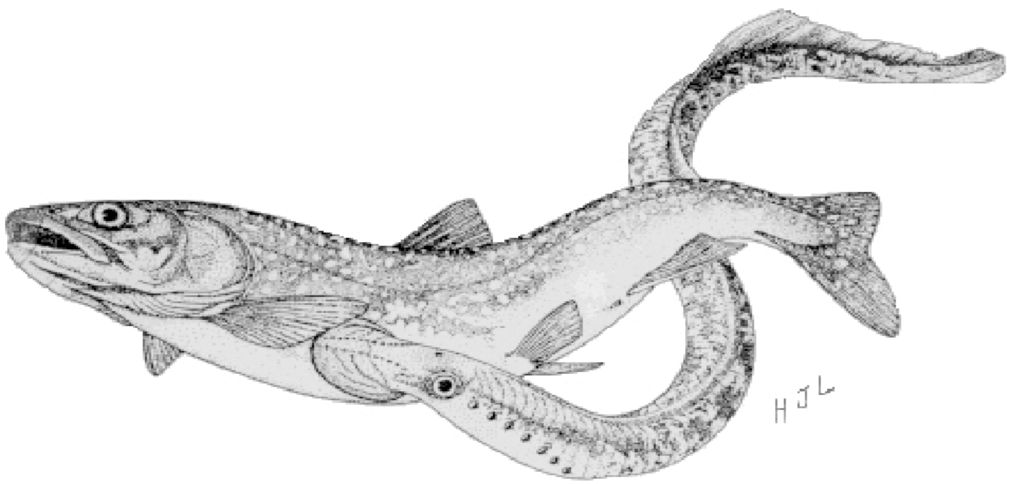
INTEGRATED MANAGEMENT OF SEA LAMPREYS IN THE GREAT LAKES 2003

ANNUAL REPORT TO

GREAT LAKES FISHERY COMMISSION



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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 2003. Lampricide treatments were conducted on 62 tributaries. Larval assessment crews surveyed 263 Great Lakes tributaries and 15 lentic areas to assess control effectiveness, plan future TFM treatments, and establish production capacity of streams. Assessment traps were operated in 83 tributaries to estimate the spawning-phase population in each Great Lake.

We evaluate sea lamprey populations relative to fish community objectives for each of the lakes. In Lake Superior the management objective for sea lampreys is a level of sea lamprey abundance that accounts for less than 5% of the annual lake trout mortality. Currently, sea lamprey-induced mortality in lake trout is estimated as 12% of the annual total. In Lake Michigan the fish community objectives are generally being met despite an increase in lamprey wounding rates on lake trout in northern waters of the lake while populations of parasitic lampreys remain higher than the fish community objective in Lake Huron. The population of larvae in the St. Marys River, lake trout wounding rates, and sea lamprey induced mortality have declined since a St. Marys River treatment strategy was initiated in 1998. Fish Community Objectives of less than 5 marks per 100 fish were met in both Lake Erie and Lake Ontario.

INTRODUCTION

Sea lamprey control is a management tool used to achieve 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. This report outlines the actions undertaken 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 technical committees to refine the target statements and develop common targets. The targets define the abundance of sea lampreys that can be tolerated and the economically viable level of control required to reach the desired level of suppression. The Commission and co-operators consider the costs of control along with the benefits to define an optimum control program, defined as a program that supports the fish community objectives, is ecologically and economically sound, and socially acceptable.

COMMISSION VISION

The Commission, in its “Strategic Vision for the First Decade of the New Millennium,” identified milestones that included:

Accomplish at least 50% of sea lamprey suppression with alternative technologies while reducing TFM use by 20%.

The pesticide 3-trifluoromethyl-4-nitrophenol (TFM) has been used as a management tool to control larval sea lampreys in the Great Lakes since 1958. In the past decade, the Service and Department have reduced the dependency on TFM through the development and implementation of alternative controls, refinement of assessment procedures, and improvement of application techniques to more efficiently treat tributaries. The use of TFM has decreased 33% from an annual average of 55,169 kg active ingredient from 1986-1990 to an annual average of 37,504 kg active ingredient from 1998-2003.

FISH COMMUNITY OBJECTIVES

Lake Superior

In the 2001 Fish Community Objectives, the Lake Superior Committee established the target for sea lamprey management in Lake Superior as:

Suppress sea lampreys to population levels that cause only insignificant mortality on adult lake trout.

The management objective for sea lampreys defines 'insignificant mortality' as a level of sea lamprey abundance that accounts for less than 5% of the annual lake trout mortality in Lake Superior. Currently, sea lamprey-induced mortality on lake trout is estimated as 12% of the annual mortality.

The desired level of sea lamprey abundance is unlikely to be achieved through the increased use of TFM, as all sea lamprey producing tributaries to Lake Superior are currently treated every four to seven years. A cost-benefit analysis indicated that increases in the number of stream treatments will result in a relatively small decline in lake-wide lamprey abundance. Increased assessment and control of lentic populations, lamprey barriers and investment in new technologies such as pheromone-based control, are being implemented.

Instead, efforts are being directed towards an increase in assessment and control of lentic populations, an increase in number of lamprey barriers, and investment in new technologies such as pheromone-based control. These methods, combined with continued TFM treatment, will further suppress sea lamprey populations in Lake Superior.

Lake Michigan

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

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

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

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

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

Lake Huron

In 1995 the Lake Huron Committee established the following targets for sea lamprey populations in their Fish Community Objectives:

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

This sea lamprey target supports the objectives for the other species groups in the fish community including, for example, the salmonine community objective:

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

While the lake-wide abundance has been relatively stable since the mid 1990s, at least twice as many lampreys remain in Lake Huron than in any of the other Great Lakes. Spawning-phase abundance is one of the measures used to determine success of applications of Bayluscide granules in the St. Marys River during 1998-2001. Estimated abundance during 2003 was 190,000, compared to 116, 000 in 2002.

Lake Erie

The Commission published a document entitled "Fish-Community Goals and Objectives for Lake Erie" in 2003. The document includes the restoration of a self-sustaining lake trout population in the eastern basin as an objective, and recognizes the link between lake trout rehabilitation and sea lamprey control in Lake Erie.

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

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

In 2003, Lake Erie spawner abundance was estimated to be ~4,000 and the sea lamprey wounding rate on lake trout was <5 wounds per 100 fish. Further reductions are expected from an enhanced assessment and control program which was initiated during 1999 and has continued since.

Lake Ontario

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

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

This 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 revised its Lake Ontario Lake Trout Rehabilitation Plan in 1998. 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 premise that continued control of sea lampreys is necessary for lake trout rehabilitation. The plan included the sea lamprey objective:

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

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

Wounding rates in Lake Ontario have been remarkably stable at or near the target during 1985-2003, ranging from 1-3 marks per 100 fish.

LAMPRICIDE CONTROL

Tributaries harbouring larval sea lampreys are treated periodically with lampricides to eliminate or reduce larval populations 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. TFM treatments eliminate about 95% of the lamprey larvae while minimising the risk to non-target species. Improved analytical and predictive techniques have enabled treatment crews to reduce the amount of lampricide use (kg/yr.) in the Great Lakes by 40% since 1990.

The Lampricide Control Task Force, established by the Great Lakes Fishery Commission in December 1995, was charged with improving the efficiency of lampricide control, and maximising sea lampreys killed in stream and lentic treatments while minimising lampricide use, costs, and impacts on stream/lake ecosystems, as well as defining lampricide control options for near and long-term stream selections and target setting. The report of progress on the charges during 2003 is presented on page 46.

Table 1. Summary of lampricide applications in tributaries of the Great Lakes, 2003.

Lake	Number of Streams	Flow (m^3/s)	TFM[1] (kg)	Bayluscide[1] (kg)	Distance (km)
Superior	13	84.0	6,871.7	209.6	227.6
Michigan	14	118.1	11,933.4	204.6	830.0
Huron	19	84.3	15,505.5	531.6	572.1
Erie	3	28.3	3,327.0	0.3	192.4
Ontario	13	50.5	4,958.0	3.1	218.5
Total	62	365.2	42,595.6	949.2	2,040.6

[1] Lampricide quantities are in kg of active ingredient

Lake Superior

Lake Superior has 1,566 (833 Canadian, 733 U. S.) tributaries. 139 (47 Canadian, 92 U. S) have historical records of sea lamprey larvae production and of these, 68 (29 Canadian, 39 U. S) tributaries have been treated with lampricides at least once during 1994-2003. 51 (19 Canadian, 32 U. S.) tributaries are treated on a regular cycle.

Table 2 provides details on the application of lampricides to tributaries treated during 2003 and Fig. 1 shows the locations of the tributaries. In 2003:

- Lampricide treatments with TFM were completed in 12 Lake Superior tributaries (6 Canadian, 6 U. S.);

- Treatment of Cash Creek was initiated on July 25th, however heavy rains resulted in cancellation of lampricide applications. The tributary was treated in its entirety on August 11th;

- Treatments of all Canadian tributaries were considered successful with the exception of the Batchawana River. Low discharge conditions may have compromised treatment effectiveness in the lower 10% of the watershed;

- Bayluscide granules were applied to lentic areas of Lake Helen. One area, located off the mouth of the upper Nipigon River, was treated in conjunction with the TFM application of the upper Nipigon River to take advantage of the reduced flows required for the river treatment;

- The Dead River was eliminated from the lampricide treatment schedule when an extensive flood destroyed all infested habitat; and,

- The Marengo River (Bad River) was treated further upstream than ever previously treated to eliminate a source of residual larvae.

Table 2. Details on the application of lampricides to tributaries of Lake Superior, 2003 (number in parentheses corresponds to location of stream in Fig. 1).

Stream	Date	Flow (m^3/s)	TFM (kg)[1,2]	Bayluscide (kg)[1,3]	Distance Treated (km)
Canada					
Batchawana R. (7)	Jul 08	4.3	292.2	0	12.5
L. Gravel R. (6)	Jul 23	0.1	8.1	0	5.8
Cypress R. (5)	Jul 24	1.0	56.4	0	5.5
Wolf R. (1)	Jul 29	6.5	549.4	6.4	16.8
Nipigon R.					
upper (2)	Aug 09	63.8	4,787.8	70.4	11.5
Lake Helen[3] (4)	Aug 10			132.8	
Cash Cr. (3)	Aug 11	1.0	217.0	0	26.3
Total (Canada)		76.7	5,910.9	209.6	78.4
United States					
Carp R. (8)	Jul 02	2.5	286.7	---	9.6
Big Garlic R. (9)	Jul 16	0.6	66.2	---	9.6
Poplar R. (13)	Aug 14	0.1	43.1	---	22.5
Ravine R. (10)	Sep 25	0.1	21.5	---	8.0
Silver R. (11)	Sep 30	2.0	114.4	---	8.0
Bad R.					
Marengo R. (12)	Oct 23	2.0	428.9	---	91.5
Total (U.S.)		7.3	960.8	---	149.2
Total (for lake)		84.0	6,871.7	209.6	227.6

[1] Lampricide quantities are in kg of active ingredient
[2] Includes a total of 8.5 TFM bars (1.6 kg of active ingredient) applied in 2 streams
[3] Treatment of 23.5 ha of lentic area in L. Helen with granular Bayluscide

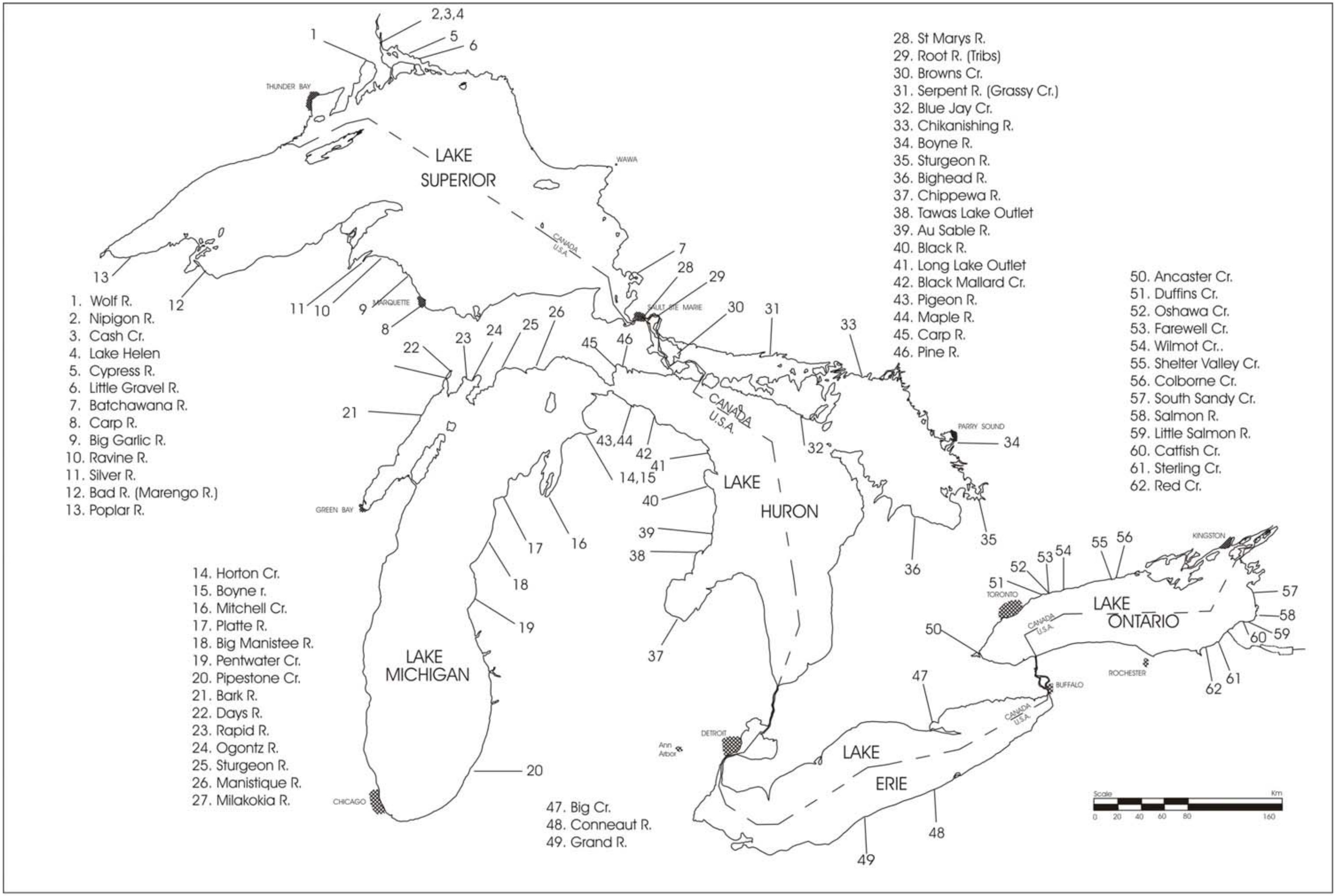

Fig. 1. Locations of tributaries treated with lampricide during 2003.

Lake Michigan

Lake Michigan has 511 tributaries. 121 have historical records of sea lamprey larvae production, and of these, 63 tributaries have been treated with lampricide at least once during 1994-2003. 32 tributaries are treated on a regular cycle.

Table 3 provides details on the application of lampricides to tributaries treated during 2003 and Fig. 1 shows the locations of the tributaries. In 2003:

- Lampricide treatments were completed in 14 Lake Michigan streams;
- Treatments of the Pentwater and Platte rivers were completed to reduce populations of residual sea lampreys;
- The protocol for application of lampricides to streams with populations of young-of-year lake sturgeons *Acipenser fulvescens* was followed for treatments of the Manistee and Manistique rivers. Maximum application rates of lampricides were limited to 1.2 times the minimum lethal concentration (concentration of lampricide necessary to kill 99.9% of sea lampreys in a 12-hour treatment) to protect juvenile lake sturgeons. The total of 140 km (Manistee River = 47 km; lower Manistique River = 93 km) treated with the sturgeon protocol represents 16.9% of the 830 km of treated Lake Michigan tributaries;
- The Manistique River upstream of the Manistique Papers, Inc. dam was treated for the first time since 1974; and,
- Treatments of backwaters and bayous of the Manistee River were coordinated with the mainstream lampricide application. This was an effective strategy to reduce survival of sea lampreys.

Table 3. Details on the application of lampricides to tributaries of Lake Michigan, 2003 (number in parentheses corresponds to location of stream in Fig. 1).

Stream	Date	Discharge (m^3/s)	TFM (kg)[1]	Bayluscide (kg)[1]	Distance Treated (km)
Rapid R. (23)	May 23	3.1	547.5	0.0	64.2
Boyne R. (15)	May 21	---	---	13.8[2]	---
Sturgeon R. (25)	Jun 6	7.1	568.6	0.0	118.8
Milakokia R. (27)	Jun 21	1.1	302.5	0.0	27.3
Pentwater Cr. (19)	Jul 8	1.3	327.8	0.0	26.0
Ogontz R. (24)	Jul 20	0.1	18.8	0.0	14.5
Platte R. (17)	Jul 20	3.5	789.6	18.4[2]	26.7
Big Manistee R. (18)	Aug 4	42.2	5,259.1	72.2[3]	61.7
Pipestone Cr. (20)	Aug 27	0.3	118.0	0.0	17.2
Manistique R. (26)	Aug 29	58.1	3,596.1	100.2[3]	441.7
Horton Cr. (14)	Sep 4	0.4	94.8	0.0	6.4
Days R. (22)	Sep 26	0.6	105.1	0.0	6.8
Mitchell Cr. (16)	Sep 27	0.2	75.6	0.0	3.8
Bark R. (21)	Sep 29	0.1	129.9	0.0	14.9
Total (for lake)		118.1	11,933.4	204.6	830.0

[1] Lampricide quantities are in kg of active ingredient
[2] Bayluscide 3.2% Granular Sea Lamprey Larvicide applied to lentic areas
[3] Includes applications of Bayluscide 70% Wettable Powder and Bayluscide 3.2% Granular Sea Lamprey Larvicide

Lake Huron

Lake Huron has 1,761 (1,334 Canadian, 427 U. S.) tributaries. 120 (55 Canadian, 65 U. S.) tributaries have historical records of sea lamprey larvae production, and of these, 68 (37 Canadian, 31 U. S.) tributaries have been treated with lampricide at least once during 1994-2003. 46 (24 Canadian, 22 U. S.) tributaries are treated on a regular cycle.

Table 4 provides details on the application of lampricides to tributaries treated during 2003 and Fig. 1 shows the locations of the tributaries. In 2003:

- Lampricide treatments were completed in 18 Lake Huron streams (8 Canadian, 10 U. S.);

- Long Lake Outlet in Alpena County was treated for the first time. An infested upstream section of the river was not treated because of uncooperative land owners;

- The protocol for application of lampricides to streams with populations of young-of-year lake sturgeons (*Acipenser fulvescens*) was followed during treatment of the Carp River. Maximum application rates of lampricides were limited to 1.2 times the minimum lethal concentration (concentration of lampricide necessary to kill 99.9% of sea lampreys in a 12-hour treatment) to protect juvenile lake sturgeons. The 9.6 km treated with the sturgeon protocol represents 1.7% of the 572.1 km of treated Lake Huron tributaries;

- Heavy thundershowers forced the release of water from two dams on the Pine River, a tributary of the Chippewa River, nearly doubling the amount of lampricide necessary for treatment;

- The Pigeon River was treated to reduce the population of residual sea lampreys;

- Mortality of nontarget fish was minimal in the majority of treatments, with the exception of some mortality to stonecat (Noturus flavus), a species sensitive to lampricide. A Voluntary Adverse Effects 6(a)(2) report was submitted to the Environmental Protection Agency;

- Bayluscide granules were applied to areas of significant larval sea lamprey density in the St. Marys River by both Service and Department treatment units. In total, 45.2 ha were treated; and,

- Brown's Creek, treated in 2002, was added to the stream treatment list after assessment personnel detected a high proportion of large (>120 mm) larvae in assessments conducted in 2003. The 2002 treatment was compromised by a series of beaver dams that prevented treatment of the entire infested area.

Table 4. Details on the application of lampricides to tributaries of Lake Huron, 2003 (number in parentheses corresponds to location of stream in Fig. 1).

Stream	Date	Discharge (m^3/sec)	TFM (kg)[1]	Bayluscide (kg)[1,2]	Distance Treated (km)
Canada					
Blue Jay Cr. (32)	Jun 17	0.9	124.4	0	8.7
Chikanishing R. (33)	Jun 19	1.5	30.3	0	1.4
Boyne R. (34)	Jun 21	0.7	18.9	0	1.5
Bighead R. (36)	Jun 23	1.4	727.6	0	36.1
St. Marys R. (28)	Jul 16	---	---	235.9[2]	---
Sturgeon R. (35)	Sep 4	0.6	118.0	0	2.1
Root R.					
Root R. tributaries (29)	Sep 29	1.4	47.0	0	8.5
Serpent R.					
Grassy Cr. (31)	Oct 1	0.6	14.3	0	1.8
Brown's Cr. (30)	Oct 16	0.2	11.1	0	3.0
Total (Canada)		7.3	1,091.6	235.9	63.1
United States					
Pine R. (46)	May 9	17.7	1,342.9		160.6
Black R. (40)	May 8	1.8	364.1	0	14.6
Black Mallard Cr. (42)	May 21	1.3	130.0	0	11.9
Long Lake Outlet (41)	May 26	0.5	101.6	0	1.6
Chippewa R. (37)	Jun 9	17.9	6,288.9	0	129.8
Tawas Lake Outlet (38)	Jun 23	2.5	508.7	0	12.4
St. Marys R. (28)	Jul 15	---	---	252.6[2]	---
Au Sable R. (39)	Aug 18	28.9	3,769.5	41.1	23.3
Carp R. (45)	Sep 11	2.0	488.6	2.0	88.3
Pigeon R. (43)	Sep 14	2.5	896.8	0	53.6
Maple R. (44)	Sep 29	1.9	522.8	0	12.9
Total (U.S.)		77.0	14,413.9	295.7	509.0
Total (for lake)		84.3	15,505.5	531.6	572.1

[1] Lampricide quantities are in kg active ingredient
[2] Bayluscide granules sprayed onto 88.4 ha of the St. Marys River

Lake Erie

Lake Erie has 842 (525 Canadian, 317 U. S.) tributaries. 21 (11 Canadian, 10 U. S.) tributaries have historical records of sea lamprey larvae production, and of these, 8 (3 Canadian, 5 U. S.) tributaries have been treated with lampricide at least once during 1994-2003. 5 (2 Canadian, 3 U. S.) tributaries are treated on a regular cycle.

Table 5 provides details on the application of lampricides to tributaries treated during 2003 and Fig. 1 shows the locations of the tributaries. In 2003:

- Lampricide treatments were completed in 3 Lake Erie tributaries (1 Canadian, 2 U. S.); and,

- Treatment of the Grand River produced minimal mortality of organisms from several sensitive species that include mudpuppies (*Necturus maculosus*), brindled madtoms (*Noturus miurus*), bullheads (*Ameiurus sp*.), and logperch (*Percina caprodes*).

Table 5. Details on the application of lampricides to tributaries of Lake Erie, 2003 (number in parentheses corresponds to location of stream in Fig. 1).

Stream	Date	Discharge (m^3)	TFM (kg)[1]	Bayluscide (kg)[1]	Distance Treated (km)
<u>Canada</u>					
Big Cr. (47)	May 24	5.7	1,752.4	0.3	55.7
Total (Canada)		5.7	1,752.4	0.3	55.7
<u>United States</u>					
Conneaut R. (48)	Apr 10	5.9	482.9	---	88.5
Grand R. (49)	Apr 14	16.7	1,091.7	---	48.2
Total (U.S.)		22.6	1,574.6	---	136.7
Total (for lake)		28.3	3,327.0	0.3	192.4

[1] Lampricide quantities are in kg active ingredient

Lake Ontario

Lake Ontario has 659 tributaries (405 Canadian, 254 U. S.). 59 tributaries (30 Canadian, 29 U. S.) have historical records of sea lamprey larvae production, and of these, 43 tributaries (22 Canadian, 21 U. S.) have been treated with lampricide at least once during 1994-2003. 29 tributaries (13 Canadian, 16 U. S.) are treated on a regular cycle.

Table 6 provides details on the application of lampricides to tributaries treated during 2003 and Fig. 1 shows the locations of the tributaries. In 2003:

- Lampricide treatments were completed in 13 Lake Ontario tributaries (7 Canadian, 6 U. S.);
- During the treatment of the main branch of the Salmon River, some stonecats (<250) and mudpuppies (<250) were killed and a 6(a)2 report was filed with the Environmental Protection Agency (EPA);
- South Sandy Creek, treated in 2002, was added to the stream treatment list after a quantitative assessment was conducted in 2003. Low flows had resulted in an ineffective treatment of the estuary in 2002; and,
- The treatment of Duffins Creek was conducted from above the sea lamprey barrier due to the presence of larvae in this portion of the stream. Adult sea lampreys were observed above the barrier during the treatment.

Table 6. Details on the application of lampricides to tributaries of Lake Ontario, 2003 (number in parentheses corresponds to location of stream in Fig. 1).

Stream	Date	Flow (m^3/s)	TFM (kg)[1]	Bayluscide (kg)[1]	Distance Treated (km)
<u>Canada</u>					
Ancaster Cr. (50)	May 27	0.3	87.2	0	5.4
Wilmot Cr. (54)	May 29	1.1	394.0	0	21.6
Duffins Cr. (51)	Jun 1	2.2	668.7	0	37.0
Oshawa Cr. (52)	Jun 3	0.7	266.8	0	20.1
Farewell Cr. (53)	Sep 7	0.1	32.1	0.1	6.0
Shelter Valley Cr. (55)	Sep 9	0.3	92.8	0	4.7
Colborne Cr. (56)	Sep 9	0.2	43.9	0	0.9
Total (Canada)		4.9	1,585.5	0.1	95.7
<u>United States</u>					
Red Cr. (62)	Apr 25	0.8	164.3	0	10.8
Catfish Cr. (60)	Apr 26	2.3	122.0	0	6.7
Sterling Cr. (61)	Apr 28	2.2	427.6	2.6	10.3
L. Salmon R. (59)	Apr 30	5.7	446.0	0.4	37.2
Salmon R. (58)	May 2	25.0	1,411.5	0	27.3
Orwell Br. (58)	May 3	2.1	184.2	0	11.9
Trout Br. (58)	May 5	1.5	112.8	0	14.2
South Sandy Cr. (57)	Oct 24	6.0	504.1	0	4.4
Total (U.S.)		45.6	3,372.5	3.0	122.8
Total (for lake)		50.5	4,958.0	3.1	218.5

[1] Lampricide quantities are in kg of active ingredient

ALTERNATIVE CONTROL

Sterile Male Release Technique

Research on the use of the sterile male release technique in sea lamprey control began in 1971. The technique was experimentally implemented in Lake Superior and in the St. Marys River during 1991-1996. Sterile male release efforts were refocused for exclusive use in the St. Marys River after 1996.

Male sea lampreys are captured during their spawning migrations in about 20 tributaries to lakes Superior, Michigan, Huron, and Ontario, and transported to the sterilization facility at the Hammond Bay Biological Station. Sea lampreys are sterilized with the chemosterilant bisazir, 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 eggs that hatch are reduced.

The Sterile Male Release Technique Task Force was established in 1984 to refine the long-term strategy for application of the technique and to coordinate a large-scale research program in Lake Superior and the St. Marys River. The Reproduction Reduction Task Force assumed these responsibilities in 2003. The report of progress of the Task Force is presented on page 54.

Highlights of the sterile male release program during 2003 include:

- A total of 30,980 spawning-phase male sea lampreys were delivered to the sterilization facility from trapping operations on the Brule (666), Manistique (13,391), Peshtigo (1,441), Cheboygan (4,916), Ocqueoc (182), Trout (114), Echo (1,139), Thessalon (2,384), Koshkawong (39), Humber/Duffins (368), AuSable (582), East AuGres (115), Tittabawassee (197), Carp Lake Outlet (1,007), and St. Marys (4,439) rivers;

- A total of 27,963 sterilized male sea lampreys were released in the St. Marys River during May 23 - July 11 (Table 8). The estimated resident population of spawning-phase sea lampreys in the St. Marys River was 27,011 (17,835 males). Assessment traps removed 9,220 sea lampreys (6,088 males), an estimated reduction of 33% from trapping. The ratio of sterile males to resident male sea lampreys remaining in the St. Marys River was estimated at 2.3:1 (27,963 sterile: 11,959 estimated untreated males extant);

- The theoretical reduction from trapping and enhanced sterile male release was estimated at 80% during 2003. The theoretical reduction from trapping and enhanced sterile male release averaged 89% during 1997-2002. Prior to enhancement (1991-1996) the theoretical reduction in reproduction averaged 58%;

- The release of sterile males combined with the removal of lampreys by traps, reduced the theoretical number of effective fertile females in the river from about 9,176 to 1,860 during 2003; and,

- In the St. Marys River Rapids, 11 sterile and five untreated males were observed on nine nests. Egg viability averaged 21% in the 10 nests excavated. Average egg viability (weighted by nests per year) during 1997-2002 was 23%.

Table 7. Theoretical effects of trapping and sterile male release and theoretical suppression of reproduction in the estimated population of sea lampreys in the St. Marys River during 1991-2003.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Population estimate	35,582	19,508	45,620	10,624	19,608	22,255	8,162	20,235	19,860	38,829	25,311	13,619	27,011
Percent males	53	58	56	57	55	63	56	57	60	64	63	63	66
Percentage of sea lampreys removed by traps	42	39	22	53	44	20	30	35	53	48	45	59	33
Sterile males released	7,516	4,508	4,832	2,667	4,238	3,650	17,181	16,743	26,285	43,184	31,459	22,684	27,963
Estimated ratio sterile to untreated males	0.7:1	0.7:1	0.2:1	1.0:1	0.7:1	0.3:1	5.4:1	2.2:1	4.7:1	3.3:1	3.6:1	6.4:1	2.3:1
Theoretical percent reduction in reproduction[1]	65	63	38	76	67	39	89	80	92	88	88	94	80
Theoretical reproducing females[2]	5,805	3,029	12,534	1,091	2,873	4,922	402	1,771	638	1,670	1,113	289	1,860

[1]Combination of trapping and sterile male release.

[2] $\left[f = \frac{1-t}{s{:}n+1} \right]$ where *t* is the proportion of animals trapped and *s:n* is the ratio of sterile to normal males.

Barriers

The Great Lakes Fishery Commission Strategic Vision includes a milestone which states that 50% of sea lamprey suppression and a 20% reduction in TFM use will be accomplished through alternative control technologies. Approximately 1,900 ha of larval type 1 habitat are available in streams that are regularly treated or have sea lamprey barriers. At the end of 2003, 15% of the type 1 larval habitat has been excluded from production by 69 barriers that have been constructed or modified to block sea lampreys on tributaries of the Great Lakes.

The revised barrier strategy and implementation plan identifies three sea lamprey barrier program priorities:

- Construction of new, effective sea lamprey barriers;
- Effective operation and maintenance of existing sea lamprey barriers in the Commission sea lamprey barrier network; and,
- Ensured blockage of adult sea lampreys at other barriers.

2003 highlights from the barrier projects are summarized below for each lake.

Lake Superior

There were 17 sea lamprey barriers on Lake Superior tributaries (Fig. 2).

New Construction:

A new seasonal stop log barrier was constructed in Furnace Creek during 2003. New construction projects are in various stages of development on the Sucker and Bad rivers and Harlow Creek.

Ensured Blockage at Other Barriers:

Black Sturgeon River and Wolf River - The Black Bay Walleye Restoration Plan identified the removal of barriers on the Black Sturgeon and Wolf rivers or addition of fishways at each site as options for improving walleye stocks in Black Bay. The Department and the Ontario Ministry of Natural Resources have proposed alternatives management strategies to the Black Bay Restoration Committee.

Billy Creek and Bark River - Perched culverts were proposed for removal by the Service-Ashland Fishery Resource Office to enhance fish passage. These sites were inspected by Service staff who determined that these projects would not negatively affect sea lamprey control.

Lake Michigan

Presently, there are 13 purpose-built or modified sea lamprey barriers on Lake Michigan tributaries (Fig. 2).

New Construction:

New construction projects are in various stages of development on the Cedar, Paw Paw, Galien, Carp Lake, and Manistique rivers and Trail and Kids creeks.

Ensured Blockage at Other Barriers:

Tannery Creek - A perched culvert was proposed for removal by Tip of the Mitt Watershed Council and the Service Alpena Fishery Resource Office to enhance fish passage. The proposed project was determined by Service staff to have the potential to result in lamprey infestation in the stream. Mitigation negotiations are underway.

Lake Huron

Nineteen barriers have been built or modified on Lake Huron streams to block the upstream movement of spawning phase sea lampreys (Fig. 2).

New Construction:

A new seasonal stop log barrier was constructed in Greene Creek during 2003. New construction projects are in various stages of development on the Black Mallard and Au Gres rivers and Schmidt Creek.

Ensured Blockage at Other Barriers:

Beaver River - Ontario Ministry of Natural Resources restored the Thornbury Dam on the Beaver River. A nature-like fishway was installed as part of the project. The Department identified the Thornbury Dam as a barrier to sea lamprey migrations, and an adjustable sea lamprey barrier was added to the base of the fishway during 2003. In addition, a sea lamprey trap will be installed in 2004.

Lake Erie

There are 7 barriers present in Lake Erie tributaries which block the upstream movement of spawning-phase sea lamprey (Fig. 2).

New Construction:

A new barrier is being developed for Conneaut Creek.

Ensured Blockage at Other Barriers

Grand River, Ontario – The Department advised the Grand River Fish Management Plan Implementation Committee (GRFMPIC) that the proposed fishway project at the Caledonia dam would pass sea lampreys. Lampricide application could cost in excess of $1 million. GRFMPIC agreed to work with the Department to ensure the Caledonia dam remains an effective sea lamprey barrier.

Lake Ontario

There are 15 barriers present in Lake Ontario tributaries which block the upstream movement of spawning-phase sea lamprey (Fig. 2).

New Construction:

A new seasonal stop log sea lamprey barrier was constructed in Wesleyville Creek in 2003 under a partnership agreement between Ontario Power Generation, Ganaraska Conservation Authority and the Great Lakes Fishery Commission. Feasibility studies, detailed design, and tendering for remedial works on an existing dam on the Credit River were completed. Negotiations regarding property agreements with the dam owner delayed construction which is now scheduled for summer 2004. A new construction project is being developed for Bronte Creek.

Ensured Blockage at Other Barriers:

Bowmanville Creek: DFO-SLCC staff consulted with Central Lake Ontario Conservation Authority and others regarding the installation of a "nature-like" fishway at the Goodyear dam on Bowmanville Creek. The proposed type of fishway would not block sea lampreys.

*Oshawa Creek: T*he Central Lake Ontario Conservation Authority notified DFO-SLCC of a proposed fish passage project at the Camp Samac dam on Oshawa Creek. DFO-SLCC advised the Central Lake Ontario Conservation Authority that sea lamprey control needs to be maintained on the Camp Samac dam on Oshawa Creek.

Harmony Creek: The Central Lake Ontario Conservation Authority notified DFO-SLCC of a proposed barrier removal project on Harmony Creek to improve fish passage. DFO-SLCC advised that the gabion weirs proposed for removal on Harmony Creek were not likely a barrier to sea lamprey, and were not a concern to the program.

Shelter Valley Creek: DFO-SLCC was notified of a fish passage project on Shelter Valley Creek by the Ontario Great Lakes Area, DFO. DFO staff consulted with MNR, and a private dam owner to ensure a fish way designed for a privately owned dam on Shelter Valley Creek would block sea lamprey.

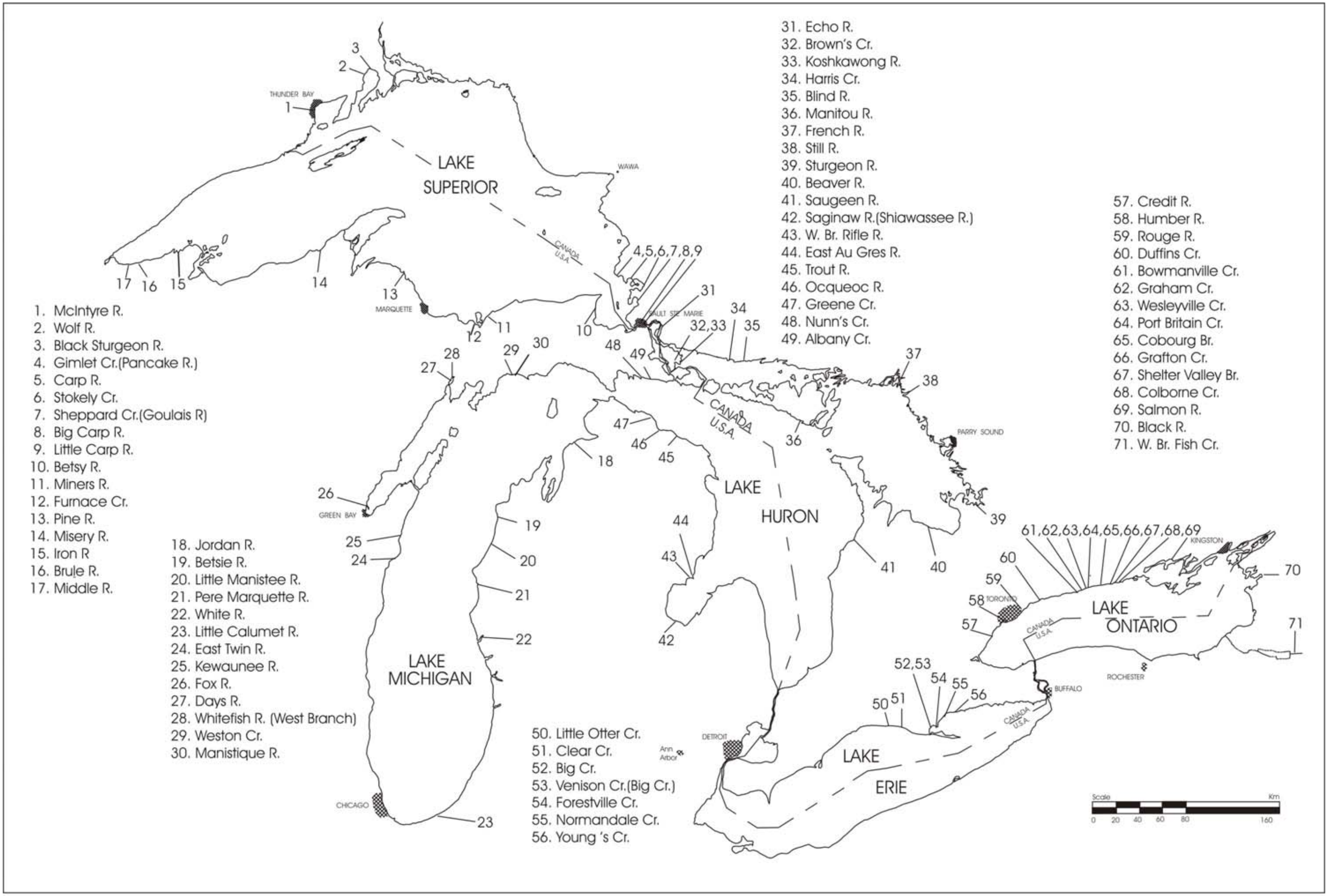

Fig. 2. Location of tributaries with sea lamprey barriers in 2003.

ASSESSMENT

Larval

Tributaries to the Great Lakes are assessed for abundance and distribution of sea lamprey larvae. Quantitative estimates of metamorphosing lampreys are used to prioritize streams for lampricide treatment. Qualitative sampling is used to define the distribution of sea lampreys within a stream and to establish the sites for lampricide application.

Tributaries considered for lampricide treatment during 2004 were assessed during 2003 to estimate larval density and amount of suitable larval habitat. Assessments were conducted with backpack electrofishers in waters <1m deep. Waters >1m were surveyed with deepwater electrofishers or Bayluscide granules. Survey plots were randomly selected in each tributary, catches of larvae were adjusted for gear efficiency, and lengths were standardized to the end of the growing season. Larval populations in each tributary were estimated by multiplying the mean density of larvae (number per m^2) by an estimated area of suitable habitat (m^2). The proportion of metamorphosing larvae during 2004 was determined from historical relations of the proportion of metamorphosed sea lampreys to larval sea lampreys collected during previous lampricide applications. Tributaries were ranked for treatment during 2004 based on an estimated cost per kill of metamorphosed sea lamprey.

Lake Superior

In 2003:

- Assessments of populations of sea lamprey larvae were conducted in 81 tributaries (38 Canadian, 43 U. S.) and offshore of 6 tributaries (1 Canadian, 5 U. S.). The status of larval sea lamprey populations in streams treated during the last 10 years is presented in Table 8;

- Populations were estimated in 42 tributaries (16 Canadian, 26 U. S.; Table 8);

- Post-treatment quantitative assessments were conducted in 1 Canadian and 2 U.S. tributaries to determine the effectiveness of lampricide treatments during 2003;

- The sea lamprey population in the area treated (23.5 ha) in Lake Helen, an intermediate lake in the Nipigon River system, was estimated during the granular bayluscide treatment in 2003. Population estimates [95% C.I.] are: larvae 28,745 [17,461-40,029] and transformers 626 [153-1,099]; and,

- A study of paired quantitative assessment sampling and catch-per-unit-effort sampling was conducted in two stream reaches (1 Canadian, 1 U. S.) as part of a larger project to test a potentially more efficient sampling method for larval assessment.

Table 8. Status of Lake Superior tributaries that have been treated for sea lamprey larvae during 1994-2003, and sea lamprey population estimates for tributaries surveyed during 2003.

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosis Estimate	On 2004 Treatment Schedule
Canada							
W. Davignon Cr.[1]	May-89	2003	No	---	2,486	500	Yes
L. Carp R.	Sep-01	2003	Yes	None	---	---	No
Big Carp R.	Sep-01	2003	Yes	None	---	---	No
Cranberry Cr.[1]	Jun-90	2003	No	---	5,146	180	Yes
Goulais R.	Jul-02	2003	Yes	2002	---	---	No
Stokely Cr.	Sep-00	2002	Yes	None	---	---	No
Chippewa R.[2]	Jul-98	2003	No	1999	7,102	301	Yes
Batchawana R.[2,A]	Jul-03	2003	Yes	None	3,537	10	No
Carp R.	Sep-00	2002	Yes	2003	---	---	No
Pancake R.	Jul-98	2003	Yes	1999	44,144	219	Yes
Agawa R.	Jul-01	2001	---	---	---	---	No
Gargantua R.	Aug-99	2003	Yes	2000	6,272	222	Yes
Michipicoten R.	Aug-99	2003	Yes	2000	1,541,200	13,906	Yes
White R. [1]	Sep-88	2003	No	1999	103,578	3,140	Yes
Pic R.	Sep-97	2003	No	1998	147,624	1,093	Yes
L. Pic R.	Sep-94	2003	Yes	1995	---	---	No
Prairie R.	Jul-94	2002	No	1998	---	---	No
Steel R.	Jul-01	2003	Yes	2001	106,593	1,003	Yes
Pays Plat R.	Aug-02	2003	Yes	2002	5,969	131	No
L. Pays Plat R.	Never	2003	No	1998	---	---	No
Gravel R.[2]	Aug-98	2003	Yes	1999	93,384	511	Yes
Mountain Bay							
Gravel R.	Jul-00	2002	---	---	---	---	No
L. Gravel R.[2]	Jul-03	2002	---	---	---	---	No
Cypress R.	Jul-03	2002	---	---	---	---	No
Jackfish R.	Jul-00	2003	Yes	2000	19,289	86	No
Nipigon R.							
upper[2]	Aug-03	2002	---	---	---	---	No
Cash Cr.	Aug-03	2002	---	---	---	---	No
Stillwater Cr.	Jul-96	2003	No	1996	596	21	No
Black Sturgeon R.	Aug-99	2000	Yes	None	---	---	No
Wolf R.							
above barrier	Jul-03	2002	---	---	---	---	No
below barrier	Jul-03	2001	---	---	---	---	No
Pearl R.	Jul-91	2003	---	1999	27,853	249	Yes
McIntyre R.	Aug-97	2003	Yes	1998	2,134	43	No
Neebing R.	Jul-94	2003	No	None	---	---	No
Kaministikquia R.	Aug-02	2003	No	---	---	---	No
Cloud R.	Jul-94	2003	No	None	---	---	No
Pigeon R.	Aug-99	2002	Yes	None	---	---	No
United States							
Waiska R.	Sep-01	2002	Yes	2001	---	---	No
Grants Cr.	Jul-63	2003	No	1999	1,344	0	No
Tahquamenon R.							
upper pools	Sep-02	2000	---	---	---	---	No
Betsy R.	Jul-00	2000	---	---	---	---	No
L. Two Hearted R.	Jul-00	2003	Yes	2000	31,919	1,228	Yes
Two Hearted R.	Sep-99	2003	Yes	2000	585,637	6,430	Yes
Sucker R.							
(Alger) - lower	Sep-02	2003	Yes	2003	3,953	46	No
Carpenter Cr.	May-98	2003	No	1998	602	21	No
Sullivans Cr.[1]	Jul-87	2003	No	1999	1,445	92	Yes

Table 8 continued

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosis Estimate	On 2004 Treatment Schedule
Miners R.	Jun-98	2003	No	1999	5,077	306	Yes
Furnace Cr.[2]	Aug-93	2003	---	1998	1,654	56	No
Five Mile Cr.	Oct-98	2003	No	1999	2,487	20	No
Au Train R.							
lower	Aug-97	2001	---	1998	---	---	No
upper & tribs[2]	Sep-01	2000	---	---	---	---	No
Rock R.	Jul-02	2001	---	---	---	---	No
Laughing Whitefish R.	Jun-98	2002	No	1999	---	---	No
Chocolay R.[3]	Sep-02	2003	Yes	---	---	---	No
Carp R.	Jul-03	2002	Yes	2001	---	---	No
Harlow Cr.	Jul-02	2003	Yes	2002	---	---	No
L. Garlic R.[3]	Aug-02	2002	---	---	---	---	No
Big Garlic R.	Jul-04	2003	Yes	---	---	---	No
Iron R.	Jul-01	2000	---	---	---	---	No
Salmon Trout R.							
(Marquette)[5]	Jul-00	2003	Yes	2000	476,355	100	No
Pine R.[1]	Oct-87	2003	No	1998	3,371	528	Yes
Huron R.	Jul-01	2003	Yes	2001	38,433	43	No
Ravine R.[2]	Sep-03	2002	---	None	---	---	Yes
Silver R.[2,4]	Sep-03	2003	---	---	---	---	Yes
Falls R.	Sep-97	2002	No	1999	---	---	No
Sturgeon R.	Aug-01	2002	Yes	2001	---	---	No
Trap Rock R.	Oct-02	2003	Yes	2003	6,702	123	No
Traverse R. - upper	Oct-02	2001	---	---	---	---	No
Eliza Cr.	Oct-77	2003	No	1999	2,135	10	No
Big Gratiot R.	Jun-84	2003	No	1999	7,751	32	No
Salmon Trout R.							
(Houghton)	Aug-92	2003	No	1999	---	---	No
Misery R.	Sep-00	2003	Yes	2000	1,428	53	No
E. Sleeping R.	Oct-99	2003	Yes	1999	61,419	318	Yes
Firesteel R.	Jun-02	2003	---	---	3,031	497	No
Ontonagon R.	May-01	2003	Yes	2001	83,410	417	No
Potato R.	Jun-01	2003	Yes	2001	---	---	No
Cranberry R.	Jun-01	2003	Yes	2001	4,232	0	No
Bad R.	Sep-01	2003	Yes	2001	---	---	No
Fish Creek	Sep-80	2003	No	1999	3,013	117	No
Red Cliff Cr.	Jun-01	2003	Yes	2001	4,089	877	Yes
Brule R.	Jun-01	2003	Yes	2001	82,375	184	No
Poplar R.	Oct-96	2002	---	None	---	---	No
Middle R.	Jun-02	2001	-	---	---	---	No
Amnicon R.	Jun-01	2003	Yes	2001	123,726	291	Yes
Nemadji							
S. Fork & Net R.	May-90	2003	---	1999	10,779	245	Yes
Black R.	Sep-00	2003	Yes	1999	87,096	220	Yes

[1] Not treated during the past 10 years, but quantitative larval surveys were conducted during 2001-2003
[2] Stream has a known lentic population
[3] Quantitative assessment conducted prior to treatment during 2003
[4] Lentic population was assessed during 2003
[5] Assessed as part of sampling efficiency study during 2003
[A] Quantitative Assessment conducted after treatment in 2003

Lake Michigan

In 2003:

- Assessments of populations of sea lamprey larvae were conducted in 67 tributaries and offshore of 8 tributaries. The status of larval sea lamprey populations in streams treated during the last 10 years is presented in Table 9;

- Populations of larvae were estimated in 33 tributaries (Table 9.)

- A post-treatment quantitative assessment was conducted in the Little Manistee River, which was subsequently scheduled for lampricide treatment during 2004;

- Mark-recapture larval population estimates were conducted on 4 stream reaches to verify habitat-based quantitative larval and metamorphosing larval population estimates;

- A study of paired quantitative assessment sampling and catch-per-unit-effort sampling was conducted in two stream reaches as part of a larger project to test a potentially more efficient sampling method for larval assessment; and,

- Quantitative larval assessment sampling was optimized in a subset of Lake Michigan streams surveyed during 2003. The number of density samples collected from each type of larval habitat (preferred or acceptable habitats) was allocated on the basis of optimization rules developed from previous annual measures of larval population density sampling and habitat variances in those reaches.

Table 9. Status of Lake Michigan tributaries that have been treated for sea lamprey larvae during 1994-2003, and sea lamprey population estimates for tributaries surveyed during 2003.

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosis Estimate	On 2004 Treatment Schedule
Hog Island Cr.	Jun-96	2003	Yes	1999	8,262	70	Yes
Black R.	Jun-99	2003	Yes	1999	330,726	713	Yes
Millecoquins R.	May-00	2003	Yes	2000	68,774	1,937	Yes
Rock R.	Aug-00	2003	No	2002	---	---	No
Crow R.	Aug-00	2003	No	2002	---	---	No
Cataract R.[1]	Sep-75	2003	---	1998	2,536	331	Yes
Milakokia R.	Jun-99	2003	Yes	None	---	---	No
Bulldog Cr.	Jun-97	2003	No	None	---	---	No
Gulliver Lake Outlet	May-00	2003	No	2000	734	164	No
Marblehead Cr.	May-00	2003	Yes	2000	3,199	24	No
Manistique R.							
above dam[1]	Oct-03	2003	No	1998	7,312	691	Yes
below dam	Sep-03	2003	Yes	1998	---	---	Yes
lentic[2]	Sep-02	2002	---	1998	---	---	No
Deadhorse Cr.[1]	May-91	2003	No	1998	455	131	Yes
Bursaw Cr.	May-97	2003	No	1998	9,935	151	Yes
Valentine Cr.	Jun-97	2003	No	None	---	---	No
Big Fishdam R.	May-99	2003	Yes	1999	33,509	506	Yes
Sturgeon R.	Jun-03	2003	Yes	2003	-	---	No
Eighteenmile Cr.	Jun-03	2003	Yes	1999	20,914	207	Yes
Ogontz R.	Jul-03	2003	No	None	---	---	No
Squaw Cr.	Aug-00	2002	Yes	None	---	---	No
Whitefish R.	Aug-01	2003	Yes	2001	765,136	35,026	Yes
Rapid R.	May-03	2003	Yes	None	---	---	No
Tacoosh R.	May-00	2003	Yes	2000	14,484	1,385	Yes
Days R.[2]	Oct-01	2002	Yes	2001	---	---	Yes
Portage Cr.	May-97	2003	No	1999	2,642	50	No
Ford R.	May-02	2003	Yes	2002	---	---	No
Bark R.	Sep-03	2003	Yes	1999	---	---	No
Cedar R.	Oct-01	2003	Yes	2001	371,649	395	Yes
Bailey Cr.	May-02	2002	No	None	---	---	No
Beattie Cr.	Oct-01	2001	No	None	---	---	No
Springer Cr.	May-99	2002	No	None	---	---	No
Peshtigo R.	Jul-01	2003	Yes	2001	314	0	No
Oconto R.	Jul-01	2003	No	2002	---	---	No
Hibbards Cr.	May-02	2003	No	2002	---	---	No
East Twin R.	Jul-00	2003	No	2000	2,841	537	Yes
Carp Lake R.[2,3]	Sep-94	2003	-	1998	135,964	1,404	No
Big Stone Cr.	May-97	2001	No	None	---	---	No
Wycamp Lake Outlet	May-00	2002	No	None	---	---	No
Horton Cr.[2,3]	Sep-03	2003	No	None	---	---	Yes
Boyne R.	Sep-02	2002	No	---	---	---	No
lentic[2]	May-03	2003	---	---	---	---	Yes
Porter Cr.[2,3]	Oct-01	2003	No	None	---	---	Yes
Jordan R. [2,3]	Jul-02	2003	Yes	2002	---	---	No
Monroe Cr.[1]	Oct-72	2003	No	1999	189	20	No
McGeach Cr.	Oct-99	2002	No	None	---	---	No
Elk Lake Outlet	May-97	2003	---	1999	30,727	1,600	Yes
Mitchell Cr.	Sep-03	2002	---	---	---	---	No

Table 9 continued

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosis Estimate	On 2004 Treatment Schedule
Boardman R. [2]	Aug-01	2002	---	---	---	---	No
Goodharbor Cr.	Oct-01	2000	---	---	---	---	No
Platte R.	Jul-03 [4]	2003[5]	---	---	64,018	793	Yes [6]
Betsie R.	Jul-02	2002	---	---	---	---	No
Big Manistee R.	Aug-03	2003	Yes	---	25,795	223	No
Bear Cr.	Jun-02	2002	Yes	---	---	---	No
L. Manistee R.	Oct-02	2003	Yes	---	10,501	925	Yes
Gurney Cr.	Jul-01	2001	---	---	---	---	No
Lincoln R.	Jun-02	2002	No	None	---	---	No
Pere Marquette R.	Aug-02	2003	Yes	2002	15	3	No
Pentwater R.	Jul-03	2003	Yes	---	---	---	No
White R.	Aug-01	2003	No	---	---	---	No
Muskegon R.	Aug-02	2001	---	---	---	---	No
Brooks Cr.	Aug-00	2003	No	2001	---	---	No
Cedar Cr.	Aug-00	2003	No	2001	---	---	No
Bridgeton Cr.	May-95	2003	---	2000	2,598	98	Yes
Minnie Cr.	Aug-00	2003	Yes	2001	10,627	200	Yes
Bigelow Cr.	Aug-02	2002	---	---	---	---	No
Black Cr.[1]	Aug-70	2003	---	---	375	152	No
Grand R.							
Norris Cr.	Jun-00	2002	No	None	---	---	No
Sand Cr.	Sep-96	2002	No	1999	---	---	No
Crockery Cr.	Jun-00	2003	Yes	2000	12,901	3,841	Yes
Bass River[1]	Oct-78	2003	---	---	3,565	200	Yes
Kalamazoo R.							
Bear Cr.	Jun-98	2003	---	1998	14,595	316	Yes
Sand Cr.	May-00	2003	---	2000	1,126	33	Yes
Mann Cr.	Jul-02	2002	No	2002	---	---	No
Allegan 4 Cr.[1]	Oct-78	2003	No	---	0	0	No
Black R.	Jun-01	2002	No	2001	---	---	No
Rogers Cr.	May-98	2003	No	None	---	---	No
St. Joseph R.							
Paw Paw R.	May-01	2003	Yes	2001	---	---	No
Mill Cr.	May-01	2003	Yes	2001	---	---	No
Brandywine Cr.	May-97	2003	No	2002	---	---	No
Brush Cr.	May-01	2003	No	2001	---	---	No
Pipestone Cr.	Aug-03	2002	---	---	---	---	No
Blue Cr.	May-01	2003	No	None	---	---	No
Galien R.							
S. Branch Spring Cr.	May-02	2002	---	---	---	---	No
Upper & E. Branch	May-02	2002	No	2002	---	---	No
S. Branch & Galina Cr.	Jun-99	2003	No	1999	882	22	No
Trail Cr.	Apr-00	2003	No	2000	1020	1	No
Burns Ditch	Jul-99	2001	---	---	---	---	No

[1]Not treated during the past 10 years, but quantitative larval surveys were conducted during 2003
[2]Stream has a known lentic population
[3]Lentic population was assessed during 2003
[4]Upper river treated during 2003
[5]Lower and middle Platte R. only
[6]Lower river on treatment schedule for 2004

Lake Huron

In 2003:

- Assessments of populations of sea lamprey larvae were conducted in 61 tributaries (24 Canadian, 37 U. S.) and offshore of 1 U.S. tributary. The status of larval sea lamprey populations in streams treated during the last 10 years is presented in Table 10.

- Populations of larvae were estimated in 30 tributaries (12 Canadian, 18 U. S. Table 10);

- A study of paired quantitative assessment sampling (QAS) and catch-per-unit-effort sampling (CPUE) was conducted in two stream reaches (1 Canadian, 1 U. S.) as part of a larger project to test a potentially more efficient sampling method for larval assessment during 2003;

- A post-treatment quantitative assessment was conducted in one U.S. tributary to determine the effectiveness of the lampricide treatment during 2002; and,

- Monitoring of long-term effectiveness and subsequent recruitment after the 1998-2003 granular Bayluscide treatments in the St. Marys River continued during 2003. Approximately 600 sites were sampled using the deepwater electrofisher and another 160 adaptively-located sites were sampled in areas of higher larval density, both inside and outside of treated areas. Surveys were conducted according to a stratified-random design. The larval sea lamprey population in the St. Marys River was estimated to be 727,000 (716,000-738,000; Table 10).

Table 10. Status of Lake Huron tributaries that have been treated for sea lamprey larvae during 1994-2003, and sea lamprey population estimates for tributaries surveyed during 2003.

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosis Estimate	On 2004 Treatment Schedule
Canada							
Root R.							
main	Sep-99	2002	No	2000	---	---	No
west Root	Oct-03	2002	Yes	---	---	---	No
Garden R.	Jul-02	2003	Yes	2002	---	---	No
Echo R.							
upper	Oct-99	2003	No	None	---	---	No
lower	Sep-99	2003	No	2001	54	0	No
Bar/Iron Cr.	Jul-98	2003	Yes	1999	9,845	539	Yes
Bar R.	Oct-01	2003	Yes	2002	---	---	No
Sucker Cr.	May-00	2002	Yes	---	---	---	No
Two Tree R.	Oct-01	2000	---	---	---	---	No
Richardson Cr.	Aug-96	2003	---	---	530	218	Yes
Watson Cr.	Jun-02	2001	---	---	---	---	No
Gordon Cr.	May-01	2003	Yes	None	---	---	No
Browns Cr.[3]	Oct-03	2003	---	---	---	---	No
Koshkawong R.	May-00	2003	No	2002	10	0	No
Thessalon R.							
upper	Jul-02	2002	---	---	---	---	No
lower	Jul-01	2000	---	---	---	---	No
Livingstone Cr.	Jun-00	2002	No	---	---	---	No
Mississagi R.							
main	Aug-00	2003	Yes	2001	429,736	3,227	Yes
Pickerel Cr.	Jun-98	2003	No	None	---	---	No
Blind R.	May-84	2001	No	1999	---	---	No
Lauzon R.	Sep-97	2003	No	1998	2,541	43	No
Spragge Cr.	Oct-95	2003	No	None	---	---	No
Unnamed (H-114)	Jun-02	2001	---	---	---	---	No
Serpent R.							
main	Jun-00	2002	No	---	---	---	No
Grassy Cr.	Oct-03	2002	---	---	---	---	No
Spanish R.	Jun-02	2002	---	---	---	---	No
Unnamed (H-267)	Jun-02	2002	---	---	---	---	No
Silver Cr.	May-94	2003	No	1998	3,892	194	Yes
Sand Cr.	Oct-01	1999	---	---	---	---	No
Mindemoya R.	Jun-02	2002	---	---	---	---	No
Timber Bay Cr.	May-01	2003	No	2001	15,872	61	No
Manitou R.	Sep-99	2003	No	2000	---	---	No
Blue Jay Cr.	Jun-03	2002	---	---	---	---	No
Chikanishing R.	Jun-03	2002	---	---	---	---	No
French R.							
O.V. Channel	Jun-92	2002	---	---	---	---	No
Wanapitei R.	Jun-00	2002	No	---	---	---	No
Still R.	Jun-96	2002	No	1999	---	---	No
Magnetawan R.	Jul-99	2003	No	1999	67,123	69	No
Naiscoot R.	Jul-99	2003	Yes	1999	52,082	901	Yes
Boyne R.	Jun-03	2002	---	---	---	---	No
Musquash R.	Aug-96	2003	Yes	1998	6,639	80	No
Sturgeon R.	Sep-03	2002	---	---	---	---	No
Nottawasaga R.							
main (incl. Boyne and Bear creeks)	May-02	2002	---	---	---	---	No
Pine R.	May-02	2002	---	---	---	---	No
Bighead R.	Jun-03	2002	---	---	---	---	No
Sauble R.	Jun-96	2003	No	1996	54,790	5,195	Yes

Table 10 continued

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosis Estimate	On 2004 Treatment Schedule
United States							
L. Munuscong R.	Jun-99	2003	Yes	1999	134,601	6,267	Yes
Big Munuscong R.	Jun-99	2003	Yes	1999	47,451	4,714	Yes
Carlton Cr.	Sep-01	2003	No	1998	---	---	No
Caribou Cr.	May-91	2003	---	1999	8,588	807	Yes
Albany Cr.	Sep-01	2002	Yes	None	---	---	No
Trout Cr.	May-01	2000	---	---	---	---	No
Beavertail Cr.	Oct-00	2000	---	---	---	---	No
Prentiss Cr.	May-01	2001	Yes	---	---	---	No
McKay Cr.	Sep-01	2002	Yes	None	---	---	No
Ceville R.	Oct-00	2001	No	---	---	---	No
Steeles Cr.[1]	May-84	2003	No	1998	4,757	126	No
Nunn's Cr.	Sep-01	2000	---	---	---	---	No
Pine R.	May-03	2002	---	---	---	---	No
Carp R.	Sep-03	2002	---	---	---	---	No
Cheboygan R.[2]							
Maple R.	Sep-03	2002	---	---	---	---	No
Pigeon R.	Sep-03	2003	No	None	---	---	No
L. Pigeon R.	Aug-98	2003	No	None	---	---	No
Sturgeon R.	Sep-99	2003	Yes	2000	98,341	4,383	Yes
Laperell Cr.	May-00	2002	No	None	---	---	No
Meyers Cr.	Sep-99	2002	No	None	---	---	No
Elliot Cr.	May-96	2003	---	1998	24,801	666	Yes
Greene Cr.	Oct-01	2000	---	---	---	---	No
Mulligan Cr.	May-94	2001	Yes	---	---	---	No
Grace Cr.[1]	Sep-77	2003	No	2000	4,045	1	No
Black Mallard Cr.	May-03	2002	---	---	---	---	No
Ocqueoc R.	Jul-02	2003[3]	Yes	---	---	---	No
Schmidt Cr.	Sep-98	2003	Yes	1999	31,436	313	Yes
Trout R.	May-00	2003	Yes	2000	27,043	2,703	Yes
Swan R.	May-96	2003	No	2001	---	---	No
Grand Lake Outlet[1]	Never	2003	No	None	0	0	No
Long Lake Cr.	May-03	2003	Yes	---	2,708	115	Yes
Devils R.	May-00	2003	Yes	2000	90,516	5,129	Yes
Black R.	May-03	2003	No	---	---	---	No
Au Sable R.	Aug-03	2003	Yes	---	35,536	712	No
Tawas Lake Outlet	Jun-03	2003	---	---	---	---	No
Silver Cr.	Jul-00	2003	No	2000	273,219	137	No
Cold Cr.	Jun-03	2002	---	---	---	---	No
Sims Cr.	Jul-98	2003	No	2000	1,646	17	No
E. Au Gres R.	May-01	2003	No	2001	16,381	107	No
Au Gres R.	Jun-00	2003	Yes	2000	242,283	2,333	Yes
Rifle R.	Oct-02	2002	---	---	---	---	No
Saginaw R.							
Cass R.[1]	Oct-84	2003	---	2001	33,598	1	No
Cass-Juniata Cr.	Sep-98	2003	No	2000	1,415	39	No
Chippewa R.							
upper	Sep-99	2003	No	2001	88,638	86	No
lower	Jun-03	2003	No	None	0	0	No
L. Salt Cr.	Oct-02	2002	---	---	---	---	No
Big Salt Cr.	Jun-03	2002	---	---	---	---	No
Carroll Cr.	May-02	2001	---	---	---	---	No
Big Salt R.	May-02	2001	---	---	---	---	No
Bluff Cr.	May-02	2002	---	---	---	---	No
Shiawassee R.	Jun-02	2001	---	---	---	---	No

[1] Not treated during the past 10 years, but quantitative larval surveys were conducted during 2003

[2] Stream has a known lentic population

[3] Upper Ocqueoc R. only

Lake Erie

In 2003:

- Assessments of larval populations were conducted in 13 tributaries (2 Canadian, 11 U. S.). The status of larval sea lamprey populations in tributaries treated during the last 10 years is presented in Table 11;
- Populations of larvae were estimated in 3 tributaries (0 Canadian, 3 U. S.; Table 11);
- Sea lamprey larvae were detected in Delaware Creek for the first time since lampricide treatment in 1986. A quantitative assessment is planned during 2004; and,
- Surveys indicate that the Young's Creek barrier has successfully blocked sea lamprey spawning migrations since the 2001 treatment. Limited larval production continues downstream of the barrier.

Table 11. Status of Lake Erie tributaries that have been treated for sea lamprey larvae during 1994-2003, and sea lamprey population estimates for tributaries surveyed during 2004.

Stream	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosing Estimate	On 2004 Treatment Schedule
Canada							
Big Otter Cr.	May-01	2002	No	2001	---	---	Yes[1]
Big Cr.	May-03	2003	No	---	---	---	No
Young's Cr.	May-01	2003	No	---	---	---	No
United States							
Cattaraugus Cr.	May-01	2003	Yes	2001	42,027	1,433	Yes
Crooked Cr.	Oct-02	2002	---	---	---	---	No
Raccoon Cr.	May-01	2003	---	2001	776	71	No
Conneaut Cr.	Apr-03	2003	Yes	---	233	0	No
Grand R.	Apr-03	2003	Yes	2003	---	---	No

[1]Contingent on spring 2004 survey results

Lake Ontario

In 2003:

- Larval populations were assessed in 41 tributaries (21 Canadian, 20 U. S.). The status of populations of larval sea lampreys in Lake Ontario tributaries treated during the last 10 years is presented in Table 12;

- Populations of larvae were estimated in 15 tributaries (5 Canadian, 10 U. S.; Table 12);

- Residual populations were estimated in 6 tributaries (0 Canadian, 6 U. S.; Table 12). All have been scheduled for treatment during 2004, except for South Sandy Creek, which was treated in fall 2003;

- A larval population detected upstream of the Cobourg Brook sea lamprey barrier in 2003 will be quantitatively assessed during 2004. Treatment evaluation surveys revealed a newly re-established larval population upstream of the Duffins Creek barrier;

- Results of the 2003 Lower Niagara River assessment were consistent with those from 2002, and indicate that larval sea lamprey production from this uncontrolled source may be increasing;

- Four *Ichthyomyzon sp.* larvae were captured during surveys of Little Sandy Creek and, along with seven larvae collected from South Sandy Creek during 2001, provide the only evidence that lampreys of this genus have successfully reproduced in Lake Ontario tributaries; and,

- A study of paired quantitative assessment sampling and catch-per-unit-effort sampling was conducted in Bronte Creek as part of a larger project to test a potentially more efficient sampling method for larval assessment.

Table 12. Status of Lake Ontario tributaries that have been treated for sea lamprey larvae during 1994-2003, and sea lamprey population estimates for tributaries surveyed during 2003.

Stream	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2003 Larval Population	2004 Metamorphosing Estimate	On 2004 Treatment Schedule
Canada							
Ancaster Cr.	May-03	2003	No	None	---	---	No
Bronte Cr.	Apr-01	2003	No	2001	62,506	14,285	Yes
Credit R.	May-02	2002	No	None	---	---	No
Rouge R.	Apr-01	2003	No	2001	33,836	4,522	Yes
Duffins Cr.	Jun-03	2003	Yes	2003	---	---	No
Lynde Cr.	Jun-02	2002	No	2002	---	---	No
Oshawa Cr.	Jun-03	2003	Yes	2003	---	---	No
Farewell Cr.	Sep-03	2003	No	None	---	---	No
Bowmanville Cr.	Apr-01	2003	No	2001	251,704	5,408	Yes
Wilmot Cr.	May-03	2003	No	2003	---	---	No
Graham Cr.	May-96	2001	Yes	2003	---	---	No
Wesleyville Cr.	Oct-02	2003	Yes	None	---	---	No
Port Britain Cr.	Apr-00	2003	Yes	None	---	---	No
Cobourg Br.	Sep-96	2003	No	2002	---	---	No
Covert Cr.	Oct-02	2003	No	None	---	---	No
Grafton Cr.	Oct-02	2003	Yes	None	---	---	No
Shelter Valley Br.[1]	Sep-03	2003	---	---	---	---	No
Colborne Cr.[1]	Sep-03	2002	---	---	---	---	No
Salem Cr.	Oct-02	2003	Yes	None	---	---	No
Proctor Cr.	Aug-98	2003	Yes	None	---	---	No
Trent R.[2]	Never	2003	---	1999	162	34	No
Mayhew Cr.	Jun-00	2002	No	None	---	---	No
Salmon R.	Jun-00	2003	No	2000	1,264	2	No
United States							
Black R.[3]	Jul-02	2003	Yes	2002	138,121	3,760	Yes
South Sandy							
estuary[2]	Oct-03	2003	---	---	---	---	No
upper	July-02	2003	Yes	2002	1,318	133	No
Skinner Cr.[3]	May-02	2003	Yes	2002	91,869	241	Yes
Lindsey Cr.[3]	May-02	2003	Yes	2002	36,559	403	Yes
Little Sandy Cr.	Jun-01	2003	No	2001	49,996	1,159	Yes
Deer Cr.[3]	May-02	2003	Yes	2002	16,441	708	Yes
Salmon R.	May-03	2003	Yes	2001	---	---	No
Grindstone Cr.[3]	Apr-02	2003	Yes	2002	77,372	1,135	Yes
Snake Cr.	Apr-02	2003	No	2002	---	---	No
Little Salmon R.	Apr-03	2003	Yes	2000	---	---	No
Catfish Cr.	Apr-03	2003	Yes	2003	---	---	No
Oswego R.							
Fish Cr.	Jun-01	2003	Yes	2001	50,105	3,469	Yes
Carpenters Br.	May-94	2003	No	None	---	---	No
Putnam Br.	May-96	2003	---	2000	---	---	No
Eightmile Cr.	Jun-01	2003	No	2001	91,240	2,786	Yes
Ninemile Cr.	May-02	2003	No	2002	---	---	No
Sterling Cr.	Apr-03	2003	Yes	None	---	---	No
Red Cr.	Apr-03	2003	No	None	---	---	No
Sodus Cr.	Jun-01	2003	No	2001	1,126	37	No
First Cr.	May-95	1999	---	None	---	---	No
Salmon Cr.	May-96	2000	---	None	---	---	No

[1] Not surveyed since last lampricide treatment
[2] Not treated in the past 10 years, but quantitative larval surveys were conducted in 2003
[3] Scheduled for lampricide treatment during 2004 based on residual larval population

Spawning Phase

Table 13. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of the Great Lakes, 2003.

Lake	Number of Streams	Total Captured	Number Sampled	Percent Males	Mean Length (mm)		Mean Weight (g)	
					Males	Females	Males	Females
Superior	25	4,838	888	54	438	439	195	203
Michigan	17	36,537	2,046	54	493	490	258	267
Huron	22	29,471	176	62	473	472	235	249
Erie	5	475	6	83	464	404	221	178
Ontario	14	4,481	927	52	485	487	251	264
Total	83	75,802	4,043					

The long-term effectiveness of the control program is determined from a time series of lake-wide spawning-phase sea lamprey abundance estimates. Traps and nets were used to capture migrating spawning-phase sea lampreys during the spring and early summer. Trap catch began to provide a measure of relative abundance as early as 1975 (varied by lake). Lake-wide abundance has been estimated since 1986 from a combination of mark-recapture estimates in streams with traps and model-predicted estimates in streams without traps.

Lake Superior

In 2003:

- 4,838 sea lampreys were trapped in 24 tributaries during 2003 (Fig. 3, Table 14);
- The estimated population of spawning-phase sea lampreys for 2003 was 86,778 (western United States 30,107, eastern United States 56,671 and Canada $r^2 = 0.54$);
- No significant trend (Fig. 4) was observed from a linear regression of spawner abundance on year during 1984-2003 (p=0.678);
- Spawning runs were monitored in the Amnicon, Middle, Bad, Poplar, Firesteel, Misery, and Silver rivers through a cooperative agreement with the Great Lakes Indian Fish and Wildlife Commission; in the Red Cliff Creek with the Red Cliff Band of Lake Superior Chippewa; in the Brule River with the Wisconsin Department of Natural Resources; and in the Miners River with the National Park Service, Pictured Rocks National Lakeshore;
- Mark-recapture estimates were attempted on two secondary streams (Poplar and Laughing Whitefish rivers) to improve the model predicted estimates of abundance; and,
- A radio-telemetry study was conducted in the Nipigon River from Lake Helen to Alexander Falls Generating Station. The movement of 34 radio-tagged lampreys was monitored by fixed receiving stations and mobile tracking units. Analysis of this movement has improved our understanding of the failure of current trapping methods and of the prospects for future, augmented efforts.

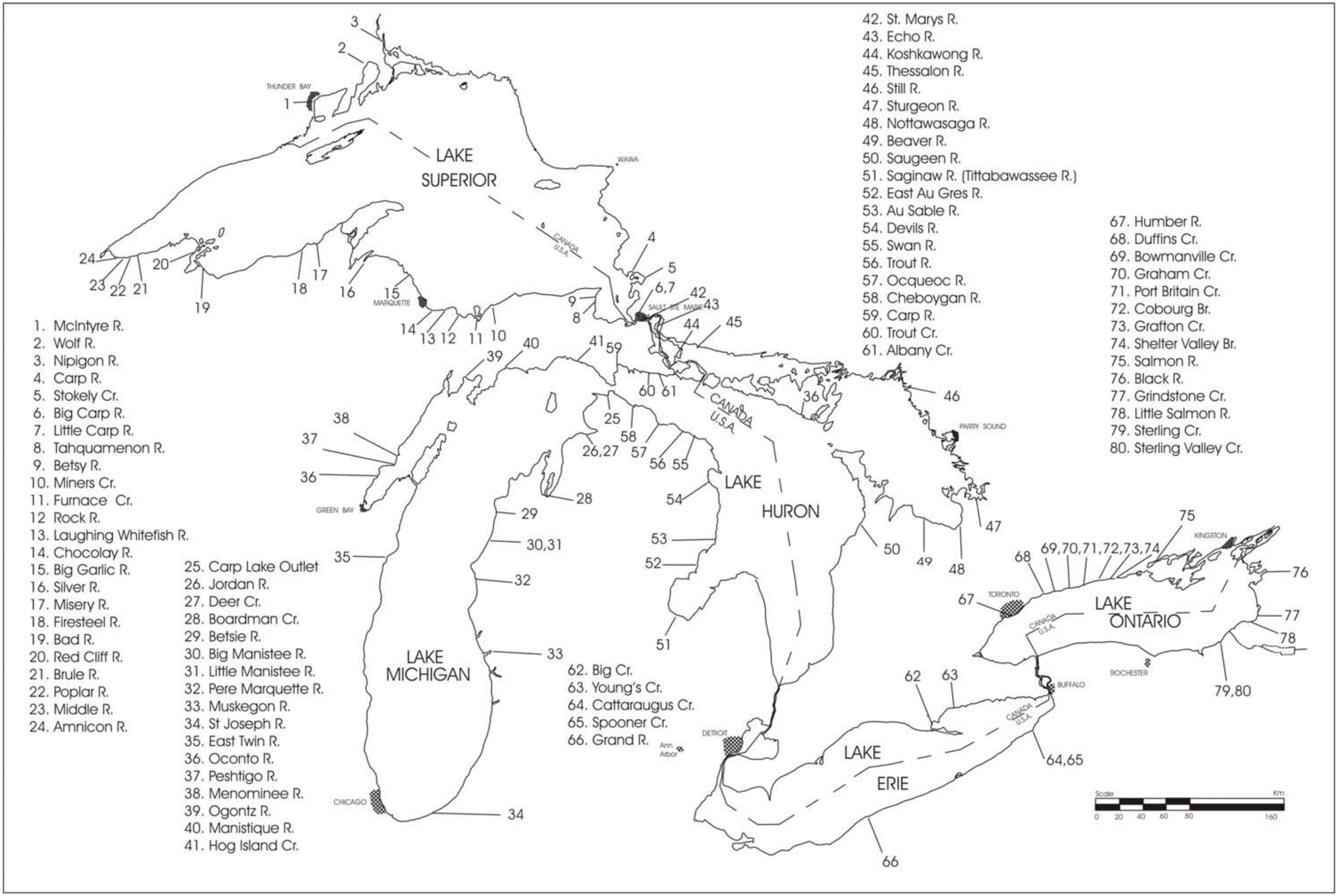

Fig. 3. Locations of tributaries where assessment traps were operated during 2003.

Table 14. Stream, number caught, spawner estimate, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Superior, 2003 (number in parentheses corresponds to location of stream in Fig. 3).

Stream	Number Caught	Spawner Estimate	Trap Efficiency	Number Sampled[1]	Percent Males	Mean Length (mm)		Mean Weight(g)	
						Males	Females	Males	Females
Canada									
Neebing-McIntyre Floodway									
Neebing R. (1)	91	148	62	0	62	---	---	---	---
McIntyre R. (1)	63	155	41	0	62	---	---	---	---
Wolf R. (2)	182	376	48	0	49	---	---	---	---
Nipigon R. (3)	2	---	---	0	---	---	---	---	---
Carp R. (4)	37	64	58	0	---	---	---	---	---
Stokely Cr. (5)	5	---	---	0	---	---	---	---	---
Big Carp R. (6)	6	---	---	0	---	---	---	---	---
L. Carp R. (7)	2	---	---	0	---	---	---	---	---
Total or Mean (north shore)	388			0	55	---	---	---	---
United States									
Tahquamenon R. (8)	215	875	25	42	81	462	470	217	252
Betsy R. (9)	92	153	60	45	56	459	433	205	198
Miners R. (10)	15	---	---	3	47	423	---	190	---
Furnace Cr. (11)	20	---	---	4	50	440	465	178	178
Rock R. (12)	380	892	42	164	52	434	438	188	196
Laughing Whitefish R. (13)	2	---	---	0	---	---	---	---	---
Chocolay R. (14)	10	21	48	1	---	500	---	286	---
Big Garlic R. (15)	105	723	14	6	38	449	439	221	208
Silver R. (16)	23	---	---	1	---	450	---	216	---
Misery R. (17)	37	39	95	2	---	---	439	---	154
Firesteel R. (18)	8	---	---	0	---	---	---	---	---
Bad R. (19)	1,372	8,297	16	368	48	427	436	179	202
Red Cliff R. (20)	86	237	36	24	75	460	465	226	223
Brule R. (21)	1,975	3,369	59	208	55	443	446	209	211
Poplar R. (22)	25	55	45	2	---	424	---	199	---
Middle R. (23)	28	41	68	16	38	415	412	173	165
Amnicon R. (24)	57	138	41	2	---	450	---	201	---
Total or Mean (south shore)	4,450			888	53	438	439	195	203
Total or Mean (for lake)	4,838			888	54	438	439	195	203

[1] The number of sea lampreys from which all length and weight measurements were determined

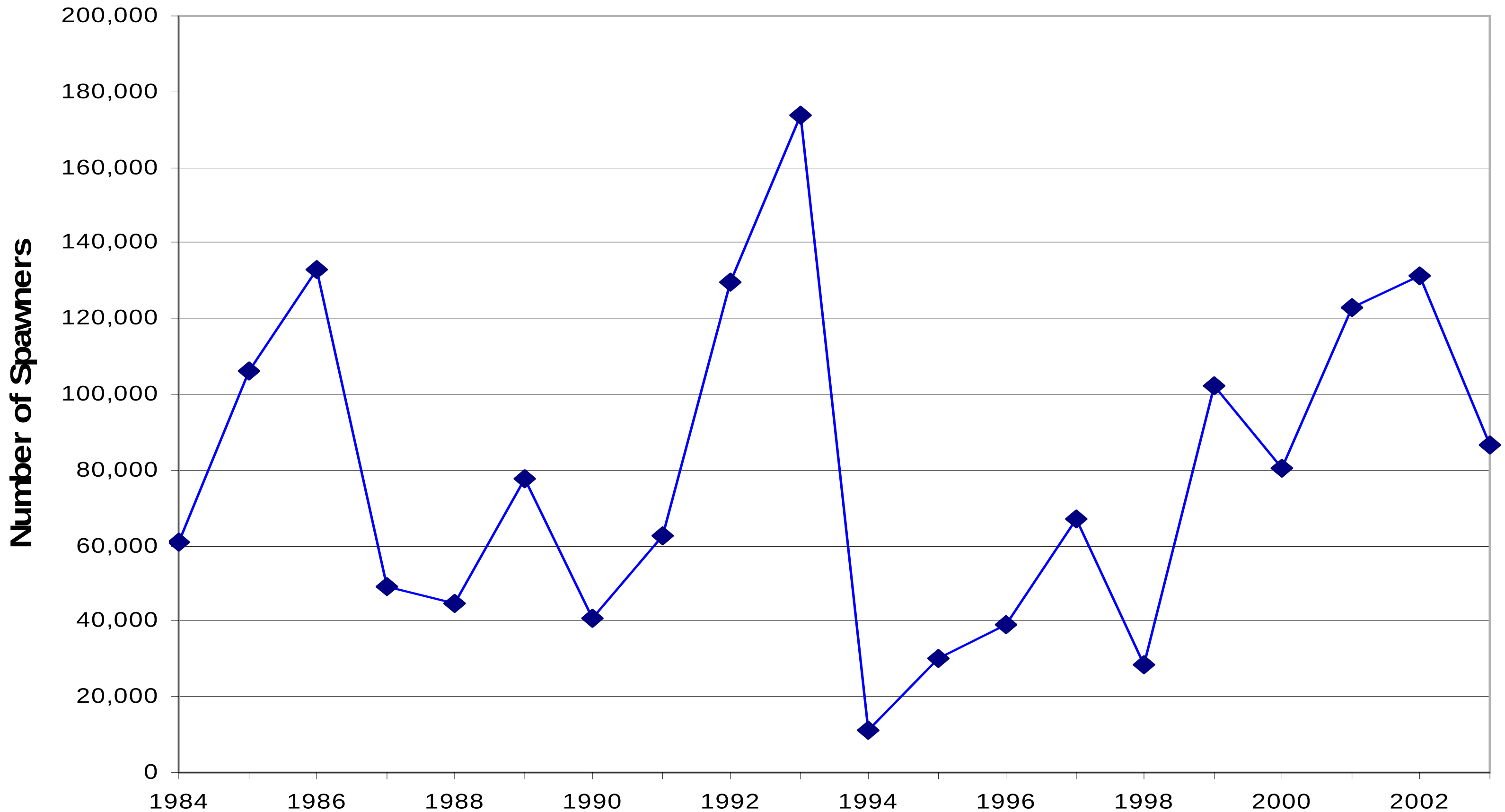

Fig. 4. Trend of spawner abundance for Lake Superior, 1984-2003.

Lake Michigan

In 2003:

- 36,537 sea lampreys were captured at 17 sites in 15 tributaries during 2003 (Fig. 3, Table 15);

- The estimated population of spawning-phase sea lampreys for 2003 was 118,805 (77,482 north and 41,323 south; $r^2 = 0.80$);

- A significant positive trend (Fig. 5) was detected from a linear regression of spawner abundance on year during 1984-2003 ($p=0.0002$, $r^2=0.55$); and,

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

Table 15. Stream, number caught, spawner estimate, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 2003 (number in parentheses corresponds to location of stream in Fig. 3).

Stream	Number Caught	Spawner Estimate	Trap Efficiency	Number Sampled[1]	Percent Males	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
Carp Lake Outlet (25)	2,161	6,007	36	267	60	470	471	207	237
Jordan R. (26)	24	---	---	4	50	468	503	211	189
Deer Cr. (27)	100	256	39	18	61	487	445	262	229
Boardman Cr. (28)	383	1,345	28	90	53	471	463	260	248
Betsie R. (29)	1,078	3,669	29	147	46	479	480	240	255
Big Manistee R. (30)	735	6,048	12	43	26	480	477	255	268
L. Manistee R. (31)	131	199	66	52	52	461	472	249	258
Pere Marquette R. (32)	187	692	27	20	55	493	504	287	308
Muskegon R. (33)	5	---	---	0	---	---	---	---	---
St. Joseph R. (34)	350	---	---	0	---	---	---	---	---
E. Twin R. (35)	143	651	22	23	---	461	460	234	239
Oconto R. (36)	33	90	37	6	67	465	470	297	295
Peshtigo R. (37)	3,014	6,481	46	226	65	487	497	245	264
Menominee R. (38)	626	2,543	25	98	79	480	471	233	232
Ogontz R. (39)	121	780	16	1	---	---	---	---	---
Manistique R. (40)	27,440	43,382	63	1,051	51	504	505	267	286
Hog Island Cr. (41)	6	---	---	0	---	---	---	---	---
Total or Mean	36,537	72,143		2,046	54	493	490	258	267

[1] The number of sea lampreys from which all length and weight measurements were determined

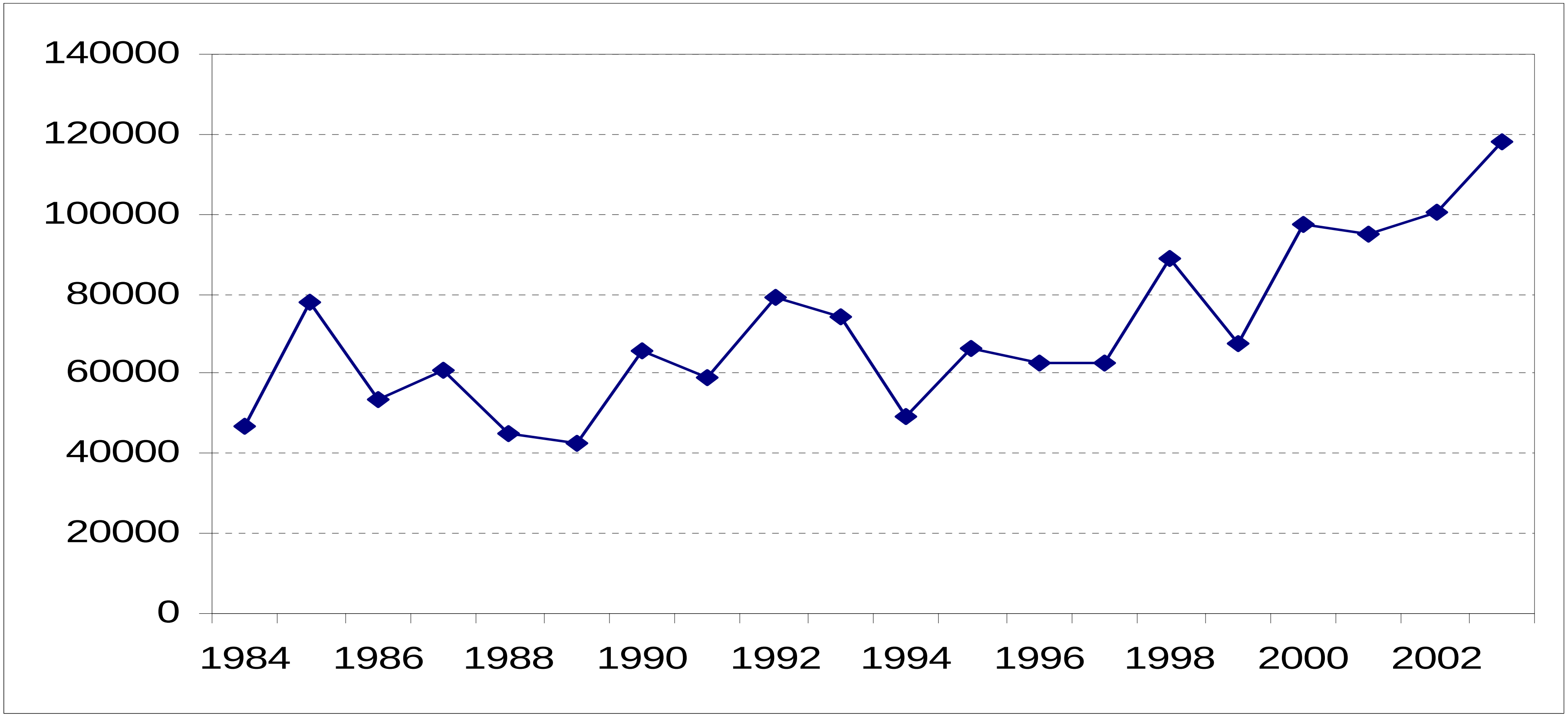

Fig. 5. Spawner abundance, 95% confidence intervals, and the trendline of the linear regression for Lake Michigan, 1984-2003.

Lake Huron

- 29,471 sea lampreys were trapped in 20 Lake Huron tributaries during 2003 (Fig. 3, Table 16);

- The estimated population of spawning-phase sea lampreys for 2003 was 184,387 (117,530 north, 39,846 south, and 27,011 St. Marys River; $r^2 = 0.78$);

- No significant trend (Fig. 6) was detected from a linear regression of spawner abundance on year during 1984-2003 ($p = 0.185$);

- Spawning runs were monitored in the Carp River and Albany and Trout creeks through a cooperative agreement with the Chippewa/Ottawa Resource Authority; in the Tittabawassee River through a cooperative agreement with Dow Chemical USA; and in the Saginaw River through a cooperative agreement with Consumers Energy;

- Traps operated in the St. Marys River at the Great Lakes Power facility in Canada, and the U.S. Army Corps of Engineers (ACE) facility captured 9,220 spawning-phase sea lampreys. The estimated spawning sea lamprey population in the river was 27,011 and trap efficiency was 34%. During 2003 the ACE Unit #10 power plant was off-line for the entire trapping season and U.S. trapping was done exclusively at the new ACE power plant using an array of portable traps';

- A mark-recapture estimate was attempted on one secondary stream, the Swan River, to improve the model-predicted estimates of abundance. No lampreys were captured; and,

- Probative trapping in one central Lake Huron stream (Saugeen R.) and four central to southern Georgian Bay streams (Still, Sturgeon, Nottawasaga and Beaver rivers) continued for the second year, to monitor populations in these lake regions and augment coverage for the lake-wide transforming-, parasitic-, and spawning-phase estimates. The only sea lamprey captured, an adult female, was trapped in the Sturgeon River.

Table 16. Stream, number caught, spawner estimate, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Huron, 2003 (number in parentheses corresponds to location of stream in Fig. 3).

Stream	Number Caught	Spawner Estimate	Trap Efficiency	Number Sampled[1]	Percent Males	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Canada									
St. Marys R. (42)	7,927	27,011	34	0	66	---	---	---	---
Echo R. (43)	2,124	5,068	42	0	61	---	---	---	---
Koshkawong R. (44)	76	---	---	0	52	---	---	---	---
Thessalon R. (45)	25	---	---	0	---	---	---	---	---
L. Thessalon R. (45)	4,324	5,127	84	0	63	---	---	---	---
Still R. (46)	0	---	---	0	---	---	---	---	---
Sturgeon R. (47)	1	---	---	0	---	---	---	---	---
Nottawasaga R. (48)	0	---	---	0	---	---	---	---	---
Beaver R. (49)	0	---	---	0	---	---	---	---	---
Saugeen R. (50)	0	---	---	0	---	---	---	---	---
Total or Mean (Canada)	14,522			0	65	---	---	---	---
United States									
Tittabawassee R. (51)	640	12,348	---	0	---	---	---	---	---
E. Au Gres R. (52)	696	2,977	23	58	64	465	479	220	248
Au Sable R. (53)	1,852	12,354	15	64	65	481	467	243	240
Devils R. (54)	146	1,823	8	8	50	478	496	239	269
Swan R. (55)	0	---	---	0	---	---	---	---	---
Trout R. (56)	332	501	66	0	53	---	---	---	---
Ocqueoc R. (57)	420	1,176	36	0	47	---	---	---	---
Cheboygan R. (58)	9,476	13,686	69	0	55	---	---	---	---
Carp R. (59)	101	578	17	43	47	470	478	249	268
Trout Cr. (60)	10	---	---	1	---	---	---	---	---
Albany Cr. (61)	28	43	65	2	---	---	---	---	---
St. Marys R. (42)	1,252	see Canada	see Canada	---	69	---	---	---	---
Total or Mean (U.S.)	14,945				59	473	472	235	249
Total or Mean (for lake)	29,471				62	473	472	235	249

[1] The number of sea lampreys from which all length and weight measurements were determined.

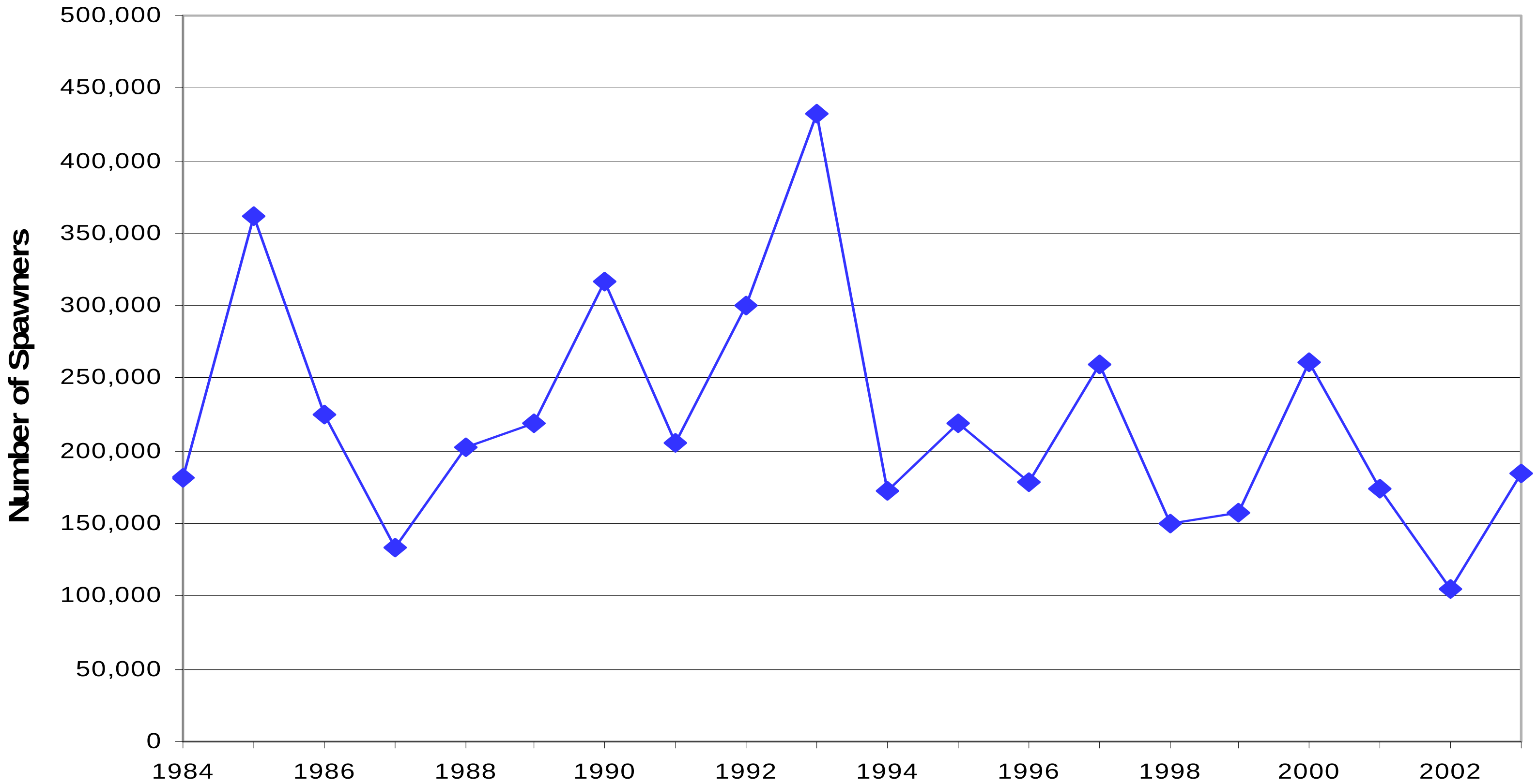

Fig. 6. Trend of spawner abundance for Lake Huron, 1984-2003.

Lake Erie

In 2003:

- 475 sea lampreys were trapped in 4 tributaries during 2003 (Fig. 3, Table 17);

- The estimated population of spawning-phase sea lampreys for 2003 was 4,150 ($r^2 = 0.84$); and,

- No significant trend (Fig. 7) was detected from a linear regression of spawner abundance on year, during post-treatment years 1989-2003 (p=0.189).

Table 17. Stream, number caught, spawner estimate, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 2003 (number in parentheses corresponds to location of stream in Fig. 3).

Stream	Number Caught	Spawner Estimate	Trap Efficiency	Number Sampled[1]	Percent Males	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Canada									
Big Cr. (62)	334	1,897	18	0	---	---	---	---	---
Young's Cr. (63)	41	---	---	0	---	---	---	---	---
Total or Mean (Canada)	375			0					
United States									
Cattaraugus Cr. (64)	44	---	---	0	---	---	---	---	---
Spooner Cr. (65)	33	80	41	6	83	464	404	221	178
Grand R. (66)	23	---	---	0	---	---	---	---	---
Total or Mean (U.S.)	100			6	83	464	404	221	178
Total or Mean (for lake)	475			6	83	464	404	221	178

[1] The number of sea lampreys from which all length and weight measurements were determined.

Fig. 7. Trend of spawner abundance for Lake Erie, 1980-2003.

Lake Ontario

In 2003:

- 4,481 sea lampreys were trapped in 13 tributaries (Fig. 3, Table 18);
- The estimated population of spawning-phase sea lampreys for 2003 was 30,482, (r^2= 0.53); and,
- A significant negative trend (Fig. 8) was detected from a linear regression of spawner abundance on year during 1984-2003 (p=0.0006, r^2=0.49).

Table 18. Stream, number caught, spawner estimate, trap efficiency, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 2003 (number in parentheses corresponds to location of stream in Fig. 3).

Stream	Number Caught	Spawner Estimate	Trap Efficiency	Number Sampled[1]	Percent Males	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
Canada									
Humber R. (67)	1,281	3,644	35	126	47	480	480	253	260
Duffins Cr. (68)	505	1,681	30	48	46	494	487	264	265
Bowmanville Cr. (69)	323	1,412	23	93	51	500	488	276	268
Graham Cr. (70)	28	---	---	8	75	455	480	204	232
Port Britain Cr. (71)	65	185	35	19	53	442	471	194	241
Cobourg Br. (72)	102	210	49	102	51	473	467	269	263
Grafton Cr. (73)	23	43	54	0	---	---	---	---	---
Shelter Valley Br. (74)	556	1,116	50	139	55	500	510	255	278
Salmon R. (75)	57	70	81	11	9	520	499	271	295
Total or Mean (Canada)	2,940			546	50	487	487	258	267
United States									
Black R. (76)	1,322	4,526	29	371	56	483	486	241	259
Grindstone Cr. (77)	33	124	27	4	---	---	---	---	---
Little Salmon R. (78)	147	---	---	2	---	---	---	---	---
Sterling Cr. (79)	36	115	31	4	---	---	---	---	---
Sterling Valley Cr. (80)	3	---	---	0	---	---	---	---	---
Total or Mean (U.S.)	1,541			381	56	483	486	241	259
Total or Mean (for lake)	4,481			927	52	485	487	251	264

[1] The number of sea lampreys from which all length and weight measurements were determined.

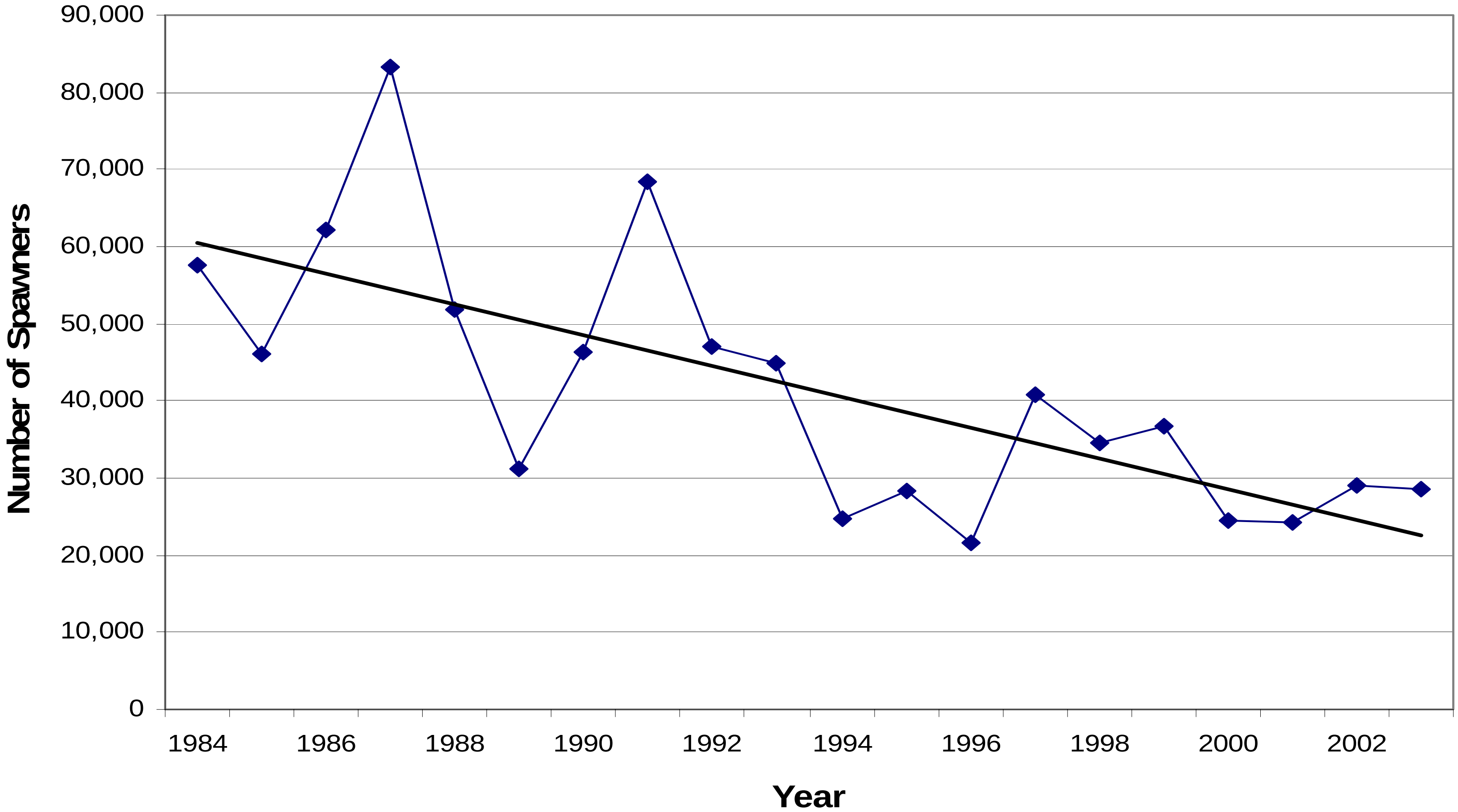

Fig 8. Trendline of the linear regression of spawner abundance for Lake Ontario, 1984-2003.

Parasitic Phase

Lake Superior

Mark-recapture of Metamorphosing Sea Lampreys:

- The recapture of spawning-phase sea lampreys that were released as metamorphosing juveniles during 2001 was completed. Of 1,046 metamorphosing lampreys marked with coded wire tags and released, 5 (0.48%) were recaptured as spawning adults during 2003. A total of 3,734 (387 Canadian, 3,347 U. S.) spawning-phase sea lampreys were scanned for coded wire tags in 22 (7 Canadian, 15 U. S.) Lake Superior streams during 2003. The estimated abundance of metamorphosing sea lampreys ranged from 361,000 in 2001 to 794,000 in 2002 (Table 19); and,

- A total of 1,329 metamorphosing sea lampreys were marked with coded wire tags and released into Lake Superior tributaries from October to December, 2003 (Brule River-197, Misery River-196, Au Train River-129, Two Hearted River-132, Chippewa River-135, Michipicoten River-136, Nipigon River-136, Wolf River-134, and McIntyre River-134). Recapture of these sea lampreys as spawning-phase adults will take place during 2005.

Table 19. Lake-wide population estimates including 95% confidence intervals (CI) of metamorphosing and spawning-phase sea lampreys in Lake Superior during 2000-2003.

Spawning Year	Estimate of Metamorphosing Lampreys (thousands)			Estimate of Spawning-phase Lampreys (thousands)
	Population	Lower CI	Upper CI	
2000	564	419	846	79
2001	361	284	494	109
2002	794	491	1,736	110
2003	652	344	2,405	87

Lake Huron

Index Catch (Canadian waters only for 2003)

Canadian index fisheries collected 2006 parasitic-phase sea lampreys (preliminary count) from northern Lake Huron (831-main basin, 1175-North Channel).

Mark-recapture of Metamorphosing Sea Lampreys:

- The mark-recapture study to estimate the abundance of metamorphosed sea lampreys entering Lake Huron during 2001 was completed. Of 601 metamorphosing sea lampreys marked with coded wire tags and released in the fall of 2001, 23 (3.8%) were recaptured as spawning adults in tributaries to the main basin of Lake Huron during 2003. A total of 25,118 spawning-phase sea lampreys were scanned for coded wire tags in 14 Lake Huron streams. The estimate of transformer abundance has ranged between 630,000 and 1,000,000 from 1992-2003 (Table 20); and

- No coded-wire tagged transformers were released into Lake Huron in 2003.

Mark-recapture of Parasitic Sea Lampreys

- The recapture of spawning-phase sea lampreys released as parasitic-phase lampreys during 2002 was completed. Of 379 parasitic-phase sea lampreys marked and released in the open waters of Lake Huron during 2002, 4 (1.1%) were recaptured as spawning adults in Lake Huron tributaries during 2003 and 4 were recaptured as spawning adults in Lake Michigan tributaries. The estimate of parasitic sea lamprey has ranged between 515,000 and 2.3 million from 1994 to 2003 (Table 20); and,

- A total of 465 parasitic-phase sea lampreys - captured by Canadian and U.S. commercial fisheries, the Chippewa/Ottawa Resource Authority, and U.S. Geological Survey (USGS)-Hammond Bay Biological Station - were marked with coded wire tags and released in northern Lake Huron. Of those, 212 were released in the main basin of the lake (USGS-99, USFWS -113 released in St. Martins Bay) and 253 were released in the North Channel. Recapture of these sea lampreys as spawning-phase adults will take place during 2004.

Table 20. Lake-wide population estimates including confidence intervals (CI) of metamorphosing, parasitic-phase, and spawning-phase sea lampreys in Lake Huron during 1992-2003.

Spawning Year	Estimate of Metamorphosing Lampreys (thousands)			Estimate of Parasitic-phase Lampreys (thousands)			Estimate of Spawning-phase Lampreys (thousands)
	Population	Lower CI	Upper CI	Population	Lower CI	Upper CI	
1992	639	492	907	---	---	---	294
1993	686	459	1,257	---	---	---	434
1994	---	---	---	515	409	688	179
1995	---	---	---	629	518	798	228
1999	803	505	1,737	1,361	788	3,527	176
2000	644	513	865	1,759	1,255	2,848	270
2001	578	491	702	2,302	1,089	14,800	171
2002	1,000[1]	374	7,813	779	442	2,203	116
2003	630	443	1,032	1,909	958	8,715	184

[1] Estimate derived from a single recaptured sea lamprey.

RISK ASSESSMENT

Priority projects included participating in sea lamprey related environmental risk management discussions with state, tribal, and federal regulatory agencies to obtain lampricide application permits, assuring the protection of federal and state-listed species, and working with others to minimize the risk to nontarget organisms.

Permits

Issues concerning management of environmental risk during lampricide applications were addressed to fulfill regulatory agency permit requirements for the Wisconsin Department of Natural Resources, Ohio Environmental Protection Agency, Michigan Department of Environmental Quality, Pennsylvania Department of Environmental Protection, Minnesota Department of Natural Resources, and Bad River Band of Lake Superior Tribe of Chippewa Indians.

Reports were prepared to comply with the U.S. 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 lampricides and must report unreasonable adverse effects on humans, domestic animals, fish or wildlife, plants, other nontarget organisms, water, and property damage. Incident reports are required if the death of a single organism of a federally-listed endangered, threatened, or candidate species or more than 50 individuals of any species or taxa is observed during a lampricide application. Reports filed during 2003 included observed mortalities of 139 stonecats (*Noturus flavus*) in the AuSable River (Lake Huron), 142 brindled madtoms (*Noturus miurus*), 72 mudpuppies (*Necturus maculosus*), and 59 stonecats in the Grand River (Lake Erie), ~ 200 mudpuppies and ~ 200 stonecats in the Salmon River (Lake Ontario), and 379 common shiners (*Luxilus cornutus*) and representatives of the Family Cyprinidae in the delta of the Ausable River (Lake Champlain).

Federal and State Endangered Species

Consultations with Service offices and state agencies were held to discuss proposed lampricide stream treatments, assess the risk to federal (endangered, threatened, and candidate) and state-listed (endangered, threatened, and special concern) species, and determine procedures that protect or avoid disturbance for each listed species. The State of Michigan issued a Threatened/Endangered Species Permit on April 3 to allow the incidental take of state-listed species.

The following protocols were implemented to protect and avoid disturbance to federal and state-listed species: the “Protocol to protect and avoid disturbance to federal and/or state-listed endangered, threatened, candidate, proposed, or special concern species and critical or proposed critical habitats in or near Great Lakes streams scheduled for lampricide treatments in the United States during 2003” and “Protocol to protect and avoid disturbance to federal and/or state-listed endangered, threatened, candidate, proposed, or special concern species and critical or proposed critical habitats in or near Great Lakes streams scheduled for granular Bayluscide applications to assess populations of larval sea lampreys during 2003.” The protocols provide to field personnel a list of protected federally and state-listed species, known locations, and steps to assure protection and avoidance. No mortality or disturbance was observed for the 38 federal- or state-listed species listed in the protocols.

Lake Sturgeon

During 1982, the lake sturgeon (*Acipenser fulvescens*) 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 2003, the lake sturgeon was listed as State endangered in Illinois, Indiana, Ohio, and Pennsylvania, threatened in Michigan and New York, and as a special concern species in Minnesota and Wisconsin. Tributaries in these states where lake sturgeon recently have been documented include the Bad, Ontonagon, Sturgeon, and St. Louis rivers (Lake Superior), Fox, Grand, Kalamazoo, Manistee, Manistique, Manitowoc, Menominee, Millecoquins, Milwaukee, Muskegon, Oconto, Peshtigo, and St. Joseph rivers (Lake Michigan), Carp, Cheboygan, Rifle, Saginaw, and St. Marys rivers (Lake Huron) and Detroit and St. Clair rivers (Lake Erie), and Black and Niagara rivers (Lake Ontario).

Consensus was achieved with the Michigan Department of Natural Resources to manage lampricide treatments to control sea lampreys and protect known populations of lake sturgeons in the Manistique and Big Manistee rivers (Lake Michigan) and Carp River (Lake Huron). Assessments during and immediately after treatments of these rivers found no dead lake sturgeons. The assessments were completed to fulfill requirements specified in the 2003 certification of approval issued for lampricide treatments by the Michigan Department of Environmental Quality.

Hungerford's Crawling Water Beetle

The Hungerford's crawling water beetle (*Brychius hungerfordi*, Coleoptera: Haliplidae) is a federal and state-listed endangered species and was found in the Carp Lake River (Lake Michigan) in Emmet County, Michigan during 1998. The population of larval sea lampreys was assessed in the Carp Lake River during 2003 and the stream ranked for treatment. To comply with the Endangered Species Act of 1973, it is necessary to determine the effect of lampricides on the Hungerford's beetle before a lampricide treatment. Support was received from four experts on the selection of *Haliplus* sp. (Coleoptera: Haliplidae) as a surrogate for the Hungerford's beetle. Service personnel collected more than 1,400 specimens of the surrogate (*Haliplus immaculicollis*) for lampricide toxicity tests to be conducted at the Upper Midwest Environmental Sciences Center.

TASK FORCE REPORTS

The Commission, through its Sea Lamprey Integration Committee (SLIC), has established task forces to recommend direction and co-ordinate actions in several focus areas: Lampricide Control, Sterile Male Release Technique, Sea Lamprey Barriers, Pheromone and Trapping, and Assessment. The progress and major actions of the task forces for 2003 are outlined below.

LAMPRICIDE CONTROL TASK FORCE

The Lampricide Control Task Force was 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 in 2003 were: Terry Morse (Chair); Dorance Brege, David Johnson, Dennis Lavis, Alex Gonzalez, Ellie Koon, John Weisser, (U.S. Fish & Wildlife Service); Rob Young, Brian Stephens, Wayne Westman (Department of Fisheries & Oceans, Canada); Gavin Christie, Dale Burkett (Great Lakes Fishery Commission Secretariat); Cindy Kolar, Mike Boogaard, Ron Scholefield (U.S. Geological Survey)

The Task Force met in February and September to develop a program budget, evaluate progress toward charges by the Commission and Sea Lamprey Integration Committee (SLIC), and to discuss research proposals and priorities.

Progress on charges:

- Implement field trials to develop and review study protocols for the application of the Bayluscide 20% Emulsifiable Concentrate (Liquid Bayluscide) in 2004. The field trial for Bayluscide 20% Emulsifiable Concentrate (Bayluscide EC) was conducted in August, 1997 during treatment of Silver Creek, a tributary to Tawas Lake Outlet (Lake Huron). Several problems were identified. During this field trial it was found that Bayluscide EC formed an emulsion when mixed with TFM. In addition, niclosamide, the active ingredient in Bayluscide, could not be detected by high performance liquid chromatography until water samples had set at least 24 hours. This compromised the ability to monitor concentrations during the treatment. It was also noted that water could not be used to dilute the formulation or clean application equipment. The U.S. agent is planning to apply Bayluscide EC during treatment of 5 streams in 2004. The Canadian agent is planning to use the formulation during at least 3 treatments in Canada.

- Revision of Standard Operating Procedures Manual. A major revision of *Standard operating procedures for the application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (Petromyzon marinus) control program* (SOP manual) is nearing completion. Members of the Standard Operating Procedures (SOP) sub-group are conducting the revision. This document defines the methods used by Sea Lamprey Control personnel in the chemical control of lampreys. The U.S. Environmental Protection Agency and Health Canada have stipulated in the restricted use pesticide labels for formulations of the lampricides TFM and Bayluscide that procedures outlined in the SOP manual be followed in all applications of lampricides. The revision of this document will be followed by peer review, reprint, and redistribution. The SOP manual was expanded, in response to a charge from SLIC, to include standard operating procedures for use of the sea lamprey sterilant Bisazir. This represents a significant addition to this document. In response to additional charges from SLIC, specified procedures have been prepared and entered into the SOP manual. The additions include an Administrative Operating Procedure (AOP) for management of records which contains a method for archiving stream treatment data, and a revised AOP on the policy for acquisition and maintenance of an inventory of lampricide stocks. The SOP sub-group also completed several initiatives related to lampricide applications: 1) Completion of a protocol for public notification of lampricide applications; 2) Revision of the press release for lampricide stream applications; 3) Development of a press release for applications of Bayluscide 3.2% Granular Sea Lamprey Larvicide; 4) Development of a public notice for posting lampricide stream applications; 5) Completion of a draft information sheet on fish consumption, irrigation, and recreational use of water during and following a stream treatment; and 6) Completion of a technical operating procedure on investigations of and responses to unexpected kills of non-target fish. All of the above products are included in the revised SOP manual.

- Every effort should be made to complete all required studies on the endangered Hungerford's crawling water beetle and submissions in the appropriate amount of time to allow treatment during 2004. *(Weisser, Burkett, Gonzalez).* About 1,400 specimens of a surrogate species were collected and delivered to the Upper Midwest Environmental Sciences Center (UMESC) for testing. The beetles are now reproducing and toxicity tests will commence in early April 2004 on the adults with the possibility of testing the larvae later in the year. The plan is to screen the toxicity of TFM and TFM/niclosamide to the surrogate species. The Carp Lake River will not be treated until the tests are complete and approval is secured. Treatment can still be scheduled for 2004 if approval to treat is received.

- Include the Lampricide Inventory Policy in the revision of the SOP. The Lampricide Inventory Policy is available online. The policy is included in the 2004 revised draft of the SOP manual.

- Lampricide Theme Paper and Treatment Effectiveness. A revised (February 2004 draft) lampricide theme paper was presented by Gordon McDonald at the Research Priorities Working Group in March 2004. A follow-up workshop with personnel from the Control and Assessment groups is planned for the summer of 2004.

Long-term Planning:

- *Lampricide deliveries in 2004:*

TFM	80,400 kg
TFM Bar	2,100 bars
Bayluscide 3.2% Granular Sea Lamprey Larvicide	13,336 kg
Bayluscide 70% Wettable Powder	454 kg

- *Research:* The research proposal "Study of Issues Related to Stream pH and Lampricide Treatments" passed peer review and toxicity testing has commenced at the UMESC and Hammond Bay Biological Station.

Tactical/Operational Planning:

- *Border-blind Treatment:* The Canadian treatment staff assisted U.S. personnel in treatment of the Manistique River in Michigan.

- *2003 Treatments.* The allocation of effort for the treatment program during 2003 involved tributaries to all the Great Lakes. All scheduled treatments were successfully completed.

- *Manistique River Treatment:* The Manistique River, a tributary to northern Lake Michigan and the largest watershed (>2,000 square miles) on the U.S. side of the Great Lakes was successfully treated. The treatment, which required the efforts of all U.S. and Canadian treatment personnel, killed millions of lampreys and few non-target organisms.

ASSESSMENT TASK FORCE

The Assessment Task Force was established in April 1996.

Purpose of Task Force:

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

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

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

Members in 2003 were: Doug Cuddy (chairperson) Mike Steeves and Paul Sullivan (Department of Fisheries and Oceans Canada); Michael Fodale, John Heinrich, Michael Twohey, 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 Dale Burkett, (Great Lakes Fisheries Commission).

Meetings were held on Feb. 25-26 and September 16-17, 2003. Two work groups of the task force, the Larval Work Group and the Trap Work Group, also met as required during the year. The Larval Work Group put considerable effort into developing an implementation plan for the recommendations that resulted from phase 1 of larval review. The primary focus of the Trap Work Group was maximizing catch in the St. Marys River.

Progress:

- Produce long term projections of transformer production using empirical data and LCSS. The LCSS is capable of using in-stream larval estimates to project transformer production for up to 4 years;

- Assessment Summary Database. The Empiric Stream Ranking System (ESTR) is the "summary" database that brings together larval data from both agents for the purpose of ranking streams for treatment. ESTR has been used to rank streams basin wide for treatment since 2000. ESTR uses pretreatment assessment data along with estimates of treatment efficiency to predict transformer abundance. It is also being used to help schedule streams for quantitative assessment;

- Review key life history parameters. Several of the SLIS II papers focused on a review and analysis of lamprey life history parameters. There are ongoing studies e.g. Compensatory Mechanisms, recruitment, survival and habitat preferences that address informational needs to assist with the assessment and management of sea lamprey populations. Lake wide mark recapture work is providing valuable information on the movement of parasitic lampreys. A field study to examine the factors influencing transformation is in progress. Additionally, the Bergstedt et al study is looking at temperature and depth preferences of parasitic lampreys;

- Stream habitat inventory. Larval sea lamprey habitat is routinely measured in those streams that are quantitatively assessed each year. Habitat has been quantified at least once for all sea lamprey producing streams and two or more times for most regular-producing streams;

- Develop estimates of the efficacy of treatment (chemical and non-chemical) options. The ATF continues to estimate lampricide treatment effectiveness by conducting post treatment larval abundance assessments on selected streams. The efficacy of barriers is evaluated by cyclical upstream assessment work. The efficacy of the St. Mary's control strategy is evaluated annually with larval estimates;

- Evaluate the level of uncertainty in transformer estimates. This continues to be an informational need that is being addressed by the Task Force members. Uncertainty in transformer estimates was identified as a major impediment by the larval review panel. The Steeves et al transformation study that is underway will help us understand many of the factors contributing to this uncertainty including growth of older larvae, over-winter mortality, and density and transformation rates;

- Evaluate the information value of adult assessment. This was done by the adult assessment review. The ATF has acted on most of the recommendations made in that report. Significant changes in adult assessment include the assessment of spawning runs in more large rivers and the implementation of a multi-year lake wide parasitic estimate study for Lakes Huron and Superior. In 2003, five additional streams were trapped in under represented areas of Lake Huron. Also in 2003, a telemetry study was conducted on the Nipigon River, the largest tributary to the Great Lakes in order to determine the cause of poor trap efficiency in a large river. The data suggests that sea lampreys do not make much effort to get past the dam on the river and hence the low catchability at the site;

- **Develop a strategy for allocating effort among categories of larval assessment.** Allocation of effort has been a priority of the task force since its inception. Annual updates of larval assessment protocols have incorporated the state of knowledge in this regard. Most of the recommendations in the Larval Review Panel Report deal with optimizing assessment effort. In 2003 the agents used stream specific density data to optimize allocation of sample plots between type 1 and type 2 habitat in a set of Lake Michigan tributaries. A field study was conducted that looked at the trade-offs between efficiency and precision between CPUE and QAS type surveys;

- **Evaluate the role of trapping as a control strategy.** Trapping for control is now a responsibility of another Task Force. Maximizing trap efficiency is an important component of the St. Marys River control strategy;

- **Produce summary data to reflect status of lamprey populations.** ESTR is designed to assimilate assessment and treatment efficacy data to track larval lamprey populations and predict transformer production from all producer streams. As well, the agents publish annually in the Lake Reports and GLFC annual report, lake wide estimates of spawning populations for each of the lakes. The development of an "ESTR like" summary data base for adult assessment data collected by the agents is in progress;

- **Develop cost effective sampling protocols.** Both agents have used a single QAS larval sampling protocol for shallow waters since 1996 and a deepwater protocol since 1998. These protocols are modified as new scientific findings are accepted. Optimization of sampling protocols is on-going and the process has been accelerated as a result of phase one of larval review;

- **Produce estimates of transformer production for stream selection.** This is done annually for all streams that we have reason to believe may warrant treatment the following year. Predictions for 2004 that were derived from stream assessments done in 2003 are published elsewhere in this annual report. Estimates are also produced for streams not assessed since the last treatment using ESTR. Transformer estimates for individual plots in the St. Marys are also made and these plots are ranked for treatment along with the suite of producer streams;

- **Coordinate training between agents.** Joint habitat classification training is done most years for larval assessment staff prior to the start of the field season. Other joint ventures between DFO and USFWS such as St. Marys trapping, in-stream mark/recapture studies, and whole-lake transformer M/R provide opportunities for inter-agency training;

- **Develop plans for adult and larval assessment programs.** Program plans and assessment budgets are developed annually;

- **Develop assessment research priorities.** The task force has a research priority list that was last revised in Sept. 2002;

- **Review internal research.** Research proposals are reviewed each year;

- **Recommend approaches for external research.** This is being done through the research priorities working group of which the chair of the ATF is a member. The lists of research priorities developed by the individual task forces forms the basis for this; and,

- **Review external research.** External research proposals applicable to assessment are reviewed annually at task force meetings.

CONNECTING CHANNEL AND LENTIC AREA TASK FORCE

The Connecting Channel and Lentic Area Task Force was established in June 2003.

Purpose of Task Force:

- Integrate estimates of contribution of sea lamprey transformers from connecting channels and lentic areas into the annual treatment ranking process by development of assessment and control strategies appropriate for those areas.

Objectives of Task Force:

- Coordination of St. Marys River control and assessment strategies including providing summary reports and ensuring tasks are appropriately addressed;
- Address assessment precision levels needed for the St. Clair, Detroit, and Niagara rivers;
- Using existing data, inventory infested lentic areas and estimate contribution of transformers; where needed, coordinate the development of proposals for consistent, comparable, and efficient assessment of their contribution;
- Identify specific research questions or hypothesis on population dynamics to define the contribution to recruitment of lentic areas and connecting channels;
- Evaluate current assessment methodologies/technologies toward the development of a “rapid” assessment technique;
- Advance specific proposals to refine knowledge relating to control of sea lampreys in connecting channels and lentic areas;
- Identify treatment options and costs; and,
- Coordinate with other task forces prior to proposing field actions to SLIC.

Members in 2003 were: Denny Lavis, Task Force Chair; Chair of SMRT Task Force (Mike Twohey); Chair of Sea Lamprey Assessment Task Force (Doug Cuddy); Chair of Lampricide Control Task Force (Terry Morse); Chair of Program Integration Working Group (John Heinrich); Statistician (Jean Adams); Sea Lamprey Program Assessment Experts (Mike Fodale and Paul Sullivan); Internal Researchers (Roger Bergstedt and Mike Jones); Lake Technical Committee member (*TBD at first meeting as the expertise need is recognized);* Outside Expert (*TBD after the first meeting or two as the expertise need develops);* additional members/invitees as needed according to meeting agenda

Initial Charges:

- Conduct a workshop to develop the terms of reference and membership for presentation to SLIC at its Fall 2003 meeting;
- Address the need for an all-out QAS effort on the St. Clair and Niagara Rivers;
- Determine if a need exists to assess lentic populations and, if so, to determine the process; and,
- Determine if a need exists to treat Lake Helen, on the Nipigon River (Lake Superior) in 2003.

Progress on Charges and Objectives:

- Workshop convened in August 2003 to develop TOR and Membership and presented same at the October SLIC meeting. Also developed report on the need to treat Lake Helen with Bayluscide as conducted earlier in the season;
- Task force met in September to formulate plans for meeting other charges. Compiled inventory of known lentic areas and discussed rapid habitat evaluation processes using RoxAnn in lentic areas and connecting channels as first step in assessments to determine need for control;
- Formulated plans for 2004 activities on the St. Marys River; and,
- Presented update on St. Marys River assessment and control operation during 2003 at SLIC and GLFC Interim meetings.

BARRIER TASK FORCE

The Barrier Task Force was established during April 1991.

Purpose of Task Force

- Coordination of efforts of Fisheries and Oceans Canada, U.S. Fish & Wildlife Service (Service), U.S. Army Corps of Engineers (Corps), Great Lakes Fishery Commission (Commission), and partners on the construction, operation, and maintenance of sea lamprey barriers.;
- Supporting GLFC Strategic Vision Milestones:
  - Suppress sea lamprey populations to economic-injury levels (maximize net benefits of sea lamprey and fishery management) by the year 2005; and,
  - Accomplish at least 50% of sea lamprey suppression with alternative technologies while reducing TFM use by 20% through increased use of current methods such as sterile-male-release, trapping, and barrier deployment.

Members in 2003 were: Kasia Mullett (Chair) and John Heinrich, U.S. Fish and Wildlife Service; Andrew Hallett, Wayne Westman and Jerry Weise, Department of Fisheries and Oceans Canada; David Gesl, U.S. Army Corps of Engineers; Sharon Hanshue, Michigan Department of Natural Resources; Bill Swink, U.S. Geological Survey; Rob McLaughlin and Gordon McDonald, University of Guelph; Dale Burkett and Gavin Christie, Great Lakes Fishery Commission (Commission).

The task force met twice during 2003 (March and September) to evaluate progress toward charges by the Commission and Sea Lamprey Integration Committee (SLIC), develop program budget, and discuss research proposals and priorities.

Progress on Charges:

- Barrier Policy Team was established in 2003 to handle policy issues related to the sea lamprey barrier program. The task force retained responsibility for the implementation components of the program. Policy team consisted of Dale Burkett (chair), Gavin Christie, Rob Young and John Heinrich and was charged with revising both the Barrier Strategy and Implementation Plan and the ranked list of barrier candidate streams. The task force assisted in the coordination and review of the plan and ranked list;

- Continued coordination among Fisheries and Oceans Canada, Service, Corps, Commission, and partners to plan and construct 21 new barriers that contribute to the annual elimination of 1% of available habitat for sea lamprey larvae, operate and maintain 66 existing sea lamprey barriers, and ensured blockage of sea lampreys at 6 other barriers;

- Facilitated a one day workshop to discuss data collection requirements for sea lamprey barriers at the point of site selection through the determination of barrier crest height that will be used to develop a contractor protocol;

- Participated in research workshops to discuss Hydraulic, Hydrological, and Biological Characteristics of Effective Sea Lamprey Barriers and Evaluation of the Great Lakes Fishery Commission Interim Policy on Barrier Placement;

- Coordinated with the Control Ranking and Evaluation Task Force to discuss process and responsibilities for ranking of candidate barrier streams and selection of new construction projects; and,

- Developed and recommended a fiscal year 2004 budget of $1,367,000 for continued barrier planning and construction, operations, maintenance, health and safety implementation, environmental assessments, and real estate acquisitions.

REPRODUCTION REDUCTION TASK FORCE

The Reproduction Reduction Task Force was established in October 2003 and incorporated the former Sterile Male Release Technique (SMRT), and Pheromone and Trapping task forces. This single report reflects the status of all pheromone, sterile-male release, and trapping issues addressed during 2003 by the current and former task forces.

Purpose of Task Force:

- Coordinate and optimize the pheromone, sterile-male release, and trapping strategies in an integrated program of sea lamprey control.

- Supporting Great Lakes Fishery Commission Strategic Vision Milestones:

  - *Achieve economic-injury levels:* Suppress sea lamprey populations to economic-injury levels (maximize net benefits of sea lamprey and fishery management) by the year 2005;

  - *Control the St. Marys River lamprey population:* Suppress sea lamprey populations in the St. Marys River to a level that allows rehabilitation of lake trout in northern Lake Huron; and,

  - *Use alternative control technologies:* Accomplish at least 50% of sea lamprey suppression with alternative technologies while reducing TFM use by 20% through use of at least one new alternative-control method, increased use of current methods such as sterile-male release, trapping, and barrier deployment.

Members in 2003 were: Michael Twohey (Chair), Gary Klar, Kasia Mullett, and Jessica Richards, U.S. Fish and Wildlife Service; Weiming Li and Mike Jones, Michigan State University; Gavin Christie and Dale Burkett, Great Lakes Fishery Commission; Doug Cuddy and Rod McDonald; Department of Fisheries and Oceans; Cindy Kolar and Roger Bergstedt, U.S. Geological Survey; Rob McLaughlin, University of Guelph; Greg Wright, Chippewa/Ottawa Resource Management Authority; Ellen Marsden, University of Vermont.

Progress on Charges:

- Develop and periodically refine the pheromone, sterility, and trapping for control research theme papers. Dr Li completed the laboratory section of the pheromone theme. The pheromone work group developed a list of research questions to be incorporated into the Laboratory to Field section of the theme. This section of the theme was on track for completion by mid-summer of 2004. An outline of a SMRT theme was produced and the theme was expected to be completed by the fall 2004 task force meetings. A draft theme for barriers and trapping is in preparation.

- Identify application strategies. Solicit or develop field evaluation of the most promising strategies. he task force and pheromone work group identified potential pheromone strategies for prioritization. The six broad strategies were prioritized based on cost, probability of success, degree of complexity, and time to implement. Research questions were developed for insertion into the research theme that will guide field trials. Field experiments by Li et al. demonstrated that traps baited with spermiated males will lure and capture ovulating females in a stream. Field experiments in 2004 were scheduled to examine 1) if the addition of the migratory pheromone can increase the numbers of sea lampreys entering a tributary relative to a comparable tributary where pheromone has not been added, and 2) if traps baited with spermiated male lampreys can attract and capture female lampreys more effectively than unbaited traps in the presence of free ranging male lampreys. Recommendations by the SMRT expert panel and a manuscript by Klassen et al. (submitted) suggest that the release of sterile female sea lampreys could be an effective way to suppress sea lamprey populations. There was uncertainty if the current dose of bisazir used to sterilize male sea lampreys was effective on females

(Hanson and Manion 1976, Dabrowski completion report 2003). Investigation of the efficacy of the current dose on females was scheduled for 2004 at the Hammond Bay Biological Station.

- Evaluate the role of trapping as an alternate control technique. Assessment of the populations of larvae in the St. Marys River, simulation modeling by Jones et al., and economic effects investigated in Jones' decision analysis project all indicate that trapping is an integral element of the integrated control strategy in the St. Marys River, and that the strategy is effectively reducing production of larvae. The task force continued to monitor effectiveness of trapping for control in some Lake Champlain tributaries. Results of compensatory mechanisms investigations suggest that trapping can be an effective and indispensable element of an integrated strategy that aggressively reduces reproduction to low larval densities. The trap work group progressed on trapping improvements:
  - Enhanced operating schedules and improved access to traps in the St. Marys River were planned for 2004.
  - A new attractant water trap was planned for use in the St. Marys River at the south side of the Great Lakes Power outflow as soon as 2005.
  - Construction of a new trap at the Sault Edison plant in the St. Marys River was planned for 2005.
  - A Project Restoration Plan for the Manistee River was submitted to enhance trapping for collection of males for SMRT.
  - The trap work group obtained information on streams that might be more effectively trapped to provide males for SMRT.

- Evaluate results of laboratory and field research and revise application strategies accordingly. An expert panel reviewed SMRT and noted that implementation and evaluation of the technique was proceeding in a highly effective and efficient manner, that there was compelling evidence the technique has reduced recruitment of sea lampreys in the St. Marys River, and that it was a vital part of the integrated control strategy. Results of telemetry studies were used to identify additional trapping sites on the St. Marys River. New traps were planned for the south end of the Great Lakes Power site and the Sault Edison plant. Recent information from Dabrowski indicated low efficacy of bisazir to sterilize females. In response, additional efficacy studies were planned for Hammond Bay during 2004. Field trials with females were not recommended until efficacy was confirmed. The task force continued to monitor advancements in understanding pheromone communication and will adjust plans for field experiments as indicated. The task force worked with the Fish Health Committee and lake committees to establish effective protocols for screening and moving sea lampreys from the lower to upper Great Lakes.

- Mediate a collaborative link between control agencies and research institutions, such that the best available resources are used and the transition from laboratory to field is adequately facilitated. Pheromone field experiments were planned for 2004 with investigators from three universities and a control agent. Control agents from the U.S. and Canada with expertise in trapping will conduct the field work. Good Laboratory Practices Training will be provided by the Upper Midwest Environmental Sciences Center (UMESC). Extraction of larval (migratory) pheromone was conducted at the Hammond Bay Biological Station with support from Peter Sorensen (University of Minnesota) and both control agents. Control agents collaborated with Partnership for Ecosystem Research and Management scientists to identify research priorities in trap design. The Hammond Bay Biological Station continued to provide support for SMRT related field activities.

- Identify chemical/biochemical registration requirements, coordinate appropriate registration research, and facilitate the registration process with U.S. Environmental Protection Agency and Health Canada through appropriate Commission and U.S. Geological Survey personnel. Applications for Experimental Use Permits for migratory and sex pheromones were submitted during 2003. ood Laboratory Practices Training was coordinated by UMESC for field trial workers to support registration requirements.

- Work with control ranking task force on issues of compensatory response of sea lampreys to reduced abundance and behavioral responses to pheromones, sterile-male release, and trapping. Results of compensatory mechanisms investigations and subsequent modeling exercises suggested that strategies to reduce reproduction can be effective in an integrated strategy that aggressively reduces recruitment to low larval densities. Control agents continued to collaborate with Dr. Jones on compensatory mechanism studies.

- Develop annual border-blind schedules that maximize efficiency. The U.S. and Canadian agents worked on both sides of the border to facilitate effective trapping, processing, and transporting of sea lampreys. The U.S. and Canadian agents both planned to provide staffing for pheromone field experiments near Hammond Bay by 2004. The task force was working to establish effective protocols for disease screening and moving sea lampreys from the lower to upper Great Lakes that utilize facilities on both sides of the border.

- Annually update standard operating procedures. Standard operating procedures for critical sterilization activities were developed; externally peer reviewed, and were on track for incorporation into a manual of standard operating procedures. The trap work group established methods and schedules for trap operation on the St. Marys River.

- Annually develop estimates of costs for effort for upcoming fiscal year. Budgets were proposed for control trapping, sterilization, and pheromones and presented to the Sea Lamprey Integration Committee. Funding for the Cattaraugus River trap project was suspended with other section 1135 funding. A draft of the preliminary restoration plan was completed and a new cost estimate of $380,000 was provided. The task force, in consultation with the Control Ranking Task Force, concludes that this project was warranted given the heavy reliance on only one other trap to obtain estimates of adult lamprey abundance in Lake Erie. The task force recommended continued planning, and further investigation of a partnering opportunity with New York State on a fish ladder, and investigation of other technical solutions. Design coordination continued on the Sault Edison trap despite uncertain funding. Improvements in trapping at Great Lakes Power on the St. Marys River were considered which include an attractant water trap on the south bank of the river. Representatives of the Secretariat and the task force chair planned to meet with Great Lakes Power to gain their cooperation and develop cost estimates.

- Working with internal and external researchers, develop proposals and participate in field research consistent with pheromone, sterility, and trapping for control research theme papers. The pheromone work group was instrumental in formulating plans for pheromone field experiments. The control agents will be involved in implementation of the field experiments. Task force members were engaged in development of research proposals for trapping, SMRT, and pheromones. The task force considered recommendations of the expert review panel in formulation of research plans. The task force believed that the risks of the expert panel recommendation to conduct occasional single-year cessations of SMRT in the St. Marys River would outweigh the benefits. High variation suggested this was not a good design, and it would not provide an unequivocal answer. Other evaluations suggested the technique was working, as noted by the review panel.

- Annually review pheromone, sterility, and trapping for control research proposals for relevance to pheromone, sterility, and trapping for control research theme papers. Task force input into research priorities was provided through the research themes and reliance on internal researchers who have membership on this task force and who attend the Research Priorities Working Group core meeting. Research proposals were not available to the task force for review.

OUTREACH 2003

Activity or Event	Number of Occurrences		Staff Days	
	Canada	US	Canada	US
School Presentations	7	32	5	27
Sports Shows	8	7	37	44.8
Youth Fishing	0	2	0	4
Civic Groups	2	9	4	6
Media Interviews	12	17	3	3.5
Media Mailings/E-mail	120	800	6	8
Station Public Displays	5	12	5	16.5
SLCC Public Aquarium	80	-	6	-
Landowner Notification	600	280	25	4
Job Outreach	2	4	2	3.5
Miscellaneous	2	1	4	10
Total Outreach	838	1,164	107	127.3
Combined Outreach	2002		234	

PERMANENT EMPLOYEES OF THE SEA LAMPREY MANAGEMENT PROGRAM 2003

DEPARTMENT OF FISHERIES AND OCEANS CANADA

Sea Lamprey Control Centre – Sault Ste. Marie, Ontario Canada
Robert J. Young, Division Manager

Section Head, Control: R. Wayne Westman
Fisheries Biologist, Control:
Treatment Supervisor: Brian Stephens
Control Technician:
Randy Stewart, Mike MacKenna
Barry Scotland, Shawn Robertson
Chris Sierzputowski, Charlie Boudreau
Peter Grey, Glenn Goulay
Jamie Smith, John Tibbles
Jamie Storozuk, Jerome Keen
Administration Support:
A/Property & Contract Manager: Lisa Vine
Clerk-Receptionist: Christine Youngson
Maintenance Supervisor: Brian Greene
Informatics: John Graham

Section Head, Assessment: Douglas Cuddy
Fisheries Biologist, Assessment:
Adult Supervisor: Rod McDonald
Upper Lakes Larval Supervisor: Fraser Neave
Upper Lakes Larval: Todd Steeves
Lower Lakes Larval Supervisor: Paul Sullivan
Assessment Technician:
Ed Achtemichuk, Jeff Rantamaki
Gale Bravener, Kevin Tallon
Chris Cowper, Andy Treble
Sean Morrison, Thomas Voigt

Environmental Studies: Jerry Weise
Barrier Coordinator: Andrew Hallett
Barrier Technologist: Joseph Hodgson

U. S. FISH AND WILDLIFE SERVICE

Marquette Biological Station
Gerald T. Klar, Field Supervisor

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

Assessment Supervisor: John Heinrich
Fishery Biologist, Assessment:
Larval Supervisor: Mike Fodale
Barrier Coordinator: Katherine Mullett
Sterilization Technique Supervisor: Michael Twohey
Risk Management Supervisor: John Weisser
Mary Henson
Cheryl Kaye
Gregory Klingler
Shawn Nowicki
Dale Ollila
Biological Science Technician:
Gregg Baldwin
Robert Katona
Daniel Kochanski
Kyle Krysiak
Dennis Smith
Mary Wilson
Deborah Winkler

Ludington Biological Station
Dennis Lavis, Station Supervisor

Treatment Lead Biologist: Ellie Koon
Fishery Biologist, Control:
Treatment Supervisor: Alex Gonzales
Kathy Hahka
Physical Science Technician:
Lead Technician: Jeffrey Sartor
Kevin Butterfield
Ken Chaltry
Tim Sullivan

Fishery Biologist, Assessment:
Larval Supervisor: Jeffrey Slade
Amy DeWeerd
Biological Science Technician:
Lois Mishler
Administration Support:
Robert Anderson
Joe Tyron
Tana Reimer
Computer Assistant: Barry Matthews