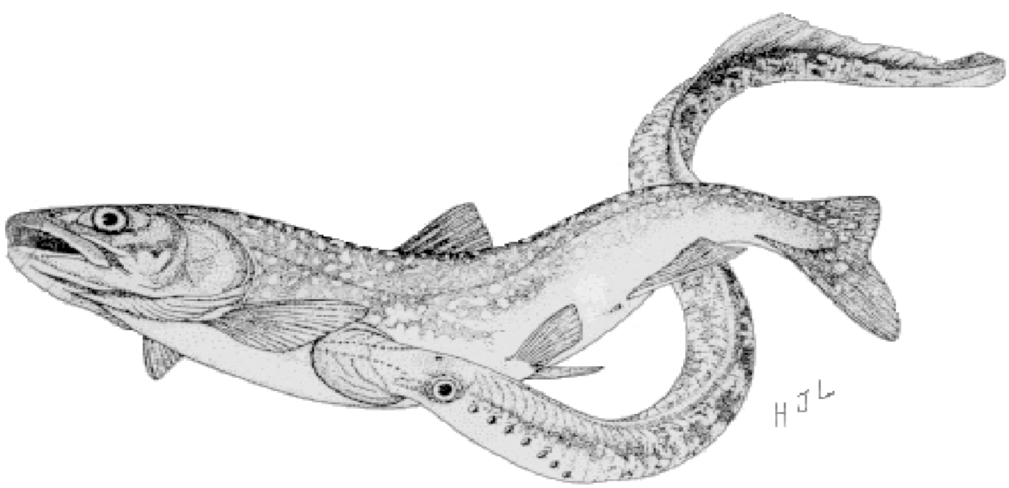
INTEGRATED MANAGEMENT OF SEA LAMPREYS IN THE GREAT LAKES 1999

ANNUAL REPORT TO

GREAT LAKES FISHERY COMMISSION



by

Larry P. Schleen
Department of Fisheries & Oceans
Sault Ste. Marie, Ontario
Canada

Gerald T. Klar
U.S. Fish and Wildlife Service
Marquette, Michigan
United States

GLFC Annual Meeting
June 5-7, 2000

Contents

INTEGRATED MANAGEMENT OF SEA LAMPREYS IN THE GREAT LAKES 1999

Larry P. Schleen
Department of Fisheries and Oceans
Sault Ste. Marie, Ontario P6A 6W4

Gerald T. Klar
United States Fish and Wildlife Service
Marquette, Michigan 49855

Executive Summary

This report summarises activities in the integrated management of sea lampreys conducted by the U.S. Fish and Wildlife Service (Service) and the Department of Fisheries and Oceans Canada (Department) in the Great Lakes during 1999. Lampricide treatments were conducted on 55 tributaries (Table 1). Larval assessment crews surveyed 290 Great Lakes tributaries, inland lakes and lentic areas to assess control effectiveness, plan future TFM treatments, and establish production capacity of streams. Assessment traps were operated in 66 tributaries to estimate the spawning-phase population in each Great Lake (Table 2).

This report evaluates sea lamprey population versus fish community objectives in each of the lakes. Lake Superior is presently above the target level for sea lamprey abundance (50% decline by the year 2000). The estimated number of spawning-phase sea lampreys in 1999 was the highest since 1986. In Lake Michigan, the fish community objective has been met with abundance of spawning sea lampreys relatively stable during 1986 to 1999, although lampreys are more abundant in the northern part of the lake than the southern. Populations of parasitic lampreys remain significantly higher than the fish community objective in Lake Huron because of the continued high production of transformers from the St. Marys River. Integrated control measures implemented in the St. Marys River in recent years are predicted to significantly reduce the number of parasitic lampreys in Lake Huron. The objectives for Lake Erie of wounding rates on lake trout of less than 5%, and assessment trap catches of lampreys less than 10% of treatment levels, are not currently being met (spawner catch in 1999 was equal to 25% of pre-treatment catch and lake trout of 533-633 mm suffered 15 wounds per 100 lake trout). The fish community objectives for sea lamprey management in Lake Ontario are currently close to being met.

The St. Marys River Control Task Force co-ordinated the second portion of the 2-year (1998-1999) granular Bayluscide treatment during 1999. A total of 4,249 kg of Bayluscide was applied to 759.8 ha with a helicopter by a contracted pesticide application firm and agent boat crews. Personnel from both the Service and Department co-operated in the successful treatment. Combined with the 1998 treatment, 45% of the larval sea lamprey population has been removed. The St. Marys River Assessment Plan will continue to evolve, and a decision tree will be developed to determine future integrated control efforts in the river.

The Sterile Male Release Technique (technique) Task Force focused on the 4th year of a 4 year assessment project (long-term study) in Lake Superior streams and the 3rd year of enhanced release of sterile male sea lampreys in the St. Marys River as part of the integrated control program for that river. The long-term study, which is addressing success of the technique, had previously released lampreys during 1996-1998 in 8 Lake Superior streams and is in the process of determination of density-dependent effects within the larval population. The St. Marys River received 26,285 sterilised males which created a 4.7:1 sterile:untreated male ratio. The theoretical reduction from trapping and enhanced sterile male release was estimated at 92% during 1999, an increase from an average of 84% during 1997-1998. The sterilisation facility continued to meet the demands of the program.

The Barrier Task force completed the two year transition phase of the barrier program from a developmental process to a fully integrated and operational part of the sea lamprey control program by releasing the document "Sea Lamprey Barrier Life Cycle and Operational Protocols". The Task Force also developed an interim environmental policy and guidelines document for the placement of sea lamprey barriers in Great Lakes tributaries.

An experimental combination fixed-crest, gradient field electrical weir was completed and 5 existing barriers were modified to stop sea lamprey migration. To date, 61 barriers have been constructed or modified on Great Lakes tributaries to stop sea lamprey migration.

The Assessment Task force continued to develop, with the Secretariat and IMSL contractor, the Empirical Stream Treatment Ranking model to rank and select streams for lampricide treatment. The Task Force developed and implemented a sampling plan to assess pre- and post-treatment abundance of larval sea lampreys in the St. Marys River, and developed plans for assessing the efficacy of the integrated control measures on the St. Marys River. The Task Force continued to co-operate in the compensatory mechanisms study, and to implement recommendations of the adult assessment review by redistributing trapping effort from small to large streams, estimating the parasitic population in Lake Huron by marking and releasing parasitic lampreys into the lake, and estimating the transformer population in Lake Superior by marking and releasing transformers into select tributaries.

The Lampricide Control Task Force continued to implement options for reduced lampricide use. The Task Force completed a manual entitled "Standard operating procedures for application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (<u>Petromyzon</u> <u>marinus</u>) control program".

Risk assessment activities focused on environmental risk management related to procurement of state, tribal and federal regulatory agency permits for control actions and assistance in co-ordinating assessments of populations of lake sturgeons (<u>Acipenser</u> <u>fluvescens</u>) and other non-target organisms.

The sea lamprey management program conducted 1,636 outreach activities that required 331 staff days.

Table 1. Summary of lampricide applications in tributaries of the Great Lakes during 1999.

Lake	Number of Streams	Flow m^3/s	TFM[1,2] kg	Bayluscide[1] kg	Distance km
Superior	13	139.3	10,526	108.7	367.0
Michigan	15	35.7	7,849	62.2	593.3
Huron	14	63.9	7,177	4,256.0	292.5
Erie	4	17.1	3,140	30.5	128.3
Ontario	9	67.7	5,032	47.5	133.8
Total	**55**	**323.7**	**33,724**	**4,504.9**	**1,514.9**

[1]Lampricides are in kg active ingredient.
[2]Includes 298 TFM bars (57.6 kg active Ingredient) applied in 22 streams.

Table 2. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of the Great Lakes during 1999.

Lake	Number of Streams	Total Captured	Number Sampled	Percent Males	Mean Length (mm)		Mean Weight (g)	
					Males	Females	Males	Females
Superior	23	11,744	837	59	455	438	217	211
Michigan	13	22,976	865	46	492	489	274	283
Huron	14	37,494	484	60	486	490	243	254
Erie	3	503	11	73	514	520	324	332
Ontario	13	5,956	760	52	494	476	254	252
Total	**66**	**78,673**	**2,957**					

INTRODUCTION

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

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

This report presents the actions of the Service and Department in the integrated management of sea lampreys in the Great Lakes during 1999. Also presented are actions to meet milestones of the Commission vision and trends in sea lamprey abundance as related to Fish Community Objectives.

COMMISSION VISION

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

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

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

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

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

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

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

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

Since the beginning of the use of lampricides in the management program, the Service and Department continually have increased their efficiency in the use of TFM. The combination of improved analytical, application, and assessment techniques and construction of barriers has reduced the use of TFM from 1980-1989 (annual avg. of 49,406 kg) to 1990-1999 (annual avg. of 38,697 kg; Fig. 1), a reduction of about 22%. This decrease has occurred through a combination of program efficiencies and implementation of alternative controls, and has occurred despite the addition of streams to the treatment program with higher TFM requirements due to high pH and total alkalinity.

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

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

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

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

FISH COMMUNITY OBJECTIVES

Lake Superior

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

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

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

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

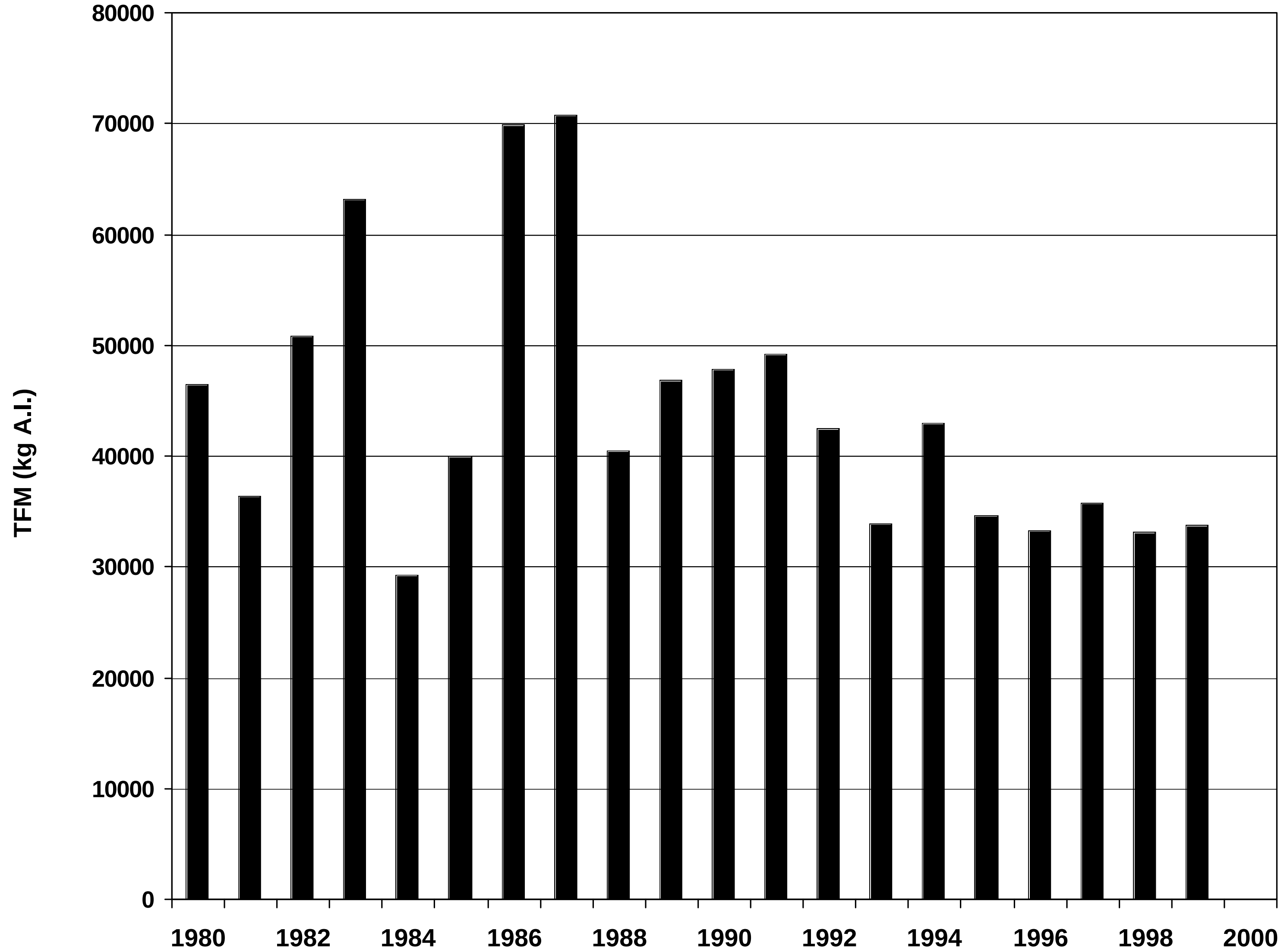


Fig. 1. Annual use of TFM (active ingredient) 1980-99.

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 to allow normal growth of lake trout.

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

At present, the Lake Committee is in the process of revising the Fish Community Objectives.

The Service maintains an extensive trapping network for spawning-phase sea lampreys in index streams of the south shore of Lake Superior and estimates populations west and east of the Keweenaw Peninsula (Fig 2). Populations east of the peninsula generally remained stable through the 1990s. Populations to the west generally declined during 1989-1995, increased in 1996, and returned to a downward trend during 1997 and 1998. The combined U.S. estimate of 74,460 spawning-phase sea lampreys in 1999 is the highest recorded since 1986. At present, the program is above the target for sea lamprey abundance (50% decline by 2000).

Lake Michigan

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

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

In general, treatment of Lake Michigan tributaries over the years has provided sufficient control of sea lampreys, yet increases in lamprey wounding rates on lake trout in northern waters of the lake are a concern.

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

> *Establish a diverse salmonine community capable of sustaining an annual harvest of 2.7 to 6.8 million kilograms (6 to 15 million pounds), of which 20-25% is lake trout.*
> *Establish self-sustaining lake trout populations.*

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

The Service 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 1986-1999 (Fig. 3). The index shows a relatively stable trend throughout the period, although the index was highest during 1998. Sea lampreys are more abundant in the northern part of the lake than in the southern. Also presented in Fig. 3 is the beginning of a series of lake-wide estimates of adult lamprey abundance (1996-1999).

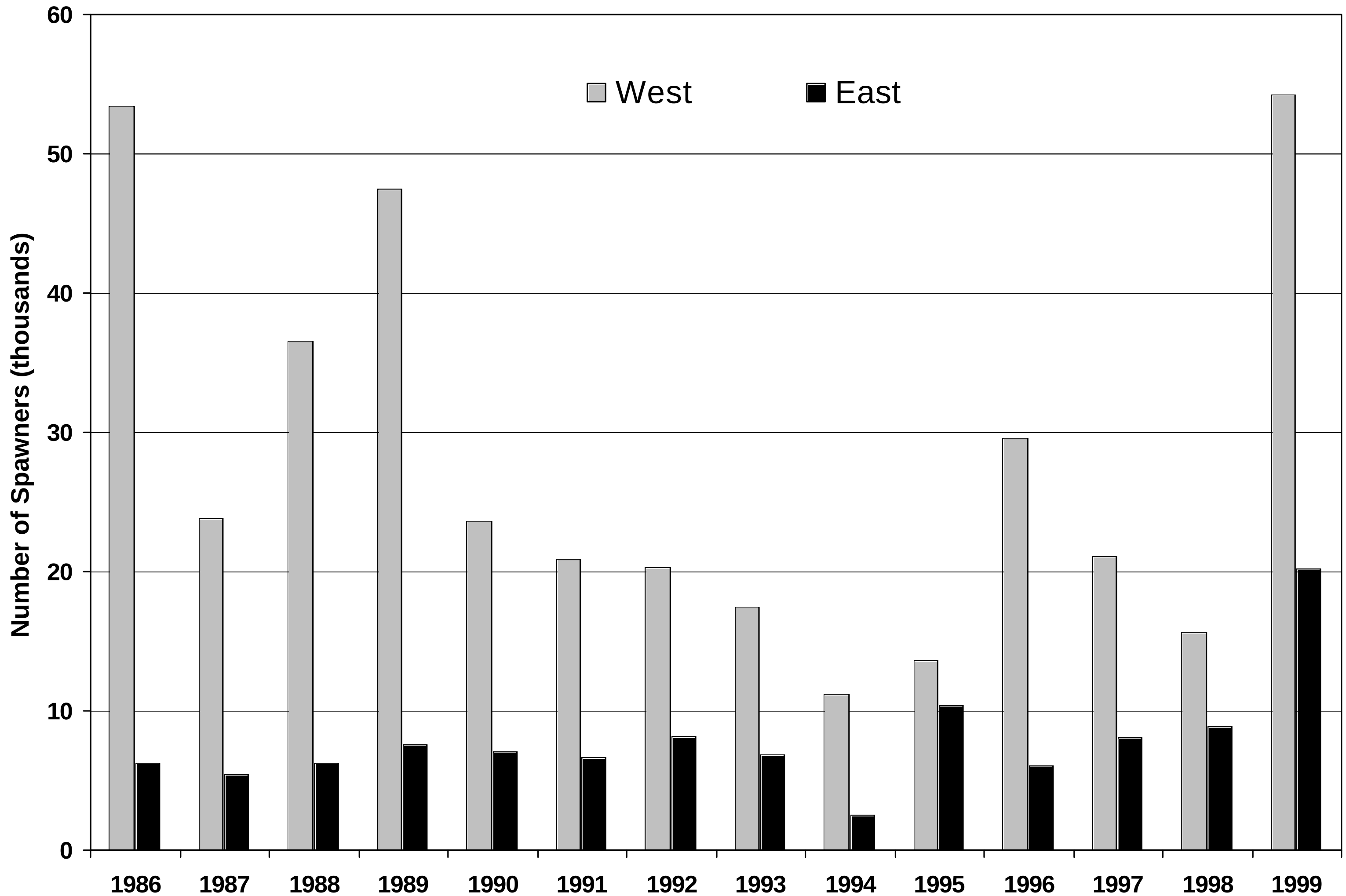


Fig. 2. Estimated number of spawning-phase sea lampreys in U.S. waters of Lake Superior (west and east of the Keweenaw Peninsula).

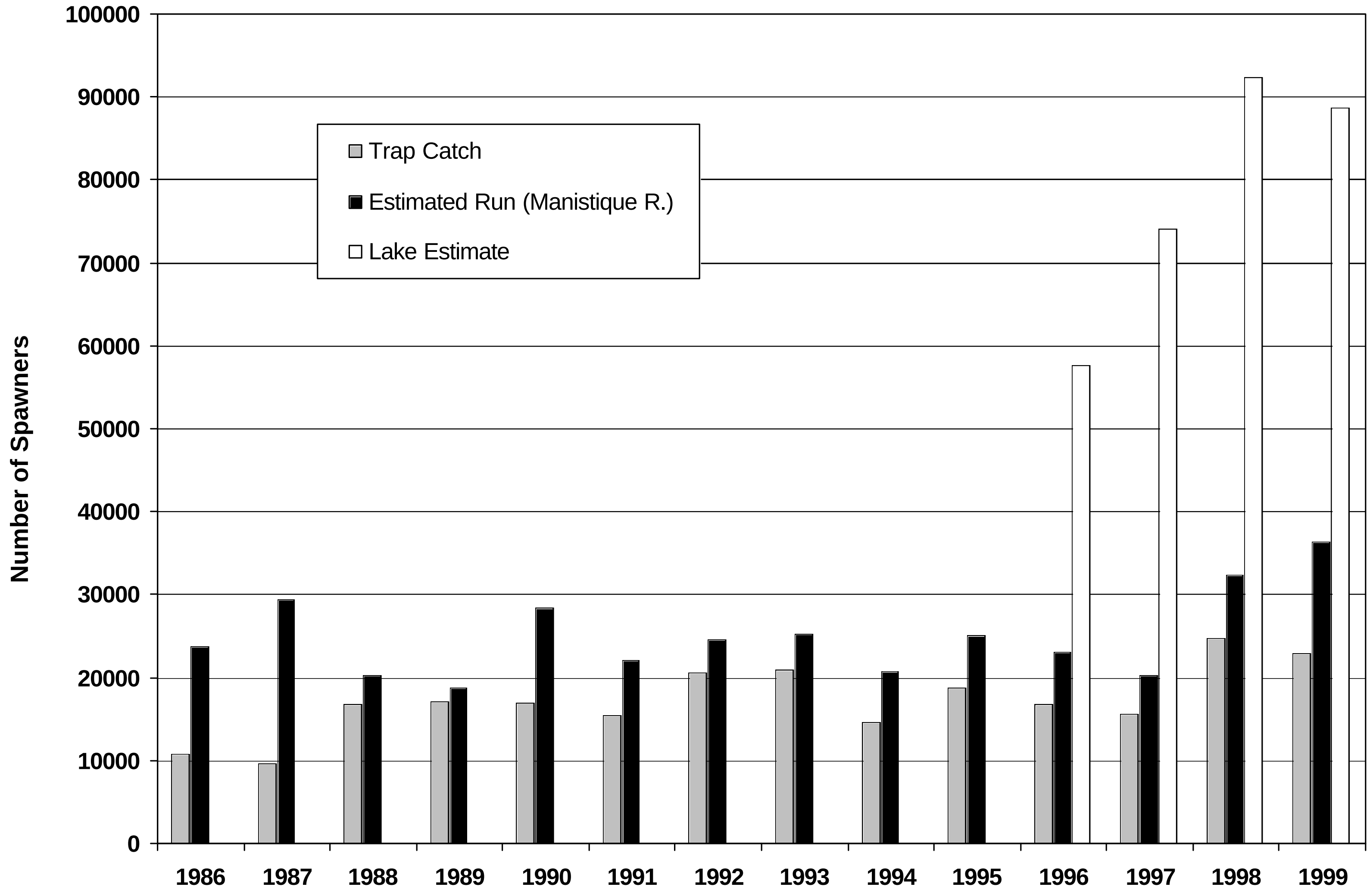


Fig. 3. Number of spawning-phase sea lampreys captured in assessment traps from annual average of 13 Lake Michigan streams (range 12-14), estimated population of spawning lampreys in the Manistique River, 1986-1999, and estimated population of Lake Michigan, 1986-1999.

Lake Huron

In 1993 the Lake Huron Committee 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.*

The progress toward this objective is measured by the abundance of spawning sea lampreys presently in 3 index streams (Thessalon, St. Marys and Cheboygan rivers) in northern Lake Huron (Fig. 4). This sea lamprey target supports the objectives for the other species groups in the fish community including, for example, the salmonine community objective:

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

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

The Service and Department annually have trapped an average of 13 streams during 1986-1999 to monitor the abundance of sea lampreys in northern Lake Huron (Fig. 4). Lamprey abundance generally increased from 1986-1993, and declined and stabilised during 1994-1999. Also presented in Fig. 4 is the beginning of a series of lake-wide estimates of adult lamprey abundance (1995-1999).

Lake Erie

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

A specific management plan for sea lampreys in Lake Erie was developed prior to the implementation of stream treatments during 1986. The plan defined an "experimental program" of control to reduce sea lamprey populations to levels where wounding on lake trout would be less than 5%, assessment trap catches of lampreys would be less than 10% of pre-treatment levels, and nest densities would be less than 2 nests per km of spawning habitat. By 1989 the first 2 of these objectives had been met in the eastern basin of Lake Erie. Based on this success, the Commission declared the control program on Lake Erie to be ongoing.

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 stocks of spawning adults. Mortality would be controlled through management of fishery exploitation and continued suppression of sea lampreys.

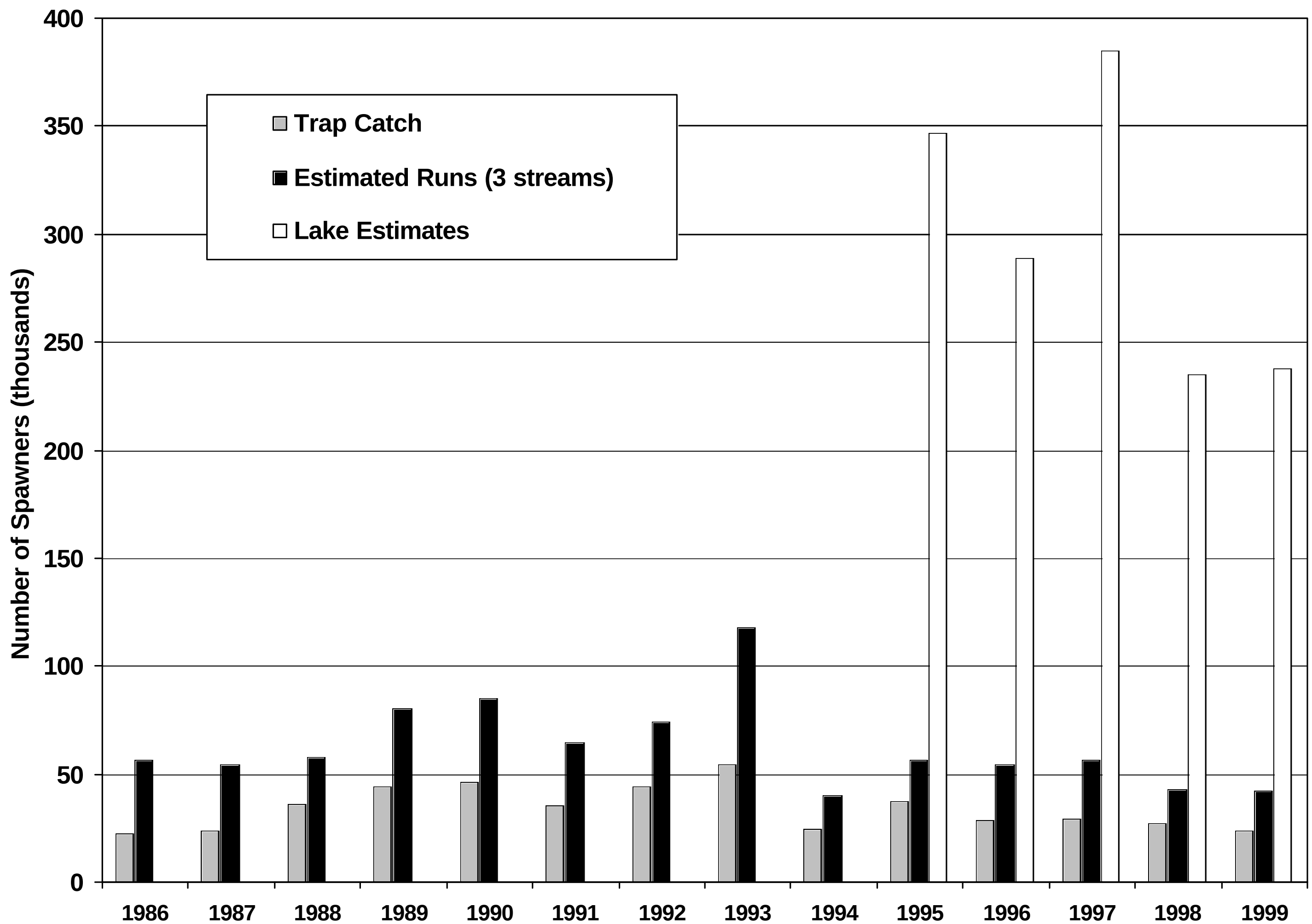


Fig. 4. Number of spawning-phase sea lampreys captured in assessment traps from an average of 13 Lake Huron streams (range 9-16), the estimated populations in the Cheboygan, St. Marys and Thessalon rivers (1986-1999), and the estimated Lake Huron populations of spawning lampreys for 1995-1999.

The Service and Department annually have trapped spawning-phase sea lampreys in an average of 7 tributaries during 1986-1999 and estimated the number of spawning lampreys in Cattaraugus Creek during 1991-1999 (Fig. 5). Current catch is less than that prior to the start of lampricide control (started during 1986 and showed effect in spawner population during 1989), but is greater than 10% of pre-treatment catch. When the management plan for sea lampreys in Lake Erie was developed (prior to the implementation of stream treatments during 1986), the target level was less than 5% wounding on lake trout 533-633 mm in length. During 1999, there were 15 wounds per 100 lake trout of 533-633 mm. Lake trout that were 634-734 mm had 14 wounds per 100 fish, and those >734 mm had 13 wounds per 100 fish.

Lake Ontario

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

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

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

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

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

This specific objective is meant to maintain an annual survival rate of 60% or greater for lake trout in order to maintain a target adult spawning stock of 0.5 to 1.0 million adults of multiple year classes. Along with sea lamprey control, angler, and commercial exploitation also will also be controlled so that annual harvest does not exceed 120,000 fish in the near term.

The Service and Department annually have operated traps in an average of 15 tributaries of Lake Ontario during 1986-1999, and estimated the spawning runs in 5 of the streams during 1992-1999. Based on these indices, abundance of spawning-phase sea lampreys in the lake has remained relatively stable during the 1990s (Fig. 6).

LAMPRICIDE CONTROL

Tributaries harbouring larval sea lampreys periodically are treated with lampricides to eliminate or reduce the populations of larvae before they recruit to the lake as parasitic adults. Service and Department treatment units administer and monitor doses of the lampricide TFM, sometimes augmented with the 70% wettable powder formulation of Bayluscide, to scheduled tributaries. Specialised equipment and techniques are employed to provide concentrations of TFM that eliminate about 95% of the lamprey larvae and minimise the risk to non-target species. During recent years the combination of improved analytical and predictive techniques has allowed treatment crews to reduce the amount of lampricide use (kg/yr.) in the Great Lakes by more than 20%.

The Lampricide Control Task Force was established during December 1995 with charges to improve the efficiency of lampricide control, to maximise sea lampreys killed in stream and lentic treatments while minimising lampricide use, costs, and impacts on stream/lake ecosystems, and to define lampricide control options for near and long-term stream selections and target setting. The report of progress on the charges during 1999 is presented on page 58.

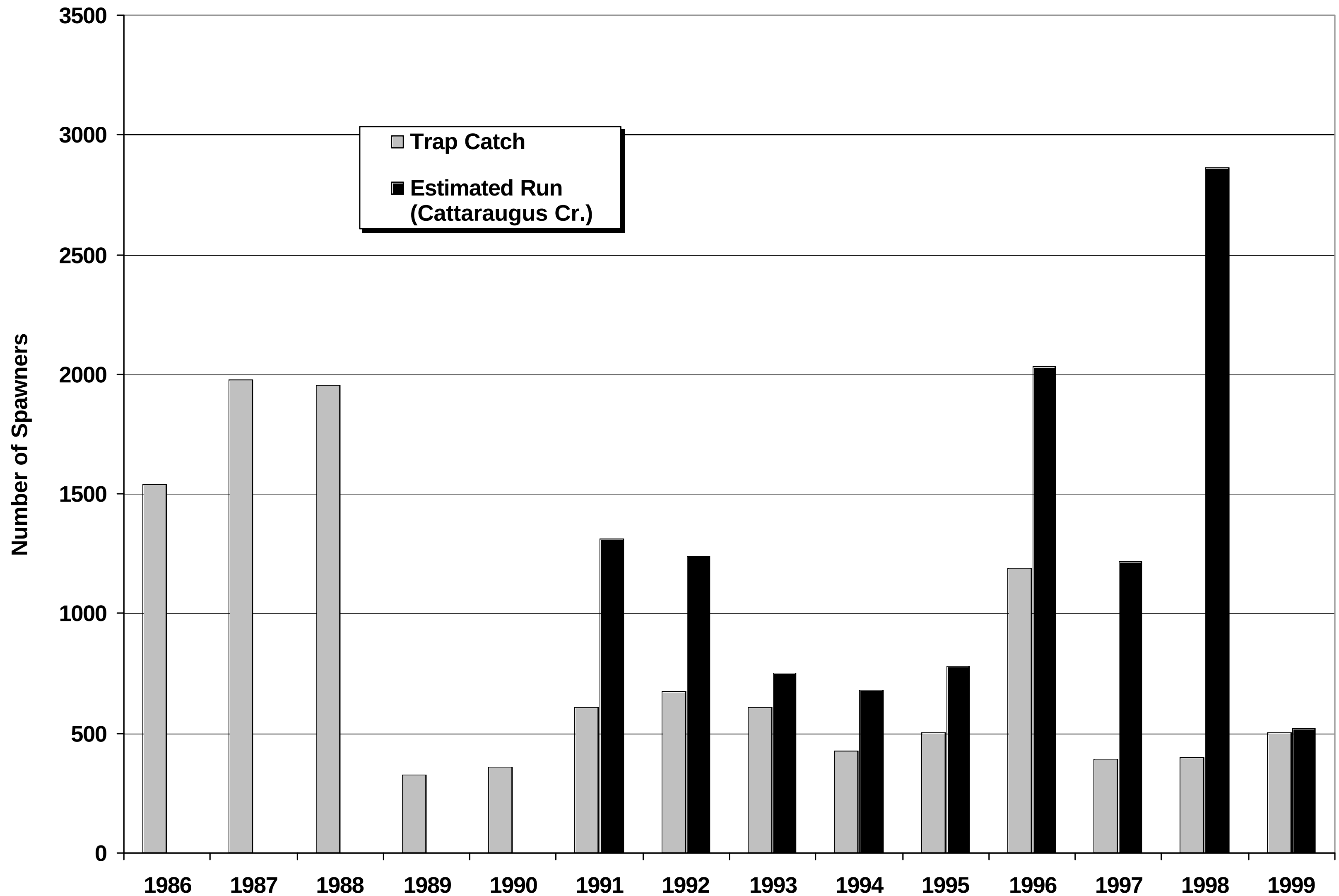


Fig. 5. Number of spawning-phase sea lampreys captured in an annual average of 7 streams (range 3-11) in Lake Erie, 1986-99, and estimated population in Cattaraugus Creek, 1991-99.

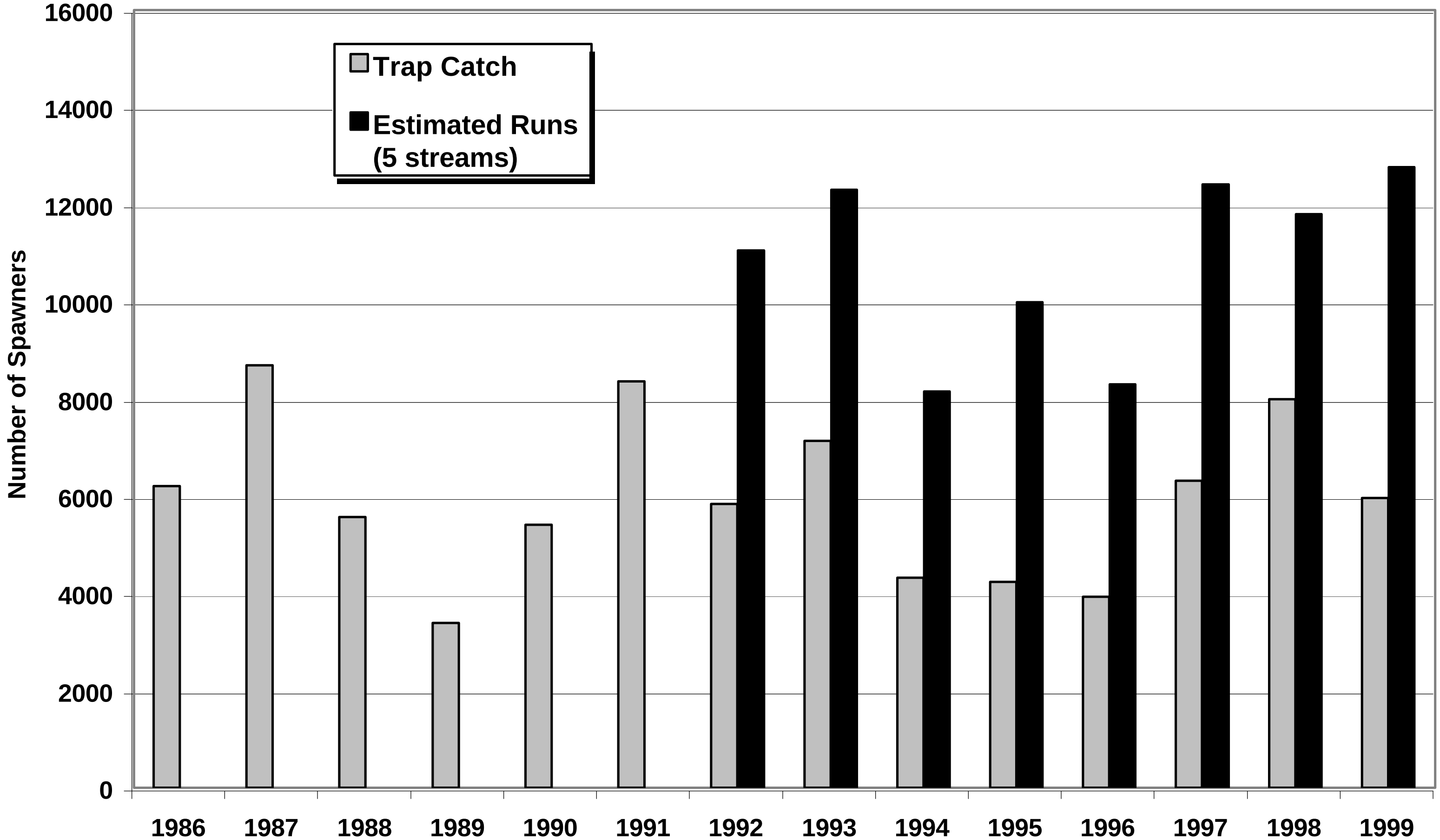


Fig. 6. Number of spawning-phase sea lampreys captured in an average of 15 streams in Lake Ontario, 1986-99, and the combined estimated populations in the Black and Humber rivers, and Duffins, Port Britain and Shelter Valley creeks, 1992-99.

Lake Superior

Tributary Information

- Lake Superior has 1,566 (733 United States, 833 Canada) tributaries.
- 136 (89 United States, 47 Canada) tributaries have historical records of larval sea lamprey production.
- 74 (41 United States, 33 Canada) tributaries have been treated at least once with lampricides during 1989-1999.
- Of these, 53 (30 United States, 23 Canada) tributaries are treated on a regular 3-5 year cycle.

The following statements highlight the 1999 treatment program on Lake Superior:

Table 3 provides details on the application of lampricides to 13 tributaries and Fig. 7 shows the location of the tributaries.

- Treatments were completed successfully in 13 scheduled streams (6 United States, 7 Canada).

- Treatment of the Sturgeon River was conducted using an interim protocol that set a maximum application of 1.2 times pH minimum lethal concentration of TFM/1% Bayluscide. The protocol was maintained for the lower 58.4 km of the 61.1 km treatment.

- The Goulais, Michipicoten, Black Sturgeon, and Nipigon rivers were treated with reduced lampricide concentrations because they have been identified as lake sturgeon-producing rivers. The targeted minimum lethal concentrations were achieved in all rivers except the lower one km of the Black Sturgeon River (Canada).

- In support of the lampricide application program, nets were fished in the Goulais, Michipicoten, and Black Sturgeon rivers during treatments to determine if there was mortality of young-of-year lake sturgeons. No lake sturgeons were found in nets during the lampricide treatments. A juvenile lake sturgeon was observed attempting to pass the dam at the main application site on the Black Sturgeon River.

- Netting for sturgeon during the Goulais, Michipicoten, and Black Sturgeon river lampricide treatments also resulted in the capture of 3,134 larval sea lampreys. Of these, 17 larvae (including 2 metamorphosing) were found alive after the treatments were concluded. The numbers of larvae remaining alive ranged from 2 (3.8%) in the Black Sturgeon, 5 (0.4%) in the Goulais, and 10 (6.3%) in the Michipicoten rivers.

- Drinking water was provided to residents of the Lake Helen Indian Reservation during the treatment of the Nipigon River.

- The L'Anse, Michigan public water supply was sampled for lampricide contamination after the application of Bayluscide (3.2%) granular sea lamprey larvicide off the mouth of the Falls River in Keweenaw Bay. Sampling was conducted to fulfil stipulations in the Michigan Department of Environmental Quality Certification of Approval for the application of lampricides in Michigan waters. No contamination was detected.

- Mortality of non-target fish species was minimal on all treatments.

Table 3. Details on the application of lampricides to tributaries of Lake Superior, 1999.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM kg [1,2]	Bayluscide kg[1]	Distance Treated km
United States					
Two Hearted R. (30)	Jun 28	3.1	496	0.0	88.5
Big Garlic R. (31)	Jul 27	0.3	37	0.0	8.0
Sturgeon R. (34)	Sep 07	7.6	528	4.0	61.1
Huron R. (32)	Sep 20	0.4	69	0.0	14.5
Silver R. (33)	Sep 21	1.8	127	0.0	8.0
East Sleeping R. (35)	Oct 05	0.2	173	0.0	22.5
Total		**13.4**	**1,430**	**4.0**	**202.6**
Canada					
Goulais R. (42)	Jun 20	11.2	1,053	0.0	104.9
Gargantua R. (41)	Aug 04	0.3	20	0.0	1.6
Michipicoten R. (40)	Aug 07	37.1	1,521	13.3	18.7
Cypress R. (39)	Aug 19	0.4	29	0.0	5.5
Black Sturgeon R. (37)	Aug 21	8.4	725	8.0	16.3
Pigeon R. (36)	Aug 24	11.5	509	5.0	4.9
Nipigon R. (38)	Aug 30	57.0	5,239	78.4	12.5
Total		**125.9**	**9,096**	**104.7**	**164.4**
Grand Total		**139.3**	**10,526**	**108.7**	**367.0**

[1]Lampricides are in kg active ingredient.
[2]Includes a total of 71 TFM bars (13.7 kg active ingredient) applied in 6 streams.

Lake Michigan

Tributary Information

- Lake Michigan has 511 tributaries.
- 121 tributaries have historical records of larval sea lamprey production.
- 68 tributaries have been treated with lampricide at least once during 1990-1999.
- Of these, 36 tributaries are treated on a regular 1-5 year cycle.

The following statements highlight the 1999 treatment program on Lake Michigan:

Table 4 provides details on the application of lampricides to 15 tributaries, and Fig. 7 shows the location of the tributaries.

- Treatments were completed successfully on 15 streams, including McGeach Creek, which was treated for the first time in 22 years.

- An interim protocol was developed for conducting treatments of streams or stream reaches with naturally spawned or planted young-of-year lake sturgeons (Acipenser fulvescens), which are listed as threatened in Michigan and New York, endangered in Illinois, Ohio, Indiana, and Pennsylvania, and of special concern in Minnesota. Maximum concentrations of lampricide were limited to 1.2 times the pH minimum lethal concentration for larval sea lampreys, which is known to have no measurable effect on young-of-year lake sturgeons. The protocol was applied to the lower 84.8 km of the 120.0 km treated on the White River and the lower 125.6 km of the 245.0 km treated on the Pere Marquette River. Treatment profiles showed that some sections received a sub-lethal dose of lampricide.

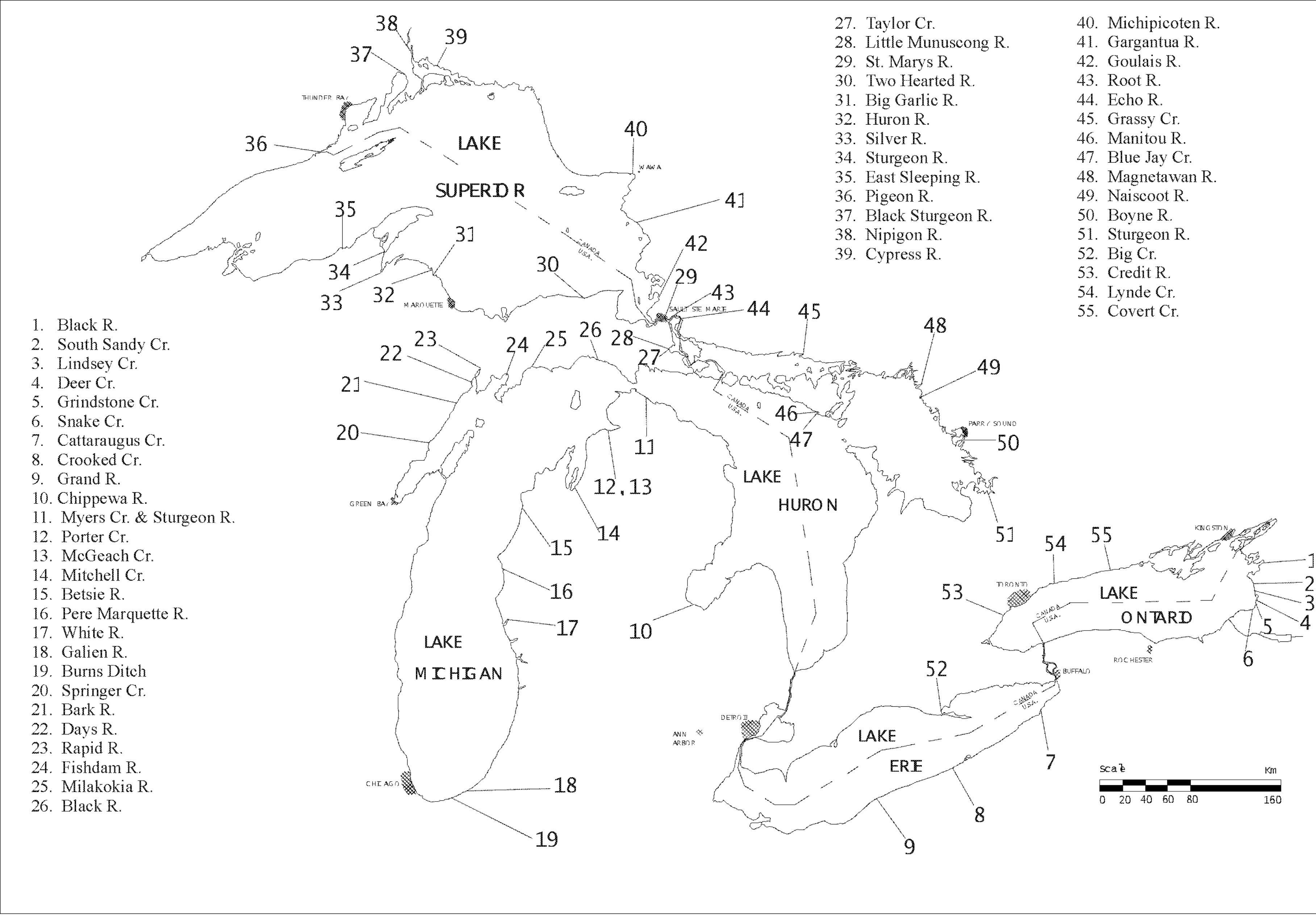


Fig. 7. Location of tributaries treated with lampricide during 1999.

- A study done in co-operation with the Service and the Upper Midwest Sciences Center on low-level residual concentrations of lampricide was completed on the Milakokia River.

- The Black River treatment was observed by the Environmental Protection Agency to satisfy requirements for TFM re-registration.

- The Gladstone, Michigan public water supply was sampled for the presence of lampricides after TFM treatments of the Rapid and Days rivers and after the application of Bayluscide 3.2% granular sea lamprey larvicide off the mouth of the Days River in Little Bay de Noc. No lampricides were detected in any of the samples. Sampling was conducted to fulfil stipulations in the Michigan Department of Environmental Quality Certification of Approval for the application of lampricides in Michigan waters.

- Mortality of non-target fish species was minimal on all treatments.

Table 4. Details on the application of lampricides to tributaries of Lake Michigan, 1999.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM kg[1,2]	Bayluscide kg[1]	Distance Treated km
United States					
Mitchell Cr. (14)	May 2	0.3	76	0	2.4
Rapid R. (23)	May 15	2.5	468	0	61.0
Fishdam R. (24)	May 19	1.2	195	0	24.0
Black R. (26)	May 27	1.1	130	0	26.0
Springer Cr. (20)	May 29	0.1	21	0	3.0
Bark R. (21)	May 31	3.2	406	0	25.7
Milakokia R. (25)	Jun 12	1.2	325	0	27.0
Galien R. (18)	Jun 27	1.1	564	0	19.8
Burns Ditch (19)	Jul 11	0.4	157	0	4.1
Betsie R. (15)	Jul 26	5.8	1,040	13.1	18.6
Pere Marquette R. (16)	Aug 8	10.2	2,591	34.7	245.0
White R. (17)	Aug 21	7.9	1,689	14.4	120.0
Porter Cr. (12)	Oct 1	0.4	84	0	0.3
Days R. (22)	Oct 2	0.2	62	0	8.0
McGeach Cr. (13)	Oct 4	0.1	41	0	8.4
Total		**35.7**	**7,849**	**62.2**	**593.3**

[1]Lampricides are in kg active ingredient.
[2]Includes a total of 118 TFM bars (22.8 kg active ingredient) applied in 5 streams.

Lake Huron

Tributary Information

- Lake Huron has 1,761 (427 United States, 1,334 Canada) tributaries.
- 117 (62 United States, 55 Canada) tributaries have historical records of larval sea lamprey production.
- 70 (34 United States, 36 Canada) tributaries have been treated with lampricide at least once during 1990-1999.
- Of these, 46 (22 United States, 24 Canada) tributaries are treated on a regular 3-5 year cycle.

The following statements highlight the 1999 treatment program on Lake Huron:

Table 5 provides details on the application of lampricides to 14 tributaries and Fig. 7 shows the location of the tributaries.

- TFM treatments were completed successfully on 13 streams (4 United States, 9 Canada).

- Treatments of the Devils River and Grand Lake Outlet (United States) and the Shebeshekong River and the main stem of the Serpent River (Canada) were deferred until 2000 because of low stream discharge encountered during the 1999 field season.

- The low level of Lake Huron and a relatively high treatment discharge resulted in a very effective treatment of the lower Magnetawan River and Byng Inlet. In the past, the large volume of standing water in Byng Inlet has compromised the effectiveness of lampricide treatments in this area.

- Mortality of non-target fishes was minimal in the majority of treatments, although mortality of some spawning chinook salmon occurred in the Root River and Blue Jay Creek.

- Bayluscide (70% wettable powder) was used for the first time to treat the Sturgeon River (tributary to the Cheboygan River) and resulted in a savings of 70 cans of TFM (approx. 693 kg active ingredient) as compared to the 1994 treatment.

- Granular Bayluscide (3.2% active ingredient) treatment of the St. Marys River continued during 1999. A total of 759.8 ha were treated with helicopter by a contracted pesticide application firm and by boat over a 9-day period. Joint crews from the Service and Department participated in the operation. Treatment effects to non-target organisms appeared insignificant.

Table 5. Details on the application of lampricides to tributaries of Lake Huron, 1999.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM kg [1,2]	Bayluscide kg [1]	Distance Treated km
United States					
Little Munuscong R. (28)	Jun 12	0.6	100	0	17.2
Munuscong R.					
Taylor Cr. (27)	Jun 15	0.4	204	0	8.0
St. Marys R. (29)	Jul 6	-	-	2,822.0[3]	-
Cheboygan R.					
Sturgeon R. (11)	Sep 6	4.8	1,061	7.0[4]	60.9
Myers Cr. (11)	Oct 5	0.1	11	0	1.9
Saginaw R.					
Chippewa R. (10)	Sep 18	5.3	3,264	0	114.2
Total		**11.2**	**4,640**	**2,829.0**	**202.2**
Canada					
Sturgeon R. (51)	May 26	2.4	288	0	1.6
Naiscoot R. (49)	Jun 8	5.1	217	0	18.0
Boyne R. (50)	Jun 9	0.8	22	0	1.7
Magnetawan R. (48)	Jul 9	35.7	1,399	0	8.6
St. Marys R. (29)	Jul 13	-	-	1,427.0[3]	-
Echo R. (below dam) (44)	Sep 15	1.4	65	0	2.5
Echo R. (above dam) (44)	Oct 7	1.4	75	0	8.0
Root R. (43)	Sep 20	4.3	255	0	39.1
Manitou R. (46)	Sep 29	0.9	106	0	1.0
Blue Jay Cr. (47)	Sep 29	0.7	106	0	7.9
Serpent R.					
Grassy Cr. (45)	Oct 5	0.04	4	0	1.9
Total		**52.7**	**2,537**	**1,427.0**	**90.3**
Grand Total		**63.9**	**7,177**	**4,256.0**	**292.5**

[1]Lampricides are in kg active ingredient.
[2]Includes a total of 77 TFM bars (14.9 kg active ingredient) applied in 6 streams.
[3]Granular formulation (3.2% active ingredient).
[4]Wettable powder formulation (70% active ingredient).

Lake Erie

Tributary Information

- Lake Erie has 842 (317 United States, 525 Canada) tributaries.
- 20 (9 United States, 11 Canada) tributaries have historical records of larval sea lamprey production.
- 9 (4 United States, 5 Canada) tributaries have been treated with lampricide at least once during 1989-1999.
- Of these, 5 (3 United States, 2 Canada) tributaries are treated on a regular 3-5 year cycle.

The following statements highlight the 1999 treatment program on Lake Erie:

Table 6 provides details on the application of lampricides to 4 tributaries and Fig. 7 shows the location of the tributaries.

- Treatments were completed in 4 streams (3 United States, 1 Canada).
- Conneaut Creek was not treated due to low stream discharge and was deferred to the 2000 schedule.
- Mortality of non-target fish species was minimal on all treatments.

Table 6. Details on the application of lampricide to tributaries of Lake Erie, 1999.
(Number in parentheses corresponds to location of stream in Fig. 7)

Stream	Date	Flow m^3/s	TFM kg [1,2]	Bayluscide kg[1]	Distance Treated km
United States					
Grand River (9)	May 2	5.8	702	0	45.1
Crooked Cr. (8)	May 9	0.2	60	0	6.4
Cattaraugus Cr. (7)	May 16	8.4	1,570	30.5	28.8
Total		**14.4**	**2,332**	**30.5**	**80.3**
Canada					
Big Cr. (52)	Jun 24	2.7	808	0	48.0
Grand Total		**17.1**	**3,140**	**30.5**	**128.3**

[1]Lampricide is in kg of active ingredient.
[2]Includes a total of 25 TFM bars (4.8 kg active ingredient) applied in 2 streams.

Lake Ontario

Tributary Information

- Lake Ontario has 659 (254 United States, 405 Canada) tributaries.
- 57 (28 United States, 29 Canada) tributaries have historical records of larval sea lamprey production.
- 39 (20 United States, 19 Canada) tributaries have been treated with lampricide at least once during 1989-1999.
- Of these, 36 (18 United States, 18 Canada) tributaries are treated on a regular (3-5 year) cycle.

The following statements highlight the 1999 treatment program on Lake Ontario:

Table 7 provides details on the applications of lampricides to 9 tributaries treated during 1999 and Fig. 7 shows the locations of the tributaries.

- Treatments were completed on 9 streams (6 United States, 3 Canada).
- Treatment of the Black River required 54% of the lampricide used on Lake Ontario during 1999. The high cost of treatment and the limited number of sea lamprey found in assessments have precluded scheduling treatment of this stream since 1991. Large numbers of larvae were observed during the treatment, conducted under ideal flow conditions.
- 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, 1999.
(Number in parentheses corresponds to location of the streams in Fig. 7)

Stream	Date	Flow m^3/s	TFM kg [1,2]	Bayluscide kg [1]	Distance Treated km
United States					
South Sandy Cr. (2)	Apr 29	3.5	469	0	11.6
Snake Cr. (6)	May 1	0.1	34	0	9.9
Deer Cr. (4)	May 3	0.4	42	0	15.4
Lindsey Cr. (3)	May 5	0.4	68	0	14.2
Grindstone Cr. (5)	May 7	0.7	129	0	26.4
Black R. (1)	Jun 1	57.8	3,395	40.2	8.9
Total		**62.9**	**4,137**	**40.2**	**86.4**
Canada					
Lynde Cr. (54)	May 11	0.3	85	0	10.9
Covert Cr. (55)	May 11	0.1	14	0	1.3
Credit R. (53)	Jun 5	4.4	795	7.3	35.2
Total		**4.8**	**895**	**7.3**	**47.4**
Grand Total		**67.7**	**5,032**	**47.5**	**133.8**

[1]Lampricides are in kg of active ingredient.
[2]Includes a total of 7 TFM bars (1.4 kg active ingredient) applied in 3 streams.

ALTERNATIVE CONTROL

Sterile Male Release Technique

Research on the use of the sterile male release technique (technique) in sea lamprey control began during 1971. The technique was experimentally implemented in Lake Superior and in the St. Marys River during 1991-1996. Releases of sterile males have been enhanced in the St. Marys River since 1997. Sterile males are no longer released in Lake Superior tributaries (except for select study streams). Male sea lampreys are captured during their spawning migrations in tributaries of 4 Great Lakes, and transported to the sterilisation facility at the Hammond Bay Biological Station. At the facility, lampreys are sterilised with the chemosterilant bisazir, decontaminated, and then released into the St. Marys River. Laboratory and field studies have shown that treated male sea lampreys are sterile, sexually competitive, and the number of larvae that hatch in streams is reduced.

The Sterile Male Release Technique Task Force was established during 1984 to refine the long-term strategy for application of the technique and to co-ordinate 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 pages 52-54.

The following statements highlight the sterile male release program during 1999:

- Male sea lampreys were collected from assessment traps on 15 Great Lakes tributaries and 28,692 were delivered to the Hammond Bay Biological Station for use in the sterilization program.

- A total of 26,285 sterilized male sea lampreys were released in the St. Marys River during May 6-July 16. The estimated resident population of spawning-phase sea lampreys in the St. Marys River was 19,860 (12,002 males). Assessment traps removed 11,204 sea lampreys (6,771 male sea lampreys; a theoretical reduction of 53% from trapping). An estimated 5,588 male sea lampreys remained in the river. The ratio of sterile males to male sea lampreys remaining in the St. Marys River was estimated at 4.7:1 (26,285 sterile:5,588 untreated males).

- The theoretical reduction from trapping and enhanced sterile male release was estimated at 92% during 1999, an increase from an average of 84% during 1997-1998. Prior to enhancement, the theoretical reduction in reproduction from sterile male release combined with the number of lampreys removed by traps averaged 62% during 1991-1996.

- With the enhanced release, the theoretical reduction in reproduction from sterile male release (on the population of spawning sea lampreys remaining after trapping) in the St. Marys River was 83% during 1999, an increase from an average of 77% during 1997-1998. Prior to enhancement, the theoretical reduction in reproduction from sterile male release averaged 32% during 1991-1996.

- Egg viability of 12 nests sampled in the St. Marys River rapids averaged 8%.

- Assessments were concluded in 7 of 8 study streams of Lake Superior (U.S. - Middle, Misery, Big Garlic and Rock rivers; Canada - Carp, Wolf and Big Carp rivers and Stokely Cr.) in this last year of a 4-year evaluation (long-term study) of the technique that is testing survival of yearling larvae and density-dependant factors. The eighth stream (Big Carp River) is one year later in the schedule. In accordance with study design, untreated spawning phase male (130) and female (130) sea lampreys were released into the Big Carp River to produce study populations. Study of this last stream will conclude during 2000.

- Assessments investigating density-dependent effects in larval populations at projected densities much lower than were created in the long-term study were initiated in a pilot study during 1999. Untreated male and female sea lampreys were introduced into 7 of the long-term study streams at about 1/20th the numbers used in the long-term study (Middle-50 males, 50 females; Misery-35 males, 35 females; Big Garlic-7 males, 7 females; Rock-24 males, 24 females; Carp-7 males, 7 females; Stokely-7 males, 7 females; and Wolf-10 males, 10 females; Table 8). Prior to release, genetic samples were collected from each sea lamprey and will be used to determine the parentage of individual offspring. Evaluation of density of yearling larvae will occur during 2000.

- Water samples from the sterilization facility effluent and from sea lamprey holding tanks inside the facility were monitored for bisazir. Bisazir was not detected in any effluent samples. Water was monitored in 42 holding tanks that held decontaminated sterile sea lampreys.

- 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 systematically in about 2% of the injections. Good injection precision was achieved. The injector continues to deliver an average dose error of +0.2 ml per injection (range -0.12 -+1.0). The average injection was 2.8 ml and the average lamprey weight was 253 g.

- A shipment of 1,460g of bisazir was received and met purity requirements.

- Samples of bisazir stock solution, as prepared for use in the facility, were analysed for concentration. Bisazir stock solution averaged 10,714 $\mu g \cdot l^{-1}$ (range, 10,700 $\mu g \cdot l^{-1}$ - 12,100 $\mu g \cdot l^{-1}$) of desired concentration (10,000 $\mu g \cdot l^{-1}$) based on a comparison with a bisazir standard prepared with 1990 stock.

- About 1,715 male and 17,929 female sea lampreys were used in studies and outreach activities.

Table 8. Interim results of the long-term study including river, number of sea lampreys released[1], number of nests observed, percent egg viability, and estimated stream habitat (types I, II, and III). These are provisional data and are not conclusive.

River	Spawner Lampreys Released: Males, Sterile	Spawner Lampreys Released: Males, Untreated	Spawner Lampreys Released: Females	Number of Nests	Percent Egg Viability	Area of Habitat (m^2)[3]: I	Area of Habitat (m^2)[3]: II	Area of Habitat (m^2)[3]: III
Middle	0	50	50	---	---	2,626	42,530	216,675
Misery[4]	0	35	35	---	---	31,522	203,682	37,113
Big Garlic	0	7	7	---	---	7,817	23,879	18,174
Rock[4]	0	24	24	---	---	65,860	50,118	33,653
Carp	0	7	7	---	---	6,895	27,397	40,400
Stokely	0	7	7	---	---	1,747	17,944	55,974
Wolf	0	10	10	---	---	2,170	29,035	109,625
Big Carp[2]	0	130	130	14	56.7	1,230	32,958	9,481

[1]A pilot study was initiated during 1999. Untreated sea lampreys were released at 1/20th the number released in the long-term study.
[2]The long-term study was initiated in the Big Carp River one year later in the schedule. The final release of lampreys occurred during 1999 and nest sampling was required. The final assessment will occur during 2000.
[3]The area of each habitat type (I, II, and III) was estimated by multiplying the average width of each type by the total stream length in which the habitat was measured. Type I habitat is preferred by sea lamprey larvae, type II is acceptable though not preferred, and sea lampreys cannot burrow in type III.
[4]The study areas on the Misery and Rock rivers were expanded from the areas studied during 1996 after larvae were found in additional areas during 1997.

Barriers

The Commission is committed to reducing the use of TFM through the implementation of alternative lamprey control strategies, which include the use of barriers to sea lamprey migration. This was the second year of a 2-year transition phase initiated by the Commission to advance the barrier program from a developmental program to a fully operational program. The Barrier Transition Team, consisting of agent barrier program staff, a Commission Secretariat representative, and consultants M. S. Millar and Ian Ross, developed a final draft of a barrier protocol document which includes standard operating procedures for site selection, design, administration, environmental assessment, identification of research needs, and operation and maintenance of sea lamprey barriers. The new program draws on engineering and biological expertise from both agents in a fully bi-national context.

A total of 61 barriers have been constructed or modified to stop sea lampreys on tributaries of the Great Lakes (Fig. 8; 12 on Lake Superior, 12 on Lake Michigan, 17 on Lake Huron, 7 on Lake Erie, 13 on Lake Ontario). The Barrier Task Force was established during 1991 to co-ordinate optimized implementation and establish research priorities for the barrier program throughout the Great Lakes. The report of progress of the task force is presented on page 56.

The following statements highlight the barrier projects on each lake during 1999:

Lake Superior

- A Wisconsin judge's ruling to issue the abandonment permit needed to remove the Orienta dam on the Iron River was appealed during 1999. The ruling was upheld and the permit was issued to remove and replace the dam with a fish and sea lamprey barrier during 2000.

- The Commission and the Bad River Band of the Lake Superior Tribe of Chippewa Indians signed a Memorandum of Agreement enabling the U.S. Army Corps of Engineers (Corps) to study Elm Hoist Bridge on the Bad River as a barrier site under Section 22 of the Water Resources Development Act of 1974 (Planning Assistance to States and Tribes). The Corps will fund 50% of the study cost.

- Automatic water level recording devices were installed on Cash Creek, a 2001 barrier candidate stream, to obtain hydrology data.

Lake Michigan

- Manistique River - Manistique Papers, Inc. built low weirs across 13 old turbine bays in the Manistique Dam to prevent lamprey passage through the flume. This dam protects 2,849 km^2 of the entire Manistique River drainage from sea lamprey infestation. The Department provided review of designs and construction inspection.

- Kids Creek (Boardman R.) - The feasibility study phase of the U.S. Army Corps of Engineers barrier project under Section 206 of the Water Resources Development Act of 1996 (Aquatic Ecosystem Protection and Restoration) continued with the development of a draft Preliminary Restoration Report. Under Section 206, the Corps supplies 50% of the project cost.

- Little Manistee River - The dual-purpose low head dam at the Michigan Department of Natural Resources (MDNR) salmonid egg-take facility, which also functions as a sea lamprey barrier, became undermined in May and passed spawning adult lampreys upstream. The MDNR had the structure rebuilt by late July thereby restoring the barrier and lamprey trapping site.

- Pere Marquette River - A pumped-source fishway around the electrical weir was constructed for operation beginning in the spring of 2000. The wooden electrical weir deck, which had become undermined since its construction during 1988, was repaired. The Department barrier engineer provided the design and construction inspection. The electrical weir has not been operated since 1990 due to concerns about steelhead passage.

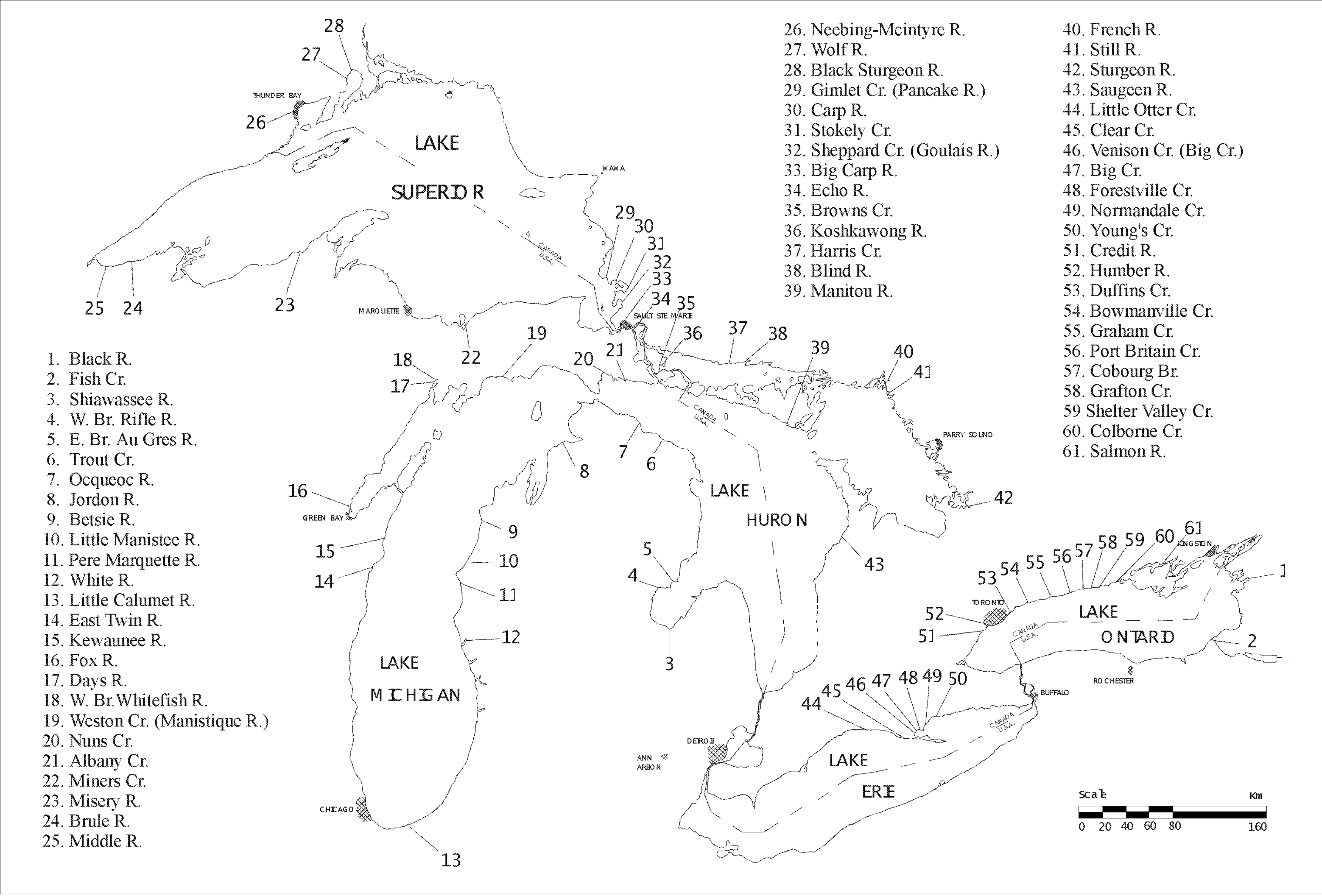


Fig. 8 Location of tributaries with sea lamprey barriers.

- White River – The Hesperia Dam required additional remedial work to function as a barrier. Boards were replaced in one bay, concrete work was done to the face of the structure, a wall along the downstream apron was repaired, and a section of the apron was provided with a steel lip.

- Paw Paw River - The U.S. Army Corps of Engineers barrier project under Section 1135 of the Water Resources Development Act of 1986 (Project Modifications for Improving the Quality of the Environment) continued with development of a draft of the Ecosystem Restoration Report. The Corps will provide 75% of the project cost.

- Automatic water level recording devices were installed in several high-priority barrier candidate streams to obtain hydrology data for future barrier design.

Lake Huron

- Ocqueoc River - Construction of an experimental barrier was completed. The barrier is a combination fixed-crest barrier with a gradient field electrical weir that is activated only when the tailwater rises to the point that sea lampreys would swim over the crest.

- Automatic water level recording devices were installed in three high-priority barrier candidate streams to obtain hydrology data for future barrier design.

Lake Erie

- Big Creek - The inflatable barrier fishway was operated during the 1999 spawning run. Major improvements were made to the fishway during the summer and fall. These included raising the walls with an additional 60 cm of concrete, rebuilding the screens and baffles to fit the higher structure, adding an overhead beam and trolley-run hoist the length of the fishway and fabricating new traps for fish and lamprey.

- Grand River, Ontario - an analysis of frequency of recurrence of Lake Erie water levels by SLCC engineering unit staff found that water levels below the Dunnville dam are high enough every two years during the April to June period to enable sea lamprey passage. Because of this, maintaining the lamprey barrier status of the next dam upstream at Caledonia is important.

Lake Ontario

- Cobourg Brook – A fishway at the sea lamprey barrier was operated through a partnership with the Central Lake Ontario Conservation Authority.

- Automatic water level recording devices were installed and monitored in three barrier candidate streams in order to obtain hydrology data for use in future barrier design.

ASSESSMENT

<u>Larval</u>

Tributaries to the Great Lakes systematically are assessed for abundance and distribution of sea lamprey larvae. Sampling information is used to determine when and where lampricide treatments are required and to measure the effectiveness of past treatments. Surveys are conducted with backpack electrofishers in waters that are <1m deep. Waters >1m in depth are surveyed with deepwater electrofishers or the granular formulation of Bayluscide. Data collected from these surveys are used to estimate the number of metamorphosed sea lampreys that will leave individual tributaries the following year and to define the upstream and downstream distribution of the larvae.

Streams were surveyed during 1999 to estimate larval density and habitat, and were selected for lampricide treatment during 2000 based on an estimated cost per kill of metamorphosed sea lampreys. Samples of larvae randomly were collected in each stream, catches were adjusted for gear efficiency, and lengths were standardized to the end of the growing season. The total number of sea lamprey larvae in each tributary was estimated by multiplying the mean density by estimated area of suitable habitat. The number of transforming sea lampreys produced in each tributary was estimated based on the probability that larvae collected during 1999 would metamorphose during 2000. The probability of metamorphosis was developed from historical relations of the proportion of metamorphosed sea lampreys to larval sea lampreys collected during lampricide applications.

The Assessment Task Force was established during 1996 to develop an optimal assessment program through the review of established protocols and the development of new techniques for assessment in the control program. The report on progress of the task force is presented on pages 57 and 58.

Lake Superior

- Assessments of populations of sea lamprey larvae were conducted in 70 tributaries (23 U.S., 47 Canada) and offshore of 12 tributaries (3 U.S., 9 Canada). The status of larval sea lamprey populations in streams treated during the last ten years is presented in Table 9.

- Populations were estimated in 22 tributaries (13 U.S., 9 Canada; Table 9).

- Assessments were conducted in 4 tributaries (3 U.S., 1 Canada) to establish stock recruitment relations as part of a Great Lakes-wide study to determine if sea lamprey populations compensate in response to the effects of control actions.

- A larval sea lamprey population was found for the first time in the Little Pays Plat River (Canada).

Lake Michigan

- Assessments of populations of sea lamprey larvae were conducted in 62 tributaries and offshore of 7 tributaries. The status of larval sea lamprey populations in streams treated during the last ten years is presented in Table 10.

- Populations were estimated in 30 tributaries (Table 10).

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

- Larvae of the 1997 and 1998 year classes were collected upstream from the flume and dam in the lower Manistique River.

- Larvae of the 1998 and 1999 year classes were collected upstream of the electric barrier in the Jordan River.

Lake Huron

- Assessments of populations of sea lamprey larvae were conducted in 93 tributaries (32 U.S., 61 Canada). The status of larval sea lamprey populations in streams treated during the last ten years is presented in Table 11.

- Populations were estimated in 34 tributaries (21 U.S., 13 Canada; Table 11).

Table 9. Status of Lake Superior tributaries that have been treated for sea lamprey larvae during 1990-1999, and sea lamprey population estimates for tributaries surveyed during 1999.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
United States							
Galloway Cr.	Jun-92	1998	No	1997			
Tahquamenon R.	Jun-97	1999	No	1997	42,067	0	No
Betsy R.	Aug-94	1999	Yes	1995	24,383	3,427	Yes
Little Two Hearted R.	Jul-91	1999	No	1994	52,263	1,076	Yes
Two Hearted R.	Sep-99	-[1]					
Sucker R. – Entire	May-98	-[2]					
Sucker R. – Lower	Oct-96	1997					
Sable Cr.	Sep-89	1999	No	1999			
Miners R.	Jun-98	-[1]					
Furnace Cr.	Aug-93	1998	No	1995			
Fivemile Cr.	Oct-98	-[1]					
AuTrain R. - Upper R. + tribs.	Aug-96	-[1]					
AuTrain R. - Lower R.	Aug-97	-[1]					
Rock R.	Jul-90	1999					Yes[4]
Laughing Whitefish R.	Jun-98	-[1]					
Chocolay R.	Jun-98	-[1]					
Carp R.	Aug-96	-[1]					
Harlow Cr.	Aug-97	-[1]					
Little Garlic R.	Jul-96	1999	Yes	1996	33,800	266	Yes
Big Garlic R.	Jul-99	1999					Yes[4]
Iron R.	Jul-96	1999	No	1997			No
Salmon Trout R.	Jun-95	1999	No	1995	417,718	602	Yes
Huron R.	Oct-99	-[1]					
Ravine R.	Sep-98	1999[2]	Yes	1996			
Falls R.	Sep-96	1999[2]	No	NA			
Sturgeon R.	Sep-99	-[1]					
Traprock R.	Sep-98	-[1]					
Traverse R.	Sep-97	-[1]					
Salmon Trout R.	Aug-92	1998	No	1994			
Misery R.	Sep-93	1999					Yes[4]
East Sleeping R.	Oct-99	-[1]					
Firesteel R.	Sep-96	1999	Yes	1997	286,151	831	Yes
Ontonagon R.	Sep-96	1999	Yes	1997	157,653	2,492	No
Potato R.	Jun-97	1999	Yes	1997	116,221	978	Yes

Table 9. Continued.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
Cranberry R.	Oct-96	1999	Yes	1997	108,640	6,093	Yes
Bad R.	Sep-98	-[1]					
Red Cliff Cr.	Oct-98	1998[2]	Yes				
Sand R.	Oct-91	1996	No	None			
Brule R.	Jul-97	-[1]					
Poplar R.	Oct-96	1999	No	1999			
Middle R.	Sep-94	1999					Yes[4]
Amnicon R.	Oct-98	1999	Yes	1999			
Nemaji R. (Black R.)	Jul-97	1999	Yes	1997	27,180	228	Yes
<u>Canada</u>							
West Davignon Cr.	May-89	1999	No	-[3]			
Little Carp R.	Jun-93	1998	No	1994			
Big Carp R.	Jun-93	1999	No	1993	5,725	355	Yes[4]
Cranberry Cr.	Jun-90	1999	No	None			
Goulais R.	Jul-99	-[1]					
Westman Cr.	Never	1998	NA	-[3]			
Haviland Cr.	Never	1999	NA	-[3]			
Stokley Cr.	Jun-80	1999	No	1996	8,838	1	Yes[4]
Harmony R.	Jun-90	1999	Yes[2]	None			
Chippewa R.	Jul-98	-[1]	-[2]				
Batchawana Bay - Chippewa R.	Sep-87	1999	-[3]		3,808	13	No
Batchawana R.	Oct-98	-[1]	-[2]				
Batchawana Bay-Batchawana R.	Aug-87	1999	-[3]		151,441	3,810	Yes
Carp R.	Jun-94	1999	No[2]	1996	112,048	57	Yes[4]
Pancake R.	Jul-98	-[1]	-[2]				
Agawa R.	Sep-97	1998	Yes				
Gargantua R.	Aug-99	-[1]					
Michipicoten R.	Aug-99	-[1]					
Pic R.	Sep-97	1998	No	1997			
Little Pic R.	Sep-94	1999	No	1995	3,202	33	No
Prairie R.	Jul-94	1999	Yes	1998			
Steel R.	Jul-89	1998	No	1989			
Pays Plat R.	Jul-97	1999	No	1997			
Little Pays Plat R.	Never	1999		-[3]			
Gravel R.	Aug-98	-[1]	-[2]				

Table 9. Continued.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
Mountain Bay - Gravel R.	Aug-88	1999	-[2]	-[3]	3,880	407	Yes
Little Gravel R.	Jul-95	1999	No[2]	1995	13,248	89	No
Cypress R.	Aug-99	-[1]					
Jackfish R.	Jul-96	1999	No	1996	93,625	1,137	Yes
Upper Nipigon R.	Sep-99	-[1]					
Lower Nipigon R.	Jul-83	1999	Yes	1983	11,775	955	No
Cash Cr.	Jul-96	1999		1996	19,138	3	No
Polly Cr.	Jul-87	1994	Yes	1988			
Stillwater Cr.	Jul-96	1999	No	1996	371	0	No
Black Sturgeon R.	Aug-99	-[1]					
Wolf R. – Above Barrier	Jul-94	1999	No	1996	200,893	33	Yes[4]
Wolf R. – Below Barrier	Jul-94	1999	Yes[2]	1994	378,155	266	Yes
Pearl R.	Jul-91	1999	No	1991	25,273	40	No
MacKenzie R.	Sep-78	1997	No[2]	-[3]			
McIntyre R.	Aug-97	-[1]					
Neebing R.	Jul-94	1998	Yes	1995			
Kaministiquia R.	Aug-97	1998	Yes	1998			
Cloud R.	Jul-94	1998	No	None			
Pigeon R.	Aug-99	-[1]					

[1]Not surveyed since last treatment.
[2]Stream had a known lentic population.
[3]Larval sea lamprey present but unable to determine age of older cohorts.
[4]Stream is subject of long-term sterile male release study and is scheduled for lampricide treatment during 2000.

Table 10. Status of Lake Michigan tributaries that have been treated for sea lamprey larvae during 1990-1999, and sea lamprey population estimates for tributaries surveyed during 1999.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
United States							
Brevort R.	May-89	1998	No	1991			
Hog Island Cr.	Jun-96	1999	Yes	1996	24,391	51	No
Black R.	Jun-99	-[1]					
Millecoquins R.	Jun-96	1999	Yes	1996	154,113	4,854	Yes
Rock R.	Jun-95	1998	No	1996	404	202	Yes
Crow R.[4]	May-86	1999	No	1996	19,500	1,429	Yes
Cataract R.[4]	Sep-75	1999	No	1995	5,047	21	No
Hudson Cr.	May-98	-[1]					
Milakokia R.	Jun-99	-[1]					
Bulldog Cr.	Jun-97	-[1]					
Gulliver Lake Outlet[4]	Aug-88	1999	No	1995	5,402	602	Yes
Marblehead Cr.	Jun-96	1999	No	1996	2,938	212	Yes
Manistique R.[4]	Aug-89	1999[2,3]	No		646,839	114	No
Johnson Cr.[4]	Aug-81	1998	No	1995			
Deadhorse Cr.	May-91	1999	No	1992	4,317	90	No
Bursaw Cr.	May-97	-[1]					
Parent Cr.	Jun-91	1998	No	1995			
Poodle Pete Cr.	Jun-91	1998	No	1994			
Valentine Cr.	Jun-97	-[1]					
Little Fishdam R.	Jul-92	1999	No	1995	14,361	43	No
Big Fishdam R.	May-99	-[1]					
Sturgeon R.	Oct-98	-[1]					
Ogontz R.	Oct-96	1999	Yes	1996	45,552	24	No
Squaw Cr.[4]	Sep-78	1999	No	1996	1,414	680	Yes
Whitefish R.	Jun-98	-[1]					
Rapid R.	May-99	-[1]					
Tacoosh R.	Oct-96	1999	Yes	1997	25,514	657	Yes
Days R.	Oct-99	1999[2,3]					Yes
Portage Cr.	Jun-97	-[1]					
Ford R.	Jun-96	1999	Yes	1996	1,209,457	4,330	Yes

Table 10. Continued.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
Bark R.	May-99	-[1]					
Arthur Bay Cr.	Apr-70	1999	No	1995			
Cedar R.	May-97	1999	Yes	1997	69,777	2,233	No
Bailey Cr.	May-98	-[1]					
Beattie Cr.[4]	Jun-88	1999	Yes	1994	2,421	28	No
Springer Cr.	May-99	-[1]					
Peshtigo R.	Aug-96	1999	No	1996	-[5]		No
Oconto R.	Sep-97	1999	No	1998	-[5]		No
Hibbards Cr.	May-98	-[1]					
East Twin R.	May-95	1999	No	1995	33,924	9,385	Yes
Carp Lake R.	Sep-94	1997	No	None			
Big Stone Cr.	May-97						
Wycamp Lake Outlet[4]	Sep-88	1999	No	-[5]	5,776	1,034	Yes
Horton Cr.	Sep-93	1999[2,3]	No	-[5]	74	0	Yes
Boyne R.	Sep-97	1999[2,3]	No	1998			
Porter Cr.	Oct-99	1999[1,2,3]					
Jordan R.	Aug-97	1999	No	1999			
McGeach Cr.	Sep-99	-[1]					
Elk Lake Outlet	May-97	1999	No	1997			
Mitchell Cr.	May-99	-[1]					
Boardman R.							
Hospital Cr.	Aug-96	1999	Yes	1997	12,761	400	Yes
Lower	Aug-96	1999[2,3]	Yes	1997	27,442	3,272	Yes
Goodharbor Cr.	May-97	1999	Yes	1997	3,488	105	No
Platte R.	Sep-96	1999	No	1997	586,470	1,206	No
Betsie R.	Jul-99	-[1]					
Big Manistee R.	Aug-98	1998	Yes	Unknown			
L. Manistee R.	Jul-98	-[1]					
Gurney Cr.	Sep-93	1999	No	1997	397	4	No
Lincoln R.	Jun-98	-[1]					
Pere Marquette R.	Aug-99	-[1]					
Pentwater R.	Jul-97	-[1]					

Table 10. Continued.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
White R.	Aug-99	-[1]					
Muskegon R.	Jul-96	1999	Yes	1997	2,362,862	65,376	Yes
Brooks Cr.[4]	Jul-89	1991	No	-[5]	5,326	152	Yes
Cedar Cr.[4]	Jul-89	1999	No	-[5]	102,476	8,174	Yes
Bridgeton Cr.	May-95	1999	No	-[5]			No
Minnie Cr.	May-95	1999	No	1997	629	0	Yes
Bigelow Cr.	May-95	1999	No	1996	118,156	8,488	Yes
Grand R.							
Norris Cr.[4]	Jun-87	1999	No	-[5]	4,740	1,248	Yes
Sand Cr.	Sep-96	1999	No	1997			
Crockery Cr.	Sep-91	1999	No	-[5]	97,263	13,427	Yes
Kalamazoo R.							
Bear Cr.	Jun-98	-[1]					
Sand Cr.	May-92	1999	Yes	1996	1,487	228	Yes
Mann Cr.	Aug-97	-[1]					
Black R.	Aug-97	-[1]					
Rogers Cr.	May-98	-[1]					
St. Joseph R.							
Paw Paw R.	Jun-97	1999	Yes	1998	28,688	2,853	No
Mill Cr.	Jun-97	1999	No	1997	23,811	397	No
Brandywine Cr.	Jun-97	1999	Yes	None	358	356	No
Brush Cr.	Jun-97	1999	No	1998			No
Galien R.	Jun-99	-[1]					
S. Br. Spring Cr.	May-98	-[1]					
Galena Cr.	Jun-99	-[1]					
Trail Cr.	May-92	1999	Yes	-[5]	18,785	7,228	Yes
Burns Ditch	Jul-99	-[1]					

[1]Not surveyed since last lampricide treatment.
[2]Stream has a known lentic population.
[3]Lentic survey during 1999.
[4]Not treated during the past 10 years but quantitative larval surveys were conducted during 1999.
[5]Larval sea lampreys present but unable to determine age of older cohorts.

- Assessments were conducted in 6 tributaries (4 U.S., 2 Canada) to establish stock recruitment relations as part of a Great Lakes-wide study to determine if sea lamprey populations compensate in response to the effects of control actions.

- Larvae were detected in the Bighead River for the first time and it is scheduled for treatment during 2000. Larvae were re-established in Bar River for the first time since the 1966 treatment.

- As a long-term measure of density of the larvae in the St. Marys River, index stations were established at 13 sites during 1994-1996, and 9 of these sites were sampled during 1999.

- As a measure of the effectiveness of the Bayluscide treatment in the St. Marys River, 900 samples were collected using the deepwater electrofisher in a stratified random design before and after treatment and in and outside of the treated areas.

- Bayluscide treatments targeted 44% of the St. Marys population of sea lamprey larvae during 1999. Assessments showed larval densities were reduced in the treated areas by 88%, and in the river by 39%.

Lake Erie

- A total of 12 streams were assessed for larval sea lamprey (4 United States, 8 Canada). The status of larval sea lamprey populations in streams treated during the last ten years is presented in Table 12.

- Sea lampreys presently exist in 11 tributaries (7 United States, 4 Canada) and the St. Clair River. Of these, larvae are abundant in 4 tributaries (2 United States, 2 Canada). Larval sea lamprey were captured from Silver Creek (Canada) for the first time.

- Quantitative assessment of 3 tributaries (1 United States, 2 Canada; Table 12) is planned for 2000 to rank the streams for potential lampricide treatment during 2001.

- Assessment (with granular Bayluscide) of the Canadian waters of the Detroit River is planned for 2000.

Lake Ontario

- Assessments were conducted in 34 tributaries (16 United States, 18 Canada). The status of populations of larval sea lamprey populations in streams treated during the last 10 years is presented in Table 13.

- Populations were estimated in 12 tributaries (4 United States, 8 Canada; Table 13).

- Assessments estimated the number of larvae that survived the 1997 and 1998 lampricide treatments of the tributaries of the Salmon River (New York) and remained in the tributaries during 1999. An estimated 8% of the 1997 pre-treatment population of larvae and 2% of the 1998 pre-treatment population remained during 1999. While these assessments were conducted as partial reviews of lampricide treatment effectiveness, the estimates do not account for larval out-migration, over-winter mortality, and transformation into parasitic adults between the pre- and post-treatment periods.

- An assessment in the Niagara River produced 11 larval sea lamprey from 63-500m^2 plots. Subsequently, the population of larvae was estimated at 36,700, of which 12,500 were predicted to transform into parasites during 2000. Variable gear efficiency and extremely low CPUE impart uncertainty to this estimate, and monitoring of the population will continue.

- As part of a Great Lakes-wide study on compensatory mechanisms in sea lamprey populations, stock recruitment relationships were assessed in 2 tributaries (1 United States, 1 Canada).

Table 11. Status of Lake Huron tributaries that have been treated for sea lamprey larvae during 1990-1999, and sea lamprey population estimates for tributaries surveyed during 1999.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
United States							
Little Munuscong R.	Jun-99	-[1]					
Big Munuscong R.	Jun-99	-[1]					
Carlton Cr.	May-86	1999	No	1996	-[5]		No
Caribou Cr.	May-91	1999	No	1996	-[5]		No
Joe Straw Cr.	May-75	1999	No	Unknown			No
Albany Cr.	May-94	1999	Yes	1994	523,351	984	Yes
Trout Cr.	May-94	1998	Yes	1994			
Beavertail Cr.	May-96	1999	Yes	1996	44,717	2,320	Yes
Prentiss Cr.	Oct-93	1999	No	1996			
McKay Cr.	May-95	1999	Yes	1995	-[5]		No
Flowers Cr.	Sep-91	1995	No				
Ceville Cr.	May-94	1999	No	1996	8,491	300	Yes
Hessel Cr.	May-91	1997	No				
Nunns Cr.	May-96	1999	No	1996	2,774	0	No
Pine R.	May-98	-[1,2]					
Martineau Cr.	Oct-93	1997	No	None			
Carp R.	May-96	1999	Yes	1996	240,330	3,189	Yes
Cheboygan R.							
Maple R.	Oct-98	1999	No	None			No
Pigeon R.	Sep-97	-[1]					
Sturgeon R.	Sep-99	-[1]					
Laperell Cr.	May-89	1999	No	-[3]	847	2	Yes
Meyers Cr.	Sep-99	-[1]					
L. Pigeon R.	Aug-98	-[1]					
Elliot Cr.	May-96	1999	No	1996	9,394	6	No
Greene Cr.	May-96	1999	Yes	1996	8,023	46	No
Mulligan Cr.	May-94	1998	No	None			
Black Mallard Cr.	May-92	1999	No	-[3]	26,785	1,495	Yes
Ocqueoc R.							
Lower	Sep-97	-[1]					
Upper	Aug-98	-[1]					
Schmidt Cr.	Sep-98	-[1]					
Trout R.	May-97	1999	Yes	1997	132,299	1,580	Yes
Swan R.	May-96	1999	No	-[3]	355	181	No
Grand Lake Outlet	Never	1998	N/A	-[3]			
Devils R.	May-95	1999	Yes	1995	11,664	894	Yes

Table 11. Continued.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
Black R.	Jun-98	-[1]					
Au Sable R.	Jul-98	-[1]					
Tawas Lake Outlet	Jul-96	1999	No	1997			
Silver Cr.	Aug-97	1999	Yes	1998	108,358	1,440	Yes
Cold Cr.	Jul-96	1999	Yes	1997	5,215	603	Yes
Sims Cr.	Jul-98	-[1]					
East Au Gres R.	May-97	1999	No	1997	114,020	308	No
Au Gres R.	May-97	1999	No	1997	46,527	7,581	Yes
Hope Cr.	Jul-96	1999	No	1997			
Rifle R.	Jul-97		Yes	1998	1,097,964	11,859	Yes
Saginaw R.							
Juniata Cr.	Sep-98	-[1]					
Chippewa R.	Sep-99	-[1,4]					
Big Salt Cr.	May-96	1998	No	None			
Big Salt R.	May-93	1997	No	1995			
Bluff Cr.	Sep-98	1999	Yes	None			
Shiawassee R.	Jun-97	1999	No	1997	15,557	905	No
<u>Canada</u>							
Root R.	Sep-99	-[1]					
Garden R.	Jul-97	-[1]					
Upper Echo R.	Oct-99	-[1]					
Lower Echo R.	Sep-99	-[1]					
Bar Cr.	Jun-98	-[1]					
Bar R.	Aug-66	1999	No	1996	190	35	No
Sucker Cr.	Jul-95	1999	Yes[3]	1996	2,467	236	Yes
Two Tree R.	May-90	1999	No	1993			
Richardson Cr.	Aug-96	1999					
Watson Cr.	Jul/Sep-98	-[1]					
Gordon Cr.	Oct-96	-[1]	-[3]				
Koshkawong R.	Jul-97	1999	Yes	1997	4,823	52	Yes
Unnamed (H-68)	Sep-75	1995	No[3]	Pre 1990			
Thessalon R.							
Upper	Jul-98	-[1]					
Middle	Aug-90	1997	No	None			
Lower	Jul-96	1999	No	1996	196,139	222	No
Livingston Cr.	Aug-94	1999	No	1995	696	190	Yes
Mississagi R.							
Main	Aug-95	1999	No[3]	1996	7,966,957	33,803	Yes
Pickerel Cr.	Jun-98	1999	No				

Table 11. Continued.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
Blind R.	May-84	1999	No	-[4]			
Lauzon R.	Sep-97	-[1]					
Spragge Cr.	Oct-95	1999	Yes	1996			
Unnamed (H-114)	Sep-97	1998	Yes	None			
Serpent R.							
Main	Jul-93	1998	No[3]	1993			Yes[6]
Grassy Cr.	Oct-99	-[1]					
Spanish R.	Jun/Oct-98	-[1]					
Kagawong R.	Aug-67	1999	No[3]	-[4]			
Silver Cr.	May-94	1998	Yes	None			
Sand Cr.	Oct-94	1999	Yes	1995	1,501	39	No
Mindemoya R.	Jun-98	1998	Yes[3]	1998			
Timber Bay Cr.	Jun-98	1999	Yes	1998	8,473	50	No
Manitou R.	Sep-99	-[1]					
Blue Jay Cr.	Sep-99	-[1]					
Chikanishing R.	Jun-95	1999	Yes	1997	889	26	No
French R.							
Main	Never	1992	N/A	-[4]			
O.V. Channel	Jun-92	1999	No	1992	83	26	No
Wanapitei R.	Aug-94	1999	Yes	1995	244,685	718	Yes
Still R.	Jun-96	1999	No	None			
Magnetawan R.	Jul-99	-[1]					
Naiscoot R.	Jul-99	-[1]					
Shebeshekong R.	Never	1998	N/A	-[4]			Yes[6]
Boyne R.	Jun-99	-[1]					
Musquash R.	Aug-96	1999	Yes	1998			
Sturgeon R.	May-99	-[1]					
Nottawasaga R.							
Main	Jun-97	1998	Yes	1997			
Pine R.	Sep-98	-[1]					
Beaver R.	Never	1998	N/A	-[4]			
Bighead R.	Never	1999	N/A	-[4]	69,122	4,619	Yes
Sauble R.	Jun-96	1999	No	1996			
Saugeen R.	Jun-71	1998	No	-[4]			

[1]Not surveyed since last treatment.
[2]Lentic survey during 1999.
[3]Larval sea lampreys present but unable to determine age of cohorts.
[4]Stream has a known lentic population.
[5]Estimates of larvae and transformers developed from incomplete data. Decision for treatment will be re-evaluated following further assessment during 2000.
[6]Treatment deferred in 1999 because of low discharge.

Table 12. Status of Lake Erie tributaries that have been treated for sea lamprey larvae during 1990-1999, and sea lamprey population estimates for tributaries surveyed during 1999.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
United States							
Buffalo R.	Never	1999	-	1995			
Cattaraugus Cr.[1]	May-99	1999	-				
Canadaway Cr.	Oct-86	1999	No	1996			
Crooked Cr.[1]	May-99	1998	-				
Raccoon Cr.[2]	Oct-90	1998	No	1997			
Conneaut Cr.	Oct-95	1999	Yes	1996	35,529	24,690	Yes
Grand R.[1]	May-99	1998	-				
Canada							
Silver Cr.	Never	1999	-	1998			
Big Otter Cr.[2]	Sep-97	1999	Yes	1998			
Big Cr.[1]	Jun-99	1999	-				
Young's Cr.[2]	May-91	1999	No	1997			

[1]Not surveyed since last lampricide treatment.
[2]Quantitative larval assessment planned for 2000.

Table 13. Status of Lake Ontario tributaries that have been treated for sea lamprey larvae during 1990-1999, and sea lamprey population estimates for tributaries surveyed during 1999.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
United States							
Black R.	Jun-99	-[2]					
South Sandy Cr.	Apr-99	1999[3]	Yes	1999			
Skinner Cr.	May-93	1998	No	1995			
Lindsey Cr.	May-99	-[2]					
Little Sandy Cr.	Apr-98	1999[3]	Yes	1998			
Deer Cr.	May-99	-[2]					
Salmon R.	May-98	-[2,3]					
Salmon R. tribs	May-98	1999[3]	Yes	1998	58,542	45	No
Grindstone Cr.	May-99	1999	No	1999			
Snake Cr.	May-99	-[2]					
Little Salmon R.	May-97	1999	Yes	1997	304,752	7,361	Yes
Catfish Cr.	May-97	1999	Yes	1997	17,357	314	Yes
Oswego R. system							
Big Bay Cr.	Sep-93	1999	No	None			
Fish Cr.	May-98	1999[3]	Yes	1998			
Carpenters Br.	May-94	1998	No	None			
Putnam Br.	May-96	1999	Yes	None			

Table 13. Continued.

Stream	Last Treated	Last Surveyed	Residual Found	Oldest Reestablished Year-Class	Estimate of 1999 Larval Population	2000 Metamorphosing Estimate	On 2000 Treatment Schedule
Ninemile Cr.	May-98	1999	No	None			
Sterling Cr.	May-97	1999	Yes	1997	26,253	4,918	Yes
Red Cr.	Apr-94	1999	No	None			
Sodus Cr.	May-98	1999	No	1999			
First Cr.	May-95	1999	No	None			
Salmon Cr.	May-96	1999	Yes	None			
<u>Canada</u>							
Niagara R.	Never	1999[1]			36,696	12,511	No
Bronte Cr.	Apr-98	1999[3]	Yes	1998			
Credit R.	Jun-99	-[2]					
Rouge R.	Jun-98	1999[3]	Yes	1998			
Duffins Cr.	Oct-97	1999[3]	Yes	1998	11,604	389	No
Lynde Cr.	May-99	-[2]					
Oshawa Cr.	Oct-96	1999	Yes	1997	131,640	29,233	Yes
Farewell Cr.	Sep-95	1999	No	1996	8,479	3,272	Yes
Bowmanville Cr.	Apr-98	1999[3]	No	1998			
Wilmot Cr.	Oct-96	1999	No	1997	107,363	5,505	Yes
Graham Cr.	May-96	1998	No	None			
Port Britain Cr.	Sep-96	1999	No	None	5,548	948	Yes
Cobourg Br.	Sep-96	1999	No	None			
Covert Cr.	May-99	-[2]					
Grafton Cr.	Sep-96	1997	No	None			
Shelter Valley Br.	Sep-96	1999	No	None			
Colborne Cr.	Jun-95	1999	No	1995			
Salem Cr.	Aug-98	1999	No	None			
Proctor Cr.	Aug-98	1999	Yes	None			
Trent R.	Never	1999[1]					
Mayhew Cr.	Oct-96	1999	Yes	1997	1,616	729	Yes
Moira R.	Never	1999[1]					
Salmon R.	Jun-97	1999	Yes	1997	67,063	25,026	Yes

[1]Never treated, but larval sea lampreys collected in 1999.
[2]Not surveyed since last lampricide treatment.
[3]Quantitative larval assessment planned for 2000.

Spawning Phase

The long-term effectiveness of the control program is measured by assessing the population of spawning-phase and parasitic-phase sea lampreys. Traps are used to monitor sea lamprey spawning migrations during spring and early summer. Traps are portable (rectangular steel or aluminum mesh, hoop or fyke nets) or permanent (generally concrete or steel plate) and usually associated with a physical or electrical barrier. Total catch of sea lampreys is a measure of relative abundance. Biological characteristics (sex, weight, length) are recorded from sea lampreys captured from some streams.

Mark/recapture studies are conducted in most streams to estimate the spawning population for the year. These estimates are computed using a modified version of Schaefer (1951). Lake estimates are computed based on a relation ($y = ax$) of discharge (x) to the estimated number of adult sea lampreys that enter tributaries (y).

Lake Superior

- 11,744 sea lampreys were trapped in 23 tributaries (Table 14, Fig. 9).

- Estimated population of spawning-phase sea lampreys for the south shore of Lake Superior was 74,460 [54,286 west ($a = 156.01$; $r^2 = 0.97$, $P < 0.01$) and 20,174 east ($a = 53.23$; $r^2 = 0.98$, $P < 0.01$) of the Keweenaw Peninsula; Table 15].

- Spawning runs were monitored in the Amnicon, Middle, Bad, Firesteel, Misery, Silver and Ontonagon rivers through co-operative agreements with the Great Lakes Indian Fish and Wildlife Commission; in the Brule River with the Wisconsin Department of Natural Resources; in the Miners River with the National Park Service, Pictured Rocks National Lakeshore; and in the Nipigon River with a joint agreement between the Department and Ontario Power Generation.

- An expert panel peer-reviewed the adult sea lamprey assessment program (1997) and recommended actions to optimise the program. The recommendations included implementation of assessment of parasitic or transformer-phase sea lampreys through an in-lake mark/recapture approach. Implementation of these recommendations continued during 1999. During September-November, 2,246 transformer-phase sea lampreys were marked with coded wire tags and released into Lake Superior rivers (Brule-482, Misery-737, AuTrain-155, Two Hearted-147, Chippewa-148, Michipicoten-93, Nipigon-149, Wolf-150, McIntyre-145).

- First returns of the coded wire tagged sea lampreys from the 1998 release are expected in Lake Superior tributaries during spring 2000. It is anticipated that about 10% of the released juveniles will be captured as spawning adults.

- Fig. 2 shows a downward trend of spawning populations in the U.S. waters of western Lake Superior from 1986-95 and 1997-98. An increase was observed during 1996, and a substantial increase during 1999. Spawning populations in the U.S. waters of eastern Lake Superior remained relatively stable during 1986-1998, but increased during 1999.

Table 14. Stream, number caught, estimated spawner population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Superior, 1999. (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. (33)	1,061	4,464	24	204	75	457	448	207	209
Betsy R. (34)	137	224	61	62	60	443	437	199	205
Miners R. (35)	29	121	24	28	43	412	421	171	194
Furnace Bay Cr. (36)	28	59	47	11	55	451	394	205	147
Rock R (37)	2,664	5,348	50	0	34	-	-	-	-
Chocolay R. (38)	9	-	-	0	-	-	-	-	-
Big Garlic R. (39)	92	434	21	15	80	453	396	212	161
Silver R. (40)	55	651	8	56	34	447	428	234	218
Misery R. (41)	1,490	2,339	64	136	56	476	469	238	222
Firesteel R. (42)	33	84	39	33	61	464	447	236	196
Ontonagon R. (43)	9	-	-	0	-	-	-	-	-
Bad R. (44)	607	12,552	5	46	22	434	434	217	220
Red Cliff Cr. (45)	112	372	30	0	-	-	-	-	-
Brule R. (46)	1,616	2,324	70	0	49	-	-	-	-
Middle R. (47)	2,069	13,515	15	244	56	458	437	229	220
Amnicon R. (48)	78	600	13	2	50	501	460	243	233
Total or Mean (South Shore)	**10,089**	**43,087**		**837**	**58**	**455**	**438**	**217**	**211**
Canada									
McIntyre R. (49)	0	-	-		-	-	-	-	-
Wolf R. (50)	1,323	2,283[3]	58		-	-	-	-	-
Nipigon R. (51)	3	-	-		-	-	-	-	-
Pancake R. (52)	1	-	-		-	-	-	-	-
Carp R. (53)	306	446	69		-	-	-	-	-
Stokely Cr. (54)	12	-	-		-	-	-	-	-
Big Carp R. (55)	10	-	-		70	-	-	-	-
Total or Mean (North Shore)	**1,655**	**2,729**							
Total or Mean (For Lake)	**11,744**	**45,816**			**59**	**455**	**438**	**217**	**211**

[1]The number of sea lampreys from which all length and weight measurements were determined.
[2]Percent males generally determined from internal body examination of the number sampled.
[3]Population estimated from the proportion of marked recaptures to unmarked adults.

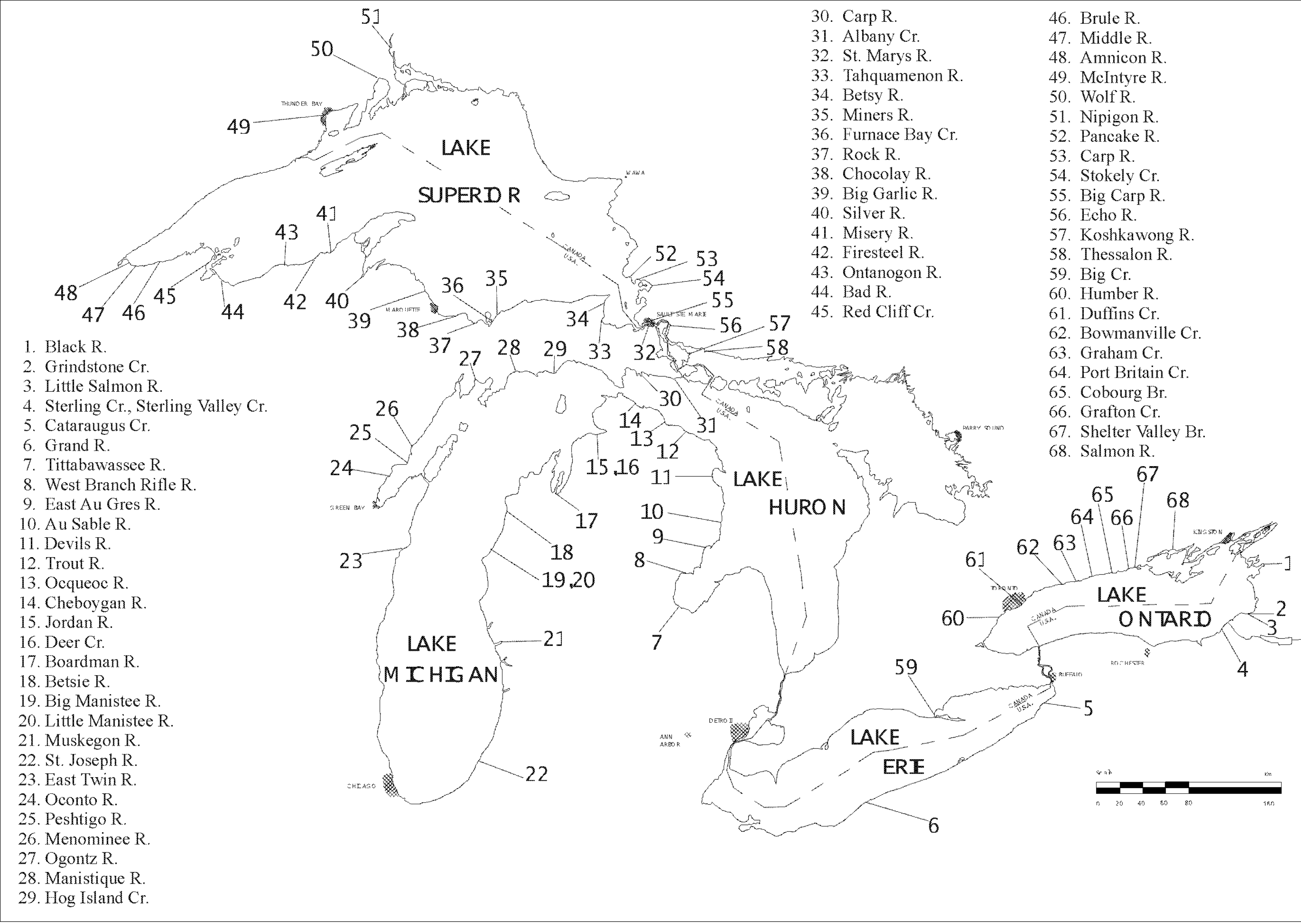


Fig. 9. Location of tributaries where assessment traps were operated during 1999.

Table 15. Spring mean 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 during 1999.

Primary Streams				Secondary Streams		
	Discharge m^3/s	Population Estimate Mark/Recap	Population Estimate Regression		Discharge m^3/s	Population Estimate Regression
EAST				**EAST**		
Tahquamenon R.	83.66	4,464	4,453	Waiska R.	14.79	79
Betsy R.	10.11	224	538	Pendills Cr.	1.51	8
Little Two Hearted R.	5.22		278	Galloway Cr.	0.74	4
Two Hearted R.	22.83		1,215	Sable Cr.	1.55	8
Sucker R.	12.60		671	Sullivans Cr.	0.45	2
Miners R.	2.95	121	157	Beaver Lake Outlet	1.26	7
Furnace Bay Cr.	1.39	59	74	Sand R. (Alger Co.)	2.51	13
Au Train R.	8.5		452	Carp R. (Marquette Co.)	5.94	32
Rock R.	3.83	5,348	5,348[4]	Little Garlic R.	1.72	9
Chocolay R.	16.09		856	Pine R. (Marquette Co.)	4.39	23
Harlow Cr.	1.82		97	Ravine R.	3.26	17
Big Garlic R.	1.73	434	92	Slate R.	2.03	11
Iron R. (Marquette Co.)	10.24		545			
Salmon Trout R. (Marquette Co.)	4.83		257			
Huron R.	7.08		377			
Silver R.	7.88	651	419			
Falls R.	4.99		266			
Sturgeon R.	70.12		3,732			
Traverse R.	2.52		134			
Subtotal (East)	**278.39**	**11,301**	**19,961**	**Subtotal (East)**	**40.15**	**213**
(w/traps)	**111.55**	**11,301**	**11,081**			
(wo/traps)	**166.84**	**0**	**8,880**			
WEST				**WEST**		
Salmon Trout R. (Houghton Co.)	5.38		839	Sand R. (Bayfield Co.)	3.79	59
Misery R.	4.18	2,339	2,339[4]			
East Sleeping R.	5.00		780			
Firesteel R.	7.95	84	1,240			
Ontonagon R.	122.66		19,136			
Potato R.	1.94		303			
Cranberry R.	1.77		276			
Bad R.	77.39	12,552	12,074			
Red Cliff Cr.	0.69	372	108			
Brule R.	19.58	2,324	3,055			
Middle R.	6.94	6,674	6,674			
Amnicon R.	11.49	600	1,793			
Nemadji R.	35.96		5,610			
Subtotal (West)		**24,945**	**54,227**	**Subtotal (West)**	**3.79**	**59**
(w/traps)	**128.22**	**24,945**	**27,283**			
(wo/traps)	**172.71**	**0**	**26,944**			
TOTAL SOUTH SHORE POPULATION ESTIMATE:				**74,460**		

[1]Primary streams are streams that are treated on a regular cycle ($\leq$ once every five years).

[2]Secondary streams are streams that are treated on an irregular cycle (> once every five years).

[3]Population estimates were calculated from stratified multiple mark/recapture studies, linear regressions relating past year's trap catch to 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 spring mean discharge to the number of lampreys entering the 14 tributaries.

[4]The Rock and Misery rivers annually receive 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

- 22,976 sea lampreys were trapped at 15 sites in 13 tributaries during 1999 (Table 16, Fig. 9).
- The estimated population of spawning-phase sea lampreys for Lake Michigan was 88,663 [60,637 north ($y = 341.04$; $r^2 = 0.94$, $P < 0.001$) and 28,026 south ($y = 38.53$; $r^2 = 0.43$, $P < 0.20$); Table 17].
- Spawning runs were monitored in the Boardman River through a co-operative agreement with the Grand Traverse Band of Ottawa and Chippewa Indians and in the Little Manistee River through a co-operative agreement with the Little River Band of Ottawa Indians.
- Fig. 3 shows the relatively stable trend of spawning populations in Lake Michigan during 1986-1999.

Table 16. Stream, number caught, estimated spawner population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 1999. (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									
Jordan R. (15)	146	323	45	55	18	446	460	217	244
Deer Cr. (16)	87	321	27	19	26	455	452	229	264
Boardman R. (17)	205	577	36	66	44	473	472	251	262
Betsie R. (18)	260	1,960	13	7	29	488	473	263	269
Big Manistee R. (19)	204	2,267	-	79	24	473	470	274	297
Little Manistee R. (20)	28	62	45	27	48	475	479	262	287
Muskegon R. (21)	62	-	24	12	100	471	-	276	-
St. Joseph R. (22)	68	-	9	11	73	465	468	266	236
East Twin R. (23)	30	64	47	4	25	423	402	171	153
Oconto R. (24)	13	-	-	0	-	-	-	-	-
Peshtigo R. (25)	1,095	5,763	4	541	51	501	506	283	294
Menominee R. (26)	184	-	-	0	-	-	-	-	-
Ogontz R. (27)	109	351	31	25	52	454	442	232	217
Manistique R. (28)	20,389	36,368	56	4	50	506	452	246	217
Hog Island Cr. (29)	96	411	23	5	67	512	489	281	275
Total or Mean	**22,976**	**48,467**		**865**	**46**	**492**	**489**	**274**	**283**

[1]The number of lampreys from which all length and weight measurements were determined.
[2]Percent males generally are determined from internal body examination of the number sampled. In the Manistique River, 20,389 additional lampreys were examined externally for secondary sexual characteristics to determine percent males.

Table 17. Spring discharge for U.S. streams, east and north and south from 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 during 1999.

Primary Streams			
	Discharge m^3/s	Population Estimate[3] Mark/Recap	Population Estimate[3] Regression
NORTH			
Hog Island Cr.	0.34	411	116
Black R.	1.78		607
Millecoquins R.	6.67		2,275
Hudson Cr.	0.17		58
Milakokia R.	4.70		1,603
Marblehead Cr.	0.46		157
Manistique R.	100.80	36,368	34,377[4]
Carp Lake R.	2.48		846
Horton Cr.	0.77		263
Boyne R.	3.03		1,033
Porter Cr.	1.04		355
Jordan R.	5.90	318	2,012
Deer Cr.	6.18	321	2,108
Boardman R.	20.30	577	6,923
Platte R.	4.00		1,364
Betsie R.	15.43	1,960	5,262
Subtotal (North)	**174.05**	**39,955**	**59,359**
(w/traps)	**148.95**	**39,955**	**50,798**
(w/o traps)	**25.10**		**8,561**
SOUTH			
Fishdam R.	4.13		159
Sturgeon R.	14.90		574
Ogontz R.	2.03	351	78
Whitefish R.	17.43		672
Rapid R.	7.71		297
Tacoosh R.	1.92		74
Days R.	4.79		185
Ford R.	47.50		1,830
Cedar R.	13.72		529
Peshtigo R.	68.50	5,763	2639
Oconto R.	48.10		1,853
East Twin R.	5.80	64	223
Big Manistee R.	108.38	2,267	4,176
Little Manistee R.	14.10	62	543
Lincoln R.	5.72		220
Pere Marquette R.	44.36		1,709
Pentwater R.	9.92		382
White R.	15.00		578
Muskegon R.	75.50		2,909
Black R. (Van Buren)	15.25		588
St. Joseph R.	145.00		5,587
Galien R.	8.44		325
Burns Ditch	4.02		155
Subtotal (South)	**682.22**	**8,507**	**26,285**
(w/traps)	**198.81**	**8,507**	**7,659**
(w/o traps)	**483.31**		**18,626**
Primary Lake Total	**850.37**	**48,462**	**85,644**

Secondary Streams		
	Discharge m^3/s	Population Estimate Regression
NORTH		
Brevort R.	4.24	145
Paquin Cr.	0.66	23
Rock R.	0.98	33
Crow R.	0.54	18
Bulldog Cr.	0.88	30
Gulliver Lake Outlet	0.34	12
Big Sucker Cr.	0.12	4
Wycamp Lake Outlet	1.05	36
Elk Lake Outlet	27.88	951
Mitchell Cr.	0.75	26
Subtotal (North)	**37.44**	**1,278**
SOUTH		
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	3
Bark R.	2.54	10
Bailey Cr.	0.10	0
Beattie Cr.	0.29	1
Menominee R.	219.00	844
Hibbards Cr.	0.12	0
Fisher Cr.	0.61	2
Gurney Cr.	0.70	3
Stoney Cr.	3.45	13
Grand R.	190.00	732
Kalamazoo R.	29.40	113
Brandywine Cr.	0.82	3
Trail Cr.	3.20	12
State Cr.	0.01	0
Subtotal (South)	**452.09**	**1,741**
Secondary Lake Total	**489.53**	**3,019**

TOTAL LAKE MICHIGAN POPULATION ESTIMATE: 88,663

[1]Primary streams are streams that are treated on a regular cycle ($\leq$ once every five years).
[2]Secondary streams are streams that are treated on an irregular cycle (> once every five years).
[3]Population estimates were calculated from stratified multiple mark/recapture studies, linear regressions relating past year's trap catch to 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 spring mean discharge to the number of lampreys entering the 11 tributaries.

[4]The Manistique River annually receives a substantial number of spawning sea lampreys, but does not meet the criteria of a primary stream (the river has a barrier near the mouth, it is treated occasionally above the barrier and irregularly below the barrier).

Lake Huron

- 37,494 sea lampreys were trapped at 15 sites in 14 tributaries (Table 18, Fig. 9).

- The estimated population of spawning-phase sea lampreys for Lake Huron was 238,112 [227,935 north ($a = 781.66$; $r^2 = 0.26$, $P < 0.50$) and 10,177 south ($a = 67.61$; $r^2 = 0.24$, $P < 0.50$) of a line from Alpena, Michigan to South Baymouth, Ontario to Espanola, Ontario; Table 19].

- Spawning runs were monitored in the Albany River through a co-operative agreement with the Chippewa/Ottawa Treaty Fishery Management Authority, and in the Tittabawassee River through a co-operative agreement with Dow Chemical USA.

- Traps operated in the St. Marys River at the Great Lakes Power facility in Canada and the U.S. Army Corps of Engineers facility in the U.S. captured 11,204 spawning-phase sea lampreys. The estimated population in the river was 19,860 and trap efficiency was 57% (Great Lakes Power - 44%, U.S. Army Corp of Engineers #10 - 13%). This was the highest combined efficiency ever achieved.

Lake Erie

- 503 sea lampreys were trapped in 3 tributaries (Table 20, Fig. 9).

- Current trap catch of spawning sea lampreys is less than the catch prior to the start of lampricide control (treatments began in 1986 and showed first effect on the spawner population in 1989), but is greater than 10% of pre-treatment catch (Fig. 9).

Lake Ontario

- 5,956 sea lampreys were trapped at 14 sites in 13 tributaries (Table 21, Fig. 9).

- Sea lamprey abundance in Lake Ontario has remained relatively stable during 1986-1999.

Table 18. Stream, number caught, estimated spawner population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Huron, 1999. (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									
Tittabawassee R. (7)	674	5,042	13	0	-	-	-	-	-
West Branch Rifle R. (8)	0	-	-	-	-	-	-	-	-
East Au Gres R. (9)	615	3,577	17	102	68	474	483	219	223
Au Sable R. (10)	148	818	18	21	76	493	470	237	244
Devils R. (11)	484	962	50	225	54	486	494	249	262
Trout R. (12)	297	800	37	0	-	-	-	-	-
Ocqueoc R. (13)	1,778	2,568	69	0	51	-	-	-	-
Cheboygan R. (14)	9,751	15,945	61	0	49	-	510	-	285
Carp R. (30)	3,482	14,817	24	125	66	488	473	263	269
Albany Cr. (31)	78	472	17	11	54	455	422	178	186
St. Marys R. (32)	2,566	See Canada	See Canada	0	64	-	-	-	-
Total or Mean (U.S.)	**19,873**	**-**	**-**	**484**	**61**	**486**	**490**	**243**	**254**
Canada									
St. Marys R. (32)	8,638	19,860	56	0	59	-	-	-	-
Echo R. (56)	5,716	11,829	48	0	56	-	-	-	-
Koshkawong R. (57)	216	-	-	0	56	-	-	-	-
Thessalon R. (58)	3,051	6,263[3]	49[3]	0	60	-	-	-	-
Total or Mean (Canada)	**17,621**	**-**	**-**	**0**	**58**	**-**	**-**	**-**	**-**
Total or Mean (for Lake)	**37,494**	**-**	**-**	**484**	**60**	**486**	**490**	**243**	**254**

[1]The number of sea lampreys from which all length and weight measurements were determined.
[2]Percent males is generally determined from internal body examination of the number sampled. But for six of the principal Lake Huron source streams for the sterile male program (Ocqueoc, Cheboygan, St. Marys (US & CAN), Echo, Koshkawong, & Thessalon), percent males was determined by external examination of the entire catch.
[3]The sum of two estimates/average of two efficiencies. The Little Thessalon River (formerly Bridgland Creek) estimate of 4,268 & efficiency of 68% are within statistical bounds, while the estimate of 1,995 & efficiency of 8% for the main stem of the Thessalon River are weak (CV >25%).

Table 19. Annual mean discharge for U.S. and Canadian streams north and south of a line from Alpena, Michigan to South Baymouth, Ontario to Espanola, Ontario in Lake Huron, ranked as primary[1] and secondary[2] producers of sea lampreys, and the estimated number of spawning-phase sea lampreys during 1999.

Primary Streams				Secondary Streams		
	Discharge m^3/s	Population Estimate[3] Mark/Recap	Population Estimate[3] Regression		Discharge m^3/s	Population Estimate[3] Regression
NORTH				**NORTH**		
St. Marys R.	2,122.50	19,860	19,860[4]	Munuscong R.	1.44	113
L. Munuscong R.	0.62		485	Carlton Cr.	0.14	11
Caribou Cr.	0.42		328	Ceville Cr.	1.08	84
Albany Cr.	0.76	472	594	Hessel Cr.	0.20	16
Trout Cr.	0.31		242	Steeles Cr.	0.23	18
Beavertail Cr.	0.68		532	Nunns Cr.	0.62	48
McKay Cr.	0.51		399	Mulligan Cr.	0.40	31
Pine R.	6.34		4,956	Sucker Cr.	0.20	16
Carp R.	8.12	14,817	6,347	Two Tree R.	0.45	35
Cheboygan R.	23.97	15,945	18,736	Richardson Cr.	0.31	24
Elliot Cr.	0.42		328	H-68	0.08	6
Greene Cr.	0.17		133	Livingstone Cr.	0.06	5
Black Mallard Cr.	0.28		219	Blind R.	6.34	496
Ocqueoc R.	2.75	2,568	2,150	Lauzon R.	0.37	29
Schmidt Cr.	0.74		578	Spragge Cr.	0.20	16
Trout R.	0.91	800	711	Serpent R.	9.85	770
Root R.	2.29		1,790	Spanish R.	215.84	16,871
Garden R.	7.98		6,238	Silver Cr.	0.48	38
Echo R.	1.61	11,829	1,258	Sand Cr.	0.28	22
Watson Cr.	0.14		109	Manitou R.	1.90	149
Gordon Cr.	0.11		86	Blue Jay Cr.	0.59	46
Browns Cr.	0.20		156			
Koshkawong R.	0.68	734	532			
Thessalon R.	10.47	6,263	8,184			
Mississagi R.	170.37		133,171			
Mindemoya R.	0.96		750			
Timber Bay Cr.	0.28		219			
Subtotal (North)	**2,364.59**	**73,288**	**209,091**	**Subtotal (North)**	**241.06**	**18,844**
(w/traps)	**2,171.77**	**73,288**	**58,372**			
(wo/traps)	**192.82**	**0**	**150,719**			
SOUTH				**SOUTH**		
Devils R.	0.71	962	48	Shiawassee R.	13.19	89
Au Sable R.	43.70	818	2,955	Cass Cr.	13.56	92
Tawas Lake Outlet	2.21		149	Mill Cr.	0.06	0
Au Gres R.	5.16		349	Pine R.	1.42	10
East Au Gres R.	2.52	3,577	170	Chikanishing R.	0.34	2
Rifle R.	9.68		654	French R.	6.83	1,466
Tittabawassee R.	49.38	5,042	3,339	Still R.	1.75	12
				Magnetawan R.	52.64	356
				Naiscoot R.	1.98	13
				Boyne R.	1.13	8
				Musquash R.	56.60	383
				Sturgeon R.	0.88	6
				Nottawasaga R.	7.78	53
				Sauble R.	3.42	23
Subtotal (South)	**113.36**	**10,399**	**7,664**	**Subtotal (South)**	**371.58**	**2,513**
(w/traps)	**96.31**	**10,399**	**6,512**			
(wo/traps)	**17.05**	**0**	**1,152**			
Primary Lake Total	**2,477.95**	**216,755**		**Secondary Lake Total**	**612.64**	**21,357**
TOTAL LAKE HURON POPULATION ESTIMATE:				**238,112**		

[1]Primary streams are streams that are treated on a regular cycle ($\leq$ once every five years).
[2]Secondary streams are streams that are treated on an irregular cycle (> once every five years).
[3]Population estimates were calculated from stratified multiple mark/recapture studies. A linear regression estimates populations for all streams by relation of mean stream discharge to the number of adult sea lampreys entering 12 tributaries.
[4]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 in addition to the regression estimate.

Table 20. Stream, number caught, estimated spawner population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 1999. (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									
Cattaraugus Cr. (5)	109	523	21	11	73	514	520	324	332
Grand R. (6)	49	-	-	-	-	-	-	-	-
Total or Mean	**158**	**523**		**11**	**73**	**514**	**520**	**324**	**332**
Canada									
Big Cr. (59)	345	2696	13	-	-	-	-	-	
Total or Mean (for lake)	**503**	**3219**		**11**	**73**	**514**	**520**	**324**	**332**

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

Table 21. Stream, number caught, estimated spawner population, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 1999. (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									
Black R. (1)	463	5,048	9	28	57	474	450	264	219
Grindstone Cr. (2)	140			3	100	495		363	
Little Salmon R. (3)	23			0					
Sterling Cr. (4)	8			0					
Sterling Valley Cr.	18			0					
Total or Mean	**652**			**31**	**61**	**477**	**450**	**280**	**219**
Canada									
Humber R. (60)	1,500	4,128	36	150	50	481	482	247	267
Duffins Cr. (61)	1,845	2,916	63	181	49	501	484	271	261
Bowmanville Cr. (62)	465	1,716	27	226	54	485	472	269	263
Graham Cr. (63)	125	214	58	57	56	459	452	245	235
Port Britain Cr. (64)	65	126[3]		35	46	508	489	277	261
Cobourg Br. (65)	258			0					
Grafton Cr. (66)	68	149[3]		0					
Shelter Valley Cr. (67)	318	546	58	80	53	520	505	272	256
Salmon R. (68)	660	1,227	54	0					
Total or Mean	**5,304**			**729**	**52**	**491**	**480**	**264**	**261**
Total for Lake Ontario	**5,956**			**760**					
Mean for Lake Ontario					**52**	**494**	**476**	**254**	**252**

[1] The number of sea lampreys from which length and weight measurements were determined.
[2] Percent males generally determined from internal body examination of the number sampled.
[3]Fall outside the accepted limits of 25% coefficient variation.

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 charter boats during 1999.

- 26 sea lampreys attached to lake trout were collected from 7 management districts.

- Lampreys were attached at a rate of 0.5 per 100 lake trout (n = 5,655) and 0.0 per 100 chinook salmon (n = 23).

Lake Michigan

The Michigan and Wisconsin Departments of Natural Resources provided data on the frequency of parasitic-phase sea lampreys attached to fish caught by sport charter boats during 1999.

- 385 sea lampreys were collected from 13 management districts; 309 sea lampreys were attached to lake trout and 76 were attached to chinook salmon.

- Lampreys were attached at a rate of 0.9 per 100 lake trout (n = 33,063) and 0.1 per 100 chinook salmon (n = 56,312).

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 during 1999. Personnel from the Sea Lamprey Control Centre, Hammond Bay Biological Station, and Marquette Biological Station, in co-operation with the Inter-Tribal Fisheries and Assessment Program of the Chippewa/Ottawa Treaty Fishery Management Authority, collected parasitic-phase sea lampreys from nine commercial fisheries.

- 3,905 sea lampreys (U.S.: sport-637, commercial-1,368; Canada: commercial-1,900) were collected from 11 management districts (6 U.S.; 5 Canada) during 1999. This size of catch has not been approached since 1994, nor exceeded since 1992 (when 5,544 were reported). Counts have been climbing steadily since the 1997 low of 2,158, and, based on the 1999 catch, an increase of 10% in the 2000 trap catch is anticipated.

- 149 of the sea lampreys captured in the sports fishery were attached to lake trout and 488 were attached to chinook salmon.

- Lampreys were attached at a rate of 1.8 per 100 lake trout (n = 8,190) and 4.5 per 100 chinook salmon (n = 10,751).

- An expert panel peer-reviewed the adult sea lamprey assessment program (1997) and recommended actions to optimise the program. The recommendations included implementation of assessment of parasitic- or transformer-phase sea lampreys through an in-lake mark/recapture approach. Implementation of these recommendations continued during 1999. A total of 1,239 parasitic-phase sea lampreys (captured by the commercial fisheries) were kept alive, tagged with coded wire, and released at several locations in the northern main basin (Hammond Bay Biological Station-326; Marquette Biological Station-580) and the North Channel (Sea Lamprey Control Centre-333).

TASK FORCE REPORTS

The Commission has established Task Forces to recommend direction and co-ordinate 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 1999 are outlined below.

ST. MARYS RIVER CONTROL TASK FORCE

- Task Force established January 1992.

- Purpose of Task Force: The Task Force presented a revised 'terms of reference' at the February 1998 Sea Lamprey Integration Committee (SLIC) meeting. The following summarizes the revised purpose and charges as approved by SLIC:

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

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

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

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

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

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

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

Progress on charges:

- A total of 759 hectares was treated with granular Bayluscide by helicopter and boat. The combined treatment unit applied 132,679 kg of Bayluscide (4,249 kg active ingredient) over a 9-day period. The agents used 389 staff days to apply the lampricide, augmented by 51 volunteer staff days from COTFMA, MDNR, USFWS hatcheries and USGS who assisted in non-target monitoring, public safety and plot maintenance. The contracted application firm, Skyline Helicopters, exceeded expectation in efficiency and price, charging $117K for the whole operation. Non-target mortality during the treatment appeared to be very insignificant. Forty-seven (47) hectares in the upper river were not treated and will be used as reference sites to compare the effect of the spot treatments to those of just trapping and sterile-male release.

- The new stratified-random design for key pre- and post-treatment larval assessment was utilised in 1999. More than 900 survey locations were sampled, including areas within established index sites.

- In the plots treated, an estimated 88% of the larvae were removed (95% confidence limits between 79-94%). An estimated 44% of the larvae in the whole river were targeted in the 1999 treatment, for an estimated removal of 35% of the whole population. Combined with the 1998 treatments, 45% of the larvae in the river have been removed. A further estimated 7% could be removed if the upstream reference plots were to be treated.

- Further refinements to the Great Lakes Power and USCOE adult traps increased trapping effectiveness to a combined 57% compared to historical 35-40% efficiencies. The spawner estimate in the St. Marys River was 19,860 with 11,204 captured in the traps.

- A total of 26,285 sterile males were released into the St. Marys, achieving a 4.7:1 ratio of sterile:normal males. Together the integrated trapping and sterile male release is estimated to have reduced the theoretical reproductive potential by 92%. Nest observations were consistent with this result.

- Fall fyke net collections continued in the lower channels of the St. Marys River. Most ‘transformers’ collected were used for statolith ageing.

- The Commission’s communications strategy for the St. Marys River program was a great success. The program received a significant amount of very positive media coverage, aided by the effective pre-treatment information packages distributed to the media.

The task force will continue to review the treatment component of the overall control strategy to determine the necessity of future treatments of the upstream reference sites and repeat treatments of hot spots in the river. The St. Marys River Assessment Plan will continue to evolve and a decision tree will be developed to determine future integrated control efforts in the river.

STERILE MALE RELEASE TECHNIQUE TASK FORCE

- Task Force established during 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.

  - Co-ordinate 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 were Michael Twohey (Chair), John Heinrich, and Dennis Lavis, U.S. Fish and Wildlife Service; Rod McDonald and Doug Cuddy, Department of Fisheries and Oceans, Canada; Gavin Christie and Rob Young, Great Lakes Fishery Commission Secretariat; Gerald McKibben (outside expert), U.S. Department of Agriculture (retired); Roger Bergstedt, U.S. Geological Survey - Biological Resources Division.

Progress on charges:

During 1995 the Commission forwarded to the Sterile Male Release Technique Task Force a list of specific charges organised in three planning groups: Strategic Long-term, Tactical/Operational, and Research.

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

- 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.

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

- Ongoing monitoring of sterile male release in the St. Marys River continues to indicate the technique is reducing production of larvae from nests at expected levels of effectiveness. During 1999 sterile male release achieved a theoretical reduction in reproduction of 82% on the population that remained after trapping. Trapping and sterile male release achieved a combined theoretical reduction of 92%. Nest evaluations indicated an average egg viability of only 8%.

- Tests of compensation in larval populations continued in the fourth year of the 4-year study protocol *Long-term evaluation of sterile-male release for control of sea lampreys in the Great Lakes (Long-term evaluation)* by Roger Bergstedt. Evaluations concluded in 7 of 8 study streams. Evaluations in one stream were initiated one year later than the other streams and will conclude during 2000.

- Tests of compensation in larval populations with densities at about 5% of those created in the *long-term evaluation* are being evaluated in a one-year pilot study. Results will be used to develop a new study of compensation in larval populations that is scheduled to begin during 2001.

Tactical/Operational Planning

- Additional sources of male sea lampreys are being sought within the Great Lakes basin. A new flow-through barrier and trap installed in the Thessalon River increased trap efficiency from a previous 5-year average of 20% to 63% during 1999. Improvements in the St. Marys River trap resulted in a record high efficiency of 56%. The task force is working with the Assessment and Barrier task forces to evaluate further improvements and to harvest more males.

- The task force continues to investigate the use of Atlantic-origin sea lampreys for sterilisation and release to supplement the technique in the Great Lakes. Sea lamprey genetics and disease are being evaluated, and the task force plans to investigate population dynamics and trapping logistics in an East Coast tributary during 2000.

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

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

- A three-year supply of bisazir was received and met purity requirements.

- Operational requirements for the technique were projected through FY 2002 in a long-range plan of operational activities (Table 22).

Research Planning

- Development of research is continuing with priorities in the following broad areas:
  - Determination of the effectiveness of ratios of sterile to untreated sea lampreys.
  - Examination of sources, processes, and methods that add to the existing supply of sea lampreys for use in the technique.
  - Examinations to improve safety and effectiveness of the current industrial technique.
- Ongoing nest evaluations in the St. Marys River continue to show that sterile male releases are reducing reproduction at the expected rate.
- 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 co-operate in the Jones et al. study on compensatory mechanisms.
- The task force is working with the Fish Health Committee to develop a disease profile of Atlantic-origin sea lampreys in order to define a disease-screening program for the eventual importation and sterilisation of these animals. Diseases were not found in sea lampreys collected from the Connecticut and Farmington rivers during 1999.
- A study of the phenotypic expression of growth in juvenile sea lampreys of Atlantic and Great Lakes origins when held and fed in fresh water was initiated at the Hammond Bay Biological Station and will conclude during 2001.
- A population estimate of adult sea lampreys at the Holyoke Dam on the Connecticut River is planned for 2000 to provide data needed to determine the feasibility of removing Atlantic-origin sea lampreys for sterilisation and release in the Great Lakes.
- An evaluation of bisazir degradation products was conducted by Texas A&M University.
- The task force co-operated with the following research during 1999:
  - Compensatory mechanisms in Great Lakes lamprey populations, Dr. Jones et al.
  - Effects of lamprey GnRH-I and III analogs on reproductive process and behaviour of male sea lampreys, Dr. Sower.
  - Studies on reproductive functions of male sea lampreys in relation to potential targets for population control, Dr. Dabrowski et al.
  - Determining the sources and complete chemical composition of the lamprey larval pheromone, and assessing the merit of measuring one of its principle components in river waters, Dr. Sorenson.
  - A putative male sea lamprey pheromone: its function, identity, and potential application in sea lamprey control, Dr. Li.
  - Experimental examinations of factors affecting polygyny and polyandry of sea lampreys (Petromyzon marinus) as a means of optimising sterile female releases, Dr. Li and Dr. Scribner.
- Substantial progress is being made in internal and external research. Research recommendations through FY2002 are listed in the long-range plan (Table 22).

Table 22. Long-range plan of operational activities in the Sterile Male Release Program through FY2002.

ACTIVITY	FY2000	FY2001	FY2002
Operations			
Trap 15 streams/sterilise 25,000 males	X	X	X
Release in the St. Marys River	X	X	X
Analysis of bisazir in water	X	X	X
Sterile female release			Facility increase
Atlantics - east coast trap study	X		
Atlantics - facility increase and new injector			X
Purchase bisazir		X	
Assessment			
Continue long term evaluation, larval	Big Carp		
Pilot study - larval evaluation	X		
Assess metamorphosis (H7)			?
Assess spawners U.S. and Canada	X	X	X
Assess year class strength in stream	X	X	X
St. Marys River assessment plan	X	X	X
Internal research			
Atlantics - disease screen		X	X
Atlantics - genetic assessment	X	X	
Atlantics - field trial		X	
Female lampreys - verify sterility in early run animals		X	
Female lampreys – polygyny - Li et al.	X	X	
External and Collaborative Research			
Lamprey pheromone - Weiming Li	X		
Lamprey pheromone - Peter Sorenson	X		
Sperm studies - Konrad Dabrowski	X		
Compensatory mechanisms studies - Jones et al.	X	X	X
Polyandry - Scribner et al.	X	X	
Parentage, reproductive success, dispersal - Scribner et al.	X		
Super sterile male - Li		X	

SEA LAMPREY BARRIER TASK FORCE

- Task Force established during April 1991.

- Purpose of Task Force:

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

  - Evaluate barrier program for achieving potential targets set for sea lamprey suppression on all lakes, for meeting targets for reducing the amount of lampricides used in the sea lamprey program, and for effectiveness relative to lampricide control.

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

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

- Members were Dennis Lavis (Chair) and Ellie Koon, U.S. Fish and Wildlife Service; Tom McAuley and Andrew Hallett, Department of Fisheries and Oceans Canada; Bill Swink, U.S. Geological Survey - Biological Resources Division, Hammond Bay Biological Station; John Schrouder, Michigan Department of Natural Resources; Les Weigum and Joe Wanielista, U.S. Army Corps of Engineers; Robert Young and Gavin Christie, Great Lakes Fishery Commission Secretariat.

Progress on charges:

- Completed transition of the barrier program from a developmental process to a fully integrated and operational part of the sea lamprey control program by developing and releasing the document, "Sea Lamprey Barrier Life Cycle and Operational Protocols," in co-operation with the Sea Lamprey Barrier Transition and Program Management Teams.

- Developed an interim environmental policy and guidelines document for the placement of sea lamprey barriers in Great Lakes tributaries. The guidelines follow a biodiversity approach. Assessments necessary to support the policy and guidelines will be determined during 2000.

- Developed a draft memorandum of understanding in co-operation with Commission partner natural resource agencies and Tribal governments detailing the responsibilities of each in an enhanced barrier program. The draft currently is in review and will be finalised during 2000.

- Continued to research a combination fixed-crest and electrical barrier, biological impacts of barriers, fish movement in relation to an electrical barrier, and compensatory mechanisms in Great Lakes sea lamprey populations.

- Developed a report to the Commission on the human health risk of direct current electrical barriers.

ASSESSMENT TASK FORCE

- Task Force established April 1996.

- Purpose of Task Force:

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

  - Create tactical and operational plans for developing cost-effective protocols for assessment, co-ordinating training among Agents to ensure standardisation of techniques, and modifying current sampling protocols.

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

- Members were Douglas Cuddy (Chair) 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); Mike Jones, (Michigan State University); Gavin Christie and Robert Young, (Great Lakes Fisheries Commission).

- Task force activities were curtailed in 1999 to free up time for SLIS II preparations.

- Task force met only once on September 15, 1999 to develop work plans and discuss research proposals.

- Progress on charges:

  - In co-operation with the Secretariat and IMSL contractor, continued the development of the Empirical Stream Treatment Ranking model (ESTR). ESTR pulls together annual assessment catch and habitat data as well as stream specific growth and transformation models from the agent's data bases to estimate transformer production and uses these estimates along with treatment cost and resource data to rank streams for lampricide treatment.

  - Developed projections of transformer production using ESTR and submitted lampricide treatment recommendations for the 2000 field season to the Program Integration Working Group.

  - Working with the Larval Assessment Work Group and the task force's statistical experts, used empirical field data sets to modify stream habitat sampling protocols in order to optimise use of field resources.

  - Developed and implemented a sampling plan to assess pre- and post-treatment abundance of larval sea lampreys in the St. Marys River for 1999.

  - Developed plans to continue the assessment in 2000 of the efficacy of the 1999 Bayluscide treatment and enhanced sterile male release in the St. Marys River.

  - Co-operated with PERM research scientists on the compensatory mechanisms study with the intense sampling of the larval populations in 16 streams with known spawning runs.

- Continued to implement recommendations of the adult assessment review panel including redistribution of trapping effort from small to large streams; estimating the parasitic population in Lake Huron by marking and releasing parasitic lampreys (n = 1,239) into the lake and estimating the transformer population in Lake Superior by marking and releasing transformers into 9 tributary streams (n = 2,246).

- Developed assessment plans for FY 2000 including new initiatives and presented these to SLIC via the Program Integration working group.

- Conducted joint Service and Department training in habitat classification.

- Reviewed research proposals in light of the task force's research priorities.

LAMPRICIDE CONTROL TASK FORCE

- Task Force established during December 1995.

- Purpose of Task Force:

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

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

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

- Progress on charges:

  - A manual of standard operating procedures for application of lampricides was developed for use by U.S. and Canadian control personnel. These procedures were titled "Standard operating procedures for application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (Petromyzon marinus) control program". Compilation of the manual was a co-operative effort among representatives of the Marquette, Ludington, and Sault Ste. Marie control groups and the Upper Midwest Environmental Sciences Center. The manual will facilitate co-operative control projects and cross-border control efforts.

  - A liability insurance policy "Contractor's Operations and Professional Services Environmental Liability" was underwritten by a Canadian insurance company. The policy covered Service personnel who assisted Department personnel during the 1999 application of Bayluscide to the St. Marys River.

- Research:

  - Research projects and proposals for 2000-2002 were reviewed and prioritised. The task force identified a proposed study to determine treatment effectiveness as the highest priority for research during 2000. Recent concerns of effectiveness of lampricide treatments at concentrations lessened to reduce lampricide use and to protect non-target species (i.e. lake sturgeon) have elevated the need for the study.

RISK ASSESSMENT

Priority projects included participating in environmental risk management discussions with state, tribal, and federal regulatory agencies to obtain lampricide application permits, and assisting the co-ordination of assessments of populations of lake sturgeons (Acipenser fulvescens) and other non-target organisms throughout the Great Lakes basin.

Permits

Issues concerning environmental risk management were addressed for regulatory agency permit requirements for the following: letter of approval from the Indiana Department of Natural Resources (March 9), Certificates of Approval from the Michigan Department of Environmental Quality (MDEQ) (March 16 and May 5), letter of approval from the New York State Department of Environmental Conservation (April 9), letter of tacit approval from the State of Ohio Environmental Protection Agency (April 21), letter of approval from the Pennsylvania Fish and Boat Commission (April 23), and letter of approval from the Environmental Protection Department of the Seneca Nations of Indians (April 29).

During 1999, additional reports were prepared to comply with the United States Environmental Protection Agency (EPA) June 16, 1998 ruling of Section 6(a)(2) of the Federal Insecticide, Fungicide, and Rodenticide Act. This section of the Act requires pesticide registrants to report to the EPA information concerning unreasonable adverse effects of their products. The Service is the registrant for the lampricides TFM and Bayluscide and must report unreasonable adverse effects on humans, domestic animals, fish or wildlife, plants, other non-target organisms, water, and property damage. Incident reports were completed for the mortality of non-target organisms ($\geq$ 50 individuals of an aquatic species or taxa) observed during lampricide applications in streams in United States waters during 1994-1999. These reporting requirements will continue.

Lake Sturgeon

During 1982, the lake sturgeon was being considered for threatened or endangered status in the United States and was listed in the Federal Notices of Review Register as a category 2 (C2) candidate species. The C2 classification was removed within the Service during 1995 and for the public during 1996. The lake sturgeon now has no formal Federal designation. During 1999, the lake sturgeon was listed as State endangered in Illinois, Indiana, Ohio, and Pennsylvania, threatened in Michigan and New York, and special concern species in Minnesota and Wisconsin.

Streams where lake sturgeons recently have been documented include the Bad, Ontonagon, Sturgeon, and St. Louis rivers (Lake Superior), Fox, Manistee, Menominee, Millecoquins, Muskegon, Oconto, and Peshtigo rivers (Lake Michigan), Detroit and St. Clair rivers (Lake Erie), and Niagara and Black rivers (Lake Ontario).

During 1999 the Michigan Department of Natural Resources expressed concern for the impact of lampricide treatments to suspected populations of lake sturgeons in the Sturgeon River (Lake Superior), Pere Marquette and White Rivers (Lake Michigan), and the Sturgeon River, a tributary to the Cheboygan River (Lake Huron). Assessments by dip and fyke nets during and immediately after treatments of these four rivers found no mortality of lake sturgeons. The assessments were completed to fulfil requirements specified in the 1999 certification of approval issued for lampricide treatments by the MDEQ.

The manuscript “Sensitivity of lake sturgeon (Acipenser fulvescens) to the lampricide 3-trifluoromethyl-4-nitrophenol (TFM) in field and laboratory exposures” by David Johnson, John Weisser and Terry Bills (Great Lakes Fishery Commission Technical Report 62, 23 p.) was published during 1999. This was a co-operative project with the Upper Midwest Environmental Sciences Center.

OUTREACH 1999

Activity or Event	Number of Occurrences U.S.	Number of Occurrences Canada	Staff Days U.S.	Staff Days Canada
School Presentations	31	16	29	5
Sports Shows	11	6	12	66
Youth Fishing	2	1	3	2
Civic Groups	9	2	5	8
Media Interviews	9	9	1	3
Media Mailings/E-mail	1,123	372	7	13
Station Public Displays	5	2	52	6
Miscellaneous	20	18	9	11
Total	1,210	426	218	113
Combined	1,636		331	

PERMANENT EMPLOYEES OF THE SEA LAMPREY MANAGEMENT PROGRAM

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

A/Program Manager: Larry P. Schleen
Biologist:
  Treatment Supervisor: R. Wayne Westman
Technician:
  Ed Achtemichuk
  Peter Grey
  Jerome Keen
  Barry Scotland
  Jamie Smith
  Randy Stewart
Finance & Administration: Jackie Bassett
Accounts Clerk: Lisa Vine
Property & Contract Manager: David J. Haight
Administrative Support:
  John Graham*
  Christine Youngson*

A/Assessment Supervisor: Douglas W. Cuddy
Biologist:
  Adult Assessment Supervisor: Rod McDonald
  A/Lake Huron Assessment Supervisor: Fraser Neave
  A/Lake Superior Assessment Supervisor: Brian Stephens
  Lower Lakes Assessment Supervisor: Paul Sullivan
  Quantitative Assessment Supervisor: Jerry Weise
Technician:
  Mike MacKenna
  Todd (Mike) Steeves*
Barrier Co-ordinator: Tom McAuley
  Barrier Assistant: Andrew Hallett*
Storesperson: William Green
Maintenance Supervisor: Dave Reid
  Maintenance Assistant: Brian Greene*

*Continuing GLFC

U. S. Fish and Wildlife Service

Gerald T. Klar, Field Supervisor
Marquette Biological Station

Control Supervisor: Terry J. Morse
Chemist: David Johnson
Biologist:
  Treatment Supervisor: Dorance Brege
  Darrian Davis
  Joseph Genovese
Lead Physical Science Technician: Robert Wootke
Physical Science Technician:
  Timothy Peiffer
  Michael St. Ours
  Kelley Stanley
Administration Supervisor: Nadine Seeke
  Mary Jo Buckett
  Steven Dagenais
  Pauline Hogan
  Betty L'Huillier
  Gloria Hoog
ADP Supervisor: Larry Carmack
  Robert Kahl
  Deborah Larson

Assessment Supervisor: John W. Heinrich
Biologist:
  Larval Supervisor: Michael Fodale
  Adult Supervisor: Katherine Mullett
  Sterile Male Supervisor: Michael Twohey
  Risk Assessment Supervisor: John Weisser
  Mary Henson
  Geraldine Larson (Amherst Office)
  Cheryl Kaye
  Dale Ollila
Biological Science Technician:
  Gregg Baldwin
  Gregory Klingler
  Kyle Krysiak
  Mark McNeill
  Deborah Winkler
  Michelle Zastrow

Ludington Biological Station
Dennis S. Lavis, Station Supervisor

Barrier Co-ordinator: Ellie Koon
Biologist:
  Treatment Supervisor: Alex Gonzalez
  Kathy Hahka
Lead Physical Science Technician: Jeffrey Sartor
Physical Science Technician:
  Kevin Butterfield
  Ken Chaltry
  Tim Sullivan

Biologist:
  Larval Supervisor: Jeffrey Slade
  Sidney Morkert
Biological Science Technician:
  Lois Mishler
Administration Support:
  Robert Anderson
  Linda Krupinski
  Tana Reimer
Computer Assistant: Barry Matthews