INTEGRATED MANAGEMENT OF SEA LAMPREYS IN LAKE ONTARIO 2002

Report to
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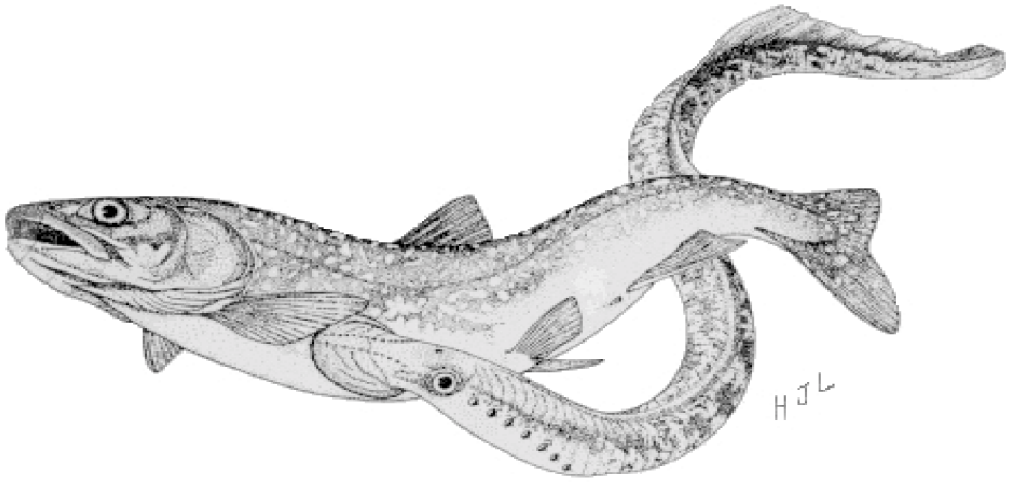

Robert J. Young
Department of Fisheries and Oceans
Sault Ste. Marie, Ontario
Canada

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

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Robert J. Young
Department of Fisheries & Oceans
Sault Ste. Marie, Ontario P6A 6W4

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

INTRODUCTION

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

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

The cooperation of state, provincial, and tribal agencies continues to be critical to the success of all aspects of the control program. For example, in collaboration with the State of Michigan, the agents employed stream treatment methods that provided the best possible suppression of sea lampreys while protecting critical lake sturgeon populations.

This report presents the actions of the Service and Department in the integrated management of sea lampreys in Lake Ontario during 2002. Also presented are actions to meet milestones of the Commission Vision and trends in sea lamprey abundance as related to Fish Community Objectives.

COMMISSION VISION

The Commission, 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 35% from an annual average of 55,169 kg active ingredient from 1986-1990 to an annual average of 35,687 kg active ingredient from 1998-2002.

FISH COMMUNITY OBJECTIVES

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

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

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

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

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

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

The fish community objective for sea lampreys was met during 2002 with 1 mark per 100 lake trout. Wounding rates in Lake Ontario have been remarkably stable during 1985-2002, ranging from 1-3 marks per 100 fish.

During 1983-2002, the Service and Department annually have trapped spawning-phase sea lampreys in an average of 15 tributaries, and have estimated lake-wide abundance of spawning lampreys with multiple regression analysis of 6 interrelated variables (Fig. 3). Estimated lake-wide abundance averaged 72,000 during 1981-1990, and was reduced to an

average of 33,000 during 1991-2000. During 1983-2002, abundance of spawners has shown a significant negative linear trend.

TRIBUTARY INFORMATION

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

- 59 (29 United States, 30 Canada) tributaries have historical records of production of sea lamprey larvae.

- 43 (22 United States, 21 Canada) tributaries have been treated with lampricide at least once during 1993-2002.

- Of these, 29 (15 United States, 14 Canada) tributaries are treated on a regular 3-5 year cycle.

LAMPRICIDE CONTROL

Lampricide treatments are systematically scheduled for tributaries harboring larval sea lampreys to eliminate or reduce the populations of larvae before they recruit to the lake as parasitic adults. Service and Department treatment units administer and monitor doses of the lampricide TFM, sometimes augmented with Bayluscide 70% Wettable Powder, to scheduled tributaries. Specialized equipment and techniques are employed to provide concentrations of lampricides that eliminate about 95% of the lamprey larvae and minimize the risk to nontarget organisms.

The following statements highlight the lampricide control program for Lake Ontario during 2002. Table 1 provides details on the application of lampricides to tributaries treated during 2002 and Fig. 1 shows the locations of the tributaries.

- Treatments were successfully completed in 15 tributaries (8 U.S., 7 Canada).

- Wesleyville Cr., a small tributary located at the eastern end of Lake Ontario, was treated for the first time.

- Grafton and Port Britain creeks were treated upstream of their respective sea lamprey barriers upon the completion of a compensatory mechanism study.

- Mortality of nontarget organisms was insignificant in the majority of tributaries treated. However, stonecats (less than 500), juvenile Chinook salmon (less than 500), and common white suckers (less than 100) were killed in the middle of the treatment area of the Credit River when pH levels unexpectedly decreased to lower than expected levels.

Table 1. Details on the application of lampricides to tributaries of Lake Ontario, 2002.
(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)
United States					
Snake Cr. (14)	Apr 25	0.4	65.4	0	9.9
Grindstone Cr. (13)	Apr 27	4.7	377.2	0	31.8
Deer Cr. (12)	Apr 30	1.1	75.5	0	10.8
Lindsey Cr. (10)	May 2	2.0	239.7	0	14.2
Ninemile Cr. (15)	May 5	1.4	207.4	0	14.0
Skinner Cr. (11)	May 7	1.5	137.2	0	6.5
Black R. (8)	Jul 12	46.0	3,188.7	35.3	9.3
South Sandy Cr. (9)	Jul 14	0.8	207.8	0	9.4
Total		57.9	4,498.9	35.3	105.9
Canada					
Credit R. (1)	May 24	8.5	1,881.9	23.2	60.2
Lynde Cr. (2)	Jun 1	0.7	183.4	0	20.5
Covert Cr. (5)	Oct 17	0.1	23.0	0	1.1
Wesleyville Cr. (3)	Oct 18	0.1	21.0	0	1.3
Port Britain Cr. (4)	Oct 18	0.1	40.3	0	4.7
Grafton Cr. (6)	Oct 20	0.2	63.0	0	7.0
Salem Cr. (7)	Oct 21	0.2	51.3	0	2.3
Total		9.9	2,263.9	23.2	97.1
Grand Total		**67.8**	**6,762.8**	**58.5**	**203.0**

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

TRIBUTARIES TREATED

1. Credit R.
2. Lynde Cr.
3. Wesleyville Cr.
4. Port Britain Cr.
5. Covert Cr.
6. Grafton Cr.
7. Salem Cr.
8. Black R.
9. South Sandy Cr.
10. Lindsey Cr.
11. Skinner Cr.
12. Deer Cr.
13. Grindstone Cr.
14. Snake Cr.
15. Nine Mile Cr.

TRIBUTARIES TRAPPED

A. Humber R.
B. Duffins Cr.
C. Bowmanville Cr.
D. Graham Cr.
E. Port Britain Cr.
F. Cobourg Br.
G. Grafton Cr.
H. Shelter Valley Cr.
I. Salmon R.
J. Black R.
K. Grindstone Cr.
L. Little Salmon R.
M. Sterling Cr.

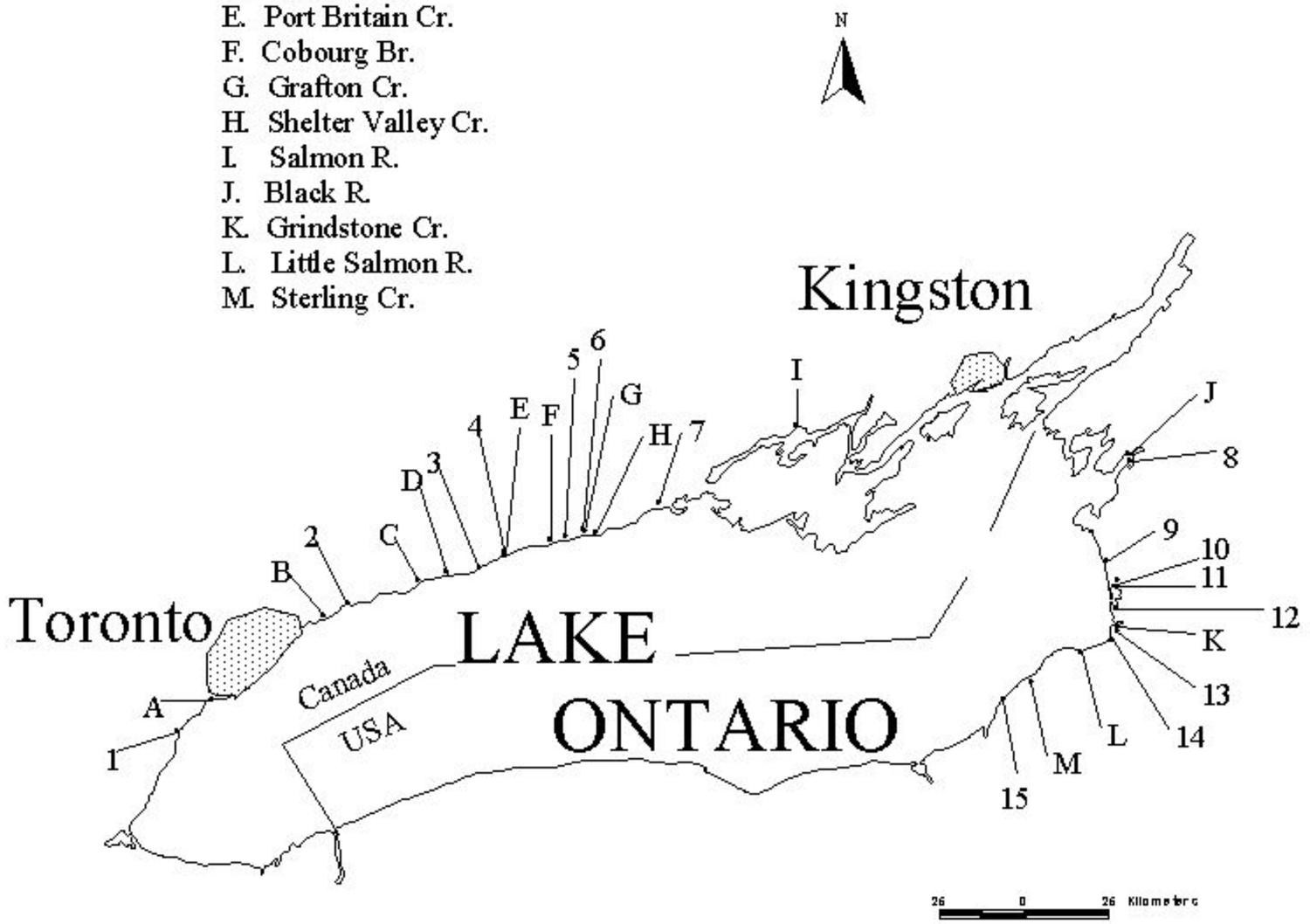

Fig. 1. Locations of Lake Ontario tributaries treated with lampricides (Numbers, Table 1) and tributaries where assessment traps were operated (Letters, Table 3) during 2002.

ALTERNATIVE CONTROL

Sterile Male Release Technique

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

Male sea lampreys are captured during their spawning migrations in 20 tributaries to lakes Superior, Michigan, Huron, and Ontario, and the St. Marys River and transported to the sterilization facility (facility) at the Hammond Bay Biological Station. At the facility sea lampreys are sterilized with the chemosterilant bisazir and decontaminated, and are then released into the St. Marys River. Laboratory and field studies have shown that treated male sea lampreys are sterile and sexually competitive, and that the numbers of eggs hatching in nests are reduced.

- A total of 777 spawning-phase male sea lampreys were transported to the sterilization facility on May 6 from trapping operations on the Humber River and Duffins Creek.

Barriers

In its *Strategic Vision for the First Decade of the New Millennium*, the Commission committed to implementing an integrated control program relying on alternative control methods to achieve 50 percent of lamprey suppression. Barriers are currently the only proven alternative control method. Presently, there are 13 barriers on Lake Ontario tributaries constructed solely to stop the migration of spawning-phase sea lampreys (Fig. 2).

The sea lamprey management program benefits substantially from a number of dams built and operated for other purposes. A Geographic Information System inventory of these "de-facto" barriers has been initiated. This will be a useful tool for identifying dams of value to sea lamprey management and for tracking a growing number of barrier mitigation proposals that have potentially serious consequences to the Great Lakes fishery. The inventory is complete or nearing completion for Michigan, Wisconsin, and Ontario.

- Wesleyville Creek - A partnership with Ontario Power Generation, Ganaraska Conservation Authority, and the Department resulted in a completed design for a barrier. The project has been submitted to Ontario Ministry of Natural Resources (OMNR) for review under the Lakes and Rivers Improvement Act.

- Bronte Creek - A partnership was formed with the Ontario Ministry of Transportation (MTO) to incorporate a lamprey control structure within the design of a new Queen Elizabeth Way bridge. Preliminary MTO plans are anticipated during January 2003.

- Shelter Valley and Graham creeks - Jump pools were scoured beyond design dimensions, so remedial work was undertaken to reduce the size of the jump pools to original specifications.

- Duffins Creek - Safety upgrades which included relocation of a sea lamprey trap and tailrace infill were completed during the fall.

- Credit River - An inspection of the fishway was completed. OMNR replaced defective wooden stoplogs with new steel stoplogs. Discussions were initiated with OMNR on modification of the dam abutments and spillway to block sea lampreys.

- Rouge River - Construction of a fishway at Milne Dam began during the fall. The barrier coordinator provided technical advice to the Department of Fisheries and Oceans–Fish Habitat Management to develop an approval under Section 20 of the Fisheries Act that specified requirements for blocking sea lampreys.

- Retroactive applications under the Navigable Waters Protection Act were submitted for sea lamprey barriers on Duffins, Lakeport, Graham, Grafton, Port Britain, and Shelter Valley creeks.

TRIBUTARIES WITH BARRIERS

1. Credit R.
2. Humber R.
3. Rouge R.
4. Duffins Cr.
5. Bowmanville Cr.
6. Graham Cr.
7. Port Britain Cr.
8. Cobourg Br.
9. Grafton Cr.
10. Shelter Valley Cr.
12. Salmon R.
13. W. Br. Fish Cr.

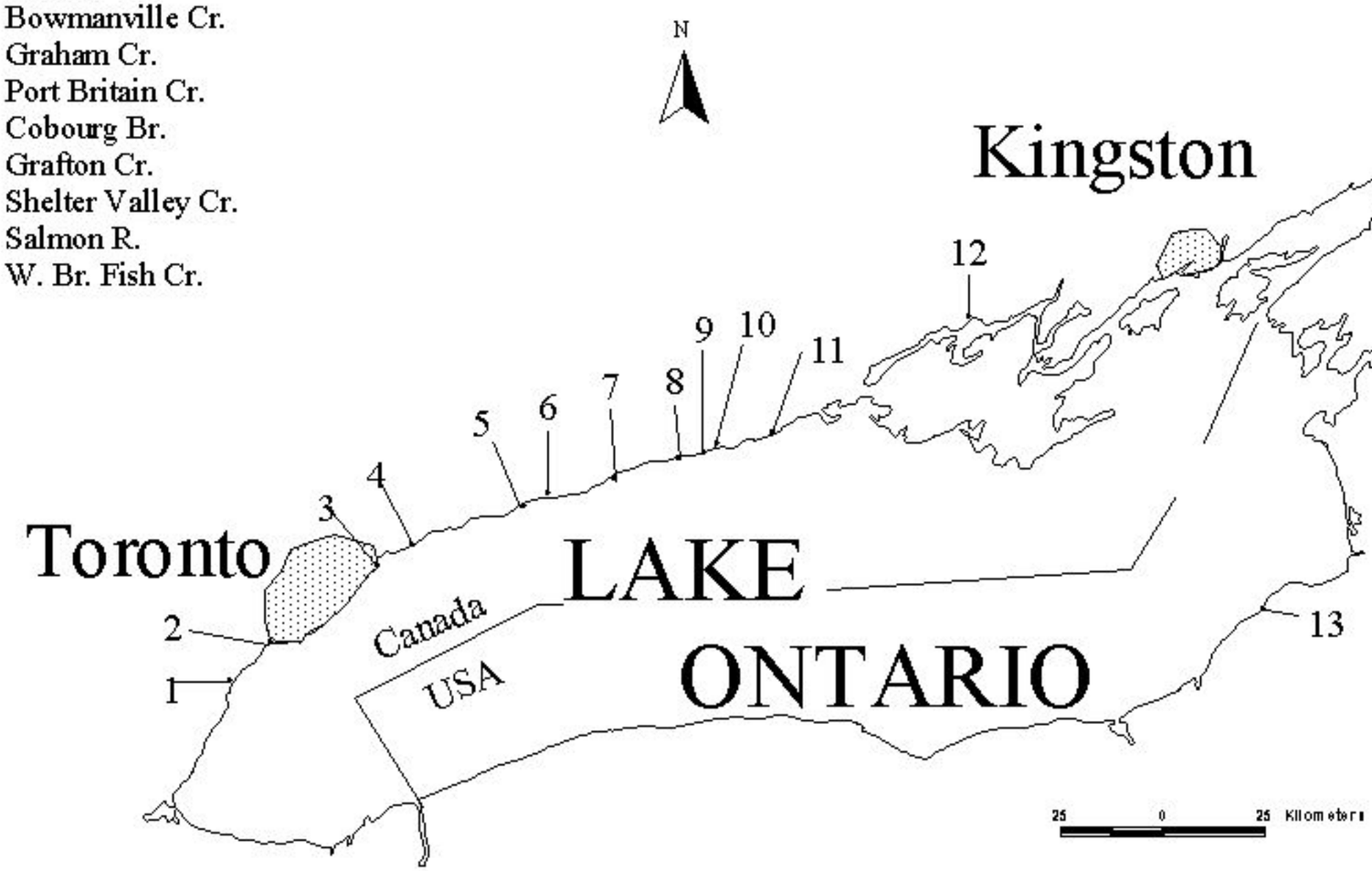

Fig. 2. Locations of Lake Ontario tributaries with sea lamprey barriers.

ASSESSMENT

Larval

Tributaries to the Great Lakes are systematically assessed for abundance and distribution of sea lamprey larvae. Quantitative estimates of the number of metamorphosing sea lampreys that will leave individual tributaries the following year 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 2003 were assessed during 2002 to estimate larval density and amount of suitable larval habitat. Assessments were conducted with backpack electrofishers in waters <1m deep. Waters >1m in depth were surveyed with deepwater electrofishers or Bayluscide 3.2% Granular Sea Lamprey Larvicide. 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. Populations of larvae in each tributary were estimated by multiplying the mean density of larvae (number per m^2) by an estimated area of suitable habitat (m^2). The probable number of larvae that would metamorphose into parasitic sea lampreys during 2003 was developed from historical relations of the proportion of metamorphosed to larval sea lampreys collected during previous lampricide applications. After the data was processed, tributaries were ranked for treatment during 2003 based on an estimated cost per kill of metamorphosed sea lampreys

- Assessments of larval populations were conducted in 37 tributaries (12 U.S., 25 Canada). The status of populations of larval sea lampreys in Lake Ontario tributaries treated during the last 10 years is presented in Table 2.

- Populations of larvae were estimated in 15 tributaries (6 U.S., 9 Canada; Table 2).

- Residual populations were estimated in the Salmon River and Skinner Creek. The Salmon River was scheduled for treatment during 2003.

- Larval surveys conducted on the Lower Niagara River indicate that sea lamprey production may be increasing from this uncontrolled source.

- Larval populations upstream of sea lamprey barriers on Duffins and Shelter Valley creeks were quantitatively estimated and are scheduled for lampricide treatment during 2003.

Table 2. Status of Lake Ontario tributaries that have been treated for sea lamprey larvae during 1993-2002, and sea lamprey population estimates for tributaries surveyed during 2002.

Streams	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2002 Larval Population	2003 Metamorphosing Estimate	On 2003 Treatment Schedule
United States							
Black R.[1]	Jul-02	2001	-	-	-	-	No
South Sandy Cr.	Jul-02	2002	No	None			No
Skinner Cr.	May-02	2002	Yes	2002	1,983	8	No
Lindsey Cr.	May-02	2002	Yes	2002	-	-	No
Little Sandy Cr.	Jun-01	2001	No	2001	-	-	No
Deer Cr.	May-02	2002	Yes	2002	-	-	No
Salmon R.	Jun-01	2002	Yes	2001	243,103	5,311	Yes
Grindstone Cr.[1]	Apr-02	2002	-	-	-	-	No
Snake Cr.[1]	Apr-02	2002	-	-	-	-	No
Little Salmon R.	May-00	2002	No	2000	2,133,797	49,037	Yes
Catfish Cr.	May-00	2002	No	2000	11,269	420	Yes
Oswego R.							
Big Bay Cr.	Sep-93	1999	No	None	-	-	No
Fish Cr.	Jun-01	2001	Yes	2001	-	-	No
Carpenters Br.	May-94	1998	No	None	-	-	No
Putnam Br.	May-96	1999	Yes	None	-	-	No
Eightmile Cr.	Jun-01	2001	Yes	2001	-	-	No
Nine Mile Cr.[1]	May-02	2002	-	-	-	-	No
Sterling Cr.	May-00	2002	No	2000	33,937	7,587	Yes
Red Cr.	Apr-94	2002	No	None	31,448	4,995	Yes
Sodus Cr.[1]	Jun-01	2001	-	-	-	-	No
First Cr.	May-95	1999	No	None	-	-	No
Salmon Cr.	May-96	2000	-	None	-	-	No
Canada							
Niagara R.	Never	2002	-	1999	-	-	No
Ancaster Cr.[1]	Apr-77	2002	No	1999	2,224	1,193	Yes
Bronte Cr.	Apr-01	2002	No	2001	-	-	No
Credit R.	May-02	2002	No	None	-	-	No
Rouge R.	Apr-01	2001	No	2001	-	-	No
Duffins Cr.	Apr-01	2002	No	2000	12,971	3,784	Yes
Lynde Cr.	Jun-02	2002	No	2002	-	-	No
Oshawa Cr.	May-00	2002	No	2000	200,949	2,825	Yes
Farewell Cr.	Apr-00	2002	No	2000	2,898	152	No
Bowmanville Cr.	Apr-01	2002	Yes	2001	-	-	No
Wilmot Cr.	May-00	2002	No	2000	51,258	1,807	Yes
Graham Cr.	May-96	2001	No	None	-	-	No
Wesleyville Cr.[1]	Oct-02	2001	-	-	-	-	No
Port Britain Cr.[1]	Apr-00	2002	-	-	-	-	No
Cobourg Br.	Sep-96	2002	No	None	-	-	No
Covert Cr.[1]	Oct-02	2001	-	-	-	-	No
Grafton Cr.[1]	Oct-02	2002	-	-	-	-	No
Shelter Valley Br.	Sep-96	2002	No	2000	37,351	8,197	Yes
Colborne Cr.	Jun-95	2002	No	1999	409	139	Yes
Salem Cr.	Oct-02	2001	-	-	-	-	No
Proctor Cr.	Aug-98	2002	Yes	-	-	-	No

Table 2. continued

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2002 Larval Population	2003 Metamorphosing Estimate	On 2003 Treatment Schedule
Trent R.[2]	Never	2002		1999	3,953	1,805	No
Mayhew Cr.	Jun-00	2002	No	None	-	-	No
Moira R.	Never	2002	-	2002	-	-	No
Salmon R.	Jun-00	2002	No	2000	52,598	0	No

[1]Not surveyed since last lampricide treatment.

[2]Not treated during the past 10 years, but quantitative larval surveys were conducted during 2002.

Spawning-phase

The long-term effectiveness of the control program has been measured by the annual estimation of the lake-wide abundance of spawning-phase sea lampreys. Traps and nets were used to capture migrating spawning-phase sea lampreys during the spring and early summer. 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.

- 5,756 sea lampreys were trapped at 14 sites in 13 tributaries (Table 3, Fig. 1).

- The estimated population of spawning-phase sea lampreys for 2002 was 38,377 ($r^2 = 0.58$).

- A significant negative trend (Fig. 3) was detected from a linear regression of spawner abundance on year during post-treatment years, 1983-2002 ($p=0.001$, $r^2=0.45$). Estimates for the period were adjusted with a refined spawner discharge model and differ from those reported in previous years.

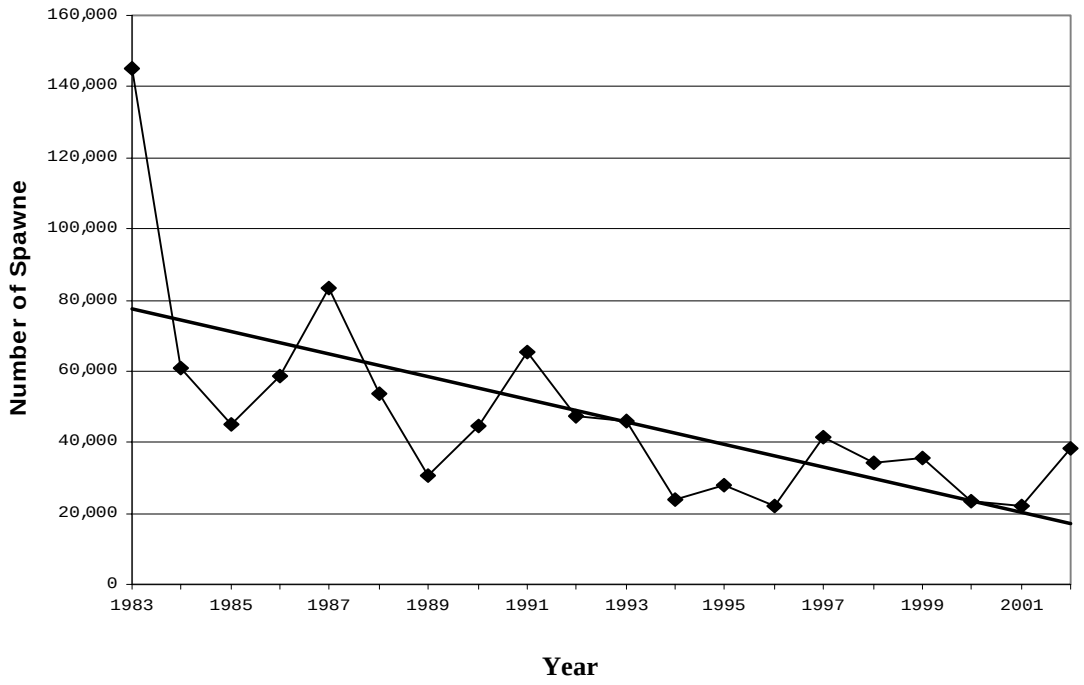

Fig 3. Trendline of the linear regression of spawner abundance for Lake Ontario, 1983-2002.

Table 3. Stream, number, spawner estimate, trap efficiency, number sampled, percent males, and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 2002. (Letters in parentheses correspond to location of stream in Fig. 1.)

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
United States									
Black R. (J)	343	4,284	8	20	40	344	502	176	316
Grindstone Cr. (K)	92	504	18	11	73	486	458	267	247
Little Salmon R. (L)	219	1,239	18	31	77	486	473	275	266
Sterling Cr. (M)	57	138	41	6	50	487	495	273	277
Sterling Valley Cr. (M)	46	560	8	1	---	---	450	---	218
Total or Mean (U.S.)	**757**			**69**	**56**	**459**	**486**	**255**	**286**
Canada									
Humber R. (A)	2,143	6,000	36	220	49	481	488	256	274
Duffins Cr. (B)	1,190	3,188	37	119	49	467	476	238	252
Bowmanville Cr. (C)	344	2,065	17	113	48	463	458	239	241
Graham Cr. (D)	53	74	71	17	41	448	425	215	216
Port Britain Cr. (E)	173	276	63	72	42	473	455	237	229
Cobourg Br. (F)	127	176	72	33	39	486	459	221	231
Grafton Cr. (G)	105	179	58	0	---	---	---	---	---
Shelter Valley Cr. (H)	837	1,153	73	218	50	507	511	260	278
Salmon R. (I)	27	---	---	2	50	413	556	139	312
Total or Mean (Canada)	**4,999**			**794**	**48**	**483**	**482**	**248**	**259**
Total or Mean (for lake)	**5,756**			**863**	**50**	**480**	**482**	**249**	**260**

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