ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1979

GREAT LAKES FISHERY COMMISSION

MEMBERS
AND PERIOD OF SERVICE
SINCE THE INCEPTION OF THE COMMISSION
IN 1956

CANADA		UNITED STATES	
A. O. Blackhurst	1956–1968	J. L. Farley	1956–1956
W. J. K. Harkness	1956–1959	C. Ver Duin	1956–
A. L. Pritchard	1956–1971	L. P. Voigt	1956–1978
J. R. Dymond	1961–1964	D. L. McKernan	1957–1966
C. H. D. Clarke	1965–1972	C. F. Pautzke	1967–1968
E. W. Burridge	1967–1977	W. M. Lawrence	1968–
F. E. J. Fry	1969–	C. H. Meacham	1969–1970
C. J. Kerswill	1971–1978	N. P. Reed	1971–1977
K. H. Loftus	1972–	R. L. Herbst	1978–
M. G. Johnson	1978–	F. R. Lockard	1978–
H. D. Johnston	1979–		

1979 SECRETARIAT

C. M. Fetterolf, Jr., Executive Secretary
A. K. Lamsa, Assistant Executive Secretary
M. A. Ross, Biological Assistant
W. J. Maxon, Chief Administrative Officer
B. S. Biedenbender, Administrative Assistant
R. E. Koerber, Word Processing Supervisor

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
1979

COMMISSIONERS

F. E. J. Fry	W. M. Lawrence
R. L. Herbst	F. R. Lockard
M. G. Johnson	K. H. Loftus
H. D. Johnston	C. Ver Duin

1451 Green Road
Ann Arbor, Michigan
U.S.A.
1982

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 1979.

Respectfully,

K. H. Loftus, *Chairman*

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ANNUAL REPORT FOR 1979

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 Commision 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 24 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, is developing close liaison with those governmental agencies who have direct responsibility for water quality, pollution abatement, and land use.

The Commission's Annual Meeting was held at Toronto, Ontario, June 26–28, 1979 and its Interim Meeting was convened in Ann Arbor, Michigan, November 27–28, 1979.

ANNUAL MEETING

PROCEEDINGS

The twenty-fourth Annual Meeting of the Great Lakes Fishery Commission was held in Toronto, Ontario on June 26–28, 1979.

Commission Chairman K. H. Loftus convened the meeting at 0900 h, and introduced Donald D. Tansley, Deputy Minister of Fisheries and Oceans, Canada, who delivered the welcoming address.

Deputy Minister Tansley listed some recent actions of the Canadian Government toward resolving problems of Great Lakes fisheries: reorganization of the Department of Fisheries and Environment into two separate departments; the appointment of Mr. H. D. Johnston to the position of Assistant Deputy Minister for Pacific and Freshwater Fisheries; and the strengthening of the Fisheries Act with respect to habitat protection. He also described the elements of success in the Department of Fisheries and Oceans (DFO) west coast program (mobilize the public, develop overall plan, sell the program to the government as an investment) and offered DFO's assistance in planning a similar program for the Great Lakes.

During the introduction of Commissioners, Chairman Loftus welcomed Mr. H. D. Johnston, who was formally appointed to the Commission shortly after the Annual Meeting.

In his Chairman's Report, Commissioner Loftus summarized activities since the 1978 Annual Meeting with respect to publications, various projects, sea lamprey control and assessment, sea lamprey barrier dams, fisheries management and research, interaction with Commission committees, overexploitation of lake trout, the character and value of the Great Lakes fishery, administrative items, and interactions with the IJC and National Marine Fisheries Service. He added that the variety of Commission activities reflected a broadening approach to the Commission's mandate to achieve control of the sea lamprey and to rehabilitate stocks of common concern. In concluding, he noted that the Commission's contribution is merely to coax, lead, and coordinate; most of the credit for Commission activities belongs to the Commission's cooperators.

In a more solemn mood, the attendees paused for a moment of silence and heard eulogies on behalf of four friends who died in the past year—Roger Bodin (long-time member of the Lake Superior Advisory Committee), Don McKernan (a former Commissioner), Cam Stevenson (editor of the Journal of the Fisheries Research Board of Canada), and Lloyd Smith (a former long-time Scientific Advisory Committee member).

Sea Lamprey Control and Research. The Commission accepted reports on sea lamprey control and research during 1978 from its United States and Canadian agents.

Mr. Braem (USFWS) described his agency's progress and findings in 1978 (published elsewhere in this Annual Report) and also reviewed activities during the first half of 1979, including studies on adult sea lamprey and ammocetes, and chemical control plans. He also responded to questions from the audience on the dangers of sea lamprey infestation of the Fox River (Green Bay, Wisconsin), which has improving water quality.

Dr. Tibbles and Messrs. B. J. H. Johnson and S. Dustin delivered the Canadian agent's 1978 Annual Report (published elsewhere in this annual report) and reported on the Sea Lamprey Control Centre's activities in the spring of 1979 which included adult sea lamprey assessment operations, stream surveys, lampricide treatments, sea lamprey barrier dam construction, and a sea lamprey larval growth study.

The annual report of the Hammond Bay Biological Station, summarizing progress since January 1978 (published elsewhere in this annual report), was submitted by Dr. Joseph Hunn, Station Chief (USFWS).

Dr. Fred Meyer (USFWS) summarized the activities of the National Fisheries Research Laboratory (La Crosse) on registration-oriented research on lampricides and other related research.

Commissioner Lawrence presented reports on the status of barrier dam programs in Ontario, the status of approved construction in the United States, proposed barrier dam construction in the United States, and research on required height of barrier dams.

Mr. Bernard Smith (USFWS) reported on the objectives of the Sea Lamprey International Symposium to be held in the summer of 1979, on the papers to be presented, and the organization of the synthesis portion of the symposium. The proceedings will be published in the Journal of the Fisheries Research Board of Canada.

The Commission approved both the 1980 and 1981 Sea Lamprey Control and Research programs and budgets and tentatively approved the Administration and General Research allocations for the two years.

	1980	*1981*
Sea Lamprey Control and Research	$5,546,600	$6,079,300
Administration and General Research	363,000	404,600
Total	$5,909,600	$6,483,900

Management and Research. Various matters pertaining to the fishery resources of the Great Lakes were brought to the attention of the Commission.

Reports from each Lake Committee (Huron, Superior, Michigan, Ontario, Erie) and the Council of Lake Committees covering management and research activities in 1978 and recommendations, were presented by committee chairmen and accepted by the Commission.

Mr. James Warren (USFWS), Chairman of the Fish Disease Control Committee, reviewed the status of fish disease control in the Great Lakes and concerns of the committee. He described the committee's plan for drawing the private hatcheries under the umbrella of the fish disease control program, and for updating the technical procedures and disease classification system for hatcheries.

Mr. Dan Bumgarner (USFWS) reported on progress with the Iron River National Fish Hatchery, noting that a decision of whether or not to issue construction permits will be handed down by a Wisconsin Department of Natural Resources hearing examiner following formal hearing proceedings in August 1979.

Mr. A. Berst (OMNR, retired) reported on planning progress of the Stock Concept Symposium with respect to time (fall 1980) and site (Allison, Ontario), the expected number of participants (75), the program, arrangements for publication in the Journal of the Fisheries Research Board of Canada, compilation of a bibliography for use by symposium participants, and the budget.

Scientific Advisory Committee (SAC)–Board of Technical Experts (BOTE). Mr. Andrew H. Lawrie (OMNR), convenor, reviewed the SAC report and recommendations to the Commission. He pointed out that committee membership had been increased and the committee renamed Board of Technical Experts (BOTE) with revised terms of reference. The report addressed Great Lakes Ecosystem Rehabilitation and Restoration (GLERR), contaminants, the protocol on use of general research funds, various research proposals, and some sea lamprey-related items.

Great Lakes Recreational Fishing Statistics. Dr. Joseph Kutkuhn (USFWS) explained that in fiscal year 1980 the Great Lakes Fishery Laboratory plans to initiate a two year study whose objective will be to develop the technical basis for a standardized, comprehensive system of collecting and centrally managing sports fishery statistics for all Great Lakes (as is done with commercial fishery statistics). The completed study will be made available for the immediate and future use by any or all fishery management agencies that wish to participate; the USFWS is presently assisting a number of states with their individual initiatives.

Values Associated with Great Lakes Fishing: Approaches to an In-depth Study. In introducing Dr. Dan Talhelm (Michigan State University), Vice-chairman R. L. Herbst stated that establishing defensable economic values for the Great Lakes fishery would be extremely valuable to fish managers for countering the demands of competing users and in selling research and management programs to governments and other funding entities. Dr. Talhelm described the value of the Great Lakes fishery as two-fold, comprising the value of the resource and the role of the resource in the economy, each with several component values, some of which require substantiation.

Michigan's Tribal, State, and Federal Great Lakes Fisheries Task Force. Dr. Joseph Kutkuhn (USFWS) described the duties of the task force appointed by Michigan's governor which resulted from USFWS and Bureau of Indian Affairs deliberations relative to concerns expressed by the Commission and others relative to overharvest of lake trout and other species. The terms of reference require the task force to circumscribe geographically the affected areas, rank the affected fish stocks, establish major parameters (growth, mortality, size, rate of replenishment) for each stock, and suggest portions of surplus production required for restoration and portions available to users.

Strategic Great Lakes Fishery Management Plan (SGLFMP). The Commission accepted a progress report from Mr. Andrew H. Lawrie (OMNR), co-chairman of the SGLFMP Steering Committee, who explained progress to date. In the fall of 1978 senior officials from all agencies with major responsibility for Great Lakes fisheries met as the Committee of the Whole and appointed an interim steering committee to develop recommendations for developing a plan for review by early 1980. The Committee of the Whole accepted the interim steering committee's stated objectives (to identify major problems and develop strategies for dealing with them as a basis for the development of operational plans) and its approach to develop a strategic plan (to identify existing goals and objectives of agencies with responsibility for or impact on Great Lakes fisheries, to examine these for commonalities and differences, to identify fundamental differences as issues to be addressed, to develop strategies for resolving issues, to recognize unreconcilable differences). The Committee of the Whole then appointed a Steering Committee with (optional) representation from all agencies with responsibility for the Great Lakes fishery, to be cochaired by Mr. Lawrie (OMNR) and Mr. William Pearce (NYDEC). Mr. Lawrie reviewed the progress of the Steering Committee, noting that goals, objectives, and issues would be identified by mid-September 1979. The Steering Committee would then direct its attention to the strategies.

Feasibility Study: Great Lakes Ecosystem Rehabilitation and Restoration (GLERR). Commission Chairman Loftus expressed the Commission's pleasure that the feasibility report for rehabilitating Great Lakes ecosystems, originally suggested by the Scientific Advisory Committee in 1977, is now complete and will be published.[1] The Commission accepted the report delivered by its editors, Dr. George Francis (University of Waterloo), Dr. John J. Magnuson (University of Wisconsin-Madison), Dr. Henry Regier (University of Toronto), and Dr. Dan Talhelm (Michigan State University). The chapters of the publication address the background and overview of the study, lake ecology, historical uses and consequences, rehabilitation methods, socioeconomic feasibility of rehabilitation, institutional arrangements for rehabilitation, rehabilitating particular ecosystems, and recommendations. The subsequent discussions strongly praised the report, identified a need for the Great Lakes Fishery Commission and the International Joint Commission to pursue ecosystem rehabilitation goals in a mutually supportive way, the need for a popular version of the report, and its usefulness as a resource document for development of the Strategic Great Lakes Fishery Management Plan.

Extended Navigation–A Status Report. Chairman Loftus expressed the Commission's concern over the unknown nature of the environmental impacts that winter navigation may have on fisheries and explained that the participants on the panel have been asked to address specific questions.

Colonel M. D. Remus, Detroit District Engineer for the Corps of Engineers, described the background of the extended navigation proposal leading to the demonstration program and the preparation of a final survey report on the feasibility of extended navigation which will be submitted to the Congress after review by the Board of Engineers for Rivers and Harbors. Accompanying the Final Survey Report will be an environmental impact statement which embraces a program of environmental action based on the "adaptive method." Total cost of extended navigation is estimated at $2.3 to $4 billion. Colonel Remus described the Great Lakes–St. Lawrence Seaway Navigation Season Extension Program, the St. Lawrence Seaway Additional Locks Study, and the Great Lakes Connecting Channels and Harbors Study as closely coordinated and interrelated but not interdependent.

Mr. George Griebenow (USFWS), coordinator of the Environmental Assessment of Great Lakes Ecosystems (EAGLE) team established by the USFWS under a memorandum of understanding with the Corps of Engineers, described EAGLE's function as involving state and public interest groups in the planning process, and transferring

[1]Rehabilitating Great Lakes Ecosystems, edited by George R. Francis, John J. Magnuson, Henry A. Regier, and Daniel R. Talhelm. December 1979. Great Lakes Fishery Commission Technical Report 37, 99 pp.

scientific data in language understandable to the Congress and vested interest groups. He listed some of the studies being conducted by USFWS as part of the environmental plan of action and added that the USFWS is a free agent and is prepared to recommend a moratorium on construction if warranted.

Mr. D. E. Gage (OMNR) stated that Canadian participation had been nonexistent, and recommended that the IJC be requested to review the winter navigation proposal, and that Canada's Department of External Affairs be approached officially by the U.S. State Department. He discussed the hydrodynamic effects of vessel passage in channels, ice jamming, and Ontario's concerns with respect to the environment, riparian interests, and generation of hydroelectric power.

Dr. Paul Nickel (Great Lakes Basin Commission) described state concerns as expressed at a Basin Commission-sponsored symposium to discuss the results of the Basin Commission's economic analysis of the Corps' survey report on winter navigation. The Basin Commission's analysis suggested that less costly alternatives to winter navigation for increasing capacity be examined; that benefits and costs should be recalculated; that regional economic benefits related to jobs were overstated; and that the extent of shippers' use of the waterway during the season extension was still in question.

Mr. James Fish (Great Lakes Commission) is a member of the Winter Navigation Board and his agency has supported the extended navigation study and demonstration program. He stated that the Corps of Engineers has attempted to respond to identified problems and changes occuring in the demonstration program and added that winter navigation in one form or another has been practiced for years and is not a complete unknown with respect to environmental costs.

Present and Future Roles of National Oceanic and Atmospheric Administration (NOAA) and National Marine Fisheries Service (NMFS) in the Development of the Great Lakes Fisheries. Dr. B. Rothschild (NOAA) reviewed a broad spectrum of his agency's activities in the Great Lakes region including the services of the National Weather Service, charting of the Great Lakes, Sea Grant research, the Fisheries Assistance Program of the Office of Coastal Zone Management, the Great Lakes Environmental Research Laboratory program of limnological studies, and support of the Great Lakes Basin Commission's Great Lakes Information Service. He proposed that senior officals from his agency with responsibility for the Great Lakes meet regularly with those associated with the Great Lakes Fishery Commission to discuss how NOAA's activities can best be interfaced with the Commission's fishery management and rehabilitation efforts.

Mr. J. T. Everett, Chief of Fishery Development for NMFS, reviewed the policy announcement on fishery development in the U.S. which was released in May of 1979. Two major elements of the policy were the fostering of cooperation among the fishing industry, regional

planning, and various levels of government. Comprehensive programs will be initiated to improve access to foreign markets, ease the regulatory burden on the fishing industry, supply information on the industry to financial institutions, improve product safety and quality, and develop new technology. The administration will propose fisheries development legislation which will allow funding of cooperative efforts as proposed by groups such as the Great Lakes Fishery Development Foundation.

Project Quinte: An Example of Federal, Provincial, and Academic Cooperation. Mr. Jack Christie (OMNR) described the Bay of Quinte, its problems of cultural eutrophication and changes in fish fauna. Project Quinte, whose personnel are scientists from the provincial and federal governments and universities, has as its goal the improvement of water quality and fish stocks, with the first step through control of municipal phosphate loading. Dr. John Cooley (DFO) added some comments on the unique nonscientific aspects of Project Quinte such as the cooperation of independent agencies in a project with no special budget, the existence of a common user data pool, and the success of a grass roots organization of self-directed inspired co-equals. He also explained how nutrient loading is affected by waterflow, speculated on the recovery of the fisheries, and suggested further action which may become necessary as local populations increase.

Report on Contaminant Research Needs in the Great Lakes. The Commission accepted a report from its Scientific Advisory Committee (SAC) on the subject. The Commission had charged SAC to determine if current research on contaminants was adequate to assess the effects of contaminants on Great Lakes fish. The SAC presented this and several related questions to 25 acknowledged experts in this area. The majority responded and were unanimous that the quantity and quality of current research were inadequate to demonstrate the effects of contaminants on Great Lakes fish. The respondents also identified research inadequacies, research needs, and research strategies. Following the report given by Mr. Vic Cairns (DFO), Commissioner Johnson added that the bottom line is that we must ensure that Great Lakes fish are edible, and that no harmful contaminants are introduced to the system.

The 1978 Canada–U.S. Water Quality Agreement. In his review of the 1978 Canada–U.S. Water Quality Agreement, Mr. Ken Oakley, Director of the Great Lakes Regional Office, International Joint Commission, discussed its purpose policy, specific and general objectives, and programs with respect to municipal and industrial discharges, pollution from agriculture and land uses, airborn pollutants, eutrophication, persistent toxic substances, and surveillance and monitoring.

National Section Meetings. Commissioner Ver Duin, Chairman of the U.S. Section, reported on four topics discussed at the U.S. Section meeting: changes in fish health services by the USFWS, reduction in federal funds for anadromous fish programs, the Indian fishery, and the official announcement by the FDA that the tolerance level for PCBs in fish would be lowered from 5 to 2 ppm.

Commissioner Johnson, Chairman of the Canadian Section, summarized the proceedings of the Canadian Section meeting. The Canadian Section was pleased to hear that the Commission was producing a 25th anniversary information package detailing its progress and aspirations, and urged that money and staff be made available for its preparation. They were pleased with the proposed Commission letter to the Department of External Affairs supporting nondestructive testing of the St. Marys River compensating works and that the Ontario Ministry of Natural Resources will look into the possibility of using dredge spoils from the St. Marys River to build an artificial reef for whitefish. In light of recent decisions in the United States with respect to native fisheries and its repercussions on management, members of the Canadian Section expressed the intention to brief themselves on Canadian Indian rights. The Canadian Section, concerned over the winter navigation program, urged the Commission to assume a state of preparedness in case it becomes necessary for the Commission to take action. In addition, the group discussed barrier dam construction for sea lamprey control and introduced Mr. Mac McKenzie, the newly hired manager for the Ontario Council of Commercial Fisheries.

Administrative and Executive Decisions. Chairman Loftus summarized executive action which included responses to various committee recommendations.

The Commission:

General

Approved the programs and budgets for Sea Lamprey Control and Research and tentative budgets for Administration and General Research for fiscal years 1980 and 1981.

Made funds available for hiring replacement staff which will allow OMNR employees to participate more actively in the development of the Strategic Great Lakes Fishery Management Plan.

Referred a Great Lakes Basin Commission resolution on the management of hazardous and toxic substances to developers of the Strategic Great Lakes Fishery Management Plan.

Appointed an ad hoc committee to develop an information package in commemoration of the Commission's 25th anniversary.

Will send letters to the U.S. State Department and the Canadian Department of External Affairs urging that the Canadian Department of Public Works proceed on nondestructive testing of the Lake Superior compensating works (St. Marys Rapids).

Will encourage National Marine Fisheries Service to undertake a study in the Great Lakes on PCBs which would be similar in nature to "Report on the Chance of U.S. Sea Food Consumers Exceeding the Current Acceptable Daily Intake of Mercury and Recommended Regulatory Controls" which was a key factor in the legal decision to increase the acceptable residue level of mercury in fish from 0.5 to 1.0 ppm.

Will review the terms of reference of all the Commission committees.

Publications

Initiated a review of the present system of editing technical report manuscripts to facilitate speedier publication.

Approved publication of "Illustrated Field Guide for Classification of Sea Lamprey Attack Marks on Great Lakes Lake Trout" by E. L. King, Jr. and T. A. Edsall.

Will publish the Lake Michigan Committee's final report of the Chub Technical Committee in the Technical Report Series.

Sea Lamprey Control and Research

Determined that in spite of the Department of Fisheries and Oceans freeze on capital expenditures, barrier dam construction in Canada may be able to proceed with special dispensation from the Deputy Minister, and requested from its Canadian sea lamprey control agent an outline of 1979–1981 barrier dam plans as well as discussion of anticipated problems.

Approved funding for construction of a barrier dam on the Middle River, Wisconsin.

Hired a formulations chemist to examine current techniques of lampricide application and to define problems and processes associated with development of bottom lampricides.

Developed a policy for amending the Memorandum of Agreement between the Commission and its Canadian and U.S. agents.

Contracted with the USFWS National Fishery Research Laboratory for research into the effect of environmental conditions on the activity of lampricides and their effects on nontarget fish species.

Responses to other sea lamprey related recommendations which emanated from lake committees will be found under responses to Lake Committees.

Fisheries Management

Requested Drs. Kutkuhn and Hartman (USFWS), authors of "Inventory of Great Lakes Fish Stock Assessment Needs," to append a synopsis of state and provincial comments on the subject document.

Will review Dr. Gleason's (Lake Superior State College) progress and plans in development of hatchery techniques in production of whitefish to 100 mm in length, and consider for possible funding at the next executive meeting.

Other fishery management items may be found under responses to Lake Committee recommendations.

Scientific Advisory Committee (SAC)

Charged the SAC to determine information needs and methods of acquiring and packaging recreational fishing statistics.

Refered to SAC the question of Commission sponsorship of a study to determine current values of the Great Lakes fishery.

Hired Dr. Dan Talhelm (Michigan State University) to develop a "state of the knowledge" (status report) of Great Lakes commercial and recreational fishery economic values.

Looked with favor on recommendations for extension of Great Lakes Ecosystem Restoration and Rehabilitation activities, and requested two Commissioners (with staff support) to work with GLERR components to develop specific terms of reference.

Decided to publish the GLERR report in the technical report series.

Looked forward to the SAC's further refinement of its report on the adequacy of contaminant research and congratulated Messrs. Johnson, Kevern, and Cairns on an auspicious beginning.

Lake Committees and Council of Lake Committees

The Scientific Advisory Committee and each Lake Committee had been asked, "Is the Commission assuming an adequate role in the development and coordination of the Great Lakes fisheries research programs?" A variety of responses and suggestions were received. The Commission requested advice of the Scientific Advisory Committee on implementation of Lake Committee ideas, encouraged Lake Committees to proceed with internal assignments to meet their own needs, and charged the Strategic Great Lakes Fishery Management Plan Steering Committee to incorporate research needs in relation to accomplishing goals and objectives in the plan.

Lake Superior Committee

The Lake Superior Committee recommended that the Commission take a stronger lead in developing more efficient means of sea lamprey control which will meet the challenge of changing attitudes and new problems. The commission responded that it is sponsoring the Sea Lamprey International Symposium in 1979 which will provide a forum for 90–100 experts to address the sea lamprey problem in the Great Lakes. The Commission expects to receive recommendations which will improve current approaches to control as well as innovative directions to pursue.

Lake Michigan Committee

In response to the Lake Michigan Commmittee recommendation that the Commission accelerate efforts to develop better bottom toxicants for large rivers and estuarine systems such as the St. Marys River, and anticipated problems in the Fox River system, the Commission related that efforts to improve bottom lampricides were underway with a formulations chemist and Hammond Bay Biological Station personnel cooperating to develop improved formulations.

Both the Lake Michigan and Lake Huron Committees urged the Commission to develop an acceptable sea lamprey sterilant as an adjunct to the ongoing control program. The Commission responded that it is aware that the sterile male technique to control sea lamprey has been demonstrated successfully except that there in no "approved" sterilant available for wide scale use. Bisazir, the compound used experimentally, may not be acceptable for regular field use. Investigations have also been conducted on the possibility of using immunosterilization techniques, which stimulated the Commission to request an in-depth report on the state of the art and status of sterilants.

The Lake Michigan Committee encouraged the Commission to press for a meeting of interested agencies to assess and develop feasible methods of sea lamprey control for the newly accessible Fox River system (Green Bay, Wisconsin). The Commission reported that the U.S. Fish and Wildlife Service, Corps of Engineers, Wisconsin Department of Natural Resources, and the Fox Valley Water Quality Planning Agency met in 1979 to discuss the problem of preventing sea lamprey movement into the watershed. The meeting recommended that the "USFWS consider a feasibility study for sea lamprey control on the Fox River, with emphasis on limiting adult migration by closure or regulation of the navigation locks or by some other means."

Both the Lake Michigan and Lake Huron Committees recommended that the Commission discontinue the use of electric assessment weirs and encourage the agents to use portable assessment traps which will greatly broaden the base of the assessment program. The Commission approved the discontinuation of electric assessment barriers and approved the control agents' expanded use of portable assessment traps which can be used on all the Great Lakes.

Lake Huron Committee

Two recommendations of the Lake Huron Committee were similar to those of the Lake Michigan Committee; responses are listed under the Lake Michigan Committee.

Lake Erie Committee

The Lake Erie Committee recommended that the Commission increase sea lamprey assessment in Lake Erie in 1979 through 1981 and begin chemical treatment in 1982, if warranted. The Commission responded that it is aware that improving water quality in tributary streams to Lake Erie is increasing the spawning and nursery areas available to sea lamprey. The Commission's agents have increased survey efforts and the Commission will request them to intensify their efforts where possible, extend to Lake Erie the use of portable assessment traps which will provide counts and biological information on spawning runs to assess changes and provide baseline data if lampricide treatments are eventually scheduled for Lake Erie streams.

Lake Ontario Committee

The Lake Ontario Committee recommended that the Sea Lamprey Control Units and cooperating agencies intensify assessment in 1979, and the appropriate 1979 data be reported in advance of the November (1979) Interim Meeting to the ad hoc committee of Lake Ontario and Oneida Lake. In responding, the Commission declined to request program changes of its control units and cooperators at such a late date, "but did request that the appropriate 1979 data be made available early to the ad hoc committee which would be requested to reconvene in November. The Commission expected the committee to determine and recommend future assessment and control action to the Commission relative to Lake Ontario and Oneida Lake.

In response to the Lake Ontario recommendation that the Commission provide a compendium of available knowledge and criteria for the construction of sea lamprey control barrier dams, the Commission will defer action on this request until after the Sea Lamprey International Symposium since that topic will be addressed there. Further, the Commission is awaiting results on barrier dam research. With symposium recommendations and research results in hand, the Commission will consider appointment of a small group to develop the compendium and consolidate the appropriate knowledge and criteria for construction of sea lamprey barrier dams.

The Lake Ontario Committee recommended that the Commission contract to determine economic values of Great Lakes sport and commercial fisheries. The Commission responded that it has already contracted a short term study to assemble existing data and is considering, as a Great Lakes Ecosystem Restoration and Rehabilitation followup, the scope and directions appropriate to a study of greater depth to assess values of Great Lakes fisheries and aquatic communities and strategies for which this information is vital.

The Lake Ontario Committee recommended and the Council of Lake Committees endorsed a program related to the Stock Concept Symposium (STOCS) to determine the best lake trout stocks for each of the Great Lakes. In responding, the Commission recognized this as an important target for which STOCS will help establish the scientific rationale and suggest methodology.

The Lake Ontario Committee drew to the Commission's attention the proposed American Eel Workshop and the possibility of a request for financial support. The Commission agreed to provide the funding upon receipt of a formal request.

The Lake Ontario Committee requested, and the Council of Lake Committees endorsed, that the commission require the minutes of annual, interim, and lake committee meetings to be printed and distributed within 90 days. The Commission stated that it would do its best toward timely publication of reports. Further, the Commission requested each lake committee chairman to supply a biologist to attend the lake committee meeting for the purpose of taking notes and producing minutes from the notes and recording tape made available by the Secretariat. The Secretariat will circulate the draft minutes for review and package the minutes for distribution. The Commission will pay travel expenses of one, and perhaps two, such persons to each lake committee meeting.

Council of Lake Committees

The Council of Lake Committees recommended that a work group develop a protocol for using coded wire tags and evaluating experimental programs. In response, the Commission asked the Council of Lake Committees to develop terms of reference and membership for such a committee, and recommended that the board of Technical Experts (BOTE) be represented on the committee.

The Council of Lake Committees requested the Commission to examine the effects of contaminants on fish and on people. The Commission responded that it is attempting to obtain funds for fishery agencies' contaminant monitoring programs, and a meshing of information for both IJC and Commission use. The BOTE is considering the effect of contaminants on fish populations which may constrain rehabilitative efforts. A workshop is planned to address the question of measuring ecosystem health. The Strategic Great Lakes Fisheries Management Plan will address strategies for dealing with the problems. Further, effects on people is implied in the new Commission requests to the National Marine Fisheries Service, in consultation with Fisheries and Oceans Canada, to critically examine the current PCB guidelines, and the rationale and methodology behind guideline setting.

Other Business. Mr. Ken Andrews (Tribal Council member of the Lake Superior Band of Chippewa, Executive Director the Great Lakes Inter-tribal Council), delivered "a message from the traditional keeper of the lakes." Mr. Andrews requested that the Commission maintain contact with the native community and that the Commission recommend appointment to the Commission of representatives of the Indian tribes surrounding the Great Lakes. In responding, Vice-chairman Herbst noted that he will ask the Commission staff to review communications and liaison status with the Indian community, and report back to the Commission any recommendations for strengthening that communication. With regard to the appointment of Indian representatives to the Commission, he explained that the Commissioners cannot recommend appointees but would refer Mr. Andrews request to those who make the appointments, the U.S. President and the Canadian Privy Council.

Adjournment. The Chairman informed the delegates that the next annual meeting will be held in Duluth, Minnesota on June 3–5, 1980.

There being no further business, Chairman Loftus adjourned the meeting at 1230 h, June 28, 1979.

INTERIM MEETING

PROCEEDINGS

The Great Lakes Fishery Commission's twenty-fourth Interim Meeting was convened in Ann Arbor, Michigan, on November 27–28, 1979, to review programs, budgets, and achievements of the preceding six months, and to consider activities of its various committees.

Sea Lamprey Control and Research. Commissioner Lawrence reported on the status of current and proposed barrier dam construction projects.

Reports on 1979 sea lamprey wounding rates on lake trout, salmon and whitefish were presented on Lakes Superior, Michigan, Huron, and Ontario.

Progress reports on sea lamprey control operations in the United States and Canada for 1979 were presented by the agents. Problem areas such as the St. Louis River, Fox River, and the St. Marys River, and the effect of chemicals on invertebrates such as *Hexagenia* spp. continue to be of concern.

Also presented were reports covering sea lamprey research at Hammond Bay Biological Station (hormonal sterilization, predator-prey ratios, resistance to lampricide), Monell Chemical Senses Center (chemical attractants), and La Crosse National Fishery Research Laboratory (registration of lampricides and sterilant bisazir, TFM formulations, TFM soil-binding).

The Sea Lamprey International Symposium had been held as scheduled on July 29—August 8, 1979 at Marquette, Michigan. Much hitherto unavailable data will be published, and SLIS conclusions and recommendations will give the GLFC directions to consider in the improvement of sea lamprey control and enhancement of fish stocks. A better appreciation of sea lamprey control and its importance has been fostered in the minds of scientists here and abroad who will now consider control implications as they conduct their research.

The Commission considered programs and budgets for fiscal years 1980 and 1981. Appropriations for fiscal year 1980 are as follows:

	U.S.	Canada	Total
Sea Lamprey Control and Research	$3,827,200	$1,719,400	$5,546,600
Administration and General Research	181,500	181,500	363,000
Total	$4,008,700	$1,900,900	$5,909,600

Requested appropriations for fiscal year 1981 are as follows:

	U.S.	Canada	Total
Sea Lamprey Control and Research	$4,194,700	$1,884,600	$6,079,300
Administration and General Research	202,300	202,300	404,600
Total	$4,397,000	$2,086,900	$6,483,900

The sea lamprey control and research program includes lampricide treatments on Lakes Superior, Michigan, Huron, and Ontario, the operation of electric weirs on Lake Huron, the expanded use of portable assessment traps on Great Lakes tributaries, sea lamprey stream surveys on all the Great Lakes including portions of the Finger Lakes–Oswego River system in New York, research at Hammond Bay Biological Station and National Fishery Research Laboratory, La Crosse, and a continuation of the barrier dam construction program.

For fiscal year 1981 a budget was submitted to the State Department which calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys for larval sea lampreys, use of portable assessment traps on Great Lakes tributaries, research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, and continuation of barrier dam construction on selected streams to prevent sea lamprey access to problem areas and reducing application costs and the use of expensive lampricides.

Fish Management and Research. The following groups reported on progress in discharging their respective mandates: Steering Committee for the Stock Concept Symposium (STOCS), organizers of the Ontario Ministry of Natural Resources/Great Lakes Fishery Commission-organized American Eel Workshop, and the Steering Committee for drafting the Strategic Great Lakes Fishery Management Plan (SGLFMP). STOCS is scheduled to be held in Alliston, Ontario, on the 29th of September through 9 October 1980, and the American Eel Workshop will be held 5 through 7 February 1980 in Toronto, Ontario. The SGLFMP Steering Committee, having identified common goals of Great Lakes fish management agencies, and issues or impediments to realization of those goals, now plans to develop strategies for resolution of those issues, and submit the Plan (goals, issues, strategies) for Great Lakes fish management agencies' review and, hopefully, adoption.

The following committees of the Great Lakes Fishery Commission gave brief reports on their activities and recommendations: Lake Ontario Committee (lake trout eggs discovered near Henderson Harbor); Lake Erie Committee (Lake Erie Fish Community Workshop, Lake St. Clair research and management coordination meeting, and Standing Technical Committee meetings on interagency management of Lake Erie yellow perch and walleye stocks); Lake Michigan Committee (interagency coho salmon tagging study); Lake Superior committee; and the Scientific Advisory Committee, which among other items, recommended that a workshop be convened to examine in a pragmatic and scientifically sound way how determination of health and well-being of aquatic communities, for example in the presence of potential contaminants, should be carried out in the Great Lakes system.

The Lake Superior Advisory Committee (LSAC) made recommendations to the U.S. Section of the Commission on Lake Superior fish management (St. Louis River management opportunities, need for interagency approach to siscowet and pink salmon, suggested strains of lake trout broodstock for Iron River National Fish Hatchery, propagation of herring and whitefish), representation and recruitment of LSAC members, and the appropriateness and desirability of state management authority in regulating Great Lakes fisheries.

The Commission was apprised of the U.S. Fish and Wildlife Service's progress in construction of the Iron River National Fish Hatchery, a facility which will greatly enhance lake trout rehabilitation efforts in the Great Lakes.

One of the Commission's major objectives is lake trout rehabilitation, an objective whose realization is subject to stresses such as habitat quality, interaction with introduced species, and exploitation. For this reason the Commission provided a forum for discussion of the Indian fishery and its impact on Great Lakes fishery management. Elmer Nitschke (Field Solicitor, Department of the Interior) discussed treaty history in the Great Lakes area and responsibilities of the Department of the Interior. Howard Tanner (Director, Michigan Department of Natural Resources) reviewed his agency's concerns that its success in rehabilitation, achieved through water quality improvements, sea lamprey control and restoration of a predator-prey balance through stocking and control of harvest, may be compromised if its authority to allocate harvest is eroded through court action. Joseph Kutkuhn (Director, USFWS Great Lakes Fishery Laboratory) discussed the contents of a "Data Inventory" which was just produced by the Bureau of Indian Affairs, Michigan Department of Natural Resources, and USFWS which identifies resources of interest in each of the three Upper Great Lakes (lake trout, lake whitefish, bloater chub, lake herring), determines how these perform (growth, mortality, reproduction, etc.), and synthesizes this information in order to estimate what is available for harvest. Also described were management options compatible with the objectives of self-sustaining stocks, a put-and-take fishery, and an intermediate condition. Bruce Green (Attorney, Native American

Rights Fund) discussed recent litigation with regard to the 1836 treaty ceding tribal territory, and current Indian fishing practices and regulations.

Administrative and Executive Actions. In the six months preceding and including the Interim Meeting, the Great Lakes Fishery Commission has:

1) Developed projects such as symposia, the Great Lakes Ecosystem Rehabilitation (GLER) document, and the Strategic Great Lakes Fishery Management Plan (SGLFMP)

a) held the Sea Lamprey International Symposium at Marquette, Michigan in the summer of 1979.

b) provided up to $5,000 to pay travel expenses of European and east coast experts without agency support in order that they may participate in the American Eel Workshop to be held February 1980 in Ontario.

c) funded ($59,000) GLER Phase II, with the purpose of fostering rehabilitation of Great Lakes ecosystems, and encouraged the consideration of new approaches for describing the socio-economics of the Great Lakes fishery.

d) offered to entertain a proposal from Dr. N. Kevern (Michigan State University), Mr. V. Cairns (DFO) and Dr. M. G. Johnson (DFO) for a workshop on how best to determine the health and well-being of aquatic communities.

2) Published

a) accepted the following for publication in the Technical Report Series

No. 39. Minimum Size Limits for Yellow Perch in Western Lake Erie, by J. Kutkuhn, W. Hartman, S. Nepszy, and R. Scholl.

Parasitic Fauna of Commercially Important and Associated Fish Species from Lake Erie, by A. Dechtiar and S. Nepszy.

b) and published and distributed the following Technical Reports

No. 33. Distribution and Ecology of Lampreys in the Lower Peninsula of Michigan, 1957–75, by Robert H. Morman. April 1979. 59 pp.

No. 34. Effects of Granular 2′, 5-dichloro-4′-nitrosalicylanilide (Bayer 73) on Benthic Macroinvertebrates in a Lake Environment, by Phillip A. Gilderhus. May 1979. Pages 1–5

No. 34. Efficacy of Antimycin for Control of Larval Sea Lampreys (*Petromyzon marinus*) in lentic habitats, by Philip A. Gilderhus. May 1979. Pages 6–17

No. 35. Variations in Growth, Age at Transformation, and Sex Ratio of Sea Lampreys Reestablished in Chemically Treated Tributaries of the Upper Great Lakes, by Harold A. Purvis. May 1979. 36 pp.

c) distributed for fish management agencies' comments

Mimeo. Report 79–1. Current Estimates of Great Lakes Fisheries Values: 1979 Status Report, by D. Talhelm, R. Bishop, K. Cox, N. Smith, D. Steinnes, and A. Tuomi. Great Lakes Fishery Commission, Ann Arbor, MI. 17 pp.

3) Improved sea lamprey control and assessment

a) initiated audit of both U.S. and Canadian sea lamprey control and research operations (program, staffing, legalities, budget) by inviting representatives on the audit team from USFWS, DFO, OMNR, a state through the Council of Lake Committees, and the Commission. Pat Chamut, DFO, will chair and Aarne Lamsa will represent the Commission.

b) assisted the Lake Champlain Fish and Wildlife Management Cooperative with their assessment of Lake Champlain ammocete populations, by providing granular Bayer 73 and advice on application.

c) requested the U.S. Fish and Wildlife Service to evaluate the seriousness of the effects of lampricides on aquatic invertebrate populations, particularly burrowing mayflies, and on the basis of early findings, initiate a program to alleviate problems identified.

4) Sponsored research

a) instructed the Secretariat to develop a new procedure for handling unsolicited requests for subsidization of research, publications, workshops and symposia. The process will include a Scientific Advisory Committee evaluation prior to the Interim Meeting, at which time the Commisison will decide which projects are to be funded.

b) accepted W. D. Youngs' report, "Evaluation of Barrier Dams to Spawning Sea Lamprey Migration," as guidance for design of barrier dams.

c) contracted with chemist R. Monroe, for development of new Bayer 73 formulations for bottom release.

d) funded ($35,000 for each of two years) USFWS La Crosse National Fishery Research Laboratory research proposal regarding effects of environmental conditions on the activity of lampricides.

e) funded ($33,000) Brussard's (Cornell U.) and Spangler's (U. of Minnesota) research on the biogenetics of sea lamprey populations.

f) funded ($6,000) Nancy Auer's (U. of Michigan) preparation of a description manual of Great Lakes larval fishes.

g) funded ($6,000) Koonce (Case Western Reserve U.) and Shuter's (OMNR) further development of a stochastic model of fish populations.

5) Interacted with its committees

a) is reviewing terms of reference for the Lake Committees, Council of Lake Committees, Fish Disease Control Committee, and the Scientific Advisory Committee for approval.

b) instructed the Great Lakes Fish Disease Control Committee to review recent revisions to the American Fisheries Society's fish disease manual and determine whether changes are required in the Commission's fish disease control model.

6) Initiated public relations activities, and reacted to changes in staff

a) secured the services of OMNR, USFWS, and DFO personnel in publicizing Interim and Annual Meetings of the Commission.

b) in honor of the Commission's 25th anniversary began development of an updated informational brochure describing the Commission's program and accomplishments, offered to co-sponsor with the IJC, OMNR, OME and DFO a television documentary on the Great Lakes, and is considering other steps to provide information on the Commission's role.

c) accepted the resignation of Bill Maxon, the Commission's Chief Administrative Officer, who is now employed by the USFWS in Washington, D.C.

d) are in the process of hiring a senior scientist for fishery resources who will work closely with cooperators on Commission activities as a resource person and facilitator.

7) Communicated with external entities

a) encouraged U.S. and Canadian federal governments in modification of the U.S. and Canadian Hunting and Fishing Surveys in order that they may be made more relevant to the Great Lakes.

b) responded to the Sport Fishing Institute's urging of the Commission to collect baseline economic data describing the economic activity of recreational fishermen around the Great Lakes, by describing the Commission's "double-barreled" approach which incorporates short term (the Talhelm report) and long term (GLER, SGLFMP) answers to economic questions.

c) met with the International Joint Commission (IJC) on 7 September for discussion of several topics of mutual interest such as the comparative thrust and roles of the Commission, the Strategic Great Lakes Fishery Management Plan and the Feasibility Study on Great Lakes Ecosystem Rehabilitation. Discussion of topics of concern led to action items which IJC is considering:

i) The Commission asked why there was not direct fishery representation on the IJC's Great Lakes Levels Advisory Board and what could be done to expand the membership. (The Commission will recommend to appointing bodies that persons with fishery expertise be appointed to the Lake Levels Advisory Board.)

ii) The Commission asked IJC for their reaction to the Commission recommending to governments a reference to IJC under the Boundary Waters Treaty to examine the effects of airborne pollutants. (The Commission will write to the U.S. and Canadian governments regarding its concern that approaches to atmospheric pollution are too often restricted to acid rain, neglecting for example transport of toxics, and also too often dwell on the atmospheric aspect to the exclusion of subsequent water pollution. Given the urgency of the problem the Commission will recommend that a reference on atmospheric pollution be given to the IJC under the Boundary Waters Act pending a binational air treaty.)

iii) The Commission requested an IJC-sponsored review of state-provincial and federal toxic substances legislation and its implementation in terms of potential vs. real effectiveness in meeting the aims of the 1978 Water Quality Agreement, particularly Annex 12.

iv) The Commission recommended to IJC a review of surveillance programs with the suggestion that the two Commissions and their cooperators were joint clients of the data produced. A second thrust of the review would involve strategies to evaluate ecosystem health.

v) The Commission asked IJC if it wished to write jointly to the Canadian government urging financial commitment to the non-destructive testing of the Lake Superior compensating works. This is in connection with minimum flows over the St. Marys Rapids to protect fish food organisms and the fishery, and the construction of remedial works. (The Commission will send a letter on behalf of both Commissions restating the need for remedial works on the St. Marys Rapids.)

vi) The above discussion led to IJC's request for an opinion from the Commission on the various water release plans from Lake Superior being considered. The Commission responded that it would not object to plan 77 provided that the timing and extent of critical low flow conditions in the rapids would not deteriorate aquatic habitat beyond that which would have occurred under alternate plans. IJC opted for plan 77.

Adjournment. After announcing that the 1980 Annual Meeting would be convened in Duluth, Minnesota, 3–5 June 1980, and that the 1980 Interim Meeting was scheduled for 2–3 December 1980 in Toronto, Ontario, the Chairman adjourned the meeting.

SUMMARY OF MANAGEMENT AND RESEARCH[1]

SEA LAMPREY INTERNATIONAL SYMPOSIUM (SLIS)

The Sea Lamprey International Symposium (SLIS) was the fifth in a series of symposia sponsored by the Great Lakes Fishery Commission. The sea lamprey control program, directed by the Commission, is one of the largest and most intensive efforts to control a vertebrate predator ever attempted.

In the belief that every program needs occasional close examination and can be improved, the Commission appointed a steering committee in 1975 to plan and implement a sea lamprey symposium. The main objectives of SLIS were threefold. First was the organization, consolidation, and publication of information on sea lamprey control and associated research. Second was to assemble experts in specialty areas involving lampreys to exchange knowledge and ideas to bring everyone to a common plateau of understanding, and finally to provide a forum for the participating scientists to develop new imaginative initiatives and stimulate new vigor in dealing with the effort to control sea lamprey predation and understand fish-lamprey interactions. With the firm conviction that the three objectives could be achieved and that many informative and valuable recommendations would be forth-coming, SLIS was held at Northern Michigan University, Marquette, Michigan, from July 30 to August 8, 1979.

The symposium was designed to be a workshop-type conference, and every attempt was made to provide a comfortable, informal atmosphere conducive to free interchange of information. Eighty-four participants from Australia, Canada, Denmark, England, Finland, Malaysia, Poland, Scotland, Sweden, and the United States assembled for 10 days and worked long and hard to ensure that the objectives of SLIS were met.

The proceddings of the symposium will be published in 1980 as a special issue of the *Canadian Journal of Fisheries and Aquatic Sciences*. Bernard R. Smith chaired the symposium steering committee.

[1]Commercial fish landings by lake and species are given in Tables 1–5 for 1979.

STRATEGIC GREAT LAKES FISHERY MANAGEMENT PLAN

In February 1979 the Committee of the Whole, composed of senior administrators from Great Lakes state, provincial, and federal resource agencies, met in Detroit, Michigan to appoint and charge a permanent steering committee, which would have responsibility for drafting a Strategic Fishery Management Plan for the Great Lakes (SGLFMP). The steering committee would consist of representatives from each state, the U.S. Fish and Wildlife Service, National Marine Fisheries Service, the Province of Ontario, and the Canadian Department of Fisheries and Oceans. The steering committee would then elect from each country co-chairmen, who would assign work groups and oversee the development of a plan.

At their first meeting the steering committee elected Dr. A. H. Lawrie and Mr. William Pearce co-chairmen. The steering committee and two work groups met frequently during 1979. One work group was assigned responsibility to develop goals and objectives, and the other was to determine major issues affecting fishery resources. Eventually, the work groups would be merged to develop strategic procedures. Both work groups presented progress reports to the Committee of the Whole at the 1979 interim meeting in Ann Arbor.

REPORTS FROM LAKE COMMITTEES

Research and management aimed at enhancing the productivity of the Great Lakes fisheries continues to be coordinated through the lake committees, umbrella organizations under the aegis of the Commission. The lake committees provide a forum for exchange of data and coordination of fishery programs on stocks of common concern within the Convention Area. Because of an increasing investment in fishery management programs and a rapid growth in the value of the fisheries,[2] the level of participation and involvement in lake committee affairs by the eight Great Lakes states, the Province of Ontario and the two federal governments has been accelerating.

New lake committee initiatives in 1979 included the following: an ad hoc committee was formed to identify stocks of common concern, assess current programs, and develop fishery management schemes for Lake St. Clair and the connecting waters of the St. Clair and Detroit Rivers; an Atlantic Salmon Work Group was organized to investigate the feasibility of reintroducing Atlantic salmon to Lake Ontario; an interagency task group was established to develop a management program for muskellunge in the upper St. Lawrence River; a Fish

[2]In 1979 the total economic impact of the Great Lakes sport and commercial fisheries was estimated at $1.16 billion (Talhelm et al. Current Estimates of Great Lakes Fisheries Values: 1979 Status Report. Great Lakes Fisheries Commission).

Community Workshop for Lake Erie was held; and plans were made for an American Eel Conference (Lake Ontario) to be held in February 1980. Details concerning the lake committee actions on these new initiatives, as well as their actions on ongoing tasks, are recorded in minutes of the annual meetings of the respective committee. A review of the highlights of these activities by species follows.

Lake Trout

Extinction of lake trout stocks in Lakes Michigan and Huron and a severe reduction of Lake Superior stocks were primary factors leading to the formation of the Great Lakes Fishery Commission in 1956, and the rehabilitation and restoration of lake trout stocks continues to be a major goal of the Commission. Lake trout are now stocked in all five Great Lakes, and the fishery agencies concerned with these waters conduct programs coordinated through the Commission to assess and evaluate the rehabilitation efforts. For Canadian waters, lake trout are reared and stocked by the Province of Ontario. For U.S. waters, these activities are carried out primarily by the USFWS, although some states stock limited numbers of lake trout and the State of Michigan holds the major share of the brood stock. Rehabilitation commenced first in Lake Superior, and progress towards the original goal is advanced there in comparison to the other lakes. Lake trout do not mature until their fifth or sixth year, and it is apparent that sea lamprey abundance and fishing mortality must be closely controlled for rehabilitation to succeed.

Lake Superior

Increasing numbers of naturally reproduced lake trout are reported over large inshore areas in both Canada and the U.S. Near the Apostle Islands (Wisconsin) the protection afforded by a recently created fish refuge resulted in the largest number of native trout recorded since the pre-lamprey days. Other areas in Wisconsin, however, remain excessively fished and show little natural reproduction. In the most heavily stocked areas of Michigan native fish make up 22–25% of the catch—an improvement over the 8–11% reported in 1977. Native lake trout abundance has shown some improvement both inshore and offshore in Canadian waters.

Changes in fishing and stocking rates have caused some differences in the abundance of hatchery-reared lake trout. As a result of improved protection from the fisheries, hatchery stocks have doubled in the Apostle Island refuge area. On the other hand, removals by the Indian treaty fishery have led to a decline in lake trout abundance in several areas of Michigan. Lake trout mortality is excessive in lower Keweenaw Bay and in Whitefish Bay, both centers for treaty fishing in Michigan. Reduced stocking rates in some areas of Michigan have resulted in fewer

hatchery fish in the populations, but this decrease has been partly compensated for in some areas by increases in native trout.

Reports of improved spawning stocks in some areas of Lake Superior have been encouraging. Approximately 12,800 lake trout were estimated to have spawned on Gull Island Shoal in 1979, and most (88%) of these fish were of native origin; only 9,000 spawned on the shoal in 1978.

A program of mapping lake trout spawning reefs using SCUBA is underway in the Wisconsin waters of Lakes Superior and Michigan. Nine reefs were mapped in 1979. These maps will provide valuable information for selecting the most favorable stocking sites.

Sea lamprey wounding rates on lake trout were reported to be either stable and low or declining to low levels in almost all areas of Lake Superior during 1979. Michigan, Minnesota and Ontario noted the lowest wounding rates since sea lamprey control began in 1958, and Wisconsin reported low rates of from 2–4% for the last decade.

Lake Michigan. Lake trout have been planted in Lake Michigan since 1965, but no significant natural reproduction has yet occurred. Fishing mortality remains high in many areas. In southern Lake Michigan extensive angler fisheries have developed, and in the northern part lake trout are taken incidentally in the whitefish fisheries of Michigan and Wisconsin and in the Indian treaty fishery in Michigan. Hence, in many areas large brood stocks have not been developed, or those that were developed have been reduced by the fisheries.

Concern for Green Lake strain lake trout stocked offshore over the Milwaukee Reef in southern Lake Michigan was expressed due to the appearance of these fish in gill nets set for chubs. Green Lake strain lake trout originated from native stocks that spawned offshore in the southern basin, and it is thought that they may be genetically adapted for offshore spawning. Consideration will be given to establishing a refuge over part of the Milwaukee Reef.

Sea lamprey wounding rates were less than 5% for all size groups of lake trout in Lake Michigan. Wounding was highest (4.9%) in northern Wisconsin, but the 1979 figure declined by half from 1978, when sea lampreys from the Peshtigo River (treated in 1977) were yet abundant in these waters. Excluding northern Wisconsin, wounding rates remained low (less than 2%) in other areas of Lake Michigan.

Lake Huron. The Province of Ontario experimented with splake, a brook trout × lake trout cross, as an alternative to lake trout in Lake Huron. The advantage of splake over lake trout is that splake mature at an earlier age, and thus have a better chance of escaping attack by sea lamprey (which tend to prey on larger fish) before reaching maturity. In 1979 the province stocked substantial numbers of splake, which had been backcrossed to lake trout, in southern Georgian Bay. Survival and growth of the backcrosses were exceptional, and after only one year in the lake these fish were prominent in the angler and assessment catches.

Two stocks of native lake trout persisted in small numbers in Georgian Bay after the species became extinct in the rest of Lake Huron in 1940s and 50s, and one of these, the McGregor Bay stock, is being enhanced with the stocking of hatchery reared fish spawned from the parental stock. McGregor Bay lake trout are potentially important in the rehabilitation program, and the enhancement project is aimed at maintaining this genetic strain.

Stocking rates of approximately one million lake trout per year in Michigan waters since 1973 have produced substantial standing stocks. Growth and early survival of lake trout has been good except in northern waters where the Indian treaty fishery reported catching 0.5 million pounds between the fall of 1978 and the spring of 1979. Survival rates for the 1973–74 year-classes in this area were estimated to be only 1–2% after the treaty fishing ended.

In comparison to sea lamprey wounding rates in Lakes Superior and Michigan, the rates in Lake Huron's main basin are relatively high. Lake trout in the smallest reference size group experienced rates of 3.1–8.6%, depending on lake area. Rates tended to be higher in the north, and were very high (14.6%) on residual stocks in the treaty fishing area. Because stocking began recently in Lake Huron, the higher rates may be a result of a high predator-to-prey ratio, rather than exceptionally large numbers of lampreys.

Lake Erie. Production stocking of hatchery reared lake trout in Lake Erie began in 1975 in New York and Pennsylvania waters, but stocking has been much less intense than in the other Great Lakes. Recoveries of large lake trout have been sparse to date.

Lake Ontario. The rehabilitation program is well underway in Lake Ontario, where production stocking began in New York waters in 1974 and in Ontario waters in 1976. Lake trout grow more rapidly and reach maturity sooner in the lower lakes, most likely due to the longer growing season; spawning has already been observed near Snowshoe Bay in New York waters. The following four strains of lake trout have been stocked in New York waters: Lake Superior; Clearwater Lake, Manitoba; and Seneca Lake, New York. Preliminary results suggest that the Seneca strain survives best, and that the Clearwater Lake strain inhabits warmer waters.

Agency biologists are concerned with an anatomical anomaly in the testes of mature lake trout taken from Lake Ontario. More than half of the fish sampled exhibited constrictions of the testes, and weights of constricted testes averaged 35% less than those of normal fish. Causes for this abnormality are unknown. Lake trout from the upper lakes will be examined for comparison.

Sea lamprey wounding rates on lake trout appear to be higher in the eastern basin of Lake Ontario than in west and central areas, but these differences may not be significant. In comparison to Lakes Superior and Michigan, the wounding rates, particularly in the eastern basin, are high and are cause for concern. Survival rates for larger lake trout in New York waters are not high enough to allow development of large brood stocks, and sea lamprey predation could be a major factor. However, the trout are not yet abundant, and wounding rates may decline as additional young fish are planted and they recruit to the adult stocks.

Whitefish

In the upper Great Lakes whitefish are the most valuable of the commercial species, and management agencies are very concerned with the conservation and improvement of the stocks. Whitefish in all three upper lakes benefited greatly from the sea lamprey control program, because unchecked lamprey populations were destroying whitefish brood stocks.

Commercial landings of whitefish from Lake Superior have been very stable, averaging about one million pounds per year over the last decade. Ontario accounts for one-third of the lakewide catch, and since 1977 the Canadian fishery has been operating on a quota system, which also incorporates lake trout quotas. When the quota of either whitefish or lake trout is taken from an area, the fishery for both species is closed.

Northern Lake Michigan continues to be the center for whitefish production in the Great Lakes. The catch in recent years has fluctuated between 3 and 4 million pounds; approximately two-thirds of the total are harvested in Michigan.

Whitefish landings from Lake Huron have generally been increasing since the late 1960s, and have averaged about 2 million pounds since 1977. A major share of the production is taken by the main-basin Canadian fishery, which expanded abruptly following recruitment into the catch of the very strong 1975 year-class. The 1975 year-class was reported as strong throughout the main basin, as was the 1977 year-class, which is beginning to recruit to the fishery. Recruitment in southern Georgian Bay and in the North Channel has improved as a result of sea lamprey control that began in the late 1960s. The whitefish fishery in Michigan is concentrated in the north, and landings have increased gradually over the decade.

Whitefish in Lake Erie have been scarce for more than 20 years, and a recovery of the stocks is not foreseen in the near future. Small but increasing numbers of young-of-the-year whitefish were reported in the eastern basin, and spawning populations were located near Kelly Island in the western basin and off Presque Isle in Pennsylvania waters.

There has been no observable trend in whitefish abundance in Lake Ontario. Stocks declined to near insignificance in the late 1960s. The effects of the first sea lamprey treatments in 1971–72 may help recovery, but the stocks are so severely depressed that rehabilitation may require many years.

Chubs

Abundance and production of chubs have changed markedly in each of the upper Great Lakes in recent years. Chubs, a complex of several closely associated species, are important commercially and were also a main food source for native lake trout before the invasion and proliferation of smelt and alewife. In the lower lakes chubs have been commercially extinct for many years.

In the U.S. waters of Lake Superior chubs appear to be declining, and their future is uncertain. Landings increased in the late 1950s due to improved markets, but the higher catches do not appear to be sustainable. The Canadian fishery by contrast is considered underdeveloped, and stocks there are considered stable.

Lake Michigan has traditionally been a center for chub production in the Great Lakes, but the fishery has been greatly depressed by declines in abundance of chubs and by diminished marketability of fish from southern waters due to increases in contaminants, especially dieldrin. Chub stocks declined throughout the late 1960s and early 1970s, apparently because of over-fishing. The lake's Chub Technical Committee (disbanded in 1979) recommended severe restrictions on catch in 1974, and state agencies allowed only assessment or quota fishing after 1975. Restrictions on commercial fishing proved to be very beneficial to the chub stocks, which responded with improved adult abundance and the first substantial year-classes in 1978 and 1979. In fact, these year-classes were estimated to be 5.3 times larger than any of the other year classes in the 1967–77 sampling period.

The Lake Michigan chub fisheries are now regulated by quota except for the Indian treaty fishery in Michigan waters. Quotas for the Wisconsin fishery were increased in 1979 as the availability of chubs improved. In Michigan waters south of Holland the 0.3 ppm tolerance limit on dieldrin established by the U.S. Food and Drug Administration has prevented opening of the fishery because many of the larger chubs have tissue concentrations of dieldrin that exceed the tolerance limit.

Chubs declined severely in Lake Huron's main basin ater a period of intensified fishing in the late 1950s and early 1960s. Michigan closed its chub fishery in 1970, and the Canadian fishery shifted to Georgian Bay in the early 1970s. Recovery of the main basin chub stocks proceeded very slowly until stronger year-classes were produced in 1977–78. These year-classes are cause for optimism, but renewed chub fishing in Canadian waters of the main basin has begun before the stocks have had an adequate time to recover.

Intensification of the Georgian Bay chub fishery began in 1970, and through 1976, landings remained at approximately 600,000 pounds. However, the yield was not sustainable and the southern stocks collapsed. Central Georgian Bay stocks also declined with intensified fishing, but recent improvements in recruitment have spared the resource.

Pink Salmon

Inadvertently stocked in Lake Superior in 1956, pink salmon have increased greatly in that lake and have spread to the remaining Great Lakes. Their presence is observed only when they ascend streams to spawn in odd-numbered years. Fishery agencies reported the largest runs to date in Lake Superior. In Lake Huron spawning runs were reported in streams along the north shore of the main basin, the western North Channel, and the south shore of Manitoulin Island. Spawning runs in Lake Erie were verified from Long Point Bay and from Pennsylvania. Lake Ontario spawning runs were also noted, so that the Great Lakes have been completely colonized. Except for insignificant angler fisheries, pink salmon are not fished or otherwise utilized.

Smelt

Introduced into the Lake Michigan watershed in 1912, smelt have become one of the dominant species in the Great Lakes. Smelt are fished commercially in Lakes Superior and Michigan, primarily during the spawning run. Lake Erie, however, holds by far the largest smelt fishery on any of the lakes. Except for Lake Erie the commercial smelt fisheries are nominal in relation to the productivity of the stocks.

Smelt are very important in the food chain of cold water fishes such as trout and salmon, and for this reason they are monitored by the fishery agencies. In Lake Michigan smelt abundance has been very stable over the 7-year sampling period; stocks are densest in the northern portion of the lake. Lake Huron smelt stocks have increased gradually during the 1973–79 assessment period, and the outlook is for continued high abundance since good year-classes were reported in 1978–79. Smelt landings from Lake Erie declined 10% in 1979 after having reached a record level of 27 million pounds in 1978. Fluctuations in landings are, however, thought to mirror market conditions rather than stock availability. A cooperative assessment of forage fish stocks in Lake Ontario was begun by the USFWS and the NYDEC.

Alewife

The alewife is a major component of the forage fish stocks in the Great Lakes, excepting Lake Superior, which is apparently too cold for the species. Significant commercial fisheries are restricted to the Wisconsin waters of Lake Michigan, where landing were down to 25 million pounds in 1979 after two years of record catches (46 million pound average) in 1977–78. The decline in landings is not thought to be associated with alewife abundance, because assessment trawling indicated that stocks had not decreased in that area of Lake Michigan. However, alewives appear to be declining on the east shore south of Frankfort. Colder winters in the late 1970s may have resulted in lower than average over-winter survival of alewife in southern Lake Michigan. Nevertheless, alewives still dominate the total fish biomass in southern Lake Michigan, and are the principal food item for adult lake trout.

Surveys in Lake Huron suggested that alewives were more abundant in 1979, and that both the 1978 and 1979 year-classes were moderately strong. The stocks appear to be increasing gradually from a 1976 low. Surveys in the lower lakes have begun, and a time series for those stocks will be available in the future.

American Eel

Eel are of significance only in Lake Ontario where a commercial fishery, operating chiefly in Ontario waters, has found a European market. Landings have increased during the 1970s, and have peaked at roughly 0.5 million pounds in 1978–79. Agency biologists are concerned because fishing success (CPUE) and mean size of eels have declined as landings increased. The stocks may be over-fished at least from the viewpoint that a greater poundage could be harvested if smaller eels were allowed to grow into adult sizes before capture. Because of concern for this fishery, the Commission offered support for an Eel Conference to be held in February 1980. Attendees will include European biologists.

Walleye

Bacause of their importance as a preminum sport and commercial fish and as a fish predator in warm water fish communities, walleye are the focus of intensive enhancement schemes in several areas of the Great Lakes. Stocking programs in Green Bay, Lake Michigan and Saginaw Bay, Lake Huron have succeeded well in increasing populations. Both bays were historic centers for walleye production in the Great Lakes.

Connecting Waters. The connecting waters between Lakes Huron and Erie, consisting of the St. Clair River, Lake St. Clair and the Detroit River, contain walleye stocks shared by Canada and the U.S. These stocks undergo extensive movements into southern Lake Huron, and also interchange with Lake Erie walleyes. Walleyes in the connecting waters are reported to be increasing in abundance, with a strong year-class produced in 1977. Fishery agencies are launching an interagency walleye tagging effort, coordinated by the USFWS and aimed at defining seasonal movements and interchange between the various waters.

Lake Erie. Interagency management of walleye in the western basin of Lake Erie is coordinated through the Commission's Lake Erie Committee, which has instituted quota management. Western basin stocks declined precipitously in the 1960s following record landings in 1956. Discovery of mercury contamination in walleyes led to closures of commercial fisheries in 1970. When mercury levels declined in the early 1970s, limited permits were given to Ontario fishermen, and in 1976 the entire fishery operated on a quota basis. Quotas were deveoped by a Standing Technical Committee, and were held at conservative levels to allow rebuilding of the stocks. The commercial fishery was not reopened in Michigan and Ohio; the quota allocation for these jurisdictions was awarded to the angler fisheries.

The walleye quota of 2.35 million fish in the western basin in 1979 was divided among the jurisdictions on a geographical area basis, but the allocation was exceeded by a factor of 1.8 because of extensive angler overharvest in Ohio. The quota had been based on a conservative exploitation rate of 9.4%. However, a greatly improved abundance of walleye due to recruitment of the strong 1977 year-class and an expansion of angler effort in Ohio resulted in the excessive 1979 catch. Ohio plans to reduce its creel limit in 1980 from 10 walleye per trip to 6 per day. This restriction is expected to significantly reduce the angler harvest.

Because of good reproduction in 1977 and the expansion of western basin stocks into the central basin, a higher exploitation rate of 16.7% will be allowed in 1980. This will result in a recommended quota of 3.0 million walleyes for the western basin of Lake Erie.

Lake Ontario. Walleye stocks in Lake Ontario's Bay of Quinte were reported to be improving as a result of a very good year-class produced in 1978. Pollution abatement in the bay is credited with the favorable reproduction.

Yellow Perch

Lake Erie continued to be the major producer of yellow perch in the Great Lakes, and although 1979 commercial catches were the largest in 6 years, they were well below levels recorded in the 1960s. Some 15 million pounds of perch were commercially taken from Lake Erie in 1979, 80% of which were harvested in Ontario waters. Ohio's commercial fishery accounted for 2.7 million pounds, or 18% of the lakewide commercial catch, but Ohio's angler fishery, which is well developed, took an additional 3.7 million pounds. Angling fisheries in Ontario's water of Lake Erie are much smaller.

The Lake Erie Committee has expressed a desire for interagency quota management of yellow perch both to enhance the reproductive capabilities of the stocks and to dampen oscillations in the catch. The Standing Technical Committee is expected to develop appropriate models for the perch stocks and make recommendations for implementing interagency management.

GREAT LAKES FISHERY COMMISSION 1979 ANNUAL REPORT ERRATA

(insert after page 33)

Table 1. Lake Superior commercial fish production in pounds for 1979.

Species	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
Alewife	42	-	-	42	-	42
Burbot	52,252	2,420	-	54,672	6,785	61,457
Carp	738	420	-	1,158	476	1,634
Chubs	669,474	97,504	10,650	777,628	601,395	1,379,023
Lake herring	100,427	88,454	189,610	378,491	1,972,030	2,350,521
Lake sturgeon	-	-	-	-	1,936	1,936
Lake trout	139,712	244,667	36,015	420,394	247,127	667,521
Lake whitefish	513,854	253,521	345	767,720	352,402	1,120,122
Northern pike	-	-	-	-	3,530	3,530
Pacific salmon	-	-	-	-	14,639	14,639
Round whitefish	764	13,022	-	13,786	39,348	53,134
Smelt	4,000	130,619	1,845,643	1,980,262	75,857	2,056,119
Suckers	22,655	7,491	-	30,146	165,625	195,771
Walleye	-	-	-	-	396	396
White bass	-	-	-	-	2	2
Yellow perch	-	-	-	-	105,119	105,119
Unidentified	-	-	-	-	14,542	14,542
Total	1,503,918	838,118	2,082,263	4,424,299	3,601,209	8,025,508

Table 2. Lake Michigan commercial fish production in pounds for 1979.

Species	Michigan			Wisconsin			Illinois	Indiana	Grand Total
	Green Bay MM-1	Michigan proper	Total	Green Bay WM-1.2	Michigan proper	Total			
Alewife	2,588,020	10,739	2,598,759	2,589,951	22,314,610	24,904,561	-	4	27,503,324
Brown trout	-	-	-	-	-	-	-	110	110
Bullheads	-	-	-	29,321	-	29,321	-	-	29,321
Burbot	24,062	1,640	25,702	70,870	1,148	72,018	-	-	97,720
Carp	-	1	1	452,097	16	452,113	-	-	452,114
Channel catfish	-	-	-	2,449	-	2,449	-	3	2,452
Chubs	-	135,388	135,388	-	1,003,874	1,003,874	78,741	586	1,218,589
Coho salmon	-	-	-	-	-	-	-	388	388
Lake herring	25	-	25	210	7	217	-	-	242
Lake trout	-	631	631	-	-	-	-	-	631
Lake whitefish	1,153,263	1,076,483	2,229,746	636,453	395,406	1,031,859	-	370	3,261,975
Northern pike	24	-	24	225	7,003	7,228	-	-	7,252
Round whitefish	-	36,301	36,301	2,175	31,352	33,527	-	-	69,828
Sheepshead	-	-	-	5,388	-	5,388	-	-	5,388
Smelt	1,373,236	15,234	1,388,470	29,539	148,217	177,756	10	1,227	1,567,463
Suckers	662,880	26,729	689,609	248,244	5,731	253,975	-	2,698	946,282
Walleye	-	-	-	12,654	-	12,654	-	-	12,654
White bass	-	-	-	2,085	-	2,085	-	-	2,085
Yellow perch	-	-	-	932,577	7,632	940,209	55,211	125,956	1,121,376
Total	5,801,510	1,303,146	7,104,656	5,014,238	23,914,996	28,929,234	133,962	131,342	36,299,194

Table 3. Lake Huron commercial fish production in pounds for 1979.

Species	Michigan: Huron proper	Michigan: Saginaw Bay MH-4	Michigan: Total	Ontario: Huron proper	Ontario: Georgian Bay GB-1,2,3,4	Ontario: North Channel NC-1,2,3	Ontario: Total	Grand Total
Bowfin	-	565	565	-	400	1,280	1,680	2,245
Bullheads	-	3,355	3,355	500	3,835	4,228	8,563	11,918
Burbot	12	225	237	-	3,110	3,943	7,053	7,290
Carp	380	654,829	655,209	39,079	8,303	4,417	51,799	707,008
Channel catfish	713	456,740	457,453	109,183	404	87	109,674	567,127
Chubs	-	585	585	152,398	271,670	480	424,548	425,133
Crappie	-	7,423	7,423	-	75	-	75	7,498
Garfish	-	124	124	-	-	-	-	124
Gizzard shad	-	26,864	26,864	8,533	-	-	8,533	35,397
Lake herring	405	-	405	6,480	45,777	6,528	58,785	59,190
Lake sturgeon	-	-	-	3,874	841	4,197	8,912	8,912
Lake trout	-	-	-	38,319	2,976	5,828	47,123	47,123
Lake whitefish	629,519	39,323	668,842	991,304	165,513	138,999	1,295,816	1,964,658
Northern pike	-	-	-	466	9,215	21,099	30,780	30,780
Pacific salmon	-	-	-	7,869	273	2,652	10,794	10,794
Quillback	-	13,572	13,572	-	-	-	-	13,572
Rock bass	-	-	-	99	5,239	3,414	8,752	8,752
Round whitefish	1	25,117	25,118	12,521	42,621	6,883	62,025	87,143
Sauger	-	-	-	-	340	20	360	360
Sheepshead	40	13,909	13,949	87,698	-	-	87,698	101,647
Smelt	-	20,000	20,000	396	1,416	18	1,830	21,830
Splake	-	-	-	22,861	2,030	24	24,915	24,915
Suckers	109,981	51	110,032	68,971	28,384	79,761	177,116	287,148
Walleye	-	-	-	221,766	37,373	43,477	302,616	302,616
White bass	-	132	132	9,884	1	77	9,962	10,094
Yellow perch	90	167,673	167,763	129,197	99,103	64,220	292,520	460,283
Unidentified	-	-	-	205,580	6,928	75,079	287,587	287,587
Total	741,141	1,430,487	2,171,628	2,116,978	735,827	466,711	3,319,516	5,491,144

Table 4. Lake Erie commercial fish production in pounds for 1979.

Species	Michigan	New York	Ohio	Pennsylvania	U.S. Total	Ontario	Grand Total
Bowfin	-	-	-	-	-	26,924	26,924
Buffalo	18,888	-	33,035	-	51,923	-	51,923
Bullheads	10,868	1,361	55,694	896	68,819	37,777	106,596
Burbot	-	-	-	105	105	1,156	1,261
Carp	382,735	7,670	1,980,681	4	2,371,090	32,430	2,403,520
Channel catfish	26,411	711	240,430	407	267,959	81,961	349,920
Crappie	-	-	-	-	-	4,332	4,332
Eels	-	-	-	-	-	242	242
Gizzard shad	-	100	1,957,468	-	1,957,568	300	1,957,868
Goldfish	-	-	196,871	-	196,871	-	196,871
Lake herring	-	-	-	-	-	4	4
Lake sturgeon	-	25	-	-	25	560	585
Lake trout	-	-	-	196	196	405	601
Lake whitefish	-	11	-	85	96	1,699	1,795
Northern pike	-	-	-	-	-	18,243	18,243
Pacific salmon	-	-	-	-	-	21,391	21,391
Quillback	-	-	82,620	-	82,620	-	82,620
Rock bass	-	162	-	-	162	47,633	47,795
Sheepshead	-	28,630	1,271,378	32,963	1,332,971	271,542	1,604,513
Sauger	-	-	-	-	-	65	65
Shiners	-	-	-	8,564	8,564	-	8,564
Smelt	-	857	139	2,151	3,147	23,856,964	23,860,111
Suckers	2,530	24,515	41,813	6,320	75,178	30,475	105,653
Sunfish	-	-	-	-	-	58,619	58,619
Walleye	-	96,943	-	4,930	101,873	1,195,179	1,297,052
White bass	10,581	10,149	1,942,310	5,498	1,968,538	1,679,487	3,648,025
White perch	-	53	-	-	53	-	53
Yellow perch	-	154,269	2,678,483	314,247	3,146,999	12,050,722	15,197,721
Unidentified	-	-	-	-	-	1,421,555	1,421,555
Total	452,013	325,456	10,480,922	376,366	11,634,757	40,839,665	52,474,422

Table 5. Lake Ontario commercial fish production in pounds for 1979.

Species	New York	Ontario	Grand Total
Bowfin	322	2.170	2.492
Bullheads	26.449	361.087	387,536
Burbot	–	121	121
Carp	228	8.358	8.586
Channel catfish	1.091	276	1.367
Crappie	1.363	15.063	16.426
Eels	40.113	492.282	532.395
Gizzard shad	–	39	39
Lake herring	–	29.749	29.749
Lake sturgeon	–	27	27
Lake trout	–	296	296
Lake whitefish	–	2.863	2.863
Northern pike	–	41.653	41.653
Pacific salmon	–	1.662	1.662
Rock bass	5.112	23.436	28.548
Round whitefish	–	197	197
Sheepshead	331	70	401
Smelt	10.400	58.279	68.679
Suckers	1.726	18.432	20.158
Sunfish	5.565	155.748	161.313
Walleye	177	52.732	52.909
White bass	154	3.756	3,910
White perch	18.133	102.580	120.713
Yellow perch	22.860	657.182	680.042
Unidentified	–	16.162	16.162
Total	134.024	2.044.220	2.178.244

SUMMARY OF TROUT, SPLAKE, AND SALMON PLANTINGS

Intensive annual plantings of hatchery-reared salmonids continue to be the principal method employed to rehabilitate Great Lakes fisheries. In 1979, about 30 million trout and salmon were planted.

In Lakes Superior, Michigan, Huron, and Ontario, salmon and trout survival is dependent upon sea lamprey control since experience has shown that planting of these species where sea lamprey are abundant results in high mortality of fish and heavy wounding of survivors. In Lake Erie there is no clear evidence that the sea lamprey population causes high mortality of planted salmon and trout; the relatively low numbers of sea lamprey in Lake Erie is usually attributed to the scarcity of suitable streams for spawning, although improved water quality in some streams is increasing the reproductive potential of the sea lamprey.

Most of the rainbow, brook, and brown trout, and all of the Pacific salmon plantings are aimed at the recreational fishery. On the other hand, a substantial part of the lake trout and the Province of Ontario's splake plantings are intended to develop self-sustaining stocks. With anglers pursuing a wide variety of species ranging from salmon and trout to yellow perch and walleye to panfish and bass, it was estimated that the economic impact of the Great Lakes recreational fishery is $1 billion annually. The economic impact of the commercial fishing industry, which harvests relatively few of the stocked salmonids, has been estimated at $160 million (Talhelm, 1979).

In an attempt to foster naturally reproducing lake trout stocks, the USFWS in 1978 successfully sought commitment from the U.S. Coast Guard for assistance in making future off-shore plants of lake trout on spawning reefs. Construction of the required tanks was underway in 1979. The Steering Committee for the Stock Concept Symposium (to be held in October 1980) continued its planning activities in 1979; it is hoped that the symposium will serve to focus attention on the makeup of lake trout stocks with respect to successful natural reproduction in the Great Lakes.

Lake trout planted in Lake Ontario by the U.S. Fish and Wildlife Service and splake planted in Lake Huron by Ontario in 1979 were marked with coded wire tags for the first time in the history of the Great Lakes lake trout planting program. Tag numbers appear in the tables under the "Fin Clip/Mark" heading as "CWT (agency code) first data row/second data row." Initial difficulties associated with placing a tag in the lake trout's rather hard snout were overcome with the casting of lake trout nose cones modified to place the tag higher up on the snout.

Lake trout have been planted annually in Lake Superior since 1958, in Lake Michigan since 1965, and in Lake Ontario since 1972. These programs have been carried out cooperatively by the U.S. Fish and Wildlife Service, the states of Michigan, Wisconsin, Minnesota and New York, and the Province of Ontario. Lake trout eggs are largely obtained from brood fish in hatcheries, and, to a lesser extent mature lake trout from inland lakes and Lake Superior. Nearly all trout are reared to yearlings (ca. 30/pound) and planted during the spring and early summer. Some, however, are planted as fingerlings in fall. Despite certain advantages (relative to hatchery production) associated with stocking in the fall, the procedure has not been used extensively; studies have shown that lake trout planted in fall as fingerlings generally do not survive nearly as well as those stocked in spring as yearlings. The higher mortality of fall-stocked fish is commonly believed to be related to their smaller size at time of planting. In a study to determine whether increasing the size of the fall-stocked fingerlings might improve their survival, the U.S. Fish and Wildlife Service, in the fall of 1971, 1972, and 1973, stocked two size groups of lake trout fingerlings: one group grown normally (oversize weight 80/lb) and the other group grown at an accelerated rate (30/lb) by special diet and elevated rearing temperatures. Data collected through assessment fishing have suggested that in general the accelerated-growth fingerlings survived better than the normal-growth fingerlings. Catches in experimental gillnets fished by the USFWS in Lake Michigan (1976, 1977) indicated that, of the trout stocked in 1971 and 1972, the accelerated growth fish had survived nearly three times as well as the normal growth fingerlings, but that from the 1973 plantings, the accelerated growth fish had survived only about half as well as the normal growth fish; there is no obvious explanation for the apparent anomaly (Wells and Eck, 1978). In 1979, approximately 547,000 accelerated growth fingerlings were planted in the U.S. waters of Lake Superior, 120,000 in Lake Michigan, 508,000 in Lake Erie, and 193,490 in Lake Ontario, in the ongoing experimental planting program.

To rehabilitate fish stocks in Lake Huron, the Province of Ontario and the State of Michigan originally agreed to plant highly-selected splake. These fish were developed in Ontario through an intensive breeding program in which male brook trout were crossed with female lake trout to produce a fast growing fish similar to lake trout in behavior and appearance, and to the brook trout in fast growth and early maturity. Following several generations of selective breeding a splake was developed which grows rapidly, matures at an early age, and inhabits deep water. First plantings were made in 1969 in Ontario waters (mostly yearlings) and in 1970 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 milt 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. Because of fish disease problems in the U.S. brood stock of splake (chronicled in Annual Reports for 1975 and 1976, Appendix B), lake trout plants were initiated in U.S. waters of Lake Huron in 1973 and continued through 1979. The Province of Ontario continued to plant highly selected splake through 1979 but also made a small planting of lake trout. Survival of Ontario's splake has improved dramatically in recent years, following hatchery cleanup and an adjustment in genetic content in favour of lake trout.

In Lake Erie, Pennsylvania made small experimental plants of lake trout fingerlings in 1969 and yearlings in 1974, 1975, and 1976. New York initiated lake trout plants in Lake Erie in 1975, and in 1978 and 1979 Pennsylvania and New York cooperated in stocking USFWS-supplied yearlings, doubling the numbers previously planted in Lake Erie. Representatives from the concerned agencies (New York, Ohio, Ontario, Pennsylvania, USFWS, etc.) met in 1979 to discuss assessment procedures for determining the success of the planting program.

Plants of yearling splake in Lake Ontario were initiated in 1972 and continued through 1974 by the Province of Ontario, but none were planted in 1975. In 1976, the Province planted a few splake and initiated lake trout planting. In addition, plants of lake trout were made by New York State in 1973 and 1978, and through a cooperative arrangement between New York and the U.S. Fish and Wildlife Service in the period 1974 through 1979.

Table 1 summarizes annual plantings of lake trout and hybrids in the Great Lakes, and Table 2 details the 1979 plants in each of the Great Lakes. Other small experimental plants of first generation splake and backcrosses have been made by Wisconsin and Michigan in Lake Superior (Table 3) with the objective of providing a nearshore fishery; these plants are not thought to contribute to offshore populations.

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 planting in each of the Great Lakes, and Table 5 details the 1979 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 1979 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. After 1972, Michigan discontinued its plants in Lake Huron but continued them in Lake Michigan. Table 8 summarizes Atlantic salmon plantings in the Great Lakes 1972–1978; none were planted in 1979.

Plantings of rainbow and steelhead trout, brown trout, and brook trout have been continued in the Great Lakes over the years, but were not included in these records prior to 1975 (1976 for brook trout) because of the variability in reporting and difficulty in separating "inland" plantings from "Great Lakes" plantings. Nevertheless, the need for stocking information on these species prompted inclusion of rainbow and steelhead trout, brown trout, and brook trout plantings in the Annual Report. Table 9 summarizes the annual plantings of rainbow and steelhead trout for 1975 through 1979, and Table 10 details the 1979 plantings. Table 11 summarizes annual plantings of brown trout for 1975 through 1979, and Table 12 details the 1979 plantings. Brook trout plantings were included for the first time in 1976 (Table 13). Table 14 details the 1979 plantings of brook trout.

The grid number system developed by Stan Smith and others in the early 1970s, is used here for the first time in the Annual Report series, in order to assist readers in the location of planting site. Copies of Great Lakes maps with superimposed numbered grids are available through this office.

The abbreviations SF, FF, F, Y, and A designate ages of planted fish. Their respective meanings are fingerlings planted in the spring, fingerlings planted in the fall, fingerlings, yearlings, and adults.

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Talhelm, D. R., R. C. Bishop, K. W. Cox, N. W. Smith, D. N. Steinnes, and A. L. W. Tuomi. 1979. Current estimates of Great Lakes fisheries values: 1979 status report. Great Lakes Fishery Commission. Ann Arbor, Michigan. Rep. 79–1: 17 pp. (Mimeo.)

Wells, L. and G. Eck. 1978. Supplementary information on lake trout. Pages 45–48 *in* Lake Michigan Committee Minutes. Great Lakes Fishery Commission. Ann Arbor, Michigan.

Table 1. Annual plantings (in thousands) of lake trout, splake[1,2] and backcrosses[3] in the Great Lakes, 1958–1979.

	LAKE SUPERIOR				
Year	Michigan	Wisconsin	Minnesota	Ontario	Total
1958	298	184	–	505	987
1959	44	151	–	473	668
1960	393	211	–	446	1,050
1961	392	314	–	554	1,260
1962	775	493	77	508	1,853
1963	1,348	311	175	477	2,311
1964	1,196	743	220	472	2,631
1965	780	448	251	468	1,947
1966	2,218	352	259	450	3,279
1967	2,059	349	382	500	3,290
1968	2,260	239	377	500	3,376
1969	1,860	251	216	500	2,827
1970	1,944	204	226	500	2,874
1971	1,055	207	280	475	2,017
1972	1,063	259	293	491	2,106
1973	894	227	284	500	1,905
1974	888	436	304	465	2,093
1975	872	493	337	510	2,212
1976	789	814	345	1,062	3,010
1977	803	551	350	677	2,381
1978	855	622	355	630	2,461
1979	1,055	508	314	526	2,403
Subtotal	23,841	8,367	5,045	11,689	48,941

	LAKE MICHIGAN				
Year	Michigan	Wisconsin	Illinois	Indiana	Total
1965	1,069	205	–	–	1,274
1966	956	761	–	–	1,717
1967	1,118	1,129	90	87	2,424
1968	855	817	104	100	1,876
1969	877	884	121	119	2,001
1970	875	900	100	85	1,960
1971	1,195	945	100	103	2,343
1972	1,422	1,284	110	110	2,926
1973	1,129	1,170	105	105	2,509
1974	1,070	971	176	180	2,397
1975	1,151	1,055	186	186	2,577
1976	1,255	1,045	160	164	2,624
1977	1,057	970	166	177	2,369
1978	1,304	994	116	175	2,589
1979	1,216	943	162	176	2,497
Subtotal	16,550	14,073	1,696	1,767	34,083

	LAKE HURON						
	Michigan			Ontario			
Year	Lake trout	Splake	Backcrosses	Lake trout	Splake	Backcrosses	Total
1969	–	–	–	–	35	–	35
1970	–	43	–	–	247	–	290
1971	–	74	–	–	468	–	542
1972	–	215	–	–	333	–	548
1973	629	–	486	–	412	–	1,527
1974	793	–	–	–	299	–	1,092
1975	1,053	–	–	–	523	–	1,576
1976	1,024	–	–	–	658	–	1,682
1977	1,033	–	250	15	879	61	2,238
1978	1,217	–	–	15	175	–	1,407
1979	1,338	–	–	15	798	–	2,151
Subtotal	7,087	332	736	45	4,827	61	13,088

	LAKE ERIE		
Year	Pennsylvania	New York	Total
1969	17	–	17
1974	26	–	26
1975	34	150	184
1976	16	186	202
1977	–	125	125
1978	118	118	236
1979	355	355	709
Subtotal	566	934	1,499

	LAKE ONTARIO			
	Ontario		New York	
Year	Splake	Lake trout	Lake trout	Total
1972	48	–	–	48
1973	39	–	66	105
1974	26	–	644	670
1975	–	–	514	514
1976	6	194	337	537
1977	–	288	298	586
1978	–	200	1,043	1,243
1979	–	201	686	887
Subtotal	119	883	3,588	4,590
Great Lakes Total, lake trout, splake and backcrosses, 1958–1979				102,202

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

Table 2. Planting of lake trout and splake[1,2] in the Great Lakes, 1979.

Location	Grid No.	Numbers	Age	Fin Clip/Mark
		LAKE SUPERIOR-LAKE TROUT		
Michigan waters				
Big Bay	1327	25,000[3,4]	Y	left ventral
Black River Harbor	1413	68,500	Y	left ventral
Grand Marais	1438	50,000[3,4]	Y	left ventral
Huron Islands	1326	75,000[3,4]	Y	adipose-left ventral
Laughing Whitefish Point	1531	50,000[3,4]	Y	left ventral
Loma Farm	1428	57,300	Y	left ventral
Manitou Island	1028	50,000[3,4]	Y	adipose-left ventral
Marquette Harbor	1529	50,000[4]	Y	left ventral
Munising	1633	25,000[4]	Y	left ventral
Ontonogan River Mouth	1318	65,800	Y	left ventral
Partridge Island	1529	90,000[3]	Y	left ventral
Pequaming	1323	46,842	Y	left pectoral-right ventral
Point Abbaye	1325	25,000[3]	Y	adipose-left ventral
Point Abbaye	1323	33,570	FF	left pectoral-right ventral
Porcupine Mts. Reef	1315	25,000[4]	Y	left ventral
Presque Isle Harbor	1414	50,000[4]	Y	left ventral
Rock Beach	1323	34,038[4]	FF	left pectoral-right ventral
Shelter Bay	1632	45,000[4]	Y	left ventral
Tahquamenon Island	1544	113,500[3]	FF	left pectoral-right ventral
Traverse Island Reef	1224	75,000	Y	adipose-left ventral
Subtotal		1,054,550		
Minnesota waters				
Little Marais	1007	59,149[4]	Y	left ventral
Palmers	1303	80,022[4]	Y	left ventral
Paradise Beach	814	50,000[4]	Y	adipose-right pectoral
Split Rock	1206	59,987[4]	Y	left ventral
Tofte	909	65,017[4]	Y	left ventral
Subtotal		314,175		
Ontario waters				
Caribou Island	320	45,000[3]	Y	left ventral
Jackson's Point	1546	50,204	Y	left ventral
Lapoints Point	1347	42,900	Y	left ventral
Mamainse Point	1245	57,341	Y	left ventral
Mary Island	320	54,900[3]	Y	left ventral
Michipicoten Harbour	744	50,302	Y	left ventral
Montreal River	1145	50,000	Y	left ventral
Rossport Dock	128	150,000	Y	left ventral
Sinclair Cove	1045	25,000	Y	left ventral
Subtotal		525,647		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Wisconsin waters				
Bark Point	1306	6,740[4]	Y	left ventral
Cornucopia	1307	20,220[4]	Y	left ventral
Devils Island Shoal	1209	211,200[3,4]	FF	both pectoral
Superior Entry	1402	270,000	Y	left ventral
Subtotal		508,160		
Total, Lake Superior		2,402,532		
		LAKE MICHIGAN-LAKE TROUT		
Illinois waters				
Waukegan	2302	100,259[3]	Y	adipose-left ventral
Waukegan Reef	2302	61,540[3]	Y	adipose-left ventral
Subtotal		161,799		
Indiana waters				
Bethlehem Steel	2706	95,000	Y	left ventral
Joerse Park	2705	38,100	Y	left ventral
Michigan City	2707	42,900	Y	left ventral
Subtotal		176,000		
Michigan waters				
Acme	916	50,000	Y	left ventral
Charlevoix	616	75,000	Y	left ventral
Ford River	306	75,000[4]	Y	left ventral
Frankfort	1011	75,800	Y	left ventral
Good Harbor Reef	814	25,000[3]	Y	adipose-left ventral
Grand Haven	1911	65,000	Y	left ventral
Greilickeville	915	75,000	Y	left ventral
Holland	211	116,000	Y	left ventral
Manistee	1210	90,000	Y	left ventral
Montague	1710	90,000	Y	left ventral
Old Mission Point	816	59,100	FF	right-pectoral-left ventral
Pentwater	1510	90,000	Y	left ventral
Petoskey	519	75,000	Y	left ventral
St. Joseph	1509	100,000	Y	left ventral
South Fox Island	513	25,000[3]	Y	left ventral
South Haven	2311	90,000	Y	left ventral
Stony Lake	1710	40,500	FF	left ventral
Subtotal		1,216,400		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Wisconsin waters				
Algoma	1004	90,000	Y	left ventral
Gills Rock	606	55,152[3]	Y	adipose-left pectoral
Kewaunee	1104	57,000[3]	Y	adipose-both ventral
Kewaunee	1104	90,000	Y	left ventral
Larson's Reef	804	154,400	Y	left ventral
Manitowoc	1303	91,100	Y	left ventral
McKinley Park	1901	4,171	FF	left pectoral
Milwaukee	1901	90,000	Y	left ventral
Port Washington	1701	40,000	Y	left ventral
Racine	2102	90,000	Y	adipose-left ventral
Sheboygan	1502	90,000	Y	left ventral
Sturgeon Bay	905	90,850	Y	left ventral
Subtotal		942,673		
Total, Lake Michigan		2,496,872		

LAKE HURON-LAKE TROUT AND SPLAKE

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Michigan waters (lake trout)				
Adams Point	607	75,000	Y	adipose-left ventral
Black River Island	1010	90,000[3]	Y	adipose-left ventral
Caseville	1510	75,000	Y	adipose-left ventral
Detour Ferry Dock	306	50,218[3]	Y	adipose-left ventral
Goose Island Shoal	303	25,000[3]	Y	adipose-left ventral
Greenbush	1110	100,000	Y	adipose-left ventral
Grindstone City	1412	100,000	Y	adipose-left ventral
Hammond Bay	505	75,000	Y	adipose-left ventral
Harbor Beach	1514	75,000	Y	adipose-left ventral
Look Out Point	1408	87,410	Y	adipose-left ventral
Martins Reef	305	25,000[3]	Y	adipose-left ventral
Middle Entrance Reef	308	25,000[3]	Y	adipose-left ventral
Middle Island	709	30,000[3]	Y	adipose-left ventral
Oscoda	1210	100,000	Y	adipose-left ventral
Port Austin	1412	75,000	Y	adipose-left ventral
Port Sanilac	1814	25,000	Y	adipose-left ventral
Reynolds Reef	404	25,000[3]	Y	adipose-left ventral
Rockport	709	30,000[3]	Y	adipose-left ventral
Round Island Shoal	302	25,000[3]	Y	adipose-left ventral
Scarecrow Island	709	75,000[3]	Y	adipose-left ventral
Sturgeon Point	1010	50,000	Y	adipose-left ventral
Tawas Point	1309	100,000	Y	adipose-left ventral
Subtotal		1,337,628		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Ontario waters (lake trout)				
South Bay (Inner Basin)	418	15,000[3]	Y	left pectoral
Ontario waters (splake)				
Heywood Island	319	153,240[3]	Y	right ventral
Jackson Shoal	822	142,458[3]	Y	right ventral
Lion's Head Dock	822	6,160	Y	adipose-right pectoral
Lion's Head Dock	822	4,953	Y	right pectoral
Mary Ward Ledges	1128	182,176[3]	Y	right ventral
Meaford Range	1126	25,917	Y	adipose, CWT (63) 1-12/blank
Meaford Range	1126	14,952	Y	adipose-rght pectoral, CWT (63) 1-12/blank
Meaford Range	1126	29,475	Y	none, CWT (63) 1-12/blank
Meaford Range	1126	10,370	Y	adipose-right pectoral, CWT (63) 1-12/blank
Meaford Range	1126	27,709	Y	right pectoral, CWT (63) 1-12/blank
North Channel	319	11,070	Y	right ventral
North Keppel Dock	1024	28,063	Y	right ventral
Pyette Point	1025	130,558	Y	right ventral
Sheguindah Gov't Dock	319	16,388	Y	right ventral
South Bay (Inner Basin)	418	15,000[3]	Y	adipose-left pectoral
Subtotal		798,489		
Total, Lake Huron		2,151,117		

LAKE ERIE-LAKE TROUT

Location	Grid No.	Numbers	Age	Fin Clip/Mark
New York waters				
Barcelona	523	100,560	Y	left pectoral-right ventral
Barcelona	523	254,000	FF	left ventral
Subtotal		354,560		
Pennsylvania waters				
Barcelona	522	100,560	Y	left pectoral-right ventral
Barcelona	522	254,000	FF	left ventral
Subtotal		354,560		
Total, Lake Erie		709,120		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
		LAKE ONTARIO-LAKE TROUT		
New York waters				
Hamlin	713	34,951[3]	FF	adipose, CWT (60) 41/2
Hamlin	713	78,900	Y	left pectoral-left maxillary
Niagara	806	34,459	FF	adipose, CWT (60) 41/2,5
Niagara	806	79,290	Y	left pectoral-left maxillary
Selkirk	623	34,577[3]	FF	adipose, CWT (60) 41/1
Selkirk	623	100,015	Y	left pectoral-left maxillary
Sodus	819	31,491[3]	FF	adipose, CWT (60) 41/1,2,4
Sodus	819	78,000	Y	left pectoral-left maxillary
Stoney Point	422	58,012[3]	FF	adipose, CWT (60) 41/1,3
Stoney Point	422	140,800	Y	left pectoral-left maxillary
Stoney Point	422	15,400	Y	left pectoral-right maxillary
Subtotal		685,895		
Ontario waters				
Clarkson	603	101,416	Y	both ventral
Main Duck Islands	421	100,000[3]	Y	both ventral
Subtotal		201,416		
Total, Lake Ontario		887,331		
Great Lakes Total		8,646,972		

[1]Lake trout × brook trout hybrid.
[2]Excludes small experimental splake plants by USFWS.
[3]Offshore plants.
[4]State plants—all other U.S. plants by U.S. Fish and Wildlife Service.

Table 3. Plantings of F_1 splake in Lake Superior, 1971, 1973, 1974, 1975, 1976, 1978 and 1979. The 1977 plant was of backcrosses.

Year	State	Location	Grid No.	Numbers	Age	Fin clip
1971	Michigan	Copper Harbor	926	13,199	Y	none
1973	Wisconsin	Bayfield Area	1409	5,000	F	dorsal-left ventral
1974	Wisconsin	Washburn	1509	10,316	Y	dorsal
		Houghton Point	1509	9,782	Y	dorsal
1975	Wisconsin	Pikes Bay	1409	15,000	Y	dorsal-right ventral
1976	Wisconsin	Pikes Bay	1409	18,360	Y	dorsal-right ventral
1977	Michigan	Copper Harbor	926	26,100	F	left pectoral-right ventral
1978	Wisconsin	Chequamegon Bay	1509	55,200	F	none
		Cornucopia	1307	26,400	F	none
		Ashland Coal Dock	1509	12,000	Y	none
1979	Wisconsin	Bark Pt.	1306	12,000	FF	none
		Bark Pt.	1306	6,000	Y	none
		Bayfield	1409	10,800	Y	none
		Cornucopia	1307	12,000	FF	none
		Houghton Pt.	1509	12,000	FF	none
		Houghton Pt.	1509	16,200	Y	none
		Madeline Is.	1409	12,000	FF	none
		Onion River	1409	36,000	FF	none
		Onion River	1409	22,700	Y	none
		Port Superior	1409	2,675	Y	none
		Washburn	1509	24,000	FF	none
		Washburn Coal Dock	1509	16,000	Y	none
Total, Lake Superior				373,732		

Table 4. Annual plantings (in thousands) of coho salmon in the Great Lakes, 1966–1979.

		LAKE SUPERIOR		
Year	Michigan	Minnesota	Ontario	Total
1966	192	-	-	192
1967	467	-	-	467
1968	382	-	-	382
1969	526	110	20	656
1970	507	111	31	649
1971	402	188	27	617
1972	152	145	-	297
1973	100	35	-	135
1974	455	74	-	529
1975	275	-	-	275
1976	400	-	-	400
1977	627	-	-	627
1978	140	-	-	140
1979	200	-	-	200
Subtotal	4,825	663	78	5,566

		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	257	-	5	2,265
1974	2,788	318	125	-	3,231
1975	2,026	433	46	-	2,505
1976	2,270	648	179	80	3,177
1977	2,314	491	179	103	3,087
1978	1,802	499	105	279	2,685
1979	3,317	320	118	289	4,044
Subtotal	30,977	4,073	964	770	36,784

	LAKE HURON	
Year	Michigan	Total
1968	402	402
1969	667	667
1970	571	571
1971	975	975
1972	249	249
1973	100	100
1974	500	500
1975	627	627
1976	690	690
1977	416	416
1978	84	84
1979	1,082	1,082
Subtotal	6,363	6,363

			LAKE ERIE		
Year	Michigan	Ohio	Pennsylvania	New York	Total
1968	–	20	86	5	111
1969	–	92	134	10	236
1970	–	253	197	74	525
1971	–	122	152	95	369
1972	–	38	131	50	219
1973	–	96	315	-	411
1974	200	188	366	29	783
1975	101	231	363	125	819
1976	199	568	248	477	1,491
1977	645	282	636	269	1,832
1978	296	240	961	134	1,631
1979	303	110	108	100	621
Subtotal	1,744	2,240	3,697	1,368	9,048

	LAKE ONTARIO		
Year	Ontario	New York	Total
1968	–	40	40
1969	130	109	239
1970	145	294	439
1971	160	122	282
1972	122	230	352
1973	272	240	512
1974	438	217	655
1975	226	812	1,038
1976	166	178	343
1977	313	39	352
1978	201	80	281
1979	286	344	630
Subtotal	2,459	2,705	5,163

Great Lakes Total, coho salmon, 1966–1979 62,924

Table 5. Plantings of coho salmon in the Great Lakes, 1979.

Location	Grid No.	Numbers	Age	Fin clip
LAKE SUPERIOR-COHO SALMON				
Michigan waters				
Dead River	1529	100,000	Y	none
Falls River	1423	50,000	Y	none
Sucker River	1439	50,000	Y	none
Subtotal		200,000		
Total, Lake Superior		200,000		
LAKE MICHIGAN-COHO SALMON				
Illinois waters				
Diversey Harbor	2603	114,140	Y	none
Jackson Harbor	1603	127,100	Y	none
Kellogg Creek	2302	25,700	Y	left ventral
Waukegan Area	2302	22,500	Y	none
Subtotal		289,440		
Indiana waters				
Little Calument River	2705	66,697	FF	right pectoral
Trail Creek	2707	50,809	FF	right pectoral
Subtotal		117,506		
Michigan waters				
Black River	2311	100,000	Y	none
Big Sauble River	1410	300,000	Y	none
Brewery Creek	915	100,000	Y	none
Cedar River	504	50,000	Y	none
Grand River	1911	100,000	Y	none
Little Manistee River	1211	675,000	Y	none
Manistee River	1211	200,000	Y	none
Muskegon River	1810	394,000	SF	none
Platte River	912	973,032	Y	none
Portage Lake	1111	150,000	Y	none
St. Joseph River	2509	200,000	Y	none
Thompson Creek	211	75,000	Y	none
Subtotal		3,317,032		
Wisconsin waters				
Kenosha	2202	76,400	Y	none
Milwaukee	1901	66,260	Y	none
Port Washington	1701	47,000	Y	none
Racine	2102	42,005	Y	none
Sheboygan	1502	88,200	Y	none
Subtotal		319,865		
Total, Lake Michigan		4,043,843		

Table 5. (Con't.)

Location	Grid No.	Numbers	Age	Fin clip
LAKE HURON-COHO SALMON				
Michigan waters				
AuSable River	1210	782,216	SF	none
Carp river	302	75,000	F	none
Cass River	1606	75,000	Y	none
Diamond Creek	1513	50,000	Y	none
Tawas River	1308	100,000	Y	none
Subtotal		1,082,216		
Total, Lake Huron		1,082,216		
LAKE ERIE-COHO SALMON				
Michigan waters				
Detroit River	603	202,831	Y	left pectoral-right ventral
Huron River	702	100,000	Y	none
Subtotal		302,831		
New York waters				
Cattaragus Creek	327	50,000	F	none
Cattaragus Creek	327	50,000	Y	none
Subtotal		100,000		
Ohio waters				
Chagrin River	1006	30,008	FF	adipose-left ventral
Huron River	1006	79,920	FF	right ventral
Subtotal		109,928		
Pennsylvania waters				
Godfrey Run	619	19,600	Y	none
Orchard Beach Run	523	9,700	Y	left ventral
Presque Isle Bay	521	10,000	Y	none
Sixteenmile Creek	522	5,000	Y	none
Trout Run	620	53,800	Y	none
Walnut Creek	620	10,000	Y	none
Subtotal		108,100		
Total, Lake Erie		620,859		

Table 5. (Con't.)

Location	Grid No.	Numbers	Age	Fin clip
		LAKE ONTARIO-COHO SALMON		
New York waters				
Eighteenmile Creek	708	25,000	F	none
Eighteenmile Creek	708	19,970	Y	none
Oak Orchard	711	31,000	Y	none
Salmon River	623	56,400	F	none
Salmon River	623	37,302	F	none
Salmon River	623	70,000	Y	none
Sandy Creek	713	35,000	F	none
Sandy Creek	713	32,865	Y	none
South Sandy Creek	623	15,000	F	none
South Sandy Creek	623	21,000		none
Subtotal		343,537		
Ontario waters				
Bronte Creek	702	40,146	Y	right pectoral
Clarkson	603	25,625	Y	adipose-right pectoral
Credit River	603	129,633	F	none
Credit River	603	90,568	Y	right pectoral
Subtotal		285,972		
Total, Lake Ontario		629,509		
Great Lakes Total		6,576,427		

Table 6. Annual plantings (in thousands) of chinook salmon in the Great Lakes, 1967–1979.

Year	Michigan	Wisconsin	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
1975	253	–	–	253
1976	201	–	291	493
1977	116	35	103	254
1978	150	–	278	478
1979	100	60	341	501
Subtotal	2,631	95	1,241	4,018

Year	Michigan	Wisconsin	Indiana	Illinois	Total
		LAKE MICHIGAN			
1967	802	–	–	-	802
1968	687	–	-	-	687
1969	652	66	–	–	718
1970	1,675	119	100	10	1,904
1971	1,865	264	180	8	2,317
1972	1,691	317	107	24	2,139
1973	2,115	697	–	174	2,986
1974	2,046	616	159	757	3,578
1975	2,816	927	156	381	4,280
1976	1,947	1,276	38	142	3,403
1977	1,576	913	141	347	2,977
1978	2,524	2,017	213	611	5,365
1979	2,307	1,964	531	183	4,984
Subtotal	22,703	9,176	1,625	2,637	36,140

LAKE HURON

Year	Michigan	Total
1968	274	274
1969	255	255
1970	643	643
1971	894	894
1972	515	515
1973	967	967
1974	776	776
1975	655	655
1976	831	831
1977	733	733
1978	1,418	1,418
1979	1,325	1,325
Subtotal	9,286	9,286

LAKE ERIE

Year	Michigan	Ohio	Pennsylvania	New York	Total
1970	–	150	–	–	150
1971	–	180	129	–	309
1972	–	–	150	–	150
1973	305	–	155	125	585
1974	502	–	189	125	816
1975	401	–	483	85	969
1976	300	246	769	65	1,381
1977	302	428	979	362	2,072
1978	–	364	668	206	1,238
1979	–	210	708	–	917
Subtotal	1,810	1,578	4,230	968	8,587

LAKE ONTARIO

Year	Ontario	New York	Total
1969	–	70	70
1970	–	141	141
1971	89	149	238
1972	190	427	617
1973	–	696	696
1974	225	963	1,188
1975	–	920	920
1976	–	593	593
1977	–	–	–
1978	393	–	393
1979	147	222	369
Subtotal	1,044	4,181	5,225

Great Lakes Total, chinook salmon, 1967–1979 63,256

Table 7. Plantings of chinook salmon in the Great Lakes, 1979.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-CHINOOK SALMON				
Michigan waters				
Dead River	1529	100,000	SF	none
Minnesota waters				
Baptism River	1107	48,762	SF	adipose
Baptism River	1107	35,212	FF	adipose-left ventral
Bluebird Landing	1303	45,697	FF	adipose-left ventral
Cascade River	811	48,347	SF	adipose
French River	1302	72,246	SF	adipose
Grand Portage Creek	716	53,000	SF	adipose-right pectoral
Lake Portage Creek	812	37,310	FF	adipose-left ventral
Subtotal		340,574		
Wisconsin waters				
Black River	1401	60,000	F	none
Total, Lake Superior		500,574		
LAKE MICHIGAN-CHINOOK SALMON				
Illinois waters				
Calumet Harbor	2703	22,800	SF	none
Diversey Harbor	2603	56,000	SF	none
Jackson Harbor	2703	14,300	SF	none
Kellogg Creek	2302	38,850	SF	none
Waukegan	2302	51,140	F	none
Subtotal		183,090		
Indiana waters				
Bethlehem Steel Pier	2706	134,478	SF	none
Inland Steel Pier	2704	186,262	SF	left pectoral
Michigan City	2707	161,153	SF	adipose-right ventral
Trail Creek	2707	48,777	SF	none
Subtotal		530,670		
Michigan waters				
Big Manistee River	1211	200,000	SF	none
Brewery Creek	915	50,000	SF	none
Grand River	1911	400,000	SF	none
Kalamazoo River	2211	153,602	SF	none
Little Manistee River	1211	603,098	SF	none
Muskegon	1810	400,000	SF	none
Portage Lake	1111	50,000	SF	none
Sauble River	1410	200,000	SF	none
St. Joseph River	2509	250,000	SF	none
Subtotal		2,306,700		

Table 7. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Wisconsin waters				
Algoma	1004	100,000	F	none
Kenosha	2202	196,611	F	none
Kewaunee	1104	100,000	F	none
Manitowoc	1303	339,200	F	none
Marinette	703	195,000	F	none
Milwaukee	1901	250,000	F	none
Oconto Park	802	100,000	F	none
Port Washington	1701	125,000	F	none
Racine	2102	40,000	F	none
Sheboygan	1502	294,000	F	none
Strawberry Creek	905	224,000	F	none
Subtotal		1,963,811		
Total, Lake Michigan		4,984,271		
LAKE HURON-CHINOOK SALMON				
Michigan waters				
Augres River	1408	100,111	SF	none
AuSable River	1210	499,922	SF	none
Flint River	1606	125,000	SF	none
Harbor Beach	1514	150,000	SF	none
Mill Creek	1110	300,000	SF	none
Nagels Creek	606	50,000	SF	none
Soo Rapids	105	100,000	SF	none
Subtotal		1,325,033		
Total, Lake Huron		1,325,033		
LAKE ERIE-CHINOOK SALMON				
Ohio waters				
Chagrin River	814	90,000	SF	none
Huron River	1006	120,000	SF	none
Subtotal		210,000		
Pennsylvania waters				
Elk Creek	619	157,100	SF	none
Elk Creek	619	100,000	FF	left pectoral
Elk Creek	619	65,000	Y	adipose
Godfrey Run	619	35,000	SF	none
Sixteenmile Creek	522	30,000	SF	none
Trout Run	620	35,000	SF	none
Walnut Creek	620	175,000	SF	none
Walnut Creek	620	55,000	FF	left pectoral
Walnut Creek	620	55,550	Y	adipose
Subtotal		707,650		
Total, Lake Erie		917,650		

Table 7. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
LAKE ONTARIO-CHINOOK SALMON				
New York waters				
North & South Sandy Creeks	623	68,000	SF	none
Oak Orchard Creek	711	57,850	SF	none
Salmon River	623	95,800	SF	none
Subtotal		221,650		
Ontario waters				
Bronte Creek	702	147,450	SF	none
Total, Lake Ontario		369,100		
Great Lakes Total		8,096,628		

Table 8. Plantings of Atlantic salmon in the Great Lakes, 1972–1979.

Year	State	Location	Grid No.,	Numbers	Age	Fin Clip
		LAKE SUPERIOR				
1972	Wisconsin	Bayfield	1409	20,000	Y	adipose-left ventral
1973	Wisconsin	Bayfield	1409	20,000	Y	right ventral
1976	Michigan	Cherry Creek	1529	9,106[2]	Y	none
1978	Wisconsin	Pikes Creek	1409	36,772	Y	none
Total				85,878		
		LAKE MICHIGAN				
1972	Michigan	Boyne River	616	10,000[2]	Y	none
1973	Michigan	Boyne River	616	15,000[2]	Y	none
1974	Michigan	Platte River	912	7,308[2]	Y	adipose
		Boyne River	616	14,555[2]	Y	none
1975	Michigan	Boyne River	616	18,742[2]	Y	none
				3,430	A	right ventral
1976	Michigan	Boyne River	616	20,438[2]	Y	none
				108[2]	A	adipose, left ventral, right ventral
				162[2]	A	left ventral
				438[2]	F	none
1977	Michigan	Pere Marquette River	1410	7,131	Y	left ventral
		Little Manistee River	1211	4,500[1]	Y	left ventral
		Pere Marquette River	1410	3,961[2]	Y	right ventral
		Little Manistee River	1211	2,997[2]	Y	right ventral
1978	Michigan	Little Manistee River	1211	5,000[3]	Y	left pectoral
		Pere Marquette River	1410	14,800[3]	Y	left pectoral
		Little Manistee River	1211	10,000[2]	Y	right pectoral
		Pere Marquette River	1410	31,654[2]	Y	right pectoral
Total				170,224		
		LAKE HURON				
1972	Michigan	Au Sable River	1210	9,000[2]	Y	none
Great Lakes Total, Atlantic salmon, 1972–1979				265,102		

[1]Atlantic salmon cross.
[2]Quebec strain.
[3]Swedish strain.

Table 9. Annual plantings (in thousands) of rainbow, steelhead, and palomino[1] trout in the Great Lakes, 1975–1979.[2]

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Total
1975	25	61	228	314
1976	36	400	9	445
1977	31	73	211	315
1978	20	116	88	225
1979	–	156	228	384
Subtotal	112	806	764	1,683

LAKE MICHIGAN

Year	Michigan	Wisconsin	Indiana	Illinois	Total
1975	701	397	217	253	1,568
1976	601	964	217	45	1,827
1977	305	683	48	276	1,312
1978	1,151	613	130	40	1,933
1979	981	1,211	182	215	2,589
Subtotal	3,739	3,868	794	829	9,229

LAKE HURON

Year	Michigan	Ontario	Total
1975	425	62	487
1976	333	33	366
1977	168	119	287
1978	389	85	473
1979	200	47	247
Subtotal	1,515	346	1,860

LAKE ERIE

Year	Michigan	Ontario	New York	Ohio	Pennsylvania	Total
1975	10	223	–	277	19	529
1976	60	250	25	196	113	644
1977	10	287	13	247	181	737
1978	30	51	19	140	117	357
1979	–	366	29	290	249	933
Subtotal	110	1,177	86	1,150	679	3,200

Table 9. (Cont'd.)

	LAKE ONTARIO		
Year	New York	Ontario	Total
1975	252	29	282
1976	186	108	295
1977	144	110	254
1978	313	121	434
1979	325	111	436
Subtotal	1,220	479	1,701
Great Lakes Total, rainbow, steelhead, and palomino trout, 1975–1979			17,673

[1] Rainbow × W. Virginia Golden hydrid (small numbers planted by Pennsylvania only).
[2] Excluding eggs and fry.

Table 10. Plantings of rainbow, steelhead, and palomino[1] trout in the Great Lakes, 1979.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-RAINBOW AND STEELHEAD TROUT				
Minnesota waters (rainbow trout)				
Baptism River	1107	20,043	Y	adipose-right pectoral
Baptism River	1107	9,996	Y	both ventrals
Baptism River	1107	12,742	FF	none
Bluebird Landing	1303	6,200	Y	adipose-right ventral
Brule River	814	29,974	Y	both ventral
Burlington Bay	1303	27,500	FF	none
French River	1302	32,150	FF	none
French River	1302	33,919	Y	adipose-right pectoral
French River	1302	32,243	Y	both ventral
Split Rock River	1106	8,051	Y	both ventral
Stewart River	1204	7,606	Y	left pectoral-right ventral
Sucker River	1302	7,606	Y	left pectoral-right ventral
Subtotal		228,030		
Wisconsin waters (rainbow trout)				
Amnicon	1402	30,000	Y	none
Brule	1404	30,000	Y	left pectoral-right ventral
Superior	1401	96,000	Y	none
Subtotal		156,000		
Total, Lake Superior		384,030		
LAKE MICHIGAN-RAINBOW AND STEELHEAD TROUT				
Illinois waters (rainbow trout)				
Chicago	2603	10,000	SF	none
Chicago	2603	19,200	Y	none
Evanston	2503	31,250	SF,Y	none
Dawes Park	2502	75,370	Y	none
Lake Forest	2402	4,350	SF,Y	none
Waukegan Harbor	2302	46,100	Y	none
Waukegan	2302	5,878	Y	none
Wilmette Harbor	2502	23,300	Y	none
Subtotal		215,448		
Indiana waters (steelhead trout)				
Little Calumet River	2705	8,955	FF	none
Little Calumet River	2705	104,698	SF	left pectoral
Trail Creek	2707	68,252	Y	left pectoral
Subtotal		181,905		

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters (steelhead trout)				
Crockery Creek	1911	5,000	Y	adipose-left pectoral
Crockery Creek	1911	50,000	FF	none
Fish Creek	1911	5,000	Y	adipose-left pectoral
Fish Creek	1911	50,000	FF	none
Flat River	1911	5,000	Y	adipose-left pectoral
Flat River	1911	50,000	FF	none
Grand River	1911	15,000	Y	adipose-left pectoral
Grand River	1911	150,000	FF	none
Looking Glass River	1911	10,000	Y	adipose-left pectoral
Looking Glass River	1911	100,000	FF	none
Muskegon River	1810	10,000	Y	adipose-left pectoral
Muskegon River	1810	35,000	Y	none
Rogue River	1911	15,000	Y	adipose-left pectoral
Rogue River	1911	150,763	FF	none
St. Joseph River	2509	30,000	Y	none
St. Joseph River	2509	300,000	FF	none
Subtotal		980,763		
Wisconsin waters (rainbow trout)				
Algoma	1004	68,500	SF	none
Algoma	1004	15,000	FF	none
Algoma	1004	47,000	Y	none
Baileys Harbor	706	6,000	FF	none
Baileys Harbor	706	25,000	Y	none
Egg Harbor	705	33,310	Y	none
Gill's Harbor	606	18,810	Y	none
Kenosha	2202	29,700	FF	none
Kenosha	2202	8,492	Y	dorsal
Kenosha	2202	46,200	Y	none
Kewaunee	1104	36,700	Y	none
Manitowoc	1303	47,400	FF	none
Manitowoc	1303	41,000	Y	none
Marinette	703	13,592	FF	none
Marinette	703	13,700	Y	none
Milwaukee	1901	54,655	SF	none
Milwaukee	1901	52,706	FF	none
Milwaukee	1901	34,160	Y	none
Oconto Park	802	46,264	FF	none
Oconto Park	802	11,700	Y	none
Peshtigo	803	40,704	FF	none
Port Washington	1701	50,886	FF	none
Port Washington	1701	40,440	Y	none
Racine	2102	62,674	SF	none
Racine	2102	17,955	FF	none
Racine	2102	27,152	Y	none
Sawyer Harbor	905	53,920	FF	none
Sawyer Harbor	905	22,732	Y	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Sheboygan	1502	48,420	FF	none
Sheboygan	1502	64,548	Y	none
Whitefish Bay	805	92,020	FF	none
Whitefish Bay	805	40,000	Y	none
Subtotal		1,211,340		
Total, Lake Michigan		2,589,456		
LAKE HURON-RAINBOW AND STEELHEAD TROUT				
Michigan waters (steelhead trout)				
Au Sable River	1210	100,000	Y	none
Rifle River	1408	100,000	FF	none
Subtotal		200,000		
Ontario waters (rainbow trout)				
Lucknow River	1519	4,600	Y	left ventral
Saugeen River	1221	21,050	Y	right ventral
Saugeen River	1221	21,050	Y	adipose
Subtotal		46,700		
Total, Lake Huron		246,700		
LAKE ERIE-RAINBOW AND STEELHEAD, AND PALOMINO TROUT				
New York waters				
Athol Springs	228	14,600	Y	none
Cattaragus Creek	327	14,000	Y	none
Subtotal		28,600		
Ohio waters (rainbow trout)				
Arcola Creek	813	8,000	SF	none
Beaver Creek	1004	5,000	SF	none
Chagrin River	912	131,680	SF	none
Conneaut Creek	718	55,000	SF	none
Grand River	814	41,200	SF	none
Green Creek	1004	4,500	F	none
Rocky River	911	21,285	SF	none
Turkey River	718	8,000	SF	none
Vermilion River	1008	9,729	F	none
Subtotal		284,394		
Ohio waters (steelhead trout)				
Conneaut Creek	718	5,520	Y	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Ontario waters (rainbow trout)				
Big Creek	321	72,095	SF	none
Big Creek	321	18,480	F	none
Big Creek	321	14,000	Y	left ventral
Big Otter Creek	316	37,500	SF	none
Cranberry Creek	321	22,675	F	none
Dedricks Creek	321	1,550	SF	none
Little Otter Creek	316	35,000	SF	none
Lyndock Creek	321	19,130	F	none
North Creek	321	10,500	F	none
Pirrie Creek	316	15,000	F	none
Saul Creek	321	900	F	none
South Creek	321	37,500	F	none
South Otter Creek	317	20,000	F	none
Stony Creek	321	11,500	F	none
Tobacco Creek	321	1,800	F	none
Venison Creek	321	19,500	F	none
White Creek	318	4,200	F	none
Young Creek	220	17,020	F	none
Young Creek	220	7,200	Y	none
Subtotal		365,550		
Pennsylvania water (rainbow trout)				
Crooked Creek	619	1,250	Y	none
Elk Creek	619	16,700	Y	none
Peck Run	522	600	Y	none
Raccoon Creek	619	50	3 yrs.	none
Sixmile Creek	522	775	Y	none
Sixteenmile Creek	522	1,295	Y	none
Taylor Run	718	50	3 yrs.	none
Taylor Run	718	760	2 yrs.	none
Temple Run	718	8,780	2 & 3 yrs.	none
Temple Run	718	60	3 yrs.	none
Twelvemile Creek	522	550	Y	none
Twentymile Creek	523	9,950	2 yrs.	none
Subtotal		40,820		
Pennsylvania waters (steelhead trout)				
Elk Creek	619	20,000	Y	none
Godfrey Run	619	56,100	Y	none
Lake Erie	620	23,000	Y	none
Sixteenmile Creek	522	20,000	Y	none
Trout Run	620	60,000	Y	none
Walnut Creek	620	20,000	Y	none
Subtotal		199,100		

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Pennsylvania waters (palomino trout)				
Crooked Creek	619	100	Y	none
Elk Creek	619	300	Y, 3yrs.	none
Godfrey Run	619	600	Y	none
Lake Erie	620	6,000	Y	left ventral
Lake Erie	620	500	Y	none
Lake Erie	620	1,000	Y	none
Orchard Beach Run	523	75	Y	none
Sixteenmile Creek	522	5	Y	none
Twelvemile Creek	522	10	Y	none
Twentymile Creek	523	300	Y	none
Subtotal		8,890		
Total, Lake Erie		932,874		
LAKE ONTARIO-RAINBOW TROUT				
New York waters (rainbow trout)				
Lake Ontario	623	5,840	Y	adipose-left pectoral
Lake Ontario	819	17,520	Y	none
Lake Ontario	707	2,650	Y	none
Lake Ontario	708	2,650	Y	none
Lake Ontario	623	12,233	Y	both ventrals
Lake Ontario	819	5,025	F	left pectoral
Lake Ontario	819	135,355	F	none
Lake Ontario	623	26,833	F	none
Subtotal		208,106		
New York waters (steelhead)				
Catfish Creek	623	2,000	Y	left ventral
East Branch Twelvemile Creek	702	10,000	Y	left ventral
Irondequoit Creek	815	4,500	Y	left pectoral-left ventral
Irondequoit Creek	815	10,000	Y	left ventral
Keg Creek	708	7,500	Y	left ventral
Salmon River	623	75,854	Y	left ventral
Sandy Creek	713	7,000	Y	left ventral
Subtotal		116,854		
Ontario waters (rainbow trout)				
Credit River	603	66,429	Y	adipose
Credit River	603	30,791	Y	adipose-right pectoral
Duffin Creek	507	13,440	Y	adipose
Subtotal		110,660		
Total, Lake Ontario		435,620		
Great Lakes Total		4,588,680		

Table 11. Annual plantings (in thousands) of brown and tiger[1] trout in the Great Lakes, 1975–1979.

		LAKE SUPERIOR		
Year	Michigan	Wisconsin	Minnesota	Total
1975	35	103	108	246
1976	35	43	10	88
1977	40	62	31	133
1978	–	94	9	103
1979	15	110	6	131
Subtotal	125	412	164	701

		LAKE MICHIGAN			
Year	Michigan	Wisconsin	Illinois	Indiana	Total
1975	279	356	10	20	665
1976	666	292	94	199	1,251
1977	226	802	42	109	1,180
1978	150	1,208	13	131	1,503
1979	199	960	1	69	1,228
Subtotal	1,520	3,618	160	528	5,827

	LAKE HURON	
Year	Michigan	Total
1975	155	155
1976	447	447
1977	210	210
1978	258	258
1979	90	90
Subtotal	1,160	1,160

		LAKE ERIE		
Year	Ohio	Pennsylvania	New York	Total
1975	–	7	26	33
1976	–	11	67	78
1977	–	49	125	174
1978	28	34	–	62
1979	–	51	26	77
Subtotal	28	152	244	424

	LAKE ONTARIO	
Year	New York	Total
1975	371	371
1976	311	311
1977	353	353
1978	94	94
1979	219	219
Subtotal	1,348	1,348

Great Lakes Total, brown and tiger trout, 1975–1979	9,460

[1] Brown × brook trout hybrid.

Table 12. Plantings of brown and tiger[1] trout in the Great Lakes, 1979.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-BROWN TROUT				
Michigan waters				
Marquette Bay	1529	10,000	FF	none
Munising Bay	1633	5,000	FF	none
Subtotal		15,000		
Minnesota waters				
Baptism River	1107	2,501	Y	none
Big Nett River	1401	602	Y	none
Blackhoof River	1401	797	Y	none
Cascade River	811	401	Y	none
Devil Track River	812	301	Y	none
Kadunce Creek	813	201	Y	none
Kimball Creek	813	201	Y	none
Temperance River	909	401	Y	none
Tischer Creek	1401	501	Y	none
Subtotal		5,906		
Wisconsin waters				
Port Wing	1405	2,500	Y	none
Saxon Harbor	1511	5,000	Y	none
Siskwit	1307	2,500	Y	none
Superior	1401	35,000	F	none
Superior	1401	35,000	Y	none
Washburn	1509	30,138	Y	none
Subtotal		110,138		
Total, Lake Superior		131,044		
LAKE MICHIGAN-BROWN AND TIGER TROUT				
Illinois waters (tiger trout)				
Evanston	2502	1,000	Y	none
Indiana waters (brown trout)				
Inland Steel Pier	2704	28,806	FF	right ventral
Michigan City	2707	13,320	FF	right ventral
Michigan City	2707	26,400	F	none
Subtotal		68,526		

Table 12. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters (brown trout)				
Benton Harbor-St. Joe	2509	50,000	FF	none
Benton Harbor-St. Joe	2509	2,829	Y	none
Betsie River	1011	10,000	Y	none
Black River	2311	19,975	FF	none
Black River	2311	5,093	Y	none
Galien River (N. Buffalo)	2708	25,000	FF	none
Grand Haven	1911	10,000	Y	none
Grand River	1911	10,000	Y	none
Green Bay, Wells St. Park	604	10,000	FF	none
Green Bay, Henes Park	703	10,000	FF	none
Kalamazoo River (Saugatuck)	2211	25,956	FF	none
Pere Marquette River	1410	9,928	Y	none
Green Bay, Rochereau Point	604	10,000	FF	none
Subtotal		198,781		
Wisconsin waters				
Algoma	1004	31,180	FF	none
Algoma	1004	37,900	Y	none
Baileys Harbor	706	10,000	FF	none
Baileys Harbor	706	17,700	Y	none
Egg Harbor	705	17,360	FF	none
Egg Harbor	705	30,400	Y	none
Kenosha	2202	23,000	FF	none
Kenosha	2202	25,200	Y	none
Kewaunee	1104	15,000	FF	none
Kewaunee	1104	22,500	Y	none
Little Sturgeon Bay	803	12,000	FF	none
Little Sturgeon Bay	803	22,000	Y	none
Manitowoc	1303	58,200	FF	none
Manitowoc	1303	67,960	Y	none
Marinette	703	20,500	FF	none
Marinette	703	10,300	Y	none
Milwaukee	1901	49,900	FF	none
Milwaukee	1901	28,642	Y	none
Oconto Park	802	31,750	FF	none
Oconto Park	802	17,400	Y	none
Point Creek	1402	14,200	Y	none
Port Washington	1701	30,200	FF	none
Port Washington	1701	23,600	Y	none
Racine	2102	32,000	FF	none
Racine	2102	25,970	Y	none
Sawyer Harbor	905	36,000	FF	none
Sawyer Harbor	905	53,700	Y	none
Sheboygan	1502	55,100	FF	none
Sheboygan	1502	65,180	Y	none
Whitefish Bay	805	32,300	FF	none
Whitefish Bay	805	42,400	Y	none
Subtotal		959,542		
Total, Lake Michigan		1,227,849		

Table 12. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
LAKE HURON-BROWN TROUT				
Michigan waters				
Point Lookout	1408	10,000	FF	left pectoral
Point Lookout	1408	10,000	Y	left ventral
Tawas Bay	1309	10,000	FF	left pectoral
Tawas Bay	1309	10,000	Y	left ventral
Thunder Bay	809	25,000	Y	left ventral
Thunder Bay	809	25,000	F	left pectoral
Subtotal		90,000		
Total, Lake Huron		90,000		
LAKE ERIE-BROWN TROUT				
New York waters				
Silver Creek	326	26,000	Y	left ventral
Pennsylvania waters				
Albion Reservoir (Temple Creek)	718	840	Y	none
Baldwin Pond (Raccoon Creek)	619	410	Y	none
Conneaut Creek	718	950	Y	none
Crooked Creek	619	1,650	Y	none
Elk Creek	619	4,400	Y	none
Lake Erie	620	5,000	Y	left ventral
Lake Erie	620	33,800	Y	none
Temple Run	718	2,290	Y	none
Twentymile Creek	523	1,650	2 yrs.	none
Subtotal		50,990		
Total, Lake Erie		76,990		
LAKE ONTARIO-BROWN TROUT				
Lake Ontario	523	20,000	Y	adipose-right ventral
Lake ontario	623	38,470	Y	none
Lake Ontario	705	15,000	Y	none
Lake Ontario	707	5,000	Y	none
Lake Ontario	708	25,000	Y	none
Lake Ontario	711	12,500	Y	adipose
Lake Ontario	713	25,000	Y	adipose-left ventral
Lake Ontario	721	20,000	Y	none
Lake Ontario	815	16,220	Y	none
Lake Ontario	816	8,000	Y	none
Lake Ontario	817	13,891	Y	none
Lake Ontario	819	7,109	Y	none
Lake Ontario	819	12,500	Y	adipose
Subtotal		218,690		
Total, Lake Ontario		218,690		
Great Lakes Total		1,744,573		

[1]Brown × brook trout hybrid.

Table 13. Annual plantings (in thousands) of brook trout in the Great Lakes, 1976–1979.

LAKE SUPERIOR

Year	Wisconsin	Minnesota	Total
1976	25	7	32
1977	123	66	188
1978	166	30	196
1979	83	27	111
Subtotal	397	130	527

LAKE MICHIGAN

Year	Michigan	Wisconsin	Illinois	Total
1976	61	12	6	79
1977	–	643	–	643
1978	–	243	5	248
1979	–	187	8	196
Subtotal	61	1,085	19	1,166

LAKE ERIE

Year	Pennsylvania	Total
1976	6	6
1977	2	2
1978	2	2
1979	–	–
Subtotal	10	10

LAKE ONTARIO

Year	New York	Total
1976	–	–
1977	8	8
1978	–	–
1979	–	–
Subtotal	8	8

Great Lakes Total, brook trout, 1976–1979	1,711

Table 14. Plantings of brook trout in the Great Lakes, 1979.

Location	Grid No.	Numbers	Age	Fin Clip
		LAKE SUPERIOR-BROOK TROUT		
Minnesota waters				
Blackhoof River	1401	802	Y	none
Cascade River	811	591	Y	none
Chester Creek	1401	149	Y	none
Deer Yard Creek	811	1,088	FF	none
Devil Track River	812	201	Y	none
E. Split Rock River	1205	1,405	Y	none
Encampment River	1205	274	Y	none
French River	1302	1,998	Y	none
Gooseberry River	1205	1,075	Y	none
Grand Marais Harbor	812	4,000	Y	none
Kadunce Creek	813	201	Y	none
Kimball Creek	813	301	Y	none
Knife River	1303	2,704	Y	none
Lester River	1302	3,855	Y	none
Poplar River	910	301	Y	none
Stewart River	1301	1,075	Y	none
Stony Point	1303	2,501	Y	none
Sucker River	1303	1,998	Y	none
Talmadge River	1302	148	Y	none
Tischer Creek	1401	148	Y	none
Two Harbors	1204	2,484	Y	none
Subtotal		27,299		
Wisconsin waters				
Bayfield	1409	27,000	F	none
Bayfield	1409	18,700	F	none
Brule River	1404	5,037	Y	right pectoral
Michigan Island	1310	100	A	none
Port Wing	1405	7,000	Y	none
Siskuit	1307	7,000	Y	none
Washburn	1509	12,000	F	none
		6,500	Y	none
Subtotal		83,337		
Total, Lake Superior		110,636		
		LAKE MICHIGAN-BROOK TROUT		
Illinois waters				
Dawes Park	2502	8,260	Y	none

Table 14.

Location	Grid No.	Numbers	Age	Fin Clip
Wisconsin waters				
Baileys Harbor	706	13,620	Y	none
Kewaunee	1104	14,350	Y	none
Manitowoc	1303	56,940	Y	none
Marinette	703	13,620	Y	none
Point Creek	1402	10,000	Y	none
Sawyer Harbor	905	11,000	Y	none
Sheboygan	1502	45,600	Y	none
Whitefish Bay	805	22,200	Y	none
Subtotal		187,330		
Total, Lake Michigan		195,590		
Great Lakes Total		306,226		

SEA LAMPREY CONTROL IN THE UNITED STATES

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Two notable events took place during 1979. The electrical sea lamprey weirs on Lake Superior were operated for the last time and the Sea Lamprey International Symposium was held at Marquette, Michigan.

The spring of 1980 will mark the first time in 28 years that electrical sea lamprey weirs will not be operated along the south shore of Lake Superior. Over the 27-year span of operation, 61 weirs were operated for one or more years. These barriers prevented nearly 450,000 adult sea lampreys from spawning in tributary streams. The weir in the Brule River, Wisconsin, caught over 26% of the number captured in United States waters of Lake Superior.

The Sea Lamprey International Symposium, sponsored by the Great Lakes Fishery Commission and convened at Marquette, Michigan, in August 1979, was attended by 88 scientists from 10 countries. The conference provided a forum where specialists from many professional disciplines discussed sea lamprey control and extensive research and studies of lamprey biology, fish-lamprey interactions, and the socioeconomic impacts of sea lamprey predation and control. Thirteen members of the staff at Marquette and Ludington were directly involved in the symposium, either administratively or through the presentation of papers.

Good progress was made in all phases of sea lamprey control in 1979. a total of 38 streams with a combined flow of 175.1 m^3/s were treated in the United States: 11 on Lake Superior, 17 on Lake Michigan, and 10 on Lake Huron.

Stream surveys were conducted on 314 tributaries of the Great Lakes. Sea lamprey ammocetes were discovered for the first time in two small tributaries of northern Lake Huron and the St. Louis River in western Lake Superior.

Most assessment methods indicate a reduced sea lamprey population in the three upper Great Lakes. A total of 2,413 adult sea lampreys were captured at the eight index barriers in 1979—the third-lowest catch on record. Previous low catches were in 1974 (1,912) and 1976 (2,098).

Portable assessment traps fished in 22 tributaries of four lakes captured 18,129 adult sea lampreys: 1,313 from Lake Superior, 5,561 from Lake Michigan, 9,548 from Lake Huron, and 1,707 from Lake Ontario. Catches in 1978 totaled 20,641 sea lampreys from 37 tributaries of the four lakes.

The number of parasitic-phase sea lampreys collected from commercial and sport fishermen increased slightly in Lake Superior and decreased slightly in Lakes Michigan and Huron. The total number collected from the three lakes decreased from 820 in 1978 to 644 in 1979.

Surveys and Chemical Treatments

Lake Superior Surveys

Pretreatment investigations were completed on 15 streams in 1979, of which 8 were later treated. In the seven untreated streams, sea lamprey populations are apparently relatively large in two, the Bad and Brule rivers, and small to moderate in five. Five of the streams are tentatively scheduled for treatment in 1980, and two will be treated when the size and abundance of lamprey larvae warrants.

Larvae that survived recent chemical treatments were recovered in 11 streams. The problem was most pronounced in sections of three rivers—the Bad (52 sea lampreys), Potato (27), and Traverse (22).

Substantial upstream extensions of larval distribution were discovered in two rivers. Sea lamprey ammocetes were found about 25 km above their former range in the Brule River, and about 35 km above the upstream limits that had prevailed since the mid-1950's in the Sucker River. These extensions probably resulted from the relatively late activation of control barriers and more favorable water levels in headwater areas in recent years.

In a resurvey of the Point Louise area in the upper St. Marys River, which yielded few sea lamprey larvae in past years (1 in 1973 and 3 in 1974), two sea lamprey larvae (69 and 71 mm long) and 640 American brook lamprey larvae were collected. Collections at another station, 270 m to the east, included two additional sea lamprey ammocetes of another year class (108 and 111 mm) and demonstrated that the extensive gravel beds in this area are periodically used by spawning adults.

Another significant problem now developing along the U.S. shore is the recent sea lamprey infestation of the St. Louis River (Fig. 1). Until a new waste treatment plant became operational in 1978–79, the stream probably was not suitable for sea lamprey production because water

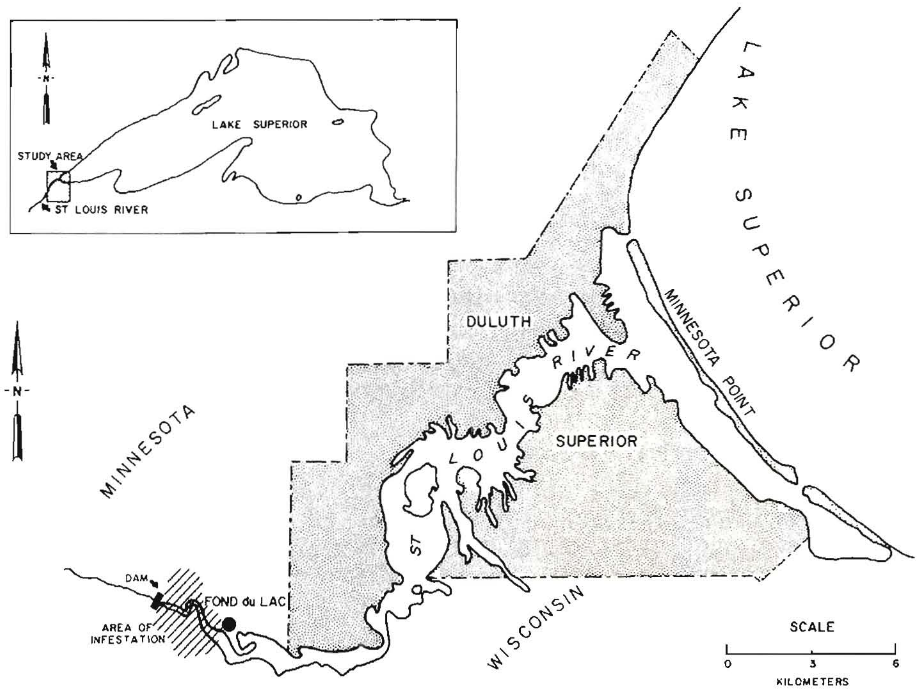

Figure 1. St. Louis River, showing portion of the river infested with sea lampreys. Insert shows location of St. Louis River on Lake Superior.

quality was poor. Larvae were found for the first time in the river in September 1979, and it appears likely that the population will increase. The length range of the 10 larvae collected (13 to 27 mm) indicated that they are of the 1979 year class, and it appears that the population is restricted to about 3.2 km of the main stream immediately below the barrier dam at Fond du Lac.

Treatment of the St. Louis River will be costly and difficult. The stream is the largest U.S. tributary to Lake Superior; flows between 17 m^3/s and 170 m^3/s during the summer and early autumn, when treatment would probably take place. The occurrence of large spawning runs of walleyes and suckers makes treatment earlier in the year undesirable. Much of the river below Fond du Lac is at or near lake level and subject to seiches, and flows of approximately 34 m^3/s are judged necessary to ensure effective treatment. At this volume, cost of treatment with TFM and 1.6% Bayer powder is estimated at $82,000. Lake seiches, multiple channels, large backwater areas, and deep water in the downstream reaches will greatly complicate treatment.

Lake Superior Chemical Treatments

During the 1979 field season, chemical treatments were completed on 11 streams with discharges totaling 24.7 m^3/s (Table 1, Fig. 2). Numbers of larval sea lampreys were high in the Huron and Two Hearted rivers and low in the rest of the streams.

Major obstacles during 1979 treatments to eradication of larval lampreys continued to be problems of access, beaver activity, and fluctuating water levels. Combinations of these factors could result in the survival of lamprey larvae in the Two Hearted, Big Garlic, and Au Train rivers and Furnace and Little Beaver creeks.

Mortality of pink salmon during fall treatments in odd-numbered years is becoming a problem, particularly in Lake Superior tributaries. The effects of a minimum lethal bank of TFM were observed on a small run of pink salmon in the Ravine River. It was estimated that about 200 salmon were present in the river during the chemical application. A concentration of TFM which averaged 0.5 ppm above the minimum lethal for sea lampreys was applied to the river. In a posttreatment survey made immediately after the chemical had cleared the river, 203 pink salmon were collected; of which 119 (77 males, 42 females) were dead, 18 were sick, and 66 appeared normal. Further examination of the dead females showed that 6 were spent, 8 were ripe with free-flowing eggs, and 28 had firm ovaries with no free-flowing eggs. A scheduled

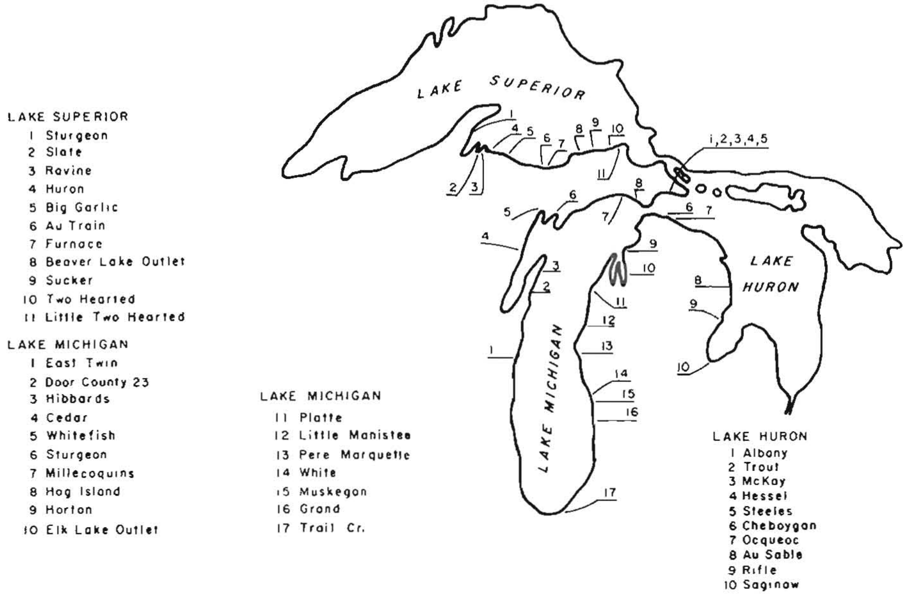

Figure 2. Location of streams tributary to the Upper Great Lakes that were treated with lampricides in 1979.

treatment of the Silver River was postponed when thousands of pink salmon were observed in the river. Spawning salmon were present in the river from mid-September until late October.

Lake Michigan Surveys

Pretreatment surveys were completed on 14 streams tributary to Lake Michigan in 1979. Twelve were subsequently treated; two, the Kalamazoo and Black (Van Buren County) rivers, will not be treated because the populations of sea lamprey larvae in both were relatively small.

A total of 112 streams were examined to monitor reestablished sea lamprey populations and to assess the success of the most recent stream treatments; of these, 55 were reinfested with larvae of various year classes. Moderate to large reestablished populations were indicated in the Carp Lake, Jordan, Manistee, Lincoln, Platte, Muskegon, Black (Mackinac County), Fishdam, Ogontz, Whitefish, Rapid, and Ford river systems.

Residual larvae were collected in 14 streams. The Whitefish River collections contained the largest number (620) of ammocetes that survived the 1978 chemical treatments.

Surveillance of the Fox River was given high priority in 1979. Despite the greatly improved water quality in the lower river and the capture of 59 adult silver lampreys in portable assessment traps at De Pere, there is still no evidence of sea lamprey spawning or survival of larvae anywhere in the system. The main stream below the dam at De Pere was sampled with granular Bayer at 21 separate sites (total area, 4.6 ha) and the tributaries below the outlet of Lake Winnebago were reexamined. No lampreys of any species were seen. Spawning gravel and larval habitat are plentiful in the main river, but bottom conditions may still be too poor to allow ammocetes to survive. There is almost no potential for lamprey production in the tributaries. Sampling in the system above Lake Winnebago was concentrated in the tributaries of Lake Poygan and the Wolf River drainage. A total of 2,514 native lampreys were collected in areas that in past surveys appeared best suited for sea lampreys. The collections included 178 metamorphosed silver lampreys, 43 metamorphosed northern brook lampreys, and 2,293 larvae that could be identified only as *Ichthyomyzon*.

Lake Michigan Chemical Treatments

Chemical treatments were completed on 17 streams with discharges totaling 120.3 m^3/s in 1979 (Table 2, Fig. 2). Numbers of larval sea lampreys were large in the Sturgeon River, intermediate in the Cedar, Little Manistee, Pere Marquette, White, and Muskegon rivers, and small in the other 11 streams.

Treatment of the Whitefish River was postponed because water levels were extremely low. Recently metamorphosed sea lampreys from the Whitefish River could contribute significant numbers of parasitic-phase sea lampreys to Lake Michigan.

Fish mortalities during chemical treatments, even though relatively small, continued to create public relations problems. Spawning white and longnose suckers are sensitive to control chemicals and a small percentage of a spawning run may die during each treatment. A kill of several hundred white and longnose suckers during treatments of the Cedar River and Hibbards Creek resulted in additional cost for clean up and disposal.

Lake Huron Surveys

Pretreatment surveys were completed on nine Lake Huron stream systems in 1979, and all were later treated partly or entirely. Small to moderate numbers of sea lampreys were indicated in all but the Rifle River, where a large population of larvae was present.

Investigations were conducted on 37 streams to assess re-established larval populations and evaluate the effectiveness of recent chemical treatments. Reinfestation by various year classes of larvae was found in 23 drainages; concentrations were largest in the East Au Gres and Little Munuscong rivers and Albany Creek.

A fish ladder at the Dow Chemical Company dam on the Tittabawassee River (Saginaw River system) has been closed between March 1 and July 15 each year since 1977, effectively closing off the Chippewa River and Bluff Creek to spawning sea lampreys. No reestablished sea lamprey larvae have been found above the dam since closure of the ladder.

Residual sea lamprey ammocetes were collected in seven streams. Larval numbers were low except in the upstreams sections of the Rifle River, where 198 ammocetes and 5 recently transformed lampreys were collected. Inland lakes, ponds, and backwaters in this section of the river complicate control eforts. Many metamorphosing sea lampreys were taken during the treatment, indicating that ammocetes may transform at age III in this river. The last previous treatment was in July 1975.

Only one residual sea lamprey was recovered from the upper Ocqueoc River during surveys in late summer, and sampling with granular Bayer in Ocqueoc Lake yielded none. However, 18 newly metamorphosed sea lampreys were captured in fyke nets below Ocqueoc Lake in the fall.

Sixteen streams where sea lampreys were not found in the past were reexamined; populations were discovered in 2 tributaries of northern Lake Huron. Eight sea lampreys (25–75 mm long) were collected in Flowers Creek near Cedarville, and one (124 mm) was taken in Huron Point Creek, a small stream about 0.8 km east of Albany Creek. Huron Point Creek has little potential for sea lamprey production, the single ammocete probably migrated from Albany Creek or its associated offshore population.

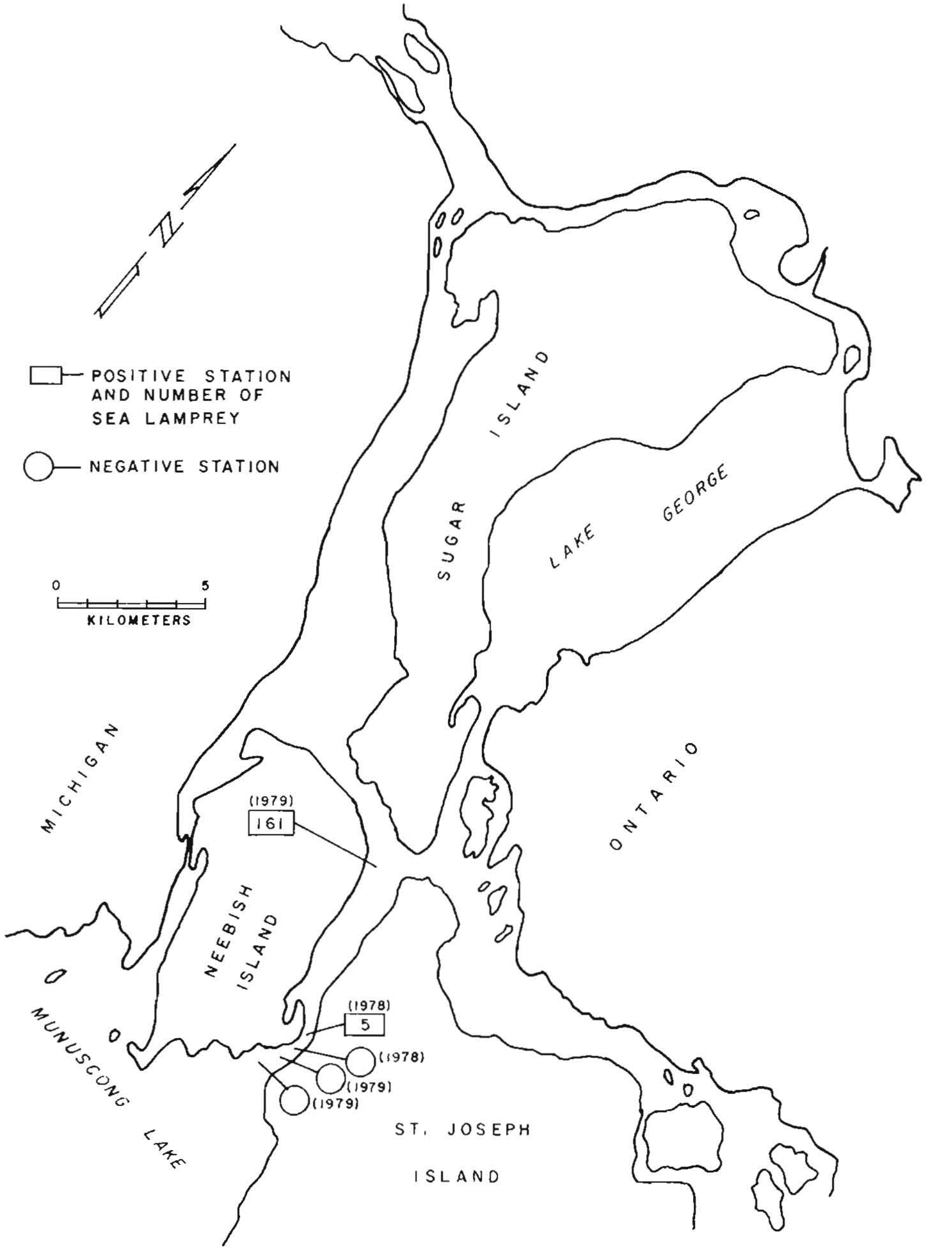

Figure 3. St. Marys River, showing principal sea lamprey ammocete concentration and downstream limits in 1979.

Sea lamprey larvae were recovered during surveys with granular Bayer offshore from two northern Lake Huron streams: 53 (33–96 mm long) off the mouth of the Carp River (most within 0.4 km of the mouth, but some up to 0.8 km from shore); and 11 (42–131 mm) from a 5.9-hectare area in Hammond Bay off the mouth of the Ocqueoc River.

Sea lamprey ammocetes caged in five streams since May 1977 to determine growth and age at metamorphosis were examined in May and October 1979. Although the age III larvae in some cages had a mean length of 134 mm and a maximum length of 150 mm, no metamorphosis occurred.

Surveys with granular Bayer in the St. Marys River were continued in 1979 to define the distribution and relative abundance of sea lamprey larvae. Surveys in 1978 revealed that larvae were scattered throughout 37 km of river downstream from the compensating gates. No larvae were collected at two stations in 1979 beyond the downstream limits of the 1978 survey. The river opens into Lake Munuscong in this area (no surveys were made in the lake). A station (370 m^2) in the Neebish Island area (Fig. 3) that accounted for 44 larvae in 1978, reexamined to obtain more data on the size of larvae, yielded 161 sea lamprey larvae, 39–127 mm long. This total is only six less than were collected from all 20 stations in 1978, and indicates a concentration of larvae in this area.

Lake Huron Chemical Treatments

Chemical treatments were completed on 10 streams with discharges totaling 30.1 m^3/s during the 1979 field season (Table 3, Fig. 2). Numbers of larval sea lampreys were high in the Sturgeon and Ocqueoc rivers, intermediate in the Chippewa and Rifle rivers and McKay and Steeles creeks, and low in the other four streams. Collections made during the first treatment of the Chippewa River indicated a moderate population of sea lamprey larvae distributed from Mount Pleasant, Michigan, upstream for 30 km. Few ammocetes were found downstream from Mount Pleasant.

The lower 3 km of Albany Creek was treated to destroy a population of residual sea lamprey larvae. The headwaters, which contained a population of reestablished ammocetes, could not be treated because flows were too low and the water was impounded. Treatments were postponed on Swan Creek because flows were low and on the Au Sable River because a large run of chinook salmon was in the stream. The Au Sable River will probably contribute sea lampreys to the parasitic population in Lake Huron because of this postponement.

Several problems were encountered during treatments. Salmonid runs, beaver activity, and low water flows continue to present major problems. Treatment success was diminished on Steeles, Hessel, and Albany creeks and the Rifle and Pine rivers because of beaver activity and low water. Groundwater seepages below the falls on the Ocqueoc River have provided a haven to ammocetes during treatments.

Lentic populations of sea lamprey ammocetes continue to plague control efforts. A large population of ammocetes was detected off the mouth of Albany Creek, but further survey of this area is needed to determine the area of distribution. The large number of ammocetes in the lower Sturgeon River during treatment suggests a potential source for the contamination of Burt Lake in the Cheboygan River system.

Lake Erie Surveys

Surveys were conducted on seven streams tributary to Lake Erie. Investigations on Cattaraugus Creek indicated that the abundance and distribution of sea lamprey larvae have increased. A total of 211 sea lampreys (12–156 mm long) were taken at stations on the main stream, the South Branch, and Clear and Spooner creeks. Spooner Creek had no previous record of sea lamprey production.

Of the other six streams examined in 1979, two—Delaware Creek, Erie County, and Canadaway Creek, Chautauqua County—were also reexamined for changes in larval distribution and abundance since the surveys in 1978. A total of 24 sea lampreys (54–171 mm long), including 4 undergoing metamorphosis, were collected from Delaware Creek, which appears to have no significant increase in larval distribution or abundance. A slight increase in sea lamprey abundance and spread in distribution was noted in Canadaway Creek, where 30 sea lamprey larvae (11–59 mm) were collected from the main stream and Beaver Creek, a tributary that had no previous record of sea lamprey production.

An extensive examination of the Buffalo River system yielded only American brook lampreys and *Ichthyomyzon* larvae.

Further investigations to update information on streams in Pennsylvania and Ohio are needed. Distributional surveys on Conneaut, Crooked, and Raccoon creeks and the Grand and Sandusky rivers, all of which have yielded sea lampreys in the past, will be required. Streams that appear suitable for sea lampreys, but that have thus far yielded no evidence of infestation, will require further study.

Lamprey surveys in western Lake Erie are seriously handicapped by the lack of a permit to use Bayer 73 in the State of Ohio. Highly conductive water, high turbidity, and the presence of estuaries—conditions that are common in the western tributaries—severly reduce the effectiveness of the electrofishing gear used for larval surveys. In other states, a granular formulation of Bayer 73 is routinely used under these conditions, but Bayer 73 is not used in Ohio because of the State's concern for native lampreys and other endangered fishes. Consequently, the reliability of surveys in demonstrating the presence or absence of larvae and their abundance and distribution in those streams is questionable.

The necessity of treating Lake Erie streams to control sea lamprey populations has been accepted by most of the agencies concerned. However, if and when a decision is made to extend controls to that basin, it is essential that the State of Ohio sanction the use of lampricides.

Lake Ontario Surveys

Surveys were conducted on 20 streams in the Lake Ontario basin in 1979; 12 are tributary to Lake Ontario proper, 3 are part of the Oswego River system, and 5 empty into the Niagara River.

Pretreatment investigations completed in the Black River, Jefferson County, confirmed that a series of dams at Watertown are definite barriers to spawning run adults and restrict sea lampreys to the lower 14.5 km of stream. A total of 146 larvae (19–161 mm long) and 16 metamorphosing lampreys were collected in 1979. The upstream limit of larval distribution was a point just above the reservoir at Dexter, New York, about 6 km from the mouth. The habitat between the upper limits of larval distribution and the dam at Watertown is almost entirely bedrock, rubble, and gravel, and has little potential for production of larvae. Treatment of the Black River will be complicated by the presence of larvae in the flowage at Dexter. Also, the probability of a lentic population in Black River Bay was suggested by the capture of a single ammocete (123 mm long) about 2.4 km off the mouth during limited surveys in 1978.

Surveys of Black Creek, a tributary of lower Oswego River, suggest that sea lampreys have been produced there almost annually since the early 1970's. The 1979 larval collections (70 sea lampreys, 33 to 144 mm long) indicated successful reproduction in 1976, 1977, and 1978. Young-of-the-year larvae were captured in 1977, along with larvae and metamorphosing lampreys that had been spawned several years earlier, probably in the period 1972–74. The 1972 and 1974 year classes were evident in survey collections made in 1976.

The origin of the adult lampreys that spawn in Black Creek is uncertain, but it seems likely that they migrate upstream from Lake Ontario. However, the possibility that they originate from an adult population further upstream in the Oswego River system itself cannot be dismissed. The mouth of Black Creek is 13 km above Lake Ontario, and spawning adults must bypass three dams, probably by way of navigation locks, to reach the tributary. The only known resident populations of adult sea lampreys in the Oswego River system are in Oneida, Cayuga, and Seneca lakes, which are 46, 99, and 120 km, respectively, upstream from Black Creek.

Chemical treatment of Black Creek is recommended because of the frequent establishment of larval year classes and the production of metamorphosed sea lampreys, which almost certainly migrate downstream 13 km to Lake Ontario. Infestation is now confined to one small tributary and the main stream below the tributary, and chemical treatment should be simple and inexpensive.

Two Lake Ontario tributaries—Grindstone and Johnson creeks—were examined to determine the effectiveness of dams as barriers to adult sea lampreys. No ammocetes were found above the dams in either stream. Ammocetes occur in Grindstone Creek below the dam at Fernwood, but Johnson Creek has not yielded larvae—although adult lampreys have been reported by residents.

No previously undetected sea lamprey populations were found in Lake Ontario streams in 1979. An initial check of streams on Grand Island in the Niagara River revealed little potential for sea lamprey production. A survey of Irondequoit Creek produced nine American brook lamprey ammocetes. Adult sea lampreys were seen in the stream in the past, and the headwater areas have potential for sea lamprey production. However, Irondequoit Bay and the lower section of the stream are heavily polluted and probably unattractive to spawning adults.

Lake Ontario Chemical Treatments

Stream treatments on the U.S. side of Lake Ontario are now the responsibility of the Canadian control agent.

Studies of Adult Sea Lampreys

Migrant Sea Lampreys

The eight index barriers on Lake Superior were operated for the last time in 1979. In the future, portable assessment traps will provide data on relative abundance and biological characteristics of spawning-phase sea lampreys. A total of 2,413 sea lampreys were captured at the barriers in 1979—the third-lowest catch on record (Table 4, Fig. 4). Previous low catches were in 1974 (1,912) and 1976 (2,098). The barrier on the Brule River in western Lake Superior accounted for 50% of the catch in 1979.

Analysis of the barrier catches in the Brule and Amnicon rivers showed dramatic decreases in runs of adults in the year after chemical treatments, followed by almost steady increases each year until the next treatment. For example, the run of adults in the Brule River declined from 6,163 in 1965 to 226 in 1966 (a 96% decrease) after the river was treated in 1965 (Table 4). By the time the river was re-treated in 1969, the run had increased to 3,374 adults, but it then decreased to only 167 in 1970 (a 95% decrease). Other decreases were 94% after the 1972 treatment and 69% after the 1977 treatment.

Similar declines were observed in the Amnicon River after chemical treatments in 1971, 1975, and 1978, the number of adults decreasing one year after chemical treatment by 97, 97, and 98%, respectively. These data support the hypothesis that adults are attracted to streams containing large populations of ammocetes, and this attraction is greatly diminished after ammocetes are destroyed by chemical treatments.

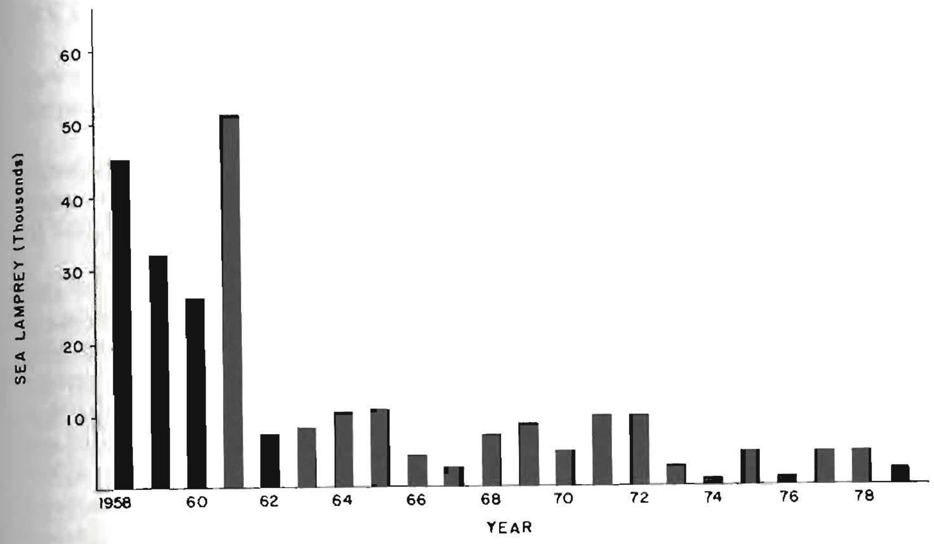

Figure 4. Annual catches of spawning-run sea lampreys at eight electric barriers on Lake Superior tributaries, 1958–79.

Barrier catches during 1973–79 indicate a 50% reduction in the adult sea lamprey population since the frequency of treatments was increased in 1972, and a 93% reduction from the 51,000 adults taken in the eight barriers in 1961. The average number of lampreys captured annually was 3,340 in 1973–79 and 6,600 in the previous 7 years, 1966–72.

The average length (433 mm) and weight (181 g) of adult sea lampreys from Lake Superior in 1979 were similar to the averages in the previous 5 years (Table 5), when the average length was 431 mm and weight 177 g. Of adult sea lampreys collected in Lake Superior, 33% were males; for the previous 8 years (1971–78) this percentage varied from 29 to 31.

The number of rainbow trout (1,606) handled at the barriers on Lake Superior increased about 12% over both the 1978 catch (1,433) and the 1974–78 average (1,443). Data from the Brule River provided evidence that most adult rainbow trout migrated up this stream before the electrical weir was activated. Between September 1978 and April 1979, about 2,000 large rainbow trout were passed over a mechanical weir operated by the Wisconsin Department of Natural Resources about 19 km upstream from the electrical barrier. During operation of the electrical barrier, April 25–July 13, 1979, only 597 large rainbow trout were handled.

The catches of longnose suckers (7,190) and white suckers (9,317) were significantly lower than the large catches in 1978 and somewhat lower than the 1974–78 averages of 9,545 longnose suckers and 9,976 white suckers.

The evidence of sea lamprey scars or wounds on spawning-run rainbow trout remained low. From 1974 to 1978, the percentage ranged from 0.8 to 3.4 and averaged 1.7; in 1979 it was 2.2.

Adult sea lamprey catches in the assessment weir on the Ocqueoc River on Lake Huron continue to fluctuate. A total of 3,248 adults were captured in 1979, compared with 2,121 in 1978, 503 in 1977, and 6,937 in 1976.

A barrier dam was built on Weston Creek, a tributary of the Manistique River (Lake Michigan), by inserting stop logs in an existing structure to prevent sea lampreys from bypassing a dam and gaining access to the upper Manistique River. Since 1974, an electrical barrier blocked the spawning run, but occasional power failures allowed a few adults to bypass the dam. The water over the barrier dam is about 61 cm deep and has a velocity of 1 m/s. The vertical drop from the low water level to the top of the barrier is 43 cm. No sea lampreys were observed surmounting the barrier dam nor captured in a temporary electrical barrier installed upstream of the barrier dam to assess its effectiveness. A portable assessment trap fished below the barrier dam captured 146 sea lampreys, indicating that many lampreys were in the stream. Four large rainbow trout apparently jumped the barrier and were observed on redds below the electrical barrier. The barrier dam apparently is more effective in preventing escapement of adults than the electrical barrier formerly used.

Assessment Traps

Investigations to locate suitable areas for the operation of portable assessment traps continued in 1979. A total of 35 traps fished on 22 tributary rivers of four of the Great Lakes captured 18,129 sea lampreys (Table 6, Fig. 5). Lampreys were trapped in all but two of the rivers. Since these investigations began in 1977, traps operated in 64 Great Lakes tributaries have collected 48,958 spawning adult sea lampreys.

Most potential assessment sites in tributaries of the three Upper Great Lakes have been evaluated. Annual trapping stations were selected on 6 Lake Superior tributaries (Tahquamenon, Betsy, Miners, Rock, Big Garlic, and Iron rivers), 11 Lake Michigan streams (Fox, Oconto, Peshtigo, Menominee, Manistique, Carp Lake, Jordan, Boardman, Betsie, Muskegon, and St. Joseph rivers), and on 3 Lake Huron streams (St. Marys, Cheboygan, and Trout rivers).

A total of 1,313 sea lampreys were trapped in four tributaries of Lake Superior. The number of lampreys captured in the Big Garlic, Rock, and Tahquamenon rivers increased from 135, 508, and 310 adults in 1978 to 191, 677, and 433 adults in 1979, respectively. A trap fished for the first time at the low-head barrier dam in the Miners River captured 12 adult sea lampreys. Although the catch at this site was low, the

Figure 5. Location of streams tributary to the Great Lakes where assessment traps were fished in 1979.

barrier presents an excellent trapping situation. Monitoring of the apparently small sea lamprey run on the Miners River will continue.

Length, weight, and sex ratios of sea lampreys trapped in Lake Superior streams were similar to those of lampreys taken in the eight electrical barriers in 1979 (Table 7). Average lengths and weights for lampreys captured in the four assessment traps of Lake Superior were 431 mm and 179 g, compared with 433 mm and 181 g for lampreys taken in the electrical barriers. Male sea lampreys represented 37% of the catch in the assessment traps and 33% in the electrical barriers.

Assessment traps were fished in six Lake Michigan rivers along the north and west shores in 1979. Traps were operated below dams in the Fox and Oconto rivers (tributaries of southern Green Bay) to determine the effects of pollution abatement on sea lamprey migrations. Although no sea lampreys were captured in the Fox River, 59 silver lampreys were collected in two traps placed at the De Pere dam. These captures indicate that the traps should have taken sea lampreys if they had been present in significant numbers. Only three sea lampreys were captured in the Oconto River, indicating that this once heavily polluted river continues to attract only limited numbers of migrant adults. Traps fished in the Peshtigo and Menominee rivers (Green Bay) collected 396 adult sea lampreys, compared with 4,200 in 1978 and 1,358 in 1977. The 94% reduction in the number of sea lampreys captured attests to the high efficiency of the chemical treatments in the Peshtigo River in 1977 and 1978. The significantly reduced trap catch, the recent decline in the rate of lake trout scarring, and the dramatic drop in the number of parasitic-phase sea lampreys collected by commercial fishermen indicate a much reduced sea lamprey population in Green Bay. Combined average lengths and weights for 69 sea lampreys from these rivers were 485 mm and 228 g; 55% were males.

The sea lamprey catch from the Manistique River (Lake Michigan) was similar in 1979 (4,948) and 1978 (5,408), although trapping effort was nearly doubled in 1979. On the basis of catch per unit of effort and the increase in the recovery of sea lampreys marked and released (13% in 1978 and 32% in 1979), we estimate a reduction in the spawning run in 1979 of at least 50%. Average lengths and weights for 1,486 sea lampreys examined were 487 mm and 236 g; males represented 44% of the population.

The operation of traps along the eastern shore of Lake Michigan was suspended (one exception) during 1979 so that other potential sites could be investigated. The capture of 68 adults in Carp Lake River, at the site of the old downstream migrant sea lamprey trap, resulted in the selection of this station for future assessment in Lake Michigan.

Fishing of assessment traps in Lake Huron tributaries was expanded to include four new tributaries in 1979. This work proved unproductive; the experimental assessment sites in the Sturgeon, Black, Thunder Bay, and Au Sable rivers produced a total of only six sea lampreys. The poor results precludes further work in these rivers.

The operation of portable traps at index stations in the St. Marys, Cheboygan, and Trout rivers of Lake Huron continued in 1979. The catch of sea lampreys in the St. Marys River remained about the same in 1979 (1,213) as it was in 1978 (1,148). Average lengths and weights for the 491 sea lampreys examined were 472 mm and 222 g, and males and females were equally represented in the population. Although the catch in the Cheboygan River increased from 3,360 in 1977 to 6,489 in 1978 to 8,327 in 1979, trapping effort was increased at a similar rate, suggesting that this large run has been stable over the past 3 years. Average lengths and weights of 534 lampreys from the river were 441 mm and 196 g; 38% were males. Because high water eroded a small bypass around the dam on the Trout River, the catch of only two spawning adults may not accurately reflect the magnitude of the run in this river. Improvements to the dam are necessary to maintain its usefulness as an index station.

Traps in four Lake Ontario tributaries, operated for the second consecutive year, captured 1,707 sea lampreys in 1979, compared with 721 in 1978. The catch nearly doubled in Grindstone Creek (315 to 623) and increased over five times in Catfish Creek (65 to 360). Combined average lengths and weights for 1.593 lampreys from these streams were 485 mm and 261 g. The percent males ranged from 50 to 52. All remaining potential trap sites on Lake Ontario have been visually examined to determine their suitability; trapping is expected to proceed on nine additional tributaries in 1980.

Parasitic Sea Lampreys

The collection of parasitic-phase sea lampreys taken by fishermen from lakes Superior, Michigan, and Huron continued in 1979 (Table 8). On the basis of data for 1978, we estimate that the 1979 returns are about 94% complete.

A total of 177 sea lampreys were taken by Lake Superior commercial and sport fishermen in 1979. Two statistical districts contributed in largest numbers of sea lampreys—61 in the Munising, Michigan, area (MS-4), and 50 in the Wisconsin area. The collections included only 10 recently metamorphosed parasitic-phase sea lampreys ≤ 200 mm long, of which 7 were collected in the Keweenaw Peninsula area (MS-3). No significant change in the sea lamprey population was indicated by the number of sea lampreys collected from the fisheries.

Further reduction of the parasitic sea lamprey population in Lake Michigan was indicated in 1979 when only 207 sea lampreys were collected, compared with 1,614 in 1977 and 337 in 1978. Three Lake Michigan statistical districts contributed significant numbers of sea lampreys in 1979—the Algoma, Wisconsin, area (WM-4), 65; the Naubinway, Michigan, area (MN-3), 61; and the Fairport, Michigan, area (MM-1), 48. Sea lampreys from the Algoma, Wisconsin, area were 82% spawning-phase adults. Lake Michigan collections included 16 recently metamorphosed parasitic-phase sea lampreys ≤ 200 mm long.

In Green Bay, where a 92% decrease in the number of sea lampreys collected from the fisheries occurred in 1978, a continued decline was indicated in 1979, when only 59 were collected, compared with 89 in 1978. This reduction in the lamprey population was also reflected by a decrease in wounding rates among lake trout, from 4.7 to 3.5% (L. Wells, personal communication).

In northern Lake Michigan, excluding Green Bay, 148 sea lampreys were collected in 1979, a 40% decrease from the total of 248 collected in 1978. Wounding rates on lake trout in this area are not available for direct comparison because parasitic sea lampreys are collected from the fisheries in statistical districts MM-2 and MM-3, whereas wounding data on lake trout are collected in districts MM-4 and MM-5.

Lake Huron collections, which are limited to the De Tour, Michigan, area (MH-1), totaled 260 sea lampreys in 1979, compared with 329 in 1978. The collections included 19 recently metamorphosed parasitic-phase sea lampreys ≤ 200 mm long. Although the number of sea lampreys collected from fishermen in 1979 indicates a slight decrease from collections in 1978, this large number of lampreys collected from a limited fishery indicates a continued high abundance of sea lampreys in the waters of northern Lake Huron.

Ammocete Studies

Lake Superior

Surveys have been conducted each fall since 1960 at index stations in Lake Superior tributaries to determine the presence of young-of-the-year sea lampreys. The maximum number of larvae collected per hour of electrofishing in the year of establishment or subsequent years is recorded. Lampreys of the 1979 year class were recovered from 31 streams. This year class was later eliminated by chemical treatments from five streams: Ravine, Slate, and Big Garlic rivers and Beaver Lake Outlet and Furnace Creek. Young-of-the-year sea lamprey larvae were discovered in 1979 for the first time in the St. Louis River. An index station is to be established on this stream in 1980. Twenty-five streams have shown no evidence of reestablishment for the past 4 years. Table 9 shows the status of the remaining reestablished populations in Lake Superior tributaries. the most significant ones, other than those in streams to be treated in 1980, appear to be in the Salmon Trout (Marquette County), Traverse, and Middle rivers. These streams were last treated in 1977 or 1978, and very few of the larvae are more than 80 mm long.

Lake Michigan

Index stations on tributaries to the north and west shores of Lake Michigan were also examined in 1979. The 1979 year class was collected from 18 of 62 streams surveyed. Sixteen streams have shown no evidence of reestablishment for the past 4 years or more. The status of the remaining reestablished populations in streams of the north and west shores of Lake Michigan is shown in Table 10.

Lake Huron

Index stations are also being monitored for young-of-the-year larvae in streams tributary to the north shore of Lake Huron. Larvae of the 1979 year class were collected from 11 of 21 streams examined. They were later eliminated in one stream (Albany Creek) by chemical treatment. Only one stream (Canoe Lake Outlet) has shown no evidence of reestablishment for the past 4 years or more. Table 11 shows the status of the remaining reestablished populations in streams along the north shore of Lake Huron.

Big Garlic River Trap

A total of 1,863 ammocetes and 48 recently transformed sea lampreys were captured at the downstream trap in the Big Garlic River, Lake Superior, in 1979. The catch for 1978 was 750 and 201, respectively. Large larvae (over 120 mm long) collected in the Big Garlic River are allowed to transform in a warm-water aquarium and are then transferred to the Hammond Bay Laboratory.

Invertebrate Studies

Increasing public awareness to potential ecosystem damage has encouraged studies of the effects of chemical treatments on stream invertebrates. The objectives of these studies are to further develop knowledge of the effects of chemical treatments on invertebrate populations and to identify potential problems before streams are treated. A few field data have been gathered. Riffle samples were taken before and after the treatment of Door County #23 Creek, Wisconsin. A series of bottom samples from a previously untreated section of the Brule River in Wisconsin were taken to identify organisms present before the scheduled spring treatment. Several staff members of the Marquette Biological Station are enrolled in the aquatic entomology course at Northern Michigan University to develop expertise in aquatic insects.

Development of Permanent Campgrounds

Many campsites currently being used by chemical treatment crews are inadequate, unsuitably located, or occasionally unavailable. Locations for construction of permanent campsites are being sought from the U.S. Forest Service and the Wisconsin Department of Natural Resources. Six locations in the Hiawatha National Forest and one in the Wisconsin Brule River State Forest are being considered.

Gas Chromatography

In August 1977, gas-liquid chromatography was first used in a field situation to analyze stream samples for Bayer 73 wettable powder. Analysis by this method was used on six streams in 1979—the Chippewa, Cedar, Little Manistique, Pere Marquette, White, and Ocqueoc rivers.

In September, gas chromatography was demonstrated to the staff of the Sea Lamprey Control Centre, Sault Ste. Marie, Ontario, during treatments of the Goulais and Thessalon rivers. During these treatments technical assistance was furnished by the National Fishery Research Laboratory, La Crosse, Wisconsin.

Future applications of gas chromatography are planned to determine Bayluscide residue levels in stream bottom samples, possible trace levels of TFM in municipal water supplies, and Bayluscide concentrations in bioassays.

Table 1. Details on the application of lampricide to tributaries of Lake Superior, 1979.
[Lampricide used is in kilograms of active ingredient.]

Stream	Date	Discharge at mouth (m^3/s)	TFM Concentration (ppm) Minimum effective	TFM Concentration (ppm) Maximum allowable	TFM Kilograms used	TFM Hours applied
Little Two Hearted River	July 7	1.9	1.3	3.7	180	12
Two Hearted River	July 9	8.5	1.7	4.7	848	12
Huron River	Aug 3	2.1	1.0	2.9	249	12
Sucker River	Sept. 7	2.7	1.8	5.4	479	12
Au Train River						
(upper Au Train)	Sept. 7	3.0	3.7	11.1	409	8
Beaver Lake Outlet						
Little Beaver Creek	Sept. 11	0.2	1.8	5.4	40	9
Big Garlic River	Sept. 11	1.6	1.8	5.4	349	12
Furnace Creek	Sept. 11	1.1	2.5	7.4	150	12
Sturgeon River						
Otter River	Sept. 19	3.0	2.5	7.5	299	8
Slate River	Sept. 19	0.3	1.4	4.1	20	8
Ravine River	Sept. 20	0.3	1.3	3.4	20	12
Total		24.7			3,043	

Table 2. Details on the application of lampricides to tributaries of Lake Michigan, 1979.
[Lampricides used are in kilograms of active ingredient.]

Stream	Date	Discharge at mouth (m^3/s)	TFM Concentration (ppm) Minimum effective	TFM Concentration (ppm) Maximum allowable	TFM Kilograms used	TFM Hours applied	Kilograms of Bayer 73 powder used
Door Co. #23 Creek	May 11	0.1	6.5	20.5	30	8	0.0
Millicoquins River	May 12	2.2	2.3	6.9	249	12	0.0
Hibbards Creek	May 13	1.7	5.0	20.0	279	8	0.0
Hog Island Creek	May 15	0.4	2.0	5.8	50	12	0.0
Whitefish River							
Chippeny Creek	May 28	1.0	2.7	8.2	190	12	0.0
Cedar River	June 10	25.5	3.0	8.0	4,521	12	21.9
Sturgeon River	June 23	8.5	1.5	4.5	1,477	12	–
Trail Creek	June 25	1.4	7.0	14.0	449	10	–
Little Manistee River	July 9	5.2	5.0	9.0	838	12	4.1
Platte River							
(lower Platte)	July 19	3.8	4.0	11.9	689	10	–
Elk Lake Outlet							
(South Channel)	July 21	0.4	3.8	11.5	120	9	–
Pere Marquette River	July 24	13.4	4.0	10.0	4,022	12	15.2
White River	Aug. 7	9.6	4.0	9.0	3,064	19	14.6
Horton Creek	Aug. 12	0.5	5.3	16.2	120	10	–
Grand River							
Crockery Creek	Aug. 20	1.1	8.0	19.5	519	12	–
Norris Creek	Oct. 19	0.1	3.0	10.0	30	11	–
Sand Creek	Oct. 21	0.4	11.0	28.0	369	11	–
Muskegon River	May 27	44.7	3.0	10.0	7,265	12	–
Cedar Creek	Aug. 22	0.2	9.0	20.5	90	9	–
East Twin River							
Jambo Creek	Oct. 3	<0.1	7.2	22.1	20	12	–
Total	—	120.3	–	–	24,391	–	55.8

Table 3. Details on the application of lampricides to tributaries of Lake Huron, 1979.
[Lampricides used are in kilograms of active ingredient.]

Stream	Date	Discharge at mouth (m^3/s)	TFM Concentration (ppm) Minimum effective	TFM Concentration (ppm) Maximum allowable	TFM Kilograms used	TFM Hours applied	Kilograms of Bayer 73 powder used
Saginaw River							
Chippewa River	May 15	12.2	4.0	8.0	3,982	13	4.6
McKay Creek	May 24	0.7	3.5	10.7	309	12	0.0
Steeles Creek	May 27	0.2	3.8	11.5	40	7	0.0
Hessel Creek	May 28	0.2	5.0	16.0	80	7	0.0
Trout Creek	May 29	0.3	1.8	5.4	30	6	0.0
Cheboygan River							
Sturgeon River	Aug. 12	7.1	7.0	20.0	1,756	10	–
Ocqueoc River	Aug. 24	2.0	5.0	16.0	928	12	3.0
Rifle River	Sept. 8	4.3	5.0	10.0	2,225	12	7.5
Albany Creek	Oct. 3	0.2	3.5	10.7	50	12	–
Au Sable River							
Pine River	Oct. 7	2.9	8.0	17.0	1,706	18	–
Total	—	30.1	–	–	11,106	–	15.1

Table 3. Details on the application of lampricides to tributaries of Lake Huron, 1979.
[Lampricides used are in kilograms of active ingredient.]

Stream	Date	Discharge at mouth (m^3/s)	TFM Concentration (ppm) Minimum effective	TFM Concentration (ppm) Maximum allowable	TFM Kilograms used	TFM Hours applied	Kilograms of Bayer 73 powder used
Saginaw River							
Chippewa River	May 15	12.2	4.0	8.0	3,982	13	4.6
McKay Creek	May 24	0.7	3.5	10.7	309	12	0.0
Steeles Creek	May 27	0.2	3.8	11.5	40	7	0.0
Hessel Creek	May 28	0.2	5.0	16.0	80	7	0.0
Trout Creek	May 29	0.3	1.8	5.4	30	6	0.0
Cheboygan River							
Sturgeon River	Aug. 12	7.1	7.0	20.0	1,756	10	-
Ocqueoc River	Aug. 24	2.0	5.0	16.0	928	12	3.0
Rifle River	Sept. 8	4.3	5.0	10.0	2,225	12	7.5
Albany Creek	Oct. 3	0.2	3.5	10.7	50	12	-
Au Sable River							
Pine River	Oct. 7	2.9	8.0	17.0	1,706	18	-
Total	-	30.1	-	-	11,106	-	15.1

Table 4. Number of adult sea lampreys taken at electric barriers operated in eight tributaries of Lake Superior through July 13, 1961-79.

Year	Betsy	Two Hearted	Sucker	Chocolay	Iron	Silver	Brule	Amnicon	Total
1961	1,366	7,498	3,209	4,201	2,430	5,052	22,478	4,741	50,975
1962	316	1,757	474	423	1,161	267	2,026	879	7,303
1963	444	2,447	698	358	110	760	3,418	131	8,366
1964	272	1,425	386	445	178	593	6,718	232	10,249
1965	187	1,265	532	563	283	847	6,163	700	10,540
1966	65	878	223	260	491	1,010	226	938	4,091
1967	57	796	166	65	643	339	364	200	2,630
1968	78	2,132	658	122	82	1,032	2,657	148	6,909
1969	120	1,104	494	142	556	1,147	3,374	1,576	8,513
1970	87	1,132	337	291	713	321	167	1,733	4,781
1971	104	1,035	485	53	1,518	340	1,754	4,324	9,613
1972	146	1,507	642	294	280	2,574	4,121	132	9,696
1973	294	894	468	270	16	495	261	149	2,847
1974	201	489	249	17	1	117	568	270	1,912
1975	197	683	478	24	8	206	285	2,606	4,487
1976	148	229	314	10	33	199	1,085	80	2,098
1977	162	654	533	4	66	312	2,572	493	4,796
1978	185	355	974	6	26	162	794	2,310	4,812
1979	104	450	367	63	21	145	1,217	46	2,413

Table 5. Average lengths and weights of sea lampreys and percentage of males from index streams of Lake Superior, 1954–79.

Year	Number in sample	Average length (mm)	Average weight (g)	Percent males
1954	2,381	458	220	57
1955	5,736	438	195	53
1956	9,265	451	202	56
1957	10,305	433	174	66
1958	12,542	426	165	57
1959	14,421	431	167	58
1960	11,906	414	147	68
1961	18,201	409	136	67
1962	6,581	431	159	69
1963	7,221	426	160	66
1964	6,706	422	155	56
1965	7,680	431	164	52
1966	3,797	410	146	42
1967	2,217	421	168	33
1968	5,874	421	161	32
1969	6,498	419	164	27
1970	4,009	431	176	35
1971	7,060	449	190	31
1972	8,032	443	192	31
1973	2,663	421	161	31
1974	1,749	432	170	30
1975	3,407	436	186	31
1976	1,904	430	181	29
1977	4,065	433	180	29
1978	3,632	430	169	31
1979	2,181	433	181	33

Table 6. Number of sea lampreys captured, marked, and released and number and percentage recaptured in assessment traps in tributaries of the Great Lakes, 1979.

Lake and stream	Dates of operation	Number of sea lampreys: Captured in trap	Number of sea lampreys: Marked and released	Total recaptured: Number	Total recaptured: Percent
Lake Superior					
Big Garlic River	5/7–7/13	191	0	–	–
Rock River	5/10–7/13	677	664	305	46
Miners River	5/10–7/2	12	11	0	0
Tahquamenon River	5/15–7/14	433	0	–	–
Subtotal		1,313	675	305	45
Lake Michigan					
West Shore					
Fox River	4/19–6/27	0	0	–	–
Oconto River	4/17–6/1	3	0	–	–
Peshtigo River	4/17–6/17	265	264	52	20
Menominee River	5/5–6/17	131	130	17	13
Manistique River	5/22–6/14	4,948	4,683	1,483	32
Weston Creek	5/16–7/12	146	145	42[a]	29[a]
East Shore					
Carp Lake River	4/30–6/6	68	67	13	19
Subtotal		5,561	5,289	1,607	30
Lake Huron					
St. Marys River	6/28–8/17	1,213	922	282	31
Cheboygan River	5/30–6/15	8,327	1,062	685	65
Sturgeon River	4/30–6/6	2	2	0	0
Black River	5/1–6/5	2	2	0	0
Trout River	4/25–6/8	2	0	–	–
Thunder Bay River	5/2–6/5	2	2	1	50
Au Sable River	5/1–6/5	0	0	–	–
Subtotal		9,548	1,990	968	49
Lake Ontario					
Oswego River					
W. Br. Fish Creek	4/24–6/14	51	0	–	–
Little Salmon River	4/24–6/15	673	0	–	–
Grindstone Creek	4/24–6/15	623	0	–	–
Catfish Creek	5/2–6/15	360	0	0	0
Subtotal		1,707	0	–	–
Total all lakes		18,129	7,954	2,880	36

[a]Twenty-two of these sea lampreys were marked and released in the main Manistique River; actual recapture for Weston Creek was 14%.

Table 7. Average lengths and weights of sea lampreys and percentage of males in catches at electric barriers and assessment traps in tributaries of the Great Lakes in 1979.

Method of capture and stream	Number in sample	Average length (mm)	Average weight (g)	Percentage males
	Lake Superior			
Electric barrier				
Betsy River	104	439	212	40
Two Hearted River	450	450	201	34
Sucker River	367	428	169	39
Chocolay River	56	419	180	46
Iron River	20	425	168	25
Silver River	129	407	172	30
Brule River	1,043	431	175	31
Amnicon River	12	444	183	25
Subtotal, barriers	2,181	433	181	33
Assessment trap				
Tahquamenon River	433	432	196	43
Miners River	1	427	150	100
Rock River	310	429	165	31
Big Garlic River	191	431	165	33
Subtotal traps	935	431	179	37
Lake Superior streams	3,116	432	180	35
	Lake Michigan			
Assessment trap				
Manistique River	1,486	487	236	44
Weston Creek	36	480	225	47
Menominee River	17	469	209	59
Peshtigo River	52	490	234	54
Carp Lake River	13	432	158	31
Lake Michigan streams	1,604	487	235	46
	Lake Huron			
Electric barrier				
Ocqueoc River	320	453	193	36
Assessment trap				
Cheboygan River	534	441	196	38
Trout River	2	461	231	50
Thunder Bay River	1	496	258	100
St. Marys River	491	472	222	50
Subtotal traps	1,028	456	208	44
Lake Huron streams	1,348	455	205	42
	Lake Ontario			
Assessment trap				
Grindstone Creek	605	487	264	52
Little Salmon River	584	489	265	50
Catfish Creek	359	479	252	52
Oswego River				
West Branch Fish Creek	45	472	247	51
Lake Ontario streams	1,593	485	261	51
Great Lakes Total	7,661	460	213	41

Table 8. Number of parasitic-phase sea lampreys and (in parentheses) number of spawning-phase sea lampreys collected in commercial and sport fisheries, by lake and statistical district, 1972–79. [Collections for 1979 are incomplete.]

District[a] and length (mm)	1972	1973	1974	1975	1976	1977	1978	1979
				Lake Superior				
M-1								
≤ 200	0	0	–	–	–	–	–	–
> 200	3 (2)	3	–	–	–	–	–	–
M-2								
≤ 200	0	0	0	0	0	0	0	0
> 200	16 (7)	13 (16)	3 (1)	14	8	6	1	0
M-3								
≤ 200	1	0	0	0	1	0	0	0
> 200	7	9 (1)	7	12	13	5 (38)	4 (2)	2
Wisconsin								
≤ 200	3	4	6	0	2	2	0	0
> 200	232 (2)	119 (1)	117	97 (2)	81 (1)	127 (5)	54 (19)	50
MS-1								
≤ 200	0	0	–	–	–	–	–	1
> 200	0	0	–	–	–	–	–	7
MS-2								
≤ 200	0	0	1	0	1	2	1	0
> 200	8 (2)	5 (1)	4 (1)	11 (1)	1	2	1	3 (1)
MS-3								
≤ 200	11	6	8	12	4	6	4	7
> 200	29	61	17	27	16	22	14 (2)	16
MS-4								
≤ 200	1	1	3	1	2	2	0	1
> 200	121 (3)	74 (1)	45	13	20	13 (1)	25 (1)	59 (1)
MS-5								
≤ 200	0	0	0	0	0	0	0	0
> 200	5	2	2	0	2	1	0	12
MS-6								
≤ 200	2	6	3	1	0	7	2	1
> 200	13	7	9	7	16	20	24	16
Total								
≤ 200	18	17	21	14	10	19	7	10
> 200	434 (16)	373 (20)	204 (2)	181 (3)	157 (1)	196 (44)	123 (24)	165 (2)
				Lake Michigan				
MM-1								
≤ 200	1	12	7	2	15	37	8	6
> 200	46	99 (1)	40 (4)	37 (9)	94 (11)	233 (12)	36 (14)	37 (5)
MM-2								
≤ 200	1	7	12	1	2	0	0	1
> 200	9	3	5	19 (1)	12 (1)	5	5	2
MM-3								
≤ 200	22	13	4	10	4	8	3	8
> 200	104 (2)	71	59	68	35 (2)	51	100	53
MM-5								
≤ 200	10	4	7	1	1	–	–	–
> 200	8 (4)	6 (2)	7	4	3	–	–	–
MM-6								
≤ 200	0	0	1	0	0	–	–	–
> 200	0	1	0	2	0	–	–	–
MM-7								
≤ 200	0	0	0	0	0	–	–	–
> 200	0	1	1	0	0	–	–	–

Table 8. (Cont'd.)

District[a] and length (mm)	1972	1973	1974	1975	1976	1977	1978	1979
MM-8								
≤ 200	2	0	1	1	0	–	–	–
> 200	1	1	1	1	0	–	–	–
WM-1								
≤ 200	5	1	1	0	1	8	0	0
> 200	31 (40)	37 (8)	38 (14)	33 (8)	41 (4)	289 (11)	4 (8)	2
WM-2								
≤ 200	144	91	107	15	24	217	6	0
> 200	432	258	250	187	98	303	13	9
WM-3								
≤ 200	6	3	1	0	3	6	1	1
> 200	108	47	29	20	38	130	25	18
WM-4								
≤ 200	3	1	1	1	1	4	2	0
> 200	27 (160)	56 (42)	54 (80)	77 (107)	25 (86)	62 (235)	17 (95)	12 (53)
WM-5								
≤ 200	5	5	2	0	0	0	–	–
> 200	11	13	19	3	7	2 (1)	–	–
WM-6								
≤ 200	2	–	–	–	–	–	–	–
> 200	0	–	–	–	–	–	–	–
Total								
≤ 200	201	137	144	31	51	280	20	16
> 200	777 (206)	593 (53)	503 (98)	451 (125)	353 (104)	1,075 (259)	200 (117)	133 (58)
Lake Huron								
MH-1								
≤ 200	2	0	0	5	3	48	7	19
> 200	88	31	10	111	120	222	322	241
MH-3								
≤ 200	4	–	–	–	–	–	–	–
> 200	5	–	–	–	–	–	–	–
MH-4								
≤ 200	0	0	0	0	1	–	–	–
> 200	21	8	12	24 (3)	6 (3)	–	–	–
Total								
≤ 200	6	0	0	5	4	48	7	19
> 200	114	39	22	135 (3)	126 (3)	222	322	241

[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. (In Lake Superior, M = Michigan and MS = Minnesota; in Lake Michigan, MM = Michigan and WM = Wisconsin; and in Lake Huron, MH = Michigan.) Lampreys were not collected from the fishermen in Lake Michigan districts MM-4, Illinois, or Indiana; or Lake Huron districts MH-2, MH-5, or MH-6.

Table 9. Tributaries of Lake Superior with reestablished populations of sea lampreys and the maximum number of ammocetes collected per hour with an electric shocker. [B indicates the presence of a year class recovered with Bayer 73.]

Stream	Date of last treatment	Year class			
		1976	1977	1978	1979
Waiska River	9/30/76		1	9	42
Pendills Creek	7/27/73	2	0	15	5
Grants Creek	7/21/63	1	3	0	1
Galloway Creek	10/6/76		0	1	0
Tahquamenon River	10/3/76		5	8	20
Betsy River	6/8/78			30	98
Little Two Hearted River	7/7/79				51
Two Hearted River	7/9/79				60
Seven Mile Creek	7/19/67	2	0	0	0
Miners River	9/5/77			6	0
Munising Falls Creek	9/3/64	0	0	0	3
Five Mile Creek	8/31/77			1	3
Deer Lake Outlet	8/13/70	1	0	0	0
Chocolay River	9/12/73	4	4	1	0
Harlow Creek	11/1/77			4	0
Little Garlic River	6/26/78			59	2
Salmon Trout River (Mqt. Co.)	6/21/78			97	11
Silver River	9/29/78				4
Sturgeon River	10/1/78				13
Trap Rock River	8/5/63	0	1	0	0
Traverse River	10/7/78				97
Big Gratiot River	10/7/75	0	15	0	0
Salmon Trout River (Htn. Co.)	10/11/78				36
Misery River	8/13/78				4
Firesteel River	9/18/77			35	19
Ontonagon River	7/29/78			1	9
Potato River	8/2/78				1
Cranberry River	9/16/77			18	0
Black River	7/14/76			B	0
Bad River	7/22/77			45	11
Fish Creek (Eileen Twp.)	7/19/72	0	B	0	0
Sand River	10/16/64	0	B	0	0
Brule River	7/19/77		4	17	0
Poplar River	7/7/77		4	3	8
Middle River	7/7/77		20	80	24
Amnicon River	9/21/78				17
Nemadji River	9/23/78				61
Split Rock River	8/1/76		1	0	0
Arrowhead River	7/7/77			1	1
Total number of streams in which year class was collected		5	12	20	25

Table 10. Tributaries of the north and west shores of Lake Michigan with reestablished populations of sea lampreys and the maximum number of ammocetes collected per hour with an electric shocker.

Stream	Date of last treatment	Year class			
		1976	1977	1978	1979
Brevort River	6/24/77		1	3	15
Black River	6/10/78			20	35
Millecoquins River	6/23/77		3	17	1
Rock River	6/27/77		0	2	0
Crow River	5/9/76	2	0	0	0
Cataract River	9/21/75	1	0	0	0
Point Patterson Creek	9/23/75	0	0	4	0
Hudson Creek	7/16/78			0	9
Bulldog Creek	6/9/77		22	2	1
Gulliver Lake Outlet	6/12/77		0	2	0
Marblehead Creek	6/11/77		2	3	2
Manistique River	8/10/74	1	5	2	0
Johnson Creek	6/13/77		0	8	0
Deadhorse Creek	6/28/77		0	4	0
Bursaw Creek	7/13/78			0	15
Parent Creek	7/14/78			9	1
Poodle Pete Creek	9/4/75	1	1	2	0
Fishdam River	10/14/76		11	25	2
Sturgeon River	6/23/79				17
Ogontz River	10/18/78				19
Hock Creek	6/23/71	1	3	0	0
Whitefish River	8/24/78				26
Rapid River	8/4/77			39	0
Portage Creek	9/2/78				2
Ford River	5/12/77		60	92	45
Cedar River	6/10/79				15
Menominee River	8/21/77			3	1
Peshtigo River	6/23/78			0	1
Hibbards Creek	5/13/79				6
Kewaunee River	5/10/75	0	1	2	0
East Twin River	5/12/75	1	0	1	0
Total number of streams in which year class was collected		6	10	19	18

Table 11. Tributaries of the north shore of Lake Huron with reestablished populations of sea lampreys and the maximum number of ammocetes collected per hour with an electric shocker.

Stream	Date of last treatment	Year class			
		1976	1977	1978	1979
Little Munuscong River	6/9/77		85	31	9
Munuscong River	5/17/78			0	4
Caribou Creek	5/13/78			2	3
Joe Straw Creek	5/10/75	1	0	0	0
Trout Creek	5/29/79				2
Beavertail Creek	5/23/75	1	4	5	7
McKay Creek	5/24/79				20
Nuns Creek	9/21/74	2	0	11	23
Pine River	5/27/77		30	6	19
McCloud Creek	10/25/72	0	0	0	3
Carp River	5/27/78			12	52
Total number of streams in which year class was collected		3	3	6	10

SEA LAMPREY CONTROL IN CANADA

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Department of Fisheries and Oceans

This report summarizes the activities of the Canadian Sea Lamprey Control Unit during the period April 1, 1979 to March 31, 1980, in compliance with a Memorandum of Agreement between the Department of Fisheries and Oceans and the Great Lakes Fishery Commission. The Department acts as agent for the Commission with respect to the Canadian portion of the sea lamprey control program, which is conducted by the Department's Sea Lamprey Control Centre located at Sault Ste. Marie, Ontario. In addition to treating the Canadian tributaries of the Great Lakes, this Centre has accepted responsibility for treating streams on the United States side of Lake Ontario.

The sea lamprey control program consists essentially of four types of activity: assessment, treatment, survey, and biological investigation. The assessment of sea lamprey spawning runs is accomplished by means of one electrical barrier and several mechanical weirs and traps; treatments of streams and other bodies of water require the controlled application of selective toxicants; surveys for larval lampreys (ammocoetes) are carried out with the use of electricity or chemicals; while biological studies are focused upon the distribution, movement, abundance, and growth of sea lamprey.

Electrical Barrier, Weir and Trap Operations

The barrier operated on Kaskawong River, a tributary of Lake Huron, captured 44 per cent more sea lamprey in 1979 than in the previous year. The average size of the sea lamprey also increased in 1979, however the change in sex ratio was slight and showed no trend.

Mechanical weirs were installed and operated on Cypress and Sable Rivers (Lake Superior), on Blue Jay and Silver Creeks (Lake Huron) and on Graham Creek (Lake Ontario). They captured 9, 11, 77, 52 and 168 spawning phase sea lamprey, respectively. Box traps made of metal framing covered with hardware cloth were set in four Lake Huron tributaries (including St. Marys River), and in three Lake Ontario streams. In total, the Lake Huron traps captured 499, and the Lake Ontario traps captured 177 spawning phase sea lamprey.

Trawling for Sea Lamprey in St. Marys River

In the fall of 1979 the annual assessment of the adult sea lamprey population by surface trawling in St. Marys River was repeated. A total of 50 sea lamprey were captured and the catch rate of 0.26 per hour represented a 44 per cent increase over the previous year's figure (see Table 1).

Sea Lamprey from the Canadian Commercial Fishery

In response to a reward offered to Great Lakes commmercial fishermen for sea lamprey and related catch data, a total of 267 specimens were submitted. Examination of these showed that females continue to predominate in commercial catches of sea lamprey, however no changes were observed in mean sizes of sea lamprey for the same months and from the same fishing gear compared with previous years.

Stream Surveys

A total of 58 Lake Superior tributaries were surveyed by means of electro-shockers or granular Bayer 73. Included were routine surveys of 26 streams which had had no previous record of sea lamprey (all with negative results); re-establishment surveys of 11 streams previously treated with lampricide; distribution surveys on nine tributaries in preparation for future treatments; treatment-evaluation surveys on six previously treated streams; and population studies on six tributaries with known sea lamprey populations.

On Lake Huron a total of 65 tributaries were surveyed. Included were routine surveys of 50 tributaries (all of which were negative for sea lamprey); re-establishment surveys of six streams; distribution surveys of six streams; treatment-evaluation surveys of eight streams; and a population study on one stream. Some streams were surveyed more than once.

On the Canadian side of Lake Ontario a total of 24 tributaries were surveyed. These included routine surveys of five streams (all of which were negative for sea lamprey) and re-establishment surveys of eight streams. On the United States side of Lake Ontario a total of 18 tributaries were surveyed, including re-establishment surveys on 13 streams; distribution surveys on eight streams; treatment-evaluation surveys on 10 streams; and population studies on two streams. Routine surveys were conducted as usual by the staff of the United States Control Unit.

Lampricide Treatments

Eight of the nine Lake Superior tributaries specified in the Memorandum of Agreement were treated with lampricide. These were Cranberry and Stillwater Creeks, Goulais, Michipicoten, Pic, Steel, Black Sturgeon and Kaministikwia Rivers. Table 2 lists details of these treatments. Nipigon River was not treated because the necessity of maintaining generation of hydro-electric power at Alexander Falls precluded reduction of discharge to treatable levels. All of the treatments were judged effective.

The seven scheduled treatments of Lake Huron tributaries (Silver, Telfer, and Sucker Creeks, Sauble, Mississagi, Thessalon, and Garden Rivers) were completed, and in addition, Sturgeon River was treated when surveys showed metamorphosing sea lamprey to be present (see Table 3). All of these treatments were judged effective.

Six streams (Port Britain, Lakeport, Grafton, Rouge, Mayhew and Salem) on the Canadian side of Lake Ontario and five streams on the United States side (Wolcott, Deer, Sterling, Little Sandy and Little Salmon) were all treated effectively (see Table 4).

Granular Bayer 73 was applied to selected areas in the Lake Superior basin as follows: Helen Lake (Nipigon River system), Mountain Bay, Cypress Bay, Mackenzie Bay and Batchawana Bay and to parts of St. Marys River (see Table 5).

Sea Lamprey Barrier Dams

Low-head barrier dams were constructed on Sturgeon River, a Lake Huron tributary, and on Gimlet Greek, a tributary of Pancake River which flows into Lake Superior. Preliminary designs were prepared for proposed barrier dams on the following Lake Superior streams, Sheppard Creek, a tributary of Goulais River, Sable River and Stokely Creek and on two Lake Ontario streams, Duffin and Graham Creeks.

Sea Lamprey Larval Growth Study

In 1978 a number of spawning phase sea lamprey had been released above a barrier in Proctors Creek, a Lake Ontario tributary, in an attempt to establish a known age population of ammocoetes whose rate of growth could then be studied. Unfortunately attempts in 1979 to find ammocoetes resulting from this introduction were unsuccessful. A similar planting of adult sea lamprey above a barrier was made in 1979 in Soper Brook, a tributary of Bowmanville Creek, another Lake Ontario stream. Young-of-the-year ammocoetes were found in the fall of 1979 indicating successful spawning in this case.

Table 1. Numbers of sea lamprey caught per hour of trawling at the Edison Sault Electric plant in St. Marys River in 1977, 1978 and 1979.

Week Ending			Trawling Time (Hours)			No. of Lamprey			No. of Lamprey per hour		
1977	1978	1979	1977	1978	1979	1977	1978	1979	1977	1978	1979
Oct. 22		Oct. 20	30.0	30.1	13.2	1		4	0.3		0.3
Oct. 29	Oct. 28	Oct. 27	29.5	30.1	15.8	3	2	5	0.1	0.1	0.3
Nov. 5	Nov. 4	Nov. 3	30.1	29.8	21.1	11	8	12	0.4	0.3	0.6
Nov. 12	Nov. 11	Nov. 10	18.8	30.2	30.7	12	0	6	0.6	0.2	0.2
Nov. 19	Nov. 18	Nov. 17	30.3	24.2	18.8	2	6	1	0.1	0.2	0.1
Nov. 26	Nov. 25	Nov. 24	23.0	27.1	27.9	8	7	9	0.4	0.3	0.3
Dec. 3	Dec. 2	Dec. 1	30.1	12.2	30.0	6	2	13	0.2	0.2	0.4
Dec. 10	Dec. 9	Dec. 8	19.0	14.8	31.2	1	0	0	0.1	0.0	0.0
	Dec. 16			–			–			–	
	Dec. 23			6.0			0			0.0	
TOTALS &/OR AVERAGES			210.8	174.6	188.8	44	31	50	0.2	0.2	0.3

Table 2. Summary of streams and bay areas treated with lampricide on Lake Superior, 1979.

Stream	Date	FLOW		TFM		Bayer 73		Granular Bayer 73		Sea[1] lamprey abundance	Stream Treated	
		m³/s	f³/s	Act. kg	Ingr. lbs.	Act. kg	Ingr. lbs.	kg	lbs.		km	miles
Cranberry Cr.	June 26–27	3.1	108	186	410	–	–	–	–	S- 4	7.6	4.7
Stillwater Cr.	July 11–13	0.1	4	25	54	–	–	–	–	S- 34	4.5	2.8
Steel R.	July 12–13	10.9	384	804	1,768	13	28	–	–	M- 569	10.1	6.3
Black Sturgeon R.	July 14–16	17.7	625	1,353	2,983	21	47	21	47	S- 176	16.3	10.1
Kaministikwia R.	July 18–23	26.3	928	2,969	6,545	43	94	2	5	S- 1,019 (10)	58.1	36.1
Michipicoten R.	Aug. 11–12	50.4	1,779	2,669	5,885	42	93	–	–	M- 713 (1)	18.5	11.5
Pic R.	Aug. 14–19	49.6	1,750	2,959	6,523	43	95	147	325	M- 587	112.7	70.0
Goulais R.	Sept. 10–14, 19–21	17.6	620	1,378	3,037	17	37	64	141	M- 2,241 (47)	132.4	82.3
											Hectares	Acres
Nipigon River System												
—Helen Lake	July 20–25	–	–	–	–	–	–	912	2,010	M- 1,810	4.0	9.9
Mountain Bay	July 23	–	–	–	–	–	–	2,075	4,575	S- 516	9.1	22.5
Cypress Bay	July 24	–	–	–	–	–	–	499	1,100	M- 456	2.3	5.7
Mackenzie Bay	July 24	–	–	–	–	–	–	612	1,350	M- 604 (5)	2.4	6.0
Batchawana Bay												
—Batchawana R.	Aug. 20, 22	–	–	–	–	–	–	1,116	2,460	A- 2,432 (8)	5.1	12.6
—Chippewa R.	Aug. 21	–	–	–	–	–	–	352	775	M- 590 (8)	1.5	3.8
Totals		175.7	6,198	12,343 kg	27,205 lbs.	179 kg	394 lbs.	5,800 kg	12,788 lbs.		360.2 km	223.8 miles
											24.4 Hectares	60.5 Acres

(1) S = Scarce; M = Moderate; A = Abundant
( ) indicates number of transforming sea lamprey larvae collected

Table 3. Summary of streams treated with lampricide on Lake Huron, 1979.

Stream	Date	FLOW m^3/s	FLOW f^3/s	TFM Act. Ingr. kg	TFM Act. Ingr. lbs.	Bayer 73 Act. Ingr. kg	Bayer 73 Act. Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	Sea[(1)] lamprey abundance	Stream Treated km	Stream Treated miles
Silver Cr.	May 30	0.4	15	87	192	1	3	–	–	A- 729	5.1	3.2
Telfer Cr.	June 1–2	0.3	10	164	361	–	–	–	–	M- 291	6.4	4.0
Sauble R.	June 3–4	4.1	143	975	2,144	16	34	–	–	S- 175	3.5	2.2
Sucker Cr.	June 14–15	0.4	15	36	79	–	–	–	–	S- 12	0.9	0.6
Mississagi R.	Aug. 20–23	60.8	2,145	3,956	8,704	62	136	7	15	A- 2,651 (48)	39.5	24.5
Thessalon R.	Sept. 17–19	7.7	273	643	1,415	10	21	5	10	M- 416 (4)	37.0	23.0
Garden R.	June 26, Sept. 24–27	9.1	323	659	1,449	–	–	27	59	M- 1,762 (1)	74.1	46.0
Sturgeon R.	Oct. 17–19	1.3	44	372	819	–	–	–	–	M- 488 (2)	16.0	9.9
											Hectares	Acres
St. Marys R.												
—Whitefish Is.	Sept. 5	–	–	–	–	–	–	714	1,575	S-	3.0	7.5
—Root R.	Sept. 6	–	–	–	–	–	–	272	600	S-	1.1	2.8
—Garden R.	Sept. 28	–	–	–	–	–	–	95	210	M-	0.4	1.0
Totals		84.1	2,968	6,892	15,163	89	194	1,120	2,469		182.5	113.4
				kg	lbs.	kg	lbs.	kg	lbs.		km	miles
											4.5	11.3
											Hectares	Acres

(1) S = Scarce; M = Moderate; A = Abundant
( ) indicates number of transforming sea lamprey larvae collected

Table 4. Summary of streams treated with lampricide on Lake Ontario, 1979.

Stream	Date	FLOW m^3/s	FLOW f^3/s	TFM Act. Ingr. kg	TFM Act. Ingr. lbs.	Bayer 73 Act. Ingr. kg	Bayer 73 Act. Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	Sea[(2)] lamprey abundance	Stream Treated km	Stream Treated miles
CANADA												
Port Britain Cr.	May 31–June 2	0.2	6	75	166	–	–	–	–	M- 371	9.6	6.0
Lakeport Cr.	June 3–4	0.3	11	150	331	–	–	–	–	M- 464	16.2	10.1
Grafton Cr.	June 6–7	0.2	6	70	153	–	–	–	–	A- 612	6.8	4.2
Rouge R.	June 9–11	3.2	113	487	1,072	–	–	–	–	S- 149	26.3	16.3
Mayhew Cr.[(1)]	June 9–12	0.3	10	85	188	–	–	95	210	A- 611	4.8	3.0
Salem Cr.	June 12–13	0.2	6	75	165	–	–	–	–	A- 632	2.1	1.3
		4.4	152	942	2,075	–	–	95	210		65.8	40.9
UNITED STATES												
Wolcott Cr.	May 4–5	0.9	30	228	502	–	–	–	–	S- 14	6.8	4.2
Deer Cr.	May 5–6	1.0	34	136	298	–	–	–	–	A- 1,362	20.6	12.8
Sterling Cr.	May 6–7	2.8	100	478	1,053	4	8	–	–	M- 570	16.1	10.0
Little Salmon R.	May 9–14	5.7	200	694	1,529	–	–	–	–	M- 2,673	77.2	48.0
Little Sandy Cr.	May 14–16	1.1	37	206	454	–	–	–	–	M- 671	29.6	18.4
		11.5	401	1,742	3,836	4	8	–	–		150.3	93.4

(1) Data include both treatments
(2) S = Scarce; M = Moderate; A = Abundant

Table 5. Summary of granular Bayer 73 treatments, Lakes Superior and Huron, 1979.

TREATMENT		Granular Bayer 73		Approx. area Treated		SEA LAMPREY LARVAE COLLECTED				
						Size Range (mm)	Number Collected			
Location	Date	lbs.	kg	Acres	Hectares		0–51 (mm)	52–101 (mm)	102+ (mm)	TOTAL
LAKE SUPERIOR										
Nipigon River System										
—Helen Lake	July 20–25	2,010	912	9.9	4.0	16-181	76	999	735	1,810
Mountain Bay	July 23	4,575	2,075	22.5	9.1	26-156	7	122	387	516
Cypress Bay	July 24	1,100	499	5.7	2.3	26-196	28	339	89	456
Mackenzie Bay	July 24	1,350	612	6.0	2.4	36-186	18	312	274	604 (5)
Batchawana Bay										
—Batchawana R.	Aug. 20–22	2,460	1,116	12.6	5.1	21-171	1,634	662	136	2,432 (8)
—Chippewa R.	Aug. 21	775	352	3.8	1.5	26-156	56	348	186	590 (8)
TOTALS		12,270	5,566	60.5	24.4		1,819	2,782	1,807	6,408 (21)
LAKE HURON										
St. Marys River										
—Whitefish Is.	Sept. 5	1,575	714	7.5	3.0	46-141	2	56	20	78 (1)
—Root R.	Sept. 6	550	250	2.5	1.0	31-146	6	46	22	74
—Garden R.	Sept. 28	210	95	1.0	0.4	36-131	5	60	2	67
TOTALS		2,335	1,059	11.0	4.4		13	162	44	219 (1)

( ) = Number of sea lamprey larvae undergoing adult transformation

Table 5. Summary of granular Bayer 73 treatments, Lakes Superior and Huron, 1979.

TREATMENT		Granular Bayer 73		Approx. area Treated		SEA LAMPREY LARVAE COLLECTED				
						Size Range (mm)	Number Collected			
Location	Date	lbs.	kg	Acres	Hectares		0–51 (mm)	52–101 (mm)	102+ (mm)	TOTAL
LAKE SUPERIOR										
Nipigon River System										
—Helen Lake	July 20–25	2,010	912	9.9	4.0	16-181	76	999	735	1,810
Mountain Bay	July 23	4,575	2,075	22.5	9.1	26-156	7	122	387	516
Cypress Bay	July 24	1,100	499	5.7	2.3	26-196	28	339	89	456
Mackenzie Bay	July 24	1,350	612	6.0	2.4	36-186	18	312	274	604 (5)
Batchawana Bay										
—Batchawana R.	Aug. 20–22	2,460	1,116	12.6	5.1	21-171	1,634	662	136	2,432 (8)
—Chippewa R.	Aug. 21	775	352	3.8	1.5	26-156	56	348	186	590 (8)
TOTALS		12,270	5,566	60.5	24.4		1,819	2,782	1,807	6,408 (21)
LAKE HURON										
St. Marys River										
—Whitefish Is.	Sept. 5	1,575	714	7.5	3.0	46-141	2	56	20	78 (1)
—Root R.	Sept. 6	550	250	2.5	1.0	31-146	6	46	22	74
—Garden R.	Sept. 28	210	95	1.0	0.4	36-131	5	60	2	67
TOTALS		2,335	1,059	11.0	4.4		13	162	44	219 (1)

( ) = Number of sea lamprey larvae undergoing adult transformation

ALTERNATIVE METHODS OF SEA LAMPREY CONTROL

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INTRODUCTION

The Great Lakes Fishery Commission is committed to a continuing program of assessing impact of residual sea lamprey populations on Great Lakes fish stocks. Its main charge is to develop an integrated, cost-effective lamprey control program that will include the continued use of chemical toxicants where appropriate, but that will also include the use of repellents, attractants, sterilants, physical barriers, and other measures that may be effective, economical, and ecologically safe. Under contract with the Commission, we perform research on the development of alternative methods for control of the sea lamprey.

Development of Methods to Sterilize Adult Sea Lampreys

Our studies have shown that the release of artificially sterilized male sea lampreys into streams containing spawning populations of sea lampreys can reduce the reproductive success of these populations. Additional research is underway to develop effective, environmentally safe means for sterilizing adult male sea lampreys for use in sea lamprey control.

We conducted laboratory studies to determine if male spawning-run sea lampreys could be sterilized by injecting Depo-Testosterone Cypionate (DTC) at dose rates of 100, 250, and 500 mg/kg. Thirty males were injected (10 at each dose rate) and released in an artificial stream in the laboratory with 30 untreated females.

Lampreys observed spawning were removed from the stream and spawned artificially. Each female spawned with a treated male was also spawned with a normal male to provide a control on the fertility of the female. Batches of eggs from different spawnings were held separately in glass battery jars partly immersed in constant temperature troughs held at 18.3 C. Dead embryos were periodically removed. After 20 days of incubation, all remaining embryos were fixed in 4% formalin and examined microscopically. The results showed clearly that the injection of DTC had no effect on the number of larvae produced, and therefore had no sterilizing action at the dose rates tested.

Feasibility of a Staged, TFM-Release Technique to Prevent Mortality of Sensitive, Nontarget Fishes in Streams During Sea Lamprey Treatment

Treating of populations of sea lamprey larvae with the lampricide 3-trifluoromethyl-4-nitrophenol (TFM) is hampered in many streams tributary to the Great Lakes by the presence of sensitive, nontarget fishes that could be killed by exposure to concentrations of TFM required to kill lamprey larvae. A potential solution to this problem was suggested by the results of preliminary laboratory tests indicating that the tolerance of sensitive, nontarget fishes to TFM could be increased by stimulating their detoxifying enzyme systems and enhancing their ability to excrete TFM residues. In practice, this approach would involve exposing these nontarget species briefly to sublethal amounts of TFM, before releasing TFM in the higher concentrations needed to kill sea lamprey larvae. Implicit in this proposed solution was the assumption that the tolerance of sea lamprey larvae to TFM would not increase as a result of pre-exposure to sublethal concentrations of the lampricide.

The results of two tests conducted at the Hammond Bay Biological Station in May-June 1979 did not offer support for this staged TFM-release approach as a solution to the problem. Under the conditions of the tests, we observed no increased survival of pre-exposed, nontarget fishes (longnose suckers, white suckers, and lake trout). Also, contrary to expectations, both tests suggested that pre-exposure of sea lamprey larvae to sublethal concentrations of TFM increased their tolerance to the chemical. The results of recently completed biochemical analyses showing levels of conjugated TFM in the gallbladder bile of the nontarget species also failed to present clear evidence that pre-exposure to TFM enhanced the ability of these fishes to excrete TFM residues.

More thorough tests are planned to investigate whether pre-exposure of sea lamprey larvae to sublethal concentrations of TFM increases their tolerance to the chemical.

Field Tests of Attractants and Repellents for Potency Against Adult Spawning-Run Sea Lampreys

In a study begun in April 1978, we explored the possibility that transforming sea lampreys could be "imprinted" en masse on their downstream migration by metering small amounts of an environmentally safe odorant (imprintant) into the lower reaches of Great Lakes tributaries in which sea lampreys spawn. If imprinting could be demonstrated, imprintants could be used as lures to help capture adult sea lampreys approaching the Great Lakes tributaries to spawn. The first step in this study was a test of phenethyl alcohol (PA) as an imprintant for sea lampreys. This chemical was selected bacause it appeared to be environmentally safe and had been used successfully an an imprintant for salmonids.

We marked 316 recently metamorphosed sea lampreys (average size, 160 mm and 5 g) by injecting a fluorescent rose dye-stripe into their posterior dorsal fins. The lampreys were then exposed to 5×10^{-5} mg/l PA for 24 hours in Lake Huron water, and released at the electromechanical sea lamprey weir site in the Ocqueoc River on April 13, 1978. We also marked 47 transformed sea lampreys captured in 1977–78 during their downstream migration in the Ocqueoc River and released them (without exposing them to PA) on the same date, as controls. Of these controls, 26 were fall migrants (average size, 171 mm and 6.4 g) which were marked with two green stripes in the posterior dorsal fin; the other 21 were spring migrants (average size, 171 mm and 6.9 g) which were marked with one green stripe in the posterior dorsal fin.

The PA was metered into the Ocqueoc River at a concentration of about 5×10^{-5} mg/l, 24 hours a day for 81 days during the sea lamprey spawning run of 1979. the PA was released directly into the water flowing through a pair of identical funnel-type fish traps installed immediately adjacent to one another in the weir. Both traps operated continuously while PA was released for 24 consecutive hours in one trap and then for 24 hours in the other trap, and so on, throughout the test period.

Records of the trap catches revealed no attraction or avoidance reaction to PA by previously unexposed sea lampreys or other species of fish. Two marked sea lampreys exposed to PA as newly transformed adults were recaptured in the Ocqueoc River weir trap a year later, during the 1979 spawning run. One of these marked lampreys was taken in the trap net receiving PA on the day of capture. We did not determine in which trap the other lamprey was captured because this individual was not identified on the day of capture. During the spawning run of 1979, we also examined about 6,000 spawning adult sea lampreys from the Cheboygan River (which received no PA or PA-exposed transformers), to determine if any of the marked lampreys had migrated into that river. These examinations yielded four marked lampreys that had been exposed to PA and released in the Ocqueoc River in 1978. None of the marked lampreys released as controls were recovered in either the Ocqueoc or Cheboygan Rivers.

A group of 100 recently transformed, PA-exposed sea lampreys was released in the Ocqueoc River during the spring of 1979 in a continuing evaluation of this chemical as a potential imprintant for sea lampreys. A refined testing procedure and the release of a larger number of PA-exposed transformers will be required to adequately evaluate the potential of this method.

Experimental Determination of the Mechanism and Effect of Sea Lamprey Predation on Lake Trout

We designed a laboratory study, begun in late 1978, to provide data needed to establish more fully the relation between sea lamprey wounding and sea lamprey-induced mortality in lake trout. A better understanding of the wounding-mortality relationship is needed to estimate the impact of the residual sea lamprey populations on lake trout stocks and to determine the optimum level of sea lamprey control. In the past, attempts have been made to determine lethal lamprey attack rates from the observed frequency of wounds and scars in samples of surviving fish. Most of this evidence linking wounding and scarring rates to lake trout mortality is circumstantial, however, because trout killed by lampreys in the wild are seldom found, and most of the methods tried or considered to circumvent this problem involved assumptions that cannot be fully met, or required bias-free data that are difficult to obtain.

In the present study, tests were designed specifically to produce basic information on wounding mortality in relation to four factors: size of lake trout, size of sea lampreys, prey-size preference of lampreys, and predator-prey ratio. These tests are being conducted by placing trout and sea lampreys together in large tanks or raceways supplied with Lake Huron water and observing the rates of wounding and mortality among the trout. Three tests have been completed. Tests 1 and 2 were conducted in fall at water temperatures that were declining from 10 C to 4 C, and test 3 was conducted in spring and summer at 10 C. Initial populations were 20 lake trout and 10 sea lampreys in tests 1 and 2, and 40 lake trout and 20 sea lampreys in test 3. Sea lampreys that died during testing were replaced, but lake trout that died were not replaced. The results of these three tests are as follows:

Test number	Average length (mm) at start of study		Duration of test (days)	Mortality of trout (percent)	Average number of attack marks on dead and live trout at end of study	
	Lake trout	Sea lampreys			Dead	Live
1	487	401	44	100	2.3	–
2	559	400	83	75	2.3	4.8
3	566	258	87	100	3.8	–

In test 1, where relatively small lake trout were exposed to large lampreys nearing the end of their parasitic life stage, mortality was rapid and complete, and the dead trout bore an average of 2.3 attack marks. In test 2, where slightly larger trout were exposed to large lampreys, 25% of the lake trout survived after 83 days; dead trout had an average of 2.3 attack marks, as in test 1, but the surviving trout had an average of 4.8 attack marks. In test 3, where the largest trout were exposed to the smallest lampreys, mortality was complete in 87 days, and the average number of attack marks was 3.8.

Interpretation of these preliminary results is difficult because the tests are unreplicated and because tests 1 and 2 were conducted under slightly different conditions than test 3. Nevertheless, the results suggest the expected relationships: attacks from large lampreys on small trout are more rapidly lethal than are attacks by small lampreys on larger trout (44 vs. 87 days); and fewer attacks are required by large lampreys to kill small trout than are required by small lampreys to kill larger trout (2.3 vs. 3.8). Although test 2 showed the expected relationship to test 1, it appears to be in disagreement with test 3. This discrepancy may be the result of the higher average water temperatures during test 3, which may have caused sea lamprey attacks to be more rapidly lethal.

Efficacy of New Formulations of Registered Lampricides Against Larval Sea Lamprey

The development of new bottom-release formulations of registered lampricides is desirable to increase the effectiveness of these compounds for use in controlling populations of sea lamprey larvae in deltas, estuaries, oxbows, and lakes. Their development has progressed more slowly than planned because attempts to obtain technical grade lampricides for reformulation were unsuccessful. Preliminary toxicity tests conducted in the interim with existing formulations and free-swimming lamprey larvae indicated that TFM alone could not be used effectively as a bottom-release lampricide because high concentrations (more than 30 mg/l for 15 minutes or more than 20 mg/l for 30 minutes) were required to produce 100% mortality among the test populations; however, Bayer 73 alone or in combination with TFM showed considerable potential.

Integrated Production of Sea Lamprey for Research

About 4,900 sea lampreys in various life stages were obtained for use in research conducted at the Hammond Bay Biological Station and the Monell Chemical Senses Center. Included were 3,246 spawning-run lampreys taken in the weir on the Ocqueoc River, 1,100 captured in the Cheboygan River, and 150 taken in the St. Marys River; 333 feeding-stage sea lampreys were purchased from a commercial fisherman trapnetting in the vicinity of Hammond Bay; about 100 recently transformed sea lampreys were provided by personnel from the Marquette Biological Station; and 18 transformers (averaging 177 mm and 7.4 g) were captured in fyke nets fished October–December in the Ocqueoc River.

The small numbers of larvae and transformers prevented or hampered completion of some of the planned work for the year.

Chemical Attractants and Repellents for Sea Lampreys

This section summarizes research conducted during 1979, at the Monell Chemical Senses Center, Philadelphia, Pennsylvania, and the Hammond Bay Biological Station, to identify and characterize intraspecific chemical signals (pheromones) involved in sea lamprey migration and reproduction. Such substances may prove to be useful as lures to help capture spawning-run lampreys or to disrupt normal pheromone communication so that successful spawning is prevented or reduced.

The occurrence of pheromone communication in spawning-run sea lampreys has been inferred from the results of a large number of two-choice preference tests in which sexually mature lampreys exhibited significant preferences for water in which sea lampreys of the opposite sex had been held. During the 1979 spawning season, approximately 700 two-choice preference tests were conducted to determine the source of the male and female pheromones, to screen fractions of pheromone-containing secretions for behavioral activity, and to further characterize the physiological and environmental factors governing the onset and intensity of pheromone communication.

The male pheromone, which elicits a preference response in females, is present in the urogenital fluid of sexually mature males (i.e., those displaying secondary sex characters). Sexually mature females showed preferences for male urogenital fluid (< 15% milt by volume) at concentrations of 51.3 and 25.6 μL/L, but not for samples of mucus scraped from the skin of sexually mature males. Preferences were also observed when urogenital fluid containing no visible milt was presented

to females at a concentration of 51.3 μL/L. Milt elicited no response in females at concentrations ranging from 6.4 to 51.3 μL/L suggesting that the active substance in male urogenital fluid may not originate in the gonads.

Rinses of eggs stripped from ovulated female lampreys frequently, but not always, elicited preference responses in males, whereas rinses of eggs surgically removed from unovulated females evoked no response. These results indicate that the female pheromone is present in the ovarian fluid of ovulated, but not unovulated, females. In previous tests, however, males responded to water in which sexually mature but unovulated females had been held, suggesting that the female pheromone may also be present in other body fluids, perhaps urine.

The results of these studies are consistent with previous findings which indicate that pheromone release, the responsiveness of the receiving sex or both correlated with sexual maturation. Although sexually mature sea lampreys show preferences for water in which a single sexually mature lamprey of the opposite sex has been held for as little as 1 hr, sexually immature lampreys do not respond to water in which immature lampreys of the opposite sex have been held. Experients to determine if sexually immature spawning-run males release the pheromone and if sexually immature females will respond to the male pheromone are currently underway.

We have also confirmed our previous observation that male sea lampreys, captured at the beginning of the spawning migration and not yet displaying secondary sex characters, are attracted to water in which sea lamprey larvae have been held. Additional tests are underway to determine if females show a similar preference for larval holding water, and if the intensity of the response changes during the course of the spawning season. Preliminary results indicate that the attraction of early-run males to water in which larvae have been held decreases as the responding animals become sexually mature.

REGISTRATION-ORIENTED RESEARCH ON LAMPRICIDES

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Registration Activities

A meeting was held with EPA officials in Washington on October 23 to discuss the Bayer 73 submission. Since all current uses of lampricides are covered by adequate labels, EPA is most reluctant to have the Commission formally submit a registration application of any kind on Bayer 73. Instead, they would prefer that nothing further be submitted until the compound is called up for review. The time frame involved could be as long as 10 years and might be even longer. EPA officials were persuaded, however, to permit the Commission to place data and completed studies in the existing file. This would assure that no reports or data are lost during the lengthy time delay or due to possible personnel changes at La Crosse or at the Commission.

Rhodamine WT was added to the list of tracer dyes which can be legally used in sea lamprey control operations. Previously, EPA had ruled that rhodamine B and fluorescein sodium could be used without additional studies or submissions.

Conditioning Studies with TFM: Influence on Acute Toxicity

The acute toxicity of TFM to groups of untreated (nonconditioned) white suckers and white suckers previously exposed (conditioned) to sublethal concentrations of TFM was investigated. All toxicity tests were conducted in a flow-through sytem.

Initially, the influence of conditioning on the subsequent acute toxicity of TFM was tested on two sizes of suckers, 15 mm and 47.5 mm.

The 24-hour LC_{50} values for both conditioned and nonconditioned fish of the small size were significantly ($P < 0.05$) less than those of the large fish (Table 1) indicating that the smaller fish were considerably more sensitive to TFM. Fish of the larger size (mean length 47.5 mm; mean wet weight 1.03 g) were used in all subsequent experiments.

In the conditioning protocol for the remainder of the experiments, all conditioned groups of fish were exposed to a constant product of toxicant concentration and time. However, individual groups of conditioned fish were exposed to different regimens of time and TFM concentrations. Comparisons of 24-hour LC_{50} values for the various combinations indicated that prior conditioning to TFM did not significantly decrease the toxicity of this chemical to white suckers (Table 2).

To determine if conditioning for more prolonged time periods influenced the acute toxicity of TFM, white suckers were exposed for 8-hour periods every 24 hours to concentrations of 0.1 of the 24-hour LC_{50} for 5 consecutive days. After the 5th day, the acute toxicity of TFM to conditioned and nonconditioned fish was established by determining the acute toxicity in a flow-through toxicity test. The 24-hour LC_{50} concentrations and 95% confidence interval estimates were 7.5 mg/l (6.68–7.20) and 7.0 mg/l (6.41–7.65) for nonconditional and conditioned fish, respectively. Again, no protection was indicated.

Conditioning Studies with TFM: Influence on Residue Dynamics

Prior exposure to subacute concentrations of TFM neither enhanced the survival of northern pike nor altered the apparent residue dynamics of this chemical in fish exposed to acutely toxic concentrations of TFM. Mortality (8/11) among fish exposed only to acutely toxic concentrations (5.0 μg/ml) for 3 hours was similar to that (8/12) of a group exposed to 1.0 μg/ml and then exposed to 5.0 μg/ml for 3 hours.

Samples of plasma, liver, epaxial muscle, and gallbladder bile were taken from surviving fish in each group for analysis of TFM residues. No differences in the residue concentrations of either free or conjugated TFM were noted between treatment groups in any of the samples analyzed (Table 3). Only slight differences were observed in the ratios of TFM concentration among both liver to plasma and gallbladder bile to plasma ratios between the two treatment groups (Table 4). These differences were probably related to both the relatively greater body burdens of TFM in the "conditioned" fish and the longer period of time available to this group for partitioning of TFM into the various body compartments.

A study was undertaken to determine if prior exposure to low concentrations of TFM influenced its distribution and metabolism in mature lake trout, white suckers, and longnose suckers when they were exposed to near lethal concentrations. Experiments were conducted in raceways at the Hammond Bay Biological Station, Millersburg, Michigan using Lake Huron water (temperature 8°C; pH 8.2). Concentrations of TFM for the "conditioning" exposure were set at 1/10th (0.3 mg/l) of the 24-hour LC_{50} for white suckers, a value previously determined by static toxicity tests.

Concentrations of free and conjugated TFM in plasma and gallbladder bile samples from conditioned lake trout were similar to those found in nonconditioned fish (Table 5). The mean liver burden of free TFM in fish from the conditioned group was significantly ($P < 0.01$) lower then that of fish in the nonconditioned group suggesting that either: (1) plasma clearance of TFM was more efficient in the former group, or (2) that the hepatic storage capacity for free TFM in this group was reduced.

Liver to plasma and bile to plasma ratios of free TFM were greater than one in samples from all treatment groups indicating that free TFM may be actively taken up by the liver and excreted into the bile. The mean liver to plasma ratio of free TFM was greater in fish of the nonconditioned group than from those of the conditioned group, but this difference was not significant (Table 6). The mean bile to plasma ratios of free TFM were similar among all treatment groups.

The mean concentrations of free and conjugated TFM in the plasma and gallbladder bile of white suckers were similar between the conditioned and nonconditioned groups (Table 7). The concentration of free TFM in the plasma in both groups was equal to or greater than that found in the gallbladder bile, but the concentration of conjugated TFM in the plasma was less. This observation suggests that glucuronidation of TFM is a major prerequisite for its transfer from plasma to bile in this species of sucker.

The concentration of total TFM in the gallbladder bile of the longnose sucker was nearly 1/1,000th that found in the white sucker (Table 6). This observation is surprising since biliary excretion is a major route of TFM elimination in other teleosts. Comparison of total TFM concentrations in the plasma and muscle of both species and the absence of mortality and morbidity in each species exposed indicates that both species were successfully eliminating the chemical. Other studies to confirm these observations and to identify specific routes of chemical clearance used by the longnose sucker would be useful.

Conclusions

Prior conditioning of fish by exposure to sublethal concentrations of TFM does not alter the metabolic distribution of TFM in lake trout, longnose and white suckers, or northern pike. Therefore, we conclude that conditioning by preexposure to TFM offers no protection to nontarget species during lampricide applications.

TFM Bar Formulations

Preliminary work was begun on development of a solid bar formulation of TFM for use in treating small headwater streams where metering pumps are now used. A solid formulation would eliminate the need to have a man monitor each metering pump. The first attempt at making a TFM bar produced a solidified material, but its consistency was too soft to be feasible. Adjustments in proportions of the various ingredients should permit production of a more handleable solid formulation.

TFM Bottom Formulations

Experimental formulations of TFM on extruded clay were sent to the National Fishery Research Laboratory by the Hammond Bay Biological Station. Amounts of the formulation calculated to give a concentration of 10 mg/l TFM was added to water, and the solutions were analyzed at 0.5, 2.0, and 24 hours. Although some variability was noted, all but one assay indicated a minimum release of 90%.

Soil Binding Study

Initiation of the soil binding study still awaits delivery of ^{14}C-labeled TFM from American Radiochemical Corporation.

Simultaneous Analysis of TFM and Bayer 73

TFM and Bayer 73 are applied separately or in combination for the control of sea lampreys in tributary streams of the Great Lakes. Monitoring stream concentrations at each site is essential to successful treatments. Currently, separate methods of analysis are required for each component. This is inconvenient and time consuming so studies were conducted in search of a method that would permit simultaneous analysis for both compounds. High performance liquid chromatography (HPLC) shows definite promise because it is rapid, and analyzes for both compounds simultaneously. Since Bayer 73 is applied at only approximately 2% of the TFM concentrations, residue levels of Bayer 73 are below the detection limits by direct HPLC analysis. However, use of a Sep Pak C_{18} disposable column will efficiently adsorb both TFM and Bayer 73 from water solutions. The chemicals can then be quantitatively removed from the column with a small volume of methanol. Methanol elution effectively concentrates the sample and provides some sample cleanup. The eluate can then be analyzed directly on HPLC. Recoveries of TFM and Bayer 73 on these columns ranged from 90 to 99% with effective sample concentration of up to 25 times. If the method proves suitable for field use, the procedure will reduce the time required for both analyses by 50% or more. Total time involved for completing the analyses is approximately 10 minutes. Investigations are continuing to further refine this procedure.

Technical Assistance

John Allen, analytical chemist, provided technical assistance to the Canadian agent during treatment of the Goulais River in Ontario. With the assistance of David Johnson of the Marquette station, the usefulness of gas chromatography for monitoring concentrations of Bayer 73 during a river treatment was demonstrated. Instrument problems were resolved and analyses for the chemical in the river were completed satisfactorily. The use of gas chromatography for the analysis of Bayer 73 during treatment of the Huron River was also demonstrated for participants in the Sea Lamprey International Symposium.

Bayer 73 Residues

Coho salmon exposed to 0.05 mg/l of Bayer 73 for 12 hours were transferred to fresh water for withdrawal and analyzed for residues of the lampricide. Residues in coho salmon were slightly higher in the bile and slightly lower in plasma than residues observed in rainbow trout. Bayer 73 was not detectable in blood plasma after 2 weeks of withdrawal, and only a small residue (0.11 μg/ml) of the lampricide remained in gallbladder bile after 4 weeks of withdrawal (Table 8).

Ancillary Bayer 73 Residue Method

Regulatory agencies require two methods of analysis for chemicals which are submitted for registration or reregistration. An ancillary procedure of analysis for Bayer 73 residues has been developed. This procedure involves formation of dimethylated derivative of the intact molecule rather than analysis for a hydrolysis product as is currently being done.

When Bayer 73 is reacted with methyl iodide and sodium hydride in dimethyl sulfoxide, a N,O-dimethyl derivative is formed which is amenable to gas chromatography. The new method is rapid and straightforward, utilizes relatively mild conditions, and yields a derivative detectable at the ng/g (ppb) level. Recovery levels exceed 95%.

Environmental Studies of Bayer 73
by Dr. Derek C. G. Muir

Studies completed by Dr. Muir include work on the active portion of the Bayer 73 molecule. His paper "Determination of niclosamide (Bayer 2353) in water and sediment samples" is in press in International Journal of Environmental Analytical Chemistry. Another paper "Studies on the rate of uptake of organic pollutants by fish in river water" is in press in Environmental Science and Technology. Abstracts of the papers follow.

Determination of niclosamide (Bayer 2353) in water and sediment samples. Derek C. G. Muir and Norbert P. Grift (Dept. of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba R31 2N6, Canada)

A method is described for the determination of niclosamide (2',5-dichloro-4'-nitrosalicylanilide) in river water and sediment. River water is extracted by shaking with ethyl acetate. Sediment is shaken with methanol:water (4:1). The mixture is centrifuged and the methanol is evaporated. The sediment extract is then partitioned with methylene chloride and the extracts are cleaned up on a Florisil column. Niclosamide can be analyzed, after methylation with methyl iodide, by gas chromatography with electron capture or alkali flame detection, or directly by high pressure liquid chromatography with a UV absorbance (313 nm) detector. Recoveries of niclosamide ranged from 99 to 116% in fortified river water and 73 to 126% in fortified pond sediment samples.

Studies on the rate of uptake of organic pollutants by fish in river water. Derek C. G. Muir and W. Lyle Lockhart (Dept. of Fisheries and Oceans, Freshwater Institute, 501 University Crescent, Winnipeg, Manitoba R31 2N6, Canada)

Rainbow trout (*Salmo gairdneri*) were exposed to low levels (0.5 to 50 μg/l) of nine pesticides as well as 2,4,5,2',4',5'-hexachlorobiphenyl and triphenylphosphate (all ^{14}C-labeled) in river water and dilutions of river and dechlorinated city water (lab). Fish were sampled at regular intervals over 24 to 32 hour exposures and oxidized to determine ^{14}C uptake. The results showed that there were striking differences in the rate of uptake of the organics between fish in river and lab water. Hexachlorobiphenyl showed the greatest differences in uptake rate while relatively water soluble compounds such as terbutryn and 2,4D showed the least effect. Differences in uptake rates were correlated with sorption coefficients of the compounds to suspended solids in river water. The lower rate of uptake of each organic in river water could be predicted by multiplying the uptake rate constant in lab water by the fraction of the compound in solution.

In this paper Dr. Muir states "Niclosamide degraded rapidly in river water (95% lost in 24 hours) but not in lab water, so that throughout much of the experiment the fish were exposed to mainly niclosamide degradation products in the river water treatment." This observation supports the GLFC position that no accumulation of Bayer 73 results from its use in sea lamprey control.

Bayer 73 Formulations

Samples of granular Bayer 73 coated with various resins to prevent dusting during application and release of chemical as the granules sink through the water column were tested in the laboratory. Only one of the coating materials, Penford Gum 380, released the active ingredient at the same rate as the uncoated formulation at all time periods tested (15 minutes to 4 hours). Sieving for particle size revealed that the batch of granular Bayer 73 used in the coating experiments (obtained from Marquette Biological Station 9/79) contained only a slight amount (less than 0.1%) of fine material smaller than No. 60 mesh. By comparison, some earlier batches contained up to 7% fines. It appears that the manufacturer has been able to improve the formulation to eliminate the dusting problem and that the coating probably will not be needed. However, release of active ingredient from the 1979 sample was only 23 to 24% in 4 hours as opposed to 39% for a sample obtained from the Ludington Biological Station 3 years before.

Lampricide Nomenclature

The scientific nomenclature of chemicals is confusing at best and, when trade names are included, confusion may result. The lampricides are no exception. Bayer 73 has uses other than for sea lamprey control and has been referred to under a number of other names. Bayer 73, the compound used in sea lamprey control is merely the ethanolamine salt of 2′,5-dichloro-4′-nitrosalicylanilide otherwise known as niclosamide or Bayer 2353. The function of the ethanolamine form is to provide a water soluble salt to facilitate its use in aquatic situations. When Bayer 73 or Bayer 2353 is added to water, the resulting solutions will contain exactly the same active ingredient.

Although TFM has no commercial use, some confusing nomenclature has evolved. Tables 9, 10, and 11 are an attempt to show the chemical formulae of the lampricides and some of the names which have been associated with them. The list of names is not meant to be a complete list of all names that have been used for the lampricides, but rather is intended to serve as a guide to help resolve some of the confusion.

Glucose-6-Phosphate Dehydrogenase Assays

It has been shown that some chemicals affect enzyme systems in fish and many interfere with vital physiological functions. Studies dealing with the effects of fishery chemicals on the in vitro metabolism of the enzyme glucose-6-phosphate dehydrogenase are currently under way. The lampricide TFM was found to be inhibitory at 128 mg/l, but this level is far above use pattern concentrations. This technique was applied to several fishery chemicals to determine its applicability as a rapid screening method for toxicity. Our data indicate this technique does not provide an index that can be compared with fish toxicity.

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Table 1. Toxicity of TFM to two sizes of conditioned and nonconditioned white suckers. Values for length, wet weight, and dry weight are mean ± S.D.; the sample numbers are listed in parentheses.

Conditioning procedure (Time × fraction 24-h LC_{50})	Length (mm)	Wet weight (mg)	Dry weight (mg)	24-h LC_{50} [a] and 95% confidence interval (mg/l)	
				Nonconditioned	Conditioned
6 h × 0.1	15.2±1.74 (15)	13.4±2.80 (15)	2.14±0.75 (15)	6.2 5.50–6.99	5.30 4.84–5.81
6 h × 0.1	47.5±1.73 (20)	1033.8±88.0 (20)	217.2±31.3 (20)	9.2 8.43–10.0	8.50 7.96–9.08

[a] 24-h LC_{50} significantly different ($P < 0.05$) for small and large fish.

Table 2. Toxicity of TFM to conditioned and nonconditioned white suckers.

Conditioning procedure (Time × fraction 24-h LC_{50})	24-h LC_{50} and 95% confidence interval (mg/l)	
	Nonconditioned	Conditioned
4 h × 0.15	9.75 8.97–10.6	9.20 8.57–9.87
6 h × 0.10	9.20 8.43–10.0	8.50 7.96–9.08
12 h × 0.05	9.40 8.66–10.2	8.40 8.00–9.04
6 h × 0.05	9.20 8.63–9.80	8.20 7.51–8.95

Table 3. TFM concentrations in plasma, gallbladder bile, liver, and muscle of northern pike following exposure to TFM. Values represent the mean ± SE; the number of animals are listed in parentheses.

Type of exposure	TFM residues							
	Plasma			Bile			Liver	Muscle
	Total (μg/ml)	Free (μg/ml)	% Bound	Total (μg/ml)	Free (μg/ml)	% Bound	Free (μg/g)	Free (μg/g)
Treated (3)	4.95 ±0.20	2.89 ±0.51	40.4 ±12.38	110.0 ±50.0	1.15 ±0.22	98.67 ±0.46	10.65 ±2.10	13.43 ±2.96
Conditioned and treated (3)	4.37 ±0.61	3.03 ±0.29	29.57 ±5.56	157.1 ±52.4	1.60 ±0.36	98.50 ±0.67	12.73 ±3.16	11.92 ±3.08

Table 4. Liver to plasma and bile to plasma ratios of TFM concentrations in northern pike. Values represent the mean ± SE; the number of animals are listed in parentheses.

Type of exposure	Liver:Plasma	Bile:Plasma
Treated (3)	2.22±0.45	21.90±4.93
Conditioned and treated (3)	2.94±0.39	33.93±7.27

Table 3. TFM concentrations in plasma, gallbladder bile, liver, and muscle of northern pike following exposure to TFM. Values represent the mean ± SE; the number of animals are listed in parentheses.

	TFM residues							
	Plasma			Bile			Liver	Muscle
Type of exposure	Total (μg/ml)	Free (μg/ml)	% Bound	Total (μg/ml)	Free (μg/ml)	% Bound	Free (μg/g)	Free (μg/g)
Treated (3)	4.95 ±0.20	2.89 ±0.51	40.4 ±12.38	110.0 ±50.0	1.15 ±0.22	98.67 ±0.46	10.65 ±2.10	13.43 ±2.96
Conditioned and treated (3)	4.37 ±0.61	3.03 ±0.29	29.57 ±5.56	157.1 ±52.4	1.60 ±0.36	98.50 ±0.67	12.73 ±3.16	11.92 ±3.08

Table 4. Liver to plasma and bile to plasma ratios of TFM concentrations in northern pike. Values represent the mean ± SE; the number of animals are listed in parentheses.

Type of exposure	Liver:Plasma	Bile:Plasma
Treated (3)	2.22±0.45	21.90±4.93
Conditioned and treated (3)	2.94±0.39	33.93±7.27

Table 5. TFM residues in plasma, gallbladder bile, liver, and lateral muscle of lake trout following selected exposures to TFM. Values represent the mean ± SEM; the number of samples are listed in parentheses.

	TFM residues					
	Plasma		Bile		Liver	Muscle
Type of exposure	Free (μg/ml)	Conjugated (μg/ml)	Free (μg/ml)	Conjugated (μg/ml)	Free (μg/g)	Free (μg/g)
Unconditioned	0.14	0.04	6.7	0.26	0.18	0.01
0.3 mg/l × 8 h	±0.07	±0.02	±1.8	±0.12	±0.10	±0.00
	(5)	(5)	(4)	(4)	(4)	(5)
Unconditioned	1.73	0.50	68.0	545.0	8.81	ND[a]
3.0 mg/l × 12 h	±0.62	±0.08	±9.4	±53.8	±2.55	
	(4)	(4)	(4)	(4)	(5)	
Conditioned	1.41	0.23	59.0	443.3	3.9[b]	0.42
0.3 mg/l × 8 h	±0.47	±0.11	±11.5	±80.9	±1.3	±0.11
+	(3)	(3)	(3)	(2)	(5)	(5)
3.0 mg/l × 12 h						

[a]Not determined.

[b]Significantly less ($P < 0.01$) than the nonconditioned group.

Table 5. TFM residues in plasma, gallbladder bile, liver, and lateral muscle of lake trout following selected exposures to TFM. Values represent the mean ± SEM; the number of samples are listed in parentheses.

Type of exposure	TFM residues: Plasma Free (µg/ml)	Plasma Conjugated (µg/ml)	Bile Free (µg/ml)	Bile Conjugated (µg/ml)	Liver Free (µg/g)	Muscle Free (µg/g)
Unconditioned 0.3 mg/l × 8 h	0.14 ±0.07 (5)	0.04 ±0.02 (5)	6.7 ±1.8 (4)	0.26 ±0.12 (4)	0.18 ±0.10 (4)	0.01 ±0.00 (5)
Unconditioned 3.0 mg/l × 12 h	1.73 ±0.62 (4)	0.50 ±0.08 (4)	68.0 ±9.4 (4)	545.0 ±53.8 (4)	8.81 ±2.55 (5)	ND[a]
Conditioned 0.3 mg/l × 8 h + 3.0 mg/l × 12 h	1.41 ±0.47 (3)	0.23 ±0.11 (3)	59.0 ±11.5 (3)	443.3 ±80.9 (2)	3.9[b] ±1.3 (5)	0.42 ±0.11 (5)

[a]Not determined.
[b]Significantly less ($P < 0.01$) than the nonconditioned group.

Table 6. Liver to plasma and gallbladder bile to plasma ratios of free TFM in lake trout. Values represent the mean ± SD; the number of fish are listed in parentheses.

Type of exposure	Concentration: Liver:Plasma	Bile:Plasma
Unconditioned 0.3 mg/l × 8 h	1.75±1.13 (5)	53.2±23.7 (4)
Unconditioned 3.0 mg/l × 12 h	5.93±2.28 (4)	45.9±7.78 (3)
Conditioned 0.3 mg/l × 8 h + 3.0 mg/l × 12 h	3.16±1.51 (3)	55.97±17.27 (2)

Table 7. TFM residues in plasma, gallbladder bile, and lateral muscle of white suckers and longnose suckers following selected exposures to TFM. Values represent the mean ± SEM; the number of fish are listed in parentheses.

Species, concentration, and exposure time	TFM residue: Plasma (µg/ml)	Plasma Conjugated (µg/ml)	Bile Free (µg/ml)	Bile Conjugated (µg/ml)	Muscle Free (µg/ml)
White suckers					
0.3 mg/l × 8 h	0.27 ±0.08 (5)	0.32 ±0.15 (3)	0.52 ±0.28 (5)	6.48 ±1.03 (4)	0.17 ±0.04 (5)
3.0 mg/l × 12 h	9.89 ±3.29 (5)	0.36 ±0.09 (2)	4.91 ±0.70 (4)	1616.7 ±236.3 (4)	ND[a]
0.3 mg/l × 8 h + 3.0 mg/l × 12 h	6.5 ±1.3 (3)	0.26 ±0.0 (2)	6.40 ±3.14 (3)	1100.0 ±381.9 (3)	3.5 ±0.38 (4)
Longnose suckers					
0.3 mg/l × 8 h	0.30 ±0.08 (5)	0.22 ±0.09 (5)	0.34 ±0.27 (5)	ND	0.07 ±0.01 (5)
3.0 mg/l × 12 h	9.93 ±3.57 (4)	1.09 ±0.05 (3)	3.2 ±0.6 (3)	1.33 ±0.37 (3)	ND
0.3 mg/l × 8 h + 3.0 mg/l × 12 h	9.11 ±1.62 (4)	1.11 ±0.07 (4)	3.1 ±0.14 (2)	±1.18 ±0.22 (2)	2.67 ±0.21 (4)

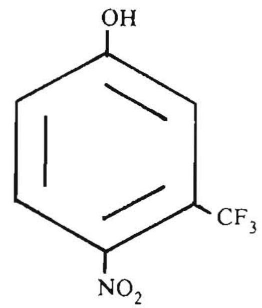
[a]Not determined.

Table 8. Residues of Bayer 73 (μg/ml) in plasma and bile of coho salmon exposed to 0.05 mg/l of the lampricide for 12 hours and transferred to fresh water for selected withdrawal times.

Withdrawal time	Plasma[a]	Bile[b]
Control	< 0.01	< 0.01
0 hour	5.00±4.23	859
4 hours	8.48±2.74	892
8 hours	6.24±1.37	1,240
12 hours	6.57±1.41	1,262
24 hours	5.47±0.482	862
3 days	1.80±0.264	188
7 days	0.439±0.203	22.9
10 days	0.073±0.056	5.87
14 days	< 0.01	2.37
21 days	< 0.01	0.303
28 days	< 0.01	0.110

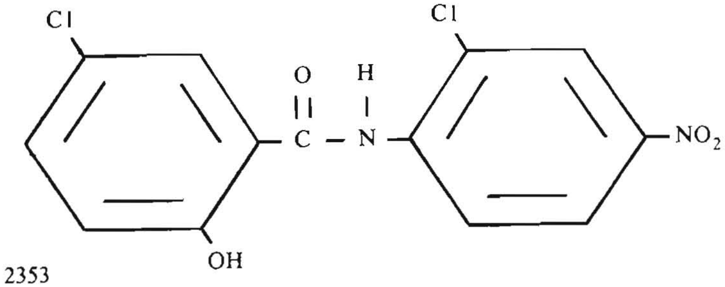
[a]Mean ± S.D.; five fish at each interval.
[b]Pooled bile from five fish.

Table 9. Structure and nomenclature of TFM



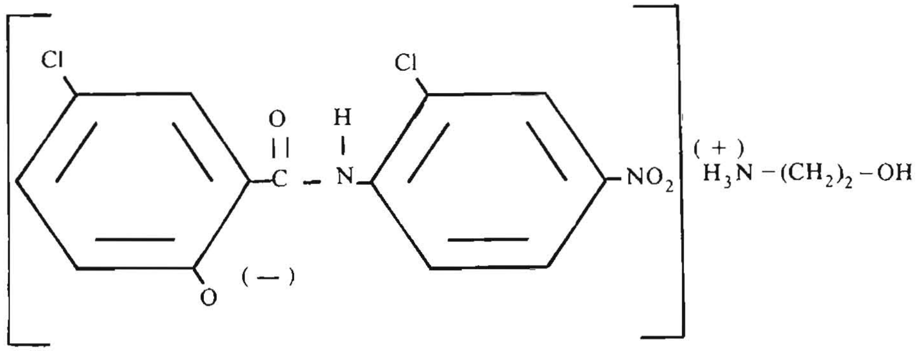
3-trifluoromethyl-4-nitrophenol
3-trifluoromethyl-4-nitrophenol
ααα-trifluoro-4-nitro-*m*-cresol
1,3,6-nitrotrifluorocresol
ααα-trifluoro-4-nitro-metacresol
2-nitro-5-hydroxybenzotrifluoride
6-nitro-3-hydroxy-1-trifluormethyl-benzol
ααα-trifluor-6-nitro-3-hydroxy-toluol
Lamprecid 2770
Dowlap F40
Dowlap[(R)] F
Eelicide - TFM

Table 10. Structure and nomenclature of Bayer 2353



Bayer 2353
Niclosamide
Niclosamid
2′,5-dichloro-4′-nitrosalicylanilide
5-chloro-N-(2′-chloro-4′-nitrophenyl)salicylamide
5-chlorosalicyloyl-(0-chloro-*p*-nitranilide)
N-(2′-chloro-4′-nitrophenyl)-5-chlorosalicylamide
2-hydroxy-5,2′-dichloro-4′nitro-benzanilide
Cestocid
Fenasal
Lintex
Nasemo
Sulgui
Tredemine
Vermitid
Yomesan

Table 11. Structure and nomenclature of Bayer 73



Bayer 73
2-aminoethanol salt of Bayer 2353
Salt of 2′, 5-dichloro-4′-nitrosalicylanilide
Bayluscid
Bayluscide

ADMINISTRATIVE REPORT FOR 1979

Meetings

The Commission held its 1979 Annual Meeting in Toronto, Ontario on 26–28 June, and its Interim Meeting in Ann Arbor, Michigan on 27–28 November 1979. In addition, both the Canadian and U.S. sections met in plenary sessions on 27 June in conjunction with the Annual Meeting in Toronto. The Commission also held executive meetings of Commissioners and staff as follows:

21–22 March	Ann Arbor, Michigan
26 and 28 June	Toronto, Ontario
6 September	Windsor, Ontario
27–28 November	Ann Arbor, Michigan

The Great Lakes Fishery Commission also met with the International Joint Commission in Windsor, Ontario on 7 September 1979 to discuss items of mutual interest.

Meetings of standing committees during 1979 were:

Lake Michigan Committee, Michigan City, Indiana, 8 February
Lake Huron Committee, St. Clair, Michigan, 21 February
Sea Lamprey Control and Research Committee, Ann Arbor, Michigan, 27 February
Lake Superior Committee, Duluth, Minnesota, 1 March
Lake Ontario Committee, Buffalo, New York, 13–14 March
Lake Erie Committee, Buffalo, New York, 14–15 March
Council of Lake Committees, Buffalo, New York, 14–15 March and Toronto, Ontario, 25 June
Great Lakes Fish Disease Control Committee, Syracuse, New York, 10–11 April
Scientific Advisory Committee, Toronto, Ontario, 25 June and Ann Arbor, Michigan, 26 November

Attendence at other Commission-related meetings included Lake Superior Advisory Committee, Lake Michigan Chub Technical Committee, Lake Michigan Study Group, Sea Lamprey International Symposium, Stock Concept Symposium Steering Committee, and Strategic Great Lakes Fishery Management Plan Steering Committee and Work Group, sea lamprey control agents annual sea lamprey conference, and Lake Erie Fish Community Workshop.

Officers and Staff

Chairman K. H. Loftus and Vice-Chairman R. L. Herbst continued their terms of office through 1979. One change in Commission membership occurred during 1979. Mr. H. D. Johnston, Assistant Deputy Minister for Pacific and Freshwater Fisheries, Department of Fisheries and Oceans Canada, was appointed Commissioner effective 9 August 1979; he replaced Dr. C. J. Kerswill who had resigned in 1978.

Two changes in staff occurred during 1979. B. S. Biedenbender accepted a position as administrative assistant on 7 January. W. J. Maxon, chief administative officer, resigned 23 August to accept a position with U.S. Fish and Wildlife Service in Washington, D.C.

The Commission's internal operating committee structure was reviewed and the following assignments were made at the 21 March 1979 executive meeting.

Finance and Administration

Commissioners	*Staff Member*
R. L. Herbst, Chairman	W. J. Maxon
K. H. Loftus	

Sea Lamprey Control and Research

Commissioners	*Staff Member*
W. M. Lawrence, Chairman	A. K. Lamsa
F. E. J. Fry	

Management and Research

Commissioners	*Staff Member*
C. Ver Duin, Chairman	C. M. Fetterolf
M. G. Johnson	
F. R. Lockard	

Further changes were made at the Annual Meeting; 1979 ended with the following Commission membership on internal operating committees. In addition the Management and Research Committee was renamed the Fisheries and Environment Committee.

Finance and Administration

Commissioners	*Staff Members*
R. L. Herbst, Chairman	B. S. Biedenbender
H. D. Johnston	C. M. Fetterolf
K. H. Loftus	

Sea Lamprey Control and Research

Commissioners	*Staff Members*
W. M. Lawrence, Chairman	C. M. Fetterolf
F. E. J. Fry	A. K. Lamsa

Fisheries and Environment

Commissioners	*Staff Members*
M. G. Johnson, Chairman	C. M. Fetterolf
C. Ver Duin	M. A. Ross

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

During 1979 the staff participated in the following conferences, meetings, and activities:

Lake St. Clair Coordination Meeting
Michigan Sea Grant
International Association for Great Lakes Research
International Joint Commission (IJC)
IJC Science Advisory Board
IJC Workshop on Hazard Assessment
American Fisheries Society
Bureau of Indian Affairs
Great Lakes Commission
Bio-Engineering Symposium
Mitigation Symposium
Meetings with USFWS, FDA, EPA, and Department of Agriculture on registration of pesticides and fishery chemicals
Iron River National Fish Hatchery Public Hearing
Lake Erie Fish Community Workshop
Symposium on Indian Fishing Rights
Winter navigation meetings

Reports and Publications

In 1979, the Commission published an Annual Report for 1976, nine papers in its Technical Report Series, and two special publications.

Walleye stocks in the Great Lakes, 1800–1975: fluctuations and possible causes, by J. C. Schneider and J. H. Leach. Tech. Rep. 31. February 1979. 51 pp.

Modeling the western Lake Erie walleye population; a feasibility study, by B. J. Shuter, J. F. Koonce, and H. A. Regier. Tech. Rep. 32. April 1979. 40 pp.

Distribution and ecology of lampreys in the Lower Peninsula of Michigan, 1957–75, by R. H. Morman. Tech. Rep. 33. April 1979. 59 pp.

Effects of granular 2′, 5-dichloro-4′-nitrosalicylanilide (Bayer 75) on benthic macroinvertebrates in a lake environment, by P. A. Gilderhus. Tech. Rep. 34. May 1979. Pages 1–5.

Efficacy of antimycin for control of larval sea lampreys (*Petromyzon marinus*) in lentic habitats, by P. A. Gilderhus. Tech. Rep. 34. May 1979. Pages 6–17.

Variations in growth, age at transformation, and sex ratio of sea lampreys reestablished in chemically treated tributaries of the upper Great Lakes, by H. A. Purvis. Tech. Rep. 35. May 1979. 36 pp.

Annotated list of the fishes of the Lake Ontario watershed, by E. J. Crossmann and H. D. Van Meter. Tech. Rep. 36. December 1979. 25 pp.

Rehabilitating Great Lakes ecosystems, edited by G. R. Francis, J. J. Magnuson, H. A. Regier and D. R. Talhelm. Tech. Rep. 37. December 1979. 99 pp.

Commercial fish production in the Great Lakes 1867–1977, N. S. Baldwin, R. W. Saalfeld, M. A. Ross, and H. J. Buettner. Tech. Rep. 3 supplement. September 1979. 187 pp.

Current estimates of Great Lakes fisheries values: 1979 status report, by D. R. Talhelm, R. C. Bishop, K. W. Cox, N. W. Smith, D. N. Steinnes, and A. L. Tuomi. GLFC mineo. Rep. 79–1. 1979. 17 pp.

Illustrated field guide for the classification of sea lamprey atack marks on Great Lakes lake trout, by E. L. King and T. A. Edsall. Spec. Pub. 79-1. 1979. 43 pp.

Accounts and Audits.

The Commission accounts for the fiscal year ending 30 September 1979 were audited by Icerman, Johnson, and Hoffman of Ann Arbor. The firm's reports are appended.

Program and Budget for Fiscal Year 1979

At the 1977 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1979 estimated to cost $4,891,000. The program called for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate and monitor sea lamprey populations, continuing field research in direct support of control operations, the operation of assessment weirs on Lakes Superior and Huron, continuing research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, including biological controls, and a continuation of construction of barrier dams on selected streams to prevent sea lamprey access to problem areas, thus improving control and reducing the use of expensive lampricides and application costs. A budget of $246,400 was adopted for administration and general research for a total program cost of $5,137,400.

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 $5,120,000.

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$3,363,500	$1,510,100	$4,873,600
Administration and General Research	123,200	123,200	246,400
Total	$3,486,700	$1,633,300	$5,120,000

Sea lamprey control and research in Canada was carried out under agreement with the Canadian Department of Fisheries and the Environment ($1,449,000) and the U.S. Fish and Wildlife Service ($3,274,600) including lampricides and contingency funding for registration-oriented research. The Commission included in its agreement with Canada $100,000 for construction of barrier dams in that country to block spawning-run sea lamprey. In the United States, the Commission held $150,000 for barrier dam construction, of which $100,000 was earmarked for a barrier dam for Wisconsin's Middle River (Lake Superior). At the end of the year, the United States government refunded $48,893; the Canadian government had $122,000 in unused funds, including $100,000 for building barrier dams which was retained by the government for future constuction.

Program and Budget for Fiscal Year 1980

At the 1978 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1980 estimated to cost $5,546,600. The program calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate and monitor sea lamprey populations, continuing field research in direct support of control operations, the operation of assessment weirs on Great Lakes tributaries, some required research to assess immediate and long-term effects of lampricides in the environment, research to improve present control technique, including biological controls, and construction of barrier dams on selected streams to prevent sea lamprey access to problem areas, thus improving control and reducing the use of expensive lampricides and application costs. A budget of $363,000 was adopted for administration and general research for a total program cost of $5,909,600 of which $4,008,700 is being requested from the U.S. Government and $1,900,900 from Canada.

The Canadian agent has scheduled 31 lampricide treatments; 6 in Canadian tributaries to Lake Ontario, 4 in New York tributaries to Lake Ontario, 9 in Lake Huron, and 12 in Lake Superior. In addition, one electric weir and six mechanical assessment traps will be operated on selected Great Lakes tributaries to catch spawning runs of sea lamprey, and stream surveys to monitor larval lamprey populations will be continued.

The U.S. agent has scheduled 53 lampricide treatments; 26 tributaries to Lake Superior, 19 to Lake Michigan, and 8 to Lake Huron. The operation of the eight assessment barriers on Lake Superior tributaries to monitor spawning runs of sea lamprey was discontinued to be replaced by a network of portable assessment traps on tributaries to Lakes Superior, Michigan, Huron, and Ontario. The U.S. agent will continue stream surveys to monitor larval lamprey populations, will maintain studies on the growth and time to metamorphosis of selected larval populations, and also will continue to assess the possible contribution of sea lampreys from the Oswego River-Finger Lakes system to the parasitic stocks of Lake Ontario.

The current sea lamprey research program at the Hammand Bay Biological Station and the registration-oriented work at the National Fishery Research Laboratory, La Crosse, Wisconsin, are to continue through fiscal year 1980.

The Commission negotiated a Memorandum of Agreement with its U.S. agent, the U.S. Fish and Wildlife Service, for work costing $3,801,000 includes lampricide purchases, contingency funding for registration-oriented research on lampricides, and barrier dam construction. A Memorandum of Agreement was also executed with its Canadian agent, the Department of Fisheries and Oceans, for service costing $1,745,600, including purchase of lampricides and construction of barrier dams. In addition, the Commission reviewed its administration and general research budget for fiscal year 1980. The funding by government for fiscal year 1980 is as follows.

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$3,827,200	$1,719,400	$5,546,600
Administration and General Research	181,500	181,500	363,000
Total	$4,008,700	$1,900,900	$5,909,600

Program and Budget for Fiscal Year 1981

At the 1979 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1981 estimated to cost $6,079,300. The program calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate and monitor sea lamprey operations, research to improve present control techniques, including biological controls, and continuation of barrier dam construction on selected streams to prevent sea lamprey access to problem areas, thus reducing the use of expensive lampricides and application costs. A budget of $404,600 was adopted for administration and general research for a total program cost of $6,483,900. But the Commission is requesting no increase over fiscal year 1980 levels since it is using unobligated funds from bank interest and unexpended monies returned by the contract agents to make up the difference. The Commission, however, has urged the governments to recognize the fiscal year 1981 requirement as the budget base for determining future budgets.

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F. W. DUNBAR, C.P.A.
L. N. WAHL, C.P.A.

OFFICES
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Great Lakes Fishery Commission
Ann Arbor, Michigan

We have examined the accompanying balance sheets of Great Lakes Fishery Commission as of September 30, 1979, and the related statements of revenues, expenditures, and changes in fund balances 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 September 30, 1979, 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 after giving effect to the change, with which we concur, in the method of accounting for unused funds as described in Note 4 of the Notes to the Financial Statements.

Icerman, Johnson & Hoffman

Ann Arbor, Michigan
December 4, 1979

GREAT LAKES FISHERY COMMISSION

BALANCE SHEETS
September 30, 1979

ASSETS	Administration and General Research Fund	Sea Lamprey Control and Research Fund	Total
CURRENT ASSETS			
Cash in bank	$199,926	1,784,847	1,984,773
Accounts receivable - United States Fish and Wildlife Service	-0-	48,893	48,893
Accounts receivable - Canadian Department of Fisheries and Oceans	-0-	103,700	103,700
Accounts receivable - other	8,757	-0-	8,757
Due from Sea Lamprey Control and Research Fund	18,700	-0-	18,700
	$227,383	1,937,440	2,164,823
LIABILITIES AND FUND BALANCE			
CURRENT LIABILITIES			
Accounts payable	$ 7,390	-0-	7,390
Due to Administrative and General Research Fund	-0-	18,700	18,700
Payroll taxes payable	351	-0-	351
Accrued wages	3,411	-0-	3,411
Total current liabilities	11,152	18,700	29,852
FUND BALANCES (Notes 2, 3, and 4)			
Reserved for specific projects	314,961	-0-	314,961
Reserved for lampricide purchases	-0-	808,553	808,553
Reserved for barrier dam projects	-0-	185,000	185,000
Unreserved:			
Designated for subsequent years' expenditures	-0-	574,000	574,000
Undesignated	(98,730)	351,187	252,457
Total fund balances	216,231	1,918,740	2,134,971
	$227,383	1,937,440	2,164,823

See notes to financial statements on pages 5 and 6.

GREAT LAKES FISHERY COMMISSION

STATEMENT OF REVENUES, EXPENDITURES, AND CHANGES IN FUND BALANCE
Year Ended September 30, 1979

ADMINISTRATION AND GENERAL RESEARCH FUND

	Budget	Actual	Over or (Under) Budget
REVENUES			
Canadian government	$ 152,350	152,350	-0-
United States government	123,200	123,200	-0-
Interest earned	-0-	192,657	192,657
Miscellaneous	-0-	1,432	1,432
	275,550	469,639	194,089
EXPENDITURES (Note 5)			
Administrative	228,000	302,892	74,892
General research	468,137	168,430	(299,707)
	696,137	471,322	(224,815)
Excess of revenues over (under) expenditures	(420,587)	(1,683)	418,904
OTHER FINANCING SOURCES (USES)			
Operating transfer from Sea Lamprey Control and Research Fund	-0-	18,700	18,700
Excess of revenues and other sources over (under) expenditures	$(420,587)	17,017	437,604
FUND BALANCE, October 1, 1978		199,214	
FUND BALANCE, September 30, 1979		$216,231	

See notes to financial statements on pages 5 and 6.

GREAT LAKES FISHERY COMMISSION

STATEMENT OF REVENUES, EXPENDITURES, AND CHANGES IN FUND BALANCE
Year Ended September 30, 1979

SEA LAMPREY CONTROL AND RESEARCH FUND

	Budget	Actual	Over or (Under) Budget
REVENUES			
Canadian government:			
Operating revenues	$1,614,750	1,394,324	(220,426)
Refund of unexpended funds	-o-	103,700	103,700
United States government:			
Operating revenues	3,363,500	3,363,500	-o-
Refund of unexpended funds	-o-	48,893	48,893
	4,978,250	4,910,417	(67,833)
EXPENDITURES			
Canadian Department of the Fisheries and Oceans	1,258,677	1,085,551	(173,126)
United States Fish and Wildlife Service	2,386,200	2,386,250	50
Lampricide purchases	1,131,200	119,763	(1,011,437)
Special studies	50,000	25,000	(25,000)
Barrier Dams	150,000	-o-	(150,000)
	4,976,077	3,616,564	(1,359,513)
Excess of revenues over (under) expenditures	2,173	1,293,853	1,291,680
OTHER FINANCING SOURCES (USES)			
Operating transfers to Administration and General Research Fund	-o-	(18,700)	18,700
Excess of revenues over (under) expendiutres and other uses	$ 2,173	1,275,153	1,272,980
FUND BALANCE, October 1, 1978		643,587	
FUND BALANCE, September 30, 1979		$1,918,740	

See notes to financial statements on pages 5 and 6.

GREAT LAKES FISHERY COMMISSION

NOTES TO FINANCIAL STATEMENTS
September 30, 1979

Note 1. SIGNIFICANT ACCOUNTING POLICIES

The Commission's September 30 fiscal year end corresponds with the United States government's fiscal year. The Canadian agency has a March 31 fiscal year, so amounts budgeted for Canadian revenue and expense represent 50% of both the 1978-79 and 1979-80 Canadian fiscal years.

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

The books of account for the Commission are maintained on a modified accrual basis of accounting. Revenues are recognized when received except that balances of budgeted receipts that have been promised by the Canadian or United States governments are set up as receivables at September 30, 1979.

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

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

Note 2. FUND BALANCE RESERVES

Commitments related to incomplete projects are recorded as reserves in the fund balance. As of September 30, 1979, the Commission had the following commitments relating to specific projects which are to be funded by the Administrative and General Research Fund.

Project Name	Budgeted	Expenditures	Amount Reserved
SGLFMP	$100,000	3,401	96,599
SGLFMP - Ontario work group	20,000	-o-	20,000
STOCS	121,000	34,302	86,698
Brussard	13,937	10,453	3,484
Gleason	6,980	5,235	1,745
Spangler	11,420	8,565	2,855
JFRB - publication of SLIS	55,000	-o-	55,000
Tahlem	2,300	311	1,989
Monroe	11,000	503	10,497
GLERR study	59,000	22,906	36,094
	$400,637	85,676	314,961

GREAT LAKES FISHERY COMMISSION

NOTES TO FINANCIAL STATEMENTS (Concluded)
September 30, 1979

Note 3. FUND BALANCE DESIGNATIONS

The increase in budgeted expenditures for fiscal year ending 1980 is to be funded by the fund balance in the Sea Lamprey Control and Research Fund. The increase in budgeted expenditures is approximately $574,000.

Note 4. CHANGE IN ACCOUNTING PRINCIPLE

The Commission changed the method of accounting for unused funds. Under the previous method, the Commission encumbered unused funds at year-end and charged them to expense. For fiscal year ended September 30, 1979, unused funds are recognized as fund balance reserves and are not charged to expense until the year of expenditure. The effect of this change is a decrease in expenditures for the current fiscal year of $1,308,514. The change has no effect on the unreserved fund balance.

Note 5. PRIOR YEAR BUDGETED EXPENDITURES

Current year expenditures for certain items had been budgeted in the 1978 fiscal year without any reservation of the prior year-end fund balance. These expenditures were approximately $95,000.

Note 6. FEDERAL INCOME TAXES

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

COMMITTEE MEMBERS — 1979

Commissioners in Italics

SCIENTIFIC ADVISORY COMMITTEE

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

SEA LAMPREY CONTROL AND RESEARCH

CANADA	UNITED STATES
F. E. J. Fry	*W. M. Lawrence*, Chm.
J. J. Tibbles	P. J. Manion

COUNCIL OF LAKE COMMITTEES

CANADA	UNITED STATES
R. M. Christie, Chm.	J. T. Addis
L. Affleck	C. R. Burrows
D. E. Gage	W. James
A. Holder	N. E. Fogle
	D. R. Graff
	B. Muench
	W. A. Pearce
	R. Scholl
	W. Shepherd
	H. J. Vondett
	A. Wright

LAKE COMMITTEES

LAKE HURON
R. M. Christie, Chm.
H. J. Vondett, V-Chm.

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

LAKE MICHIGAN
H. J. Vondett, Chm.
W. James, V-Chm.
J. T. Addis
B. Muench

LAKE SUPERIOR
C. R. Burrows, Chm.
L. Affleck, V-Chm.
J. T. Addis
A. Wright

LAKE ERIE
N. E. Fogle, Chm.
A. Holder, V-Chm.
D. R. Graff
R. Scholl
W. Shepherd

GREAT LAKES FISH DISEASE CONTROL COMMITTEE

J. W. Warren, Chm.	R. H. Griffiths	V. A. Mudrak
T. G. Carey, Secy.	J. R. Hammond	J. O'Grodnick
D. Bumgarner	J. G. Hnath	L. Pettijohn
J. Byrne	R. W. Horner	P. J. Pfister
J. B. Daily	G. E. Hudson	H. J. Sippel
V. Duter	W. James	S. F. Snieszko
P. Economen	T. Johnson	B. W. Souter
D. Goldthwaite	C. Lakes	