APPENDIX XVII

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EXECUTIVE SUMMARY

of the

ANNUAL REPORT FOR THE YEAR 1985

on

***SEA LAMPREY** MANAGEMENT IN CANADA AND THE UNITED STATES*

presented to

GREAT LAKES FISHERY COMMISSION

by

DEPARTMENT OF FISHERIES AND OCEANS CANADA

and

U.S. FISH AND WILDLIFE SERVICE

April 1986

SEA LAMPREY MANAGEMENT IN CANADA AND THE UNITED STATES

EXECUTIVE SUMMARY

Management of sea lampreys in the Great Lakes by the Department of Fisheries and Oceans Canada and the U.S. Fish and Wildlife Service continued in 1985. Larval surveys, stream treatments, and assessments of adult populations were conducted in tributaries of Lakes Superior, Michigan, Huron, and Ontario. Activities in Lake Erie tributaries were limited to larval surveys and assessment of adult sea lampreys.

Surveys for larval sea lampreys were completed in 410 tributaries of the Great Lakes: 120 tributaries of Lake Superior, 127 of Lake Michigan, 112 of Lake Huron, 16 of Lake Erie, and 35 of Lake Ontario. In addition, 35 offshore areas were examined. Distribution and abundance of larvae were substantiated in the St. Marys River. Larvae were found for the first time in Coldwater River (Lake Huron), and also in the Carp River (Lake Superior) where they have been absent since 1963.

Chemical treatments were completed in 73 tributaries of four Great Lakes: 24 tributaries of Lake Superior, 18 of Lake Michigan, 16 of Lake Huron, and 15 of Lake Ontario. The Big Salt River, a tributary of the Saginaw River (Lake Huron), was treated for the first time, and TFM was applied to the Neebing-McIntyre River system (Lake Superior) which had not required treatment since 1972.

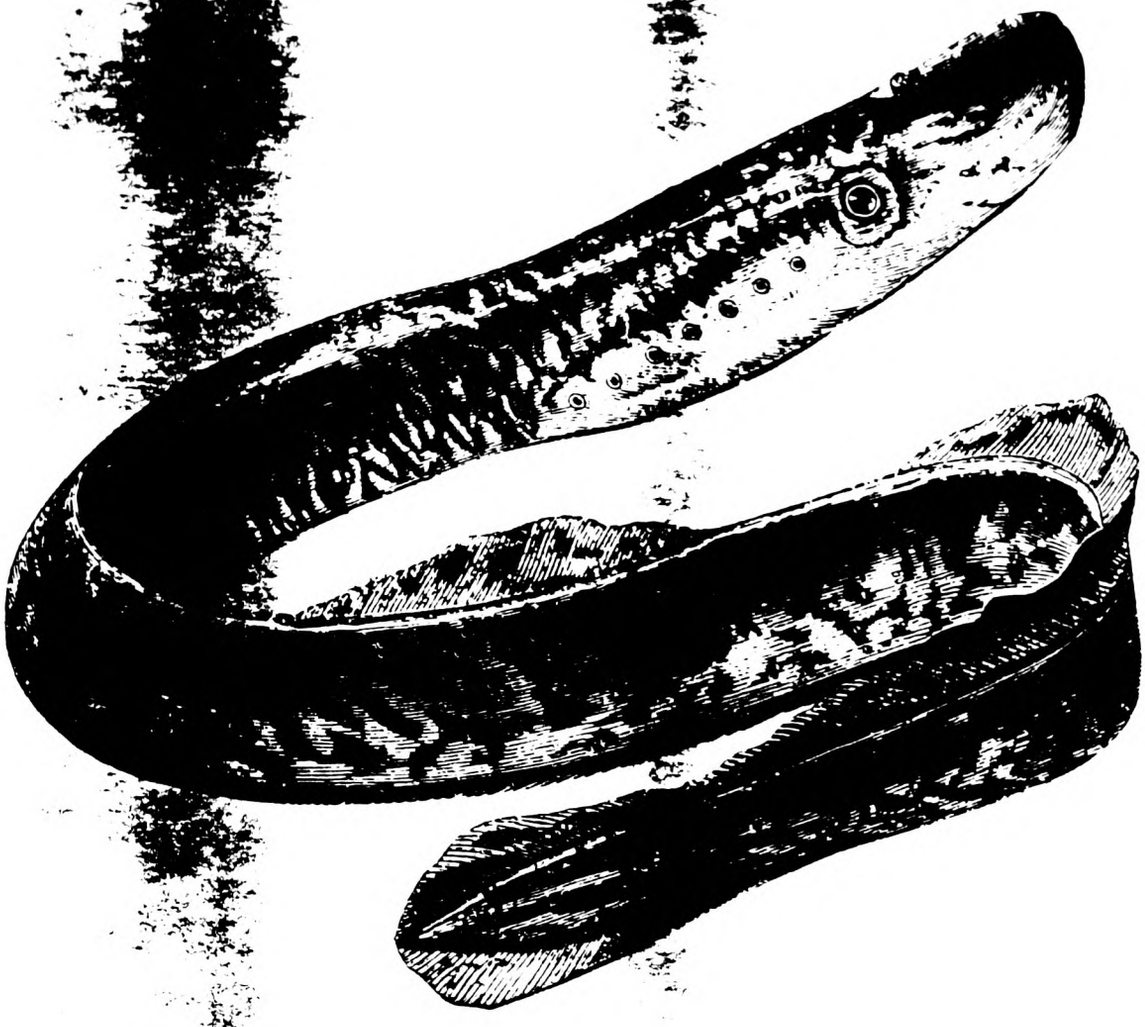
Assessment traps were placed in 51 tributaries of the Great Lakes and captured 57,103 spawning-phase sea lampreys: 1,770 from Superior, 15,471 from Lake Michigan, 31,760 from Lake Huron, 2,383 from Lake Erie, and 5,719 from Lake Ontario. The number of spawning adults was estimated in the Manistique River (Lake Michigan) and the Cheboygan, Ocqueoc, and St. Marys rivers (Lake Huron). An estimated 116,500 adults were present in these rivers.

Commercial and sport fishermen collected 5,964 parasitic-phase sea lampreys in the Great Lakes: 330 from Lake Superior, 1,086 from Lake Michigan, 4,523 from Lake Huron, 15 from Lake Erie, and 10 from Lake Ontario. These data show lampreys are far more common in Lake Huron than the other lakes. Information on the incidence of sea lampreys and marks on fish was provided by 235 charter captains in the Upper Great Lakes and by sport anglers in Batchawana Bay (Lake Superior).

Several special studies were conducted in 1985. Investigations of the effects of lampricides on nontarget organisms were conducted in treated and control sections of the Silver River (Lake Superior); Ford, Sturgeon, and Platte rivers (Lake Michigan); and Carp and Rifle rivers (Lake Huron). Studies on numbers of larval sea lampreys were completed in Batchawana Bay and in Salem Creek, a Lake Ontario tributary. Other special studies investigated survival of larvae in polluted sediments, transformation of larvae, and the effectiveness of electrofishing gear.

Fisheries and Oceans

APPENDIX XVIII



Sea Lamprey Control

ANNUAL REPORT - 1985

Sea Lamprey Control Centre - Sault Ste. Marie, Ontario

Canada

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ANNUAL REPORT

of the

SEA LAMPREY CONTROL CENTRE

for

1985

EXECUTIVE SUMMARY

The Department of Fisheries and Oceans 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 is augmented in the field season by approximately 30 casuals and students. The control program consists of five main field projects; Adult Sea Lamprey Assessment, Larval Sea Lamprey Assessment, Lampricide Treatment, Barrier Dam Construction and Maintenance, and Special Studies.

The sea lamprey control program 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 control 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 spawning phase adult sea lamprey populations throughout the Great Lakes is accomplished through the operation of 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.

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 18,363 spawning phase sea lamprey were collected from trapping devices fished in 13 tributaries: Lake Superior - Pancake River (0), Carp River (129), Stokely Creek (4); Lake Huron - St. Marys River (7,763), Kaskawong River (648), Thessalon River (4,566); Lake Ontario - Humber River (2,828), Duffin Creek (1,059), Bowmanville Creek (466), Wilmot Creek (58), Graham Creek (672), Shelter Valley Brook (123), and Lakeport Creek (47).

Commercial fishermen submitted a total of 1,197 predatory phase lamprey to the Centre for a reward: Lake Superior - 24, Lake Huron - 1,158, and Lake Erie - 15. The Lake Huron catch consisted of 731 from the North Channel, 408 from the main basin and 19 from Georgian Bay. Over an 18 year period (1967-84), a total of 652 predatory phase sea lamprey have been submitted to the Centre from the Lake Erie commercial fisheries.

LARVAL SEA LAMPREY ASSESSMENT

Surveys were conducted on 90 tributaries and seven lake areas of the Great Lakes as follows: Lake Superior 25 - 4; Lake Huron 33 - 3; Lake Ontario (Canada) 17; Lake Ontario (USA) 15.

Sea lamprey larvae were taken from the Coldwater River, Lake Huron, for the first time. Further surveys will be required to determine the magnitude of this population.

Larval escapement from previous treatments was documented in seven tributaries: Wolf River (Lake Superior); Root, Garden, and Chikanishing Rivers (Lake Huron); Shelter Valley Brook, Deer, and South Sandy Creeks (Lake Ontario).

Surveys conducted upstream of dams on eight tributaries indicate that spawning phase sea lamprey have gained access above those structures on the Thessalon and Echo Rivers.

Granular Bayer 73 lake surveys conducted off the mouth of Mackenzie, Wolf and Black Sturgeon Rivers, and Polly Creek (Lake Superior); Manitou and Sturgeon Rivers (Lake Huron); and Blind and Little Sandy Creeks (Lake Ontario) identified the presence of sea lamprey in all except the Black Sturgeon River and Blind Creek.

LAMPRICIDE TREATMENTS

A total of 30 tributaries were treated with the selective lampricide TFM in 1985: Lake Superior - 8; Lake Huron - 7; and Lake Ontario - 15 (8 in Canada and 7 in the United States). In addition, granular Bayer 73 treatments were carried out in areas of three Lake Superior bays, two inland lakes and two river.

Sea lamprey larval populations were considered to have been moderate to abundant in all of the tributaries treated with the exception of the Steel, Pigeon, Chippewa (Lake Superior) and Sauble (Lake Huron) Rivers. However, larvae of transformation size were present in all of the streams. Larvae undergoing adult transformation were present in eight of the tributaries with the largest numbers being collected from Salem - 212, and Duffin - 30, Creeks (Lake Ontario) and the Neebing-McIntyre River - 91 (Lake Superior).

Non-target fish mortalities were considered to have been negligible in all of the tributaries except the Salmon River, Skinner and Sterling Creeks (Lake Ontario), the Serpent River (Lake Huron) and the Goulais River (Lake Superior. Fish kills on the Skinner, Sterling and Serpent tributaries involved coarse fish and resulted from a combination of unfavourable stream conditions and excessive lampricide concentrations. Mortality of approximately 400 chinook salmon in the Little Salmon River was attributed to relatively high lampricide concentrations under conditions of low water temperatures and deteriorating fish health.

Application of the bottom toxicant granular Bayer 73 to previously treated areas of the Great Lakes indicated a continued decline in the numbers of larvae collected as compared to previous treatments. Exceptions were the St. Marys River and Echo Lake (Lake Huron), and the Trent River-Canal (Lake Ontario).

Four areas of the St. Marys River totalling 6.39 hectares were treated with 1,906.5 kilograms of granular Bayer 73. A total of 6,679 larval sea lamprey were collected, including 29 animals undergoing adult transformation. Approximately 73 per cent of the collection was taken from the southeast flank of Whitefish Island with the majority of these larvae coming from a previously untreated section. Treatment of the Whitefish Island area was facilitated by a significant reduction in water discharge as a result of the dewatering of the St. Marys River rapids for the purpose of constructing a concrete dike.

A small area of the Trent River (0.92 hectares) adjacent to the mouth of Mayhew Creek was treated with the bottom formulation of lampricide, granular Bayer 73. Of the 257 larvae collected, 33 were undergoing adult transformation. Although it is felt that these animals originated from Mayhew Creek, reports of adult sea lamprey spawning in the Trent River is cause for concern.

SEA LAMPREY BARRIER DAM CONSTRUCTION AND MAINTENANCE

Low-head barrier dams constructed by this Centre on nine tributaries; the Carp, Gimlet, Stokely, Sheppard (Lake Superior), Kaskawong, Sturgeon (Lake Huron), Duffin, Graham and Lakeport (Lake Ontario), appear to be effective in preventing the upstream migration of spawning phase sea lamprey. Dams on the Echo (Lake Huron) and Credit (Lake Ontario) Rivers have, for various reasons, not been effective as sea lamprey barrier dams.

A concrete dam with steel lip, lamprey trap and removable steel plates to allow for the seasonal upstream movement of anadromous fish species was constructed on Shelter Valley Brook in 1985. The total cost of construction, completed in November, was $[illegible]2,520.

Construction of a dam on the Still River in 1985 (Lake Huron) was deferred due to the high cost; the lowest bid being approximately $100,000.

Maintenance work was carried out at the Gimlet, Sable, Stokely, Kaskawong, Echo, Lakeport, Graham and Duffin barrier dams. Also a 10 m long segment of the Shannonville dam on the Salmon River (Lake Ontario) was faced and capped with 20 cm of reinforced concrete.

SPECIAL STUDIES

Studies on the St. Marys River (Lake Huron) involved a spawning phase sea lamprey population study in the upper river, larval sea lamprey population studies in several areas of the river and continued efforts to define larval population spatial parameters. Results of these studies indicated that approximately 23,850 adult sea lamprey were present in the area of the river below the Great Lakes Power dam. Results of collective larval population studies suggest a staggering 20 million larvae occupy the river from Point Louise to the south flank of St. Joseph Island, a distance of approximately 52 kilometres.

Sea lamprey larval distribution and population studies were conducted in Batchawana Bay, Lake Superior. This study involved the use of the submersible "Sea Link II" (a USA/NOAA project). The dives took place on July 25 and 26 and involved the laying of underwater transects, the placing of temperature recorders and the placement of marked ammocoetes in cages to measure capture efficiency. Observations during the dives were video taped and are available for viewing. Results of a portion of the overall study indicated that an area of the bay totalling 3.02 hectares had a population of approximately 10,446 larval sea lamprey, only 23 (0.2 per cent) of which were undergoing adult transformation.

A sea lamprey larval growth study was initiated on Salem Creek (Lake Ontario). This is a relatively small stream with an average summer discharge of 0.2 m^3/s. Only 2.1 km of the stream is inhabited by sea lamprey. The study was initiated with a population estimate carried out in conjunction with the lampricide treatment of the stream in September. Results of the study indicated a larval population, prior to treatment, of approximately 259,363 animals consisting of 17,216 larvae undergoing adult transformation.

ADULT SEA LAMPREY ASSESSMENT

Introduction

Efforts to control sea lamprey on 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 (GLFC) in 1955 the Canadian control program became the responsibility of the federal Department of Fisheries, as designated Canadian agent of the GLFC. The electrical barrier networks then rapidly developed on Lake Superior and eventually Lake Huron, but were reduced after 1963 when the success of chemical control became apparent. The Canadian Lake Superior barriers were removed after 1967 while those on Lake Huron were progressively eliminated until none were left after 1980.

Although initially intended as control measures, the original mechanical trapping devices and electrical barriers were retained only 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). Similarly, a regulated dip net operation conducted from 1968 to 1978 and again in 1981 on the Humber River, a Lake Ontario tributary, provided valuable assessment information over the period preceding and following the 1971 introduction of chemical control to that lake.

Mechanical trapping, reintroduced in 1971, has replaced electrical 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. Permanent trapping devices are presently regarded as the most stable and consistent collecting method 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 with 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 the Centre introduced an "Angler Diary Cooperator Programme" directed at obtaining information on the frequency of lamprey marking and sightings from the sport fishery. The lake trout fishery of Batchawana Bay, Lake Superior was selected for the pilot study. For 1984, the programme was expanded to include as well the sensitive lake trout fisheries of Michipicoten and Thunder Bays, Lake Superior. In 1985, a charterboat operator working around Montreal River was also enlisted.

Also commencing in 1983 was the monitoring of fishing derbies for the purpose of determining lamprey marking rates, or for the recapture of tagged lamprey released to investigate movement. This programme is intended to take advantage of the recent tremendous interest in these organized events, which provide considerable opportunity to fisheries agencies, as amply demonstrated by the wealth of information obtained from the Empire State Lake Ontario (ESLO) derbies by New York Department of Environmental Conservation (NYDEC). Four derbies were attended by Centre personnel in 1985, one on Lake Superior and three on Lake Huron, while data from another two derbies on Lake Erie were provided by the Ontario Ministry of Natural Resources (OMNR) in an informal exchange of information.

The Fish Creek tag-recapture study of transformed sea lamprey, which commenced in September 1982, was completed in 1985.

LAKE SUPERIOR

Spawning Phase Sea Lamprey

For 1985, a total of 133 spawning phase sea lamprey were collected from trapping devices operated on three tributaries to Lake Superior. Locations of these streams are shown on Figure 2, operational data in Table I, and biological data in Table II.

Once again, the catch from the dam trap on Stokely Creek was very low, at four specimens. Since the first season of operation in spring 1982, this device has averaged only six adults annually.

The collection of 129 specimens from the Carp (Sable) River dam trap is up from the 45 captured last year. Of some concern, this count is similar to previous catches made at the former electrical barrier operated on this stream in the 1950's and '60's, yet it is not considered indicative of any pronounced change in the sea lamprey population of Batchawana Bay and adjacent waters.

Indeed, the trapping effort at the Gimlet Creek dam in nearby Pancake River suggests the opposite, for no specimens were taken this year, despite the feeling that the operation was as effective as in any recent attempt. Further, during a TFM treatment conducted on the Pancake River over June 11 and 12, a concerted effort was made to locate spawning adults and nests. This coincided with the time when the run has normally peaked and spawning activity has commenced (two-thirds of the Carp River collection had been made by these dates). Intensive observations resulted in 21 adult sea lamprey counted and relatively few suspect nests noted, even on considerable stretches of prime gravel. This stream was historically recognized as carrying one of the major spawning runs of eastern Lake Superior.

Predatory Phase Sea Lamprey

Commercial Fisheries

To date, three Lake Superior fisheries have submitted 24 sea lamprey. While the number is inadequate to develop realistic conclusions, the entire Lake Superior data set will be presented in an internal technical report to be released next year.

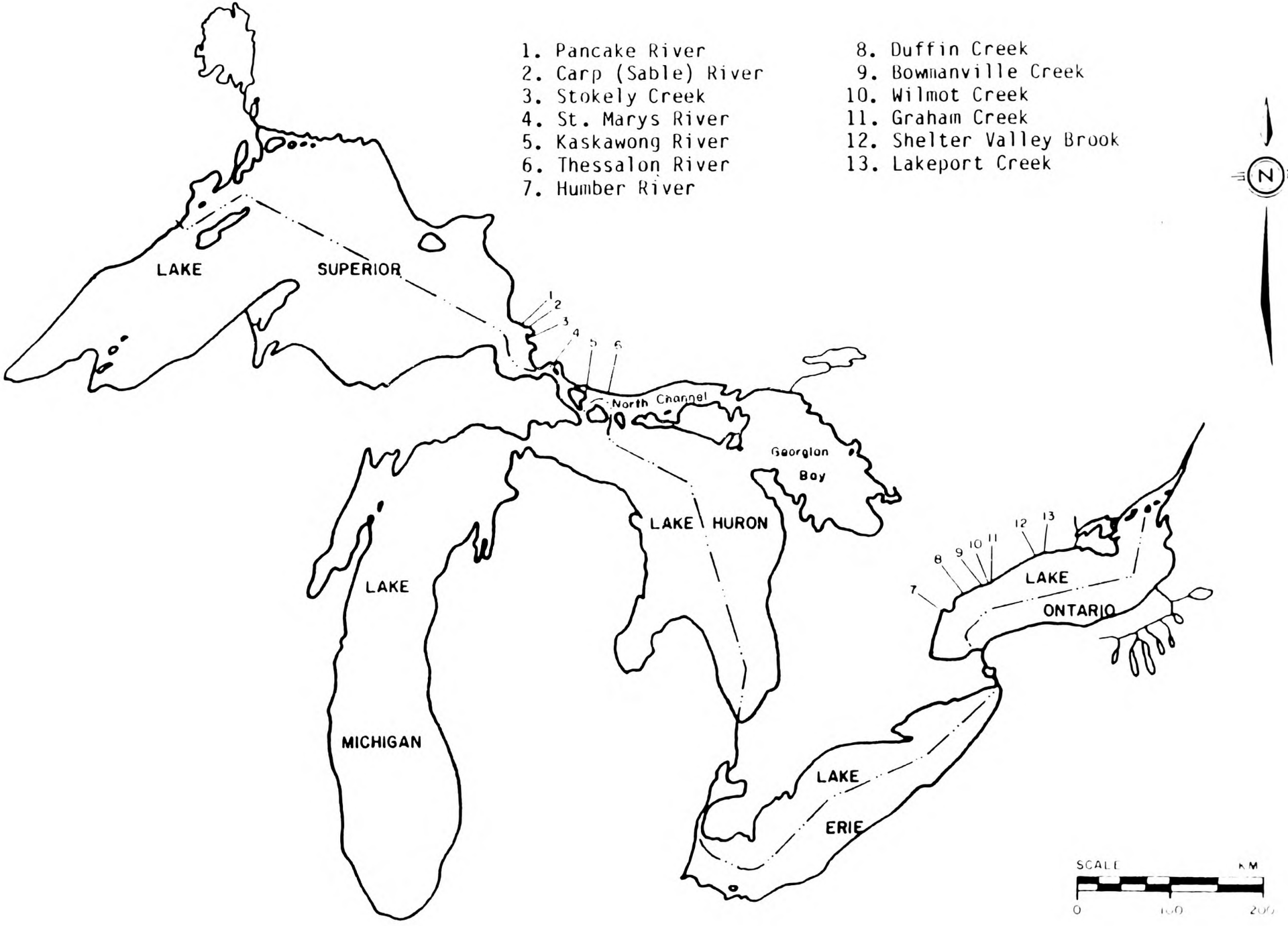


Figure 1. Location of tributaries where spawning phase sea lamprey were trapped, 1985.

Table I. Pertinent operational data and numbers of spawning phase sea lamprey collected by assessment gear fished in 13 Great Lakes tributaries in 1985.

LAKE/Tributary	Gear Fished	No.	Period Gear Fished	Total Nights Operated	Sea Lamprey Collected
LAKE SUPERIOR					
Stokely Creek	DT	1	May 2 - July 10	69	4
Carp (Sable) River	DT	1	May 3 - July 10	68	129
Pancake River	PT	1	Apr. 30 - July 10	71	0
LAKE HURON					
St. Marys River	PT	2	June 7 - Aug. 9	63	7,763
Kaskawong River	DT	1	Apr. 29 - July 10	72	648
Thessalon River	PT	3	Apr. 30 - July 11	72	4,566
LAKE ONTARIO					
Humber River	DT	2	Apr. 25 - June 24	60	2,828
Duffin Creek	DT	1	Apr. 29 - June 28	60	1,059
Bowmanville Creek	PT	2	Apr. 29 - June 26	58	466
Wilmot Creek	PT	1	Apr. 27 - June 26	59	58
Graham Creek	DT	1	Apr. 27 - June 28	62	672
Shelter Valley Brook	PT	1	Apr. 26 - June 25	60	123
Lakeport Creek	DT	1	Apr. 25 - June 28	64	47
TOTALS - 13		18			18,363

PT = Portable Trap DT = Dam Trap

Commercial Fisheries (Continued)

According to fishermen, sea lamprey activity remains low over the Canadian waters of the lake. The higher incidence of marking reported from the eastern end of Nipigon Bay during the past few years apparently was resolved for the 1985 fishing season. In 1984, it had become necessary to treat the Pays Plat River, a stream that had last been treated in 1963, but according to surveys sea lamprey had not become reestablished until the late 1970's or early 1980's.

Table II. Spawning phase sea lamprey biological data collected from assessment units fished in Canadian tributaries to the Great Lakes, 1985.

LAKE/Tributary	Unit	Number Collected/Sampled		Percent Males	Mean Length (mm) Males	Mean Length (mm) Females	Mean Weight (g) Males	Mean Weight (g) Females
LAKE SUPERIOR								
Stokely Creek	DT	4	4	50	431	415	205	179
Carp (Sable) River	DT	129	129	47	442	437	203	197
Pancake River	PT	0	-	-	-	-	-	-
Lake Superior Totals		133	133	47	442	436	203	196
LAKE HURON								
St. Marys River	PT	7,763	1,932	57	479	484	240	251
Kaskawong River	DT	648	364	46	477	491	227	248
Thessalon River	PT	4,566	2,456	62	491	493	243	259
Lake Huron Totals		12,977	4,752	59	485	489	241	255
LAKE ONTARIO								
Humber River	DT	2,828	1,135	64	483	474	244	245
Duffin Creek	DT	1,059	429	60	481	477	242	248
Bowmanville Creek	PT	466	428	63	486	471	247	237
Wilmot Creek	PT	58	58	67	478	468	248	252
Graham Creek	DT	672	377	64	495	502	252	276
Shelter Valley Br.	PT	123	120	64	502	479	265	245
Lakeport Creek	DT	47	47	55	488	472	256	244
Lake Ontario Totals		5,253	2,594	63	486	478	247	249
GRAND TOTALS/Averages		18,363	7,479	60	485	484	243	251

PT = Portable Trap DT = Dam Trap

Sport Fisheries

a) Angler Diary Programme

The field record used in 1985 remained unchanged from the previous year. The convention used for reporting marks is that put forward by the 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).

The diary programme for the Thunder Bay and Michipicoten Bay fisheries was not vigourously pursued this past season. A concerted effort in 1984, during the first year of operation in these areas, led to a response from 32 per cent of the original 57 volunteers. The information they submitted was summarized in the Annual Report for that year, with the exception of one set of field records not received until summer 1985. However, a questionnaire was sent in early October of 1985 to 56 of the cooperators, along with a request that any completed forms be returned. Responses were submitted by 21 per cent of the volunteers. Three of the respondents indicated they were not interested in participating further; three recommended a preference for seeing the programme expanded to rainbow and salmon; another three indicated that they had spent very little time fishing; and one respondent from each area noted that for them lake trout fishing had been poor. One questionnaire packet was returned, not having been delivered. The only field records received to date were from one Michipicoten Bay cooperator. They indicated that in five fishing trips, amounting to 22 hours of fishing, no lake trout were caught.

The Batchawana Bay investigation remains viable because of the perseverance of some ten committed volunteers. To date, information on 159 lake trout has been provided for the 1985 season. A breakdown of the marking incidence by standard size categories for lake trout is given in Table II.1, supplemented by data from another 14 lake trout obtained at a fishing derby (described later). Many of the specimens are small, and it is worth noting that 14 per cent of the 173 lake trout sampled were under 12.9 inches (328 mm) in length.

Table II.1. Sea lamprey predation data from a lake trout angler diary programme and a fishing derby on Batchawana Bay, Lake Superior, 1985.

Total Length* (Inches)	Lake Trout Sample Size	No.of Wounds	No.Wounds /100 fish	No.Other Marks**	No.Other Marks /100 fish
under 17.0	131	7	5.3	14	10.7
17.0 - 20.9	42	8	19.0	16	38.1
TOTALS/MEAN	173	15	8.7	30	17.3

* Standard total length categories
** Includes healed wounds and superficial marks

What is suggested by this data in comparison with the two earlier years of sampling? A shift in average lengths to the lower class occurred for the second time in three years. In 1983 the 17.0 to 20.9 inch class had nearly twice the number of lake trout in it as the 17.0 inch class; for 1984 they were equally represented; and during the past season the smaller class had better than three times as many specimens angled. Where nearly nine per cent of the 1984 catch was longer than 20.9 inches, not a single lake trout was reported from the larger length categories this past season. Despite this, wounding was up considerably. Both of the length categories that are represented show pronounced increases. Inexplicably however, the per cent 'Other marks' for both years were essentially unchanged. Nine lamprey were recorded attached to these lake trout, ranging in length up to about 330 mm.

Undoubtedly sea lamprey are having a significant if not major impact on the present Batchawana Bay lake trout population. However, experience from other Great Lakes situations suggests that such a small, geographically discrete bay would, when subjected to a high level of recruitment to the adult sea lamprey population, show substantially greater incidences of marking than are observed. Rather, it is the conviction of this office that recruitment is low in relation to historical levels, and that admittedly rudimentary evidence obtained in 1985 portends further decline.

A charterboat operator out of Montreal River was recruited during the late summer. Unfortunately, the fishing season was essentially finished in the area so that no information was collected. This source holds promise for next season.

b) Fishing Derby Information

The 1985 Batchawana Bay mini-derby was held on July 20, about one month later than traditionally. The poor quality of the lake trout fishery led to the derby being opened to all species. Consequently, it was a northern pike, at 3.6 pounds, that was overall winner. A total of 14 lake trout, two northern pike, and one coho were entered. The lake trout marking information is blended with the angler diary information in Table III. Only one of the lake trout carried marks (one wound and two scars).

LAKE HURON

Spawning Phase Sea Lamprey

Trapping operations for 1985 were confined to only three streams, yet the resulting catch was staggering (a total of 12,977 specimens compared with 5,359 from the same streams in 1984). Figure 1 and Tables I and II provide locations, operational data, and biological information, respectively.

Although no operational changes were made to the trapping on the St. Marys River, the dewatering of the international rapids during construction of a concrete berm could have had a major impact on the collection, since lamprey movement upstream from the twin Sault basin was restricted to the power canals or navigational locks. The count of 7,763 sea lamprey was more than double that of last year and quadrupled that of 1983. For 1985, the percentage of males from the Canadian traps was 5.6 per cent lower than that from the U.S. traps,

the reversal of a previous apparent trend mentioned in the 1984 Annual Report, this allays some of the concern, if not the interest, expressed at that time about any interpretation of these sex ratios. A spawning phase sea lamprey population study was conducted in 1985 and is discussed on page 106 of this Report.

The beaver dam on the Kaskawong River, that had been the source of anguish when attempting to interpret past collections from the barrier dam, was washed out in the spring floods. The question of whether or not the beaver dam prevented part of the run from reaching the permanent trap was no longer an issue. It is not known if this change had any bearing on the capture of 649 specimens this spring (a nearly six-fold increase over 1984). However collections of this magnitude have not been seen in this river since the early 1950's, even though the stream has been trapped consistently over the years by a variety of techniques. It was also possible, in conjunction with a TFM treatment conducted May 28, to carry out detailed observations for adult sea lamprey immediately preceding the usual spawning period. Only some 30 individuals were noted, attesting to the effectiveness of the dam trap.

Two well-separated trap sites were again fished on the Thessalon river, one located at Rydal Bank on the main stem and the other at Little Rapids on Bridgeland Creek, a major tributary. At both sites, rock cribs were once more used to stabilize the traps and help guide the animals. However, while the Bridgeland operation was conducted essentially as in 1984, it happened that two traps were fished over the entire season at Rydal Bank, rather than one, when the success of the (intended) temporary location was recognized. Despite the operation of two devices, the combined catch of 677 was little different from the 622 caught by the single trap in 1984. In 1983, two private individuals reported dip-netting some 550 adults at this dam on their own initiative. These counts contrast with those from earlier portable trapping conducted at the dam in 1979 and 1980 when only two and no specimens were taken, respectively. Even earlier, a Lipsberg weir operated at Ansonia (some 10 km downstream but above the Bridgeland confluence) between 1950 and 1954 inclusive had an average catch of 1,680 specimens. This pattern recurs in the Bridgeland Creek collections where a mechanical weir operated from 1946 to 1950 averaged just over 6,000 adults each year, a Lipsberg weir averaged 1,270 from 1951 to 1954, and portable traps averaged 430 from 1979 to 1983, took 998 in 1984, and this year captured 3,889. These results suggest that the formerly large spawning runs, which had suffered a dramatic decline, are now showing an alarming resurgence.

While recognizing the dangers of comparing counts between different techniques, streams, and years, it appears that a very real, very undesirable trend in sea lamprey abundance is being demonstrated by the northern Lake Huron trapping network.

Predatory Phase Sea Lamprey

Commercial Fisheries

At the time of reporting, 13 fisheries had submitted a total of 1,150 sea lamprey and 13 silver lamprey, with accompanying information. The sea lamprey catch consisted of 731 adults from the North Channel, 19 from Georgian Bay, and 408 from the main basin (all but 39 taken from OH-1). The picture is the same as has been suggested by collections for the last few years, with a large number of lamprey presently found in the North Channel/northwestern main basin of the lake.

It was not until 1983 that numbers in the catch began to escalate in NC-1, with OH-1 apparently following in 1984. The size of the catch this year in comparison with that for 1984, implies that the population may be stabilizing. However no 'unit of effort' has been applied, and the impact of these counts of the new quota system and the overall 'modernization' programme of the OMNR is unknown. The annual averages for that time when returns were depressed in the two key areas mentioned (i.e., 1972-82 for the North Channel, and 1973-83 for the northwestern main basin), commencing with the year when the counts bottomed out in each, were about 100 specimens from the former and 150 from the latter.

If it can be assumed that the preceding counts were representative of actual lamprey abundance at the time, then the present population is determined (by simple ratio) to be about five times larger than during the preceding period of low counts. It is intriguing to note that the Thessalon River catch first began to increase in 1983, coincident with the initiation of what were considered to be improvements in trapping effectiveness. If one can reasonably postulate that the effectiveness of the trap site was improved by some 75 per cent over the course of the next few years, then the real expansion in abundance did not occur until the 1984 and 1985 seasons (when two of the three year classes contributing to the larger 1983 parasitic phase catch would have entered their spawning phase). In introducing this factor, the relative increase in catch would seem nearer to five-fold than the nine-fold suggested by counts alone. Sheer speculation it is true. But what if the 1986 catch is roughly similar to this past year's?

If we look at the Kaskawong collections we find a trapping device much more stable in terms of year-to-year effectiveness, but regrettably at the mercy of whatever curves the now-destroyed beaver dam may have tossed at the system. The 1985 collection does however show a better than 3-fold increase over the previous four year average.

Despite the many complicating features which exist to remove any meaning from so simplistic and fragile a concept, yet it may well be that the annual commercial fishery catches are nonetheless providing a reasonable measure of relative abundance. With the introduction of effort statistics to refine the measure, as proposed by the Lake Huron Fisheries Assessment Unit of the OMNR, a predictive capability may indeed be available.

The concern in 1984 that lamprey numbers were increasing in southern Georgian Bay, expressed at the time by local fishermen, did not arise this year. For 1985 two fisheries were requested to collect adult specimens, resulting in the submission of 19 sea and seven silver lamprey, which was not alarming in their estimation. Although not monitored in 1984, these same fishermen had indicated a combined catch on the order of 100 feeding adults over that fishing season. It is apparent from the collection that any problems that do occur should not be attributed to sea lamprey without first gauging the presence of silver lamprey. Monitoring will be continued for at least another two years to ensure the catch this past season was not an abnormal situation, and that the increase in hybrid trout stocks observed by the OMNR does not lead to a resurgence in sea lamprey numbers.

Sport Fisheries

This year, in addition to monitoring the two chinook salmon derbies held in the St. Marys River (first sampled in 1984), staff also attended a salmon derby held (for the first time) in the North Channel. The information obtained must be treated with some caution, as it was mainly generated by volunteer derby officials with limited previous instruction and experience, and only occasional random spot-checks. For the kinds of conclusions being drawn, it is likely satisfactory.

A total of 766 chinook salmon were entered by the participants in the Can-Am Team Salmon Tournament (September 6-8) and the Stroh's Light King Salmon Derby (August 19-September 14) held within the confines of the St. Marys River. Of these, 514 were checked for lamprey marks, with any associated lamprey sightings being recorded as well. Of the sampled catch, 308 (59.9 per cent) showed a total of 666 marks, for a marking rate of 129.6 marks per 100 fish. A count of 217 wounds was taken from 155 chinook, providing wounding rates of 30.2 per cent wounded and 42.2 wounds per 100 fish. About 85 lamprey were reported as attached to 57 of the sampled chinook for an incidence of attachment of some 11 per cent. Four fish were reported to be carrying four lamprey <u>each</u>, and an unverified report was received of a fish with six lamprey attached. These data would suggest that the level of lamprey activity this year on the St. Marys run of chinook was relatively unchanged from that recorded in 1984. The problem in interpretation rests, as usual, with the question of the stability of the chinook population.

The recent upsurge in interest in pink salmon as a fish suitable for catching, particularly by the casual or family-oriented fisherman, and its relatively high abundance in the north end of Lake Huron (North Channel/St. Marys River) has generated an entirely different class of fishery. It has also led to the organization in the area of local derbies principally targetting this species. One of these derbies was monitored this year by the Centre. Confined to the lower Thessalon River and a small section of the North Channel outside the river mouth, it was open to all salmon species. However, only pink salmon were entered at the weigh-in station. Of the 179 fish entered, 155 were male and 24 female, with a combined average weight of 844 g, and fork length of 425 mm. The marking rate was 1.7 per cent, with one wound, two superficial marks and no scars being recorded. The per cent wounded was 0.6, as was the number of wounds per 100 fish. The largest fish entered was a 1,725 g male, while the wounded fish weighed 1,570 g. The OMNR has reported pink salmon taken from the Thessalon River in the 5,000 g (11 lb.) range.

LAKE ERIE

Predatory Phase Sea Lamprey

Commercial Fisheries

The collection of feeding phase sea lamprey was maintained on Lake Erie for calendar year 1985. As in every year since 1967, the offices of the Lake Erie Research and Assessment units of the OMNR have coordinated the collection of incoming specimens and catch records. To date, the only submissions have come from the western and west-central basins, with 13 fisheries contributing 15 sea and six silver lamprey specimens. Fishermen from across the lake have reported no major shifts in the apparent abundance of lamprey, which is perceived by the commercial fishery as being low.

Sport Fisheries

The Lake Erie OMNR has, at the urging of this Centre, been instrumental in initiating within their angler diary programme and through the larger fishing derbies the collection of lamprey wounding information. The GLFC marking standards are being adopted wherever feasible, while being applied to all species (lake trout being only rarely, if ever, encountered).

While the information is being treated by the OMNR in their own reports, a brief synopsis is given here. The angler diary programme has not as yet provided wounding data in consistent fashion, but there is promise for next year. However, data from two derbies held in 1985 were compiled and sent to our Centre. The significant occurrence of silver lamprey and the use in some instances of untrained volunteers must be kept in mind when interpreting reports of Lake Erie lamprey activity, such as the following.

The Erieau Salmon Derby, held July 13 to 27, was based out of the port of Erieau in the central basin. For 51 coho, 34 rainbow, four chinook, and four walleye, the respective rates, in 'wounds per 100 fish', were 2.0, 2.9, 0, and 50. No lamprey were observed attached to fish. Further to the east, but still in the central basin, the Summer Salmon Search was held from June 29 to July 21 out of Port Stanley. For the 130 cono, 74 rainbow, five chinook and two palomino trout (hybrid cross between the West Virginia golden trout and a wild rainbow strain) entered, the respective rates were 1.5, 1.4, 0, and 0. One lamprey was reported attached to a coho.

Salmon fishing in the central basin was reported as substantially down this year, but fortunately for the fishermen was offset by the eastward expansion of the tremendous walleye populations of the western basin. Concern has been expressed whether the proliferation of the walleye in the central basin will benefit the lamprey. It is hoped that the present level of monitoring can be maintained, if not enhanced, in order to stay current with the situation.

LAKE ONTARIO

Spawning Phase Sea Lamprey

Traps fished in seven tributaries captured a total of 5,253 spawning phase sea lamprey (Figure 1, and Tables I and II).

The Humber River catch rose from a low of 1,366 in 1984 to 2,828 in 1985 - a count that is more typical of this site since the incorporation into the Old Mill dam of a second permanent trap three years ago. This count fell short of the eleven year mean of 3,322 specimens obtained from the 1968 - '78 dip net operation. For the first time since organized collections have been made from this stream, the sex ratio has exceeded 60 per cent males, being determined as 64 per cent. The previous 16 year discontinuous data set averaged 54 per cent, with a value in 1984 of 56 per cent. The mean weights of sea lamprey were first measured at 162 g from 1968 to 1972, but by 1977 averaged an amazing 244 g. From then until 1983 the mean weight of the animal then fluctuated between 200 and 250 g with a mean around 230 g. Last year the size of the Humber River sea lamprey again jumped, to 266 g. For this past spring the weight was back down to 245 g. These signs suggest that prey are plentiful and that the animal is

not being stressed by scarcity of food. A further implication is that other factors such as the control programme are also not overly stressful, since the population seems to be trending away from a predominance of females.

With a tally of 1,059 specimens, Duffin Creek surpassed all previous counts made since the installation of the dam for the 1981 season, the previous high having been 606.

A similar situation was also true for the Bowmanville Creek operation, where a record catch of 466 specimens occurred this year. Previous collections, made since 1976, ranged between 28 and 309 spawners.

The Wilmot Creek catch of 58 adults, while increased over the very low count of nine last year, was no better than average for the stream, excluding the extraordinary 1983 catch of 566. In the absence of known explanations for such changes, the tremendous recent fluctuations in numbers taken at this site make suspect the value of this trap operation as an indicator of relative abundance.

This was the second year of operation for the Graham Creek dam and permanent trap. By comparison with previous collections made from 1976 to 1982 with a mechanical weir, the 1984 catch of 26 specimens was a disappointment. While a washout in that spring caused the stream to go around the dam, providing unrestricted access to its upper reaches, this problem should not have been critical as repairs were completed by May 9. The 1985 catch of 672 spawners was as a consequence a most unwelcome surprise.

The poor success of the 1984 operations on Shelter Valley Brook led to a change in technique for this year. A portable trap with short downstream-facing wings occluding about one-half the width of the stream was placed at a location near the mouth. The 1984 catch of 123 adults, although closer to the highest count of 152, cannot be related to any earlier counts made here. This stream has considerable value to the Lake Ontario network because of its location in the eastern end of the central basin, and so the construction of a new barrier dam this past fall in Shelter Valley, offering a permanent trap site, is most welcome.

The Lakeport Creek barrier dam and trap were operated for the first time this past season, taking a total of 47 spawning phase sea lamprey. As no earlier collections are known to have ever been made from this stream, no relationships can be drawn. A TFM treatment conducted May 5 and 6, shortly after start-up of the trap, may have negatively influenced the catch to some extent.

In summary, with the exception of the Humber catch (which nonetheless showed a significant increase in total over 1984), all of the most reliable sites showed increases in numbers reaching record highs. Without understanding why the Humber River and Wilmot Creek operations did not yield higher catches, it is difficult to suggest that any real increase was being measured. However, this is believed to be the case (a feeling that is not supported by the U.S. trap data).

A Late Spawner

A September 18-19 TFM treatment of Salem Creek resulted in the capture of a spawning phase male, 357 mm long and weighing 114 g in a preserved state.

Predatory Phase Sea Lamprey

Commercial Fisheries

As in previous years, contacts were made with several fishermen representing a cross-section of the Lake Ontario fishery. It was once again apparent that lamprey sightings were low across the fishery, and that any marking observed was not of concern. If a few fishermen are approached next year to seek their cooperation in collecting specimens, it will only be on the basis of 'time and opportunity permitting', and likely concentrated in that portion of the fishery working outside and east of Prince Edward County.

No specimens have been received from Lake Ontario in 1985.

A Transformer Tag/Recapture Study-Oneida Lake, New York

In September 1982 and August 1983 the Centre used latex dye injections to mark 1,588 and 1,528 transforming sea lamprey, respectively, from both Fish and Big Bay Creeks, two tributaries of Oneida Lake, New York. The previous followup to that effort is described in the 1984 Annual Report. For this year, the only marked specimens yet expected to be available for capture were those from the August 1983 release. As these should have reached the spawning stage by spring 1985, then in-stream collections were the only remaining source for returns.

Collections conducted by fishery agencies that had any reasonable chance of showing these marked lamprey included the 5,253 spawners captured by the Lake Ontario trap operations of this Centre, the 466 taken by the USFWS from their network in New York State waters of the same lake, and another 3,240 taken by New York Department of Environmental Conservation (NYDEC) at their Cayuga Inlet barrier dam. No latex dye-marked specimens were discovered in these collections. Traps operated this year by NYDEC on Catherine Creek, Seneca Lake, failed to catch any adult sea lamprey, nor were any marked adults captured incidentally during nest count surveys.

LARVAL SEA LAMPREY ASSESSMENT

LAKE SUPERIOR

Larval surveys were conducted on 25 tributaries and four lake areas on Lake Superior in 1985. All streams surveyed had a history of sea lamprey larvae production. For numerical information from completed surveys see Table III.

Surveys to determine relative treatment effectiveness were conducted on five streams treated with lampricide in 1984, and one treated in 1983. No residual sea lamprey were found in surveys of the Black Sturgeon River last treated in August 1983 and the Batchawana, Agawa, Pays Plat and Jackfish Rivers, each treated in 1984. The Wolf River however, also treated in 1984, was found to harbour a small population of residual sea lamprey larvae. Only five of 1,111 sea lamprey larvae collected appear to be residual animals, using total body length as an indicator of age.

Populations of reestablished sea lamprey larvae have once again been confirmed in each of the six streams listed above. Reestablishment surveys were also conducted on the Sand River, last treated in the mouth area with granular Bayer 73 in 1971, the Mackenzie River, last treated in 1978, and the Kaministikwia River and Stillwater Creek last treated in 1983. Reestablished sea lamprey populations were found in the Mackenzie and Kaministikwia Rivers and Stillwater Creek. The Sand River remains without a reestablished sea lamprey population to date.

Preparing for 1985 treatments, distribution surveys were conducted on the Big Carp, Goulais, Pancake and Neebing-McIntyre Rivers and West Davignon Creek. Also, in preparation for potential 1986 treatments, surveys to show distributional patterns of sea lamprey larvae were conducted on the Carp, Michipicoten, Gravel and Cypress Rivers.

Collections of larvae made from Stokely, Polly and Stillwater Creeks, and Carp, Michipicoten, Gravel, Cypress, Nipigon (above Lake Helen), Pearl, Mackenzie and Pine Rivers to provide information on larval population size and age class structure are useful in part to assist in formulating treatment schedules. The Carp, Michipicoten, Gravel, Cypress, Nipigon and Pearl Rivers have been included in the 1986 schedule of streams to be treated with lampricide.

The special studies unit while collecting larval lamprey specimens to be used in tagging studies in various sites provided a thorough assessment of larval populations in Tier and Stokely Creeks. Surveys conducted periodically on Tier Creek since 1954 have resulted in the collection of only two sea lamprey larvae to date. Work on the Stokely Creek reveals that while there is no firm evidence of successful spawning taking place upstream of the Sea Lamprey Control Centre's barrier dam, sea lamprey larvae are still being collected. The larvae, probably remnants of the previous established populations of sea lamprey, are surprisingly small (length), having displayed little growth over the past few years. Because of apparent low sea lamprey numbers the stream continued to be omitted from the treatment schedule.

Table VIII. Summary of larval lamprey collections from surveys of streams and adjacent lake areas (L. Superior)

STREAM No.	STREAM Name	Month(s) of Survey	Date of most recent treatment preceding Survey	NUMBER LAMPREY LARVAE COLLECTED: SEA LAMPREY Range (mm)	SEA LAMPREY 0-51 (mm)	SEA LAMPREY 51-101 (mm)	SEA LAMPREY Lamprey in 5mm increments (upper class limit) 106	111	116	121	126	131	136	141	146	151	156	161	166	171+	SEA LAMPREY TOTAL LARVAE	NATIVE LAMPREY Ich. spp.	NATIVE LAMPREY L.a.
S-2	West Davignon Cr.	May	June 1981*																		0	0	94
S-5	Big Carp R.	June	June 1981*	66-76		3															3	0	128
S-24	Goulais R.	Aug.	June 1982*	6-141	117	66	10	6	5	4	4	2	2	1							217	0	489
S-36	Stokely Cr.		June 1980																				
	-above barrier	June/Aug		80-126		7	6	3	3	2	2										23	0	3400
	-below barrier	Aug.		101-156			1				1						1t				3 1t	0	474
S-37	Tier Cr.	Aug.	N.A.																		0	0	500
S-52	Batchawana R.	Aug.	Aug. 1984	31-46	4																4	0	124
		Sept.		16-26	6																6	0	123
S-54	Carp R.		Aug. 1982																				
	-above dam	July		31-131	72	199						1									272	0	137
	-below dam	July		46-76	4	13															17	0	68
S-56	Pancake R.	June	July 1981*	56-61	0	2															2	0	75
S-93	Agawa R.	July	Aug. 1984	26-46	5																5	0	0
S-100	Sand R.	July	1971																		0	0	0
S-167	Michipicoten R.	July	Aug. 1982	26-151	450	117	6	2		3	1					1					580	0	0
S-360	Pays Plat R.	July	July 1984	16-41	141																141	17	1
S-368	Gravel R.	July	July 1982	26-81	12	15															27	4	0
		Aug.	July 1982																		0	0	0
S-374	Cypress R.	July	July 1982	86-101		4															4	0	0
S-385	Jackfish R.	July	July 1984	21-41	142																142	7	0
S-392	Nipigon R.																						
	-above lk. Helen	July	July 1981	21-131	85	432	29	10	10	7	2	3									578	6	0
S-414	Polly Cr.	Aug.	June 1983	26-166	81	35	3	4	3	5	5	6	8	4	2	3	1		2		162	0	0
	-off mouth	Aug.		26-146	2	8	1	1	2				1	1	2						19	0	0
S-455	Stillwater Cr.	July	June 1983	21-56	62	1															63	0	0
S-509	Black Sturgeon R.	July	Aug. 1983	31-51	6																6	0	0
	- off mouth	July	N/A																		0	0	0
S-517	Wolf R.	July	July 1984	21-131	1074	35					1	1									1111	0	0
	-off mouth	July	N/A	31-121	1	9				1											11	0	0
S-528	Pearl R.	July	July 1982	21-126	38	123		1		1	1										164	3	0
S-556	Mackenzie R.	July	Aug. 1978	56-131		7	3	1	2	1	1	1									16	0	0
	-off mouth	July	Aug. 1983	56-176		6	1						1				1			5	14	0	0
S-571	Neebing-McIntyre R.	June/July	1972*	66-166		2		1			1	2	2		1	1	1	1	1		15	56	80
S-573	Kaministikwia R.	July	Aug. 1983	26-81	111	219															330	0	0
S-589	Pine R.	July	1975																		0	1	0

* = Stream subsequently treated in 1985

t = number of transforming larvae in size class and included in total

Granular Bayer 73 surveys were conducted in "off mouth" areas of four tributaries: Polly Creek, Wolf, Black Sturgeon and Mackenzie Rivers. Larvae were collected from the areas adjacent to Polly Creek, Mackenzie and Wolf Rivers. Site selection was rather nebulous, with no well defined bottom drop-off, a characteristic often associated with the presence of larvae. The Mackenzie River mouth area, treated last in August 1983, is scheduled to be treated with granular Bayer 73 in 1986.

LAKE HURON

Larval surveys were conducted on 33 streams and three lentic areas in the Lake Huron drainage in 1985. See Table IV for a summary of larvae collected from completed surveys.

Survey work on the St. Marys River continued with surveys intended to note sea lamprey distributional patterns and relative population size and age structure. The complete survey assessment report on the St. Marys River, conducted by the special studies unit is presented on page 107 of this report.

Treatment evaluation surveys were conducted on the Root, Garden, Thessalon, Blind, Chikanishing, Wanapitei, Magnetawan and Naiscoot Rivers and Sucker and Brown Creeks, each treated in 1984. While residual larvae were collected from the Root, Garden and Chikanishing Rivers, the numbers were relatively low. Residuals were not collected from the remaining streams listed above.

Reestablished populations of sea lamprey larvae in streams treated during the 1984 field season were confirmed in the Root, Garden, Thessalon, Blind, Magnetawan and Naiscoot Rivers and Brown Creek. No larvae were taken from the Wanapitei River or Sucker Creek and the length of larvae taken from the Chikanishing River does not allow one to firmly state that successful hatching and survival has occurred since the 1984 treatment.

Gordon Creek, last treated in May 1982, and the Still River, last treated in 1983, were not reestablished as "producers" until this year's effort. Based on larval length, successful spawning appears to have been achieved in 1984 in Gordon Creek and 1985 in the Still River.

The Key River, treated only in 1972, was surveyed in response to adult lamprey sightings and reports of increased fish scarring. Only native lamprey were collected.

Preparing for scheduled TFM lampricide treatments, distribution surveys were conducted on Richardson and Watson Creeks and the Serpent and Sturgeon Rivers, each subsequently treated in 1985. As well, distribution surveys were conducted on the Spanish and Manitou Rivers and Blue Jay Creek, each scheduled to be treated in 1986.

Population surveys were conducted on the Mississagi, Spanish, Manitou and Sturgeon Rivers and Blue Jay Creek. Work on the Blue Jay and Mississagi Rivers in 1984 resulted in the collection of relatively low numbers of larvae. Ultimately another series of surveys were completed in 1985 to verify that they continue to remain as productive sea lamprey producing streams.

The Spanish River continues to be regularly surveyed to provide information concerning larval populations in light of the fact that effluent from the paper industry appears to periodically reduce larval populations in the system.

Population surveys using granular Bayer 73 were conducted in offshore waters associated with the mouth areas of an unnamed tributary to Stuart Lake (Echo River) and the Sturgeon and Manitou Rivers. A localized sea lamprey larval population was once again noted off the mouth of the tributary to Stuart Lake and the Manitou River, while the observation of a concentrated pocket of sea lamprey larvae found off the Sturgeon River mouth represents a first time documentation in that particular area. A barrier dam on the Sturgeon River and an improved natural falls on the Manitou River restrict lamprey spawning runs to the lower reaches of each system, enhancing the opportunity for larvae to be flushed to suitable off-mouth habitat areas.

Surveys were conducted on four streams designated as routine, i.e., no history of sea lamprey production. The North Channel at Little Current was surveyed for the first time by Sea Lamprey Control Centre personnel. No larvae were collected. Observations on site indicate that spawning and larval habitat are marginal. The North, Coldwater and Maitland Rivers, surveyed on a number of occasions in past years were once again checked. No larvae were taken from the North or Maitland Rivers, however two sea lamprey larvae along with 390 native lamprey larvae were taken from the Coldwater River system. Based on 1985 survey results and the history of past surveys on the Coldwater River, one must conclude a small population of sea lamprey has become established in the system in recent years.

Results of surveys on streams in southern Georgian Bay continue to suggest the sea lamprey are failing to reestablish in streams identified at one time as regular producers. Surveyed were, Hog, Silver and Bothwell Creeks and the Nottawasaga, Pretty and Sydenham Rivers (see the 1983 Sea Lamprey Control Centre's Annual Report, page 17 for frequency of treatment of these streams).

Surveys conducted on the Echo River in 1984 confirmed the presence of two year classes of sea lamprey larvae above the barrier dam while surveys conducted this year established that adult lamprey are continuing to swim upstream of the structure, with larval distribution now approximating pre-dam distributional limits.

Larvae were taken from above the Rydal Mill dam, on the Thessalon River for the first time since 1971. Since only 14 sea lamprey larvae were collected in 1985 from the extensive system above the dam, it is impossible to establish when and how frequently spawning has successfully been achieved in recent years. The method(s) of adult spawning phase lamprey movement past the structure is a matter of speculation at this time, but one must consider (1) inundation of land around the dam during spring run-off, (2) improper placement of stop logs in the structure, (3) inopportune timing of stop log removal to control lake levels, (4) careless handling of adult lamprey by humans as spawners congregate below the structure during the spawning run.

Table IV. Summary of larval lamprey collections from surveys of streams and adjacent lake areas tributary to Lake Huron, Canada, 1985.

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)															
No.	Name			Range (mm)	0-51 (mm)	51-101 (mm)	106	111	116	121	126	131	136	141	146	151	156	161	166	171+	TOTAL LARVAE	Ict. Spp.	L.su.
H-5	St. Marys R.	June/July Aug.																				
	-above Compensating Works		N/A	31-136	15	203	9	6	5	3	2		1								244	0	176
	-below Compensating Works		Annual GBTS treatments	16-171	303	667	29	27	26	15	18	15	22[2t]	13	9[1t]	6[2t]	8[3t]	3[2t]	1	1[1t]	1163[11t]	6	162
H-3	Root R.	July	June 1984	21-151	419	78	1			1	1	2		2		1					505	0	32
H-4	Garden R.	Aug.	June 1984	16-141	337	38								1							376	0	9
H-10	Echo R.																					
	-Cuddy Cr.	Aug.	July 1980	16-81	12	15															27	0	19
	-Stuart Cr.	Aug.	July 1980	26-101	1	25															26	18	9
	-Unnamed trib. - Stuart Lake	Sept.	July 1980	41-96	2	46															48	0	11
H-39	Sucker Cr.	July	May 1984																		0	0	0
H-51	Richardson Cr.	June	1974*																		0	0	6
H-57	Watson Cr.	June	June 1982*																		0	0	22
H-58	Gordon Cr.	July	May 1982	31-61	101	3															104	0	18
		Aug.	May 1982	6-56	31	5															36	0	0
H-59	Brown Cr.	July	May 1984	6-91	80	3															83	0	1
H-88	Thessalon R.																					
	-above Rydal Dam	Sept.	1971	46-76	2	12															14	174	64
	-below Rydal Dam	Oct.	June 1984	16-66	25	1															26	0	2
H-102	Mississagi R.	Aug.	Aug. 1983	26-111	264	112	1	2													379	3	4
H-110	Blind R.	Aug.	May 1984	46-76	2	16															18	0	0
H-116	Serpent R.	June	June 1981*																		0	0	0
H-134	Spanish R.	Aug.	1972	11-121	31	52		1		1											85	53	0
	-Aux Sables R.	Aug.	July 1978	26-81	85	29															114	65	0
	-Gough R.	June	1972	46-116	1	14			2												17	225	0
	-Gough R.	Aug.	1972	71-96		3															3	28	0
	-La Cloche Cr.	June	1972	26-156	10	56		2	1				1	1			1				72	6	0
	North Channel -Little Current	Aug.	N/A																		0	0	0

H-313	Manitou R.	June	June 1986	26-41	7															7	88	0
	-off mouth	Aug.		16-156	45	17	4	3	1	2	4[1t]	1	1[1t]	2	2[2t]	2[1t]	1			85[5t]	0	0
H-314	Blue Jay Cr.	June	June 1982	26-126	22	45	7	4		2	1									81	0	0
		Aug.	June 1982																	0	0	0
H-420	Chikanishing R.	June	July 1984	66-146		3	1		1				1		1					7	239	0
H-606	French R.																					
	-Wanapitei R.	June	Aug. 1984																	0	2	0
H-676	Key R.	June	1972																	0	121	0
H-726	Still R.	June	June 1983																	0	0	0
		Sept.	June 1983	16-26	39															39	0	0
H-745	Magnetawan R.	June	July 1984	26-36	4															4	0	0
H-832	Naiscoot R.	June	July 1984	21-41	51															51	0	0
H-1341	North R.	July	N/A																	0	0	0
H-1342	Coldwater R.	May	N/A	116-121				1		1										2	281	0
		July	N/A																	0	109	0
H-1343	Sturgeon R.		1979*																	0	0	0
	-off mouth	July	N/A	31-166	6	11	1	4	9	4	4	1	7	2	1	4	3	1	2	60	27	0
H-1345	Hog Cr.	July	1978																	0	2	0
H-1360	Nottawasaga R.	July	1978																	0	114	0
H-1369	Pretty R.	July	1972																	0	0	0
H-1376	-Silver Cr.	June	Sept. 1982																	0	0	0
		July	Sept. 1982																	0	0	0
H-1421	Bothwell Cr.	June	1979																	0	0	0
H-1422	Sydenham R.	July	1972																	0	0	0
H-1614	Maitland R.	July	N/A																	0	0	0

* = stream subsequently treated in 1985

t = number of transforming larvae in size class and included in total

LAKE ONTARIO, CANADA

Surveys were conducted on 17 of the 26 Lake Ontario sea lamprey producing streams during the 1985 field season. Streams designated as "non-producers" were not scheduled to be surveyed. Table V summarizes the streams surveyed and includes the number of lamprey according to length increments collected.

The Rouge River, last treated in October 1983, Lynde, Oshawa and Proctor Creeks and Shelter Valley Brook last treated in May or June of 1984, were surveyed to determine relative treatment effectiveness and also to note if sea lamprey have once again successfully reestablished in each system. While no residual lamprey were collected from Lynde, Oshawa or Proctor Creeks, each was confirmed as a "producer" once again. A single residual lamprey was taken from the Rouge River and 18 sea lamprey from a collection of 500+ animals taken from Shelter Valley Brook have been designated as residuals. Low numbers of residuals taken indicate a relatively successful treatment in each case. A reestablished population of sea lamprey was confirmed in Shelter Valley Brook but the single small sea lamprey larva taken from the Rouge River serves only to indicate the need for additional work.

Population study surveys were completed on seven tributaries to Lake Ontario and include Bronte, Duffin and Farewell Creeks each subsequently added to the established 1985 treatment schedule (Bronte Creek ultimately was not treated due to low water flows). The remaining four streams, Bowmanville, Wilmot and Graham Creeks and Cobourg Brook were surveyed, the results of which will be used to assist in drafting the 1986 treatment schedule.

Distribution surveys were conducted on the Credit River, Grafton, Lakeport and Smithfield Creeks in preparation for scheduled 1985 treatments, and on Bronte, Duffin and Farewell Creeks subsequently added to the 1985 treatment schedule. Additionally, similar surveys were conducted on Bowmanville, Wilmot and Graham Creeks and Cobourg Brook, streams tentatively identified as potential 1986 treatment streams.

Following the treatment of Salem and Lakeport Creeks in 1985, treatment evaluation surveys were conducted within each system. Rainfall during the Lakeport Creek treatment reduced lampricide treatment levels and prompted the initiation of evaluation surveys. Salem Creek, designated as a sea lamprey study stream, was surveyed following the treatment to measure relative treatment effectiveness. Surveys on each stream were negative.

Table V. Summary of larval lamprey collections from surveys of streams tributary to Lake Ontario, Canada, 1985.

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+		Ichn. spp.	L. sp.
0-76	Bronte Cr.	June	Sept. 1982	36-126	25	60	13	4	4	4	2										112	0	0
		Sept.	Sept. 1982	26-166	25	23				1	1	3			1		1		1[1t]		56[1t]	0	0
0-92	Credit R.	May	May 1980																		0	0	0
0-110	Rouge R.	June	Oct. 1983																		0	0	0
		Sept.	Oct. 1983	31-96	1	1															2	0	0
0-117	Duffin Cr.	May	Sept. 1980*	36-106	4	3	1														8	0	63
		June	Sept. 1980	36-121	29	25	2	5	1	1											63	0	8
		Sept.	Sept. 1980	16-156	38	14				2				1	1[1t]		1[1t]				57[2t]	0	0
0-121	Lynde Cr.	June	May 1984																		0	0	0
		Sept.	May 1984	21-41	41																41	0	0
0-124	Oshawa Cr.	May	May 1984																		0	0	0
		June	May 1984																		0	0	24
		Sept.	May 1984	21-51	158																158	0	7
0-125	Farewell Cr.	May	May 1981*	26-151	62	57	17	9	6	2	2	1		1	3	1					161	0	12
		June	May 1981	66-71		1															1	0	0
		Sept.	May 1981																		0	0	15
0-131	Bowmanville Cr.	May	May 1983	26-131	138	134	7	3	2		1	1									286	0	30
		Sept.	May 1983	81-131		2	1	2	3		1	1									10	0	292
0-132	Wilmot Cr.	May	Oct. 1983	21-121	106	4	1			1											112	0	208
		Sept.	Oct. 1983	16-86	9	47															56	0	0
0-133	Graham Cr.	May	June 1983	26-106	49	104	1														154	0	88
		Sept.	June 1983	41-136	2	10	5	2	1	2		1	2								25	0	25
0-148	Cobourg Br.	May	June 1983	26-106	87	8	2														97	0	37
		Sept.	June 1983	16-146	29	104			1		1	1	1		1						138	0	174
0-154	Grafton Cr.	May	May 1982*	51-111		3		1													4	0	0
0-157	Shelter Valley Br.	May	June 1984	16-96	488	29															517	0	109
0-161	Lakeport Cr.	May	May 1985																		0	0	0
0-163	Salem Cr.	Sept.	Sept. 1985																		0	0	0
0-166	Proctor Cr.	May	May 1984	21-56	119	1															120	0	0
0-168	Smithfield Cr.	May	May 1982*																		0	0	0

t = number of transforming larvae in size class and included in total

* = stream subsequently treated in 1985

LAKE ONTARIO, UNITED STATES

The Canadian Sea Lamprey Control Centre unit continues to be responsible for larval assessment on known sea lamprey producing streams on the United States side of Lake Ontario.

Larval surveys were conducted on 15 of the 26 known sea lamprey producing streams during the 1985 field season. Table VI lists the streams surveyed and includes the number of larvae collected according to total body length increments.

Completed surveys on Deer, Catfish, Red and Sodus Creeks treated in May 1984 and South Sandy Creek last treated in October 1983 indicate that with the exception of Sodus Creek, sea lamprey have again reestablished in the systems. Also, based on survey results, the 1984 treatment of Catfish, Red and Sodus Creeks appears to have been successful with no residual larvae being collected. Residual larvae however were collected from Deer and South Sandy Creeks. One noteworthy source of larval escapement in the Deer Creek system appears to have been an untreated pocket of sea lamprey larvae located upstream of the established lampricide application site but not uncovered until completion of the 1985 surveys. Rainfall during the 1984 treatment and natural groundwater seepage added to the residual problem. The few residual lamprey taken from the South Sandy system suggests an acceptable treatment effectiveness.

Snake Creek last treated in May 1980, surveyed in 1981 and 1982, was surveyed again in 1985. While surveys in 1981 and 1982 were negative, surveys conducted in 1985 were able to be completed through an area of usually impounded waters (beaver pond), and resulted in the collection of sea lamprey larvae which included three year old animals. The stream was at that time scheduled to be treated in 1985 but low water forced a re-scheduling to 1986.

Sage Creek, treated in 1978 and surveyed in 1979, 1980, 1981 and 1982, and Blind Creek last treated in 1976 and surveyed in 1977, 1978, 1980, 1981 and 1983 were surveyed again in 1985. The two streams continue to be termed as "not reestablished", although in the case of Sage Creek a single sea lamprey larva was collected.

Preparing for the 1985 and 1986 treatments, population and distribution surveys were completed on the Black, Salmon and Little Salmon Rivers and Skinner, Lindsey, Little Sandy and Grindstone Creeks.

Table VI. Summary of larval lamprey collections from surveys of streams tributary to Lake Ontario, United States, 1985.

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.
NYO-19	Black R.	May	Aug. 1980	41-151	27	110	2	2	1						1	2					145	0	0
NYO-45	South Sandy Cr.	May	Oct. 1983	36-151	38	180					1				2	1					222	0	0
NYO-47	Skinner Cr.	May	May 1983*	26-151	153	202	9	7	2		1	1				1					376	0	0
		Sept.	May 1983	26-31	1																1	0	0
NYO-48	Lindsey Cr.	May	May 1983*	16-151	330	145	3	3	2	3	1		1		1	1					490	0	0
		Sept.	May 1983	31-91	29	22															51	0	11
NYO-49	Blind Cr.		1976																				
	-off mouth	June	N/A																		0	0	0
NYO-50	Little Sandy Cr.	April	May 1982*	26-141	75	7								2							84	0	0
	-off mouth	June	May 1982	36-46	3																3	0	0
NYO-52	Deer Cr.	May	May 1984	26-151	244	97	1	1	1	1					1	2					348	0	0
NYO-53	Salmon R.	May	May 1983	36-156	37	73	1	2	1	2							1				117	0	0
		Sept.	May 1983	16-31	18																18	0	0
	-Beaverdam Br.	April	May 1983	46-161	1	65	6	1	5	2	5	2	1	1	2	1	1	1			94	0	0
		Sept.	May 1983	16-106	3	3	1														7	0	0
	-Orwell Br.	April	May 1983	21-156	97	147	3	1	3	3	6			3	3	2	2				270	0	0
		Sept.	May 1983	11-31	33																33	0	0
	-Trout Br.	April	May 1983	21-121	33	133	2	2	1	1											172	0	0
		Sept.	May 1983	16-36	171																171	0	0
NYO-54	Grindstone Cr.	April	April 1982*	21-136	171	236	9	10	4	3	3		2								438	0	0
		May	May 1985																		0	0	0
NYO-55	Snake Cr.	May	May 1980	31-151	21	113		2	3	2	2	1	1		3						149	0	0
		Sept.	May 1980	66-106		7	1														8	0	0
NYO-57	Sage Cr.	May	April 1978	71-76		1															1	0	0
NYO-58	Little Salmon R.																						
	-Dam downstream	April	Sept. 1982	31-156	87	157	12	5	5	3							2				271	0	0
	-Dam downstream	May	Sept. 1982*	36-51	3																3	0	0
	-Dam upstream	May	1975																		0	0	0
NYO-60	Catfish Cr.	May	May 1984	26-56	158	2															160	0	0
NYO-78	Red Cr.	May	May 1984	31-56	36	2															38	0	0
NYO-84	Sodus Cr.	May	May 1984																		0	0	1

* Stream subsequently treated in 1985

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 1985:

West Davignon Creek	May 29-30
Big Carp River	June 4-7
Pancake River	June 11-12
Pigeon River	June 20-21
Steel River	July 16-18
Neebing-McIntyre River	August 9-11
Chippewa River	August 27-28
Goulais River	September 9-13

In addition to the TFM treatments, a granularized formulation of Bayer 73 was applied to portions of Batchawana, Mountain and Goulais Bays and Helen Lake.

Table VII lists the pertinent treatment data, while Figure 2 shows the approximate location of the streams treated, and Figures 3 to 10 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 V to this Annual Report.

West Davignon Creek - Figure 3

West Davignon Creek is located in Algoma District, flowing within the municipal boundaries of the city of Sault Ste. Marie. West Davignon Creek and its major tributary, Bennett Creek (which joins the main stream 1.1 km from the mouth), flow over a moderately steep gradient in their headwaters with a succession of riffles and pools until the lower 0.8 km where the stream slows somewhat. The stream flows through a mixture of scrub farmland and built-up city property. Average summer flows in West Davignon Creek are less than 0.3 m^3/s. A series of small falls (total drop of 6 m) exists on the main West Davignon Creek about 7 km from the mouth. Spawning gravel and good larval habitat are both abundant. In 1979, a diversion channel was completed on West Davignon Creek, to prevent flooding in the built-up areas along the original stream course during high flow periods. Essentially, West Davignon Creek now has two mouths, with the diversion channel emptying into Leigh Bay to the west of the original mouth.

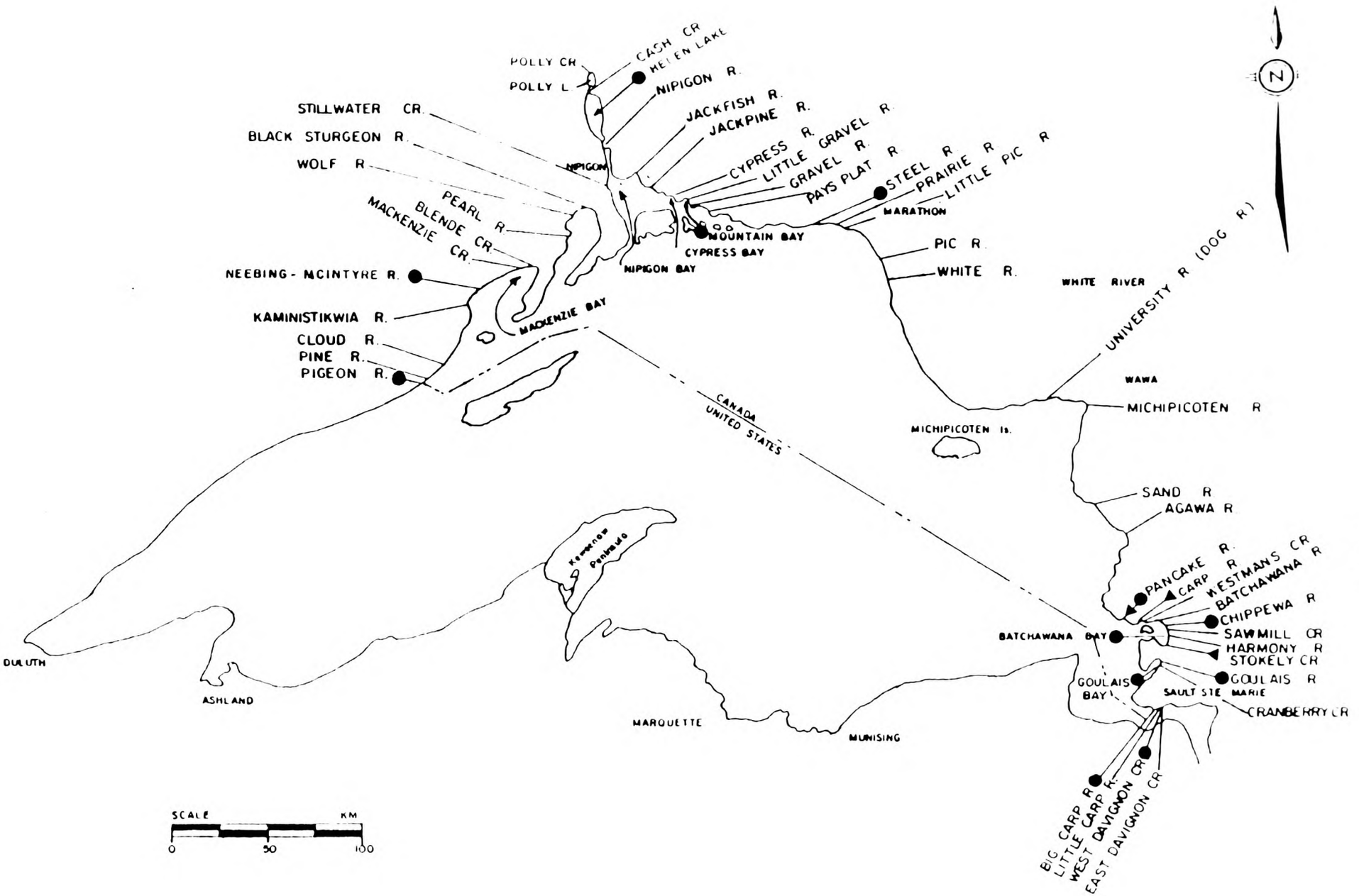


Figure 2. Map of Lake Superior showing location of all known sea lamprey producing streams, lakes and bays, indicating those treated (●) with lampricide in 1985.

Table VII. Summary of streams and lake areas treated with lampricide on Lake Superior, 1985.

STREAM/LAKE	Date	Flow m^3/s	Active Ingredient TFM kg	Bayer 73 kg	Granular Bayer 73 kg	*/Sea Lamprey Collected	Area Treated km	ha
West Davignon Cr.	May 29-30	0.49	45.72	-	-	M/ 209	8.6	
Big Carp R.	June 4-7	0.62	76.78	-	-	M/ 469	12.7	
Pancake R.	June 11-12	2.37	151.64	-	-	A/ 330	8.5	
Pigeon R.	June 20-21	13.79	718.89	11.12	-	S/ 60	5.8	
Steel R.	July 16-18	10.51	984.20	15.56	-	S/ 34	10.1	
Neebing-McIntyre R.	Aug. 9-11	3.30	724.42	-	0.03	A/ 1,142 (91)	10.6	
Chippewa R.	Aug. 27-28	3.74	323.43	-	-	S/ 32 (1)	2.9	
Goulais R.	Sept. 9-13	18.84	2,314.70	-	1.90	A/ 1,659 (18)	100.9	
BATCHAWANA BAY								
- off Carp R.	July 22,Aug. 1	-	-	-	18.14	S/ 19		1.48
- off Stokely Cr.	July 23	-	-	-	13.61	S/ 32		1.10
- off Harmony R.	July 24	-	-	-	9.09	S/ 2		0.74
- off Chippewa R.	July 26, 29	-	-	-	40.82	M/ 908 (2)		3.29
- off Batchawana R.	July 30-31	-	-	-	22.68	S/ 142		1.86
- off Sand Pt.	July 30-31	-	-	-	9.07	S/ 108		0.73
Helen Lake	Aug. 11	-	-	-	9.07	S/ 16 (1)		0.73
Mountain Bay	Aug. 13	-	-	-	22.68	M/ 402		1.83
Goulais Bay	Aug. 21-22	-	-	-	34.02	S/ 30 (1)		2.79
TOTALS		53.66	5,339.78	26.68	181.11	5,594 (114)	160.1	14.55

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

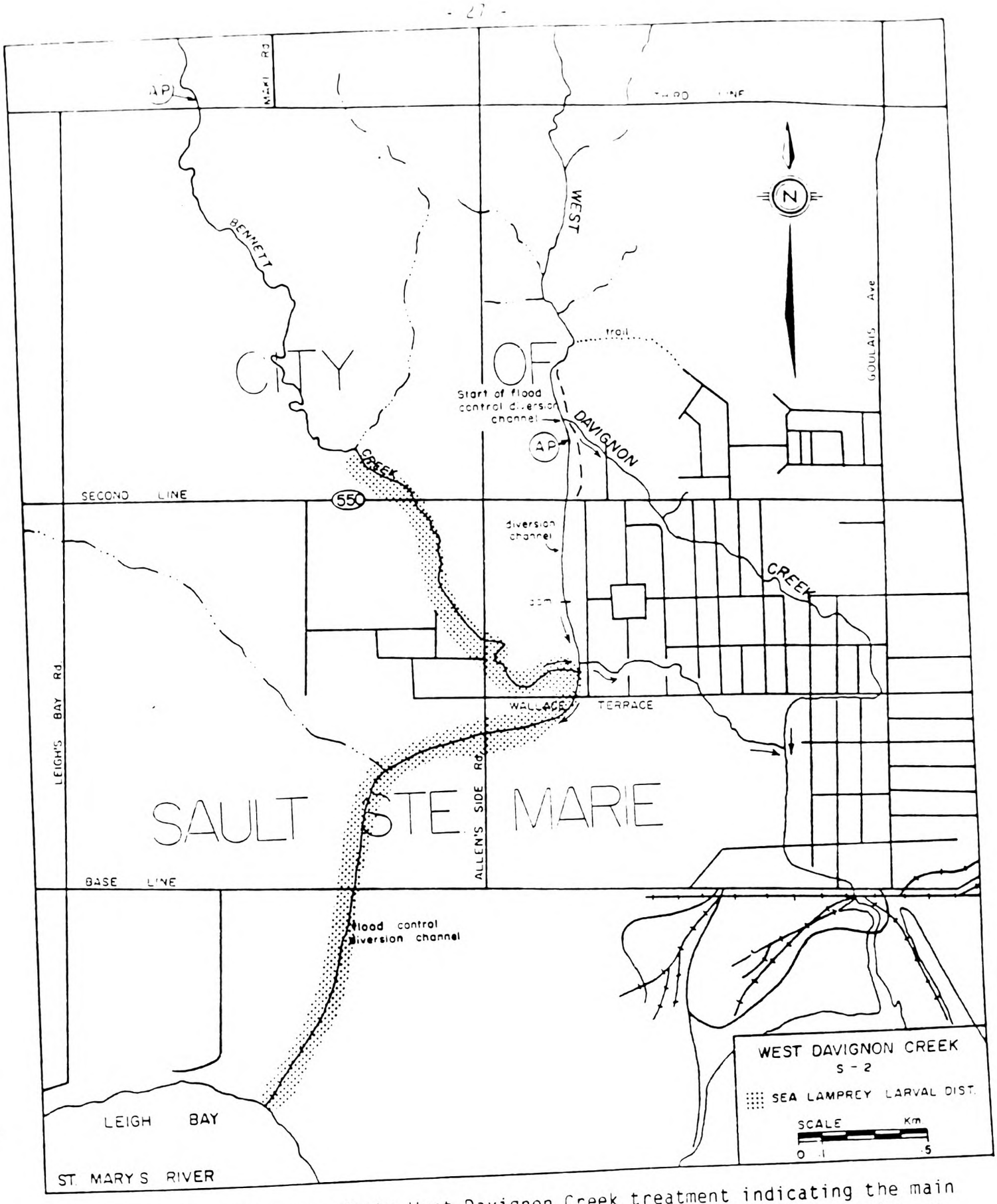


Figure 3. Detailed map of the West Davignon Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 29-30, 1985.

West Davignon Creek (Continued)

West Davignon Creek had been treated with lampricide seven times previously; in 1958, 1959, 1963, 1967, 1972, 1977 and 1981.

Treatment flows were ideal on West Davignon Creek at the beginning of the treatment; however because of severely plugged culverts at the entrances to the original old channels on both West Davignon and Bennett Creeks it would have been impossible to treat either section with a block of lampricide. Both channels had barely a trickle of flow, all the water going straight down the diversion channel (see Figure 3). To substantiate 1984 surveys, electroshocking crews checked both old channels but found only native lamprey. Therefore, the main application point on the main West Davignon Creek was moved down to just above Second Line on the diversion channel.

The treatment progressed favourably until the early hours of the second day when severe thundershowers raised flows substantially. One boost feeder was operated for a short time but luckily the rain had held off long enough to achieve theoretical lethals to the mouth of the diversion channel. Sufficient lampricide trickled into the old Bennett channel to confirm that only native lamprey occurred there, hence the treatment was considered to be fully successful.

A total of 209 sea lamprey larvae (61 to 151 mm in length) were collected. Larval sea lamprey were rated as moderately abundant overall in Bennett Creek and the downstream diversion channel. No larval sea lamprey were found in the diversion channel above the confluence of Bennett Creek. Sea lamprey larvae were collected in Bennett Creek from just above Second Line to Base Line on the diversion channel. Of interest was the fact that no sea lamprey larvae under 61 mm were collected and no adults were observed during the treatment, although spawning should have been occurring at this time.

Non-target fish mortality was considered to have been negligible.

Big Carp River - Figure 4

The Big Carp River flows through mixed scrub and small farms in the western outskirts of the city of Sault Ste. Marie, District of Algoma, entering the upper St. Marys River just west of Leigh Bay. There are two major tributaries and a number of small trickles. Natural barriers are present on the main branch approximately 10 km from the mouth and on both of the tributaries. Much of the stream consists of riffles and pools however, there has been a continual history of small beaver impoundments. In the lower 2.4 km the river flow slows considerably and is affected by lake seiche. Abundant larval habitat and adequate spawning gravel are present in the stream. Discharge varies considerably throughout the year but generally is less than 0.3 m^3/s during summer months.

The stream had been treated six times previously; in 1959, 1962, 1968, 1972, 1977 and 1981.

Larval sea lamprey distribution has varied somewhat in the main branch and the tributaries, probably due to beaver dams acting as deterrents or barriers to adult sea lamprey spawning runs.

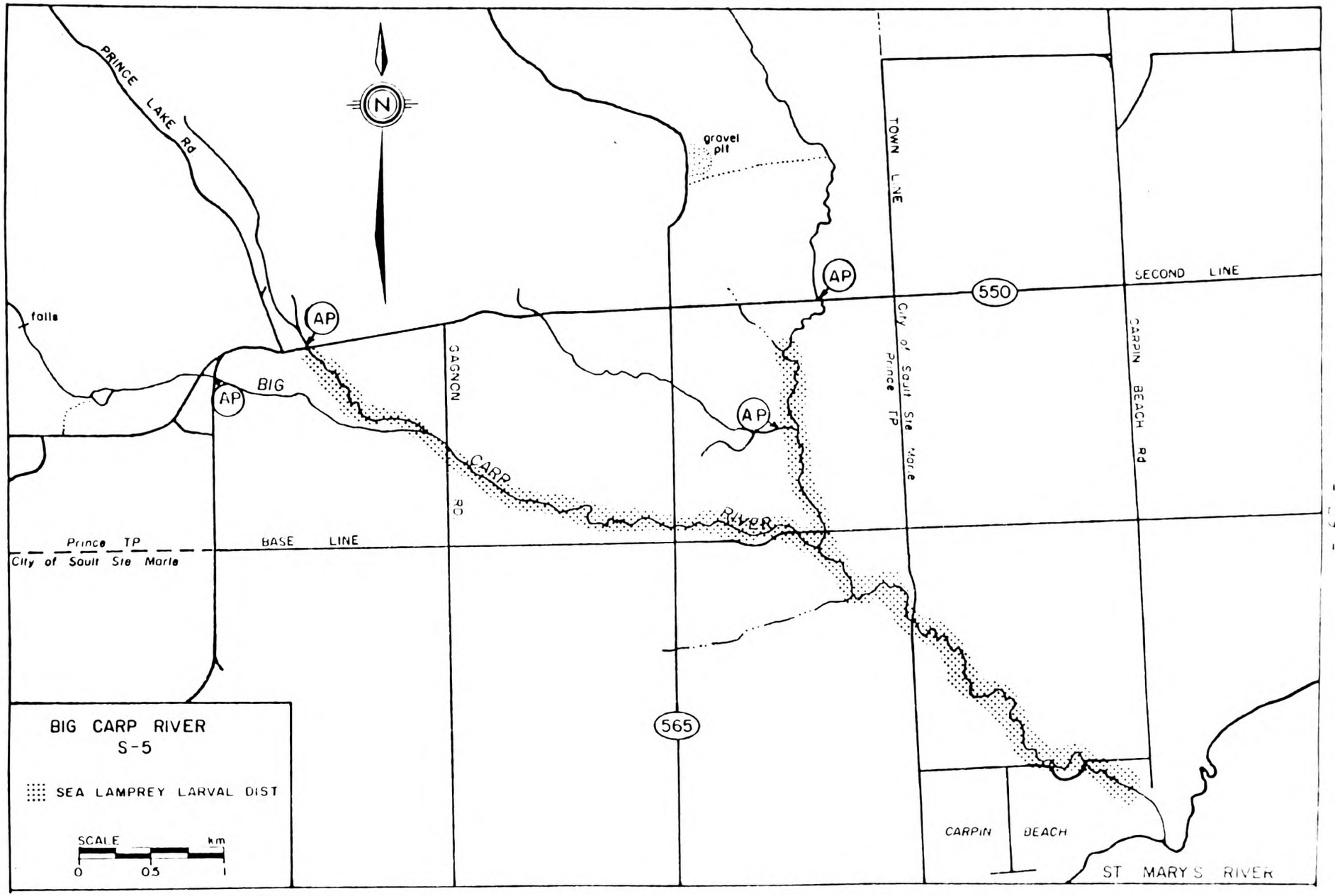


Figure 4. Detailed map of the Big Carp River treatment indicating the main lampricide application points and sea lamprey larval distribution on June 4-7, 1985.

Big Carp River (Continued)

Ideal treatment conditions were experienced for the lampricide treatment of the Big Carp River. Flows were receding after recent rains and the weather was sunny, except for a brief period on June 5. Treatments of the main river and a tributary at Prince Lake Road were initiated on June 4, and fairly good coincidence of these blocks occurred. A boost feeder at Gagnon Road maintained a lethal block to the confluence with the major tributary at Base Line. A feeder was started on the major tributary on June 5 and this lampricide block partially coincided with the block from the main river (this tributary actually contributed more flow than the main river). Therefore, a feeder was operated on the main river for about 11 hours to ensure a lethal block leaving the confluence. Theoretical lethals were achieved right to the mouth. One other tributary was treated from just above its confluence to prevent escapement and dilution.

Although limited supplementary application was required, four people were needed for the long and rough walks.

Larval sea lamprey were moderate in numbers with 469 (46 to 146 mm in length) being collected and were found from just below the feeder on the tributary at Prince Lake Road and about 1 km below the feeder on the main tributary on Highway 550 to the mouth. Of interest was the fact that no larvae under 46 mm nor adult spawning phase sea lamprey were observed.

Non-target fish mortality was considered to have been negligible.

Pancake River - Figure 5

The Pancake River is located in the District of Algoma, and after flowing through uninhabited mixed bushland, enters Pancake Bay of Lake Superior about 64 km north of the city of Sault Ste. Marie. The river water is soft and clear with summer flows averaging 0.8 m^3/s. A series of falls on the main river located approximately 7.2 km above the mouth serve as a barrier to adult sea lamprey. Below these falls the stream is basically riffles and pools with abundant spawning gravel and suitable larval habitat. In the last 0.2 km the stream slows and widens slightly. Gimlet Creek, a former sea lamprey-producing tributary enters the Pancake River a short distance above its mouth. Gimlet Creek, a meandering stream heavily overgrown with alders, has a history of numerous beaver impoundments throughout its course. Past treatments on Gimlet Creek from its natural barrier falls about 4.8 km above the confluence have been very difficult because of its nature and poor access. A low-head barrier dam to stop upstream migration of sea lamprey was built in 1979 on Gimlet Creek just above its confluence with the main river.

The Pancake River had been treated with lampricide seven times previously; in 1958, 1961, 1965, 1969, 1973, 1977 and 1981.

A favourable discharge of 2.4 m^3/s on the Pancake River system and good weather conditions facilitated the 1985 lampricide treatment. The treatment was also greatly simplified by treating Gimlet Creek from the barrier dam site, just above its confluence with the Pancake River. Despite some minor mechanical difficulties with generators and radios at the remote main application site, theoretically lethal levels were achieved right to the mouth, and flow time from the upper application site to the mouth was only 13 hours. One of the other two

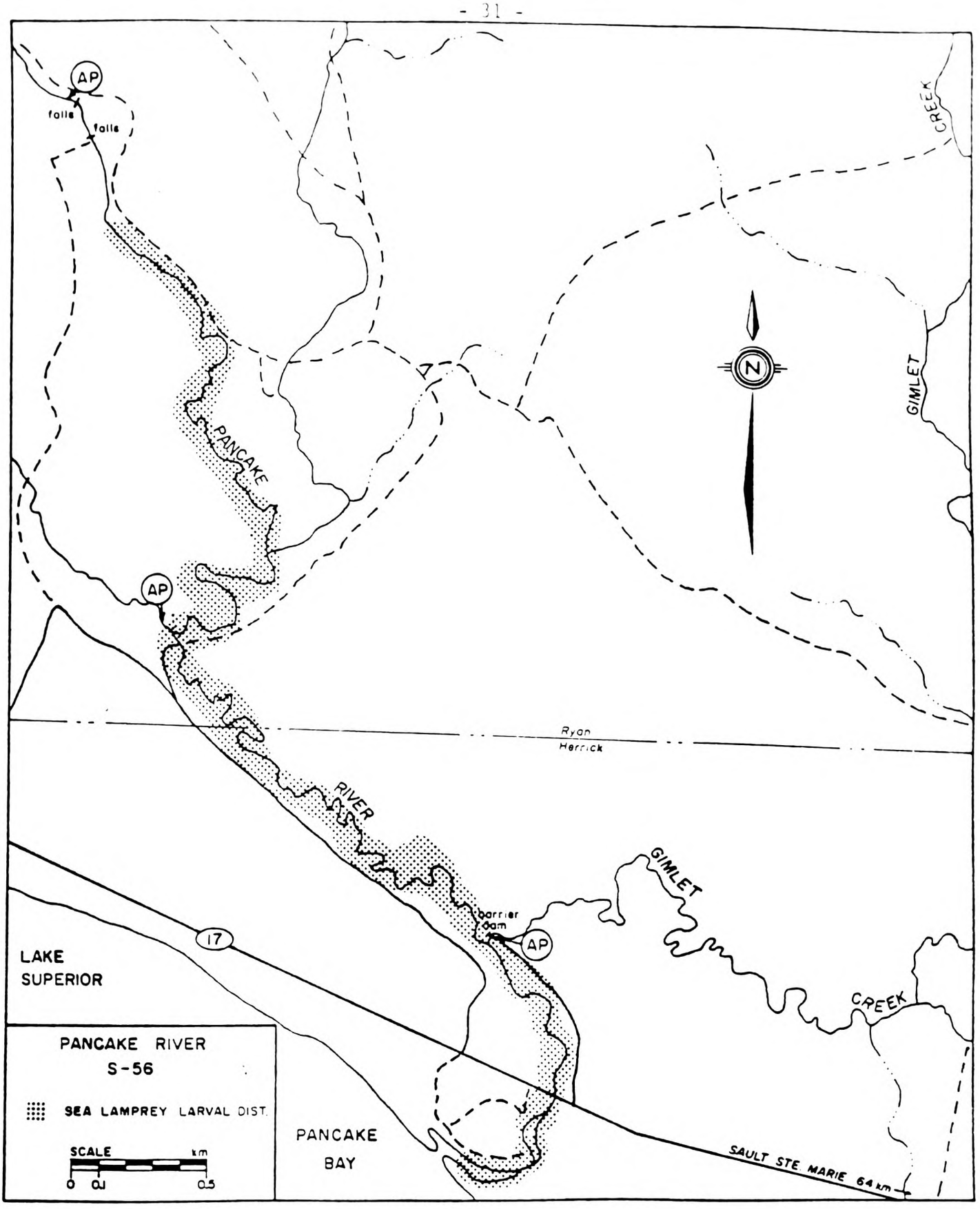


Figure 5. Detailed map of the Pancake River treatment indicating the main lampricide application points and sea lamprey larval distribution on June 11-12, 1985.

Pancake River (Continued)

major tributaries was drip fed, the other being sprayed by supplementary crews to prevent escapement. At these flows, most of the river could be boated, which assisted the supplementary application crews.

Larval sea lamprey were quite abundant overall with 330 (31 to 161 mm in length) being collected. They were observed from just below the major rapids (less than a kilometre below the main application point) to just above the mouth. Only a few sea lamprey larvae were observed in Gimlet Creek below the barrier dam. Nineteen adult spawning phase sea lamprey were observed in the main Pancake River just below the major rapids mentioned above.

Non-target fish mortality was rated as low overall, but some stretches had a moderate kill of dace and logperch.

Pigeon River - Figure 6

The Pigeon River, forming a part of the Ontario-Minnesota border for some 75 km, is a large, complex river system covering about 1,500 km^2 of rugged, relatively inaccessible terrain in Minnesota and Ontario. The mouth of the Pigeon River is located approximately 40 km south of the city of Thunder Bay, Ontario. The Pigeon River has a mean annual discharge in excess of 14 m^3/s with flows as low as 2 m^3/s in summer. Pigeon Falls, located 2.5 km above the mouth, provides an effective barrier to spawning run adult sea lamprey. Suitable spawning gravel is present in the upper area of the river below Pigeon Falls and there is ample larval habitat (silt-detritus) in the lower 2.4 km. The water is soft and the stream is often thermally stratified in the lower 1.5 km during late summer.

The Pigeon River had been treated with lampricide five times previously; in 1963, 1964, 1970, 1976 and 1981.

Prior to treatment, a bioassay was conducted to determine treatment levels and a check was made to determine the extent of thermal stratification. The bioassay indicated an 8-h level of 0.5 ppm with 1.6 per cent Bayer 73 additive and a maximum level of 1.9 ppm/12-h for brook trout. A treatment level of 0.7 ppm/12-h was chosen because of the short watershed affected and the relatively high spring discharge. On June 18 the river was thermally stratified in the lower 0.3 km of river. This thermally stratified area did not expand during the treatment.

Substantial flows (approximately 14 m^3/s) made for a quick and effective treatment and helped to minimize the area of temperature stratification. Lethal levels were attained throughout the river except in the lower 0.3 km. Supplementary applications of lampricide were limited to three large backwater areas.

Larval sea lamprey were considered to have been scarce with only 60 (2 to 149 mm in length) collected. Relatively turbid water hampered the unit collecting efforts, but gulls were observed feeding on sea lamprey larvae during the treatment. Larval distribution extended from just downstream of the fall to just upstream of the mouth. Four spawning phase lamprey were observed during the treatment.

Non-target fish mortality was considered to have been negligible.

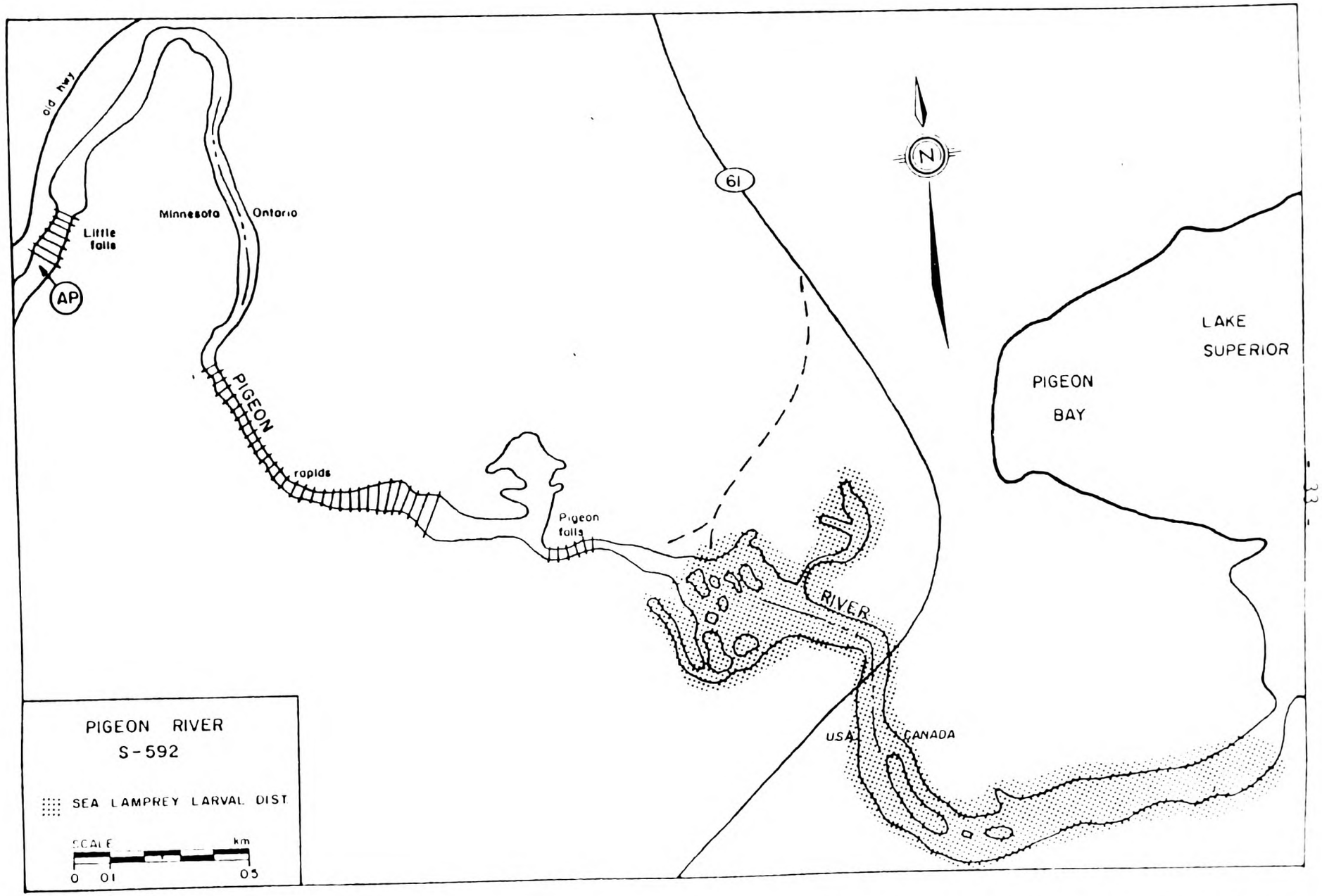


Figure 6. Detailed map of the Pigeon River treatment indicating the main lampricide application point and sea lamprey larval distribution on June 20-21, 1985.

Steel River - Figure 7

The Steel River is tributary to Lake Superior approximately 44.8 km west of Marathon, Ontario, in the District of Thunder Bay. A series of waterfalls situated at the outlet of Santoy Lake, 10.1 km from the river mouth, are a natural barrier to spawning phase sea lamprey. The watershed has a moderately fast run-off over rugged terrain with no road access to the river between Santoy Lake and Highway 17, a distance of approximately 8.6 km. Lamprey spawning habitat is in abundance, however larval habitat is confined primarily to a few backwater areas located above Highway 17 and the immediate mouth area. There are only a few small tributaries below Santoy Lake, none of which produce sea lamprey ammocoetes.

The Steel River was treated with the lampricide TFM for the sixth time in 1985, previous treatments being conducted in 1962, 1966, 1972, 1979, and 1983.

Since the 1983 lampricide treatment was only partially effective in eradicating the resident sea lamprey larval population, the river was rescheduled for treatment in 1985. The current treatment, conducted under optimum run-off conditions, was very effective throughout the entire watershed. Sea lamprey larvae were scarce with the majority of the 34 specimens collected being in the extreme lower end of the watershed. Only three specimens less than 61 mm were collected, suggesting that very little spawning activity occurred in 1984. One spawning phase sea lamprey was observed during the treatment.

Non-target fish mortality was negligible.

Neebing-McIntyre River - Figure 8

Prior to 1982, the Neebing and McIntyre Rivers in Thunder Bay were separate watersheds. As a result of flood control measures, the Neebing and McIntyre Rivers were joined in 1982-83 to form a common mouth which empties into Thunder Bay, Lake Superior, just south of their two original mouths.

The *Neebing River* flowed into Lake Superior through the Northwest Exhibition Grounds located between the former cities of Port Arthur and Fort William. Sea lamprey ammocoetes were first discovered in the Neebing River in 1971. The stream is relatively long and complicated in its headwaters but has an average summer flow of only 0.3 m^3/s. A series of small waterfalls 17 km above the mouth provided sufficient deterrent to migrating adult sea lamprey and the one and only previous lampricide treatment in 1972 originated from that point. Two tributaries enter the Neebing River below this point. The upper 10 km of stream are riffles and long pool areas with adequate spawning gravel and sand-silt larval habitat. The river is very slow in the lower 4.8 km and bottom type is entirely a silt-sand-clay mixture. A low, metal dam, constructed in 1968 approximately 4.8 km above the mouth of the Neebing River, is probably a barrier to adult sea lamprey. Very few larval sea lamprey had been found by surveys in the Neebing River since the 1972 treatment but since it would have to be covered with lampricide to prevent dilution of the McIntyre River lampricide block it was decided to apply lampricide from the dam mentioned above, to assess the size and extent of the larval sea lamprey population.

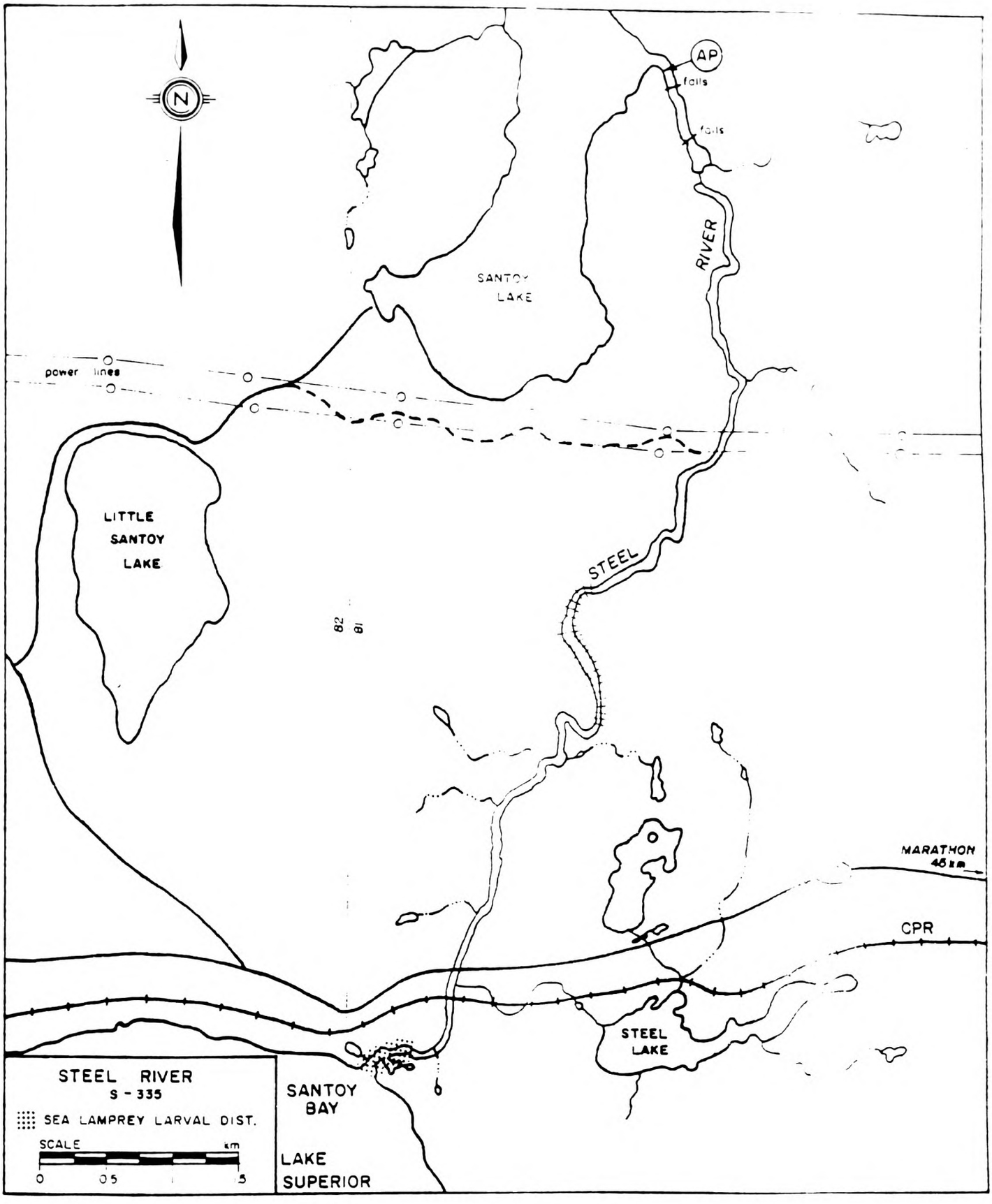


Figure 7. Detailed map of the Steel River treatment indicating the main lampricide application point and sea lamprey larval distribution on July 17-18, 1985.

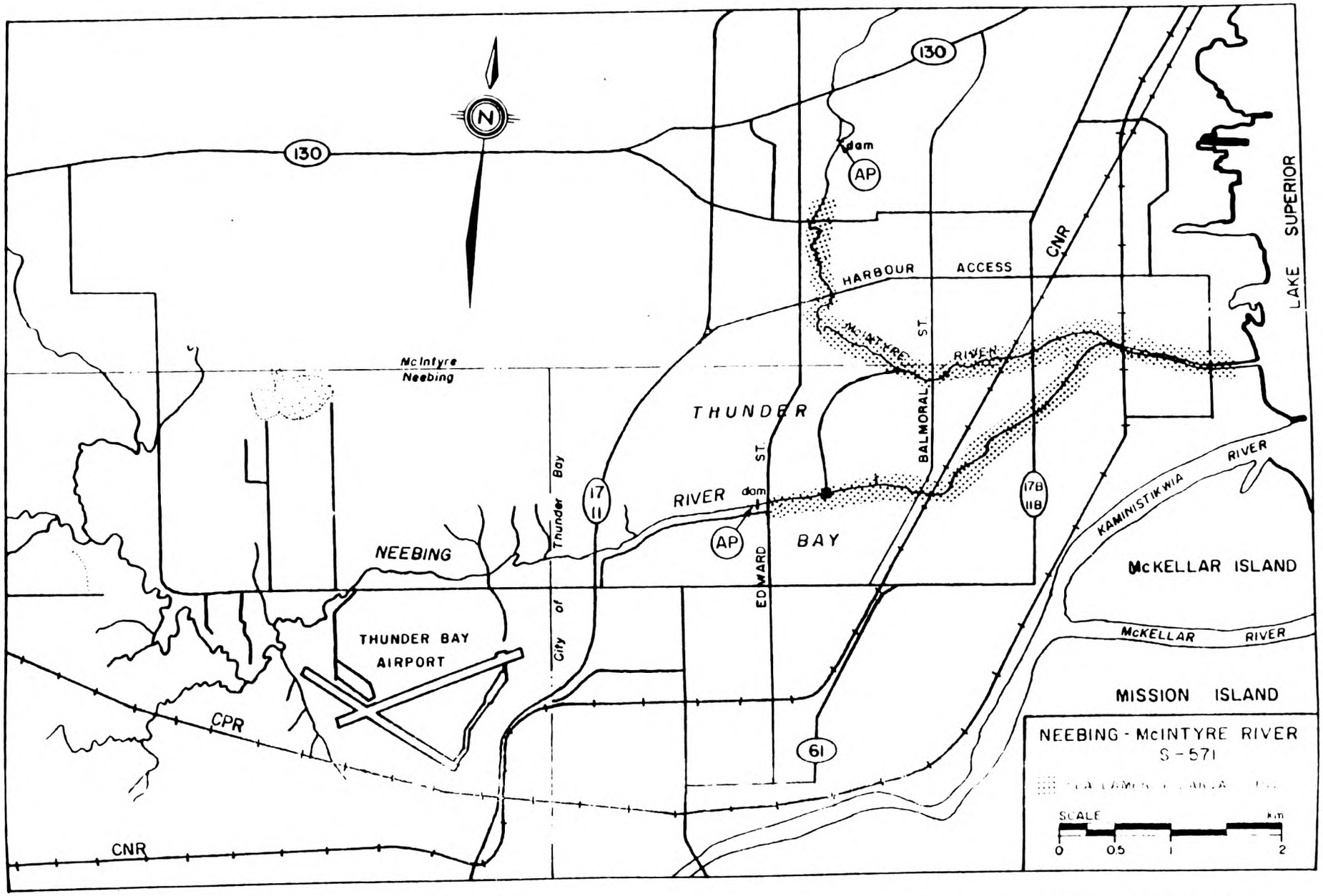


Figure 8. Detailed map of the Neebing-McIntyre River treatment indicating the main lampricide application points and sea lamprey larval distribution on August 9-11, 1985.

Neebing-McIntyre River (Continued)

The *McIntyre River* is a relatively small stream (summer [illegible] than 0.3 m^3/s), but is rather complicated in its upper reaches with [illegible] small tributaries; in its lower 9.5 km it is straightforward [illegible] major tributaries. A man-made dam on the Lakehead University property [illegible] 6 km above the mouth is an apparent barrier to adult migrating sea [illegible]. Below this dam the stream flows initially over bedrock and then gravel, [illegible]ffles and pools until the lower 3 km where the stream flows with little gradient through a greatly widened and deepened channel to its new mouth.

The McIntyre River was treated twice before with lampricide [illegible] 1960 and 1964, but no sea lamprey were collected in the 1964 treatment.

In 1984 larval sea lamprey were re-discovered in the McIntyre River for the first time since the 1960 treatment.

Because of adequate flows (unexpected for August) the lampricide blocks moved fairly well through both streams, with the exception of the lowermost portion of the McIntyre. Theoretically lethal levels were attained to the confluence of both branches but because of missed coincidence the lampricide block was sublethal in the last kilometre of stream (because of scarcity of sea lamprey larvae, boosting of the block in this area was not deemed necessary).

This was a very informative treatment from the standpoint of larval sea lamprey abundance and distribution. A total of 1,142 (11 to 191 mm in length), including 91 undergoing adult transformation, were collected. Larval sea lamprey were extremely abundant in the McIntyre section and were distributed from approximately 1 km below the dam to the confluence; however, [illegible]ae were very scarce below Balmoral Street. Larval sea lamprey were much less abundant in the Neebing section but collecting conditions were more difficult due to extreme turbidity. Distribution extended from just below the [illegible] to the confluence. A few sea lamprey larvae were collected to within [illegible] of the mouth, below the confluence of the two branches.

Non-target fish mortality was considered to have been negligible.

Chippewa River - Figure 9

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 is a fairly large (average summer flows 4 m^3/s), extensive watershed but two falls of about 7 m high each, 1.9 km above the mouth, constitute a barrier to migrating adult sea lamprey. 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 sandy and silty larval habitat. No tributaries exist below the falls.

The Chippewa River had been treated with lampricide 13 times previously; annually from 1961 to 1966 and in 1968, 1970, 1972, 1977, 1980, 1983 and 1984.

The 1985 lampricide treatment was a continuation of the intensified treatment strategy on the Chippewa River aimed at reducing annual recruitment of

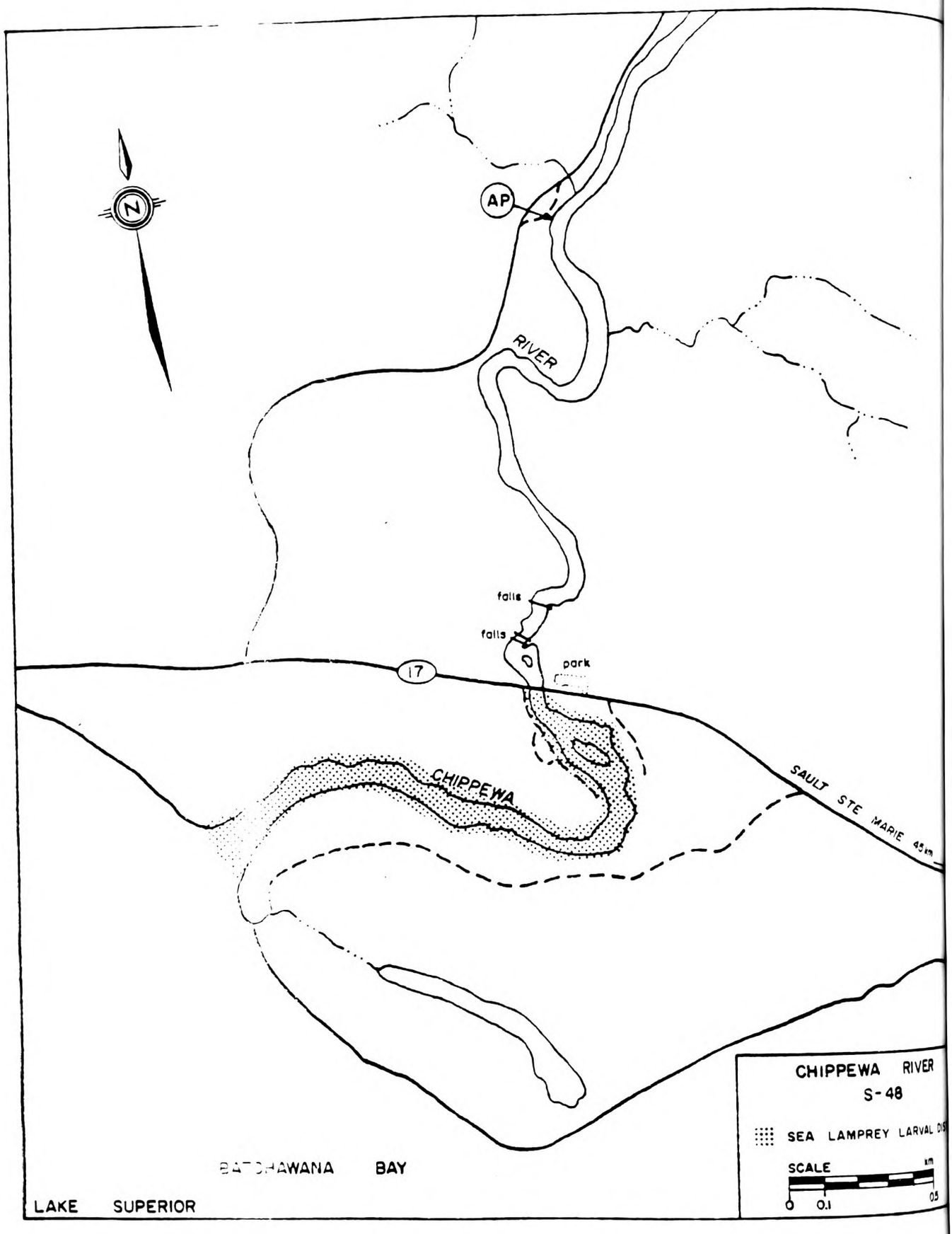


Figure 9. Detailed map of the Chippewa River treatment indicating the main lampricide application point and sea lamprey larval distribution on August 27-28, 1985.

Chippewa River (Continued)

young-of-the-year sea lamprey larvae to the lentic zone in Batchawana Bay. Despite the high level of Lake Superior during the treatment period, the treatment was successful, lethal levels being maintained to the mouth.

Larval sea lamprey were scarce, with all but three of the 32 collected being young-of-the-year. Only one larva in this collection was undergoing adult transformation.

Non-target fish mortality was limited to several hundred trout-perch and a few pink salmon.

Goulais River - Figure 10

The Goulais River, a large, fairly complex river in Algoma District crosses Highway 17 approximately 20 km north of the city of Sault Ste. Marie and flows into Goulais Bay, Lake Superior. Whitman Falls, a natural 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 10 major tributaries, seven of which generally contain sea lamprey ammocoete populations: Achigan, Whitman, Dam, Perry, Bellevue, Sheppard and Robertson Creeks. The major tributaries all enter the main Goulais River above Highway 17 which is approximately 18 km from the mouth. This area above Highway 17 is basically undeveloped, mixed deciduous and coniferous bushland with 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 meanders considerably throughout its course and contains numerous oxbows and cut-off areas. In the lower 32 km the river slows considerably and flows through a wide floodplain with characteristic high gravel-clay banks. It finally enters Goulais Bay by several separate mouths through a divided delta. Excellent spawning gravel is abundant throughout 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 with the remainder ranging from 0.1 m^3/s to 0.5 m^3/s. All of the major tributaries have a natural barrier and/or deterrent(s) to the upstream migration of sea lamprey with the exception of Bellevue Creek which usually has a number of beaver dams. These tributaries are generally "riffle and pool" streams with the exception of Bellevue and Robertson Creeks, which are slower and deeper.

Originally scheduled for treatment in August, extremely low flow caused postponement until the week of September 9 to 13 - timely rain showers early in September raised flows to good treatable levels. In fact, more rainfall occurred throughout most of the first day of treatment. However, by increasing application rates and boosting the main block considerably below Searchmont, excellent TFM levels were maintained to the mouth of the Goulais River. In all, the main stem, plus 10 tributaries had to be treated coincidentally.

As usual, supplementary application crews were fully occupied because of rapid flow times, numerous backwater areas and limited access. Several isolated lagoons harbouring larval sea lamprey were treated separately (September 5 and

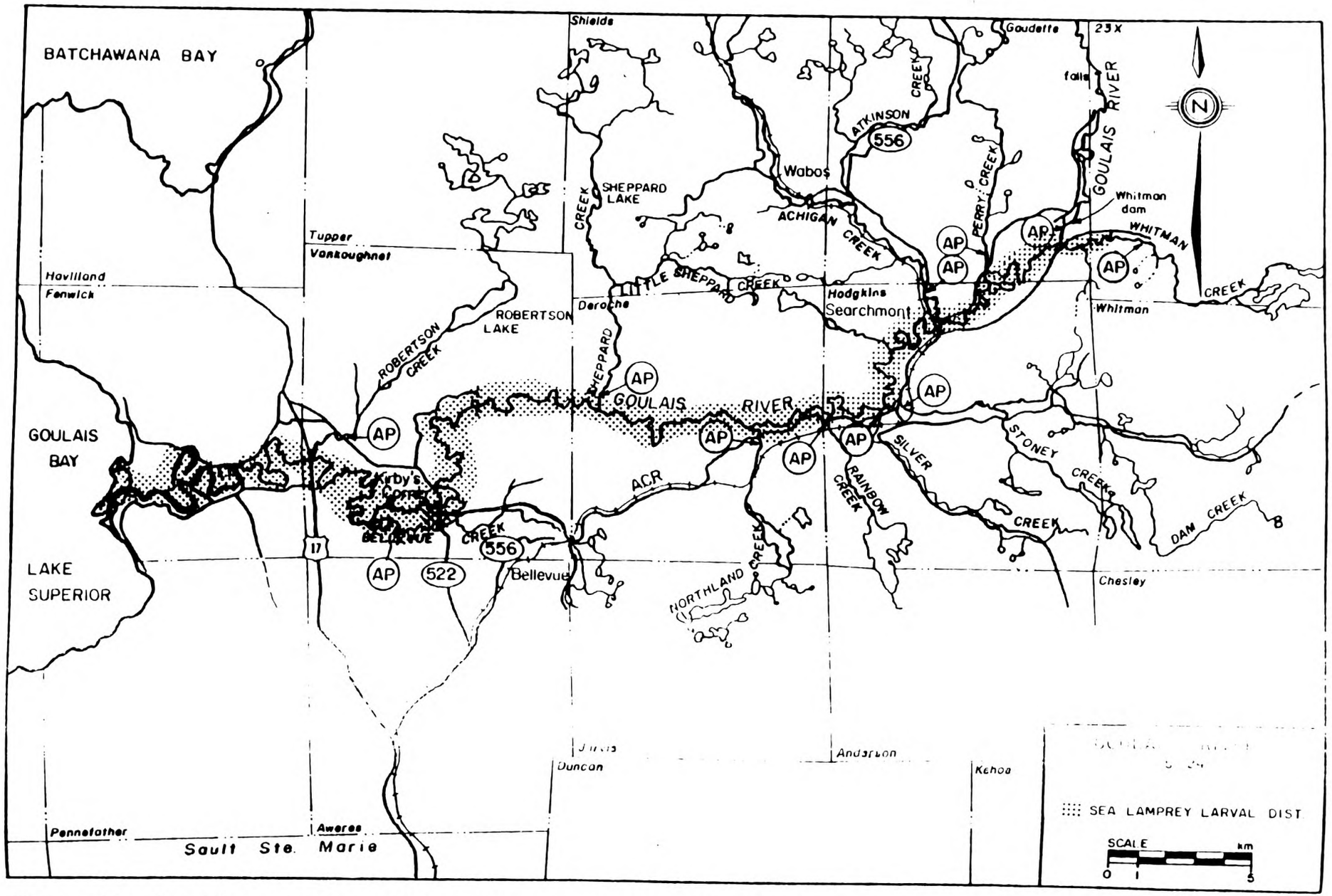


Figure 10. Detailed map of the Goulais River treatment indicating the main lampricide application points and sea lamprey larval distribution on September 9-13, 1985.

Goulais River (Continued)

6) prior to the main treatment. Sea lamprey larvae were abundant in the main Goulais as far down as Highway 17, where numbers decreased considerably. They appeared to be relatively scarce in the tributaries.

Although this treatment, which usually requires two complete treatment units, taxed the available personnel; the large number of larval sea lamprey collected, 1,659 (11 to 186 mm in length) including 18 undergoing adult transformation, certainly justified undertaking it in 1985. Numbers of obvious residuals from the June 1982 treatment were collected, including numbers of transformers. An attempt to treat the Goulais system in 1984 was "rained out" shortly after initiation, however part of Achigan Creek and Perry and Dam Creeks were treated successfully, thus slightly simplifying the 1985 treatment. The new low-head barrier dam on Sheppard Creek also appears to be effective; all that was required was a short block of lampricide from that dam to the confluence.

Thorough surveillance of the Goulais River by survey crews should indicate if the Goulais River will have to be treated on an advanced basis due to residual sea lamprey larvae.

Non-target fish mortality was relatively low, especially for the size of the system. The treatment occurred during the pink salmon run and many dead and live pink salmon were observed. Trout-perch had the highest mortality rate and a few dace, white suckers, logperch, and sculpins were also observed dead.

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, Goulais and Mountain Bays and Helen Lake were treated with the granularized formulation of Bayer 73 (2',5-dichloro-4-nitrosalicylanilide). Application of Bayer 73 granules to a portion of Cypress Bay was not performed in 1985 due to inclement weather conditions. Table VII lists the pertinent treatment data, Figure 11 shows the general locations of treatment areas in Batchawana Bay, whereas Figures 12 to 19 describe each specific treatment area.

BATCHAWANA BAY - Figure 11

Areas off Stokely Creek and the Harmony, Chippewa, Batchawana and Carp Rivers were again treated with Bayer 73 granules in 1985. Only the lentic area off the Chippewa River continues to produce appreciable numbers of larval sea lamprey and numbers seem to be decreasing there as well.

Stokely Creek - Figure 12

A 1.1 ha area on the fairly well-defined drop-off zone off the mouth of Stokely Creek was treated with 272 kg of Bayer 73 granules on July 23. Larval sea lamprey continue to remain very scarce; only 32 were collected, 86 to 131 mm in length. There is some concern that spawning may occur in limited gravel areas below the low-head barrier dam constructed in 1981 but, if so, small larvae have not moved into the lentic area off the mouth.

Harmony River - Figure 13

A relatively small (0.74 ha) area directly off the mouth of the Harmony River was treated with 182 kg of granular Bayer 73 on July 24. Although treatment conditions were good, only two larval sea lamprey, 21 to 71 mm in length, were collected. The lentic population off the Harmony River, although never very large, seems to have been reduced to insignificant.

Chippewa River - Figure 14

A large (3.29 ha) area on the well-defined drop-off zone off the Chippewa River was treated with 816 kg of granular Bayer 73 over a period of two days, July 26 and 29. Treatment conditions were ideal both days but a larger portion was treated on July 26. Larval sea lamprey were moderately abundant with 908 collected, 37 to 162 mm in length (including two undergoing transformation). The treatment was in conjunction with special studies by a submersible and included a larval sea lamprey population estimate. Generally speaking, the annual TFM treatments of the Chippewa River and granular Bayer treatments in the lentic zone appear to be effective in that both the size of the population and mean length of the larvae have been reduced.

Batchawana River - Figure 15

A 1.86 ha area off the mouth of the Batchawana River was treated with 454 kg of Bayer 73 granules on July 30 to 31. Larval sea lamprey were relatively scarce with only 142 being collected, 36 to 161 mm in length. Numbers of sea lamprey larvae continue to remain low since the 1980 treatment - the lake drop-off zone adjacent to the Batchawana River appears to be gradually becoming less well defined and consequently it is difficult to key in on a

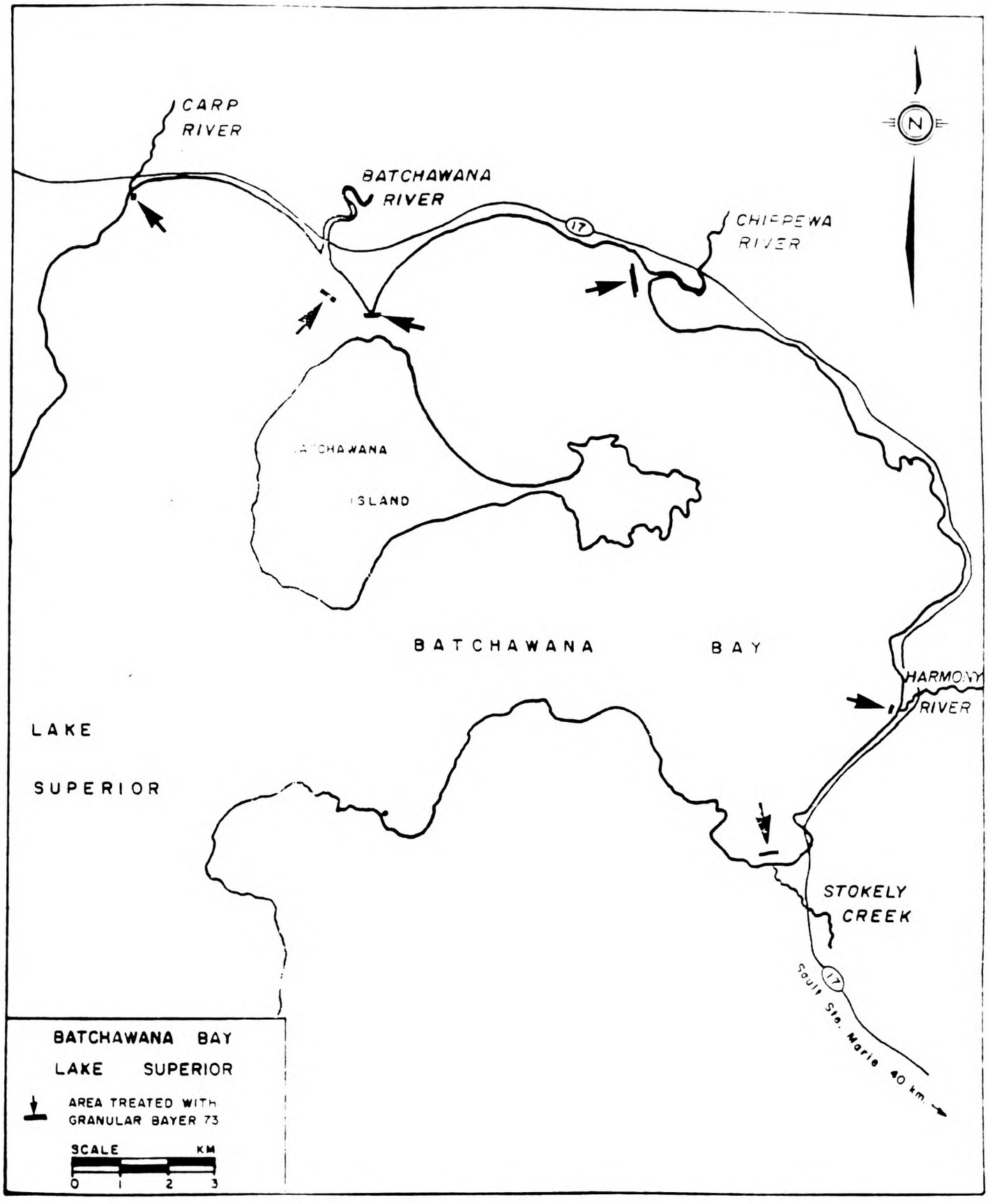


Figure 11. Map of Batchawana Bay showing approximate locations of granular Bayer 73 treatment areas in 1985.

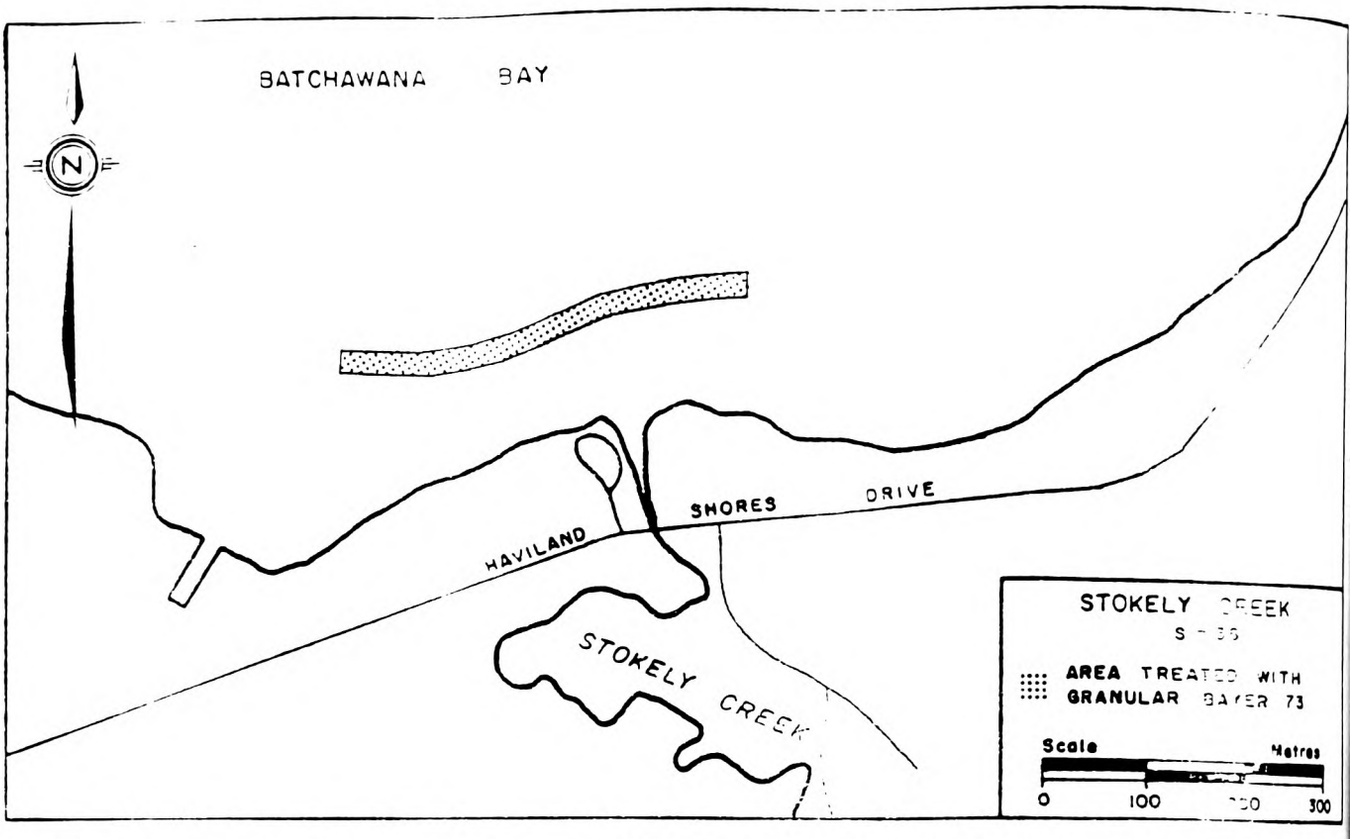


Figure 12. Lake area adjacent to Stokely Creek treated with granular Bayer 73 in 1985.

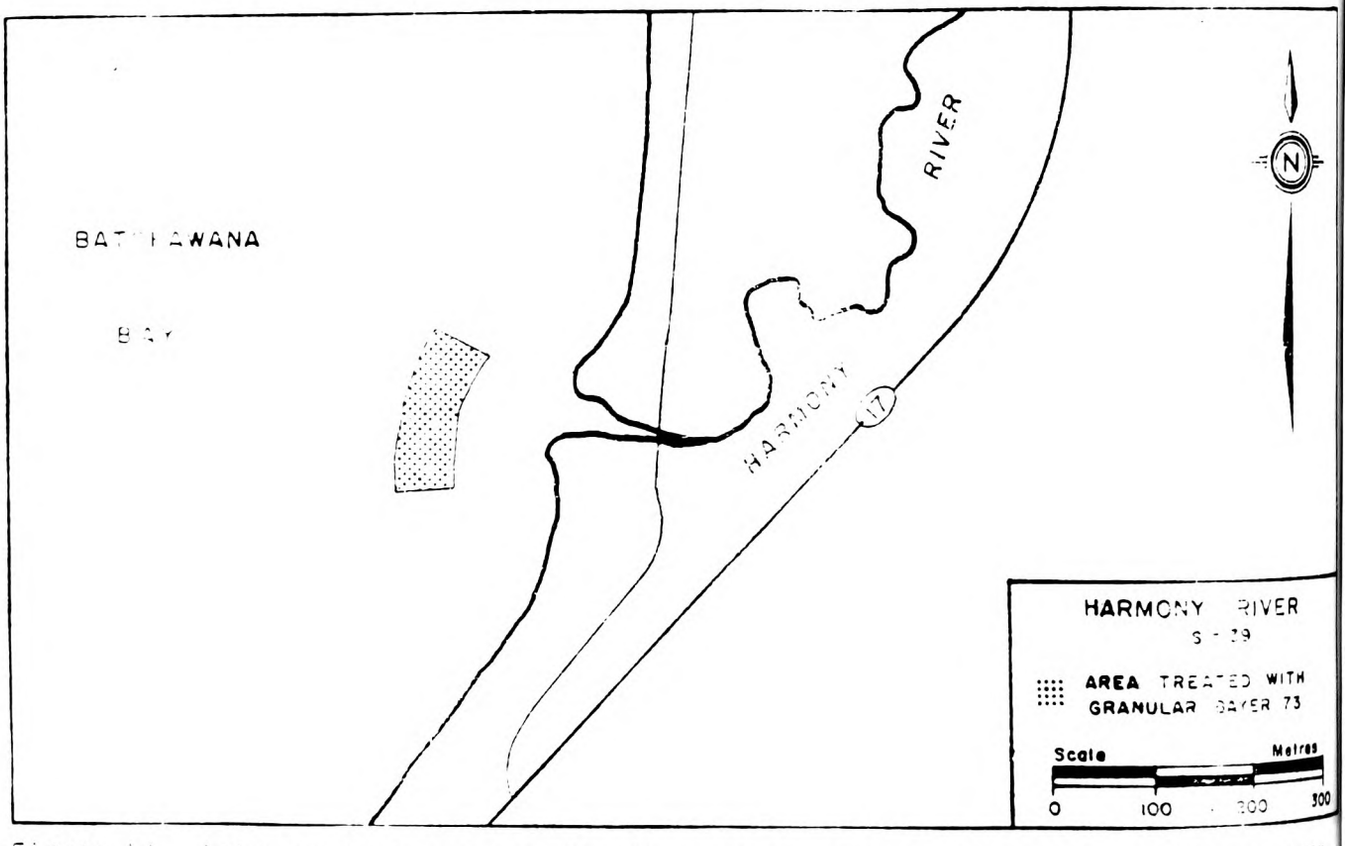


Figure 13. Lake area adjacent to the Harmony River treated with granular Bayer 73 in 1985.

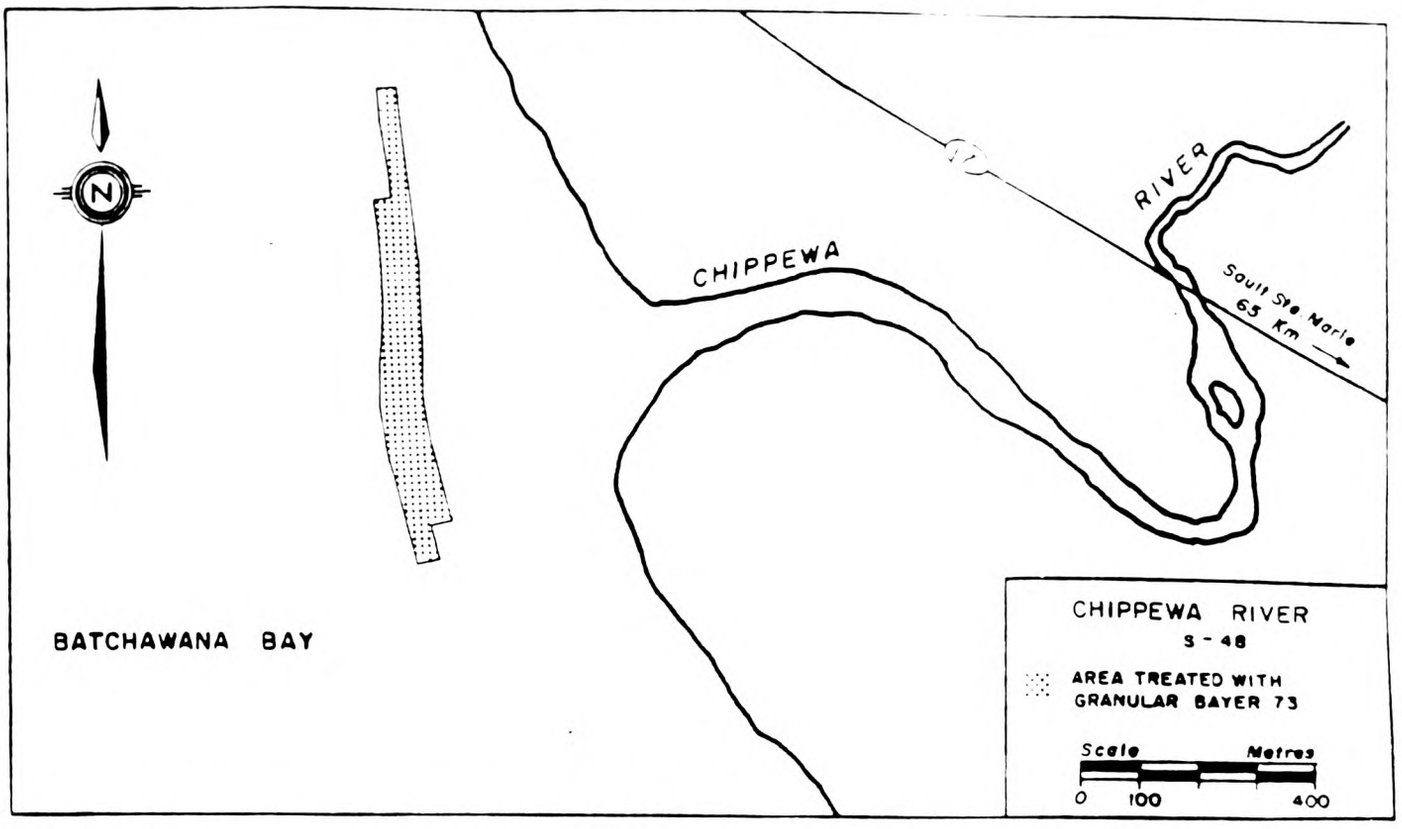


Figure 14. Lake area adjacent to the Chippewa River treated with granular Bayer 73 in 1985.

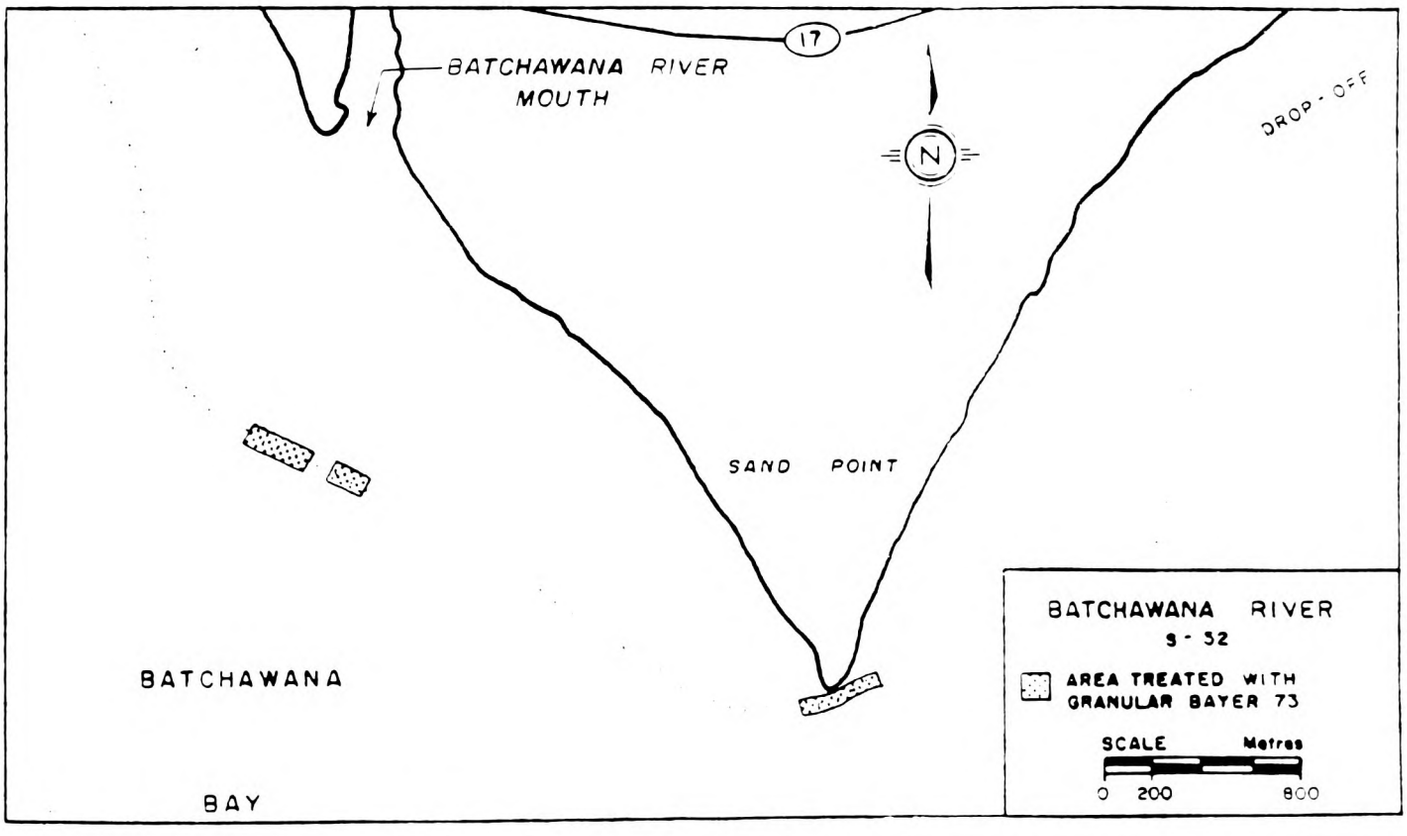


Figure 15. Lake areas adjacent to the Batchawana River treated with granular Bayer 73 in 1985.

Batchawana River (Continued)

suitable treatment area. Larval sea lamprey [illegible] scattered in low numbers over a fairly large area.

A small (0.73 ha) area immediately off [illegible] so treated with 181 kg of granular Bayer 73 on July 30 to 31. [illegible] sea lamprey, 46 to 161 mm in length, were collected. It is likely [illegible] larvae originate from the Batchawana River. Their numbers have varied [illegible] decreased from the first time this area was treated in 1981 when [illegible] prey larvae were collected.

Carp River - Figure 16

Because of very low water temperatures, only a [illegible] (0.37 ha) area immediately off the mouth of the Carp River was treated with [illegible] kg of Bayer 73 granules on July 22. Only 10 larval sea lamprey, [illegible] in length, were collected.

On August 1 water temperatures were much improved and an expanded 1.1 ha sized area was treated with 272 kg of granular Bayer 73. However only nine larval sea lamprey, 21 to 106 mm in length, were collected from this area. The size of the lentic population off the Carp River appears to be only marginally significant. In 1984 only 17 sea lamprey larvae were collected.

GOULAIS BAY - Figure 17

On August 21 and 22, seven separate areas totalling 2.79 ha off the several mouths of the Goulais River were treated with [illegible] kg of Bayer 73 granules. Despite excellent conditions and the presence of the area treated, larval sea lamprey were very scarce and scattered in distribution. Only 30 sea lamprey larvae (46 to 131 mm in length) including one transforming larvae, were collected from the seven areas. Thus there does not appear to be a large lentic population of sea lamprey larvae associated with the Goulais River.

MOUNTAIN BAY - Figure 18

A 1.83 ha area along the fairly well-[illegible] off zone off the mouths of the Gravel and Little Gravel Rivers was [illegible] 454 kg of Bayer 73 granules on August 13. Treatment conditions [illegible] ble this year as opposed to 1984, when the treatment was deferred [illegible] very low bottom temperatures. In the 1985 treatment larval [illegible] were moderately abundant; 402 were collected, 21 to 171 [illegible], but were mostly concentrated near the immediate mouth of the [illegible]. Larval numbers appear to remain at a suppressed level as compared [illegible] s prior to 1980.

HELEN LAKE - Figure 19

Because of the very high discharge fro[illegible] er during August of this year, conditions were not ideal for granular [illegible] ications in Helen Lake immediately off the mouth of the Upper Nipigon [illegible]. y strong currents would have made effective granular Bayer applicat[illegible] ble. As a result, only a small (0.74 ha) area in Helen Lake, immediately across from the lower mouth of the Upper Nipigon River, was treated with [illegible] of granular Bayer. Only 16 larval sea lamprey, 21 to 161 mm in length, were collected. Future granular Bayer treatments in Helen Lake should be contingent with lowered flows in the Nipigon River.

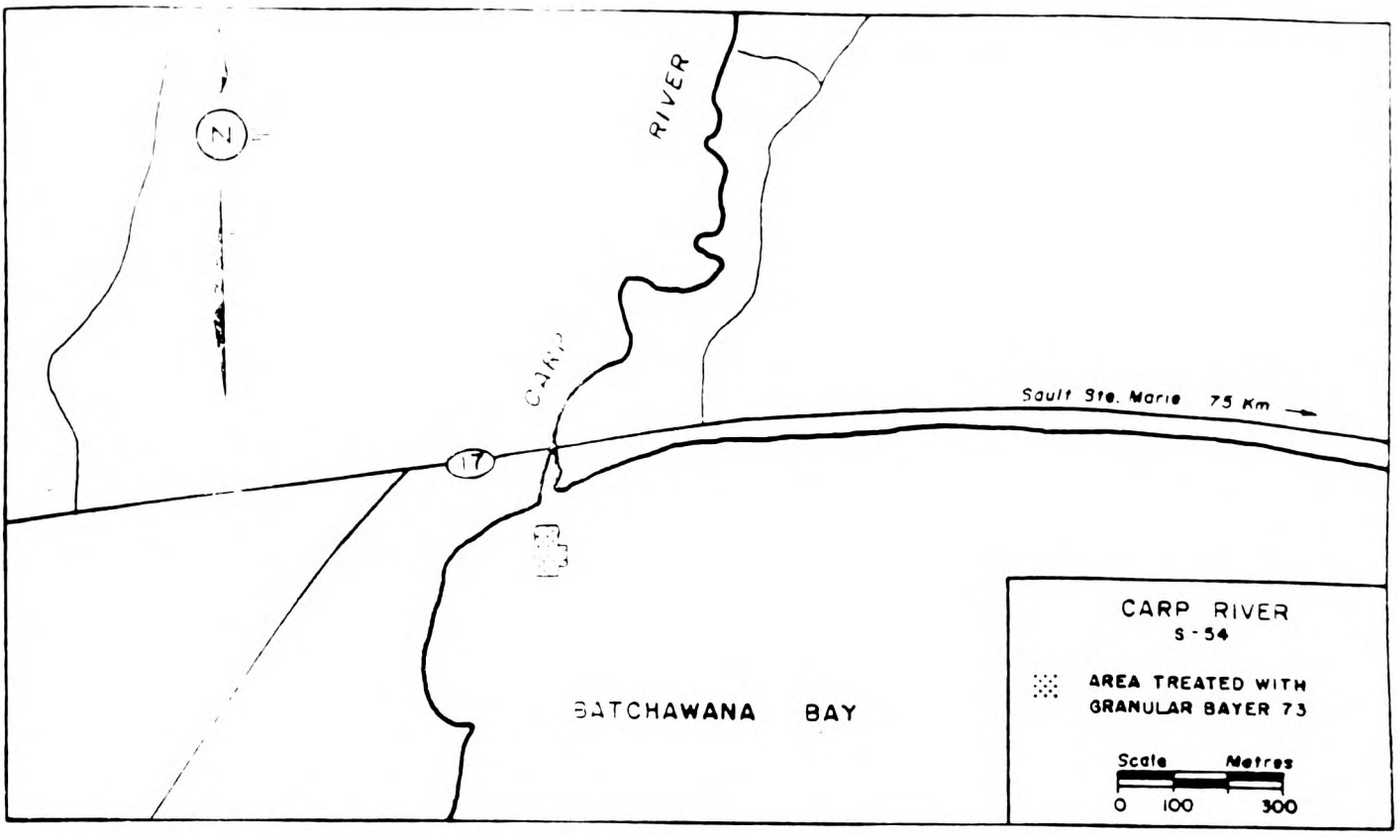


Figure 16. Lake area adjacent to the Carp River treated with granular Bayer 73 in 1985.

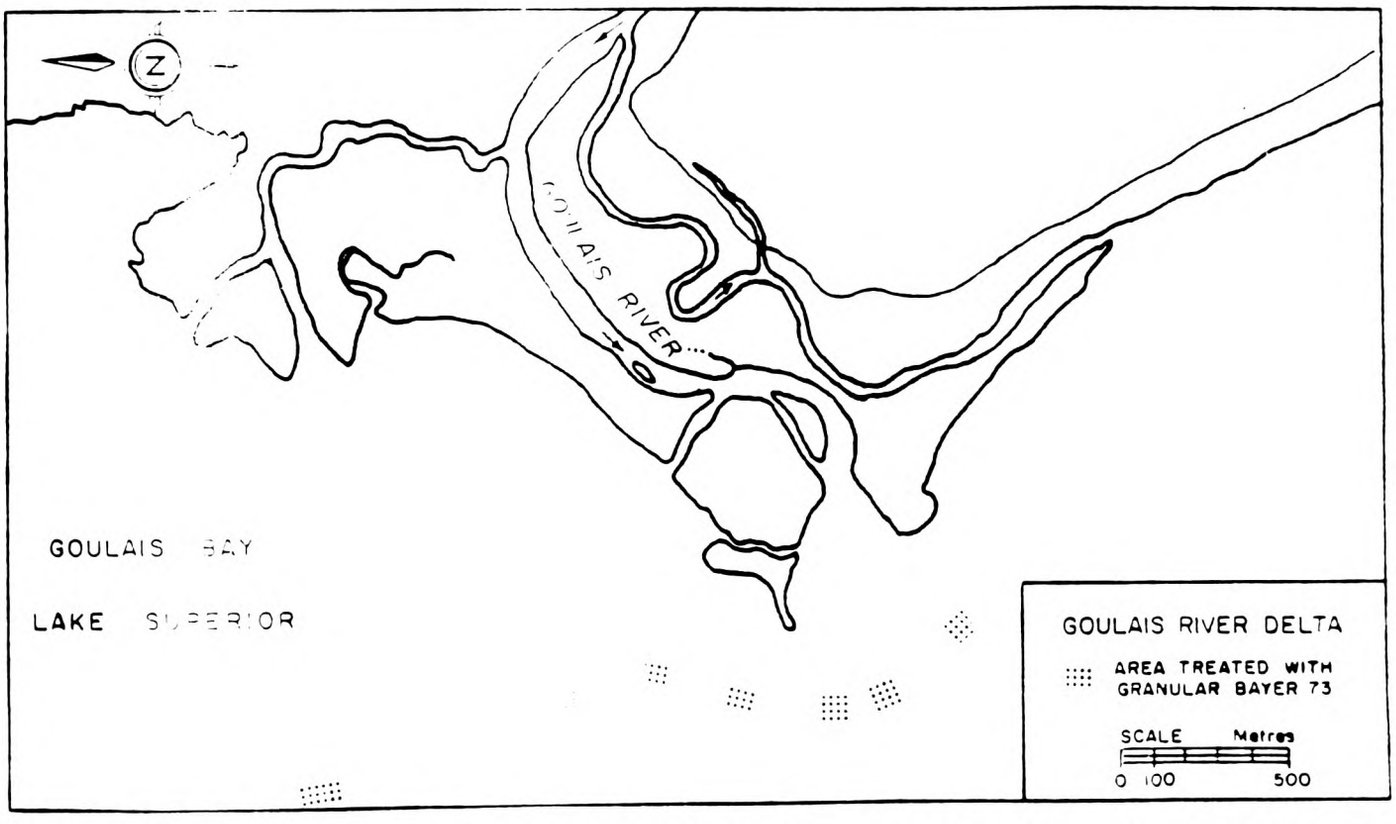


Figure 17. Lake areas adjacent to the Goulais River treated with granular Bayer 73 in 1985.

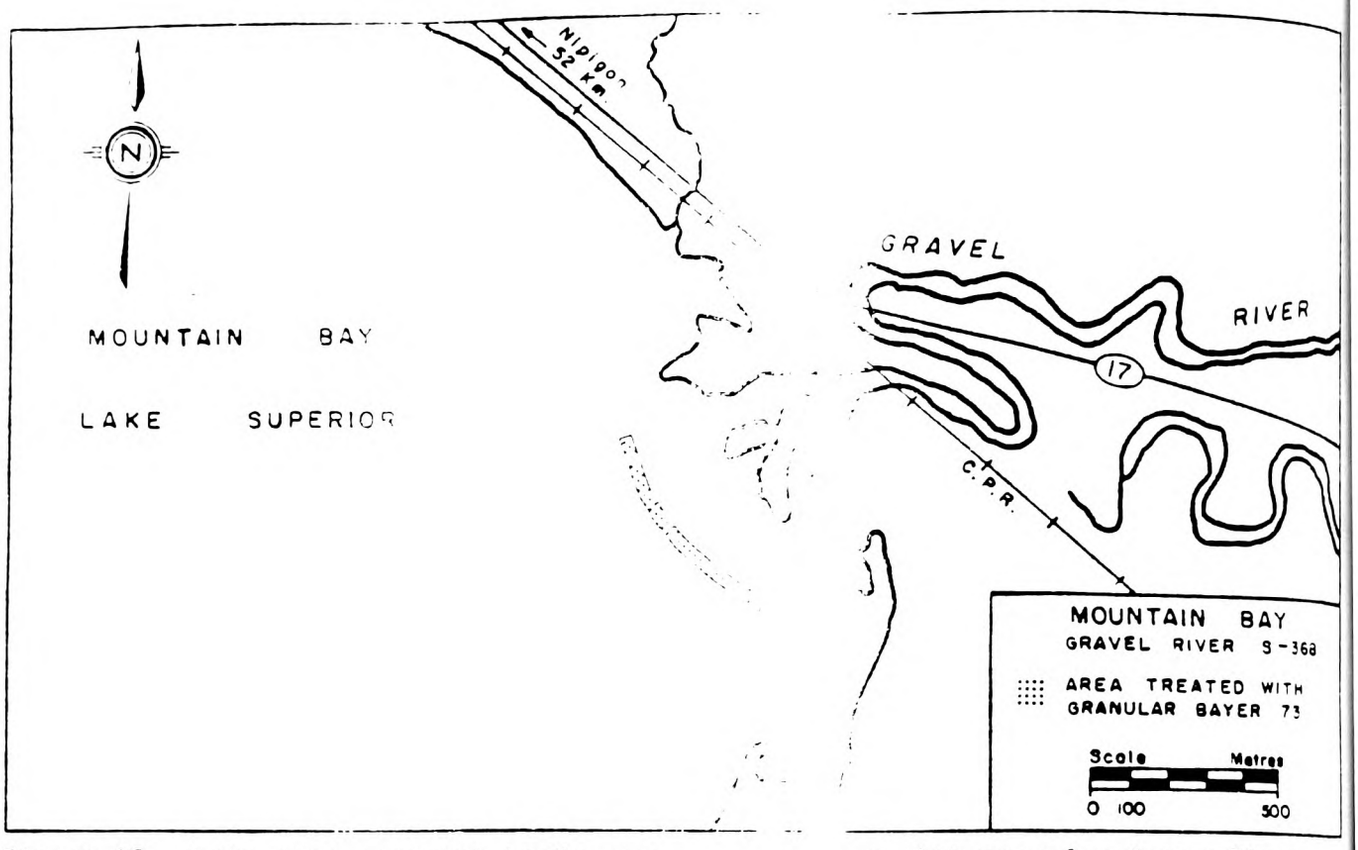


Figure 18. Lake area adjacent to Mountain Bay treated with granular Bayer 73 in 1985.

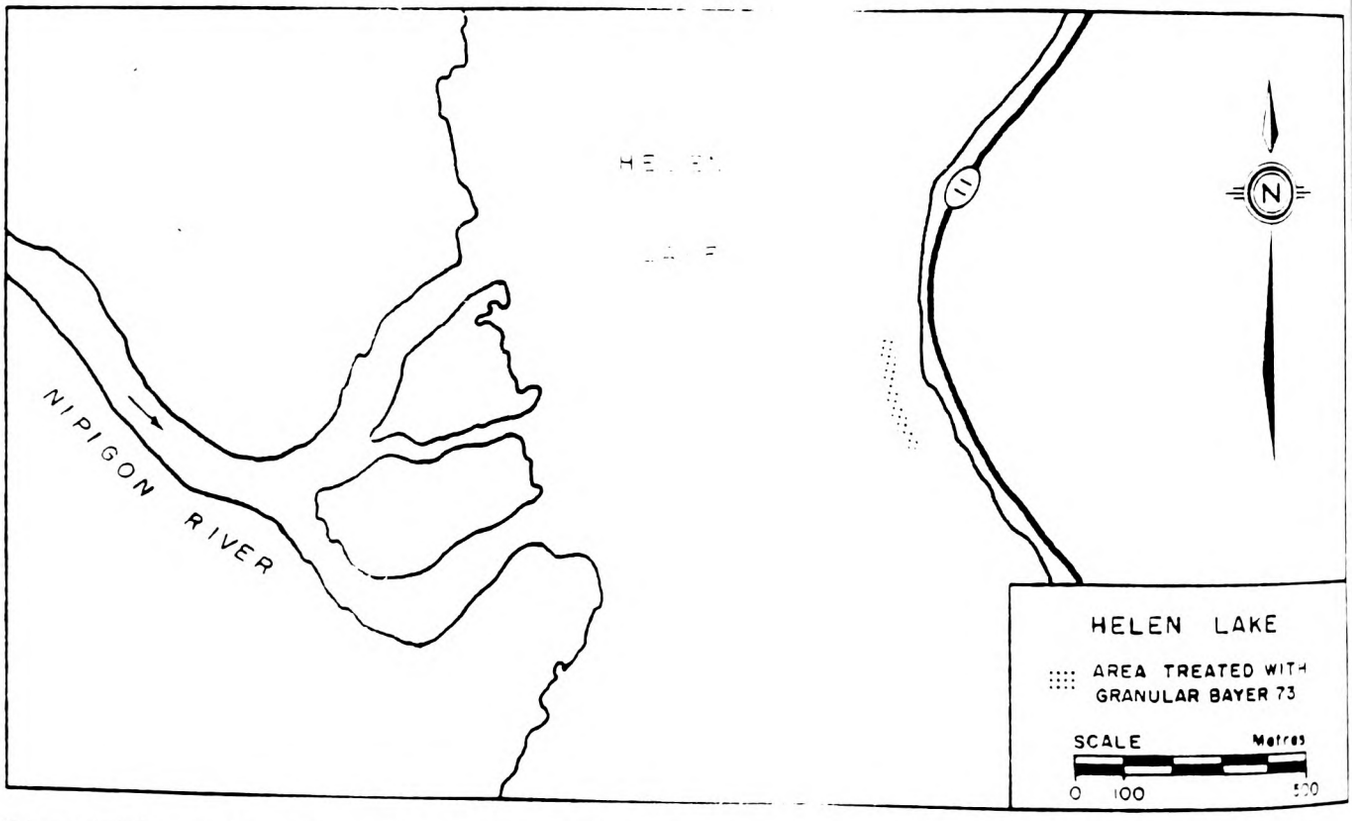


Figure 19. Lake area adjacent to Helen Lake treated with granular Bayer 73 in 1985.

LAKE HURON LAMPRICIDE (TFM) TREATMENTS

The following seven streams tributary to Lake Huron were treated with the selective lampricide, 3-trifluoromethyl-4-nitrophenol (TFM) in 1985:

Kaskawong River	May 28-29
Sturgeon River	May 31
Sauble River	June 2-3
Mindemoya River	June 5-6
Watson Creek	June 13-14
Richardson Creek	June 20
Serpent River	June 26-27

Table VIII lists the pertinent treatment data, Figure 20 depicts the general location of the streams treated, and Figures 21 to 28 illustrate treatment details.

The sections that follow contain 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 V.

Kaskawong River - Figure 21

The Kaskawong River is located in the southeast section of St. Joseph Island. The river drains two small lakes and flows through approximately 16 km of cedar swamp and beaver ponds before entering Milford Haven on the North Channel of Lake Huron. The river has an average spring discharge of approximately 0.3 m^3/s, contains limited amounts of spawning gravel, and is a regular producer of sea lamprey. Previous treatments conducted in 1966, 1970, 1974 and 1982 were often complicated by poor access, low discharge, beaver ponding and a high potential for excessive larval escapement. Consequently, in 1980 a sea lamprey barrier dam was constructed 1.6 km from the mouth, in order to eliminate the need to treat the upstream portion of the watershed. Hence the 1985 treatment was conducted from the dam with relative ease.

Larval sea lamprey abundance was considered moderate with a total of 360 specimens (31 to 171 mm in length) being collected.

In the past sea lamprey larvae have been very scarce throughout the estuary, and the presence of the recently constructed dam does not appear to cause any downstream shift in the distribution limits. There is some concern that the dam might, in fact, play a contributing role in the development of an offshore population of sea lamprey larvae.

Non-target fish mortality was negligible.

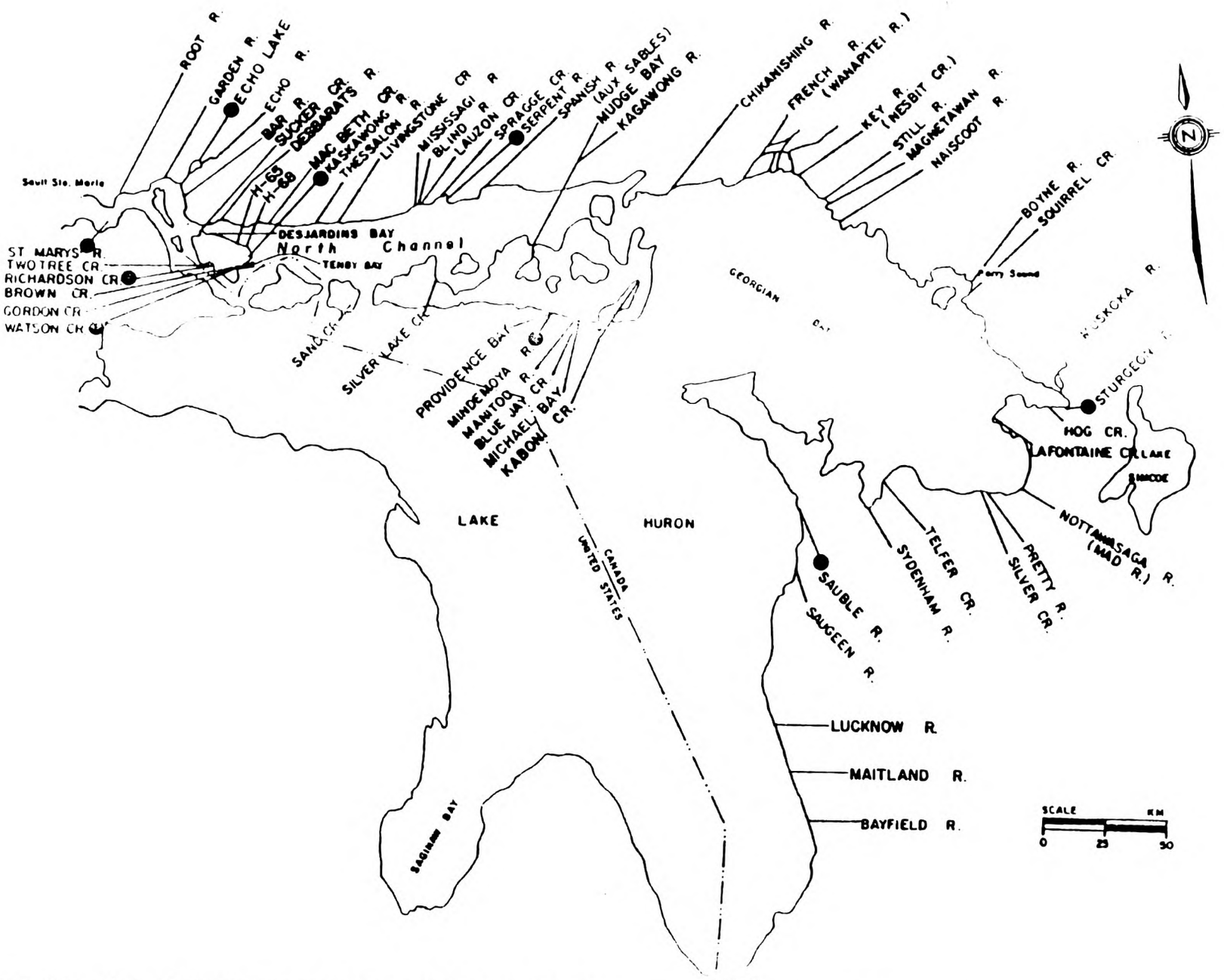


Figure 20. Map of Lake Huron showing location of all known sea lamprey producing streams, lakes and

Table VIII. Summary of streams and lake areas treated with lampricide on Lake Huron, 1985.

STREAM	Date	Flow m^3/s	Active Ingredient TFM kg	Bayer 73 kg	Granular Bayer 73 kg	*/Sea Lamprey Collected	Area Treated km	Area Treated ha
Kaskawong River	May 28-29	0.507	62.16	-	-	M/ 360	1.6	
Sturgeon River	May 31	1.372	210.74	-	-	A/ 486	1.5	
Sauble River	June 2-3	7.664	1,479.03	11.75	-	S/ 26	3.5	
Mindemoya River	June 5-6	0.636	151.44	-	0.01	M/ 340	8.5	
Watson Creek	June 13-14	0.055	10.56	-	-	M/ 249	1.9	
Richardson Creek	June 20	0.456	67.02	-	-	A/ 353	2.6	
Serpent River	June 26-27	12.936	292.80	-	-	A/ 948	11.5	
Echo Lake	July 23	-	-	-	12.50	M/ 142		0.99
St. Marys River								
- Whitefish Island	Aug.13,14,15	-	-	-	35.20	A/ 4,907 (23)		2.79
- Station H	Aug.14,15	-	-	-	37.43	A/ 1,580 (4)		2.88
- Root River	Aug.15	-	-	-	9.08	M/ 78 (2)		0.72
- Garden River	Aug.21	-	-	-	13.62	M/ 114		1.44
TOTALS		23.626	2,273.75	11.75	107.84	9,583 (29)	31.1	8.82

*/ - S = Scarce; M = Moderate; A = Abundant
( ) - indiates number of transforming sea lamprey larvae included in the collection

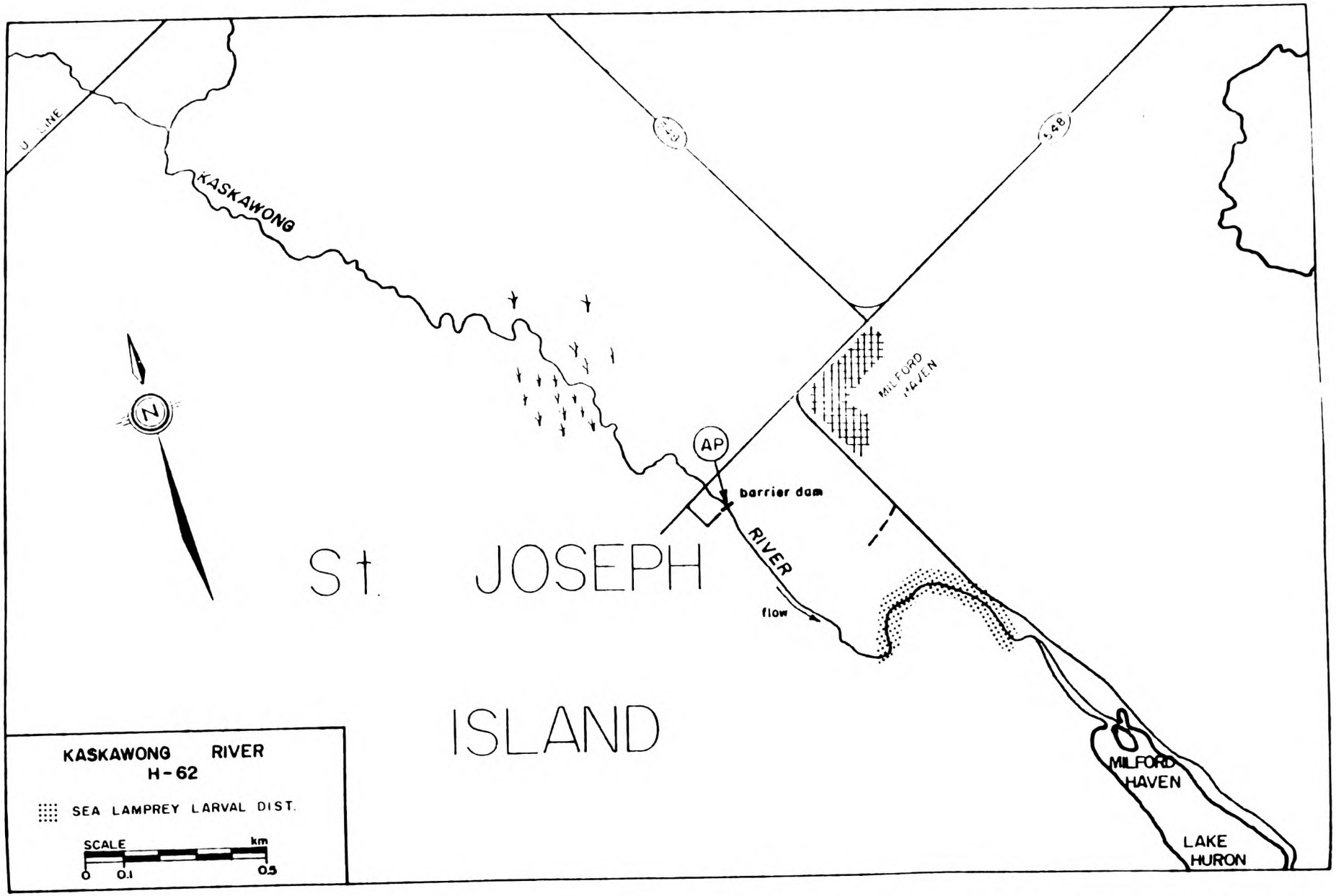


Figure 21. Detailed map of the Kaskawong River treatment indicating the main lampricide application point and sea lamprey larval distribution on May 28-29, 1935.

Sturgeon River - Figure 22

The Sturgeon River, a relatively short watershed located in Simcoe County, flows into southern Georgian Bay midway between Port Severn and the Town of Midland, Ontario. The stream, which flows through a mixture of open farmland and cedar swamp, has a moderate gradient except in the upper section where the flow is sluggish, with numerous beaver impoundments. Riffles and pools are predominant in the lower section except for the last 0.5 km where the stream widens and slows . Adequate spawning and larval habitat are available throughout the river. Numerous small, spring-fed tributaries which enter Sturgeon River along its course cause a many-fold increase in flow from the top of the watershed to the mouth. Summer flows on this hard water stream approach 0.5 m^3/s.

Prior to the construction of a sea lamprey barrier dam, 1.5 km upstream from the mouth in 1979, lampricide treatments (1960, 1968, 1972, 1976, 1979) were conducted from an old mill dam situated at the Village of Hillsdale, 22 km from the mouth. The barrier dam, greatly reduced the complexity of the 1985 treatment and, by permitting optimum discharge, provided an excellent treatment throughout the estuary. Sea lamprey larvae were abundant, with a total of 486 specimens (21-176 mm in length) being collected. The maximum density of sea lamprey larvae occurred in the lowermost portion of the estuary and although the effectiveness of the TFM block extended well into the delta area, surveys with granular Bayer 73, after the TFM treatment, indicated that a small population of larvae are present on the delta.

Mortality of non-target fish species was negligible.

Sauble River - Figure 23

The Sauble River, a relatively large system situated at the base of the Bruce Penninsula, flows into Lake Huron at Sauble Beach, Ontario. Discharge is quite variable in this hard water stream, with flows approximating 60 m^3/s during the peak run-off period and 2 m^3/s during the late summer. A series of small vertical limestone falls, located approximately 3.5 km from the mouth, appear to stop spawning phase sea lamprey. The entire portion of the watershed below the falls has little gradient. Spawning habitat is limited to the river immediately below the falls while larval habitat is abundant from the falls to the river mouth. Previous lampricide treatments of the Sauble River have been conducted in 1970, 1974 and 1979.

The 1985 treatment was conducted at a discharge considerably higher than previous treatments, however this was advantageous due to near record high lake levels. The lampricide block was not appreciably attenuated by the large volume of water in the estuary or by strong seiche action. Sea lamprey larvae were very scarce throughout the watershed (26 collected) and, although the Sauble River is not noted for high production of larval sea lamprey, numbers observed appeared substantially less than recorded in previous treatments. Larvae smaller than 76 mm were noticeably absent, indicating that lamprey spawning activity continues to be sporadic on this watershed.

Non-target fish mortality was negligible.

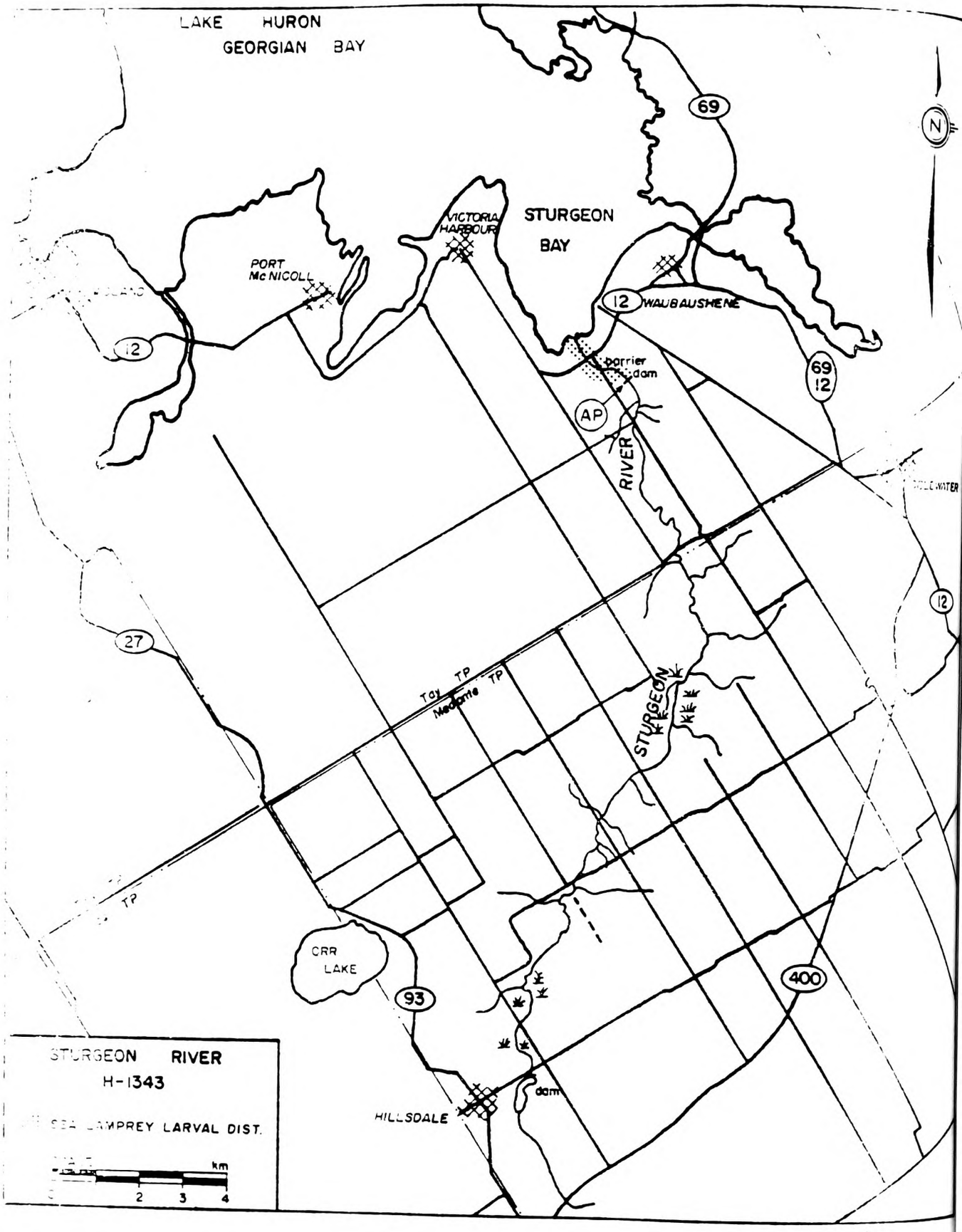


Figure 22. Detailed map of the Sturgeon River treatment indicating the main lampricide application point and sea lamprey larval distribution on May 31, 1985.

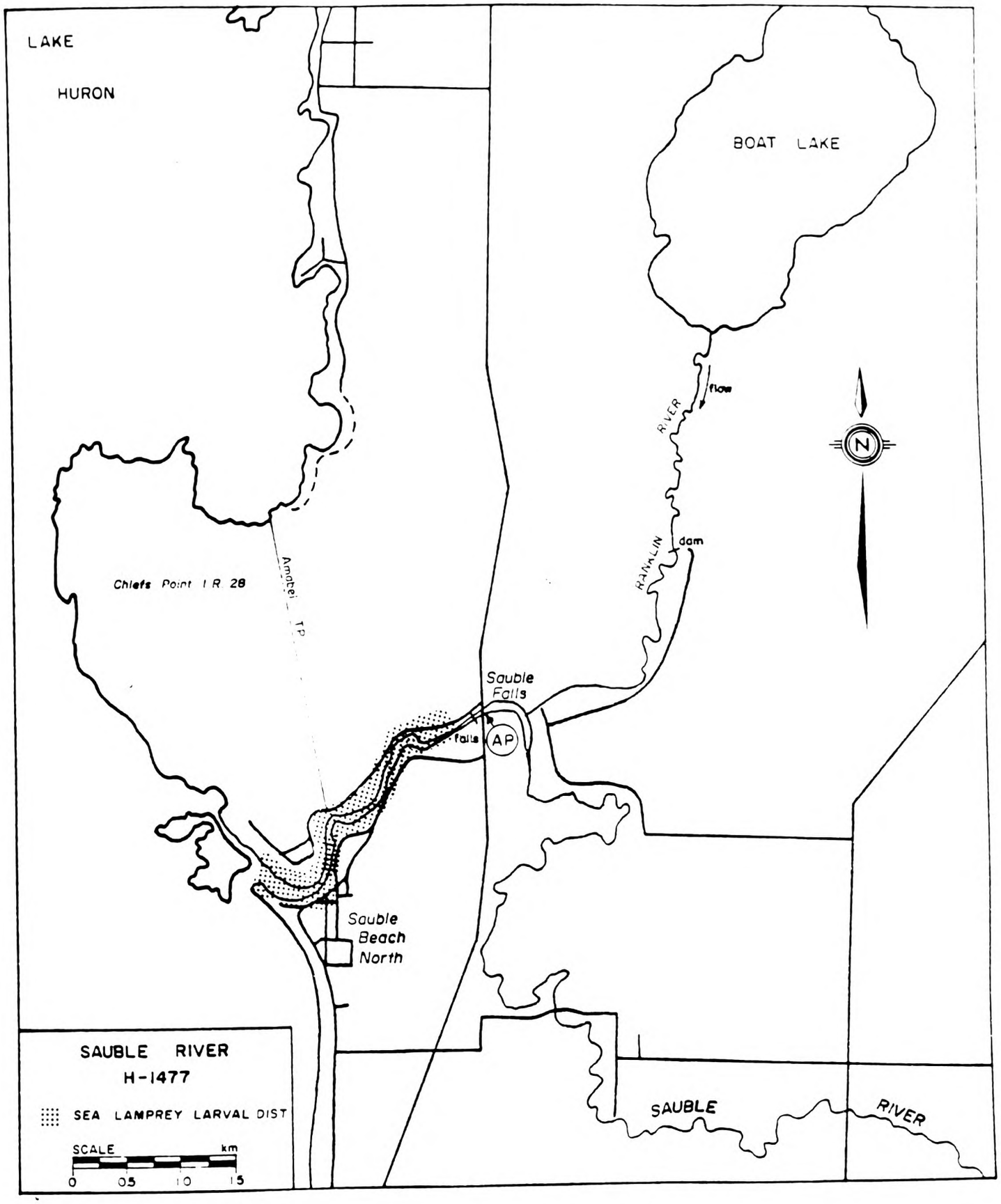


Figure 23. Detailed map of the Sauble River treatment indicating the main lampricide application point and sea lamprey larval distribution on June 2-3, 1985.

Mindemoya River - Figure 2

The Mindemoya River is a relatively short, hard water stream draining Mindemoya Lake and entering Lake Huron at the village of Providence Bay. This stream, having an average summer discharge of 0.8 m^3/s traverses relatively flat, sandy clay farmland, and contains limited spawning gravel but relatively abundant larval habitat. Mindemoya River was previously treated in 1969, 1973, 1977 and 1981.

Treatment discharge during the 1985 treatment was rather low for early June, however the absence of beaver ponding allowed for flow times similar to those previously recorded at higher discharges. Sea lamprey larvae were relatively scarce above a waterfall situated approximately 4 km above the mouth, however abundance increased markedly below this point and larvae were numerous through to the mouth area. Although the waterfall, obviously serves as a deterrent, limited numbers of adults have surpassed the falls annually since the 1981 treatment. A total of 340 sea lamprey larvae (26 to 161 mm in length) were collected.

Non-target mortality of other fish was negligible.

Watson Creek - Figure 2

Watson Creek, located on the south side of St. Joseph Island and tributary to Tenby Bay on the North Channel of Lake Huron, is a small stream draining a cedar swamp and passing through a series of large beaver ponds. The majority of sea lamprey ammocoetes inhabit only a short section of the stream, since the upstream migration of adults is deterred by a large beaver dam situated approximately 1.5 km from the mouth. Previous treatments of this creek have been conducted in 1966, 1970, 1974, 1978 and 1982.

Lampricide was applied to Watson Creek in 1985 from the outlet of the large beaver pond where, as noted in the 1982 treatment, a few large residual sea lamprey ammocoetes had been observed. Spawning gravel is very scarce above the pond complex and although surveys in 1982 indicated the presence of a few ammocoetes above the pond, a subsequent treatment of the stream above the pond complex produced no sea lamprey larvae. Post treatment surveys in June 1985 above the complex were negative. Apparently limited numbers of sea lamprey ammocoetes are present in the pond system and subsequently migrate downstream to repopulate the lower section of the watershed between successive lampricide treatments. An effective treatment of this particular section of the watershed would be very impractical.

Sea lamprey larvae were abundant (2-3 collected) throughout the lower section of the watershed and distributed well into the mouth area.

Mortality of non-target fish species was negligible.

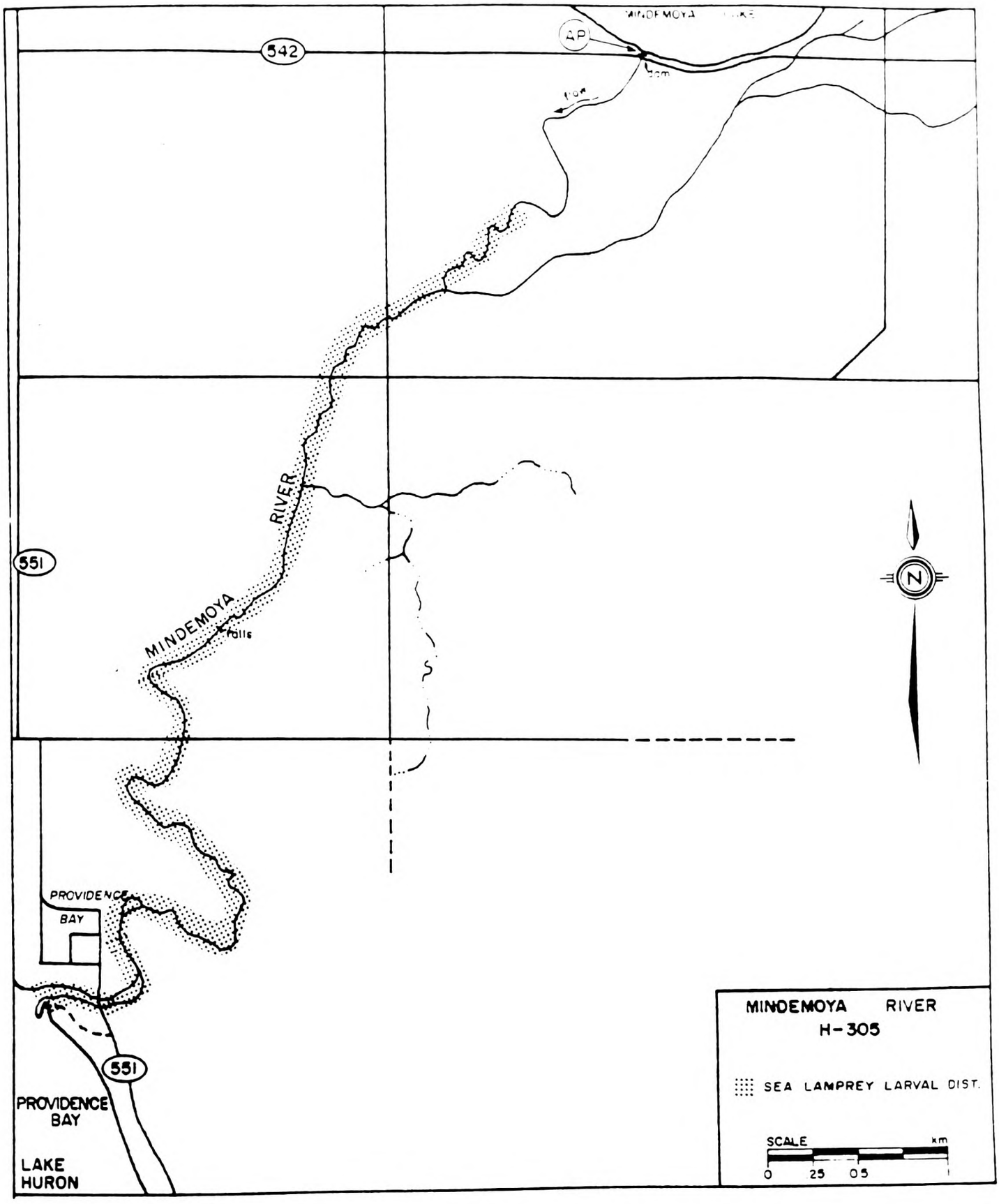


Figure 24. Detailed map of the Mindemoya River treatment indicating the main lampricide application point and sea lamprey larval distribution on June 5-6, 1985.

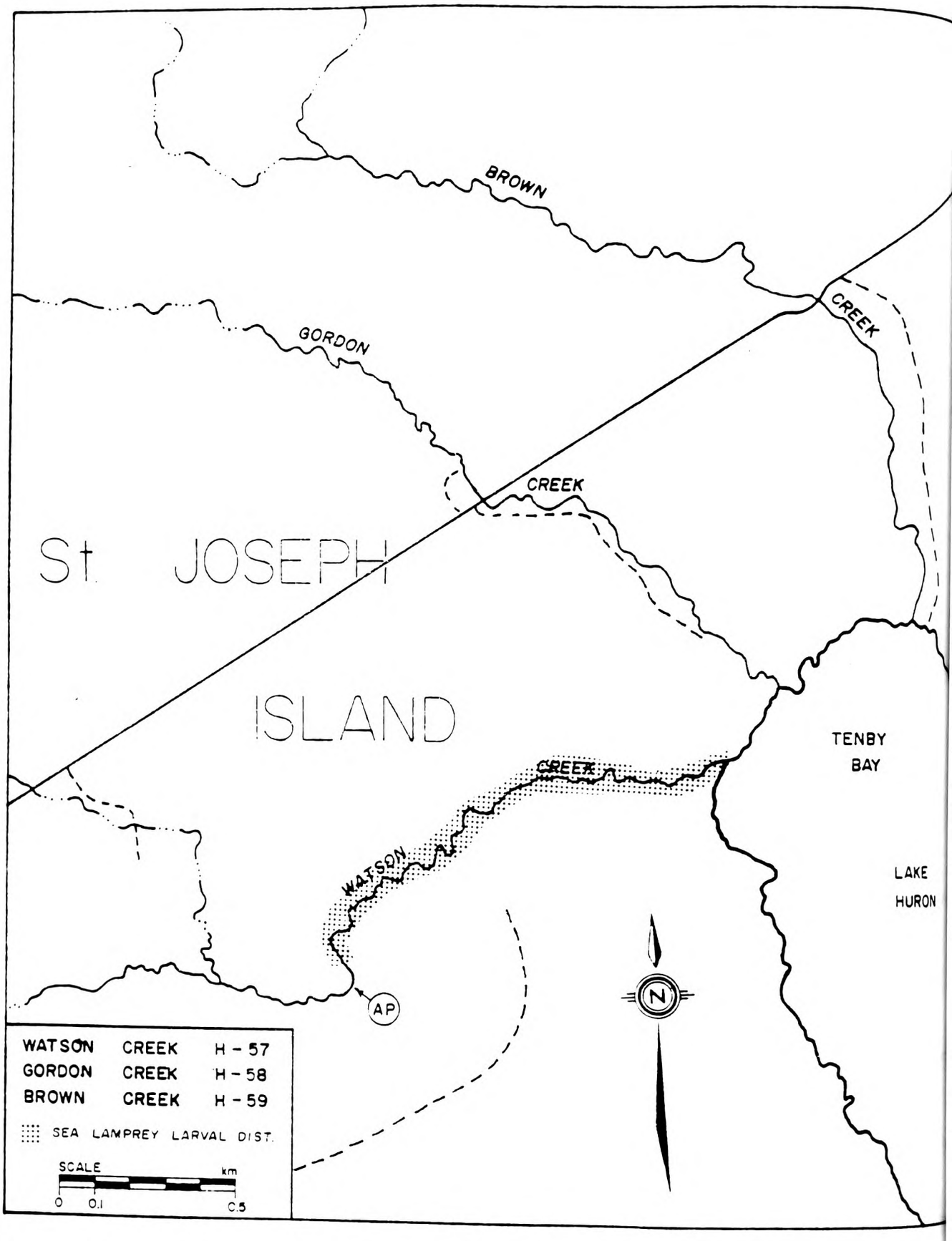


Figure 25. Detailed map of the Watson Creek treatment indicating the main lampricide application point and sea lamprey larval distribution on June 13-14, 1985.

Richards[illegible] - Figure 26

[illegible] Creek, a small stream situated on the western side of St. Joseph Island, flows into Lake Munuscong in the St. Marys River system. This stream, a sporadic producer of sea lamprey ammocoetes, has been treated with lampricide [illegible] 1966 and 1974. The upstream migration of spawning adult sea lamprey is [illegible] by an old mill dam at Kentvale, approximately 4.8 km from the mouth, however the most of the spawning occurs lower in the watershed.

The 1985 lampricide treatment was preceded by the removal of a large beaver dam situated approximately 300 m upstream from the mouth. Considerable water was impounded by the dam and removal facilitated a rapid passage of the TFM block. Sea lamprey larvae were very abundant, their upstream distribution extending to immediately below the feeder site. Twenty-one per cent of the 353 specimens collected were greater than 120 mm in lengtn.

Serpent River - Figure 27

The Serpent River, a complex system of interconnected lakes and channels originating in the Pre-Cambrian Shield north of the City of Elliott Lake, has soft acidic water with an average July discharge of approximately 11 m^3/s. A small falls situated 9.0 km from the mouth appears to block spawning sea lamprey. Although good larval habitat is abundant throughout the system, spawning gravel is limited to a few small patches below swifts. Historically most of the larvae have originated from a small tributary, Grassy Creek, having an average summer discharge of 0.1 m^3/s. Larval production in the main river has probably been limited by pollution from uranium processing at Elliott Lake.

[illegible] Serpent River has been treated with lampricide in 1961, 1967, 1970, 1971, 19[illegible] 1981.

The main lampricide application point on the Serpent River was moved downstream for the 1985 treatment in order to avoid a water intake situated immediately below a waterfalls approximately 6 km above the mouth and operated by the [illegible] of North Shore for the Village of Serpent River. The facility has no filtration system and no holding capacity and consequently cannot be shut down during lampricide treatments without depriving the community of water. The Ontario Ministry of Environment, contacted prior to the current treatment, expressed no concern regarding a possible treatment above the intake. Pretreatment surveys conducted above the water intake however produced no sea lamprey [illegible]tes, consequently lampricide was applied below the water intake.

Treatment of the main stem was routine with no problems and the optimum treatment discharge allowed for a rapid passage of the TFM through the estuary. Although lethal concentrations of lampricide were achieved over a portion of the delta, no sea lamprey were observed in this area. Sea lamprey larvae were relatively scarce in the main river with a total of 79 specimens being collected. Forty-seven of these individuals were collected above Grassy Creek and 32 specimens were collected below the confluence. The apparent lack of sea gull predation on lampreys in the main river indicated that ammocoetes were indeed scarce.

Treatment of the only sea lamprey producing tributary, Grassy Creek was complicated by beaver impoundments, very low discharge, fluctuating alkalinities

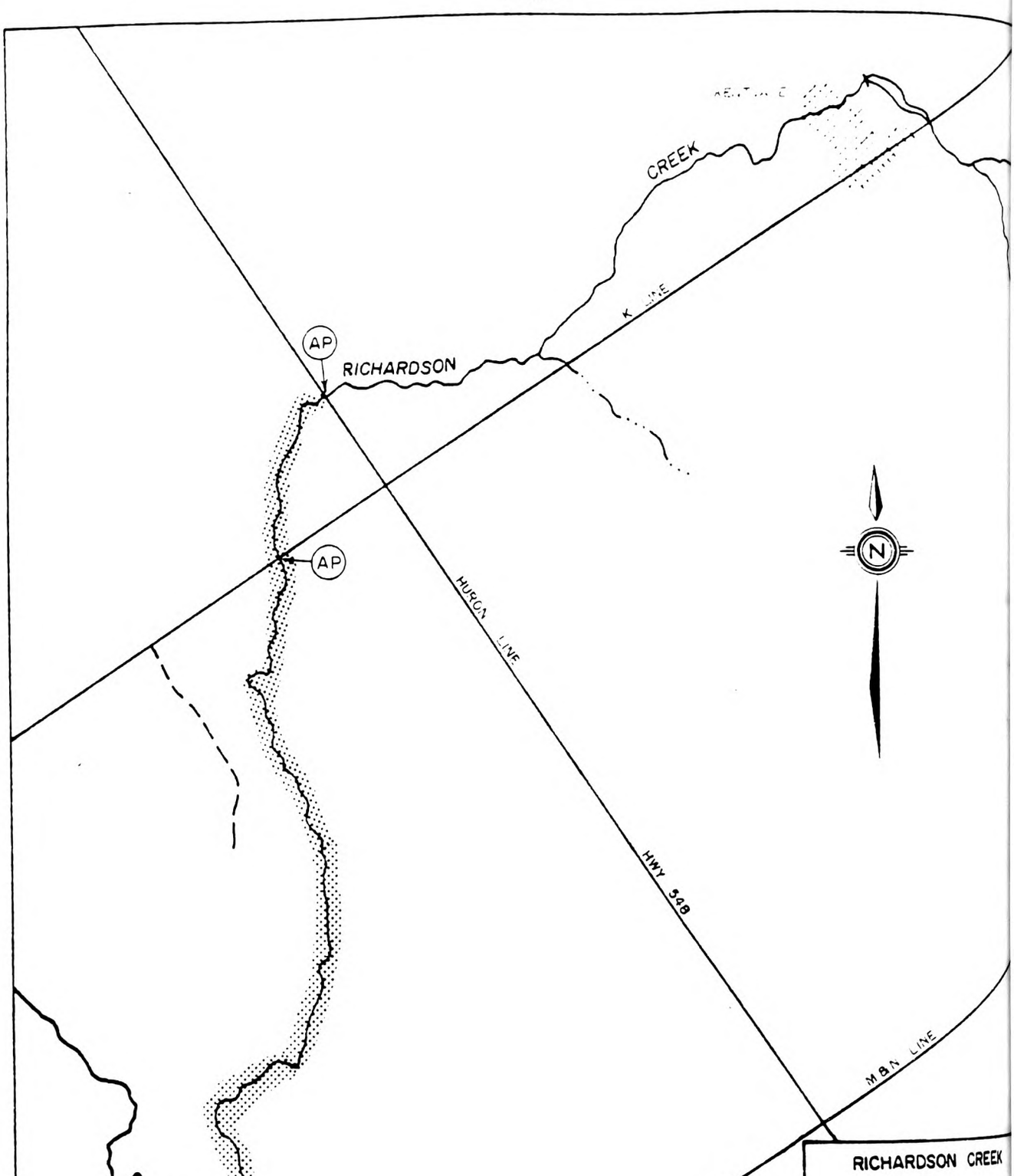


Figure 26. Detailed map of the Richardson Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on June 20, 1985.

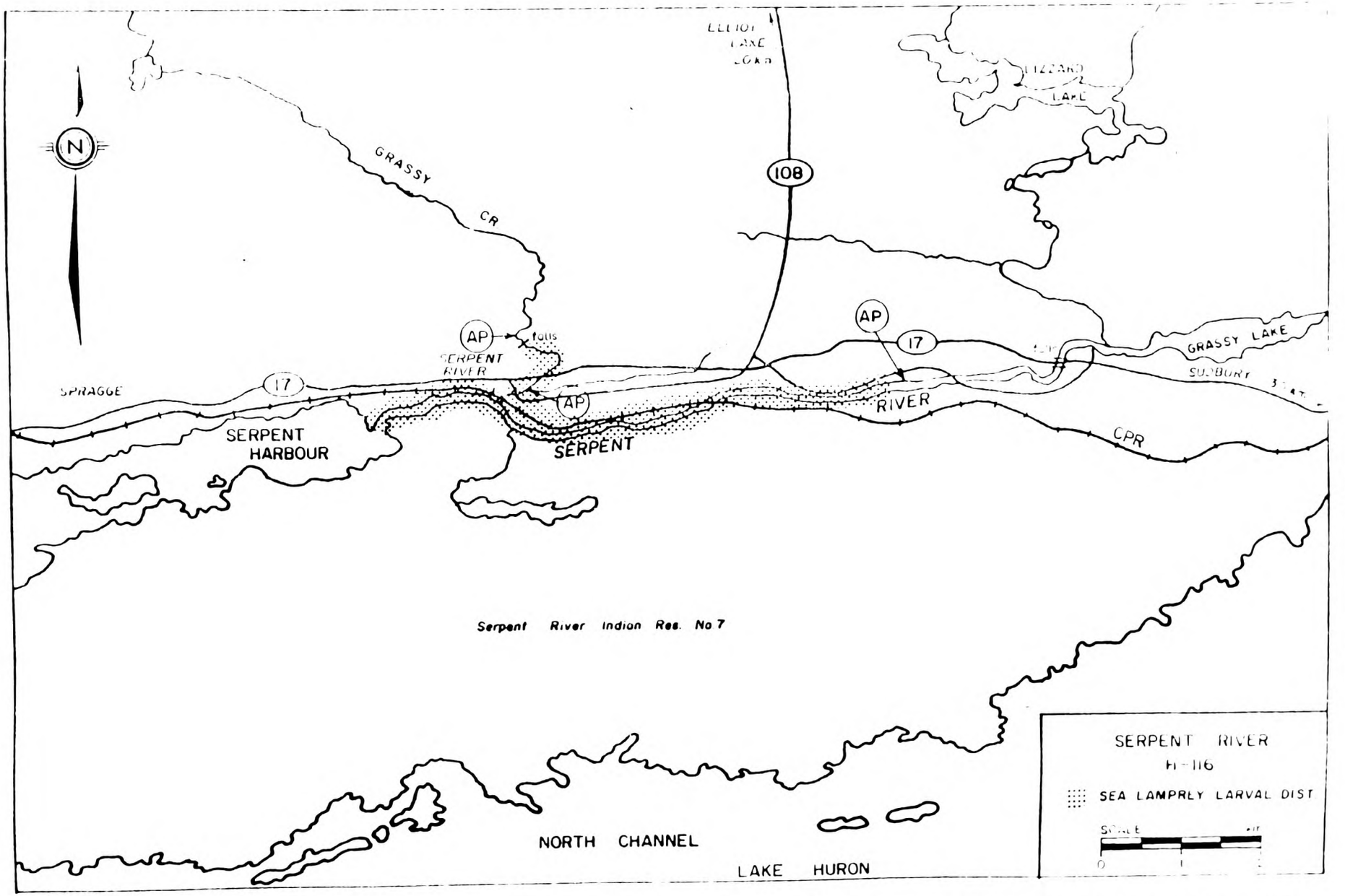


Figure 27. Detailed map of the Serpent River treatment indicating the main lampricide application points and sea lamprey larval distribution on June 26-27, 1985.

Serpent River (Continued)

and blank values and low dissolved oxygen levels. An effective lampricide treatment was conducted, however heavy fish mortality occurred throughout a 1.0 km section of the tributary. A drip feeder situated on a very small tributary to Grassy Creek approximately 150 m above the confluence at the outlet of a beaver pond was to cover for dilution and act as a boost for the main block. During the evening, a beaver built a small dam a short distance below the feeder, an activity that apparently went undetected. When the concentration in the lampricide block in the main tributary did not rise as expected, feed rates were increased and consequently a lampricide "loading" occurred in the impounded water. With the eventual release of this water containing high concentrations of lampricide, maximum allowable levels were exceeded in the main tributary and significant mortality of dace, darters, shiners and small bowfins occurred.

Sea lamprey ammocoetes were extremely abundant in the tributary with approximately 57 per cent of the 869 specimens collected being over 120 mm in length. During the pretreatment draining of the beaver impoundments on June 25, 1985 numerous sea lamprey ammocoetes were sighted swimming or lying on exposed mud banks.

LAKE HURON GRANULAR BAYER 73 TREATMENTS

The granular formulation of Bayer 73 was applied to one area in Echo Lake, in the Echo River system, and four areas in the St. Marys River system. Table VIII lists the pertinent treatment data whereas Figures 28 to 33 describe the actual treatment areas.

ECHO LAKE - Figure 28

The application of granular Bayer 73 to the delta of the Echo River in Echo Lake on July 23, 1985 was completed under nearly optimum conditions. Winds were light, visibility was good and there was a noticeable absence of gulls and terns. A total of 142 sea lamprey larvae (26 to 156 mm in length) were collected, 10.7 per cent of which were greater than 121 mm. Although twice as many sea lamprey ammocoetes were collected in 1985 as in the 1983 treatment, their density was significantly lower in 1985. Predation by birds in 1983 made the collection of many larvae extremely difficult.

ST. MARYS RIVER - Figure 29

Whitefish Island - Figure 30

A 2.79 ha area, situated immediately below Whitefish Island and adjacent to the St. Marys Rapids, was treated with 703.9 kg of Bayer 73 granules on August 13, 14, 15, 1985. Although most of the treatment area duplicated that covered in previous years, the dewatering of the St. Marys Rapids during the construction of the Whitefish Island spawning channel allowed for the effective application of Bayer 73 granules to an area where current velocities had previously been too high for good treatments. Sea lamprey were relatively abundant throughout the entire treatment area, however most of the 4,907 specimens collected were found in one small section of the newly treated area. Undoubtedly the effectiveness of the Bayer 73 granules was enhanced by the lack of current, however, overall abundance appeared significantly higher as compared to previous treatments. Approximately 60 per cent of the collection consisted of ammocoetes 40 to 60 mm in length whereas 23 specimens were commencing metamorphosis. Predation by gulls on sea lamprey larvae was considered to have been very high.

Station "H" - Figure 31

On August 14-15, 1985, an area extending from the Sault Ste. Marie golf course to approximately 0.5 km upstream of the Sault Ste. Marie sewage treatment plant was treated with 748.6 kg of Bayer 73 granules. The treatment site extended from the shoreline and out 30 m into the main river channel. Sea lamprey larvae continue to be abundant in this area, with a total of 1,576 larvae and four transformers being collected. Seventy-seven per cent of the larvae were less than 100 mm in length. Recruitment to this area of preferred habitat from the St. Marys Rapids occurs annually and although repeated annual applications of Bayer 73 granules do not appear to have significantly reduced the numbers present, they may have prevented a substantial increase in larval density.

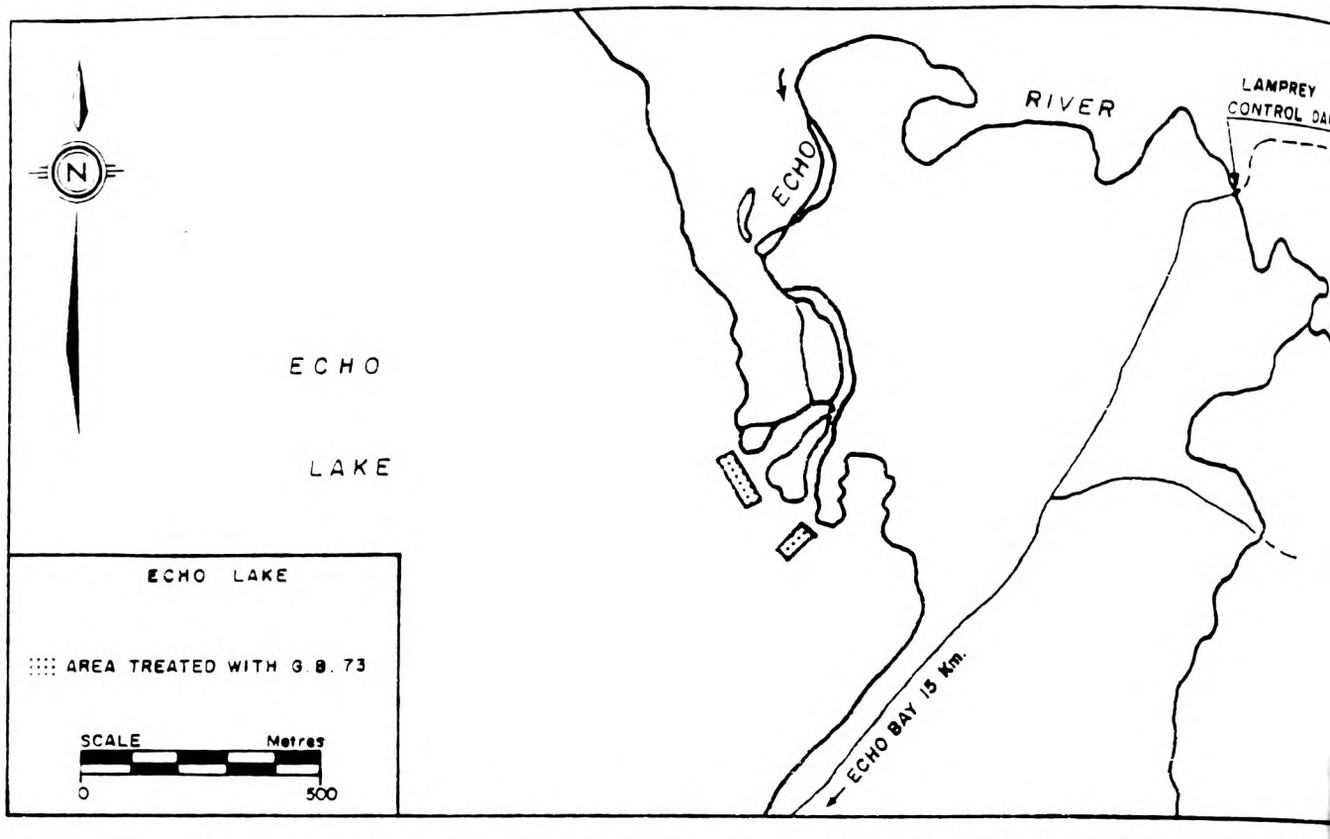


Figure 28. Lake areas adjacent to the Echo River treated with granular Bayer 73 in 1985.

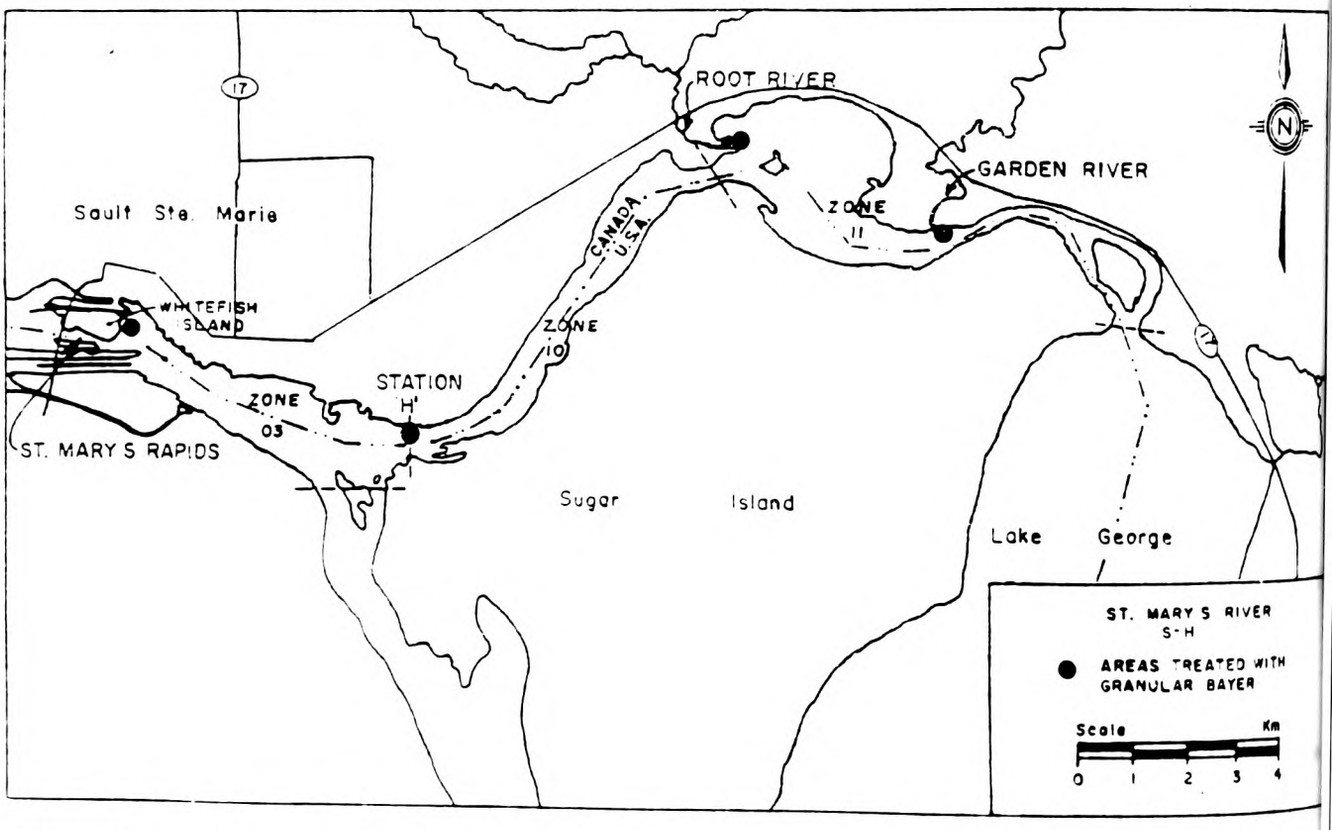


Figure 29. Areas of the St. Marys River where granular Bayer 73 was applied in 1985.

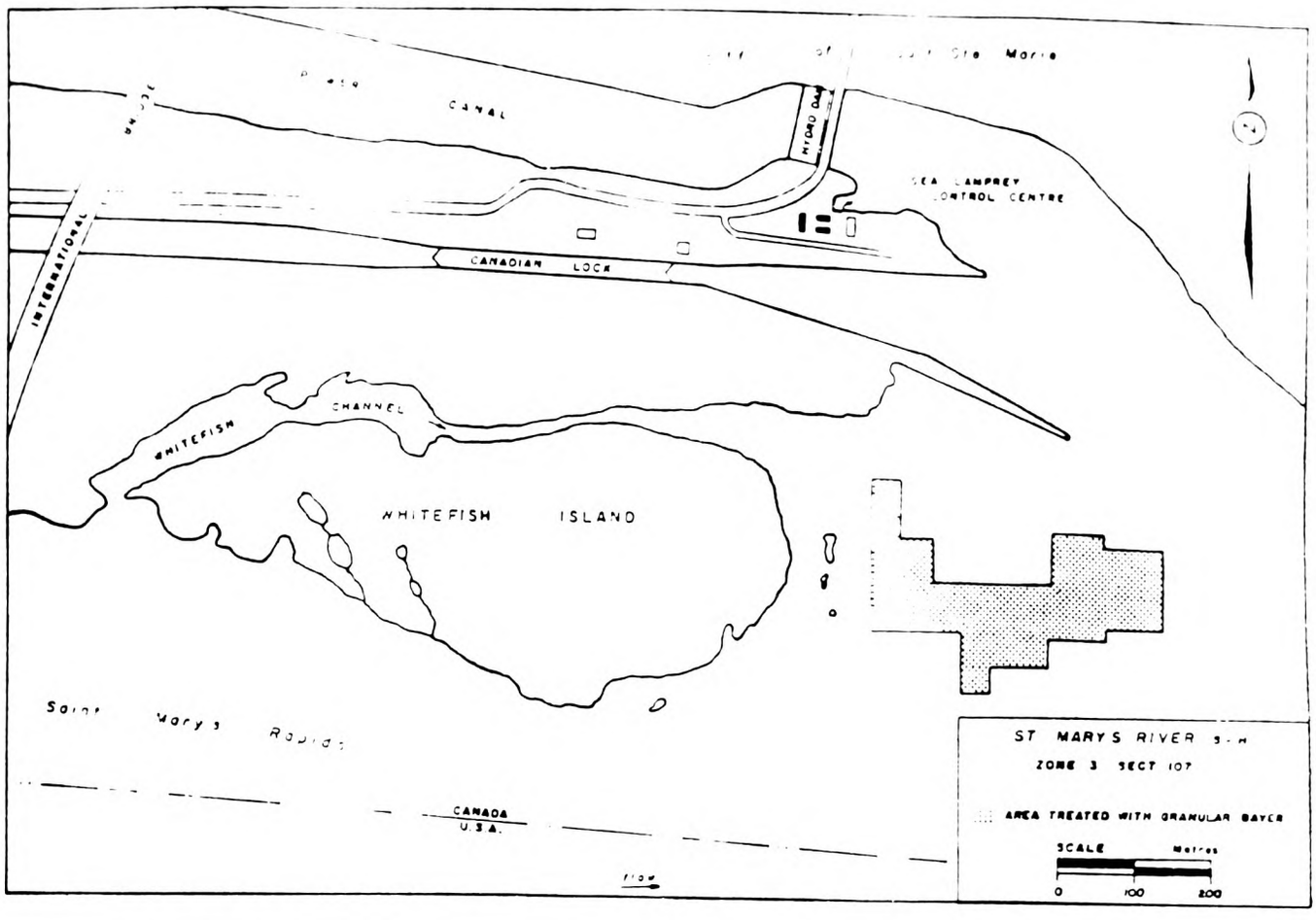


Figure 30. Area of the St. Marys River treated with granular Bayer 73 in 1985.

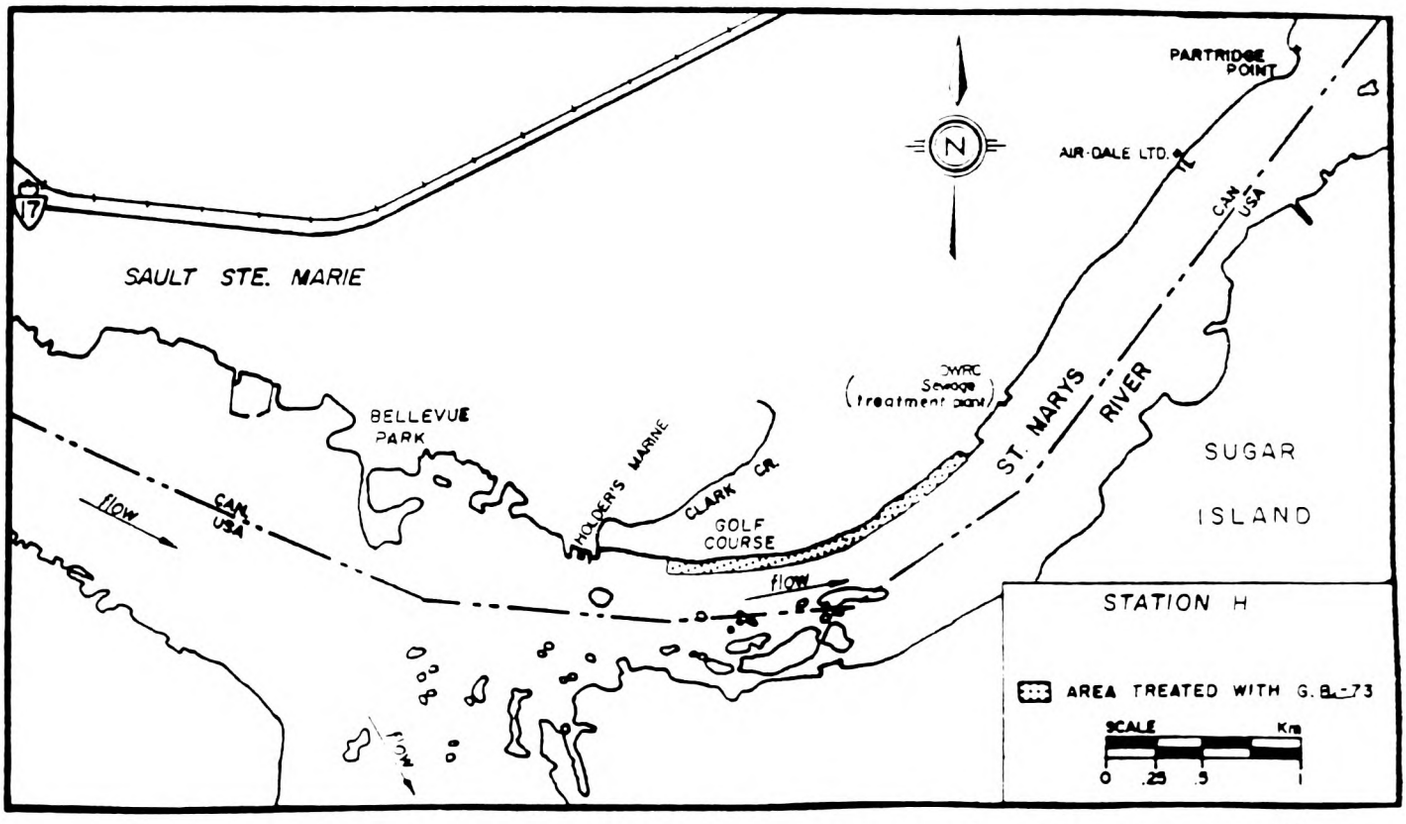


Figure 31. Area of the St. Marys River treated with granular Bayer 73 in 1985.

Root River - Figure 32

Granular Bayer 73 was applied to two areas (0.72 ha) in the St. Marys River situated at the mouth of the Root River on August 15, 1985. These areas were similar in size and location to those treated in 1983 and 1984. Larval sea lamprey abundance, considered scarce to moderate, was similar to that observed in the previous two treatments with a total of 78 ammocoetes 31 - 162 mm in length, including two metamorphosing specimens, being collected. Relative to other sites in the St. Marys River system inhabited by sea lamprey larvae, the Root River delta can now be considered a low density area.

Garden River - Figure 33

Bayer 73 granules were applied on August 21, 1985 to a 1.44 ha area of the St. Marys River shoreline extending 720 m downstream from the confluence with the Garden River. Previous treatments of this particular area have indicated that sea lamprey larvae tend to be concentrated in the near shore area where there is relatively low current velocity and optimum habitat. The majority of the larvae inhabiting this area apparently emigrate from the Garden River, however some recruitment probably occurs from the upper St. Marys River as well. Following the initial treatment of this area in 1980, when 1,640 sea lamprey larvae were collected, ammocoete densities have remained suppressed with collections ranging from 450 to 72 specimens. The 1985 treatment produced 114 ammocoetes (29 - 145 mm in length) with no metamorphosing specimens present. Observations during the 1984 TFM treatment of the Garden River indicated that lampricide concentrations may have been adequate to cause significant mortality of ammocoetes in the upper section of the area treated with granular Bayer 73. Compared with the ammocoete densities in this section observed during previous treatments, numbers were scarce in the 1985 treatment.

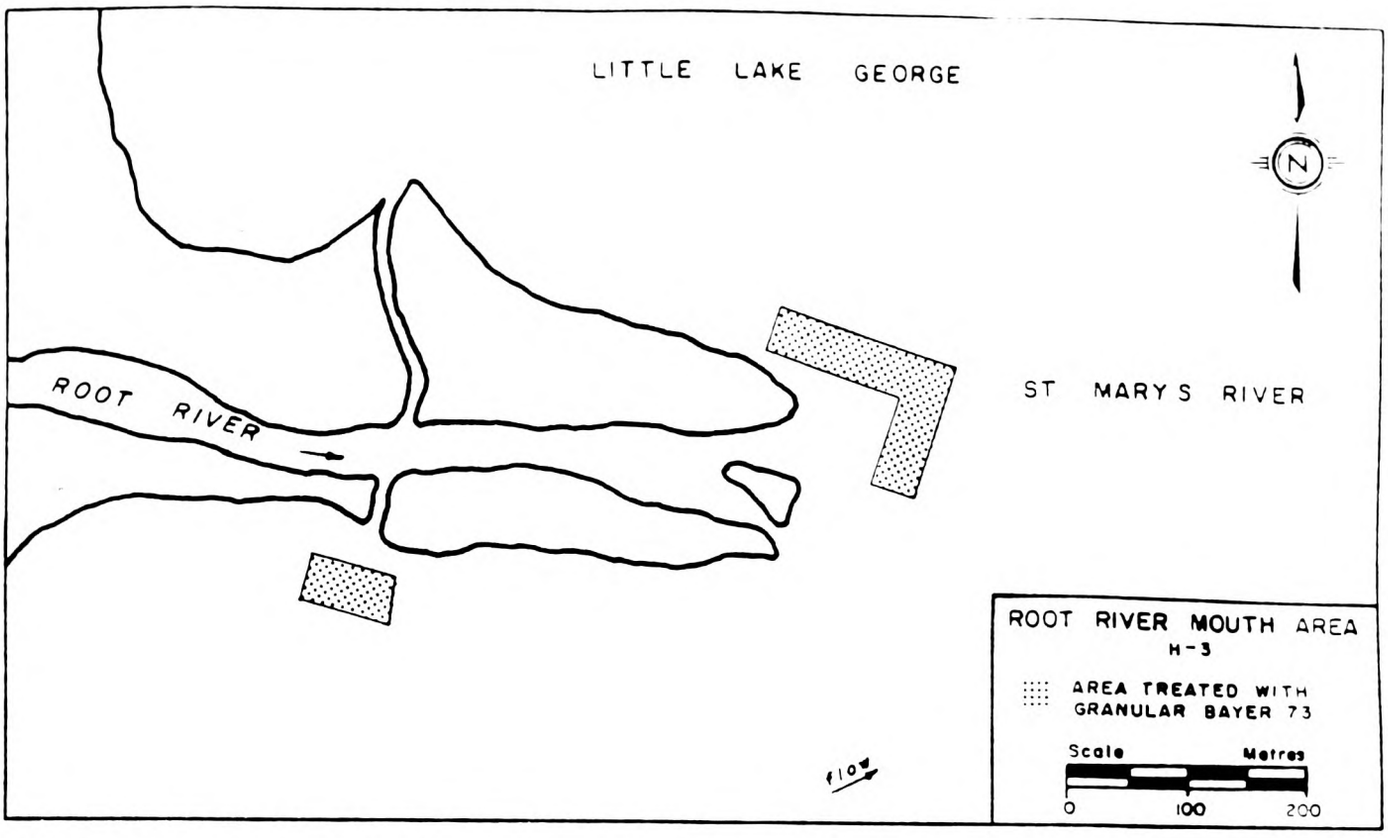


Figure 32. Areas of the St. Marys River treated with granular Bayer 73 in 1985.

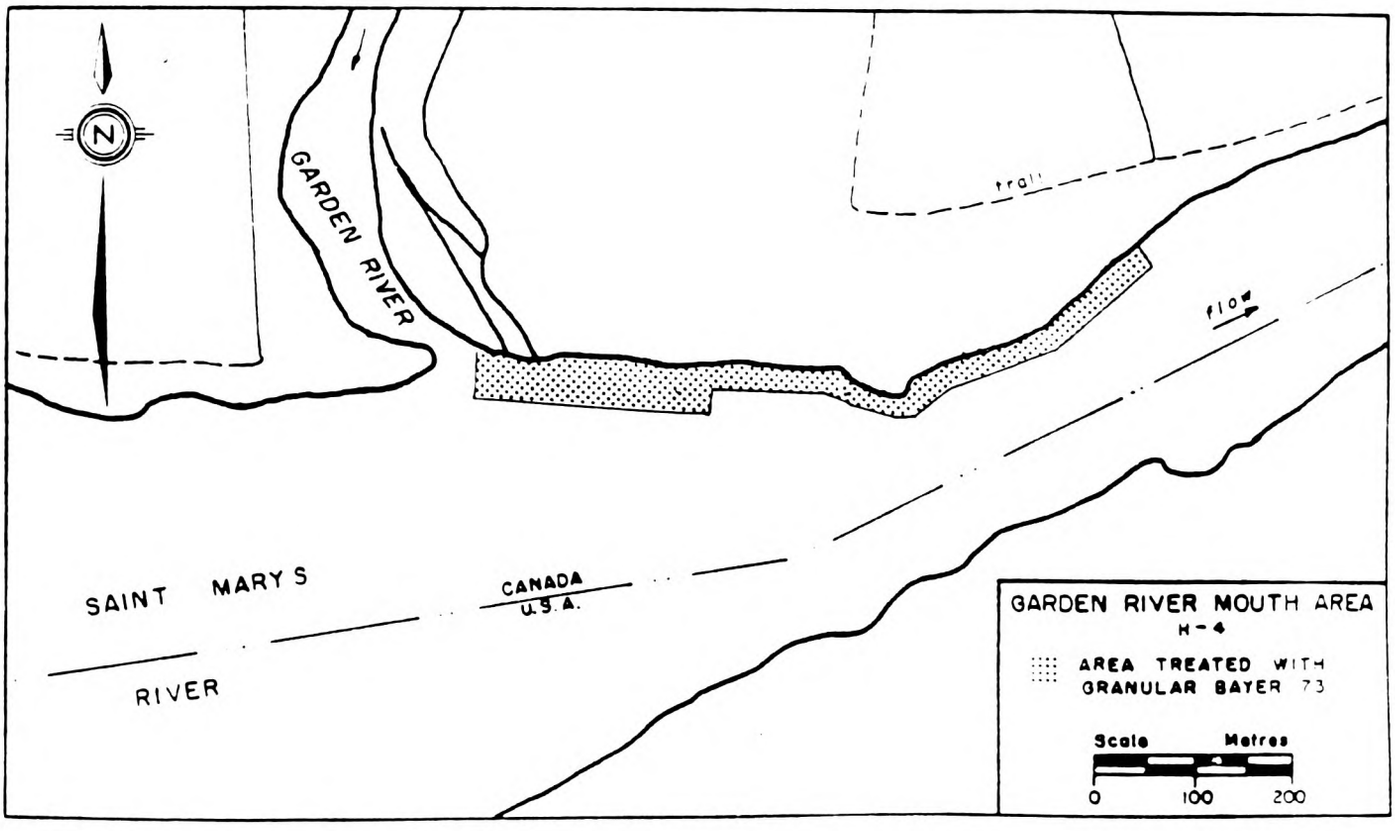


Figure 33. Area of the St. Marys River treated with granular Bayer 73 in 1985.

LAKE ONTARIO, CANADA, LAMPRICIDE (TFM) TREATMENTS

The following Canadian streams tributary to Lake Ontario were treate with the selective lampricide, 3-trifluoromethyl-4-nitrophenol (TFM) in 1985:

Smithfield Creek	May 2
Grafton Creek	May 3
Lakeport Creek	May 5-6
Port Britain Creek	May 7-9
Credit River	May 11-12
Salem Creek	September 18-19
Farewell Creek	September 19-21
Duffin Creek	October 29-30

Table IX lists the pertinent treatment data, Figure 34 depicts the general location of the streams treated, and Figures 35 to 42 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 V to this Annual Report.

Smithfield Creek - Figure 35

Smithfield Creek is a small stream which enters the eastern basin of Lake Ontario, through the Murray Canal approximately 10 km east of Brighton, in Northumberland County. Approximately 4.3 km of the stream are inhabited by larval sea lamprey with regular spawning producing moderate numbers of sea lamprey larvae. Smithfield Creek had previously been treated with lampricide in 1971, 1976 and 1982.

The 1985 treatment of Smithfield Creek was routine and relatively uncomplicated. A total of 532 (26 to 176 mm in lengtn) sea lamprey larvae were collected. The most interesting aspect of the treatment was the high abundance of large sea lamprey ammocoetes observed throughout the middle and upper reaches of the watershed. Larvae appear to grow extremely fast in this watershed and imminent transformation of some individuals in three growing seasons is probable. The size of some of these larvae lead to the hypothesis that some of these specimens were residuals and might have originated from above the dam although surveys in this area were negative.

Non-target fish mortality was negligible throughout the watershed.

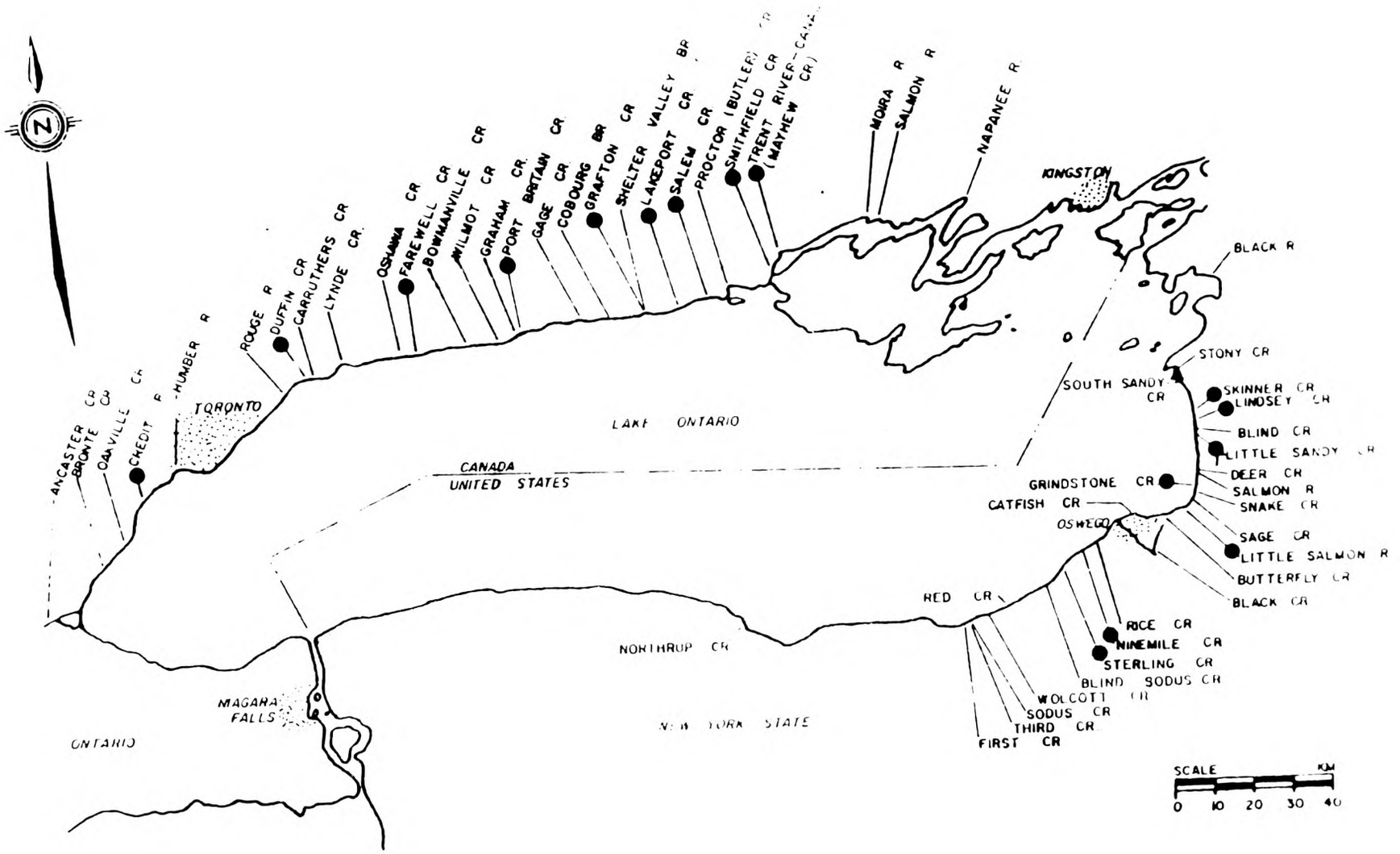


Figure 34. Map of Lake Ontario showing location of all known sea lamprey producing streams and indicating those streams treated (●) with lampricide in 1985.

Table IX. Summary of streams treated with lampricide on Lake Ontario, 1985.

STREAM	Date	Flow m^3/s	Active Ingredient TFM kg	Bayer 73 kg	Granular Bayer 73 kg	*/Sea Lamprey Collected		Area Treated km	ha
CANADA									
Smithfield Cr.	May 2	0.175	58.66	-	-	A	532		5.30
Grafton Cr.	May 3	0.230	90.51	-	-	M	391		4.20
Lakeport Cr.	May 5-6	0.694	233.61	-	0.5	M	388		14.70
Port Britain Cr.	May 7-9	0.203	90.16	-	-	A	902		10.30
Credit R.	May 11-12	7.741	1,779.90	13.81	1.0	A	1,407		35.20
Salem Cr.	Sept. 18-19	0.130	52.44	-	2.0	A	4,442 (212)		3.38
Farewell Cr.	Sept. 19-21	0.157	56.67	-	1.3	M	514 (66)		5.87
Duffin Cr.	Oct. 29-30	1.444	628.03	-	-	M	409 (90)		6.22
Trent R.	Sept. 21	-	-	-	204.0	M	257 (33)	0.9	
TOTALS - CANADA		10.774	2,989.98	13.81	208.8		8,985 (401)	0.9	85.17
UNITED STATES									
Grindstone Cr.	May 2-6	0.728	174.30	-	-	A	790		31.24
Ninemile Cr.	May 7-11	1.010	292.62	-	-	M	624		24.10
Sterling Cr.	May 11-12	0.950	405.77	-	-	M	279		7.77
Little Sandy Cr.	May 14-15	1.600	190.00	-	-	M	256		13.26
Little Salmon R.	Oct. 18-19	3.785	344.48	-	-	M	470 (14)		12.50
Skinner Cr.	Oct. 22-24	1.053	162.40	-	-	M	528 (8)		15.70
Lindsey Cr.	Oct. 25-26	0.630	128.88	-	-	A	1,123 (3)		14.71
TOTALS - UNITED STATES		9.756	1,698.45	-	-		4,070 (25)		119.28
GRAND TOTALS		20.530	4,688.43	13.81	208.8		13,055 (426)	0.9	204.45

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

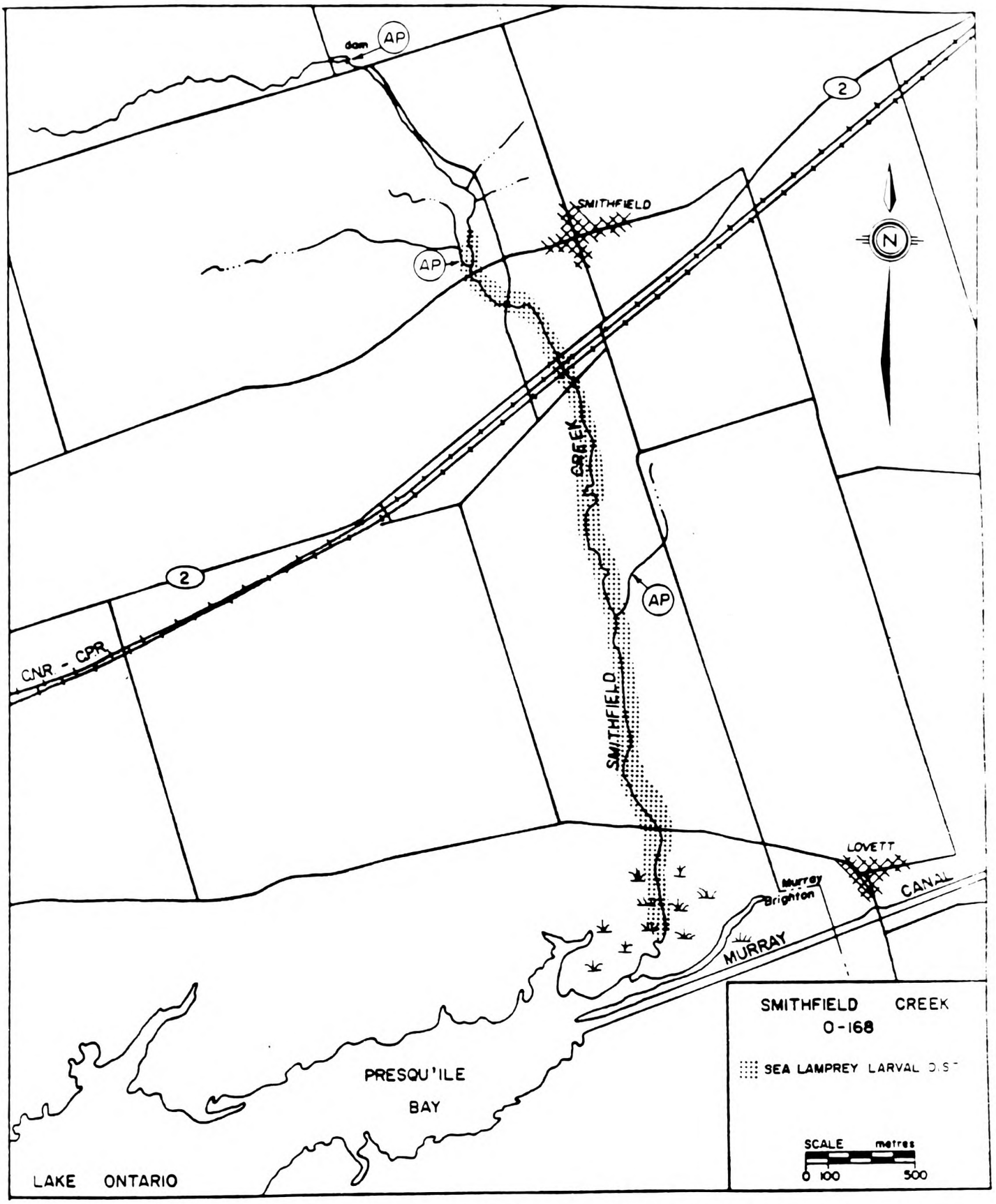


Figure 35. Detailed map of the Smithfield Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 2, 1985.

Grafton Creek - Figure 36

Grafton Creek, a small stream in Northumberland County, enters Lake Ontario approximately 9.6 km east of the town of Cobourg, Ontario. The creek, with an average summer flow approximating 0.2 m^3/s, flows off moderately fast through farmland. A dam located 6.4 km from the creek mouth constitutes an effective barrier to spawning run sea lamprey. The creek has several small tributaries below this dam, none of which appear to be major producers of sea lamprey larvae. The creek divides into two branches above Highway 2, where a flow control structure has been built to insure a division of water between the two branches. This creek had been treated with lampricide on four previous occasions; in 1971, 1975, 1979 and 1982.

The 1985 treatment was less complex than before due to the absence of sea lamprey in a large portion of the upper watershed. Only two main application points were needed and travel time for the TFM block was short. Sea lamprey larvae were moderately abundant (391 from 16 to 156 mm in length) and distributed throughout the treated portion of the watershed.

Incidental mortality of non-target fish species was negligible.

Lakeport Creek - Figure 37

Lakeport Creek is a relatively small but complex stream with two sea lamprey producing tributaries and a number of small feeder tributaries. The creek drains rolling farmland, orchards and cedar swamps before emptying into Lake Ontario at the village of Lakeport in Northumberland County. Although summer discharge averages below 0.3 m^3/s, a minimal amount of rainfall increases the discharge substantially. Prior to 1985, spawning sea lamprey were able to penetrate approximately 9 km of the main stream before being halted by a log dam. No barriers existed on the tributary systems. Lampricide treatments in 1971, 1976, 1979 and 1982 were frequently complicated by a multiplicity of application points, rapid runoff and rain showers.

In 1984 a low-head sea lamprey barrier dam, situated approximately 1 km from the mouth, was constructed on Lakeport Creek. The 1985 lampricide treatment was conducted on the entire watershed, with the intent that subsequent treatments would originate from the newly constructed dam site.

The current treatment was plagued by moderate to heavy rain which quickly increased discharges on all the smaller tributaries substantially. The lampricide block was maintained at target levels throughout most of the watershed, by substantially increasing application rates. The lower 3 km of stream received what appeared to be a sub-lethal dose of TFM, however post treatment surveys were negative.

A total of 388 (21 to 161 mm in length) sea lamprey were collected and were found in moderate abundance in the upper, abundant in the middle, and scarce in the lower reaches of the creek.

Non-target fish mortality was negligible.

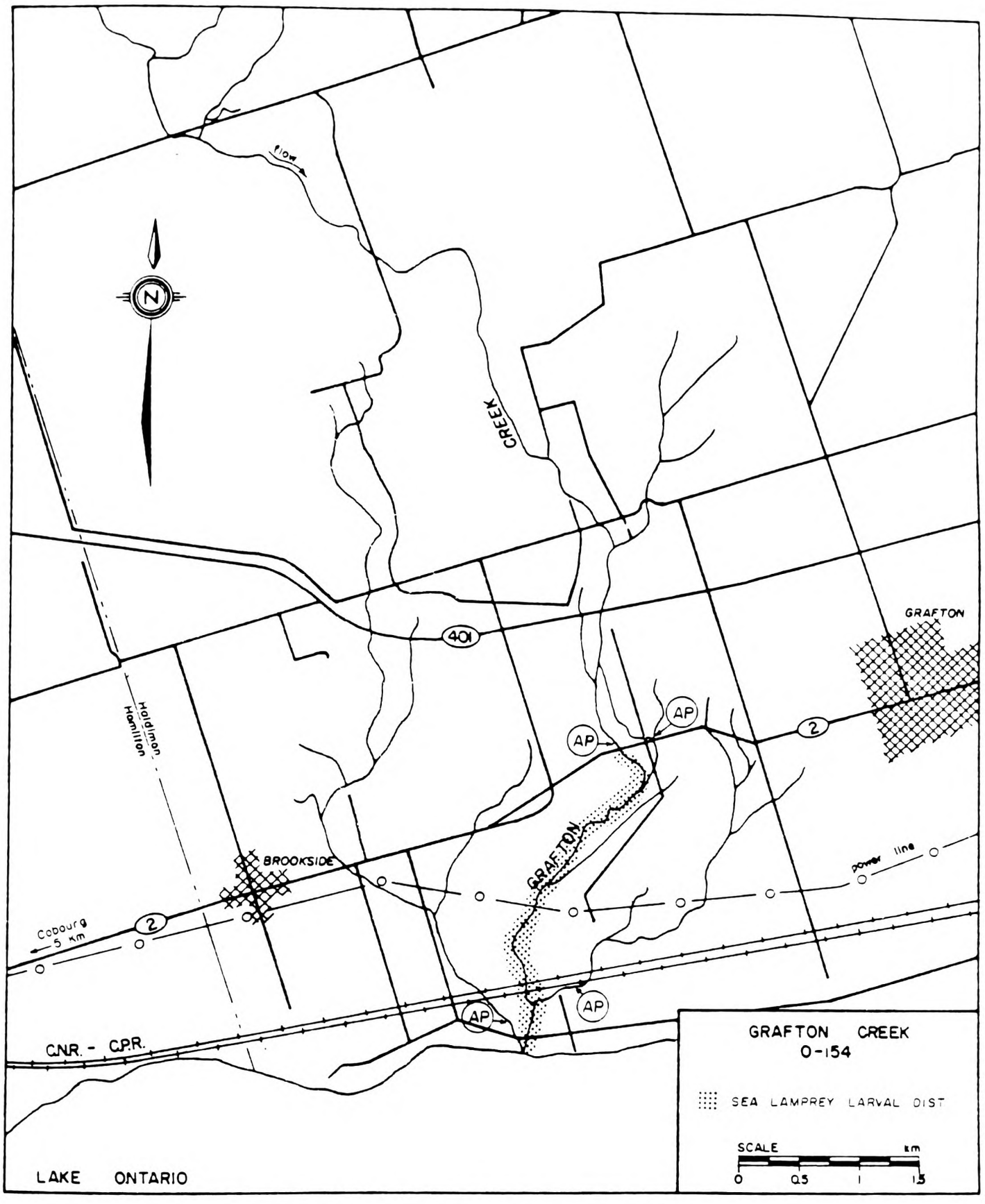


Figure 36. Detailed map of the Grafton Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 3, 1985.

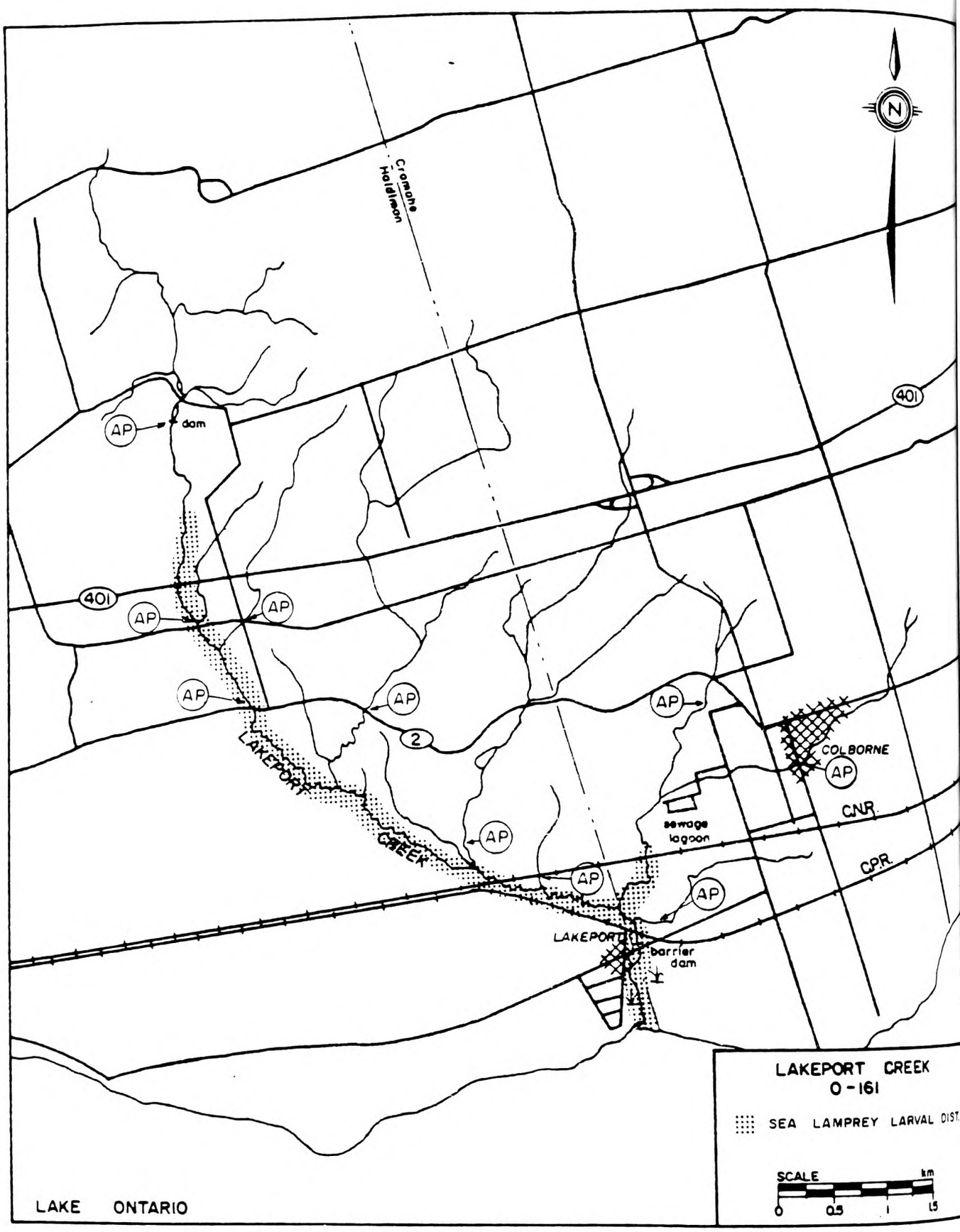


Figure 37. Detailed map of the Lakeport Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 5-6, 1985.

Port Britain Creek - Figure 38

Port Britain Creek, a small stream located in Durham County, Hope Township, flows into Lake Ontario 6.5 km west of the town of Port Hope, Ontario. A number of small tributaries and freshets contribute to this moderately fast flowing stream, whose average summer flow is approximately 0.2 m^3/s. The stream consists of riffles and pools to within 1 km of the mouth where it widens into a well defined channel. Sea lamprey spawning and larval habitat are abundant. The stream flows mainly through rolling pastureland and the water is quite hard and usually clear. The stream had previously been treated with lampricide in 1971, 1976, 1979 and 1982.

Although a dam is present about 12 km above the stream mouth, sea lamprey ammocoetes have have never been collected above a large beaver impoundment located approximately 1.6 km below this dam. Although the beaver dam apparently served as a deterrent, it was removed by landowners following the 1982 treatment, and sea lamprey adults now have access to an extended portion of the watershed.

Sea lamprey larvae were abundant (902 from 11 to 166 mm in length collected) throughout the watershed with heaviest concentrations occurring in the middle and lower reaches. Ammocoetes were distributed throughout the estuary which is flanked on either side by large lagoons. Lampricide was not applied to the lagoons due to the large volume of water present and consequently a few larvae may have escaped by swimming into fresh water.

Non-target fish mortality was light overall, however a small number of common white suckers, darters and dace were killed in a small section of stream below a booster feeder.

Credit River - Figure 39

The Credit River, located in Peel County, is tributary to the western basin of Lake Ontario at the town of Port Credit. The Credit has an average May treatment discharge of approximately 7.0 m^3/s. The upper portion of the river inhabited by sea lamprey larvae has a moderate gradient over a gravel and boulder substrate, while the lower portion is rather sluggish and enters Lake Ontario through a long estuary. There are no sea lamprey producing tributaries to this river.

The upstream migration of spawning adult sea lamprey has been historically arrested at Reid's Mill Dam situated 15.8 km above the mouth. This dam was breached by record floods in March 1980, but was reconstructed in the fall of 1980.

Relatively small numbers of sea lamprey ammocoetes were collected during previous lampricide treatments below Reid's Mill Dam in 1971, 1977 and 1980 and they were mainly confined to the upper portion of the estuary.

Surveys subsequent to the breaching of the dam in 1980, determined that the upstream distribution of sea lamprey larvae had been extended to the village of Norval, approximately 19.4 km upstream from the Reid's Mill Dam. Accordingly lampricide was applied to the Credit River on May 11, 1985 from a point situated

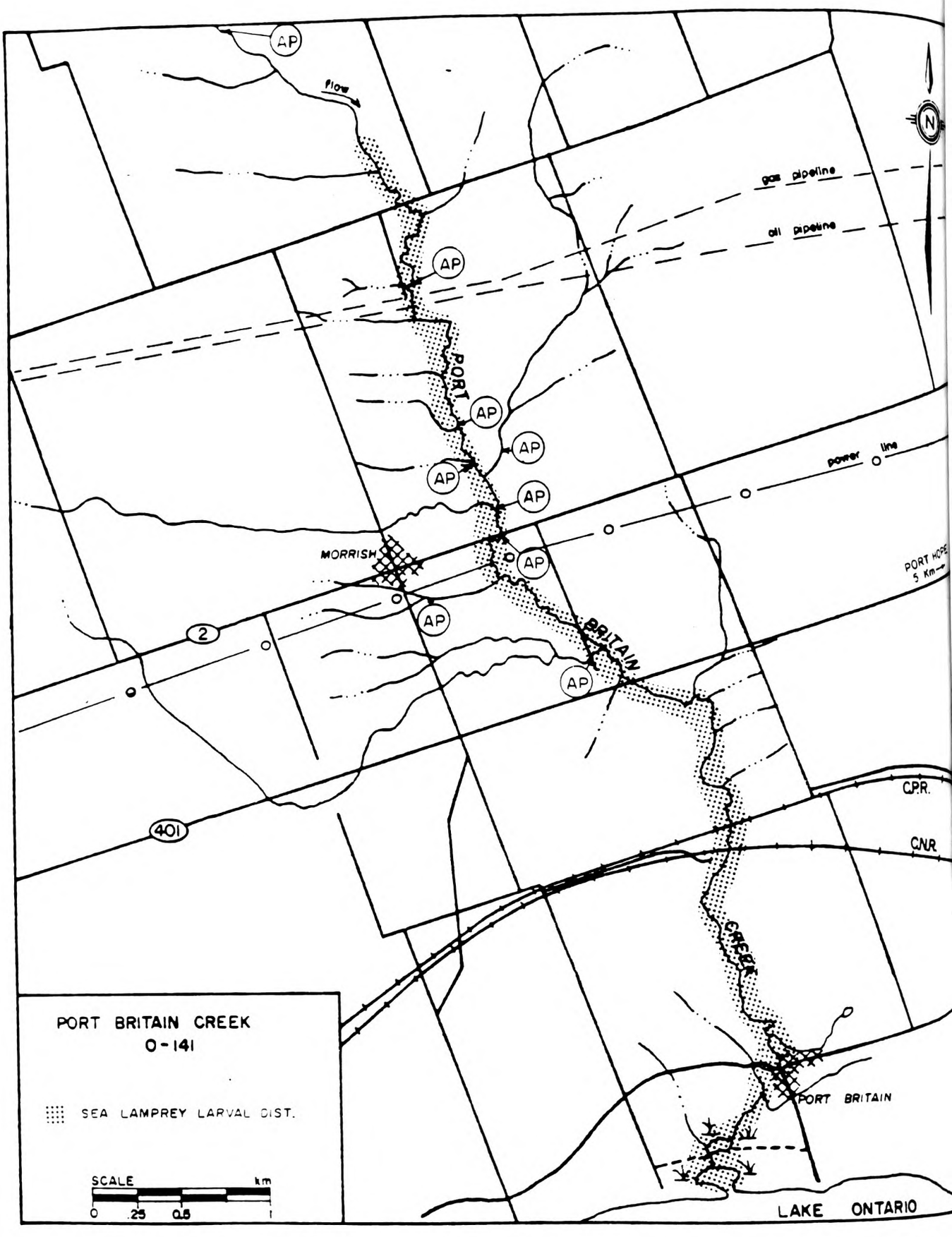


Figure 38. Detailed map of the Port Britain Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 7-9, 1985.

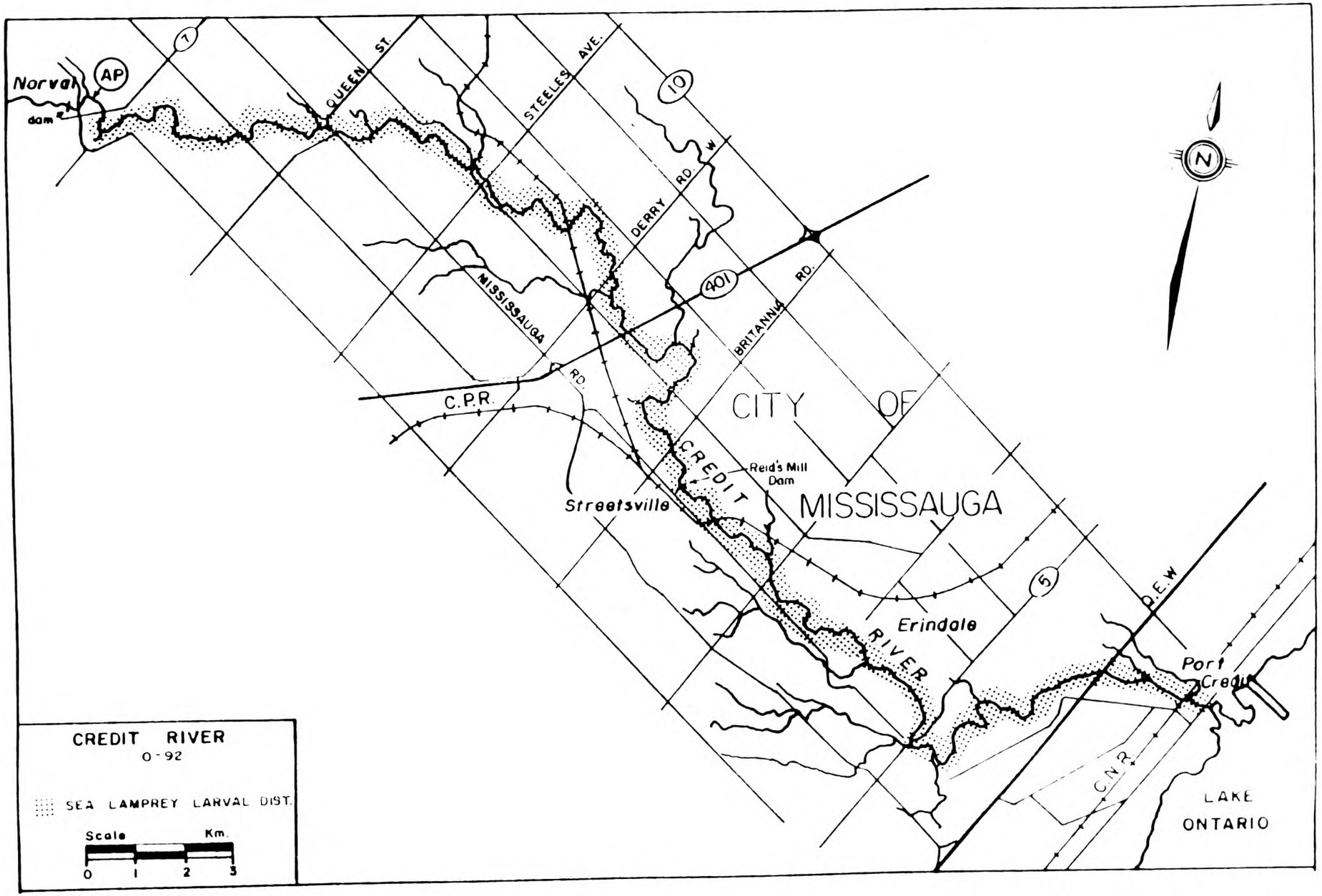


Figure 39. Detailed map of the Credit River treatment indicating the main lampricide application points and sea lamprey larval distribution on May 11-12, 1985.

Credit River (Continued)

immediately above Highway 7 in the village of Norval. The discharge of 7.6 m^3/s at the feeder site provided for an extremely fast flow time with the lampricide block moving approximately 2 km/h. A 1 km section situated in the lowermost portion of the estuary was thermally stratified and consequently a complete kill of ammocoetes was not obtained in this area.

A total of 1,407 sea lamprey larvae (41 to 196 mm in length) were collected during the treatment. Larvae were very abundant in portions of the watershed above Reid's Mill dam, with a number of year classes represented in the population. Ammocoetes appeared to be relatively scarce below the QEW and although some escapement undoubtedly occurred in the stratified area, numbers are believed to be small.

Non-target fish mortality was limited to a number of stonecats above the town of Streetsville.

Salem Creek - Figure 40

Salem Creek is a relatively small stream (average summer flow of less than 0.2 m^3/s) in Northumberland County located about 8 km west of the village of Brighton, Ontario. Salem Creek is short and uncomplicated, with a man-made dam about 3.4 km above the mouth acting as a barrier to adult sea lamprey. The stream flows fairly rapidly through woodland (mostly cedar) in the upper section, then through a dairy farm, and finally, in the past, through a large ponded estuary before entering Lake Ontario. The lower portion is now a single, more defined channel. Larval habitat is very good with much sand, silt and detritus in the pools; there are stretches of coarse and fine gravel providing excellent spawning facilities for sea lamprey.

Salem Creek had been previously treated with lampricide in 1971, 1976, 1979 and 1982.

Despite a fairly low discharge, a straightforward and effective treatment was completed on September 19. With only a 14.5-h application period, lethal levels were attained at the mouth for the required 12 h.

Because of huge numbers of larval sea lamprey observed in this stream, the supplementary application of lampricide had to be meticulous. Every backwater, trickle and even footprint had to be sprayed with TFM or Bayer 73 granules to prevent escapement.

Larval sea lamprey were very abundant with a total of 4,442 (11 to 181 mm in length) being collected, 212 of which were transforming. The large numbers of transforming larvae observed suggest three-years-to-transformation in Salem Creek.

Non-target fish mortality was negligible; two white suckers and 16 American brook lamprey were the only non-target fish observed killed during the treatment. Several live pink salmon were observed at the mouth and the dam during the treatment.

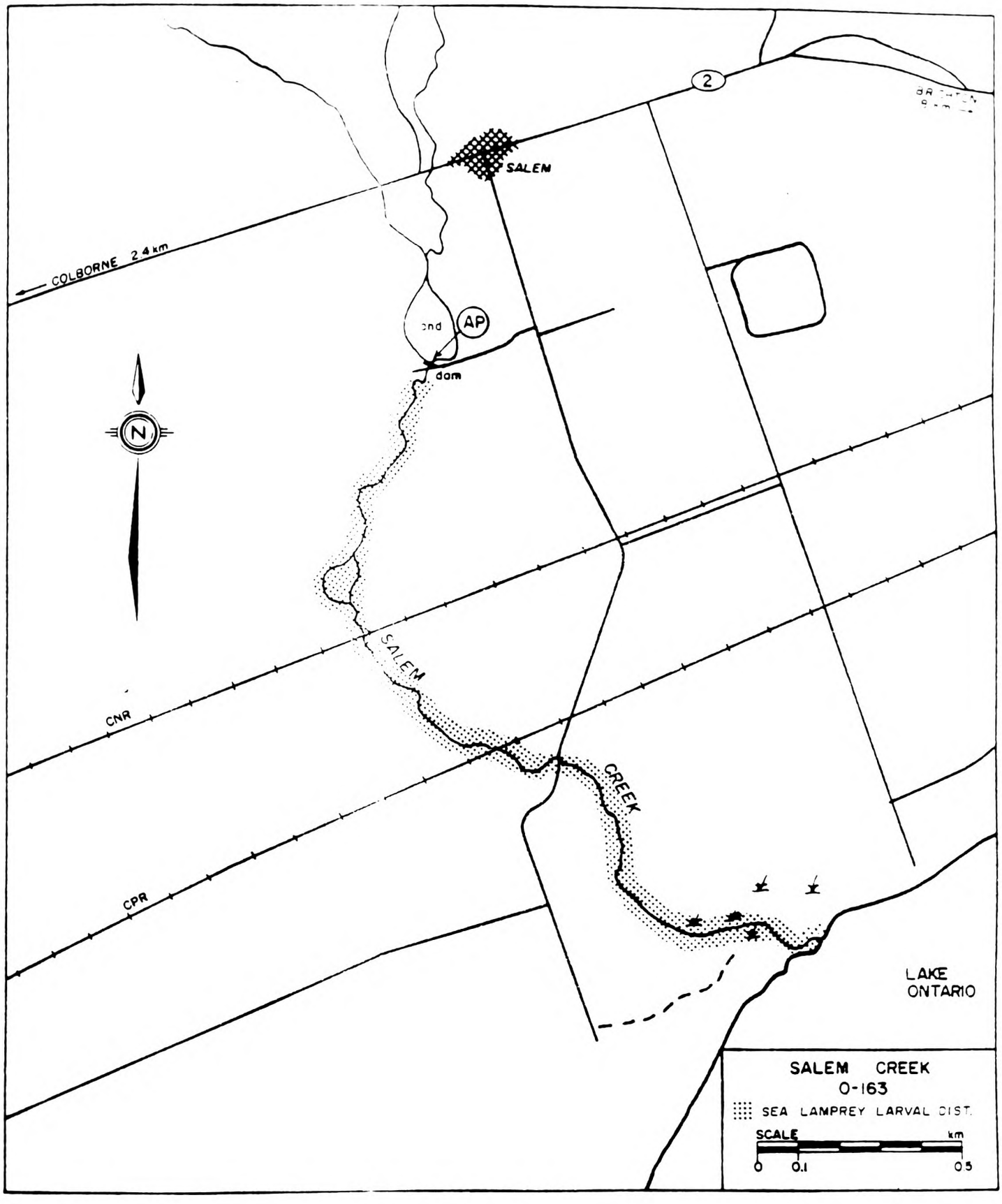


Figure 40. Detailed map of the Salem Creek treatment indicating the main lampricide application point and sea lamprey larval distribution on September 18-19, 1985.

Farewell Creek - Figure 41

This small stream originates in agricultural land in Darlington and Whitby Townships and flows into central Lake Ontario through a large estuary at the eastern limits of the City of Oshawa. The watershed has two major tributaries, Harmony and Black Creeks. Harmony Creek normally dries up in the summer and is not a known producer of sea lamprey. Farewell Creek has a moderate gradient, riffles and pools with excellent spawning and larval habitat and has a mid-summer discharge of approximately 0.15 m^3/s.

Because of 1985 survey results, Farewell Creek was added to the 1985 treatment schedule. It had been treated with lampricide four times previously, in 1971, 1973, 1977 and 1981. The 1971, 1973 and 1981 lampricide treatments originated 5.8 km above the mouth, just above a 0.6 m vertical cement culvert, which appeared to be a barrier. In 1976, surveys indicated that moderate numbers of sea lamprey ammocoetes were present above the culvert, resulting in an additional 9.3 km of stream being treated in 1977. The 1985 treatment was also initiated at the above mentioned culvert.

Extremely low flow during the treatment in September magnified the effects of attenuation and groundwater dilution. Even with an 18 h application of TFM to Harmony Creek from just above the confluence, theoretical lethal levels were not reached in the lower one kilometre of stream. However observations by treatment personnel indicated early activation and death of larvae and therefore no attempt was made to boost the block in this lower end. Larval sea lamprey were quite scarce in the upper 3 km of the treated portion, became increasingly more abundant towards the mouth and were scarce in the lower 1 km of the stream. A total of 514 (21 to 191 mm in length), including 66 undergoing transformation, were collected. Because of the presence of numerous transforming sea lamprey, it appears that the addition of Farewell Creek to the 1985 treatment program was justified.

Non-target fish mortality was minimal overall, but one short stretch above Highway 401 had moderate mortality of brown bullhead. Other species collected in very low numbers were: white sucker, logperch, stonecat, rock bass and dace.

Duffin Creek - Figure 42

Duffin Creek is a moderately complex stream system, composed of two main branches situated in Pickering Township of Clarke County, and is tributary to central Lake Ontario, approximately 4.8 km south of the town of Pickering. The two branches have divergent characteristics with the west branch having large boulders, little larval habitat and is subject to low summer flows and high water temperatures. The main branch is typically riffle and pool, th substrates of gravel and sandy, silty clay and has sustained summer flow. pr to 1980 upstream migration of spawning sea lamprey was stopped by an old da at Whitevale on the west branch and by a dam on the main branch situated 19.2 km from the mouth. Duffin Creek has two tributaries that regularly produce sea lamprey; the West Duffin and an unnamed creek.

This hardwater creek system has a moderate gradient above the confluence of the west branch, while the lower 4.8 km is somewhat sluggish and discharges through a large estuary. The mean May discharge is approximately 2.6 m3/s.

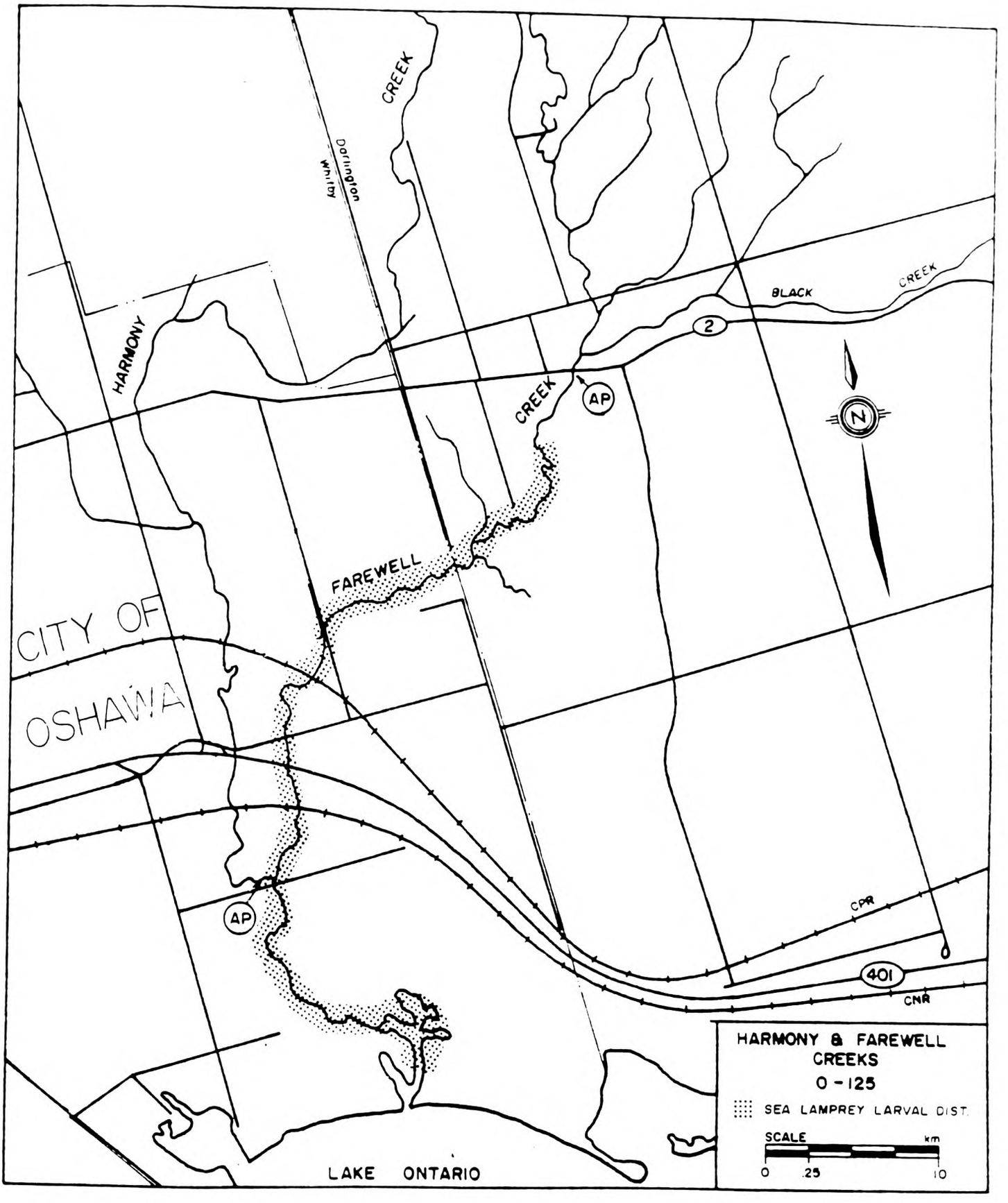


Figure 41. Detailed map of the Farewell Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on September 19-21, 1985.

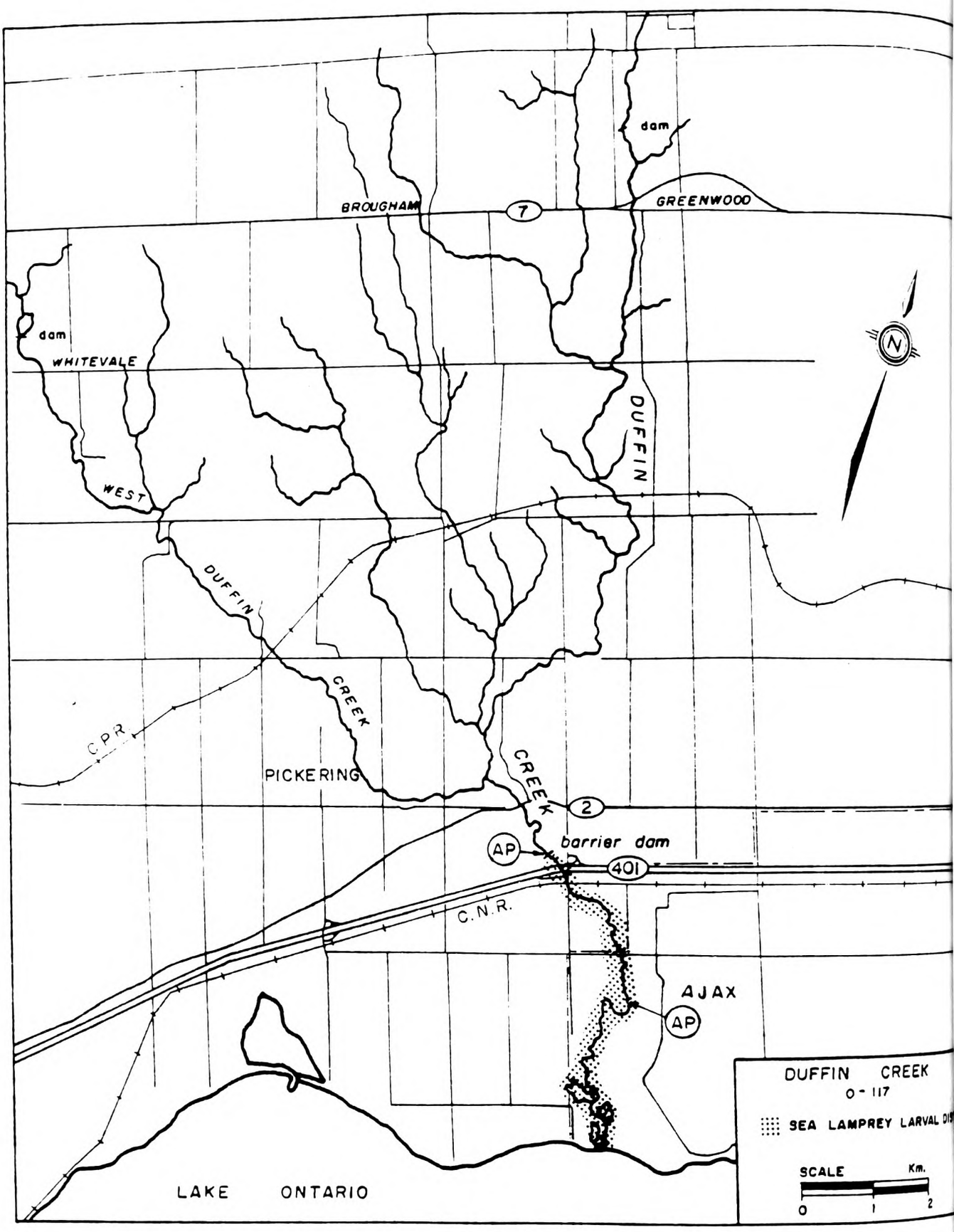


Figure 42. Detailed map of the Duffin Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on October 29-30, 1985.

Duffin Creek (Continued)

Previous lampricide treatments have been conducted in 1971, 1973, 1975, 1978 and 1980.

In September 1980, a sea lamprey barrier dam was constructed on Duffin Creek approximately 6.2 km upstream from the mouth. The installation of the dam eliminated the need to treat the east and west branches and a number of tributaries and consequently decreased the complexity of the 1985 treatment.

During the current treatment, lampricide was applied to Duffin Creek from immediately above the barrier dam and an optimum discharge and low Lake Ontario level facilitated a rapid and effective passage of the TFM block through the lengthy estuary. Two large lagoons on either side of the stream in the lower portion of the estuary did not appreciably dilute the lampricide block nor did escapement into these systems appear to be significant, since sufficient mixing was present to provide lethal levels of lampricide well into the mouth areas.

Stream temperatures were very cold throughout the entire treatment with respective minimum and maximum temperatures of 3°C and 5.5°C recorded. Lampricide was applied for 18 h in order to compensate for the cold water temperatures and although a few larvae and transformers were alive after 10 h of exposure to greater than six ppm TFM, a satisfactory level of mortality is believed to have been achieved.

Moderate numbers of sea lamprey larvae were observed throughout the watershed with distribution extending to the immediate mouth area. Of the 409 (26 to 176 mm in length) sea lamprey specimens collected, 90 of these individuals were metamorphosing.

Non-target fish mortality was limited to a few log perch and darters and moderate numbers of gizzard shad in the mouth.

LAKE ONTARIO, CANADA, GRANULAR BAYER 73 TREATMENT

Trent River - Figure 43

A 0.92 ha area in the Trent River off the mouth of Mayhew Creek was treated with 204 kg of granular Bayer on September 21. Pertinent treatment data is listed in Table IX and Figure 43 shows the general location of the Trent River. Because of the very fast current in the Trent River the area suitable for Bayer application was limited to the immediate shoreline and sheltered area where Mayhew Creek empties into the Trent River. Larval sea lamprey were moderately abundant - a total of 257 larvae, 36 to 171 mm in length, were collected. Of these 33 were in stages of transformation and all age classes were included. It is felt that these larvae originate from Mayhew Creek because of their close proximity to its mouth, however there is always the possibility they may be the result of adult sea lamprey spawning in the large Trent River system itself.

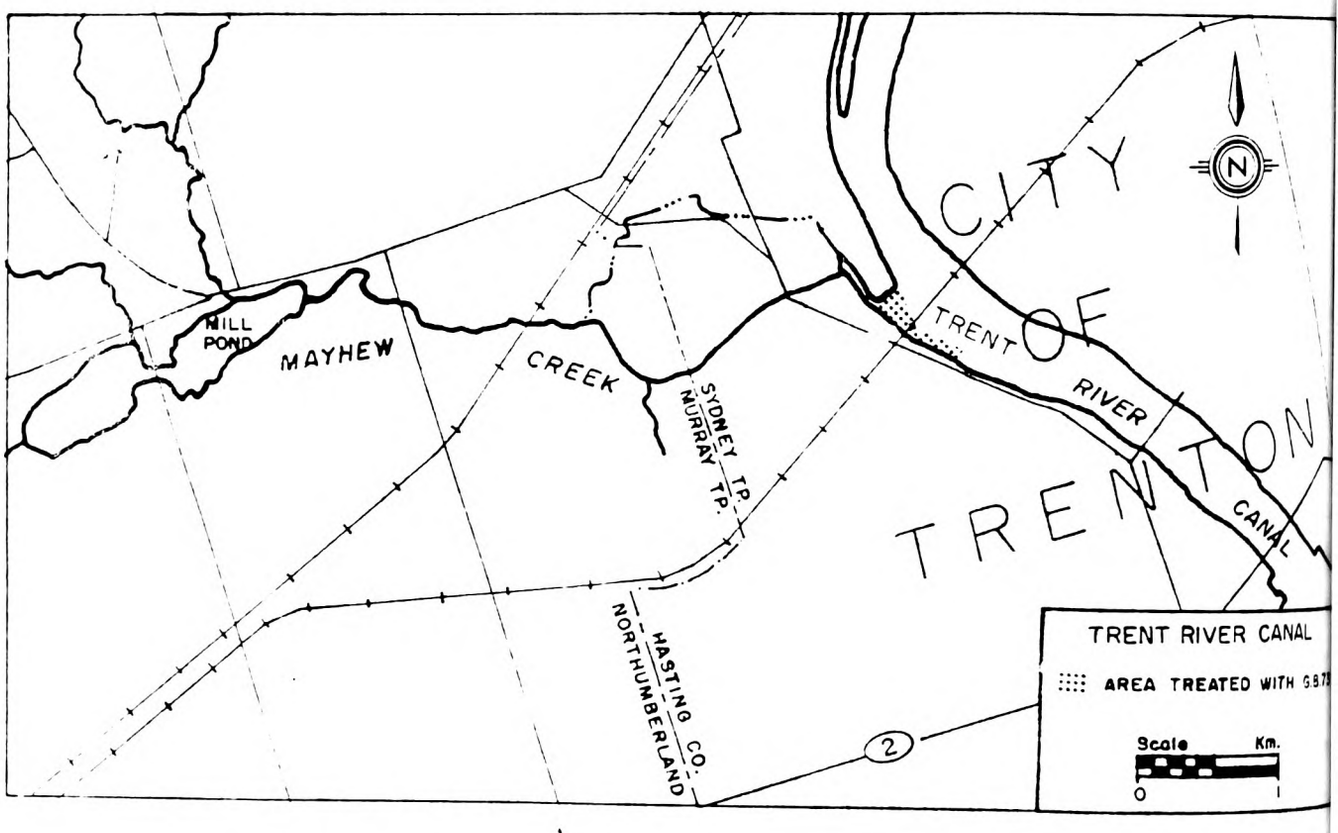


Figure 43. Area in the Trent River, off the mouth of Mayhew Creek, treated with granular Bayer 73 in 1985.

LAKE ONTARIO, UNITED STATES, LAMPRICIDE (TFM) TREATMENTS

The following seven United States (New York) streams tributary to Lake Ontario were treated with the selective lampricide, 3-trifluoromethyl-4-nitrophenol (TFM) in 1985:

Grindstone Creek	May 2-6	Little Salmon River	October 18-19
Ninemile Creek	May 7-11	Skinner Creek	October 22-24
Sterling Creek	May 11-12	Lindsey Creek	October 25-26
Little Sandy Creek	May 14-15		

Table IX lists the pertinent treatment data, Figure 34 depicts the general location of the streams treated, and Figures 44 to 50 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 V to this Annual Report.

Grindstone Creek - Figure 44

This stream is located in Richland and Albion Townships, Oswego County, and flows into Lake Ontario through a large marshy area on the southern boundary of Selkirk Shores State Park, west of the Town of Pulaski, New York. The main branch of Grindstone Creek has a man-made dam at Fernwood, 11.4 km above the mouth, which is a barrier to adult spawning phase sea lamprey. This branch, with an average summer discharge of 0.75 m^3/s, is characterized by fairly rapid flow over good spawning gravel and sand-silt larval habitat. The major tributary to Grindstone Creek, Little Grindstone Creek, flows into the main branch approximately 3 km above the mouth. Little Grindstone Creek itself has a major tributary which is also a producer of larval sea lamprey. Both of these tributaries have numerous small feeder streams and some impounded areas (total average summer discharge of 0.25 m^3/s). Adult spawning sea lamprey may pass unimpeded to the headwaters of these tributaries which contain suitable spawning and larval habitat.

Grindstone Creek had previously been treated with lampricide in 1972, 1975, 1978 and 1982.

Grindstone Creek, because of its complicated nature, which includes several slow impounded sections (beaver ponds), has always been difficult to treat. Low stream discharge, despite the early spring date, magnified the effects of attenuation and dilution by small tributaries, necessitating numerous boost feeders to maintain blocks of lampricide.

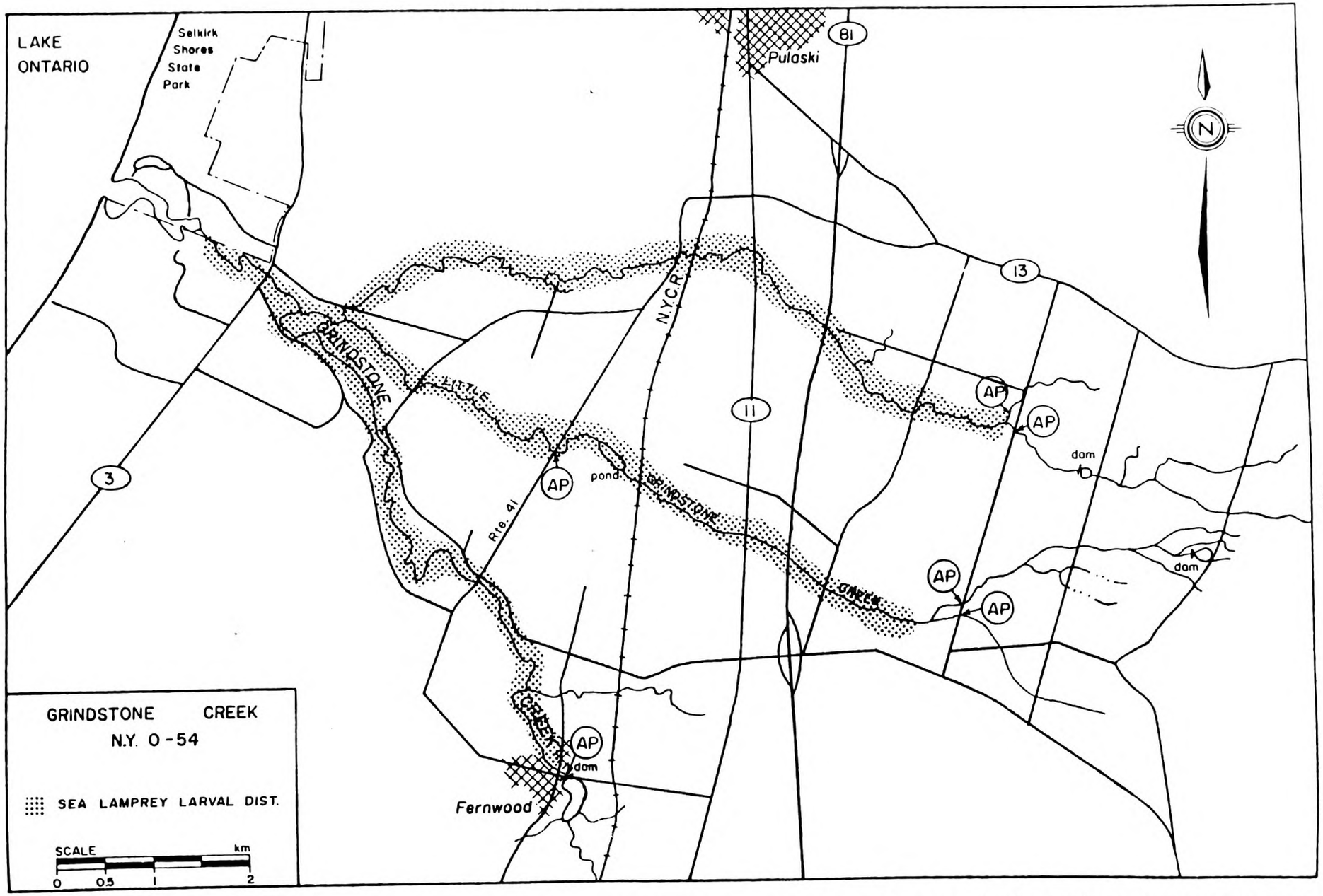


Figure 44. Detailed map of the Grindstone Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 2-6, 1985.

Grindstone Creek (Continued)

Treatment of the tributary system was initiated two days prior to the treatment of the main branch from the dam at Fernwood. As there was no attempt to make the blocks of lampricide from the tributary system and the main branch coincide, a separate feeder was operated at the mouth of the tributary system when the block from the main branch passed that point.

Because of a huge beaver impoundment at the upper end of the main tributary to Little Grindstone, with no access to the bottom of the beaver dams, the upper application point on this branch was slightly below the known upper distribution of larval sea lamprey (surveys in 1985 prior to treatment uncovered a small number of larvae beginning at the base of the beaver dams). A long lampricide block, 20+ h in duration, leaving the Interstate 81 intersection on Little Grindstone never reached detectable levels at County Route 41 (see Figure 44) as the entire stretch was severely ponded by beaver dams. A separate feeder was finally operated from County Route 41 to treat the lower section of Little Grindstone Creek.

Lethal levels were attained through the remainder of the watershed to within the last 0.8 km of the stream mouth, where no larval sea lamprey were observed.

A total of 790 larval sea lamprey, 16 to 191 mm in length, were collected during the treatment. Non-target fish mortality was limited to insignificant numbers of white suckers, chubs, mudminnows and bullheads.

Larval sea lamprey were abundant in the main branch and the north branch of Little Grindstone and moderately abundant overall in Little Grindstone proper. No ammocoetes were observed in the last 0.8 km of Grindstone Creek. Adult sea lamprey were observed throughout the system, with greatest numbers in the main branch.

Ninemile Creek - Figure 45

Ninemile Creek is located in Cayuga County flowing into Lake Ontario approximately 12 km southwest of the city of Oswego, New York. An old mill dam about 25.7 km above the mouth appears to block adult migrating sea lamprey. This stream, with an average spring discharge of 1.2 m^3/s flows fairly slowly throughout much of its course. Potential spawning gravel is patchy, with the bottom composed predominately of sand, clay, silt and detritus. An old concrete dam at Hannibal, 17.7 km above the mouth, would probably need minimal work to make it an effective barrier to adult sea lamprey. One small tributary, Muck Creek, about 3 km above Hannibal is a producer of larval sea lamprey. Ninemile Creek had previously been treated in 1978 and 1982.

Although flows had been very low prior to the treatment, rain showers the evening before the date of application increased flows to reasonable levels, allowing Ninemile Creek to be treated with one block of lampricide, in contrast to the conditions in 1982, when the stream was treated in two sections. Even with the better flow, two major boost feeders were required to maintain the block of lampricide. As before, one sea lamprey tributary, Muck Creek, was treated a short distance above its confluence with the main. Lethal concentrations were attained throughout the stream, essentially to the mouth.

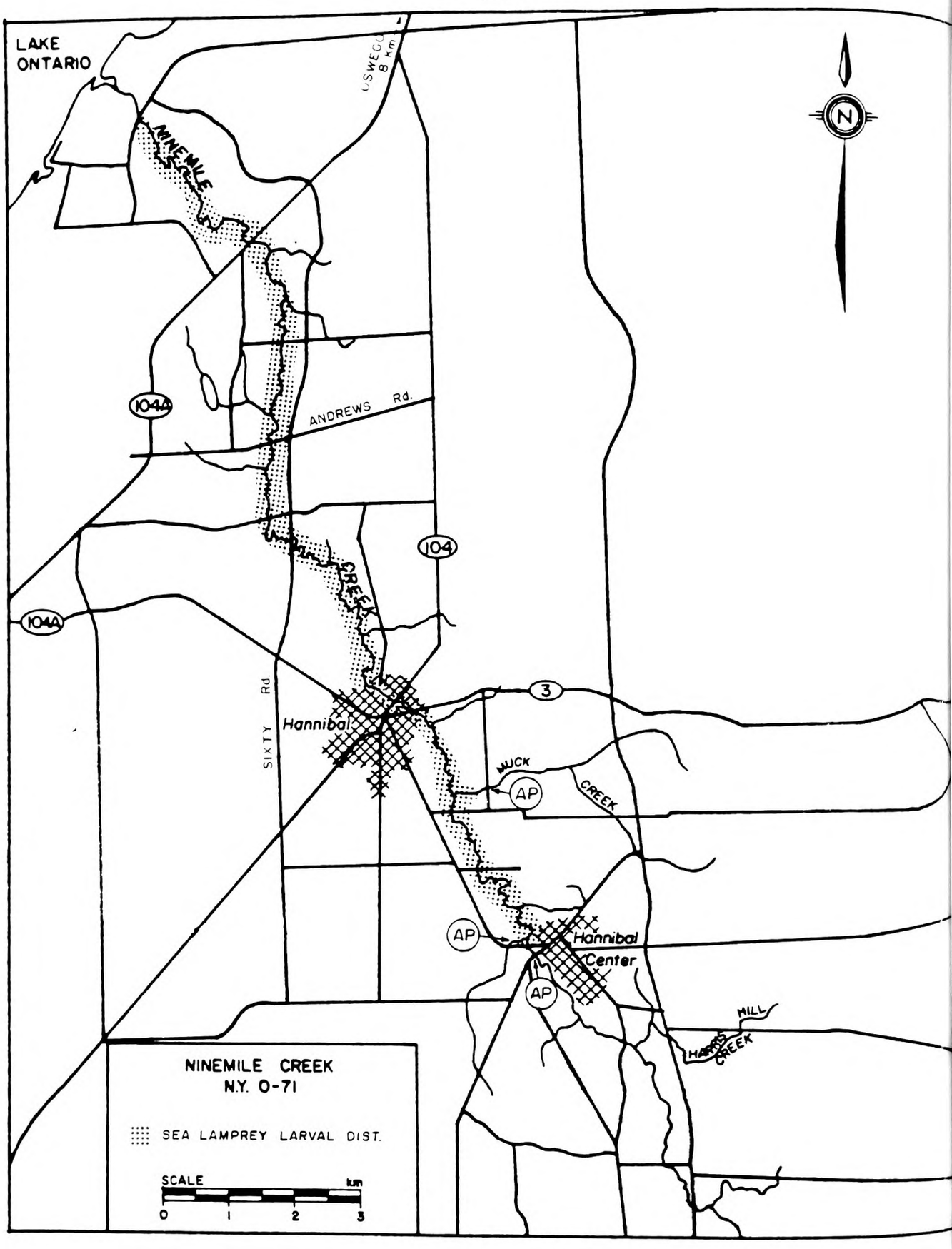


Figure 45. Detailed map of the Ninemile Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 7-11, 1985.

Ninemile Creek (Continued)

Portions of the stream required diligent supplementary application work, particularly the upper regions and the long stretch from Hannibal to Sixty Road.

A total of 624 sea lamprey larvae, 21 to 171 mm in length, were collected. Larvae were moderate in numbers overall but patchy in distribution. Numbers were greatest from the old dam in Hannibal to Andrews Road and in a short stretch below Highway 104A. No larval sea lamprey were observed in the lower 1 km of stream.

Adult spawning phase sea lamprey were found scattered throughout the stream in moderate numbers.

Non-target fish mortality was low overall, but several "sport fish" including nine Northern pike and a rainbow trout were observed killed, as well as several brown bullhead, white suckers and assorted benthic minnows.

Sterling Creek - Figure 46

Sterling Creek and its one major tributary, Sterling Valley Creek, are both located in Cayuga County, New York, about 15 km west of Oswego, New York. Both branches flow through mixed agricultural land and scrub bush. The main branch has a 2.5 m high concrete dam (barrier) just above Highway 104A in the village of Sterling, New York, approximately 9 km above the stream's mouth. Another old concrete dam, 0.5 km below this, is not a barrier to spawning sea lamprey (both adults and ammocoetes were collected above it). Below the barrier dam the main branch flows in riffles and rapids for about 1.8 km and then slows and widens considerably, flowing through a massive, shallow, marshy estuary.

Sterling Valley Creek, which joins the main branch approximately 5 km above the mouth, has a 3 m high barrier dam in the village of Sterling Valley, about 7.5 km above the confluence. Riffles and pools, with good spawning facilities and larval habitat predominate for 3 km below the barrier dam, after which the stream widens and slows greatly. Both branches have very little water pickup along their courses below the dams.

Sterling Creek had been treated four times before; in 1972, 1975, 1979 and 1982.

Flows in both the main Sterling Creek and Sterling Valley Creek were lower than ideal for this lampricide treatment. Also very high pH values (up to 8.75 the day before treatment on Sterling Valley Creek) caused some concern as to proper treatment levels.

The main pump feeders on both Sterling and Sterling Valley Creek were operated simultaneously but without expectation of having the treated blocks coincide. Good treatment levels were achieved on Sterling Creek to the confluence with Sterling Valley Creek but in fact no lampricide was detected below Fraden Road on Sterling Valley Creek. Below this road, Sterling Valley Creek is very deep and slow, and at the treatment flow, no appreciable amount of lampricide was expected to reach the confluence.

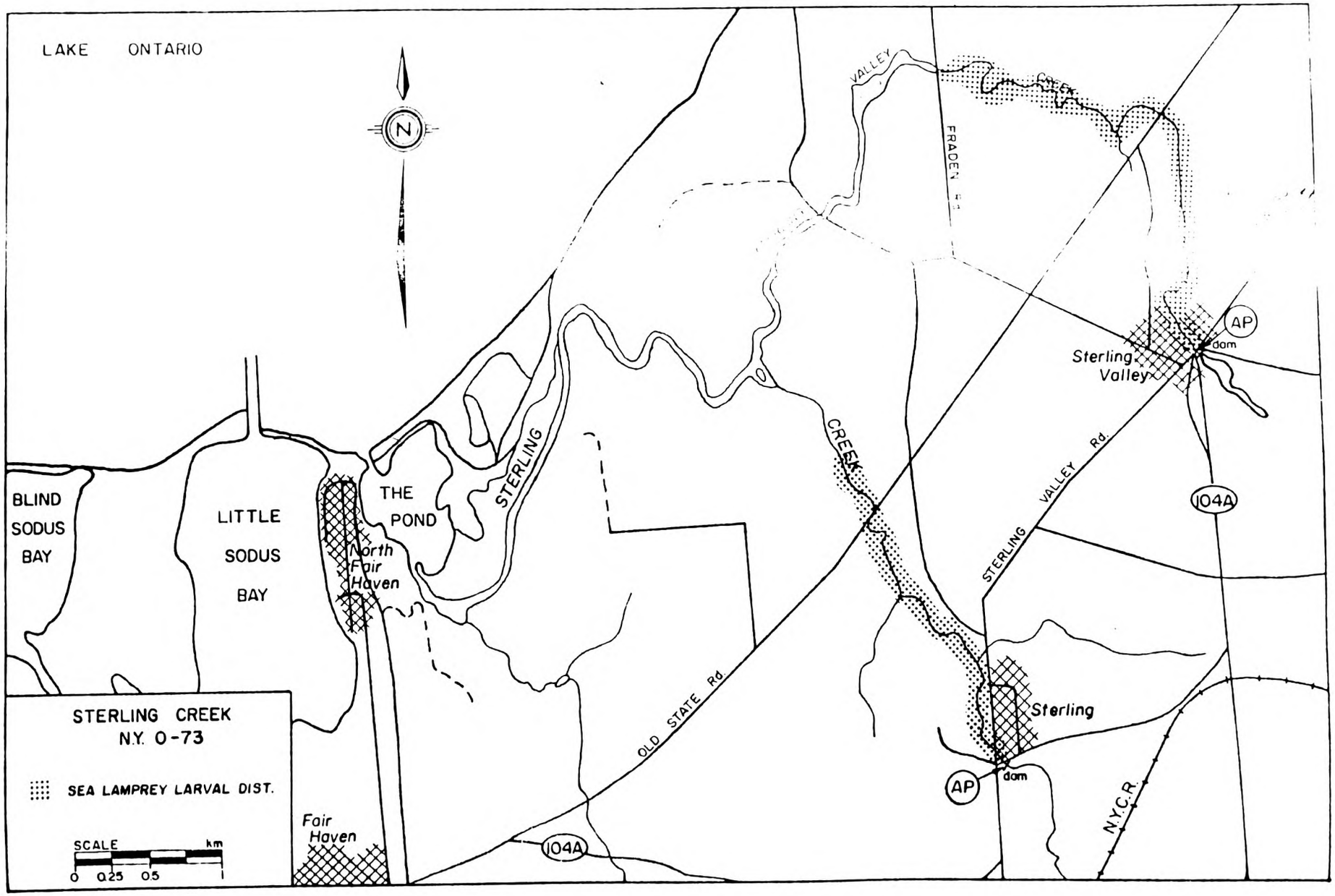


Figure 46. Detailed map of the Sterling Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 11-12, 1985.

Sterling Creek (Continued)

The treatment began on May 10 using "instant" 12 h levels and numbers of adult sea lamprey were observed dead in Sterling Creek after 3 h. However, no dead or even sick adult sea lamprey were evident in Sterling Valley Creek of the several hundred observed in the stream below the dam after 3 h of 7.0+ ppm. As the pH values were higher in Sterling Valley Creek than in Sterling Creek, concentrations were raised to approximately 11 ppm for a short time. This seemed to be effective as the adults began quickly dying. Further downstream, when sea lamprey larvae also appeared to be dying quickly, the concentrations were dropped to approximately 8 ppm for the remainder of the application period.

Appreciable amounts of supplementary application of TFM were necessary on both branches.

A total of 279 larval sea lamprey (21 to 166 mm in length) were collected. Larvae were moderately abundant overall, with greatest numbers being collected in Sterling Valley Creek, from Old State Road to above Fraden Road. Larval sea lamprey were scarce to non-existent in the slow lower sections of both branches.

Non-target fish mortality was negligible in Sterling Creek but moderate numbers of brown bullhead, northern pike, carp, logperch, fantail darters, common shiners, rock bass, bowfin, bluntnose minnows and Johnny darters were killed in one stretch of Sterling Valley Creek.

Little Sandy Creek - Figure 47

Little Sandy Creek is a relatively small but complex watershed traversing agricultural and scrub bush land in Boylston and Sandy Creek Townships, Oswego County, before entering North Pond approximately 8 km north of Port Ontario. The stream contains two tributary systems that regularly produce sea lamprey larvae. The main stem of the watershed which passes through the villages of Sandy Creek and Lacona has an approximate summer discharge of 0.4 m^3/s. The upper reaches of the main stem have a relatively rapid runoff over boulder and bedrock substrate, however the middle reaches consist mostly of riffles and pools. Below Highway 3 the stream is inundated during high lake levels, however at lower levels a definite stream channel exists to the mouth. The two sea lamprey producing tributaries are also of riffle and pool type, with a somewhat slower runoff. Although good larval habitat is relatively scarce in the majority of the main stem, good spawning facilities exist and abundant numbers of sea lamprey larvae reside immediately below Highway 3 to the mouth area. Abundant spawning and larval habitat exist in both tributary systems. The absence of physical barriers allows the passage of spawning adults well into the upper reaches on the main stem and tributaries. Lampricide treatments had previously been conducted on this regular producer in 1972, 1973, 1976, 1979 and 1982.

Timely thundershowers the day prior to treatment raised flows to ideal levels in the main Little Sandy Creek and its tributaries. Surveys in 1985, prior to treatment, substantiated the results of the 1984 distribution surveys - larval sea lamprey distribution was lowered in both the main branch and the major tributary, thus simplifying and shortening the treatment time from past treatments. The tributary system still required four application points but

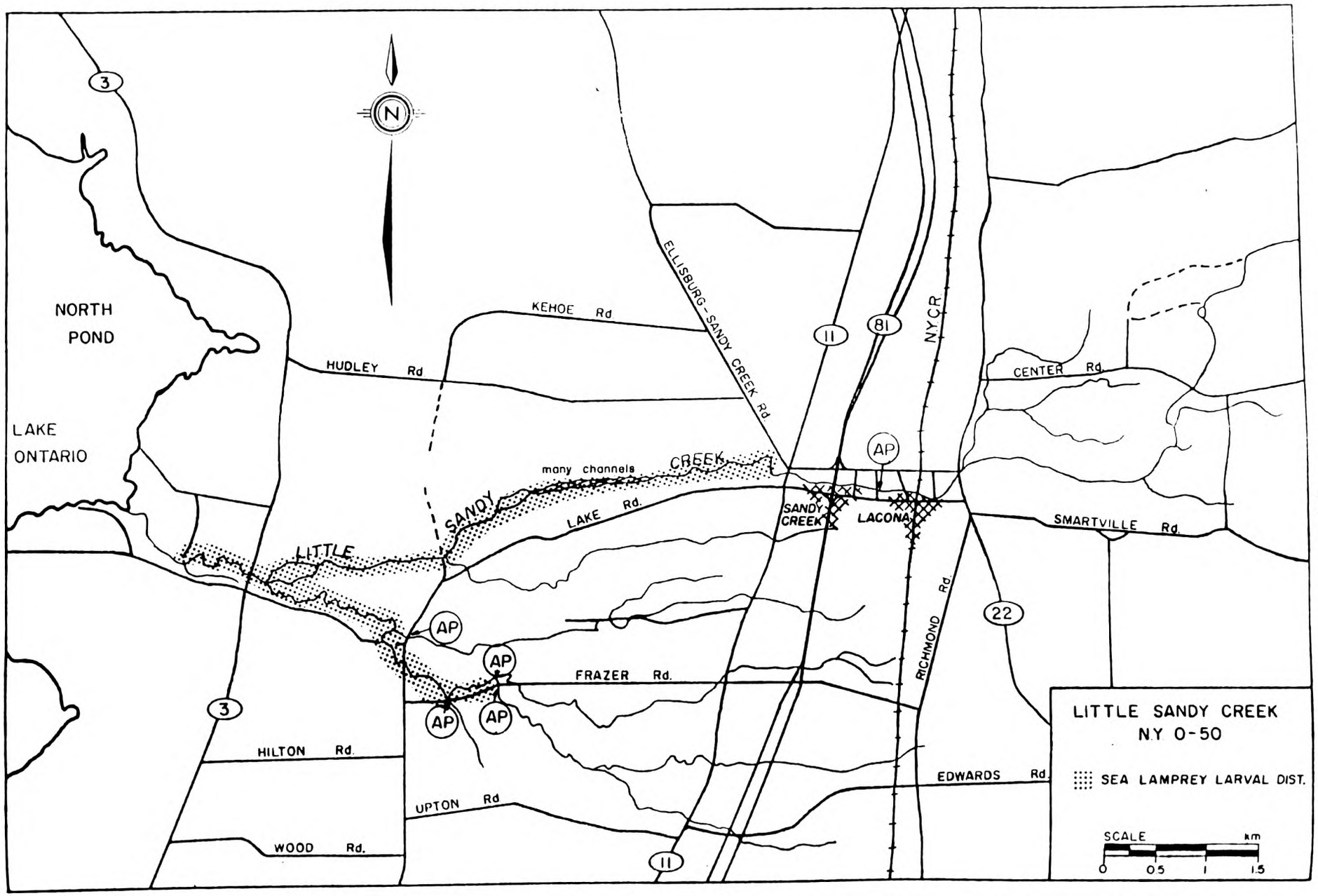


Figure 47. Detailed map of the Little Sandy Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on May 14-15, 1985.

Little Sandy Creek (Continued)

good levels were achieved throughout it. The upper application point was slightly below the known upper limits of sea lamprey larvae, but the very low number of larvae found and lack of access above Frazer Road did not justify treating further up.

Flow times are very short in the main branch of Little Sandy Creek, as the upper portion is mostly riffles. The stream slows considerably in the lower section below Route 3 and even at the reasonable flow, lethal levels were not attained in the last 0.5 km of stream. However apparent scarcity of larvae in this lower section indicated there was no need to apply lampricide by boat.

Many supplementary applications of TFM were required, both in this lower end and above Route 3 in the main branch where many splits and backwaters occur.

A total of 256 sea lamprey larvae (26 to 176 mm in length) were collected. Larval sea lamprey were very abundant in the main branch, especially from Kehoe Road to a short distance below Route 3. Sea lamprey larvae were scarce in the tributary, most being observed just upstream of the confluence with the main river.

Non-target fish mortality was considered to have been negligible.

Little Salmon River - Figure 48

The Little Salmon River is a large dendritic watershed traversing five townships in Oswego County, New York. Above the town of Mexico the river bifurcates, each branch having numerous tributaries. Below Mexico the river has one sea lamprey producing tributary, Black Creek, and flows through mixed farmland before entering Lake Ontario at the Village of Texas. Lampricide treatments in 1975 and 1979 were conducted on the entire watershed, however remedial works on a dam in Mexico in 1978 resulted in the establishment of an effective barrier to spawning sea lamprey, and consequently the complexity of the 1982 treatment decreased significantly.

The Little Salmon River watershed is reasonably soft, is subject to highly variable discharges, and has an average summer flow of approximately 1 to 1.5 m^3/s.

The 1985 treatment of the Little Salmon River commenced at 0820 h on October 18 from the uppermost dam situated in the village of Mexico. Treatment levels were based on water chemistry data and regression lines drawn from accumulated Canadian bioassay data. The minimum lethal for sea lamprey larvae was determined to be 1.2 ppm/12 h with a maximum safe level for white suckers at 2.4 ppm/12 h. The application rate at the feeder averaged 1.8 ppm/16 h with a level of 1.3 ppm/12 h being attained at the mouth.

According to local fishermen, a heavy run of spawning chinook salmon had entered the river on approximately October 14 to 16 and were distributed throughout the watershed, and moderate to heavy angling pressure was present at the onset of the treatment.

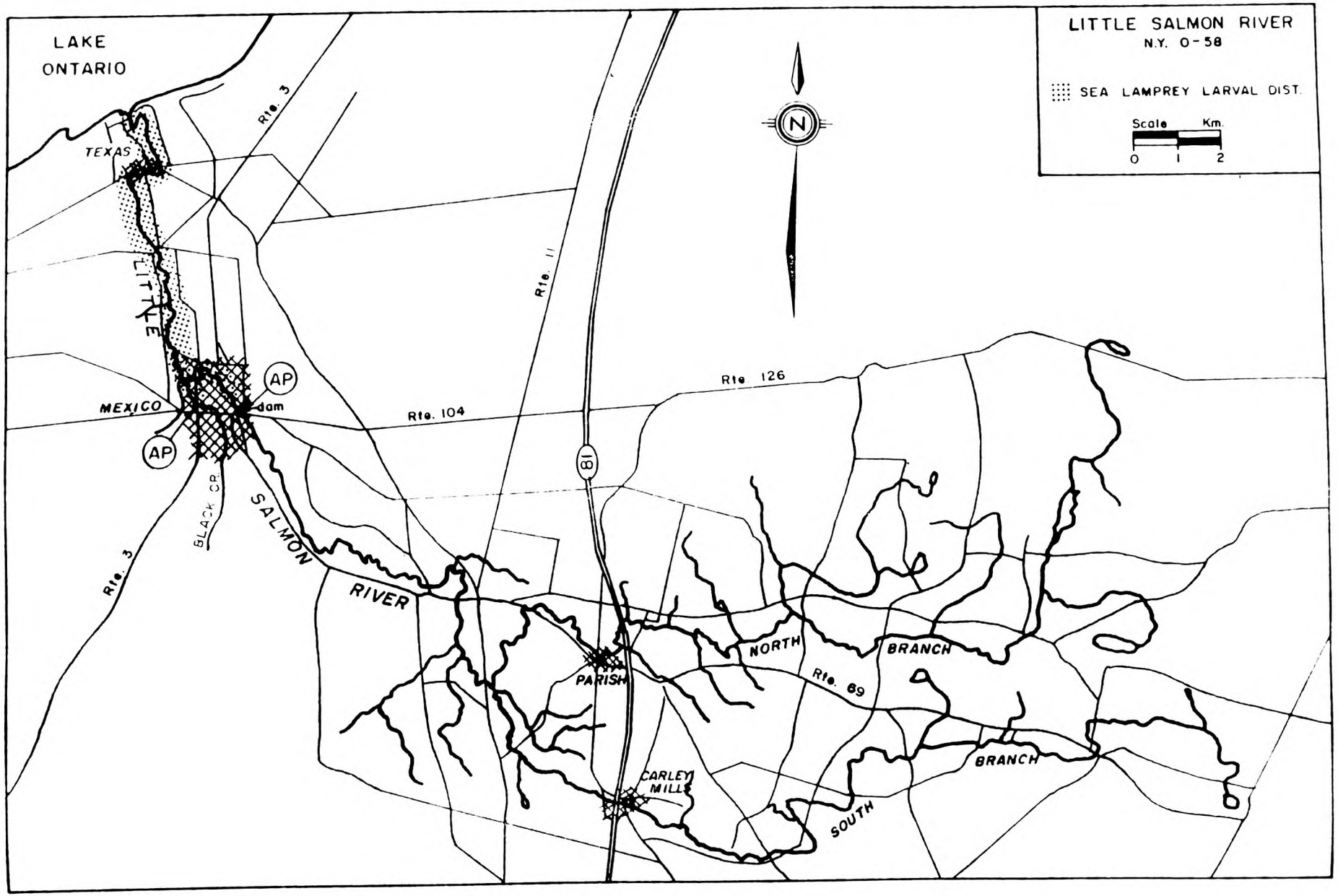


Figure 48. Detailed map of the Little Salmon River treatment indicating the main lampricide application points and sea lamprey larval distribution on October 18-19, 1985.

Little Salmon River (Continued)

A light mortality of chinook salmon was noted on October 18. During the evening of October 19, mortality of chinooks escalated significantly with a total of 350 to 400 succumbing to the lampricide. Mortality of other non-target species such as Northern hog sucker and blacknose dace was considered insignificant.

A total of 470 sea lamprey larvae (21 to 176 mm in length) were collected including 14 transforming individuals. Sea lamprey larvae were considered moderately abundant from Mexico to Texas and relatively scarce from Texas to the mouth.

Skinner Creek - Figure 49

Skinner Creek is a moderate sized stream with an average summer flow of approximately 0.5 m^3/s. The creek is located in Jefferson and Oswego Counties and flows through farm and pastureland into North Pond approximately 38 km south of Watertown, New York. A man-made dam on the main branch at Mannsville, approximately 14 km above the stream mouth, acts as a barrier to spawning run sea lamprey. Below this dam, the stream consists of riffles and pools with abundant spawning gravel and larval habitat but in the lower 3 km it gradually slows and widens, entering Lake Ontario through a large marshy, estuarine area. Big Deerlick Creek is the only sea lamprey producing tributary however, several small tributaries enter the main stream below Mannsville.

Skinner Creek had previously been treated six times, in 1972, 1973, 1976, 1978, 1980 and 1983.

The initial stage of the 1985 treatment was complicated by a multiplicity of application sites and a rapid flow time, however no major problems were encountered in regulating lampricide concentrations. The treated portion of Big Deerlick Creek, the only sea lamprey producing tributary, was blocked by beaver activity and consequently the removal of a number of dams was necessary prior to treatment.

A total of 528 sea lamprey larvae (16 to 166 mm in length), including eight undergoing transformation, were collected. Although sea lamprey larvae were abundant in the middle reaches of Skinner Creek, no ammocoetes were collected in the lower 2.0 km of the watershed. Three year classes of larvae were present in the stream. Apparently, significant numbers of larvae do not metamorphose in Skinner Creek until at least Age IV. Ammocoetes were relatively scarce in Big Deerlick Creek.

While non-target fish mortality was insignificant in Skinner Creek, heavy mortality of brown bullheads, grass pickerel, golden shiners and white suckers were observed in the treated portion of Big Deerlick Creek even though lampricide concentrations barely reached minimum lethal levels for sea lamprey larvae as determined from regression lines drawn from accumulated bioassay data.

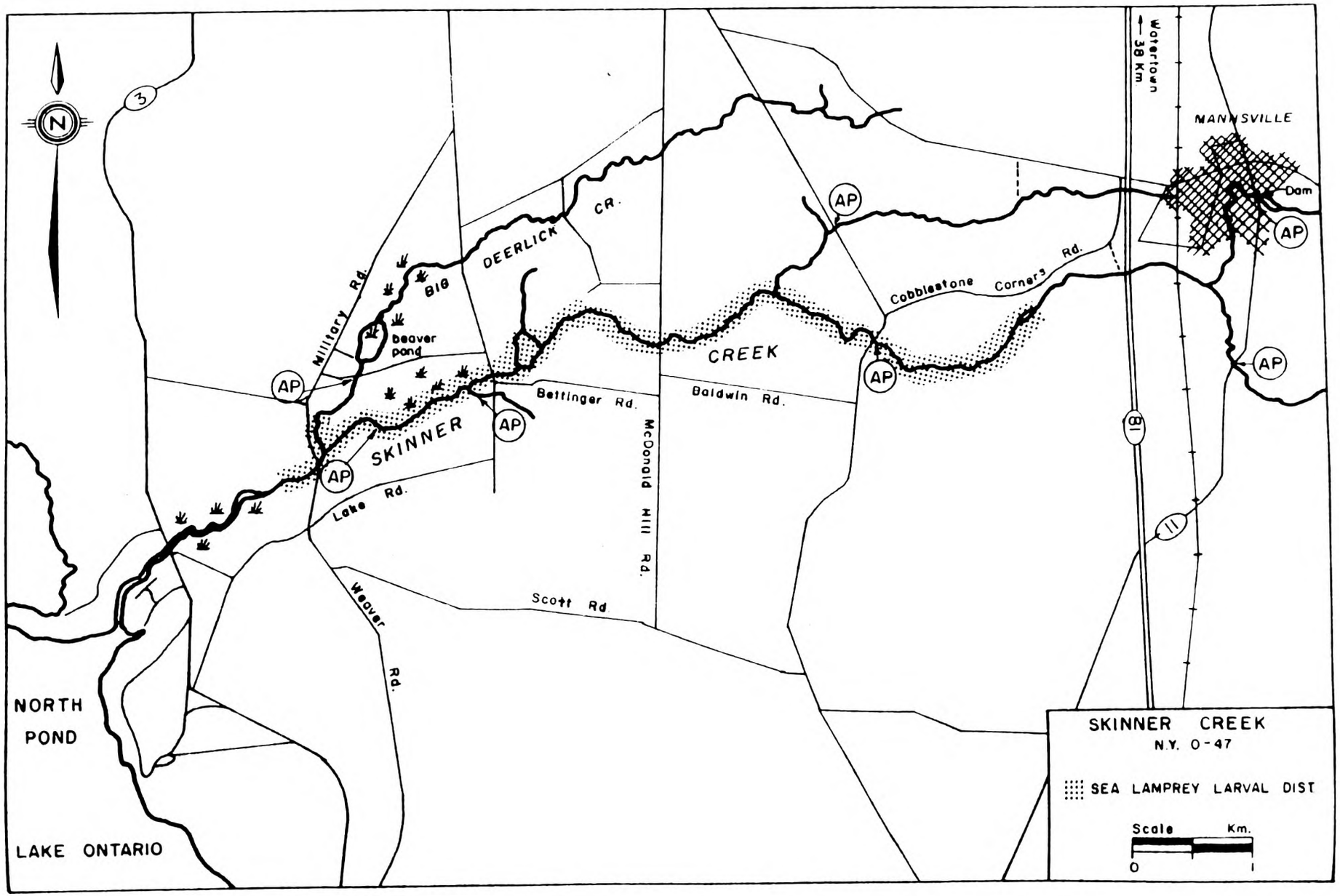


Figure 49. Detailed map of the Skinner Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on October 22-24, 1985.

Lindsey Creek - Figure 50

Lindsey Creek, a regular producer of abundant numbers of sea lamprey larvae, is situated in Jefferson and Oswego Counties and flows into Lake Ontario just west of the village of Sandy Creek. The headwaters of the stream originate from two main branches and a sea lamprey producing tributary, Jacobs Brook. A lengthy beaver impounded tributary, Mud Creek, enters Lindsey Creek approximately 1 km above the mouth and sporadically produces a small number of sea lamprey larvae. No barriers to spawning run sea lamprey are present in these stream systems and ammocoete distribution typically extends well into the headwaters.

Previous lampricide treatments have been conducted in 1972, 1974, 1978, 1980 and 1983.

The 1985 treatment was complicated by the number of applications required to cover the upstream distribution of sea lamprey larvae in the tributary streams. By precise application a coincidence of all lampricide blocks was achieved, thus eliminating a requirement for additional stream set-ups. Due to low discharge and the presence of many beaver impoundments, lampricide was applied to Mud Creek, however escapement of sea lamprey larvae from Lindsey into Mud Creek in the confluence area is believed to be insignificant since ammocoetes were extremely scarce in that particular area.

Sea lamprey larvae were abundant throughout the watershed with the highest numbers observed in Jacobs Brook. Although the downstream distribution in Lindsey extended well into the mouth area, the apparent numbers decreased appreciably.

Of the 1,123 sea lamprey ammocoetes collected, only three were undergoing metamorphosis. This stream would appear to exhibit a pattern similar to Skinner Creek with no significant transformations occurring before at least Age IV.

Non-target fish mortality was relatively light, however a variety of species were represented, i.e., white sucker, chinook salmon, longnose sucker, chain pickerel, brown bullhead, bowfin, bluntnose minnow, blacknose dace, mudminnow, logperch and dace.

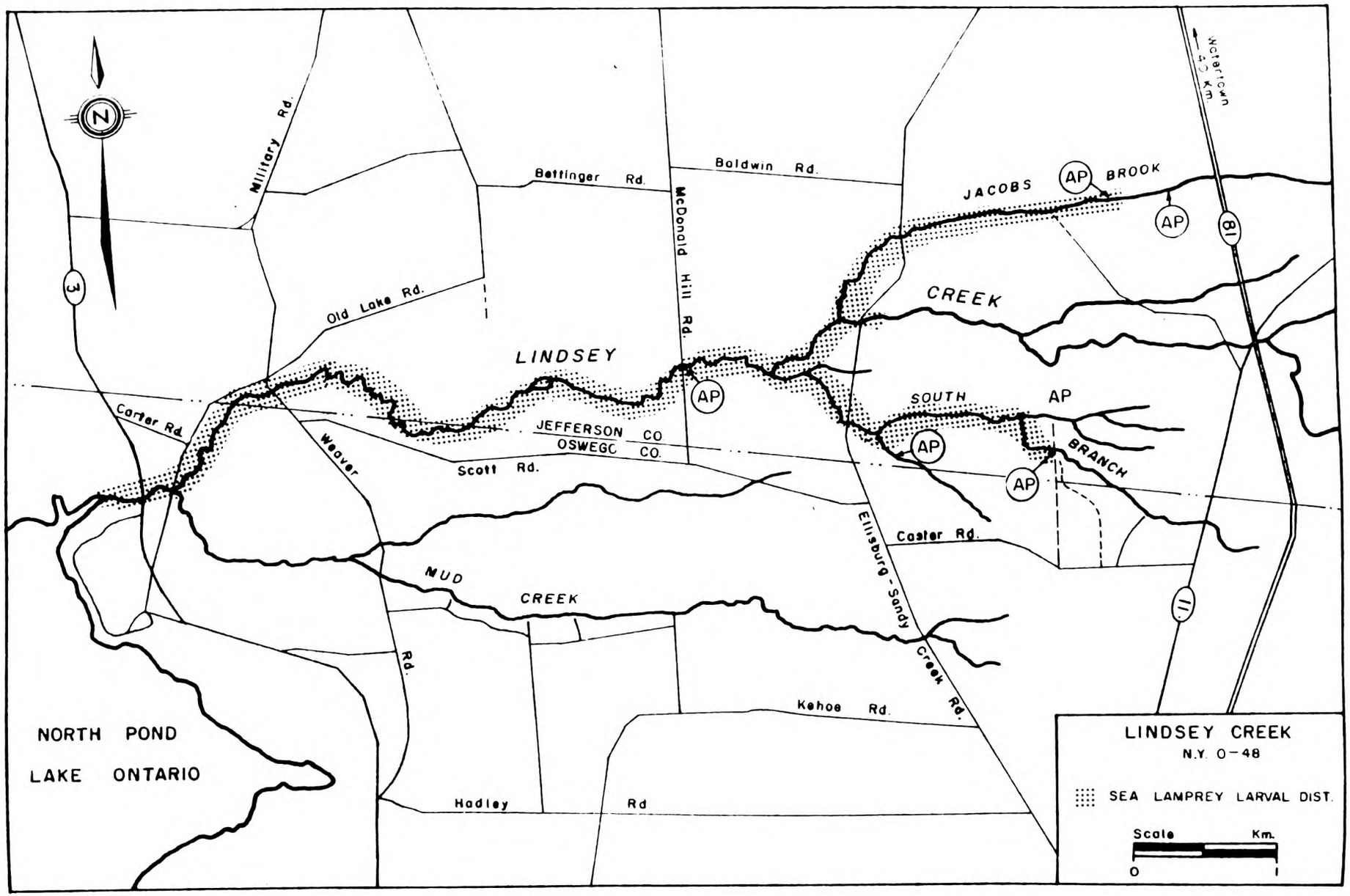


Figure 50. Detailed map of the Lindsey Creek treatment indicating the main lampricide application points and sea lamprey larval distribution on October 25-26, 1985.

SEA LAMPREY BARRIER DAM PROJECT

CONSTRUCTION

Shelter Valley Creek (Lake Ontario)

A low-head barrier dam (Figure 51) was built 400 m from the mouth of this stream at a picturesque site leased from a private landowner. Construction took place during the months of October and November 1985.

In response to a Ministry of Natural Resources request, removable plates were designed and incorporated in the crest to allow the passage of non-jumping fish, should the need arise, at times other than during the lamprey run.

The concrete dam has the shape of an upstream pointing "V" with a built in trap (0.6 m x 1.2 m) at the apex. A curved 125 mm steel lip extends downstream along the full 12.8 m length of the crest. The dam is 12.0 m long between abutment walls and will have a mean drop of 50 cm during the lamprey run.

The total cost of the dam was $42,520. Its position near the mouth will permit a reduction in treated length of the stream of 97 per cent.

Still River (Lake Huron)

Construction of this barrier was deferred until 1985.

MAINTENANCE AND SITE INSPECTION

Minor maintenance work was carried out at the Gimlet, Carp, Stokely, Kaskawong, Echo, Lakeport, Graham and Duffin barriers. Also a 10 m long segment of the Shannonville dam on the Salmon River was faced and capped with 20 cm of reinforced concrete.

Potential sites were examined on the Little Pic River, Oshawa, Port Britain and Grafton Creeks. Surveying was carried out at the Echo dam with a view toward creating a definite lamprey barrier.

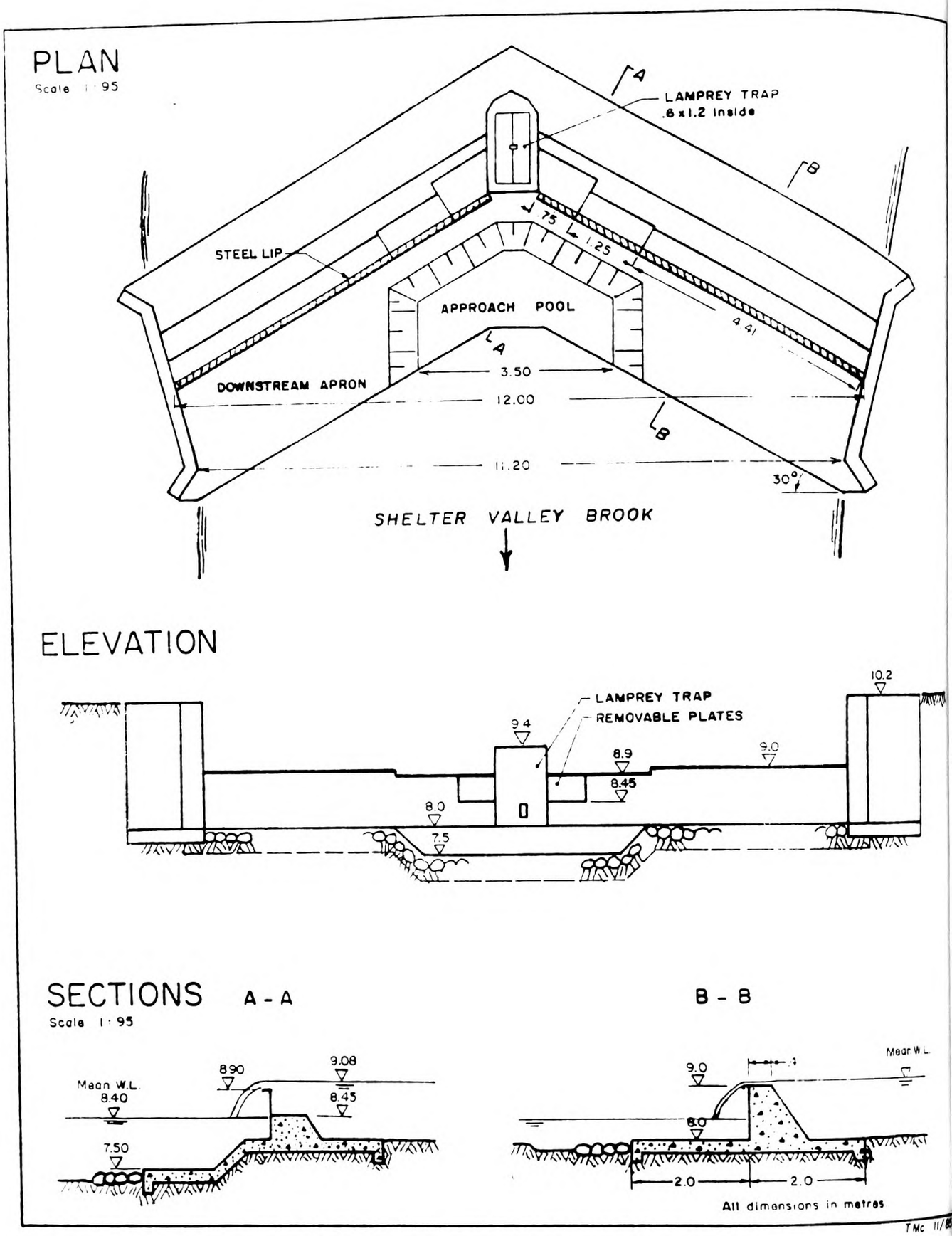


Figure 51. Low-head barrier dam constructed on Shelter Valley Brook in October and November, 1985.

EFFECTS OF LOW-HEAD BARRIER DAMS ON TREATMENTS

Four streams on which low-head barrier dams have been constructed were treated in 1985 while a fifth one, Stokely Creek, did not require treatment. The amounts of lampricide used per unit of stream discharge and the lengths of streams treated in treatments conducted since the installation of the dams are compared with the corresponding mean values for the three pre-construction treatments in Table X and Figure 52.

Table X. Comparative effects of low-head barrier dams on first round of post barrier treatments.

STREAM (Year of Construction)	TFM (kg A.I./m^3s^{-1})			Length treated (km)		
	Pre-Barrier Mean*1	1985 Treatment	Per cent Reduction	Pre-Barrier Mean	1985 Treatment	Per cent Reduction
Sturgeon (1979)	425.2	154.0	64	20.8	1.5	93
Gimlet (1979)	165.7	53.0	68	5.2	.1	98
Kaskawong (1980)	502.2	122.6	75	11.4	1.4	88
Duffin (1980)	425.2	434.8	-2	28.3	5.8	80
Stokely (1980-81)	210.2	not req'd.	100	10.9	not req'd.	100

*1 Mean of last three treatments

Reductions in the amount of lampricide used in the Sturgeon, Gimlet and Kaskawong treatments proved to be better than the projected amounts by 20 to 28 per cent. The Duffin Creek treatment which took place on October 30 at water temperatures near 5°C required about one-third more lampricide than would be used at more normal temperatures. It is expected that several streams with low-head barrier dams may require less frequent treatments or even no further treatments. Stokely Creek appears to be one of these.

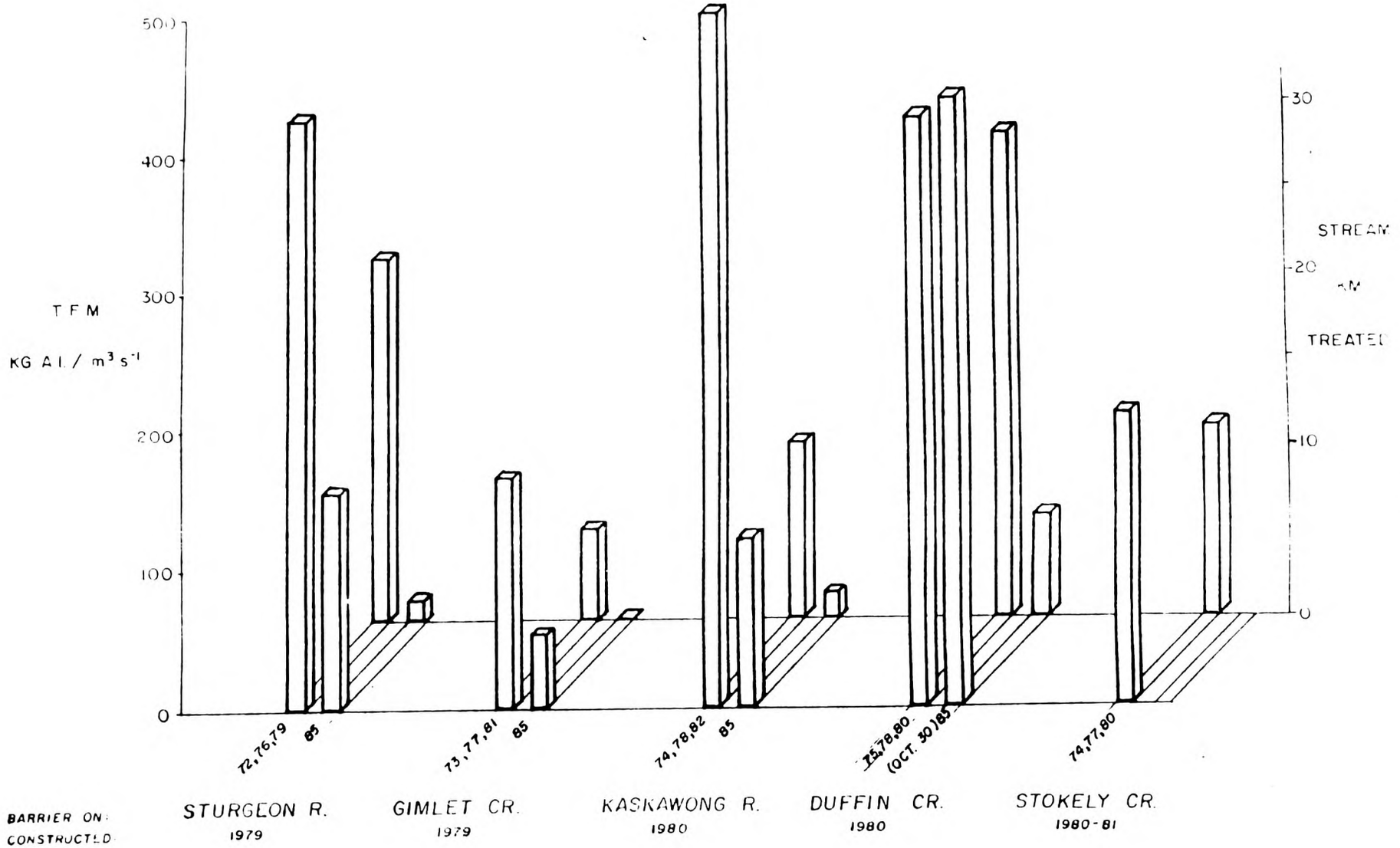


Figure 52. Comparative effects of low-head barrier dams on 1985 treatments.

SPECIAL STUDIES

POPULATION ESTIMATE OF LARVAL LAMPREY FROM THE HARMONY (CHIPPEWA) RIVER DELTA

On July 26 and 29, 1985, an area of 3.01 ha along the Harmony (Chippewa) River delta of Batchawana Bay was treated with granular Bayer 73, continuing an annual attrition program on sea lamprey larval numbers. A Petersen Estimate of the numbers of larval lampreys present, 95 per cent confidence limits in brackets, at the time of treatment resulted in:

41,496 northern brook lamprey (34,517 - 49,889)
10,446 sea lamprey, including (8,689 - 12,559)
23 individuals undergoing transformation; and (19 - 28)
46 individuals of the native species (38 - 55)

A treatment of 1.30 ha along the river delta in 1984 resulted in an estimate of:

137,118 northern brook lamprey, (98,106 - 191,694)
38,047 sea lamprey, including (27,222 - 53,195)
31 individuals undergoing transformation; and (22 - 43)
62 individuals of the native species (44 - 86)

The smaller treatment area in 1984 represents concentrated efforts to control the area of greatest abundance and the larger treatment area in 1985 represents expansion to control the fringe areas of a decreased population.

In 1984 the sea lamprey population was estimated to be 38,047 in 1.3 ha or 29,267 per ha, with a transformation rate of 24 per ha. In 1985 the population was estimated to be 10,446 in 3.02 ha or 3,459 per ha (a reduction of 88 per cent) with a transformation rate of eight per ha (a reduction of 67 per cent).

The ratio of transforming sea lamprey per 10,000 larvae increased from eight in 1984 to 22 in 1985 (175 per cent increase). This observation reflects a shift in the average age of the sea lamprey larvae on the delta area resulting from the lack of recruitment to the population affected by annual chemical treatments of the river in September 1983 and late August 1984. This policy was continued with the treatment of the river in late August of 1985.

SUBMERSIBLE STUDY IN HARMONY BAY, LAKE SUPERIOR

During the month of June, a total of 5,563 northern brook lamprey, were collected from the East Davignon and Stokely Creeks utilizing modified Harrison-designed backpack electro-shocking units. These larval lamprey were held in a sand substrate with circulating water while six individualized marks were injected by syringe using different combinations of rose, green and yellow dyes suspended in carbopol to identify groups. The larvae were held one week before release to observe any mortality due to handling.

Two weeks prior to the proposed diving schedule of the submersible on July 25 and 26, the six groups (A to F) of marked larvae were transported to Harmony Bay and released at their respective locations (Figure 53), utilizing a SCUBA diver to release them on the bottom. The areas of release were marked with underwater sonar targets and locations were recorded as Loran-C waypoints and latitude-longitude coordinates.

A group of larvae were confined to a cage (4.645×10^{-3} m^2) at location F, to provide a calibration test for the electro-shocking array mounted to the front of the submersible. The cage was removed from the testing site immediately prior to actual testing of the electro-shocker.

Calibration testing of the electro-shocker showed that the unit was very effective at activating larval lamprey but collecting these animals with the suctioning device mounted behind the shocking array was not very successful. The unit's effectiveness for sampling would be improved if a plexiglass umbrella was mounted above the electrical array and the suction was initiated from the apex of the dome. When activated by the electrical field, the larval lamprey attempted to escape by swimming vertically and would naturally funnel themselves into a suctioning device suspended above them by a dome.

Field testing of the electro-shocking array in depths ranging from nine 20 m adjacent to the Harmony (Chippewa) River delta resulted in larval lampreys activated by the shocking array but attempts at collecting them were futile.

Attempts at activating and observing any of the marked lamprey in areas C, D, and E were negative and no further investigations were carried out at areas A or B.

Survival of larval lamprey in the bay had been tested in June by caging several densities of ammocoetes at 9 and 21 m depth. After two weeks, the same time frame between release and electro-shocking by submersible, the cages were lifted and no mortality was observed. At both locations the cages were lifted with crayfish clinging to their frames.

The chemical treatments with granular Bayer 73 along the steep drop-off of the Harmony (Chippewa) River delta on July 26 and 29 resulted in the capture of several of the marked lamprey released in Harmony Bay (Table XI). Of particular interest is the observation that four individuals released at area A on July 11, were captured on the Harmony (Chippewa) River delta on July 26. These animals had migrated approximately 2 km in 15 days. Representatives from each release site except the southwest corner (area D) were captured on the Harmony (Chippewa) River delta.

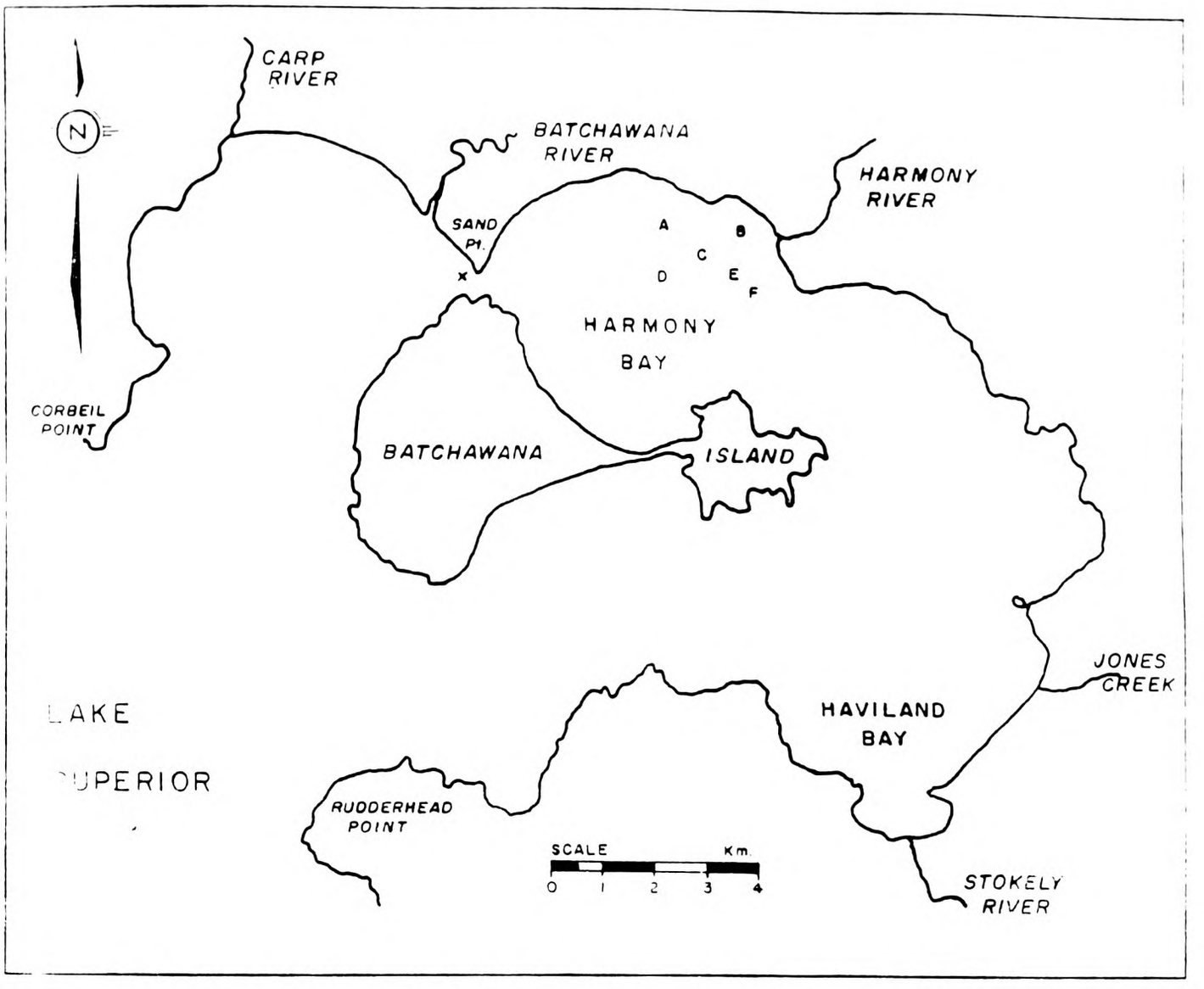


Figure 53. Harmony Bay submersible study, 1985. Locations of releases and recaptures.

Area of Release	Number Released	Colour	Location	Number Recaptured	Area of Recapture
A	1,118	Green	Dorsal	4	Harmony (Chippewa) River delta
				1	Sand Point
B	1,016	Green	Fin	1	Harmony (Chippewa) River delta
C	1,044	Red	Dorsal	1	Harmony (Chippewa) River delta
D	1,059	Yellow	Dorsal	0	N/A
E	1,032	Red	Fin	4	Harmony (Chippewa) River delta
				1	Harmony (Chippewa) River,Hwy.17
F*	280	Yellow	Fin	26	Calibration test
TOTALS	5,549			38	

* Ammocoetes in this area were confined in a cage until calibration testing with the electro-shocking array attached to the submersible was attempted.

On July 31 a single recapture from area A was collected from a granular Bayer 73 application to the west side of Sand Point. A distance of approximately 3.25 km had been travelled by this individual in 20 days.

Chemical treatment of the Harmony (Chippewa) River on August 27 to 28, 1985 resulted in the capture of one marked lamprey from area E at the base of Chippewa Falls on August 27. This ammocoete (129 mm in length) had travelled approximately 1 km from the point of release to traverse the river delta and an additional 1.5 km of river to reach the base of the falls in a period of 32 days.

ST. MARYS RIVER

Activities for 1985 included sea lamprey larval distribution surveys, larval population estimates, and estimating the size of the 1985 spawning run of sea lamprey.

Larval Surveys

Surveys, using the toxicant granular Bayer 73 were done during the months of July and August for the purpose of more precisely determining the upstream and downstream distribution of sea lamprey larvae in the Canadian waters of the St. Marys River and to evaluate larval density within areas of known distribution. A total of 81 plots were surveyed, 45 of which were located in the upper river (upstream of the compensating works) and 36 in the lower river (Figures 54, 55 and 56). Of these, 14 and 17 respectively, were positive for sea lamprey larvae. All survey data is summarized in Table XI.

Upstream and downstream distribution remains essentially unchanged from that documented in 1984. Infestation extends from about 1.5 km upstream of Point Louise (Figure 54), 52 km downstream, via Lake Nicolet, to about 1.5 km into Munuscong Lake (Figure 56). In addition, the Lake George channel is infested to a point approximately 2.5 km into Lake George (Figure 55).

Intensive surveying of the area immediately above the compensating gates was possible in 1985 due to complete closure of the gates for remedial work in the rapids. Although habitat is minimal in this area, the substrate being predominately bedrock and boulder, seven of the 10 plots done were positive for sea lamprey larvae with a total of 209 being collected (sites 42 to 51, Table XI).

Surveys of about 2 km of the harbour area below the rapids at Sault Ste. Marie, an area previously thought to have heavily polluted substrate, found moderately large numbers of sea lamprey larvae. Of the 12 plots surveyed, 11 were positive and a total of 782 sea lamprey were taken from them.

Two surveys, using electro-shockers, were done in late June - early July in Whitefish Channel at Sault Ste. Marie to continue evaluating growth rates and to obtain specimens for mark-recapture population studies in the river (sites 52 and 53, Figure 55). Growth rates, based on evaluation of the length-frequency distribution of the 363 larvae collected are slow, averaging about 20 mm per year for the first four years of life in Whitefish Channel. Small sample size has prevented growth rate estimation of larvae beyond four years of age in

Whitefish Channel. Downstream, in the main river where large samples of [illegible] lampreys are regularly taken, length-frequency differentiation seems [illegible] inadequate for determining age and growth rates.

During 1985 a Loran "C" navigation receiver was used for the first [illegible] to document survey locations. The instrument performed well and will allow [illegible] to relocate survey sites with much greater precision than in the past.

Larval Population Estimates

Estimates of sea lamprey larval populations were made in 15 of the [illegible] plots surveyed with granular Bayer in 1985. The technique used was a simple [illegible] census mark-recapture, differing from the simple Petersen method only to the [illegible] extent that the specimens used for marking were originally collected outside the [illegible] study plots.

Sea and/or American brook lamprey larvae were marked with subcutaneous [illegible] injections of Rose Tracer-glo pigment and released in the study plots normally [illegible] 24 h prior to treatment. Treatment with Bayer 73 granules was at the rate of [illegible] 225 kg/ha (200 lb./acre). All collecting was by personnel using scap nets from [illegible] boats patrolling the study plots.

The results of the 1985 population estimates are summarized on Table [illegible] XII. These population data will be pooled with that collected in previous years [illegible] to make a composite population estimate for all of the Canadian waters of the [illegible] St. Marys River.

Due to the difficulty of obtaining sea lamprey larvae in the Sault Ste. [illegible] Marie area, American brook lamprey are frequently substituted in mark-recapture [illegible] studies. The relative susceptibility and/or catchability of the two species [illegible] during granular Bayer treatments has not been firmly established. A pilot study [illegible] done and reported in the 1984 Annual Report, found American brook lamprey to be [illegible] 3.41 times as recoverable as sea lamprey larvae.

In 1985 the recoverability of the two species was again compared in two [illegible] of the population estimate test plots (Sites 66 and 67, Figure 55, and Table [illegible] XII). In each test plot equal numbers of similar sized and marked American [illegible] brook and sea lamprey larvae were released. Personnel were instructed to be [illegible] non-selective while collecting following treatment with the Bayer 73 at 225 [illegible] kg/ha. Recoveries of sea lamprey were much higher than of American brook [illegible] lamprey in both test plots; being 1.44 and 2.67 times as great. This [illegible] contradicts the findings of 1984 when sea lamprey were only 0.29 times as [illegible] recoverable.

Collecting conditions undoubtedly contributed to this disparity. Low [illegible] waters and overcast skies in 1984 probably favoured collection of the light [illegible] coloured brook lamprey at that time. Although weather and surface conditions [illegible] were good in 1985, heavy gull predation on both test plots, which typically [illegible] delayed in response to the timing of larval activity, favoured the collection of [illegible] sea lamprey larvae as they tend to emerge sooner than brook lampreys in granular [illegible] Bayer treatments.

Adult Population Estimate

A Shaefer type population estimate was made of the spawning run of sea lampreys in the St. Marys River in 1985. This was the first time a composite estimate was made of the run at Sault Ste. Marie. Earlier estimates were designed to test the efficiency of individual trapping sites.

This study was done with the cooperation of the U. S. Fish and Wildlife Service and utilized their normal assessment traps at the U. S. Corps of Engineers Power House, along with the two assessment traps operated by this Centre at the Great Lakes Power House on the Canadian side of the river.

A portion of the sea lampreys from each trapping site were marked and released daily (Monday to Friday) approximately 5 km downstream at the Sugar Island ferry crossing. Marking, by fin perforation was discrete as to site of original capture and week of release. All recaptured animals were removed from the population and sampled for biological data (length, weight, sex). The data from the study that ran from June 9 to August 9 and resulted in a computed composite estimate of 23,852 lamprey is summarized in Table XIII.

Of particular interest is the 47 per cent efficiency of the assessment traps in 1985. Although this was undoubtedly enhanced by the timely shut down of the St. Marys Rapids for remedial construction work during the period of the study, it does suggest that intensified trapping along with other integrated control measures such as a sterile male release program could effectively reduce recruitment to the larval population in the river.

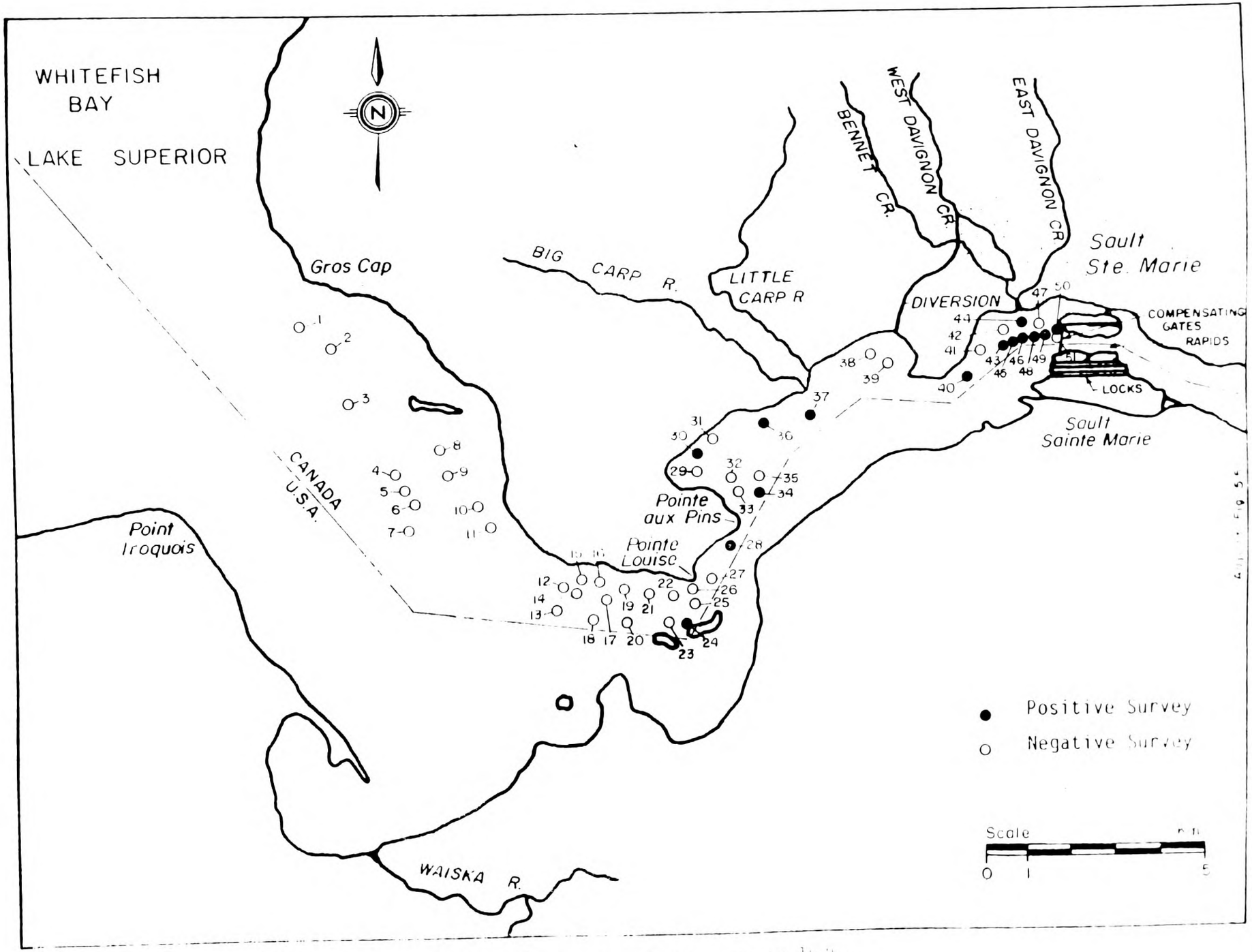
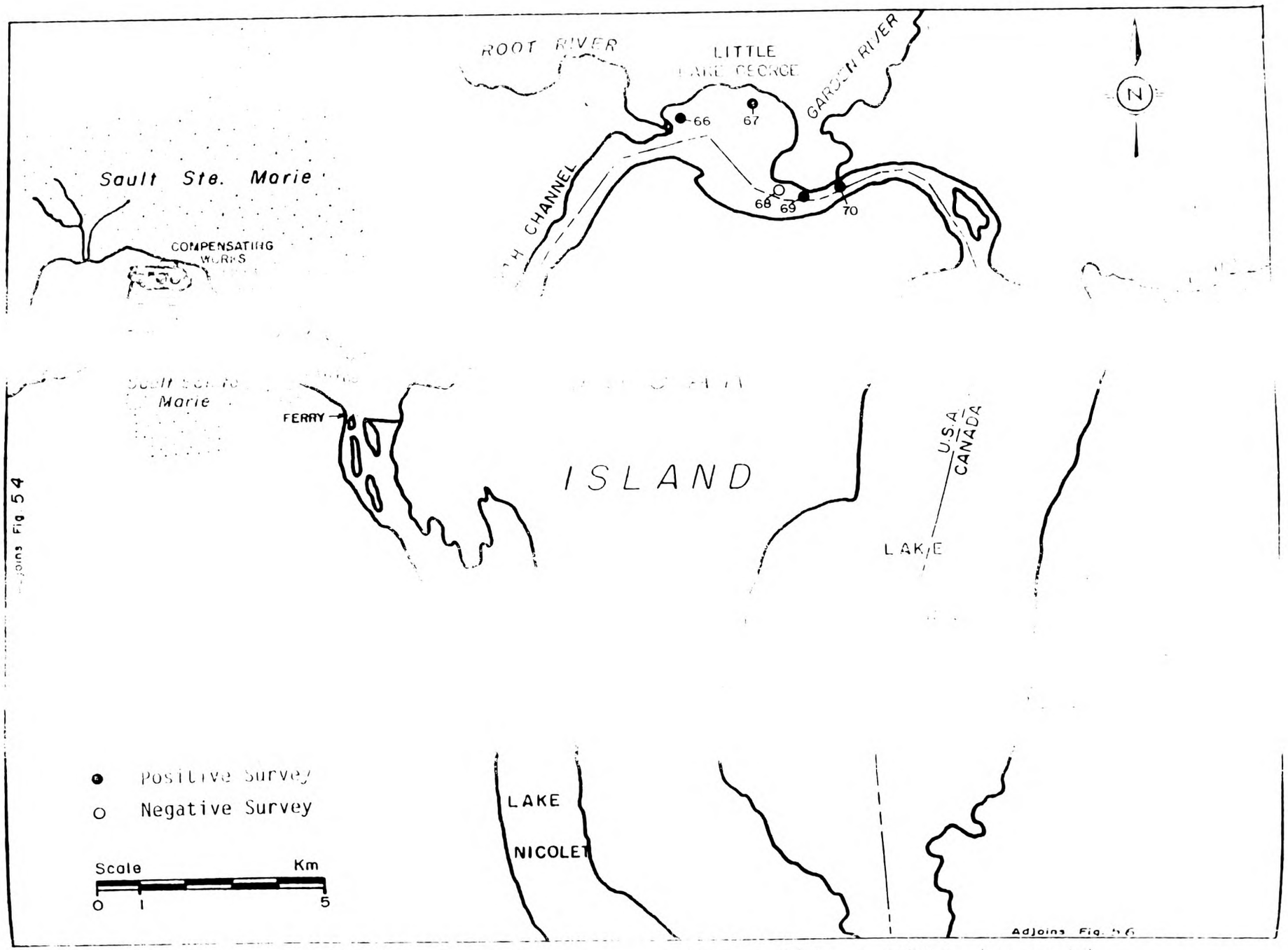


Figure 54. Upper St. Marys River sampling locations and surveys conducted in 1975.


ROOT RIVER
LITTLE
LAKE GEORGE
GARDEN RIVER
66
67
68
69
70
N
Sault Ste. Marie
COMPENSATING
WORKS
H CHANNEL
Sault Ste.
Marie
FERRY
ISLAND
U.S.A.
CANADA
LAKE
LAKE
NICOLET
Positive Survey
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Adjoins Fig 54
Adjoins Fig 56

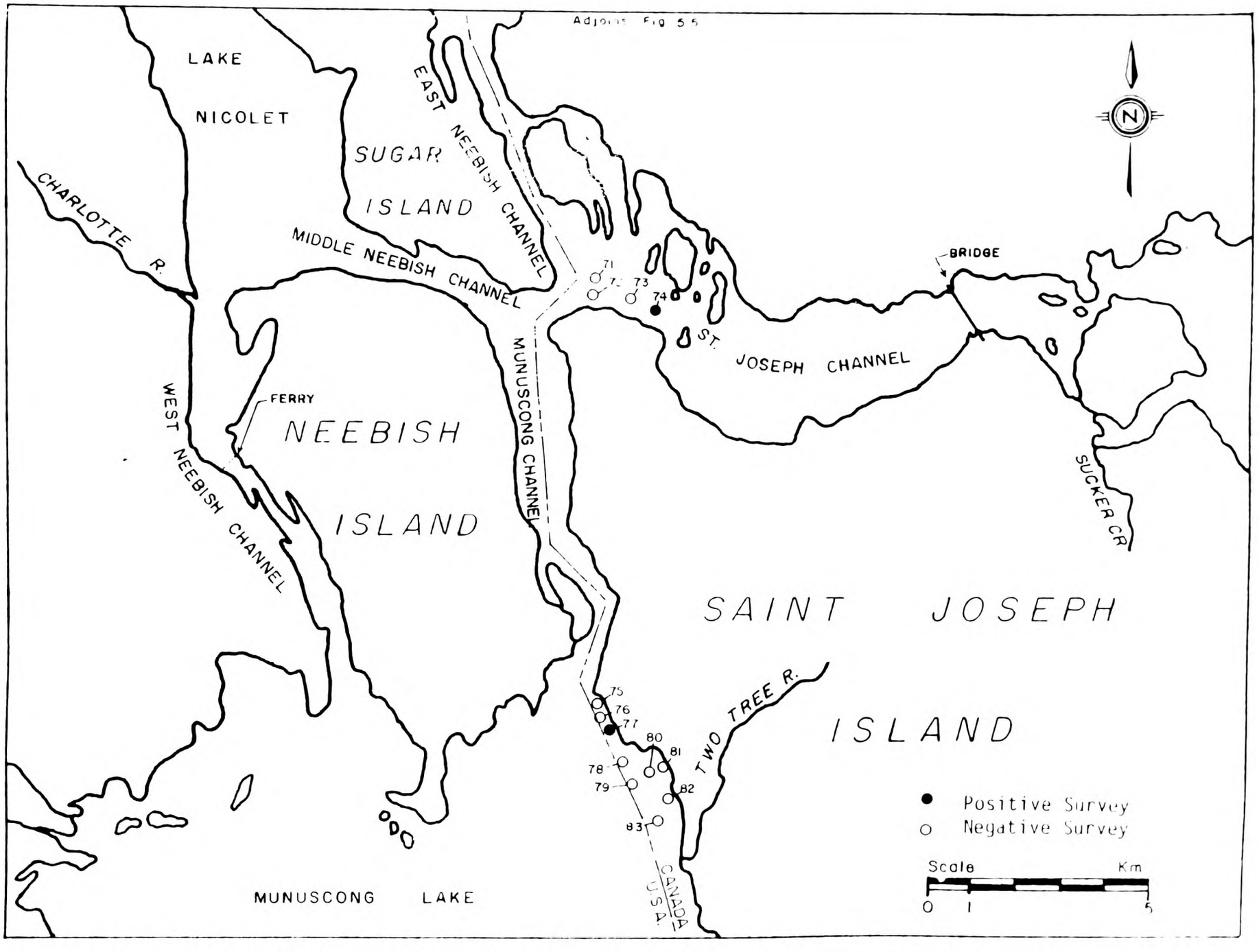


Figure 56. Southern portion of lower St. Marys River showing locations of surveys done in 1985.

Table XI. Summary of larval assessment data from Canadian waters of the St. Marys River, 1985.

Location[1]	Date of Survey	Area (m^2) Surveyed	Method	Quantity[2] G.B. (kg) Used	Person Hours Collecting	Petromyzon marinus				Lampetra appendix	Ich. spp.
						No. larvae	Size Range (mm)	No. Transf.	Size Range (mm)	No.	No.
1	Aug. 29	1,000	G.B.	22.7	4.0	0	-	0	-	0	0
2	Aug. 29	1,000		22.7	4.0	0	-	0	-	0	0
3	Aug. 29	1,000		22.7	6.0	0	-	0	-	0	0
4	Aug. 30	1,000		22.7	4.0	0	-	0	-	0	0
5	Aug. 30	1,000		22.7	4.0	0	-	0	-	0	0
6	Aug. 30	1,000		22.7	4.0	0	-	0	-	0	0
7	Aug. 9	2,000		45.4	6.0	0	-	0	-	0	0
8	Aug. 28	1,000		22.7	3.0	0	-	0	-	0	0
9	Aug. 28	1,000		22.7	4.0	0	-	0	-	0	0
10	Aug. 28	1,000		22.7	4.0	0	-	0	-	0	0
11	Aug. 28	1,000		22.7	3.0	0	-	0	-	1	0
12	Aug. 22	1,000		22.7	4.0	0	-	0	-	0	0
13	Aug. 22	1,000		22.7	6.0	0	-	0	-	1	0
14	Aug. 30	1,000		22.7	4.0	0	-	0	-	0	0
15	Aug. 30	1,000		22.7	4.0	0	-	0	-	16	0
16	Aug. 22	1,000		22.7	4.0	0	-	0	-	0	0
17	Aug. 23	1,000		22.7	4.0	0	-	0	-	22	0
18	Aug. 22	1,000		22.7	6.0	0	-	0	-	69	0
19	Aug. 30	1,000		22.7	4.0	0	-	0	-	152	0
20	Aug. 23	1,000		22.7	3.0	0	-	0	-	0	0
21	Aug. 23	1,000		22.7	4.0	0	-	0	-	27	0
22	Aug. 9	2,000		45.4	7.0	0	-	0	-	84	0
23	Aug. 23	1,000		22.7	4.0	0	-	0	-	25	0
24	Aug. 9	2,000		45.4	4.0	2	82-92	0	-	130	0
25	Aug. 23	1,000		22.7	4.0	0	-	0	-	2	0
26	Aug. 30	1,000		22.7	4.0	0	-	0	-	0	0
27	Aug. 23	1,000		22.7	3.0	0	-	0	-	5	0
28	Aug. 9	2,000		45.4	6.0	15	45-112	0	-	539	0
29	Aug. 8	1,000		22.7	4.0	0	-	0	-	13	0
30	Aug. 22	1,000		22.7	4.0	1	117	0	-	0	0
31	Aug. 22	1,000		22.7	6.0	0	-	0	-	0	0
32	Aug. 8	1,000		22.7	3.0	0	-	0	-	4	0
33	Aug. 22	1,000		22.7	4.0	0	-	0	-	1	0
34	Aug. 8	2,000		45.4	9.0	2	68-112	0	-	91	0
35	Aug. 22	1,000		22.7	4.0	0	-	0	-	0	0
36	Aug. 8	1,000		22.7	4.0	2	45-114	0	-	1	0
37	Aug. 8	2,000		45.4	5.0	7	64-76	0	-	8	0
38	Aug. 8	1,000		22.7	4.0	0	-	0	-	0	0
39	Aug. 8	2,000		45.4	3.0	0	-	0	-	0	0
40	Aug. 7	1,000		22.7	4.0	6	50-87	0	-	53	0
41	Aug. 7	1,000		22.7	4.0	0	-	0	-	3	0
42	Aug. 6	1,000		22.7	2.7	0	-	0	-	0	0

43	Aug. 7	1,000		22.7	4.0	18	50-105	0	-	41	0
44	Aug. 6	1,000		22.7	4.3	26	62-103	0	-	56	0
45	Aug. 23	2,000		45.4	6.0	35	38-107	0	-	81	0
46	Aug. 7	1,000		22.7	4.0	37	54-110	0	-	42	0
47	Aug. 6	1,000		22.7	4.0	0	-	0	-	2	0
48	Aug. 23	2,000		45.4	5.0	35	59-134	0	-	271	0
49	Aug. 6	1,000		22.7	4.0	54	35-117	0	-	12	0
50	Aug. 6	1,000		22.7	4.0	4	97-124	0	-	12	0
51	Aug. 6	1,000		22.7	4.0	0	-	0	-	0	0
52	June 28	1,000	E.S.	-	4.0	135	19-154	0	-	30	0
53	July 8	1,000	E.S.	-	12.5	228	28-152	0	-	40	1
54	July 30	1,000	G.B.	22.7	6.0	115	78-152	0	-	24	1
55	July 30	1,000		22.7	6.0	0	-	0	-	0	0
56	July 30	1,000		22.7	6.0	262	28-132	0	-	30	4
57	July 30	1,000		22.7	6.0	89	31-154	0	-	17	0
58	July 30	1,000		22.7	6.0	51	30-162	0	-	17	0
59	July 30	1,000		22.7	6.0	14	47-139	0	-	2	0
60	July 29	1,000		22.7	6.0	4	73-139	0	-	0	0
61	July 29	1,000		22.7	6.0	12	60-100	0	-	0	0
62	July 29	1,000		22.7	6.0	29	33-115	0	-	0	0
63	July 29	1,000		[illegible]	[illegible]	[illegible]	[illegible]	0	-	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
66	Aug. 16	6,000		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
67	Aug. 16	2,000		45.4	12.0	1	139	3	134-155	0	0
68	Aug. 16	1,000		22.7	4.0	0	-	0	-	0	0
69	Aug. 16	1,000		22.7	4.0	1	73	0	-	0	0
70	Aug. 16	1,000		22.7	6.0	2	57-62	1	132	1	0
71	Aug. 2	2,000		45.4	6.0	0	-	0	-	0	0
72	Aug. 2	1,000		22.7	6.0	0	-	0	-	0	0
73	Aug. 2	1,000		22.7	4.0	0	-	0	-	0	0
74	Aug. 2	1,000		22.7	6.0	1	115	0	-	0	0
75	Aug. 1	1,000		22.7	7.0	0	-	0	-	0	0
76	July 31	1,000		22.7	6.0	0	-	0	-	0	0
77	July 31	1,000		22.7	6.0	1	83	0	-	0	0
78	Aug. 1	2,000		45.4	6.0	0	-	0	-	0	0
79	July 31	1,000		22.7	4.0	0	-	0	-	0	0
80	July 31	1,000		22.7	4.0	0	-	0	-	0	0
81	July 31	1,000		22.7	5.0	0	-	0	-	1	0
82	Aug. 1	1,000		[illegible]	[illegible]	0	-	0	-	0	[illegible]
[illegible]	Aug. 1	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]
TOTALS -											
Electro-shocking (2 Plots)	2,000				16.5	363	19-154	0	-	70	[illegible]
Granular Bayer (81 Plots)	98,000			2,224.5	403.0	1,033	28-162	11	132-169	1,856	[illegible]

[1] Survey locations - Nos. 1 to 51 on Figure 54; 52 to 70 on Figure 55; 71 to 83 on Figure 56

[2] Granular Bayer expressed as kg of product (5% active ingredient)

Table XII. St. Marys River mark-recapture larval population estimates, 1985.

Location[1]	Release Date	No. Marked Released P.m.	No. Marked Released L.a.	Treatment Date	Area Treated ha	Person hours Collecting	Recaptures P.m.	Recaptures L.a.	Unmarked Captures[2] P.m.	Unmarked Captures[2] L.a.	Population Estimate[3] [2] for study area P.m.	Population Density[2] P.m./ha
7	Aug. 8	0	300	Aug. 9	0.20	6.0	-	83	0	0	0	0
22	Aug. 8	0	300	Aug. 9	0.20	7.0	-	0	0	84	0	0
24	Aug. 8	0	300	Aug. 9	0.20	4.0	-	77	2	130	8	40
28	Aug. 8	0	300	Aug. 9	0.20	6.0	-	2	15	539	2,250	11,250
32	Aug. 7	0	300	Aug. 8	0.20	3.0	-	120	0	0	0	0
34	Aug. 7	0	300	Aug. 8	0.20	5.0	-	53	7	8	40	200
37	Aug. 7	0	300	Aug. 8	0.10	3.0	-	23	0	4	0	0
39	Aug. 7	0	300	Aug. 8	0.20	9.0	-	3	2	91	200	1,000
45	Aug. 22	0	300	Aug. 23	0.20	5.0	-	19	35	271	553	2,765
48	Aug. 22	33	341	Aug. 23	0.20	6.0	0	3	35	81	4,363	21,810
58	July 29	0	300	July 30	0.10	6.0	-	52	51	17	294	2,940
66	Aug. 13	657	657	Aug. 16	0.60	13.0	91	63	1(7)	0	9(60)	15(100)
67	Aug. 13	300	300	Aug. 16	0.20	12.0	96	36	1(3)	0	5(14)	25 (70)
71	July 31	0	300	Aug. 2	0.20	6.0	-	14	0	0	0	0
78	July 31	0	300	Aug. 1	0.20	6.0	-	66	0	0	0	0

[1] Location: Numbers 7 through 48 on Figure 54;
58, 66, 67 on Figure 55; and
71, 78 on Figure 56

Note: Numbers also correspond to those on Table XI

[2] Bracketed figures denote numbers of transformers - not included in larvae numbers

[3] Population estimate is based on simple ratio and proportion

Table XIII. Data summary - St. Marys River adult sea lamprey population estimate, 1985.

	DFO Traps	USFWS Traps	TOTALS
Total original catch	7,788	3,423	11,191
Total marked and released	2,402	1,344	3,826
Recaptures with DFO marks	824	233	1,057
Recaptures with USFWS marks	451	73	524
Total number of recaptures	1,275	306	1,581
Sex ratio of recaptures (% males)	62.4	68.0	63.5

SHAEFER POPULATION ESTIMATE: 23,852

SALEM CREEK POPULATION STUDY

Salem Creek, Cramahe Township, Northumberland County, Ontario, a tributary to Lake Ontario was scheduled for chemical treatment in September 1985,3.5 years following the last chemical treatment in May 1982. Biannual electro-fishing surveys of the stream following the 1982 treatment failed to produce any evidence of sea lamprey larvae which may have escaped chemical application but did document annual recruitment from a limited spawning run of adult sea lamprey. Local accounts from people dipping smelts in the spring of 1985 reported thirty-eight adult sea lamprey captured and killed at the Blyth Road culvert. In preparation for a growth study of the reestablished population of sea lamprey larvae, a population estimate was initiated in May 1985 on the 2.1 km of stream inhabited by larval sea lamprey.

The stream was divided into three sections, "A", "B", and "C" (Figure 57) and on May 2 to 4, a total of 1,096 larval sea lamprey were captured by electro-fishing techniques, marked with injections of dye in carbopol ventrally from the anus to the tip of the caudal peduncle, and were released back to the same area of the stream from which they had been collected. A subsample of 332 ammocoetes from section "A" were anesthetized, measured to the nearest millimetre, weighed to the nearest tenth of a gram and revived before release into the same area. Individual colours were used for each section. Section "A" had 368 larvae marked with red dye, section "B" had 327 green marked larvae, and section "C" had 388 yellow marked larvae. The length frequency distribution of these marked ammocoetes is shown in the accompanying figure. Four ammocoetes succumbed to the initial trauma of shocking and marking and nine additional red marked ammocoetes from section "A" were lost to bioassay collectors on May 6 when a preliminary population estimate was conducted.

Salem Creek has been traditionally used as the source of bioassay specimens required by the chemical treatment unit because of the large number of ammocoetes available and the ease of shocking the stream. It also afforded an opportunity to estimate the population using electro-shockers and to compare this value to that from the chemical treatment. Since only ammocoetes over 60 mm were required for bioassay specimens, results were calculated using marked ammocoetes over 60 mm ($\hat{N}_{>60\ mm}$) and then estimating total population ($\hat{N}_{es}$) from the ratio of ammocoetes less than 60 mm to total ammocoetes collected during the initial electro-shocking. Population numbers were calculated using Chapman's adjusted Petersen estimate (Ricker 1975) for each area and then totalled for a value of 35,731 (Table XIV).

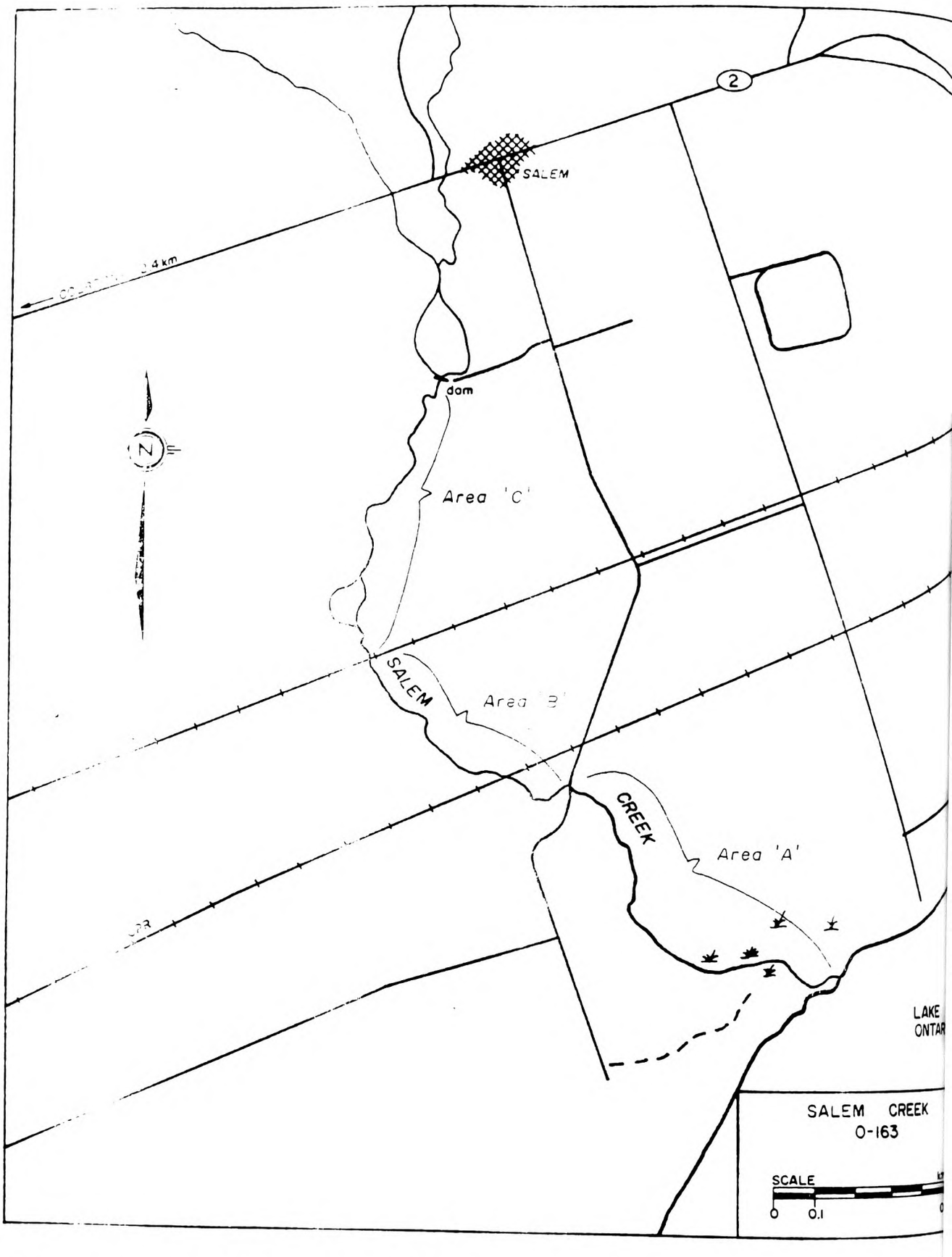


Figure 7. Map of Salem Creek showing locations of the study areas.

The September 13, 1985 treatment of Salem Creek resulted in a collection of 4,472 (12 to 176 mm) larval sea lamprey, including 30 (40 to 135 mm) marked ammocoetes, 212 (118 to 167 mm) transforming sea lamprey and 586 (13.1 per cent) ammocoetes identified as young-of-the-year (YOY) (12 to 31 mm). In addition approximately 75 transformers were frozen and delivered to an investigator at the University of Guelph for statolith analysis but no results have been received at this time. Calculation of the ammocoete population (Chapman's adjusted Petersen estimate) ($\hat{N}_{Ct}$) from the spring marking (excluding YOY) resulted in a value of 147,753 (Table XIV). Estimates of the YOY ($\hat{N}_{YOY}$) from capture ratios resulted in 16,924. It is acknowledged that the difficulty of capturing YOY has probably underestimated the actual numbers of YOY by at least a factor of 0.5. The spring estimate utilizing electro-shockers was only 24.2 per cent of the fall estimate. Follow up studies on this stream will attempt to verify if the low estimate of population using electro-shockers is a true evaluation of electro-shocking efficiency.

The numbers of transformers were estimated ($\hat{N}_t$) from the ratio of transformers/ammocoetes in the collections turned in by the treatment personnel and fyke net collections. Several collections of transformed animals the day following treatment were intentionally excluded from the collections. The numbers of transformers were estimated to be 9,549.

Transformed animals and a sample of ammocoetes over 120 mm were processed (after preservation with 10 per cent formaldehyde) for weight, length and sex. Similarly all transformed sea lamprey and ammocoetes over 120 mm collected from the 1985 October treatments of Skinner, Lindsey, and Duffin Creeks and the Little Salmon River (Lake Ontario tributaries) were processed for weight, length and sex. The results are summarized in Table XV.

Of the sample of 212 transforming sea lamprey from Salem Creek, 36 per cent were males with an average length of 141 mm and an average weight of 4.31 g while the females averaged 143 mm in length and 4.58 g in weight. A total of 115 additional transforming sea lamprey were collected from the remaining four streams that were treated in the fall of 1985. The transforming sea lamprey from these four streams were on the average larger than those from Salem Creek, and the largest collected was from Lindsey Creek, a female, 188 mm in length and 11.18 g in weight. When all transforming sea lamprey from Lake Ontario were considered as a group, 39 per cent were males averaging 146 mm in length and 4.83 g in weight. The females averaged 148 mm in length and 5.15 g in weight. The ammocoetes over 120 mm had a sex ratio of 39 per cent males, males averaging 134 mm and 3.76 g while the females averaged 133 mm and 3.72 g.

The sample of adult sea lamprey (2,602) captured during the spawning run in Canadian tributaries of Lake Ontario had a sex ratio of approximately 63 per cent males and has remained near the 60 per cent value for the last several years. If the sex ratio of transformed sea lamprey (39 per cent males) from the five streams treated in 1985 accurately represents all streams of Lake Ontario currently being treated with chemical, the question arises, "Why is there such a difference between sex ratios observed in the transformer population and the adult spawning population?".

Reference

Ricker, W. E. 1975. Computation and Interpretation of biological statistics of fish populations. Dept. Env. Fish. & Marine Serv., Bull. 191: 382 pp.

Table XIV.
Salem Creek population estimate, May 1985 (sampling by electro-shockers).

Station	Number Marked	Number Recaptured	Number Unmarked	$\hat{N}_{>60mm}$	(95% Con.Lim.)	$\hat{N}_{es}$	(95% Con.Lim.)
A	269	29	794	9,576	(6,707-13,673)	13,456	(9,425-19,2
B	174	15	120	3,227	(1,986-5,246)	6,065	(3,732-9,8
C	251	11	214	9,786	(5,595-17,143)	15,244	(8,716-26,7
Total	694	55	1,128	22,589	(14,285-36,062)	35,731	(27,515-46,4

Salem Creek population estimate, September 1985 (sampling by chemical treatment).

Station	Number Marked	Number Recaptured	Number Unmarked >32 mm	Number Unmarked <32 mm	$\hat{N}_{ct}$	(95% Con.Lim.)	$\hat{N}_{yoy}$	(95% Con.Lim.)
A	368	3	812	43	75,276	(34,062-301,104)	3,972	(1,797-15,88
B	327	11	473	116	13,257	(8,071-25,951)	3,177	(1,934-6,22
C	388	16	2,571	427	59,220	(38,720-102,310)	9,775	(6,391-16,88
Total	1,083	30	3,856	586	147,753	(80,853-429,365)	16,924	(10,122-33,99

Salem Creek transformer population estimate, September 1985

Station	Number Transformers	Number Ammocoetes	$\hat{N} = \hat{N}_{ct} + \hat{N}_{yoy}$	$\hat{N}_t$	(95% Con.Lim.)	$\% \hat{N}_{ct}$
A	68	673	79,248	8,007	(3,623-32,029)	10.1
B	17	587	16,434	476	(290-932)	2.9
C	46	2,976	68,995	1,066	(697-1,842)	1.5
Total	131	4,236	164,677	9,549	(4,610-34,803)	5.8

$\hat{N}_{>60mm}$ = Estimator number of ammocoetes over 60 millimetres
$\hat{N}_{es}$ = Number of ammocoetes estimated by electro-shocker results
$\hat{N}_{yoy}$ = Number of ammocoetes estimated as young-of-the-year
$\hat{N}_{ct}$ = Number of ammocoetes over 32 mm estimated during chemical treatment
$\% \hat{N}_{ct}$ = Estimated number of transforming sea lamprey expressed as a per cent

Table XV. Summary of data from larval sea lamprey >120 mm from Lake Ontario tributaries, 1985.

Collection Site	Ammocoetes							Transformers						
	Number Males	%	$\bar{W}$ g	$\bar{L}$ mm	Number Females	$\bar{W}$ g	$\bar{L}$ mm	Number Males	%	$\bar{W}$ g	$\bar{L}$ mm	Number Females	$\bar{W}$ g	$\bar{L}$ mm
Salmon Creek	146	29	3.96	132	364	3.53	132	77	36	4.31	141	135	4.58	144
Skinner Creek	51	51	3.59	132	49	3.63	133	3	38	4.26	143	5	6.30	156
Lindsey Creek	50	35	3.74	132	93	3.63	131	1	33	5.13	144	2	8.96	176
Duffin Creek	100	56	4.06	138	80	4.54	142	38	42	5.75	155	52	6.23	159
Little Salmon Cr.	28	44	3.77	136	35	4.03	139	16	71	5.68	150	7	6.7	4
Combined	337	39	3.76	134	521	3.77	133	129	39	4.33	146	193	5.17	14

APPENDIX I

MEMORANDUM OF AGREEMENT

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 PROGRAM

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 reward.

timated cost ,400. (Canad rrency)
,900. (U. S. ncy)

B. LARVAL SEA LAMP SESSMENT PRO

To evaluate the s ss of curren d past lampri applica-
tions and to pla ture treatme operations, th partment
will determine the esence, relati abundance and tribution
of sea lamprey l e by conducting surveys using pricides
and/or electro-fi g gear on app imately 20 La Superior,
20 Lake Huron, and Lake Ontario anadian and Uni States),
tributaries, and r related lak reas, as requi .

stimated cost $ 9,200. (Canadi Currency)
$169,500. (U. S. rrency)

C. CHEMICAL TREATME OJECT

To control sea l ey throughout he Great Lakes by periodic
application of i icides, the Department will reat the
following 28 tri ies and six ke areas curre infested
with sea lamprey l e:

1. Lake Superior

a. With TFM - Davignon nd, Big Goulais,
ewa, Pan el, McIntyr ng, and
n Rivers.

b. With Granu ayer 73 - , Batchawana tain and
ess Bays, n en Lake.

2. Lake Huron

a. With TFM - awong, Min n, Serpent, eon and
le Rivers a ichardson and Creeks.

b. With Granu ayer 73 - St rys River an o Lake.

3. Lake Ontario

a. With TFM: nada - Credit iver, and Britain,
fton, Lakepor , alem and Smith ld Creeks.

ited States - Little Sandy, rindstone,
mile and Ste ng Creeks, and tle Salmon
er.

b. With Granu Bayer 73: Tr River-Canal.

timated cost $1,133,600. (Can Currency)
1,161,200. (U. S. rrency)

C. LAMPRICIDE REQUIREMENTS

a. The Department will use approximately 26,800 lbs. of TF 352 lbs. of powdered Bayer 73, and 20,000 lbs. of Granul Bayer 73 from existing inventory in carrying out t lampricide treatments and surveys proposed in th Agreement.

b. The Commission will purchase, for Canadian use, approx mately 30,159 lbs. of TFM, 20,000 lbs. of Granular Bay 73 and 650 lbs. Powdered Bayer 73 in 1985, to comple future treatment commitments.

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

D. SEA LAMPREY BARRIER DAM PROJECT

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

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

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

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

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

4. Additional costs for this program to be funded from fund 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 account ability of the Centre's current sea lamprey control program, th Department will:

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

2. Continue the study of sea lamprey larval populations and relate 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 Centre 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.

II. IT IS AGREED that the Director of the Sea Lamprey Control Centre shall be the field representative of the Department and, in this capacity, be the liaison officer between the Department and the Executive Secretary of the Commission, and shall be empowered to act for the Commission in all matters pertaining to management and operation of the Sea Lamprey Control program in Canada, and will follow the program set out herein as closely as practicable. The Centre will also perform sea lamprey control in the United States as directed by the Commission. The Director of the Sea Lamprey Control Centre shall have the power to make changes or variations as may be necessary or desirable due to field conditions, with the knowledge and consent of the Commission. The Director of the Sea Lamprey Control Centre will be responsible to the Director General, Ontario Region, Department of Fisheries and Oceans, Pacific and Freshwater Fisheries (as representative of the Deputy Minister) to comply with policies and procedures which apply to the Department with respect to expenditures and the accountability for and control of assets.

III. IT IS AGREED that progress reports on accomplishments shall be made by the Sea Lamprey Control Centre to the Commission at its interim and annual meetings, and final report for the year submitted not later than the Commission's Annual Meeting in 1986.

IV. IT IS AGREED that the Commission shall pay or cause to be transferred to Her Majesty upon demand the sum of $2,199,200. Canadian Currency ($1,781,400. U. S. Currency) as soon as practicable after October 1, 1984. The total $2,199,200. Canadian Currency ($1,781,400. U. S. Currency) is the estimated cost to Her Majesty to carry out Her functions under this Agreement, exclusive of the additional $282,300. (U.S. Currency) to be forwarded to the Commission for the purchase of lampricides. The Commission shall cause $1,040,700. Canadian Currency ($843,100. U. S. Currency) [and

part of the $2,199,200. Canadian Currency ($1,781,400. U.S. Currency) sum above], to be forwarded to the Director of the Sea Lamprey Control Centre to fund the requirements for temporary personnel, other operational costs, and the balance of the Sea Lamprey Control Centre's program in Canada and the United States, exclusive of the salaries for the continuing employees of the Sea Lamprey Control Centre.

V. IT IS AGREED that in the event of an increase in the annual salaries and wages paid to the continuing employees of the Sea Lamprey Control Centre of the Department during the term of the Agreement, the budgeted amount of $1,158,500. Canadian Currency ($938,300. U. S. Currency) included in Section IV shall be increased by an amount to cover such salary increases, including the increased amount payable in respect of superannuation.

VI. IT IS AGREED that the Department shall expend funds made available to it for the purposes and objects authorized by law and this Agreement and account to the Commission for funds so expended by making quarterly reports within 30 days of the quarterly dates and a final report as provided hereunder. The Department shall report to the Commission by December 1, 1985 on funds expended for the period October 1, 1984 to September 30, 1985. Any unexpended amount of the funds advanced shall be refunded to the Commission as soon after the end of the period covered by the Agreement as final costs are determined.

VII. IT IS AGREED that the Sea Lamprey Control Centre shall expend funds made available to it for the purposes and objects authorized by law and this Agreement and account to the Commission for funds so expended by making quarterly reports within 30 days of the quarterly dates and a final report as provided hereunder. The Sea Lamprey Control Centre shall report to the Commission at its annual meeting in 1986 on all work carried out and on funds expended for the period October 1, 1984 to September 30, 1985. Any unexpended amount shall be refunded in accordance with Article VI.

VIII. IT IS AGREED that an audit may be performed, on behalf of the Commission of the funds expended by the Sea Lamprey Control Centre in carrying out the Commission's program. This audit will be conducted on a cyclical basis by the Department as part of its internal audit plan. A copy of the report will be provided to the Commission.

IX. IT IS AGREED that the Commission will delegate to the Director and Administrative Officer of the Sea Lamprey Control Centre, signing authority for expended funds for the Commission's program.

X. IT IS AGREED that the Commission will hire, through the Centre additional personnel required to perform its program in Canada and the United States. These employees will be paid in accordance with Government of Canada Treasury Board schedules for salary, pay benefits, and travel, and will follow the work schedules of continuing employees of the Sea Lamprey Control Centre.

XI. IT IS AGREED that property, equipment, supplies, and material acquired by the Department with Commission funds heretofore used by the Department in the Great Lakes sea lamprey work, and presently available, shall be utilized in the work under this Agreement without cost to the Commission. Property, equipment, supplies, and materials acquired by the Commission with the funds made available by the Department shall be identified as the property of the Commission, and be maintained on a Commission inventory and, shall be subject to the disposition in the manner which the Commission may direct. The Centre will provide insurance (fire, theft, property damage and public liability) for vehicles and equipment as required.

XII. IT IS AGREED that the Commission, through the Director of the Sea Lamprey Control Centre, shall administer contributions to Workmen's Compensation, Income Tax, Unemployment Insurance, Ontario Hospital Insurance Plan, and Canada Pension Plan for Commission employees working out of the Sea Lamprey Control Centre.

XIII. IT IS AGREED that in recognition of the fact that the Department is organized and staffed for conduct of the program of the Commission on a continuing basis, the Commission will develop its program for the ensuing year on or before September 30, 1985 and, subject only to the availability of appropriations, signify its intentions as to the role of the Department in that conduct of the program for such year. It is understood that the costs of Her Majesty and the Sea Lamprey Control Centre in terminating or curtailing operations in line with the intentions of the Commission shall be allowable costs under this Agreement.

XIV. IT IS AGREED that the Department will cooperate with the Commission in matters relating to Provincial and Municipal governments and with the public in general, in assisting the Commission in the performance of Sea Lamprey Control in Canada.

THIS AGREEMENT is made contingent upon the availability of funds to the Great Lakes Fishery Commission to carry out its purposes and shall not obligate Her Majesty or the Great Lakes Fishery Commission in the event of unavailability of funds resulting from failure to appropriate by the respective government.

IN WITNESS WHEREOF, the authorized representatives of the parties hereto have affixed their signature as of the dates set forth opposite their respective signatures.

SIGNED, SEALED, AND DELIVERED
in the presence of

Date	Witness	Minister of Fisheries and Oceans for Canada
March 4 1985		
Date	Witness	Chairman, Great Lakes Fishery Commission

APPENDIX II

DEPARTMENT OF FISHERIES & OCEANS
SEA LAMPREY CONTROL CENTRE

LAMPRICIDE INVENTORY - 1985

ITEM (CANS)

Storage Building	Batch No.	Year	Number of Cans	5-gal Plastic Containers	Pounds Active Ingredient
New York	C02530506	1983	343		8,442.60
New York	unknown	-	2		49.50
1	1	1982	91.5	12	2,304.56
1	2	1982	128	5	2,932.10
1	3	1982	421		9,559.74
2	1	1983	784	2	18,021.17
2	2	1983	68		1,514.11
2	C02530506	from NY	1		24.61
2	2	1984	466		10,374.10
1	3	1984	745		16,842.70
2	4	1984	157		3,539.00
1	3	1985	256		5,814.70
2	4	1985	716		15,985.96
1	5	1985	396		8,942.28
TOTAL			**4,574.5**	**19**	**104,347.13**

ITEM (BARS)

32 cartons - 20 bars per carton; 917 grams per bar =

TOTAL: 586.88 kg = 1,295.54 lbs

GRANULAR BAYER 73:

395 cartons @ 50 lbs each

TOTAL: 19,750.00 lbs

POWDERED BAYER 73:

28 packages @ 5 lbs each = 140 lbs
1,515 packages @ 5 lbs each = 757.5 lbs

TOTAL: 897.50 lbs

APPENDIX III

TOTAL LAMPRICIDES USED IN 1985

	KILOGRAMS ACTIVE INGREDIENT OF:		
	TFM	Powdered Bayer 73	Granular Bayer 73
LAKE SUPERIOR	5,339.8	26.7	231.9
LAKE HURON	2,273.8	11.8	257.9
LAKE ONTARIO (CANADIAN)....	2,990.0	13.8	13.9
LAKE ONTARIO (U.S.A.).....	1,698.5	-	6.9
TOTALS	12,302.1	52.3	510.6

APPENDIX IV

FISH SPECIES REFERENCE

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*
Silver lamprey	*Ichthyomyzon unicuspis* (*Ich.* spp.)
Northern brook lamprey	*Ichthyomyzon fossor* (*Ich.* spp.)
American brook lamprey	*Lampetra appendix*
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 namaycush*
Brook trout	*Salvelinus fontinalis*
Splake	*Salvelinus fontinalis* × *Salvelinus namaycush*
Rainbow smelt	*Osmerus mordax*
Grass pickerel	*Esox americanus vermiculatus*
Northern pike	*Esox lucius*
Lake chub	*Couesius plumbeus*
Common carp	*Cyprinus carpio*
Bonneyhead 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 IV (continued)

Common Name	Scientific Name
Redhorse sucker	*Moxostoma* spp.
Brown bullhead	*Ictalurus nebulosus*
Stonecat	*Noturus flavus*
Burbot	*Lota lota*
Trout-perch	*Percopsis omiscomaycus*
Ninespine stickleback	*Pungitius pungitius*
Rock bass	*Ambloplites rupestris*
Pumpkinseed	*Lepomis gibbosus*
Johnny darter	*Micropterus dolomieui*
Smallmouth bass	*Etheostoma nigrum*
Yellow perch	*Perca flavescens*
Logperch	*Percina caprodes*
Mottled sculpin	*Cottus bairdi*
Slimy sculpin	*Cottus cognatus*
Sculpin spp.	*Cottus* spp.

APPENDIX V

GLOSSARY OF TERMS, ABBREVIATIONS, METRIC EQUIVALENTS, AND SYMBOLS

TERMS

Ammocoete - Larval (young) lamprey

Residual - Sea lamprey larvae (ammocoetes) that survive 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.

[illegible]

- Conducted to evaluate the effectiveness [illegible]

- Conducted to provide additional population size and [illegible] established sea lamprey larval populations.

ABBREVIATIONS

[illegible] - [illegible] layer 73
[illegible] - [illegible] active ingredient
[illegible] - [illegible] cubic metres per second
ppb - [illegible] parts per billion
ppt - [illegible] parts per trillion
( ) - [illegible] lampricide application point
[illegible] - [illegible] stream sample station
4WD - four-wheel-drive vehicle
2WD - two-wheel-drive vehicle
[illegible] - [illegible] staff gauge
[illegible] - pre-establishment survey
[illegible] - [illegible] distribution survey
[illegible] - [illegible] assessment evaluation survey
[illegible] - [illegible] population study survey
[illegible] - [illegible]

METRIC CONVERSIONS

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

SYMBOLS

[illegible] - [illegible] stream; denotes area of sea lamprey larval [illegible] as established during chemical treatments
[illegible] - [illegible] footpath)
[illegible] - [illegible] roads
[illegible] - [illegible] to good condition
[illegible] - [illegible] road
[illegible] - [illegible] (fast water) area on a river
[illegible] - [illegible]
[illegible] - [illegible]
[illegible] - [illegible]

U. S. DEPARTMENT OF THE INTERIOR

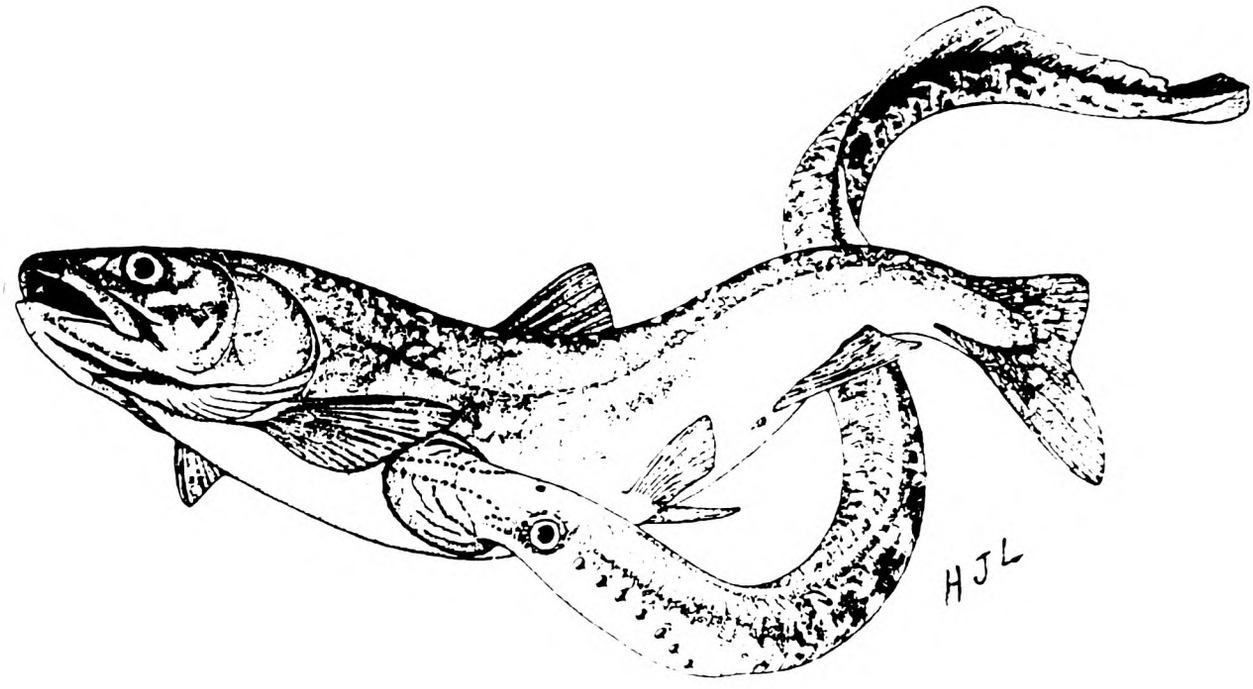
FISH AND WILDLIFE SERVICE

SEA LAMPREY MANAGEMENT IN THE UNITED STATES

ANNUAL REPORT

TO

GREAT LAKES FISHERY COMMISSION



by

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Contents

SEA LAMPREY MANAGEMENT IN THE UNITED STATES

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This report summarizes the activities of the U.S. Fish and Wildlife Service in the conduct of sea lamprey control in the United States in 1985. Surveys to evaluate larval sea lamprey populations were performed on 320 tributaries of the Great Lakes. Larval surveys in the St. Marys River substantiated numbers and lateral distribution of ammocetes in Lake Nicolet. Lake Erie streams were surveyed in preparation for chemical treatments in the fall of 1986. Chemical treatments were completed on 43 streams (Table 1). The Big Salt River, a tributary of the Saginaw River, was treated for the first time; few ammocetes were found. Assessment traps placed in 38 tributaries of the Great Lakes captured 38,740 spawning-phase sea lampreys (Table 2). Estimates of the total number of spawning adults were determined in a Lake Michigan stream (Manistique River) and three Lake Huron tributaries (Cheboygan, Ocqueoc, and St. Marys rivers). A total of 4,757 parasitic-phase sea lampreys were collected from commercial (1,991) and sport (2,766) fishermen in the Upper Great Lakes. Of those captured in the sport fishery, 284 were from charter and 2,482 from noncharter anglers. Information on incidence of lampreys and marks on fish was reported by 235 charter captains. Tests of the effects of lampricides on nontarget organisms were conducted in treated and control sections of six streams in three lake basins.

LAKE SUPERIOR

Larval Assessment

Unusually high water levels hindered surveys in 1985, but most scheduled examinations were completed. Ninety-five tributaries of Lake Superior were surveyed to assess populations of larval sea lampreys. Thirty-one streams showed no recruitment for the past 4 or more years. Thirty-three streams contained reestablished populations (Table 3). Ammocetes in the Carp River were the first taken in the river since treatment in 1963. Sea lamprey distribution increased in the Pine, Misery, and Firesteel rivers. Moderate numbers of residual sea lampreys were found in the Sucker, Huron, Ravine, East Sleeping, and Middle rivers. The Ravine River was treated later, and the others are scheduled for treatment. Lesser numbers of residual sea lampreys were observed in the Betsy, Two Hearted, Laughing Whitefish, Slate, Silver, Traverse, Cranberry, and Brule rivers. The Slate and Silver rivers were treated later.

Surveys continued in the St. Louis River in 1985. The population of sea lampreys apparently has declined since 1983. A possible explanation is spills from a paper mill upstream of the dam at Fond du Lac. The mill's waste ponds reportedly overflow during periods of heavy rainfall.

Fourteen offshore areas were examined, and sea lampreys were collected from four. Many larvae were taken off the Sucker, Little Garlic, and Falls rivers but only one off the Big Garlic River; all streams were treated later. Seven inland lakes were examined and sea lampreys were taken from four--Beaver, Little Beaver, Harlow, and Pine lakes. Bismark Creek, a Harlow Lake tributary, was treated later to prevent recruitment to the lake. Streams associated with the other lakes are scheduled for treatment.

Nine streams with some potential for sea lamprey production were examined. All surveys were negative except in the Floodwood River where one sea lamprey ammocete was recovered near the stream mouth. Additional surveys upstream in the Floodwood River did not yield lampreys, and the larva likely drifted from the Potato River, about 0.8 km (0.5 miles) away.

Chemical Treatment

Chemical treatments were completed on 16 streams (Table 4, Fig. 1) with a combined flow of 29 m^3/s (1,024 cfs). Most treatments were routine with few problems. The treatment of the Ontonagon River was the most complicated and some problems were encountered in matching the chemical banks from the East and Middle Branches. The treatment of the Misery River could be the final treatment of the headwater area, since a barrier dam has been built about 6 km (4 miles) upstream of the mouth and should block lampreys. Access to this area has been difficult because of road washouts.

Ammocete numbers were generally low in the treated streams except in the Salmon Trout and Misery rivers. Some large ammocetes were collected in the Au Train River system at the mouths of Rock Bay and Cole Creeks; however, no transforming lampreys were found.

Spawning phase Sea Lampreys

Assessment traps in 10 tributaries of Lake Superior captured 1,637 adult sea lampreys in 1985 (Table 5, Fig. 1), compared with 967 in 1984. The number of lampreys increased in the Middle, Iron, Rock, and Tahquamenon rivers over that taken in 1984 (largest increase was in the Rock River, from 561 to 938). Traps were operated for the first time in the St. Louis River, but no adult lampreys were taken. The average length and weight of adult lampreys taken in 1985 remained about the same as that in 1984, but the percentage of males increased from 30% to 38%.

Parasitic-phase Sea Lampreys

A total of 260 sea lampreys were collected from commercial fishermen in Lake Superior through October 1985 (Table 6), compared with 213 taken in 1984. Fishermen in statistical districts MS-4 (Munising, Michigan, area) and Wisconsin collected most sea lampreys from U.S. waters of Lake Superior—128 and 72, respectively. In 1984, 78 lampreys were taken in MS-4 and 123 in the Wisconsin district. The increase in parasitic-phase sea lampreys collected in MS-4 corresponds to an increase in the spring wounding rates on lake trout taken for assessment purposes by commercial fishermen (11.3% in 1985, compared with

6.2% in 1984). Although the number of sea lampreys collected in the Wisconsin district decreased, spring wounding rates on lake trout increased from 2.3% in 1984 to 3.7% in 1985. However, fishing effort was less in Wisconsin in 1985 than in 1984 and may account for the smaller number of lampreys collected.

Parasitic-phase sea lampreys are collected throughout the year from commercial fishermen, therefore, lampreys that would spawn in either the present or succeeding year may be found in the catch. To better define the relation of the catch of these feeding lampreys to the number of spawning-phase lampreys taken in assessment traps, spawning year was determined for the 260 parasitic-phase sea lampreys captured in 1985—178 would have spawned in 1985 and 82 in 1986 (Table 6). Large-mesh gill nets fished during January-May accounted for most of the sea lampreys of the 1985 spawning year.

Lake Superior sport fishermen captured 46 parasitic-phase sea lampreys in 1985 (Table 6), compared with 21 in 1984. Of the total, 8 were from charter captains and 38 were from noncharter fishermen. Eighteen charter captains provided information on occurrence of sea lampreys and lamprey marks in their catches of fish. Lake trout are the primary target species in the charter fishery of Lake Superior, and captains reported 0.3 lamprey attached per 100 trout in their catch (Table 7). Fresh wounds (Type A, Stage I-III) were observed at 5 per 100 trout in the spring, 4.1 in summer, and 1.9 in fall (Table 8). Lampreys were attached to chinook salmon at a rate of 0.1 per 100 fish.

LAKE MICHIGAN

Larval Assessment

Surveys were conducted on 127 Lake Michigan tributaries to assess populations of larval sea lampreys. Twenty streams were examined in preparation for chemical treatments; 11 were treated and 9 are scheduled for treatment. Larvae of the 1985 year class were collected in 34 streams. Reestablished populations are present in 27 of the 66 tributaries on the north and west shores of Lake Michigan that are monitored annually (Table 9). Reinfestation of some tributaries may have been aided by a rise in lake levels and increased stream flows which eliminated natural barriers to spawning run adults.

Residual sea lampreys were found in 21 streams, but in most streams the numbers were small and no remedial action was needed. However, the number of residual lampreys in the lower reaches of the Ford River necessitated retreatment of this section of stream. Sufficient residuals were present in McAlpine Creek, a small headwater tributary of Millecoquins River, to schedule this stream to be re-treated in 1986.

Areas upstream of dams on six rivers were investigated to determine whether lampreys had bypassed the barriers. No larvae were found above the dams on the Betsie, Grand, St. Joseph, and East Twin rivers. Age I sea lampreys were present in the Boardman River above the Union Street dam. Sea lampreys had infested this area twice before and treatments were conducted in 1975 and 1980 to eliminate the population. Surveys in the Manistique River verified that a few ammocetes of the 1983 year class first detected in 1984 were still

present in the main stream, about 96 km (60 miles) above the dam near the mouth. The 1985 year class also was documented in this same area. In addition, a single larva of the 1984 year class was collected in the East Branch of the Fox River, a major headwater tributary of the Manistique River. This new finding extends the upstream distribution of sea lamprey larvae an additional 48 km (30 miles). The size and number of larvae do not warrant treatment of the upper river as yet; however, the fact that adults bypassed the dam in three successive years is of serious concern and necessitates extensive surveys to monitor the upstream reaches.

Surveys off the mouths of 12 streams demonstrated the presence of sea lamprey larvae in two areas. Sixteen sea lampreys were found off Horton Creek and 2 were recovered off Beattie Creek. Horton Creek was treated later and reexamination of the lentic area indicated that the lake population had been eliminated.

Fyke nets were fished in the fall in Hibbards Creek and in the Lincoln River to monitor downstream movement of recently metamorphosed sea lampreys. Three transformed sea lampreys were captured in the Lincoln River and two in Hibbards Creek.

Chemical Treatment

Treatments were completed on 13 streams (Table 10, Fig. 2) with a combined flow of 114.7 m^3/s (4,052 cfs). Most of the treatments were routine with few problems in spite of the fact that the summer of 1985 was one of the wettest on record. The Paw Paw, Platte, Peshtigo, and Manistique rivers were treated using Bayer 73 wettable powder in conjunction with TFM. Analysis with gas chromatography (GC) and high performance liquid chromatograph (HPLC) demonstrated that Bayer 73 concentrations could be determined accurately with HPLC.

Many tadpoles were recovered in the Platte, Peshtigo, Manistique, and Big Fishdam rivers and Blue, Bear, and Brandywine creeks. Moderate numbers of sea lampreys were collected in the Paw Paw, Black, Ford, and Sturgeon rivers and Trail and Horton creeks, and few were taken in the remaining streams.

Some fish mortality was observed during treatments of Trail and Brandywine creeks and Carp Lake and Ford rivers. Fish mortality was negligible on the other treated streams.

Spawning-phase Sea Lampreys

A total of 15,471 sea lampreys were captured in assessment traps in eight west shore and five east shore tributaries of Lake Michigan in 1985 (Table 11, Fig. 2). Along the west shore, the catch of lampreys increased in 1985 over the number taken in 1984 in the Manistique (9,085 to 13,291), Peshtigo (240 to 332), and Menominee (126 to 500) rivers. A stratified tagging and recovery system was used for the second consecutive year to estimate the number of spawning-phase sea lampreys present in the Manistique River (25,221 in 1984 vs. 39,144 in 1985) and verified the concurrent increase in trap catch. No lampreys were captured for the seventh consecutive year in the Fox River.

The catch of sea lampreys in five streams along the east shore of Lake Michigan was 1,327 in 1985, compared with 1,315 in 1984. The catches increased in four of the five tributaries, but decreased by 447 in the Carp Lake River (655 vs. 208). Prolonged high water with a resultant decrease in trapping efficiency probably was the main factor in the decline.

Parasitic-phase Sea Lampreys

Lake Michigan commercial fishermen captured 366 sea lampreys through October 1985 (Table 6), compared with 216 in the same period in 1984. Of the total, 210 were collected from northern Lake Michigan and 141 from Green Bay, compared with 114 and 83 in 1984.

Spawning year was determined for the 366 parasitic-phase sea lampreys; 172 would have spawned in 1985 and 194 in 1986 (Table 6). Commercial pound nets set for rainbow smelt and alewife near the estuary of the Ahnapee River captured most of the adults of the 1985 spawning year (106).

A total of 720 parasitic-phase sea lampreys were obtained from the sport fishery (Table 6), 43 from charter and 677 from noncharter fishermen. As in 1984, most of the lampreys were recovered from statistical districts WM-4 and WM-5, the Algoma to Milwaukee area of Wisconsin, and MM-6, the Arcadia to Little Sable Point area of Michigan.

Information on occurrence of sea lampreys and lamprey marks on fish was reported by 162 charter captains (Tables 7 and 8). The number of lampreys observed per 100 fish was about the same for lake trout and chinook salmon (0.3 vs. 0.4, respectively), but the rate of fresh wounds per 100 fish was higher for lake trout (spring, 6.2 vs. 1.2; summer, 5.1 vs. 1.1; fall, 2.7 vs. 0.6).

Special Studies

Lamprey survival in polluted bottom substrates--Two studies were conducted with caged ammocetes to determine whether lamprey larvae could survive in polluted bottom substrates. The first study was conducted in the lower Fox River. Ichthyomyzon ammocetes used as test animals were collected from Walla Walla Creek, an upstream tributary of the Fox River with better water quality. Three cages were placed in selected locations 0.3 km to 1.6 km (0.25-1 mile) downstream of the dam at DePere in the lower Fox River on May 3. Bottom materials from the immediate area, along with 50 Ichthyomyzon ammocetes, were placed in each cage. A control cage was placed in Walla Walla Creek. On October 15, only two of the three test cages could be found; 16 ammocetes were recovered from one cage and 4 from the other. The control cage had been vandalized and no larvae remained. Sea lampreys were not used in this study to avoid the possibility that escaped larvae might influence future survey results, since sea lampreys have not been found in the Fox River. A similar study was conducted in the Menominee River, but with sea lamprey ammocetes as test animals. Only one of three cages placed in the stream on May 2 could be found 165 days later, on October 14. Of the 50 larvae caged, 31 survived in an area where the streambed appeared to be polluted. In a control cage in Beattie Creek, 23 larvae survived. These studies in the Fox and Menominee rivers show that some ammocetes can survive through the summer in streams where water quality and substrates are polluted.

Transformation study--Larval sea lampreys (age III) were collected in May 1985 from Whitefish Bay Creek, a tributary of the west shore of Lake Michigan in Door County, Wisconsin. The mean total length of the 110 larvae was 129 mm (range, 120-150 mm). The ammocetes were held in two aquaria at the Marquette Station until September to determine the rate of transformation. The aquaria were at room temperature and aerated, but larvae were not fed. At the completion of the study, two ammocetes (2%) had undergone transformation. Previous studies have suggested that transformation might begin at age III in some streams, but this is the first definitive evidence we have to support this hypothesis. The stream will be chemically treated in 1986, and we will further define the rate of transformation of this year class.

Electroshocker effectiveness--Studies were conducted in June to evaluate the effectiveness of the Mark II electroshocker. The unit was designed specifically for electrofishing for sea lamprey ammocetes. With few minor modifications, the unit has been widely used in the control program since the late 1960s. The shocker appeared to be effective in most streams with relatively low water conductivities, but we lacked specific measurements. These studies more clearly define the degree of effectiveness of the Mark II units.

The Fishdam River in Delta County, Michigan, was selected for the experiments because it is representative of streams used by sea lampreys in the Upper Peninsula. The stream is 8 m (26 ft.) wide, 0.3 m (1 ft.) to 0.6 m (2 ft.) deep, and has a flow of 0.7 m^3/s (25 cfs) in the study area. Conductivity was about 200 umhos/cm, and water temperature varied from 10 to 13°C (50 to 55°F) during the study.

Seven hundred sea lamprey larvae 60 mm and longer were collected from Fishdam River with Mark II electroshockers. The ammocetes were anesthetized, measured, marked with latex dyes, and allowed to acclimate in the study area. No significant mortality occurred.

Before the larvae were subjected to the stimulus of the Mark II units, several sites within the study area were tested to simulate the total voltage output of the units and the voltage gradients in the electrical fields. The units were designed for use in streams with water conductivities from 100 to 300 umhos/cm, and usually operate near their maximum voltage output potential. Pick-up electrodes and an oscilloscope were used to measure voltage gradients in the water and substrate. The units delivered uniform, pulsated, rectangular DC wave forms with maximum amplitudes of 150 volts at 0.8 ampere; frequencies of either 3 pulses per second at a pulse duration of 83 ms or 30 pulses per second at a pulse duration of 8 ms; and a 25% duty cycle. Desired voltage gradients of 1 v/cm in the center of the electrical fields were achieved when electrodes were 50 cm (20 inches) apart.

Two experiments were conducted to observe responses of larvae subjected to the stimuli of the Mark II units. In the first, two marked ammocetes were placed in each of 20 cylindrical plastic mesh cages. The containers restricted lateral movement, but allowed larvae to burrow into the substrate. Ten cages were placed in 15 cm (6 inches) of water and 10 in 30 cm (12 inches). Larvae were allowed 16 hours to acclimate. Then, larvae within each cage were stimulated with the units and observed for 30 seconds. The test was then repeated. A total of 80 larvae were tested. Larval emergence during the first 10 seconds of the stimuli in the four series of tests averaged 78% (range, 67-89%) and after 30 seconds averaged 87% (range, 67-100%).

The second experiment was designed to simulate a more natural setting for the test specimens. Marked larvae were confined temporarily in similar cages at five sites. The number of ammocetes placed in each site varied from 16 to 60. The cages were removed after the larvae had burrowed. After 16 hours, an area of 9.3 m^2 (100 sq. ft.) around each site was electrofished with the Mark II units. The exposure time was 30 seconds/larvae, i.e., if 30 larvae had been introduced at a site, the stimulus time was 15 minutes. A total of 166 larvae were tested. An average of 69% (range, 50-85%) of the larvae were recovered.

The recovery rate for all marked larvae in all tests combined was 74%. This value is probably biased towards a lower rate because of larval dispersal. Some larvae likely moved from the test sites, however, at least 85% were recovered in some tests in both of the experiments. Although the studies did not simulate actual stream surveys, observations suggested that the Mark II electroshockers are effective in most shallow streams in the Upper Peninsula. These data were supported by a comparison of length-frequency histograms derived from survey and chemical treatment collections from the study area of the Fishdam River in 1985.

LAKE HURON

Larval Assessment

Seventy-nine streams of Lake Huron were surveyed to assess larval sea lamprey populations. Pretreatment surveys were completed on 15 streams; 6 were treated later and the others are scheduled for treatment. Reestablishment and posttreatment surveys revealed few residual sea lampreys in 16 streams and moderate numbers in 1, the Carp River. The 1985 year class was recovered from 12 of 23 north shore tributaries that are monitored annually (Table 12). This represents the first increase for several years, and is likely a reflection of increased lamprey activity in the St. Marys River.

Few sea lampreys were recovered from two of three offshore areas examined in 1985. Three larvae were found off the Carp River and apparently the last chemical treatment significantly reduced the larval abundance in the lentic area. Two sea lampreys were taken from 17 plots in the navigation channel off the Cheboygan River, one larva was collected 1.1 km (0.7 miles) from the breakwall.

Evaluation of barrier dams continued in two streams in 1985. Sea lampreys did not surmount the barrier in the East Au Gres River. Modifications of the Dow Chemical Company dam in 1984 in the Tittabawassee River, a tributary in the Saginaw River system, allowed sea lampreys access to the upper watershed and sea lampreys were found in two tributaries, the Chippewa and Big Salt Rivers. An unusually large number of young-of-the-year sea lampreys was found in the Chippewa River and sea lampreys were detected for the first time in the Big Salt River. In the Chippewa River, the catch per unit of effort increased nearly tenfold over 1983, and the length of stream infested tripled.

Surveys to assess sea lamprey populations in the St. Marys River continued in 1985. A total of 1,375 larval (32-162 mm) and 19 recently transformed sea lampreys were collected.

Fourteen sites in the lower St. Marys River downstream of the compensating gates that were surveyed with electrofishing gear in 1963 were reexamined with backpack shockers in 1985. A total of 178 larval lampreys were collected at 10 of the 14 sites, including 66 sea lampreys (32-162 mm). Although the catch per unit of effort for all species of larvae was similar for both years (14.7 larvae/hour in 1963 vs. 15.5 larvae/hour in 1985), the number for sea lampreys increased considerably (0.4 larvae/hour in 1963 vs. 6 larvae/hour in 1985).

Fifty 0.2-ha (0.5 acre) sites in the St. Marys River were surveyed with Bayer 73 granules to define further the abundance and lateral distribution of ammocetes. Sites included 2 areas in the harbor between the Edison Power Plant and Sugar Island; 17 areas in the channels formed by the mainland and Steere and unnamed islands #1, #2, and #3; and 31 locations in Lake Nicolet (Fig. 3).

Sea lamprey larvae were collected from 34 of the 50 sites examined. Seventeen larvae (60-120 mm) were collected from one of the sites in the harbor area. Fifteen of the 17 sites examined in the channels yielded a total of 874 larval (32-162 mm) and 18 recently transformed lampreys. These channels produced more large (>120 mm) ammocetes (111) than in all other sites in the river (7 larvae) in 1985. Lake Nicolet was surveyed to study lateral distribution of larvae; 18 of the 31 sites yielded a total of 418 larvae (40-138 mm) and 1 recently transformed lamprey (148 mm). Larvae were collected from six shoreline areas of Sugar Island from Baie de Wasai downstream to Shingle Bay (Fig. 3). The population appears to be concentrated along the eastern dropoff of the shipping lane. Larvae are also scattered between the shipping lane and Sugar Island and the shipping lane and mainland shore.

Chemical Treatment

Chemical treatments were completed on nine streams (Table 13, Fig. 4) with a combined flow of 45 m^3/s (1,586 cfs). The Big Salt River, tributary of the Saginaw River system, was treated for the first time and few ammocetes were collected. Ammocete were abundant in the three tributaries of the Cheboygan River, moderate in the Rifle and Trout rivers, and low in the other streams.

A few fish were killed during treatments of Mill Creek, and the Rifle, Trout, and Big Salt rivers.

Spawning-phase Sea Lampreys

Assessment traps were operated in six tributaries of Lake Huron (Table 14, Fig. 4), and a stratified tagging and recovery system was used to estimate the population in three of the streams. The catch in the Cheboygan River decreased by 7,644 lampreys, but largely was a result of high water levels that delayed placement and hindered operation of assessment traps. An estimated 40,469 sea lampreys were present in the spawning run of the Cheboygan River in 1985, compared with an estimate of 25,863 in 1984. The catch from the Ocqueoc and St. Marys rivers increased by 349 and 1,741, respectively, over the number taken in 1984. Estimates also were made of the total number of spawning adults in the Ocqueoc (13,065) and St. Marys (23,852) rivers. The estimate of the total population of sea lampreys in the St. Marys River was a joint project conducted in cooperation with the Sea Lamprey Control Centre of Canada. Traps placed in the East Au Gres, Tittabawassee, and Chippewa rivers for the first time in 1985 caught 680, 10, and 0 lampreys, respectively.

Parasitic-phase Sea Lampreys

A total of 1,365 sea lampreys were collected by commercial fishermen in Lake Huron (Table 6), compared with 1,265 in 1984. Fishermen from statistical district MH-1 (DeTour-Rogers City, Michigan, area) contributed 1,173 sea lampreys in 1985, compared with 1,067 in 1984. A total of 431 parasitic-phase sea lampreys were captured by two state-licensed fishermen in the estuary of the St. Marys River (Drummond Island, Michigan, area of MH-1) from May 15 to August 15, indicating a high abundance of sea lampreys in this area. The number of sea lampreys collected by commercial fishermen in statistical district MH-2 (Alpena, Michigan, area) decreased from 151 in 1984 to 108 in 1985. Sea lampreys collected in MH-4 (Tawas City-Bay Port, Michigan, area) increased from 47 in 1984 to 83 in 1985.

Spawning year was determined for the 1,365 parasitic-phase sea lampreys collected by the commercial fisheries; 55 would have spawned in 1985 and 1,310 in 1986 (Table 6). Most (996) of the sea lampreys that would spawn in 1986 were captured in trap nets set for lake whitefish.

Sport fishermen of Lake Huron captured 2,000 parasitic-phase sea lampreys (233 from charter and 1,767 from noncharter fishermen) in 1985 (Table 6). Many of the lampreys were collected in five of the six statistical districts, but twice as many were taken in MH-3 (823, Black River to Au Sable Point area) than any other district.

Information on occurrence of sea lampreys and lamprey marks on fish was reported by 55 charter captains (Tables 7 and 8). Far more lampreys were observed on chinook salmon than on lake trout (6.7/100 vs. 1.3/100). Fresh wounds were less common on chinook salmon than lake trout during the spring (10.7/100 vs. 13.8/100), but more abundant on salmon in the summer (20.4/100 vs. 11.4/100). Insufficient data were collected on lake trout in fall for a comparison. The rates of these indices of abundance varied little throughout the statistical districts of the lake. Parasitic lampreys appear to be significantly more abundant in Lake Huron than Lakes Superior and Michigan.

LAKE ERIE

Larval Assessment

Surveys to assess populations of larval sea lampreys in preparation for chemical treatment in 1986 were conducted in 16 tributaries of Lake Erie. Sea lampreys were present in 10 streams. Larvae were abundant in Cattaraugus and Conneaut creeks; medium in Halfway Brook, Crooked and Raccoon creeks, and the Grand River; and few in Cayuga (a tributary of the Buffalo River), Canadaway, Delaware, and Wheeler creeks. A total of 65 recently transformed larvae were recovered--30 from Conneaut Creek, 19 from Raccoon Creek, 11 from Crooked Creek, and 5 from the Grand River. The 1985 year class of larvae was collected from Cattaraugus, Conneaut, and Canadaway creeks.

Sea lamprey larvae were found for the first time in two New York streams, Cayuga Creek and Halfway Brook. Cayuga Creek appeared polluted when surveyed in 1981; however, the water quality has been rapidly improving. A total of three larvae limited to one year class (81-86 mm) were taken from 14 locations in 1985 and continued improvements in water quality should enhance larval survival. Halfway Brook contains moderate numbers of sea and American Brook lamprey larvae.

Delaware and Canadaway creeks are short drainages in New York with a few sea lampreys mostly in the lower reaches. Both streams contain many American brook lampreys. Larval and spawning habitat are present throughout most of Delaware Creek. In Canadaway Creek, larval habitat is quite sparse except in the estuary and in a tributary, Beaver Creek, that also contains sea lamprey larvae. Lamprey production is limited in both drainages by wide fluctuations in water levels.

Cattaraugus Creek is the largest contributor of sea lampreys to Lake Erie in New York, about 120 km (75 miles) of mainstream and tributaries are infested. Scarcity of larval habitat limits survival of ammocetes in most of the upper river; however, both the estuary and newly formed harbor area contain some larval habitat and larvae. Larvae are also scattered outside the breakwalls in Lake Erie. Cattaraugus Creek has three infested tributaries, but only Clear Creek supports a significant larval population.

Crooked and Raccoon creeks are relatively small Pennsylvania streams, with an estimated summer flow of 0.6 m^3/s (20 cfs). About 29 km (18 miles) of Crooked Creek and 16 m (10 miles) of Raccoon Creek are inhabited by larval sea lampreys.

Conneaut Creek is the largest, known, sea lamprey producer on the U.S. side of Lake Erie. Larval infestation includes about 160 km (100 miles) of the main stream and another 48 km (30 miles) of the West Branch and its tributaries. The lower one-third of the main stream, about 48 km (30 miles), flows through Ohio and the rest of the drainage is in Pennsylvania. Larval habitat is abundant in the Pennsylvania section and more lampreys were taken there (639 larvae; 20-176 mm) than in the Ohio section where bedrock is the predominant substrate. Despite the scarcity of habitat in the lower river, sampling at 10 sites in 1985 yielded 257 larvae (25-175 mm) and 24 recently transformed sea lampreys.

The Grand River and Wheeler Creek, tributaries to Lake Erie in Ohio, also produce sea lamprey larvae. The Grand River contains moderate numbers of sea lampreys confined to the main stream and limited primarily by the paucity of larval habitat. Bedrock is prevalent throughout most of the infested drainage, which extends from the mouth upstream about 48 km (30 miles) to a barrier dam. Larval and transformed sea lampreys were collected from 8 of 13 sites throughout the main stream. Wheeler Creek, a short coastal stream near Geneva, contains a sparse sea lamprey population, but larval American brook lampreys are numerous throughout the system.

Sea lamprey larvae were not found in the Chagrin River and five smaller Lake Erie tributaries. In the Chagrin River, however, several hundred adults were captured during spawning migrations in 1984 and 1985.

Spawning-phase Sea Lampreys

A total of 2,383 sea lampreys were captured in three tributaries of Lake Erie in 1985 (Table 15, Fig. 5), an increase of 1,373 over the number taken in 1984 (1,010). The increase was largest in Cattaraugus Creek (625 to 1,732), but this may have been due in part to decreased trap efficiency in 1984; one of two turbines of the powerhouse was in operation in 1984, but both were generating in 1985. The average length and weight of sea lampreys was slightly less than for lampreys taken in 1984, and the percentage of males also decreased (61% to 52%).

LAKE ONTARIO

Larval Assessment

Surveys of Lake Ontario streams in 1985 included tributaries of the Oswego River system (Fish and Big Bay creeks and the Seneca River); the upper Niagara River; and Irondequoit Creek, a stream with no history of larval lamprey production.

Fish Creek was surveyed to monitor larval populations reestablished since the 1984 treatment and to assess an offshore population in Oneida Lake. Larvae from the 1984 and 1985 year classes were recovered from two tributaries of Fish Creek, the Little and Mad rivers. Residual sea lampreys (43 larvae, 71-158 mm) were also collected from the lower Mad River. These larvae were apparently the result of sublethal concentrations of lampricide in backwater areas during the 1984 treatment, but their numbers do not warrant re-treatment. A total of 12 larvae (55-155 mm) were recovered from five of six 0.2-ha (0.5-acre) sites in Oneida Lake off the mouth of Fish Creek examined with granular Bayer 73. Presently, the lentic population does not appear to be a serious problem.

Representatives of the 1984 year class and one residual larva were collected from one site examined in Big Bay Creek.

The Seneca River and three of its tributaries was surveyed with granular Bayer 73. One sea lamprey larva (54 mm) was collected during surveys of 14 0.2-ha (0.5-acre) sites scattered throughout 48 km (30 miles) of the Seneca River. The larva was recovered near the confluence of Carpenter Brook, which contains sea lamprey larvae. Three tributaries of the Seneca River known to harbor larval sea lampreys were reexamined. A total of 55 larvae (35-105 mm) were collected from two locations in Carpenter Brook. Larvae of the 1984 year class (25 larvae, 37-55 mm) were collected from a site that in 1981 and 1983 yielded samples of three year classes, suggesting mortality of older animals. Small populations of larvae were collected from Crane and Cold Spring brooks.

The source of larvae in these three Seneca River tributaries is still unknown. The most probable sources of spawning-phase adults are Cayuga and Seneca lakes, which would involve downstream migration, or Lake Ontario, which would require circumvention of seven dams and eight locks in the Oswego and Seneca rivers. A third possibility, but less likely one, is the existence of parasitic-phase sea lampreys in the main channel of the Seneca-Oneida-Oswego river system.

No sea lamprey larvae were found in Irondequoit Creek, although reports of improving water quality and resurging steelhead populations have raised our expectations of larval production.

U.S. Corp of Engineer personnel reported observing several hundred lamprey larvae during dredging in October in the upper Niagara River near Grand Island. No larvae were collected for identification; however, a photograph was taken of what appears to be a recently transformed American brook lamprey.

Spawning-phase Sea Lampreys

A total of 466 adult sea lampreys were captured in assessment traps fished in six tributaries of Lake Ontario in 1985 (Table 16, Fig. 5), a decline from the number taken in 1984 (602). Numbers of sea lampreys declined in Sterling Valley, Catfish, and Grindstone creeks and increased in Sterling Creek and the Little Salmon River. A trap placed at an old mill dam on South Sandy Creek caught one sea lamprey. Lampreys were slightly smaller in 1985 than those taken in 1984. Most lampreys were males (62%), a characteristic prevalent since sampling began in 1978.

Parasitic-phase Sea Lampreys

Information on the occurrence of lampreys in the charter sport fishery was received from one captain in Oswego, New York (statistical district MO-1). He examined 763 fish and observed 10 feeding lampreys (1.3 lampreys per 100 fish), of which 8 were on lake trout and 2 were on brown trout. The same operator collected 17 lampreys and reported a similar incidence (1.3 lampreys per 100 fish, n = 1,326) in 1984.

LAKES SUPERIOR, MICHIGAN, HURON, AND ONTARIO

Treatment Effects on Nontarget Organisms

Short-term tests--Routine monitoring of the effects of TFM applications on nontarget organisms in streams continued in 1985. Tests were completed in the Silver River (Lake Superior), Ford, Sturgeon, and Platte rivers (Lake Michigan), and Carp and Rifle rivers (Lake Huron). As in previous years, the lampricide had little effect on fish (Table 17). A total of 209 fish (17 species) were tested and only 6 died. Organisms of 42 invertebrate genera (Table 18) were tested in six streams. Organisms that appeared to be affected by treatment included Ephemeropterans (Baetis, Pseudocloeon, Epeorus, Hexagenia, and Litobrancha), Trichopterans (Chimarra, Dolophilodes, and Glossosoma), and a Dipteran (Simulium). (Mayflies, especially Baetidae, which died as they emerged from the nymphal stage while confined underwater were not counted in mortality estimates.)

The small size or scarcity of some species of invertebrates make them unsuitable for use in caged tests. To assess treatment effects on invertebrate communities further, invertebrate drift was collected from the Silver, Platte, Carp (North Branch), and Rifle (Houghton Creek) rivers. As yet, these samples have not been processed.

Long-term tests--Spring and fall samples of Hexagenia were collected from the Whitefish River on Lake Michigan to determine recovery of this species from the 1983 lampricide application. Random samples (three from each of 10 silt beds at a control and treated area; total of 60 samples) were collected with an Ekman dredge. The number of Hexagenia increased from 2.7 to 4.0 nymphs per lift in the East Branch of the Whitefish River from May to September, but remained about the same in Scott Creek (1.4 vs. 1.1 nymphs per lift), a Whitefish River tributary. The East Branch will be treated in 1986, but Scott Creek should never again require treatment because of the barrier dam constructed in 1982 to stop upstream movement of adult lampreys.

Index sites of invertebrate communities were established in treated and control sections of the Brule, Whitefish, and Sturgeon (Cheboygan County, MI) rivers. The first set of samples was collected in the fall of 1985 with a kick net and sampling will be repeated each spring and fall. The results of these types of tests will be used to refine treatment scheduling.

Comparison of mortality of three Ephemeridae--Three genera of burrowing mayflies (Ephemera, Hexagenia, and Litobrancha) were studied during the 1985 fall treatment of the Sturgeon River (Delta County, Michigan) on Lake Michigan to compare results with a similar study completed in June 1982. Large nymphs of each genera were collected by electrofishing and placed in cages 107 x 76 x 43 cm (3.5 x 2.5 x 1.5 ft.). The mayflies were allowed to burrow into 20 cm (8 inches) of substrate. Since Hexagenia and Ephemera were more readily available, from 36 to 50 of each species were placed in cages at four locations to be treated and at an untreated control area; 25 Litobrancha were placed in each cage at two treated sites and a control site.

Mortality of the three mayflies varied (Table 18). Few of the Ephemera died. Litobrancha appeared to be more susceptible to the lampricide than Hexagenia when the two were tested together in a tributary of the Sturgeon River, Eighteen Mile Creek. However, the 12-hour LC50 as determined from a bioassay during treatment was similar; 4.7 mg/L of TFM for Hexagenia and 4.6 mg/L for Litobrancha. The 12-hour LC50 determined for Ephemera was considerably higher, 8.4 mg/L of TFM. These results are similar to findings in 1982.

Fish Creek (Lake Ontario)--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. Invertebrate drift samples collected on the day before, during, and after treatment of the Mad River and Cobb Brook (tributaries of Fish Creek) were identified, enumerated, and analyzed in 1985. Riffle samples from these streams have been sorted and enumerated, but analysis is incomplete.

Drift increased for some organisms during the treatment. Of 92 organisms collected in samples, 7 appeared to be most sensitive to the TFM application and the drift including: Oligochaeta (earthworms), Branchiobdellida (a leech-like commensal of crayfish), Hydracarina (water mites), Dolophilodes, Leucotrichia, and Ochotrichia (caddisflies) and Hexatoma (cranefly). By total number of organisms in the samples, these invertebrates comprised 3% of pretreatment drift, 65% during treatment, and 39% after treatment.

Table 1. Summary of chemical treatments in streams of the Great Lakes in 1985.

Lake	Number of treatments	Discharge at mouth		TFM[a]		Bayer 73 powder	
		m^3/s	ft^3/s	Act. kg	Ingr. lbs	Act. kg	Ingr. lbs
Superior	16	29.0	1,024	5,931	13,073	0	0
Michigan	18	114.7	4,052	19,699	43,425	77	170
Huron	9	45.0	1,586	14,392	31,729	18	38
Total	43	188.7	6,662	40,022	88,227	95	208

[a]Includes 1,070 bars (222 kg, 491 lbs A.I.).

Table 2. Number and biological characteristics of adult sea lampreys captured in assessment traps in 33 tributaries of the Great Lakes in 1985.

Lake	Number of streams	Total captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
					Males	Females	Males	Females
Superior	10	1,637	1,562	38	429	422	175	176
Michigan	13	15,471	4,971	51	490	491	240	253
Huron	6	18,783	3,678	51	480	481	230	236
Erie	3	2,323	1,943	52	507	507	273	279
Ontario	6	466	311	62	488	480	269	265

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	1982	1983	1984	1985
Waiska River	10/27/82		1	11	16
Pendills Creek	9/20/82		179	21	13
Naomikong Creek	7/23/63	0	5	0	0
Galloway Creek	7/12/83		51	0	2
Tahquamenon River	7/7/83		3	2	1
Betsy River	9/17/82		46	58	48
Little Two Hearted River	8/5/83		2	0	3
Two Hearted River	8/6/83		18	168	30
Sable Creek	10/5/84				40
Sullivans Creek	10/16/75		96	25	4
Beaver Lake Outlet	9/11/79	3	4	4	3
Miners River	6/29/82	3	21	37	
Anna River	5/18/65	1	3	0	0
Five Mile Creek	8/5/81	0	2	0	0
Carp River	7/20/63	0	6	0	
Iron River	6/29/83		90	18	
Pine River	9/27/72	3	40	0	
Huron River	9/6/84				14
Sturgeon River	8/23/82		13	76	44
Traverse River	7/23/82	42	196	160	7
Little Gratiot River	8/6/72	0	0	1	0
Misery River	6/29/85				6
East Sleeping River	7/17/85				16
Firesteel River	7/1/85				68
Potato River	9/23/80	7	5	35	2
Cranberry River	6/17/82	71	24	53	62
Black River	8/8/81	B	B	0	0
Montreal River	7/12/75	B	0	0	0
Bad River	8/1/84				108
Brule River	9/3/83			66	34
Middle River	5/26/84			50	32
Amnicon River	5/29/84			18	40
Nemadji River	9/2/82		8	24	8
Total number of streams in which year class was collected		9	22	18	23

Table 4. Details on the application of lampricides to streams of Lake Superior, 1985.

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

Stream	Date	Discharge at mouth		TFM[a]		Stream treated	
		m^3/s	f^3/s	Act. kg	Ingr. lbs	km	miles
Misery River (4)	June 29	0.7	25	249	548	22.6	14
Firesteel River (2)	July 1	1.1	40	299	660	27.4	17
Ontonagon River (1)	July 11	17.6	620	3,639	8,133	241.9	150
East Sleeping River (3)	July 17	0.1	5	60	132	3.2	2
Salmon Trout River (9) (Marquette County)	July 26	0.9	32	190	418	11.3	7
Sand River (13)	July 29	0.2	6	30	66	1.6	1
AuTrain River (14)							
Au Train River (lower)	Aug. 22	3.0	105	679	1,496	14.5	9
Buck Bay Creek	Aug. 25	0.3	12	50	110	4.8	3
Cole Creek	Aug. 26	0.1	5	30	66	3.2	2
Furnace Creek (15)	Aug. 27	0.3	9	40	88	1.6	1
Little Garlic River (11)	Sept. 19	0.1	4	41	91	8.1	5
Ravine River (8)	Sept. 20	0.1	3	20	44	4.8	3
Slate River (7)	Sept. 20	0.1	3	10	22	1.6	1
Silver River (6)	Sept. 20	0.6	20	60	132	6.5	4
Harlow Creek (12)							
Bismark Creek	Sept. 21	0.1	2	10	22	1.6	1
Falls River (5)	Sept. 23	1.1	40	90	198	1.6	1
Big Garlic River (10)	Sept. 25	0.5	18	75	165	8.1	5
Sucker River (16)	Oct. 30	2.1	75	309	682	9.7	6
Total		29.0	1,024	5,931	13,073	374.1	232

[a]Includes 346 TFM bars (72 kg, 159 lbs A.I.) applied in four streams.

Table 5. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Superior, 1985.

[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
t. Louis River (A)	0	-	-	-	-	-	-
iddle River (B)	215	215	24	419	414	161	165
ad River (C)							
White River	1	1	0	-	411	-	168
ron River (D)	20	18	39	402	428	152	185
ig Garlic River (E)	17	15	40	401	410	175	190
ock River (F)	938	867	35	421	421	168	174
iners River (G)	20	20	35	401	415	147	158
ucker River (H)	23	23	22	463	418	207	225
etsy River (I)	43	43	40	412	424	161	176
ahquamenon River (J)	360	360	55	447	436	193	189
otal or average	1,637	1,562	38	429	422	175	176

Table 6. Number of parasitic-phase sea lampreys collected in commercial and sport fisheri in 1985, and year lampreys would have spawned.[a]

Lake Superior district	Spawning year: Commercial fishery 1985	Commercial fishery 1986	Sport fishery 1986	Lake Michigan district	Spawning year: Commercial fishery 1985	Commercial fishery 1986	Sport fishery 1986	Lake Huron district	Spawning year: Commercial fishery 1985	Commercial fishery 1986	Spor fishe 1986
M-1	-	-	6	MM-1	7	78	-	MH-1	21	1,152	161
M-2	2	1	3	MM-2	-	-	-	MH-2	8	100	318
M-3	2	1	-	MM-3	25	39	7	MH-3	-	-	823
Wis.	52	20	12	MM-4	-	-	9	MH-4	26	57	317
MS-1	-	-	-	MM-5	-	-	42	MH-5	-	-	365
MS-2	-	-	10	MM-6	-	-	183	MH-6	-	1	16
MS-3	15	10	4	MM-7	-	15	50				
MS-4	97	31	1	MM-8	-	-	55				
MS-5	5	10	-	WM-1	13	-	7				
MS-6	5	3	-	WM-2	6	32	31				
				WM-3	10	26	19				
				WM-4	106	4	142				
				WM-5	-	-	120				
				WM-6	-	-	26				
				Ill.	-	-	13				
				Ind.	-	-	16				
Total	178	82	46		172	194	720		55	1,310	2,000

[a]Parasitic-phase sea lampreys are collected throughout the year from commercial fishermen; therefore, lampreys that would have spawned in either the present or succeeding year may be found in the catch. Those lampreys taken in the sport fishery are collected primarily in the summer when only lampreys that would have spawned the following year are present.

Table 7. Incidence of sea lampreys, and number of lake trout and chinook salmon[a] taken by 235 captains in the charter boat fishery, 1985.

[Incidence of sea lampreys is the number of lampreys attached per 100 fish; includes lampreys that were brought in the boat and those that were observed but dropped off the fish.]

Lake and district[b]	Incidence on lake trout		Incidence on chinook salmon	
	Sea lampreys per 100 trout	Number of trout	Sea lampreys per 100 salmon	Number of salmon
Superior				
M-1	0.1	1,153	0.0	93
M-2	0.7	458	0.0	4
M-3	0.0	8	-	
Wis.	0.3	656	0.0	64
MS-3	1.4	71		-
MS-4	0.4	225	25.0	4
All districts	0.3	2,571	0.6	167
Michigan				
MM-3	0.4	497	0.0	111
MM-4	0.8	126	0.0	75
MM-5	0.6	545	0.7	1,911
MM-6	0.5	763	0.3	3,140
MM-7	0.0	509	0.4	1,843
MM-8	0.2	2,447	0.3	4,155
WM-1	0.0	59	-	
WM-3	0.0	5	0.0	260
WM-4	0.2	1,247	0.1	1,148
WM-5	0.9	220	0.7	1,807
WM-6	0.2	1,475	0.2	435
Ill.	0.0	227	0.1	917
Ind.	0.4	285	0.0	202
All districts	0.3	8,405	0.4	16,004
Huron				
MH-1	2.0	99	4.3	797
MH-2	2.0	195	7.8	516
MH-3	1.3	2,217	7.0	1,590
MH-4	1.2	1,131	4.5	465
MH-5	6.7	15	10.6	659
MH-6	0.0	3	4.8	273
All districts	1.3	3,660	6.7	4,300

[a]Lake trout and chinook salmon are the primary target species of the charter fishery of the Upper Great Lakes.

[b]Data were not obtained from districts MS-1, MS-2, MM-1, MM-2, and WM-2.

Table 8. Number of sea lamprey wounds per 100 lake trout or chinook salmon, and number fish (in parentheses) taken by 235 captains in the charter boat fishery, 1985.[a]

[Wounds are the marks of Type A, Stages I-III; spring is before July 1, summer is July 1 to September 1, and fall is after September 1.]

Lake and district[b]	Sea lamprey wounds per 100 fish					
	Lake trout			Chinook salmon		
	Spring	Summer	Fall	Spring	Summer	Fall
Superior						
M-1	0.0 (165)	1.5 (835)	0.0 (153)	0.0 (20)	0.0 (57)	0.0 (16)
M-2	5.8 (102)	7.9 (338)	0.0 (18)	0.0 (1)	0.0 (3)	-
M-3	0.0 (8)	-	-	-	-	-
Wis.	8.5 (222)	6.7 (270)	3.0 (164)	0.0 (19)	0.0 (36)	0.0 (9)
MS-3	20.0 (10)	7.1 (42)	5.2 (19)	-	-	-
MS-4	3.8 (131)	3.9 (156)	4.5 (22)	25.0 (4)	-	-
All districts	5.0 (638)	4.1 (1,641)	1.9 (376)	2.2 (44)	0.0 (96)	0.0 (25)
Michigan						
MM-3	3.0 (299)	4.7 (193)	0.0 (5)	-	1.1 (92)	0.0 (18)
MM-4	1.1 (88)	0.0 (38)	-	0.0 (2)	0.0 (59)	0.0 (14)
MM-5	7.4 (336)	2.4 (209)	-	0.7 (138)	1.1 (1,718)	0.0 (55)
MM-6	1.8 (432)	3.0 (328)	0.0 (3)	0.3 (955)	0.7 (2,081)	0.0 (104)
MM-7	4.5 (199)	3.6 (305)	0.0 (5)	0.6 (341)	0.7 (1,398)	1.9 (104)
MM-8	6.4 (1,634)	3.3 (756)	5.3 (57)	1.3 (2,303)	0.7 (1,564)	0.3 (288)
WM-1	3.4 (57)	0.0 (2)		-	-	-
WM-3	-	0.0 (4)	0.0 (1)	-	0.0 (234)	0.0 (26)
WM-4	10.8 (437)	11.0 (807)	0.0 (3)	5.4 (202)	4.6 (936)	0.0 (10)
WM-5	17.0 (159)	9.6 (52)	0.0 (9)	1.0 (789)	1.0 (723)	1.0 (295)
WM-6	3.9 (791)	3.6 (657)	0.0 (27)	3.2 (218)	0.6 (176)	0.0 (41)
Ill.	12.3 (57)	3.1 (170)	-	0.9 (223)	0.0 (640)	1.9 (54)
Ind.	27.8 (36)	2.8 (249)	-	0.0 (94)	0.0 (72)	0.0 (36)
All districts	6.2 (4,527)	5.1 (3,768)	2.7 (110)	1.2 (5,266)	1.1 (9,693)	0.6 (1,045)
Huron						
MH-1	4.9 (41)	12.1 (58)	-	6.1 (33)	10.6 (488)	11.6 (276)
MH-2	23.9 (46)	17.0 (147)	0.0 (2)	8.3 (132)	32.2 (335)	14.3 (49)
MH-3	12.3 (1,067)	11.7 (1,137)	0.0 (13)	5.5 (145)	17.9 (892)	20.4 (553)
MH-4	17.8 (332)	9.9 (799)	-	13.1 (260)	21.3 (155)	34.0 (50)
MH-5	25.0 (8)	28.6 (7)	-	12.6 (470)	41.6 (113)	22.4 (76)
MH-6	0.0 (1)	0.0 (2)	-	9.1 (186)	25.4 (71)	25.0 (16)
All districts	13.8 (1,495)	11.4 (2,150)	0.0 (15)	10.7 (1,226)	20.4 (2,054)	18.6 (1,020)

[a]Lake trout and chinook salmon are the primary target species of the charter fishery of the Upper Great Lakes. Little data are reported on lake trout in the fall because of a closure on sport fishing for the species after August 15 in many areas of Lakes Michigan and Huron.

[b]Data were not obtained from districts MS-1, MS-2, MM-1, MM-2, and WM-2.

Table 9. Tributaries of the north and west shores of Lake Michigan 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	1982	1983	1984	1985
Brevort River	5/6/82	1	28	0	2
Paquin Creek	6/8/78	1	6	1	2
Hog Island Creek	7/8/82	4	30	1	32
Black River	5/10/82	1	17	12	56
Millecoquins River	6/9/85				24
Crow River	5/9/76	4	0	0	0
Swan Creek	7/10/61	0	0	76	0
Milakokia River	10/16/82		77	48	33
Marblehead Creek	6/13/81	0	0	6	2
Deadhorse Creek	6/28/77	0	0	3	24
Parent Creek	5/20/83		0	0	26
Poodle Pete Creek	9/4/75	0	0	0	12
Valentine Creek	6/26/77	0	0	0	6
Hock Creek	5/7/81	0	0	2	0
Whitefish River	6/4/83		93	328	9
Rapid River	10/21/84				6
Days River	9/3/82		0	3	0
Portage Creek	6/5/83		0	2	0
Bark River	6/3/83		0	8	0
Cedar River	9/28/82		50	65	15
Bailey Creek	8/18/77	0	0	20	0
Beattie Creek	8/19/77	1	10	21	7
Menominee River	8/21/77	B	B	B	0
Hibbards Creek	5/13/79	5	77	31	0
Whitefish Bay Creek	4/22/63	54	0	11	5
Door County #23 Creek	5/11/79	0	9	0	0
East Twin River	7/9/82	0	1	1	
Total number of streams in which year class was collected		9	12	19	16

Table 10. Details on the application of lampricides to streams of Lake Michigan, 1985

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

Stream	Date	Discharge at mouth		TFM[a]		Bayer 73 powder		Stream treated	
				Act. Ingr.		Act. Ingr.			
		m^3/s	f^3/s	kg	lbs	kg	lbs	km	miles
Trail Creek (18)	May 19	1.8	63	519	1,144	0	0	33.9	21
St. Joseph River (17)									
Paw Paw River	June 2	12.5	440	3,433	7,568	14	32	48.4	30
Blue Creek	June 17	0.8	30	230	506	0	0	12.9	8
Millecoquin River (9)	June 9	3.0	105	1,038	2,289	0	0	29.0	18
Black River (15)	June 14	2.4	85	519	1,144	0	0	40.3	25
Brandywine Creek (16)	June 28	0.1	3	10	22	0	0	6.5	4
Kalamazoo River (14)									
Bear Creek	June 29	0.2	8	80	176	0	0	12.9	8
Sand Creek	June 29	0.1	2	10	22	0	0	3.2	2
Elk Lake Outlet (12)	July 11	12.2	430	1,397	3,080	0	0	1.6	1
Platte River (13)									
Middle section	July 15	4.3	153	758	1,672	4	8	1.6	1
Lower section	July 26	4.3	153	689	1,518	3	7	4.8	3
Upper section	July 29	4.7	165	868	1,914	3	7	16.1	10
Peshtigo River (1)	July 30	18.1	640	2,405	5,302	35	77	16.1	10
Bulldog Creek (8)	Aug. 9	<0.1	1	20	44	0	0	1.6	1
Manistique River (7)	Aug. 12	24.1	850	2,116	4,664	18	39	1.6	1
Ford River (2)									
Lower section	Sept. 9	11.3	400	3,074	6,776	0	0	56.5	35
Horton Creek (11)	Sept. 12	0.6	20	140	308	0	0	1.6	1
Sturgeon River (3)	Oct. 5	10.2	360	1,536	3,386	0	0	201.6	125
Carp Lake River (10)	Oct. 11	1.7	60	419	924	0	0	19.4	12
Little Fishdam River (6)	Oct. 19	0.4	14	53	117	0	0	6.5	4
Ogontz River (4)	Oct. 20	0.8	30	56	123	0	0	19.4	12
Big Fishdam River (5)	Oct. 22	1.1	40	329	726	0	0	37.1	23
Total		114.7	4,052	19,699	43,425	77	170	572.6	355

[a]Includes 235 TFM bars (48 kg, 107 lbs A.I.) applied in five streams.

Table 11. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 1985.

[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)	332	332	60	507	517	262	289
Menominee River (C)	500	486	55	504	495	262	262
Cedar River (D)	13	9	78	474	456	229	184
Ford River (E)	1	1	100	486	-	163	-
Days River (F)	0	-	-	-	-	-	-
Manistique River (G)	13,291	2,946	50	491	491	235	250
Brevort River (H)	7	7	71	494	509	225	320
ast Shore							
Carp Lake River (I)	208	94	54	453	466	195	217
Jordan River (J)							
Deer Creek	115	115	45	483	490	246	268
Boardman River (K)	124	112	42	498	492	252	252
Betsie River (L)	474	469	49	474	474	231	242
St. Joseph River (M)	406	400	48	483	493	246	259
otal or average	15,471	4,971	51	490	491	240	253

Table 12. Tributaries of the north shore of Lake Huron with reestablished populations of sea lampreys, and the maximum number collected per hour with an electric shocker.

Stream	Date of last treatment	1982	1983	1984	1985
Charlotte River	10/22/81	0	0	0	2
Little Munuscong River	6/14/85				9
Munuscong River	5/22/82	34	11	0	53
Carlton Creek	6/10/77	0	14	19	3
Albany Creek	10/24/84				63
Trout Creek	5/13/84			0	20
Beavertail Creek	6/23/81	23	3	20	16
Ceville Creek	5/12/78	0	0	0	9
Hessel Creek	5/28/79	3	1	0	47
Nunns Creek	10/19/82		2	1	2
Pine River	6/2/85				12
Carp River	5/19/85				182
Total number of streams in which year class was collected		3	4	3	12

able 13. Details on the application of lampricides to streams of Lake Huron, 1985.

[Number in parentheses corresponds to location of stream in Figure 4.]

tream	Date	Discharge at mouth		TFM[a]		Bayer 73 powder		Stream treated	
		m^3/s	f^3/s	Act. Ingr. kg	lbs	Act. Ingr. kg	lbs	km	miles
Creek (9)	May 3	0.1	2	30	60	0	0	3.2	2
River (3)	May 19	8.5	300	1,520	3,350	0	0	158.1	98
River (2)	June 2	7.1	250	1,848	4,074	0	0	161.3	100
le Munuscong R. (1)	June 14	0.4	14	130	287	0	0	32.3	20
e River (7)	Aug. 9	7.4	260	3,929	8,662	12	26	193.5	120
oygan River (4)									
urgeon River	Sept. 14	5.9	210	2,006	4,422	0	0	69.4	43
ple River	Sept. 17	3.7	130	659	1,452	0	0	16.1	10
geon River	Sept. 28	3.5	125	1,367	3,014	6	12	43.5	27
eoc River (5)	Oct. 13	3.7	130	828	1,826	0	0	6.5	4
t River (6)	Oct. 15	0.3	10	339	748	0	0	8.1	5
naw River (8)									
g Salt River[b]	Oct. 27	4.4	155	1,736	3,828	0	0	40.3	25
l		45.0	1,586	14,392	31,729	18	38	732.3	454

cludes 489 TFM bars (102 kg, 225 lbs A.I.) applied in four streams.

tial treatment.

Table 14. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Huron, 1985.

[Letter in parentheses corresponds to location of stream in Figure 4.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
St. Marys River (A)	3,428	1,[illegible]44	63	490	494	249	264
Cheboygan River (B)	9,972	1,[illegible]63	51	479	482	228	238
Ocqueoc River (C)	4,693	[illegible]45	42	474	477	218	226
East Au Gres River (D)	680	513	38	461	469	191	206
Tittabawassee River (E)	10	[illegible]	50	421	490	165	271
Chippewa River (F)	0	-	-	-	-	-	-
Total or average	18,783	3,[illegible]78	51	480	481	230	236

Table 15. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 1985.

[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)	156	[illegible]	41	505	509	259	275
Grand River (B)	495	[illegible]	49	507	514	266	282
Cattaraugus Creek (C)	1,732	1,[illegible]94	54	508	505	276	278
Total or average	2,383	1,9[illegible]3	51	507	507	273	279

Table 16. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 1985.

[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)	85	0	-	-	-	-	-
Sterling Valley Cr. (B)	253	247	60	487	478	269	267
Catfish Creek (C)	0	-	-	-	-	-	-
Little Salmon River (D)	52	52	73	488	482	263	236
Grindstone Creek (E)	70	12	42	530	505	320	308
South Sandy Creek (F)	1	0	-	-	-	-	-
Total or average	466	311	62	488	480	269	265

Table 17. Number of fish caged before lampricide application, and number live after treatment, 1985.

Species of fish	Lake Michigan				Lake Huron			
	Ford River		Platte River		Carp River (No. Br.)		Rifle River (Houghton Cr.)	
	Number		Number		Number		Number	
	Caged	Live	Caged	Live	Caged	Live	Caged	Live
Coho salmon			13	13	1	1		
Chinook salmon					1	1		
Brook trout					1	1		
Brown trout							15	15
Rainbow trout			23	21				
Central mudminnow	10	10			6	6		
Brassy minnow					2	2		
Blacknose dace					10	9		
Creek chub	13	11						
Longnose dace	10	10						
Northern hogsucker	10	10						
Brook stickleback					10	10		
Smallmouth bass	8	8						
Fantail darter	9	8						
Johnny darter	9	9						
Logperch	1	1						
Mottled sculpin			7	7				
Sculpin sp.			7	7			43	43

Table 18. Number of invertebrates caged before lampricide application, and number live after treatment, 1985.

Taxon	Lake Superior		Lake Michigan						Lake Huron			
	Silver River		Ford River		Sturgeon River		Platte River		Carp River (No. Br.)		Rifle River (Houghton Cr.)	
	Number		Number		Number		Number		Number		Number	
	Caged	Live	Caged	Live	Caged	Live	Caged	Live	Caged	Live	Caged	Live
Plecoptera												
Nemouridae									2	1		
Prostoia												
Perlodidae									17	17		
Isoperla												
Ephemeroptera												
Baetidae												
Baetis	3	1	13	7			9	9	20	18	16	16
Centroptilum			3	2								
Pseudocloeon	5	1	8	5			3	3				
Oligoneuriidae												
Isonychia			10	10			10	10				
Heptageniidae									10	7		
Epeorus												
Stenacron			2	2								
Stenonema	10	10	7	7					10	10		
Ephemerellidae												
Ephemerella	8	8							20	19		
Tricorythidae												
Tricorythodes							10	10			10	9
Caenidae												
Brachycercus			1	1								
Baetiscidae												
Baetisca	10	10	1	1								
Leptophlebiidae												
Paraleptophlebia	10	9							20	18		
Potamanthidae												
Potamanthus			40	30								

(continued)

Table 18. Continued.

Taxon	Lake Superior		Lake Michigan						Lake Huron			
	Silver River		Ford River		Sturgeon River		Platte River		Carp River (No. Br.)		Rifle River (Houghton Cr.)	
	Number		Number		Number		Number		Number		Number	
	Caged	Live	Caged	Live	Caged	Live	Caged	Live	Caged	Live	Caged	Live
Ephemeroptera (continued)												
Ephemeridae												
Ephemera			10	8	[a]50	50						
					[a]45	44						
					40	38						
					36	34						
Hexagenia					[a]49	40	24	23				
					[a]50	29						
					48	9						
					50	7						
Litobrancha					[a]25	4						
					a25	2						
Trichoptera												
Philopotamidae												
Chimarra							6	2	1	0		
Dolophilodes	17	1					1	0			10	0
Polycentropodidae												
Neureclipsis	2	2										
Hydropsychidae												
Ceratopsyche	5	5					10	10				
Cheumatopsyche			1	0								
Hydropsyche			8	7								
Glossosomatidae												
Glossosoma	8	1					14	3	20	12	17	0
Brachycentridae												
Brachycentrus							19	19			8	6
Limnephilidae												
Neophylax									10	9		
Pycnopsyche									10	10		
Helicopsychidae												
Helicopsyche	10	10							2	1		

(continued)

Table 18. Continued.

Taxon	Lake Superior		Lake Michigan						Lake Huron			
	Silver River		Ford River		Sturgeon River		Platte River		Carp River (No. Br.)		Rifle River (Houghton Cr.)	
	Number		Number		Number		Number		Number		Number	
	Caged	Live	Caged	Live	Caged	Live	Caged	Live	Caged	Live	Caged	Live
Coleoptera												
Psephenidae												
Psephenus			9	8								
Ectopria			1	1								
Elmidae												
Optioservus (larvae)	9	9	1	0								
Optioservus (adult)	10	9	10	10			10	10			10	10
Stenelmis (larvae)			9	8								
Stenelmis (adult)			10	10								
Diptera												
Tipulidae												
Antocha	2	0										
Hexatoma	1	1										
Pilaria	4	0										
Simuliidae												
Simulium							17	9			19	8
Athericidae												
Atherix	10	9							10	10		
Isopoda												
Asellus							20	20				
Gastropoda												
Physidae												
Physa			9	8								
Ancylidae												
Ferrissia	10	10										
Viviparidae												
Campeloma			10	10								

[a]Eighteen Mile Creek, a tributary of the Sturgeon River.

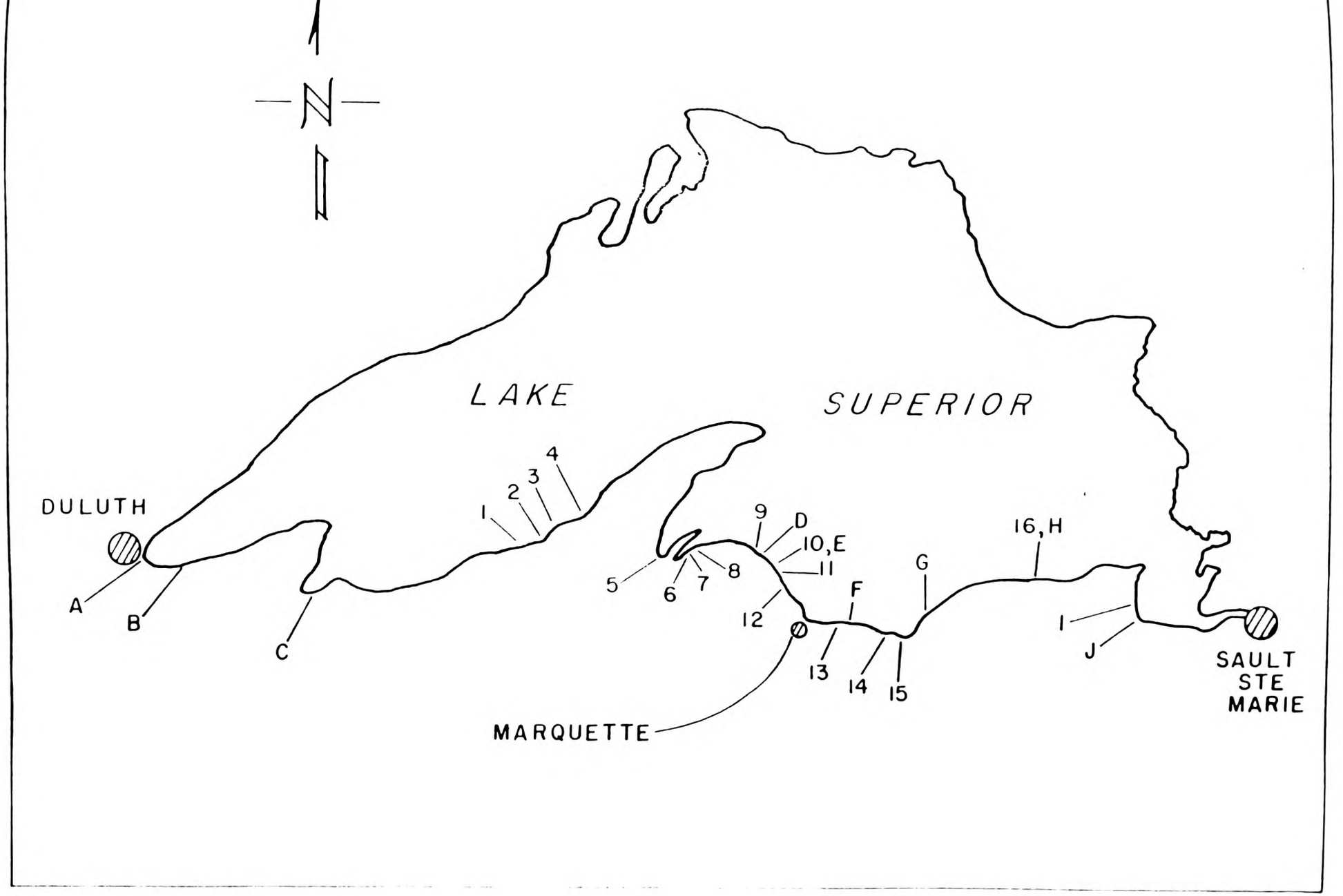

Figure 1. Location of streams tributary to Lake Superior treated with lampricides (numerals; see Table 4 for names of streams), and of streams where assessment traps were fished (letters; see Table 5 for names of streams) in 1965.

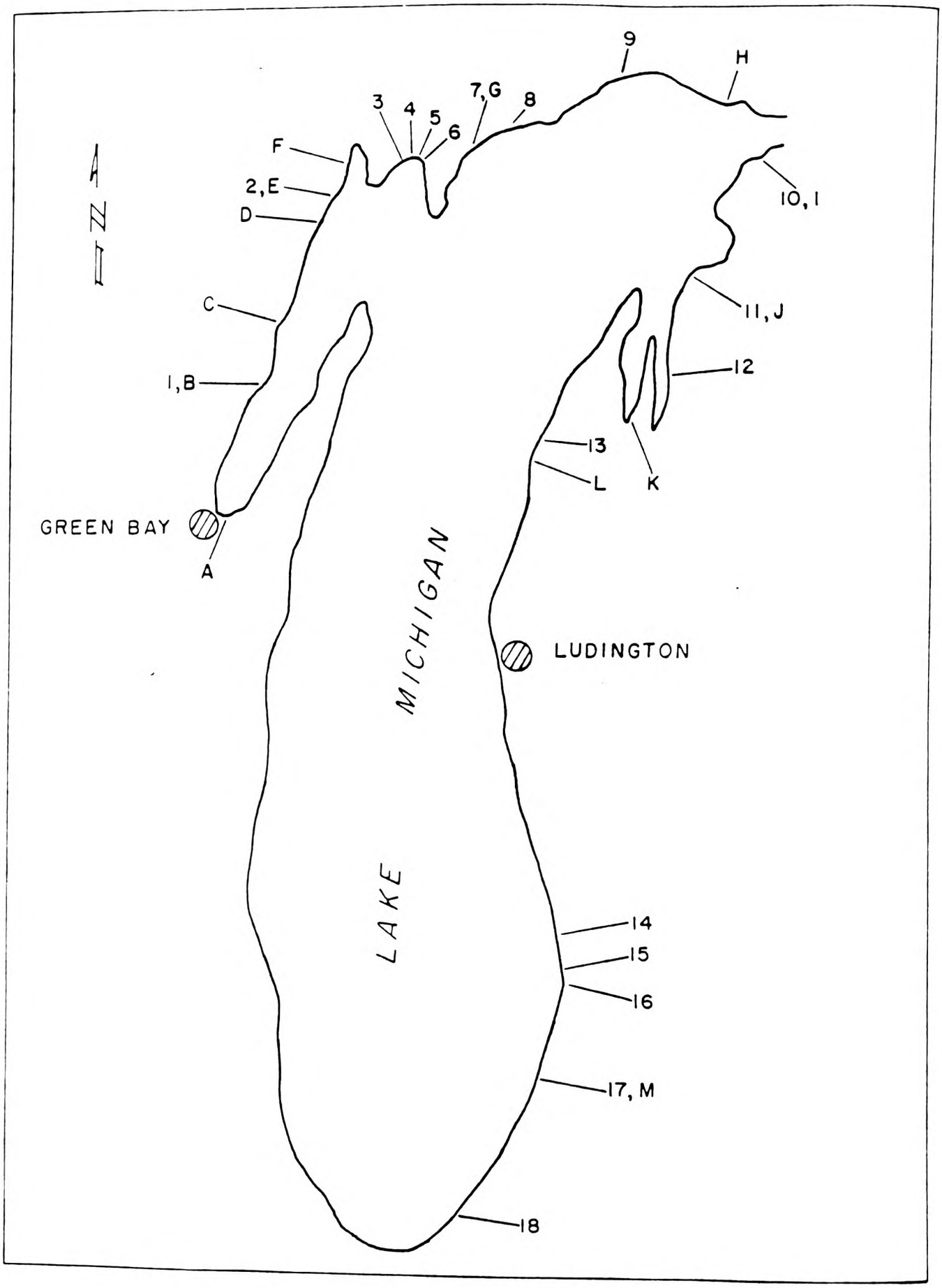

Figure 2. Location of streams tributary of Lake Michigan treated with lampricides (numerals; see Table 10 for names of streams), and of streams where assessment traps were fished (letters; see Table 11 for names of streams) in 1985.

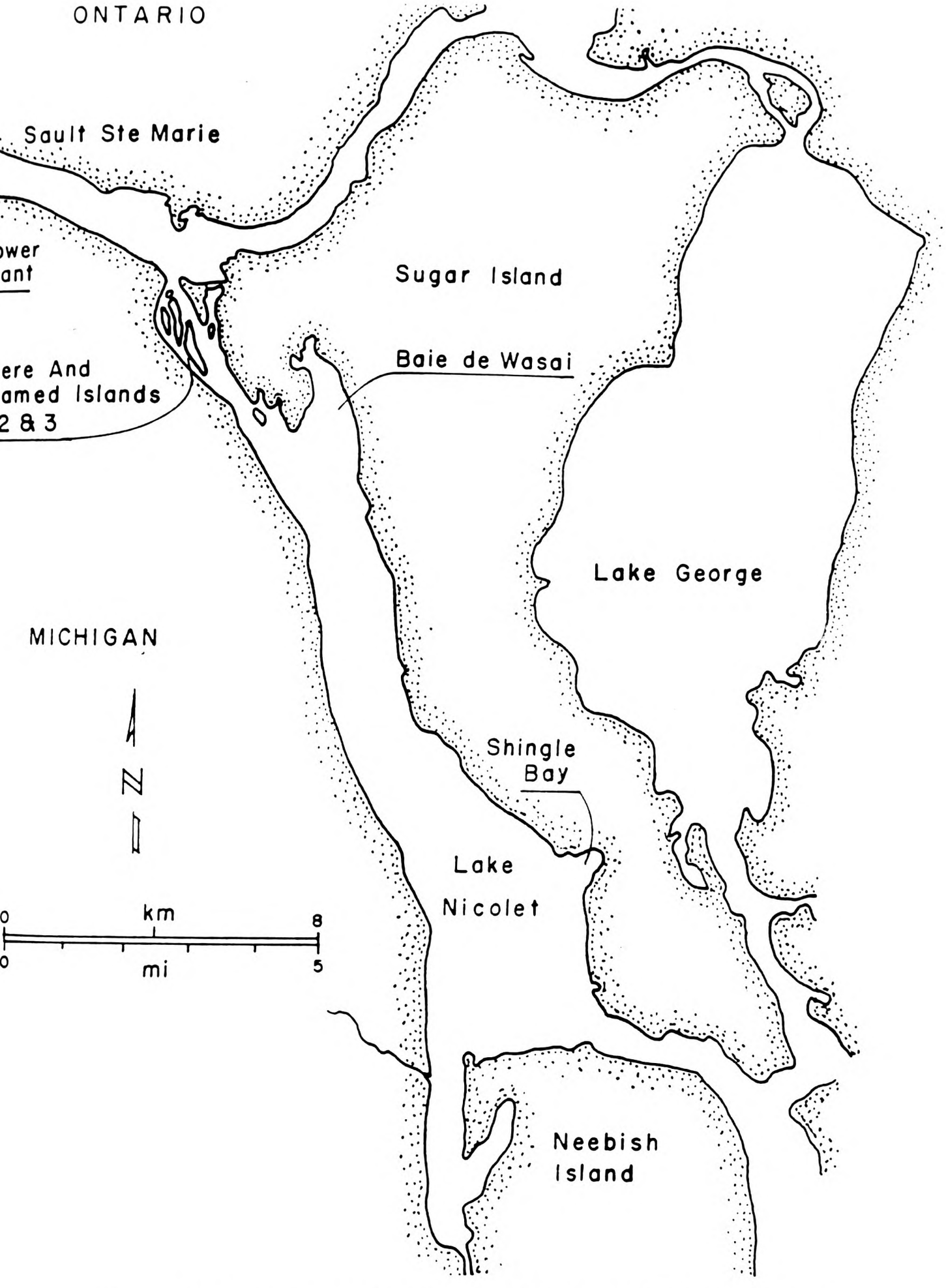

Figure 3. St. Marys River, showing locations mentioned in text.

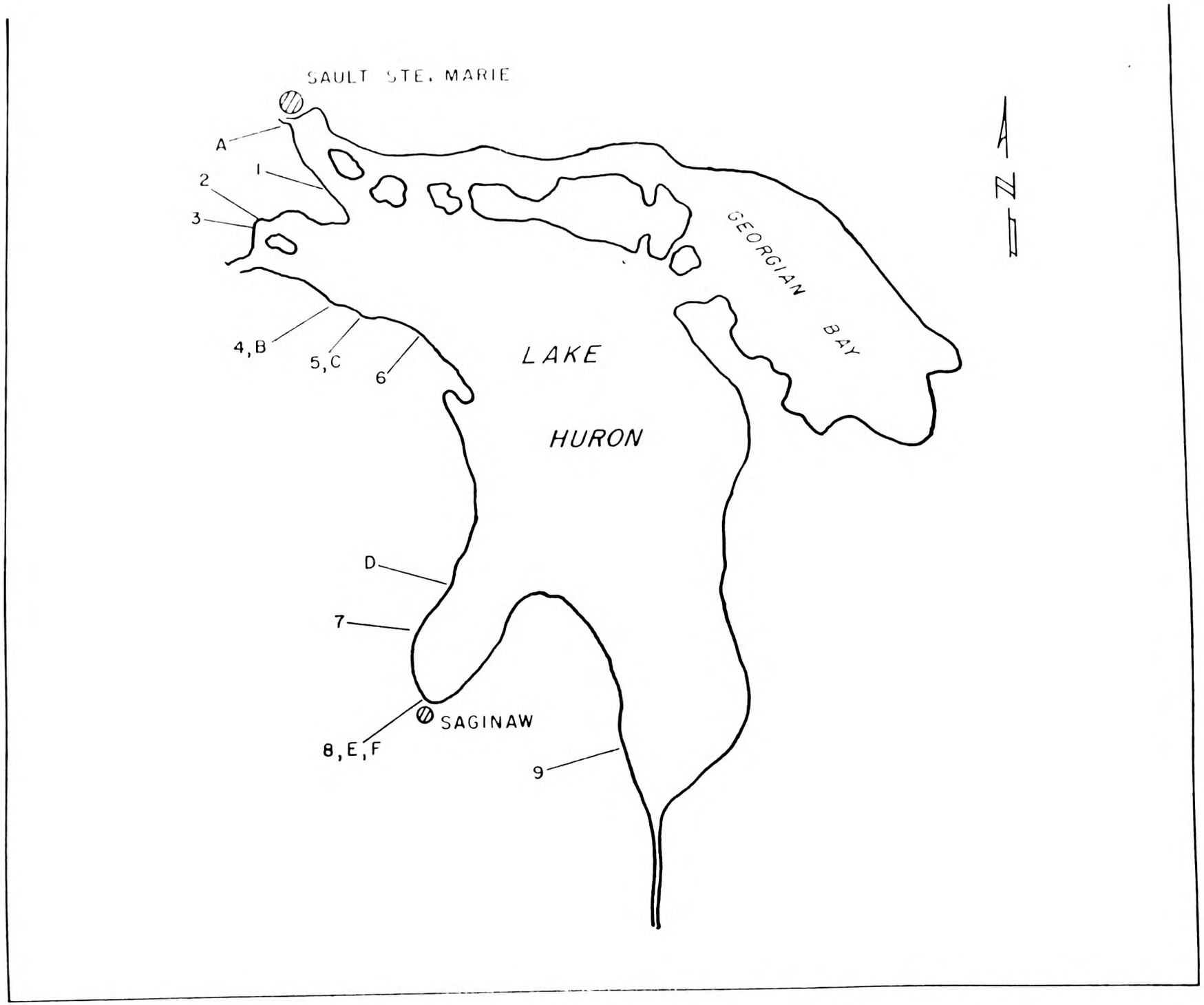

Figure 4. Location of streams tributary of Lake Huron treated with lampricides (numerals; see Table 13 for names of streams), and of streams where assessment traps were fished (letters; see Table 14 for names of streams) in 1985.

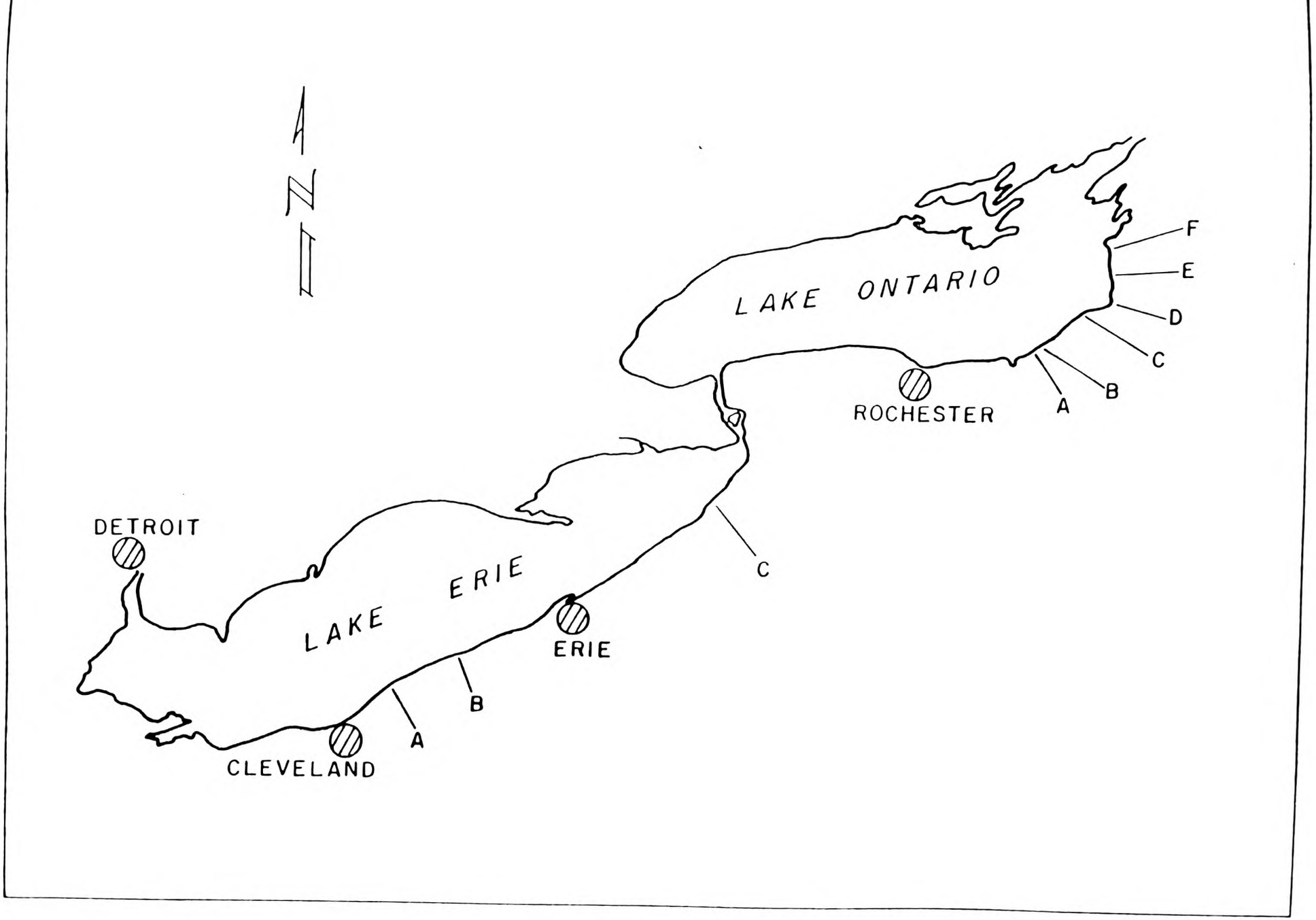

Figure 5. Location of streams tributary of Lakes Erie and Ontario where assessment traps were fished in 1985 (see Tables 15 and 16 for names of streams).

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