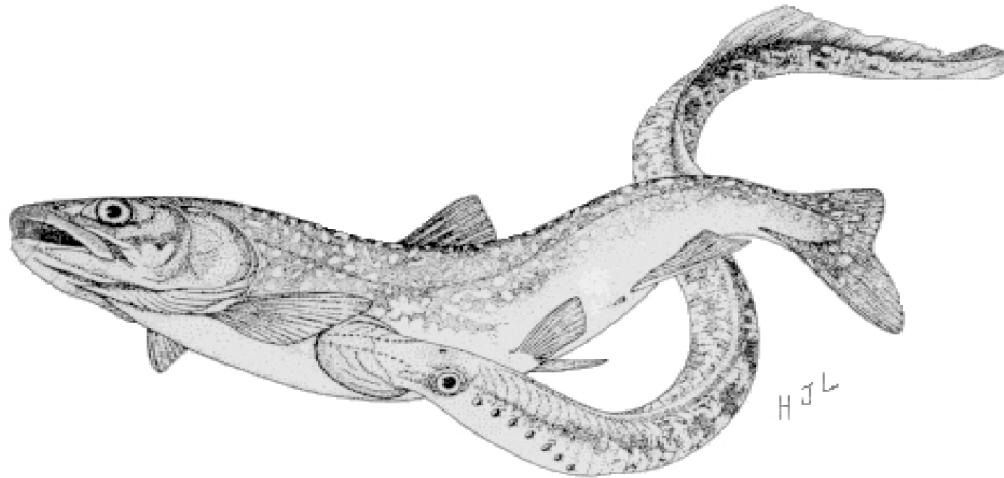


INTEGRATED MANAGEMENT OF SEA LAMPREYS IN LAKE SUPERIOR 2002

Report to
Lake Superior Committee Annual Meeting
Milwaukee, Wisconsin
March 18-19, 2003



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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. The target for each lake will define the abundance of sea lampreys that can be tolerated and the economically viable level of control required to reach the desired suppression.

The 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 Superior 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 lamprey 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, the 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 through 1990 to an annual average of 35,687 kg active ingredient from 1998 through 2002.

FISH COMMUNITY OBJECTIVES

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 total.

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 being treated. A cost-benefit analysis indicates that an increase in the number of stream treatments will result in a relatively small decline in lake-wide lamprey abundance.

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 additional methods will be combined with continued TFM treatment to further suppress sea lamprey populations in Lake Superior.

TRIBUTARY INFORMATION

- Lake Superior has 1,566 (733 U.S., 833 Canada) tributaries.
- 139 (92 U.S., 47 Canada) tributaries have historical records of production of sea lamprey larvae.
- 68 (39 U.S., 29 Canada) tributaries have been treated with lampricides at least once during 1993-2002.
- Of these, 52 (32 U.S., 20 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 TFM that eliminate about 95% of the lamprey larvae and minimize the risk to non target organisms.

The following statements highlight the lampricide control program for Lake Superior 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 with TFM were completed in 14 tributaries (11 U.S., 3 Canada).
- Treatment effectiveness studies were conducted in 2 U.S. tributaries.
- The interim protocol for application of lampricides to streams with populations of young-of-year lake sturgeon was followed during treatment of the Tahquamenon River. The protocol limits the concentrations of TFM and Bayluscide 70% Wettable Powder to 1.2 times minimum lethal concentration (MC: concentration required to kill 99.9% of sea lampreys in a 12-hour treatment) to protect young-of-year lake sturgeon.
- Rainfall during treatment of the Firesteel River tripled stream discharge and made maintenance of effective lampricide concentrations difficult. Some troutperch and longnose dace were killed in the west branch of the river and a 6(a)2 report was filed with the Environmental Protection Agency (EPA).
- Rainfall during treatment of the Rock River increased stream discharge significantly. Maintenance of effective lampricide concentrations was difficult, however, the high discharge allowed coverage of areas normally hard to reach and treat effectively.
- Wet weather during the spring and fall also produced higher-than-normal stream discharge during treatments of the Silver, Traverse, and Trap Rock rivers. This resulted in greater-than-normal use of TFM in these treatments.
- Great numbers of transformed larvae were observed during treatment of the Chocelay and Kaministiquia rivers. In addition, significant numbers of large (>120 mm) larvae were observed during treatments of the Sucker, Little Garlic, Trap Rock, and Traverse rivers, and Harlow Creek. These observations support the quantitative assessment projection for these tributaries.
- Treatments of all Canadian tributaries were considered successful with the exception of the Pays Plat River. Heavy rains reduced treatment effectiveness in about 40% of the total treatment distance.

Table 1. Details on the application of lampricides to tributaries of Lake Superior, 2002
(Number in parentheses corresponds to location of stream in Fig. 1.)

Stream	Date	Flow (m ³ /s)	TFM (kg) ^{1,2}	Bayluscide (kg) ¹	Distance treated (km)
<u>United States</u>					
Middle R. (14)	Jun 8	0.3	90.8	0	37.0
Firesteel R. (13)	Jun 21	3.5	418.5	0	57.9
Harlow Cr. (8)	Jul 3	0.7	75.8	0	11.3
Rock R. (6)	Jul 8	1.4	213.0	0	24.1
L. Garlic R. (9)	Aug 29	0.1	22.5	0	8.0
Chocolay R. (7)	Sep 1	3.5	410.3	1.6	40.2
Tahquamenon R. (4)	Sep 13	9.1	612.8	8.9	9.7
Sucker R. - lower (5)	Sep 16	1.7	216.8	0	9.7
Silver R. (10)	Oct 10	5.4	248.3	0	8.0
Traverse R. (12)	Oct 11	0.5	11.3	0	4.8
Trap Rock R. (11)	Oct 14	1.1	198.0	0	14.5
Total		27.3	2,518.1	10.5	225.2
<u>Canada</u>					
Goulais R. (3)	Jun 20	7.1	845.6	0	105.0
Kaministiquia R. (1)	Aug 9	31.0	2,687.1	22.0	70.4
Pays Plat R. (2)	Aug 17	5.3	261.0	0	8.6
Total		43.4	3,793.7	22.0	184.0
<u>Grand Total</u>		70.7	6,311.8	32.5	409.2

¹Lampricide quantities are in kg of active ingredient.

²Includes a total of 5.33 TFM bars (1.0 kg of active ingredient) applied in 2 streams

TRIBUTARIES TREATED

1. Kaministiquia R.
2. Pays Plat R.
3. Goulais R.
4. Tahquamenon R.
5. Sucker R.
6. Rock R.
7. Chocolay R.
8. Harlow Cr.
9. Little Garlic R.
10. Silver R.
11. Trap Rock R.
12. Traverse R.
13. Firesteel R.
14. Middle R.

TRIBUTARIES TRAPPED

- | | |
|------------------------|------------------|
| A. Neebing-McIntyre R. | L. Rock R. |
| B. Wolf R. | M. Chocolay R. |
| C. Nipigon R. | N. Big Garlic R. |
| D. Carp R. | O. Silver R. |
| E. Stokely Cr. | P. Misery R. |
| F. Big Carp R. | Q. Firesteel R. |
| G. Little Carp R. | R. Bad R. |
| H. Tahquamenon R. | S. Red Cliff Cr. |
| I. Betsy R. | T. Brule R. |
| J. Miners R. | U. Middle R. |
| K. Furnace Bay Cr. | V. Amnicon R. |

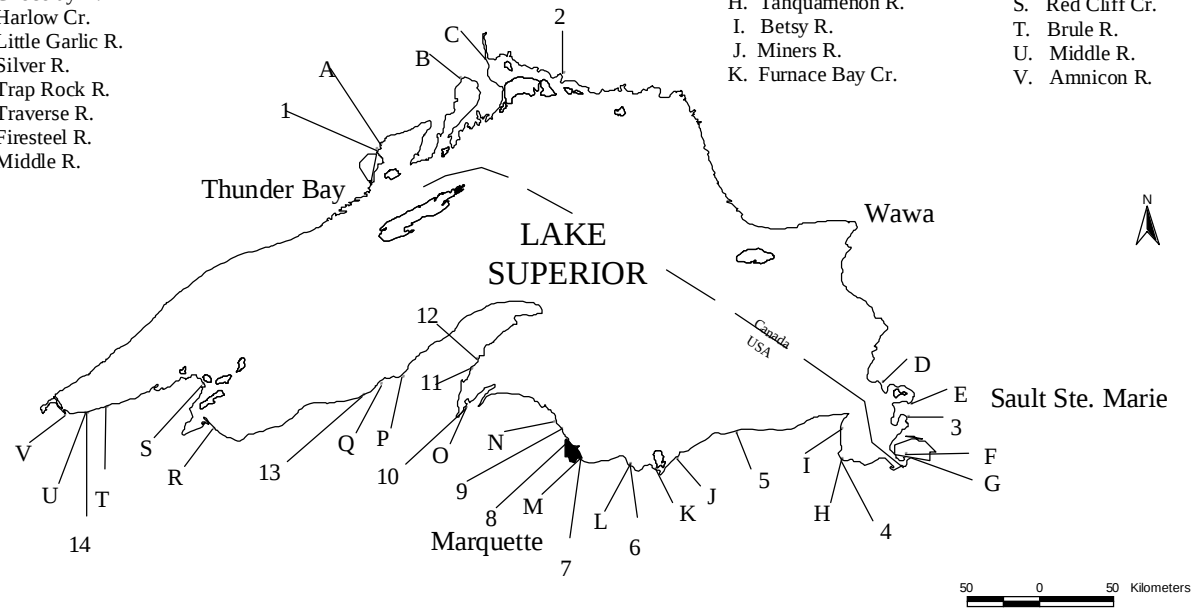


Fig. 1. Locations of Lake Superior tributaries treated with lampricides (Numbers, Table 1) and tributaries where assessment traps were operated during 2002 (Letters, Table 3).

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, decontaminated, and 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 hatched in nests are reduced.

- A total of 2,408 spawning-phase male sea lampreys were transported to the sterilization facility during May 21-June 26 from trapping operations on the Rock (266), Misery (96), Brule (175), and Middle (1,871) rivers.

Barriers

In its *Strategic Vision for the First Decade of the New Millennium*, the Commission committed to implementing an integrated control program that relying on alternative control methods to achieve 50 percent of lamprey suppression. Barriers are currently the only proven alternative control method. Presently, there are 16 barriers on Lake Superior tributaries (Fig. 2).

The sea lamprey management program benefits substantially from a number of dams built and operated for other purposes. A Geographic Information System (GIS) inventory of these “de-facto” barriers has been initiated. This will be a useful tool in identifying dams of value to sea lamprey management and 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, and Wisconsin.

- Little Carp River - Construction of the barrier was completed in March. Revisions to the final site and access road were completed in June.
- Big Carp River - Technical support and engineering support were provided for the first year of the fishway performance and telemetry study. The study is being conducted by the Great Lakes Laboratory for Fishery and Aquatic Sciences.
- Pine River - An all-purpose exotic species barrier was constructed by the Huron Mountain Club. Sea lamprey barrier staff provided technical support.

- Misery River - The barrier is now functioning to block sea lampreys. A perpetual easement for additional crest height was secured with the assistance of the Michigan Department of Natural Resources.
- Sheppard Creek (Goulais River) - The remote barrier is in poor condition and no longer blocks sea lampreys. The decommissioning of this structure was recommended.
- Furnace Creek - Construction of the barrier was deferred due to withdrawal of State funds from the Clean Michigan Initiative. The Alger County Soil Conservation District was to use the funds for purchasing real estate, engineering and permitting. Funding may be restored during 2003.
- Stokely Creek - A structural engineering inspection at the barrier revealed numerous perforations of the sheet piling and significant corrosion between the water line and the crest. Deflection of the barrier was temporarily stabilized by infilling the tailrace with large rip-rap, however, corrosion must be addressed. Alternatives include repair, replacement, or decommissioning.
- Wolf River - A retroactive application under the Navigable Waters Protection Act was submitted for the sea lamprey barrier.
- In an effort to provide three additional miles of habitat for coaster brook trout, a cooperative project among the Service-Ashland Fishery Resources Office, the Minnesota Department of Transportation, and Grand Portage Tribe resulted in construction of a fish passage in a culvert in Grand Portage Creek. Sea lampreys have not previously reproduced downstream of the culvert.

TRIBUTARIES WITH BARRIERS

1. McIntyre R.
2. Wolf R.
3. Black Sturgeon R.
4. Gimlet Cr. (Pancake R.)
5. Carp R.
6. Stokely Cr.
7. Sheppard Cr. (Goulais R.)
8. Big Carp R.
9. Little Carp R.
10. Betsy R.
11. Miners R.
12. Pine R.
13. Misery R.
14. Iron R.
15. Brule R.
16. Middle R.

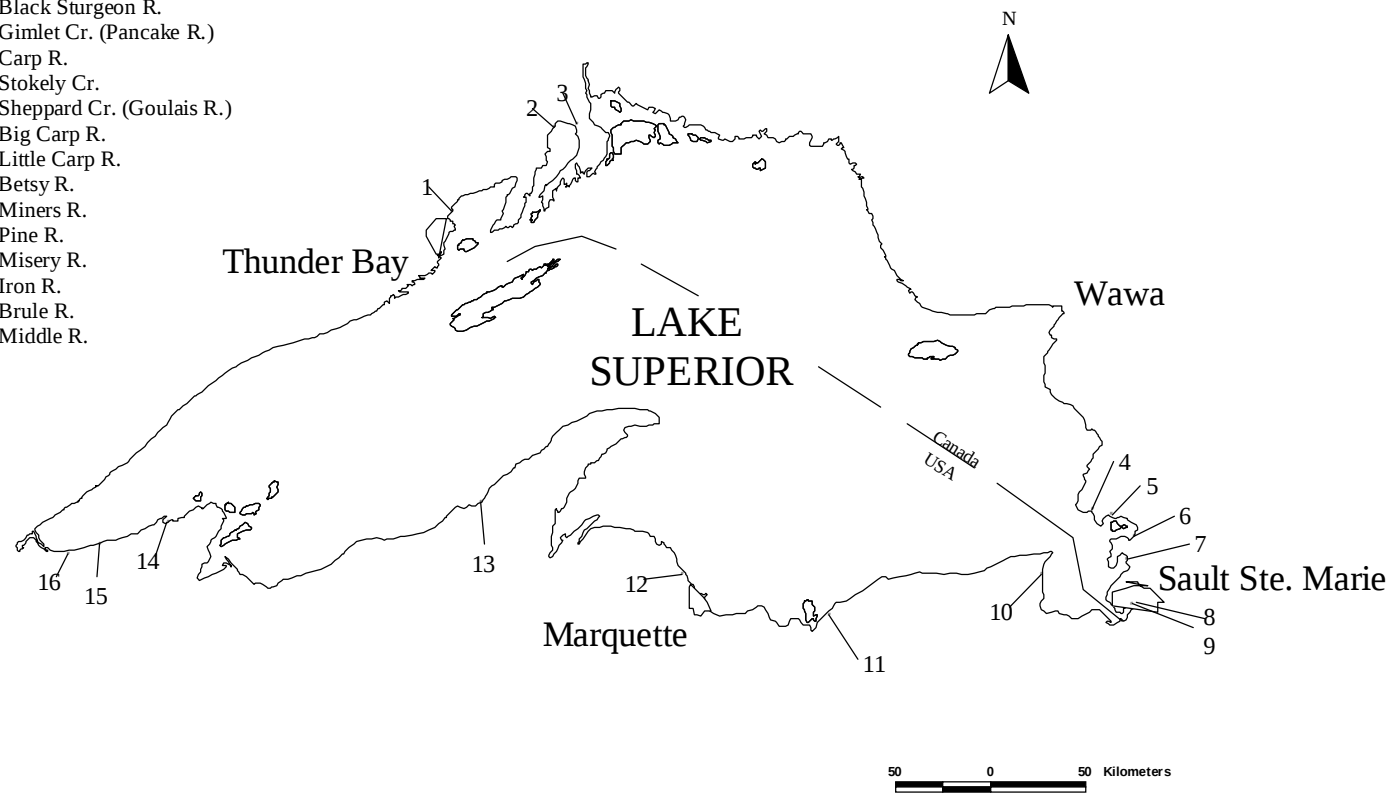


Fig. 2. Locations of Lake Superior tributaries with sea lamprey barriers.

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 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 the 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 m²) by an estimated area of suitable habitat (m²). The probable number of larvae that would metamorphose into parasitic sea lampreys during 2003 was developed from historical relations of the proportion of metamorphosed sea lampreys 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 populations of sea lamprey larvae were conducted in 113 tributaries (37 U.S., 76 Canada) and offshore of 6 tributaries (3 U.S., 3 Canada). The status of larval sea lamprey populations in streams treated during the last 10 years is presented in Table 2.
- Populations were estimated in 38 tributaries (20 U.S., 18 Canada; Table 2).
- Post-treatment quantitative assessments were conducted in 2 U.S. tributaries to determine the effectiveness of lampricide treatments during 2002.
- 51 non-producing tributaries were assessed along the Canadian shoreline of Lake Superior. No sea lamprey producers were found.
- Efforts were made to pinpoint the source of increased wounding in Thunder and Nipigon bays. The Kaministiquia River was the likely source in Thunder Bay. Treatment of the river in August 2002 produced numerous metamorphosing larvae. The source of the wounding in Nipigon Bay is believed to be the Nipigon River system which includes Helen Lake.

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

Tributary	Last Treated	Last Surveyed	Residuals Found	Oldest Reestablished Year Class	Estimate of 2002 Larval Population	2003 Metamorphosing Estimate	On 2003 Treatment Schedule
<u>United States</u>							
Waiska R.	Sep-01	2002	Yes	2001	-	-	No
Grants Cr.	Jul-63	2002	No	1999	1,344	0	No
Ankodosh Cr.	Jul-73	2002	No	1999	1,801	0	No
Roxbury Cr. ¹	Never	2002	No	1999	1,903	0	No
Tahquamenon R. - Upper Pools	Sep-02	2000	-	-	-	-	No
Dead Sucker R.	Jul-75	2002	-	1998	-	-	No
Betsy R.	Jul-00	2000	-	-	-	-	No
Little Two Hearted R.	Jul-00	2000	-	-	-	-	No
Two Hearted R.	Sep-99	1998	-	-	-	-	No
Sucker R. (Alger) - Lower	Sep-02	2001	-	-	-	-	No
Chipmunk Cr.	May-98	2000	No	None	-	-	No
Carpenter Cr.	May-98	2000	Yes	1998	-	-	No
Sullivans Cr. ¹	Jul-87	2002	-	1999	2,024	0	No
Miners R.	Jun-98	2002	No	1999	4,492	2	No
Furnace Cr. ²	Aug-93	2001	-	1998	-	-	No
Five Mile Cr.	Oct-98	2001	No	1999	-	-	No
Au Train R. (Lower R.)	Aug-97	2001	-	1998	-	-	No
Au Train R. (Upper R. & Tribs.) ²	Sep-01	2000	-	-	-	-	No
Rock R.	Jul-02	2001	-	-	-	-	No
Laughing Whitefish R.	Jun-98	2002	No	1999	1,353	31	No
Chocolay R. ³	Sep-02	2002	Yes	-	-	-	No
Carp R.	Jul-01	2002	Yes	2001	30,940	945	Yes
Dead R. ¹	Sep-84	2002	-	1998	137,935	376	Yes
Harlow Cr.	Jul-02	2002	-	-	866	92	No
Little Garlic R. ³	Aug-02	2002	-	-	-	-	No
Big Garlic R.	Aug-00	2002	Yes	2000	61,904	2,837	Yes
Iron R.	Jul-01	2000	-	-	-	-	No
Salmon Trout R. (Marquette)	Jul-00	2001	Yes	None	-	-	No
Pine R. ¹	Oct-87	2002	-	1998	7,582	0	No
Huron R.	Jul-01	2001	-	-	-	-	No
Ravine R. ²	Sep-98	2002	Yes	1998	18,789	62	Yes
Silver R. ^{2,4}	Oct-02	2001	-	-	-	-	Yes
Falls R.	Sep-97	2002	-	1999	-	-	No
Sturgeon R.	Aug-01	2002	Yes	2001	245	0	No
Trap Rock R.	Oct-02	2001	-	-	-	-	No
Traverse R. - Upper	Oct-02	2001	-	-	-	-	No
Eliza Cr.	Oct-77	2002	-	1999	4,618	16	No
Big Gratiot R.	Jun-84	2002	-	1999	26,887	72	No
Salmon Trout R. (Houghton)	Aug-92	2002	-	1999	-	-	No
Misery R.	Sep-00	2002	Yes	2000	4,648	3	No
East Sleeping R.	Oct-99	2001	Yes	1999	-	-	No
Firesteel R.	Jun-02	2002	-	-	3,031	497	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
Ontonagon R.	May-01	2002	Yes	2001	-	-	No
Potato R.	Jun-01	2001	-	-	-	-	No
Cranberry R.	Jun-01	2001	Yes	2001	4,232	0	No
Bad R.	Sep-01	2002	Yes	2001	72,339	3,798	Yes ⁵
Red Cliff Cr.	Jun-01	2001	Yes	2001	-	-	No
Brule R.	Jun-01	2001	-	-	-	-	No
Poplar R.	Oct-96	2002	-	1999	48,997	1,831	Yes
Middle R.	Jun-02	2001	-	-	-	-	No
Amnicon R.	Jun-01	2001	-	-	-	-	No
Nemadji- South Fork & Net R.	May-90	2001	-	1999	-	-	No
Nemadji- Black R.	Sep-00	2001	Yes	1999	-	-	No
<u>Canada</u>							
Little Carp R.	Sep-01	2001	-	-	-	-	No
Big Carp R.	Sep-01	2002	Yes	None	8,356	99	No
Goulais R.	Jul-02	2002	Yes	None	-	-	No
Stokely Cr.	Sep-00	2002	Yes	None	4,475	63	No
Chippewa R. ²	Jul-98	2002	No	1999	5,401	129	No
Batchawana R. ²	Oct-98	2002	Yes	1999	503,411	727	Yes
Carp R.	Sep-00	2002	Yes	2001	10,284	1,296	Yes
Pancake R.	Jul-98	2002	Yes	1999	69,149	88	No
Agawa R.	Jul-01	2001	-	-	-	-	No
Gargantua R.	Aug-99	2001	Yes	2000	-	-	No
Michipicoten R. ⁶	Aug-99	2002	Yes	2000	-	-	No
White R. ¹	Sep-88	2002	No	1999	22,153	16	No
Pic R.	Sep-97	2001	No	1998	-	-	No
Little Pic R.	Sep-94	2001	Yes	1995	-	-	No
Prairie R.	Jul-94	2002	-	1998	-	-	No
Steel R.	Jul-01	2000	-	-	-	-	No
Pays Plat R.	Aug-02	2001	-	-	-	-	No
Little Pays Plat R.	Never	2002	No	1998	4,123	3	No
Gravel R. ²	Aug-98	2002	Yes	1999	138,480	33	No
Mountain Bay-Gravel R.	Jul-00	2002	-	-	-	-	No
Little Gravel R. ²	Jul-95	2002	No	1995	68,397	941	Yes
Cypress R.	Aug-99	2002	Yes	2000	30,272	414	Yes
Jackfish R.	Jul-00	2002	-	-	-	-	No
Nipigon R.							
Upper ²	Sep-99	2002	Yes	None	191,470	1,388	Yes
Cash Cr.	Jul-96	2002	No	1996	184,151	457	Yes
Stillwater Cr.	Jul-96	2002	No	1996	596	21	No
Black Sturgeon R.	Aug-99	2000	Yes	None	-	-	No
Wolf R.							
Above Barrier	Sep-00	2002	Yes	None	11,972	1,492	Yes
Below Barrier	Sep-00	2001	Yes	2001	-	-	Yes

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
Pearl R.	Jul-91	2000	-	1999	-	-	No
McIntyre R.	Aug-97	2002	Yes	1998	2,134	43	No
Neebing R.	Jul-94	2002	No	None	-	-	No
Kaministiquia R.	Aug-02	2002	Yes	-	-	-	No
Cloud R.	Jul-94	2002	No	1998	988	194	No
Pigeon R.	Aug-99	2002	Yes	None	2,828	0	No

¹Not treated during the past 10 years, but quantitative larval surveys were conducted during 2000-2002.

²Stream has a known lentic population.

³Quantitative assessment conducted prior to treatment during 2002.

⁴Lentic population was assessed during 2002.

⁵Upper Marengo River only.

⁶Assessed as part of sampling efficiency study 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. Lakewide 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.

- 7,799 sea lampreys were trapped in 21 tributaries during 2002 (Table 3, Fig. 1).
- The estimated population of spawning-phase sea lampreys for 2002 was 110,391 (42,806 western U.S. and 67,585 eastern U.S. and Canada; $r^2=0.54$).
- No significant trend (Fig. 3) was detected from a linear regression of spawner abundance during 1983-2002 ($p=0.618$). Lake Superior estimates (1983-2002) were recalculated with additional data that accounted for sea lampreys introduced in seven tributaries for research studies from 1983-2002.
- Spawning runs were monitored in the Amnicon, Middle, Bad, Firesteel, Misery, and Silver rivers and Red Cliff Creek through cooperative agreement with the Great Lakes Indian Fish and Wildlife Commission; in the Brule River with the Wisconsin Department of Natural Resources (WDNR); and in the Miners River with the National Park Service, Pictured Rocks National Lakeshore.

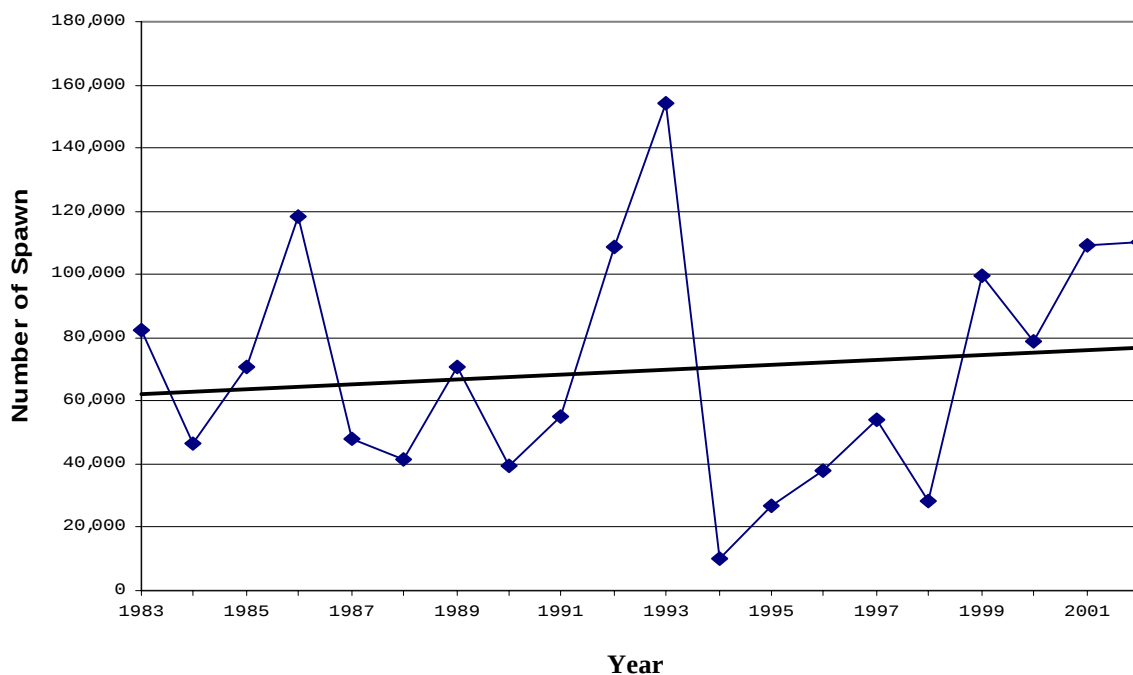


Fig. 3. Trendline of the linear regression of spawner abundance for Lake Superior, 1983-2002.

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

Stream	Number caught	Spawner estimate	Trap efficiency	Number sampled ¹	Percent males	Mean Length (mm)		Mean Weight (g)	
						Males	Females	Males	Females
United States									
Tahquamenon R. (H)	411	6,025	7	20	60	434	424	175	174
Betsy R. (I)	599	8,943	7	41	68	441	427	168	190
Miners R. (J)	39	---	---	0	---	---	---	---	---
Furnace Bay Cr. (K)	30	68	44	9	56	428	451	186	225
Rock R. (L)	828	1,367	61	91	45	437	435	194	199
Chocolay R. (M)	277	2,825	10	18	64	454	442	214	200
Big Garlic R. (N)	64	424	15	4	50	435	490	230	285
Silver R. (O)	7	---	---	0	---	---	---	---	---
Misery R. (P)	463	602	77	107	---	401	417	148	161
Firesteel R. (Q)	90	212	42	21	---	448	453	186	226
Bad R. (R)	1,039	13,678	8	233	52	416	---	413	---
Red Cliff Cr. (S)	7	24	29	1	100	390	---	134	---
Brule R. (T)	490	1,114	44	38	50	433	439	203	218
Middle R. (U)	2,624	3,327	79	325	49	419	419	171	189
Amnicon R. (V)	30	552	5	1	38	374	---	132	---
Total or Mean (South Shore)	6,998	39,161		909	52	426	423	185	188
Canada									
Neebing-McIntyre Floodway									
Neebing R. (A)	108	204	53	0	61	---	---	---	---
McIntyre R. (A)	119	226	53	0	61	---	---	---	---
Wolf R. (B)	269	430	62	0	59	---	---	---	---
Nipigon R. (C)	1	---	---	0	---	---	---	---	---
Carp R. (D)	238	619	38	0	---	---	---	---	---
Stokely Cr. (E)	46	91	51	0	---	---	---	---	---
Big Carp R. (F)	16	---	---	0	40	---	---	---	---
Little Carp R. (G)	4	---	---	0	100	---	---	---	---
Total or Mean (North Shore)	801	1,570		0	59	---	---	---	---
Total or Mean (for lake)	7,799	40,731		909	53	426	423	185	188

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

Parasitic-Phase

The Michigan Department of Natural Resources provided data on the frequency of parasitic-phase sea lampreys attached to fish caught by sport charter boats during 2002.

- 19 sea lampreys attached to lake trout were collected from 2 management districts.
- Lampreys were attached at a rate of 0.45 per 100 lake trout ($n = 4,230$).
- The recapture of spawning-phase sea lampreys that were released as metamorphosing juveniles during 2000 was completed. Of 1,501 metamorphosing lampreys marked with coded wire tags and released, 11 (0.73%) were recaptured as spawning adults during 2002. A total of 6,343 (5,542 U.S.; 801 Canada) spawning-phase sea lampreys were scanned for coded wire tags in 16 (9 U.S.; 7 Canada) Lake Superior streams during 2002. The estimated abundance of 794,000 (491,000- 1,736,000) is a measure of the 2001 parasitic cohort.
- A total of 1,192 metamorphosing sea lampreys were marked with coded wire tags and released into Lake Superior tributaries during September and October, 2002. (Brule River-184, Misery River-228, AuTrain River-152, Two Hearted River-123, Chippewa River-102, Michipicoten River-102, Nipigon River-101, Wolf River-101, and McIntyre River-99). Recapture of these sea lampreys as spawning-phase adults will take place in 2004.

Table 4. Lake-wide population estimates including 95% confidence intervals (CI) of metamorphosing, and spawning-phase sea lampreys in Lake Superior during 2000-2002.

Spawning year	Estimate of metamorphosing lampreys (thousands)			Estimate of spawning-phase lampreys (thousands)
	Population	Lower CI	Upper CI	
<u>Lake Superior</u>				
2000	564	419	846	79
2001	361	284	494	109
2002	794	491	1,736	110