ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1976

GREAT LAKES FISHERY COMMISSION

MEMBERS — 1976

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GREAT LAKES FISHERY COMMISSION

Established by Convention between Canada and the United States for the Conservation of Great Lakes Fishery Resources.

ANNUAL REPORT

FOR THE YEAR

1976

1451 Green Road
Ann Arbor, Michigan,
U.S.A.
1979

LETTER OF TRANSMITTAL

In accordance with Article IX of the Convention on Great Lakes Fisheries, I take pleasure in submitting to the Contracting Parties an Annual Report of the activities of the Great Lakes Fishery Commission in 1976.

Respectfully,

K. H. Loftus, *Chairman*

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ANNUAL REPORT FOR 1976

INTRODUCTION

A Convention on Great Lakes Fisheries, ratified by the Governments of the United States and Canada in 1955 provided for the establishment of the Great Lakes Fishery Commission.

The Commission was given the responsibilities of formulating and coordinating fishery research and management programs, advising governments on measures to improve the fisheries, and implementing a program to control the sea lamprey.

In accordance with Article VI of the Convention, the Commission pursues much of its program through cooperation with existing agencies. Sea lamprey control, a direct Commission responsibility, is carried out under contract with federal agencies in each country.

The Commission has now been in existence for 21 years. Its efforts to control the sea lamprey and reestablish lake trout have, in the main, been very successful although inherent problems remain. Residual populations of sea lampreys continue to be a source of mortality. Operational costs and costs of the chemicals used in the sea lamprey control program continue to rise. The need to develop and test alternative and supplementary control methods is urgent. Also, because of environmental considerations, the Commission is obligated to continue its support of research on the immediate and long-term effects of the chemicals being used. Self-sustaining populations of lake trout have not been widely reestablished, and efforts to encourage natural reproduction by lake trout must be intensified. To this end, the Commission, working with its cooperators, developed a lake trout policy statement in 1976 to establish a framework within which the agencies would pursue various management practices while working towards reestablishment of lake trout (see Appendix A).

Through the years of its existence, the Commission has encouraged close cooperation among state, provincial, and federal fisheries agencies on the Great Lakes. Many, and probably most, of the fisheries problems are of concern to all agencies. The development of integrated and mutually acceptable management programs, supported by adequate biological and statistical information is vital. The Commission is grati-

fied with the spirit of interagency cooperation that has developed and anticipates continued cooperation for the benefit of the fishery resource and its users.

Further, recognizing that ultimately the welfare of the fishery resource of the basin depends upon maintaining an environment of the highest possible quality, the Commission, with the support of other fishery agencies, is developing close liaison with those governmental agencies who have direct responsibility for water quality, pollution abatement, and land use.

The Commission's Annual Meeting was held at Traverse City, Michigan, June 15–16, 1976 and its Interim Meeting was convened in Ann Arbor, Michigan, December 13–15, 1976.

ANNUAL MEETING

PROCEEDINGS

The twenty-first Annual Meeting of the Great Lakes Fishery Commission was held in Traverse City, Michigan, June 15–16, 1976.

Chairman Loftus called the meeting to order at 0830 hours and announced that the morning session would be followed by a luncheon featuring food items produced from underutilized fish species.

The Chairman then introduced Dr. Wayne H. Tody, Deputy Director, Michigan Department of Natural Resources, who welcomed the Commission and delegates to Traverse City on behalf of Governor Milliken, the Natural Resources Commission, and Director Howard Tanner. He provided some background on the Michigan Department of Natural Resources and described Michigan as one of 16 states having a "super department" responsible for the entire natural resource area, including fish and wildlife, recreation, and environmental protection. Dr. Tody expressed his appreciation for the degree to which Great Lakes fishery resources have been restored through the cooperative efforts of the Commission and its participating agencies.

In his report to the Commission, Chairman Loftus reviewed policy decisions reached during the past year and emphasized the success of the "Management Policy for Great Lakes Fisheries." This document has proven useful as a framework to which cooperating agencies can make reference in their efforts to develop their individual programs. Also, it clearly states the Commission's position for reference by agencies outside the Great Lakes area. Four policy statements have been developed dealing with fish disease control, barrier dams to limit sea lamprey access to streams, sea lamprey control in New York's Finger Lakes, and lake trout rehabilitation. The Commission also reviewed internal Commission and Committee operations. Recommendations from the G.F.M. Smith Committee on Commission Structure and Function, concerning upgrading the important role of Lake Committees and broadening of the Scientific Advisory Committee (SAC), are being implemented. In the fall of 1975 the SAC completed a review of Commission-sponsored programs at the Hammond Bay Biological Station, which resulted in a number of recommendations currently being implemented. Other actions taken by the Commission dealt with such matters as continued support for the Percid International Symposium, the feasibility of western Lake Erie walleye modelling,

input into recommendations relative to the Great Lakes Basin Commission's "Framework Study," and transmittal of the SAC statement on environmental quality and fish resources to the International Joint Commission for its consideration.

The Chairman concluded his report by reiterating his 1975 annual report's emphasis on the central role that the Commission's collective cooperators can play in fisheries on the continent. He expressed his feeling that continuing efforts in fisheries and ecosystem quality are finally beginning to solidify, and that the Great Lakes fishery people are going to be the first to get a clear glimpse of future directions to be taken for the preservation of aquatic resources.

Sea Lamprey Control and Research. The Commission accepted reports on sea lamprey control and research during 1976 from its two agents.[1]

A meeting of the Sea Lamprey Control and Research Committee was held in April which resulted in the Committee's reaffirmations of its strong support of the Commission's December 1, 1975 policy statement, "The role of barrier dams in an integrated sea lamprey control program." The Committee made recommendations to the Commission concerning 1) the inclusion of Lake Erie tributary surveys in the U.S. transitional period and fiscal year 1977 programs, and 2) the use of any savings realized from the lower lampricide bid price for those same periods to build up the reserve lampricide stock.

Also presented were reports covering sea lamprey research at the Hammond Bay Biological Station (chemo-sterilants) and registration-oriented research at the Fish Control Laboratories (La Crosse) on TFM and Bayer 73.

A brief report on the current registration status of TFM was presented. All pertinent documents and data were delivered to EPA, on February 3, 1976, for the reregistration of TFM lampricide. In view of the safety of this chemical, La Crosse also petitioned for an exemption from the establishment of a residue tolerance in fish and water. Unfortunately, there will be a delay in the EPA's review of this submittal because of a heavy backlog in their registration division.

Following the various reports on sea lamprey control and research programs, the Commission reviewed programs and budgets for fiscal years 1977 and 1978.[2] Appropriations for fiscal year 1977 are as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,932,700	$1,317,600	$4,250,300
Administration and General Research	75,000	75,000	150,000
Total	$3,007,700	$1,392,600	$4,400,300

[1]The reports on sea lamprey control and research in the United States and Canada appear as Appendices C, D, E, and F.

[2]More detail on programs and budgets appears in the Administrative Report, Appendix G.

The budget request for fiscal year 1978 ($4,555,600) is a modest increase of $155,300 over the fiscal year 1977 budget. Of the total figure, $4,349,561 is allocated to sea lamprey control. It was pointed out that the estimated value of the Great Lakes fishery is $450 million and sea lamprey control is absolutely essential to the maintenance of much of this fishery. In this light, the cost benefit ratio becomes impressive.

Management and Research. Numerous matters pertaining to the fishery resources of the Great Lakes were brought to the attention of the Commission. Reports were received from each Lake Committee, covering management and research activities in 1976.

The Lake Ontario Committee recommended to the Commission the development of a coordinated multi-government research and management program for the American eel on Lake Ontario and the St. Lawrence River. The Committee also made recommendations concerning fish contaminant monitoring, fisheries funding support, winter navigation, genetic integrity of fish stocks, fish disease control, sea lamprey research needs, and fish stock assessment.

The Lake Erie Committee report highlighted such items as commercial and sport catch, status of major species, stocking program, and contaminants. Concerning the latter, it was reported that the 1974–1975 U.S. Fish and Wildlife Service reexamination of total mercury in walleye, white bass, yellow perch, emerald and spottail shiners indicated a significant decrease since 1970 and 1971. Recommendations made to the Commission dealt with endorsement of the yellow perch technical report adopted by the Committee and the Walleye Scientific Protocol Committee's technical report upon adoption by the Lake Erie Committee.

The Lake Huron Committee reported on such fishery investigations as larval fish and fish habitat assessment, status of forage fish stocks, survival and growth of lake trout, splake and splake x lake trout backcrosses, angler distribution, and commercial fish landings. Total commercial fish landings in Lake Huron were down some 100,000 pounds from 1974 with Ontario reporting the largest decline in yellow perch and rainbow smelt. Michigan reported a significant increase in lake whitefish catch.

The Lake Michigan Committee presented information on sea lamprey wounding, fishing regulations, status of fish stocks, and reports by the new Lake Trout Technical and Sport Fishing Statistics Committees. Agencies responding to the recommendation of the Lake Michigan club Technical Committee reported continuing difficulties in closing the chub fishery.

The Lake Superior Committee reported on the status and management of major species such as lake trout, herring, lake whitefish, and chubs and added that all agencies plan to continue their lake trout assessment programs through 1976. Adult sea lamprey catch statistics from eight index weirs of U.S. tributaries revealed an increase of 135% in 1975—a catch higher than the previous two years but only half the size

of the 1971 or 1972 catch. The 1975 catch was equal to that of 1970 and appears to be conforming to a cyclical pattern. The Committee reviewed the question of fall vs. spring sea lamprey wounding rates and recommended that the greatest effort to measure wounding rates be made in the spring.

The Commission received a report from the Chairman of the combined Upper Great Lakes Committees which included information on sea lamprey control, salmonid plantings, fish disease, contaminant levels in fish, use of underutilized species, and reaction to a proposal from Pennsylvania for introducing striped bass into Lake Erie which was submitted for comment by Great Lakes Fishery agencies. The Committee also reported action taken which included: steps to preserve the genetic strain of Green Lake lake trout (while not a pure strain, the Green Lake fish represent those trout most closely identified with native Lake Michigan lake trout stocks which were eliminated by sea lamprey); an offshore plant of 210,000 Green Lake strain yearling lake trout in Lake Michigan; revisions in Lake Committee format; and several actions regarding sea lamprey. Recommendations for Commission consideration included: a request for more participation by the Scientific Advisory Committee in Lake Committee activities; a request that the Commission encourage agencies and federal aid entities to provide more funding for assessment programs; that the Commission request that lake trout be included in the list of fish eligible for funding under the Anadromous Fish Conservation Act; that the Scientific Advisory Committee address spring versus fall sea lamprey wounding; that the Commission support such federal (U.S.) efforts as the currently debated toxic substances bill; and that the Commission investigate the possibility of contacting all agencies with capabilities and responsibilities to conduct analyses to formulate lakewide comprehensive surveys to define more adequately the areas of significant contamination affecting water quality and utilization of fish.

Special Reports. Representatives of the Upper Great Lakes Regional Commission briefly outlined its activities, noting that their major responsibility is for economic development in the northern counties of Michigan, Wisconsin, and Minnesota. One activity has been funding research to develop new food products using underutilized Great Lakes fish species. Presentations on such fish products were given by Emory Swanson and Associates, Michigan State University, University of Wisconsin, Ohio State University, and New York State University-Albany, followed by a lunch featuring numerous dishes made from underutilized fish species.

The Secretariat summarized the purpose and scope of the Sea Lamprey International Symposium (SLIS) scheduled for the fall of 1978.[3] The objective is to stimulate publication of Great Lakes sea

[3]Subsequently rescheduled for August 1979.

lamprey information, develop a better understanding of fish-lamprey interactions, and improve sea lamprey control.

The Chairman of the Percid International Symposium (PERCIS) presented a progress report, including the tentative program and contributions.

In addition, the Director of the International Joint Commission Regional Office, Windsor, Ontario, presented an update on the Great Lakes Water Quality Agreement, covering topics such as development and accomplishment of remedial programs, development and implementation of water quality objectives to protect aquatic life, surveillance monitoring results, and surveillance and remedial plans for areas of significance to the fishery.

The Chairman of the Great Lakes Fish Disease Control Committee summarized progress to date and drew attention to future needs. He expressed pleasure with the expanding coverage of fish disease inspection programs and increasing efforts to control the introduction and spread of fish diseases in the Great Lakes basin. However, he pointed out the diminishing number of therapeutics available for controlling fish diseases because of registration requirements. Some therapeutics will never be cleared and research to find clear alternatives is a long and costly effort, one which will be left largely to governmental agencies because the potential market is small.

A representative of Michigan Sea Grant presented an illustrated description of a cooperative purse seining project under development on Lake Michigan. Participants include the Upper Great Lakes Regional Commission, Michigan Sea Grant and three commercial fishermen. The objective is to develop a selective, live-catch commercial fishing gear for Great Lakes use that will operate with minimal conflict with the sport fishery.

The Director-General for the Ontario Region of the Department of Fisheries and Environment, Canada, presented a report on development of the "Strategic Plan for Ontario Fisheries" (SPOF), a Federal-Provincial effort to assess the status of Ontario fisheries and recommend broad courses of action for the future. The principal observations of the SPOF Task Force were examined under three components: societal goals related to the fisheries resource, public issues and basic problems in fisheries management in Ontario, and strategies in the future.

Scientific Advisory Committee (SAC). The Committee accepted a report from the Scientific Advisory Committee on the technical review of Commission-funded research at the Hammond Bay Biological Station of the U.S. Fish and Wildlife Service. The SAC recognized the excellent and commendable record of accomplishment to date but believed it was time for the Commission to reassert an aggressive and progressive research role similar to that which existed at the time of development of the chemical treatment program to control sea lamprey. The report contained a number of recommendations for the Laboratory and the Commission concerning development and use of sterile lamprey, sea

lamprey wounding criteria, chemosensory studies of sea lamprey, and sources of experimental lamprey, plus several suggestions for improving sea lamprey control.

National Section Meetings. Commissioner Ver Duin, Chairman of the U.S. Section, reported on the U.S. Section meeting. Comments by Dr. Tody, Deputy Director of the Michigan Department Natural Resources relative to making the U.S. Section more effective, were discussed. The topic of contaminants and contaminant surveillance programs received considerable attention, with the Commission being urged to endorse the current U.S. federal legislation to control toxic substances. Other discussions focussed on lake trout and the importance of genetic strains. In addition, two resolutions presented by the Michigan Fish Producers Association relative to catch fees and more equitable allocation of lake trout between commercial and sport interest were addressed.

Chairman Loftus reported on the Canadian Section Meeting. He noted that it is Ontario's intention to reactivate participation by representatives of segments of the public. Other topics included a proposed Lake St. Clair fish habitat study, the proposed striped bass introduction by Pennsylvania, the report of the Walleye Scientific Protocol Committee, and the existing federal-provincial agreement.

Administrative and Executive Decisions. Chairman Loftus summarized recent executive action which included responding to various committee recommendations. He regretted that time did not permit the Commission to act on all matters transmitted to them.

General

1) The Commission elected Mr. L. P. Voigt as Chairman and Dr. C. J. Kerswill as Vice-chairman for 2-year terms.

2) The Commission completed a formal policy statement on lake trout rehabilitation.[4]

3) Chairman Loftus referred to statements appearing in the Congressional Record for May 5, 1976, pages H-3958 through H-3968 which resulted from an examination of Canada-U.S. relations by 15 U.S. Congressmen under the guidance of Representative Philip Ruppe of Michigan. The record contains references to fishery management on Lake Erie, which in the opinion of the Great Lakes Fishery Commission, contained less than up-to-date information. Therefore, the Commission is arranging to supply items such as the report of the Lake Erie Yellow Perch Committee and the Walleye Scientific Protocol Committee to the appropriate people in an effort to clarify the record.

[4]Policy on lake trout rehabilitation may be found in Appendix A.

Responses to Lake Committee Recommendations

Lake Erie Committee

4) Referring to the walleye Scientific Protocol Committee (SPC), he noted that the Commission was in receipt of the latter's completed report and complimented the SPC on the completion of a long and arduous task. He stated that the Commission "looks forward to learning whether the Lake Erie Committee accepts the report as a scientific basis for proceeding to develop management action for walleyes in the western part of the lake."

5) He noted that the report of the Lake Erie Yellow Perch Technical Committee had been transmitted to the Commission from the Lake Erie Committee with that Committee's endorsement of the recommendations contained therein. The report was officially transmitted by the Commission to senior administrators of the agencies involved.

Upper Lakes Committees

6) The Upper Great Lakes Committees had recommended greater participation by the Scientific Advisory Committee (SAC) in the deliberations of the Lake Committees. The recommendation will be brought to the attention of the SAC, and the Commission will urge the SAC to be represented at meetings of Lake Committees. He noted that the SAC had usually in the past participated in meetings of Lake Committees. Further, that inasmuch as Lake Committees have sought participation by the SAC, they (the Lake Committees) had an obligation to respond to the input they receive from the SAC.

7) A recommendation urging increased funding for stock assessment. The Commission refers to its admonitions relative to evaluation and assessment of stocks on a number of occasions in the past. Assessment to date has been less than adequate. The Commission strongly urges the Upper Great Lakes Committees to determine what specifically needs to be done, to establish priorities, and to provide "for instances." In brief, for the Commission to respond, the recommendation needs to be more specific.

8) A recommendation that the list of species eligible for funding under the Anadromous Fish Conservation Act be expanded to include lake trout. The Commission did not feel that it can or should respond to this recommendation.

9.) A recommendation that the SAC resolve the issue of spring versus fall wounding rates as a measure of sea lamprey abundance. The Commission felt that this question was not a matter to be resolved by the SAC but rather for the scientists directly involved with the problem to further examine the data and to make what further resolution was possible. There may be some opportunity for the SAC to offer advice or comment, but they (the SAC) cannot be expected to go beyond the scientists who are generating the data.

10) A recommendation urging Commission support for legislation, now before the U.S. Congress on toxic substances. Supportive action was taken by the Commission at its Executive Session in April 1976, and a letter providing such support was transmitted to EPA Administrator Russell Train.

11) A recommendation urging the development of a comprehensive survey of contaminants. The Commission noted that such a survey program had been developed by IJC's Upper Great Lakes Reference Group and a similar project is under consideration by IJC's Lower Lakes Surveillance Subcommittee, thus the development of such survey programs is underway. Further, fisheries people from all or most of the interested agencies are involved in current and planned activities along these lines. This response also answers the similar recommendation of the Lake Ontario Committee.

Lake Ontario Committee

12) A recommendation urging lake-wide assessment of fish stocks as an interagency activity. The Chairman referred to recommendations and responses 7 and 11 above and noted they appeared to be tied together. Stock assessment should receive the highest priority; however, the stock assessment program would also provide fish samples for contaminant analysis. He added that while agencies should participate in IJC's contaminant survey, the development of a systematic stock assessment program should receive high priority from the Lake Ontario Committee.

13) A recommendation that the Great Lakes Fishery Commission request IJC to provide annual status reports on water quality in Lake Ontario. The Commission agrees with the recommendation and expects that such reports will become part of the closer liasion now being developed with IJC.

14) A recommendation to establish an interagency management plan for the American eel. The Commission endorsed the establishment of an American eel work group. Upon the development of a plan by the Lake Ontario Committee, the Commission can perhaps provide some assistance in dealing with agencies outside the Convention area, i.e., Quebec.

15) A recommendation urging Commission support for agency research budget requests. The Commission cannot inject itself into agency budgeting priorities. Nevertheless, the Commission might respond to a very specific situation when it appears that a program of particular concern to the Commission is being jeopardized by budgetary restraints imposed on an individual agency.

16) A recommendation urging Commission support for ongoing studies on the St. Lawrence Seaway in connection with the possible extension of the shipping (navigation) season. The Commission has asked its Secretariat to look into the question to see if the Commission can fulfill a useful function in the matter. Presently, the Commission is unsure of existing institutional arrangements.

17) Recommendations pertaining to genetic composition of stocks and catalog of origins of planted salmonids. Chairman Loftus noted that similar recommendations had been submitted by the Upper Great Lakes Committees. The Commission is in full accord with the expressed concern. The Commission has discussed the entire question in some depth and is seriously considering the establishment of a large-scale bi-national workshop or symposium to address the whole question of the stock concept and the needs for research into fish genetics and selection. The SAC will be approached for advice on advisability, content, and organization of such a symposium.

Responses to Sea Lamprey Control and Research Committee

18) Recommended the inclusion of surveys of the tributaries to Lake Erie in the program for the transitional period in U.S. (July 1–September 30) and in the FY 1977 programs.

19) Recommended that any savings realized from the lower bid price for lampricide in the transitional period and in FY 1977 be used to purchase additional lampricide to build up the reserve stock.

20) Reaffirmed its strong support of the December 1, 1975 policy statement on "The Role of Dams in an integrated Sea Lamprey Control Program" and recommended the inclusion of funds for a barrier dam program in FY 1978 program.

21) Commended the agents for the excellence of visual aids used to present reports to the Committee and requested that the agents continue and extend the use of visual aids in future reports to the Commission and this Committee.

Responses to Committee on Commission Structure and Function

22) Chairman Loftus explained that in response to the above Committee's recommendation for expansion of the Scientific Advisory Committee (SAC), arrangements have been completed to add six scientists as follows: United States—Dr. Alfred M. Beeton, Dr. Niles Kevern, Dr. John Magnuson; Canada—Dr. Jeffrey Watson, Dr. William Beamish, and Dr. George R. Francis.

23) The Commission also established a committee (S. Smith, A. Lawrie, C. Fetterolf) to prepare new terms of reference for the broadened SAC.

Adjournment. The Chairman informed the delegates of scheduled meetings as follows:

Interim Meeting, Ann Arbor, Michigan, December 23, 1976.[5]
Annual Meeting, Sault Ste. Marie, Ontario, June 14–15, 1977.

There being no further business, incoming Chairman Voigt adjourned the meeting at 1500 hours, June 16, 1976.

[5]Subsequently changed to December 13–15, 1976.

INTERIM MEETING

PROCEEDINGS

The Commission's Interim Meeting was convened in Ann Arbor, Michigan on December 14, 1976 to consider the sea lamprey control and research program, to review budgets for fiscal years 1977 and 1978, to examine the relationship of coastal zone management programs to Great Lakes fisheries, and to consider the status of the Indian fishery, contaminants, reports of internal committees, and several other items.

A representative of the U.S. General Accounting Office announced the beginning of a study requested by the Chairman of the House Committee on Merchant Marine and Fisheries and the Chairman of the House Subcommittee on Fisheries Wildlife Conservation and the Environment to study policies, issues and options available to revitalize the Great Lakes commercial fishing industry.

Sea Lamprey Control and Research. The Commission heard reports on the incidence of sea lamprey wounding on lake trout, salmon, and whitefish in the Great Lakes.

Progress reports covering sea lamprey research at Hammond Bay Biological Station (USFWS) included: chemical sensing in sea lamprey; investigation of homing behavior; development of uniform criteria for sea lamprey wounding; chemosterilization of sea lamprey, and production of sea lamprey for research. Registration-oriented research on lampricides at the Fish Control Laboratory, LaCrosse, Wisconsin (USFWS) was summarized and highlighted.

The sea lamprey control agents also presented progress reports on sea lamprey control operations in the United States (June–November 1976) and Canada (April–November 1976).

Following the reports on the sea lamprey control and research programs, the Commission considered programs and budgets for fiscal years 1977 and 1978. At the Annual Meeting in Toronto, Ontario, in June 1975, the Commission adopted a budget for fiscal year 1977 in the amount of $4,525,400. The budget and program was subsequently revised to match reduced appropriations and the Commission adopted the following budget for fiscal year 1977.

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,932,700	$1,317,600	$4,250,300
Administration and General Research	75,000	75,000	150,000
Total	$3,007,700	$1,392,600	$4,400,300

The total budget request for fiscal year 1978 ($4,555,600) endorsed at the Annual Meeting in June 1976, called for continuation of sea lamprey control in Lakes Ontario, Huron, Michigan, and Superior, stream surveys for larval sea lamprey, operation of electric assessment weirs on Lakes Superior and Huron, continuing, although dwindling, research to assess the immediate and long term effects of lampricides in the environment, research to improve present control techniques, and a new project to build barrier dams on selected rivers to prevent sea lamprey access to problem areas and reduce the use of expensive lampricides and application costs.

Relationship of Coastal Zone Management Programs to Great Lakes Fisheries. A panel composed of representatives of federal and state governments and the Great Lakes Basin Commission discussed the coastal zone management program and its relevance to fishery programs in the Great Lakes, particularly to having greater fisheries input into programs under development. The purpose of the 1972 Coastal Zone Management Act is to "develop unified policies, standards and procedures for making decisions about the use of coastal resources."

Status of Indian Fishery. Reports were given by representatives of the U.S. Fish and Wildlife Service, State of Michigan, Minnesota, Wisconsin, and the Province of Ontario on the status of Indian fishery rights and ongoing litigation, principally in Michigan.

Recent decisions and current litigation were cited to indicate the unsettled situation with regard to the rights of Indian bands to fish the waters of Lakes Superior, Michigan, and Huron. Most of the information came from the State of Michigan where the Bay Mills Band claims exclusive rights to fishing in Whitefish Bay and unlimited rights in large sections of Lakes Superior, Michigan, and Huron. Currently, Indian fishing in Ontario waters of the Great Lakes is not a significant problem because of minor fishing effort. Historically, Canadian Indian bands have each received different rights by treaties.

Scientific Advisory Committee. The Scientific Advisory Committee, recently expanded from 6 members to 12 members, critically considered its role and reviewed and adopted a proposed framework which outlines the structure, organization and responsibilities of the committee. They also considered water quality problems, the role of the U.S. Fish and Wildlife Service in the Great Lakes as tabled with the Great Lakes Fishery Commission, fish stocks, and made four recommendations: (1) concerning the feasibility of modelling walleye populations of western Lake Erie; (2) the carrying capacity of large piscivores in the Great Lakes; (3) habitat modification as a means of sea lamprey control; and (4) development of compatible systems of information storage and retrieval among fishery management agencies.

Management and Research. The Commission was apprised of progress made in conducting an inventory of Great Lakes fishery resource assessment programs which involve cooperative effort from all agencies working through the Commission.

The U.S. Fish and Wildlife Service presented reports on the status of the proposed Iron River National Fish Hatchery and the new Allegheny National Fish Hatchery. The Province of Ontario added information on disease eradication measures taken at the Dorion Hatchery.

The Lake Erie Committee reported on plans for a Standing Technical Committee. The report of the Scientific Protocol Committee for Management of Walleye in Western Lake Erie is expected to be finalized by January 1977. Strong support for the scientific findings of this report was obtained from all Lake Erie agencies including those not directly involved in the issues. The report of the Yellow Perch Committee has drawn agencies together in adherence to existing statutes regarding minimum size limits to bring about some improvement in western Lake Erie stocks of yellow perch. Lake Erie agencies also described plans towards adopting recommendations for yellow perch and walleye management. The Lake Erie Committee discussed the development of a workshop to identify the desired Lake Erie fish community.

The Chairman of the Lake Michigan Lake Trout Technical Committee summarized the committee's concern with the biological aspects of attaining a self-sustaining lake trout population, and plans for unified lake-wide sampling starting in 1977. Items include monitoring the offshore plant of Green Lakes strain lake trout, sampling early life stages, implementing a unified stock assessment program, and pooling data for reporting to the Lake Michigan Committee.

The Lake Michigan Chub Technical Committee reported on the closure of the chub fishery which was finally implemented in October 1976 to protect stocks, and the assessment programs which became fully operational in Wisconsin, Michigan, and Illinois. Indiana chub catch is negligible.

Eastland Fisheries Survey. Commissioner Lawrence reviewed the history of the Eastland Resolution, unanimously passed by the Congress in 1973, which strongly supports strengthening of the U.S. fishing industry. Input through public meetings from the Great Lakes regions has been consolidated into recommendations which were submitted in the Great Lakes portion of the survey report at a national meeting in Washington where sets of regional recommendations were combined in a statement to the Congress.

Contaminants. The Mirex problem in Lake Ontario was described as a symptom of a larger problem of implementing controls over the release of environmental contaminants. News of Mirex's potential health hazards precipitated a ban on possession of fish taken in the State of New York's waters of Lake Ontario. Furthermore, it influenced the state to reduce stocking rates of certain species into Lake Ontario.

A representative from the IJC reviewed the goals, objectives, and activities of the 1972 Canada-U.S. Great Lakes Water Quality Agreement, currently under five year review by the governments. Specific problems discussed included pesticides, heavy metals, anoxia, and nutrient loading, each lake being considered individually.

Symposia. PERCIS, a symposium on percid communities, was held at Quetico, Ontario, in the fall of 1976. It was noted the proceedings would be published by the Journal of Fisheries Research Board of Canada in a single volume estimated to exceed 600 pages.

The Secretariat gave a brief progress report and discussed tentative plans for the Sea Lamprey International Symposium (SLIS), noting changes in the steering committee membership.

Summary of Administration and Executive Action. The Chairman of the U.S. Section summarized action taken by U.S. members of the Commission.

1) Acknowledged recommendations of Dr. Wayne H. Tody (Deputy Director, Michigan Department of Natural Resources) for improving the functions of the Commission, but noted the changes would require renegotiation of the 1955 Convention on Great Lakes Fisheries. Since the U.S. administration is in the process of change, the timing appears inappropriate.

2) Emphasized the need for reactivation of the lake advisory committees for Lakes Michigan, Huron, Erie, and Ontario.

3) In response to the Lake Superior Advisory Committee:

a) Responded on financing of barrier dams for stopping spawning sea lamprey.

b) Informed the Lake Superior Committee that establishment of quotas for siscowet (fat lake trout) by states as referred to them by the Lake Superior Advisory Committee is a matter for consideration, not only by each state, but in concert with Ontario.

c) Instructed Secretariat to maintain close contact with the Surveillance Committee of IJC and their contaminants monitoring subgroup.

d) Informed the Lake Superior Committee of the Lake Superior Advisory Committee's encouragement, and that of the U.S. Section, to form a lake trout technical committee if deemed helpful.

e) Commended the Lake Superior Advisory Committee for their continued active participation in the Commission's activities.

The Chairman of the Commission summarized action taken in executive session, enumerating the following items:

1) Instructed the Secretariat to explore with IJC the need for annual water quality reports at lake committee meetings and the Great Lakes Fishery Commission's annual meeting.

2) Charged the Scientific Advisory Committee to form a steering committee to work toward a plan of development for a bi-national stock concept symposium.

3) Commission agreed to sponsor a meeting to provide background information on the stock concept, its reality and implications, in conjunction with the meeting of the International Association for Great Lakes Research, Ann Arbor, May 10–12, 1977.

4) Thanked the Scientific Advisory Committee for their consideration of the draft document on the role of the U.S. Fish and Wildlife Service in Great Lakes, and advised that the comments were forwarded to the U.S. Fish and Wildlife Service.

5) Instructed the Secretariat to investigate what is involved and the cost of developing a bi-national storage and retrieval system for Great Lakes fishery data.

6) Instructed the Secretariat to investigate why the U.S. Department of Interior was not included in the interagency advisory committee for portions of implementation of the U.S. Toxic Substances Control Act, and recommend inclusion if appropriate.

7) Instructed the Secretariat to inform U.S. Congressman Ruppe of progress in international-interstate management of Lake Erie fisheries.

8) Agreed to enter into a $1,000 contract with F.W.H. Beamish for update of the Cyclostomata bibliography.

9) Requested from Wisconsin Department of Natural Resources a report on status and prognosis for Green Lake strain lake trout which are in their custody.

10) Instructed Secretariat to complete update of Technical Report #3, Commercial Fish Production in the Great Lakes.

11) Will notify U.S. Fish and Wildlife Service of Commission support for Bernard R. Smith as senior scientist with duties to aid the Sea Lamprey International Symposium.

12) Charged Sea Lamprey International Symposium Steering Committee to explore publication of proceedings in fishery journals.

13) Relayed to Sea Lamprey International Symposium Steering Committee the Commission's endorsement of SAC recommendations that models be developed for wounding and wound characteristics as a measure of attack rates, mortality rates, and related phenomena.

14) Instructed Secretariat to draft position statement on continuing sea lamprey control and rehabilitation of fisheries in light of contamination problem.

15) Advised the Lake Superior Committee that if siscowets (fat lake trout) are not included in the lake trout quotas by Lake Superior fishery management agencies, the matter should be referred back to the Commission.

16) Commission committed itself to be more responsive to the needs of cooperators.

17) Commission reviewed its internal committee structure.

18) Instructed the Secretariat to make necessary arrangements with USFWS to co-sponsor a workshop on coordination of fishery research in the Great Lakes.

19) Communicate to sea lamprey control agents the Commission's encouragement that agents place more emphasis on assessment and prediction, with the understanding that assessment is not thoroughly reliable and that agents will not be held accountable for their predictions.

20) Reconfirmed to sea lamprey control agents the Commission's desire that the agents map known or suspected sources of transforming sea lampreys that may not now be subject to current control efforts and directed that evaluation of the contribution of these areas to the sea lamprey problem and costs estimates for treatment be submitted.

21) Requested from U.S. agents comments on the feasibility and value of establishing assessment barriers on Lake Michigan tributaries to obtain better information on sea lamprey control in that body of water.

22) Advised sea lamprey control agents that they should provide more documentation that concentrations of pre-spawning anadromous salmonids decoy sea lamprey, thus modify their homing behavior.

23) Returned to Lake Ontario Committee their request for determination of specific needs for sea lamprey barriers for Lake Ontario tributaries, with comment that the Commission feels it is a question to be addressed by the Lake Ontario Committee itself.

24) Directed the Secretariat to secure from the sea lamprey control agents what chemical analysis had been done on tributary streams.

25) Will express Commission support for IJC recommendation for remedial work in St. Marys Rapids for water control structures at Sault Ste. Marie.

Adjournment. The Chairman informed the delegates of scheduled meetings as follows:

Management and Research Committee, Ann Arbor, 12 April 1977.
Sea Lamprey Control and Research Committee, Ann Arbor, 13 April 1977.
Annual Meeting, Sault Ste. Marie, Ontario, 14–16 June 1977.
Scientific Advisory Committee, Ann Arbor, 30 November 1977.
Interim Meeting, 1–2 December 1977.

The meeting adjourned at 1350 hours, 15 December 1976.

APPENDIX A

SUMMARY OF MANAGEMENT AND RESEARCH

In 1975 and 1976 the Great Lakes Fishery Commission (GLFC), working closely with its cooperators, developed policy statements on lake trout rehabilitation, fish disease control, and low head barrier dams to offer guidance to Great Lakes agencies charged with the stewardship of natural resources. A fourth policy on involvement of the Commission in sea lamprey control in the Oswego River/Finger Lakes provided internal guidelines for the Commission on its responsibilities both within and outside the Convention on Great Lakes Fisheries.

A. **Position on Lake Trout Rehabilitation.** The statement was developed over a period of about a year while the need for a policy became increasingly obvious as the reproduction failure of planted lake trout continued, exploitation pressures accelerated, and many lake trout were planted in areas near shore where they would be vulnerable to capture and have little chance of reproducing successfully.

In issuing the statement the Commission explained that an early draft was distributed to cooperating agencies seeking their comments, and that the final policy incorporated, so far as the Commission deemed appropriate, the suggestions received. The Commission also commented that it did not pressume to furnish a detailed management plan, but believed that the policy provided a framework within which all cooperating entities could make further progress in the ongoing development and implementation of an integrated Great Lakes fishery management program.

POSITION ON LAKE TROUT REHABILITATION

A POLICY STATEMENT OF THE GREAT LAKES FISHERY COMMISSION ADOPTED 14 JUNE 1976

Article IV(A) of the Convention of Great Lakes Fisheries charges the Great Lakes Fishery Commission to determine measures for continued productivity of desirable fish species in the Convention area. The Commission views development and maintenance of balanced fish communities supported by natural reproduction as the ultimate goal of this charge, and believes that stocking with hatchery-reared lake trout is an essential step towards achieving this goal and reestablishment of self-sustaining lake trout populations—a major Commission objective.

The primary purpose in selecting planting sites for lake trout should be to obtain successful reproduction. Suitability of habitat should be a major determinant. However, where habitat quality has deteriorated, populations of lake trout, important predators in the fish community, may have to be maintained by hatchery plantings until habitat quality is restored. The Commission also acknowledges the importance of fisheries for planted lake trout and that in some areas social and economic conditions temporarily dictate that planting sites should be chosen to facilitate harvest.

The Commission recognizes that in Lakes Superior and Michigan substantial stocks of lake trout have been reestablished through planting, controlling sea lampreys, and limiting commercial exploitation. Effectual natural reproduction requires large numbers of spawning fish. Although some natural reproduction occurs in certain areas, the Commission has determined that the present planting program as designed, combined with mortality, harvest, and unknown environmental factors, has not yet been sufficient to establish the desired level of natural reproduction.

Existing hatchery facilities do not permit expansion of the lake trout stocking program, therefore the Commission urges that cooperating agencies develop means to meet the needs for increased production of hatchery-reared lake trout. Hatchery-reared lake trout should be planted in accordance with an annual planting program developed in concert with the States, the Province of Ontario, the U.S. Fish and Wildlife Service, and the Secretariat. Further, to increase the effectiveness of the planting program, the Commission recommends that periodic review and analysis of genetic constitution and behavior of planted stocks and of planting techniques and strategies should be undertaken. The Commission has concluded that efforts to determine those factors which limit natural reproduction should be accelerated and coordination among investigators intensified.

The Commission has determined that, to attain the stated objective of self-sustaining populations of lake trout, exploitation by sport, commercial, and native fisheries must be effectively controlled so that an adequate spawning stock is assured. The Commission acknowledges that allocation of the harvest among users is the responsibility of the agencies which have regulatory authority. The Commission urges that these agencies develop mutually acceptable allocation criteria; that they base total allowable catches of lake trout, including incidental captures, on the principle of optimum sustainable yield; and that all cooperating agencies develop and conduct adequate monitoring programs to meet these objectives.

B. **Position on Fish Disease.** The Commission had long recognized that disease prevention and control in the hatcheries supplying fish to the Great Lakes was critical to the success of its efforts to establish

stocks and rehabilitate populations. As a result, the Commission requested its Great Lakes Fish Disease Control Committee under the leadership of James W. Warren of the U.S. Fish and Wildlife Service Fish Pathology Laboratory, Genoa, Wisconsin, to develop a model fish disease control program. The committee, with representatives from all Great Lakes states, the Province of Ontario, and both federal governments, did an outstanding job which the Commission endorsed enthusiastically. The product was reported in the Sports Fishing Institute Bulletin and distribution was world-wide.

Two parts of the report are included herein, the Commission recommendations and the policy itself.

RECOMMENDATIONS OF THE GREAT LAKES FISHERY COMMISSION FOR THE CONTROL OF FISH DISEASES IN THE GREAT LAKES BASIN

The following recommendations of the Great Lakes Fish Disease Control Committee of the Great Lakes Fishery Commission were approved by the Commission at its 1975 Annual Meeting. These recommendations are hereby transmitted to the member agencies:

(1) The Commission recommends agency adoption of the Great Lakes Fish Disease Control Policy and implementation of appropriate elements of the Model Fish Disease Control Program. The Fish Disease Control Policy is the established policy of the Commission. The Model Fish Disease Control Program is hereby presented to the member agencies as a Commission guide to the coordinated development of fish disease controls in the Great Lakes basin.

(2) The Commission recommends agency endorsement and active support of legislation similar to United States H.R. 1083 "The Fish Disease Control Act of 1975."

(3) The Commission recognizes the threat of certain infectious diseases and recommends their inclusion in the Great Lakes Fish Disease Control Program according to the following three major categories:

(a) EMERGENCY DISEASES
Whirling Disease caused by Myxosoma cerebralis
Ceratomyxa shasta *infections of salmonids*
Viral Hemmorhagic Septicemia (VHS)

(b) CERTIFIABLE DISEASES
Whirling Disease caused by Myxosoma cerebralis
Ceratomyxa shasta *infections of salmonids*
Infectious Hematopoietic Necrosis (IHN)
Viral Hemorrhagic Septicemia (VHS)
Enteric Redmouth (ERM)

In addition, the following diseases shall be monitored for observational and hatchery classification purposes:

Infectious Pancreatic Necrosis (IPN)
Bacterial Kidney Disease (BKD)
Furunculosis

(c) REPORTABLE DISEASES

In addition to the diseases listed in (b) above, the following diseases shall be reported should they be detected:

Ichthyopthirius
Copepodes—Lernaea
Salmincola
Drug resistant or velogenic strains of:
Motile Aeromonads
Pseudomonads
Columnaris
Other diseases as determined by the Great Lakes Fish Disease Control Committee.

(4) The Commission recommends the prompt and effective eradication of "Emergency Diseases," wherever practicable, which are detected in the Great Lakes basin. (A Model Eradication Plan was attached as a guide to the member agencies.)

(5) The Commission recommends the intitation of cooperative broodstock inspections with the goal of inspecting, by December 1975, all broodstocks supplying agency fisheries programs.

(6) The Commission recommends that each donor agency furnish a report of the disease history of all eggs and fish to the receiving agency prior to the transfer of such stocks.

GREAT LAKES FISH DISEASE CONTROL POLICY

Efficient propagation of fish may be severely affected by the occurrence of fish diseases. Major disease outbreaks have caused serious losses in fish hatcheries and Great Lakes fish populations as well. Disease problems have resulted in reduced survival of stocked fish, production cost increases of 20 to 30 percent, significant losses of fish to the public, and diminished economic returns to Great Lakes communities.

To work toward the attainment of fish disease control in the Great Lakes basin, it shall be the policy of the Great Lakes Fishery Commission to encourage each member agency to:

— Develop, by 1980, legislative authority and regulations to allow control and possible eradication of fish diseases,
— Prevent the release of seriously diseased fish,
— Discourage the rearing of diseased fish,

— *Prevent the importation, into the Great Lakes basin, of fish infected with certain certifiable diseases,*
— *Prevent the transfer, within the Great Lakes basin, of fish infected with certain certifiable diseases, and*
— *Eradicate fish diseases wherever practicable.*

The Great Lakes Fishery Commission will strive to coordinate the fish disease control program of the member agencies. To this end the Commission endorses and supports the Model Fish Disease Control Program as a guide for member agency program development.

C. **Barrier Dams.** Initial efforts to reduce abundance of sea lampreys were carried out by means of mechanical or electromechanical barriers installed in sea lamprey producing streams to prevent mature sea lampreys from reaching spawning areas. In the late 1940's the barrier program was initiated in the U.S. as a cooperative effort by the Fish and Wildlife Service and the states. Concurrently, the Ontario Department of Lands and Forests operated a small number of mechanical barriers in streams entering Lakes Huron and Superior. In the early 1950's the Ontario mechanical and electromechanical barriers were operated under the sponsorship of a joint federal-provincial committee. After 1955 the program was continued under Commission auspices. At its peak in 1959, the program included about 135 barriers in the United States and Canada. Shortly after the selective toxicant 3-trifluoromethyl-4-nitrophenol (TFM) was developed and successfully field tested, a decision was made to phase out the barriers except for those maintained at key locations for assessment purposes.

In recent years the Commission became increasingly concerned by its total dependence on chemical lampricides for control. The world's only manufacturer of TFM, Hoechst of Germany, supplied the world's only user, the GLFC. While the Commission increased research efforts to develop alternative controls, it had been unsuccessful in gaining acceptance by State Department to fund a program to construct barrier dams on selected streams to increase effectiveness and efficiency of the control program or result in long term monetary savings, depending on the site.

As a step towards a renewed effort for barrier dam funding, the Commission and its agents and cooperators developed the following policy statement adopted by the Commission on 1 December 1975.

THE ROLE OF DAMS IN AN INTEGRATED SEA LAMPREY CONTROL PROGRAM

Barriers, natural or man-made, play an extremely important role in limiting the number of streams used by spawning sea lampreys or in restricting the potential spawning area within a river system. Since the sea lamprey population in the Great Lakes is dependent upon reproduction which takes place in only about 400 of the 5,750 tributaries

entering the Great Lakes, the Commission regards construction of barriers as a valuable and practical supplement to lampricides in development of an integrated sea lamprey control program.

Among the major advantages to be realized through the installation of properly designed barrier dams in selected sea lamprey producing streams are:

1. *More effective control on streams where physical characteristics make lampricide treatment difficult, expensive, or ineffective;*
2. *Savings in time, manpower, and related costs through a reduction in stream miles requiring periodic lampricide treatment;*
3. *Reduced dependency on chemicals;*
4. *Reduced lampricide purchases in the face of rising costs and a potentially limited supply;*
5. *Reduced quantity of lampricides added to the environment; and*
6. *Restoration and/or survival of non-target species in some streams.*

The benefits from dams designed specifically for sea lamprey control far outweigh the disadvantages. Proper design and knowledgeable selection of streams and sites minimize possible adverse effects such as significant changes in aquatic invertebrate communities, increased water temperatures, silting, or interference with upstream movement of anadromous fish.

In view of the foregoing, the Commission strongly endorses the installation of barrier dams as part of an integrated control program. Direct participation by the Commission is limited except for possible financial assistance to States and the Province to construct devices designed specifically for sea lamprey control. The Commission, however, strongly urges the Great Lakes States and the Province of Ontario, in concert with their respective federal governments and in cooperation with this Commission, to initiate an active barrier dam program to enhance the efficiency and effectiveness of the sea lamprey control program in the waters of the Great Lakes. The Commission recognizes that action by the States and Province must be taken within the constraints imposed by laws or regulations of the individual agency.

D. **Commission involvement in sea lamprey control outside the Convention Area.** Sea lamprey control was extended from the upper three Great Lakes to Lake Ontario in 1972. Extensive stream surveys for ammocete populations preceded and accompanied the control work and increased New York's long-standing interest in sea lamprey control in the Oswego River-Finger Lakes system tributary to Lake Ontario.

In June 1975, the Commission's Scientific Advisory Committee commented,

"The sea lampreys of the Oswego River drainage have provided information of particular interest to the Commission on the biology of the sea lamprey. Certain lakes of the Oswego River drainage can continue to be useful to the interests of the Commission as a potential

area for testing alternative methods of sea lamprey control, such as barriers, and biological or ecological control, and as an area to more fully evaluate fish community adaptations in the expectation that complete eradication from the Great Lakes may not be possible. It is noted also that Lake Champlain has similar possibilities in these respects. The research potential of these inland waters is significant and has not been fully exploited in relation to possible applications to solving the larger problem of the sea lamprey in the Great Lakes."

"The Scientific Advisory Committee recommends, therefore, that the Commission should express its interests in these areas, and upon evaluation of the survey information from the Oswego River drainage, should offer its cooperation and assistance in the conduct of studies, and the evaluation and development of plans for the control of sea lamprey populations."

In early November 1975, Mr. A. L. McLain, former Acting Executive Secretary of the GLFC, and then Great Lakes Coordinator, U.S. Fish and Wildlife Service, Twin Cities, advised New York that the decision by the Commission as to destroying larval sea lamprey populations in the Oswego River/Finger Lakes drainage would depend on the significance of their contribution to Lake Ontario.

In late November 1975, Herbert Doig, Director, Division of Fish and Wildlife, New York State Department of Environmental Conservation (NYDEC) apprised the Commission that in 1974 the department staff recommended sea lamprey control on Seneca and Cayuga Lake tributaries. A former NYDEC Commissioner, James L. Biggane, announced this decision to organized sportsmen at the annual meeting of the New York State Conservation Council, Inc.

The objectives of this project were to:

(1) Provide the public with nearly lamprey scar/wound-free salmonids by reduction of the lamprey population;
(2) Increase the number of large-size 27"+ lake trout;
(3) Evaluate results of experimental control in comparison with results in the Great Lakes; and
(4) Determine whether Finger Lakes lamprey control should become a permanent operation, either as part of the Great Lakes control program under the Great Lakes Fishery Commission, or as a Department of Environmental Conservation responsibility.

The department wanted faster and more extensive action than the Commission's agent was performing in support of the Commission's program, and offered a variety of alternative survey and treatment proposals with various levels of involvement by GLFC and NYDEC personnel.

NYDEC recommended,

"(1) The Commission act on the Department of Environmental Conservation's alternative proposals at the 1975 Interim Meeting and inform NYDEC promptly of its decision.

(2) The Department of Environmental Conservation and/or the Commission develop detailed plans to complete the treatment of Finger Lakes waters in 1976.
(3) The Department of Environmental Conservation and/or Commission immediately develop public relations programs to inform local residents and the general public about the 1976 survey-treatment operations."

The Commission interpreted the general thrust of New York's communication as a request for broad scale involvement of its agents in sea lamprey survey-treatment activities in the Finger Lakes region of New York State. In general response the Commission stated:

"Great Lakes Fishery Commission involvement in a sea lamprey control program in the Finger Lakes, on the basis of current knowledge of the impact of Finger Lake sea lampreys on fish stocks of common concern to Canada and the United States in the Convention Area, may be outside the Commission's area of responsibility. The Commission is unable to commit support to such a program at this time. Studies by the Commission's agents are underway in the Oswego River system, which includes the Finger Lakes, to determine the contribution of sea lampreys from the system to Lake Ontario. When that determination is made, the extent of the Commission's control responsibility within the system will be defined and appropriate control measures will be proposed."

The rational for the Commission's stance is found in Article I of the Convention on Great Lakes Fisheries between Canada and the United States,

"This Convention shall apply to Lake Ontario (including the St. Lawrence River from Lake Ontario to the forty-fifth parallel of latitude), Lake Erie, Lake Huron (including Lake St. Clair), Lake Michigan, Lake Superior and their connecting waters, hereinafter referred to as 'the Convention Area.' This Convention shall also apply to the tribuaries of each of the above waters to the extent necessary to investigate any stock of fish of common concern, the taking or habitat of which is confined predominately to the Convention Area, and to eradicate or minimize the populations of sea lamprey *(Petromyzon marinus)* in the Convention Area."

The Commission, therefore, must first establish that sea lamprey in Finger Lake tributaries contribute significantly to sea lamprey populations in Lake Ontario (the Convention Area) before undertaking control measures.

A conclusion of the Commission was that it is vulnerable on many fronts if it oversteps its charge or the bounds of the Convention Area. For example, there are groups critical of adding any chemical to natural systems, especially a toxicant; others object to mortality of non-target native lamprey along with sea lamprey. The Commission is funded

jointly by Canada and the United States. There are critics in each country ready to point out use of Commission funds solely to benefit one party to the Convention. In short, the Commission must be able to justify its activities on the basis of scientifically-derived data in line with the Convention authority.

New York State was advised that the Commission's Sea Lamprey Control and Research Committee, which has, in part, the responsibility for preparation of annual plans and budgets, would meet in Ann Arbor on 6 April and that in formulating their plans, the participants would consider the guidance provided by the Commission to the effect that:

> *"Studies in the Oswego-Finger Lakes system should be concentrated in that part of the system most likely to answer the question of emigration of sea lamprey to Lake Ontario. The agent(s) have discretion in selection of survey techniques to provide the most informative type of data and in assigning priority to precise areas where surveys should be conducted."*

The Commission also advised New York that the Oswego system survey work was proposed to continue 1 July as funds became available and that if the state could wait until the Commission's study and evaluation had been completed, there was a chance some control of sea lamprey in the Finger Lakes would become a Commission-funded and operated program. In the event the study and evaluation showed no significant contribution of sea lamprey to Lake Ontario from the Finger Lakes, any control program would be entirely New York State's financial and legal responsibility.

Informally, the Commission stated that if New York planned to proceed on its own in the Finger Lakes, the Commission could cooperate in an advisory capacity so long as its own program was not jeopardized.

New York was further apprised that a positive statement of its plans submitted to the Commission prior to its Executive Meeting in Ann Arbor on 7 April 1976, or prior to its Annual Meeting in Traverse City on 14 June 1976, with a well-defined request for Commission assistance, would enable determination as to what extent it could be of service.

Paul Neth, Supervisor of Inland Fisheries, NYDEC, presented the invited statement at the 6 April 1976 Sea Lamprey Control and Research Committee Meeting. On the matter of sea lamprey ammocete surveys New York respectfully requested that the GLFC:

(1) Support New York's efforts to determine ammocete distribution in tributaries to Seneca, Cayuga, and Keuka Lakes through the loan of ammocete shockers and Bayer 73, and
(2) Complete its proposed ammocete and transformer surveys and studies in the Oswego system and reach a final decision on its involvement in the Finger Lakes as soon as practical, hopefully in 1977.

In the event of a "no treatment" or "long delayed" treatment decision by the Commission, New York must plan to proceed on its own and realizes this will be a difficult task. New York asked that the Commission consider providing the following assistance to insure that the job is handled capably and thoroughly and to minimize problems stemming from inexperienced personnel doing the job:

(1) Provide an experienced supervisor or advisor, cleared to use TFM and Bayer 73, to help set up and oversee New York's efforts in the Finger Lakes;
(2) Help New York, in connection with ongoing treatment in Lake Ontario early in 1977, to thoroughly train a team to handle all facets of sea lamprey ammocete control operations; and
(3) Provide chemicals and treatment equipment on loan or repayment basis in the event that New York is unable to obtain all items that are needed to do the job when it is scheduled.

The Commission considered these points at its 7 April 1976 Executive Meeting and responded on the matter of support for New York efforts to determine ammocete distribution in tributaries to Seneca, Cayuga, and Keuka Lakes,

> *"(1) The Commission approved that the U.S. Agent, the Sea Lamprey Control Offices, Marquette Biological Station, U.S. Fish and Wildlife Service, prepare three Mark I shockers for use on a loan basis. Mr. Neth is in contact with Investigations Chief Bernie Smith and his assistant, Robert Braem, on this matter.*
> *(2) The Commission did not approve sending New York state 400 pounds of granular 5% Bayer 73 on a loan basis. The label reads, 'For use only by Bureau of Commercial Fisheries personnel'. That agency has now become part of the U.S. Fish and Wildlife Service. Our registration and labeling experts advise that this precludes New York use without supervision by such personnel trained in Bayer 73 use."*

The Commission received NYDEC's formal strategic and operational sea lamprey control plans at its 14 June 1976 Executive Meeting. New York's statement concluded,

> "We remain hopeful that sea lamprey ammocete and transformer surveys in the Oswego River system will be completed on schedule and that upon an assessment of results, the Commission will reach a final decision on its involvement in this system, including the Finger Lakes as soon as practical in 1977."
>
> "We realize that sea lamprey control operations are complex, best handled by experienced and properly equipped people. However, in the event of a 'no treatment' or 'long-delay' treatment decision by the Commission, New York must plan to proceed on its own or explore other contractual or cooperative arrangements with the Commission. In the event of such decision, we respecfully

request that the Commission consider implementing one of the following arrangements with New York for sea lamprey control in the Finger Lakes."

"(1) Contractual. New York would contract the work done through the Commission and control operations would be handled by either the U.S. or Canadian agent of the Commission. All agreed-upon costs would be borne by New York. Final contractual arrangements would be contingent upon the capability of the contractor to handle this work in addition to ongoing Great Lakes operations and our resolving any public relations issues or legal requirements for treatment. Desirable treatment timetable would be the fall of 1977 or spring of 1978."

"(2) Cooperative. New York would handle sea lamprey control operations primarily with its own staff and funding. However, to insure that the job is handled both capably and thoroughly, and to minimize problems stemming from inexperienced personnel doing the job, we would ask the Commission to:

(a) Provide an experienced supervisor or advisor, with clearance to use TFM and Bayer 73 to help set up and oversee our efforts.

(b) Help us to thoroughly train a New York team to handle all phases of sea lamprey control operations. This might be done in connection with ongoing treatment in Lake Ontario early in 1977.

(c) Provide chemicals and treatment equipment on a loan or repayment basis in the event that we are unable to obtain all items that are needed to do the job when it is scheduled. Under this arrangement treatment timetable would be the fall of 1977."

"Of these two options, we would prefer the contractual arrangement if the Commission decides that this is possible."

The Commission's response was brief and firm:

"(1) That surveys by the agents will continue to concentrate on those areas that may be contributing sea lampreys to Lake Ontario; and

(2) That the decision on implementation of Commission-sponsored sea lamprey control will rest on the data from the surveys.

If New York decides (1) to initiate a sea lamprey control program in the Finger Lakes before the Commission reaches a decision, or (2) to proceed in light of a 'no treatment' Commission decision, the general conclusion by the Commission was to provide professional guidance and training, but not to enter into a contractual arrangement with New York."

APPENDIX B

SUMMARY OF TROUT, SPLAKE, AND SALMON PLANTINGS

Intensive annual plantings of hatchery-reared salmonids continue to be the principal method employed to rehabilitate Great Lakes fisheries. In 1976, over 26 million trout and salmon were planted. Even comparatively warm and shallow Lake Erie received over 2.5 million salmon and trout in 1975 and about 3.9 million in 1976, belying the general public misconception that it is a "dead lake."

In Lakes Superior, Michigan, Huron and Ontario, salmon and trout survival is dependent upon sea lamprey control since experience has shown that planting of these species where sea lamprey are abundant results in high mortality of fish and heavy lamprey wounding on survivors. In Lake Erie there is no evidence that the sea lamprey population causes high mortality of planted salmon and trout.

Most of the rainbow and brown trout and all the Pacific salmon plantings are aimed at the recreational fishery. On the other hand, a substantial part of the lake trout and the Province of Ontario's splake plantings are intended to develop self-sustaining stocks. With anglers pursuing a wide variety of species ranging from salmon and trout to yellow perch and walleye to pan fish and bass, it was estimated that Great Lakes recreational fishermen spent $350 million on daily fishing expenses in 1975.

Lake trout have been planted annually in Lake Superior since 1958 and in Lake Michigan since 1965. These programs have been carried out cooperatively by the U.S. Fish and Wildlife Service, the states of Michigan, Wisconsin and Minnesota and the Province of Ontario. Lake trout eggs are obtained from brood fish in hatcheries or from mature lake trout from inland lakes. Nearly all trout are reared to yearlings (ca. 30/pound) and planted during the spring and early summer. In the fall of 1971, 1972, and 1973, however, the U.S. Fish and Wildlife Service made experimental plants of fall fingerlings to compare survival and growth of regular-size fall fingerlings (about 80/pound) with fingerlings whose growth was accelerated to about 30/pound through diet and the use of heated rearing water. Data collected through assessment fishing to compare the survival and growth of the paired plants has shown considerable variation in the comparative performance over the years, but in general the accelerated-growth fingerlings have outperformed the normal-growth fish. Better information on the comparative survival of

the two groups may emerge when the fish become vulnerable to large mesh assessment gillnets. If all plants of accelerated-growth fingerlings are advantageous, production in U.S. Federal hatcheries could be increased at minimum cost.

To rehabilitate fish stocks in Lake Huron, the Province of Ontario and the State of Michigan originally agreed to plant highly-selected splake. These fish were developed in Ontario through an intensive breeding program in which male brook trout were crossed with female lake trout to produce a fast growing fish similar to lake trout in behavior and appearance and to the brook trout in fast growth and early maturity. Following several generations of selective breeding a splake was developed which grows rapidly, matures at an early age, and inhabits deep water. First plantings were made in 1969 in Ontario waters (mostly yearlings) and in 1970 the Michigan waters (mostly fingerlings). Because of a shortage of highly-selected splake brood fish and the need to expand rehabilitation efforts in U.S. waters of Lake Huron, splake sperm also was used to fertilize lake trout eggs to produce backcrosses. It was believed these fish would retain the advantages of early maturity and fast growth. The first backcrosses were produced in the fall of 1971 and planted in Lake Huron as yearlings in the spring of 1973 and the program was to continue but unfortunately, in the fall of 1972 kidney disease was discovered in the splake brood stock held in the United States. Because of fish disease control policies, the sexual products from the fish were deemed unacceptable for rearing and consequently planting programs with splake and backcrosses were postponed in the United States. New brood stock was established by egg and fry imports from Ontario, but because the State of Michigan felt that rehabilitation efforts could not be deferred on Lake Huron, lake trout plantings were initiated in 1973 to bring stocking levels up to approximately one million lake fish.

Further difficulties with disease in the new United States brood fish in 1974 necessitated their removal and further delayed the U.S. splake-backcross stocking program, making it improbable that any hybrids could be produced prior to 1977. While a new splake brood stock from Ontario eggs was being established, it was agreed to continue planting lake trout in U.S. waters of Lake Huron in the interim. During this period of difficulty in the United States, Ontario was able to continue their plants of highly-selected splake in Lake Huron.

In Lake Erie, Pennsylvania made small experimental plants of lake trout fingerlings in 1969 and yearlings in 1974, 1975, and 1976. New York initiated lake trout plants in Lake Erie in 1975.

Plants of yearling splake in Lake Ontario were initiated in 1972 and continued through 1974 by the Province of Ontario, but none were planted in 1975. In 1976, the Province planted a few splake and initiated lake trout plantings. In addition, plants of lake trout were made by New York State in 1973 and through a cooperative arrangement between New York and U.S. Fish and Wildlife Service in 1974 to 1976.

Table 1 summarizes annual plantings of lake trout and hybrids in the Great Lakes and Table 2 details the 1976 plants in each of the Great Lakes. Other small experimental plants of first generation splake have been made by Wisconsin and Michigan in Lake Superior (Table 3).

Coho salmon, usually stocked in the spring as yearlings, have been planted annually in Lakes Superior and Michigan since 1966, and in Lakes Huron, Erie, and Ontario since 1968. Table 4 summarizes annual plantings in each of the Great Lakes, and Table 5 details the 1976 plantings in each of the Great Lakes.

Annual plantings of chinook salmon, usually stocked in the spring as fingerlings, have been made in Lakes Superior and Michigan since 1967, in Lake Huron since 1968, in Lake Erie since 1970, and in Lake Ontario since 1969. Table 6 summarizes annual plantings of chinook salmon in the Great Lakes and Table 7 details the 1976 plantings in each of the Great Lakes.

In 1972, Michigan and Wisconsin inaugurated plants of Atlantic salmon in the Upper Great Lakes. In 1972, Wisconsin planted 8,000 3-year-old and 12,000 2-year-old fish in Lake Superior; in 1973 the entire plant was 2-year-old fish. After 1972, Michigan discontinued its plants in Lake Huron but continued them in Lake Michigan. Table 8 summarizes Atlantic salmon plantings in the Great Lakes 1972-1976.

Plantings of rainbow and steelhead trout, brown trout, and brook trout have been continued in the Great Lakes over the years, but have not been included in these records because of the variability in reporting and difficulty in separating "inland" plantings from "Great Lakes" plantings. Nevertheless, the need for stocking information on these species prompted the recent inclusion of rainbow and steelhead trout and brown trout plantings in the Annual Report. Table 9 summarizes the annual plantings of rainbow and steelhead trout for 1975 and 1976 and Table 10 details the 1976 plantings. Table 11 summarizes annual plantings of brown trout for 1975 & 1976, and Table 12 details the 1976 plantings. The 1976 brook trout plantings are included for the first time (Table 13).

Table 1. Annual plantings (in thousands) of lake trout, splake[1,2] and backcrosses[3] in the Great Lakes, 1958-1976.[4]

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Ontario	Total
1958	298	184	—	505	987
1959	44	151	—	473	668
1960	393	211	—	446	1,050
1961	392	314	—	554	1,260
1962	775	493	77	508	1,853
1963	1,348	311	175	477	2,311
1964	1,196	743	220	472	2,631
1965	780	448	251	468	1,947
1966	2,218	352	259	450	3,279
1967	2,059	349	382	500	3,290
1968	2,260	239	377	500	3,376
1969	1,860	251	216	500	2,827
1970	1,944	204	226	500	2,874
1971	1,055	207	280	475	2,017
1972	1,063	259	293	491	2,106
1973	894	227	284	500	1,905
1974	888	436	304	465	2,093
1975	872	493	337	510	2,212
1976	789	814	345	714	2,652
Subtotal	21,128	6,686	4,026	9,508	41,348

LAKE MICHIGAN

Year	Michigan	Wisconsin	Illinois	Indiana	Total
1965	1,069	205	—	—	1,274
1966	956	761	—	—	1,717
1967	1,118	1,129	90	87	2,424
1968	855	817	104	100	1,876
1969	877	884	121	119	2,001
1970	875	900	100	85	1,960
1971	1,195	945	100	103	2,343
1972	1,422	1,284	110	110	2,926
1973	1,129	1,170	105	105	2,509
1974	1,070	971	176	180	2,397
1975	1,151	1,055	186	186	2,577
1976	1,255	1,045	160	164	2,624
Subtotal	12,972	11,166	1,252	1,239	26,628

Table 1—(Cont'd)

LAKE HURON

Year	Michigan			Ontario	
	Splake	Lake trout	Backcrosses	Splake	Total
1969	—	—	—	35	35
1970	43	—	—	247	290
1971	74	—	—	468	542
1972	215	—	—	333	548
1973	—	629	486	412	1,527
1974	—	793	—	299	1,092
1975	—	1,053	—	523	1,576
1976	—	1,024	—	658	1,682
Subtotal	332	3,499	486	2,975	7,292

LAKE ERIE

Year	Pennsylvania	NewYork	Total
1969	17	—	17
1974	26	—	26
1975	34	150	184
1976	16	186	202
Subtotal	93	336	429

LAKE ONTARIO

Year	Ontario		New York	
	Splake	Lake trout	Lake trout	Total
1972	48	—	—	48
1973	39	—	66	105
1974	26	—	644	670
1975	—	—	514	514
1976	6	194	337	537
Subtotal	119	194	1,561	1,874

Great Lakes total, lake trout	73,659
Great Lakes total, splake	3,912
Grand Total	77,571

[1]Lake trout × brook trout hybrid.
[2]Excludes small experimental splake plants by Michigan and Wisconsin in Lake Superior (see Table 3).
[3]Lake trout × splake hybrid (see text).
[4]Excludes fry and eggs

Table 2, Planting of lake trout and splake[1,2] in the Great Lakes, 1976.

Location	Numbers	Fin clip
LAKE SUPERIOR-LAKE TROUT		
Michigan waters		
Black River Harbor Area		
Black River Harbor	56,000	right pectoral
Ontonagon Area		
Porcupine Mts. State Park	25,000[4]	right pectoral
Ontonagon River Mouth	28,000	right pectoral
Porcupine Reef	56,000[3]	right pectoral
Keweenaw Bay Area		
Copper Harbor	28,000	right pectoral
	25,000[4]	right pectoral
Manitou Island	56,000[3]	adipose-right pectoral
Traverse Island Reef	28,000[3]	right pectoral
Pequaming	28,000	right pectoral
Huron Island Area	28,000[3]	adipose-right pectoral
Huron Island Reef	28,000[3]	adipose-right pectoral
Marquette Area		
Partridge Island Reef	56,000[3]	adipose-right pectoral
Loma Farms	28,877	right pectoral
Marquette	56,000	right pectoral
Marquette Harbor	32,890[4]	right pectoral
Laughing Whitefish Point Reef	28,000[3]	right pectoral
Munising Area		
Shelter Bay	28,877	right pectoral
	4,070[4,6]	left pectoral
Autrain Island	28,000[3]	right pectoral
Munising City Dock	31,000	right pectoral
Grand Marais Area		
Grand Marais	56,000	right pectoral
	25,000[4]	right pectoral
Whitefish Bay Area		
Iroquois Point Reef	28,000[3]	right pectoral
Subtotal	788,714	
Wisconsin Waters		
Washburn Coal Dock	25,130[4,5]	right pectoral
Devil's Island Shoal	180,000[3,4,5]	right pectoral/left ventral
	111,400[4,5]	right pectoral
Bark Point	21,600[4]	right pectoral
Cornucopia	142,473[4]	right pectoral
Port Superior Marina	7,000[4]	right pectoral
Squaw Bay	17,800[4,5]	right pectoral
Bayfield	105,000	right pectoral
Washburn Harbour	160,700	right pectoral
Herbster	43,000	right pectoral
Subtotal	814,103	

Table 2—(Cont'd)

Location	Numbers	Fin clip
Minnesota waters		
Duluth (Lester River)	83,450	right pectoral
Two Harbors	14,930	right pectoral
Little Marais	82,511	right pectoral
Grand Marais (Good Harbor Bay)	50,043	right pectoral
Hovland (Cannon Ball Bay)	50,142[4]	right pectoral
Flood Bay	63,700	right pectoral
Subtotal	344,776	
Ontario waters		
Copper Island	25,000[3]	right pectoral
Grebe Point	10,000	right pectoral
Woodbine Harbour	15,000	right pectoral
Salter Island	10,000[3]	right pectoral
Simpson Channel	15,000	right pectoral
Armour Island	25,000[3]	right pectoral
Spar Island	25,000[3]	right pectoral
MacKenzie River	20,000	right pectoral
Conmee Point	10,000	right pectoral
Papoose Island	40,000[3]	right pectoral
Lefebvre Island	10,000[3]	right pectoral
Amethyst Harbour	15,600	right pectoral
Mary Island	20,000[3]	right pectoral
Kent Island	5,000[3]	right pectoral
Palette Island	5,000[3]	right pectoral
Lambert Island	14,400[3]	right pectoral
Silver Islet	9,970[3]	right pectoral
Sunnyside Beach	5,000	right pectoral
Michipicoten River	50,000	right pectoral
	98,000	adipose
Batchawana Bay	86,000	adipose
Montreal River	50,000	right pectoral
LaPointe Point	50,000	right pectoral
Pancake Point	25,000	right pectoral
	25,000	right pectoral
Lizzard Island	35,000[3]	right pectoral
Sinclair Cove	15,000	right pectoral
Kama	154,000[3](fry)	none
Rossport	154,300[3](fry)	none
Gurney	40,000 (fry)	none
Subtotal (excluding 348,300 fry)	713,970	
Total lake trout, Lake Superior	2,661,563	

[Note: 740,370 (28%) of total 2,661,563, were planted offshore.]

Table 2—(Cont'd)

Location	Numbers	Fin clip
LAKE MICHIGAN-LAKE TROUT		
Michigan waters		
Ford River (Escanaba)	25,000	right pectoral
Kipling Reef	50,000[3]	right pectoral
Minneapolis Shoal	25,000[3]	right pectoral
Stonington Point	25,000	right pectoral
Seul Choix Point	25,000[3]	right pectoral
Milakokia Shoal	25,000[3]	right pectoral
Trout Island Shoal	25,000[3]	right pectoral
Simmons Reef	25,000[3]	right pectoral
Grays Reef	25,000[3]	right pectoral
South Fox Island	35,500[3]	adipose-right pectoral
Petoskey	75,000	right pectoral
Charlevoix	80,000	right pectoral
Fishermans Island	25,000[3]	right pectoral
Grand Traverse Bay (East Arm)	51,000	right pectoral
Grand Traverse Bay (West Arm)	51,000	right pectoral
Good Harbor Bay	36,000[3]	adipose-right pectoral
Frankfort	75,000	right pectoral
Manistee	75,000	right pectoral
Pentwater	75,000	right pectoral
Montague	75,000	right pectoral
Grand Haven	50,000	right pectoral
Holland	75,000	right pectoral
South Haven	75,000	right pectoral
St. Joseph	75,000	right pectoral
Grand Traverse Shoal	51,000[3]	none
Sheboygan Reef	25,000[3]	none
Subtotal	1,254,500	
Wisconsin waters		
Larsen's Reef	102,000[3]	right pectoral
Gills Rock	70,000[3]	dorsal-adipose
Sturgeon Bay	102,000	right pectoral
Algoma	106,000[3]	right pectoral
Kewaunee	100,000[3]	right pectoral
Manitowoc	109,000[3]	right pectoral
Sheboygan	104,000	right pectoral
Sheboygan-Milwaukee Reef	277,300[3]	dorsal-left ventral
Racine	75,000	right pectoral
Subtotal	1,045,300[9]	
Indiana waters		
Bethlehem Steel Pier	164,000	right pectoral
Illinois waters		
Waukegan Reef	66,000[3]	right pectoral

Table 2—(Cont'd)

Location	Numbers	Fin clip
Waukegan	62,500[3]	right pectoral
Waukegan	31,500	right pectoral
Subtotal	160,000	
Total lake trout, Lake Michigan	2,623,800	

[Note: 988,000 (38%) of total 2,623,800, were planted off shore.]

LAKE HURON-SPLAKE AND LAKE TROUT		
Michigan waters		
Pottaganissing Bay	25,000[3]	left pectoral
Hessel Area		
Middle Entrance Reef	26,000[3]	left pectoral
Goose Island Shoal	26,000[3]	left pectoral
Pomeroy Reef (Port Dolomite)	26,500[3]	left pectoral
Mackinac City Area		
Round Island Shoal	54,000[3]	left pectoral
North Graham Shoal	54,000[3]	left pectoral
Zela Shoal	54,000[3]	left pectoral
Raynolds Reef (Cheboygan)	25,000[3]	left pectoral
Hammond Bay	75,000	left pectoral
Adams Point	75,000	left pectoral
Alpena Area		
Scarecrow Island	79,000[3]	left pectoral
Middle Island	50,000[3]	left pectoral
Black River Island	79,000[3]	left pectoral
Greenbush	75,000	left pectoral
Tawas Point	100,000	left pectoral
Grindstone City	100,000	left pectoral
Port Sanilac	100,500	left pectoral
Total lake trout, Lake Huron	1,024,000	
Ontario waters (splake)[1]		
Heywood Island	9,400[3]	none
	90,600[3]	right ventral
Christian Island	93,500[3]	right ventral
Mowat Island	43,000[3]	right ventral
Davey Island	56,000[3]	right ventral
Burnt Island	88,549[3]	right ventral
Thunder Bay	24,665	right ventral
Jackson Shoal	52,715[3]	right ventral
Surprise Shoal	19,545[3]	right ventral
Lion's Head	30,530	right ventral
Darling Shoal	24,060[3]	right ventral
Meaford Range	54,605	right ventral
	69,562	adipose-right ventral
Barrow Bay	736[6]	tagged
South Bay	640[6]	none
Total splake, Lake Huron	658,107	
Total lake trout & splake, Lake Huron	1,682,107	

[Note: 975,869 (58%) of total 1,682,107 were planted off shore.]

Table 2—(Cont'd)

Location	Numbers	Fin clip
LAKE ERIE-LAKE TROUT		
Pennsylvania waters		
Presque Isle Area	15,500[3,4]	none
New York waters		
Barcelona	72,500[3,5]	right ventral
	113,500[3,5]	adipose-left ventral
Subtotal	186,000	
Total lake trout, Lake Erie	201,500	
[Note: All 201,500 (100%) were planted off shore.]		
LAKE ONTARIO-LAKE TROUT & SPLAKE		
New York waters (lake trout)		
Hamlin Beach State Park	5,685[3,4]	adipose-dorsal
	128,000[3,4,5]	adipose-left pectoral
Stony Island	57,235[3,4]	dorsal
	146,000[3,4,5]	adipose-left pectoral
Subtotal, lake trout	336,920	
Ontario waters (splake)		
Amherst Island	5,888	anal
Ontario waters (lake trout)		
Yorkshire Shoal	20,000[3,7]	adipose-right ventral
Charity Shoal	80,000[3]	adipose-right ventral
Credit River	94,120	right ventral
Subtotal, lake trout	194,120	
Total lake trout, Lake Ontario	531,040	
Total splake, Lake Ontario	5,888	
Total lake trout & splake, Lake Ontario	536,928	
[Note: 436,920 (81%) of total 536,928 were planted offshore.]		
Total lake trout and splake, Great Lakes, 1976	7,705,898[2,10]	

[1]Lake trout × brook trout hybrid.
[2]Excludes plantings of F1 splake in Lake Superior (See Table 3).
[3]Offshore plants.
[4]State plants—all other U.S. plants by U.S. Fish and Wildlife Service.
[5]Fast growth fall fingerling plants—other plants consist of yearling fish.
[6]Two-year old X-brood stock.
[7]Excludes 90,000 eggs.
[8]Excludes 200,100 eggs.
[9]Excludes 306,000 eggs.
[10]Excludes fry.

Table 3. Plantings of F_1 splake in Lake Superior, 1971, 1973, 1974, 1975 and 1976

Year	State	Location	Numbers	Fin clip
1971	Michigan	Copper Harbor	13,199	none
1973	Wisconsin	Bayfield Area	5,000	dorsal-left ventral
1974	Wisconsin	Washburn	10,316	dorsal
		Houghton Point	9,782	dorsal
1975	Wisconsin	Pikes Bay	15,000	dorsal-right ventral
1976	Wisconsin	Pikes Bay	18,360	dorsal-left pectoral
	Total, Lake Superior		71,657	

Table 4. Annual plantings (in thousands) of coho salmon in the Great Lakes, 1966-1976.

LAKE SUPERIOR

Year	Michigan	Minnesota	Ontario	Total
1966	192	—	—	192
1967	467	—	—	467
1968	382	—	—	382
1969	526	110	20	656
1970	507	111	31	649
1971	402	188	27	617
1972	152	145	—	297
1973	100	35	—	135
1974	455	74	—	529
1975	275	—	—	275
1976	400	—	—	400
Subtotal	3,858	663	78	4,599

LAKE MICHIGAN

Year	Michigan	Wisconsin	Indiana	Illinois	Total
1966	660	—	—	—	660
1967	1,732	—	—	—	1,732
1968	1,176	25	—	—	1,201
1969	3,054	217	—	9	3,280
1970	3,155	340	48	—	3,543
1971	2,411	267	68	5	2,751
1972	2,269	258	96	—	2,623
1973	2,003	510	—	5	2,518
1974	2,788	318	125	—	3,231
1975	2,026	433	46	—	2,505
1976	2,270	667	179	80	3,196
Subtotal	23,544	3,035	562	99	27,240

Table 4—(Cont'd)

LAKE HURON

Year	Michigan	Total
1968	402	402
1969	667	667
1970	571	571
1971	975	975
1972	249	249
1973	100	100
1974	500	500
1975	627	627
1976	690	690
Subtotal	4,781	4,781

LAKE ERIE

Year	Michigan	Ohio	Pennsylvania	New York	Total
1968	—	20	86	5	111
1969	—	92	134	10	236
1970	—	254	197	74	525
1971	—	122	152	95	369
1972	—	38	131	50	219
1973	—	96	315	—	411
1974	200	188	366	29	783
1975	101	231	363	125	819
1976	199	568	248	477	1,491
Subtotal	500	1,609	1,992	865	4,964

LAKE ONTARIO

Year	Ontario	New York	Total
1968	—	40	40
1969	130	109	239
1970	145	294	439
1971	160	122	282
1972	122	230	352
1973	272	240	512
1974	438	217	655
1975	226	812	1,038
1976	166	178	343
Subtotal	1,659	2,242	3,900
Great Lakes total, coho salmon, 1966-1976			45,484

Table 5. Plantings of coho salmon in the Great Lakes, 1976.

Location	Numbers	Fin clip
LAKE SUPERIOR		
Michigan waters		
Black River	75,000	none
Presque Isle River	25,000	none
Dead River	200,000	none
Falls River	100,000	none
Total, Lake Superior	400,000	
LAKE MICHIGAN		
Michigan waters		
Menominee River	50,000	none
Manistique River	31,500	none
Thompson Creek	100,000	none
Brewery Creek	73,600	none
Platte River	500,903	none
Portage Lake	151,549	none
	80,065[1]	none
Big Manistee River	202,779	none
Little Manistee River	400,282	none
Big Sauble River	251,015	none
Grand River	100,591	none
St. Joseph River	199,545	none
E. Grand Traverse Bay	128,063[1]	none
Subtotal	2,269,892	
Wisconsin waters		
West Twin River	5,150	left pectoral
	4,180	right pectoral
Two Rivers	5,126	left ventral
Two Rivers (breakwater)	5,796	right ventral
Algoma Harbor	5,130	adipose
	5,454	adipose-left ventral
Sturgeon Bay Canal	144,600	none
Algoma Pond	30,000	none
Kenosha	87,337	none
Two Rivers Pond	15,000	none
Big Manitowoc	9,000	none
Manitowoc Pond	45,000	none
Little River	53,000	none
McKinley Harbor	19,000	none
Milwaukee	81,000	none
Port Washington	41,000	none
Racine	51,000	none
Sheboygan (Coast Guard Station)	30,000	none
Sheboygan River	10,000	none
Sheboygan Release Pond	20,000	none
Subtotal	666,773	

Table 5—(Cont'd)

Location	Numbers	Fin clip
Indiana waters		
Trail Creek	106,249	none
Little Calumet River (E. branch)	73,224	none
Subtotal	179,473	
Illinois waters		
Diversey Harbor, Chicago	40,997	none
Waukegan	39,264	none
Subtotal	80,261	
Total, Lake Michigan	3,196,399	
LAKE HURON		
Michigan waters		
Carp River	50,000	none
Tawas River	80,800	none
Au Sable River	200,068	none
Cass River	100,000	none
Diamond Creek	113,391	none
Elk Creek	146,270	none
Total, Lake Huron	690,529	
LAKE ERIE		
Michigan waters		
Huron River	198,611	none
Pennsylvania waters		
Bear Creek	1,100	none
Elk Creek	47,686	none
Godfrey Run	93,214	none
Presque Isle Bay	70,640	none
Sixteen Mile Creek	35,000	none
Subtotal	247,640	
New York waters		
Cattaraugus Creek	200,000[1]	none
	86,872	none
Gowanda Hospital Pond	40,000[1]	none
	50,000[1]	adipose
Dunkirk Harbor	100,000[1]	none
Subtotal	476,872	

Table 5—(Cont'd)

Location	Numbers	Fin clip
Ohio waters		
Huron River	53,434	left pectoral
	194,013[1]	right pectoral
Chagrin River	35,000	none
	183,490[1]	left pectoral
	74,313	right pectoral
Christiana Creek	22,283[1]	none
Put-in-Bay	5,000	none
Subtotal	567,533	
Total, Lake Erie	1,490,656	
LAKE ONTARIO		
Ontario waters		
Bronte Creek	31,500	right ventral
Credit River	134,355	right ventral
Subtotal	165,855	
New York waters		
Pulaski Pond (Salmon River)	11,285	left pectoral
	27,300	adipose
Salmon River	89,990	none
Little Salmon River	7,200	none
Sandy Creek	26,000	adipose
S. Sandy Creek	4,800	none
Skinner Creek	6,000	none
Oak Orchard Creek	5,000	none
Subtotal	177,575	
Total, Lake Ontario	343,430	
Total coho salmon Great Lakes, 1976	6,121,014	

[1]Fingerlings.

Table 6. Annual plantings (in thousands) of chinook salmon in the Great Lakes, 1967-1976.

LAKE SUPERIOR

Year	Michigan	Minnesota	Total
1967	33	—	33
1968	50	—	50
1969	50	—	50
1970	150	—	150
1971	252	—	252
1972	472	—	472
1973	509	—	509
1974	295	228	523
1975	253	—	253
1976	201	291	493
Subtotal	2,265	519	2,785

LAKE MICHIGAN

Year	Michigan	Wisconsin	Indiana	Illinois	Total
1967	802	—	—	—	802
1968	687	—	—	—	687
1969	652	66	—	—	718
1970	1,675	119	100	10	1,904
1971	1,865	264	180	8	2,317
1972	1,691	317	107	24	2,139
1973	2,115	757	—	174	3,046
1974	2,046	616	159	757	3,578
1975	2,816	927	156	381	4,280
1976	1,947	1,191	38	142	3,317
Subtotal	16,296	4,257	740	1,496	22,788

LAKE HURON

Year	Michigan	Total
1968	274	274
1969	255	255
1970	643	643
1971	894	894
1972	515	515
1973	967	967
1974	776	776
1975	655	655
1976	831	831
Subtotal	5,810	5,810

Table 6—(Cont'd)

LAKE ERIE

Year	Michigan	Ohio	Pennsylvania	New York	Total
1970	—	150	—	—	150
1971	—	180	—	—	180
1972	—	—	150	—	150
1973	305	—	155	125	585
1974	502	—	189	125	816
1975	401	—	483	85	969
1976	300	246	769	65	1,381
Subtotal	1,508	576	1,746	400	4,231

LAKE ONTARIO

Year	Ontario	New York	Total
1969	—	70	70
1970	—	141	141
1971	89	149	238
1972	190	427	617
1973	—	696	696
1974	225	963	1,188
1975	—	920	920
1976	—	593	593
Subtotal	504	3,959	4,463
Great Lakes Total, chinook salmon, 1967-1976			40,077

Table 7. Plantings of chinook salmon in the Great Lakes, 1976.

Location	Numbers	Fin clip
LAKE SUPERIOR		
Michigan waters		
Black River	50,220	none
Dead River	100,672	none
Sturgeon River	50,463	none
Subtotal	201,355	
Minnesota waters		
Grand Portage Creek	14,264[1]	left-ventral
Hollow Rock Creek	15,000[1]	left-ventral
Baptism River	86,600	none

Table 7—(Cont'd)

Location	Numbers	Fin clip
French River	88,700	none
Cascade River	86,600	none
Subtotal	291,164	
Total, Lake Superior	492,519	

LAKE MICHIGAN

Michigan waters		
Menominee River	101,340	none
Cedar River	50,500	none
Escanaba River	100,500	none
Petoskey	100,800	none
Brewery Creek	51,480	none
Bowers Harbor	50,600	none
Portage Lake	50,374	none
Big Manistee River	135,454	none
Little Manistee River	301,300	none
Sauble River	101,101	none
Muskegon River	200,277	none
Grand River	401,070	none
Kalamazoo River	101,354	none
St. Joseph River	200,408	none
Subtotal	1,946,558	
Wisconsin waters		
South Milwaukee	15,000	left-pectoral
Strawberry Creek	192,000	none
Ahnapee River	100,000	none
Kewaunee River	100,000	none
Holding Pond	100,000	none
LePere Dam	60,000	none
Little Manitowoc	100,000	none
West Twin River	100,000	none
Little River	67,000	none
Oak Creek	111,600	none
Pensaukee	75,000	none
Sauk Creek	50,000	none
Root River	7,900	none
Sheboygan River	112,000	none
Subtotal	1,190,500	
Illinois waters		
Jackson Harbor, Chicago	38,056	none
Diversey Harbor, Chicago	63,758	none
Waukegan	40,185	none
Subtotal	141,999	

Table 7—(Cont'd)

Location	Numbers	Fin clip
Indiana waters		
Trail Creek	38,000	none
Total, Lake Michigan	3,317,057	

LAKE HURON

Michigan waters		
Nagel's Creek	50,460	none
Harrisville	201,780	none
Au Sable River	251,440	none
Au Gres River	100,770	none
Cass River	100,496	none
Flint River	125,590	none
Total, Lake Huron	830,536	

LAKE ERIE

Michigan waters		
Detroit River	200,020	none
Huron River	100,362	none
Subtotal	300,382	
Ohio waters		
Chagrin River	123,200	none
Huron River	123,200	none
Subtotal	246,400	
Pennsylvania waters		
Elk Creek	370,000	none
Walnut Creek	399,000	none
Subtotal	769,000	
New York waters		
Cattaraugus Creek	65,000	none
Total, Lake Erie	1,380,782	

Table 7—(Cont'd)

Location	Numbers	Fin clip
LAKE ONTARIO		
New York waters		
Salmon River	235,000	none
Little Salmon River	64,000	none
Sterling Creek	32,000	none
Grindstone Creek	32,000	none
Sandy Creek	66,700	none
Eighteen Mile Creek	49,000	none
Oak Orchard Creek	64,700	none
North Sandy Creek	25,000	none
South Sandy Creek	25,000	none
Total, Lake Ontario	593,400	
Total chinook salmon, Great Lakes, 1976	6,614,294	

[1]Planted by USFWS—all other U.S. plants are state plants.

Table 8. Plantings of Atlantic salmon in the Great Lakes, 1972-1976.

Year	State	Area	Numbers	Fin clip
LAKE SUPERIOR				
1972	Wisconsin	Bayfield	20,000	adipose-left ventral
1973	Wisconsin	Bayfield	20,000	right ventral
1976	Michigan	Cherry Creek	9,106	none
Total			49,106	
LAKE MICHIGAN				
1972	Michigan	Boyne River	10,000	none
1973	Michigan	Boyne River	15,000	none
1974	Michigan	Platte River	7,308	adipose
		Boyne River	14,555	none
1975	Michigan	Boyne River	9,005	none
			13,167	none
1976	Michigan	Boyne River	20,438	none
			162	none
Total			89,635	
LAKE HURON				
1972	Michigan	AuSable River	9,000	none
Total, Atlantic salmon, Great Lakes 1972-1976			147,741	

Table 9. Annual plantings (in thousands) of rainbow, steelhead, and palomino[1] trout in the Great Lakes, 1975-1976.

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Total
1975	25	61	228	314
1976	36	367	9	412
Subtotal	61	428	237	726

LAKE MICHIGAN

Year	Michigan	Wisconsin	Indiana	Illinois	Total
1975	701	397	217	253	1,568
1976	601	1,000	217	45	1,863
Subtotal	1,302	1,397	434	298	3,431

LAKE HURON

Year	Michigan	Ontario	Total
1975	425	62	484
1976	333	33	366
Subtotal	758	95	850

LAKE ERIE

Year	Michigan	Ontario	New York	Ohio	Pennsylvania	Total
1975	10	223	—	277	19	529
1976	60	15	25	196	113	410
Subtotal	70	238	25	473	132	939

LAKE ONTARIO

Year	New York	Ontario	Total
1975	252	29	281
1976	186	108	295
Subtotal	438	137	576

Great Lakes Total, rainbow, steelhead and palomino trout, 1975–1976. 6,755

[1]Rainbow × W. Virginia golden trout hybrid.

Table 10. Plantings of rainbow, steelhead and palomino trout in the Great Lakes, 1976.

Location	Numbers	Fin clip
LAKE SUPERIOR		
Michigan waters (rainbow)		
Dead River	10,120	none
Michigan waters (steelhead)		
Black River Harbor	5,130	none
Presque Isle	5,130	none
Ann River	5,054	none
Two Hearted River	10,260	none
Subtotal	25,574	
Wisconsin waters (rainbow)		
Port Wing	21,086	none
Cornucopia	33,426	none
Washburn Harbor	52,164	none
Barks Dale	3,451	none
Lake Superior	44,200	none
Onion River	41,962	none
Park Point	2,025	none
Wisconsin Point	1,075	none
Herbster	14,618	none
W. Sand Bay	7,524	none
Brule River	145,000	none
Subtotal	366,531	
Minnesota waters (rainbow)		
Sucker River	1,250	none
Baptism River	6,300	none
Split Rock River	1,890	none
Subtotal	9,440	
Total rainbow trout, Lake Superior	386,091	
Total steelhead trout, Lake Superior	25,574	
Total rainbow and steelhead trout, Lake Superior		411,665
LAKE MICHIGAN		
Michigan waters (rainbow)		
Little Bay De Noc	20,009	none
Thompson Creek	15,002	none
Harbor Springs	21,132	none
Charlevoix	20,007	none
Elk River	15,340	none
E. Grand Traverse Bay	20,004	none
W. Grand Traverse Bay	58,761	none
Frankfort	17,086	none
Montague	20,001	none

Table 10—(Cont'd)

Location	Numbers	Fin clip
Muskegon	23,006	none
Grand Haven	21,543	none
Holland	18,914	none
Duck Lake	10,016	none
Pigeon Lake	20,275	none
Saugatuck	20,000	none
South Haven	20,008	none
New Buffalo	15,005	none
Manistee River	5,000	none
Subtotal	361,109	
Michigan waters (steelhead)		
Cedar River	10,350	none
E. Branch Whitefish River	5,054	none
Jordan River	5,035	none
Bear River	38,500	none
Boardman River	5,168	none
Elk River	5,035	none
Betsie River	10,260	none
Big Manistee River	20,140	none
Ruby Creek	5,076	none
Pentwater River	5,058	none
Muskegon River	20,140	none
Bear Creek	33,660	none
Prairie Creek	5,058	none
Kalamazoo River	5,076	none
Rabbitt River	5,076	none
Black River	10,530	none
Paw Paw River	10,440	none
St. Joseph River	39,862	none
Subtotal	239,518	
Wisconsin waters (rainbow)		
Bailey's Harbor	19,350	none
Whitefish Bay	15,000	none
Coast Guard Station	20,000	none
Stone Quarry	10,000	none
Sister Bay	10,000	none
Gill's Rock	10,000	none
Ellison Bay	5,000	none
Moonlite Bay	10,000	none
Fish Creek	5,000	none
Ephraim	10,000	none
Egg Harbor	14,250	none
Wester's	15,125	none
	32,000	adipose-left ventral
Schaur Park	13,000	none
	17,000	adipose-left ventral
Braunsdorf Beach	10,688	none
Kewaunee	44,624	none

Table 10—(Cont'd)

Location	Numbers	Fin clip
Algoma	26,688	none
Kenosha	101,614	none
	10,000	left ventral
Two Rivers	46,300	none
Manitowoc	15,000	none
Manitowoc Harbor	30,000	none
Cleveland	20,200	none
Two Creeks	5,200	none
Marinette	109,040	none
Milwaukee	95,175	none
Oconto	40,500	none
Racine	85,825	none
Quarry Park	4,000	none
Sheboygan	110,950	none
Ozaukee	38,100	none
Subtotal	999,629	
Indiana waters (steelhead)		
Salt Creek	11,000	none
Trail Creek	98,286	none
Little Calumet River (E. Br.)	107,783	none
Subtotal	217,069	
Illinois waters (rainbow)		
Belmont Harbor, Chicago	12,607	none
Willmette Harbor, Chicago	12,607	none
Calumet Harbor, Chicago	20,040	none
Subtotal	45,254	
Total rainbow trout, Lake Michigan	1,405,992	
Total steelhead trout, Lake Michigan	456,587	
Total rainbow and steelhead trout, Lake Michigan		1,862,579
LAKE HURON		
Michigan waters (rainbow)		
St. Marys River	5,000	none
Carp River	10,010	none
Thunder Bay	64,550	none
	18,046[3]	none
Rogers City	10,009	none
Harrisville	10,010	none
Tawas Bay	10,001	none
Caseville	10,000	none
Port Austin	10,000	none
Port Hope	10,000	none
Harbor Beach	30,139	none
Port Sanilac	10,000	none
Ausable River	2,000	none

Table 10—(Cont'd)

Location	Numbers	Fin clip
Michigan waters (steelhead)		
Carp River	20,150	none
St. Marys River	5,166	none
Cheboygan River	5,184	none
Ocqueoc River	5,238	none
Thunder Bay River	5,238	none
AuSable River	65,613	none
Whitney Drain	16,020	none
Rifle River	10,440	none
Subtotal	133,049	
Ontario waters (rainbow)		
Saugeen River	10,000	right pectoral
Beaver River	9,200	right pectoral
Upper Beaver River	10,000	none
Boyne River	2,000	none
Coldwater River	2,000	none
Subtotal	33,200	
Total rainbow trout, Lake Huron	232,965	
Total steelhead trout, Lake Huron	133,049	
Total rainbow and steelhead trout, Lake Huron		366,014
LAKE ERIE		
Michigan waters (rainbow)		
Detroit River	32,087	none
International Lake	8,000	none
Subtotal	40,087	
Michigan waters (steelhead)		
Detroit River	20,292	none
Ontario waters (rainbow)		
Big Creek	5,000[1]	adipose-right pectoral
	7,650[5]	tetracycline
	12,445[5]	tetracycline
	5,000	none
Burnt Mill Creek	300[1]	none
Silver Otter Creek	200[1]	none
Little Otter Creek	1,100[1]	none
Big Otter Creek	29,000[5]	tetracycline
South Otter Creek	21,000[5]	tetracycline
South Otter Creek	35,000[5]	none
Stable Creek	1,150[5]	tetracycline
Deer Creek	2,300[5]	tetracycline
Trout Creek	4,200[5]	tetracycline

Table 10—(Cont'd)

Location	Numbers	Fin clip
Dace Creek	1,150[5]	tetracycline
Lyndock Creek	4,975[5]	tetracycline
Stoney Creek	4,600[5]	tetracycline
Stream E	380[5]	tetracycline
South Creek	9,935[5]	tetracycline
South Creek	10,000[5]	none
North Creek	6,115[5]	tetracycline
Deerlick Creek	14,525[5]	tetracycline
Windham Creek	765[5]	tetracycline
Teeterville Creek	1,100[5]	tetracycline
Young Creek	28,680[5]	tetracycline
Corinth Creek	30,000[5]	none
Pirrie Creek	10,000[5]	none
Lehman's Dam	1,250[1]	none
	20[2]	none
	1,250[1]	none
Komoka Creek	300[1]	none
Flat Creek	500[1]	none
Subtotal (does not include 234,970 fry)	14,920	
New York waters (rainbow)		
Point Gratiot (Dunkirk)	10,000[3]	adipose
Athol Springs	15,000[3]	left ventral
Subtotal	25,000	
Ohio waters (rainbow)		
Arcola Creek	6,000	none
Chagrin River	79,150	none
Rocky River	49,840	none
Turkey Creek	6,000	none
Subtotal	140,990	
Ohio waters (steelhead)		
Conneaut Creek	27,500	none
	28,000	left ventral
Subtotal	55,500	
Pennsylvania waters (rainbow)		
Godfrey Run	5,000	none
Little Elk Creek	300	none
Twentymile Creek	5,070	none
Big Conneaut-Tee Creek	40	none
Buttermilk Run	452	none
Crooked Creek	1,450	none
	150[4]	none

Table 10—(Cont'd)

Location	Numbers	Fin clip
Elk Creek	17,650	none
	600[4]	none
Racoon Creek	400	none
	450[1]	none
Sevenmile Creek	193	none
	375[4]	none
Sixmile Creek	2,266	none
	1,188[4]	none
Sixteenmile Creek	400	none
Taylor Run	990	none
Temple Run	3,015	none
Trout Run	50	none
	350[4]	none
Twelvemile Creek	199	none
	369[4]	none
Walnut Creek	1,900	none
	100[4]	none
Subtotal	42,957	
Pennsylvania waters (steelhead)		
Godfrey Run	43,500	none
Trout Run	20,500	none
Subtotal	64,000	
Pennsylvania waters (palomino[6])		
Godfrey Run	5,000	none
Crooked Creek	150[4]	none
Sixmile Creek	10	none
Sevenmile Creek	8	none
	27[4]	none
Twelvemile Creek	10	none
	15[4]	none
Elk Creek	565[4]	none
Twentymile Creek	180[4]	none
Subtotal	5,965	
Total rainbow trout, Lake Erie	261,954	
Total steelhead trout, Lake Erie	139,792	
Total palomino trout, Lake Erie	5,965	
Total rainbow, steelhead and palomino trout, Lake Erie		409,711
LAKE ONTARIO		
New York waters (rainbow)		
Selkirk Shores State Park	10,494	none
Fairhaven Beach	11,260	none
Wilson	29,729	none
Sodus Beach	8,576	none
Olcott	21,429	none

Table 10—(Cont'd)

Location	Numbers	Fin clip	
Stoney Point	26,200	none	
Sodus Point	49,900	none	
Subtotal	157,588		
New York waters (steelhead)			
Trout Brook	9,000	left ventral	
Orwell Brook	12,000	left ventral	
Pulaski Pond	3,000	left ventral	
Irondequoit Creek	4,800	left ventral	
Subtotal	28,800		
Ontario waters (rainbow)			
Credit River	44,180	right ventral	
	49,291	right ventral	
Duffin's Creek	10,000	right ventral	
Soper's Creek	5,000	right ventral	
Subtotal	108,471		
Total rainbow trout, Lake Ontario	266,059		
Total steelhead trout, Lake Ontario	28,800		
Total rainbow and steelhead trout, Lake Ontario	294,859		
Total rainbow and steelhead and palomino trout, Great Lakes, 1976			3,342,828

[1]Yearlings. All other Ontario fish, unless otherwise, indicated, are fry.
[2]Brood fish.
[3]Fingerlings.
[4]Two-year old fish, and older.
[5]Fry,
[6]Rainbow × W. Virginia Golden hybrid.

Table 11. Annual plantings (in thousands) of brown trout in the Great Lakes, 1975-1976.

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Total
1975	35	103	108	246
1976	35	34	10	79
Subtotal	70	137	118	325

LAKE MICHIGAN

Year	Michigan	Wisconsin	Illinos	Indiana	Total
1975	279	356	10	20	665
1976	666	298	94	199	1,258
Subtotal	945	654	104	219	1,923

LAKE HURON

Year	Michigan	Total
1975	155	155
1976	447	447
Subtotal	602	602

LAKE ERIE

Year	Pennsylvania	New York	Total
1975	7	26	33
1976	112	67	179
Subtotal	119	93	212

LAKE ONTARIO

Year	New York	Total
1975	371	371
1976	311	311
Subtotal	682	682

Great Lakes Total, brown trout, 1975–1976 3,743

Table 12. Plantings of brown trout in the Great Lakes, 1976.

Location	Numbers	Fin clip
LAKE SUPERIOR		
Michigan waters (rainbow)		
Marquette Bay	20,011	none
Huron Bay	10,000	none
Sturgeon River	5,000	none
Subtotal	35,011	
Wisconsin waters		
Superior Entry	21,450	none
Saxon Harbor	4,200	none
S. Washburn Harbor	2,500	none
Bodin's Landing	1,000	none
Barksdale	5,000	none
Subtotal	34,150	
34,150		
Minnesota waters		
Baptism River	6,808	none
Split Rock River	1,260	none
Cascade River	410	none
Devil Track River	495	none
Kandunce Creek	198	none
Temperance River	499	none
Subtotal	9,670	
Total, Lake Superior	78,831	
LAKE MICHIGAN		
Michigan waters		
Little Bay DeNoc	30,014	none
	20,000[1]	none
Escanaba River	25,000[1]	none
	23,000	none
Grand Traverse, E.	102,498	none
Grand Traverse, W.	26,687	none
Frankfort	19,621	none
Manistee	20,013	none
S. Branch Pere Marquette	15,000[1]	none
White River	15,000[1]	none
Betsie River	15,000[1]	none
	5,500	none
White Lake	10,000	none
Muskegon	20,000	none
	1,000[3]	none
Grand Haven	10,000	none

Table 12—(Cont'd)

Location	Numbers	Fin clip
Holland	50,000[1]	none
Saugatuck	10,000	none
	10,000[1]	none
South Haven	15,000	none
	50,000[1]	none
Benton Harbor	20,000	none
Galien River	10,000	none
Pine River Channel	128,000[2]	none
Little Traverse Bay	10,000	none
Ludington	5,000	none
Subtotal	666,333	
Wisconsin waters		
Bailey's Harbor	10,550	none
Egg Harbor	7,500	none
Fish Creek	9,500	none
Stone Quarry	10,922	none
Wester's	21,000	adipose
	9,240	none
Braunsdorf Beach	7,000	none
Sturgeon Bay (Coast Guard Sta.)	19,693	none
Schauer Park	21,000	adipose
	5,000	none
Ephraim	9,500	none
Kewaunee	26,837	none
Algoma	11,770	none
Kenosha	500	left pectoral
Two Rivers	20,000	none
Cleveland	5,000	none
Manitowoc	6,000	none
Little River	2,800	none
Marinette	7,200	none
Oconto Park	8,800	none
Milwaukee	30,513	none
Ozaukee	10,887	none
Sheboygan	37,000	none
Subtotal	298,212	
Illinois waters		
Burnham Harbor, Chicago	13,390	none
Belmont Harbor, Chicago	38,663	none
Waukegan	42,212	none
Subtotal	94,265	
Indiana waters		
E. Chicago	80,750	right ventral
	34,250	none

Table 12—(Cont'd)

Location	Numbers	Fin clip
Michigan City	84,000	none
Subtotal	199,000	
Total, Lake Michigan	1,257,810	
LAKE HURON		
Michigan waters		
Carp River	10,000	none
Hessel-Cedarville	10,000	none
Thunder Bay	75,262	none
	84,169[1]	none
AuSable River	10,000	none
Tawas Bay	20,007	none
	20,000[1]	none
Whitney Drain	10,144	none
	20,000[1]	none
Caseville	10,000	none
Grindstone City	20,000	none
	20,000[1]	none
Harbor Beach	20,000	none
Port Sanilac	10,000	none
Rockport	7,260	none
Point Lookout	100,000[1]	none
Total, Lake Huron	446,842	
LAKE ERIE		
Pennsylvania waters		
Elk Creek	1,530[3]	none
Crooked Creek	550[3]	none
Twentymile Creek	600[3]	none
Big Conneaut-Tee Creek	260	none
Conneaut Creek	320	none
Lake Erie	5,000	none
Racoon Creek	100[3]	none
Sevenmile	45[3]	none
Taylor Run	615	none
Temple Run	2,085	none
Trout Run	100[3]	none
Twelvemile Creek	27[3]	none
Subtotal	11,232	
Michigan waters		
Lake St. Clair	100,416[1]	none

Table 12—(Cont'd)

Location	Numbers	Fin clip
New York waters		
Dunkirk Harbor	10,000	adipose-left ventral
	2,350	jaw tagged
	18,650	none
Athol Springs	15,000	adipose-right ventral
	18,650	right ventral
	2,350	jaw tagged
Subtotal	67,000	
Total, Lake Erie	1,178,648	
LAKE ONTARIO		
New York waters		
Hamlin Beach State Park	167,408	none
Wilson Harbor	21,000	none
Selkirk Shores State Park	80,243	none
Fair Haven	21,050	none
Association Island	21,050	none
Total, Lake Ontario	310,751	
Total brown trout, Great Lakes, 1976	2,272,882	

[1]Fingerlings.
[2]Fry.
[3]Two-year old fish, or older.

Table 13. Plantings of brook trout in the Great Lakes, 1976.

Location	Numbers	Fin clip
LAKE SUPERIOR		
Wisconsin waters (rainbow)		
Onion River	5,054	none
Washburn	8,000	none
Bodin's Landing	860	none
Subtotal	13,914	
Minnesota waters		
Kimball Creek	302	none
French River	1,400	none
Sucker River	1,400	none

Table 13—(Cont'd)

Location	Numbers	Fin clip
Split Rock River (W. Branch)	980	none
Cascade River	700	none
Devil Track River	140	none
Grand Marais Harbor	1,540	none
Baptism River	980	none
Subtotal	7,442	
Total, Lake Superior	21,356	
LAKE MICHIGAN		
Wisconsin waters		
Manitowoc	6,900	none
Illinois waters		
Mouth of Kellogg Creek	6,420	none
Michigan waters		
Grand Traverse Bay	61,290	none
Total, Lake Michigan	74,610	
LAKE ERIE		
Pennsylvania waters		
Twentymile Creek	650	none
Buttermilk Run	450	none
Crooked Creek	1,100	none
Elk Creek	3,055	none
Racoon Creek	200	none
Sevenmile Creek	44[1]	none
	100	none
Twelvemile Creek	45[1]	none
	311	none
Walnut Creek	111[1]	none
	287	none
Total, Lake Erie	6,353	
Total brook trout, Great Lakes, 1976	102,319	

[1]Two-year old fish, and older.

APPENDIX C

SEA LAMPREY CONTROL IN THE UNITED STATES

Robert A. Braem and Harry H. Moore
U.S. Fish and Wildlife Service

The number of adult sea lampreys captured at the eight index barriers on Lake Superior decreased from 4,487 in 1975 to 2,098 in 1976. The greatest decline was in the Amnicon River where the catch was 97% below the 2,606 caught in 1975. The Brule River accounted for 51% of the 1976 catch. The percentage of spawning rainbow trout bearing sea lamprey wounds or scars was 1.4 in 1975 and 1.1 in 1976.

A total of 382 tributaries of the upper three Great Lakes (106 of Lake Superior, 172 of Lake Michigan, and 104 of Lake Huron) were surveyed for the collection of pretreatment information and data on reestablished populations, or to verify that sea lampreys had not become established in streams that had not previously contained them. Sea lamprey larvae were found in three streams not previously infected.

Investigations on Lake Ontario were concentrated on the Oswego River, in continuation of a study started in 1975 to determine the distribution of larval sea lamprey populations in various parts of the system and the contribution they make to adult stocks in Lake Ontario. Survey crews using backpack shockers and Bayer 73 granules conducted larval surveys in July and August, and the use of fyke nets to capture recently metamorphosed downstream migrants was started in late October.

Extremely low water levels, caused by the driest season in at least 40 years, made survey conditions ideal but severely curtailed stream treatments. Many streams were treated at less than optimum flow and 20 treatments had to be postponed. Scheduled treatments were carried out on 17 tributaries of Lake Superior, 15 of Lake Michigan, and 5 of Lake Huron.

Presented at: Great Lakes Fishery Commission, Annual Meeting, Sault Ste. Marine, Ontario, June 14–16, 1977.

Surveys and Chemical Treatments

Lake Superior Surveys. Pretreatment surveys were completed on 16 Lake Superior streams in 1976. Larval sea lampreys were relatively scarce in 12 but were moderately abundant in 4—the Firesteel, Bad, Brule, and Middle Rivers. Many of the larvae in the Firesteel were in or near a previously untreated oxbow.

Thirty-three other streams were examined to monitor reestablished populations and check for the presence of residual sea lampreys. Reestablished populations were moderately large in 5 streams (Betsy, Two Hearted, Sturgeon, Huron, and Ontonagon Rivers), small in 12, and lacking in 16. The only significant occurrence of residual larvae was in the Ravine River where 24 sea lampreys (41-62 mm long) were collected. An attempt had been made to treat this stream at extremely low flows 6 weeks earlier.

In resurveys of 57 streams that had no previous record of sea lamprey production, ammocetes were found in only one—the Poplar River, Cook County, Minnesota (Fig. 1)—where 15 larvae (98-131 mm long) were collected. The lamprey production potential of the stream is small because larval habitat is very limited and a barrier falls is about 150 yards above the mouth.

Lake Superior Chemical Treatments. A total of 17 streams, with a combined flow (measured just before treatment) of 670 cfs, were treated

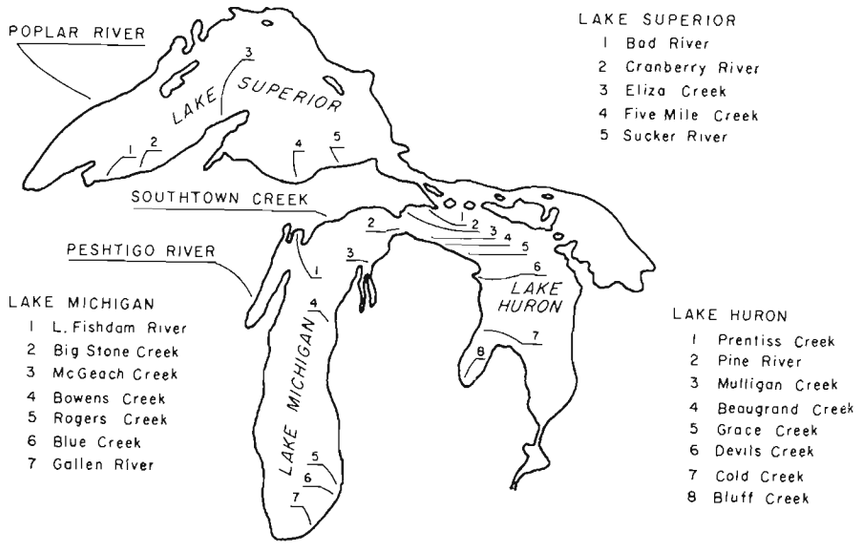

Figure 1. Tributaries of the upper Great Lakes in which new sea lamprey populations were found in 1976 (three: Poplar and Peshtigo Rivers and Southtown Creek), or on which chemical treatments were postponed (20, as listed).

(Table 1). Ammocete numbers were generally low. Metamorphosing ammocetes were collected from the Firesteel River below an old river channel which had not been previously treated. Treatment of this channel resulted in the collection of many transforming and large larval sea lampreys.

Washington Creek, on Isle Royal, a stream treated for the first time, had a moderately large population of sea lamprey ammocetes, many of which were large enough to transform.

Annual treatments of the Silver River and its estuary and alluvial fan over the past 5 years have resulted in a reduction in ammocete numbers. No ammocetes were collected in the river during the 1976 treatment, and the numbers collected on the alluvial fan and in the estuary were only 14% of the numbers collected during the first treatment in 1969.

Scheduled treatments of the Bad, Sucker, and Cranberry Rivers and Five Mile and Eliza Creeks were postponed due to low water (Fig. 1).

Lake Michigan Surveys. Pretreatment surveys were completed on 41 streams tributary to Lake Michigan. Larval sea lamprey populations appeared to be large in 12 (Black, Millecoquins, Ogontz, Whitefish, Rapid, Ford, Cedar, Jordan, Manistee, Pere Marquette, White, and Muskegon Rivers), small to medium in 27, and lacking in 2 (Bear River and Bass Lake Outlet) that have been only marginally productive and have not been treated.

Of 74 additional streams examined for reestablished larval sea lampreys, 34 were reinfested. Populations ranged from small to medium in all except the Sturgeon River, where ammocetes were abundant.

No sea lampreys were detected in the Grand River system above the newly erected (1975) fish ladder in Grand Rapids, or in the Betsie River above the sea lamprey barrier at the former Homestead damsite. The White River above the dam at Hesperia contained ammocetes of the 1976 year class scattered throughout 25 miles of mainstream and one tributary. The Hesperia dam was partly washed out during floods in September 1975 and repaired late in 1976, isolating a single age group in the upper river. The population will be monitored closely to determine minimum age to metamorphosis in this stream.

Sea lampreys were found in 2 of 57 streams with no previous history of successful sea lamprey reproduction (Fig. 1): the Peshtigo River, Marinette County, Wisconsin, where 91 sea lampreys (28–173 mm long), including 7 that were metamorphosing were taken, and Southtown Creek, Schoolcraft County, Michigan, where 7 larvae (47–174 mm), including 3 that were metamorphosing were found. The Peshtigo River has the potential to become a major sea lamprey producer now that the new water treatment facility at Peshtigo, Wisconsin, is fully operational. The improvement of water quality over the past few years probably explains the recent establishment of a sea lamprey population in the stream.

Table 1. Details on the application of lampricides to tributaries of Lake Superior in 1976.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)		Pounds used	Hours applied	Pounds of powder used	Granules	
			Minimum effective	Maximum allowable				Pounds used	Acres surveyed
Washington Creek	June 22	22	1.5	4.0	198	12	-	-	-
Au Train River (upper)	June 30	104	1.8	5.2	572	12	8.4	31.5	6.0
Black River	July 14	40	2.0	5.8	396	12	-	35.0	7.0
Nemadji River	July 29	10	3.5	10.6	154	-	-	-	-
Gooseberry River	Aug. 1	3	2.7	8.0	286	14	-	-	-
Split Rock River	Aug. 1	2	2.7	8.0	66	12	-	-	-
Falls River	Aug. 12	42	3.0	9.3	264	8	-	12.5	2.5
Sturgeon River									
Otter River	Aug. 13	80	2.8	8.5	440	6	-	35.0	7.0
Ravine River	Aug. 14	1	1.7	5.0	44	32	-	10.0	2.0
Silver River	Aug. 15	7	2.7	8.0	176	18	-	85.0	17.0
Beaver Lake Outlet	Aug. 16	15	2.5	7.6	132	10	-	20.0	4.0
Furnace Creek	Sept. 8	10	2.6	11.0	242	12	-	92.5	18.5
Big Garlic River	Sept. 22	16	2.0	5.8	198	8	-	10.0	2.0
Waiska River	Sept. 30	20	1.9	5.4	198	13	-	-	-
Tahquamenon River	Oct. 3	270	2.7	8.0	4,378	17	2.1	-	-
Galloway Creek	Oct. 6	3	1.7	5.0	66	9	-	-	-
Firesteel River	Oct. 9	25	2.8	8.5	726	16	1.4	-	-
Total	. . .	670	. . .	. . .	8,536	. . .	11.9	331.5	66.0

Table 1. Details on the application of lampricides to tributaries of Lake Superior in 1976.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM: Concentration (ppm) Minimum effective	TFM: Concentration (ppm) Maximum allowable	TFM: Pounds used	TFM: Hours applied	Bayer 73: Pounds of powder used	Bayer 73: Granules Pounds used	Bayer 73: Granules Acres surveyed
Washington Creek	June 22	22	1.5	4.0	198	12	-	-	-
Au Train River (upper)	June 30	104	1.8	5.2	572	12	8.4	31.5	6.0
Black River	July 14	40	2.0	5.8	396	12	-	35.0	7.0
Nemadji River	July 29	10	3.5	10.6	154	-	-	-	-
Gooseberry River	Aug. 1	3	2.7	8.0	286	14	-	-	-
Split Rock River	Aug. 1	2	2.7	8.0	66	12	-	-	-
Falls River	Aug. 12	42	3.0	9.3	264	8	-	12.5	2.5
Sturgeon River									
Otter River	Aug. 13	80	2.8	8.5	440	6	-	35.0	7.0
Ravine River	Aug. 14	1	1.7	5.0	44	32	-	10.0	2.0
Silver River	Aug. 15	7	2.7	8.0	176	18	-	85.0	17.0
Beaver Lake Outlet	Aug. 16	15	2.5	7.6	132	10	-	20.0	4.0
Furnace Creek	Sept. 8	10	2.6	11.0	242	12	-	92.5	18.5
Big Garlic River	Sept. 22	16	2.0	5.8	198	8	-	10.0	2.0
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Tahquamenon River	Oct. 3	270	2.7	8.0	4,378	17	2.1	-	-
Galloway Creek	Oct. 6	3	1.7	5.0	66	9	-	-	-
Firesteel River	Oct. 9	25	2.8	8.5	726	16	1.4	-	-
Total	...	670	...	...	8,536	...	11.9	331.5	66.0

Surveys with Bayer 73 granules were conducted on 3 inland lakes and 29 estuaries during the 1976 field season. No larvae were found in the lakes—Lake Charlevoix off Horton Creek, Pere Marquette Lake on the Pere Marquette River, or Bass Lake in the Bass Lake Outlet drainage—but ammocetes were recovered in 15 of the estuaries. The largest concentration was found in a marshy area at the mouth of the Rapid River. Analyses of length frequencies indicated the ammocetes belonged to the 1973–75 year classes, established after the 1972 chemical treatment. Although the larvae were concentrated in the main channel, some ammocetes were scattered throughout backwater areas and side channels. These areas will be given careful attention during chemical treatment (probably in 1977).

Reestablished populations of larvae were also found in the estuaries of the Rock, Deadhorse, Fishdam, Ogontz, Days, and Bark Rivers and Hog Island, Marblehead, Bursaw, and Parent Creeks. Sea lamprey ammocetes were common at the mouth of the Ford River; however, 89 of 91 collected were age-groups I and II; only 2 were survivors of the 1974 treatment. A few residual ammocetes were also recovered from estuaries of the Milakokia River (2), Valentine Creek (6), and the Whitefish River (5).

Scuba gear, underwater viewers, and probes were employed to find suitable ammocete habitat in 21 offshore surveys. Areas of good habitat were later sprayed with granular Bayer 73.

Sea lamprey ammocetes were recovered from offshore areas of five streams. The largest number was recovered off the Ogontz River, where 646 ammocetes (70–162 mm long) and 77 transforming lampreys (141–158 mm) were captured (Fig. 2). A total of nine larvae (36-139 mm) were collected at three other offshore stations in Ogontz Bay. Other areas investigated included the alluvial fan of the Days River, where 67 ammocetes (38–175 mm), including 49 residual lampreys, were recovered; and that of the Cedar River, where 45 ammocetes (27–154 mm) were collected. One ammocete (38 mm) was captured off Bursaw Creek and one (57 mm) between the breakwalls off the Manistique River.

Lake Michigan Chemical Treatments. Fifteen streams, with a combined flow (measured just before treatment) of 4,856 cfs, were treated (Table 2). High water levels predominated in the spring, and extremely low water in the late summer resulted in an early cessation of treatments. Many tributaries of the 15 treated streams were dry between pools.

Numbers of larval sea lampreys were high in the White, Black, and Muskegon Rivers and in the lower reaches of the Cedar and Pere Marquette Rivers, and medium to low in the rest of the treated streams. The residual population in Ten Mile Creek, a tributary of the Ford River, was not as large as it was expected to be.

Little River, a tributary of the Oconto River, was treated for the first time. Ammocetes were few, but all of those collected exceeded 90 mm in length, and 88% were females.

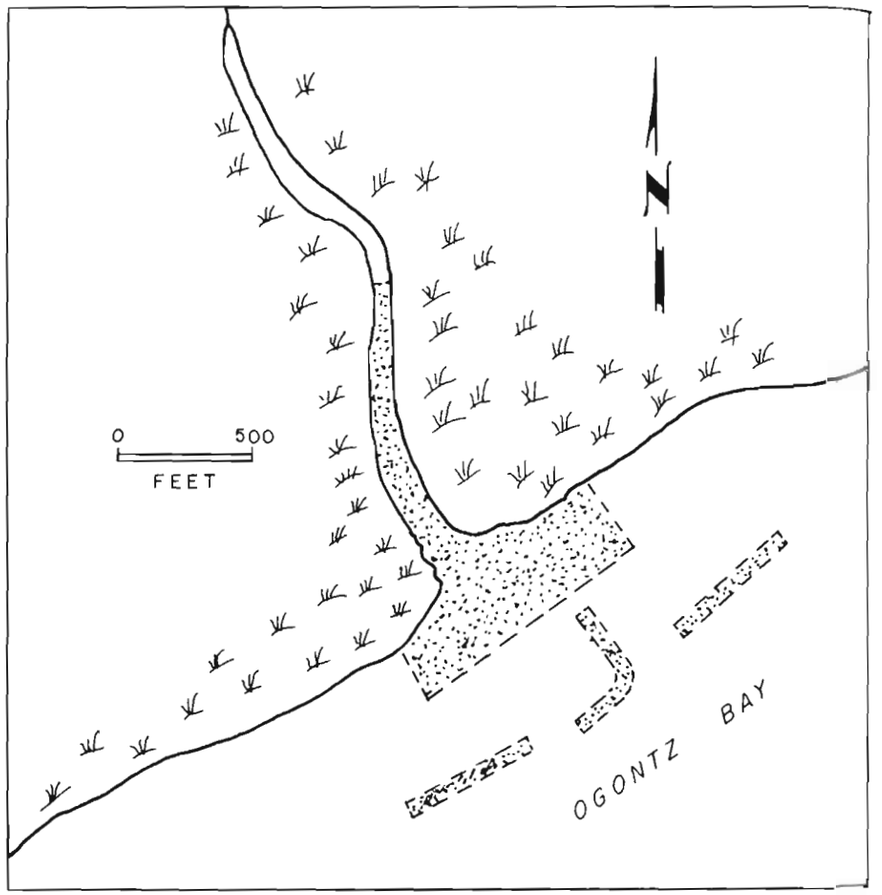

Figure 2. Areas (stippled) of Ogontz Bay, Lake Michigan, that were sprayed with Bayer 73 granules in 1976.

It is estimated that 30,000 white suckers and longnose suckers were killed during the Cedar River treatment. An unusually large run of spawning suckers unexpectedly entered the river while the treatment was in progress and migrated into a chemical bank not tailored for spawning suckers.

A large fish kill occurred near the mouth of the Muskegon River during treatment. The cause was not determined, but the evidence pointed to stress factors in addition to TFM. Efforts to identify these stresses continue, with the hope of reducing their effect during future treatments.

Treatments scheduled for Bowen, Rogers, Big Stone, and McGeach Creeks and the Galien and St. Joseph (Blue Creek) Rivers

Table 2. Details on the application of lampricides to tributaries of Lake Michigan in 1976.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73			
			Concentration (ppm)		Pounds used	Hours applied	Pounds of powder used	Granules		
			Minimum effective	Maximum allowable				Pounds used	Acres surveyed
Crow River	May 9	70	4.8	15.0	1,452	12	—	—	—
Cedar River	May 10	600	2.0	4.0	6,270	14	53.9	—	—
Ford River									
Ten Mile Creek	May 21	135	3.2	9.8	1,738	13	0.4	—	—
Pere Marquette River	May 21	1,023	4.0	10.0	18,108	16	54.0	—	—
Oconto River									
Little River	May 24	50	3.0	8.0	374	10	2.5	—	—
Whitefish River	June 4	325	3.0	9.0	5,698	12	1.8	—	—
White River	June 15	622	5.0	14.0	10,290	16	—	—	—
Muskegon River	June 24	1,810	4.0	9.0	29,105	12	150.0	—	—
Brevort River									
Little Brevort R.	June 24	23	2.8	8.5	154	12	—	7.5	1.5
Silver Creek	June 24	7	2.5	7.6	88	12	—	2.5	0.5
Black River	June 28	25	3.2	10.0	440	12	—	5.0	1.0
Millecoquins River	July 30	120	3.0	9.3	1,782	12	—	—	—
Horton Creek	Aug. 26	16	6.0	12.0	293	9	—	—	—
Gurney Creek	Sept. 1	10	5.0	12.0	135	10	—	—	—
Big Fishdam River	Oct. 14	20	3.5	10.6	462	18	—	—	—
Rapid River	Oct. 16	a_	4.3	13.2	462	—	—	—	—
Total	...	4,856	...	...	76,851	...	262.6	15.0	3.0

[a]TFM spread in mouth of river.

Table 2. Details on the application of lampricides to tributaries of Lake Michigan in 1976.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)		Pounds used	Hours applied	Pounds of powder used	Granules	
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Ten Mile Creek	May 21	135	3.2	9.8	1,738	13	0.4	—	—
Pere Marquette River	May 21	1,023	4.0	10.0	18,108	16	54.0	—	—
Oconto River									
Little River	May 24	50	3.0	8.0	374	10	2.5	—	—
Whitefish River	June 4	325	3.0	9.0	5,698	12	1.8	—	—
White River	June 15	622	5.0	14.0	10,290	16	—	—	—
Muskegon River	June 24	1,810	4.0	9.0	29,105	12	150.0	—	—
Brevort River									
Little Brevort R.	June 24	23	2.8	8.5	154	12	—	7.5	1.5
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Horton Creek	Aug. 26	16	6.0	12.0	293	9	—	—	—
Gurney Creek	Sept. 1	10	5.0	12.0	135	10	—	—	—
Big Fishdam River	Oct. 14	20	3.5	10.6	462	18	—	—	—
Rapid River	Oct. 16	[a]	4.3	13.2	462	—	—	—	—
Total	. . .	4,856	. . .	. . .	76,851	. . .	262.6	15.0	3.0

[a]TFM spread in mouth of river.

were postponed because of low water (Fig. 1). The partial treatment of the Little Fishdam River in 1975 apparently eliminated all ammocetes—thus obviating the need for retreatment of this stream in 1976.

Lake Huron Surveys. Pretreatment surveys conducted on 19 tributaries of Lake Huron revealed large populations of sea lamprey larvae in 2, the Pine River (Mackinac County) and Ocqueoc River. Ammocetes were scarce to moderately abundant in 13 streams, and absent in 4 others that are marginally suited for sea lamprey production and have not been treated.

Reestablishment surveys of 40 streams showed 25 to be reinfested. Large populations of reestablished larvae were found in the Little Munuscong, Carp, and Rifle Rivers and Albany Creek, and small to medium-sized populations in the other 21.

In resurveys of six untreated streams in which larval sea lampreys had been previously collected, ammocetes were found in four—two tributaries of the Saginaw River and Mill and Ceville Creeks. Of the Saginaw River tributaries, the Chippewa River produced 125 sea lampreys (36–167 mm long) at 18 of 23 stations, and Bluff Creek yielded 103 (16–156 mm) at 3 of 8 stations; 33 larvae (22–100 mm) were taken in Mill Creek and 9 (35–79 mm) in Ceville Creek.

No sea lampreys were found during resurveys of 39 Lake Huron tributaries that had been negative in the past.

Surveys with Bayer 73 were conducted off the mouths of 16 streams and in the estuaries of 2 others. Sea lamprey larvae were found in Lake Huron off the Cheboygan River (34 larvae, 49–130 mm long), the Ocqueoc River (201 larvae, 32–133 mm), the Devils River (8 larvae, 41–132 mm), and the Carp River (12 larvae, 35–134 mm). In Ocqueoc Lake, 5 larvae (48–146 mm) were found off the mouth of the upper Ocqueoc River. Four large ammocetes (144–161 mm) and one transforming lamprey (149 mm) were collected in the estuary of Martineau Creek, and 16 larvae (41–140 mm) in the estuary of the Carp River.

Lake Huron Chemical Treatments. Only five streams, with discharges totaling 1,545 cfs (measured just before treatment) were treated during the summer (Table 3). A partial treatment of the East Au Gres River eliminated a population of large ammocetes that might have transformed if they had survived for another year. Two tributaries of the East Au Gres River remain to be treated in spring 1977.

Larval sea lamprey numbers were high in the East Au Gres and Ocqueoc Rivers, intermediate in the Cheboygan River (Maple River), and low in the Au Sable River and 266–20 Creek.

Because of low stream flows, treatments were postponed on the Pine, Devils, and Saginaw (Bluff Creek) Rivers; Grace, Mulligan, Prentiss, and Beaugrand Creeks; and Tawas Lake Outlet or Cold Creek (Fig. 1).

Lake Ontario Surveys. Investigations on Lake Ontario in 1976 were concentrated on the Oswego River, continuing the study started in 1975 to determine the distribution of larval sea lamprey populations in

Table 3. Details on the application of lampricides to tributaries of Lake Huron in 1976.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)		Pounds used	Hours applied	Pounds of powder used	Granules	
			Minimum effective	Maximum allowable				Pounds used	Acres surveyed
Au Sable River	Aug. 3	1,300	3.0	7.0	12,623	10	54.0	—	—
Ocqueoc River	Aug. 15	110	4.0	10.0	2,025	16	6.3	20.0	4.0
266-20 Creek	Aug. 18	1	9.5	18.5	5	6	—	—	—
Cheboygan River									
Maple River	Aug. 27	70	6.0	15.0	1,463	15	—	—	—
East Au Gres River	Sept. 10	64	5.0	12.0	1,845	16	—	—	—
Total	. . .	1,545	. . .	. . .	17,961	. . .	60.3	20.0	4.0

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Ocqueoc River	Aug. 15	110	4.0	10.0	2,025	16	6.3	20.0	4.0
266-20 Creek	Aug. 18	1	9.5	18.5	5	6	—	—	—
Cheboygan River Maple River	Aug. 27	70	6.0	15.0	1,463	15	—	—	—
East Au Gres River	Sept. 10	64	5.0	12.0	1,845	16	—	—	—
Total	. . .	1,545	. . .	. . .	17,961	. . .	60.3	20.0	4.0

various parts of the system and their contribution to adult stocks in Lake Ontario. Crews using backpack shockers and Bayer 73 granules conducted surveys in July and August, and the setting of fyke nets in the stream for the capture of recently metamorphosed downstream migrants was started in late October (Fig. 3). Three tributaries to the Genesee River were also surveyed, since a canal system connects the Genesee River with the Oswego River.

No lamprey larvae were found during surveys with Bayer 73 granules on the main stems of the Oswego, Oneida, or Seneca Rivers, or in deepwater areas in their tributaries. Sixty-nine plots totaling 10.5 acres were surveyed in areas that appeared suitable for larvae on the basis of bottom composition, current patterns, and relation to probable spawning sites. Stream levels were nearly normal, in contrast to the flood conditons experienced in 1975 when similar work was attempted. Collecting conditions were generally fair, with water depth and turbidity the most common problems.

Additional surveys with Bayer 73 granules were carried out by crews from the New York Department of Environmental Conservation on tributaries and their deltas in Cayuga and Seneca Lakes, with the assistance of a biologist from the Marquette Sea Lamprey Control Station. In Cayuga Lake, 19 sea lampreys (75–146 mm long) were collected from 4 of the 24 stations sampled. The larvae were found in the Cayuga Inlet complex and off the mouths of Salmon and Yawger Creeks. Lampreys were found in 1 of 10 plots checked on Seneca Lake, and 20 larvae (53–173 mm) were taken near the mouth of Keuka Lake Outlet.

Surveys with backpack shockers in 23 feeder streams below Oneida and Seneca Lakes revealed sea lamprey populations in 2. Three larvae (65–70 mm long) were found in Cold Spring Brook, which enters the Seneca River at Weedsport (Fig. 3), and 18 (75–144 mm) were collected in Black Creek, which joins the Oswego River at Fulton. Both of these streams are small, as is Carpenter Brook, in which sea lampreys were found in 1975. The ammocetes were restricted in distribution and relatively scarce in all three streams, suggesting only limited reproduction at infrequent intervals or unfavorable conditions for ammocete survival. It is possible that the ammocetes in Cold Spring and Carpenter Brooks were produced by adults from Cayuga and Seneca Lakes instead of migrants from Lake Ontario. There are seven dams and 45–50 miles of river between these tributaries and Lake Ontario, whereas the outlet of Cayuga Lake is only 15–25 miles upstream from them on the Seneca River.

Fyke nets were fished from October 20 to December 4 to determine if sea lampreys produced in tributaries of Oneida, Cayuga, and Seneca Lakes move downstream through the Oswego system and contribute to the adult stocks in Lake Ontario. Nets were set in the vicinity of Mud Lock at the outlet of Cayuga Lake and below the dam at Caughdenoy, which is about 4 miles downstream from Oneida Lake.

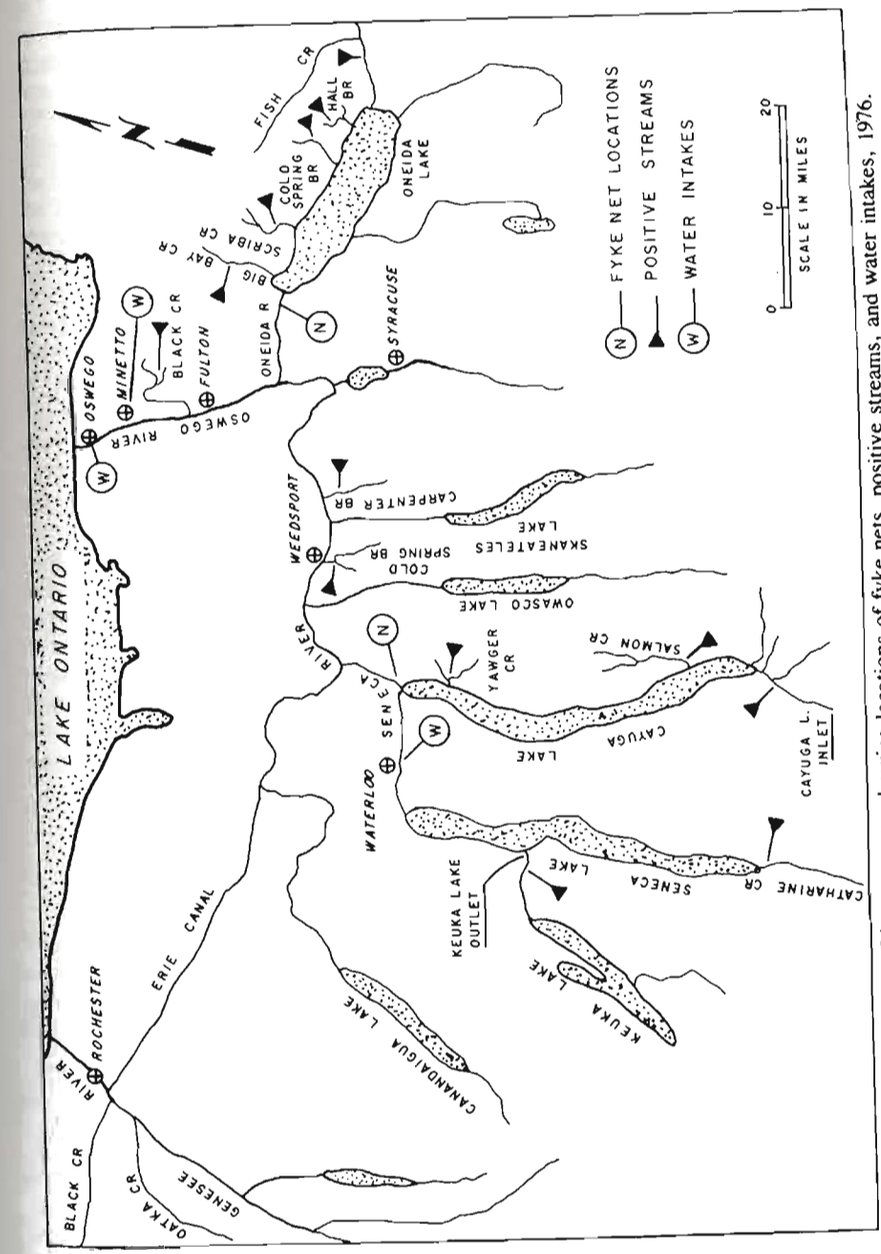

Figure 3. Oswego River system, showing locations of fyke nets, positive streams, and water intakes, 1976.

Six recently transformed lampreys were captured at Caughdenoy; the first was taken on November 15, and the last on November 28. No newly metamorphosed lampreys were taken at Mud Lock, but three adults were caught in the nets immediately below the dam: one male, 451 mm long, weighing 255 g, and two females, 530 mm and 371 g and 526 mm and 390 g. All had fed shortly before capture.

The rivers at both locations were at or near flood stage during most of the period, and water velocities were high. Water temperatures on October 20, at the start of the operation, were 11 C at Mud Lock and 9 C at Caughdenoy. By November 29, they had dropped to 0 C at both locations.

To supplement the fyke netting program, field crews checked water-intake facilities at power plants and factories along the river as possible collecting sites for migrating lampreys. Recently transformed lampreys were reportedly caught in the spring at power plants in Minetto and Oswego, and information from a factory in Waterloo indicated the possible presence of adults there. Arrangements were made for power plant personnel to notify the Marquette Sea Lamprey Control Station if lampreys are seen in the future, and to preserve the animals.

Besides the work on the Oswego River system, a limited survey was made of tributaries of the Genesee River in the Avon-Scottsville area because of concern that sea lampreys may have reached that area through the Erie Canal. This section of the river is made inaccessible to adults from Lake Ontario by barrier falls further downsteam near Rochester. Of three tributaries checked—Conesus Lake Outlet and Black and Oatka Creeks—only Oatka Creek appeared suitable for lampreys; however no larvae were collected at 11 stations on the stream.

Studies of Adult Sea Lampreys

Migrant Sea Lampreys. The operation of barriers on eight tributaries of the south shore of Lake Superior, to provide an index of sea lamprey abundance and provide data on their biological characteristics, continued in 1976. The barriers were operated from April 12 to July 13, without interruption. Low stream flows decreased trapping efficiency during the last month of operation.

The number of adult sea lampreys captured in 1976 was 2,098, compared with 4,487 in 1975 (Table 4). Of the 1976 catch, 1,085, or 51% of the total, were taken at the weir on the Brule River. The catch dropped from 2,606 in 1975 to 80 in 1976 on the Amnicon River, and from 683 to 229 on the Two Hearted River. The catch of adult lampreys at these barriers is the second-lowest since the initial decline in catch in 1962 (Fig. 4). The number of adults fluctuated between 1,912 and 4,487 during 1973–76.

Table 4. Number of adult sea lampreys taken at electric barriers operated in eight tributaries of Lake Superior through July 13, 1961-76.

Year	Betsy	Two Hearted	Sucker	Chocolay	Iron	Silver	Brule	Amnicon	Total
1961	1,366	7,498	3,209	4,201	2,430	5,052	22,478	4,741	50,975
1962	316	1,757	474	423	1,161	267	2,026	879	7,303
1963	444	2,447	698	358	110	760	3,418	131	8,366
1964	272	1,425	386	445	178	593	6,718	232	10,249
1965	187	1,265	532	563	283	847	6,163	700	10,540
1966	65	878	223	260	491	1,010	226	938	4,091
1967	57	796	166	65	643	339	364	200	2,630
1968	78	2,132	658	122	82	1,032	2,657	148	6,909
1969	120	1,104	494	142	556	1,147	3,374	1,576	8,513
1970	87	1,132	337	291	713	321	167	1,733	4,781
1971	104	1,035	485	53	1,518	340	1,754	4,324	9,613
1972	146	1,507	642	294	280	2,574	4,121	132	9,696
1973	294	894	468	270	16	495	261	149	2,847
1974	201	489	249	17	1	117	568	270	1,912
1975	197	683	478	24	8	206	285	2,606	4,487
1976	148	229	314	10	33	199	1,085	80	2,098

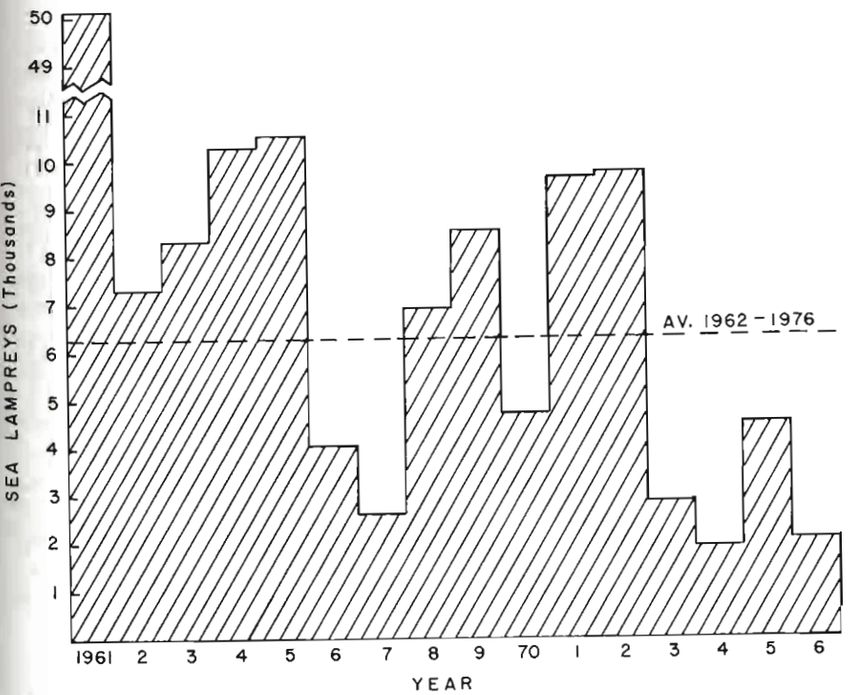

Figure 4. Sea lamprey catch from eight streams tributary to Lake Superior, 1961–76.

Compared with the 1975 catch, the numbers of sea lampreys captured declined 58% at the weirs on streams east of the Keweenaw Peninsula and 40% at the weirs on two streams in western Lake Superior. Only the catches from the Iron and Brule Rivers increased.

Although stream temperatures in April were above normal, the sea lamprey run developed slowly. The largest 5-day catches were made June 10-14 and June 21-25 (7% of the total run during each period). During the last 5 days of operation, 3% of the total run was taken.

The average length and weight of sea lampreys from Lake Superior in 1976 (430 mm and 181 g) did not differ significantly from these measurements in 1975 (436 mm and 186 g; see Table 5).

The sex ratio of sea lampreys in Lake Superior has changed drastically since 1962. In 1962, the percentage of males was about 69, or 2.2 males per female. In 1968, the sex ratio was almost completely reversed: 68% females, and 2.1 females per male. In the 6-year period 1971-76, the percentage of males was stable at 29 to 31, whereas in the previous 6 years (1965-70) it varied from 27 to 52 and averaged 37. In 1976 the percentage of females was 71 (or about 2.5 females per male).

The number of rainbow trout handled at the Lake Superior index barriers declined to 1,089 in 1976—considerably below the 1970-75

Table 5. Average lengths and weights of sea lampreys and percentage of males from index streams of Lake Superior, 1954-76.

Year	Number in sample	Average length (mm)	Average weight (g)	Percentage males
1954	2,381	458	220	57
1955	5,736	438	195	53
1956	9,265	451	202	56
1957	10,305	433	174	66
1958	12,542	426	165	57
1959	14,421	431	167	58
1960	11,906	414	147	68
1961	18,201	409	136	67
1962	6,581	431	159	69
1963	7,221	426	160	66
1964	6,706	422	155	56
1965	7,680	431	164	52
1966	3,797	410	146	42
1967	2,217	421	168	33
1968	5,874	421	161	32
1969	6,498	419	164	27
1970	4,009	431	176	35
1971	7,060	449	190	31
1972	8,032	443	192	31
1973	2,663	421	161	31
1974	1,749	432	170	30
1975	3,407	436	186	31
1976	1,904	430	181	29

average of 1,453. Likewise, the number of white suckers trapped was only 6,132, compared with the 6-year average of 9,215, and the number of longnose suckers 4,314, compared with the average of 13,077. It is believed that most trout and suckers migrated upstream before the barriers were in operation because water temperatures were above normal in early April.

The percentage of rainbow trout longer than 305 mm (total length) scarred or wounded by sea lampreys declined from 1.4 in 1975 to 1.1 in 1976.

An electrical barrier was installed on the White River, a tributary of the Bad River, Lake Superior, to prevent upstream migration of sea lampreys while a dam was under repair. The Lake Superior District Power Company supplied the electrical service and maintained the barrier from July 19 to October 4. The barrier was dismantled after the dam had been repaired.

An electrical barrier was operated without incident from March 22 to September 17 on Weston Creek, a tributary of the Manistique River, Lake Michigan, to block sea lampreys from bypassing the dam at Manistique. This barrier has been in operation for 3 consecutive years. Surveys for sea lamprey larvae above the Manistique dam have failed to produce larvae since chemical treatment, and indicate that Weston Creek was the route adults used to bypass the dam.

The assessment weir on the Ocqueoc River, Lake Huron, captured 6,937 adult sea lampreys, compared with 1,901 in 1975. The increase may have been due in part to improvements in weir design or more regular servicing, or both, but visual observations of other streams in the area indicated a significant increase in the number of lampreys.

The average length and weight of adults taken at the Ocqueoc River increased slightly in 1976, from 460 mm and 209 g in 1975 to 472 mm and 227 g in 1976. The percentage of males also increased from 31 to 35.

Samples of sea lampreys were taken periodically from the spawning migration below the Manistique River (Lake Michigan) dam. The average length and weight of the 114 adults (476 mm and 257 g) were closely similar to these values in 1975 (482 mm and 256 g). The percentage males declined from 33 in 1975 to 21 in 1976.

Small mechanical traps (2 by 2 by 4 feet) were fished at several locations as part of a pilot study to determine the efficiency of traps for evaluating the relative abundance and biological characteristics of sea lampreys that congregate at dams and powerhouses. There is now virtually no direct evaluation of the lamprey population in Lake Michigan, or in the U.S. waters of Lake Ontario, and the electric barrier on the Ocqueoc River is the only assessment device in U.S. waters of Lake Huron.

The traps are constructed of ½-inch mesh galvanized hardware cloth on a metal frame. Funnels project 18 inches into the trap from each end. The terminal openings of the funnels are 1-½ by 3 inches, thus excluding large fish. Because large sport fish are not captured, the trap

requires attention only once or twice a week, depending on the number of lampreys involved. Lampreys are captured as they probe the walls of dams seeking passage upstream.

Lampreys caught in the traps are fin clipped and released to determine the efficiency of the traps and to obtain data for population estimates and data on length, weight, and sex ratios.

A small mechanical trap was operated for the second year at the dam on the Rock River, Lake Superior. In 1976, 498 sea lampreys were captured, an increase of 32% over 1975 (377). Adults were marked and released upon capture, and about 78% were recaptured.

The average length and weight of the Rock River sample was 400 mm and 173 g, compared with 430 mm and 181 g for lampreys from the index barriers on Lake Superior. Sex ratios for lampreys from the Rock River and those taken at the index barriers were nearly identical.

In additon to the second year of fishing at Rock River, traps were fished for the first time in four other streams tributary to Lake Superior: Pendills Creek, Big Garlic River, Sturgeon River, and Salmon Trout River (Houghton County). No sea lampreys were captured in Pendills Creek although the trap was fished from June 3 to August 10. Even though this stream has a history of lamprey runs, adults may not have ascended the stream in 1976, as no young-of-the-year larvae were collected in late summer.

A trap fished at a barrier dam on the Big Garlic River from May 10 to August 15 captured 90 adult sea lampreys. A total of 82 were fin clipped and released, and 21 (26%) were recaptured. The average length (413 mm) and weight (187 g) of the adult lampreys in the Big Garlic River were similar to these values for lampreys taken at the index barriers. Male lampreys made up 24% of the Big Garlic sample, compared with 29% of the catch at the barriers.

A trap was also fished at a water control structure built in 1975 on the Sturgeon River at the outlet of Otter Lake, Houghton County. Eighteen adults were collected, marked, and released, but none were recaptured. A fish passageway associated with the dam allows sea lampreys to migrate upstream. Young-of-the-year sea lampreys were collected in 1976 in the Otter River upstream from the structure.

A trap was fished on the Salmon Trout River from May 25 to 28—a time when sea lampreys were moving into other Lake Superior tributaries—but the site (an old wooden dam) appeared unsuitable for a mechanical trap and no adults were captured.

In cooperation with the U.S. Corps of Engineers, traps were fished below powerhouse No. 10 in the St. Marys River. A single trap fished in 1975 at this location captured 429 adults. In 1976, 627 were captured in three traps and an additional 562 were dipnetted at night. Of 959 adults either tagged or fin clipped, about 11% were recaptured. By a simple proportion method, the population estimate for this one area of the St. Marys River was about 11,000 sea lampreys.

A field study designed to demonstrate the effectiveness of the technique of releasing sterilized males as a means of limiting lamprey reproduction was conducted in the Big Garlic River, Marquette County, Michigan. A total of 270 male sea lampreys were sterilized with the compound, *P, P*-Bis(1-aziridinyl)-*N*-methylphosphinothioic amide (PMPA), and released along with 30 normal males and 70 normal females into the study area of the Big Garlic River. Preliminary examination of the field data indicated that the production of ammocetes was reduced 80 to 90%.

Parasitic Sea Lampreys. The collection of parasitic-phase sea lampreys taken by fishermen from Lakes Superior, Michigan, Huron, and Erie continued in 1976 (Table 6). The 1976 collections are incomplete because records of lampreys taken during the late fall are usually not available until fishing resumes in the spring. By December 31, collections included 123 sea lampreys taken by Lake Superior commercial and sport fishermen, of which 69 (56%) were taken in Wisconsin; the collections included only 6 parasitic-phase sea lampreys less than 201 mm long.

Lake Michigan fishermen collected 339 sea lampreys in 1976, of which 67% were taken from two statistical districts in Wisconsin: the Gills Rock area (WM-2) produced 116, and the Algoma area (WM-4) 111. Fishermen of the Gills Rock area contributed 23 (49%) of the parasitic-phase sea lampreys less than 201 mm long. Of the sea lampreys captured off Algoma, 86 (77%) were spawning-phase adults.

Lake Huron fishermen captured 86 sea lampreys in 1976, of which 76 (88%) were taken from the De Tour, Michigan, area (MH-1).

One Lake Erie commercial fisherman collected seven sea lampreys from Sandusky Bay (Ohio area 0-1, not shown in Table 6).

Ammocete Studies

Since 1973 the number of Lake Superior tributaries infected with sea lamprey ammocetes has gradually declined. The number of streams with young-of-the-year ammocetes has declined from 42 streams in 1973 to 37 in 1974 and 34 in 1975. By the end of 1976, larvae of the 1976 year class had been collected in 23 streams; however, chemical treatments eliminated this year class in 4, and 7 remain to be surveyed. Table 7 shows the present status of the remaining reestablished populations in tributaries of Lake Superior.

Recruitment of ammocetes to the offshore area in Eagle Harbor has been prevented since 1973 by chemical treatments of Eliza Creek. Growth of ammocetes in this offshore area of Lake Superior has been studied since 1973. The mean length of ammocetes in this population increased from 72 mm in 1973 to 124 mm in 1976. The mean increments

Table 6. Number of parasitic-phase sea lampreys and (in parentheses) the number of spawning-phase sea lampreys collected in commercial and sport fisheries, by lake and statistical district, 1971-76.
[Collections for 1976 are incomplete.]

District[a] and length (mm)	1971	1972	1973	1974	1975	1976	Total 1971-76
Lake Superior							
M-1							
200 or less	0	0	0	—	—	—	0
>200	1	3 (2)	3	—	—	—	7 (2)
M-2							
200 or less	0	0	0	0	0	0	0
>200	5	16 (7)	13 (16)	3 (1)	14	8	59 (24)
M-3							
200 or less	0	1	0	0	0	0	1
>200	16	7	9 (1)	7	12	0	51 (1)
Wisc.							
200 or less	9	3	4	6	0	1	23
>200	302	232 (2)	199 (1)	117	97 (2)	67 (1)	1,014 (6)
MS-2							
200 or less	0	0	0	1	0	1	2
>200	23	8 (2)	5 (1)	4 (1)	11 (1)	0	51 (5)
MS-3							
200 or less	33	11	6	8	12	2	72
>200	68	29	61	17	27	10	212
MS-4							
200 or less	5	1	1	3	1	2	13
>200	145	121 (3)	74 (1)	45	13	17	415 (4)
MS-5							
200 or less	0	0	0	0	0	0	0
>200	18	5	2	2	0	2	29
MS-6							
200 or less	2	2	6	3	1	0	14
>200	12	13	7	9	7	12	60
Total							
200 or less	49	18	17	21	14	6	125
>200	590	434 (16)	373 (20)	204 (2)	181 (3)	116 (1)	1,898 (42)
Lake Michigan							
MM-1							
200 or less	0	1	12	7	2	14	36
>200	30	46	99 (1)	40 (4)	37 (9)	38 (11)	290 (25)
MM-2							
200 or less	2	1	7	12	1	2	25
>200	20	9	3	5	19 (1)	2	58 (1)
MM-3							
200 or less	14	22	13	4	10	2	65
>200	68 (3)	104 (2)	71	59	68	7	377 (5)
MM-5							
200 or less	2	10	4	7	1	1	25
>200	3	8 (4)	6 (2)	7	4	3	31 (6)
MM-6							
200 or less	0	0	0	1	0	0	1
>200	0	0	1	0	2	0	3

Table 6—(Cont'd)

District[a] and length (mm)	1971	1972	1973	1974	1975	1976	Total 1971-76
MM-7							
200 or less	0	0	0	0	0	0	0
>200	2	0	1	1	0	0	4
MM-8							
200 or less	2	2	0	1	1	0	6
>200	1	1	1	1	1	0	5
WM-1							
200 or less	3	5	1	1	0	1	11
>200	63 (16)	31 (40)	37 (8)	38 (14)	33 (8)	9 (4)	211 (90
WM-2							
200 or less	175	144	91	107	15	23	555
>200	410	432	258	250	187	93	1,630
WM-3							
200 or less	24	6	3	1	0	3	37
>200	124	108	47	29	20	15	343
WM-4							
200 or less	8	3	1	1	1	1	15
>200	112 (130)	27 (160)	56 (42)	54 (80)	77 (107)	24 (86)	350 (605)
WM-5							
200 or less	9	5	5	2	0	0	21
>200	14	11	13	19	3	0	60
WM-6							
200 or less	0	2	—	—	—	—	2
>200	0	0	—	—	—	—	0
Total							
200 or less	239	201	137	144	31	47	799
>200	847 (149)	777 (206)	593 (53)	503 (98)	451 (125)	191 (101)	3,362 (732)
Lake Huron							
MH-1							
200 or less	2	2	0	0	5	3	12
>200	110	88	31	10	111	73	423
MH-3							
200 or less	0	4	—	—	—	—	4
>200	40	5	—	—	—	—	45
MH-4							
200 or less	0	0	0	0	0	1	1
>200	35	21	8	12	24 (3)	6 (3)	106 (6)
MH-6							
200 or less	0	—	—	—	—	—	0
>200	15	—	—	—	—	—	15
Total							
200 or less	2	6	0	0	5	4	17
>200	200	114	39	22	135 (3)	79 (3)	589 (6)

[a]Boundaries are defined in "Fishery Statistical Districts of the Great Lakes," by S. H. Smith, H. J. Buettner and R. Hile, Great Lakes Fishery Commission Technical Report No. 2, 1961. Lampreys were not collected from the fishermen in Lake Superior district MS-1; Lake Michigan districts MM-4, Illinois, or Indiana; and Lake Huron districts MH-2 or MH-5.

Table 7. Tributaries of Lake Superior with reestablished populations of sea lampreys and the number collected per hour with an electric shocker. [B indicates the presence of a year class recovered with Bayer 73.]

Stream	Date of last treatment	Year classes present			
		1973	1974	1975	1976
Pendills Creek	7/27/73		0	4	0
Ankodosh Creek	7/26/73		3	0	0
Betsy River	8/22/74			41	24
Two Hearted River	7/26/75				42
Seven Mile Creek	7/19/67	0	0	0	2
Miners River	7/12/73	B	0	6	0
Five Mile Creek	10/17/73		11	0	0
Au Train River	6/30/76				5
Laughing Whitefish River	8/2/73	24	0	0	12
Harlow Creek	10/1/74			13	29
Little Garlic River	10/3/74			66	1
Big Garlic River	8/27/75			29	6
Iron River	8/9/72	B	B	B	—
Salmon Trout River (Marquette County)	6/11/75			24	—
Huron River	9/21/74			25	36
Sturgeon River	7/7/75			B	4
Traverse River	10/1/75				40
Little Gratiot River	8/6/72	0	2	0	0
Salmon Trout River (Houghton County)	10/17/74			95	163
Misery River	10/17/74			4	4
Ontonagon River	6/26/75			3	18
Potato River	10/20/74			18	0
Bad River	8/18/73		5	134	45
Sand River	10/16/64	0	8	0	0
Brule River	7/29/74		1	28	6
Poplar River	7/25/74			16	76
Middle River	7/25/74		1	117	87
Amnicon River	6/15/75			16	0
Nemadji River	6/17/75			11	0
Arrowhead River	8/16/73	1	2	0	4
Number of streams		4	9	20	19

were 22 mm in 1974, 12 mm in 1975, and 18 mm in 1976. Four transforming sea lampreys were collected in 1976 and three in 1974.

Sea lamprey ammocetes that migrate from Furnace Creek congregate in a steep dropoff area (12 to 35 feet deep) in Lake Superior that extends from ½ mile off the mouth of Furnace Creek north-northwest about 2 miles to Five Mile Creek (Fig. 5). Ammocetes have been collected from small plots on the dropoff over the past few years. In 1976, a plot 60 feet wide and 4,000 feet long was surveyed with Bayer 73 granules. Within the plot, 635 native ammocetes were marked and released to provide a population estimate. The recovery of 65 (10%) of

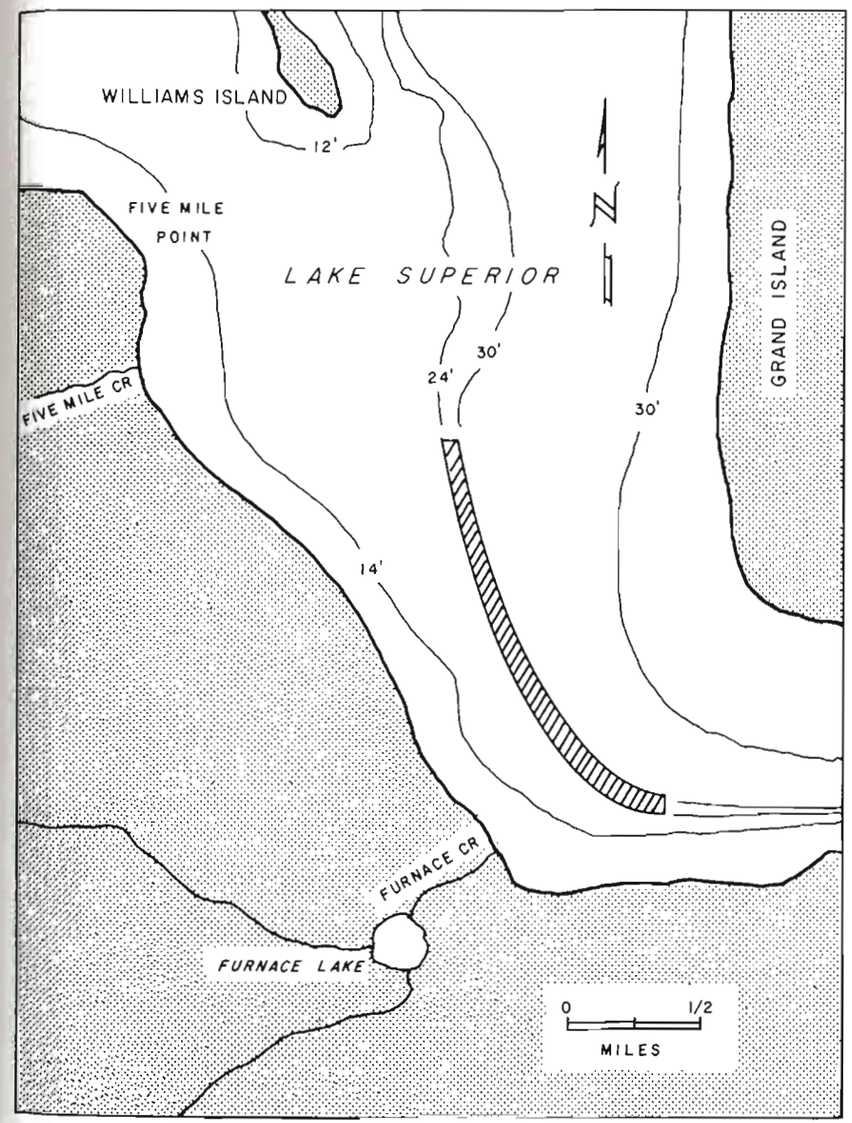

Figure 5. Area (hatched) surveyed with Bayer 73 granules offshore of Furnace Creek in Lake Superior, 1976.

the marked ammocetes, along with 53 larval and 2 transforming sea lampreys, yielded an estimate of 540 sea lampreys.

Control of lake-dwelling populations is best accomplished by eliminating the ammocetes before they migrate from their parent

Table 8. Percentage of transformation of sea lamprey ammocetes of the same age and similar size ranges confirmed in a cage or aquarium at four locations. [Average water temperature (C) from mid-May to July 31 in parentheses.]

Location	1974	1975	1976
Lakes Superior	5	10	8
	(7)	(12)	(11)
Lake Michigan	—	53	50
		(14)	(12)
Big Garlic River	46	51	76
	(14)	(16)	(14)
Aquarium	75	84	100
	(20)	(21)	(20)

stream, and this is being attempted by annual treatments of Furnace Creek.

A study of the rate of transformation of larvae confined in four locations was continued. As in the past, known-age ammocetes of the 1960 year class collected in the downstream trap of the Big Garlic River each spring were used as test animals. Ammocetes were caged in Lakes Superior and Michigan at a depth of 35 feet, in a backwater of the Big Garlic River, and in an aquarium at the Marquette laboratory. Results of the 1976 study (Table 8), like those of the similar 1974 and 1975 studies, showed that the lowest rate of transformation (8%) occurred in Lake Superior (average temperature, 11 C) and the highest rate (100%) in the aquarium (average temperature, 20 C).

Preliminary analysis of these data indicated that larvae migrating into offshore areas of Lake Michigan will transform at a rate comparable to that in a stream environment, whereas the transformation rate for larvae migrating into Lake Superior is severely curtailed. However, larvae that failed to metamorphose in Lake Superior in 1975 were observed an additional year and 44% (16 of 36) transformed. Obviously, ammocetes that migrate into Lake Superior and survive more than 1 year transform at a significant rate.

APPENDIX D

SEA LAMPREY CONTROL IN CANADA

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This report summarizes the activities of the Canadian sea lamprey control program during the period April 1, 1976 to March 31, 1977, in compliance with a Memorandum of Agreement between the Department of Fisheries and Environment and the Great Lakes Fishery Commission. The Canadian sea lamprey control program is the responsibility of the Department's Sea Lamprey Control Centre located in Sault Ste. Marie, Ontario.

Electric Barrier and Weir Operations

Electric barriers were operated for the purpose of assessing the sea lamprey runs on five Canadian tributaries to Lake Huron; namely Kaskawong, Blue Jay, Still, Naiscott and Harris Rivers (Table 1). The 1976 total sea lamprey collection (461 specimens) was 62 per cent greater than the 1975 total; however the significance of this increase in terms of the general abundance of sea lamprey in Lake Huron is unknown.

Mechanical weirs and traps were operated on one tributary of Lake Superior, five tributaries of Lake Ontario, and in St. Marys River, in order to assess sea lamprey runs in these streams. The traps, which consisted of hardware cloth over steel frames were located either adjacent to natural structures which obstructed lamprey movement, or were fished in conjunction with mechanical weirs. A total of more than 200 adult sea lamprey were captured by these devices.

Table 1. Numbers of sea lamprey taken in electrical assessment barriers, Lake Huron, from 1971 to 1976 inclusive.

Streams	Count for the season					
	1971	1972	1973	1974	1975	1976
North Channel						
Kaskawong	271	207	135	146	168	187
Georgian Bay						
Still	960	426	14	10	28	48
Naiscoot	1	2	0	0	0	0
Harris	445	472	8	1	8	13
Lake Huron						
Blue Jay	332	380	22	61	127	213
TOTALS	2009	1487	179	218	331	461

Stream Surveys

Sea lamprey surveys, employing electro-shockers or granular Bayer 73, were conducted on selected streams and embayments located as follows: 17 on Lake Superior, 94 on Lake Huron, 180 on the Canadian side of Lake Ontario, and 13 on the U.S. side of Lake Ontario. Routine surveys of 235 streams not known to produce sea lamprey revealed one new sea lamprey stream on the Canadian side of Lake Ontario, and a doubtful stream on Lake Superior. Distribution surveys, re-establishment surveys, treatment-evaluation surveys and population studies were also conducted.

Applications of granular Bayer 73 were made in several embayments and estuarine areas of Lakes Superior and Huron. Those on Lake Superior were Nipigon River, Steel River, Mountain Bay, and Batchawana Bay. Those on Lake Huron were St. Marys River, Tenby Bay and the Western Channel of French River.

Lampricide Treatments

On Lake Superior, eight of the eleven scheduled stream treatments were completed. These included treatments of the Pigeon, Cloud, Wolf, Little Gravel, Gravel, Harmony and Sable Rivers, and Cash Creek. Treatments of Big Carp, Goulais and Chippewa Rivers were postponed due to low water.

On Lake Huron, eight of the nine scheduled stream treatments were completed. These included Silver, Sturgeon, Mad, Telfer, Boyne, Magnetawan, Chikanishing, Still and French Rivers. On the French River only the West Channel was treated. Treatment of the Naiscott River was postponed because of low water.

On the Canadian side of Lake Ontario all of the six scheduled treatments were completed. These were on Mayhew, Lakeport, Port Britain, Salem, Smithfield and Oakville Creeks. Two additional streams were treated, one of which, Carruthers Creek, was found to contain sea lamprey for the first time in 1976. Butler Creek was the other addition to the list of treatments.

On the U.S. side of Lake Ontario all of the six scheduled treatments were completed. These were on Blind, Lindsey, Skinner, Deer, Little Sandy and Catfish Creeks. Tables 2, 3, 4 and 5 summarize the numerical features of these treatments.

Sea Lamprey from Commercial Fishermen

In response to the offer of a reward for the collection of sea lamprey and related catch data, commercial fishermen on the Great Lakes submitted 85 specimens during 1976. Although this is substantially lower than the numbers obtained by this means in former years, additional specimens were expected in later shipments. The numbers received were insufficient to demonstrate significant differences in the statistics obtained in earlier years, however there was no indication of a departure from the average sizes observed previously, nor from the tendency of females to predominate among sea lamprey associated with offshore commercial fishing gear.

Sea Lamprey from Humber River, Lake Ontario

The individual who contracts with this Centre to collect sea lamprey in the Humber River during each year's spawning run, captured 4,030 specimens in 1976. This was a decrease of 41 per cent from the number caught in 1975. The increase in the numbers collected annually since 1968 (except for 1974 and 1976) apparently contradicts other evidence of a general decline in sea lamprey predation rates on fish since the inauguration of sea lamprey control in Lake Ontario.

Sea Lamprey Trawling and Tagging: Lake Ontario and St. Marys River

During part of the fall of 1976 a surface trawl was towed behind a motorboat off the mouth of the Credit River in Lake Ontario. In 89

Table 2. Summary of streams treated with lampricide, Lake Superior, 1976.

STREAM No.	STREAM Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles treated
S-587	Cloud R.	July 11-18	5	188	—	—	Scarce	4.6
S-592	Pigeon R.	July 14-15	280	1,240	23	—	Moderate	3.2
S-410	Cash Cr.	July 18-21	38	811	15	—	Scarce	15.5
S-517	Wolf R.	Aug. 4-8	98	1,155	18	—	Abundant	7.0
S-369	Little Gravel R.	Aug. 9-10, 14-18	1	45	—	—	Abundant	4.3
S-368	Gravel R.	Aug. 11-13	86	671	12	54	Scarce	10.0
S-39	Harmony R.	Sept. 22-23	4	64	—	3	Scarce	1.8
S-54	Sable R.	Oct. 25-29	9	224	—	—	Moderate	5.4
TOTALS			521	4,398	68	57		51.8

Table 3. Summary of streams treated with lampricide, Lake Huron, 1976.

STREAM No.	STREAM Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles treated
H-1376	Silver Cr.	June 5-6	11	165	1	—	Moderate	3.2
H-1343	Sturgeon R.	June 8-13	25	587	5	10	Moderate	13.6
H-1360	Nottawasaga R. - Mad R.	June 15-19	90	2,203	21	—	Scarce	29.6
H-1421	Telfer Cr.	June 21-24	6	162	2	—	Moderate	5.0
H-1053	Boyne R.	July 11-12	28	157	—	—	Scarce	5.0
H-745	Magnetawan R.	July 15-16	746	1,990	39	—	Moderate	6.0
H-420	Chikanishing R.	July 17-18	6	28	—	—	Scarce	3.5
H-726	Still R.	Aug. 6-9	56	400	—	—	Scarce	12.3
H-606	French R. - Western Channel	Aug. 11-13	8	120	—	—	Scarce	0.8
TOTALS			976	5,812	68	10		79.0

Table 4. Summary of streams treated with lampricide on the Canadian (Ontario) side of Lake Ontario, 1976.

STREAM No.	STREAM Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles treated
O-230	Trent River-Canal - Mayhew Cr.	May 9-10	30	350	3	—	Abundant	2.0
O-161	Lakeport Cr.	May 10-11	21	431	—	—	Abundant	9.0
O-141	Port Britain Cr.	May 13-14	11	340	3	2	Abundant	6.0
O-163	Salem Cr.	May 16-17	15	251	2	—	Abundant	1.3
O-168	Smithfield Cr.	May 19-20	40	535	5	3	Scarce	3.0
O-79	Oakville Cr.	June 17-21	64	1,520	14	29	Scarce	31.0
O-166	Butler Cr.	Sept. 13-14	3	103	—	—	Moderate	3.7
O-120	Carruthers Cr.	Sept. 17-22	3	217	—	—	Moderate	9.5
TOTALS			187	3,747	27	34		65.5

Table 5. Summary of streams treated with lampricide on the United States (New York) side of Lake Ontario, 1976.

STREAM No.	STREAM Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles treated
NY-0-49	Blind Cr.	May 9-10	12	227	—	—	Scarce	3.7
NY-0-48	Lindsey Cr.	May 13-15	45	532	—	—	Moderate	9.0
NY-0-47	Skinner Cr.	May 16-17 June 4-5	28	328	—	—	Abundant	7.7
NY-0-52	Deer Cr.	June 6-8	11	168	—	13	Abundant	7.8
NY-0-50	Little Sandy Cr.	June 8-12	32	383	—	—	Moderate	15.3
NY-0-60	Catfish Cr.	June 11-12	25	204	—	—	Scarce	3.1
TOTALS			153	1,842	—	13		46.6

hours of trawling, 11 sea lamprey were captured. These were marked with Petersen tags and later released in the same area. None were recaptured.

Later in the fall, a similar trawling operation was conducted in the St. Marys River at the outfall of the Edison Electric plant in Saute Ste. Marie, Michigan. During 108 hours of trawling 13 sea lamprey were captured, a rate of capture which is one-sixth of the previous year's figure. These animals were not tagged or released.

Release of Sterile Male Sea Lamprey in Sable River: Lake Superior

The feasibility of using sterilized sea lamprey as an alternate control method has been under investigation at the Hammond Bay Biological Station of the U.S. Fish and Wildlife Station. A test of the method in a field situation was undertaken in Sable River, a tributary of Lake Superior, by introducing 400 sterilized male sea lamprey during the normal spawning run. Some of the experimental animals (identified by tags) were later observed in nests along with unmarked sea lamprey. However when the river was treated later in the year, young-of-the-year larvae were collected, indicating that some successful spawning had occurred.

APPENDIX E

ALTERNATIVE METHODS OF SEA LAMPREY CONTROL

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INTRODUCTION

The Great Lakes Fishery Commission (GLFC) is committed to a continuing program of assessing the impact of residual sea lamprey populations on Great Lakes fish stocks. Its main charge is to develop an integrated, cost-effective lamprey control program that will include the continued use of chemical toxicant where appropriate, but that will also include the use of repellents, attractants, sterilants, physical barriers, and other methods as may prove useful, economical, and ecologically safe.

The Great Lakes Fishery Laboratory, under contract with GLFC, performs research on the development of alternative methods for control of the sea lamprey. This research is conducted at the Hammond Bay Biological Station (HBBS) located on Lake Huron near Rogers City, Michigan, and at the Monell Chemical Senses Center (MCSC) at the University of Pennsylvania, Philadelphia, Pennsylvania.

Integrated Production of Sea Lamprey for Research

Approximately 250,000 sea lamprey were reared from eggs to the burrowing stage at HBBS and released into the upper Big Garlic River, Marquette County, Michigan. It is hoped they will survive and grow to

produce large ammocetes and transformers needed for research. Larvae that survive can be captured as needed by electroshocking, or trapped in the inclined-plane downstream trap operated on the lower Big Garlic River by the Marquette Sea Lamprey Control Station.

Limited numbers of seven year classes of sea lamprey, reared in the laboratory from eggs, are being held at HBBS. Approximately 800 large larvae and 300 recently transformed individuals collected during the summer from the Big Garlic River and from streams near HBBS are also being held at HBBS. A total of 6,947 spawning run adult sea lampreys were captured in the Ocqueoc River weir March-July 1976. Many of these were transported to HBBS for use in various research projects at HBBS and the Monell Chemical Senses Center, University of Pennsylvania, Philadelphia, Pa. Two large parasitic-phase sea lampreys were captured in fyke nets fished in the Ocqueoc River during the fall of 1976. These lampreys had apparently been carried upstream by migrating salmon, dropped off later, and were captured moving downstream.

Three fyke nets were fished from October 4 to December 31 at the weir site on the Ocqueoc River to assess the magnitude of the downstream movement of transformers. Only three transformers were taken. Unusually low water levels were evident during the fall and may have influenced the behavior of the transformers.

Development of Methods to Sterilize Sea Lamprey

Chemosterilant Studies. Laboratory tests at Hammond Bay Biological Station have shown that *P,P*-Bis (1-aziridinyl)-*N*-methylphosphinothioic amide (PMPA) dissolved in saline and injected intraperitoneally at a dosage of 100 mg/kg sterilizes spawning run sea lampreys. A field test in 1974 on the Big Garlic River, Marquette County, Michigan, conducted cooperatively with the Service's Marquette Sea Lamprey Control Station (MSLCS) also demonstrated that injected males were sterilized. Sterility of the females was not confirmed. However, according to E. F. Knipling (personal communication), the effect obtained by destroying the females and sterilizing and releasing only the males is the same as that obtained by sterilizing and releasing both sexes. Since we are able to distinguish the sexes accurately, it should be necessary to sterilize only males in any future work. This approach will greatly reduce the number of lampreys to be injected and released. Observations of spawning lamprey showed that the chemosterilant had no noticeable effect on their nest building or spawning behavior, nor did it destroy their mating competitiveness, which is a basic requirement for the successful application of the sterile-male-release-technique.

A follow-up field test in cooperation with MSLCS was conducted to more fully determine the effectiveness of the PMPA-sterilized male release technique for use in sea lamprey control. This follow-up test was conducted on the Big Garlic River between Kreig's Falls and Mac's Falls (section 111 of the test area used in 1974). This portion of the river was chosen because it contained good spawning habitat. Kreig's Falls, the upstream end of the test area was a complete barrier to the upstream movement of lampreys and a trap at the downstream end of the study area (immediately above Mac's Falls) prevented downstream movement. No adult lampreys were present above Kreig's Falls that could move downstream into the study area, and Mac's Falls was a complete barrier to upstream movement. Thus, the size and composition of the introduced population of spawning run lampreys in the test area was not altered by migration.

During early June 1976, approximately 1,000 adult lampreys were collected below the power dam on the lower Manistique River, Lake Michigan, and transported to HBBS. From these, 70 females and 300 males, sexed on the basis of external characters, were selected for the test. These individuals were then weighed, and marked with a Petersen-type tag. The tag was attached so that a white, numbered disc was visible on one side of the lamprey and an unnumbered, colored disc was visible on the other side. The location and color of the disc distinguished the sex of the lamprey and also distinguished normal males from PMPA-sterilized males.

Of the 300 tagged males, a total of 270 were sterilized with an intraperitoneal injection of PMPA at a dosage of 100 mg/kg. Injected lampreys were placed in static-water recovery tanks where they were held for 24 hours. After the lampreys were removed from the recovery tanks, the water in these tanks was treated with hydrochloric acid to degrade any PMPA released by the lampreys. According to Dr. A. B. Borkovec (U.S. Department of Agriculture, Beltsville, Md.), PMPA in aqueous solution can be completely degraded in minutes by treatment with 10 ml concentrated hydrochloric acid per gallon of solution.

The 270 PMPA-sterilized males, 30 normal males, and 70 normal females were transported from HBBS to the test area and released immediately below Kreig's Falls on June 5, 1976. Males began building nests on June 15; females joined males on the nests and spawning began on June 20 and continued through July 6. Each nest on which adult lamprey were observed was individually marked, and its position relative to adjacent nests were mapped. Daily observations of the nest building and spawning activity of the lamprey on the nests were made until spawning ceased. We observed 84 males on nests with females. Of these, 65 were sterile males, which indicated that sterile males were able to compete successfully with normal males for females.

On July 6-8, all 213 nests in the study area were examined to determine if they contained embryos and to ascertain the stage of development of those present. The majority of these nests (139) contained no embryos. They apparently were built by males who were not successful in attracting females. Seventy-four nests containing eggs

were found during this preliminary survey. The final nest dismantling began approximately 18 days after the last spawning act was observed on an individual nest, or was determined from the stage of development of embryos in the previous subsample survey. This time period was required to produce hatching at the stream temperature present during the study. The nests were dismantled in a manner to allow most embryos (both alive and dead) to drift with the current into a fine mesh plankton net. The nest dismantling procedure continued until no more embryos appeared. All entrapped embryos were preserved in 4% formalin. All collections have been cleaned (the debris removed), and are ready for counting and staging.

A total of 110,447 embryos from eleven nests have been counted and staged (Table 1) to date. Staging data has demonstrated that in nests where sterile males spawned with normal females, embryos developed through the early stages and then died. Where normal males spawned, development of the embryos was normal. A critical evaluation of our nesting observations, combined with the results of our embryo counting and staging data, will be necessary before a final evaluation can be made of the actual reduction in reproductive success that occurred. However, preliminary examination of the data indicates the reproductive failure of the females in the spawning population approached 90%, which is what should be expected in a population in which 90% of the males were sterile.

Although preliminary, the results from this recent field test confirm those of earlier laboratory and field studies, which showed that PMPA is an effective sterilant for adult sea lampreys. The sterile-male-release-technique continues to demonstrate its potential as a useful tool as part of an integrated approach to the control of the sea lamprey.

Immunological Studies. An attempt is being made to develop an immunological method for sterilizing spawning run sea lampreys. Research at the HBBS has already produced several chemical compounds that induce sterility in spawning run sea lampreys. However, the development of an immunological method for doing so is highly desirable because such a tool would utilize non-toxic and species-specific materials.

Antigens were prepared from sea lamprey gonadal products and tissue, mixed with Freund's adjuvant, and injected intramuscularly into domestic rabbits (6 months old, approximately 3 pounds).

The first injections contained 0.5 ml of antigen mixed with 0.5 ml of adjuvant. A booster shot was given 7 days after the initial injection and the rabbits were test bled 21 days later. Immunoelectrophoresis or immunodiffusion failed to reveal antibodies to the soluble portions or any of the antigens used. The dosage of antigen was doubled, from 0.5 ml to 1.0 ml, and the rabbits given a second booster shot. Another test bleeding was made 10 days later. Rabbits injected with two of the antigens derived from female sea lamprey ova or ovarian tissue were positive. Antibody could be demonstrated by both immunodiffusion and

Table 1. Summary of nest observations and embryo counts from 11 nests excavated July 1976.

Nest number	Date spawning observed	Number of females	Number of males		Number of embryos in each nest		Percentage dead embryos in each nest
			Sterile	Normal	Alive	Dead	
4	6-23	1	1	0	0	16,110	100
	6-25	1	1	0			
6	6-25	1	1	0	3,208	23,695	88
	6-26	1	0	1			
	6-27	1	1	0			
26	6-22	1	1	0	0	5,938	100
28	6-22	2	1	0	0	9,470	100
30	6-23	1	1	0	0	13,903	100
	6-30	2	1	0			
	7-5	1	1	0			
33	6-27	1	0	1	5,036	883	15
43	6-23	1	1	0	0	19,212	100
57	6-23	1	1	0	0	5,138	100
64	6-24	1	1	0	0	3,430	100
70	6-26	1	1	0	0	4,141	100
83	7-3	1	1	0	51*	527	91
	Total	18	14	2	8,295	102,447	

*Nests were observed for only 20 minutes each day; a normal male apparently spawned in this nest observed.

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83	7-3	1	1	0	51*	527	91
	Total	18	14	2	8,295	102,447	

*Nests were observed for only 20 minutes each day; a normal male apparently spawned in this nest observed.

immunoelectrophoresis. We are able to obtain approximately 30 ml of antisera from each rabbit.

Antisera obtained from rabbits will be injected into prespawning lampreys at varying dose rates. Injections will be made intraperitoneally so that the injected antisera will come into direct contact with the lamprey's gonadal mass. These lampreys will then be tagged to permit individual recognition and placed in an artificial spawning stream. When they exhibit spawning behavior, they will be removed from the stream and spawned with normal individuals of the opposite sex. The resulting eggs and embryos will be held at 18 C and checked for viability, and for rate of normalcy of development.

Development of Criteria for Aging Lamprey-inflicted Wounds on Great Lakes Salmonids

The major objective of this study is to develop criteria for specifying the age and sequential stages of healing of sea lamprey inflicted wounds and scars on lake trout. Hopefully, this should permit a more accurate assessment of the effects of residual sea lamprey populations on lake trout stocks in the Great Lakes.

Preliminary tests were conducted using rainbow trout and splake as prey, because lake trout were not always readily available to us, and it was felt that these species might yield wounding and wound healing data that would be beneficial in interpreting data obtained from lake trout. A total of 14 lamprey attachments and resultant wounds have been observed on rainbow trout since this study began at HBBS in the spring of 1975. Photographic records showing the progress of wound healing on four of these fish have been completed; the scar from a wound inflicted last spring on the fifth individual is still being observed and photographed.

Studies on wounding and wound healing in lake trout began in January 1976 and a total of 28 lamprey attachments and wounds have been observed. Sixteen of the lake trout wounded by lamprey died, presumably as a result of these wounds. Observations and photographs were made of healing of non-lethal wounds on seven of the surviving lake trout. Lampreys detached from the other five lake trout without forming wounds on them.

Lampreys also formed attachments on 12 F_5 splake since we began tests with this species in the spring of 1976. Five of these splake died, apparently as a result of lamprey attachment and feeding. Wounds on the seven survivors were observed and photographed.

Two major types of lamprey-inflicted wounds have been observed in this study. The type "A" wound is an open lesion exposing the musculature immediately after lamprey detachment; damage is variable with some excavation of tissue. In the type "B" wound, the musculature is not exposed after lamprey detachment, but appears as an

abraded area with the scales missing and usually no visible perforation through the integument. It can appear as an elongated scrape or abrasion.

The staging criteria of type "A" wounds are as follows:

Stage I—Fresh Wound

An obviously fresh, open lesion, surrounded or partially covered by necrotic epidermal tissue. Underlying muscle is usually inflamed and ragged in appearance. Some loss of muscle tissue may have occurred.

Stage II—Healing Wound

The necrotic tissue sloughes off and a transparent membrane forms over the lesion. The entire wounded area becomes smooth to touch. Underlying tissue can still be observed, however, and may be somewhat inflamed. The area in which muscle tissue was lost begins to fill with new tissue.

Stage III—Transitional Scar

This stage begins with the appearance of pigmentation. Pigmentation gradually intensifies, the pit fills gradually with new tissue, and the epidermis begins to take on a more normal appearance during this stage. Scales are still absent and area is very smooth to touch. A slight depression can still be seen and felt.

Stage IV—Scar

Wound site is generally stabilized. Pigmentation is virtually complete, and scales, when present, are usually arranged irregularly.

The staging criteria for type "B" wounds are as follows:

Stage I—Fresh Wound

The sounded area is covered with necrotic hemorrhaged tissue. The integument is abraded and rough to touch. Some swelling may be present. Scales are usually absent.

Stage II—Healing Wound

Inflamation or hemorrhaging has diminished or is confined to central portion of the wounded area. A transparent membrane is forming and the wound is smooth to the touch.

Stage III—Transitional Scar

Normal pigmentation and epidermal characteristics are becoming evident. Scar becomes progressively more heavily pigmented.

Stage IV—Scar

Pigmentation is essentially complete. Scale regeneration is well advanced or complete. Scales, if present, are arranged irregularly. At this point the scar might be difficult to see in the field.

The staging criteria for both types of wounds can be considered preliminary and tentative. As we obtain more data on wounding and wound healing we may be able to characterize more stages and be able to more precisely define them. This additional data should allow us to establish uniform criteria for staging and assigning age to sea lamprey inflicted wounds under field conditions.

Chemical Sensing in the Sea Lamprey

Studies are underway at the Monell Chemical Senses Center, the University of Pennsylvania, to identify and characterize non-toxic chemical substances, including sea lamprey pheromones, that when strategically applied will attract or repel sexually mature sea lamprey and thereby facilitate their capture as they attempt to enter streams to spawn.

Initial efforts at the Monell Center have been directed at (1) setting up an electrophysiological recording system and a stimulus-delivery system with which to screen chemicals for their effectiveness as olfactory stimuli for the sea lamprey, and (2) devising a behavioral assay to determine if these chemicals that are shown to be effective olfactory stimuli (by electrophysiological testing) will attract or repel sea lamprey. Although gross electrophysiological recordings (EEG) from the olfactory bulbs of fish may be used as an indicator of the effectiveness of an odorant in evoking changes in the ongoing electrical activity of the olfactory system, such recordings do not permit reliable identification of a substance as an attractant or repellent, i.e., the electrical activity of the olfactory bulb is not consistently inhibited by repellents or increased by attractants. However, it is reasonable to predict that substances having a dramatic behavioral effect via the olfactory system will also have a considerable effect on the electrical activity in the olfactory bulb, and hence, the EEG response. Since the EEG recording technique is a relatively simple one, its use permits a large number of substances to be screened quickly. Those substances evoking significant changes in the EEG can then be tested behaviorally to determine if they are attractants or repellents.

To obtain an EEG recording from an adult sea lamprey, the lamprey is immobilized with an intramuscular injection of Flaxedil and rigidly fixed in a plastic trough. The gills are perfused with aerated well water (about 0.5 l/min, 10 C). The olfactory bulbs are exposed by removing the overlying tissue and the exposed tissue is covered with mineral oil to prevent drying. The electrical activity is recorded with stainless steel bipolar electrodes, positioned on the postero-lateral portion of the bulb using a micromanipulator. The electrical activity picked up by these electrodes is led to a high gain differential preamplifier and recorded on magnetic tape or a penwriter. The output of the preamplifier is electronically integrated (time constant of 0.5 sec) to give a measure of the cumulative activity. Quantitative comparisons of responses to various stimuli (and concentrations) are made by measuring the total area under the integrated curve (AC integration) or the amplitude of the DC integrated response. All measurements are taken after a stable maximum response to a standard stimulus (10^{-4}M isoleucine) has been reached by repeated application.

Stimuli are applied to the olfactory epithelium by injecting aliquots of a known volume into a continuously flowing stream of well water (10 C) which perfuses the olfactory epithelium via a small Teflon tube placed in the single naris. Normally, water moves into and out of the olfactory sac by rhythmic movements of the nasopharyngeal pouch provided by respiratory movements. This pouch is continuous with the nasal tube and in the immobilized animal it is necessary to cannulate it with a hypodermic needle to provide an exit for the solutions being perfused into the nose.

The stimulus delivery system is similar to one described in the literature. Constant volumes of stimuli are drawn into glass pipettes and placed in plastic holding tubes, with their tips in one arm of a 3-way stopcock through which the water perfusing the nose is flowing. By switching the stopcocks the stimulus is drawn into the background stream of water and washed over the epithelium. Background water also flows through the plastic holding tubes which form water jackets around the pipettes, equalizing the temperatures of all solutions.

To date preliminary testing has been conducted on feeding-stage lampreys with several substances, including two (L-isoleucine methylester hydrochloride and ethylene diamine; 100 mg/l) known to be strong behavioral attractants in feeding-stage lampreys. Both of these chemicals increase the ongoing activity in the olfactory bulb when applied to the olfactory system. Human saliva, glycine and L-alanine had no consistent effect on the EEG response. These and a variety of other substances, including water in which larvae, adult males, and adult females have resided, will be tested at several concentrations in spawning stage animals when they become available in the spring.

A modification of the apparatus used by Beamish and Neidert for the study of sea lamprey behavior has been constructed and tested. This apparatus consists of a 15-cm × 180-cm acrylic trough into which water

at a constant temperature (10 C) is continuously pumped. The water enters both ends of the trough at 500 ml/min and exists from two drain ports at the center. The lamprey to be tested is placed in the trough and given 30-60 min to acclimate. The position of the lamprey in the trough is then noted every 5 min during six 30-min periods. The first two 30-min periods serve as a control with fresh water entering both ends of the trough. At the beginning of the third 30-min period a stimulus solution (10 C) is pumped into one end of the trough from a reservoir at the same rate that fresh water is entering the other end. The position of the lamprey is again noted at 5-min intervals for the next four 30-min test periods. The data are then analyzed to determine if the lamprey spent significantly more time in the treated end (attractive substance), the untreated end (aversive substance), or showed no preference (ineffective substance).

APPENDIX F

REGISTRATION-ORIENTED RESEARCH ON LAMPRICIDES IN 1976

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Introduction

In 1976, the Fish Control Laboratory completed the registration-oriented research protocol on TFM and submitted petitions for an exemption from the establishment of a tolerance for TFM in fish and water and for an amendment of existing registrations on the use of TFM as a lampricide. The function of the Fish Control Laboratory with regard to TFM is now one of providing technical support to the Fish and Wildlife Service Liaison Officer in his negotiations with the Environmental Protection Agency.

Research on Bayer 73 continued on the original protocol with maximum effort to overcome interference problems in the analytical procedure caused by lipid elements in tissue samples. Good progress was made in most areas. Individual work elements are reported below.

Registration Submission-TFM

A petition proposing an exemption from the establishment of a tolerance for the sodium salt of 3-trifluoromethy1-4-nitrophenol (TFM) in fish and water and a petition for amendment of registration were filed with the Environmental Protection Agency on February 3, 1976 by the U.S. Fish and Wildlife Service. The submission has been designated as Pesticide Petition No. 6E1743 and Food Additive Petition No. 6H5122.

Submission of the petitions represents completion of the TFM research protocol originally contracted to the Fish Control Laboratory by the Commission.

Preliminary comments on the submission were received from William H. Miller of the Environmental Protection Agency on 10/22/76. The Fish and Wildlife Service responded to the items in question and began negotiating clarification of further research needs. Dialogue between the FWS Liaison Officer and the regulatory agency is continuing with favorable results.

Solubility of Bayer 73 at Various pH's

Preliminary investigations show that the solubility of Bayer 73 in water is strongly influenced by pH. Enough Bayer 73, 70% wettable powder, was added to water of pH's 6.5, 7.5, and 8.5 to give a concentration of 10 mg/l if all the Bayer 73 dissolved. After 24 h at room temperature without stirring we found 0.076 mg/l at pH 6.5, 1.97 mg/l at pH 7.5, and 3.76 mg/l at pH 8.5.

Analysis of Bile from TFM-Exposed Goldfish for Sulfate Conjugates

Large goldfish were exposed to a 1-mg/l solution of TFM for 12 h at 19 C and sampled at 0 and 24 h after withdrawal. Five fish were pooled for each sample, and both bile and muscle were collected. Control samples also were collected. Bile was analyzed straight and after hydrolysis with β-glucuronidase and aryl sulfatase. The 0- and 24-h samples contained 1.5 and 0.05 μg/ml, respectively, of free TFM prior to hydrolysis. After hydrolysis with β-glucuronidase we found 280 μg/ml in the 0-h sample and 480 μg/ml in the 24-h samples. After hydrolysis with aryl sulfatase we found 60 μg/ml in the 0-h sample and 92 μg/ml in the 24-h sample. The water phase of the bile samples after solvent extraction was checked with $BaCl^2$ for sulfate, but none had visible sulfate precipitate. The limit of visible sulfate is about 5 mg/l. Aryl sulfatase is usually contaminated with a small amount of glucuronidase. The data indicate that the major residue of TFM in bile is the glucuronide conjugate.

Methods for Analysis of Bayer 73 in Water

Two procedures for the determination of the concentration of Bayer 73 in water have been developed for field use. The procedures are quite similar except one procedure uses acid hydrolysis and color development with N-1-naphthylethylenediamine dihydrochloride and the other uses base hydrolysis and color development with 1-naphthol. Both procedures use chloroform extraction for sample cleanup and concentration. These was no detectable interference to the analysis of Bayer 73 by these methods from the presence of 3-trifluoromethyl-4-nitrophenol (TFM) or phytoplankton. The time required for the analysis ranges from 30 min to 1 h depending on the number of samples to be run and the familiarity of the technician with the procedures. The method is sensitive to 0.01 mg/l of Bayer 73 in water.

The colorimetric methods for the analysis of Bayer 73 in water were demonstrated to the U.S. and Canadian lamprey control personnel, April 13 and 14. The colorimetric method for Bayer 73 analysis was field tested the week of May 9-14 during the treatment of the Cedar River, Michigan for control of sea lamprey. The method worked well, and the concentration found in the river was very close to the calculated concentration of application. During the field testing we found that the standards must be run in the river water to give results comparable to the bioassay results.

Development of Methods for the Analysis of Bayer 73 Residues in Fish

The continued use and registration of Bayer 73 as a lampricide depends on the development of a suitable analytical method for the determination of Bayer 73 in water and in fish plasma, bile, and urine. Suitable methods have been developed and are currently being used. The procedure for the analysis of Bayer 73 in fish muscle involves a loss of Bayer 73 at several steps during the analysis. Much of this can be overcome by using a standard carried through the procedure for constructing a standard curve. Additional loss of Bayer 73 is apparently due to binding with lipids. This loss varies with different species of fish and is related to fat content. This loss can be corrected by the use of standard addition spikes. The present limit of detection for Bayer 73 using this method is 0.005 μg/g (ppm).

This procedure has been used in the analysis of coho salmon which were exposed to Bayer 73 for 12 h and then transferred to fresh water. Muscle residues were determined over a 7-day withdrawal period. Corrected residues ranged from 0.139 μg/g for the 0-h sample to less than 0.005 μg/g after 7 days of withdrawal. Recoveries for the spiked samples in this study averaged 97.6% with SD of 27.6. Average residues in blood plasma ranged from 5.1 mg/l at 0 h to 0.332 mg/l at 168 h of withdrawal. Bile residue ranged from 988 mg/l at 6 h to 189 mg/l at 168 h of withdrawal.

Uptake of Bayer 73 by Fish

Largemouth bass were exposed to 0.05 μg/ml of ^{14}C-labeled 2',5-dichloro-4'nitrosalicylanilide (Bayer 73) for up to 144 h. Fish were removed at 0, 2, 4, 8, 12, 24, 48, 72, and 144 h. Blood, brain, spleen, liver, kidney, bile, and muscle tissue were taken for analysis of

radioactive residues. The residue concentrations generally increased during the 144 h of exposure in all the tissue samples.

Elimination studies were run on largemouth bass exposed to the lampricide for 24 h and transferred to fresh water. Samples were taken for radiometric analysis at 0, 1, 3, 7, 10, and 14 days after termination of the exposure. Residue concentrations declined in most tissues during the 14-day withdrawal period, but the decline was rather slow. The residues in the bile were not significantly reduced during the withdrawal period.

Ultraviolet Decomposition of ^{14}C-Bayer 2353

^{14}C-Bayer 2353 was spotted on silica gel TLC plates and streaked on glass slides. The plates and slides were exposed to UV for up to 7 days. Based on TLC and radiochromatogram scans, about one-half of the parent compound had been degraded within 48 h and nearly all the parent compound was gone within 120 h. There appeared to be at least three degradation products resulting from the UV exposure.

An aqueous solution of ^{14}C-Bayer 2353 buffered at pH 7 was exposed to long-wave UV light for up to 14 days. Small portions were removed at 0, 1, 4, 7, and 14 days and spotted on TLC plates. After 14 days of exposure more than 75% of the parent compound had been degraded based on radiochromatogram scans.

Degradation of ^{14}C-Bayer 2353 in Water

Aqueous solutions of ^{14}C-Bayer 2353 buffered at pH's 5, 7, and 9 were streaked on TLC plates after 26 and 56 days in solution. Development, scanning, and autoradiography showed little degradation up to 56 days.

Field Studies

The two chemicals, TFM and Bayer 73, used in combination to control sea lampreys in large rivers, are being researched to provide data for continued registration with regulatory agencies. The requirements for documenting the persistence of chemicals in the environment necessitated the collection of water, soil, and a variety of organisms from a stream during and after treatment for analysis of Bayer 73 residues.

Sampling adequate numbers of organisms for analysis in large rivers is difficult for several reasons. Power dams on many of the large sea lamprey rivers in Michigan cause violent fluctuations in level and velocity which severely limit numbers and diversity of organisms. Other rivers are simply too deep and too fast for collection of invertebrates.

Others have no adequate sized areas of gravel-rubble bottom which is necessary for a good diversity of invertebrates. Several large rivers in Upper and Lower Michigan were inspected for suitable sampling sites. No suitable areas were found in the rivers scheduled for treatment with the combination in 1967.

At our request, the sea lamprey control crew treated the Ocqueoc River (scheduled for treatment with TFM alone) with the combination to provide the necessary environmental samples. Samples of water, bottom soil, fish, aquatic insects, and other invertebrates were collected at two different stations before, during, and 1, 3, and 7 days after treatment. The samples were frozen after collection and will soon be analyed for residues of Bayer 73.

Technical Services

During the past year, the Fish Control Laboratory continued to provide technical support services to the Sea Lamprey Control Program.

As part of a special charge from the Commission, the Laboratory developed colorimetric methods for the determination of Bayer 73 levels in water. Equipment needed for the procedure was purchased with Commission funds and transferred to the Sea Lamprey Control Program after it was determined that the method was feasible. Demonstration and instruction in conducting the analyses were provided to personnel of the U.S. and Canadian agents at Marquette, Michigan on April 13-14, 1976.

On May 9-14, Messrs. John Allen and Verdel Dawson of the Fish Control Laboratory participated in a treatment of the Cedar River to assist Mr. Zimmerman in resolving problems encountered under field conditions.

Dr. Joseph Hunn and John L. Allen participated in a meeting of the Michigan Water Resources Commission at Escanaba, Michigan on August 26, 1976 at the request of the Sea Lamprey Control Office. The Commission was investigating a fish kill on the Muskegon River.

An improperly labeled shipment of TFM received at the Marquette station was checked for levels of activity and laboratory reports were filed to indicate that two items on the label had been reversed.

Contract Work

Investigation of Liquid-Liquid and Gel Permeation Chromatography for Bayer 73 Residue Analysis

A special contract was let to Analytical Bio-Chemistry Laboratories, Inc. to determine if liquid-liquid or gel permeation chromato-

graphy could be used to overcome problems caused by lipids in the cleanup and analysis of Bayer 73 residues.

After 6 months of study, ABC Laboratories reported that none of the methods tried yielded adequate cleanup for the detection of Bayer 73 residues in fish tissues. Consultations with ABC personnel and a review of their laboratory data has convinced us that liquid-liquid or gel permeation chromatography holds no potential for resolving the problems associated with lipids. Despite the negative findings, the research has eliminated the need to pursue research in the area concerned and has yielded information on techniques that will be useful in related analytical problems.

Radioimmune Assay for Bayer 73 Residue Analysis

A contract was let to Dr. John Lech of the Medical College of Wisconsin-Milwaukee to explore the potential application of the radioimmune assay technique for Bayer 73 residue determinations. Preliminary results were encouraging and Dr. Roa of Endocrine Laboratories in Madison, Wisconsin has begun work in conjunction with Dr. Lech. Work will continue into 1977.

Literature on TFM and Bayer 73

Bills, T. D., and L. L. Marking. 1976. Toxicity of 3-trifluoromethyl-4-nitrophenol (TFM), 2', 5-dichloro-4'-nitrosalicylanilide (Bayer 73), and a 98:2 mixture to fingerlings of seven fish species and to eggs and fry of coho salmon. U.S. Fish and Wildlife Service, Investigations in Fish Control No. 69. 11 pp.

Christianson, G. G. 1976. Removal of 3-trifluoromethyl-4-nitrophenol from media by microorganisms. M.S. Thesis. University of Wisconsin-La Crosse, La Crosse, Wisc. 38 pp.

Dawson, V. K., L. L. Marking, and T. D. Bills. 1976. Removal of toxic chemicals from water with activated carbon. Transactions of the American Fisheries Society 105(1):119-123.

Maki, A. W., and H. E. Johnson. 1976. The freshwater mussel (*Anodonta* sp.) as an indicator of environmental levels of 3-trifluoromethyl-4-nitrophenol (TFM). U.S. Fish and Wildlife Service, Investigations in Fish Control No. 70. 7 pp.

Maki, A. W., and H. E. Johnson. 1976. Evaluation of a toxicant on the metabolism of model stream communities. Journal of the Fisheries Research Board of Canada 33(12):2740-2746.

Menzie, C. M., and J. B. Hunn. 1976. Chemical control of the sea lamprey: the addition of a chemical to the environment. Pages 1–14 *in* F. Coulston and F. Korte, eds. Environmental Quality and Safety, Volume 5. Georg Thieme Verlag, Stuttgart.

Meyer, F. P., R. A. Schnick, K. B. Cumming, and B. L. Berger. 1976. Registration status of fishery chemicals, February 1976. The Progressive Fish-Culturist 38(1):3–7.

Rye, R. P., Jr., and E. L. King, Jr. 1976. Acute toxic effects of two lampricides to twenty-one freshwater invertebrates. Transactions of the American Fisheries Society 105(2):322-326.

Sills, J. B., and J. L. Allen. 1976. Residues of 3-trifluoromethyl-4-nitrophenol (TFM) undetected in lake trout and chinook salmon from the upper Great Lakes. The Progressive Fish-Culturist 38(4):197.

Statham, C. N., and J. J. Lech. 1976. Studies on the mechanism of potentiation of the acute toxicity of 2,4-D n-butyl ester and 2',5-dichloro-4'-nitrosalicylanilide in rainbow trout by carbaryl. Toxicology and Applied Pharmacology 36(2):281–296.

Statham, C. N., M. J. Melancon, Jr., and J. J. Lech. 1976. Bioconcentration of xenobiotics in trout bile: a proposed monitoring aid for some waterborne chemicals. Science 193(4254):680–681.

APPENDIX G

ADMINISTRATIVE REPORT FOR 1976

Meetings. The Commission held its 1976 Annual Meeting in Traverse City, Michigan June 15-16, 1976, and its Interim Meeting in Ann Arbor, Michigan on December 14-15, 1976. The Commission also held executive meetings of Commissioners and staff as follows: April 7 (Ann Arbor, Michigan), June 14, 16 (Traverse City, Michigan), September 14, (Ann Arbor, Michigan), and December 13, 15 (Ann Arbor, Michigan). In addition, the U.S. Section of the Commission held an executive meeting on December 2, 3 (Washington, D. C.) and December 13 (Ann Arbor, Michigan) and a plenary session in conjunction with the Annual Meeting in Traverse City, June 16, 1976. The Canadian Section also met at the same time during the Annual Meeting. The Great Lakes Fishery Commission also met with the International Joint Commission in Fort Erie, Ontario, on March 3 to discuss items of mutual interest. Meetings of Standing Committees during 1976 were:

Lake Ontario Committee, Toronto, Ontario, March 9–10
Lake Erie Committee, Toronto, Ontario, March 10–11
Combined Upper Great Lakes, Milwaukee, Wisconsin, February 24–25
Lake Superior, Milwaukee, Wisconsin, February 24–25
Lake Huron, Milwaukee, Wisconsin, February 24–25
Lake Michigan, Milwaukee, Wisconsin, February 24–25
Sea Lamprey Control and Research Committee, Ann Arbor, Michigan, April 6
Great Lakes Fish Disease Control Committee, Traverse City, Michigan, June 13
Finance and Administration Committee, Traverse City, Michigan, June 13
Scientific Advisory Committee:
Traverse City, Michigan, June 14
Ann Arbor, Michigan, December 13–14

Officers and Staff. At the close of the 1976 Annual Meeting, the Commission elected Mr. L. P. Voigt, Chairman, and Dr. C. J. Kerswill, Vice-Chairman, for two-year terms. At several Commission meetings, Mr. J. H. Hemphill sat in as an alternate for Mr. N. P. Reed. Internal Committee assignments established in June 1974 remained unchanged through 1976 and were as follows:

Scientific Advisory Committee (SAC)
F. E. J. Fry, Chairman
W. M. Lawrence

Finance and Administration Committee (F&A)
L. P. Voigt, Chairman
N. P. Reed
E. W. Burridge
K. H. Loftus

Sea Lamprey Control and Research Committee (SLCR)
W. M. Lawrence, Chairman
L. P. Voigt
C. J. Kerswill
K. H. Loftus

Management and Research Committee (M&R)
C. J. Kerswill, Chairman
F. E. J. Fry
N. P. Reed
Claude Ver Duin

Changes in Commission staff in 1976 included the retirement of Walter R. Crowe, part-time Administrative Assistant, in September, and the employment of Jane Herbert as part-time Fishery Biologist, in December. There were no other changes in staff.

Staff activities. The Commission's staff (Secretariat) performs several major functions. The Secretariat provides assistance to the standing committees for all phases of the Commission's program. On behalf of the Commission it provides liaison with agencies and individuals with whom the Commission deals, including assistance in coordinating fishery programs, planning meetings, arranging the presentation of reports, and preparation of minutes. The Secretariat provides direct assistance to the Commission in program development and acts on behalf of the Commission as circumstances may require. During 1976 the staff participated in conferences, meetings, and activities sponsored by:

Lake Michigan Study Group
Lake Erie Walleye Management-Scientific Protocol Committee
Lake Superior Advisory Committee
Great Lakes Commission
State Fish and Game Directors and National Marine Fisheries Service Meeting
American Fisheries Society
Michigan Sea Grant
Eastland Fisheries Survey
International Joint Commission (IJC) Annual Meeting

IJC Research Advisory Board
IJC Water Quality Objectives Subcommittee
IJC Scientific Basis for Water Quality Criteria Committee
IJC Implementation Committee
IJC Environmental Mapping Workshop
American Institute of Fishery Research Biologists, Great Lakes Division
Midwest Fish and Wildlife Conference
International Association for Great Lakes Research
Effluent Standards and Water Quality Information Advisory Committee of EPA
Interagency Lake Trout Assessment Subcommittee
Sea Lamprey Conference
Great Lakes Basin Commission
U.S. Fish and Wildlife Service Ichthyoplankton Workshop
International Fishery Commissions Pension Society
Public Hearing, Washburn, Wisconsin regarding Fish Refuge
Ontario Ministry of Natural Resources Workshop on Management of Lake Erie Fisheries
Canada-U.S. University Seminar on Improving Management of the Great Lakes
National Water Pollution Control Federation

Accounts and Audit. The Commission accounts for the fiscal year ending June 30, 1976 and the transitional period July 1-September 31, 1976 were audited by Icerman, Johnson, and Hoffman of Ann Arbor. The firm's reports are appended.

Scientific Advisory Committee. In response to the recommendations of the "G.F.M. Committee on Commission Function and Structure," in 1976 the Commission enlarged its Scientific Advisory Committee from 6 members to 12. The Scientific Advisory Committee now consists of the following (new members in italics):

Canada	United States
Commissioner F. E. J. Fry, Chairman	Commissioner W. M. Lawrence
F. W. H. Beamish	*A. M. Beeton*
G. R. Francis	*N. Kevern*
M. G. Johnson	J. H. Kutkuhn
A. H. Lawrie (Convenor)	*J. J. Magnuson*
H. A. Regier	S. H. Smith
J. Watson	D. A. Webster

Program and Budget for Fiscal Year 1976. At the 1975 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1976 estimated to cost $4,128,300. The program called for continuation of sea lamprey control on Lakes Superior, Michigan, Huron, and Ontario; continuation of sea lamprey research at Hammond Bay Biological Station and registration-oriented studies on lampricides through the Fish Control Laboratories, La Crosse, Wisconsin; establishment of a sea lamprey survey capability for Lake Erie (the only Great Lake without sea lamprey control); and another attempt to initiate a sea lamprey barrier dam project to reduce future costs of lampricide treatments and improve sea lamprey control in difficult-to-treat streams. A budget of $129,200 was adopted for administration and general research.

Subsequently, the program for sea lamprey control and research was revised to match reduced appropriations provided by the U.S. government, including deferral of the sea lamprey barrier dam program. Final funding for fiscal year 1976 was as follows:

	U.S.	Canada	Total
Sea Lamprey Control and Research	$2,613,400	$1,160,700	$3,774,100
Administration and General Research	64,600	64,600	129,200
Total	$2,678,000	$1,225,300	$3,903,300[1]

Sea lamprey control and research in Canada in fiscal year 1976 was carried out under agreement with the Canadian Department of Environment ($881,100) and the U.S. Fish and Wildlife Service ($1,753,000). In addition, the Commission contracted with Chemagro Agricultural Division of Mobay Chemical Corporation and with the North American subsidiaries of Farbewerke Hoechst Ag. to purchase lampricides worth about near $1.1 million. At the end of the fiscal year, the Canadian agent had an overexpenditure of $13,000 which was absorbed by the Canadian government. The refund from the U.S. agent for fiscal year 1976 was included with the refund from the transitional period—$46,172: these monies were used to purchase supplemental lampricides.

Program and Budget for Transitional Period (July 1-September 30, 1976). After notification that the U.S. fiscal year was being changed in 1976 to begin on October 1 rather than July 1, the Commission submitted a budget request of $1,191,000 (U.S. only) for the transitional period. Following negotiation with the State Department, who had unilaterally submitted a lesser budget, a final budget of $1,182,700 was adopted; the additional funding was obtained through a supplemental appropriations bill. Funding was as follows:

	U.S. only
Sea Lamprey Control and Research	$1,163,950
Administration and General Research	18,750
	$1,182,700[1]

Sea Lamprey control and research in the U.S. during the transitional period was carried out under agreement with the U.S. Fish and Wildlife Service ($610,315). In addition, the Commission contracted with the U.S. subsidery of Farbewerke Hoeschst Ag. to purchase 87,630

[1]Includes supplementary contributions totalling $43,500 (U.S. $30,000, Canada $13,500) to partially cover cost-of-living increases to employees of the Commission's U.S. agent.

[1]Includes $17,000 for cost-of-living increase to the U.S. agent.

pounds of TFM at $5.79 per pound. The Commission also purchased from the Chemagro Agricultural Division of Mobay Chemical Corporation some 20,000 pounds of Bayluscide 5% granules at $1.10 per pound. The Commission also held $25,000 in reserve for contingency funding for registration-oriented studies on lampricides. At the end of the transitional period, the U.S. Fish and Wildlife Service refunded $46,172 in unexpended funds from fiscal year 1976 & the transitional period which were used to purchase supplemental lampricides.

Program and Budget for Fiscal Year 1977. At the 1975 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1977 estimated to cost $4,375,400. The program calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate sea lamprey infested streams on Lake Erie, the operation of assessment weirs on Lakes Superior and Huron, continuing research to improve present control techniques, including biological controls, and a new project to build barrier dams on selected streams to prevent sea lamprey access to problem areas, improving lamprey control and reducing the use of expensive lampricides and application costs. A budget of $150,000 was adopted for administration and general research for a total program cost of $4,525,400.

Following revisions to adjust to changes in proposed contributions by the governments, including deferral of the proposed construction of barrier dams, the Commission proceeded with the following program for sea lamprey control and research on a budget of $4,300,300.

The Canadian agent has scheduled treatments of 25 tributaries to their waters of the Great Lakes and 6 tributaries in the State of New York. Several problem areas involving major applications of granula Bayer 73 also are scheduled. In addition, an assessment barrier network of 5 units will be operated on selected Lake Huron tributaries and stream surveys to monitor larval lamprey populations will be continued.

The U.S. agent has scheduled 66 lampricide treatments; 19 tributaries to Lake Superior, 32 to Lake Michigan, and 15 to Lake Huron. The continued operation of the eight assessment barriers on Lake Superior tributaries and the device on the Ocqueoc River, a tributary to Lake Huron, is planned. The U.S. agent also will maintain stream surveys to monitor larval lamprey populations, will maintain studies on the growth and time to metamorphosis of selected larval populations, and also will continue the project initiated in fiscal year 1976 to assess the possible contribution of sea lampreys from the Oswego River-Finger Lakes system to the parasitic stocks of Lake Ontario.

The current sea lamprey research program at the Hammond Bay Biological Station and the registration-oriented work at the Fish Control Laboratories, La Crosse, Wisconsin, are to continue through fiscal year 1977.

The Commission negotiated a Memorandum of Agreement with its U.S. agent, the U.S. Fish and Wildlife Service, for work involving

$2,127,830 and expects to provide lampricides valued at $692,070. A Memorandum of Agreement has also been executed which provides the Commission's Canadian agent, the Department of Environment, with $1,335,400 which includes lampricides valued at $400,400. The Commission also held $75,000 in reserve for contingency funding for registration-oriented research on lampricides. In addition, the Commission reviewed its Administration and General Research budget for fiscal year 1977. The funding by government for fiscal year 1977 is as follows:

	U.S.	Canada	Total
Sea Lamprey Control and Research	$2,982,700	$1,317,600	$4,300,300
Administration and General Research	75,000	75,000	150,000
Total	$3,057,700	$1,392,600	$4,450,300[1]

Program and Budget for Fiscal Year 1978. At the 1976 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1978 estimated to cost $4,349,570. The program calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate sea lamprey infested streams on Lake Erie, continuing field research in direct support of control operations, the operation of assessment weirs on Lakes Superior and Huron, continuing research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, including biological controls, and another effort to initiate building of barrier dams on selected streams to prevent sea lamprey access to problem areas, thus reducing the use of expensive lampricides and application costs. A budget of $206,060 was adopted for administration and general research for a total program cost of $4,555,600 of which $3,104,200 is being requested from the U.S. Government and $1,451,400 from Canada.

Reports and Publications. In 1976, the Commission published an Annual Report for 1974 and a policy statement of lake trout rehabilitation titled "Position on lake trout rehabilitation, a policy statement of the Great Lakes Fishery Commission adopted June 14, 1976."

[1]Includes supplementary contribution totalling $50,000 to partially cover cost-of-living increases to employees of the Commission's U.S. agent.

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Great Lakes Fishery Commission
Ann Arbor, Michigan

We have examined the accompanying balance sheets of Great Lakes Fishery Commission as of September 30, 1976, and the related statements of revenues and expenditures and encumbrances, changes in encumbrances and fund balances, and source and application of funds for the three months then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the financial statements mentioned above present fairly the financial position of Great Lakes Fishery Commission at September 30, 1976, and the results of its operations and changes in its financial position for the three months then ended, in conformity with generally accepted accounting principles applied on a basis consistent with the preceding year.

Icerman, Johnson & Hoffman

Ann Arbor, Michigan
November 30, 1976

Great Lakes Fishery Commission
Balance Sheets
June 30, 1976

	Administration and General Research Fund	*Sea Lamprey Contral and Research Fund*	*Total*
Assets			
Cash in bank	$17,383	421,961	439,344
Accounts receivable	-0-	150,749	150,749
	$17,383	572,710	590,093
Liabilities and Fund Balance			
Current Liabilities			
Accounts payable	$ 587	71,979	72,566
Accrued wages	3,328	-0-	3,328
	3,915	71,979	75,894
Encumbrances (Note 2)	-0-	107,249	107,249
Fund Balance	13,468	393,482	406,950
	$17,383	572,710	590,093

See notes to financial statements on page 120.

Great Lakes Fishery Commission
Statement of Revenues and Expenditures and Encumbrances
Year Ended June 30, 1976

Administration and General Research Fund

	Budget	*Actual*	*Over or (Under) Budget*
Revenues			
Canadian government	$ 64,600	64,600	-0-
United States government	64,600	64,600	-0-
Miscellaneous	-0-	1,497	1,497
	129,200	130,697	1,497
Expenditures and Encumbrances			
Salaries	83,400	85,953	2,553
Fringe benefits	10,220	17,093	6,873
Research	11,000	10,394	(606)
Travel	6,880	11,103	4,223
Communications	1,500	2,217	717
Rents and utilities	1,300	1,152	(148)
Printing and reproduction	10,000	8,984	(1,016)
Other contractual services	1,700	-0-	(1,700)
Supplies	1,700	4,144	2,444
Equipment	1,500	425	(1,075)
	129,200	141,465	12,265
Excess of expenditures and encumbrances over revenues	$ -0-	10,768	10,768

See notes to financial statements on page 120.

Great Lakes Fishery Commission
Statement of Revenues and Expenditures and Encumbrances
Year Ended June 30, 1976

Sea Lamprey Control and Research Fund.

	Budget	*Actual*	*Over or (Under) Budget*
Revenues			
Canadian government:			
Operating revenues	$1,147,200	1,226,400	79,200
Cost of living increase	-0-	13,500	13,500
United States government:			
Operating revenues	2,553,000	2,583,400	30,400
Refund for unexpended funds (Note 3)	-0-	138,597	138,597
Cost of living increase	-0-	30,000	30,000
Interest	-0-	43,927	43,927
	3,700,200	4,035,824	335,624
Expenditures and Encumbrances			
Canadian Department of the Environment	881,100	960,300	79,200
United States Fish and Wildlife Service	1,753,060	1,760,309	7,249
Lampricide purchases (Note 2)	933,040	1,256,509	323,469
Special studies	75,000	3,840	(71,160)
Building rentals	58,000	-0-	(58,000)
	3,700,200	3,980,958	280,758
Excess of revenues over expenditures and encumbrances	$ -0-	54,866	54,866

See notes to financial statements on page 120.

Great Lakes Fishery Commission
Statements of Changes in Encumbrances and Fund Balances
Year Ended June 30, 1976

Administration and General Research Fund

	Encumbrances	*Fund Balance*
Balances, July 1, 1975	$ -0-	11,236
Excess of revenues over expenditures and encumbrances	-0-	(10,768)
Transfer from the Sea Lamprey Control and Research Fund	-0-	13,000
Balances, June 30, 1976	$ -0-	13,468
Sea Lamprey Control and Research Fund		
Balances, July 1, 1975	$ 89,808	351,616
Excess of revenues over expenditures and encumbrances	-0-	54,866
Prior year encumbrances paid	(89,808)	-0-
Outstanding encumbrances applicable to the 1975-76 budget	107,249	-0-
Transfer to the Administration and General Research Fund	-0-	(13,000)
Balances, June 30, 1976	$107,249	393,482

See notes to financial statements on page 120.

Great Lakes Fishery Commission
Statements of Source and Application of Funds
Year Ended June 30, 1976

	Administration and General Research Fund	*Sea Lamprey Control and Research Fund*	*Total*
Source of Commission Funds			
Revenues:			
Actual	$130,697	4,035,824	4,166,521
Non-budget transfers	13,000	-0-	13,000
	143,697	4,035,824	4,179,521
From reduction in assets:			
Cash	1,290	-0-	1,290
Prepaid expenses	520	-0-	520
From increasing liabilities:			
Accounts payable	-0-	18,524	18,524
Accrued wages	1,729	-0-	1,729
Encumbrances at June 30, 1976	-0-	107,249	107,249
	$147,236	4,161,597	4,308,833
Application of Commission Funds			
Expenditures			
Actual	$141,465	3,980,958	4,122,423
Non-budget transfers	-0-	13,000	13,000
	141,465	3,993,958	4,135,423
Expenditures for items encumbered June 30, 1975	-0-	89,808	89,808
To increase in assets:			
Cash	-0-	25,660	25,660
Accounts receivable	-0-	52,171	52,171
To reduction in liabilities:			
Accounts payable	5,771	-0-	5,771
	$147,236	4,161,597	4,308,833

See notes to financial statements on page 120.

Great Lakes Fishery Commission

Notes to Financial Statements
June 30, 1976

Note 1. *Significant Accounting Policies*
All amounts appearing on the financial statements are in United States dollars.

The books of account for the Commission are maintained on a modified accural basis of accounting. Revenues are recognized when received except that balances of budgeted receipts that have been promised by the Canadian or United States governments are set up as receivables at June 30, 1976.

Inventories, equipment and related property items are expensed as they are purchased.

The cash balances for both funds operate from two bank accounts, one checking account and one savings account. Therefore, at any point in time, the bank accounts are each composed partly of the Administration and General Research Fund and partly of the Sea Lamprey Control and Research Fund.

The commission changed its year end to September 30, effective September 30, 1976, to correspond with the change in the United States government's fiscal year.

Note 2. *Budgeted Encumbrances*
Unused funds at year-end are set up as encumbrances and charged to expenses. At June 30, 1976, these funds from the United States Government consist of $107,249 which are encumbered for lapricide purchases and research in the Sea Lamprey Control and Research Fund.

Note 3. *Sea Lamprey Control and Research Fund Revenues*
The refund from the United States government includes re funds for the year ended June 30, 1975, which were $31,348 in exess of the amounts believed to be refundable.

Note 4. *Federal Income Taxes*
The Great Lakes Fishery Commission is exempt from federal income taxes under Sec. 501(c)(1) of the Internal Revenue Code.

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Great Lakes Fishery Commission
Ann Arbor, Michigan

We have examined the accompanying balance sheets of Great Lakes Fishery Commission as of June 30, 1976, and the related statements of revenues and expenditures and encumbrances, changes in encumbrances and fund balances, and source and application of funds for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the financial statements mentioned above present fairly the financial position of Great Lakes Fishery Commission at June 30, 1976, and the results of its operations and changes in its financial position for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with the preceding year.

Icerman, Johnson & Hoffman

Ann Arbor, Michigan
November 30, 1976

Great Lakes Fishery Commission
Balance Sheets
September 30, 1976

	Administration and General Research Fund	*Sea Lamprey Control and Research Fund*	*Total*
Assets			
Cash in bank	$17,381	1,186,083	1,203,464
Accounts receivable	-0-	219,932	219,932
	$17,381	1,406,015	1,423,396
Liabilities and Fund Balance			
Current Liabilities			
Accounts payable	$ 469	-0-	469
Accrued wages	1,782	-0-	1,782
	2,251	-0-	2,251
Encumbrances (Note 2)	-0-	219,932	219,932
Fund Balance	15,130	1,186,083	1,201,213
	$17,381	1,406,015	1,423,396

See notes to financial statements on page 127.

Great Lakes Fishery Commission
Statement of Revenues and Expenditures and Encumbrances
Three Months Ended September 30, 1976

Administration and General Research Fund

	Budget	*Actual*	*Over or (Under) Budget*
Revenues			
Canadian government (Note 1)	$18,750	18,750	-0-
United States government	18,750	18,750	-0-
Miscellaneous	-0-	65	65
	$37,500	37,565	65
Expenditures and Encumbrances			
Salaries	$24,475	23,908	(567)
Fringe benefits	5,725	2,408	(3,317)
Research and other contractual services	700	6,280	5,580
Travel	4,200	1,570	(2,630)
Communications	600	250	(350)
Printing and reproduction	800	469	(331)
Supplies	800	1,018	218
Equipment	200	-0-	(200)
	$37,500	35,903	(1,597)
Excess of expenditures and encumbrances over revenues	$ -0-	1,662	(1,662)

See notes to financial statements on page 127.

Great Lakes Fishery Commission
Statement of Revenues and Expenditures and Encumbrances
Three Months Ended September 30, 1976

Sea Lamprey Control and Research Fund

	Budget	*Actual*	*Over or (Under) Budget*
Revenues			
Canadian government (Note 1):			
Operating revenues	$ 717,200	739,450	22,250
United States government:			
Operating revenues	1,163,950	1,163,950	-0-
Refund for unexpended funds	-0-	112,683	112,683
Interest	-0-	19,516	19,516
	1,881,150	2,035,599	154,449
Expenditures and Encumbrances			
Canadian Department of the Environment (Note 1)	520,000	520,000	-0-
United States Fish and Wildlife Service	610,315	604,998	(5,317)
Lampricide purchases (Note 2)	725,835	74,000	(651,835)
Special studies (Note 2)	25,000	44,000	19,000
	1,881,150	1,242,998	(638,152)
Excess of revenues over expenditures and encumbrances	$ -0-	792,601	792,601

See notes to financial statements on page 127.

Great Lakes Fishery Commission
Statements of Changes in Encumbrances and Fund Balances
Three Months Ended September 30, 1976

Administration and General Research Fund

	Encumbrances	*Fund Balance*
Balances, July 1, 1976	$ -0-	13,468
Excess of revenues over expenditures and encumbrances	-0-	1,662
Balances, September 30, 1976	$ -0-	15,130

Sea Lamprey Control and Research Fund

Balances, July 1, 1976	$107,249	393,482
Excess of revenues over expenditures and encumbrances	-0-	792,601
Outstanding encumbrances applicable to the 9-30-76 budget	112,683	-0-
Balances, September 30, 1976	$219,932	1,186,083

See notes to financial statements on page 127.

Great Lakes Fishery Commission
Statements of Source and Application of Funds
Three Months Ended September 30, 1976

	Administration and General Research Fund	*Sea Lamprey Control and Research Fund*	*Total*
Source of Commission Funds			
Revenues:			
Actual	$37,565	2,035,599	2,073,164
Non-budget transfers	-0-	-0-	-0-
	37,565	2,035,599	2,073,164
From reduction in assets:			
Cash	2	-0-	2
Encumbrances at September 30, 1976	-0-	112,683	112,683
		2,148,282	2,185,849
Application of Commission Funds			
Expenditures			
Budget	$35,903	1,242,998	1,278,901
Non-budget transfers	-0-	-0-	-0-
	$35,903	1,242,998	1,278,901
To increase in assets:			
Cash	-0-	764,122	764,122
Accounts receivable	-0-	69,183	69,183
To reduction in liabilities:			
Accrued wages	1,546	-0-	1,546
Accounts payable	118	71,979	72,097
	$37,567	2,148,282	2,185,849

See notes to financial statements on page 127.

Great Lakes Fishery Commission

Notes to Financial Statements
September 30, 1976

Note 1. *Significant Accounting Policies*

The Commission has adopted a new fiscal year end. The fiscal year end is now September 30 instead of June 30, to correspond with the change in the United States government fiscal year.

The Canadian agency did not change its fiscal year so that amounts budgeted for Canadian revenue and expenses represents approximately 54% of the 1976-77 fiscal year budget. This per cent was used because as of September 30, 1976, the Commission had received 54% of the total amount budgeted from the Canadian government for the next fiscal year.

All amounts appearing on the financial statements are in United States dollars.

The books of account for the Commission are maintained on a modified accrual basis of accounting. Revenues are recognized when received except that balances of budgeted receipts that have been promised by the Canadian or United States governments are set up as receivables at September 30, 1976.

Inventories, equipment and related property items are expensed as they are purchased.

The cash balances for both funds operate from two bank accounts, one checking account and one savings account. Therefore, at any point in time, the bank accounts are each composed partly of the Administration and General Research Fund and partly of the Sea Lamprey Control and Research Fund.

Note 2. *Budgeted Encumbrances*

Unused funds at year-end are set up as encumbrances and charged to expenses. At September 30, 1976, these funds from the United States Government consist of $219,932 which are encumbered for lapricide purchases and research in the Sea lamprey Control and Research Fund.

Note 3. *Federal Income Taxes*

The Great Lakes Fishery Commission is exempt from federal income taxes under Sec. 501(c)(1) of the Internal Revenue Code.

COMMITTEE MEMBERS — 1976

[Commissioners in Italics]

SCIENTIFIC ADVISORY COMMITTEE

CANADA	UNITED STATES
F. E. J. Fry,.Chm.	*W. M. Lawrence*
F. W. H. Beamish	A. M. Beeton
G. R. Francis	N. Kevern
M. G. Johnson	J. H. Kutkuhn
A. H. Lawrie (Convenor)	J. J. Magnuson
H. A. Regier	S. H. Smith
J. Watson	D. A. Webster

SEA LAMPREY CONTROL AND RESEARCH

CANADA	UNITED STATES
C. J. Kerswill	*W. M. Lawrence*, Chm.
K. H. Loftus	*L. P. Voigt*
J. J. Tibbles	A. L. McLain

MANAGEMENT AND RESEARCH COMMITTEE

CANADA	UNITED STATES
C. J. Kerswill, Chm.	*C. Ver Duin*, Chm.
F. E. J. Fry	*N. P. Reed*
R. M. Christie	M. Conlin
D. E. Gage	D. L. Haney
W. Hendry	E. Kinney
A. Holder	W. A. Pearce
J. J. Tibbles	J. A. Scott
	C. W. Threinen

FINANCE AND ADMINISTRATION COMMITTEE

CANADA	UNITED STATES
E. W. Burridge, Chm.	*L. P. Voigt*
K. H. Loftus	*N. P. Reed*

LAKE COMMITTEES

LAKE HURON

J. A. Scott, Chm.
R. M. Christie, V-Chm.

LAKE ONTARIO

W. A. Pearce, Chm.
D. E. Gage, V-Chm.

LAKE MICHIGAN

C. W. Threinen, Chm.
M. W. Conlin, V-Chm.
R. Hollingsworth
H. J. Vondett

LAKE SUPERIOR

W. Hendry, Chm.
J. A. Scott, V-Chm.
C. R. Burrows
C. W. Threinen

LAKE ERIE

D. L. Haney, Chm.
A. Holder, V-Chm.
N. E. Fogle
D. R. Graff
W. Shepherd