List of documents

U. S. DEPARTMENT OF THE INTERIOR

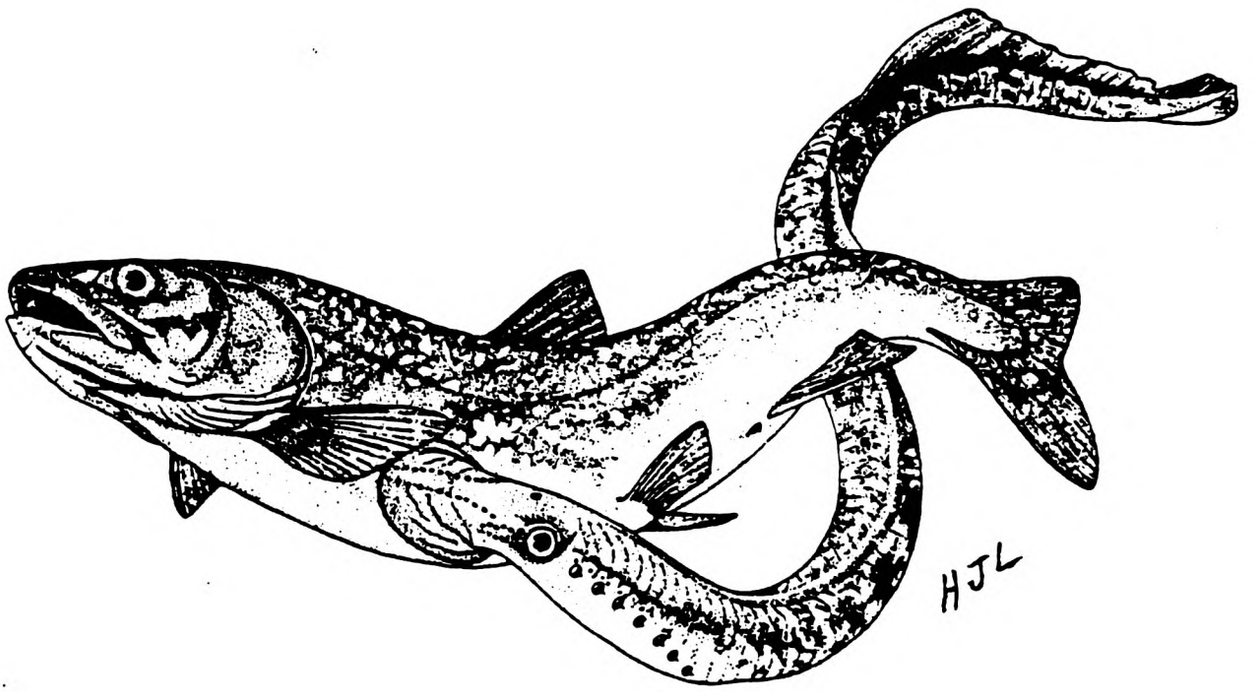
FISH AND WILDLIFE SERVICE

SEA LAMPREY CONTROL IN THE UNITED STATES

ANNUAL REPORT

TO

GREAT LAKES FISHERY COMMISSION



by

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SEA LAMPREY CONTROL IN THE UNITED STATES

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This report summarized the activities of the U.S. Fish and Wildlife Service in the conduct of sea lamprey control in the United States during 1984. Surveys were performed on 264 streams to evaluate sea lamprey populations. An extensive study in the St. Marys River determined the range of sea lamprey ammocetes to be from Shermans Park about 6.4 km (4 miles) upstream of the locks to downstream of Neebish Island in Munuscong Lake. Chemical treatments were completed in 39 streams (Table 1). Included were first treatments of the Dead and Sable rivers, tributaries of Lake Superior; two tributaries of the Saginaw River (Cass and Shiawassee rivers) of Lake Huron; and three tributaries of Oneida Lake (Fish, Big Bay, and Scriba creeks). A new bar formulation of TFM was used to treat small tributaries on several streams. Assessment traps, placed in 32 tributaries of the Great Lakes, captured 34,095 spawning-phase lampreys (Table 2). A total of 1,699 parasitic-phase sea lampreys were collected from commercial fishermen. Most lampreys (1,265) came from Lake Huron. Information on sea lampreys was collected from charter captains and noncharter fishermen. Charter captains captured 190 feeding lampreys and recorded data on thousands of fish (primarily lake trout and chinook salmon), including marking rates of sea lampreys on these fish. Noncharter fishermen turned in 1,423 parasitic lampreys. Onsite testing of the effects of lampricides on nontarget organisms continued in 1984 by holding organisms in cages in treated and control sections of six streams in three lake basins.

LAKE SUPERIOR

Larval Assessment

Eighty-one tributaries of Lake Superior were surveyed to assess populations of larval sea lampreys in 1984. Thirty-five streams contained reestablished populations (Table 3). Ammocetes in Naomikong Creek represented the first recruitment since 1970 and those in the Sand and Pine rivers the first since 1972. Thirty streams show no recruitment for the past 4 or more years. The 1983 year class appears abundant, and the most collected were taken in Pendills and Galloway creeks and the Pine and Firesteel rivers. The collection in Sullivans Creek was the largest since 1962, Traverse River since 1964, Iron River since 1967, and Sand River (Marquette County, Michigan) since 1970. The unusually warm summer of 1983 may have warmed cold streams such as Pendills, Galloway, and Sullivans creeks sufficiently to allow better survival. Reasons for resurgence in other streams are not known, but the increase appears to be lakewide and the need for continuous monitoring is obvious. Examinations at index sites revealed moderate numbers of residual sea lampreys in the Betsy and Traverse rivers, and small numbers in the Little Two Hearted, Little Garlic, Iron, Sturgeon, Salmon Trout (Houghton County, Michigan), and Cranberry (Ontonagon County, Michigan) rivers.

Table 1. Summary of chemical treatments in streams of the Great Lakes in 1984.

Lake	Number of treatments	Discharge at mouth		TFM		Bayer 73 powder	
				Act. Ingr.		Act. Ingr.	
		m^3/s	f^3/s	kg	lbs	kg	lbs
Superior	16	38.3	1,350	6,019	13,266	-	-
Michigan	11	57.0	2,010	11,278	24,860	-	-
Huron	9	24.5	869	10,178	22,440	7	16
Ontario	3	38.0	1,340	1,747	3,850	-	-
Total	39	157.8	5,569	29,222	64,416	7	16

Table 2. Number and biological characteristics of adult sea lampreys captured in assessment traps in 32 tributaries of the Great Lakes in 1984.

Lake	Number of streams	Total captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
					Males	Females	Males	Females
Superior	8	967	951	30	431	426	162	157
Michigan	13	10,769	3,936	44	477	475	233	246
Huron	3	20,747	2,025	51	465	464	217	220
Erie	3	1,010	937	61	512	509	283	291
Ontario	5	602	431	56	493	485	286	282

Table 3. Tributaries of Lake Superior with reestablished populations of sea lampreys, and the maximum number collected per hour with an electric shocker.

[B indicates the presence of a year class recovered with Bayer 73.]

Stream	Date of last treatment	Year class 1981	1982	1983	1984
Pendills Creek	9/20/82			179	8
Naomikong Creek	7/23/63	0	0	1	0
Galloway Creek	7/12/83			51	0
Tahquamenon River	7/7/83			0	2
Betsy River	9/17/82			46	58
Little Two Hearted River	8/5/83			1	0
Two Hearted River	8/6/83			18	74
Sullivans Creek	10/16/75	13	0	34	0
Beaver Lake Outlet	9/11/79	0	3	0	0
Miners River	6/29/82		3	21	0
Anna River	5/18/65	2	1	3	
Five Mile Creek	8/5/81	0	0	2	0
Au Train River	10/15/80	19	0	14	0
Sand River	10/3/72	6	0	48	0
Harlow Creek	11/2/83				29
Little Garlic River	6/30/82		55	93	64
Iron River	6/29/83			90	18
Salmon Trout River (Mqt. Co.)	5/19/83			228	20
Pine River	9/27/72	0	0	40	0
Falls River	9/8/80	B	0	0	
Sturgeon River	8/23/82			8	18
Traverse River	7/23/82		33	165	11
Little Gratiot River	8/6/72	0	0	0	1
Misery River	6/19/82		63	60	9
East Sleeping River	6/22/82		60	23	142
Firesteel River	7/3/81	2	76	187	5
Ontonagon River	7/26/82		27	1	7
Potato River	9/23/80	0	4	1	7
Cranberry River	6/17/82		71	9	0
Black River	8/8/81	B	B	0	
Montreal River	7/12/75	0	B	0	
Brule River	9/3/83				21
Middle River	5/26/84				1
Amnicon River	5/29/84				17
Nemadji River	9/2/82			8	5
Total number of streams in which year class was collected		7	13	25	20

Twelve offshore areas were reexamined. However, the only signficant sea lamprey population detected was off Black River where thirty sea lamprey ammocetes (65-146 mm long) were collected from six stations in July. Six inland lakes were reexamined, but no significant populations were detected.

Posttreatment surveys were completed in nine streams. Extensive surveys were conducted in the Big Garlic and Salmon Trout (Marquette County, Michigan) rivers after the 1983 treatment. The inclined-plane trap in the Big Garlic River was operated for 20 days (April 11-30) to evaluate treatment effectiveness. Six sea lamprey ammocetes were captured, compared with a catch of 1,582 larvae and 1 transformed lamprey for a like period in the spring of 1983, or a reduction of 99.6%. Twelve stations were electrofished and accounted for five residual sea lampreys in June. The stream was treated again in September 1984 as part of a sterile male study, and 12 more residual sea lampreys were collected. Six stations were examined in the Salmon Trout River in June, and 70 residual sea lampreys were collected. The residuals were taken from all stations; rainfall during the treatment probably decreased effectiveness. Significant numbers of residual sea lampreys were recovered in the Brule River. A total of 258 larvae (21-121 mm long) were found primarily associated with small tributaries where low flows hampered the 1983 treatment and also in the untreated headwaters of the main stream. A few residual sea lampreys were found in the Two Hearted, Miners, Ontonagon, Bad, Middle, and Nemadji rivers.

Chemical Treatment

Chemical treatments were completed on 16 streams with a combined flow of 38 m^3/s (1,350 cfs) during the 1984 field season (Table 4, Fig. 1). The Bad, Chocolay, and Sucker rivers required the most effort because of many application points and tributaries, length of stream, and poor access. Water levels fell rapidly and contributed to the mismatch of two chemical banks in the Bad River, however, only a few ammocetes were found in posttreatment surveys. No significant kill of sport fish occurred during any treatment, but a large number of minnows were killed in an 0.4-km (0.25-mile) section downstream of an application site in the Marengo River, a tributary of the Bad River.

A section of the Dead River downstream of a dam in Marquette, Michigan, was treated for the first time. Larvae of the 1980 and 1983 year classes were present. A total of 103 sea lampreys (mean length, 152 mm) of the age IV group were collected and 50% were metamorphosing. We assume the rapid growth associated with sea lamprey larvae found below impoundments was responsible for the high percentage of age IV transformed lampreys.

A new bar formulation of TFM was used in tributaries of main streams in three treatments. Two hundred bars were used effectively in small, soft water tributaries. The bars eliminated the need to man several feeders at night in remote areas during treatment of the Sucker River and reduced manpower needs during treatments of the Chocolay and Bad rivers.

Table 4. Details on the application of lampricides to streams of Lake Superior, 1984.

[Number in parentheses corresponds to location of stream in Figure 1.]

Stream	Date	Discharge at mouth		TFM		Stream treated	
				Act. Ingr.			
		m^3s	f^3s	kg	lbs	km	miles
Poplar River (3)	May 24	2.3	80	150	330	16.1	10
Middle River (2)	May 26	2.3	80	140	308	19.4	12
Amnicon River (1)	May 29	3.4	120	220	484	6.5	4
Gratiot River (7)	June 8	1.0	36	60	132	1.6	1
Elm River (5)	June 10	0.8	30	70	154	1.6	1
Salmon Trout River (6) (Houghton County)	June 11	2.3	81	170	374	1.6	1
Rad River (4)	Aug. 1	10.2	360	3,153	6,952	183.9	114
Silver River (8)	Aug. 30	0.8	30	90	198	4.8	3
Furnace Creek (14)	Aug. 30	0.3	9	30	66	1.6	1
Ravine River (9)	Sept. 1	0.1	2	20	44	8.1	5
Dead River[a] (12)	Sept. 4	5.9	210	389	858	1.6	1
Huron River (10)	Sept. 5	1.0	35	220	484	9.7	6
Chocolay River (13)	Sept. 17	5.1	180	868	1,914	32.3	20
Big Garlic River (11)	Sept. 27	0.8	27	80	176	4.8	3
Sable Creek[a] (15)	Oct. 5	0.3	10	20	44	1.6	1
Sucker River (16)	Oct. 6	1.7	60	339	748	40.3	25
Total		38.3	1,350	6,019	13,266	335.5	208

[a]Initial treatment.

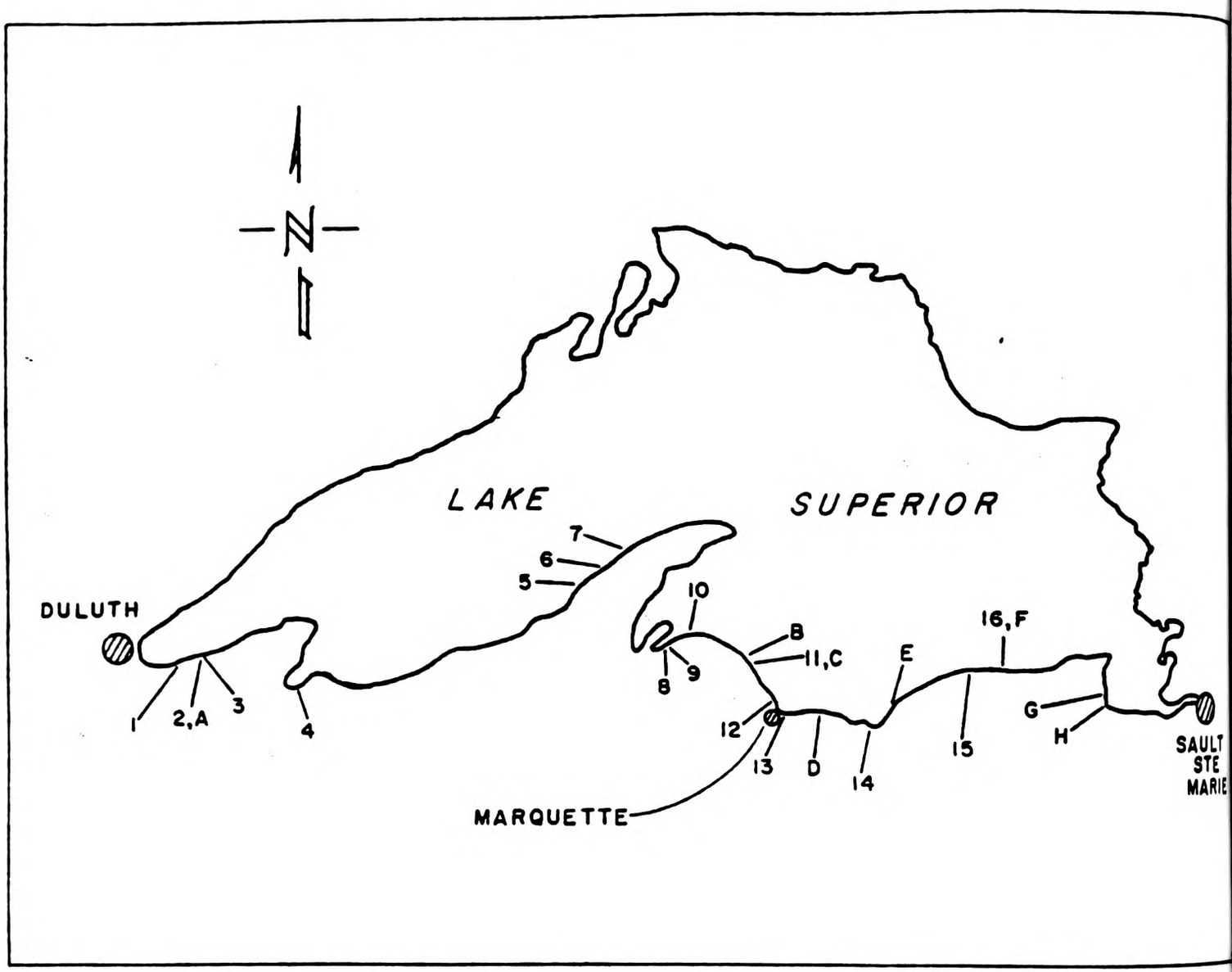

Figure 1. Location of streams tributary of Lake Superior treated with lampricides (numerals; see Table 4 for names of streams), and of streams where assessment traps were fished (letters; see Table 5 for names of streams) in 1984.

Spawning-phase Sea Lampreys

Assessment traps were placed in eight tributaries of Lake Superior in 1984 (Table 5, Fig. 1). The catch of adult sea lampreys was 967, compared with 1,464 in 1983. The number of lampreys declined in the Iron, Big Garlic, Rock, and Sucker rivers (largest decrease was in the Big Garlic River, 361 vs. 26) and increased slightly in the Miners, Betsy, and Tahquamenon rivers. A trap placed for the first time at the barrier dam in the Middle River captured 19 sea lampreys. The average length and weight of adult lampreys increased slightly in 1984 over 1983, but the percentage of males remained constant.

Parasitic-phase Sea Lampreys

A total of 218 sea lampreys were collected from commercial fishermen in Lake Superior through September 1984, compared with 487 taken in 1983. Fishermen in statistical districts of Wisconsin and MS-4 (Munising, Michigan, area) collected most sea lampreys from U.S. waters of Lake Superior—123 and 78, respectively. In 1983, 158 lampreys were taken in the Wisconsin district and 289 in MS-4. The decrease in parasitic-phase lampreys collected corresponds to a reduction in the spring wounding rates on large lake trout (>25 inches) in these two areas. Wounding was 0.6% in the Wisconsin district and 6.3% in MS-4 in 1984, compared with 2.3% and 23.5% in 1983.

A program was begun in 1984 to monitor the incidence of parasitic-phase sea lampreys in the sport fisheries. There are only about 35 known sport charter fishermen on Lake Superior, of which 11 provided information on occurrence of sea lampreys and fish catches. A total of 21 sea lampreys were captured, 2 by charters and 19 by noncharter sport fishermen. Most lampreys came from statistical district MS-4, the area near Marquette, Michigan, and all were attached to lake trout.

LAKE MICHIGAN

Larval Assessment

One hundred twenty-two tributaries of Lake Michigan were surveyed to assess larval sea lamprey populations. Pretreatment surveys were completed on 16 streams; six were treated later and the others are scheduled for future treatment.

An extensive posttreatment survey was conducted in the Ford River in May; 89 stations were examined by electrofishing and 35 (39%) contained residual sea lampreys. Of the 685 ammocetes collected, 12% were of transformation size. As in the past, most ammocetes were associated with high water channels, although some drift into the main channel had occurred, particularly in the lower 80 km (50 miles). Fyke nets were placed in the lower river for 33 days in late fall to evaluate treatment effectiveness. Seven transformed lampreys were taken in spite of flooding and ice formation throughout most of the period. Based on evaluation of the residual population, the Ford River will be re-treated in 1985.

Table 5. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Superior, 1984.

[Letter in parentheses corresponds to location of stream in Figure 1.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
Middle River (A)	19	9	11	400	418	130	175
Iron River (B)	3	3	67	438	479	189	198
Big Garlic River (C)	26	26	19	395	417	131	160
Rock River (D)	561	560	24	429	428	151	155
Miners River (E)	20	20	35	391	378	148	128
Sucker River (F)	73	73	21	415	414	168	166
Betsy River (G)	67	62	26	438	426	191	180
Tahquamenon River (H)	198	198	51	439	434	208	208
Total or average	967	951	30	431	426	175	165

A network of index stations on streams tributary to the north and west shores of Lake Michigan has been monitored since 1978. Larvae of the 1984 year class were recovered from 23 of 66 streams examined. Twenty-nine streams contain reestablished populations, including Swan and Bailey creeks where the first recruitment since 1961 and 1973, respectively, was detected. Surveys at index sites revealed that adult lampreys passed Manistique River Dam and the experimental low-head barrier dam in Weston Creek, a Manistique River tributary. Seven larvae of the 1983 year class were collected in the main stream near Germfask about 97 km (60 miles) upstream from the dam, and 18 larvae of the 1984 year class were taken upstream of the barrier in Weston Creek. Twenty-three streams have shown no evidence of recruitment for 4 or more years.

No major populations of larvae were detected in 16 offshore areas examined. Small numbers of larvae were taken off 10 streams--Black, Manistique, Ogontz, Whitefish, Days, Ford, Cedar, Carp Lake, Bear, and Platte (Loon Lake) rivers. One transformed sea lamprey was recovered off the Days River.

Surveys were conducted on five streams to determine the influence of dams on larval distribution. The Whitefish and Days rivers were examined upstream of recently constructed low-head dams; no sea lampreys were found. The Grand and St. Joseph rivers were surveyed upstream of dams with fish ladders; no ammocetes were found. The removal of a dam in Watervliet on the Paw Paw River, a St. Joseph River tributary, opened 161 km (100 miles) of additional habitat for sea lamprey recruitment. Results from 1984 surveys indicate larval distribution has been extended upstream 10 km (6 miles).

The ammocete population in the Menominee River was evaluated recently to determine if chemical treatment is warranted. When treated in 1977, the river had a discharge of 42 m^3/s (1,400 cfs). At this level, control cost would approach $100,000. A population estimate of 1,300 sea lamprey larvae, based on the Petersen method, indicated chemical treatment was not practical. Further monitoring will detect any increases in the population and address some of the sampling problems encountered in this large river.

Chemical Treatment

Chemical treatments were completed in 11 streams with a combined flow of 57 m^3/s (2,010 cfs) during the 1984 field season (Table 6, Fig. 2). Mortality of nontarget fish was minor and no public relation problems were noted. The treatment of the lower Millecoquins River was postponed in 1984 because high water levels and low water temperatures would require the use of excessive amounts of TFM to treat the river successfully. This section of the river will be treated with TFM and Bayer 73 in 1985 when water conditions are more favorable.

Beaver ponds and spawning suckers caused some problems during treatment of Bursaw Creek. Beaver ponds created a greater dilution than predicted from a pretreatment dye study, and the chemical concentration averaged 0.2 ppm below predicted minimum lethal in the ponds. Several hundred white suckers were killed though the concentrations were low. All ammocetes collected or observed in this section were dead.

Table 6. Details on the application of lampricides to streams of Lake Michigan, 1984.

[Number in parentheses corresponds to location of stream in Figure 2.]

Stream	Date	Discharge at mouth		TFM		Stream treated	
				Act. Ingr.			
		m^3s	f^3s	kg	lbs	km	miles
Hudson Creek (4)	May 11	0.2	6	10	22	3.2	2
Bursaw Creek (2)	May 13	0.5	18	70	154	4.8	3
Seiners Creek[a] (3)	May 15	0.1	2	10	22	3.2	2
Duck Creek (9)	July 12	0.6	22	80	176	4.8	3
Gibson Creek (11)	July 12	0.1	3	10	22	1.6	1
Muskegon River (10)	July 23	39.6	1,400	7,914	17,446	96.8	60
Boyne River (6)	Aug. 3	2.0	70	459	1,012	8.1	5
Jordan River (7)	Aug. 6	7.6	270	1,497	3,300	59.7	37
Carp Lake River (5)	Aug. 17	0.5	16	140	308	16.1	10
Pentwater River (8) Lambricks Creek[a]	Aug. 27	0.1	3	20	44	3.2	2
Rapid River (1)	Oct. 21	5.7	200	1,068	2,354	24.2	15
Total		57.0	2,010	11,278	24,860	225.7	140

[a]Initial treatment.

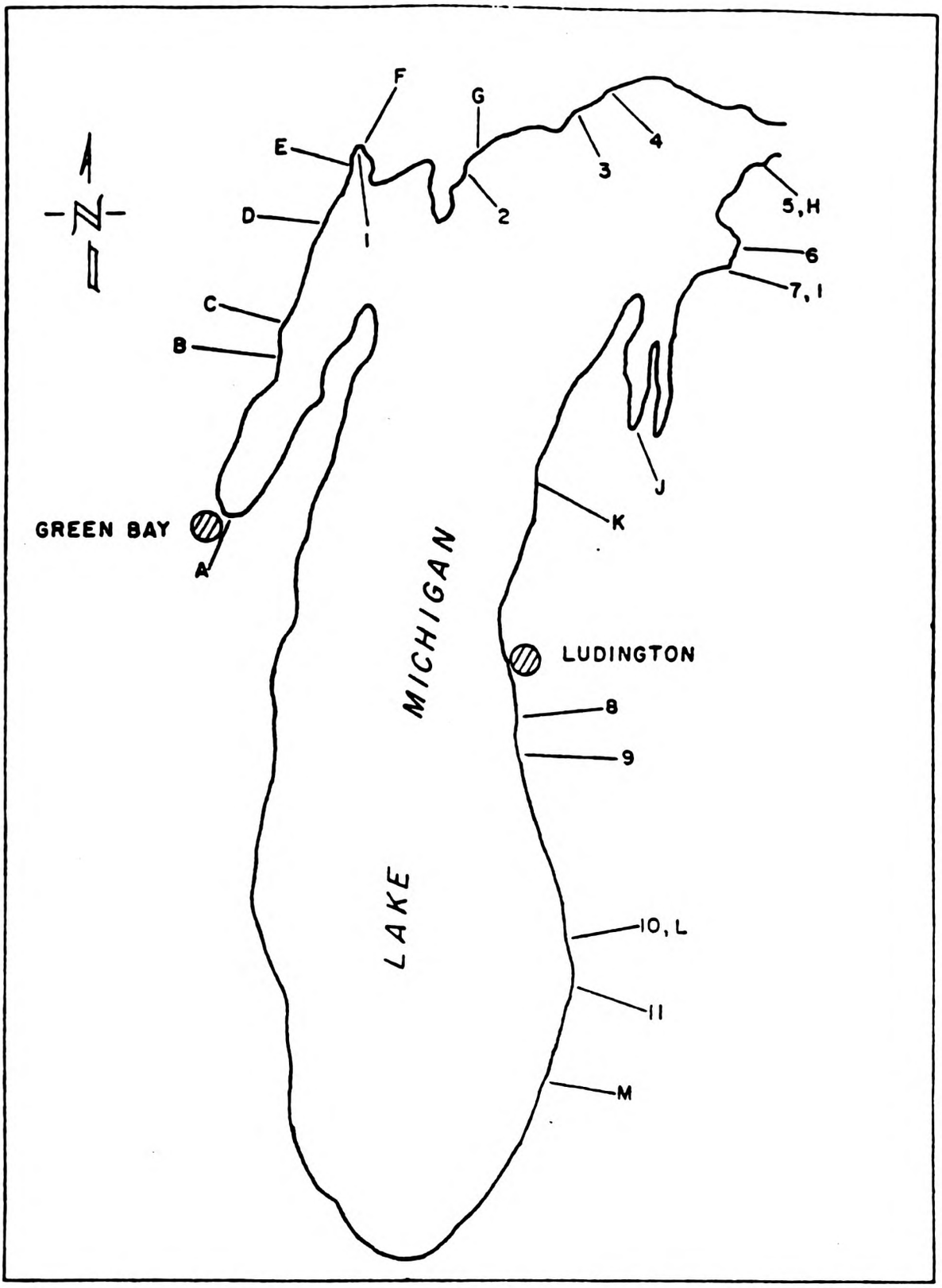

Figure 2. Location of streams tributary of Lake Michigan treated with lampricides (numerals; see Table 6 for names of streams), and of streams where assessment traps were fished (letters; see Table 7 for names of streams) in 1984.

The Muskegon River treatment required coordination with Consumers Power Company officials to schedule desired stream discharge and make arrangements for storage and working space at Croton Dam. The magnitude of this treatment required the cooperative efforts of personnel from Marquette and Ludington Stations. Adequate TFM concentrations were maintained throughout the stream as demonstrated by mortality of caged test ammocetes. Some mortality of walleye and chinook salmon occurred near Croton Dam during the early part of the treatment when the stream discharge was only 80% of expected.

Spawning-phase Sea Lampreys

A total of 10,769 sea lampreys were captured in assessment traps in seven west shore and six east shore tributaries of Lake Michigan in 1984 (Table 7, Fig. 2). Along the west shore, the number taken in the Peshtigo River (240) decreased from that taken in 1983 (590), whereas the catch in the Menominee River (126) increased from that in 1983 (73). The number of sea lampreys captured in the Manistique River (9,085) decreased from the catch in 1983 (10,480). A stratified tagging and recovery system was used to estimate the number of spawning-phase sea lampreys in the Manistique River (25,221) and also in the Cheboygan River (25,863) of Lake Huron. No sea lampreys were captured for the sixth consecutive year in the Fox River.

The catch of sea lampreys in six streams along the east shore of Lake Michigan was 1,315 in 1984, compared with 997 in 1983. Most of the increase occurred in the Carp Lake River with an increase of 414 lampreys over that in 1983. Catches declined in the Muskegon and St. Joseph rivers.

Parasitic-phase Sea Lampreys

Lake Michigan commercial fishermen captured 216 sea lampreys through October 1984, compared with 200 in the same period in 1983. Lamprey populations in the northern portion of the lake appear unchanged. Northern Lake Michigan and Green Bay produced 114 and 83 sea lampreys, respectively, compared with 103 and 88 in 1983.

The charter fishery grew rapidly in the past few years and there were about 800 registered operators in Lake Michigan in 1984. Materials to participate in the program to monitor the incidence of lampreys in the sport fishery were distributed to 319 operators, and information was returned by 128 captains.

A total of 401 parasitic sea lampreys were obtained from the sport fisheries, 69 from charter and 332 from noncharter fishermen. Large numbers of lampreys were recovered in statistical districts WM-4 (107), the Algoma to Manitowoc area; WM-5 (64), the Sheboygan to Milwaukee area; and MM-6 (53), the Arcadia to Little Sable Point area. Most sea lampreys were captured in July to September, and 74% of the total were attached to chinook salmon.

Treatment Effects on Nontarget Organisms

Mortality of Hexagenia in several areas of the Whitefish River during treatment in 1983 provided an excellent opportunity to investigate recovery of these populations after a TFM application. About 92% of the Hexagenia in an area of Scott Creek, a tributary of the Whitefish River, died during treatment.

Table 7. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 1984.

[Letter in parentheses corresponds to location of stream in Figure 2.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
st Shore							
Fox River (A)	0	-	-	-	-	-	-
Peshtigo River (B)	240	221	19	463	492	256	282
Menominee River (C)	126	104	30	486	490	257	296
Ford River (D)	2	2	100	434	-	167	-
Days River (E)	0	-	-	-	-	-	-
W. Br. Whitefish R. (F)	1	1	0	-	445	-	212
Manistique River (G)	9,085	2,482	48	484	481	235	247
ast Shore							
Carp Lake River (H)	655	470	37	435	441	165	180
Jordan River (I)							
Deer Creek	12	12	67	497	503	283	345
Boardman River (J)	91	91	48	492	478	245	244
Betsie River (K)	269	269	41	451	437	254	256
Muskegon River (L)	27	27	44	507	500	410	405
St. Joseph River (M)	261	257	46	492	499	256	278
otal or average	10,769	3,936	44	477	475	233	246

Since the fall of 1980 and the completion of the low-head barrier dam in the West Branch of the Whitefish River, lampreys are denied access to Scott Creek, which enters 1.6 km (1 mile) upstream of the barrier. Because no further treatments are anticipated in Scott Creek, the tributary provides an ideal site to observe year-to-year changes in density of a Hexagenia population depleted severely by a recent TFM application. The Hexagenia population in Scott Creek will be compared with the population in the East Branch of the Whitefish River since the East Branch tributary will continue to be treated to control sea lampreys about every third year.

Silt beds in the East Branch of the Whitefish River and Scott Creek were selected for study in 1984 to determine long-terms effects of TFM applications upon Hexagenia populations. Random samples (3 samples from each of 10 silt beds from each tributary; total of 60 samples) were collected with an Ekman dredge. From May to October, Hexagenia nymphs declined from 3 to 1.8 per lift in the East Branch and increased from 0.7 to 2.4 per lift in Scott Creek. Long-term data will be essential to assess population trends.

Special Studies

Case history study--A case study of Seiners Creek was prepared for the Sea Lamprey Committee of the Great Lakes Fishery Commission. The stream is a small, cool, trout stream in Mackinac County, Michigan. Seiners Creek is about 11 km (7 miles) long and has a normal summer discharge of 0.1 m^3/s (3 cfs). The stream has been monitored irregularly since 1959 and sea lampreys were detected for the first time in 1980, when 73 yearling larvae were recovered by electrofishing. An index station was established in 1980 and an average of 31 sea lampreys per hour were recovered annually since. Based on stream characteristics, the population was deemed low. Distribution of lampreys was restricted to the downstream 2.4 km (1.5 miles), and none were found offshore. The stream was treated in May and a population study completed. Seiners Creek held about 1,000 sea lampreys, which confirmed the judgment of low abundance. Seiners Creek was reexamined in October; no sea lampreys were found.

LAKE HURON

Larval Assessment

Fifty-one tributaries of Lake Huron were surveyed to assess larval sea lamprey populations. Pretreatment surveys were completed in 11 streams; six were treated later and the others are scheduled for treatment. Posttreatment surveys were conducted in nine streams. Residual sea lampreys were found in the Rifle and East Au Gres Rivers, Tawas Lake Outlet, and Elliot, Pine, Carp, and Trout creeks. Reestablished populations of sea lampreys were detected in 20 streams, including 14 streams with young-of-the-year ammocetes. Moderate numbers of ammocetes are indicated in the Pine (Mackinac County), Carp, Cheboygan, and Rifle rivers, and small populations in the others.

Sea lampreys were recovered in 8 of 10 offshore areas reexamined in 1984. The most serious infestations appear off the Carp and Pine (Mackinac County) rivers; 812 larvae were collected off the Carp River and 125 larval and 15 transformed sea lampreys were taken off the Pine River. Lesser numbers were indicated off Albany, Nunns, Elliot, and Black Mallard creeks and the Sturgeon and Ocqueoc rivers.

Chemical Treatment

Chemical treatments were completed in nine streams during the field season (Table 8, Fig. 3). Most treatments were routine with few problems. Two of the four tributaries of the Saginaw River treated, the Shiawassee and Cass rivers, were original treatments. Neither river had a large number of ammocetes, but many were metamorphosing. The treatment of the Chippewa River was accomplished by using Bayer 73 wettable powder to reduce TFM requirements. Concentrations of Bayer 73 were monitored by gas chromatography (GC) and high performance liquid chromatography (HPLC). Data from GC and HPLC analyses were compared to determine accuracy of the HPLC. Results were encouraging, but improvements must be made before HPLC can replace GC as the standard method of Bayer 73 analyses in the field.

Spawning-phase Sea Lampreys

During the 1984 spawning season, 20,747 sea lampreys were captured in assessment traps in three tributaries of Lake Huron (Table 9, Fig. 3), an increase of 3,431 over the number taken in 1983. The catch in the Cheboygan River (17,616) increased 20% (2,904 lampreys) over the catch in 1983 and accounted for 85% of the total from Lake Huron. An estimated 25,863 sea lampreys were in the spawning run in the Cheboygan River as determined by a stratified tagging and recovery system. The catch from the St. Marys and Ocqueoc rivers increased by 97 and 434 lampreys, respectively, over the number taken in 1983. Males represented 57% of the lampreys from the St. Marys River in 1984, compared with 44% in 1983; however, the average length and weight remained consistent with previous years. Lampreys from Lake Huron, except for those from the St. Marys River, were smaller than those taken in Lakes Michigan, Erie, and Ontario, but larger than the lampreys from Lake Superior.

Parasitic-phase Sea Lampreys

A total of 1,265 sea lampreys were collected by commercial fishermen in Lake Huron, compared with 1,527 in 1983. Fishermen from statistical district MH-1 (DeTour-Rogers City area) contributed 1,067 sea lampreys in 1984, compared with 1,302 in 1983, indicating a continued high abundance in northern Lake Huron. The number of sea lampreys collected by commercial fishermen in statistical district MH-2 (Alpena area) remained about the same in 1984 (151) as in 1983 (158). Sea lampreys collected in MH-4 (Tawas City-Bay Port area) decreased slightly, from 67 in 1983 to 47 in 1984.

About 70 licensed charters fish the waters of Lake Huron, and the materials necessary to participate in the program to monitor the incidence of feeding lampreys were distributed to 55 of the fishermen. Information was returned from 29 of the operators.

Parasitic-phase lampreys were collected from sport fishermen from statistical districts of MH-4 (Port Austin-Grindstone City area) and MH-5 (Harbor Beach area) in 1983, and comparisons of the numbers collected from these same districts in 1984 are: MH-4, 349 in 1983 and 352 in 1984; MH-5, 44 in 1983 and 134 in 1984. For all collections from the sport fishery of Lake Huron combined, 79% of the sea lampreys were attached to chinook salmon.

Table 8. Details on the application of lampricides to streams of Lake Huron, 1984. [Number in parentheses corresponds to location of stream in Figure 3.]

Stream	Date	Discharge at mouth		TFM		Bayer 73 powder		Strea treate
				Act. Ingr.		Act. Ingr.		
		m^3s	f^3s	kg	lbs	kg	lbs	km mi
Steeles Creek (4)	May 11	0.2	6	30	66	-	-	1.6
Pine River (9)	May 12	1.9	68	758	1,672	-	-	16.1
Trout Creek (2)	May 13	0.1	5	10	22	-	-	1.6
McKay Creek (3)	May 14	0.2	7	70	154	-	-	6.5
East Au Gres River (7)	June 29	1.4	50	838	1,848	-	-	56.5
Ocqueoc River (5)	Aug. 20	2.2	77	519	1,144	-	-	6.5
Saginaw River (8)								
Chippewa River	Sept. 14	5.3	188	3,293	7,260	7	16	74.2
Shiawassee River[a]	Oct. 5	3.3	118	1,088	2,398	-	-	16.1
Cass River[a]	Oct. 8	7.1	250	2,385	5,258	-	-	16.1
Bluff Creek	Oct. 21	0.4	15	329	726	-	-	21.0
Albany Creek (1)	Oct. 23	0.3	10	40	88	-	-	1.6
Devils River (6)	Nov. 2	2.1	75	818	1,804	-	-	21.0
Total		24.5	869	10,178	22,440	7	16	238.8

[a]Initial treatment.

Table 9. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Huron, 1984.

[Letter in parentheses corresponds to location of stream in Figure 3.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight	
				Males	Females	Males	Female
St. Marys River (A)	1,687	869	57	480	485	243	254
Cheboygan River (B)	17,616	559	44	464	463	205	212
Ocqueoc River (C)	1,444	597	48	441	441	181	188
Total or average	20,747	2,025	51	465	464	217	220

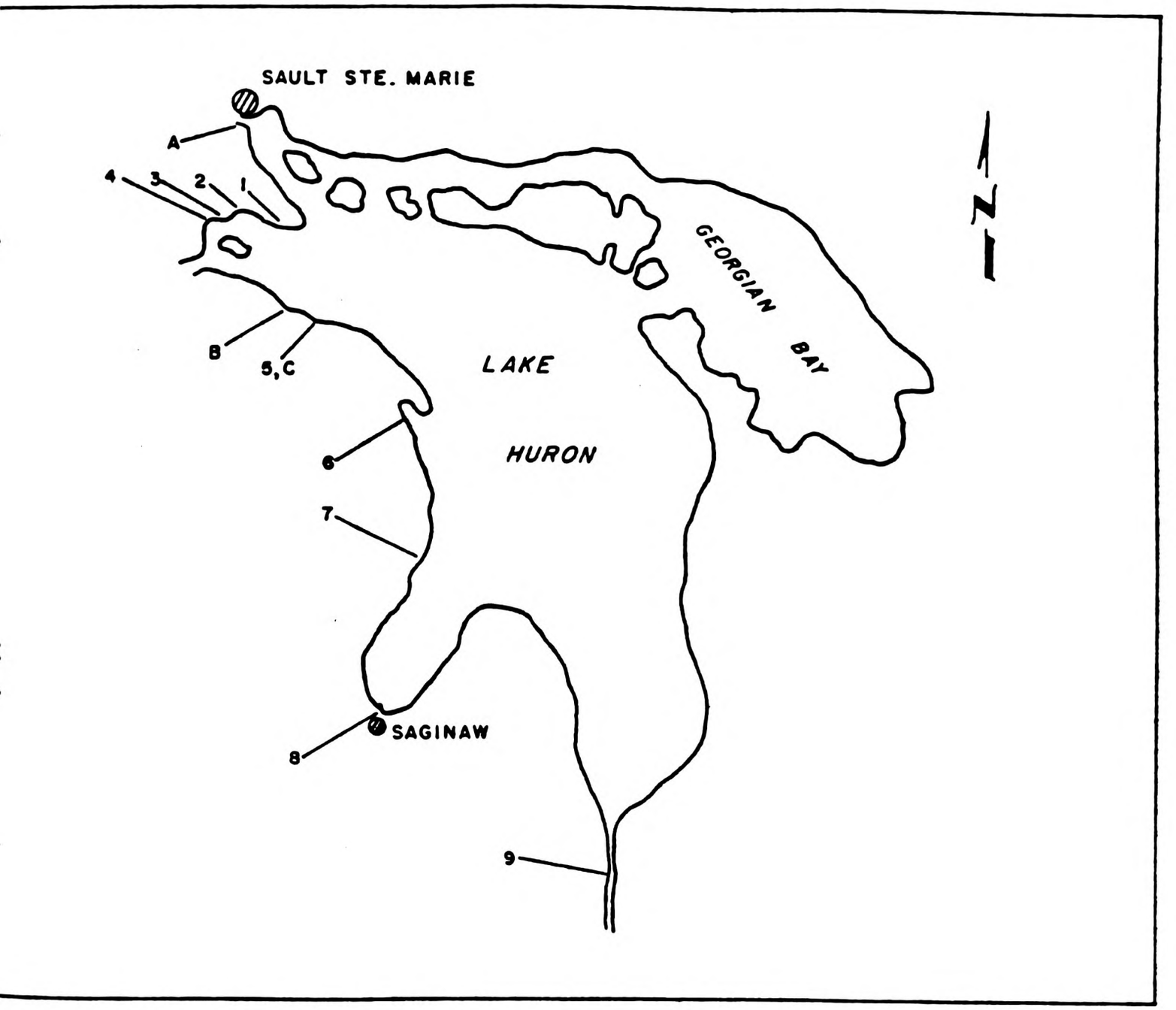

Figure 3. Location of streams tributary of Lake Huron treated with lampricides (numerals; see Table 8 for names of streams), and of streams where assessment traps were fished (letters; see Table 9 for names of streams) in 1984.

Special Studies

Transformation study--Larval sea lampreys (age V) were collected by electrofishing in May 1984 from Trout Creek, a small tributary of the north shore of Lake Huron. The mean total length of the 62 larvae was 127 mm and the range was 120-146 mm. The larvae were held in an aquarium at the Marquette Station until September to determine the rate of transformation. The aquarium was at room temperature and aerated, but larvae were not fed. At the completion of the study, two ammocetes (3%) had undergone transformation. Previous studies have shown that transformation rates for larvae held in this manner are higher than those expected to occur in parent streams. Trout Creek has a lake in its drainage and is warmer than most other north shore tributaries during periods of maximum growth of ammocetes. Therefore, growth of larvae is greater and transformation rates likely higher than for most other north shore tributaries.

St. Marys River--Surveys to assess populations of larval sea lampreys in the St. Marys River were continued in 1984. A total of 69 stations were surveyed with Bayer 73 granules to define further the abundance and distribution of ammocetes in the river (Fig. 4). All sites examined during the 1984 surveys were referenced with a Loran-C navigational device. Preliminary findings indicate that this device, combined with fathometer readings, will assure a greater degree of accuracy in relocating sites, especially in wide areas of the river.

Most sea lamprey larvae came from Lake Nicolet. A total of 1,134 ammocetes (28-150 mm long) were collected at 15 of 16 sites examined. Larvae were collected from the lake entrance downstream to the northern end of Neebish Island near the entrance to Middle Neebish Channel, where four transforming larvae were taken. The densest population appears to be along the Sugar Island side of the lake on the dropoff to the shipping channel. Considerably fewer larvae are along the west edge of the shipping lane.

Fifty-three sea lamprey larvae (28-100 mm long) were collected from two of six sites examined on the U.S. side of Munuscong Channel, downstream of Middle Neebish Channel. Although a sea lamprey larva was taken near the outlet, none were recovered from three sites offshore.

Sea lamprey larvae were recovered for the first time in Munuscong Lake. A total of 45 larvae (32-132 mm long) were collected from 6 of 15 sites examined in the northern end of the lake. Most larvae were from sites sampled near Moon Island and two unnamed islands southeast of Winter Point, the southernmost tip of Neebish Island.

A few larvae were collected in three additional areas. Thirteen ammocetes (67-142 mm long) were taken from 3 of 14 sites examined in U.S. waters upstream of the locks to Shermans Park. A single ammocete was collected from one of five areas surveyed near the inlet of Lake George. Three sites examined in Middle Neebish Channel yielded 18 sea lamprey larvae (48-128 mm).

No sea lampreys were found in four areas surveyed in West Neebish Channel downstream of the "rock cut" and seven areas sampled in the lower river from Lake Munuscong Outlet to DeTour passage. An area of excellent spawning habitat was identified at Frying Pan Isle near DeTour Village.

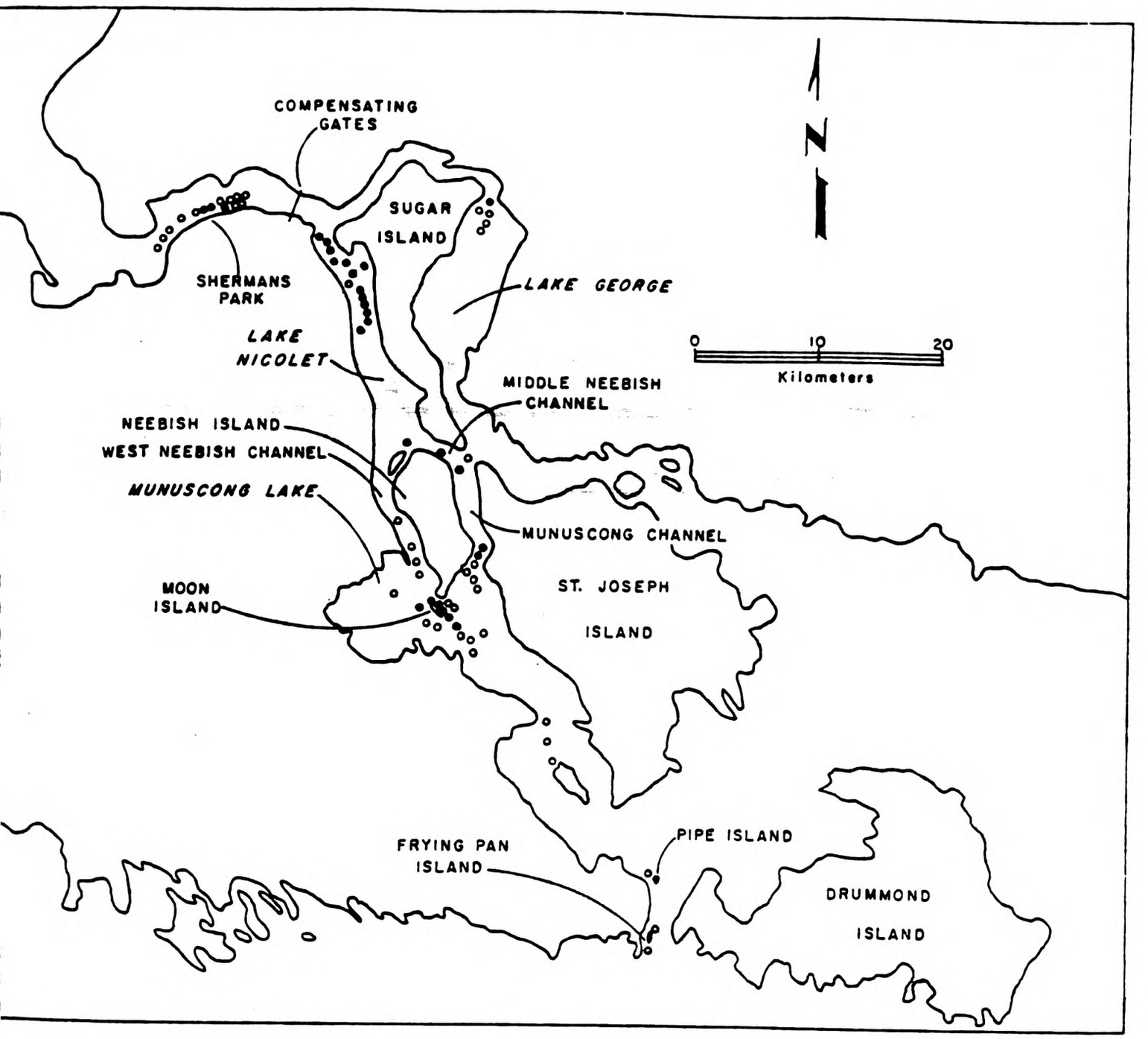

Figure 4. Location of sites surveyed with Bayer 73 granules for larval sea lampreys in the St. Marys River in 1984. Closed circles indicate sites where sea lampreys were taken; open circles indicate sites where sea lampreys were not collected.

The sea lamprey population in the St. Marys River is building rapidly and apparently contributing significantly to the parasitic population in northern Lake Huron and possibly northern Lake Michigan. Larval sea lampreys are distributed in three lake basins (George, Nicolet, and Munuscong) in the river system, as well as in a significant area of the upper river. The size and numbers of larvae collected in the 1984 surveys would warrant chemical treatment on any other system. Emphasis in the future should be shifted from larval studies to feasibility studies for chemical treatment or alternate control methods.

LAKE ERIE

Larval Assessment

Surveys to assess larval sea lamprey populations were attempted on seven Ohio tributaries of Lake Erie. Adverse weather conditions prohibited reliable surveys in Conneaut Creek and Grand River, known sea lamprey producers. Five other streams (Chagrin and Huron rivers and Arcola, Cowles, and Wheeler creeks) were surveyed under more favorable conditions. No evidence of successful sea lamprey reproduction was found during surveys of the Chagrin and Huron rivers and Arcola and Cowles creeks. Larval sea lampreys were not found between the dam and estuary of the Chagrin River even though spawning sea lampreys were observed downstream of a dam and 105 were captured in traps in the spring of 1984. A comprehensive survey of the estuary with granular Bayer is needed to detect and assess larval populations. Survey of the upper river also is needed to determine if the barrier dam at Daniels Park stops the upstream migration of lampreys. Sea lamprey larvae (26-69 mm long) of the 1983 and 1984 year classes were collected in Wheeler Creek which had no previous record of sea lamprey production. Native American brook lampreys were abundant.

Spawning-phase Sea Lampreys

Assessment traps were fished in three tributaries of Lake Erie in 1984 (Table 10, Fig. 5). The number of sea lampreys captured in Cattaraugus Creek decreased from 1,671 in 1983 to 625 in 1984. The decline at this site may be due in part to a decrease in efficiency caused by repair to one of the two turbines at the powerhouse. Traps were operated for the first year in two tributaries in Ohio. While the numbers of lampreys captured in the Grand and Chagrin rivers were not large, 280 and 105, respectively, the rivers will be included in the future assessment network.

LAKE ONTARIO

Larval Assessment

Posttreatment evaluations of Fish, Big Bay, and Scriba creeks were conducted in late summer. These streams were treated for the first time in 1984. Residual sea lampreys and young-of-the-year larvae were found in the Fish Creek drainage and Big Bay Creek. Isolated pockets of residual larvae are not uncommon after initial treatments of some streams if dense populations are present at the time of treatment. Once these populations are located and evaluated, they can be eliminated in later treatments. Larvae of the 1984 year class were detected in tributaries of Fish Creek (East and West Branches and in Mad and Little rivers) and Big Bay Creek. No evidence of residual lampreys or the 1984 year class was found during examination of Scriba Creek.

Table 10. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 1984.

[Letter in parentheses corresponds to location of stream in Figure 5.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
Chagrin River (A)	105	105	48	517	508	278	274
Grand River (B)	280	280	57	517	516	282	295
Cattaraugus Creek (C)	625	552	66	510	505	284	293
Total or average	1,010	937	61	512	509	283	291

Table 11. Details on the application of lampricides to streams of Lake Ontario, 1984.

[Number in parentheses corresponds to location of stream in Figure 5.]

Stream	Date	Discharge at mouth		TFM		Stream treated	
				Act. Ingr.			
		m^3s	f^3s	kg	lbs	km	miles
Scriba Creek (2)	May 30	13.9	490	160	352	1.6	1
Big Bay Creek (1)	June 2	1.4	50	90	198	11.3	7
Fish Creek (3)	June 4	22.7	800	1,497	3,300	80.6	50
Total		38.0	1,340	1,747	3,850	93.5	58

Table 12. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 1984.

[Letter in parentheses corresponds to location of stream in Figure 5.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
Sterling Creek (A)	43	0	-	-	-	-	-
Sterling Valley Cr. (B)	427	427	55	494	485	287	282
Catfish Creek (C)	2	2	100	439	-	177	-
Little Salmon River (D)	2	0	-	-	-	-	-
Grindstone Creek (E)	128	2	100	463	-	243	-
Total or average	602	431	56	493	485	286	282

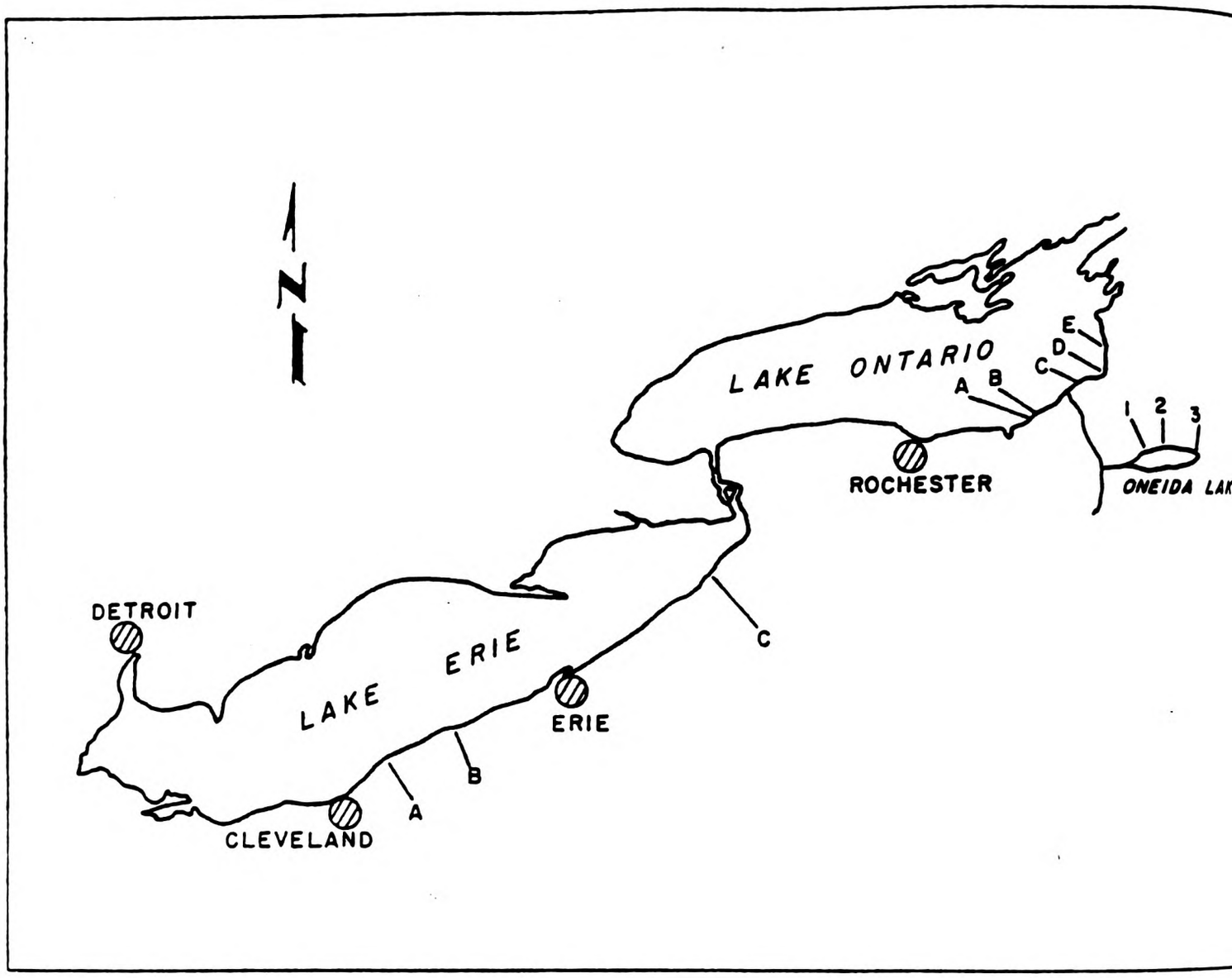

Figure 5. Location of streams tributary of Lakes Erie and Ontario where assessment traps were fished (letters; see Tables 10 and 12 for names of streams), and of streams tributary of Lake Ontario treated with lampricides (numerals; see Table 11 for names of streams) in 1984.

A total of 187 residual sea lampreys (44-176 mm long), including six transforming larvae, were recovered from 22 of 60 sites examined in the Fish Creek drainage. Most locations (15) that yielded residual larvae were associated with backwaters and confluences of tributaries, common refuges for larvae during treatment. Of the residuals collected, 104 larvae (41-158 mm) were taken in three backwater areas in the Mad River. No significant concentrations of larvae were found in the other seven locations.

Thirteen residual sea lampreys (57-152 mm long), including one transforming larva, were recovered from 2 of 10 sites examined in Big Bay Creek. All were collected near the confluence of Big Bay and Dykeman creeks, an area which had the densest larval population before treatment.

Chemical Treatment

Three Lake Ontario tributaries of Oneida Lake--Fish, Big Bay, and Scriba creeks--were treated with lampricides for the first time (Table 11, Fig. 5). Emphasis was placed on collecting pretreatment data, including flow characteristics and bioassay data, and as a result, TFM concentrations were maintained, fish mortality was minimal, and no significant problems developed. Coordination among personnel from the Canadian Sea Lamprey Control Centre, New York State Department of Environmental Conservation, and the Marquette and Ludington Sea Lamprey Control Stations was excellent and resulted in successful treatments of Oneida Lake tributaries.

Spawning-phase Sea Lampreys

The catch of sea lampreys in assessment traps in five tributaries of Lake Ontario declined from 1,331 in 1983 to 602 in 1984 (Table 12, Fig. 5). Numbers of lampreys decreased in all streams and declines ranged from 7% (461 to 427) in Sterling Valley Creek to 81% (678 to 128) in Grindstone Creek. Most lampreys were males (56%), a characteristic of the population prevalent since sampling began in 1978.

Parasitic-phase Sea Lampreys

Information on the occurrence of sea lampreys in the charter sport fishery was received from two operators in Oswego, New York (statistical district NO-2). They examined 757 fish and captured 21 feeding lampreys; 11 on brown trout and 10 on lake trout.

Treatment Effects on Nontarget Organisms

The initial treatment of Fish Creek in 1984 provided an opportunity to gain valuable information on effects of lampricides on invertebrates in a stream that had never been treated. All past field studies on the effects of TFM on nontarget invertebrates were conducted on previously treated systems. Riffle samples were taken from the Mad River (treated) and Cobb Brook (control) in September 1983, immediately before and after the treatment in early June 1984, 4 weeks after treatment, and again in September. Drift samples also were collected from these two tributaries of the West Branch of Fish Creek the day before, during, and the day after TFM application. The samples are being processed through a cooperative agreement with the National Fishery Research Laboratory, La Crosse, Wisconsin.

LAKES SUPERIOR, MICHIGAN, AND ONTARIO

Treatment Effects on Nontarget Organisms

Efforts continued in 1984 to establish a routine monitoring method of the effects of TFM applications on nontarget organisms in streams having a history of environmental complaints associated with treatments. Onsite testing of organisms was completed in the Bad and Huron rivers (Lake Superior), Rapid and Jordan rivers (Lake Michigan), and Fish Creek (Lake Ontario). Several treated sites were studied in the Bad and Jordan rivers, whereas a single site was selected in the other streams.

Before lampricide application, invertebrates and fish were caged in a portion of the stream that was to be treated, and as a control, in areas that would not be treated. Small fish (<15.2 cm, <6 inches) were collected by electrofishing several days before treatment and caged in modified minnow traps. Invertebrates were dislodged from the substrate into a kick net and uninjured specimens were placed in cages (developed in 1983) the day before treatment.

The lampricide had little effect on most of the 14 species of fish included in the tests (Table 13). Mortality of darter species in the Rapid River probably resulted from exposure to high concentrations of TFM needed to assure minimum lethal concentrations through long stretches of the river. High water complicated this treatment and may have stressed caged fish. Species previously noted as susceptible to TFM such as blacknose dace, longnose dace, and sculpins were not affected greatly by the exposure to TFM.

Organisms of 32 invertebrate genera were tested at seven locations in five streams (Table 14). Mayflies, especially Baetidae, which died as they emerged from the nymphal stage when confined underwater, were not counted in mortality estimates. Among Ephemeridae, mortality was noted for Hexagenia (100%, one specimen) and Litobrancha (18% and 44%), whereas no dead Ephemera were observed. Other organisms often affected by treatment included Chimarra and Dolophilodes of the net-spinning caddisfly family Philoptomatidae, and a case builder, Glossosoma. Smaller organisms such as flatworms, Dugesia; blackflies, Simulidae; and microcaddisflies, Leucotrichia, are difficult to keep in cages and disappeared from both control and treatment cages.

Table 13. Percentage of fish dead or missing of those caged at one or two locations during treatments of four streams with lampricides in 1984.

	Lake Superior						Lake Michigan					
	Bad River			Huron River			Rapid River			Jordan River		
		Percentage			Percentage			Percentage			Percentage	
Species of fish	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost
Rainbow trout							3	0	0	8	25	0
										14	0	0
Brown trout										10	0	0
Blacknose dace	7	0	0	9	22	0	10	0	0			
Longnose dace	10	10	0	10	0	0	5	0	0			
	13	0	0									
Common shiner	2	0	0				2	50	0			
Hornyhead chub	1	100	0									
Creek chub	1	0	0									
White sucker							4	0	0			
Black bullhead							1	100	0			
Fantail darter							19	89	5			
Johnny darter	4	50	0	9	0	0	4	25	0			
Logperch	10	10	0				5	100	0			
	1	0	0									
Mottled sculpin	9	0	0	10	0	0	7	0	0			
Sculpin sp.										10	0	0

Table 14. Percentage of invertebrates dead or missing of those caged at one or two locations during treatments of five streams with lampricides in 1984.

Taxon	Lake Superior						Lake Michigan						Lake Ontario		
	Bad River			Huron River			Rapid River			Jordan River			Fish Creek		
		Percentage			Percentage			Percentage			Percentage			Percentage	
	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost
Plecoptera															
Perlidae															
Acroneuria													5	0	0
Paragnetina													2	0	0
Phasganophora													3	0	0
Ephemeroptera															
Siphlonuridae															
Isonychia	1	0	0										2	0	0
Baetidae															
Baetis	7	0	14	6	0	0	2	0	0	16	0	0			
	21	19	0							12	8	0			
Heterocloeon	2	0	0												
Pseudocloeon	4	0	0	2	0	0	3	0	0				6	0	0
	1	0	0												
Heptageniidae															
Epeorus	9	0	0										8	0	0
Heptagenia	2	50	0												
Stenonema							10	0	0						
Leptophlebiidae															
Paraleptophlebia							10	0	0				9	11	22
Ephemerellidae															
Ephemerella							21	0	0	9	0	22	19	0	0
										1	0	0			
Tricorythidae															
Tricorythodes										5	20	0			
Baetiscidae															
Baetiscus				10	20	10									
Ephemeridae															
Ephemera										20	0	5			
Hexagenia										1	100	0			
Litobrancha										9	44	0			
										22	18	0			

Taxon	Lake Superior						Lake Michigan						Lake Ontario		
	Bad River			Huron River			Rapid River			Jordan River			Fish Creek		
		Percentage			Percentage			Percentage			Percentage			Percentage	
	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost	No.	Dead	Lost
Trichoptera															
Philopotamidae															
Chimarra	2	100													
	10	40	50												
Dolophilodes	8	75	25	20	95	0	1	100	0	2	100	0	20	85	15
Polycentropodidae															
Polycentropus							1	0	0				1	0	0
Hydropsychidae															
Cheumatopsyche				1	0	0							7	0	0
Hydropsyche	10	10	0	5	0	0	1	0	0						
Symphitopsyche	10	0	10	4	0	0	9	0	0				3	0	0
Glossosomatidae															
Glossosoma				15	93	0	10	80	20	19	26	53			
Hydroptilidae															
Leucotrichia	10	20	70												
Brachycentridae															
Brachycentrus				10	0	0				5	0	20			
Lepidostomatidae										10	0	0			
Lepidostoma													10	0	0
Helicopsychidae															
Helicopsyche				16	0	0	10	0	0						
Coleoptera															
Elmidae							6	0	33						
Optioservus (larvae)				10	10	20									
Optioservus (adult)	9	0	10	6	0	0									
	2	0	0												
Stenelmis (adult)	1	0	0	6	0	0									
	9	0	0												
Diptera															
Simuliidae	10	20	80							18	11	72			
										15	33	0			
Turbellaria															
Planariidae															
Dugesia										20	10	90			

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CONTENTS

ANNUAL REPORT

of the

SEA LAMPREY CONTROL CENTRE

for

1984

EXECUTIVE SUMMARY

Although the Centre's reporting obligations to the Great Lakes Fishery Commission are being met by a joint annual report prepared in collaboration with the Commission's United States agent, we will continue providing this Report in the interests of continuity, and to provide an accessible and detailed documentation of our activities and information.

The Sea Lamprey Control Centre, located at Sault Ste. Marie, Ontario, is responsible for implementing sea lamprey control on the Canadian side of the Great Lakes and to the New York tributaries of Lake Ontario. The staff of 31.5 employees, listed on the inside front cover, is augmented in the field season by approximately twenty-six casuals and students. The control program consists of five main field projects; Adult Sea Lamprey Assessment, Larval Sea Lamprey Assessment, Lampricide Treatment (two units), Barrier Dam Construction and Maintenance, and Special Studies.

The sea lamprey control program still depends almost exclusively on the use of the selective lampricide TFM, despite continuing efforts to find and develop alternate methods. While our reliance on lampricide may be reduced through successful developments of other techniques, the continued availability of lampricide must be considered vital to the sea lamprey control program.

The lampricide TFM, 3-trifluoromethyl-4-nitrophenol (sodium salt), has been used successfully as the principle means of sea lamprey control since its discovery as a selective toxicant in 1957. This material is supplied as a water soluble liquid at approximately thirty-six per cent active ingredient.

Bayer 73, the ethanolamine salt of 2',5-dichloro-4'-nitrosalicylanilide, is occasionally used as an additive to the lampricide TFM in treating selected rivers. This material is supplied as a wettable powder at 70 per cent active ingredient. Applied at a rate of between one to two per cent of the TFM, it has generally reduced the amount of TFM required for treatment by 30 to 50 per cent.

The heavy granule formulation of Bayluscide or granular Bayer 73 (five per cent active ingredient) has been tested and is particularly effective as a survey tool, especially in streams which are deep, turbid or have low electrical conductivity. Used in estuarine and lacustrine areas, Bayer 73 has proven more

effective than the TFM which dissipates rapidly in the lake. The heavy granule quickly reaches the bottom causing lamprey to leave their burrows and generally surface where they can be sampled. The granular material has also been efficient in overcoming the effect of thermal stratification in estuarine areas by sinking through the thermal barrier to reach lamprey not normally exposed to the TFM contained in the overlying warmer stream water.

In addition to granular Bayer 73, backpack electro-shockers are used to survey streams to detect the occurrence of sea lamprey ammocoetes, to determine their distribution, or to estimate their abundance.

Evaluation of adult sea lamprey populations throughout the Great Lakes is accomplished through the operation of mechanical weirs and trapping devices. Information provided by commercial and sport fishermen also gives an indication of the levels of parasitic phase sea lamprey in the lakes. Another method of assessing sea lamprey activity is by monitoring the incidence of lamprey-inflicted wounds and scars on fish. Although this activity is the primary responsibility of the fisheries management agencies of the Province of Ontario and the appropriate States, sport fishing "cooperators" provided similar data directly to this Centre.

All evidences of the sea lamprey population sizes in the Great Lakes attest to the continued effectiveness of the sea lamprey control program. The reduction in sea lamprey abundance, where control measures have been implemented, is estimated to approach 90 per cent below their peak levels in the pre-control period. The resulting decrease in lamprey-induced fish mortality has been a major factor in the restoration of the Great Lakes fisheries - particularly the fishery for "large desirable" salmonids which now exceeds a total of one billion dollars in value. As the decision to treat Lake Erie streams with lampricide has not yet been made, this lake remains the only one of the Great Lakes in which sea lamprey control is not in effect.

The assistance and cooperation of the Ontario Ministry of Natural Resources is gratefully acknowledged. The Ministry has, over the years, provided aircraft for moving personnel and equipment to inaccessible locations, provided accommodations for our field personnel, and have operated the lamprey traps built into the lower dams on the Saugeen and Ganaraska Rivers.

ADULT SEA LAMPREY ASSESSMENT

A total of 7,658 spawning phase sea lamprey were collected from trapping devices fished in 16 tributaries: Lake Superior - Pancake River (5), Carp River (45), Stokely Creek (1); Lake Huron - St. Marys River (3,624), Kaskawong River (115), Thessalon River (1,620), Mindemoya River (37), Manitou River (1), Blue Jay Creek (33); Lake Ontario - Humber River (1,366), Don River (0), Duffin Creek (520), Bowmanville Creek (242), Wilmot Creek (9), Graham Creek (26), Shelter Valley Brook (14).

The commercial fishery submitted a total of 1,614 predatory phase sea lamprey during the 1984 calendar year: Lake Superior - 24; Lake Huron - 1,585; Lake Erie - 5.

The 1984 sport fishery co-operator programme, first introduced in 1983 as a pilot study on Batchawana Bay, Lake Superior, was expanded in 1984 to the Michipicoten Bay and Thunder Bay areas of Lake Superior. In Batchawana Bay, sea lamprey predation data was reported on 287 lake trout and reflected a wounding rate of 2.8 per hundred fish. Both wounding and marking rates were substantially lower than in 1983.

Results from Michipicoten and Thunder Bay indicated a wounding rate of 8.3 and 12.5 per hundred fish from samples of 48 and 160 lake trout, respectively.

LARVAL SEA LAMPREY ASSESSMENT

Surveys to determine the current status of larval sea lamprey populations were carried out on 87 tributaries and bay areas of the Great Lakes: Lake Superior - 28; Lake Huron - 31; Lake Erie - 1; Lake Ontario - 27 (including 6 New York State tributaries).

No new sea lamprey producing tributaries were established as a result of these surveys, however larvae (365) were taken from the McIntyre River, Lake Superior, for the first time since 1964.

Residual sea lamprey larvae, representing escapement from previous treatments, were taken from the following eight tributaries: Steel and Little Carp Rivers (Lake Superior); Thessalon and Mississagi Rivers (Lake Huron); Rouge and Little Salmon Rivers and Wilmot and Graham Creeks (Lake Ontario).

Surveys conducted above sea lamprey barrier dams on Gimlet and Stokely Creeks (Lake Superior), Echo, Kaskawong, Sturgeon and Saugeen Rivers (Lake Huron),Graham and Duffin Creeks (Lake Ontario) indicated that, with the exception of the Echo and Graham, these dams have prevented the upstream migration of spawning run sea lamprey. However, establishment of a sea lamprey larval population has taken place below all of these structures with the exception of Gimlet Creek and the Saugeen River.

Granular Bayer 73 surveys conducted in the Trent River-Canal, adjacent to the mouth area of Mayhew Creek, resulted in the collection of 169 larval sea lamprey - seven of which were undergoing adult transformation.

LAMPRICIDE TREATMENTS

A total of 26 tributaries were treated with the selective lampricide TFM in 1984: Lake Superior - 8; Lake Huron - 10; and Lake Ontario - 8 (four in Canada and four in the United States). In addition, Granular Bayer 73 treatments were carried out in three lake bays and two rivers.

Four tributaries and two bays were deferred from treatment in 1984 due to high water discharge (Goulais River - Lake Superior), thermal water stratification (Moira River - Lake Ontario), reduction in larval density (Spanish River - Lake Huron), untimely change in larval distribution (Graham Creek - Lake Ontario), and low water temperatures (Mountain and Cypress Bays - Lake Superior).

Treatment of the Goulais River (Lake Superior) was aborted after partial completion due to excessive rainfall. This tributary has been rescheduled for treatment in 1985.

The Pays Plat River was treated with lampricide for the first time since 1963. Sea lamprey larvae were abundant with all year classes present. Inhabitants of the Pays Plat Indian Reserve were provided with water during the time TFM was present in the lower section of the river.

Granular Bayer 73 treatments indicated the continuing presence of large numbers of larval sea lamprey in Batchawana Bay off the mouth area of the Chippewa River and in three areas of the St. Marys River. Treatment of four areas in the lower French River produced small numbers of larvae from only one. Sea lamprey larvae appear to be scarce in the lower French River, consequently no increased control efforts are required.

BARRIER DAM CONSTRUCTION AND MAINTENANCE

Low head barrier dams constructed on the Carp River, Gimlet Creek, Stokely Creek (Lake Superior), Kaskawong and Sturgeon Rivers (Lake Huron) have been effective in blocking the spawning migrations of sea lamprey. Washouts at the Echo River dam (Lake Huron) in 1983 and the Graham Creek dam (Lake Ontario) in 1984 have allowed for the reestablishment of a larval population above these sites.

Two low head barrier dams were constructed in 1984. On Sheppard Creek, a tributary to the Goulais river (Lake Superior), a gabion with concrete grout dam, including a curved steel lip and jumping pool (no lamprey trap) was completed in September at a cost of $38,919. This structure will reduce the length of stream requiring lampricide treatment by approximately 97 per cent. A structure completed on Lakeport Creek (Lake Ontario) in September of 1984, at a cost of $21,760., has an 11.7 metre long overflow crest (65 cm head) with a curved steel lip adjacent to the downstream jumping pool. A built-in concrete lamprey trap will be operational in the spring of 1985.

Maintenance and improvement work were carried out at the Gimlet Creek, Sable River, Stokely Creek (Lake Superior), Kaskawong River (Lake Huron), Duffin and Graham Creeks (Lake Ontario) dam sites.

Survey work was initiated at the Still River dam site in preparation for construction in 1985 whereas site inspections were carried out at six additional sites for future construction consideration.

BIOLOGICAL STUDIES

During the summer of 1984 larval surveys were continued in St. Marys River to define further the extent of sea lamprey distribution and to estimate the numbers of larvae in selected study areas. Sea lamprey larvae were found approximately one kilometre upstream of the International Rapids, and approximately 1.3 km downstream of the entrance into Lake Munuscong along the shore of St. Joseph Island. Slightly more than one per cent of the larvae collected (3,243) were in the preliminary stages of metamorphosis.

Sea lamprey larval population studies conducted in Batchawana Bay, adjacent to the Chippewa River (Lake Superior) and within the river proper resulted in estimates of 38,000 and 10,000 sea lamprey larvae, respectively.

In May and June 1984 the Biological Studies Group (with the assistance of personnel from several other agencies) conducted a Petersen type population estimate of the ammocoete population in Fish Creek (New York State) in conjunction with the lampricide treatment carried out by the United States Control Unit. Prior to the treatment, 16,800 sea lamprey ammocoetes, marked by dye injection, were released into 19 study sections in the Fish Creek system. During the treatment a total of 35,211 ammocoetes (including 205 marked ones) were collected from these sections. The initial Petersen population estimate applicable to the study sections was extrapolated—using the proportionate area of the study sections to the total treated area of the stream—to yield an estimate of 6.1 million ammocoetes for the entire system.

ADULT SEA LAMPREY ASSESSMENT

Introduction

Efforts to control sea lamprey in the Canadian side of the Great Lakes began in 1946 when the Ontario Department of Lands & Forests installed mechanical trapping devices in tributaries to the North Channel of Lake Huron. A gradual expansion of this effort occurred throughout Lake Huron and into the remaining three lakes. By 1954, with the creation of a joint Federal-Provincial Research Committee, the first electrical barriers were installed in Canada in three Lake Superior tributaries. After the formation of the Great Lakes Fishery Commission in 1955 the Canadian control program became the responsibility of the Federal Fisheries Department, as designated Canadian agent of the Commission. The electrical barrier networks then rapidly developed on Lake Superior and eventually Lake Huron, but by 1967, owing to the success of chemical control, the Canadian Lake Superior barriers were removed with Lake Huron following by 1980. Although initially intended as control measures the original mechanical trapping devices and electrical barriers proved only to have value as a means of assessing populations of spawning adults, both by enumeration of the adults caught, and by trends in their biological characteristics (length, weight, and sex). A regulated dip net operation conducted on the Humber River, a Lake Ontario tributary, from 1968 to 1978 and again in 1981 provided valuable assessment information during the period just before and during introduction of chemical control on that lake.

Mechanical trapping, reintroduced in 1971, has replaced the barriers as the principal assessment methodology for spawning populations. Mechanical weirs, portable traps and permanent barrier dam traps have proven to be practical, and in many instances highly successful, collecting devices. For 1984 only one weir was installed and, while a number of portable traps were in operation, permanent trapping devices continued to be increasingly emphasized as offering the most stable and consistent collecting method now available.

Information on the predatory phase of the sea lamprey is currently obtained from the Great Lakes commercial and sport fisheries. Systematic efforts to obtain specimens and ancillary information from the commercial fishery were initiated in 1967. Payment is offered for specimens submitted when accompanied by observations on date, location, and depth of capture, type and size of gear used, and the species of fish (if any) the lamprey were associated with.

In 1983 and 1984, this Centre conducted a "Cooperator Program" to obtain information from anglers on the frequency of lamprey attacks on lake trout populations, including actual observations of lamprey attachments. The project, first implemented as a pilot study on Batchawana Bay, Lake Superior in 1983, was expanded for 1984 to two further areas on Lake Superior having significant lake trout fisheries (Michipicoten Bay and Thunder Bay). Additionally, four sport fishing derbies were monitored by the Centre, and one by the New York Department of Environmental Conservation (NYDEC) in a cooperative venture, to obtain pertinent information on lamprey movement and activity. Further consideration will be given to the monitoring of such derbies as a source of parasitic sea lamprey and/or predation related data.

LAKE SUPERIOR

Spawning Phase Investigations

A total of 51 sea lamprey were collected in 1984 from trapping devices operated on Lake Superior. The locations of the tributaries being assessed are shown on Figure 1, operational data on Table I, and the biological information in Table II.

During 1984, the Stokely Creek permanent dam trap collected only one sea lamprey. Since its installation in the winter of 1981-82, this device has been responsible for the capture of 21 specimens.

The new barrier dam on the Carp (Sable) River, in place prior to the 1984 spawning season, included a permanent trap. This trap took 45 sea lamprey, not unlike numbers taken from the mechanical weir which preceded it, and comparable to the mean annual catches (61) of the electrical weir that operated from 1954 to 1967.

Trapping at the base of the barrier dam on Gimlet Creek, a tributary to the Pancake River, was continued this year. A rectangular portable trap fished at the surface caught five specimens.

Predatory Phase Investigations

Commercial Fisheries

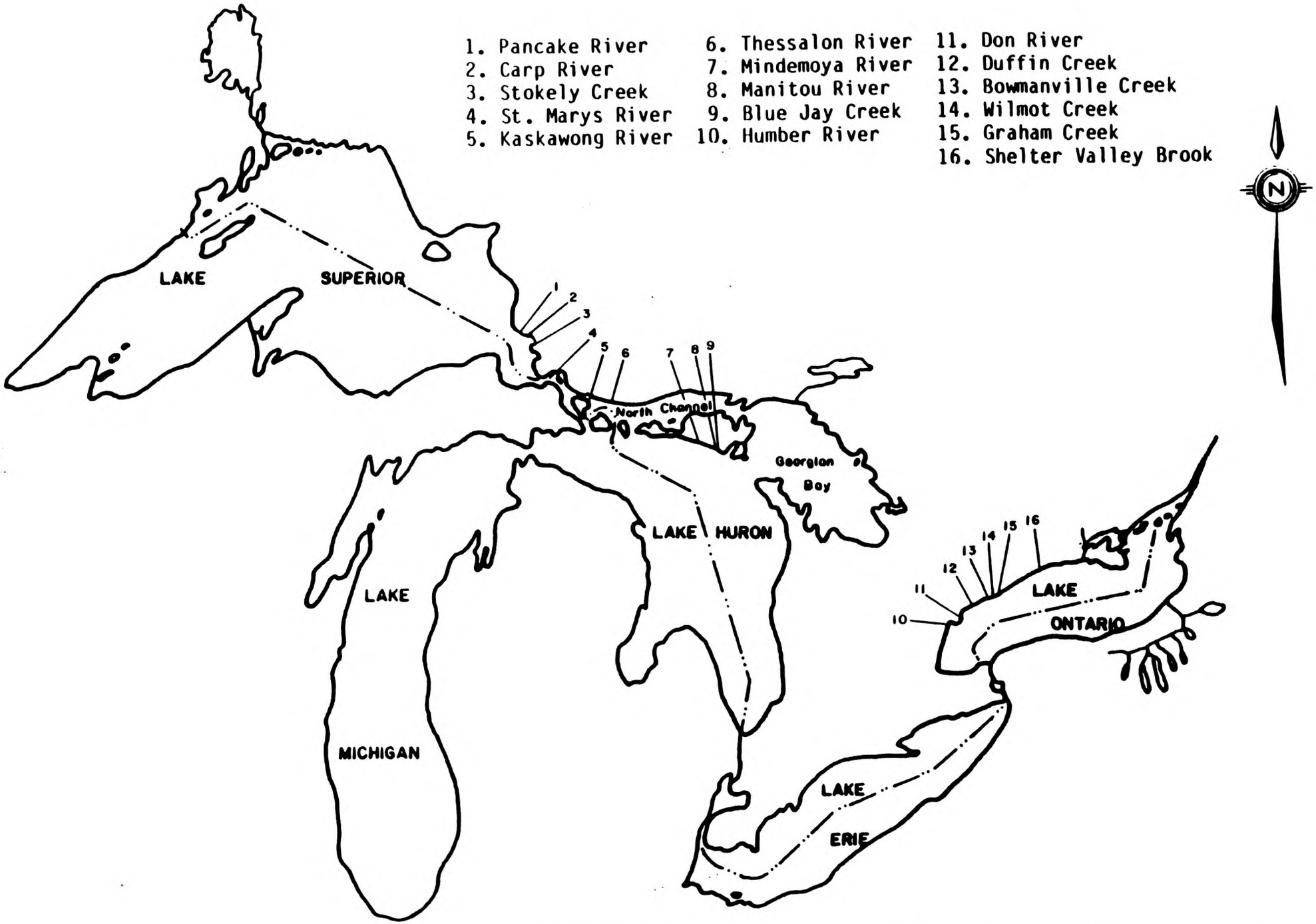
A total of only 24 sea lamprey were submitted from three fisheries during calendar year 1984. Contacts with a number of other fisheries suggested annual sightings to be quite low (rarely exceeding 20 specimens, and frequently none to 'a few'). Biological Information from all lakes is intended to be reported in future in three-year blocks of data through the Centre's Technical Report Series.

Sport Fisheries

The sport fishery cooperator program in Lake Superior (introduced in 1983 as a pilot study on Batchawana Bay) in 1984 continued in that area and expanded to the Michipicoten Bay and Thunder Bay areas.

The field record was modified from that used in the pilot study by the addition of a column for 'superficial marks', and another for recording the lengths of any lamprey landed (Figure 2). For summary reporting purposes however, superficial marks and scars will continue to be grouped under 'other marks'.

Complete information records submitted through the program are summarized in Table III. The convention used for reporting marks is that put forward by the Great Lakes Fishery Commission's (GLFC) sponsored "Committee to Recommend Standards for Reporting Sea Lamprey Marking Data", namely 'wounds per 100 fish'. The transition from wounds to scars was designated as between Stages III and IV of the Type A mark (from the King - Edsall Classification, GLFC Special Publication 79-1).



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...ada where spawning phase sea lamprey were trapped, 1984.

Table 1. Pertinent operational data and numbers of spawning phase sea lamprey collected by assessment gear fished in 16 Great Lakes tributaries in 1984.

LAKE/Tributary	Gear Fished	No.	Period Gear Fished	Total Nights Operated	Sea Lamprey Collected
LAKE SUPERIOR					
Stokely Creek	DT	1	Apr. 27 - July 3	67	1
Carp River	DT	1	May 4 - July 10	67	45
Pancake River	PT	1	Apr. 27 - June 27	61	5
LAKE HURON					
St. Marys River	PT	2	June 19 - Aug. 10	52	3,624
Kaskawong River	DT	1	May 3 - June 29	57	115
Thessalon River	PT	2	Apr. 30 - July 3	64	1,620
Mindemoya River	PT	1	May 5 - June 29	55	37
Manitou River	PT	2	May 5 - June 29	53	1
Blue Jay Creek	MW	1	May 8 - June 26	29	33
LAKE ONTARIO					
Humber River	DT	2	Apr. 17 - June 26	70	1,366
Don River	PT	1	May 1 - June 5	19	0
Duffin Creek	DT	1	Apr. 28 - June 25	58	520
Bowmanville Creek	PT	2	Apr. 30 - June 25	56	242
Wilmot Creek	PT	1	Apr. 29 - June 25	56	9
Graham Creek	DT	1	May 1 - June 25	55	26
Shelter Valley Brook	PT	2	Apr. 29 - June 25	57	14
TOTALS - 16		22			7,658

PT = Portable Trap DT = Dam Trap MW = Mechanical Weir

Table II. Spawning phase sea lamprey biological data collected from assessment units fishe in Canadian tributaries to the Great Lakes, 1984.

LAKE/Tributary	Unit	Number Collected	Number Sampled	Percent Males	Mean Length(mm) Males	Mean Length(mm) Females	Mean Weight(g) Males	Mean Weight(g) Females
LAKE SUPERIOR								
Stokely Creek	PT	5	5	60	416	377	183	135
Carp River	DT	45	45	38	446	441	200	183
Pancake River	DT	1	1	0	-	485	-	230
Lake Superior Totals		51	51	39	442	438	197	182
LAKE HURON								
St. Marys River	PT	3,624	1,893	64	473	478	233	241
Kaskawong River	DT	115	115	40	447	455	214	217
Thessalon River	PT	1,620	1,097	61	462	465	226	236
Mindemoya River	PT	37	36	47	449	442	201	198
Manitou River	PT	1	1	100	495	-	230	-
Blue Jay Creek	MW	33	31	45	488	485	239	249
Lake Huron Totals		5,430	3,173	62	469	471	230	237
LAKE ONTARIO								
Humber River	DT	1,366	487	56	490	480	263	1,268
Don River	PT	0	-	-	-	-	-	-
Duffin Creek	DT	520	308	52	497	488	264	271
Bowmanville Creek	PT	242	239	57	494	490	259	267
Wilmot Creek	PT	9	9	67	511	455	304	233
Graham Creek	DT	26	24	71	516	494	292	276
Shelter Valley Br.	PT	14	13	62	520	459	313	201
Lake Ontario Totals		2,177	1,081	55	494	484	264	267
GRAND TOTALS/Averages		7,658	4,304	60	475	474	238	245

PT = Portable Trap DT = Dam Trap MW = Mechanical Weir

SPORT FISHERY COOPERATOR PROGRAMME
(NEW FORM TO BE USED FOR EACH DAY FISHED)

NAME _____ DATE ___ Day ___ Month 1984 Year

LAKE TROUT CAUGHT	1st	2nd	3rd	4th	5th	6th
LOCATION CODE (refer to Map)						
Total **length** of L.trout (inches)						
Fin clip(s)						
No. of lamprey **wounds**						
No. of lamprey **superficial marks**						
No. of lamprey **scars**						
No. of **feeding lamprey attached**						
Length (inches) of lamprey boated						

No. of hours fishing ____

Note: PLEASE RECORD ALL LAKE TROUT CAUGHT.

If participating in a derby on this date, please check /_/ and give name of the derby in "remarks".

Remarks: _____

Figure 2. Field Record provided to sport fishery cooperators, Lake Superior, 1984.

Table III. Sea lamprey predation data from lake trout sport fishing catches in Lake Superior, 1984.

Total Length* (Inches)	Lake Trout Sample Size	No. of Wounds	No. Wounds /100 Fish	No. Other Marks**	No. Other Marks /100 Fish
		BATCHAWANA BAY			
< 17.0	80	2	2.5	9	11.3
17.0 - 20.9	74	5	6.8	23	31.1
21.0 - 24.9	14	1	7.1	6	42.9
25.0 - 28.9	1	0	0	1	100
unavailable	118	0	0	8	6.8
TOTALS/MEAN	287	8	2.8	47	16.4
		MICHIPICOTEN BAY			
< 17.0	14	0	0	1	7.1
17.0 - 20.9	11	0	0	1	9.1
21.0 - 24.9	10	0	0	2	20.0
25.0 - 28.9	11	3	27.3	10	90.9
29.0 - 32.9	2	1	50.0	5	250.0
TOTALS/MEAN	48	4	8.3	19	39.6
		THUNDER BAY			
< 17.0	19	0	0	8	42.1
17.0 - 20.9	51	1	2.0	19	37.3
21.0 - 24.9	49	5	10.2	38	77.6
25.0 - 28.9	31	8	25.8	42	135.5
29.0 - 32.9	10	6	60.0	27	270.0
TOTALS/MEAN	160	20	12.5	134	83.8

* Standard total length categories

** Includes healed wounds and superficial marks

The 111 lake trout from Batchawana Bay, for which there are complete records, show an incidence of wounding substantially lower than that recorded last year although the relative number of other marks reported this year remains essentially unchanged. Incomplete records provided on another 118 lake trout show no wounds but eight other marks. These results substantially reduce the tabled marking rates, so that for a total of 229 fish, the number of wounds per 100 fish is 1.3, while the number of other marks per 100 fish is 17.5. However, as individual lengths were not provided for this latter group of fish, they would not be listed by length range in the table.

The annual Batchawana Bay lake trout mini-derby, held on June 23, was monitored for lamprey activity. A total of 58 lake trout, ranging from 28 to 62 cm, with a mean of 46 cm, were sampled. Five wounds were observed on four fish for a count of 8.6 wounds per 100 fish. The number of 'other marks per 100 fish' was 12.1, and a single sighting of an attached (approximately 30 cm) lamprey was made.

Initial efforts for Michipicoten and Thunder Bays resulted in the submission of complete sea lamprey data for 48 and 160 lake trout, respectively. A further lake trout was taken from Thunder Bay but no length was provided. While wounding and other marking data are considerably higher in these two areas than in Batchawana Bay (especially so in Thunder Bay) the cooperator sample shows a greater percentage of larger fish taken in these areas (again, most pronounced in Thunder Bay). The marking information clearly demonstrates the positive correlation between fish length and incidence of wounds.

One of the Thunder Bay cooperators provided a few incidental records on lake trout caught in Pigeon Bay. A total of seven fish, ranging from 33 to 58 cm inclusive, were reported as being without wounds.

Actual sightings of attached lamprey were limited to six for Batchawana Bay (all from March, and all apparently small), and one questionable report from Thunder Bay.

LAKE HURON

Spawning Phase Investigations

In 1984 on Lake Huron 5,430 sea lamprey were collected by trapping. Figure 1 and Tables I and II provide locations, operational data and biological information, respectively.

The St. Marys River collection, despite the removal of a small portable trap from the operation, was substantially higher than for 1983 (a 50 per cent increase). U.S. operations in this same system rose only six per cent however. It is thought that, while an overall increase has indeed occurred, the increased Canadian catch is due in part to a greater mean flow in the power dam tailrace resulting from less down time on the generating turbines in spring 1984. A major concern has developed with respect to sex ratio interpretation because of the work in the St. Marys River. For the past two years (since Canadian collections have been large enough to be representative) the Canadian catches have contained 10 per cent more males than the U.S. collections. An effort in future to study this occurrence may contribute to a better understanding of the significance of sex ratio.

The Kaskawong River permanent dam trap caught 115 adults (down from 170 last year). It is difficult to explain this because this stream has not been treated since 1982 and evidence from surrounding waters suggests that a general increase in sea lamprey activity is occurring, unless the size of the run is influenced by the presence of a large beaver dam downstream of the trap site. This dam may not be active in future, since it was reported that several beaver carcasses were found this spring at the beaver impoundment.

Trapping on the Thessalon river was altered considerably this year with the installation of two rock cribs - one at the traditional site on Bridgeland Creek, and one at a former site located at the base of the Rydal Bank dam on the main stem - to create more stable trapping conditions. The present catch of 1,620 specimens is not comparable to earlier efforts, as the main stem trapping contributed so greatly to the total, and overall effectiveness was likely enhanced. Between-site comparison suggests that while the determined sex ratios were essentially the same, the specimens caught at the traditional site were on average five per cent longer and some 14 per cent heavier for both sexes. Further study is needed to determine whether this is a recurring phenomenon, and, if it is, whether it is significant.

Recent concerns that an upsurge in sea lamprey numbers is occurring in the northern main basin of Lake Huron led to a one year reinstatement of the trapping network along the south shore of Manitoulin Island. This action resulted in the capture of only 71 sea lamprey from three streams: Mindemoya Creek - 37, Manitou River - 1, and Blue Jay Creek - 33. While little historical information is available from the first for purposes of comparison, Manitou River was monitored at one time by an electrical barrier which took an average of 459 specimens annually in the late 1960's and which fell off to less than 10 annually through the early 1970's, until being discontinued after the 1975 season. Although these portable traps are probably less effective than the former electrical barrier observations of the limited spawning habitat of this stream also failed to locate any sea lamprey. The Blue Jay catch was marginal in comparison with previous collections from the mechanical weir, which had averaged 73 specimens per year between 1978 and 1981 inclusive. Further, the former electrical barrier operated from 1967 to 1977 yielded a mean annual catch of 552 specimens. Even after the lake-wide decrease in sea lamprey abundance, which commenced with the 1970 spawning run, the yearly average at the Blue Jay was 272 specimens. It does not appear that the 1984 spawning run on the south shore of Manitoulin Island supports the contention that parasitic phase abundance has increased in that area.

Ancillary information taken at the Blue Jay weir included sea lamprey marking rates on three fish species greater than 30 cm in length. For the 148 rainbow trout examined in this category, the incidence was 2 wounds/100 fish, for the 3,982 white suckers examined it was determined to be 0.3 wound/100 fish, and for 339 longnose suckers as 0.6 wound/100 fish.

Predatory Phase Investigations

Commercial Fisheries

Information from the Lake Huron commercial fisheries indicates that the abundance of sea lamprey has increased in the North Channel and northern main basin. As no precise form of "catch per unit effort" information is presently available, it is not possible to determine whether these catches are indicative

of a genuine upsurge in the population, but the agreement prevalent amongst the long term participants in the assessment program provides strong circumstantial evidence. Also, recent observations of greater lamprey activity by commercial fishermen operating in areas adjacent to the previously recognized problem area raises the possibility of another geographical expansion. Reports of this nature were received from the eastern end of the North Channel, and the northeast and central portions of the main basin. Conflicting, and as yet unresolved, communications have been received from southern Georgian Bay, although the weight of the evidence continues to favour low levels of activity. It is intended to step up the monitoring of these 'fringe' areas by increasing the numbers of participants in the commercial assessment network.

For calendar year 1984, the participating Lake Huron fishermen reported an incidental catch of 1,585 predatory phase sea lamprey. Approximately 95 per cent of these were taken from the North Channel and from that portion of the main basin in the St. Joseph-Cockburn Islands area and along the southwestern shore of Manitoulin Island.

Sport Fisheries

The only sport fishery-related activity conducted on Lake Huron (other than regular information communication with sport fishing associations, individuals, and representatives of the OMNR) was the monitoring of two annual fishing derbies held in the St. Marys River and principally targetted at the late summer-early fall run of chinook salmon. The Stroh Light King Salmon Derby (based out of Sault Ste. Marie, Michigan from August 18 to September 15) and the Can-Am Team Salmon Tournament (based out of Sault Ste. Marie, Ontario from September 7 to 9) provided a combined, examined catch of 593 chinook. Of these, 61 (approximately 10 per cent) were recorded as having sea lamprey attached, while 230 (39 per cent) were carrying one to five wounds, and 281 (47 per cent) were showing one to five scars.

LAKE ERIE

Predatory Phase Investigations

Commercial Fisheries

The collection of feeding phase sea lamprey was continued for calendar year 1984. As in every year since 1967, the offices of the Lake Erie Research and Assessment Units of the OMNR coordinated incoming specimens and catch records. While a small series of mysteries and misfortunes substantially reduced the numbers of specimens ultimately submitted by the fishery, nowhere in the commercial operations was there evidence of significant shifts in sea lamprey abundance. Only five sea lamprey specimens were acceptable for processing.

LAKE ONTARIO

Spawning Phase Investigations

Routine Spawning Phase Collections

Traps fished in seven tributaries captured a total of 2,177 spawning phase sea lamprey: Humber River - 1,366; Don River - 0; Duffin Creek - 520; Bowmanville Creek - 242; Wilmot Creek - 9; Graham Creek - 26; and Shelter Valley Brook - 14 (Figure 1, Table I).

Major decreases in catch occurred in two of the four tributaries that had been sampled in 1983. The Humber River catch fell off by approximately 70 per cent, and since this collecting site is one of the most stable on Lake Ontario, and interpretation of the catch is not affected by a TFM treatment regime, then the decrease is thought to be real (at least for that sector of the lake). While the Wilmot Creek catch fell off dramatically, there is reason to suspect that high continuous water levels over the entire duration of the trapping season significantly reduced trapping effectiveness. This idea was reinforced by the sighting of numbers of spent or spawning lamprey. Nonetheless the capture of only nine specimens this year implies some degree of reduction in the run. A TFM treatment carried out in October of 1983 may also have negatively affected the Wilmot Creek run.

In Bowmanville Creek, last treated in May of 1983, the size of the run significantly increased this year. The much reduced incidence of vandalism in 1984 likely contributed to these improved numbers and the catch is therefore considered to be more representative of the run. As the collection size is consistent with normal limits established by previous years of trapping, the increase is not seen as having much significance. On Shelter Valley Brook, a number of operational problems resulted in a shuffle of trap sites, lost trapping time, and a great reduction in effectiveness. High waters were also responsible in part for inhibiting operations, and a TFM treatment carried out during June 16 to 18 could have interfered with the trailing end of the run. However the treatment also afforded an excellent survey for adults in the stream. The sighting of only 66 adults is construed as indicative of the overall size of the run.

The Graham Creek barrier dam was in place in advance of the spawning season, offering a new trapping opportunity through the associated dam trap. However, flood waters inundated a bypassing channel around one end thereby eliminating the barrier's effectiveness for the period late April to May 9, when the problem was resolved. The trap functioned as a partial weir during this critical period, with the face of the dam serving as a trap lead. Thus, the season's catch of 29 specimens cannot be compared with past mechanical weir operations.

The Don River trapping was conducted on a trial basis and was abandoned when vandalism became excessive and the critical period of operation passed without the capture of a single sea lamprey.

Spawning Phase Tag/Recapture Study - Oswego River

A special investigation was conducted on the Oswego River system in conjunction with the Oneida Lake treatment program, in order to study the upstream movement of spawning phase sea lamprey within the system. A joint trapping operation was set up between Department of Fisheries (DFO) and the New York Department of Environmental Conservation (NYDEC), commencing with a trap site at the lowermost dam on the Oswego River (a main stem tributary), one in the Oneida River, one in Big Bay Creek, four in Fish Creek, and one in Carpenter Brook (a Seneca River tributary), with the Cayuga Lake Inlet fishway being considered a final site (Figure 3).

The traps located at the lowermost site were intended to collect the specimens initially required for tagging purposes and provide a basic appreciation of the size of the natural run for 1984 that attained at least the first dam. There were major concerns that the catch taken at the site would be inadequate to meet minimal needs, so that the release was augmented by 556 specimens taken from the Canadian trapping network and transported (in three separate trips) to the mouth of the Oswego River. The lowermost set of traps added 51 to this count, for a total introduction of 617 tagged specimens to the mouth of the system. The marked used was a V-notch clip to either the front or rear dorsal fin.

The trapping network in the system upstream of the first dam yielded one specimen from Carpenter Brook and 1,605 from Cayuga Lake Inlet, none of which were recognized as having been marked. Manual collections made during the three stream treatments to Oneida Lake tributaries provided two specimens from Big Bay Creek, none from Scriba Creek, and 22 from Fish Creek. An incidental catch made by hand from Carpenter Brook added another three specimens to this count of 24. Again, none showed any sign of marks, so that no upstream movement was demonstrated.

However, recaptures were made at the lowest trapping site, consisting of three specimens from those initially captured from these traps - which were subsequently marked and released back to the Oswego River, and 20 from the Canadian supplementary releases. Further, it would appear that significant numbers (if not all) of the marked specimens eventually returned to Lake Ontario, as evidenced from reports of recaptures of V-notch clipped sea lamprey at a few diverse trapping sites in the Lake Ontario network (two from Sterling Creek and one from Grindstone Creek in New York State, and one each from the Humber River and Duffin Creek in Ontario).

Predatory Phase Investigations

Commercial Fisheries Collections

No parasitic phase sea lamprey were submitted from the commercial fisheries of Lake Ontario. A survey of several of the principal operators in the Canadian waters revealed that the only fisheries observing more than five sightings annually operate in the main lake, from the southwestern tip of Prince Edward County to the outflow of the lake, and outward from shore to the International Boundary. Incidental catches of lake trout are more common in this area, likely accounting for this situation.

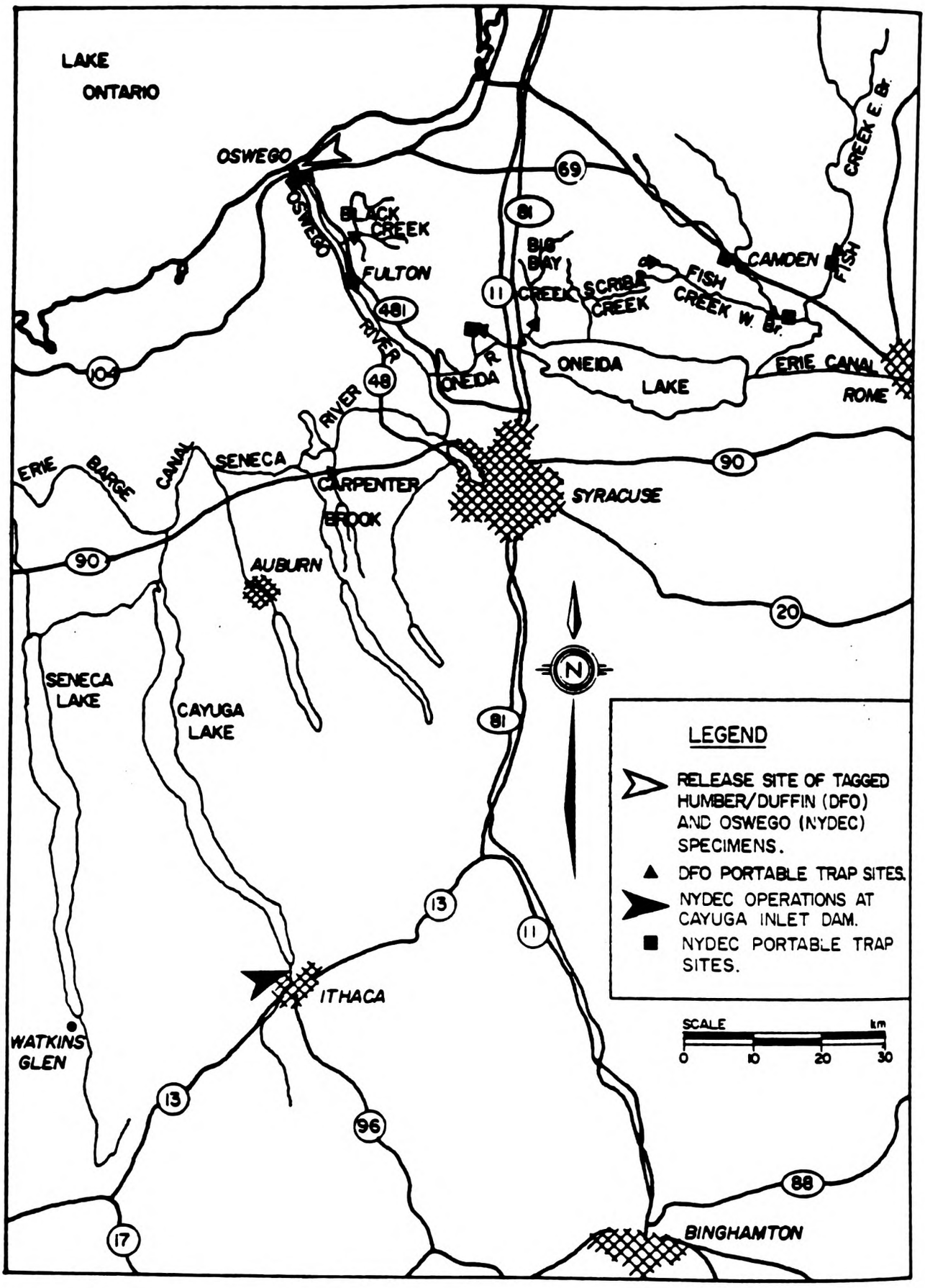


Figure 3. A map of the Oswego/Oneida/Seneca River waterway of New York State, showing release and trapping sites utilized in the Oneida River system spawning phase mark-recapture study, 1984.

A Transformer Tag/Recapture Study - Fish Creek, New York

In two consecutive years, transforming sea lamprey from Fish Creek and Big Bay Creek (tributaries to Oneida Lake, New York) were tagged, using coloured latex dyes injected into the dorsal fin, and released back to the stream of origin. This study was intended to demonstrate the possibility of parasitic phase sea lamprey from this heavily infested system migrating to Lake Ontario. Attempts to monitor the September 1982 release of 1,588 tagged specimens included: the inspection of 107 parasitic phase specimens submitted during spring 1983 from the Empire State Lake Ontario Derby (ESLO), St. Catharines Game and Fish Association Salmon Derby, and Oswego County (New York) Derby, another 18 from miscellaneous New York sport fishery and assessment sources, and one from the Canadian commercial fishery; and the 1984 spawning phase operations which handled 2,177 specimens from the DFO index network, 602 from the U. S. Fish and Wildlife Service (USFWS) index network, 52 from the NYDEC trapping effort on the Oswego River, 1,605 from the NYDEC Cayuga Lake Inlet fishway, and 28 from the adult tag/recapture study conducted on the Oswego River system. No marks were found. If these transformers follow the normally accepted time frame for the parasitic life stage, then none should have survived beyond the 1984 spawning run.

The August 1983 release of 1,528 tagged transformers was monitored in 1984 through two fishing derbies (the ESLO and St. Catharines) from which 155 parasitic phase specimens were obtained (144 and 11, respectively). In addition, the Shackleton Point Research Station, Cornell University, collected some 60 to 70 parasitic phase specimens from Oneida Lake by capturing sea lamprey attaching to the transom of a boat (during a deliberate series of runs conducted in early summer). To date none of the dye-tagged transformers have been found. The lamprey tagged in the late summer of 1983 will return to spawn in the spring of 1985; the sampling program will be continued at that time.

LARVAL SEA LAMPREY ASSESSMENT

LAKE SUPERIOR

Larval surveys were conducted on 28 streams tributary to Lake Superior during the 1984 field season. Table IV summarizes larval survey results, while Appendix 4 includes the total amount of lampricide used during the course of those surveys.

During 1983, 10 streams were treated with TFM. Consistent with an accelerated treatment program on Batchawana Bay tributaries, the Chippewa and Batchawana Rivers were treated again in 1984, eliminating the need to conduct surveys to assess the effectiveness of the 1983 treatments on those streams. The remaining eight streams were surveyed. While significant escapement is apparent in the Steel River (refer 1983 Annual Report), and minor escapement is evidenced on Little Carp River, the TFM treatments of the lower Nipigon (downstream of Lake Helen), Black Sturgeon and Kaministikwia Rivers and of Cash, Polly and Stillwater Creeks were apparently very successful, based on survey findings.

Surveys to note reestablished sea lamprey populations in known sea lamprey producing streams, were conducted simultaneously with treatment evaluation surveys on the 1983 treated streams. Streams treated prior to 1983 were also surveyed for reestablishment. Reestablished larval populations were found in Little Carp River and Cash and Polly Creeks, each treated in 1983, while reestablishment has not been confirmed in the lower Nipigon, Black Sturgeon, and Kaministikwia Rivers and Stillwater Creek, each treated in 1983. With the exception of Stillwater Creek, each of the 1983 treated streams not containing reestablished larvae, had been treated in July or August, the timing of which may have effectively eliminated or significantly reduced the numbers of larvae of a 1983 hatch.

East Davignon Creek and Neebing River, last treated in 1972, the White, Little Gravel and McIntyre Rivers, last treated in 1978, 1982 and 1960 respectively, were also surveyed to detect the occurrence of reestablished larval sea lamprey populations. Results indicate that while reestablishment has not occurred in East Davignon Creek or Neebing River, larval sea lamprey are once again present in the White, Little Gravel and McIntyre Rivers. Most significant was the confirmation of a larval population in the McIntyre River, located in the City of Thunder Bay, after an absence of more than 20 years. While the majority of larval sea lamprey collected are progeny of a successful 1983 hatch, there are representatives of earlier hatches. The diversion of the adjacent Neebing River and the McIntyre River through a common mouth as a flood control measure may have encouraged an increased use of the McIntyre River by spawning phase sea lamprey.

Surveys to assess the relative abundance and mean larval size of known populations of sea lamprey in given streams were conducted on West Davignon, Cranberry and Stokely Creeks, and Big Carp, Carp (previously referred to as Sable), Pancake, Michipicoten, Little Pic, Prairie, Gravel, Cypress, Nipigon (upstream of Lake Helen), Pearl, and Pigeon Rivers. Distributional limits of sea lamprey larvae in those streams identified as potential 1985 treatment candidates were established as required. Similar surveys were conducted on the Goulais River in preparation for the 1985 treatment.

Table IV. Summary of larval lamprey collections from surveys of streams tributary to Lake Superior, 1984.

STREAM		Month(s) of Survey	Date of most recent treatment preceding Survey	NUMBER LAMPREY LARVAE COLLECTED																			
				SEA LAMPREY																		NATIVE LAMPREY	
							Lamprey in 5 mm increments (upper class limit)														TOTAL	Ich.	
No.	Name			Range (mm)	0-51 (mm)	51-101 (mm)	106	111	116	121	126	131	136	141	146	151	156	161	166	171+	LARVAE	spp.	L.a.
S-1	East Davignon Cr.	Aug.	1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	5,100
S-2	West Davignon Cr.	Aug.	June 3-4/81	66-136	0	75	10	1	3	1	2	0	2	-	-	-	-	-	-	-	94	0	389
S-4	Little Carp R.	Aug.	June 7-8/83	21-86	18	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	0	96
S-5	Big Carp R.	Aug.	June 17-18/81	56-116	0	85	7	4	2	-	-	-	-	-	-	-	-	-	-	-	98	0	1,087
S-23	Cranberry Cr.	Aug.	1979	141-146	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0	0
S-24	Goulais R.:																						
	- Perry Cr.	Oct.	Sept. 24/84	36-41	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0
	- Whitman Cr.	Sept.	June 14-19/82	71-91	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0	0
	- Dam Cr.	Sept.	June 14-19/82	36-56	20	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	0	0
	- Bellevue Cr.	Aug.	June 14-19/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	45
	- Sheppard Cr.	Aug.	Aug. 12-15/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	42
	- Robertson Cr.	Sept.	Aug. 12-15/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	11
	- lagoons	Sept.	Aug. 12-15/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
S-36	Stokley Cr.	July	June 25-26/80	71-126	0	24	2	-	-	-	1	-	-	-	-	-	-	-	-	-	27	0	582
S-54	Carp R.	Aug.	Aug. 9-12/82	26-96	41	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	0	399
S-56	Pancake R.	Aug.	July 8-9/81	26-101	69	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138	0	78
S-138	Old Woman R.	Aug.	n.a.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
S-167	Michipicoten R.	Aug.	Aug.21-22/82	41-106	2	31	1	-	-	-	-	-	-	-	-	-	-	-	-	-	34	0	0
S-301	White R.	July	Sept./78	56-121	-	22	4	-	1	1	-	-	-	-	-	-	-	-	-	-	28	0	0
S-322	Little Pic R.	July	Aug. 22-28/81	51-176	-	10	-	-	-	-	-	-	-	-	-	1	-	-	-	1	12	0	0
S-327	Prairie R.	July	1972	91-106	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	3	434	0
S-335	Steel R.	July	Aug.16-19/83	21-161	266	26	2	2	2	1	3	4	3	6	3	3	-	1	-	-	322	0	0
S-368	Gravel R.	July	July 19/82	26-116	141	17	1	-	1	-	-	-	-	-	-	-	-	-	-	-	160	18	0
S-369	Little Gravel R.	July	July 14-15/82	26-76	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0	0
	" " "	Aug.	" "	26-76	23	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	0	0
S-374	Cypress R.	Aug.	July 17-18/82	47-111	3	63	-	1	-	-	-	-	-	-	-	-	-	-	-	-	67	0	0

S-392	Nipigon R.:																						
	- above Lake Helen	July	July 2-3/81	16-86	60	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70	0	0
	- above Lake Helen	Aug.	" "	21-106	83	29	1	-	-	-	-	-	-	-	-	-	-	-	-	-	114	0	0
	- below Lake Helen	Aug.	July 10-11/83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
S-410	Cash Cr.	Aug.	June 18-21/83	26-41	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0	0
S-414	Polly Cr.	Aug.	June 15-16/83	6-41	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0	0
S-455	Stillwater Cr.	Aug.	June 12-13/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
S-509	Black Sturgeon R.	Aug.	Aug. 24-29/83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
S-528	Pearl R.	July	July 15-16/82	31-71	28	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	1	0
S-570	McIntyre R.	July	1964	31-146	284	66	4	2	1	1	1	3	1	1	1	-	-	-	-	-	365	17	-
	"	Aug.	1964	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
S-571	Neebing R.	July	1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	41	227
S-572	Kaministikwia R.	July	Aug. 19-23/83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
S-592	Pigeon R.	July	July 6-7/81	36-116	3	72	2	1	1	-	-	-	-	-	-	-	-	-	-	-	79	-	-

Old Woman River, a stream not identified as a sea lamprey producer, was included in the 1984 survey schedule. Abundant spawning substrate and adequate larval habitat continue to make the stream a potential sea lamprey producer.

To check the effectiveness of barrier dams located on Stokely Creek, Carp River and Gimlet Creek, a tributary to the Pancake River, surveys were conducted in 1984. Since no larval sea lamprey were collected upstream of the Gimlet Creek dam and only larger (residual) sea lamprey larvae were taken from above the Stokely Creek dam, each appear to be stopping spawning run sea lamprey. However smaller larvae (26 to 31 mm in length) were taken from above the Carp River dam which was completed in December 1983. Spawning phase sea lamprey have been found in Lake Superior streams well into the summer on occasion and it may well be that the smaller larvae collected from the Carp River are progeny of a late 1983 spawning.

LAKE HURON

A total of thirty-one streams tributary to the Lake Huron basin were surveyed in 1984. With the exception of three small tributaries flowing into Wolsey Lake, Manitoulin Island, all have previous documentation of sea lamprey production. Table V includes pertinent information resulting from these surveys while Appendix 4 records the amount of lampricide used when conducting surveys on Lake Huron streams, 1984. A summary of surveys conducted on the St. Marys River by the Special Studies Unit appears on page 95 of this report.

Treatment evaluation surveys conducted on the Mississagi and Still Rivers, treated in 1983, and the Thessalon River, treated in 1984, indicate relatively minor escapement occurred in the Thessalon and Mississagi Rivers. Thermal stratification in the mouth area of the Thessalon River prevented the lethal block of TFM from contacting larvae in the deeper water, while lake dilution reduced the TFM block to sublethal concentrations in the most westerly mouth channel of the Mississagi River.

Surveys to determine if sea lamprey became reestablished following the lampricide treatment were conducted on fourteen tributaries. Reestablished populations of sea lamprey have been confirmed in the following streams; the year of the most recent treatment preceding the surveys is included in brackets: Echo River (1983), Mississagi River (1983) and the Manitou River (1982). The remaining streams, Two Tree Creek (1982), Silver Lake Creek (1981), Kaboni Creek (1978), Still River (1983), Boyne River (1976), Hog Creek (1978), Nottawasaga River (1976), Pretty River (1972), Silver Creek (1982), Telfer Creek (1979), and the Bayfield River (1972) have to date not been confirmed as producing larvae since their most recent treatment. As noted in the 1983 annual report, there continues to be a significant reduction in the number of streams used by sea lamprey in southern Georgian Bay when compared to the number of producing streams in the 1960's and early 1970's of the same area.

Surveys required for scheduling lampricide treatments were conducted on Richardson and Blue Jay Creeks and the Kaskawong, Serpent, Spanish, Mindemoya, Wanapitei (tributary to the French River), Sturgeon, Sauble and Saugeen Rivers. Based on surveys done in 1984 and earlier, some of these streams were candidates for 1985 treatments, and upon these streams, distribution surveys were also performed. Distribution work was also conducted on the Garden and Thessalon Rivers and Brown Creek, in preparation for a 1984 treatment.

Barrier dams have been installed to stop the upstream spawning migration of sea lamprey on the Echo, Kaskawong, Sturgeon and Saugeen Rivers. With the exception of the Echo River dam, the structures appear to have performed as designed. In the spring of 1983 a washout at the Echo River dam site allowed at least a portion of the 1983 spawning run to move upstream past the structure into the upper river section, as evidenced by the 1983 year class of larval sea lamprey collected during surveys.

The Spanish River was surveyed in 1984 in an effort to show whether changes in the larval population have resulted from a 1983 chemical spill from the paper mill located on the river in the town of Espanola. An attempt was made to duplicate the 1980 survey effort in the 1984 surveys. Results indicate that fewer larvae are in the river and that they are generally smaller in size compared to larvae collected in 1980. The Aux Sables River, a tributary to the Spanish River, acts as a continuous recruitment source of sea lamprey larvae to the main river and appears to be the major source of larval lamprey collected from the main river, downstream of its confluence with the Aux Sables. The Aux Sables River was not affected by the 1983 chemical spill.

LAKE ERIE

Survey work on Lake Erie tributaries completed in the 1950's and 1960's identified Big, Big Otter, Catfish, Potters and Youngs Creeks and the Grand River as sea lamprey producers. Further larval assessment work on these tributaries was scheduled to begin in 1984 and extend through 1985 in preparation for the tentatively scheduled 1986 treatment program. While the time frame for Lake Erie treatments remained in question, surveys were conducted on the Grand River, which being a large and potentially complex system, would demand a considerable survey effort to define the extent of its sea lamprey population. The numerical data originating from completed surveys is included in Table VI; amount of lampricide used to complete 1984 surveys on the Grand River system is recorded in Appendix 4.

Initial surveys in May 1984, were conducted on Whiteman Creek, the Grand River tributary from which sea lamprey larvae were first taken in 1964. No sea lamprey larvae were taken from the tributary in May although 173 American Brook lamprey were collected. Additional surveys, conducted in the main Grand River downstream of Whiteman Creek, resulted in the collection of only *Ichthyomyzon* spp. and American brook lamprey larvae.

Granular Bayer 73 surveys were completed for the first time on the Grand River system in September 1984. While only six plots were surveyed in 1984 they included the distance from the Town of Dunnville upstream almost to the City of Brantford. Despite the small total area sampled, the results suggest there is not a large population of sea lamprey larvae in the river, and if larvae do exist, they are apparently localized and in relatively low numbers.

Considering that Adult Assessment personnel collected spawning phase sea lamprey at the Dunnville dam site and upstream at the Caledonia dam in 1981, and that Ontario Ministry of Natural Resources personnel reported sighting spawning phase sea lamprey at Brantford's Lorne dam in the mid-1970's; the 1984 survey results seem inconsistent with opinions, based on the abundance of spawning sea lamprey. Either successful spawning, hatching and survival of larvae is not being realized or survey efforts to date have simply failed to identify areas of larval infestation in the large river system.

Table V. Summary of larval lamprey collections from surveys of streams tributary to Lake Huron, 1984.

STREAM		Month(s) of Survey	Date of most recent treatment preceding Survey	NUMBER LAMPREY LARVAE COLLECTED																			
				SEA LAMPREY																		NATIVE LAMPREY	
							Lamprey in 5mm increments (upper class limit)														TOTAL LARVAE	Ich. spp.	L.a.
No.	Name			Range (mm)	0-51 (mm)	51-101 (mm)	106	111	116	121	126	131	136	141	146	151	156	161	166	171+			
H-5	St. Marys R.	July-Oct	Annual GBTS treatments	16-171	241	24	21	11	18 1t	9	9 1t	9	12	6 2t	9 3t	8 6t	7 4	6 6t	2 2t	1	617 25t	1,356	4
H-4	Garden R.	June	July 20-21/81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-10	Echo R.																						
	- above dam	Aug.	1980	26-61	484	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	492	0	13
H-50	Two Tree R.	Aug.	May 31/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-51	Richardson Cr.	Sept.	1974	16-146	24	46	1	-	1	-	-	-	1	-	1 1t	-	-	-	-	-	74 1t	0	26
	"	Oct.	1974	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-59	Brown Cr.	May	June 17-18/80	11-131	7	43	7	4	3	2	3	1	-	-	-	-	-	-	-	-	70	0	29
H-62	Kaskawong R.	Aug.	June 7-11/82	11-106	49	18	2	-	-	-	-	-	-	-	-	-	-	-	-	-	119	0	0
H-88	Thessalon R.	June	Sept. 17-19/79	41-161	1	7	-	-	-	1	3	1	4	2	1	-	3	1	-	-	24	0	1
	"	Aug.	June 19-22/84	46-166	1	9	1	-	-	-	-	-	1	1	-	-	1	-	1	-	15	0	0
H-102	Mississagi R.	Aug.	Aug. 5-8/83	11-116	4	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	6	0	0
H-116	Serpent R.	July	June 24-25/81	36-141	21	71	3	4	1	-	1	2	1	2	-	-	-	-	-	-	106	0	0
	"	Aug.	"	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-134	Spanish R.:	July	1972																				
	-above Aux Sable R	"	"	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
	-Aux Sable R.	"	July 1978	26-126	45	15	2	-	-	-	1	-	-	-	-	-	-	-	-	-	63	10	0
	-below Aux Sable R	"	1972	26-81	172	44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	216	34	0
	-LaCloche Cr.	"	1972	41-96	1	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	1	0
	-Gough Cr.	"	1972	36-91	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	90	0
	-below Aux Sable R	Aug.	1972	16-71	126	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	0	0
	-Aux Sable R.	"	July 1978	26-116	46	30	-	-	1	-	-	-	-	-	-	-	-	-	-	-	77	69	0
H-266	No Name	June	n.a.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-269	No Name	June	n.a.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-270	No Name	June	n.a.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-272	Silver Lake Cr.	Aug.	May 28-29/81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-305	Mindemoya R.	June	May 30-31/81	26-121	39	60	4	1	5	1	-	-	-	-	-	-	-	-	-	-	148	0	0
	"	Aug.	" "	11-101	39	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	1	0
H-313	Manitou R.	June	June 10-11/82	41-81	4	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	0	0

H-314	Blue Jay Cr.	June	June	9-10/82	36-81	4	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	0	0
	"	Aug.	"	"	36-101	39	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	0	0
H-331	Kaboni Cr.	Aug.		1978	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-606	French R.:																							
	-Wanapitei R.	July	Aug.	16-18/78	46-126	1	19	1	-	-	-	1	-	-	-	-	-	-	-	-	-	21	31	0
H-726	Still R.	June	June	3-5/83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-1053	Boyne R.	June		1976	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-1343	Sturgeon R.	May		1979	51-136	-	30	2	-	1	-	-	-	1	-	-	-	-	-	-	-	-	34	26	0
H-1345	Hog Cr.	May		1978	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	15	0
H-1360	Nottawasaga R.:																							
	- Mad R.	May		1976	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	82	0
H-1369	Pretty R.	May		1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-1376	Silver Cr.	May	Sept.	23-24/82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-1421	Telfer Cr.	May		1979	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
H-1477	Sauble R.	June		1979	51-161	-	65	4	2	1	1	3	3	2	-	1	-	1	1	-	-	84	356	0
H-1492	Saugeen R.	June		1971	81-96	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	23	0
H-1681	Bayfield R.	June		1970	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	47	0

N^{xt} = number of transforming larvae included in the total

Table VI. Summary of larval lamprey collections from surveys of the Grand River, Lake Erie, 1984.

STREAM		Month(s) of Survey	Date of most recent treatment preceding Survey	NUMBER LAMPREY LARVAE COLLECTED																			
				SEA LAMPREY																		NATIVE LAMPREY	
							Lamprey in 5mm increments (upper class limit)														TOTAL LARVAE		
No.	Name			Range (mm)	0-51 (mm)	51-101 (mm)	106	111	116	121	126	131	136	141	146	151	156	161	166	171+		Ich. spp.	L.a.
E-149	Grand R.	May-Sept.	n.a.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	9	111
	-Whiteman Cr.	May	n.a.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	173

LAKE ONTARIO, CANADA

Twenty-one of the 27 documented sea lamprey producing streams tributary to the Canadian side of Lake Ontario were surveyed between late April and September, 1984. Table VII summarizes the numerical information collected during surveys, and Appendix 4 includes the total amount of lampricide used by survey personnel during the survey period.

Treatment evaluation surveys were conducted on the six streams treated in 1983. While survey collections indicate that no escapement occurred in Bowmanville and Cobourg Brooks and Mayhew Creek, apparently minor escapement did occur in the Rouge River and Wilmot Creek. Residual sea lamprey were also collected from the estuary area of Graham Creek, where thermal stratification prevented a lethal TFM block from penetrating the deeper water of the area during the 1983 treatment.

With the exception of the Rouge River and Mayhew Creek, the remaining streams treated in 1983 have once again been reinfested with sea lamprey. Surveys were conducted on the Rouge River at a time when, even had there been a successful 1984 hatch, larvae would probably not have been collected. Surveys conducted on Mayhew Creek however were done at a time which should have permitted the collection of representatives of a successful 1983 or 1984 hatch. Considering streams treated earlier than 1983, Oakville Creek treated in 1982 was reestablished as a producing stream once again with the collection of three larvae, whereas Carruthers Creek, treated in 1976, has to date not been reestablished as a sea lamprey producer.

Seventeen streams were surveyed to provide pertinent data for scheduling lampricide treatments. Surveys to define patterns of sea lamprey larvae distribution were conducted on those streams identified as possible candidates for 1985 treatments based on current and previous survey findings. The streams surveyed were; Ancaster, Bronte, Duffin, Farewell, Port Britain, Grafton, Shelter Valley, Lakeport, Salem, Proctor, and Smithfield Creeks and Cobourg Brook.

Surveys conducted well upstream in Graham Creek, confirm that the newly constructed barrier dam, completed in May 1984, failed to stop the 1984 spawning run of adult lamprey. However, surveys conducted upstream of the existing Duffin Creek barrier dam resulted in the collection of only large sea lamprey larvae, residuals of the last TFM treatment. Evidence provided by larval surveys suggest that since its construction in 1980, the barrier dam built on this stream has effectively blocked the adult sea lamprey spawning runs. Spawning does occur however downstream of the barrier dam site as evidenced by larval assessment survey results.

Surveys were conducted upstream of the barrier dam on the Credit River, in response to the sighting of an adult sea lamprey reported (1983) to this Centre by the Credit River Conservation Authority. A substantial population of larval sea lamprey was confirmed. Using larval length as an indicator of age, almost all the individuals collected appear to be representatives of the 1983 year class. Four of the larvae collected may be representatives of an earlier year class while one larva may belong to the 1984 year class. A 1983 washout at one end of the barrier dam structure located on a flood control channel and the poor state of repair of the structure prior to 1983 provide a plausible explanation for the increased distributional range of sea lamprey larvae in the Credit River.

Granular Bayer surveys conducted off the mouth of Mayhew Creek in the adjacent waters of the Trent-Severn Waterway system resulted in the collection of larvae, some of which were transformers. A record of sea lamprey larvae in the same area had been documented in previous years; however it is not known whether the larvae were spawned in the Trent-Severn Waterway or in its tributary, Mayhew Creek.

LAKE ONTARIO - UNITED STATES

Surveys were conducted on six of the 26 streams tributary to the New York State side of Lake Ontario known to produce sea lamprey.

Each of the streams surveyed, except for Little Salmon River and Red Creek, had been treated in the spring of 1982 and each was reestablished as a sea lamprey producer in 1983 based on survey findings. The Little Salmon River system had been treated in the fall of 1982 and was not confirmed as a producer of sea lamprey again until this year. Residual sea lamprey larvae collected from a small tributary to the Little Salmon River somewhat bias the numerical summary included in Table VIII, in that of the 170 sea lamprey larvae collected, 157 measured less than 76 mm in length. Red Creek had not been treated prior to 1984.

No lampricide was used in conducting these 1984 surveys.

Table VII. Summary of larval lamprey collected from streams tributary to the Canadian side of Lake Ontario, 1984.

STREAM No.	STREAM Name	Month(s) of Survey	Date of most recent treatment preceding Survey	NUMBER LAMPREY LARVAE COLLECTED																		
				SEA LAMPREY																	NATIVE LAMPREY	
							Lamprey in 5mm increments (upper class limit)														TOTAL LARVAE	Ich. spp.	L.a.
				Range (mm)	0-51 (mm)	51-101 (mm)	106	111	116	121	126	131	136	141	146	151	156	161	166	171+			
H-60	Ancaster Cr.	Sept.	Apr.29-30/77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
O-76	Bronte Cr.	May	Sept.19-22/82	26-171	140	69	-	-	-	-	1	-	1	-	-	-	-	1	-	1	213	0	0
	"	Sept.	" "	16-131	32	92	1	-	-	-	-	1	-	-	-	-	-	-	-	-	126	0	0
O-79	Oakville Cr.	May	June 3-6/82	101-106	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	0
O-92	Credit R.	May	May 12-13/80	41-156	19	81	4	1	2	1	-	-	-	1	3	2	1	-	-	-	115	0	0
	"	Sept.	" "	26-146	1	96	15	4	3	-	-	-	2	1	1	-	-	-	-	-	123	0	0
O-110	Rouge R.	May	Oct.25-27/83	41-46	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0
O-117	Duffin Cr.	May	Sept.21-23/80	41-156	2	4	-	-	-	1	-	-	-	-	1	-	1	-	-	-	9	0	30
	"	Sept.	" "	16-146	66	18	-	1	-	-	-	-	-	-	1	-	-	-	-	-	86	0	0
O-120	Carruther's Cr.	Sept.	Sept.17-22/76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
O-125	Farewell Cr.	May	May 1-2/81	26-161	85	20	5	-	1	-	-	1	1	1	-	1	-	1	-	-	116	0	45
		Sept.	" "	66-131	-	31	2	1	-	-	-	1	-	-	-	-	-	-	-	-	35	0	3
O-131	Bowmanville Cr.	May	May 6-7/83	26-66	73	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	0	28
	"	Sept.	" "	11-111	161	66	-	1	-	-	-	-	-	-	-	-	-	-	-	-	228	0	8
O-132	Wilmot Cr.	April	Oct.20-22/83	61-71	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0	9
	"	Sept.	" "	16-36	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	0	0
O-133	Graham Cr.	April	June 12-13/83	26-51	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	0	0
	"	May	" "	21-56	103	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	104	0	0
	"	Sept.	" "	16-141	118	519	2	2	1	2	1	-	-	1	-	-	-	-	-	-	647	0	0
O-141	Port Britain Cr.	April	May 14-15/82	16-121	62	41	3	-	1	1	-	-	-	-	-	-	-	-	-	-	108	0	0
	"	Sept.	" "	16-141	29	77	3	-	2	3	1	-	2	1	-	-	-	-	-	-	118	0	4
O-148	Cobourg Br.	May	June 8-9/83	46-51	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	102
	"	Sept.	" "	16-81	9	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	0	6
O-154	Grafton Cr.	April	May 6-7/82	21-66	13	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	0	30
	"	Sept.	" "	11-101	101	99	1	-	1	-	-	-	-	-	-	-	-	-	-	-	202	0	15
O-157	Shelter Valley Br.	April	Sept.16-18/82	21-71	84	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115	0	62

O-161	Lakeport Cr.	April	May 10-11/82	21-101	45	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117	0	22
	"	Sept.	" "	11-116	46	102	3	1	1	-	-	-	-	-	-	-	-	-	-	-	153	0	36
O-163	Salem Cr.	April	May 17/82	26-116	48	142	3	3	1	-	-	-	-	-	-	-	-	-	-	-	197	0	86
	"	Sept.	" "	16-121	30	112	1	1	1	1	-	-	-	-	-	-	-	-	-	-	146	0	0
O-166	Proctor Cr.	April	June 4-5/81	26-176	49	40	5	7	7	11	13	11	9	6	2	4	-	-	-	1	165	0	0
O-168	Smithfield Cr.	April	May 12/82	21-101	12	129	-	-	-	-	-	-	-	-	-	-	-	-	-	-	141	0	0
	"	Sept.	" "	11-121	11	38	11	7	3	3	-	-	-	-	-	-	-	-	-	-	73	0	0
O-230	Mayhew Cr.	Apr-Sept	June 10/83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
O-230	Trent R.	Sept.	June 10/83	21-161	3	68	15	13	13	7	5	8^{1t}	7^{2t}	6^{1t}	11	8^{3t}	4	1	-	-	169^{7t}	0	0

N^{xt} = number of transforming larvae included in the total

Table VIII. Summary of larval lamprey collections from surveys of streams tribuary to Lake Ontario, United States, 1984.

STREAM		Month(s) of Survey	Date of most recent treatment preceding Survey	NUMBER LAMPREY LARVAE COLLECTED																		
				SEA LAMPREY																	NATIVE LAMPREY	
							Lamprey in 5mm increments (upper class limit)														TOTAL LARVAE	Ich. spp.	L.a.
No.	Name			Range (mm)	0-51 (mm)	51-101 (mm)	106	111	116	121	126	131	136	141	146	151	156	161	166	171+			
NY050	Little Sandy Cr.	June	May 11-13/82	36-131	46	123	2	5	1	-	1	1	-	-	-	-	-	-	-	-	179	-	-
NY054	Grindstone Cr.	June	Apr.29-May 1 1982	21-106	124	164	1	-	-	-	-	-	-	-	-	-	-	-	-	-	289	-	-
NY058	Little Salmon R.	June	Sept.9-14/82	36-161	48	110	3	3	1	1	1	1	1	-	-	-	-	1	-	-	170	-	-
NY071	Ninemile Cr.	June	May 6-10/82	31-111	39	109	-	2	-	-	-	-	-	-	-	-	-	-	-	-	150	-	-
NY073	Sterling Cr.	June	May 10-11/82	36-131	11	108	4	3	-	1	-	1	-	-	-	-	-	-	-	-	128	-	-
NY078	Red Cr.	May	n.a.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

LAMPRICIDE TREATMENTS

LAKE SUPERIOR LAMPRICIDE (TFM) TREATMENTS

The following eight streams tributary to Lake Superior were treated with the selective lampricide 3-trifluoromethyl-4-nitrophenol (TFM) in 1984:

Pays Plat River	- July 7- 8	Agawa River	- August 14
Jackfish River	- July 11-12	Batchawana River	- August 28-30
Wolf River	- July 13-15	Chippewa River	- August 29-30
Goulais River	- August 7 & October 18	Pic River	- September 6-14

In addition to the TFM treatments, a granularized formulation of Bayer 73 was applied to portions of Batchawana Bay. Only four tributaries to the Goulais River were successfully treated with lampricide in 1984; treatment of the main river and the remaining tributaries were postponed to 1985 because of consistently high flows in the fall of the year.

Table IX lists the pertinent treatment data, while Figure 4 shows the approximate location of the streams treated, and Figures 5 to 12 illustrate pertinent details of the treatments.

The following are brief descriptions of the streams and accounts of the lampricide treatments. The sea lamprey larval abundance ratings, although subjective in that they are not based on a standardized unit of effort, are realistic in that they take into account such pertinent factors as: stream distance treated, degree of collecting difficulty, observations of larval sea lamprey density in non-collection areas, and the number of larvae actually collected. The stream treatment dates include the time from the first lampricide application to the time of the last water sample taken for TFM analysis from the stream.

Terms, abbreviations and symbols used are explained in Appendix 6 to this Annual Report.

Pays Plat River - Figure 5

The Pays Plat River is located in the District of Thunder Bay, approximately 6 km west of the village of Rossport. It is a moderately large stream (average summer flows 2 m^3/s) with one major tributary, West Fox Creek, which joins the main river 7.2 km above the mouth. The Pays Plat River system drains several lakes and flows through uninhabited bushland with very little access. A natural barrier occurs below Pays Plat Lake about 12 km above Lake Superior and a 15 m fall occurs on West Fox Creek 3.2 km above its confluence with the Pays Plat River. Abundant spawning gravel and adequate larval habitat are found throughout the river which flows fairly rapidly, except for a large pond-like section about 4.8 km above the mouth, and the lower 1.2 km of the river which is wide and deep.

The Pays Plat River had been treated with lampricide only twice before: in 1959 and 1963.

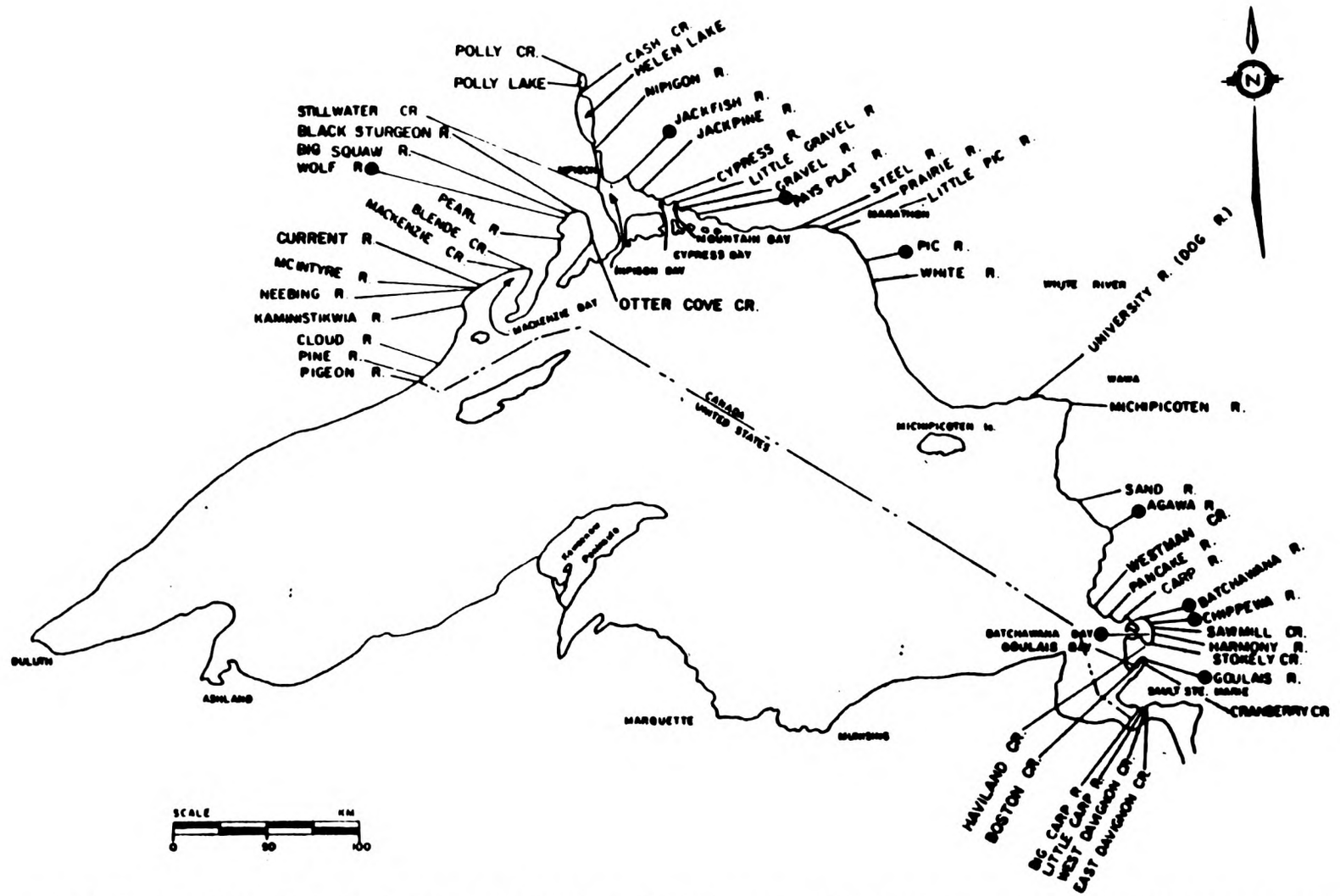


Figure 4. Map of Lake Superior showing location of all known sea lamprey producing streams, lakes and bays, indicating those treated (●) with lampricide in 1984.

Table IX. Summary of rivers and lake areas treated with lampricide on Lake Superior, 1984.

RIVERS	Date	Flow m^3/s	TFM Act. Ingr. kg	Bayer 73 Act. Ingr. kg	Granular Bayer 73 kg	Sea Lamprey *	Collected	Area Treated km	ha
Pays Plat R.	July 7-8	14.05	793.31	-	-	A	341	6.00	
Jackfish R.	July 11-12	7.09	690.34	8.68	0.28	M	661	9.80	
Wolf R.	July 13-15	8.12	715.66	10.18	0.02	M	669	11.30	
Goulais R.	Aug. 7,Oct. 18	4.78	437.63	-	36.55	M	1,132 (44)^t	16.46	2.97
Agawa R.	Aug. 14	5.57	303.38	-	-	S	17	1.30	
Batchawana R.	Aug. 28-30	9.43	790.00	-	-	S	29 (2)^t	13.00	
Chippewa R.	Aug. 29-30	4.95	262.78	4.13	-	M	339	2.90	
Pic R.	Sept. 6-14	16.34	2,947.86	47.47	2.56	S	187 (1)^t	112.65	
LAKE AREAS OF BATCHAWANA BAY									
- off Carp R.	July 19	-	-	-	4.50	S	17		0.37
- off Chippewa R.	July 30-31	-	-	-	29.50	A	1,236 (1)^t		2.42
- off Batchawana R.	Aug. 2 & 16	-	-	-	25.00	S	179 (3)^t		2.04
- off Sand Pt.	Aug. 10	-	-	-	9.10	S	46 (4)^t		0.74
TOTALS		70.332	6,940.96	70.46	107.51		4,851 (55)	173.41	8.54

* S = Scarce; M = Moderate; A = Abundant
( )^t = indicates number of transforming sea lamprey larvae included in the collection

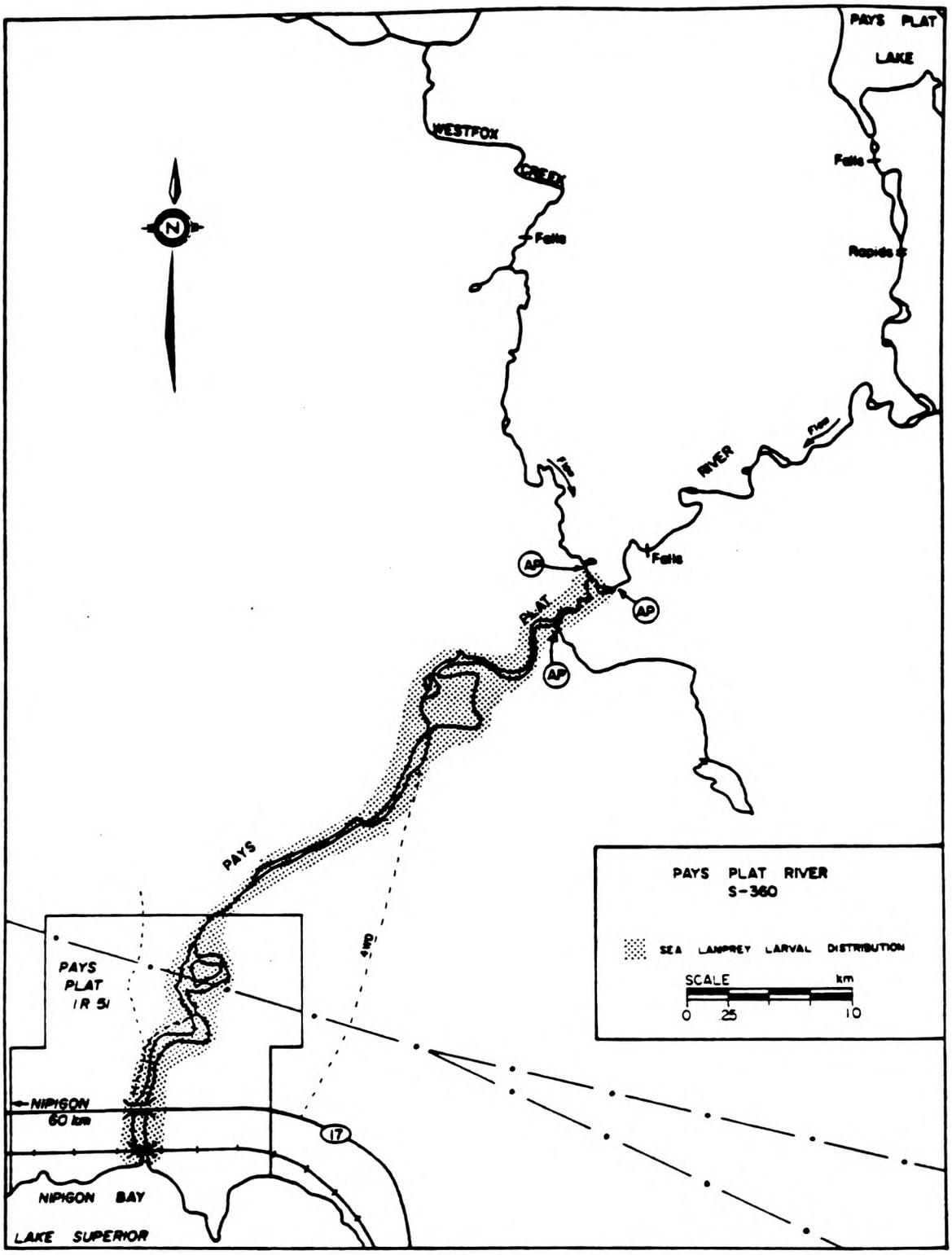


Figure 5. Detailed map of Pays Plat River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

A helicopter was used to transport lampricide, equipment and personnel to the application point on the main Pays Plat River, approximately 0.5 km below the first falls. The treatment was conducted successfully despite a steadily increasing discharge resulting from heavy rains two days prior to the treatment. West Fox Creek was treated at its confluence with the main river to prevent sea lamprey escapement. Supplementary applications into a number of oxbows and the large pond partway down the river required appreciable amounts of lampricide.

Larval sea lamprey were quite abundant with the largest numbers being found in the upper river above the pond. A total of 341 larval sea lamprey, 31 to 186 mm in length, were collected. Non-target fish mortality consisted primarily of large numbers of trout-perch.

Inhabitants of the Pays Plat Indian Reserve were informed, prior to the treatment, of the passage of the block of lampricide. They ceased pumping river water from their three pumping sites prior to the detection of TFM. Personnel from the Sea Lamprey Control Centre provided drinking water to the inhabitants during the time when TFM was present in the lower river. The inhabitants were informed when all traces of TFM were gone from the river mouth, at which time they commenced pumping water from the river again.

Jackfish River - Figure 6

The Jackfish River is a moderate sized stream (average summer flow 1.5 m^3/s) located in Thunder Bay District, crossing Highway 17, 18 km east of the Town of Nipigon. A 6 m waterfall approximately 10 km above the mouth is a barrier to adult sea lamprey. Below this barrier only one significant tributary, Limestone Creek (average summer flow 0.2 m^3/s), enters the river. A 4 m high fall 1.5 km above Limestone Creek's confluence with the main river constitutes a barrier to migrating sea lamprey. Limestone Creek has meager amounts of spawning gravel below the fall but an abundance of suitable larval habitat as it meanders through small beaver impoundments to its mouth. Below the barrier fall, the Jackfish River flows through a series of rapids and another small fall, becomes riffles and pools for a very short distance, and then becomes deeper and slower in the lower 7 to 8 km. Excellent spawning gravel is present in the upper section and there is abundant larval habitat of mixed sand, silt and clay to the mouth.

The Jackfish River had been treated with lampricide six times previously: in 1960, 1964, 1969, 1973, 1977 and 1981.

Due to a the high flow, the lampricide treatment of the Jackfish River was quick and effective with lethal lampricide levels being attained to the mouth. As in the past, a helicopter was used to transport lampricide, equipment and personnel to the main application point. Lampricide was applied to Limestone Creek for several hours a short distance above its mouth to prevent escapement - other supplementary application was minimal.

Larval sea lamprey were quite abundant in the upper river, especially near and below Limestone Creek, but appeared to be scarce in the lower river. However since the period of larval activity from Highway 17 to the mouth occurred during darkness, it is difficult to estimate abundance in that section. All year classes of larval sea lamprey were evident, while the limit of their

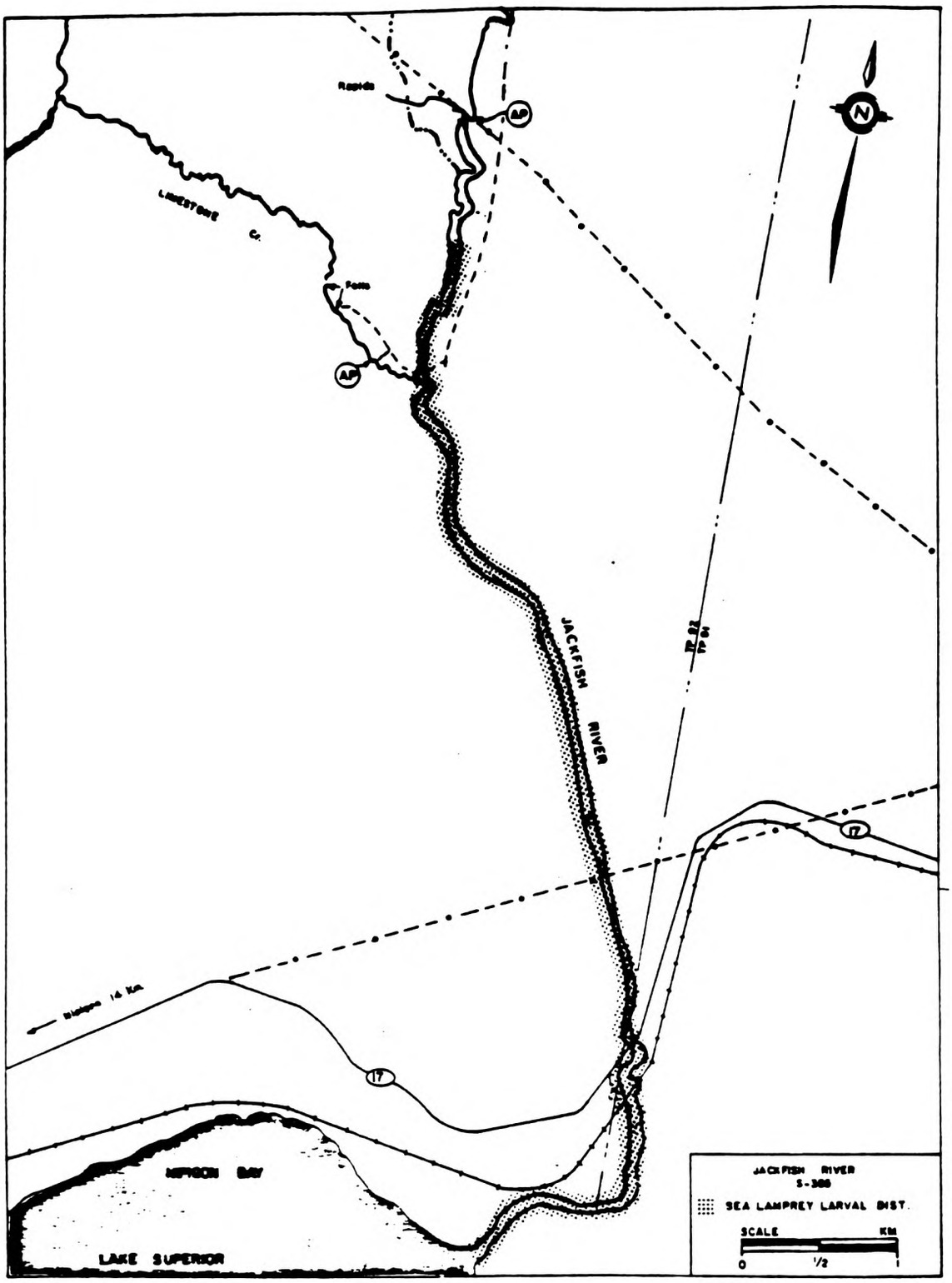


Figure 6. Detailed map of Jackfish River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Jackfish River (Continued)

upstream distribution was about one km below the short section of Limestone Creek that was treated. A total of 661 sea lamprey larvae, 26 to 171 mm in length, were collected during the treatment.

Hundreds of trout-perch were observed killed during the lampricide treatment; other non-target fish mortality was negligible.

Wolf River - Figure 7

The Wolf River, a moderately large stream with an average summer discharge of 3.5 m^3/s, flow through mixed bushland and open farmland into Black Bay, Lake Superior. The stream is located in the District of Thunder Bay and crosses Highway 17 approximately 65 km northeast of the City of Thunder Bay. The stream flows quickly through a series of rapids, riffles and pools until the lower kilometre where it deepens and slows considerably. A 7.5 m high waterfall located 11.3 km upriver of the mouth has been proven an effective barrier to adult spawning sea lamprey. There are no lamprey producing tributaries below the fall but there are numerous isolated oxbows and puddles throughout the lower watershed, with noticeable areas of groundwater seepage. Spawning gravel is very abundant and excellent larval habitat is plentiful. This stream has always been a significant producer of sea lamprey ammocoetes and has been treated with lampricide 10 times previously: in 1961 (twice), 1962, 1966, 1970, 1972, 1976, 1978, 1980 and 1982.

No problems were encountered during this treatment. Because of the high flow experienced, a very quick and effective lampricide treatment resulted, with lethal lampricide levels being attained to the mouth. At this flow supplementary application effort was reduced and boating was greatly facilitated. All major isolated oxbows were treated on July 13, the day before the major application of lampricide to the river.

Larval sea lamprey were moderately abundant, with 669 (26 to 201 mm in length) being collected. Of interest was the fact that only 25 sea lamprey larvae, all greater than 100 mm in length, were collected above a small falls just above Highway 17. This falls was heightened by stream channelization in 1980 and apparently no adult spawning has occurred above this point since the 1982 treatment. It may be possible to initiate future treatments from this point, shortening the length of stream treated from 11.3 km to 5.3 km.

Goulais River - Figure 8

The Goulais River is a large, fairly complex river in Algoma District which crosses Highway 17 approximately 20 km north of the City of Sault Ste. Marie and flows into Goulais Bay, Lake Superior. Whitman Dam, a natural waterfall and barrier to spawning sea lamprey is located approximately 87 km above the mouth. Total summer flow of the Goulais River averages 10 m^3/s. There are ten major tributaries, seven of which generally contain sea lamprey ammocoete populations; Achigan, Whitman, Dam, Perry, Bellevue, Sheppard and Robertson Creeks. The major tributaries enter the main Goulais River above Highway 17 which is approximately 18 km from the mouth. This area above Highway 17 is basically undeveloped, with mixed deciduous and coniferous bushland and only limited road access. The upper 55 km of the main river has fairly good gradient with riffles and pools and some rapid areas. The Goulais River

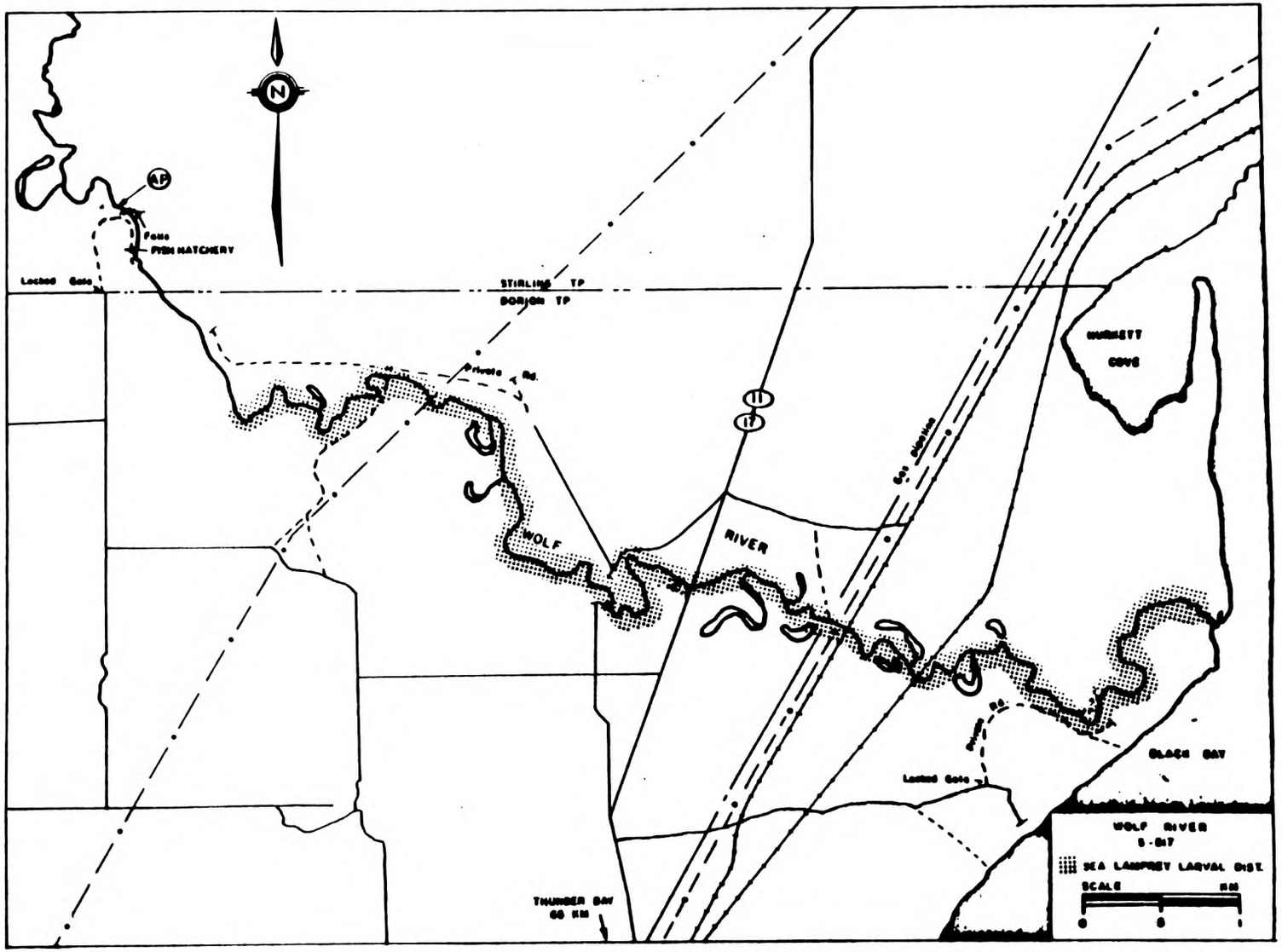


Figure 7. Detailed map of Wolf River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

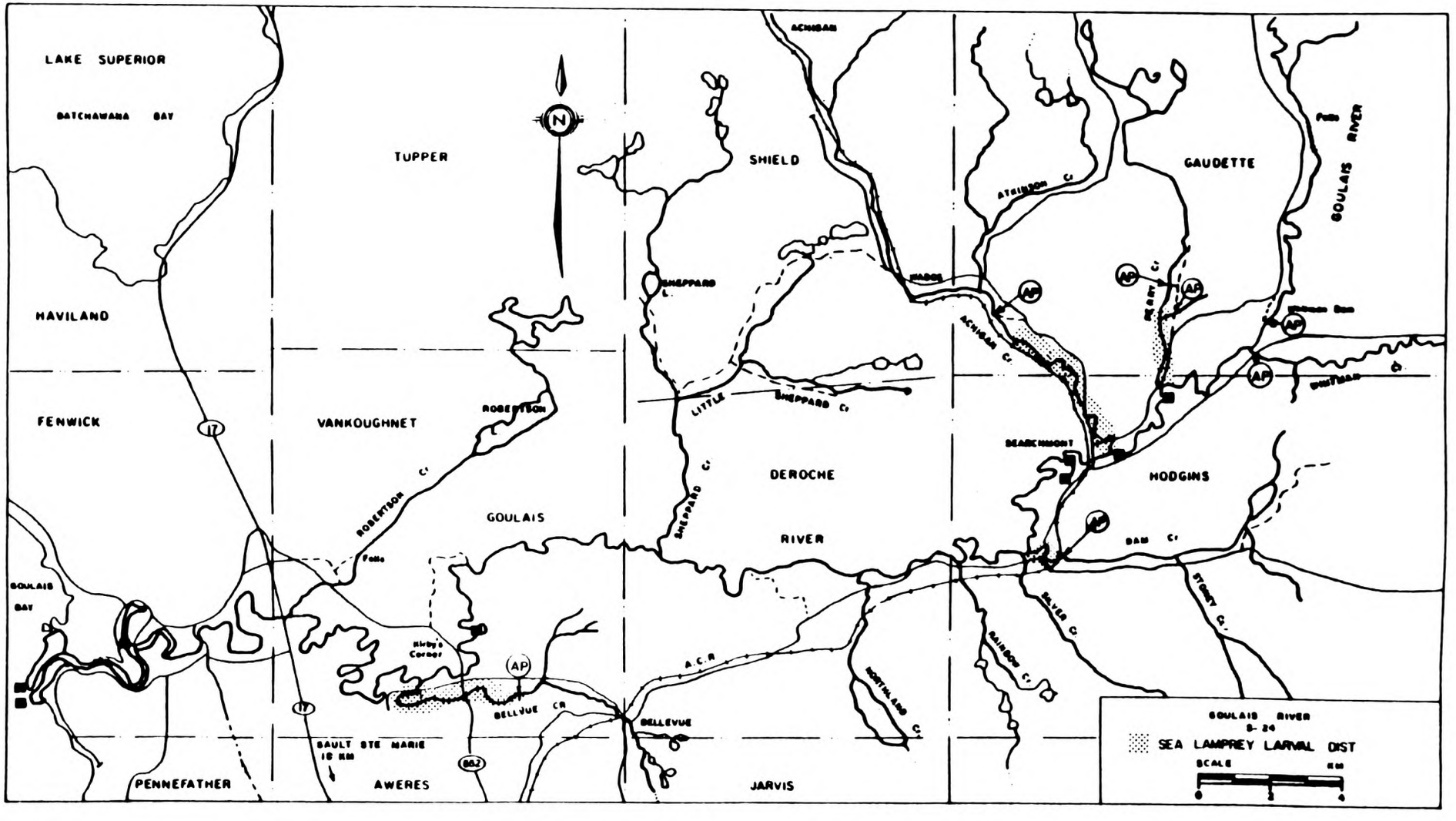


Figure 8. Detailed map of Goulais River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Goulais River (Continued)

meanders throughout its course and contains numerous oxbows and cut-off areas. The lower 32 km of river flows slowly through a wide floodplain with characteristic high gravel-clay banks, and finally enters Goulais Bay in several mouths through a divided delta. Excellent spawning gravel is abundant in the upper 55 km of river and larval habitat is abundant throughout.

The sea lamprey producing tributaries have similar qualities with areas of good spawning gravel and larval habitat. Achigan Creek is the largest tributary with an average summer flow of 1 m^3/s, whereas the remainder range from 0.1 to 0.5 m^3/s. Each of the major tributaries has a natural barrier and/or deterrent(s) to the upstream migration of sea lamprey. These tributaries are generally "riffle and pool" streams with the exception of Bellevue and Robertson Creeks, which are slower and deeper.

The Goulais River, a major producer of sea lamprey larvae, had been treated with lampricide eight times previously: in 1960, 1962, 1964, 1968, 1972, 1977, 1979 and 1982.

A lampricide treatment of the entire Goulais River system was scheduled for the last week of August but low flow caused the postponement of the treatment until September. Bellevue Creek had been treated separately on August 21 to 23 with no larval sea lamprey being found. Isolated lagoons and oxbows were treated separately on various days from August 17 to September 27. Large numbers of sea lamprey larvae, including 41 transformers, were collected from those treatments.

On August 7 and 24 a total of 2.97 ha off the main mouth of the Goulais River was treated with Bayer 73 granules. Larval sea lamprey were very scarce with only 23 being collected (66 to 144 mm in length), three of which were transformers.

On September 24, TFM treatments of the main Goulais, Perry Creek, Achigan Creek and the mouth of Whitman Creek were initiated. Heavy rain showers began shortly after start up, and the threat of considerably more rain resulted in the termination of lampricide application on the main Goulais and Whitman Creek after only three hours of operation. However, the feeders on Achigan and Perry Creeks were operated for 15 and 13 h, respectively, in an attempt to achieve successful treatments. Flow increased considerably in both tributaries and theoretical lethal levels were not achieved to the mouth of either tributary. A treatment evaluation survey conducted on Perry Creek uncovered only one residual sea lamprey.

On September 25 flow on the main Goulais River had increased over fivefold from the flow at the start of the treatment on September 24.

On October 18 a lampricide treatment of Dam Creek was conducted to facilitate a study by University of Guelph students on the effects of TFM in deep-sediment invertebrates. The treatment of approximately 1.5 km of stream was routine and only 11 sea lamprey larvae were collected.

The Goulais River system is scheduled for retreatment in 1985.

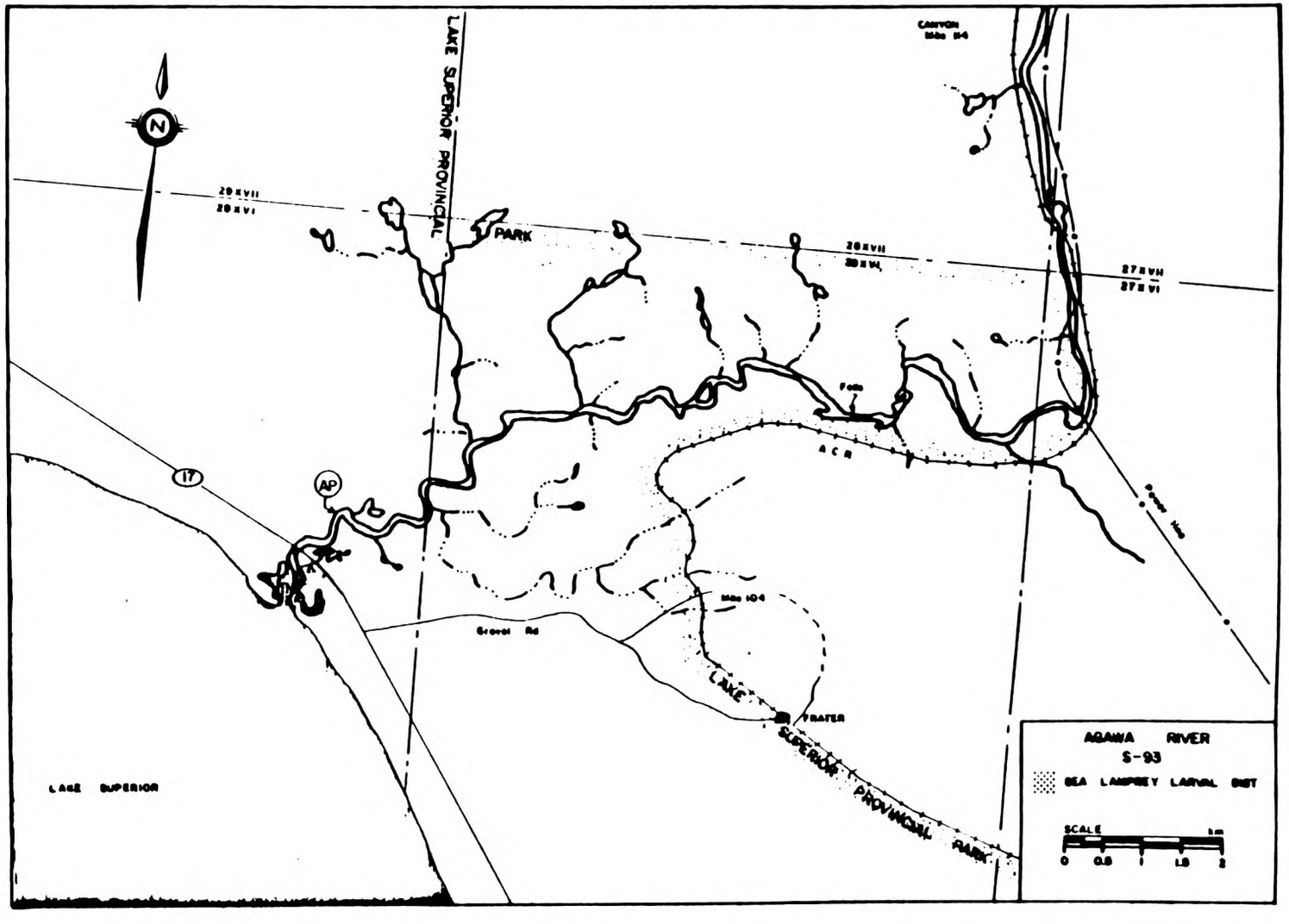


Figure 9. Detailed map of Agawa River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Agawa River - Figure 9

The Agawa River, located in the District of Algoma, flows through rugged, mixed bush country in Lake Superior Provincial Park before entering Lake Superior 145 km north of the City of Sault Ste. Marie. The Agawa River is moderately large with summer flows averaging 2.5 m^3/s. A 10 m high waterfall 11 km above the mouth is a barrier to anadromous fishes. From the fall the Agawa River flows moderately quickly, with many riffles and small rapids over large stone and gravel. Suitable larval habitat of sand and silt is essentially limited to backwater areas in the lower 1.5 km of river. No major tributaries enter the river below the barrier falls. The only access to the river is by the Algoma Central Railway at a point 18 km above the mouth, or Highway 17, 1.1 km above the mouth.

The Agawa River had been treated with lampricide four times previously: in 1962, 1966, 1971 and 1975.

The 1984 treatment was quick and successful. The relatively high flow of 5.6 m^3/s allowed the required concentration of lampricide to move through the mouth area within a 16 hour period. Lampricide was applied from a short distance (1.5 km) above Highway 17, access being by a "Bombardier".

Larval sea lamprey were very scarce with only 17 being collected (86 to 171 mm in length) from the river below Highway 17. The apparent absence of small ammocoetes suggests that sea lamprey do not spawn every year in this river.

Batchawana River - Figure 10

The Batchawana River is a relatively large stream (average summer flow of 6 m^3/s) in the District of Algoma, entering Batchawana Bay of Lake Superior about 55 km north of the City of Sault Ste. Marie. The river is long and extensive but a waterfall (approximately 4.5 m vertical drop, with rapids above and below) 10 km from the mouth is a barrier to adult migrating sea lamprey. Several tiny tributaries enter the main river below this fall but none produce sea lamprey. Flowing through scenic mixed bushland, the Batchawana River has good road and boat access. For approximately 6 km below the barrier fall the river flows moderately fast over stone and gravel; below this the river slows, becomes wider and deeper with a bottom of sand, detritus, vegetation and debris, and is affected by lake seiche. There are a number of isolated oxbows and lagoons which often harbour sea lamprey ammocoetes. The Batchawana River had been treated with lampricide 13 times previously: in 1959, 1961-1966, 1968, 1971, 1975, 1977, 1980 and 1983.

Rain showers prior to the treatment raised flows to a favourable level for this treatment. Despite fairly strong seiche action in the lower river, a lethal block of lampricide was maintained right out of the river mouth. Because of the extreme softness of the water, no additive (Bayer 73) was used during this treatment. Larval sea lamprey were very scarce, however more young-of-the-year larvae could have been collected with a greater collecting effort. Of the 29 larvae collected (11 to 186 mm in length) 19 were residuals from the 1983 fall treatment. Two of the larvae collected (just inside the river's mouth) were in the process of transformation.

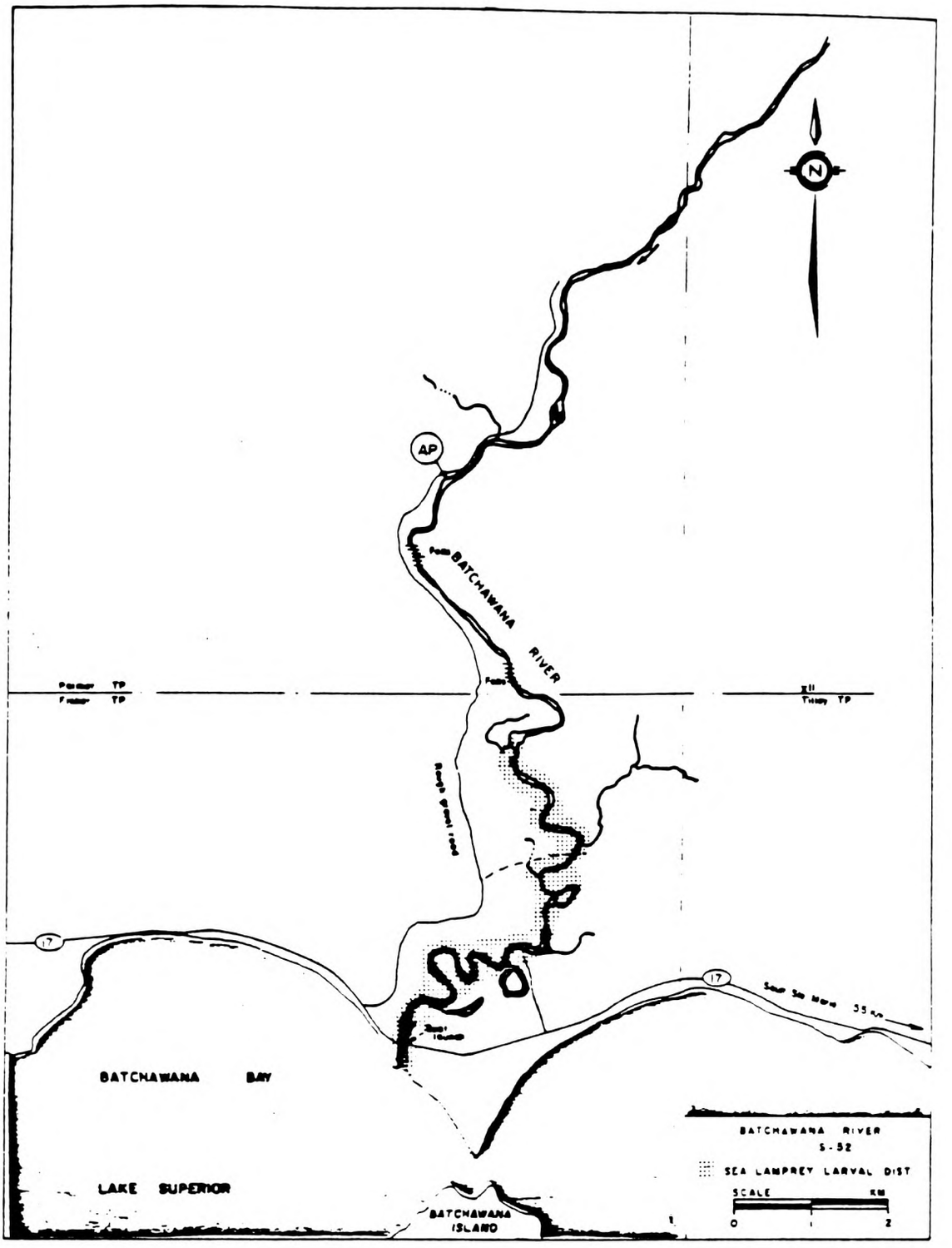


Figure 10. Detailed map of Batchawana River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Chippewa River - Figure 11

The Chippewa River is located in the District of Algoma, entering Batchawana Bay of Lake Superior about 45 km north of the City of Sault Ste. Marie. It has a fairly large average summer flow of 4 m^3/s. However two falls of about 7 m high each restrict anadromous fish to the lower 1.9 km of the river. Below the falls the river flows quickly over rock and gravel for about 0.5 km, then widens and slows considerably, with a bottom of sand and silt larval habitat. There are no tributaries below the falls.

The Chippewa River had been treated with lampricide twelve times previously - annually from 1961 to 1966 and in 1968, 1970, 1972, 1977, 1980 and 1983. Because of a large and persistent population of larval sea lamprey in the lentic area off the river's mouth, advanced lampricide treatments of the Chippewa River have been performed in an effort to reduce recruitment of larvae to the bay.

The 1984 lampricide treatment was very quick and effective, due to the high flow, with lethal levels attained through to the mouth.

Larval sea lamprey were moderately abundant, with 339 (6 to 126 mm in length) being collected. Only two sea lamprey larvae, 111 and 126 mm in length, respectively, were larger than 26 mm. These two larvae were found near the river mouth and quite likely were migrants from the lake.

Pic River - Figure 12

The Pic River a large and complex stream flows into Lake Superior about 8 km southeast of the Town of Marathon, Ontario, in the District of Thunder Bay. This river flows through rugged, uninhabited boreal forest with extremely limited road access. The Pic River has been scarred by a long history of logging operations and ensuing log drives. Its banks have been scoured, and pulp logs and bark smother areas of the river's bank and bottom. Manitou Falls, located approximately 96 km upriver of the mouth, is a natural barrier to migratory adult sea lamprey. Below the falls, the river meanders at a moderate rate of flow to within a few kilometres of the mouth where the river widens and deepens forming a collecting area for rafts of pulpwood as well as a protected harbour. Spawning gravel appears to be scarce in the main river which contains substrates consisting mainly of clay, sand, silt and wood fibers. The high percentage of clay throughout the lower 96 km of the river accounts for the extremely high level of turbidity. Water in the main river and its tributaries is moderately hard, and the annual mean flow at the mouth can exceed 57 m^3/s.

The major tributaries to the Pic River are the Kagiano River, Black River and Nama Creek, with smaller but significant tributaries being Cirrus, Skipper, Big Jo, Goodchild and Spruce Creeks. In addition, there are many small tributaries entering the main river. The Kagiano River, which joins the main river 5 km below Manitou Falls, is a sea lamprey producing tributary with an average summer flow of 3 m^3/s. A waterfall 1 km above its confluence with the main river is a barrier to anadromous sea lamprey. Nama Creek, previously the major sea lamprey producing tributary to the Pic River, has an average summer flow of 2 m^3/s and empties into the main river 32 km downriver of Manitou Falls. A series of rapids and small falls 8 km from the mouth serve as a barrier to spawning run sea lamprey. Fourbay Creek, the major tributary to Nama Creek, has a sea lamprey barrier falls approximately 4 km above the confluence

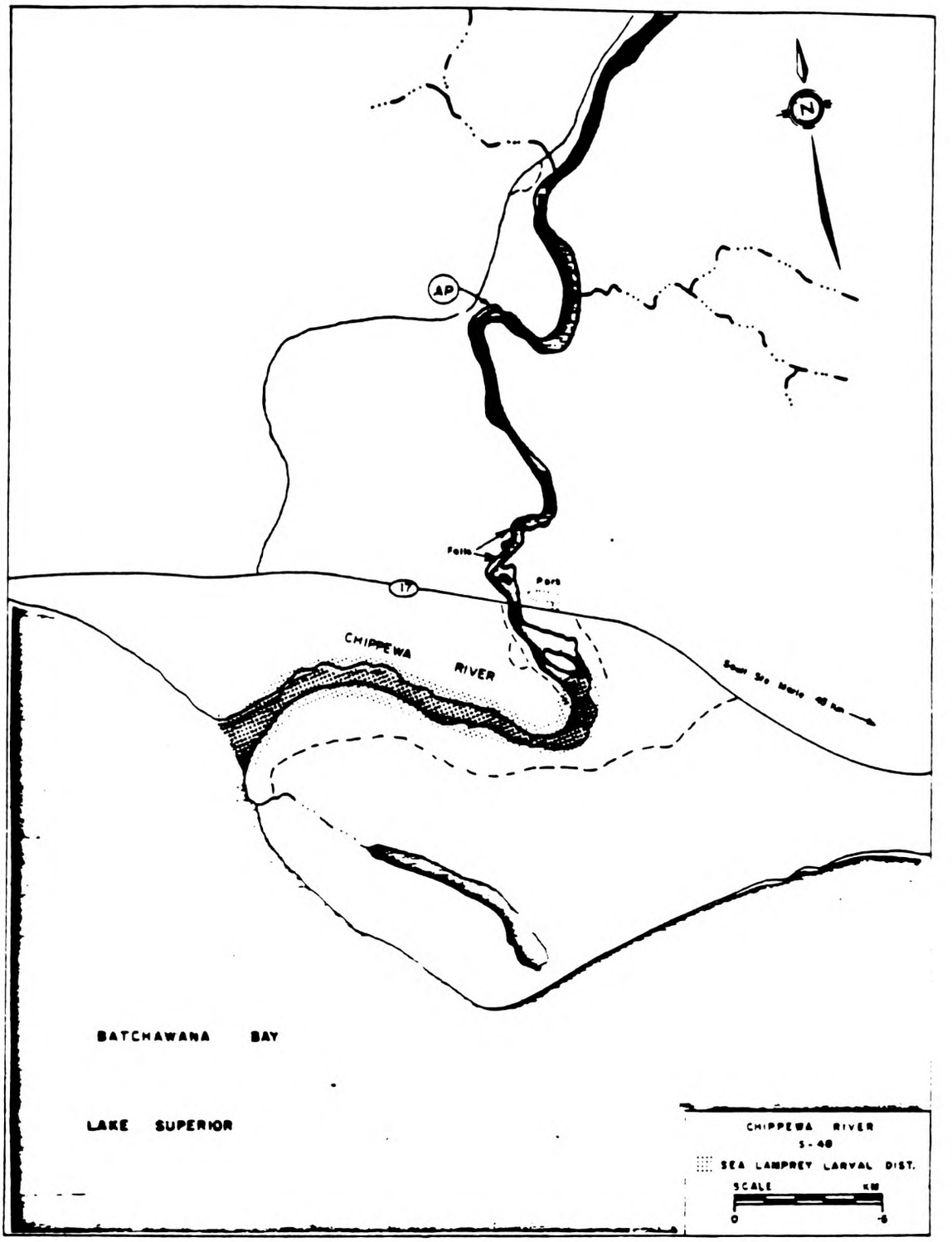


Figure 11. Detailed map of the Chippewa River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

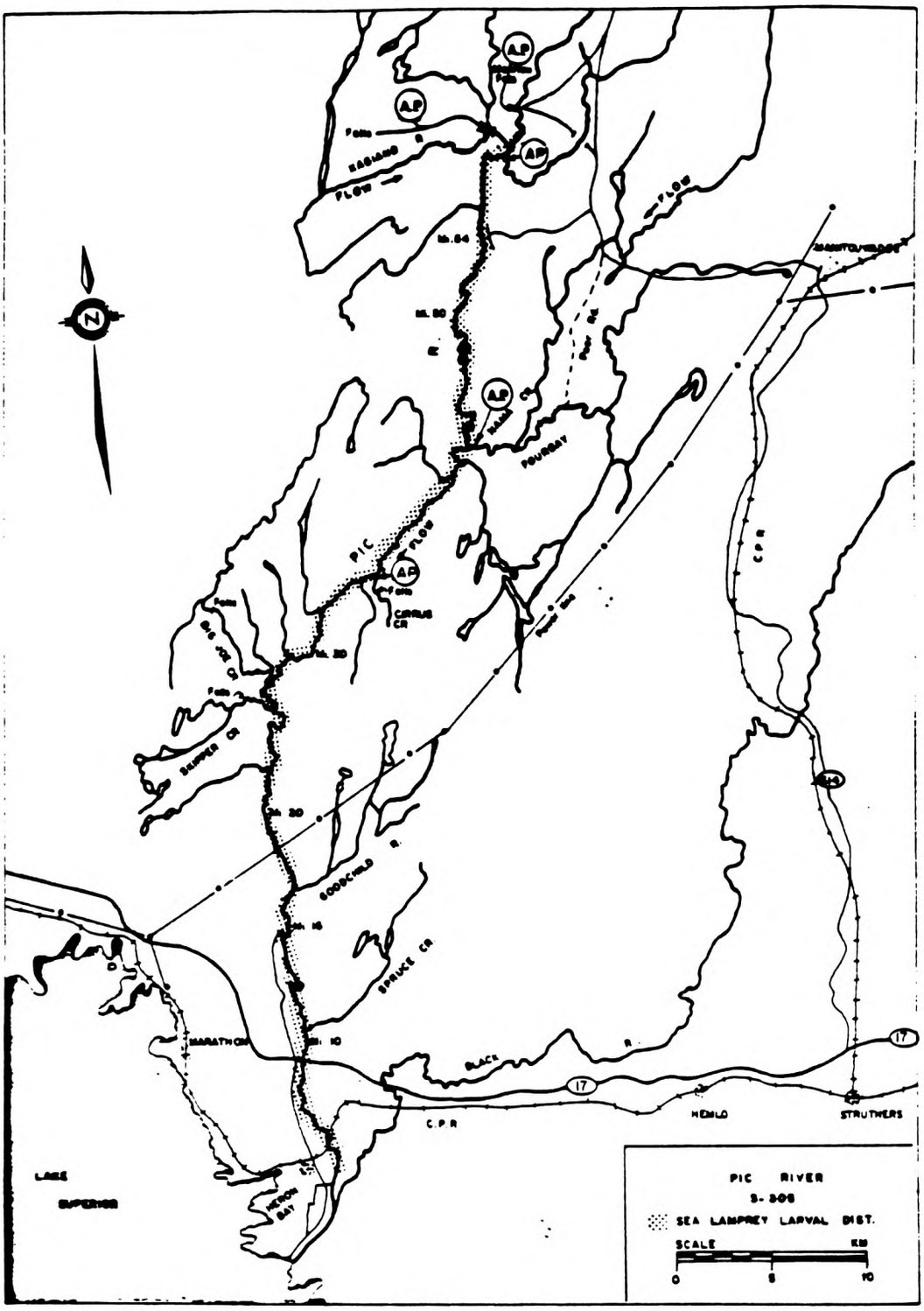


Figure 12. Detailed map of the Pic River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Pic River (Continued)

of the two streams. The Black River, the largest tributary to the Pic River, has an annual mean flow of approximately 23 m^3/s. This river empties into the main river 5 km from Lake Superior and, fortunately, does not harbour a sea lamprey larval population. A barrier (dam) to anadromous fishes is present on this river 6.5 km above its confluence with the Pic.

The Pic River has been treated with lampricide on four previous occasions: 1963, 1965, 1975 and 1979. Sea lamprey ammocoetes were very scarce in the 1963 and 1965 treatments, but abundance seemed greater in the 1975 treatment. Distribution is difficult to determine as collecting conditions are extremely poor. In the 1975 treatment, sea lamprey ammocoetes were collected from the main river, Kagiano River and Nama-Fourbay Creek.

The 1984 lampricide treatment of the Pic River was conducted in 112.7 km of watershed under a very stable flow regime. The cessation of logging activities prior to the actual treatment greatly facilitated travel by boat on the watershed, since the large rafts of pulp logs frequently present during previous treatments were absent in 1984. Access to the main application site was by road, whereas air transportation (helicopter) was required for Kagiano and Nama Creeks.

The apparent absence of sea lamprey ammocoetes in the Nama Creek system permitted lampricide application to be conducted at the confluence with the main Pic, a considerable savings in resources. Some confusion as to the location of the Kagiano feeder site combined with fog banks which delayed helicopter access, resulted in a 5 h non-coincidence of the Pic-Kagiano lampricide blocks. Although the Kagiano system was contributing approximately 25 per cent of the total flow in the upper watershed, the effect of the non-coincidence was minimal, and target levels of lampricide were attained well into the Pic River estuary.

A total of 187 sea lamprey larvae, 41 to 176 in length, were collected during the treatment. The collecting of larvae was hindered by turbidity and periods of rain, however sea lamprey abundance estimates indicated that numbers of ammocoetes may have decreased compared to the 1979 treatment. The area of maximum larval density was situated between Manitou Falls and the Nama-Pic confluence. An intense collecting effort in the lower 25 km of watershed indicated that sea lamprey larvae were very scarce. Non-target fish mortality was negligible.

LAKE SUPERIOR GRANULAR BAYER 73 TREATMENTS

In a continuing effort to reduce the population of larval sea lamprey in lentic areas of Lake Superior, portions of Batchawana Bay were treated with the granularized formulation of Bayer 73 (2',5-dichloro-4-nitrosalicylanilide). Applications of Bayer 73 granules to portions of Mountain and Cypress Bays were not attempted in 1984 due to very low water temperatures in July, when the treatments were scheduled. Table IX lists the pertinent treatment data, Figure 4 shows the general locations, whereas Figures 13 to 16 describe each treatment area.

Batchawana Bay - Figure 13

Areas off the Chippewa, Batchawana and Sable Rivers were treated with Bayer 73 granules, as in past years. The lentic area off the Chippewa River mouth again produced a large number of larval sea lamprey but other areas in the Bay showed very low numbers.

Chippewa River - Figure 14

A 2.42 ha area along the well-defined drop-off area adjacent to the mouth of the Chippewa River was treated with 590 kg of Bayer 73 granules on July 30-31. Larval sea lamprey were very abundant, with a total of 1,236 being collected (41 to 161 mm in length) including one in transformation stage. Despite annual granular Bayer 73 treatments in the bay and TFM treatment of the Chippewa River in 1977, 1980, 1983 and 1984, numbers of larval sea lamprey continue to remain high in the lentic area.

Sand Point - Figure 15

A small 0.74 ha area off Sand Point near the mouth of the Batchawana River was treated with 182 kg of Bayer 73 granules. Only 46 sea lamprey larvae, 56 to 161 mm in length, were collected, and of these, four were in stages of transformation.

Batchawana River - Figure 15

A 2.04 ha area along the drop-off zone off the Batchawana River was treated with 499 kg of Bayer 73 granules on August 2 and 16, 1984. Only 177 larval sea lamprey were collected (26 to 151 mm in length), three of which were undergoing transformation. Larval sea lamprey numbers have been relatively low in annual granular Bayer treatments off the Batchawana River since the 1980 treatment when 1,474 sea lamprey larvae were collected. The drop-off zone adjacent to the Batchawana River appears to be less well defined than in past years, consequently it is becoming more difficult to find an area of sea lamprey larval abundance to treat.

Annual granular Bayer treatments in conjunction with advanced TFM treatments of the Batchawana River have been effective in reducing this lentic population of sea lamprey larvae.

Carp River - Figure 16

A small 0.37 ha area off the mouth of the Carp River was treated with 91 kg of Bayer 73 granules. Only 17 larval sea lamprey, 46 to 131 mm in length, were collected. However bottom temperatures were less than ideal (14°C) at the time of treatment. This bay area should continue to undergo annual treatments not only to keep the current larval sea lamprey population low, but to monitor any effect that the barrier dam (located 0.8 km upriver) which became operational in 1984, may have on changes in larval density in the lower river and bay.

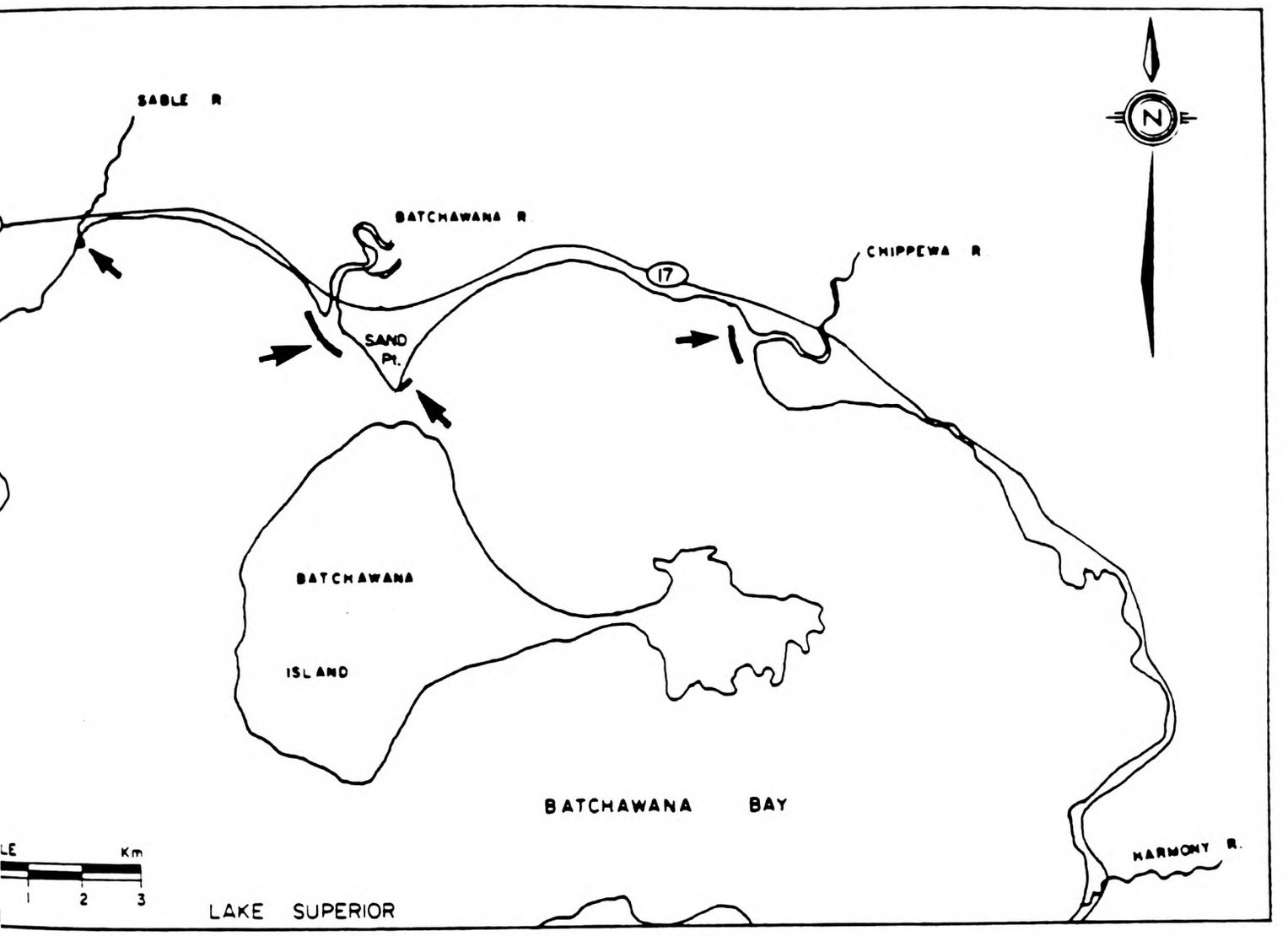


Figure 13. Map of Batchawana Bay showing approximate location of granular Bayer 73 treatment areas in 1984.

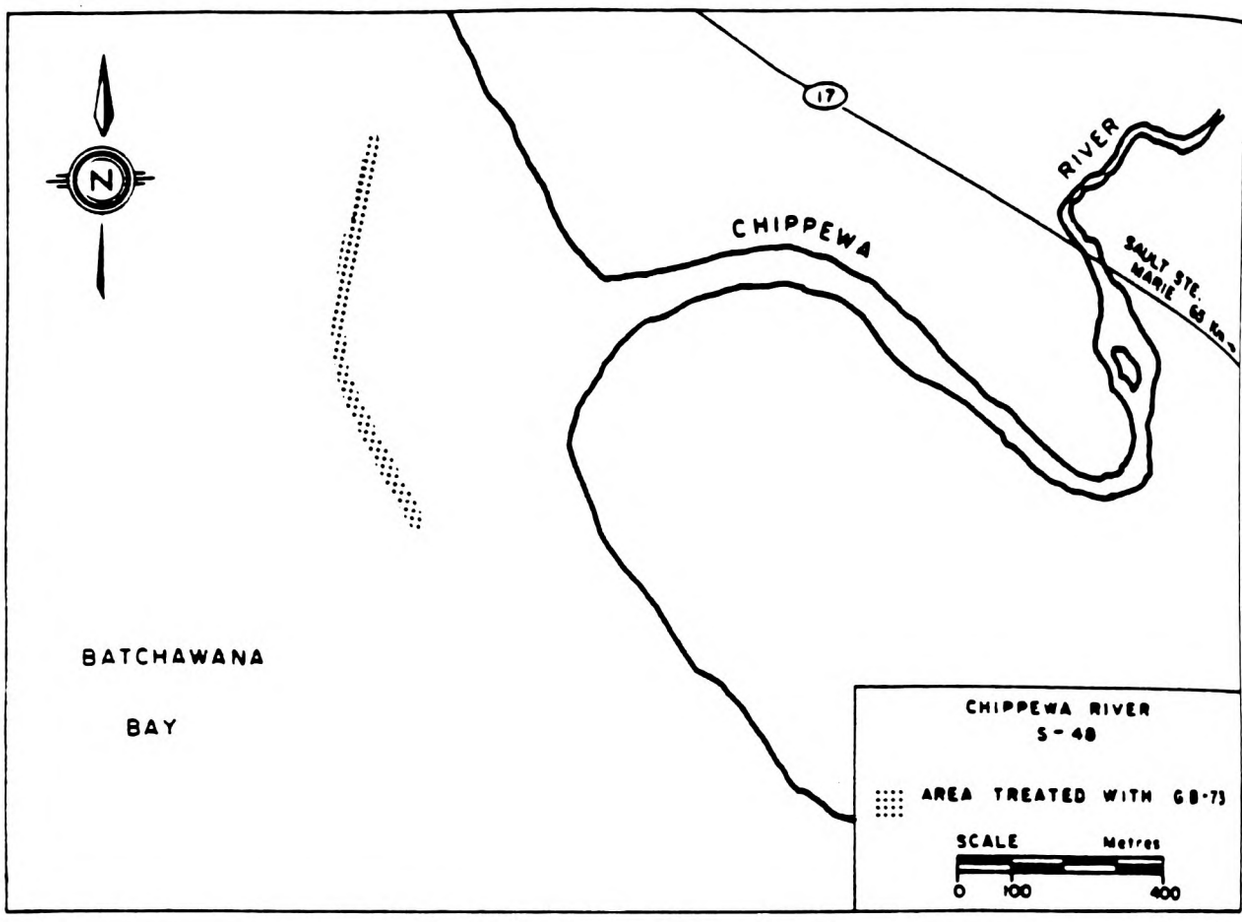


Figure 14. Lake area adjacent to the Chippewa River treated with granular Bayer 73 in 1984.

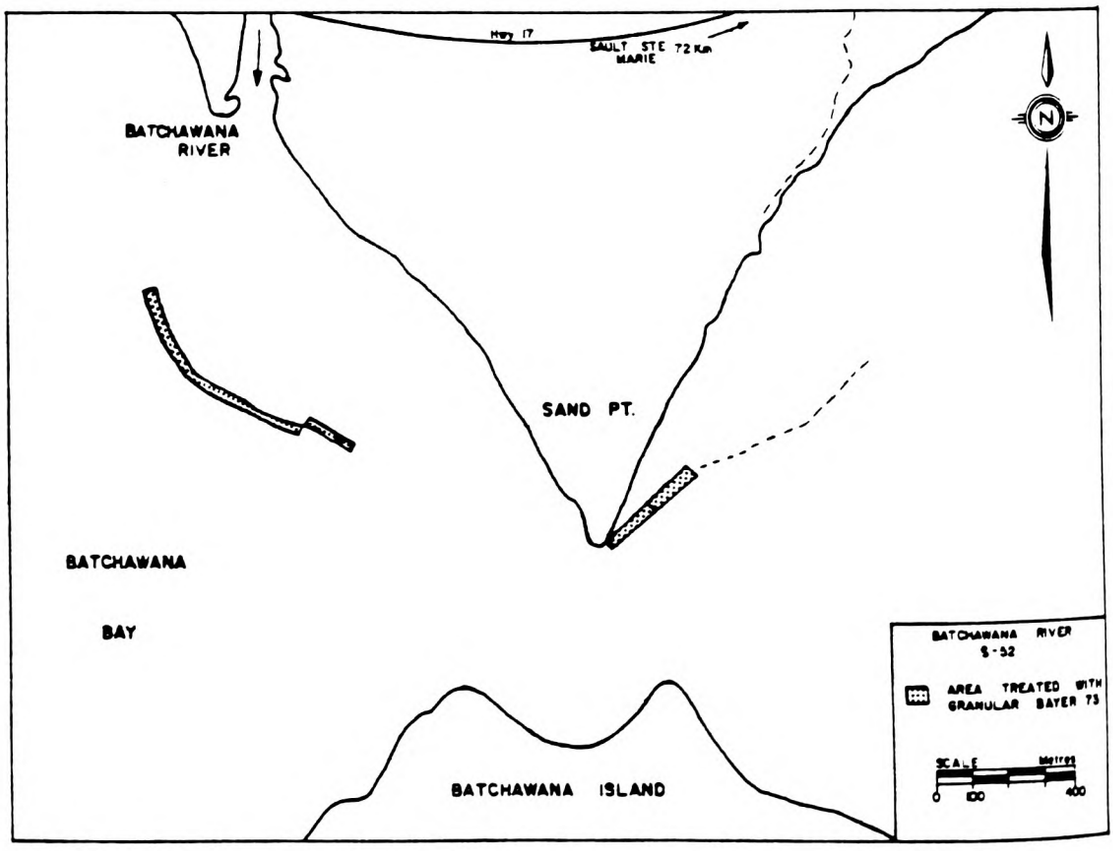


Figure 15. Lake area adjacent to the Batchawana River and Sand Point treated with granular Bayer 73 in 1984.

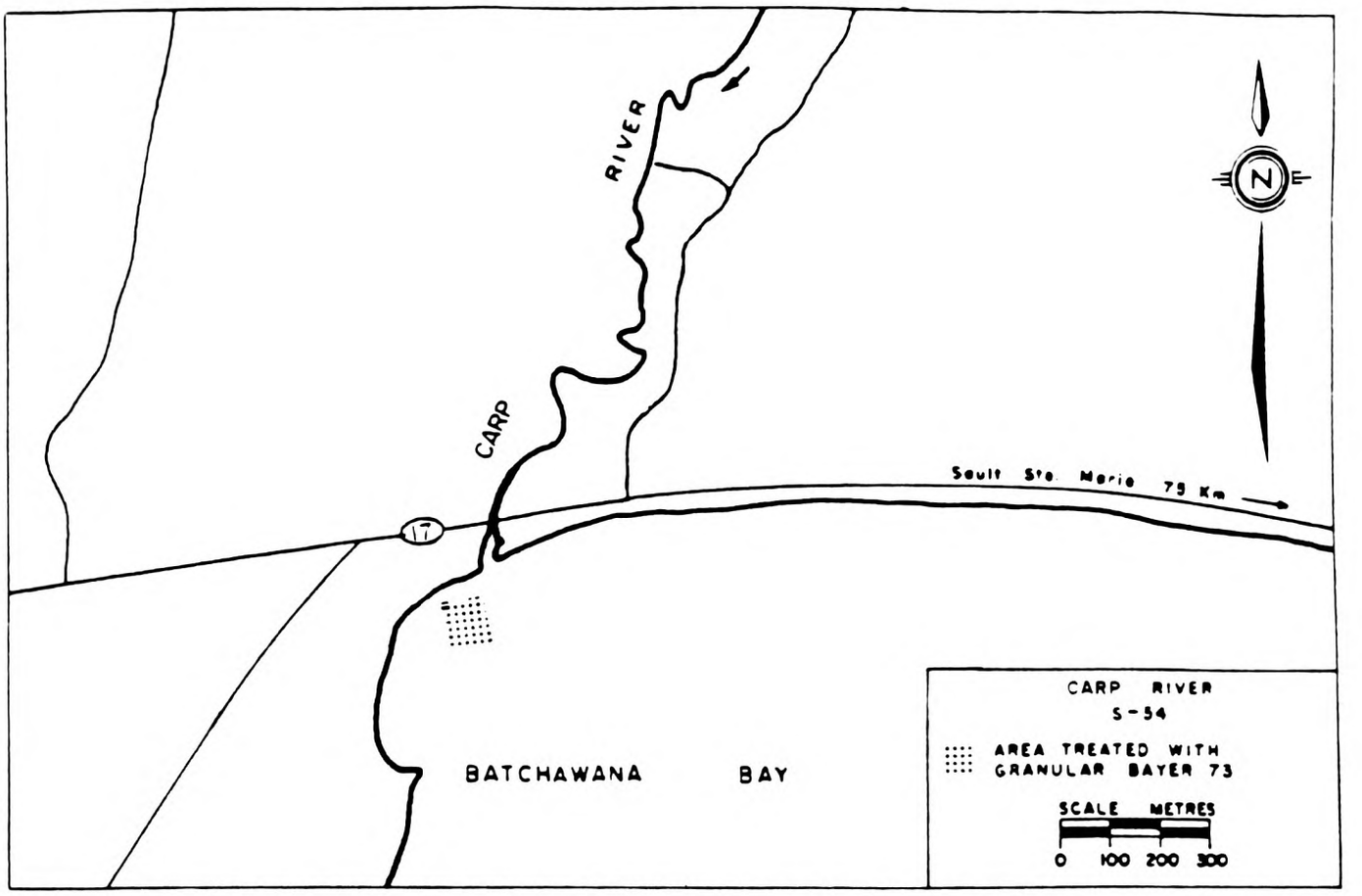


Figure 16. Lake area adjacent to the Carp River treated with granular Bayer 73 in 1984.

LAKE HURON LAMPRICIDE (TFM) TREATMENTS

The following ten streams tributary to Lake Huron were treated with the selective lampricide, 3-trifluoromethyl-4-nitrophenol (TFM) in 1984:

Brown Creek	-	May 29-31
Sucker Creek	-	May 31
Blind River	-	May 31
Root River	-	June 6-9
Garden River	-	June 6-8; 12-14
Thessalon River	-	June 19-22
Naiscoot River	-	July 5-6
Magnetawan River	-	July 10-12
Chikanishing River	-	July 13-14
Wanapitei River	-	August 10-11

Table X lists the pertinent treatment data, Figure 17 depicts the general location of the streams treated, and Figures 18 to 27 illustrate treatment details.

The following are brief descriptions and accounts of the streams and their respective treatments. Although the sea lamprey larval abundance ratings are subjective in that they are not based on a standardized unit of effort, they are realistic in that they take into account such factors as: stream distance treated, degree of collecting difficulty, observations of larval sea lamprey density in non-collection areas, and the number of larvae actually collected during present and past treatments. The stream treatment dates are inclusive of the time from the first lampricide application to the time of the last water sample taken from the stream for TFM analysis.

Terms, abbreviations and symbols used are explained in Appendix 6.

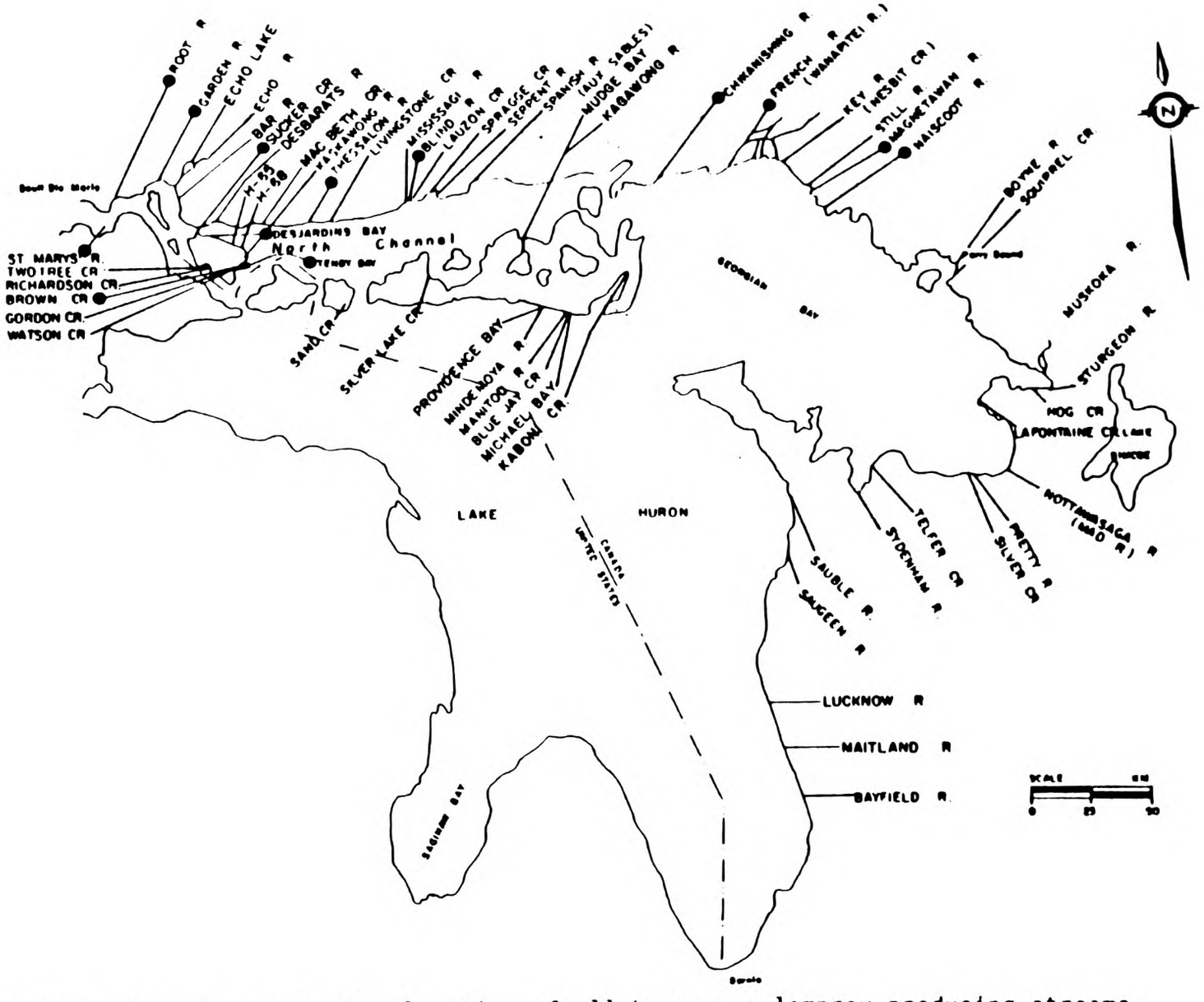
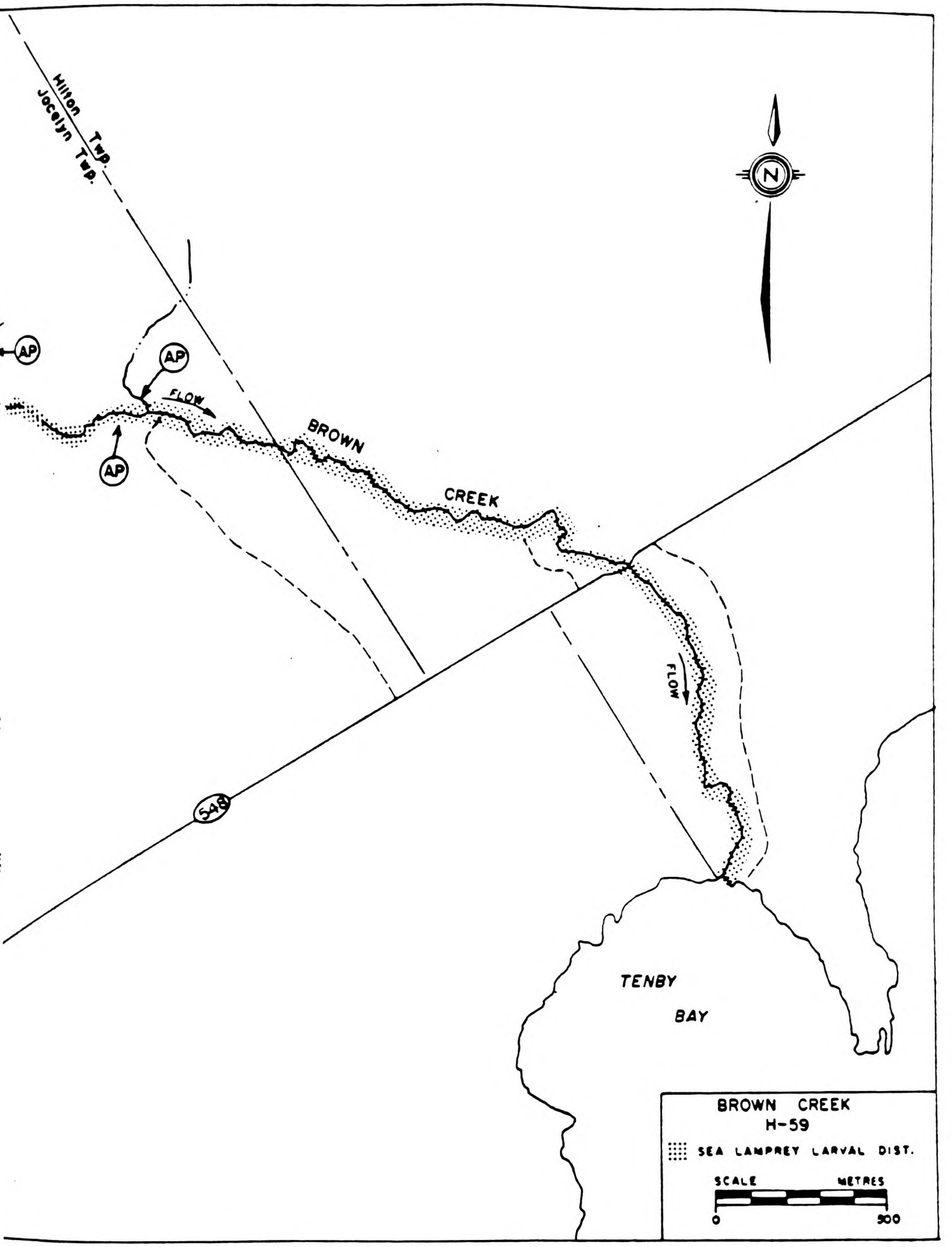


Figure 17. Map of Lake Huron showing location of all known sea lamprey producing streams, lakes and bays, indicating those treated (●) with lampricide in 1984.

Table X. Summary of streams and lake areas treated with lampricide on Lake Huron, 1984.

RIVERS	Date	Flow m^3/s	TFM Act. Ingr. kg	Bayer 73 Act. Ingr. kg	Granular Bayer 73 kg	Sea Lamprey * Collected		Area Treated km	ha
Brown Cr.	May 29-31	0.11	28	-	-	A	496	3.9	
Sucker Cr.	May 31	0.05	36	-	-	S	99	0.8	
Blind R.	May 31	12.72	546	-	-	M	97	0.4	
Root R.	June 6-9	1.05	172	-	-	M	396	27.4	
Garden R.	June 6-8, 12-14	17.89	1,066	-	-	M	879	58.1	
Thessalon R.	June 19-22	7.30	593	7	1	A	1,604	35.0	
Naiscoot R.	July 5,6	2.54	127	-	-	M	272	10.5	
Magnetawan R.	July 10-12	29.50	1,375	-	-	M	521	15.0	
Chikanishing R.	July 13,14	0.29	14	-	-	M	439	1.4	
Wanapitei R.	Aug. 10,11	22.85	1,040	16	-	S	204 (12)t	6.3	
French R.	July 14	-	-	-	3	S	46		0.32
Tenby Bay	July 18,20	-	-	-	13	M	207		1.07
Desjardins Bay	July 20	-	-	-	2	S	-		0.18
St. Marys R.									
- Root R.	July 30	-	-	-	9	S	81		0.72
- Whitefish Island	July 31	-	-	-	22	A	525 (10)t		1.71
- Station H	Aug. 1	-	-	-	34	A	2,071 (1)t		2.70
- off Garden R.	Aug. 2	-	-	-	18	M	309		1.92
TOTALS		94	4,997	23	102		8,246 (23)t	158.8	8.62

* S = Scarce; M = Moderate; A = Abundant



gure 18. Detailed map of Brown Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Brown Creek - Figure 18

Brown Creek, a small beaver-impounded stream situated in Hilton and Jocelyn Townships, Algoma District, is a regular and prolific producer of sea lamprey larvae. Sea lamprey ammocoetes have, in the past, inhabited 3.2 km of this riffle and pool stream with the upstream migration of adults being blocked by a series of beaver dams. Previous lampricide treatments have been conducted in 1961, 1966, 1970, 1974, 1978 and 1980.

Surveys conducted prior to the 1984 treatment indicated the presence of sea lamprey above previous feeder sites. A low discharge and the presence of numerous impoundments necessitated treatment of the creek in two sections. A treatment concentration of 1.0 ppm TFM for 12 hrs was determined from water chemistry and previous bioassay data.

During the 1984 treatment, passage of the TFM block through beaver impounded areas, at target concentrations, was facilitated by removal of dams prior to treatment. The ponded areas had previously negated the effectiveness of the block while allowing escapement of ammocoetes. Supplemental application of lampricide in the ponded areas was conducted via backpack sprayers. Sea lamprey larvae were very abundant throughout that portion of the watershed not subject to beaver ponding. Ammocoetes appeared to be scarce or absent in a number of the larger ponds and for short distances below their outfall.

Mortality of non-target fish was minimal and consisted of dace, creek chub, brook stickleback, mudminnow and some brook trout. This mortality was primarily concentrated at the lampricide application points.

Sucker Creek - Figure 19

Sucker Creek, a small stream on St. Joseph Island in Hilton Township, Algoma District, empties into Desjardins Bay through a large marshy estuary. A waterfall 0.5 km upstream from the mouth limits the distance available to spawning sea lamprey and their larvae. This stream had been previously treated seven times, the last occurring in 1980.

Due to the low flows, a section of the stream estuary was treated with lampricide by boat. Although this area was stratified, the continual mixing of the water by boats seemed to allow for adequate penetration of TFM.

Ammocoetes, the majority of which were confined to the uppermost portion of the treated area, were relatively scarce. Non-target fish mortality was negligible.

Blind River - Figure 20

Blind River is a large drainage system consisting of many lakes, situated north of the Town of Blind River in Algoma District. Fortunately, the upstream migration of adult sea lamprey is halted by a flow control dam in the Town of Blind River, approximately 0.25 km from the mouth. Larval sea lamprey production is not great due to limited spawning and larval habitat.

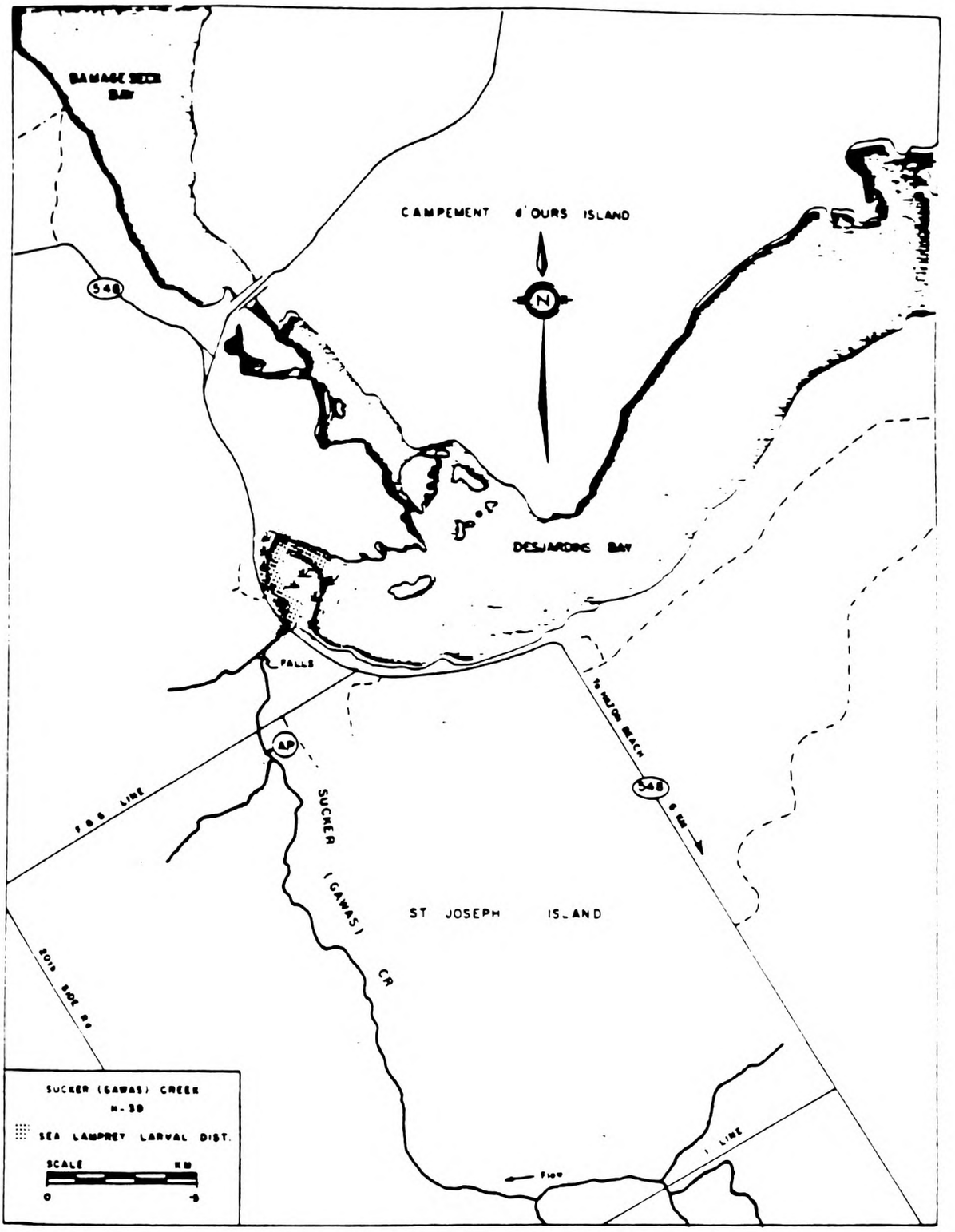


Figure 19. Detailed map of Sucker Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

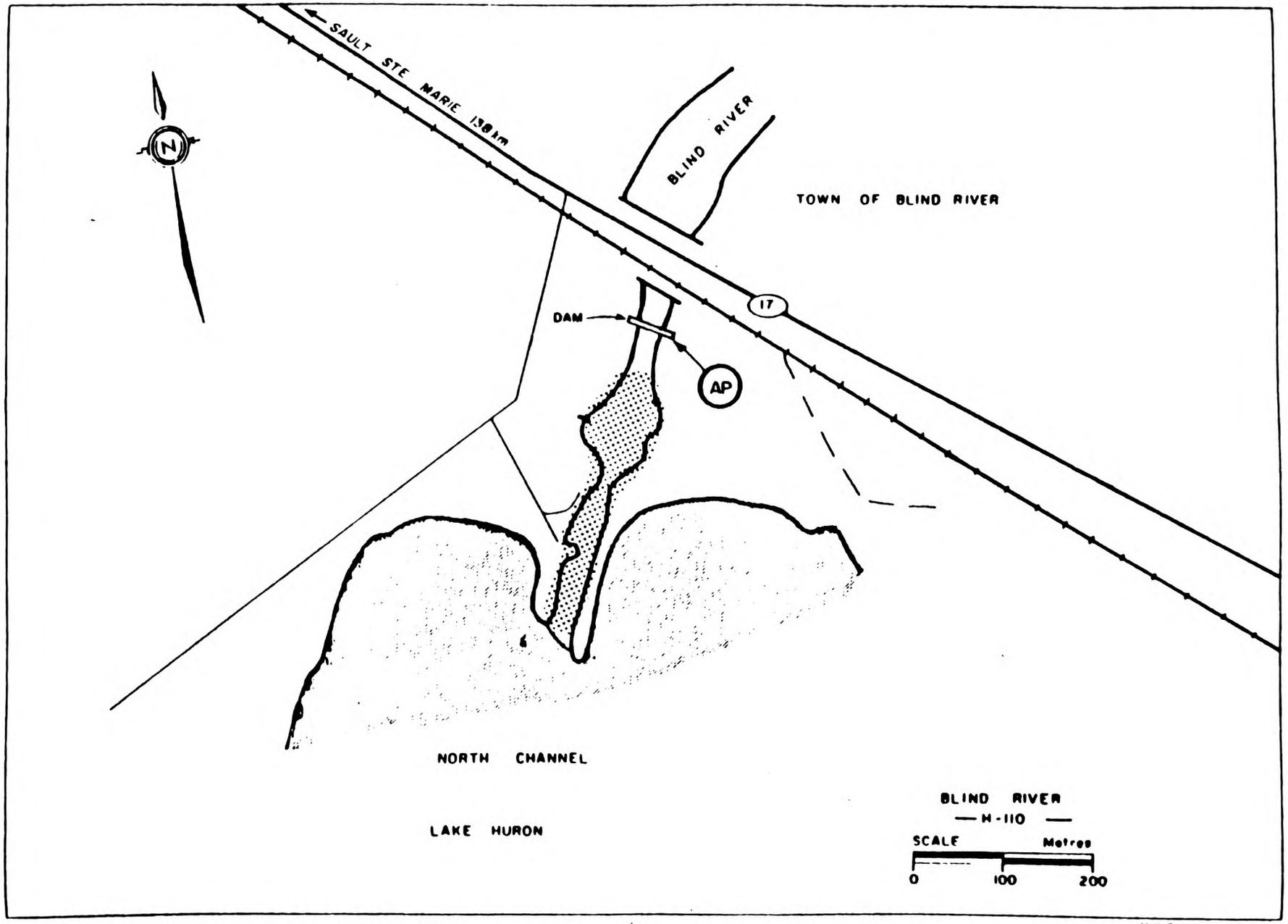


Figure 20. Detailed map of Blind River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Blind River (Continued)

Spawning of adult sea lamprey in this watershed was sporadic during the 1970's and larval production was low. However, increased numbers of spawning sea lamprey in the last few years has resulted in a build up of the larval population. Possible reasons for this apparent increase in lamprey activity are the improvement in water quality resultant from the installation of a sewage treatment facility for the Town of Blind River, and the large uncontrolled population of sea lamprey in the neighbouring St. Marys River.

Due to relatively high flows and low stream temperature, the Blind River and adjacent lake area were not thermally stratified during this treatment as was the case during the 1982 treatment. By manipulating stoplogs at the control dam, reduced flows were achieved. The lampricide block moved quickly out past the mouth and an excellent mix of lampricide from top to bottom was achieved. Larval sea lamprey were moderately abundant, 97 being collected, 76 to 176 mm in length. Most were collected in the lower 0.2 km of stream but very few beyond the mouth proper. Gulls were observed feeding on ammocoetes throughout the treatment. Numerous spawning phase sea lamprey were observed swimming during the treatment and about 70 were collected for biological studies.

Root River - Figure 21

The Root River, a tributary to the St. Marys River, is a complex system composed of a number of tributary systems traversing scrub bushland in Tarentorus Township, the City of Sault Ste. Marie, and the Garden River and Rankin Indian Reserves. The upper reaches of this soft water stream consist of riffles and pools with a substrate of boulder, rubble and/or gravel interspersed with occasional pockets of coarse to fine stand. The lower portion of the watershed is somewhat sluggish and turbid having a sandy, silty clay substrate. The watershed is subject to highly variable flows which may range from 28 m^3/s in spring runoff to 0.3 to 0.4 m^3/s in July and August.

The upstream migration of sea lamprey is blocked by waterfalls situated 23.5 km from the mouth on the main river and 8.5 km from the confluence on Crystal Creek, a major tributary. Upstream migration on other tributary systems has been variable and appears to be influenced by beaver ponds, availability of spawning habitat and fluctuating discharges.

The Root River a regular and moderate producer of sea lamprey ammocoetes, has been previously treated with lampricide in 1961, 1966, 1970, 1974, 1977 and 1980. Reestablishment has been sporadic in some tributary systems and consequently, no treatment was conducted on the West and West West Root in 1977 and again in 1980.

Stream discharge was less than ideal for the 1984 treatment, but with the aid of three boost feeder and satisfactory coincidence of the main lampricide block with the Crystal Creek block, a theoretical lethal level was achieved to the mouth. There was a constant threat of rain and thunder storms throughout the four day treatment period but no measurable precipitation occurred.

Because of the long inaccessible stretches of both the main river and Crystal Creek in the Indian Reserves, some escapement may have occurred due to lack of supplementary lampricide application.

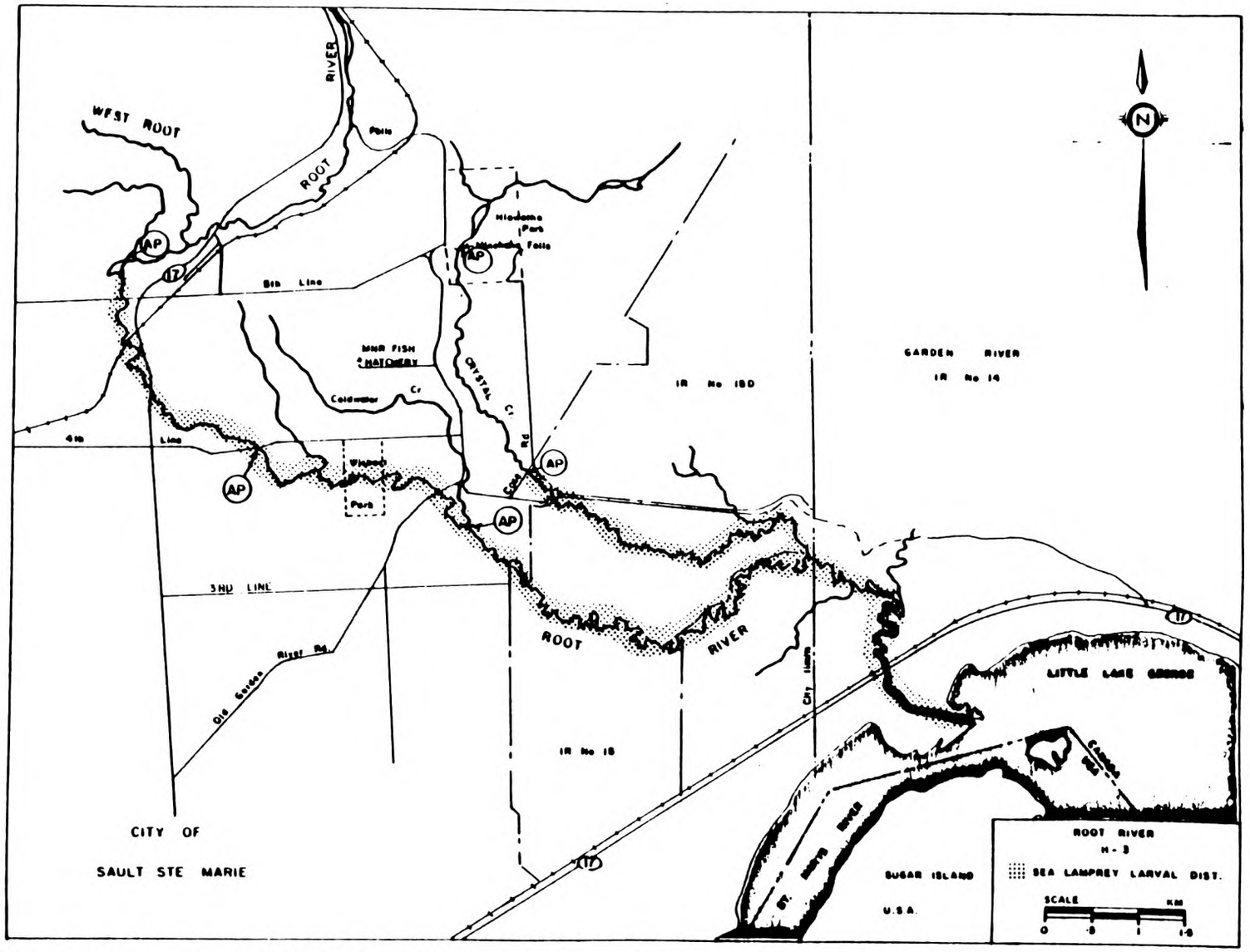


Figure 21. Detailed map of the Root River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Root River (Continued)

Larval sea lamprey were rated as moderate in abundance with 396, 21 to 176 mm in length, being collected during the treatment. Larvae were scattered throughout the system, but greatest numbers were in the central part of the main river.

Approximately 50 spawning phase sea lamprey were observed during the treatment.

Non-target fish mortality was minimal with small numbers of logperch, longnose dace and trout-perch being killed, mainly near the upper application point in the main river.

Garden River - Figure 22

The Garden River flows through rough, uninhabited deciduous hardwood forest of the Pre-Cambrian Shield and joins the St. Marys River approximately 11.0 km east of Sault Ste. Marie. The river is characterized by long stretches of swift, shallow water flowing over boulders and gravel, interspersed with deep, quiet pools having sand-clay substrates. The discharge is variable and high spring flows have created many isolated beach pools and oxbows. The mean summer discharge approximates 4.3 m^3/s and the water is soft and clear.

The upstream migration of sea lamprey is blocked on the mainstem by a waterfall located 61 km from the mouth and on the major sea lamprey producing tributary, Maud Creek, by a falls approximately 4.8 km from the confluence.

Garden River, a prolific producer of sea lamprey ammocoetes, has been treated in 1966, 1970, 1974, 1977, 1979 and 1981. During this period no major changes in sea lamprey distribution have occurred. An electrical barrier was operated on this river in 1965 and 1966.

The 1984 lampricide treatment covered 74.1 km of watershed in Dunkin, Curtis, Gilmore, Chesley and Anderson Townships and Garden River Indian Reserve in Algoma District. Maud Creek was treated separately prior to the main block; all other tributaries including one sea lamprey producer, Silver Creek, were treated concurrently with the Garden River treatment.

A treatment concentration of 0.8 ppm TFM for 12 hrs was determined from the water chemistry and previous bioassay data. The treatment was plagued by heavy rain and thunderstorms, however the subsequent increase in discharge was delayed sufficiently to allow for the passage of the lampricide block, without the requirement for a boost.

Numerous oxbows and isolated pools were treated prior to application of the main lampricide block in order to allow for a more concentrated effort on numerous seepage areas, springs, back eddies and groundwater exchanges which have been an unquantified source of escapement during past treatments. Ammocoetes were moderately abundant throughout the main river and in the upper portion of the Maud-Driving tributary system but were very scarce in the lower portion of the river.

Non-target fish killed during the treatment consisted primarily of large numbers of logperch and trout-perch.

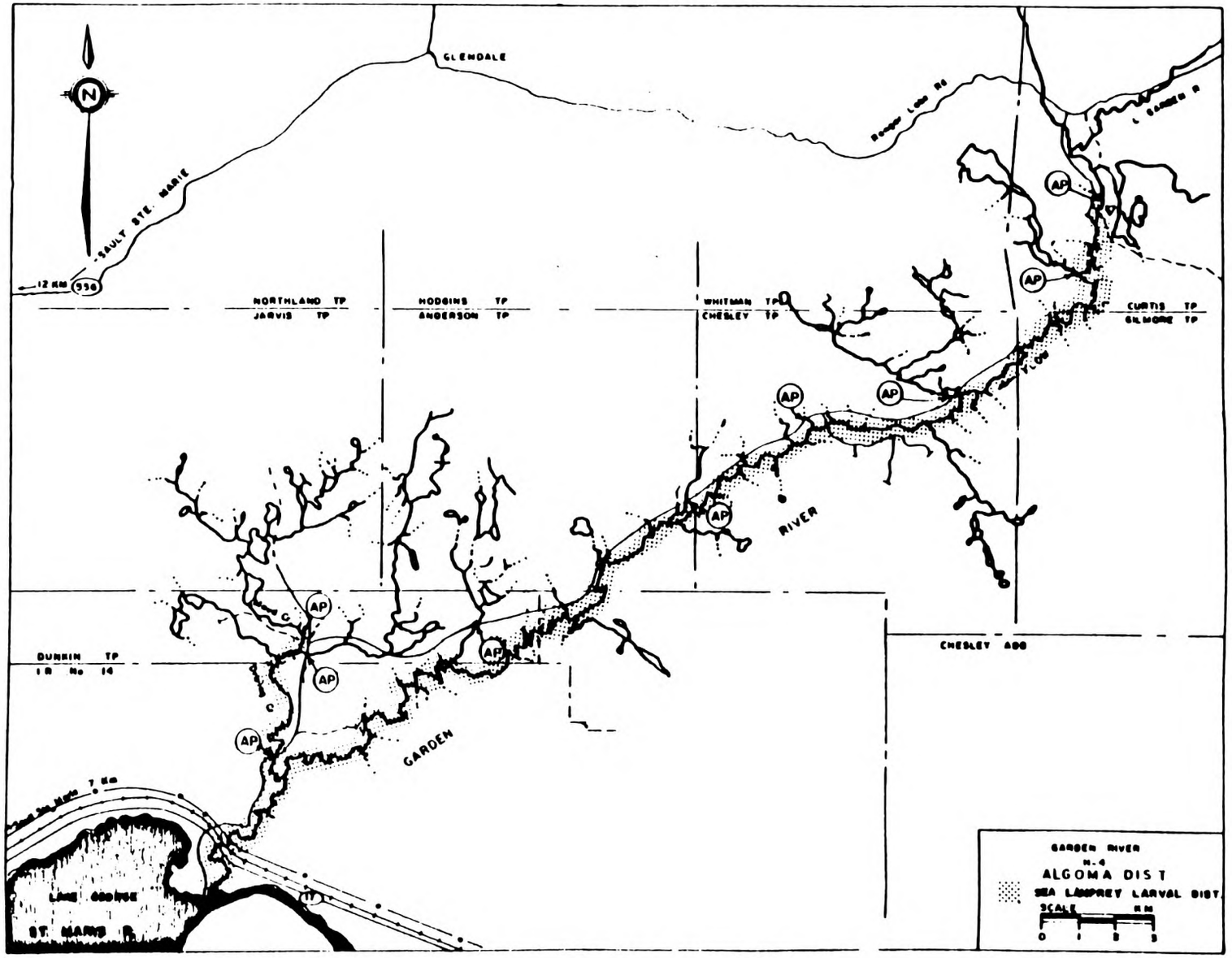


Figure 22. Detailed map of Garden River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Thessalon River - Figure 23

A 36.8 km section of the Thessalon River located in Lefroy Township, Algoma District, was treated with lampricide. A control dam situated in the Village of Rydal Bank serves as a barrier to anadromous sea lamprey. The river, tributary to the North Channel at the Town of Thessalon, has been treated in 1967, 1971, 1975 and 1979.

The most interesting aspect of the 1984 lampricide treatment on the Thessalon River was the discovery of two previously undetected sea lamprey producing tributaries. Both of these small unnamed streams (approximate flows of 0.014 m^3/s) had limited spawning facilities, however substantial numbers of sea lamprey larvae were present. The uppermost stream contained what appeared to be one year class of larvae and was the heaviest producer with literally thousands of specimens observed. The lowermost stream also contained one year class, however fewer numbers were present. Collection data indicated that sea lamprey spawning had not occurred annually in either stream although two adults were observed in the lower tributary during the treatment. The discovery of these two tributaries prompted post-treatment surveys on a number of small feeder streams, however no other larval populations were detected.

Treatment of the main Thessalon and the two major tributaries, Bridgeland and MacDonald Creeks, was routine with no problems encountered. Required lampricide levels were attained to within 300 m of the river mouth. Below this, treatment effectiveness was partially negated by thermal stratification.

Surveys conducted in the stratified area with granular Bayer 73 during the passage of the TFM block indicated that the larvae are relatively scarce and that escapement was minimal. The granular Bayer application covered approximately 25 per cent of the stratified area. TFM analysis indicated that stratification probably occurred just prior to the passage of the block of chemical, since top and bottom lampricide concentrations were mixed during initial sampling.

Larval sea lamprey were abundant throughout the watershed with substantial numbers being observed in MacDonald and Bridgeland Creeks and the small tributaries. Approximately 22 per cent of the 1,627 sea lamprey larvae collected were greater than 120 mm in length. Of interest was the length frequency range of 76 to 146 mm for the collection of 474 specimens from one of the small tributaries. This collection appears to consist of one year class.

Non-target fish mortality was insignificant and consisted mainly of trout-perch.

Naiscoot River - Figure 24

The Naiscoot River and its major tributary, the Harris River, drain Naiscoot and Harris Lakes, respectively, joining at Highway 529 and emptying midway on the eastern shore of Georgian Bay approximately 48 km north of Parry Sound, Ontario. The treated portion of this river system is situated in Wallbridge and Harris Townships, and the Naiscoutaing Indian Reserve in the District of Parry Sound.

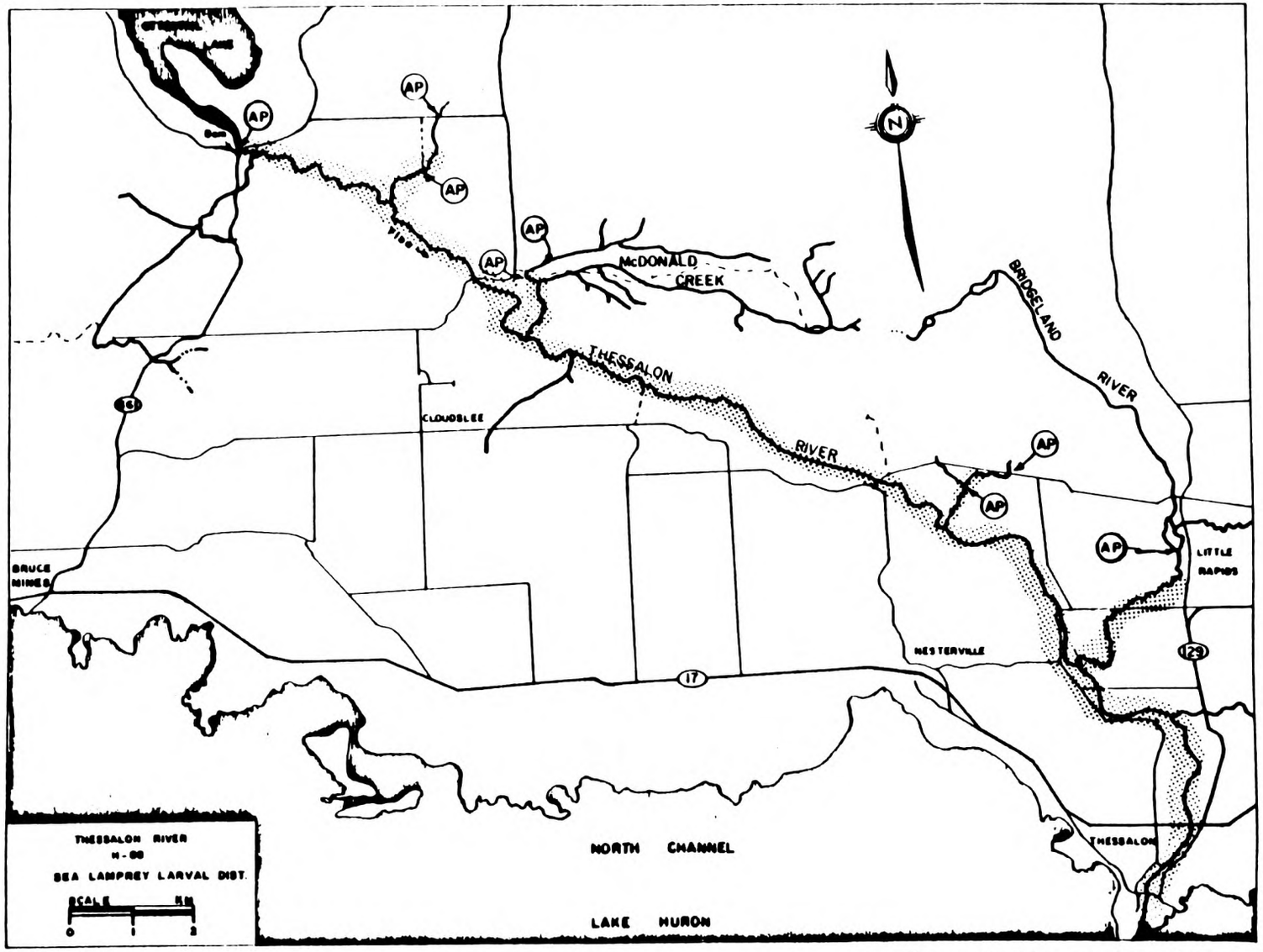


Figure 23. Detailed map of Thessalon River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

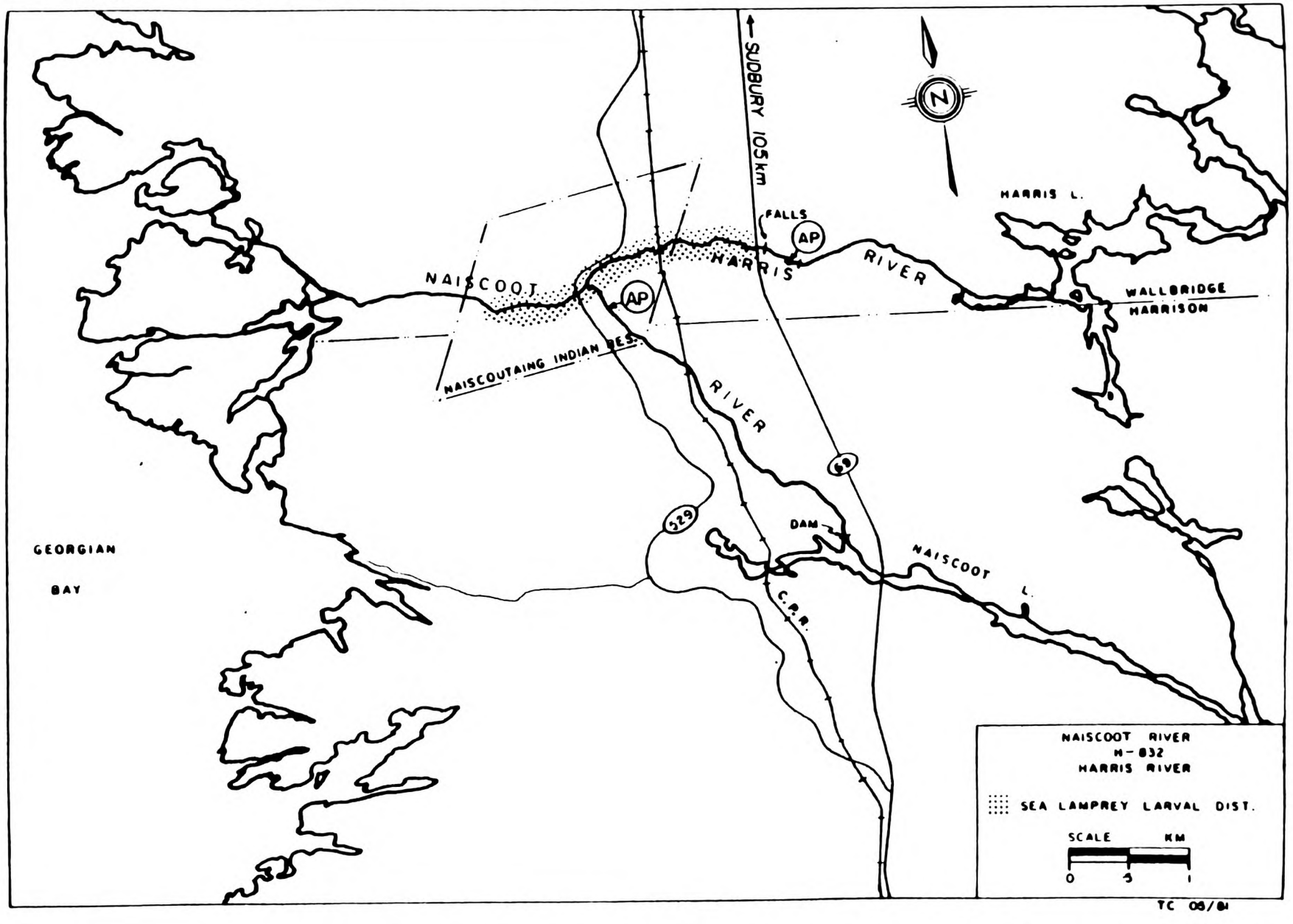


Figure 24. Detailed map of Naiscoot River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Naiscoot River (Continued)

Upstream migration of spawning sea lamprey is halted by a waterfall just above Highway 69 on the Harris and by a control dam on the Naiscoot River situated at the outlet of Naiscoot Lake. The Naiscoot has little gradient and contains little discernible spawning gravel whereas the Harris River has a moderate gradient and adequate spawning and larval habitat. The total summer discharge is variable, with the lower 8 km of the main river channel subject to seiche action.

Lampricide treatments have been conducted on the Naiscoot River in 1960, 1968, 1972 and 1980. An electrical barrier was operated on both rivers from 1965 to 1978. A treatment concentration of 0.4 ppm TFM for 12 hrs was determined from the water chemistry and previous bioassay data. Optimum treatment flows existed for the 1984 treatment and consequently an excellent treatment was obtained throughout the long estuary.

As no sea lamprey larvae were found in the Naiscoot River above the confluence with the Harris River, only the Harris was treated with chemical in 1984. Lampricide was applied to the Harris River immediately above the barrier fall and to the Naiscoot from just above the Harris-Naiscoot confluence.

Sea lamprey were moderately abundant in the upper section of Harris Creek but numbers diminished near the lower end. Below the confluence of the Naiscoot River, sea lamprey were very scarce with only four larvae being collected.

Non-target fish mortality was limited to a few brown bullhead and logperch.

Magnetawan River - Figure 25

The Magnetawan River originates in the Huntsville-South River area of central Ontario and traverses a series of lakes and scrub bush land of the Pre-Cambrian Shield before entering Byng Inlet on central Georgian Bay at the Village of Britt. Average July discharge for this soft, dark-watered river would approximate 13 m^3/s from a drainage area of 2,850 km^2.

The upstream migration of sea lamprey is halted by a 2.4 m vertical waterfall situated 5.5 km from the mouth. The treated portion of the river, situated in Wallbridge Township, Parry Sound District, has a moderate gradient and is characterized by deep pools, interspersed with broad, shallow, sandy areas. Spawning gravel is located below three chutes situated throughout the watershed. This river, a moderate producer of sea lamprey larvae, has been treated in 1960, 1968, 1972, 1976 and 1980.

Since access to the lampricide application site on the Magnetawan River by water involves numerous portages, transportation of lampricide and equipment to the application site for the 1984 treatment was provided by a Hughes 500D helicopter. A previous treatment, conducted in 1980 and designed to provide lampricide coverage throughout Byng Inlet, indicated that the majority of the sea lamprey larvae were situated in the upper portion of the Inlet. The 1980 treatment resulted in significant mortality of non-target species, due in part, to the requirement for a high application rate. Consequently concentrations of

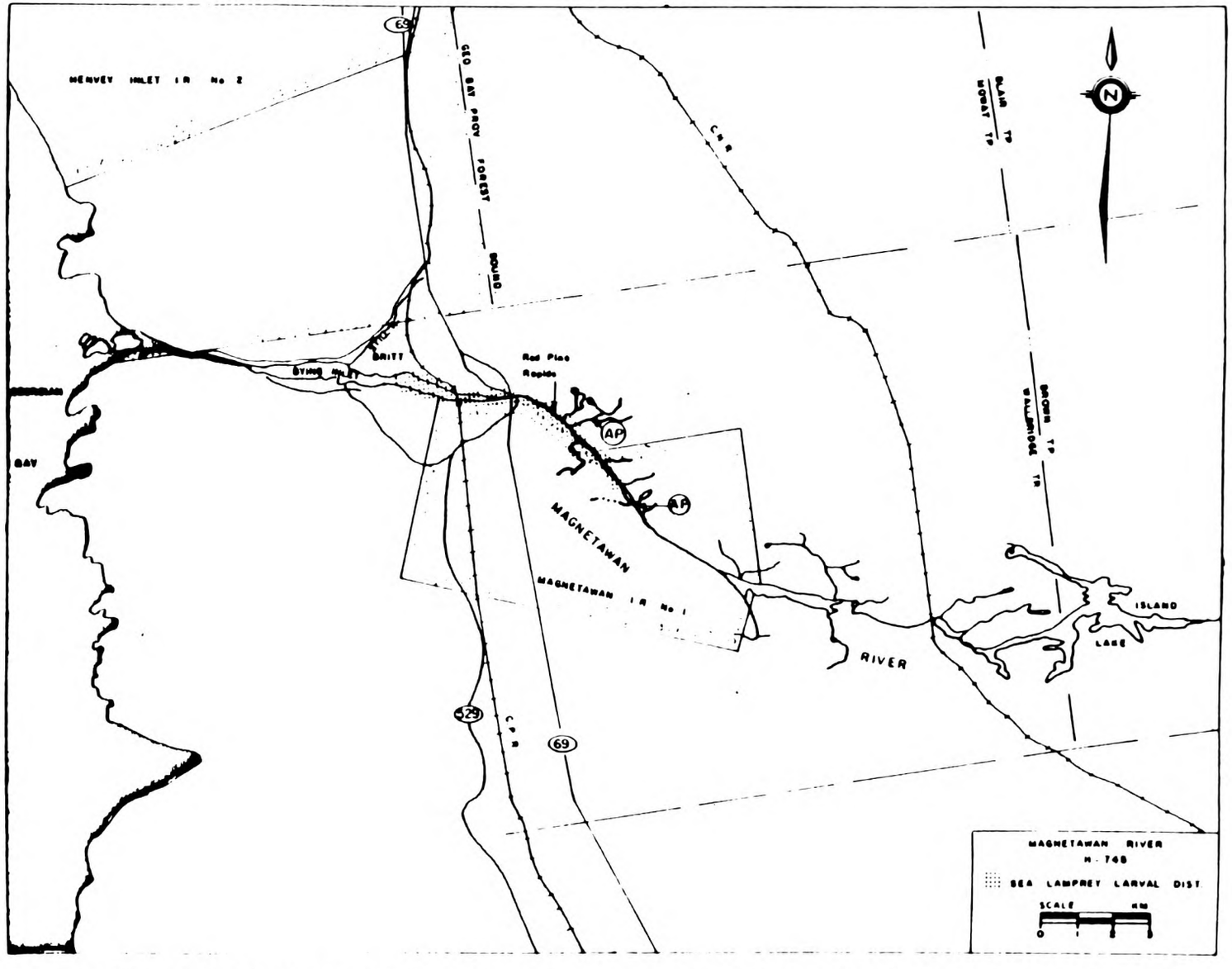


Figure 25. Detailed map of Magnetawan River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Magnetawan River (Continued)

lampricide at the feeder during the 1984 application were purposely lowered to avoid non-target fish mortality. Although the treatment was conducted in July, discharges were relatively high from excessive June rainfall and consequently, the objective of an effective treatment of the upper portion of Byng Inlet was attained.

Sea lamprey ammocoetes were moderate, the highest densities being observed in a 0.5 km section of the upper portion of river and in that section of Byng Inlet above the railway bridge. Below this point lamprey were apparently scarce, but other factors such as stratification, strong winds and the immensity of Byng Inlet makes larval collecting difficult.

Chikanishing River - Figure 26

The Chikanishing River situated in the northwest corner of Georgian Bay was treated with lampricide on July 13-14. Previous lampricide treatments have been conducted in 1960, 1968, 1972, and 1976. A treatment concentration of 0.3 ppm TFM for 8 hrs was determined from water chemistry and previous bioassay data.

The treatment originated from a small chute immediately above the barrier falls rather than at Highway 637. The downstream relocation of the lampricide application point had been requested by the Ministry of Natural Resources in order to prevent exposure of a resident brook trout population to TFM. Previous lampricide treatments had been conducted through the area in question with no observable negative impact on the trout population.

Sea lamprey were relatively abundant in the upper portion of the river but scarce in the lower portion. All year classes were present indicating that adult lamprey had been spawning successfully in this stream for a number of years subsequent to the 1976 treatment.

Fish mortality was minimal and confined to a few brown bullhead in the lower portion of the stream.

Wanapitei River - Figure 27

The Wanapitei River, located in Sudbury District, is a large watershed originating in the Pre-Cambrian Shield north of Sudbury and is tributary to the lower French River system on northern Georgian Bay. The river splits into two main branches approximately 1.6 km below a 3.1 m fall, has little gradient, and is quite wide and turbid. This watershed has been previously treated with lampricide in 1969, 1973 and 1978.

The flow of the Wanapitei River for the 1984 treatment was regulated by Ontario Hydro through the McVittie Dam near Burwash. Lampricide and equipment were ferried by boat from Hartley Bay, a distance of 10 km.

The treatment concentration of 0.4 ppm TFM and 1.6 per cent powdered Bayer 73, determined by bioassay, provided for an effective level of ammocoete mortality with negligible impact on non-target species.

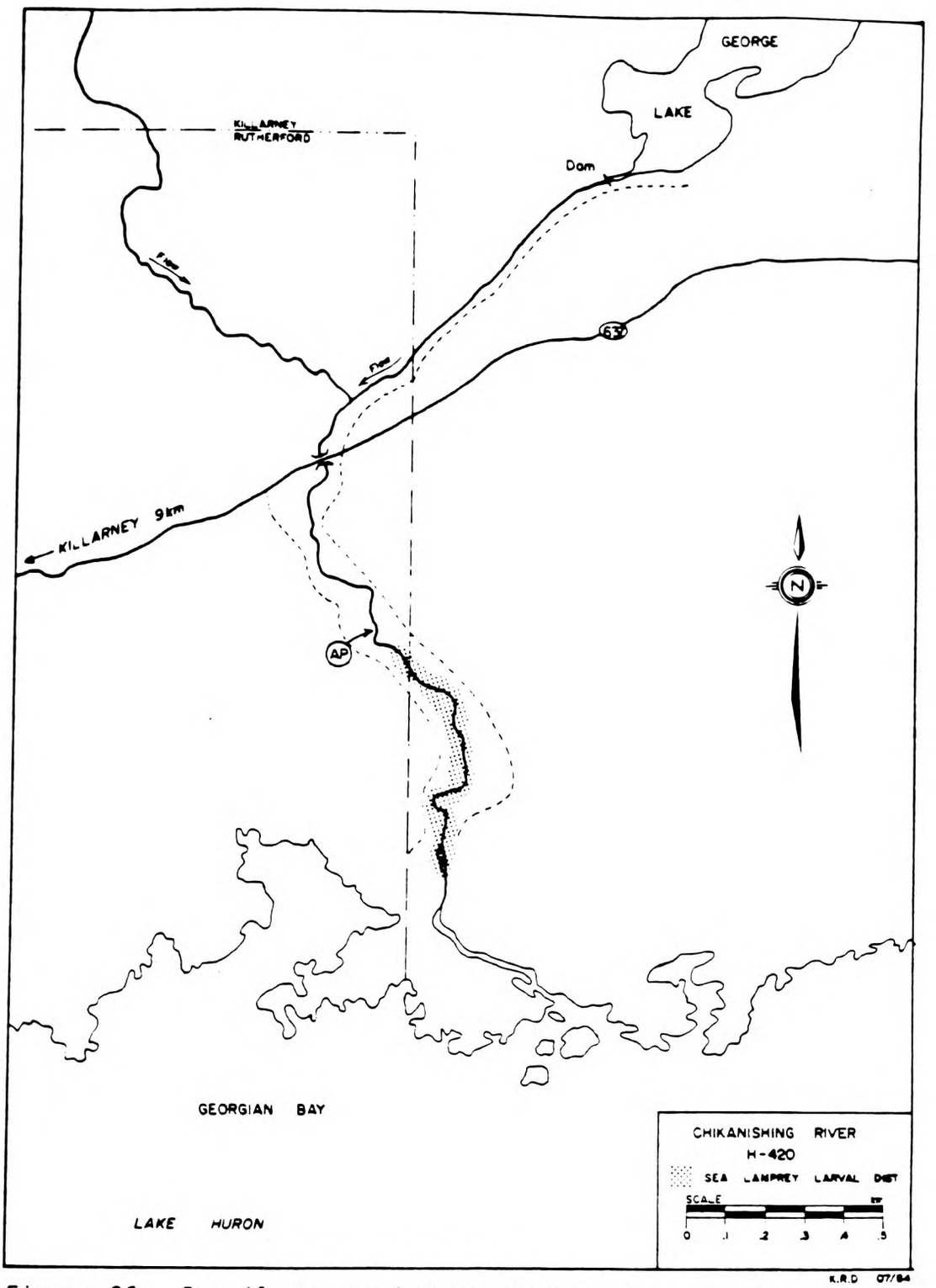


Figure 26. Detailed map of Chikanishing River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

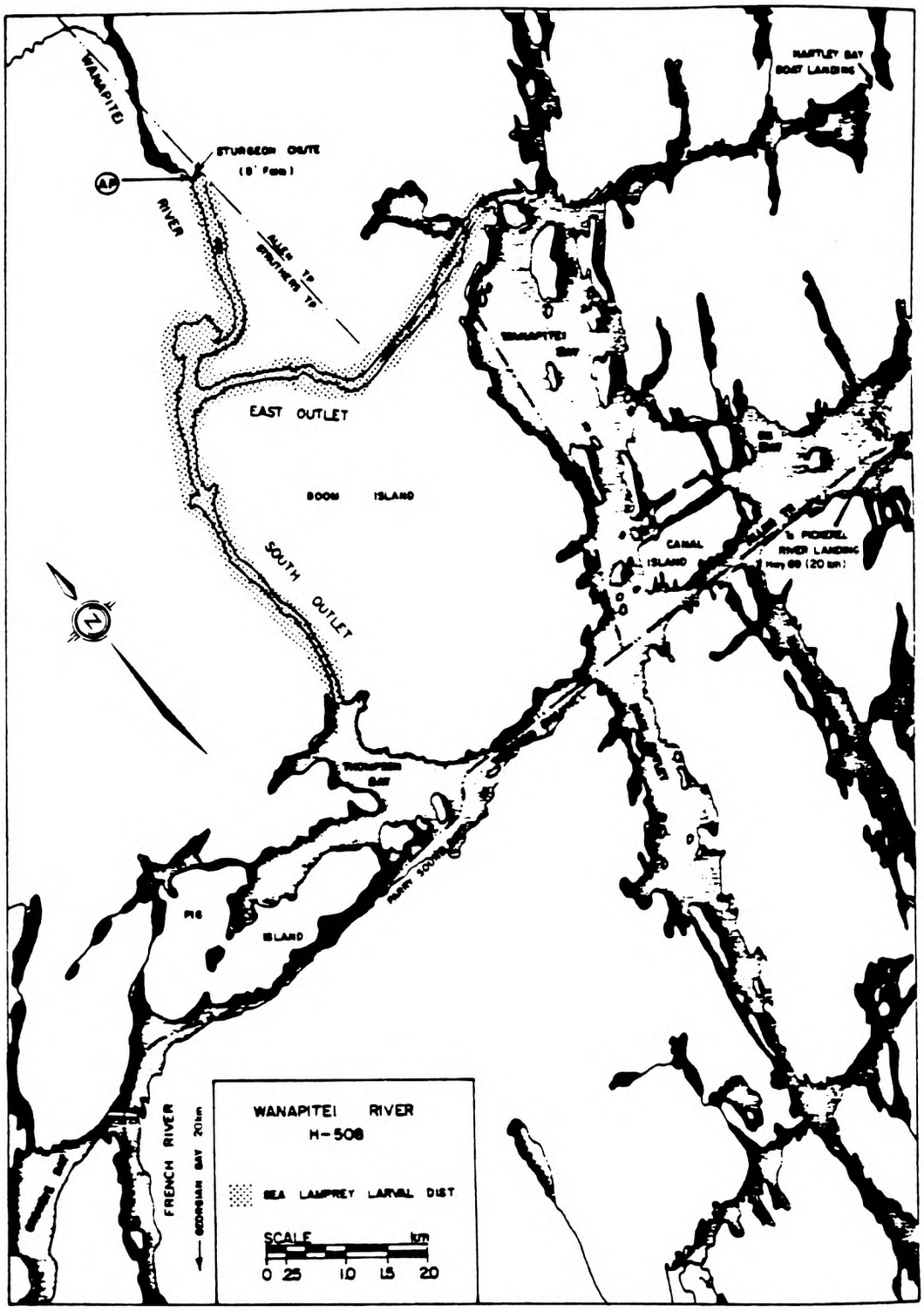


Figure 27. Detailed map of Wanapitei River showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Wanapitei River (Continued)

Strong directional winds along with high flows allowed for a fairly rapid movement of the TFM block with desired concentrations being obtained at both mouths.

Sea lamprey larvae appeared to be relatively scarce, with the majority of the population residing in the upper portion of the watershed. Estimates of lamprey abundance on this watershed are always very subjective, and may possibly be too low due to high turbidity and the occurrence of ammocoete activity periods during the night.

LAKE HURON GRANULAR BAYER 73 TREATMENTS

The granular formulation of Bayer 73 was applied to four areas in the St. Marys River system, to the deltas of three streams tributary to Tenby Bay and one stream tributary to Desjardins Bay and to selected areas in the Western Channel of the lower French River system. Table X lists the pertinent treatment data whereas Figures 28 to 35 describe the actual treatment areas.

Repeated applications of Bayer 73 granules to known areas of high larval density have significantly reduced the numbers of ammocoetes in some instances and have provided some measure of control..

French River - Figure 28

The lower section of the Western Channel of the French River system is composed of numerous channels and bays which fan out over an area approximately 51 km^2 prior to entering Georgian Bay.

Surveys conducted since 1983 have identified the existence of small pockets of sea lamprey associated with limited areas of spawning habitat. Sea lamprey were found in abundance previously in one of these channels which was subsequently treated in 1976 with TFM.

In 1984, four areas totalling 0.32 ha were treated with 68 kg of granular Bayer 73. Sea lamprey were relatively scarce with 46 specimens (41 to 161 mm in length) being collected from only two (F-26, F-27) areas. Although the presence of multiple year classes in the collection indicates that limited spawning occurs on an annual basis in one channel (F-26), continued treatment and monitoring of selected areas with Bayer 73 granules appears to be a practical and economical means of control in this area at the present level of infestation.

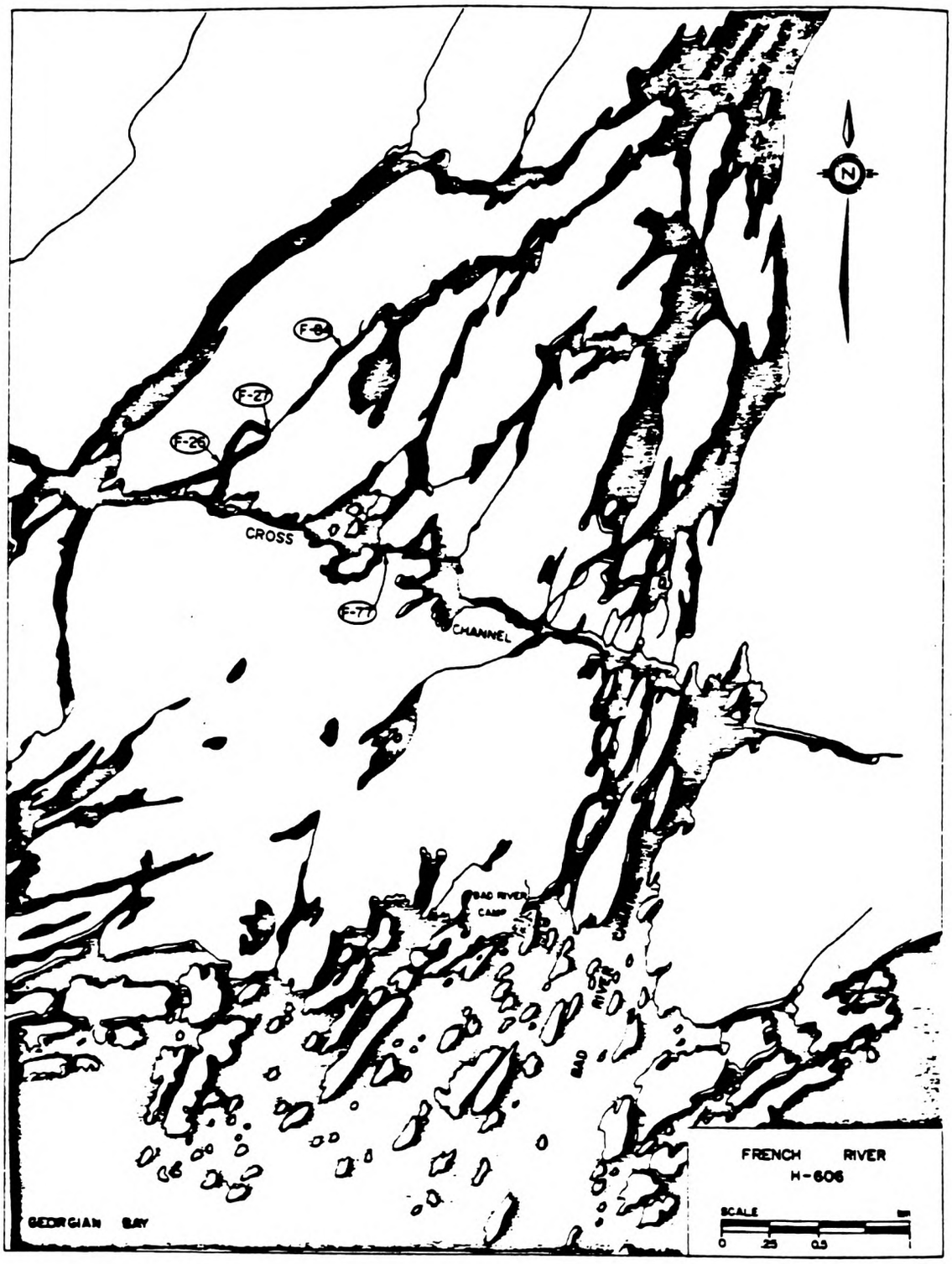


Figure 28. Detailed map of lower French River showing approximate locations of granular Bayer 73 treatment areas in 1984.

Tenby Bay - Figure 29

The deltas of three streams tributary to Tenby Bay were treated with granular Bayer in 1984. The delta of Brown Creek, the most prolific sea lamprey producer of the three tributaries was treated on July 28. An area of 0.9 ha was treated with 227 kg of Bayer 73 granules. Sea lamprey ammocoetes were moderately abundant in this area with 200 specimens (61 to 141 mm in length) being collected.

On July 20, small granular Bayer treatments were conducted off the mouths of Gordon and Watson Creeks. Four specimens (96 to 126 mm in length) were found in Gordon Creek, while three sea lamprey (71 to 126 mm in length) were found in Watson Creek. It appears that the latter two would not make any significant contribution to the population of Tenby Bay.

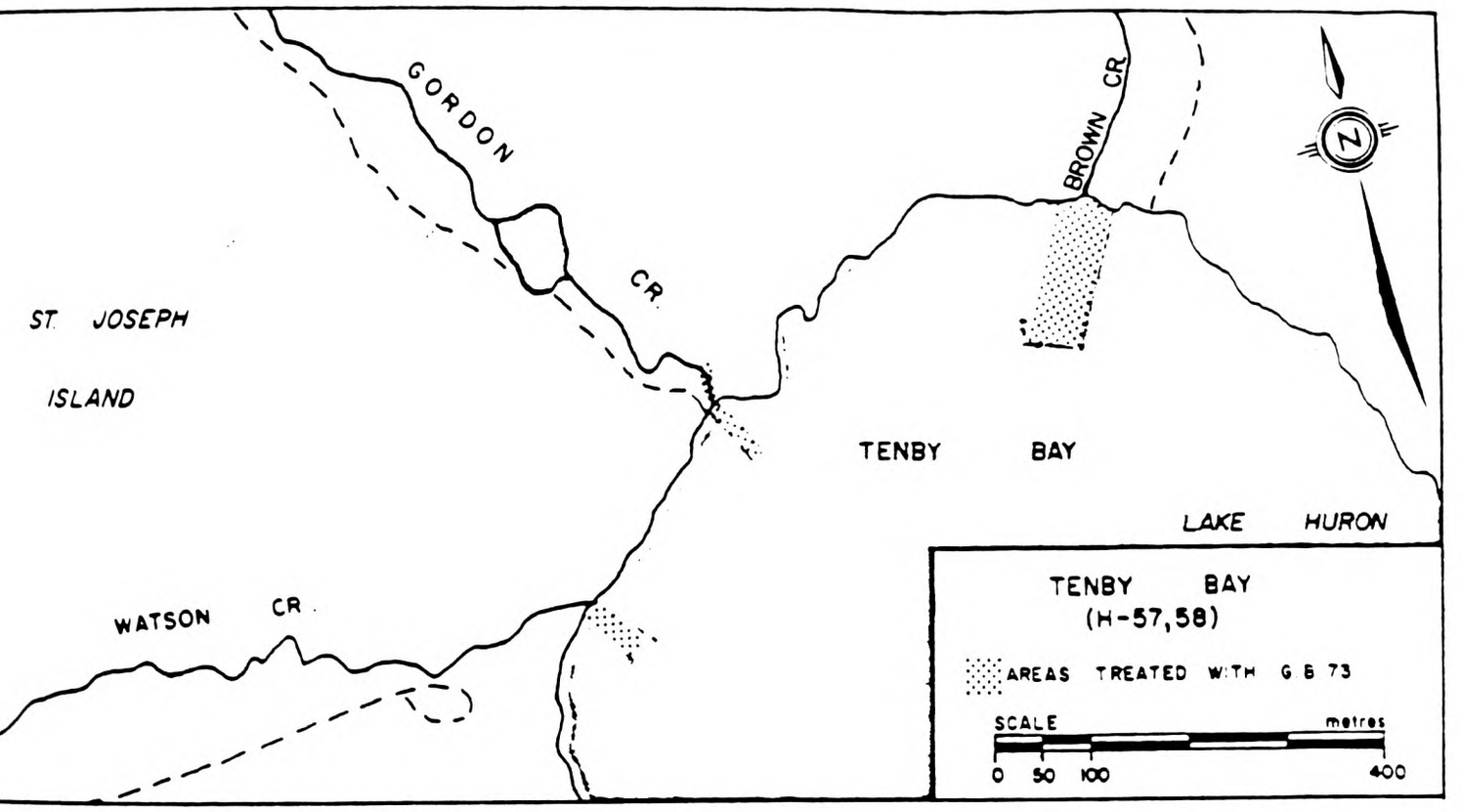


Figure 29. Map of Tenby Bay showing approximate location of areas treated with granular Bayer 73 in 1984.

Desjardins Bay - Figure 30

Two small areas were treated with 45 kg of Bayer 73 granules in the estuarine area of Sucker Creek, a tributary to Desjardins Bay on July 14. No sea lamprey were found in either of the treated areas.

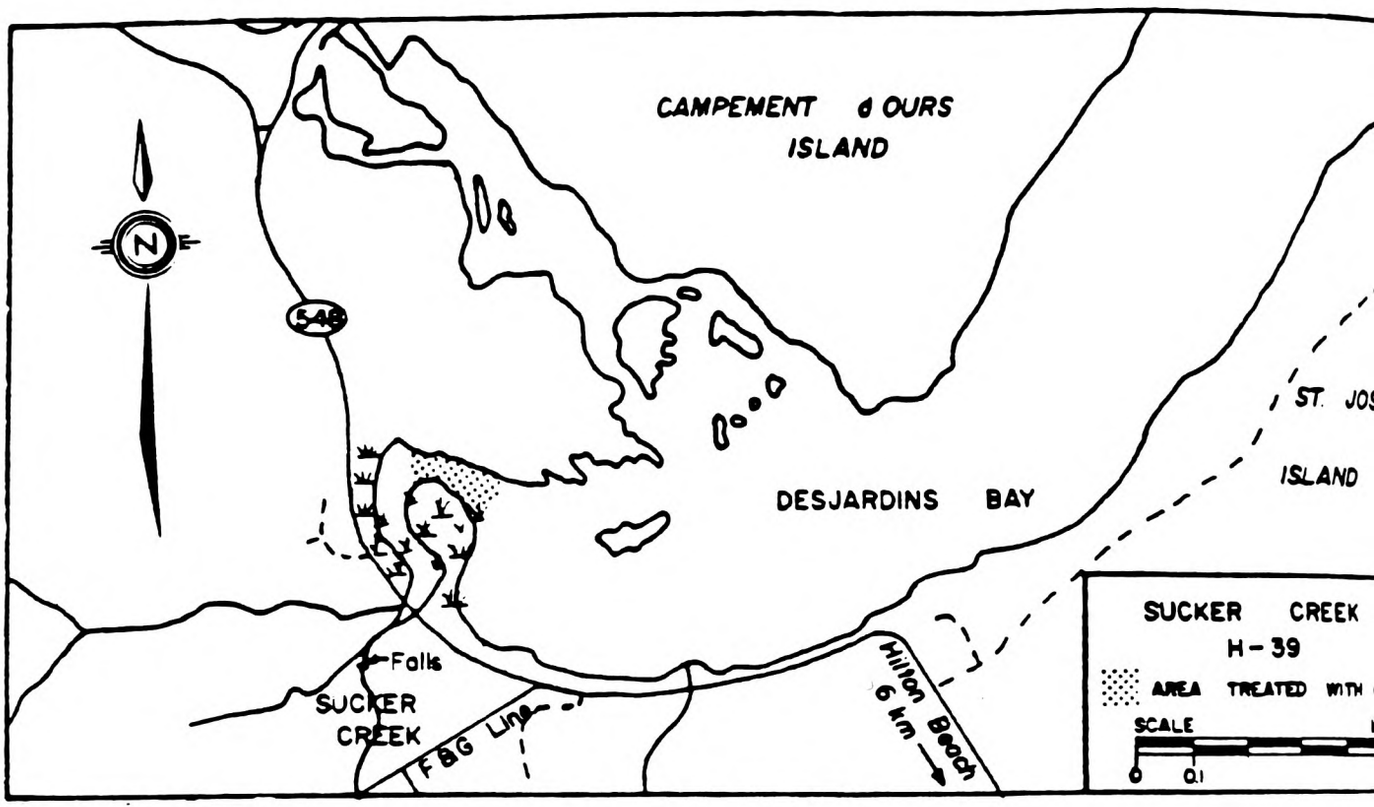


Figure 30. Map of Sucker Creek showing estuarine area treated with granular Bayer 73 in 1984.

St. Marys River - Figure 31

Whitefish Island - Figure 32

A 1.71 ha area, situated immediately below Whitefish Island and adjacent to the St. Marys Rapids was treated with 431 kg of Bayer 73 granules on July 31.

Although strong winds and the presence of gulls and terns made collection efforts more difficult, sea lamprey appeared to be less abundant than in the 1983 treatment of this area.

A total of 515 larval-staged and 10 transforming lamprey were collected during treatment, whereas 3,226 specimens were captured in 1983.

The number of sea lamprey larvae observed during treatments of Whitefish Island area continue to fluctuate erratically and appear to be cyclic in nature, with a year of high abundance succeeded by two or three years of declining numbers.

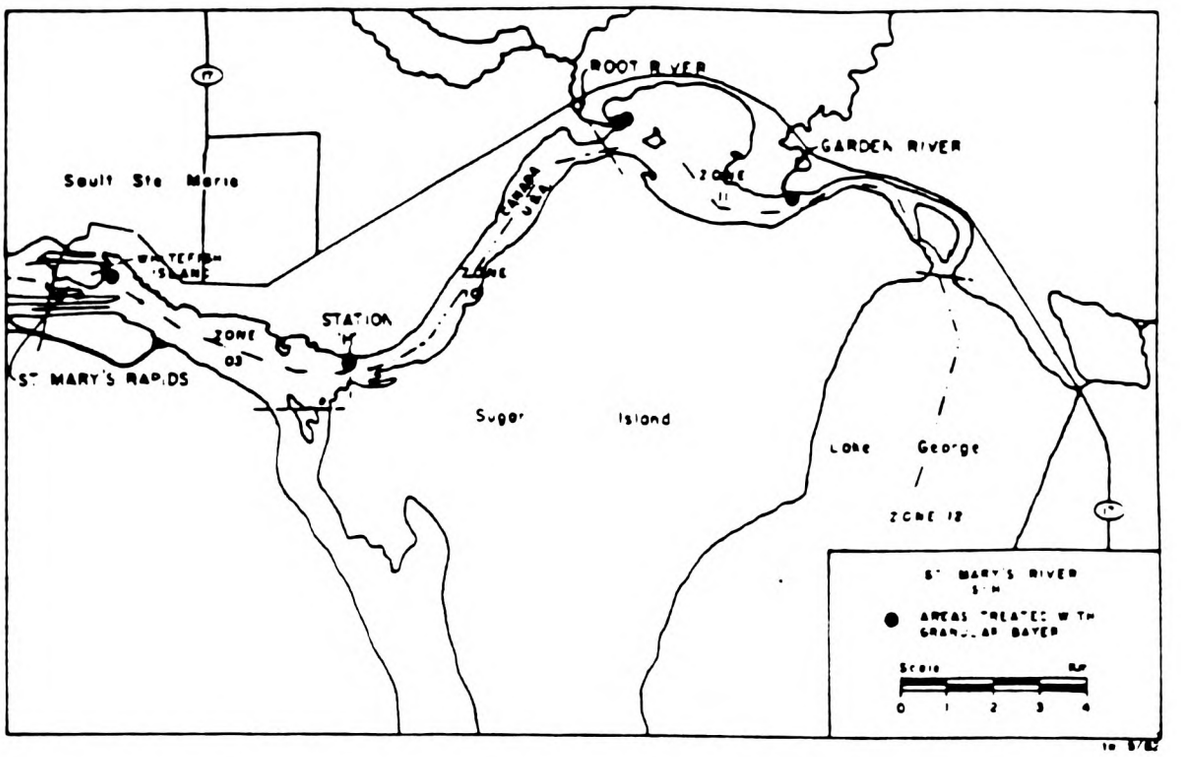


Figure 31. Map of the upper St. Marys River showing general location of the four areas treated with granular Bayer 73 in 1984.

Station "H" - Figure 33

On August 1, a 2.7 ha area situated midway between Bellevue Park and the Sault Ste. Marie sewage treatment plant was treated with granular Bayer 73.

A total of 2,071 larval-staged and one transforming lamprey were collected in 1984 compared to 2,290 in 1983.

Root River - Figure 34

Granular Bayer was applied to two areas (0.72 ha) on the delta of the Root River on July 30. Ammocoetes were relatively scarce with a total of 71 larval specimens, 31 to 176 mm in length, being collected. No apparent change in ammocoete density has occurred for a number of years.

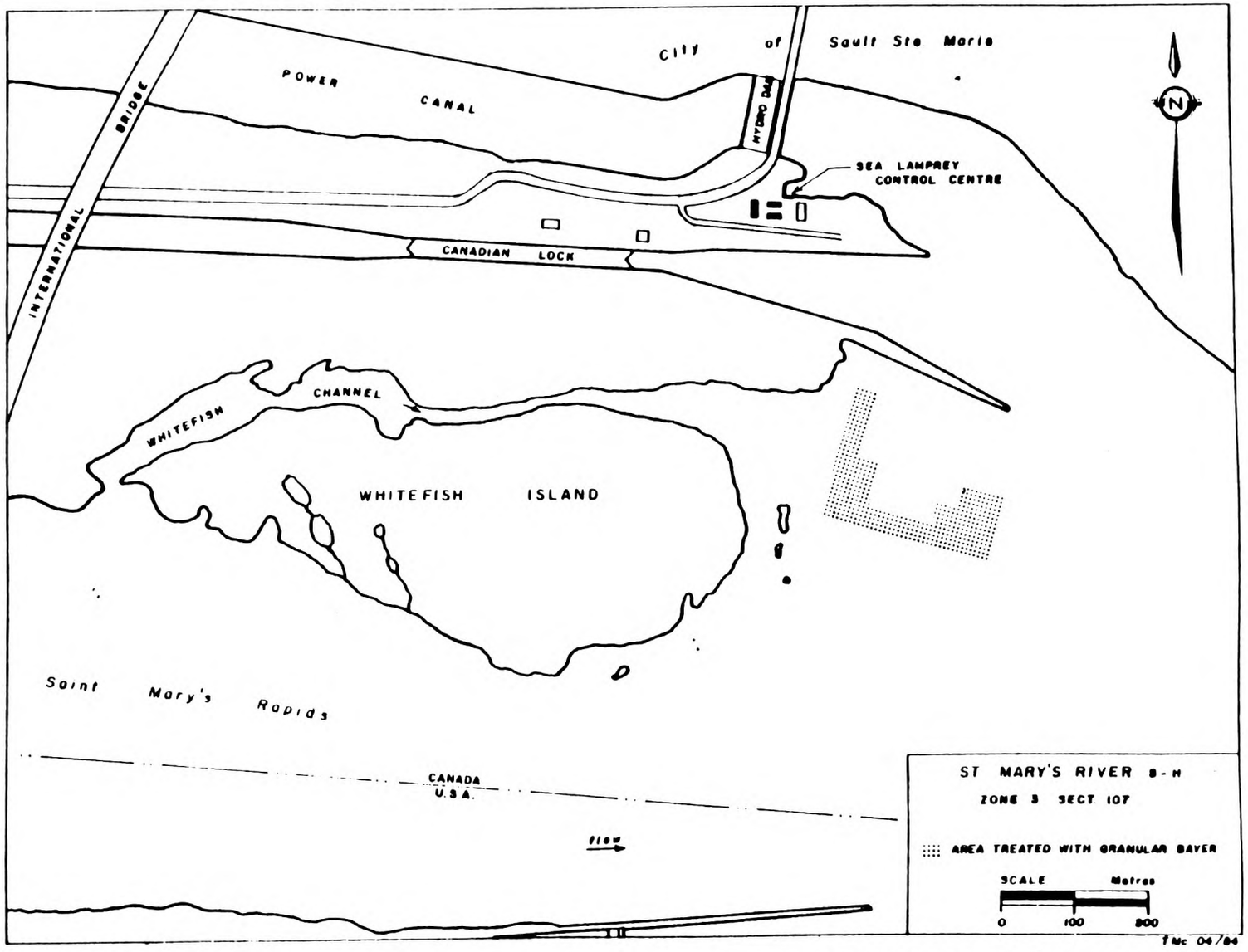


Figure 32. Map of Whitefish Island, St. Marys River, showing general location of area treated with granular Bayer 73 in 1984.

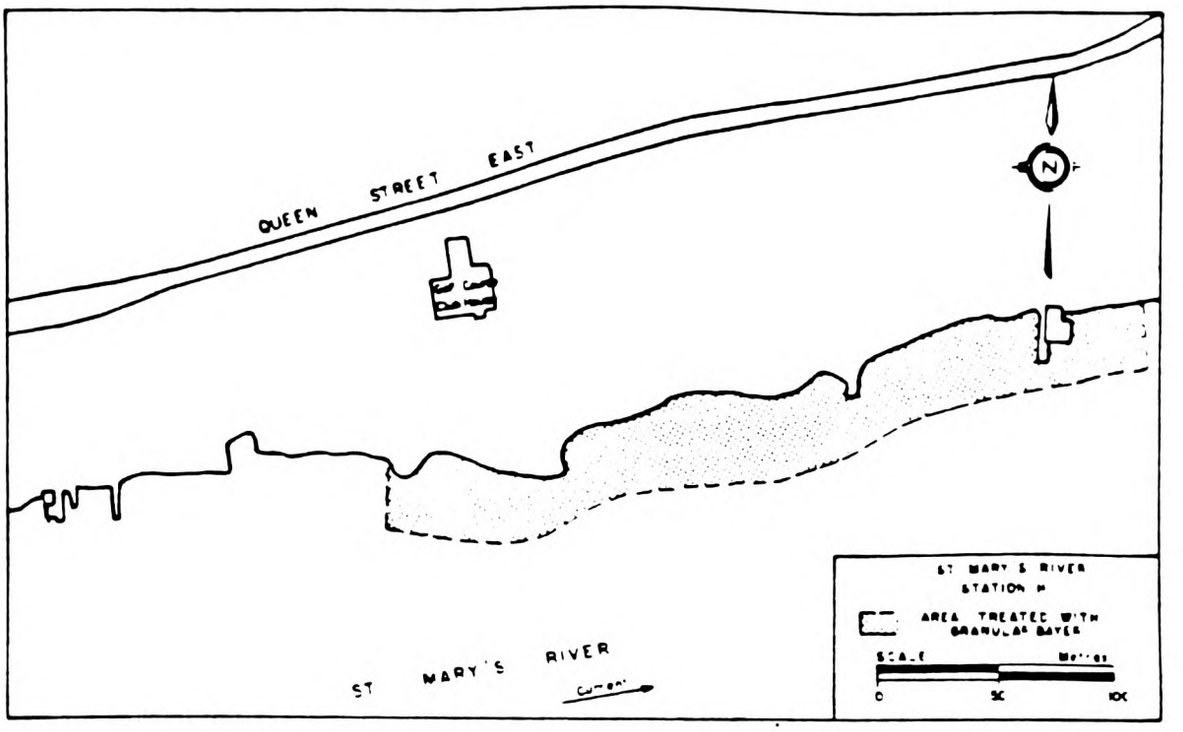


Figure 33. Map of the Station "H" area of the St. Marys River showing general location of the area treated with granular Bayer 73 in 1984.

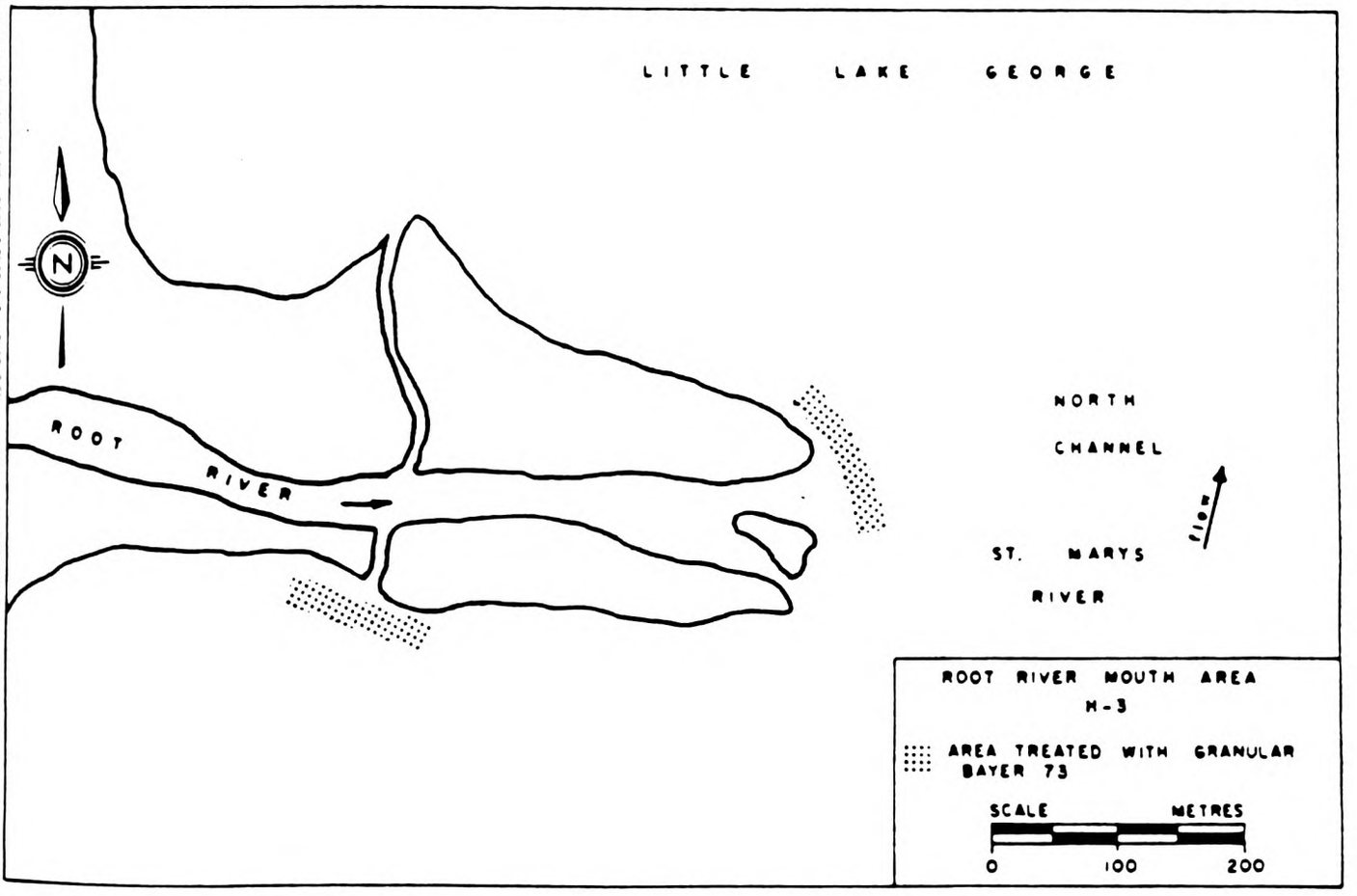


Figure 34. Map of the Root River area of the St. Marys River showing general locations of the areas treated with granular Bayer 73 in 1984.

Garden River - Figure 35

On August 2, an area of St. Marys River (1.9 ha) extending downstream 960 m from the mouth of Garden River was treated with 364 kg of Bayer 73 granules. The area was similar in size and location to that treated previously from 1980 to 1983.

Sea lamprey were less abundant than in 1983, probably owing to the fact that the Garden River was treated that year at a higher flow than normal, and lampricide penetrated well out into the delta area.

A total of 309 specimens (26 to 151 mm in length) were collected, not including some predation by gulls and terns.

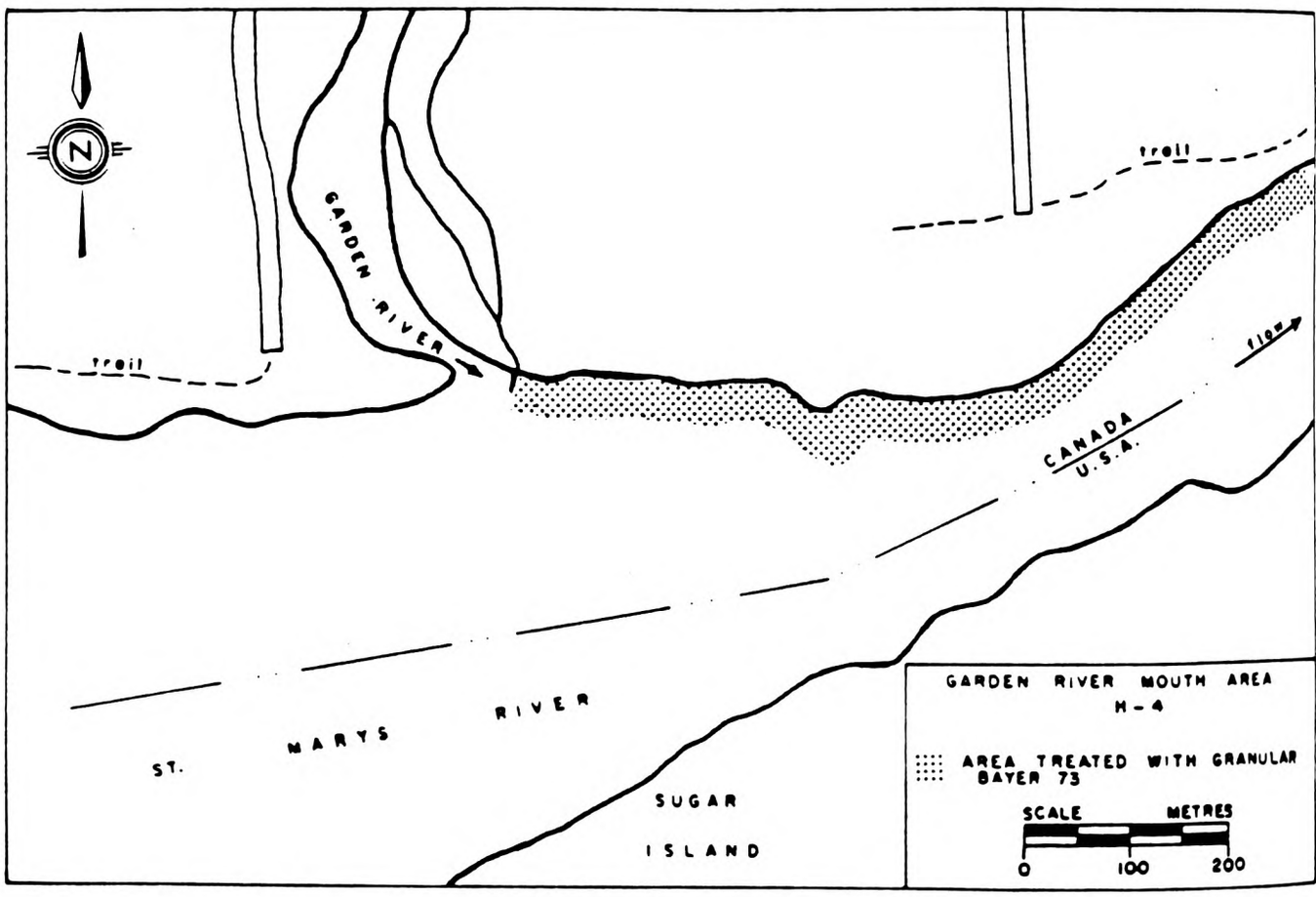


Figure 35. Map of the Garden River area of the St. Marys River showing general location of the area treated with granular Bayer 73 in 1984.

LAKE ONTARIO, CANADA, LAMPRICIDE (TFM) TREATMENTS

The following four Canadian streams tributary to Lake Ontario were treated with the selective lampricide 3-trifluoromethyl-4-nitrophenol (TFM) in 1984.

Lynde Creek	-	May 3-4
Oshawa Creek	-	May 7-8, 11
Proctor Creek	-	May 14-15
Shelter Valley Brook	-	June 16-18

Because of very high water discharge in May, the Moira River treatment was deferred until June. However by June 19, when flows were suitable, a mock treatment using Rhodamine dye showed pronounced temperature stratification and very poor mixing. Thus the lampricide treatment was again deferred until a later date.

Because the low head barrier dam on Graham Creek (constructed in 1983-84) was breached in May, the treatment was deferred. The dam was subsequently repaired in 1984 however, further surveys will be required to determine the extent and timing of the pending treatment.

Table XI lists the pertinent treatment data, Figure 36 depicts the general location of the streams treated, and Figures 37 to 40 illustrate treatment details.

The following are brief descriptions of the streams and accounts of their treatments. Although sea lamprey larval abundance ratings are subjective in that they are not based on a standardized unit of effort, they are realistic in that they take into account such pertinent factors as; stream distance treated, degree of collecting difficulty, observations of larval density in non-collection areas, and the number of larvae actually collected during present and past treatments. The dates of stream treatments are inclusive of the time from the first lampricide application to the time of the last water sample taken from the stream for TFM analysis.

Terms, abbreviations and symbols used are explained in Appendix 6.

Lynde Creek - Figure 37

Lynde Creek, situated in Whitby Township, Ontario County, is a medium size stream traversing relatively flat agricultural land north of the Town of Whitby and is tributary to central Lake Ontario through a large estuary. Lynde Creek splits into two branches 5.2 km above the mouth; each branch consisting of riffles and pools, with abundant larval and spawning habitat. Discharges steadily increase along their courses due to numerous small tributaries entering the system. Adult lamprey may pass unimpeded to the headwaters of both branches. Average summer flow in this stream is approximately 0.4 m^3/s.

Lynde Creek had been treated with lampricide four times previously, in 1971, 1975, 1978, and 1981.

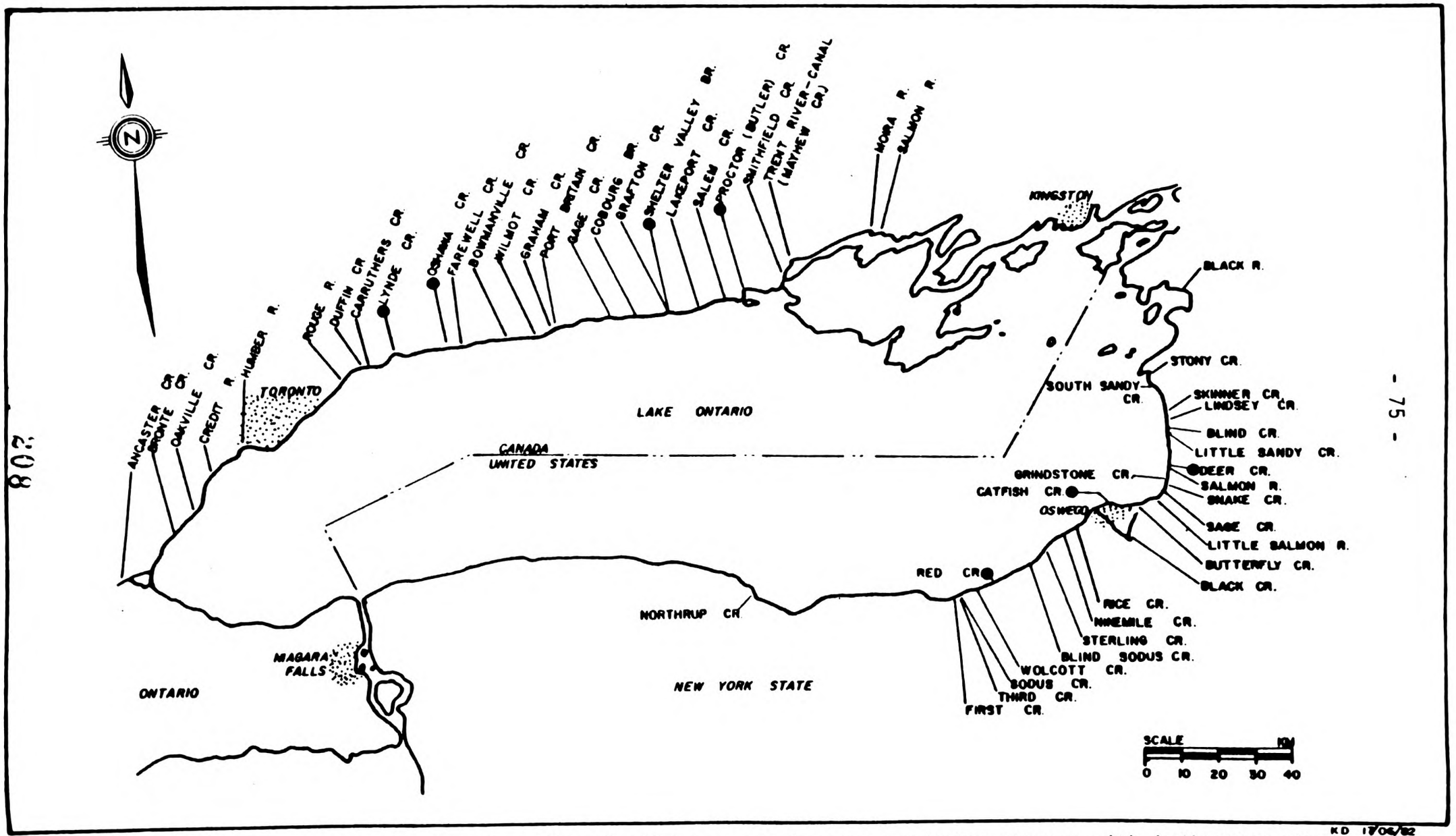


Figure 36. Map of Lake Ontario showing location of all known sea lamprey producing streams with indication of those streams treated (●) with lampricide in 1984.

Table XI. Summary of streams treated with lampricide on Lake Ontario, 1984.

STREAM	Date	Flow m^3/s	TFM Act. Ingr. kg	Bayer 73 Act. Ingr. kg	Granular Bayer 73 kg	*	Sea Lamprey Collected	Area Treated km
CANADA								
Lynde Creek	May 3-4	0.830	389.63	-	-	M	92	17.20
Oshawa Creek	May 7-8	1.120	560.08	-	-	M	89	18.50
	May 11	1.840	639.85	-	-	M	26	
Proctor Creek	May 14-15	0.460	195.00	-	-	A	314	5.90
Shelter Valley Brook	June 16-18	0.493	289.86	-	0.12	M	604	20.10
TOTALS - CANADA		4.743	2,074.42	-	0.12		1,125	61.70
UNITED STATES								
Deer Creek	May 3-4	0.541	131.57	-	-	A	254	14.50
	May 6-7	1.265	105.53	-	-		2	
Sodus Creek	May 8	0.589	230.02	-	-	S	80	2.23
Red Creek	May 10-11	1.180	330.82	-	-	M	308	10.04
Catfish Creek	May 13	2.010	183.03	-	-	S	37	1.20
TOTALS - UNITED STATES		5.585	980.97	-	-		681	27.97
GRAND TOTALS		10.328	3,055.39	-	0.12		1,806	89.67

* S = Scarce; M = Moderate; A = Abundant

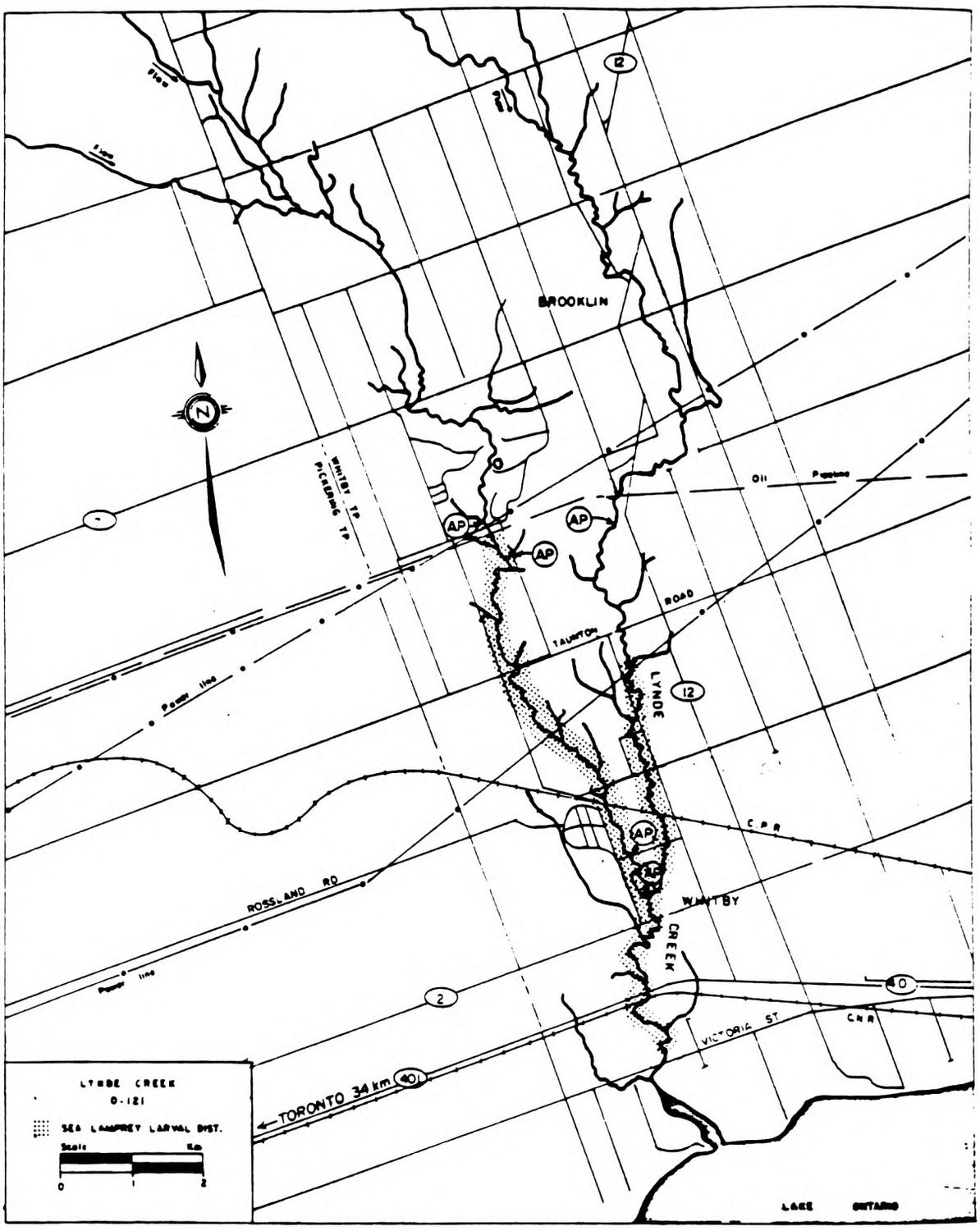


Figure 37. Detailed map of Lynde Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Lynde Creek (Continued)

Despite steady rains and a rising discharge during the latter part of the treatment, an effective treatment was achieved. Coincidence of the lampricide blocks in the main branch and the major tributary was excellent. Two unscheduled boost feeders were operated to counteract the rising flows. The rapid influx of rain water lowered pH's and alkalinity for a short period, probably accounting for the mortality of several hundred logperch, stonecat and white sucker in a short stretch of stream from Rossland Road to Highway 401.

Larval sea lamprey, representing three year classes, were fairly scarce in the main tributary and upper reaches of the main stem but moderately abundant in the main branch from Taunton Road to Highway 401. Only 92 larval sea lamprey, 31 to 171 mm in length, were collected by the treatment unit, but University of Guelph personnel picked up several hundred for an age-determination study.

Two spawning phase sea lamprey were sighted on the main branch below Rossland Road.

Oshawa Creek - Figure 38

Oshawa Creek, traversing Whitby Township in Ontario County, originates in rolling agricultural land north of the City of Oshawa and is tributary to central Lake Ontario through Oshawa Harbour. The stream bifurcates into west and east branches 11.7 km above the mouth. The main west branch has a dam 6.0 km from the confluence and the east branch has a dam 1.6 km above the confluence. These dams constitute barriers to spawning sea lamprey. The stream typically consists of riffles and pools with a moderate gradient and has good spawning and larval habitat. Average summer discharges in Oshawa Creek are approximately 0.5 m^3/s.

Oshawa Creek had been treated with lampricide four times previously, in 1971, 1975, 1978 and 1981.

The initial lampricide treatment of Oshawa Creek on May 7-8 was "washed out" below Highway 2 due to heavy rains, which in conjunction with discharge from storm sewers in the City of Oshawa, raised the flow in excess of 3.5 m^3/s from the initial flow of approximately 1.2 m^3/s. On May 11 a second treatment was initiated. Once again heavy rain threatened the treatment but this time an effective level was attained to the mouth. Because of high flows and resultant turbidity, ammocoete collecting was difficult. Larval sea lamprey were collected from a short distance below the upper application site on the main branch to the mouth in Oshawa Harbour but none were observed in the east branch. A total of 115 sea lamprey larvae, 41 to 161 mm in length, were collected. Three spawning phase sea lamprey were sighted in the main branch below Rossland Road. The only non-target fish mortality observed were several hundred alewife in the mouth area and approximately 20 white sucker in the lower 2 km of stream.

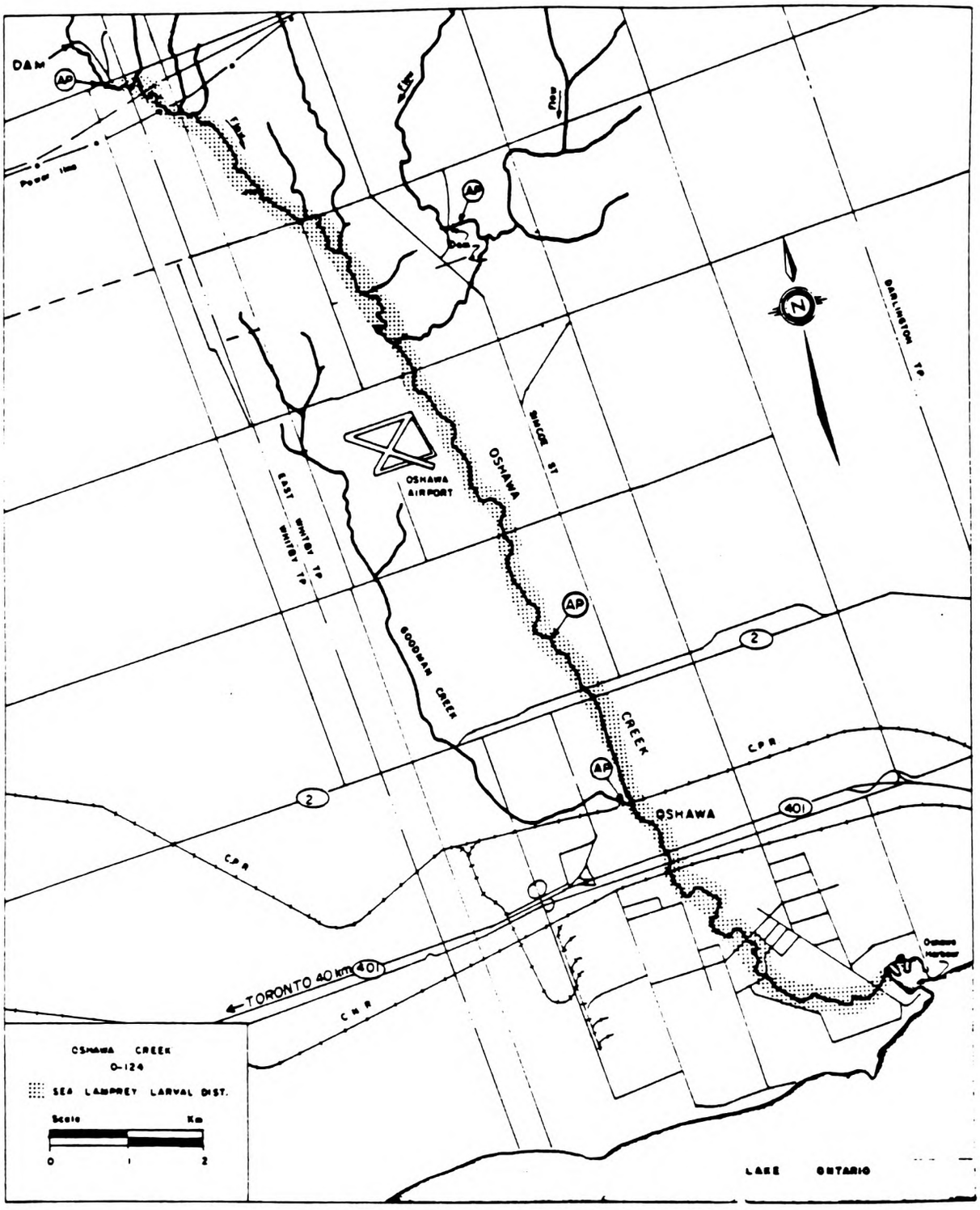


Figure 38. Detailed map of Oshawa Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Proctor Creek - Figure 39

Proctor Creek is a small stream (average summer flow 0.15 m^3/s) in Brighton Township, Northumberland County which flows relatively quickly through the Village of Brighton into a large, marshy estuary before entering Presqu'ile Bay, Lake Ontario. A small concrete-rubble dam (about 1.2 m high) located 5.9 km above the mouth had constituted a lamprey barrier in previous years but is now removed, allowing access for adult sea lamprey to the stream's headwaters. Proctor Creek has excellent spawning gravel throughout its course with numerous small pools containing good sand-silt larval habitat. Two tiny tributaries flow into Proctor Creek below the above mentioned dam, however neither contain sea lamprey.

Proctor Creek had been treated three times previously: in 1971, 1976 and 1981.

This was a straightforward and very successful lampricide treatment. Because of the relatively high flow for this small stream, a lethal block of lampricide moved quickly and spread out well in the channelized-marshy mouth area. The two small tributaries were treated to counteract dilution and prevent escapement. Larval sea lamprey were scarce above Highway 2 but became quite abundant in the lower 2 km of stream. A total of 314 larval sea lamprey, 26 to 171 in length, were collected during the treatment.

Although the above mentioned dam is no longer present, no larval sea lamprey were found for about 0.5 km below its past site. Surveys will be required to determine future larval sea lamprey distribution in Proctor Creek.

Shelter Valley Brook - Figure 40

Shelter Valley Brook, a small watershed draining rolling agricultural land situated in Haldimand Township, Northumberland County, is tributary to eastern Lake Ontario just east of Grafton. The stream has two sea lamprey producing tributaries, excellent spawning and larval habitat, and typically consists of riffles and pools with an average July discharge of 0.4 m^3/s. A small dam situated 12.3 km from the mouth constitutes a barrier to the upstream migration of spawning sea lamprey on the main branch.

This brook is a prolific producer of sea lamprey larvae relative to its size and had previously been treated in 1971, 1974, 1977, 1980 and 1982.

Although numerous lampricide applications throughout the watershed kept treatment personnel extremely busy, lethal lampricide levels were attained throughout the entire watershed. The main tributary to Shelter Valley Brook was treated from a point 1.4 km above any previous treatment and larval sea lamprey were collected a short distance below that point, as indicated by spring 1984 distribution surveys. Overall, larval sea lamprey were rated as moderately abundant, with 604 being collected, 21 to 186 mm in length. A number of the sea lamprey larvae collected were obviously residuals from the September 1982 treatment. There is considerable water pickup and groundwater interchange throughout this stream which offers potential for escapement during a lampricide treatment. Approximately 65 spawning phase sea lamprey were observed during the treatment.

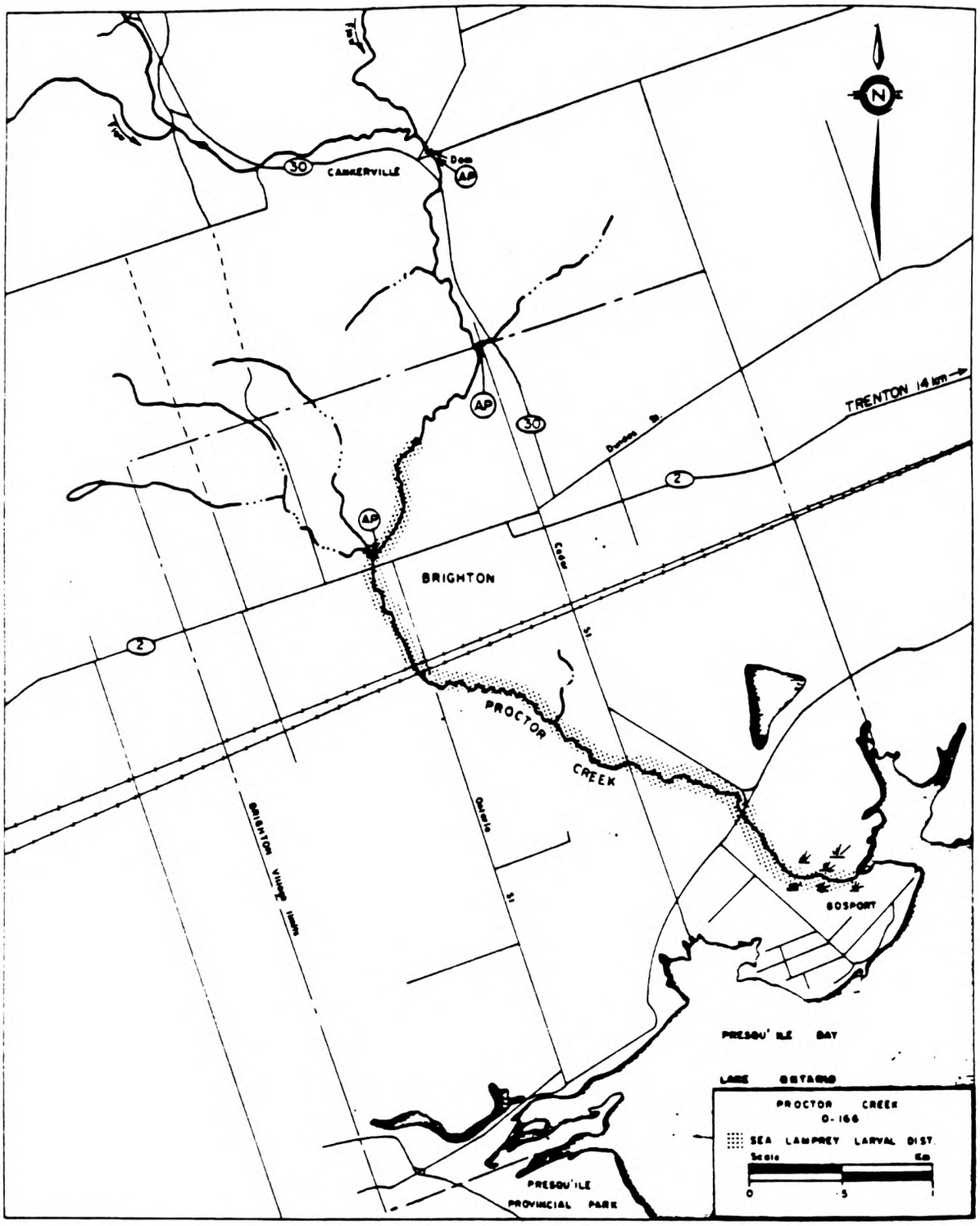


Figure 39. Detailed map of Proctor Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

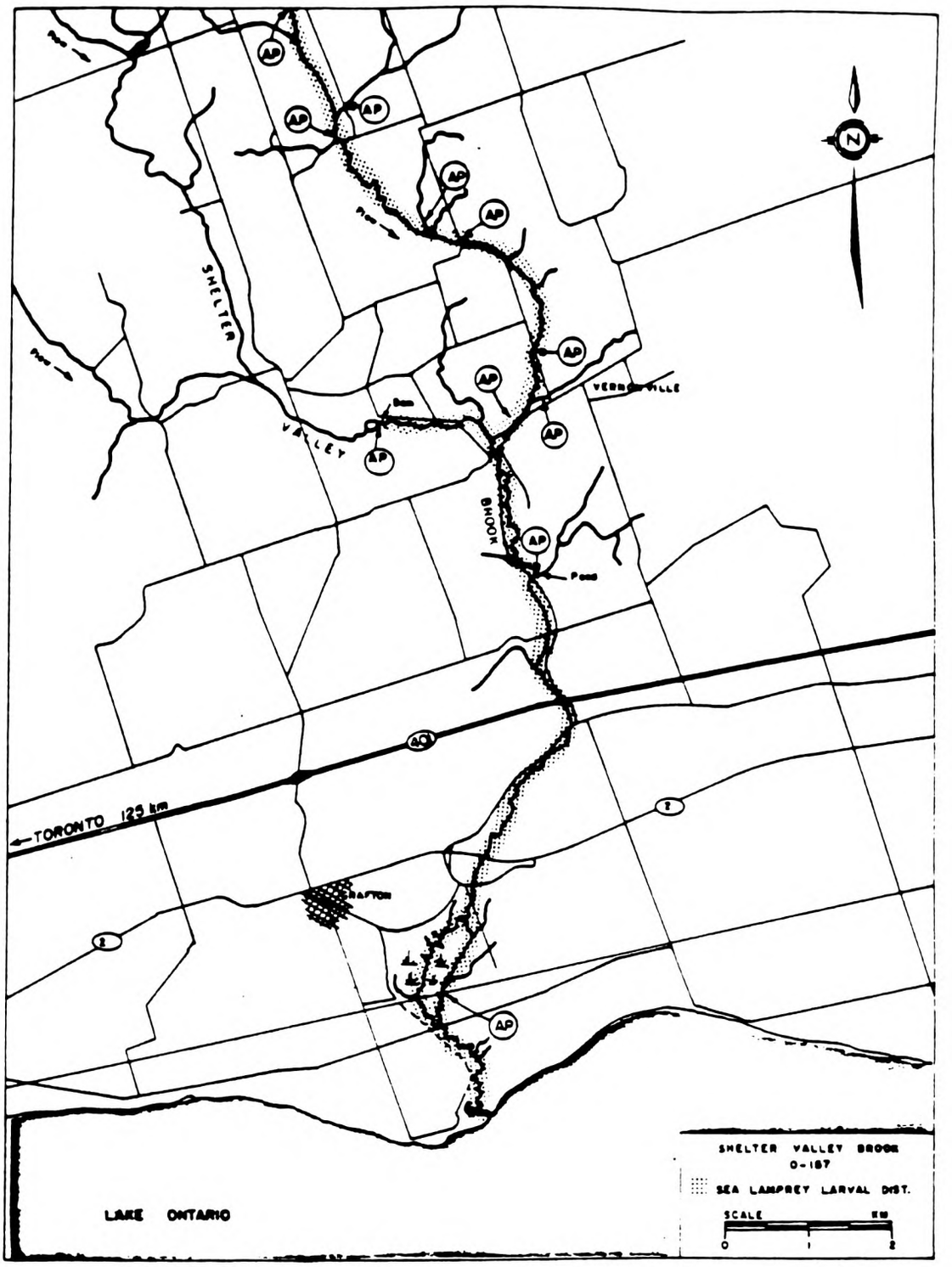


Figure 40. Detailed map of Shelter Valley Brook showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

LAKE ONTARIO, UNITED STATES, LAMPRICIDE (TFM) TREATMENTS

The following four United States (New York) streams tributary to Lake Ontario were treated with the selective lampricide 3-trifluoromethyl-4-nitrophenol (TFM) in 1984.

Deer Creek	-	May 3-4, 6-7
Sodus Creek	-	May 8
Red Creek	-	May 10-11
Catfish Creek	-	May 13

Table XI lists the pertinent treatment data, Figure 36 depicts the general location of the streams treated, and Figures 41 to 44 illustrate treatment details.

The following are brief descriptions of the streams and accounts of their treatments. Although sea lamprey larval abundance ratings are subjective in that they are not based on a standardized unit of effort, they are realistic in that they take into account such pertinent factors as; stream distance treated, degree of collecting difficulty, observations of larval density in non-collection areas, and the number of larvae actually collected during present and past treatments. The dates of stream treatments are inclusive of the time from the first lampricide application to the time of the last water sample taken from the stream for TFM analysis.

Terms, abbreviations and symbols used are explained in Appendix 6.

Deer Creek - Figure 41

Deer Creek, a relatively small watershed traversing marginal farmland and scrub bush land in Richland and Sandy Creek Townships, Oswego County, is tributary to Lake Ontario approximately 3.0 km north of Port Ontario. The upper portion of the watershed is characterized by riffles and pools with a moderate gradient over a gravel, rubble and sand substrate. Average May-June treatment discharge would approximate 0.8 m^3/s. Below the confluence with Little Deer, the only sea lamprey producing tributary, the stream widens, deepens and is inundated during periods of high lake levels. Deer Creek is a moderate to heavy producer of sea lamprey larvae with excellent spawning and larval habitat. No physical barriers restrict the upstream migration of spawning sea lamprey. Previous lampricide treatments have been conducted in 1972, 1973, 1976, 1979 and 1981.

At the onset of the 1984 treatment, the discovery of a 1983 year class of sea lamprey above the proposed lampricide application points necessitated movement of main feeders twice subsequently. Treatment complexity was increased substantially by these additional applications. Steady rain on an already saturated watershed led to the eventual cancellation of the first treatment. The second treatment commenced downstream from the previous application point, and was effective to about 1.0 km below Route 3 where it was terminated because of the absence of lamprey.

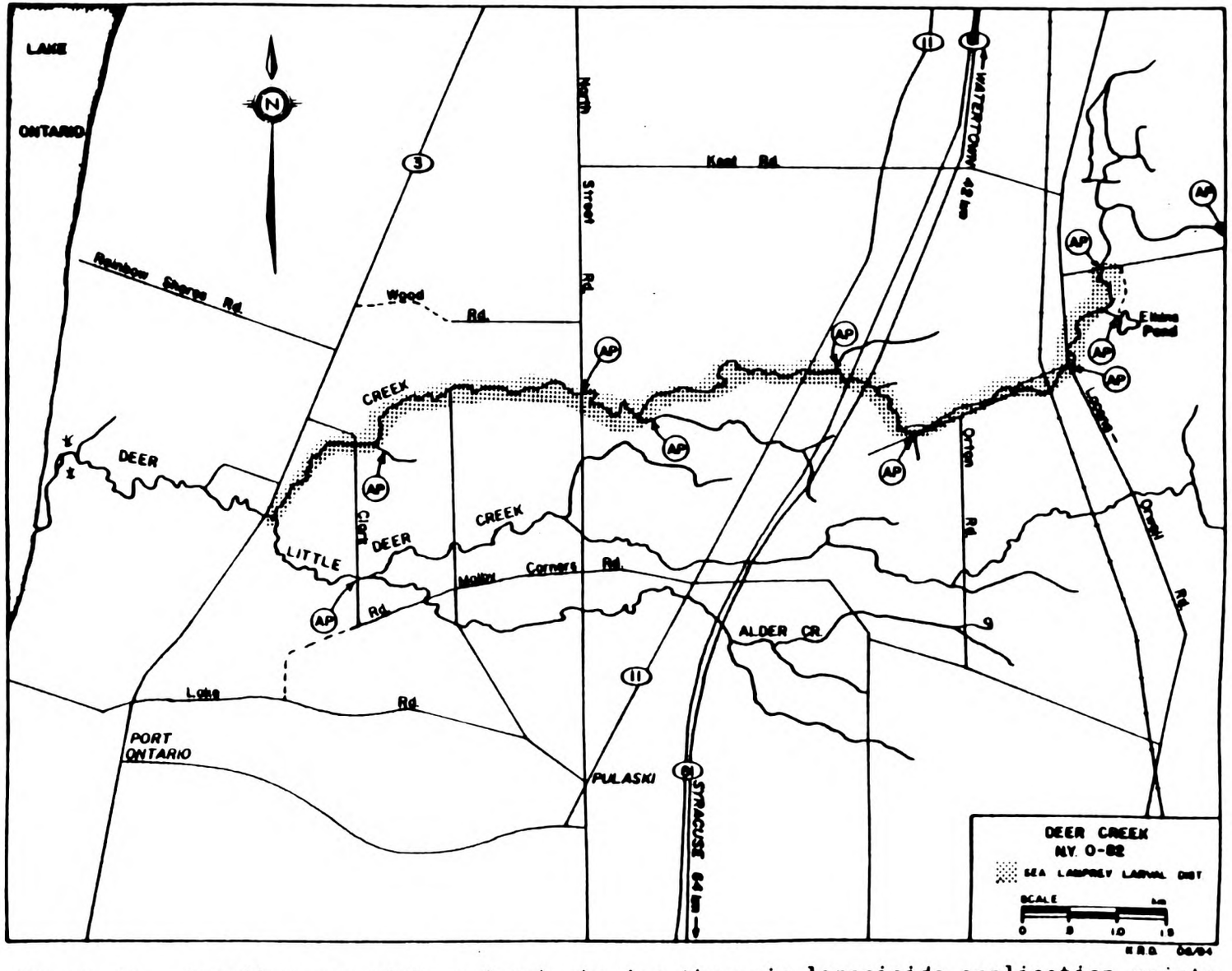


Figure 41. Detailed map of Deer Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Deer Creek (Continued)

Ammocoetes were abundant in the middle reaches of the watershed, scarce in the upper and, as noted in previous treatments, scarce to absent below Route 3.

A total of 57 adult sea lamprey were observed during collections. Non-target fish mortality was insignificant and consisted of a few grass pickerel below application points.

Sodus Creek - Figure 42

Sodus Creek, a small, hardwater stream situated in Rose and Huron Townships, Wayne County, empties into Sodus Bay through a large marshy estuary near the Town of Resort, New York. The upstream migration of spawning sea lamprey is stopped by a dam situated 4.2 km from the mouth. No sea lamprey producing tributaries are present. This stream, which had been previously treated in 1971, 1975, 1977 and 1981, regularly produces moderate numbers of sea lamprey larvae.

During the 1984 treatment, although periods of moderate to heavy rains doubled the stream discharge, the required levels of TFM were maintained without problems.

Ammocoetes were moderately abundant in the upper and middle reaches and very scarce throughout the lengthy estuary. Non-target fish mortality consisted of small numbers of spottail shiner, Johnny darter, white sucker and golden shiner in a small tributary. No adult sea lamprey were observed during the treatment.

Red Creek - Figure 43

Red Creek is a meandering stream of moderate hardness traversing mixed farmland in Victory, North Wolcott and Fair Haven Townships of Wayne County, New York. The watershed has highly variable discharges, many large swampy areas and flows into Lake Ontario through a lengthy, turbulent estuary situated approximately 40 km west of Oswego. The upstream migration of spawning sea lamprey is halted by a dam at the Town of Red Creek on the main river and by an old mill pond dam on the only sea lamprey producing tributary, Little Creek.

Lampricide was applied to Red and Little Creeks for the first time in 1984 at a stream discharge considerably higher than normal. Although the relatively high flow facilitated the passage of the TFM through numerous swampy areas in the main stream, lampricide concentrations dropped below target levels at the lowermost access point. Close observation for lamprey activity in this area of low concentration indicated that sea lamprey ammocoetes were scarce to absent, consequently no effort was made to boost the lampricide block. Red Creek is apparently typical of a number of sea lamprey producing streams tributary to New York waters of Lake Ontario that have long marshy estuaries lacking sea lamprey larvae.

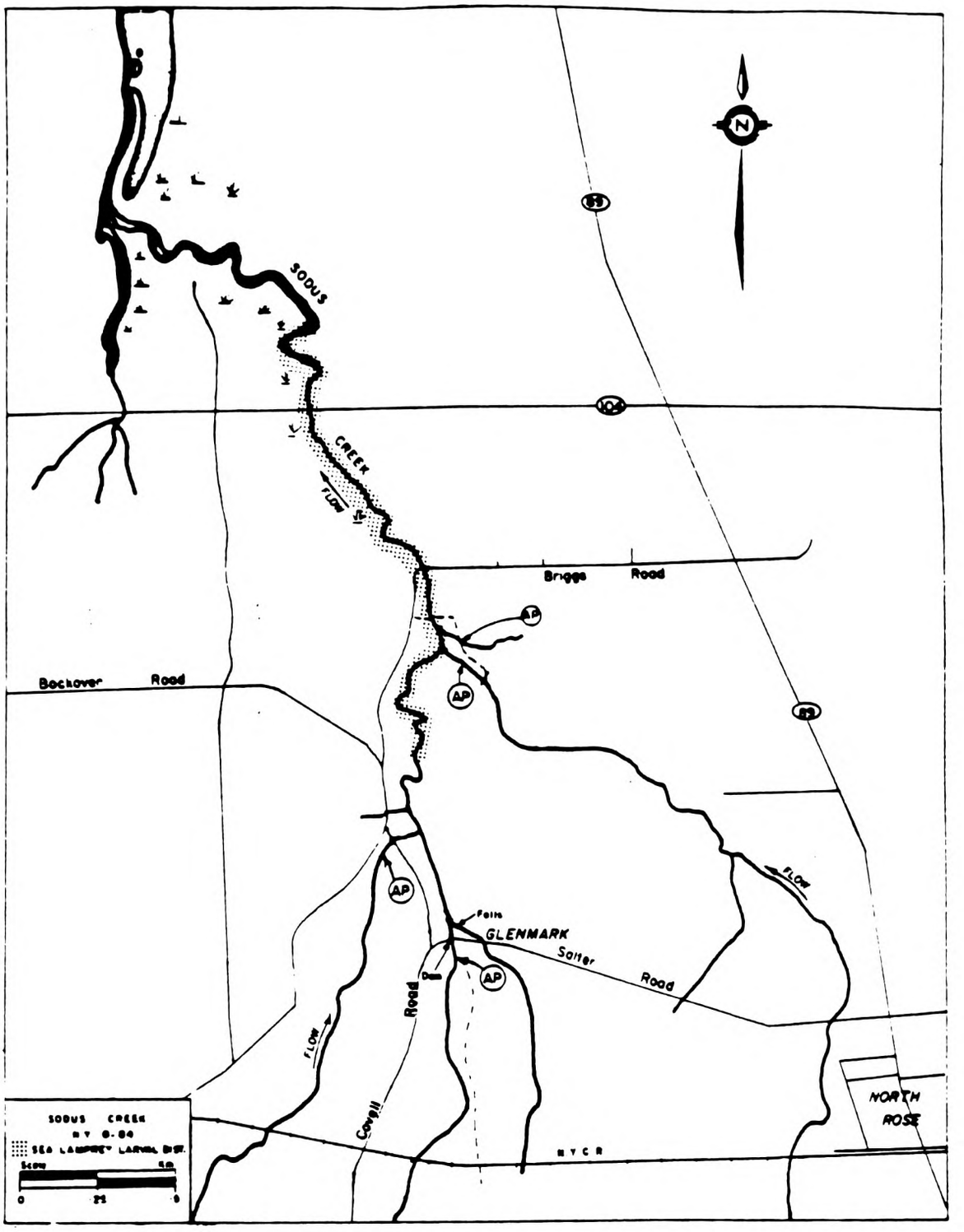


Figure 42. Detailed map of Sodus Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

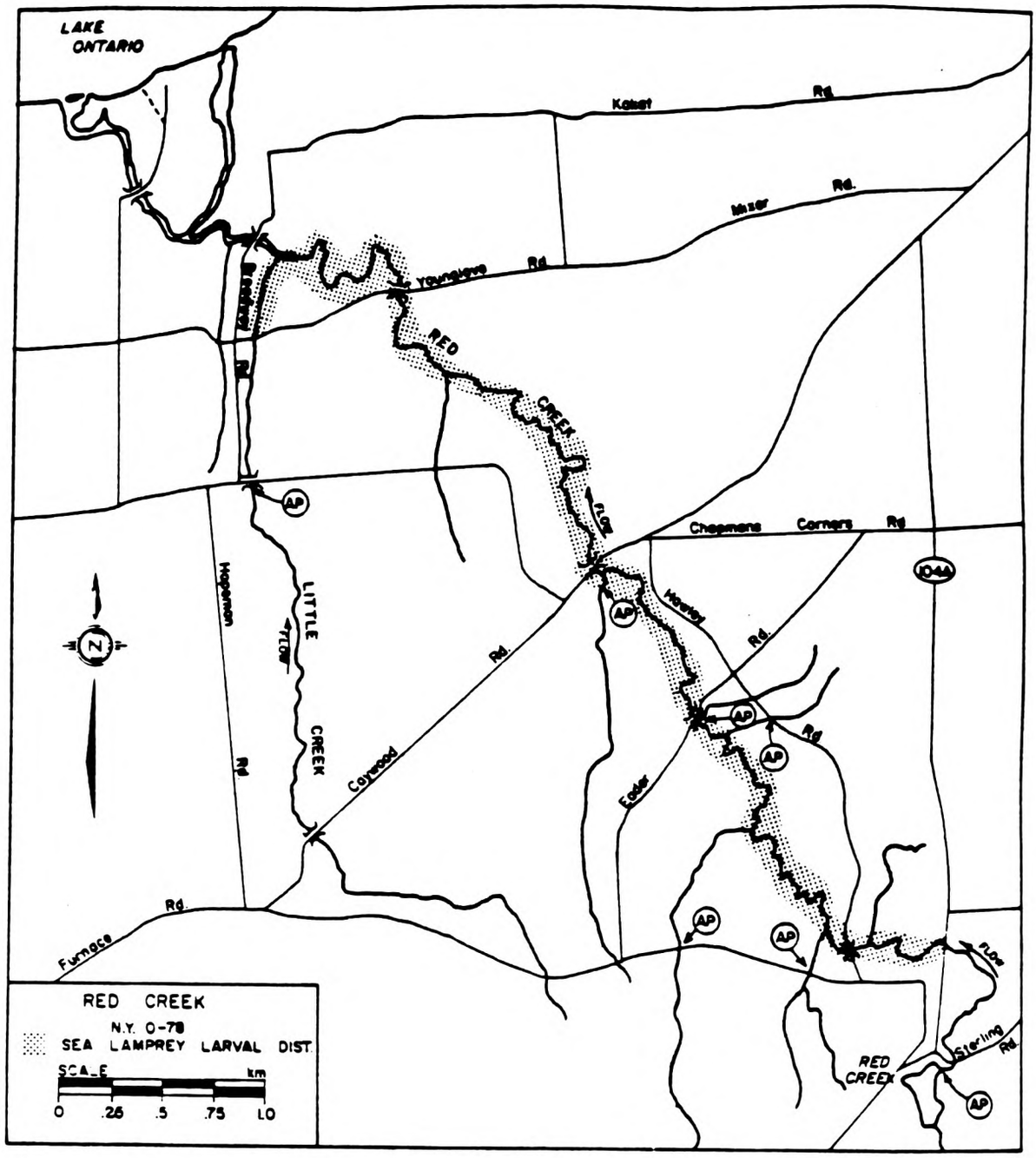


Figure 43. Detailed map of Red Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

Red Creek (Continued)

Sea lamprey larvae were moderately abundant below the limited stretches of available spawning habitat, and noticeably scarce to absent in and below the swampy areas. Apparent gaps in the length frequency distribution and the fact that 71.1 per cent of the specimens collected were greater than 120 mm in length, suggest that successful spawning may not occur annually and that survival may be relatively low.

Catfish Creek - (Figure 44)

Catfish Creek is a moderately sized stream (average treated flow of 1 m^3/s) located in New Haven Township, Oswego County, New York. An old mill dam located 1.2 km above the mouth was repaired in 1979 and now serves as a barrier to anadromous sea lamprey. Catfish Creek was previously treated in 1972, 1976 and 1980.

A relatively high stream discharge in 1984 allowed for an excellent treatment of the large volume of standing water in the marina situated in the estuary.

Sea lamprey larvae were relatively scarce; with only 37 (56 to 161 mm in length) being collected. Mortality to non-target fish was negligible.

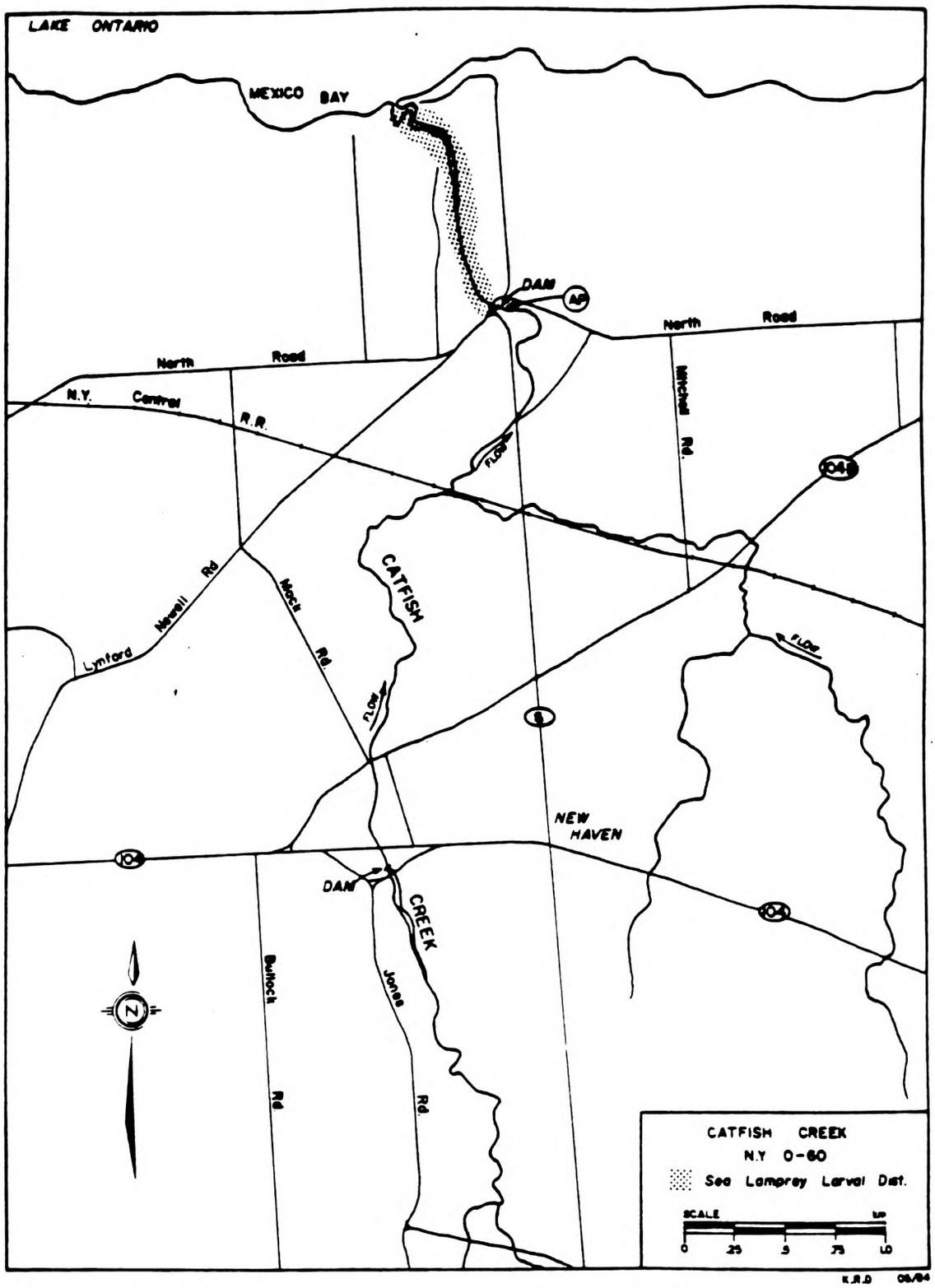


Figure 44. Detailed map of Catfish Creek showing the main lampricide application points (AP) and sea lamprey larval distribution, 1984.

SEA LAMPREY BARRIER DAM PROJECT

LAKE SUPERIOR

Sheppard Creek Dam

A low head barrier dam was constructed during August and September 1984 on Sheppard Creek, a tributary to the Goulais River, approximately 35 km N-NE of Sault Ste. Marie. The dam is situated in Deroche Township, approximately 350 m upstream from the confluence with the Goulais River (Figure 45).

Access to the site involved improving 5 km of old logging roads, fording the Goulais River and building several hundred metres of new road. Because of the relative inaccessibility, a trap for collecting migrant lamprey was not included in the design, and the dam was designed to make use of materials on site. Gabions were used incorporating stone from the stream bed and clean river bank sand was used in mortar to cap the overflow crest.

The 21.7 m long structure has a 15 cm wide steel lip along the face of the main spill crest (13.8 m long). A curved lip in the central section (3.4 m long) just above the fish jump pool facilitates successful migration over the barriers. Head at the dam at the mean discharge of 1.2 m^3/s is 70 cm. The total cost of construction was $38,919.

Projected benefits from the dam will be a reduction of 97 per cent in the length of Sheppard Creek requiring treatment. As excellent spawning gravel is located below the structure, it is expected that treatment will be required from the dam to the confluence with the Goulais River.

Maintenance and improvement work was carried out at the existing lamprey barrier dams on Gimlet and Stokely Creeks, and on the Sable River.

The Whitefish River (tributary to the Kaministikwia) was surveyed at a site near the mouth and tentative design plans were drafted. A site search on the Cypress River below Highway 17 proved negative.

LAKE HURON

A maintenance project was completed at the Kaskawong River barrier, however the work proposed for the Echo River dam was postponed until the 1985 field season.

A site was selected, surveying completed and plans drafted, for a structure on the Still River which flows into Byng Inlet of Georgian Bay.

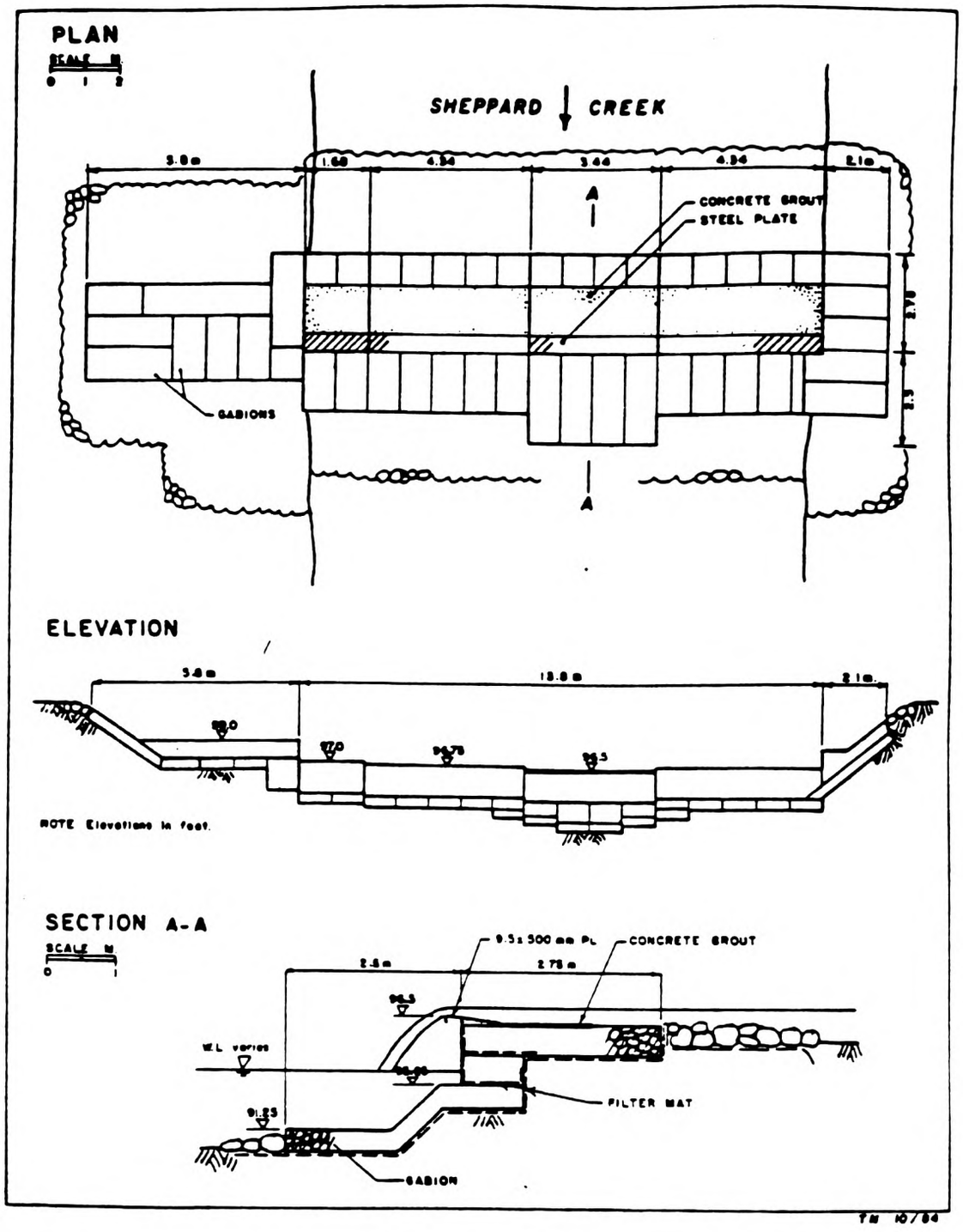


Figure 45. Low head barrier dam constructed on Sheppard Creek between August and September, 1984, to stop anadromous sea lamprey.

LAKE ONTARIO

Lakeport Creek Dam

A low head barrier dam was constructed in August and September of 1984 on Lakeport Creek, in the village of Lakeport, Cramahe Township (Figure 46).

The 16.6 m long concrete dam is situated 1 km upstream from Lake Ontario. It has an 11.7 m long overflow crest with a 15 cm wide steel lip between the bank abutments. A fish jump pool (2.9 m x 3.5 m) was excavated in the shale bedrock below the lowest section of the crest. A 0.8 x 0.9 m built-in concrete trap adjacent to this section will create an important sea lamprey assessment opportunity for the northeast section of Lake Ontario.

Head at the dam at a mean discharge of 0.45 m^3/s is 65 cm. The projected resulting reduction in the length of Lakeport Creek requiring treatment is 94 per cent. The dam was built at a cost of $21,760.

Maintenance and improvement work were done at the Duffin and Graham Creek barriers.

The Graham Creek barrier which suffered a brief washout in the first week of May before it was fully completed was reinforced with stone along the west bank. Approximately 200 m of spawning gravel was removed from the stream below the dam, and the work area was seeded.

Work at Duffin Creek included squaring the inside of the steel sheet piling trap with concrete, removing rip-rap from the stream which had been removed from the banks and placed in the stream by local fishermen, preparing the east bank and covering it for 40 m in length with "fabriform" erosion protection.

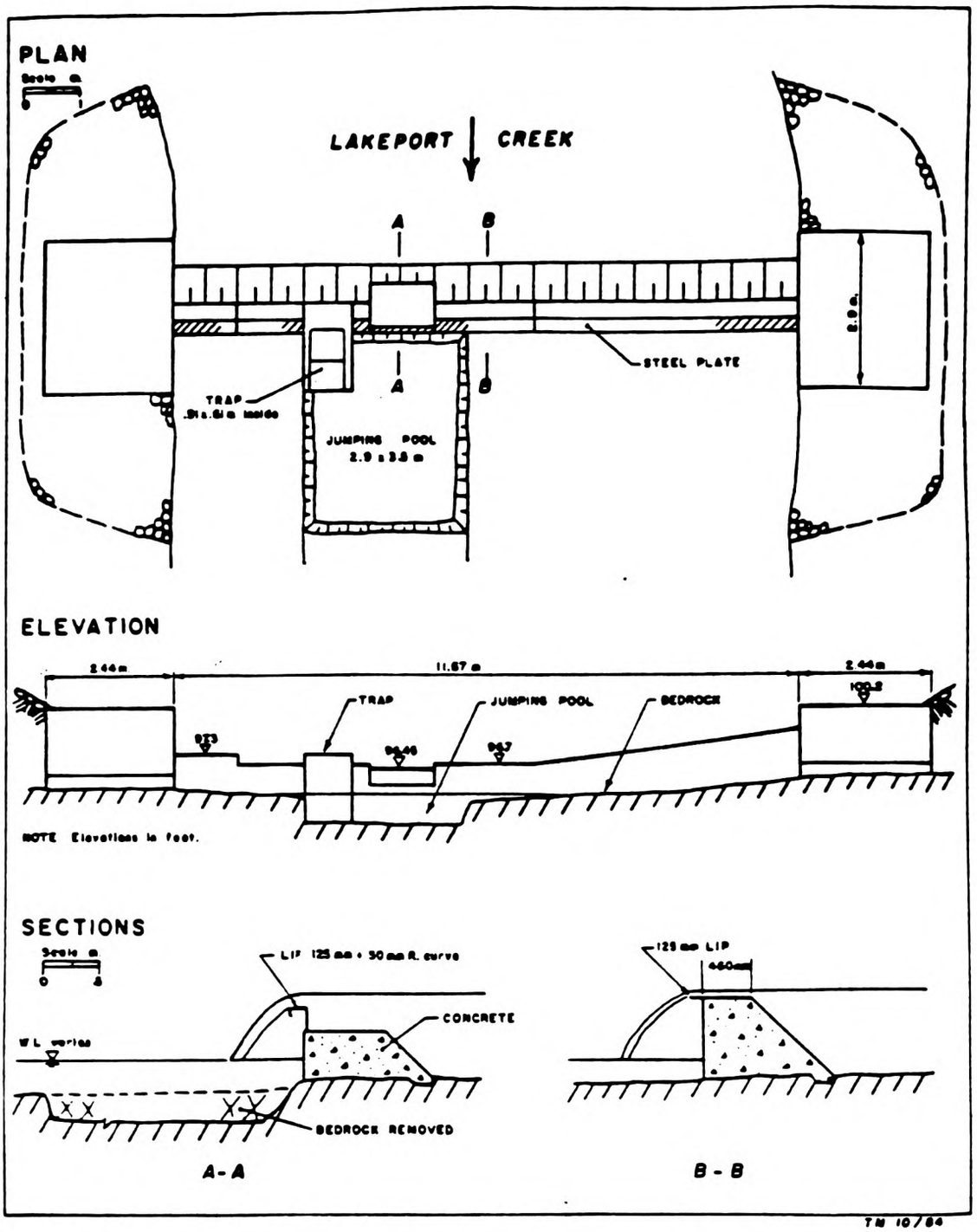


Figure 46. Low head barrier dam constructed on Lakeport Creek between August and September, 1984, to stop anadromous sea lamprey.

BIOLOGICAL STUDIES

BATCHAWANA BAY

A series of population estimates of larval sea lamprey were conducted in the mouth and delta areas of Chippewa River by releasing a total of 3,050 American brook lamprey collected from streams tributary to Batchawana Bay and marked by dye injection. Different colours were used for the different releases.

On July 12, 1,050 marked American brook lamprey were released on the Chippewa River delta (drop-off area) where treatment with granular Bayer 73 would take place. On July 30, an area of 1.3 ha was treated with 15.9 kg active ingredient Bayer 73, and 0.37 ha of the same area that contained the greatest numbers of sea lamprey ammocoetes was immediately retreated with an additional 4.5 kg active ingredient Bayer 73. The treatment of the delta area resulted in a collection of; 4,440 unmarked American brook lamprey, 34 (3.2%) marked American brook lamprey, 2 *Ichthyomyzon* spp., and 1,232 sea lamprey (including one metamorphosing individual). The collecting effort was 68 person hours.

A Petersen estimate of the total number of larval lampreys in the 1.3 ha treated area yielded 175,258, with an average density of 13.5 larvae per m^2, including 2.9 sea lamprey per m^2. Of the total, 38,078 were sea lamprey including 31 metamorphosing individuals, and 137,180 were native species.

Two SCUBA equipped divers estimated that there were three to four dead ammocoetes per square metre lying on the slope of the treated area and two to three dead ammocoetes per square metre lying at the base of the slope in water approximately 12 m deep.

On July 12, 985 marked American brook lamprey were released in an area of 7.71 ha in the Chippewa River and on August 14 an additional 1,015 similarly marked animals were released into the same area. On August 29 and 30, the river was treated at a flow of 4.95 m^3/s with a total of 262.8 kg active ingredient TFM plus 4.1 kg active ingredient Bayer 73. After 42 person hours of collecting effort 721 unmarked American brook lamprey, 70 (3.5%) marked American brook lamprey, and 339 sea lamprey larvae were collected. The population of sea lamprey was estimated at 10,325, and the number of American brook lamprey at 21,961.

As the river was last treated on September 13 and 14, 1983, only young-of-the-year (Y.O.Y.) larvae were expected in the 1984 collections. The American brook lamprey population consisted of; 1,829 Y.O.Y., 20,600 older than Y.O.Y. larvae and 743 metamorphosing animals. The sea lamprey population consisted of: 9,624 Y.O.Y., 57 older than Y.O.Y. larvae and no metamorphosing larvae. It is assumed that the majority of American brook larvae older than Y.O.Y. originated from the extensive population present above the Chippewa Falls and that downstream migration resulted in the colonization of the lower 2.4 km. Although larval lampreys may move upstream from delta populations into estuarine habitat, the rate of such movement is far less than the downstream migration from long established populations. The distribution of larval sea lamprey suggests that some migration may have occurred from the delta to the estuary.

Although the Y.O.Y. sea lamprey were distributed within and immediately below the spawning gravel extending 0.4 km downstream of the Chippewa Falls, the two older larvae were collected near the mouth of the river, 2.0 km downstream.

The Y.O.Y. sea lamprey captured in the river ranged in length from 10 to 21 mm and had a mean length of 14.4 mm. The Y.O.Y. American brook lamprey had a mean length of 25.1 mm (range 20 to 35 mm). The delta population had no Y.O.Y. larvae present.

Inspection of past chemical treatment collections from the Chippewa River provides an estimate of growth rates for reestablished sea lamprey populations in the river. Age classes and corresponding lengths at September 1 are as follows:

	0	I	II	III	IV	IV Transformers
Mean length mm	18	38	63	93	123	128
Range mm	16-26	26-51	51-76	76-111	111-156	111-146

These growth rates are estimates, subject to yearly fluctuations depending on water temperatures which dictate spawning dates and the length of time available for growth. The described length ranges are only a guide since the lengths of adjacent age classes actually overlap.

It was anticipated that the September 1983 treatment would eliminate larval recruitment from the river to the bay and inspection of the collection of larval sea lamprey from the delta in 1984 supports this opinion. There were only nine (0.7 per cent) sea lamprey larvae less than 51 mm in length and these may be more than one year old because the colder waters of the bay would reduce growth rates compared to the river system.

Preparations have been made for a joint study in July 1985, coordinated through the Great Lakes Fishery Commission and its agents, with the Michigan State University, and the National Oceanographic and Atmospheric Administration, National Undersea Research Program at the University of Connecticut Avery Point Campus. This will involve the use of a submersible research vessel to investigate the distribution of larval lamprey in the deep waters of Batchawana Bay adjacent to the Chippewa River delta.

ST. MARYS RIVER

Activities for 1984 included sea lamprey distribution surveys, larval population estimates, testing the survival of sea lamprey larvae after exposure to granular Bayer in a treatment, and sea lamprey habitat evaluation.

Larval Distribution Surveys

Surveys, using granular Bayer 73, were done during the months of July, August and September in order to further define the upstream and downstream distribution limits of sea lamprey larvae in the river; as well as to evaluate what are believed to be low density populations in other areas. In all, 38 plots were surveyed of which 23 were positive for sea lamprey larvae (Figure 47, Table XII).

Table XII. Summary of granular Bayer survey data, Canadian waters of the St. Marys River, July - October 1984.

Location Refer to Figure 45	Date D/ M/ Y	Method	Area Surveyed m^2	Quantity G.B. used kg	Person-Hours Collecting	*Petromyzon marinus* Number	*Petromyzon marinus* Size Range	*Lampetra appendix* Number	*Ichthyomyzon* spp. Number
1	22/08/84	G.B.	1,000	22.7	4.0	0	-	0	0
2	22/08/84		2,000	45.4	5.8	18	68-120	710	0
3	13/08/84		1,600	22.7	9.2	0	-	182	0
4	24/08/84		1,000	22.7	4.0	0	-	0	0
5	24/08/84		1,000	22.7	4.0	0	-	0	0
6	24/08/84		1,000	22.7	4.0	0	-	0	0
7	24/08/84		1,000	22.7	4.0	0	-	82	0
8	22/08/84		1,000	22.7	7.0	0	-	95	0
9	22/08/84		1,000	22.7	4.0	0	-	0	0
10	22/08/84		1,000	22.7	4.0	0	-	0	0
11	22/08/84		1,000	22.7	5.0	1	86	34	0
12	17/08/84		1,000	22.7	4.0	0	-	13	0
13	17/08/84		1,000	22.7	6.0	1	72	18	0
14	17/08/84		1,000	22.7	4.0	0	-	4	0
15	17/08/84		1,000	22.7	4.0	3	46-86	0	0
16	13/08/84		1,000	22.7	8.1	0	-	1	0
17	13/08/84		1,000	22.7	5.0	0	-	12	0
18	16/08/84		2,000	45.4	6.0	38	51-126	23	0
19	16/08/84		1,000	22.7	5.0	1	125	0	0
20	16/08/84		1,000	22.7	3.0	3	87-96	1	0
21	16/08/84		1,000	22.7	5.0	2	57-122	17	0
22	16/08/84		1,000	22.7	4.0	3 (4)	96-141	12	0
23	16/08/84		1,000	22.7	4.0	0	-	0	0
24	15/08/84		2,000	45.4	11.0	29	42-134	2	0
25	15/08/84		1,000	22.7	4.0	66	24-137	6	1
26	30/07/84		1,000	22.7	5.0	1	77	0	0
27	30/07/84		1,000	22.7	4.0	0	-	0	0

28	30/07/84	G.B.	1,000	22.7	2.0	0	-	0	0
29	30/07/84		1,000	22.7	5.0	2 (4)	136-158	1	0
30	15/08/84		1,000	22.7	6.0	0 (1)	147	0	0
31	15/08/84		1,000	22.7	7.0	1 (2)	131-155	1	0
32	15/08/84		1,000	22.7	3.0	0	-	0	0
33	15/08/84		1,000	22.7	6.5	0	-	1	1
34	14/08/84		2,000	45.4	7.0	64	29-171	78	2
35	14/08/84		1,000	22.7	7.0	0 (1)	134	1	0
36	14/08/84		1,000	22.7	7.0	0 (6)	137-157	3	0
37	05/09/84		2,000	45.4	15.0	0 (6)	150-163	1	0
38	14/08/84		1,000	22.7	7.0	0	-	0	0
TOTALS			43,000	976.1 (48.8 kg A.I.)	209.6	233 (24)	24-171	1,309	4

( ) Number of transformers in brackets. This number is not included in ammocoete numbers.

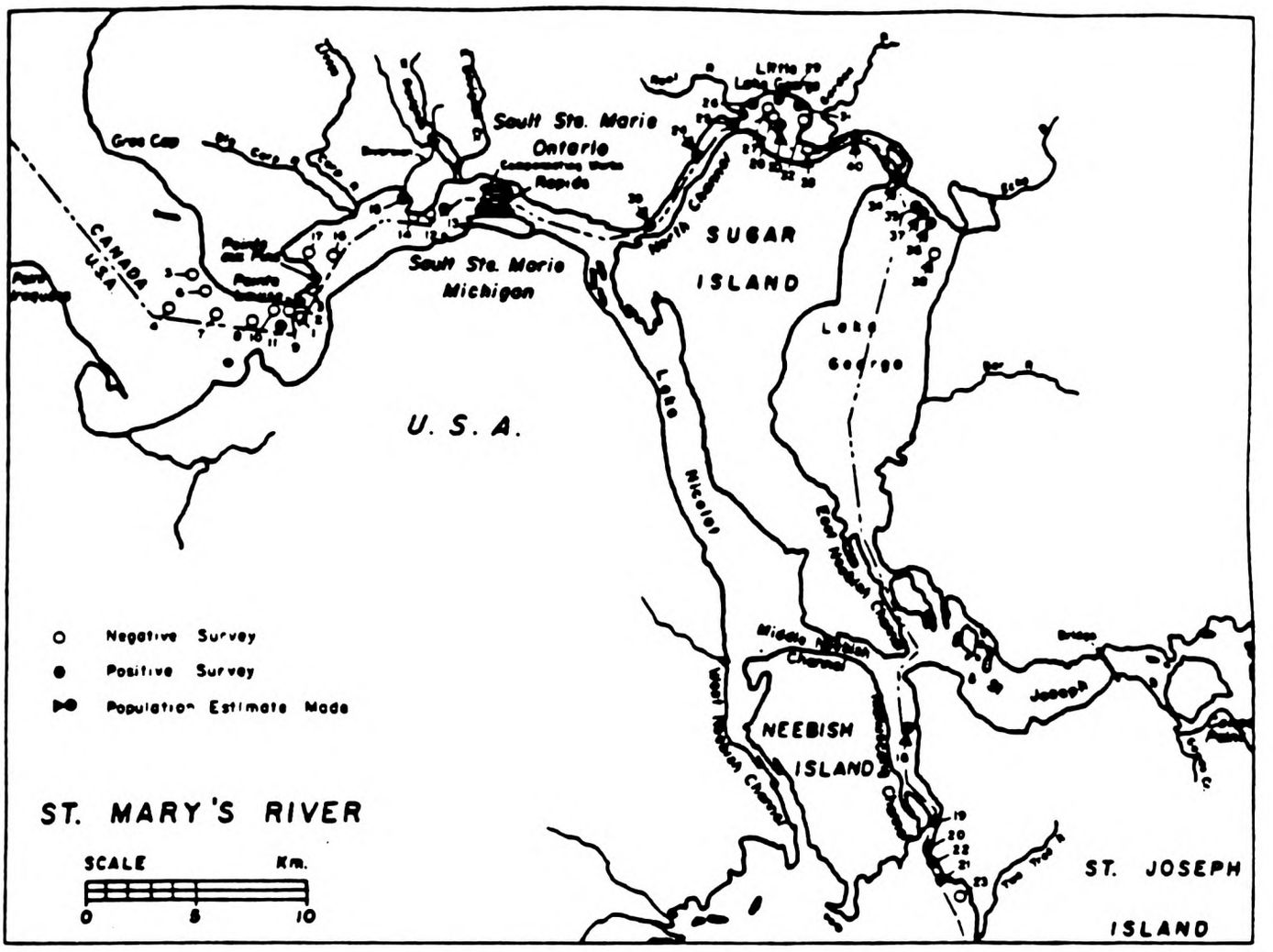


Figure 47. Map of St. Marys River showing locations of study plots where granular Bayer 73 surveys and population estimates were conducted in 1984.

ST. MARYS RIVER

Larval Distribution Surveys (Continued)

Above the compensating works at Sault Ste. Marie, distribution was extended upstream by 1 km to an area about 1 km west of Pointe Louise, although only one larva was taken from this site. In the Munuscong Channel of the lower river, distribution was extended approximately 3 km downstream to an area about 1.3 km into Munuscong Lake. No areas of apparent high abundance were found in Munuscong Lake. In the Lake George Channel the known downstream distribution remains essentially unchanged.

Interestingly, transforming sea lamprey were taken in surveys for the first time from Little Lake George (7), Lake George (13) and Munuscong Lake (4). An overall transformation rate of 1.02 per cent for specimens collected during all surveys and granular Bayer treatments in 1984 was the highest observed in over 10 years. (A rate of 1.11 per cent was found in 1972 during the initial granular Bayer treatment of the Whitefish Island area.) This apparent higher transformation rate in 1984 may be a reflection of the unusually warm summer of 1983.

Larval Population Estimates

During the summer of 1984 a start was made to estimate the number of larval sea lamprey in the Canadian waters of the St. Marys. Density estimates, using a mark-release-technique were made at 10 specific sites in the lower river (Figure 45). Two of these were done in conjunction with routine granular Bayer treatments of large areas (1.9 and 2.7 ha), with known high density, whereas the other eight were done in conjunction with distribution and population evaluation surveys of smaller plots (0.1 or 0.2 ha).

Specimens used for marking and releasing were mostly American brook lamprey larvae because of the relative scarcity of large size sea lamprey larvae in the immediate Sault Ste. Marie area. The relative susceptibility of American brook and sea lamprey larvae to granular Bayer and/or their catchability was field tested in one of the study plots, i.e., 12-102b, Table XIII. Similar sized larvae of both species were marked in identical fashion with subcutaneous injection of Rose Tracer-glo pigment, and released simultaneously in the study plot. In this "pilot" test, American brook lamprey were found to be 3.47 times as catchable as sea lamprey larvae.

The mark-release and treatment data for all 10 study plots is summarized in Table XIII. Population and density estimates have been adjusted to reflect the difference in catchability observed between brook and sea lamprey. Transforming sea lamprey were assumed to have similar catchability to sea lamprey larvae--an assumption that has yet to be tested.

A very rough estimate of 12 million sea lamprey larvae in the Canadian waters of the St. Marys River has been made by combining the results of the 1984 studies and three earlier population estimates made below Whitefish Island, with other data developed from correlations between estimates of populations derived from mark-recapture studies, and catch-per-unit-effort figures obtained in approximately 250 collections made in treatments and surveys since 1972. The number of transforming sea lamprey produced in 1984 is estimated at about 200,000 based on the transformer-to-ammocoete ratio of 1.7 per cent found in the 10 mark-release-recapture studies done this year (Table XIV).

All of the population figures presented here are preliminary estimates only. Following the 1985 field season, when more population work is scheduled, a complete report, including some measure statistical confidence, is planned.

Survival of Sea Lamprey after Exposure to Bayer 73

It has long been speculated that a significant survival of sea lamprey activated by granular Bayer may occur if the larvae swim or drift into fresh water; thus compromising the efficacy of the toxicant for treatment purposes, particularly in flowing water situations. This hypothesis was field tested on one of the granular Bayer treatment areas on the St. Marys River in 1984, i.e., site 10-103, 201, 202 where the granular Bayer application rate was 253 kg/ha.

Following the Bayer application, ammocoetes collected while swimming at the surface were immediately placed in fresh water and subsequently taken back to the laboratory where they were held for six hours. Of the 204 sea lamprey

Table XIII. St. Marys River mark-recapture population estimates, 1984.

Location Refer to Figure 45	Release Date D/ M/ Y	Number Released L.a.	Number Released P.m.	Treatment Date D/ M/ Y	Area Treated ha	Person-Hours Collecting	Marked Recaptures L.a.	Marked Recaptures P.m.	Unmarked Recaptures L.a.	Unmarked Recaptures P.m.[1]	POPULATION Estimate[2] for study area (P.m.)	POPULATION Density P.m./ha
39	30/07/84	1,200	0	01/08/84	2.70	70.0	131	0	47	2,070 (1)	65,860 (32)	24,393 (13)
30	30/07/84	300	0	15/08/84	0.10	6.0	84	0	0	0 (1)	0 (12)	0 (120)
40	01/08/84	1,400	0	02/08/84	1.92	56.0	55	0	2,429	320	28,292	14,735
24	13/08/84	200	0	15/08/84	0.20	11.0	12	0	2	29	1,679	8,394
33	13/08/84	200	0	15/08/84	0.10	6.5	13	0	1	0	0	0
34	13/08/84	400	0	14/08/84	0.20	7.0	50	0	78	64	1,778	8,892
36	13/08/84	200	0	14/08/84	0.10	7.0	82	0	3	0 (6)	(51)	0 (508)
38	13/08/84	200	0	14/08/84	0.10	7.0	58	0	0	0	0	0
18	13/08/84	200	0	16/08/84	0.20	6.0	23	0	23	38	1,148	5,739
37	28/08/84	353	483	05/09/84	0.20	15.0	33	13	1	0 (6)	0 (223)	0 (1115)

1 Number of transformers in brackets ( ) - This number not included in ammocoete numbers

2 Based on simple ratio-proportion with a correction factor of 3.47 for difference in catchability between L.a. and P.m. (factor derived from results of one comparative study done in 1984)

Table XIV. Sea lamprey collected from St. Marys River 1984 (does not include Tenby Bay).

METHOD	NO. LARVAE	NO. TRANSFORMERS	TOTAL
Granular Bayer Survey	233	24	257
Granular Bayer Treatment	2,975	11	2,986
Sub Total[1]	3,208	35	3,243
Electroshocking[2]	368	2	370
Other[3]	10	0	10
GRAND TOTAL	3,586	37	3,623

[1] Sub Total - should be equivalent to the numbers reported in annual report drafts

[2] Sea lamprey taken by electroshocking are part of ongoing growth rate study in Whitefish Channel and were not included in annual report data

[3] Other - includes larvae collected in association with compensating gate manipulation done in December 1984 - not included in annual report data.

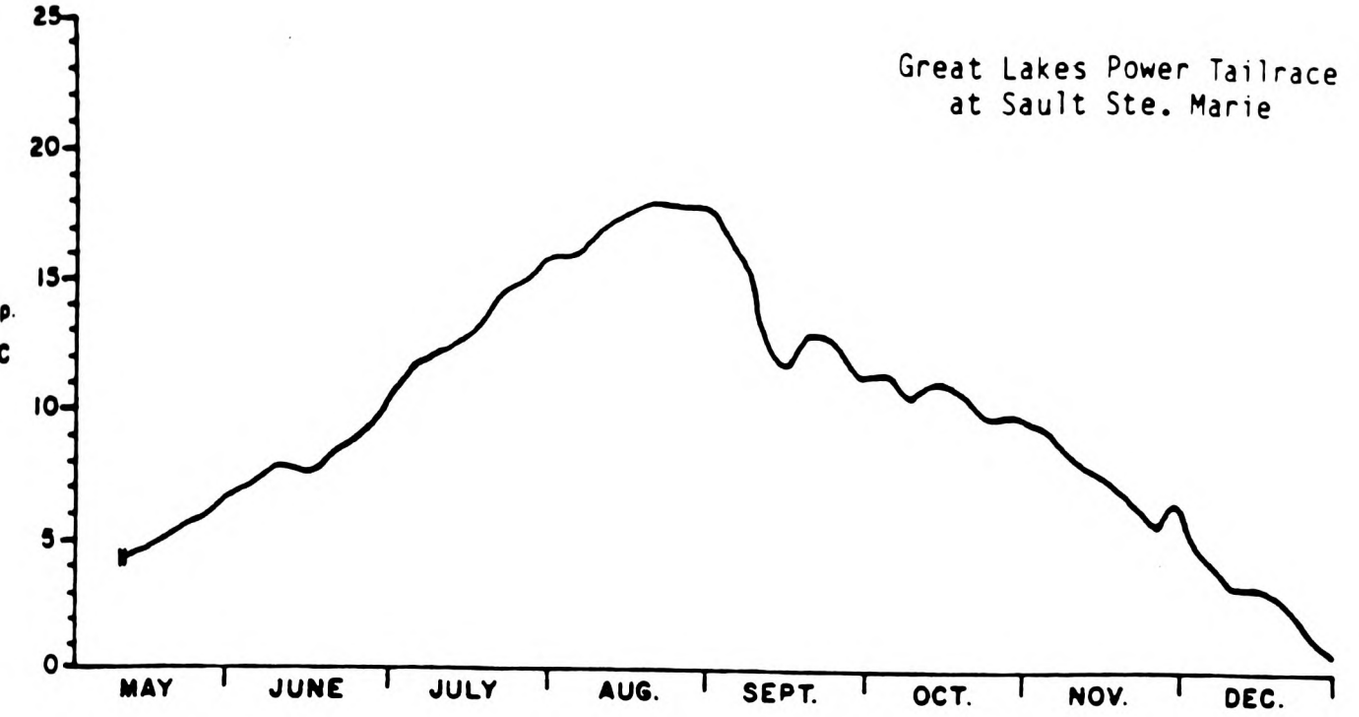
Survival of Sea Lamprey after Exposure to Bayer 73 (Continued)

larvae collected, 168, or 82 per cent, survived without apparent damage. The survivors ranged in size from 24 to 151 mm in length and averaged 59.1 mm with a standard deviation of 26.7 mm; whereas the dead ammocoetes ranged in size from 31 to 99 mm in length and averaged 56.2 mm with a standard deviation of 26.4 mm.

Habitat Evaluation

Substrate sampling in 1984 was done in conjunction with larval surveys. A total of about 90 dredge hauls were made using a 23 cm ponar type dredge. No sea lamprey larvae were captured using the dredge.

River temperatures were monitored at the same two sites as in 1983, i.e., at Sault Ste. Marie and at the St. Joseph Island bridge. Five day average temperatures have been plotted on Figure 46. Water temperature was probably near normal in 1984 since the mean air temperature at Sault Ste. Marie was very close to the 30 year normal (Environment Canada Data).



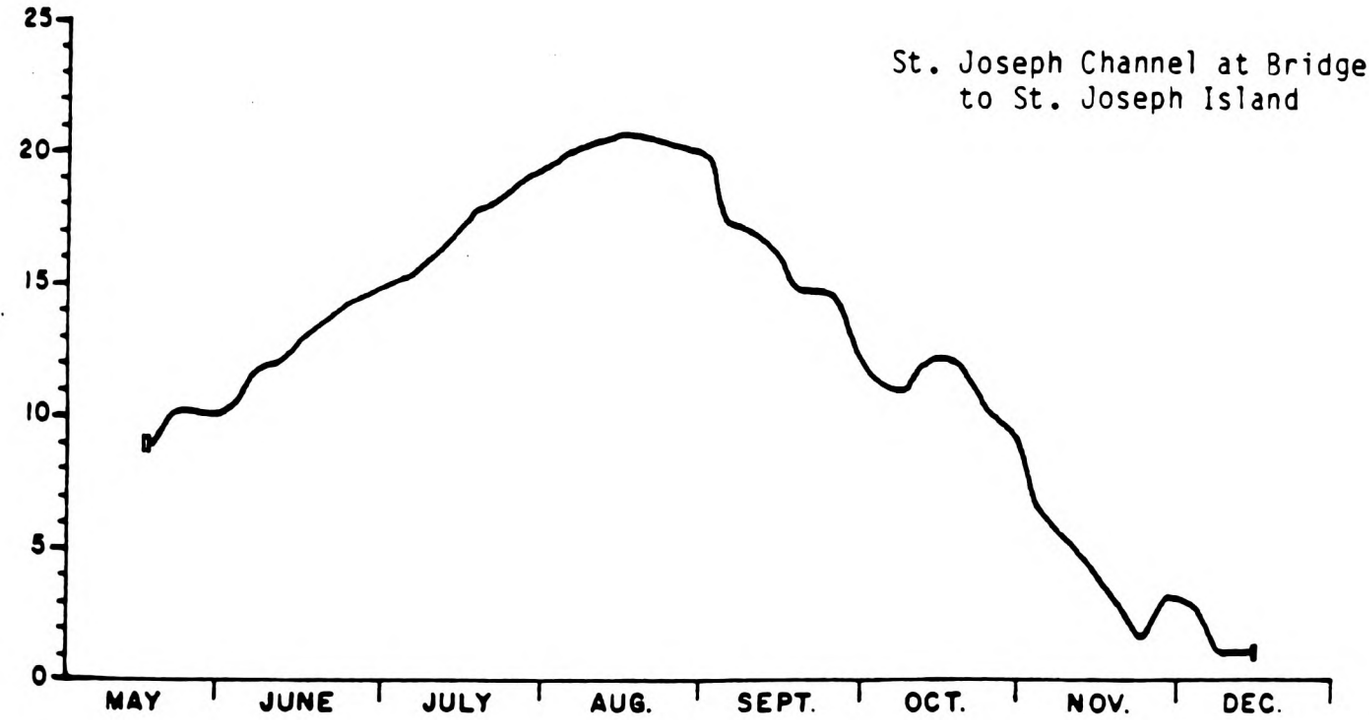


Figure 48. St. Marys River water temperatures (5 day mean temperatures plotted), May to December 1984.

FISH CREEK (NEW YORK) SEA LAMPREY LARVAL POPULATION ESTIMATE

Introduction

In 1983 the Great Lakes Fishery Commission (GLFC), acting on a recommendation of its Sea Lamprey Committee (SLC), gave its approval for the lampricide treatment of Fish Creek, a tributary of Oneida Lake, New York (GLFC 1983). Justification for the proposed treatment was the belief, widely held among the GLFC's agents and cooperators, that Fish Creek was a significant source of recruitment of sea lamprey to Lake Ontario. Because Fish Creek was one of the few remaining untreated streams in the Great Lakes drainage with a known large population of sea lamprey ammocoetes and its hydrologic conditions were suited for scientific study, it was recommended by the Sea Lamprey Control Centre that Petersen-type (mark and recapture) estimate of the population of sea lamprey be performed during the proposed treatment of the river. The Ludington sub-station of the GLFC's United States Control Unit (headquarters: Marquette, Michigan) was responsible for the treatment (scheduled for June 1984), while the Canadian Control Unit (Sault Ste. Marie, Ontario) was responsible for the population estimate.

Description of the Watershed

The Fish Creek system drains an area to the north and east of Oneida Lake (Figure 49). Upstream of the Oswego Road bridge the Fish Creek watershed has a moderately steep gradient with many rocky or gravelly riffles, but below that point the gradient is low with a predominately sandy or silty bottom. Little River, the major tributary, is slow moving and in many places marshy. From the results of larval assessment work, the personnel of the United States Sea Lamprey Control Unit based at Ludington, Michigan, estimated that 125 km of stream were infested with sea lamprey ammocoetes. The total flow of Fish Creek (measured in June 1983 at Fish Creek landing) was approximately 34.7 m^3/s.

Materials and Methods

Because of limited availability of personnel, a reduced-area design for the population estimate was chosen. "Study sections" were selected for the population estimate in the parts of Fish Creek and its tributaries scheduled for treatment (Figure 47). These study sections, 19 in number ranged from 0.2 to 4.0 km in length, amounted in aggregate to approximately 47 per cent of the total treated length of the river system. The releases of marked ammocoetes and the collections of specimens during the lampricide treatments were confined to the study sections.

Approximately 18,000 sea lamprey ammocoetes for marking purposes were collected from Fish Creek by means of shockers prior to the treatment (May 24 to 31, 1984). Most of them (99+%) were collected from the West Branch of Fish Creek, and the remainder from Little River and its tributaries. After being anaesthetized with MS-222, the ammocoetes were marked by single subcutaneous injections of fluorescent dye in the ventral post-anal area, or sometimes in the mid-lateral area. The specimens were held captive for at least a day after marking in tanks supplied with air and circulating river water. While lampricide-treated water was present at the holding area, the water supply to the tanks containing the marked ammocoetes destined for Little River was shut off.

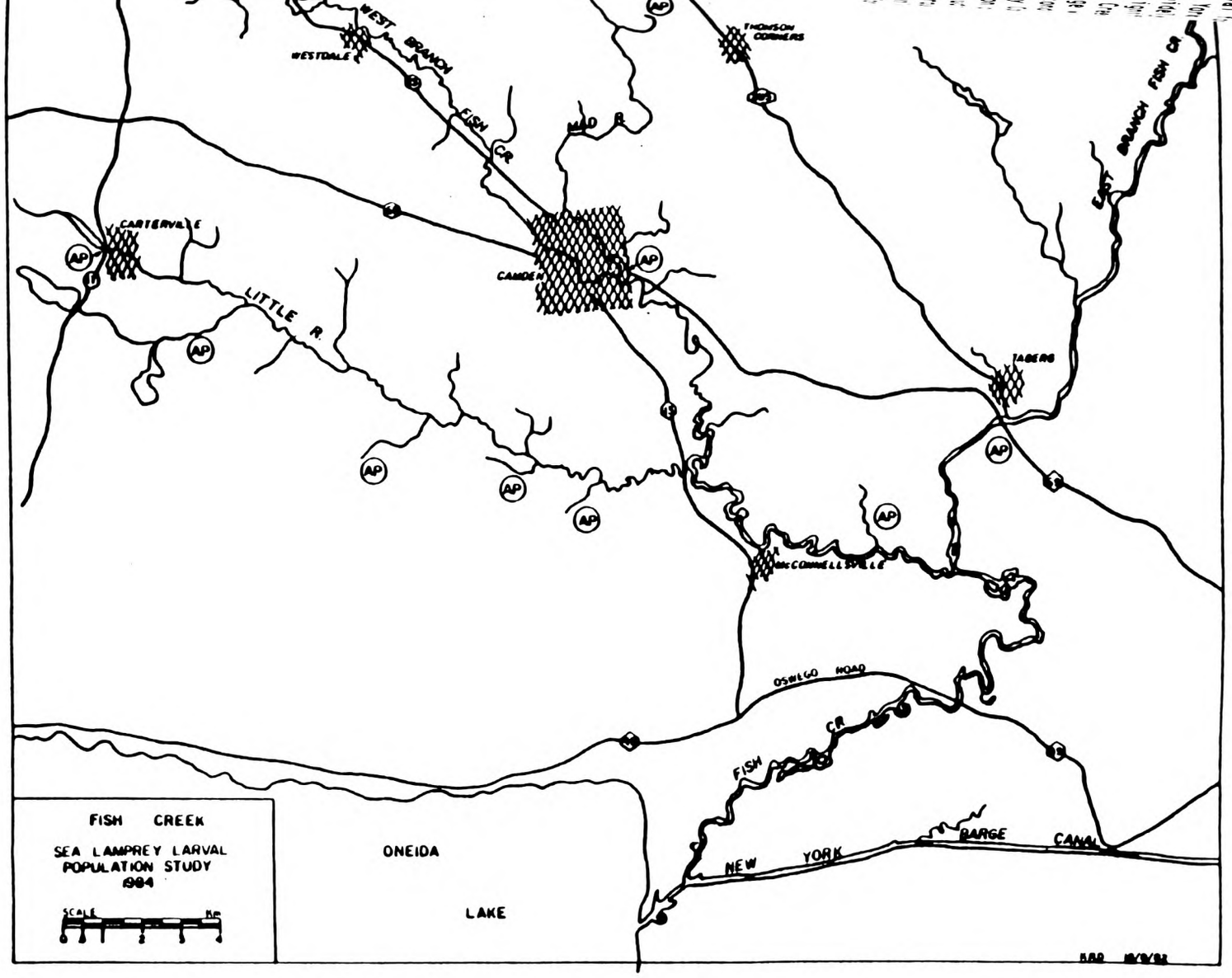


Figure 49. Map of Fish Creek system, New York State.

Marked ammocoetes were released prior to the lampricide treatment in a random pattern in each study section, in numbers approximately proportional to the relative areas of the sections (Table XV). The numbers of marked ammocoetes released into Little River and the remainder of the system ("Fish Creek proper") were 2,340 and 14,460, respectively. During the passage of the lampricide-treated water through each study-section, marked and unmarked ammocoetes were collected by people on foot or in boats using dip nets in daylight hours, or by fyke nets anchored in the stream at night. The collecting effort amounted to approximately 193 person-hours spent dip-netting, plus 45 overnight fyke-net sets.

Based on the numbers of marked ammocoetes released, and the counts of marked and unmarked specimens collected during the lampricide treatment, two separate Petersen-type population estimates were calculated from the pooled data from the combined study sections in Fish Creek and in Little River, including their respective tributaries. Each of the two pooled population estimates was then multiplied by a factor equal to the total treated area of the watershed in question divided by the combined areas of the study areas in the same drainage.

Results

The lampricide treatment of Fish Creek began on June 4, 1984 starting with the Mad River at Jones Road, followed by the West Branch at Camden and its other tributaries in succession downstream. A separate treatment of Little River was initiated on June 7, 1984, from the dam at Cartersville.

The numbers and length ranges of sea lamprey ammocoetes collected in each study section during the treatments of Fish Creek proper and Little River are shown in Table XV. In the entire system 35,211 ammocoetes were collected, of which 205 were marked. In Little River, 10,613 were collected, of which 43 were marked; while in Fish Creek proper 24,598 were collected of which 162 were marked. The total treated areas of streambed expressed as multiples of the combined areas of the relevant study sections were as follows: for Little River, 2.78; for Fish Creek proper, 2.06; and for the entire system, 2.11. Table XVI shows the calculations of the numbers of ammocoetes in these sections based on the numerical relationships described in the previous section. The numbers estimated in Little River, Fish Creek proper, and the entire Fish Creek system were 1.6×10^6, 4.5×10^6 and 6.1×10^6, respectively.

DISCUSSION

The numbers of ammocoetes marked and released, and the numbers collected, both marked and unmarked, were sufficient to ensure acceptable statistical precision of the Petersen estimate. As the length ranges of the marked ammocoetes were within the maxima and minima of those collected, the methods of recapture were effective for all the animals released. The main source of potential error could have been in the selection of the study sections, and the assumption that the mean density of ammocoetes in them was equal to that in the entire stream, for each of the two estimates made. We are of the opinion, however, that this assumption was not unreasonable--given the fact that the 19 study sections were located throughout the treated parts of the watershed, and included 47 per cent of the entire treated length of stream.

Table XV. Fish Creek sea lamprey ammocoete population estimate: Numbers of marked sea lamprey released and numbers and length ranges of marked and unmarked sea lamprey collected by study sections, 1984.

Study Section boundary Station Nos.	Relative area as % of Total	No. of MARKED ammocoetes released	Dates of recapture (1984)	Method of Collection	No. of MARKED ammocoetes recaptured	No. of UNMARKED ammocoetes collected	Total No. of ammocoetes collected	Size Ranges of Ammocoetes MARKED (mm)	UNMARKED (mm)
Fish Creek proper and tributaries, excluding Little River									
306 - 150	3.97	1,150	4 June	Hand & Fyke nets	25	7,392	7,417	48 - 138	31 - 176
221 - 219	2.74	700	4 June	Hand nets	4	35	39	50 - 96	31 - 166
143 - 142	2.53	650	4 June	Hand & Fyke nets	7	3,780	3,787	57 - 137	26 - 193
417 - 44	6.62	1,700	5/6 June	Hand nets	0	44	44	-	59 - 179
74 - 66	7.90	3,130	5/6 June	Hand & Fyke nets	33	2,870	2,903	58 - 132	35 - 170
59 - 53	0.35	100	5/6 June	Hand nets	0	313	313	-	91 - 192
48 - 45	3.42	980	5/6 June	Hand nets	18	5,200	5,218	70 - 153	31 - 172
30 - 27	12.40	3,880	5/6 June	Hand & Fyke nets	20	2,988	3,008	45 - 137	25 - 194
20 - 18	4.17	1,100	6 June	Hand	18	1,355	1,373	58 - 147	42 - 181
5 - 3	4.04	1,070	6 June	Hand	37	459	496	64 - 143	46 - 181
Sub-total	48.14	14,460			162	24,436	24,598	45 - 153	26 - 194
Little River and tributaries									
127 - 126	6.83	550	7/8 June	Hand net	6	900	906	68 - 145	75 - 195
122 - 121	2.28	150	8 June	Hand net	8	299	307	62 - 113	43 - 181
111 - 99(a)	5.80	410	9 June	Hand net	6	2,068	2,074	56 - 115	20 - 168
100 - 99(b)	2.28	200	10/11 June	Hand net	0	48	48	-	147 - 181
94 - 85	9.94	500	9 June	Hand net	7	4,762	4,769	50 - 115	24 - 166
84 - 83	0.12	65	10 June	Hand net	0	10	10	-	122 - 168
79 - 77	7.04	400	10 June	Hand net	11	2,188	2,199	72 - 152	37 - 159
75 - 75+	0.10	15	10 June	Hand net	3	91	94	61 - 109	78 - 149
75 - 74	1.65	50	4-6 June	Hand & Fyke nets	2	204	206	83 - 91	55 - 156
Sub-total	36.04	2,340			43	10,570	10,613	50 - 152	20 - 195
GRAND TOTAL	47.01	16,800			205	35,006	35,211	45 - 153	20 - 195

Table XVI. Calculations of ammocoete populations in Fish Creek and in its two main subdivisions, based on marking and recapture, 1984

Statistic or Estimate	Little River	Fish Creek Proper	Entire System
Number of ammocoetes marked and released (M)	2,340	14,460	16,800
Number of marked ammocoetes recaptured (R)	43	162	205
Total number of ammocoetes captured in treatments (C)	10,613	24,598	35,211
Estimate of total numbers of ammocoetes in the study areas [N_s = M.C/R]	5.8×10^5	2.2×10^6	2.8×10^6
Total treated area of stream as a multiple of total study areas (A/a)	2.78	2.07	2.12
Estimate of total numbers of ammocoetes in the treated sections of the streams ($N_t = N_s \cdot A/a$)	1.6×10^6	4.5×10^6	6.1×10^6

APPENDIX 1

MINI SALMON HATCHERY

In October, 1984, the Ontario Minister of Natural Resources, Alan Pope, announced a "Community Fisheries Involvement Program" (CFIP) aimed at enhancing certain fish communities through collaboration with local interest groups which would provide volunteer assistance. A group of sports fishermen in Sault Ste. Marie, Ontario - the Sault and District Anglers Association (SDAA) - has undertaken to raise chinook salmon from eggs to smolt stage for release into Lake Huron waters in the spring of 1985. The Sea Lamprey Control Centre has made available the facilities in its "Mini Aquarium" for use as a "Mini Salmon Hatchery".

SDAA members, with the help of Sault Ste. Marie District OMNR staff collected, fertilized and hatched some 40,000 chinook salmon eggs which have been placed in the mini hatchery at the Sea Lamprey Control Centre, in circulating St. Marys River water. Because of the high water temperatures of the river flow (the effluent of Lake Superior), most of the eggs hatched during the last week of November and early December. The fry were transferred to tanks and fed a moist pellet diet. They average 5.0 cm long and 1.0 g in weight. Immersion type heaters have been installed to elevate the temperatures from approximately 0°C to 7°C. With the increase in temperature, the remaining eggs hatched immediately and the larval fish rapidly absorbed their yolk sacs and became swim-up fry. They are feeding and growing rapidly. Mortality rates have been low, with over 30,000 fry swimming to date. After the fry smolt, they will be released into the St. Marys River. It is hoped that the returning adult salmon will provide enhanced angling opportunities for local sportsmen and tourists.

The facility will be utilized this spring to hatch and rear an additional 40,000 rainbow trout eggs.

The Sea Lamprey Control Centre is pleased to be able to provide these facilities and to assist in this worthwhile project.

APPENDIX 2

ELECTRONIC DATA PROCESSING

Electronic processing of this Centre's stream treatment, adult assessment, and larval survey data became a reality in the summer of 1984. A local computer company was awarded a contract for developing the system, writing the appropriate programs, and handling data input and output. To date current data and some of the earlier data for sea lamprey assessment have been processed, but when the system is operating satisfactorily (which should be very soon) earlier data will be processed, beginning with the most recent years. The Great Lakes Fishery Commission has designated a sum of $50,000. for this purpose, and we expect to begin using it in this fiscal year.

With Departmental funding, the Centre has acquired an IBM-PC computer which will be used eventually as a remote terminal to access the central computer's data banks directly, and also as a self-contained unit to allow the Centre's staff to manipulate selected batches of data on disk storage provided by the contracting firm.

To the greatest extent practicable, the Centre had adopted codes and formats that are compatible with those of the U.S. Control unit. We have found that in order to make our own data files accessible to ourselves, as well as to others, we have had to develop specific programs for storage and retrieval. However it will be a relatively simple matter to make electronically stored data accessible to the other control unit as the need arises. Already we are able to generate output reports of stream treatment information in a format identical with that used in our joint reports to the Commission.

During February and March a six week course on Data Processing and use of the IBM-PC Mini Computer was given to the scientific and technical staff of the Sea Lamprey Control Centre by the contractor for the Centre's EDP services.

APPENDIX 3

MEMORANDUM OF AGREEMENTS FOR 1984

THIS AGREEMENT made in duplicate

BETWEEN

HER MAJESTY THE QUEEN for Canada (hereinafter referred to as "Her Majesty") represented herein by the Minister of Fisheries and Oceans.

OF THE FIRST PART, and

THE GREAT LAKES FISHERY COMMISSION (hereinafter referred to as the "Commission")

OF THE OTHER PART.

WHEREAS, certain duties have been placed upon the Commission under the Convention on Great Lakes Fisheries between the United States and Canada, ratified on October 11, 1955,

AND WHEREAS, the Commission is required, so far as feasible, to utilize official agencies of the United States and Canada in the performance of its duties,

AND WHEREAS, the Department of Fisheries and Oceans (hereinafter called the "Department") is the agency of Her Majesty charged with the conduct and control of investigations of practical and economic problems connected with fisheries,

NOW, THEREFORE, THIS AGREEMENT WITNESSETH,

I. During the period of October 1, 1983 to September 30, 1984, the Department shall conduct, as far as is practicable, the following program of sea lamprey control in the Great Lakes as determined by the Commission.

A. ADULT SEA LAMPREY ASSESSMENT PROJECT

To obtain biological information and to monitor changes in adult sea lamprey abundance, the Department shall:

1. Maintain and operate, during the sea lamprey spawning run, a mechanical weir on Blue Jay Creek (Lake Huron).

2. Maintain and operate, during the sea lamprey spawning run, permanent barrier dam traps on seven tributaries; Sable River and Stokely Creek (Lake Superior), Kaskawong River (Lake Huron), Humber River and Duffin, Graham and Lakeport Creeks (Lake Ontario).

3. Maintain and operate, during the sea lamprey spawning run, portable traps on nine tributaries; Pancake River (Lake Superior), St. Marys, Thessalon, Mindemoya and Manitou Rivers (Lake Huron), Don River, Shelter Valley Brook and Bowmanville and Wilmot Creeks (Lake Ontario).

4. Obtain parasitic sea lamprey and/or related predation data from the sport and commercial fisheries in response to a reward.

5. Operate experimental traps in the St. Marys River during the period of November and December for the purpose of capturing parasitic phase sea lamprey.

6. Conduct an adult sea lamprey tag-recapture study on the Humber River to evaluate the efficiency of the two permanent trapping devices.

Estimated cost $202,300. Canadian Funds
$166,100. United States Funds

B. LARVAL SEA LAMPREY ASSESSMENT PROJECT

To evaluate the success of current and past lampricide applications and to plan future treatment operations, the Department will determine the presence, relative abundance and distribution of sea lamprey larvae by conducting surveys using lampricides and/or electro-fishing gear on approximately 25 Lake Superior, 25 Lake Huron, 50 Lake Ontario (Canadian and United States), and one Lake Erie (Grand River) tributary, and their related lake areas.

Estimated cost $194,200. Canadian Funds
$159,300. United States Funds

C. CHEMICAL TREATMENT PROJECT

To control sea lamprey throughout the Great Lakes by periodic application of lampricides, the Department will treat the following 34 tributaries and five lake areas currently infested with sea lamprey larvae:

1. Lake Superior

   a. With TFM - Goulais, Chippewa, Batchawana, Agawa, Pic, Pays Plat, Wolf and Jackfish Rivers.

   b. With Granular Bayer 73 - Batchawana, Mountain and Cypress Bays.

2. Lake Huron

   a. With TFM - Root, Garden, Thessalon, Spanish, Blind, Magnetawan, Wanapitei, Chikanishing and Naiscoot Rivers and the Sucker and Brown Creeks.

   b. With Granular Bayer 73 - St. Marys and Lower French Rivers and the Desjardins and Tenby Bays.

3. Lake Ontario

a. With TFM: Canada - Rouge and Moira Rivers, Shelter Valley Brook and the Lynde, Oshawa, Wilmot, Graham and Proctor Creeks.

: United States - South Sandy, Deer, Catfish, Sodus and Red Creeks.

Estimated cost $1,353,300. Canadian Funds
$1,109,500. United States Funds

4. LAMPRICIDE REQUIREMENTS

a. The Department will use approximately 54,300 lbs. of TFM, 750 lbs. of powdered Bayer 73, and 22,000 lbs. of granular Bayer 73 from existing inventory in carrying out the lampricide treatments and surveys proposed in this Agreement.

b. The Commission will purchase, for Canadian use, approximately 27,000 lbs. of TFM, 20,000 lbs. of granular Bayer 73 and 1,000 lbs. powdered Bayer 73 in 1984, to complete future treatment commitments.

Estimated cost $317,100. Canadian Funds
$260,000. United States Funds

D. SEA LAMPREY BARRIER DAM PROJECT

The Department enhances sea lamprey control by denying spawning run sea lamprey access to tributaries, or sections of such, by constructing and maintaining barriers on tributaries where the effectiveness of lampricides is limited because of uncontrollable factors, and in situations where barriers will save application costs in future years. The project includes:

1. The maintenance of 10 barrier dam structures and two permanent traps on the Humber River.

2. The construction of barrier dams on four tributaries: Sable River and Sheppard Creek (Lake Superior), Graham and Lakeport Creeks (Lake Ontario).

a. With the exception of Sheppard Creek, these dams will include permanent adult sea lamprey trapping devices.

3. The preparation for future dam construction on pre-selected tributaries.

Estimated cost $144,000. Canadian Funds
$118,000. United States Funds

E. SPECIAL STUDIES PROJECT

To assist in the development of methods which will enhance the effectiveness of sea lamprey control through improved evaluation of sea lamprey populations, the Department will:

1. Conduct studies of ammocoete populations and of related environmental factors in St. Marys River and Batchawana Bay; and

2. Evaluate the performance of new or modified methods of evaluating sea lamprey populations.

Estimated cost $155,000. Canadian Funds
$127,100. United States Funds

TOTAL ESTIMATED COST $2,048,800. Canadian Funds
$1,680,000. United States Funds
and
$317,100. Canadian Funds
$260,000. United States Funds

The exchange rate for the United States and Canadian currency reflected herein is based on $.82 U.S. dollars, and this rate shall be maintained until September 30, 1984.

* * * * * * * * * * *

THIS AGREEMENT made in duplicate

BETWEEN

HER MAJESTY THE QUEEN for Canada (hereinafter referred to as "Her Majesty") represented herein by the Minister of Fisheries and Oceans.

OF THE FIRST PART, and

THE GREAT LAKES FISHERY COMMISSION (hereinafter referred to as the "Commission")

OF THE OTHER PART.

WHEREAS, certain duties have been placed upon the Commission under the Convention on Great Lakes Fisheries between the United States and Canada, ratified on October 11, 1955,

AND WHEREAS, the Commission is required, so far as feasible, to utilize official agencies of the United States and Canada in the performance of its duties,

AND WHEREAS, the Department of Fisheries and Oceans (hereinafter called the "Department") is the agency of Her Majesty charged with the conduct and control of investigations of practical and economic problems connected with fisheries,

NOW, THEREFORE, THIS AGREEMENT WITNESSETH,

I. During the period of October 1, 1984 to September 30, 1985, the Department shall conduct, as far as is practicable, the following program of sea lamprey control in the Great Lakes as determined by the Commission.

A. ADULT SEA LAMPREY ASSESSMENT PROJECT

To obtain biological information and to monitor changes in adult sea lamprey abundance, the Department shall:

1. Maintain and operate, during the sea lamprey spawning run, permanent barrier dam traps on seven tributaries; Carp (Sable) River and Stokely Creek (Lake Superior), Kaskawong River, (Lake Huron), Humber River and Duffin, Graham and Lakeport Creeks, (Lake Ontario).

2. Maintain and operate, during the sea lamprey spawning run, portable traps on six tributaries; Pancake River, (Lake Superior), St. Marys and Thessalon Rivers, (Lake Huron), Bowmanville and Wilmot Creeks as well as Shelter Valley Brook, (Lake Ontario).

3. Obtain parasitic sea lamprey and/or related predation data from the sport and commercial fisheries in response to a reward.

Estimated cost $218,400.(Canadian Currency)
$176,900.(U. S. Currency)

B. LARVAL SEA LAMPREY ASSESSMENT PROJECT

To evaluate the success of current and past lampricide applications and to plan future treatment operations, the Department will determine the presence, relative abundance and distribution of sea lamprey larvae by conducting surveys using lampricides and/or electro-fishing gear on approximately 20 Lake Superior, 20 Lake Huron, and 20 Lake Ontario (Canadian and United States), tributaries, and their related lake areas, as required.

Estimated cost $209,200. (Canadian Currency)
$169,500. (U. S. Currency)

C. CHEMICAL TREATMENT PROJECT

To control sea lamprey throughout the Great Lakes by periodic application of lampricides, the Department will treat the following 28 tributaries and six lake areas currently infested with sea lamprey larvae:

1. Lake Superior

   a. With TFM - West Davignon Creek and, Big Carp, Goulais, Chippewa, Pancake, Steel, McIntyre-Neebing, and Pigeon Rivers.

   b. With granular Bayer 73 - Goulais, Batchawana, Mountain and Cypress Bays, and Helen Lake.

2. Lake Huron

   a. With TFM - Kaskawong, Mindemoya, Serpent, Sturgeon and Sauble Rivers and Richardson and Watson Creeks.

   b. With granular Bayer 73 - St. Marys River and Echo Lake.

3. Lake Ontario

   a. With TFM: Canada - Credit River, and Port Britain, Grafton, Lakeport, Salem and Smithfield Creeks.

   : United States - Little Sandy, Grindstone, Ninemile and Sterling Creeks, and Little Salmon River.

   b. With granular Bayer 73: Trent River-Canal.

Estimated cost $1,433,600. (Canadian Currency)
$1,161,200. (U. S. Currency)

4. LAMPRICIDE REQUIREMENTS

a. The Department will use approximately 26,800 lbs. of TFM, 352 lbs. of powdered Bayer 73, and 20,000 lbs. of granular Bayer 73 from existing inventory in carrying out the lampricide treatments and surveys proposed in this Agreement.

b. The Commission will purchase, for Canadian use, approximately 30,159 lbs. of TFM, 20,000 lbs. of granular Bayer 73 and 650 lbs. powdered Bayer 73 in 1985, to complete future treatment commitments.

Estimated cost $282,300. (U.S. Currency)

D. SEA LAMPREY BARRIER DAM PROJECT

The Department enhances sea lamprey control by denying spawning run sea lamprey access to tributaries, or sections of such, by constructing and maintaining barriers on tributaries where the effectiveness of lampricides is limited because of uncontrollable factors, and in situations where barriers will save application costs in future years. The project includes:

1. The maintenance of nine barrier dam structures, and two permanent traps on the Humber River.

2. The construction of barrier dams on two tributaries: Still River (Lake Huron), and Shelter Valley Brook (Lake Ontario).

   a. These dams will include permanent adult sea lamprey trapping devices.

3. The preparation for future dam construction on pre-selected tributaries.

4. Additional costs for this program to be funded from funds held by the Commission.

Commission's Contribution $151,600. (Canadian Currency)
$122,800. (U. S. Currency)

E. SPECIAL STUDIES PROJECT

With the intent of enhancing the effectiveness and/or accountability of the Centre's current sea lamprey control program, the Department will:

1. Continue the study of sea lamprey larval populations and related environmental factors within the St. Marys River;

2. Continue the study of sea lamprey larval populations and related environmental factors within Batchawana Bay;

3. Initiate a study on Lake Ontario (Salem Creek) with the intent of determining sea lamprey larval age at adult transformation, as well as other pertinent growth related factors;

4. Provide technical/scientific support to the Commission Workshop on Evaluating Sea Lamprey Populations (WESLP), by attending conferences, researching and writing reports.

Estimated cost $186,400. (Canadian Currency)
$151,000. (U. S. Currency)

TOTAL ESTIMATED COST $2,199,200. (Canadian Currency)
$1,781,400. (U. S. Currency)

and

$282,300.
(U.S. Currency)

The exchange rate for the United States and Canadian currency reflected herein is based on $.81 U.S. dollars, and this rate shall be maintained until September 30, 1985.

* * * * * * * * *

APPENDIX 4

TOTAL LAMPRICIDES USED IN 1984

	KILOGRAMS ACTIVE INGREDIENT OF:		
	TFM	Powdered Bayer 73	Granular Bayer 73
LAKE SUPERIOR	6,941.0	70.5	137.0
LAKE HURON	4,997.0	23.0	186.2
LAKE ERIE	-	-	3.0
LAKE ONTARIO (CANADIAN)....	2,074.4	-	5.2
LAKE ONTARIO (U.S.A.).....	981.0	-	-
TOTALS	14,993.4	93.5	331.4

APPENDIX - 5

FISH SPECIES REFERENCE LIST

The following species of fish are referred to in this report. The common and scientific names of these fishes are those listed in the American Fisheries Society's "Common and Scientific Names of Fishes", Special Publication No. 12, Fourth Edition, 1980.

Common Name	Scientific Name
Sea lamprey	*Petromyzon marinus (P.m.)*
Silver lamprey	*Ichthyomyzon unicuspis (Ich. spp.)*
Northern brook lamprey	*Ichthyomyzon fossor (Ich. spp.)*
American brook lamprey	*Lampetra appendix (L.a.)*
Bowfin	*Amia calva*
Alewife	*Alosa pseudoharengus*
Pink salmon	*Oncorhynchus gorbuscha*
Coho salmon	*Oncorhynchus kisutch*
Chinook salmon	*Oncorhynchus tshawytscha*
Round whitefish	*Prosopium cylindraceum*
Brown trout	*Salmo trutta*
Rainbow trout	*Salmo gairdneri*
Lake trout	*Salvelinus fontinalis*
Brook trout	*Salvelinus namaycush*
Splake	*Salvelinus fontinalis X Salvelinus namayc*
Rainbow smelt	*Osmerus mordax*
Grass pickerel	*Esox americanus vermiculatus*
Northern pike	*Esox lucius*
Lake chub	*Couesius plumbeus*
Common carp	*Cyprinus carpio*
Horneyhead chub	*Nocomis biguttatus*
River chub	*Nocomis micropogon*
Golden shiner	*Notemigonus crysoleucas*
Common shiner	*Notropis cornutus*
Spottail shiner	*Notropis hudsonius*
Blacknose dace	*Rhinichthys atratulus*
Longnose dace	*Rhinichthys cataractae*
Creek chub	*Semotilus atromaculatus*
Pearl dace	*Semotilus margarita*
Longnose sucker	*Catostomus catostomus*
White sucker	*Catostomus commersoni*

APPENDIX 5

Common Name	Scientific Name
edhorse sucker	*Moxostoma* spp.
rown bullhead	*Ictalurus nebulosus*
tonecat	*Noturus flavus*
urbot	*Lota lota*
rout-perch	*Percopsis omiscomaycus*
inespine stickleback	*Pungitius pungitius*
ock bass	*Ambloplites rupestris*
umpkinseed	*Lepomis gibbosus*
ohnny darter	*Micropterus dolomieui*
mallmouth bass	*Etheostoma nigrum*
ellow perch	*Perca flavescens*
ogperch	*Percina caprodes*
ottled sculpin	*Cottus bairdi*
limy sculpin	*Cottus cognatus*
culpin spp.	*Cottus* spp.

APPENDIX 6

GLOSSARY OF TERMS, ABBREVIATIONS, METRIC EQUIVALENTS, AND SYMBOLS

TERMS

Ammocoete - Larval (young) lamprey

Residual - Sea lamprey larvae (ammocoetes) that survived lampricide treatment. Survival may have occurred as a result of sublethal lampricide concentrations or untreated areas of the watershed harbouring sea lamprey larvae.

Abundance - Descriptive of relative population densities of sea lamprey larvae, i.e. numbers of individuals per unit area. The terms are understood to imply subjective judgements based on levels expected from previous experience of other areas, or of the same area at other times.

TFM - The active ingredient 3-trifluoromethyl-4-nitrophenol (sodium salt) as supplied by the Hoechst or Maumee Chemical Companies.

Bayer 73 - Ethanolamine salt of 2',5-dichloro-4'-nitrosalicylanilide, available as a 70 per cent active ingredient wettable powder commercially known as "Bayluscide". It is used to synergize TFM.

Granular Bayer 73 (G.B. 73) - Sand granules coated with Bayer 73 at approximately five per cent by weight active ingredient. Used for ammocoete surveys, to synergize TFM, and treatment of estuarine and lacustrine environments.

Lampricide - The formulation of TFM (aqueous) and/or Bayer 73 (powdered or granular).

Bioassay range - The first value in ppm is the calculated 99.9 per cent mortality level for sea lamprey ammocoetes. The second value in ppm is the calculated 25 per cent mortality level for brook trout and/or other experimental fish as noted in the text.

Hardness (of water) - A measure of the amount of calcium and magnesium ions present. In the usage of this report, hardness refers to alkalinity (by methyl-orange or phenolphthalein titration) or ionic content (measured by conductance).

Initial surveys - Conducted on streams which have never been surveyed before.

Routine surveys - Conducted to determine the presence (or absence) of sea lamprey ammocoetes in streams that have never had a known sea lamprey population.

Reestablishment surveys - Conducted to determine if sea lamprey ammocoetes have repopulated streams previously treated with lampricide.

Distribution surveys - conducted to determine the geographical distribution of sea lamprey ammocoetes in a watershed.

Treatment evaluation surveys - Conducted to evaluate the effectiveness of the lampricide treatment.

RMS (Continued)

pulation Study surveys - conducted to provide additional population size and growth-age data on established sea lamprey larval populations.

BREVIATIONS

B. 73 - granular Bayer 73
s. act. ingr. - pounds active ingredient
/s - cubic metres per second
m - parts per million
b - parts per billion
P - lampricide application point
- denotes stream sample station
D - four-wheel-drive vehicle
D - two-wheel-drive vehicle
S.G. - recording staff gauge
est. - reestablishment survey
st. - distribution survey
.Eval. - treatment evaluation survey
p.Sty. - population study survey
- River
. - Creek
. - Brook
r. - harbour
. - Island

TRIC EQUIVALENTS

/s - cubic metres per second (m^3/s = 35.3 f^3/s)
- kilometre (km = 0.621 mile)
- hectare (ha = 2.47 acres)
- metre (m = 3.28 feet)
- centimetre (cm = .3937 inch)
- millimetre (mm = .03937 inch)
- kilogram (kg = 2.2 lbs.)
- gram (g = .03527 ounce)
- litre (L = 0.2201 Imperial gallon)

MBOLS

- overlaying stream; denotes area of sea lamprey larval distribution as established during chemical treatments
- trail (footpath)
- poor roads
- roads in good condition
- end of road

- rapids (fast water) area on a river
♂ - male
♀ - female
- marsh