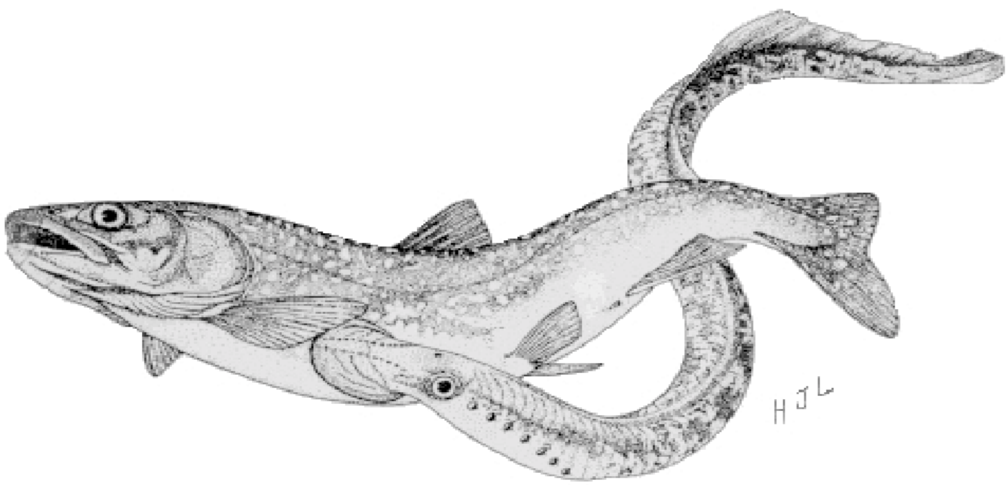
INTEGRATED MANAGEMENT OF SEA LAMPREYS IN THE GREAT LAKES 2000

ANNUAL REPORT TO

GREAT LAKES FISHERY COMMISSION



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Executive Summary

This report summarizes activities in the integrated management of sea lampreys conducted by the U.S. Fish and Wildlife Service (Service) and the Department of Fisheries and Oceans Canada (Department) in the Great Lakes during 2000. Lampricide treatments were conducted in 63 tributaries (Table 1). Larval assessment crews surveyed 382 tributaries, inland lakes, and lentic areas to assess control effectiveness, plan future TFM treatments, and estimate production capacity of streams. Assessment traps were operated in 69 tributaries to estimate the spawning-phase population in each Great Lake (Table 2).

This report evaluates sea lamprey populations versus fish community objectives in each of the lakes. Lake Superior exceeded the 1986-1989 average and therefore was well above the target of 50% decline by the year 2000. The Lake Superior Committee is currently refining the Fish Community Goals and Objectives for Lake Superior. In Lake Michigan, the fish community objective was met even with a long-term increase in abundance of spawning sea lampreys during 1986-1998. Populations of parasitic lampreys remain significantly higher than the fish community objective in Lake Huron because of the continued high production of transformers from the St. Marys River. The lamprey management program met the fish community objective in Lake Ontario, but did not for Lake Erie.

Risk assessment focused on environmental risk management as related to regulatory agency permits for control actions and on coordination of lake sturgeon (Acipenser fulvescens) and other non-target organism related issues throughout the Great Lakes Basin.

The St. Marys River Control Task Force completed all charges given by the Sea Lamprey Integration Committee (SLIC). The SLIC dissolved the task force, and any related responsibilities were assigned to the Assessment, Lampricide Control, and Sterile Male Release Technique Task Forces.

The Sterile Male Release Technique Task Force focused on a pilot study of density-dependent effects in 7 Lake Superior streams and the 4th year of enhanced release of sterile male sea lampreys in the St. Marys River. The pilot study investigated survival of yearling larvae that were propagated from a low density of spawner stock that was introduced into the study streams during 1999. The St. Marys River received 43,184 sterilized males which created a 3.3:1 sterile:untreated male ratio. The theoretical reduction from trapping and sterile male release was estimated at 88% during 2000 resulting in a reduction of the estimated number of reproducing females from 8,406 to 1,010.

The Barrier Task Force coordinated with the U.S. Army Corps of Engineers to develop eight new barrier projects under Section 1135 of the Water Resources Development Act. The task force also was involved with workshops to develop fish passage and barrier research and the measurement of environmental criteria for barrier placement.

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[1]*Presented during Annual Meeting by Michael B. Twohey, U.S. Fish and Wildlife Service, Marquette, Michigan.*

The Assessment Task Force continued to develop, with the Secretariat, the Empirical Stream Treatment Ranking model to rank and select streams for lampricide treatment. For the first time, the model was used to predict potential transformer production from residual populations. Preliminary rank lists for treatment during 2001 were prepared prior to the fall meeting of the SLIC. The task force continued to develop and implement plans to evaluate control efforts in the St. Marys River. The task force cooperated in the long-term sterile male release, compensatory mechanisms, and the lampricide treatment effectiveness studies. The task force continued to implement recommendations of the adult assessment review by redistributing trapping effort from small to large streams, estimating the parasitic population in Lake Huron by marking and releasing parasitic lampreys into the lake, and estimating the transformer production in Lake Superior by marking and releasing transformers into select tributaries. The Task Force prepared a report on the use of granular Bayluscide as a survey tool in streams designated as lake sturgeon streams.

The Lampricide Control Task Force continued to implement options for reducing lampricide use. The TFM use for 2000 was 50% less than the average use for the decade of the 1980s, meeting the objective stated in the Commission Vision Statement.

The sea lamprey management program conducted 2,131 outreach activities that required 227 staff days.

Table 1. Summary of lampricide applications in tributaries of the Great Lakes during 2000.

Lake	Number of Tributaries	Flow (m^3/s)	TFM[1,2] (kg)	Bayluscide[1] (kg)	Distance (km)
Superior	19	14.2	2,084.0	136.6	284.9
Michigan	18	48.7	11,249.8	116.1	499.2
Huron	16	116.7	10,749.6	52.8	475.2
Erie	1	5.0	552.9	0.0	83.7
Ontario	9	24.6	2,907.0	13.1	111.4
Total	**63**	**209.2**	**27,543.3**	**318.6**	**1,454.4**

[1]Lampricides are in kg of active ingredient.

[2]Includes 302 TFM bars (61.6 kg active ingredient) applied in 10 tributaries.

Table 2. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of the Great Lakes during 2000.

Lake	Number of tributaries	Total Captured	Number sampled	Percent (%) males	Mean length (mm)		Mean weight (g)	
					Males	Females	Males	Females
Superior	23	18,545	1,039	42	450	442	217	211
Michigan	16	29,489	659	47	479	483	267	262
Huron	13	52,415	355	60	506	507	293	286
Erie	3	1,189	16	69	509	523	261	263
Ontario	14	5,033	809	58	496	492	270	270
Total	**69**	**106,671**	**2,878**					

INTRODUCTION

Sea lamprey control is a critical fishery management action delivered to support the Fish Community Objectives developed by the Lake Committees as part of the Strategic Plan for Great Lakes Fishery Management. Objectives for acceptable levels of mortality that allow the establishment and maintenance of self-sustaining stocks of lake trout and other salmonids have been established or are being reviewed on all of the lakes. In some cases, the Lake Committees have established specific targets for sea lamprey populations in the Fish Community Objectives or the lake trout rehabilitation plans. The current control program reflects actions by the U.S. Fish and Wildlife Service (Service) and Department of Fisheries and Oceans Canada (Department) as contract agents of the Great Lakes Fishery Commission (Commission) to meet these targets.

The Commission is working in partnership with the Lake Committees through their Lake Technical Committees to refine the target statements and to develop common target formats for each of the lakes. The target for each lake will define the abundance of sea lampreys that can be tolerated and the economically viable level of control required to reach the desired suppression. The Commission and cooperators will consider the costs of control along with the benefits to define an optimum control program. The program must support the Fish Community Objectives, be ecologically and economically sound, and be socially acceptable.

This report presents the actions of the Service and Department in the integrated management of sea lampreys in the Great Lakes during 2000. Also presented are actions to meet milestones of the Commission vision and trends in sea lamprey abundance as related to Fish Community Objectives.

COMMISSION VISION

The Commission established the "Strategic vision of the Great Lakes Fishery Commission for the decade of the 1990s" during 1992, and established the following integrated management of sea lamprey vision statement:

> *The Commission will provide an integrated sea lamprey management program that supports the fish community objectives for each of the Great Lakes and that is ecologically and economically sound and socially acceptable.*

To achieve the vision, the Commission set milestones. The following are the milestones and the accomplishments to those milestones:

1) *Establish target levels of sea lamprey abundance by 1994 that maximize net benefits of sea lamprey and fisheries management.*

Beginning during 1993 and ending during 1998 each Lake Committee had established Fish Community Objectives for sea lamprey abundance that were based on their subjective judgment of levels necessary for lake trout rehabilitation. The sea lamprey portion of the process to set economic injury levels is largely complete. The Commission and Lake Committees are initiating discussion and planning to focus fish community objectives on economic injury levels.

2) *Suppress sea lamprey populations to target levels through an optimal program of control, assessment, and research. This program will be characterized by:*

   a) *maintenance of lampricide registrations with environmental agencies,*

The Service has become the registrant for all lampricides used in the United States and Canada. The U.S. Geological Survey-Biological Resources Division (USGS-BRD) has provided technical support for establishment and maintenance of registrations.

   b) *development and use of alternative control techniques to reduce reliance on lampricides to 50 percent of current levels,*

The pesticide TFM was first used as a management tool to control larval sea lampreys in the Great Lakes during 1958. Recently, the Service and Department have used less TFM by more efficiently treating tributaries. The volume use of TFM has decreased from an annual average of 49,406 kg active ingredient during 1980-1989 to 38,697 kg active ingredient during 1990-99, which has occurred through improved application techniques, implementation of alternative controls, and refined assessments.

   c) *development of quantitative assessment and improved control technologies for lentic areas and connecting channels*

This has been implemented as two separate milestones: 1) development of quantitative assessment of sea lamprey populations in all areas, and 2) improved control in lentic and connecting channels. Both have been met and further refinements were continuing.

   d) *improvement of information gathering and research through program coordination among sea lamprey control agents, fish management agencies, other agencies and private groups, and researchers.*

Research primarily has been met through delivery of outstanding work products of the internal research team of USGS-BRD centers (Great Lake Science Center and its Hammond Bay Biological Station, and Upper Midwest Environmental Sciences Center) and PERM scientists at Michigan State University, and of the external research through alternative control and IMSL research contracts. Information gathering has been met through Service and Department representation on lake technical committees, the SLIC organization of task forces and working groups, and outreach activities with private groups.

FISH COMMUNITY OBJECTIVES

Lake Superior

The Lake Superior Committee during 1990 established the following specific targets for sea lamprey populations in their Fish Community Objectives:

Achieve a 50% reduction in parasitic-phase sea lamprey abundance by 2000, and a 90% reduction in parasitic-phase sea lamprey abundance by 2010.

Based on estimates of the damage caused by the parasitic-phase population during the mid-1980s, these reductions were established to reflect the need for enhanced control on Lake Superior, with full recognition of the need for further evaluation of the costs of suppressing lamprey to these levels. The base for this objective was the average of the estimated annual abundance during 1986-1989, and, during the 1990s, the objective was achieved during 1994 and 1995. Estimated abundance during 2000 was greater than the 1986-1989 average (Fig. 4).

Achieve a sustained annual yield of 4 million pounds of lake trout from naturally reproducing stocks, and an unspecified yield of other salmonid predators, while maintaining a predator/prey balance which allows normal growth of lake trout.

Naturally reproducing stocks of lake trout can be maintained only with a total annual mortality of less than 45%. Reaching this objective for total mortality requires a combination of fishery exploitation regulation and control of sea lamprey abundance.

The Lake Committee currently is in the process of revising the Fish Community Objectives.

Lake Michigan

The Lake Michigan Committee during 1995 established the following targets for sea lamprey populations in their Fish Community Objectives:

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

In general, treatment of Lake Michigan tributaries over the years has provided sufficient control of sea lampreys, yet increases in lamprey wounding rates on lake trout in northern waters of the lake are a concern. The long-term trend of sea lamprey abundance is a significant linear increase during 1981-2000 (Fig. 5).

The sea lamprey objective was developed to support the other fish community objectives for Lake Michigan, specifically those for lake trout and other salmonids.

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. Establish self-sustaining lake trout populations.

Control of sea lamprey populations and fishery exploitation is necessary to meet these objectives. The lake-wide management plan specifies four different areas where the chances of successful lake trout rehabilitation exist: refuges, primary, secondary, and deferred rehabilitation zones. The primary zones and refuges where priority should be given to control sea lamprey populations include the mid-northern region of the lake, the mid-lake reef zone, and an offshore reef area in the southwest portion of the lake.

Lake Huron

The Lake Huron Committee during 1990 established the following specific targets for sea lamprey populations in their Fish Community Objectives:

> *Reduce sea lamprey abundance to allow the achievement of other fish community objectives; obtain a 75% reduction in parasitic sea lamprey by the year 2000 and a 90% reduction by the year 2010 from present levels.*

The progress toward this objective is measured by the estimated abundance of spawning sea lampreys presently in 3 index streams (Thessalon, St. Marys, and Cheboygan rivers) in northern Lake Huron and by estimated lake-wide abundance. While the lake-wide abundance had been relatively stable throughout the 1990s (Fig. 6), there remained at least twice as many lampreys in Lake Huron during 2000 than any of the other Great Lakes. Estimated abundance of spawning-phase sea lampreys during 2001 will be one of the measures to determine success of the granular Bayluscide treatments of 1998-1999 in the St. Marys River. This sea lamprey target supports the objectives for the other species groups in the fish community including, for example, the Salmonine community objective:

> *Establish a diverse salmonine community which can sustain an annual harvest of 5.3 million pounds, with lake trout the dominance species and anadromous species also having a prominent place.*

Lake Erie

The Lake Erie Committee developed a draft "Guiding Principles for Determination of Fish Community Objectives" during 1999. The draft recognized sea lampreys as a pest species requiring control.

A specific management plan for sea lampreys in Lake Erie was developed prior to the implementation of stream treatments during 1986. The plan defined an experimental program of control to reduce sea lamprey populations to levels where wounding on lake trout would be less than 5%, assessment trap catches of lampreys would be less than 10% of pretreatment levels, and nest densities would be less than 2 nests per km of spawning habitat.

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 would be controlled through management of fishery exploitation and continued suppression of sea lampreys.

The fish community objective for sea lampreys was not met during 2000, and has not been met during 1996-2000. During 1980-2000, the Service and Department annually have trapped spawning-phase sea lampreys in an average of 6 tributaries, and have estimated lake-wide abundance of spawning lampreys with multiple regression analysis of 6 interrelated variables (Fig. 7). Lampricide control began during 1986 and first showed effect in the spawner population during 1989. Estimated lake-wide abundance averaged 17,000 during 1980-1988, was reduced to an average of 4,000 during 1989-1994, has since increased to 8,000 during 1995-2000, and was almost 16,000 during 2000. During 1989-2000, abundance of spawners has shown a significant positive linear trend. In addition, there were 15 A1-A3 wounds per 100 lake trout > 432 mm in New York waters of the lake during 2000.

Lake Ontario

The Lake Ontario Committee during 1988 supported the continuation of sea lamprey control and defined a specific target for sea lamprey populations in terms of mortality to lake trout in the Fish Community Objectives:

> *Limit the size of the sea lamprey population to a level that will not cause mortality in excess of 90,000 lake trout annually.*

This specific objective was developed to support the productive salmonine community including a lake trout population that shows significant reproduction in the near term.

The Lake Ontario Committee has revised its Lake Ontario Lake Trout Rehabilitation Plan from the original plan developed during 1983. The goal of the plan is to rehabilitate the population of lake trout to a self-sustaining level as defined in the Fish Community Objectives. The plan includes the fundamental premise that the continued control of sea lampreys is necessary for lake trout rehabilitation. The plan includes the specific objective for sea lampreys:

> *Controlling sea lamprey so that fresh wounding rates (A1) of lake trout larger than 431 mm is less than 2 marks/100 fish.*

This specific objective is meant to maintain an annual survival rate of 60% or greater for lake trout in order to maintain a target adult 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 fish community objective for sea lampreys was met during 2000, and has been met during 1996-2000. During 1981-2000, the Service and Department annually have trapped spawning-phase sea lampreys in an average of 15 tributaries, and have estimated lake-wide abundance of spawning lampreys with multiple regression analysis of 6 interrelated variables (Fig. 8). Estimated lake-wide abundance averaged 72,000 during 1981-1990, and was reduced to an average of 33,000 during 1991-2000. During 1981-2000, abundance of spawners has shown a significant negative linear trend. In addition, there were < 2 wounds per 100 lake trout > 431 mm in New York waters of the lake during 2000.

LAMPRICIDE CONTROL

Lampricide treatments are systematically scheduled for tributaries harboring larval sea lampreys to eliminate or reduce the populations of larvae before they recruit parasitic juveniles to the lake. Service and Department treatment units administer and monitor doses of the lampricide TFM, sometimes augmented with the 70% wettable powder formulation of Bayluscide, to scheduled tributaries. Specialized equipment and techniques are employed to provide concentrations of TFM that eliminate most of the lamprey larvae and minimize the risk to non-target species.

The Lampricide Control Task Force was established during December 1995 with charges to improve the efficiency of lampricide control, to maximize sea lampreys killed in stream and lentic treatments while minimizing lampricide use, costs, and impacts on stream/lake ecosystems, and to define lampricide control options for near and long-term stream selection and target setting. The report of progress on the charges during 2000 is presented on pages 60-61.

Lake Superior

Tributary Information

- Lake Superior has 1,566 (733 U.S., 833 Canada) tributaries.

- 136 (89 U.S., 47 Canada) tributaries have historical records or production of sea lamprey larvae.

- 70 (41 U.S., 29 Canada) tributaries have been treated with lampricide at least once during 1991-2000.

- Of these, 58 (30 U.S., 28 Canada) tributaries are treated on a regular 3-5 year cycle.

The following statements highlight the lampricide control program in Lake Superior during 2000. Table 3 provides details on the application of lampricides to tributaries treated during 2000 and Fig. 1 shows the locations of the tributaries.

- Treatments were successfully completed in 17 of 18 scheduled tributaries (13 U.S., 4 Canada). The Big Carp River was not treated due to insufficient discharge.

- Treatment effectiveness studies were conducted in 7 tributaries (4 U.S., 3 Canada).

- Low water levels in the Potato, Cranberry, Little Garlic, Middle, and Rock rivers required additional application sites to maintain proper lampricide concentrations.

- Granular Bayluscide was applied to selected areas in Batchawana Bay (3.2% active ingredient) and Mountain Bays (5.0% active ingredient). Moderate numbers of larvae were observed during these treatments.

- Mortality of non-target species was not significant in any of the tributaries treated.

Table 3. Details on the application of lampricides to tributaries of Lake Superior, 2000. (Number in parentheses corresponds to location of stream in Fig. 1)

Stream	Date	Flow (m^3/s)	TFM (kg)[1,2]	Bayluscide (kg)[1]	Distance treated (km)
United States					
Cranberry R. (17)	Jun 8	0.1	80.7	0.0	24.1
Potato R. (16)	Jun 9	0.2	83.1	0.0	27.4
Firesteel R. (15)	Jun 25	1.1	214.8	0.0	24.1
Betsy R. (7)	Jul 8	1.4	77.4	0.0	19.3
Little Two Hearted R. (8)	Jul 10	0.7	52.1	0.0	22.5
Salmon Trout R. (13)	Jul 11	0.7	109.8	0.0	12.9
Little Garlic R. (10)	Aug 24	0.0	18.4	0.0	8.0
Big Garlic R. (11)	Aug 28	0.1	14.6	0.0	9.7
Silver R. (12)	Sep 7	0.4	50.6	0.0	8.0
Middle R. (18)	Sep 9	0.2	50.5	0.0	33.4
Misery R. (14)	Sep 10	0.6	160.2	0.0	20.9
Nemadji R.					
Black R. (19)	Sep 13	0.4	81.3	0.0	8.3
Rock R. (9)	Sep 19	0.6	103.5	0.0	25.7
Total		6.5	1,097.0	0.0	244.3
Canada					
Jackfish R. (2)	Jul 12	3.9	353.0	0.0	9.0
Stokely Cr. (6)	Aug 20	0.3	24.0	0.0	10.9
Carp R. (4)	Sep 5	0.5	24.0	0.0	7.5
Wolf R. (1)	Sep 13	3.0	586.0	0.0	13.2
Batchawana Bay (5)	Aug 1			69.7	
Mountain Bay (3)	Sep 15			66.9	
Total		7.7	987.0	136.6	40.6
Grand Total		**14.2**	**2,084.0**	**136.6**	**284.9**

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

[2]Includes a total of 39 TFM bars (7.9 kg of active ingredient) applied in 4 streams.

Lake Michigan

Tributary Information

- Lake Michigan has 511 tributaries.
- 121 tributaries have historical records of sea lamprey larvae production.
- 64 tributaries have been treated with lampricide at least once during 1991-2000.
- Of these, 35 tributaries are treated on a regular 3-5 year cycle.

The following statements highlight the lampricide control program for Lake Michigan during 2000. Table 4 provides details on the application of lampricide to tributaries treated during 2000 and Fig. 1 shows the locations of the tributaries.

- Treatments were successfully completed in 18 of 19 scheduled tributaries. Treatment of the Boardman River was deferred until 2001 because the Michigan Department of Natural Resources (MDNR) operates an egg-take facility on the stream and its operation coincided with the scheduled treatment.
- An interim lampricide application protocol was applied to treatments of the Muskegon, Millecoquins, and the Ford rivers to protect young-of-year lake sturgeon (Acipenser fulvescens). This protocol defines limits to the concentration of lampricides that can be safely applied to lake sturgeon rehabilitation streams. The lake sturgeon is listed in the State of Michigan as a threatened species.
- Reduced lampricide concentrations were used during treatments of the Ford, Tacoosh, and Rock rivers and Squaw and Marblehead creeks because of low water levels.
- Mortality of non-target fish was minimal in the majority of treatments, although some chinook salmon and walleye died in the upper Muskegon River. A Voluntary Adverse Effects 6 (a)(2) report was submitted to the Environmental Protection Agency addressing this incident.

Table 4. Details on the application of lampricides to tributaries of Lake Michigan, 2000. (Number in parentheses corresponds to location of stream in Fig. 1)

Stream	Date	Flow (m^3/s)	TFM (kg)[1,2]	Bayluscide (kg)[1]	Distance treated (km)
United States					
Trail Cr. (27)	Apr 30	1.8	394.9	0.0	25.7
Kalamazoo R.					
Sand Cr. (26)	May 3	0.1	15.3	0.0	2.0
Gulliver Lake Outlet (34)	May 3	0.1	10.0	0.0	3.2
Marblehead Cr. (33)	May 11	0.1	29.1	0.0	4.8
Millecoquins R. (37)	May 12	3.6	563.0	5.1	41.7
East Twin R. (28)	May 25	1.1	221.6	0.0	8.0
Wycamp Cr. (20)	May 26	0.2	46.0	0.0	2.3
Tacoosh R. (31)	May 30	0.1	82.4	0.0	12.9
Grand R.					
Norris Cr. (24)	Jun 24	0.4	49.8	0.0	0.3
Crockery Cr. (25)	Jun 25	1.4	596.4	0.0	31.8
Crow R. (35)	Aug 4	0.3	43.7	0.0	3.2
Rock R. (36)	Aug 5	0.1	7.6	0.0	3.2
Squaw Cr. (32)	Aug 16	0.1	12.3	0.0	3.2
Muskegon R. (23)	Aug 20	35.4	6,802.2	103.6	171.7
Porter Cr. (22)	Sep 21	0.2	53.6	0.0	0.3
Horton Cr. (21)	Sep 23	0.2	116.5	0.0	0.9
Days R. (30)	Sep 28	0.4	91.7	0.0	8.0
Ford R. (29)	Sep 28	3.1	2,113.7	7.4	176.0
Total		**48.7**	**11,249.8**	**116.1**	**499.2**

[1]Lampricide quantities are in kg of active ingredient.
[2]Includes a total of 224 TFM bars (46.7 kg of active ingredient) applied in 2 streams.

Lake Huron

Tributary Information

- Lake Huron has 1,761 (427 United States, 1,334 Canada) tributaries.

- 117 (62 United States, 55 Canada) tributaries have historical records of production of sea lamprey larvae.

- 70 (34 United States, 36 Canada) tributaries have been treated with lampricide at least once during 1991-2000.

- Of these, 40 (22 United States, 18 Canada) tributaries are treated on a regular 3 to 5 year cycle.

The following statements highlight the lampricide control program in Lake Huron during 2000. Table 5 provides details on the application of lampricides to tributaries during 2000 and Fig. 1 shows the locations of the tributaries.

- Treatments were successfully completed in 16 of 19 scheduled tributaries (9 U.S., 7 Canada) including the first ever treatment of the Bighead River (Georgian Bay). Black Mallard Creek and the Shebeshekong River were not treated due to insufficient discharge. Albany Creek was not treated due to time constraints.

- U.S. and Canadian personnel treated the Rifle, Carp, and Mississagi rivers using the interim sturgeon protocol. Lampricide concentrations were restricted to 1.2 times the minimum lethal concentration required for 99.9% sea lamprey mortality.

- Beaver dams precluded application of lethal doses of lampricide to some sections of the Trout River.

- Mortality of non-target fish was minimal in the majority of treatments, although some stonecats (Noturus flavus) died during the Rifle River treatment. A Voluntary Adverse Effects 6 (a)(2) report was submitted to the Environmental Protection Agency addressing the incident. An unexpected shift in stream pH caused an increase in lampricide toxicity, which caused the fish mortality.

Table 5. Details on the application of lampricides to tributaries of Lake Huron, 2000.
(Number in parentheses corresponds to location of stream in Fig. 1)

Stream	Date	Flow (m^3/s)	TFM (kg)[1,2]	Bayluscide (kg)[1]	Distance Treated (km)
United States					
Cheboygan R.					
Laperell Cr. (50)	May 13	0.1	34.5	0.0	2.4
Devils R. (48)	May 16	1.2	246.1	0.0	4.8
Trout R. (49)	May 31	0.4	226.2	0.0	6.5
AuGres R. (46)	Jun 10	8.5	1,641.3	0.0	78.5
Tawas Lake Outlet (47)					
Silver and Cold crs.	Jul 8	1.1	289.8	0.0	21.6
Rifle R. (45)	Jul 19	4.9	1,931.7	8.4	177.0
Carp R. (51)	Oct 12	2.1	545.6	2.0	88.5
Beavertail Cr. (53)	Oct 12	0.1	18.7	0.0	11.3
Ceville Cr. (52)	Oct 19	0.1	4.7	0.0	2.4
Total		18.5	4,938.6	10.4	393.0
Canada					
Bighead R. (44)	May 7	4.2	1,612.0	0.0	26.0
Sucker Cr. (38)	May 11	0.04	6.0	0.0	1.0
Koshkawong R. (39)	May 11	0.2	33.0	0.0	1.6
Livingstone Cr. (40)	Jun 20	0.04	3.0	0.0	1.5
Serpent R. (42)	Jun 20	7.0	193.0	0.0	6.9
Wanapitei R. (43)	Jun 28	19.7	1,009.0	11.3	9.7
Mississagi R. (41)	Aug 9	67.0	2,955.0	31.1	35.5
Total		98.2	5,811.0	42.4	82.2
Grand Total		**116.7**	**10,749.6**	**52.8**	**475.2**

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

[2]Includes a total of 38 TFM bars (7.3 kg of active ingredient) applied in 3 streams.

Lake Erie

Tributary Information

- Lake Erie has 842 (317 United States, 525 Canada) tributaries.
- 21 (10 United States, 11 Canada) tributaries have historical records or production of sea lamprey larvae.
- 8 (4 United States, 4 Canada) tributaries have been treated with lampricide at least once during 1990-2000.

- Of these, 5 (3 United States, 2 Canada) tributaries are treated on a regular 3-5 year cycle.

The following statements highlight the lampricide control program in Lake Erie during 2000. Table 6 provides details on the application of lampricides to tributaries treated during 2000 and Fig. 1 shows the locations of the tributaries.

- The treatment of Conneaut Creek was completed in two phases, the river downstream from Highway 198 (at Conneautville) to Highway 215 during April 28-30 and the remainder downstream from Highway 215 to the mouth during May 25-26. The upper section was discontinued upstream of the Ohio state line due to less than agreed to minimum stream discharge and unstable pH levels in the stream. The lampricide block traveled through Ohio waters at less than minimum lethal levels. The lower river was treated when stream discharge exceeded permit levels of 100 cfs and the stream water pH levels were more stable.

- Mortality of some non-target species occurred during the upstream treatment of Conneaut Creek. A Voluntary Adverse Effects 6 (a)(2) report was submitted to the Environmental Protection Agency for 75 dead mudpuppies. Several Bigeye chub, logperch, stonecats, and white suckers died when pH levels decreased to lower than expected levels.

Table 6. Details on the application of lampricides to tributaries of Lake Erie, 2000. (Number in parentheses corresponds to location of stream in Fig. 1)

	Date	Flow (m^3/s)	TFM (kg)[1]	Bayluscide (kg)[1]	Distance Treated (km)
United States					
Conneaut Cr. (1)	Apr 28	5.0	552.9	0.0	83.7
Total		**5.0**	**552.9**	**0.0**	**83.7**

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

Lake Ontario

Tributary Information

- Lake Ontario has 659 (254 United States, 405 Canada) tributaries.

- 57 (28 United States, 29 Canada) tributaries have historical records or production of sea lamprey larvae.

- 39 (20 United States, 19 Canada) tributaries have been treated with lampricide at least once during 1990-2000.

- Of these, 31 (16 United States, 15 Canada) tributaries are treated on a regular 3-5 year cycle.

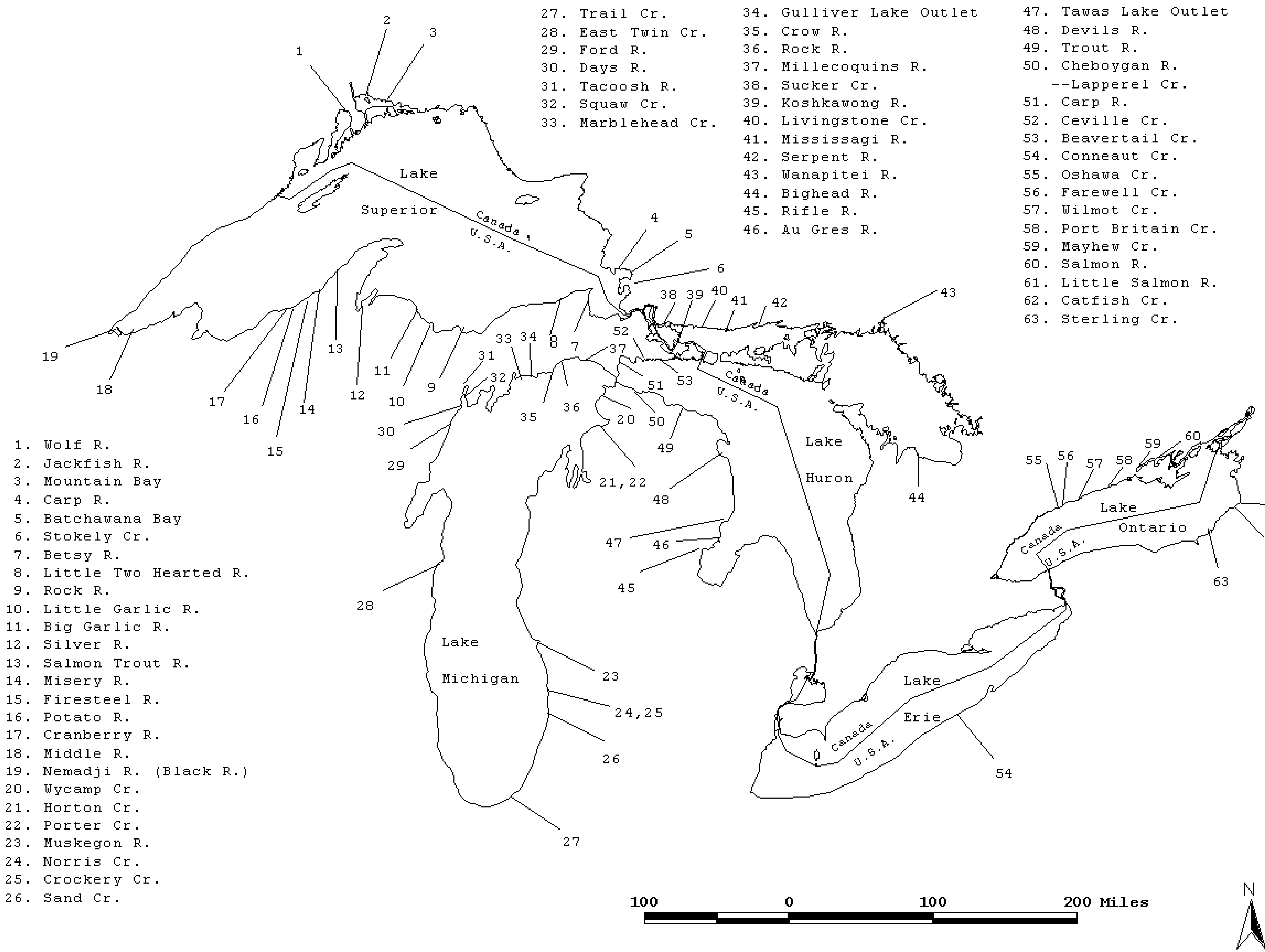

Fig. 1. Location of tributaries treated with lampricide during 2000.

The following statements highlight the lampricide control program in Lake Ontario during 2000. Table 7 provides details on the application of lampricides to the tributaries treated during 2000 and Fig. 1 shows the locations of the tributaries.

- Treatments were successfully completed in 9 of 9 scheduled tributaries (3 U.S., 6 Canada).
- Mortality of non-target fish was minimal in the majority of treatments. About 300 common white suckers and 500 northern log perch were killed in the lower portion of Farewell Creek.

Table 7. Details on the application of lampricides to tributaries of Lake Ontario, 2000. (Number in parentheses corresponds to location of stream in Fig. 1)

Stream	Date	Flow (m^3/s)	TFM (kg)[1,2]	Bayluscide (kg)[1]	Distance Treated (km)
United States					
Catfish Cr. (62)	May 27	1.8	106.0	0.0	1.2
Sterling Cr. (63)	May 28	2.7	433.0	0.0	10.3
Little Salmon R. (61)	May 30	2.1	270.0	0.0	35.0
Total		6.6	809.0	0.0	46.5
Canada					
Port Britain Cr. (58)	Apr 27	0.3	74.0	0.0	1.4
Farewell Cr. (56)	Apr 28	0.5	155.0	0.0	5.5
Oshawa Cr. (55)	Apr 30	0.6	271.0	0.0	15.0
Wilmot Cr. (57)	May 2	0.7	291.0	0.0	16.5
Mayhew Cr. (59)	Jun 3	0.4	73.0	0.0	3.5
Salmon R. (60)	Jun 6	15.5	1,234.0	13.1	23.0
Total		18.0	2,098.0	13.1	64.9
Grand Total		**24.6**	**2,907.0**	**13.1**	**111.4**

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

[2]Includes 1 TFM bar (0.2 kg of active ingredient) applied in 1 stream.

ALTERNATIVE CONTROL

Sterile Male Release Technique

Research of the sterile male release technique (technique) for sea lamprey control began during 1971. The technique was experimentally implemented in Lake Superior and in the St. Marys River during 1991-1996. The technique was refocused for exclusive use in the St. Marys River after 1996. Male sea lampreys were captured during their spawning migrations in 20 tributaries to lakes Superior, Michigan, Huron, and Ontario and the St. Marys River, and transported to the sterilization facility at the Hammond Bay Biological Station. At the facility, sea lampreys were sterilized with the chemosterilant bisazir, decontaminated, and released into the St. Marys River. Laboratory and field studies have shown that treated male sea lampreys were sterile, sexually competitive, and the number of eggs that hatch in nests was reduced.

The Sterile Male Release Technique Task Force was established during 1984 to refine the long-term strategy for application of the technique and to coordinate a large-scale research program for evaluating the success of the technique. The report of progress of the Task Force is presented on pages 50-55.

The following statements highlight the sterile male release program during 2000:

- A total of 44,329 spawning-phase male sea lampreys were transported to the sterilization facility from trapping operations on the Rock (1,200), Misery (375), Brule (554), Middle (2,139), Manistique (11,852), Peshtigo (81), Cheboygan (7,525), Ocqueoc (1,883), Black Mallard (36), Trout (243), Echo (2,826), Thessalon (1,412), Koshkawong (10), Tittabawassee (1,342), AuSable (278), AuGres (608), Carp (976), and St. Marys (10,989) rivers for sterilization and later release in the St. Marys River.

- A total of 43,184 sterilized male sea lampreys were released in the St. Marys River during May 8-July 24. The estimated resident population of spawning-phase sea lampreys in the St. Marys River was 38,829 (25,018 males). Assessment traps removed 18,613 sea lampreys (12,019 male sea lampreys; a theoretical reduction of 48% from trapping). An estimated 12,999 male sea lampreys remained in the river. The ratio of sterile males to resident male sea lampreys remaining in the St. Marys River was estimated at 3.3:1 (43,184 sterile males released: 12,999 estimated untreated males extant).

- The theoretical reduction from trapping and enhanced sterile male release was estimated at 88% during 2000, an increase from an average of 87% during 1997-1999. Prior to enhancement, the theoretical reduction in reproduction from sterile male release, combined with the number of lampreys removed by traps, averaged 58% during 1991-1996.

- Egg viability of 48 nests sampled in the St. Marys River rapids averaged 24%.

- Larval surveys were conducted on the Big Carp River and concluded *The long-term evaluation of sterile male release for control of sea lampreys in the Great Lakes* (Jones et al). The Big Carp River replaced the Whitefish River during 1997 and was a year behind schedule. Results are pending a completion report by the principal investigator.

- Field surveys were completed for a pilot study initiated during 1999 to investigate density dependent effects on yearling populations at low spawner densities. The number of spawners released was 5% of those released during *The long-term evaluation*. Field sampling also contributed to the study *Genetic assignment of larval parentage as a means of assessing mechanisms underlying adult reproductive success and larval dispersal* (Scribner and Jones).

Barriers

The Commission is committed to reducing the use of TFM through the implementation of alternative lamprey control strategies, which includes the use of barriers to sea lamprey migration. A total of 61 barriers have been constructed or modified to stop sea lampreys on tributaries of the Great Lakes (Fig. 2; 12 on Lake Superior, 12 on Lake Michigan, 17 on Lake Huron, 7 on Lake Erie, 13 on Lake Ontario). The Barrier Task Force was established during 1991 to coordinate and optimize implementation, and establish research priorities for the barrier program throughout the Great Lakes. The report on progress of the Task Force is presented on pages 59-60.

The following statements highlight the barrier projects on each lake during 2000:

Lake Superior

Barrier-related highlights for 2000:

- McIntyre River - The built-in sea lamprey trap at this barrier was replaced with a new trap to improve efficiency, and the river banks were stabilized.

- Cash Creek - A stream gauging station was operated to obtain hydrology data for engineering design and feasibility studies leading to barrier construction.

- Misery River - The MDNR Forest Management Division replaced the wooden bridge just downstream of the barrier with a wider structure to lessen fluctuations of water caused by narrow bridge abutments.

- Betsy River - Plans for repair of Shelldrake Dam were finalized based on its value as a lamprey barrier.

- Iron River – Following a legal process that began during 1993, a permit was issued by the Wisconsin Department of Natural Resources (WDNR) to remove the Orienta Dam and replace it with a lamprey and fish barrier.

- Bad River - The U.S. Army Corps of Engineers (Corps) completed a barrier feasibility study conducted under authority of Section 22, WRDA of 1974, including a site survey, hydrologic analysis, and soil borings. A proposal for further barrier planning under the expanded Section 1135 authority was accepted by the Corps to begin during 2001.

- Stokely Creek – The river banks were stabilized.

- Gimlet Creek – A culvert under the access road was replaced.

- Electrofishing surveys were conducted in Cash Creek and Whitefish River to determine fish community structure and relative abundance in support of the barrier program.

Lake Michigan

- Manistique River - Manistique Papers, Inc. continued work to prevent sea lamprey passage at the dam in Manistique. Two of the 13 low weirs built across the old turbine bays during 1999 were further reinforced to control leakage and prevent lamprey passage through the flume.

- Kids Creek (Boardman R.) - The feasibility study of the Corps barrier project under Section 206 of the Water Resources Development Act of 1996 (Aquatic Ecosystem Protection and Restoration) continued with a significant revision of the draft Preliminary Restoration Report to reduce the costs.

- Pere Marquette River - The electrical weir with its pumped-source pool and weir fishway was operated for the first time. Adjustments were made to maximize fish passage and to prevent lamprey passage. Construction of a viewing window was started in the fall.

- Paw Paw River - The Corps completed a revised draft Ecosystem Restoration Report and Environmental Assessment for the inflatable barrier and fishway proposed for construction during 2001.

- Four new Corps barrier projects were among those funded under the Section 1135 authority, including the Rapid River (Delta County, Michigan), Carp Lake River (Emmet County, Michigan), the South Branch Galien River (Berrien County, Michigan) and Trail Creek (LaPorte County, Indiana). The Corps assumes 75% of the costs of projects built under Section 1135.

- Stream gauging stations were installed on the Cedar and Rapid rivers to obtain hydrology data for use in future barrier construction. A stream gauging station on the Millecoquins River was discontinued as a result of a repositioning of the stream in the Barrier Implementation Strategy.

- The dual-purpose low head dam at the MDNR salmonid egg-take facility on the Little Manistee River required additional work to ensure stopboards were sealed against the dam base.

Lake Huron

- Beaver River - A proposal was received from the Ontario Ministry of Natural Resources (OMNR) for a barrier mitigation project at the Thornbury Dam. Several alternatives including removal of the barrier were presented. The Department advised that recruitment of sea lamprey upstream of the dam was likely unless sea lamprey passage was prevented. Negotiation with the OMNR was pending.

- Echo River - A concrete pad and railing were installed to improve worker safety at the barrier and trap.

- Ocqueoc River - The experimental combination low head electrical barrier constructed during 1999 was operated for the first time. The electrical field was activated for only a brief period in the early part of the season.

- Tittabawasee River - The MDNR and Dow Chemical Company, in partnership with the Commission, built on an earlier Commission-funded research project to begin an initiative to improve fish passage and lamprey trapping and blockage at the Dow Dam.
- New Corps projects - Two new Lake Huron barrier projects were among those funded under the Section 1135 authority and included the Black Mallard River and Schmidt Creek.
- Fisheries assessment - To support barrier program feasibility studies and evaluation of alternatives during environmental assessments, fyke netting and electrofishing surveys were conducted in the Root and Thessalon rivers. Browns Creek was electrofished as part of the barrier post-construction monitoring plan.
- Hydrology data - Stream gauging stations were installed and maintained on the Rifle River and the Thessalon River to collect hydrology data needed for preliminary design and feasability studies.

Lake Erie

- Grand River (Ontario) - The Grand River Conservation Authority (GRCA) proposed installation of a Denil fishway at the Caledonia Dam, risking opening the upper Grand River to sea lamprey reproduction. The Department estimated the cost of treating the Grand at $1,000,000, every three to four years. The Department continued negotiations with the GRCA to prevent lamprey passage at this site.

- Big Creek - The experimental inflatable barrier and fishway was operated on Big Creek. Three upgrades were made to the fishway. A chainfall used to raise and lower trap cages was replaced with a pneumatic hoist, improving the safety of the work area. A new trap cage was fabricated to replace the upstream trap cage. A fishway baffle was modified to adjust flow through the fishway to improve trap efficiency. Performance of the barrier and fishway are being monitored to establish optimal operational procedures.

- Grand River (Ohio) - Following a dam safety inspection by the Dam Safety Engineering Program of the Ohio Department of Natural Resources, Ashtabula County Parks proposed removal of Harpersfield Dam. A multi-agency effort led by the Grand River Partnership, Harpersfield Dam Subcommittee was currently evaluating alternatives. Dam removal or fish passage potentially could open an extensive area to sea lamprey infestation.

- Conneaut Creek - A proposed barrier project on this stream was among those accepted for study under the Section 1135 authority. A multi-agency group was formed to assemble environmental data and to facilitate the permit process.

Lake Ontario

- Bronte Creek - The Stream Reach Selection protocol was carried out on Bronte Creek. The preferred site in the selected stream reach is at the QEW highway bridge crossing. Negotiations were underway with the Ministry of Transportation which had plans to build a second bridge in the same area.

- Rouge River - A Denil fishway was proposed as a barrier mitigation project at Milne Dam. Since a fishpass allowing sea lamprey escapement was installed at a dam north of Steeles Avenue, Milne Dam became the last sea lamprey barrier to the upper Rouge River. Negotiations with the OMNR were ongoing.

- Humber River - OMNR, Aurora District proposed that a notch cut in the spillway during 1998 to improve salmonid passage be widened and deepened. Negotiations with the OMNR were ongoing.

- Welland River - The Niagara District Conservation Authority (NDCA) proposed removal of the Canboro and Port Davidson weirs on Oswego Creek. Based on a review of upstream sea lamprey habitat quantity and quality, the NDCA was informed that removal of these barriers constituted a low risk for the Department and could proceed.

- Black River - Some initial remedial works projects were attempted during 1994-1996 to correct sea lamprey passage routes at the Dexter Dam complex. Other potential routes were identified during the following years and preliminary repair plans were considered. During 1997-2000, improved methods of habitat-based quantitative larval assessment determined that establishing an effective barrier at Dexter would result in no savings in TFM treatment costs, hence barrier efforts at Dexter Dam were discontinued.

- Hydrology data - Stream gauging stations were installed and maintained on Bronte and Grindstone creeks and the Little Salmon River to collect hydrology data needed for preliminary design and feasibility studies.

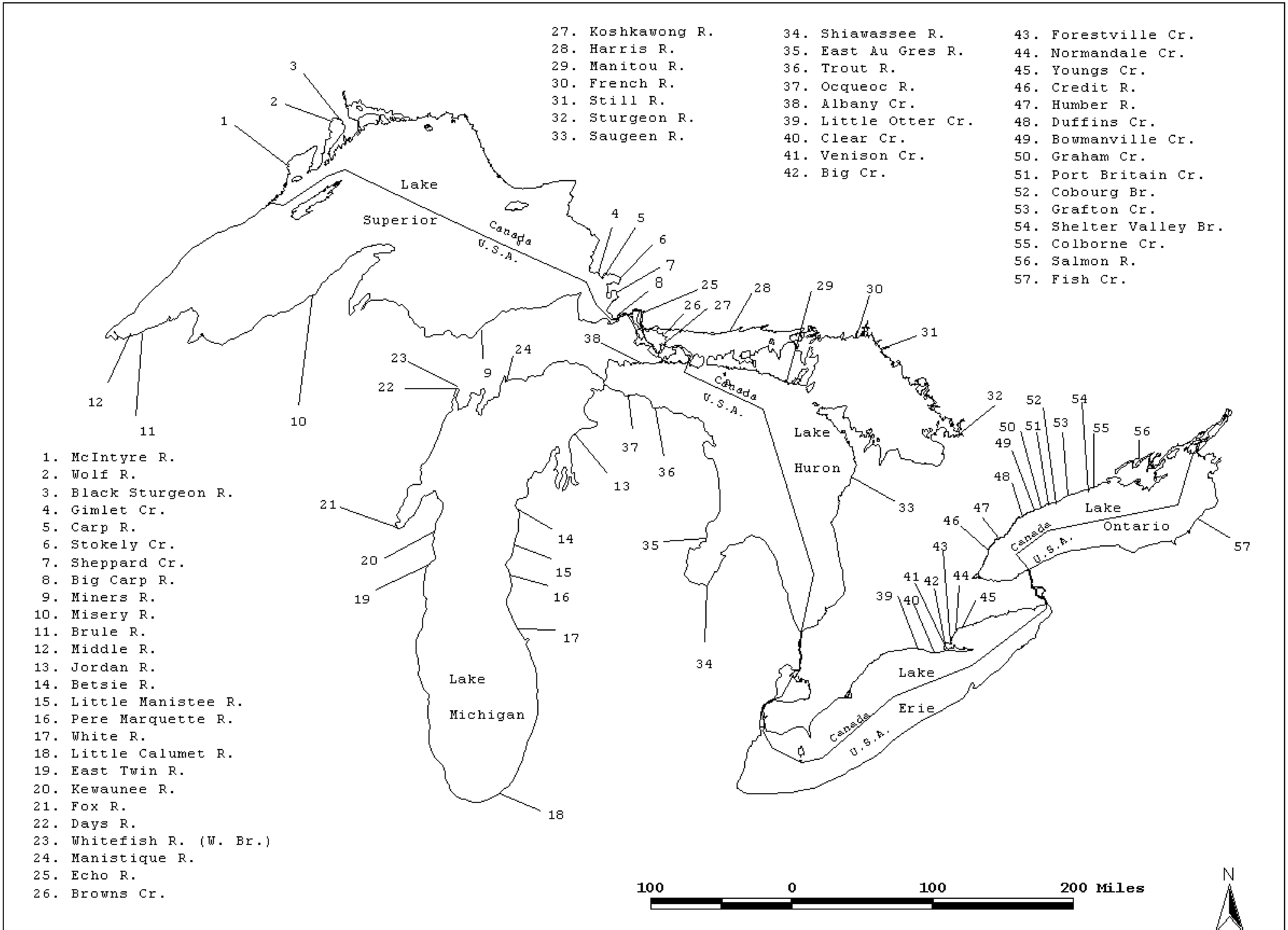

Fig. 2. Location of tributaries with sea lamprey barriers.

ASSESSMENT

Larval

Tributaries to the Great Lakes were systematically assessed for abundance and distribution of sea lamprey larvae. Sampling information was used to determine when and where lampricide treatments were required and to measure the effectiveness of past treatments. The number of metamorphosed sea lampreys that will leave individual tributaries during the following year was estimated and survey information was used to define the upstream and downstream distribution of larvae.

Tributaries considered for lampricide treatment during 2001 were assessed during 2000 to estimate larval density and habitat. Assessments were conducted with backpack electrofishers in waters <1m deep. Waters >1m in depth were assessed with deepwater electrofishers or the granular formulation of Bayluscide. Survey plots were randomly selected in each tributary, catches of larvae were adjusted for gear efficiency, and lengths of larvae were standardized to the end of the growing season. Populations of larvae in each tributary were estimated by multiplying the mean density of larvae (number per m^2) by an estimated area of suitable habitat (m^2). The estimated number of larvae that would transform into parasitic sea lampreys during 2001 was developed from historical relations of the proportion of metamorphosed to larval sea lampreys collected during previous lampricide applications. After processing the data, tributaries were ranked for treatment during 2001 based on an estimated cost per kill of metamorphosed sea lampreys.

The Assessment Task Force was established during 1996 to develop an optimal assessment program through the review of established protocols and the development of new techniques for assessment. The report on progress of the task force is presented on pages 56-59.

Lake Superior

- Assessments of populations of sea lamprey larvae were conducted in 109 tributaries (59 U.S., 50 Canada) and offshore of 4 tributaries (3 U.S., 1 Canada). The status of larval sea lamprey populations in tributaries treated during the last 10 years is presented in Table 8.

- Populations were estimated in 39 tributaries (24 U.S., 15 Canada; Table 8).

- Assessments were conducted in 5 U.S. tributaries to establish stock recruitment relations as part of a Great Lakes-wide study to determine if sea lamprey populations compensate in response to the effects of control actions.

- Populations of sea lampreys were discovered for the first time in two U.S. tributaries; Iron River (Bayfield County, Wisconsin) and Section 11SW Creek (Chippewa County, Michigan).

Lake Michigan

- Assessments of populations of sea lamprey larvae were conducted in 103 tributaries and offshore of 5 tributaries. The status of larval sea lamprey populations in streams treated during the last 10 years is presented in Table 9.

- Populations were estimated in 56 tributaries (Table 9).

- Assessments were conducted in 3 U.S. tributaries to establish stock recruitment relations as part of a Great Lakes-wide study to determine if sea lamprey populations compensate in response to the effects of control actions.

Lake Huron

- Assessments of populations of sea lamprey larvae were conducted in 79 tributaries (48 U.S., 31 Canada). The status of larval sea lamprey populations in tributaries treated during the last 10 years is presented in Table 10.

- Larval populations were estimated in 33 tributaries (22 U.S., 11 Canada, Table 10).

- Assessments were conducted in 5 tributaries (4 U.S., 1 Canada) to establish stock recruitment relations as part of a Great Lakes-wide study to determine if sea lamprey populations compensate in response to the effects of control actions.

- As a long-term measure of larval density in the St. Marys River, index stations were established at 13 sites during 1994-1996, and 9 of these sites were sampled during 2000.

- As a measure of long-term effectiveness and subsequent recruitment after the 1998-1999 granular Bayluscide treatments in the St. Marys River, 750 sites were sampled using the deepwater electrofisher in a stratified random design. An additional 150 adaptively-located sites were sampled from areas of higher larval density both in and outside of the treated areas.

Lake Erie

- Assessments of populations were conducted in 28 tributaries (16 U.S., 12 Canada). The status of larval sea lamprey populations in tributaries treated during the last 10 years is presented in Table 11.

- Larval populations were estimated in 5 tributaries (3 U.S., 2 Canada; Table 11).

- Assessment (with granular Bayluscide) of the Canadian waters of the Detroit River was conducted during 2000. No sea lampreys were captured.

Table 8. Status of Lake Superior tributaries that have been treated for sea lamprey larvae during 1991-2000, and sea lamprey population estimates for tributaries assessed during 2000.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
United States							
Waiska R.[1]	May-88	2000	No	1997	34,824	3,196	Yes
Grants Creek[1]	Jul-63	2000	No	1997	1,700	0	No
Roxbury Creek[1]	Never	2000	No	1996	1,341	0	No
Galloway Cr.	Jun-92	2000	No	1997			
Tahquamenon R.	Jun-97	2000	Yes	1997	53,518	895	Yes[3]
Betsy R.	Jul-00	–[2]					
Little Two Hearted R.	Jul-00	–[2]					
Two Hearted R.	Sep-99	–[2]					
Sucker R. - Lower R.	May-98	2000	No	1998	106,669	4	No
Chipmunk Cr.	May-98	2000					
Carpenter Cr.	May-98	2000	No	1999			
Miners R.	Jun-98	2000	Yes	1998	6,166	18	No
Furnace Cr.	Aug-93	2000	No	1995	617	92	No
Fivemile Cr.	Oct-98	–[2]					
Au Train R. - Upper R. + tribs.	Aug-97	2000	Yes	1997	96,997	10,997	Yes
Au Train R. - Lower R.	Aug-97	2000	No	1997	7,812	26	No
Rock R.	Sep-00	2000	Yes		95,941	1,524	Yes
Laughing Whitefish R.	Jun-98	–[2]					
Chocolay R.	Jun-98	2000	Yes	1998	208,871	1	No
Carp R.	Aug-96	2000	No	1996	68,998	9,082	Yes
Harlow Cr.	Aug-97	2000	Yes	1997	29,479	143	No
Little Garlic R.	Aug-00	–[2]					
Big Garlic R.	Aug-00	2000	Yes		693	25	No
Iron R.	Jul-96	2000		1997	67,366	897	Yes
Salmon Trout R.	May-00	–[2]					
Huron R.	Oct-99	–[2]	No	2000	6,242	1,499	Yes[3]
Ravine R.	Sep-98	2000	Yes[4]	1996			
Silver R.	Sep-00	–[2]					Yes
Falls R.	Sep-96	1999	No[4]				
Sturgeon R.	Sep-99	2000	Yes		275,231	7,354	Yes
Traprock R.	Sep-98	–[2]					
Traverse R.	Sep-97	2000	Yes	1998	203,722	762	Yes[3]
Salmon Trout R.	Aug-92	1998	No	1994			
Misery R.	Sep-00	2000	Yes		1,395	59	No
East Sleeping R.	Oct-99	–[2]	No	2000	3,540	602	No
Firesteel R.	Jun-00	–[2]			11,399	947	No
Ontonagon R.	Sep-96	2000	Yes	1997	4,033,535	61,052	Yes
Potato R.	Jun-00	–[2]	Yes	2000	9,673	2,491	Yes[3]
Cranberry R.	Jun-00	–[2]	No	2000	23,457	6,490	Yes[3]

Table 8. Continued.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
Bad R.	Sep-98	2000	Yes	1999	1,683,808	82,497	Yes
Red Cliff Cr.	Oct-98	2000	Yes[4]	1999	27,586	6,668	Yes
Sand R.	Oct-91	2000					
Brule R.	Sep-97	2000	Yes	1998	320,095	36,010	Yes
Poplar R.	Oct-96	1999	No	1999			
Middle R.	Sep-00	2000	Yes	None	15,017	68	No
Amnicon R.	Oct-98	2000	Yes	1999	309,485	6,431	Yes
Nemadji R. (Black R.)	Sep-00	–[2]					
Nemadji R. (Net R.)	May-90	2000	No	1996	378	0	No
Canada							
Little Carp R.	Jun-93	2000	No	1994	2,350	514	Yes[3]
Big Carp R.	Jun-93	2000	No	1993	21,188	406	Yes
Cranberry Cr.	Jun-90	1999	No	None			
Goulais R.	Jul-99	2000	Yes	2000	35,737	895	No
Stokley Cr.	Aug-00	2000	Yes		4,526	0	No
Chippewa R.	Jul-98	2000	–[4]				
Batchawana R.	Oct-98	–[2]	–[4]				
Batchawana Bay - Batchawana R.	Aug-00	–[2]					
Carp R.	Sep-00	2000	Yes		933	3	No
Pancake R.	Jul-98	–[2]	–[4]				
Agawa R.	Sep-97	2000	Yes		4,202	397	Yes
Gargantua R.	Aug-99	–[2]					
Michipicoten R.	Aug-99	2000	Yes	None	49,854	341	No
Pic R.	Sep-97	2000	No	1997			
Little Pic R.	Sep-94	2000	Yes	1995			
Prairie R.	Jul-94	2000	Yes	1998			
Steel R.[1]	Jul-89	2000	No	1989	14,784	1,157	Yes
Pays Plat R.	Jul-97	2000	Yes	1997	117,716	68	No
Little Pays Plat R.[1]	Never	2000	N/A[5]		7,141	3	No
Gravel R.	Aug-98	–[2]	–[4]				
Mountain Bay - Gravel R.	Jul-00	–[2]					
Little Gravel R.	Jul-95	2000	–[4]	1995	47,806	281	No
Cypress R.	Aug-99	–[2]					
Jackfish R.	Jul-00	–[2]					
Upper Nipigon R.	Sep-99	2000	Yes	None	30,451	62	No
Cash Cr.	Jul-96	2000	No	1996	31,008	10	No
Stillwater Cr.	Jul-96	2000	No	1996	717	0	No
Black Sturgeon R.	Aug-99	2000	Yes		4,741	0	No
Wolf R. - Above Barrier	Sep-00	2000	Yes		3,150	3	No
Wolf R. - Below Barrier	Sep-00	–[2]	Yes[4]				

Table 8. Continued.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
Pearl R.	Jul-91	2000	No	1991	759	135	No
McIntyre R.	Aug-97	2000	Yes	1998	3,317	695	No
Neebing R.	Jul-94	2000	Yes	1995	1,742	22	No
Kaministiquia R.	Aug-97	2000	Yes	1998	949,027	799	No
Cloud R.	Jul-94	1998	No	None			
Pigeon R.	Aug-99	2000	Yes	None	1,885	0	No

[1]Not treated during the past 10 years, but quantitative larval assessments were conducted during 2000.
[2]Not assessed since last treatment.
[3]Estimates of larvae and transformers developed from 1998 or 1999 data. Decision for treatment will be re-evaluated following further assessment during 2001.
[4]Stream has a known lentic population.
[5]Larval sea lamprey present, but unable to determine age of older cohorts.

- Residual populations detected in Conneaut Creek were not sufficiently abundant to warrant lampricide treatment during 2001.

- Residual populations found in Cattaraugus Creek were abundant enough to warrant an accelerated treatment in 2001.

Lake Ontario

- Larval assessments were conducted in 63 tributaries (25 U.S., 38 Canada). The status of larval sea lamprey populations in streams treated during the last 10 years is presented in Table 12.

- Larval populations were estimated in 11 tributaries (5 U.S., 6 Canada; Table 12).

- Assessments were conducted in 2 Canadian tributaries to establish stock recruitment relations as part of a Great Lakes-wide study to determine if sea lamprey populations compensate in response to the effects of control actions.

- Larval sea lampreys were discovered for the first time in an unnamed tributary (O-140, Ontario, Canada). Larval sea lampreys were captured from Scriba, Oak Orchard, and Ancaster creeks for the first time since 1984, 1993, and 1994 respectively.

Table 9. Status of Lake Michigan tributaries that have been treated for sea lamprey larvae during 1991-2000, and sea lamprey population estimates for tributaries assessed during 2000.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
United States							
Brevort R. - Lower R.[1]	May-89	2000	No	1996	8,823	206	No
Hog Island Cr.	Jun-96	2000	No	1996	10,254	86	No
Black R.	Jun-99	–[2]					
Milllecoquins R. (Furlong Cr.)	May-00	–[2]	No	2000	2,089	676	Yes[3]
Rock R.	Aug-00	–[2]					
Crow R.	Aug-00	–[2]					
Cataract R.[1]	Sep-75	2000	No	1997	11,813	16	No
Hudson Cr.	May-98	–[2]					
Milakokia R.	Jun-99	–[2]					
Bulldog Cr.	Jun-97	2000	No				
Gulliver Lake Outlet	May-00	–[2]					
Marblehead Cr.	May-00	–[2]					
Manistique R. - Lower R.[1]	Aug-89	2000	No[4]	1997	80,952	6,519	Yes
Johnson Cr.[1]	Aug-81	2000	No	1998	178	0	No
Deadhorse Cr.	May-91	2000	No	1997	1,760	183	Yes
Bursaw Cr.	May-97	2000	No	1998	824	0	No
Parent Cr.	Jun-91	2000	No	1998	17,085	22	No
Poodle Pete Cr.	Jun-91	2000	No	1997	11,502	522	Yes
Valentine Cr.	Jun-97	–[2]					
Little Fishdam R.	Jul-92	1999	No	1995	13,228	696	Yes[3]
Big Fishdam R.	May-99	–[2]					
Sturgeon R.	Oct-98	–[2]					
Ogontz R.	Oct-96	2000	Yes	1997	100,811	216	No
Squaw Cr.	Aug-00	–[2]					
Whitefish R.	Jun-98	2000	Yes	1998	331,513	3,006	Yes
Rapid R.	May-99	–[2]					
Tacoosh R.	May-00	–[2]					
Days R.	Sep-00	2000	Yes[4]	1996	0	0	Yes
Portage Cr.	Jun-97	2000	No	None	0	0	No
Ford R.	Oct-00	–[2]					
Bark R.	May-99	2000	Yes	1999			
Arthur Bay Cr.[1]	Apr-70	2000	No	1995	18	13	No
Cedar R.	May-97	2000	Yes	1997	366,480	11,240	Yes
Bailey Cr.	May-98	–[2]					
Beattie Cr.[1]	Jun-88	1999			1,729	185	Yes
Springer Cr.	May-99	–[2]					
Peshtigo R.	Aug-96	2000	No	–[5]	35,159	3,327	Yes
Oconto R.	Sep-97	2000	No	1998	27,127	3,323	Yes

Table 9. Continued.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
Hibbards Cr.	May-98	–[2]					
Door County #23[1]	May-79	2000	No	1997	744	1	No
East Twin R.	Jul-00	–[2]					
Carp Lake R.	Sep-94	2000	No	1997	109,235	1,317	No
Big Stone Cr.	May-97	1999	No				No
Wycamp Lake Outlet	May-00	1999[2]			54	35	No
Horton Cr.	Sep-00	2000	No[4]		3	0	Yes
Boyne R.	Sep-97	2000	No[4]	1998	137,671	205	No
Porter Cr.	Sep-00	2000[2]	No[4]				Yes
Jordan R.	Aug-97	2000	No	1998	157,976	234	No
McGeach Cr.	Sep-99	1998[2]			227	190	No
Elk Lake Outlet	May-97	1999	No	1997			No
Mitchell Cr.	May-99	1998[2]			47	21	No
Boardman R.							
Hospital Cr.	Aug-96	1999	Yes	1997	17,120	6,369	Yes[6]
Lower	Aug-96	1999	Yes[4]	1997	19,290	7,216	Yes[6]
Goodharbor Cr.	May-97	2000	Yes	1997	21,282	2,720	Yes
Platte R.	Sep-96	2000	Yes	1997	1,411,053	8,508	Yes
Betsie R.	Jul-99	1999[2]		2000	24,285	2,514	Yes[3]
Big Manistee R.	Aug-98	1998	Yes	1999	110,289	103,027	Yes[3]
L. Manistee R.	Jul-98	2000	No	1999			No
Gurney Cr.	Sep-93	2000	No	1997	521	159	Yes[3]
Lincoln R.	Jun-98	2000	No	1998			No
Pere Marquette R.	Aug-99	2000	Yes	2000	69,256	2,669	No
Pentwater R.	Jul-97	2000	No	1998	100,696	5,134	Yes
White R.	Aug-99	2000	Yes	2000	69,239	14,824	Yes
Muskegon R.	Aug-00	2000	Yes		36,564	13,685	No
Brooks Cr.	Aug-00	1999[2]			62	15	No
Cedar Cr.	Aug-00	1999[2]			951	358	No
Bridgeton Cr.	May-95	1999	No				No
Minnie Cr.	Aug-00	1999[2]			8	2	No
Bigelow Cr.	Aug-00	1999[2]			1,140	438	No
Grand R.							
Norris Cr.	Jun-00	1999[2]			42	8	No
Sand Cr.	Sep-96	2000	No	1997	579	42	No
Crockery Cr.	Jun-00	1999[2]			1,221	254	No
Kalamazoo R.							
Bear Cr.	Jun-98	2000	No		4,008	0	No
Sand Cr.	May-00	1999[2]			35	35	No
Mann Cr.	Aug-97	2000	No				No

Table 9. Continued.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
Black R.	Aug-97	2000	No		206,964	4,968	Yes
Rogers Cr.	May-98	2000	No				No
St. Joseph R.							
Paw Paw R.	Jun-97	2000	Yes	1997	36,660	8,798	Yes
Mill Cr.	Jun-97	2000	No	1997	58,635	2,892	Yes
Brandywine Cr.	May-97	2000	No				
Brush Cr.	Jun-97	2000	No	1998	5,397	287	Yes
Blue Cr.[1]	Jun-88	2000	No	1997	6,926	287	Yes
Galien R.	Jun-99	1998[2]			46	46	No
Trail Cr.	Apr-00	1999[2]			291	261	No
Burns Ditch	Jul-99	1998[2]			0	0	No

[1]Not treated during the past 10 years, but quantitative larval assessments were conducted during 2000.
[2]Not assessed since last lampricide treatment.
[3]Estimates of larvae and metamorphosing larvae developed from 1998 or 1999 data. Decision for treatment will be re-evaluated following further assessment during 2001.
[4]Stream has a known lentic population.
[5]Larval sea lamprey present, but unable to determine age of older cohorts.
[6]Treatment deferred in 2000 because of scheduling conflicts.

Table 10. Status of Lake Huron tributaries that have been treated for sea lamprey larvae during 1991-2000, and sea lamprey population estimates for tributaries assessed during 2000.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
United States							
Little Munuscong R.	Jun-99	2000	Yes	1999	12,211	20	No
Big Munuscong R.	Jun-99	-[1]					
Carlton Cr.	May-86	2000	No	1997	323	223	No[2]
Caribou Cr.	May-91	1999	No	1996			
Joe Straw Cr.	May-75	2000	No	Unknown	123	0	No[2]
Huron Point Cr.	Never	2000	No	Unknown	0	0	No[2]
Albany Cr.	May-94	2000	Yes	1997	24,760	687	Yes[3]
Trout Cr.	May-94	2000	No	1996	21,727	1,579	Yes
Beavertail Cr.	Oct-00	-[1]					
Prentiss Cr.	Oct-93	2000	Yes	1996	8,502	2,782	Yes
McKay Cr.	May-95	1999	Yes	1995[4]	19,578	591	Yes
Flowers Cr.	Sep-91	1995	No				
Ceville Cr.	Oct-00	-[1]					
Hessel Cr.	May-91	1997	No				
Steeles Cr.	May-84	2000	No	1997	473	20	No[2]
Nunns Cr.	May-96	2000	No	1996	7,229	774	Yes
Pine R.	May-98	-[1]	-[5]				
Martineau Cr.	Oct-93	1997	No	None			
Carp R.	Oct-00	-[1]					
Little Black R.[6]	Jun-67	2000	No	-[4]	102	102	No
Cheboygan R.	Oct-83	2000	No[5]	-[4]			
Maple R.	Sep-97	1999	No	1999			No
Pigeon R.	Sep-97	2000	No	1998	274,854	8,473	Yes
Sturgeon R.	Sep-99	1998[1]			5,096	2,477	No
Laperell Cr.	May-00	1999[1]			9	1	No
Meyers Cr.	Sep-99	1998[1]			1	1	No
Elliot Cr.	May-96	2000	No	1996	42,757	75	No
Greene Cr.	May-96	2000	Yes	1996	22,701	983	Yes
Mulligan Cr.	May-94	1998	No	None			No
Black Mallard Cr.	May-92	2000[7]	No	1993	43,626	16,164	Yes[2]
Ocqueoc R.							
Lower	Sep-97	2000	Yes[5]	1998			
Upper	Aug-98	2000	Yes				Yes[3]
Schmidt Cr.	Sep-98	2000	Yes	1999	8,046	266	No
Trout R.	May-00	2000[1]			2,325	248	No
Swan R.	May-96	2000	No	1997	355	181	No
Devils R.	May-00	2000[1]		1988	126	894	No
Black R.	Jun-98	2000	No				No

Table 10. Continued.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
Au Sable R.	Jul-98	2000	Yes	1998	46,259	523	No
Tawas Lake Outlet	Jul-96	2000	Yes	1997			No
Silver Cr.	Jul-00	2000[1]			1,251	47	No
Cold Cr.	Jul-00	1999[1]			53	20	No
Sims Cr.	Jul-98	2000	No				No
East Au Gres R.	May-97	2000	No	1997	124,727	5,290	Yes
Au Gres R.	Jun-00	2000[1]			817	581	No
Rifle R.	Jul-00	2000	Yes		14,450	12,852	No
Saginaw R.							
Juniata Cr.	Sep-98	2000	Yes				No
Chippewa R.	Sep-99	1999[1]		2000	8,944	8,887	No
Big Salt Cr.	May-96	1998	No				No
Big Salt R.	May-93	1997	No				No
Bluff Cr.	Sep-98	1999	Yes				No
Shiawassee R.	Jun-97	1999	No	1998	13,738	4,399	Yes[3]
<u>Canada</u>							
Root R.	Sep-99	–[1]					
Garden R.	Jul-97	2000	Yes	1998	3,599,786	59,752	Yes
Upper Echo R.	Oct-99	–[1]					
Lower Echo R.	Sep-99	–[1]					
Bar Cr.	Jun-98	–[1]					
Bar R.[6]	Aug-66	2000	No	1996	29,572	515	Yes
Sucker Cr.	May-00	–[1]		1996			
Two Tree R.	May-90	2000	No	1993	24,727	894	Yes
Richardson Cr.	Aug-96	2000	No	None			
Watson Cr.	Jul-98	2000	Yes	1999			
Gordon Cr.	Oct-96	2000	No	1997	916	305	Yes
Browns Cr.	Sep-98	2000	Yes	1999	13,567	1,769	Yes
Koshkawong R.	May-00	–[1]	Yes	1997			
Thessalon R.							
Upper	Jul-98	–[1]					
Lower	Jul-96	2000	No	1996	103,629	2,690	Yes
Livingston Cr.	Jun-00	–[1]	No	1995			
Mississagi R.							
Main	Aug-00	–[1]			66,036	6,071	Yes[3]
Pickerel Cr.	Jun-98	1999	No				
Lauzon R.	Sep-97	–[1]					
Spragge Cr.	Oct-95	1999	Yes	1996			
Unnamed (H-114)	Sep-97	1998	Yes	None			
Spanish R.	Jun-98	2000	Yes				

Table 10. Continued.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
Serpent R.							
Main	Jun-00	–[1]					
Grassy Cr.	Oct-99	–[1]					
Silver Cr.	May-94	2000	Yes	None			
Sand Cr.	Oct-94	1999	Yes	1995	964	306	Yes[3]
Mindemoya R.	Jun-98	2000	Yes	1998	43,333	88	No
Timber Bay Cr.	Jun-98	2000	Yes	1998	11,555	690	Yes
Manitou R.	Sep-99	–[1]					
Blue Jay Cr.	Sep-99	–[1]					
Chikanishing R.	Jun-95	2000	Yes	1997	336	27	No
French R.							
O.V. Channel	Jun-92	1999	No	1992			
Wanapitei R.	Jun-00	–[1]		1995			
Still R.	Jun-96	1999	No	None			
Magnetawan R.	Jul-99	–[1]					
Naiscoot R.	Jul-99	–[1]					
Boyne R.	Jun-99	–[1]					
Musquash R.	Aug-96	1999	Yes	1998			
Sturgeon R.	May-99	–[1]					
Nottawasaga R.							
Main	Jun-97	2000	Yes	1997	7972	345	No
Pine R.	Sep-98	2000	Yes	1999	34,900	384	No
Bighead R.	May-00	2000	Yes				
Sauble R.	Jun-96	2000	No	1996	2,812	0	No

[1]Not assessed since last lampricide treatment.
[2]Treatment deferred during 2000 because of scheduling conflicts.
[3]Estimates of larvae and transformers developed from 1998 and 1999 data. Decision for treatment will be re-evaluated following further assessment during 2001.
[4]Larval sea lamprey present, but unable to determine age of older cohorts.
[5]Stream has a known lentic population.
[6]Not treated during the past 10 years, but quantitative larval assessments were conducted during 2000.
[7]Lentic assessment during 2000.

Table 11. Status of Lake Erie tributaries that have been treated for sea lamprey larvae during 1991-2000, and sea lamprey population estimates for tributaries assessed during 2000.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
United States							
Cattaraugus Cr.	May-99	2000	Yes	1999	47,100	4,666	Yes
Crooked Cr.	May-99	2000	No	1999			
Raccoon Cr.[1]	Oct-90	2000		1997	1,795	1,275	Yes
Conneaut Cr.	May-00	2000	Yes	2000	18,922	921	No
Grand R.	May-99	2000		1999			
Canada							
Big Otter Cr.	Sep-97	2000	Yes	1998	29,012	24,948	Yes
Big Cr.	Jun-99	2000	Yes	1999			
Young's Cr.	May-91	2000		1998	8,651	2,661	Yes

[1]Not treated during the past 10 years, but quantitative larval assessments were conducted during 2000.

Table 12. Status of Lake Ontario tributaries that have been treated for sea lamprey larvae during 1991-2000, and sea lamprey population estimates for tributaries assessed during 2000.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
United States							
Black R.	Jun-99	1998[1]					
South Sandy Cr.	Apr-99	2000	No	1999	20,211	0	No
Skinner Cr.	May-93	2000		1998			
Lindsey Cr.	May-99	2000	Yes	1999	46,960	1,555	Yes
Little Sandy Cr.	Apr-98	2000	No	1998	62,357	3,994	Yes
Deer Cr.	May-99	2000	Yes	1999			
Salmon R.	May-98	2000	No	1998	1,252,512	11,914	Yes
Grindstone Cr.	May-99	1999[1]	No	1999			
Snake Cr.	May-99	2000	No	None			
Little Salmon R.	May-00	2000	No	2000			
Catfish Cr.	May-00	2000	No	2000			
Oswego R.							
Big Bay Cr.	Sep-93	1999	No	None			
Fish Cr.	May-98	2000	Yes	1998	46,649	2,616	Yes
Carpenters Br.	May-94	1998	No	None			
Putnam Br.	May-96	1999	Yes	None			
Ninemile Cr.	May-98	2000	No	1999			
Sterling Cr.	May-00	2000	No	2000			
Red Cr.	Apr-94	1999	No	None			
Sodus Cr.	May-98	2000	No	1999			
First Cr.	May-95	1999	No	None			
Salmon Cr.	May-96	2000		None			
Canada							
Bronte Cr.	Apr-98	2000	Yes	1998	114,287	36,126	Yes
Credit R.	Jun-99	2000	Yes	1999	2,825	900	No
Rouge R.	Jun-98	2000	Yes	1998	3,766	2,043	Yes
Duffins Cr.	Oct-97	2000		1998	3,924	2,187	Yes
Lynde Cr.	May-99	2000	No	1999			
Oshawa Cr.	May-00	2000	No	2000			
Farewell Cr.	Apr-00	1999[1]					
Bowmanville Cr.	Apr-98	2000	Yes	1998	64,224	5,057	Yes
Wilmot Cr.	May-00	2000	No	2000			
Graham Cr.	May-96	1998	No	None			
Port Britain Cr.	Apr-00	2000	Yes	2000			
Cobourg Br.	Sep-96	1999	No	None			
Covert Cr.	May-99	2000	No	1999			
Grafton Cr.	Sep-96	2000		1999			
Shelter Valley Br.	Sep-96	1999	No	None			

Table 12. Continued.

Tributary	Last Treated	Last Assessed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2000 Larval Population	2001 Transformer Estimate	On 2001 Treatment Schedule
Colborne Cr.	Jun-95	1999	No				
Salem Cr.	Aug-98	2000	No	1999			
Proctor Cr.	Aug-98	2000	No	1998			
Trent R.[2]	Never	2000			2,970	935	No
Mayhew Cr.	Jun-00	1999[1]					
Salmon R.	Jun-00	1999[1]					

[1]Not assessed since last lampricide treatment.
[2]Never treated, but quantitative larval assessments were conducted during 2000.

Spawning-Phase

The long-term effectiveness of the control program has been measured by the annual estimation of the lake-wide abundance of spawning-phase sea lampreys. Traps and nets were used to capture migrating spawning-phase sea lampreys during the spring and early summer. Trap catch provided a measure of relative abundance as early as 1975 (varied by lake) and since 1986 mark and recapture studies have been conducted in tributaries with traps to estimate abundance of spawning lampreys. An expert panel peer-reviewed the adult assessment methods during 1997 and recommended actions to optimize the program. The recommendations included refinement of a model to estimate abundance in tributaries without traps from five independent variables. Of these variables, 2 were continuous (drainage area and number of years since last treatment) and 3 were categorical (geographic region, whether the stream has been treated $\leq$ or > every 5 years, and year). The sum of the model-predicted estimates through mark and recapture techniques in tributaries with traps and estimates in tributaries without traps represented lake-wide abundance. Additional recommendations to the adult program included implementation of a concurrent assessment of parasitic or transformer-phase sea lampreys through an in-lake mark and recapture approach.

Lake Superior

- 18,545 sea lampreys were trapped in 23 tributaries during 2000 (Table 13, Fig. 3).
- The estimated population of spawning-phase sea lampreys for 2000 was 100,097 (45,566 western U.S. and 54,531 eastern U.S. and Canada; r^2=0.42).
- No significant trend (Fig. 4) was detected from a linear regression of spawner abundance during 1981-2000 (p=0.744).

Table 13. Stream, number caught, estimated spawner population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Superior, 2000. (Number in parentheses corresponds to location of stream in Fig. 3)

Stream	Number caught	Spawner estimate	Trap efficiency	Number sampled[1]	Percent males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
United States									
Tahquamenon R. (7)	932	5,035	18	141	52	475	414	231	184
Betsy R. (8)	221	699	32	54	57	449	422	184	192
Miners R. (9)	14	---	---	14	50	406	413	167	185
Furnace Cr. (10)	38	81	47	4	100	---	---	144	---
Rock R. (11)	3,498	4,261	82	58	43	494	462	261	232
Chocolay R. (12)	142	949	15	10	50	442	450	188	211
Big Garlic R. (13)	32	51	63	9	33	366	451	237	226
Silver R. (14)	214	937	23	53	65	434	420	203	207
Misery R. (15)	990	1,764	56	255	45	433	429	206	199
Firesteel R. (16)	304	1,036	29	79	54	456	436	233	220
Ontonagon R. (17)	13	---	---	2	50	375	402	151	165
Bad R. (18)	283	2,767	10	23	26	360	354	279	173
Red Cliff Cr. (19)	91	380	24	24	72	440	441	179	132
Brule R. (20)	1,349	4,135	33	37	54	480	508	249	273
Middle R. (21)	6,330	6,900	92	259	38	---	466	---	227
Amnicon R. (22)	260	3,380	8	17	44	451	448	228	204
Total or Mean (South Shore)	**14,711**	**32,375**		**1,039**	**42**	**450**	**442**	**217**	**211**
Canada									
Neebing R. (1)	554	801	69	0					
McIntyre R. (1)	2	---	---	0	---	---	---	---	---
Wolf R. (2)	2,639	---	---	0	---	---	---	---	---
Nipigon R. (3)	0	---	---	0	---	---	---	---	---
Carp R. (4)	546	1,352	40	0	---	---	---	---	---
Stokely Cr. (5)	44	82	54	0	---	---	---	---	---
Big Carp R. (6)	49	49	99	0	---	---	---	---	---
Total or Mean (North Shore)	**3,834**	**2,284**		**0**	**---**	**---**	**---**	**---**	**---**
Total or Mean (for lake)	**18,545**	**34,659**		**1,039**	**42**	**450**	**442**	**217**	**211**

[1] The number of sea lampreys from which all length and weight measurements were determined.
[2] Sex is generally determined from internal body examination of the number sampled. Mean percent males determined by data from the Rock, Misery, Middle, and Brule rivers.

- Spawning runs were monitored in the Amnicon, Middle, Bad, Firesteel, Misery, Silver, and Ontonagon rivers and Red Cliff Creek through cooperative agreements with the Great Lakes Indian Fish and Wildlife Commission; in the Brule River with the WDNR; and in the Miners River with the National Park Service, Pictured Rocks National Lakeshore.

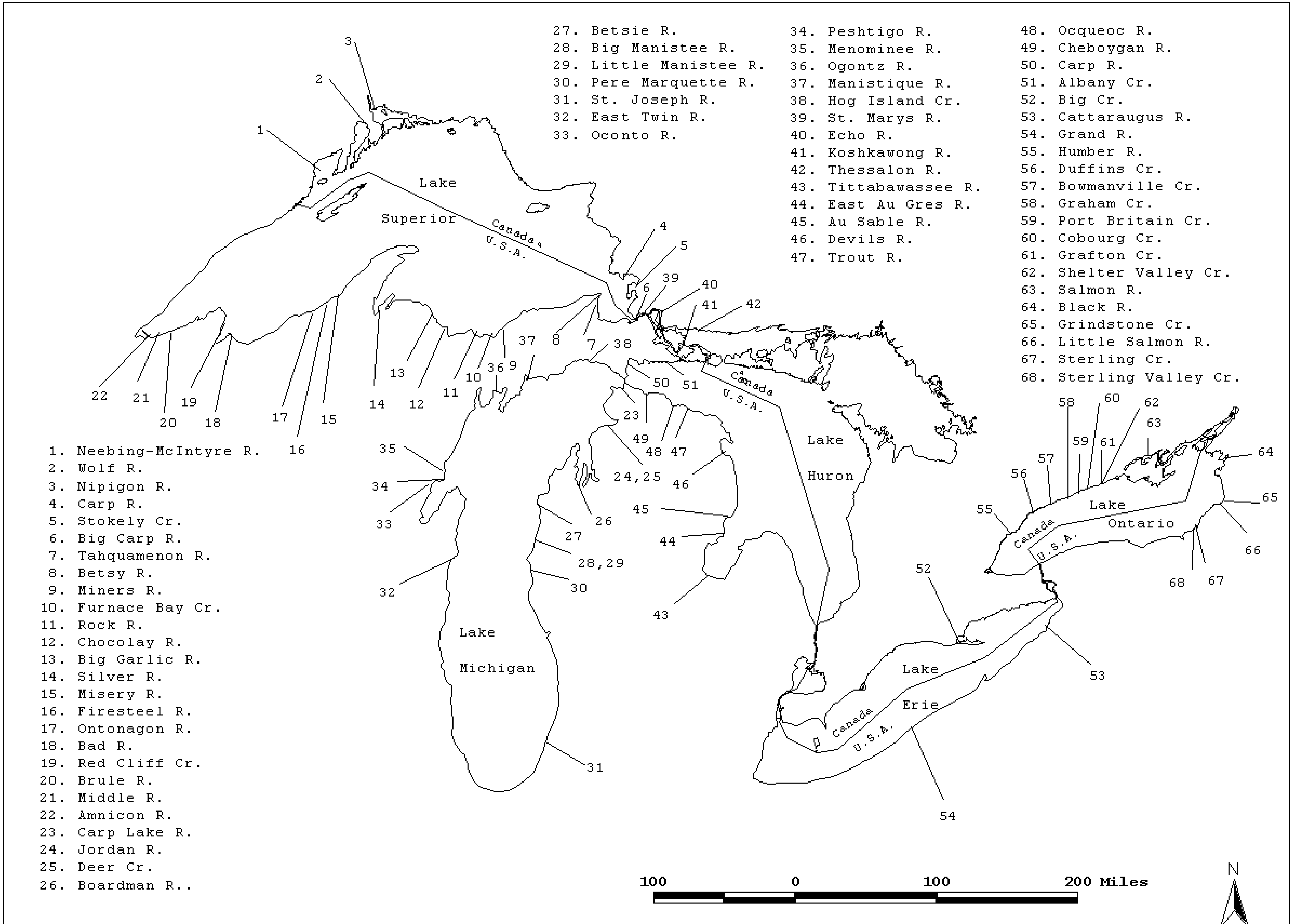

Fig. 3. Location of tributaries where assessment traps were operated during 2000.

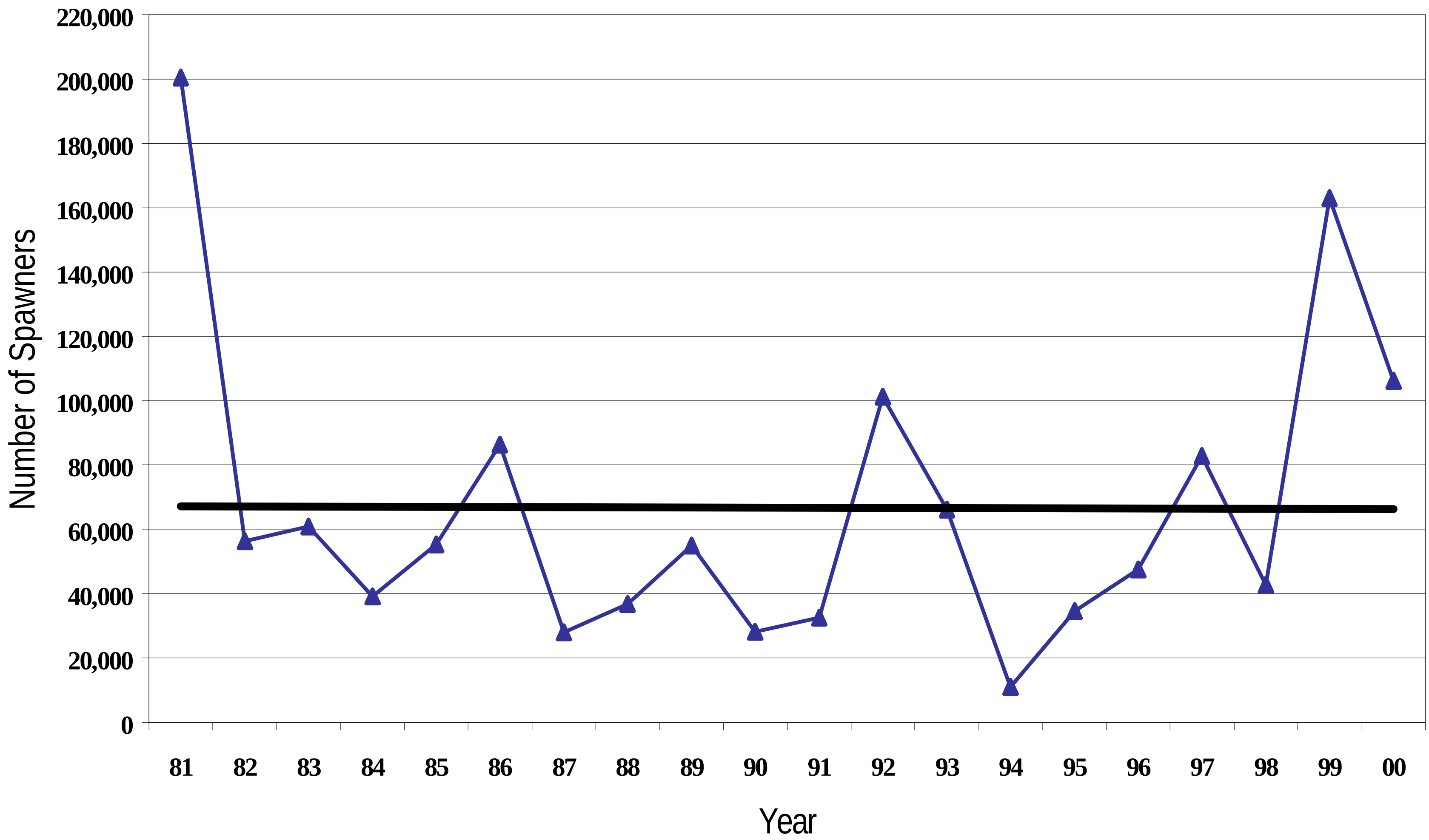

Fig. 4. Trend line of the linear regression of spawner abundance for Lake Superior during 1981- 2000.

- During September-November, 1,500 transformer-phase sea lampreys were marked with coded wire tags and released into Lake Superior rivers (Brule-226, Misery-230, AuTrain-160, Two Hearted-154, Harlow-51, Chippewa-151, Michipicoten-131, Nipigon-131, Wolf-133, and McIntyre-133).

- Returns of the coded wire tagged sea lampreys from the 1998 release were first recovered from Lake Superior during the 2000 spawning run. Of 1,038 transformers marked, 33 (3 %) were recaptured as spawning adults. From this information, an estimated 568,400 (318,300-711,400) transformer-phase sea lampreys left streams during 1998 and were parasitic during 1999.

Lake Michigan

- 29,489 sea lampreys were trapped at 16 sites in 14 tributaries during 2000 (Table 14, Fig. 3).

- The estimated population of spawning-phase sea lampreys in Lake Michigan for 2000 was 115,475 (67,992 north and 47,483 south.; $r^2 = 0.77$).

- A significant positive trend (Fig. 5) was detected from a linear regression of spawner abundance on year during 1981-2000 ($p=0.002$, $r^2=0.41$).

- Spawning runs were monitored in the Boardman and Betsie rivers through a cooperative agreement with the Grand Traverse Band of Ottawa and Chippewa Indians and in the Little Manistee River through a cooperative agreement with the Little River Band of Ottawa Indians.

Lake Huron

- 52,415 sea lampreys were trapped in 13 tributaries during 2000 (Table 15, Fig. 3).

- The estimated population of spawning-phase sea lampreys in Lake Huron for 2000 was 274,003 (229,287 north and 44,716 south, $r^2 = 0.77$).

- No significant trend (Fig. 6) was detected from a linear regression of spawner abundance during 1981-2000 ($p = 0.079$)

- Spawning runs were monitored in the Albany River through a cooperative agreement with the Chippewa/Ottawa Resource Authority and in the Tittabawassee River through a cooperative agreement with Dow Chemical USA.

- Traps operated in the St. Marys River at the Great Lakes Power facility in Canada and the Corps facility captured 19,135 spawning-phase sea lampreys. The estimated spawning lamprey population in the river was 38,829 and trap efficiency was 49%.

Table 14. Stream, number caught, estimated population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 2000. (Number in parentheses corresponds to location of stream in Fig. 3)

Stream	Number caught	Spawner estimate	Trap efficiency	Number sampled[1]	Percent males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Carp Lake R. (23)	650	885	73	193	22	483	478	235	235
Jordan R. (24)	107	242	44	34	35	472	514	267	301
Deer Cr. (25)	68	228	30	16	50	487	457	274	232
Boardman R.(26)	278	993	28	76	47	481	488	266	279
Betsie R. (27)	335	1,654	20	88	45	482	482	258	263
Big Manistee R. (28)	400	4,607	9	23	17	427	404	317	294
Little Manistee R. (29)	154	324	47	61	62	474	489	283	288
Pere Marquette R. (30)	274	734	37	88	70	484	492	276	292
St. Joseph R. (31)	8	---	---	0	---	---	---	---	---
East Twin R. (32)	34	90	38	9	11	480	464	258	222
Oconto R. (33)	5	---	---	0	---	---	---	---	---
Peshtigo R. (34)	1,173	6,174	---	0	---	---	---	---	---
Menominee R. (35)	80	---	---	0	---	---	---	---	---
Ogontz R. (36)	55	920	6	3	100	340	---	275	---
Manistique R. (37)	25,810	54,043	48	48	52	500	514	242	294
Hog Island Cr. (38)	58	194	30	20	37	485	490	308	243
Total or Mean	**29,489**	**71,088**		**659**	**47**	**479**	**483**	**267**	**262**

[1]The number of sea lampreys from which all length and weight measurements were determined.
[2]Sex is generally determined from internal body examination of the number sampled. In the Manistique River, 25,810 additional sea lampreys were examined externally for secondary sexual characteristics to determine percent males.

Lake Erie

- 1,189 sea lampreys were trapped in 3 tributaries during 2000 (Table 16, Fig. 3).

- The estimated population of spawning-phase sea lampreys in Lake Erie for 2000 was 15,570 (r^2 = 0.87).

- A significant positive trend (Fig. 7) was detected from a linear regression of spawner abundance during post-treatment years, 1989-2000 (p=0.023, r^2=0.42).

Lake Ontario

- 5,033 sea lampreys were trapped at 14 sites in 13 tributaries (Table 17, Fig. 3).

- The estimated population of spawning-phase sea lampreys in Lake Ontario for 2000 was 37,066 (r^2 = 0.44).

- A significant negative trend (Fig. 8) was detected from a linear regression of spawner abundance during 1981-2000 (p=0.000, r^2=0.49).

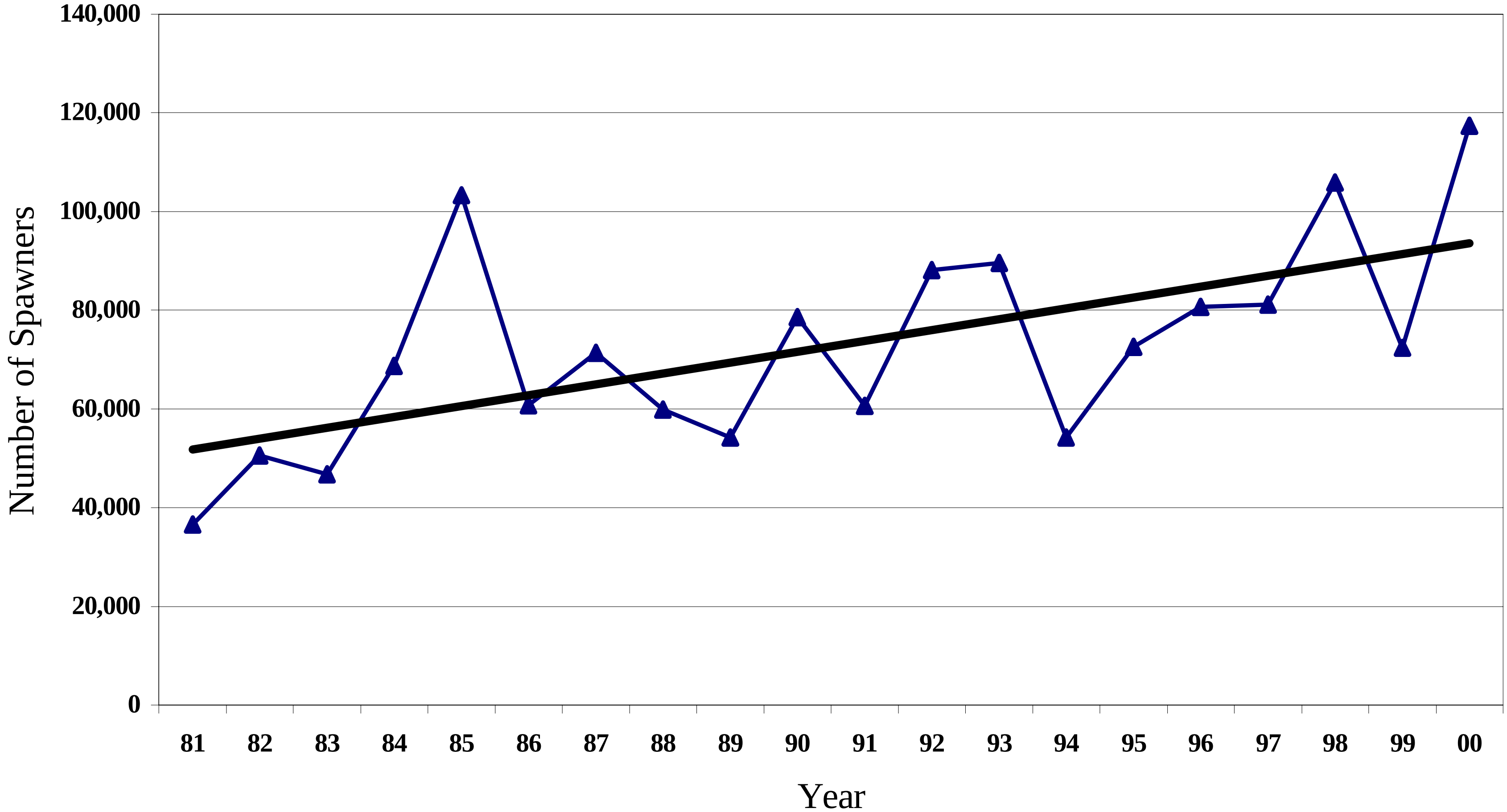

Fig. 5. Trend line of the linear regression of spawner abundance on year for Lake Michigan during 1981-2000.

Table 15. Stream, number caught, estimated population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Huron, 2000. (Number in parentheses corresponds to location of stream in Fig. 3)

Stream	Number caught	Spawner estimate	Trap efficiency	Number sampled[1]	Percent males[2]	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
<u>United States</u>									
Tittabawassee R. (43)	2,582	24,195	11	0	---	---	---	---	---
East Au Gres R. (44)	1,405	5,216	27	0	---	---	---	---	---
Au Sable R. (45)	903	4,273	21	0	---	---	---	---	---
Devils R. (46)	337	1,192	28	115	43	499	494	277	276
Trout R. (47)	341	1,277	26	0	44	---	---	---	---
Ocqueoc R. (48)	3,558	5,175	69	0	53	---	---	---	---
Cheboygan R. (49)	13,755	28,832	48	0	56	---	---	---	---
Carp R. (50)	2,274	7,902	29	240	55	515	512	308	290
Albany Cr. (51)	11	---	---	0	100	442	---	200	---
St. Marys R. (39)	5,437	See Canada	See Canada	0		-	-	-	-
Total or Mean (U.S.)	**30,603**	**78,062**		**355**	**58**	**506**	**507**	**293**	**286**
<u>Canada</u>									
St. Marys R. (39)	13,698	38,829	49	0	64	---	---	---	---
Echo R. (40)	5,390	11,194	48	0	58	---	---	---	---
Koshkawong R. (41)	12[3]	---	---	0	---	---	---	---	---
Thessalon R. (42)	68	---	---	0	---	---	---	---	--
Little Thessalon R.	2,644	3,131	84	0	74	---	---	---	---
Total or Mean (Canada)	**21,812**	**53,154**		**0**	**62**				
Total or Mean (for lake)	**52,415**	**131,216**		**355**	**60**	**506**	**507**	**293**	**286**

[1]The number of sea lampreys from which all length and weight measurements were determined.
[2]Sex generally determined from internal body examination of the number sampled, but at 6 trapping sites sex was determined by external examination of all sea lampreys caught (Ocqueoc-3,558, Cheboygan-13,755, St Marys US-5,437, St Marys Can.-13,698, Echo-5,390, and Thessalon-2,712).
[3]Number caught was not a complete season's catch.

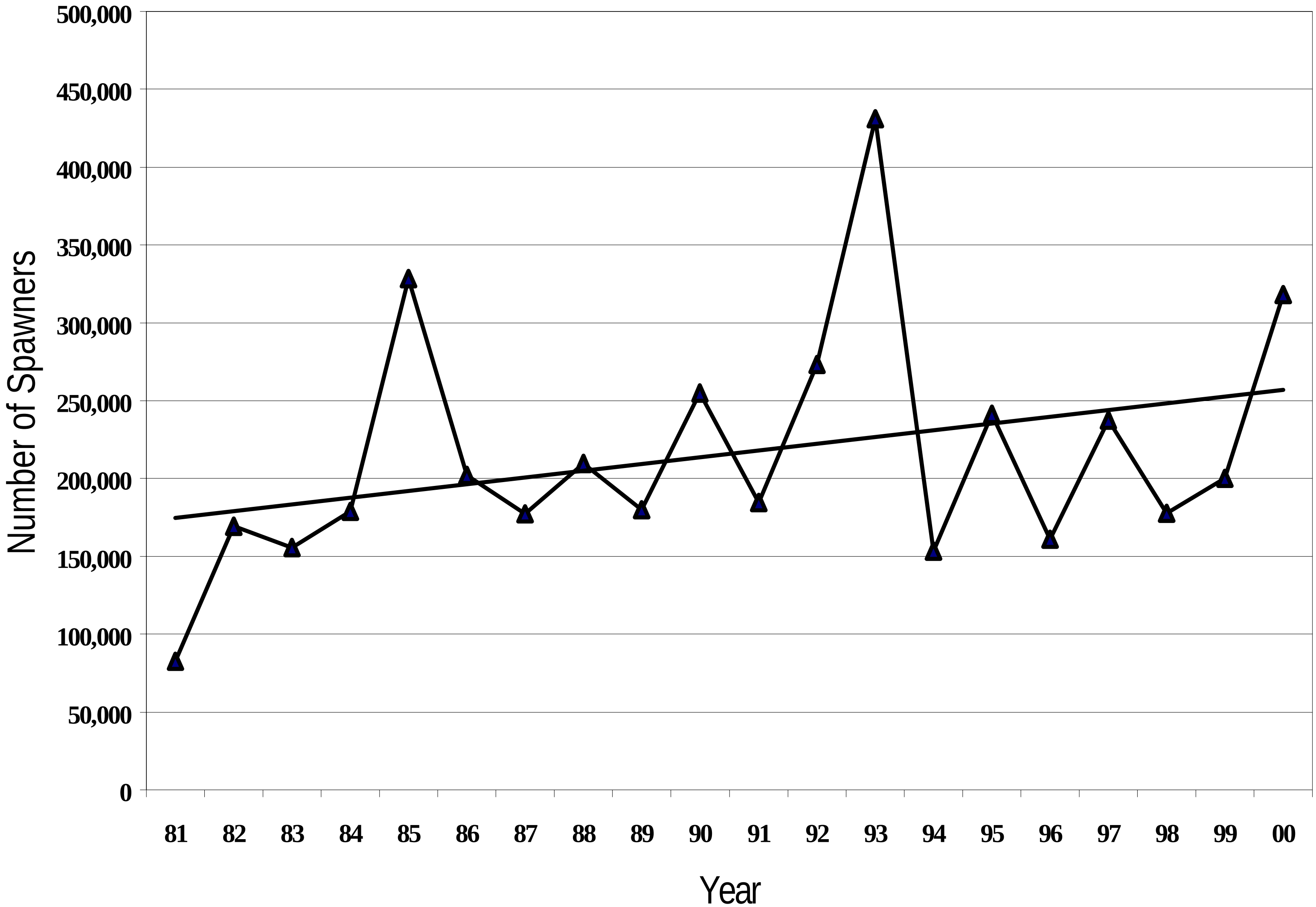

Fig. 6. Trend line of the linear regression of spawner abundance for Lake Huron during 1981–2000.

Table 16. Stream, number caught, estimated population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 2000. (Number in parentheses corresponds to location of stream in Fig. 3)

Stream	Number caught	Spawner estimate	Trap efficiency	Number sampled[1]	Percent males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
United States									
Cattaraugus Cr. (53)	75	999	8	3	100	492	---	284	---
Grand R. (54)	157	1,292	12	13	61	516	523	252	263
Total or Mean (U.S.)	**232**	**2,291**		**16**	**69**	**509**	**523**	**261**	**263**
Canada									
Big Cr. (52)	957	5,887	16	0	---	---	---	---	---
Total or Mean (Canada)	**957**	**5,887**		**0**					
Total or Mean (for lake)	**1,189**	**8,178**		**16**	**69**	**509**	**523**	**261**	**263**

[1]The number of sea lampreys from which all length and weight measurements were determined.
[2]Percent males generally determined from internal body examination of the number sampled.

Table 17. Stream, number caught, estimated population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 2000. (Number in parentheses corresponds to location of stream in Fig. 3)

Stream	Number caught	Spawner estimate	Trap efficiency	Number sampled[1]	Percent males[2]	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
United States									
Black R. (64)	74	---	---	0	---	---	---	---	---
Grindstone Cr. (65)	50	228	22	3	67	460	460	257	257
Little Salmon R. (66)	54	---	---	0	---	---	---	---	---
Sterling Cr. (67)	8	---	---	0	---	---	---	---	---
Sterling Valley Cr. (68)	17	48	35	1	100	510	---	336	---
Total or Mean (U.S.)	**203**	**276**		**4**	**75**	**476**	**460**	**283**	**257**
Canada									
Humber R. (55)	1,569	5,915	27	140	51	486	487	267	273
Duffins Cr. (56)	1,350	2,548	53	139	55	495	495	270	266
Bowmanville Cr. (57)	366	3,051	12	121	48	483	472	273	247
Graham Cr. (58)	195	225	87	56	59	486	468	275	257
Port Britain Cr. (59)	186	241	77	58	53	506	492	260	257
Cobourg Br. (60)	202	287	70	65	66	465	475	250	295
Grafton Cr. (61)	89	189	47	0	---	---	---	---	---
Shelter Valley Cr. (62)	504	783	64	131	60	527	522	280	291
Salmon R. (63)	369	---		95	77	505	526	278	299
Total or Mean (Canada)	**4,830**	**13,239**		**805**	**58**	**496**	**492**	**270**	**270**
Total or Mean (for lake)	**5,033**	**13,515**		**809**	**58**	**496**	**492**	**270**	**270**

[1]The number of sea lampreys from which all length and weight measurements were determined.
[2]Percent males generally determined from internal body examination of the number sampled.

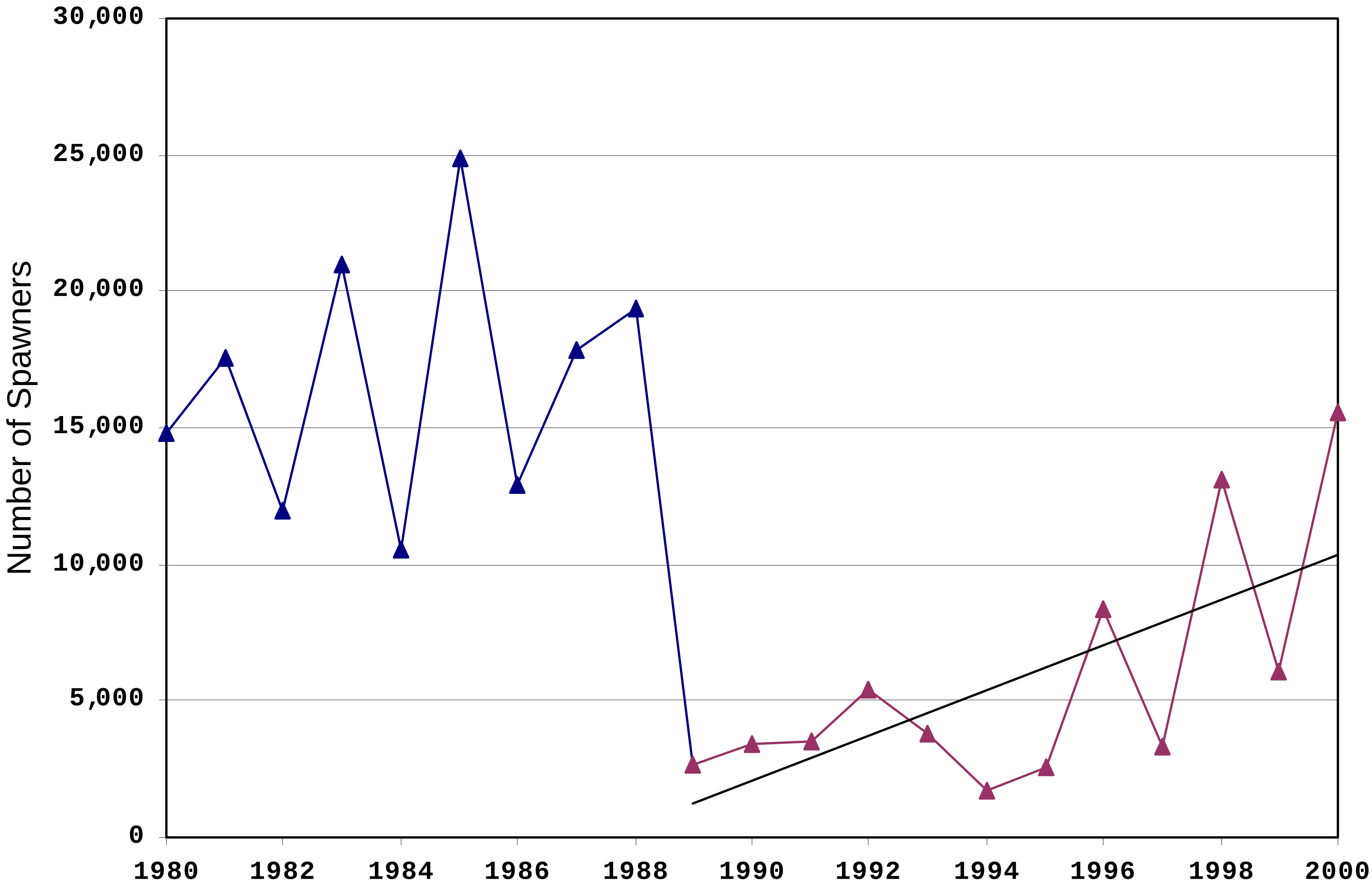

Fig. 7. Lake Erie spawner estimates during 1980-2000 and trend line showing an increase in abundance from 1989-2000.

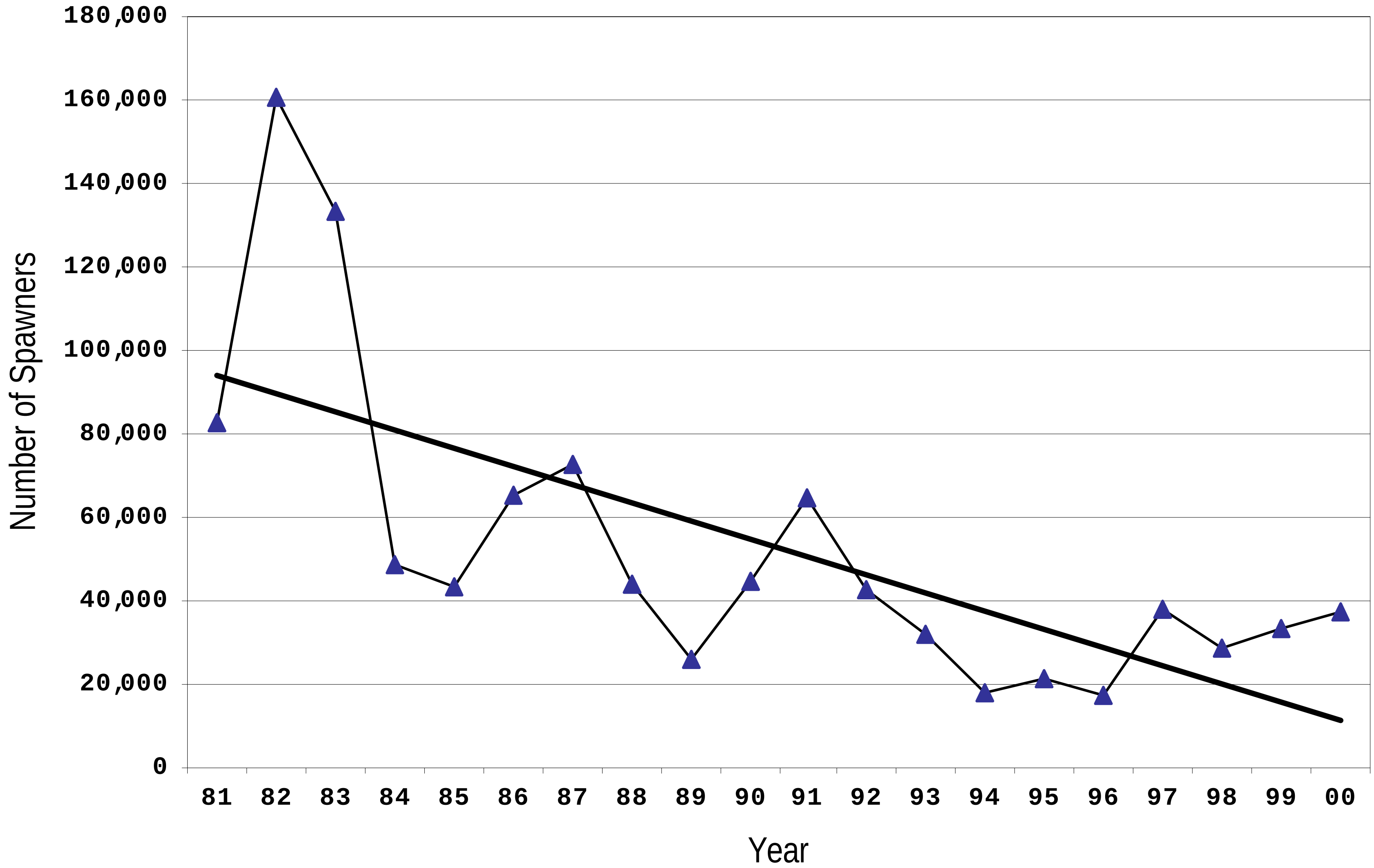

Fig. 8. Lake Ontario spawner estimates and trend line showing a decrease in abundance from 1981-2000.

Parasitic-Phase

The MDNR provided data on the frequency of parasitic-phase sea lampreys attached to fish caught by sport charter boats during 2000.

Lake Superior

- 19 sea lampreys were collected from 7 management districts; 18 sea lampreys were attached to lake trout, and 1 was attached to a chinook salmon.

- Lampreys were attached at a rate of 0.4 per 100 lake trout (n = 4,512) and 1.1 per 100 chinook salmon (n = 88).

Lake Huron

- 2,872 sea lampreys (U.S.: sport-730, commercial-694; Canada: commercial-1,448) were collected from 9 management districts (6 U.S.; 3 Canada) during 2000.

- 176 of the sea lampreys captured in the sports fishery were attached to lake trout and 554 were attached to chinook salmon.

- Lampreys were attached at a rate of 2.3 per 100 lake trout (n = 7,776) and 7.6 per 100 chinook salmon (n = 7,239).

- A total of 442 parasitic-phase sea lampreys (captured by the commercial fisheries) were tagged with coded wire and released at several locations in northern Lake Huron (Hammond Bay-115, Nunns Creek-150, and the North Channel-177). Parasitic lampreys were collected in cooperation with the Chippewa/Ottawa Resource Authority and USGS-Hammond Bay Biological Station.

TASK FORCE REPORTS

The Commission through its Sea Lamprey Integration Committee (SLIC) has established Task Forces to recommend direction and coordinate actions in several focus areas: St. Marys River Control, Sterile Male Release Technique, Barriers, Assessment, and Lampricide Control. The progress and major actions of the Task Forces for 2000 are outlined below.

ST. MARYS RIVER CONTROL TASK FORCE

- Task Force established during January 1992.

- Purpose of Task Force:

  Coordinate the adaptive implementation of the St. Marys River integrated sea lamprey control strategy that initially includes a combination of trapping, sterile male release, and granular Bayluscide applications, but later maintains the required level of suppression without further use of lampricides. Major charges included the following:

  - Coordinate the St. Marys River actions of the other SLIC task forces and review their progress in delivering the St. Marys River control strategy and assessment plan.

  - Evaluate the success of the control strategy and use an adaptive-management approach to recommend the most cost-effective approach to continuing control with the least possible reliance on lampricides.

  - Provide information on near and long-term control actions, effects, and assessment needs to the Lake Huron Technical Committee for inclusion in sea lamprey management plans and Economic Injury Level target-setting exercises.

  - With input from the other SLIC task forces, develop detailed near-term plans for larval assessment, adult assessment/trapping, sterile male release, and lampricide operations and lampricide supplies.

  - Establish research priorities to support the most effective and efficient control possible on the St. Marys River and review and recommend external and internal research projects for relevance against priorities.

- Members were Larry Schleen (Chair) and Douglas Cuddy, Department of Fisheries and Oceans Canada; Dennis Lavis, John Heinrich and Terry Morse, U.S. Fish and Wildlife Service; Roger Bergstedt, U.S. Geological Survey; James Johnson (Lake Huron Technical Committee representative), Michigan Department of Natural Resources; Richard Fleming (outside expert), Forestry Canada; and Gavin Christie and Robert Young, Great Lakes Fishery Commission Secretariat.

- Progress on charges:

  - The task force held its last official meeting on Sept. 15, 1999. Due to staff commitments to the SLIS II Symposium during August 2000, no formal meetings were held during winter 1999-2000. The task force interacted with the Assessment Task Force and held a conference call on April 5, 2000 to finalize the 2000 assessment plan and to discuss the long-term plans for the upstream untreated reference sites. The Task Force made its final presentation to SLIC at the April 19-20, 2000 meeting. A summary of the 2000 larval assessment plan was included in the SLIC 00-01 briefing book.

  - The SLIC Core on April 20, 2000 made the following recommendation about the St. Marys River Control Task Force: "SLIC recognizes that the St. Marys Task Force has met all of its charges from the Commission. Therefore, SLIC recommends that the St. Marys Task Force be dissolved and any residual charges be assigned to the Assessment, Lampricide Control and Sterile Male Release Task Forces." During the October 2000 SLIC meeting the components of the St. Marys River program were reviewed to ensure that all issues were included within these other task forces.

STERILE MALE RELEASE TECHNIQUE TASK FORCE

- Task force established April 1984

- Purpose of task force:

  - Continue to refine the long-term strategy for application of sterile male release in an integrated program of sea lamprey control.

  - Coordinate the current large-scale research program into the effectiveness of the sterile male release technique in Lake Superior and the St. Marys River and include operational and research studies to test all required hypotheses.

- Members are Michael Twohey (chair), John Heinrich, and Dennis Lavis, U.S. Fish and Wildlife Service; Rod McDonald and Doug Cuddy, Department of Fisheries and Oceans, Canada; Gavin Christie, Great Lakes Fishery Commission Secretariat; Gerald McKibben (outside expert), U.S. Department of Agriculture (retired); Roger Bergstedt, U.S. Geological Survey; and Dr. Weiming Li, Michigan State University.

- A task force meeting was held in July. Meetings were minimized to provide staff and task force members time to work on SLIS II manuscripts.

Progress on charges:

Strategic Long-term Integrated Management of Sea Lamprey (IMSL) Planning

- The task force continued to work with the Assessment task force to refine understanding of the stock recruitment relation and its effects on release strategies.

- Effectiveness of the current control strategy in the St. Marys River is being monitored in cooperation with the Assessment task force and through the St. Marys River Assessment Plan.

- Monitoring of sterile male releases in the St. Marys River continues to indicate the technique is reducing production of larvae from nests.

- Preliminary analysis of larval assessment data from 8 long-term evaluation streams indicates that sterile male releases affect recruitment to the yearling stage, on average, but that the effect will frequently not be observed due to the large inter-annual variability in recruitment per spawner. When spawner densities were reduced to levels much below 1 female per 100 m^2 of weighted larval habitat, high recruitment events were not observed. This suggests that suppression in recruitment may be possible if spawner densities, or effective spawner densities using sterile male releases, were pushed low enough.

- Long-term suppression targets have been modeled as part of the St. Marys River integrated control strategy.

- Theoretical effects of trapping and sterile male release and theoretical suppression of reproduction on the estimated population of sea lampreys in the St. Marys River during 1991-2000 are presented in Table 18.

- A model of the effectiveness of sterile male releases and trapping in the St. Marys River indicates that acquiring additional lampreys for sterilization from within the river has a substantial benefit over obtaining additional males from outside sources.

Tactical/Operational Planning

- The task force continued to work with the Assessment and Barrier task forces to increase the supply of male sea lampreys for use in the technique.

- The task force continued to work with the Assessment task force to plan and implement cost effective enhancements to trapping in the St. Marys River.
- Improvements at existing adult assessment trap sites outside the St. Marys River have the potential to provide 3,400 males at a cost of about $18 per male.

Table 18. Theoretical effects of trapping and sterile male release and theoretical suppression of reproduction in the estimated population of sea lampreys in the St. Marys River during 1991-2000.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Population estimate	35,582	19,508	45,620	10,624	19,608	22,255	8,162	20,235	19,860	38,829
Percent males	53	58	56	57	55	63	56	57	60	64
Percentage of sea lampreys removed by traps	42	39	22	53	44	20	30	35	53	48
Sterile males released	7,516	4,508	4,832	2,667	4,238	3,650	17,181	16,743	26,285	43,184
Estimated ratio sterile to untreated males	0.7:1	0.7:1	0.2:1	1.0:1	0.7:1	0.3:1	5.4:1	2.2:1	4.7:1	3.3:1
Theoretical percent reduction in reproduction[1]	65	63	38	76	67	39	89	80	92	88
Theoretical reproducing females[2]	5,805	3,029	12,534	1,091	2,873	4,922	402	1,771	638	1,670

[1]Combination of trapping and sterile male release.

[2]Estimated female population reduced by the theoretical reduction in reproduction.

- The task force investigated the use of Atlantic origin sea lampreys for sterilization and release to supplement the technique in the Great Lakes. Sea lamprey genetics, diseases, population dynamics, and trapping logistics were evaluated in the Connecticut River.

- Following direction by the Commission and SLIC, the task force suspended most efforts toward the importation and use of Atlantic origin sea lampreys because the short-term benefits do not outweigh the potential for some adverse effect. The use of Atlantic origin males currently was not vital to attain short-term goals in the St. Marys River. Additional males may be useful in the long term to expand the technique into other tributaries, or for eradication after success of current control efforts. The costs of obtaining Great Lakes males will increase with success of control efforts. New technologies (e.g., pheromones) may mitigate the benefits of additional sterile males.

- The task force investigated the use of female sea lampreys for sterilization and release in Great Lakes tributaries. Sterile female sea lampreys have potential to be used in tributaries that do not receive sterilized male sea lampreys.

- The sterilization facility continued to meet the Michigan Department of Environmental Quality permit requirements for the discharge of effluent. Bisazir was not detected in water effluent during the field season.

Research Planning

- Development of research continues with priorities in the following broad areas:

    - Determination of the effectiveness of ratios of sterile to untreated sea lampreys

    - Examination of sources, processes, and methods that add to the existing supply of sea lampreys for use in the technique.

    - Examinations to improve safety and effectiveness of the current industrial technique.

- Analysis of data from the study *Long-term evaluation of sterile-male release for control of sea lampreys in the Great Lakes (Long-term evaluation)* suggests further information is needed for the following:

    - Accurate age interpretation.
    - Recruitment at low stock sizes.
    - Variability in recruitment.

- Field sampling was concluded on a study that tested compensation in larval populations with densities at about 1/20th of those created in the *Long-term evaluation*. These results will compliment observations made in the *Long-term evaluation* and compensatory mechanism studies.

- Results of the *Long-term evaluation* and the above study were being evaluated to guide development of future studies that will continue investigation of compensation in low larval densities. New evaluations will be proposed to begin during 2002 and will continue evaluations of spawner run allocation, reproduction and larval recruitment, and year class survival and growth. The new study will compliment ongoing compensatory mechanism studies.

- The task force continued to work with the Fish Health Committee to develop a disease profile of Atlantic origin sea lampreys. Lampreys from three Atlantic coastal tributaries are being sampled for diseases during 1999-2002. No diseases have been observed in samples collected through 2000.

- A study of the phenotypic expression of growth in juvenile sea lampreys of Atlantic and Great Lakes origins when held and fed in fresh water continued during 2000. While data were not conclusive, differences in growth were not observed. This study will not continue due to a decision to suspend further efforts to import Atlantic origin males for use in the technique.

- The study titled *Experimental examination of factors affecting polygyny and polyandry of sea lampreys* (*Petromyzon marinus*) *as a means of optimizing sterile female releases* (Li et al.) was investigating efficacy of a proposed sterile female release technique and will yield useful information about spawning behaviors that may affect sterile male release strategies.
- The task force continued cooperation with Dr. Weiming Li to develop procedures that will enhance the potency of sex pheromone release, and thus, the mating competitiveness of sterile male sea lampreys also may be enhanced. The project has been funded from the Great Lakes Protection Fund.
- The task force continued efforts to confirm the identity of bisazir breakdown products that occur at pH 2.
- The task force cooperated with the following research projects during 2000:
  - *Long-term evaluation of sterile-male release for control of sea lampreys in the Great Lakes*, Bergstedt et al.
  - *Compensatory mechanisms in Great Lakes lamprey populations*, Jones et al.
  - *Genetic assignment of larval parentage as a means of assessing mechanisms underlying adult reproductive success and larval dispersal*, Scribner and Jones.
  - *Collection of lamprey brains and pituitaries for purification of hormones*, Sower.
  - *Studies on the role of sperm activating proteins and the mechanism by which protease-inhibitor interaction controls fertilization in lamprey*, Dabrowski et al.
  - *Determining the sources and complete chemical composition of the lamprey larval pheromone, and assessing the merit of measuring one of its principle components in river waters*, Sorenson.
  - *A putative male sea lamprey pheromone: its function, identity, and potential application in sea lamprey control*, Li.
  - *Experimental examinations of factors affecting polygyny and polyandry of sea lampreys (Petromyzon marinus) as a means of optimizing sterile female releases*, Li and Scribner.
  - *Phenotypic expression of growth in juvenille sea lampreys of Atlantic and Great Lakes origin when held in fresh water*, Bergstedt.
- Research recommendations through FY2003 are listed in the Long-range plan (Table 19).

Table 19. Long-range plan of SMRT activities through FY2003.

Activity	FY2001	FY2002	FY2003
Operations			
Harvest in 15-20 tributaries	X	X	X
Increase Great Lakes harvest		design/begin	X
Increase St. Marys River trapping	Design/begin	X	X
Release in St. Marys River	X	X	X
Analysis of bisazir in water	X	X	X
Sterile female release			increase facility
Purchase bisazir	X		
Atlantics - disease profile	X	X	
Assessment			
Assess spawners U.S. and Canada	X	X	X
Assess larval year class strength in Lake Superior streams	X	X	X
St. Marys River, assess larval recruitment year classes (H6), metamorphosis (H7), parasitics (H8), and spawners (H8)	St. Marys River Assessment Plan	St. Marys River Assessment Plan	St. Marys River Assessment Plan
LTS2 - Larval assessment in streams (H6)		X	X
Internal research			
Polygamy - Li and Scribner	X	X	
LTS2 - release in streams and evaluate spawning		X	X
Compensatory mechanism studies - Jones et al.	X	X	X
Sex pheromones – Li	X		
External and Collaborative Research			
Female lampreys - verify sterility in early run animals – Dabrowski	X		
Quality assurance – Dabrowski	X		
Hydrolysis products of bisazir	X	X	
Super sterile male – Li	X	X	X
Lamprey migratory pheromone - Sorenson	X	X	X

ASSESSMENT TASK FORCE

Task Force established April 1996.

- Purpose of Task Force:

  - Develop strategic and long-term IMSL plans for projecting transformer production, developing summary databases, reviewing and improving key life history parameters, developing a habitat inventory, estimating efficacy of control options, evaluating the uncertainty in assessment parameters, and evaluating the role of trapping as a control strategy.

  - Create tactical and operational plans for developing cost-effective protocols for assessment, coordinating training among agents to ensure standardization of techniques, and modifying current sampling protocols.

  - Establish internal and external research priorities, review research titles for relevance against priorities, and recommend research approaches.

- Members were Doug Cuddy (Chair) and Paul Sullivan (Department of Fisheries and Oceans Canada); Michael Fodale, John Heinrich, Katherine Mullett and Sidney Morkert, (U.S. Fish and Wildlife Service); Bill Swink and Jean Adams (U.S. Geological Survey, Biological Resources Division); Bill Mattes (Great Lakes Indian Fish and Wildlife Commission); Michael Jones, (Michigan State University); Gavin Christie and Jeffrey Slade, (Great Lakes Fishery Commission).

- Met once on September 20, 2000 to develop workplans, prepare responses to Commission and SLIC action items, and discuss research proposals.

- Cooperated with the Lampricide Control task force on the treatment efficiency study and with the Sterile Male Release task force on the sterile male long-term study.

- At the request of the Commission the task force prepared a report on the effect of not using granular Bayluscide as an assessment tool in streams designated as “sturgeon streams.” The task force formed a sub-group to prepare this report. The group determined that the alternatives for deepwater assessment were more costly than use of granular Bayluscide. The group also evaluated the potential impacts of granular Bayluscide to juvenile sturgeon by continuing its use at the current rate. They concluded that a small percentage of a population of sturgeon in a river might be found within treated plots, but that effect to total population would be insignificant.

- Progress on charges:

- *Produce long term projection of transformer production using empirical data and LCSS.* In co-operation with the Secretariat and IMSL contractor, the task force continued the development of the Empirical Stream Treatment Ranking model (ESTR). ESTR integrated annual assessment catch and habitat data as well as stream specific growth and transformation models from agent databases to estimate transformer production and projected these estimates with treatment cost and resource data to rank streams for lampricide treatment. ESTR also was used to predict transformer production from residual populations from streams ranked during 1998-1999.

- *Assessment Summary Database.* The summary database was an integral part of ESTR.

- *Review key life history parameters.* Several of the papers delivered at SLIS II in August addressed lamprey life history parameters. Ongoing studies included the compensatory mechanisms study and habitat preferences study, which were also addressed informational needs that assisted with the assessment and management of sea lamprey populations. In 2000, the task force co-operated with PERM research scientists on the compensatory mechanisms study by conducting intense sampling of the larval populations in 16 streams with known spawning runs.

- *Stream habitat inventory.* Larval sea lamprey habitat was routinely measured in those streams that were quantitatively assessed each year. By 2000, habitat had been quantified at least once for all regular-producing streams and for many streams, two or more times.

- *Develop estimates of the efficacy of treatment (chemical and non-chemical) options.* Estimates of the residual populations of larval sea lampreys were made following a treatment for those streams that were thought to have the potential to rank for another lampricide treatment.

  The task force is continuing to assess the efficacy of the St. Mary's control strategy that used a combination of Bayluscide granular treatment, trapping and sterile male release. Working with statistical experts, the task force developed and implemented a sampling plan that used a stratified adaptive design to assess abundance of larval sea lampreys in the St. Marys River and evaluate control efforts. Data collected during 2000 verified that the 1998 and 1999 Bayluscide treatments resulted in a 45% reduction in the larval population.

  The task force also supported the lampricide treatment effectiveness study (Swink et al.) by conducting pre and post treatment larval abundance assessments.

- *Evaluate the level of uncertainty in transformer estimates.* This was identified as a major informational need by the larval assessment sub-group of the "How to design an optimal sea lamprey control program" breakout group at SLIS II. It will also be a key component of the larval assessment review scheduled for fall 2001. Measures of uncertainty were incorporated in the decision analysis models being developed for the St. Marys River control strategy by the PERM scientist at MSU.

- *Evaluate the information value of adult assessment.* This was done by the adult assessment review panel. The task force has acted on most of the recommendations made in their report. Significant changes in adult assessment included the assessment of spawning runs in more large rivers and the implementation of a multi-year lake wide parasitic estimate for Lake Huron and multi-year transformer estimates for Lake Superior.

- *Develop a strategy for allocating effort among categories of larval assessment.* The larval assessment protocols provided a guide for prioritizing stream assessment activities. We anticipate that the upcoming larval review will critically evaluate the current allocation of effort and make recommendations to guide us in the future.

- *Evaluate the role of trapping as a control strategy.* This is the subject of a SLIS II paper. The combination of trapping and sterile male release plays a major role in the St. Marys River control strategy.

- *Produce summary data to reflect status of lamprey populations.* The agents annually prepare in reports to the lake committees and Commission, lake wide estimates of spawning populations for each of the lakes as well as larval and transformer estimates in each stream ranked for lampricide treatment. The Secretariat has established a joint database that will store assessment summary data of the agents.

- *Develop cost-effective sampling protocols.* Protocols have been developed and were used by both agents for sampling wadeable and non-wadeable waters of streams and lentic areas. These protocols have been modified as new scientific findings were accepted. We anticipate that there will be continuing improvements from the upcoming larval review.

- *Produce estimates of transformer production for stream selection.* This has been done annually for all streams that we have reason to believe warrant treatment the following year. Estimates were presented yearly in the annual report to the Commission.

- *Coordinate training between agents.* Efforts were made to ensure interagency data consistency. Joint habitat classification training occurred annually since 1997 for larval assessment staff prior to the start of the field season. Joint training in the tagging of lampreys has also been done.

- *Develop plans for adult and larval assessment programs.* Program plans and assessment budgets for FY 2001 were roughed out at the Sept. 20-21 meeting. New initiatives were presented, discussed and prioritized. The task force identified program needs and delivered recommendations that could not be accommodated within the base program to SLIC. Plans were made to continue the assessment of the efficacy of the 1998/99 granular Bayluscide treatment and of the enhanced sterile male release and trap-up of spawners in the St. Marys River.

– *Develop assessment research priorities.* The task force has a research priority list that was developed during 1998. The list will be revisited following the larval review.

– *Review internal research.* Several ongoing and new proposals were discussed and subsequently ranked by task force members. New proposals were in the pre-proposal conceptual stage only and needed further development before the task force can give final support.

– *Recommend approaches for external research.* No action.

– *Review external research*. External research pre-proposals were reviewed at the research priorities working group.

SEA LAMPREY BARRIER TASK FORCE

- Task Force established during April 1991.

- Purpose of Task Force:

  - Refine the long-term strategy for the application of barriers in an integrated program of sea lamprey control including the decision model, resulting rank-order list of projects, and rules for the order in which to build the priority barriers.

  - Evaluate the potential for barriers to contribute to meeting targets for sea lamprey suppression on all lakes and for reducing the amount of lampricides used in the sea lamprey program; and evaluate effectiveness of barriers relative to lampricide control.

  - Coordinate the implementation of an accelerated program of barrier construction including development of detailed plans and accurate cost estimates, meeting all environmental assessment requirements, and supporting the Commission decision process.

  - Establish research priorities and recommend research direction into barrier technology, efficacy, and ecosystem impacts.

- Members were Dennis Lavis (Chair) and Ellie Koon, U.S. Fish and Wildlife Service; Andrew Hallett, Department of Fisheries and Oceans Canada; Bill Swink, U.S. Geological Service; John Schrouder, Michigan Department of Natural Resources; Les Weigum and Joe Wanielista, U.S. Army Corps of Engineers, Detroit District; and Gavin Christie, Great Lakes Fishery Commission Secretariat. Tom McAuley, Barrier Engineer and Coordinator with Department of Fisheries and Oceans Canada accepted a position with the International Joint Commission and resigned from the task force.

- The task force met once during 2000 to develop program budget, discuss research proposals, and evaluate progress toward charges.

Progress on charges:

- Coordinated with the U.S. Army Corps of Engineers to develop 8 new barrier projects under Section 1135 and other Corps authorities; 7 of the projects were within jurisdiction of the Detroit Michigan District and one was within jurisdiction of the Buffalo, New York District. Planning and development toward construction of two ongoing projects continued.

- Continued refinement of the interim environmental policy and guidelines for the placement of sea lamprey barriers in Great Lakes tributaries by meeting with proposed investigators to develop sampling strategies and research proposal to demonstrate the feasibility of measuring the criteria.

- Provided comment and direction toward a workshop on fish passage proposed by BOTE to continue to focus research direction into fish behavior in and around barriers and passage structures, combination barriers, biological impacts of barriers, and enhanced methods of trapping sea lampreys.

- Provided oversight to the barrier operational program conducted by Commission barrier coordinators. Detailed descriptions of completed and ongoing barrier projects during 2000 were provided in the barrier section of this report.

- The task force continued to work with the Assessment, St. Marys, and Sterile Male Release Technique task forces to refine understanding of the stock recruitment relationship and compensatory mechanisms in sea lamprey populations and the potential impact on barrier effectiveness.

- Developed and recommended a fiscal year 2001 barrier program budget of $1,376,000. Construction of three barriers is planned for 2001.

LAMPRICIDE CONTROL TASK FORCE

- Task Force established during December 1995.

- Purpose of Task Force

    - Improve the efficiency of lampricide control to maximize the numbers of sea lampreys killed in stream and lentic area treatments while minimizing lampricide use, costs, and impacts on stream and lake ecosystems.

    - Define lampricide control options for near and long-term stream selection and target setting.

- Members were Terry Morse (Chair), Dorance Brege, David Johnson, Dennis Lavis, Alex Gonzalez, and John Weisser, U.S. Fish & Wildlife Service; Larry Schleen, Brian Stephens, Robert Young, and Wayne Westman, Department of Fisheries and Oceans, Canada; Gavin Christie, Great Lakes Fishery Commission Secretariat; Terry Bills and Ronald Scholefield, U.S. Geological Survery; and Dr. Weiming Li, Michigan State University.

- Progress on charges:

  - In the "Strategic Vision of the Great Lakes Fishery Commission for the Decade of the 1990's" the Commission set a target level of lampricide use for the year 2000 at 50% of current use (defined as average annual use over a complete stream-treatment cycle). The TFM use for 2000 was 50% less than the average use for the decade of the 1980s, meeting the objective stated in the Commission's vision statement.

  - Five major sea lamprey producing tributaries to Lake Huron (Rifle and Carp rivers) and Lake Michigan (Betsy, Muskegon, and Ford rivers) were treated during 2000 with a combined U.S. and Canadian treatment crew.

  - The treatment effectiveness studies were the top research priority of the task force during 2000. Seven study streams were treated during 2000. The Big Carp River, a Canadian tributary to Lake Huron, was deferred to 2001 because of low flows.

  - A manual titled "Standard operating procedures for application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (*Petromyzon marinus*) control program" was issued to all cooperators and select program representatives during May 2000. The document is the result of a cooperative binational effort to create a document that summarizes the procedures used in the program for chemical control of sea lampreys in the United States and Canada. The manual will be revised annually.

RISK ASSESSMENT

Priority projects included participating in sea lamprey related environmental risk management discussions with state, tribal, and federal regulatory agencies to obtain lampricide application permits and assisting in the coordination of lake sturgeons (<u>Acipenser fulvescens</u>) and other non-target organisms related issues.

<u>Permits</u>

Issues concerning environmental risk management were addressed for regulatory agency permit requirements for applications of lampricides for the following: letter of approval from the Pennsylvania Fish and Boat Commission (February 14), letter of tacit approval from the State of Ohio Environmental Protection Agency (February 22), letter of approval from the Wisconsin Department of Natural Resources (March 13), Certificates of Approval from the Michigan Department of Environmental Quality (March 15 and May 22), and letter of approval from the Indiana Department of Natural Resources (April 7).

During 2000, reports were prepared to comply with the United States Environmental Protection Agency (EPA) June 16, 1998 ruling of Section 6(a)(2) of the Federal Insecticide, Fungicide, and Rodenticide Act. This section of the Act requires pesticide registrants to report to the EPA information concerning unreasonable adverse effects of their products. The Service is the registrant for the lampricides, active ingredients TFM and niclosamide, and must report unreasonable adverse effects on humans, domestic animals, fish or wildlife, plants, other non-target organisms, water, and property damage. Incident reports were completed for the mortality of non-target organisms ($\geq$ 50 individuals of an aquatic species or taxa) observed during lampricide applications in tributaries in United States waters. Reports filed during 2000 included observed mortalities of 75 mudpuppies from TFM in Conneaut Creek (Lake Erie), 78 walleyes and 84 white suckers from TFM and Bayluscide in the Musekgon River (Lake Michigan), and 144 stonecats from TFM and Bayluscide in the Rifle River (Lake Huron).

Federal and State Endangered Species

No federally listed endangered, threatened, or candidate species were known to exist in tributaries where lampricides were applied. Concurrence was received from the Service's Ecological Services Offices.

Concurrence was also achieved with state agencies and tribal nations to apply lampricides in tributaries throughout the Great Lakes basin and to take actions to minimize the risk to State listed endangered, threatened, and special concern species. The priority concern was the lake sturgeon listed as threatened in Michigan.

Lake Sturgeon

During 1982, the lake sturgeon was being considered for threatened or endangered status in the United States and was listed in the Federal Notices of Review Register as a category 2 (C2) candidate species. The C2 classification was removed within the Service during 1995 and for the public during 1996. The lake sturgeon now has no formal Federal designation.

During 2000, the lake sturgeon was listed as State endangered in Illinois, Indiana, Ohio, and Pennsylvania, threatened in Michigan and New York, and special concern species in Minnesota and Wisconsin.

Tributaries where lake sturgeons recently have been documented include the Bad, Ontonagon, Sturgeon, and St. Louis rivers (Lake Superior), Fox, Kalamazoo, Manistee, Manistique, Menominee, Millecoquins, Muskegon, Oconto, Peshtigo, and St. Joseph rivers (Lake Michigan), Carp, Cheboygan, Saginaw, and St. Marys rivers (Lake Huron) and Detroit and St. Clair rivers (Lake Erie), and Niagara and Black rivers (Lake Ontario).

The Michigan Department of Natural Resources expressed concern for the impact of lampricide treatments to suspected populations of lake sturgeons in the Ford, Millecoquins, and Muskegon rivers (Lake Michigan) and the Carp and Rifle rivers (Lake Huron). Assessments by dip and fyke nets during and immediately after treatments of these five rivers found no dead lake sturgeons. The assessments were completed to fulfill requirements specified in the 2000 certification of approval issued for lampricide treatments by the Michigan Department of Environmental Quality.

Other Non-target Organisms

Mudpuppy

The Ohio Environmental Protection Agency expressed concern for the impact of a lampricide treatment to a population of mudpuppies in Conneaut Creek (Lake Erie). The mudpuppy is among the group of non-target organisms most sensitive to lampricides. Consensus was achieved with the Ohio EPA to allow the treatment and to minimize the risk to the mudpuppy. Assessments by dip net conducted during and immediately after the treatment by personnel of the Service, Ohio EPA, and Dr. Timothy Matson of the Cleveland Museum of Natural History observed the mortality of three mudpuppies. The assessments were completed to fulfill requirements specified in the 2000 letter of tacit approval from the Ohio EPA. The mudpuppy (Necturus maculosus) is not federally listed as an endangered, threatened, or candidate species and is not listed by the State of Ohio as endangered, threatened, or special interest species.

OUTREACH 2000

Activity or event	Number of Occurrences U.S.	Number of Occurrences Canada	Staff Days U.S.	Staff Days Canada
School presentations	22	17	16	5
Sports shows	3	6	41	70
Youth fishing	3	N/A	4	N/A
Civic groups	8	1	4	4
Media interviews	17	5	2	2
Media mailings/Electronic mail	1,052	358	6	12
Station public display	3	2	22	6
Landowner notification	417	206	4	12
Employment outreach	10	1	15	2
Total outreach	1,535	596	114	113
Combined outreach	**2,131**		**227**	

PERMANENT EMPLOYEES OF THE SEA LAMPREY MANAGEMENT PROGRAM

U.S. Fish and Wildlife Service
Marquette Biological Station
Gerald T. Klar, Field Supervisor

Control Supervisor: Terry J. Morse
Chemist: David Johnson
Biologist:
- Dorance Brege, Treatment Supervisor
- Darrian Davis
- Joseph Genovese

Lead Physical Science Technician: Robert Wootke
Physical Science Technician:
- Timothy Peiffer
- Michael St. Ours
- Kelley Stanley

Administration Supervisor: Nadine Seeke
- Mary Jo Buckett
- Steven Dagenais
- Pauline Hogan
- Gloria Hoog
- Betty L'Huillier

ADP Supervisor: Larry Carmack
- Robert Kahl
- Deborah Larson

Assessment Supervisor: John W. Heinrich
Biologist:
- Michael Fodale, Larval Supervisor
- Katherine Mullett, Adult Supervisor
- Michael Twohey, Sterile Male Supervisor
- John Weisser, Risk Assessment Supervisor
- Jessica Doemel
- Mary Henson
- Cheryl Kaye
- Geraldine Larson (Amherst Office)
- Dale Ollila

Biological Science Technician:
- Gregg Baldwin
- Gregory Klingler
- Kyle Krysiak
- Mark McNeill
- Deborah Winkler
- Michelle Zastrow

Ludington Biological Station
Dennis S. Lavis, Station Supervisor

Barrier Coordinator: Ellie Koon
Biologist:
- Alex Gonzalez, Treatment Supervisor
- Kathy Hahka

Lead Physical Science Technician:
- Jeffrey Sartor

Physical Science Technician:
- Kevin Butterfield
- Ken Chaltry
- Tim Sullivan

Computer Assistant: Barry Matthews

Biologist:
- Sidney Morkert, Larval Supervisor

Biological Science Technician:
- David Keffer
- Lois Mishler

Administration Support:
- Robert Anderson
- Linda Krupinski
- Tana Reimer

Department of Fisheries and Oceans
Sea Lamprey Control Centre - Sault Ste. Marie, Ontario Canada
Larry P. Schleen, Division Manager

Section Head, Control: Robert J. Young
Fisheries Biologist, Control:
- R. Wayne Westman, Treatment Supervisor
- Brian Stephens, Assistant Treatment Supervisor

Technician, Control:
- Randy Stewart
- Peter Grey
- Jerome Keen
- Barry Scotland
- Jamie Smith
- Jamie Storozuk*
- Shawn Robertson*

Finance & Administration: Jackie Bassett
Accounts Clerk: Lisa Vine
Property & Contract Manager: David J. Haight
Administrative Support:
- John Graham
- Christine Youngson*

Section Head, Assessment: Douglas W. Cuddy
Fisheries Biologist, Assessment:
- Rod McDonald, Adult Supervisor
- Fraser Neave, Upper Lakes Larval Supervisor
- Paul Sullivan, Lower Lakes Larval Supervisor
- Jerry Weise, Environmental Studies
- Todd (Mike) Steeves*

Technician, Assessment:
- Mike MacKenna
- Ed Achtemichuk
- John Tibbles*
- Jeffrey Rantamaki*
- Kevin Tallon*

Barrier Coordinator: Andrew Hallett
- Technician, Barrier: Joseph Hodgson*

Storesperson: William Greene
Maintenance Supervisor: Dave Reid
- Maintenance Assistant: Brian Greene*

*Continuing GLFC appointments