INTEGRATED MANAGEMENT OF SEA LAMPREYS IN THE GREAT LAKES 1997

ANNUAL REPORT TO

GREAT LAKES FISHERY COMMISSION

by

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Integrated Management of Sea Lampreys in the Great Lakes 1997

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Executive Summary

This report summarizes activities in the integrated management of sea lampreys conducted by the Department of Fisheries and Oceans Canada (DFO) and the U.S. Fish and Wildlife Service (USFWS) in the Great Lakes in 1997. Lampricide treatments were conducted on 52 tributaries (Table 1). Larval assessment crews surveyed 184 Great Lakes tributaries and inland lakes, and 12 lentic areas to assess TFM treatment or barrier effectiveness, plan future TFM treatments, and establish production capacity of streams. Assessment traps were operated in 63 tributaries to estimate the spawning-phase population in each lake (Table 2).

This report evaluates sea lamprey population and fish wounding trends against fish community objectives in each of the lakes. The lamprey management program met fish community objectives in Lakes Michigan and Ontario in 1997. In Lake Superior, the spawning phase sea lamprey population has declined by 31% from the 1986-90 period to the 1991-97 period, compared to the objective of a 50% decline outlined in the fish community objectives. Populations of parasitic lamprey remained significantly higher than the fish community objectives in Lake Huron because of continued high production of transformers from the St. Mary's River. The assessment program will be enhanced in Lake Erie in 1998 to identify sources of untreated transformers because fish wounding rates and spawning phase abundance increased above the fish community objectives during 1997.

The St. Marys River Control Task Force recommended to the Great Lakes Fishery Commission (GLFC) an integrated control strategy for the St. Marys River. This strategy includes an enhanced trapping and sterile male release program, to be implemented immediately, and a granular Bayluscide treatment program, with 200 acres to be treated in 1998 and a further 1,935 acres in 1999. An assessment plan to adequately evaluate the integrated control methods is being developed for peer review.

The Sterile Male Release Technique Task Force focused on the second year of the long-term assessment project in Lake Superior streams and enhanced release of sterile males as part of the integrated control program in the St. Mary's River. We released 17,181 sterilized males into the St. Mary's River creating a 5:1 sterile:normal male ratio. The long term assessment program released lampreys, determined nesting success and evaluated the 1997 larval year-class strength in eight Lake Superior tributaries as part of a study of density dependent effects on lamprey populations. The operation of the sterilization facility continues to meet the demands of the program.

The Barrier Task Force continued to work on the long-range barrier strategy. An evaluation was developed to determine the effectiveness of electrical barriers. An external review of the GLFC Barrier program was conducted in 1997. To date, 57 barrier dams have been constructed or modified on Great Lakes tributaries to stop sea lamprey migration. In 1997, 2 barrier dams were constructed and 7 existing barriers were modified to prevent passage of spawning sea lampreys.

The GLFC established its Assessment Task Force in April 1996 to optimize the operations of the larval and adult assessment programs. The task force hosted and began implementing the recommendations from an external peer review of the adult assessment program. In addition, the task

force coordinated revisions to estimates of electofishing efficiency, larval growth, transformation rates and larval distribution within streams. As well, the task force submitted estimates of transformer production to the Program Integration Working Group.

The Lampricide Control Task Force continued to implement options for reducing lampricide use. The Rifle River on the U.S. side of Lake Huron was treated with an international crew, which allowed savings of 1,550 kgs/active TFM (≈ $100,000). Bayluscide powder was used as a synergist for the first time on the Oconto River, Lake Michigan, reducing TFM use by 1,398 kgs/active (≈ $86,000).

Risk assessment studies focused on the effects of lampricide treatments to lake sturgeon (Acipenser fulvescens) and freshwater mussels. No sturgeon were collected during the lampricide treatment of the Paw Paw River, while three juvenile sturgeon were collected at low pH sites during the Oconto River treatment. A three-year sturgeon assessment program continued on the Sturgeon and Bad rivers. A cooperative study between the Upper Mississippi Science Center, the Marquette Biological Station, and the Bad River Band observed no mortality in two species of freshwater mussels at the TFM LC99.9 for sea lamprey.

The sea lamprey management program conducted 535 outreach activities that required 235 staff days.

Table 1. Summary of lampricide treatments in streams of the Great Lakes in 1997.

Lake	Number of streams	Flow m^3/s	TFM[1,2] kg	Bayluscide[1] kg	Distance km
Superior	15	82.9	8,513	89.3	296.2
Michigan	15	54.9	10,414	46.6	343.8
Huron	13	60.2	12,667	40.2	568.7
Erie	1	3.6	1,277	0	55.7
Ontario	8	24.8	2,922	9.4	157.8
Total	**52**	**226.4**	**35,793**	**185.5**	**1,422.2**

[1]Lampricides are in kg of active ingredient.
[2]Includes 643 TFM bars (124 kg active ingredient) applied in 21 streams.

Table 2. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of the Great Lakes in 1997.

Lake	Number of streams	Total captured	Number sampled	Percent males	Mean Length (mm)		Mean Weight (g)	
					Males	Females	Males	Females
Superior	21	6,728	1,743	33	419	418	172	175
Michigan	12	15,572	228	38	468	460	231	236
Huron	16	46,486	531	55	461	460	226	222
Erie	4	395	55	73	498	479	278	254
Ontario	14	6,317	1,262	57	468	456	234	224
Total	**67**	**75,498**	**3,819**					

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. The Lake Committees have established objectives for acceptable levels of mortality that allow the establishment and maintenance of self-sustaining stocks of lake trout and other salmonids. In some cases, the Lake Committees established specific targets for sea lamprey populations in the Fish Community Objectives or in 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 works in partnership with the Lake Committees through their Lake Technical Committees to refine the current sea lamprey target statements and to develop common target formats for each of the lakes. These targets will consider the costs of control along with the benefits to define the control program that supports the Fish Community Objectives and is ecologically and economically sound and socially acceptable. The targets for each lake define the abundance of sea lampreys that can be tolerated and the economically viable level of control required to reach the optimal population level.

This report presents the actions of the Service and Department in the integrated management of sea lampreys in the Great Lakes during 1997. Also, we relate recent trends in lampricide use to the Commission Vision and in sea lamprey abundance to Fish Community Objectives.

COMMISSION VISION

The Commission (GLFC 1992) identified milestones in relation to integrated management of sea lamprey that included:

> *Development and use of alternative control techniques to reduce reliance on lampricides to 50% of current levels.*

Since the beginning of the use of lampricides in the management program, the Service and Department have continuously increased their efficiency in the use of TFM. The combination of improved analysis, application, and assessment techniques and construction of barriers has reduced TFM use by 23% for the period of 1990-97 (annual avg. of 40,000 kg) when compared to 1980-89 (annual avg. of 52,000 kg) (Fig. 1).

FISH COMMUNITY OBJECTIVES

Lake Superior

The Lake Superior Committee (LSC) in 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.*

The LSC established these reductions to reflect the need for enhanced control on Lake Superior based on estimates of the damage caused by the parasitic-phase population in the mid-1980s, with full recognition of the need for further evaluation of the costs of suppressing lamprey to these levels.

This sea lamprey target was developed to support the following objective for the community of lake trout and other salmonids.

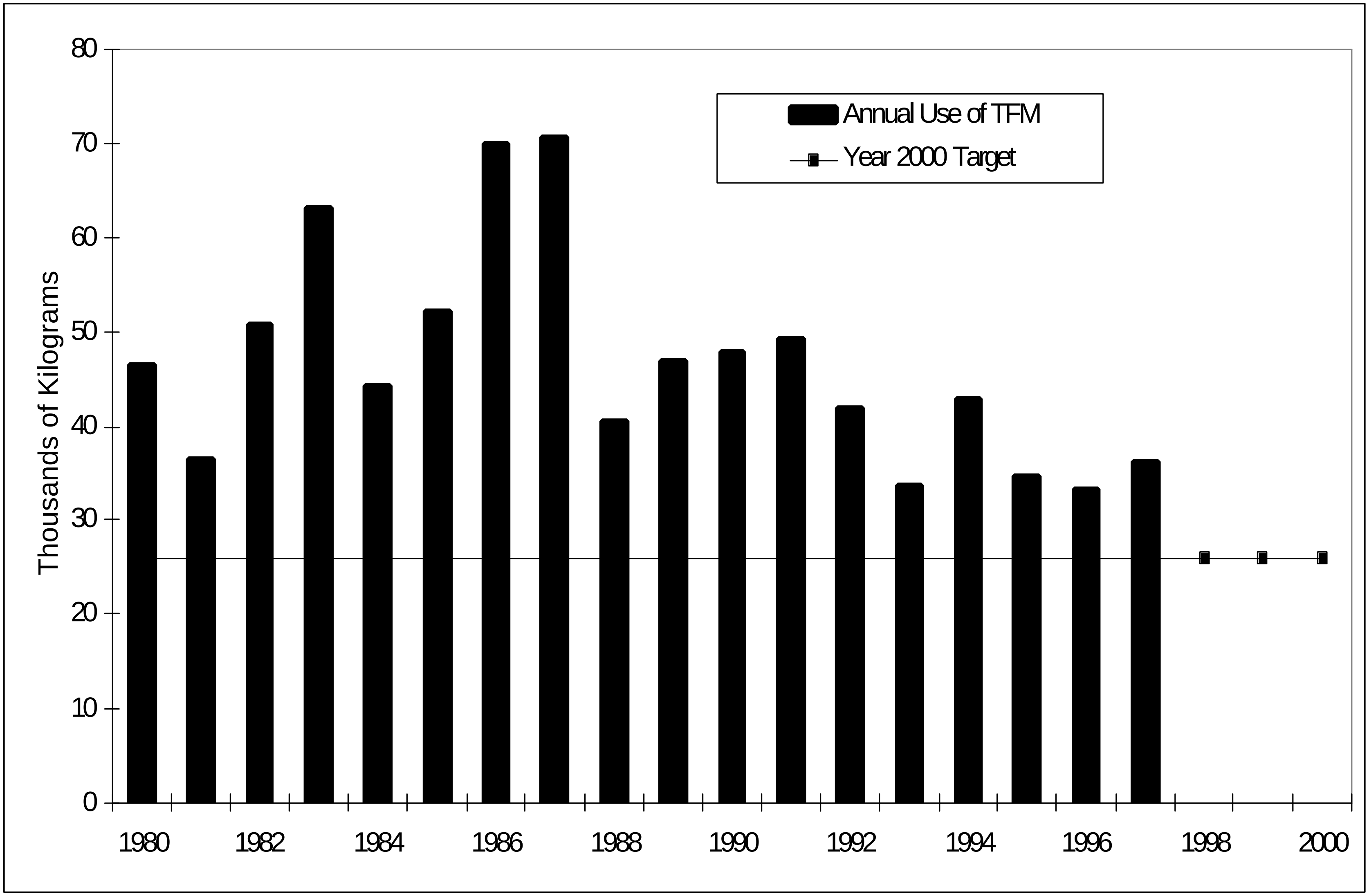

Fig. 1. Average annual use of TFM (active ingredient) during 1980-89 was 52,000 kg and for 1990-97 was 40,000 kg. Target use for the year 2000 is 26,000 kg.

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

The Service maintains an extensive trapping network for spawning-phase sea lampreys in index streams of the south shore of Lake Superior and annually estimates populations east and west of the Keweenaw Peninsula (Fig. 2). Populations east of the Peninsula have generally remained stable during the period 1986-97, whereas populations to the west have declined an average of 45% during 1991-97 when compared to the period 1986-90. The 1997 combined population estimate of 29,234 is 31% below the 1986-90 average of 42,500. At present, the program is above the target for sea lamprey abundance (50% decline by 2000).

Lake Michigan

The Lake Michigan Committee (LMC) established the following specific objective for sea lamprey populations in their Fish Community Objectives in 1995:

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

In general, treatment of Lake Michigan tributaries over the past 38 years has provided sufficient control of sea lampreys, yet recent increases in lamprey wounding rates on lake trout in northern waters of the lake concerns the LMC.

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

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 will be necessary to meet these objectives. The lake-wide management plan specifies four different areas in order to focus lake trout rehabilitation to the areas where the chances of success are best: refuges, primary, secondary, and deferred rehabilitation zones. The primary zones and refuges where priority should be given to reducing mortality caused by sea lampreys 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.

The Service annually has trapped spawning-phase sea lampreys in 12-14 tributaries of Lake Michigan, and estimated the number of spawning lampreys in the Manistique River during 1986-97 (Fig. 3). The index shows the population in the lake has been stable during the time period, but assessments also show lampreys are more abundant in the northern part of the lake than in the southern part.

Lake Huron

The Lake Huron Committee (LHC 1993) established a specific objective for sea lamprey abundance as part of its 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.

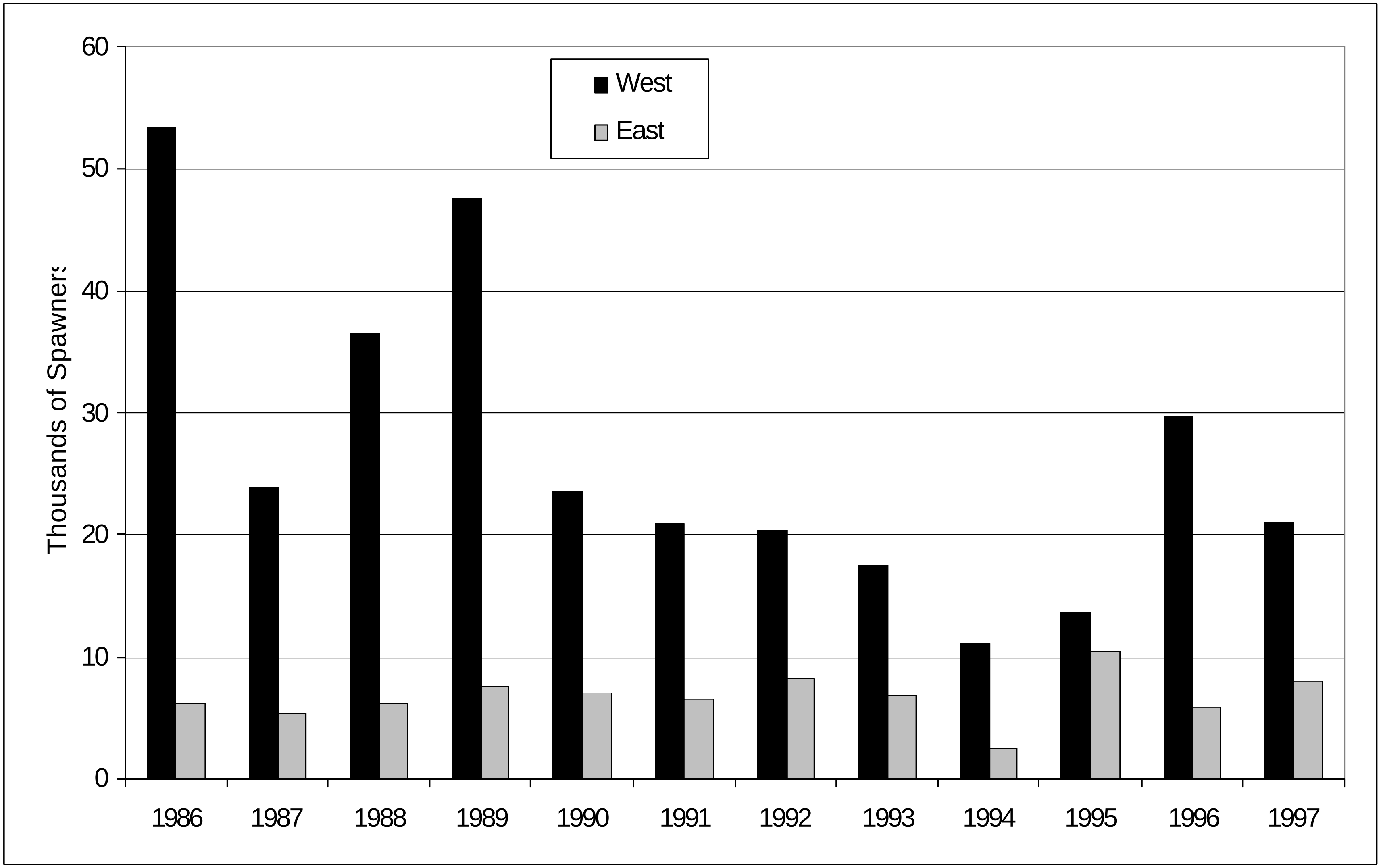

Fig. 2. Estimated number of spawning-phase sea lampreys in U.S. waters (west and east of the Keweenaw Peninsula) of Lake Superior.

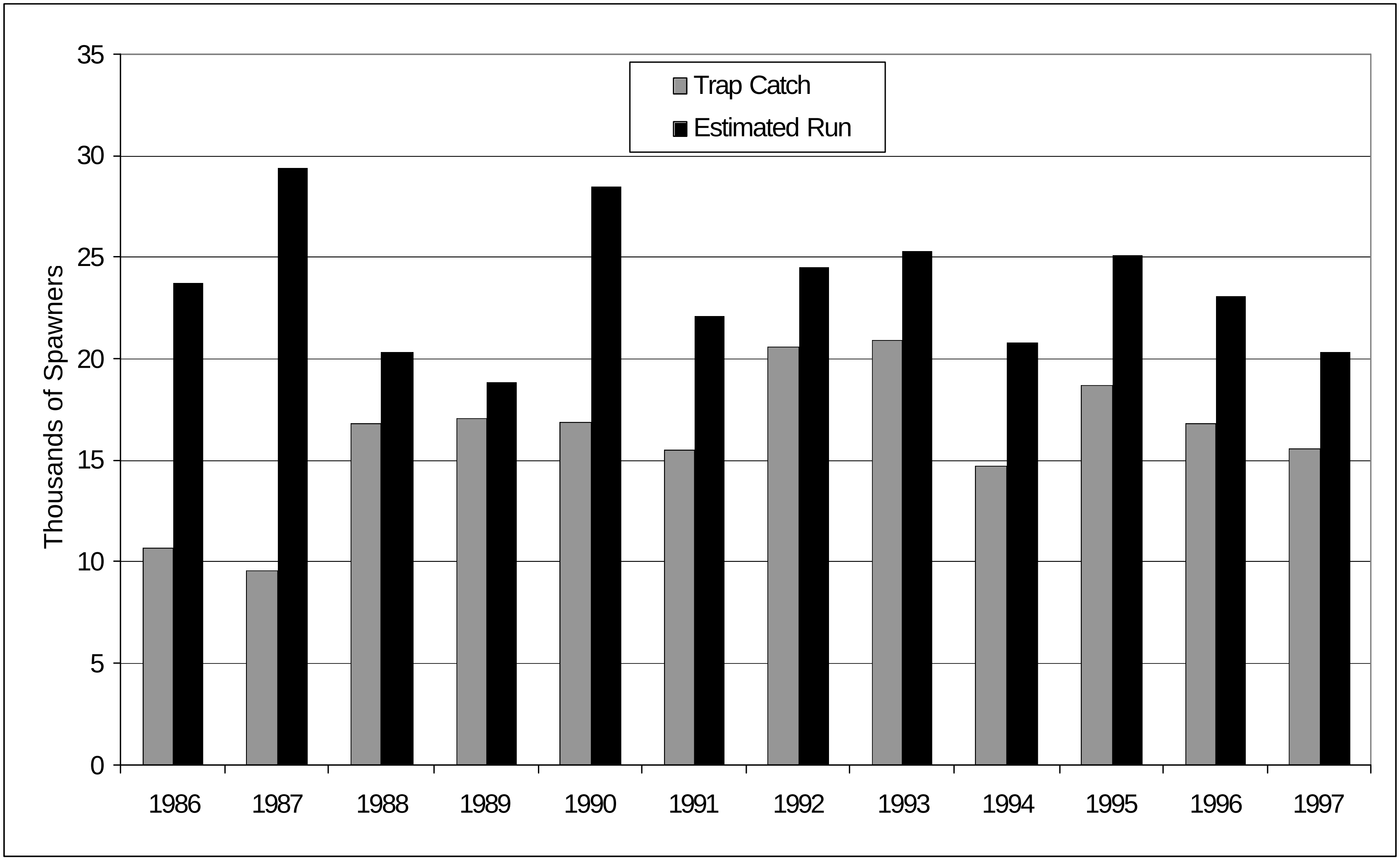

Fig. 3. Number of spawning-phase sea lampreys captured in assessment traps in an annual average of 13 streams (range, 12-14) in Lake Michigan, 1986-97, and estimated population of spawning lampreys in the Manistique River, 1986-1997.

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 dominant species and anadromous species also having a prominent place.*

The LHC determined the total annual mortality of lake trout should not exceed 45% to attain and maintain a self-sustaining lake trout population capable of supporting 3-4 million pounds of yield. The plan calls for management of exploitation and control of lampreys to reach this objective. The lake-wide management plan identifies refuges and special rehabilitation zones in which rehabilitation is most likely to succeed. These priority zones are distributed throughout the lake, including the northern section and the North Channel. The plan states these areas should be priority areas for the suppression of lampreys and control of fishery exploitation.

The Service and Department have trapped an average of 12 streams during 1986-97 to monitor abundance of sea lampreys in northern Lake Huron. Lamprey abundance generally increased from 1986 to 1993 but declined abruptly in 1994 and stabilized from 1995 to 1997 (Fig. 4). The trap catches suggest an excessive number of sea lampreys in Lake Huron and the data corroborates similar patterns in indices of parasitic sea lamprey abundance and fish wounding. We suggest that without continued substantive action to manage the presently under-controlled population of larvae in the St. Marys River we will fail to make progress in achieving sea lamprey objectives for lake trout rehabilitation in Lake Huron.

Lake Erie

The Lake Erie Committee (LEC) is currently developing Fish Community Goals and Objectives for the lake. The LEC is considering the previous management plans and will define objectives for the eastern basin salmonid community. The current draft in development recognizes the need for continuing control but does not set specific objectives for sea lamprey.

A management plan for sea lampreys in Lake Erie was developed prior to the implementation of stream treatments in 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 lamprey would be less than 10% of pre-treatment levels, and nest densities would be less than 2 nests per km of spawning habitat. The first two of these objectives had been met by 1989 in the eastern basin of Lake Erie. In 1992 the Great Lakes Fishery Commission declared the control program on Lake Erie to be an ongoing program similar to the stream treatment programs in the other Great Lakes based on the success of the experimental control program.

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

The Service and Department annually have trapped spawning-phase sea lampreys in an average of 6 tributaries since 1986 and estimated the number of spawning lampreys in Cattaraugus Creek during 1991-97 (Fig. 5). Current catches are significantly less than those prior to the start of lampricide management (first round of treatments conducted in 1986/87 and showed effect in spawner population by 1989) but are greater than 10% of pretreatment catches. Lake trout wounding currently exceeds the target of 5%. Assessment will be intensified in 1998 in order to quantify known sources of parasitic sea lamprey.

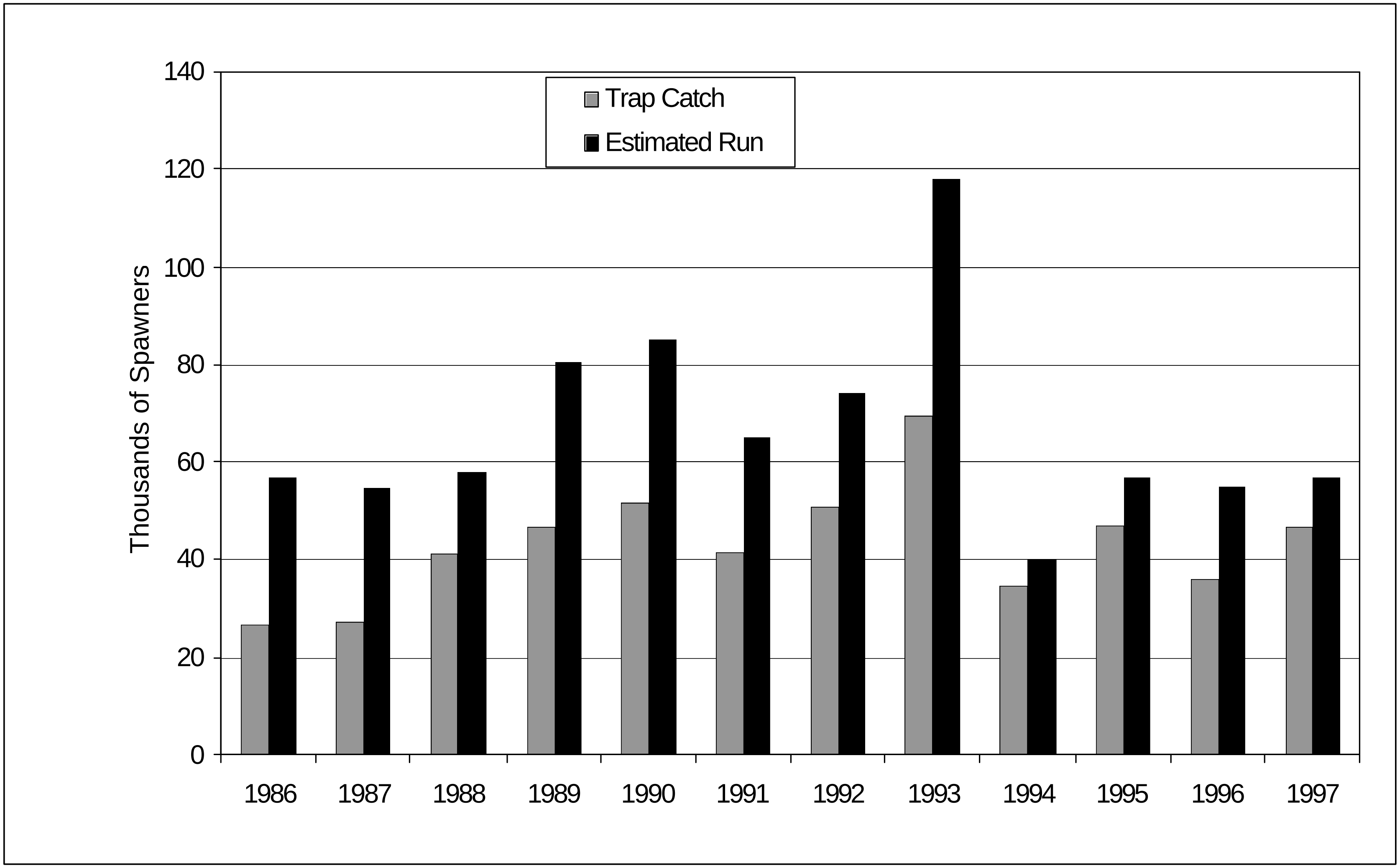

Fig. 4. Number of spawning-phase sea lampreys captured in assessment traps in an annual average of 12 streams (range, 9-16) in Lake Huron, 1986-97, and estimated population of spawning lampreys in the Cheboygan, St. Marys, and Thessalon rivers, 1986-97 (population in Thessalon not estimated in 1988 and 1991).

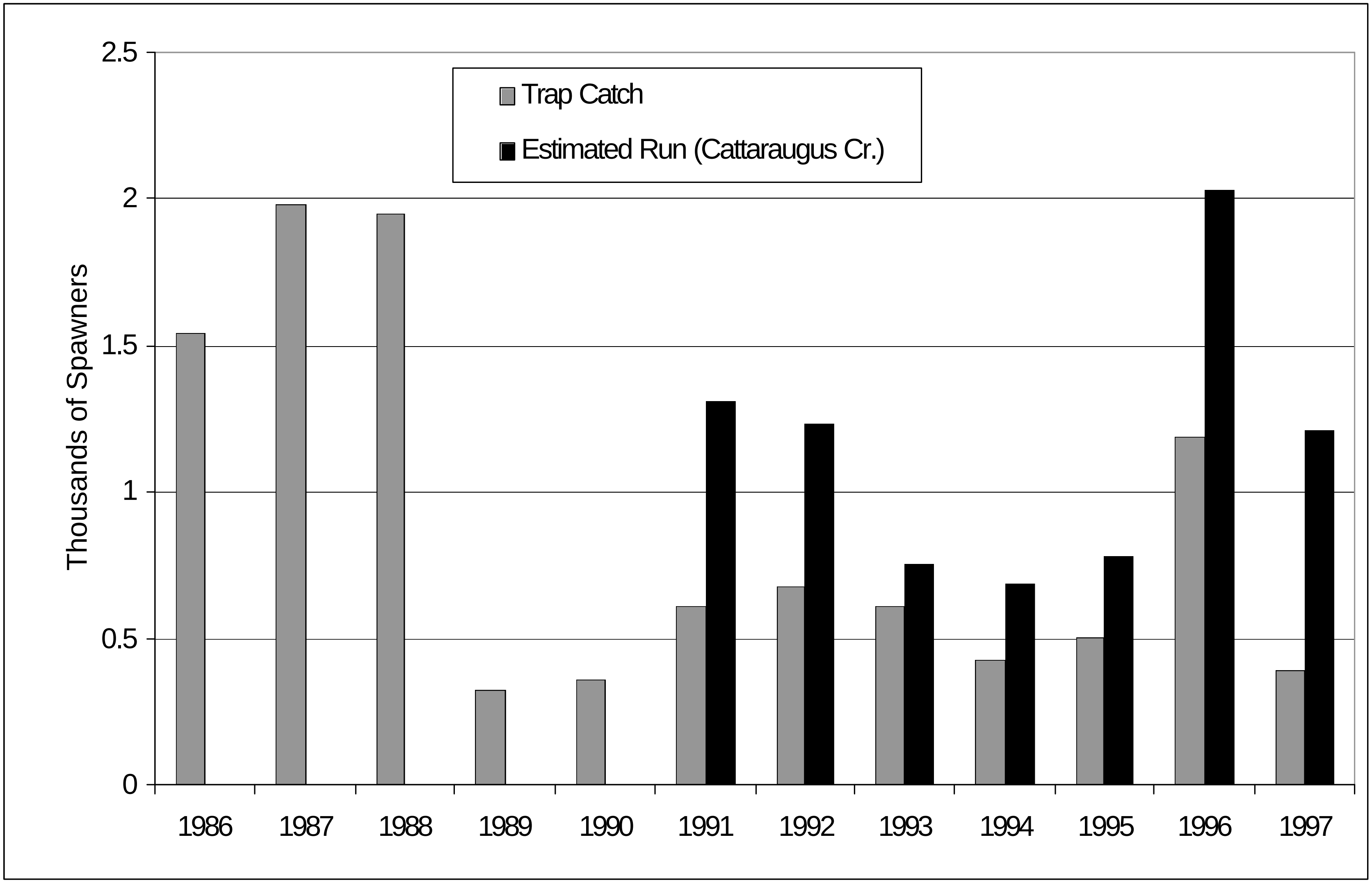

Fig. 5. Number of spawning-phase sea lampreys captured in an annual average of 7 streams (range, 4-11) in Lake Erie, 1986-97, and estimated population in Cattaraugus Creek, 1991-97.

Lake Ontario

The Lake Ontario Committee (LOC 1988) in the Lake Ontario Fish Community Objectives supported continuing sea lamprey control and defined a specific objective for lampreys in terms of mortality to lake trout:

> *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 objective was developed to support the productive salmonine community including a lake trout population that shows significant reproductive potential in the near term.

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

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

This objective is meant to maintain the annual survival rate of > 60% to maintain a target adult spawning stock of 0.5 to 1.0 million adults of multiple year classes. Along with sea lamprey mortality, angler, and commercial exploitation should be controlled so that annual harvest does not exceed 120,000 fish.

The Service and Department annually have operated traps in an average of 15 index streams for spawning-phase sea lampreys in Lake Ontario since 1986. During that period, spawning catches have remained relatively stable, ranging from about 4,000 to 8,000 annually (Fig. 6). Lake wide wounding rates average about 2 marks/100 fish, with annual survival between 50-70%. As well, lake trout deaths from sea lampreys were about 30,000. Thus, the control program is achieving the current sea lamprey objectives for Lake Ontario.

LAMPRICIDE CONTROL

Tributaries harbouring larval sea lampreys are treated periodically with lampricides to eliminate or reduce the larval population before the larvae transform and recruit to the lake as parasitic adults.

Department and Service treatment units administer and monitor doses of the lampricide TFM (sometimes augmented with the wettable powder formulation of Bayer 73) to scheduled tributaries. Specialized equipment and techniques are employed to provide concentrations of TFM that are effective in eliminating about 95% of the lamprey larvae and that minimize the risk to nontarget species. In recent years the combination of improved analytical and predictive techniques has allowed treatment crews to reduce lampricide concentrations in individual treatments by about 25%.

The Lampricide Control Task Force was established in December 1995 with charges to improve the efficiency of lampricide control, to maximize sea lamprey 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 progress report on the charges in 1997 is presented on page 53.

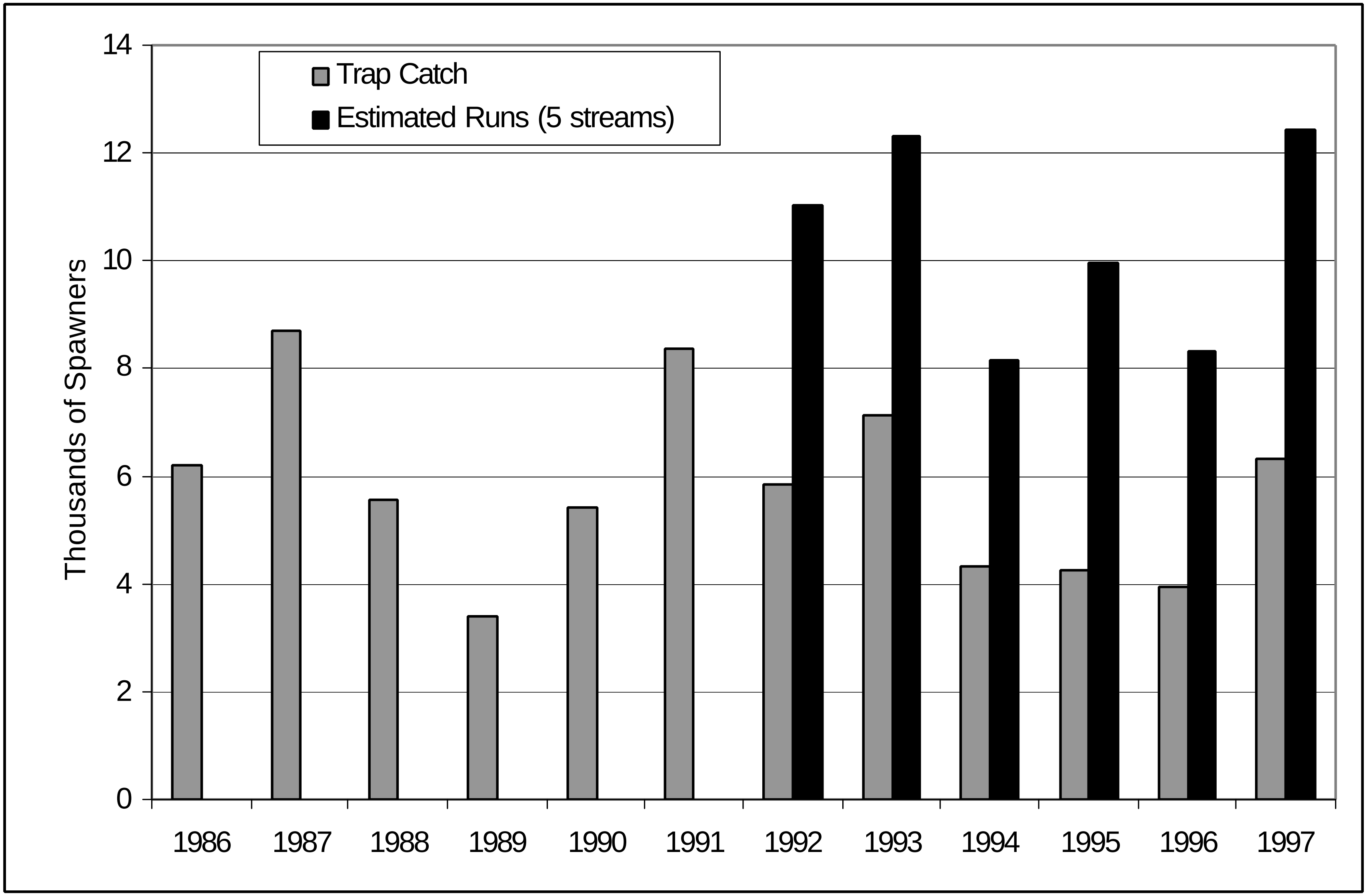

Fig. 6. Number of spawning-phase sea lampreys captured in assessment traps in an annual average of 15 streams (range, 13-16) in Lake Ontario 1986-97, and of the sum of their estimated populations in the Black and Humber rivers, and Duffins, Port Britain, and Shelter Valley creeks, 1992-97.

Lake Superior

Tributary Information

- 1,566 (733 United States, 833 Canada) tributaries to Lake Superior.
- 136 (89 United States, 47 Canada) tributaries have larval sea lamprey production records.
- 77 (44 United States, 33 Canada) tributaries have been treated with lampricide at least once during 1986-97.
- Of these, 53 (30 United States, 23 Canada) tributaries are treated on a 3-5 year cycle.

Table 3 and Fig. 7 detail the applications of lampricide to 15 tributaries of Lake Superior in 1997. The following statements highlight the treatment program.

United States

- Treatments were completed on all scheduled streams. Minimum lethal concentrations of lampricide were maintained throughout all treatments.
- Savings of TFM were realized although stream discharges were significantly higher throughout the season. Total discharge of treated Lake Superior streams averaged two times (35 vs. 18 m^3/s) that of the last round of applications.
- As a requirement of the permit from the State of Michigan, municipal water systems at L'Anse and Marquette, Michigan were monitored for contamination by TFM after treatment of the Falls River and Harlow Creek. No contamination of either water system was found.

Canada

- Treatments were successful in reducing populations of larval sea lamprey and desired concentrations of lampricide were maintained throughout the majority of areas targeted for treatment.
- Annual treatments of the Gravel River were continued in order to reduce recruitment of larval sea lampreys to the lentic population in Mountain Bay.
- Low treatment discharge limited treatment effectiveness in the Neebing/McIntyre Floodway and the Agawa River.
- Drinking water was provided to residents of the Pays Plat First Nation during the treatment of the Pays Plat River.
- Mortality of juvenile lake sturgeon (8 collected) was observed for the first time in the history of lampricide treatments on the Pic River. Protection of this sensitive species will be a prime consideration in planning future treatments.

Table 3. Details on the applications of lampricides to tributaries of Lake Superior, 1997.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM[1,2] kg	Bayluscide[1] kg	Distance treated km
UNITED STATES					
Potato R. (36)	Jun 14	0.1	100	0	24.1
Tahquamenon R. (30)	Jun 27	21.0	1,093	14.3	17.7
Black R. (37)	Jul 12	1.2	72	0	8.0
Brule R. (38)	Jul 16	6.7	821	0	9.7
Harlow Cr. (32)	Aug 23	0.2	31	0	4.8
AuTrain R. (31)	Aug 25	4.2	901	0	14.5
Falls R. (34)	Sep 3	0.8	58	0	1.6
Silver R. (33)	Sep 4	0.7	86	0	8.0
Traverse R. (35)	Sep 7	0.1	33	0	14.5
Total		35.0	3,195	14.3	102.9
CANADA					
Gravel R. (41)	Jul 16	6.6	450	5	16.1
Pays Plat R. (42)	Jul 18	3.8	238	0	8.6
McIntyre R. (40)	Aug 13	0.2	32	0	1.8
Kaministiquia R. (39)	Aug 14	27.9	2,712	41.0	65.1
Pic R. (43)	Sep 5	9.4	1,877	29.0	101.7
Agawa R.[3] (44)	Sep 19	—[3]	9	0	—
Total		47.9	5,318	75	193.3
Grand Total		82.9	8,513	89.3	296.2

[1]Lampricides are in kg of active ingredient.
[2]Includes a total of 143 TFM bars (26.7 kg active ingredient) applied in 9 streams.
[3]Lentic areas were hand sprayed with lampricide

Lake Michigan

Tributary Information

- 511 tributaries to Lake Michigan.
- 121 tributaries have larval sea lamprey production records.
- 65 tributaries have been treated with lampricide at least once during 1988-97.
- Of these, 33 tributaries are treated on a 3-5 year cycle.

Table 4 and Fig. 7 detail the application of lampricides to 15 tributaries of Lake Michigan in 1997. The following statements highlight the treatment program.

- Minimum lethal concentrations were maintained on all treatments.
- Good Harbor Creek (Leelanau County) was treated for the first time since 1980. Treatment of Porter Creek was deferred due to lack of sea lamprey larvae.
- The use of TFM in the Paw Paw River treatment was reduced by 56% from 1992 applications. Savings of TFM resulted from the use of Bayluscide wettable powder and from timing the convergence of treatments in Mill Creek and the mainstream.

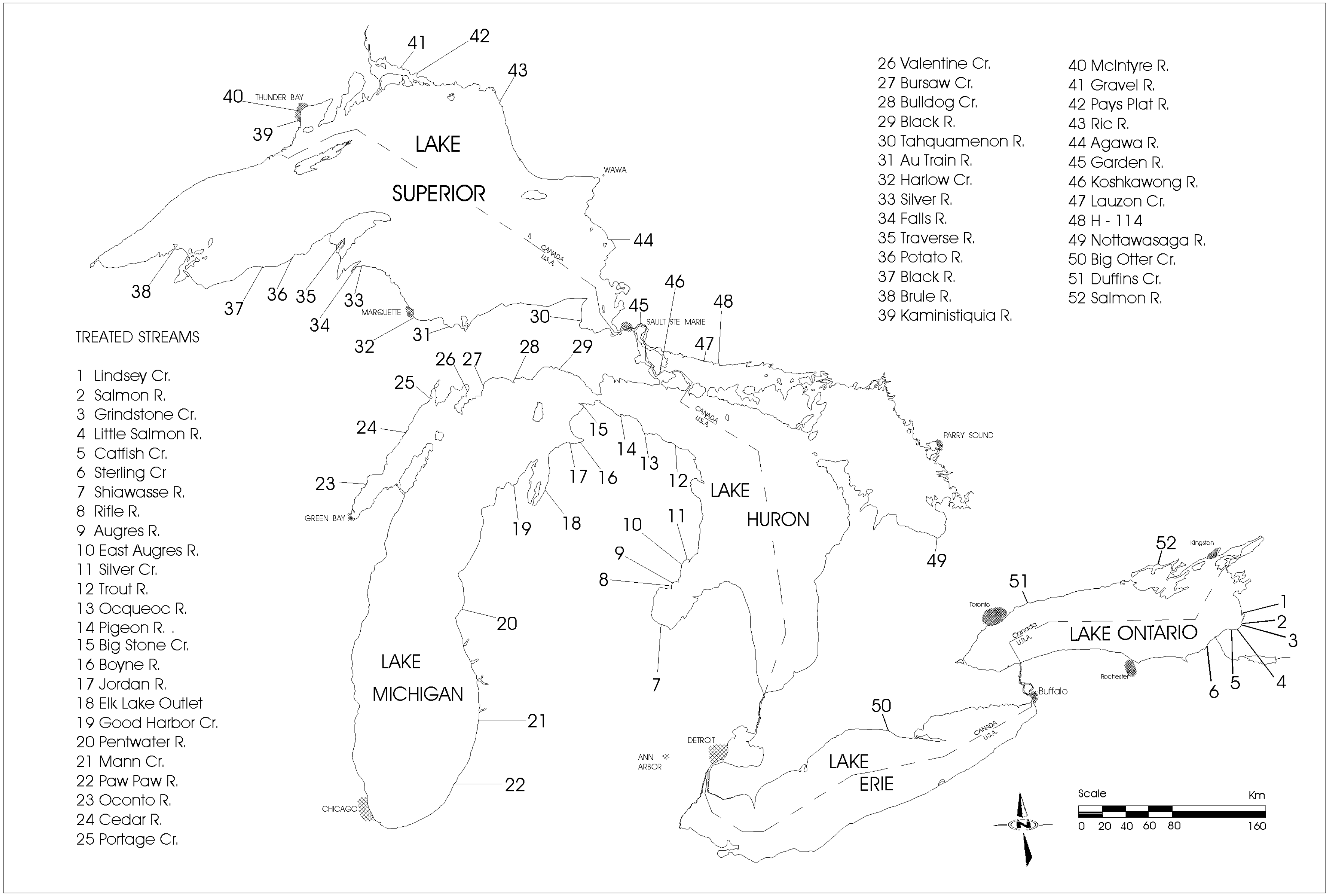

Fig. 7. Location of tributaries treated with lampricides in 1997.

Table 4. Details on the application of lampricides to tributaries of Lake Michigan, 1997.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM[1,2] kg	Bayluscide[1] kg	Distance treated km
Big Stone Cr. (15)	May 1	0.5	54	0	1.6
Good Harbor Cr. (19)	May 16	1.8	378	0	4.8
Cedar R. (24)	May 17	14.2	3,118	0	72.4
Elk Lake Outlet (18)	May 19	1.5	372	0	0.4
Bursaw Cr. (27)	May 30	0.3	29	0	4.8
Portage Cr. (25)	May 31	0.5	39	0	9.7
Paw Paw R. (22)	May 31	11.9	2,198	11.0	141.6
Valentine Cr. (26)	Jun 1	0.2	15	0	4.8
Bulldog Cr. (28)	Jun 3	0.1	20	0	1.6
Pentwater R. (20)	Jul 13	1.8	376	0	21.7
Mann Cr. (21)	Aug 9	0.1	22	0	1.6
Black R. (29)	Aug 10	1.3	273	0	30.6
Jordan R. (17)	Aug 25	6.0	1,264	8.6	24.1
Boyne R. (16)	Sep 6	2.2	393	3.8	6.4
Oconto R. (23)	Sep 22	12.5	1,863	23.2	17.7
Total		54.9	10,414	46.6	343.8

[1]Lampricides are in kg of active ingredient.
[2]Includes a total of 318 TFM bars (62.0 kg active ingredient) applied in 5 streams.

Lake Huron

Tributary Information

- 1,761 (427 United States, 1,334 Canada) tributaries to Lake Huron.
- 116 (62 United States, 54 Canada) tributaries have larval sea lamprey production records.
- 68 (32 United States, 36 Canada) tributaries have been treated with lampricide at least once during 1988-97.
- Of these, 47 (23 United States, 24 Canada) tributaries are treated on a 3-5 year cycle.

Table 5 and Fig. 7 detail the application of lampricides to 13 tributaries of Lake Huron (8 United States and 5 Canadian) in 1997. The following statements highlight the treatment program.

United States

- Treatments were completed on all scheduled streams. Minimum lethal concentrations were maintained throughout all treatments.
- Mortality of nontarget fish occurred in a previously untreated reach of the Shiawassee River. The mortality was caused by an unexpected drop in pH of the stream water.
- A new liquid formulation of Bayluscide, Bay EC 20, was tested during the treatment of Silver Creek, a tributary of the Tawas River. Two methods of application were used. For nine hours,

separate applications of TFM and Bayluscide were tested and judged successful. This was followed by a four hour application of a mixture of TFM and the liquid Bayluscide. This mixture was incompatible and the Bayluscide concentrations could not be quantified.

- Control agents from Ludington, Marquette, and Sault Ste. Marie cooperated in the treatment of the Rifle River. The effort reduced treatment time from 28 to 8 days and saved an estimated $100,000 in lampricide costs.

Canada

- All treatments were successful in reducing populations of larval sea lamprey; desired concentrations of lampricide were maintained throughout targeted areas in all streams treated.

- Mortality of non-target fishes was insignificant in all treatments.

- Treatments of the Naiscoot River and Brown's Creek were deferred due to low discharge. These streams will be treated in 1998.

Table 5. Details on the application of lampricides to tributaries of Lake Huron, 1997.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM[1,2] kg	Bayluscide[1] kg	Distance treated km
UNITED STATES					
Augres R. (9)	May 4	5.2	939	0	64.4
E. Augres R. (10)	May 6	4.1	646	0	20.9
Trout R. (12)	May 6	2.7	809	0	16.0
Shiawassee R. (7)	Jun 28	7.5	3,190	0	73.5
Rifle R. (8)	Jul 26	6.2	2,143	9.5	177.0
Silver Cr. (11)	Aug 11	0.8	160	1.2[3]	19.3
Ocqueoc R. (13)	Sep 19	2.9	749	0	6.1
Pigeon R. (14)	Sep 22	3.7	866	5.1	53.6
Total		33.1	9,502	15.8	430.8
CANADA					
Nottawasaga R. (49)	May 31	13.1	2,246	24.4	61.6
Garden R. (45)	Jul 8	13.3	875	0	74.1
Koshkawong R. (46)	Jul 31	0.2	30	0	1.6
Lauzon Cr. (47)	Sep 18	0.4	12	0	0.4
H-114 (48)	Sep 18	0.1	2	0	1.2
Total		27.1	3,165	24.4	137.9
Grand Total		60.2	12,667	40.2	568.7

[1]Lampricides are in kg of active ingredient.
[2]Includes a total of 160 bars (31.2 kg active ingredient) applied in 2 streams.
[3]Experimental liquid Bayluscide, EC 20, applied in Silver Cr.

Lake Erie

Tributary Information

- 842 (317 United States, 525 Canada) tributaries to Lake Erie.
- 20 (10 United States, 10 Canada) tributaries have larval sea lamprey production records.
- 18 (8 United States, 10 Canada) tributaries have been treated with lampricide at least once during 1986-97.
- Of these, 5 (3 United States, 2 Canada) tributaries are treated on a (3-5 year) cycle.

Table 6 and Fig. 7 detail the application of lampricide to Big Otter Creek in 1997. The following statement highlights the treatment program on Lake Erie.

- Big Otter Creek and a major tributary, Little Otter Creek, were sucessfully treated at an optimum treatment discharge. The apparent scarcity of sea lamprey larvae below the confluence of the main branch and tributary negated the necessity to maintain a minimum lethal lampricide concentration throughout the lower reach of the river and a substantial savings of lampricide was realized.

Table 6. Details on the application of lampricide to one tributary of Lake Erie in 1997.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM[1,2] kg	Bayluscide[1] kg	Distance treated km
Big Otter Cr. (50)	Sep 25	3.6	1,277	-------	55.7

[1]Lampricide is in kg of active ingredient.
[2]Includes a total of 12 TFM bars (2.3 kg active ingredient)

Lake Ontario

Tributary Information

- 659 (254 United States, 405 Canada) tributaries to Lake Ontario.
- 57 (28 United States, 29 Canada) tributaries have larval sea lamprey production records. (All Oswego River tributaries counted as one tributary.)
- 39 (19 United States, 20 Canada) tributaries have been treated with lampricide at least once during 1988-97.
- Of these, 31 (17 United States, 14 Canada) tributaries are treated on a regular (3-5 year) cycle.

Table 7 and Fig. 7 detail the application of lampricide to 8 tributaries of Lake Ontario in 1997. The following statements highlight the treatment program.

- All treatments were successful in reducing populations of larval sea lamprey and desired concentrations of lampricide were maintained throughout targeted areas in all streams treated.

- Treatments of the Salmon River (New York) tributaries (Orwell, Trout, and Beaverdam brooks) were advanced one year to reduce lake recruitment from residual larval populations. Substantial numbers of residuals were observed in Orwell Brook.

- Mortality of non-target fishes appeared to be insignificant in all treatments.

Table 7. Details on the application of lampricides to tributaries of Lake Ontario, 1997.
(Number in parentheses corresponds to location of tributary in Fig. 7)

Stream	Date	Flow m^3/s	TFM[1,2] kg	Bayluscide[1] kg	Distance treated km
UNITED STATES					
Lindsey Cr.(1)	Apr 24	1.4	149	0	19.7
Salmon R. (2)					
Orwell Br.	May 3	3.3	242	0	9.8
Beaverdam Br.	May 4	1.7	68	0	1.2
Trout Br.	May 5	1.9	154	0	16.0
Grindstone Cr.(3)	Apr 27	3.7	241	0	35.6
Little Salmon R.(4)	May 25	2.2	271	0	35.9
Catfish Cr.(5)	May 2	1.8	126	0	1.2
Sterling Cr.(6)	May 23	2.2	436	2.1	7.3
Total		18.2	1,687	2.1	126.7
CANADA					
Duffins Cr.(51)	Jun 21	1.4	618	0	18.1
Salmon R.(52)	Jun 18	5.2	617	7.3	23.0
Total		6.6	1,235	7.3	31.1
Grand Total		24.8	2,922	9.4	157.8

[1]Lampricides are in kg of active ingredient.
[2]Includes a total of 10 TFM bars (2.3 kg active ingredient) applied in 4 streams.

ALTERNATIVE CONTROL

Sterile Male Release Technique

Research on the use of the sterile male release technique (technique) in sea lamprey control began in 1971. The technique has been used experimentally in Lake Superior and the St. Marys River since 1991. Male sea lampreys are captured during their spawning migrations in tributaries to Lakes Superior, Michigan, Huron, and Ontario and transported to the sterilization facility at the Hammond Bay Biological Station. At the facility, lampreys are sterilized with the chemosterilant bisazir, decontaminated, and released into selected tributaries of Lake Superior and into the St. Marys River. Laboratory and field studies have shown that treated male lampreys are sterile, sexually competitive, and the number of larvae that hatch in streams is reduced with the technique.

The Sterile Male Release Technique Task Force was established in 1984 to refine the long-term strategy for application of the technique and to coordinate a large-scale research program for evaluating the technique in Lake Superior and the St. Marys River. The report of progress of the Task Force is presented on page 46.

The following statements highlight the sterile male release program for 1997.

- Male lampreys were collected from assessment traps on 15 Great Lakes tributaries. A total of 27,147 were delivered to the Hammond Bay Biological Station for sterilization and release into 2 target and 8 study streams.

- An enhanced release program was employed on the St. Marys River with a total of 17,181 sterilized male lampreys released during May 7-July 28. This number includes 15,960 sterilized male lampreys that would have been released in Lake Superior tributaries under the release strategy employed during 1991-1996.

- The ratio of sterile to untreated male lampreys achieved in the St. Marys River was estimated to be 5.4:1 (17,181 sterile males released:3,189 estimated number of normal males) with the Schaefer method which was used the past 12 years to estimate population size. There is uncertainty in this estimate because high discharge (1,218 m^3/s) in the river during the spawning run attracted an unusually high number of lampreys toward the open compensating gates. A variance-weighted average of several Petersen estimates from subsets of the total run provided a second population estimate that yielded a ratio of 2.9:1.

- Theoretical reduction in reproduction in the St. Marys River due to sterile male release averaged 23 percent during 1993-1996 and is estimated at 84 percent in 1997 (derived from the traditional Schaefer population estimate). The theoretical reduction in reproduction from sterile male release combined with the number of lampreys removed by traps averaged 55 percent during 1993-1996 and was 89 percent in 1997. An estimate of the theoretical reduction derived from a ratio of 2.9:1 sterile to untreated male lampreys (derived from the second population estimate previously described) resulted in an estimated reduction of 74 percent and a total reduction of 83 percent when combined with trapping.

- Assessment of the technique continued in the second year of a 4-year study which is testing survival of yearling larvae and density dependant factors in 8 tributaries of Lake Superior (U.S. - Middle, Misery, Big Garlic, and Rock rivers; Canada - Carp, Stokely, Wolf, and Big Carp rivers). During June 2-12, untreated male and female lampreys were released into each study stream in proportion to the estimated area of available larval habitat (range 130 to 1,000 each of males and females). In addition, sterile male lampreys were released in 4 of the streams at a ratio of 3:1 sterile to untreated males (range, 390-3,000). Assessments of egg viability and strengths of larval year classes were made in all study streams. Preliminary data are presented in Table 8.

- A total of 1,500 sterilized males were released into the Bad River on June 7. An estimated ratio of 0.8:1 sterile to untreated male lampreys was achieved with a theoretical reduction in progeny of 45 percent.

- More than 30,000 of the 31,000 female lampreys harvested from the 5 largest source streams in the Upper Great Lakes were used in studies or outreach activities. Fewer than 1,000 female lampreys from these sites were destroyed.

- Water effluent from the Sterilization Facility and water from holding tanks that held lampreys following injection were monitored for bisazir contamination. Bisazir was detected only in one tank, at a concentration less than the quantification limit of 25 µg/L.

- Quality assurance testing was conducted to determine the precision of volume of bisazir solution injected into lampreys. The amount of bisazir stock solution injected was measured randomly in about two percent of the injections.

Table 8. Preliminary results of the long-term study including river, number of lampreys released, number of nests observed, percent egg viability, and estimated stream habitat (types I, II, and III). These are provisional data from the second year of a 4-year study and are not conclusive.

River	Spawner Lampreys Released			Number of Nests	Percent Egg Viability	Area of Habitat (m^2)[1]		
	Males		Females			I	II	III
	Sterile	Untreated						
Middle	3,000	1,000	1,000	101	33	8,742	52,226	165,741
Misery[2]	0	700	700	37	69	41,077	163,122	42,370
Big Garlic	0	130	130	37	37	3,402	19,570	16,551
Rock[2]	1,428	476	476	63	28	56,870	43,626	42,428
Carp	390	141	140	41	32	1,298	5,968	64,717
Stokely	0	130	130	69	78	1,878	13,528	46,754
Wolf	0	200	200	28	72	890	24,464	92,722
Big Carp[3]	390	130	130	35	29	1,566	38,181	13,318

[1]The area of each habitat type (I, II, and III) was estimated by multiplying the average width of each habitat type by the total stream length in which the habitat was measured. Type I habitat is preferred by sea lamprey larvae, type II habitat is acceptable though not preferred, and sea lamprey cannot burrow in type III habitat.

[2] The study areas on the Misery and Rock rivers were expanded from the areas studied in 1996 after distribution surveys in 1997 identified additional infested areas.

[3] The Big Carp River sampled in 1997 replaced the Whitefish River which was sampled in 1996.

Barriers

The Commission has expressed a strong commitment to reductions in TFM use through the implementation of alternative lamprey control strategies, including construction of barriers to sea lamprey migration. The 1994 basin-wide barrier plan was revised in 1996. The plan now includes 157 potential projects on 145 Great Lake tributaries.

A total of 57 barrier dams have been constructed or modified to stop sea lampreys on tributaries of the Great Lakes: 13 on Lake Superior, 13 on Lake Michigan, 12 on Lake Huron, 7 on Lake Erie and 12 on Lake Ontario (Fig. 8). The Sea Lamprey Barrier Task Force was established in 1991 to expand the development and use of sea lamprey barriers. The report on progress in 1997 is presented on page 50.

The following statements highlight the barrier projects on each lake.

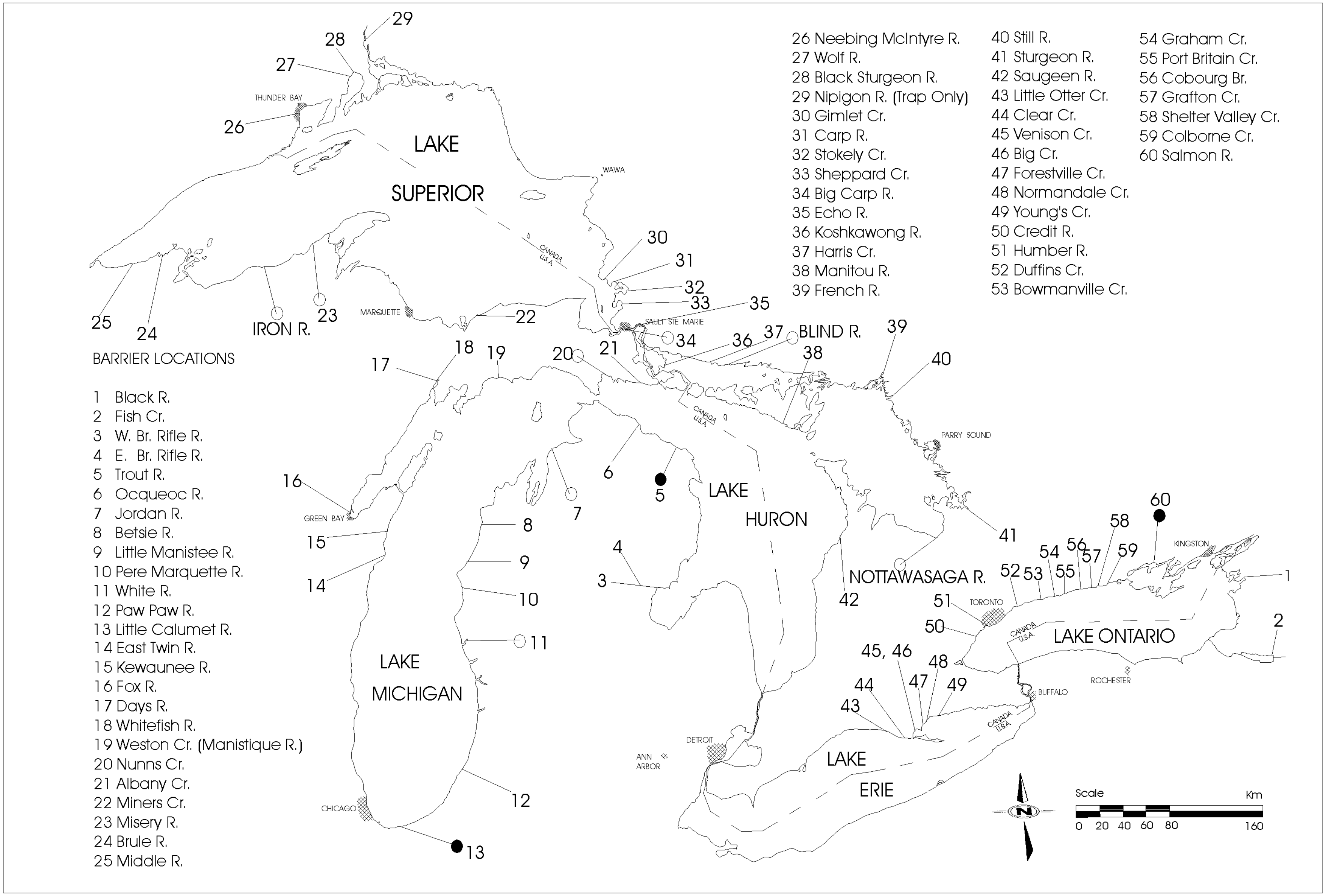

Fig. 8. Location of tributaries with sea lamprey barriers and locations of 1997 construction (●) and improvements/modifications (○).

Lake Superior

- **Iron River, Orienta Dam:** The State of Wisconsin is seeking to remove this dam. The dam will be removed and replaced by a fish and lamprey barrier in 1998, pending a favorable ruling from an administrative law judge.

- **Misery River:** A Michigan DNR Fisheries Division work crew installed a crest addition that raises the height of the barrier by 12". The project will be evaluated by surveys to determine year-class presence and by observation of water level by trapping crews.

- **Nipigon River:** A large double lamprey trap (2.4 x 2.4 x 6m) was fabricated out of steel in Sault Ste. Marie and installed at the Alexander Falls Generating Station in August, 1997. A stainless steel impeller circulates up to 0.29 m^3/s attractant water through two liftable trap baskets.

- **Cash Creek:** Preliminary engineering hydrology and surveying work was carried out in late 1997. Leveloggers were installed in November. The target date for construction of a lamprey barrier has been deferred until 1999 upon completion of fish species assessment.

- **Big Carp River:** Repair work was carried out on vandalized control and temperature lines at the inflatable crest barrier. A data access module and power outage backup were added to the site and the access software was upgraded.

Lake Michigan

- **Jordan River:** New pulsators donated by Smith-Root, Inc. were installed in the electrical barrier. William Swink of the Hammond Bay Biological Station conducted an evaluation of the upgraded electrical weir that showed it to be effective in blocking sea lampreys.

- **Pere Marquette River:** The Michigan Department of Natural Resources (MDNR) and Michigan State University conducted a preliminary study of steelhead movements. Capture methods were improved, transmitters were successfully implanted, and radio-tagged fish were recorded as they passed the barrier site. Construction of the fishway at the electrical weir is slated for summer 1998.

- **White River, Hesperia Dam:** In 1995 and 1996 wooden stopboards were replaced with aluminum boards. The cost of replacement was shared by the MDNR and the Commission, and labor was provided by the Village of Hesperia. The final phase of remedial work was completed in September 1997 with labor and heavy equipment donated by the Village of Hesperia.

- **Paw Paw River:** Hydrology analysis, design work, and real estate arrangements continued for the Paw Paw River barrier project and a draft of the Environmental Assessment has been completed. This project is a partnership with the Commission, the MDNR, and the U.S. Army Corps of Engineers.

- **Little Calumet River:** The Praxair, Inc. lowhead dam near Portage, Indiana was completed in March. Barrier coordinators provided technical input to insure that the dam is a barrier to lampreys. The company twice modified the design at no expense to the Commission.

Lake Huron

- **Nuns Creek:** The dam at the tribal hatchery was improved by removing excess stone fill from the downstream side, closing lifting holes in the sheet piling and welding a steel lip to the crest. The Sault Ste. Marie Tribe of Chippewa Indians provided oversight and labour.

- **Trout River:** The Sportsmans Dam near Rogers City was improved by installing a steel-plate lip on the inclined spillway and installing steel-sheet piling on a washed-out section of the embankment. A permanent trap was installed. The U.S.D.A. Natural Resources Conservation Service provided project management assistance.

- **Nottawasaga River:** The breach at the Nicholston Dam was repaired in February. A lamprey lip has been incorporated in the long term plans for privatized open-flow fishway operation at the dam.

- **Blind River:** Welding repairs were made to a steel lip on an existing dam in the Town of Blind River.

Lake Erie

- **Big Creek:** Tests showed that the Proportional Integral Derivative control system and pressure transducers were working well. However, an air leak appeared at the inflatable lamprey barrier within a week after the crest was raised in April 1997. Since the barrier could not maintain proper crest height, a large beam was installed across the abutments in May and the crest was chained to the beam. However, sea lamprey did get beyond the structure. When crest plates were removed in July the source of the leak was found to be a crushed PVC pipe. All PVC pneumatic supply piping will be replaced by steel pipe in 1998.

Lake Ontario

- **Salmon River:** The mill dam at Shannonville was replaced with a low-head barrier. The project was conducted in partnership with the Tyendinaga Mohawks. The old mill dam was structurally deteriorating enabling the upstream migration of spawning sea lamprey. Three lampricide treatments in the past 10 years had been required over 22.9 km of the river. The new concrete dam is 50 m long and incorporates a built-in lamprey trap. The main crest, at 1.6 m above bedrock, is 70 cm lower than the main crest of the mill dam. We expect the new dam will eliminate TFM treatments on this river.

ASSESSMENT

Larval

Tributaries of the Great Lakes are systematically assessed for abundance and distribution of sea lamprey larvae to determine when and where lampricide treatments are required and the effectiveness of past treatments. Surveys are conducted with backpack electrofishers in waters that are primarily <1 m deep. Waters primarily >1 m in depth are surveyed with deepwater electrofishers or the granular formulation of Bayluscide. Data collected from these surveys are used to estimate the numbers of transforming larvae that will leave individual tributaries the following year and to recommend where lampricides should be applied.

Streams considered for lampricide treatment in 1998 were surveyed in 1997 to estimate larval density and habitat. Survey plots were randomly selected in each stream, catches of larvae corrected for gear efficiency, and lengths of larvae standardized to the end of the growing season. Populations of larvae were estimated by multiplying the mean density of larvae in the plots by the estimated total habitat suitable to larvae in the tributary. A curve for probability of transformation derived from historical data was used to estimate the number of larvae that would transform and leave the stream in 1998. Streams were scheduled for treatment in 1998 based on an estimated cost per kill of transformers.

The GLFC established the Assessment Task Force in 1996 to develop an optimal assessment program through the review of established protocols and the development of new techniques for assessment in the sea lamprey management program. The report of progress of the task force is presented on page 52.

Lake Superior

- Larval surveys were conducted in 45 tributaries (18 U.S., 27 Canada) and offshore of 8 tributaries. The status of larval populations in sea lamprey producing tributaries surveyed within the last ten years is presented in Table 9.

- The larval population in the Pic River (Canada) was estimated at 427,873 (15,783 transformers) using a single census mark-recapture technique at the time of the lampricide treatment (Sept 1997). This compares with QAS assessment estimates of 383,878 larvae and 18,188 transformers.

- Assessment of the larval population in Helen Lake (Nipigon River) using the deepwater electrofisher commenced. An estimate of 60,600 sea lamprey larvae was made for the 341 ha. sampled in 1997 which is approximately 40% of the total area infested.

Table 9. Status of Lake Superior tributaries that are known to have larval sea lamprey populations, 1988-97.

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
UNITED STATES				
Waiska R	May-88	1995	No	1993
Pendills Cr.	Sep-88	1996	No	1992
Galloway Cr.	Jun-92	1996	No	1993
Tahquamenon R.	Jun-97	1997	No	None
Betsy R.	Aug-94	1997	Yes	1995
Little Two Hearted R.	Jul-91	1996	No	1992
Two Hearted R.	Oct-95	_[1]		
Sucker R.-Entire	Jul-94	1997	Yes	1994
Lower	Oct-96	1997	Yes	1996
Sable Cr.	Sep-89	1995	No	None
Miners R.	Aug-92	1997	Yes	1993
Furnace Cr.	Aug-93	1996	No	1994
Fivemile Cr.	Aug-81	1997	No	1992
AuTrain R.				
Upper R. + Tribs.	Aug-96	_[1]		
Lower R.	Aug-97	_[1]		
Rock R.	Jul-90	1997	No	1996
Laughing Whitefish R.	Aug-83	1997	No	1992
Chocolay R.	Aug-94	1997	Yes	1994
Carp R.	Aug-96	_[1]		
Harlow Cr.	Aug-97	_[1]		
Little Garlic R.	Jul-96	_[1]		
Big Garlic R.	Jul-93	1995	No	1993
Iron R.	Jul-96	_[1]		
Salmon Trout R.	Jun-95	1997	Yes	1995
Huron R.	Sep-94	1997	Yes	1994
Ravine R.	Aug-87	1997	No	1992
Silver R.	Sep-97	_[1]	_[2]	
Falls R.	Sep-97	_[1]		
Sturgeon R.	Oct-94	1997	Yes	1994
Traprock R.	Aug-63	1997	No	1992
Traverse R.	Sep-97	_[1]		
Salmon Trout R.	Aug-92	1996	No	1992
Misery R.	Sep-93	1995	No	1994
East Sleeping R.	Jun-95	1997	Yes	1995
Firesteel R.	Sep-96	_[1]		
Ontonagon R.	Sep-96	_[1]		
Potato R.	Jun-97	_[1]		

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
Cranberry R.	Oct-96	–[1]		
Bad R.	Sep-95	1997	Yes	1996
Red Cliff Cr.	Jun-94	1997	–[2]	1994
Sand R.	Oct-91	1996	No	None
Brule R.	Jul-97	–[1]		
Poplar R.	Oct-96	–[1]		
Middle R.	Sep-94	–[1]		
Amnicon R.	Oct-94	1997	Yes	1995
Nemadji R. (Black R.)	Jul-97	–[1]		
CANADA				
West Davignon Cr.	May-89	1997	No	None
Little Carp R.	Jun-93	1997	No	1994
Big Carp R.	Jun-93	1997	No	1993
Cranberry Cr.	Jun-90	1997	No	None
Goulais R.	Aug-95	–[1]	–[3]	
Haviland Cr.	Never	1994	N/A	Unknown[3]
Stokely Cr.	Jun-80	1997		1996
Harmony R.	Jun-90	1997	Yes[2]	None
Chippewa R.	Aug-90	1997	No[2]	1991
Batchawana R.	Jul-94	1997	Yes[2]	1994
Carp R.	Jun-94	1997	No[2]	1996
Pancake R.	Jul-93	1997	No[2]	1993
Westman Cr.	Never	1997	N/A	Unkown[3]
Agawa R.	Sep-97	–[1]		
Gargantua R.	Jun-95	–[1]		
Michipicoten R.	Jul-95	1997	Yes	1995
White R.	Sep-88	1997	No	1993
Pic R.	Sep-97	–[1]		
Little Pic R.	Sep-94	1997	No	1995
Prairie R.	Jul-94	1997	No	None
Steel R.	Jul-89	1996	No	1989
Pays Plat R.	Jul-97	–[1]		
Gravel R.	Jul-97	1997	No[2]	1997
Little Gravel R.	Jul-95	1997	No[2]	1995
Cypress R.	Jul-94	1997	Yes[2]	1994
Jackpine R.	Never	1994	N/A	Unkown[3]
Jackfish R.	Jul-96	–[1]		
Upper Nipigon R.	Aug-92	1997	Yes[2]	1992
Lower Nipigon R.	Jul-83	1997	Yes	1983
Cash Cr.	Jul-96	–[1]	–[2]	
Stillwater Cr.	Jul-96	–[1]		
Black Sturgeon R.	Jul-95	1997	Yes	1995
Wolf R.	Jul-94	1997	Yes[2]	1994
Pearl R.	Jul-91	1996	No	1991
MacKenzie	Sep-78	1997	No[2]	Unknown[3]
Current	Never	1994	N/A[2]	Unknown[3]
McIntrye R.	Aug-97	–[1]		
Neebing R.	Jul-94	1997	Yes	1995
Kaministiquia R.	Aug-97	–[1]		
Cloud R.	Jul-94	1996	No	None
Pigeon R.	Jul-94	1996	Yes	1995

[1] Not surveyed since last lampricide treatment.

[2] Stream has a known lentic population.

[3] Larval Sea Lamprey present but unable to determine age of older cohorts.

Lake Michigan

- Larval surveys were conducted in 44 tributaries and offshore of 4 tributaries. The status of larval populations in sea lamprey producing tributaries surveyed within the last ten years is presented in Table 10.

Table 10. Status of Lake Michigan tributaries that are known to have larval sea lamprey populations, 1988-97.

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
<u>UNITED STATES</u>				
Brevort R.	May-89	1997	No	1991
Paquin Cr.	Oct-87	1996	No	1993
Hog Island Cr.	Jun-96	_[1]		
Sucker Cr.[2]	Jun-61	1997		None
Black R.	Jun-96	_[1]		
Mile Cr.[2]	Sep-72	1997		None
Millecoquins R.	Jun-96	_[1]		
Rock R.	Jun-95	1997	No	1996
Cataract R.	Sep-77	1997	No	1991
Hudson Cr.	May-90	1997	No	1990
Swan Cr.	Jul-92	1996	No	None
Milakokia R.	Jun-94	1997	Yes	1994
Bulldog Cr.	Jun-97	_[1]		
Gulliver Lake Outlet	Aug-88	1997	No	1993
Marblehead Cr.	Jun-96	_[1]		
Manistique R.	Aug-89	1996	No	1992
Johnson Cr.[2]	Aug-81	1997		1995
Deadhorse Cr.	May-91	1997	No	1992
Bursaw Cr.	May-97	_[1]		
Parent Cr.	Jun-91	1997	No	1994
Poodle Pete Cr.	Jun-91	1997	No	1991
Valentine Cr.	Jun-97	_[1]		
Little Fishdam R.	Jul-92	1997	No	1996
Big Fishdam R.	May-95	1997	No	1995
Sturgeon R.	May-94	1997	Yes	1994
Ogontz R.	Oct-96	_[1]		
Whitefish R.	Aug-95	1997	Yes	1995
Rapid R.	Jun-95	1997	Yes	1995
Tacoosh R.	Oct-96	_[1]		
Days R.	Jun-94	1997	_[3]	1994
Portage Cr.	Jun-97	_[1]		
Ford R.	Jun-96	_[1]		
Bark R.	Oct-92	1995	No	None
Cedar R.	May-97	_[1]		
Sugar Cr.[2]	Aug-77	1997		None
Arthur Bay Cr.[2]	Apr-70	1997		1996
Bailey Cr.	Sep-93	1997	No	1994
Beattie Cr.	Jun-88	1997	No	1993

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
Springer Cr.[2]	Aug-77	1997		1993
Peshtigo R.	Aug-96	–[1]		
Oconto R.	Sep-97	–[1]		
Pensaukee R.[2]	Nov-77	1997		None
Hibbards Cr.	May-95	1997	Yes	1995
Whitefish Bay Cr.[2]	May-87	1997		
Kewaunee R.[2]	May-75	1997		1996
East Twin R.	May-95	1997	No	1995
Carp Lake R.	Sep-94	1997	No	None
Big Stone Cr.	May-97	–[1]		
Big Sucker Cr.	May-89	1997	No	1989
Wycamp Lake O.	Sep-88	1996	No	1994
Horton Cr.	Sep-93	1997	[3]	1994
Boyne R.	Sep-97	–[1]	[3]	
Jordan R.	Aug-97	–[1]		
Elk Lake O.	May-97	–[1]		
Mitchell Cr.	Jun-94	1997	No	1994
Boardman R.				
Hospital Cr.	Aug-96	–[1]		
Lower	Aug-96	–[1]	[3]	
Goodharbor Cr.	May-97	–[1]		
Platte R.	Sep-96	–[1]		
Betsie R.	Jun-95	1995	No	1995
Big Manistee R.	Aug-94	1997	Yes	1994
Little Manistee R.	Jul-94	1997	Yes	1994
Gurney Cr.	Sep-93	1997	Yes	1994
Lincoln R.	Jun-94	1997	Yes	1994
Pere Marquette R.	Aug-95	1995	Yes	
Pentwater R.	Jul-97	–[1]		
Grand R.				
Crockery Cr.	Sep-91	1995	No	1992
Sand Cr.	Sep-96	1996	Yes	
Kalamazoo R.				
Bear Cr.	May-92	1997	No	1993
Sand Cr.	May-92	1995	Yes	None
Mann Cr.	Aug-97	–[1]		
Swan Cr.[2]	Jul-77	1997		None
Black R.	Aug-97	–[1]		
Brandywine Cr.[2]	Jun-85	1997		1994
Rogers Cr.[2]	Jul-77	1997		
St. Joseph R.				
Paw Paw R.	Jun-97	–[1]		
Mill Cr.	Jun-97	–[1]		
Brandywine Cr.	Jun-97	–[1]		
Brush Cr.	Jun-97	–[1]		
Blue Cr.	Jun-88	1995	No	1991
Pipestone Cr.	Jun-88	1995	No	None

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
Galien R.	Jun-93	1997	No	1993
Trail Cr.	May-92	1995	Yes	None
Burns Ditch	Jun-93	1995	Yes	None

[1]Not surveyed since last lampricide treatment.
[2]Not treated in last 10 years but larval surveys were conducted in 1997.
[3]Stream has a known lentic population.

Lake Huron

- Larval surveys were conducted in 55 tributaries (27 U.S., 28 Canada). The status of larval populations in sea lamprey producing tributaries surveyed within the last ten years is presented in Table 11.

Table 11. Status of Lake Huron tributaries that are known to have larval sea lamprey populations, 1988-97.

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
UNITED STATES				
Little Munuscong R.	May-95	_[1]		
Munuscong R.	May-96	1997	Yes	
Canoe Lake Outlet	May-70	1997	No	None
Caribou Cr.	May-91	1997	No	1995
Bear Lake Outlet	Jun-77	1997	No	None
Joe Straw Cr.	May-75	1997	No	1994
Albany Cr.	May-94	1997	Yes	1994
Trout Cr.	May-94	1997	Yes	1995
Beavertail Cr.	May-96	_[1]		
Prentiss Cr.	Oct-93	1996	Yes	Unkown[3]
McKay Cr.	May-95	1997	No	1995
Flowers Cr.	Sep-91	1995	No	1993
Ceville Cr.	May-94	1997	No	1996
Hessel Cr.	May-91	1997	No	Unknown[3]
Nunns Cr.	May-96	1996	No	None
Pine R.	Jun-93	1997	_[2]	1993
Martineau Cr.	Oct-93	1997	No	None
Cheboygan R.				
Maple R.	Aug-92	1997	No	1993
Pigeon R.	Sep-97	_[1]		
Sturgeon R.	Aug-94	1997	No	1995
Laperell Cr.	May-89	1996	No	1994
Meyers Cr.	May-89	1994	No	1993
Little Pigeon R.	Oct-88	1997	No	1994
Elliot Cr.	May-96	1997	Yes	1996
Greene Cr.	May-96	_[1]		
Mulligan Cr.	May-94	1995	Yes	None
Ocqueoc R.				
Lower	Sep-97	_[1]		
Upper	Sep-94	1997	Yes	1995
Schmidt Cr.	Aug-93	1997	Yes	1994
Trout R.	May-97	_[1]		
Swan R.	May-96	_[1]		

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
Grand Lake Outlet	Never treated	1996	N/A	Unknown[3]
Devils R.	May-95	–[1]		
Black R.	May-94	1997	Yes	1994
Au Sable R.	Jun-95	1997	Yes	1995
Pine R.	Jun-87	1997	No	None
Tawas Lake Outlet	Jul-96	–[1]		
Silver Cr.	Aug-97	1997	Yes	None
Cold Cr.	Jul-96	–[1]		
East Au Gres R.	May-97	–[1]		
Au Gres R.	May-97	–[1]		
Hope Cr.	Jul-96	–[1]		
Pine R.	Oct-88	1997	No	1989
Big Salt Cr.	May-96	–[1]		
Carroll Cr.	May-88	1997	No	1990
Rifle R.	Jul-97	–[1]		
Saginaw R.				
Shiawassee R.	Jun-97	–[1]		
Chippewa R.	Sep-95	1997	Yes	1996
Big Salt R.	May-93	1997	No	1993
Bluff Cr.	Oct-85	1997	No	Unknown[3]
Pine R.	Apr-88	1994	No	None
CANADA				
Root R.	Sep-95	1997	Yes	1996
Garden R.	Jul-97	–[1]		
Echo R.				
Upper EchoR.	Jul-94	1997	Yes[2]	1994
Bar Cr.	Jun-94	1997	Yes	1994
Sucker Cr.	Jul-95	1997	Yes[2]	1996
Twotree R.	May-90	1996	No	1993
Richardson Cr.	Aug-96	–[1]		
Watson Cr.	Jun-94	1997	No[2]	1994
Gordon Cr.	Oct-96	–[1]	–[2]	
Brown's Cr.	Sep-92	1997	Yes[2]	1993
Koshkawong R.	Jul-97	–[1]		
Unnamed (H-68)	Sep-75	1995	No[2]	pre 1990
Thessalon R.				
Upper Thessalon R.	Sep-91	1997	Yes	1992
Middle Thessalon R.	Aug-90	1997	No	None
Lower Thessalon R.	Jul-96	–[1]		
Livingstone Cr.	Aug-94	1997	No	1995
Mississagi R.				
Mississagi R. (main)	Aug-95	1997	No[2]	1996
Pickerel Cr.	Never treated	1997	N/A	1994
Blind R.	May-84	1997	No	Unknown[3]
Lauzon R.	Sep-97	–[1]		
Spragge Cr.	Oct-95	1997	Yes	1996
Unnamed (H-114)	Sep-97	–[1]		
Serpent R.				
Serpent R. (main)	Jul-93	1997	No[2]	1993
Grassy Cr.	Jun-96	1997	Yes	1996?
Spanish R.	Aug-94	1997	Yes	1994
Kagawong R.	Aug-67	1997	No[2]	Unknown[3]

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
Silver Cr.	May-94	1996	Yes	none
Sand Cr.	Oct-94	1996	Yes	1995
Mindemoya R.	Jun-93	1997	Yes[2]	1993
Timber Bay Cr.	Jun-93	1997	Yes	1993
Manitou R.	May-94	1997	No[2]	1994
Blue Jay Cr.	May-94	1997	Yes[2]	1994
Chikanishing R.	Jun-95	1996	Yes	None
French R.				
Main	Never	1992	N/A	Unknown[3]
French (O.V. Chan)	Jun-92	1997	No	1992
French(Wanapitei)R.	Aug-94	1997	Yes	1995
Still R.	Jun-96	[1]		
Magnetawan R.	Jul-93	1997	Yes[2]	1993
Naiscoot R.	Jun-93	1997	No	1993
Shebeshekong R.	None	1997	N/A	Unknown[3]
Boyne R.	Jun-95	1997	No	1995
Musquash R.	Aug-96	1996	Yes	
Sturgeon R.	Jun-95	1996	No[2]	1995
Nottawasaga R.				
Main Nottawasaga.	Jun-97	[1]		
Boyne R.	Jun-97	[1]		
Bear Cr.	Jun-97	[1]		
Pine R	Aug-96	1996	Yes	
Beaver R.	Never	1995	N/A	Unknown[3]
Sauble R.	Jun-96	[1]		
Saugeen R.	Jun-71	1997	No	Unknown[3]

[1] Not surveyed since last lampricide treatment.
[2] Stream has a known lentic population.
[3] Larval sea lamprey present but unable to determine age of older cohorts.

Lake Erie

- Larval surveys were conducted in 6 tributaries (4 U.S., 2 Canada). The status of larval populations in sea lamprey producing tributaries surveyed within the last ten years is presented in Table 12.

Table 12. Status of Lake Erie tributaries that are known to have larval sea lamprey populations, 1988-97.

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
UNITED STATES				
Cattaraugus Cr.	Oct-94	1997	No	1995
Crooked Cr.	Oct-90	1997	No	1991
Conneaut Cr.	Oct-95	1997	Yes	1996
Grand River.	Apr-87	1997	No	
CANADA				
Big Otter Creek	Sep-97	1997	[1]	
Big Creek	Jun-96	1997	No	1996

[1] Not surveyed since last lampricide treatment.

Lake Ontario

- Larval surveys were conducted in 34 tributaries (14 U.S., 20 Canada). The status of larval populations in sea lamprey producing tributaries surveyed within the last ten years is presented in Table 13.

- The Department and Service conducted a Petersen mark and recapture in the Black River, New York, using a new formulation of granular Bayluscide. We estimated 55,280 larvae and 530 transforming sea lamprey in the river. We collected 8% of marked lamprey released into the study plots. This efficiency rate is similar to past estimates derived from mark and recapture experiments using Bayluscide.

Table 13. Status of Lake Ontario tributaries that are known to have larval sea lamprey populations, 1988-97.

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
UNITED STATES				
Black R	Jun-91	1997	No	1995
South Sandy Cr.	May-96	_[1]		
Skinner Cr.	May-93	1997	No	1995
Lindsey Cr.	Apr-97	_[1]		
Little Sandy Cr.	May-95	1997	Yes	1995
Deer Cr.	May-95	1997	Yes	1996
Salmon R.	May-95	1997	Yes	1995
Salmon R. tributaries	May-97	_[1]		
Grindstone Cr.	May-97	1996		
Snake Cr.	May-95	1997	No	1996
Little Salmon R.	May-97	_[1]		
Catfish Cr.	May-97	_[1]		
Oswego R. System				
Big Bay Cr.	Sept-93	1997	No	None
Fish Cr.	Jun-95	1997	Yes	1995
Carpenters Br.	May-94	1996	No	None
Putnam Br.	May-96	_[1]		
Ninemile Cr.	Jun-95	1997	No	1995
Sterling Cr.	May-97	_[1]		
Red Cr.	Apr-94	1996	No	None
Sodus Cr.	May-95	1997	No	1995
First Cr.	May-95	1996	No	None
Salmon Cr.	May-96	1996	Yes	1996
Oak Orchard Cr.	May-88	1997	No	None
CANADA				
Bronte Cr.	Jun-95	1997	No	1995
Credit R.	Jun-96	1997	No	1996
Rouge R.	May-94	1997	No	1995
Duffins Cr.	Oct-97	_[1]		
Lynde Cr.	Sept-95	1996	No	1996
Oshawa Cr.	Oct-96	_[1]		
Farewell Cr.	Sept-95	1996	No	1996

Stream	Last Treated	Last Surveyed	Residuals Found (Yes/No)	Oldest Untreated Year-Class
Bowmanville Cr.	Jun-95	1997	No	1995
Wilmot Cr.	Oct-96	_[1]		
Graham Cr.	May-96	1997	No	None
Port Britain Cr.	Sept-96	1997	No	None
Cobourg Cr.	Sept-96	_[1]		
Covert Cr.	Apr-94	1997	No	1994
Grafton Cr.	Sept-96	1997	No	None
Shelter Valley Cr.	Sept-96	1997	No	None
Colborne Cr.	Jun-95	1997	No	1995
Salem Cr.	Sept-94	1997	No	1995
Proctors Cr.	Jun-95	1997	No	1995
Mayhew Cr.	Oct-96	1997	Yes	1997
Salmon R.	Jun-97	1997	Yes	1997

_[1] Not surveyed since last lampricide treatment.

Spawning-Phase

Mechanical traps are used to monitor spawning migrations of sea lampreys in spring and early summer. Traps are either portable (rectangular steel and/or aluminum mesh, hoop or fyke nets) or permanent (generally concrete or steel plate) and usually are associated with a physical or electrical barrier. Trap catch of sea lampreys is a measure of relative abundance. Biological characteristics (sex, weight, and length) are recorded from lampreys removed from streams with significantly large collections and not used in the SMRT program.

Mark and recapture studies are conducted in most streams to estimate the spawning population for the year. Lake estimates for the south shore are computed based on a regression relation between stream discharge and the estimated number of adult lampreys that enter tributaries.

Lake Superior

- 6,728 sea lampreys were trapped in 21 tributaries (Table 14, Fig. 9).

- The estimated population of spawning-phase sea lampreys for the south shore of Lake Superior was 29,234 [21,147 west ($y=62.60$; $r^2=.72$, $P<0.10$) and 8,087 east ($y=19.12$; $r^2=.94$, $P<0.002$) of the Keweenaw Peninsula; Table 15].

- Spawning runs were monitored through cooperative agreements with the Great Lakes Indian Fish and Wildlife Commission (Amnicon, Middle, Bad, Firesteel, Misery, Falls, Silver, and Huron rivers), the Wisconsin Department of Natural Resources (Brule River), and the National Park Service, Pictured Rocks National Lakeshore (Miners River).

- Spawning populations in the U.S. waters of eastern Lake Superior remained stable, while spawning populations in western Lake Superior have increased in the past two years (Fig. 2).

Table 14. Stream, number, estimated population, trap efficiency and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Superior, 1997.
(Number in parentheses corresponds to location of stream in Fig. 9)

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
UNITED STATES									
Tahquamenon R. (30)	434	1,570	28	120	58	421	424	166	181
Betsy R. (31)	270	416	65	144	50	418	424	172	185
Big Garlic R. (34)	53	228	23	8	87	434	430	181	154
Iron R. (35)	0	-	-	0	-	-	-	-	-
Miners R. (32)	10	40	25	1	100	421	-	158	-
Rock R. (33)	1,308	2,658	50	672	34	410	413	154	159
Huron R. (36)	18	-	-	2	50	396	395	160	215
Silver R. (37)	42	145	29	2	50	414	455	200	238
Falls R. (38)	3	-	-	0	-	-	-	-	-
Misery R. (39)	1,090	2,881	38	732	38	426	423	188	188
Firesteel R. (40)	37	-	82	2	50	420	381	176	170
Bad R. (41)	269	4,442	6	40	25	428	414	185	177
Brule R. (42)	2,097	3,016	69	0	-	-	-	-	-
Middle R. (43)	48	121	40	4	50	443	391	185	168
Amnicon R. (44)	81	571	14	16	37	404	391	176	158
Total or Mean (South Shore)	5,760			1,743	30	419	418	172	175
CANADA									
McIntyre R. (45)	211	436	48	0	-	-	-	-	-
Wolf R. (46)	266	-	-	0	-	-	-	-	-
Pancake R. (47)	21	90	23	0	-	-	-	-	-
Carp R. (48)	161	227	71	0	-	-	-	-	-
Stokely Cr. (49)	8	-	-	0	-	-	-	-	-
Big Carp R. (50)	301	459	66	0	53	-	-	-	-
Total or Mean (North Shore)	968			0	53				
Total for Lake Superior	6,728			1,743	-	-	-	-	-
Mean for Lake Superior					33	419	418	172	175

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

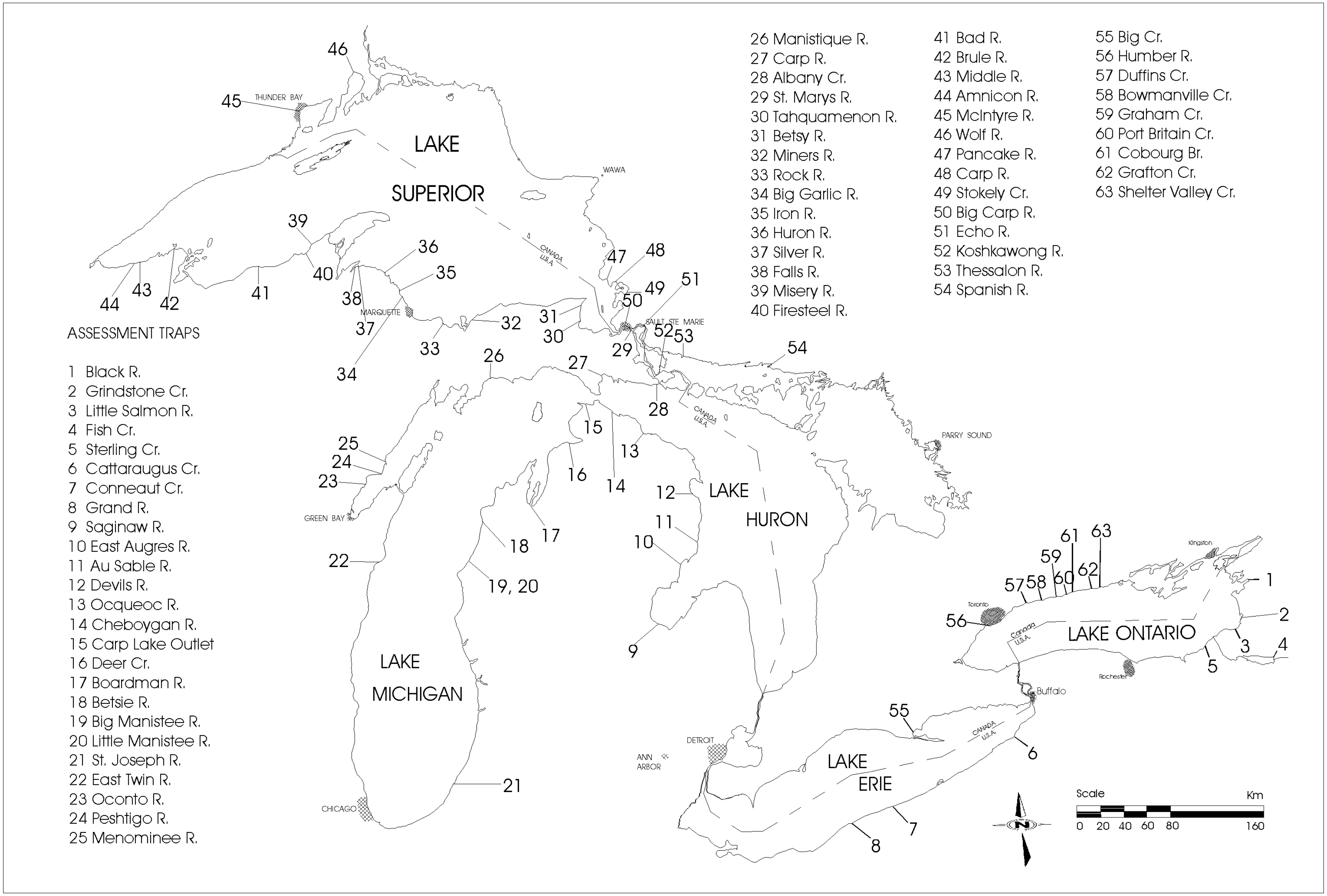

Fig. 9. Location of tributaries where assessment traps were operated in 1997.

Table 15. Spring discharge for U.S. streams east and west of Keweenaw Bay in Lake Superior, ranked as primary[1] and secondary[2] producers of sea lampreys, and the estimated number of spawning-phase sea lampreys in 1997.

[Population estimates were calculated from stratified multiple mark/recapture studies, linear regressions relating past years trap catch to mark/recapture estimates, or trap efficiencies from mark/recapture studies conducted from 1986-93 in 9 of 15 streams with traps. Simple linear regressions estimate populations for all streams by the relation of drainage area to the number of lampreys entering the 11 tributaries.]

Primary Streams[1]				Secondary Streams[2]		
	Discharge	Population Estimate			Discharge	Population Estimate
Stream	m^3/s	Mark/Recapture	Regression	Stream	m^3/s	Regression
EAST				**EAST**		
Tahquamenon R.	83.66	1,570	1,600	Waiska R.	14.79	28
Betsy R.	10.11	416	193	Pendills Cr	1.51	3
Little Two Hearted R.	5.22		100	Galloway Cr.	0.74	1
Two Hearted R.	22.83		437	Sable Cr.	1.55	3
Sucker R.	12.60		241	Sullivans Cr.	0.45	1
Miners R.	2.95	40	56	Beaver Lake Outlet	1.26	2
Furnace Cr.	1.39		27	Sand R. (Alger Co.)	2.51	5
Au Train R.	8.50		163	Carp R. (Marquette Co.)	5.94	11
Rock R.[3]	3.83	2,658	2,658	Little Garlic R.	1.72	3
Chocolay R.	16.09		308	Pine R. (Marquette Co.)	4.39	8
Harlow Cr.	1.82		35	Ravine R.	3.26	6
Big Garlic R.	1.73	228	33	Slate R.	2.03	4
Iron R. (Marquette Co.)	10.24		196			
Salmon Trout R. (Marquette Co.)	4.83		92			
Huron R	7.08		135			
Silver R.	7.88	145	151			
Falls R.	4.99		95			
Sturgeon R.	70.12		1,341			
Traverse R.	2.52		48			
Salmon Trout R.(Houghton Co.)	5.38		103			
Subtotal (East)	283.77	5,057	8,012	Subtotal (East)	40.15	75
(w/traps)	110.16	5,057	4,691			
(w/o traps)	173.61	0	3,321			
WEST				**WEST**		
Misery R.[3]	4.18	2,881	2,881	Sand R. (Bayfield Co.)	3.79	24
East Sleeping R.	5.00		313			
Firesteel R.	7.95		498			
Ontonagon R.	122.66		7,679			
Potato R.	1.94		122			
Cranberry R.	1.77		111			
Bad R.	77.39	4,442	4,845			
Red Cliff Cr.	0.69		43			
Brule R.	19.58	3,016	1,226			
Middle R	6.94	121	435			
Amnicon R	11.49	571	719			
Nemadji R.	35.96		2,251			
Subtotal (West)	295.55	11,031	21,123	Subtotal (West)	3.79	24
(w/traps)	119.58	11,031	10,106			
(w/o traps)	175.97	0	11,017			
TOTAL SOUTH SHORE POPULATION ESTIMATE:				29,234		

[1] Primary streams are streams that are treated on a regular cycle (≤ once every 5 years).
[2] Secondary streams are streams that are treated on an irregular cycle (> once every 5 years).
[3] The Rock and Misery rivers annually receives a substantial number of spawning sea lampreys, but do not meet the criteria of a primary stream (the rivers have a barrier at the mouth and are not treated). The estimate of spawners in the rivers is an addition to the regression estimate.

Lake Michigan

- 15,572 sea lampreys were trapped in 12 tributaries (Table 16, Fig. 9).

- The estimated population of spawning-phase sea lampreys for Lake Michigan was 74,091 [34,176 east ($y=195.50x$; $r^2=0.97$, $P<0.001$) and 39,915 west ($y=54.87x$; $r^2=0.81$, $P<0.02$); Table 17].

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

- The spawning population remained relatively stable between 1986-97 (Fig. 3).

Table 16. Stream, number, estimated population, trap efficiency, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 1997.
(Number in parentheses corresponds to location of stream in Fig. 9)

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									
Carp Lake Outlet (15)	58	121	48	15	7	430	430	180	185
Deer Cr. (16)	81	216	37	22	45	469	460	265	241
Boardman R. (17)	273	1,145	24	48	46	460	455	217	222
Betsie R. (18)	538	3,469	15	68	62	473	472	248	257
Big Manistee R. (19)	613	7,225	8	32	-	-	-	-	-
Little Manistee R. (20)	67	150	45	19	42	467	482	249	258
St. Joseph R. (21)	18	-	-	2	100	490	-	228	-
East Twin R. (22)	37	84	44	5	60	446	412	192	196
Oconto R. (23)	87	301	29	10	60	493	452	212	206
Peshtigo R. (24)	477	3,626	13	7	88	468	270	198	128
Menominee R. (25)	49	-	-	0	-	-	-	-	-
Manistique R. (26)	13,274	20,276	66	0	46	-	-	-	-
						-	-	-	-
Total	15,572	36,613		228					
Mean for Lake Michigan					38	468	460	231	236

[1]The number of lampreys from which length and weight measurements were determined.
[2] Percent males generally determined from internal body examination of the number sampled. In the Manistique River, 13,274 additional lampreys were examined externally for secondary sexual characteristics to determine percent males.

Table 17. Spring discharge for U.S. streams east and west of Manistique, Michigan - Elberta, Michigan in Lake Michigan, ranked as primary[1] and secondary[2] producers of sea lampreys, and the estimated number of spawning-phase sea lampreys in 1997.

[Population estimates were calculated from stratified multiple mark/recapture studies, linear regressions relating past years trap catch to mark/recapture estimates, or trap efficiencies from mark/recapture studies conducted from 1986-93 in 9 of 15 streams with traps. Simple linear regressions estimate populations for all streams by the relation of mean stream discharge to the number of lampreys entering the 10 tributaries].

Primary Streams[1]			
		Population Estimate	
Stream	Discharge m^3/s	Mark/ Recapture	Regression
EAST			
Hog Island Cr.	0.34		66
Black R.	1.78		348
Millecoquins R.	6.67		1,304
Hudson Cr.	0.17		33
Milakokia R.	4.70		919
Marblehead Cr.	0.46		90
Manistique R.[3]	100.80	20,276	20,276
Carp Lake R.	2.48	121	485
Horton Cr.	0.77		151
Boyne R.	3.03		592
Porter Cr.	1.04		203
Deer Cr.	6.18	216	1,208
Boardman R.	20.30	1,145	3,969
Platte R.	4.00		782
Betsie R.	15.43	3,469	3,017
Subtotal (East)	168.15	25,227	33,443
(w/traps)	145.19	25,227	28,955
(w/o traps)	22.96		4,488
WEST			
Fishdam R.	4.13		227
Sturgeon R.	14.90		818
Ogontz R.	2.03		111
Whitefish R.	17.43		956
Rapid R.	7.71		423
Tacoosh R	1.92		105
Days R.	4.79		263
Ford R.	47.50		2,606
Cedar R.	13.72		753
Peshtigo R.	68.50	3,626	3,759
Oconto R.	48.10	301	2,639
East Twin R.	5.80	84	318
Big Manistee R.	108.38	7,225	5,947
Little Manistee R.	14.10	150	774
Lincoln R.	5.72		314
Pere Marquette R.	44.36		2,434
Pentwater R.	9.92		544
White R.	15.00		823
Muskegon R.	75.50		4,143
Black R. (Van Buren)	15.25		837
St. Joseph R.	145.00		7,956
Galine R.	8.44		463
Burns Ditch	4.02		221
Subtotal (West)	682.22	11,386	37,434
(W/traps)	244.88	11,386	13,437
(W/o traps)	437.34		23,997
Primary Lake Total	36,613		70,877

Secondary Streams[2]		
Stream	Discharge m^3/s	Population Estimate Regression
EAST		
Brevort R.	4.24	83
Paquin Cr.	0.66	13
Rock R.	0.98	19
Crow R.	0.54	11
Bulldog Cr.	0.88	17
Gulliver Lake Outlet	0.34	7
Big Sucker Cr.	0.12	2
Wycamp Lake Outlet	1.05	21
Elk Lake Outlet	27.88	545
Mitchell Cr.	0.75	15
Subtotal (East)	37.44	733
WEST		
Deadhorse Cr	0.20	1
Parent Cr.	0.27	1
Poodle Pete Cr.	0.27	1
Valentine Cr.	0.42	2
Little Fishdam R.	0.69	4
Bark R.	2.54	14
Bailey Cr.	0.10	1
Beattie Cr.	0.29	2
Menominee R.	219.00	1,202
Hibbards Cr.	0.12	1
Fischer Cr.	0.61	3
Gurney Cr.	.70	4
Stoney Cr.	3.45	19
Grand R.	190.00	1,043
Kalamazoo R.	29.40	161
Brandywine Cr.	0.82	4
Trail Cr.	3.20	18
State Cr.	0.01	0
Subtotal (West)	452.09	2,481
Secondary Lake Total	489.53	3,214

TOTAL LAKE MICHIGAN POPULATION ESTIMATE: 74,091

[1]Primary streams are streams with consistent and significant larval production that are treated on a regular cycle ($\leq$ once every five years).
[2]Secondary streams are streams with significant but sporadic larval production that are treated on an irregular cycle (> once every five years).
[3]The Manistique River annually receives a substantial number of spawning sea lampreys, but does not meet the criteria of a primary stream. The river is treated occasionally above and irregularly below a barrier near the mouth. The estimate of spawners in the river is based on a regression of previous mark recapture data. This stream estimate is added to the lake population estimate.

Lake Huron

- 46,486 sea lampreys were trapped at 16 sites in 13 tributaries (Table 18, Fig. 9).
- The estimated population for Lake Huron is 385,034 [365,057 north (y=1340.83x; r^2=.72, P<0.01) and 19,977 south (y=132.73; r^2=.60, P<0.20) of a line from Alpena, Michigan to Espanola, Ontario, Table 19].
- Traps were monitored through cooperative agreements in the Albany River by the Chippewa/Ottawa Treaty Fishery Management Authority and in the Tittabawassee River by Dow Chemical U.S.A.
- Spawning populations in Lake Huron increased significantly between 1986-93, and remained relatively stable from 1994-97 (Fig. 4).

Table 18. Stream, number, estimated population, trap efficiency, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Huron, 1997.
(Number in parentheses corresponds to location of stream in Fig. 9)

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
UNITED STATES									
Saginaw R. (9)									
Tittabawassee R.	3,669	9,740	38	-	-	-	-	-	-
Big Salt R.	55	-	-	56	45	449	463	211	235
Pine R.	296	-	-	315	69	468	461	233	222
Cass R.	26	-	-	0	-	-	-	-	-
East Au Gres R. (10)	63	751	8	4	75	434	452	211	261
Au Sable R. (11)	247	2,119	12	14	71	408	467	206	278
Devils R. (12)	13	-	-	4	50	460	525	183	316
Ocqueoc R. (13)	9,836	15,730	62	0	50	-	-	-	-
Cheboygan R. (14)	22,941	33,937	68	0	49	-	-	-	-
Carp R. (27)	484	703	69	79	-	475	464	225	218
Albany Cr. (28)	150	362	41	59	47	437	442	198	201
St. Marys R. (29)	57	See Canada		0	63	-	-	-	-
Total or Mean	37,837			531	56	461	460	226	222
CANADA									
St Marys R. (29)	2,552	8,162	32	0	56	-	-	-	-
Echo R. (51)	2,045	4,071	50	0	53	-	-	-	-
Koshkawong R. (52)	599	734	82	0	50	-	-	-	-
Thessalon R. (53)	3,451	14,423	24	0	55	-	-	-	
Spanish R. (54)	2	-	-	0	-	-	-	-	-
Total or Mean	8,649			0	54	-	-	-	-
Total for Lake Huron	46,486			531					
Mean for Lake Huron					55	461	460	226	222

[1]The number of lampreys from which all length and weight measurements were determined.
[2]Percent males generally determined from internal body examination of the number sampled, but at six trapping sites where no sampling was conducted, males determined by external examination of lampreys (Ocqueoc – 9,836, Cheboygan – 22,941, St. Marys US - 57, St. Marys Can. – 2,552, Echo/Thessalon combined – 5,496).

Table 19. Mean discharge for Lake Huron streams north and south of a line Alpena, Michigan-Espanola, Ontario ranked as primary[1] and secondary[2] producers of sea lampreys, and the estimated number of spawning-phase sea lampreys in 1997. [Population estimates were calculated from results of stratified multiple mark/recapture studies. A linear regression estimates populations for all streams by the relation of mean stream discharge to the number of adult lampreys entering 11 tributaries.]

Primary Streams[1]

Stream	Discharge m^3/s	Population Estimate: Mark/ Recapture	Population Estimate: Regression
NORTH			
St. Marys[3]	2,122.50	8,162	8,162
L. Munuscong	0.62	-	831
Caribou	0.42	-	563
Albany	0.76	383	1,019
Trout	0.31	-	416
Beavertail	0.68	-	912
McKay	0.51	-	684
Pine	6.34	-	8,501
Carp	8.12	703	10,888
Cheboygan	23.97	33,937	32,140
Elliot	0.42	-	563
Greene	0.17	-	228
Black Mallard	0.28	-	375
Ocqueoc	2.75	15,730	3,687
Schmidt	0.74	-	992
Trout	0.91	-	1,220
Root	2.29	-	3,071
Garden	7.98	-	10,700
Echo	1.61	4,071	2,159
Watson	0.14	-	188
Gordon	0.11	-	147
Browns	0.20	-	268
Koshkawong	0.68	734	912
Thessalon	10.47	14,423	14,038
Mississagi	170.37	-	228,437
Mindemoya	0.96	-	1,287
Timber Bay	0.28	-	375
Subtotal (North)	2,364.59	78,143	332,763
(w/ traps)	2,170.86	78,143	73,005
(w/o traps)	193.73	0	259,758
SOUTH			
Devils	0.71	37	94
AuSable	43.70	2,119	5,800
Tawas	2.21	-	293
Au Gres	5.16	-	685
E. AuGres	2.52	751	334
Rifle	9.68	-	1,285
Tittabawassee	49.38	9,792	6,554
Subtotal (South)	113.36	12,699	15,045
(w/ traps)	96.31	12,699	12,782
(w/o traps)	17.05	0	2,263
Primary Lake Total	2,477.95	90,842	347,808

Secondary Streams[2]

Stream	Discharge m^3/s	Population Estimate Regression
NORTH		
Munuscong	1.44	163
Carlton	0.14	19
Ceville	1.08	145
Hessel	0.20	27
Steels	0.23	31
Nuns	0.62	83
Mulligan	0.40	54
Sucker	0.20	22
Two Tree	0.45	60
Richardson	0.31	42
H-68	0.08	11
Livingstone	0.06	8
Blind	6.34	850
Lauzon	0.37	50
Spragge	0.20	27
Serpent	9.85	1,321
Spanish	215.84	28,940
Silver	0.48	64
Sand	0.28	38
Manitou	1.90	255
Blue Jay	0.59	79
Subtotal (North)	241.06	32,294
SOUTH		
Shiawassee	13.19	175
Cass	13.56	180
Mill	0.06	1
Pine	1.42	19
Chikanishing	0.34	5
French	216.83	2,878
Still	1.75	23
Magnetawan	52.64	699
Naiscoot	1.98	26
Boyne	1.13	15
Musquash	56.60	751
Sturgeon	0.88	12
Nottawasaga	7.78	103
Sauble	3.42	45
Subtotal (South)	371.58	4,932
Secondary Lake Total	612.64	37,226

TOTAL LAKE HURON POPULATION ESTIMATE 385,034

[1]Primary streams are streams with consistent and significant larval production that are treated on a regular cycle (< once every five years).
[2]Secondary streams are streams with significant but sporadic larval production that are treated on an irregular cycle (>once every five years).

[3]The St Marys River annually receives a substantial number of spawning sea lampreys, but does not meet the criteria of a primary stream (the river is not treated). The estimate of spawners in the river is an addition to the regression estimate.

Lake Erie

- 395 sea lampreys were trapped in 4 tributaries (Table 20, Fig. 9).

- The spawning population plunged in 1989-90 in the aftermath of the 1986-87 first round of treatments and has been relatively low from 1991-97, except for 1996 (Fig. 5).

Table 20. Stream, number, estimated population, trap efficiency, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 1997.
(Number in parentheses corresponds to location of stream in Fig. 9)

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
UNITED STATES									
Cattaraugus Cr. (6)	285	1,216	23	55	73	498	479	278	254
Conneaut Cr. (7)	0	-	-	-	-	-	-	-	-
Grand R. (8)	32	-	-	-	-	-	-	-	-
Total or Mean	317	1,216		55	73	498	479	278	254
CANADA									
Big Cr. (55)	78	-	-	0	-	-	-	-	-
Total or Mean	78	-	-	0	-	-	-	-	-
Total for Lake Erie	395			55					
Mean for Lake Erie					73	498	479	278	254

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

Lake Ontario

- 6,317 sea lampreys were trapped at 14 sites in 13 tributaries (Table 21, Fig. 9).

- The estimated population for Lake Ontario is 63,452 [y=591.61; r^2= 0.55, P<0.010 (Table 22)]. The estimate is the result of a cooperative effort between the U.S. Fish and Wildlife Service and the Canadian Department of Fisheries and Oceans and combines the data of both agencies.

- The Lake Ontario spawning population remained relatively stable during 1986 – 1997 (Fig. 6).

Table 21. Stream, number, estimated population, trap efficiency, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 1997.
(Number in parentheses corresponds to location of the stream in Fig. 9)

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. (1)	502	3,170	16	287	69	477	444	252	213
Grindstone Cr. (2)	17	-	-	-	-	-	-	-	-
Little Salmon R. (3)	115	909	13	6	83	473	380	233	160
Fish Cr. (4)	0	-	-	-	-	-	-	-	-
Sterling Cr. (5).	361	3,123	12	20	55	447	484	190	262
Sterling Valley Cr.	47	357	13	2	0	-	455	-	246
Total or Average	1,042			315	68	475	448	249	217
CANADA									
Humber R. (56)	2,551	5,783	44	382	51	459	456	216	223
Duffins Cr. (57)	1,550	2,444	63	287	53	474	461	237	231
Bowmanville Cr. (58)	223	830	27	109	55	457	455	217	213
Graham Cr. (59)	152	229	66	66	44	455	474	214	235
Port Britain Cr. (60)	127	319	40	22	55	436	449	224	218
Cobourg Br. (61)	261	706	37	0					
Grafton Cr. (62)	17	-	-	0					
Shelter Valley Cr. (63)	394	696	57	81	44	484	472	256	254
Total or Average	5,275			947	51	464	460	226	228
Total for Lake Ontario	6,317			1,262					
Mean for Lake Ontario					57	468	456	234	224

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

Table 22. Annual mean discharge for streams for U.S. and Canadian streams in Lake Ontario and the estimated number of spawning-phase sea lampreys in 1997.

Stream	Discharge m^3/s	Population Estimate Mark/ Recapture	Population Estimate Regression	Stream	Discharge m^3/s	Population Estimate Mark/ Recapture	Population Estimate Regression
UNITED STATES				CANADA			
Black R.	116.03	3,170	3,170	Bronte Cr.	3.04		1,799
South Sandy Cr.	7.11		4,206	Credit R.	8.12		4,804
Skinner Cr.	1.56		923	Humber R.	7.00	5,783	4,141
Lindsay Cr.	1.28		757	Rouge R.	2.71		1,603
Little Sandy Cr.	2.01		1,189	Duffin's Cr.	3.13	2,444	1,852
Deer Cr.	1.56		923	Lynde Cr.	1.47		870
Salmon R.	21.61		12,785	Oshawa Cr.	1.43		846
Grindstone Cr.	3.42		2,023	Farewell Cr.	1.05		621
Snake Cr.	0.78		461	Bowmanville Cr.	2.25	830	1,331
Little Salmon R.	5.59	909	3,307	Wilmot Cr.	1.14		674
Catfish Cr.	1.69		1,000	Graham Cr.	0.98	229	580
Nine Mile Cr.	1.22		722	Port Britain Cr.	0.51	319	302
Sterling Cr.	1.75	3,123	1,035	Cobourg Br.	1.68	706	994
Sterling Valley Cr.	1.31	357	775	Covert Cr.	0.21		124
Red Cr.	0.90		532	Grafton Cr.	0.37		219
Sodus Cr.	0.90		532	Shelter Valley Cr.	0.90	696	535
First Cr.	0.15		89	Colborne Cr.	0.52		308
Salmon Cr.	1.60		947	Salem Cr.	0.10		59
				Proctors Cr.	0.35		207
				Salmon R.	10.49		6,206
Subtotal	170.47		35,377	Subtotal	47.45		28,074
(w/traps)	128.10			(w/traps)	16.82		
(w/o traps)	42.37			(w/o traps)	30.63		

TOTAL LAKE ONTARIO POPULATION ESTIMATE: 63,452

Parasitic-Phase

Lake Superior

The Michigan Department of Natural Resources provided data on the frequency of parasitic-phase sea lampreys attached to fish caught by sport charterboats.

- 33 lampreys were collected from 8 management districts; 32 were attached to lake trout and 1 was attached to a chinook salmon.

- Lampreys were attached at a rate of 0.60 per 100 lake trout (n = 5,346) and 2.6 per 100 chinook salmon (n = 39).

Lake Michigan

The Michigan and Wisconsin Department of Natural Resources provided data on the frequency of parasitic-phase sea lampreys attached to fish caught by sport charterboats in 1997.

- 374 sea lampreys were collected from 13 management districts; 295 of the sea lampreys were attached to lake trout and 79 were attached to chinook salmon.

- Lampreys were attached at a rate of 0.8 per 100 lake trout (n = 37,972) and 0.1 per 100 chinook salmon (n = 54,179).

Lake Huron

The Michigan Department of Natural Resources provided data on the frequency of parasitic-phase sea lampreys attached to fish caught by sport charter boats in 1997. Personnel from the Hammond Bay Biological Station and Sea Lamprey Control Centre collected parasitic-phase sea lampreys from nine commercial fisheries.

- 2,158 sea lampreys (United States: 638 from sport and 369 from commercial fisheries; Canada: 1,151 from commercial fisheries) were collected from 11 management districts (6 United States; 5 Canada).

- 162 of the sea lampreys captured in the sport fishery were attached to lake trout and 476 were attached to chinook salmon.

- Lampreys were attached at a rate of 3.0 per 100 lake trout (n = 5,374) and 4.7 per 100 chinook salmon (n = 10,107).

- The population of parasitic-phase sea lampreys in Lake Huron remains excessively high and is a major impediment to lake trout rehabilitation in Lake Huron.

TASK FORCE REPORTS

The Commission 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 1997 are outlined below.

ST. MARYS RIVER CONTROL TASK FORCE

- Task Force (SMRCTF) established January 1992

- Charge is to develop a strategy for sustainable sea lamprey control on the St. Marys River that includes an integrated program of options that minimize costs and environmental impacts, while maximizing suppression of transformer production from the river over the long term.

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

- Meetings held on February 26-28 and September 10-11, 1997

- Progress on the charge in 1997:

Most of the key studies required to make long-term control strategy recommendations were completed in 1996. Some studies, such as additional TFM treatment scenarios and non-target monitoring, were completed and/or refined in 1997. During 1997 the SMRCTF concentrated on analyzing the data from these studies. The SMRCTF provided several possible control options for the St. Marys River at the June 1997 Annual Meeting of the GLFC. The Lake Huron Technical Committee (LHTC) and the Lake Huron Committee (LHC) evaluated the benefits on the Lake Huron fish community of the following control options, against no control at all:

1. Enhanced sterile male release and trapping alone;
2. Sterile male release and trapping alone until the year 2000 when granular Bayluscide spot treatments would start;
3. Sterile male release and trapping with granular Bayluscide spot treatments over a five year rotation;
4. Sterile male release and trapping with only one round of granular Bayluscide treatments.

The LHTC (supported by the LHC) recommended at the GLFC's Interim Meeting in December 1997 that the GLFC proceed with an integrated program of sterile male release, trapping, and granular Bayluscide spot treatments. An adaptive management approach should be used to evaluate the success of these options and the need to continue spot treatments after the first round.

The Committees' evaluation also suggested that implementing granular Bayluscide spot treatments as soon as possible would both hasten the benefits to the fish community and increase the effect on the sea lamprey population.

Bayluscide applications in the first year of the program should be at a start-up level of 200 acres to further evaluate the effectiveness of the spot treatments, to refine the application methods, and to refine the environmental assessment, permitting, and registration requirements. The Committees recommend treating as much of the remaining 1,935 acres as funding allows in 1999 (treating 2,135 acres will kill an estimated 55% of the total larvae in the river). Treating a large area as quickly as possible will increase the abruptness of the effect, which will facilitate statistical detection of that change.

The adaptive management approach includes an optimal program of assessment of all life stages of the sea lamprey population and the status of its prey. The control tactics will be continually modified to deliver the most cost-effective and environmentally safe lamprey suppression program possible. The SMRCTF is currently developing an **assessment plan** that will address all key questions faced in this control plan and evaluate the effects of lampricide applications and the success of the trapping/sterile male release program separately.

Summary of key 1997 St. Marys River activities:

1. Index surveys:

The 13 established index sites were surveyed with deep-water electrofishing gear in 1997 to determine larval densities. Some sites have now been surveyed four times. Considerable variation in catches has occurred. We may already be observing effects of the trapping/sterile male program that has been conducted since 1991. These index sites will be monitored to evaluate the effects of the integrated control measures.

2. Trapping/sterile male release:

Trap catches of sea lamprey spawners were considerably lower than normal. This resulted from the extremely high discharge in the rapids, which in turn was due to opening of the compensating gates in an effort to alleviate high water levels in Lake Superior. The estimated run of spawners was ~8,200, which is significantly less than the long-term average of 20,000. It is likely that many of the sterile male and normal male and female spawners migrated through the rapids to streams in Lake Superior.

In this first year of an enhanced sterile male release program, the Agents stocked ≈ 17,181sterile males for a theoretical sterile to normal ratio of 5.4:1. (See Sterile Male Release report, page 46).

The new Great Lakes Power trap was modified before and during the spawning season in an attempt to improve its performance. To date, modifications have been partially successful, but further modifications are required to prevent escapement and facilitate trap emptying. The new traps at the U.S. Corps of Engineers hydroelectric facility were completed in 1997 and should be ready for operation in the 1998 spawning season.

3. Non-target assessment:

During the course of ongoing ruffe surveys, personnel from the USFWS Alpena office conducted bottom trawling in potential granular Bayluscide treatment areas, in an effort to gain information on populations of non-target species prior to treatments. Few fish were caught and no endangered species were observed.

4. TFM treatment scenarios:

The latest version of the computer flow model was utilized to analyze TFM treatment scenarios, including a full-river treatment. If TFM was applied at more than one site near normal river discharge, the results indicated the north channel would be effectively treated as well as a portion of Lake Nicolet. The most cost effective treatment could achieve a reduction of about 57% of the total number of larvae in the river, but at a cost approaching $12 million. Thus a TFM treatment would be significantly less cost effective than other control options.

The flow model was also utilized to assist in predicting bottom water velocities in potential granular Bayluscide treatment zones.

5. 1998 granular Bayluscide treatment zones:

Three areas, totaling 203 acres, have been selected for treatment in 1998. The areas are all in U.S. waters in upper Lake Nicolet. Three established assessment index sites are included in these plots. These initial treatments will allow the Agents to experience the logistics of large-scale application, in preparation for treatment of approximately 2,000 acres in 1999.

6. Public Information:

The GLFC Secretariat has prepared a fact sheet entitled “International Sea Lamprey Management on the St. Marys River” which describes the adopted control strategy. This publication is available to agencies and the public for general information on the proposed control/assessment strategy.

The Secretariat has also prepared a slide show presentation that will be shown to stakeholder groups throughout the early part of 1998, to inform the public about the control strategy.

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 (current chairperson), Michael Fodale (chairperson during spring meeting), and Dennis Lavis, U.S. Fish and Wildlife Service; Rod McDonald and Rob Young, Department of Fisheries and Oceans, Canada; Gavin Christie and John Heinrich, Great Lakes Fishery Commission Secretariat; Jim Smith (outside expert), Mississippi State University, Delta Research and Extension Center; Charles Bronte (Lake Superior Technical Committee representative) and Roger Bergstedt, U.S. Geological Survey, Biological Resources Division.

- Meetings held on March 5-6 and September 16-17, 1997

- Progress on charges:

  - In 1995 the Commission forwarded to the Sterile Male Release Technique Task Force a list of specific charges organized in three planning groups: Strategic Long-term, Tactical/Operational, and Research. Progress on the charges is described below.

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

- Assessment of the technique continued in the second year of the 4-year study, Long-term evaluation of sterile-male release for control of sea lampreys in the Great Lakes (Long-term evaluation) by Roger Bergstedt.

- A long-range plan of operational activities through FY2000 is detailed in Table 23.

- The Sterile Male Release Technique Task Force reviewed the sequential hypotheses that describe the series of events that must occur in a successful sterile male release program. The research hypotheses addressing the long-term success of the technique are:

  1. Male sea lampreys are successfully sterilized.
  2. Sterilized males reach the spawning grounds and construct nests at the expected ratio of sterilized to resident males.
  3. Sterilized males attract females to nests and mate normally.
  4. Sterility persists through mating and percent survival of embryos at hatch is reduced in individual nests.
  5. Percent survival of embryos at hatch is reduced in individual streams.
  6. The abundance of year classes of burrowed larvae (after leaving the nest) is reduced in individual streams.
  7. Reductions in abundance of larvae persist through the larval life stage and result in reductions in the number of metamorphosing sea lampreys in individual streams.
  8. The number of parasitic-phase sea lampreys in the lake is reduced.
  9. Damage to fish in the lake is reduced.

- Tests of hypothesis 6 continued in the second year of the 4-year study protocol *Long-term evaluation*.

- The Task Force continues to work with the Barrier, Assessment, and St. Marys River Control task forces to refine understanding of the stock recruitment relation and its effects on release strategies.

- The combination of sterile male release, trapping, and granular Bayluscide spot treatments has been identified as the most cost effective control option for the St. Marys River. This option offers the potential to reduce larval populations in the river by 97 percent.

- The Task Force recommended the release of 43,600 sterile male lampreys in the St. Marys River as an optimum number to assure achievement of targeted reductions. This would require the acquisition of an additional 10,000 male lampreys from sources outside the St. Marys River.

- The Task Force is working with the Assessment and St. Marys River Control task forces to develop a plan for assessment of the integrated management plan which includes enhanced sterile male release in the St. Marys River.

Tactical/Operational Planning

- Operational requirements for the technique were projected through FY 2000 in a long-range plan of operational activities (Table 23).

- The Task Force took the following actions to increase the supply of lampreys for sterilization:

  - The Task Force recommended and the Commission approved funding to install a permanent weir on the Carp River and a barrier on the Thessalon River to increase the supply of lampreys available for sterilization by a total of about 2,250 male lampreys.

  - The Task Force is investigating the use of Atlantic origin lampreys for sterilization and release to supplement the technique in the Great Lakes.

  - The Task Force is investigating the use of female lampreys for sterilization and release in the Great Lakes tributaries. Sterile female lampreys have the potential for use in tributaries that do not receive sterilized male lampreys.

- The Hammond Bay Biological Station was issued a new effluent permit for August 1, 1997 through October 1, 2001. The permit stipulates that concentrations of bisazir lower than the detection limit of 25 µg/l are not reportable to the Michigan Department of Environmental Quality. The concentration of bisazir in water effluent has not exceeded this limit during the last seven years of operation.

- The Task Force recommended an operational budget for FY 1998 and FY 2000. The Commission approved the FY 1998 operational budget.

Research Planning

- The hierarchy of hypotheses used to evaluate the success of the sterile male release was reviewed and remains appropriate as stated.

- Areas were identified in which hypotheses for evaluation studies may be developed. Research priorities remain in the following broad areas and development of research continues.

  - Determination of effectiveness of the current application levels in Lake Superior and the St. Marys River.

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

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

- The current research study described in the *Long-term evaluation* may lead into testing of hypothesis 7.

- The Task Force worked closely with the Assessment, Barrier, and St. Marys River Control task forces to understand compensatory mechanisms. The current *Long-term evaluation* tests for density dependant responses with the following parameters: spawner run allocation, reproduction and larval recruitment, and year class survival and growth. The Task Force continues to cooperate in the Jones et al. study on compensatory mechanisms.

- Substantial progress is being made in internal and external research. Research recommendations through FY2000 are listed in the Long-range plan (Table 23).

- Behavior of spawning, male, Atlantic origin lampreys with Great Lakes female lampreys was investigated at the Hammond Bay Biological Station. Results are being analyzed.

- The effect of the early sterilization and release of about 16,000 non-resident male lampreys from lakes Huron and Michigan into the St. Marys River was evaluated. These lampreys were captured in traps throughout the spawning season.

- Tests were contracted in 1995 to define the environmental fate and toxicity of bisazir. The information was required in a review of the Hammond Bay Biological Station effluent permit from the Michigan Department of Natural Resources. A draft report for the contracted study*, Hydrolysis of Bisazir as a function of pH at 25^{o}C* (ABC Laboratories, Inc. 1996) was received in 1997. The hydrolysis study produced a list of suspected degradation products of bisazir. Additional studies will be conducted to identify those products.

- The Task Force provided lampreys and cooperated with external researchers on the following projects:

  - Dr. John Kelso, *Radio-telemetry investigations of the upstream migratory behavior of sea lampreys, including sterilized males*.

  - Dr. Stacia Sower, *Effects of lamprey GnRH-I and III analogs on reproductive process and behavior of male sea lampreys*.

  - Dr. Konrad Dabrowski, *Regulation of function in spermatozoa of the sea lamprey (Petromyzon marinus) - the first step to contraception.*

- The Task Force reviewed external research proposals for relevance to SMRT. The proposals were prioritized in the following order:

  - *Compensatory mechanisms in Great Lakes lamprey populations*, Mike Jones 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*, Dr. Peter Sorenson.

  - *A putative male sea lamprey pheromone: its function, identity, and potential application in sea lamprey control*, Dr. Weiming Li.

  - *Studies on reproductive functions of male sea lamprey in relation to potential targets for population control*, Dabrowski et al. The Task Force was interested in the first objective of the study which dealt with the effects of bisazir on sperm.

- The Task Force made the following recommendations for internal research:

  - Develop a proposal for investigation of the effect of polygamy on a sterile female sea lamprey release technique for FY99.

  - Advance to FY99 funding of a proposal to investigate phenotypic expression in growth of juvenile sea lampreys of Atlantic and Great Lakes origins when held and fed in fresh water.

  - Further planning and research on the use of Atlantic origin lampreys should be focused on resolution of risks until the Commission makes a decision on importation of these lampreys. If the Commission requests further research to define the level of risk, the Task Force asks that it provide guidance on a level of acceptable risk.

Table 23. A long-range plan of operational activities in the Sterile Male Release Program through FY2000.

Activity	FY98	FY99	FY00
Operations			
Trap 15 streams/sterilize 25,000 male sea lampreys	X	X	X
Release sterile male lampreys in St. Marys River	X	X	X
Release 1,500 sterile male lampreys in Bad River	X	X	X
Analyze bisazir in water	X	X	X
Carp River Weir	build	use	use
Bridgeland Creek trap	build	use	use
Purchase bisazir	X		
Assessment			
Release sterile male lampreys in 8 L.S. study streams	X	X[1]	
Continue long-term evaluation	X	X	X[1]
Assess spawning runs in U.S. and Canadian tributaries	X	X	X
Assess year class strength in stream	X	X	X
St. Marys River assessment plan	X	X	X
Internal research			
Analysis of bisazir in tissues	X		
Atlantics - genetic, and disease assessment		X	
Atlantics - trap study/field trial			X
Female lampreys - polygamy		X	
External and Collaborative Research			
GnRh research - Stacia Sower	X		
Lamprey pheromone - Weiming Li	X	X	X
Lamprey pheromone - Peter Sorenson	X	X	X
New industrial Q/A method	X		
Compensatory mechanisms studies -Jones et al.	X	X	

[1]Studies on the Big Carp River started and will conclude one year later than studies on the other seven streams.

SEA LAMPREY BARRIER TASK FORCE

- Task Force established 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 to meeting targets 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 GLFC decision process.

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

- Members are: Dennis Lavis (Chair) and Ellie Koon from U.S. Fish and Wildlife Service; Tom McAuley and Andrew Hallett from Department of Fisheries and Oceans Canada; Bill Swink from U.S. Geological Service, Biological Resources Division, Hammond Bay Biological Station; John Schrouder from Michigan Department of Natural Resources; Les Weigum from U.S. Army Corps of Engineers; Dr. David Noakes from University of Guelph; Dr. Dan Hayes from Michigan State University; John Heinrich and Gavin Christie from Great Lakes Fishery Commission Secretariat.

- Meetings held on: February 19-20 and September 8-9, 1997

Progress on the charge in 1997:

- Developed structure for long-range strategy and submitted 5-year plan.

- Developed evaluation to determine effectiveness of electrical barriers.

- Recommended research direction into a combination low-head and electrical barrier, biological impacts of low-head dams, and compensatory mechanisms in Great Lakes sea lamprey populations.

- Provided oversight to FY 1997 construction program conducted by GLFC Barrier Coordinators. Completed projects include (additional highlights are detailed in the Barrier section found earlier in this report):

  Lake Superior
  - Misery River: Installation of additional 12 inch crest on barrier;
  - Nipigon River: Installation of large double lamprey trap;
  - Big Carp River: Repairs to vandalized control and temperature lines, added a data access module and power outage backup to inflatable crest barrier.

  Lake Michigan
  - Jordan River: New pulsators donated by Smith-Root, Inc. were installed and the electrical barrier effectiveness was tested;
  - White River: Repairs to dam in Hesperia;
  - Little Calumet River: Low head dam construction.

  Lake Huron
  - Nuns Creek: Tribal hatchery dam improvements allow it to function as sea lamprey barrier;
  - Trout River: Sportsmans Dam improved so it now functions as a barrier;
  - Nottawasaga River: Breach at the Nicolston Dam repaired.

  Lake Ontario
  - Salmon River: Low head dam constructed.

- Developed and recommended a FY 1998 barrier program at a level of $680,000. Construction projects are scheduled for the McIntyre River (Lake Superior), Pere Marquette River (Lake Michigan), Greene and Browns creeks and the Ocqueoc River (Lake Huron), and Big Creek (Lake Erie). Planning and design is slated for the Little Salmon River or Grindstone Creek (Lake Ontario) while operational funds are provided for the Jordan River electrical barrier (Lake Michigan) and for the Big Carp River (Lake Superior), and Big Creek, and Cobourg Brook (Lake Erie) fishways.

ASSESSMENT TASK FORCE

- Task Force established April 1996

- Charges:

  - 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, co-ordinating 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 are: Robert Young (Chair), Douglas Cuddy, and Paul Sullivan (Department of Fisheries and Oceans Canada); Michael Fodale, John Heinrich, Katherine Mullet, and Jeffrey Slade (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)

- Meetings held on March 4-5 and September 17-18, 1997

- Progress on charges in 1997:

  - Developed projections of transformer production and submitted TFM treatment recommendations for the 1998 field season to the Program Integration Working Group.

  - Completed review of the Adult Assessment program by external review panel.

  - Revised estimates of backpack electofishing efficiency, larval growth, and the relationship between larval length and transformation rates. The task force worked with Secretariat staff in revising parameter estimates used by the LCSS.

  - Completed scheduled research on the efficiency of deep-water and backpack electrofishers.

  - Initiated a study to help reduce the use of TFM and improve the efficiency of treatments in response to a recommendation from the Lampricide Control Task Force. The results of the study will be used to determine the benefits of maintaining lethal concentrations of TFM in the estuary by evaluating the downstream distribution of larvae.

  - Conducted joint Service and Department training in habitat classification.

LAMPRICIDE CONTROL TASK FORCE

- Task Force established December 1995

- Purposes 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 are Terry Morse (Chair), Dorance Brege, David Johnson, Dennis Lavis, and Alex Gonzalez, U.S. Fish and Wildlife Service; Reginald Goold, Larry Schleen, and Wayne Westman, Department of Fisheries and Oceans, Canada; John Heinrich, Great Lakes Fishery Commission Secretariat; and Terry Bills and Ronald Scholefield, U.S. Geological Survey, Biological Resources Division.

- Meetings held on February 25-26 and September 3-4, 1997

- Progress on lampricide savings options in 1997:

  - Control agents continued to implement options for saving lampricide. Options are progressing which will contribute significantly toward achieving the Commission's Vision goal of a 50 percent reduction in use of TFM by 2001.

  - The Rifle River, a tributary of Lake Huron in lower Michigan, was successfully treated by crews from both the U.S. and Canada. The result of this cooperative effort was a savings of TFM of 1,550 kg (3,415 lbs) active ingredient valued at nearly $100,000. The Manistee River, a tributary of Lake Michigan, is targeted for a similar effort in 1998.

  - Bayluscide 70% Wettable Powder was used for the first time on the Oconto River (Lake Michigan). The reduction in use of TFM which resulted from the use of Bayluscide was estimated at 1,398 kg (3,082 lbs) active ingredient.

  - Studies to assess the downstream distribution of larvae were completed on 17 streams (9 Canada, 8 U.S.). In 1998, 11 streams (7 Canada, 4 U.S.) are recommended for similar studies of downstream distribution.

- Impediments to long-term planning:

  - Liability issues prevent U.S. treatment personnel from working in Canada. Insurance covering liability is being investigated. Information was provided to an insurance broker in Canada. The U.S. agent is awaiting estimates of premiums from the underwriter.

  - The U.S. staff was reduced by 4 people for 1997 due to budget constraints.

- Research:

  - Research projects and proposals for 1998-2000 were reviewed and prioritized. A critical research need was identified and will be forwarded at the Research Workshop in 1998.

RISK ASSESSMENT

Protection of lake sturgeons (Acipenser fulvescens) during sea lamprey management activities is a priority. In 1982 the lake sturgeon was being considered for threatened or endangered status and was listed in the Federal Notices of Review Register as a category 2 (C2) candidate species. In 1995 the C2 classification was removed and the lake sturgeon now has no formal designation. Streams where lake sturgeons have been documented recently include the Sturgeon and Bad rivers (Lake Superior) and Peshtigo, Oconto, and Manistee rivers (Lake Michigan).

The Michigan Department of Natural Resources expressed concern for the impact of treatment on a suspected population of lake sturgeons in the Paw Paw River (Lake Michigan). Assessments were conducted during the treatment of the system to determine mortality of lake sturgeons. The assessments were completed to fulfill requirements specified in the 1997 Certification of Approval issued by the Michigan Department of Environmental Quality. Collection methods included fyke nets fished at 6 locations in the lower Paw Paw River and 38 dip net collections conducted throughout the system. No lake sturgeons were observed or collected.

The populations of lake sturgeons in the Sturgeon, Bad, and Oconto rivers are being assessed in each stream for three consecutive years. The objectives of the studies are to protect and minimize disturbance to lake sturgeons and habitat, to test collection methods, and to determine if adult and juvenile lake sturgeons are present in the rivers in July and August. Adult fish enter the rivers in the spring, but little information is available to document reproduction and length of time that juveniles remain in the streams before moving into the Great Lakes.

Assessments were conducted in the Sturgeon and Peshtigo rivers in July and August by the U.S. Fish and Wildlife Service Fishery Resources Offices, Ashland and Green Bay, Wisconsin, Keweenaw Bay Indian Community, Michigan and Wisconsin Departments of Natural Resources, and Michigan Technological University. Numerous collection methods were used in the Sturgeon River and electrofishing was used in the Peshtigo River. A total of 53 juveniles (range, 55-170 mm) were collected and released in the Sturgeon River and a single fish (165 mm) was captured in the Peshtigo River. The findings demonstrate that juvenile fish remain in these rivers throughout the summer.

Assessment collections following a lampricide application in the Oconto River on September 23 produced 3 dead juvenile lake sturgeons (range, 248-277 mm). Nontarget mortality was not observed at 7 of 9 sites examined in the Oconto River. All mortality of sturgeons occurred at the site where low pH affected the toxicity of lampricides to the greatest extent.

In a cooperative 3-year study, personnel from the Upper Mississippi Science Center, LaCrosse, Wisconsin, the Bad River Band of Lake Superior Chippewa Indians Natural Resources Department, and Marquette Biological Station conducted flow-through toxicity tests on adults and juveniles of 2 species of freshwater mussels. The mussels and sea lamprey larvae were exposed to a series of concentrations of a mixture of TFM + 1% Bayluscide. Mortality of mussels was minimal in all tests and at the highest concentrations ranged from 10-20% for juveniles and 0-10% for adults. These concentrations were 1.9 to 2.3 times the LC99.9 for sea lamprey larvae and significantly higher than concentrations normally used to control sea lampreys in streams with similar water chemistry. No mortality of mussels was observed at the LC99.9 for sea lamprey larvae. Observations of behavior indicated that the highest concentrations of lampricides narcotized some mussels, however the response was highly variable and recovery appeared nearly complete by 12-hour post exposure.

OUTREACH 1997

The Service and Department routinely are involved in outreach activities to inform the public of the benefits and operations of the sea lamprey management program. These activities range from major group participation at sports shows in metropolitan areas to the efforts of individuals in the many contacts with the media and presentations at schools. A summary of these activities for 1997 follows.

	Number of Occurrences		Staff Days	
Activity or Event	U.S.	Canada	U.S.	Canada
School presentations	46	11	20	4
Shows & conventions	6	6	42	71
Youth fishing fairs	2	1	11	2
Civic/agency presentations	11	2	9	8
Media interviews	41	7	4	2
Media mailings	325	51	12	6
Public displays	5	2	9	12
Miscellaneous	14	6	21	2
Total	450	85	128	107
Combined Total	535		235	

PERMANENT EMPLOYEES OF THE SEA LAMPREY MANAGEMENT PROGRAM

Department of Fisheries and Oceans
Sea Lamprey Control Centre – Sault Ste. Marie, Ontario Canada

Control Supervisor: Larry P. Schleen

Biologist:
- Reginald J. Goold, Treatment Supervisor
- R. Wayne Westman, Treatment Supervisor

Technicians:
- Ed. D. Achtemichuk
- Lothar W. Dahlke
- Jamie A. Smith
- Brian E. Stephens
- Randy A. Stewart

Finance & Administration: Jackie A. Bassett
- Accounts Clerk, Lisa R. Vine

Administrative Support:
- *Tina M. Berry
- Christine A. Youngson

* Continuing GLFC

Assessment Supervisor: Robert J. Young

Biologist:
- Rod B. McDonald, Adult Assessment Supervisor
- Douglas W. Cuddy, Larval Assessment Supervisor
- Jerry G. Weise, Quantitative Assessment Supervisor
- Paul W. Sullivan, Lower Lakes Assessment Supervisor

Technicians:
- Robert P. Bouchard
- Mike G. MacKenna
- *Mike T. Steeves

Barrier Coordinator: Tom C. McAuley
- *Barrier Assistant, Andrew G. Hallett,

Property & Contract Manager: David J. Haight
- Storeperson, William L. Green,

Maintenance Supervisor: Dave C. Reid
- *Maintenance Assistant, Brian Greene,

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

Marquette Biological Station

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
- Elizabeth L'Huillier
- Mary Jo Buckett
- Steven Dagenais
- Pauline Hogan
- Gloria Hoog

Assessment Supervisor: Rotating Assignment

Biologist:
- Michael Fodale, Larval Supervisor
- Katherine Mullett, Adult Supervisor
- Michael Twohey, Sterile Male Supervisor
- John Weisser
- Glenn Barner
- Mary Henson
- Jennifer Kagel
- Cheryl Kaye
- Dale Ollila

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

ADP Supervisor: Larry Carmack
- Robert Kahl
- Deborah Larson

Ludington Biological Station

Dennis S. Lavis, Station Supervisor

Barrier Coordinator: Ellie M. Koon

Biologist:
- Alex Gonzalez, Treatment Supervisor
- Kathy Hahka

Lead Physical Science Technician: Jeffrey Sartor

Physical Science Technician:
- Kevin Butterfield
- Tim Sullivan

Computer Assistant: Barry Matthews

Biologist:
- Jeffrey Slade, Larval Supervisor
- Sidney Morkert

Biological Science Technician:
- David Keffer
- Lois Mishler

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