ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1973

GREAT LAKES FISHERY COMMISSION

MEMBERS – 1973

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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

1973

1451 Green Road
ANN ARBOR, MICHIGAN,
U. S. A.
1975

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 1973.

Respectfully,

W. M. Lawrence, *Chairman*

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ANNUAL REPORT FOR 1973

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 18 years. Its efforts to control the sea lamprey and reestablish lake trout have, in the main, been very successful although inherent problems remain.

With sea lamprey control and lake trout rehabilitation having attained operational status, the Commission now seeks to devote greater attention to other problems of vital and immediate concern.

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 gratified with the spirit of inter-agency cooperation that has developed, and anticipates continued cooperation for the benefit of the fisheries resource and its users. The following statement was developed in collaboration with Great Lakes agencies to define objectives and needs for the wise management of the fisheries resources of the Great Lakes basin:

A MANAGEMENT POLICY FOR GREAT LAKES FISHERIES

Recognizing the benefits to be derived from successful international management of present and potential fishery resources of the Great Lakes, the Great Lakes Fishery Commission has developed, in conjunction with its United States and Canadian sections, this statement of policy, needs, and objectives. The statement is identified with the Commission because of the Commission's international mandate;

the statement itself, however, is based on contributions from all State, Provincial, and Federal agencies that assist the Commission in the performance of its duties.

The Great Lakes Fishery Commission recognizes with some pride the progress of its program, and is especially gratified at the close working relationships that have developed among the several participating agencies.

The sea lamprey has been brought to the point of control, and the rehabilitation of devastated fish communities has been initiated in each of the Great Lakes.

During the 19 years of the Commission's existence, social and economic conditions have changed markedly. The economic importance of the Great Lakes was recognized at the outset; indeed the Commission would not otherwise have been organized. Now the Great Lakes are regarded as a major recreational resource the demand for which has increased tremendously during the Commission's existence. Also, the value of these lakes as a source of food may increase more quickly than anticipated.

We have learned, slowly but surely, that exploitation of fish stocks must be more carefully and precisely tuned to the ecological status of those stocks if violent fluctuations in abundance and the attendant social and economic disruptions are to be avoided.

We have learned that high-quality habitat is vital to high-quality fish communities. We have witnessed the loss of both in certain areas throughout the Great Lakes. The threat remains, although major programs to reclaim or maintain environmental quality exist.

New species as invaders or introductions can have dramatic or subtle effects on native fish communities. These effects may be detrimental or beneficial; they are difficult to measure and sometimes impossible to control in management programs. The sea lamprey, which has been of consuming interest to the Commission, is a prime example. Other non-native species, notably the rainbow trout and the brown trout, have proved valuable additions to the fish fauna of the Great Lakes. The Commission and its cooperating agencies must learn how to restructure fish communities effectively.

The following definition developed by the U.S. Marine Fisheries Advisory Committee is appropriate: "Good fisheries management is a continuing, experimental process that is concerned with the assessment, protection, and utilization of living aquatic resources in a manner that provides the greatest benefits to society. This involves developing basic policies and assessing the allocation and priorities among user groups. Fisheries management includes: the application of results from researches in biologic, economic, legal, institutional, and social aspects of fisheries together with continuing monitoring and evaluation of effects of such applications; development of fisheries technology; improvement of statistical and educational programs; and the development and enforcement of regulations designed to protect and enhance living aquatic resources and to aid in their utilization."

To attain the objectives outlined in the foregoing definition, the Commission directs attention to the following (no priority is implied):

1. The need to increase efforts in monitoring the status of fish stocks, the levels of exploitation, and habitat conditions.
2. The need to increase efforts in research designed to define more precisely the capacity of stocks to accommodate to the major stresses of special concern and, where appropriate, increase or quicken rehabilitation efforts.
3. The need to resolve common-property problems and develop means of control of all users to permit large-scale experimental management.

4. The need to maintain and intensify present methods of sea lamprey control and to develop and test other methods.
5. The need to develop close liaison with other resource management agencies that deal with environmental quality and land use to ensure:
   a. That fishery resources receive full consideration in the planning and decision-making process.
   b. That fish communities are recognized as suitable indicators of environmental quality.
6. The need to develop a program to monitor and control fish diseases within the Great Lakes Basin.
7. The need to develop and support mechanisms for the resolution of fish management problems that arise between jurisdictional agencies. In this regard, the Commission should provide technical assistance and encourage the exchange of proposals and information between concerned agencies until negotiated settlements are reached.
8. The need to establish a means whereby the Executive levels of Federal, State, and Provincial Governments may be apprized of the imperative for satisfying the foregoing needs.

Cooperating agencies are encouraged to reexamine their commitments and to seek means of achieving greater levels of effectiveness within their waters. The potential benefits assuredly are great.

The Commission's Annual Meeting was held in Ottawa, Ontario, June 19-21, 1973 and its Interim Meeting Convened in Ann Arbor, Michigan, December 4-5, 1973.

ANNUAL MEETING

PROCEEDINGS

The eighteenth Annual Meeting of the Great Lakes Fishery Commission was held in Ottawa, Ontario, June 19-21, 1973.

Mr. K. C. Lucas, Senior Assistant Deputy Minister, Fisheries and Marine Service, Department of the Environment of Canada, welcomed the Commission to Ottawa. He commended the Commission for its progress to date, and cited its programs as models of international cooperation. He urged the Commission to devote increasing attention to achieving optimum sustained productivity of fish stocks of common interest. Finally he suggested reexamination of the terms of the Convention to determine if revisions might be in order to provide an "alternative framework within which the many fishery experts associated with the Great Lakes could contribute in an even more spectacular fashion in the years ahead."

Thereafter, the Commission unanimously adopted resolutions recognizing the contributions made by Hjalmar O. Swenson, Minnesota Department of Natural Resources, and Willis King and Travis Roberts, Bureau of Sport Fisheries and Wildlife who were retiring.

In his report to the Commission and delegates, the Chairman reviewed the Commission's duties as outlined in the Convention. He stated that the order in which duties were listed was purposeful. Sea lamprey control (No. 4) was recognized as a crisis demanding immediate attention, but No. 1, the need "to make possible the maximum sustained productivity of any stock of fish in the Convention area . . ." was regarded as of paramount importance. He alluded to the problems of environmental deterioration, contaminants, unstable fisheries, and the inevitable social problems when a resource is shared by two countries, eight states, and one province. He emphasized the need for obtaining accurate and detailed information on fish stocks, and stressed the importance of close liaison with other governmental agencies dealing with water quality and land use. He encouraged continued effort to improve the efficiency of meetings.

Management and Research.[1] Numerous matters pertaining to the management of the Great Lakes fishery received consideration by the Commission.

Reports from each Lake Committee (Superior, Michigan, Huron, Erie, and Ontario) covering management and research activities in 1973 were accepted.

In early 1973, the Commission sponsored the establishment of an international committee to consider coordinated management of the walleye in western Lake Erie. A progress report by this committee was presented at the Annual Meeting, and accepted by the Commission (see Appendix A).

A report on the status of U.S. Federal Aid Programs (Anadromous Fish Conservation Act, PL 89-304 and Dingell-Johnson Sport Fish Restoration Act PL 81-681) in the Great Lakes was presented by the Assistant Director, Bureau of Sport Fisheries and Wildlife. He noted that these two acts enable the federal government to assist states in carrying out constructive fisheries research and management programs. The Anadromous Fish Conservation Act (PL 89-304) established in 1967, is dependent upon direct Congressional appropriation. From 1967-1973, expenditures on the Great Lakes total about $5 million–about 37% of all Anadromous Fish funds. Dingell-Johnson funds, derived from taxes on sales of fishing tackle, are shared 75% by the federal government and 25% by the state. Expenditures on the Great Lakes in fiscal year 1973 will total about $455,000.

The Assistant Director stated that the Bureau was eager to move ahead in concert with the Commission, with Canada, and with the states in the development of a long-range hatchery program and to improve the status of the total fishery on the Great Lakes. He urged the Commission to establish a task force to work out an agreement to be used by cooperating agencies to define objectives, goals, and areas of responsibility. With these guidelines the Bureau would do its utmost to obtain funds to meet its obligations. He stressed that before the Bureau could expand its programs, the Bureau's role would have to be very clearly defined, and that planning, budgeting, and administrative constraints would have to be met.

Sea Lamprey Control and Research. The Commission accepted reports on sea lamprey control and research during 1973 from its two agents.[2]

In January, 1973, the Commission was advised that appropriations by the United States would not meet the budget request for fiscal year 1974 adopted at the Interim Meeting in December, 1972; as a consequence the Canadian contribution was also reduced to meet the 69:31 cost sharing formula. As a result of the foregoing, the Commission adopted a revised sea lamprey control and research budget for fiscal year 1974 as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$1,863,350	$837,150	$2,700,500
Administration and General Research	50,750	50,750	101,500
Total	$1,914,100	$887,900	$2,802,000

The reduced budget required some changes in the original program planned for fiscal year 1974. In the United States, effort would be reduced in:

[1] Information on management programs and the status of stocks is presented in Appendix A.

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

(1) locating and investigating possible concentrations of sea lamprey, (2) studies of reestablished larval lamprey populations, (3) detecting and treating residual larval populations that survived lampricide treatments, (4) survey for new sea lamprey-producing streams, and (5) survey for treatment of lentic areas. The Canadian program would be similarly reduced. The reduced budget also necessitated the deferment of some registration-oriented research on lampricides and prevented any build up of lampricide reserves. The reduced budget did not require any curtailment of the chemical treatment schedule.

The program calls for the following activities in fiscal year 1974:

Lake Superior. Retreat 20 streams, 14 in the United States and 6 in Canada. In Canada treat 5 lentic areas. Continue the operation of 8 assessment barriers.

Lake Michigan. Retreat 26 streams and 3 lentic areas.

Lake Huron. Retreat 18 streams, 12 in the U.S. and 6 in Canada. Treat 3 lentic areas in Canada. Continue the operation of 7 assessment barriers in Canada and 1 in the United States.

Lake Ontario. Treat 9 Canadian streams, and retreat U.S. streams as required.

Lake Erie. Survey approximately 35 streams that may harbor sea lampreys.

Research. Continue field research projects, continue scheduled registration-oriented research on TFM and Bayer 73.

The Commission adopted a budget request for fiscal year 1975 as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,499,650	$1,122,395	$3,622,045
Administration and General Research	55,250	55,250	110,500
Total	$2,554,900	$1,177,645	$3,732,545

The general program called for intensive sea lamprey control in the upper lakes including lampricide treatments and surveys; continuation of full scale research programs including field research, research at Hammond Bay, registration-oriented research; and a modest beginning of a sea lamprey barrier dam project as a segment of an integrated control program. Specifically the program included:

Lake Superior. Retreat 43 streams, 33 in the United States and 10 in Canada. Treat 13 lentic areas. Continue the operation of 8 sea lamprey assessment barriers.

Lake Michigan. Retreat 26 streams, and 5 lentic areas off river mouths.

Lake Huron. Treat 20 streams, 10 in the United States and 10 in Canada. Treat 13 lentic areas on the Canadian side. Continue the operation of 7 assessment barriers in Canada and 1 in the United States.

Lake Ontario. No treatment scheduled; carry out necessary survey program.

Research. Continue field research projects; at Hammond Bay continue research in support of field operations, feasibility of biological control methods, and the biology of lamprey transformation; continue registration-oriented research program for lampricides.

The Commission also received reports on research programs dealing with field studies, sea lamprey biology, and registration-oriented research, and from the two National Sea Lamprey Barrier Task Forces.

Scientific Advisory Committee. The Commission accepted a report from its Scientific Advisory Committee containing recommendations pertaining to:

1. A uniform procedure for the submission of research proposals,
2. Studies on the thermal requirements of sea lamprey reproduction,
3. Inventory of sea lamprey data, and
4. Research prospectus.

Adjournment. After determining that the Interim Meeting would convene in Ann Arbor, Michigan on December 4-5, 1973, and that the next Annual Meeting would convene at a selected site in the United States on June 18-20, 1974, the meeting adjourned at 1200 hours, June 21, 1973.

INTERIM MEETING

PROCEEDINGS

The Commission's Interim Meeting convened in Ann Arbor, Michigan, on December 4-5, 1973, to consider the sea lamprey control and research programs, to review programs and budgets for fiscal years 1974 and 1975, and activities of special committees.

Sea Lamprey Control and Research. The Commission heard reports on incidence of sea lamprey wounding throughout the Great Lakes Basin. Reports on sea lamprey control operations were presented by the Canadian and United States agents. Progress reports on sea lamprey research and research oriented toward the registration of lampricides were also presented.

Following the reports on the sea lamprey control and research programs, the Commission considered programs and budgets for fiscal years 1974 and 1975. At the Annual Meeting in Ottawa, June 1973, the Commission adopted a budget for fiscal year 1974 in the total amount of $2,802,000. Subsequently, U.S. employees engaged in sea lamprey control activities were granted a cost-of-living increase. The Department of State, therefore, requested and received a supplemental appropriation to cover the above increase. To meet the 69:31 sharing formula, the Canadian contribution was increased by $26,000. Therefore, the Commission adopted the following budget for fiscal year 1974:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$1,921,350	$863,150	$2,784,500
Administration and General Research	50,750	50,750	101,500
Total	$1,972,100	$913,900	$2,886,000

As for fiscal year 1975, the Commission was advised by the Executive Secretary that it was unlikely the total amount of its request of $2,554,900 (U.S. portion of the total budget of $3,732,545) would be forthcoming. Therefore, until firm figures were available, it was not feasible to revise the program.

Management and Research. The Commission heard progress reports on the activities of certain subcommittees that had been established to consider problems of special concern.

The committee to evaluate sea lamprey control in Lake Superior had not been activated because of the unavailability of a key member.

The committee on Commission functions was in the formative stage.

The initial progress report of the Scientific Protocol Committee for the Management of the Walleye in Western Lake Erie was presented for Commission consideration. The report included a statement of goals, an outline of procedures, and defined the area and stock to be considered.

The Commission established a Great Lakes Fish Disease Control Committee at its Annual Meeting in Ottawa, June, 1973. The initial progress of the Committee which defined objectives and plans was presented.

The Lake Superior ad hoc subcommittee on lake herring presented a report containing its findings, conclusions, and recommendations. The subcommittee believed it had completed its charge, and expected to present a final report to the Lake Superior Committee in March, 1974.

Other Business. The Chairman summarized action taken in Executive Session, enumerating the following items:

1. Approved financial support for the preparation of a camera-ready proof of a computerized bibliography on cyclostomes.
2. Reviewed budgets for fiscal years 1974 and 1975, including plans for revision of the 1975 request in anticipation of reduced appropriations.
3. Endorsed the printing of a brochure containing the Commission's Management Policy for Great Lakes Fisheries.
4. Accepted the recommendations of the Scientific Advisory Committee pertaining to updating of Technical Report No. 3, Commercial Fish Production in the Great Lakes 1867-1960, including supplement 1961-1968, and the establishment of a standing committee on data and methods.
5. Considered the continuation of the Great Lakes Bibliography.
6. Considered means for closer liaison with International Joint Commission (IJC).
7. Placed high priority on a survey on Oneida-Oswego watershed, New York, tributary to Lake Ontario.
8. Arranged to replace Dr. Lloyd L. Smith on the Scientific Advisory Committee.

Adjournment. After announcing that the Annual Meeting would convene in Rochester, New York, June 18-20, 1974, the Chairman adjourned the meeting at 1100 hours, December 5, 1973.

APPENDIX A

SUMMARY OF MANAGEMENT AND RESEARCH

The Commission's programs to control sea lampreys and coordinate management and restoration of the fisheries resource have continued throughout the Convention Area.

With sea lamprey control and lake trout rehabilitation having attained operational status, the Commission has in the past few years been able to devote more attention to other problems of vital and immediate concern. Recognizing that ultimately the welfare of the basin's fisheries resource depends upon maintaining an environment of the highest possible quality, the Commission, with the support of other fisheries agencies, is endeavoring to develop closer liaison with those governmental agencies who have direct responsibility in water quality, pollution abatement, and land use. Through the years of its existence, the Commission has encouraged close cooperation among state, provincial, and federal fisheries agencies on the Great Lakes, particularly the eight bordering states and the Province of Ontario, who have jurisdiction in their respective waters. 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 to all agencies and the Commission is pleased to see significant progress in the past few years. The efforts of special inter-agency groups to summarize, evaluate, and recommend action toward the solution of particular problems have been especially noteworthy.

Annual reports for 1971 and 1972 covered areas of major concern throughout the basin and programs and problems in each of the lakes. Problems and areas of concern have not changed significantly. The Commission has found that inter-agency committees, assigned the task of delimiting and evaluating problems, and making recommendations through the Commission or through parent lake committees have been an effective means of developing integrated and acceptable management programs that assist the Commission in meeting its responsibilities as defined in the Convention. This report will deal with programs, problems, and progress in 1973, and with the activities of various special committees.

Sea Lamprey Control. Reports on control operations by the Commission's agents appear as Appendixes C and D. Control operations in 1973 were somewhat intensified over the preceeding biennium, and results indicate a further and continued reduction in the abundance of sea lampreys in the Great Lakes Basin.

Sea Lamprey Research. A report on sea lamprey research carried out in 1973 appears as Appendix E. During 1973 research on chemicals in support of field operations continued. Investigations into the feasibility of biological controls, especially sterilants, advanced to the point that field tests could be considered. Research on lamprey biology, determined from laboratory experiments, was continued along with laboratory culture of lampreys.

Registration-oriented Research on Lampricides. A report on the fairly extensive Commission-supported program on registration of lampricides is presented in Appendix F.

Cooperative Fisheries Management. Reference has been made to the efforts of special committees or inter-agency groups to summarize, evaluate, and recommend in the planning program or toward the solution of particular problems. These committees have assisted the Commission in its major coordinating function. Some groups are permanent, some have been temporary, and the composition and objectives of others have changed with changing conditions. Activities of these various groups are summarized hereafter.

Scientific Advisory Committee (SAC). This Committee, established at the Commission's organizational meeting in 1956, has the following charge: "The Committee shall advise the Commission on such matters relating to lamprey control and research and general fishery research as the Commission may submit to it." Present membership of the SAC is one Commissioner and three scientist members from each Contracting Party, assisted by such experts and advisors as needed. Through the years the Commission has relied upon the SAC for objective and expert advice on the many matters with which the Commission must deal.

Lake Trout Rehabilitation Committee. This inter-agency committee, established in 1957, was made up of representatives from federal, state, and provincial agencies, and the Secretariat. Its assigned task was the planning, development, and implementation of the lake trout restoration program on the upper Great Lakes. The Committee was instrumental in the establishment of the existing cooperative program in which different agencies have accepted responsibility for different phases of the program according to their capability. The Committee assisted the Commission in developing certain objectives, policies, and procedures that have proved effective. Matters of major import include:

a) Development of a lake trout brood stock.
b) Inventory of hatchery capability within the Great Lakes area for the rearing of lake trout.
c) Support of investigations to determine "best" planting procedures, considering initial objectives.
d) Support of the Commission decision that all planted lake trout would be marked by fin clipping.
e) Support of the Commission in its decision that the objective of the

lake trout planting program was to reestablish a self-sustaining population of lake trout.

f) Assist with the development of an ongoing program to assess results.

Ad hoc Committee on Regulation of Lake Superior Lake Trout Fishery. At the Commission's Interim Meeting, June 1960, an ad hoc committee composed of representatives from Michigan, Ontario, Minnesota, Wisconsin and the Great Lakes Fishery Commission was asked to consider the need for controls on the catch of lake trout in Lake Superior, and to prepare a recommendation. The ad hoc committee recommended "that the future management of the Lake Superior lake trout fishery be based on an actual catch limit for the lake, adopted by the state and provincial governments on the recommendation of the Great Lakes Fishery Commission; the catch limit would be reconsidered each year.

It is further recommended that the Great Lakes Fishery Commission suggest to the two countries what percentage of the catch should be taken in the four jurisdictional areas . . . ; and that this distribution be reconsidered at intervals of not less than five years, or on the request of any agency concerned."

At the Annual Meeting, June 1960, the ad hoc committee, in an effort to accede to the initial recommendation encountered some difficulty and recommended "that regulatory agencies support a multiple area quota system of management for Lake Superior, but that implementation be deferred until success of sea lamprey control was evident."

The Commission agreed that all regulatory agencies should be notified that a quota system would likely be recommended by the Commission following evidence of sea lamprey control in Lake Superior, and that the agencies should be asked to seriously consider measures needed for implementation as well as the collection of information which would facilitate determination of the allowable harvest."

At the Interim Meeting in November 1961, the Commission recommended that there being evidence of effective sea lamprey control "the 1962 harvest of lake trout in Lake Superior be limited to the fishing effort required to support necessary biological studies and suggest that agencies act to accomplish this objective through appropriate procedures available to them." As a result of the foregoing recommendation, the four jurisdictional agencies inaugerated restrictions in 1962 designed to limit the catch of the amount required for biological assessment. Ontario imposed a quota; the three states closed the fishery except for special permits or fishing by agency vessels. In March, 1962, the Lake Trout Rehabilitation Committee recommended a quota of 60,000 pounds for the United States and 44,000 pounds for Canada for 1962. Subsequently, upon recommendation of the Lake Trout Rehabilitation Committee, quotas were assigned by numbers of fish rather than pounds. At its annual meeting in February 1963, the Lake Trout Rehabilitation Committee recommended the following quotas for 1963: Michigan 22,000 lake trout, Wisconsin 18,000; Minnesota 3,200; and Ontario 45,000 for a total of 88,200 fish. An identical quota was recommended for

1964. In 1965, the quota was raised to 96,000 fish, 51,000 in the United States and 45,000 in Canada. After 1965, sampling programs in Lakes Superior and Michigan were developed and approved by the Lake Committees.

Research Prospectus. From the first the Commission recognized that many problems other than sea lamprey control and lake trout restoration existed, but of necessity the latter received highest priority. However, in 1961 the Commission instructed the Secretariat to develop a research prospectus that would provide, on a priority basis, a listing of those areas of investigation or problems on each lake that would be most rewarding in the development of a coordinated management effort. The Secretariat solicited input from the States and Province. These materials were assembled, organized, and refined with guidance from the Commission and the assistance of numerous agency representatives. In 1964, the Secretariat distributed a 51-page document entitled "A Prospectus for Investigations of the Great Lakes Fishery (Doc. 64-10, Comm. Circ., 51 p., mimeo). The document consists of two parts: Part I lists those broad areas of investigation that pertain throughout the basin; Part II lists needful activities on a lake by lake basis. Most of the investigations listed are now being pursued. Updating of the prospectus has been considered, but the Commission and cooperating agencies have agreed that extensive revision at this time is unnecessary.

Walleye Management, Lake Erie. At the Commission's Interim Meeting in November, 1962, the State of Ohio requested that the decline of the walleye population in Lake Erie be taken under consideration by the Commission, and that recommendations for appropriate management measures be made. The Commission stated that recommendations should come only after detailed and thorough consideration of the entire problem by the Commission and all agencies concerned. The Commission agreed that a comprehensive summary of all available information would be most desirable, and arranged for such a compilation. A preliminary but comprehensive 39-page summary of available data was distributed in December, 1963.[3] After review of this material the Scientific Advisory Committee stated that it could not, on the basis of the information collected, recommend administrative action to improve the fishery. The Commission, therefore, suggested that jurisdictional agencies again review the matter, and consider what administrative action they could take to encourage recovery of the fishery. Agencies met to consider the matter in February, 1964 but were unable to agree. Representatives of state, provincial, and federal agencies met again in August 1964, and agreed that the most logical action was a restriction on the fishery for a sufficiently long time to assess the effects of (reduced) exploitation. They, therefore, proposed a complete closure for 3 years on

[3]The Walleye Fishery in Lake Erie–A compilation of information collected by agencies concerned with the Lake Erie fishery to be used in reviewing the decline of walleye and associated conditions. *Not for publication,* Great Lakes Fishery Commission, December 24, 1963, 39 p., mimeo).

the premise that adequate cooperative evaluation on the effects of the closure would be carried out. The proposal was unacceptable to New York, Pennsylvania, and Ontario. Over the next two or three years agencies were unable to agree on joint action. Certain regulations such as increased size limits, closed seasons, area and gear restrictions, were imposed by individual agencies in an effort to protect walleyes to maturity. There developed a consensus that the "walleye problem" pertained primarily to the walleye population in the western basin of Lake Erie. In 1967 it was agreed that the Commission, Ohio, and Ontario would provide financial support for a comprehensive report which would include "information on ecology, a history of the fishery, data on mortality and exploitation rates, and would conclude with management recommendations." Objective of the study would be to determine how current management practices should be altered to enhance the long-term value of the walleye resource. This action resulted in the publication in 1969 of Great Lakes Fishery Commission Technical Report No. 15 *The Ecology and Management of the Walleye in Western Lake Erie.* Presented in the report is the following recommendation: "We recommend that the walleye resource of Western Lake Erie be conserved by a combination of minimum size limit, quota, and fishing season regulations. Very few accidental captures in small-mesh gillnets should be tolerated; 5 or 10 percent of the total catch is far too high. Management policy should be reviewed annually in the light of current analyses based on samples of the existing populations." Subsequent to the publication of Technical Report No. 15, certain developments took place. With the approval of the Great Lakes Fishery Commission agencies (independently) imposed certain regulations that they believed would reduce walleye exploitation. In 1970, because of the discovery of mercury contamination, marketing of walleyes from the western basin of Lake Erie was prohibited. The ban remained in effect in 1973. In March, 1973 in a continuing effort to achieve a mutually acceptable and unified approach to management of the walleye in western Lake Erie, the Commission called a meeting of representatives from the Bureau of Sport Fisheries and Wildlife, Great Lakes Fishery Commission, Ontario, Ohio, Michigan, New York, and Pennsylvania. Dr. Henry Regier, University of Toronto, and a member of the Commission's Scientific Advisory Committee, served as Chairman. As a result of this meeting a formal document was prepared which sets forth the various components for developing a system for better management and fair sharing of western basin walleyes among Ontario, Ohio, and Michigan while simultaneously fostering a recovery of the walleye resource. The Commission was urged to accept the document and to establish a Walleye Scientific Protocol Committee (SPC) to develop detailed plans. The proposal was endorsed by the Commission in executive session and the Commission transmitted the proposal to the two counties through the United States Department of State and the Canadian Department of External Affairs. The SPC held its initial meeting November 14, 1973.

The problem of walleye management in western Lake Erie has been a particularly thorny one, but an acceptable approach has finally been established which will lead to a plan whose implementation is anticipated.

At its Interim Meeting in December, 1964 the Commission decided to establish three permanent committees for (a) Finance and Administration, (b) Sea Lamprey Control and Research, and (c) Management and Research. The Commission also recommended the establishment of a committee for each lake on which the agencies (States and Province) having jurisdictional responsibility for the lakes would be represented. Accordingly, at its Annual Meeting in 1965, the Commission adopted a revised Rule 17 (Rules of Procedure) establishing the above committees.

Finance and Administration Committee. This Committee, composed of one Commissioner from each country and such advisors as needed, shall advise the Commission on matters pertaining to the Commission's accounts, budgets, publications, meetings, and other fiscal or administrative matters referred to it by the Commission.

Sea Lamprey Control and Research Committee. This Committee, composed of one Commissioner from each national section, a member from each of the Commission's (control) agents, and a member from each agency cooperating in the sea lamprey program, and selected advisors, shall advise the Commission on the progress and needs of the sea lamprey control and research program. This Committee has the major responsibility for the preparation of annual plans and budgets; over the past two or three years it has encouraged research directed toward a more comprehensive or integrated control program, including barriers and biological controls to supplement control with lampricides. Also, the Committee has supported the current "registration-oriented" research program on the acute and long-term effects in the environment of the lampricides being used. The goal is to obtain registration of the lampricides from the federal Environmental Protection Agency.

Management and Research Committee. This Committee is composed of one Commissioner from each national section, a representative of each federal government, and the chairman and vice-chairman of each lake committee. The Committee shall advise the Commission on the status and problems of the fisheries, both commercial and sport, progress and adequacy of research, significant findings, measures to improve the productivity of the fisheries, and other management or research matters referred to it.

Lake Committees. These Committees are composed of a senior staff member from each agency having jurisdiction on the lake, and such experts and advisors as may be chosen by each agency. It also was agreed that representatives of federal agencies working on the lakes would participate in meetings of the Lake Committees. Since they were established, the Commission has used them as a major vehicle for the development of integrated and broadly acceptable management programs. Furthermore, the Lake Committees have assumed responsibility for certain activities formerly pursued directly under Commission auspices; for example, the Lake Trout Rehabilitation

Committee was formally disbanded in 1965 and its responsibilities assumed by the lake committees. One of the most useful functions of the lake committees has been to provide a forum for negotiation of problems that arise between agencies. From time to time Lake Committees have chosen to establish special work groups to assist them in the pursuit of their objectives.

Commission Rule of Procedure 17(c) states "The Commission may, from time to time, establish temporary committees or subcommittees as it desired. These special work groups, ad hoc committees, etc., established by the Commission or its Lake Committees, have been effective in summarizing, evaluating, and making recommendations on many matters that come before the Commission.

Special Committees, Work Groups, etc. Some of the accomplishments and activities by these subcommittees are summarized briefly hereafter.

Economic Planning Study Group. This group, established in 1965, and consisting of a biologist and an economist from each National Section was asked to "assess likely costs and benefits of sea lamprey control and lake trout rehabilitation." The deliberations of the group culminated in the preparation of a 49-page report "An Economic Evaluation of Sea Lamprey Control and Lake Trout Restoration in Lake Superior" (Great Lakes Fishery Commission, June 1968, 49 p. mimeo). Significant conclusions may be summarized very briefly as follows:

a) A lake trout fishery stabilized at about 4.1 million pounds would be established in Lake Superior by 1976.
b) Lake trout will be restored to about 85% of pre-lamprey control level.
c) Catch will be shared by sport and commercial fishermen with no major innovations in fishing methods.
d) The commercial fishery will operate under a "limited entry" concept.
e) Introduction of exotic species will not seriously affect lake trout.
f) Lamprey control will approximate $0.4 million annually.
g) Continued planting of lake trout after the reestablishment of a viable brood stock will not materially increase annual production, and planting costs will therefore be eliminated.
h) Annual net benefits of lamprey control and lake trout restoration amount to $2.0 million.

Recommendations were:

a) Research and testing of valuation approaches should be encouraged to achieve best use.
b) Develop a systematic data collecting system to provide relevant economic statistics.
c) Collect better cost data on planting and lamprey control programs.

Splake, Lake Huron. The rehabilitation program on Lake Huron has lagged behind that on Lakes Superior and Michigan. Full scale sea lamprey

control was not initiated until 1966. Enhancement of the fisheries resource by means of extensive plantings has also been slower than equivalent programs in Lakes Superior and Michigan. In the 1950's Ontario initiated experiments with book trout X lake trout hybrids (splake) on the premise that this hybrid would mature at a young age and be able to occupy the habitat formerly used by lake trout. As early as 1958, the Commission and the Scientific Advisory Committee encouraged the Province to pursue vigorously its experiments with splake. Results with splake selected for early maturity and deep swimming habits suggested that the hybrid might be less vulnerable than lake trout to sea lamprey predation because it would reproduce at a small size before growing sufficiently large to become fully vulnerable to attack by sea lamprey.

As a result of the foregoing, the Lake Huron Committee at its annual meeting in March 1966 recommended "that planting of trout in Lake Huron be restricted to selected hybrids." The recommendation was adopted by the Commission at the Annual Meeting, June 1966. Unfortunately, numbers of highly selected splake (F_5) available for planting in Lake Huron have been somewhat limited because of a shortage of brood stock. (Planting rates are shown in Appendix B). At the meeting of the Lake Huron Committee in 1968, the State of Michigan suggested that a review of the splake program in Lake Huron was in order at the Commission's annual meeting, June 1968. Michigan's position on the splake program was summarized as follows: (a) lake trout appear to be a more desirable predator for Lake Huron than splake, (b) there was evidence that Lake Huron could be successfully rehabilitated with lake trout, and (c) the splake program was fraught with uncertainty such as a shortage of brood stock and the lack of demonstrated superiority of the splake's reproductive potential. Thus, it was clear that the two management agencies were not in full accord. Nevertheless, an agreement was reached that Michigan would continue to rear highly selected splake and "that no lake trout plantings would be made in Lake Huron unless requested by the Great Lakes Fishery Commission."

In Michigan hatcheries stocks of selected splake brood stock supplied by Ontario in 1966 suffered severe mortalities from kidney disease and were discarded. Eggs from these diseased fish were not acceptable at federal hatcheries in Michigan for rearing to planting size. In a further attempt to establish a splake brood stock in the United States, splake fingerlings (1969 year class) were provided by Ontario to the Bureau of Sport Fisheries and Wildlife. After quarantine at Genoa, Wisconsin, this brood stock was transferred to the Jordan River National Fish Hatchery prior to final transfer to Michigan's Marquette Fish Hatchery in 1971.

In 1972, kidney disease was diagnosed in the F_5 brood stock at Marquette. Hence, Jordan River could not accept eggs from this brood stock for rearing because of disease control policies endorsed by the Bureau of Sports Fisheries and Wildlife. The disease problem, therefore, prompted a review of the policy on splake in Lake Huron.

A meeting to resolve the problem, attended by representatives from

Ontario, Michigan, and the Bureau of Sport Fisheries and Wildlife was convened by the Great Lakes Fishery Commission at Ann Arbor, October, 1972. At this meeting certain agreements were reached. Basically, Michigan's insistance that restoration of the Lake Huron fishery could not be postponed further was accepted–the annual planting of 1 million lake trout, splake, or backcrosses, was essential. The basic agreement was that until such time as adequate numbers of selected splake were available, plantings of lake trout and lake trout × splake backcrosses would be continued in Michigan waters of the lake. The latter were expected to exhibit more rapid rates of growth than lake trout. Regarding the long range program, Ontario would endeavor to supply about 2,500 highly selected splake fingerlings to the U.S. Bureau of Sport Fisheries and Wildlife for developing a new brood stock.

Lake Michigan Study Group (LMSG). This special work group consisting of a representative from each jurisdictional agency and each cooperating federal agency and such scientific advisors as needed was established by the Lake Michigan Committee at its annual meeting in March, 1968. Its charge from the Lake Michigan Committee was (a) to outline generally the comprehensive studies needed to develop a systems approach for the management of the Lake Michigan fishery resource, and (b) to be responsible for preparing recommendations for consideration by the Lake Michigan Committee for submission to the Great Lakes Fishery Commission. The Lake Michigan Study Group, meeting annually since its establishment, has assumed responsibility for such matters as fish population assessment and planting schedules. It provides the parent committee the background information to enable it to act in an informed manner. A major accomplishment of the LMSG has been to establish close rapport between the fisheries agencies on Lake Michigan.

Barrier Dam Task Forces. At the Annual Meeting in June, 1971 the Scientific Advisory Committee recommended that the Commission establish national task forces to develop a plan for using barrier dams on selected streams as a segment of an integrated sea lamprey control program. The Commission accepted the recommendation and instructed the Secretariat to establish the National Task Forces, each to be composed of appropriate representatives of state or provincial agencies, and the Commission's control agents. The Task Forces presented progress reports at the Interim Meeting in December, 1971 and further developments at the Annual Meeting, June 1972. At that meeting, the Commission adopted an item of $201,315 in the budget for fiscal year 1974 to initiate a program of barrier construction. Unfortunately, subsequent allotments were less than the request and it was, therefore, not possible to initiate the barrier program in that year. Similarly, funding for barrier dams in the fiscal year 1975 budget (as adopted by the Commission at the Annual Meeting in June, 1973) was subsequently denied by the U.S. government. Consequently, the Commission has been unable to establish a barrier program as part of integrated sea lamprey control because of insufficient funds.

Lake Superior Lake Herring Subcommittee. This special committee was established, upon recommendation by the State of Michigan, by the Lake Superior Committee at its annual meeting in March, 1972. It was made up of representatives from the Bureau of Sport Fisheries and Wildlife, the Province of Ontario, the States of Michigan, Minnesota, Wisconsin, and the Great Lakes Fishery Commission. Its charge from the Lake Superior Committee was: (a) review the literature and summarize the biology of the herring stocks in the Great Lakes, particularly in Lake Superior, (b) review, evaluate, and summarize those factors most likely to be responsible for the decline of the lake herring in Lake Superior, and (c) prepare a summary report of its findings with management recommendations for a rational approach to prevent further depletion of the herring stocks in Lake Superior.

The subcommittee presented a preliminary report containing its conclusions and recommendations to the Lake Superior Committee at the latter's annual meeting in March, 1973. The Lake Superior Committee accepted the report with the understanding that further review would be required before taking further action. At the Commission's Annual Meeting in June, 1973, the Lake Superior Committee informed the Commission that it had accepted the report but did not request any response. At the Commission's Interim Meeting in December, 1973 the Chairman of the Lake Herring Subcommittee stated that the subcommittee had completed its charge and that a final report would be presented to the Lake Superior Committee in March, 1974. For the Commission's information he summarized the conclusions and recommendations contained in the report and reviewed the steps that have been taken by agencies to reduce exploitation of the herring.

Subcommittee for Reevaluation of Formula for Allocation of Federally-raised Lake Trout. At the request of the Lake Superior and Lake Michigan Committees at their annual meetings in 1972, representatives from Michigan, Wisconsin, Minnesota, Illinois, Indiana, Bureau of Sport Fisheries and Wildlife, and the Great Lakes Fishery Commission met in Ann Arbor in October, 1972 to consider the above question. This group developed a suggested planting schedule for the upper lakes (Superior, Michigan, Huron), for 1972, 1973, and 1974-1979 which was accepted by the concerned lake committees at their meetings in March, 1973.

The subcommittee also recommended the establishment of another subcommittee to consider when the Commission's first objective–the establishment of a self-sustaining population of lake trout–was met and to establish criteria for diverting plantings from one area to another.

Ad hoc Committee, Yellow Perch, Lake Erie. Upon recommendation from the State of Ohio an ad hoc committee was established by the Lake Erie Committee at its annual meeting, March 1972. Its charge was "to examine available information and consider what steps could or should be taken to maintain or enhance the stock; and to prepare recommendations for consideration by the Lake Erie Committee at the next meeting." It was agreed that membership would consist of biologists engaged in fisheries investigations on Lake Erie and that all agencies would be represented. The

committee presented an initial progress report at the Interim Meeting, December 1972. The ad hoc perch committee presented a second report to the Lake Erie Committee at the latter's annual meeting, March 1973. Following consideration of the report, the Lake Erie Committee endorsed the following: (a) each agency would give high priority to providing necessary data, (b) Dr. Hartman would prepare a summary of the problem, including such matters of data format, and (c) the Secretariat would coordinate a "perch workshop" in the autumn of 1973. Thereafter, the ad hoc perch committee would be prepared to provide a synthesis to the Lake Erie Committee in 1974.

Action by the Lake Erie Committee was reported to the Commission's Annual Meeting, June 1973.

Fish Disease Control Committee. At its annual meeting in January 1972, the Lake Michigan Study Group reviewed the matter of fish disease control in the Great Lakes basin and recommended to its parent committee that a basin-wide fish disease control committee be established. The Lake Michigan Committee accepted the recommendation and transmitted it to the Commission at the Annual Meeting in June; the Commission accepted the recommendation and authorized the Chairman to appoint such a standing committee. The following charge was issued to the Committee: (a) conduct an inventory of diagnosed fish diseases in provincial, state, federal, and private fish hatcheries in the Great Lakes area, (b) determine the degree of surveillance now extant, (c) review existing regulations pertaining to disease control, (d) review existing capabilities for disease control, and (e) propose measures for eradication and control. The Committee includes administrators and fisheries pathologists from cooperating agencies.

The Chairman of the Great Lakes Fish Disease Control Committee presented its first progress report at the Commission's Interim Meeting, December, 1973.

Ad hoc Committee on Sea Lamprey Data. This Committee was established by the Commission upon recommendation of the Scientific Advisory Committee at the Annual Meeting, June 1973. The Scientific Advisory Committee developed guidelines for the above Committee and these were endorsed by the Commission. The Committee, chaired by Dr. Henry Regier, Scientific Advisory Committee, and consisting of representatives from the Commission's control agents presented a progress report at the Interim Meeting, December 1973.

Lake Superior Study Group to Evaluate Sea Lamprey Control in Lake Superior. This group was established by the Commission upon recommendation of the Scientific Advisory Committee at the Annual Meeting, June 1973. It was asked to consolidate available information and develop a report on the efficiency and effects of sea lamprey control in Lake Superior. The group consisted of representatives of the Scientific Advisory Committee, the Bureau of Sport Fisheries and Wildlife, and the Commission's control agents. Because of the temporary unavailability of a key member, the group was not activated by the end of 1973.

Committee on Commission Functions. The establishment of this Committee, recommended by members of the Scientific Advisory Committee, to be "composed of a judicious selection of Commission members and governmental agency staff members from both countries" was authorized by the Commission at the Annual Meeting, June 1973. Purpose of the Committee was to "review Commission activities to assure that its functions were an integral part of the total scientific plan for the conservation and enhancement of the natural resources of the Great Lakes." At the time of the Interim Meeting, December 1973, the Committee had not been established.

APPENDIX B

SUMMARY OF LAKE TROUT, SPLAKE, AND SALMON PLANTINGS

Intensive annual plantings of hatchery-reared salmonids continue to be the principal method employed to rehabilitate Great Lakes fisheries.

Lake trout have been planted annually in Lake Superior since 1958 and in Lake Michigan since 1965. The planting has 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. Since the fall of 1971, however, experimental plants of fall fingerlings have been made. Survival and growth of regular-size fall fingerlings (approx. 80/pound) have been compared with fingerlings whose growth was accelerated to about 30/pound through diet and the use of heated rearing water. Assessment fishing has shown better survival of the larger fingerlings (by about 2:1) over the first winter. Comparisons after two years of lake life show less advantage for the accelerated growth fish, but being larger they may have dispersed farther or may be less vulnerable to the gear. Better assessment of the comparative survival of the two groups may emerge when the fish become vulnerable to large mesh gillnets. If the fall plants of accelerated growth fingerlings continue to be advantageous, U.S. Federal hatchery production could be increased at minimum cost. In addition, in the fall of 1973 the State of Michigan initiated experimental reef plants by placing one million eyed-eggs, obtained from wild lake trout, on Dahlia Shoal in northern Lake Michigan.

Table 1 summarizes annual plantings of lake trout in Lake Superior and Lake Michigan, and Tables 2 and 3 detail the 1973 lake trout plantings in Lake Superior and Lake Michigan, respectively.

Splake (lake trout X brook trout hybrids) also are being planted in three of the Great Lakes. In Lake Superior, small experimental plants of first generation hybrids have been made by Wisconsin and Michigan (Table 4).

Rehabilitation of fish stocks in Lake Huron was initiated with plants of highly-selected splake in 1969 in Ontario waters (mostly yearlings) and in 1970 in 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 was used to fertilize lake trout eggs to produce backcrosses. It was believed these fish would retain most of the advantages (early maturity and fast growth) of the highly-selected splake. The first backcrosses were planted in Lake Huron as

yearlings in 1973 and the program was to have continued. 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 in the United States planting programs with splake and backcrosses were postponed. 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 (accelerated and normal growth fingerling) were planted in 1973 to bring stocking levels up to approximately one million lake trout and hybrids. Table 5 summarizes annual plantings of splake, lake trout, and backcrosses in Lake Huron, and Table 6 details the plantings for 1973 in United States waters and in the major geographical divisions of Canadian waters.

Plants of yearling splake in Lake Ontario were initiated in 1972 and continued in 1973 by the Province of Ontario. In addition, plants of lake trout were started by New York State in 1973. Both lots of fish were stocked over former lake trout spawning reefs in the eastern basin of Lake Ontario. Table 7 summarizes annual plantings of lake trout and splake in Lake Ontario and Table 8 details the plantings for 1973.

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 9 summarizes annual plantings in each of the Great Lakes, and Table 10 details the 1973 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 11 summarizes annual plantings of chinook in the Great Lakes while Table 12 details the 1973 plantings in each of the Great Lakes.

In 1972, Michigan and Wisconsin inaugerated 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. In 1973, Michigan discontinued its plants in Lake Huron but increased them in Lake Michigan; all the fish have been stocked as 2-year-olds. Table 13 summarizes Atlantic salmon plantings in the Great Lakes 1972-1973.

From 1965 to 1972 kokanee plantings were made in Lake Huron and Lake Ontario by the Ontario Ministry of Natural Resources. Plantings consisted of eyed eggs (2,051,000 eggs), swim-up fry (16,017,000 fish), and fingerlings (1,089,000 fish). Eyed egg plants were discontinued in Lake Ontario after 1965 and in Lake Huron after 1966. After 1972, all stocking of kokanee into Great Lakes waters came to an end.

Table 1. Annual plantings (in thousands) of lake trout in Lake Superior, 1958-1973, and Lake Michigan 1965-1973.

	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
Subtotal	18,579	4,943	3,040	7,819	34,381

	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
Subtotal	9,496	8,095	730	709	19,030
Grand Total					54,411

Table 2. Lake trout plantings in Lake Superior, 1973.

Location	Numbers	Fin clip
Michigan waters		
Porcupine Mountains	175,000	adipose
Jacobsville (Rabbit Bay)	80,000	adipose
Baraga	25,000	adipose
Pequaming	25,000	adipose
Huron Bay	100,000	adipose
Loma Farms	106,840	adipose

Table 2 (Continued)

Location	Numbers	Fin clip
Marquette	100,000	adipose
Shelter Bay	125,000	adipose
Grand Marais	50,000	adipose
Pendills Bay	107,060	adipose
Subtotal	893,900	
Wisconsin waters		
Bayfield area[1]	63,668	adipose
Bayfield area	58,000	adipose
Washburn	47,000	adipose
Devil's Island Shoal[1]	57,946	adipose
Subtotal	226,614	
Minnesota waters		
Duluth (Lester River)[1]	50,220	adipose
Duluth (Lester River)	29,930	adipose
Palmers (Stony Pt.)	30,091	adipose
Two Harbors	30,782	adipose
Split Rock	29,895	adipose
Beaver Bay (Kings Landing)	30,008	adipose
Little Marais	29,994	adipose
Tofte	23,759	adipose
Grand Marais	28,991	adipose
Subtotal	283,670	
Ontario waters		
West end		
Thunder Bay (Lambert Island)	125,000	adipose-right pectoral
Nipigon Bay (Rossport)	125,000	adipose-right pectoral
East end		
Inner Batachawana Bay	60,000	adipose-left ventral
Pancake Point	70,000	adipose-left ventral
Agawa Bay (Sinclair Cove)	60,000	adipose-left ventral
Michipicoten Bay	59,940	adipose-left ventral
Subtotal	499,940	
Total lake trout, Lake Superior	1,904,124	

[1]Fish planted by state agencies; other U.S. plants by U.S. Fish and Wildlife Service.

Table 3. Lake trout plantings in Lake Michigan, 1973.

Location	Numbers	Fin clip
Michigan waters		
Spring Yearling Plants		
Escanaba	85,000	adipose
Fox Island Shoals	75,000	right pectoral-right ventral

Table 3 (Continued)

Location	Numbers	Fin clip
Petoskey	100,000	adipose
Charlevoix	108,300	adipose
Grand Traverse Bay, East Arm	75,000	adipose
Grand Traverse Bay, West Arm	75,000	adipose
Leland (Good Harbor Bay)	75,850	left pectoral-left ventral
Frankfort	50,000	adipose
Manistee	80,000	adipose
Pentwater	75,000	adipose
Montague	50,000	adipose
Saugatuck	60,000	adipose
South Haven	60,000	adipose
Benton Harbor	60,000	adipose
Subtotal, spring plants	1,029,150	
Fall Fingerling Plants		
Grand Haven–accelerated growth	50,000	both ventrals
–normal growth	50,000	adipose-both ventrals
Subtotal, fall plants	100,000	
Subtotal, Michigan[1]	1,129,150	
Wisconsin waters		
Spring Yearling Plants		
Sturgeon Bay	220,000	adipose
Kewaunee	300,000	adipose
Manitowoc	150,000	adipose
Sheboygan	100,000	adipose
Milwaukee	100,000	adipose
Racine	100,000	adipose
Subtotal, spring plants	970,000	
Fall Fingerling Plants		
Kewaunee–accelerated growth	50,000	dorsal
–normal growth	50,000	dorsal-right ventral
Sheboygan–accelerated growth	50,000	dorsal
–normal growth	50,000	dorsal-right ventral
Subtotal, fall plants	200,000	
Subtotal, Wisconsin	1,170,000	
Indiana waters[2]		
Gary (Bethlehem Steel Pier)	105,000	adipose
Illinois waters[2]		
Highland Park Boat Ramp, Chicago	105,000	adipose
Total, Lake Michigan	2,509,150	

[1]Total does not include 1,000,000 eyed eggs planted on Dahlia Shoal.
[2]Spring yearling plants only.

Table 4. Splake plantings in Lake Superior, 1971 and 1973.

Year	State	Location	Numbers	Fin clip
1971	Michigan	Copper Harbor	13,199	none
1973	Wisconsin	Bayfield area	5,000	dorsal-left ventral

Table 5. Annual plantings (in thousands) of splake, lake trout, and backcrosses[1] in Lake Huron, 1969-1973.

	Michigan			Ontario	
Year	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
Total	332	629	486	1,495	2,942

[1]Lake trout × splake (see text).

Table 6. Splake, lake trout, and backcross plantings in Lake Huron, 1973.

Location	Numbers	Age	Fin clip
Ontario waters	SPLAKE		
Georgian Bay–Vail Point	97,650	fingerlings	right pectoral-right ventral
	91,530	yearlings	left ventral
	550	3-year-old	right pectoral-right ventral
–Lion's Head	53,400	yearlings	left pectoral-right ventral
	1,000	yearlings	tagged
	820	yearlings	left ventral
Main Basin–Burnt Island	103,420	fingerlings	right pectoral-right ventral
–South Bay	62,050	yearlings	adipose-left pectoral
	1,190	3-year-old	right pectoral-right ventral
Subtotal, splake, Ontario	411,610		
Michigan waters	BACKCROSS[1]		
Potagannissing Bay (Harbor Island)	50,000	yearlings	right pectoral
Hessel (Goose Island and Brulee Pt.)	111,000	yearlings	right pectoral
Rogers City	75,000	yearlings	right pectoral
Presque Isle	50,000	yearlings	right pectoral
Rockport	50,000	yearlings	right pectoral
Harrisville	50,000	yearlings	right pectoral
Grindstone City	100,000	yearlings	right pectoral
Subtotal, backcross, Michigan	486,000		

[1]Lake trout × splake (see text).

Table 6 (Continued)

Location	Numbers	Age	Fin clip
	LAKE TROUT[1]		
Hessel-Cedarville (Pomeroy Reef)	75,000	fingerlings	both ventrals
St. Ignace	5,000[2]	3-year-old	adipose-both ventrals
Zela Reef Shoal (Cheboygan)	62,500	fingerlings	voth ventrals
Point aux Pins (Cheboygan)	66,250	fingerlings	both ventrals
Raynolds Reef (Cheboygan)	80,165	fingerlings	both ventrals
Hammond Bay	100,000	fingerlings	both ventrals
Rockport	240,000	fingerlings	adipose-both ventrals
Subtotal, lake trout	628,915		
Subtotal, Michigan	1,114,915		
Total, splake and lake trout, Lake Huron	1,526,525		

[1]Fall plants of accelerated growth fingerlings except fall plant at Rockport (240,000 fish) which consisted of normal growth fingerlings, and St. Ignace plant of 3-year-old lake trout.

[2]Plant by State of Michigan.

Table 7. Annual plantings (in thousands) of splake and lake trout in Lake Ontario, 1972-1973.

	Ontario	New York	
Year	Splake	Lake trout	Total
1972	48	–	48
1973	39	66	105
Total	87	66	153

Table 8. Plantings of splake and lake trout in Lake Ontario, 1973.

Location	Numbers	Age	Fin clip
Ontario waters	Splake		
Charity Shoal	7,530	yearling	left ventral
	22,600	yearling	adipose-right pectoral
N-E of Main Duck Is.	8,880	yearling	adipose-right pectoral
Subtotal	39,010		
	Lake trout		
New York waters			
Calf Island Shoal	66,000	yearling	left ventral
Total lake trout and splake, Lake Ontario	105,010		

Table 9. Annual plantings (in thousands) of coho salmon in the Great Lakes, 1966-1973.

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
Subtotal	2,728	589	78	3,395

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	4	2,750
1972	2,269	258	96	–	2,623
1973	2,003	510	–	5	2,518
Subtotal	16,460	1,617	212	18	18,307

LAKE HURON

Year	Michigan	Total
1968	402	402
1969	667	667
1970	571	571
1971	975	975
1972	249	249
1973	100	100
Subtotal	2,964	2,964

LAKE ERIE

Year	Ohio	Pennsylvania	New York	Total
1968	30	86	5	121
1969	92	134	10	236
1970	254	197	74	525
1971	122	152	95	369
1972	38	131	50	219
1973	96	315	–	411
Subtotal	632	1,015	234	1,881

Table 9 (Continued)

Year	Ontario	New York	Total
		LAKE ONTARIO	
1968	–	40	40
1969	130	109	239
1970	145	294	439
1971	160	122	282
1972	122	230	352
1973	272	240	512
Subtotal	829	1,035	1,864
Great Lakes Total 1966-1972			28,411

Table 10. Plantings of coho salmon in the Great Lakes, 1973.

Location	Numbers	Fin clip
LAKE SUPERIOR		
Michigan waters		
Marquette	100,017	none
Minnesota waters		
French River	35,046	none
Total, Lake Superior	135,063	
LAKE MICHIGAN		
Michigan waters		
Thompson[1]	67,400	left ventral
Grand Traverse Bay, West Arm (Brewery Creek)	150,834	none
Platte River	1,135,133	none
Portage Lake	266,477	none
Little Manistee River	55,935	right ventral
	52,833	left pectoral
	56,946	right pectoral
Sable River	217,707	none
Subtotal	2,003,265	
Wisconsin waters		
Little River	36,000	none
Strawberry Creek	6,000	none
Sturgeon Bay	237,700	none
Ahnapee River	29,000	none
Algoma	4,960	dorsal-left pectoral
	4,972	dorsal-right pectoral

[1]Alaskan strain.

Table 10 (Continued)

Location	Numbers	Fin clip
Kewaunee River	40,000	none
	15,800	none
Two Rivers	4,944	dorsal-adipose
	4,946	dorsal-left ventral
	4,977	dorsal-right ventral
Manitowoc	29,000	none
	4,982	left maxillary
	4,961	right maxillary
Sheboygan River	42,200	none
Oak Creek	4,952	adipose-left pectoral
	4,984	adipose-right pectoral
	4,991	adipose-left ventral
	4,996	adipose-right ventral
South Milwaukee	5,000	dorsal-left maxillary
	5,000	dorsal-right maxillary
Subtotal	510,365	
Illinois waters		
Illinois State Park, Zion	5,127	left pectoral-right ventral
Kellogg Ditch	200	right pectoral-left ventral
Subtotal	5.327	
Total, Lake Michigan	2,518,957	
LAKE HURON		
Michigan waters		
Cass River	100,026	none
Total, Lake Huron	100,026	
LAKE ERIE		
Ohio waters		
Huron River	48,600	left pectoral
	47,872[1]	adipose
Subtotal	96,472	
Pennsylvania waters		
Elk Creek	41,500	none
Trout Run	53,200	adipose-left pectoral
Walnut Creek	32,300	none
Godfrey Run	113,700	none
Presque Isle Bay	56,700	adipose-right pectoral
Six Mile Creek	8,000	none
Orchard Beach Run	9,800	none
Subtotal	315,200	
Total, Lake Erie	411,672	

[1]Fall fingerlings.

Table 10 (Continued)

Location	Numbers	Fin clip
LAKE ONTARIO		
Ontario waters		
Bronte Creek	31,060	adipose
Credit River	190,530	adipose
Humber River	50,010	adipose
Subtotal	271,600	
New York waters		
Sandy Creek	30,200	none
Skinner Creek	14,500	right ventral
	14,700	left ventral
Salmon River	24,900[1]	adipose-right ventral
	57,000	none
	37,000	right ventral
	61,500	left ventral
Subtotal	239,800	
Total, Lake Ontario	511,400	
Grand Total, Coho salmon, Great Lakes 1973	3,677,118	

[1]Fall fingerlings.

Table 11. Annual plantings (in thousands) of chinook salmon in the Great Lakes, 1967-1973.

LAKE SUPERIOR

Year	Michigan	Total
1967	33	33
1968	50	50
1969	50	50
1970	150	150
1971	252	252
1972	472	472
1973	509	509
Subtotal	1,516	1,516

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	–	24	2,032
1973	2,115	757	–	174	3,046
Subtotal	9,487	1,523	280	216	11,506

Table 11 (Continued)

LAKE HURON

Year	Michigan	Total
1968	274	274
1969	255	255
1970	643	643
1971	894	894
1972	515	515
1973	967	967
Subtotal	3,548	3,548

LAKE ERIE

Year	Michigan	Ohio	Pennsylvania	New York	Total
1970	–	150	–	–	150
1971	–	180	129	–	309
1972	–	–	150	–	150
1973	305	–	155	125	585
Subtotal	305	330	434	125	1,194

LAKE ONTARIO

Year	Ontario	New York	Total
1969	–	70	70
1970	–	141	141
1971	89	149	238
1972	190	427	617
1973	–	696	696
Subtotal	279	1,483	1,762

Table 12. Plantings of chinook salmon in the Great Lakes, 1973.

Location	Numbers	Fin clip
LAKE SUPERIOR		
Michigan waters		
Falls River	119,217	none
Dead River	276,240	none
Sucker River	113,190	none
Total, Lake Superior	508,647	
LAKE MICHIGAN		
Michigan waters		
Menominee River	112,500	none
Big Cedar River	110,250	none

Table 12 (Continued)

Location	Numbers	Fin clip
Grand Traverse Bay West Arm (Brewery Creek)	102,700	none
Big Manistee	150,266	none
Little Manistee	356,140	none
Sable River	102,000	none
Muskegon River	420,002	none
Grand River	454,570	none
Kalamazoo River	105,840	none
St. Joseph River	200,978	none
Subtotal	2,115,246	
Wisconsin waters		
Little River	60,000	none
Pensaukee	60,000	none
Strawberry Creek	6,000	none
Sturgeon Bay	100,000	none
Ahnapee River	77,000	none
Kewaunee River	77,000	none
Two Rivers	82,000	none
Little Manitowoc River	98,000	none
Sheboygan River	85,000	none
Kenosha	112,000	none
Subtotal	757,000	
Illinois waters		
Kellogg Ditch	8,429	left pectoral
	7,040	left ventral
Illinois Beach State Park, Zion	2,792	none
	12,243	right pectoral
Waukegan River	29,250	none
	9,856	left ventral
	12,250	adipose
Diversey Harbor	46,661	none
	37,000	right ventral
	8,000	left ventral
Subtotal	173,521	
Total, Lake Michigan	3,045,767	
LAKE HURON		
Michigan waters		
Nagles Creek	52,000	none
Thunder Bay River	52,000	none
	2,605	left pectoral
Harrisville	226,490	none
Au Sable River	405,745	none
Au Gres River	75,690	none
Cass River	152,800	none
Total, Lake Huron	967,330	

Table 12 (Continued)

Location	Numbers	Fin clip
LAKE ERIE		
Michigan waters		
Detroit River	304,500	none
Pennsylvania waters		
Walnut Creek	77,500	none
Elk Creek	77,500	none
Subtotal	155,000	
New York waters		
Dunkirk Harbor	28,000	none
Eighteen Mile Creek	36,000	none
Cattaraugus Creek	36,000	none
Chautauqua Creek	25,000	none
Subtotal	125,000	
Total, Lake Erie	584,500	
LAKE ONTARIO		
New York waters		
Sandy Creek	124,600	none
Sodus Creek	40,000	none
	5,300[1]	none
Salmon River	516,400	none
	9,300[1]	none
Total, Lake Ontario	695,600	
Grand Total, Chinook salmon, Great Lakes 1973	5,801,844	

[1]Fall fingerling plants.

Table 13. Plantings of Atlantic salmon in the Great Lakes, 1972-1973.

Year	State	Area	Number of fish	Fin clip
		LAKE SUPERIOR		
1972	Wisconsin	Bayfield	20,000	adipose-left ventral
1973	Wisconsin	Bayfield	20,000	right ventral
Total			40,000	
		LAKE MICHIGAN		
1972	Michigan	Boyne R.	10,000	none
1973	Michigan	Boyne R.	15,000	none
Total			25,000	
		LAKE HURON		
1972	Michigan	Au Sable R.	9,000	none

APPENDIX C

SEA LAMPREY CONTROL IN THE UNITED STATES

Bernard R. Smith and Robert A. Bream

U.S. Fish and Wildlife Service

A major decline in the number of spawning-run sea lampreys captured at the eight electric index barriers on Lake Superior occurred in 1973. The catch of 2,847 lampreys was only 217 more than the record low of 1967. This decrease in the number of adult sea lampreys is a direct result of the intensified control program of the past 2 years. Increased funding has permitted increased surveillance and more frequent treatment of major lamprey-producing tributaries, which in turn has reduced the numbers of sea lampreys in Lake Superior.

There is no index of sea lamprey abundance in Lakes Michigan and Huron comparable with that based on catches in electric barriers in Lake Superior; however, there are indications that the control program is effective also in these areas: The collection of sea lampreys from fishermen in Lake Michigan decreased from 1,231 in 1971 to 559 in 1973; the numbers for Lake Huron for the same years were 200 and 5. Although collections for 1973 are incomplete, they already suggest a further significant reduction in sea lamprey population. Large salmonids are abundant in most areas and are providing excellent fishing.

The treatment schedule continued at an accelerated pace on the upper three lakes. A total of 54 streams with a combined flow of 8,658 cfs were treated during the year.

Surveillance of sea lamprey ammocete populations in lentic areas as well as in streams was increased during the year. Several potentially dangerous situations were examined and special attention was given to stream mouths and deltas, offshore or within river systems.

Surveys and Chemical Treatments

Lake Superior Surveys. Pretreatment surveys were completed on 20 streams tributary to Lake Superior. Eighteen were treated during the 1973 field season and the remaining two were scheduled for treatment in 1974. None of the streams appeared to have a large population throughout, although ammocetes were abundant in certain sections of several streams. The size of larvae in the Laughing Whitefish River and Five Mile Creek indicated that these streams required treatment ahead of schedule to prevent possible escapement of transforming lampreys in the fall of 1973.

Sea lamprey larvae were found in 14 of the 34 streams examined during reestablishment and posttreatment surveys. Reestablished larvae were found in 13 streams and residual larvae in 5. The size of the reestablished populations was small to moderate in all streams except the Salmon Trout River, Marquette County, Michigan, where a large population had developed since the last treatment in June 1971. Moderate numbers of sea lampreys survived recent treatments of the Rock River and the delta of Bismark Creek in Harlow Lake.

No sea lampreys were collected from six streams that seem to be suitable for ammocetes but have no history of production, or from two untreated streams where small numbers of larvae have been taken in the past.

In conjunction with regular surveys, several streams were examined each spring for evidence of sea lamprey spawning. Although the reliability of nest counts and adult lamprey observations as an index of abundance from year to year is questionable, the additional information on the status of the lamprey population is worth the little additional effort.

Evidence of spawning and nests were found in 16 of 25 Lake Superior streams examined. The Little Garlic, Traverse, Bad, and Middle Rivers were the most heavily used. On spawning riffles of the Bad River that have been checked annually since 1964, 98 nests were found in 1973 as compared with 86 in 1972. This count has ranged from a high of 189 in 1964 to a low of 38 in 1966. The Split Rock River contained what appeared to be the first significant run of adult lampreys in that stream since it was last treated in 1964. Although 29 nests were counted in 1973, no evidence of a reestablished larval population was found during surveys with shockers and Bayer granules in late August.

Lake Superior Chemical Treatments. A total of 22 streams with a combined flow of 3,235 cfs were treated (Table 1). The 19 streams on the proposed schedule were treated, as well as 3 additional streams in which large ammocetes were found. Treatments of eight streams were either postponed or cancelled on the basis of survey information which indicated that no ammocetes were present or that none were large enough to metamorphose in 1973.

The Sable River, near Grand Marais, Michigan, was treated to eliminate young-of-the-year ammocetes and to check for survival of older larvae. This stream has a history of small spawning runs and resulting year classes of ammocetes that do not survive more than 1 or 2 years. No older lampreys were collected during treatment.

Streams entering three problem lentic areas were re-treated and the deltas of two areas were surveyed with granular Bayer 73. The Sucker River and the adjacent delta in East Bay were surveyed for the third successive year. Only 43 ammocetes were collected in 1973, compared with 288 in 1972 and 602 in 1971.

The streams entering Huron Bay (Silver, Slate, and Ravine Rivers) were treated again in 1973. Ammocetes remained scarce in the vicinity of the

Table 1. Details on the application of lampricides to tributaries of Lake Superior in 1973.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)				Powder	Granules	
			Minimum effective	Maximum allowable	Pounds used	Hours applied	Pounds used	Pounds used	Acres treated
Furnace Creek	June 12	21	2.5	6.0	220	15	–	5.0	1.0
Mosquito River	June 14	13	4.5	10.0	198	10	–	–	–
Ontonagon River	June 24	780	2.0	6.0	7,766	12	–	–	–
Miners River	July 12	26	4.0	10.5	660	13	–	2.5	0.5
Little Two Hearted River	July 12	59	1.5	5.0	462	14	–	–	–
Two Hearted River	July 15	180	1.5	6.0	1,870	14	–	–	–
Ankodosh Creek	July 26	15	3.0	7.5	154	11	–	–	–
Firesteel River	July 27	65	2.0	5.5	792	14	–	–	–
Pendills Creek	July 27	30	1.5	4.0	154	9	–	–	–
Tahquamenon River	July 29	600	2.0	4.0	6,490	18	79.1	–	–
Laughing Whitefish River	Aug. 2	90	2.0	5.0	660	13	–	2.5	0.5
Arrowhead River	Aug. 16	300	1.0	2.0	616	9	–	–	–
Bad River	Aug. 18	765	2.0	5.5	6,886	12	3.2	–	–
Ravine River	Aug. 28	2	2.0	5.0	44	18	–	7.5	1.5
Silver River	Aug. 29	20	2.5	6.0	286	18	–	10.0	2.0
Slate River	Aug. 30	2	2.0	5.5	22	8	–	5.0	1.0
Sucker River	Sept. 5	100	2.0	5.0	968	12	–	35.5	3.5
Chocolay River	Sept. 12	150	2.0	7.0	1,804	12	–	–	–
Eliza Creek	Sept. 18	1	1.5	3.5	22	8	–	–	–
Five Mile Creek	Oct. 17	1	1.5	3.5	22	12	–	2.5	0.5
Traverse River	Oct. 18	8	1.5	5.0	264	20	–	0.6	0.1
Mud Lake Outlet	Oct. 21	7	1.0	2.5	132	29	–	3.7	1.0
Total	–	3,235	–	–	30,492	–	82.3	74.8	11.6

Table 1. Details on the application of lampricides to tributaries of Lake Superior in 1973.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)				Powder	Granules	
			Minimum effective	Maximum allowable	Pounds used	Hours applied	Pounds used	Pounds used	Acres treated
Furnace Creek	June 12	21	2.5	6.0	220	15	–	5.0	1.0
Mosquito River	June 14	13	4.5	10.0	198	10	–	–	–
Ontonagon River	June 24	780	2.0	6.0	7,766	12	–	–	–
Miners River	July 12	26	4.0	10.5	660	13	–	2.5	0.5
Little Two Hearted River	July 12	59	1.5	5.0	462	14	–	–	–
Two Hearted River	July 15	180	1.5	6.0	1,870	14	–	–	–
Ankodosh Creek	July 26	15	3.0	7.5	154	11	–	–	–
Firesteel River	July 27	65	2.0	5.5	792	14	–	–	–
Pendills Creek	July 27	30	1.5	4.0	154	9	–	–	–
Tahquamenon River	July 29	600	2.0	4.0	6,490	18	79.1	–	–
Laughing Whitefish River	Aug. 2	90	2.0	5.0	660	13	–	2.5	0.5
Arrowhead River	Aug. 16	300	1.0	2.0	616	9	–	–	–
Bad River	Aug. 18	765	2.0	5.5	6,886	12	3.2	–	–
Ravine River	Aug. 28	2	2.0	5.0	44	18	–	7.5	1.5
Silver River	Aug. 29	20	2.5	6.0	286	18	–	10.0	2.0
Slate River	Aug. 30	2	2.0	5.5	22	8	–	5.0	1.0
Sucker River	Sept. 5	100	2.0	5.0	968	12	–	35.5	3.5
Chocolay River	Sept. 12	150	2.0	7.0	1,804	12	–	–	–
Eliza Creek	Sept. 18	1	1.5	3.5	22	8	–	–	–
Five Mile Creek	Oct. 17	1	1.5	3.5	22	12	–	2.5	0.5
Traverse River	Oct. 18	8	1.5	5.0	264	20	–	0.6	0.1
Mud Lake Outlet	Oct. 21	7	1.0	2.5	132	29	–	3.7	1.0
Total	–	3,235	–	–	30,492	–	82.3	74.8	11.6

Slate and Ravine Rivers, and the population on the Silver River delta was halved since the 1972 treatment. It is hoped that continued treatments will reduce the ammocete population in Huron Bay.

Eliza Creek was treated again to reduce recruitment of ammocetes to a population of offshore areas of Eagle Harbor. Sea lamprey larvae were scarce in the creek. The population in Eagle Harbor was not disturbed so that growth and survival under lake conditions can be assessed later.

Ammocete populations as indicated by collections taken during treatments, were large in 4 streams (Ontonagon, Little Two Hearted, and Bad Rivers and Furnace Creek) and moderate to small in the remaining 18 streams.

No significant fish kills resulted from any of the treatments.

Lake Michigan Surveys. Pretreatment surveys were completed on 21 Lake Michigan tributaries scheduled for treatment in 1973 and 1974. The relative abundance of sea lamprey ammocetes was large in 6 rivers—the Carp Lake, Platte, Betsie, Sturgeon, Whitefish, and Cedar—and low to moderate in the 15 other streams. Several heavily infested oxbows of the Cedar River were treated with Bayer 73 during survey operations.

Survey crews examined 66 streams to assess the current status of larval populations that had developed since last treatment or had survived these treatments. Sea lamprey larvae had become reestablished in 34 streams; large populations were evident in the Manistee, Pere Marquette, and Ford Rivers. Significant populations have not been reestablished in at least 24 of the streams that were treated before 1971. Residual larvae were collected in 14 of the streams; the largest number, 144 (40-78 mm long), were found in a tributary of the Rapid River that was overlooked during pretreatment surveys. Residual populations in the other streams were relatively small.

Five Lake Michigan streams in which ammocete growth rates (and consequently the potential for early metamorphosis) are high were monitored in 1973 (Table 2). As in previous years, the Manistee River population showed the greatest size increments and should be treated on a 2-year cycle to prevent the production of parasitic-stage sea lampreys.

Fourteen Lower Peninsula streams were examined for spawning adults and nests. A total of 269 adults and 332 nests were counted in 10 streams. The most intensively used stream was the Muskegon River, where 107 nests and 25 adults were tallied. No evidence of spawning was found in the Pere Marquette River in the spring despite an intensive search, although subsequent surveys with shockers demonstrated relatively high production of ammocetes of the 1973 year class.

The large run of adult sea lampreys that congregated below the Manistique Pulp and Paper Company dam on the Manistique River was sampled regularly to provide data on a Lake Michigan spawning population. Investigations confirmed at least one route by which adult lampreys bypass the dam and gain access to the upper river. The escapement took place through leaks beneath a concrete dike that separates the headwaters of Weston Creek from the Manistique River at a point just above the paper

Table 2. Mean length (mm) and length increment of age groups of sea lamprey ammocetes collected in the spring and fall from five tributaries of Lake Michigan, 1973.
[Numbers of ammocetes measured are shown in parentheses.]

Stream	Age group 0	I			II			III
	Fall	Spring	Fall	Increment	Spring	Fall	Increment	Spring
Platte River	27 (123)	42 (25)	75) (119)	33	67 (339)	111 (305)	44	–
Betsie River	33 (195)	46 (181)	74 (441)	28	82 (28)	112 (9)	30	–
Manistee River	38 (227)	51 (180)	89 (479)	38	–	–	–	–
White River[1]	–	50 (21)	–	–	105 (118)	–	–	135 (74)
Muskegon River[1]	–	39 (127)	–	–	77 (417)	–	–	116 (156)

[1]Insufficient fall sample; stream was treated with TEM in June 1973.

company dam. An electric barrier was built in October at the mouth of Weston Creek to eliminate this bypass. Another potential problem area was eliminated by plugging a hold in the wall of the flume that may have allowed passage of adults during periods of high water. The Manistique Pulp and Paper Company has been very cooperative.

Sea lamprey larvae were found on deltas of 3 of 10 Lake Michigan streams surveyed with Bayer 73 granules. A small, previously undetected population was found off Mitchell Creek, where three larvae (155-172 mm long) were taken from a 0.5-acre plot. The infected area off the mouth of Porter Creek is larger than previously suspected. These ammocetes may be from Porter Creek or the result of spawning in the cooling water outlet of the Northern Michgian Electric Cooperative generating plant, which is about 450 feet east of Porter Creek. The source of the population will be investigated. A survey of the Boyne River delta yielded 15 sea lamprey larvae (48-116 mm long) after the stream was treated in April 1973. This number is a significant reduction from the 268 larvae taken in the same area in 1972.

Examination of the two channels of Elk Lake Outlet revealed an increase in the number of larvae in the north channel and a decrease in the south channel; 58 larvae were found in the north channel, and only 1 in the south channel, which previously had contained a moderate population.

Lake Michigan Chemical Treatments. Twenty-one streams with a combined total flow of 3,547 cfs were treated (Table 3). Treatments of four streams were postponed due to lack of water or the lack of large ammocetes. Marblehead Creek was added to the schedule when transforming ammocetes were found during the survey.

Table 3. Details on the application of lampricides to tributaries of Lake Michigan in 1973.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)		Pounds used	Hours applied	Powder	Granules	
			Minimum effective	Maximum allowable			Pounds used	Pounds used	Acres treated
Boyne River	April 18	103	4.0	8.0	1,452	11	5.6	27.5	4.5
Burns Ditch	April 27	81	8.0	15.0	1,738	11	–	–	–
State Creek	April 29	13	4.0	8.0	120	8	–	–	–
Galien River	May 10	61	8.0	17.0	1,485	14	–	–	–
St. Joseph River									
Pipestone Creek	May 12	46	9.0	16.0	836	16	–	–	–
Whitefish River	May 17	450	2.5	8.0	7,216	12	2.8	–	–
Jordan River	May 30	275	6.0	14.0	5,962	16	–	–	–
Ogontz River	June 1	35	1.0	4.0	352	16	–	10.0	1.5
Fishdam River	June 4	121	2.0	7.0	1,122	12	–	–	–
White River	June 7	520	5.0	14.0	9,064	16	18.9	–	–
Muskegon River	June 22	1,600	4.0	10.0	17,556	11	105.0	–	–
Pentwater River	July 27	60	5.0	14.0	1,122	16	5.6		
Lincoln River	Aug. 8	30	6.0	12.0	919	17	–	–	–
Elk Lake Outlet	Aug. 13	–	–	–	–	–	–	24.0	2.5
Kalamazoo River									
Bear Creek	Aug. 15	8	8.0	15.0	330	18	–	–	–
Swan Creek	Aug. 16	33	7.0	11.0	924	12	–	–	–
Mann Creek	Aug. 16	5	7.0	11.0	132	12	–	–	–
Brandywine Creek	Aug. 26	2	4.5	11.5	22	8	–	–	–
Black River	Aug. 28	50	4.0	8.0	627	16	–	–	–
Horton Creek	Sept. 12	17	6.0	13.0	264	8	–	10.0	1.5
Porter Creek	Sept. 13	8	7.0	14.0	110	7	–	22.5	2.0
Paquin Creek	Oct. 25	15	3.0	8.0	286	12	–	–	–
Marblehead Creek	Oct. 30	14	4.0	11.0	198	12	–	–	–
Total	–	3,547	–	–	51,837	–	137.9	94.0	12.0

Table 3. Details on the application of lampricides to tributaries of Lake Michigan in 1973.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)				Powder	Granules	
			Minimum effective	Maximum allowable	Pounds used	Hours applied	Pounds used	Pounds used	Acres treated
Boyne River	April 18	103	4.0	8.0	1,452	11	5.6	27.5	4.5
Burns Ditch	April 27	81	8.0	15.0	1,738	11	–	–	–
State Creek	April 29	13	4.0	8.0	120	8	–	–	–
Galien River	May 10	61	8.0	17.0	1,485	14	–	–	–
St. Joseph River									
Pipestone Creek	May 12	46	9.0	16.0	836	16	–	–	–
Whitefish River	May 17	450	2.5	8.0	7,216	12	2.8	–	–
Jordan River	May 30	275	6.0	14.0	5,962	16	–	–	–
Ogontz River	June 1	35	1.0	4.0	352	16	–	10.0	1.5
Fishdam River	June 4	121	2.0	7.0	1,122	12	–	–	–
White River	June 7	520	5.0	14.0	9,064	16	18.9	–	–
Muskegon River	June 22	1,600	4.0	10.0	17,556	11	105.0	–	–
Pentwater River	July 27	60	5.0	14.0	1,122	16	5.6		
Lincoln River	Aug. 8	30	6.0	12.0	919	17	–	–	–
Elk Lake Outlet	Aug. 13	–	–	–	–	–	–	24.0	2.5
Kalamazoo River									
Bear Creek	Aug. 15	8	8.0	15.0	330	18	–	–	–
Swan Creek	Aug. 16	33	7.0	11.0	924	12	–	–	–
Mann Creek	Aug. 16	5	7.0	11.0	132	12	–	–	–
Brandywine Creek	Aug. 26	2	4.5	11.5	22	8	–	–	–
Black River	Aug. 28	50	4.0	8.0	627	16	–	–	–
Horton Creek	Sept. 12	17	6.0	13.0	264	8	–	10.0	1.5
Porter Creek	Sept. 13	8	7.0	14.0	110	7	–	22.5	2.0
Paquin Creek	Oct. 25	15	3.0	8.0	286	12	–	–	–
Marblehead Creek	Oct. 30	14	4.0	11.0	198	12	–	–	–
Total	–	3,547	–	–	51,837	–	137.9	94.0	12.0

Sea lampreys were abundant in the Boyne, Jordan, White, Pentwater, Muskegon, Lincoln, and Ogontz Rivers and in Bear Creek, a tributary of the Kalamazoo River.

Sea lamprey distribution in Pipestone Creek (a St. Joseph River tributary) had extended above Pipestone Lake for the first time since the original treatment in 1965. Distribution in the Pentwater River also extended above the previous limit, reversing the general trend of recent years, which had been toward a reduction in area inhabited. Sea lamprey production from these areas is small.

Fish kills occurred during treatment of Bear Creek and Lincoln River. Brown trout were killed in Bear Creek when high concentrations of TFM were applied to maintain minimum lethal concentrations between successive access points. Not only was the population of brown trout larger than anticipated, but the stream was treated in mid-August when brown trout are approaching the spawning season and are more sensitive to TFM than at other times. Northern pike were killed in the estuary of the Lincoln River just above Lincoln Lake. The probable cause was the high water temperature in the estuary, which added to the stress caused by the larvicide. No other fish were killed in the system.

Lake Huron Surveys. Pretreatment surveys yielded sea lampreys in 18 of 21 Lake Huron tributaries. Treatments will be postponed indefinitely in three streams in which no sea lampreys were collected (Rock Falls and Sucker Creeks and Black River). Ammocete densities were relatively high in Elliot, Green, and Black Mallard Creeks and the Carp and Trout Rivers. Populations in the other 13 infested streams were small.

Surveys to measure reestablishment and the success of treatment were conducted on 22 streams; 16 were reinfested and at least 8 contained small to moderate numbers of larvae that had survived the previous chemical treatment. No sea lampreys were found in six streams. Reestablished populations were large in the Pigeon, East Au Gres, and Rifle Rivers and moderate in the Pine River (Iosco County). Relatively small reestablished populations were found in 12 streams, although some of the streams had been treated in 1972 and will undoubtedly develop larger populations within the next year or two. The numbers of residual larvae were generally small, except in a tributary of the Pine River (Mackinac County) that was subsequently re-treated.

Twenty-five tributaries of the St. Clair River and Lake St. Clair were resurveyed for the first time since 1963. As in all previous surveys, no sea lampreys were found. The limiting factors to sea lamprey production in these southern streams appear to be insufficient flow (in all but the Belle River and Chrysler Drain) and the lack of spawning and larval habitat. Native ammocetes, *Ichthyomyzon* spp., were found in four streams. Most surveys in the region were conducted with granular Bayer 73 because of high turbidity (caused by suspended clay).

Spawning surveys on 11 Lower Peninsula streams in 1973 yielded a total count of 50 adults and 255 nests. A general decrease in spawning from

1972 was apparent; the decrease was greatest in two of the highest sea lamprey-producing streams, the Devils and Rifle Rivers which were last treated in 1972.

Bayer 73 granules were used to survey the deltas of five Lake Huron streams. Sea lamprey larvae were found for the first time off the mouths of three streams: 8 larvae (108-175 mm long) were collected off the Cheboygan River, 70 (29-172 mm long) were taken off Elliot Creek, and 1 (145 mm long) off Mulligan Creek. The population on the Cheboygan River delta is apparently small, although a dense growth of aquatic vegetation in the area may have prevented the chemical from reaching some of the ammocetes.

Lake Huron Chemical Treatments. Eleven streams with a total flow of 1,876 cfs were treated during the year (Table 4). Nine streams were scheduled for treatment and two were added in which ammocetes 120 mm and longer were collected during stream surveys.

Large ammocetes were discovered in the estuary of Trout Creek after the 1972 treatment. Apparently high lake levels increased the volume of the estuary and diluted the chemical, allowing survival of sea lamprey ammocetes. When the stream was re-treated in 1973, powdered Bayer 73 was introduced in the estuary to synergize the chemical. A large number of ammocetes were killed below Highway M-134.

The Au Sable River, in which ammocetes grow rapidly, is presently on a 3-year treatment schedule. Granular Bayer 73 surveys in several bayous and off the mouth of the river a week after treatment produced only one sea lamprey ammocete. Apparently TFM penetrates these areas in sufficient strength during normal treatment to eradicate existing populations.

Lake Erie Surveys. Stream survey crews examined 26 Lake Erie tributaries in Ohio and Michigan in 1973 to determine the presence, abundance, and general distribution of sea lamprey larvae. Ammocetes were found in the Grand River, Lake County, Ohio, and in Conneaut Creek, Ashtabula County, Ohio.

Personnel from the New York Department of Environmental Conservation, who rechecked 94 streams in New York, discovered sea lampreys in one tributary of Cattaraugus Creek in Erie County.

In addition to the three streams where sea lamprey larvae were found in 1973, Raccoon and Crooked Creeks in Erie County, Pennsylvania, are classed as positive as a result of surveys in 1965. There is also a record of a transformed sea lamprey being caught in a fyke net in the Sandusky River in the 1960's.

The populations in all of the infected Lake Erie streams apparently are small and restricted in distribution; however, the surveys were superficial, and additional effort will be required in many areas before a complete assessment of the sea lamprey-producing potential of these streams can be formulated.

Table 4. Details on the application of lampricides to tributaries of Lake Huron in 1973.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 76		
			Concentration (ppm)				Power	Granules	
			Minimum effective	Maximum allowable	Pounds used	Hours applied	Pounds used	Pounds used	Acres treated
Carp River	May 5	500	2.0	9.0	4,554	12	–	–	–
Au Sable River	July 19	1,300	4.0	9.0	14,542	10	42.0	13.8	1.5
Cheboygan River	Aug. 2	–	–	–	–	–	–	36.8	3.0
Little Munuscong River	Sept. 20	25	3.0	9.0	616	16	1.4	–	–
Munuscong River	Sept. 24	30	6.0	14.0	682	16	–	–	–
Carlton Creek	Sept. 25	5	6.0	14.0	–	7	8.4	–	–
Albany Creek	Oct. 3	7	3.5	10.5	242	18	1.8	–	–
Caribou Creek	Oct. 4	1	3.5	10.5	22	9	–	–	–
Bear Creek	Oct. 6	1	3.5	9.5	22	9	–	–	–
Trout Creek	Oct. 6	4	3.5	9.0	44	7	3.9	–	–
Prentiss Creek	Oct. 7	3	7.0	18.0	220	19	3.9	–	–
Total	–	1,876	–	–	20,944	–	61.4	50.6	4.5

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Total	–	1,876	–	–	20,944	–	61.4	50.6	4.5

Lake Ontario Surveys. No stream surveys were undertaken by the U.S. agent on Lake Ontario in 1973.

Canadian survey crews conducted pretreatment investigations on eight streams scheduled for re-treatment by the Sea Lamprey Control Unit from Sault Ste. Marie, Ontario. In addition to larvae that had survived treatment in 1972, reestablished populations were apparent in all but two streams (Blind and Sodus Creeks). All of the streams were re-treated with the exception of Grindstone Creek where stream flows were too low. During surveys immediately after treatments, two residual sea lampreys were found in Lindsey Creek, seven in Little Sandy Creek, and eight in tributaries of the Salmon River.

Crews from the New York Department of Environmental Conservation conducted posttreatment and reestablishment surveys in late summer and early fall on all streams treated in 1972 and 1973. Reestablished populations were evident in 13 streams; numbers of ammocetes were relatively large in Stony, Skinner, Lindsey, Little Sandy, Grindstone, and Sterling Creeks. Small to moderate numbers of larvae were taken in seven streams and none in seven others. One residual ammocete each was taken from Skinner, Little Sandy, and Catfish Creeks and three were collected from tributaries of the Salmon River.

State personnel found no sea lampreys in eight other tributaries of Lake Ontario that appear to have potential for sea lamprey production, or in the Oneida River. Sea lampreys were found in 5 of the 40 tributaries of Oneida Lake examined; all the infested streams are along the north shore of the lake. The populations were small to moderate, except for the very large population in Fish Creek. Fyke net operations showed that this stream is producing parasitic-phase sea lampreys.

Studies of Adult Sea Lampreys

Migrant Sea Lampreys. Electric barriers were operated on eight streams tributary to the south shore of Lake Superior from early April until July 13 to provide an index of abundance and data on the biological characteristics of sea lampreys.

The total of 2,847 sea lampreys in 1973 was 71% less than for the corresponding period in 1972, and only 8% over the lowest recorded catch in 1967 (Table 5). The catch was only 7% of the precontrol (1958-61) average of 38,535.

The spawning run developed erratically. An early peak (11% of the total run) appeared May 21-25, but the catches were largest (24% of the total run) on June 5-10. The run declined slowly through late June and early July; the last 5-day period of operation produced 72 sea lampreys, or 3% of the total catch.

In comparison with the 1972 catches, the numbers of sea lampreys declined 90% west of the Keweenaw Peninsula and 55% in eastern Lake Superior. Counts for the Silver and Brule Rivers, the major producers in 1972, declined 81 and 94%, respectively.

Table 5. Number of adult sea lampreys taken at electric barriers operated in eight tributaries of Lake Superior through July 13, 1961-73.

River	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Betsy	1,366	316	444	272	187	65	57	78	120	87	104	146	294
Two Hearted	7,498	1,757	2,447	1,425	1,265	878	796	2,132	1,104	1,132	1,035	1,507	894
Sucker	3,209	474	698	386	532	223	166	658	494	337	485	642	468
Chocolay	4,201	423	358	445	563	260	65	122	142	291	53	294	270
Iron	2,430	1,161	110	178	283	491	643	82	556	713	1,518	280	16
Silver	5,052	267	760	593	847	1,010	339	1,032	1,147	321	340	2,574	495
Brule	22,478	2,026	3,418	6,718	6,163	226	364	2,657	3,374	167	1,754	4,121	261
Amnicon	4,741	879	131	232	700	938	200	148	1,576	1,733	4,324	132	149
Total	50,975	7,303	8,366	10,249	10,540	4,091	2,630	6,909	8,513	4,781	9,613	9,696	2,847
Percentage of the 1958-61 mean	132	19	22	27	27	11	7	18	22	12	25	25	7

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Average length of sea lampreys caught at the barriers decreased from 443 mm in 1972 to 421 mm in 1973 and average weight from 192 g to 161 g. The percentage of males in 1973 was 31, the same as in 1972.

The percentage of rainbow trout longer than 30.5 cm (total length) with sea lamprey wounds or scars declined slightly, from 3.3 in 1972 to 3.0 in 1973.

The number of rainbow trout handled at the barriers reached an all-time high in 1973, whereas the numbers of longnose and white suckers were at an all-time low. The number of fish of these species taken in 1973 and (in parentheses) the average number caught in 1967-72 were as follows: spawning-run rainbow trout, 1,805 (1,058); white suckers, 6,001 (12,603); and longnose suckers, 7,693 (18,657). Rainbow trout increased 71%, whereas the numbers of white suckers and longnose suckers were 48 and 41% below the 6-year average.

The weir on the Ocqueoc River, a tributary of Lake Huron, captured 641 adult sea lampreys. Escapement of sea lampreys through the weir, which was constructed in 1972, was reported. To prevent escapage of lampreys through the weir, workmen intensified the electrical field and stabilized the stream bed in the fall of 1973.

A collection of 546 spawning-run sea lampreys were obtained from the Manistique River, a tributary of Lake Michigan. The lampreys averaged 480 mm in length and 226 g in weight, and 45% were males in 1973; comparable figures for 1972 are 465 mm, 231 g, and 33%.

Parasitic Sea Lampreys. Parasitic-phase sea lampreys have been collected from Lake Superior since August 1969, from Lakes Michigan and Huron since August 1970 (Table 6), and from Lake Erie since September 1971. Analysis of the 1973 collections is incomplete.

In 1973, 295 sea lampreys were taken by Lake Superior commercial and sport fishermen (Table 7); 93% of the total came from 3 of the 10 statistical districts–51% from Wisconsin, 21% from the Keweenaw Peninsula area (MS-3) and 21% from the Munising, Michigan, area (MS-4).

Fishermen operating in the Keweenaw Peninsula area (MS-3) contributed 57% of the parasitic-phase sea lampreys less than 201 mm long taken in 1969-73.

The percentage of males has been consistently higher among sea lampreys caught at the weirs than among those taken by fishermen. In 1970-73, the percentage was 32% in weir catches and 22% in the fisheries.

Lake Michigan fishermen captured 559 sea lampreys in 1973, of which 53% were taken in the Gills Rock, Wisconsin, area (WM-2). The percentage of males among parasitic-phase sea lampreys taken by Lake Michigan fishermen was 30.4 in 1970, 30.7 in 1971, 39.7 in 1972, and 35.7 in 1973.

Sixty-eight percent of the parasitic-phase sea lampreys less than 201 mm long were collected from the Gills Rock, Wisconsin, area (WM-2) in 1970-73.

Fishermen collected only five parasitic-phase sea lampreys from Lake Huron and six from Lake Erie in 1973.

The analysis of data is continuing.

Table 6. Number of sea lampreys collected in commercial and sport fisheries by lake and month, 1969-73.

[No spawning-phase sea lampreys were collected in 1969-70. Collections are not complete for 1973.]

	Parasitic-phase												
	Length 200 mm or less					Length greater than 200 mm					Spawning-phase		
Month	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973	1971	1972	1973
Lake Superior													
Jan.	–	0	6	4	0	–	12	25	74	24	0	0	0
Feb.	–	1	0	1	1	–	15	27	57	18	0	0	0
Mar.	–	0	3	1	2	–	19	53	54	64	0	0	0
Apr.	–	1	2	0	2	–	18	51	20	118	0	0	0
May	–	1	2	2	2	–	19	52	33	53	0	3	2
June	–	1	5	5	0	–	4	39	35	1	0	3	0
July	–	0	2	2	0	–	12	91	44	2	0	2	0
Aug.	0	0	0	0	0	11	22	65	33	6	0	1	0
Sept.	0	0	0	0	0	32	31	52	54	0	0	7	0
Oct.	0	0	3	0	0	11	19	30	4	0	0	0	0
Nov.	4	7	9	1	0	9	7	12	6	0	0	0	0
Dec.	8	20	15	2	0	43	36	90	19	0	0	0	0
Total	12	31	47	18	7	106	214	587	433	286	0	16	2
Lake Michigan													
Jan.	–	–	7	6	4	–	–	11	21	11	0	0	0
Feb.	–	–	14	2	1	–	–	4	0	3	0	0	0
Mar.	–	–	6	1	2	–	–	7	3	21	3	0	1
Apr.	–	–	10	5	4	–	–	70	17	27	34	0	6
May	–	–	54	52	62	–	–	76	81	101	94	123	31
June	–	–	135	113	35	–	–	334	243	145	16	77	13
July	–	–	3	14	3	–	–	71	204	72	0	5	1
Aug.	–	0	4	1	0	–	18	114	59	16	2	1	0
Sept.	–	0	0	0	0	–	42	50	68	0	0	0	0
Oct.	–	0	0	2	0	–	31	70	38	0	0	0	0
Nov.	–	5	0	1	0	–	22	11	13	0	0	0	0
Dec.	–	42	5	4	0	–	34	26	31	0	0	0	0
Total	–	47	238	201	111	–	147	844	778	396	149	206	52
Lake Huron													
Jan.	–	–	0	0	0	–	–	2	0	1	0	0	0
Feb.	–	–	0	0	0	–	–	0	1	0	0	0	0
Mar.	–	–	0	0	0	–	–	0	0	0	0	0	0
Apr.	–	–	0	4	0	–	–	1	0	0	0	0	0
May	–	–	1	1	0	–	–	5	4	1	0	0	0
June	–	–	0	1	0	–	–	25	11	2	0	0	0
July	–	–	0	0	0	–	–	34	16	1	0	0	0
Aug.	–	0	0	0	0	–	13	48	6	0	0	0	0
Sept.	–	0	0	0	0	–	49	48	41	0	0	0	0
Oct.	–	0	0	0	0	–	29	31	30	0	0	0	0
Nov.	–	0	0	0	0	–	0	3	5	0	0	0	0
Dec.	–	0	0	0	0	–	0	2	0	0	0	0	0
Total	–	0	1	6	0	–	91	199	114	5	0	0	0

Table 7. Number of sea lampreys collected in commercial and sport fisheries by lake and statistical district, 1969-73.

[Collections were begun in August 1969 in Lake Superior and August 1970 in Lakes Michigan and Huron. No spawning-phase sea lampreys were taken in 1969-70. Collections are not complete for 1973.]

	Parasitic-phase												
	Length 200 mm or less					Length greater than 200 mm					Spawning-phase		
District[1]	1969	1970	1971	1972	1973	1969	1970	1971	1972	1973	1971	1972	1973
Lake Superior													
M-1	0	0	0	0	0	1	3	2	3	3	0	2	0
M-2	0	0	0	0	0	7	6	5	16	9	0	7	0
M-3	0	0	0	1	0	11	16	16	7	6	0	0	0
Wisc.	3	15	8	3	2	30	101	302	232	148	0	2	1
MS-1	0	0	0	0	0	3	4	0	0	0	0	0	0
MS-2	0	0	0	0	0	1	10	23	8	1	0	2	0
MS-3	6	13	32	11	4	18	19	67	29	59	0	0	0
MS-4	2	2	5	1	1	24	49	143	120	59	0	3	1
MS-5	0	0	0	0	0	2	0	18	5	0	0	0	0
MS-6	1	1	2	2	0	9	6	12	13	1	0	0	0
Total	12	31	47	18	7	106	214	587	433	286	0	16	2
Lake Michigan													
MM-1	–	0	0	1	8	–	6	29	46	64	0	0	1
MM-2	–	25	2	1	0	–	5	20	9	0	0	0	0
MM-3	–	3	14	22	8	–	40	68	106	51	3	2	0
MM-4	–	0	0	0	0	–	0	0	0	0	0	0	0
MM-5	–	4	2	10	2	–	2	3	7	1	0	4	1
MM-6	–	0	0	0	0	–	0	0	0	0	0	0	0
MM-7	–	0	0	0	0	–	0	2	0	0	0	0	0
MM-8	–	1	2	2	0	–	0	1	1	0	0	0	0
WM-1	–	1	3	5	1	–	2	62	31	8	16	40	8
WM-2	–	0	175	144	84	–	1	410	432	215	0	0	0
WM-3	–	11	23	6	2	–	20	123	108	17	0	0	0
WM-4	–	1	8	3	1	–	66	112	27	34	130	160	42
WM-5	–	1	9	5	5	–	5	14	11	6	0	0	0
WM-6	–	0	0	2	0	–	0	0	0	0	0	0	0
Ill.	–	0	0	0	0	–	0	0	0	0	0	0	0
Ind.	–	0	0	0	0	–	0	0	0	0	0	0	0
Total	–	47	238	201	111	–	147	844	778	396	149	206	52
Lake Huron													
MH-1	–	0	1	2	0	–	69	109	88	4	0	0	0
MH-2	–	0	0	0	0	–	0	0	0	0	0	0	0
MH-3	–	0	0	4	0	–	10	40	5	0	0	0	0
MH-4	–	0	0	0	0	–	11	35	21	1	0	0	0
MH-5	–	0	0	0	0	–	0	0	0	0	0	0	0
MH-6	–	0	0	0	0	–	1	15	0	0	0	0	0
Total	–	0	1	6	0	–	91	199	114	5	0	0	0

[1]Boundaries are defined in "Fishery Statistical Districts of the Great Lakes" by S. H. Smith, H. J. Buettner, and R. Hile published in Great Lakes Fishery Commission Technical Report No. 2, 1961.

Reestablishment of Larvae in Treated Streams

Reestablishment studies continue to provide information on the establishment of year classes in streams each year. Larvae of the 1972 year class were recovered in 36 streams, compared with an average of 43 streams for the four previous year classes. Larvae of the 1973 year class were collected in 26 streams, and an additional 14 streams remain to be surveyed. Chemical treatments in 1973 eliminated larvae of the 1973 year class in seven streams. Table 8 shows the present status of the remaining reestablished populations in tributaries of Lake Superior.

Studies of Lentic Populations

Additional manpower and the authorization for four men to scuba dive made it possible to intensify surveillance of lentic areas in Lake Superior. Surveys of lentic areas on deltas of inland lakes, estuaries, and offshore areas of Lake Superior were conducted in eastern Lake Superior.

Table 8. Tributaries of Lake Superior with reestablished populations of sea lampreys.

Stream	Date of last treatment	Year class present			
		1970	1971	1972	1973
Betsy River	7/23/70		X	X	X
Little Two Hearted River	7/12/73				X
Two Hearted River	7/15/73				X
Sullivans Creek	8/2/71			X	
Seven Mile Creek	7/19/67				X
Beaver Lake Outlet	7/28/71			X	X
Furnace Creek	6/12/73				X
Au Train River	8/10/72			X	X
Rock River	9/21/71		X		
Harlow Creek	7/5/72			X	X
Little Garlic River	6/30/70	X	X	X	X
Big Garlic River	9/6/72				X
Salmon Trout River (Mq.)	6/23/71		X	X	X
Huron River	7/26/72			X	X
Sturgeon River	7/29/72				X
Big Gratiot River	8/5/72			X	
Salmon Trout River (Htn.)	8/5/72			X	X
Misery River	9/8/69		X	X	
East Sleeping River	8/27/72				X
Ontonagon River	6/24/73				X
Potato River	7/8/71			X	
Brule River	7/17/72			X	
Poplar River	10/22/71				X
Middle River	9/24/72				X
Nemadji River	7/15/72[1]		X		X
Number of streams		1	6	13	19

[1]Treated a tributary (Black River) only.

Small numbers of sea lamprey larvae were collected for the first time in Lake Superior off Pendills Creek (1), Ankodosh Creek (9), Five Mile Creek (2), and Big Garlic River (1). Spawning areas in these streams are a short distance from the mouth and the streams support only small populations of ammocetes.

Deltas in inland lakes continue to harbor populations of ammocetes after chemical treatments. Ammocetes were recovered from deltas of the Sucker River, Big Garlic River, Au Train River, Harlow Creek, and the Sturgeon River. These delta-oriented ammocetes result from (1) downstream migration of reestablished populations, (2) incomplete mortality of larvae during chemical treatments, and (3) migration of lake-dwelling larvae to the deltas.

The delta of Bismark Creek in Harlow Lake was treated in August 1973 as part of a study to test the orientation of lake-dwelling ammocetes to stream mouths or deltas. The experiment began in July 1970 when 476 marked sea lampreys were released in the middle of Harlow Lake (75 acres). Two marked ammocetes were recovered in 1973, compared with 3 in 1972, 26 in 1971, and 3 in 1970.

The Huron and Firesteel Rivers have estuaries 1.5 to 2 miles long. Yearling sea lampreys were collected within 300 yards of the mouth of these rivers, indicating extensive downstream drift and the necessity for lethal concentrations of selective larvicides to carry the length of the estuaries.

As part of a study of the ammocete populations in offshore areas of Lake Superior, 21 ammocetes of known age (age-group XIII) from the Big Garlic River were caged and placed in 40 feet of water in Lake Superior. Control animals (100) were caged in the Big Garlic River. The study was designed to determine whether ammocetes that migrate into deep, cold waters of Lake Superior can survive and metamorphose at rates similar to those of stream-dwelling larvae. Examination of the cages in October 1973 showed a 55% mortality and no transformation in the Lake Superior group and 38% mortality and 31% transformation in the control group. These preliminary data from a small sample suggest that it may be difficult if not impossible for sea lamprey ammocetes to reach the transformation stage in the deeper waters of Lake Superior. Additional experiments are planned.

Examination of the St. Marys River upstream from Sault Ste. Marie, Michigan, revealed water flows and extensive gravel beds suitable for sea lamprey spawning. Preliminary results show an extremely large population of American brook lampreys. A total of 736 American brook lamprey larvae were collected in one test area of 5,000 square feet. One sea lamprey larva 123 mm long) was also collected in this sample. Inasmuch as about 50 sea gulls were feeding heavily on the surfacing ammocetes, the total larval population was probably several times larger than the number collected. Sea lampreys were absent in seven other areas sampled in the St. Marys River. Further examination of the upper St. Marys River for spawning adults and ammocetes will be conducted in 1974.

Age and Growth of Larvae in Big Garlic River

The isolated population of larval lampreys established in the Big Garlic River in 1960 continues to provide information on the biology of sea lampreys. The known-age population is now in its 14th year of life and has produced transformed lampreys for 9 consecutive years. The downstream trap captured 272 metamorphosed lampreys in the fall of 1973, compared with 159 during the same period in 1972, an increase of about 71%.

The number of ammocetes captured at the downstream trap decreased about 83% in the 1972-73 migration period from the movement in 1971-72 (530 in 1972-73 and 3,062 in 1971-72). The reduction in the number of larval lampreys is the result of the chemical treatment of the lower section of the study area in September 1972. The treatment removed an estimated two-thirds of the sea lamprey population in the stream. During the eight migration seasons (fall and spring), the following numbers of larval and transformed sea lampreys of the 1960 year class have been taken:

Period	Larval	Transformed
1965-66	7,684	4
1966-67	7,931	46
1967-68	10,728	229
1968-69	13,244	398
1969-70	6,075	358
1970-71	3,759	659
1971-72	3,062	901
1972-73	530	193

The elimination of larvae from the lower one-fifth of the river in 1972 provided an opportunity to study movement of larvae. These data show that large ammocetes in a population moved downstream first. Larvae captured in the upper section of the river in the fall of 1972 averaged 129 mm (range, 98-173) compared with an average length of 155 mm (range, 130-174) for those captured in the lowest section in the spring of 1973. Since little growth takes place during the winter, the larger size was attributed to movement rather than growth. In addition, the larvae captured in the lower section transformed at a higher rate than those in the upper section.

A total of 106 ammocetes were collected with an electrical shocker in October for annual growth information. The ammocetes averaged 135 mm long (range, 108-180 mm), an increase in mean length of 6 mm since October 1972.

APPENDIX D

SEA LAMPREY CONTROL IN CANADA

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Fisheries and Marine Service
Resource Management Branch
Department of the Environment

This report summarizes the activities of the Canadian sea lamprey control program during the period April 1, 1973 to March 31, 1974, in compliance with a Memorandum of Agreement between the Department of the Environment and the Great Lakes Fishery Commission. The Department acts as agent for the Commission in carrying out sea lamprey control on the Canadian side of the Great Lakes. The Canadian sea lamprey control program is the responsibility of the Department's Sea Lamprey Control Centre located at Sault Ste. Marie, Ontario.

Electric Barrier Operation

In 1973 seven electric assessment barriers were operated on tributaries to the Canadian side of Lake Huron: One on the North Channel, three on Georgian Bay, and three on the main basin of Lake Huron. The total catch in 1973 was 197 sea lamprey (Table I) a decrease of 87 per cent from the 1972 catch, and of 92 per cent from the average catch for 1969-1972.

The marked decline in the 1973 total sea lamprey run on the Canadian side of Lake Huron, as measured by the assessment barriers, was most striking in Georgian Bay; however every river except the Manitou shared in the reduction. This consistency supports the assumption that the reduced runs in 1973 reflect a reduction in the 1973 sea lamprey population in the Canadian waters of Lake Huron.

Stream Surveys

Sea lamprey larval surveys were conducted on 38 streams tributary to Lake Superior from June through September, 1973. Sixteen streams with no previous sea lamprey history underwent routine surveys with two new sea lamprey producing streams being discovered: the Jackpine and the Mackenzie. Both of these new sea lamprey populations are confined to the estuarine area due to the presence of a natural barrier near the mouths of the rivers, and the extreme sacrcity of larval habitat found in that area from the barrier to the lake. Thirteen of 16 previously treated streams, surveyed

Table I. Numbers of sea lamprey taken in electrical assessment barriers, Lake Huron, from 1969 to 1973 inclusive.

Streams	Count for season				
	1969	1970	1971	1972	1973
North Channel Area					
Kaskawong	478	482	271	207	135
Georgian Bay Area					
Still	1621	558	960	426	14
Naiscoot-Harris	785	173	446	474	8
Mad	42	8	15	1	0
Totals	2448	739	1421	901	22
Lake Huron Area					
Manitou	144	3	12	11	14
Blue Jay	1130	236	332	380	22
Bayfield	582	128	7	7	4
Totals	1856	367	351	398	40
Grand Totals	4782	1588	2043	1506	197

to determine whether sea lamprey had become reestablished, produced sea lamprey larvae. Sea lamprey larvae were collected from the Big Pic River for the first time since 1967 when one small sea lamprey (51 mm) was collected in the main river. However because of the immensity and inaccessibility of this watershed, a lamprey population has likely been present, but undetected, since the last chemical treatment in 1965. Eleven streams underwent distribution surveys in preparation for lampricide treatments in 1973 or 1974. Treatment evaluation surveys were conducted on five streams treated with lampricide with small numbers of residual sea lamprey larvae being collected from the Pancake and Jackpine Rivers.

In the Lake Huron drainage 37 streams underwent sea lamprey larval surveys. Routine surveys conducted on 10 streams revealed previously undetected populations of sea lamprey larvae in two: Sand Creek and the Western Channel of the lower French River. Surveys on the Western Channel revealed very marginal sea lamprey larval populations in three areas—the Bad River Channel, the Cross Channel, and a cut emptying into the Cross Channel. Extensive survey work is required in the complex mouth area of the French River to determine the density and distribution of these populations. Reestablishment surveys were conducted on 19 streams with sea lamprey larvae being found in 11. Two of the more significant streams, in terms of past treatment cost and/or sea lamprey larval abundance, failing to show reestablished populations of sea lamprey were the Bayfield and Saugeen Rivers, last treated with lampricide in 1970 and 1971 respectively. It is interesting to note that both of these rivers still experience small adult sea lamprey spawning runs. Distribution surveys were conducted on 12

streams, six of which were treated with lampricide in 1973. The distribution survey conducted in the St. Marys River was carried out in conjunction with a biological and topographic study of the St. Marys River rapids in the Whitefish Island area. Seventy-two sea lamprey larvae (21 to 161 mm in length) including two fully transformed sea lamprey, and 44 native lamprey larvae were collected. The majority of these lamprey came from two areas which have not previously been treated with lampricide.

On the Canadian side of Lake Ontario distribution surveys were conducted on nine streams. Two of these streams and a tributary to a third were subsequently treated with lampricide in 1973. On the United States (New York) side, distribution and treatment-evaluation surveys were conducted on the eight streams treated with lampricide in 1973 as well as on Fish Creek, a tributary to Oneida Lake. Small numbers of sea lamprey larvae were found in Lindsay, Little Sandy, Beaverdam and Trout Creeks after the 1973 treatments. These residual sea lamprey larvae were collected from common problem areas such as the mouths of small freshets and water impoundments. In addition, surveys were conducted in June and August on the Niagara River. In August a Canadian survey unit was assisted by a team of SCUBA divers from the Bureau of Sport Fish and Wildlife from Marquette, Michigan, who provided information on sea lamprey larval and spawning habitat in the river and delta areas and also assisted in the application of lampricide. Granular Bayer 73 was applied to 20 areas (approximately 5.2 acres) from which 55 American brook lamprey only, were collected.

Lampricide Treatments

On Lake Superior all five streams specified in the Memorandum of Agreement were treated with the lampricide TFM. In addition, granular Bayer 73 treatments were conducted in the lower Nipigon River, Stillwater Creek estuary, Mackenzie River estuary and in five areas of Batchawana Bay (Table II). Both the Pine River and the Mackenzie River estuary were treated for the first time in 1973, sea lamprey larvae having been collected from them for the first time in 1971 and 1973 respectively. Only 16 sea lamprey larvae (36 to 176 mm in length) were collected from the Pine River during this treatment and it was concluded that extreme annual fluctuations in water discharge, extreme scarcity of lamprey larval habitat, and the presence of a long river estuary tend to suppress this sea lamprey larval population. Sea lamprey larvae were abundant in the Mackenzie River estuary with 687 (31 to 196 mm in length) including one transforming sea lamprey, being collected.

Six of the seven specified Lake Huron streams were treated with the lampricide TFM—the Echo, Mindemoya, Manitou, Blue Jay, Kaboni and Wanapitei, a tributary to the French River. Gawas Creek, located on St. Joseph Island, was deferred due to the relative scarcity of sea lamprey larvae, and the Sand Creek, located on Cockburn Island, was added to the schedule when sea lamprey larvae were discovered in this stream for the first

Table II. Summary of streams and lake areas treated with lampricide on the Canadian side of Lake Superior, 1973.

Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles or acres[1] treated
Cloud	July 9-12	10	212	–	–	Scarce	4 M
Pine	July 12-13	53	347	6	25	Scarce	2 M
Jackfish	July 15-19	56	584	10	50	Moderate	8 M
Pancake	July 23-27	16	204	–	–	Abundant	8 M
Kaministikwia	Aug. 12-14 Sept. 16-20	995	8,038	150	20	Moderate	49 M
Mackenzie Bay	July 20	–	–	–	1,150	Abundant	7.8 A
Nipigon Bay							
Nipigon	Aug. 16-25	–	–	–	1,800	Abundant	8.0 A
Stillwater	Aug. 19, 21	–	–	–	500	Moderate	2.2 A
Batchawana Bay							
Stokely	Aug. 26	–	–	–	204	Scarce	1.3 A
Harmony	Aug. 27	–	–	–	170	Scarce	1.1 A
Sable	Aug. 27	–	–	–	70	Scarce	0.4 A
Batchawana	Aug. 28-29	–	–	–	782	Abundant	5.2 A
Chippewa	Aug. 30	–	–	–	323	Abundant	2.2 A
Totals		1,130	9,385	166	5,094		71 M 28 A

[1]Lake or estuarine area treated with granular Bayer 73 (acres).

Table III. Summary of streams and lake areas treated with lampricide on the Canadian side of Lake Huron, 1973.

Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles or acres[1] treated
Echo	June 12-15,20,23	117	3,096	–	–	Scarce	28.0 M
Blue Jay	July 9-11	25	654	5	3	Moderate	7.5 M
Manitou	July 19	93	1,221	11	–	Moderate	1.0 M
Kaboni	July 12-24	3	273	2	18	Moderate	7.0 M
Mindemoya	July 25-26	18	473	4	36	Abundant	1.5 M
French Wanapitei	Aug. 20-22	540	3,133	1	–	Scarce	6.0 M
Sand	Sept. 10-12	5	368	2	–	Moderate	3.0 M
Echo River							
Stewart Lake	June 20, Aug. 24	–	–	–	350	Abundant	2.5 A
Michael Bay							
Blue Jay	July 17,21	–	–	–	400	Scarce	3.0 A
Manitou	July 19-21,23	–	–	–	750	Moderate	7.0 A
Providence Bay							
Mindemoya	July 22	–	–	–	425	Moderate	4.5 A
Magnetawan River							
Byng Inlet	Aug. 13	–	–	–	425	Moderate	4.0 A
Key River							
Portage Lake	Aug. 14	–	–	–	125	Scarce	1.0A
St. Marys River							
Whitefish Island	Sept. 6-7	–	–	–	2,075	Moderate	9.0 A
Totals		801	9,218	25	4,607		54 M 31 A

[1]Lake or estuarine area treated with granular Bayer 73 (acres).

time. In addition, five lake areas and two river areas were treated with granular Bayer 73 in a continuing effort to eradicate sea lamprey larvae populations in these "awkward to treat" areas (Table III). Only 42 sea lamprey larvae (71 to 141 mm in length) were collected from the costly and complicated Wanapitei River treatment; the treatment was deemed necessary since the small reestablished sea lamprey larval population posed a threat of spreading sea lamprey infestation to much of the huge French River system. The abundance of sea lamprey larvae (1,125 including 37 transforming larvae) collected from this initial lampricide treatment of Sand Creek, the only known sea lamprey producing stream on Cockburn Island, may explain the relatively high incidental catch of adult sea lamprey from the Burnt Island commercial fisheries (Statistical Division OH1) during the past few years. The closest known sea lamprey producing stream to Sand Creek is Canoe Lake Outlet located on Drummond Island (U.S.A.) which was treated with lampricide for the first time in 1970.

Of the 19 streams scheduled for lampricide treatment on Lake Ontario in 1973 (Ontario–11, New York State–8), 10 were completed (Table IV).

In New York State, Grindstone Creek was deferred due to an inadequate water discharge level (low). Only the three major tributaries to the Salmon River were treated, the main river being deferred after extensive surveys indicated the absence of a significant residual sea lamprey larval population. Treatment of these New York streams, previously treated in 1972 by a chemical control unit from the United States Fish and Wildlife Service, Marquette, Michigan, was complicated by significant increases in water discharge from headwater to mouth areas and numerous water impoundment areas. Treatment in the estuarine areas of these streams was further complicated by the extreme (record) high water levels experienced in Lake Ontario during the spring of 1973. Residual sea lamprey larvae (those larvae larger than 51 mm in length) were moderately abundant in all of the streams treated with lampricide except Sodus and Blind.

Of the 11 streams tributary to the Canadian side of Lake Ontario scheduled for treatment in 1973, only three were completed. Three streams were deferred due to the relative scarcity of larval sea lamprey and/or the apparent absence of residual sea lamprey, and five streams were deferred due to excessively high water discharge levels. Residual sea lamprey larvae from the 1971 treatments were collected from Graham Creek and the tributary to Duffin Creek. Adult sea lamprey were collected from the three streams treated (236 from Graham) indicating their continued use by adult sea lamprey for spawning.

Sea Lamprey from Commercial Fishermen

During 1973, 188 adult sea lamprey were submitted by Great Lakes commercial fishermen in response to the offer of a reward. This number was approximately 15 per cent of the 1972 collection. The collection included nine specimens from Lake Superior, 63 from the North Channel, 65 from Lake Huron proper, four from Lake Erie, and 47 from Lake Ontario.

Table IV. Summary of streams treated with lampricide on the Canadian and United States (New York) side of Lake Ontario, 1973.

Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles or acres[1] treated
CANADA							
Harmony-Farewell	May 7-8	20	472	4	34	Scarce	2.5
Graham	May 15-18	34	1,075	10	119	Moderate	14.0
	June 5-6						
Duffin (tributary)	June 3-4	2	54	1	3	Scarce	2.8
Totals		56	1,601	15	156		19.3
UNITED STATES							
Sodus	Apr. 30-May 1	25	435	–	–	Scarce	2.0
Blind	May 1-2	11	237	–	–	Scarce	4.0
Salmon							
Beaverdam	May 6-8, 12	40	420	–	–	Moderate	7.5
Orwell	May 9-11	60	407	–	–	Abundant	7.0
Trout	May 14-16	45	325	–	–	Abundant	10.0
Lindsay	June 3-4	27	232	–	2.5	Abundant	7.0
Skinner	June 5-7	28	368	–	–	Abundant	9.0
Little Deer	June 9-10	16	150	–	–	Abundant	9.0
Little Sandy	June 13-14	17	524	–	–	Moderate	11.0
Totals		269	3,098		2.5		66.5
Grand Totals		325	4,699	15	158.5		85.8

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Blind	May 1-2	11	237	–	–	Scarce	4.0
Salmon							
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Little Sandy	June 13-14	17	524	–	–	Moderate	11.0
Totals		269	3,098		2.5		66.5
Grand Totals		325	4,699	15	158.5		85.8

Measurement of length and weight, and examination for sex and maturity revealed no significant differences between the 1973 catch of sea lamprey and those of previous years. The tendencies for females to predominate in offshore collections, and for smaller lamprey to be associated with fish caught in small mesh gear were again in evidence.

Sea Lamprey from Humber River, Lake Ontario

The individual who has collected sea lamprey under contract since 1968 from the Humber River in Toronto, captured 6,308 specimens in 1973, an increase of 37 per cent over the 1972 catch, and of 160 per cent over that of 1971. Owing to the absence of larval sea lamprey, the Humber River has not been treated with lampricide, a fact that may lead to a concentration of migratory adult individuals in it. It is believed therefore that the recent large runs are not representative of the sea lamprey population of Lake Ontario as a whole. The Humber River collection in 1973 did not differ significantly in average size or sex ratio from those of earlier years.

Trawling in St. Marys River

Trawling for adult sea lamprey in St. Marys River was resumed on October 22, 1973. There were no changes from the techniques, the gear, or the area of trawling that were made in the previous four years. A trawl made of half-inch square mesh netting and measuring eight by four feet at the mouth, was towed in the propellor wash 10 or 12 feet astern of an 18 foot aluminum boat powered by an inboard/outboard motor. The area finished was in front of the Edison Electric Company's plant in Sault Ste. Marie, Michigan, about one mile below the United States locks. Trawling was carried out on three or four evenings per week between 5:00 p.m. and midnight.

The weekly catches and the catch per hour of trawling for 1972 and 1973 are compared in Table V. No significant difference can be shown between the average rates of capture of 0.24 and 0.30 lamprey per hour for 1972 and 1973 respectively.

Table V. Numbers of sea lamprey caught per hour of trawling in St. Marys River: 1972 and 1973.

Week ending		Trawling time hours-minutes		No. of lamprey		No. of lamprey per hour	
1972	1973	1972	1973	1972	1973	1972	1973
Oct. 28	Oct. 27	16-30	23-30	3	2	0.2	0.1
Nov. 4	Nov. 3	21-30	24-0	2	6	0.1	0.2
Nov.11	Nov.10	24-30	14-30	11	2	0.4	0.1
Nov.18	Nov.17	18-0	18-15	5	13	0.3	0.7
Nov.25	Nov.24	24-0	12-30	3	6	0.1	0.5
Dec. 2	Dec. 1	17-0	20-15	5	8	0.3	0.4
Dec. 9	Dec. 8	8-30	22-20	2	10	0.2	0.4
	Dec. 15		24.0		4		0.2
Totals		130-0	159-20	31	51	0.2	0.3

APPENDIX E

BIOLOGICAL STUDIES ON THE SEA LAMPREY, 1973

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INTRODUCTION

The Hammond Bay Biological Station conducts studies on the life history of the sea lamprey and on the effects of lampricides on selected life stages. Studies during 1973 centered on the effects of Bayluscide, TFM, and antimycin on larval lampreys; chemosterilization of adults; culture methods; and monitoring migrations of lampreys in the Ocqueoc River.

Toxicity of Bayluscide to Larval Sea Lampreys, Rainbow Trout, and Mayfly Nymphs

Bayluscide (70% Bayer 73, wettable powder) was tested against three aquatic organisms in Lake Huron water at 12.8 C. LC50's (μg/l) for active ingredient are 72 for larval lampreys, 103 for rainbow trout, and 11,400 for mayfly nymphs. The compound proved selective toward the lamprey. Mayflies are surprisingly resistant. Theoretically, if granular Bayluscide were applied to the bottom 2 inches of water at 110 μg/l (the concentration required to kill lampreys), the concentration would be sublethal to trout through dilution at 4.2 inches and above the bottom.

Toxocity of Antimycin to Larval Sea Lampreys, Rainbow Trout, and Mayfly Nymphs

Antimycin (10% liquid formulation) was tested against three aquatic organisms in Lake Huron water at 12.8 C. LC50's (μg/l) for active ingredient are 3.60 for sea lampreys, 0.175 for rainbow trout, and 560.0 for mayfly nymphs. The compound is not selective for lamprey, but mayfly nymphs are more resistant than lampreys or trout.

Toxocity of Larvicides to Sea Lamprey Embryos

The toxicity of TFM, Bayer 73 (Bayluscide), and the combination of the two, TFM:Bayer 73, to stage 9 sea lamprey embryos was determined in three different waters at 18.4 C. Twenty-five embryos were exposed to each concentration for 24 hours, then washed with untreated water and returned to untreated water for another 24 hours, after which they were examined for mortality. Each toxicant was less toxic to the embryos in harder water. In every case, embryos were more resistant than larvae indicating that developing embryos could survive in streams treated with these larvicides.

CHEMOSTERILIZATION

Sterilization of Spawning Lampreys

A total of 163 adult lampreys was inducted with (P,P-bis(1-aziridinyl) -N-methyl phosphinothioic amide), a chemosterilant, at dose rates between 10 and 100 mg/kg. Sixteen lampreys were injected i.p. with this compound each week throughout the spawning migration and released in an artificial spawning channel constructed in the laboratory.

A pair of lampreys injected at a dose rate of 100 mg/kg was observed attempting to spawn. They were removed from the channel and mated with normal individuals. All embryos developed fertilization membranes and a few showed some signs of cleavage. Embryos derived from the mating between the injected female and a normal male were dead within 10 days. Milt from the injected male was used to fertilize 958 eggs from a normal female. Although development began, only one of the embryos developed to the burrowing prolarval stage (17-33 days).

Three lampreys were injected at a dose rate of 20 mg/kg. A male was used to fertilize 1,002 eggs from a normal female. Of these, only seven embryos reached the burrowing prolarval stage. Eggs from two injected females were fertilized with sperm from normal males. All embryos from one of these matings were dead within 10 days. Eggs from the other female (3,109) produced two burrowing prolarvae.

Spawns obtained from two females injected at a rate of 25 mg/kg yielded 1,553 eggs, and 2,014, respectively. These spawns were fertilized with sperm from normal males and each produced one burrowing prolarva.

Three lampreys (one male and two females) injected at a dose rate of 10 mg/kg were spawned with normal partners. Sperm from the injected male was used to fertilize 1,148 ripe eggs from an uninjected female. This mating produced 28 burrowing prolarvae. The two injected females produced batches of eggs numbering 2,826 and 3,869. When normal sperm was used to fertilize these eggs they produced 1,003 and 2,511 burrowing prolarvae, respectively.

CULTURE

Larval Lamprey Culture

Spawning adults of sea lampreys, northern brook lampreys, American brook lampreys, and silver lampreys were collected and spawned in 1973. Embryos were used to stock rearing facilities with 1973-year class larvae and to provide materials for experiments to determine the acute toxicity of larvicides to stage 9 sea lamprey embryos.

Four spawns of northern brook lamprey were obtained. These eggs were hatched at 18.4 C and the embryos were maintained at this temperature until they reached stage 17 (burrowing prolarvae). They were then transferred to aquariums containing sand and fed yeast twice weekly. One month later no larvae could be found.

Two spawns of American brook lampreys were raised to burrowing stage and transferred to aquariums. One group survived and both 1972- and 1973-year classes of this species are under culture.

Eggs from the silver lampreys were not viable but a male silver lamprey was successfully used to fertilize eggs from a northern brook lamprey. Resulting hybrids developed and around 150 burrowing larvae were produced. They were transferred to an aquarium but none were found a month later.

An inventory of larval lamprey stocks held in the laboratory indicated that approximately 17,800 lampreys are on hand. The majority are laboratory-reared sea lamprey including representatives of each year-class since 1969.

Approximately 100 transformed American brook lampreys and 70 northern brook transformers have been collected. Spawn from these individuals should provide sufficient larvae to compare the growth, survival, and competitiveness of these native species with sea lampreys.

Effects of Temperature on the Growth and Survival of Larval Sea Lampreys

In order to determine the optimal temperature for the growth and survival of larval lampreys, 1,800 young-of-the-year sea lamprey larvae were placed in each of four constant temperature troughs, each measuring 3.34 m long, 0.62 m wide, and 21.6 cm deep. Approximately 50 mm of clean beach sand was placed on the bottom of each trough and 237 liters of water were added to each trough. Lake water entered the trough at approximately 2 liters per minute. The water was turned off for 24 hours every Monday and Thursday when 217 grams of yeast were added to each trough.

Growth and survival increased as the temperature increased. Thick mats of fungi which formed in the two coldest troughs caused heavy mortality. Growth and survival of larvae in the two warmest troughs were excellent, even during winter months. At the termination of the experiment, the 15.6 C trough had 366 larvae per square meter and the 21.1 C trough had 454 larvae per square meter.

MIGRATIONS

Downstream Migration of Sea Lampreys

Fyke nets have been fished continuously in the Ocqueoc River since 31 October 1962. A single fyke net fished in the same location since 1963 has been used to estimate the annual downstream migration of recently metamorphosed sea lampreys (Table 1). Mark-recapture studies of over 10,000 downstream migrating lampreys between the fall of 1963 and the spring of 1968 were used to evaluate the efficiency of this net under a variety of conditions and to provide a basis of reliable population estimates of the downstream migrations. A total of 32 groups of marked lampreys were released throughout this period and population estimates were made each year based on the recovery rate of the marked lampreys for that year. Percent recapture for the 32 groups varied between 1 and 12% with an average recapture rate of 5.6%. This figure has been used in subsequent years to estimate the total downstream migrations.

In the fall of 1968, the Ocqueoc River was treated with the larvicide, TFM. Before the larvicidal treatment, the average estimated production of parasitic phase lampreys from the Ocqueoc River had been 62,502. Following the treatment, production during the 1968-69 migrational year dropped to 12,089 or a reduction of approximately 81%. In the second year following treatment, 1969-70, a further reduction to 4,625 (slightly more than 7% of pretreatment average) took place. In 1970-71, the Ocqueoc River produced 2,679 downstream migrating lampreys, or about 4.3% of the pretreatment number. In 1971-72, the estimated migration was 1,750 or 2.8% of the pretreatment number. The river was treated for the second time in August 1972. A portion of the lake (near the inlet) was treated with granular Bayer. The estimated migration for 1972-73 was 482 or only 0.8% of the pretreatment number.

Table 1. Downstream migration of recently metamorphosed sea lampreys in the Ocqueoc River.

Migrational year (Fall-Spring)	Actual catch (One net)	Estimated migration
1963-64	3,373	42,005
1964-65[a]	–	–
1965-66	3,913	56,958
1966-67	3,248	80,396
1967-68	3,363	70,651
1968-69	677	12,089
1969-70	259	4,625
1970-71	150	2,679
1971-72	98	1,750
1972-73	27	482

[a]Net loss due to extremely high water levels.

The net is fished downstream from the outlet of Ocqueoc Lake, a small inland lake which is part of the Ocqueoc River system. Since no lampreys were captured in nets fished upstream from the lake it is assumed that the majority, if not all, of the survivors of the chemical treatments were residents of the lake which was not treated.

Upstream Migration of Lamprey

A new weir was constructed during the late winter of 1973 at a site near the outlet of Ocqueoc Lake, about 5 miles upstream from the previous weir site. The weir was activated on 26 March 1973. During the month of May, the weir seemed to be operating at a fairly high rate of efficiency. Thereafter, a washout beneath the traps permitted an unknown number of fish and lampreys to elude the weir. Although repairs were made, the 673 lampreys trapped in 1973 is the lowest total on record.

APPENDIX F

REGISTRATION-ORIENTED RESEARCH ON LAMPRICIDES, 1973

Fred P. Meyer, Director

Fish Control Laboratories
La Crosse, Wisconsin 54601

INTRODUCTION

Registration-oriented research on lampricides has progressed on schedule and results to date indicate that TFM is a relatively environmentally safe compound.

TFM

Toxicity to Nontarget Animals

Mammals:—Contract studies at WARF Institute, Madison, Wisconsin are progressing well with only a minor delay in the life span feeding trials with hamsters. A 6-month chronic feeding study on beagles was completed. Lactating dairy cows were fed ^{14}C-TFM and milked twice during 24 hours post-dose. The concentration of TFM and metabolites in the first milking averaged 0.7 ppm and declined to 0.2 ppm at the second milking. Tissue levels of TFM and metabolites 26 hours posttreatment were undetectable in fat, low in muscle (0.01 ppm), higher in liver (0.2 ppm) and highest in kidney (0.7 ppm).

Fish:—Chronic effects of TFM on reproduction, growth, and mortality of yearling brook trout are being assessed in a flow-through diluter system. The fish are being exposed to 0.7, 1.6, 3.3, 8.1, and 14 mg/l of the 35.7% formulation. Growth depression has been noted in fish in the highest concentration.

Plants:—Algal toxicity tests have been concluded with 10 species of diatoms, green and blue-green algae. Results indicate that a 50% inhibition of growth occurred at TFM concentrations of less than 10 mg/l for most species. However, exposure to TFM concentrations up to 30 mg/l and subsequent resuspension of algae in toxicant-free medium result in a growth pattern similar to controls indicating that at use-pattern concentrations TFM is algistatic rather than algicidal.

Physiology

Biotransformation of TFM:—Cooperative studies between the Fish Control Laboratories and Dr. John Lech of the Medical College of Wisconsin have established that the major mode of detoxification of TFM by fishes is that of glucuronidation. When rainbow trout and sea lamprey larvae are simultaneously exposed to TFM, lamprey larvae take up more TFM than trout and are apparently unable to detoxify it as well as trout leading to the difference in toxicity between the fishes. Inhibition of glucuronyl transferase activity which is necessary for glucuronidation in trout reduces the selective toxicity of unacceptable levels.

Residues

Fish:—No detectable residue (less than 0.01 μg/g) of TFM was found in muscle of lake trout from Lake Superior and Lake Michigan or in chinook salmon from Lake Huron. Twenty-five fish were sampled from each lake.

BAYLUSCIDE (BAYER 73)

Toxicity to Nontarget Animals

Fish:—The toxicity of Bayer 73 to chinook salmon, rainbow trout, carp, channel catfish, and green sunfish was determined at selected temperatures, hardnesses, and pH's. In all tests toxicosis was very rapid with little or no change in toxicity from 3 to 96 hours. The 96-hour LC50's for the species tested ranged from 0.0409 mg/l with rainbow trout to 0.216 mg/l with green sunfish in static toxicity tests using soft water at 12 C. While in flow-through toxicity tests, the 96-hour LC50's ranged from 0.0244 mg/l with rainbow trout to 0.367 mg/l with yellow perch in city filtered water at 12 C. The toxicity of Bayer 73 to the species tested was not substantially affected by variation in temperature or hardness, but it was significantly less toxic in alkaline than in acidic or neutral pH water at 12 C.

Invertebrates:—Bayer 73 was tested against scud and midge larvae in well water at 21 C and the 96-hour LC50 for scud was 3.2 mg/l and for midge larvae 1.5 mg/l. Tests indicate the 48-hour EC50 immobilization value for Bayer 73 and daphnids is 0.2 mg/l.

Thirty-day, flow-through toxicity tests of Bayer 73 with early instar crayfish resulted in a time-independent LC50 of 16.5 mg/l, which was attained in 10 days.

The accumulation and magnification of ^{14}C-Bayer 73 was relatively low in crayfish and daphnids and ranged from 3 to 55 times the concentration in water (1μg/l). After the daphnids were transferred to Bayer 73-free water, residues declined by 50% within 1 day.

Efficacy of Lampricides

The influence of temperature, hardness, and pH on the toxicity of Bayer 73 to sea lamprey larvae was evaluated in static toxicity tests. The

toxocity was not significantly (P = 0.05) affected by variations in temeprature, hardness, or pH. The LC50's in soft, reconstituted water at pH 7.5 and 12 C ranged from 0.0500 mg/l at 3 hours to 0.400 mg/l at 96 hours.

Intermittent-flow toxicity tests of Bayer 73 were run to determine its toxicity under simulated stream conditions. The concentration of chemical in test chambers increased gradually over 2 hours, maintained a peak for about 10 hours, and then gradually diminished. Each chamber contained burrowed sea lamprey larvae, free-swimming sea lamprey larvae, brook trout, steelhead, and crayfish.

Mortalities occurred among the brook trout and steelhead earlier than the lamprey. The chemical was not selective for either burrowed or free-swimming lamprey over the trout. Crayfish were extremely resistant to the effects of Bayer 73.

Residues

Fish:—Rainbow trout were exposed to 0.05 mg/l of ^{14}C-Bayer 73 for 12 hours at 12 C. After exposure to Bayer 73, fish were transferred to fresh running water and tissue levels of radioactivity were monitored. At 0-hour withdrawal, the muscle residue was calculated to be 0.08 μg/g of Bayer 73 and the level declined to 0.02 μg/g after 24 hours of withdrawal. The highest levels of radioactivity were measured in the gallbladder bile.

ANTIMYCIN

A new formulation of antimycin for control of larval lamprey has a coating on the granules which permits them to sink 30 feet or more before releasing the toxicant. In most problem areas the toxicant is released on the bottom where the lamprey are burrowed. Trials of the formulation were conducted in Michigan at Horton Bay of Lake Charlevoix (relatively static water) and Ocqueoc Lake (influenced by the Ocqueoc River). Sea lamprey larvae were caged on the bottom and fish were caged at selected distances above the bottom.

In each trial about 90% of the caged larvae were killed. In Ocqueoc Lake about 1,500 wild sea lamprey larvae were also killed. In the Charlevoix trial, most of the fish 1.5 meters or more from the bottom survived. In the Ocqueoc trial, caged rainbow trout, a sensitive fish, were killed at all depths, indicating extensive upwelling of water from the bottom. No wild game fish were killed in either trial, indicating relative safety to those populations.

The same area in Ocqueoc Lake was treated with Bayer 73 using the same experimental design to compare the efficacy of the two compounds. Bayer 73 killed about 90% of the larvae and 20% of the caged fish.

REGISTRATION

TFM:—The registration process requires various types of tests be conducted. In an attempt to make clear what has been and is required, a checklist has been developed.

TFM Checklist for Registration Research

I. Chemical characterization
- A. Properties—solubility, pK, volatility
- B. Formulation—solubilization, handling
- C. Assay—testing for purity
- D. Stability—radiation, redox, thermal

II. Toxicity
- A. Fish
  1. Acute—96-hour LC50's (4 species)
  2. Chronic—30-day LC50's (4 species)
  *3. Reproduction—1-year (2 species)
  4. Eggs—30-day (3 species)
- B. Invertebrates
  1. Acute—96-hour LC50's (6 species)
  2. Chronic—10- to 30-day LC50's (6 species)
  3. Reproduction—3-month (1 species—Daphnia)
- C. Algae and plants
  1. Acute—96-hour LC50's (2 species)
  †2. Chronic—30-day LC50's (2 species)

III. Efficacy
- A. Laboratory
  1. Effectiveness—pH, T, TH, t, ecosystems
  2. Specificity—species, life stage
  3. Counteraction—half-life, detox., sorption
- B. Field
  1. Effectiveness—on-site assay, treatment, algae action, exposure time
  2. Environmental impact—treatment assessment
  3. Methodology—best technique, best formulation
  4. Sampling—for residues

VI. Residues
- A. Methods
  1. Development—improved detection
  2. Tracers—exp. with labeled compounds
  3. Confirmation—backup method
- B. Use pattern
  1. Lab—control runs
  2. Field—actual trials
  3. Monitoring—continued sampling

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*In progress.
†Not considered needed.
Unmarked items have been completed.

C. Metabolites (fish done, cows not done)
*1. Methods–development of suitable methods
*2. Analyses–assay after treatments

V. Toxicity to organisms (required in all cases)

A. Acute
1. Oral LD50 (rat)
2. Oral LD50–birds (BWQ and MD)
†3. Dermal LD50 (rabbit)
†4. Inhalation LD50 (rats)–omit if the product is not a dust or liquid
†5. Eye irritation (rabbits)
†6. Primary skin irritation (rabbits)
7. 96-hour LC50 (rainbow trout and bluegills)

B. Subacute
1. 90-day feeding (rat and hamster)
2. 8-day LC50 aquatic birds (MD)
†3. Chronic bird toxicity (including reproduction)
4. 6-month dog feeding

VI. Pathology to tissues–oral intubation
*A. Carcinogenicity–lifespan, 2 years (rat)
†B. Mutagenicity–cytogenetic, dominant lethal, or host-mediated assay tests
*C. Teratogenicity–(rabbit)

VII. Metabolism in cells (labeled compounds)
*A. Fish
*B. Cow

LITERATURE

Bothwell, Max L., A. M. Beeton, and John J. Lech. 1973. Degradation of the lampricide 3-trifluoromethyl-4-nitrophenol by bottom sediments. Journal of the Fisheries Research Board of Canada 30(12, part I):1841-1846.

Dawson, Verdel K. 1973. Photodecomposition of the piscicides TFM (3-trifluoromethyl-4-nitrophenol) and antimycin. M.S. Thesis. University of Wisconsin–La Crosse. 65 p.

Kawatski, J. A. 1973. Acute toxicities of antimycin A, Bayer 73, and TFM to the ostracod *Cypretta kawatai*. Transactions of the American Fisheries Society 102 (4):829-831.

Lech, John J. 1973. Isolation and identification of 3-trifluoromethyl-4-nitrophenyl glucuronide from bile of rainbow trout exposed to 3-trifluoromethyl-4-nitrophenol. Toxicology and Applied Pharmacology 24(1):114-124.

Lech, John J. 1973. Preparation and properties of 3-trifluoromethyl-4-aminophenol. Journal of the Fisheries Research Board of Canada 30(3):461-463.

Lech, John J., Sharon Pepple, and Marie Anderson. 1973. Effects of novobiocin on the acute toxicity, metabolism and biliary excretion of 3-trifluoromethyl-4-nitrophenol in rainbow trout. Toxicology and Applied Pharmacology 25(4):542-552.

Lech, John J., Sharon K. Pepple, and Charles N. Statham. 1973. Fish bile analysis. Possible aid in monitoring water quality. Toxicology and Applied Pharmacology 25(3):430-434.

Olson, Lee E., and Leif L. Marking. 1973. Toxicity of TFM (lampricide) to six early life stages of rainbow trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 30(8):1047-1052.

CONTRACT RESEARCH

Bureau contracts for the following studies were awarded in 1973.

1. Safety evaluation of the lampricide Bayer 73. Ninety-day studies on rats and hamsters.
WARF Institute Inc., Madison, Wisconsin Amount: $13,600

2. Research study on the microbial degradation of TFM.
University of Wisconsin-Milwaukee, Center for Great Lakes Studies, Milwaukee, Wisconsin Amount: $ 7,749

3. Research study on the uptake, distribution, and metabolism of ^{14}C-Bayer 73 in rainbow trout and sea lamprey.
The Medical College of Wisconsin, Milwaukee, Wisconsin Amount: $11,207

4. Manufacture of 5 millicuries of ^{14}C-Bayer 73.
American Radiochemical Corp., Sanford, Florida Amount: $ 2,603

APPENDIX G

ADMINISTRATIVE REPORT FOR 1973

Meetings. The Commission held its 1973 Annual Meeting in Ottawa, Ontario Canada, June 19-21, 1973, and its Interim Meeting in Ann Arbor, December 4-5, 1973. Meetings of Committees during 1973 were:

Lake Erie Committee, Erie, Pennsylvania, March 6-7
Lake Ontario Committee, Erie, Pennsylvania, March 7-8
Lake Michigan Committee, Milwaukee, Wisconsin, March 13
Lake Superior Committee, Milwaukee, Wisconsin, March 14
Lake Huron Committee, Milwaukee, Wisconsin, March 15
Sea Lamprey Control and Research Committee, Ann Arbor, April 11
Scientific Advisory Committee, Ann Arbor, April 11
Finance and Administration Committee, Ottawa, Ontario, Canada, June 19

Officers and Staff. No changes occurred in the Commission staff during 1973.

Staff Activities. The Commission's staff (Secretariat) performs several major functions. It provides staff assistance to the Commission 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. The Secretariat provides direct assistance to the Commission in the development of the program and from time to time acts on behalf of the Commission as circumstances may require. During 1973 the Secretariat attended and participated in the following meetings and conferences.

Canadian Committee on Freshwater Fisheries Research
In-Service Training Program (Michigan Department of Natural Resources)
Lake Michigan Study Group
Combined Task Force on Organizational Policy (Great Lakes Basin Commission and Great Lakes Commission)
Commercial Walleye Fishery in Lake Erie
Great Lakes Water Quality Board (U.S. and Canadian International Joint Commission)
Great Lakes Commission
Sports Fishing Symposium
Great Lakes–A Great Resource Program
Lake Superior Advisory Committee

Great Lakes Fish Disease Control Committee
Lake Erie Walleye Management–Scientific Protocol Committee
Sea Lamprey Data Analysis

Accounts and Audit. The Commission accounts for the fiscal year ending June 30, 1973 were audited by Icerman, Johnson, and Hoffman of Ann Arbor. The firm's report is appended.

Program and Budgets for Fiscal Year 1973. At its Annual Meeting in June, 1971, the Commission adopted the following budget request for fiscal year 1973:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$1,809,800	$813,100	$2,622,900
Administration and General Research	36,500	36,500	73,000
Total	$1,846,300	$849,600	$2,695,900

The program called for intensification of sea lamprey control in the upper Great Lakes, extension of chemical treatment to New York tributaries of Lake Ontario, continuation of registration-oriented research, operation of assessment barriers, and the development of a research program to test the feasibility of biological control.

Following further discussion between the U.S. Department of State, the Commission, and its Sea Lamprey control and Research Committee after the Annual Meeting, the following revised budget request was adopted:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$1,841,750	$824,950	$2,666,700
Administration and General Research	42,350	42,350	84,700
Total	$1,884,100	$867,300	$2,751,400

Eventual allotments, including supplemental contributions to partially cover cost-of-living increases to employees of Commission's U.S. agent, were $1,900,100 from the U.S. Department of State and $874,600 from the Canadian Department of External Affairs for a total allotment of $2,774,700.

Expenditures for fiscal year 1973 amounted to $2,690,000 for Sea Lamprey Control and Research and $84,700 for Administration and General Research. Thus, expenditures matched allotments; the program was carried out essentially as planned.

Program and Budget for Fiscal Year 1974. At the 1972 Annual Meeting, the Commission adopted a program for sea lamprey control and research in fiscal year 1974 estimated to cost $3,248,320. Generally, the program provides for continuation of intensified control in the upper lakes, continuation of Hammond Bay sea lamprey research, and registration-oriented studies on lampricides, and a modest beginning for design and construction of barrier dams as a segment of an integrated program to control sea lampreys. A budget of $98,000 was adopted for administration and general research.

Following several revisions to adjust to changes in proposed contributions by the two governments, the Commission ultimately proceeded with the following program for sea lamprey control and research on a budget of $2,748,400.

Lake Superior. Retreat 25 streams (20 in the United States and 5 in Canada) with lampricides; treat with granular Bayer 73 the estuaries of 14 streams in Canada; routinely survey other streams to determine time for treatment; and operate assessment barriers on 8 sea lamprey spawning streams in the United States.

Lake Michigan. Retreat 25 streams and continue surveys for scheduling future treatments of lamprey infested streams.

Lake Huron. Retreat 28 streams (21 in the United States and 7 in Canada) with lampricides; treat with granular Bayer 73 the estuaries of 22 streams in Canada; continue surveys on other streams to determine the need for retreatment, and operate 8 assessment barriers (7 in Canada and 1 in the United States) to assess changes in abundance of stocks of spawning sea lampreys.

Lake Ontario. Retreat 19 streams (8 in the United States and 11 in Canada) with lampricides; treat with granular Bayer 73 the estuaries of 11 streams in Canada, and continue surveys to determine the need for retreatment.

Research. Study the growth and transformation of reestablished sea lamprey populations over a wide range of conditions to determine changes occasioned by stream treatments. Study the growth, movements, and transformation of larval sea lampreys in an experimental section of the Big Garlic River.

Develop more effective chemicals for treatment deepwater larval habitat; develop the laboratory culture of sea lamprey ammocetes; determine the resistance of embryological stages of sea lamprey to the lampricide (TFM) and mixtures thereof; and investigate the feasibility of biological control using such techniques as chemical and immunological methods of sea lamprey sterilization, the possibility of sex control of laboratory-reared ammocetes, and the competitive displacement potential of hybrid lampreys; and conduct research on induction of transformation, detection of biochemical changes, and searching for early indications of transformation.

Conduct research to develop the data required to reregister the lampricides TFM, TFM-Bayer 73 mixture, and Bayer 73 granules: (1) investigate the acute and chronic toxicity and reproductive studies of Bayer 73 on fish and invertebrates; (2) conduct standard toxicological tests of TFM-Bayer 73 mixtures on non-target organisms (wildlife and mammals); and (3) determine the safety (toxicity) of TFM on non-target organisms (wildlife and mammals).

Agreements to carry out the program were made with the U.S. Bureau of Sport Fisheries and Wildlife and the Canadian Department of Environment. The Commission also reviewed its Administration and General Research Budget for fiscal year 1974. The funding for fiscal year 1974 is as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$1,921,250	$863,150	$2,784,400[1]
Administration and General Research	50,750	50,750	101,500
Total	$1,972,000	$913,900	$2,885,900

[1] Includes supplementary contribution totalling $84,000 ($58,000 U.S. and $26,000 Canadian) to cover cost-of-living increases to employees of the Commission's U.S. agent.

Program and Budget for Fiscal Year 1975. At the 1973 Annual Meeting, the Commission adopted a program for sea lamprey control and research in fiscal year 1975 estimated to cost $3,624,245. Generally, the program provides for continuation of intensified control in upper Great Lakes, a continuation of sea lamprey control activities on Lake Ontario, continuation of sea lamprey research at the Hammond Bay Biological Station, registration-oriented studies on lampricides, and a modest beginning for design and construction of sea lamprey barrier dams as a segment of an integrated program to control sea lamprey. A budget of $108,300 was adopted for administration and general research.

Reports and Publications. The Commission published an Annual Report for 1972 and the following technical reports:

"Microbial degradation of the lampricide larvicide 3-trifluoromethyl-4-nitrophenol in sediment-water systems" by Lloyd L. Kempe, Great Lakes Fishery Commission, Tech. Rep. 18, 16 p. January 1973.

"Lake Superior–A case history of the lake and its fisheries" by A. H. Lawrie and Jerold F. Rahrer, Great Lakes Fishery Commission Tech. Rep. 19, 69 p. January 1973.

"Lake Michigan–Man's effects on native fish stocks and other biota" by LaRue Wells and Alberton L. McLain, Great Lakes Fishery Commission, Tech. Rep. 20, 55 p. January 1973.

"Lake Huron–The ecology of the fish community amd man's effects on it" by A. H. Berst and G. R. Spangler, Great Lakes Fishery Commission, Tech. Rep. 21, 41 p. February 1973.

"Effects of exploitation, environmental changes, and new species on the fish habitats and resources of Lake Erie" by Wilbur L. Hartman, Great Lakes Fishery Commission, Tech. Rep. 22, 43 p. April 1973.

"A review of the changes in the fish species composition of Lake Ontario" by W. J. Christie, Great Lakes Fishery Commission, Tech. Rep. 23, 65 p. January 1973.

"Lake Opeongo–The ecology of the fish community and of man's effects on it" by N. V. Martin and F. E. J. Fry, Great Lakes Fishery Commission, Tech. Rep. 24, 34 p. March, 1973.

"Some impacts of man on Kootenay Lake and its salmonids" by T. G. Northcote and Institute of Animal Resource Ecology, University of British Columbia, Vancouver, B.C., Great Lakes Fishery Commission, Tech. Rep. 25, 46 p. April 1973.

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OFFICES
ANN ARBOR, MICHIGAN
HOWELL, MICHIGAN

September 19, 1973

Great Lakes Fishery Commission
1451 Green Road
P. O. Box 640
Ann Arbor, Michigan

We have examined the statements of assets and liabilities arising from cash transactions of the designated funds of the Great Lakes Fishery Commission as of June 30, 1973, and the related statements of revenues, expenditures and fund balance 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 referred to above present fairly the assets and liabilities arising from cash transactions of the designated funds of the Great Lakes Fishery Commission at June 30, 1973, and the revenues and expenditures of the Commission for the year then ended, on a basis consistent with that of the preceding year.

Icerman, Johnson & Hoffman

Exhibit A

Great Lakes Fishery Commission
Statement of Assets and Liabilities
Arising from Cash Transactions
June 30, 1973
(In United States Dollars)

	Administration and General Research Fund	*Lamprey Control Operation Fund*	*Total*
Assets			
Cash in bank (Page 6)	$1,541	$10,451	$11,992
Accounts receivable (Page 7)	992	57,362	58,354
Totals (Note)	$2,533	$67,813	$70,346
Liabilities and Fund Balance			
Liabilities:			
Accounts payable	$3,987	$ -0-	$ 3,987
Reserve for Lampricide obligation	-0-	37,145	37,145
Fund balance (deficit) (Pages 3 and 4)	1,454	30,668	29,214
Totals	$2,533	$67,813	$70,346

Note – Assets do not include program property such as land and improvements, equipment and inventories.

Exhibit B

Great Lakes Fishery Commission
Administrative and General Research Fund
Statement of Revenues, Expenditures and Fund Balance
Year Ended June 30, 1973
(In United States Dollars)

	Actual	*Budget*
Revenues		
Canadian Government	$42,350	$42,350
United States Government	42,350	42,350
Sale of automobile	111	-0-
Miscellaneous	321	-0-
Sale of office equipment	150	-0-
Totals	$85,282	$84,700
Expenditures (including reserve at June 30, 1973)		
Salaries	$61,140	$59,900
Fringe benefits	5,851	6,300
Research	-0-	2,500
Travel	5,097	4,500
Communication	1,646	1,500
Rents and utilities	352	800
Printing and reproduction	10,126	5,900
Other contractual services	1,395	1,500
Supplies	1,391	1,500
Equipment	111	300
Totals	$87,109	$84,700
Decrease in fund balance	$ 1,827	
Fund balance, July 1, 1972	373	
Fund balance, (deficit) June 30, 1973	$ (1,454)	

Exhibit C

Great Lakes Fishery Commission
Lamprey Control Operation Fund
Statement of Revenues, Expenditures and Fund Balance
Year Ended June 30, 1973
(In United States Dollars)

	Actual	*Budget*
Revenues		
Canadian Government (Note A)	$ 832,140	$ 832,140
United States Government (Note A)	1,857,750	1,857,750
Refund from Canadian Department of the Environment	2,973	-0-
Refund from United States Bureau of Sport Fisheries and Wildlife	34,172	-0-
Sale of Equipment	1,508	-0-
Interest	7,040	-0-
Totals	$2,735,583	$2,689,890
Expenditures (including reserve at June 30, 1973)		
Canadian Department of the Environment (Note B)	$ 723,700	$ 723,700
United States Bureau of Sport Fisheries and Wildlife	1,521,100	1,521,100
Lampricide purchases	501,033	445,090
Adjustment for currency valuation (Note C)	1,867	-0-
Totals	$2,747,700	$2,689,890
Decrease in fund balance	$ 12,117	
Fund balance, July 1, 1972	42,785	
Fund balance, June 30, 1973	$ 30,668	

Note A – Includes $7,190 supplemental payment from the Canadian Government and $16,000 supplemental payment from the United States Government.

Note B – The Canadian Department of the Environment withheld $725,567 in Canadian funds as the Canadian share of Lamprey Control Operations. This was the equivalent of $723,700 in United States Dollars.

Note C – Adjustment for currency valuation:

Canadian Dollars	$725,567
United States Dollars	$723,700
Adjustment for currency valuation	$ 1,867

Department of the Environment
Financial Report to Great Lakes Fishery Commission
April 1, 1972 to March 31, 1973
Canadian Funds

	$
Administration	139,021.07
Chemical Control, Lake Superior	202,098.10
Chemical Control, Lake Huron	231,990.41
Barriers, Lake Huron	31,508.28
Stream Surveys, Lake Superior	46,681.42
Stream Surveys, Lake Huron	45,248.29
	696,547.57
SUPERANNUATION COSTS (7% of $372,098.)	26,046.86
	722,594.43
Refund to G.L.F.C. by cheque	2,972.57
	725,567.00

Certified correct _____

Fisheries and Marine Services
Sea Lamprey Control Centre
Sault Ste. Marie, Ontario
June 8, 1973

BUREAU OF SPORT FISHERIES AND WILDLIFE
SEA LAMPREY CONTROL AND RESEARCH PROGRAM

Report of Expenditures for All Activities
July 1, 1972 through June 30, 1973

Activity	Funds Programmed	Salaries	Expenses	Total	Unobligated Balance
Program Costs Marquette, Michigan Ludington, Michigan Hammond Bay, Michigan LaCrosse, Wisconsin	$1,352,400	$892,837	$440,453	$1,333,290	$19,110
Washington, D. C.	40,000	-0-	40,000	40,000	-0-
Regional Office Administrative Services	67,500	63,502	3,998	67,500	-0-
Regional Office Supervision	61,200	42,111	4,027	46,138	15,062
Totals	$1,521,100	$998,450	$488,478	$1,486,928	$34,172

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