ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1978

GREAT LAKES FISHERY COMMISSION

MEMBERS — 1978

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K. H. Loftus	L. P. Voigt

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M. A. Ross, Biological Assistant
W. J. Maxon, Chief Administrative Officer
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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
1978

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

LETTER OF TRANSMITTAL

In accordance with Article IX of the Convention on Great Lakes Fisheries, I take pleasure in submitting to the Contracting Parties an Annual Report of the activities of the Great Lakes Fishery Commission in 1978.

Respectfully,

L. P. Voigt, *Chairman*

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ANNUAL REPORT FOR 1978

INTRODUCTION

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

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

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

The Commission has now been in existence for 23 years. Its efforts to control the sea lamprey and reestablish lake trout have, in the main, been very successful although inherent problems remain. Residual populations of sea lampreys continue to be a source of mortality. Operational costs and costs of the chemicals used in the sea lamprey control program continue to rise. The need to develop and test alternative and supplementary control methods is urgent. Also, because of environmental considerations, the Commission is obligated to continue its support of research on the immediate and long-term effects of the chemicals being used. Self-sustaining populations of lake trout have not been widely reestablished, and efforts to encourage natural reproduction by lake trout must be intensified.

Through the years of its existence, the Commission has encouraged close cooperation among state, provincial, and federal fisheries agencies on the Great Lakes. Many, and probably most, of the fisheries problems are of concern to all agencies. The development of integrated and mutually acceptable management programs, supported by adequate biological and statistical information is vital. The Commission is gratified with the spirit of interagency cooperation that has developed and anticipates continued cooperation for the benefit of the fishery resource and its users.

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

The Commission's Annual Meeting was held at Rochester, N.Y., June 13–15, 1978 and its Interim Meeting was convened in Ann Arbor, Michigan, November 29–30, 1980.

ANNUAL MEETING

PROCEEDINGS

The twenty-third annual meeting of the Great Lakes Fishery Commission was held in Rochester, New York, June 13–15, 1978.

Commission Chairman Lester P. Voigt convened the meeting at 0920 h and introduced Mr. Langdon Marsh, First Deputy Commissioner, New York State Department of Environmental Conservation. Mr. Marsh welcomed the Commission and delegates on behalf of Governor Hugh Carey and Conservation Commissioner Peter Berle to New York State and the city of Rochester. He drew attention to the successful sport fishery now established in Lake Ontario and efforts to restore the historic fishery for lake trout. He regretted that New York had to suspend development of the Lake Ontario salmon fishery pending a decline in contaminant levels but stated that they are making efforts to improve water quality in their streams and Lake Ontario. He commended the Great Lakes Fishery Commission and its agents for the success of the sea lamprey control program, noting that sea lamprey control is a critical prerequisite in the restoration of salmonids in the Great Lakes. He also stressed the responsibility for national and international cooperation in the management of Great Lakes fisheries.

After thanking Mr. Marsh, Chairman Voigt welcomed Dr. Murray Johnson, Ontario Region, Director General, Canada Department of Fisheries and Environment, as the new Canadian Commissioner. Dr. Johnson hoped he could add a new dimension to the Commission with his background in environmental matters rather than in fisheries.

In his chairman's report, Commissioner Voigt thanked some of the key individuals involved and drew attention to important progress being initiated or underway such as the Strategic Great Lakes Fishery Management Plan, improvements in internal operating procedures, the formation and activities of the Council of Lake Committees, Scientific Advisory Committee activities, progress in the barrier dam program to stop spawning runs of sea lamprey, progress in registration of lampricides, and programming for the upcoming Sea Lamprey International Symposium and the Stock Concept Symposium.

Scientific Advisory Committee (SAC). Mr. Andrew Lawrie (OMNR), SAC Convenor, reported that the SAC:

Charged a subcommittee to evaluate the feasibility of rehabilitating Great Lakes ecosystems;

Supported development of western Lake Erie walleye quotas and efforts toward the feasibility of modelling those stocks;

Believed the Commission's Technical Report Series should be reserved for subjects of primary concern to Commission responsibilities;

Concluded that a Great Lakes fishery management plan should include efforts to develop estimates of piscivore carrying capacity for each Great Lake;

Responded to a question concerning the Commission's adequacy in the development and coordination of Great Lakes fishery research, by noting a need for definition of binational management goals in the context of a Great Lakes fishery management plan before research can be coordinated better, and noted that otherwise the Commission was adequately meeting its responsibilities;

Commented on the need for, and some positive steps being taken toward, an international, computer-based, storage and retrieval system for Great Lakes fisheries data; and,

Concerning adequacy of research on effects of contaminants on Great Lakes fish stocks, recognized the urgency of the problem but believed the SAC was not yet ready to respond.

Members of the SAC subcommittee summarized the first draft on the feasibility study of Great Lakes Ecosystem Restoration and Rehabilitation (GLERR).[1] The first draft, still subject to revision, was an attempt to assemble the information prepared by individuals from about 15 different agencies and institutions into one document. Restoration per se was an unlikely outcome but rehabilitation was considered a more apt term for the program. Subcommittee members commented on man-induced stresses (about 16 different kinds were identified) which affect the Great Lakes biota, the socioeconomic feasibility of rehabilitation, restoration-rehabilitation-enhancement techniques in use (sea lamprey control, fish stocking, limiting fish catch, and stream rehabilitation), and possible institutional arrangements for rehabilitation. SAC recommended that the draft undergo review by various groups prior to finalizing the document for presentation to the Commission in June 1980.

Fisheries Management. Reporting on behalf of the fish disease control committee, Mr. James Warren (USFWS) emphasized the importance of fish disease control in fish culture operations which in turn are essential for the rehabilitation of Great Lakes fish stocks. The Food and Drug Administration (FDA) has tightened control on sales, use and registration of drugs for controlling common fish diseases, and the USFWS and Commission have urged the FDA to identify guidelines for registration of those therapeutics which are needed for hatchery operations.

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

Dr. J. Kutkuhn (USFWS) summarized some of the salient points of the report on the inventory of fish stock assessment needs which had been presented at the Commission's interim meeting in December 1977. He identified three deficiencies in assessment—overall coverage seemed to be only about one-half of what it should be, assessment of the sports fishery was inadequate, and compilation, synthesis, and interpretation of data for application to management was not timely. Representatives of each of the lake committees generally supported the report's recommendations, although some of the lake committees also expressed some qualifications.

Mr. Eric Gage (OMNR) reported for the Lake Ontario Committee on winter navigation, sea lamprey in the Oswego River system, contaminants, commercial fish harvest and particularly the eel fishery, salmonid stocking, and trout reproduction. Mr. Griebenow (USFWS) added comments on winter navigation, expressing the need for a total examination of lake levels, international impacts, cost-benefit ratio, and the total evironmental effects. He advised that such a study is being formulated through a program known as the Evnironmental Assessment of the Great Lakes–St. Lawrence Ecosystem (EAGLE). He asked the Commission for their open-minded support for the EAGLE team and the need for a holistic approach to the problems.

Mr. A. Holder (OMNR) reported for the Lake Erie Committee and the Lake Erie Committee's Standing Technical Committee. In 1978 young-of-the-year abundance for walleye was the highest on record and for yellow perch the third highest. Harvest of walleyes was now effectively controlled and they were relatively abundant in the western basin. The Lake Erie Committee suggested that the following two reports be published in the Commission's Technical Report Series: "First Technical Report of the Lake Erie Committee's Scientific Protocol Committee on Interagency Management of the Walleye Resources of Western Lake Erie" and "Technical Rationale for Adjusting the Minimum Size Limit for Yellow Perch in Western Lake Erie." Mr. Holder also summarized the Standing Technical Committee's recommendations on walleye quotas for 1978 and 1979 and added information on their workshop for standardizing interagency assessment of yearling walleye.

Mr. Ron Christie (OMNR) summarized the report of the Lake Huron Committee which featured information on the forage base, status of splake (lake trout × brook trout hybrid) and backcrosses (splake × lake trout) stocks, chub populations, and regulation changes.

Mr. Henry Vondett (MDNR) summarized the report of the Lake Michigan Committee which featured information on sea lamprey abundance, yellow perch year class variations in southern Green Bay, the lake-wide coho salmon assessment study, alewife populations, observations of lake trout fry in Grand Traverse Bay, and technical committee reports on chub, lake trout, and sport fishing statistics.

Mr. C. Burrows (MnDNR) reported for the Lake Superior Committee on sea lamprey control and wounding rates on lake trout, whitefish, and rainbow smelt abundance, the low population levels of lake herring and chub, and consideration of a put-grow-take fishery for lake trout, including costs of providing fish. The Lake Superior committee also recommended forming a technical committee to develop a more precise model to determine the cost benefits of the put-grow-take concept under various parameters.

Mr. Ron Christie (OMNR) reported for the Council of Lake Committees, explaining the council had difficulty reaching consensus on strategic and operational planning for Great Lakes fisheries and was seeking further direction and clarification from the Commission before proceeding.

Mr. Vondett (MDNR) reported for the plenary session of the Upper Great Lakes Committee; the topics included the danger of sea lamprey infesting the Fox River system, sea lamprey barrier dams, coastal zone management programs, the status of lake trout broodstocks, coded wire tagging of fish, and lake trout stocking schedules.

Sea Lamprey Control and Research. The Commission accepted reports on sea lamprey control for 1977 from Dr. Tibbles and Mr. Dustin of the Canadian Department of Fisheries and Environment (DFE), and Mr. Braem of the U.S. Fish Wildlife Service (USFWS). Their reports are published elsewhere in this annual report. Both groups also presented progress reports for the spring of 1978. Some discussion centered on new stream populations of sea lamprey larvae, problem areas where sea lamprey larvae continue to be found in lake environments off streams in which they spawn, and the potentially serious problems that could arise if pollution abatement programs in the Fox River (Green Bay, Wisconsin) open access for sea lamprey to the extensive watershed above Lake Winnebago.

Commissioner Lawrence reported progress on use of barrier dams to prevent sea lamprey spawning in problem rivers, including the recent approval by the Commission for a contract with the State of Michigan for construction of a barrier dam in the West Branch of the Whitefish River (Lake Michigan). He stressed that while some savings in lampricide costs will accrue from the construction of barrier dams, a major benefit will be the elimination of lampreys from the areas where treatment is difficult and ineffective. Research to make barrier dams more effective is underway including studies on burst swimming speeds of sea lamprey and their ability to surmount obstructions. Dr. William Youngs (Cornell University) presented a preliminary report on the latter.

Mr. Thomas Edsall (USFWS) summarized the 1977 annual report of the Hammond Bay Biological Station (report is published elsewhere in this annual report), including information on sea lamprey chemosterilization and immunological studies, and criteria to specify the age of lamprey-inflicted wounds and scars on lake trout. He also presented a progress report for the spring of 1978, highlighting recent activities in the aforementioned areas as well as studies on chemical sensing in the sea lamprey and on the burst swimming speed of adult spawning run sea lamprey.

Dr. Fred Meyer (USFWS) summarized the activities of the Fish Control Laboratory on registration-oriented research on lampricides (published elsewhere in this annual report). He also expressed his appreciation for the excellent work of Mr. Harry Van Meter (USFWS) registration liasion officer to EPA, and credited him with much of the progress that has been made. These appreciative comments were also endorsed by Commissioner Lawrence on behalf of the Commission. Mr. Van Meter reported on the status of registration of lampricides and added that his efforts had been channeled in two main directions: registration of fishery-use drugs through FDA and registration of fishery-use chemicals, including lampricides, through EPA.

Mr. Bernie Smith (USFWS) summarized progress on the Sea Lamprey International Symposium which was scheduled for the summer of 1979. He reported that a firm agenda would be ready by the end of 1978, that the budget provided by the Commission appeared adequate, and that the symposium was providing an impetus to compile and synthesize "old sea lamprey data, a desirable development."

The Commission approved both 1979 and 1980 Sea Lamprey Control and Research programs and budgets, and also gave tentative approval to the administration and general research allocations for the two years:

	1979	*1980*
Sea Lamprey Control and Research	$4,891,000	$5,546,600
Administration and General Research	246,400	363,000
Total	$5,137,400	$5,909,600

Roundtable on Toxic Materials: Criteria for Decision and the Decision Train. The session was chaired by the Commission's Executive Secretary, Carlos Fetterolf, who explained that the roundtable would address the effect of contaminants and regulatory agency decisions on utilization of the fishery.

Ms. E. J. Campbell, Consumer Safety Officer, Division of Regulatory Guidance, Food and Drug Administration, Washington, D. C., explained the purpose of the Federal, Food, Drug, and Cosmetic Act, her agency's role, and commented upon the proposal to reduce the tolerance for PCBs in fish from 5 ppm to 2 ppm and the procedure for public comment, including the use of the Federal Register. Discussion centered on PCB concentrations in fish, methods of reducing contaminant loads by proper preparation, and effects of contaminants on New York's fisheries.

Dr. Donald L. Grant, Pesticide Section, Toxicological Evaluation Division, Health and Welfare Canada, explained the Canadian decision to reduce PCB tolerance from 5 ppm to 2 ppm, and remarked upon export of contaminated products.

Dr. David Axelrod, Director, Division of Laboratories and Research, Department of Health, New York State, explained New York's decision for "no consumption" of fish from Lake Ontario because of Mirex contamination and the decision train for reaching regulatory decisions. He also commented on export of products with contaminants.

Dr. Brian Wheatley, Director, Environmental Contaminants Program, Medical Services Branch, Health and Welfare Canada, pointed out that the department has as one of its responsibilities, the provision of health care to all Indian people living on reserves in Canada. He described the department's concern with the effects of contaminants in Indian communities, many of which have high dietary levels of fish, the department's recommendations, and studies underway and proposed.

Dr. John Allin, Fisheries Branch, Ontario Ministry of Natural Resources, described the province's fish sampling program and the booklets, "Guide to Eating Ontario Sport Fish," which provide recommended consumption guidelines.

Mr. A. P. Hafner, Food Technologist, Food Inspection Division, Michigan Department of Agriculture, described the sampling program being conducted with fish marketed in Michigan.

Dr. Wayland Swain, Director, Large Lakes Research Station, U.S. EPA, Grosse Ile, Michigan, discussed the present status and future directions related to toxic substances in the Great Lakes, particularly DDT and PCB's.

Dr. Rich L. Thomas, Director, Great Lakes Biolimnology Laboratory, Canada Centre for Inland Waters, summarized information on lead, its toxicity, and distribution in the Great Lakes.

Dr. David Edgington, Head, Ecological Sciences Section, Argonne National Laboratory, Illinois, described their research with radio nuclides.

Status of National Fish Hatcheries (USFWS). Mr. Richard St. Pierre (USFWS) reported on the status of the Allegheny National Fish Hatchery (Pennsylvania), and Mr. P. Manion summarized improvements underway or completed at the Pendills Creek, Hiawatha Forest, and Jordan River National Fish Hatcheries (Michigan). He also described progress towards construction of the new Iron River National Fish Hatchery in northern Wisconsin.

National Section Meetings. Commissioner Kerswill, who chaired the meeting of the Canadian Section, summarized the discussions which included the St. Marys River remedial works, sea lamprey barrier dams and the policy statement, winter navigation, atmospheric input of pollutants and the IJC, and lack of Canadian control over U.S. charter boats in Canadian waters of Lake Erie and Lake of the Woods. The Canadian Section also considered a resolution from the Ontario Council of Commecial Fisheries to discontinue plantings of Pacific salmon in the Great Lakes. Receipt of the resolution was acknowledged, but it was not endorsed. Concern was also expressed about the inability to meet demands for disease free fish stocks for planting and the lack of information about the presence of tumors in Great Lakes fish. The Canadian Section recommended that the disease problem be reviewed by the Commission's Fish Disease Control Committee, and that the Scientific Advisory Committee consider the tumor problem.

Commissioner Claude Ver Duin, U.S. Section chairman, reported for the U.S. Section. The Section accepted the recommendations from the Lake Superior Advisory Committee, discussed the "Ruppe Bill" recently introduced into the Congress, which would add three sections to the Great Lakes Fishery Act of 1956, opposed a bill for reciprocal licenses for sports fishermen (the Great Lakes would be heavy losers under such an arrangement), considered the problem of increased insurance rates for commercial fishermen (an association of fishing interests which include the Great Lakes has been established to work with insurance companies to resolve the problem), considered a request from the commercial fishing industry that they be allowed to contribute to the fish monitoring program (no action taken), and discussed a suggestion that the Commission and the fishery agencies devote more effort to public relations programs. The U.S. Section also acknowledged receipt of a communication from the Ottawa Sportsmen Association (Lance-Baraga, Michigan) relative to the need for effective control of Indian fisheries. The U.S. Section (and the Commission) recognized the need for adequate control of all fisheries if the objective of self-sustaining populations of lake trout is to be achieved. A report from the Michigan Fish Producers Association on the potential of hatchery operations for whitefish was also received. The U.S. Section also considered the proposal by the National Marine Fisheries Service (NMFS) to concentrate their Great Lakes efforts on marketing, but the commercial fishing industry is opposed to the one project proposed and objects to moving the Ann Arbor NMFS office to Chicago.

Administrative and Executive Decisions. The Commission:

Approved the Sea Lamprey Control and Research and Administration and General Research programs and budgets for fiscal years 1979 and 1980;

Made several administrative decisions including the hiring of a new biological assistant, meeting schedules and attendance, and approved a personnel procedures manual;

Activated the barrier dam program by approving three barrier dam contracts. This program is designed to deny sea lamprey access to spawning areas;

Heard the report of its ad hoc committee to clarify the need for sea lamprey control in the Oswego River system and consider the feasibility of associated sea lamprey control and research needs;

Contracted with Dr. William Beamish (University of Guelph) to continue work on the bibliography on cyclostomes and approved his project for compiling data on sea lamprey scarring in Atlantic salmon;

Contracted with Dr. William Youngs (Cornell University) for work on required height of sea lamprey barriers and endorsed complementary research at the Hammond Bay Biological Laboratory on burst swimming speeds of sea lampreys;

Requested the USFWS Fish Control Laboratory at La Crosse to investigate the feasibility of neutralizing TFM as an emergency safety measure;

Approved funding for key-punching of sea lamprey data in U.S. and Canada to facilitate analyses prior to the Sea Lamprey International Symposium. The Commission also endorsed the steering committee's plans and approved a budget;

Instructed the Secretariat to complete the compilation of registration-oriented studies on lampricides for use by cooperators as a reference guide;

Approved a manuscript (Hanson and Manion) on chemosterilization of the sea lamprey for publication in the technical report series;

Expressed its gratitude for the report by Drs. Kutkuhn and Hartman (USFWS) on current status of fish stock assessment programs;

Noted the communication relative to the status of, and hoped-for improvement in timeliness of, reports on commercial fishery statistics, and the continued effort to intergrate Canadian and U.S. statistics;

Discussed the development of the Strategic Great Lakes Fishery Management Plan at length and noted the Council of Lake Committee's request for direction. The Commission has requested staff to prepare a summary statement for review which will be considered by the Commission and Council of Lake Committees;

Approved the Executive Secretary's attendance at the IJC hearing in July 1978 concerning IJC water quality objectives to present Commission comments, stressing the need for an approach that will measure the quality of the ecosystem;

Noted the concern of its cooperators concerning winter navigation, and advised that staff has been requested to stay current with developments;

Rejected the purchase of equipment for marking fish with coded wire tags for the present, but noted the interest in this topic and suggested that if a specific proposal should emerge the Commission would be willing to reconsider;

Agreed to provide financial support to the Scientific Advisory Committee as necessary for its Great Lakes Ecosystem Rehabilitation and Restoration Steering Committee;

Concluded that the Stock Concept Symposium is of major importance and announced that the date has been advanced to late 1979 or early 1980. Selected a steering committee with Mr. A. Berst (OMNR) and Dr. R. Simon (USFWS) as co-chairmen;

Expressed its pleasure with progress on developing western Lake Erie walleye quotas and the continued interest in further modelling work on an improved data base;

Announced its shared concern with the Fish Disease Control Committee at the lack of approved drugs and chemicals for fish culture purposes. The Commission committed to corresponding with FDA on the need for guidelines for research from which to obtain registration. Similar correspondence will go to Canada. The commission also charged the Fish Disease Control Committee to review agency progress since the fish disease control policy was issued in 1975; and

Announced its intention to initiate a series of internal management audits to assess how well the Commission is meeting its objectives and responsibilities. Assistance of various cooperators will be sought in these audits.

Election of Officers. Mr. K. H. Loftus was elected as chairman and Mr. R. L. Herbst as vice-chairman to serve two year terms. Newly-elected Chairman Loftus expressed his appreciation for the honor and assured the audience that he would perform his duties to the best of his ability. He recognized the development of a strategic Great Lakes fishery management plan as an important challenge.

Other Business. Commissioner Ver Duin, on behalf of the Commission, expressed thanks to the outgoing chairman, Lester P. Voigt and made a presentation in recognition of his excellent service. Mr. Voigt expressed his appreciation for the gift and the cooperation of fellow commissioners and attendees.

Adjournment. The next annual meeting was scheduled for June 25–27, 1979 in Toronto, Ontario. The chairman thanked the attendees for their participation in a productive meeting and adjourned the meeting at 1220 h, June 15, 1978.

INTERIM MEETING

PROCEEDINGS

The Great Lakes Fishery Commission's 23rd Interim Meeting was convened in Ann Arbor, Michigan on 29–30 November 1978, to review programs, budgets, and achievements of the preceding six months, and to consider the activities of its various committees. Commissioner Frank R. Lockard (Director, Division of Fish and Wildlife, Indiana Department of Natural Resources) was welcomed as the newly appointed replacement for Commissioner L. P. Voigt, whose resignation had previously been accepted by U. S. President Carter. Margaret Ross was introduced to attendees as the most recent addition to the Commission staff.

SEA LAMPREY CONTROL AND RESEARCH

The Commission considered programs and budgets for fiscal years 1979 and 1980. The sea lamprey control and research program for 1979 includes lampricide treatments on Lakes Superior, Michigan, Huron, and Ontario, the operation of electric assessment weirs on Lake Superior and Huron, use of portable assessment traps on Great Lakes tributaries, sea lamprey stream surveys on all the Great Lakes including portions of the Finger Lakes-Oswego River system in New York, research at Hammond Bay Biological Station and registration-oriented research on lampricides conducted through the National Fishery Research Laboratory at La Crosse, Wisconsin.

Appropriations for fiscal year 1979 are as follows:

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

For fiscal year 1980 a program and budget was submitted to the U.S. and Canadian governments which calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys for larval sea lamprey, operation of electric assessment weirs on Lake Superior and Lake Huron, use of portable assessment traps on Great Lakes tributaries, research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, and continuation of barrier dam construction on selected streams to prevent sea lamprey access to problem areas, reducing application costs and the use of expensive lampricides.

Requested appropriations for fiscal year 1980 are as follows:

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

Commissioner Lawrence reported on his Committee's progress in drafting a programmatic environmental assessment statement for barrier dam construction, the updating of "Guidelines for the Barrier Dam Program," and the status of current and proposed projects.

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

Progress reports on sea lamprey control operations in the United States and Canada for 1978 were presented by the agents, who warned that the St. Marys River may be a greater potential contributor to adult sea lamprey populations in Lake Huron than was previously recognized.

Also presented were reports covering sea lamprey research at Hammond Bay Biological Station (chemo-and immuno-sterilization, similarity of growth of feeding-stage sea lamprey taken from Hammond Bay in the 1940's and 1978, sea lamprey burst swimming speeds), Monell Chemical Senses Center (screening for sea lamprey attractants and repellents), and Cornell University (evaluating effectiveness of barrier dams). Uniform criteria for sea lamprey inflicted wounds were submitted to the Commission for publication as a field guide. A report on ongoing lampricide registration activity was received as was a status report from the Steering Committee of the Sea Lamprey International Symposium.

FISH MANAGEMENT AND RESEARCH

The Steering Committee for the Stock Concept Symposium, the editors of the Feasibility Study on Great Lakes Ecosystems Rehabilitation and Restoration, and the Interim Steering Committee for the Strategic Great Lakes Fishery Management Plan reported on progress in discharging their respective mandates.

The following committees of the Great Lakes Fishery Commission gave brief reports on their activities and recommendations: Lake Ontario Committee (the second Lake Ontario Fish Stock Assessment Workshop, the 1980 American Eel Conference), Lake Erie Committee (the 1980 Lake Erie Fish Community Workshop, deliberations of the Standing Technical Committee on walleye quotas), Lake Huron Committee (Ontario's paired planting experiment to compare lake trout and lake trout × splake), Lake Michigan committee (distribution study of coho salmon stocked and fin-clipped by all four Lake Michigan states in 1978), Lake Superior Advisory Committee, and Scientific Advisory Committee.

The Great Lakes Fishery Laboratory's (USFWS) future role in contaminant surveillance and trend monitoring on the Great Lakes as described (quality control, scanning for "new contaminants investigating impact of contaminants of fish resources), and the New York State Public Service Commission sought Great Lakes Fishery Commission criticism and a written endorsement of a state plan for baseline stock assessment. A USFWS representative delivered a progress report on development of the proposed Iron River National Fish Hatchery.

INTERNATIONAL JOINT COMMISSION

The status of mutual business was reported, and the Great Lakes Fishery Commission was invited to meet with the IJC in 1979. The 1978 Water Quality Agreement and Great Lakes Quality Fish contaminant Surveillance Program (both whole lake and nearshore components) were described.

ADMINISTRATIVE AND EXECUTIVE ACTIONS

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

1. Developed projects such as symposia and a strategic plan for Great Lakes fishery
   —Allocated funds for the development and staging of the Stock Concept Symposium (STOCS) under the guidance of Co-chairman Al Berst (OMNR) and Ray Simon (USFWS).
   —Represented by Chairman Loftus and Vice-chairman Herbst, met with natural resource agency heads or their designees, and fish chiefs, or their designees, to define and initiate the development of a Strategic Great Lakes Fishery Management Plan.
   —Requested more information on other sources of funding for the Bio-Engineering symposium before decision to commit Commission funds is made.

2. Published
   —Accepted the following manuscripts for publication in the Technical Report Series:

   "Biology of larval and metamorphosing sea lamprey, *Petromyzon marinus*, of the 1960 year class in the Big Garlic River, Michigan, Part II, 1966–1972" by Patrick J. Manion and Bermard R. Smith,
   "Distribution and ecology of lampreys in the lower peninsula of Michigan, 1957–1975" by R. H. Mormon,
   "Effects of granular 2′, 5-dichloro-4′-nitrosalicylanilide (Bayer 73) on benthic macro-invertebrates in a lake environment" by Phil Gilderhus,
   "Efficacy of antimycin for control of sea lamprey in lentic habitats" by Phil Gilderhus,
   "Variations in growth, age at transformation, and sex ratios in sea lamprey (*Petromyzon marinus*) re-established in chemically treated. tributaries of the upper Great Lakes" by Harold Purvis.
   —Published Technical Report No. 29, "Chemosterilization of the sea lamprey," by Lee Hanson and Pat Manion.
   —Expressed interest in producing a field guide for the classification of sea lamprey scarring and wounding.

3. Improved sea lamprey control and assessment
   —Granted $83,400 to the Michigan Department of Natural Resources for construction of a barrier dam on the West Branch of the Whitefish River.
   —At the request of the Canadian sea lamprey control agent, cancelled three Lake Huron sea lamprey assessment barriers in favor of portable assessment traps.

4. Sponsored research
   —Funded Dr. Henry Booke's (Stevens Point, University of Wisconsin) proposed study, "Biochemical genetic assessment of Lake Superior lake trout stocks."
   —Requested United States Fish and Wildlife Service and the authors of two research proposals for biogenetic identification of sea lamprey stocks to develop a joint or integrated proposal for further consideration.
   —Drafted a policy for the Great Lakes Fishery Commission general research program, to be reviewed by the Scientific Advisory Committee (SAC).

5. Interacted with its committees
   —Notified Lake Committees of the Environmental Protection Agency's funding of lakewide studies of the effects of power

plant entrainment and impingement, and encouraged their participation in planning and coordinating any studies initiated.

—Commenced an initiative to make the U.S. Lake Advisory Committees more active in affairs of the U.S. Section.

—Responded positively to the Council of Lake committees request for continued and expanded compilation fish planting summaries by the Commission.

—Responded to its Council of Lake Committee's concern regarding controversial United States Fish and Wildlife Service 1977 lake trout plants in Whitefish Bay by reaffirming the Commission's intent to continue coordination of lake trout plantings through the Lake Committees and acknowledging the responsibility of the states for fishery management descisions.

—Requested its Fish Disease Control Committee to review status of progress and compliance since GLFC endorsement of Great Lakes Fish Disease Control Policy in 1975.

—Forwarded four research proposals to the Scientific Advisory committee for comment.

6. Communicated with external entities

—Presented a statement at an International Joint Committee (IJC) public hearing supporting the "New and Revised Water Quality Objectives for the Great Lakes" as a welcome first step in the rehabilitation of the Great Lakes, stressing that the ultimate goal of ecosystem quality should not be confused with the achievement of water quality objectives, and suggesting that steps be taken to deal with additive stresses, the synergistic effects of pollutants, the as-yet-untouched and unresolved matter of numbers and areas of noncompliance, and that ecological indices as well as chemical tests be used as measures of success.

—Presented a statement at the IJC public hearings supporting and offering constructive criticism on their five year study on Pollution from Land Use Activities Reference Group (PLUARG) document, "Environmental Strategy for the Great Lakes System."

—Considered the IJC planned water release schedule from Lake Superior generally acceptable, concluded that the state, provincial, and federal agencies were in close touch with the situation, and that a statement from GLFC was not necessary.

—Agreed to meet with the IJC in the fall of 1979.

—Encouraged the National Marine Fishery Service (NMFS) to meet with interested members of the Great Lakes community to discuss the closure of National Marine Fishery Service's Ann Arbor office and the attendant shift in emphasis to marketing.

—Transmitted a letter to the U.S. Food and Drug Administration urging establishment of protocols for securing registration of fish disease therapeutics and prophylactics.

—Presented two statements at a July U.S. House of Representatives committee hearing on H.R. 12531, a bill which would amend the Great Lakes Fishery Act of 1956. The Commission supported the three major parts of the bill (development of a fishery management plan, increased fish stock assessment and catch monitoring, development of added hatchery capability), but pointed out that authority to pursue these programs already exists, and that the bill does not recognize the international aspects of Great Lakes management. A week prior to the hearing Representative Ruppe offered a draft discussion amendment which expanded the membership and responsibilities of Lake Advisory Committees, so they would be similar to Regional Councils under the Fishery Conservation and Management Act of 1976 (P.L. 94-265). The U.S. Section commented that it is the consensus of the Commission that the draft amendment provides for a cumbersome and expensive series of Lake Advisory Committees to the U.S. Section to do work that can be more efficiently, economically, and expertly handled by the existing Lake Committees of the Commission.

—Will formally express concern to the Parties to the Convention regarding the over-exploitation of lake trout in the U.S. waters of eastern Lake Superior, which seriously conflicts with the Commission goal of rehabilitation.

ADJOURNMENT

After announcing that the Annual Meeting would be convened in Toronto, Ontario, 25–28 June 1979, and that the Interim Meeting was tentatively scheduled for 27–28 November 1979 in Ann Arbor, Michigan, the Chairman adjourned the meeting.

SUMMARY OF MANAGEMENT AND RESEARCH

In the 1976 Annual Report, the Summary of Management and Research focused on Commission policies, and the 1977 Annual Report explained the Commission's growing concern with improving Great Lakes water quality and coordination of fishery interests with the International Joint Commission. This summary will examine the status of key fish stocks in the Great Lakes, progress in fish disease control, and steps taken toward development of the Strategic Great Lakes Fishery Management Plan.

COMMERCIAL FISHING

In 1979, the Commission intends to publish a revised version of its Technical Report No. 3, Commercial Fish Production in the Great Lakes (1867–1960), updating the original report's catch records through 1977. Plans are for continued updating but in the interim, annual commercial fish production will be documented by species, area, and jurisdiction in the Commission's Annual Reports (see Tables 1–5 for 1978 commercial catches in the Great Lakes).

Areas such as Saginaw Bay, Georgian Bay and the North Channel in Lake Huron, and Green Bay in Lake Michigan are defined in terms of statistical district on the tables. (Hile, 1962).[1] Native American catches reported sold are indicated by parentheses, and are considered conservative estimates of the total Native American catch. Commercial fish production figures were supplied by the Great Lakes Fishery Laboratory of the United States Fish and Wildlife Service (USFWS) and Ontario Ministry of Natural Resources; cooperators have reviewed and occasionally modified the data. Man-made factors such as regulations, contaminants, and economic conditions which may have altered fishing pressure over the years or directed it from one species to another have been identified by a number of states, and appear as footnotes on the tables.

Total production in the Great Lakes has remained relatively stable over the years, although the contributions to the catch of various species have varied. Total commercial fish production in 1978 was greatest in

[1] Hile, R. 1962. Collection and analysis of commercial fishery statistics in the Great Lakes Fish. Comm. Tech. Rep. 5:31 p.

Lake Michigan (53 million lbs.) followed by Lakes Erie (51 million lbs.), Superior (9 million lbs.), Huron (6 million lbs.), and Ontario (3 million lbs.) in 1978. No commercial catch has been reported for Lake St. Clair since 1970 when mercury contamination of fish resulted in the closure of Ontario's commercial fishery.

STATUS OF MAJOR SPECIES

The Commission has continued its programs to control sea lampreys and coordinate management and restoration of the fisheries resource throughout the Convention Area. This report will examine the status of several stocks of fish in the Great Lakes, identify some areas of major concern and steps being taken to address some of the problems.

LAKE TROUT

Restoration of self-reproducing lake trout stocks remains a primary goal of the Commission which coordinates the programs among U.S. agencies and the Province of Ontario. On the U.S. side the program is a cooperative venture among the states and USFWS. The State of Michigan holds a large part of the brood stock and supplies eggs to other cooperating agencies, the USFWS raises and plants most of the fish, some of the states also rear and plant smaller numbers of lake trout, and all cooperate in evaluating the performance of both native and stocked lake trout. On the Canadian side the Province of Ontario rears and plants its own fish, including the highly selected splake (brook trout × lake trout hybrid) planted in certain areas, and also cooperates with its U.S. counterparts in assessment programs.

Lake Superior

Lake trout survival has been good in many parts of Lake Superior, although abundance in some areas has declined greatly. In Ontario waters the populations have remained relatively stable with generally high percentages of native trout. In Minnesota waters lake trout are increasing in number although native fish are still a low 3% of the catch. In Wisconsin waters, size of the lake trout population is increasing in areas closed to fishing, but remains small in areas open to fishing. In the Gull Island refuge, lake trout stocks have now recovered to the 1974 level, the level which existed prior to heavy fishing by several user groups in 1975, and which led to the establishment of the fish refuge. In Michigan waters of Lake Superior, abundance of trout declined moderately in inshore areas from Keweenaw Peninsula to Marquette and declined sharply to the west of the Peninsula and in Whitefish Bay (eastern Lake Superior), resulting in the lowest catch per unit of effort in the latter area since 1962.

Lake Michigan

When lake trout plants were initiated in Lake Michigan in 1965, native lake trout were extinct. The planted fish grew rapidly and some reached maturity by 1970. Spawning-related activity has been observed but until recent years no progeny have been observed. The first evidence of successful natural reproduction, presumably by planted lake trout, was discovered in 1976 in a study on larval fish entrainment at the Traverse City Municipal Power Plant by a biological consulting firm. The Michigan Department of Natural Resources, in sampling the water intake in 1977 and 1978, recovered numerous lake trout eggs in various stages of development, including sac and advanced fry (20–30 mm). No older survivers have been found to date.

A Lake Trout Technical Committee was formed in 1976 under the aegis of the Lake Michigan Committee to develop through interagency cooperation a technical data base and methodology for annually assessing the lake trout population in Lake Michigan. Prior to this, the lake trout population was sampled independently by the several agencies, and the only coordinated effort was a review of the allotment of hatchery fish for stocking and preparation of an annual, interagency report on lamprey wounding and scarring. The committee has accomplished one of its main objectives—the establishment of a systematic annual survey of the fishable lake trout population at a lakewide network of index stations. Age composition and growth data from the surveys have been compiled and summarized for two years providing considerable insight into population structure and overall survival; a stable stock is apparently being maintained by the annual lakewide stocking of about 2.2 million hatchery-reared yearlings each year. Thirteen consecutive year classes (1965–77) stocked in 1966 through 1978 were represented in the 1978 catch. Fish of the original 1965 plants (1964 year class) are now scarce.

Lake Huron

Annual plantings of about one million lake trout in Michigan waters have resulted in sizeable standing stocks. Survival of lake trout appears good particularly for the 1973–75 year classes.

Ontario has maintained its annual splake plantings in Lake Huron but also added a small stocking of lake trout in 1978. Because survival of splake past age three has been poor, Ontario hopes to improve survival of future plantings by stocking backcrosses (splake × lake trout). In Canadian waters commercial catches of lake trout and splake were nearly double that of 1977.

Lake Erie

Annual plantings of lake trout have been continued in the eastern end of Lake Erie since 1974, but numbers of planted fish have been small

compared to the other Great Lakes. Few recoveries of older fish have been made.

Lake Ontario

Splake were planted in Canadian waters of Lake Ontario in 1972 through 1974. In 1976 and subsequent years the province substituted lake trout. New York waters have received lake trout plantings since 1973. New York's 1973 plantings of trout of Seneca Lake origin grew rapidly, survived well, and matured early. It was believed that some of the fish spawned in 1977 and 1978, but spawn collected both years exhibited limited hatching success attributed to poor fertilization and high sac fry mortality due to blue sac disease.

LAKE WHITEFISH

Lake whitefish formerly was an important commercial species in all the Great Lakes, but now is commercially prominent only in Lakes Superior, Michigan, and Huron. Lake whitefish populations in these lakes were severely reduced by sea lamprey predation, but following sea lamprey control the fish have responded dramatically, reaching high levels of abundance in many areas to become the mainstay of several successful commercial fisheries.

Lake Superior

In Lake Superior, where sea lamprey probably never reached maximum abundance prior to implementating control measures, the catch of lake whitefish has gradually increased from an annual average of 500,000–600,000 pounds (1958–1967) to a fairly stable level of one million pounds in 1973 through 1978. In eastern Michigan waters (Whitefish Bay), an unregulated fishery has reduced stock abundance, compressed the population's age structure, and fostered increased growth rates. The fishery is presently dependent upon four-year-old fish. Prior to 1976 the fishery was based on four age groups, five through eight-year-olds. In other Michigan waters the lake whitefish fishery is still supported by older age groups. Catch of Wisconsin lake whitefish has continued its upward trend since 1970. Canadian harvest showed some increase over previous years.

Lake Michigan

The major fisheries for lake whitefish are found in northern Lake Michigan where this species continues to be the mainstay of the industry. From a low of only 25,000 pounds in 1957, the fishery has, as a direct result of sea lamprey control begun in 1960, rebounded to annual catches fluctuating between 3 and 4 million pounds. Over half the catch is landed in Michigan with the balance from Wisconsin. Few are harvested from Indiana or Illinois waters.

Lake Huron

In Lake Huron, lake whitefish population declines were not as extreme as experienced in Lake Michigan. Since 1900, commercial harvest has varied from a high of 6.6 million pounds in 1953 to a low of 450,000 pounds in 1959, increasing thereafter with some fluctuation to an average of over 1.1 million pounds through the early 1970's, to over 2 million pounds in 1977 and 1978.

Lake Erie and Lake Ontario

In contrast to earlier years when lake whitefish were a major component of the commercial fishery in Lakes Erie and Ontario, recent annual catches have ranged in Lake Erie from a few hundred pounds to 5,000 pounds in 1977 and 1978 and in Lake Ontario from a high of 51,000 pounds in 1970 to a low of 4,000 pounds in 1976. The catch in 1978 was almost 5,000 pounds.

CHUBS

Chubs are of commercial importance in Lakes Superior, Michigan, and Huron but are commercially extinct in Lakes Erie and Ontario.

Lake Superior

In U.S. waters of Lake Superior, abundance of chubs appears to be declining, but the species is still considered underutilized in Canadian waters. The Michigan fishery has been regulated by quota since 1975; a reduction in quota is being considered if the catch continues to drop. Wisconsin's landings were the lowest recorded since 1960. Minnesota's production was the second lowest since 1957, and was only slightly better than that of 1977.

Lake Michigan

Chubs, a major commercial species in Lake Michigan, declined rapidly in abundance through the 1960's and early 1970's, probably because of excessive harvest and competition by alewives. The Chub Technical Committee was formed in 1974 to address the problem. Their initial recommendation led to a closure of the fishery in 1976 except for assessment purposes. By 1978, chub stocks appeared to be recovering; the 1978 year class was the strongest observed in Lake Michigan since surveys began in 1967.

Lake Huron

The commercial fishery for chubs in U.S. waters of Lake Huron has been closed since 1970; the stocks appear to be gradually increasing in abundance. The major Canadian chub fishery operates in Georgian Bay where catches have dropped approximately 40% in 1977 and 1978 from the period 1971–76, mainly because of declining catches in southern Georgian Bay.

GREAT LAKES FISH DISEASE CONTROL COMMITTEE

The Commission, in its efforts to improve and perpetuate Great Lakes fishery resources, considers fish disease prevention to be of great importance. It adopted in June 1975 the Great Lakes Fish Disease Control Policy and a Model Fish Disease Control Program, both of which were issued under the title, "Recommendations of the Great Lakes Fishery Commission for the Control of Fish Diseases in the Great Lakes Basin." The document provided to the cooperating agencies technical and administrative guidance for the establishment of coordinated fish disease control.

At the 1978 Annual Meeting the Commission instructed its Fish Disease Control Committee to evaluate cooperating agencies' progress since 1975 in supporting Commission recommendations on fish disease control. This review also provided an opportunity to determine how well the Great Lakes Fish Disease Control Program, as presently written, served the cooperating agencies, and whether improvements could be made.

When the report of findings was presented as the Commission's December 1978 Interim Meeting, the Commission was extremely pleased and gratified that during the past three years many of the cooperating agencies have made important progress in fish disease control. Nevertheless, some areas for concern were identified and addressed in many of the recommendations which follow. The Commission reminded its cooperators that in order to further the ongoing process of basinwide fish disease control all agencies must work actively in their own jurisdictions towards shared goals, be active participants in meetings of the Fish Disease Control Committee, and submit agreed-upon reports in timely fashion.

At its November 1978 and March 1979 Executive Meetings the Commission took the following action:

1. Endorsed the continuation of interagency cooperative technical assistance as an essential cornerstone in basinwide fish disease control;
2. Encouraged all cooperating agencies to provide the necessary personnel, facilities and equipment needed to effectively control fish diseases in a manner at least commensurate with their Great Lakes fishery programs;
3. Reaffirmed its 1975 recommendation that all cooperating agencies create or exercise existing authority to develop amd implement regulations for the control and eradication of certain fish diseases in both public and private facilities;
4. Strongly encouraged indemnification of private hatchery losses

resulting from agency-endorsed eradication efforts be considered as a key element in program development.

5. Recommended that cooperating agencies have those fish health specialists who are designed as Certifying Officials for the purposes of the Great Lakes Disease Control Program certified as Fish Health Inspectors by the Fish Health Section of the American Fisheries Society;

6. Reaffirmed its 1975 recommendation to all cooperating agencies to halt the importation into the Great Lakes basin of eggs or fish carrying the diseases listed in Annex IV of the Great Lakes Fish Disease Control Program, eggs or fish originating from uninspected stocks, and eggs or fish from hatcheries where Certifiable Diseases are known to occur; and

7. Recommended that the cooperating agencies adopt the changes made in the Great Lakes Fish Disease Control Program by the Fish Disease Control Committee in its report of findings to the Commission, November 1978.

STRATEGIC GREAT LAKES FISHERY MANAGEMENT PLAN

The Council of Lake Committees at their annual meeting urged the Commission to assume a leadership role in developing a strategic management plan for the Great Lakes fisheries. The Great Lakes Basin Commission had earlier asked for Commission involvement in developing a fishery plan for U.S. waters. At the Commission's April Executive Meeting, the Commissioners agreed to sponsor such a plan, and allocated funds and staff support to initiate the process. At the Commission's Annual Meeting in June, the Commission met with the Council of Lake Committees and other interested parties to discuss ways and means of developing a strategic plan.

This led to a meeting of senior administrators from the concerned agencies in October 1978 to develop a planning protocol and appoint an interim steering committee, which would identify broad areas of concern and outline a process and framework for strategic planning. After completion of their assignments, a permanent steering committee would be organized to complete the task. Completion of a draft plan was targeted for the 1980 annual meeting.

Table 1. Lake Superior commercial fish production in pounds for 1978. (Native American catches reported sold are in parentheses.)[1]

Species	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
Alewife	25	–	–	25	–	25
Burbot	65,436	5	–	65,441	14,302	79,743
Carp	–	584	–	584	366	950
Chubs	772,501	169,151	31,244	972,896	652,205	1,625,101
	(151)	–	–	(151)	–	(151)
Lake herring	123,758	53,448	152,020	329,226	1,897,030	2,226,256
	(1,007)	–	–	(1,007)	–	(1,007)
Lake sturgeon	–	–	–	–	890	890
Lake trout	145,027	187,095[3]	34,583	366,705	285,412	652,117
	(340,897)[2]	–	–	(340,897)	–	(340,897)
Lake whitefish	406,858	270,584	141	677,583	334,359	1,011,942
	(359,100)	–	–	(359,100)	–	(359,100)
Northern pike	–	–	–	–	2,787	2,787
	(51)	–	–	(51)	–	(51)
Pacific salmon	–	–	–	–	4,045	4,045
Rock bass	–	–	–	–	2	2
Round whitefish	595	21,869	286	22,750	32,158	54,908
	(11)	–	–	(11)	–	(11)
Sauger	–	–	–	–	13	13
Smelt	490	307,332	2,117,812	2,425,634	653,702	3,079,336
	(30)	–	–	(30)	–	(30)
Suckers	16,960	22,237	–	39,197	92,246	131,442
Walleye	–	–	–	–	567	567
White bass	–	–	–	–	940	940
Yellow perch	–	–	–	–	90,115	90,115
Unidentified	–	–	–	–	14,410	14,410
Total	1,531,650	1,032,305	2,336,086	4,900,041	4,075,549	8,974,590
	(701,247)	–	–	(701,247)	–	(701,247)

[1]Based on Tri Party assessment data and wholesale fish transaction report. Data is incomplete.
[2]Includes 597 pounds of siscowet.
[3]Includes catches of siscowet.

Table 1. Lake Superior commercial fish production in pounds for 1978. (Native American catches reported sold are in parentheses.)[1]

Species	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
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Carp	–	584	–	584	366	950
Chubs	772,501	169,151	31,244	972,896	652,205	1,625,101
	(151)	–	–	(151)	–	(151)
Lake herring	123,758	53,448	152,020	329,226	1,897,030	2,226,256
	(1,007)	–	–	(1,007)	–	(1,007)
Lake sturgeon	–	–	–	–	890	890
Lake trout	145,027	187,095[3]	34,583	366,705	285,412	652,117
	(340,897)[2]	–	–	(340,897)	–	(340,897)
Lake whitefish	406,858	270,584	141	677,583	334,359	1,011,942
	(359,100)	–	–	(359,100)	–	(359,100)
Northern pike	–	–	–	–	2,787	2,787
	(51)	–	–	(51)	–	(51)
Pacific salmon	–	–	–	–	4,045	4,045
Rock bass	–	–	–	–	2	2
Round whitefish	595	21,869	286	22,750	32,158	54,908
	(11)	–	–	(11)	–	(11)
Sauger	–	–	–	–	13	13
Smelt	490	307,332	2,117,812	2,425,634	653,702	3,079,336
	(30)	–	–	(30)	–	(30)
Suckers	16,960	22,237	–	39,197	92,246	131,442
Walleye	–	–	–	–	567	567
White bass	–	–	–	–	940	940
Yellow perch	–	–	–	–	90,115	90,115
Unidentified	–	–	–	–	14,410	14,410
Total	1,531,650	1,032,305	2,336,086	4,900,041	4,075,549	8,974,590
	(701,247)	–	–	(701,247)	–	(701,247)

[1]Based on Tri Party assessment data and wholesale fish transaction report. Data is incomplete.
[2]Includes 597 pounds of siscowet.
[3]Includes catches of siscowet.

Table 2. Lake Michigan commercial fish production in pounds for 1978. (Native American catches reported sold are in parentheses.)[1]

Species	Michigan: Green Bay MM-1	Michigan: Michigan proper	Michigan: Total	Wisconsin: Green Bay WM-1,2	Wisconsin: Michigan proper	Wisconsin: Total	Illinois	Indiana	Grand Total
Alewife	3,454,273	600	3,454,873	184,795	40,229,505	40,414,300	–	10,047	43,879,220
Brown trout	–	–	–	–	–	–	–	223	223
Bullheads	–	–	–	111,911	–	11,911	–	–	111,911
Burbot	19,770	2,369	22,139	97,140	1,580	98,720	–	14	120,873
	(2,406)	–	(2,406)	–	–	–	–	–	(2,406)
Carp	52	1,639	1,691	756,942[2]	3,172[2]	760,114	–	39	761,844
	–	(228)	(228)	–	–	–	–	–	(228)
Channel catfish	–	1,004	1,004	1,756	–	1,756	–	55	2,815
Chubs	–	41,572	41,572	3	232,427[3]	232,430	15,700	2,631	292,333
	(1,090)	(103,728)	(104,818)	–	–	–	–	–	(104,818)
Crappies	–	1	1	–	–	–	–	–	1
Lake herring	–	–	–	158	151	309	–	–	309
	(50)	–	(50)	–	–	–	–	–	(50)
Lake trout	–	20	20	–	–	–	–	–	20
	(35,300)	(298,946)	(334,246)	–	–	–	–	–	(334,246)
Lake whitefish	903,789	1,099,454	2,003,243[4]	730,894	580,002	1,310,896	–	887	3,315,026
	(328,179)	(448,184)	(776,363)	–	–	–	–	–	(776,363)
Northern pike	77	–	77	14,858	–	14,858	–	–	14,935
	(437)	(111)	(548)	–	–	–	–	–	(548)
Pacific salmon	–	–	–	–	–	–	–	1,748[6]	1,748
Rainbow trout	–	–	–	–	–	–	–	14	14
Round whitefish	286	18,587	18,873[5]	1,125	26,625	27,750	–	–	46,623
	(153)	(147,108)	(147,261)	–	–	–	–	–	(147,261)
Sheephead	–	–	–	1,448	–	1,448	–	–	1,448
Smelt	1,157,101	4,030	1,161,131	113,508	90,225	203,733	1,035	4,244	1,370,143
	(717)	(1,048)	(1,765)	–	–	–	–	–	(1,765)
Suckers	76,593	45,117	121,710	254,900	6,030	260,930	–	3,677	386,317
	(4,814)	–	(4,814)	–	–	–	–	–	(4,814)
Walleye	–	–	–	15,500	–	15,500	–	–	15,500
White bass	–	–	–	953	–	953	–	–	953
Yellow perch	32	60	92	440,873	22,966	463,839	148,720	94,772	707,423
	(37,569)	(4,917)	(42,486)	–	–	–	–	–	(42,486)
Total	5,611,973	1,214,453	6,826,426	2,726,764	41,192,683	43,919,447	165,455	118,351	51,029,679
	(410,715)	(1,004,270)	(1,414,985)	–	–	–	–	–	(1,414,985)

[1]Based on Tri Party assessment data and wholesale fish transaction report. Data is incomplete.
[2]PCB contamination resulted in elimination of most markets.
[3]Fishery closed. Wisconsin DNR contracted with commercial fishermen for assessment of chub populations.
[4]USFWS figure is 2,275,674 pounds.
[5]USFWS figure is 72,379 pounds.
[6]Catch includes both chinook and coho salmon.

Table 3. Lake Huron commercial fish production in pounds for 1978.
(Native American catches reported sold are in parentheses.)[1]

	Michigan			Ontario				
Species	Huron proper	Saginaw Bay MH-4	Total	Huron proper	Georgian Bay GB-1,2,3,4	North Channel NC-1,2,3	Total	Grand Total
Bowfin	–	390	390	–	27	–	27	417
Buffalo	–	2,620	2,620	–	–	–	–	2,620
Bullheads	–	5,352	5,352	1,319	6,201	333	7,853	13,205
Burbot	65	–	65	–	2,887	1,670	4,557	4,622
Carp	85	686,823	686,908	32,999	13,531	1,316	47,846	734,754
Channel catfish	200	433,482	433,682	71,789	131	135	72,055	505,737
Chubs	–	–	–	156,168	335,164	1,229	492,561	492,561
Crappie	–	19,150	19,150	–	–	–	–	19,150
Eels	–	–	–	18	–	–	18	18
Gizzard shad	–	17,347	17,347	875	–	–	875	18,222
Lake herring	175	–	175	8,110	35,992	8,331	52,433	52,608
Lake sturgeon	–	–	–	2,691	971	4,317	7,979	7,979
Lake trout	–	–	–	34,904	198	894	35,996	35,996
	(208,300)	–	(208,300)	–	–	–	–	(208,300)
Lake whitefish	516,304	40,339	556,643	1,425,160	158,570	196,766	1,780,496	2,337,139
	(192,500)	–	(192,500)	–	–	–	–	(192,500)
Northern pike	–	–	–	444	6,388	10,654	17,486	17,486
Pacific salmon	–	–	–	520	746	12	1,278	1,278
Quillback	–	6,802	6,802	–	–	–	–	6,802
Rock bass	–	–	–	436	2,019	150	2,605	2,605
Round whitefish	–	20,076	20,076	21,017	28,423	5,841	55,281	75,357
	(8,392)	–	(8,392)	–	–	–	–	(8,392)
Sauger	–	–	–	–	1,900	–	1,900	1,900
Sheephead	30	12,809	12,839	16,040	–	–	16,040	28,879
Smelt	–	–	–	3,373	6,120	500	9,993	9,993
Splake	–	–	–	26,459	189	4	26,652	26,652
Suckers	5,300	132,005	137,305	108,326	42,674	51,640	202,640	339,945
Walleye	–	–	–	171,080	50,944	14,292	236,316	236,316
White bass	–	844	844	14,695	1,819	1,135	17,649	18,493
Yellow perch	–	164,357	164,357	274,597	76,957	28,587	380,141	544,498
	(1,203)	–	(1,203)	–	–	–	–	(1,203)
Unidentified	–	–	–	248,714	2,813	56,860	308,387	308,387
Total	522,159	1,542,396	2,064,555	2,619,734	774,664	384,666	3,779,064	5,843,619
	(410,395)	–	(410,395)	–	–	–	–	(410,395)

[1] Based on Tri Party assessment data and wholesale fish transaction report. Data is incomplete.

Table 4. Lake Erie commercial fish production in pounds for 1978.

Species	New York	Pennsylvania	Ohio	Michigan	U.S. Total	Ontario	Grand Total
Bowfin	–	–	–	–	–	25,379	25,379
Buffalo	–	–	36,379	21,017	57,396	–	57,396
Bullheads	104	105	74,253	483	74,945	43,742	118,687
Burbot	13	2	–	–	15	8	23
Carp	1,201	188	1,546,160	310,078	1,857,627	63,877	1,921,504
Channel catfish	401	479	204,519	23,341	228,740	97,901	326,641
Crappie	2	–	–	–	2	–	2
Eels	–	–	–	–	–	281	281
Gizzard shad	1,256	–	1,557,204[3]	–	1,558,460	465	1,558,925
Goldfish	–	–	757,752[3]	–	757,752	–	757,752
Lake sturgeon	–	–	–	–	–	2,163	2,163
Lake trout	–	70	–	–	70	3	73
Lake whitefish	–	1,070	–	–	1,070	4,406	5,476
Northern pike	–	–	–	–	–	55,332	55,332
Pacific salmon	–	–	–	–	–	6	6
Quillback	–	–	102,644	–	102,644	–	102,644
Rock bass	173	1	–	–	174	27,354	27,528
Sheephead	9,352	13,952[1]	1,189,317[3]	2,318	1,214,939	351,433	1,566,372
Shiners	–	7,000	–	–	7,000	–	7,000
Smelt	695	5,990	13,690	–	20,375	26,608,833	26,629,208
Suckers	11,172	921	33,596	1,058	46,747	28,585	75,332
Sunfish	–	–	–	–	–	50,570	50,570
Walleye	54,731	14,762[2]	–	–	69,493	588,838	658,331
White bass	22,961	15,642[1]	1,687,354[4]	6,261	1,732,218	1,648,767	3,380,985
White perch	2	–	–	–	2	–	2
Yellow perch	122,610	344,321	2,108,664[4]	4,430	2,580,025	8,805,838	11,385,863
Unidentified	–	–	–	–	–	1,755,056	1,755,056
Total	224,673	404,503	9,311,532	368,986	10,309,694	40,158,837	50,468,531

[1]Increase over 1977 catch due to increase in fishing pressure.
[2]Strong 1976 year class from the eastern basin recruited to the fall 1978 history.
[3]Markets for fish by-products developed.
[4]Increase in fishing pressure may be related to the closure of the commercial fishery for walleye.

Table 5. Lake Ontario commercial fish production in pounds for 1978.

Species	New York	Ontario	Grand Total
Alewife	–	1,000	1,000
Bowfin	–	10,262	10,262
Bullheads	38,141	361,390	399,531
Burbot	–	5	5
Carp	764	9,157	9,921
Channel catfish	–	3,721	3,721
Crappie	1,221	13,793	15,014
Eels	42,303	508,225	550,528
Gizzard shad	–	2,900	2,900
Lake herring	–	12,159	12,159
Lake sturgeon	–	3,975	3,975
Lake trout	–	670	670
Lake whitefish	–	4,674	4,674
Northern pike	–	25,673	25,673
Pacific salmon	–	652	652
Rock bass	10,293	37,354	47,647
Round whitefish	–	860	860
Sauger	–	31	31
Sheephead	–	203	203
Smelt	44,457	59,943	104,400
Suckers	5,977	9,668	15,645
Sunfish	6,254	149,887	156,141
Walleye	4,279	16,197	20,476
White bass	–	10,733	10,733
White perch	23,989	501,427	525,416
Yellow perch	14,046	707,193	721,239
Unidentified	–	19,352	19,352
Total	191,724	2,471,104	2,662,828

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 1978, about 24 million trout and salmon were planted.

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

Most of the rainbow, brook, and brown trout, and all of the Pacific salmon plantings are aimed at the recreational fishery. On the other hand, a substantial part of the lake trout and the Province of Ontario's splake plantings are intended to develop self-sustaining stocks. With anglers pursuing a wide variety of species ranging from salmon and trout to yellow perch and walleye to panfish and bass, it was estimated that Great Lakes recreational fishermen spend $440 million in fishing expenses annually. The economic impact of the commercial fishing industry, which harvests relatively few of the stocked salmonids, has been estimated at $160 million (Talhelm, 1979).

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

Lake trout have been planted annually on a large scale production basis in Lake Superior since 1958, in Lake Michigan since 1965, and in Lake Ontario since 1972. These programs have been carried out cooperatively by the U.S. Fish and Wildlife Service, the states of Michigan, Wisconsin, Minnesota and New York, and the Province of Ontario. Lake trout eggs are largely obtained from brood fish in hatcheries, and, to a lesser extent mature lake trout from inland lakes and Lake Superior. Nearly all trout are reared to yearlings (ca.30/pound) and planted during the spring and early summer. Some, however, are planted as fingerlings in fall. Despite certain advantages (relative to hatchery production) associated with stocking in the fall, the procedure has not been used extensively; studies have shown that lake trout planted in fall as fingerlings generally do not survive nearly as well as those stocked in spring as yearlings. The higher mortality of fall-stocked fish is commonly believed to be related to their smaller size at time of planting. In a study to determine whether increasing the size of the fall-stocked fingerlings might improve their survival, the U.S. Fish and Wildlife Service, in the fall of 1971, 1972, and 1973, stocked two size groups of lake trout fingerlings: one group grown normally (oversize weight 80/lb) and the other group grown at an accelerated rate (30/lb) by special diet and elevated rearing temperatures. Data collected through assessment fishing have suggested that in general the accelerated-growth fingerlings survived better than the normal-growth fingerlings. Catches in experimental gillnets fished by the USFWS in Lake Michigan (1976, 1977) indicated that, of the trout stocked in 1971 and 1972, the accelerated growth fish had survived nearly three times as well as the normal growth fingerlings, but that from the 1973 plantings, the accelerated growth fish had survived only about half as well as the normal growth fish; there is no obvious explanation for the apparent anomaly (Wells and Eck, 1978). In 1978, approximately 135,000 accelerated growth fingerlings were planted in the U.S. waters of Lake Superior, 65,000 in Lake Michigan, 101,000 in Lake Huron, and 538,000 in Lake Ontario, in the ongoing experimental planting program.

To rehabilitate fish stocks in Lake Huron, the Province of Ontario and the State of Michigan originally agreed to plant highly-selected splake. These fish were developed in Ontario through an intensive breeding program in which male brook trout were crossed with female lake trout to produce a fast growing fish similar to lake trout in behavior and appearance, and to the brook trout in fast growth and early maturity. Following several generations of selective breeding a splake was developed which grows rapidly, matures at an early age, and inhabits deep water. First plantings were made in 1969 in Ontario waters (mostly yearlings) and in 1970 in Michigan waters (mostly fingerlings). Because of a shortage of highly-selected splake brood fish and the need to expand rehabilitation efforts in U.S. waters of Lake Huron, splake milt also was used to fertilize lake trout eggs to produce backcrosses. It was believed these fish would retain the advantages of early maturity and fast growth. The first backcrosses were produced in the fall of 1971 and planted in Lake Huron as yearlings in the spring of 1973, and the program was to have continued. Because of fish disease problems in the U.S. brood stock of splake (chronicled in Annual Reports for 1975 and 1976, Appendix B), lake trout plants were initiated in U.S. waters of Lake Huron in 1973 and continued through 1978. The Province of Ontario continued to plant highly selected splake through 1978 but also made a small planting of lake trout in 1978.

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

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

Table 1 summarizes annual plantings of lake trout and hybrids in the Great Lakes, and Table 2 details the 1978 plants in each of the Great Lakes. Other small experimental plants of first generation splake and backcrosses have been made by Wisconsin and Michigan in Lake Superior (Table 3) with the objective of providing a nearshore fishery; these plants are not thought to contribute to offshore populations.

Coho salmon, usually stocked in the spring as yearlings, have been planted annually in Lakes Superior and Michigan since 1966, and in Lakes Huron, Erie, and Ontario since 1968. Table 4 summarizes annual plantings in each of the Great Lakes, and Table 5 details the 1978 plantings in each of the Great Lakes. An ongoing Lake Michigan study on the distribution of thirteen groups of coho salmon planted in 1978, made the rather surprising discovery that cohos stocked in Lake Erie, particularly those planted as fall fingerlings, were appearing in Lake

Michigan (Patriarche, 1979). Fewer coho were planted in 1978 than in 1977.

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 1978 plantings in each of the Great Lakes. Numbers planted in the upper lakes have doubled over those in 1977. However, some Lake Erie agencies are reviewing their chinook programs, citing low returns to the creel.

In 1972, Michigan and Wisconsin inaugurated plants of Atlantic salmon in the Upper Great Lakes. In 1972, Wisconsin planted 8,000 3-year-old and 12,000 2-year-old fish. After 1972, Michigan discontinued its plants in Lake Huron but continued them in Lake Michigan. Table 8 summarizes Atlantic salmon plantings in the Great Lakes 1972–1978; numbers planted in Lakes Michigan and Superior were substantially larger in 1978 than in previous years.

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. Neverthless, 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 1978, and Table 10 details the 1978 plantings. Table 11 summarizes annual plantings of brown trout for 1975 through 1978, and Table 12 details the 1978 plantings. Brook trout plantings were included for the first time in 1976 (Table 13). Table 14 details the 1978 plantings of brook trout.

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Table 1. Annual plantings (in thousands) of lake trout, splake[1,2] and backcrosses[3] in the Great Lakes, 1958–1978.

Year	LAKE SUPERIOR				
	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
Subtotal	22,786	7,859	4,731	11,163	46,539

Year	LAKE MICHIGAN				
	Michigan	Wisconsin	Illinois	Indiana	Total
1965	1,069	205	–	–	1,272
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
Subtotal	15,333	13,130	1,534	1,591	31,587

Table 1. (Cont'd.)

LAKE HURON

Year	Michigan Lake trout	Michigan Splake	Michigan Backcrosses	Ontario Lake trout	Ontario Splake	Ontario 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
Subtotal	5,749	332	736	30	4,029	61	10,937

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
Subtotal	211	579	790

LAKE ONTARIO

Year	Ontario Splake	Ontario Lake trout	New York 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
Subtotal	119	682	2,902	3,703

Great Lakes Total, lake trout	88,280
Great Lakes Total, splake and backcrosses	5,277
Great Lakes Total, lake trout, splake and backcrosses, 1958–1978	93,557

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

Table 2. Planting of lake trout and splake[1,2] in the Great Lakes, 1978.

Location	Numbers	Fin clip
LAKE SUPERIOR-LAKE TROUT		
Michigan waters		
Copper Harbor	27,400	adipose
Grand Marais	25,250[3]	adipose
Huron Island	82,000[3]	adipose
Iroquois Island Reef	28,150[3]	adipose
Laughing Fish Point	42,600[4]	adipose
Loma Farms	21,300[4]	adipose
Manitou Island	78,000[3]	adipose
Marquette	21,300[4]	adipose
Munising Harbor	21,300[4]	adipose
Ontonagon River	28,000	adipose
Partridge Island	85,170[4]	adipose
Pequaming Point	29,000[3]	adipose
Porcupine Mountains	96,342[3]	adipose
Strands Cabin-Black River Harbor	24,520[3]	adipose
Shelter Bay	42,600[4]	adipose
Traverse Island	78,000[3]	adipose
Pequaming	42,500[5]	both ventrals
Taquahmenon Island	81,900[3,5]	both ventrals
Subtotal	855,332	
Wisconsin waters		
Bark Point	64,835[4]	adipose
Cornucopia	71,825[4]	adipose
Superior	304,000	adipose
Devil's Island Shoal	181,081[3,4,5]	adipose-left ventral
Subtotal	621,741	
Minnesota waters		
Durfee Creek	59,900	adipose
Flood Bay	80,565	adipose
King's Landing	80,515	adipose
Lester River	86,020	adipose
Paradise Beach	47,731[3]	adipose
Subtotal	354,731	
Ontario waters		
Armour Harbour	15,750[3]	adipose
Battle Island	10,500[3]	adipose
Beetle Point	11,550[3]	adipose
Buck Island	13,500[3]	adipose
Caribou Island	13,500[3]	adipose
Copper Island	12,600[3]	adipose
Duncan Cove	11,900[3]	adipose
First Island	9,000	adipose
Lambert Island	5,600	adipose
Lapoints Point	56,500	adipose
Mamainse Point	18,400	adipose

Table 2. (Cont'd.)

Location	Numbers	Fin clip
Mary Island	15,000[3]	adipose
Michipicoten River	50,000	adipose
Montreal River	50,000	adipose
North Minnie Island	9,550[3]	adipose
Palette Island	28,000[3]	adipose
Pancake Point	32,680	adipose
Quarry Island	9,550[3]	adipose
Rent Island	17,000[3]	adipose
Rossport	80,000	adipose
Second Island	13,500[3]	adipose
Silver Harbour	15,000[3]	adipose
Silver Harbour East	15,000[3]	adipose
Silver Harbour West	15,000[3]	adipose
Sinclair Cove	25,000	adipose
Sunnyside Point	25,000	adipose
Sunnyside Point	13,500[3]	adipose
Swedes Gap	11,550[3]	adipose
Third Island	13,500[3]	adipose
Woodbine Harbour	11,550[3]	adipose
Subtotal	629,180	
Total, Lake Superior	2,460,984	

Note: 1,028,974 (42%) of total 2,460,984 were planted offshore.

LAKE MICHIGAN-LAKE TROUT

Michigan Waters		
Acme	75,000	adipose
Charlevoix	75,000	adipose
Dahlia Shoal	50,000[3]	adipose
Fisherman's Island	25,000[3]	adipose
Ford River mouth	50,000	adipose
Ford River	50,000	adipose
Frankfort	72,000	adipose
Grand Haven	75,000	adipose
Greillickville	75,000	adipose
Holland	105,000	adipose
Ille Aux Galets	100,000[3]	adipose
Manistee	70,000	adipose
Montague	75,000	adipose
Pentwater	75,000	adipose
Petoskey	75,000	adipose
South Haven	96,000	adipose
St. Joseph	96,000	adipose
Good Harbor Bay	32,000[3]	adipose-right ventral
South Fox Island	33,000[3]	adipose-right ventral
Subtotal	1,304,000	

Table 2. (Cont'd.)

Location	Numbers	Fin clip
Wisconsin waters		
Algoma	95,000	adipose
Kewaunee	90,100[3]	adipose
Manitowoc	95,000	adipose
Milwaukee	85,000	adipose
Port Washington	38,000	adipose
Racine	80,500	adipose
Sheboygan	100,000	adipose
Sturgeon Bay	140,000	adipose
Gills Rock	65,000[3]	adipose-right ventral
Larson's Reef	140,800	adipose-right ventral
Kewaunee	65,000[3,5]	left pectoral-right ventral
Subtotal	994,400	
Illinois waters		
Waukegan Reef	116,000[3]	adipose
Indiana waters		
Burns Harbor, Bethlehem Steel	100,000	adipose
East Chicago	37,500	adipose
Michigan City	37,500	adipose
Subtotal	175,000	
Total, Lake Michigan	2,589,400	

Note: 576,100 (22%) of total 2,589,400 were planted offshore.

LAKE HURON-LAKE TROUT AND SPLAKE

Michigan waters (lake trout)		
Oscoda	75,000[5]	adipose-left pectoral
Port Sanilac	26,000[5]	adipose-left pectoral
Adams Point	75,000	right pectoral
Black River Island	104,000[3]	right pectoral
Detour ferry dock	50,000	right pectoral
Goose Island Shoal	25,000[3]	right pectoral
Greenbush	100,000	right pectoral
Grindstone City	100,000	right pectoral
Hammond Bay	105,000	right pectoral
Harbor Beach	75,000	right pectoral
Martins Reef	25,000[3]	right pectoral
Middle Entrance	25,000[3]	right pectoral
Oscoda	100,000[3]	right pectoral
Port Sanilac	25,000	right pectoral
Reynolds Reef	26,000[3]	right pectoral
Rockport	52,000[3]	right pectoral
Round Island Shoal	25,000[3]	right pectoral

Table 2. (Cont'd.)

Location	Numbers	Fin clip
Scarecrow Island	78,000[3]	right pectoral
Tawas Point	100,000	right pectoral
Zela Shoal	26,000[3]	right pectoral
Subtotal	1,217,000	
Ontario waters (lake trout)		
South Bay	15,000	right pectoral
Ontario waters (splake)		
South Bay	15,000	adipose-right pectoral
Fisher Harbour (North Channel)	7,040	none
Heywood Island (North Channel)	152,460	right pectoral
Subtotal	174,500	
Subtotal, lake trout	1,232,000	
Subtotal, splake	174,500	
Total, Lake Huron	1,406,500	

Note: 486,000 (35%) of total 1,406,500 were planted offshore.

LAKE ERIE-LAKE TROUT

Location	Numbers	Fin clip
New York waters		
Lake Erie	118,225[3]	left pectoral-right ventral
Pennsylvania waters		
Lake Erie	118,224[3]	left pectoral-right ventral
Total, Lake Erie	236,449	

LAKE ONTARIO-LAKE TROUT

Location	Numbers	Fin clip
New York waters		
Hamlin	136,452[3,5]	left pectoral
Selkirk	129,220[3,5]	left pectoral
Sodus	136,452[3,5]	left pectoral
Stony Island	136,080[3,5]	left pectoral
Hamlin	125,118[3]	left ventral
Selkirk	124,976[3]	left ventral
Sodus	126,781[3]	left ventral
Stoney Island	128,335[3]	left ventral
Subtotal	1,043,414	

Table 2. (Cont'd.)

Location	Numbers	Fin clip
Ontario waters		
Main Duck Island	100,000[3]	right pectoral-left ventral
Mississauga	100,000	right pectoral-left ventral
Subtotal	200,000	
Total, Lake Ontario	1,243,414	

Note: 1,143,414 (92%) of total 1,243,414 were planted offshore.

Great Lakes Total, splake	174,500	
Great Lakes Total, lake trout	7,762,247	
Great Lakes Total, lake trout and splake	7,936,747	

[1]Lake trout × brook trout hybrid.

[2]Excludes small experimental splake plants by Wisconsin in Lake Superior. (See Table 3.)

[3]Offshore plants.

[4]State plants—all other U.S. plants by U.S. Fish and Wildlife Service.

[5]Fast growth fall fingerling plants—other plants consist of yearling fish.

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

Year	State	Location	Numbers	Fin clip
1971	Michigan	Copper Harbor	13,199	None
1973	Wisconsin	Bayfield Area	5,000	dorsal-left ventral
1974	Wisconsin	Washburn	10,316	dorsal
		Houghton Point	9,782	dorsal
1975	Wisconsin	Pikes Bay	15,000	dorsal-right ventral
1976	Wisconsin	Pikes Bay	18,360	dorsal-right ventral
1977	Michigan	Copper Harbor	26,100	left pectoral-right ventral
1978	Wisconsin	Chequamegon Bay	55,200	none
1978	Wisconsin	Cornucopia	26,400	none
	Total, Lake Superior		179,357	

Table 4. Annual plantings (in thousands) of coho salmon in the Great Lakes, 1966–1978.

	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
Subtotal	4,625	663	78	5,366

	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
Subtotal	27,660	3,753	846	481	32,740

Table 4. (Cont'd.)

	LAKE HURON	
Year	Michigan	Total
1968	402	402
1969	667	667
1970	571	571
1971	975	975
1972	249	249
1973	100	100
1974	500	500
1975	627	627
1976	690	690
1977	416	416
1978	84	84
Subtotal	5,281	5,281

	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
Subtotal	1,441	2,130	3,589	1,268	8,428

	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
Subtotal	2,173	2,361	4,533

Great Lakes Total, coho salmon, 1966–1978 56,348

Table 5. Plantings of coho salmon in the Great Lakes, 1978.

Location	Numbers	Fin clip
LAKE SUPERIOR-COHO SALMON		
Michigan waters		
Dead River	140,245	none
Total, Lake Superior	140,245	
LAKE MICHIGAN-COHO SALMON		
Illinois waters		
Calumet Harbor	25,000	adipose-left pectoral
Diversey Harbor	77,880	adipose-left pectoral
Jackson Inner Harbor	25,000	adipose-left pectoral
Kellogg Ditch	21,000	adipose-left pectoral
Waukegan River	26,400	adipose-left pectoral
Waukegan Harbor Area	103,500	adipose-left pectoral
Subtotal	278,780	
Indiana waters		
Little Calumet River	55,000	adipose-right ventral
Trail Creek	50,000	adipose-right ventral
Subtotal	105,000	
Michigan waters		
Little Manistee River	302,980	adipose
Portage Lake	100,600	adipose
Sauble River	200,650	adipose
Brewery Creek	80,999	adipose-right pectoral
Black River	50,280	left pectoral
St. Joseph River	192,592	left pectoral
Platte River	118,397	left ventral-left maxillary
Platte River	267,957	left ventral-right maxillary
Muskegon River	106,621	none
Grand River	112,203	right pectoral
Cedar River	46,277	right ventral-left maxillary
Platte River	129,848	right ventral-left maxillary
Thompson Creek	92,557	right ventral-left maxillary
Subtotal	1,801,961	
Wisconsin waters		
Algoma	50,000	adipose-left pectoral
East Twin River	25,000	adipose-left pectoral
Kenosha	90,300	adipose-left pectoral
Little Manitowoc River	72,000	adipose-left pectoral
Little River	6,500	adipose-left pectoral
Milwaukee	90,500	adipose-left pectoral
Port Washington	45,000	adipose-left pectoral
Racine	40,000	adipose-left pectoral
Sheboygan River	60,000	adipose-left pectoral
Racine	10,000	left maxillary
Kenosha	10,000	right maxillary
Subtotal	499,300	
Total, Lake Michigan	2,685,041	

Table 5. (Cont'd.)

Location	Numbers	Fin clip
LAKE HURON-COHO SALMON		
Michigan waters		
Port Hope	54,176	none
Tawas River	30,000	none
Subtotal	84,176	
Total, Lake Huron	84,176	
LAKE ERIE-COHO SALMON		
Michigan waters		
Detroit River	195,973	none
Huron River	100,092	none
Subtotal	296,065	
New York waters		
Chautauqua Creek	43,000	none
Eighteen Mile Creek	40,000	none
Cattaraugas Creek	51,150	right ventral
Subtotal	134,150	
Ohio waters		
Chagrin River	118,230[1]	left pectoral
Huron River	122,030[1]	right pectoral
Subtotal	240,260	
Pennsylvania waters		
Elk Creek	51,780	none
Godfrey Run	79,400	none
Presque Isle Bay	419,784	none
Sixteen Mile Creek	150,000	none
Trout Run	259,780	none
Subtotal	960,744	
Total, Lake Erie	1,631,219	
LAKE ONTARIO-COHO SALMON		
New York waters		
Salmon River	20,000	adipose-left ventral
Salmon River	19,937	left ventral
Salmon River	40,000[1]	left ventral
Subtotal	79,937	
Ontario waters		
Bronte Creek	49,455	adipose
Credit River	92,407	adipose
Marindale Pond	28,971	adipose
Clarkson	30,240	adipose-right ventral
Subtotal	201,073	
Total, Lake Ontario	281,010	
Total, Great Lakes	4,821,691	

[1] Fall fingerling—other plants consist of yearling fish.

Table 6. Annual plantings (in thousands) of chinook salmon in the Great Lakes, 1967–1978.

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
Subtotal	2,531	35	900	3,516

LAKE MICHIGAN

Year	Michigan	Wisconsin	Indiana	Illinois	Total
1967	802	–	–	–	802
1968	687	–	–	–	687
1969	652	66	–	–	718
1970	1,675	119	100	10	1,904
1971	1,865	264	180	8	2,317
1972	1,691	317	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
Subtotal	20,396	7,212	1,094	2,454	31,156

Table 6. (Cont'd.)

LAKE HURON

Year	Michigan	Total
1968	274	274
1969	255	255
1970	643	643
1971	894	894
1972	515	515
1973	967	967
1974	776	776
1975	655	655
1976	831	831
1977	733	733
1978	1,418	1,418
Subtotal	7,961	7,961

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
Subtotal	1,810	1,368	3,522	968	7,670

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
Subtotal	897	3,959	4,856

Great Lakes Total, chinook salmon, 1967–1978 55,159

Table 7. Plantings of chinook salmon in the Great Lakes, 1978.

Location	Numbers	Fin clip
LAKE SUPERIOR-CHINOOK SALMON		
Michigan waters		
Black River	50,000	none
Dead River	100,000	none
Subtotal	150,000	
Minnesota waters		
Kenosha Harbor	14,680[2]	dorsal
Baptism River	43,333	none
Cascade River	44,455	none
French River	7,800[1]	none
French River	51,125	none
Grand Portage Creek	51,992[2]	none
Kenosha Harbor	64,469[2]	none
Subtotal	277,854	
Wisconsin waters		
Black River	50,000	none
Total, Lake Superior	477,854	
LAKE MICHIGAN-CHINOOK SALMON		
Illinois waters		
Montrose Harbor	182,651	adipose
Calumet Harbor	25,000	none
Diversey Harbor	205,700	none
Jackson Inner Harbor	83,000	none
Kellogg Ditch	23,000	none
Montrose Harbor	25,000	none
Waukegan	67,000	none
Subtotal	611,351	
Indiana waters		
East Chicago, Jeorse Park	62,426	left ventral
Trail Creek	35,000	none
Michigan City, Coast Guard Station	34,322	right pectoral
Burns Harbor, Bethlehem Steel Pier	81,461	right pectoral
Subtotal	213,209	
Michigan waters		
Big Manistee River	350,000	none
Brewery Creek	100,000	none
Escanaba River	100,000	none
Grand River	500,192	none
Kalamazoo River	150,000	none
Little Manistee River	400,028	none
Muskegon River	350,000	none
Portage Lake	50,334	none
St. Joseph River	305,000	none
Sauble River	218,000	none
Subtotal	2,523,554	

Table 7. (Cont'd.)

Location	Numbers	Fin clip
Wisconsin waters		
Kenosha	79,149	dorsal
Ahnapee River	147,000	none
Kenosha	117,000	none
Kewaunee River	365,000	none
Little Manitowoc River	150,000	none
Marinette	150,000	none
Milwaukee	230,000	none
Pensaukee River	60,000	none
Port Washington	100,000	none
Sheboygan River	175,000	none
Sturgeon Bay	244,000	none
Two Rivers	200,000	none
Subtotal	2,017,149	
Total, Lake Michigan	5,365,263	
LAKE HURON-CHINOOK SALMON		
Michigan waters		
AuGres River	110,181	none
AuSable River	500,925	none
Cass River	100,000	none
Flint River	125,000	none
Harbor Beach	150,891	none
Harrisville	55,000	none
Mill Creek	250,000	none
Nagles Creek	25,581	none
St. Marys River	100,000	none
Subtotal	1,417,578	
Total, Lake Huron	1,417,578	
LAKE ERIE-CHINOOK SALMON		
New York waters		
Cattaraugas Creek	206,000	none
Ohio waters		
Chagrin River	181,959	none
Huron River	181,959	none
Subtotal	363,918	
Pennsylvania waters		
Elk Creek	291,750	none
Walnut Creek	280,250	none
Elk Creek	45,865	right ventral
Walnut Creek	50,000	right ventral
Subtotal	667,865	
Total, Lake Erie	1,237,783	

Table 7. (Cont'd.)

Location	Numbers	Fin clip
LAKE ONTARIO-CHINOOK SALMON		
Ontario waters		
Bronte Creek	200,060	none
Martindale Pond	192,548	none
Subtotal	392,608	
Total, Lake Ontario	392,608	
Great Lakes Total	8,891,086	

[1]Yearling—other plants consist of fingerling fish.
[2]USFWS plant—all other U.S. plants by respective states.

Table 8. Plantings of Atlantic salmon in the Great Lakes, 1972–1978.

Year	State	Location	Numbers	Fin clip
		LAKE SUPERIOR		
1972	Wisconsin	Bayfield	20,000	adipose-left ventral
1973	Wisconsin	Bayfield	20,000	right ventral
1976	Michigan	Cherry Creek	9,106	none
1978	Wisconsin	Pikes Creek	36,772	none
Total			85,878	
		LAKE MICHIGAN		
1972	Michigan	Boyne River	10,000	none
1973	Michigan	Boyne River	15,000	none
1974	Michigan	Platte River	7,308	adipose
		Boyne River	14,555	none
1975	Michigan	Boyne River	9,005	none
			13,167[1]	none
1976	Michigan	Boyne River	20,438	none
			162[1]	none
1977	Michigan	Pere Marquette River	7,131	left ventral
		Little Manistee River	4,500	left ventral
		Pere Marquette River	3,961	right ventral
		Little Manistee River	2,997	right ventral
1978	Michigan	Little Manistee River	5,000[1]	left pentoral
		Pere Marquette River	14,800[3]	left pectoral
		Little Manistee River	10,000[2]	right pectoral
		Pere Marquette River	16,332[2]	right pectoral
Total			154,356	
		LAKE HURON		
1972	Michigan	Au Sable River	9,000	none
Great Lakes Total, Atlantic salmon, 1972–1978			249,234	

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

Table 9. Annual plantings (in thousands) of rainbow, steelhead, and palomino[1] trout in the Great Lakes, 1975–1978.[2]

Year	Michigan	Wisconsin	Minnesota	Total
		LAKE SUPERIOR		
1975	25	61	228	314
1976	36	400	9	445
1977	31	73	211	315
1978	20	116	88	225
Subtotal	112	650	536	1,299

Year	Michigan	Wisconsin	Indiana	Illinois	Total
		LAKE MICHIGAN			
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
Subtotal	2,758	2,657	612	614	6,640

Year	Michigan	Ontario	Total
	LAKE HURON		
1975	425	62	487
1976	333	33	366
1977	168	119	287
1978	389	85	473
Subtotal	1,315	299	1,613

Year	Michigan	Ontario	New York	Ohio	Pennsylvania	Total
		LAKE ERIE				
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
Subtotal	110	811	57	860	430	2,267

Year	New York	Ontario	Total
	LAKE ONTARIO		
1975	252	29	282
1976	186	108	295
1977	144	110	254
1978	313	121	434
Subtotal	895	368	1,264
Great Lakes Total, rainbow, steelhead, and palomino trout, 1975–1978			13,083

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

Table 10. Plantings of rainbow, steelhead, and palomino[1] trout in the Great Lakes, 1978.

Location	Numbers	Fin Clip
LAKE SUPERIOR-RAINBOW AND STEELHEAD TROUT		
Michigan waters (steelhead trout)		
Black River	5,000[2]	none
Presque Isle Harbor	5,000[2]	none
Two Hearted River	10,000[2]	none
Subtotal	20,000	
Minnesota waters (rainbow and steelhead trout)		
Baptism River	10,003	adipose-left ventral
Brule River	20,001	adipose-left ventral
French River	21,158	adipose-left ventral
Split Rock River	10,003	adipose-left ventral
Baptism River	4,270	none
Baptism River	33,780[4]	none
Beaver River	25,000[4]	none
Cascade River	1,500	none
Cascade River	12,422[4]	none
Cross River	6,040	none
Cross River	10,000[4]	none
Devil Track River	1,500	none
Devil Track River	12,421[4]	none
Flute Reed River	11,971[4]	none
French River	3,015	none
French River	33,600[4]	none
Kadunce Creek	1,000	none
Kadunce Creek	12,421[4]	none
Kimball Creek	1,000	none
Kimball Creek	11,971[4]	none
Onion River	546	none
Onion River	10,000[4]	none
Split Rock River	1,006	none
Split Rock River	11,000[4]	none
Stewart River	2,185	none
Stewart River	11,608[4]	none
Sucker River	2,491	none
Temperance River	2,500	none
Temperance River	21,990[4]	none
Subtotal	88,218	
	(218,184 fry)	
Wisconsin waters (rainbow and steelhead trout)		
Amnicon River	30,000	none
Black River	30,000	none
Cornucopia	4,000	none
Madeline Island	5,000	none
Port Wing	7,340	none
Superior Entry	10,000	none
Little Brule River	30,000	right ventral
Subtotal	116,340	
Total, Lake Superior	224,558	

Table 10. (Cont'd.)

Location	Numbers	Fin Clip
LAKE MICHIGAN-RAINBOW AND STEELHEAD TROUT		
Illinois waters (rainbow trout)		
Burnham Harbor, Chicago	39,600	none
Montrose Harbor	248	floy tag
Subtotal	39,848	
Indiana waters (steelhead trout)		
Little Calumet River and Trail Creek	19,114[2]	left ventral
Little Calumet River and Trail Creek	110,625[2]	none
Subtotal	129,739	
Michigan waters (rainbow trout)		
Muskegon River	20,000[2]	none
Thompson Creek	9,620[2]	none
West Grand Traverse Bay	35,158[2]	none
Subtotal	64,778	
Michigan waters (steelhead trout)		
Bear River	5,000[2]	none
Betsie River	15,206[2]	none
Boardman River	5,000[2]	none
Boyne River	5,000[2]	none
Cedar River	10,000[2]	none
Crockery Creek	50,000	none
Elk River	9,215[2]	none
Flat River	50,000	none
Galien River	10,000[2]	none
Grand River	151,392	none
Kalamazoo River	10,000[2]	none
Lookinglass River	25,000	none
Menominee River	10,000[2]	none
Muskegon River	100,000	none
Muskegon River	40,000[2]	none
Pentwater River	5,000[2]	none
Rabbit River	50,000	none
Rabbit River	10,000[2]	none
Rogue River	150,000	none
Ruby Creek	5,000[2]	none
St. Joseph River	250,000	none
St. Joseph River	30,000[2]	none
White River	70,000	none
White River	20,000[2]	none
Subtotal	1,085,813	
Wisconsin waters (rainbow and steelhead trout)		
Kewaunee	11,250	left pectoral
Algoma	65,700	none
Baileys Harbor	34,000	none
Fish Creek	3,000	none

Table 10. (Cont'd.)

Location	Numbers	Fin Clip
Gills Rock	14,950	none
Kenosha	58,380	none
Kewaunee	64,525	none
Marinette	19,330	none
Milwaukee	58,644	none
Oconto	41,390	none
Port Washington	38,600	none
Racine	57,208	none
Sheboygan	39,000	none
Sturgeon Bay	31,825	none
Two Rivers	35,340	none
Westers Landing	17,000	none
Racine	22,500	right pectoral
Subtotal	612,642	
Total, Lake Michigan	1,932,820	
LAKE HURON RAINBOW AND STEELHEAD TROUT		
Michigan waters (rainbow trout)		
St. Marys River	10,000[2]	none
Tawas Bay	34,969[2]	none
Thunder Bay	114,643	none
Subtotal	159,612	
Michigan waters (steelhead trout)		
AuSable River	50,000[2]	none
Carp River	14,000[2]	none
Cheboygan River	10,000[2]	none
Rifle River	100,000	none
Rifle River	20,000[2]	none
St. Marys River	15,288[2]	none
Thunder Bay River	10,000[2]	none
Whitney Drain	10,000[2]	none
Subtotal	229,288	
Ontario waters (rainbow trout)		
Beaver River	5,000	adipose
Boyne River	5,000	adipose
Mitchell Creek	10,000	adipose
Saugeen River	8,500[2]	adipose-left pectoral
Saugeen River	9,000[2]	adipose-left ventral
Saugeen River	8,500[2]	left pectoral
Beaver River	10,000	left ventral
Colpoy Bay	9,500[2]	left ventral
Saugeen River	9,000[2]	left ventral
Anderson Creek	5,000	none
Beaver Creek	263,958[4]	none
Belgrave Creek	5,000	none
Subtotal	84,500	
	(263,958 fry)	
Total, Lake Huron	473,400	

Table 10. (Cont'd.)

Location	Numbers	Fin Clip
LAKE ERIE-RAINBOW, STEELHEAD AND PALOMINO TROUT		
Michigan waters (steelhead trout)		
Belle River	10,000[2]	none
Detroit River	20,000[2]	none
Subtotal	30,000	
New York waters (rainbow trout)		
Athol Springs area	18,894[2]	adipose
Ohio waters (rainbow trout)		
Arcola Creek	3,000	none
Chagrin River	30,000	none
Grand River	14,000	none
Rocky River	10,000	none
Turkey Creek	3,000	none
Subtotal	60,000	
Ohio waters (steelhead trout)		
Conneaut Creek	35,000	none
Conneaut Creek	45,000[2]	none
Subtotal	80,000	
Pennsylvania waters (rainbow trout)		
Lake Erie	10,000[2]	left ventral
Conneaut Creek	100[3]	none
Crooked Creek	1,250[2]	none
Crooked Creek	1,000[3]	none
Elk Creek	1,000[3]	none
Elk Creek	15,700[2]	none
Lake Erie	5,000[2]	none
Little Elk Creek	300[2]	none
Taylor Run	2,230[2]	none
Temple Run	7,110[2,3]	none
Trout Run	1,000[3]	none
Twenty Mile Creek	11,050[2]	none
Walnut Creek	4,250[2,3]	none
Walnut Creek	1,000[2]	none
Subtotal	60,990	
Pennsylvania waters (steelhead trout)		
Godfrey Run	18,000[2]	none
Lake Erie	8,000[2]	none
Trout Run	18,000[2]	none
Walnut Creek	1,000[3]	none
Subtotal	45,000	

Table 10. (Cont'd.)

Location	Numbers	Fin Clip
Pennsylvania waters (palomino trout)		
Crooked Creek	100[3]	none
Elk Creek	500[3]	none
Lake Erie	10,000[2]	none
Twenty Mile Creek	300[2]	none
Subtotal	10,900	
Ontario waters (rainbow trout)		
Big Creek	18,500[4]	none
Big Otter Creek	20,000[4]	none
Burnt Mill Creek	200[2]	none
Burnt Mill Creek	15,000[4]	none
Cranberry Creek	16,550[4]	none
Dedricks Creek	5,000[4]	none
Deerlick Creek	8,600[4]	none
Earl Creek	5,400[4]	none
Earl Creek	6,000[4]	none
Harrington Creek	10,000[4]	none
Little Otter Creek	800[2]	none
Little Otter Creek	8,000[4]	none
Lyndock Creek	14,100[4]	none
Minnow Creek	1,800[4]	none
Mosquito Creek	13,600[4]	none
North Branch Creek	10,000[4]	none
Pirrie Creek	15,000	none
Pumpkinseed Creek	6,450[4]	none
Saul Creek	3,600[4]	none
Silver Creek	30,000	none
South Creek	38,400[4]	none
South Otter Creek	40,000[4]	none
Stony Creek	17,200[4]	none
Tobacco Creek	2,900[4]	none
Trout Creek	20,000[4]	none
White Creek	13,600[4]	none
Young Creek	41,200[4]	none
Young Creek	5,000	none
Subtotal	51,000	
	(335,900 fry)	
Subtotal, palomino trout	10,900	
Subtotal, rainbow and steelhead trout	345,884	
Total, Lake Erie	356,784	
LAKE ONTARIO-RAINBOW AND STEELHEAD TROUT		
Ontario waters (rainbow trout)		
Bronte Creek	10,000	none
Credit River	99,900[2]	right ventral
Duffin's Creek	11,050[2]	right ventral
Subtotal	120,950	

Table 10. (Cont'd.)

Location	Numbers	Fin Clip
New York waters (rainbow trout)		
Olcott	3,785[2]	adipose-left pectoral
Wilson	3,785[2]	adipose-left pectoral
Sodus	25,904[2]	adipose-left ventral
Sodus	125,000	right pectoral
Selkirk	7,600[2]	right ventral-left ventral
Subtotal	166,074	
New York waters (steelhead trout)		
Four Mile Creek	10,000	left ventral
Irondequoit Creek	15,000	left ventral
Keg Creek	7,500	left ventral
Salmon River	87,186	left ventral
Salmon Creek	7,600	left ventral
Sandy Creek	10,000	left ventral
Twelve Mile Creek, East Branch	10,000	left ventral
Subtotal	147,286	
Total, Lake Ontario	434,310	
Great Lakes Total, palomino trout	10,900	
Great Lakes Total, rainbow and steelhead trout	3,410,972	
Great Lakes Total, palomino, rainbow and steelhead trout	3,421,872	

[1]Rainbow × W. Virginia Golden trout.
[2]Yearlings. Non-footnoted plants are fingerlings.
[3]Adults. Non-footnoted plants are fingerlings.
[4]Fry. Non-footnoted plants are fingerlings.

Table 11. Annual plantings (in thousands) of brown and tiger[1] trout in the Great Lakes, 1975–1978.

		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
Subtotal	110	302	158	570

		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
Subtotal	1,321	2,658	159	459	4,599

	LAKE HURON	
Year	Michigan	Total
1975	155	155
1976	447	447
1977	210	210
1978	258	258
Subtotal	1,070	1,070

		LAKE ERIE		
Year	Ohio	Pennsylvania	New York	Total
1975	–	7	26	33
1976	–	11	67	78
1977	–	49	125	174
1978	28	34	–	62
Subtotal	28	101	218	347

	LAKE ONTARIO	
Year	New York	Total
1975	371	371
1976	311	311
1977	353	353
1978	94	94
Subtotal	1,129	1,129

Great Lakes Total, brown and tiger trout, 1975–1978: 7,715

[1]Brown × brook trout hybrid.

Table 12. Plantings of brown and tiger[1] trout in the Great Lakes, 1978.

Location	Numbers	Fin clip
LAKE SUPERIOR-BROWN TROUT		
Minnesota waters		
Baptism River	2,950	none
Beaver River	2,042	none
Cascade River	403	none
Devil Track River	500	none
Flute Reed River	450	none
Kadunce Creek	452	none
Kimball Creek	445	none
Big Nett River	598	none
Temperance River	403	none
Tischer Creek	501	none
Subtotal	8,744	
Wisconsin waters		
Chequamegon Bay	47,335	none
Cornucopia	10,000	none
Herbster	5,000	none
Port Wing	5,000	none
Saxon Harbor	10,000	none
Superior Entry	17,080	none
Subtotal	94,415	
Total, Lake Superior	103,159	
LAKE MICHIGAN-BROWN AND TIGER TROUT		
Illinois waters (tiger trout)		
Evanston, Dawes Park	580	none
Illinois waters (brown trout)		
Chicago, Diversey Harbor	7,300	adipose-left pectoral
Chicago, Wilson Avenue Ramp	5,500	none
Subtotal	12,800	
Indiana waters (brown trout)		
Trail Creek	11,621	none
Burns Harbor, Bethlehem Steel Pier	33,097	right pectoral
East Chicago, Jeorse Park	43,803	right pectoral
Michigan City, Coast Guard Station	42,489	right pectoral
Subtotal	131,010	
Michigan waters (brown trout)		
Betsie River	25,038[2]	none
Grand Traverse Bay, East	12,500[2]	none
Grand Traverse Bay, West	12,500[2]	none
Menominee River	25,000[2]	none
Muskegon River	25,000	none
St. Joseph River	25,000	none
South Haven	25,000	none
Subtotal	150,038	

Table 12. (Cont'd.)

Location	Numbers	Fin clip
Wisconsin waters		
Oconto	4,350	adipose-left maxillary
Marinette	7,440	adipose-right maxillary
Whitefish Bay	42,100	adipose-right ventral
Baileys Harbor	32,900	both ventral
Whitefish Bay	66,600	both ventral
Algoma	76,950	none
Baileys Harbor	15,000	none
Cleveland	10,000	none
East Sturgeon Bay	70,330	none
Ephraim	37,600	none
Fish Creek	80,560	none
Kenosha	38,975	none
Kewaunee	76,400	none
Marinette	99,585	none
Milwaukee	65,340	none
Oconto	121,710	none
Port Washington	15,515	none
Racine	68,137	none
Sawyer Harbor	2,500	none
Sheboygan	84,493	none
Sturgeon Bay	35,350	none
Two Rivers	125,360	none
Whitefish Bay	30,906	none
Subtotal	1,208,101	
Subtotal, brown trout	1,501,949	
Subtotal, tiger trout	580	
Total, Lake Michigan	1,502,529	
LAKE HURON-BROWN TROUT		
Michigan waters		
Grindstone City	50,901[2]	none
Port Sanilac	25,056[2]	none
Tawas River	50,000[2]	none
Thunder Bay	32,348	none
Thunder Bay	99,927[2]	none
Subtotal	258,232	
Total, Lake Huron	258,232	
LAKE ERIE-BROWN TROUT		
Ohio waters		
Arcola Creek	5,000[2]	none
Grand River	22,600[2]	none
Subtotal	27,600	

Table 12. (Cont'd.)

Location	Numbers	Fin clip
Pennsylvania waters		
Albion Reservoir, Temple Run	500[3]	none
Baldwin Pond, Raccoon Creek	410[3]	none
Conneaut Creek	420	none
Crooked Creek	1,650	none
Elk Creek	5,200	none
Lake Erie	21,000	none
Walnut Creek	1,000	none
Temple Run	2,460[3]	none
Twenty Mile Creek	1,650	none
Subtotal	34,290	
Total, Lake Erie	61,890	
LAKE ONTARIO-BROWN TROUT		
New York waters		
Oswego	16,140	adipose-left pectoral
Olcott	15,000	none
Selkirk	16,140	none
Wilson	14,965	none
Hamlin	31,297	right ventral
Subtotal	93,542	
Total, Lake Ontario	93,542	
Great Lakes Total, brown trout	2,018,772	
Great Lakes Total, tiger trout	580	
Great Lakes Total	2,019,352	

[1]Brown × brook trout hybrid.
[2]Fingerling. Non-footnoted plants are yearlings.
[3]Adult/yearling mix. Non-footnoted plants are yearlings.

Table 13. Annual plantings (in thousands) of brook trout in the Great Lakes, 1976–1978.

LAKE SUPERIOR

Year	Wisconsin	Minnesota	Total
1976	25	7	32
1977	123	66	188
1978	166	30	196
Subtotal	314	103	417

LAKE MICHIGAN

Year	Michigan	Wisconsin	Illinois	Total
1976	61	12	6	79
1977	–	643	–	643
1978	–	243	5	248
Subtotal	61	898	11	970

LAKE ERIE

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

LAKE ONTARIO

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

Great Lakes Total, brook trout, 1976–1978 1,405

Table 14, Plantings of brook trout in the Great Lakes, 1978.

Location	Numbers	Fin clip
LAKE SUPERIOR-BROOK TROUT		
Minnesota waters		
Baptism River	1,073	none
Cascade River	1,206	none
Chester River	148	none
Deer Yard Creek	200	none
Devil Track River	407	none
Duluth	4,824	none
Encampment River	274	none
French River	1,925	none
Gooseberry River	1,073	none
Grand Marais Harbor	4,627	none
Kadunce Creek	303	none
Kimball Creek	437	none
Knife River	2,674	none
Lester River	1,406	none
Little Manitou River	148	none
Manitou River	1,369	none
Poplar River	377	none
Silver Creek	503	none
Sucker River	1,931	none
Split Rock River	1,295	none
Stewart River	1,073	none
Talmadge River	148	none
Tischer Creek	148	none
Two Harbors	2,412	none
Subtotal	29,981	
Wisconsin waters		
Bark Bay Point	6,200	none
Bayfield City Dock	14,000	none
Chequamegon Bay	82,798	none
Cornucopia	12,400	none
Herbster	2,500	none
Houghton Point	17,200	none
Little Sand Bay	5,725	none
Madeline Island	5,046	none
Michigan Isle	100	none
Onion River	6,000	none
Port Wing	2,500	none
Pikes Bay	6,900	none
Saxon Harbor	2,500	none
Superior Entry	2,500	none
Subtotal	166,369	
Total, Lake Superior	196,350	

Table 14. (Cont'd.)

Location	Numbers	Fin clip
LAKE MICHIGAN-BROOK TROUT		
Illinois waters		
Evanston, Dawes Park	5,000	none
Wisconsin waters		
Baileys Harbor	36,700	none
Cleveland	11,800	none
Kewaunee River	30,000	none
Little River	20,000	none
Sheboygan	60,300	none
Two Rivers	52,900	none
Whitefish Bay	30,925	none
Subtotal	242,625	
Total, Lake Michigan	247,625	
LAKE ERIE-BROOK TROUT		
Pennslyvania waters		
Walnut Creek	1,750	none
Total, Lake Erie	1,750	
Great Lakes Total	445,725	

SEA LAMPREY CONTROL IN THE UNITED STATES

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All phases of sea lamprey control progressed well in 1978. A total of 65 stream treatments were completed in the United States during the field season (Table 1): 19 tributaries of Lake Superior, 14 of Lake Michigan, 15 of Lake Huron, and 7 of Lake Ontario.

Surveys to assess ammocete populations of the sea lamprey were conducted on 312 tributaries of the Great Lakes. Small populations were discovered for the first time in six streams—two tributaries of Lake Superior, two of Lake Erie, and two of Lake Ontario (Fig. 1). Sea lamprey larvae were found in the St. Marys River from the compensating gates at its upper end to a point 23 miles downstream. The average flow of 75,000 cfs and large areas of impounded water make

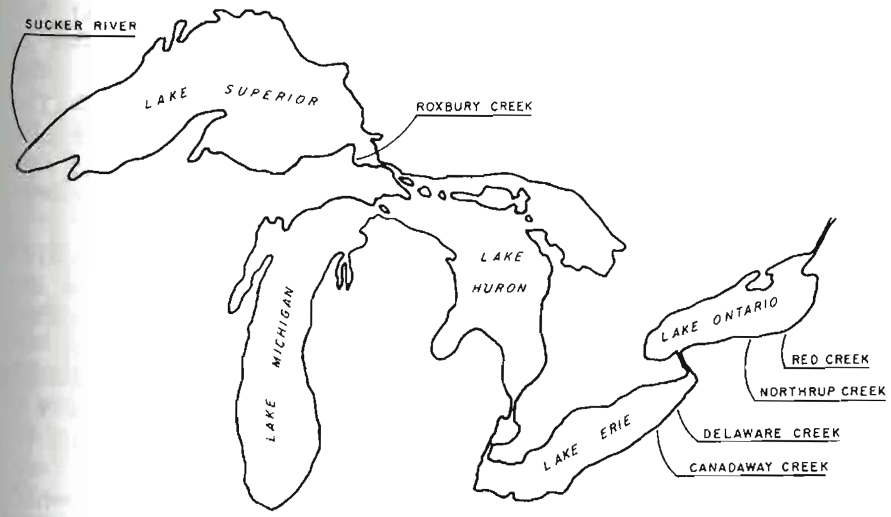


Figure 1. Streams tributary to the Great Lakes in which sea lampreys were collected for the first time in 1978.

chemical treatment of the upper St. Marys River prohibitively expensive.

The number of spawning-run sea lampreys in Lake Superior did not change significantly; 4,812 were taken at eight electric assessment barriers, compared with 4,796 in 1977. The two barriers in western Lake Superior (on the Amnicon and Brule revers) accounted for 64% of the catch in both 1977 and 1978.

Portable assessment traps fished on 37 tributary rivers of four of the Great Lakes demonstrated their utility as a monitoring device. The traps captured 1,003 adult sea lampreys in Lake Superior, 11,240 in Lake Michigan, 7,677 in Lake Huron, and 721 in Lake Ontario.

The number of parasitic-phase sea lampreys collected by fishermen in Green Bay declined 92% in 1978. This sharp decrease, and a corresponding reduction of wounding rates on lake trout, were the result of initial treatment of the Peshtigo River in 1977 and re-treatments of the Cedar and Ford rivers in 1976 and 1977, respectively.

Surveys and Chemical Treatments

Lake Superior Surveys

Pretreatment investigations were completed on 15 Lake Superior tributaries in 1978, and 13 of these were later treated. Moderate to large sea lamprey populations were indicated in six of the rivers treated: Salmon Trout (Marquette County), Sturgeon, Traverse, Salmon Trout (Houghton County), Misery, and Ontonagon. The presence of 58 larvae (63–139 mm long) above the dam on the Rock River demonstrated that this barrier was bypassed by spawning adults in at least 1, and possibly 2 years, since it was rebuilt in 1971. Chemical application sites on Silver Creek (a tributary of the Traverse River) and Newholm Creek (a tributary of the Ontonagon River) were moved upstream because larval populations were detected in the upper reaches of the streams. The upstream populations were missed in earlier sampling because extensive flooding resulting from beaver dams in Silver Creek, and chronic turbidity in the lower end of Newholm Creek, adversely affect surveys in these areas.

Of 74 streams checked to assess reestablished larval populations, 32 were found to be reinfested to varying degrees. The length of the ammocetes (43–78 mm) in Washington Creek, Isle Royale, indicates that this stream should be treated not later than 1980.

Extensive posttreatment surveys conducted on the Firesteel and Bad rivers yielded only 2 residual sea lampreys (59 and 62 mm long) at 1 of 10 stations on the Firesteel River, but a total of 39 (64–130 mm) at 10 of 20 stations on the Bad River. Portions of the Bad River were re-treated in late September to remedy the situation. In a further examination after this treatment, 65 sea lampreys (22–123 mm) were collected in two high-water channels. These channels and several similar ones were later treated.

A survey of the Yellow Dog River (a tributary of the Iron River, Marquette County, Michigan, above Lake Independence) was prompted by concern that sea lampreys may have bypassed the dam at the outlet of the lake and gained access to the upper reaches of the system. Fortunately, only larvae of native lampreys (*Ichthyomyzon*) were present.

Reexaminations of seven streams where sea lamprey larvae had not been previously found produced six ammocetes (15–18 mm long) in the Sucker River (St. Louis County, Minnesota) and two larvae (111–134 mm) in Roxbury Creek (Chippewa County, Michigan). Production from Sucker River will probably be trivial because larval habitat is limited, scouring occurs, and there are barrier falls within 0.5 mile of the mouth. Roxbury Creek is a small, cold-water stream with only marginal potential. Investigations on the St. Louis River have revealed no evidence of a larval sea lamprey population to date, but the potential for a major problem exists if current pollution control programs are as successful as predicted.

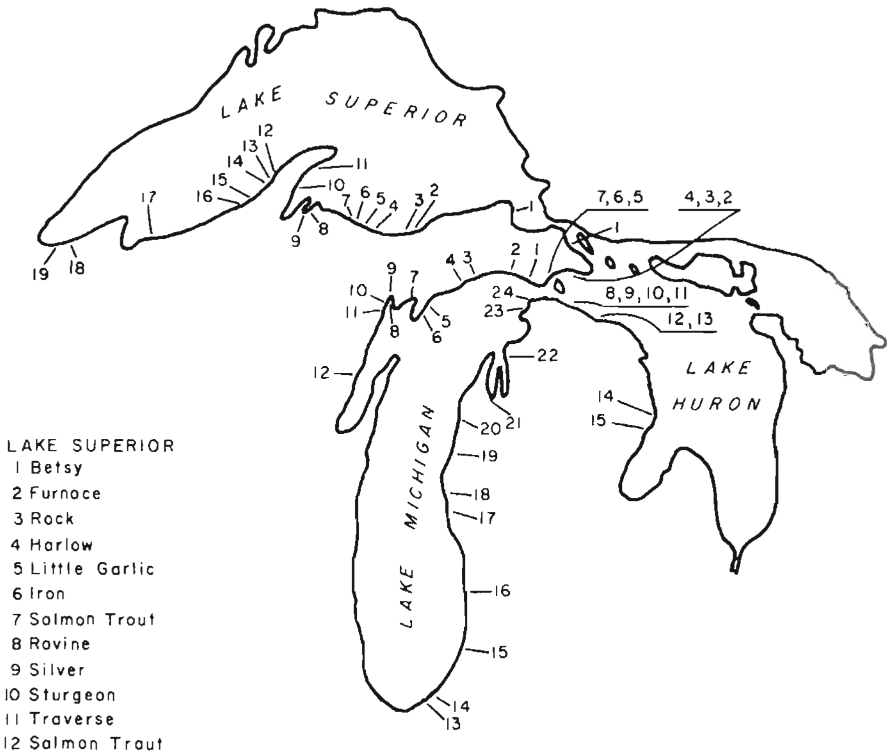
Lake Superior Chemical Treatments

Nineteen streams, with a combined flow of 2,115 cfs (measured just before treatment), were treated during the season (Table 2, Fig. 2). Scheduled treatments of the Sucker River (Alger County, Michigan), Falls River (Baraga County, Michigan), and Fish Creek (Bayfield County, Eileen Township, Wisconsin) were postponed because the ammocetes were either too few or too small to justify treatment. The Huron River, which contains a large population of small ammocetes, is to be treated during the Sea Lamprey International Symposium as a demonstration treatment in August 1979.

Sea lamprey larvae were abundant upstream from previously known upper limits on Newholm Creek (a tributary of the Ontonagon River) and Silver Creek (a tributary of the Traverse River). Eleven collections during the treatment of Newholm Creek contained 1,148 larvae and 2 transformed sea lampreys. Two collections from Silver Creek contained 239 ammocetes and 13 transformed larvae.

Chemical treatments of the Potato River (a tributary of the Bad River, Wisconsin) in 1977 and again in 1978 left ammocetes in certain side channels and backwaters. Successful treatment of these areas will require the assignment of personnel to follow the chemical bank downstream and treat the oxbows and side channels at the same time the main stream is treated.

The Potato River (Ontonagon County, Michigan) was re-treated because many large ammocetes were found after the low-water treatment in 1977. Treatment personnel used backpack sprayers to boost concentrations as beaver dams and low flows diluted the bank of



LAKE SUPERIOR
1 Betsy
2 Furnace
3 Rock
4 Harlow
5 Little Garlic
6 Iron
7 Salmon Trout
8 Ravine
9 Silver
10 Sturgeon
11 Traverse
12 Salmon Trout
13 Misery
14 East Sleeping
15 Ontonagon
16 Potato
17 Bad
18 Amnicon
19 Nemadji

LAKE MICHIGAN
1 Paquin
2 Black
3 Hudson
4 Milakokia
5 Bursaw
6 Parent
7 Ogontz
8 Squaw
9 Whitefish

LAKE MICHIGAN (Cont.)
10 Days
11 Portage
12 Peshtigo
13 Stote
14 Galien
15 Allegan 4
16 Grand
17 Pentwater
18 Bass Lake
19 Manistee
20 Betsie
21 Boardman
22 Horton
23 Big Stone
24 Carp Lake

LAKE HURON
1 Big Munuscong
2 Caribou
3 Carr
4 Albany
5 Prentiss
6 Ceville
7 Carp
8 Cheboygan
9 Elliot
10 Grass
11 Greene
12 Black Mallard
13 Trout
14 Tawas
15 East Au Gres

Figure 2. Location of streams tributary to the Upper Great Lakes that were treated with lampricides in 1978.

chemical. A total of 764 ammocetes and 29 transformed sea lampreys were collected in the 10 miles of stream treated.

There were no serious fish kills in Lake Superior tributaries.

Lake Michigan Surveys

Surveys were conducted on 105 Lake Michigan tributaries in 1978 in preparation for chemical treatments and to assess reestablished sea lamprey populations. Reinfestation was verified in 54 of the streams, and 20 were later treated.

A single sea lamprey ammocete, 40 mm long, was collected from the main stem of the Oconto River. Although a population had existed in one of the tributaries (Little River) until it was chemically treated in 1976, this was the first record of the survival of larvae in the main river, and may reflect improved water quality resulting from the closure of a paper mill at Oconto Falls. One sea lamprey larva was recovered in each of Sucker and Mile creeks—the first larvae collected in these streams since 1961 and 1972, respectively.

Survey collections in the fall on the Pere Marquette River accounted for a total of 1,128 sea lamprey ammocetes, of which 13% were longer than 100 mm. The high incidence of large larvae indicates that sea lampreys will be of transformation size by fall 1979, and that treatment should be scheduled accordingly.

A moderate-sized reestablished population is present below the dam on the Manistique River, but reinfestation of the river system above the dam appears to be inconsequential. A total of 238 sea lamprey larvae (32–142 mm long) were collected below the dam, only 9 of which were over 100 mm long. Extensive investigations above the dam accounted for only four sea lamprey larvae (lengths, 18, 99, 107, and 112 mm).

In posttreatment examinations of 17 streams, residual sea lampreys were found in 6. The most significant population was in the Whitefish River, where 278 residual larvae were collected after the treatment in August 1978. At least 90% of these survivors were found in, or associated with, side channels and two small tributaries. Moderate numbers of residual sea lampreys were recovered from the Sturgeon River, and small numbers from the Millecoquin, Pensaukee, and Pentwater rivers and Big Stone Creek.

Surveys for lentic populations of larval sea lampreys were conducted in inland lakes off the mouths of four Lower Peninsula streams. Larvae were found only off the Manistee River, in Manistee Lake.

No sea lamprey larvae were discovered during reexaminations of 38 streams that have been consistently negative (i.e., no larvae collected) in past years.

Lake Michigan Chemical Treatments

A total of 24 streams, with a combined flow (measured just before treatment), of 4,034 cfs were treated during the year (Table 3, Fig. 2).

Scheduled treatments of the Manistique, Little Fishdam, and Ahnapee rivers and Ephraim, Lilly Bay, and Mitchell creeks were postponed because too few larvae were present to justify the work. Treatment of the Elk River was postponed because of low water levels.

A shortage of manpower during the treatment of the Whitefish River prevented the simultaneous treatment of all backwaters and the mouths of tributary streams that did not contain larvae. Large numbers of ammocetes avoided the main bank of chemical by swimming into these areas during the treatment. Intensive surveys and limited chemical treatments are scheduled for the Whitefish River in 1979 to evaluate and remedy this problem.

The Peshtigo River was treated while its flow was at double the rate measured during the 1977 treatment, to prevent dilution of the chemical bank in the lower sections of the river and to further reduce the number of ammocetes left during the low-water treatment in 1977. However, only 124 larvae were collected in 1978, compared with 2,529 in 1977, despite a 72% increase in collection effort in 1978. No sea lamprey larvae were found in the lowest 2.5 miles of stream during either treatment. Treatment of the river during the low-water period was thus successful, and future treatments during periods of low flow will result in a saving of about 2,200 pounds of TFM.

The Ogontz River was treated in 1977 and 1978 to eliminate recruitment of young-of-the-year larvae to the estuary and offshore areas. No residual ammocetes were found in 1978, although the 1977 treatment was at extremely low water levels which (in contrast to the situation in the Peshtigo River) are not desirable during treatments of this stream. No sea lampreys were observed in the estuary. The present low level of abundance of ammocetes in the Ogontz River suggests that annual treatments will not be necessary.

No significant mortality of fish occurred during chemical treatments. Large spawning runs of salmon were present during treatment of the Manistee and Betsie rivers, but no mortalities occurred. About 40 salmon died during the Horton Creek treatment, but this number represented only a small percentage of the total run.

Lake Huron Surveys

Surveys were conducted on 54 Lake Huron tributaries in preparation for scheduled chemical treatments and to assess reestablished sea lamprey populations. Reestablished larvae were found in 30 streams.

Posttreatment surveys were completed on 14 streams treated in 1977 and 1978. Sea lampreys that survived these treatments were found in four: 50 residual ammocetes were collected in Swan Creek, 16 in Albany Creek, 13 in the Au Gres River, and 1 in Mulligan Creek. The Swan River was tentatively scheduled for treatment in 1979.

Investigations of 31 Lake Huron tributaries that have been consistently negative in the past yielded no sea lampreys.

Lentic areas associated with 14 streams were examined for the presence of larval populations; sea lampreys were recovered from 4. Sea lampreys were found in Hammond Bay, offshore from the Ocqueoc River, where 70 (maximum length, 136 mm) were collected from 6 of 14 stations. Eleven stations in Ocqueoc Lake were negative, but fyke nets set below the outlet of the lake in spring 1978 by the staff of the Hammond Bay Biological Station captured 5 ammocetes, 32 recently metamorphosed lampreys, and 1 feeding adult (225 mm long). Netting operations in the same area in the fall yielded 12 metamorphosing sea lampreys. Large ammocetes that survived the 1976 chemical treatment are the probable source of these lampreys. Along the north shore, 16 larvae (56–92 mm) were taken off Albany Creek, 2 (45–63 mm) off McKay Creek, and 45 (30–131 mm) off the Carp River. The ammocetes captured off Albany and McKay creeks were reestablished; however, those taken off the mouth of the Carp River were residual.

Six recently transformed sea lampreys were collected from Lake Huron tributaries by survey personnel in 1978—one from the Rifle River and five from the Chippewa River (which is a major tributary to the Saginaw River system). Although relatively small numbers of ammocetes have been found in the Chippewa River since 1971, the 1978 collection was the first one that contained metamorphosed lampreys.

Survey of the Rifle River indicated a main stream population almost equal to that found before the 1975 treatment. In fall 1974, 672 ammocetes (24–124 mm long) were collected from 14 stations; in 1978, these same 14 stations yielded 581 ammocetes (18–165 mm) and 1 transforming sea lamprey. The number of postive tributaries of the Rifle River decreased from 20 in 1974 to 9 in 1978.

Lake Huron Chemical Treatments

A total of 15 streams, with a combined flow (measured just before treatment), of 1,693 cfs, were treated during the year (Table 4, Fig. 2). All treatments scheduled were completed.

The lower 6 miles of the Cheboygan River were treated for the first time. A few ammocetes were collected from the river below the dam in Cheboygan. Apparently some larvae escaped as a result of the intrusion of cold, untreated Lake Huron water beneath the warmer treated river water. Additional studies will be conducted to measure escapement and to solve this treatment problem.

The only mortality of nontarget species in Lake Huron tributaries occurred in Elliot Creek, where about 200 spawning white suckers were killed.

Lake Erie Surveys

Sea lamprey surveys on Lake Erie in 1978 were confined to the reexamination of 13 streams in the State of New York.

Investigations on Cattaraugus Creek indicated an increase in the abundance of sea lamprey larvae, as well as an extension in their distribution. A total of 145 sea lampreys (24–174 mm long), including 3 transforming individuals, were taken at stations on the main stream, the South Branch, and Clear Creek. Sampling in previous years has suggested the presence of only a small population, restricted to Clear Creek.

Reexamination of 12 streams where sea lamprey larvae had not been found in the past disclosed small populations in 2. Thirty-eight sea lampreys (23–131 mm long) were collected in Delaware Creek (Erie County), and 16 (33–46 mm) in Canadaway Creek (Chautauqua County). A dense population of larval American brook lampreys present in both of these streams may have masked the small sea lamprey population in Delaware Creek in previous surveys. All of the sea lampreys collected in Canadaway Creek were of the 1978 year class. Recent pollution abatement measures in the drainage have improved lamprey habitat in this stream.

Lake Ontario Surveys

A total of 32 streams in the Lake Ontario basin were examined in 1978; 15 flow directly into Lake Ontario, 16 are part of the Oswego River system, and 1 is a tributary of the Niagara River.

Rechecks of 14 Lake Ontario tributaries that had no past record of sea lamprey production resulted in the collection of ammocetes in 2. One larva (63 mm long) was collected in Red Creek (Wayne County), and one (85 mm) in Northrup Creek (Monroe County). Both streams appear to have very limited productive potential at present because of poor water quality.

Investigations were continued in the Black River (Jefferson County), where a small population of sea lamprey larvae has been discovered in 1977 below the dam in the village of Dexter. In 1978, 76 ammocetes (19–107 mm long) were found above the dam, which was previously considered to be a barrier. Access to the upper river was evidently gained through seepage channels in the bedrock below the dam. The upstream limit of distribution is not yet known, but it is hoped that dams about 8 miles farther upstream (in Watertown) will prove to be a definite block to spawning adults. A single ammocete (123 mm) was also taken with Bayer 73 granules about 1.5 miles off the mouth of the river, in Black River Bay, and may indicate problems with a lentic population.

Of 16 streams tributary to the Oswego River system that were examined, 11 that have had no past record of sea lamprey infestation continued to be negative. Surveys on the five positive streams to monitor larval distribution and abundance revealed small populations in three streams tributary to the Seneca River and large populations in two tributaries of Oneida Lake. Eight stations on Fish Creek (Oneida Lake), examined under poor conditions in May, accounted for 781 sea lamprey larvae, of which 205 were longer than 100 mm. Sampling effort of 20 minutes at a single station on Big Bay Creek (Oneida Lake) in August yielded 49 sea lampreys, including 30 that were metamorphosing.

Studies of Adult Sea Lampreys

Migrant Sea Lampreys

The number of sea lampreys captured at the eight index barriers on Lake Superior in 1978 was 4,812—nearly identical to the number (4,796) captured in 1977 (Fig. 3, Table 5). The two barriers in western Lake Superior (on the Brule and Amnicon rivers) accounted for 64% of the total catch in both years. The Brule River contributed 2,572 adults and the Amnicon River 493 to the total catch in 1977; in 1978, the contribution of the Brule River decreased to 794 and that of the Amnicon River increased to 2,310. The chemical treatment of the Brule River in 1977 may be responsible for the reduction in the spawning run into that stream.

In comparison with an average of 7,000 lampreys taken annually in the eight Lake Superior barriers during the 6-year period 1967–72, the catch during the past 6 years (1973–78), since intensified control measures have been in effect, has averaged 3,500. These averages indicate a 50% reduction in the lamprey population since intensification

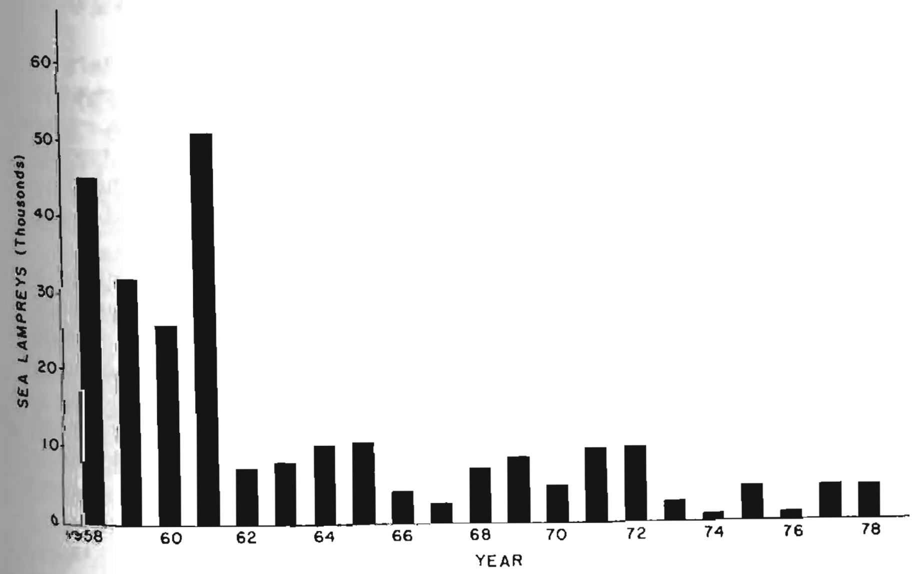


Figure 3. Annual catches of spawning-run sea lampreys at eight electric barriers on Lake Superior tributaries, 1958–78.

began in 1972, and a 93% reduction from the 51,000 adults taken in the peak year of 1961.

The average length and weight of Lake Superior adults in 1978 were closely similar to the averages for the previous 4 years (Table 6): 430 mm and 169 g for 1978 and 432 mm and 179 g for 1974–77.

The sex ratio of adult sea lampreys in Lake Superior has stabilized: the percentage of males has varied only from 29 to 31 for the past 8 years (1971–78). In 1978 the percentage was 31 (Table 6).

The number of sea lampreys captured at the electric barrier in the Ocqueoc River (Lake Huron) has been variable over the past 5 years, fluctuating from a low of 503 to a high of 6,937 and averaging 2,200. The catch was 2,121 in 1978. Mean length and weight of adults in 1978 were 442 mm and 192 g, compared with the 5-year average of 461 mm and 206 g. The percentage of males ranged from 35 to 44 and averaged 37 in 1973–77; in 1978 it was 40.

The number of rainbow trout handled at the barriers in Lake Superior was similar to that in 1977—about 6% below the 1973–77 average. The number of longnose suckers was 46% higher and the number of white suckers 44% higher than the 1973–77 average; catches of both species were far greater than the small numbers taken in 1977. The numbers of the three species taken in 1978, and (in parentheses) the average number caught in 1973–77 were as follows: spawning-run rainbow trout, 1,433 (1,518); longnose suckers, 12,540 (8,572); and white suckers, 12,466 (8,683).

The percentage of spawning-run rainbow trout bearing scars or wounds remained low. From 1973 to 1977 the scarring rate ranged from 1.1 to 3.4% and averaged 2.1%; in 1978 it was 0.8%.

An electric barrier was operated on Weston Creek, a tributary of the Manistique River (Lake Michigan), to prevent adult sea lampreys from bypassing the dam at the City of Manistique and gaining access to the upper Manistique River. For the first year since 1975 the barrier operated without interruption. Survey crews working above the dam recovered four sea lamprey ammocetes, which probably belonged to the 1975 and 1977 year classes.

A water control structure in Weston Creek will be tested as a lamprey barrier in the spring of 1979, with the hope that it will supplant the electric barrier. Stop logs will be used to create a barrier 20 inches high, and the structure will be monitored to determine whether it prevents upstream migration of adult sea lampreys.

Feasibility studies of the portable assessment trap as a means of monitoring spawning sea lamprey populations and of locating suitable areas for their operation continued in 1978. A total of 54 traps were fished on 37 tributary rivers of four of the Great Lakes (Fig. 4, Table 7). Lampreys were captured in 34 of the rivers. Traps have been fished in 56 Great Lakes tributaries since investigations began in 1976.

Figure 4. Location of streams tributary to the Great Lakes in which portable assessment traps were fished to assess populations of spawning sea lampreys in 1978.

Most potential trap sites along the Lake Superior shoreline have been evaluated. Assessment sites were selected on the Rock, Tahquamenon, Big Garlic, Iron, Betsy, and Silver rivers. The completion of a sea lamprey barrier dam on the Miners River affords an additional site to be tested in 1979.

The number of sea lampreys captured in the Rock River in 1976–78 (range, 477–508) indicated little change in this population. A total of 135 sea lampreys were trapped in the Big Garlic River in 1978, compared with 30 in 1977 and 90 in 1976. The catch of 310 spawning-phase lampreys in the Tahquamenon River in 1978, with only a slight increase in trapping effort over that in 1977, suggests a substantial increase in the size of the run; the 1977 catch was 170.

Length, weight, and sex ratios of the sea lampreys trapped in Lake Superior streams were similar to those of lampreys taken in six electrical barriers located in State of Michigan waters for 1977 and 1978 (Table 6). Average lengths and weights for lampreys captured in four assessment traps in Michigan waters of Lake Superior in 1978 were 414 mm and 158 g, compared with 432 mm and 174 g for lampreys taken from the six electrical barriers in Michigan, and 430 mm and 169 g for all eight Lake Superior electrical barriers.

A number of sea lampreys taken in the electrical weirs on the Betsy and Iron rivers were marked and released upstream (Table 7). The recapture of marked lampreys in traps at dams above the weirs indicates that these dams will be reliable assessment sites.

Traps fished in the Peshtigo and Menominee rivers (tributaries of Green Bay) collected 4,200 adult sea lampreys, compared with 1,358 in 1977. On the basis of catch per unit of effort, we estimate that the spawning population increased by 30% in the Menominee River and by 100% in the Peshtigo River in 1978. Combined average lengths and weights for 1,645 sea lampreys from these rivers were 508 mm and 275 g.

The 5,408 sea lampreys captured in the Manistique River (Lake Michigan) in 1978 was significantly higher than the 3,273 in 1977. Effort and trapping method were similar for the 2 years. On the basis of the relatively low recovery rate of lampreys marked and released in this river (13% of 4,687), and visual observations made by personnel servicing the traps, the spawning run entering the Manistique River appeared to be several times greater than the number trapped. Average lengths and weights for the 894 sea lampreys examined were 493 mm and 247 g.

The operation of assessment traps in 19 east shore Lake Michigan tributaries resulted in the capture of 1,632 sea lampreys from 17 of the streams. Dams on these rivers were generally a considerable distance upstream from the mouth, which probably contributed to the low recovery rate of marked lampreys at most sites. Annual assessment is recommended on five of these rivers (Betsie, Boardman, Jordan, Muskegon, and St. Joseph). Biological information on sea lampreys was collected mainly from two rivers—the Betsie, where lengths and weights for 68 lampreys were 495 mm and 252 g; and the St. Joseph, where the averages for 224 lampreys were 478 mm and 235 g (Table 6).

Fishing of assessment traps on Lake Huron was again limited to the Cheboygan and Trout rivers, and the St. Marys River, which connects Lakes Superior and Huron. Although the catch of sea lampreys in the Cheboygan River increased from 3,360 in 1977 to 6,489 in 1978, trapping effort was increased at a similar rate, suggesting there was no change in magnitude of the run. Average lengths and weights for the 551 lampreys examined were 452 mm and 185 g. The catch in the St. Marys River was 1,419 in 1977 and 1,148 in 1978. Although fishing effort in 1978 was increased slightly, we believe there was a reduction of about 25% in the number of spawning adults in that system. Average lengths and weights for 300 sea lampreys from the river were 475 mm and 228 g.

Traps in five Lake Ontario tributaries, operated for the first time in 1978, captured 721 sea lampreys. The use of traps for annual assessment appears favorable on the Little Salmon River and Grindstone Creek and will continue in 1979. Combined average lengths and weights for 193 lampreys from these two streams were 461 mm and 223 g. All remaining potential trap sites on Lake Ontario tributaries will be examined in 1980.

Continued trapping of sea lampreys in the lower Oswego River below the dam in the City of Oswego does not appear feasible because there are no suitable trap sites.

Parasitic Sea Lampreys

The collection of parasitic-phase sea lampreys taken by fishermen from Lakes Superior, Michigan, and Huron continued in 1978 (Table 8). On the basis of data for 1977, we estimate that the 1978 returns were about 80% complete. Collections were discontinued in Lake Erie because the number of sea lampreys collected in past years has been insignificant.

A total of 142 sea lampreys were taken by Lake Superior commercial and sport fishermen in 1978, of which 70 (49%) were taken in Wisconsin. The collections included only six recently metamorphosed parasitic-phase sea lampreys ≤ 200 mm long. This slight reduction in the number of sea lampreys collected from the fisheries probably does not indicate a significant change in the sea lamprey population, inasmuch as no change was indicated by the catch at barriers. Biases in both the electric barrier catch and collections from the fisheries account for minor fluctuations.

Lake Michigan fishermen collected 319 sea lampreys in 1978, compared with 1,614 in 1977. This sharp reduction in the parasitic sea lamprey population in Lake Michigan was most dramatic in Green Bay, where only 86 sea lampreys were collected in 1978 as compared with 1,110 in 1977—a 92% decrease. This reduction in the lamprey population is also reflected by a decrease in wounding rates among lake trout, from 17.3 to 4.7%.

Undoubtedly the chemical treatment of the Peshtigo River in 1977 was the primary reason for the sharp decrease in sea lamprey numbers in Green Bay. The chemical treatments of the Cedar River in 1976 and the Ford River in 1977 probably contributed.

In northern Lake Michigan proper, 233 sea lampreys were collected in 1978, a 54% decrease from the total of 504 collected in 1977. Wounding rates on lake trout in this area decreased from 5.1 to 3.2%.

Two Lake Michigan statistical districts contributed the largest number of sea lampreys in 1978: the Algoma, Wisconsin, area (WM-4), 114 (36%); and the Naubinway, Michigan, area (MN-3), 88 (28%). Sea lampreys captured from the Algoma, Wisconsin, area were 83% spawning-phase adults. Lake Michigan collections included 18 recently metamorphosed parasitic-phase sea lampreys ≤ 200 mm long.

Lake Huron collections, which are limited to the De Tour, Michigan, area (MH-1), totaled 329 sea lampreys captured by fishermen in 1978, compared with 270 in 1977. The collections included only seven recently metamorphosed parasitic-phase sea lampreys ≤ 200 mm long.

This high number of lampreys, most of which were captured by one commercial fisherman, seems to indicate a continued high abundance of sea lampreys in the lower St. Marys River and surrounding waters of northern Lake Huron.

Fyke Net Operations

Fyke nets fished in tributary streams provide information on downstream movement of transformed and larval lampreys. The catches also provide an estimate of the efficiency of chemical treatments.

Nets were set in five streams tributary to the north and west shores of Lake Michigan (Sturgeon, Whitefish, Ford, Bark, and Cedar rivers) and fished for about 1 month in late fall 1978. No larval or transformed sea lampreys were captured. Nets fished at the same sites and during the same period in 1962 captured 4 larval and 601 transformed sea lampreys.

Nets were also fished in five streams tributary to the south shore of Lake Superior (Big Garlic, Bad, Brule, Middle, and Amnicon rivers) for a like period. Five transformed sea lampreys were captured—four in the Bad River and one downstream from Saux Head Lake in the Big Garlic River. Nets fished in four of these streams during a similar period in 1961 captured 36 transformed lampreys.

Ammocete Studies

Lake Superior

Surveys have been conducted each fall since 1960 at index stations in Lake Superior tributaries to determine the presence of young-of-the-year sea lampreys. Lampreys of the 1978 year class were recovered from 24 streams. This year class was later eliminated, by chemical treatments, from 10 streams: Ravine, Silver, Sturgeon, Traverse, Salmon Trout (Houghton County), Misery, Amnicon, and Nemadji rivers and Furnace and Harlow creeks. Twenty-two streams have shown no evidence of reestablishment for the past 4 or more years. Table 9 shows the status of the remaining reestablished populations in Lake Superior tributaries.

Surveys with Bayer 73 and backpack shockers were again conducted on deltas associated with inland lakes on the Miners, Au Train, and Big Garlic rivers and Harlow Creek. Two of these deltas harbored sea lamprey larvae: Au Train Lake, one larva (89 mm long); and Saux Head Lake, one larva (147 mm). Nineteen residual sea lampreys (47–177 mm) were recovered in Harlow Creek downstream from Harlow Lake. This system was later treated.

A single residual ammocete (142 mm long) was recovered in Eagle Harbor off Eliza Creek. The stream was last treated in 1977.

Lake Michigan

A network of index stations to determine the presence of young-of-the-year sea lampreys was established for streams along the north and west shores of Lake Michigan; monitoring is similar to that at the index stations on Lake Superior tributaries. Sea lampreys of the 1978 year class were recovered from 15 streams—the Milakokia and Ogontz rivers and Portage Creek. Twelve streams have shown no evidence of new year classes for the past 4 or more years. The status of the remaining reestablished sea lamprey populations in streams of the north and west shores of Lake Michigan is shown in Table 10.

Lake Huron

Index stations have been established and are being monitored for young-of-the-year larvae in streams tributary to the north shore of Lake Huron. Lampreys of the 1978 year class have been recovered from seven streams. Two streams have shown no evidence of reestablishment for the past 4 or more years. Table 11 shows the status of remaining reestablished populations for streams of the north shore of Lake Huron.

St. Marys River

Surveys with granular Bayer were conducted in the St. Marys River to determine the distribution and relative abundance of sea lamprey larvae. Previous surveys had established the downstream distribution to a point about 4 miles below the compensating gates. The surveys in 1978 extended the known range downstream to Johnson Point, 23 miles below the gates. Ammocetes were widely scattered in areas of diverse habitat: off the downstream tips of islands in the dredge dumping grounds, along the drop-off of the shipping channel, and in offshore sand flats.

A visual survey by divers revealed a suitable spawning area north of Neebish Island. A total of 44 sea lamprey ammocetes were collected from a 4,000 square foot area surveyed with granular Bayer downstream from this spawning habitat. Five larvae were collected near Johnson Point. Additional studies are needed to determine how far below Neebish Island the population extends, and the lateral distribution of the larvae in the river. More information is needed to determine the contribution of this lamprey population to the parasitic stocks in northern Lakes Huron and Michigan.

Fluorometric Dye Tracing

Fluorescent dyes are used in pretreatment planning to determine water flows, chemical distribution patterns, time of travel, and dilution rates. Rhodamine WT, which can be measured accurately at concentrations in parts per billion, was used during pretreatment planning for the first time in 1978. In such minute concentrations, Rhodamine WT is not visible to the unaided eye, but can be monitored with a fluorometer. In contrast, fluorescein, which has been used routinely in pretreatment time-of-travel studies, colors the water a brilliant green and often causes concern among citizens and public agencies.

Rhodamine WT can be metered into the stream before a chemical treatment to identify problem areas. The dye was metered over a 12-hour period into the lower Cheboygan River to simulate a chemical treatment of the stream and determine the effect of a lake seiche on a treatment. A detailed profile of the bank of dye was obtained by continually traversing the stream by boat with the recording fluorometer.

Rhodamine WT also can be used in groundwater flow studies. A dye tracer study by fluorometry was conducted to assess the potential for contamination of the municipal water supply of Mt. Pleasant, Michigan, if the Chippewa River were treated. This stream has harbored larval sea lampreys for a number of years, but treatment has been deferred because of possible contamination of the water supply, which is drawn in part from a Ranney well located near to the stream.

Rhodamine WT was metered for 12 hours into the Chippewa River upstream from the Mt. Pleasant waterworks to simulate a lampricide treatment. Water pumped from the Ranney well (500 gallons per minute) was monitored continuously for the presence of the dye. None was detected (limit of detection = 0.02 ppb). Therefore, it is expected that lampricide treatment of the Chippewa River will not result in contamination of Mt. Pleasant's water supply under similar conditions of groundwater storage, stream volume, and the amount of water drawn by the Ranney well. The Chippewa River was scheduled for treatment in 1979.

Table 1. Summary of chemical treatments in United States waters of the Great Lakes in 1978.
[Lampricides used are in pounds of active ingredient.]

Lake	Number of streams	Discharge at mouth (cfs)	TFM	Bayer 73 Powder	Bayer 73 Granules
Superior	19	2,115	18,062	3.5	25.0
Michigan	24	4,034	51,832	194.2	30.0
Huron	15	1,693	36,872	75.2	0.0
Ontario[a]	7	1,376	6,440	22.0	0.0
Total	65	9,218	113,206	294.9	55.0

[a] Treated by crew from the Sea Lamprey Control Centre, Department of Fisheries and Oceans Canada.

Table 2. Details on the application of lampricides to tributaries of Lake Superior in 1978.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM: Concentration (ppm) Minimum effective	TFM: Concentration (ppm) Maximum allowable	TFM: Pounds used	TFM: Hours applied	Bayer 73: Pounds of powder used	Bayer 73: Granules Pounds used	Bayer 73: Granules Acres surveyed
Betsy River	June 8	90	1.2	3.3	550	12	–	–	–
Iron River	June 12	105	1.4	4.1	726	12	–	–	–
Salmon Trout River (Marquette County)	June 21	45	2.0	5.8	484	16	–	–	–
Little Garlic River	June 26	10	1.7	5.0	110	12	–	–	–
Ontonagon River	July 29	600	2.0	5.8	5,654	12	–	–	–
East Sleeping River	Aug. 1	10	1.3	3.5	198	18	3.5	–	–
Potato River	Aug. 2	1	2.6	7.8	374	18	–	–	–
Misery River	Aug. 13	17	3.5	10.7	550	14	–	–	–
Furnace Creek	Sept. 13	26	1.8	5.0	176	8	–	–	–
Amnicon River	Sept. 21	107	1.2	3.3	682	12	–	–	–
Nemadji River									
Black River	Sept. 23	50	1.0	2.9	330	12	–	–	–
Bad River									
Potato River	Sept. 26	25	1.8	5.4	572	14	–	–	–
Ravine River	Sept. 29	15	1.2	3.3	88	12	–	7.5	1.5
Silver River	Sept. 29	80	1.4	4.1	462	12	–	7.5	1.5
Sturgeon River	Oct. 1	850	1.4	4.1	5,896	12	–	10.0	2.0
Traverse River	Oct. 7	17	1.0	2.9	176	12	–	–	–
Salmon Trout River (Houghton County)	Oct. 11	35	2.6	6.2	374	12	–	–	–
Rock River	Nov. 1	30	3.0	9.0	506	12	–	–	–
Harlow Creek	Nov. 3	2	1.4	4.1	154	6	–	–	–
Total		2,115			18,062		3.5	25.0	5.0

Table 2. Details on the application of lampricides to tributaries of Lake Superior in 1978.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM				Bayer 73		
			Concentration (ppm)				Pounds of powder used	Granules	
			Minimum effective	Maximum allowable	Pounds used	Hours applied		Pounds used	Acres surveyed
Betsy River	June 8	90	1.2	3.3	550	12	–	–	–
Iron River	June 12	105	1.4	4.1	726	12	–	–	–
Salmon Trout River (Marquette County)	June 21	45	2.0	5.8	484	16	–	–	–
Little Garlic River	June 26	10	1.7	5.0	110	12	–	–	–
Ontonagon River	July 29	600	2.0	5.8	5,654	12	–	–	–
East Sleeping River	Aug. 1	10	1.3	3.5	198	18	3.5	–	–
Potato River	Aug. 2	1	2.6	7.8	374	18	–	–	–
Misery River	Aug. 13	17	3.5	10.7	550	14	–	–	–
Furnace Creek	Sept. 13	26	1.8	5.0	176	8	–	–	–
Amnicon River	Sept. 21	107	1.2	3.3	682	12	–	–	–
Nemadji River									
Black River	Sept. 23	50	1.0	2.9	330	12	–	–	–
Bad River									
Potato River	Sept. 26	25	1.8	5.4	572	14	–	–	–
Ravine River	Sept. 29	15	1.2	3.3	88	12	–	7.5	1.5
Silver River	Sept. 29	80	1.4	4.1	462	12	–	7.5	1.5
Sturgeon River	Oct. 1	850	1.4	4.1	5,896	12	–	10.0	2.0
Traverse River	Oct. 7	17	1.0	2.9	176	12	–	–	–
Salmon Trout River (Houghton County)	Oct. 11	35	2.6	6.2	374	12	–	–	–
Rock River	Nov. 1	30	3.0	9.0	506	12	–	–	–
Harlow Creek	Nov. 3	2	1.4	4.1	154	6	–	–	–
Total		2,115			18,062		3.5	25.0	5.0

Table 3. Details on the application of lampricides to tributaries of Lake Superior in 1978.
[Lampricides used are in pounds of active ingredient.]

			TFM				Bayer 73		
			Concentration (ppm)				Pounds of powder used	Granules	
Stream	Date	Discharge at mouth (cfs)	Minimum effective	Maximum allowable	Pounds used	Hours applied		Pounds used	Acres surveyed
Big Stone Creek	May 12	15	6.0	16.0	176	10	–	–	–
Carp Lake River	May 28	54	4.0	10.0	550	12	–	–	–
Paquin Creek	June 8	15	2.9	8.6	176	10	–	–	–
Black River	June 10	75	2.9	8.6	1,012	12	–	–	–
Peshtigo River	June 23	830	2.0	4.5	4,708	12	39.2	–	–
Bursaw Creek	July 13	3	4.3	13.4	132	18	–	–	–
Parent Creek	July 14	3	4.1	12.7	44	14	–	–	–
Hudson Creek	July 16	1	3.0	9.0	44	12	–	–	–
Days River	July 23	80	1.5	3.8	418	12	6.0	–	–
Pentwater River	July 28	56	8.0	15.0	1,452	12	–	–	–
Bass Lake Outlet[a]	Aug. 1	3	8.0	19.0	66	12	–	–	–
Manistee River	Aug. 16	2,094	4.0	8.0	27,214	12	149.0	–	–
Whitefish River	Aug. 24	225	3.3	9.9	5,984	12	–	–	–
Betsie River	Aug. 30	180	7.0	10.5	3,014	10	–	–	–
Squaw Creek	Sept. 1	6	2.1	6.2	66	12	–	–	–
Portage Creek	Sept. 2	6	3.0	8.0	110	12	–	–	–
Horton Creek	Oct. 4	26	7.0	12.0	308	7	–	30.0	6.0
Boardman River									
Hospital Creek	Oct. 5	44	9.0	13.5	704	12	–	–	–
State Creek	Oct. 13	6	5.0	13.0	22	8	–	–	–
Galien River	Oct. 14	156	9.0	12.0	3,080	12	–	–	–
Ogontz River	Oct. 18	30	1.4	4.1	352	16	–	–	–
Milakokia River	Oct. 23	95	2.7	8.2	1,650	16	–	–	–
Allegan 4 Creek	Oct. 24	2	3.0	6.0	22	7	–	–	–
Grand River									
Bass River	Oct. 25	29	6.0	16.0	528	12	–	–	–
Total		4,034			51,832		194.2	30.0	6.0

[a] Initial treatment.

Table 4. Details on the application of lampricides to Lake Huron in 1978.
[Lampricides used are in pounds of active ingredient.]

			TFM				
			Concentration (ppm)				
Stream	Date	Discharge at mouth (cfs)	Minimum effective	Maximum allowable	Pounds used	Hours applied	Pounds of Bayer 73 powder used
Prentiss Creek	May 11	16	4.5	13.5	198	9	–
Ceville Creek	May 12	38	3.2	9.5	308	12	–
Grass Creek	May 13	4	7.0	18.0	44	8	–
Carr Creek	May 13	11	2.2	6.6	44	8	–
Caribou Creek	May 13	25	2.0	5.8	88	8	–
Albany Creek	May 16	78	1.4	4.1	264	10	–
Elliot Creek	May 16	10	4.0	12.0	308	13	–
Big Munuscong River	May 17	80	3.0	9.0	638	10	–
Green Creek	May 25	5	3.0	10.0	154	29	–
Carp River	May 27	289	3.0	9.0	4,136	12	–
Black Mallard Creek	June 9	17	5.0	10.0	330	13	–
Trout River	June 12	10	7.0	14.0	418	12	–
East Au Gres River	June 22	78	6.0	12.0	2,222	12	–
Tawas Lake Outlet	July 13	45	4.0	6.0	528	12	–
Cheboygan River	Sept. 9	987	4.0	11.0	27,192	18	75.2
Total		1,693			36,872		75.2

Table 4. Details on the application of lampricides to Lake Huron in 1978.
[Lampricides used are in pounds of active ingredient.]

Stream	Date	Discharge at mouth (cfs)	TFM: Concentration (ppm) Minimum effective	TFM: Concentration (ppm) Maximum allowable	TFM: Pounds used	TFM: Hours applied	Pounds of Bayer 73 powder used
Prentiss Creek	May 11	16	4.5	13.5	198	9	–
Ceville Creek	May 12	38	3.2	9.5	308	12	–
Grass Creek	May 13	4	7.0	18.0	44	8	–
Carr Creek	May 13	11	2.2	6.6	44	8	–
Caribou Creek	May 13	25	2.0	5.8	88	8	–
Albany Creek	May 16	78	1.4	4.1	264	10	–
Elliot Creek	May 16	10	4.0	12.0	308	13	–
Big Munuscong River	May 17	80	3.0	9.0	638	10	–
Green Creek	May 25	5	3.0	10.0	154	29	–
Carp River	May 27	289	3.0	9.0	4,136	12	–
Black Mallard Creek	June 9	17	5.0	10.0	330	13	–
Trout River	June 12	10	7.0	14.0	418	12	–
East Au Gres River	June 22	78	6.0	12.0	2,222	12	–
Tawas Lake Outlet	July 13	45	4.0	6.0	528	12	–
Cheboygan River	Sept. 9	987	4.0	11.0	27,192	18	75.2
Total		1,693			36,872		75.2

Table 5. Number of adult sea lampreys taken at electric barriers operated in eight tributaries of Lake Superior through July 13, 1961–78.

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

Table 6. Average lengths and weights of sea lampreys and percentage of males in catches at electric barriers and assessment traps in tributaries of the Great Lakes in 1978.

Method of capture and stream	Number in sample	Average length (mm)	Average weight (g)	Percentage males
	Lake Superior			
Electric barrier				
Michigan streams				
Betsy River	181	440	204	38
Two Hearted River	341	448	189	30
Sucker River	928	429	165	34
Chocolay River	5	441	194	40
Iron River	24	438	184	25
Silver River	132	403	155	34
Subtotal, Michigan	1,161	432	174	33
Wisconsin streams				
Brule River	754	424	154	27
Amnicon River	1,267	430	171	30
Subtotal, Wisconsin	2,021	428	165	29
Subtotal, all barriers	3,632	430	169	31

Table 6. (Cont'd.)

Method of capture and stream	Number in sample	Average length (mm)	Average weight (g)	Percentage males
Assessment trap				
Tahquamenon River	95	433	183	56
Rock River	238	412	150	35
Big Garlic River	104	402	156	31
Otter River	1	334	77	0
Subtotal, traps	438	414	158	39
Lake Superior streams	4,070	428	168	32
Lake Michigan				
Assessment trap				
Peshtigo River	957	510	276	49
Menominee River	688	505	274	52
Manistique River	894	493	247	44
Boyne River	3	514	269	33
Jordan River				
Deer Creek	5	493	290	80
Elk River	15	476	219	40
Boardman River	6	469	230	33
Betsie River	68	495	252	53
White River	1	387	182	100
Muskegon River	8	503	266	63
Grand River	2	487	246	50
Kalamazoo River	1	387	223	100
St. Joseph River	224	478	235	45
Paw Paw River	3	464	223	33
Lake Michigan streams	2,875	500	262	48
Lake Huron				
Electric barrier				
Ocqueoc River	375	442	192	39
Assessment trap				
Cheboygan River	551	452	185	35
St. Marys River	300	475	228	56
Subtotal, traps	851	460	200	42
Lake Huron streams	1,226	455	198	42
Lake Ontario				
Assessment trap				
Oswego River				
West Branch Fish Creek	11	428	192	45
Little Salmon River	105	458	218	59
Grindstone Creek	88	465	229	47
Catfish Creek	18	488	252	39
Lake Ontario streams	222	461	224	52

Table 7. Number of sea lampreys captured, marked, and released and number and percentage recaptured in assessment traps in tributaries of the Great Lakes, 1978.

Lake and stream	Dates of operation	Number of sea lampreys: Captured in trap	Number of sea lampreys: Marked and released	Total recaptured: Number	Total recaptured: Percentage
Lake Superior					
Iron River (Wis.)	5/31–6/24	0	0	–	–
Sturgeon River					
Otter River	5/22–6/19	5	5	1	20
Iron River (Mich.)	5/31–6/24	10[a]	10	3	30
Big Garlic River	5/22–8/17	135	126	96	76
Rock River	5/19–9/1	508	499	243	49
Tahquamenon River	5/23–6/15	310	245	38	16
Betsy River	5/23–6/16	35[a]	35	8	23
Subtotal		1,003	920	389	42
Lake Michigan					
North Shore					
Manistique River	5/25–6/1	5,408	4,687	597	13
Menominee River	4/24–6/9	1,840	1,827	692	38
Peshtigo River	4/18–6/9	2,360	2,360	954	40
Subtotal		9,608	8,874	2,243	25
East Shore					
Bear River	5/9–5/30	4	4	0	0
Boyne River	5/8–6/6	29	28	2	7
Jordan River					
Deer Creek	5/12–6/6	40	36	1	3
Elk River	5/9–6/6	16	0	–	–
Boardman River	5/9–6/7	62	58	3	5
Crystal River	5/9–5/31	0	0	–	–
Platte River	5/10–6/6	0	0	–	–
Betsie River	5/10–6/6	451	430	60	14
Manistee River					
Bear Creek	5/9–6/6	7	7	0	0
Pentwater River					
South Branch	5/1–5/25	1	1	0	0
White River	5/1–5/25	11	11	0	0
Muskegon River	5/2–5/25	67	67	5	7
Grand River	5/1–5/25	28	28	2	7
Kalamazoo River	5/2–5/25	6	6	1	17
Rabbit River	5/1–5/25	9	9	0	0
Swan Creek	5/2–5/25	2	2	0	0
Black River					
South Branch	5/2–5/25	7	7	0	0
St. Joseph River	5/3–5/25	879	879	229	26
Paw Paw River	5/2–5/25	13	13	1	8
Subtotal		1,632	1,586	304	19

Table 7. (Cont'd.)

Lake and stream	Dates of operation	Number of sea lampreys: Captured in trap	Number of sea lampreys: Marked and released	Total recaptured: Number	Total recaptured: Percentage
Lake Huron					
Cheboygan River	5/25–6/8	6,489	2,107	1,555	74
Trout River	5/8–6/21	40	40	0	0
St. Marys River	6/26–8/10	1,148	795	291	37
Subtotal		7,677	2,942	1,846	63
Lake Ontario					
Oswego River	5/9–6/2	81	81	6	7
West Br. Fish Creek	4/25–6/9	18	9	0	0
Little Salmon River	4/25–6/9	242	150	17	11
Grindstone Creek	4/25–6/9	315	260	32	12
Catfish Creek	4/25–6/9	65	57	10	18
Subtotal		721	557	65	12
Total all lakes		20,641	14,879	4,847	33

[a]Captured at electrical barrier and released upstream.

Table 8. Number of parasitic-phase sea lampreys and (in parentheses) number of spawning-phase sea lampreys collected in commercial and sport fisheries, by lake and statistical district, 1972–78. [Collections for 1978 are incomplete.]

District[a] and length (mm)	1972	1973	1974	1975	1976	1977	1978	Total 1972–78
Lake Superior								
M-1								
≤ 200	0	0	–	–	–	–	–	0
> 200	3 (2)	3	–	–	–	–	–	6 (2)
M-2								
≤ 200	0	0	0	0	0	0	0	0
> 200	16 (7)	13 (16)	3 (1)	14	8	6	0	60 (24)
M-3								
≤ 200	1	0	0	0	1	0	0	2
> 200	7	9 (1)	7	12	13	5 (38)	4 (2)	57 (41)
Wisc.								
≤ 200	3	4	6	0	2	2	0	17
> 200	232 (2)	119 (1)	117	97 (2)	81 (1)	127 (5)	51 (19)	904 (30)
MS-2								
≤ 200	0	0	1	0	1	2	1	5
> 200	8 (2)	5 (1)	4 (1)	11 (1)	1	2	1	32 (5)
MS-3								
≤ 200	11	6	8	12	4	6	4	51
> 200	29	61	17	27	16	22	13 (2)	185 (2)
MS-4								
≤ 200	1	1	3	1	2	2	0	10
> 200	121 (3)	74 (1)	45	13	20	13 (1)	20 (1)	306 (6)

Table 8. Number of parasitic-phase sea lampreys and (in parentheses) number of spawning-phase sea lampreys collected in commercial and sport fisheries, by lake and statistical district, 1972–78. [Collections for 1978 are incomplete.]

District[a] and length (mm)	1972	1973	1974	1975	1976	1977	1978	Total 1972–78
				Lake Superior				
M-1								
≤ 200	0	0	–	–	–	–	–	0
> 200	3 (2)	3	–	–	–	–	–	6 (2)
M-2								
≤ 200	0	0	0	0	0	0	0	0
> 200	16 (7)	13 (16)	3 (1)	14	8	6	0	60 (24)
M-3								
≤ 200	1	0	0	0	1	0	0	2
> 200	7	9 (1)	7	12	13	5 (38)	4 (2)	57 (41)
Wisc.								
≤ 200	3	4	6	0	2	2	0	17
> 200	232 (2)	119 (1)	117	97 (2)	81 (1)	127 (5)	51 (19)	904 (30)
MS-2								
≤ 200	0	0	1	0	1	2	1	5
> 200	8 (2)	5 (1)	4 (1)	11 (1)	1	2	1	32 (5)
MS-3								
≤ 200	11	6	8	12	4	6	4	51
> 200	29	61	17	27	16	22	13 (2)	185 (2)
MS-4								
≤ 200	1	1	3	1	2	2	0	10
> 200	121 (3)	74 (1)	45	13	20	13 (1)	20 (1)	306 (6)

Table 8. (Cont'd.)

District[a] and length (mm)	1972	1973	1974	1975	1976	1977	1978	Total 1972–78
MS-5								
≤ 200	0	0	0	0	0	0	0	0
> 200	5	2	2	0	2	1	0	12
MS-6								
≤ 200	2	6	3	1	0	7	1	20
> 200	13	7	9	7	16	20	23	95
Total								
≤ 200	18	17	21	14	10	19	6	105
> 200	434 (16)	373 (20)	204 (2)	181 (3)	157 (1)	196 (44)	112 (24)	1,657 (110)
Lake Michigan								
MM-1								
≤ 200	1	12	7	2	15	37	8	82
> 200	46	99 (1)	40 (4)	37 (9)	94 (11)	233 (12)	35 (14)	584 (51)
MM-2								
≤ 200	1	7	12	1	2	0	0	23
> 200	9	3	5	19 (1)	12 (1)	5	5	58 (2)
MM-3								
≤ 200	22	13	4	10	4	8	3	64
> 200	104 (2)	71	59	68	35 (2)	51	85	473 (4)
MM-5								
≤ 200	10	4	7	1	1	–	–	23
> 200	8 (4)	6 (2)	7	4	3	–	–	28 (6)
MM-6								
≤ 200	0	0	1	0	0	–	–	1
> 200	0	1	0	2	0	–	–	3
MM-7								
≤ 200	0	0	0	0	0	–	–	0
> 200	0	1	1	0	0	–	–	2
MM-8								
≤ 200	2	0	1	1	0	–	–	4
> 200	1	1	1	1	0	–	–	4
WM-1								
≤ 200	5	1	1	0	1	8	0	16
> 200	31 (40)	37 (8)	38 (14)	33 (8)	41 (4)	289 (11)	4 (8)	473 (93)
WM-2								
≤ 200	144	91	107	15	24	217	4	602
> 200	432	258	250	187	98	303	13	1,541
WM-3								
≤ 200	6	3	1	0	3	6	1	20
> 200	108	47	29	20	38	130	25	397
WM-4								
≤ 200	3	1	1	1	1	4	2	13
> 200	27 (160)	56 (42)	54 (80)	77 (107)	25 (86)	62 (235)	17 (95)	318 (805)
WM-5								
≤ 200	5	5	2	0	0	0	–	12
> 200	11	13	19	3	7	2 (1)	–	55 (1)
WM-6								
≤ 200	2	–	–	–	–	–	–	2
> 200	0	–	–	–	–	–	–	0
Total								
≤ 200	201	137	144	31	51	280	18	862
> 200	777 (206)	593 (53)	503 (98)	451 (125)	353 (104)	1,075 (259)	184 (117)	3,936 (962)

Table 8. (Cont'd.)

District[a] and length (mm)	1972	1973	1974	1975	1976	1977	1978	Total 1972–78
				Lake Huron				
MH-1								
≤ 200	2	0	0	5	3	48	7	65
> 200	88	31	10	111	120	222	322	904
MH-3								
≤ 200	4	–	–	–	–	–	–	4
> 200	5	–	–	–	–	–	–	5
MH-4								
≤ 200	0	0	0	0	1	–	–	1
> 200	21	8	12	24 (3)	6 (3)	–	–	71 (6)
Total								
≤ 200	6	0	0	5	4	48	7	70
> 200	114	39	22	135 (3)	126 (3)	222	322	980 (6)

[a] Boundaries are defined in "Fishery Statistical Districts of the Great Lakes," by S. H. Smith, H. J. Buettner, and R. Hile, Great Lakes Fishery Commission Technical Report No. 2, 1961. Lampreys were not collected from the fishermen in Lake Superior district MS-1; Lake Michigan districts MM-4, Illinois, or Indiana; or Lake Huron districts MH-2, MH-5, or MH-6.

Table 8. (Cont'd.)

District[a] and length (mm)	1972	1973	1974	1975	1976	1977	1978	Total 1972–78
				Lake Huron				
MH-1								
≤ 200	2	0	0	5	3	48	7	65
> 200	88	31	10	111	120	222	322	904
MH-3								
≤ 200	4	–	–	–	–	–	–	4
> 200	5	–	–	–	–	–	–	5
MH-4								
≤ 200	0	0	0	0	1	–	–	1
> 200	21	8	12	24 (3)	6 (3)	–	–	71 (6)
Total								
≤ 200	6	0	0	5	4	48	7	70
> 200	114	39	22	135 (3)	126 (3)	222	322	980 (6)

[a] Boundaries are defined in "Fishery Statistical Districts of the Great Lakes," by S. H. Smith, H. J. Buettner, and R. Hile, Great Lakes Fishery Commission Technical Report No. 2, 1961. Lampreys were not collected from the fishermen in Lake Superior district MS-1; Lake Michigan districts MM-4, Illinois, or Indiana; or Lake Huron districts MH-2, MH-5, or MH-6.

Table 9. Tributaries of Lake Superior with reestablished populations of sea lampreys and the number collected per hour with an electric shocker.

Stream	Date of last treatment	Year classes recovered			
		1975	1976	1977	1978
Waiska River	9/30/76			1	0
Pendills Creek	7/27/73	4	2	0	7
Grants Creek	7/21/63	0	1	0	0
Tahquamenon River	10/3/76			4	0
Betsy River	6/8/78				6
Little Two Hearted River	7/24/75	1	1	3	1
Two Hearted River	7/26/75	0	42	10	25
Sucker River	9/29/77				3
Sable Creek	9/7/73	80	79	32	23
Seven Mile Creek	7/19/67	0	2	0	0
Deer Lake Outlet	8/13/70	0	1	0	0
Little Garlic River	6/26/78				21
Huron River	9/21/74	25	43	46	102
Trap Rock River	8/5/63	0	0	1	0
Little Gratiot River	8/6/72	2	0	0	0
Gratiot River	10/7/75		0	2	0
Elm River	9/10/64	0	2	0	0
Cranberry River	9/16/77				18
Washington Creek	6/22/76		19	2	0
Bad River	9/26/78[a]				19
Fish Creek[b]	7/9/72	1	1	0	0
Sand River	10/16/64	0	2	1	0
Brule River	7/9/77			1	12
Poplar River	7/7/77			1	1
Middle River	7/7/77				87
Split Rock River	8/1/76			0	1
Number of streams		6	12	12	14

[a] Partial treatment.
[b] Bayfield County, Eileen Township.

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

Stream	Date of last treatment	Year classes recovered 1975	1976	1977	1978
Hog Island Creek	9/18/75		1	5	0
Black River	6/10/78				14
Millecoquins River	6/23/77			2	0
Rock River	6/27/77			0	4
Crow River	5/9/76		1	0	0
Bulldog Creek	6/9/77			16	0
Marblehead Creek	6/11/77			1	3
Manistique River[a]	6/7/75	1	2	8	–
Johnson Creek	6/13/77			0	4
Parent Creek	7/14/78				13
Poodle Pete Creek	9/4/75		3	1	0
Fishdam River	10/14/76			5	11
Sturgeon River	10/14/77				19
Hock Creek	6/23/71	1	3	1	0
Rapid River	8/4/77				1
Ford River	5/12/77			45	18
Sunny Brook	5/1/71	4	0	0	0
Cedar River	5/10/76		5	15	24
Menominee River	8/21/77				2
Oconto River	5/24/76		0	1	0
Hibbards Creek	5/21/75	6	11	6	0
Door County #23 Creek	5/8/75	4	13	0	–
Kewaunee River	5/10/75	0	0	2	0
East Twin River	5/12/75	1	0	1	1
Number of streams		6	8	14	12

[a]Data from a combination of Bayer 73 and electrofishing.

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

Stream	Date of last treatment	Year classes recovered 1975	1976	1977	1978
Little Munuscong River	6/9/77			42	1
Joe Straw Creek	5/10/75	0	1	0	0
Albany Creek	5/16/78				23
Trout Creek	5/11/75	3	12	0	0
Beavertail Creek	5/23/75	1	0	4	11
McKay Creek	5/13/75	3	6	5	11
Hessel Creek	10/4/74	2	21	0	2
Steeles Creek	10/6/74	5	14	29	10
Nunns Creek	9/21/74	0	1	0	0
Pine River	5/27/77			17	1
Number of streams		5	6	5	7

SEA LAMPREY CONTROL IN CANADA

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This report sumarizes the activities of the Canadian sea lamprey control agent during the period April 1, 1978 to March 31, 1979, in compliance with a Memorandum of Agreement between the Department of Fisheries and Oceans and the Great Lakes Fishery Commission. The Department acts as agent for the Commission with respect to the Canadian portion of the sea lamprey control program, which is conducted by the Department's Sea Lamprey Control Centre located at Sault Ste. Marie, Ontario. In addition to treating the Canadian tributaries of the Great Lakes, this Centre has accepted responsibility for treating streams on the United States side of Lake Ontario.

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

Electrical Barrier, Weir and Trap Operations

The barriers operated on four Canadian tributaries of Lake Huron, to assess their sea lamprey runs, captured a total of 222 sea lamprey—slightly more than the figure for the previous year (see Table I). However, there appears to be no significant change in sea lamprey abundance in Lake Huron as a whole. Examination of specimens for size, sex, and maturity revealed no significant differences from the values obtained in the previous year.

Mechanical weirs were installed and operated on Cypress and Sable Rivers (Lake Superior), on Blue Jay Creek (Lake Huron), and on Graham Greek (Lake Ontario). They captured 36, 3, 19 and 60 spawning phase sea lamprey, respectively. Box traps made of metal framing covered with hardware cloth were set in three Lake Huron tributaries (including St. Marys River) and in four Lake Ontario streams. In total, the first three captured 57, and the last four captured 352 spawning phase sea lamprey.

Stream Surveys

A total of 76 streams, embayments, and lake areas in the Lake Superior drainage were surveyed by means of electro-shocking or granular Bayer 73. Routine surveys of 43 streams and one bay revealed three new sources of sea lamprey larvae; one of which was treated and the remaining two were of minor importance. In addition, there were 18 re-establishment, 8 distribution, and 8 treatment-evaluation surveys, and 3 population studies carried out on Lake Superior streams.

On Lake Huron a total of 72 tributaries, bay areas and inland lakes were surveyed; some of them more than once. These included 36 routine surveys (in which only one new source of sea lamprey larvae was found), 24 re-establishment surveys, 11 distribution surveys, 3 treatment-evaluation surveys and 4 population studies.

On the Canadian side of Lake Ontario 25 streams were surveyed. The single routine survey performed gave negative results. Re-establishment surveys were made on 18 streams, and treatment-evaluation surveys on 6 streams. Population studies were conducted on 2 streams.

On the U.S. side of Lake Ontario 16 streams were surveyed, some of them more than once. Three re-establishment surveys, 12 distribution surveys and 8 treatment-evaluation surveys were carried out. Routine surveys are the responsibility of the U.S. agent of the Commission.

In addition to the foregoing, granular Bayer 73 was applied to selected parts of tributaries and embayments in Lake Superior (Batchawana Bay, Mountain Bay, Mackenzie Bay, Steel River, Nipigon River and Stillwater Creek), and in Lake Huron (St. Marys River at Whitefish Island and the mouth of Root River).

Lampricide Treatments

On Lake Superior all of the eight scheduled streams (Little Carp, Sable, Little Gravel, Pearl, Cypress, Gravel, Wolf, and White Rivers) were treated. In addition, Mackenzie Creek was treated for the first time after sea lamprey were found in it.

On Lake Huron all of the 10 scheduled streams (Kaskawong, Sucker, Gordon, Brown, Watson, Aux Sables, Sand, Wanapitei, Echo, and Kaboni) were treated, and Hog Creek was also treated for the first time after sea lamprey were found in it.

On the Canadian side of Lake Ontario all of the six scheduled streams were treated (Oshawa, Lynde, Cobourg, Bowmanville, Duffin and Salmon).

On the United States side of Lake Ontario the seven scheduled stream treatments were completed (Sage, Ninemile, Blind Sodus, Salmon, Skinner, Lindsey and Grindstone).

Details of the foregoing are summarized in Tables 2, 3, 4 and 5.

Sea Lamprey from Commercial Fishermen

In response to the offer of a reward payable to commercial fishermen on the Great Lakes for the collection of predatory sea lamprey and related catch information, a total of 407 specimens were received in 1978. Although examination of the specimens has yet to be completed, tentative indications point to a continuation of the features that characterized past collections: a predominance of female lamprey in most offshore commercial gear, and an association of smaller lamprey with smaller prey species.

Sea Lamprey from Humber River, Lake Ontario

The 2,453 sea lamprey captured in 1978 in the Humber River, under a contract with the Canadian agent, represent an increase of 53 per cent in comparison with the 1977 catch. However the two latest catches remain lower than those of any year since 1971, and the 1978 catch is only 36% of the peak catch of 1975. A slight decrease in average size, and in the proportion of males was recorded in 1978.

Trawling for Adult Sea Lamprey in St. Marys River

The annual assessment of the adult sea lamprey population in St. Marys River was repeated in the fall of 1978, by trawling at the outflow of the Edison Electric plant in Sault Ste. Marie, Michigan. Over a nine week period an average catch rate of 0.2 sea lamprey per hour was obtained (see Table 6). This figure is not significantly different from the catch rates recorded in the two previous years.

Improvements to Sea Lamprey Barrier Dams

Work carried out on the Shannonville Dam located on the Salmon River (a Lake Ontario tributary) consisted of building a retaining wall, adding land fill and increasing the height of the south side of the dam.

Sea Lamprey Larval Growth Study

Following an introduction of 86 spawning-phase sea lamprey above a dam on Proctor's Creek (a Lake Ontario tributary) annual growth rates and the time to reach transformation will be studied.

Table 1. Numbers of sea lamprey taken in electrical barriers, Lake Huron, from 1973 to 1978 inclusive.

Stream	Count for the Season 1973	1974	1975	1976	1977	1978
NORTH CHANNEL						
Kaskawong	135	146	168	187	184	209
GEORGIAN BAY						
Still	14	10	28	48	1	0
Naiscoot	0	0	0	0	0	0
Harris	8	1	8	13	31	13
Totals	157	157	204	248	216	222

Table 2. Summary of streams and bay areas treated with lampricide on Lake Superior, 1978.

Stream	Date	FLOW m³/s	FLOW f³/s	TFM Act. kg	TFM Ingr. lbs.	Bayer 73 Act. kg	Bayer 73 Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. Stream Treated km	Approx. Stream Treated miles
Little Carp R.	June 20–21	0.24	8.5	43.1	95	–	–	–	–	Scarce	9.3	5.8
Sable R.	June 24–25	1.22	43.0	126.1	278	–	–	–	–	Scarce	10.9	6.8
Little Gravel R.	July 7–8	0.23	8.0	44.5	98	–	–	–	–	Moderate	6.9	4.3
Pearl R.	July 9–10	1.19	42.0	130.6	288	1.8	4	3.2	7	Scarce	3.9	2.4
Cypress R.	July 11–12	1.98	70.0	104.3	230	–	–	–	–	Moderate	5.1	3.2
Gravel R.	July 13–14	4.56	161.0	355.2	783	5.4	12	13.6	30	Scarce	16.1	10.0
Wolf R.	July 15–18	3.23	114.0	585.1	1,290	8.2	18	10.4	23	Abundant	11.3	7.0
White R.	Sept. 11–12	26.46	935.0	3,001.5	6,617	47.6	105	–	–	Scarce	4.8	3.0
Mackenzie Cr.	Sept. 19	1.47	52.0	84.8	187	1.4	3	–	–	Scarce	1.1	0.7
											Hectares	Acres
Nipigon River System												
Lower Nipigon R.	Aug. 10–13	–	–	–	–	–	–	2,245.3	4,950	Moderate	7.9	19.5
Stillwater Cr.	Aug. 13, 19	–	–	–	–	–	–	90.7	200	Scarce	0.4	0.9
Mackenzie Bay												
Mackenzie Cr.	Aug. 18	–	–	–	–	–	–	453.6	1,000	Scarce	1.9	4.6
Mountain Bay												
Gravel R.	Aug. 15–17	–	–	–	–	–	–	2,279.3	5,025	Moderate	9.2	22.8
Steel R.	Sept. 9	–	–	–	–	–	–	219.1	483	Moderate	0.8	2.0
Batchawana Bay												
Stokely Cr.	July 31	–	–	–	–	–	–	136.1	300	Scarce	0.6	1.4
Harmony R.	July 31	–	–	–	–	–	–	408.2	900	Scarce	1.7	4.1
Batchawana R.	Aug. 1	–	–	–	–	–	–	589.7	1,300	Moderate	2.4	6.0
Chippewa R.	Aug. 3	–	–	–	–	–	–	249.5	550	Scarce	1.0	2.5
Sable R.	Aug. 4	–	–	–	–	–	–	362.9	800	Scarce	1.5	3.7
Totals		40.6	1,433.5	4,475.2 kg	9,866 lbs.	64.4 kg	142 lbs.	7,061.6 kg	15,568 lbs.		69.4 km 27.4 Hectares	43.2 miles 67.5 acres

Table 2. Summary of streams and bay areas treated with lampricide on Lake Superior, 1978.

Stream	Date	FLOW		TFM		Bayer 73		Granular Bayer 73		Sea lamprey abundance	Approx. Stream Treated	
		m^3/s	f^3/s	Act. kg	Ingr. lbs.	Act. kg	Ingr. lbs.	kg	lbs.		km	miles
Little Carp R.	June 20–21	0.24	8.5	43.1	95	–	–	–	–	Scarce	9.3	5.8
Sable R.	June 24–25	1.22	43.0	126.1	278	–	–	–	–	Scarce	10.9	6.8
Little Gravel R.	July 7–8	0.23	8.0	44.5	98	–	–	–	–	Moderate	6.9	4.3
Pearl R.	July 9–10	1.19	42.0	130.6	288	1.8	4	3.2	7	Scarce	3.9	2.4
Cypress R.	July 11–12	1.98	70.0	104.3	230	–	–	–	–	Moderate	5.1	3.2
Gravel R.	July 13–14	4.56	161.0	355.2	783	5.4	12	13.6	30	Scarce	16.1	10.0
Wolf R.	July 15–18	3.23	114.0	585.1	1,290	8.2	18	10.4	23	Abundant	11.3	7.0
White R.	Sept. 11–12	26.46	935.0	3,001.5	6,617	47.6	105	–	–	Scarce	4.8	3.0
Mackenzie Cr.	Sept. 19	1.47	52.0	84.8	187	1.4	3	–	–	Scarce	1.1	0.7
											Hectares	Acres
Nipigon River System												
Lower Nipigon R.	Aug. 10–13	–	–	–	–	–	–	2,245.3	4,950	Moderate	7.9	19.5
Stillwater Cr.	Aug. 13, 19	–	–	–	–	–	–	90.7	200	Scarce	0.4	0.9
Mackenzie Bay												
Mackenzie Cr.	Aug. 18	–	–	–	–	–	–	453.6	1,000	Scarce	1.9	4.6
Mountain Bay												
Gravel R.	Aug. 15–17	–	–	–	–	–	–	2,279.3	5,025	Moderate	9.2	22.8
Steel R.	Sept. 9	–	–	–	–	–	–	219.1	483	Moderate	0.8	2.0
Batchawana Bay												
Stokely Cr.	July 31	–	–	–	–	–	–	136.1	300	Scarce	0.6	1.4
Harmony R.	July 31	–	–	–	–	–	–	408.2	900	Scarce	1.7	4.1
Batchawana R.	Aug. 1	–	–	–	–	–	–	589.7	1,300	Moderate	2.4	6.0
Chippewa R.	Aug. 3	–	–	–	–	–	–	249.5	550	Scarce	1.0	2.5
Sable R.	Aug. 4	–	–	–	–	–	–	362.9	800	Scarce	1.5	3.7
Totals		40.6	1,433.5	4,475.2 kg	9,866 lbs.	64.4 kg	142 lbs.	7,061.6 kg	15,568 lbs.		69.4 km	43.2 miles
											27.4 Hectares	67.5 acres

Table 3. Summary of streams treated with lampricide on Lake Huron, 1978.

Stream	Date	FLOW m³/s	FLOW f³/s	TFM Act. kg	TFM Ingr. lbs.	Bayer 73 Act. kg	Bayer 73 Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream treated km	Approx. stream treated miles
Kaskawong R.	June 27–29	0.89	31.5	358.3	790	–	–	–	–	Scarce	9.6	6.0
Sucker (Gawas) Cr.	June 27	0.03	1.0	13.2	29	–	–	–	–	Moderate	0.8	0.5
Gordon Cr.	June 28–29	0.01	0.3	2.3	5	–	–	–	–	Abundant	1.3	0.8
Brown Cr.	July 5–7	0.04	1.5	18.6	41	–	–	–	–	Abundant	3.2	2.0
Watson Cr.	July 5–6	0.05	1.8	17.2	38	–	–	–	–	Moderate	1.6	1.0
Aux Sables R.	July 11	6.5	231.0	162.3	358	–	–	–	–	Scarce	2.1	1.3
Sand Cr.	July 29–30	0.61	21.5	129.3	285	1.3	2.8	–	–	Moderate	4.8	3.0
Wanapitei R.	Aug. 16–18	14.38	508.0	933.0	2,057	–	–	–	–	Moderate	10.0	6.25
Hog Cr.	Sept. 13–15	0.32	11.5	70.8	156	–	–	0.91	2	Moderate	9.0	5.6
Echo R.	Sept. 9–10	2.46	87.0	239.0	527	–	–	–	–	Scarce	9.6	6.0
Kaboni Cr.	Oct. 3–4	1.42	50.0	261.5	576.5	1.7	3.85	–	–	Scarce	4.0	2.5
											Hectares	Acres
St. Marys R.												
Root R.	July 17–24	–	–	–	–	–	–	326.6	720	Moderate	1.58	3.90
Whitefish Is.	Sept. 20–21	–	–	–	–	–	–	539.8	1,190	Scarce	2.53	6.24
Totals		26.71	945	2,205.5 kg	4,862.5 lbs.	3.0 kg	6.7 lbs.	867.3 kg	1,912 lbs.		56 km 4.1 Hectares	35 miles 10.1 Acres

Table 4. *Summary of streams treated with lampricide on Lake Ontario (Canada), 1978.*

Stream	Date	FLOW m³/s	FLOW f³/s	TFM Act. kg	TFM Ingr. lbs.	Bayer 73 Act. kg	Bayer 73 Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. Stream Treated km	Approx. Stream Treated miles
Oshawa Cr.	May 4–5	1.44	50.8	460.8	1,016	–	–	–	–	Abundant	18.5	11.5
Lynde Cr.	May 7–9 & 11–13	1.24	43.9	685.8	1,512	–	–	–	–	Moderate	34.3	21.3
Cobourg Br.	May 31–June 1	1.16	41.1	334.3	737	–	–	–	–	Moderate	14.2	8.8
Bowmanville Cr.	June 3–4	1.44	50.8	452.2	997	–	–	–	–	Abundant	8.8	5.5
Duffin Cr.	June 6–8	1.90	67.1	645.9	1,424	–	–	–	–	Moderate	25.1	15.6
Salmon R.	June 11–14	3.03	107.0	522.0	1,151	4.08	9	–	–	Moderate	22.9	14.2
Totals		10.21	360.7	3,101	6,837	4.08	9	–	–		123.8	76.9

Table 5. Summary of streams treated with lampricide on Lake Ontario (United States), 1978.

Stream	Date	FLOW m³/s	FLOW f³/s	TFM Act. kg	TFM Ingr. lbs.	Bayer 73 Act. kg	Bayer 73 Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	Sea lamprey abundance	Approx. stream treated km	Approx. stream treated miles
Sage Cr.	Apr. 28–May 2	0.37	13	145.2	320.2	–	–	–	–	Scarce	25.4	15.8
Ninemile Cr.	May 4–8	1.13	40	303.0	668.0	–	–	–	–	Abundant	24.1	15.0
Blind Sodus Cr.	May 25–28	0.14	5	146.8	323.7	–	–	–	–	Moderate	15.3	9.5
Salmon R.	May 28–June 7	35.29	1,247	1,758.2	3,876.1	9.98	22	–	–	Moderate	68.1	42.3
Skinner Cr.	Oct. 19–24	0.48	17	223.4	492.6	–	–	–	–	Moderate	21.9	13.6
Lindsey Cr.	Oct. 23–26	0.37	13	144.7	319.1	–	–	–	–	Moderate	24.9	15.5
Grindstone Cr.	Oct. 28–Nov. 1	1.19	42	199.0	438.7	–	–	–	–	Moderate	42.6	26.5
Totals		38.97	1,377	2,920.3	6,438.4	9.98	22	–	–		222.3	138.2

Table 6. Numbers of sea lamprey caught per hour of trawling at the Edison Sault Electric plant in St. Marys River in 1976, 1977 and 1978.

Week Ending			Trawling Time (Hours)			No. of Lamprey			No. of Lamprey per hour		
1976	1977	1978	1976	1977	1978	1976	1977	1978	1976	1977	1978
–	Oct. 22	–		30.0	30.1		1			0.3	
–	Oct. 29	Oct. 28		29.5	30.1		3	2		0.1	0.1
Nov. 6	Nov. 5	Nov. 4	31.2	30.1	29.8	3	11	8	1.0	0.4	0.3
Nov. 13	Nov. 12	Nov. 11	25.0	18.8	30.2	7	12	0	0.2	0.6	0.2
Nov. 20	Nov. 19	Nov. 18	31.8	30.3	24.2	0	2	6	0.0	0.1	0.2
Nov. 27	Nov. 26	Nov. 25	20.0	23.0	27.1	3	8	7	0.2	0.4	0.3
–	Dec. 3	Dec. 2		30.1	12.2		6	2		0.2	0.2
–	Dec. 10	Dec. 9		19.0	14.8		1	0		0.1	0.0
–	–	Dec. 16			–			–			–
–	–	Dec. 23			6.0			0			0.0
Totals &/or Averages			108.0	210.8	174.6	13	44	31	0.1	0.2	0.2

Table 6. Numbers of sea lamprey caught per hour of trawling at the Edison Sault Electric plant in St. Marys River in 1976, 1977 and 1978.

Week Ending			Trawling Time (Hours)			No. of Lamprey			No. of Lamprey per hour		
1976	1977	1978	1976	1977	1978	1976	1977	1978	1976	1977	1978
–	Oct. 22	–		30.0	30.1		1			0.3	
–	Oct. 29	Oct. 28		29.5	30.1		3	2		0.1	0.1
Nov. 6	Nov. 5	Nov. 4	31.2	30.1	29.8	3	11	8	1.0	0.4	0.3
Nov. 13	Nov. 12	Nov. 11	25.0	18.8	30.2	7	12	0	0.2	0.6	0.2
Nov. 20	Nov. 19	Nov. 18	31.8	30.3	24.2	0	2	6	0.0	0.1	0.2
Nov. 27	Nov. 26	Nov. 25	20.0	23.0	27.1	3	8	7	0.2	0.4	0.3
–	Dec. 3	Dec. 2		30.1	12.2		6	2		0.2	0.2
–	Dec. 10	Dec. 9		19.0	14.8		1	0		0.1	0.0
–	–	Dec. 16			–			–			–
–	–	Dec. 23			6.0			0			0.0
Totals &/or Averages			108.0	210.8	174.6	13	44	31	0.1	0.2	0.2

ALTERNATIVE METHODS OF SEA LAMPREY CONTROL

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Introduction

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

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

Development of Methods to Sterilize Adult Sea Lampreys

A new sea lamprey control method now being developed and evaluated at the Hammond Bay Biological Station involves releasing artificially sterilized, sexually mature lampreys into streams containing spawning populations of lampreys. In principle, these sterile individuals will compete successfully with fertile ones for mates, reducing the reproductive success of the spawning population. Chemical compounds and immunological methods are currently being tested and developed to produce sterility in spawning-run male lampreys.

Chemical Methods

Studies continued on sterilizing spawning-run sea lamprey males by immersion in an aqueous solution of *P,P*-bis(1-aziridinyl)-*N*-methylphosphinothioic amide (bisazir). An artificial stream for spawning lampreys was stocked with the following groups of treated animals:

Number	Sex	Treatment
30	Females	None
30	Males	None (controls)
10	Males	25 mg/l bisazir (4 h)
10	Males	50 mg/l bisazir (2 h)
10	Males	50 mg/l bisazir (4 h)

Lampreys observed spawning were removed and spawned artificially. Each female spawned with a treated male was also spawned with a normal male to provide a control on the fertility of the female. The following batches of eggs from different spawnings were held in glass battery jars partially immersed in constant temperature troughs at 18.3 C:

Number of batches of eggs	Treatment of male parent
18	None (controls)
7	25 mg/l bisazir (4 h)
6	50 mg/l bisazir (2 h)
7	50 mg/l bisazir (4 h)

Dead embryos were periodically removed. After 21 days of incubation, all remaining embryos were fixed in 4% formalin for microscopic examination.

The results of this study show the immersion of male lampreys in aqueous solutions of bisazir reduced the survival rate of normal embryos at all concentrations and immersion times tested. In all instances, the survival of normal embryos beyond 15–17 days of incubation was lower in the experimental lots than it was in the corresponding controls. Nearly complete sterility occurred when males were immersed in a 50 mg/l solution for 4 hours or in a 100 mg/l solution for 2 hours.

Immunological Methods

Antisera made in rabbits to three antigens derived from lamprey sex products were tested as sterilants for spawning sea lampreys. The three were:

Antigen	Derived from
Male 2	Sea lamprey sperm
Female 2	Homogenized eggs
Female 3	Homogenized eggs (wash)

Antisera against either male or female sex products were injected intraperitoneally so that the anitsera would come into direct contract with the lamprey's gonadal tissue. Antiserum against female sex products was injected only into females, and antiserum against male only into males. The spawning lampreys were injected with antisera, held for various time periods, and spawned. If the injected lamprey was a female, a small part of her eggs was collected and fertilized with sperm from an uninjected male. As a control, the same male was used to fertilize eggs from an uninjected female. If the injected lamprey was a male, it was used to fertilize eggs from an uninjected female. As a control, eggs from this female were also fertilized with sperm from an uninjected male.

Evaluation of the results of this pilot study is difficult because of the inherently large variation in the viability of embryos obtained from different pairs of lampreys. The results appear to be consistent with those obtained in 1977, which suggested that reduced production of stage-15 embryos resulted from spawnings in which the male lamprey was treated with Antimale-2 antigen or in which the female was treated with Antifemale-2 or -3 antigen. The data suggest also that the production of stage-15 embryos may be inversely related to the length of the interval between injection of the lamprey with the antigen and spawning.

Development of Criteria to Specify the Age of Sea Lamprey-inflicted Wounds and Scars on Lake Trout

We recently completed the development of standard criteria for specifying the age of lamprey-inflicted attack marks (wounds and scars) on lake trout. These criteria were developed from observations of attack marks on about 300 lake trout that were exposed to sea lampreys in the laboratory.

Two basic types of lamprey attack marks were produced on lake trout in this study: the type A wound in which the skin of the trout was broken, exposing the underlying musculature, and the type B wound in which the skin of the trout was abraded, without exposing the underlying musculature. Four stages of healing based on visual and tactile criteria that could be applied by a trained observer under field conditions were also described for each of the two wound types.

An illustrated field guide for the classification of sea lamprey attack marks was circulated for review by fishery agencies in the Great Lakes states and Ontario. The draft field guide was also discussed at a workshop held during the Interim Meeting of the Great Lakes Fishery Commission in November 1978. The reviewers and the workshop participants agreed that the field guide would be useful in classifying lamprey wounds observed in lake trout under field conditions and that it should be processed for distribution. The field guide has been revised and a camera-ready copy has been submitted to the Great Lakes Fishery Commission.

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

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

In the present study, tests were designed specifically to produce basic information on wounding mortality versus: size of lake trout, size of sea lampreys, prey-size preference of lampreys, and predator-prey ratio. These tests are being conducted by placing 20 trout and 10 sea lampreys together in large concrete raceways supplied with untempered Lake Huron water and observing the wounding and mortality among the trout. In this first set of tests, lake trout were obtained from the Jordon River National Fish Hatchery, and the sea lampreys from a commercial fisherman in the Hammond Bay area. Water temperature in these tests declined slowly from 10.0 C at the beginning of the period to 0.5 C at the end.

In one test, 10 lampreys (355–440 mm long; average 401 mm) produced a total of 44 wounds on the 20 trout (435–504 mm long; average 483 mm) in 44 days. All trout were wounded and 13 bore multiple wounds. By day 30, 19 of the trout died; the one remaining trout carried 4 wounds on day 30, and died on day 44. In a second test, 8 of 20 trout (540–596 mm long; average 560 mm) survived exposure to 10 lampreys (378–417 mm long; average 400 mm) for 44 days; the 5 trout that survived until the test was terminated on day 83 bore a total of 24 wounds. Only two of 40 lake trout in the control groups died during the tests; whereas 14 sea lampreys died and were replaced during the tests.

The results of this initial set of tests indicate that mortality may be very high among small- and medium-sized lake trout wounded in the fall by large sea lampreys nearing the end of their parasitic-feeding life stage.

Field Tests or Attractants and Repellents for Potency Against Adult Spawning-run Sea Lamprey

A study was initiated in April 1978 to test the potential of phenethyl alcohol (PEA) as an attractant ("imprintant") for sea lampreys. Three hundred sixteen recently metamorphosed sea lampreys (average size 160 mm and 5 g) from the Peshtigo River, Wisconsin, were individually marked by injecting a fluorescent rose dye-stripe into their posterior dorsal fin; exposed to 5×10^{-5} mg/liter PEA for 24 hours in Lake Huron water; and released at the electro-mechanical weir site in the Ocqueoc River on April 13, 1978. A total of 47 sea lamprey transformers captured in 1977–78 during their downstream migration in the Ocqueoc River were also marked and released (without exposing them to PEA) on April 13, 1978 to serve as controls. Twenty-six of these controls were fall migrants (average size 171 mm and 6.4 g) and were marked with two green stripes in the posterior dorsal fin; the other 21 were spring migrants (average size 171 mm and 6.9 g) and were marked with one green stripe in the posterior dorsal fin. During 1979 spawning season PEA will be metered into one of the two compartments of the trap at the electro-mechanical weir on the Ocqueoc River to determine if the lampreys exposed to PEA as transformers are attracted to PEA on their spawning run.

Maximum (Burst) Swimming Speed of Spawning-run Sea Lampreys

The installation of barrier dams on certain streams as part of an integrated sea lamprey control program has long been endorsed by the Great Lakes Fishery Commission and its cooperators. Consideration is being given to the design of low-head dams that would prevent the upstream movement of spawning-run lampreys during low and normal conditions of stream flow, and that would create velocity barriers when high stream flow would otherwise render the dam an ineffective barrier to upstream movement. Information is needed on the maximum (burst) swimming speed of spawning-run sea lampreys to develop reliable engineering design criteria for these velocity barriers.

Tests designed to determine the maximum swimming speed of spawning-run sea lampreys were conducted in a flow-through test aparatus at the lamprey weir site on the Ocqueoc River. Water pumped into the test apparatus from the river flowed into a head box, then through a flume (8 × 1 × 1 ft) and finally into a foot box which discharged into the river. In each test, the desired water velocity was established in the flume; recently captured lampreys were removed from the weir, usually in mid-to-late afternoon, and placed in the foot box. The behavior and swimming ability of these lampreys was then observed until about 2400 hours that same day, when the test was terminated. We conducted a total of 12 tests with 622 spawning-run lampreys during

June 1–29, 1978, at water temperatures ranging from 16.5 to 25.0°C, and at water velocities of 4.5 to 13.6 ft/sec.

Virtually all attempts by lampreys to ascend the flume by swimming lasted less than 6 seconds. At water volocities of about 8 ft/s or less, lampreys were usually able to swim the entire length of the flume in a single, 4- to 6-second burst of activity. At higher water velocities, the duration of swimming activity was reduced to about 1-3 seconds and lampreys were often observed progressing upstream in the flume in a step-wise fashion by alternately swimming and attaching to the walls of the flume to rest. Some lampreys were able to ascend the length of the test flume and enter the head box under almost every set of conditions we established. At the highest water velocities (average flume velocity of 12.8 ft/s on June 28 and 13.6 ft/s on June 29), nearly 4% of the lampreys were able to traverse the entire length of the flume and enter the head box. The data collected at 17–25°C suggests that a completely effective velocity barrier for spawning-run sea lampreys would have to be one in which water velocity of greater than 13 ft/s was maintained for a distance of more than 8 feet. The barrier also may have to be designed to deny attachment sites to lampreys, if water velocities in the barrier do not greatly exceed the maximum (burst) swimming speed of the lamprey.

Additional burst swimming speed data are needed at spawning run temperatures below 17°C.

Integrated Production of Sea Lamprey for Research

A total of 2,121 spawning-run sea lampreys were obtained from the electrical weir on the Ocqueoc River, April 5–July 1, 1978, and an additional 1,000 spawners were taken from the Cheboygan River with small, experimental, machanical traps. The Marquette Sea Lamprey Control Station provided 300 spawning-run sea lampreys from the St. Marys River. A total of 285 feeding-stage sea lampreys were purchased from a local commercial fisherman trapnetting in the Hammond Bay area.

Three riffle-type fyke nets fished at the weir site on the Ocqueoc River from March 1 to April 30, and from October 1 to December 31, yielded 32 transformers during the spring, averaging 171 mm and 6.8 g, and 11 downstream migrants, averaging 175 mm and 6.9 g, in the fall.

Identification of Biochemicals that Attract or Repel Sea Lampreys

Approximately 900 two-choice preference tests conducted during 1978, at the Monell Chemical Senses Center and the Hammond Bay Biological Station, to identify nontoxic chemical substances, including sea lamprey pheromones, that will attract or repel spawning-run sea lampreys. Emphasis was placed on further characterizing the chemically-mediated attraction of spawning stage sea lampreys to ripe conspecifics of the opposite sex observed in tests conducted during the 1977 spawning season. Several other potential attractants and repellents, however, were also tested.

A number of potential chemical attractants and repellents for spawning stage sea lampreys have been examined. Rinses of dead lampreys, as well as several compounds isolated from human saliva, evoked a strong avoidance response in ripe sea lampreys. In addition, ripe females showed a significant preference for chloride salts at concentrations as low as 3×10^{-5} M. Although the basis of this preference is unclear, it may be an osmoregulatory phenomenon, rather than a chemosensory mediated response. The most promising attractants in terms of population control are, however, the substances released by ripe female and male sea lampreys which attract conspecifics of the opposite sex. Although a great deal of research remains to be done to identify the substances involved and their precise biological function(s), there is now sufficient behavioral evidence that sex phermones are involved in sea lamprey reproduction.

During the 1979 spawning season an effort will be made to determine the source of the active substances released by ripe male and female sea lampreys (mucus, urogenital fluids, etc.), and to identify the specific compounds involved. In addition, the timing of the occurrence and intensity of the responses to the attractants and the physiological and environmental factors influencing their release will be studied. Finally, the possibility that upstream migrants use chemical cues emanating from the resident larval population will be examined.

REGISTRATION-ORIENTED RESEARCH ON LAMPRICIDES

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ABSTRACT

Negotiations with the Environmental Protection Agency (EPA) resulted in new labels for lampricide containers and approval for all current uses of TFM. Rulings were also received that fluorescein (sodium) and rhodamine B, as used by Sea Lamprey Control crews, do not require registration.

Development of residue dynamics data on Bayer 73 is progressing well. Problems with the analytical method have been resolved and analyses of fish tissues and body fluids were being processed at the end of the calendar year. Bayer 73 residues are rapidly eliminated from muscle tissue but may persist beyond 3 weeks in bile.

Preliminary research on improved formulations for granular Bayer 73 were begun. Six different resins were used to coat granules.

Preliminary studies indicate an increase in the toxicity of TFM in waters containing high nitrite levels.

Registration Activities

The National Fishery Research Laboratory attempted to clarify the status of several compounds and to determine which studies, if any, are needed to establish labels for fishery uses. EPA responded by stating that rhodamine B and fluorescein sodium dyes do not require registration when used to determine water flows, distribution patterns, and dilution rates for applying lampricides accurately.

In concert with the Fish and Wildlife Service Registration Liaison Officer, supplemental labels were developed to cover TFM and the TFM: Bayer 73 combination lampricides as used by the Great Lakes Fishery Commission's lamprey control crews. New labels received EPA

approval on May 5, 1978, and instructions on affixing the labels to chemical containers on hand were mailed to the field crews.

This approval means that all current uses of TFM as a lampricide are now covered by adequate labels. Although EPA has not yet formally responded to our February 1976 submission for amended registration and Exemption from a Requirement of a Tolerance (ERT), the granted supplemental labels provide the needed legal coverage. Thus, no immediate concerns related to the registration of lampricidal uses of TFM are anticipated until EPA calls for reregistration of the compound.

Preparation of the petition for Exemption from the Requirement of Tolerance and submission for amended registration of the use of Bayer 73 as a synergist for TFM and as a sampling tool was delayed by the problems encountered in residue methodology. When the first analytical method was developed, generation of information related to residue dynamics could begin. This work was well along by the end of calendar year 1978.

Development of the required second analytical method has been difficult. A method developed by D. Muir for a meeting in Halifax, Nova Scotia in May 1979 failed to meet requirements posed by environmental and animal tissue samples associated with the use of Bayer 73 in sea lamprey control. The search for an alternate method continues.

EPA reviewed the Service's Pesticide Petition and Food Additive Petition for TFM and recommended that we extend the request for an ERT to include meat, milk, and eggs. In addition, EPA suggested that the Fish and Wildlife Service petition for an ERT on dimethylformamide (DMF) which is used as a solvent for TFM. The La Crosse National Fishery Research Laboratory prepared draft letters responding to both requests and provided additional data on safety and residue concerns of DMF.

Technical Information Services

Information was received that an emulsifiable liquid concentrate formulation of Bayer 73 exists. Although foreign literature describes use of such a product in snail control, it is apparently not available in the United States. Efforts are under way to develop a source of the formulation for research use.

Bayer 73 Residue Method Development

A method for analysis of residues of the lampricide Bayer 73 in fish muscle tissue developed last year utilized a solvent partitioning cleanup procedure. We were able to refine the procedure to eliminate unnecessary steps and optimize the cleanup and recovery of Bayer 73. Steps involving incubation of tissue extracts and the use of potassium permanganate and lead acetate as oxidizing agents have been evaluated.

The presence of 30% H_2O_2 during hydrolysis of Bayer 73 to form 2-chloro-4-nitroaniline is essential for good recoveries, especially in the presence of interfering lipid materials. The use of gas chromatographic columns containing 6% OV-3 on Gas Chrom Q or 5% OV-17 on Chromasorb W-HP seems to be most effective for Bayer 73 analysis.

Bayer 73 Residues in Fish

Largemouth bass, channel catfish, and rainbow trout were exposed to solutions containing 0.05 mg/l of Bayer 73. Samples for residue analysis were taken after 2 to 24 hours of exposure. Fish were also placed in lampricide-free water and sampled for up to 3 weeks.

Residues in channel catfish declined while the fish were in the test solution, whereas largemouth bass maintained a fairly constant residue level (Table 1). After transfer to lampricide-free water, both species eliminated Bayer 73 residues from muscle (Table 2) and bile (Table 3). Muscle residues dropped below detectable levels within 3 days in channel catfish (Table 2), after 7 days in rainbow trout (Table 4), and after 14 days in largemouth bass (Table 2).

Residues of Bayer 73 in plasma and bile of rainbow trout exposed to 0.05 mg/l of Bayer 73 increased with time up to 24 hours. After 24 hours of exposure, concentrations in plasma and bile averaged 5.30 and 473 μg/ml, respectively (Table 5). Rainbow trout exposed to 0.05 mg/l of Bayer 73 for 12 hours and then transferred to fresh water slowly eliminated residues from the plasma over a 3-week period, but the bile still retained 0.76 μg/ml after 3 weeks of withdrawal (Table 4). Residues in muscle dropped below detectable levels after 10 days of withdrawal, but two of five fish sampled after 3 weeks showed detectable residues of 0.018 and 0.028 μg/g.

Formulation Studies with Bayer 73

The granular formulation of Bayer 73 used for lamprey surveys in lentic habitat usually contains very fine particles which blow about when the product is handled. During application, this dusty material can be a hazard to the applicator and can also constitute a significant loss of chemical, either by blowing away or floating on surface tension of the water.

Another source of chemical loss is believed to occur from the surface of granules as they sink through the water column.

After discussions with lamprey treatment and research personnel, it was agreed that a study should be made on how formulation could be improved to minimize the problems stated above. Arrangements were made with a custom formulator in Verona, Wisconsin to coat samples of granular Bayer 73 with selected resin materials. Following instructions from the La Crosse National Fishery Research Laboratory, the formulator produced 18 samples coated with various amounts of six different resins.

Toxicity of Bayer 73 to Eggs

The Biology Department of Viterbo College, La Crosse, Wisconsin encourages its upperclassmen to conduct student research projects. Under the direction of Dr. Joseph Kawatski, Theodore Bissell began a limited study of the effects of Bayer 73 exposure on incubating rainbow trout eggs. Eggs and chemical for the study were provided by the La Crosse National Fishery Research Laboratory whose technical staff also provided scientific advice.

Other Research on Lampricides

As part of the ongoing research program of the La Crosse National Fishery Research Laboratory, interactions between environmental contaminants and fishery chemicals are being investigated. Such studies are not funded by the Great Lakes Fishery Commission.

In the initial work, chemicals selected for study have centered on compounds for which considerable data exists. TFM was chosen as one of the fishery chemicals and nitrite nitrogen as a contaminant that could cause potential problems.

Results indicate that contaminants may influence the toxicity of fishery chemicals.

A recent chemical treatment of the Muskegon River with TFM for larval sea lamprey control resulted in an unexpected kill of northern pike and white suckers. A spot check of selected water quality characteristics of the river indicated relatively high nitrite nitrogen levels (0.02–0.03 mg/l). It was postulated there may bave been an interaction between the nitrite and TFM that resulted in increased toxicity. The La Crosse National Fishery Research Laboratory was asked to evaluate the possibility of this interaction under laboratory conditions.

We exposed northern pike and white suckers to TFM, nitrite, and combinations of the two and analyzed the data for individual toxicities and combined toxicities (Table 6). For both species, the toxicity of the combination was greater than that of the individual compounds, indicating that interaction may have been a factor in the fish kill. Consideration should be given to developing a program to evaluate potential effects of contaminants on the toxicity of the lampricides, since they may have been a factor in previous fish kills where no explanation was available.

Literature on TFM and Bayer 73

Dawson, V. K., P. D. Harman, D. P. Schultz, and J. L. Allen. 1978. Rapid method for determination of Bayer 73 in water during lampricide treatments. Journal of the Fisheries Research Board of Canada 35(9): 1262–1265.

Dwyer, W. P., F. L. Mayer, J. L. Allen, and D. R. Buckler. 1978. Chronic and simulated use-pattern exposures of brook trout (*Salvelinus fontinalis*) to 3-trifluoromethyl-4-nitrophenol (TFM). U.S. Fish and Wildlife Service, Investigations in Fish Control 84. 6 pp.

Schultz, D. P., and P. D. Harman. 1978. Hydrolysis and photolysis of the lampricide 2′, 5-dichloro-4′-nitrosalicylanilide (Bayer 73). U.S. Fish and Wildlife Service, Investigations in Fish Control 85. 5 pp.

Schultz, D. P., and P. D. Harman. 1978. Uptake, distribution, and elimination of the lampricide 2′,5-dichloro-4′-nitrosalicylanilide (Bayer 73) by largemouth bass (*Micropterus salmoides*). Journal of Agricultural and Food Chemistry 26(5): 1226–1230.

Table 1. Uptake and muscle tissues of 150- to 430-gram channel catfish and 190- to 550-gram largemouth bass during selected exposures to a 0.05-mg/l solution of Bayer 73 at a temperature of 19±1 C, pH 6.8 to 7.1, and total hardness of 22 mg/l as $CaCO_3$.

Exposure time (hours)	μg/g Bayer 73 (Mean ± SE)	
	Channel catfish	Largemouth bass
Control	0.000±0.000	0.000±0.000
2	0.051±0.005	0.043±0.010
4	0.034±0.004	0.053±0.008
8	0.025±0.001	0.048±0.007
12	0.022±0.002	0.058±0.003
24	0.019±0.001	0.048±0.003

Table 2. Residues in muscle tissues of 230- to 420-gram channel catfish, and 190- to 550-gram largemouth bass during selected withdrawal intervals following a 24-hour exposure to a 0.05-mg/l solution of Bayer 73 at a temperature of 19±1 C, pH 7.6 to 7.7, and total hardness of 24 to 26 mg/l as $CaCO_3$.

Withdrawal interval (days)	μg/g Bayer 73 (Mean ± SE)	
	Channel catfish	Largemouth bass
0	0.019±0.002	0.035±0.003
1	0.008±0.001	0.021±0.002
3	0.000±0.000	0.015±0.000
7	0.000±0.000	0.015±0.0026
10	0.000±0.000	0.015±0.0018
14	0.000±0.000	0.008±0.0009
Control	0.000±0.000	0.000±0.000

Table 3. Residues in pooled samples of bile from channel catfish and largemouth bass exposed to Bayer at selected withdrawal intervals.

Withdrawal interval (days)	μg/g Bayer 73 (Mean ± SE)	
	Channel catfish	Largemouth bass
0	34.3	No samples
1	54.0	No samples
3	49.5	126
7	48.4	117
10	36.8	104
14	35.1	50.0

Table 4. Residues of Bayer 73 in plasma, bile, and muscle of rainbow trout exposed to 0.05 mg/l of Bayer 73 for 12 hours and then transferred to fresh water for selected withdrawal times.

Withdrawal time	Plasma[a] (μg/ml)	Bile[b] (μg/ml)	Muscle[a] (μg/g)
Control	<0.01	<0.01	<0.01
0 hour	8.11 ±5.11	726	0.146 ±0.061
4 hours	10.0 ±3.85	313	0.130 ±0.032
8 hours	8.93 ±2.06	1.004	0.141 ±0.042
12 hours	7.48 ±1.67	792	0.118 ±0.088
24 hours	6.93[c] ±2.53	1,180	0.160 ±0.063
3 days	3.35 ±2.23	117	0.022 ±0.007
7 days	0.100 ±0.028	0.95	0.010 0.002
10 days	0.064 ±0.025	1.45	<0.01
14 days	0.040 ±0.007	1.11	<0.01
21 days	<0.01	0.76	<0.015[d]

[a]Mean ± S.D.; five fish sampled at each interval.
[b]Pooled bile from five fish.
[c]Four fish sampled.
[d]Two of five fish showed 0.018 and 0.028 μg/g, respectively.

Table 5. Uptake of Bayer 73 (μg/ml) in plasma, bile, and muscle of rainbow trout exposed to 0.05 mg/l of Bayer 73 for selected exposure periods.

Exposure time (hours)	Plasma[a]	Bile[a]	Muscle[a]
0	<0.01	<0.01	<0.01
2	2.36	26.6	0.025
	±0.430	±24.3	±0.016
4	2.96	85.4	0.021
	±0.399	±39.5	±0.005
8	5.84	376	0.066
	±1.18	±182	±0.008
12	7.66	380	0.045
	±1.82	±112	±0.017
24	5.30	473	0.024
	±1.08	±82.1	±0.008

[a]Mean ± S.D.; five fish sampled at each interval.

Table 6. Toxicity of TFM and nitrite nitrogen applied individually and in combination against northern pike and white suckers in soft water, pH 7.5, and 12 C.

	96-hour LC_{50} and 95% confidence intervals				
	Individually		In combination		Additive index and range
Species	NO_2-N	TFM	NO_2-N	TFM	
Northern pike	6.00 5.18–6.95	2.20 1.93–2.49	1.91 1.61–2.26	0.700 0.591–0.829	0.571 0.155 to 1.13
White suckers	5.85 4.51–7.59	0.835 0.532–1.31	2.52 2.26–2.82	0.360 0.322–0.403	0.160 −0.385 to 0.840

ADMINISTRATIVE REPORT FOR 1978

Meetings

The Commission held its 1978 Annual Meeting in Rochester, New York, on 13–15 June, and its Interim Meeting in Ann Arbor, Michigan on 29–30 November 1978. In addition, both the U.S. and Canadian sections met in plenary sessions on 14 June in conjunction with the Annual Meeting in Rochester, New York. The Commission also held executive meetings of Commissioners and staff as follows:

6 March	Milwaukee, Wisconsin
6 April	Ann Arbor, Michigan
12 and 15 June	Rochester, New York
2–3 October	Washington, D. C.
28 and 30 November	Ann Arbor, Michigan

Meetings of standing committees during 1978 were:

Lake Erie Committee, Erie, Pennsylvania, 28 February–1 March.
Lake Ontario Committee, Erie, Pennsylvania, 12 March.
Lake Huron Committee, Milwaukee, Wisconsin, 14 March.
Lake Michigan Committee, Milwaukee, Wisconsin, 15 March.
Combined Upper Great Lakes Committees, Milwaukee, Wisconsin, 15 March.
Lake Superior Committee, Milwaukee, Wisconsin, 16 March.
Council of Lake Committees, Milwaukee, Wisconsin, 16 March. (Replaces former Management and Research Committee.)
Great Lakes Fish Disease Control Committee, Ann Arbor, Michigan, 28–29 March.
Sea Lamprey Control and Research Committee, Ann Arbor, Michigan, 5 April.
Scientific Advisory Committee, Rochester, New York, 12 June.
Lake Superior Advisory Committee, Marquette, Michigan, 24–25 October.
Scientific Advisory Committee, Ann Arbor, Michigan, 29 November.

At the combined Upper Great Lakes Committees meeting, the Management and Research Committee agreed to disband itself to be replaced by a new Council of Lake Committees. The Management and

Research Committee had consisted of the chairman and vice-chairman of each lake committee, two federal government representatives (one each for U.S. and Canada), and two or more commissioners. The Council of Lake Committees would consist of representatives from state and provincial agencies represented on the lake committees, with no more than one representative for each lake from each agency.

Attendence at other Commission-related meetings included Sea Lamprey International Symposium Steering Committee, Stock Concept Symposium Steering Committee, Lake Michigan Study Group, Lake Michigan Chub Technical Committee, Lake Michigan Lake Trout Technical Committee, Lake Michigan Sports Fishing Statistics Committee, and Lake Erie Standing Technical Committee, and Sea Lamprey Control Agents' annual Sea Lamprey Conference.

Officers and Staff

Several changes in Commissioners occurred in 1978. Dr. Murray G. Johnson, Director General Ontario Region, Fisheries and Marine Service, Department of Fisheries and the Environment, Canada, was appointed Commissioner effective 1 May, 1978; he replaced Mr. E. W. Burridge who had resigned in December 1977. Mr. R. L. Herbst, Assistant Secretary for Fish and Wildlife and Parks, Department of the Interior, was appointed Commissioner on 18 September 1978, replacing Mr. N. P. Reed who resigned in 1977. Mr. Herbst had been appointed as U.S. federal alternate Commissioner in 1977 pending his formal appointment. Mr. F. R. Lockard, Director of the Division of Fish and Wildlife, Indiana Department of Conservation, was appointed Commissioner 9 November 1978 to succeed Mr. L. P. Voigt. Mr. Voigt's letter of resignation was accepted by the President on 2 November 1978; "effective upon a date to be determined"; Mr. Voigt's last meeting as a Commissioner was the Interim Meeting of 29–30 November 1978. Further, Canadian Commissioner Dr. C. J. Kerswill retired from the Commission following the Annual Meeting in June; the position was still vacant at the end of 1978.

Several changes in staff occurred. Fishery biologist Jane Herbert resigned to accompany her husband when he accepted a position in another state. She was replaced by Margaret Ross who was hired on 17 July. Ruth Koerber, word processing supervisor, came on staff 4 December. Trudy Stedman (nee Woods) was married during the year and resigned on 31 December.

The function of the Commission's internal operating committees was reviewed and the following assignments were made at the March 1978 Executive Meeting.

Finance and Administration

Commissioners	*Staff Member*
L. P. Voigt	W. J. Maxon
C. J. Kerswill	

Sea Lamprey Control and Research

Commissioners	*Staff Member*
W. M. Lawrence, Chairman	A. K. Lamsa
K. H. Loftus	
Vacant	

Management and Research

Commissioners	*Staff Member*
C. Ver Duin, Chairman	C. M. Fetterolf
F. E. J. Fry	
R. L. Herbst	
C. J. Kerswill	

It was suggested that the Chairman be an ex-officio member of all operating committees. There was also agreement that ad hoc committees could be created to consider special items as the need arises. The internal operating committees are expected to meet and discuss their assigned items prior to the general executive meeting so that considered opinions with recommendations can be presented to the entire Commission. This was expected to save considerable time during the Executive Meetings.

Further changes were made following the Annual Meeting to reflect the changes in Commissioners and election of Commission officers; 1978 ended with the following Commission membership on internal operating committees. Newly-appointed Commissioner Lockard was not appointed to an internal operating committee until 1979. No changes were made in staff representation, other than Margaret Ross, the new Biological Assistant, sat on the renamed Fisheries and Environment Committee.

Finance and Administration

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

Sea Lamprey Control and Research

Commissioners	*Staff Member*
W. M. Lawrence, Chairman	A. K. Lamsa
Vacant	

Fisheries and Environment (formerly Management and Research Committee)

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

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 also provides direct assistance to the Commission in program development and acts on behalf of the Commission as circumstances may require. During 1978 the staff participated in conferences, meetings, and activities sponsored by:

Michigan Sea Grant Policy Committee
Symposium on Coolwater Fish
Congressional Hearing on Treaty Indian Fishing Rights
GLERL meeting regarding Environmental Mapping Task Force
IJC Research Advisory Board meeting
Steering Committee meeting for AFS Review of EPA's Quality Criteria for Water
Corps of Engineers Public Hearing on Extended Navigation
Witness for the Ohio DNR (20 July 1977)
Great Lakes Commission
Winter Navigation group meeting
International Association for Great Lakes Research
USFWS Lab Directors
American Fisheries Society
American Institution of Fishery Research Biologists
Lake trout stocking meeting with USFWS and U.S. Coast Guard

Accounts and Audits

The Commission accounts for the fiscal year ending 30 September 1978 were audited by Iceman, Johnson, and Hoffman of Ann Arbor. The firm's reports are appended.

Program and Budget for Fiscal Year 1978

At the 1976 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1978 estimated to cost $4,349,600. The program called for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate and monitor sea lamprey populations, continuing field research in direct support of control operations, the operation of sea lamprey assessment weirs on Lakes Superior and Huron, continuing research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, including biological controls, and another effort to initiate building of barrier dams on selected streams to prevent sea lamprey access to problem areas, thus reducing the use of expensive lampricides

and application costs. A budget of $206,000 was adopted for administration and general research for a total program cost of $4,555,600, as follows:

	U.S.	*Canada*	*Total*
Sea Lamprey Control and Research	$3,001,200	$1,348,400	$4,349,600
Administration and General Research	103,000	103,000	206,000
Total	$3,104,200	$1,451,400	$4,555,600

Sea lamprey control and research in Canada was carried out under agreement with the Canadian Department of Fisheries and the Environment ($1,210,711) and the U.S. Fish and Wildlife Service ($2,250,850). In addition, the Commission contracted with the North American subsidiaries of Hoechst Ag. to purchase 100,000 pounds of the lampricide TFM at $5.88 per pound for the sea lamprey control agents. The Commission also purchased 1,500 pounds of Bayluscide wettable powder at $9.80 per pound to use as a "synergist" with TFM and 50,800 pounds of 5% granular Bayluscide at $1.20 per pound to use as a "synergist" with TFM and 50,800 pounds of 5% granular Bayluscide at $1.20 per pound for lentic surveys for larval lampreys. The Commission also retained $50,000 in reserve for contingency funding for registration-oriented research on lampricides. Further, the Commission included in its agreement with Canada $100,000 for construction of barrier dams in that country to block spawning-run sea lamprey. In the U.S., the Commission contracted with the states of Wisconsin and Michigan for the construction of three barrier dams, with the Commission share at $143,757. At the end of the fiscal year, the United States government refunded $59,070. Expenditures by the Canadian government fell short of the estimated cost by approximately $165,000, comprising $100,000 due to delays in the construction of barrier dams, approximately $15,000 due to late deliveries of equipment, and $50,000 in retroactive salary commitments arising from contractual agreements. Canada put their monies into a Great Lakes Fisheries Commission holding account pending realization of the commitments.

Program and Budget for Fiscal Year 1979

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

Following revisions to adjust to changes in proposed contributions by the two governments, the Commission ultimately proceeded with the following program for sea lamprey control and research on a budget of $5,120,000.

The Canadian agent has scheduled 38 lampricide treatments; 6 in Canadian tributaries to Lake Ontario, 6 in New York tributaries to Lake Ontario, 14 in Lake Huron, and 12 in Lake Superior. In addition, an assessment barrier network of three electric weirs and four mechanical traps will be operated on selected Lake Huron 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 58 lampricide treatments; 20 tributaries to Lake Superior, 25 to Lake Michigan, and 13 to Lake Huron. The continued operation of the eight assessment barriers on Lake Superior tributaries, one on Lake Michigan, and the device on the Ocqueoc River, a tributary to Lake Huron, is planned. The operation of portable assessment traps on tributaries to Lakes Superior, Michigan, and Huron to assess adult sea lamprey populations will also be maintained. 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 the project initiated in fiscal year 1976 to assess the possible contribution of sea lampreys from the Oswego River-Finger Lakes system to the parasitic stocks of Lake Ontario.

The current sea lamprey research program at the Hammond Bay Biological Station and the registration-oriented work at the Fish Control Laboratory, La Crosse, Wisconsin, are to continue through fiscal year 1979.

The Commission negotiated a Memorandum of Agreement with its U.S. agent, the U.S. Fish and Wildlife Service, to cost $3,249,600, including lampricides. A Memorandum of Agreement has also been executed which provides the Commission's Canadian agent, the Department of Fisheries and Environment, with $1,449,000, including lampricides. In the United States, the Commission also held $25,000 of the original $50,000 in reserve for contingency funding for registration-

oriented research on lampricides: $25,000 had been obligated earlier to the U.S. Fish and Wildlife Service for a newly required study. 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 to reduce costs of control: $150,000 was held by the Commission for use on the U.S. side and $100,000 was included in the Canadian Memorandum of Agreement. In addition, the Commission reviewed its administration and general research budget for fiscal year 1979. The funding by government for fiscal year 1979 is as follows:

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

Program and Budget for Fiscal Year 1980.

At the 1978 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1980 estimated to cost $5,546,600. The program calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate and monitor sea lamprey populations, continuing field research in direct support of control operations, the operation of assessment weirs on Lakes Superior and Huron, some 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 $363,000 was adopted for administration and general research for a total program cost of $5,909,600 of which $4,008,700 is being requested from the U.S. Government and $1,900,900 from Canada.

Reports and Publications

In 1978, the Commission published an Annual Report for 1975 and the following two papers in its Technical Report Series.

Chemosterilization of the sea lamprey (*Petromyzon marinus*), by Lee H. Hanson and Patrick J. Manion. Great Lakes Fishery Commission, Tech. Rep. 29, July 1978, 15 pp.

Biology of larval and metamorphosing sea lampreys, *Petromyzon marinus*, of the 1960 year class in the Big Garlic River, Michigan, Part II, 1966-72, by Patrick J. Manion and Bernard R. Smith. Great Lakes Fishery Commission, Tech. Rep. 30, Oct 1978, 35 pp.

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Great Lakes Fishery Commission
Ann Arbor, Michigan

We have examined the accompanying balance sheets of Great Lakes Fishery Commission as of September 30, 1978, and the related statements of revenues and expenditures, changes in encumbrances and fund balances, and source and application of funds for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the financial statements mentioned above present fairly the financial position of Great Lakes Fishery Commission at September 30, 1978, and the results of its operations and changes in its financial position for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with the preceding year.

Icerman Johnson & Hoffman

Ann Arbor, Michigan
December 21, 1978

GREAT LAKES FISHERY COMMISSION

BALANCE SHEETS
September 30, 1978

ASSETS	Administration and General Research Fund	Sea Lamprey Control and Research Fund	Total
CURRENT ASSETS			
Cash in bank	$208,884	726,987	935,871
Accounts receivable - United States Fish and Wildlife Service	-0-	59,070	59,070
	$208,884	786,057	994,941
LIABILITIES AND FUND BALANCE			
CURRENT LIABILITIES			
Accounts payable	$ 2,918	-0-	2,918
Payroll taxes payable	2,895	-0-	2,895
Accrued wages	3,857	-0-	3,857
Total current liabilities	9,670	-0-	9,670
ENCUMBRANCES (Note 2)	-0-	142,470	142,470
FUND BALANCE	199,214	643,587	842,801
	$208,884	786,057	994,941

See notes to financial statements on page 7.

GREAT LAKES FISHERY COMMISSION

STATEMENT OF REVENUES AND EXPENDITURES
Year Ended September 30, 1978

ADMINISTRATION AND GENERAL RESEARCH FUND

	Budget	Actual	Over or (Under) Budget
REVENUES			
Canadian government	$103,030	103,030	-o-
United States government	103,030	103,030	-o-
Interest earned	-o-	100,320	100,320
Miscellaneous	-o-	30	30
	206,060	306,410	100,350
EXPENDITURES			
Salaries	102,535	125,118	22,583
Fringe benefits	24,425	17,804	(6,621)
Travel	17,600	26,659	9,059
Communications	2,600	4,424	1,824
Meetings	1,900	4,147	2,247
Printing and reproduction	12,000	15,198	3,198
Other	2,200	5,818	3,618
Supplies	3,600	6,562	2,962
Equipment and improvements	1,200	40,701	39,501
Sea Lamprey International Symposium	25,000	33,095	8,095
General research	13,000	26,708	13,708
	206,060	306,234	100,174
Excess of revenues	$ -o-	176	176

See notes to financial statements on page 7.

GREAT LAKES FISHERY COMMISSION

STATEMENT OF REVENUES AND EXPENDITURES
Year Ended September 30, 1978

SEA LAMPREY CONTROL AND RESEARCH FUND

	Budget	Actual	Over or (Under) Budget
REVENUES			
Canadian government:			
Operating revenues	$1,190,472	1,210,516	20,044
United States government:			
Operating revenues	3,001,170	3,001,170	-o-
Refund of unexpended funds	-o-	74,723	74,723
	4,191,642	4,286,409	94,767
EXPENDITURES			
Canadian Department of the Environment	1,052,792	1,052,792	-o-
United States Fish and Wildlife Service	2,250,850	2,250,850	-o-
Lampricide purchases (Note 2)	688,000	890,578	202,578
Special studies for lampricide registration	50,000	-o-	(50,000)
Barrier Dams	150,000	143,757	(6,243)
	4,191,642	4,337,977	146,335
Excess of revenues (expenditures)	$ -o-	(51,568)	(51,568)

See notes to financial statements on page 7.

GREAT LAKES FISHERY COMMISSION

STATEMENTS OF CHANGES IN ENCUMBRANCES AND FUND BALANCES
Year Ended September 30, 1978

ADMINISTRATION AND GENERAL RESEARCH FUND

	Encumbrances	Fund Balance
Balances, October 1, 1977	$ -0-	8,189
Excess of revenues	-0-	176
Adjustment of interest earnings (Note 3)	-0-	190,849
Balances, September 30, 1978	$ -0-	199,214

SEA LAMPREY CONTROL AND RESEARCH FUND

	Encumbrances	Fund Balance
Balances, October 1, 1977	$ 33,769	886,004
Excess of revenues (expenditures)	-0-	(51,568)
Adjustment of interest earnings (Note 3)	-0-	(190,849)
Prior year encumbrances paid	(33,769)	-0-
Outstanding encumbrances applicable to the 9-30-78 budget	142,470	-0-
Balances, September 30, 1978	$142,470	643,587

See notes to financial statements on page 7.

GREAT LAKES FISHERY COMMISSION

STATEMENTS OF SOURCE AND APPLICATION OF FUNDS
Year Ended September 30, 1978

	Administration and General Research Fund	Sea Lamprey Control and Research Fund	Total
SOURCE OF COMMISSION FUNDS			
Revenues:			
Actual	$306,410	4,286,409	4,592,819
From reduction in assets:			
Cash	-0-	159,017	159,017
From increase in liabilities:			
Payroll taxes payable	2,895	-0-	2,895
Accrued wages	1,329	-0-	1,329
From increase in encumbrances	-0-	108,701	108,701
From adjustment of interest earnings (Note 3)	190,849	-0-	190,849
	$501,483	4,554,127	5,055,610
APPLICATION OF COMMISSION FUNDS			
Expenditures:			
Actual	$306,234	4,337,977	4,644,211
To increase in assets:			
Cash	192,894	-0-	192,894
Accounts receivable	-0-	25,301	25,301
To reduction of liabilities:			
Accounts payable	2,355	-0-	2,355
To adjustment of interest earnings (Note 3)	-0-	190,849	190,849
	$501,483	4,554,127	5,055,610

See notes to financial statements on page 7.

GREAT LAKES FISHERY COMMISSION

NOTES TO FINANCIAL STATEMENTS
September 30, 1978

Note 1. SIGNIFICANT ACCOUNTING POLICIES

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

The books of account for the Commission are maintained on a modified accrual basis of accounting. Revenues are recognized when received except that balances of budgeted receipts that have been promised by the Canadian or United States governments are set up as receivables at September 30, 1978.

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

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

Note 2. BUDGETED ENCUMBRANCES

Unused funds at year-end are encumbered and charged to expenses. At September 30, 1978, these funds from the United States Government amounted to $59,070 which were encumbered for lampricide purchases and research in the Sea Lamprey Control and Research Fund.

Unused funds from the Canadian Government, if any, have not been determined.

Note 3. INTEREST EARNINGS

Prior to the current fiscal year, interest income was recorded in the Sea Lamprey Control and Research Fund. The current year's interest income has been recorded in the Administration and General Research Fund as required by Section VII of the Great Lakes Fishery Commission's Financial Regulations. An adjustment of $190,849 has been made to transfer all prior interest earnings from the Sea Lamprey Control and Research Fund to the Administration and General Research Fund.

Note 4. FEDERAL INCOME TAXES

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

COMMITTEE MEMBERS — 1978

Commissioners in Italics

SCIENTIFIC ADVISORY COMMITTEE

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

SEA LAMPREY CONTROL AND RESEARCH

CANADA	UNITED STATES
K. H. Loftus	*W. M. Lawrence*, Chm.
J. J. Tibbles	L. P. Voight
	P. J. Manion

COUNCIL OF LAKE COMMITTEES

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

LAKE COMMITTEES

LAKE HURON	LAKE ONTARIO
R. M. Christie, Chm.	D. E. Gage, Chm.
H. J. Vondett, V-Chm.	W. A. Pearce, V-Chm.

LAKE MICHIGAN	LAKE SUPERIOR	LAKE ERIE
H. J. Vondett, Chm.	C. R. Burrows, Chm.	N. E. Fogle, Chm.
M. W. Conlin, V-Chm.	L. Affleck, V-Chm.	A. Holder, V-Chm.
J. T. Addis	J. T. Addis	D. R. Graff
R. Hollingsworth	A. Wright	D. L. Haney
		W. Sheperd