ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1974

GREAT LAKES FISHERY COMMISSION

MEMBERS – 1974

CANADA	UNITED STATES
E. W. Burridge	W. M. Lawrence
K. H. Loftus	N. P. Reed
F. E. J. Fry	Claude Ver Duin
C. J. Kerswill	L. P. Voigt

SECRETARIAT

R. W. Saalfeld, Executive Secretary
A. K. Lamsa, Assistant Executive Secretary
W. R. Crowe, Administrative Assistant
T. C. Woods, Secretary

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

1974

1451 Green Road
ANN ARBOR, MICHIGAN,
U. S. A.
1976

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 1974.

Respectfully,

W. M. Lawrence, *Chairman*

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IN MEMORIAM

ROBERT W. SAALFELD
1921-1974

Bob Saalfeld's death on June 9, 1974 was a grevious loss to the Great Lakes Fishery Commission. Under his leadership from 1971 to 1974 the commission's program advanced steadily. Bob was especially successful in fostering the spirit of cooperation that has been established among the numerous governmental agencies with which the Commission deals.

Bob's broad grasp of the problems of the Great Lakes Fisheries, his understanding of associates, and his ability to inspire his fellow workers to their best efforts are sorely missed.

ANNUAL REPORT FOR 1974

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 19 years. Its efforts to control the sea lamprey and reestablish lake trout have, in the main, been very successful although inherent problems remain. Residual populations of sea lampreys continue to be a source of mortality. Operational costs and costs of the chemicals used in the sea lamprey control program continue to rise. The need to develop and test alternative and supplementary control methods is urgent. Also, because of environmental considerations, the Commission is obligated to continue its support of research on the immediate and long-term effects of the chemicals being used. Self-sustaining populations of lake trout have not been widely reestablished, and efforts to encourage natural reproduction by lake trout must be intensified.

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

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

The Commission's Annual Meeting was held at Rochester, New York, June 18-20, 1974 and its Interim Meeting convened in Ann Arbor, Michigan, December 3, 1974.

ANNUAL MEETING

PROCEEDINGS

The nineteenth Annual Meeting of the Great Lakes Fishery Commission was held in Rochester, New York, June 18-20, 1974.

The meeting convened at 1000 hours, June 18. To open the meeting, Chairman Lawrence expressed the deep regret of the Commission and the delegates for the death of Executive Secretary Robert W. Saalfeld on June 9. He noted that cancellation of the meeting had been seriously considered, but it was agreed that it would have been Bob's wish that the work of the Commission continue. He, therefore, proposed that the meeting be dedicated to Mr. Saalfeld and asked the audience to rise and observe a few moments of silence in remembrance.

Upon introduction by the Chairman, Mr. Robert Young, Deputy Commissioner, New York State Department of Environmental Conservation welcomed the Commission and delegates to Rochester and New York State on behalf of Governor Wilson and Commissioner Biggane. In his address, Mr. Young stressed the common interest of New York and the Great Lakes Fishery Commission in sea lamprey control and the restoration and rehabilitation of the fisheries resources of Lake Erie and Lake Ontario. As evidence of New York's sincere interest in the entire program he cited the State's recent participation in sea lamprey surveys, the full-scale commitment to a special Great Lakes program, and the imminent completion of a $4.5 million hatchery for salmonids. He urged the Commission to give Lake Ontario equal consideration with the other lakes in plans for sea lamprey control and fish stocking. He encouraged the completion of the necessary survey work on the Oneida Lake-Oswego River system and promised New York's continuing support for the entire program.

In his report to the Commission and delegates, Commission Chairman Lawrence summarized accomplishments, enumerated current problems, and commented on probable developments. The Commission is justifiably proud of the degree of sea lamprey control that has been achieved to date. The cooperative large-scale stocking program with lake trout and other salmonids has also been outstandingly successful. In recent years the Commission has been able to devote more attention to its responsibilities for promoting and coordinating fishery research and management. The Commission is pleased with the cooperative spirit that prevails among inter-agency committees and work groups that have been established to resolve problems and develop resource-oriented, mutually acceptable management programs. Problems that derive from environmental degradation and contaminants remain of major concern. Residual populations of sea lampreys and the, at best, limited natural reproduction by lake trout are continuing problems. Lake Erie may have to be included in the sea lamprey control program. In considering the future, Dr. Lawrence referred to the objectives and needs defined in *A Management Policy for Great Lakes Fisheries*, published by the Commission in August, 1974.

On behalf of the Commission and the Secretariat, Mr. Crowe presented an overview of the Commission's program over the past 19 years. To refresh the memories of the audience he summarized the Commission's duties as outlined in the Convention. He enumerated briefly some of the major developments to the present as follows:

1. Discovery and testing of a selective lampricide.
2. The development of lake trout brood stocks in fish hatcheries and the rearing and planting of more than 50 million yearling lake trout in 1958-1974. In addition, some 65 million salmon have been planted since 1965.
3. Contributions to the body of scientific knowledge on the biology of sea lampreys, lake trout, and the fish fauna of the Great Lakes.
4. Publication by the Commission in 1961-1974 of 27 Technical Reports dealing with various aspects of the program.
5. Commission support of "registration-oriented" research to ascertain immediate and long-term effects in the environment of the chemicals being used in the sea lamprey control program. Results to date indicate the effects in the environment to be very small, and the sea lamprey control program has been a model of careful planning and effective execution.
6. Establishment of numerous inter-agency work groups to define problems, synthesize information, and recommended options for resolution.
7. Commission support of resource-oriented programs. If the welfare of the resource remains as the prime criterion and its productivity is maintained and enhanced, management problems are amenable to resolution and negotiation.

He then referred briefly to some of the problems that include: residual sea lampreys, need to develop and test alternative and supplementary control methods, continued registration-oriented research on chemicals, lake trout reproduction, divided (multiple) jurisdictions and the great difficulty of achieving mutually acceptable management programs in the face of ever-changing conditions, continued environmental degradation, and lack of funds and personnel to pursue all lines of pertinent inquiry.

Referring to the future he envisioned increased restrictions on user groups and stressed that protection and preservation of the resource must receive the highest priority. Sea lamprey control would have to continue indefinitely. Fish culture would continue to play an important part in the management program. Current progress permits optimism for pollution control and environmental protection.

The Chairman invited Mr. William Nye, Director, Ohio Department of Natural Resources to summarize Ohio's recently enacted (circa June 14,

1974) legislation (S.B. 532) for the management of sport and commercial fishing in Ohio. Mr. Nye described the establishment in November, 1973, by Governor John Gilligan, of the "Task Force on Lake Erie Area Fisheries". Represented on the Task Force were sport and commercial fishing interests, the Ohio Division of Wildlife, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, as well as experts from Ohio State University, and the Ohio Attorney General's office. The deliberations of the Task Force resulted in legislation, which Mr. Nye described as an important milestone in the management of an important resource. In describing the legislation Mr. Nye stressed the following points:

a) The legislation provides for an equitable distribution of the costs of management, inventory, and enforcement.
b) Details on distribution of the quota are left to the discretion of the Ohio Division of Wildlife and the Wildlife Council; rules are not "locked" into law.
c) The legislation includes provision for "limited entry" and again leaves the manner of implementation up to the Wildlife Division, except for specifying that license holders in 1973 shall be eligible to renew their licenses. New licenses would not be issued unless the fish population is large enough to support additional fishing.
d) License fees and penalties are substantially increased.
e) The legislation provides for royalty payments (catch fee). Although such payments may be minimal, the Task Force recognized the importance of the concept.
f) Finally, the Task Force, which was representative of all interests, was unanimous in its support of the provisions of the Bill–Director Nye felt this was perhaps the most significant breakthrough in the whole program.

He concluded that remaining problems include the fact of divided jurisdiction. He expressed the hope that other jurisdictions, especially Ontario, would recognize the worth of the legislation, and eventually move in the same direction.

Management and Research[1]

Numerous matters pertaining to the fishery resources of the Great Lakes were brought to the attention of the Commission.

Reports from each Lake Committee (Superior, Michigan, Huron, Erie, and Ontario) covering management and research activities in 1974 were presented by committee chairmen, and accepted by the Commission. Some of the Lake Committee reports included recommendations to the Commission; Commission action on the recommendations is described hereafter for individual lakes. The Commission felt that many of the recommendations

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

could be implemented at the Lake Committee level, with the Commission subsequently informed of action taken.

The Lake Superior Committee recommended endorsement by the Commission of the report and recommendations of the Lake Herring Subcommittee, and that the Commission urge jurisdictional agencies to implement the recommendations as soon as possible. The Commission considered the report of the Lake Herring Subcommittee an excellent one, but deferred formal action pending review and comment by the Scientific Advisory Committee.

The Lake Michigan Committee asked for Commission endorsement of continued planting of brown trout and rainbow trout in Lake Michigan by the Fish and Wildlife Service. The Commission endorsed such plantings, pending the development of additional state hatcheries.

The Lake Ontario Committee expressed its concern over water level fluctuations in Lake St. Lawrence and the deleterious effects of these fluctuations on fish communities. The Commission shared the concern and would so inform the International Joint Commission.

Concern over environmental degradation, water quality, and contaminants was expressed by several Lake Committees. The Commission agreed to transmit these concerns to its Scientific Advisory Committee for evaluation and consolidation.

The Commission received and accepted reports from the following special committees: Walleye Scientific Protocol Committee; Lake Michigan Technical Chub Committee; Fish Disease Control Committee; Sea Lamprey Data Inventory Committee; Committee on Commission Structure and Function; and Committee to Evaluate Sea Lamprey Control in Lake Superior.

Sea Lamprey Control and Research

The Commission accepted reports on sea lamprey control and research during 1974 from its two agents.[2]

At its Annual Meeting in June, 1973, the Commission endorsed a budget request for $3,732,545 (U.S. share–$2,554,900; Canada–$1,177,645) for fiscal year 1975. Subsequently, the Commission learned that appropriations by the U.S. Congress would amount to $2,198,000. Thus, in accordance with the 69:31 sharing formula, a revised budget for fiscal year 1975 was prepared and approved by the Commission at its Interim Meeting in December, 1973 as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,142,750	$ 962,050	$3,104,800
Administration and General Research	55,250	55,250	110,500
Total	$2,198,000	$1,017,300	$3,215,300

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

The program for fiscal year 1975 called for surveillance of all lamprey-producing areas, continuation of lampricide treatments on Lakes Superior, Michigan, Huron, and the Canadian side of Lake Ontario. Research programs at Hammond Bay and La Crosse would continue. Reduced funding required: (1) that treatment program in U.S. waters be somewhat reduced and that efforts be concentrated on "the most dangerous" areas; (2) that construction of sea lamprey control barriers be deferred. The entire program would have to be carried out at a less than optimum level.

For fiscal year 1976 the Commission endorsed a budget request calling for the following:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,848,500	$1,279,800	$4,128,300
Administration and General Research	64,600	64,600	129,200
Total	$2,913,100	$1,344,400	$4,257,500

Projected program for fiscal year 1976 called for: (1) meeting the full needs for chemical control on sea lamprey-producing areas in Lakes Superior, Michigan, Huron, and Ontario; (2) design and construction of sea lamprey control barriers on selected streams as part of an integrated sea lamprey control program; (3) continuation of sea lamprey research; (4) surveys in the lower Great Lakes including the Oneida Lake-Oswego River system in New York; and (5) operation of assessment barriers on Lakes Superior and Huron.

Fishery Input to International Joint Commission

The Commission and the various fishery agencies with whom it conducts its business have expressed concern over water quality management on the Great Lakes. A major constraint, among others, to the development or reestablishment of stable fish communities is the existing degraded condition of water quality in the Great Lakes. The condition is general in the lower lakes, and occurs locally inshore in the upper lakes.

Water quality management is within the area of responsibility of the International Joint Commission. For the Great Lakes Fishery Commission and cooperating agencies to achieve their objective (a healthy fishery resource), fishery considerations must be included in the objectives of the International Joint Commission, and in the formulation and implementation of plans endorsed by the latter body.

Generally, the International Joint Commission's interest in fish has tended to regard them as concentrators of contaminants, and hence sensitive indicators whose body loads can be used as indices of water quality. Commissioner Loftus noted that fishery people were fully aware that fish are useful as bioassay animals, but stressed that the long-term response of fish communities to stress, i.e. pollution, will be more revealing than chemical analyses of fish flesh.

Terms of reference for the International Joint Commission are very broad. It was noted that fishery input to the International Joint Commission has been on a somewhat ad hoc basis, and that properly fisheries (as such) should be an integral part of the IJC infrastructure. Fishery consideration by the International Joint Commission will likely be in proportion to commitment by fishery agencies.

It was agreed that the Great Lakes Fishery Commission should further develop its fishery management plan and expand and solidify its relationship with the International Joint Commission so that IJC's program will develop in response. It was stressed that the status of the Great Lakes Fishery Commission is equal to that of the International Joint Commission.

Scientific Advisory Committee

The Scientific Advisory Committee (SAC) met on June 17, 1975 at Rochester, New York, and presented the following comments and recommendations for Commission consideration:

1. Urged that an adequate sampling program be maintained in Lake Superior so that the status of lake trout rehabilitation and sea lamprey control may be fully evaluated.
2. Urged that the Committee to Evaluate Lake Trout Restoration and Sea Lamprey Control in Lake Superior be activated at the earliest possible time.
3. Urged review and adoption of its recommendation (December, 1973) relative to a Standing Committee on Data and Methods.
4. Noted with satisfaction progress in research pertaining to thermal requirements for sea lamprey development. Agreed to approach agencies in the United States and Canada that may be able to contribute to studies concerning the possibility of influencing stream temperatures by manipulating stream cover to affect solar radiation.
5. Urged the development of a comprehensive report on the status of pink salmon in the Great Lakes.
6. Concerning comprehensive ecological studies on Lake St. Clair, the SAC noted that the information that would accrue could be used to develop criteria for sustained production, and that such criteria should be transmitted to IJC.
7. Relative to the systematization of catch statistics, the SAC reiterated its recommendation presented at the Commission's Interim Meeting, December, 1973.

Administrative and Executive Decisions

1. The Commission took the following action. Elected Mr. Kenneth H. Loftus and Mr. Nathaniel P. Reed Chairman and Vice Chairman, respectively, for 2 year terms.
2. Initiated action to fill the vacancy created by the untimely death of Executive Secretary Robert W. Saalfeld as quickly as possible.
3. Approved Administration and General Research budget of $110,500 for fiscal year 1975 and a request of $129,200 for fiscal year 1976.

4. Reviewed "surviving spouse" benefits that would accrue to Mrs. R. W. Saalfeld.
5. Reviewed the contract with Dr. Piavis on research on the effects of diurnal temperature fluctuations in the embryonic development of sea lampreys. (Payment will be made upon receipt of a satisfactory report.)
6. Approved reproduction on microfiche cards of Selley and Beamish's bibliography on cyclostomes, at a cost of $100. Duplicate sets, in multiples of 10, will be available at $5.00 per set. The Commission will make duplicates available at cost plus postage and handling.
7. Confirmed the appointments of Dr. Murray Johnson, Dr. Joseph Kutkuhn, and Mr. Andrew Lawrie to the Scientific Advisory Committee upon recommendation of the National Sections.
8. Agreed to support an international symposium on percids to the extent of $5,000 in fiscal year 1975, and an equivalent amount in each of the next two years. Transmission of Commission action to the symposium's steering committe was deferred pending review of the proposal by the SAC.
9. Reviewed a progress report from the Committee on Commission Structure and Function. The Commission asked the committee to "flesh out" its recommendations in greater detail for presentation at the Interim Meeting in December, 1974.
10. Accepted the report of the SAC, noting that negotiations pertaining to the proposed ecological studies on Lake St. Clair should be pursued through the Lake Erie Committee.
11. Complimented the Fish Disease Control Committee on excellent progress, and urged the committee to consider problems associated with private hatcheries in its deliberations.
12. Approved publication of a brochure, *A Management Policy for Great Lakes Fisheries.*
13. Established a procedure for quarterly meetings of the Commission and the Secretariat to reduce the time devoted to administrative matters at Interim and Annual Meetings.

Adjournment

Meetings were scheduled as follows:

Interim Meeting, Ann Arbor, December 2-3, 1974:

Annual Meeting, Toronto, Ontario, Canada, June 17-19, 1975.

After expressing the Commission's appreciation for New York's hospitality, the meeting adjourned at 1400 hours, June 20, 1974.

INTERIM MEETING

PROCEEDINGS

The Commission's Interim Meeting convened in Ann Arbor, Michigan at 0900 hours on December 3, 1974. A severe snow storm disrupted travel and prevented several delegates from reaching Ann Arbor as scheduled. The meeting, originally scheduled December 2-3, had to be condensed to December 3 only. After disposing of preliminary matters (adoption of agenda, approval of the minutes for the 1974 Annual Meeting, and the unfortunate cancellation of reports on Great Lakes water quality by the CoChairmen of IJC's Upper Lakes Reference Group) Chairman Loftus turned to the main business of the meeting.

Sea Lamprey Control and Research

Reports on the incidence of sea lamprey wounds and scars on lake trout, salmon, and whitefish were presented.

Progress reports on sea lamprey control operations in the United States (June-November, 1974) and Canada (April 1-November 8, 1974) were presented by the agents.

Also presented were reports covering sea lamprey research at Hammond Bay Biological Station (chemosterilants) and registration-oriented research on TFM and Bayer 73 in the United States and Canada.

A brief report on the status and progress of the protocol for EPA registration of lampricides was presented. Final reports on required research are expected to be in hand by October, 1975 at which time application for registration will be forwarded to the federal environmental agencies in the United States and Canada.

Following the various reports on the sea lamprey control and research programs, the Commission reviewed programs and budgets for fiscal years 1975 and 1976. Appropriations for fiscal year 1975 were as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,142,750	$ 962,050	$3,104,800
Administration and General Research	55,250	55,250	110,500
Total	$2,198,000	$1,017,300	$3,215,300

At the Annual Meeting (June, 1974) it had been indicated that because of the reduced budget for fiscal year 1975 ($3,215,300), fewer lampricide treatments would be possible. In the intervening period the U.S. agent had been able to borrow lampricide from the Canadian agent which permitted the U.S. agent to treat 53 streams, rather than 34 as originally planned. Thus, program reductions were less severe than originally contemplated.

The total budget request for fiscal year 1976 ($4,257,500) endorsed at the Annual Meeting in June called for a full-scale sea lamprey control and research program, continuation of required registration-oriented research, surveys in Lakes Erie and Ontario, monies for barriers as part of a fully integrated sea lamprey control program, and support of chemical sensing studies at the Monell Chemical Senses Center, University of Pennsylvania.

Special Subcommittees

Progress reports were presented by the Great Lakes Fish Disease Control Committee, the Walleye Scientific Protocol Committee, the Lake Michigan Technical Chub Committee, and the Sea Lamprey-Lake Trout Evaluation Committee. Concerning the latter, there was some question on its "charge". The committee believed that the Commission was fully apprised of available relevant information; others felt that questions on mortality, wounding rates, etc. should be examined on a much broader scale. It was agreed that the charge to the committee should be more clearly defined.

A report from the Committee on Commission Structure and Function was deferred until the Annual Meeting, June, 1975.

Scientific Advisory Committee

The inclement weather forced the cancellation of a formal meeting scheduled for December 1, 1974, but certain advisors were present to discuss several items. It was noted that a document for Commission consideration at their executive session, February, 1975, would be prepared. Topics for consideration would include: herring in Lake Superior; Dr. Piavis' studies on sea lamprey incubation under various thermal regimes; the International Percid Symposium; the charge to the sea lamprey-lake trout evaluation committee; and an approach to environmental considerations as recommended by the Lake Committees.

Other Business

Matters brought to the attention of the Commission included comments on remedial structures in the St. Marys Rapids to prevent dewatering of The Canadian side of the rapids, the need for participation by the Great Lakes Fishery Commission and other fishery agencies in planning processes that deal with the management of aquatic resources, and the St. Lawrence eel ladder. Mr. Loftus alerted the delegates to Federal-Provincial joint planning for fisheries in Canada, development of the Ontario Fishery Information System, and the projected joint meeting of the Canadian Section and the International Joint Commission. These matters would be more fully reported at the June, 1975 Annual Meeting.

Adjournment

The Chairman informed the delegates of scheduled meetings as follows:

Annual Meeting, Inn on the Park, Toronto, June 17-19, 1975;

Lower Lake Committees (Ontario, Erie) at the Hilton Inn, Lansing, Michigan, March 11-13, 1975; and

Upper Lake Committees (Huron, Michigan, Superior), Plankinton Hotel, Milwaukee, Wisconsin, March 25-26, 1975.

The meeting adjourned at 1545 hours, December 3, 1974.

APPENDIX A

SUMMARY OF MANAGEMENT AND RESEARCH

Within the past biennium the Great Lakes Fishery Commission has, through its Lake Committees and various work groups, devoted increasing attention to a broad spectrum of fishery matters other than sea lamprey control, lake trout restoration, and fish stocking.[3] Some of the issues of concern pertain to one lake, others are of more general concern.

Lake Superior Agencies on Lake Superior have expressed serious concern over the general decline of herring abundance in Lake Superior, the only one of the Great Lakes that now supports a significant population of the species. The expressed concern led to the establishment of the Lake Superior Lake Herring Subcommittee (LSLHS) in 1972. The Committee, representing state, provincial, and federal fishery agencies, was asked to: (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 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 herring stocks in Lake Superior. The LSLHS presented its completed report, with conclusions and recommendations to the Lake Superior Committee (LSC), at the latter's annual meeting in March, 1974, and stated that it had completed its charge. Major conclusions reached by the LSLHS were:

1. The decline of herring stocks in Lake Superior is real, and action to halt the decline is imperative now and
2. Commercial exploitation has been mainly responsible for the decline, although other factors including competition with bloaters and smelt and pollution in bay areas have also contributed to the decline.

Recommendations were:

1. Commercial exploitation should be reduced in areas where catch-effort statistics show reduction in recruitment.
2. Commercial fishing should be prohibited, experimentally, in those major fishing areas where herring stocks have declined.
3. Results should be carefully evaluated and monitoring methods should be standardized.

[3]Plantings of salmonids, 1958-74 are summarized in Appendix B.

4. Research into the inter-specific relationships of herring, smelt, and chubs should be continued and intensified.
5. Discrete stocks of herring should be identified.
6. Studies to determine what population levels are required for maintenance of the stock should be initiated.
7. Better information on the role of pollution relative to lake herring should be obtained.

The Lake Superior Committee accepted and endorsed the report, transmitted it to the Great Lakes Fishery Commission at the latters annual meeting in June, 1974, with the plea that the Commission urge cooperating agencies to implement the recommendations with all possible speed. In presenting the report for the Commission's consideration, the Lake Superior Committee noted that various agencies had already taken steps to implement some of the recommendations of the LSLHS. The Commission accepted the recommendations from the Lake Superior Committee, noting that it considered the report excellent, but deferred formal action pending a review by its Scientific Advisory Committee.

In his report to the Commission's Management and Research Committee the Chairman of the Lake Superior Committee summarized the deliberations of his Committee at their annual meeting of March, 1974 as follows.

Sea lamprey. The control program is proceeding satisfactorily, and the intensified efforts of the past biennium have been effective.

Lake trout. Abundance of planted lake trout continues to be high. The percentage of native lake trout continues to increase, especially in Wisconsin waters. When sexually mature, planted lake trout tend to return to planting sites to spawn. Many of these sites are along shorelines which are either unsuitable for spawning or egg incubation. The Lake Superior Committee recommended continued effort toward planting on areas suitable for spawning and successful reproduction.

In Whitefish Bay, mortality of "legal" size lake trout is higher than in other inshore areas in Michigan waters: 25-inch and longer lake trout are relatively scarce. This was attributed to factors other than sea lamprey activity.

F_1 splake. Michigan and Wisconsin have obtained good results with plants of brook trout X lake trout hybrids. The fish grow rapidly and tend to remain in the planting areas. Both states plan to continue to use F_1 splake in their management programs.

Chubs. The downward trend in catches evident over the past several years continued except in Wisconsin waters where landings rose slightly.

Whitefish. Whitefish production in Lake Superior remains fairly stable, and stocks appear to be in a healthy state.

Contaminants. Mercury body burden exceeding FDA action levels was reported in fish from certain areas throughout the lake.

Lake trout sampling program. All agencies agreed to continue the sampling program but stressed the need to activate the Lake Superior Study

Group to resolve problems of interpreting data on lake trout wounding and sea lamprey induced mortality. Also, they expressed the need to establish better indices to measure the effectiveness of sea lamprey control.

Lake Michigan At the present time two problems are of major concern.

Lake trout. Growth and survival of planted lake trout continues to be high, but at the same time, removal, primarily by the highly successful sport fishery, is rapid. To the present time, extensive sampling has not found any naturally-produced juvenile lake trout in Lake Michigan despite widespread lake trout spawning at least since 1971. Reasons for the apparent failure of planted lake trout to reproduce have not been determined. Numerous possibilities are being investigated. When ready to spawn, planted lake trout tend to return to planting sites. These sites are often in shallow water in areas unsuitable for spawning or successful incubation of eggs. To encourage successful reproduction, experimental plants of several life history stages are being made on offshore reefs formerly used by native Lake Michigan lake trout. Contaminants and/or predation-competition may be inhibiting factors and investigations on these matters are going forward. It is also possible that sampling has simply failed to catch any young lake trout that may be present.

More than half of the lake trout planted to date in Lake Michigan are from hatchery brood fish of Lake Superior origin held at the State of Michigan hatchery at Marquette; consequently they may be regarded as "domestic" lake trout. It is possible that the planted progeny have not yet "adapted" to Lake Michigan through the natural selection process. Several generations may be required and, furthermore, the selection process will not operate most efficiently until self-perpetuating stocks are established in the lake.

Chubs. Stocks of chubs (now composed of 99% bloaters, *Coregonus hoyi*) have declined drastically within the past decade. Concern over the matter led the Lake Michigan Committee to establish the Lake Michigan Technical Chub Committee in April, 1974. The Committee, composed of representatives of the four bordering states and the U.S. Fish and Wildlife Service, was requested to: (1) recommend interim allowable catch quotas (by July, 1974) to be considered by the management agencies; (2) provide background for the recommendations; and (3) make recommendations to improve the ability to set such quotas for the future harvest of chubs from Lake Michigan. In July, 1974 the Chub Technical Committee adopted five basic principles upon which to base a management program, and transmitted the statement to the fishery administrators of the four states.

1. The decline of the chub populations in Lake Michigan is clearly evident from systematic sampling and from reduced CPE in the commercial catch.
2. The reduction is of sufficient magnitude to severely limit chub reproduction.
3. Diminished stocks of chubs face competitive pressure from smelt and alewives while commercial exploitation continues.
4. Because of reduced recruitment, no surplus is available for harvest.

5. Drastic reduction of the commercial catch will allow more escapement and thereby enhance the reproductive potential of the chub stocks.

Thus, the Technical Chub Committee recommended as follows: "In view of the fact that there is no harvestable surplus, the Committee unanimously agrees that there is no biological justification for a continuation of a chub fishery in Lake Michigan. We, therefore, recommend that the chub fishery be suspended in 1975 and that the suspension remain in effect until the population stabilizes and a harvestable surplus occurs". Thereafter, fishery administrators from the four states met in Chicago in July, 1974 and agreed to seek legislative approval for a 90% closure of the chub fishery in 1975; they also agreed to authorize a projected catch of 310,000 pounds (10% of what might be caught under an unrestricted fishery) for assessment purposes, to be allotted to the four states. Finally, they asked the Chub Technical Committee to develop, by November 1, 1974, a coordinated lakewide program to assess results. At the Commission's Interim Meeting in December, 1974, the Chub Technical Committee outlined an assessment program.

Lake Huron The current situation in Lake Huron differs somewhat from that in Lakes Superior and Michigan. The rehabilitation effort is not so far advanced. Full-scale sea lamprey control was not initiated until 1966 (Lake Superior-1958; Lake Michigan-1960), and although the control program has been equally effective, the delay deferred the intensive fish stocking program. Furthermore, as a result of an experimental program initiated in Ontario in the 1950's, the recommendation by the Lake Huron Committee in 1966 "that planting of trout in Lake Huron be restricted to selected hybrids" (brook trout X lake trout = splake) was adopted by the Commission at its Annual Meeting in June, 1966. These fish were developed in Ontario through an intensive breeding program which hybridized male brook trout with female lake trout to produce a fast growing fish similar to lake trout in behavior and appearance and to the brook trout in fast growth and early maturity. Following several generations of selective breeding a splake was developed which grows rapidly, matures at an early age, and inhabits deep water.

At the annual meeting of the Lake Huron Committee in March, 1968, the State of Michigan expressed reservations over the splake program and suggested that lake trout be used for rehabilitation in Lake Huron. After extensive discussion it was mutually agreed at the Commission's Annual Meeting in June, 1968 "that no lake trout plantings would be made in Lake Huron unless requested by the Great Lakes Fishery Commission." Because numbers of highly selected (F_5) splake available for planting in Lake Huron have been limited by a shortage of brood stock, splake sperm also was used to fertilize lake trout eggs to produce backcrosses. It was believed these fish would retain the advantages of early maturity and fast growth. The first backcrosses were produced in the fall of 1971 and planted in Lake Huron as yearlings in the spring of 1973 and the program was to have continued. Unfortunately, in 1972, kidney disease was diagnosed in F_5 splake brood stock held at Michigan's Marquette Fish Hatchery, and eggs from that source were, therefore, unacceptable at the Jordan River National Fish Hatchery where the lake trout and splake for most of the Great Lakes plantings are reared. Thus, the disease problem prompted a review of the policy for splake in Lake Huron.

At a meeting in October, 1972, certain modifications in policy were agreed upon. Michigan's insistence that the restoration effort in Lake Huron could not be delayed longer was accepted, and it was agreed that until such time as adequate numbers of selected splake were available, annual plantings of one million lake trout, splake, or splake X lake trout backcrosses would be made in Michigan waters of the lake. It was also agreed that Ontario would continue its program with F_5 splake and supply about 2,500 selected splake fingerlings to the U.S. Fish and Wildlife Service for the development of a brood stock. Also, it was agreed that the plantings programs in Michigan and Ontario waters of Lake Huron could be pursued with minimal interference between fish stocks.

Plantings of selected splake were initiated in 1969, and plants of lake trout and splake X lake trout backcrosses were started in 1973. In the period 1969-73, a total of 2.9 million splake, lake trout, and backcrosses were planted. Restoration of the fishery resource in Lake Huron has also been pursued through massive plantings of salmon. In 1965-72, Ontario planted 13.0 million kokanee (0.9 million fingerlings, 10.4 million fry, and 1.7 million eggs) in Canadian waters of the lake. Plantings of large salmon were initiated in 1968 by introducing 0.4 million coho salmon and 0.3 million chinook salmon in Michigan waters.

Because the intensive planting program in Lake Huron has been in operation for a shorter time, and has amounted to only 9.5 million large salmonids compared to 39.3 million in Lake Superior and 48.9 million in Lake Michigan, the recreational fishery has not developed to the same magnitude as in Lakes Superior or Michigan. Nevertheless, the fishery is expanding rapidly.

The sequence of events caused by the invasion of sea lampreys and alewives started sooner in Lake Huron than in Lakes Michigan and Superior with the result that overall deterioration of the fishery resource was more extreme than in either of the other lakes. To the present, response to current management efforts has not been so encouraging as in the upper lakes. Herring have virtually disappeared, chubs have been reduced to insignificance, and whitefish stocks have not shown the same resurgence as in Lake Michigan.

Lake Erie Major concerns in Lake Erie relate to two areas: environmental deterioration and serious decline or outright disappearance of the most valuable fish species. Since about 1962 the Commission and cooperating state and provincial agencies have wrestled with the walleye problem in an effort to preserve, restore, and enhance stocks of this very valuable species. Publication of "The Ecology and Management of the Walleye in Western Lake Erie" (Great Lakes Fishery Commission, Technical Report No. 15, May 1969) and establishment of the Walleye Scientific Protocol Committee in 1973 have provided a basis upon which to establish a management program which, it is hoped, will prove effective. Within the past three or four years, reduced commercial exploitation[1] has reduced mortality of adult walleyes and fortuitious weather conditions during walleye spawning season have produced one or two strong year classes. Consequently, there has been a significant buildup of stocks.

Eutrophication, primarily man-induced, has been especially conspicuous in Lake Erie. In 1974, the Lake Erie Committee initiated a request that a "statement of environmental concern" should be developed under Commission auspices and transmitted to those governmental agencies having responsibility for water quality, pollution abatement, and land use.

Lake Ontario All of the factors that have led deterioration of the fishery resource in the Great Lakes over the past 75-100 years (deforestation, industrialization-urbanization, habitat modification, intensive and selective exploitation by the commercial fishery, invasion by marine species) have operated on Lake Ontario for a longer period than on the other Great Lakes. Consequently, the cumulative effects have been more severe. Further, intensive restoration efforts (sea lamprey control, massive stocking with suitable species) have been in operation for a shorter period than in the other lakes. Thus, the current situation in Lake Ontario is not fully comparable to that in the other lakes. Results on Lakes Superior, Michigan, and Huron permit an optimistic prognosis but it is too early for results to be apparent.

General Two very complex matters are of major concern to the Commission and its cooperating agencies at the present time. The first is the development of a means whereby fishery interests, per se, will receive proper consideration in the planning, decision making, and implementation of programs of those agencies having responsibility for water quality, pollution abatement, and land use. To this end the Commission and Great Lakes fishery agencies are increasing their direct participation in the deliberations of such agencies as the International Joint Commission. The second matter derives from the complexities that follow when dealing with the eight states and the Province of Ontario (who have broad jurisdiction within their respective territorial waters) and two federal governments. Because social, economic, or other constraints differ widely between the jurisdictional agencies, so may management programs and objectives. Thus, the development of mutually acceptable and integrated management programs is extremely difficult. The establishment in 1965 of the Lake Committees, composed of senior fisheries administrators from each jurisdictional agency, has been effective in promoting integration of programs. So long as the welfare of the fishery resource remains as the primary consideration, related problems are amenable to negotiation and resolution.

[1]Reduced commercial exploitation resulted from dual causes: high mercury content in walleyes resulted in a market ban in the U.S. and Ontario in 1970 and in 1971 Ohio closed the commercial fishery for a 5-year period.

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. In the fall of 1971, 1972, and 1973, however, the U.S. Fish and Wildlife Service made experimental plants of fall fingerlings to compare survival and growth of regular-size fall fingerlings (approx. 80/pound) 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 fall plants of accelerated-growth fingerlings are advantageous, production in U.S. Federal hatcheries could be increased at minimum cost. In 1974, two additional small lots of accelerated-growth fingerlings were made in Lake Michigan without matching plants of normal-growth fish.

To rehabilitate fish stocks in Lake Huron, the Province of Ontario and the State of Michigan agreed to plant highly selected splake. These fish were developed in Ontario through an intensive breeding program which hybridized male brook trout with female lake trout to produce a fast growing fish similar to lake trout in behavior and appearance and to the brook trout in fast growth and early maturity. Following several generations of selective breeding a splake was developed which grows rapidly, matures at an early age, and inhabits deep water. First plants were made 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 also was used to fertilize lake trout eggs to produce backcrosses. It was believed these fish would retain the advantages of early maturity and fast growth. The first backcrosses were produced in the fall of 1971 and planted in Lake Huron as yearlings in the spring of 1973 and the

program was to 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 fingerlings) were planted in 1973 to bring stocking levels up to approximately one million lake trout and hybrids.

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

In Lake Erie, Pennsylvania made small experimental plants of lake trout fingerlings in 1969 and yearlings in 1974. Good growth and some survival of the 1969 plant were recorded but the fish disappeared after three years in the lake.

Plants of yearling splake in Lake Ontario were initiated in 1972 and continued through 1974 by the Province of Ontario. In addition, plants of lake trout were started in New York State waters in 1973. Both lots of fish are being stocked over former lake trout spawning reefs in the eastern basin of Lake Ontario.

Table 1 summarizes annual plantings of lake trout and hybrids in the Great Lakes and Table 2 details the 1974 plants in each of the Great Lakes. Other small experimental plants of first generation splake have been made by Wisconsin and Michigan in Lake Superior (Table 3).

Coho salmon, usually stocked in the spring as yearlings, have been planted annually in Lakes Superior and Michigan since 1966, and in Lakes Huron, Erie, and Ontario since 1968. Table 4 summarizes annual plantings in each of the Great Lakes, and Table 5 details the 1974 plantings in each of the Great Lakes.

Annual plantings of chinook salmon, usually stocked in the spring as fingerlings, have been made in Lakes Superior and Michigan since 1967, in Lake Huron since 1968, in Lake Erie since 1970, and in Lake Ontario since 1969. Table 6 summarizes annual plantings of chinook salmon in the Great Lakes and Table 7 details the 1974 plantings in each of the Great Lakes.

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

2-year-olds. Table 8 summarizes Atlantic salmon plantings in the Great Lakes 1972-1974.

From 1965 to 1972 kokanee salmon were planted 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. There is some evidence of natural reproduction and assessment of kokanee stocks is being continued.

Table 1 Annual plantings (in thousands) of lake trout, splake[1 2], and backcrosses[3] in the Great Lakes, 1958-1974.

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Ontario	Total
1958	298	184	–	505	987
1959	44	151	–	473	668
1960	393	211	–	446	1,050
1961	392	314	–	554	1,260
1962	775	493	77	508	1,853
1963	1,348	311	175	477	2,311
1964	1,196	743	220	472	2,631
1965	780	448	251	468	1,947
1966	2,218	352	259	450	3,279
1967	2,059	349	382	500	3,290
1968	2,260	239	377	500	3,376
1969	1,860	251	216	500	2,827
1970	1,944	204	226	500	2,874
1971	1,055	207	280	475	2,017
1972	1,063	259	293	491	2,106
1973	894	227	284	500	1,905
1974	888	436	304	465	2,093
Subtotal	19,467	5,379	3,344	8,284	36,474

LAKE MICHIGAN

Year	Michigan	Wisconsin	Illinois	Indiana	Total
1965	1,069	205	–	–	1,274
1966	956	761	–	–	1,717
1967	1,118	1,129	90	87	2,424
1968	855	817	104	100	1,876
1969	877	884	121	119	2,001
1970	875	900	100	85	1,960
1971	1,195	945	100	103	2,343
1972	1,422	1,284	110	110	2,926
1973	1,129	1,170	105	105	2,509
1974	1,070	971	176	180	2,397
Subtotal	10,566	9,066	906	889	21,427

Table 1–(Cont'd)

LAKE HURON

Year	Michigan			Ontario	Total
	Splake	Lake trout	Backcrosses	Splake	
1969	–	–	–	35	35
1970	43	–	–	247	290
1971	74	–	–	468	542
1972	215	–	–	333	548
1973	–	629	486	412	1,527
1974	–	793	–	299	1,092
Subtotal	332	1,422	486	1,794	4,034

LAKE ERIE

Year	Pennsylvania	Total
1969	17	17
1974	26	26
Subtotal	43	43

LAKE ONTARIO

Year	Ontario	New York	Total
	Splake	Lake trout	
1972	48	–	48
1973	39	66	105
1974	26	644	670
Subtotal	113	710	823

Great Lakes Total, Lake trout	60,076
Great Lakes Total, Splake and Backcrosses	2,725
Grand Total	62,801

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

Table 2. Plantings of lake trout and splake[1 2] in the Great Lakes, 1974.

Location	Numbers	Fin clip
LAKE SUPERIOR-LAKE TROUT		
Michigan waters		
Ontonagon area	108,900	left pectoral-right ventral
	110,000[3]	left pectoral-right ventral
Eagle Harbor	25,200	left pectoral-right ventral
Big Traverse Bay	98,800[3]	left pectoral-right ventral
Pequaming	27,400	left pectoral-right ventral
Huron Bay (Pt. Abbaye Reef)	39,050[3]	left pectoral-right ventral
Loma Farms	52,480	left pectoral-right ventral
Marquette-shore plants	117,900	left pectoral-right ventral
-Partridge Island Reef	50,000[3]	left pectoral-right ventral
Shelter Bay	126,400	left pectoral-right ventral
Munising	50,000[4]	left pectoral-right ventral
Grand Marais	54,000	left pectoral-right ventral
Pendills Bay	27,500	left pectoral-right ventral
Subtotal	887,630	
Wisconsin waters		
Ashland (Devil's Island Reef)	65,602[3 4]	left pectoral-right ventral
Bayfield (Eagle Island Reef)	48,636[3 4]	left pectoral-right ventral
Bayfield area	25,600	left pectoral-right ventral
Bayfield area	56,400	left pectoral-right ventral
Washburn	182,700	left pectoral-right ventral
Onion River	29,100	left pectoral-right ventral
Herbster	28,304[4]	left pectoral-right ventral
Subtotal	436,342	
Minnesota waters		
Duluth-Lester River	100,000	left pectoral-right ventral
Palmers (Stony Point)	38,812[4]	left pectoral-right ventral
Split Rock	83,461	left pectoral-right ventral
Little Marais	82,039	left pectoral-right ventral
Subtotal	304,312	
Ontario waters		
West end		
Thunder Bay (Lambert Island)	125,000	left pectoral-right ventral
Nipigon Bay	125,000	left pectoral-right ventral
East end		
Inner Batchawana Bay	40,000	left pectoral-right ventral
Pancake Point	40,000	left pectoral-right ventral
Montreal River	30,000	left pectoral-right ventral
Agawa Bay	50,000	left pectoral-right ventral
Michipicoten Bay	55,000	left pectoral-right ventral
Subtotal	465,000	
Total, Lake Superior	2,093,284	

Table 2–(Cont'd)

Location	Numbers	Fin clip
LAKE MICHIGAN-LAKE TROUT		
Michigan waters		
Escanaba	20,000[3]	adipose-right ventral
Peninsula Point (Escanaba)	35,000	adipose-right ventral
Deepwater Point (Stonington)	14,000[3]	adipose-right ventral
Minneapolis Shoal	33,600[3]	adipose-right ventral
Trout Island Shoal (Port Inland)	25,200[3]	adipose-right ventral
Mille Coquins Reefs (Naubinway)	25,000[3]	adipose-right ventral
Simmons Reef	29,500[3]	left pectoral-right ventral
Grays Reef	25,000[3]	adipose-right ventral
South Fox Island Shoal	25,000[3]	left pectoral-right ventral
Petosky	77,000	adipose-right ventral
Charlevoix	25,000[3]	adipose-right ventral
Fisherman Island (Charlevoix)	50,000[3]	adipose-right ventral
Charlevoix	15,000[5]	adipose-left ventral
Grand Traverse Shoal	60,050[3 5]	adipose-left ventral
Grand Traverse Bay, East (Acme)	75,000	adipose-right ventral
Grand Traverse Bay, West (Greilickville)	75,000	adipose-right ventral
Good Harbor Bay (Leland)	56,800[3]	left pectoral-right ventral
Frankfort	50,000	adipose-right ventral
Manistee	48,000	adipose-right ventral
Ludington	48,000	adipose-right ventral
Montague	49,000	adipose-right ventral
Grand Haven	50,000	adipose-right ventral
Saugatuck	60,200[5]	adipose-left ventral
South Haven	50,000	adipose-right ventral
Benton Harbor	49,000	adipose-right ventral
Subtotal	1,070,350	
Wisconsin waters		
Gills Rock	25,000	adipose-right ventral
Sturgeon Bay (Bayside)	93,000	adipose-right ventral
Sturgeon Bay (Lakeside)	98,000	adipose-right ventral
Algoma	90,000[3]	adipose-right ventral
Kewaunee	93,000	adipose-right ventral
	125,000[3 5]	adipose-left ventral
Manitowoc	98,000	adipose-right ventral
Sheboygan	98,000	adipose-right ventral
Port Washington	65,000	adipose-right ventral
Milwaukee	90,000	adipose-right ventral
Racine-Kenosha	96,000	adipose-right ventral
Subtotal	971,000	
Indiana waters		
Bethlehem Steel Dock	180,000	adipose-right ventral
Illinois waters		
Highland Park	176,000	adipose-right ventral
Total, Lake Michigan	2,397,350	

Table 2–(Cont'd)

Location	Numbers		Fin clip
LAKE HURON-SPLAKE AND LAKE TROUT			
Ontario waters			
Georgian Bay-Meaford area	136,248	fingerlings	right pectoral
	103,415	yearlings	right pectoral-right ventral
	974	4-year-old	dorsal
-Lion's Head	21,615	yearlings	right pectoral-right ventral
Main Basin-South Bay	25,500	yearlings	adipose-right ventral, tetr-cycline
	11,600	yearlings	tetracycline
Total, splake	297,878		
Michigan waters			
Hessel-Cedarville	48,000	yearlings	adipose-left ventral
Hessel-Cedarville (Pomeroy Reef)	96,000[3]	yearlings	adipose-left ventral
Graham Shoal	70,000[3]	yearlings	adipose-left ventral
Zela Shoal	72,000[3]	yearlings	adipose-left ventral
Raynolds Reef	64,000[3]	yearlings	adipose-left ventral
Hammond Bay	72,000	yearlings	adipose-left ventral
Rogers City	70,000	yearlings	adipose-left ventral
Rockport	50,000[3]	yearlings	adipose-left ventral
Black River Island	64,000[3]	yearlings	adipose-left ventral
Greenbush	59,000	yearlings	adipose-left ventral
Tawas Point	48,000	yearlings	adipose-left ventral
Grindstone City	80,000	yearlings	adipose-left ventral
Total, lake trout	793,000		
Total, splake and lake trout in Lake Huron	1,092,352		
LAKE ERIE-LAKE TROUT			
Pennsylvania waters			
Offshore	26,050		none
LAKE ONTARIO-SPLAKE AND LAKE TROUT			
Ontario waters	SPLAKE		
Charity Shoal	20,200	yearling	adipose-right ventral
Big Bar Shoal	5,600	yearling	adipose-right ventral
Total, splake	25,800		

Table 2–(Cont'd)

LAKE TROUT			
New York waters			
Calf Island Shoal	127,300[4]	yearling	left pectoral
Offshore Hamlin Beach (Central basin)	251,600	fingerlings[5]	adipose
Offshore Stoney Island and Selkirk Shores (Eastern basin)	265,300	fingerlings[5]	adipose
Total, lake trout	644,200		
Total, splake, trout trout, Lake Ontario	670,000		
Grand total lake trout planted in Great Lakes, 1974			5,953,884
Grand total splake planted in Great Lakes, 1974			325,152
Grand Total			6,279,036

[1]Lake trout x brook trout hybrid.
[2]Excludes small experimental splake plants in Lake Superior (see Table 3).
[3]Offshore plants.
[4]State plants-all other U.S. plants by U.S. Fish and Wildlife Service.
[5]Fast growth fall fingerling plants-other plants consist of yearling fish.

Table 3. Small experimental splake plantings in Lake Superior, 1971, 1973, and 1974.

Year	State	Location	Numbers	Fin clip
1971	Michigan	Copper Harbor	13,199	none
1973	Wisconsin	Bayfield area	5,000	dorsal-left ventral
1974	Wisconsin	Washburn	10,316	dorsal
		Houghton Point	9,782	dorsal
		Total, Lake Superior	38,297	

Table 4. Annual plantings (in thousands) of coho salmon in the Great Lakes, 1966-1974.

LAKE SUPERIOR				
Year	Michigan	Minnesota	Ontario	Total
1966	192	–	–	192
1967	467	–	–	467
1968	382	–	–	382
1969	526	110	20	656
1970	507	111	31	649
1971	402	188	27	617
1972	152	145	–	297
1973	100	35	–	135
1974	455	74	–	529
Subtotal	3,183	663	78	3,924

Table 4–(Cont'd)

LAKE MICHIGAN

Year	Michigan	Wisconsin	Indiana	Illinois	Total
1966	660	–	–		660
1967	1,732	–	–	–	1,732
1968	1,176	25	–	–	1,201
1969	3,054	217	–	9	3,280
1970	3,155	340	48	–	3,543
1971	2,411	267	68	5	2,751
1972	2,269	258	96	–	2,623
1973	2,003	510	–	5	2,518
1974	2,788	318	125	–	3,231
Subtotal	19,248	1,935	337	19	21,539

LAKE HURON

Year	Michigan	Total
1968	402	402
1969	667	667
1970	571	571
1971	975	975
1972	249	249
1973	100	100
1974	500	500
Subtotal	3,464	3,464

LAKE ERIE

Year	Michigan	Ohio	Pennsylvania	New York	Total
1968	–	20	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
1974	200	188	366	29	783
Subtotal	200	820	1,381	263	2,664

LAKE ONTARIO

Year	Ontario	New York	Total
1968	–	40	40
1969	130	109	239
1970	145	294	439
1971	160	122	282
1972	122	230	352
1973	272	240	512
1974	438	217	655
Subtotal	1,267	1,252	2,519
Great Lakes Total, coho salmon, 1966-1974			34,110

Table 5. Plantings of coho salmon in the Great Lakes, 1974.

Location	Numbers	Fin clip
	LAKE SUPERIOR	
Michigan waters		
Black River	76,316	none
Presque Isle River	25,024	none
Falls River	100,030	none
Huron River	50,045	none
Dead River	100,023	none
Sucker River	103,565	none
Subtotal	455,003	
Minnesota waters		
Gooseberry River	25,690	none
Silver Creek	19,190	none
Stewart River	29,360	none
Subtotal	74,240[1]	
Total, Lake Superior	529,243	
	LAKE MICHIGAN	
Michigan waters		
Cedar River	129,528	none
Manistique River	115,500	none
Thompson Creek	100,400	none
Lake Charlevoix	140,204	none
Brewery Creek	100,018	none
Platte River	804,131	none
Portage Lake	244,653	none
Big Manistee River	345,111	none
Little Manistee River	150,067	none
Big Sable River	48,968	none
Muskegon River	205,559	none
Grand River	201,983	none
St. Joseph River	201,900	none
Subtotal	2,788,022	
Wisconsin waters		
Little River	40,000	none
Ahnapee River	29,000	none
Algoma	10,000	right maxillary
	10,000	adipose-right pectoral
Kewaunee River	40,000	none

Table 5–(Cont'd)

Location	Numbers	Fin clip
Two Rivers	16,000	none
	10,000	adipose-left pectoral
	10,000	dorsal-left ventral
	10,000	dorsal-right ventral
	10,000	left maxillary
Little Manitowoc	40,000	none
Sheboygan River	40,000	none
Milwaukee	39,950	none
Kenosha	13,000	none
Subtotal	317,950	
Indiana waters		
Trail Creek	64,000	none
Little Calumet River (East Branch)	61,000	none
Subtotal	125,000	
Total, Lake Michigan	3,230,972	
LAKE HURON		
Michigan waters		
Tawas River	100,019	none
Au Gres River	200,000	none
Cass River	200,029	none
Total, Lake Huron	500,048	
LAKE ERIE		
Michigan waters		
Huron River	200,000	none
Ohio waters		
Chagrin River	79,100	none
Huron River	109,326	none
Subtotal	188,426[2]	
Pennsylvania waters		
Elk Creek	46,400	none
Godfrey Run	104,400	none
Trout Run	66,800	none
Walnut Creek	25,200	none
Presque Isle Bay	96,800	right pectoral
Sixteen Mile Creek	26,300	left pectoral
Subtotal	365,900	
New York waters		
Eighteen Mile Creek	5,000	right ventral
Cattaraugus Creek	10,000	right ventral

Table 5–(Cont'd)

Location	Numbers	Fin clip
Chautauqua Creek	9,000	right ventral
Twenty Mile Creek	5,000	right ventral
Subtotal	29,000	
Total, Lake Erie	783,326	
LAKE ONTARIO		
Ontario waters		
Credit River	403,645	left ventral
Humber River	34,780	left ventral
Subtotal	438,425	
New York waters		
Salmon River	39,000	none
	25,000	adipose
	22,400	right ventral
	17,200[2]	left ventral
Skinner Creek	11,100	adipose
	8,800	right ventral
Sandy Creek	41,000	none
	52,300[2]	none
Subtotal	216,800	
Total, Lake Ontario	655,225	
Grand Total coho salmon planted 1974	5,698,814	

[1]"Advanced fry"
[2]Fall fingerling

Table 6. Annual plantings (in thousands) of chinook salmon in the Great Lakes, 1967-1974.

Year	Michigan	Minnesota	Total
LAKE SUPERIOR			
1967	33	–	33
1968	50	–	50
1969	50	–	50
1970	150	–	150
1971	252	–	252
1972	472	–	472
1973	509	–	509
1974	295	228	523
Subtotal	1,811	228	2,039

Table 6–(Cont'd)

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
1974	2,046	616	159	757	3,578
Subtotal	11,533	2,139	439	973	15,084

LAKE HURON

Year	Michigan	Total
1968	274	274
1969	255	255
1970	643	643
1971	894	894
1972	515	515
1973	967	967
1974	776	776
Subtotal	4,324	4,324

LAKE ERIE

Year	Michigan	Ohio	Pennsylvania	New York	Total
1970	–	150	–	–	150
1971	–	180	–	–	309
1972	–	–	150	–	150
1973	305	–	155	125	585
1974	502	–	189	125	816
Subtotal	807	330	623	250	2,010

LAKE ONTARIO

Year	Ontario	New York	Total
1969	–	70	70
1970	–	141	141
1971	89	149	238
1972	190	427	617
1973	–	696	696
1974	225	963	1,188
Subtotal	504	2,446	2,950
Great Lakes Total, chinook salmon, 1967-1974			26,407

Table 7. Plantings of chinook salmon in the Great Lakes, 1974.

LAKE SUPERIOR

Location	Numbers	Fin clip
Michigan waters		
Dead River	100,188	none
Black River (Gogebic Co.)	100,100	none
Big Iron River	95,000	none
Subtotal	295,288	
Minnesota waters		
Cascade River	71,900	none
Baptism River	72,299	none
French River	83,505	none
Subtotal	227,704[1]	
Total, Lake Superior	522,992	

LAKE MICHIGAN

Location	Numbers	Fin clip
Michigan waters		
Menominee River	100,496	none
Petoskey (9 Mile Point)	101,468	none
Brewery Creek	100,110	none
Portage Lake	50,456	none
Big Manistee River	250,248	none
Little Manistee River	402,330	none
Big Sable River	151,248	none
Muskegon River	300,135	none
Grand River	300,777	none
Kalamazoo River	86,944	none
St. Joseph River	201,740	
Subtotal	2,045,952	
Wisconsin Waters		
Little River	40,000	none
Strawberry Creek (Sturgeon Bay)	148,000	none
Ahnapee River	40,000	none
Kewaunee River	50,000	none
Two Rivers	68,400	none
Little Manitowoc River	50,000	none
Sheboygan River	50,000	none
Port Washington	45,000	none
Milwaukee	45,000	none
Kenosha	80,000	none
Subtotal	616,400	

Table 7–(Cont'd)

Illinois waters		
Kellogg Ditch, Camp Logan, Zion	168,891	none
	7,500	adipose
	10,000	adipose-left pectoral
Waukegon River, Waukegan	204,022	none
	10,000	right ventral
	7,380	right pectoral-left ventral
Diversey Harbor	222,958	none
	10,000	left pectoral
	7,500	left pectoral-right ventral
	7,500	adipose-left ventral
Jackson (inner) Harbor, Jackson Park	90,950	none
	10,000	left ventral
Subtotal	756,701	
Indiana waters		
Trail Creek	73,000	none
Little Calumet River (East Branch)	86,000	none
Subtotal	159,000	
Total, Lake Michigan	3,578,053	
LAKE HURON		
Michigan waters		
Mill Creek (Harrisville)	200,058	none
AuSable River	401,292	none
AuGres River	174,944	none
Total, Lake Huron	776,294	
LAKE ERIE		
Michigan waters		
Detroit River	300,784	none
Huron River	201,180	none
Subtotal	501,964	
Pennsylvania waters		
Elk Creek	84,940	none
Walnut Creek	103,900	none
Subtotal	188,840	
New York waters		
Lake Erie-Dunkirk and Barcelona Harbor	53,000	none
Eighteen Mile Creek	36,000	none
Cattaraugus Creek	36,000	none
Subtotal	125,000	
Total, Lake Erie	815,804	

LAKE ONTARIO		
Ontario waters		
Bronte Creek	224,550	tetracycline mark
New York waters		
North Sandy Creek	27,000	none
South Sandy Creek	54,000	none
Salmon River	506,200	none
Grindstone Creek	35,400	none
Little Salmon River	70,800	none
Sterling Creek	35,400	none
Sandy Creek	130,000	none
Oak Orchard	104,500	none
Subtotal	936,300	
Total, Lake Ontario	1,187,850	
Total chinook salmon Great Lakes, 1974	6,880,993	

[1] Spring spawning stock.

Table 8. Plantings of Atlantic salmon in the Great Lakes, 1972-1974.

Year	State	Area	Numbers	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
1974	Michigan	Platte R.	7,308	adipose
		Boyne R.	14,555	none
Total			46,863	
		LAKE HURON		
1972	Michigan	AuSable R.	9,000	none
Total, Atlantic salmon, Great Lakes 1972-1974			95,863	

APPENDIX C

SEA LAMPREY CONTROL IN THE UNITED STATES

Bernard R. Smith and Robert A. Braem
U.S. Fish and Wildlife Service

Another milestone in control of the sea lamprey was reached in 1974 when the catch of spawning-run adults in the eight index weirs of Lake Superior fell to the record low of 1,912--or 718 fewer than the previous low of 2,630 in 1967. This catch is less than 4% of the highest catch, recorded in 1961. The percentage of rainbow trout with sea lamprey wounds or scars declined from 3.0 in 1973 to 1.6 in 1974, providing an additional indication that the lamprey population was low. A decrease in the number of streams where larval populations have become reestablished also points to fewer adults in the lakes. The 1970 year class of larvae is the most recent year class that has been collected in 22 of 81 tributaries in which larvae formerly occurred on Lake Superior, in 29 of 110 on Lake Michigan, and 13 of 59 on Lake Huron.

Routine control work continued as planned. Scheduled chemical treatments were carried out on a total of 53 streams: 18 tributaries of Lake Superior, 22 of Lake Michigan, and 13 of Lake Huron. Observations of sea lamprey populations in streams and lentic areas continued during the year with emphasis on populations on deltas, survival and rate of transformation in offshore areas, and growth of larvae in reestablished populations. About 281 tributaries of the three upper Great Lakes were surveyed for pretreatment information or for collections of data on reestablished populations or to verify that sea lampreys had not become established in negative streams. No extraordinary situations were found that are expected to be detrimental to the control program.

Surveys and Chemical Treatments

Lake Superior Surveys. Surveys of Lake Superior streams were delayed until mid-July by high water levels during the early part of the field season. Pretreatment examinations of 18 streams indicated that sea lamprey larvae were relatively abundant in the Salmon Trout (Marquette County), Misery, Middle, and upper Au Train Rivers and in Harlow Creek. Sea lamprey

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populations were small to medium in 11 other streams and absent in 2 streams adjacent to offshore ammocete populations in Huron Bay.

Reestablishment and posttreatment surveys were conducted on 22 streams; reestablished populations were found in 10 and residual larvae in 3. None of the populations appeared to be large, although in limited areas of the Two Hearted, Ontonagon, and Bad Rivers ammocetes of the 1973 and 1974 year classes were moderately abundant. The few residual larvae collected were confined to specific areas of the Little Two Hearted, Traverse, and Arrowhead Rivers where problems with ground water and excessive runoff were encountered during the 1973 chemical treatments.

No sea lamprey larvae were found during routine surveys of nine streams that seem suitable for sea lampreys but have no past record of ammocete production.

During the annual sea lamprey spawning survey of the Bad River 43 nests were found in 1974, compared with 98 in 1973. Although the 1974 work was hampered by relatively high turbidity and strong winds, significantly fewer nests appeared to be present in areas where visibility was good. Nest counts have ranged from a high of 189 in 1964 when the annual surveys began, to a low of 38 in 1966. In an index area of the Middle River, the number of nests declined from 52 in 1973 to 42 in 1974.

Lamprey ammocetes were collected on the deltas of all seven tributaries of Lake Superior surveyed during the 1974 field season. High winds prevented collecting on the Furnace Creek delta in Lake Superior.

The Lake Superior District Power Company has abandoned the power dam on the White River, a tributary of the Bad River. The gates of the dam were opened on August 9, and remained open until the Federal Power Commission ordered them closed on November 19. The fate of the dam is uncertain but if it is removed, 100 or more miles of the stream will be accessible to sea lampreys. Treatment costs and difficulties will increase substantially because much of the upper river is ideal lamprey habitat. The dam was inspected while the gates were open to see if the concrete apron and rock ledges at the base of the dam constituted a barrier to sea lampreys. Although high water hampered assessment, the apron and ledges did not appear to be a barrier.

Lake Superior Chemical Treatments. A total of 18 streams tributary to Lake Superior, with a combined flow of 924 cfs, were treated (Table 1). The schedule was maintained and four additional streams were treated when survey information demonstrated the need. Fish Creek (Eileen Township) was not treated as planned because no sea lamprey ammocetes were found during the pretreatment survey.

Sea lamprey larvae, as indicated by treatment collections, were abundant in only one section of the Au Train River, moderately abundant in the Middle and Huron Rivers, and uncommon to scarce in the other.

The Silver and Sucker River are treated annually to control ammocete populations on their deltas and adjacent to the deltas. The value of repeated treatments was demonstrated by the size of the treatment collections. The

Table 1. Details on the application of lampricides to tributaries of Lake Superior in 1974.
[Lampricides used are in pounds of active ingredient.]

			TFM				Bayer 73		
			Concentration (ppm)					Granules	
Stream	Date	Discharge at mouth (cfs)	Minimum effective	Maximum allowable	Pounds used	Hours applied	Pounds of powder used	Pounds used	Acres treated
Middle River	July 25	10	1.5	5.0	154	16	1.5	–	–
Poplar River	July 25	10	2.0	6.0	176	16	–	–	–
Brule River	July 29	180	1.5	5.0	1,320	12	–	–	–
Betsy River	Aug. 22	60	1.5	4.0	484	12	–	–	–
Au Train River	Sept. 5	280	2.0	5.0	2,618	12	33.5	27.5	3.7
Rock River	Sept. 8	62	3.0	9.0	990	12	–	–	–
Silver River	Sept. 18	20	2.0	6.0	286	19	–	35.0	6.0
Huron River	Sept. 21	25	1.5	4.5	352	18	–	2.5	0.5
Harlow Creek	Oct. 1	24	1.8	5.1	330	18	–	2.5	0.5
Little Garlic River	Oct. 3	12	1.8	6.0	154	16	–	–	–
Furnace Creek	Oct. 3	18	2.0	7.0	176	12	–	20.0	3.0
Beaver Lake Outlet	Oct. 7	4	2.2	6.4	44	12	–	10.0	2.0
Big Garlic River	Oct. 8	70	2.0	5.5	528	12	–	5.0	1.0
Eliza Creek	Oct. 16	2	2.0	5.8	22	10	–	0.5	–
Salmon Trout River	Oct. 17	45	2.2	6.0	396	12	–	–	–
Misery River	Oct. 17	34	3.5	10.3	726	21	1.0	–	–
Potato River	Oct. 20	3	2.5	7.0	396	23	–	–	–
Sucker River	Oct. 22	65	2.0	6.0	704	16	–	42.0	4.5
Total	–	924	–	–	9,856	–	36.0	145.0	21.2

Table 1. Details on the application of lampricides to tributaries of Lake Superior in 1974. [Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM: Concentration (ppm) Minimum effective	TFM: Concentration (ppm) Maximum allowable	TFM: Pounds used	TFM: Hours applied	Bayer 73: Pounds of powder used	Bayer 73: Granules Pounds used	Bayer 73: Granules Acres treated
Middle River	July 25	10	1.5	5.0	154	16	1.5	–	–
Poplar River	July 25	10	2.0	6.0	176	16	–	–	–
Brule River	July 29	180	1.5	5.0	1,320	12	–	–	–
Betsy River	Aug. 22	60	1.5	4.0	484	12	–	–	–
Au Train River	Sept. 5	280	2.0	5.0	2,618	12	33.5	27.5	3.7
Rock River	Sept. 8	62	3.0	9.0	990	12	–	–	–
Silver River	Sept. 18	20	2.0	6.0	286	19	–	35.0	6.0
Huron River	Sept. 21	25	1.5	4.5	352	18	–	2.5	0.5
Harlow Creek	Oct. 1	24	1.8	5.1	330	18	–	2.5	0.5
Little Garlic River	Oct. 3	12	1.8	6.0	154	16	–	–	–
Furnace Creek	Oct. 3	18	2.0	7.0	176	12	–	20.0	3.0
Beaver Lake Outlet	Oct. 7	4	2.2	6.4	44	12	–	10.0	2.0
Big Garlic River	Oct. 8	70	2.0	5.5	528	12	–	5.0	1.0
Eliza Creek	Oct. 16	2	2.0	5.8	22	10	–	0.5	–
Salmon Trout River	Oct. 17	45	2.2	6.0	396	12	–	–	–
Misery River	Oct. 17	34	3.5	10.3	726	21	1.0	–	–
Potato River	Oct. 20	3	2.5	7.0	396	23	–	–	–
Sucker River	Oct. 22	65	2.0	6.0	704	16	–	42.0	4.5
Total	–	924	–	–	9,856	–	36.0	145.0	21.2

Silver River delta produced 50 sea lamprey ammocetes, compared with the high of 609 in 1969, and the Sucker River delta 4, compared with the high of 602 in 1971.

Little Beaver Creek, a tributary of Little Beaver Lake and Beaver Lake Outlet, was also treated as part of a continuing project to keep ammocete populations from developing on its delta. Treatment collections from the area contained 38 sea lamprey ammocetes. Annual treatment of this stream is not necessary because it does not regularly produce year classes of sea lampreys.

The delta of the Big Garlic River in Sauxhead Lake was treated for the first time since 1972 in conjunction with the scheduled treatment of the Big Garlic system. The collection of 70 sea lamprey larvae from the delta area indicated that more frequent treatment of the delta is advisable.

Eliza Creek was re-treated for the third consecutive year to prevent recruitment of a sea lamprey population in the bay off its mouth. No sea lamprey larvae were found during treatment.

Sea lamprey ammocetes were discovered in Hanson Creek, a tributary of Furnance Lake and Furnace Creek. Subsequent treatment revealed a moderately large population of ammocetes.

No significant fish kills resulted from any of the treatments.

Lake Michigan Surveys. Pretreatment surveys were completed on 24 Lake Michigan tributaries scheduled for chemical treatment in 1974 and 1975. The relative abundance of sea lamprey ammocetes was low to moderate in all streams except the Manistee River, where larval density appeared to be as high as that observed during pretreatment sampling in 1972.

Sixty streams were examined to determine the status of larval populations that survived the most recent chemical treatments or became reestablished after the treatments. Reestablished populations were large in three streams–the Jordan, Pere Marquette, and White Rivers–and small to intermediate in 33 others. Few residual larvae were present in any of the streams.

Two streams that produced sea lamprey ammocetes in the past were resurveyed to determine if present populations warranted chemical treatments. In the Menominee River, 4.1 acres were sprayed with Bayer 73 granules and an additional 7,000 square feet were checked with back-pack shockers. A total of 50 sea lamprey larvae (20-92 mm long) were taken. A similar but smaller survey (11,800 square feet) in 1969 accounted for 42 larval sea lampreys (29-170 mm long), of which only 3 were shorter than 78 mm. In addition, six fyke nets and an experimental inclined-screen trap were fished from November 4 to November 22, 1974, about 0.6 mile below the Scott Paper Company dam. No ammocetes or young adults were captured. In the light of these findings, TFM treatment has been deferred and monitoring with Bayer 73 granules will continue. A resurvey of the Big Suamico River, where one sea lamprey ammocete was taken in 1967, was negative.

Reexamination of 15 previously negative streams disclosed no new sea lamprey populations.

Extensive surveys were conducted above dams on 14 Lower Peninsula streams to (1) verify the impassability of the dams to spawning-run sea lampreys, (2) evaluate the capacity of these stream areas for sea lamprey production as justification for continued maintenance of the barriers, and (3) assess the status and ecology of native lampreys.

Sea lampreys were found above a dam in only one of these streams, the Boardman River. Three stations above the Union Street dam in Traverse City yielded 22 sea lamprey larvae (14-88 mm long) and 430 American brook lampreys. The opening of the dam during the 1974 spawning run explains the presence of the 1974 year class, but not that of the earlier year classes.

Sampling of ammocete populations in five Lake Michigan streams to estimate growth increment was interrupted in 1974 by chemical treatment of three streams--the Platte, Betsie, and Manistee Rivers. Samples were collected in the spring. Of the treated streams, only the Platte River produced lampreys of the 1974 year class.

Ammocete growth was faster in the Muskegon River than in the other streams sampled; age-I ammocetes were larger than in the other streams and had a spring-to-fall growth increment of 32 mm.

The deltas of 12 tributaries of Lake Michigan were examined for larval lampreys during the 1974 field season. Sea lampreys were found on four.

The number of sea lamprey ammocetes collected from the Boyne River and Porter Creek deltas was less than in previous years. Collections in the Boyne River were reduced from a high of 268 in 1972 to 4 large ammocetes (79-134 mm long) in 1974, indicating no recruitment since the spring 1973 treatment of the river. The Porter Creek ammocete collection was down from 54 in 1973 to 21 in 1974.

Sea lamprey ammocetes were first found off the mouth of Carp Lake River in 1971. Only two sea lampreys were found in 0.25 acre. A more extensive survey was conducted in 1974 to determine distribution and size of the population. Only four sea lampreys were found in 4.6 acres surveyed. The bottom is equally divided between rubble and hard-packed sand, and water depth increases gradually from shore. The area is not particularly suitable for burrowing ammocetes and is unlike the softer bottom types of deltas that have produced large numbers of sea lampreys.

Lake Michigan Chemical Treatments. A total of 22 streams with a combined flow of 5,695 cfs were treated during the year (Table 2). Ammocete populations, as indicated by treatment collections during and after treatment, were large in the Manistee, Sturgeon, and Little Rivers and in Squaw Creek.

The Manistee River was treated a year ahead of schedule when large numbers of ammocetes more than 100 mm long were discovered by survey. Subsequent treatment indicated the number of large ammocetes was not as large as anticipated; however, several larvae were in the early stages of transformation.

Table 2. Details on the application of lampricides to tributaries of Lake Michigan in 1974.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM: Concentration (ppm) Minimum effective	TFM: Concentration (ppm) Maximum allowable	TFM: Pounds used	TFM: Hours applied	Bayer 73: Pounds of powder used	Bayer 73: Granules Pounds used	Bayer 73: Granules Acres treated
Mitchell Creek	May 3	25	6.0	16.0	412	10	–	–	–
Boardman River[a]	May 6	16	8.0	17.0	293	10	–	–	–
Cedar River	May 10	700	1.5	5.0	10,274	13	63.4	–	6.0
Platte River	May 21	490	3.0	10.0	5,289	24	15.0	7.5	2.0
Ford River	May 24	300	2.0	6.0	5,698	14	70.5	10.0	10.0
Days River	June 7	75	1.5	4.0	462	12	8.5	5.0	1.5
Rapid River	June 8	175	1.5	8.0	1,023	12	–	–	–
Sturgeon River	June 20	245	1.0	5.0	2,860	14	1.4	5.0	3.0
Milakokia River	July 11	50	3.0	10.0	1,078	14	1.8	–	–
Hudson Creek	July 11	2	2.0	6.0	44	15	–	–	–
Bark River	July 12	20	5.0	13.0	748	14	–	–	–
Manistee River	July 25	1,858	5.0	13.0	23,067	10	143.0	–	–
Manistique River	Aug. 10	1,300	1.5	2.5	9,438	12	111.0	–	–
Betsie River	Aug. 12	220	5.0	13.0	4,884	14	17.0	–	–
Little River	Aug. 23	4	3.5	14.5	88	12	–	10.0	1.5
Valentine Creek	Sept. 5	5	2.0	6.0	66	18	–	–	–
Brevort River	Sept. 7	110	3.0	11.0	1,375	16	–	16.4	2.0
Parent Creek	Sept. 8	4	3.2	10.3	66	12	–	–	–
Millecoquins River[b]	Sept. 10	6	4.0	10.0	44	6	–	–	–
Bursaw Creek	Sept. 10	25	1.0	10.0	484	14	–	–	–
Squaw Creek	Sept. 20	45	2.4	7.0	550	14	–	–	–
Good Harbor Creek	Oct. 17	20	7.0	17.0	506	12	–	–	–
Total	–	5,695	–	–	68,749	–	431.6	53.9	26.0

[a]Treated Hospital Creek only, a tributary.
[b]Treated Three Mile Creek only, a tributary.

Table 2. Details on the application of lampricides to tributaries of Lake Michigan in 1974.
[Lampricides used are in pounds of active ingredient.]

			TFM				Bayer 73		
			Concentration (ppm)					Granules	
Stream	Date	Discharge at mouth (cfs)	Minimum effective	Maximum allowable	Pounds used	Hours applied	Pounds of powder used	Pounds used	Acres treated
Mitchell Creek	May 3	25	6.0	16.0	412	10	–	–	–
Boardman River[a]	May 6	16	8.0	17.0	293	10	–	–	–
Cedar River	May 10	700	1.5	5.0	10,274	13	63.4	–	6.0
Platte River	May 21	490	3.0	10.0	5,289	24	15.0	7.5	2.0
Ford River	May 24	300	2.0	6.0	5,698	14	70.5	10.0	10.0
Days River	June 7	75	1.5	4.0	462	12	8.5	5.0	1.5
Rapid River	June 8	175	1.5	8.0	1,023	12	–	–	–
Sturgeon River	June 20	245	1.0	5.0	2,860	14	1.4	5.0	3.0
Milakokia River	July 11	50	3.0	10.0	1,078	14	1.8	–	–
Hudson Creek	July 11	2	2.0	6.0	44	15	–	–	–
Bark River	July 12	20	5.0	13.0	748	14	–	–	–
Manistee River	July 25	1,858	5.0	13.0	23,067	10	143.0	–	–
Manistique River	Aug. 10	1,300	1.5	2.5	9,438	12	111.0	–	–
Betsie River	Aug. 12	220	5.0	13.0	4,884	14	17.0	–	–
Little River	Aug. 23	4	3.5	14.5	88	12	–	10.0	1.5
Valentine Creek	Sept. 5	5	2.0	6.0	66	18	–	–	–
Brevort River	Sept. 7	110	3.0	11.0	1,375	16	–	16.4	2.0
Parent Creek	Sept. 8	4	3.2	10.3	66	12	–	–	–
Millecoquins River[b]	Sept. 10	6	4.0	10.0	44	6	–	–	–
Bursaw Creek	Sept. 10	25	1.0	10.0	484	14	–	–	–
Squaw Creek	Sept. 20	45	2.4	7.0	550	14	–	–	–
Good Harbor Creek	Oct. 17	20	7.0	17.0	506	12	–	–	–
Total	–	5,695	–	–	68,749	–	431.6	53.9	26.0

[a]Treated Hospital Creek only, a tributary.
[b]Treated Three Mile Creek only, a tributary.

The portion of Bear Creek (a Manistee River tributary) above the Michigan Department of Natural Resources trout-rearing facility was not treated because of the danger to trout concentrated in the rearing ponds. The 5 miles of stream above the ponds are to be treated in the spring of 1975, before the rearing season begins.

The Little River (Marinette County, Wisconsin) and the Manistique River above the dam in Manistique were treated for the first time. The sea lamprey population was large (for a stream of its size) in the Little River and very small in the Manistique River. The electrical barrier on Weston Creek, the suspected route to the upper Manistique River for sea lampreys, has probably blocked sea lamprey spawners. No young of the year were observed during treatment.

Lake Huron Surveys. Pretreatment surveys of 11 streams tributary to Lake Huron were completed in 1974. Small to medium populations of larval sea lampreys were present in all of the streams except Mill Creek, an untreated and only marginally productive stream, where no lampreys were found. The population in the Pine River (Iosco County) was significantly smaller than either the original population or the one that became reestablished after the first chemical treatment, and the infestation has been reduced from 17 tributaries to 4.

Reestablishment and posttreatment surveys were conducted on 26 streams. Reestablished populations were large in the Rifle River; of moderate size in the Carp, East Au Gres, and Devils Rivers; small in 13 streams; and lacking in 9. Only the Carp River contained a signigificant number of residual larvae. Survey collections included 82 sea lamprey ammocetes that survived the 1973 chemical treatment.

A total of 94 streams where sea lampreys have never been found were reexamined with negative results.

Extensive surveys conducted above dams on the Black (Cheboygan River system), Thunder Bay, Au Sable, and Saginaw Rivers yielded no sea lampreys.

Granular Bayer 73 was used in the survey of the deltas of eight streams tributary to Lake Huron. Sea lamprey larvae were found on both deltas of the Ocqueoc River, in Hammond Bay and 3 miles upstream in Ocqueoc Lake: 103 were collected from 16 acres of the Hammond Bay delta and 54 from 4.1 acres of the Ocqueoc Lake delta. Of the ammocetes collected on the Ocqueoc Lake delta, 46 were 55 to 89 mm long and thus probably drifted in from the river since the 1973 fall survey.

Ammocete populations of two Lake Huron tributaries, the Rifle and Au Sable Rivers, have demonstrated high growth rates and the potential for early metamorphosis. Growth of these ammocetes is monitored by spring and fall sampling. Age-I sea lampreys of the Rifle River increased in mean length from 48 mm in the spring to 76 mm in the fall, an increment of 28 mm. The mean length of age-0 ammocetes was 32 mm in the fall. There was no spring sample from the Au Sable River because the stream had been treated in July 1973. The mean length of a sample of age-0 sea lampreys taken in the fall of 1974 was 36 mm.

Lake Huron Chemical Treatments. Thirteen Lake Huron tributaries totaling 290 cfs were treated during the year (Table 3). Sea lamprey ammocetes were abundant in Trout River and Black Mallard (Carp) Creek and common in the rest of the streams. No significant fish kills occurred during treatments.

Field crews treated the lower Ocqueoc River ahead of schedule to facilitate assessment of the magnitude and distribution of an ammocete population on its Hammond Bay delta. The survey was coordinated with the stream treatment to take advantage of the synergistic action on TFM of the Bayer 73 granules. After a 16-acre plot was sprayed with Bayer 73 granules, 103 sea lamprey ammocetes 31 to 150 mm long were collected. High winds and choppy water severely hampered collecting.

A report of feeding adult sea lampreys in a small private trout pond was confirmed during the summer when a 15.5-inch sea lamprey was captured while feeding on a fish, and several others were observed attached to trout in the pond. The pond is fed by Cold Creek, Iosco County, Michigan, which contains sea lamprey larvae. A TFM treatment of the pond yielded a transforming sea lamprey. Evidence indicates that sea lampreys may be able to mature in this heavily stocked trout pond.

Studies of Adult Sea Lampreys

Migrant Sea Lampreys. Electric barriers are operated on selected tributaries along the south shore of Lake Superior to provide an index of the abundance of sea lampreys and provide data on their biological characteristics. The barriers were operated from early April until July 13. Weather conditions favored efficient operation.

The number of adult sea lampreys captured at the barriers again declined significantly. The 1,912 spawning-run adults taken in 1974 was 935 less than in 1973, 49,063 less than the record high in 1961, and 718 less than the previous record low in 1967 (Table 4).

Compared with the 1974 catches, the numbers of sea lampreys increased 51% in two streams west of the Keweenaw Peninsula and decreased 56% in six streams east of the Peninsula. The catch from the barrier on the Chocolay River declined from 270 in 1973 to 17 in 1974, a 94% reduction.

The 1974 run developed slowly. The largest 5-day catch was taken May 21-25 (25% of the total run) and a second minor peak occurred June 5-9 (17%). The migration declined rapidly through late June and early July. Less than 1% of the total run was taken in the last 5 days of operation.

The Ocqueoc River weir, Lake Huron, captured 915 adult sea lampreys in 1974. The catch is probably not indicative of the size of the run, however, because equipment failed during an electrical storm on June 4, allowing escapement through the weir.

An electrical barrier was operated from March 19 until September 12 on Weston Creek, a tributary of the Manistique River, Lake Michigan, to prevent sea lampreys from bypassing the dam at Manistique. No young-of-

Table 3. Details on the application of lampricides to tributaries of Lake Huron in 1974.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM: Concentration (ppm) Minimum effective	TFM: Concentration (ppm) Maximum allowable	TFM: Pounds used	TFM: Hours applied	Bayer 73: Pounds of powder used	Bayer 73: Granules Pounds used	Bayer 73: Granules Acres treated
Tawas Lake Outlet									
Silver Creek	June 20	101	3.0	10.0	605	14	3.0	–	–
Greene Creek	June 25	2	3.0	7.0	154	48	1.4	–	–
Black Mallard Creek	June 26	22	4.5	10.0	220	14	7.4	–	–
Grass Creek	July 10	4	6.5	14.0	22	5	–	–	–
Trout River	July 11	10	7.0	14.0	770	34	–	–	–
Elliot Creek	July 14	7	6.0	15.0	110	10	–	–	–
Cheboygan River									
Meyers Creek	Aug. 23	3	6.5	14.0	66	10	–	–	–
Ocqueoc River, lower[a]	Aug. 27	70	6.0	9.0	1,826	15	5.6	105.0	16.0
Nuns Creek	Sept. 21	28	4.0	8.0	792	25	–	–	–
Beavertail Creek	Sept. 24	22	5.0	12.0	880	29	–	–	–
Hessel Creek	Oct. 4	6	6.5	17.0	506	24	–	–	–
McKay Creek	Oct. 5	5	5.0	12.0	308	24	1.0	7.5	1.0
Steeles Creek	Oct. 6	10	5.0	13.0	132	8	–	2.5	0.2
Total	–	290	–	–	6,391	–	18.4	115.0	17.2

[a]Ocqueoc River from Ocqueoc Lake to Lake Huron treated with special effort toward eradicating a Lake Huron delta population.

Table 4. Number of adult sea lampreys taken at electric barriers operated in eight tributaries of Lake Superior through July 13, 1961-74

River	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Betsy	1,366	316	444	272	187	65	57	78	120	87	104	146	294	201
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	489
Sucker	3,209	474	698	386	532	223	166	658	494	337	485	642	468	249
Chocolay	4,201	423	358	445	563	260	65	122	142	291	53	294	270	17
Iron	2,430	1,161	110	178	283	491	643	82	556	713	1,518	280	16	1
Silver	5,052	267	760	593	847	1,010	339	1,032	1,147	321	340	2,574	495	117
Brule	22,478	2,026	3,418	6,718	6,163	226	364	2,657	3,374	167	1,754	4,121	261	568
Amnicon	4,741	879	131	232	700	938	200	148	1,576	1,733	4,324	132	149	270
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	1,912
Percentage of the 1958-61 mean	132	19	22	27	27	11	7	18	22	12	25	25	7	5

the-year larvae were found in treatment collections from the upper river, indicating the barrier was successful in preventing adults from reaching this area.

The average length and weight of sea lampreys from Lake Superior did not change significantly in 1974. Average length was 432 mm in 1974 compared with 423 in 1973, and weight increased from 168 g in 1973 to 170 in 1974. The percentage of males was 30 in 1974 compared with 31 in 1973.

Adult sea lampreys from the Ocqueoc River weir, Lake Huron, in 1974 averaged 455 mm in length and 194 g in weight, compared with 431 mm and 172 g in 1973. The percentage males increased from 38 in 1973 to 44 in 1974.

The percentage of rainbow trout longer than 305 mm (total length) with sea lamprey wounds or scars declined from 3.0 in 1973 to 1.6 in 1974.

The number of rainbow trout handled at the barriers declined somewhat from the record high in 1973, but was 28% above the 1968-73 average. The number of longnose suckers and white suckers increased from the record low of 1973, but was still 41 and 28%, respectively, below the 1968-73 average. The number of fish of these species taken in 1974, and (in parentheses) the average number caught in 1968-73 were as follows: spawning-run rainbow trout, 1,655 (1,199); longnose suckers, 11,683 (16,121); and white suckers, 6,835 (11,466).

A collection of 666 spawning-run sea lampreys taken below the compensating gates at the Manistique River Paper Mill Dam averaged 484 mm in length and 235 g in weight, and 34% were males; comparable values for collections in 1973 were 480 mm, 226 g, and 45%.

Parasitic Sea Lampreys. Parasitic-phase sea lampreys have been collected from the fisheries of Lake Superior since August 1969, from Lakes Michigan and Huron since August 1970, and from Lake Erie since September 1971. The 1974 collections are incomplete because records of lampreys taken by fishermen during the late fall are usually not available until fishing operations begin the following spring. By December 31, the 1974 collections included 180 sea lampreys taken by Lake Superior commercial and sport fishermen. Two areas of Lake Superior contributed 79% of the 1974 total—Wisconsin, 56%; and the Munising, Michigan area (MS-4), 23% (Table 5).

Collections contain only 11 parasitic-phase sea lampreys less than 201 mm long from Lake Superior in 1974; 73% were taken from two areas—5 in Keweenaw Bay (MS-3) and 3 in Whitefish Bay (MS-6).

Lake Michigan fisheries contributed 677 sea lampreys in 1974, of which 52% (354) were taken from the Gills Rock, Wisconsin, area (WM-2). Seventy-six percent (107) of the parasitic-phase sea lampreys less than 201 mm long were collected from the same area.

The fisheries of Lakes Huron and Erie contributed 18 and 8 parasitic-phase sea lampreys, respectively, in 1974.

In sexing of parasitic-phase sea lampreys, the differentiation of sperm

Table 5. Number of sea lampreys collected in commercial and sport fisheries, by lake and statistical district, 1969-74
[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 for 1974 are not complete.]

District[a]	Parasitic-phase												Spawning-phase			
	Length 200 mm or less						Length greater than 200 mm									
	1969	1970	1971	1972	1973	1974	1969	1970	1971	1972	1973	1974	1971	1972	1973	1974
Lake Superior																
M-1	0	0	0	0	0	0	1	3	1	3	3	0	0	2	0	0
M-2	0	0	0	0	0	0	7	6	5	16	13	3	0	7	16	1
M-3	0	0	0	1	0	0	11	16	16	7	9	1	0	0	1	0
Wisc.	3	15	8	3	4	1	30	101	302	232	199	100	0	2	1	0
MS-1	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0
MS-2	0	0	0	0	0	1	1	10	23	8	5	4	0	2	1	1
MS-3	6	13	32	11	6	5	18	19	67	29	61	7	0	0	0	0
MS-4	2	2	5	1	1	1	24	49	143	120	74	41	0	3	1	0
MS-5	0	0	0	0	0	0	2	0	18	5	2	2	0	0	0	0
MS-6	1	1	2	2	6	3	9	6	12	13	7	9	0	0	0	0
Total	12	31	47	18	17	11	106	214	587	433	373	167	0	16	20	2
Lake Michigan																
MM-1	–	0	0	1	12	7	–	6	29	46	99	40	0	0	1	4
MM-2	–	25	2	1	7	12	–	5	20	9	3	5	0	0	0	0
MM-3	–	3	14	22	13	4	–	40	68	106	71	51	3	2	0	0
MM-4	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
MM-5		4	2	10	4	7	–	2	3	7	6	3	0	4	2	0
MM-6	–	0	0	0	0	1	–	0	0	0	1	0	0	0	0	0
MM-7		0	0	0	0	0	–	0	2	0	1	1	0	0	0	0
MM-8	–	1	2	2	0	0	–	0	1	1	1	0	0	0	0	0
WM-1	–	1	3	5	1	1	–	2	62	31	37	16	16	40	8	14
WM-2	–	0	175	144	91	107	–	1	410	432	258	247	0	0	0	0
WM-3	–	11	23	6	3	1	–	20	123	108	47	23	0	0	0	0
WM-4	–	1	8	3	1	1	–	66	112	27	56	49	130	160	42	80
WM-5	–	1	9	5	5	0		5	14	11	13	3	0	0	0	0
WM-6	–	0	0	2	0	0	–	0	0	0	0	0	0	0	0	0
Ill.	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
Ind.	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
Total	–	47	238	201	137	141	–	147	844	778	593	438	149	206	53	98
Lake Huron																
MH-1	–	0	1	2	0	10	–	69	109	88	31	0	0	0	0	0
MH-2	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
MH-3	–	0	0	4	0	0	–	10	40	5	0	0	0	0	0	0
MH-4	–	0	0	0	0	8	–	11	35	21	8	0	0	0	0	0
MH-5	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
MH-6	–	0	0	0	0	0	–	1	15	0	0	0	0	0	0	0
Total	–	0	1	6	0	18	–	91	199	114	39	0	0	0	0	0

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

Table 5. Number of sea lampreys collected in commercial and sport fisheries, by lake and statistical district, 1969-74
[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 for 1974 are not complete.]

District[a]	Parasitic-phase												Spawning-phase			
	Length 200 mm or less						Length greater than 200 mm									
	1969	1970	1971	1972	1973	1974	1969	1970	1971	1972	1973	1974	1971	1972	1973	1974
Lake Superior																
M-1	0	0	0	0	0	0	1	3	1	3	3	0	0	2	0	0
M-2	0	0	0	0	0	0	7	6	5	16	13	3	0	7	16	1
M-3	0	0	0	1	0	0	11	16	16	7	9	1	0	0	1	0
Wisc.	3	15	8	3	4	1	30	101	302	232	199	100	0	2	1	0
MS-1	0	0	0	0	0	0	3	4	0	0	0	0	0	0	0	0
MS-2	0	0	0	0	0	1	1	10	23	8	5	4	0	2	1	1
MS-3	6	13	32	11	6	5	18	19	67	29	61	7	0	0	0	0
MS-4	2	2	5	1	1	1	24	49	143	120	74	41	0	3	1	0
MS-5	0	0	0	0	0	0	2	0	18	5	2	2	0	0	0	0
MS-6	1	1	2	2	6	3	9	6	12	13	7	9	0	0	0	0
Total	12	31	47	18	17	11	106	214	587	433	373	167	0	16	20	2
Lake Michigan																
MM-1	–	0	0	1	12	7	–	6	29	46	99	40	0	0	1	4
MM-2	–	25	2	1	7	12	–	5	20	9	3	5	0	0	0	0
MM-3	–	3	14	22	13	4	–	40	68	106	71	51	3	2	0	0
MM-4	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
MM-5	–	4	2	10	4	7	–	2	3	7	6	3	0	4	2	0
MM-6	–	0	0	0	0	1	–	0	0	0	1	0	0	0	0	0
MM-7	–	0	0	0	0	0	–	0	2	0	1	1	0	0	0	0
MM-8	–	1	2	2	0	0	–	0	1	1	1	0	0	0	0	0
WM-1	–	1	3	5	1	1	–	2	62	31	37	16	16	40	8	14
WM-2	–	0	175	144	91	107	–	1	410	432	258	247	0	0	0	0
WM-3	–	11	23	6	3	1	–	20	123	108	47	23	0	0	0	0
WM-4	–	1	8	3	1	1	–	66	112	27	56	49	130	160	42	80
WM-5	–	1	9	5	5	0	–	5	14	11	13	3	0	0	0	0
WM-6	–	0	0	2	0	0	–	0	0	0	0	0	0	0	0	0
Ill.	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
Ind.	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
Total	–	47	238	201	137	141	–	147	844	778	593	438	149	206	53	98
Lake Huron																
MH-1	–	0	1	2	0	10	–	69	109	88	31	0	0	0	0	0
MH-2	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
MH-3	–	0	0	4	0	0	–	10	40	5	0	0	0	0	0	0
MH-4	–	0	0	0	0	8	–	11	35	21	8	0	0	0	0	0
MH-5	–	0	0	0	0	0	–	0	0	0	0	0	0	0	0	0
MH-6	–	0	0	0	0	0	–	1	15	0	0	0	0	0	0	0
Total	–	0	1	6	0	18	–	91	199	114	39	0	0	0	0	0

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

sacks from eggs continues to be a problem. Criteria are being developed that will ensure correct sexing.

Ammocete Studies

Preliminary results from the examination of streams for the presence of the 1974 year class indicate a significant decrease in the number of streams infested and in the abundance of young of the year, compared with the 1973 year class. Larvae of the 1974 year class were collected in 17 streams, but subsequent chemical treatments eliminated this year class in 8 of these. Table 6 shows the present status of the remaining reestablishment populations in tributaries of Lake Superior.

A study of the survival and rate of transformation between larvae caged in Lake Superior (at a depth of 35 feet) and the Big Garlic River was continued in 1974. Age-group XIV larvae (mean length, 152 mm) collected from the inclined trap on the Big Garlic River were used as test animals. On May 9, 60 larvae were caged in each area and thermographs installed.

The first inspection of the larvae on July 1 showed no evidence of transformation in either group. One dead larvae was found in a Lake Superior cage and two in the Big Garlic River cages. By mid-September, 26 lampreys (46%) had transformed in the Big Garlic but only 3 (5%) in Lake Superior. The final inspection on October 29 showed no additional transformation or mortality. Average length of the larvae that did not transform decreased 6 mm in the Big Garlic River and 4 mm in Lake Superior.

Lake Superior monthly water temperatures were 9.6 F (range, 8.9-10.3) lower than temperatures in the Big Garlic River from May to July and 4.3 lower during August, but 5.9 higher in September. The colder water of Lake Superior from May to August accounted for a drastic reduction not only in the number of larvae that transformed, but also in the rate of transformation. In mid-September, the average length of the mouth was 5.1% of the body length in transforming lampreys from the river, compared with 2.6% in those held in Lake Superior. However, by October 29, because of the relatively warmer water in Lake Superior, the mouth length of this group increased to 6.1% of the body length, compared with 6.7% for the Big Garlic group.

Data from a small sample (21 larvae) caged in Lake Superior in 1973 indicated high mortality. The high mortality resulted from the poor condition of the larvae collected in the Big Garlic River trap. The greater care used in selecting larvae in 1974 resulted in much higher survival.

Electrofishing in two index areas in the estuary on the Firesteel River suggested that the kill of ammocetes during the most recent chemical treatment had been complete. Before the treatment, samples of 162 and 99 ammocetes were collected in the two areas.

At two index areas in the estuary of the Silver River, 8 residual larvae were collected in one, compared with 132 last year, and none in the second, compared with 53 last year. Only one larvae was longer than 65 mm.

Table 6. Tributaries of Lake Superior with reestablished populations of sea lampreys

Stream	Date of last treatment	Year classes present 1971	1972	1973	1974
Waiska River	10/2/72			X	
Galloway Creek	9/12/71			X	
Little Two Hearted River	7/12/73			X	
Two Hearted River	7/15/73			X	X
Dead Sucker River	9/11/63		X	X	
Sable River	9/7/73				X
Sullivans Creek	8/2/71		X	X	
Seven Mile Creek	7/19/67			X	
Salmon Trout River (Mqt.)	6/23/71	X	X	X	X
Falls River	8/23/70			X	
Sturgeon River	7/29/72			X	X
Traverse River	10/18/73				X
Big Gratiot River	8/5/72		X		
East Sleeping River	8/28/72			X	X
Ontonagon River	6/24/73			X	
Cranberry River	8/24/72			X	
Bad River	8/18/73				X
Amnicon River	7/13/72		X		
Nemadji River	7/15/72[a]	X	X	X	X
Split Rock River	10/19/64			X	X
Arrowhead River	8/16/73			X	
Number of streams		2	6	16	9

[a]Only a tributary (Black River) was treated.

The delta of Bismark Creek in Harlow Lake was treated in August 1974 as part of a continuing 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 75-acre Harlow Lake. Two marked ammocetes were recovered in 1974 (one of which was transforming), 2 in 1973, 3 in 1972, 26 in 1971, and 3 in 1970. In addition, 51 residual (unmarked) larvae were collected off the delta.

Field crews equipped with scuba gear or underwater viewers examined areas off the mouths of 18 streams tributary to Lake Superior to find suitable larval habitat and then sprayed these areas with granular Bayer 73. No sea lamprey larvae were recovered in 11 of the areas, but seven offshore areas previously known to harbor ammocetes again produced sea lamprey larvae. In the resurvey of an area in the upper St. Marys River that yielded 1 sea lamprey ammocete and more than 700 American brook lamprey larvae in 1973, 3 sea lamprey larvae (length range, 69-103 mm) and 728 American brook lampreys were recovered. The source of this apparently small sea lamprey population is unknown. Extensive gravel beds in the upper St.

Marys River were examined again for spawning lampreys, but none were found. The larvae may result from limited spawning in the St. Marys River or in tributary streams.

The largest number of larvae was recovered off the mouth of Furnace Creek. Ammocetes were recovered from a few hundred feet off the mouth in 2 to 3 feet of water to 3/4 mile offshore on a 40-foot dropoff.

Preliminary data from the offshore populations of ammocetes collected off Eliza Creek and Harlow Lake indicate that larvae migrate and concentrate in areas of preferred habitat. Deltas of streams, dropoff areas, and obstructions in offshore areas that tend to break up currents and form pockets of silt and detritus appear to be preferred habitats.

The Rock River was treated in 1974 to destroy the 1971 year class, which survived the September treatment of that year. The dam at the mouth, reconstructed in 1971, apparently remained lamprey-proof; no ammocetes of subsequent year classes were found above the dam. Though lampreys have spawned below the dam in recent years, no larvae were found during surveys of the river and of offshore areas.

Age and Growth of Larvae in the Big Garlic River

The isolated population of larval sea lampreys established in the Big Garlic River in 1960 was in its 15th year of life in 1974, and has produced transformed lampreys for 10 consecutive years.

A total of 1,299 ammocetes were captured at the downstream trap during the 1973-74 migration period. All live larvae captured at the downstream trap in the spring were transferred to warm-water tanks (65-70 F) at the Marquette Station, and a control group of 57 larvae was placed in holding cages in the Big Garlic River. Transformation was higher in the tanks (75%) than in the colder river water (45%).

The average length of 99 ammocetes collected with an electric shocker in October was 136 mm (range, 95-174 mm), compared with 135 mm (range, 108-180 mm) for 106 measured in 1973.

Knowledge of the life history of larval and recently metamorphosed lampreys has been greatly expanded by the study on the Big Garlic River. However, the numbers of lampreys of the 1960 year class remaining in the river are small, and the study would provide little additional information, except for longevity, on the life history of the sea lamprey. It will, therefore, be terminated in 1975.

Larval and transformed sea lampreys are now difficult to obtain because of the effectiveness of the control program; consequently, sea lampreys remaining in the upper Big Garlic River will be used for research studies by the Marquette and Hammond Bay Field Stations, and by investigators from other agencies conducting research on lampreys.

In cooperation with the Fish Control Laboratory, La Crosse, Wisconsin, and the Hammond Bay Biological Station, a field study was initiated on the effects of the chemosterilant, *P,P*-Bis(1-aziridinyl)-*N*-methylphosphinothioic amide (AI3-61585), on adult sea lampreys. A total of 600 adults were injected, tagged, and released in the Big Garlic River. The sterilant had no apparent effect on nesting or spawning behavior of the adults. Those nests spawned in by sterilized lampreys did not produce any progeny and eggs died before hatching. The potential use of the sterilant in control of sea lamprey populations is being studied.

APPENDIX D

SEA LAMPREY CONTROL IN CANADA

J. J. Tibbles, S. M. Dustin, and B. G. H. Johnson
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, 1974 to March 31, 1975, 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.

Since the inception of an international sea lamprey control program, following the establishment of the Commission nineteen years ago, control of sea lamprey and restoration of fisheries for large salmonids have become increasingly evident realities in the Great Lakes. Beginning in Lake Superior and extending downstream by successive lakes, sea lamprey control measures are now employed in all but the Lake Erie and Lake St. Clair drainages. The resulting decreases in lamprey-induced fish mortality have permitted planted salmonids (including native, hybrid, and exotic stocks) to prosper and to support productive fisheries in those lakes where control measures have been implemented.

Electric Barrier Operation

In 1974 seven electrical 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 1974 was 225 sea lamprey (Table 1), an increase of 14 per cent from that of 1973, but a decrease of 88 per cent from the 1969-1973 average catch. The increased sea lamprey catch in 1974 was confined to the single North Channel barrier and to one of the Lake Huron barriers. The relatively small magnitude and limited distribution of the increase suggest that it does not reflect a significant widespread change in sea lamprey abundance.

Table 1. Numbers of sea lamprey taken in electrical assessment barriers, Lake Huron, from 1969 to 1974 inclusive.

Streams	Count for season					
	1969	1970	1971	1972	1973	1974
North Channel Area						
Kaskawong	478	482	271	207	135	146
Georgian Bay Area						
Still	1621	558	960	426	14	10
Naiscoot-Harris	785	173	446	474	8	1
Mad	42	8	15	1	0	1
Totals	2448	739	1421	901	22	12
Lake Huron Area						
Manitou	144	3	12	11	14	4
Blue Jay	1130	236	332	380	22	61
Bayfield	582	128	7	7	4	2
Totals	1856	367	351	398	40	67
GRAND TOTALS	4782	1588	2043	1506	197	225

Stream Surveys

Sea lamprey larval surveys were conducted on 40 Lake Superior tributaries, 69 Lake Huron tributaries, and 15 Lake Ontario tributaries. On Lake Superior, 13 routine surveys of streams with no previous record of sea lamprey yielded no evidence of their presence. Reestablished populations of sea lamprey were discovered in six of the thirteen streams surveyed for this purpose. Distribution surveys were conducted on nine watersheds, and treatment-evaluation surveys on five streams. A population-estimate survey was conducted on the Michipicoten River to identify the presence of transforming sea lamprey. This river had been considered for lampricide treatment in 1974; however previous survey data indicated that the fall treatment of 1970 had been effective in eradicating the 1970 year-class of sea lamprey larvae. No transforming sea lamprey were found as a result of the 1974 surveys (331 sea lamprey larvae collected from 36 to 116 mm in length) and the river has been rescheduled for treatment in 1975.

On Lake Huron 37 routine surveys yielded no evidence of new sea lamprey infestations, while reestablished populations of sea lamprey were found in 12 of 23 streams surveyed. Distribution surveys were carried out on 16 streams, treatment-evaluation surveys on eight, and a population-estimate survey on one watershed.

On the Canadian side of Lake Ontario, reestablished populations of sea lamprey were found in three of the five streams surveyed for that purpose. Distribution surveys were completed on 10 streams and treatment-evaluation surveys on three. On the U.S. side of Lake Ontario, distribution surveys were performed on six streams in preparation for treatments to be carried out in 1975.

Lampricide Treatments

On Lake Superior five of the seven streams specified in the Memorandum of Agreement were successfully treated. These were the Cranberry, Sable, Pearl, Gravel, and Stokely Rivers (Table 2), while the Black Sturgeon and Big Pic River treatments were deferred owing to high water flows and limited control capability over flow in these extensive watersheds. In addition, granular Bayer 73 was applied to five areas in Batchawana Bay, areas of the Nipigon River system, and on the estuaries of the Gravel and Mackenzie Rivers in an effort to control offshore larval populations of sea lamprey.

On Lake Huron the nine streams specified in the Memorandum of Agreement were successfully treated with lampricide. These were: Gordon, Brown's, Watson's, Richardson and Gawas Creeks, Root, Kaskawong, Sauble and Garden Rivers (Table 3). Granular Bayer 73 was applied separately to the estuaries of Gordon, Brown's and Watson's Creeks, and to selected areas in the French River, and below the rapids in St. Marys River.

On Lake Ontario the five streams specified in the Memorandum of Agreement were successfully treated. These were: Shelter Valley, Wilmot, Bronte, Bowmanville and Cobourg. Table 4 lists these streams with the pertinent details.

Sea Lamprey from Commercial Fishermen

During 1974, 146 predatory-phase sea lamprey were received from Great Lakes commercial fishermen in response to the offer of a reward for specimens and catch information. Seventeen specimens were from Lake Superior, 10 from Lake Huron and 119 from Lake Ontario. Owing to the small numbers collected from the upper lakes, no meaningful comparisons can be made with those examined in previous years. However in Lake Ontario, sea lamprey caught in the fall were between four and five cm longer, on the average, than those collected in 1973. The sex ratio in 1974 was approximately 0.5 male per female whereas in 1973 there were approximately 1.3 males per female in the corresponding fishery. This change in size and sex ratio resembles the change recorded for sea lamprey in Lake Superior following the initial decline of sea lamprey abundance in the 1960's in response to sea lamprey control measures. The situation in Lake Ontario is therefore considered encouraging with respect to the growing effectiveness of sea lamprey control.

Sea Lamprey from Humber River, Lake Ontario

In 1974, 3,350 sea lamprey were collected at a dam in the Humber River (a tributary of Lake Ontario that flows through Toronto) by a man who has fished under contract with this Centre since 1968. The present catch represents a 47 per cent reduction from that of 1973, and may indicate a decline in abundance of sea lamprey in the neighbouring waters of Lake Ontario. However, owing to the fact that the Humber has no resident population of larval sea lamprey and therefore has never been treated with

Table 2. Summary of streams treated with lampricide, Lake Superior, 1974.

Stream Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles treated
Cranberry	June 4-7	15	190	–	–	Moderate	4.7
Sable	June 25-26	32	282	–	100	Abundant	4.9
Pearl	July 10-11	70	428	8	10	Moderate	2.1
Gravel	July 24-25	220	954	18	28	Moderate	10.0
Stokely	Aug. 20-21	14	174	–	–	Moderate	6.5
Totals		351	2,028	26	176		28.2

Table 3. Summary of streams treated with lampricide, Lake Huron, 1974.

Stream Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles treated
Gordon	May 14	7	38	–	–	Moderate	0.8
Brown's	May 16-17	9	85	–	–	Moderate	2.0
Watson's	May 22	5	41	–	–	Abundant	0.5
Richardson	May 23	11	92	2.5	19	Scarce	1.6
Root	May 30-31, June 27-28, July 3-4	184	998	–	–	Scarce	26.4
Gawas	June 20	5	29	0.3	300	Scarce	0.8
Kaskawong	June 25-28	10	266	–	15	Scarce	6.4
Sauble	July 9-10	115	2,638	26.5	–	Scarce	2.2
Garden	Aug. 13-17, 20-22, Sept. 4-5	150	2,145	–	38	Abundant	46.0
Totals		496	6,332	29.3	372		86.7

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Table 4. Summary of streams treated with lampricide, Canadian side of Lake Ontario, 1974.

Stream Name	Date	Flow (cfs)	TFM lbs. act. ingr.	Bayer 73 lbs. act. ingr.	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream miles treated
Shelter Valley	Apr. 28-30	34	1,118	–	39	Moderate	9.5
Wilmot	May 3-4	37	1,317	–	28	Scarce	11.5
Bronte	May 7-9	147	2,673	26	10	Scarce	15.0
Bowmanville	May 25-27	63	1,612	16	19	Scarce	5.5
Cobourg	May 30-31, June 2	57	1,070	8	19	Scarce	4.5
Totals		338	7,790	50	115		46

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Totals		338	7,790	50	115		46

lampricide, its runs of sea lamprey can not be considered representative of those of Lake Ontario tributaries as a whole. Individuals of the 1974 collection did not differ significantly in either average size or sex ratio from those of previous years.

Sea Lamprey Tag-and-Recapture Studies, Lake Ontario

Sea lamprey captured on their upstream migration in the Humber River were tagged and released in Lake Ontario. Approximately 100 specimens were released at each of five sites along the lake shore and another 100 in the mouth of the Humber itself. Of particular interest was the fact that 52 of the sea lamprey released in the mouth of the Humber were recaptured at the dam, indicating a high degree of efficiency in the collection of sea lamprey by the contract fisherman. Of the sea lamprey released at other sites there was no evident tendency to return to the Humber River in preference to other streams closer to the release points.

Trawling in St. Marys River

Trawling for adult sea lamprey in St. Marys River was resumed in October 1974, at the same site, with the same equipment, and in the same manner as in the past five years. A trawl made of half-inch square mesh netting and measuring eight by four feet at the mouth was towed in the propeller wash 10 to 12 feet astern of an inboard/outboard powered boat. The area fished was in front of the Edison Electric Company's plant in Sault Ste. Marie, Michigan, about one mile below the International Rapids. Trawling was carried out on four or five evenings per week between 5:00 p.m. and midnight until freeze-up. The weekly catches and catch per hour of trawling are compared in Table 5. There was a 32 per cent increase in the catch per hour of sea lamprey in 1974 compared with 1973. This, following as it does a lesser increase from 1972 to 1973, suggests that sea lamprey are becoming more abundant in the St. Marys River.

Table 5. Numbers of sea lamprey caught per hour of trawling in St. Marys River: 1973 and 1974, to December 8 and 7 respectively.

Week Ending		Trawling Time Hours – Minutes		No. of Lamprey		No. of Lamprey per hour	
1973	1974	1973	1974	1973	1974	1973	1974
	Oct. 19		24-30	–	2	–	0.1
Oct. 27	Oct. 26	23-30	22-30	2	1	0.1	0.04
Nov. 3	Nov. 2	24-0	20-0	6	5	0.2	0.25
Nov. 10	Nov. 9	14-30	30-0	2	23	0.1	0.8
Nov. 17	Nov. 16	18-15	22-30	13	26	0.7	1.2
Nov. 24	Nov. 23	12-30	29-30	6	20	0.5	0.7
Dec. 1	Nov. 30	20-15	29-30	8	11	0.4	0.4
Dec. 8	Dec. 7	22-20	22-0	10	4	0.4	0.2
Totals/Averages*		135-20	200-30	47	92	0.3*	0.5*

APPENDIX E

ALTERNATIVE METHODS OF SEA LAMPREY CONTROL

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INTRODUCTION

The sea lamprey research conducted by the Great Lakes Fishery Laboratory at the Hammond Bay Biological Station is designed to develop methods for use in an integrated program of sea lamprey control in the Great Lakes. This program will include the continued application of selected larvicides where appropriate, and the use of repellents, attractants, irritants, sterilants, physical barriers, and other methods that may prove effective in attaining the desired level of control.

CHEMOSTERILIZATION

Development of Chemosterilants

A field study to determine the usefulness of the compound p,p-bis (1-aziridinyl)-N-methyl phosphinothioic amide as a chemosterilant for sea lampreys was conducted jointly by the Hammond Bay Biological Station, the Marquette Sea Lamprey Control Station, and the LaCrosse Fish Control Laboratory. The Big Garlic River, Marquette County, Michigan, was chosen as the study site because it was known to produce larval sea lampreys. The site extended upstream about 9 km from a modified inclined-plane trap, which prevented upstream movement of sea lampreys from Lake Superior and captured all sea lampreys moving downstream. It was divided into five areas by waterfalls that blocked the upstream movement of sea lampreys from one area to the next. A fyke net was also placed at the lower end of each area to prevent downstream losses.

In the spring of 1974, approximately 1,000 spawning-run sea lampreys collected below a dam on the Manistique River, a tributary of Lake Michigan were sexed, weighed, and tagged with Petersen tags; 290 of them were then injected with the chemosterilant at a rate of 100 mg/kg of body weight and released together with 300 controls as indicated in Table 1.

Presented at: Great Lakes Fishery Commission
Annual Meeting
Toronto, Ontario
June 17-19, 1975

Table 1. Distribution by number of test lampreys in five areas of the Big Garlic River, Spring 1974. Areas are numbered progressively downstream to upstream.

Area number	Males		Females	
	Injected	Uninjected	Injected	Uninjected
I	–	50	–	50
II	–	50	50	–
III	50	50	50	50
IV	40	–	–	50
V	50	–	50	–

Daily observations revealed that the spawning acts of treated males and females were entirely normal. Injected males competed effectively with normal males for partners, and injected females apparently laid a full complement of eggs. After spawning had ended we examined samples of eggs (a total of 255 eggs) from 93 of the 95 nests in the study area to determine egg viability.

A flash flood on June 16 permitted some downstream movement of sea lampreys past the fyke nets separating the various test areas. This downstream movement made interpretation of data from Areas I, II, and III difficult because of the mixing of both injected and uninjected individuals of both sexes in the three areas. The four nests sampled in Area I (Table 1) all produced large numbers of hatched embryos; in Area II, 5 of 13 nests were not successful; in Area III, 21 of 36 nests produced no larvae at all, and several of the others produced very few.

In Areas IV and V no unsterilized individuals were present and the effectiveness of the chemosterilant was clearly demonstrated. Considerable embryo development was observed in eggs found in 23 nests sampled in Area IV on July 6, but only one live embryo (stage 12) was found when the nests were sampled on July 23. Considerable development of the embryos (stages 2-10) was also found in eggs from the 19 nests sampled in Area V on July 6. However, only 19 live embryos (stages 8 and 9) were found in these nests on July 13, and no live embryos were found on July 23.

Intensive shocking of the larval habitat in Areas IV and V produced no larvae, whereas spot checks in Areas I, II, and III produced many.

In summary, the injection of the chemosterilant had no noticeable effect on the spawning behavior or competitiveness of the sea lampreys. Complete sterility appears to have occurred in the males, but insufficient information precluded our stating conclusively that the females were also sterilized. Results showed, however, that the release of only injected males is as effective as sterilizing and releasing both sexes.

Although the release of sterile males is an inefficient means for controlling lampreys when natural populations are high, it may be a highly efficient approach when natural populations are low, and thus effectively complement the use of larvicides. The latter are highly efficient in terms of the number of individual lampreys destroyed when natural populations are high but their use becomes progressively less efficient when the natural population is low.

CULTURE

Culture of Lamprey Larvae for Experimental Use

The following species and year classes of larval lampreys are being cultured in the laboratory:

Species	*Year-class*	*Numbers*
Sea lamprey	1969	206
	1970	314
	1971	1,315
	1972	387
	1973	2,694
	1974	5,500
American brook	1972	150
	1973	50
	1974	1,500
Northern brook	1974	3,300
Chestnut	1974	2,200
	Total	17,616

In addition to these, we have about 4,000 mixed year-class American brook and northern brook lampreys collected from the Black River, Presque Isle County, Michigan. This collection contains at least 200 recently transformed individuals of each species, which will serve as a source of eggs and sperm in the spring of 1975.

Effect of Fluctuating Temperature on Development of Sea Lamprey Embryos

Sea lamprey embryos were allowed to develop in the laboratory under the following temperature regimes: 40-55°; 40-60°; 40-65°; 45-55°; 45-60°; 45-65°; and 45-70°F. In each of the seven regimes, eggs were fertilized at the highest temperature, allowed to remain at that temperature for 12 hours, and then gradually exposed over a period of 1 to 2 hours to the lowest temperature. Thereafter, temperatures were changed every 12 hours.

Test eggs in the first five experimental temperature regimes produced no burrowing-stage larval sea lampreys, but the controls yielded 95% that reached this stage at the end of 19 days. The sixth experimental regime had a survival of only 19% to the burrowing larval stage, whereas, 88% of the controls survived. Embryos in the sixth experiment reached the burrowing stage in 43 days, but the controls required only 19. No burrowing larvae were produced in the seventh experimental regime.

An earlier study showed that the optimum constant temperature for development of sea lamprey embryos is 65°F and that a constant temperature above 75°F or below 55°F is lethal.

MIGRATIONS

Upstream Movement of Adults

The electrified weir on the Ocqueoc River was put into operation on April 8, 1974, and the first incoming sea lamprey was captured on April 30. When the weir was deactivated on July 2, it had captured 901 spawning-run sea lampreys, as compared with 639 in 1973.

To assess the weir's effectiveness, we marked 546 adult weir-caught sea lampreys by means of Petersen tags (256) and fin clipping (281), and released them upstream on the spawning grounds extending 1.2 km below Ocqueoc Falls. Daily visits to locate tagged lampreys and to capture spawning adults for use as brood stock in other studies requiring lamprey eggs and larvae subsequently yielded 41 (15.5%) of the Petersen-tagged lampreys that had been released earlier. Included were 8 found dead on the spawning grounds, 23 recaptured alive on nests, and 10 that had lost their tags but were still identifiable as members of the tagged group. Of the 281 fin-clipped lampreys released, 49 (17.4%) were recaptured on nests in the study area. Twenty-three unmarked adult lampreys were also observed on the spawning grounds below Ocqueoc Falls, indicating (by simple proportion) that at least 139 lampreys (the equivalent of about 15% of the 1974 weir catch) had by-passed the weir.

Downstream Movement of Metamorphosed Sea Lampreys

Fyke nets fished continuously in the Ocqueoc River since 1962 have provided useful data for evaluating the effectiveness of control efforts in this important sea lamprey-producing stream. Before the first larvicidal treatment in 1968, the average yearly production of parasitic sea lampreys in the Ocqueoc River was estimated to be about 62,500 individuals. Production of sea lampreys following the initial treatment in 1971-72 decreased to 1,750, or 2.8% of the pretreatment number. In August 1972 the river was treated again and granular Bayer 73 was applied for the first time in the delta where the river enters Ocqueoc Lake, a small inland lake which is part of the Ocqueoc River system. Subsequent production in 1972-73, was estimated at 482, only 0.8% of the original pretreatment number.

In the fall of 1973 the delta in Ocqueoc Lake was treated twice, once with an experimental antimycin granule and then with granular Bayer 73. Both treatments killed considerable numbers of large larval sea lampreys and the production of "transformers" from the Ocqueoc River during the 1973-74 migrational season was only 232, less than 0.4% of the original pretreatment number.

APPENDIX F

REGISTRATION-ORIENTED RESEARCH ON LAMPRICIDES IN 1974

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INTRODUCTION

Registration-oriented research on lampricides has progressed in an orderly manner and results of studies on TFM should be ready for submission in the fall of 1975 to renew the registration.

TFM

Toxicity to Nontarget Animals

Mammals:—The contract studies at WARF Institute, Madison, Wisconsin are nearing completion. The chronic feeding study on rats is in the final phase, that of evaluation of the histopathology of tissue taken at the termination of the experiment. The feeding phase of the chronic study with hamsters should terminate early in 1975. The final evaluation of the rabbit teratology study should also be available at that time.

Invertebrates and aquatic vertebrates:—TFM was tested against various groups of nontarget aquatic organisms. Invertebrates exposed were flatworms (*Catenula* sp.), annelids (*Tubifex tubifex*), daphnids (*Daphnia magna*), seed shrimps (*Cypridopsis* sp.), glass shrimp (*Palaemonetes kadiakensis*), mayfly nymphs (*Callibaetis* sp.), backswimmers (*Notonecta* sp.), mosquito larvae (*Culex* sp. and *Anopheles* sp.), bivalve mollusks (*Corbicula* sp., *Sphaerium* sp., *Sphaerium* sp., *Elliptio* sp., and *Pleurocera* sp.). Vertebrates exposed to TFM were larvae of gray treefrog (*Hyla versicolor*), leopard frog (*Rana pipiens*), and bullfrogs (*Rana catesbeina*). Larvae of tree frogs were the most sensitive organisms to TFM (96-h LC50 = 1.98 mg/l), while backswimmers were the least sensitive (96-h LC50 = 555 mg/l). Soft-bodied invertebrates were less sensitive to TFM than snails and bivalve mollusks. The invertebrates tested were not as susceptible as larval lampreys in similar standardized tests.

Physiology

Coho salmon (*Oncorhynchus kisutch*) exposed to an acute, sublethal concentration of TFM (approximately 3 mg/l for 4 h) exhibited an increased

output of urine ($ml \cdot kg^{-1} \cdot h^{-1}$) during the exposure period. Urine flow returned to control levels during the 20-h postexposure period in TFM-free water. Urinary excretion of Na, K, Ca, Mg, and Cl (μ equiv$\cdot kg^{-1} \cdot h^{-1}$) was not affected. The rate of urinary loss of the five ions had no measurable effect on their levels in the plasma or gallbladder bile as determined in samples taken 20 h postexposure.

Residues

Yellow perch and carp were exposed to 1 mg/l of TFM for 12 h at 12 C. The fish were then transferred to fresh water and after selected withdrawal times the muscle was analyzed for residues of TFM. The concentration of TFM in the muscle of yellow perch and carp at the time of withdrawal was 0.12 and 0.40 μg/g, respectively. The residue concentration dropped rapidly after transfer to fresh water, and by 4 h postexposure the concentrations were 0.06 and 0.07 μg/g for yellow perch and carp, respectively.

Analysis of field grade TFM formulations by EPA showed approximately 120% of the label declaration of active ingredient. Our analysis agreed with EPA when active ingredient was calculated on a weight/volume basis, but we find near 100% of declared active ingredient if calculated on weight/weight basis.

BAYLUSCIDE (BAYER 73)

Toxicity to Nontarget Animals

Mammals:—Contract work at WARF Institute, Madison, Wisconsin on the subacute feeding of Bayer 73 to rats and hamsters for 90 days was completed in August and September, respectively. No gross or histopathological tissue alterations of significance were noted.

Birds:—The acute oral LD50 of Bayer 73 (WP) for hen mallards and bobwhite quail cocks appears to be in excess of 2,000 mg/kg. The calculated acute oral LD50 for female ring-billed gulls is 500 (77.8-3,210) mg/kg.

In a 48-h drinking water test with mallard ducks, there was no mortality at 0.01, 0.10, and 1.00 mg/l of Bayer 73.

This study was accomplished at the Denver Wildlife Research Center, Denver, Colorado.

Invertebrates:—Bayer 73 (70% AI), a molluscide and synergist used with TFM was tested against scud, *Gammarus pseudolimnaeus*; daphnid, *Daphnia magna*; crayfish, *Orconectes nais*; and midge larvae, *Chironomus plumosus* in well water (pH 7.4 and total hardness 272 mg/l as $CaCo_3$) at 21 C. All values are based on whole formulation rather than active ingredient.

Static toxicity tests gave 96-h LC50's of 25 mg/l for crayfish, 3.2 mg/l for scud, 0.52 mg/l for fourth instar midge larvae, and a 48-h EC50 immobilization value of 2.0 mg/l for daphnids.

Thirty-day, flow-through toxicity tests of Bayer 73 with early instar crayfish resulted in a time-independent LC50 of 16 mg/l, which was attained in 10 days.

Daphnids were exposed continuously through a complete life cycle (21 days) to 0.08, 0.16, 0.25, 0.50, and 1.0 mg/l of Bayer 73. In these 3-wk studies with daphnids, reproductive impairment was found to be a more sensitive measure of toxicity than survival. The concentration producing a 50% reproductive impairment (0.38 mg/l) was lower than the 3-wk LC50 (0.65 mg/l). The 16% reproductive impairment concentration is 0.29 mg/l, which represents a minimal reproducible value below which the variability in reproduction could not be detected from controls.

Midge larvae were exposed continuously through a complete life cycle (28 days) to 0.1, 0.56, 1.0, 1.8, and 3.2 mg/l of Bayer 73. Adult emergence in 0.1 mg/l was similar to emergence in controls. At concentrations of 0.56, 1.0, and 1.8 mg/l peak adult emergence was delayed 3 days; however, the adult emergence from these concentrations slightly exceeded those from the controls. Midge larvae exposed to 3.2 mg/l took 4 days longer than the controls to metamorphose into the adult form. Also, at this concentration a 20% reduction in successful emergence occurred.

The accumulation and magnification of ^{14}C-Bayer 73 was relatively low in scud, daphnids, and midge larvae, and ranged from 3 to 55 times the concentration in water (1 µg/l). All organisms accumulated maximal residues at equilibrium (24 h). After the organisms were transferred to pesticide-free water, approximately 50% of the Bayer 73 residue was lost in 24 h.

This study was accomplished at the Fish Pesticide Research Laboratory, Columbia, Missouri.

Physiology

Uptake, metabolism, and elimination of 2′,5-dichloro-4′-nitrosalicylanilide (Bayer 73) was studied in rainbow trout (*Salmo gairdneri*) exposed to ^{14}C-Bayer 73 in water. Transfer of trout to fresh water after exposure to Bayer 73 for 12 h resulted in the disappearance of ^{14}C from most tissues after 48 to 74 h. A 24-h ^{14}C bile to water ratio of 10,000:1 indicated a high degree of biliary concentration. A single polar ^{14}C metabolite was purified from bile.

These studies serve to establish that 2′,5-dichloro-4′-nitrosalicylanilide is taken up and metabolized by rainbow trout. Thin layer chromatography and preparative workup of beta-glucuronidase treated bile indicated the presence of only one metabolite. The polar metabolite isolated from bile has been identified with reasonable certainty as Bayer 73 glucuronide. The hydrolysis of the metabolite by beta-glucuronidase and the inhibition of hydrolysis by the specific beta-glucuronidase inhibitor saccharo-1,4-lactone, together with fragments observed during electron impact mass spectroscopy indicated a glucuronide conjugate. Cleavage of the amide bond by acid hydrolysis to liberate 5-chlorosalicylic acid, identical infrared spectrums of analytical standard Bayer 73, and the beta-glucuronidase released radioactive

compound along with analytical TLC indicate that the beta-glucuronidase hydrolysis product is unchanged 2′,5′dichloro-4′-nitrosalicylanilide. The fragments observed during electron impact mass spectroscopy of the beta-glucuronidase released compound confirm these observations.

This study was accomplished by Dr. John J. Lech, The Medical College of Wisconsin-Milwaukee.

Residues

Fish:—Bayer 73 can be detected by gas chromatography of its BSTFA [bis-(trimethylsilyl)-trifluoroacetamide] derivative. When chromatographed as the BSTFA derivative on a 100 cm X 4 mm column of 1% Dexsil 300 at 225 C with a flow rate of 60 ml/min, 0.1 ng of Bayer 73 can easily be detected.

Bile from carp exposed to 0.1 mg/l of Bayer 73 was found to contain 50 µg/ml of Bayer 73 residues, as measured by analysis of alkaline hydrolyzed bile for chloronitroaniline. This procedure measures both free and conjugated residues of Bayer 73.

Environment:—Bayer 73 (WP), used to enhance the toxicity of TFM to sea lamprey larvae, is added to the flow of large rivers along with TFM, thus exposing the entire stream to low concentrations of Bayer 73 for several hours. The registrations of both chemicals are being upgraded to comply with current requirements imposed by FEPCA, 1972. In keeping with these requirements, a sampling program was completed to provide data on the uptake and persistence of Bayer 73 in different parts of a stream ecosystem.

The sampling was done in the Manistee River in Michigan. Samples were taken 200 yards downstream from the main application station and several miles farther downstream where the concentration was lower and the length of exposure longer. Fish, aquatic insects, crayfish, amphipods, isopods, snails, earthworms, bottom soil, and water were sampled before treatment, during treatment, and 1, 3, and 6 days after treatment. The 99 individual samples are in frozen storage awaiting analysis for Bayer 73.

Status of Registration Research

Bayer 73 Checklist for Registration Research

Status[a]		
+	I.	Chemical characterization
	II.	Toxicity
0		A. Fish—chronic TI LC50
0		B. Invertebrates—WQ *Daphnia*
	III.	Efficacy
0		A. Laboratory—counteraction
0		B. Field—environmental impact, methods
	IV.	Residues
i		A. Methods—backup method

i		B. Use pattern
0		C. Metabolites–cow
	V.	Safety studies
+		A. Acute
+		B. Subacute
i		C. Chronic–2-year rat, being negotiated
?		D. Mutagenicity–dependson V.C. above
+	E	E. Teratogenicity
+		F. Metabolism–fish

[a]+ = complete; i = in progress; 0 = on line to be done FY 76; ? = need depends on other test outcome.

LAMPRICIDAL MIXTURE

Toxicity to nontarget animals

Fish:–Green eggs, eyed eggs, sac fry, and fingerling fry of coho salmon were exposed to TFM and Bayer 73 individually and in combination in soft water at selected pH's. Data were analyzed for 96-h LC50's, their 95% confidence intervals, and additive indices and their ranges. In all instances except one, the range for the index overlapped zero, indicating the toxicity of the mixture is strictly additive.

ANTIMYCIN

Granular Formulations for Control of Lampreys in Lentic Habitat

Two field tests were done with the delayed-release, granular formulation antimycin in an attempt to delineate the lower limit of concentration which will give effective control. Both tests were done with 6.6 pounds of the formulation per acre, which gives a concentration of 150 ppb of antimycin in the bottom 2 inches of water. This was half the concentration used in previous tests. The trial in Harlow Lake at the mouth of Bismark Creek produced a kill of sea lamprey larvae comparable to those obtained in previous trials at 300 ppb. The kill of caged and wild sea lamprey larvae (several hundred) and a followup treatment with Bayer 73, indicated that over 95% of the larvae on the area were killed with antimycin. All largemouth bass in cages 5 and 10 feet from the bottom survived.

The other trial was conducted in Ocqueoc Lake at the mouth of the Ocqueoc River. The water temperature was 10 C, substantially lower than the 25 C in Harlow Lake. Sixty-six percent of the caged sea lamprey larvae were killed, but a followup treatment with Bayer 73 indicated that somewhat less than that percentage of the wild population was killed with antimycin. Survival of largemouth bass caged at the bottom in the treatment area was further indication that the concentration used was too low. Low water temperatures substantially lengthen the effective contact time of antimycin as well as many other chemicals, and in this case the contact time needed was probably longer than the time required for dilution of the chemical to below lethal levels.

The results of four field trials (three with 90% or better efficacy) indicate that antimycin is a viable alternative chemical for sea lamprey control in problem areas but higher concentrations (200-250 ppb in the bottom 2 inches of water) are needed in water colder than 15 C.

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Kawatski, J. A., and M. J. McDonald. 1974. Effect of 3-trifluoromethyl-4-nitrophenol on *in vivo* tissue respiration of four species of fish with preliminary notes on its *in vitro* biotransformation. Comparative and General Pharmacology 5:67-76.

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APPENDIX G

ADMINISTRATIVE REPORT FOR 1974

Meetings. The Commission held its 1974 Annual Meeting in Rochester, New York, June 18-20, 1974, and its Interim Meeting in Ann Arbor, Michigan on December 3, 1974. In addition, the Commission decided to hold more frequent (at least quarterly) executive meetings of Commissioners and staff. Executive Meetings in 1974 were held as follows: June 18-20 (Rochester, New York); July 12 (Milwaukee, Wisconsin); October 1 (Ann Arbor, Michigan); and December 3 (Ann Arbor, Michigan).

Meetings of Standing Committees during 1974 were:
Lake Erie–Buffalo, New York, March 12-13
Lake Ontario–Buffalo, New York, March 13-14
Combined Upper Great Lakes–Milwaukee, Wisconsin, March 26-27
  Lake Superior–Milwaukee, Wisconsin, March 26
  Lake Huron–Milwaukee, Wisconsin, March 27
  Lake Michigan–Milwaukee, Wisconsin, March 27
Sea Lamprey Control and Research–Ann Arbor, Michigan, May 2
Scientific Adivsory: Rochester, New York, June 17
  Ann Arbor, Michigan, May 2
  Ann Arbor, Michigan, December 1
Finance and Administration–Rochester, New York, June 19

Officers and staff. The Commission suffered a severe loss in 1974 with the death of its Executive Secretary, Mr. Robert W. Saalfeld on June 9. The dedicated service and guidance that Mr. Saalfeld had given the Commission will be sorely missed.

At the close of the 1974 Annual Meeting, the Commission elected Mr. K. H. Loftus, Chairman, and Mr. Nathaniel P. Reed, Vice-Chairman for two-year terms. At a quarterly executive meeting on October 1 the Commission approved assignment of its members to various committees as follows:

Sea Lamprey Control and Research Committee

W. M. Lawrence, Chairman
C. J. Kerswill
K. H. Loftus
L. P. Voigt

Management and Research Committee

C. J. Kerswill, Chairman
F. E. J. Fry
N. P. Reed
Claude Ver Duin

Scientific Advisory Committee

F. E. J. Fry, Chairman
W. M. Lawrence

Finance and Administration Committee

L. P. Voigt, Chairman
E. W. Burridge
K. H. Loftus
N. P. Reed

These appointments increased the Commission membership from the previous two members to four on three of these committees. This was a revision in the Commission's Rules of Procedure.

Changes in the Commission's staff in 1974 included the detailing of Mr. A. L. McLain by the U.S. Fish and Wildlife Service as Acting Executive Secretary while a new Executive Secretary was being sought to replace the late Mr. Saalfeld.

Staff activities. The Commission's staff (Secretariat) performs several major functions. The Secretariat provide staff assistance to the Committees for all phases of the Commission's program. On behalf of the Commission it provides liaison with agencies and individuals with whom the Commission deals, including assistance in coordinating fishery programs, planning meetings, arranging the presentation of reports, and preparation of minutes. The Secretariat provides direct assistance to the Commission in the development of the program and from time to time acts on behalf of the Commission as circumstances may require. During 1974 the staff attended and participated in the following meetings and conferences:

Canadian Committee for Freshwater Fisheries Research
Lake Erie Yellow Perch Workshop
Lake Michigan Study Group
Great Lakes Fish Disease Control Committee
Lake Erie Walleye Management-Scientific Protocol Committee
Lake Superior Lake Herring Committee
Lake Superior Advisory Committee
Percid International Symposium (PERCIS)-Steering Committee Meetings
St. Marys River Study Team (IJC)
IJC Public Hearing, Sault Ste. Marie, Ontario, Canada
Great Lakes Commission
Upper Great Lakes Regional Commission
Interstate Marine Fisheries Commissions
American Fisheries Society

Accounts and Audit. The Commission accounts for the fiscal year ending June 30, 1974 were audited by Icerman, Johnson, and Hoffman of Ann Arbor. The firm's report is appended.

Program and Budget for Fiscal Year 1974

At its 1972 Annual Meeting the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1974 which provided for continuation of sea lamprey control in Lake Superior, Lake Michigan, Lake Huron, and Lake Ontario; continuation of sea lamprey research at the Hammond Bay Biological Station; continuation of 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. The estimated cost for sea lamprey control and research was $3,248,320 and for administration and general research $98,000 as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,241,340	$1,006,980	$3,248,320
Administration and General Research	49,000	49,000	98,000
Total	$2,290,340	$1,055,980	$3,346,320

Subsequently the program for sea lamprey control and research was revised to match reduced appropriations provided by the U.S. government. This included deferring the start of the sea lamprey barrier dam program which would have reduced lampricide and manpower costs over the years. The final funding for fiscal year 1974 was 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

Sea lamprey control and research in Canada in fiscal year 1974 was carried out under agreement with the Canadian Department of Environment ($809,910) and the U.S. Fish and Wildlife Service ($1,890,590), including Commission purchases of lampricides. At the end of the fiscal year the Canadian agent refunded $601 and the U.S. agent $137,872; these monies were used to rebuild depleted reserves of lampricide. The Commission also reviewed its fiscal year 1974 administration and general research budget and approved a transfer of $12,500 from the sea lamprey control and research budget to cover death benefits to the late Executive Secretary's wife, increases in printing costs, and other, unexpected inflationary prices increases.

Program and Budget for fiscal year 1975

At its 1973 Annual Meeting, the Commission adopted a program and budget for sea lamprey control in fiscal year 1975 estimated to cost $3,624,245. It provided for continuation of sea lamprey control in lakes

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

Superior, Michigan, Huron, and Ontario, continuation of sea lamprey research and studies leading toward registration of lampricides, and a modest start for design and construction of sea lamprey barrier dams on selected rivers to reduce future lampricide and manpower costs. A budget of $108,300 was adopted for administration and general research.

Following 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 $3,104,800. Unfortunately, the Commission was again forced to defer the sea lamprey barrier dam program.

Lake Superior. Retreat 18 streams (10 in the U.S. and 8 in Canada) with lampricides; treat with granular Bayer 73 the estuaries of those streams in Canada deemed necessary; routinely survey other streams to determine time for retreatment; and operate assessment barriers on 8 sea lamprey spawning streams in the U.S.

Lake Michigan. Retreat 16 streams and continue routine surveys to determine when treatments on other sea lamprey-infested streams are required to prevent escapement of parasitic sea lamprey to the lake.

Lake Huron. Retreat 17 streams (8 in the U.S. and 9 in Canada); treat with granular Bayer 73 the estuaries of those streams in Canada deemed necessary; continue routine surveys on other streams to determine need for retreatment; and operate 8 assessment barriers (7 in Canada and 1 in the U.S.) to assess changes in abundance of sea lamprey spawning stocks.

Lake Ontario. Retreat 5 streams in Canada and continue routine surveys on Canadian streams to determine need for retreatment.

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

Develop more effective chemicals for treating deep-water larval habitat; develop the laboratory culture of sea lamprey ammocetes; determine the resistance of embryological states of sea lamprey to the lampricide TFM; investigate the feasibility of biological control using such techniques as chemical and immunological methods of lamprey sterilization, the possibility of sex control of laboratory-reared ammocetes, and the competitive displacement potential of hybrid lampreys; and conduct research on inducement of transformation, detection of biochemical changes, and identification of early indicators of transformation.

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

Agreements to cary out the program were made with the U.S. Fish and Wildlife Service ($1,570,200) and the Canadian Department of Environment ($800,000). The Commission placed orders with the North American subsidaries of Farbewerke Hoechst Ag., Germany for 120,000 pounds of lampricide at $4.57 per pound--the only bid received. The Commission also retained funds to purchase Bayer 73, contract special registration-oriented studies in Canada and pay the rent on the buildings occupied by its U.S. sea lamprey control agents.

The Commission reviewed its administration and general research program and budget for fiscal year 1975 and revised it to $110,500 to reflect increase in services.

The funding by countries for fiscal year 1975 is as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$2,186,750	$ 981,820	$3,168,570[1]
Administration and General Research	55,250	55,250	110,500
Total	$2,242,000	$1,037,070	$3,279,070

Program and Budget for Fiscal Year 1976

At the 1974 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1976 estimated to cost $4,128,300. The program called for continuation of sea lamprey control on Lakes Superior, Michigan, Huron, and Ontario; continuation of sea lamprey research at Hammond Bay Biological Station and registration-oriented studies on lampricides; establishment of a sea lamprey survey capability for Lake Erie (the only Great Lake without sea lamprey control); and another attempt to initiate a sea lamprey barrier dam project to reduce future costs of lampricide treatments. A budget of $129,200 was adopted for administration and general research.

Reports and Publications. In 1974 the Commission published two papers in its Technical Report Series, a management policy for Great Lakes Fisheries, and a Cyclostomata bibliography on microfiche.

"Control of the sea lamprey (*Petromyzon marinus*) in Lake Superior, 1953-70" by Bernard R. Smith, J. James Tibbles, and B. G. H. Johnson, Great Lakes Fishery Commission, Tech. Rep. 26, 60 p. March 1974.

"Movement and recapture of parasitic-phase sea lampreys (*Petromyzon marinus*) tagged in the St. Marys River and Lakes Huron and Michigan, 1963-67" by Harry H. Moore, Frederick H. Dahl, and Aarne K. Lamsa, Great Lakes Fishery Commission, Tech. Rep. 27, 19 p, July 1974.

A Management Policy for Great Lakes Fisheries, Great Lakes Fishery Commission, August 1974.

The Cyclostomata: an annotated bibliography, by L. J. Selley & FWH Beamish Great Lakes Fishery Commission, x + 961 pp. on 12 microfiche.

[1]Includes supplementary contribution totalling $63,770 (U.S. $44,000 and Canada $19,770) to partially cover cost-of-living increases to employees of the Commission's Canadian and U.S. agents.

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OFFICES
ANN ARBOR, MICHIGAN
HOWELL, MICHIGAN

Great Lakes Fishery Commission
Ann Arbor, Michigan

We have examined the accompanying balance sheet of Great Lakes Fishery Commission as of June 30, 1974 and the related statements of revenue and expenditure, changes in fund balance and source and application of funds for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the financial statements mentioned above present fairly the financial position of Great Lakes Fishery Commission at June 30, 1974 and the results of its operations and changes in its financial position for the year then ended, in conformity with generally accepted accounting principles applied on a consistent basis.

Icerman, Johnson & Hoffman

Ann Arbor, Michigan
September 20, 1974

Great Lakes Fishery Commission
Balance Sheet
June 30, 1974

	Administration and General Research Fund	*Sea Lamprey Control and Research Fund*	*Totals*
Assets			
Current Assets			
Cash in bank	$ 545	$132,612	$133,157
Accounts receivable	314	177,335	177,649
	$ 859	$309,947	$310,806
Liabilities and Fund Balance			
Current Liabilities, accounts payable and accrued expenses	$10,565	$ 79,341	$ 89,906
Fund Balance			
Current year budget encumbrances (Note 2)	$ 2,500	$119,097	$121,597
Fund balance (deficit) (Note 6)	(12,206)	111,509	99,303
	$ (9,706)	$230,606	$220,900
	$ 859	$309,947	$310,806

See notes to financial statements on pages 7 and 8.

Great Lakes Fishery Commission
Administrative and General Research Fund
Statement of Revenues and Expenditures
Year Ended June 30, 1974

	Actual	*Budget*	*Over or (Under) Budget*
Revenues			
Canadian government	$ 50,750	$ 50,750	$ -0-
United States government	50,750	50,750	-0-
Miscellaneous	305	-0-	305
	$101,805	$101,500	$ 305
Expenditures			
Salaries	$ 67,408	$ 63,480	$ 3,928
Fringe benefits	10,921	8,620	2,301
Research	10,000	10,000	-0-
Travel	4,778	5,200	(422)
Communications	1,991	1,500	491
Rents and utilities	1,248	900	348
Printing and reproduction	10,361	6,100	4,261
Other contractual services	1,234	1,600	(366)
Supplies	1,440	1,600	(160)
Equipment (Note 2)	3,176	2,500	676
	$112,557	$101,500	$11,057
Excess of expenditures over revenues	$ 10,752		$10,752
		(from SLCR)	+12,500
			$1,748.00

See notes to financial statements on pages 7 and 8.
$12,500 transfer approved to cover deficit.

Great Lakes Fishery Commission
Sea Lamprey Control and Research Fund
Statement of Revenues and Expenditures
Year Ended June 30, 1974

	Actual	*Budget*	*Over or (Under) Budget*
Revenues			
Canadian government	$ 863,150	$ 863,150	$ -0-
United States government	1,921,350	1,921,350	-0-
Refund from Canadian Department of the Environment (Note 3)	601	-0-	601
Refund from United States Bureau of Sport Fisheries and Wildlife (Note 3)	137,872	-0-	137,872
Interest	9,564	-0-	9,564
	$2,932,537	$2,784,500	$148,037
Expenditures			
Canadian Department of the Environment (Note 4)	$ 744,710	$ 744,710	$ -0-
United States Bureau of Sport Fisheries and Wildlife	1,525,200	1,525,200	-0-
Lampricide purchases (Note 2)	581,505	483,540	97,963
Special studies	21,269	31,050	(9,781)
Adjustment for foreign currency exchange (Note 4)	(20,988)	-0-	(20,988)
	$2,851,696	$2,784,500	$ 67,196
Excess of revenues over expenditures	$ 80,841		$ 80,841

See notes to financial statements on pages 7 and 8.

Great Lakes Fishery Commission
Statement of Changes in Fund Balance
Year Ended June 30, 1974

	Administrative and General Research Fund	*Sea Lamprey Control and Research Fund*	*Totals*
Balance (deficit), beginning	$ (1,454)	$ 30,668	$29,214
Excess of revenue over expenditures (expenditure over revenue)	(10,752)	80,841	70,089
Balance (deficit), ending	$(12,206)	$111,509	$99,303

COMMITTEE MEMBERS - 1974

[Commissioners in Italics]

SCIENTIFIC ADVISORY COMMITTEE

CANADA	UNITED STATES
F. E. J. Fry, Chm.	*W. M. Lawrence*
M. G. Johnson	J. H. Kutkuhn
A. H. Lawrie	S. H. Smith
H. A. Regier	D. A. Webster

SEA LAMPREY CONTROL AND RESEARCH

CANADA	UNITED STATES
K. H. Loftus	*L. P. Voigt, Chm.*
J. J. Tibbles	G. L. Buterbaugh

MANAGEMENT AND RESEARCH COMMITTEE

CANADA	UNITED STATES
C. J. Kerswill	*Claude Ver Duin, Chm.*
G. C. Armstrong	W. J. Harth
R. M. Christie	C. E. Parker
E. Gage	R. J. Poff
A. Holder	J. A. Scott
	H. J. Vondett

FINANCE AND ADMINISTRATION COMMITTEE

CANADA	UNITED STATES
E. W. Burridge, Chm.	*L. P. Voigt*

LAKE COMMITTEES

LAKE HURON	LAKE ONTARIO
J. A. Scott, Chm.	E. Gage, Chm.
R. M. Christie	C. E. Parker

LAKE MICHIGAN	LAKE SUPERIOR	LAKE ERIE
R. J. Poff, Chm.	H. J. Vondett, Chm.	C. E. Parker, Chm.
W. J. Harth	R. J. Poff	R. B. Kenyon
W. H. Tody	C. R. Burrows	N. E. Fogle
F. Lockard		A. Holder