ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1981

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	1969–1980	C. H. Meacham	1969–1970
C. J. Kerswill	1971–1978	N. P. Reed	1971–1977
K. H. Loftus	1972–	R. L. Herbst	1978–1981
M. G. Johnson	1978–	F. R. Lockard	1978–1981
H. D. Johnston	1979–		
H. A. Regier	1980–		

1981 SECRETARIAT

C. M. Fetterolf, Jr., Executive Secretary
A. K. Lamsa, Assistant Executive Secretary
R. L. Eshenroder, Senior Scientist for Fishery Resources
M. A. Ross, Fishery Biologist
B. S. Biedenbender, Administrative Officer
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

1981

COMMISSIONERS

M. G. Johnson	R. L. Herbst
H. D. Johnston	W. M. Lawrence
K. H. Loftus	F. R. Lockard
H. A. Regier	C. Ver Duin

1451 Green Road
Ann Arbor, Michigan
U.S.A.
1983

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 1981.

Respectfully,
W. M. Lawrence, *Chairman*

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ANNUAL REPORT FOR 1981

INTRODUCTION

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

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

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

The Commission has now been in existence for 26 years. Its efforts to manage 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 Ottawa, Ontario, June 17–19, 1981 and its Interim Meeting was convened in Washington, D.C., December 8–9, 1981.

ANNUAL MEETING

PROCEEDINGS[1]

The twenty-sixth annual meeting of the Great Lakes Fishery Commission was held in Ottawa, Ontario, on June 17–19, 1981. This meeting was the third in a series of four meetings celebrating the Commission's twenty-fifth anniversary.

Acting Commission Chairman, Mr. H. D. Johnston, convened the meeting at 0930 h and called upon Commissioner K. H. Loftus, Ontario Ministry of Natural Resources, to introduce Mr. Alan Pope, Minister of Natural Resources for Ontario, who delivered the welcoming address.

Mr. Pope noted the aptness of returning in the twenty-fifth anniversary year to the site of the first Commission meeting. At the first meeting James Sinclair, Canadian Minister of Fisheries, recognized that to "restore this great fishery in the very heartland of America" the Commission's role had to be considerably more than one of lamprey extermination. Recounting the Commission's and its cooperators' achievements over the years, including the Strategic Great Lakes Fishery Management Plan which will be signed into existence at this meeting, Mr. Pope concluded that the objectives and intent of the drafters of the 1954 Convention are being realized.

In the Chairman's Report Commissioner Johnston summarized significant Commission activities since the previous annual meeting (June 1980), stating that the Commission had begun to implement recommendations from the Sea Lamprey International Symposium and the Sea Lamprey Program Audit report; held the Stock Concept Symposium; provided encouragement, the forum, and financial and secretariat support to fishery agencies to develop the Joint Strategic Plan for Management of Great Lakes Fisheries; co-sponsored the Acid Rain Fisheries Symposium held at Cornell University, Ithaca, New York; sponsored the Fish Health Workshop and the Adaptive Environmental Assessment Workshop; maintained a sea lamprey control and research program; and sponsored various research projects.

[1] Minutes of the meeting are available from the Secretariat for readers desiring further detail.

JOINT STRATEGIC PLAN FOR MANAGEMENT OF GREAT LAKES FISHERIES

Commissioner Loftus reported that the Commission's first major activities in the Great Lakes, finding and implementing means for controlling sea lamprey and effectively coordinating lake trout rehabilitation, arose out of the kinds of crises which forged unity, purpose and effort among Great Lakes agencies. As sea lamprey were brought under control, the Commission began about a decade ago to pursue more seriously the coordination of research and management of stocks of common concern. Agencies such as the Ontario Ministry of Natural Resources had started work on their own coordinated management plans, and the Commission's Lake Committees soon urged that the Commission begin developing an international strategic plan. In 1978 the Committee of the Whole, composed of federal, state and provincial natural resource agency leaders, assigned the task to a steering committee co-chaired by Mr. A. H. Lawrie (Ontario Ministry of Natural Resources) and Mr. William Pearce (New York Department of Environmental Conservation). They presented the Committee of the Whole with a draft plan in December 1980. Commissioner Loftus explained that the plan, based on elements of consensus, accountability, environmental management, management of information, and strategic planning, having undergone a few changes during in-house review, is now ready for each agency's formal adoption. He congratulated the agencies for accomplishing such a large task and producing an excellent strategic plan in such a short time.

Acting Chairman Johnston read the agencies' Memorandum of Acceptance of the Joint Strategic Great Lakes Fishery Management Plan, the Wisconsin Department of Natural Resources "Reservation to the Memorandum of Acceptance for the Joint Strategic Great Lakes Fishery Management Plan," and the "Resolution by the Great Lakes Fishery Commission to Support Implementation of the Joint Strategic Plan for Management of Great Lakes Fisheries."[2] Acting Chairman Johnston signed the Commission resolution, Commissioner Lawrence attesting. The following officials signed the Memorandum of Acceptance:

Agency	Signatory	Attester
Fisheries and Oceans Canada	D. D. Tansley*	H. Douglas Johnston*
Illinois Department of Conservation	David Kenney	Maurine E. Richter Bruce Muench*
Indiana Department of Natural Resources	Joseph Cloud	Frank R. Lockard
Michigan Department of Natural Resources	Howard A. Tanner	John A. Scott*
Minnesota Department of Natural Resources	Joseph N. Alexander	Jerome H. Kuehn*
National Marine Fisheries Service	Terry Leitzell	Robert W. Hanks*
New York State Department of Environmental Conservation	Robert F. Flacke	Bruce D. Shupp*
Ohio Department of Natural Resources	Robert W. Teater	Russell L. Scholl*
Ontario Ministry of Natural Resources	Alan Pope*	Arthur S. Holder*
Pennsylvania Fish Commission	Ralph W. Abele*	Howard T. Hardie, Jr.
United States Fish and Wildlife Service	Galen L. Buterbaugh*	G. Ray Arnett*
Wisconsin Department of Natural Resources	Carroll D. Besadny*	James S. Christensen

*Participated in signing ceremony at Ottawa.

[2]The documents are available upon request from the Great Lakes Fishery Commission.

Following the signing, Mr. R. M. Christie, Chairman of the Council of Lake Committees, stated that the Plan was a formal framework for the kind of practices that have been ongoing in lake committee activities over the years. Using the framework of the Strategic Plan, preparation of operational plans by lake committees will ensure participation of environmental management agencies, coordination and development of fisheries management agencies' allocation policies, involve the public, and the collection and analysis of data to develop accurate estimates of fish yields.

The Fish Habitat Advisory Committee was incorporated into the Joint Strategic Plan for Management of Great Lakes Fisheries to assist in addressing environmental matters related to fisheries. Mr. J. M. Cooley (Department of Fisheries and Oceans Canada) delivered some suggestions from the Commission's Board of Technical Experts on the new committee's format and function.

GREAT LAKES ECOSYSTEM REHABILITATION STUDY (GLER), PHASE II

Commissioner H. A. Regier reported on the principal objectives of GLER II, resultant publications, presentations, and university courses, and the major findings as perceived by members of the project team. In his opinion GLER is just one of the interdisciplinary series of tools and approaches to meet the environmental challenges and opportunities of the day. Others are the Commission's Joint Strategic Plan for Management of Great Lakes Fisheries, the International Joint Commission's Pollution from Land Use Activities Reference Group Report (PLUARG), and the 1978 Canada/U.S. Great Lakes Water Quality Agreement.

THE ADAPTIVE ENVIRONMENTAL ASSESSMENT TRAINING WORKSHOP

Dr. George Spangler (University of Minnesota) explained that an adaptive management workshop using computer simulation modelling is a mechanism for defining a process, not the state of a system. For example, in studying fish communities in lakes, eliciting common elements makes it possible to achieve a common understanding or interpretation of a system.

The process makes explicit the assumptions of how the system works. The synthesis of various views—research, fishery management, environmental management, fish culture—allows understanding of the system, and to predict outcomes if one or more elements of the system are altered.

At a recent training session in Vancouver, British Columbia, sponsored by the Commission, selected people from the Great Lakes area learned to build computer models of interactions between fish communities and environmental perturbating (in "Lake Erie"), and sea lamprey and salmonids (in "Lake Michigan"). The workshop consisted of three phases: scoping of the problem several weeks before the workshop (policy level input required); 4–5 days of building a model; and refinement through scenario building. The adaptive environmental assessment training workshop structured decision rules so problems can be readdressed in light of new information.

Report of the Board of Technical Experts

Dr. Joseph Kutkuhn (U.S. Fish and Wildlife Service) reported the proceedings of the Board's first 1981 semi-annual meeting where it was briefed by its committees on sea lamprey research and habitat concerns, on sea lamprey program research, implementation of Sea Lamprey Program Audit Team recommendations, and the proposed role of the Fish Habitat Advisory Committee. Special assignments handled by the Board included defining rehabilitated lake trout stocks, developing an ecosystem approach workshop, and evaluating a number of unsolicited research proposals for possible funding by the Commission. The Board was briefed on the status of pink salmon in the Great Lakes, and supported several internal research projects: analysis of decision rules employed in, and methodology for evaluating sea lamprey management; adaptive environmental assessment modelling efforts; Great Lakes Ecosystem Rehabilitation, phase III, and archiving Great Lakes fish specimens.

Management and Research

Reports from each lake committee (Superior, Huron, Michigan, Erie, and Ontario) and the Council of Lake Committees covering management and research activities in the past year and recommendations were presented by the committee chairmen and accepted by the Commission. Highlights of the 1980 lake committee meetings are presented in this annual report under "Summary of Management and Research."

Mr. James Warren (USFWS), Chairman of the Great Lakes Fish Disease Control Committee, highlighted the accomplishments of the committee over its first eight years (improved agency cooperation and approach, healthier hatchery products) and current activities such as the authoring of a fish health handbook, and increased participation of the private sector in committee activities. (His report is presented elsewhere in this annual report.)

Sea Lamprey Control and Research

The Commission accepted reports on sea lamprey control and research during 1980 from its United States and Canadian contract agents.

Mr. Braem (U.S. Fish and Wildlife Service) introduced the subject of sea lamprey control in the U.S. with a slide show which briefly sketched the tools and tasks of the program and reviewed important segments of the 1980 program (published as a combined U.S.-Canadian report elsewhere in this annual report). He also reviewed activities during the spring of 1981 and added information on studies of adult sea lamprey, ammocetes, and chemical control plans.

Dr. J. J. Tibbles and Mr. S. Dustin described Canadian activities in 1980 (published as a combined U.S.-Canadian report elsewhere in this annual report) and reviewed progress in the spring of 1981, including information on assessment of adult sea lamprey, stream surveys, chemical treatments, and barrier dam construction. Dr. Tibbles also added information on changes in the Memorandum of Agreement between the Commission and the Department of Fisheries and Oceans, efforts to achieve commonality in certain sea lamprey control practices and information handling procedures between the U.S. and Canadian sea lamprey groups, and a research proposal for the Commission to sponsor field investigations on long term effects of TFM on nontarget organisms.

Mr. G. Buterbaugh (U.S. Fish and Wildlife Service) reported that as a result of internal review and the Sea Lamprey Program Audit recommendations, the Service has instituted several procedural changes regarding sea lamprey research including compiling of research needs through appropriate workshops, transferring the administration of the Hammond Bay Biological Station (Michigan) from the Great Lakes Fishery Laboratory in Ann Arbor, Michigan, to the National Fisheries Research Laboratory at La Crosse, Wisconsin, and upgrading the Hammond Bay Biological Station facilities.

Dr. Fred Meyer (U.S. Fish and Wildlife Service) reviewed the activities (presented elsewhere in this annual report) of the National Fisheries Research Laboratory (La Crosse) on registration-oriented research involving lampricides and other related research.

Dr. J. Kutkuhn (U.S. Fish and Wildlife Service) after commenting on the transfer of administration of the Hammond Bay Biological Station from the Great Lakes Fishery Laboratory to the La Crosse National Fisheries Research Laboratory, reported on Hammond Bay Biological Station studies (reported elsewhere in this annual report). Dr. J. Teeter summarized research conducted during 1980 at the Monell Chemical Senses Center, Philadelphia, Pennsylvania, and the Hammond Bay Biological Station to identify and characterize intraspecific chemical signals involved in sea lamprey migration and reproductive behavior. Such substances may prove useful as highly specific lures to help capture spawning-run lampreys or as agents for disrupting normal pheromone communication so that successful spawning is prevented or reduced.

The Assistant Executive Secretary of the Commission reported on the status of the lowhead barrier dam program in Canada and the United States. These dams are designed to block spawning-run lampreys from reaching spawning beds in streams difficult-to-treat with lampricides and to reduce costs of control. Mr. J. Scott (MDNR) added further information and expressed his appreciation for the Commission's support for Michigan's planning for barrier dams—a hydrologist and engineers have been hired, and the first project proposal should be available in one year. Michigan may need Commission assistance later in acquiring or leasing land, and for dam construction and maintenance.

Institutional Responsibilities and Future Plans for Sea Lamprey Management

Commissioner Regier explained that although sea lamprey management has been in the past effective and reasonably efficient, policies and procedures can always benefit from periodic review. To this end a sea lamprey workshop was held in February and again in May to find a desirable and workable process, and to clarify responsibilities of the various players—a working document is now available for cooperators' examination. It appears that lake committees will be responsible for setting quantitative targets and performance measures; adaptive management assistance (computer simulation modeling) from the Board of Technical Experts will help Lake Committees make informed judgements on sea lamprey-lake trout interactions. The Board will also assist the Commission in determining future directions and policies. The contract agents (Department of Fisheries and Oceans and U.S. Fish and Wildlife Service) are clearly identified and distinguished from their control units. The Sea Lamprey Control and Research Committee was disbanded and replaced by the Commission's internal "Sea Lamprey Committee," and will be known under the latter name. The document, "Process for Implementation of Sea Lamprey Management" will be accepted as of 1 July 1981.

Update on the Stock Concept Symposium

Mr. A. Berst (Ontario Ministry of Natural Resources, retired) reported on the Stock Concept Symposium which had been held that previous fall (1980), on organizer's plans for publishing papers in the Canadian Journal of Fisheries and Aquatic Sciences (December 1981 issue), and for publishing the recommendations as a Commission special report.

Update on the St. Marys Rapids Remedial Works

Commissioner M. G. Johnson reported on a matter of direct concern to Michigan and Ontario, the unsettled plans to avoid continuation of recurrent dewatering of the St. Marys Rapids, the connecting waterway between

Lake Superior and Lake Huron. There have been many suggestions for mitigation, but no one has yet accepted responsibility for agreement and construction. It was thought necessary to estimate the cost/benefits for mitigating structures, but this means that under-utilized natural resources could be ravished because of any unfavorable cost/benefit ratios. The consultants hired by the Commission summarized the history of the matter and available options, and the Commission plans to solidify its position for transmittal to IJC after consulting with the Michigan Department of Natural Resources and the Ontario Ministry of Natural Resources, the agencies with responsibility for fishery management in the affected waters.

Reports from Other Agencies

Dr. C. Edwards reported on behalf of the IJC, commenting on the status of IJC Commissioners and suggesting that the joint Great Lakes Fishery Commission-IJC meeting be held in conjunction with the 1981 Interim Meeting in December 1981 to discuss matters of mutual concern.

A representative from Michigan Sea Grant introduced a teaching unit on the sea lamprey (slide/tape show, board game) which is part of a Great Lakes series of teaching units which also include fisheries, toxic substances, urban areas, and other topics. The sea lamprey unit, which costs $37.50 is regional in approach, and is backed up by workshops to help teachers teach about the Great Lakes.

National Section Meetings

U.S. Section Chairman Ver Duin reported on the discussion and proceedings of the U.S. Section meeting which included the U.S. Food and Drug Administration proposal to reduce the PCB action guidelines in fish from 5 ppm to 2 ppm, changes in medical and hospital services available to seamen and commercial fishermen, and the native peoples' fishery in Michigan. In addition U.S. advisors' concerns were reviewed which included needs for a preparatory meeting prior to the annual meeting, diversion of Great Lakes water, several public laws, ice control structures, and Indian representation on lake advisory committees. The U.S. Section also passed motions expressing concern over potential water diversions from the Great Lakes, supporting environmental mapping by the International Joint Commission, encouraging boundary marker maintainence by the Coast Guard and establishment of Fish Habitat Advisory Committee terms of reference, and supporting incorporation of barrier dams in highway culverts to block spawning-run sea lamprey, and sea lamprey control in Oneida Lake.

The Chairman of the Canadian Section, Commissioner M. G. Johnson, reported that extensive discussions centered on the significance to Canada of the Joint Strategic Plan for Management of Great Lakes Fisheries and its implementation.

Administrative and Executive Actions

A summary of Commission actions since the 1980 Annual Meeting was presented as follows:

General

— revised and approved budgets for fiscal years 1981 through 1983.
— expressed concern over the United States Fish and Wildlife Service restrictions on their employees' travel to Canada which affected Commission business.

Publications

— agreed to develop a popular brochure on the Joint Strategic Plan for Management of Great Lakes Fisheries.
— agreed to fund publication of a supplement (covering 1979–1983) to Cyclostomata, an Annotated Bibliography

Fisheries and environment

— supported completion of the Iron River National Fish Hatchery.
— discussed dewatering of the St. Marys Rapids, which connects Lake Superior to Lake Huron.
— funded a study of non-consumptive extramarket values.
— funded an adaptive management workshop (computer simulation modelling of Great Lakes fisheries).
— funded phase III of the Great Lakes Ecosystem Rehabilitation project.

Sea lamprey

— agreed to review the proposed Canada / Ontario barrier dam agreement and modify the Commission's barrier dam guidelines.
— authorized a new lampricide teratology study as required by the EPA.
— accepted the "Process for Integrated Management of Sea Lamprey" report and agreed to work towards its implementation.
— funded a study to evaluate decision rules used by the sea lamprey control units.
— authorized the phasing down of the lampricide inventory over five years to a two year supply.
— adopted a policy to curb unintentional introduction of sea lamprey to watersheds outside the Great Lakes whenever the Commission supplies sea lampreys to researchers.

Liaison with Commission committees

— supported the Council of Lake Committees initiative to standardize lake committee agendas and reporting formats.
— encouraged the lake committees who are making significant progress in establishing goals and criteria for lake trout rehabilitation, and has charged the Board of Technical Experts with developing a definition of rehabilitated lake trout stocks.
— regarded favorably the Lake Michigan Committee and Council of Lake Committees' request that lake trout stocks with potential for rehabilitation be catalogued, but is awaiting recommendations from the Stock Concept Symposium and publication of the symposium papers. The Commission believes the catalogue will be a constructive step in applying science to management as a result of the symposium.
— encouraged agencies to take responsibility for transferring information generated by the Stock Concept Symposium to field and hatchery operations once the symposium proceedings are published.
— thanked the Lake Committees and the Council of Lake Committees for developing the process for standardizing basinwide sea lamprey marking reports and expressed anticipation that the use of more standardizing will assist in determining the effectiveness of the Commission's sea lamprey management program.
— expressed its pleasure that the responsibility for single, lakewide reports of sea lamprey wounding on appropriate species of fish for the Interim Meeting have been accepted by the lake committees.
— congratulated the Lake Erie Committee on creation of an effective substructure which efficiently uses available technical expertise in an advisory capacity.
— commended the Lake Huron Committee for establishing an interagency chub technical committee to be involved with chub assessment and management and observed that this type of initiative has been effective in the other Great Lakes.

Election of Officers

Elected Commissioner W. M. Lawrence as Chairman for the remainder of former Chairman Herbst's term (up to and including the 1982 Annual Meeting) because Commissioner Herbst had resigned from the Commission.

ADJOURNMENT

Announced that the next annual meeting was scheduled for Green Bay, Wisconsin, on June 9 and 10, 1982. The Chairman thanked the guest speakers, Department of Fisheries and Oceans who hosted some of the festivities, participants for their excellent presentations, and the attendees, before adjourning the meeting at 11:20 h on June 19, 1981.

INTERIM MEETING

PROCEEDINGS[1]

The Great Lakes Fishery Commission's 1981 Interim Meeting was convened at Washington, D.C. on December 8 and 9. It was the last of a series of four meetings celebrating the Commission's twenty-fifth anniversary.

SEA LAMPREY MANAGEMENT

The Commission accepted the following reports on eight major areas of concern and interest relative to managing sea lamprey in the Great Lakes: populations of larval lampreys in inland lakes and off stream mouths in the Great Lakes, areas in which they are difficult to control; sea lamprey spawning in the large St. Marys River which connects Lake Superior to Lake Huron and where sea lamprey control is not practical with current technology; potential expansion of sea lamprey spawning into other connecting waterways; the large catch of lamprey taken by portable assessment traps; the sea lamprey in Oneida Lake and development of a control plan (Oneida Lake is in New York State and a probable contributor of lamprey to Lake Ontario); New York Department of Environmental Conservation's proposals for managing sea lamprey in the Finger Lakes; the need for more information on effects of lampricides on aquatic insects; and the status of sea lamprey control in the Nipigon River system, suspected to be the largest, single contributor of sea lamprey in Canadian waters of Lake Superior.

The Commission also heard reports on efforts toward implementing integrated management of sea lamprey. The first report addressed a workshop exploring the management of cold water fish communities through adaptive (computer) simulation modelling. The process consisted of two parts, first a scoping session in which the "client group" (representative Commissioners, fishery managers, sea lamprey control unit members, and others) define the problem, and second a full scale workshop to develop the submodels and models.

[1] Minutes of the meeting are available from the Secretariat for readers desiring further detail.

The United States Fish and Wildlife Service reported on the results of a workshop addressing research needs for sea lamprey control which identified the following five areas as most important: research on non-chemical supplemental control methods; improved bottom release lampricides; alternate chemical lampricides; loss of activity of the lampricide Bayer 73 in streams; and lamprey biology.

In addition, the Commission accepted a proposal which would lead to the formation of a steering committee to develop recommendations for implementing a program of integrated management of sea lamprey, and heard a summary on the status of the Commission's barrier dam program.

Relative to sea lamprey wounding on fish, the Secretariat gave the report of the ad hoc committee which is developing standards for classification of sea lamprey wounds. Other reports on trends in marking of fish by sea lamprey were presented for each of the Great Lakes.

The Commission's contract agents, the U.S. Fish and Wildlife Service and Department of Fisheries and Oceans Canada, reported on progress in sea lamprey control, research, and registration of lampricides. (More detailed information is available elsewhere in this annual report under Sea Lamprey Control in the Great Lakes and Sea Lamprey and Related Research at the National Fishery Research Laboratory. Hammond Bay Biological Station and Monell Chemical Senses Center.)

The Secretariat summarized programs and budgets for fiscal years 1982 and 1983. Program costs for fiscal year 1982 were expected to total $6.8 million and for fiscal year 1983 $7.1 million.

Board of Technical Experts (BOTE)

The Board Chairman reviewed the group's mandate and membership, and summarized some of its duties which include providing peer review of research proposals received by the Commission, serving on appropriate committees, providing advice and evaluation of specific topics, identifying important socio-economic issues, and developing research priorities. The Board of Technical Experts announced its support of the following projects: adaptive management workshops which center on computer-assisted simulation modelling; establishment of a reference collection of Great Lakes biota; evaluation of current decision rules and methodology in sea lamprey management; and Great Lakes Ecosystem Rehabilitation, Phase III. Several projects were also recommended for Commission funding.

Fish Health Workshop Summary

The Commission received a preliminary report on the proceedings of the Fish Health Workshop held in the fall of 1981. A full report will be forthcoming in 1982. The Workshop, a product of the BOTE/GLFC contaminant research needs survey, reviewed methods for measuring effects of contaminant stress on fish, assessed the utility of each method of measuring

stress, and developed a preliminary strategy for implanting awareness of fish health concerns into existing programs. The workshop identified the need for a multidisciplinary approach, and focused on identifying existing and emerging problems with fish health at individual, population, and community levels. Various actions needed for implementation include establishment of coordination and cooperation between fisheries assessment and research biologists and review of their programs for useful components, reorientation of research programs to obtain better fish health information, consolidation of existing data, identification of "hot spots," study of several case examples, and evaluation of the proceeding approach.

Report from the International Joint Commission

The Director of the International Joint Commission Great Lakes Regional Office, William Nye, presented a report on the proceedings of the Commission's November 1981 meeting on the Great Lakes Water Quality Agreement, at which the Science Advisory Board reported on energy futures and their impact on the Great Lakes, recommended new and revised water quality objectives for inclusion in the Agreement, expressed concern that U.S. federal budget cuts were proportionately more damaging to Great Lakes research compared to other areas of the U.S., and discussed the Information System for Hazardous Organics in Water. He continued with a report from the Water Quality Board which identified various areas in the Great Lakes where water quality was a concern, and added information on the status of phosphorus removal, on recommendations relative to development of an adequate information base, improved hazard and risk assessment, and betterment of toxic substances control programs. In conclusion, he reported on the International Joint Commission efforts to focus public attention in ever greater detail on Great Lakes issues, and discussed the need for a closer working relationship between the International Joint Commission and the Great Lakes Fishery Commission.

Lake Committee Reports

Three of the Commission's five lake committees elected to report on programs in progress. The Lake Ontario Committee reported on the dedication of the new New York Salmon River Hatchery, the opening of the Cornwall Ontario eel ladder, the contaminant problem and need for factual information, information on the recent IJC meeting, and the status of 1981 sport and commercial fisheries. The Lake Erie Committee reported on its Standing Technical Committee's two work groups on walleye and yellow perch. The walleye task group made recommendations on a joint walleye/yellow perch task group, on a fishing mortality rate for evaluation, and on increasing assessment of walleye in the central basin of Lake Erie. The yellow perch task group is reviewing its charge and management alternatives for the central basin, and considering proposals for allocation of yellow perch. The Lake Superior Committee reported on Wisconsin's and Ontario's draft plans for fish management, on ad hoc committees to define lake trout rehabilitation and to evaluate put-grow-and-take lake trout fisheries.

The new chairman of the Council of Lake Committees, W. A. Pearce (New York Department of Environmental Conservation), expressed his pleasure at seeing the Council of Lake Committees come of age, due in large part to the positive outlook of the past chairman, R. M. Christie (Ontario Ministry of Natural Resources), and the need expressed in the Strategic Great Lakes Fishery Management Plan for a strong coordination of programs.

Policies on Allocation of Lake Trout Stocks and Other Important Great Lakes Species

Several Great Lakes fishery management agencies provided reports on their policies relative to allocation of fish stocks.

Minnesota presented its lake trout allocation policy—past, present and future—in which Minnesota's faith in the feasibility of rehabilitation was reaffirmed and the primary allocation of lake trout was identified for long-term buildup of spawning stocks, although some harvest is allowed in the interim to provide tangible results to the public. Several factors which may hinder rehabilitation were also identified.

The Michigan report noted that lake trout rehabilitation should not be compromised by overharvest, and that all but southern Lake Huron and southern Lake Michigan can be rehabilitated.

Illinois' contribution addressed the distribution of federal lake trout planted in Illinois waters and the importance of continuing stocking until half of the lake trout standing stock is naturally-spawned fish. Control of sea lamprey, fishery assessment, and catch monitoring are necessary.

The Wisconsin report explained how lake trout catches are allocated among tribal, recreational and commercial fisheries, with rehabilitation and socio-economic considerations in mind. The report also reviewed the history of fish stocking and rehabilitation efforts in Lakes Superior and Michigan, various actions taken by the Wisconsin Department of Natural Resources from 1967 to 1980, and Wisconsin's future management plans.

Ohio addressed harvest and international and in-state allocation of Lake Erie yellow perch.

Pennsylvania reported that regulation of yellow perch and walleye fisheries is being reviewed, and that incidental commercial catches and sports harvest of lake trout will be addressed in the Pennsylvania/New York management plan for lake trout.

New York's presentation reported that eastern Lake Erie's walleye population may be overharvested and that allocation will be addressed in a manner similar to that of western Lake Erie stocks (e.g. quota management). A Lake Erie management plan for lake trout is being drafted by New York and Pennsylvania, with input from Ontario, for submission to the Lake Erie Committee. The New York report also addressed Lake Ontario concerns, noting that the U.S. Fish and Wildlife Service, New York Department of Environmental Conservation, Ontario Ministry of Natural Resources, and Fisheries and Oceans Canada are developing for the Lake Ontario Committee a lakewide management plan for Lake Ontario lake trout with goals and guidelines for allocation, along with projected rates on achieving rehabilitation.

The Province of Ontario's approach to allocation at the lake committee level stresses the resolution of questions such as which stocks are of common concern, and equitable development of quotas. Further, a committee of Ontario Ministry of Natural Resources and commercial fishery representatives has been established to discuss modernization of the commercial fishery and its regulations.

A Proposed Policy For Use Of Lake Trout From U.S. Federal Hatcheries

The U.S. Fish and Wildlife Service reviewed the history of the lake trout rehabilitation program in the Great Lakes which resulted in the 1976 Commission policy for lake trout rehabilitation. It has become increasingly clear that rehabilitation will be lengthy and that harvest must be restricted. In 1979 the Commission brought its concerns to the attention of its signing parties, through the U.S. State Department, and the Canadian Department of External Affairs. The U.S. State Department relayed these concerns to the U.S. Fish and Wildlife Service which produces lake trout for the Great Lakes at a cost of $9 million. In response, the Service developed a policy statement which emphasized planting lake trout for restoration purposes, supported continued assessment activities and research, and discouraged lake trout harvest.

Adjournment

After announcing that the 1982 Annual Meeting would be convened in Green Bay, Wisconsin, 9–10 June, and that the 1982 Interim Meeting was scheduled for 2–3 December in Toronto, Ontario, the chairman adjourned the meeting.

BOARD OF TECHNICAL EXPERTS REPORT

Dr. F. W. H. Beamish, Chairman
Board of Technical Experts
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The expanded membership of the Board includes 14 scientists with Secretariat and Commissioner liaison. In preparation for the Board's expanded role in Commission activities, the Board was provided with informational briefings on the responsibilities assumed by Hammond Bay Biological Station, Monell Chemical Senses Center and the La Crosse National Fishery Research Laboratory, all of which are involved in sea lamprey research.

The Board has established a number of subcommittees, each charged with specific objectives. A Research Review Committee makes recommendations on the suitability of external research applications subsequent to external peer review initiated by the Secretariat; the Board recommendations are then forwarded to the Commission. A Fish Habitat Advisory Committee has been formed to develop options for providing fish habitat advice to the Commission. The Sea Lamprey Committee reviewed the recommendations of the Sea Lamprey International Symposium and initiated a series of workshops directed toward integrated management of sea lamprey through the Committee on Experimental Adaptive Management Research. The Board is also anxious to undertake the responsibility to develop or update annually a comprehensive research plan directed toward integrated management of sea lamprey. The Board has recognized the value of social-economic information as it pertains to effective decision making by forming a committee to identify important social-economic issues and to itemize research priorities. Another subcommittee has reviewed and reported on the Stock Concept Symposium recommendations. The Board is represented at all Lake Committee meetings for the purpose of keeping the Board membership abreast of Lake Committee activities and to be prepared to advise if called upon.

Other initiatives included an Adaptive Management Workshop (Sault Ste. Marie, Michigan, September 30–October 6, 1981) which successfully

initiated the development of a simulation model responsive to coldwater fishery management activities currently in place and anticipated for future implementation in the Great Lakes. The Board was supportive of a reference collection of Great Lakes biota to be catalogued by and stored at the Royal Ontario Museum (Toronto, Canada). It was believed the collection would, in subsequent years, be useful for contaminant analyses, tissue banks and pathology studies. The Board initiated support for a study to examine current decision rules and methodology for evaluation of sea lamprey management which will formalize current decision rules used by the control units in selection of streams for lampricide treatment and to develop a methodology to statistically evaluate the control program. The Great Lakes Ecosystem Rehabilitation program has been supported by the Board for several years. With the completion of phases I and II, the Board has now encouraged the GLER group to critically evaluate public and governmental responses to the approaches recommended in the earlier studies but not yet employed by agencies as a management strategy.

SUMMARY OF MANAGEMENT AND RESEARCH[1]

Reports From Lake Committees

This section examines 1981 highlights of fishery management and research activities and major changes in the status of fish stocks in the Convention Area as reported to the Commission's lake committees in the spring of 1982. Great Lakes state, provincial, and federal fishery agencies participate in lake committee meetings, which provide a forum for implementing coordinated management and research programs and scientific data exchange on fish stocks of common concern. A review of these activities by species follows.

LAKE TROUT

Restoration of self-sustaining stocks of lake trout in the Great Lakes is a major challenge for the Commission and its cooperators. Suppression of parasitic sea lamprey populations through chemical control has allowed planted lake trout to mature and spawn in the upper lakes and in Lake Ontario. Although over 120 million lake trout have been planted in the lakes since the 1950s, a number of factors have impeded establishment of wild stocks in all lakes but Superior. Progress in lake trout rehabilitation is reviewed for each lake as follows:

Lake Superior—Substantial numbers of naturally reproduced (native) lake trout are reported for extensive inshore areas in Michigan, Ontario and Wisconsin's waters of Lake Superior. Native lake trout made up 33–36% of the assessment catch in Michigan waters between Keweenaw Point and Grand Marais. West of Keweenaw Point natives were 17% of the catch. Most of these natives are younger fish, produced after 1974, and it is anticipated that as they recruit to the spawning stocks, natural reproduction should improve even more. Although most lake trout stocks in Michigan's waters are improving, those in lower Keweenaw Bay and off Munising are regressing probably due to excessive fishing. Sea lamprey wounding rates in Michigan waters are low except in areas where the fishery removes large numbers of trout, leaving fewer prey fish for the sea lampreys and resulting in higher attack rates.

[1]Commercial fish landings by lake and species for 1981 are given in Tables 1–5.

In Ontario waters the proportion of natives in the inshore catch is highly variable, ranging between 5–95%, depending upon area. Stocks north and west of Cape Gargantua have shown the greatest improvement (usually greater than 40% native), and stocks south of the cape contain fewer than 20% natives. Sea lamprey wounding rates are generally low (less than 7%) except in areas near the Nipigon River where rates were 13–23%. The lower Nipigon River is difficult to treat with lampricides because of its large size, but plans are being formulated for chemical control.

The major spawning ground in Wisconsin waters continues to be Gull Island Shoal where an estimated 12–13,000 lake trout spawned in 1981. A fish refuge created in 1976 is credited with the improvement in this stock. Mortality rates on male trout have declined from 59% in 1974–76 to 53% in 1976–80. Mortality rates for females during the same period were not obtainable. Sea lamprey wounding rates were formerly the lowest (less than 5% for all size classes of lake trout) in the lake, but rates have trebled in the last two years.

The numbers of native lake trout in Minnesota waters are lower than in other jurisdictions, but numbers have increased steadily since 1978, and CPUE of female spawners has improved from insignificant levels in 1970–72 to 50 per 1,000 m of gill net in 1980–81. Sea lamprey wounding rates have generally been declining in Minnesota since 1974–75.

Lake Michigan—No significant natural reproduction is reported for lake trout in Lake Michigan. Stocking began there in 1965, but the first plantings were heavily fished. The Lake Trout Technical Committee, a group of agency biologists reporting to the Lake Michigan Committee, estimated that the lakewide catch of lake trout was 261,000 fish in 1981. This large catch is considered to be a factor inhibiting the development of larger spawning stocks. Sea lamprey wounding rates increased in northern Wisconsin and Michigan waters, and may be related to declines in the ratio of prey to predators. Wounding rates remained low (less than 1%) in the south.

Lake Huron—In Canadian waters stocking is concentrated in southern Georgia Bay, and the first strong year-classes of hatchery splake (a brook trout x lake trout hybrid) were realized there in 1978–79. However, in some areas these year-classes suffered 90% annual mortality due to capture in commercial fishing operations. To alleviate this problem, various areas will be closed to fishing in 1982 and some fishing operations will be retired. Females from the 1978 year-class first spawned in 1981, but it is not known if this was successful. Sea lamprey populations and wounding rates are low in Georgian Bay.

Lake trout stocking in Michigan waters began with the 1973 year-class, and this and all subsequent year-classes have appeared in proportion to their stocking density in assessment catches except in Statistical District MH-1 where intensive treaty fisheries severely reduced the number of older fish. Spawning lake trout are abundant south of Roger City and north of

Harbor Beach, but if natural reproduction is occurring, it has not been detected. In northern and central Lake Huron (main basin), sea lamprey wounding rates are high, varying between 8–17%, and lamprey predation is probably a significant source of lake trout mortality. Wounding rates are lower in southern Lake Huron.

Lake Erie—Stocking is confined to the U.S. waters of the eastern basin, and large stockings began there in 1979. Information from small plants made before 1979 indicates that total mortality rates on older fish are 30–40% per year. Sea lamprey wounding rates averaged 8%.

Lake Ontario—Lake trout stocking began in 1973, but until recently, high sea lamprey abundance allowed few lake trout to survive to spawning age. Following chemical treatment of the Black River in 1980, sea lamprey wounding rates declined from 6–11% to 3–5%. Larger stockings of lake trout, started in 1978, should fare better than the earlier plants. In fact, recruitment of these fish to assessment nets in the fall of 1981 resulted in a doubling of the CPUE.

LAKE WHITEFISH

Whitefish landings from the upper Great Lakes reached a modern high in 1981 with a reported catch of 9.9 million pounds, an increase of 22% from 1980. Major increases in catch were reported from Lakes Michigan and Huron, which recorded the highest landings since 1947 and 1954, respectively. Each of the upper lakes experienced improvements in whitefish abundance following the initiation of chemical control of sea lamprey, and this is considered a prime factor in the recovery of the stocks.

In the lower lakes, whitefish continue to be scarce, although catches from Lake Erie are improving slightly.

LAKE HERRING

Lake herring were once abundant and supported large fisheries in each of the Great Lakes, but invasion of exotic species, overfishing and/or habitat destruction have caused catastrophic declines in all areas except in northeastern Lake Superior, where about 2–3 million pounds are taken commercially each year. The species has recently made a remarkable recovery in Wisconsin's waters of Lake Superior, but low market prices have inhibited expansion of the fishery. Large fry stockings were made in Minnesota waters of Lake Superior in 1975, 1976, and 1978, but it is not known if these plantings have contributed significantly to the stocks. The recovery of lake herring stocks in southwestern Lake Superior raises hopes that the species can be rehabilitated in other areas of suitable habitat.

CHUBS

Chubs are a complex of several closely-related species (related to the whitefish) that inhabit deep water. They formerly provided food for native lake trout and supported valuable fisheries. Chubs have been commercially extinct in the lower lakes for many years, and have undergone significant changes in the upper lakes.

In Lake Superior 1981 landings declined to approximately 0.5 million pounds or about 1/3 of the average in the preceding decade. Michigan and Ontario reported that poor market conditions depressed their chub fisheries. For example, the commercial catch quota in Michigan waters was about 1 million pounds, but only 20% of this was taken. In Wisconsin waters of the lake, predation by siscowets, a deep water form of lake trout, is believed to be a factor in the declining chub harvest.

Lake Michigan was traditionally the major producer of chubs in the Great Lakes, and stocks there are reported to be increasing following serious declines related to overfishing in the late 1960s and early 1970s. Between 1975 and 1978 catches were restricted by law to small amounts required for assessment purposes. This restriction was apparently instrumental in effecting a recovery in both reproduction and adult abundance, such that catch quotas have been increased each year during 1979–81. Landings in 1981 amounted to 2.2 million pounds, and could have been larger except that levels of dieldrin in chub flesh continue to preclude sale of fish from southern State of Michigan waters.

Chubs in the main basin of Lake Huron are gradually improving following a stock collapse in the 1960s. Assessment catches of adult chubs have increased tenfold since 1978, and stronger year-classes were produced in 1978–80. However, chub abundance was so low in the early 1970s that the recent improvements, although encouraging, still leave the stocks far below carrying capacity. The Canadian commercial fishery has responded to the higher stock levels and shifted efforts from Georgian Bay (where stocks have recently declined) to the main basin. This fishery landed about 0.5 million pounds in 1981, which was about 4 times the average catch in 1971–80. The fishery remains closed in Michigan waters.

PINK SALMON

Inadvertently stocked in the Thunder Bay area of Lake Superior in 1956, pink salmon established increasingly strong odd-year spawning runs in many Lake Superior tributaries. These runs peaked in 1979; the 1981 runs, expected to be very large, were much reduced. However, spawning runs from Lakes Michigan and Huron were reported to be larger in 1981 than in 1979, and colonization of these lakes is not as advanced as in Lake Superior.

Pink salmon had spread to all the Great Lakes by 1979. Even-year runs have been established in Lake Superior, apparently as a result of some fish not reaching maturity until age 3 (pink salmon normally spawn at age 2).

The future role of pink salmon in the Great Lakes remains uncertain. It is not known whether peak abundance has been reached in Lake Superior, or whether the 1981 decline is only a temporary interruption in the proliferation of the species.

RAINBOW SMELT

This species colonized and became a major component of the fish fauna in all of the Great Lakes after being introduced into the Lake Michigan watershed in 1912. In Lake Superior the species is apparently declining in abundance, particularly in southwestern waters, where it had formerly been the dominant fish. For example, Minnesota, which had the largest smelt fishery in Lake Superior, reported that landings declined from a peak catch of 2.9 million pounds in 1976 to 0.3 million pounds in 1981.

In contrast to the situation in Lake Superior, smelt stocks in Lakes Michigan and Huron are reported to be increasing, with strong 1978–80 year-classes. Smelt were the dominant food item in lake trout stomachs collected from Lake Huron's main basin.

Smelt support an extensive commercial fishery in Ontario's waters of Lake Erie, and a record catch of 30.3 million pounds was made in 1981. Strong year-classes were produced in 1979 and 1981, and landings are expected to remain high for the next 2 years.

In Lake Ontario bottom travel surveys (begun in 1978) suggest that smelt stocks are increasing.

ALEWIFE

Alewives are native to Lake Ontario and gained access to the other Great Lakes via the Welland Canal, which bypasses Niagara Falls. They became very abundant during the 1950s in Lakes Michigan and Huron, and have fluctuated in abundance in these lakes due in part to periodic mortalities associated with the stress of overwintering in the Great Lakes. Adult stocks in both lakes equal or slightly exceed the mean abundance for the 1973–81 sampling period.

Adult alewife stocks in Lake Ontario continue to increase after a catastrophic winter mortality in 1976–77. Adult biomass in 1981 was five times greater than in 1978.

WALLEYE

Rehabilitation of walleye stocks is a major concern of fishery agencies in the Great Lakes. Large stockings (0.3 million fingerlings) in 1979 and 1981 in Saginaw Bay, a former center of walleye fishing in the upper lakes, were very successful. The species is closed to commercial fishing in the bay, but trapnetters reported (about 50% reporting) releasing 37,000 walleye from their nets. Stocking rates are expected to increase to 0.5 million fingerlings in the future.

Connecting Waters—Walleye stocks in the connecting waters (St. Clair River, Lake St. Clair and the Detroit River) remain abundant with the strong 1979 year-class recruiting to the fishery. Assessment CPUE for walleye in 1981 was about twice the mean of the preceding 10 years.

The interagency tagging program continues in Lake St. Clair and in the Thames River. Most tag recoveries were from Lake St. Clair, but 32% were from the St. Clair River and southern Lake Huron.

Lake Erie—The Western basin walleye fisheries continue to be managed by catch quotas set by the Lake Erie Committee. The 1981 quota of 4.2 million fish was exceeded by only 2.6%, and is the best match between recommended quota and actual catch observed since quotas were implemented in 1976. An increase in the recommended fishing rate from 0.200 in 1980 to 0.285 in 1981, reductions in daily creel limits in Ohio and stronger year-classes are credited with the improvement in quota compliance.

Lake Ontario—Walleye in the Bay of Quinte were at very low levels of abundance until a strong year-class was produced in 1978. This year-class was protected from commercial fishing, but an angler fishery developed quickly, and the catch peaked in 1980 at 167,000 fish. Because the 1978 year-class was not succeeded by another strong year-class, the 1981 catch declined to 103,000 walleyes. It is hoped that walleye from the 1978 year-class will reproduce a strong year-class in 1982, the first year that females will spawn.

YELLOW PERCH

Yellow perch support extensive fisheries in shallow embayments in the upper lakes and in most inshore areas in the lower lakes. Commercial landings from two such embayments in the upper lakes, Green Bay and Saginaw Bay, are declining, but for opposite reasons. In Green Bay weaker year-classes after 1977 are responsible (despite high fishing effort) for a two-thirds drop in landings following 1979. In Saginaw Bay stronger year-classes have resulted in a slowdown of yellow perch growth rates and fewer fish are reaching the minimum legal size (8.0 inches).

Lake Erie is the major producer of yellow perch in the Great Lakes, although commercial landings declined about 5 million pounds from 1979–80, when catches averaged 15 million pounds. The decline was greatest in the central basin, and was due to the passing of the very strong 1977 year-class. Bigger year-classes in 1979–80 are expected to improve catches in 1982. A task group is developing recommendations for future quota management of the yellow perch fishery in the central basin.

Table 1. Lake Superior commercial fish production in pounds for 1981

Species	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
Alewife	10	–	445	455	–	455
Burbot	24,173	27	2,761	26,961	9,871	36,832
Carp	257	165	–	422	–	422
Chubs	207,277	123,886	14,992	346,155	202,567	548,722
Lake herring	34,673	60,942	148,841	244,456	2,916,904	3,161,360
Lake sturgeon	–	–	–	–	383	383
Lake trout	115,897	313,092	35,326	464,315	387,664	851,979
Lake whitefish	802,140	207,919	6	1,010,065	379,133	1,389,198
Northern pike	–	–	–	–	5,589	5,589
Pacific salmon	–	–	–	–	12,887	12,887
Round whitefish	2,415	10,062	661	13,138	93,258	106,396
Smelt	329	46,913	308,345	355,587	93,008	448,595
Suckers	49,198	1,048	2,487	52,733	242,642	295,375
Walleye	20	–	–	20	655	675
Yellow perch	2,935	–	–	2,935	134,765	137,700
Unidentified	–	–	–	–	48,751	48,751
Total	1,239,324	764,054	513,864	2,517,242	4,528,077	7,045,319

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Unidentified	–	–	–	–	48,751	48,751
Total	1,239,324	764,054	513,864	2,517,242	4,528,077	7,045,319

Table 2. Lake Michigan commercial fish production in pounds for 1981.

	Michigan			Wisconsin					
Species	Green Bay MM-1	Michigan proper	Total	Green Bay WM-1,2	Michigan proper	Total	Illinois	Indiana	Grand Total
Alewife	1,082,230	–	1,082,230	4,498,721	13,732,591	18,231,312	–	6	19,313,548
Bullheads	–	–	–	20,061	–	20,061	–	–	20,061
Burbot	18,596	81	18,677	59,798	2	59,800	–	199	78,676
Carp	–	78	78	384,883	–	384,883	–	4	384,965
Channel catfish	90	844	934	252	–	252	–	–	1,186
Chubs	6,374	436,996	443,370	1,961	1,583,559	1,585,520	156,609	12,987	2,198,486
Lake herring	–	701	701	1	–	1	–	–	702
Lake trout	39,714	359,242	398,956	–	–	–	–	78	399,034
Lake whitefish	1,500,768	3,372,950	4,873,718	355,244	554,718	909,962	–	191	5,783,871
Northern pike	–	–	–	7,659	–	7,659	–	–	7,659
Pacific salmon	–	–	–	–	–	–	–	1,232	1,232
Round whitefish	2	168,435	168,437	5,472	40,891	46,363	–	–	214,800
Sheepshead	–	–	–	127	–	127	–	–	127
Smelt	1,189,639	3,502	1,193,141	71,937	973,908	1,045,845	–	2,776	2,241,762
Suckers	817,130	21,896	839,026	343,489	3,796	347,285	–	7,136	1,193,447
Walleye	4,370	737	5,107	–	–	–	–	–	5,107
White bass	–	–	–	4,506	–	4,506	–	–	4,506
Yellow perch	55,402	1,180	56,582	249,045	56,463	305,508	56,738	285,345	704,173
Total	4,714,315	4,366,642	9,080,957	6,003,156	16,945,928	22,949,084	213,347	309,954	32,553,342

Table 3. Lake Huron commercial fish production in pounds for 1981

Species	Michigan			Ontario				Grand Total
	Huron proper	Saginaw Bay MH-4	Total	Huron proper	Georgian Bay GB-1,2,3,4	North Channel NC-1,2,3	Total	
Alewife	–	150	150	–	–	–	–	150
Bowfin	–	390	390	–	5	–	5	395
Buffalo fish	–	261	261	–	–	–	–	261
Bullheads	–	2,572	2,572	84	2,075	–	2,159	4,731
Burbot	875	208	1,083	330	10,231	3,941	14,502	15,585
Carp	826	769,555	770,381	30,403	4,287	3,540	38,230	808,611
Channel catfish	1,785	511,153	512,938	62,852	751	140	63,743	576,681
Chubs	147	–	147	481,646	124,567	398	606,611	606,758
Crappie	–	21,594	21,594	–	–	–	–	21,594
Garfish	–	282	282	–	–	–	–	282
Gizzard shad	–	–	–	6,531	–	–	6,531	6,531
Lake herring	–	–	–	6,969	27,354	9,597	43,920	43,920
Lake sturgeon	49	–	49	4,405	693	6,752	11,850	11,899
Lake trout	4,221	–	4,221	58,446	1,687	5,755	65,888	70,109
Lake whitefish	872,710	65,824	938,534	1,305,342	230,807	263,965	1,800,114	2,738,648
Northern pike	–	–	–	263	7,812	27,864	35,939	35,939
Pacific salmon	–	–	–	17,321	1,072	20,414	38,807	38,807
Quillback	–	48,956	48,956	–	–	–	–	48,956
Rock bass	–	–	–	350	253	438	1,041	1,041
Round whitefish	10,444	31,778	42,222	9,248	18,657	4,178	32,083	74,305
Sauger	–	–	–	–	535	–	535	535
Sheepshead	–	15,149	15,149	71,039	–	–	71,039	86,188
Smelt	–	20,482	20,482	169,685	–	–	169,685	190,167
Splake	–	–	–	–	120,956	3,829	124,785	124,785
Suckers	12,570	209,667	222,237	108,276	61,375	56,430	226,081	448,318
Walleye	421	–	421	272,356	24,157	44,465	340,978	341,399
White bass	–	455	455	13,054	10	109	13,173	13,628
Yellow perch	2,474	188,617	191,091	541,757	107,819	113,206	762,782	953,873
Unidentified	–	–	–	50,160	16,286	124,664	191,110	191,110
Total	906,522	1,887,093	2,793,615	3,210,517	761,389	689,685	4,661,591	7,455,206

Table 4. Lake Erie commercial fish production in pounds for 1981

Species	Michigan	New York	Ohio	Pennsylvania	U.S. Total	Ontario	Grand Total
Alewife	–	–	–	9,550	9,550	3,600	13,150
Bowfin	–	–	–	–	–	37,221	37,221
Buffalo	29,774	–	32,167	–	61,941	–	61,941
Bullheads	10,183	530	99,624	3,375	113,712	66,929	180,641
Burbot	–	–	–	1,853	1,853	2	1,855
Carp	664,668	645	2,047,165	258	2,712,736	32,248	2,744,984
Channel catfish	49,147	110	262,733	1,285	313,275	99,922	413,197
Crappie	–	11	–	–	11	34,660	34,671
Eel	–	–	–	–	–	237	237
Gizzard shad	–	1	24,523	45,376	69,900	–	69,900
Goldfish	–	–	7,252	–	7,252	–	7,252
Lake sturgeon	–	–	–	–	–	998	998
Lake trout	–	–	–	–	–	3,893	3,893
Lake whitefish	–	7	–	2,267	2,274	23,427	25,701
Northern pike	–	–	–	–	–	29,920	29,920
Pacific salmon	–	–	–	–	–	32,581	32,581
Quillback	–	–	95,994	–	95,994	–	95,994
Rock bass	–	363	–	–	363	–	363
Sheepshead	–	8,187	1,050,513	223,024	1,281,724	446,967	1,748,691
Sauger	–	–	–	–	–	–	–
Shiners	–	–	–	1,763	1,763	–	1,763
Smelt	–	737	–	16,606	17,343	30,308,451	30,325,794
Suckers	–	8,283	38,946	32,997	80,226	32,797	113,023
Sunfish	–	1	–	–	1	71,301	71,302
Walleye	–	41,524	–	24,634	66,158	2,100,341	2,166,499
White bass	14,322	20,232	1,035,389	64,593	1,134,536	1,936,423	3,070,959
White perch	–	10	2,901	971	3,882	–	3,882
Yellow perch	–	114,728	1,994,978	312,018	2,421,724	8,341,542	10,763,266
Unidentified	–	–	–	–	–	1,065,817	1,065,817
Total	768,094	195,369	6,692,185	740,570	8,396,218	44,222,250	52,618,468

Table 5. Lake Ontario commercial fish production in pounds for 1981.

Species	New York	Ontario	Grand Total
Bowfin	–	60	60
Bullheads	30,727	307,450	338,177
Burbot	15	–	15
Carp	1,450	160,444	161,894
Channel catfish	3,296	30,876	34,172
Crappie	1,695	–[1]	1,695
Eel	94,753	239,776	334,529
Garfish	3	–	3
Gizzard shad	3,660	678	4,338
Lake herring	2	5,318	5,320
Lake sturgeon	–	661	661
Lake trout	–	100	100
Lake whitefish	–	1,695	1,695
Northern pike	164	35,835	35,999
Rock bass	9,247	46,831	56,078
Sheepshead	1,150	906	2,056
Smelt	–	74,301	74,301
Suckers	4,210	10,230	14,440
Sunfish	4,657	131,255	135,912
Walleye	530	3,187	3,717
White bass	721	5,319	6,040
White perch	36,698	98,343	135,041
Yellow perch	47,619	1,236,867	1,284,486
Unidentified	–	166,026	166,026
Total	240,597	2,556,158	2,796,755

[1]Crappie reported with rock bass.

FISH DISEASE CONTROL IN THE GREAT LAKES BASIN

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BACKGROUND

The Great Lakes Fish Disease Control Committee (GLFDCC) was created by Commission action in 1973 in response to a recognized need for an organized interagency effort to protect the health of cultured and free-ranging fish. The committee is comprised of a mixture of administrators and fish pathologists and now includes key representation from Canadian and U.S. private fish producers. Early objectives of the GLFDCC were to draft, for Commission consideration, recommendations on technical procedures and fishery management policies that would effectively prevent the introduction and spread of serious fish diseases within the Great Lakes Basin. The work of the committee is directed at supporting the fish disease control policy of the Commission which is to encourage each cooperating agency to:

—prevent the release of seriously-diseased fish,
—discourage the rearing of diseased fish,
—prevent the importation, into the Great Lakes basin, of fish infected with certifiable diseases, and
—eradicate fish diseases wherever practicable.

Certifiable diseases include, but are not limited to, viral hemorrhagic septicemia (VHS), infectious hematopoietic necrosis (IHN), enteric redmouth (ERM), whirling disease caused by *Myxosoma cerebralis*, and ceratomyxosis caused by *Ceratomyxa shasta*. In addition, more common diseases, including furunculosis, bacterial kidney disease (BKD), and infectious pancreatic necrosis (IPN) are carefully monitored for prevention purposes.

Work of the committee has always been based upon a consensus. Through this procedure the committee developed a ''Model Fish Disease Control Program'' which was approved by the Commission in 1975. The ''model program'' guides cooperating parties in the development of their fish health protection programs and helps to coordinate the overall disease control effort. The ''model'' concept was used because it was not dictatorial and allowed the cooperators essential independence and flexibility. An important component of the model program is the requirement for annual hatchery and wild broodstock inspections to check for disease agents. This surveillance program, when combined with on-going diagnostic work, provides key information for the control of the spread of serious fish diseases. Each fish culture facility and wild broodstock carries a specific disease classification that determines where fish or eggs can be safely transferred.

Historical Highlights

1973—GLFDCC was created by Commission in June.
—first committee meeting held in October to set objectives, identify diseases of concern, review existing disease programs, and develop an agenda for future committee activities.
1974—The Commission approved recommendations on:
—which diseases should be considered as Emergency Diseases, Certifiable Diseases, and Reportable Diseases.
—the prompt and effective eradication of Emergency Diseases.
—the inspection of all broodstocks supplying Great Lakes hatcheries.
—the prior notification of the health status of eggs or fish being transferred between cooperating agencies.
1975—dealt with the whirling disease problem at the Sturgeon River State Fish Hatchery in Michigan which led to the burial of 90 tons of infected coho salmon and rainbow trout fingerlings.
—submitted for Commission adoption the final draft of the Great Lakes Fish Disease Control Policy, the Model Great Lakes Fish Disease Control Program, and six recommendations to put it into action.
1976—organized the technical procedures and administrative support required for the implementation of the Great Lakes Fish Disease Control Program.
—obtained Commission support for an initiative to accelerate FDA and EPA approval of the drugs and chemicals in the United States needed to control fish diseases.
1977—Canada implemented Fish Health Protection Regulations.
—updated data on the extent of disease problems in the Great Lakes basin.

—continued to pursue efforts to register fish health drugs and chemicals in the United States.
—the Commission submitted a formal resolution on this topic to FDA and EPA.
1978—conducted an in-depth program review of cooperator compliance with the fish disease control recommendations of the Commission and arrived at the following:
—that continuation of the interagency cooperative inspection program is essential to basin-wide fish disease control.
—that all cooperators should strive to provide the necessary personnel, facilities and equipment needed to implement program.
—that all agencies develop and implement vital regulations.
—that indemnification procedures are essential to support disease eradication efforts in the private sector if required by a government agency.
—that all cooperating parties cease the importation of eggs or fish infected with, or exposed to, Certifiable Diseases. (This move was specifically aimed at West Coast salmon and steelhead trout sources where IHN virus and BKD were becoming serious problems.)
1979—expanded GLFDCC to include representatives from the private sector.
—dealt with a change in the policy of the U.S. Fish and Wildlife Service regarding cooperative inspection and diagnostic services to State and private hatcheries and how this policy change affected the Great Lakes Fish Disease Control Program.
—developed a comprehensive list of ''Certifying Officials'' in North America for use by cooperative parties.
1980—private fish health cooperative formed to cooperate with GLFDCC.
—cooperative agreement drafts between USFWS and states were reviewed which directly support provisions of Commission's fish disease control program.
—dealt with IPN problem associated with coho salmon in Lake Ontario. Several special meetings, including a special meeting of the Commission, resolved the matter and was also instrumental in enhancing fish disease control activities in Pennsylvania.
1981—set forth on a major project to publish ''A Guide to Integrated Fish Health Management in the Great Lakes Basin.''
—assisted Ontario in dealing with an ERM problem encountered at their primary broodstock hatchery for spring spawning rainbow trout.
—a special sub-committee reviewed the effectiveness of the Great Lakes Fish Disease Control Program and found it to be satisfactory, that uninspected sources of eggs should be avoided, and that the ''Guide'' would be a valuable companion to the existing ''model program.''

A LOOK TO THE FUTURE

Fish disease control in the Great Lakes basin has begun. Seriously infected populations are still being perpetuated in some locations but many problems have been reduced. In plotting a course for the future, the programs used to control livestock and poultry diseases provide excellent guidance. Immunization, nutrition, genetic improvement, improved husbandry practices, facility rehabilitation, and improved diagnostic techniques will open new doors to progress. Although the concept of "zoning" areas believed to be free of certain diseases and thereby prohibiting the stocking of disease carriers in "zoned" watersheds or lake basins has not yet received consensus support in the GLFDCC, this concept remains viable. As fishery management programs develop, "zoning" may become a valuable disease control tool that works in concert with the "stock concept" of fishery management.

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 1981, about 28 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, most lake trout and 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 non-native commercial fishing industry, which harvests relatively few of the stocked salmonids, has been estimated at $160 million (Talhelm, 1979).

Article IV(A) of the Convention on Great Lakes Fisheries charges the Great Lakes Fishery Commission to determine measures for continued productivity of desirable fish species in the Convention area. The Commission views securing fish communities based on foundations of self-sustaining stocks as the ultimate goal of this charge, and believes that stocking with hatchery-reared lake trout is an essential step towards achieving self-sustaining lake trout populations—a major Commission objective. It is an objective which is being increasingly realized in Lake Superior, and maybe, with luck and continued commitment, on the verge of being realized in Lake's Michigan and Huron, and even Lake Ontario.

Lake trout have been planted annually in Lake Superior since 1958, in Lake Michigan since 1965 in Lake Huron and Erie since 1969, and in Lake Ontario since 1972. These fish are provided by the U.S. Fish and Wildlife

Service, the Great Lakes 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. The Ontario Ministry of Natural Resources plans to study relative survival rates of 1981–1982 year-classes fingerlings and yearlings in Lake Superior.

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 1981 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.

Lake trout broodstock came to be increasingly scrutinized subsequent to the 1980 Stock Concept Symposium, and as early results became available from experimental plantings in Lake Michigan of Green Lake trout, and in Lake Ontario of three strains of lake trout (Clearwater Lake, Lake Superior, and Seneca Lake strains). Choice and handling of broodstock will doubtlessly figure largely in future hatchery programming.

Table 1 summarizes annual plantings of lake trout and hybrids in the Great Lakes, and Table 2 details the 1981 plants in each of the Great Lakes. Other small experimental plants of first generation splake and backcrosses have been made by Wisconsin, Michigan, and Minnesota, 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 1981 coho plantings.

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 1981 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 1972–1981.

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 1981, and Table 10 details the 1981 plantings. Table 11 summarizes annual plantings of brown trout for 1975 through 1981, and Table 12 details the 1981 plantings. Brook trout plantings were included for the first time in 1976 (Table 13). Table 14 details the 1981 plantings of brook trout.

The grid number system developed by Stan Smith and others in the early 1970s, is used 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.

Coded wire tag numbers appear under the "Fin Clip/Mark" heading in Table 2 as "CWT (agency code) first data row/second data row."

Literature

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.)

Table 1. Annual plantings (in thousands) of lake trout, splake[1,2] and backcrosses[3] in the Great Lakes, 1958–1981.

	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
1980	778	522	351	759	2,409
1981	714	639	312	1.014	2,679
Subtotal	25,333	9,528	5,708	13,462	54,029

	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
1980	1,375	1,255	87	174	2,891
1981	1,459	831	173	172	2,635
Subtotal	19,384	16,159	1,956	2,113	39,609

Table 1. (Cont'd.)

	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
1980	1,381	–	–	–	561	–	1,941
1981	1,340	–	–	49	680	–	2,068
Subtotal	9,808	332	736	94	6,068	61	17,097

	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
1980	168	339	507
1981	20	20	41
Subtotal	754	1,293	2,047

	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

Table 1. (Cont'd.)

1980	-	383	1,194	1,577
1981	-	387	1,146	1,533
Subtotal	119	1,653	5,928	7,700
Great Lakes Total, lake trout, splake and backcrosses, 1958–1981				120,482

[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. Plantings of lake trout and splake[1,2] in the Great Lakes, 1981.

Location	Grid No.	Numbers	Age	Fin Clip/Mark
LAKE SUPERIOR-LAKE TROUT				
Michigan waters				
Arnheim Reef	1323	50,100[3]	Y	right pectoral
Big Bay Point	1328	50,000[4]	Y	right pectoral
Black River	1413	25,000[4]	Y	right pectoral
Copper Harbor	926	25,000[4]	Y	right pectoral
Grand Marais	1437	25,000[4]	Y	right pectoral
Huron Islands	1325	51,100[3]	Y	right pectoral
Laughing Fish Point	1531	63,000[3]	Y	right pectoral
Loma Farms	1428	25,000[4]	Y	right pectoral
Marquette Bay	1529	25,000[4]	Y	right pectoral
Munising	1634	25,000[4]	Y	right pectoral
Partridge Island	1529	71,000[3]	Y	right pectoral
Pequaming Point	1323	50,000	FF	adipose-left ventral
Presque Isle Harbor	1529	25,000[4]	Y	right pectoral
Shelter Bay	1632	50,000[4]	Y	right pectoral
Taquahmenon Island Reef	1544	102,900[3]	FF	adipose-left ventral
Traverse Island Reef	1224	50,700[3]	Y	right pectoral
Subtotal		713,800		
Minnesota waters				
Five Mile Rock	812	21,500	Y	adipose-right pectoral
Good Harbor Bay	910	21,500	Y	adipose-right pectoral
King's Landing	1106	75,580	FF	adipose-both ventral
Little Marais	1007	49,932[4]	Y	right pectoral
Lutsen	909	21,400	Y	adipose-right pectoral
Split Rock	1106	50,809	Y	right pectoral
Stoney Point	1302	49,991	Y	right pectoral
Sugar Loaf Cove	1008	21,400	Y	adipose-right pectoral
Subtotal		312,112		
Ontario waters				
Bart Island Harbor	229	7,500[3]	Y	right pectoral
Chummys Harbor	228	7,500[3]	Y	right pectoral
Cobinosh Island	229	16,500[3]	Y	right pectoral
Coldwell	234	140,000	Y	right pectoral
French Harbor	227	7,500	Y	right pectoral
Jackson Point	1546	31,800[3]	Y	right pectoral
Lambert Island	320	33,000[3]	Y	adipose-right pectoral
Lapoints	1347	45,000	Y	right pectoral
Mamainse Point	1245	50,000	Y	right pectoral
Michipicoten Harbor	744	50,000	Y	right pectoral
Montreal River	1145	50,000	Y	right pectoral
Morn Harbour	228	8,250	Y	right pectoral

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Palette Island	320	23,000[3]	Y	adipose-right pectoral
Pie Island	519	154,440[3]	FF	adipose-right ventral
Rossport Dock	128	144,035	Y	right pectoral
Silver Harbor	320	156,000[3]	Y	adipose-right pectoral
Sinclair Cove	1045	25,000	Y	right pectoral
Slate Island	231	4,015[3]	FF	right ventral
Small Lake Harbor	229	8,250	Y	right pectoral
Squaw Bay	518	44,905	FF	adipose-right ventral
Swedes Gap	229	7,500	Y	right pectoral
Subtotal		1,014,195		
Wisconsin waters				
Bayfield	1409	50,575[4]	FF	adipose-left ventral
Devil's Island	1209	287,400[4]	FF	adipose-left ventral
Saxon Harbor	1511	30,000[4]	FF	adipose-left ventral
Siskwit	1307	50,400[4]	FF	adipose-left ventral
Superior Entry	1402	182,000	Y	right pectoral
Washburn	1511	38,340[4]	FF	right pectoral
Subtotal		638,715		
Total, Lake Superior		2,678,822		

LAKE MICHIGAN-LAKE TROUT

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Illinois waters				
Julian's Reef	2403	124,000[3]	Y	adipose-right pectoral
Great Lakes Harbor	2402	49,000	FF	right ventral
Subtotal		173,000		
Indiana waters				
Burns Harbor	2707	48,200	FF	right ventral
Burns Harbor	2707	41,000	Y	right pectoral
East Chicago	2705	45,000	Y	right pectoral
Michigan City	2707	38,000	Y	right pectoral
Subtotal		172,200		
Michigan waters				
Benton Harbor	2509	100,000	Y	right pectoral
Charlevoix	517	124,000	Y	right pectoral
E. Grand Traverse Bay	915	108,230[4]	Y	right pectoral
Fisherman Island	616	25,000[3]	FF	adipose-left pectoral
Frankfort	1011	75,100	Y	right pectoral
Good Harbor Reef	814	33,000[3]	FF	adipose-left ventral

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Grand Haven	1911	79,700	Y	right pectoral
Greilickville	915	100,000[4]	Y	right pectoral
Holland	2111	101,000	Y	right pectoral
Ille Aux Galets	417	25,000[3]	FF	adipose-left pectoral
Ironton	517	73	7,8yrs	left ventral, right pectoral
Ironton	517	667	4yrs	right pectoral
Ironton	517	250	6yrs	right pectoral
Ludington	1410	50,000	Y	right pectoral
Manistee	1210	85,000	Y	right pectoral
Montague	1710	50,000	Y	right pectoral
Northport	715	20,000[4]	Y	right pectoral
Pentwater	1510	75,000	Y	right pectoral
Petoskey	518	50,000	Y	right pectoral
Pine River	616	124,000[4]	Y	right pectoral
St. Joseph River	2509	100,000[4]	Y	right pectoral
South Fox Island	513	33,000[3]	FF	adipose-left ventral
South Haven	2311	100,000	Y	right pectoral
Subtotal		1,459,020		
Wisconsin waters				
Black Can Reef	905	212,500[3]	Y	adipose-right pectoral
Kewaunee	1104	80,000[3]	Y	adipose-right pectoral
Manitowoc	1303	80,000[3]	Y	adipose-right pectoral
Northeast Reef	1803	93,000[3]	Y	adipose-right pectoral
Northeast Reef	1803	33,000[3]	FF	adipose-dorsal
Port Washington	1701	50,000	Y	right pectoral
Sheboygan	1502	50,000	Y	right pectoral
Sturgeon Bay Reef	905	65,800[3]	FF	adipose-left ventral
Whitefish Point Reef	805	50,500[3]	FF	adipose-left pectoral
Whitefish Point Reef	805	66,000[3]	FF	adipose-left ventral
Wind Point	2101	50,000	Y	right pectoral
Subtotal		830,800		
Total, Lake Michigan		2,635,020		

LAKE HURON-LAKE TROUT AND SPLAKE

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Michigan waters (lake trout)				
Au Sable River	1210	90,000[4]	Y	adipose
Black River Island	1010	53,500[3]	FF	left pectoral
Detour Ferry Dock	306	50,000	Y	adipose
Greenbush	1110	58,000	Y	adipose
Grindstone City	1412	97,000	Y	adipose

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Hammond Bay	505	74,900	Y	adipose
Harbor Beach	1514	95,000	Y	adipose
Middle Entrance Reef	303	105,100[3]	FF	left pectoral
Middle Island Shoal	710	53,500[3]	FF	left pectoral
Oscoda	1210	90,000	Y	adipose
Point Lookout	1408	70,000	Y	adipose
Port Austin	1412	25,000	Y	adipose
Port Sanilac	1814	50,000	Y	adipose
Rockport	709	53,500[4]	FF	left pectoral
Rogers City Steel	607	75,300	Y	adipose
Round Island Shoal	302	87,800[3]	FF	left pectoral
Scarecrow Island	810	53,500[3]	FF	left pectoral
Sturgeon Point	1110	87,400	Y	adipose
Tawas Point	1309	70,000	Y	adipose
Subtotal		1,339,500		
Ontario waters (lake trout)				
Iroquois Bay	220	24,460	Y	right pectoral
Mowat Island	628	24,100	Y	right pectoral
Subtotal		48,560		
Ontario waters (splake)				
Boucher Point	1126	33,155	Y	left pectoral
Cape Dundas	925	27,493	Y	left pectoral
Heywood Island	319	88,500[3]	Y	left pectoral
Jackson Shoal	822	36,820	Y	left pectoral
Mary Ward Ledges	1128	101,531[3]	Y	left pectoral
Meaford Range	1126	120.180	Y	adipose + CWT
Mowat Island	628	33,081	FF	right ventral
North Keppel Dock	1024	64,469	Y	left pectoral
Pyette Point	1024	73,460	Y	left pectoral
Two Mile Point	629	12,960	FF	right ventral
Vails Point	1024	39,781	Y	left pectoral
Wall Island	628	48,605	FF	right ventral
Subtotal		680,035		
Total, Lake Huron		2,068,095		
LAKE ERIE-LAKE TROUT				
New York waters				
Ripley	523	20,250[3]	Y	adipose+CWT(60)41/16
Pennsylvania waters				
Ripley	523	20,250[3]	Y	adipose+CWT(60)41/16
Total, Lake Erie		40.500		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
LAKE ONTARIO-LAKE TROUT				
New York waters				
Dablon Point	322	123,200[3]	Y	adipose+CWT(60) 41/14,26,27
Dablon Point	322	49,800[3]	Y	adipose+left pectoral
Hamlin	713	29,498[3]	FF	adipose+CWT(60) 41/42,43
Hamlin	713	2,513[4]	2yrs	left maxillary
Hamlin	713	121,900	Y	adipose+CWT(60) 41/17,25,30
Hamlin	713	50,000	Y	adipose-left pectoral
Niagara	806	20,224	FF	adipose+CWT(60)41/44
Niagara	806	50,090	Y	adipose-left pectoral
Niagara	806	120,600	Y	adipose+CWT(60)41/18, 20,32
Selkirk	623	20,581	FF	adipose+CWT(60)41/40
Selkirk	623	122,590	Y	adipose+CWT(60)41/21, 23,29
Selkirk	623	50,290	Y	adipose-left pectoral
Sodus	818	20,624	FF	adipose+CWT(60)41/41
Sodus	818	50,010[3]	Y	adipose-left pectoral
Sodus	818	122,330[3]	Y	adipose+CWT(60)41/22, 24,28
Stony Point	422	21,223	FF	adipose+CWT(60)41/39
Stony Point	422	48,900	Y	adipose-left pectoral
Stony Point	422	79,300[3]	Y	adipose+CWT(60)41/15, 19,31
Stony Point	422	42,100	Y	adipose+CWT(60)41/15, 19
Subtotal		1,145,773		
Ontario waters				
Clarkson	603	94,992	Y	right pectoral
Grimsby Harbor	803	18,360	Y	right pectoral
Main Duck Island	421	200,380[3]	Y	right pectoral
Port Hope	411	73,580	Y	right pectoral
Subtotal		387,312		
Total, Lake Ontario		1,533,085		
Great Lakes Total		8,955,522		

[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 and 1973 to 1981. 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
1979	Wisconsin	Bark Point	1306	12,000	F	none
		Bark Point	1306	6,000	Y	none
		Bayfield	1409	10,800	Y	none
		Cornucopia	1307	12,000	F	none
		Houghton Point	1509	12,000	F	none
		Houghton Point	1509	16,200	Y	none
		Madeline Island	1409	12,000	F	none
		Onion River	1409	36,000	F	none
		Onion River	1409	22,700	Y	none
		Port Superior	1409	2,675	Y	none
		Washburn	1509	24,000	F	none
		Washburn Coal Dock	1509	16,000	Y	none
1980	Wisconsin	Ashland Coal Dock	1509	21,150	Y	none
		Bark Point	1306	12,700	F	none
		Bodins-Houghton Point	1509	25,400	FF	none
		Cornucopia Harbor	1307	10,650	Y	none
		Cornucopia Harbor	1307	12,700	F	none
		Onion River Mouth	1409	10,650	Y	none
		Onion River Mouth	1409	25,400	F	none
		Superior Entry	1401	8,400	F	none
		Washburn Coal Dock	1509	20,360	Y	none
		Washburn Coal Dock	1509	25,400	F	none
1981	Michigan	Marquette Bay	1529	10,000	Y	none
	Minnesota	French River	1302	1,550	FF	none
	Wisconsin	Bayfield	1409	13,750	F	none
		Herbster	1306	13,750	F	none
		Saxon Harbor	1511	13,750	F	none
		Siskwit	1307	13,750	F	none
		Superior	1401	12,000	F	none
		Washburn	1509	111,514	F	none
				29,945	Y	none
Total, Lake Superior				754,551		

Table 4. Annual plantings (in thousands) of coho salmon in the Great Lakes, 1966–1981.

		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
1980	350	–	–	350
1981	227	–	–	227
Subtotal	5,402	663	78	5,916

		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
1980	2,243	492	169	39	2,943
1981	1,707	2,451	102	329	2,451
Subtotal	34,927	7,016	1,235	1,138	42,178

	LAKE HURON	
Year	Michigan	Total
1968	402	402
1969	667	667
1970	571	571

Table 4. (Cont'd.)

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
1980	375	375
1981	135	135
Subtotal	6,873	6,873

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
1980	498	500	543	81	1,621
1981	270	273	468	–	1,011
Subtotal	2,512	3,013	4,708	1,449	11,678

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

Table 4. (Cont'd.)

1979	286	344	630
1980	77	299	377
1981	363	–	363
Subtotal	2,899	3,004	5,903

Great Lakes Total, coho salmon, 1966–1981	72,548

Table 5. Plantings of coho salmon in the Great Lakes, 1981.

Location	Grid No.	Numbers	Age	Fin clip/Mark
LAKE SUPERIOR-COHO SALMON				
Michigan waters				
Black River	1413	67,520	Y	none
Dead River	1529	92,407	Y	none
Sucker River	1439	67,500	Y	none
Subtotal		227,427		
Total, Lake Superior		227,427		
LAKE MICHIGAN-COHO SALMON				
Illinois waters				
Camp Logan, Zion	2302	16,900[1]	Y	right ventral
Chicago	2603	90,000	Y	none
Chicago	2703	71,100	Y	none
N.W. Univ. Lagoon	2503	50,000	Y	none
Waukegan	2302	95,814	Y	none
Subtotal		323,814		
Indiana waters				
Little Calumet River	2705	62,974	FF	none
Trail Creek	2707	38,979	FF	none
Subtotal		101,953		
Michigan waters				
Brewery Creek	915	45,000	Y	none
Grand River	1911	290,016	Y	none
Little Manistee River	1211	202,815	Y	none
Platte River	912	944,205	Y	none
Portage Lake	1111	90,013	Y	none
Sable River	1410	90,048	Y	none
Thompson Creek	211	45,067	Y	none
Subtotal		1,707,164		
Wisconsin waters				
Kenosha	2202	26,000	Y	none
Milwaukee	1901	60,600	Y	none
Port Washington	1701	79,100	Y	none
Racine	2102	53,000	Y	none
Sheboygan	1502	99,800	Y	none
Subtotal		318,500		
Total, Lake Michigan		2,451,431		
LAKE HURON-COHO SALMON				
Michigan waters				
Port Hope	1813	45,045	Y	none

Table 5. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin clip/Mark
Tawas River	1308	90,087	Y	none
Subtotal		135,132		
Total, Lake Huron		135,132		
LAKE ERIE-COHO SALMON				
Michigan waters				
Detroit River Yacht Club	603	180,043	Y	none
Huron River	702	90,052	Y	none
Subtotal		270,095		
Ohio waters				
Chagrin River	912	128,683	F	none
Huron River	1006	144,431	F	none
Subtotal		273,114		
Pennsylvania waters				
Elk Creek	619	90,000	Y	none
Godfrey Run	619	58,700	Y	none
Orchard Beach Run	523	14,000	Y	left ventral
Presque Isle Bay	521	84,000	Y	none
Sixteen Mile Creek	523	40,000	Y	none
Trout Run	620	91,000	Y	none
Walnut Creek	620	90,000	Y	none
Subtotal		467,700		
Total, Lake Erie		1,010,909		
LAKE ONTARIO-COHO SALMON				
Ontario waters				
Georgetown	603	20,000	F	right ventral
Lowville	702	59,000	FF	right ventral
Lowville Park	702	30,000	Y	adipose
Norval	603	53,500	F	adipose
Norval	603	138,552	Y	adipose
Port Credit	603	50,000	F	right ventral
Stewart Town	603	12,000	F	right ventral
Subtotal		363,052		
Total, Lake Ontario		363,052		
Great Lakes Total		4,187,951		

[1] Imprinted with morpholine.

Table 6. Annual plantings (in thousands) of chinook salmon in the Great Lakes, 1967–1981.

	LAKE SUPERIOR			
Year	Michigan	Wisconsin	Minnesota	Total
1967	33	–	–	33
1968	50	–	–	50
1969	50	–	–	50
1970	150	–	–	150
1971	252	–	–	252
1972	472	–	–	472
1973	509	–	–	509
1974	295	–	228	523
1975	253	–	–	253
1976	201	–	291	493
1977	116	35	103	254
1978	150	–	278	478
1979	100	60	341	501
1980	276	60	393	729
1981	250	60	52	362
Subtotal	3,157	215	1,686	5,109

	LAKE MICHIGAN				
Year	Michigan	Wisconsin	Indiana	Illinois	Total
1967	802	–	–	–	802
1968	687	–	–	–	687
1969	652	66	–	–	718
1970	1,675	119	100	10	1,904
1971	1,865	264	180	8	2,317
1972	1,691	317	107	24	2,139
1973	2,115	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
1980	2,903	2,430	621	152	6,106
1981	2,205	1,848	263	431	4,747
Subtotal	27,811	13,454	15,963	3,220	46,993

Table 6. (Cont'd.)

	LAKE HURON	
Year	Michigan	Total
1968	274	274
1969	250	250
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
1980	1,878	1,878
1981	1,523	1,523
Subtotal	12,682	12,682

	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
1980	–	350	544	–	894
1981	–	–	449	71	519
Subtotal	1,810	1,928	5,223	1,039	10,00

	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
1980	118	788	906
1981	12	1,468	1,480
Subtotal	1,174	6,437	7,611

Great Lakes Total, chinook salmon, 1967–1981 82,395

Table 7. Plantings of chinook salmon in the Great Lakes, 1981.

Location	Grid No.	Numbers	Age	Fin Clip/Mark
LAKE SUPERIOR-CHINOOK SALMON				
Michigan waters				
Big Iron River	1316	75,000	SF	none
Black River	1413	75,000	SF	none
Dead River	1529	100,000	SF	none
Subtotal		250,000		
Minnesota waters				
Grand Portage Creek		51,985[1]	F	right pectoral
Wisconsin waters				
Black River	1401	60,000	Y	none
Total, Lake Superior		361,985		
LAKE MICHIGAN-CHINOOK SALMON				
Illinois waters				
Chicago	2603	314,000	F	none
Great Lakes Naval Training Center Harbor	2402	20,400	F	none
Kellogg Creek	2302	71,200[2]	Y	none
Kellogg Creek	2302	20,000[2]	Y	right pectoral
Waukegan	2302	5,000	F	none
Subtotal		430,600		
Indiana waters				
East Chicago	2704	81,992	SF	none
Little Calumet River	2705, 2706	84,728	SF	none
Trail Creek	2707	96,672	SF	none
Subtotal		263,392		
Michigan waters				
Escanaba River	306	50,000	SF	none
Grand River	1911	425,174	SF	none
Kalamazoo River	1211	100,050	SF	none
Little Manistee River	1211	500,204	SF	none
Manistee River	1211	279,027	SF	none
Manistique River	211	50,000	SF	none
Muskegon River	1810	250,140	SF	none
Portage Lake	1111	100,000	SF	none
Sable River	1410	100,000	SF	none
South Haven	2311	100,050	SF	none
St. Joseph River	2509	250,096	SF	none
Subtotal		2,204,741		

Table 7. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Wisconsin waters				
Anapee River	1004	103,100	F	none
East Twin River	1303	75,000	F	none
Kenosha	2202	193,660	F	none
Kewaunee	1104	200,000	F	none
Little River	703	125,000	F	none
Manitowoc River	1303	152,000	F	none
Menominee River	703	100,000	F	none
Milwaukee	1901	197,500	F	none
Oconto Park	802	100,000	F	none
Port Washington	1701	70,000	F	none
Racine	2102	112,000	F	none
Sheboygan	1502	150,000	F	none
Sturgeon Bay	905	243,000	F	none
West Twin River	1303	27,000	F	none
Subtotal		1,848,260		
Total, Lake Michigan		4,746,993		
LAKE HURON-CHINOOK SALMON				
Michigan waters				
Au Gres River	1408	100,000	SF	none
Au Sable River	1210	550,000	SF	none
Cass River	1606	100,282	SF	none
Harbor Beach	1514	100,039	SF	none
Harrisville	1110	225,000	SF	none
Lexington Creek	1915	100,000	SF	none
Nagels Creek	606	57,374	SF	none
Port Austin	1411	100,039	SF	none
Port Sanilac	1814	90,011	SF	none
St. Marys River		100,000	SF	none
Subtotal		1,522,745		
Total, Lake Huron		1,522,745		
LAKE ERIE-CHINOOK SALMON				
New York waters				
Canadaway Creek	425	70,500	SF	none
Pennsylvania waters				
Elk Creek	619	56,000	SF	none
Elk Creek	619	31,000	FF	none
Elk Creek	619	51,644	Y	adipose
Godfrey Run	619	50,000	SF	none
Sixteen Mile Run	523	50,000	SF	none
Trout Run	620	50,000	SF	none

Table 7. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Walnut Creek	620	93,500	SF	none
Walnut Creek	620	29,000	FF	none
Walnut Creek	620	37,700	Y	adipose
Subtotal		448,844		
Total, Lake Erie		519,344		
LAKE ONTARIO-CHINOOK SALMON				
Ontario waters				
Erindale	603	11,997	SF	right ventral
New York waters				
Black River	424	102,240	SF	none
Eighteen Mile Creek	708	83,500	SF	none
Genesee River	815	137,500	SF	none
Niagara River	806	125,500	SF	none
North Sandy Creek	523	75,000	SF	none
Oak Orchard Creek	711	137,500	SF	none
Oswego River	721	135,000	SF	none
Salmon River	623	459,500	SF	none
Sodus Bay	819	137,500	SF	none
South Sandy Creek	523	75,000	SF	none
Subtotal		1,468,240		
Total, Lake Ontario		1,480,237		
Great Lakes Total		8,631,304		

[1] USFWS plant, all other U.S. plants by state agencies.
[2] Imprinted with morpholine.

Table 8. Plantings of Atlantic salmon in the Great Lakes, 1972–1981.

Year	State	Location	Grid No.	Numbers	Age	Fin Clip/Mark
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[4]	Y	none
1978	Wisconsin	Pikes Creek	1409	36,772	Y	none
1980	Minnesota	French River	1302	7,584[1]	Y	left ventral
Total				93,462		
LAKE MICHIGAN						
1972	Michigan	Boyne River	616	10,000[4]	Y	none
1973	Michigan	Boyne River	616	15,000[4]	Y	none
1974	Michigan	Platte River	616	7,308[4]	Y	adipose
		Boyne River	616	14,555[4]	Y	none
1975	Michigan	Boyne River	616	18,742[4]	Y	none
				3,430[3]	A	right ventral
1976	Michigan	Boyne River	616	20,438[4]	Y	none
				162[4]	A	left ventral
1977	Michigan	Pere Marquette River	1410	7,131[2]	Y	left ventral
		Little Manistee River	1211	4,500[2]	Y	left ventral
		Pere Marquette River	1410	3,961[4]	Y	right ventral
		Little Manistee River	1211	2,997[4]	Y	right ventral
1978	Michigan	Little Manistee River	1211	5,000[2]	Y	left pectoral
		Pere Marquette River	1410	14,880[3]	Y	left pectoral
		Little Manistee River	1211	10,000[4]	Y	right pectoral
		Pere Marquette River	1410	16,322[4]	Y	right pectoral
1981	Michigan	Manistee River	1211	19,529[4]	Y	left ventral
		Petoskey	519	29[4]	A	none
Total				173,984		
LAKE HURON						
1972	Michigan	Au Sable River	1210	9,000[4]	Y	none
Great Lakes Total, Atlantic salmon, 1972–1981				276,446		

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

Table 9. Annual plantings (in thousands) of rainbow, steelhead, and palomino[1] trout in the Great Lakes, 1975–1981.[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
1980	66	119	471	656
1981	55	95	–	150
Subtotal	233	1,020	1,235	2,489

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
1980	1,311	1,137	70	113	2,630
1981	558	1,007	230	186	1,981
Subtotal	5,608	6,012	594	1,128	13,840

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
1980	345	320	665
1981	211	82	293
Subtotal	2,071	748	2,818

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
1980	50	433	72	202	531	1,287
1981	50	12	86	131	456	734
Subtotal	210	1,622	244	1,483	1,666	5,221

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
1980	759	734	1,493
1981	483	81	564
Subtotal	2,462	1,294	3,758
Great Lakes Total, rainbow, steelhead, and palomino trout, 1975–1981			28,126

[1]Rainbow × W. Virginia Golden hybrid (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, 1981.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-RAINBOW AND STEELHEAD TROUT				
Michigan waters (steelhead trout)				
Black River	1424	10,000	Y	none
Chocolay River	1530	10,000	Y	none
Ravine River	1424	10,000	Y	right pectoral
Sucker River	1439	10,000	Y	none
Two Hearted River	1441	15,000	Y	right pectoral
Subtotal		55,000		
Wisconsin waters (rainbow trout)				
Amnicon	1402	30,000	Y	none
Flag River	1405	1,500	Y	none
Herbster	1306	1,500	Y	none
Little Brule	1404	30,000	Y	none
Siskwit	1307	1,500	Y	none
Superior	1401	30,500	Y	none
Subtotal		95,000		
Total, Lake Superior		150,000		
LAKE MICHIGAN-RAINBOW AND STEELHEAD TROUT				
Illinois waters (rainbow trout)				
Calumet Harbor	2703	19,800	Y	none
Chicago	2603	55,201	Y	none
Chicago	2703	5,287	Y	none
Great Lakes Harbor	2402	73,280	F	none
Waukegan	2302	32,800	Y	none
Subtotal		186,368		
Indiana waters (steelhead trout)				
Little Calumet River	2705, 2706	58,102	FF	none
Little Calumet River	2705, 2706	78,716	Y	adipose
Trail Creek	2707	40,130	FF	none
Trail Creek	2707	53,409	Y	adipose
Subtotal		230,357		
Michigan waters (steelhead trout)				
Bear River	519	10,000	Y	none
Betsie River	915	20,004	Y	none
Big Cedar River	504	7,500	Y	none
Big Rabbit River	2211	10,000	Y	none
Black River	2311	15,000	Y	none
Boardman River	915	20,000	Y	none
Bowers Harbor	815	5,000	Y	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Carp River	320	10,000	Y	none
Crockery Creek	1911	5,000	Y	right pectoral
Elk River	816	5,000	Y	none
Fish Creek	1911	5,000	Y	right pectoral
Flat River	1911	5,000	Y	right pectoral
Galien River	2311	10,000	Y	none
Grand River	1911	15,000	Y	right pectoral
Kalamazoo River	2211	25,000	Y	none
Little Manistee River	1211	585	Y	adipose
Little Manistee River	1211	3,000	Y	adipose-left ventral
Little Manistee River	1211	93,673	FF	adipose
Little Manistee River	1211	30,700	Y	adipose
Little Manistee River	1211	6,713	FF	none
Little Manistee River	1211	915	Y	adipose
Looking Glass River	1911	10,000	Y	right pectoral
Manistee River	1211	30,000	Y	right ventral
Manistique River	211	15,000	Y	none
Muskegon River	1810	50,008	Y	right pectoral
Nine Mile Point	517	5,000	Y	none
Paw Paw River	2509	10,000	Y	none
Pentwater River	1510	10,000	Y	none
Petoskey	519	5,000	Y	none
Rogue River	1911	15,000	Y	right pectoral
Ruby Creek	1410	5,000	Y	none
St. Joseph River	2509	30,000	Y	right pectoral
Thompson Creek	211	10,000	Y	none
Traverse City	915	25,000	Y	none
White River	1710	20,020	Y	none
Whitefish River	208	14,575	Y	none
Subtotal		557,693		
Wisconsin waters (rainbow trout)				
Algoma	1004	73,000	F	none
Bailey's Harbor	706	10,000	F	none
Bailey's Harbor	706	10,000	Y	none
Coast Guard Station	905	28,100	F	none
Gill's Rock	606	10,000	A	none
Kenosha	2202	40,000	F	none
Kenosha	2202	33,300	Y	none
Kewaunee	1104	70,730	F	none
Kewaunee	1104	8,000	Y	none
Little River	703	6,000	F	none
Manitowoc River	1303	43,000	F	none
Manitowoc River	1303	33,100	Y	none
Manitowoc River	1303	6,822	Y	adipose-left pectoral
Manitowoc River	1303	3,178	Y	adipose-left pectoral
Menominee River	703	13,000	F	none
Milwaukee	1901	30,400	F	none
Milwaukee	1901	49,400	Y	none
Oconto Park	802	40,500	F	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Peshtigo	803	13,000	F	none
Port Washington	1701	30,000	F	none
Port Washington	1701	32,500	Y	none
Racine	2102	66,300	F	none
Racine	2102	33,700	Y	none
Red Arrow Park	703	8,400	F	none
Schauer Park	805	10,800	Y	none
Schauer Park	805	20,000	F	none
Sheboygan	1502	102,572	F	none
Sheboygan	1502	24,550	Y	none
Sheboygan	1502	17,350	Y	left pectoral
Sturgeon Bay	905	27,100	F	none
Surf Club	703	7,000	F	none
Two Rivers	1303	30,000	F	none
Two Rivers	1303	18,850	Y	none
Wester's	805	33,100	F	none
Whitefish Bay	805	23,000	F	none
Subtotal		1,006,752		
Total, Lake Michigan		1,981,170		

LAKE HURON-RAINBOW AND STEELHEAD TROUT

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters (steelhead trout)				
Au Sable River Harbor	1210	111,243	Y	none
Au Gres River	1408	10,000	Y	none
Carp River	202	10,000	Y	none
Caseville	1510	15,000	Y	none
Cheboygan River	403	10,000	Y	none
Ocqueoc River	505	10,000	Y	none
Pinnebog River	1411	10,000	Y	none
St. Marys River	1647	15,000	Y	none
Thunder Bay	809	20,000	Y	none
Subtotal		211,243		
Ontario waters (rainbow trout)				
Port Albert	1519	14,600	Y	adipose
Sarnia Harbor	2015	40,000	Y	adipose
Southampton	1221	27,600	Y	adipose
Subtotal		82,200		
Total, Lake Huron		293,443		

LAKE ERIE-RAINBOW AND STEELHEAD, AND PALOMINO TROUT

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters (steelhead trout)				
Huron River	702	50,000	Y	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Ohio waters (rainbow trout)				
Arcola Creek	717	8,000	F	none
Beaver Creek	1006	5,000	F	none
Chagrin River	912	19,000	F	none
Conneaut Creek	718	29,060	F	none
Rocky River	911	4,000	F	none
Vermilion River	1007	25,000	F	none
Wheeler Creek	717	8,000	F	none
Subtotal		98,060		
Ohio waters (steelhead trout)				
Conneaut Creek	718	32,550	F	none
New York waters (rainbow trout)				
Athol Springs	228	17,900	Y	none
Barcelona Harbor	424	20,000	FF	none
Barcelona Harbor	424	10,000	Y	adipose-right ventral
Barcelona Harbor	424	3,300	Y	none
Cattaragus Creek	327	4,850	Y	none
Cattaragus Creek	327	10,000	Y	adipose-left pectoral
Dunkirk Harbor	327	20,000	FF	none
Subtotal		86,050		
Ontario waters (rainbow trout)				
Big Creek	321	5,800	Y	adipose
Big Creek	321	65	A	none
Lynn River	220	216	A	none
Young Creek	321	6,000	Y	adipose
Subtotal		12,081		
Pennsylvania water (rainbow trout)				
Conneaut Creek	718	460	Y	none
Conneaut Creek	718	7,589	Y,2yrs	none
Crooked Creek	619	3,150	Y	none
Elk Creek	619	19,512	Y	none
Temple Run	718	1,051	Y	none
Twelve Mile Creek	523	12,600	Y	none
Walnut Creek	620	60,000	F	none
Walnut Creek	620	1,000	Y	none
Subtotal		105,362		
Pennsylvania waters (steelhead trout)				
Elk Creek	0619	50,000	Y	none
Godfrey Run	619	74,500	Y	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Sixteen Mile Creek	523	50,000	Y	none
Trout Run	620	13,000	Y	left ventral
Trout Run	620	113,400	Y	none
Walnut Creek	620	49,000	Y	none
Subtotal		349,900		
Pennsylvania waters (palomino trout)				
Crooked Creek	619	50	Y	none
Elk Creek	619	300	Y,2yrs	none
Walnut Creek	620	50	Y	none
Subtotal		400		
Total, Lake Erie		734,403		
LAKE ONTARIO-RAINBOW AND STEELHEAD TROUT				
Ontario waters (rainbow trout)				
Port Credit	603	81,234	Y	adipose
New York waters (rainbow trout)				
Hamlin Beach	713	32,030	FF	none
Hamlin Beach	713	20,104	Y	none
Olcott Harbor	708	18,000	FF	none
Olcott Harbor	708	9,207	Y	none
Selkirk Shores	623	30,400	FF	none
Selkirk Shores	623	21,300	Y	none
Sodus Point	819	48,800	FF	none
Sodus Point	819	12,810	Y	none
Wilson Harbor	707	18,030	FF	none
Wilson Harbor	707	12,634	Y	none
Subtotal		223,315		
New York waters (steelhead trout)				
Beaverdam Brook	623	23,200	Y	adipose-left pectoral
Beaverdam Brook	623	32,645	Y	adipose-left ventral
Beaverdam Brook	623	47,975	Y	left ventral
Four Mile Creek	707	24,000	Y	none
Irondequoit Creek	815	27,880	Y	none
Keg Creek	709	14,900	Y	none
Orwell Brook	623	12,615	Y	left ventral
Salmon Creek	815	19,400	Y	none
Sandy Creek	713	23,000	Y	none
Trout Brook	623	15,000	Y	left ventral
Twelve Mile Creek	707	18,900	Y	none
Subtotal		259,515		
Total, Lake Ontario		564,064		
Great Lakes Total		3,723,080		

[1] Virginia Golden hybrid (small numbers planted by Pennsylvania only).

Table 11. Annual plantings (in thousands) of brown and tiger[1] trout in the Great Lakes, 1975–1981.

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
1980	–	85	5	90
1981	10	73	–	83
Subtotal	135	570	169	743

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
1980	105	1,046	24	116	1,292
1981	32	1,014	65	58	1,169
Subtotal	1,657	5,678	249	702	8,288

LAKE HURON

Year	Michigan	Total
1975	155	155
1976	447	447
1977	210	210
1978	258	258
1979	90	90
1980	90	90
1981	45	45
Subtotal	1,295	1,295

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
1980	32	46	50	128
1981	35	41	34	111
Subtotal	95	239	328	663

Table 11. (Cont'd.)

Year	LAKE ONTARIO New York	Total
1975	371	371
1976	311	311
1977	353	353
1978	94	94
1979	219	219
1980	–	–
1981	454	454
Subtotal	1,802	1,802

Great Lakes Total, brown and tiger trout, 1975–1981 12,791

[1]Brown × brook trout hybrid.

Table 12. Plantings of brown and tiger[1] trout in the Great Lakes, 1981.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-BROWN TROUT				
Michigan waters				
Marquette Bay	1529	10,000	Y	none
Wisconsin waters				
Ashland	1509	32,000	Y	none
Herbster	1306	3,150	Y	none
Port Wing	1405	2,500	F	none
Saxon Harbor	1511	5,000	F	none
Saxon Harbor	1511	3,000	Y	none
Siskwit	1307	2,500	F	none
Superior	1401	25,000	F	none
Subtotal		73,150		
Total, Lake Superior		83,150		
LAKE MICHIGAN-BROWN TROUT				
Illinois waters				
Chicago	2603	5,000	SF	adipose
Chicago	2603	10,894	SF	none
Diversey Harbor	2603	49,186	FF	none
Subtotal		65,080		
Indiana waters				
East Chicago	2704	17,656	FF	none
Little Calumet River	2705, 2706	24,148	FF	none
Michigan City	2707	16,306	FF	none
Subtotal		58,110		
Michigan waters				
Betsie River	1011	8,400	Y	none
Manistee	1211	8,400	Y	none
Petosky	519	3,400	Y	none
Pine River	616	3,400	Y	none
Sable River	1410	8,400	Y	none
Subtotal		32,000		
Wisconsin waters				
Algoma	1004	40,000	F	none
Algoma	1004	27,000	Y	none
Bailey's Harbor	706	10,000	F	none
Bailey's Harbor	706	15,200	Y	none
Brauns Dorf Beach	905	10,600	Y	none
Egg Harbor	705	10,875	F	none
Egg Harbor	705	10,000	Y	none

Table 12. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Ephraim	605	10,000	Y	none
Fish Creek	705	10,875	F	none
Fish Creek	705	15,250	Y	none
Gill's Rock	606	5,000	Y	none
Kenosha	2202	15,000	F	none
Kenosha	2202	32,835	Y	none
Kewaunee	1104	35,000	F	none
Kewaunee	1104	27,000	Y	none
Manitowoc	1303	40,600	F	none
Manitowoc	1303	25,400	Y	none
Marinette Surf Club	703	30,000	Y	none
Menominee River	703	15,000	Y	none
Milwaukee	1901	36,025	F	none
Milwaukee	1901	25,700	Y	none
Moonlight Bay	706	5,300	Y	none
Oconto Park	802	30,700	F	none
Oconto Park	802	11,100	Y	none
Oconto Pier	802	30,700	F	none
Oconto Pier	802	19,390	Y	none
Peshtigo River	803	10,000	F	none
Port Washington	1701	15,000	F	none
Port Washington	1701	25,125	Y	none
Racine	2102	15,000	F	none
Racine	2102	24,700	Y	none
Red Arrow Park	703	17,500	Y	none
Rowleys Bay	607	5,300	Y	none
Shauer Park	805	10,500	F	none
Shauer Park	805	16,000	Y	none
Sheboygan	1502	40,000	F	none
Sheboygan	1502	87,723	Y	none
Sturgeon Bay	905	37,800	F	none
Sturgeon Bay	905	39,150	Y	none
Two Rivers	1303	35,000	F	none
Two Rivers	1303	24,800	Y	none
Westers	805	21,200	F	none
Westers	805	14,900	Y	none
Whitefish Bay	805	10,500	F	none
Whitefish Bay	805	9,450	Y	none
Winegar Pond	803	10,000	Y	none
Subtotal		1,014,198		
Total, Lake Michigan		1,169,388		

LAKE HURON-BROWN TROUT

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters				
Saginaw Bay, Pt. Lookout	1408	10,000	Y	right pectoral
Tawas Bay, East Tawas	1309	10,000	Y	right ventral
Thunder Bay, Part Pt.	809	25,000	Y	right ventral
Subtotal		45,000		
Total, Lake Huron		45,000		

Table 12. (Cont'd.)

LAKE ERIE-BROWN TROUT

Location	Grid No.	Numbers	Age	Fin Clip
New York waters				
Barcelona Harbor	424	17,150	Y	none
Cattaraugus Creek	327	17,150	Y	none
Subtotal		34,300		
Ohio waters				
Beaver Creek	1006	5,000	F	none
Grand River	814	28,080	F	none
Grand River	814	2,000	Y	none
Subtotal		35,080		
Pennsylvania waters				
Conneaut Creek	718	1,825	Y	none
Conneaut Creek	718	711	Y,2yr	none
Crooked Creek	619	400	Y	none
Elk Creek	619	1,600	Y	none
Orchard Beach Run	523	800	Y	none
Raccoon Creek	619	440	Y	none
Trout Run	620	35,100	Y	none
Twenty Mile Creek	523	400	Y	none
Subtotal		41,276		
Total, Lake Erie		110,656		

LAKE ONTARIO-BROWN TROUT

Location	Grid No.	Numbers	Age	Fin Clip
New York waters				
Braddock's Bay	815	18,250	Y	none
Chaumont Bay	324	35,000	FF	none
Fair Haven	720	25,500	Y	none
Genesee	815	24,300	Y	none
Hamlin	713	31,650	Y	none
Irondequoit	815	18,250	Y	none
Olcott	708	4,000	FF	none
Olcott	708	29,000	Y	none
Oswego	721	25,600	Y	left ventral
Point Breeze	711	30,350	Y	none
Pultneyville	817	15,450	Y	none
Ray Bay	523	25,600	Y	adipose
Selkirk	623	25,550	Y	none
Selkirk	623	50,000	FF	none
Sodus Point	819	47,900	Y	none
Webster	816	18,400	Y	none
Wilson	707	29,000	Y	none
Subtotal		453,800		
Total, Lake Ontario		453,800		
Great Lakes Total		1,861,994		

[1] Brown × brook trout hybrid.

Table 13. Annual plantings (in thousands) of brook trout in the Great Lakes, 1976–1981.

LAKE SUPERIOR

Year	Wisconsin	Minnesota	Total
1976	25	7	32
1977	123	66	188
1978	166	30	196
1979	83	27	111
1980	124	15	139
1981	80	–	80
Subtotal	601	145	746

LAKE MICHIGAN

Year	Michigan	Wisconsin	Illinois	Total
1976	61	12	6	79
1977	–	643	–	643
1978	–	243	5	248
1979	–	187	8	196
1980	–	185	20	204
1981	8	200	–	208
Subtotal	69	1,470	39	1,578

LAKE ERIE

Year	Pennsylvania	Total
1976	6	6
1977	2	2
1978	2	2
1979	–	–
1980	6	6
1981	–	–
Subtotal	16	16

LAKE ONTARIO

Year	New York	Total
1976	–	–
1977	8	8
1978	–	–
1979	–	–
1980	326	326
1981	106	106
Subtotal	432	432

Great Lakes Total, brook trout, 1976–1981 2,772

Table 14. Plantings of brook trout in the Great Lakes, 1981.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-BROOK TROUT				
Wisconsin waters				
Bayfield	1409	44,120	Y	none
Bayfield	1409	200	A	none
Saxon Harbor	1511	3,175	Y	none
Siskwit	1307	3,175	Y	none
Washburn	1509	29,040	Y	none
Subtotal		79,710		
Total, Lake Superior		79,710		
LAKE MICHIGAN-BROOK TROUT				
Michigan waters				
Thompson Creek	211	8,000	Y	right ventral
Wisconsin waters				
Algoma	1004	27,900	F	none
Bailey's Harbor	706	12,333	Y	none
Kewaunee	1104	27,900	F	none
Manitowoc	1303	27,900	F	none
Schauer Park	805	6,167	Y	none
Schauer Park	805	33,270	F	none
Sheboygan	1502	29,997	Y	none
Sturgeon Bay	905	6,500	Y	none
Two Rivers	1303	27,900	F	none
Subtotal		199,867		
Total, Lake Michigan		207,867		
LAKE ONTARIO-BROOK TROUT				
New York waters				
Oswego Harbor	721	105,800	SF	none
Total, Lake Ontario		105,800		
Great Lakes Total		393,377		

SEA LAMPREY CONTROL IN THE GREAT LAKES

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The activities in 1981 by the sea lamprey control units of Canada and the United States are summarized in a joint report—the first time since the inception of the program on the Great Lakes. Sea lamprey ammocetes were recovered in 219 of a total of 498 streams surveyed. Larvae were found for the first time in four tributaries of the St. Marys River and in eight estuarine areas (three in Lake Superior, four in Lake Ontario, and one in Oneida Lake). Chemical treatments were completed on 57 streams and 9 estuarine areas (Table 1). Spawning-run sea lampreys were captured in assessment traps fished in 60 tributaries (Table 2). The number of parasitic-phase sea lampreys captured by fishermen remained low in Lakes Superior (236) and

Table 1. Summary of chemical treatments in streams and estuarine or bay areas of the Great Lakes in 1981.

Lake	Number of treatments	Discharge at mouth m³/s	Discharge at mouth f³/s	TFM Act. kg	TFM Ingr. lbs	Bayer 73 Powder Act. kg	Bayer 73 Powder Ingr. lbs	Bayer 73 Granules Total used[a] kg	Bayer 73 Granules Total used[a] lbs
Superior	24	134.1	4,725	16,122	35,535	131	288	6,937	15,296
Michigan	18	91.0	3,206	12,854	28,339	77	170	–	–
Huron	16	39.8	1,413	4,996	11,006	5	10	2,396	5,275
Ontario	8	31.5	1,114	2,428	5,344	–	–	–	–
TOTAL	66	296.4	10,458	36,400	80,224	213	468	9,333	20,571

[a] Sand granules coated with Bayer 73 at 5% by weight active ingredient.

Table 2. Number and biological characteristics of adult sea lampreys captured in assessment traps in 60 tributaries of the Great Lakes in 1981.

Lake	Number of streams	Total captured	Number sampled	Percent males	Mean length (mm) Males	Mean length (mm) Females	Mean weight (g) Males	Mean weight (g) Females
Superior	13	1,846	1,669	36	431	424	183	176
Michigan	14	9,750	3,928	38	468	463	211	216
Huron	15	10,816	2,267	39	448	449	199	205
Erie	5	2,351	2,223	52	490	486	246	254
Ontario	13	1,918	1,570	58	473	472	245	250

Table 2. Number and biological characteristics of adult sea lampreys captured in assessment traps in 60 tributaries of the Great Lakes in 1981.

Lake	Number of streams	Total captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
					Males	Females	Males	Females
Superior	13	1,846	1,669	36	431	424	183	176
Michigan	14	9,750	3,928	38	468	463	211	216
Huron	15	10,816	2,267	39	448	449	199	205
Erie	5	2,351	2,223	52	490	486	246	254
Ontario	13	1,918	1,570	58	473	472	245	250

Michigan (262), as in 1980, but increased significantly in Lake Huron (1,547); Lake Erie fishermen captured 109. In addition, several special studies were carried out in conjunction with the control program. This report presents the results of these studies, and summarizes progress in control in each lake basin.

Lake Superior

SURVEYS

Surveys to assess populations of sea lampreys were conducted in 161 tributaries of Lake Superior in 1981; sea lampreys were found in 77. Pretreatment distributional surveys were conducted on 33 streams; 12 were treated in 1981 and 15 were scheduled for 1982. Posttreatment surveys indicated the presence of residual sea lamprey ammocetes (generally few) in 21 streams treated in 1979 or 1980. Sea lamprey ammocetes had become reestablished in 43 streams flowing into Lake Superior. Lampreys of the 1981 year class were found in 27 streams. Surveys in the spring of 1982 were expected to increase this number.

Lentic surveys in 34 offshore and inland lake areas revealed 3 new positive areas—2 in Batchawana Bay and 1 off the Wolf River. Seventeen larval sea lampreys were collected off the mouth of the Neebing River near Thunder Bay, Ontario, although sea lampreys did not become reestablished in the river after the chemical treatment in 1972. Sea lamprey ammocetes were found in 12 areas along the south shore; however, no new infestations were discovered.

TREATMENTS

Lampricide treatments were conducted in 19 tributaries and 5 lake areas of Lake Superior in 1981 (Table 3, Fig. 1). Most treatments were routine. Sea lamprey ammocetes were abundant in the Nipigon, Ontonagon, and Silver rivers and moderate to scarce in the rest of the streams treated.

Some problems were encountered during the treatments of the Little Pic, Sucker, and Waiska rivers. In the Little Pic River, low water levels and limited access created a high dependency on a chartered helicopter to transport supplies and personnel. In the Sucker and Waiska rivers, water temperatures dropped to almost 5°C during the treatments. Chemical banks were lengthened to compensate for the longer time required to kill ammocetes at low temperatures, but some American brook lamprey ammocetes were still alive after the extended banks had passed.

Annual treatments were made on the Furnace, Silver, Slate, Ravine, Big Garlic, and Sucker rivers to prevent recruitment to offshore lentic populations. The treatment of the Sucker River was more extensive than usual because transformed larvae were found in areas above the traditional application points.

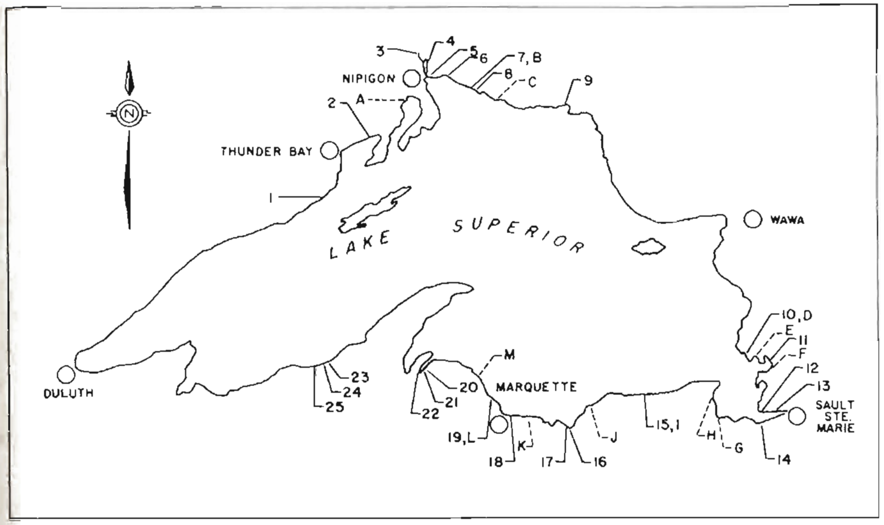

Figure 1. Location of streams and inland lake or bay areas of Lake Superior treated with lampricides (numerals; see Table 3 for names of streams or areas), and of streams where assessment traps were fished (letters; see Table 4 for names of streams) in 1981.

The annual attrition of lentic populations of larval sea lampreys, through the application of granulated Bayer 73, was continued with the treatment of selected areas within Nipigon River and in Helen Lake and four Lake Superior bays. Significant reductions from the numbers of sea lampreys collected in 1980 were noted in all of the bay areas in 1981 except Mackenzie Bay, where a slight increase was indicated. The largest numbers of sea lamprey larvae were found within the Nipigon River system (the lower Nipigon River and Helen Lake).

A solid bar formulation of TFM, developed at the La Crosse National Fishery Research Laboratory for use in controlling sea lampreys in small tributaries, was tested in Five Mile Creek in 1981. The bars, which dissolve at a constant, predetermined rate, can be used in various numerical combinations to give a desired concentration of TFM. Results of the field test were encouraging. The formulation may be a valuable tool in applying TFM to small streams.

Mortality of other species of fish was low for all Lake Superior streams treated. No large populations of pink salmon were present in streams treated in September and October. The abundance of these salmon in streams has resulted in the postponement of treatments in the past.

SPAWNING-RUN SEA LAMPREYS

Assessment traps were fished in 13 tributaries of Lake Superior in 1981 (Fig. 1). The catch of adult sea lampreys was 1,846, compared with 1,130 in 1980. Catches at the Tahquamenon and Rock rivers increased by

Table 3. Details on the application of lampricides to streams and inland lake or bay areas of Lake Superior, 1981. [Number in parentheses corresponds to location of stream or area in Figure 1.]

Stream, inland lake, or bay area	Date	Discharge at mouth		TFM Act. Ingr.		Bayer 73 Powder Act. Ingr.		Bayer 73 Granules Total used[a]		Stream treated		Area treated	
		m^3/s	f^3/s	kg	lbs	kg	lbs	kg	lbs	km	miles	ha	acres
CANADA													
West Davignon Cr. (13)	June 3	0.7	25	99	218	–	–	–	–	12.9	8	–	–
Big Carp R. (12)	June 17	1.0	35	90	198	–	–	–	–	9.7	6	–	–
Jackfish R. (6)	June 26	8.5	300	665	1,465	10	22	2	4	9.7	6	–	–
Nipigon R. (3)	July 2	67.6	2,386	7,044	15,528	108	237	12	27	12.9	8	–	–
Pigeon R. (1)	July 6	15.9	560	844	1,860	13	29	–	–	6.5	4	–	–
Pancake R. (10)	July 8	2.2	76	162	356	–	–	–	–	14.5	9	–	–
Little Pic R. (9)	Aug. 22	3.6	126	918	2,024	–	–	7	15	46.7	29	–	–
Batchawana Bay (11)													
Sable River	July 21	–	–	–	–	–	–	454	1,000	–	–	1.6	4
Batchawana R.	July 22	–	–	–	–	–	–	726	1,600	–	–	2.8	7
Stokely Cr.	July 24	–	–	–	–	–	–	181	400	–	–	0.8	2
Chippewa R.	July 27	–	–	–	–	–	–	544	1,200	–	–	2.4	6
Sand Point	July 29	–	–	–	–	–	–	272	600	–	–	1.2	3
Cypress Bay (7)	Aug. 5	–	–	–	–	–	–	181	400	–	–	0.8	2
Nipigon R. System (3)													
Helen Lake (4)	Aug. 5	–	–	–	–	–	–	680	1,500	–	–	2.8	7
Lower R. (5)	Aug. 5	–	–	–	–	–	–	2,472	5,450	–	–	10.1	25
Mountain Bay (8)	Aug. 6	–	–	–	–	–	–	635	1,400	–	–	2.4	6
Mackenzie Bay (2)	Aug. 7	–	–	–	–	–	–	771	1,700	–	–	3.2	8
Total		99.5	3,508	9,822	21,649	131	288	6,937	15,296	112.9	70	28.1	70
UNITED STATES													
Firesteel R. (23)	July 3	1.1	40	349	770	–	–	–	–	24.2	15	–	–
Black R. (25)	July 8	3.0	106	250	550	–	–	–	–	1.6	1	–	–
Chocolay R. (18)	July 19	4.0	140	818	1,804	–	–	–	–	64.5	40	–	–
Five Mile Cr.[b] (17)	Aug. 5	0.1	2	2	4	–	–	–	–	1.6	1	–	–
Furnace Cr. (16)	Aug. 12	0.4	15	70	154	–	–	–	–	6.5	4	–	–
Ontonagon R. (24)	Aug. 27	19.3	680	4,092	9,020	–	–	–	–	241.9	150	–	–
Silver R. (22)	Sept. 11	0.8	30	90	198	–	–	–	–	4.8	3	–	–
Slate R. (21)	Sept. 13	0.2	6	10	22	–	–	–	–	1.6	1	–	–
Ravine R. (20)	Sept. 14	0.1	3	10	22	–	–	–	–	1.6	1	–	–
Big Garlic R. (19)	Sept. 29	1.0	35	120	264	–	–	–	–	8.1	5	–	–
Sucker R. (15)	Oct. 10	2.3	80	329	726	–	–	–	–	40.3	25	–	–
Waiska R. (14)	Oct. 26	2.3	80	160	352	–	–	–	–	27.4	17	–	–
Total		34.6	1,217	6,300	13,886	–	–	–	–	424.1	263	–	–
GRAND TOTAL		134.1	4,725	16,122	35,535	131	288	6,937	15,296	537.0	333	28.1	70

[a] Sand granules coated with Bayer 73 at 5% by weight active ingredient.
[b] Treated with solid bar formulation of TFM.

257 and 252, respectively, and these two rivers accounted for 64% of the total taken in Lake Superior (Table 4). Biologically, sea lampreys from the north and south shores were similar except that the percentage of males was lower among those from the north shore (Table 4).

PARASITIC SEA LAMPREYS

In Lake Superior, a total of 236 sea lampreys were submitted for reward by commercial and sport fishermen in 1981 (212 in U.S. and 24 in Canada), a decrease from the 299 collected in 1980. In the United States, fishermen from the Apostle Island area (statistical district of Wisconsin) and the Munising, Michigan, area (statistical district MS-4) contributed the largest numbers (92 and 74, respectively). The collections included only nine recently metamorphosed parasitic-phase sea lampreys (a group designated here to include those $\leq$200 mm long), of which seven were collected in the Isle Royale area. The 24 lampreys from Canadian waters were captured in eastern Lake Superior (OS-7).

SPECIAL STUDIES

Lower Nipigon River flow studies—During the period of reduced flows for the upper Nipigon River treatment, studies were conducted in the lower Nipigon River to gather information that might be useful in planning the treatment of this lower section. Continual discharge measurements at the outlet of Helen Lake were taken throughout the period of controlled flow to relate controlled flows at the upper hydro dams to the flows at the outlet of Helen Lake. Also, a rhodamine dye was applied into the outlet of Helen Lake when discharges were lowest, and monitored with a fluorometer throughout the lower Nipigon River. It appears that a lampricide treatment of the lower Nipigon River at significantly reduced flows is feasible and would provide a significant measure of control.

Sea lamprey barrier dam study—No sea lamprey barrier dams were constructed in 1981. However, a study to assess the ability of migratory salmonids to surmount such structures was carried out on Stokely and Gimlet creeks. The study indicated that coho and chinook salmon and rainbow trout surmounted the dams, but pink salmon did not.

Transformation study—The rate of transformation of large sea lamprey larvae from the Waiska River was determined. Ammocetes removed from the stream with electroshockers in May were held in aquaria at room temperature at the Marquette Biological Station. The mean length of 48 larvae collected was 130 mm (range, 116-154). When the animals were reexamined in October, 12 (25%) had transformed. Mean length of the transformed lampreys was 134 mm (range, 122–147); the remaining larvae had shrunk to an average length of 116 mm (range, 100–137).

The Waiska River was last treated in September 1976, and the 1977 year class became established after treatment. Although some of the lampreys used in the study may have been residuals from previous treatments, these data indicate that some ammocetes transformed at age IV.

Table 4. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Superior, 1981. [Letter in parentheses corresponds to location of stream in Figure 1.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
CANADA							
Wolf R. (A)	1	1	100	380	—	105	—
Cypress R. (B)	30	11	9	490	410	217	179
Little Gravel R. (C)	13	12	42	430	470	149	222
Pancake R. (D)	9	9	33	410	420	186	177
Sable R. (E)	17	12	33	460	430	208	193
Stokely Cr. (F)	12	12	17	430	420	183	182
Total or average	82	57	28	430	430	176	190
UNITED STATES							
Tahquamenon R. (G)	594	593	48	437	437	192	190
Betsy R. (H)	211	211	33	433	427	190	184
Sucker R. (I)	168	29	28	414	389	157	139
Miners R. (J)	22	10	60	437	411	190	159
Rock R. (K)	581	581	28	428	416	174	166
Big Garlic R. (L)	182	182	32	417	418	163	168
Iron R. (M)	6	6	17	464	422	257	199
Total or average	1,764	1,612	37	432	423	184	175
GRAND TOTAL OR AVERAGE	1,846	1,669	36	431	424	183	176

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				Males	Females	Males	Females
CANADA							
Wolf R. (A)	1	1	100	380	—	105	—
Cypress R. (B)	30	11	9	490	410	217	179
Little Gravel R. (C)	13	12	42	430	470	149	222
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Stokely Cr. (F)	12	12	17	430	420	183	182
Total or average	82	57	28	430	430	176	190
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Total or average	1,764	1,612	37	432	423	184	175
GRAND TOTAL OR AVERAGE	1,846	1,669	36	431	424	183	176

Big Garlic River trap—The downstream trap in the Big Garlic River yielded 28 transformed sea lampreys and 1,030 sea lamprey ammocetes in 1981, compared with 77 and 2,189, respectively, in 1980. Large larvae (>120 mm) collected in the spring are allowed to transform in aquaria, and then transferred to the Hammond Bay Biological Station for use in research. Small larvae (<120 mm) are held in aquaria for use in bioassays conducted by personnel of the Marquette chemical control units.

Disinfection of the water supply of the Iron River National Fish Hatchery—Personnel from a Marquette chemical treatment crew, in cooperation with people from the Iron River National Fish Hatchery (Iron River, Wisconsin), the Fish Disease Control Center (Genoa, Wisconsin), and the Twin Cities Area Office (St. Paul, Minnesota), conducted a fish eradication treatment of Middle and Schacte creeks, tributaries of the Iron River, upstream from the hatchery. The streams were treated with calcium hypochlorite (HTH) and neutralized below the hatchery with sodium thiosulfate. The desired sterilization of the streams was accomplished and no fish were killed below the hatchery.

Lake Michigan

SURVEYS

Surveys to assess sea lamprey populations were conducted on 165 streams tributary to Lake Michigan in 1981; 62 contained sea lamprey larvae. The 1981 year class of sea lampreys was collected from 24 of 88 streams examined during the time of year when the 1981 year class should have been present. Reestablished populations were detected in 53 streams. Lentic areas off the mouths of 18 streams were surveyed; sea lampreys were recovered from 6: Black, Manistique, Jordan, and Platte (Loon Lake) rivers, Hog Island Creek, and Sunny Brook. No new populations of sea lampreys were located in surveys of 61 previously unproductive streams. Sea lamprey larvae were not collected in surveys upstream from dams on the Paw Paw (St. Joseph River), St. Joseph, Betsie, and Grand rivers, indicating that these barriers are effective in stopping spawning runs.

Pretreatment surveys were completed on 33 streams, of which 14 were treated: Millecoquins, Manistique, Fishdam, Ogontz, Rapid, Peshtigo, Black (Van Buren County), Kalamazoo, and St. Joseph rivers and Bulldog, Marblehead, Johnson (Schoolcraft County), Hock, and Gurney creeks. Sixteen were scheduled for treatment in 1982: Brevort, Black (Mackinac County), Milakokia, Sturgeon, Days, Cedar, Kewaunee, East Twin, Carp Lake, Platte, Lincoln, Manistee, and Muskegon rivers and Point Patterson, Bursaw, and Parent creeks.

Posttreatment surveys were conducted on the Jordan and Boyne rivers and Gurney and Blue creeks. Residual sea lampreys were found only in the Jordan River (6) and Blue Creek (1).

TREATMENTS

Chemical treatments were completed on 18 streams tributary to Lake Michigan in 1981 (Table 5, Fig. 2). Sea lamprey ammocetes were abundant in the Fishdam, Manistique, Boyne, Jordan, and St. Joseph rivers and Bulldog and Gurney creeks; transformed lampreys were numerous in the Manistique River. Johnson Creek, a small stream near Thompson, Michigan, was successfully treated with an experimental solid bar formulation of TFM.

SPAWNING-RUN SEA LAMPREYS

A total of 9,750 sea lampreys were captured in assessment traps in 14 tributaries of Lake Michigan (6 on the west shore and 8 on the east shore; Table 6, Fig. 2). On the west shore, the catch in the Peshtigo River (294) was about the same as in 1980 (305), whereas the catch in the Menominee River (77) declined from that of 1980 (194). The combined catch in these two streams declined 91% after chemical treatments of the Peshtigo River in 1977 and 1978 (from 4,200 in 1978 to 371 in 1981). The number of sea lampreys captured in the Manistique River (8,226) was similar to that in 1980 (7,895). No sea lampreys were captured for the third successive year in the Fox River, and none were taken at the newly constructed barrier dam in the West Branch of the Whitefish River.

Catches of sea lampreys in eight streams along the east shore of Lake Michigan remained about the same or declined slightly from catches in 1980. The main exception was the Carp Lake River, where the catch increased from 293 in 1980 to 608 in 1981. A trap was placed in the Manistee River below Tippy Dam for the first time, and although only 9 lampreys were caught in the trap, many others were observed at night near the dam and 61 were captured by hand in shallow water.

Sea lampreys captured in the Carp Lake River were significantly smaller (average length and weight, 424 mm and 167 g) than those captured at other sites in Lake Michigan (lakewide average, 467 mm and 215 g). The proximity to Lake Huron is apparently not an influencing factor because lampreys from nearby streams in Lake Huron averaged 25 mm longer and 33 g heavier than the Carp Lake River lampreys.

PARASITIC SEA LAMPREYS

Lake Michigan fishermen collected 262 sea lampreys for bounty in 1981, a small increase from the 227 captured in 1980. The major areas of capture were near Algoma and Baileys Harbor, Wisconsin, and Fairport, Michigan. Excluding Green Bay, northern Lake Michigan produced the same number (181) of sea lampreys as in 1980. The number of sea lampreys taken in Green Bay, although relatively small, increased 72%, from 47 in 1980 to 81 in 1981. Wounding rates on lake trout in Green Bay during the same period increased from 1.5% to 3.7%.

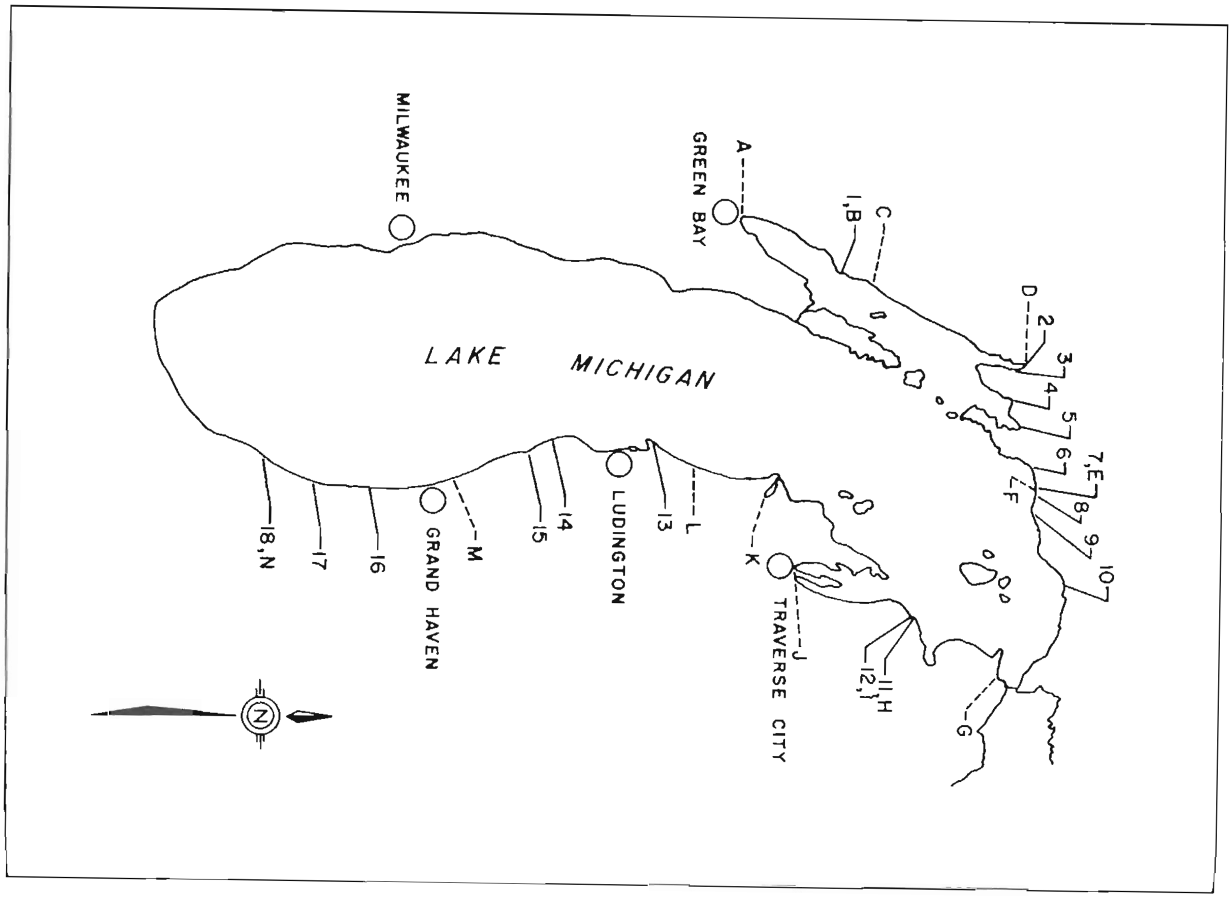

Figure 2. Location of streams tributary to Lake Michigan treated with lampricides (numerals; see Table 5 for names of streams), and of streams where assessment traps were fished (letters; see Table 6 for names of streams) in 1981.

Table 5. Details on the application of lampricides to streams tributary to Lake Michigan, 1981. [Number in parentheses corresponds to location of stream in Figure 2.]

Stream	Date	Discharge at mouth		TFM Act. Ingr.		Bayer 73 powder Act. Ingr.		Stream treated	
		m³/s	f³/s	kg	lbs	kg	lbs	km	miles
Hock Cr. (3)	May 7	0.5	20	50	110	–	–	1.6	1
Rapid R. (2)	May 9	6.1	215	868	1,914	–	–	96.8	60
Gurney Cr. (13)	June 10	0.2	8	40	88	–	–	6.5	4
Millecoquins R. (10)	June 19	5.1	180	708	1,562	11	25	19.4	12
Boyne R. (11)	June 19	2.3	80	469	1,034	2	5	9.7	6
Bulldog Cr. (9)	June 22	<0.1	2	20	44	–	–	1.6	1
Jordan R. (12)	June 23	6.0	210	1,437	3,168	6	13	58.1	36
Fishdam R. (5)	July 3	1.3	46	279	616	–	–	37.1	23
Ogontz R. (4)	July 6	0.3	10	100	220	–	–	11.3	7
Kalamazoo R. (16)									
Rabbit R.	July 11	6.4	225	1,587	3,498	–	–	62.9	39
Bear Cr.	July 24	0.2	8	65	143	–	–	6.5	4
Sand Cr.	July 25	<0.1	2	10	22	–	–	4.8	3
Mann Cr.	July 26	0.1	5	25	55	–	–	3.2	2
Peshtigo R. (1)	Aug. 3	17.0	600	1,597	3,520	19	42	16.1	10
Black R. (17)	Aug. 8	1.6	55	409	902	–	–	82.3	51
Marblehead Cr. (8)	Aug. 13	<0.1	1	20	44	–	–	3.2	2
Manistique R. (7)	Aug. 16	31.2	1,100	2,844	6,270	30	65	1.6	1
Johnson Cr.[a] (6)	Aug. 18	<0.1	1	1	3	–	–	1.6	1
St. Joseph R. (18)									
Paw Paw R.	Aug. 20	9.4	332	1,467	3,234	9	20	24.2	15
Blue Cr.	Aug. 22	0.6	22	146	323	–	–	11.3	7
Pipestone Cr.	Aug. 24	0.5	20	233	513	–	–	12.9	8
Stony Cr. (14)	Sept. 4	1.4	50	389	858	–	–	16.1	10
Flower Cr. (15)	Sept. 7	0.4	14	90	198	–	–	12.9	8
TOTAL		91.0	3,206	12,854	28,339	77	170	501.7	311

[a] Experimental treatment with a solid bar formulation of TFM.

Table 6. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 1981. [Letter in parentheses corresponds to location of stream in Figure 2.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
WEST SHORE							
Fox R. (A)	0	0	–	–	–	–	–
Peshtigo R. (B)	294	294	52	495	492	242	252
Menominee R. (C)	77	77	43	480	484	214	234
W. Br. Whitefish R. (D)	0	0	–	–	–	–	–
Manistique R. (E)	8,226	2,488	37	473	473	213	223
Weston Cr. (F)	30	2	50	586	529	319	265
EAST SHORE							
Carp Lake R. (G)	608	608	36	422	425	163	170
Boyne R. (H)	13	12	33	515	488	298	246
Jordan R.							
Deer Cr. (I)	52	52	46	490	473	260	255
Boardman R. (J)	62	62	39	459	473	200	238
Betsie R. (K)	187	187	39	468	467	226	232
Manistee R. (L)	9	70[a]	34	476	464	256	244
Muskegon R. (M)	55	45	47	468	495	210	243
St. Joseph R. (N)	137	31	23	490	463	255	212
TOTAL OR AVERAGE	9,750	3,928	38	468	463	211	216

[a] Includes 61 sea lampreys captured by hand.

Table 6. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Michigan, 1981. [Letter in parentheses corresponds to location of stream in Figure 2.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
WEST SHORE							
Fox R. (A)	0	0	-	-	-	-	-
Peshtigo R. (B)	294	294	52	495	492	242	252
Menominee R. (C)	77	77	43	480	484	214	234
W. Br. Whitefish R. (D)	0	0	-	-	-	-	-
Manistique R. (E)	8,226	2,488	37	473	473	213	223
Weston Cr. (F)	30	2	50	586	529	319	265
EAST SHORE							
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Boardman R. (J)	62	62	39	459	473	200	238
Betsie R. (K)	187	187	39	468	467	226	232
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Muskegon R. (M)	55	45	47	468	495	210	243
St. Joseph R. (N)	137	31	23	490	463	255	212
TOTAL OR AVERAGE	9,750	3,928	38	468	463	211	216

[a] Includes 61 sea lampreys captured by hand.

Lake Michigan collections included 15 recently metamorphosed parasitic sea lampreys, of which 6 were from northern Green Bay.

SPECIAL STUDIES

Transformation study—The rate of transformation of large sea lamprey larvae from Bulldog Creek (Schoolcraft County) was determined. Ammocetes were removed from the stream with electroshockers in May, and held in aquaria at room temperature at the Marquette Biological Station. The mean length of 76 larvae collected was 136 mm (range, 120–161). Upon reexamination in October, 22 (29%) had transformed. Mean length of the transformed lampreys was 134 mm (range, 125–147); the remaining larvae had shrunk to an average length of 122 mm (range, 105–138).

Bulldog Creek was last treated in June 1977 and the 1977 year class of sea lampreys became established almost immediately after treatment. Although some of the lampreys used in the study may have been residuals from previous treatments, these data indicate some transformation at age IV. The stream was treated in 1981.

Weston Creek barrier dam—Observations were made for the third consecutive year on a low-head barrier on Weston Creek, a tributary of the Manistique River. The barrier was created by inserting a gate 1.1 m high by 1 m wide in an existing structure. The gate created a vertical drop that ranged from 5.5 to 23 cm and averaged 18 cm during the peak of the sea lamprey migration. The vertical drop, combined with a water flow 66 cm deep over the gate at a velocity of about 2.7m/s, prevented upstream migration of sea lampreys but allowed passage of trout. Fishermen reported catching many rainbow trout between the barrier and an experimental electric weir upstream. Sea lampreys have not been observed surmounting the barrier, nor have they been captured at the weir since 1979, strongly suggesting that one or more factors—velocity, height of water column, or vertical drop—stopped sea lamprey migrations.

Invertebrate drift—The effects of TFM on the composition and abundance of benthic drift were studied in Bulldog Creek in June and July 1981. Drift samples were collected at three locations, two downstream and one upstream of the TFM application site. Samples were also taken at one station in Ferina Creek, the control stream. Nets were removed at 2-hour intervals during the treatment and for 24 hours before and after it. Additional samples were collected during a 24-hour period 1 week before treatment and 1 week after treatment. Problems encountered were extreme fluctuations in stream flow (0.1 to 1.1 m^3/s) in a relatively short period (1 week) and TFM concentrations that approached double those lethal for sea lampreys for 1 hour. Evaluation of the data is incomplete.

LAKE HURON

SURVEYS

Of a total of 119 tributaries of Lake Huron (39 in Canada and 80 in U.S.) surveyed to assess populations of larval sea lampreys, 65 were infested.

Surveys in Canada revealed no new larval populations; however, sea lampreys were found for the first time in four U.S. tributaries of the St. Marys River. Three—Mission, Frechette, and Ermatinger creeks—are relatively small and have little potential for sustaining sea lamprey production. The fourth—the Charlotte River—however, revealed a well established population throughout 24 km of the river system; 774 larvae (28–162 mm long) and 60 transforming sea lampreys were collected. Canadian surveys in the St. Marys River indicated an increasing abundance and continuing geographic extension of the larval population.

In Canada, surveys in 1981 on streams previously treated indicated the presence of residual sea lamprey larvae in seven: Telfer and Silver creeks and Root, Echo, Thessalon, Mississagi, and Wanapitei rivers.

TREATMENTS

The selective lampricide TFM was applied to 12 tributaries of Lake Huron and the granulated formulation of Bayer 73 was applied to areas of the St. Marys River and three Manitoulin Island bays (Table 7, Fig. 3). Charlotte River and Mill Creek were treated for the first time.

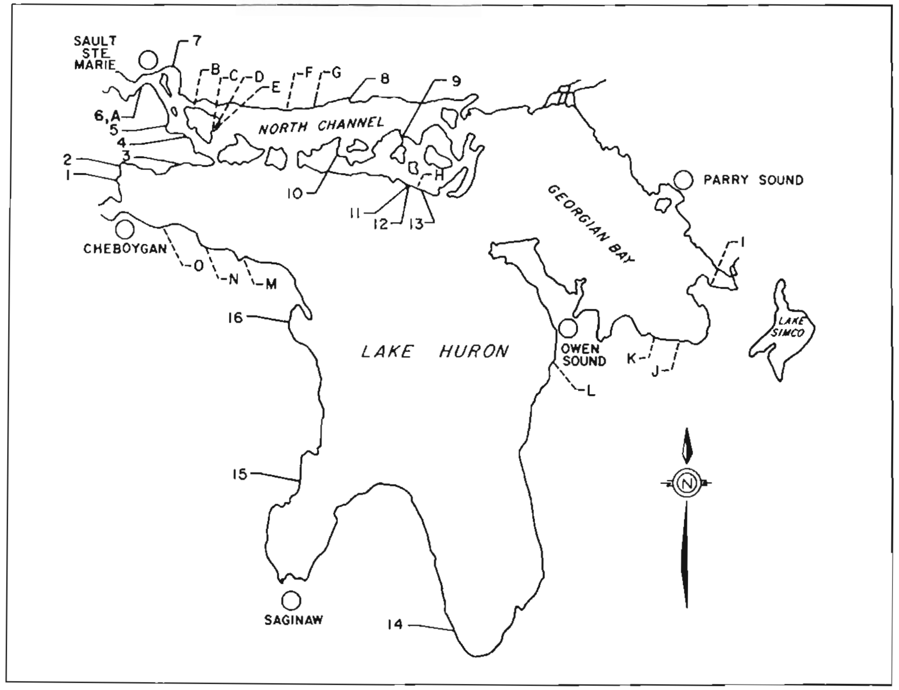

Figure 3. Location of streams and bay areas of Lake Huron treated with lampricides (numerals; see Table 7 for names of streams or areas), and of streams where adult sea lamprey collecting devices were fished (letters; see Table 8 for names of streams) in 1981.

Table 7. Details on the application of lampricides to streams and bay areas of Lake Huron, 1981. [Number in parentheses corresponds to location of stream or area in Figure 3.]

Stream, inland lake, or bay area	Date	Discharge at mouth		TFM		Bayer 73				Stream treated		Area treated	
				Act. Ingr.		Powder Act. Ingr.		Granules Total used[a]					
		m³/s	f³/s	kg	lbs	kg	lbs	kg	lbs	km	miles	ha	acres
CANADA													
Silver Lake Cr. (10)	May 28	0.6	20	166	365	–	–	–	–	6.4	4	–	–
Mindemoya R. (11)	May 30	1.2	41	133	293	1	2	–	–	6.4	4	–	–
Serpent R. (8)	June 24	14.8	524	427	939	–	–	–	–	11.3	7	–	–
Michael Bay (13)	July 14	–	–	–	–	–	–	284	625	–	–	1.2	3
Providence Bay (12)	July 15	–	–	–	–	–	–	91	200	–	–	0.4	1
Mudge Bay (9)	July 15	–	–	–	–	–	–	136	300	–	–	0.4	1
Garden R. (7)	July 20	7.5	264	457	1,005	–	–	–	–	57.9	36	–	–
St. Marys R. (6)	Aug. 12	–	–	–	–	–	–	1,885	4,150	–	–	7.3	18
Total		24.1	849	1,183	2,602	1	2	2,396	5,275	82.0	51	9.3	23
UNITED STATES													
East Au Gres R. (15)	May 17	3.5	124	679	1,496	4	8	–	–	43.5	27	–	–
Carp R. (1)	May 22	2.8	100	1,177	2,596	–	–	–	–	158.1	98	–	–
Mill Cr.[b] (14)	May 30	<0.1	1	20	44	–	–	–	–	3.2	2	–	–
Devils R. (16)	May 30	0.8	28	190	418	–	–	–	–	4.8	3	–	–
Pine R. (2)	June 5	4.0	150	1,128	2,486	–	–	–	–	251.6	156	–	–
Little Munuscong R. (4)	June 19	1.1	40	150	330	–	–	–	–	33.9	21	–	–
Beavertail Cr. (3)	June 23	0.3	11	210	462	–	–	–	–	8.1	5	–	–
Charlotte R.[b] (5)	Oct. 22	3.1	110	259	572	–	–	–	–	27.4	17	–	–
Total		15.7	564	3,813	8,404	4	8	–	–	530.6	329	–	–
GRAND TOTAL		39.8	1,413	4,996	11,006	5	10	2,396	5,275	612.6	380	9.3	23

[a] Sand granules coated with Bayer 73 at 5% by weight active ingredient.
[b] Initial treatment.

Table 7. Details on the application of lampricides to streams and bay areas of Lake Huron, 1981. [Number in parentheses corresponds to location of stream or area in Figure 3.]

Stream, inland lake, or bay area	Date	Discharge at mouth		TFM		Bayer 73 Powder		Bayer 73 Granules		Stream treated		Area treated	
				Act. Ingr.		Act. Ingr.		Total used[a]					
		m^3/s	f^3/s	kg	lbs	kg	lbs	kg	lbs	km	miles	ha	acres
CANADA													
Silver Lake Cr. (10)	May 28	0.6	20	166	365	–	–	–	–	6.4	4	–	–
Mindemoya R. (11)	May 30	1.2	41	133	293	1	2	–	–	6.4	4	–	–
Serpent R. (8)	June 24	14.8	524	427	939	–	–	–	–	11.3	7	–	–
Michael Bay (13)	July 14	–	–	–	–	–	–	284	625	–	–	1.2	3
Providence Bay (12)	July 15	–	–	–	–	–	–	91	200	–	–	0.4	1
Mudge Bay (9)	July 15	–	–	–	–	–	–	136	300	–	–	0.4	1
Garden R. (7)	July 20	7.5	264	457	1,005	–	–	–	–	57.9	36	–	–
St. Marys R. (6)	Aug. 12	–	–	–	–	–	–	1,885	4,150	–	–	7.3	18
Total		24.1	849	1,183	2,602	1	2	2,396	5,275	82.0	51	9.3	23
UNITED STATES													
East Au Gres R. (15)	May 17	3.5	124	679	1,496	4	8	–	–	43.5	27	–	–
Carp R. (1)	May 22	2.8	100	1,177	2,596	–	–	–	–	158.1	98	–	–
Mill Cr.[b] (14)	May 30	<0.1	1	20	44	–	–	–	–	3.2	2	–	–
Devils R. (16)	May 30	0.8	28	190	418	–	–	–	–	4.8	3	–	–
Pine R. (2)	June 5	4.0	150	1,128	2,486	–	–	–	–	251.6	156	–	–
Little Munuscong R. (4)	June 19	1.1	40	150	330	–	–	–	–	33.9	21	–	–
Beavertail Cr. (3)	June 23	0.3	11	210	462	–	–	–	–	8.1	5	–	–
Charlotte R.[b] (5)	Oct. 22	3.1	110	259	572	–	–	–	–	27.4	17	–	–
Total		15.7	564	3,813	8,404	4	8	–	–	530.6	329	–	–
GRAND TOTAL		39.8	1,413	4,996	11,006	5	10	2,396	5,275	612.6	380	9.3	23

[a] Sand granules coated with Bayer 73 at 5% by weight active ingredient.
[b] Initial treatment.

Although most treatments were relatively routine, problems were encountered in Garden and Charlotte rivers. A combination of factors (heavy runoff, inadequate road access, and numerous tributaries and backwater areas) provided a virtual nightmare for secondary application personnel on the 57.8 km of the Garden River infested with sea lampreys. On the Charlotte River, high water discharge and low temperatures reduced treatment effectiveness.

Three Manitoulin Island bays and four areas of the St. Marys River were treated with granular Bayer 73. The 652 sea lamprey larvae (21–196 mm long) collected in Michael Bay at the mouth of the Manitou River were surprising because larvae are relatively scarce in the river. A subsequent treatment of this lentic area with granular Bayer 73 was scheduled in conjunction with a TFM treatment of the river in 1982. Sea lamprey larvae continued to be relatively abundant in specific areas of the St. Marys River; all year classes were represented, including larvae undergoing transformation.

SPAWNING-RUN SEA LAMPREYS

During the 1981 spawning season, 10,816 sea lampreys were captured in portable assessment traps (Table 8, Fig. 3). Of this total, 72% were from the Cheboygan River and 23% from the St. Marys and Ocqueoc rivers; less than 5% came from Canadian tributaries.

After the electrical weir on the Ocqueoc River was removed in 1980, the weir site was modified into a low-head dam. The vertical drop of this dam during the peak water discharge period in 1981 was 32 to 40 cm. Although the structure is not a complete barrier to spawning-phase sea lampreys, 593 were captured in a permanent weir trap and two portable traps fished at the site.

Biological data for the spawning-run sea lampreys taken in 1981 were consistent with those for lampreys captured in previous years; the population consisted of slightly more males and larger lampreys than the population in Lake Superior, but fewer males and significantly smaller lampreys than is characteristic of the populations in Lakes Erie and Ontario.

PARASITIC SEA LAMPREYS

Commercial fishermen in Lake Huron collected 1,547 parasitic-phase sea lampreys (256 in Canada and 1,291 in U.S.) with related catch data. These numbers represent a 27% decrease in Canada but a 67% increase in the United States, compared with 1980 returns. The increase in the United States is attributed primarily to additional commercial fishermen providing specimens for the $2 bounty, as well as the positive response to a $5 reward for live sea lampreys required for a mark and recapture study.

In Canadian waters, 144 of the sea lampreys were from the western end of the North Channel (statistical district NC-1) and 112 were from Lake Huron proper (OH-1). Included in these collections were 20 recently transformed sea lampreys from NC-1 and 29 from OH-1.

Table 8. Number and biological characteristics of adult sea lampreys captured in assessment devices fished in tributaries of Lake Huron, 1981. [Letter in parentheses corresponds to location of stream in Figure 3.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
CANADA							
St. Marys R. (A)	8	7	57	490	440	241	198
Sucker Cr. (B)	5	5	40	390	450	218	210
Gordon Cr. (C)	0	0	–	–	–	–	–
Brown Cr. (D)	0	0	–	–	–	–	–
Kaskawong R. (E)	155	155	33	450	450	205	216
Thessalon R. (F)	230	229	36	460	460	231	232
Blind R. (G)	0	0	–	–	–	–	–
Blue Jay Cr. (H)	103	102	35	470	470	200	209
Sturgeon R. (I)	2	1	0	–	460	–	222
Silver Cr. (J)	7	6	33	490	470	208	286
Beaver R. (K)	25	23	30	440	450	167	193
Saugeen R. (L)	2	2	50	410	420	151	164
Total or average	537	530	35	460	460	214	221
UNITED STATES							
St. Marys R. (A)	1,946	565	44	463	469	219	233
Trout R. (M)	22	14	57	445	434	190	186
Ocqueoc R. (N)	583	300	40	415	416	178	173
Cheboygan R. (O)	7,728	858	37	440	440	183	190
Total or average	10,279	1,737	40	444	445	195	200
GRAND TOTAL OR AVERAGE	10,816	2,267	39	448	449	199	205

Table 8. Number and biological characteristics of adult sea lampreys captured in assessment devices fished in tributaries of Lake Huron, 1981. [Letter in parentheses corresponds to location of stream in Figure 3.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
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The largest number of sea lampreys in U.S. waters were taken from the Rogers City (589) and De Tour (385) areas (MH-1). Further, 53 of 59 recently metamorphosed sea lampreys collected were from statistical district MH-1. The higher catch of sea lampreys per unit of effort in trap net fisheries in MH-1 than in other statistical districts suggests that this district may contain, or be adjacent to, localized sources of uncontrolled populations of larval sea lampreys.

SPECIAL STUDIES

Mark and recapture study—A study to determine the movement of parasitic-phase sea lampreys and the streams in which they spawn began in 1981 in northern Lake Huron. A total of 830 lampreys, captured by commercial fishermen in trap nets set for lake whitefish out of three ports (De Tour, Mackinaw City, and Rogers City), were fin marked with fluorescent pigment dyes (coded to indicate port and time of release) and released near the point of capture. The primary recovery gear for these marked lampreys will be the assessment traps operated in streams to capture spawning lampreys in 1982.

Radio telemetry study—A study to determine the movement, behavior, and spawning grounds of sea lampreys in the St. Marys River was begun in 1981. A preliminary test at the Hammond Bay Biological Station, in which dummy radio transmitters were implanted in 18 sea lampreys, showed that the lampreys suffered no serious effects. Consequently, transmitters were implanted into 12 lampreys before they were released in the St. Marys River. Preliminary observations revealed that the transmitters had little effect on lamprey behavior, and most lampreys were located daily. Scuba divers observed one of the tagged individuals in an area where lamprey spawning was not suspected, and the movement of some of the other test animals showed other possible spawning areas. This study was scheduled to be continued in 1982.

Fyke net study—Fyke nets experimentally fished in Two Tree River and Gordon Creek (St. Joseph Island) during September and October collected no newly transformed downstream migrant sea lampreys.

Trawling for adult sea lampreys—Surface trawling for adult sea lampreys in the St. Marys River was begun on October 19 and terminated on December 3. Equipment and techniques used were similar to those used in previous years. A total of 41 parasitic-phase sea lampreys were captured in 171 hours of trawling, for a catch rate of 0.24 per hour (compared with 0.06 in 1980 and 0.3 in 1979). Thirty-seven of the captured specimens were marked with Petersen disc tags and released. Two were recaptured in the trawl and re-released, and one was taken by a commercial fisherman from a lake whitefish captured in a gill net in southeastern Whitefish Bay, Lake Superior.

LAKE ERIE

SURVEYS

No surveys for larval sea lampreys were carried out on Lake Erie tributaries in 1981. Currently, 12 tributaries are known to be infested with larvae: Catfish, Big Otter, Big, Cranes, and Young creeks and the Grand River in Canada; and Cattaraugus, Delaware, Canadaway, Conneaut, Crooked, and Raccoon creeks in the United States.

SPAWNING-RUN SEA LAMPREYS

A total of 2,351 sea lampreys were collected in assessment traps fished in five tributaries in 1981 (Table 9, Fig. 4). About 96% were taken from two tributaries—856 from Young Creek and 1,400 from Cattaraugus Creek.

Collectively, the 1981 data indicate reductions in the percentage of males (from 56 in 1980 to 52 in 1981) and in mean length and weight from 508 mm and 280 g in 1980 to 488 mm and 250 g in 1981 (sexes combined). These changes suggest either a declining food source or an increasing adult sea lamprey population.

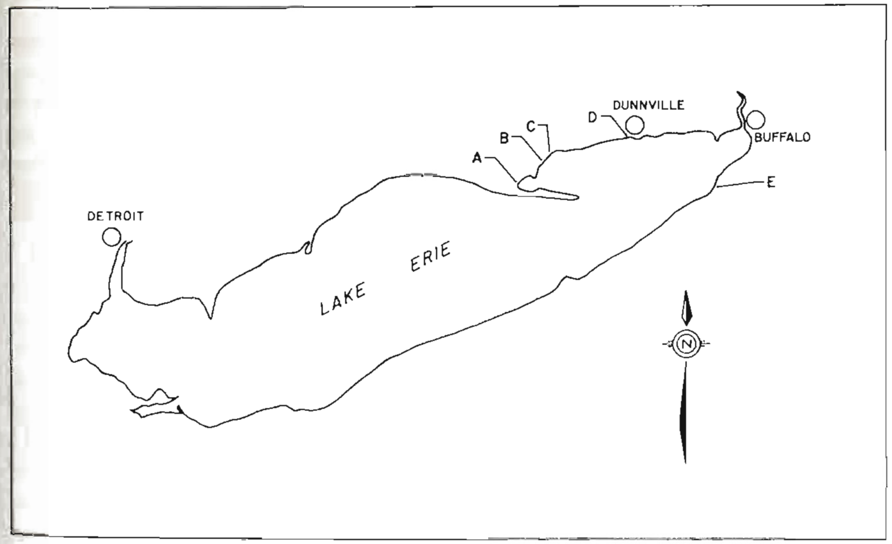

Figure 4. Location of streams tributary to Lake Erie where assessment traps were fished in 1981 (see Table 9 for names of streams).

Table 9. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 1981. [Letter in parentheses corresponds to location of stream in Figure 4.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
CANADA							
Big Cr. (A)	58	56	39	490	490	269	261
Fisher Cr. (B)	14	14	36	470	460	210	236
Young Cr. (C)	856	852	45	480	470	232	239
Grand R. (D)	23	23	44	490	480	236	245
Total or average	951	945	44	480	470	234	240
UNITED STATES							
Cattaraugus Cr. (E)	1,400	1,278	59	497	498	254	264
GRAND TOTAL OR AVERAGE	2,351	2,223	52	490	486	246	254

Table 9. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Erie, 1981. [Letter in parentheses corresponds to location of stream in Figure 4.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
CANADA							
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Grand R. (D)	23	23	44	490	480	236	245
Total or average	951	945	44	480	470	234	240
UNITED STATES							
Cattaraugus Cr. (E)	1,400	1,278	59	497	498	254	264
GRAND TOTAL OR AVERAGE	2,351	2,223	52	490	486	246	254

PARASITIC SEA LAMPREYS

Commercial fishermen in Canada provided 109 parasitic sea lampreys and related catch data in response to a reward of $3 for each lamprey in 1981. Of the 109 lampreys, 12 came from the Wheatley area (statistical district OE-1), and 97 from the Port Dover area (OE-4).

Lake Ontario

SURVEYS

Surveys for larval sea lampreys were conducted in 53 tributaries and 20 lake areas in 1981. No new stream populations were discovered; however small numbers of larvae were found for the first time in Lake Ontario adjacent to the mouths of Duffin, Oshawa, Bowmanville, and Wilmot creeks, and in Oneida Lake off the mouth of Fish Creek.

Surveys of streams previously treated (year of most recent treatment in parentheses) with lampricide failed to indicate the presence of a reestablished larval population in eight creeks—Carruthers (1976), Gage (1971), Blind (1976), Sage (1978), Butterfly (1972), Blind Sodus (1978), Wolcott (1979), and First (1980)—and the Salmon River (Ontario, 1978). Similar surveys indicated the presence of residual larvae in Bronte, Graham, Shelter Valley, Credit, Snake, and Lindsey creeks. Shelter Valley Creek was rescheduled for treatment in 1982, and Bronte, Credit, and Lindsey creeks were tentatively rescheduled for treatment in 1983.

Eight streams between Rochester, New York, and the Niagara River were surveyed to determine the effects of ongoing pollution abatement programs. Although water quality appeared to be improving in all of the streams examined, no sea lamprey larvae were found. Johnson Creek showed the greatest potential for producing larvae and there have been unconfirmed reports of adult sea lampreys in this creek.

Within the extensive Oswego River drainage (Fig. 5), 4 areas in Oswego Harbor, 8 areas in Oneida Lake adjacent to the mouth of Fish Creek, 12 tributaries of Oneida Lake, 1 tributary of the Erie Canal above Oneida Lake, and 5 tributaries of the Seneca River were surveyed. New larval populations were found only in Oneida Lake. Surprisingly, no sea lamprey larvae were found in four tributaries of Oneida Lake that had yielded sea lamprey larvae in past surveys: Scriba, Dakin, and Cold Spring creeks and Hall Brook. Larval sea lampreys were collected in three of five tributaries of the Seneca River surveyed: Carpenter, Cold Spring, and Crane brooks. The lengths of the animals collected indicated that larval recruitment had occurred annually for several years in Carpenter and Cold Spring brooks but only sporadically in Crane Brook.

TREATMENTS

Eight streams were treated with TFM—four in Ontario and four in New York (Table 10, Fig. 6). Larval sea lampreys of transformation size were present in all of the streams treated. Black Creek, a tributary of the Oswego River system, was treated for the first time. Ideal stream discharges and the apparent confinement of larval sea lampreys to the lower

Table 10. Details on the application of lampricide to streams of Lake Ontario, 1981. [Number in parentheses corresponds to location of stream in Figure 6.]

Stream	Date	Discharge at mouth		TFM Act. Ingr.		Stream treated	
		m^3/s	f^3/s	kg	lbs	km	miles
CANADA							
Farewell Cr. (3)	May 1	0.4	15	180	397	6.4	4
Oshawa Cr. (2)	May 3	0.8	28	282	621	20.9	13
Lynde Cr. (1)	May 6	0.3	12	246	542	30.6	19
Proctor Cr. (4)	May 11	0.2	6	84	185	8.0	5
Total		1.7	61	792	1,745	65.9	41
UNITED STATES							
Salmon R.[a] (6)	May 1	28.5	1,007	1,448	3,185	67.6	42
Sodus Cr. (8)	May 9	0.1	5	48	106	4.8	3
Black Cr.[b] (7)	May 11	0.8	28	93	205	4.8	3
Deer Cr. (5)	May 30	0.4	13	47	103	14.5	9
Total		29.8	1,053	1,636	3,599	91.7	57
GRAND TOTAL		31.5	1,114	2,428	5,344	157.6	98

[a] Figures include data for three major tributaries treated independently of the main river in May.
[b] Initial treatment.

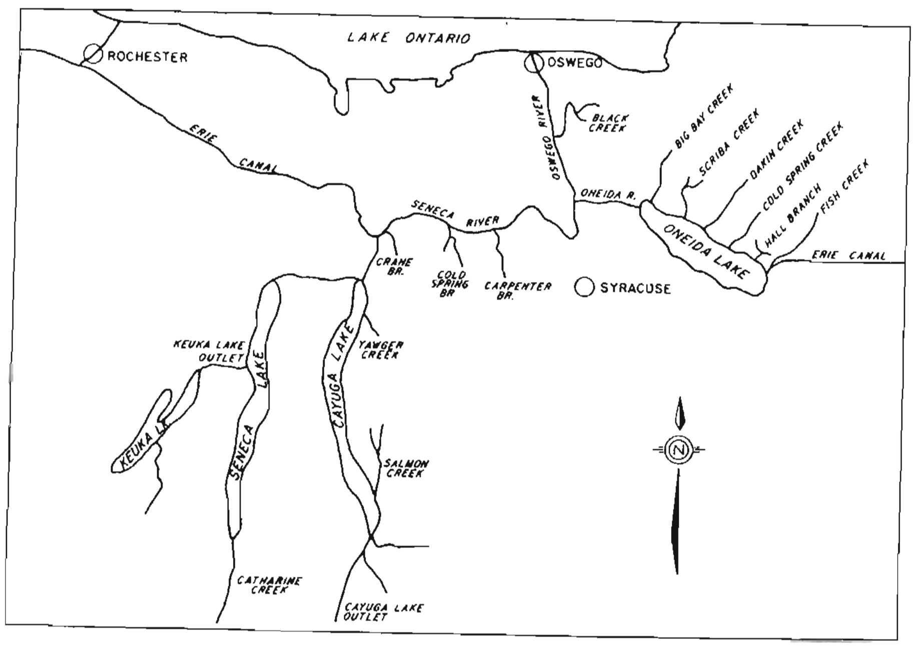

Figure 5. Oswego River system, showing locations of known sea lamprey-producing tributaries.

2.6 km of the creek simplified the treatment. Sea lamprey larvae up to 181 mm long were abundant and several year classes were present.

Treatments were relatively routine except for Lynde Creek and the Salmon River. In Lynde Creek, significant increases in water discharges from the headwater to the mouth area necessitated a number of secondary lampricide applications to maintain desired concentrations. The Salmon River, a large, complex system that flows into Lake Ontario through Selkirk Shores State Park, west of Pulaski, New York, was treated for the fifth time in 1981. Treatment of the river was facilitated by a controlled discharge implemented by the Niagara Mohawk Power Company. The main lampricide application point was below the intake pump station for the Salmon River Hatchery. This site is about 2 km below the Lighthouse Generating Plant, which serves as the upstream barrier to anadromous sea lampreys in the river. Some escapement of sea lamprey larvae can be expected from this untreated area. The three major sea lamprey-producing tributaries of the Salmon River (Beaverdam, Orwell, and Trout brooks) were treated independently of the main stream because of the complexities involved. Beaverdam Brook also is the water source for the hatchery. A new dam (1980) on Beaverdam Brook located at the hatchery, about 0.5 km upstream from the confluence with the main river, appears to be a barrier to sea lampreys. Water impoundment areas, groundwater exchange, and numerous spring-fed trickles provided areas for escapement of sea lamprey

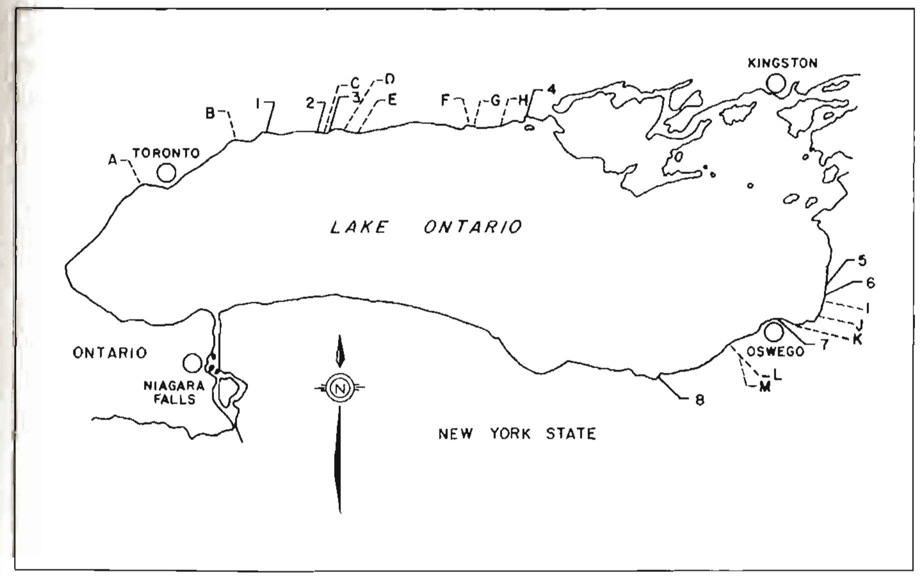

Figure 6. Location of streams tributary to Lake Ontario treated with lampricides (numerals; see Table 10 for names of streams), and of streams where assessment traps were fished (letters; see Table 11 for names of streams) in 1981.

larvae. Some escapement can be expected from these tributaries, but the most significant occurred in Orwell Brook.

Mortality of other fishes was considered minimal in all of the streams treated, and consisted primarily of logperch, stonecats, bullheads, and suckers.

SPAWNING-RUN SEA LAMPREYS

A total of 1,918 spawning-run sea lampreys was collected from 13 tributaries in spring 1981 (Fig. 6). Of 1,570 of these animals examined (Table 11), little change in biological characteristics was indicated from those sampled in 1980. Perhaps the most interesting aspect of these data was the sex ratio, which suggested an adult sea lamprey population in Lake Ontario consisting of about 58% males. In addition, the 3-year trend data from New York tributaries show a subtle increase in the male composition of the population, whereas similar data from Lake Superior show a general reduction in the percent of males in the population from 1963 (71) to 1981 (36).

PARASITIC-PHASE SEA LAMPREYS

As in 1980, no sea lampreys were submitted for bounty by commercial fishermen on Lake Ontario in 1981.

SPECIAL STUDY

Experimental shocker for use in hard water—In Carpenter Brook, a tributary of the Seneca River in New York, an experimental shocker was tested to determine its effectiveness for sampling larval lampreys in highly conductive water. The preliminary results indicate that with certain modifications this type of shocker can be used effectively. However, additional testing must be done to ensure greater reliability of the equipment.

Table 11. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 1981. [Letter in parentheses corresponds to location of stream in Figure 6.]

Stream	Number captured	Number sampled	Percent males	Mean length (mm)		Mean weight (g)	
				Males	Females	Males	Females
CANADA							
Humber R. (A)	608	608	57	470	460	243	245
Duffin Cr. (B)	293	287	57	470	460	239	240
Bowmanville Cr. (C)	182	182	60	480	490	233	254
Wilmot Cr. (D)	107	107	58	480	490	238	255
Graham Cr. (E)	32	27	56	480	480	237	269
Grafton Cr. (F)	2	0	-	-	-	-	-
Shelter Valley Br. (G)	14	14	50	480	490	242	267
Salem Cr. (H)	3	3	67	480	510	248	323
Total or average	1,241	1,228	58	470	470	240	247
UNITED STATES							
Grindstone Cr. (I)	210	0	-	-	-	-	-
Little Salmon R. (J)	113	113	66	485	477	246	248
Catfish Cr. (K)	11	11	63	498	473	280	218
Sterling Valley Cr. (L)	218	218	59	484	478	274	268
Sterling Cr. (M)	125	0	-	-	-	-	-
Total or average	677	342	61	484	478	264	261
GRAND TOTAL OR AVERAGE	1,918	1,570	58	473	472	245	250

Table 11. Number and biological characteristics of adult sea lampreys captured in assessment traps in tributaries of Lake Ontario, 1981. [Letter in parentheses corresponds to location of stream in Figure 6.]

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Grafton Cr. (F)	2	0	–	–	–	–	–
Shelter Valley Br. (G)	14	14	50	480	490	242	267
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SEA LAMPREY AND RELATED RESEARCH AT NATIONAL FISHERY RESEARCH LABORATORY, HAMMOND BAY BIOLOGICAL STATION, AND MONELL CHEMICAL SENSES CENTER, 1981

Fred P. Meyer, Director
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Monell Chemical Senses Center
Philadelphia, Pennsylvania 19104

Abstract

Administrative responsibility for the Hammond Bay Biological Station (HBBS) was transferred to the National Fishery Research Laboratory (LNFRL) La Crosse, Wisconsin on June 14, 1981.

A meeting to discuss research needs of sea lamprey control units and to prioritize the use of research funds was held at Marquette, Michigan on October 7, 1981.

The National Fishery Research Laboratory submitted two label revisions for TFM to the Environmental Protection Agency (EPA); provided data to EPA to establish TFM tolerances in potable water, fish, meat, and milk; and pursued negotiations with EPA on the kinds of studies needed to maintain TFM registration.

A solid bar formulation of TFM was developed to control sea lamprey larvae in small headwater streams.

Radioactive residues of the chemosterilant bisazir were dectectable after 10 days of withdrawal. Whole body analyses showed that males contained 0.512 and 1.46 µg/g 10 days after treatment by immersion and injection, respectively; females contained 0.853 and 3.47 µg/g, respectively.

Samples of ^{14}C-labeled TFM and reduced-TFM (R-TFM) received from Pathfinder Laboratories for soil binding studies were greater than 94 and 98% pure.

The toxicity of TFM in combination with chlorpyrifos, toxaphene, carbaryl, endrin, mirex, malathion, or hexachlorobenzene is additive.

Egg stages of the mayfly, *Hexagenia*, are probably not severely affected by lampricide treatment. TFM became more toxic to nymphs as they grew to the 16-mm stage and then did not appear to change. Bayer 73 appears to be nontoxic to nymphs in concentrations used for treatment.

Male spawning-run sea lamprey were exposed to radiation dosages of 250, 500, 1,000, or 2,000 rads from a cobalt-60 unit. Some sterility was induced at all levels, but complete sterility was not achieved at the highest dosage tested. The high rate of embryo mortality observed in progeny from males receiving the higher dosages indicates that ionizing radiation has potential for sterilizing male sea lamprey.

The injection of antisera at the levels tested had no noticeable effect on nest building or spawning behavior of sea lampreys.

A review of toxicity records of compounds tested at Hammond Bay Biological Station (HBBS) in the 1950's and 1960's resulted in a list of 12 nitrosalicylanilide compounds. Each compound killed 100% of larval sea lampreys at 0.1 mg/L or less. These 12 compounds merit further testing.

Preliminary results indicate that tributyltin fluoride (TBTF) was acutely toxic to larval sea lamprey at concentrations that were not toxic to fingerling rainbow trout or to burrowing mayfly nymphs. A pelleted slow release formulation, however, was ineffective in killing larval sea lampreys after 2 weeks of exposure at an applicaton rate of 16 pounds per acre; 20% of the rainbow trout in the same tank died.

A cooperative study involving the Hammond Bay Biological Station, the La Crosse National Fishery Research Laboratory, the Southeastern Fish Control Laboratory (SEFCL), and the Alabama Cooperative Fishery Research Unit (ACFRU) is under way to determine the potential of methallibure as a chemosterilant for fish and lampreys.

Administration and Personnel

Hammond Bay Supervision—On June 14, 1981 administrative responsibility for supervision and research guidance at the Hammond Bay Biological Station was shifted from the Great Lakes Fishery Laboratory to the National Fishery Research Laboratory, La Crosse, Wisconsin. The transition of administrative responsibilities occurred smoothly and without problems. E. Louis King was asked to continue as Acting Station Chief. Recruitment for a permanent station chief was begun.

Research Planning—A meeting to discuss research needs of the sea lamprey control units, and to prioritize the use of research funds was held on October 7, 1981 at the Ramada Inn, Marquette, Michigan. Attending were 18 representatives from sea lamprey control centers at Sault Ste. Marie and Marquette and from the Regional Office of the Fish and Wildlife Service, and Research representatives from Hammond Bay, La Crosse, and Washington, D.C. Dr. Robert E. Stevens, Chief, Division of Fishery Ecology Research, Washington, D.C. convened the meeting with a discussion of the need for input from SLC units in planning and prioritizing research for the coming year and beyond. While short-term research needs would receive primary consideration, long-term needs should also be raised. Discussions of needed research were not restricted by what it would cost, who should do it, or where it should be done. Roles of the several participating agencies and offices were discussed.

Following the discussions, participants were asked to rank the several indicated needs according to priority. The following priority ranking for research by the FWS was developed:

No. 1. Research on nonchemical alternate control methods. Work on bisazir, attractants and repellents (including light), irradiation sterilization, and immunosterilization should continue.

No. 2. Bottom-release formulations—ongoing work with Bayer 73, TFM, TBTF, and other compounds should continue.

No. 3. Alternate chemical lampricides—screening of candidate compounds and evaluation of TBT should continue.

No. 4. Study of basis for loss of Bayer 73 activity in streams must be expedited.

No. 5. *Lamprey biology—including physiology and control of the transformation process, factors affecting ammocete numbers, population dynamics of ammocetes and transformers, populations of feeding lampreys, and impacts on lake trout populations.

*Includes high priority work that exceeds the currently available expertise, facilities, and manpower at the HBBS and NFRL.

Other high priority work that was beyond existing research capabilities included: Methods to treat huge areas like the St. Mary's system; standardization of data collection and ADP methods; predator/prey relationships, interaction between populations, mortality rates, models, etc.; and capability to predict numbers of transformers, feeding adults, and spawning adults.

The meeting adjourned after agreeing that a similar meeting in 1982 would be useful. The date set was October 19 at Marquette, Michigan.

Registration-Oriented Activities

In December 1981, the Environmental Protection Agency (EPA) approved two label revisions (Section B) for the lampricide, TFM; the labels had been submitted in response to an EPA request. One of the label changes requires that municipalities using streams as potable water sources be notified of an impending TFM treatment at least 24 hours prior to application. Another similar change requires that agricultural irrigators who use streams as a source of irrigation water be notified of an impending TFM treatment at least 24 hours prior to application.

EPA had also requested additional data to establish tolerances for TFM (Section F) in potable water, fish, meat, and milk. The FWS provided information in May 1981, that supported TFM tolerances of 0.05 ppm in potable water, 0.1 ppm in milk and meat, and 20 ppm in fish. In addition, EPA required a teratology study in a second mammalian species. This study is scheduled to begin in FY 1982. EPA, in their response December 1, 1981, stated that the establishment of tolerances "must await clearance of the inert ingredient used in the product for the proposed use as a lampricide to be applied to freshwater streams." The LNFRL continues to pursue this new requirement.

EPA raised questions (May 18, 1981) regarding the microbial degradation, residue dynamics, and chronic effects of exposure to TFM. On September 21, 1981, EPA stated that they concurred with comments they received from FWS with respect to the environmental chemistry requirements. EPA will now require only a hydrolysis study and a photodegradation study; the studies will identify TFM degradates. the LNFRL is also pursuing this issue.

Sea Lamprey Control Research-La Crosse

Solid-Bar Formulation of TFM—A solid bar formulation of TFM was developed for controlling sea lampreys in small tributaries of the Great Lakes system. The bars dissolve at a constant rate over time and replace the liquid formulation that must be applied with a mechanical pump. The use of the bar formulation is expected to result in a substantial saving in manpower and to allow treatment of many small tributaries that cannot now be treated. Each 9″ × 12″ × 1″ bar will treat 0.5 cfs of water at 1.0 mg/L of TFM for 8 hours at 18°C. Water temperature and velocity influence the rate at which the bars dissolve; the fine details for their use over a wide range of stream characteristics must be developed in the field.

Field trials were conducted with the bars in two Michigan streams—a soft, acid tributary of Lake Superior and a hard, alkaline tributary of Lake Michigan. Both trials resulted in elimination of larval lampreys. These tests indicated that the bars will be very useful in treating small streams, especially where access is difficult.

Experimental Formulations of TFM and Bayer 73—Experimental formulations of TFM and Bayer 73 on sand and clay were received from Hammond Bay Biological Station for analysis of active ingredient. The clay sample was first ground; then both the clay and the sand formulations were suspended in methanol, distilled water, or well water and analyzed by HPLC using an MCH 10 reverse phase column and methanol:0.01 M acetate buffer (81:13) at 2 mL/min. Active ingredient levels of the formulations were very near the stated amount when extracted with methanol, but complete recovery was not achieved from either formulation when extracted with distilled water. Well water provided relatively efficient extraction of the lampricides from the clay formulation (Table 1).

Analysis of ^{14}C-labeled TFM and R-TFM—Samples of ^{14}C-labeled TFM and reduced-TFM (R-TFM) for use in soil binding studies were received from Pathfinder Labs and analyzed for purity by HPLC on a reverse phase column. Fractions were collected every 30 seconds and placed in scintillation vials. The samples were then counted on a liquid scintillation counter and compared with the UV elution patterns. The UV chromatograms were almost identical to the plots of counts per minute versus time for each of the three compounds.

The TFM separation revealed some impurities, but the parent material made up greater than 94% of the total counts. The R-TFM assayed to greater than 98% purity.

Influences of Contaminants on Toxicity of Lampricides—Contaminants in the aquatic environment are suspected to alter the activity of lampricides. Past experimental work at the LNFRL suggested that the toxicity of mixtures of lampricides and nitrite nitrogen was additive or greater than additive, and that toxicity of mixtures of lampricides and heavy metals were additive. Additive toxicity essentially means that toxicity of a mixture of components is the sum or expected effects for each component, and that the toxicity is neither synergistic (greater than additive) or antagonistic (less than additive). However, components displaying additive toxicity can still pose a hazard to nontarget organisms because the summation of additive effects of sublethal components can produce a lethal effect.

Selected compounds that sometimes contaminate waters of the Great Lakes Region were tested in combination with TFM to determine their interaction with lampricides. The compounds were chlorpyrifos (Dursban), toxaphene, carbaryl, endrin, mirex, malathion, and hexachlorobenzene. To rainbow trout, the toxicity of TFM and listed compounds was simply additive. Readers are reminded, however, that the toxicity of these contaminants still contributes to the total burden of toxic chemicals in water treated with lampricides.

Toxicity of Lampricides to Mayflies—Concern over the possible adverse effects of lampricide treatments on mayfly populations led to the testing of the lampricides against various life stages of the mayfly, (*Hexagenia* sp.). Eggs and nymphs collected during the summers of 1980 and 1981 were exposed to TFM and Bayer 73 and a mixture of the two. Life

Table 1. Analysis of formulations of TFM and Bayer 73 for active ingredient by HPLC

Sample	Solvent	TFM conc. (mg/L)		Percent recovery	Bayer 73 conc. (mg/L)		Percent recovery
		Label	Assay		Label	Assay	
Clay pellets (5%) 98% TFM, 2% Bayer 73	Methanol	49	45.0	91.8	1	1.28	128
	Well water	49	49.3	101	1	0.81	81.0
	Distilled water	49	38.1	77.8	1	0.84	84.0
Sand granules (5%)	Methanol	-	-	-	5	5.62	112
	Well water	-	-	-	5	3.59	71.8
	Distilled water	-	-	-	5	1.94	38.8

Table 1. Analysis of formulations of TFM and Bayer 73 for active ingredient by HPLC

Sample	Solvent	TFM conc. (mg/L)		Percent recovery	Bayer 73 conc. (mg/L)		Percent recovery
		Label	Assay		Label	Assay	
Clay pellets (5%)							
98% TFM, 2% Bayer 73	Methanol	49	45.0	91.8	1	1.28	128
	Well water	49	49.3	101	1	0.81	81.0
	Distilled water	49	38.1	77.8	1	0.84	84.0
Sand granules (5%)	Methanol	–	–	–	5	5.62	112
	Well water	–	–	–	5	3.59	71.8
	Distilled water	–	–	–	5	1.94	38.8

stages exposed were eggs, newly hatched nymphs, 7-, 16-, 23-, and 27-mm nymphs. For eggs, embryological development during incubation and hatching success were used to determine the survival. Generally, survival rates of exposed and unexposed eggs were similar (approximately 60–80%); this 20 to 40% mortality among eggs may be due to handling, stress, lack of natural substrates, or it may approximate natural mortality among eggs. We conclude that the egg stage would probably not be severely affected by lampricide treatments.

Considering the six life stages tested, it is apparent that as the nymphs became larger they became much more sensitive to TFM and the TFM:Bayer 73 mixture but not to the Bayer 73 alone. Bayer 73 alone can probably be considered nontoxic to the nymphs tested at concentrations up to 0.5 mg/L at 17°C. TFM became more toxic as the nymphs grew to about 16 mm; after the nymphs reached the 16-mm stage, the toxicity did not appear to change. For the mixture, the toxicity curves closely parallel those for TFM alone, indicating the toxicity of the mixture is due primarily to the TFM component. The testing to determine the different sensitivity of the various life stages were conducted in vessels without substrate. To determine if this would bias the results, we exposed the 23-mm nymphs to the lampricides in vessels with and without substrate. We found less mortality in the vessels with substrate; however, HPLC analysis of water samples from the list solutions indicated that TFM was slightly absorbed by the sediments and Bayer 73 was strongly absorbed, which subsequently reduced the concentrations and which may have been the cause for the reduced mortality. Tests are continuing to evaluate this and how shorter contact times of the lampricides affect the mayfly nymphs.

Synthesis and Purity of the Lamprey Chemosterilant Bisazir—Information on persistence of residues of bisazir in sea lamprey is needed for determining the safety of the chemical for use as a control agent. Radioactive labeled (^{14}C) bisazir was prepared by Pathfinder Labs, Inc., St. Louis, Missouri for use in the study of the persistence of bisazir residue. The bisazir was prepared with the ^{14}C in the aziridinyl ring so the radioactivity is confined to the most stable portion of the molecule. The material received has a specific activity of 6.52 mCi/mM. The material was analyzed by Pathfinder Labs, Inc. using four different solvent systems on silica gel G thin layer chromatography and by our laboratory using high performance liquid chromatography (HPLC) with UV detection and a methanol:water (40:60) solvent system. Fractions of the HPLC eluent were analyzed by liquid scintillation. All analysis showed the material to be 98% pure.

Bisazir Residues in Sea Lamprey—An experimental compound, p,p-bis (1-aziridinyl)-N-methylphosphinothioic amide called bisazir (also PMPA), has been shown to be an effective chemosterilant for adult sea lampreys and has performed effectively in a field situation. While the compound destroys viability of the sex products, it does not reduce sex drive or mating instincts. Bisazir is an effective sterilant for both male and

female sea lampreys and can be administered by either bath treatment or i.p. injection.

Bisazir is highly active and nonspecific in its effects. Its chemosterilant characteristics are known to affect insects and lampreys. The compound is an identified dominant lethal gene mutagen and is considered to present potential human health hazards. The persistence of residues of bisazir in sea lampreys treated with the sterilant had not been determined. If no residues persist after a prescribed post-treatment holding period, EPA might allow the use of sterilized animals as a sea lamprey control tool.

Radiolabeled bisazir was used to determine total resudies of bisazir remaining in sea lamprey after treatment with the sterilant. Bisazir-aziridinyl-^{14}C with specific activity of 6.52 mCi/mM was obtained from Pathfinder Labs, Inc. Unlabeled bisazir was obtained from the Beltsville Agricultural Research Center, Beltsville, Maryland.

The sea lampreys exposed to the sterilant in the bath solutions were sampled immediately after removal from the bath solution and after 1, 2, 3, 4, 7, and 10 days of withdrawal. At each sampling period, five animals were taken for whole body analyses, and one was dissected to provide blood, brain, gills, gonads, gut, heart, kidney, liver, and muscle to determine the distribution of the chemical.

Whole body analyses of sea lampreys treated with bisazir showed a rapid decrease in residues of bisazir during withdrawal. However, radioactive residues of the sterilant were detectable after 10 days of withdrawal from the chemical. The analyses showed males contained 0.703 and 2.71 μg/g 2 days after treatment by immersion and injection, respectively, and 0.512 and 1.46 μg/g 10 days after treatment. Whole body analyses showed females contained 1.20 and 6.04 μg/g 2 days after treatment by immersion and injection, respectively, and 0.853 and 3.47 μg/g 10 days after treatment.

Tissues analyzed for organ distribution of the chemical included blood, brain, gills, gonad, gut, heart, kidney, liver, and muscle. The pattern of elimination of bisazir from individual organs was similar to that of the whole body (Tables 2, 3, 4, and 5). An early rapid elimination was followed by prolonged persistence of the remaining residues. Radioactive residues remaining were not identified. Residues detected could represent tissue binding of the parent compound or an incorporation of metabolites into body systems. It is impossible at this point to speculate as to the number or identity of residue products that might be involved.

The most rapid loss of bisazir residues was in the blood, indicating that residues remaining in other tissues after the initial rapid loss are probably bound. Residues were highest in brain immediately after bath exposure but declined rapidly to concentrations similar to the other tissues. Concentrations of residues in the liver and kidney did not decrease significantly after the first day of withdrawal. As expected, residues of bisazir generally persisted at higher concentrations in liver and kidney, since these are the major organs involved in biotransformation and elimination of xenobiotics.

Table 2. Organ distribution of residues of bisazir in male sea lampreys exposed to 100 mg/L of ^{14}C-bisazir for 2 hours and placed in fresh, flowing well water for withdrawal.

Withdrawal time (days)	Residues of bisazir ($\mu g/g$)								
	Blood	Brain	Gills	Gonad	Gut	Heart	Kidney	Liver	Muscle
0	28.7	87.2	31.0	31.0	35.1	30.6	31.5	3.38	25.4
1	0.631	0.746	1.34	1.01	1.37	0.498	2.29	1.46	0.834
2	0.124	0.908	0.545	1.62	0.509	0.193	2.01	0.983	0.673
3	0.089	0.207	0.495	0.246	0.415	0.183	2.43	2.62	0.484
4	0.092	0.538	1.36	1.25	0.686	0.960	3.17	1.12	0.819
7	0.027	0.233	0.352	0.493	0.431	0.116	0.938	1.03	0.188

Table 3. Organ distribution of residues of bisazir in female sea lampreys exposed to 100 mg/L of ^{14}C-bisazir for 2 hours and placed in fresh, flowing well water for withdrawal.

Withdrawal time (days)	Residues of bisazir ($\mu g/g$)								
	Blood	Brain	Gills	Gonad	Gut	Heart	Kidney	Liver	Muscle
0	22.8	46.6	31.7	10.2	25.1	–[a]	29.5	5.57	21.4
1	0.946	3.26	2.54	4.09	2.63	1.22	5.41	4.70	1.59
2	0.201	1.48	1.59	1.77	1.45	0.418	3.88	2.10	0.823
3	0.136	1.23	1.45	1.49	0.964	0.309	4.27	3.38	0.465
4	0.124	1.31	1.18	1.45	1.35	0.326	3.87	3.42	0.691
7	0.057	0.577	1.44	1.33	0.444	0.291	3.66	2.88	0.377
10	0.084	0.542	0.962	1.41	0.653	0.344	2.15	3.72	0.326

[a] Sample lost.

Table 4. Organ distribution of residues of bisazir in male sea lampreys injected i.p. with 100 $\mu g/g$ of ^{14}C-bisazir in saline and placed in fresh, flowing well water for withdrawal.

Withdrawal time (days)	Residues of bisazir ($\mu g/g$)								
	Blood	Brain	Gills	Gonad	Gut	Heart	Kidney	Liver	Muscle
1	5.65	3.02	3.12	9.16	12.3	3.33	12.3	8.67	2.28
2	0.997	3.31	1.56	3.82	6.16	1.24	6.22	4.63	1.20
3	0.397	15.1	1.14	3.27	5.73	1.12	5.30	6.52	0.916
4	0.618	3.83	2.39	5.39	11.6	2.41	10.9	9.00	2.99
7	0.487	1.13	2.49	4.16	8.33	2.17	14.4	12.13	1.39
10	0.464	1.67	1.75	4.67	5.46	1.78	12.5	5.25	1.34

Table 5. Organ distribution of residues of bisazir in female sea lampreys injected i.p. with 100 $\mu g/g$ of ^{14}C-bisazir in saline and placed in fresh, flowing well water for withdrawal.

Withdrawal time (days)	Residues of bisazir ($\mu g/g$)								
	Blood	Brain	Gills	Gonad	Gut	Heart	Kidney	Liver	Muscle
1	6.79	6.94	6.32	21.3	16.1	5.37	15.9	9.98	4.29
2	1.51	3.81	3.03	9.17	15.8	2.33	10.6	8.96	1.64
3	2.26	3.75	3.51	10.3	11.0	2.83	15.4	22.2	1.31
4	0.676	4.45	2.05	7.52	7.30	1.96	8.51	8.49	1.09
7	0.754	1.44	2.47	5.71	6.02	2.16	13.1	8.34	1.14
10	0.332	2.37	2.26	6.54	7.08	2.54	12.1	13.1	1.11

Significant residues of bisazir persisted in the gonads and gut of injected male and female lampreys. The elevated residues in these organs are probably related to the route of administration of the chemical.

Spawning-phase adult sea lampreys were trapped from the Ocqueoc and Cheboygan rivers along the northern Lake Huron shore. The animals were transferred to the National Fishery Research Laboratory, La Crosse, Wisconsin and held in fresh, flowing well water for 48-hour acclimation before treatment. Male and female lampreys were each separated into two groups. One group was exposed to a bath solution of 100 mg/L of bisazir (isotope dilution: 1 part ^{14}C bisazir + 9 parts cold bisazir) for 2 hours and transferred to fresh, flowing well water. The other group was injected i.p. with 100 mg/kg of bisazir (isotope dilution: 1 part ^{14}C bisazir + 9 parts cold bisazir) in saline solution and transferred to fresh, flowing water. Untreated animals provided tissues for baseline data and for comparative purposes.

Methallibure—Methallibure is being studied as a possible chemosterilant for lampreys and other fishes. It affects pituitary function and has been used to prevent development of gonads and to inhibit or reduce the production of gametes in some teleost fishes.

A cooperative study is under way involving the Southeastern Fish Control Laboratory at Warm Springs, Georgia; the Hammond Bay Biological Station at Millersburg, Michigan; the Alabama Cooperative Fishery Research Unit at Auburn, Alabama; and the National Fishery Research Laboratory, La Crosse, Wisconsin to evaluate the effects of methallibure on adult goldfish, tilapia, and sea lampreys. Gonadosomatic indices, secondary sexual characteristics, and effects on courtship and spawning behavior will be checked. Goldfish and tilapia have been treated at the SEFCL and are now under observation. Sea lampreys will be treated at HBBS in May and June. Gonads of the three species will be collected at intervals and submitted to the ACFRU for determination of the gonadosomatic indices and for histological evaluations of gonadal development.

Results of 1982 studies should indicate if methallibure has potential as a chemosterilant for sea lampreys.

TECHNICAL ASSISTANCE

Verdel Dawson demonstrated the use of HPLC for simultaneous analysis of TFM and Bayer 73 in water to the Marquette Sea Lamprey Control Agents during treatment of the Peshtigo River, July 30 and August 4.

John Allen assisted the Marquette Sea Lamprey Congrol Agents during treatment of the Manistique River by analyzing the river water for TFM using direct injection of the river water into the HPLC.

The Ludington Biological Station, Ludington, Michigan, has had problems with residues of TFM leaching out of their concrete floor in storage areas where TFM had leaked years ago. Some of this TFM has gotten into their effluent discharge so they are currently using activated carbon filters and monitoring their effluent for residues of TFM on a weekly basis in compliance with their EPA discharge permit (residues must be 0.10 mg/L or less). We agreed to assist with the analysis of some of the samples until other procedures can be established. The samples were prefiltered through millipore filters (0.45 micron) to remove particulates and then concentrated on Waters C_{18} Sep Paks. The eluted chemical was then analyzed by HPLC on a reverse phase MCH-10 column with methanol: 0.01 M acetate buffer (87:13; V:V) at a flow rate of 1 mL/min. No Bayer 73 was detected in any of the samples. TFM concentrations were as follows:

Date sample collected	Concentration (mg/L)
10/05/81	<0.005
10/13/81	<0.005
10/19/81	0.043
10/26/81	0.100
11/02/81	0.010
11/09/81	0.010
11/16/81	0.005
11/23/81	0.010
11/30/81	0.009

SEA LAMPREY CONTROL RESEARCH HAMMOND BAY

Irradiation Sterilization—Male spawning-run sea lampreys were exposed to radiation dosages of 250, 500, 1,000, or 2,000 rads from a cobalt-60 unit located at the Munson Medical Center, Traverse City, Michigan. The irradiated lampreys were released into an artificial spawning stream at the HBBS where their survival, behavior, and reproductive ability were monitored. Each irradiated male exhibiting spawning behavior was removed from the stream and spawned artificially with a normal female. Each normal female which had been spawned artificially with an irradiated male was also spawned with a normal male as a control. Development of the embryos from each spawning was monitored until complete mortality

occurred or until the survivors reached the burrowing stage. All surviving prolarvae were preserved in 4% formalin for subsequent microscopic examination.

Observations of the lampreys in the stream showed that irradiated males did not exhibit any apparent adverse behavior from the radiation treatment. Their survival rates and spawning behavior, including competitiveness for spawning partners, appeared to be normal. The survivors of the embryological portion of the study were examined microscopically for abnormalities and enumerated. The results indicated that some sterility was induced at all dosages tested (Table 6). Generally, embryo mortality increased as the levels of radiation to which the adult males had been exposed were increased. Complete sterility was not achieved at the highest dosage tested, as indicated by the production of some live, apparently normal prolarvae. However, the high rates of mortality observed at the two highest dosages tested would indicate that ionizing radiation has potential as a method for sterilizing male sea lampreys.

Immunosterilization—A cooperative study was conducted with the National Fish Health Research Laboratory (NFHRL) Leetown, West Virgi-

Table 6. Summary of effects of exposure of male spawning-run sea lampreys to selected doses of cobalt-60 radiation on the production of normal prolarvae after 21 days of incubation when treated males were artificially spawned with untreated females. Each female spawned with a treated male was also spawned with a normal male to provide a control.

Dose rate (rads)	Number spawned artificially	Average number of eggs per spawning (ranges in parentheses)	Average percentage per spawning (ranges in parentheses)		
			Dead	Live, abnormal prolarvae	Live, normal prolarvae
250	7	951 (283–1,285)	51.0 (21.9–99.9)	4.9 (0.1–9.3)	44.1 (0.0–69.2)
Control	7	1,017 (260–2,112)	24.3 (2.1–93.8)	2.8 (0.0–11.9)	72.9 (5.8–97.1)
500	7	665 (421–1,295)	56.5 (24.1–97.4)	9.8 (0.0–23.2)	33.7 (2.6–52.7)
Control	7	617 (364–892)	29.2 (7.1–57.2)	4.2 (0.0–20.8)	66.6 (42.8–92.1)
1,000	8	946 (506–1,621)	90.2 (73.1–100.0)	4.8 (0.0–17.4)	5.0 (0.0–12.0)
Control	8	752 (329–1,179)	43.7 (2.9–99.6)	0.7 (0.0–1.8)	55.6 (0.4–96.4)
2,000	8	1,124 (99–1,900)	97.3 (88.6–100.0)	2.0 (0.0–8.1)	0.8 (0.0–3.3)
Control	8	676 (175–1,633)	30.0 (6.3–82.1)	5.8 (0.0–36.0)	64.1 (17.5–92.2)

nia, to investigate the potential for developing an immunological method for sterilizing male spawning-run sea lamprey. The NFHRL stripped male lampreys and centrifuged their sperm. The supernatant was labeled male antigen 2 and the particulate was resuspended in saline and labeled male antigen 1. Three to 6-month-old rabbits were used to produce antisera against the antigens. Three rabbits were pre-bled and the first rabbit, #413, was injected intramuscularly with a pooled sample of male antigen 2 mixed with Freunds Complete Adjuvant. The second rabbit, #414, was injected subcutaneously with a single sample of male antigen 1 and the third rabbit, #415, was injected intramuscularly with a single sample of male antigen 2 plus Freunds Complete Adjuvant. Each rabbit received a booster shot 7 days later, and 10 days after the booster shot each was test-bled. An immunoelectrophoresis was done on each rabbit's antiserum and results were found to be negative. One week later they were test-bled again and another booster shot was administered to each of the three rabbits. Antiserum was retested by a macroscopic slide agglutination test, microtiter agglutination test, and a precipitin test. The tests were found to be positive for antibody production. Antisera was then collected from the rabbits and sent to HBBS.

Spawning-run lampreys were obtained from traps on the St. Marys River. Male lampreys were weighed, fin-clipped, and injected with the antiserum at a dose rate of 10 mL/kg. Ten males were injected with pooled antisera produced in the two rabbits injected with male antigen 2 antigen and five with antisera produced in the rabbit injected with male antigen 1 antigen. These lampreys were placed in the artificial stream in the laboratory along with normal males and females. The lampreys were observed periodically and those observed in the spawning act were removed and artificially spawned. One portion of the eggs stripped from each female was fertilized with sperm from an injected male; a second portion was fertilized with sperm from a normal male to provide a control. Eggs were placed in 10-liter jars containing 6 liters of Lake Huron water which was held at 18.3°C. After 21 days of incubation, the study was terminated; the remaining dead prolarvae, the live abnormal prolarvae, and the five normal prolarvae were preserved in 4% formalin and later counted (Tables 7 and 8).

The injection of antisera had no noticeable effect on nest building or spawning behavior. Nine of the 10 lamprey injected in one group and four of the five injected in the other were observed spawning. However, the injections did not reduce the survival rate of normal prolarvae at the dose rate tested and therefore had no sterilizing effect. This experiment is to be continued during the spring of 1982 in an effort to further evaluate the potential of this approach for sterilizing adult male sea lamprey.

Screening for New Lampricides—In response to requests from the Great Lakes Fishery Commission's control agents for the development of new lampricides that could be used to supplement or replace those currently in use, we conducted a preliminary review of the toxicity records of

Table 7. Effects of injection (10 mL/kg) of male sea lampreys with antiserum produced in rabbits that had been injected with male antigen 2 on the production of normal prolarvae after 21 days incubation when treated males were artificially spawned with untreated females. Each female spawned with a treated male was also spawned with a normal male to provide a control.

Batch	Total number eggs	Percentage dead	Percentage live, but abnormal	Percentage live and normal
Experimental	1,023	23.9	21.9	54.2
Control	1,334	23.1	1.4	75.5
Experimental	644	99.1	0.0	0.9
Control	680	74.7	0.0	25.3
Experimental	1,085	92.3	0.2	7.6
Control	1,273	62.3	0.0	37.7
Experimental	1,671	22.0	0.0	78.0
Control	1,496	48.0	0.0	52.0
Experimental	744	39.4	0.0	60.6
Control	539	10.2	22.8	67.0
Experimental	1,144	8.0	0.3	91.8
Control	1,177	7.2	0.1	92.7
Experimental	1,083	28.5	0.0	71.5
Control	1,215	39.4	0.3	60.2
Experimental	972	33.6	0.4	65.9
Control	1,137	3.4	0.6	96.0
Experimental	1,334	1.6	0.9	97.5
Control	1,811	2.7	0.4	96.9

Table 8. Effects of injection (10 mL/kg) of male sea lampreys with antiserum produced in rabbits that had been injected with male antigen 1 on the production of normal prolarvae after 21 days incubation when treated males were artificially spawned with untreated females. Each female spawned with a treated male was also spawned with a normal male to provide a control.

Batch	Total number eggs	Percentage dead	Percentage live, but abnormal	Percentage live and normal
Experimental	1,103	8.0	1.4	90.7
Control	1,036	4.2	0.7	95.1
Experimental	1,141	5.5	0.2	94.3
Control	2,634	6.4	0.3	93.3
Experimental	1,003	39.5	0.0	60.5
Control	1,047	11.3	0.9	87.9
Experimental	1,499	9.7	0.3	90.1
Control	1,707	20.3	0.9	78.7

compounds tested in the 1950's and 1960's at HBBS. This file search resulted in a list of 45 compounds which displayed various degrees of selective toxicity toward sea lampreys. All of these compounds were from the nitrophenol or nitrosalicylanilide groups. The nitrosalicylanilide compounds as a group were considerably more toxic to larval sea lampreys than were the nitrophenols. Results from preliminary bioassays showed that 12 nitrosalicylanilides killed 100% of larval sea lamprey at 0.1 µmg/L or less. These 12 compounds merit further evaluation since they were not only highly toxic to larval sea lampreys, but were also selectively toxic.

Tributyltin Fluoride (TBTF)—TBTF incorporated in a slow-release carrier was first tested at HBBS in 1979. All larval sea lamprey exposed to a concentration of 100 mg/L total formulation in standing water for 24 hours were killed. According to the supplier, this formulation (Ecopro 1330) would theoretically have released a concentration of only 0.047 µmg/L in aqueous solution in the 24-hour test period. Because the results of this test indicated TBTF is acutely toxic to larval sea lampreys, we conducted further tests to more fully evaluate this compound as a potential lampricide.

Standing water bioassays were conducted with technical grade TBTF to determine toxic concentrations for larval sea lamprey, fingerling rainbow trout, and nymphs of the burrowing mayfly (*Hexagenia limbata*). The results of these bioassays conducted in Lake Huron water with free-swimming organisms (10 individuals of each organism per test concentration), exposed for 24 hours at 15.6°C, were as follows:

Test concentration (mg TBTF/liter) of water	Percentage mortality					
	Rainbow trout fingerlings		Burrowing mayfly nymphs		Sea lamprey larvae	
	24 h	48 h	24 h	48 h	24 h	48 h
0.0 (control)	0.0	0.0	10.0	30.0	0.0	0.0
0.01	0.0	0.0	10.0	30.0	40.0	100.0
0.03	0.0	0.0	0.0	30.0	90.0	100.0
0.05	70.0	90.0	0.0	20.0	100.0	100.0
0.07	100.0	100.0	10.0	30.0	100.0	100.0
0.09	100.0	100.0	10.0	40.0	100.0	100.0
0.10	100.0	100.0	10.0	40.0	100.0	100.0

These preliminary results indicated that TBTF was acutely toxic to larval sea lamprey at concentrations that were not lethal to fingerling rainbow trout or burrowing mayfly nymphs. This compound may have promise as a selective lampricide. The minimum lethal concentration (MLC100) producing 100% mortality of sea lamprey larvae was 0.01 mg/L in 48 hours. No rainbow trout were killed at 0.03 mg/L in 48 hours, indicating a safety factor of approximately three. Mortality of burrowing mayfly nymphs exposed to TBTF at test concentrations of 0.01 to 0.1 mg/L for 24 to 48 hours did not appear to be significantly higher than that of the unexposed controls. The cause of the relatively high mortality of the nymphs in the control tanks was not determined.

Additional bioassays were conducted to determine the potential of a pelleted slow-release formulation of tributyltin fluoride (Ecopro 1330) as a lampricide. Bioassays were conducted in tanks in which Lake Huron water was added at a rate to produce a complete interchange of water every 24 hours. No burrowed larval sea lamprey were killed after 2 weeks exposure to an application of 16 pounds per acre of Ecopro 1330, while 20% of rainbow trout died in the same tank. One hundred percent of larval sea lamprey exposed to 64 pounds per acre were killed in 48 hours of exposure, while all rainbow trout were killed in 24 hours. Additional tests with Ecopro 1330 were unsuccessful in an attempt to determine an effective/selective larvicidal concentration for this material. It would appear that this formulation has little potential as a controlled-release toxicant for sea lamprey. Test results indicate that if TBTF has any potential at all as a lampricide, a redesign of the release properties or a change in the pellet configuration of the Ecopro formulation will be required.

Lampricide Formulation Changes—The application of the registered lampricides TFM and Bayer 73 has been effective in reducing stream dwelling sea lamprey larval populations. Larval populations residing in deepwater, lentic habitats (e.g., lakes within stream systems, estuaries, stream mouth embayments and deltas) are usually not affected by conventional stream treatments. It has been generally acknowledged that these lentic populations could be effectively controlled with the use of a "bottom-release" formulation, which when applied to the surface would quickly carry the larvicide to the bottom before any significant release of active ingredient occurred. A toxic layer of larvicide would ideally be established in a thin layer of water on the substrate, thereby greatly reducing the amount of active ingredient required to produce a toxic dose for the target organism.

Granulated Bayer 73 is available commercially as a bottom-release toxicant but is not registered for general use as a sea lamprey larvicide. Granular Bayer also has certain performance characteristics which impede its effective application. In an effort to develop an effective, registerable bottom-release formulation, a high density clay carrier material, into which a mixture of TFM and Bayer 73 was incorporated, has been evaluated.

Standing water toxicity tests were conducted to determine the effectiveness of a selected clay-pelleted TFM-Bayer mixture (98 parts TFM, 2 parts Bayer 73; 5% total active ingredient by weight). For reference and comparative purposes, granular Bayer 73 containing 5% active ingredient by weight was also tested. Both formulations were applied at a rate of 100 pounds total formulation per acre. With the clay-pelleted formulation, the size of the pellets was adjusted so that 80 pellets per square foot were equivalent to 100 pounds per acre. These tests were conducted in 40-liter glass aquariums with burrowed larval sea lamprey at constant water temperatures of 45, 60, and 75°F in waters with total alkalinities of 40–70, 80–100, and 130–200 mg/L $CaCO_3$. The sea lampreys were exposed to the test formulations for no longer than 6 hours. The results from these bioassays are given in Tables 9 and 10. The average time to death and the percent total mortality of larval lamprey were similar for both formulations (Table 9). The rate of larval emergence was similar for both formulations in the three waters tested at the three temperatures. The rate of emergence generally increased with temperature increase for both materials. However, the percent mortality rates for larvae placed in fresh water immediately after emergence was significantly higher with the sand granules (Table 10). Higher application rates or formulations containing a higher percentage of active ingredients will be tested.

ATTRACTANT AND REPELLENT RESEARCH—MONELL CHEMICAL SENSES CENTER

This report summarizes research conducted during 1981 at the Monell Chemical Senses Center and the Hammond Bay Biological Station to identify and characterize intraspecific chemical signals (pheromones) involved in sea lamprey migration and reproductive behavior. Such substances may prove to be useful as highly specific lures to aid in capturing spawning-run lampreys or as agents for disrupting normal pheromone communication so that successful spawning is prevented or reduced.

Table 9. Average time to death and percent mortality of sea lamprey larvae exposed to 5% clay pellets (98% TFM and 2% Bayer 73) and 5% sand granules (Bayer 73) at an application rate of 100 pounds per acre. Forty larvae were exposed during each test.

			Average time to death (h)		Percent mortality (6 h)	
Test water	Total alkalinity	pH	Clay pellets	Sand granules	Clay pellets	Sand granules
			45°F			
Pendill's Creek	54.0	7.3	3.62	4.03	97.5	85.0
Lake Huron	88.0	8.2	4.87	4.05	90.0	62.5
Trout River	162.2	8.1	3.65	3.65	85.0	90.0
			60°F			
Pendill's Creek	71.0	7.4	2.52	1.72	97.5	100.0
Lake Huron	85.0	8.1	2.33	1.88	100.0	95.0
Trout River	130.0	8.1	2.45	1.72	100.0	100.0
			75°F			
Pendill's Creek	101.0	7.6	1.62	1.88	100.0	100.0
Lake Huron	94.0	8.1	1.92	1.13	100.0	100.0
Trout River	164.0	8.2	3.00	1.38	100.0	100.0

Table 10. Percent emergence and percent mortality of emerged sea lamprey larvae exposed to 5% clay pellets (98% TFM and 2% Bayer 73) at an application rate of 100 pounds per acre. Twenty larvae were exposed to each test formulation and larvae were placed in fresh water immediately after emergence.

			Percent emerged (6h)		Percent mortality of emerged larvae (24 h)	
Test water	Total alkalinity	pH	Clay pellets	Sand granules	Clay pellets	Sand granules
			45°F			
Pendill's Creek	54.0	7.3	85.0	75.0	47.0	73.3
Lake Huron	88.0	8.2	50.0	40.0	10.0	87.5
Trout River	162.2	8.1	80.0	75.0	12.5	46.7
			60°F			
Pendill's Creek	71.0	7.4	80.0	90.0	50.0	61.1
Lake Huron	85.0	8.1	90.0	95.0	27.8	63.2
Trout River	130.0	8.1	75.0	80.0	40.0	62.5
			75°F			
Pendill's Creek	101.0	7.6	100.0	95.0	25.0	78.9
Lake Huron	94.0	8.1	100.0	95.0	10.0	36.8
Trout River	164.0	8.2	100.0	100.0	10.0	40.0

The results of approximately 5,000 two-choice preference tests, conducted during the 1977–1981 spawning season, indicate that at least three different chemical signals may be involved in sea lamprey migration and spawning behavior. Two of these presumed pheromones, one released by sexually mature males and the other by sexually mature females, may be classified as sex attractants. The male pheromone is present in the urine of sexually mature, but not immature, males and elicits a preference response in spawning-run males and appears to be present in ovarian fluid (and perhaps urine) of sexually mature females. The third chemical signal is released by sea lamprey larvae and appears to attract sexually immature spawning-run adults.

During the 1981 spawning season, efforts were directed at purifying and identifying the behaviorally active compound(s) present in the urine of sexually mature males and at further characterizing the response of early spawning-run adults to substances released by sea lamprey larvae.

Male Sex Attractant—The results of a large number of two-choice preference tests conducted during the 1979 and 1980 spawning seasons have shown that: (1) the male pheromone is present in, and presumably released with, urine; (2) the active compounds are released in quantities sufficient to elicit a behavioral response in females only after the males display secondary sex characteristics; (3) milt alone does not elicit a preference response in females; (4) concentrations of urine as low as 6.4 μL/L of water in the test tank can elicit a preference response; (5) the active compounds are relatively heat stable and can be concentrated by lyopholyzation and stored for at least 9 months without appreciable loss of behavioral activity; and (6) at least the major components have molecular weights of less than 1,000.

During the 1981 spawning season, our major effort was directed at purifying the major behaviorally active compounds in urine from sexually mature males so that sufficient quantities could be prepared for structural studies. During June and July, 18 pooled samples of urine were collected from sexually mature males. The pools ranged in volume from 30 to 170 mL and totaled 1970 mL. Eight of the urine samples (820 mL) elicited preference responses in females at a concentration of 12.8 μL/L. An HPLC profile of behaviorally active male urine shows at least eight peaks which can be differentiated and several of these appear to represent more than one compound. This profile simply indicates that there are a number of compounds in active urine which can be distinguished by this particular combination of column, solvents, flow rate and detector wavelength. It is likely that there are a large number of compounds present which are not seen under the conditions used for this profile, e.g., compounds which do not absorb UV light.

Samples of behaviorally active urine were concentrated by lyopholyzation and chromatographed on Sephadex G-10 and LH-20 columns. The fractions obtained from these columns were bioassayed in the preference tanks using sexually mature females. Behavioral activity was found only in the first two post-void fractions from both columns suggesting that at least the major active compounds had molecular weights between 300 and 1,000. An HPLC profile of a behaviorally active LH-20 fraction (F-2) was obtained under exactly the same conditions (column, solvents, flow rate, and chart speed) as that for urine except that the sensitivity was increased. Two large peaks, each with a shoulder suggesting more than one compound, and at least two smaller peaks can be distinguished. The compounds represented by the two major peaks have been separated by preparative scale HPLC and will be tested when sexually mature females become available this summer. This process of fractionation and bioassay will continue until fractions are generated which have behavioral activity and appear to contain a single compound. As much pure material as possible will then be prepared and structural determination begun.

Ammocete Pheromone—Experiments conducted during 1979–80 indicated that substances released by sea lamprey larvae evoke a preference response in sexually immature spawning-run adults and that the active compounds can be concentrated on Amberlite XAD-2 resin. Attempts to replicate these experiments during the 1981 spawning season were only partially successful. The response of spawning-run lampreys to substances released by ammocetes is quite variable, probably because the responsiveness of the test animals decreases as they become more sexually mature. It is also possible that the quantities of the active substances released by ammocetes change as a function of uncontrolled environmental or physiological factors. The results to date suggest that spawning-run adults are responsive to ammocete metabolites or excretions only a relatively short period of time, prior to the appearance of secondary sex characteristics.

Currently, we are attempting to concentrate large quantities of organic compounds from tanks containing sea lamprey larvae by continuously recirculating the water through Amberlite XAD-2 columns. The columns are extracted with methanol every 7 to 10 days and the material is either frozen and stored in solution or lyopholyzed to dryness and stored. Preliminary fractionation has been performed with Sephadex G-10 and LH-20 columns and the fractions frozen until testing can begin in the spring.

Special Studies

TFM Teratology Study—EPA notified the U.S. Fish and Wildlife Service that a teratology study on TFM in a second species will be required to meet reregistration requirements. Negotiations with bidders for the development of an acceptable protocol are under way. Funds for the study will be provided by the Commission out of their "Special Studies" budget.

Publications in Calendar Year 1981

Abidi, S. L. 198–. Detection of diethylnitrosamine in nitrite-rich water following treatment with rhodamine flow tracers. Water Research. In press.

Hanson, L. H. 1981. Sterilization of sea lampreys (*Petromyzon marinus*) by immersion in an aqueous solution of bisazir. Canadian Journal of Fisheries and Aquatic Sciences 38(10):1285–1289.

ADMINISTRATIVE REPORT FOR 1981

Meetings

The Commission held its 1981 Annual Meeting in Ottawa, Ontario, on 17–19 June, and its Interim Meeting in Washington, D.C., on 8–9 December 1981. In addition, both Canadian and U.S. sections met in plenary session on 18 June in conjunction with the Annual Meeting in Ottawa. The Commision also held executive meetings of commissioners and staff as follows:

18 February	Ann Arbor, Michigan
16 June	Ottawa, Ontario
9 September	Detroit, Michigan
7 December	Washington, D.C.

Meetings of standing committees during 1981 were:

Sea Lamprey Control and Research, Ann Arbor, Michigan, 16–17 February
Lake Ontario Committee, Niagara Falls, New York, 3–4 March
Lake Huron Committee, Milwaukee, Wisconsin, 10 March
Lake Michigan Committee, Milwaukee, Wisconsin 11 March
Lake Superior Committee, Milwaukee, Wisconsin, 12 March
Lake Erie Committee, Windsor, Ontario, 17–18 March
Great Lakes Fish Disease Control Committee, La Crosse, Wisconsin, 14–15 April
Council of Lake Committees, Detroit, Michigan, 28 April
Board of Technical Experts, Ottawa, Ontario, 15 June and Toronto, Ontario, 9 November

Attendance at other Commission-related meetings included the sea lamprey control agents' annual sea lamprey conference, Sea Lamprey Audit Team, Joint Strategic Plan for Management of Great Lakes Fisheries Steering Committee and Work Groups, Adaptive Management Workshop, sea lamprey management planning meetings, Walleye Standing Technical Committee, and the Sea Lamprey Wounding Workshop.

Officers and Staff

Several changes in Commission membership occurred during 1981. Commissioner F. R. Lockard resigned 23 February when he accepted an appointment as Director, Department of Game and Inland Fisheries, State of Washington. Chairman R. L. Herbst tendered his resignation and prior to the 16 June Annual Meeting, G. R. Arnett was designated alternate commissioner. Mr. Arnett was the newly appointed Assistant Secretary of the Interior for Fish, Wildlife, and Parks, replacing Mr. Herbst. Commissioner W. M. Lawrence was elected to finish Mr. Herbst's 1981/1982 term as GLFC chairman, effective at the close of the 1981 Annual Meeting. Vice-chairman Johnston continued his term of office through 1981.

No changes in staff occurred during 1981.

The Commission's Sea Lamprey Control and Research Internal Operating Committee was renamed the Sea Lamprey Committee. The words ''internal operating'' were dropped from the Commission's committee structure. Committee assignments established in June 1980 remained formally unchanged through June 1981. Alternate Commissioner Arnett was added to the Finance and Administration Committee, and 1981 ended with the following Commission membership on committees.

Finance and Administration

Commissioners	*Staff Members*
H. D. Johnston, Chairman	B. S. Biedenbender
G. R. Arnett	C. M. Fetterolf

Sea Lamprey

Commissioners	*Staff Members*
H. A. Regier, Chairman	C. M. Fetterolf
W. M. Lawrence	A. K. Lamsa

Fisheries and Environment

Commissioners	*Staff Members*
C. Ver Duin, Chairman	R. L. Eshenroder
M. G. Johnson	C. M. Fetterolf
K. H. Loftus	M. A. Ross

Staff Activities

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

During 1981 the staff participated in the following conferences, meetings, and activities:

American Fisheries Society
Canada Sport Fishing Conference
Canadian Committee for Fisheries Research
Fish Health Workshop
Great Lakes Basin Commission
Great Lakes Ecosystem Rehabilitation
IJC Science Advisory Board
IJC Water Quality Board
IJC Surveillance Work Group
International Association for Great Lakes Research
Michigan Fish Producers Association
Michigan Sea Grant
National Wildlife Federation—Great Lakes Affiliates
Ontario Council of Commercial Fisheries
Ontario Hydro
U.S. Army Corps of Engineers (winter navigation)
Walleye Tagging Study Group
Wisconsin Sea Grant

Accounts and Audits

The Commission accounts for the fiscal year ending 30 September 1981 were audited by Icerman, Johnson, and Hoffman of Ann Arbor. The firm's reports are appended.

Program and Budget for FY 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, continuing field research in direct support of control operations, the operation of portable assessment weirs on all the Great Lakes, continuing research to assess immediate and long-term effects of lampricides in the environment, 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. The Commission requested no increase over fiscal year 1980 levels since it used unobligated funds to make up the difference. The Commission, however, urged the governments to recognize the fiscal year 1981 requirement as the budget base for determining future budgets.

The Canadian agent performed 24 lampricide treatments on streams tributary to Lakes Superior, Huron, and Ontario (both in the United States and Canada). In addition, stream surveys to monitor larval lamprey populations were continued. Several problem areas involving major applications of granular Bayer 73 also were treated. In addition, an assessment network of weirs and portable assessment traps were operated on selected tributaries to monitor sea lamprey spawning runs to measure changes in abundance and biological characteristics.

Lampricide treatments were completed on 45 streams in Lake Superior, Michigan, and Huron. The U.S. agent maintained stream surveys to monitor larval lamprey populations, maintained studies on the growth and time to metamorphosis of selected larval populations, and operated a network of portable assessment traps on selected Great Lakes tributaries to monitor sea lamprey spawning runs to measure changes in abundance and biological characteristics.

The current sea lamprey research program at the Hammond Bay Biological Station and the registration-oriented work at the National Fishery Research Laboratory, La Crosse, Wisconsin, were continued through fiscal year 1981.

The Commission negotiated a Memorandum of Agreement with its U.S. agent, the U.S. Fish and Wildlife Service, for work involving $3,076,800 and provided lampricides valued at $605,750. A Memorandum of Agreement was executed which provided the Commission's Canadian agent, the Department of Fisheries and Oceans, with $2,046,700 including lampricides valued at $468,250. The Commission also held $15,000 in reserve for contingency funding for registration-oriented research on lampricides. Funding was also approved for the construction of barrier dams on carefully selected streams to prevent sea lamprey access to hard-to-treat areas and reduce costs of control: $335,000 was approved for use on the U.S. side and $150,000 on the Canadian side. In addition, the Commission reviewed its administration and general research budget for fiscal year 1981.

The increase in program costs over fiscal year 1980—$574,300 was absorbed by the Commission using unobligated funds derived from bank interest and unexpended monies returned by the contract agents. Consequently, the funding by governments for fiscal year 1981 was 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

At the end of the fiscal year the U.S. agent refunded $161,070. The Canadian agent had unexpended funds in the amount of $149,761 of which $57,000 was carried over to complete barrier dam construction and $37,000 to build a docking facility in Sault Ste. Marie. The Commission also earned $454,000 bank interest during fiscal year 1981. These monies were used to further the Commission's mandate in the Great Lakes such as the Great Lakes Ecosystem Rehabilitation Project, Adaptive Management Modelling, and several other research projects, as well as reducing future requests for funding.

Program and Budget for FY 1982

At the 1980 annual meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1982 estimated to cost $6,359,000. The program calls for contination 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 all the Great Lakes required to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, including biological control, 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 $448,400 was adopted for administration and general research for a total program cost of $6,807,400. The funding by governments for fiscal year 1982 is as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$4,387,700	$1,971,300	$6,359,000
Administration and General Research	224,200	224,200	448,400
TOTAL	$4,611,900	$2,195,500	$6,807,400

On 29 September 1981, the U.S. Government announced across-the-board funding reductions which included the Great Lakes Fishery Commission's appropriation. The fiscal year 1982 budget was cut by $323,000 on the U.S. side thus triggering a $145,100 cut on the Canadian side for a total loss of $468,100 in funding.

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 Hammond Bay Biological Station and the registration-oriented work at the National Fishery Research Laboratory, La Crosse, Wisconsin, are to continue through fiscal year 1982.

The Commission negotiated a Memorandum of Agreement with its U.S. agent, the U.S. Fish and Wildlife Service, for work costing $3,365,100 which 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 $2,058,900, including purchase of lampricides and funding of barrier dams projects.

Program and Budget for Fiscal Year 1983

At the 1981 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1983 estimated to cost $6,858,000. 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 all the Great Lakes, required research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, 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 $590,600 was adopted for administration and general research for a total program cost of $7,448,600. The Commission approved the use of $310,000 from fiscal year 1981 unobligated funds to reduce funding requests to governments. Thus, the total request will be $7,138,600 shared by the Canadian and U.S. Governments according to the contribution formulas.

ICERMAN, JOHNSON & HOFFMAN
Certified Public Accountants
303 NATIONAL BANK AND TRUST BUILDING
ANN ARBOR, MICHIGAN 48104
(313) 769-6200

To the Great Lakes Fishery Commission
Ann Arbor, Michigan

We have examined the statements of certain assets, liabilities and fund balances resulting from cash transactions of the Great Lakes Fishery Commission as of September 30, 1981, and the related statements of cash receipts and disbursements 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.

As described in Note 1 to the financial statements, the accompanying statements are prepared on the cash basis of accounting, and accordingly, they are not intended to be presented in conformity with generally accepted accounting principles

In our opinion the financial statements referred to above present fairly certain assets, liabilities and fund balances arising from cash transactions of the Great Lakes Fishery Commission as of September 30, 1981, and the cash transactions for the year then ended, in conformity with the Commission's cash basis of accounting, as described in Note 1 to the financial statements, applied on a consistent basis after restatement for the change, with which we concur, to the cash basis of accounting as described in Note 2 to the financial statements.

Ann Arbor, Michigan
December 21, 1981

Icerman Johnson & Hoffman

GREAT LAKES FISHERY COMMISSION

STATEMENTS OF CERTAIN ASSETS, LIABILITIES AND FUND BALANCES
RESULTING FROM CASH TRANSACTIONS
September 30, 1981

ASSETS	Administration and General Research Fund	Sea Lamprey Control and Research Fund	Totals (Memorandum Only)
Cash, including certificates of deposit of $1,853,000	$ 848,363	1,180,817	2,029,180
Due from United States Fish and Wildlife Service (Note 3)	-0-	161,070	161,070
Due from Canadian Department of Fisheries and Oceans (Note 3)	-0-	149,761	149,761
Due from Sea Lamprey Control and Research Fund (Note 3)	179,731	-0-	179,731
Total Assets	$1,028,094	1,491,648	2,519,742
LIABILITIES AND FUND BALANCES			
Liabilities:			
Payroll tax withholdings	$ 506	-0-	506
Due to Administration and General Research Fund (Note 3)	-0-	179,731	179,731
Total Liabilities	506	179,731	180,237
Fund Balances:			
Reserved for specific projects (Note 4)	380,615	-0-	380,615
Reserved for barrier dam project	-0-	100,000	100,000
Unreserved:			
Designated for subsequent years' expenditures (Note 5)	-0-	1,210,188	1,210,188
Undesignated	646,973	1,729	648,702
Total Fund Balances	1,027,588	1,311,917	2,339,505
Total Liabilities and Fund Balances	$1,028,094	1,491,648	2,519,742

See Notes to Financial Statements.

GREAT LAKES FISHERY COMMISSION

STATEMENTS OF CASH RECEIPTS AND DISBURSEMENTS AND CHANGES IN FUND BALANCES
Year Ended September 30, 1981

	Administration and General Research Fund			Sea Lamprey Control And Research Fund			Totals (Memorandum Only)		
	Budget	Actual	Variance - Favorable (Unfavorable)	Budget	Actual	Variance - Favorable (Unfavorable)	Budget	Actual	Variance - Favorable (Unfavorable)
Receipts:									
Canadian government	$ 202,850	202,850	-0-	1,621,414	1,624,208	2,794	1,824,264	1,827,058	2,794
United States government	181,500	181,500	-0-	3,827,200	3,827,200	-0-	4,008,700	4,008,700	-0-
Interest earned	-0-	453,991	453,991	-0-	-0-	-0-	-0-	453,991	453,991
Miscellaneous	-0-	1,352	1,352	-0-	-0-	-0-	-0-	1,352	1,352
	384,350	839,693	455,343	5,448,614	5,451,408	2,794	5,832,964	6,291,101	458,137
Disbursements:									
Canadian Department of the Fisheries and Oceans	-0-	-0-	-0-	12,71,668	1,204,432	67,236	1,271,668	1,204,432	67,236
United States Fish and Wildlife Service	-0-	-0-	-0-	3,076,800	2,915,730	161,070	3,076,800	2,915,730	161,070
Lampricide purchases	-0-	-0-	-0-	1,014,750	1,585,260	(570,510)	1,014,750	1,585,260	(570,510)
Special studies - contingency	-0-	-0-	-0-	15,000	15,000	-0-	15,000	15,000	-0-
Barrier Dams	-0-	-0-	-0-	462,688	199,565	263,123	462,688	199,565	263,123
Administration	302,200	316,414	(14,214)	-0-	-0-	-0-	302,200	316,414	(14,214)
General research	375,152	330,302	44,850	-0-	-0-	-0-	375,152	330,302	44,850
	677,352	646,716	30,636	5,840,906	5,919,987	(79,081)	6,518,258	6,566,703	(48,445)
Excess of Receipts Over (Under) Disbursements	(293,002)	192,977	485,979	(392,292)	(468,579)	(76,287)	(685,294)	(275,602)	409,692
Other Sources (Uses):									
Foreign exchange gains (losses)	-0-	(2,107)	(2,107)	-0-	(2,750)	(2,750)	-0-	(4,857)	(4,857)
Interfund transfers (Note 3)	-0-	179,731	179,731	-0-	(179,731)	(179,731)	-0-	-0-	-0-
	-0-	177,624	177,624	-0-	(182,481)	(182,481)	-0-	(4,857)	(4,857)
Excess of Receipts and Other Sources Over (Under) Disbursements and Other Uses	(293,002)	370,601	663,603	(392,292)	(651,060)	(258,768)	(685,294)	(280,459)	404,835
FUND BALANCE - October 1, 1980, as previously stated	647,173	647,173	-0-	1,433,610	1,433,610	-0-	2,080,783	2,080,783	-0-
Adjustments to Fund Balance (Note 2)	9,814	9,814	-0-	529,367	529,367	-0-	539,181	539,181	-0-
FUND BALANCE - October 1, 1980, as adjusted	656,987	656,987	-0-	1,962,977	1,962,977	-0-	2,619,964	2,619,964	-0-
FUND BALANCE - September 30, 1981	$ 363,985	1,027,588	663,603	1,570,685	1,311,917	(258,768)	1,934,670	2,339,505	404,835

See Notes to Financial Statements.

GREAT LAKES FISHERY COMMISSION

STATEMENTS OF CASH RECEIPTS AND DISBURSEMENTS AND CHANGES IN FUND BALANCES
Year Ended September 30, 1981

	Administration and General Research Fund			Sea Lamprey Control And Research Fund			Totals (Memorandum Only)		
	Budget	Actual	Variance - Favorable (Unfavorable)	Budget	Actual	Variance - Favorable (Unfavorable)	Budget	Actual	Variance - Favorable (Unfavorable)
Receipts:									
Canadian government	$ 202,850	202,850	-0-	1,621,414	1,624,208	2,794	1,824,264	1,827,058	2,794
United States government	181,500	181,500	-0-	3,827,200	3,827,200	-0-	4,008,700	4,008,700	-0-
Interest earned	-0-	453,991	453,991	-0-	-0-	-0-	-0-	453,991	453,991
Miscellaneous	-0-	1,352	1,352	-0-	-0-	-0-	-0-	1,352	1,352
	384,350	839,693	455,343	5,448,614	5,451,408	2,794	5,832,964	6,291,101	458,137
Disbursements:									
Canadian Department of the Fisheries and Oceans	-0-	-0-	-0-	12,71,668	1,204,432	67,236	1,271,668	1,204,432	67,236
United States Fish and Wildlife Service	-0-	-0-	-0-	3,076,800	2,915,730	161,070	3,076,800	2,915,730	161,070
Lampricide purchases	-0-	-0-	-0-	1,014,750	1,585,260	(570,510)	1,014,750	1,585,260	(570,510)
Special studies - contingency	-0-	-0-	-0-	15,000	15,000	-0-	15,000	15,000	-0-
Barrier Dams	-0-	-0-	-0-	462,688	199,565	263,123	462,688	199,565	263,123
Administration	302,200	316,414	(14,214)	-0-	-0-	-0-	302,200	316,414	(14,214)
General research	375,152	330,302	44,850	-0-	-0-	-0-	375,152	330,302	44,850
	677,352	646,716	30,636	5,840,906	5,919,987	(79,081)	6,518,258	6,566,703	(48,445)
Excess of Receipts Over (Under) Disbursements	(293,002)	192,977	485,979	(392,292)	(468,579)	(76,287)	(685,294)	(275,602)	409,692
Other Sources (Uses):									
Foreign exchange gains (losses)	-0-	(2,107)	(2,107)	-0-	(2,750)	(2,750)	-0-	(4,857)	(4,857)
Interfund transfers (Note 3)	-0-	179,731	179,731	-0-	(179,731)	(179,731)	-0-	-0-	-0-
	-0-	177,624	177,624	-0-	(182,481)	(182,481)	-0-	(4,857)	(4,857)
Excess of Receipts and Other Sources Over (Under) Disbursements and Other Uses	(293,002)	370,601	663,603	(392,292)	(651,060)	(258,768)	(685,294)	(280,459)	404,835
FUND BALANCE - October 1, 1980, as previously stated	647,173	647,173	-0-	1,433,610	1,433,610	-0-	2,080,783	2,080,783	-0-
Adjustments to Fund Balance (Note 2)	9,814	9,814	-0-	529,367	529,367	-0-	539,181	539,181	-0-
FUND BALANCE - October 1, 1980, as adjusted	656,987	656,987	-0-	1,962,977	1,962,977	-0-	2,619,964	2,619,964	-0-
FUND BALANCE - September 30, 1981	$ 363,985	1,027,588	663,603	1,570,685	1,311,917	(258,768)	1,934,670	2,339,505	404,835

See Notes to Financial Statements.

GREAT LAKES FISHERY COMMISSION

NOTES TO FINANCIAL STATEMENTS

Note 1. NATURE OF ORGANIZATION AND SIGNIFICANT ACCOUNTING POLICIES

Nature of the organization:

The Commission is an international organization created by convention between the United States and Canada, established to control Sea Lamprey and improve fish stock. The Commission operations are controlled by two funds:

1. Administration and General Research Fund which covers administrative expenses of the Commission and expenses of programs of general research contracted by the Commission or performed by the Commission's staff.

2. Sea Lamprey Control and Research Fund which covers expenditures for the Lamprey Control Program including research on Sea Lampreys. The Commission presently contracts the Lamprey Control Program to the United States Fish and Wildlife Service and the Canadian Department of Fisheries and Oceans.

No transfers of appropriations may be made between funds unless authorized by the Commission except as referred to in Notes 1 and 3.

Significant accounting policies:

Basis of accounting:

The Commission's accounts are maintained on a cash basis, and the statements of certain assets, liabilities, and fund balances resulting from cash transactions and the statements of cash receipts and disbursements reflect only cash received and disbursed. Therefore, receivables, inventories, fixed assets, payables, accrued income and expenses, and depreciation, which are material in amount, are not reflected and these statements are not intended to present the financial position or results of operations or changes in financial position in conformity with generally accepted accounting principles.

Fiscal year:

The Commission's September 30 fiscal year end corresponds with the United States government's fiscal year. The Canadian government has a March 31 fiscal year, consequently amounts budgeted for Canadian revenue and expense represent 50 of both the 1980-81 and 1981-82 Canadian fiscal years.

Income taxes:

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

Interest and miscellaneous income:

The Commission has credited all interest and miscellaneous income to the Administration and General Research Fund in accordance with established financial regulations.

NOTES TO FINANCIAL STATEMENTS (Continued)

Note 2. CHANGE IN BASIS OF ACCOUNTING

During the year ended September 30, 1981 the Commission changed from the modified accrual basis of accounting to the cash basis of accounting. Fund balances as of October 1, 1980 have been restated retroactively to effect this change.

Note 3. INTERFUND TRANSFERS AND LIABILITIES

Unused funds from United States Fish and Wildlife Service and Canadian Department of Fisheries and Oceans are refunded to the Sea Lamprey Control and Research Fund and subsequently transferred to the Administration and General Research Fund. The total transfer of $179,731 to the Administration and General Research Fund for fiscal year ending September 30, 1981 consists of $18,661 in Canadian refunds and $161,070 in United States refunds. Approximately $50,000 in additional funds has been retained by the Canadian Department of Fisheries and Oceans for future barrier dam expenditures and is not included in the refund receivable as of September 30, 1981.

Note 4. FUND BALANCE RESERVES

Commitments related to incomplete projects are recorded as reservations of fund balance. As of September 30, 1981, the Commission had the following commitments relating to specific projects which are to be funded by the Administration and General Research Fund.

Project Name	Total Budgeted	Expenditures through 9-30-80	Expenditures during year ended 9-30-81	Reserved @ 9-30-81
SGLFMP	$100,000	32,454	10,143	57,403
SGLFMP - Ontario Work Group	16,950	-0-	-0-	16,950
STOCS	226,000	123,855	15,899	86,246
SLAT	11,500	3,242	116	8,142
Brussard - 1979 project	13,937	10,453	-0-	3,484
Brussard - 1980 project	15,601	10,637	-0-	4,964
U.S. Fish & Wildlife slide/tape show production	1,825	-0-	325	1,500
Dept. of Fisheries & Oceans slide/tape show production	13,514	-0-	9,933	3,581
Ecosystem Health Workshop	9,121	-0-	4,137	4,984
Monroe	10,550	1,520	1,019	8,011
Atlantic Salmon Planning Conference	1,275	-0-	-0-	1,275
Gorbman	53,250	-0-	17,750	35,500
Koonce - Lake Erie Perch Modeling	22,842	-0-	17,132	5,710
Magnuson - Lake Trout Fry Movements	12,440	-0-	9,330	3,110
Allendorf - Allelic Frequency Divergence	5,305	-0-	3,979	1,326
Brussard - Overrun	7,590	-0-	5,693	1,897
Spangler Travel Funds	800	-0-	-0-	800
Lampricide Impact Review	10,000	-0-	-0-	10,000
Spitz Review	5,000	-0-	812	4,188

NOTES TO FINANCIAL STATEMENTS (Concluded)

Note 4. FUND BALANCE RESERVES (Concluded)

Project Name	Total Budgeted	Expenditures through 9-30-80	Expenditures during year ended 9-30-81	Reserved @ 9-30-81
Smith-Lamprey History and Typing	$ 4,200	-0-	-0-	4,200
Smith Project Canadian Addendum	1,645	-0-	-0-	1,645
Yellow Perch Committee - Computer Expense	2,000	-0-	103	1,897
Spangler/Krueger -Genetic Analysis	25,000	-0-	-0-	25,000
Talhelm Study (Part of GLERR II)	15,000	-0-	5,588	9,412
Word Processing System	20,000	-0-	-0-	20,000
Adaptive Environmental Assessment	38,500	-0-	12,696	25,804
GLERR III Study	33,500	-0-	3,664	29,836
Young Study	15,000	-0-	11,250	3,750
	$692,345	182,161	129,569	380,615

Note 5. UNRESERVED FUND BALANCE DESIGNATIONS

The excess of expenditures over revenues budgeted for the fiscal years ending September 30, 1982 and 1983 is to be funded by the fund balance in the Sea Lamprey Control and Research Fund. The budgeted excess of expenditures over revenues is approximately $200,000 for the year ending September 30, 1982 and $310,000 for the year ending September 30, 1983. Funds in the amount of $700,188 have been designated for future barrier dam construction. Total funds designated for subsequent years expenditures are $1,210,188.

Note 6. PENSION PLAN

The Commission contributes to the International Fishery Commissions' Pension Society, established in 1957, for all full-time employees/annuitants. The Commission's contribution was $10,528 for the year ended September 30, 1981. There is no unfunded liability as of September 30, 1981.

COMMITTEE MEMBERS—1981

Commissioners in Italics

BOARD OF TECHNICAL EXPERTS

CANADA	UNITED STATES
F. W. H. Beamish, Chm.	N. Kevern
W. J. Christie	J. L. Forney
J. Cooley	J. H. Kutkuhn
J. Donnan	J. J. Magnuson
G. R. Francis	P. J. Manion
A. P. Grima	G. Spangler
P. Ihssen	T. M. Stauffer
H. A. Regier	D. Talhelm
C. J. Walters	

SEA LAMPREY CONTROL AND RESEARCH

CANADA	UNITED STATES
H. A. Regier, Chm.	*W. M. Lawrence*
J. J. Tibbles	P. J. Manion

COUNCIL OF LAKE COMMITTEES

CANADA	UNITED STATES
R. M. Christie, Chm.	W. A. Pearce, V-Chm.

Members are listed below under Lake Committees

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D. Borgeson, Chm.	W. A. Pearce, Chm.
R. M. Christie, V-Chm.	D. E. Gage, V-Chm.

LAKE MICHIGAN	LAKE SUPERIOR	LAKE ERIE
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B. Muench, V-Chm.	L. Affleck, V-Chm.	D. Graff, V-Chm.
D. Borgeson	J. T. Addis	D. Borgeson
W. James	J. H. Kuehn	W. F. Shepherd
		R. L. Scholl

GREAT LAKES FISH DISEASE CONTROL COMMITTEE

J. W. Warren, Chm.	B. Gress	V. A. Mudrak
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G. Armstrong	J. E. Harvey	R. Ritzert
D. Bumgarner	J. G. Hnath	N. Robbins
J. Byrne	R. W. Horner	H. J. Sippel
J. Cady	G. E. Hudson	S. F. Snieszko
J. B. Daily	B. J. Hudson	B. W. Souter
V. Duter	S. Huffaker	W. Thompson
P. Economen	C. Lakes	R. A. Williamson
D. Goldthwaite		