay	Aug-14	Aug-14	Oct-11
Black Sturgeon R.	Black Bay	Aug-11	Jul-04	Never
Wolf R.	Black Bay	Aug-16	Aug-16	Aug-15
D'Arcy Cr.	Black Bay	Aug-16	Aug-16	Never[1]
MacKenzie R.	MacKenzie Bay	Aug-16	Aug-16	Aug-16
Current R.	Thunder Bay	Aug-15	Aug-15	Aug-14
Neebing-McIntyre Floodway	Thunder Bay	Aug-14	Jul-90	Never
Kaministiquia R. (Lower)	Thunder Bay	Aug-16	Aug-16	Aug-16
Pigeon R.	Pigeon Bay	Aug-15	Aug-15	Aug-10[2]
United States				
Pendills Cr.	Tahquamenon Bay	Jul-12	Jul-12	Never[2]
Grants Cr.	Tahquamenon Bay	Aug-15	Aug-15	Never[2]
Halfaday Cr.	Tahquamenon Bay	Jul-12	Jul-12	Never[2]
Ankodosh Cr.	Tahquamenon Bay	Aug-15	Aug-15	Sep-16
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	Jun-16	Jun-16	Never[2]
Anna R.	Munising Bay	Aug-14	Aug-14	Aug-11
Miners R.	Miners Lake	Sep-13	Sep-13	Jun-11
Furnace Cr.	Furnace Bay	Jul-16	Jul-16	Aug-10[1]
	Furnace Lake – Outlet	Jun-12	Jun-12	Never[2]
	Furnace Lake – Offshore Hanson Cr.	Sep-10	Aug-09	Never[2]

Table 13. *continued.*

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Furnace Cr.	Furnace Lake – Offshore Gongeau Cr.	Sep-10	Aug-09	Never[2]
Five Mile Cr.	Offshore mouth	Jul-16	Jul-16	Never[2]
Carp R.	Offshore mouth	Jun-16	Jun-16	Jun-15
Dead R.	Presque Isle Harbor	Jun-16	Jun-16	Jun-15[1]
Harlow Cr.	Harlow Lake – Offshore Bismark Cr.	Jul-14	Jul-14	Never[2]
Little Garlic R.	Little Garlic R.	Aug-11	Aug-11	Jul-12
Garlic R.	Garlic R. offshore mouth	Jul-12	Sep-05	Never[2]
	Saux Head Lake	Jun-16	Jun-16	Jun-15
Ravine R.	Huron Bay	Jul-16	Jul-16	Sep-15
Slate R.	Huron Bay	Jul-16	Jul-16	Sep-15
Silver R.	Huron Bay	Aug-15	Aug-15	Aug-16
Falls R.	Huron Bay	Jul-16	Jul-16	Sep-15
Trap Rock R.	Torch Lake	Jun-16	Jun-16	Sep-15
Eliza Cr.	Eagle Harbor	Jun-16	Jun-16	Never[2]
Mineral R.	Offshore mouth	Sep-11	Sep-11	Never[2]
Black R.	Black River Harbor	Aug-15	Aug-15	Jun-16
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]
Amnicon R.	Superior Bay	Aug-15	Aug-12	Never

[1] Scheduled for treatment during 2017

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

Table 14. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Superior for larval assessment purposes during 2016.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
United States		
Tahquamenon River (Lotic)	3.48	0.62
Carpenter Creek (Lentic)	1.74	0.31
Beaver Lake Creek (Lentic)	4.94	0.88
Furnace Creek (Lentic)	3.48	0.62
Five Mile Creek (Lentic)	1.74	0.31
Carp River (Lentic)	2.32	0.41
Dead River (Lentic)	2.32	0.41
Garlic River (Lentic)	1.74	0.31
Ravine River (Lentic)	2.76	0.41
Slate River (Lentic)	2.32	0.41
Falls River (Lentic)	2.32	0.41
Trap Rock River (Lentic)	2.32	0.41
Little Gratiot River (Lotic)	1.16	0.21
Eliza Creek (Lentic)	1.16	0.21
Flintsteel River (Lotic)	0.58	0.10
Ontonagon River (Lotic)	0.87	0.16
Cranberry River (Lotic)	1.45	0.26
Reefer Creek (Lotic)	0.58	0.10
Arrowhead River	0.15	0.03
Total (United States)	**37.45**	**6.60**
Canada		
Goulais River (Lentic)	1.68	0.30
Harmony River (Lentic)	1.12	0.20
Carp River (Lentic)	1.68	0.30
Michipicoten River (Lentic)	0.28	0.05
Michipicoten River (Lotic)	0.56	0.10
Pic River (Lotic)	1.12	0.20
Aquasabon River (Lotic)	0.84	0.15
Pays Plat River (Lentic)	0.56	0.10
Cypress River (Lentic)	0.84	0.15
Jackpine River (Lentic)	2.52	0.45
Nipigon River (Lotic)	2.24	0.40
Wolf River (Lentic)	0.84	0.15
D'Arcy Creek (Lentic)	0.70	0.13
D'Arcy Creek (Lotic)	0.14	0.03
Portage Creek (Lotic)	0.42	0.08
MacKenzie River (Lentic)	0.84	0.15
Kaministikwia River (Lotic)	5.04	0.90
Total (Canada)	**21.42**	**3.83**
Total for Lake	**58.87**	**10.43**

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

Lake Michigan

- Larval assessment surveys were conducted on 102 tributaries and 17 lentic areas. The status of larval Sea Lamprey populations in historically infested Lake Michigan tributaries and lentic areas is presented in Tables 15 and 16.
- Surveys to estimate the abundance of larval Sea Lampreys were conducted in five tributaries.
- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 14 tributaries. No new Sea Lamprey infestations were discovered.
- Post-treatment assessments were conducted in 15 tributaries and 3 lentic areas to determine the effectiveness of lampricide treatments during 2015 and 2016. Surveys indicated that all treatments were effective.
- Surveys were conducted in seven tributaries to Lake Michigan to evaluate sea lamprey barrier effectiveness. No sea lampreys were detected upstream from the barriers.
- A two-year evaluation of larval and juvenile Sea Lamprey production potential was completed on Grand River tributaries upstream from the 6th Street Dam. The purpose of the work was to evaluate the production potential of Sea Lampreys upstream from critical barriers by quantitatively assessing larval habitat and native lamprey abundances as a surrogate. Results from the 2014-2015 study are being analyzed and will be available spring 2017.
- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 36.58 kg active ingredient of gB (Table 17).

Table 15. Status of larval Sea Lampreys in Lake Michigan tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2016.

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	May-12	Aug-16	No	Yes	---	---	***2017***[3]
Lower	Aug-13	Jun-16	No	Yes	---	---	***2017***[3]
Paquin Cr.	Oct-87	May-15	---	Yes	---	---	Unknown
Davenport Cr.	Sep-13	Jun-16	No	Yes	---	---	Unknown
Hog Island Cr.	Sep-13	Aug-16	No	Yes	---	---	***2017***[1]
Sucker R.	Jun-61	May-15	---	Yes	---	---	Unknown
Black R.	Jun-13	Aug-16	No	Yes	---	---	***2017***[1]
Mattix Cr.	Aug-15	Jun-16	No	---	---	---	Unknown
Mile Cr.	Oct-13	Aug-16	Yes	Yes	---	---	***2017***[3]
Millecoquins R.	Sep-13	Sep-16	Yes	Yes	---	---	***2017***[1]
Rock R.	Sep-13	Jun-16	Yes	Yes	---	---	Unknown
Crow R.	Aug-13	Aug-16	No	Yes	---	---	***2017***[3]
Cataract R.	Sep-13	Jun-16	Yes	Yes	---	---	Unknown
Pt. Patterson Cr.	Jul-13	Aug-16	No	No	---	---	Unknown
Hudson Cr.	Jul-13	Aug-16	No	Yes	---	---	***2017***[3]
Swan Cr.	Jul-13	Aug-14	No	No	---	---	Unknown
Seiners Cr.	May-84	May-12	---	No	---	---	Unknown
Milakokia R.	Oct-16	Aug-16	---	---	---	---	Unknown
Bulldog Cr.	Jun-13	Jul-16	Yes	No	---	---	Unknown
Gulliver Lake Outlet	Sep-13	Aug-16	No	Yes	---	---	Unknown
Marblehead Cr.	May-16	Jul-16	No	---	---	---	Unknown
Manistique R.	Sep-16	Aug-16	---	---	---	---	Unknown
Southtown Cr.	Jul-13	Jun-15	No	No	---	---	Unknown
Thompson Cr.	Never	Aug-16	---	Yes	---	---	Unknown
Johnson Cr.	Jun-13	Jun-15	No	No	---	---	Unknown
Deadhorse Cr.	Sep-13	Jul-16	Yes	Yes	---	---	***2017***[3]
Gierke Cr.	Never	Jul-16	---	Yes	---	---	Unknown
Bursaw Cr.	Sep-13	Jul-16	No	Yes	---	---	***2017***[3]
Parent Cr.	Jul-13	Jul-16	No	Yes	---	---	***2017***[3]
Poodle Pete Cr.	Sep-13	Jul-16	No	Yes	---	---	***2017***[3]
Valentine Cr.	May-12	May-16	No	Yes	---	---	***2017***[3]
Little Fishdam R.	May-01	Jun-16	---	Yes	---	---	Unknown
Big Fishdam R.	Aug-16	Jul-16	---	---	---	---	Unknown
Sturgeon R.	Aug-15	Jul-16	No	No	---	---	Unknown
Ogontz R.	Jun-16	Sep-16	No	---	---	---	Unknown
Squaw Cr.	May-12	May-16	No	Yes	---	---	***2017***[3]
Hock Cr.	May-81	May-16	---	Yes	---	---	***2017***[3]
Whitefish R.	May-16	Aug-16	No	Yes	---	---	Unknown
Rapid R.	May-15	Aug-16	Yes	Yes	---	---	***2017***[3]
Tacoosh R.	Oct-14	Jun-15	No	---	---	---	Unknown
Days R.							
Barrier downstream	Sep-16	Jul-16	---	---	---	---	***2017***
Barrier upstream	Oct-11	May-16	---	No	---	---	Unknown
Escanaba R.	Never	Jun-15	---	---	---	---	Unknown

Table 15. *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
Portage Cr.	Oct-09	Jul-16	---	Yes	---	---	***2017***[3]
Ford R.	Oct-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Sunnybrook Cr.	May-71	May-16	---	No	---	---	Unknown
Bark R.	Apr-15	Aug-16	Yes	Yes	---	---	***2017***[3]
Cedar R.	Oct-14	Sep-16	No	Yes	---	---	***2017***[1]
Sugar Cr.	May-08	Jun-15	---	No	---	---	Unknown
Arthur Bay Cr.	Jun-10	Jun-15	---	Yes	---	---	Unknown
Rochereau Cr.	Apr-63	Aug-14	---	No	---	---	Unknown
Johnson Cr.	May-10	Aug-16	---	Yes	---	---	***2017***[3]
Bailey Cr.	Apr-15	Jul-15	Yes	---	---	---	Unknown
Beattie Cr.	Apr-15	Jul-15	No	---	---	---	Unknown
Springer Cr.	Apr-13	Jun-15	No	No	---	---	Unknown
Menominee R.	Jul-16	Sep-15	---	---	---	---	Unknown
Little R.	Aug-77	Jul-14	---	No	---	---	Unknown
Peshtigo R.	Oct-15	Sep-16	No	Yes	---	---	Unknown
Oconto R.	Apr-15	Sep-16	Yes	Yes	---	---	***2017***[3]
Pensaukee R.	Nov-77	Jun-15	---	No	---	---	Unknown
Suamico R.	Never	Jun-12	---	No	---	---	Unknown
Ephraim Cr.	Apr-63	Jun-15	---	No	---	---	Unknown
Hibbards Cr.	May-07	Sep-16	---	Yes	---	---	Unknown
Whitefish Bay Cr.	May-16	Sep-16	No	No	---	---	Unknown
Shivering Sands Cr.	Apr-12	Sep-16	Yes	No	---	---	Unknown
Lilly Bay Cr.	Apr-63	May-14	---	No	---	---	Unknown
Bear Cr.	May-75	Jul-15	---	No	---	---	Unknown
Door Co. 23 Cr.	May-07	Sep-16	---	Yes	55	0	Unknown
Silver Creek	Never	Sep-16	---	Yes	0	0	Unknown
Ahnapee R.	Apr-64	Sep-15	---	No	---	---	Unknown
Three Mile Cr.	May-14	Sep-16	Yes	Yes	---	---	***2017***[3]
Kewaunee R.							
Barrier downstream	May-75	Jul-15	---	Yes	---	---	Unknown
Barrier upstream	May-75	Jul-15	---	Yes	---	---	Unknown
Casco Cr.	May-14	Jul-15	Yes	No	---	---	Unknown
Scarboro Cr.	May-75	Jul-15	---	Yes	---	---	Unknown
East Twin R.	Oct-08	Sep-16	---	Yes	---	---	***2017***[3]
Fischer Cr.	May-87	Jul-15	---	No	---	---	Unknown
French Farm Cr.	Never	May-15	---	---	---	---	Unknown
Carp Lake Outlet	Sep-13	Aug-16	Yes	Yes	---	---	***2017***[3]
Big Stone Cr.	Sep-13	Aug-16	No	---	---	---	Unknown
Big Sucker R.	Sep-13	Aug-16	No	---	---	---	Unknown
Wycamp Lake Outlet	Sep-13	Aug-16	No	Yes	---	---	***2017***[3]
Bear R.	Never	Aug-16	---	No	---	---	Unknown
Horton Cr.	Sep-13	Jul-16	Yes	Yes	---	---	***2017***[3]
Boyne R.	Jul-15	Jul-16	Yes	Yes	---	---	***2017***[3]
Porter Cr.	Sep-13	Jul-16	No	No	---	---	Unknown
Jordan R.	Aug-15	Jul-16	Yes	---	---	---	2019
Monroe Cr.	Aug-13	Aug-16	No	No	---	---	Unknown

Table 15. *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
Loeb Cr.	Aug-13	Jun-14	No	---	---	---	Unknown
McGeach Cr.	Oct-99	May-15	No	---	---	---	Unknown
Elk Lake Outlet	Jul-11	Jun-16	No	Yes	---	---	***2017***[3]
Yuba Cr.	May-06	Jun-14	No	---	---	---	Unknown
Acme Cr.	Aug-63	May-15	No	---	---	---	Unknown
Mitchell Cr.	Jun-13	Aug-16	No	Yes	---	---	***2017***[3]
Boardman R. (lower)	Aug-15	Sep-16	No	No	---	---	2018
Boardman R. (mid.)	Aug-15	Jun-16	No	No	---	---	2018
Hospital Creek	Aug-15	Jun-16	Yes	No	381	286	2018
Leo Cr.	Never	Sep-16	No	No	---	---	Unknown
Leland River	Never	Jun-14	No	---	---	---	Unknown
Good Harbor Cr.	Jul-10	Sep-16	No	No	---	---	Unknown
Crystal R.	Nov-11	Sep-16	No	No	---	---	Unknown
Platte R. (upper)	Jun-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Platte R. (middle)	Jun-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Platte R. (lower)	Jun-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Betsie R.	Jul-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Bowen Cr.	Jun-09	Jul-15	No	---	---	---	Unknown
Big Manistee R.	Aug-16	Oct-16	Yes	---	---	---	2019
Bear Cr.	Aug-16	Oct-16	Yes	---	---	---	2019
L. Manistee R.	Jul-15	Aug-16	No	Yes	---	---	2018
Gurney Cr.	Jun-16	Oct-16	No	---	---	---	Unknown
Cooper Cr.	Jul-08	Jul-15	No	No	---	---	Unknown
Lincoln R.	Jun-14	Oct-16	No	Yes	---	---	***2017***[3]
Pere Marquette R.	Sep-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Bass Lake Outlet	Aug-78	Jul-15	No	---	---	---	2019
Pentwater R. (N. Br.)	Jul-16	Jul-16	---	---	---	2019	Unknown
South Branch	Never	Jul-16	---	No	---	---	Unknown
Lambricks Cr.	Sep-84	Aug-14	No	No	---	---	Unknown
Stony Cr.	Jun-10	Sep-16	No	Yes	---	---	***2017***[3]
Flower Cr.	Jun-11	Sep-16	No	Yes	---	---	***2017***[3]
White R.	Sep-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Duck Cr.	Jul-84	May-15	No	No	---	---	Unknown
Muskegon R.	Sep-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Brooks Cr.	Sep-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Cedar Cr.	Sep-14	Sep-16	Yes	No	---	---	***2017***[1]
Bridgeton Cr.	Sep-14	Sep-16	Yes	No	---	---	***2017***[1]
Minnie Cr.	Sep-14	Sep-16	No	No	---	---	***2017***[1]
Bigelow Cr.	Jul-15	Sep-16	No	Yes	---	---	***2017***[1]
Big Bear Cr.	Aug-70	May-15	No	No	---	---	Unknown
Mosquito Cr.	Sep-68	Aug-14	---	---	---	---	Unknown
Black Cr.	Aug-08	Sep-16	No	No	---	---	Unknown
Grand R.	Never	Jul-12	---	No	---	---	Unknown
Norris Cr.	Aug-08	Sep-16	No	Yes	---	---	***2017***[3]
Lowell Cr	Sep-65	Jun-13	No	No	---	---	Unknown
Buck Cr.	Sep-65	Oct-15	No	No	---	---	Unknown
Rush Cr.	Sep-65	Oct-15	No	No	---	---	Unknown

Table 15. *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
Sand Cr.	Jun-07	Sep-16	No	No	---	---	Unknown
Crockery Cr.	Jul-12	Sep-16	Yes	Yes	45,850	24,835	***2017***
Bass R.	Aug-04	Sep-16	No	No	---	---	Unknown
Rogue R.	Sep-09	Aug-16	No	No	---	---	Unknown
Pigeon R.	Oct-64	Jun-16	No	No	---	---	Unknown
Pine Cr.	Oct-64	Jun-16	No	No	---	---	Unknown
Gibson Cr.	Jul-84	Jun-16	No	No	---	---	Unknown
Kalamazoo R.	Oct-65	Jul-12	---	No	---	---	Unknown
Bear Cr.	Jul-14	Jun-15	No	No	---	---	Unknown
Sand Cr.	Sep-10	Sep-15	No	Yes	---	---	Unknown
Mann Cr.	Jul-16	Sep-15	---	---	---	---	2020
Rabbit R.	Sep-15	Jul-15	---	---	---	---	Unknown
Swan Cr.	Jul-13	Sep-15	No	No	---	---	Unknown
Allegan 3 Cr.	Sep-65	Jun-16	No	No	---	---	Unknown
Allegan 4 Cr.	Oct-78	May-15	---	Yes	---	---	Unknown
Allegan 5 Cr.	Jul-14		No	No	---	---	Unknown
Black R.							
North Branch	Jun-77	May-15	No	No	---	---	Unknown
Middle Branch	Sep-15	Jun-16	Yes	No	6,296	6,296	***2017***
South Branch	Never	Jun-16	---	Yes	---	---	***2017***[3]
Brandywine Cr.	Aug-85	Sep-14	---	No	---	---	Unknown
Rogers Cr.	May-98	Jun-16	No	Yes	---	---	***2017***[1]
St. Joseph R.	Never	Jul-10	---	No	---	---	Unknown
Lemon Cr.	Oct-65	Sep-11	---	No	---	---	Unknown
Pipestone Cr.	May-14	Oct-14	No	--	---	---	Unknown
Meadow Dr.	Oct-65	Sep-11	---	No	---	---	Unknown
Hickory Cr.	Jul-15	Aug-15	No	---	---	---	Unknown
Paw Paw R.	Sep-15	Jun-15	---	---	---	---	***2017***[3]
Blue Cr.	Sep-15	Jun-16	No	No	---	---	***2017***[3]
Mill Cr.	Sep-15	Oct-16	No	No	---	---	***2017***[3]
Brandywine Cr.	Sep-15	Jun-15	---	---	---	---	***2017***[3]
Brush Cr.	Sep-15	Oct-16	No	No	---	---	***2017***[3]
Hayden Cr.	Sep-15	Oct-16	Yes	No	---	---	***2017***[3]
Campbell Cr.	Sep-15	Oct-16	No	No	---	---	***2017***[3]
Galien R. (N. Br.)	Jun-16	May-16	---	---	---	---	2020
E. Br. & Dowling Cr.	Oct-10	May-16	---	---	---	---	2020
S. Br. & Galina Cr.	Jun-16	May-16	---	---	---	---	2020
Spring Cr.	Jun-16	May-16	---	---	---	---	2020
S. Br. Spring Cr.	Jun-16	May-16	---	---	---	---	2020
State Cr.	Apr-14	May-16	No	No	---	---	Unknown
Trail Cr.	Apr-14	Sep-15	No	No	---	---	Unknown
Donns Cr.	May-66	Sep-15	No	No	---	---	Unknown
Burns Ditch	Jun-15	Sep-15	No	---	---	---	Unknown

[1] Stream being treated based on expert judgement.
[2] Stream being treated based on geographic efficiency.
[3] Stream being treated based on next large-scale treatment.

Table 16. Status of larval Sea Lampreys in historically infested lentic areas of Lake Michigan during 2016.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Brevort R.	Brevort Lake (Silver Cr. – Offshore)	Jun-16	Jul-08	Never[1]
	Brevort Lake (L. Brevort R. – Offshore)	Jun-16	Aug-74	Never
Paquin Cr.	Paquin Cr. (Offshore)	Jul-08	Jul-08	Never[1]
Hog Island Cr.	Hog Island Cr. (Offshore)	Jun-16	Sep-12	Jun-07[1]
Black R.	Black R. (Offshore)	Aug-15	Aug-11	Jun-76[1]
Mile Cr.	Mile Cr. (Offshore)	Jun-08	Jun-08	Aug-68[1]
Millecoquins R.	Millecoquins Lake (Cold Cr. – Offshore)	Jun-16	Sep-10	Never[1]
Milakokia R.	Seul Choix Bay	Jun-14	Aug-80	Never
Manistique R.	Manistique R. (Offshore)	Jul-16	Jul-16	Sep-16
Deadhorse Cr.	Deadhorse Cr. (Offshore)	Jul-11	Oct-64	Never
Bursaw Cr.	Bursaw Cr. (Offshore)	Jul-11	Jul-11	Never[1]
Valentine Cr.	Big Bay De Noc (Offshore)	Sep-11	Aug-94	Never
Ogontz R.	Big Bay De Noc (Offshore)	Jul-15	Jul-15	Sep-14
Whitefish R.	Little Bay De Noc	Jun-13	Jul-11	Jun-83[1]
Rapid R.	Little Bay De Noc	Jul-16	Jul-16	May-15
Days R.	Little Bay De Noc	Jul-15	Aug-13	Aug-14
Escanaba R.	Little Bay De Noc	Jun-15	Jul-06	Never[1]
Portage Cr.	Portage Bay	Jul-84	Aug-82	Never
Ford R.	Green Bay	Jul-16	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
Beattie Cr.	Green Bay	Jul-08	Jul-85	Never
Menominee R.	Green Bay	Sep-15	Sep-15	Jul-16[1]
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-16	Jul-16	Sep-13
Boyne R.	Boyne Harbor (Lake Charlevoix)	Jun-14	Jun-14	Aug-15
Porter Cr.	Lake Charlevoix	Jun-14	Jun-14	Sep-13
Jordan R.	Lake Charlevoix	Jun-14	Jun-14	Aug-15
Monroe Cr.	Lake Charlevoix	Aug-16	Jun-13	Aug-13
Mitchell Cr.	Grand Traverse Bay (East Arm)	May-04	May-04	Never[1]
Boardman R.	Grand Traverse Bay (West Arm)	Jun-16	Jun-16	Jun-12
Leland R.	Leland R. (Offshore)	Jun-1	Jun-13	Never[1]
Platte R.	Loon Lake	Sep-16	Sep-16	Never[1]
	Platte Lake	Sep-16	Jul-03	Never[1]
Betsie R.	Betsie Lake	Sep-16	Aug-83	Never[1]
Big Manistee R.	Manistee Lake (Big Manistee - Offshore)	Jul-15	Jul-08	Never[1]
	Manistee Lake (Little Manistee – Offshore)	Jul-15	Jul-08	Jul-08

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

Table 17. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Michigan for larval assessment purposes during 2016.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Brevort Lake (Lentic)	1.74	0.31
Hog Island Creek (Lentic)	2.32	0.41
Millecoquins Lake (Lentic)	3.48	0.62
Manistique River (Lentic)	2.32	0.41
Manistique River (Lotic)	0.44	0.08
Rapid River (Lentic)	2.32	0.41
Ford River (Lentic)	2.32	0.41
Bark River (Lentic)	2.32	0.41
Cedar River (Lentic)	2.32	0.41
Peshtigo River (Lotic)	4.64	0.83
East Twin River (Lotic)	1.16	0.21
Carp Lake River (Lentic)	1.12	0.20
Bear River (Lentic)	1.12	0.20
Horton Creek (Lentic)	1.12	0.20
Boyne River (Lentic)	0.84	0.15
Porter Creek (Lentic)	0.56	0.10
Jordan River (Lentic)	1.12	0.20
Monroe Creek (Lentic)	1.12	0.20
Boardman River (Lentic)	1.68	0.30
Platte River (Lotic)	1.68	0.30
Betsie River (Lentic)	0.84	0.15
Total for Lake	**36.58**	**6.51**

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

Lake Huron

- Larval assessment surveys were conducted on 93 tributaries (38 Canada, 55 U.S.) and 18 lentic areas (9 Canada, 9 U.S.). The status of larval Sea Lamprey populations in historically infested Lake Huron tributaries and lentic areas are presented in Tables 18 and 19.

- Surveys to estimate abundance of larval Sea Lampreys were conducted in 30 tributaries (20 Canada, 10 U.S.) and 6 lentic areas (4 Canada; 2 U.S.).

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 15 tributaries (8 Canada; 7 U.S.). No new infestations were found.

- Post-treatment assessments were conducted in 21 tributaries (14 Canada; 7 U.S.) and in 5 lentic areas (5 Canada; 0 U.S.) to determine the effectiveness of lampricide treatments during 2015 and 2016. Silver, Timber Bay, and Hughson creeks and the Mindemoya River are scheduled for 2017 treatments based on the presence of residual Sea Lampreys.

- Surveys to evaluate barrier effectiveness in 13 tributaries (6 Canada; 7 U.S.) revealed no evidence of escapement.

- Monitoring of larval Sea Lampreys in the St. Marys River continued during 2016. With the use of DWEF , 892 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 999,000 (95% CI; 720,000-1,300,000).

- More than 10,400 Sea Lamprey larvae were collected for research purposes from the Cheboygan, Ocqueoc, Trout, and Saginaw river systems.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 50.98kg active ingredient of gB (24.50 kg Canada, 26.49 kg U.S.; Table 20).

Table 18. Status of larval Sea Lampreys in Lake Huron tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2016.

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			
Canada							
St. Marys R.	Jul-16	Aug-16	---	---	999,000	250,000	***2017***
Whitefish Ch.	May-16	Sep-15	---	---	---	---	Unknown
Root R.	May-16	May-16	---	---	---	---	2018[3]
Garden R.	Jul-14	Aug-15	Yes	Yes	1,162,720	148,490	***2017***
Driving Cr.	May-15	May-15	---	---	---	---	Unknown
Echo R.							
Upper	Jul-11	Jul-16	---	No	---	---	Unknown
Lower	Sep-71	Sep-16	---	No	---	---	Unknown
Bar & Iron Cr.	Jun-15	Sep-16	Yes	Yes	32,068	2,227	Unknown
Bar R.	Oct-11	Jul-14	No	No	---	---	Unknown
Sucker Cr.	Apr-12	Jul-15	No	No	---	---	Unknown
Two Tree R.	May-15	Jul-15	No	No	---	---	Unknown
Richardson Cr.	Sep-16	Aug-16	---	---	---	---	Unknown
Watson Cr.	May-15	Jul-15	No	Yes	---	---	2019[1]
Gordon Cr.	Sep-11	Sep-16	---	Yes	356	356	Unknown
Browns Cr.	May-16	Sep-16	Yes	No	---	---	Unknown
Koshkawong R.	May-15	Jul-15	No	No	---	---	Unknown
No Name (H-65)	Jun-13	Sep-16	No	Yes	---	---	2018[3]
No Name (H-68)	Sep-75	Sep-16	---	Yes	---	---	Unknown
MacBeth Cr.	Jun-67	Aug-16	---	Yes	---	---	Unknown
Thessalon R.							
Upper	Aug-11	Jul-16	---	Yes	---	---	2018[3]
Patten Lake Cr.	Aug-11	Sep-16	---	Yes	2,373	2,373	***2017***
Lower	Jul-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Livingstone Cr.	Jun-13	Jun-15	No	No	---	---	Unknown
Mississagi R.	Aug-13	Aug-16	No	Yes	---	---	***2017***[1]
Harris/Bolton Cr.	Jul-12	Aug-16	---	Yes	---	---	***2017***[1]
Blind R.	May-84	Jun-16	---	No	---	---	Unknown
Lauzon R.	Jun-15	Jun-15	No	---	---	---	Unknown
Spragge Cr.	Oct-95	Jun-15	No	No	---	---	Unknown
No Name (H-114)	Jun-15	Jun-15	No	---	---	---	Unknown
Marcellus Cr.	Jun-13	Jun-15	No	No	---	---	Unknown
Serpent R.							
Main	Jun-16	Aug-15	---	---	---	---	2019[1]
Grassy Cr.	Jun-16	Jun-15	---	---	---	---	2019[1]
Spanish R.							
Main	Sep-15	Sep-16	No	No	---	---	2018[3]
LaCloche Cr.	Jun-14	Sep-15	No	No	---	---	2018[3]
Birch Cr.	Jun-14	Jun-15	No	No	---	---	2018[3]
Aux Sables R.	Sep-15	Sep-16	Yes	No	---	---	2018[3]
Kagawong R.	Aug-67	Jun-15	---	No	---	---	Unknown
Unnamed (H-267)	May-11	Aug-16	---	Yes	13,580	7,365	***2017***
Silver Cr.	Jun-16	Aug-16	Yes	No	3,925	1,963	***2017***
Sand Cr.	Oct-15	Jul-12	---	---	---	---	Unknown
Mindemoya R.	Sep-15	May-16	Yes	No	23,642	7,737	***2017***
Timber Bay Cr.	Sep-15	Aug-16	Yes	No	7,965	1,511	***2017***

Table 18. *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
Hughson Cr.	Sep-15	Aug-16	Yes	Yes	20,472	8,299	***2017***
Manitou R.	Aug-13	May-16	Yes	Yes	2,579	781	2018[3]
Blue Jay Cr.	Sep-15	May-16	Yes	---	---	---	2019[1]
Kaboni Cr.	Oct-78	Jun-15	---	No	---	---	Unknown
Chikanishing R.	Jun-03	May-15	---	No	---	---	Unknown
French R. System							
O.V. Channel	Jun-12	May-15	Yes	Yes	---	---	Unknown
Wanapitei R.	Jun-11	May-15	No	No	---	---	Unknown
Key R. (Nesbit Cr.)	Sep-72	May-15	---	No	---	---	Unknown
Still R.	Jun-96	May-16	---	Yes	20,497	2,016	***2017***
Magnetawan R.	Jul-15	Aug-15	No	---	---	---	2018[3]
Naiscoot R.	May-16	Aug-16	Yes	Yes	---	---	2018[3]
Shebeshekong R.	Never	Aug-16	---	Yes	7,615	3,807	Unknown
Boyne R.	Jun-16	Aug-16	No	No	---	---	2020[1]
Musquash R.	Aug-13	Jun-16	No	No	---	---	Unknown
Simcoe/Severn	Never	Jun-16	---	Yes	---	---	Unknown
Coldwater R.	Never	Sep-15	---	No	---	---	Unknown
Sturgeon R.	Apr-12	Jun-16	No	No	---	---	Unknown
Hog Cr.	Sep-78	Sep-15	---	No	---	---	Unknown
Lafontaine Cr.	Jun-68	May-14	---	No	---	---	Unknown
Nottawasaga R.							
Main	May-13	Jun-16	Yes	Yes	260,869	207,630	***2017***
Boyne R.	May-13	Jun-16	Yes	Yes	---	---	***2017***
Bear Cr.	Jun-13	May-16	No	No	---	---	Unknown
Pine R.	May-16	Jun-16	No	---	---	---	2018[3]
Marl Cr.	Apr-13	May-16	No	No	---	---	Unknown
Pretty R.	May-72	May-15	---	No	---	---	Unknown
Silver Cr.	Sep-82	May-15	---	No	---	---	Unknown
Bighead R.	Aug-15	Sep-15	No	---	---	---	2018[1]
Bothwells Cr.	Jun-79	May-15	---	No	---	---	Unknown
Sydenham R.	Jun-72	May-15	---	No	---	---	Unknown
Sauble R.	Jun-04	Jun-16	---	Yes	---	---	Unknown
Saugeen R.	Jun-71	May-14	---	No	---	---	Unknown
Bayfield R.	Jun-70	May-13	---	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	Jul-14	No	No	---	---	Unknown
Little Munuscong R.	Jul-16	Jun-16	---	---	---	---	2018[3]
Big Munuscong R.	Jun-99	May-16	---	No	---	---	Unknown
Taylor Cr.	Jul-15	Sep-15	No	---	---	---	2018[3]
Gogomain River	Jul-16	Sep-16	No	---	---	---	Unknown
Carlton Cr.	Jul-15	Sep-15	No	---	---	---	Unknown
Canoe Lake Outlet	May-70	Apr-13	---	No	---	---	Unknown
Caribou Cr.	Jun-11	Jul-16	No	Yes	473	0	Unknown
Bear Lake Outlet	Sep-16	Aug-15	---	---	---	---	Unknown
Carr Cr.	Jun-13	Sep-16	Yes	---	---	---	Unknown

Table 18. *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			
Joe Straw Cr.	Jun-13	Jun-15	No	No	---	---	Unknown
Saddle Cr.	Never	Sep-16	---	No	---	---	Unknown
Huron Point Cr.	Jun-13	Jul-16	Yes	Yes	3,088	62	Unknown
Albany Cr.	Jul-15	Sep-15	No	No	---	---	Unknown
Barrier upstream	Sep-01	Aug-15	No	No	---	---	Unknown
Trout Cr.	Jul-15	Sep-15	No	---	---	---	Unknown
Beavertail Cr.	May-11	Jul-16	---	Yes	17,725	1,541	2018[3]
Prentiss Cr.	May-11	Aug-16	---	Yes	5,237	1,048	2018[3]
McKay Cr.	May-11	Jul-16	---	Yes	25,352	7,640	***2017***
Flowers Cr.	Jun-13	Jun-16	No	No	---	---	Unknown
Ceville Cr.	Aug-16	Jun-16	---	---	---	---	Unknown
Hessel Cr.	Jul-15	Sep-15	No	---	---	---	Unknown
Steeles Cr.	Sep-16	Aug-15	---	---	---	---	Unknown
Nunns Cr.	Jul-16	Sep-16	No	---	---	---	Unknown
Barrier upstream	Jul-16	Sep-16	No	---	---	---	Unknown
Pine R.	Jun-15	Sep-15	Yes	---	---	---	2018[1]
McCloud Cr.	Jul-15	Sep-15	No	No	---	---	Unknown
Carp R.	Jul-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Martineau Cr.	Jul-16	Aug-15	---	---	---	---	Unknown
Hoban Cr.	Jun-12	Jun-15	No	No	---	---	Unknown
266-20 Cr.	Aug-76	Jul-15	---	No	---	---	Unknown
Beaugrand Cr.	Jun-16	Jul-15	---	---	---	---	2016
Little Black R.	May-67	May-14	---	No	---	---	Unknown
Cheboygan R.	Oct-83	Jun-16	---	Yes	---	---	Unknown
Laperell Cr.	May-00	Jun-16	---	No	---	---	Unknown
Meyers Cr.	Sep-99	Jun-16	---	Yes	175	175	***2017***[2]
Maple R.	Aug-16	Sept-15	---	---	---	---	2019[1]
Pigeon R.	Sep-16	Oct-16	Yes	---	---	---	2019[1]
Little Pigeon R.	Aug-12	Jun-16	No	No	---	---	Unknown
Sturgeon R.	Aug-16	Oct-16	No	---	---	---	2019[1]
Elliot Cr.	Jun-13	Aug-16	No	Yes	---	---	***2017***[1]
Greene Cr.							
Barrier downstream	Jul-12	Aug-16	---	No	---	---	Unknown
Barrier upstream	Jun-07	Aug-16	---	No	---	---	Unknown
Grass Cr.	May-78	Apr-11	---	No	---	---	Unknown
Mulligan Cr.	Jun-16	Aug-16	No	---	---	---	2020
Grace Cr.	Jun-13	Aug-16	No	No	0	0	Unknown
Black Mallard Cr.	May-15	Aug-16	Yes	Yes	17,195	0	2018
Seventeen Cr.	Jul-12	Aug-16	No	No	---	---	Unknown
Ocqueoc R.							
Barrier downstream	Jul-16	Jun-16	---	---	---	---	2020
Seventeen Cr.	Jul-12	Jun-13	No	No	---	---	Uknown
Ocqueoc R.							
Barrier downstream	Jun-13	Sep-15	No	Yes	23,868	4,187	***2016***
Barrier upstream	Oct-14	Jun-16	No	No	---	---	Unknown
Johnny Cr.	Sep-70	Aug-16	---	No	---	---	Unknown
Schmidt Cr.							

Table 18. *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
Lower	Jun-13	Aug-16	No	Yes	---	---	2018[1]
Upper	May-08	Aug-16	---	No	---	---	Unknown
Nagels Cr.	Never	Jun-15	---	No	---	---	Unknown
Trout R.							
Barrier Downstream	Jul-16	Aug-16	Yes	---	---	---	2020[1]
Barrier upstream	Oct-07	Aug-16	---	No	---	---	Unknown
Swan R.	Jun-10	Jul-15	---	No	---	---	Unknown
Grand Lake Outlet	Never	Jun-16	---	No	---	---	Unknown
Middle Lake Outlet	Jun-67	Aug-14	---	No	---	---	Unknown
Long Lake Outlet	Jun-16	Jun-16	---	---	---	---	2020
Squaw Cr.	Jun-13	Jun-16	No	No	---	---	Unknown
Devils R.	Oct-14	Sep-16	No	No	---	---	2018[1]
Black R.	Aug-15	Aug-15	Yes	---	---	---	2018[3]
Mill Cr.	Never	Jun-15	---	No	---	---	Unknown
Au Sable R.	Jul-15	Aug-16	Yes	No	---	---	2018[1]
Pine R.	May-87	Jun-16	---	No	---	---	Unknown
Tawas Lake Outlet	Jun-15	Sep-16	No	No	---	---	2019
Cold Cr.	Jul-13	Sep-16	No	Yes	---	---	2018[1]
Sims Cr.	Jul-09	Jun-14	---	No	---	---	Unknown
Grays Cr.	Sep-05	Jun-14	---	No	---	---	Unknown
Silver Cr.	Jun-15	Sep-16	Yes	Yes	33,765	649	2018[3]
East Au Gres R.	Jun-16	Sep-16	No	---	---	---	2020
Au Gres R.	Apr-14	Aug-16	No	Yes	---	---	***2017***[1]
Rifle R.	Aug-14	Sep-16	Yes	Yes	---	---	***2017***[1]
Saginaw R.							
Shiawassee R.	May-15	Jul-16	Yes	Yes	---	---	2018
Cass R.	May-15	Jul-16	No	No	---	---	2018[3]
Flint River	Never	Jul-16	---	No	---	---	Unknown
Armstrong Cr.	May-15	Jul-16	No	No	---	---	Unknown
Tittabawassee R.	Never	Jul-16	---	Yes	---	---	Unknown
Chippewa R.	May-16	Aug-16	No	Yes	---	---	2018[1]
Pine R.	May-16	Aug-16	No	No	---	---	2018[1]
Carroll Cr.	May-14	Jul-16	No	Yes	4,842	4,842	***2017***
Big Salt R.	May-15	Jul-16	Yes	Yes	---	---	2018
Rock Falls Cr.	Never	Jul-14	---	No	---	---	Unknown
Sucker Cr.	Never	Aug-12	---	No	---	---	Unknown
Cherry Cr.	Never	Aug-12	---	No	---	---	Unknown
Mill Cr.	May-85	Sep-13	---	No	---	---	Unknown
Carroll Cr.	May-14	Oct-15	No	Yes	---	---	2017
Big Salt R.	May-15	Sep-15	No	No	---	---	***2018***
Rock Falls Cr.	Never	Jul-14	---	No	---	---	Unknown
Sucker Cr.	Never	Aug-12	---	No	---	---	Unknown
Cherry Cr.	Never	Aug-12	---	No	---	---	Unknown
Mill Cr.	May-85	Sep-13	---	No	---	---	Unknown

[1] Stream being treated based on expert judgment
[2] Stream being treated based on geographic efficiency
[3] Stream being treated based on large scale treatment strategy

Table 19. Status of larval Sea Lampreys in historically infested lentic areas of Lake Huron during 2016.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
Canada				
Echo River	Echo Lake	Sep-16	Jul-14	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	Aug-13	Aug-91	Jul-84
Brown’s Cr.	Tenby Bay	Aug-13	Aug-91	Aug-87
Koshkawong R.	North Channel	Aug-91	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	Jun-16	Jun-16	Jun-15
Unnamed (H-114)	North Channel	Jun-16	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	Jul-13	Jul-13	Oct-12
Blue Jay Cr.	Michael's Bay	Jul-13	Jul-10	Oct-12
Still R.	Byng Inlet	Aug-16	Aug-16	Jun-12
Boyne R.	Georgian Bay	May-16	May-16	Never
Severn R.	Georgian Bay	May-14	May-14	Never
Sturgeon R.	Sturgeon Bay	May-14	June-99	Never
Bighead R.	Georgian Bay	Jun-16	Jun-16	Never
United States				
Caribou Cr.	Caribou Cr. (Offshore)	Jul-16	Jul-16	Jun-10
Albany Cr.	Albany Bay (Offshore)	Jul-16	Jul-16	Never[1]
Trout Cr.	Trout Cr. (Offshore)	Jul-14	Jul-11	Never[1]
McKay Cr.	McKay Bay	Jul-11	Jul-11	May-75[1]
Flowers Cr.	Flowers Bay	Jun-12	Jul-80	Never
Nunns Cr.	St. Martin Bay	Aug-14	Aug-87	Never
Pine R.	St. Martin Bay	Aug-15	Aug-15	Never[1]
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	Jul-16	Jul-16	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	Aug-16	Aug-16	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-15	Sep-14	Aug-15
East Au Gres R.	East Au Gres R. (offshore)	Aug-15	Jun-86	Never

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

Table 20. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Huron for larval assessment purposes during 2016.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
United States		
Munuscong R.	0.14	0.03
Gogomain R.	0.65	0.12
Caribou Cr.	1.74	0.31
Albany Cr.	2.32	0.41
Carp R.	2.32	0.41
Cheboygan R.	8.68	1.55
Elliot Cr.	1.12	0.20
Mulligan Cr.	1.12	0.20
HBBS Cr.	1.12	0.20
Trout R.	0.84	0.15
Long Lake Cr.	1.12	0.20
Saginaw R.	5.32	0.95
Total (United States)	**26.49**	**4.73**
Canada		
Echo River	0.84	0.15
Echo River	0.84	0.15
Sucker Creek	0.56	0.10
MacBeth Creek	0.14	0.03
Thessalon River	0.56	0.10
Mississagi River	3.36	0.60
Mississagi River	0.84	0.15
Lauzon River	0.84	0.15
Unnamed (H-114)	0.84	0.15
Serpent River	0.56	0.10
Spanish River	1.68	0.30
Kagawong River	0.84	0.15
Still River	1.68	0.30
Still River	1.68	0.30
Boyne River	0.56	0.10
Musquash River	1.12	0.20
Simcoe/Severn System	0.84	0.15
Nottawasaga River	3.36	0.60
Bighead River	1.68	0.30
Sauble River	1.68	0.30
Total (Canada)	**24.50**	**4.38**
Total for Lake	**50.99**	**9.11**

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

Lake Erie

- Larval assessments were conducted on 51 tributaries (20 Canada, 31 U.S.) and offshore of 1 U.S. tributary. The status of larval Sea Lampreys in historically infested Lake Erie tributaries and lentic areas is presented in Tables 21 and 22.

- Surveys to detect new larval populations were conducted in 25 tributaries (10 Canada, 15 U.S.). No new populations were discovered.

- Post-treatment assessments were conducted in 4 tributaries (1 Canada, 3 U.S.) to determine the effectiveness of lampricide treatments conducted during 2015 and 2016. Surveys indicated that all treatments were effective.

- Surveys to evaluate barrier effectiveness were conducted in 7 tributaries (6 Canada, 1 U.S.). No larval Sea Lampreys were detected upstream of these structures, however; removal of a privately owned stoplog dam on Silver Creek has resulted in an increase in larval distribution.

- A total of 2.3 ha of the St. Clair River was surveyed with gB, including the upper river and the three main delta channels. Thirty-five Sea Lamprey larvae were captured throughout the river with no additional areas of high density detected.

- Larval assessments were conducted in non-wadable lentic and lotic areas using 14.85 kg active ingredient of gB (7.00 kg Canada, 7.85 kg U.S.; Table 23).

- The control agents continue to delineate the distribution and abundance of the larval Sea Lamprey population in the St. Clair River, hypothesized to be a source of feeding juveniles in Lake Erie. Results of these efforts are currently being evaluated and formulated into a plan that will identify further actions and strategies for Sea Lamprey control in this important interconnecting waterway.

Table 21. Status of larval Sea Lampreys in Lake Erie tributaries with a history of Sea Lamprey production, and estimates of abundance from tributaries surveyed during 2016.

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	Apr-15	---	No	---	---	Unknown
Catfish Cr.	Apr-16	Jun-16	No	---	---	---	Unknown
Bradley Cr.	Apr-16	Jun-16	No	---	---	---	Unknown
Silver Cr.	Oct-09	Jun-16	---	Yes	---	---	2018
Big Otter Cr.	Sep-13	Jun-16	Yes	Yes	---	---	***2017***[1]
South Otter Cr.	Aug-10	May-16	---	No	---	---	Unknown
Clear Cr.	May-91	May-16	---	No	---	---	Unknown
Big Cr.	Sep-13	May-16	Yes	Yes	---	---	***2017***[1]
Forestville Cr.	Aug-13	Apr-16	No	No	---	---	Unknown
Normandale Cr.	Jun-87	Apr-16	---	No	---	---	Unknown
Fishers Cr.	Jun-87	Jun-15	---	No	---	---	Unknown
Young's Cr.	Aug-13	Jun-15	No	No	---	---	Unknown
United States							
Buffalo R.	Never	Jun-14	---	No	---	---	Unknown
Buffalo Cr.	Jun-13	Jul-16	No	No	---	---	Unknown
Cayuga Cr.	Never	Jul-16	---	No	---	---	Unknown
Cazenovia Cr.	Sept-13	Jul-16	No	No	---	---	Unknown
Big Sister Cr.	Apr-15	Jul-16	Yes	No	---	---	Unknown
Delaware Cr.	Jun-13	Aug-16	No	No	---	---	Unknown
Cattaraugus Cr.	May-16	Jul-16	Yes	---	---	---	2019
Halfway Br.	Oct-86	Jul-16	---	No	---	---	Unknown
Canadaway Cr.	May-16	Jul-16	No	---	---	---	Unknown
Chautauqua Cr.	Never	Aug-16	---	No	---	---	Unknown
Crooked Cr.	Oct-15	Jul-16	Yes	Yes	827	768	***2017***
Raccoon Cr.	May-15	Jul-16	No	No	---	---	Unknown
Conneaut Cr.	May-15	Jul-16	Yes	Yes	---	---	2018
Wheeler Cr.	Never	Aug-15	---	No	---	---	Unknown
Grand R.	Apr-13	Jul-16	Yes	Yes	2,539	2,539	***2017***[2]
Chagrin R.	Never	Jul-16	---	No	---	---	Unknown
St. Clair River/Lake St. Clair Tributaries							
St. Clair R.	Never	Jun-16	---	Yes	---	---	Unknown
Black R.	Never	Jun-16	---	No	---	---	Unknown
Mill Cr.	Never	Jun-16	---	No	---	---	Unknown
Pine R.	Apr-88	Jun-16	---	Yes	---	---	Unknown
Belle R.	Never	Jun-16	---	No	---	---	Unknown
Clinton R.	Never	Jun-16	---	Yes	---	---	Unknown
Paint Cr.	May-15	Jun-16	No	---	---	---	Unknown
Thames R.	Never	May-16	---	No	---	---	Unknown
Komoka Cr.	Aug-15	May-16	Yes	No	---	---	Unknown

[1]Stream being treated based on expert judgment.
[2]Stream being treated based on deferral from previous year.

Table 22. Status of larval Sea Lampreys in historically infested lentic areas of Lake Erie during 2016.

Tributary	Lentic Area	Last Surveyed	Last Survey Showing Infestation	Last Treated
<u>United States</u>				
Cattaraugus Cr.	Sunset Bay	Aug-14	Aug-12	Never[1]
Conneaut Cr.	Conneaut Harbor	Jul-10	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 23. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Erie for larval assessment purposes during 2016.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
<u>Canada</u>		
St. Clair R.	6.16	1.10
Talbot Cr.	0.84	0.15
Total (Canada)	**7.00**	**1.25**
<u>United States</u>		
St. Clair R.	6.73	1.20
Conneaut Cr. (lotic)	0.56	0.10
Conneaut Cr. (lentic)	0.56	0.10
Total (United States)	**7.85**	**1.40**
Total for Lake	**14.85**	**2.65**

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

Lake Ontario

- Larval assessments were conducted on 58 tributaries (20 Canada, 38 U.S.). The status of larval Sea Lampreys in historically infested Lake Ontario tributaries and lentic areas is presented in Tables 24 and 25.

- Surveys to estimate abundance of larval Sea Lampreys were conducted in 6 tributaries (2 Canada, 4 U.S.).

- Surveys to detect the presence of new larval Sea Lamprey populations were conducted in 23 tributaries (5 Canada, 18 U.S.). No new populations were detected.

- Post-treatment assessments were conducted in 10 tributaries (5 Canada, 5 U.S.) to determine the effectiveness of lampricide treatments conducted during 2015 and 2016. Surveys indicated that all treatments were effective.

- Surveys to evaluate barrier effectiveness were conducted in 7 tributaries (4 Canada, 3 U.S.). Two year classes of Sea Lampreys were detected upstream of the Veyance Dam on Bowmanville Creek.

- In 2015, larval Sea Lampreys were detected in Levi and Heritage creeks (Credit River tributaries) with no prior history of infestation. Multiple age classes of larvae, including those newly-metamorphosed, were found and subsequently treated during 2016. Post treatment assessments in 2016 yielded no residual lampreys.

- Due to the discovery of production from the Owasco Lake Outlet (Seneca River tributary), additional surveys were performed on several Seneca River and Erie Canal tributaries. No native lampreys or Sea Lampreys were found despite the presence of suitable habitat.

- Following a long history of lentic infestation off the mouth of the Black River (New York), the first gB treatment of this area took place in 2015 in conjunction with the TFM application. Post-treatment surveys in 2016 yielded no residual Sea Lampreys.

- Larval assessment surveys were conducted in non-wadable lentic and lotic areas using 5.88 kg active ingredient of gB (1.68 kg Canada, 4.20 kg U.S.; Table 26).

Table 24. Status of larval Sea Lampreys in Lake Ontario tributaries with a history of Sea Lamprey production and estimates of abundance from tributaries surveyed during 2016.

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-14	---	Yes	---	---	Unknown
Ancaster Cr.	May-03	Jun-15	---	Yes	---	---	Unknown
Grindstone Cr.	Never	Jun-16	---	No	---	---	Unknown
Bronte Cr.	Apr-16	Jun-16	No	No	---	---	2019[1]
Sixteen Mile Cr.	Jun-82	Aug-16	---	No	---	---	Unknown
Credit R.	Jun-16	Jun-16	No	No	---	---	2019[1]
Humber R.	Never	Jun-14	---	No	---	---	Unknown
Rouge R.	Jun-11	Jun-15	---	Yes	---	---	Unknown
Little Rouge. R.	Jun-15	Jun-15	No	No	---	---	Unknown
Petticoat Cr.	Sep-04	Jun-16	---	Yes	---	---	Unknown
Duffins Cr.	Jun-15	Jul-15	No	No	---	---	2018[1]
Carruthers Cr.	Sep-76	Jul-16	No	No	---	---	Unknown
Lynde Cr.	Jun-15	Jul-15	No	No	---	---	2018[1]
Oshawa Cr.	Jun-15	Jul-15	Yes	No	---	---	2018[1]
Farewell Cr.	Jun-15	Jul-15	Yes	No	---	---	2018[1]
Bowmanville Cr.	May-14	Jun-16	No	Yes	---	---	***2017***[1]
Wilmot Cr.	Jun-15	Jul-15	No	No	---	---	2018[1]
Graham Cr.	May-96	Jul-15	---	No	---	---	Unknown
Wesleyville Cr.	Oct-02	Jul-14	No	No	---	---	Unknown
Port Britain Cr.	Apr-16	Jun-16	No	No	---	---	2019
Gage Cr.	May-71	Jun-16	---	No	---	---	Unknown
Cobourg Br.	Oct-96	Jun-15	---	Yes	---	---	Unknown
Covert Cr.	Apr-16	Jun-16	Yes	No	---	---	Unknown
Grafton Cr.	May-14	Jun-16	No	Yes	1,448	1,024	Unknown
Shelter Valley Cr.	Apr-16	Jun-16	No	No	---	---	Unknown
Colborne Cr.	May-14	Jun-16	No	Yes	1,338	1,142	***2017***
Salem Cr.	Jun-15	Jul-15	Yes	No	---	---	2018[1]
Proctor Cr.	Jun-15	Jul-15	Yes	No	---	---	Unknown
Smithfield Cr.	Sep-86	Jul-15	---	No	---	---	Unknown
Trent R. (Canal System)	Sep-11	Jun-16	No	Yes	---	---	Unknown
Mayhew Cr.	Jun-15	Jul-15	No	No	---	---	2018[1]
Moira R.	Jun-15	Jul-15	Yes	No	---	---	Unknown
Salmon R.	Jun-16	Jun-15	---	---	---	---	Unknown
Napanee R.	Never	Jul-15	---	Yes	---	---	Unknown
United States							
Black R.	Aug-15	Jul-16	Yes	Yes	---	---	2018[1]
Stony Cr.	Sep-82	Aug-14	---	No	---	---	Unknown
Sandy Cr.	Never	Jul-16	---	No	---	---	Unknown
South Sandy Cr.	Apr-16	Jul-16	---	Yes	6,341	3,012	***2017***[1]
Skinner Cr.	Apr-05	Aug-15	---	No	---	---	Unknown
Lindsey Cr.	Jun-14	Jul-16	Yes	Yes	---	---	***2017***[1]
Blind Cr.	May-76	Jul-16	---	No	---	---	Unknown
Little Sandy Cr.	May-16	Jul-16	Yes	Yes	2,673	1,184	Unknown

Table 24. *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
Deer Cr.	Apr-04	Jul-16	---	No	---	---	Unknown
Salmon R.	May-14	Aug-14	Yes	Yes	---	---	***2017***[1]
Orwell Brook	May-14	Jul-16	No	No	---	---	Unknown
Trout Brook	May-14	Jul-16	Yes	Yes	---	---	***2017***[1]
Altmar Cr.	Oct-15	Jul-16	Yes	No	---	---	***2017***[1]
Grindstone Cr.	Apr-16	Jul-16	Yes	No	---	---	2019[1]
Snake Cr.	Apr-15	Aug-15	No	No	---	---	2018[1]
Sage Cr.	May-78	Jul-16	---	No	---	---	Unknown
Little Salmon R.	Jun-14	Jul-16	Yes	Yes	---	---	***2017***[1]
Butterfly Cr.	May-72	Jul-16	---	No	---	---	Unknown
Catfish Cr.	Apr-15	Jul-16	Yes	Yes	---	---	2018[1]
Oswego R.							
Black Cr.	May-81	Aug-14	---	No	---	---	Unknown
Big Bay Cr.	Sep-93	Aug-15	---	No	---	---	Unknown
Scriba Cr.	Jun-10	Apr-14	---	No	---	---	Unknown
Fish Cr.	May-16	Jul-16	No	No	---	---	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	Jul-16	Yes	Yes	---	---	Unknown
Rice Cr.	May-72	Aug-15	---	No	---	---	Unknown
Eight Mile Cr.	Apr-15	Aug-15	Yes	Yes	---	---	Unknown
Nine Mile Cr.	May-14	Aug-16	Yes	Yes	75,032	45,806	***2017***
Sterling Cr.	May-15	Aug-15	Yes	Yes	---	---	2018[1]
Blind Sodus Cr.	May-78	Aug-16	---	No	---	---	Unknown
Red Cr.	Apr-15	Aug-15	No	Yes	---	---	Unknown
Wolcott Cr.	May-79	Aug-14	---	No	---	---	Unknown
Sodus Cr.	Apr-15	Aug-15	No	No	---	---	Unknown
Forest Lawn Cr.	Never	Aug-15	---	Yes	---	---	Unknown
Irondequoit Cr.	Never	Aug-16	---	No	---	---	Unknown
Larkin Cr.	Never	Aug-15	---	No	---	---	Unknown
Northrup Cr.	Never	Aug-15	---	No	---	---	Unknown
Salmon Cr.	Apr-05	Aug-15	---	Yes	---	---	Unknown
Sandy Cr.	Apr-14	Aug-16	No	No	---	---	Unknown
Oak Orchard Cr.							
Marsh Cr.	Apr-14	Aug-16	No	No	---	---	Unknown
Johnson Cr.	Apr-10	Aug-16	---	No	---	---	Unknown
Third Cr.	May-72	Aug-14	---	No	---	---	Unknown
First Cr.	May-95	Aug-16	---	No	---	---	Unknown

[1]Stream is being treated based on expert knowledge.
[2]Stream being treated based on geographic efficiency.

Table 25. Status of larval Sea Lampreys in historically infested lentic areas of Lake Ontario during 2016.

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	Jul-16	Aug-14	Aug-15

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

Table 26. Details on application of granular Bayluscide to tributaries and lentic areas of Lake Ontario for larval assessment purposes during 2016.

Tributary	Bayluscide (kg)[1]	Area Surveyed (ha)
Canada		
Trent R. (lotic)	1.68	0.30
Total (Canada)	**1.68**	**0.30**
United States		
Black R. (lentic)	1.68	0.30
Black R. (lotic)	1.68	0.30
Catfish Cr. (lotic)	0.84	0.15
Total (United States)	**4.20**	**0.75**
Total for Lake	**5.88**	**1.05**

[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 Lampreys 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 with the Service's Green Bay Fish and Wildlife Conservation Office (GBFWCO) to calculate marking statistics and Lake Trout abundance estimates to better understand the damage caused by Sea Lampreys.

Lake Superior

- Lake Trout marking data for Lake Superior are provided by the MIDNR, Minnesota Department of Natural Resources, and 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 2016 was 7.5 A1-A3 marks per 100 Lake Trout >532mm (Figure 4) which is greater than the target of 5 marks per 100 fish.

- The MIDNR provided data on the frequency of juvenile Sea Lampreys attached to fishes caught by sport charter fishers.

    - A total of 62 juvenile Sea Lampreys were collected from 8 management districts: 59 were attached to Lake Trout and 3 were attached to Chinook Salmon. Attachment rates during 2016 were 1.13 per 100 Lake Trout (n=5,206) and 5.66 per 100 Chinook Salmon (n=53), which was lower for the attachment rate on Lake Trout during 2015 (1.92 per 100 lake trout) but higher for the attachment rate on Chinook Salmon during 2015 (0.00 per 100 Chinook Salmon).

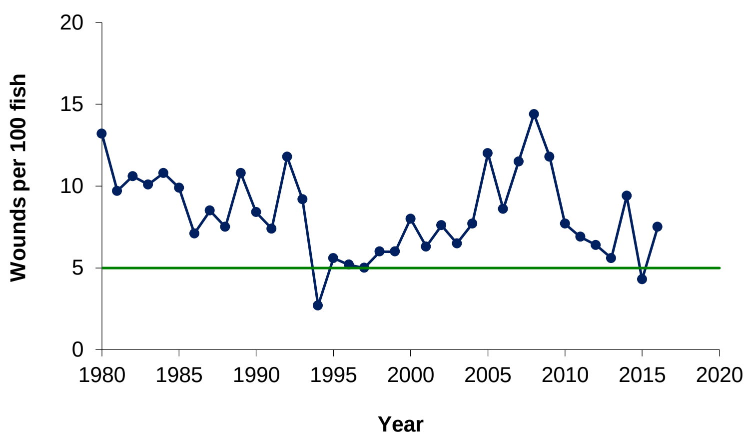


Figure 4. Average number of A1-A3 marks per 100 Lake Trout >532 mm caught during April-June assessments in Lake Superior 1980 – 2016. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout.

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 United States Geological Survey (USGS), and analyzed by the Service's GBFWCO.

- Based on standardized fall assessment data, the marking rate during 2016 was 3.7 A1-A3 marks per 100 Lake Trout >532mm which is the lowest marking rate observed since 1993 (Figure 5).

- The MIDNR and WDNR provided data on the frequency of juvenile Sea Lampreys attached to fish caught by sport charter fishers.

    - A total of 303 juvenile Sea Lampreys were collected from 14 management districts: 85 were attached to Lake Trout and 218 were attached to Chinook Salmon. Attachment rates during 2016 were 0.17 per 100 Lake Trout (n=50,170) and 0.36 per 100 Chinook Salmon (n=60,930), which were lower than the attachment rates on Lake Trout and Chinook Salmon during 2015 (0.26 and 0.55, respectively).

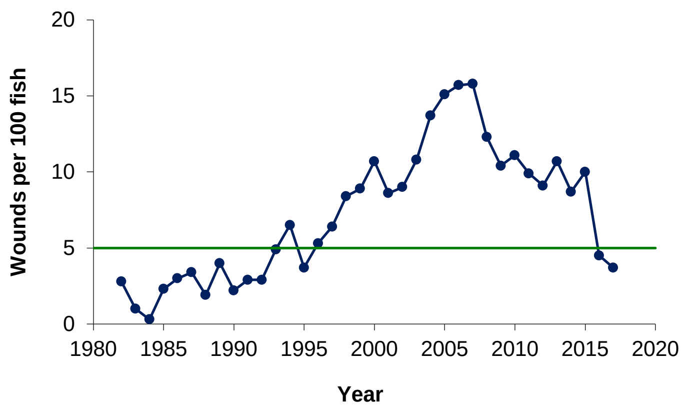


Figure 5. Average number of A1-A3 marks per 100 Lake Trout >532 mm from standardized fall assessments in Lake Michigan 1982 – 2016. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout.

Lake Huron

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

- Based on standardized spring assessment data, the marking rate during 2016 was 4.0 A1-A3 marks per 100 Lake Trout >532 mm. The marking rate had been greater than the target of 5 per 100 Lake Trout since 1983 (Figure 6), but has decreased to less than the target for the first time in the time series.

- Marking rates on Lake Whitefish and ciscoes have been increasing and may be important initial hosts for juvenile Sea Lampreys.

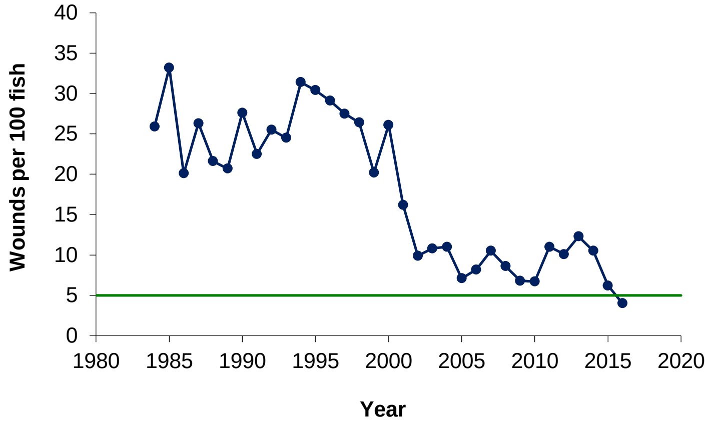


Figure 6. Average number of A1-A3 marks per 100 Lake Trout >532 mm caught in U.S. waters during spring assessments in Lake Huron 1984-2016. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout.

- Canadian commercial fisheries in northern Lake Huron continued to provide parasitic juvenile Sea Lampreys in 2016, along with associated catch information including date, location, and host species. The total number of Sea Lampreys 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. Although the data for 2016 is not yet available, the CPUE value for 2015 was the lowest in nearly 30 years (Figure 7).

- 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 2016, fyke nets were fished for a total of 638 net days, capturing 54 out-migrating juveniles (0.08 juveniles per net day; Figure 8).

- The MIDNR provided data on the frequency of juvenile Sea Lampreys attached to fishes caught by sport charter fishers.

    - A total of 78 juvenile Sea Lampreys were collected from 6 management districts: 73 were attached to Lake Trout and 5 were attached to Chinook Salmon. Attachment rates during 2016 were 0.81 per 100 Lake Trout (n=9,018) and 0.81 per 100 Chinook Salmon (n=617), which were lower than the attachment rates on Lake Trout and Chinook Salmon during 2015 (1.57 and 3.41, respectively).

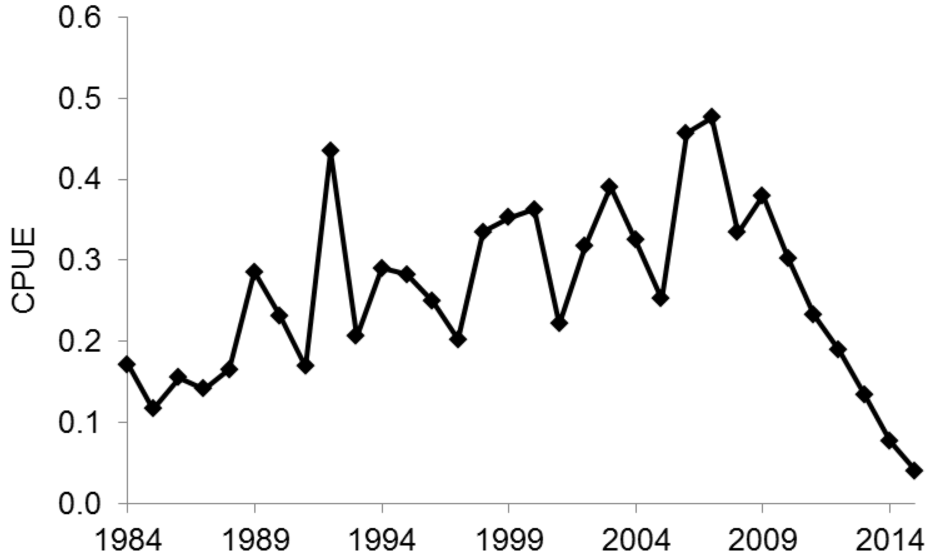


Figure 7. Northern Lake Huron commercial fisheries index showing CPUE (number of parasitic juvenile Sea Lampreys per km of gillnet per night) for 1984-2015.

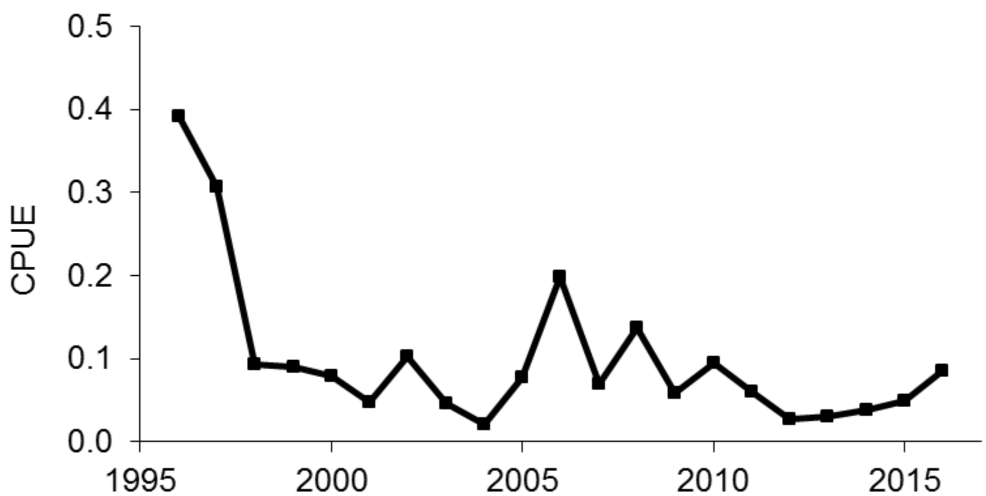


Figure 8. CPUE (number of out-migrating juvenile Sea Lampreys per net day) of fall fyke netting in the St. Marys River during 1996-2016.

Lake Erie

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

- Based on standardized fall assessment data, the marking rate during 2016 was 15.0 A1-A3 marks per 100 Lake Trout >532 mm, up from 11.6 in 2015. The marking rate has been greater than the target for the last 11 years (Figure 9).

- In cooperation with Walpole Island First Nation, the GLFC Commission? and partners completed the first year of an annual index for out-migrating juvenile Sea Lampreys in the St. Clair River (SCR). Nine floating fyke nets were deployed in December, 2015 in the main SCR shipping channel and captured 392 juvenile Sea Lampreys over a period of 33 days (1.35 juveniles per net day).

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

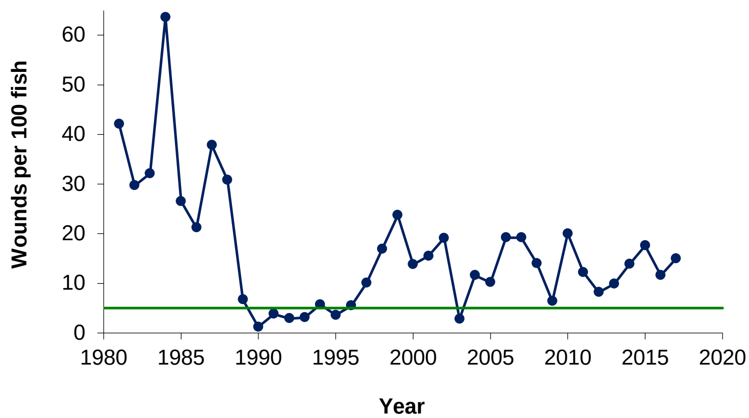


Figure 9. Average number of A1-A3 marks per 100 Lake Trout >532 mm from standardized fall assessments. The horizontal line represents the target of 5 A1-A3 marks per 100 Lake Trout 1981-2016.

Lake Ontario

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

- Based on standardized fall assessment data, the marking rate during 2016 was 1.4 A1 marks per 100 Lake Trout >431 mm which is less than the target of 2 A1 marks per 100 Lake Trout target (Figure 10).

- The NYSDEC provided data on the frequency of juvenile Sea Lampreys attached to fish caught by sport charter fishers during April 15 – September 30, 2016.

    - An estimated 1,680 juvenile Sea Lampreys were observed by anglers. Sea Lampreys were attached to Chinook Salmon (60.71%), Rainbow Trout (7.14%), Brown Trout (19.05%), and Lake Trout (11.91%). Attachment rates were 1.34 per 100 trout and salmon in the west region, 0.31 in the west central region, 1.69 in the east central region, and 0.61 in the east region. In comparison to 2015, attachment rates were greater in the east central region (1.30) and less in the west, west central, and east regions (1.78, 1.44 and 1.30 respectively).

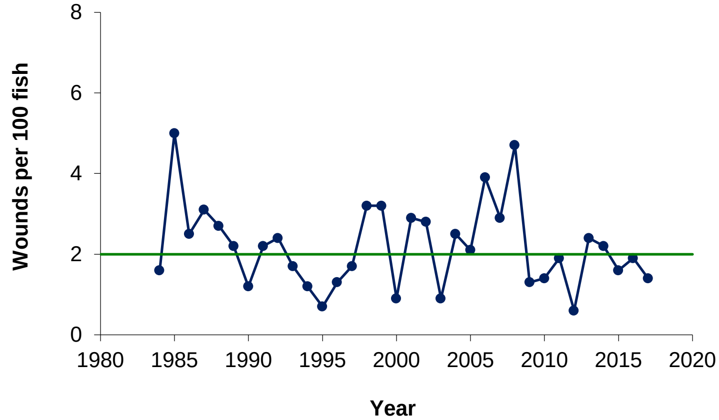


Figure 10. Number of A1 marks per 100 Lake Trout >431 mm from standardized fall assessments in Lake Ontario 1983-2016. The horizontal line represents the target of 2 A1 marks per 100 Lake Trout.

Adult Assessment

An annual index of adult Sea Lamprey abundance is derived by summing individual population estimates from traps operated in a specific suite of streams (index streams) during spring and early summer. 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 Lampreys, 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 3,255 Sea Lampreys were captured in 10 tributaries, 7 of which are index locations. Adult population estimates based on mark-recapture were obtained from 6 of the 7 index locations; the Betsy River was estimated using the relative annual pattern of abundance (Table 27, Figure 21).

- The index of adult Sea Lamprey abundance was 20,857 (95% CI; 13,442-28,271), which was greater than the target of 9,664 (Figure 11-12). The index target was estimated as the mean of indices during a period with acceptable marking rates (1994-1998).

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

- A resistance weir was installed near the mouth of the Marengo River (Bad River tributary) to test an alternative adult assessment technology and to remove individuals prior to spawning. Installation was difficult due to high stream discharge and shifting sand, but once installed the weir and trap remained in place despite record high water levels throughout the spring. The weir was fully operational for a week near the end of April before the river was treated with lampricide. Two Sea Lampreys were captured, entering the trap through a PVC pipe that the weir was mounted on.

Table 27. Information collected regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Superior during 2016 (letter in parentheses corresponds to streams in Figure 21).

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)	170	915	19	20	65	413	401	195	203
Big Carp R. [3] (B)	5	5	100	3	67	460	420	217	170
Total or Mean (Canada)	**175**	---	---	**23**	**65**	**419**	**404**	**197**	**199**
United States									
Tahquamenon R. (C)	1,244	9,465	13	13	62	486	473	226	223
Betsy R. (D)	118	396	30	1	100	488	---	273	---
Rock R. (E)	207	363	57	45	47	432	438	190	196
Silver R.[3] (F)	22	---	---	2	100	383	---	148	---
Misery R. [3] (G)	7	18	39	2	50	456	443	240	179
Bad R. (H)	131	1,605	8	3	0	---	431	---	180
Brule R. (I)	709	3,194	22	28	71	444	452	203	228
Middle R. (J)	642	4,705	14	29	21	463	431	224	201
Total or Mean (U.S.)	**3,080**	---	---	**123**	**48**	**446**	**440**	**204**	**203**
Total or Mean (for lake)	**3,255**	---	---	**146**	**51**	**441**	**435**	**202**	**202**

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

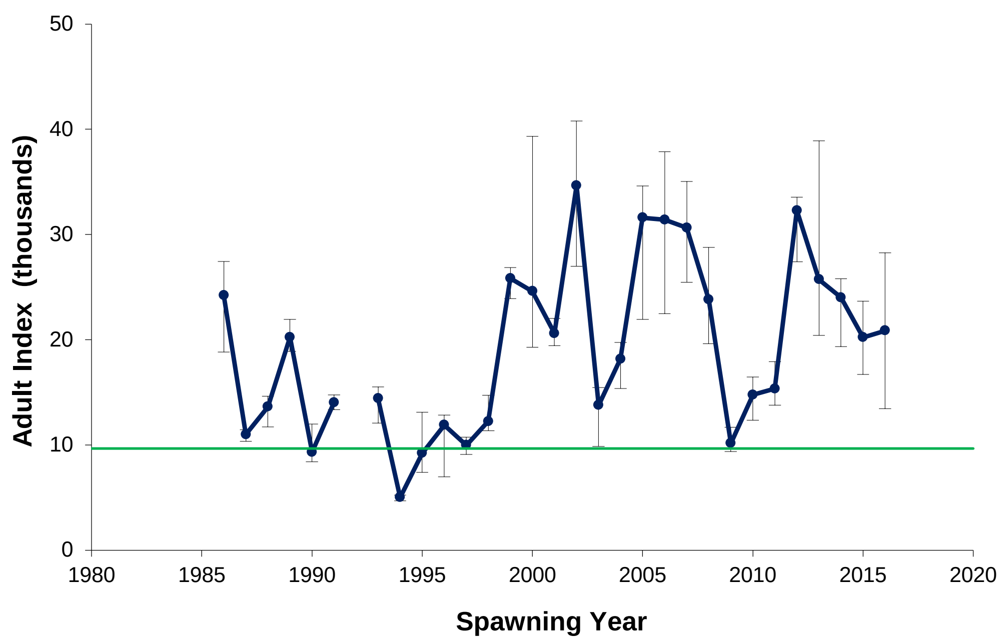


Figure 11. Index estimates with 95% confidence interval (vertical bars) of adult Sea Lampreys. The adult index in 2016 was 20,857 with 95% confidence interval (13,442-28,271). The point estimate was greater than the target of 9,700 (green horizontal line). The index target was estimated as the mean of indices during a period with acceptable marking rates (1994-1998).

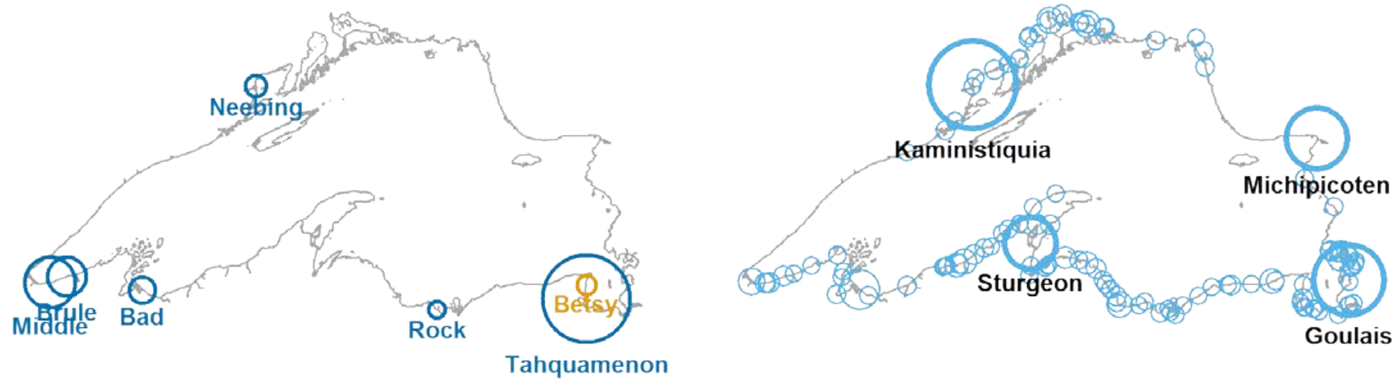


Figure 12. LEFT: Estimated index of adult sea lampreys during the spring spawning migration, 2016. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). All index streams are identified. RIGHT: Maximum estimated number of larval sea lampreys in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (Kaministiquia 6,600,000; Goulais 5,000,000; Michipicoten 4,100,000; Sturgeon 3,300,000).

Lake Michigan

- A total of 9,297 Sea Lampreys were captured at 8 sites in 8 tributaries, 6 of which are index locations. Adult population estimates based on mark-recapture were obtained from all six index locations (Table 28, Figure 21).

- The index of adult Sea Lamprey abundance was 16,125 (95% CI; 11,112-21,138), which was less than the target of 24,874 (Figures 13-14). The index target was estimated at 0.56 times the mean of indices (1995-1999).

- 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 28. Information collected regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Michigan during 2016 (letter in parentheses corresponds to stream in Figure 21).

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)	654	1,086	60	47	60	485	473	245	234
Boardman R. [3] (B)	58	---	---	---	---	---	---	---	---
Betsie R. (C)	676	1,259	54	55	51	464	486	245	254
Big Manistee R. (D)	256	2,486	10	3	67	512	475	288	229
St. Joseph R. (E)	397	1,486	27	43	33	483	482	239	248
Trail Cr. [3] (F)	65	---	---	---	---	---	---	---	---
Peshtigo R. (G)	1,372	1,617	85	110	50	483	495	244	276
Manistique R. (H)	5,819	8,191	71	350	52	492	490	255	274
Total or Mean	**9,297**	**---**	**---**	**608**	**52**	**489**	**489**	**251**	**267**

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

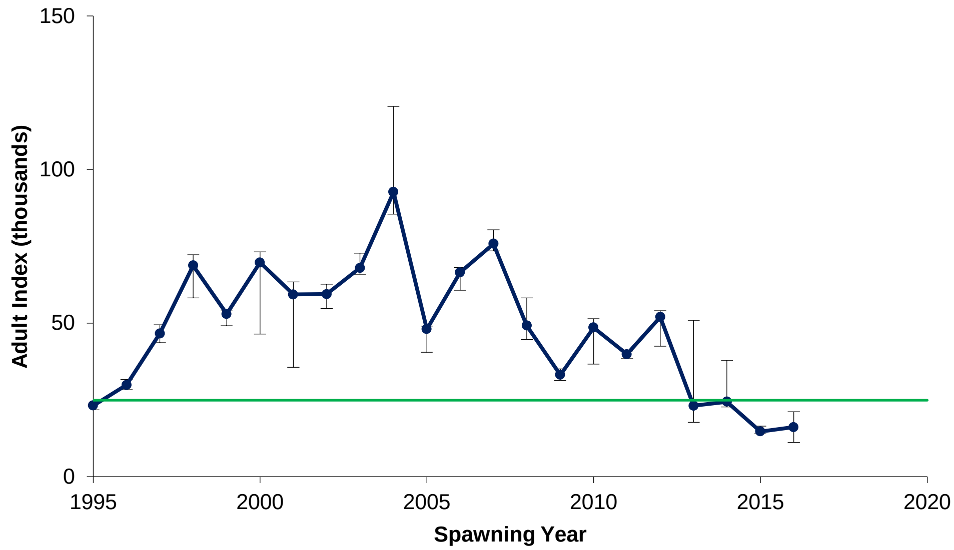


Figure 13. Index estimates with 95% confidence intervals (vertical bars) of adult sea lampreys. The adult index in 2016 was 16,125 with 95% confidence interval (11,112-21,138). The point estimate met the target of 24,874 (green horizontal line). The index target was estimated as 5/8.9 times the mean of indices (1995-1999).

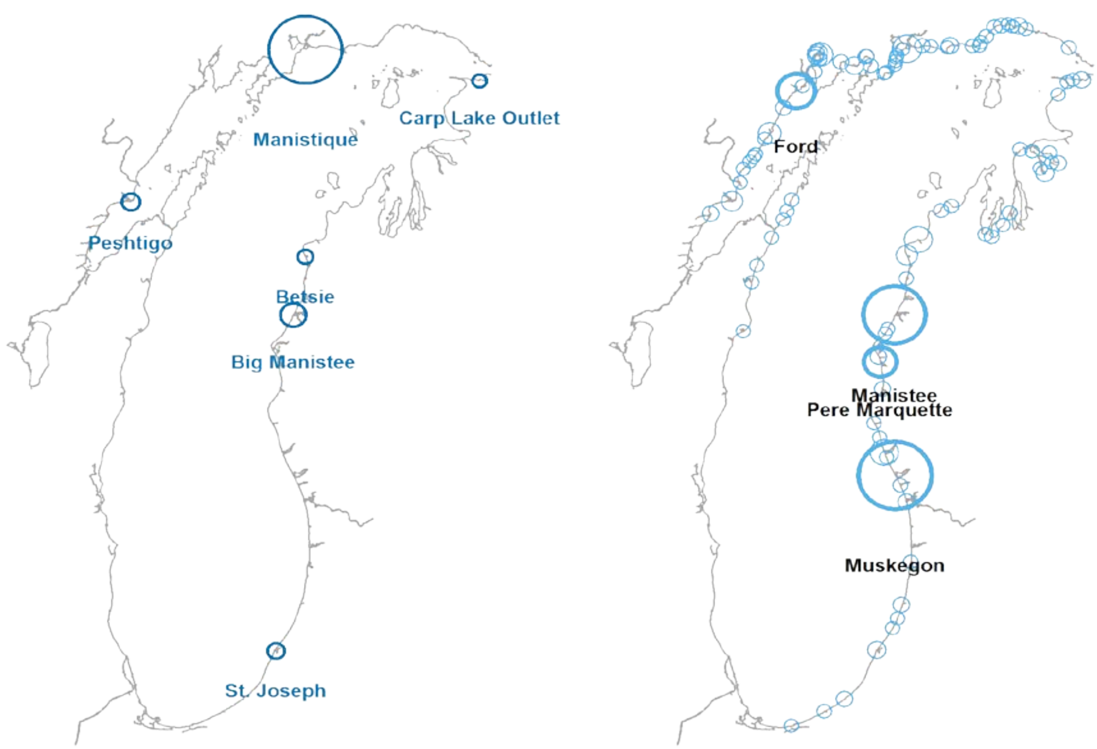


Figure 14. LEFT: Estimated index of adult sea lampreys during the spring spawning migration, 2016. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). All index streams are identified. RIGHT: Maximum estimated number of larval sea lampreys in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (Muskegon 4,500,000; Manistee 3,600,000; Ford 1,800,000; Pere Marquette 1,400,000).

Lake Huron

- A total of 13,961 Sea Lampreys were trapped in six tributaries, all of which are index locations. Adult population estimates based on mark-recapture were obtained from all six tributaries (Table 29, Figure 21).

- The index of adult Sea Lamprey abundance was 27,383 (95% CI; 23,978-30,788), which was higher than the target of 24,113 (Figure 15-16). The index target was estimated as 0.25 times the mean of indices between 1989 and 1993.

- A total of 2,287 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 6,884 adult Sea Lampreys and trapping efficiency was 33%.

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

- The SLCP assisted Michigan State University with EPA-funded Sea Lamprey alarm substance field trials on the Ocqueoc River. The team tested whether the natural Sea Lamprey alarm cue (a repellent) may be combined with the partial pheromone 3kPZS (an attractant) in a push-pull configuration to guide migrants into a trap in a free-flowing river channel (i.e., a trap not associated with a barrier). The work will continue in 2017.

- The SLCP assisted University of Guelph researchers with a project aimed at understanding adult Sea Lamprey behavior near traps on the St. Marys River. Two hypotheses are being tested to explain why many Sea Lampreys that encounter traps do not enter them. Entrance rates may be influenced by: a) the local hydrodynamic conditions at the traps when Sea Lampreys encounter them and/or b) differences in behavior among individual Sea Lampreys. Researchers are first screening Sea Lampreys for "behavioral type", tagging and releasing them, monitoring their behavior near traps with PIT tagging equipment, and measuring water flows.

Table 29. Information collected regarding adult Sea Lamprey captured in assessment traps or nets in tributaries of Lake Huron during 2016 (letter in parentheses corresponds to stream in Figure 21).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
Canada									
St. Marys R. (A)	2,287	6,884	33	56	70	478	489	245	257
Echo R. (B)	886	2,377	37	21	67	479	493	260	274
Thessalon R. (C)									
Bridgeland Cr.	1,384	1,900	73	---	---	---	---	---	---
Total or Mean (Canada)	**4,557**	---	---	**77**	**69**	**478**	**490**	**252**	**262**
United States									
East Au Gres R. (D)	656	1,846	36	59	68	456	445	235	258
Ocqueoc R. (E)	3,965	6,016	66	229	49	463	472	219	237
Cheboygan R. (F)	4,783	8,360	57	224	52	475	487	231	249
St. Marys R. (A)	See Canada	See Canada	See Canada	15	67	490	485	261	289
Total or Mean (U.S.)	**9,404**	---	---	**527**	**59**	**468**	**477**	**228**	**245**
Total or Mean (for Lake)	**13,961**	---	---	**604**	**62**	**470**	**478**	**232**	**246**

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

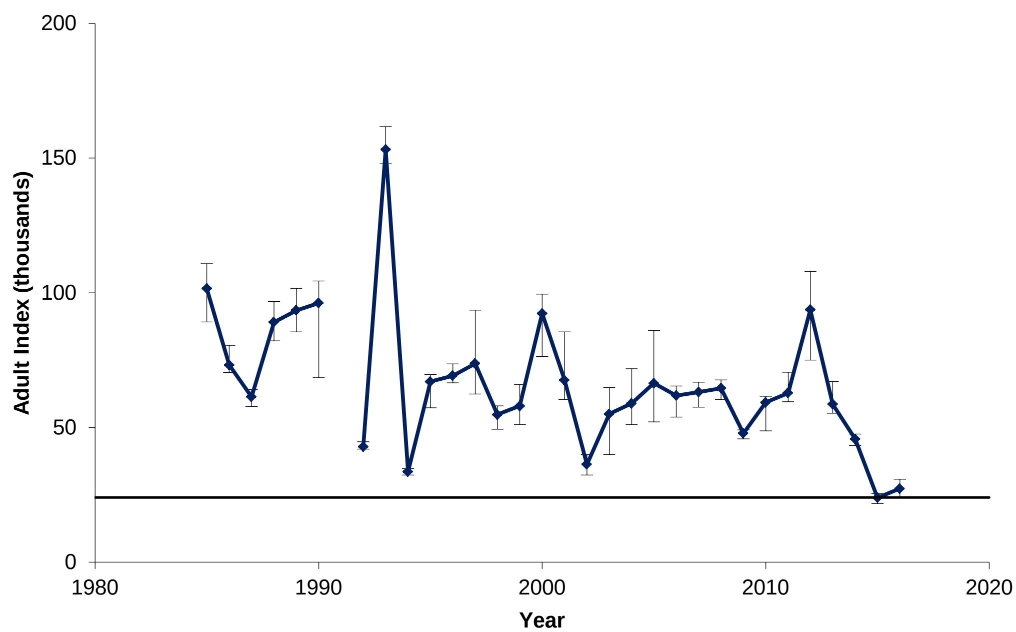
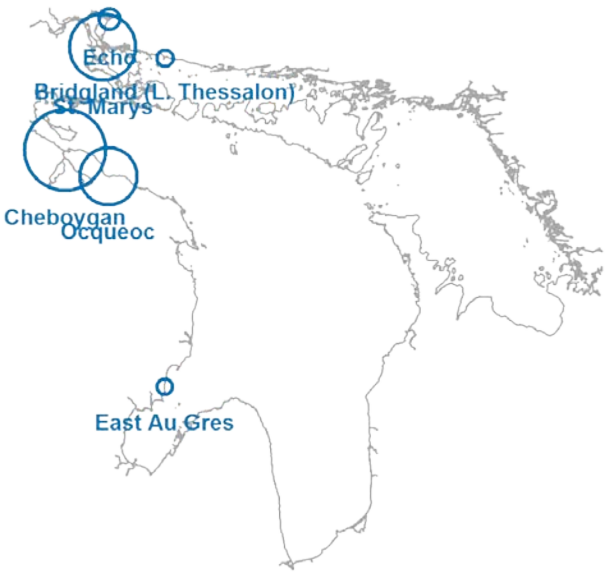


Figure 15. Index estimates with 95% confidence intervals (vertical bars) of adult Sea Lampreys. The adult index in 2016 was 27,383 with 95% confidence interval (23,978-30,788). The point estimate was slightly above the target of 24,113 (green horizontal line). The index target was estimated as 0.25 times the mean of indices between 1989 and 1993.



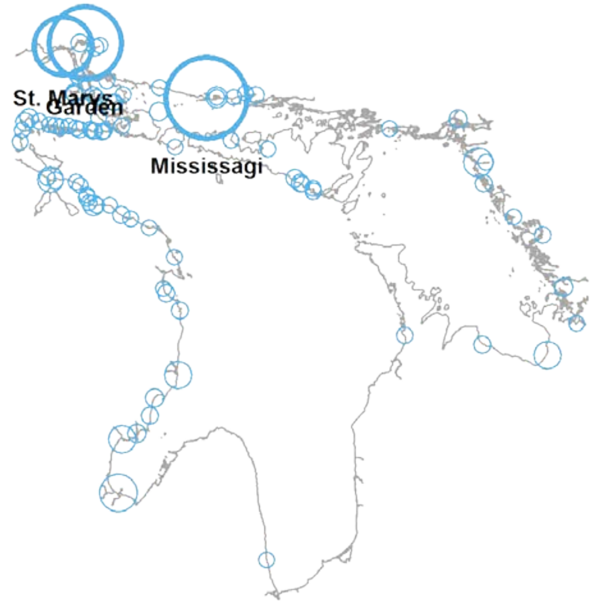


Figure 16. LEFT: Estimated index of adult sea lampreys during the spring spawning migration, 2016. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). All index streams are identified. RIGHT: Maximum estimated number of larval sea lampreys 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 1,560 Sea Lampreys were trapped in 5 tributaries during 2016, all of which are index locations. Adult population estimates based on mark-recapture were obtained from 4 of the 5 index locations; the other (Cattaraugus Creek) was estimated using the relative annual pattern of abundance (Table 30, Figure 21).

- The index of adult Sea Lamprey abundance was 4,788 (95% CI; 2,716 - 6,860), which was higher than the target of 3,039 (Figure 17-18). The index target was estimated as the mean of indices during a period with acceptable marking rates (1991-1995).

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

Table 30. Information collected regarding Sea Lamprey adults captured in assessment traps or nets in tributaries of Lake Erie during 2016 (letter in parentheses corresponds to stream in Figure 21).

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.	116	245	47	8	50	483	501	265	284
Big Cr. (B)	1,029	1,506	68	---	---	---	---	---	---
Young's Cr. (C)	63	96	66	32	56	497	513	266	243
Total or Mean (Canada)	**1,208**	**---**	**---**	**40**	**55**	**495**	**510**	**266**	**252**
United States									
Cattaraugus Cr. (D)	136	---	---	---	---	---	---	---	---
Grand R. (E)	216	1,459	15	7	86	487	259	222	222
Total or Mean (U.S.)	**352**	**---**	**---**	**7**	**86**	**430**	**317**	**243**	**263**
Total or Mean (for Lake)	**1,560**	**---**	**---**	**47**	**64**	**493**	**507**	**264**	**251**

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

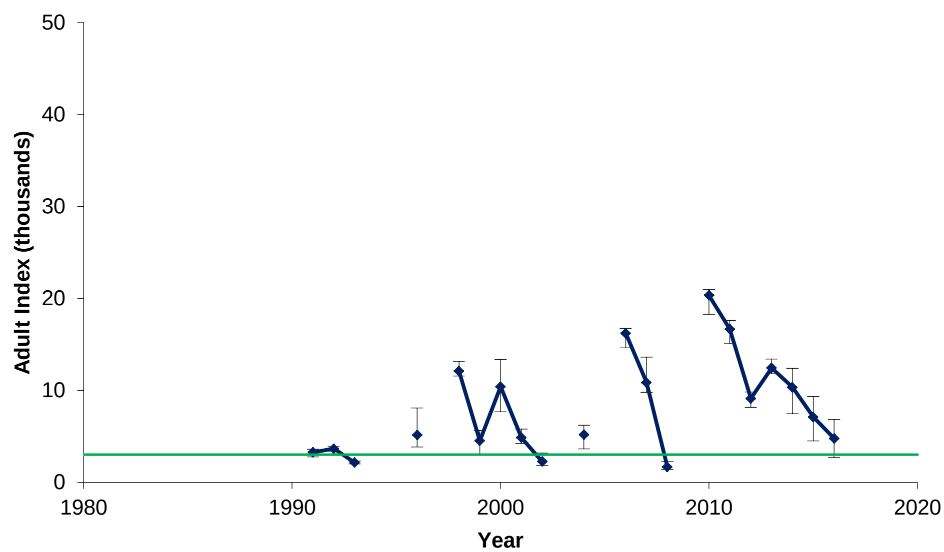


Figure 17. Index estimates with 95% confidence intervals (vertical bars) of adult Sea Lampreys. The adult index in 2016 was 4,788 with 95% confidence interval (2,716-6,860). The point estimate was above the target of 3,039 (green horizontal line). The index target was estimated as the mean of indices during a period with acceptable marking rates (1991-1995).

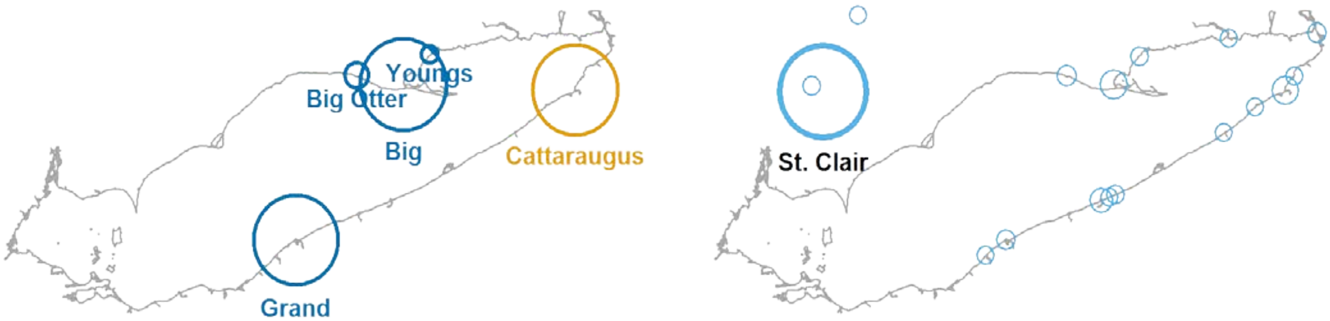


Figure 18. LEFT: Estimated index of adult Sea Lampreys during the spring spawning migration, 2016. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). All index streams are identified. RIGHT: Maximum estimated number of larval Sea Lampreys in each stream surveyed during 1995-2012. Tributaries composing over half of the lake-wide larval population estimate are identified (St. Clair 920,000).

Lake Ontario

- A total of 4,004 Sea Lampreys were trapped in 8 tributaries, 5 of which are index locations. Adult population estimates based on mark-recapture were obtained from 4 of the 5 index locations; the other (Sterling Creek) was estimated using the relative annual pattern of abundance (Table 31, Figure 21).

- The index of adult Sea Lamprey abundance was 7,191 (95% CI; 4,310 - 10,072), which was less than the target of 11,368 (Figure 19-20).

Table 31. Information collected regarding Sea Lamprey adults captured in assessment traps or nets in tributaries of Lake Ontario during 2016 (letter in parentheses corresponds to stream in Figure 21).

Tributary	Number Caught	Adult Estimate	Trap Efficiency (%)	Number Sampled[1]	Percent Males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Canada									
Humber R. (A)	2,648	3,656	72	174	61	493	474	279	260
Duffins Cr. (B)	326	1,260	26	8	75	512	479	296	247
Bowmanville Cr. (C)	403	803	---	195	67	498	500	267	278
Cobourg Cr.[3] (D)	179	411	44	100	54	468	460	238	211
Salmon R.[3] (E)	4	---	---	---	---	---	---	---	---
Total or Mean (Canada)	**3,560**	---	---	**477**	**64**	**491**	**480**	**267**	**253**
United States									
Black R. (F)	280	800	35	20	50	467	472	228	248
Salmon R.(G)									
Orwell Br.[3]	158	416	38	22	59	499	519	288	291
Sterling Cr. (H)	6	---	---	---	---	---	---	---	---
Total or Mean (U.S.)	**444**	---	---	**42**	**55**	**485**	**494**	**262**	**269**
Total or Mean (for lake)	**4,004**	---	---	**519**	**61**	**491**	**481**	**266**	**255**

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

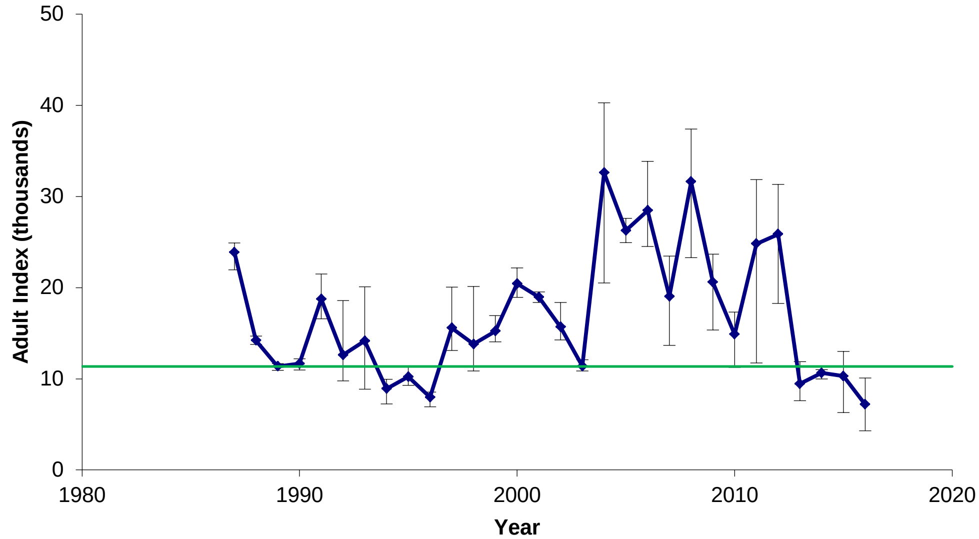


Figure 19. Index estimates with 95% confidence intervals (vertical bars) of adult Sea Lampreys. The adult index in 2016 was 7,191 with 95% confidence interval (4,310-10,072). The point estimate met the target of 11,368 (green horizontal line). The index target was estimated as the mean of indices during a period with acceptable marking rates (1993-1997).

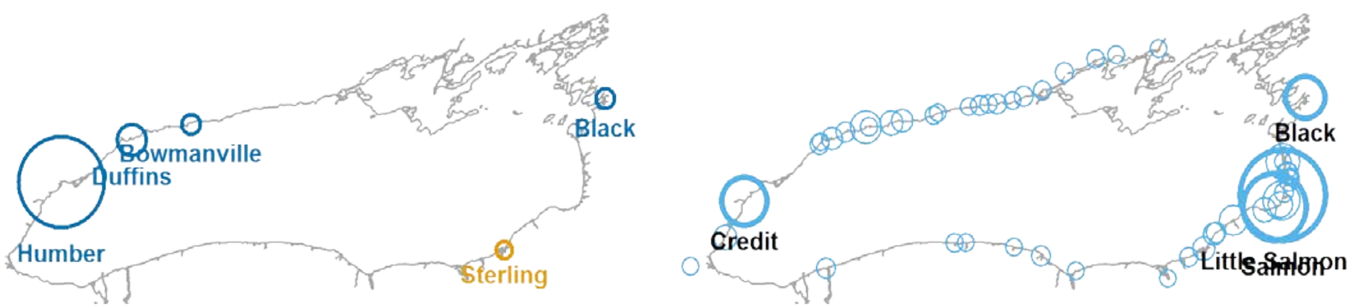


Figure 20. LEFT: Estimated index of adult Sea Lampreys during the spring spawning migration, 2016. Circle size corresponds to estimated number of adults from mark-recapture studies (blue) and model predictions (orange). All index streams are identified. RIGHT: Maximum estimated number of larval Sea Lampreys 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).

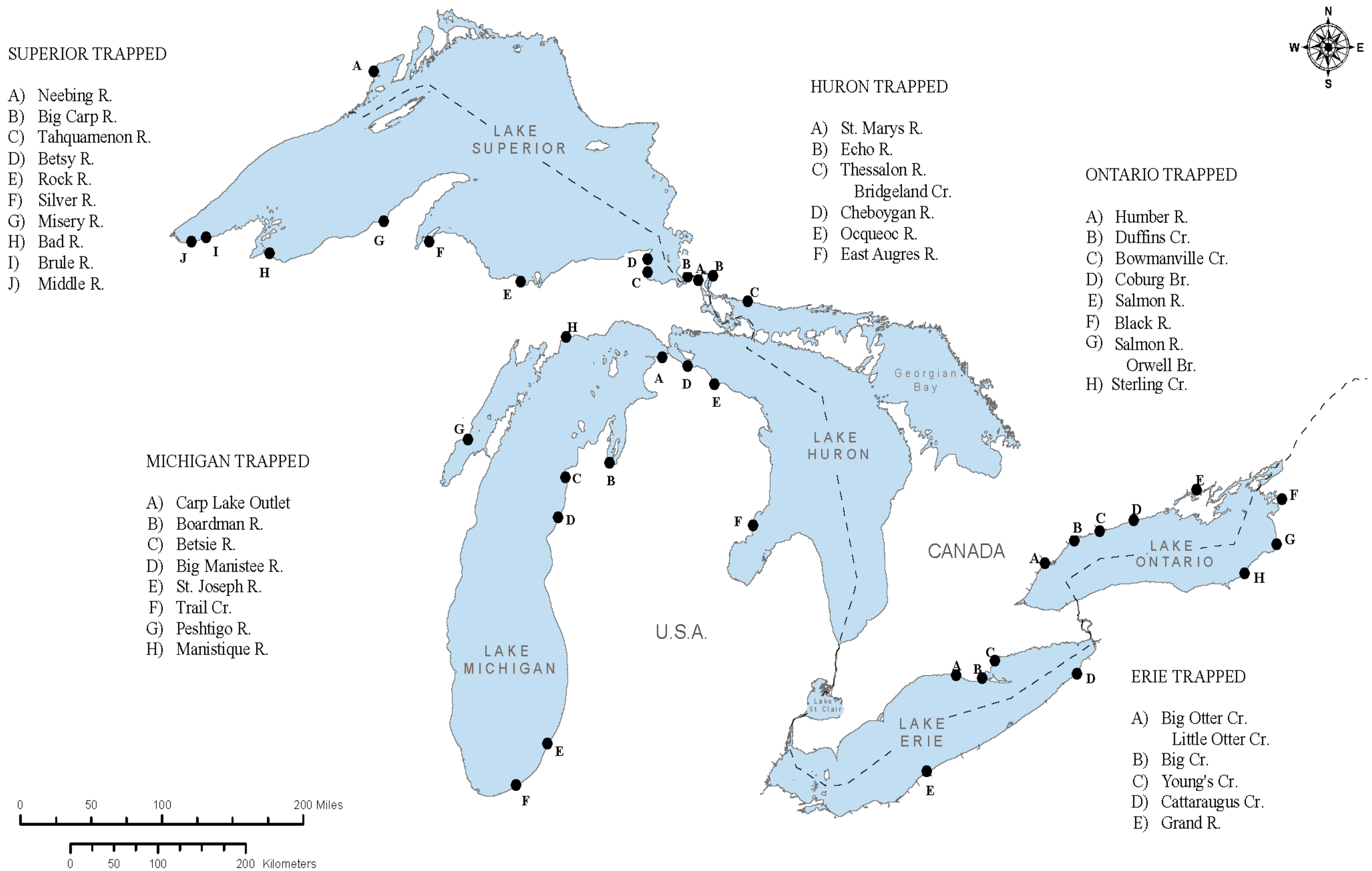


Figure 21. Locations of tributaries where assessment traps were operated during 2016.

RISK MANAGEMENT

Risk management addresses environmental and non-target issues related to the implementation of the SLCP. 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 Species at Risk Act (SARA) is intended to protect endangered or threatened organisms and their habitats in Canada. SARA permits are sought for lampricide applications that are expected to overlap with the known occurrence and critical habitat of federally listed threatened and endangered species. Permits are issued by DFO under section 73 of SARA annually.

Endangered Species Act

Section 7 of the Endangered Species Act (ESA) requires all US federal agencies to 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 2016, 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:

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

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 review due to limited availability of 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 2016, the following state regulatory offices reviewed listed species within their jurisdiction and issued permits to conduct lampricide applications:

- Minnesota Department of Natural Resources
- Michigan 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

Granular Bayluscide Study

Three field tests were conducted (May 31 – June 9) on the Middle Channel of the St. Clair River to determine the dissipation of niclosamide (2', 5-dichloro-4'-nitrosalicylanilide) in the water column and sediment following the application of Bayluscide 3.2% granular Sea Lamprey larvicide.

Piping Plover Risk Assessment

The Service is seeking to treat the middle and lower sections of the Platte River with a mixture of TFM and 1% niclosamide . Currently, the mixture cannot be used prior to September 1 because piping plovers (PIPL; *Charadrius melodus*) nest at the mouth of the river and there is a concern that insects exposed to the mixture may be eaten by PIPL and have an adverse effect. A study was conducted on the Manistee River (August 23 – September 7) to determine the concentration of the mixture in mayfly larvae (*Hexagenia limbata*), water, and sediment during and after the treatment. Residue concentrations in mayfly larvae will be used to calculate the daily dietary exposure of PIPL adults and chicks. This calculation will be compared to a No Observable Adverse Effects Level (NOAEL) estimated from avian toxicity studies to determine the risk to PIPL.

Lake Sturgeon Collection on the Manistee River

The Service's Risk Management Team (RMT) participated in the partner-led effort to collect young-of-the-year lake sturgeon (LAS: *Acipenser fulvescens*) before the treatment of the Manistee River (Lake Michigan). A total of 117 LAS were removed prior to treatment (August 22 - 26 and August 28), held in fresh water during the treatment in the Little River Band of Ottawa Indian (LRBOI) Streamside Rearing Facility, and returned to the river the day after treatment. In addition to the 117 collected pre-treatment, 13 dead and 1 live LAS were collected the day after the treatment. All live LAS collected were measured, weighed, finclipped for genetics, and pit tagged.

Field Protocols

Both federal and state listed species are included in protocols that are annually developed by the RMT for field staff. The protocols detail conservation measures to be followed where Sea Lamprey control activities are scheduled near listed species. During 2016, the following protocols were implemented to protect and avoid disturbance to federal- and state- listed species:

- *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 2016.*

- *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 2016*.

The protocols provided field personnel with a list of protected federal and state listed species, their known locations, and measures to avoid and protect. No mortality or disturbance was observed during 2016 for the 88 federal and state listed species and the de-listed bald eagle (*Haliaeetus leucocephalus*) identified in the 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 2016, NEPA was required for new cooperative agreements for the following actions:

- Sand River lampricide treatment
- Raspberry River lampricide treatment

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 the 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 32).

Table 32. Summary of 6(a)(2) reports submitted for incidents of non-target mortality during 2016.

Lake	Stream	Mortality	Frequency	Comments
Superior	Silver R.[1] (Huron Bay-lentic)	Trout-perch (*Percopsis omiscomaycus*)	133	Sensitive due to spawning
Michigan	Manistee R.[2]	Chinook salmon (*Oncorhynchus tshawytscha*)	88	Sensitive due to spawning
Erie	Cattataugus Cr.[3]	Stonecats (*Noturus flavus*)	465	Fish sensitive to lampricide

[1] Granular Bayluscide treatment.
[2] TFM/niclosamide treatment.
[3] TFM 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.

<u>Lampricide Control Task Force</u>

Purpose

Maximize the number of Sea Lampreys killed in individual streams and lentic areas while minimizing costs and impacts on aquatic ecosystems.

2016 Membership

Lori Criger (Chair), Alex Gonzalez, Cheryl Kaye, Stephen Lantz, Chris Gagnon, Tim Sullivan, Aaron Jubar (Service); Brian Stephens, Bruce Morrison, Shawn Robertson, Fraser Neave (Department); Jean Adams (USGS/GLFC); Mike Boogaard, Terry Hubert, Karen Slaght (USGS); Michael Wilkie (Wilfred Laurier University); Dale Burkett, Mike Siefkes, (GLFC 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.

2016 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. As the field season continues into the fall period, streams are to be treated for a longer duration because of seasonal variation in TFM sensitivity.

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, DFO conducted lampricide treatments in the US that were geographically closer to its headquarters to reduce travel time.

3. Crews from both USFWS and DFO worked together to complete the St. Marys granular Bayluscide treatment plots.

4. Two treatments (Jarvis River; Lake Superior, and Grand River; Lake Erie) from the 2016 rank list were deferred due to unfavorable environmental conditions. The Garden River (Lake Huron) was also deferred. However, treatments to Richardson Creek, Boyne River, and Sturgeon River lentic (Lake Huron), were added to the treatment schedule based on larval assessments conducted during the 2016 field season.

2017 Objectives:

1. Treat all streams listed on the 2017 treatment rank list.

2. Review past treatment results and larval assessment data to direct implementation of applicable treatment strategies to achieve improved efficacy for streams ranked for treatment in 2017.

3. Deploy additional personnel from within the program to treat more streams in the spring to take advantage of seasonal susceptibility, optimal stream discharge and water chemistries as well as 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 DFO staff conducting or assisting with treatments in Michigan.

5. To increase treatment effectiveness on St. Marys River granular Bayluscide applications, both spray boats will be utilized to ensure treatments are completed before aquatic vegetation becomes problematic.

6. Support and provide input into research that investigates Sea Lamprey sensitivity and non-target effects of other aquatic organisms to lampricides which may lead to new control strategies and minimize effects on non-target species.

Strategy 2: Measure the effectiveness of lampricide application and account for its variation among streams.

2016 Outcomes:

1. Lampricide analysis and water chemistry data from treatments in 2016 were reviewed to identify potential areas that did not receive theoretical lethal TFM concentrations during stream treatments. Information is provided to larval assessment to help guide treatment evaluation survey effort and if required, may result in re-treatment.

2017 Objectives:

1. Review past treatment history and larval assessment information for streams ranked for treatment in 2016 to identify impediments to effectiveness and develop strategies to increase efficacy.

2. At the direction of the SLCB, work with other task forces to plan work that will measure effectiveness of lampricide applications.

3. Assist UMESC in field studies in support of the development of a niclosamide bar and a new formulation liquid niclosamide.

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

Strategy 1: Implement integrated strategies for Sea Lamprey control for each lake and evaluate their effectiveness.

2016 Outcomes:

1. Implemented the large scale treatment strategy targeting large producers in the Lake Superior basin.

2. Assistance to the LATF to develop possible control strategies in the Huron-Erie Corridor as directed by SLCB is ongoing.

2017 Objectives:

1. Optimize stream treatment schedules to facilitate the implementation of the next large scale treatment strategy which targets Lake Michigan in 2017.

2. Assist in the development of recommendations and implement tactics from the lampricide control review to increase effectiveness of treatments.

Barrier Task Force

Purpose

The task force was established during April 1991 to coordinate efforts of the Department, the Service, and the USACOE on the construction, operation, and maintenance of Sea Lamprey barriers.

2016 Membership

Pete Hrodey (Chair), Kevin Mann, Cheryl Kaye, and Rob Elliott (Service); Brian Stephens, Tonia Van Kempen, Bhuwani Paudel, and Tom Pratt (Department); Jim Galloway and Carl Platz (USACOE); Gary Whelan (MIDNR); David Gonder (OMNR); Nicholas Johnson (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.

2016 Outcomes:

1. Planning continued on 14 barrier construction projects to prevent Sea Lampreys from accessing spawning habitat.

2. Routine maintenance at all purpose-built Sea Lamprey barriers was completed to ensure adult Sea Lampreys do not have access to spawning habitat.

3. Inspection of approximately 200 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.

4. Review of 40 fish passage projects was initiated or completed to determine the effect of fish passage and dam or culvert removals to Sea Lamprey control operations.

5. Completed electrofishing surveys and habitat assessments conducted upstream of barriers of concern in the Brule, Chagrin, Kalamazoo, and Manistique rivers and Big, Big Otter, and Bowmanville creeks to quantify potential infestation risk; barrier inspections were also completed to verify historical information and at locations not currently represented in the barrier database.

2017 Objectives:

1. Initiate construction of the Manistique River (Lake Michigan) Sea Lamprey barrier.

2. Complete final design and construction planning for the Grand River (Lake Erie) Sea Lamprey barrier in Harpersfield, OH. Plan for construction in FY18 to ensure that Sea Lampreys remain blocked at the Harpersfield Dam.

3. Initiate rebuild of Denny's Dam on the Saugeen River (Lake Huron), subject to successful consultation between OMNRF and Saugeen Ojibway Nation to ensure that Sea Lampreys remain blocked at Denny's Dam.

4. 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.

5. Members remain engaged in the process to reach a decision point regarding the Black Sturgeon River (Lake Superior) Camp 43 dam.

6. Continue working on priority GLFER barrier projects with the U. S. Army Corps of Engineers: Bad (Lake Superior) and Little Manistee rivers (Lake Michigan) to limit Sea Lamprey access to spawning habitat.

7. Investigate repair, rebuild, or removal alternatives to restore the blocking function of the Sea Lamprey barrier on Duffins Creek (Lake Ontario).

8. Investigate retrofit of the Big Otter Creek (Lake Erie) Black Bridge railway crossing to function as a Sea Lamprey barrier.

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

10. 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.

2016 Outcomes:

1. Participated in a field experiment in the Carp Lake Outlet to test use of the alarm cue as a short-range repellent in push-pull trapping. Results indicate that Sea Lamprey can be effectively moved from one side of the stream to another using 3kPZS.

2. Participated in a field experiment in the Ocqueoc River to determine whether exposure to the larval odor (pheromone) alters Sea Lamprey response to the alarm cue. Preliminary analysis indicates that exposure to the alarm cue in combination with the larval odor does slow the lamprey's progression, but does not significantly alter the tendency to move upstream. Work to identify the chemical nature of the alarm cue is ongoing.

3. 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. Zero unmarked adult lampreys were captured during 2016 in the upper Cheboygan, despite a parasitic lamprey caught on a fish in Mullett Lake, and thousands of

larval Sea Lamprey collected during treatment of Maple and Sturgeon rivers (upper Cheboygan tributaries).

4. 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. All indications are that no Sea Lamprey made it upstream, although further larval assessment work is needed to confirm.

5. Participated in a field experiment in the Ocqueoc River to evaluate the use of the repellent in trap-and-pass fishways in the Great Lakes (to selectively remove Sea Lamprey from passing fishes). The first year of the project was compromised by delays in equipment acquisition, but some work was done in one of the two channels that were planned.

2017 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 Lampreys 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 Lampreys from accessing spawning habitat.

4. The CWG will continue to assess the upper Cheboygan River population during 2017 to confirm that adult populations upstream of the Cheboygan Lock and Dam complex are small. The CWG plans to develop 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.

2016 Membership

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

Progress towards goals described in the GLFC Vision:

Goal 1: Suppress Sea Lamprey populations to target levels.

Strategy 2: Conduct detection and distribution surveys to identify all sources of larval Sea Lampreys.

2016 Outcomes:

1. Detection surveys were conducted on 109 tributaries basin-wide during 2016. Two new producing tributaries (Flintsteel River and Wild Goose Creek) and one new lentic area (Jackpine River) were found during 2016 in Lake Superior. Both the Flintsteel River and Jackpine River lentic area are scheduled for treatment in 2017. Wild Goose Creek did not rank for treatment, but will be re-evaluated in 2017. No new sources of Sea Lampreys were identified in lakes Michigan, Huron, Erie, or Ontario.

2. Distribution surveys were conducted during 2016 in tributaries scheduled for treatment in 2016 and 2017.

3. During the 2016 field season, 46 gB surveys covering 23,000 m^2 were conducted in the upper and lower portions of the St. Clair River to supplement previous data and to fill spatial gaps where needed. Thirty-five Sea Lamprey larvae were collected during gB surveys.

2017 Objectives:

1. Conduct detection surveys as required. When new infestations are found, rank for treatment as size structure dictates.

2. Conduct distribution surveys where required for 20167 and 2018 treatments.

3. Conduct ranking, distribution and index plot surveys in the St. Clair River. Aid in the development of the Critical Path Analysis outlining potential St. Clair River gB treatment in 2018.

4. Conduct gB evaluation surveys in the upper and lower Niagara River.

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

2016 Outcomes:

1. Post-treatment assessments were conducted on 95 tributaries and 18 lentic areas that were treated during 2015 and 2016. Any tributaries that had substantial residual populations were ranked for re-treatment. The Betsy and Huron rivers and Roxbury Creek in Lake Superior are scheduled for 2017 treatments based on the presence of residual Sea Lampreys. In Lake Huron, Silver, Timber Bay, and Hughson creeks and the Mindemoya River are scheduled for 2017 treatments based on the presence of residual Sea Lampreys.

2. A complete pre- and post-treatment population assessment was conducted on the Manistee River in 2016. Prior to treatment, this Lake Michigan tributary contained an estimated 1.34 million Sea Lamprey larvae. Post-treatment assessments indicated 37,348 residual larvae. Control agents estimate treatment efficacy for this large and complex Lake Michigan tributary to be 98%.

2017 Objectives:

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

2016 Outcomes:

1. During the fall Larval Assessment Task Force meeting, agents consulted with environmental DNA (eDNA) experts to learn more about the usefulness and potential future applicability of this new and emerging technology to Sea Lamprey larval assessment.

2017 Objectives:

1. In order to identify research priorities and a strategy for utilizing eDNA for larval assessment, develop a Technical Assistance Project proposal outlining objectives and desired outcomes of emerging eDNA research projects.

2. If required, hold a Larval Assessment Work Group meeting to review larval protocols and other topics of concern in detail. Continued protocol discussions are necessary to promote consistency among offices throughout times of significant staff turnover.

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

2016 Outcomes:

1. Prepared for implementation of the second year of the 2016–2018 targeted streams strategy for Lake Michigan tributaries.

2. Began evaluating treatment effectiveness of the Lake Superior tributaries that were treated during 2016 as a part of the targeted streams strategy.

2017 Objectives:

1. Complete the summary of the 2014–2015 targeted streams strategy. Draft a final report for the 17-02 SLCB meeting.

2. Conduct distribution surveys in preparation for the next set of targeted streams in Lake Huron in 2018.
3. A rough draft of the results of the 2014 – 2015 targeted streams strategy was assembled.

4. Work with the TTF and LCTF to continue updating HEC Assessment and Control Plan, as directed by the SLCB.

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.

2016 Membership

Gale Bravener (Chair) and Mike Steeves (Department), Jessica Barber, Peter Hrodey, Greg Klingler (Service), Jean Adams, Scott Miehls, Jane Rivera, Alex Haro (USGS); Weiming Li, Michael Wagner (Michigan State University), Heather Dawson (University of Michigan), Rob McLaughlin (University of Guelph), Michael Siefkes, Dale Burkett (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.

2016 Outcomes:

1. The new Adult Index was employed for the second year. This method of tracking lake wide abundance of adult sea lamprey replaced the former method that relied more heavily on modeled population estimates. A total of 29 index streams were trapped throughout the Great Lakes in 2016, and mark recapture population estimates were obtained from 26 of the 29. Mark-recapture population estimates could not be obtained on the Betsy River, Sterling Creek and Cattaraugus Creek due to low numbers of recaptures, and therefore were model-estimated.
2. Several recent and ongoing research projects were monitored for potential application in the adult assessment program. These included testing alternatives to the modified Schaefer method for estimating populations of adult Sea Lampreys in streams, testing electrical leads to traps, and testing eel-ladder style traps.
3. The Secretariat office, along with USFWS Green Bay continued to collect and assemble up to date lake trout abundance and wounding rate data from the various agencies around the Great Lakes, and generating lake wide averages for status graphs.

2017 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.

2016 Outcomes:

1. Collection via screw traps, fyke nets, or electrofishing were considered in several tributaries with potential for recently metamorphosed juveniles in fall 2016. Most of these were subsequently treated, could not be collected on due to high water, or were deemed to have very few juveniles. However, there was some additional collection effort by electrofishing on areas where juveniles or large larvae were discovered upstream of the last treatment. In the Neebing River (Lake Superior), 85 juveniles were captured and removed.
2. There are several recent and ongoing research projects aimed at improving the capture efficiency of adults and recently metamorphosed juveniles for control purposes. No new methods were deployed in 2016.
3. A workgroup was formed to address the long standing question of whether trapping for control can be cost-effective. A general framework for trapping adult sea lampreys is in development. The results from a new research project involving a Sea Lamprey Management Strategy Evaluation model (SLamMSE) is expected to be very helpful in evaluating the potential of trapping adults for control.

2017 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.
3. Continue to develop a trapping for control framework, evaluating when and where trapping for control is likely to be successful and cost-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.

2016 Outcomes:

1. The Li lab has identified several new pheromone compounds over the past couple of years, some of which were tested for biological activity in 2016. In total, they have identified 14 compounds from larval washings (e.g. LW1 compounds 971 and 973) and 7 compounds from mating pheromones (e.g. PAMS-24 could be a territoriality pheromone). However, no pheromone combinations tested were as effective at attracting or retaining ovulating females as washings from spermiated males.
2. The Li lab has also made significant progress identifying and testing pheromone antagonists. Antagonists are showing promise not only for migration (3kPZS) but mate finding and nest building (DkPES, PAMS-24, Spermidine). At the right concentration, tri-sulfated PZS is very effecting at repelling ovulating females from spermiated male washings.
3. The pheromone workgroup has refocused the Chemosensory Cue Strategy and is finalizing objectives, plans for regular meetings, reporting out, and communicating the strategy more broadly.

2017 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. Continue to characterize potential antagonists, including tests of potential antagonists in a quasi-natural environment (single stream).
3. The pheromone workgroup will finalize the Chemosensory Cue Strategy.

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

2016 Outcomes:

1. The research project focused on identifying the chemical nature of the alarm cue is continuing to make progress.
2. A 3-year push-pull demonstration project with pheromone attractant and alarm cue repellant is now complete. When 3kPZS was applied at 10-^{12} M, it drew significantly more lamprey upstream. The alarm cue extract at 1 PPM was a consistent repellent, resulting in a high probability of trap encounter. Trap performance was poor (8% efficacy) despite high attraction to the entrance (88%).
3. In 2016 a model fishway equipped with an eel-ladder was designed, constructed and installed in the Ocqueoc River. After calibration, 30 preliminary trials were run using 300 female Sea Lampreys. The eel ladder-trap was highly effective at removing individual Sea Lamprey (77%). There is evidence of discrete behavioral patterns between individuals, with two groups of Sea Lamprey that passed (fast vs. slow) and two groups that did not pass (no attempt vs. abandon after attempt(s)).

2017 Objectives:

1. Continue work to isolate and identify the chemical structure of the Sea Lamprey alarm cue (Wagner Lab and Nair Lab, MSU).
2. Complete field-testing of push-pull application of the Sea Lamprey alarm cue in open-water trapping scenarios.
3. Test the use of push-pull and eel ladders in an experimental selective fishway to ascertain whether behavioral manipulation can be used to separate and trap sea that approach and enter a fishway without altering a native fish's ability to pass.
4. Complete a preliminary experiment to determine whether post-metamorphic Sea Lamprey (transformers) respond to the alarm cue.

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

2016 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 and wounding rates on lake trout.

2017 Objectives:

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

OUTREACH

The Service and Department are involved in outreach activities to inform the public of the benefits and operations of the SLCP. These efforts educate the public about Sea Lampreys and the devastating effect they have on Great Lakes fishes. The primary tool used during outreach events is an interactive display with graphics and an aquarium that houses live larval and adult lampreys for visitors to experience Sea Lampreys first-hand. During 2016, this display was in attendance at several large capacity events (Table 33).

Table 33. Dates and locations of public outreach performed by agents of the SLCP in 2016.

Date	Location	Venue	Lead Agency
January 28-31	Schaumburg, IL	Chicagoland Fishing Travel and Outdoor Expo	USFWS
February 12-15	Mississauga, ON	Spring Fishing and Boat Show	DFO
February 17-21	Duluth, MN	Duluth Boat, Sports, Travel and RV Show	USFWS
February 27 - March 1	Thunder Bay, ON	Central Canada Outdoor Show	DFO
March 17	Television Broadcast	TVOKids – The Mystery Files Episode "Alien Invaders"	GLFC
March 19-22	Grand Rapids, MI	Ultimate Sport Show	USFWS
April 5-8	Bloomfield Hills, MI	Cranbrook Institute of Science, Spring Event	GLFC
April 7	Ypsilanti, MI	Washtenaw Community College Earth Day	GLFC
April 23	Cheboygan, MI	Earth Week Plus Expo	HBBS
May 6	Dearborn, MI	Rouge River Water Festival	GLFC
May 20	Rochester, MI	Clinton River Water Festival	GLFC
May 28	Samia, ON	Blue Water Anglers Event	GLFC/DFO
June 11	Cheboygan, MI	Michigan DNR Youth Fishing Tournament	HBBS
June 11	Lansing, MI	Grand American Fish Rodeo	USFWS
June 11	Alpena, MI	Hooked 4 Life Fishing Clinic and Derby	HBBS
June 12	Detroit, MI	Detroit River Fish 4 Kids	GLFC
July 8-10	Fairport Harbor, OH	Tall Ships	GLFC
July 15-17	Bay City, MI	Tall Ships	GLFC
July 21	Millersburg, MI	Presque Isle County Fair	HBBS
July 23	Alpena, MI	Brown Trout Festival	HBBS
August 5-7	Green Bay, MI	Tall Ships	GLFC
August 13-14	Southampton, ON	Saugeen Ojibway First Nation Pow Wow	DFO
August 26 – September 4	Owen Sound, ON	Owen Sound Salmon Spectacular	GLFC/DFO
September 8-11	Erie, PA	Tall Ships	GLFC
September 11	Lake Hudson, MI	Great Outdoor Youth Jamboree	GLFC
September 17-18	Brockville, ON	Tall Ships	GLFC
September 26-28	Michigan City, IN	Indiana Environmental Health Association Education Conference	GLFC
October 15	Elmira, MI	Jordan River Festival	USFWS
December 8	Walpole Island, ON	Walpole Island First Nations Event	GLFC/DFO

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: Brian Stephens

Lampricide Control Biologists:
- Bruce Morrison: Supervisor
- Shawn Robertson: Supervisor
- Alan Rowlinson: Assistant Supervisor
- Barry Scotland: Assistant Supervisor
- Tonia Van Kempen: Environmental Supervisor

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

Lampricide Analysis Technicians:

Jerome Keen	Richard Middaugh

Lampricide Application Technicians:

Zach Allan	Melissa Landry
Sarah Daniher	Adam Loubert
Kevin Finlayson	Matt McAulay
Kathy Hansen	Sean Nickle
Laura Harman	Chris Sierzputowski
Paul Kyostia	Jamie Smith
Joe Lachowsky	Clinton Wilson

Barriers:
- Bhuwani Paudel: Barrier Engineering Coordinator
- Joe Hodgson: Barrier Engineering 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	Sean Morrison
Nathan Coombs	Andrea Phippen
Jennifer Hallett	Jeff Rantamaki
Sarah Larden	Thomas Voigt

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

Maintenance:
- Brian Greene: Supervisor
- Chad Hill: Assistant

UNITED STATES FISH AND WILDLIFE SERVICE

Aaron Woldt, Deputy Assistant Regional Director, Fisheries and Acting Sea Lamprey Program Manager

Ludington Biological Station – Ludington, Michigan
Scott Grunder, Station Supervisor

Administrative Support:
- Danya Sanders

Lampricide Control Fish Biologists:
- Timothy Sullivan, Treatment Supervisor
- Alex Gonzalez, Treatment Supervisor
- Christopher Eilers
- Daniel McGarry
- Jenna Tews

Lampricide Control Lead Physical Science Technician:
- Vacant

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

Lampricide Control Biological Science Technicians:

Zachary Berry (CS)	Todd Gerardot (CS)
Lisa Dennis (CS)	Bobbie Halchishak (CS)
Lauren Freitas (CS)	Vacant (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)
Gary Haiss (CS)	John Stegmeier (CS)

Maintenance Worker:
- Michael Sell

(CS) Career Seasonal

UNITED STATES FISH AND WILDLIFE SERVICE (CONTINUED)

Aaron Woldt, Deputy Assistant Regional Director, Fisheries and Acting Sea Lamprey Program Manager

Marquette Biological Station – Marquette, Michigan

Katherine Mullett, Station 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:
- Stephen Lantz

Maintenance Worker:
- David Magno

Unit Supervisor (Adult): Jessica Barber

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

Barrier and Trapping Biological Science Technicians:

Dennis Smith	Sean Soucy (CS)
Kevin Letson	Vacant (CS)
Cassie Abrams (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:

Susan Becker (CS)	Randy Parker (CS)
Stephen Healy (CS)	Cory Racine (CS)
Janet McConnell(CS)	Dan Suhonen (CS)
Tiffany Opalka-Myers (CS)	Vacant (CS)

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

Larval Assessment Biological Science Technicians:

Nikolas Rewald	Nicholas Chartier (CS)
Jason VanEffen	Rachael Guth (CS)
Jarvis Applekamp (CS)	Vacant (CS)
Joshua Beaulaurier (CS)	

(CS) Career Seasonal

Ted Lawrence with host Ethan "E.B." Burnett, co-host of the TVO Kids show 'The Mystery Files'. The episode "Alien Invaders" aired March 17, 2016 and focused on Sea Lamprey. Courtesy TVOKids.

Bob Lambe (GLFC) gives an overview of the Sea Lamprey Control Program to Senator Gary Peters (MI) at Hammond Bay Biological Station, May, 2016. (Photo by A. Miehls).