ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1980

GREAT LAKES FISHERY COMMISSION

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

CANADA		UNITED STATES	
A. O Blackhurst	1956–1968	J. L. Farley	1956–1956
W. J. K. Harkness	1956–1959	C. Ver Duin	1956–
A. L. Pritchard	1956–1971	L. P. Voigt	1956–1978
J. R. Dymond	1961–1964	D. L. McKernan	1957–1966
C. H. D. Clarke	1965–1972	C. F. Pautzke	1967–1968
E. W. Burridge	1967–1977	W. M. Lawrence	1968–
F. E. J. Fry	1969–1980	C. H. Meacham	1969–1970
C. J. Kerswill	1971–1978	N. P. Reed	1971–1977
K. H. Loftus	1972–	R. L. Herbst	1978–
M. G. Johnson	1978–	F. R. Lockard	1978–
H. D. Johnston	1979–		
H. A. Regier	1980–		

1980 SECRETARIAT

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

GREAT LAKES FISHERY COMMISSION

Established by Convention
between Canada and the United
States for the Conservation of
Great Lakes Fishery Resources

ANNUAL REPORT
for the year
1980

COMMISSIONERS

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

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

LETTER OF TRANSMITTAL

In accordance with Article IX of the Convention on Great Lakes Fisheries, I take pleasure in submitting to the Contracting Parties an Annual Report of the activities of the Great Lakes Fishery Commission in 1980.

Respectfully,

W. M. Lawrence, *Chairman*

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ANNUAL REPORT FOR 1980

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 25 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 Duluth Minnesota, June 3–5, 1980 and its Interim Meeting was convened in Toronto, Ontario, December 2–3, 1980.

ANNUAL MEETING

PROCEEDINGS

The twenty-fifth Annual Meeting of the Great Lakes Fishery Commission was held on June 3–5, 1980 at Duluth, Minnesota. Chairman Loftus called the meeting to order at 0920 h, and explained that this would be the first of four meetings which would celebrate a quarter-century of Commission activities following ratification of the Convention in 1954, passage of enabling legislation in 1955, and the first meeting in 1956.

The welcoming address was given by Duluth Mayor John Fedo, who described the importance of Lake Superior fisheries to Duluth and congratulated the Commission for its success with sea lamprey control. Minnesota Department of Natural Resources Commissioner Joseph Alexander also welcomed the Commission and described recent improvements in the water quality of the St. Louis River.

After introductions and adoption of the agenda, Chairman Loftus gave the Chairman's Report which reviewed Commission activities since the 1979 Annual Meeting. These activities included sponsorship of symposia, workshops, strategic fisheries planning, publications, improvements in sea lamprey control and research, other fishery research, and cooperative interagency management of fishery resources in the Great Lakes.

Sea Lamprey Control and Research

In recognition of the Commission's twenty-fifth anniversary, Dr. Tibbles and Mr. Braem reviewed the history of sea lamprey control in the Great Lakes. Early control measures such as mechanical and electrical weirs were highlighted along with the first successful field test of TFM in 1957 and the first indication of reduced sea lamprey spawning runs in Lake Superior during 1962.

Mr. Dustin presented the Canadian Agent's 1979 annual report (included elsewhere in this report) and the 1980 Progress Report. Assessment of spawning and parasitic phase sea lamprey, ammocete surveys, and chemical treatments were reviewed in both reports. Mr. Braem also noted problems with treating streams containing spawning runs of pink salmon, and stated that assessments indicated declining sea lamprey populations in the upper Great Lakes.

The annual report of the Hammond Bay Biological Station (presented elsewhere in this report) was given by Mr. Thomas Edsall (USFWS). It was noted that Dr. Joseph Hunn had resigned as director of the station, and that the USFWS would be seeking a replacement.

Dr. Fred Meyer (USFWS) reviewed the activities (presented elsewhere in this report) of the National Fishery Research Laboratory (La Crosse) on registration-oriented research involving lampricides and other related research.

Mr. Bernie Smith (USFWS) presented a report on the Sea Lamprey International Symposium (SLIS), which was held July 30–August 8, 1979 at Marquette, Michigan. A total of 58 background papers were given at the symposium, and in addition four synthesis papers, which provide recommendations for sea lamprey control and research, were prepared. Mr. Smith asked that the Commission form a committee to screen these recommendations and provide a listing of suggestions judged to be of highest priority. Commissioner Lawrence thanked Mr. Smith for his work with SLIS, and stated that the Commission was considering ways to implement the recommendations.

Recent progress in the barrier dam program was discussed by Commissioner Lawrence, who noted that engineering studies on five Michigan and four Ontario streams were being undertaken.

Management and Research

Reports from each Lake Committee (Superior, Michigan, Huron, Erie, and Ontario) and the Council of Lake Committees were given by committee chairmen. Highlights of the 1979 lake committee meetings are given in this report under "Summary of Management and Research."

Mr. James Warren reported on recent activities of the Great Lakes Fish Disease Control Committee. He noted that the committee is seeking representation from private fish breeders in both countries, and this action was encouraged by the Commission.

Biologists from Wisconsin and Minnesota reviewed progress in pollution abatement in the St. Louis River estuary, and the associated improvements in warmwater fish populations.

Mr. Gary Eck (USFWS) presented a report on the development of methodology for collecting Great Lakes sport fishing statistics.

As part of the twenty-fifth year celebration of the Commission's founding, Mr. Gil Radonski (Sport Fishing Institute), Dr. Stanford Smith (USFWS, retired), and Mr. Les Voigt (past Commissioner) contributed to a session on the past, present, and future role of the Commission. The speeches stressed the continuing need for cooperative programs for developing and managing the fishery resources of the Great Lakes.

A progress report from the Strategic Great Lakes Fishery Management Plan Steering Committee was given by Mr. William Pearce (New York Department of Environmental Conservation), who noted that fishery agencies had reviewed goal and issue statements in the plan and that input was being sought from other groups. The steering committee hoped to have a final plan in time for the 1980 Interim Meeting.

Mr. Al Berst, Steering Committee Co-Chairman of the Stock Concept Symposium (STOCS), outlined the symposium's rationale and scope. Information on STOCS is given elsewhere in this report—see "Summary of Management and Research."

Lake trout spawning shoals in Wisconsin's waters of Lakes Michigan and Superior were mapped in 1978–79. Dr. Ross Horrall (University of Wisconsin) reviewed this program, and noted that substrates suitable for egg incubation often comprise only a small area within any shoal complex. He recommended that egg and fry stockings be targeted for these areas.

Board of Technical Experts

Board Chairman Dr. John Magnuson reviewed recent activities of this advisory group. He stated that the Board intended to foster the implementation of concepts developed at Commission-sponsored symposia, and would also be seeking new directions for fishery research. Dr. Magnuson also gave a progress report on phase II of Great Lakes Ecosystem Rehabilitation (GLER II). He noted that results from phase I studies were published as Report No. 37 in the Technical Report Series. Phase II studies will explore specific case histories and foster an inter-disciplinary/inter-institutional approach for selected areas in the Great Lakes that have been severely degraded. Rehabilitation strategies, developed through the GLER process, were then illustrated for Green Bay in a slide/tape show, which will be distributed by Wisconsin Sea Grant.

National Section Meetings

Commissioner Johnson, Chairman of the Canadian Section, reported that the Section will urge the Canadian Department of External Affairs to seek Canadian input into U.S. planning efforts for extended navigation and will encourage the agencies concerned with the dewatering problem in the St. Marys Rapids to expedite a solution to the problem. The Canadian Section also discussed walleye management in Lake Erie, Indian fisheries, and potential uses for pink salmon.

U.S. Section Chairman Ver Duin reported that he would testify against HR 7232 (amendment to the black Bass Act) at a public hearing on June 6, 1980.

Administrative and Executive Actions

A summary of Commission actions since the 1979 Annual Meeting was given as follows:

General
- — sponsored the Sea Lamprey International Symposium.
- — agreed to fund a Fish Health Workshop.
- — funded the production of informational, slide/tape shows in the sea lamprey control program and on restoration of Great Lakes fisheries.
- — supported an updating of the U.S. federal lake trout distribution formula.
- — funded an Atlantic Salmon Workshop.

Publications
- — published Technical Reports 33–37.
- — distributed Special Reports concerning fishery values and classification of sea lamprey attack marks.
- — accepted two papers for publication.

Fisheries research
- — funded GLER II studies.
- — funded modelling studies of Lake Erie fisheries.
- — supported production of a key to larval fishes.

Sea lamprey research
- — contracted for feasibility studies on applications of sonar for quantifying sea lamprey movements in streams.
- — contracted for genetic research on sea lamprey populations.
- — funded USFWS research at La Crosse Research Station concerning effects of pollutants on lampricide toxicology.
- — provided supplementary funding to Monell Chemical Senses Center for field work on sea lamprey pheromones.
- — contracted for development of new lampricide formulations.

Sea Lamprey control and assessment
- — initiated a program audit of the sea lamprey control and research program.
- — provided Bayer 73 to the Lake Champlain Fish and Wildlife Management Cooperative for surveys of ammocete populations.
- — agreed to provide technical training and lampricides (at cost) to the New York Department of Environmental Conservation for control of sea lamprey populations in the Finger Lakes.
- — formed a committee to develop standardized reporting procedures for sea lamprey wounding data.

- — requested that the Lake Ontario Committee clarify its proposals for treatment of Oneida Lake and Oswego River tributaries.
- — referred the SLIS Recommendations to the Board of Technical Experts for review.
- — authorized unobligated funds for construction of barrier dams and purchase of lampricides in FY 1982.

Liaison with committees
- — approved the terms of reference for the lake committees and the council of Lake Committees.
- — asked the Great Lakes Fish Disease Control Committee to reconsider its policy on IPNV.
- — provided responses to all recommendations from its committees.

Communication with external entities
- — met with the International Joint Commission (IJC) to discuss issues of common concern.
- — advised the Contracting Parties that fishery representatives should be appointed to governmental boards/committees having impacts on fishery interests.
- — requested that the Contracting Parties support an IJC reference on atmospheric pollution.
- — directed that position papers be developed in concert with the IJC on the adequacy of toxic substances control and surveillance.
- — directed that Commission concerns regarding protection of lake trout spawning stocks be expressed at a public hearing on Indian treaty fishing in Michigan on February 22, 1980.
- — advised the Contracting Parties and the U.S. Corps of Engineers that Canadian input was needed in the navigation season extension planning process.

Election of Officers

Commissioner Herbst was elected Chairman and Commissioner Johnston vice-chairman for the next two years. Chairman Herbst expressed thanks for Commissioner Loftus's leadership over the past two years.

Adjournment

The next annual meeting will be held in Ottawa on June 17–19, 1981. The Chairman thanked attendees for their participation and adjourned the meeting at 1150 h on June 5, 1980.

INTERIM MEETING

PROCEEDINGS[1]

The Great Lakes Fishery Commission's twenty-fifth Interim Meeting was convened in Toronto, Ontario, on December 2–3, 1980, to review programs, budgets, and achievements of the preceding six months, and to consider activities of its various committees.

Vice-Chairman H. Douglas Johnston opened the meeting in place of Chairman Robert Herbst, who was unable to attend, and welcomed the delegates to the second of four meetings in celebration of the Commission's twenty-fifth anniversary.

Dr. J. Keith Reynolds, Deputy Minister, Ontario Ministry of Natural Resources, welcomed the Commission and attendees to Ontario and congratulated the Commission on its program successes over twenty-five years; its ventures into coordination of research and management, especially the science synthesis symposia series—Salmonid Communities in Oligotrophic Lakes (SCOL), Percid International Symposium (PERCIS), Sea Lamprey International Symposium (SLIS), and Stock Concept Symposium (STOCS); the Commission's contribution to emergence of the ecosystem approach, and its mutual understanding with the International Joint Commission (IJC); and, perhaps most important, the Commission's sponsorship of the Joint Strategic Plan for Management of Great Lakes Fisheries.

Administration and Executive Actions

Acting Chairman Johnston reported on Commission activities since the 1980 Annual Meeting in Duluth:

Development of symposia and plans
— established a team to refine the Sea Lamprey International Symposium recommendations and provide advice on implementation.
— held the Stock Concept Symposium September 30–October 9, 1980, at Alliston, Ontario.

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

— announced the transmittal of the Joint Strategic Plan for Management of Great Lakes Fisheries from the Steering Committee to the Committee of the Whole.
— received the report of the Sea Lamprey Audit Team.

Publications
— published Technical Report 39, "Minimum Size Limits for Yellow Perch in Western Lake Erie," by Hartman, Nepszy, and Scholl.
— revised, updated and reprinted Technical Report 3, Commercial Fish Production in the Great Lakes 1867–1977," by Baldwin, Saalfeld, Ross and Buettner.

Sea lamprey control and research
— requested the chairman of Ontario Hydro to assist the Canadian Agent by reducing the volume of water released during sea lamprey treatment of the Nipigon River system in 1981.
— requested that permissible uses of bisazir, a potential sea lamprey sterilant, be determined.
— requested the U.S. and Canadian Agents to develop a draft proposal for use of bisazir within the sea lamprey control program.
— announced a meeting designed to achieve uniformity in the format for reporting sea lamprey marking data.

Fish management
— announced a meeting to review and possibly revise the formula for distribution of federally-reared lake trout.

External sponsored research
— contracted with Aubrey Gorbman (University of Washington) for a three-year study on physiological factors regulating reproduction in lampreys with emphasis on endocrinology.
— received a report from William Youngs (Cornell University) which establishes that water velocity of 2.58m/sec. through an orifice is effective as a barrier to sea lamprey penetration.
— received the recently published 1973–78 supplement to the annotated Cyclostomata bibliography which the Commission had financially supported in part and which was developed by Tandler, Jones and Beamish, University of Guelph.

Other actions
— requested the Great Lakes Fish Disease Control Committee to reconsider research needs and the implementation of strategies for the control of infectious pancreatic necrosis virus in the Great Lakes.
— voted to bestow meritorious acievement awards to Andy Lawrie (Ontario Minstry of Natural Resources), Stan Smith (Bureau of

Commercial Fisheries, Fish and Wildlife Service, National Marine Fisheries Service, retired), and Dwight Webster (Cornell University) for the excellent and numerous services they have performed over the years.

— completed a new slide/tape show, "The Sea Lamprey—Great Lakes Invader."
— authorized a contract for U.S. and Canadian veterans of sea lamprey control to prepare a history of events preceding formation of the Commission, and the Commission's early efforts in sea lamprey control and research.
— announced drafting of a policy advocating representation of fishery interests on committees considering actions which could change the physical, chemical or biological conditions of the Great Lakes or their tributaries.
— announced that the GLFC will meet with the IJC in the spring of 1981 to discuss matters of mutual concern, including toxic materials, surveillance and remedial works on the St. Marys River.
— corresponded with directors of Great Lakes states, provincial and federal natural resources, environment, health, and agriculture agencies commending the IJC's recommendations based on its Pollution from Land Use Activities Reference Group (PLUARG) study, especially the call for a comprehensive management strategy and complementary plans to deal with Great Lakes pollution.
— authorized contracting a consultant to provide an update on flow regimes over the St. Marys River Rapids at Sault Ste. Marie, Ontario and Michigan, the most recent decisions relative to discharges, testing of the compensating works, construction of remedial works, and an assessment of the situation for discussion with the IJC in the spring.
— requested the Canadian Section to encourage official Canadian contact with the U.S. government regarding the status of proposals for winter navigation.
— acknowledged contact by the U.S. Section with Senators Proxmire and Bayh in support of continued funding of state fishery programs through the Andadromous Fish Conservation Act, PL 89-304.

Sea Lamprey Control and Research

Reports on sea lamprey marking and fish/lamprey interactions were presented for Lakes Superior, Michigan, Huron, Erie, and Ontario. No major changes in wounding rates were recorded in any of the lakes.

Continuing large-scale stocking of salmonids—primarily lake trout and chinook and coho salmon—and their availability have made those species easier indicators of sea lamprey predation than whitefish (Lake Huron) and white suckers (Lake Ontario).

Research progress reports were presented from the Hammond Bay Biological Station, Monell Chemical Senses Center, La Crosse National Fishery Research Laboratory, and Canada Centre for Inland Waters. Findings included:

Hammond Bay—Attempts to sterilize adult sea lampreys using male and female hormones had no detectable effect on male fertility; water velocity of 12 or 13 fps for a distance of 6 or 4.5 feet, respectively, would be effective in preventing spawning sea lampreys from navigating flooded barrier dams; previous exposure of ammocetes to sublethal concentrations of TFM does not increase tolerance.

Monell—Intraspecific chemical signals play an important role in sea lamprey spawning migration and reproductive behavior. Pheremones are released by adult males and females, and by ammocetes. Field testing of major components of the male pheremone should begin in 1982.

La Crosse—Because of the expense associated with registration of bisazir with the U.S. Environmental Protection Agency and the hazards anticipated with its use, the recommendation was repeated that the GLFC abandon bisazir and pursue other sea lamprey sterilization techniques. A solid bar formulation of TFM should be approved by EPA and ready for use in 1981; a new method for field analysis of TFM and Bayer was developed; and tests showed that Bayer, at treatment concentrations, was not a problem with *Hexagenia* (burrowing mayflies) and that *Hexagenia* in the egg stage were most tolerant to TFM, least tolerant as newly-hatched nymphs.

Canada Centre for Inland Waters—TFM exhibits 50% degradation at about 1,500 Langleys (accumulated solar radiation), a favorable rate.

The Commission received reports from the Control Agents (Fish and Wildlife Service and Fisheries and Oceans Canada) on portable assessment trap catches of sea lampreys, chemical treatment of tributary streams, larval surveys and barrier dam progress.

Commissioner Henry Regier, Chairman of the GLFC Sea Lamprey Committee, concluded the presentations on sea lamprey control and research by observing that we are holding our own but have made no real progress in the last year, citing problems with large rivers, pink salmon vulnerability, and public attitude toward lampricides, he wondered if there was a need for research to assist agents in meeting such challenges. Acting Chairman Johnson commented that the overall record of sea lamprey control is impressive.

BOARD OF TECHNICAL EXPERTS REPORT

The Board of Technical Experts (BOTE) name has been changed from Scientific Advisory Committee and the Commission has brought into its membership less traditional fisheries scientists such as sociologists and economists.

The Board has assigned its members to internal committees charged with developing insights which relate to achievement of Commission objectives and recommendations for internal research initiatives and program directions. Responsibilities include anticipating and identifying problems, providing technical review of the Technical Report Series, reviewing research proposals, and conducting research of value to the GLFC.

BOTE's current activities include organization of adaptive management training workshops, surveying specimen archiving needs, and the rehabilitation project reported below.

GREAT LAKES ECOSYSTEM REHABILITATION PROJECT

The GLER project has grown out of a feeling that, despite the functions and efforts of various public and private organizations, no one completely understands the entire Great Lakes ecosystem and no present organization could effectively manage or be responsible for such a system. A new ecosystem approach is being developed which incorporates process-oriented inquiry techniques to offer fair and balanced opportunities for both holistic and reductionist approaches. The concept has been tested and has been demonstrated to be effective, especially in terms of public recognition of ecological problems. Rehabilitation of degraded ecosystems requires that agencies with mandates to serve "sensitive uses" act as lead agencies in the process.

THE SEA LAMPREY: GREAT LAKES INVADER

This slide tape show, the first of two marking the Commission's 25th anniversary, was shown to attendees for review and comment.

GLFC PROGRAM AND BUDGET FOR 1981 AND 1982

The GLFC for fiscal year 1981 is $6.484 million, as follows:

	Canada	*U.S.*
Sea Lamprey Control and Research	$1,884,000	$4,195,000
Administration and General Research	$202,300	$202,300

Estimated budget for fiscal year 1982 is $6.807 million as follows:

	Canada	*U.S.*
Sea Lamprey Control and Research	$1,971,000	$4,388,000
Administration and General Research	$224,200	$224,200

MEETING OF THE COMMITTEE OF THE WHOLE

Commissioner Loftus reported that the Committee of the Whole, made up of agency directors or their designees, had met to review the Strategic Great Lakes Fishery Management Plan as prepared by the Steering Committee, made minor editing changes, and agreed to subject the plans to serious review within their respective agencies prior to the official signing ceremony scheduled for June 1981.

REPORT OF THE SEA LAMPREY AUDIT TEAM

Team Chairman Chamut reported the conclusion that the sea lamprey control program has been remarkably successful. However, he added that a signficant constraint on continued effectiveness is lack of a management and planning process administered by the Commission. Important elements of the Commission's research program have lost momentum, and it is important for the Commission to address new challenges which must be met if the long-term success of lamprey control is to be assured. The evolution of the sea lamprey control effort into two national control programs is inconsistent with the intent of the Convention, and should be remedied. It is recommended that the Commission upgrade its public information efforts with regard to sea lamprey control. Barrier dams are seen as important supplements to present controls, and implementation of a vigorous barrier dam construction program is highly desirable.

REPORT ON THE STRATEGIC GREAT LAKES FISHERY MANAGEMENT PLAN

Steering Committee Co-Chairman Lawrie stated that the intent of the plan is to provide a process for cooperation in fish management through the Lake Committees. The commitment is to cooperative solutions of common problems. Agencies retain their flexibility, and decisions are to be reached through consensus.

Committee of the Whole members will take the document to their respective agencies for consideration prior to the signing ceremony in June of 1981. The GLFC, as facilitator for the drafting process and as possible arbitrator, will not sign the document but will review it for acceptability.

Commissioner Loftus commended the management agencies for reaching an accord, and Acting Chairman Johnston concluded that the Committee of the Whole had embarked upon an important step in coordinating Great Lakes Fishery management and in providing a process for further interaction with other agencies.

LAKE COMMITTEE PROGRESS REPORTS

Lake Erie—The committee's Standing Technical Committee has been reconstituted with new terms of reference to its sub-groups: Walleye Task

Group, Yellow Perch Task Group (quota development), Lake Trout Task Group (assessment methods).

Lake Ontario—The lake trout rehabilitation strategy is under review, and there is evidence of lake trout spawning, which has been filmed in southeast waters.

Lake Huron—Numbers of yearling chubs have increased and recent whitefish year classes have increased 3–4 times those caught in 1973–6. Lakewide gill net surveys in the spring of 1980 showed a scarcity of lake trout in northern Lake Huron, but fall surveys showed spent and ripe females in planted offshore sites.

Lake Superior—The Wisconsin Department of Natural Resources planted lake trout eggs in Astroturf "sandwiches" to determine the feasibility of the method. It appears that progeny of three-year-old pink salmon are returning to spawn at two years of age in even-number years.

Lake Michigan—Michigan and Wisconsin's sport catch of coho salmon showed a dramatic increase in both numbers and average size of fish. Wisconsin has ceased planting lake trout in northern Green Bay, because its objective of establishing a spawning population on reefs was found to be compromised by a large gill-net fishery for whitefish.

Commission Executive Action

Finance and Administration Committee Chairman Johnston reported the Commission approved a policy advocating fishery representation on all environmental advisory groups in the Great Lakes; requested that the DFO perform a financial audit of the Sea Lamprey Control Centre at a cost not to exceed $8,000; and awarded John Howell and Bernie Smith (USFWS, retired) meritorious achievement awards for their career contributions to the sea lamprey program.

Sea Lamprey Committee Chairman Regier reported that the Commission received and has accepted in principle a Michigan DNR barrier dam proposal for 1980 through 1983; received the Sea Lamprey Audit Team's report; and that a meeting of people associated with the Sea Lamprey Control and Research Committee, Sea Lamprey Audit Team, Strategic Great Lakes Fishery Management Plan, Board of Technical Experts, and Sea Lamprey Internation Symposium will be held to consider the current status of the sea lamprey program and how best to meet upcoming challenges.

Fisheries and Environment Committee Chairman Ver Duin reported Chairman Herbst will see if a USFWS hatchery has room to hold the new brood stock Green Lake strain lake trout; the cooperative USFWS/Coast Guard offshore lake trout planting program got underway in the fall of 1980; the Committee of the Whole has accepted the Strategic Great Lakes Fishery Management Plan from the Steering Committee with few revisions; the hiring of a consultant to report on the effects of, remedies for, and jurisdictional responsibilities associated with dewatering of the St. Marys

Rapids, a topic which the GLFC will introduce at its upcoming meeting with the IJC; the funding of Koonce's (Case Western U.) yellow perch modeling study, Magnuson's (U. of Wisconsin) study of lake trout fry movement, Allendorf's (U. of Montana) theoretical analysis of expected patterns of allelic frequency divergence in fish populations, Cunninghams's (OMNR) STOCS bibliography, and the Lake Erie Committee's walleye stock pilot study.

Adjournment

The meeting was adjourned at 11:55 a.m. on December 3, 1980. The annual meeting will be convened on June 17–19, 1981, at the Holiday Inn Centre, Ottawa, Ontario.

SUMMARY OF MANAGEMENT AND RESEARCH[1]

Stock Concept International Symposium (STOCS)

The Stock Concept Symposium was held at the Nottawasaga Inn, Alliston, Ontario from 30 September through 9 October 1980. The Symposium was attended by 80 delegates drawn from university and government agencies in the British Isles, Europe, and the west and east coasts of North America, including Alaska. However, the majority of the delegates came from the Great Lakes region.

The symposium addressed the whole question of the stock concept in fisheries, and needs for research as applied to the rehabilitation of Great Lakes fish stocks and improvement of the fishery resources. Althogether 38 papers were presented during the four days of plenary session. The last four days of the conference were organized into a series of concurrent workshop sessions in which delegates synthesized scientific information into practical applications of the stock concept in fisheries. It is expected that about seven synthesis papers will be prepared, based on outlines that were developed in the workshop sessions.

The proceedings of STOCS will be published in December 1981 as a special issue of the Canadian Journal of Fisheries and Aquatic Sciences. This will assure permanent availability and wide distribution.

Co-chairmen of the symposium steering committee were Mr. Alfred Berst and Dr. Raymond Simon.

Strategic Great Lakes Fishery Management Plan (SGLFMP)

Considerable progress was made by cooperating agencies toward development of a strategic plan in 1980. The Steering Committee presented a draft plan to the agencies and the Committee of the Whole for review and comment. The Committee of the Whole, composed of senior administrators from Great Lakes state, provincial and federal resource agencies, accepted in principal a modified draft plan from the Steering Committee at the Commission's Interim Meeting. This draft will be given a final review by the agencies, and agency acceptance is scheduled for the Commission's 1981 Annual Meeting.

[1]Commercial fish landings by lake and species are given in Tables 1–5 for 1980.

Reports from Lake Committees

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

LAKE TROUT

Rehabilitation of lake trout stocks in the three upper lakes and in Lake Ontario continues to be a major goal of the Commission. Initiation of chemical sea lamprey control in 1958 along with restrictions on fishing effort allowed native lake trout stocks in Lake Superior to survive, albeit in greatly diminished numbers. Near extinction in Lake Superior and essentially complete extinction of lake trout in the other lakes has necessitated a large scale stocking program aimed at reestablishing brood stocks, which will hopefully repopulate the lakes. Progress in lake trout rehabilitation is reviewed for each lake as follows:

Lake Superior—Abundance of naturally reproduced (native) lake trout is reported to be improving over large areas in both Canada and the U.S. Inshore stocks declined much more severely than did offshore stocks after the sea lamprey invasion, and consequently inshore stocks were almost entirely (greater than 90% in most areas) composed of hatchery fish up to the mid-1970s. In the latter part of the 1970s native lake trout became much more common in assessment and commercial catches.

In Ontario waters of Lake Superior 90% of the lake trout commercially caught (whitefish fishermen are allowed a specified quota of lake trout) north and west of Cape Gargantua are now of native origin, and 40% of the catch south of the Cape are native. Although these statistics indicate substantial progress towards rehabilitation, Ontario's criteria for a rehabilitated stock specify a density of 2.1 pounds of lake trout per acre in areas of favorable habitat and an adult survival rate greater than 50% per year; few areas in Ontario waters now meet these requirements.

In Michigan waters the proportion of native lake trout in assessment catches has increased three-fold since 1976 and amounts to 38% averaged over the shoreline. However, since 1978 no improvements were reported for the area east of Marquette where excessive catches taken in the Indian treaty fishery and lower stocking rates have reduced brood stocks by two-thirds from levels recorded in the early 1970s. In the area west of Marquette, fishing intensity is more moderate in most areas, stocking rates are higher and the proportion of native lake trout in assessment catches continues to improve.

Improvements in abundance of native lake trout were also observed in Wisconsin's waters of Lake Superior, and result from increased stocking and the creation of a large fish refuge east of the Apostle Islands. Spawning stocks on Gull Island Shoal, the main spawning area in Wisconsin waters, have doubled in size since 1979 and were estimated to number 21,000 fish of which 90% were native. On the other hand, stockings on Devils Island Shoal since 1971 have not produced a spawning run. This is believed to have resulted from a failure of stocked fish to return to the stocking site for spawning. Apparently, these fish dispersed and spawned in other locations, which were less suitable for reproduction.

Native lake trout are still relatively scarce along the Minnesota shoreline of Lake Superior, although the trend in abundance since 1976 has been upward. Spawner abundance has doubled since 1974, when sampling was previously conducted.

Sea lamprey wounding rates were reported to be either stable and low or declining to low levels in almost all areas of Lake Superior in 1980. Two exceptions to this were an area off the Nipigon River in Ontario waters and areas east of Marquette in Michigan waters. The Nipigon River is believed to be the source of lamprey infestation in Ontario waters, and this river is scheduled for chemical treatment in 1981. Wounding rates on lake trout as high as 40% in the area east of Marquette are comparable to rates observed before the chemical control program took effect in the early 1960s, and are in large part a result of the overfishing problem discussed earlier, which left fewer lake trout as prey for the parasitic lamprey populations. Continued fishing and lamprey predation on the residual stocks are a threat to the rehabilitative effort in these waters, and the ability of the stocks to reproduce may end if stringent controls on fishing are not soon imposed.

Contrasts between various areas of Lake Superior, which experienced different levels of fishing, stocking, and sea lamprey control, show that success in developing self-reproducing lake trout stocks is clearly obtainable, if these factors are properly manipulated. Failure to address each factor consistently over time can prevent rehabilitation from occurring or can set back rehabilitative progress.

Lake Michigan—Significant natural reproduction of lake trout has not been observed in Lake Michigan despite extensive stockings made since 1965. Excessive catches of lake trout in angler and commercial fisheries have been responsible in part for the failure. Wisconsin is working towards a system of zoning which would limit fishing in certain areas. However, in Michigan waters fishery regulation and control of fishing, especially as concerns the new treaty fishery, remain unresolved with the result that lake trout stocks were not properly protected and were overfished, particulary in northern waters. Overfishing caused abundance declines of 47–72% in four areas located between the north shore and Good Harbor Bay. These declines are based on comparisons of assessment catches made between 1976–78 and 1979–8.

Sea lamprey wounding rates on lake trout declined for the third consecutive year in northern Lake Michigan and remained low (less than 2%) in other areas of the lake.

A Lake Trout Technical Committee has begun work on establishing

goals for lake trout rehabilitation in Lake Michigan. A discussion paper which addresses the potential carrying capacity of the lake for lake trout was presented to the Lake Michigan Committee.

Lake Huron—Lake trout have been stocked along the Michigan shoreline since 1973, and survival of the first six year-classes was considered good. Lake trout of spawning age are appearing in good numbers south of Rogers City, but older lake trout are much scarcer in the north were Indian treaty fisheries made large catches in 1978–79.

Backcross lake trout stocked in 1979–80 in Georgian Bay and the North Channel by the Province of Ontario have survived exceptionally well. In one area anglers caught 30% of the 1979 stocking. Backcross are a hybrid between lake trout and splake, a lake trout × brook trout cross. These fish have an earlier age at maturity than lake trout and therefore have a better chance of escaping sea lamprey predation (lampreys tend to prey on larger fish) before their first spawning.

Sea lamprey wounding rates on backcross in Georgian Bay are low (less than 1%), but rates on lake trout in the main basin are much higher (5–12%), and are cause for concern. Main basin rates are highest in the north (10–12%) and lowest in the south (5–7%).

Sea lamprey control in Lake Huron's main basin may be inadequate. Sea lamprey are known to spawn in the St. Marys River, which connects Lake Superior with Lake Huron, but this river is too large to treat effectively with conventional methods. Hence, the wounding problem in northern Lake Huron may require new control technology.

Lake Erie—Recoveries of stocked lake trout in the eastern basin of Lake Erie continue to be sparse. Stocking levels have been nominal since the first planting in 1975. Survival of the planting stock may have been reduced because of the stress of long transportation times between stocking sites and the supplying hatcheries.

Lake Ontario—Production stocking of lake trout began in New York waters in 1974 and in Ontario waters in 1976. The first mature females were observed along the New York shoreline in 1979, and Ontario reported spawning in 1980. Sea Lamprey wounding rates on the smallest reference size group of lake trout varied from 6–11% over the last five years in the eastern basin. East–west differences in wounding rates have not been significant so that the eastern basin rates may be typical for the lake. Lake Ontario wounding rates are considered high like those of Lake Huron, when compared to Lakes Michigan and Superior. High wounding rates in these lakes have been associated with lake trout mortality rates that have left too few survivors for development of significant brood stocks. Hence, there is concern for Lake Ontario that improvements in sea lamprey control may be required if rehabilitation is to succeed.

WHITEFISH

Whitefish continue to be the most valuable species (6.3 million pounds landed in 1979) in the commercial fisheries of the upper Great Lakes. Fishery management agencies are increasingly concerned with protection and enhancement of the stocks. Stock assessment in Ontario's waters of Lake Superior indicates that the whitefish fishery is fishing at or beyond the maximum sustained yield in some areas. Reduced quotas are being considered.

In Lake Michigan, Michigan's whitefish catch in 1980 (2.2 million pounds) was close to the average catch of the preceeding decade. The exploitation rate of 39% is considered by biologists to be above the optimum by 26%.

Whitefish landings from both Michigan's and Ontario's portions of Lake Huron's main basin continue to improve with recruitment into the catch of strong year-classes produced in 1978–79. Landings in Michigan were at a modern high (since the 1940s) of 0.75 million pounds in 1980, and although Ontario catch figures were not complete, their catch will likely be a new record.

Whitefish stocks in Lake Huron's main basin and North Channel benefited from sea lamprey control, which began in the mid-1960s. For instance, whitefish survival rates increased from 23 to 37% in the North Channel and from 16 to 14% in the main basin after control was effected. Sea lamprey populations in Georgian Bay were low before control began, and whitefish stocks there did not improve during this period.

LAKE HERRING

Once a common inshore fish in the Great Lakes, lake herring, because of overfishing and species changes, have suffered catastrophic abundance declines in all of the Great Lakes excepting in northeastern Lake Superior. Significant lake herring fisheries now operate only in Ontario's waters of Lake Superior, and because of concern for the welfare of the species quota management is expected to be implemented there.

Both Wisconsin and Minnesota reported an exceptional year-class of lake herring produced in their waters of Lake Superior during 1978. This would be the first reproduction there of any consequence since the late 1950s, and it raises hopes that the species could recover from the very low levels of abundance existing in other areas of the Great Lakes.

CHUBS

Lake Michigan has traditionally been the center for chub production in the Great Lakes with recorded catches as high as 12 million pounds in the early 1960s. However, these higher catches were not sustainable, and landings declined to only 3 million pounds by 1974, after which protective quotas were imposed on the fisheries by all agencies. Under quota management chub stocks improved markedly, and reproduction has improved each year since 1976. Assessment catches of young-of-the-year chubs in 1980 were six times higher than in 1979, and adult catches have increased 40 times from the low levels of 1977.

Because of improvements in Lake Michigan chub abundance, Wisconsin is increasing its quota to 1.3 million pounds (was 1.1 million in 1980).

Chub quotas in Michigan waters are not being taken, especially in the south, because dieldrin levels in chub flesh exceed U.S. Food and Drug Administration tolerance levels.

In Lake Huron's main basin chub stocks are in a recovery phase following a period of overfishing in the 1950s and early 1960s. Improvements in stock abundance have been much more gradual than in Lake Michigan, but a stronger 1977 year-class is expected to augment the spawning populations.

Chub stocks in southern Georgian Bay were fished to depletion in the early 1970s, and these stocks have not shown any signs of recovery.

COHO SALMON

Michigan introduced coho salmon into Lake Michigan in 1966, and exceptional returns from this effort prompted introductions by various fishery agencies into the other Great Lakes. However, significant fisheries exist at present only in Lakes Michigan and Ontario.

An interagency evaluation of coho salmon natural reproduction, dispersal, and hatchery diet was conducted in Lake Michigan during 1979. Results showed that the rate of return from hatchery stockings was 7.4% and that 9.3% of the spawning run was from natural reproduction. Michigan stockings comprised 50–75% of the catch taken in other states, and Michigan received 2.5% of its catch from other state stockings. Different hatchery diets did not affect salmon survival.

SMELT

Introduced into the Lake Michigan watershed in 1912, smelt have become a prominent item in the diet of salmon and trout in all of the Great Lakes. In Lake Erie smelt are also commercially important with landings of 25 million pounds in 1979 and 1980. Major changes in smelt abundance during 1980 were reported only for Lake Huron, where a series of strong year-classes has resulted in smelt becoming the dominant pelagic species in the lake.

ALEWIFE

The alewife is a common pelagic species in all of the Great Lakes except Lake Superior, where it is rather uncommon. It invaded Lake Erie and the upper lakes via the Welland Canal, which was also used by the sea lamprey to bypass Niagara Falls.

Alewife indices of abundance in Lake Michigan in 1980 were the lowest recorded since surveys began in 1973. The decline was most severe in northern areas were heavy mortality that begun in the winter of 1979–80 continued on into the spring. Young-of-the-year reproduction was, however, reasonable good in 1980. Adult alewives also declined in Lake Huron during 1980, and reproduction there was also good. In Lake Ontario alewives have been gradually increasing in abundance since a large die-off occurred in 1976–77.

WALLEYE

In the upper Great Lakes the walleye, a warmwater species, is restricted to shallow bays where it has been eagerly sought in angler and commercial fisheries. Green Bay (Lake Michigan) and Saginaw Bay (Lake Huron) were historic centers for walleye fishing in the upper lakes, but stocks declined in both areas following periods of intensive fishing and environmental degradation. Management agencies are now stocking walleyes in both areas, and preliminary results have been encouraging. However, it is not known whether the stocked fish will be able to spawn successfully and repopulate the bays.

Connecting Waters—The St. Clair River, Lake St. Clair, and the Detroit River, which connect Lakes Huron and Erie, are important spawning grounds and migration routes for walleyes. In a recent study, walleyes tagged in Lake St. Clair moved in considerable numbers northward into the St. Clair River and southern Lake Huron; smaller numbers moved southward into the Detroit River and Lake Erie. Most of the southern Lake Huron walleyes are thought to spawn in the connecting waters and their tributaries, but according to recent observations, some also spawn in southern Lake Huron itself.

Walleye abundance in the connecting waters has been high due to an exceptionally strong year-class produced in 1977. Indices of abundance are approximately twice as high as they were in the early and mid-1970s. Larger stocks in the connecting waters may be responsible for the recent northward expansion of the walleye range in southern Lake Huron. Ontario biologists reported that walleyes are now being taken commercially north of Grand Bend in an area where walleye were formerly not in commercial abundance.

Lake Erie—Walleye stocks in the western basin of Lake Erie are the largest of any in the Great Lakes, but because of a near collapse of these stocks in the 1960s, the fishery has been regulated (since 1976) by quotas. Rates of exploitation are agreed upon by the Lake Erie Committee, and are based on projections of standing stock made by a Standing Technical Committee.

Walleye fishing rates were kept conservative (less than 0.10) through 1979 to allow rebuilding of the stocks, but quotas were exceeded each year because of a substantial over-harvest by Ohio's angler fishery. Nonetheless, walleye stocks increased during the late 1970s, and walleyes expanded their range into the central basin (a sign of increasing abundance). Because of these favorable events, the 1980 fishing rate was increased to 0.20. This increased fishing rate and a smaller Ohio creel limit (from 10 per trip to 6 per day) reduced Ohio's overharvest from a factor of 1.8 in 1979 to 0.37 in 1980—a large improvement.

An encourging review of the status of walleye stocks in the western basin and knowledge that an exceptionally large year-class was produced in 1980 led the lake committee to increase the fishing rate further to 0.285 for 1981.

Lake Ontario—Angler fisheries in Ontario's Bay of Quinte continue to expand with recovery of the walleye stocks. The 1980 catch of 167,000 fish is the largest observed in recent times. Pollution abatement is associated with the recovery and expansion of the fishery, but at present the fishery is dependent mainly on one strong year-class, that of 1978.

YELLOW PERCH

Yellow perch are most abundant in shallow, warmwater areas of the Great Lakes and are often associated with walleyes. The most important yellow perch fisheries on the Great Lakes are in Green Bay, Saginaw Bay, and Lake Erie. Southern Green Bay accounted for 83% of the Lake Michigan commercial catch of yellow perch in 1979, and biologists are concerned that this level of fishing may be excessive. Landings from southern Green Bay are currently less than half of the 1952–64 average, and there are indications of overfishing in the stock (fast growth and high mortality). To reduce the catch several areas in the bay will be closed to commercial fishing in 1980.

Yellow perch stocks in Saginaw Bay are currently recovering from overfishing that occurred in the 1960s. Strong year-classes produced in 1978–79 are contributing to the recovery.

Yellow perch landings from Lake Erie in 1980 were unchanged from 1979, when 15 million pounds were caught. Annual catches in the late 1950s and throughout the 1960s were in excess of 20 million pounds, however, and plans are being developed for interagency management procedures that should lead to enhanced stocks.

Table 1. Lake Superior commercial fish production in pounds for 1980

Species	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
Alewife	16	–	132	148	–	148
Burbot	37,725	2,592	2,171	42,488	10,833	53,321
Carp	404	84	–	488	–	488
Chubs	534,501	104,335	18,370	657,209	533,062	1,190,271
Lake herring	77,789	152,215	181,596	411,618	2,848,033	3,259,651
Lake trout	144,485	360,482	35,328	540,268	471,308	1,011,576
Lake whitefish	724,117	341,544	2	1,065,663	501,054	1,566,717
Northern pike	–	–	–	–	2,639	2,639
Round whitefish	307	38,963	438	39,708	118,952	158,660
Smelt	1,854	75,953	413,616	491,435	36,959	528,394
Suckers	9,021	12,530	1,709	23,260	171,805	195,065
Walleye	–	5,090	–	5,090	773	5,863
Yellow perch	1,710	–	–	1,710	84,315	86,025
Total	1,531,942	1,093,778	653,362	3,279,082	4,779,783	8,058,865

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Yellow perch	1,710	–	–	1,710	84,315	86,025
Total	1,531,942	1,093,778	653,362	3,279,082	4,779,783	8,058,865

Table 2. Lake Michigan commercial fish production in pounds for 1980.

Species	Michigan			Wisconsin			Illinois	Indiana	Grand Total
	Green Bay MM-1	Michigan proper	Total	Green Bay WM-1,2	Michigan proper	Total			
Alewife	604,850	–	604,850	1,718,104	11,188,920	12,907,024	–	–	13,511,874
Bullheads	–	–	–	26,358	–	26,358	–	–	26,358
Burbot	–	28,092	28,092	61,955	929	62,914	–	10	91,016
Carp	–	–	–	159,373	143	159,516	–	–	159,516
Channel catfish	118	265	383	1,972	–	1,972	–	10	2,365
Chubs	24	217,201	217,225	2,122	1,122,512	1,124,634	130,190	2,593	1,474,642
Lake herring	–	127	127	–	55	55	–	–	182
Lake trout	14,287	230,266	244,553	–	–	–	–	123	244,676
Lake whitefish	1,375,191	2,054,228	3,429,419	413,754	346,704	760,458	–	878	4,190,755
Northern pike	9	375	384	11,349	–	11,349	–	–	11,733
Pacific salmon	–	–	–	–	–	–	–	894	894
Round whitefish	211	127,388	127,599	5,174	57,116	62,290	–	–	189,889
Sheepshead	–	–	–	707	–	707	–	–	707
Smelt	524,845	636	525,481	47,655	398,321	445,976	–	2,705	974,202
Suckers	1,127,893	48,841	1,176,734	173,356	3,626	176,982	40	3,112	1,357,188
Walleye	59	1.635	1.694	571	–	571	–	–	2,265
White bass	–	–	–	2,119	–	2,119	–	–	2,119
Yellow perch	54,564	1,036	55,600	338,834	6,387	345,221	490,430	175,227	625,478
Total	3,729,837	2,682,664	6,412,501	2.963,400	13,124,746	16,088,146	179,660	185,522	22,865,859

Table 3. Lake Huron commercial fish production in pounds for 1980

Species	Michigan			Ontario				
	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	–	532	532	–	–	–	–	532
Bullheads	–	1,768	1,768	312	1,390	966	2,668	4,436
Burbot	115	159	274	–	21,860	3,669	25,529	25,803
Carp	120	562,539	562,659	33,466	15,766	7,149	56,381	619,040
Channel catfish	1,043	492,904	493,947	54,347	67	–	54,414	548,361
Chubs	–	–	–	225,065	171,254	1,434	397,753	397,753
Crappie	–	7,178	7,178	–	–	–	[1]	7,178
Eel	–	–	–	–	2	16	18	18
Garfish	–	373	373	–	–	–	–	373
Gizzard shad	–	–	–	3,190	–	–	3,190	3,190
Lake herring	–	–	–	5,696	43,692	2,736	52,124	52,124
Lake sturgeon	–	–	–	3,709	1,431	9,443	14,583	14,583
Lake trout	2,359	–	2,359	61,017	856	12,624	74,497	76,856
Lake whitefish	729,424	72,609	802,033	1,164,350	196,034	163,260	1,523,644	2,325,677
Northern pike	–	–	–	257	6,509	12,906	19,672	19,672
Pacific salmon	–	–	–	14,240	58	116	14,414	14,444
Quillback	–	64,894	64,894	–	–	–	–	64,894
Rock bass	–	322	322	199	2,742	975	3,916	4,238
Round whitefish	21,464	28,725	50,189	12,461	33,159	2,830	48,450	98,639
Sheepshead	–	14,042	14,042	48,158	–	–	48,158	62,200
Smelt	–	22,000	22,000	677	–	–	677	22,677
Splake	–	–	–	71	81,399	5,067	86,537	86,537
Suckers	5,683	129,449	135,132	40,782	90,632	76,579	207,993	343,125
Walleye	1,057	–	1,057	275,231	25,026	29,185	329,442	330,499
White bass	–	6	6	9,959	6,534	6,045	22,538	22,553
Yellow perch	–	195,075	195,075	446,976	80,893	16,312	544,181	739,256
Unidentified	–	–	–	7,350	23,130	–	30,480	30,048
Total	761,265	1,592,575	2,353,840	2,407,513	802,434	351,312	3,561,259	5,915,099

[1]Crappie reported with rock bass.

Table 4. Lake Erie commercial fish production in pounds for 1980

Species	Michigan	New York	Ohio	Pennsylvania	U.S. Total	Ontario	Grand Total
Bowfin	–	–	–	–	–	15,374	15,374
Buffalo	36,275	–	29,219	–	65,494	–	65,494
Bullheads	–	42	50,851	1,028	51,921	37,379	89,300
Burbot	–	2	–	1,536	1,538	–	1,538
Carp	545,006	886	1,368,481	190	1,914,563	22,582	1,937,145
Channel catfish	20,635	161	252,320	776	273,892	87,469	361,361
Crappie	–	1	–	–	1	–[1]	1
Eels	–	–	–	–	–	127	127
Gizzard shad	–	601	487,125	5,784	493,510	800	494,310
Goldfish	–	–	83,162	–	83,162	–	83,162
Lake sturgeon	–	22	–	–	22	619	641
Lake trout	–	–	–	3,303	3,303	798	4,101
Lake whitefish	–	3	–	2,393	2,396	1,892	4,288
Northern pike	–	–	–	–	–	21,292	21,292
Pacific salmon	–	–	–	–	–	21,562	21,562
Quillback	–	–	79,448	–	79,448	–	79,448
Rock bass	–	96	–	–	96	52,235	52,331
Sheepshead	–	5,833	902,773	155,187	1,063,793	336,240	1,400,033
Sauger	–	–	–	–	–	252	252
Shiners	–	–	–	7,031	7,031	–	7,031
Smelt	–	472	80	6,168	6,720	25,103,200	25,109,920
Suckers	–	6,843	33,052	15,566	55,461	68,051	123,512
Sunfish	–	1	–	–	1	37,893	37,894
Walleye	–	56,117	–	24,388	80,505	1,778,116	1,858,621
White bass	2,770	7,057	1,524,441	14,495	1,548,763	1,972,594	3,521,357
White perch	–	–	186	–	186	–	186
Yellow perch	–	91,257	2,784,412	281,748	3,157,417	12,608,971	15,766,388
Unidentified	–	–	–	–	–	1,142,558	1,142,558
Total	604,686	169,394	7,595,550	519,593	8,889,223	43,310,004	52,199,227

[1]Crappie reported with rock bass.

Table 5. Lake Ontario commercial fish production in pounds for 1980.

Species	New York	Ontario	Grand Total
Bowfin	–	120	120
Bullheads	34,379	367,209	401,588
Burbot	36	–	36
Carp	7,766	–	7,766
Channel catfish	1,568	23,847	25,415
Crappie	1,662	_[1]	1,662
Eel	65,915	364,514	430,429
Garfish	4	–	4
Gizzard shad	14,128	420	14,548
Lake herring	60	11,709	11,769
Lake sturgeon	–	813	813
Lake trout	–	11	11
Lake whitefish	–	9,111	9,111
Northern pike	1,775	44,126	45,901
Rock bass	9,878	31,880	41,758
Round whitefish	–	57	57
Sauger	–	3	3
Sheepshead	583	56	639
Smelt	–	49,387	49,387
Suckers	7,582	10,844	18,426
Sunfish	5,930	160,738	166,668
Walleye	874	126,517	127,391
White bass	93	7,318	7,411
White perch	36,736	122,124	158,860
Yellow perch	20,982	589,918	610,900
Unidentified	–	60,110	60,110
Total	209,951	1,980,832	2,190,783

[1]Crappie reported with rock bass.

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 1980, about 35 million trout and salmon were planted.

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

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

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

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

Service, the Great Lakes states of Michigan, Wisconsin, Minnesota and New York, and the Province of Ontario. Lake trout eggs are largely obtained from brood fish in hatcheries, and, to a lesser extent mature lake trout from inland lakes and Lake Superior. Nearly all trout are reared to yearlings (ca. 30/pound) and planted during the spring and early summer. Some, however, are planted as fingerlings in fall. Despite certain advantages (relative to hatchery production) associated with stocking in the fall. the procedure has not been used extensively; studies have shown that lake trout planted in fall as fingerlings generally do not survive nearly as well as those stocked in spring as yearlings. The higher mortality of fall-stocked fish is commonly believed to be related to their smaller size at time of planting. The Ontario Ministry of Natural Resources plans to study relative survival rates of 1981–1987 yearclasses of fingerlings and yearlings in Lake Superior.

To rehabilitate fish stocks in Lake Huron, the Province of Ontario and the State of Michigan originally agreed to plant highly-selected splake. These fish were developed in Ontario through an intensive breeding program in which male brook trout were crossed with female lake trout to produce a fast growing fish similar to lake trout in behavior and appearance, and to the brook trout in fast growth and early maturity. Following several generations of selective breeding a splake was developed which grows rapidly, matures at an early age, and inhabits deep water. First plantings were made in 1969 in Ontario waters (mostly yearlings) and in 1970 in Michigan waters (mostly fingerlings). Because of a shortage of highly-selected splake brood fish and the need to expand rehabilitation efforts in U.S. waters of Lake Huron, splake milt also was used to fertilize lake trout eggs to produce backcrosses. It was believed these fish would retain the advantages of early maturity and fast growth. The first backcrosses were produced in the fall of 1971 and planted in Lake Huron as yearlings in the spring of 1973, and the program was to have continued. Because of fish disease problems in the U.S. brood stock of splake (chronicled in Annual Reports for 1975 and 1976, Appendix B), lake trout plants were initiated in U.S. waters of Lake Huron in 1973 and continued through 1979. The Province of Ontario continued to plant highly selected splake through 1980 but also made a small planting of lake trout. Survival of Ontario's splake has improved dramatically in recent years, following hatchery cleanup and an adjustment in genetic content in favour of lake trout.

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

Table 1 summarizes annual plantings of lake trout and hybrids in the Great Lakes, and Table 2 details the 1980 plants in each of the Great Lakes. Other small experimental plants of first generation splake and backcrosses have been made by Wisconsin and Michigan in Lake Superior (Table 3) with the objective of providing a nearshore fishery; these plants are not thought to contribute to offshore populations.

Coho salmon, usually stocked in the spring as yearlings, have been planted annually in Lakes Superior and Michigan since 1966, and in Lakes Huron, Erie, and Ontario since 1968. Table 4 summarizes annual planting in each of the Great Lakes, and Table 5 details the 1980 coho plantings.

Annual plantings of chinook salmon, usually stocked in the spring as fingerlings, have been made in Lakes Superior and Michigan since 1967, in Lake Huron since 1968, in Lake Erie since 1970, and in Lake Ontario since 1969. Table 6 summarizes annual plantings of chinook salmon in the Great Lakes and Table 7 details the 1980 plantings in each of the Great Lakes.

In 1972, Michigan and Wisconsin inaugurated plants of Atlantic salmon in the Upper Great Lakes. In 1972, Wisconsin planted 8,000 3-year-old and 12,000 2-year-old fish. After 1972, Michigan discontinued its plants in Lake Huron but continued them in Lake Michigan. Table 8 summarizes Atlantic salmon plantings in the Great Lakes 1972–1980.

Plantings of rainbow and steelhead trout, brown trout, and brook trout have been continued in the Great Lakes over the years, but were not included in these records prior to 1975 (1976 for brook trout) because of the variability in reporting and difficulty in separating "inland" plantings from "Great Lakes" plantings. Nevertheless, the need for stocking information on these species prompted inclusion of rainbow and steelhead trout, brown trout, and brook trout plantings in the Annual Report. Table 9 summarizes the annual plantings of rainbow and steelhead trout for 1975 through 1980, and Table 10 details the 1980 plantings. Table 11 summarizes annual plantings of brown trout for 1975 through 1980, and Table 12 details the 1980 plantings. Brook trout plantings were included for the first time in 1976 (Table 13). Table 14 details the 1980 plantings of brook trout.

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

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

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

Literature

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

Table 1. Annual plantings (in thousands) of lake trout, splake[1,2] and backcrosses[3] in the Great Lakes, 1958–1980.

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Ontario	Total
1958	298	184	–	505	987
1959	44	151	–	473	668
1960	393	211	–	446	1,050
1961	392	314	–	554	1,260
1962	775	493	77	508	1,853
1963	1,348	311	175	477	2,311
1964	1,196	743	220	472	2,631
1965	780	448	251	468	1,947
1966	2,218	352	259	450	3,279
1967	2,059	349	382	500	3,290
1968	2,260	239	377	500	3,376
1969	1,860	251	216	500	2,827
1970	1,944	204	226	500	2,874
1971	1,055	207	280	475	2,017
1972	1,063	259	293	491	2,106
1973	894	227	284	500	1,905
1974	888	436	304	465	2,093
1975	872	493	337	510	2,212
1976	789	814	345	1,062	3,010
1977	803	551	350	677	2,381
1978	855	622	355	630	2,461
1979	1,055	508	314	526	2,403
1980	778	522	351	759	2,409
Subtotal	24,619	8,889	5,396	12,448	51,350

LAKE MICHIGAN

Year	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
1979	1,217	943	162	176	2,497
1980	1,375	1,255	87	174	2,891
Subtotal	17,925	15,328	1,783	1,941	36,974

LAKE HURON

Year	Michigan			Ontario			Total
	Lake trout	Splake	Backcrosses	Lake trout	Splake	Backcrosses	
1969	–	–	–	–	35	–	35
1970	–	43	–	–	247	–	290
1971	–	74	–	–	468	–	542
1972	–	215	–	–	333	–	548
1973	629	–	486	–	412	–	1,527
1974	793	–	–	–	299	–	1,092
1975	1,053	–	–	–	523	–	1,576
1976	1,024	–	–	–	658	–	1,682
1977	1,033	–	250	15	879	61	2,238
1978	1,217	–	–	15	175	–	1,407
1979	1,338	–	–	15	798	–	2,151
1980	1,381	–	–	–	561	–	1,941
Subtotal	8,468	332	736	45	5,388	61	15,029

LAKE ERIE

Year	Pennsylvania	New York	Total
1969	17	–	17
1974	26	–	26
1975	34	150	184
1976	16	186	202
1977	–	125	125
1978	118	118	236
1979	355	355	709
1980	168	339	507
Subtotal	734	1,273	2,006

LAKE ONTARIO

Year	Ontario		New York	Total
	Splake	Lake trout	Lake trout	
1972	48	–	–	48
1973	39	–	66	105
1974	26	–	644	670
1975	–	–	514	514
1976	6	194	337	537
1977	–	288	298	586
1978	–	200	1,043	1,243
1979	–	201	686	887
1980	–	383	1,194	1,577
Subtotal	119	1,266	4,782	6,167

Great Lakes Total, lake trout, splake and backcrosses, 1958–1980 111,527

[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 in the Great Lakes, 1980.

Location	Grid No.	Numbers	Age	Fin Clip/Mark
LAKE SUPERIOR-LAKE TROUT				
Michigan waters				
Big Bay Harbor	1327	56,000[2,3]	Y	left pectoral
Black River Harbor	1413	28,300	Y	left pectoral
Copper Harbor	926	26,500	Y	left pectoral
Grand Marais Harbor	1438	28,000[2]	Y	left pectoral
Huron Island	1326	56,000[2,3]	Y	left pectoral
Kelsey Creek	1323	33,400	FF	right pectoral
L'Anse City Dock	1423	33,200	FF	right pectoral
Laughing Fish Point	1531	50,000[2,3]	Y	left pectoral
Loma Farms	1428	26,300	Y	left pectoral
Marquette (Lower Harbor)	1529	41,500[2,3]	Y	left pectoral
Munising City Dock	1634	26,400	Y	left pectoral
Ontonogan River	1318	30,000	Y	left pectoral
Partridge Island Reef	1529	56,000[2,3]	Y	left pectoral
Porcupine Mt State Park	1316	30,000	Y	left pectoral
Presque Isle Harbor	1529	26,200	Y	left pectoral
Rock Beach	1323	33,400	FF	right pectoral
Shelter Bay	1632	41,000[2]	Y	left pectoral
Tahquamenon Island	1544	100,000[3]	FF	right pectoral
Traverse Island	1224	56,000[2,3]	Y	left pectoral
Subtotal		778,200		
Minnesota waters				
Beaver Bay (Kings Landing)	1106	111,093	Y	left pectoral
Brighton Beach	1302	41,107	Y	left pectoral
Good Harbor Bay	812	61,500	Y	left pectoral
Hollow Rick	715	49,900	Y	right pectoral-left ventral
Two Harbors (Flood Bay)	1204	87,100	Y	left pectoral
Subtotal		350,700		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Ontario waters				
Caribou Island	320	70,476[3]	Y	left pectoral
Chummy Island	228	16,746[3]	Y	left pectoral
Jackson's Point	1546	50,000	Y	left pectoral
Lambert Island	320	8,500[3]	FF	right pectoral
Lapoints Point	1347	40,000	Y	left pectoral
Mamainse Point	1245	40,000	Y	left pectoral
Mary Island	320	16,800[3]	Y	left pectoral
Michipicoten Harbour	744	50,000	Y	left pectoral
Montreal River	1145	50,000	Y	left pectoral
Morn Harbour	228	12,480	Y	left pectoral
Palette Island	320	12,320[3]	Y	left pectoral
Pie Island	519	172,166[3]	FF	right pectoral
Rossport Dock	128	102,240	Y	left pectoral
Silver Harbour	320	36,960[3]	Y	left pectoral
Silver Islet	519	4,800[3]	3 yrs.	adipose
Silver Islet	519	10,000[3]	Y	left pectoral
Sinclair Cove	1045	25,000	Y	left pectoral
Small Island	320	6,160[3]	Y	left pectoral
Squaw Bay	518	25,334	FF	right pectoral
Swedes Gap	229	4,267	Y	left pectoral
Tracy Shoal	228	4,267	Y	left pectoral
Subtotal		758,516		
Wisconsin waters				
Devils Island Shoal	1209	180,000[2,3]	FF	adipose-right ventral
Superior Entry	1402	297,900	Y	left pectoral
Washburn Coal Dock	1509	43,620[2]	Y	left pectoral
Subtotal		521,520		
Total, Lake Superior		2,408,936		
LAKE MICHIGAN-LAKE TROUT				
Illinois waters				
Chicago	2603	87,000	Y	left pectoral
Indiana waters				
Burns Harbor	2706	87,000	Y	left pectoral
Joerse Park	2705	45,000	Y	left pectoral
Michigan City	2707	42,000	Y	left pectoral
Subtotal		174,000		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Michigan waters				
Acme	916	100,000	Y	left pecotral
Acme	916	41,300	FF	left pectoral-right ventral
Benton Harbor	2509	73,000	Y	left pectoral
Benton Harbor	2509	22,000[2]	Y	left pectoral
Big Reef	516	50,000[3]	Y	left pectoral
Charlevoix	616	101,100	Y	left pectoral
Charlevoix	517	23,000	FF	right pectoral
Fishermen's Island	616	25,000[3]	Y	left pectoral
Frankfort	1011	83,950	Y	left pectoral
Good Harbor Reef	814	33,000[3]	Y	both ventral
Grand Haven	1911	75,000	Y	left pectoral
Greilickville	915	100,000	Y	left pectoral
Greilickville	915	41,600	FF	left pectoral-right ventral
Holland	2111	75,000	Y	left pectoral
Holland	2111	20,000[2]	Y	left pectoral
Ille Aux Galets	417	50,000[3]	Y	left pectoral
Ludington	1410	50,000	Y	left pectoral
Manistee	1210	75,000	Y	left pectoral
Montague	1710	50,000	Y	left pectoral
Pentwater	1510	77,150	Y	left pectoral
Petoskey	518	59,900	Y	left pectoral
Petoskey	519	21,000	FF	right pectoral
South Fox Island	513	33,000[3]	Y	both ventral
South Haven	2311	75,000	Y	left pectoral
South Haven	2311	20,000[3]	Y	left pectoral
Subtotal		1,375,000		
Wisconsin waters				
Clay Banks	905	63,200[3]	Y	dorsal
Clay Banks	905	63,600[3]	Y	dorsal-left pectoral
Clay Banks	905	62,900[3]	Y	dorsal-right pectoral
Clay Banks	905	20,000[3]	Y	left pectoral
Clay Banks	905	42,000[3]	Y	left pectoral
Manitowoc	1303	96,700	Y	left pectoral
Milwaukee	1901	100,000[3]	Y	left pectoral
Northeast Reef	1803	91,000[3]	Y	both ventral
Northeast Reef	1803	100,000[3]	Y	left pectoral
Northeast Reef	1803	7,900[3,4]	Y	left pectoral
Kewaunee	1104	96,500	Y	left pectoral
Kewaunee	1104	141,800	FF	right pectoral
Port Washington	1701	44,000	Y	left pectoral
Racine	2102	80,000	Y	left pectoral
Sheboygan	1502	97,200	Y	left pectoral
Sturgeon Bay	905	148,500	Y	left pectoral
Subtotal		1,255,300		
Total, Lake Michigan		2,891,300		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
LAKE HURON-LAKE TROUT AND SPLAKE				
Michigan waters (lake trout)				
Adams Point	607	100,000	Y	right ventral
Black River Island	810	75,000[3]	Y	right ventral
Detour Ferry Dock	306	52,200	Y	right ventral
Greenbush	1110	90,000	Y	right ventral
Grindstone City	1412	100,000	Y	right ventral
Hammond Bay	505	102,400	Y	right ventral
Harbor Beach	1514	100,000	Y	right ventral
Middle Entrance Reef	303	104,000[3]	Y	right ventral
Oscoda	1210	100,000	Y	right ventral
Point Brule	303	102,100	Y	right ventral
Point Lookout	1408	90,000	Y	right ventral
Port Sanilac	1814	50,000	Y	right ventral
Rockport (Middle Island)	709	75,000[3]	Y	right ventral
Scarecrow Island	810	75,000[3]	Y	right ventral
Sturgeon Point	1110	90,000	Y	right ventral
Tawas	1309	75,000	Y	right ventral
Subtotal		1,380,700		
Ontario waters (splake)				
Boucher Point	1126	13,489	Y	right pectoral
Cape Dundas	923	52,930	Y	right pectoral
Heywood Island	319	70,000[3]	Y	right pectoral
Jackson Shoal	822	50,908	Y	right pectoral
Mary Ward Ledges	1128	10,000[3]	Y	right pectoral
Meaford Range	1025	123,544	Y	adipose, CWT right ventral
Nottawasaga Bay	1126	28,723	Y	right pectoral
Pyette Point	1025	69,157	Y	right pectoral
Vail Point	1025	81,037	Y	right pectoral
White Cloud-Grif. I	1024	60,727[3]	Y	right pectoral
Subtotal		560,515		
Total, Lake Huron		1,941,215		
LAKE ERIE-LAKE TROUT				
New York waters				
Barcelona	523	29,245	FF	right pectoral
Barcelona	523	126,940[3]	FF	right ventral
Barcelona	523	182,320	FF	right ventral
Subtotal		338,505		

Table 2. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip/Mark
Pennsylvania waters				
Barcelona	522	126,950[3]	FF	right ventral
Erie	521	41,173[3]	Y	adipose-CWT(60)41/11
Subtotal		168,123		
Total, Lake Erie		506,628		
LAKE ONTARIO-LAKE TROUT				
New York waters				
Dablon Point	322	84,710[3]	Y	adipose-CWT(60)41/06
Dablon Point	322	28,260[3]	Y	adipose-CWT(60)41/12
Dablon Point	322	23,511[3]	Y	adipose-CWT(60)41/13
Hamlin Beach State Park	713	82,770[3]	Y	adipose-CWT(60)41/10
Hamlin Beach State Park	713	30,405[3]	FF	adipose-CWT(60)41/36
Hamlin Beach State Park	713	95,741[3]	Y	adipose-left ventral
Niagara	806	30,260[3]	FF	adipose-CWT(60)41/35
Niagara Point	806	82,164[3]	Y	adipose-CWT(60)41/09
Niagara Point	806	95,988[3]	Y	adipose-left ventral
Selkirk	623	30,260[3]	FF	adipose-CWT(60)41/38
Selkirk Shores State Park	623	83,984[3]	Y	adipose-CWT(60)41/07
Selkirk Shores State Park	623	95,646[3]	Y	adipose-left ventral
Sodus	818	30,300[3]	FF	adipose-CWT(60)41/08
Sodus Point	818	82,743[3]	Y	adipose-CWT(60)41/08
Sodus Point	818	96,558[3]	Y	adipose-left ventral
Stoney Point	422	60,480[3]	FF	adipose-CWT(60)41/34
Stoney Point	422	159,986[3]	Y	adipose-left ventral
Subtotal		1,193,766		
Ontario waters				
Bronte Creek	702	25,016	Y	adipose-right ventral
Clarkson	603	69,500	Y	adipose-right ventral
Main Duck Islands	421	198,580[3]	Y	adipose-right ventral
Port Hope	411	65,000	Y	right ventral
Port Weller	805	25,000	Y	right ventral
Subtotal		383,096		
Total, Lake Ontario		1,576,862		
Great Lakes Total		9,324,941		

[1]Lake trout × brook trout hybrid.
[2]State plants—all other U.S. plants by U.S. Fish and Wildlife Service.
[3]Offshore plants.
[4]Fish allotted to Illinois DOC, but planted in Wisconsin waters.

Table 3. Plantings of F_1 splake in Lake Superior, 1971 and 1973 to 1980. The 1977 plant was of backcrosses.

Year	State	Location	Grid No.	Numbers	Age	Fin clip
1971	Michigan	Copper Harbor	926	13,199	Y	none
1973	Wisconsin	Bayfield Area	1409	5,000	F	dorsal-left ventral
1974	Wisconsin	Washburn	1509	10,316	Y	dorsal
		Houghton Point	1509	9,782	Y	dorsal
1975	Wisconsin	Pikes Bay	1409	15,000	Y	dorsal-right ventral
1976	Wisconsin	Pikes Bay	1409	18,360	Y	dorsal-right ventral
1977	Michigan	Copper Harbor	926	26,100	F	left pectoral-right ventral
1978	Wisconsin	Chequamegon Bay	1509	55,200	F	none
		Cornucopia	1307	26,400	F	none
1979	Wisconsin	Bark Point	1306	12,000	F	none
		Bark Point	1306	6,000	Y	none
		Bayfield	1409	10,800	Y	none
		Cornucopia	1307	12,000	F	none
		Houghton Pt.	1509	12,000	F	none
		Houghton Pt.	1509	16,200	Y	none
		Madeline Island	1409	12,000	F	none
		Onion River	1409	36,000	F	none
		Onion River	1409	22,700	Y	none
		Port Superior	1409	2,675	Y	none
		Washburn	1509	24,000	F	none
		Washburn Coal Dock	1509	16,000	Y	none
1980	Wisconsin	Ashland Coal Dock	1509	21,150	Y	none
		Bark Point	1306	12,700	F	none
		Bodins-Houghton Point	1509	25,400	FF	none
		Cornucopia Harbor	1307	10,650	Y	none
		Cornucopia Harbor	1307	12,700	F	none
		Onion River Mouth	1409	10,650	Y	none
		Onion River Mouth	1409	25,400	F	none
		Superior Entry	1401	8,400	F	none
		Washburn Coal Dock	1509	20,360	Y	none
		Washburn Coal Dock	1509	25,400	F	none
Total, Lake Superior				535,542		

Table 4. Annual plantings (in thousands) of coho salmon in the Great Lakes, 1966–1980.

	LAKE SUPERIOR			
Year	Michigan	Minnesota	Ontario	Total
1966	192	–	–	192
1967	467	–	–	467
1968	382	–	–	382
1969	526	110	20	656
1970	507	111	31	649
1971	402	188	27	617
1972	152	145	–	297
1973	100	35	–	135
1974	455	74	–	529
1975	275	–	–	275
1976	400	–	–	400
1977	627	–	–	627
1978	140	–	–	140
1979	200	–	–	200
1980	350	–	–	350
Subtotal	5,175	663	78	5,916

	LAKE MICHIGAN				
Year	Michigan	Wisconsin	Indiana	Illinois	Total
1966	660	–	–	–	660
1967	1,732	–	–	–	1,732
1968	1,176	25	–	–	1,201
1969	3,054	217	–	9	3,280
1970	3,155	340	48	–	3,543
1971	2,411	267	68	5	2,751
1972	2,269	258	96	–	2,623
1973	2,003	257	–	5	2,265
1974	2,788	318	125	–	3,231
1975	2,026	433	46	–	2,505
1976	2,270	648	179	80	3,177
1977	2,314	491	179	103	3,087
1978	1,802	499	105	279	2,685
1979	3,317	320	118	289	4,044
1980	2,243	492	169	39	2,943
Subtotal	33,220	4,565	1,333	809	39,727

	LAKE HURON	
Year	Michigan	Total
1968	402	402
1969	667	667
1970	571	571
1971	975	975
1972	249	249
1973	100	100
1974	500	500
1975	627	627
1976	690	690
1977	416	416
1978	84	84
1979	1,082	1,082
1980	375	375
Subtotal	6,738	6,738

	LAKE ERIE				
Year	Michigan	Ohio	Pennsylvania	New York	Total
1968	–	20	86	5	111
1969	–	92	134	10	236
1970	–	253	197	74	525
1971	–	122	152	95	369
1972	–	38	131	50	219
1973	–	96	315	–	411
1974	200	188	366	29	783
1975	101	231	363	125	819
1976	199	568	248	477	1,491
1977	645	282	636	269	1,832
1978	296	240	961	134	1,631
1979	303	110	108	100	621
1980	498	500	543	81	1,621
Subtotal	2,242	2,740	4,240	1,449	10,669

	LAKE ONTARIO		
Year	Ontario	New York	Total
1968	–	40	40
1969	130	109	239
1970	145	294	439
1971	160	122	282
1972	122	230	352
1973	272	240	512
1974	438	217	655
1975	226	812	1,038
1976	166	178	343
1977	313	39	352
1978	201	80	281
1979	286	344	630
1980	77	299	377
Subtotal	2,536	3,004	5,540

Great Lakes Total, coho salmon, 1966–1980 68,590

Table 5. Plantings of coho salmon in the Great Lakes, 1980.

Location	Grid No.	Numbers	Age	Fin clip
		LAKE SUPERIOR-COHO SALMON		
Michigan waters				
Black River	1414	74,998	Y	none
Dead River	1529	150,028	Y	none
Huron River	1323	75,020	Y	none
Sucker River	1439	50,227	Y	none
Subtotal		350,273		
Total, Lake Superior		350,273		
		LAKE MICHIGAN-COHO SALMON		
Illinois waters				
Chicago (Diversey Harbor)	2603	15,000	Y	none
Kellogg Creek	2302	24,000	Y	adipose
Subtotal		39,000		
Indiana waters				
Little Calument River (East Branch)	2705	53,711	FF	none
Michigan City	2707	50,441	F	none
Trail Creek	2707	65,334	FF	none
Subtotal		169,486		
Michigan waters				
Big Sable River	1410	99,480	Y	none
Brewery Creek	915	50,000	Y	none
Grand River	1911	399,981	Y	none
Little Manistee River	1211	400,158	Y	none
Platte River	912	1,001,723	Y	none
Platte River	1011	26,315	Y	none
Portage Lake	1111	165,290	Y	none
Thompson Creek	211	100,061	Y	none
Subtotal		2,243,008		
Wisconsin waters				
Algoma	1004	75,000	Y	none
Kenosha	2202	75,400	Y	none
Milwaukee	1901	103,069	Y	none
Port Washington	1701	50,000	Y	none
Racine	2102	79,600	Y	none
Sheboygan	1502	108,807	Y	none
Subtotal		491,876		
Total, Lake Michigan		2,943,370		

Table 5. (Con't.)

Location	Grid No.	Numbers	Age	Fin clip
		LAKE HURON-COHO SALMON		
Michigan waters				
Carp River	202	75,130	Y	none
Elk Creek	1714	49,477	Y	none
Huron County	1510	100,000	Y	none
Sanilac County	1814	50,523	Y	none
Tawas River	1308	100,000	Y	none
Subtotal		375,130		
Total, Lake Huron		375,130		
		LAKE ERIE-COHO SALMON		
Michigan waters				
Detroit River	603	298,000	Y	none
Huron River	702	200,000	Y	none
Subtotal		498,000		
New York waters				
Cattaraugus Creek	327	80,600	FF	none
Ohio waters				
Chagrin River	814	237,099	Y	none
Huron River	1006	212,695	Y	none
Rocky River	911	50,000	FF	none
Subtotal		499,794		
Pennsylvania waters				
Elk Creek	619	52,700	Y	none
Godfrey Run	619	76,320	Y	none
Orchard Beach Run	523	7,500	Y	left ventral
Orchard Beach Run	523	7,500	Y	left ventral
Presque Isle Bay	521	138,000	Y	none
Sixteen Mile Creek	523	60,700	Y	none
Trout Run	620	100,000	Y	none
Walnut Creek	620	100,000	Y	none
Subtotal		542,720		
Total, Lake Erie		1,621,114		

Table 5. (Con't.)

Location	Grid No.	Numbers	Age	Fin clip
		LAKE ONTARIO-COHO SALMON		
New York waters				
Eighteen Mile Creek	708	40,000	FF	none
Oak Orchard Creek	711	40,000	FF	none
Salmon River	623	149,200	FF	none
Sandy Creek	713	44,900	FF	none
South Sandy Creek	623	24,900	FF	none
Subtotal		299,000		
Ontario waters				
Bronte Creek	702	18,400	Y	none
Credit River	603	41,256	Y	none
Lowville	702	17,200	Y	none
Subtotal		76,856		
Total, Lake Ontario		375,856		
Great Lakes Total		5,665,743		

Table 6. Annual plantings (in thousands) of chinook salmon in the Great Lakes, 1967–1980.

		LAKE SUPERIOR		
Year	Michigan	Wisconsin	Minnesota	Total
1967	33	–	–	33
1968	50	–	–	50
1969	50	–	–	50
1970	150	–	–	150
1971	252	–	–	252
1972	472	–	–	472
1973	509	–	–	509
1974	295	–	228	523
1975	253	–	–	253
1976	201	–	291	493
1977	116	35	103	254
1978	150	–	278	478
1979	100	60	341	501
1980	276	60	393	729
Subtotal	2,907	155	1,634	4,747

		LAKE MICHIGAN			
Year	Michigan	Wisconsin	Indiana	Illinois	Total
1967	802	–	–	–	802
1968	687	–	–	–	687
1969	652	66	–	–	718
1970	1,675	119	100	10	1,904
1971	1,865	264	180	8	2,317
1972	1,691	317	107	24	2,139
1973	2,115	697	–	174	2,986
1974	2,046	616	159	757	3,578
1975	2,816	927	156	381	4,280
1976	1,947	1,276	38	142	3,403
1977	1,576	913	141	347	2,977
1978	2,524	2,017	213	611	5,365
1979	2,307	1,964	531	183	4,984
1980	2,903	2,430	621	152	6,106
Subtotal	25,606	11,606	2,246	2,789	42,246

LAKE HURON

Year	Michigan	Total
1968	274	274
1969	250	250
1970	643	643
1971	894	894
1972	515	515
1973	967	967
1974	776	776
1975	655	655
1976	831	831
1977	733	733
1978	1,418	1,418
1979	1,325	1,325
1980	1,878	1,878
Subtotal	11,159	11,159

LAKE ERIE

Year	Michigan	Ohio	Pennsylvania	New York	Total
1970	–	150	–	–	150
1971	–	180	129	–	309
1972	–	–	150	–	150
1973	305	–	155	125	585
1974	502	–	189	125	816
1975	401	–	483	85	969
1976	300	246	769	65	1,381
1977	302	428	979	362	2,072
1978	–	364	668	206	1,238
1979	–	210	708	–	917
1980	–	350	544	–	894
Subtotal	1,810	1,928	4,774	968	9,481

LAKE ONTARIO

Year	Ontario	New York	Total
1969	–	70	70
1970	–	141	141
1971	89	149	238
1972	190	427	617
1973	–	696	696
1974	225	963	1,188
1975	–	920	920
1976	–	593	593
1977	–	–	–
1978	393	–	393
1979	147	222	369
1980	118	788	906
Subtotal	1,162	4,969	6,131

Great Lakes Total, chinook salmon, 1967–1980 73,764

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

Location	Grid No.	Numbers	Age	Fin Clip/Mark
LAKE SUPERIOR-CHINOOK SALMON				
Michigan waters				
Big Iron River	1316	75,000	F	none
Black River	1413	75,000	F	none
Dead River	1529	100,000	F	none
St. Marys River	1647	26,150	F	none
Subtotal		276,150		
Minnesota waters				
Beaver River	1106	73,010	SF	tetracycline
Beaver River	1106	8,085	SF	none
Cascade River	811	54,390	SF	tetracycline
Cascade River	811	5,635	SF	adipose
French River	1302	38,955	SF	tetracycline
French River	1302	7,840	SF	adipose
Grand Portage Creek	715	75,433	SF	right ventral
Lester River	1302	47,530	SF	tetracycline
Rosebush Creek	812	18,130	SF	tetracycline
Rosebush Creek	812	2,450	SF	adipose
Silver Creek	1204	36,750	SF	tetracycline
Temperance River	908	24,304	SF	none
Subtotal		392,522		
Wisconsin waters				
Black River	1401	60,000	SF	none
Total, Lake Superior		728,672		
LAKE MICHIGAN-CHINOOK SALMON				
Illinois waters				
Chicago (Calumet Harbor)	2703	8,094	SF	none
Chicago (Diversey Harbor)	2603	82,512	SF	none
Kellogg Creek	2203	21,500	SF	adipose-right pectoral
Waukegan (Midland Paint Pier)	2203	40,075	SF	none
Subtotal		152,181		
Indiana waters				
Bethlehem Steel Pier	2706	175,332	SF	left ventral
Bethlehem Steel Pier	2706	11,491	SF	none
East Chicago (Inland Steel)	2705	172,727	SF	none
Michigan City	2707	221,194	SF	adipose
Trail Creek	2707	40,607	SF	none
Subtotal		621,351		

Table 7. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters				
Big Manistee River	1211	300,260	SF	none
Big Sable River	1410	300,150	SF	none
Black River	2311	50,196	SF	none
Brewery Creek	915	100,156	SF	none
Escanaba River	306	50,000	SF	none
Grand River	1911	601,011	SF	none
Kalamazoo River	2211	200,200	SF	none
Little Manistee River	1211	550,272	SF	none
Manistique River	211	50,000	SF	none
Muskegon River	1810	300,000	SF	none
Portage Lake	1111	100,164	SF	none
St. Joseph River	2509	300,483	SF	none
Subtotal		2,902,892		
Wisconsin waters				
Algoma	1004	100,000	SF	none
East Twin River	1303	50,000	SF	none
Gills Rock	606	114,200	SF	none
Harrington Beach	1702	40,000	SF	right ventral
Kenosha	2202	125,000	SF	none
Kewaunee River	1104	199,800	SF	none
Little Manitowoc River	1303	98,000	SF	none
Little River	703	120,000	SF	none
Manitou Park	1303	50,000	SF	none
Menominee River	703	200,000	SF	none
Menominee River (Stevenson Island)	703	100,000	SF	none
Milwaukee	1901	265,000	SF	none
Oak Creek	2002	125,000	SF	none
Oconto Park Lagoon	802	100,000	SF	none
Port Washington	1701	40,000	SF	right pectoral
Sheboygan	1502	150,000	SF	none
Strawberry Creek	905	249,500	SF	none
West Twin River	1303	50,000	SF	none
Wind Point	2102	253,000	SF	none
Subtotal		2,429,500		
Total, Lake Michigan		6,105,924		

Table 7. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
LAKE HURON-CHINOOK SALMON				
Michigan waters				
Au Gres River	1408	100,400	SF	none
Au Sable River	1210	600,105	SF	none
Carp River	202	100,000	SF	none
Cass River	1606	125,252	SF	none
East Moran Bay	301	100,000	SF	none
Flint River	1606	125,280	SF	none
Harbor Beach	1514	250,120	SF	none
Harrisville	1110	300,182	SF	none
Nagels Creek	606	50,000	SF	none
Port Sanilac	1814	100,156	SF	none
St. Marys River	104	26,150	SF	none
Subtotal		1,877,645		
Total, Lake Huron		1,877,645		
LAKE ERIE-CHINOOK SALMON				
Ohio waters				
Chagrin River	1006	140,300	FF	none
Huron River	814	209,300	FF	none
Subtotal		349,600		
Pennsylvania waters				
Elk Creek	619	100,500	SF	none
Elk Creek	619	55,000	FF	right ventral
Elk Creek	619	76,372	Y	right pectoral
Godfrey Run	619	40,000	SF	none
Orchard Beach Run	523	30,000	SF	none
Trout Run	620	30,000	SF	none
Walnut Creek	620	100,000	SF	none
Walnut Creek	620	40,250	SF	right ventral
Walnut Creek	620	72,000	Y	right pectoral
Subtotal		544,122		
Total, Lake Erie		893,722		

Table 7. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
LAKE ONTARIO-CHINOOK SALMON				
New York waters				
Beaverdam Brook	623	195,600	SF	none
Black River	623	86,000	SF	none
Eighteen Mile Creek	708	94,000	SF	none
Genesee River	815	69,000	SF	none
Oak Orchard Creek	711	119,220	SF	none
Salmon River	623	153,250	SF	none
Sandy Pond (North)	623	31,000	SF	none
Sandy Pond (South)	623	40,000	SF	none
Subtotal		788,070		
Ontario waters				
Bronte Creek	702	117,603	F	none
Total, Lake Ontario		905,673		
Great Lakes Total		10,511,636		

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

Year	State	Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR						
1972	Wisconsin	Bayfield	1409	20,000	Y	adipose-left ventral
1973	Wisconsin	Bayfield	1409	20,000	Y	right ventral
1976	Michigan	Cherry Creek	1529	9,106[4]	Y	none
1978	Wisconsin	Pikes Creek	1409	36,772	Y	none
1980	Minnesota	French River	1302	7,584[1]	Y	left ventral
Total				93,462		
LAKE MICHIGAN						
1972	Michigan	Boyne River	616	10,000[4]	Y	none
1973	Michigan	Boyne River	616	15,000[4]	Y	none
1974	Michigan	Platte River	912	7,308[4]	Y	adipose
		Boyne River	616	14,555[4]	Y	none
1975	Michigan	Boyne River	616	18,742[4]	Y	none
				3,430[3]	A	right ventral
1976	Michigan	Boyne River	616	20,438[4]	Y	none
				162[4]	A	left ventral
1977	Michigan	Pere Marquette River	1410	7,131[2]	Y	left ventral
		Little Manistee River	1211	4,500[2]	Y	left ventral
		Pere Marquette River	1410	3,961[4]	Y	right ventral
		Little Manistee River	1211	2,997[4]	Y	right ventral
1978	Michigan	Little Manistee River	1211	5,000[2]	Y	left pectoral
		Pere Marquette River	1410	14,800[3]	Y	left pectoral
		Little Manistee River	1211	10,000[4]	Y	right pectoral
		Pere Marquette River	1410	16,322[4]	Y	right pectoral
Total				154,426		
LAKE HURON						
1972	Michigan	Au Sable River	1210	9,000[4]	Y	none
Great Lakes Total, Atlantic salmon, 1972–1980				256,888		

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

Table 9. Annual plantings (in thousands) of rainbow, steelhead, and palomino[1] trout in the Great Lakes, 1975–1980.[2]

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Total
1975	25	61	228	314
1976	36	400	9	445
1977	31	73	211	315
1978	20	116	88	225
1979	–	156	228	384
1980	66	119	471	656
Subtotal	178	925	1,235	2,339

LAKE MICHIGAN

Year	Michigan	Wisconsin	Indiana	Illinois	Total
1975	701	397	217	253	1,568
1976	601	964	217	45	1,827
1977	305	683	48	276	1,312
1978	1,151	613	130	40	1,933
1979	981	1,218	182	215	2,589
1980	1,311	1,137	70	113	2,630
Subtotal	5,050	5,005	864	942	11,859

LAKE HURON

Year	Michigan	Ontario	Total
1975	425	62	487
1976	333	33	366
1977	168	119	287
1978	389	85	473
1979	200	47	247
1980	345	320	665
Subtotal	1,860	666	2,525

LAKE ERIE

Year	Michigan	Ontario	New York	Ohio	Pennsylvania	Total
1975	10	223	–	277	19	529
1976	60	250	25	196	113	644
1977	10	287	13	247	181	737
1978	30	51	19	140	117	357
1979	–	366	29	290	249	933
1980	50	433	72	202	531	1.287
Subtotal	160	1,610	158	1,352	1,210	4,487

Table 9. (Cont'd.)

LAKE ONTARIO

Year	New York	Ontario	Total
1975	252	29	282
1976	186	108	295
1977	144	110	254
1978	313	121	434
1979	325	111	436
1980	759	734	1,493
Subtotal	1,979	1,213	3,194

Great Lakes Total, rainbow, steelhead, and palomino trout, 1975–1980 24,404

[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, 1980.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-RAINBOW AND STEELHEAD TROUT				
Michigan waters (rainbow trout)				
Marquette (Lower Harbor)	1529	5,800	Y	none
Big Two Hearted River	1441	10,000	Y	adipose-left ventral
Black River	1413	10,000	Y	none
Chocolay River	1530	10,000	Y	none
Munising Bay	1633	10,000	Y	none
Ravine River	1424	10,000	Y	adipose-left ventral
Soo Rapids	1647	10,000	Y	none
Subtotal		65,800		
Minnesota waters (rainbow trout)				
Baptism River, E. Br.	1106	14,762	Y	none
Baptism River, W. Br.	1106	139,561	F	none
Devil Track River	812	20,143	F	none
Flute Reed River	814	29,324	F	none
French River	1302	23,553	Y	none
Subtotal		227,343		
Minnesota waters (steelhead trout)				
Brule River	813	25,308	F	none
Cascade River	811	25,308	F	none
Deer Yard Creek	811	10,545	F	none
Devil Track River	812	11,951	F	none
French River	1302	7,953	F	none
Stewart River	1204	86,203	F	none
Sucker	1302	51,240	F	none
Temperance River	909	25,308	F	none
Subtotal		243,816		
Wisconsin waters (rainbow trout)				
Amnicon River	1402	30,000	Y	none
Black River	1401	30,000	Y	none
Little Brule River	1404	34,290	Y	none
Washburn	1509	24,680	Y	none
Subtotal		118,970		
Total, Lake Superior		655,929		
LAKE MICHIGAN-RAINBOW AND STEELHEAD TROUT				
Illinois waters (rainbow trout)				
Chicago (Diversey Harbor)	2603	10,030	FF	none
Chicago (Jackson Harbor)	2703	26,000	FF	none
Chicago (Navy Pier)	2703	25,000	FF	none
Highland Park	2502	30,000	SF	none
Waukegan (Midland Paint Pier)	2302	21,850	Y	none
Subtotal		112,880		

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Indiana waters (steelhead trout)				
Little Calumet River (East Branch)	2705	38,941	FF	adipose
Trail Creek	2707	30,862	FF	adipose
Subtotal		69,803		
Michigan waters (rainbow trout)				
Green Bay	504	4,557	Y	none
Harbor Springs	519	10,050	FF	none
Little Bay de Noc	206	5,800	Y	none
Subtotal		20,407		
Michigan waters (steelhead trout)				
Bear River	519	20,000	FF	none
Betsie River	1011	20,000	Y	none
Big Manistee River	1211	50,107	Y	none
Boardman River	915	19,989	Y	none
Boyne River	616	10,000	Y	none
Carp River	320	10,000	Y	none
Cedar River	504	10,000	Y	none
Crockery Creek	1911	50,000	FF	none
Crockery Creek	1911	5,000	Y	none
Elk River	816	20,000	Y	none
Fish Creek	1911	50,000	FF	none
Fish Creek	1911	5,000	Y	adipose-right pectoral
Flat River	1911	50,000	FF	none
Flat River	1911	5,000	Y	adipose-right pectoral
Grand River	1911	150,000	FF	none
Grand River	1911	15,000	Y	adipose-right pectoral
Lake Michigan	2211	20,000	Y	none
Little Bay de Noc	206	10,000	Y	none
Little Traverse Bay	519	10,000	Y	none
Looking Glass River	1911	100,000	FF	none
Looking Glass River	1911	10,000	Y	adipose-right pectoral
Manistique River	211	10,000	Y	none
Menominee River	703	10,000	Y	none
Muskegon River	1810	50,000	Y	none
Pentwater River	1510	10,000	Y	none
Rogue River	1911	150,000	FF	none
Rogue River	1911	15,000	Y	adipose-right pectoral
Ruby Creek	1410	5,000	Y	none
St. Joseph River	2509	300,000	FF	none
St. Joseph River	2509	30,000	Y	adipose-right pectoral
W. Grand Traverse Bay	815	40,000	FF	none
White River	1710	30,081	Y	none
Subtotal		1,290,177		

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Wisconsin waters (rainbow trout)				
Algoma	1004	45,000	Y	none
Baileys Harbor	706	27,577	Y	none
Cleveland	1402	17,540	FF	none
Egg Harbor	705	10,000	Y	none
Fish Creek	605	10,000	Y	none
Gills Rock	606	17,577	Y	none
Kenosha	2202	27,300	FF	none
Kenosha	2202	44,000	Y	none
Kewaunee	1104	48,232	FF	none
Kewaunee	1104	17,564	Y	none
Manitowoc	1303	22,400	FF	none
Manitowoc	1303	85,558	Y	none
Marinette	703	25,577	Y	none
Milwaukee	1901	72,575	FF	none
Milwaukee	1901	60,400	Y	none
Oconto Park	802	20,000	FF	none
Oconto Park	802	37,197	Y	none
Peshtigo Surf Club	803	5,000	FF	none
Port Washington	1701	29,200	FF	none
Port Washington	1701	41,000	Y	none
Racine	2102	27,706	SF	none
Racine	2102	46,700	FF	none
Racine	2102	65,100	Y	none
Sheboygan	1502	73,300	FF	none
Sheboygan	1502	52,500	Y	none
Sturgeon Bay	905	21,800	FF	none
Sturgeon Bay Office	804	33,825	Y	none
Two Rivers	1303	16,350	FF	none
Two Rivers	1303	42,860	Y	none
Westers	805	36,500	FF	none
Westers	805	20,000	Y	none
Whitefish Bay	805	36,500	FF	none
Subtotal		1,136,838		
Total, Lake Michigan		2,630,105		

LAKE HURON-RAINBOW AND STEELHEAD TROUT

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters (rainbow trout)				
Brulee Point	401	5,800	Y	none
Grindstone City	1412	10,000	Y	none
Port Hope	1513	10,000	Y	none
Port Sanilac	1814	10,000	Y	none
Subtotal		35,800		
Michigan waters (steelhead trout)				
Au Gres River	1408	15,000	Y	none
Au Sable River	1210	50,000	Y	none
Bird Creek	1411	5,000	Y	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Carp River	202	10,000	Y	none
Cheboygan River	403	10,000	Y	none
Chippewa River	1606	10,000	Y	none
Ocqueoc River	403	10,000	Y	none
Pigeon River	1510	20,000	Y	none
Pinnebog River	1411	15,000	Y	none
Rifle River	1408	102,000	FF	none
Thunder Bay	809	20,002	Y	none
Subtotal		267,002		
Ontario waters				
Belgrave Creek	1619	80,000	SF	none
Blyth Creek	1619	45,000	SF	none
Duffus Creek	2017	10,000	SF	none
Hopkins Creek	1619	35,000	SF	none
Mary Ward Ledges	1128	9,900		none
Naftels Creek	1719	30,000	SF	none
Port Alberts	1519	18,500	Y	adipose-right ventral
Sarnia	2015	14,211	Y	none
Sarnia	2015	32,500	Y	right ventral
Saugeen River	1221	15,000	Y	right ventral
Tricks Creek	1719	30,000	SF	none
Subtotal		320,111		
Total, Lake Huron		622,913		

LAKE ERIE-RAINBOW AND STEELHEAD, AND PALOMINO TROUT

Location	Grid No.	Numbers	Age	Fin Clip
Michigan waters (steelhead trout)				
Huron River	603	50,000	Y	none
New York waters				
Athol Springs	228	9,500	FF	right pectoral
Athol Springs	228	21,300	Y	none
Barcelona	424	9,500	FF	right ventral
Cattaragus Creek	327	10,000	FF	adipose
Cattaragus Creek	327	21,450	Y	none
Subtotal		71,750		
Ohio waters (rainbow trout)				
Arcola Creek	717	8,000	F	none
Beaver Creek	1007	5,000	F	none
Chagrin River	814	92,142	F	none
Conneaut Creek	718	52,480	FF	none
Grand River	814	10,000	F	none
Rocky River	911	20,000	F	none
Wheeler Creek	717	8,000	F	none
Subtotal		195,622		

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Ohio waters (steelhead trout)				
Conneaut Creek	718	6,214	Y	none
Ontario waters (rainbow trout)				
Big Creek	321	55,000	SF	none
Big Creek	321	3,000	Y	right ventral
Big Otter Creek	321	50,000	SF	none
Cranberry Creek	321	14,000	F	none
Deerlick Creek	321	22,000	F	none
Little Otter Creek	316	60,000	F	none
Lyndock Creek	321	10,600	F	none
Lynn River	220	10,000	SF	none
North Creek	321	12,000	F	none
Pirrie Creek	316	30,000	F	none
Pumpkinseed Creek	321	6,000	F	none
South Creek	321	25,400	F	none
South Otter Creek	317	20,000	F	none
Stony Creek	321	22,000	F	none
Young Creek	220	86,500	SF	none
Young Creek	220	6,000	Y	right ventral
Subtotal		432,500		
Pennsylvania waters (palomino trout)				
Crooked Creek	619	150	Y	none
Crooked Creek	619	10	2 yrs.	none
Elk Creek	619	1,200	Y	none
Elk Creek	619	15	3 yrs.	none
Trout Run	620	2,000	Y	none
Subtotal		3,375		
Pennsylvania water (rainbow trout)				
Conneaut Creek (Temple Run)	718	4,061	Y	none
Conneaut Creek (Temple Run)	718	652	2 yrs.	none
Crooked Creek	619	2,050	2 yrs.	none
Elk Creek	619	10,885	2 yrs.	none
Elk Creek (Little Elk Creek)	619	250	Y	none
Godfrey Run	619	15,000	F	none
Raccoon Creek (Baldwin Pond)	619	400	Y	none
Raccoon Creek (Baldwin Pond)	619	50	2 yrs.	none
Sixteen Mile Creek	523	15,000	F	none
Trout Run	620	30,000	F	none

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Twelve Mile Creek (Anderson Run)	522	200	2 yrs.	none
Twelve Mile Creek	522	400	2 yrs.	none
Twentymile Creek	523	5,100	2 yrs.	none
Walnut Creek	620	200	2 yrs.	none
Subtotal		84,248		
Pennsylvania waters (steelhead trout)				
Elk Creek	619	50,000	Y	none
Godfrey Run	619	142,000	Y	none
Orchard Beach Run	523	50,000	Y	none
Trout Run	620	156,000	Y	none
Trout Run	620	8,000	Y	left ventral
Walnut Creek	620	32,000	Y	none
Walnut Creek (Bear Creek)	620	5,000	Y	none
Subtotal		443,000		
Total, Lake Erie		1,286,709		

LAKE ONTARIO-RAINBOW AND STEELHEAD TROUT

Location	Grid No.	Numbers	Age	Fin Clip
New York waters (rainbow trout)				
Braddock's Bay	815	7,070	Y	none
Genesee River	815	83,000	SF	none
Grindstone Creek	623	21,000	FF	none
Hamlin Beach	713	15,890	SF	none
Kendall	712	148,333	SF	none
Olcott Hrbor	708	10,700	Y	none
Oswego	721	74,500	SF	none
Selkirk Shores State Park	623	30,890	Y	none
Sodus Point Pier	819	68,745	FF	none
Sodus Point Pier	819	25,770	Y	none
Wilson Harbor	707	10,700	Y	none
Subtotal		496,598		
New York waters (steelhead trout)				
Beaverdam Brook		15,000	Y	left ventral
Four Mile Creek		7,500	Y	left ventral
Irondequoit Creek		13,500	Y	none
Keg Creek		5,000	Y	left ventral
Orwell Brook		26,000	Y	left ventral
Oswego		63,800	Y	none
Rochester		83,000	Y	none
Salmon Creek		5,000	Y	left ventral
Sandy Creek		7,000	Y	left ventral
Trout Brook		32,000	Y	left ventral
Twelve Mile Creek		5,000	Y	left ventral
Subtotal		262,800		

Table 10. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Ontario waters (rainbow trout)				
Carlisle	702	5,000	Y	right ventral
Credit River	603	330,000	F	none
Credit River	603	43,017	Y	adipose-right pectoral
Credit River	603	79,729	Y	right ventral
Duffin Creek	507	10,000	Y	right ventral
Duffin Creek	507	50,000	F	none
Port Credit	603	216,000	Y	right ventral
Subtotal		733,746		
Total, Lake Ontario		1,493,144		
Great Lakes Total		6,688,800		

Table 11. Annual plantings (in thousands) of brown and tiger[1] trout in the Great Lakes, 1975–1980.

LAKE SUPERIOR

Year	Michigan	Wisconsin	Minnesota	Total
1975	35	103	108	246
1976	35	43	10	88
1977	40	62	31	133
1978	–	94	9	103
1979	15	110	6	131
1980	–	85	5	90
Subtotal	125	497	169	791

LAKE MICHIGAN

Year	Michigan	Wisconsin	Illinois	Indiana	Total
1975	279	356	10	20	665
1976	666	292	94	199	1,251
1977	226	802	42	109	1,180
1978	150	1,208	13	131	1,503
1979	199	960	1	69	1,228
1980	105	1,046	24	116	1,292
Subtotal	1,625	4,664	184	644	7,119

LAKE HURON

Year	Michigan	Total
1975	155	155
1976	447	447
1977	210	210
1978	258	258
1979	90	90
1980	90	90
Subtotal	1,250	1,250

LAKE ERIE

Year	Ohio	Pennsylvania	New York	Total
1975	–	7	26	33
1976	–	11	67	78
1977	–	49	125	174
1978	28	34	–	62
1979	–	51	26	77
1980	32	46	50	128
Subtotal	60	198	294	552

Table 11. (Cont'd.)

Year	LAKE ONTARIO New York	Total
1975	371	371
1976	311	311
1977	353	353
1978	94	94
1979	219	219
1980	–	–
Subtotal	1,348	1,348

Great Lakes Total, brown and tiger trout, 1975–1980 10,929

[1]Brown × brook trout hybrid.

Table 12. Plantings of brown and tiger[1] trout in the Great Lakes, 1980.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-BROWN TROUT				
Minnesota waters				
Baptism River	1107	680	Y	none
Big Net River	401	402	Y	none
Blackhoof River	401	799	Y	none
Cascade River	811	402	Y	none
Chester River	1401	1,013	Y	none
Devil Track River	812	300	Y	none
Kadunce Creek	813	200	Y	none
Kimball Creek	813	201	Y	none
Temperance Creek	909	400	Y	none
Tischer Creek	1401	1,001	Y	none
Subtotal		5,398		
Wisconsin waters				
Ashland	1509	32,000	Y	none
Herbster	1306	8,750	FF	none
Saxon Harbor	1511	3,500	Y	none
Superior Entry	1401	28,250	FF	none
Washburn	1509	12,597	Y	none
Subtotal		85,097		
Total, Lake Superior		90,495		
LAKE MICHIGAN-BROWN AND TIGER TROUT				
Illinois waters (brown trout)				
Chicago (Diversey Harbor)	2603	22,762	FF	none
Illinois waters (tiger trout)				
Chicago (Diversey Harbor)	2603	1,000	FF	none
Indiana waters (brown trout)				
Bethlehem Steel	2706	23,082	FF	none
East Chicago	2705	48,970	FF	none
Michigan City	2707	44,073	FF	none
Subtotal		116,125		
Michigan waters (brown trout)				
Acme	916	13,409	FF	none
Bowers Harbor	815	13,409	FF	none
Elk Rapids	816	12,918	FF	none
Greillickville	915	13,409	FF	none
Little Traverse Bay	519	25,805	FF	none
Pine River Channel	616	26,508	FF	none
Subtotal		105,458		

Table 12. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Wisconsin waters (brown trout)				
Algoma	1004	25,000	F	none
Algoma	1004	18,564	FF	none
Algoma	1004	23,300	Y	none
Baileys Harbor	706	20,000	F	none
Baileys Harbor	706	20,700	Y	none
Braunsdorf Beach	905	11,100	Y	none
Cleveland	1402	25,000	F	none
Egg Harbor	705	20,000	FF	none
Egg Harbor	705	15,300	Y	none
Ephraim	605	13,050	Y	none
Fish Creek	705	20,000	FF	none
Fish Creek	705	15,900	Y	none
Gills Rock	606	10,000	Y	none
Harrington Beach	1702	13,400	Y	none
Kenosha	2202	20,000	FF	none
Kenosha County	2202	19,800	Y	none
Kewaunee	1104	25,000	F	none
Kewaunee	1104	32,780	Y	none
Manitowoc	1303	34,600	F	none
Manitowoc	1303	20,860	Y	none
Marinette Bay	703	21,500	F	none
Marinette Bay	703	5,000	Y	none
Milwaukee	1901	25,000	FF	none
Milwaukee Harbor	1901	36,034	Y	none
Moonlight Bay	706	19,500	FF	none
Moonlight Bay	706	10,800	Y	none
Oconto Park	802	27,000	FF	none
Oconto Park	802	29,200	Y	none
Peshtigo River	803	16,065	FF	none
Peshtigo River	803	5,000	Y	none
Port Washington	1701	20,000	FF	none
Port Washington	1701	13,400	Y	left pectoral
Racine	2102	25,000	FF	none
Racine	2102	27,000	Y	none
Shauer Park	805	10,000	F	none
Shauer Park	805	12,100	Y	none
Sheboygan	1502	40,000	FF	none
Sheboygan	1502	67,390	Y	none
Stevenson Island	703	7,800	Y	none
Sturgeon Bay	905	20,000	F	none
Sturgeon Bay	905	19,500	FF	none
Sturgeon Bay	905	34,750	Y	none
Two Rivers	1303	25,000	F	none
Two Rivers	1303	36,900	Y	none
West Twin River	1303	300	Y	none
Westers	805	10,800	Y	none
Westers	805	20,000	F	none
Whitefish Bay	805	10,000	F	none
Whitefish Bay	805	10,000	Y	none
Winegar Pond	803	14,000	FF	none
Winegar Pond	803	23,100	Y	none
Subtotal		1,046,493		
Total, Lake Michigan		1,291,838		

Table 12. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
LAKE HURON-BROWN TROUT				
Michigan waters				
Point Lookout	1408	10,000	Y	left pectoral
Point Lookout	1408	10,000	FF	right pectoral
Tawas Bay	1309	10,000	FF	right pectoral
Tawas Bay	1309	10,000	Y	left pectoral
Thunder Bay	809	25,000	FF	right pectoral
Thunder Bay	809	25,000	Y	left pectoral
Subtotal		90,000		
Total, Lake Huron		90,000		
LAKE ERIE-BROWN TROUT				
New York waters				
Barcelona	424	20,200	Y	none
Cattaraugus Creek	327	20,000	Y	none
Dunkirk	425	10,000	Y	none
Subtotal		50,200		
Ohio waters				
Beaver Creek	1007	5,000	F	none
Grand River	814	26,500	F	none
Subtotal		31,500		
Pennsylvania waters				
Conneaut Creek	718	401	Y	none
Conneaut Creek (Albion Reservoir)	718	400	Y	none
Conneaut Creek (Albion Reservoir)	718	50	2 yrs.	none
Conneaut Creek (Temple Creek)	718	2,057	Y	none
Conneaut Creek (Temple Creek)	718	335	2 yrs.	none
Crooked Creek	619	600	2 yrs.	none
Elk Creek	619	16,450	Y	none
Elk Creek	619	2,600	2 yrs.	none
Godfrey Run	619	8,500	Y	none
Raccoon Creek (Baldwin Pond)	619	100	Y	none
Trout Run	619	10,000	Y	none
Twentymile Creek	523	3,500	Y	none
Twentymile Creek	523	650	2 yrs.	none
Walnut Creek	620	300	Y	none
Subtotal		45,943		
Total, Lake Erie		127,643		

Table 12. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
LAKE ONTARIO-BROWN TROUT				
New York waters				
Braddock's Bay	815	6,450	Y	adipose
Braddock's Bay	815	6,450	Y	adipose-left ventral
Fair Haven	720	15,900	FF	none
Fair Haven	720	17,000	Y	none
Genesee Pier	815	8,090	Y	adipose
Genesee Pier	815	8,090	Y	adipose-left ventral
Hamlin	713	5,750	Y	adipose
Hamlin	713	8,000	Y	adipose-left ventral
Hamlin	713	5,650	Y	none
Irondequoit	815	13,000	Y	none
Olcott	708	66,000	FF	none
Olcott	708	20,200	Y	none
Oswego	721	96,600	SF	none
Oswego	721	27,500	Y	none
Point Breeze	711	20,150	Y	none
Pultneyville	817	10,250	Y	none
Ray Bay	523	43,400	FF	none
Ray Bay	523	3,100	Y	adipose-right ventral
Ray Bay	523	17,100	Y	right ventral
Selkirk	623	30,000	Y	none
Sodus	819	49,950	FF	none
Sodus	819	17,000	Y	none
Webster	816	12,950	Y	none
Wilson	707	20,200	Y	none
Subtotal		528,780		
Total, Lake Ontario		528,780		
Great Lakes Total		2,128,756		

[1]Brown × brook trout hybrid.

Table 13. Annual plantings (in thousands) of brook trout in the Great Lakes, 1976–1980.

Year	LAKE SUPERIOR Wisconsin	Minnesota	Total
1976	25	7	32
1977	123	66	188
1978	166	30	196
1979	83	27	111
1980	124	15	139
Subtotal	521	145	666

Year	Michigan	LAKE MICHIGAN Wisconsin	Illinois	Total
1976	61	12	6	79
1977	–	643	–	643
1978	–	243	5	248
1979	–	187	8	193
1980	–	185	20	204
Subtotal	61	1,270	39	1,370

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

Year	LAKE ONTARIO New York	Total
1976	–	–
1977	8	8
1978	–	–
1979	–	–
1980	326	326
Subtotal	334	334

Great Lakes Total, brook trout, 1976–1980 2,386

Table 14. Plantings of brook trout in the Great Lakes, 1980.

Location	Grid No.	Numbers	Age	Fin Clip
LAKE SUPERIOR-BROOK TROUT				
Minnesota waters				
Cascade River	811	603	Y	none
Chester Creek	1401	152	Y	none
Deer Yard Creek	811	202	Y	none
Devil Track River	840	240	Y	none
Encampment River	1205	188	Y	none
French River	1302	1,998	Y	none
Gooseberry River	1205	1,072	Y	none
Kandance Creek	813	294	Y	none
Kimball Creek	813	294	Y	none
Knife River	1303	2,670	Y	none
Lester River	1302	1,350	Y	none
Split Rock River (W. Branch)	1205	1,400	Y	none
Stewart River	1303	1,224	Y	none
Stony Point	1302	122	Y	none
Superior Lake	811	640	Y	none
Sucker River	1302	1,998	Y	none
Temperance River	909	600	Y	none
Tischer Creek	1401	424	Y	none
Subtotal		15,471		
Wisconsin waters				
Ashland	1509	14,200	Y	none
Ashland	1509	100	2 yrs.	none
Ashland Ore Dock	1509	12,000	FF	none
Cornucopia Harbor	1307	7,000	FF	none
Houghton Point	1509	12,000	FF	none
Madeline Island	1409	6,000	FF	none
Onion River Mouth	1409	14,000	FF	none
Onion River Mouth	1409	17,750	Y	none
Port Superior Harbor	1409	7,000	FF	none
Washburn	1509	21,600	Y	none
Washburn Coal Dock	1509	12,000	FF	none
Subtotal		123,650		
Total, Lake Superior		139,121		
LAKE MICHIGAN-BROOK TROUT				
Illinois waters				
Chicago (Diversey Harbor)	2603	1,300	Y	none
Waukegan (Midland Pier)	2302	18,200	Y	none
Subtotal		19,500		

Table 14. (Cont'd.)

Location	Grid No.	Numbers	Age	Fin Clip
Wisconsin waters				
Algoma	1004	15,000	Y	none
Bailey's Harbor	706	25,375	Y	none
Coast Guard Station	905	8,250	Y	none
Kewaunee	1104	15,000	Y	none
Manitowoc	1303	10,000	Y	none
Moonlight Bay	706	9,375	Y	none
Sheboygan	1502	33,900	Y	none
Sturgeon Bay	905	13,000	Y	none
Surf Club	703	15,000	Y	none
Two Rivers	1303	10,000	Y	none
Westers	805	15,000	Y	none
Whitefish Bay	805	15,000	Y	none
Subtotal		184,900		
Total, Lake Michigan		204,400		
LAKE ERIE-BROOK TROUT				
Pennsylvania waters				
Conneaut Creek (Taylor Run)	718	1,407	Y	none
Conneaut Creek (Temple Run)	718	1,705	Y	none
Crooked Creek	619	900	2 yrs.	none
Elk Creek	619	800	2 yrs.	none
Elk Creek (Little Elk Creek)	619	50	Y	none
Twelve Mile Creek (Peck Run)	522	300	2 yrs.	none
Twentymile Creek	523	1,000	2 yrs.	none
Subtotal		6,162		
Total, Lake Erie		6,162		
LAKE ONTARIO-BROOK TROUT				
New York waters				
Oswego	721	326,020	SF	none
Total, Lake Ontario		326,020		
Great Lakes Total		675,703		

SEA LAMPREY CONTROL IN THE UNITED STATES

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The electrical weirs used to capture adult sea lampreys were removed from service in the fall of 1979, and portable traps are now used to assess the relative abundance and monitor biological characteristics of the parasite. In 1980, portable traps fished in 37 tributaries of the Great Lakes captured 21,988 adult sea lampreys: 1,061 from Lake Superior, 9,488 from Lake Michigan, 9,465 from Lake Huron, 1,181 from Lake Erie, and 793 from Lake Ontario.

The number of parasitic-phase sea lampreys collected by fishermen increased from 1,046 in 1979 to 1,293 in 1980. The increase was greatest in northern Lake Huron, where 149 more lampreys were taken in 1980 than in 1979. This sharp increase may be a result of an increasing and largely uncontrolled population of sea lampreys in the St. Marys River.

Surveys were conducted on 296 streams for distribution, abundance, and growth of sea lamprey ammocetes. New populations were discovered in Seiners Creek (Lake Michigan) and in the Dead River (Lake Superior), each consisting of a few lampreys of the 1979 year class.

Chemical treatments were completed during the 1980 field season on most of the streams that were specified in the Memorandum of Agreement between the Great Lakes Fishery Commission and the U.S. Fish and Wildlife Service. Of the 44 streams listed, 32 were treated, 4 were postponed until 1981, 1 was not treated because of high water, and 7 were postponed until the number and size of ammocetes warrant treatment. The Huron River (Lake Superior) and the Carp River (Lake Huron) were added to the schedule and treated during the season. Chemical treatments were completed on 34 streams—19 on Lake Superior, 7 on Lake Michigan, and 8 on Lake Huron—with a combined flow of 150.3 m^3/s.

Studies of Adult Sea Lampreys

Migrant sea lampreys—Portable assessment traps are now used to monitor relative abundance and biological characteristics of adult sea lam-

preys in the Great Lakes. In general, the results are encouraging, particularly in the Lower Lakes, where assessment was limited or lacking in the past.

A total of 53 traps were operated in 37 tributaries of the Great Lakes in 1980 (Fig. 1, Table1). In Lake Superior streams, the catch of adult sea lampreys at the six assessment sites declined slightly in 1980 (1,061) from the 1979 total (1,438), but remained about the same as the catch in 1978 (1,164). The portable assessment traps in the Iron and Betsy rivers were experimental and were upstream from the electrical weirs. For purposes of comparison, the catches at the electrical barriers from these two rivers were used in 1978 and 1979. The sharpest decline was recorded on the Rock River, where 329 lampreys were taken in 1980, compared with 677 in 1979 and 508 in 1978.

The average length (428 mm) and weight (172 g) of adult sea lampreys from Lake Superior captured in traps at the assessment sites (Table 2) were similar to averages for lampreys collected during the previous 5 years, 1975–79, at the eight electrical barriers (433 mm and 179 g). The percent-

Figure 1. Location of streams tributary to the Great Lakes where assessment traps were fished in 1980. (Included is the Sucker River, Lake Superior, where an experimental mechanical trap was operated.)

age of males (43) in 1980 (Table 2) was higher than the previous 5-year average obtained at the electrical barriers (31). The increase in males was due primarily to the sample in the Tahquamenon River (301 of 822 sea lampreys examined from Lake Supèrior), where males represented 52% of the run.

An experiment to determine if sea lampreys could be captured in traps at electrical barrier sites, without the electrical charge, was unsuccessful. Traps previously fished at electrical barriers were installed along abutments in the Iron, Sucker, and Betsy rivers. No sea lampreys were captured in the Iron and Betsy rivers. In the Sucker River only 19 sea lampreys were taken by this method, whereas at the electrical barrier, 367 lampreys were captured in 1979 and 974 in 1978. A mark-release study was attempted in the Sucker River, but none of the lampreys were recaptured.

A total of 9,488 sea lampreys were taken in assessment traps in tributaries of Lake Michigan. Catches in the Peshtigo (350) and Menominee (194) rivers in 1980 increased slightly over those in 1979, but were much lower than the catches in 1978 (2,360 and 1,840, respectively). The increased number of adult sea lampreys captured in the Manistique River (7,895 in 1980 compared with 4,948 in 1979), when analyzed on a catch per unit of effort basis, represents an increase in the run of about 25%. No sea lampreys were captured for the second year in the Fox River, and only a small run (2 lampreys caught) was indicated in the Oconto River. A trap operated in the Escanaba River for the first time since 1977 failed to catch sea lampreys. The river may be too polluted to attract spawning lampreys.

In the seven streams on the east shore of Lake Michigan (Fig. 1), the numbers of lampreys varied markedly from one river to another when compared with records for past years. The most significant differences occurred in the Carp Lake River, where the run of lampreys increased from 68 in 1979 to 293 in 1980, and in the St. Joseph River, where the run declined from 879 in 1978 to 176 in 1980.

Assessment in Lake Huron was from catches of adult sea lampreys in portable traps in three tributaries and at the electrical barrier in the Ocqueoc River. No significant changes in runs of lampreys captured in the traps occurred. Although the number captured in the St. Marys River increased from 1,213 in 1979 to 1,995 in 1980, the change resulted partly from increased efficiency (one-way devices were installed in the traps to reduce escapement). The catch of lampreys in the Cheboygan River, when compared on a per unit effort basis, suggests the run changed little during 1978–80. Catches of adult sea lampreys in the electrical barrier in the Ocqueoc River continue to fluctuate without trend. A total of 473 adults were captured in 1980, compared with 3,248 in 1979, 2,121 in 1978, 503 in 1977, and 6,937 in 1976.

Assessment traps operated for the first time in Cattaraugus Creek (at a dam near Springville, New York), Lake Erie, captured 1,181 sea lampreys. A sample of 900 lampreys averaged 512 mm (maximum, 595 mm) and 284 g (maximum, 417 g)—the largest sea lampreys ever in the Great

Lakes. The large size may be a result of the recent introduction of salmonids, or an indication of a low but increasing sea lamprey population. Males composed 56% of the sample.

Assessment trapping, conducted in three Lake Ontario tributaries since 1978, was expanded to include nine additional streams in 1980. Results were negative at most sites, but annual index stations will be established on Sterling and Sterling Valley creeks. Extensive vandalism at the trapping site on Beaver Dam Brook prevented inclusion of the stream in the assessment network, even though sea lampreys were present in significant numbers. Catches at the index stations on Catfish and Grindstone creeks and the Little Salmon River declined from 1,656 in 1979 to 387 in 1980.

Assessment sites in tributaries of the Great Lakes with the most potential for trapping adult sea lampreys have been evaluated. Index stations will be monitored annually in a total of 25 streams: 6 tributaries of Lake Superior (Tahquamenon, Betsy, Miners, Rock, Big Garlic, and Iron rivers), 10 of Lake Michigan (Fox, Peshtigo, Menominee, Manistique, Carp Lake, Jordan, Boardman, Betsie, Muskegon, and St. Joseph rivers), 3 of Lake Huron (St. Marys, Cheboygan, and Trout rivers), 1 of Lake Erie (Cattaraugus Creek), and 5 of Lake Ontario (Sterling, Sterling Valley, Catfish, and Grindstone creeks and the Little Salmon River). Experimental work with the traps will continue at new sites created by the construction of barrier dams (West Branch of the Whitefish River, Lake Michigan) and at sites where sea lamprey runs may develop as a result of improved water quality through pollution abatement (e.g., St. Louis River, Lake Superior). Certain other streams, previously monitored but not chosen as annual index stations, may be checked periodically to determine if runs are developing.

Parasitic sea lampreys—Spring and fall collections of parasitic-phase sea lampreys taken by fishermen from Lakes Superior, Michigan, and Huron continued in 1980 (Table 3).

In Lake Superior, a total of 290 sea lampreys were taken by 33 commercial fishermen. Two statistical districts contributed the largest numbers—130 from the Munising, Michigan, area (MS-4) and 107 from the Wisconsin area. The collections included 21 recently metamorphosed parasitic-phase sea lampreys (a group designated here to include those ≤ 200 mm long), of which 8 were collected in the Keweenaw Peninsula area (MS-3) and 6 in the Wisconsin area. The addition of a major trap net fisherman who began operations in the Munising, Michigan, area in 1980 may have contributed significantly to the increase in the number of sea lampreys taken there.

Twenty-three Lake Michigan fishermen collected 228 sea lampreys in 1980. The largest number came from two statistical districts—81 from the Algoma, Wisconsin, area (WM-4) and 57 from the Naubinway, Michigan, area (MM-3). Sea lampreys from the Algoma area were 63% spawning-phase adults, collected in commercial pound nets set for rainbow smelt and alewives in proximity to the estuary of the Ahnapee River. Lake Michigan collections included 17 recently metamorphosed sea lampreys, of which 9 were collected in the Escanaba, Michigan, area (MM-1).

In Green Bay, the collection of only 43 lampreys in 1980 and 67 in 1979 continues to indicate a low abundance of sea lampreys. This low abundance is also reflected by the number of spawning-phase sea lampreys collected from portable assessment traps in the Peshtigo and Menominee rivers—396 in 1979 and 499 in 1980—as compared with 4,200 taken in 1978. Wounding rates on lake trout in this area also decreased from 3.6% in 1979 to 1.5% in 1980 (T. J. Lychwick, Wisconsin Department of Natural Resources, Sturgeon Bay, Wisconsin, personal communication).

The number of sea lampreys collected from the fisheries of northern Lake Michigan, excluding Green Bay, remained about the same—162 in 1979 and 174 in 1980—whereas wounding rates on lake trout decreased from 2.3% in 1979 to 0.9% in 1980. However, correlation of these two sets of data may not be warranted: Wounding data on lake trout were collected in statistical districts WM-3, WM-4, the southern portion of MM-3, and MM-5, whereas the largest number of parasitic-phase sea lampreys was collected in the northern portion of MM-3, adjacent to the Straits of Mackinac, and may reflect an influx of sea lampreys from northern Lake Huron.

A total of 772 sea lampreys, including 36 recently metamorphosed lampreys, were collected from three fishermen in northern Lake Huron (MH-1). Catches from two of these fishermen (DeTour and Cedarville areas) increased from 260 in 1979 to 367 in 1980, indicating a continuing problem in the vicinity of the St. Marys River. An additional 405 lampreys were collected by a trap net fisherman at Rogers City. This fisherman had supplied 282 lampreys in 1978 and 333 in 1979 to the Hammond Bay Biological Station for use in feeding experiments. These were not previously counted in catches from Lake Huron.

A comparison of the catch of lampreys per unit of effort in trap nets fished for lake whitefish from DeTour and Rogers City showed that the fishery at Rogers City caught lampreys at a higher rate than the DeTour fishery over each of the past 3 years (Table 4). Fishermen have commented that larger numbers of sea lampreys are collected when lake trout are present in their trap nets, and this may be a factor in the higher catch rate at Rogers City.

Weston Creek barrier dam—Observations were made at a low-head barrier on Weston Creek, tributary of the Manistique River, Lake Michigan, to determine its effectiveness in stopping adult sea lamprey migrations again in 1980. In 1979, the water fell over a vertical drop of 43 cm, but in 1980 a rise in water level reduced the drop to 0 to 24 cm. The water over the barrier was about 84 cm deep and had a velocity of 2.7 m/s. No lampreys were observed surmounting the barrier, nor were any captured at a temporary electrical weir installed upstream from the barrier. It appears that the velocity and height of the water column, even without a vertical drop, were sufficient to prevent lampreys from surmounting the barrier.

Ammocete Studies

Lake Superior—Surveys have been conducted each fall since 1960 at index stations in Lake Superior tributaries to determine presence of young-of-the-year sea lampreys. Lampreys of the 1980 year class were recovered from 30 of 81 streams examined. Chemical treatments later eliminated this year class from seven streams: Au Train, Huron, Silver, Poplar, Middle, and Amnicon rivers and Furnace Creek. Chemical treatments failed to eliminate them from the Bad and Brule rivers, and larvae were recovered outside the treated portion of the Big Garlic River. Twenty-five streams have shown no evidence of reestablishment for the past 4 years or more. Table 5 shows the status of the remaining reestablished populations in Lake Superior streams.

Lake Michigan—Ammocetes of the 1980 year class were recovered from 14 of 62 streams tributary to the north and west shores of Lake Michigan examined for larvae. Thirty-two streams contain reestablished populations; 16 have shown no evidence of reestablishment for the past 4 years or more. Table 6 shows the status of the remaining reestablished populations in these streams.

Lake Huron—Sea lampreys of the 1980 year class were recovered from 7 of 22 streams in the Upper Peninsula of Michigan that are examined annually for young-of-the-year larvae. Eleven of the streams contain reestablished populations; 5 have shown no evidence of reestablishment for the past 4 years or more. Table 7 shows the status of the remaining reestablished populations in these streams. In the Lower Peninsula, 23 drainages were examined for the reinfestation and the presence of the 1980 year class. Young-of-the-year larvae were collected in 11 of the 14 streams with reestablished populations.

Transformation studies—Larvae from the Whitefish and Big Garlic rivers were caged in the St. Marys River to determine transformation rates. The mean length of larvae from the Whitefish River was slightly greater than that of ammocetes from the Big Garlic River (144 and 139 mm, respectively). The age of the larvae could not be determined. Twenty-one larvae from each source were caged at a depth of 5.5 m in the St. Marys River and an additional 21 were placed in an aquarium at the Marquette Biological Station. The aquaria were maintained at room temperature. The St. Marys River warmed slowly through the summer, reaching 13°C on June 25 and 16°C on July 14. More than half of each group caged in the St. Marys River died from unknown causes before transformation began.

As in previous experiments, the transformation rate of specimens from the Big Garlic River was greatest in the warmer water. Larvae from the Big Garlic River transformed at a rate of 70% in the aquarium and 10% in the St. Marys River. However, larvae from the Whitefish River transformed at similar rates in the St. Marys River and in the aquarium (67% and 62%, respectively). Although these results are based on a small sample, this study suggests the need to compare transformation rates of larvae from different streams. The study also demonstrated that larvae transform in the St. Marys River, and in at least one group of larvae, at rates higher than expected.

Big Garlic trap—Seventy-seven transformed sea lampreys and 2,189 sea lampreys ammocetes were captured at the downstream trap in the Big Garlic River, Lake Superior in 1980. The catch in 1979 was 48 and 1,863, respectively. Large larvae (> 120 mm long) collected in the Big Garlic River are allowed to transform in a warmwater aquarium and then transferred to the Hammond Bay Biological Station.

Fyke nets—Fyke nets were fished in five streams tributary to the south shore of Lake Superior, for about 1 month in late fall, to provide further information on downsteam movement of newly transformed sea lampreys and on the relative efficiency of chemical treatments. A total of 16 transformed sea lampreys were captured from three of the streams: 1 from Furnace Creek, 1 from the Big Garlic River, and 14 from the Rock River. The catch was not entirely unexpected, as these streams contain inland lakes where sea lamprey populations are difficult to control. Again, the need for closer surveillance is indicated, particularly on the Rock River. No transformed sea lampreys were captured in the other two streams, the Au Train and Chocolay rivers; however, one adult female sea lamprey (361 mm, 140 g) with nearly ripe eggs was recovered from the Chocolay River on November 17, 1980.

Surveys and Chemical Treatments

Lake Superior surveys—Pretreatment surveys were conducted on 19 streams tributary to Lake Superior in 1980; 14 of the streams were later treated, 3 (Waiska, Firesteel, and Ontonagon rivers) are scheduled for treatment in 1981, and 2 (Nemadji River and Beaver Lake Outlet) will not require treatment before 1982. Larval abundance in the streams to be treated in 1981 appears moderate in the Firesteel and low in the other two.

Populations of reestablished sea lamprey ammocetes were found in 32 streams, including the Anna River, where they were recovered for the first time since 1965. Surveys indicated that four of the reinfested rivers (Two Hearted, Sucker, Traverse, and Misery) have substantial populations of reestablished ammocetes.

An extensive posttreatment survey of the Huron River showed the need for re-treatment. Electrofishing and sampling with granular Bayer 73 in June 1980 revealed that residual larvae were scattered throughout the 10 km of river traditionally inhabited by sea lampreys. The 15 stations surveyed yielded 1,964 residual sea lampreys (20–155 mm long). Ammocetes were particularly abundant in the vicinity of small feeder streams and oxbows

that were overlooked during the 1979 treatment. About 71% of the residuals (1,403) were recovered from one heavily infested oxbow. The sex ratio of 163 large (> 120 mm) ammocetes was 1:1.6, or closely similar to that of adult sea lampreys captured in portable assessment traps in Lake Superior streams in 1980. The stream was re-treated in October. Small numbers of residual sea lampreys were recovered from 12 other streams: Two Hearted, Miners, Big Garlic, Ravine, Slate, Traverse, Salmon Trout (Houghton County), Ontonagon, Bad, Poplar, and Nemadji rivers and Harlow Creek.

Ten streams that were negative in the past were reexamined, and one new population was discovered. Thirty-seven sea lamprey larvae (36–63 mm long) of the 1979 year class were collected from the Dead River in Marquette County, Michigan. Although spawning had been observed, no larvae had previously been collected. No evidence of ammocetes of the 1980 year class was found.

Surveys with Bayer 73 granules and backpack shockers of offshore areas associated with Lake Superior tributaries continued in 1980. Sea lamprey ammocetes were recovered offshore from Fish (Eileen Township), Furnace, and Eliza creeks and the Ravine, Slate, Silver, Falls, and Black rivers. Larvae were collected on deltas of inland lakes in Harlow Creek and the Big Garlic and Sturgeon rivers.

An extensive survey of the St. Louis River with Bayer 73 granules and backpack shockers was undertaken in September to determine if the 1980 year class had become established and to assess the survival and downstream distribution of the 1979 year class. There was no evidence of the 1980 year class, and only 5 sea lamprey larvae (42–68 mm long) of the 1979 year class were collected at the more than 50 stations sampled. However, one of the ammocetes was found about 6 km downstream from the lower limit of distribution indicated by the 1979 survey. High water, turbidity, and frequent strong winds plagued the survey and validity of the results is questionable. A major effort will be made in 1981 to obtain a more reliable assessment of the lamprey population in this potentially troublesome stream.

Lake Superior chemical treatments—Chemical treatments were completed on 19 streams (Table 8, Fig. 2). Larval sea lampreys were abundant in the Silver, Brule, Tahquamenon, and Middle rivers and Washington Creek and low in the other streams. Rains during the treatments of the Bad, Brule, and Otter rivers and Washington and Fish creeks necessitated additional feeders and high chemical use. Prolonged high water levels caused postponement of the Black River treatment.

Mortality of spawning anadromous fishes and species with low tolerance to lampricides continues to be a problem. Although most pink salmon spawn in odd numbered years, an increasing number have established an even-year spawning cycle. Their susceptibility to TFM has caused cancellation of scheduled treatments in the past. The Silver River was not treated during the fall of 1979 because of the presence of a large number of pink

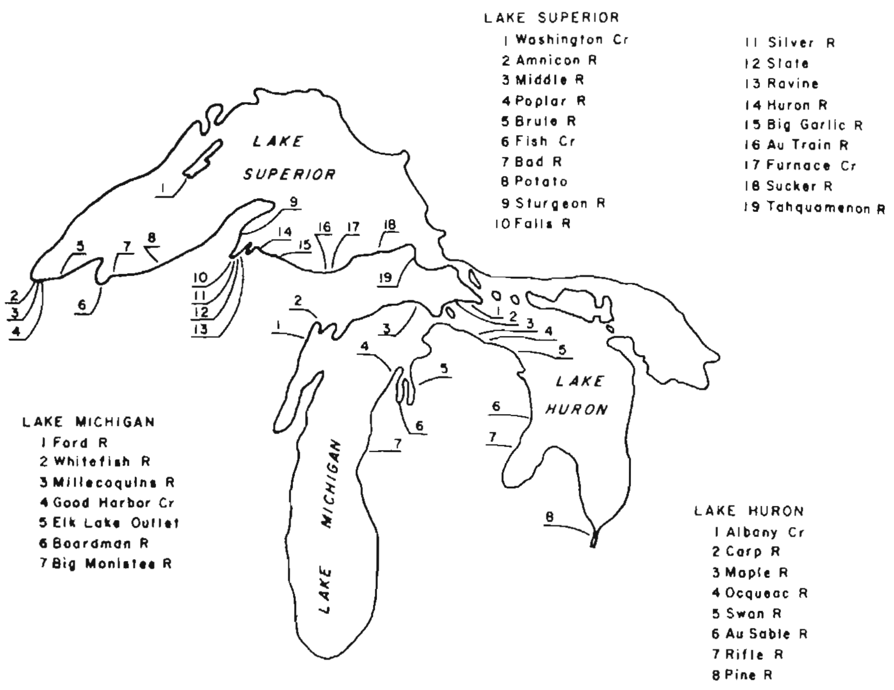

Figure 2. Location of streams tributary to the Upper Great Lakes that were treated with lampricides in 1980.

salmon; consequently, sea lamprey ammocetes from the 1979 year class are now established in Huron Bay. A few pink and coho salmon were killed during treatments of the Silver, Big Garlic, Sucker, and Huron rivers in 1980. Mortality of fishes with low tolerance to lampricides occurred in the Brule, Bad, and Otter rivers. Minor kills of white suckers logperch, bullheads, and northern pike usually occur when these species are present. Public reaction to even minor fish kills is becoming more common and additional time is required to monitor environmental effects.

The Furnace, Big Garlic, Silver, Otter, Au Train, and Sucker rivers were treated to control lentic populations of sea lamprey ammocetes. The Huron River was treated to eliminate the residual population left in backwaters during the 1979 treatment.

Lake Michigan surveys—Pretreatment surveys were conducted on 17 Lake Michigan streams in 1980. Four of these (Whitefish, Ford, and Boardman rivers and Good Harbor Creek) were later treated, and 10 are scheduled for treatment in 1981 and 3 in 1982. Of the streams scheduled for treatment in 1981 and 1982, surveys indicate that the Carp Lake, Jordan, and Platte rivers contain moderate to large numbers of sea lamprey ammocetes.

Investigations to determine the status of reestablished populations and to evaluate the effectiveness of recent chemical treatments verified the reinfestation of ammocetes in 52 streams and the presence of residual sea lampreys in 18. Moderate to large populations of reestablished larvae were indicated in the Manistee, Muskegon, Boyne, Brevort, Black (Mackinac County), and Fishdam rivers. Sea lampreys of the 1980 year class were recovered from 28 of the reinfested streams. Residual sea lampreys were scarce in all streams except the Ford and Whitefish rivers, which were treated in May 1980, and the Milakokia River, treated in October 1978. In the Ford River, 172 residual ammocetes (30–148 mm long) were collected. Most of the animals were taken from oxbows and high-water channels, although 30 were collected offshore in Lake Michigan. The 58 residual larvae (25–128 mm) found in the Whitefish River were mostly of the 1979 year class and were not associated with areas that provide havens for ammocetes (such as oxbows, high-water channels, and springs). A total of 54 sea lampreys (55–118 mm) were collected that had survived the 1978 treatment of the Milakokia River; they probably survived because the concentrations of lampricide in about 0.8 km of stream below the outlet of Heinz Lake was sublethal. Smaller numbers of residual sea lampreys were found in 16 other streams.

In addition to the surveys conducted off the mouth of the Ford River, offshore areas associated with 22 other streams were sampled with Bayer 73 granules. The most significant populations detected were off the Manistique River, where 157 sea lampreys (32–156 mm long) were taken, and off the Carp Lake River where 60 (24–117 mm) were recovered. The Manistique River is scheduled for treatment in 1981, and the Carp Lake River in 1982.

No sea lampreys were collected above dams on the Paw Paw (a tributary of the St. Joseph River), main St. Joseph, Betsie, or Grand rivers, indicating that these barriers were effective in stopping spawning runs. The low-head barrier on the Betsie River was built in 1974 to replace the former Homestead Hydroelectric Dam.

Surveys of two untreated streams, Fischer Creek and the Suamico River, where small numbers of sea lampreys had been found in the past were negative.

Eighteen previously unproductive streams were reexamined and one new population was discovered. Seventy-three sea lamprey larvae (29–52 mm long) of the 1979 year class were collected from Seiners Creek, Mackinac County. The stream is small and does not appear to have the potential for survival of large numbers of sea lampreys. This discovery and other recent infestations, such as in the Oconto, Dead, and St. Louis rivers, demonstrate the need to monitor closely all streams that appear suitable for sea lamprey production.

Investigations continued on the Fox River system to determine if sea lampreys have become established in response to recent pollution control programs. Surveys in the lower river and at selected sites in the drainage above Lake Winnebago in 1980 revealed no sea lamprey larvae. Bayer 73 granules were used at 23 locations (total area, 1.9 ha) in the river below Lake Winnebago, of which 12 were in the 4.8–km section of stream below the dam at DePere. Water temperatures during the surveys in early September were favorable for the application of Bayer 73, but collecting efficiency was hampered by turbidity, waves, and high water. Overall reliability of the survey was judged as only fair. Limited sampling above Lake Winnebago in the Wolf River and tributaries yielded no sea lampreys, but large numbers of silver and northern brook lampreys.

In spite of the substantial improvement in stream quality in the lower Fox River in the last decade, the stream still appears too polluted to attract significant numbers of spawning-run sea lampreys or to permit larvae to survive in the river below Lake Winnebago. The fact that no fish activity was observed in the lower river during Bayer applications suggests that streambed conditions are not suitable for bottom-dwelling fishes or lamprey larvae. Also, survey personnel judged that water quality was below that commonly associated with most sea lamprey-producing streams.

Although sea lamprey production has not yet been documented anywhere in the Fox River system, how long this situation will last is questionable in light of ongoing pollution control efforts. It is essential, therefore, that ways be found to minimize the impact of the infestation when it occurs. The failure of sea lampreys to successfully use the Fox River seems primarily attributable to two factors that have probably co-existed in the lower river since the mid-1800s. One factor centers on the poor ecological conditions that still exist, despite substantial improvements in water quality in the last decade, and the second on the series of 14 dams and 19 navigational locks between DePere and the outlet of Lake Winnebago. It is likely that the large discharge of relatively poor-quality water into southern Green Bay diverts adult lampreys not only from entering the river, but also from moving into adjacent parts of the bay in significant numbers. If adults do enter the river and spawn, it appears likely that the resulting larvae do not survive because of the unsuitable streambed conditions that apparently still exist in many areas. The dams are not foolproof barriers to the upstream movement of adults (locks and other possible bypass routes exist), but they are individually and collectively a formidable deterrent. Each successive dam is expected to stop a large percentage of the adults that eventually reach it.

Infestation of the Fox River system almost certainly hinges on the degree to which future pollution control measures are effective in upgrading water quality and streambed environment. Significant improvement in conditions in the lower river is expected to result in the buildup of a major run of spawning adults and the establishment of a larval population in at least the section of stream below the dam at DePere. Even if stream quality does not improve enough to permit ammocete survival, it may be enough to attract large numbers of spawners, as does the Humber River on Lake Ontario. The presence of a large population of adults in the lower river will increase the probability that some will bypass the dams and eventually

reach the drainages above Lake Winnebago. The full consequences of such a development are unpredictable. It is almost certain that the Wolf River and several of its tributaries can produce large numbers of sea lamprey larvae and chemical treatments of those streams would be very costly and difficult. Whether the metamorphosed lampreys would migrate back to Lake Michigan or adapt to a parasitic existence in Lake Winnebago is debatable, but it seems logical to take steps now to prevent either of these situations from developing.

The only means to guarantee that adult sea lampreys do not reach the upper drainages seems to be to completely block the system by sealing one of the locks in the lower river. This will, of course, prohibit the passage of watercraft between Lake Winnebago and Lake Michigan. A marine railway, like that operated on the Trent-Severn Canal in Ontario, is one solution to this problem, but an admittedly costly one. The other readily apparent course of action would be to seal a lock, not provide alternate means of passage, and allow the boating public to adjust to the closure. Either of these actions are controversial, but considering all the unknowns associated with the problem, a decision should not be unduly delayed. The railway will be costly to build and maintain, and the complete closure will surely meet with opposition from the boating public. As for sea lamprey control considerations, the most practical move now may be to close a lock (Rapide Croche) as soon as possible and then determine if a marine railway is justified, in light of the relatively small volume of boat traffic using that portion of the waterway.

Lake Michigan chemical treatments—Chemical treatments were completed on seven streams during the field season (Table 9, Fig. 2). Larval sea lampreys were abundant in the Ford and Whitefish rivers and Goodharbor Creek, and scarce in the other streams. Treatments of the Whitefish and Ford rivers required the assistance of Ludington chemical personnel and additional personnel from the Marquette Station.

The Whitefish River was re-treated to eliminate residuals from the 1978 treatment. Treatments of Blacksmith Bayou on the Manistee River and the North Channel of Elk Lake Outlet involved TFM applications to large lentic areas. Numerous sea lamprey ammocetes were killed while mortality of other fishes and invertebrates was negligible.

Thermal stratification in estuaries of streams has often been noted as a problem by personnel of chemical control units. Lampricides applied to river water are prevented from contacting the sediment by an underlying layer of cool lake water. Temperature data were collected at three estuarine stations in the Manistique River on various dates from May 8 to June 18, to determine if favorable temperatures for spring treatments are present. Isothermal conditions from May 12 to 17 indicated that the estuary could be treated in the spring; however, costs would increase because of the larger volume of water during spring runoff, and the susceptibility of spawning-run suckers to lampricides must be considered.

Although the estuary was usually stratified from May 18 to June 18, it was isothermal on June 6. Two later observations also indicated isothermal conditions on August 22 and September 10. These examinations suggest that late summer estuarine treatments may be effective. Further data are needed to determine (1) whether intermittent destratification in summer occurs annually, (2) the duration of these potential periods of homogeneous temperature, and (3) the factors influencing destratification.

Studies to determine the optimum time of treatment for the lower Manistique River were undertaken in June and July. Rhodamine dye was introduced into the river in simulation of a lampricide application. Fluorometric analysis in the river mouth harbor indicated that the river water below the thermocline was dissipated by random currents before simulated lethal contact time could be attained. These limited studies indicate that this and other large rivers should be treated under isothermal conditions.

Lake Huron surveys—Pretreatment investigations were completed on 11 Lake Huron tributaries in 1980. Four of the streams, the Swan, Au Sable, Rifle, and Pine (St. Clair County) rivers, were later treated. The other seven streams are scheduled for treatment in 1981; surveys indicated that ammocetes are abundant in the Carp and East Au Gres rivers.

Residual sea lampreys were found in 15 streams, including 2 major tributaries of the Cheboygan River system. The largest numbers of residual larvae were recovered in the Ocqueoc River (28) and the Pine River (22), a major tributary of the lower Au Sable River. The numbers of residuals in the other streams were small.

No sea lampreys were found in the Chippewa River, a tributary of the Tittabawassee River (Saginaw River system), since closure of the fish ladder at the Dow Chemical Dam in 1977. The fishway is closed from March 1 to July 15.

No new sea lamprey populations were located during the reexamination of 16 historically unproductive streams.

Sea lamprey ammocetes were found in 11 of 16 lentic areas surveyed with Bayer 73 granules and backpack shockers. Except for populations in Burt Lake off the mouth of the Sturgeon River (Cheboygan River system) and in St. Martin Bay off of the Carp River, few larvae were collected. In St. Martin Bay, 1,477 larvae (26–178 mm long) were collected during surveys in July, August, and September. In Burt Lake, 122 larvae (43–164 mm) were recovered in sampling with Bayer 73 granules. Intensive control efforts will be made to reduce populations in these two areas.

The St. Clair River was surveyed in mid-summer to determine the abundance and distribution of sea lamprey ammocetes. A four-man team used scuba gear, probes, and underwater viewers to determine bottom composition. About 19,928 m^2 of habitat was sampled with Bayer 73 granules and portable shockers. A total of 139 ammocetes were collected from 15 of 22 sites examined. Sea lamprey ammocetes made up 9% of the collection, *Ichthyomyzon* 37%, and American brook lampreys 54%. Although fewer ammocetes were collected in a 1975 survey (47), the percent of sea lampreys then was similar to that taken in 1980. Average length of sea lampreys was 63 mm (43–87 mm) in 1980 and 52 mm (42–61 mm) in 1975. Analysis of the data from both years indicates no large concentrations of ammocetes, but the larvae were distributed throughout a 45-km section of the river, from 11 km downstream from Port Huron-Sarnia to Lake St. Clair. Much of the good larval habitat on the shelves of the river is covered with dense vegetation in summer; further surveys will be conducted in spring, before the vegetation emerges.

Surveys at five stations in Lake St. Clair proper yielded one sea lamprey (43 mm long) and eight *Ichthyomyzon* larvae (52–98 mm).

Lake Huron chemical treatments—Chemical treatments were completed on eight streams during the field season (Table 10, Fig. 2). Larval sea lampreys were abundant in tributaries of the Rifle River and in the Au Sable and Carp rivers and scarce in the other streams. The Ocqueoc and Carp rivers and Albany Creek were treated to prevent drift of sea lampreys into lentic areas. Most of the population of larvae discovered off the Carp River should have been eliminated by treatment of the lower river. Six tributaries of the Rifle River, treatments of which had been scheduled for 1979 but were postponed because of beaver impoundments and low flows, were treated successfully in late June. Sea lamprey populations varied in number, but were especially large in Eddy and Mansfield creeks.

Lake Erie surveys—Survey were conducted to assess the relative abundance and distribution of sea lamprey larvae in three Pennsylvania streams—Conneaut, Crooked, and Raccoon creeks. Investigations on Conneaut Creek were restricted to the portion of the stream in Pennsylvania, where a total of 240 larvae (48–176 mm long) were collected. Sea lamprey infestation in the main stream extended to reaches of three major tributaries. The approximately 38 km of lower river in Ohio are scheduled for reexamination in 1981. In Crooked Creek, a large sea lamprey population was evident; 557 larvae (31–159 mm) were collected and almost the entire 17 km of main stream were infested. A more moderate-sized population was evident in Raccoon Creek, where 194 sea lampreys (28–164 mm) were taken. The larvae were present in the main stream to a point about 6 km above the mouth, and in one tributary.

Investigations of two New York streams, Cattaraugus and Canadaway creeks, were limited to checking the upstream limits of larval distribution indicated in previous surveys and collecting specimens for electrophoresis studies by Charles Krueger at the University of Minnesota.

No larvae were found during surveys of three Pennsylvania streams that appeared to have potential for lamprey production, or in the Huron River, a Michigan tributary at the far western end of the lake.

Currently, six Lake Erie tributaries—three in New York (Cattaraugus, Delaware, and Canadaway creeks) and three in Pennsylvania (Conneaut, Raccoon, and Crooked creeks)—are known to be infested with sea lamprey larvae and suspected of contributing to the Lake Erie parasitic stocks of sea lampreys in their respective areas. In Ohio, the Grand and Sandusky rivers have histories of minor sea lamprey infestations; however, they have not been surveyed since 1977.

Evaluation of sea lamprey populations in many streams in Ohio is severely hampered by turbidity and highly conductive water, which decrease the effectiveness of the electrofishing gear normally used for larval surveys. Bayer 73 granules are routinely used under these circumstances elsewhere, but unfortunately Bayluscide is lethal to native lampreys which are classified as endangered species in Ohio. In an effort to overcome this problem, cooperative investigations will be initiated with the State of Ohio to develop alternate larval sampling methods and techniques that will minimize the adverse effects on native lampreys and be acceptable to the State's environmental agencies.

Lake Ontario surveys—Stream surveys in Lake Ontario in 1980 were concerned primarily with a reexamination of the main channels of the Oswego river and one of its major tributaries, the Oneida River. In extensive sampling (46 locations) with Bayer 73 granules, no evidence was found of larval sea lampreys in the main stream of either river, or off the mouth of the Oswego River in Lake Ontario. As in past investigations, the limiting factor for sea lamprey reproduction throughout most of the system appeared to be poor water quality and polluted streambed habitats. However, two relatively small and widely separated main channel areas appear to be more favorable for sea lampreys. One is the 3 km of stream between Lake Ontario and the lowermost dam on the Oswego River, and the other extends for abut 0.6 km below the dam at Caughdenoy on the Oneida River. Spawning-run adults have been trapped or observed at both locations and suitable spawning gravel is available, but there is no evidence of successful reproduction in recent years. Ammocetes were reportedly dug for use as fish bait many years ago at the present site of the boat marina in Oswego, but our surveys in that area indicate that the quality of bottom sediments is now too poor for larval survival. Further downstream, and particularly in Oswego Harbor, the quality of habitat is substantially better. The amount of larval habitat below the Caughdenoy dam is significantly less, and much of it is of marginal quality.

A survey for the distribution of sea lamprey ammocetes was completed in Black Creek, a small tributary of the lower Oswego River, in anticipation of a possible chemical treatment in 1981. In 1980 and in previous years, about 3.2 km of the main stream and a small tributary were infested and larval sizes indicated almost annual recruitment to the population. The mouth of the stream is about 12.8 km upstream from Lake Ontario and it seems likely that metamorphosed lampreys migrate downstream through the Oswego River and contribute to parasitic stocks in Lake Ontario.

An initial examination was made of the St. Lawrence River in the Thousand Islands area to determine if sea lamprey larvae were present and thus might serve as a source of contamination for Lake Ontario. Unfortunately, heavy growths of submergent vegetation at the time of survey (mid-August) made it impossible to assess reliably the spawning potential in most places or to use Bayer 73 granules for larval surveys. In the future, surveys will be attempted earlier in the year when weed growth is lighter.

Sea lamprey larvae were collected from two tributaries of the Oswego River system and one tributary of Lake Ontario for electrophoresis studies. Several hundred large ammocetes and transforming sea lampreys were also collected from Big Bay Creek (Oneida Lake) and transported alive to the Hammond Bay Biological Station for experimental use.

Table 1. Number of adult sea lampreys captured in assessment traps in tributaries of the Great Lakes, 1978–80.

Location	1978	1979	1980
Lake Superior			
Iron River	26[a]	21[a]	3
Big Garlic River	135	191	122
Rock River	508	677	329
Miners River	–	12	82
Betsy River	185[a]	104[a]	188
Tahquamenon River	310	433	337
Subtotal	1,164	1,438	1,061
Lake Michigan[b]			
Oconto River	–	2	2
Peshtigo River	2,360	265	305
Menominee River	1,840	131	194
Manistique River	5,408	4,948	7,895
Weston Creek	–	146	61
Carp Lake River	–	68	293
Jordan River			
Deer Creek	40	–	67
Boardman River	62	–	163
Betsie River	451	–	317
Sable River	–	–	2
Muskegon River	67	–	13
St. Joseph River	879	–	176
Subtotal	11,107	5,560	9,488
Lake Huron			
St. Marys River	1,148	1,213	1,995
Cheboygan River	6,489	8,327	7,469
Sturgeon River	–	2	0
Trout River	40	2	1
Subtotal	7,677	9,544	9,465
Lake Erie			
Cattaraugus Creek	–	–	1,181
Lake Ontario[b]			
Sterling Creek	–	–	28
Sterling Valley Creek	–	–	324
Catfish Creek	65	360	29
Grindstone Creek	315	623	311
Little Salmon River	242	673	47
Salmon River			
Beaver Dam Brook	–	–	54
Subtotal	622	1,656	793
Total all lakes	20,570	18,198	21,988

[a] Figures represent catches at electrical barriers.

[b] No lampreys were captured in traps in 1980 in the Fox and Escanaba rivers on Lake Michigan, or in Sodus, Wolcott, Rice, Skinner, South Sandy, and Stony creeks on Lake Ontario.

Table 2. Adult sea lampreys captured in assessment traps in tributaries of the Great Lakes in 1980: average length and weight, and percent males.

Lake and stream	Number in sample	Average length (mm)	Average weight (g)	Percent males
Lake Superior				
Iron River	3	429	179	67
Big Garlic River	122	419	167	38
Rock River	143	419	157	36
Miners River	82	410	168	38
Betsy River	171	431	164	37
Tahquamenon River	301	438	186	52
Lake Superior streams	822	428	172	43
Lake Michigan				
Oconto River	2	485	238	0
Peshtigo River	305	480	236	42
Menominee River	194	477	239	34
Manistique River	3,007	471	221	36
Weston Creek	61	501	252	46
Carp Lake River	260	417	163	35
Jordan River				
Deer Creek	67	469	251	30
Boardman River	163	457	219	29
Betsie River	317	467	228	40
Sable River	2	438	155	50
Muskegon River	13	483	229	15
St. Joseph River	120	481	233	40
Lake Michigan streams	4,513	469	221	37
Lake Huron				
St. Marys River	691	474	227	49
Cheboygan River	621	445	197	31
Ocqueoc River[a]	205	439	172	39
Lake Huron streams	1,517	457	208	40
Lake Erie				
Cattaraugus Creek	900	512	284	56
Lake Ontario				
Sterling Creek	27	486	244	56
Sterling Valley Creek	80	488	241	51
Catfish Creek	27	487	262	59
Grindstone Creek	111	478	252	55
Little Salmon River	43	466	251	56
Salmon River				
Beaver Dam Brook	54	491	250	65
Lake Ontario streams	342	482	249	56

[a] Lampreys were captured in the electrical barrier.

Table 3. Number of parasitic-phase sea lampreys and (in parentheses) number of spawning-phase lampreys collected by commercial and sport fishermen in various statistical districts of the Great Lakes, 1976–80.

District[a]	Length[b] (mm)	1976	1977	1978	1979	1980
			Lake Superior			
M-2	≤ 200	0	0	0	0	1
	> 200	8	6	1	0	2
M-3	≤ 200	1	0	0	0	0
	> 200	13	5 (38)	4 (2)	4	10
Wisc.	≤ 200	2	2	0	3	6
	> 200	81 (1)	127 (5)	54 (19)	58	98 (3)
MS-1	≤ 200	–	–	–	1	0
	> 200	–	–	–	7	2
MS-2	≤ 200	1	2	1	0	1
	> 200	1	2	1	3 (1)	1
MS-3	≤ 200	4	6	4	7	8
	> 200	16	22	14 (2)	16	13
MS-4	≤ 200	2	2	0	1	2
	> 200	20	13 (1)	25 (1)	59 (1)	126 (2)
MS-5	≤ 200	0	0	0	0	3
	> 200	2	1	0	12	5
MS-6	≤ 200	0	7	2	1	0
	> 200	16	20	24	17	7
Total	≤ 200	10	19	7	13	21
	> 200	157 (1)	196 (44)	123 (24)	176 (2)	264 (5)
			Lake Michigan			
MM-1	≤ 200	15	37	8	8	9
	> 200	94 (11)	233 (12)	36 (14)	38 (5)	19 (3)
MM-2	≤ 200	2	0	0	1	–
	> 200	12(1)	5	5	2	–
MM-3	≤ 200	4	8	3	8	2
	> 200	35 (2)	51	100	60	55
MM-5	≤ 200	1	–	–	–	–
	> 200	3	–	–	–	–
MM-6	≤ 200	0	–	–	–	–
	> 200	0	–	–	–	–
MM-7	≤ 200	0	–	–	–	–
	> 200	0	–	–	–	–
MM-8	≤ 200	0	–	–	–	–
	> 200	0	–	–	–	–
WM-1	≤ 200	1	8	0	0	1
	> 200	41 (4)	289 (11)	4 (8)	2	1
WM-2	≤ 200	24	217	6	2	0
	> 200	98	303	13	14	14
WM-3	≤ 200	3	6	1	1	5
	> 200	38	130	25	23	34

Table 3. (Cont'd.)

District[a]	Length[b] (mm)	1976	1977	1978	1979	1980
WM-4	≤ 200	1	4	2	0	0
	> 200	25 (86)	62 (235)	17 (95)	13 (53)	30 (51)
WM-5	≤ 200	0	0	–	0	0
	> 200	7	2 (1)	–	1	4
Total	≤ 200	51	280	20	20	17
	> 200	353 (104)	1,075 (259)	200 (117)	153 (58)	157 (54)
			Lake Huron			
MH-1[c]	≤ 200	3	48	21	32	36
	> 200	120	222	590	592	736
MH-2	≤ 200	–	–	–	–	0
	> 200	–	–	–	–	1
MH-4	≤ 200	1	–	–	–	0
	> 200	6 (3)	–	–	–	2
Total[c]	≤ 200	4	48	21	32	36
	> 200	126 (3)	222	590	592	739

[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 M-1; Lake Michigan districts MM-4, WM-6, Illinois, or Indiana; or Lake Huron districts MH-3, MH-5, or MH-6.

[b]Lampreys ≤ 200 mm long were recently metamorphosed parasitic-phase sea lampreys.

[c]Includes corrections of previously published figures to reflect 282 lampreys in 1978 and 364 in 1979 taken by fishermen in MH-1 for research studies at the Hammond Bay Biological Station.

Table 4. Sea Lamprey catch per unit of effort (one lift of a trap net set for lake whitefish) in statistical district MH-1, Lake Huron
[Number of sea lampreys in parentheses.]

Port	1978	1979	1980
DeTour	0.53 (286)	0.41 (235)	0.52 (306)
Rogers City	0.89 (282)	0.89 (364)	1.30 (405)
Combined	0.66 (568)	0.61 (599)	0.79 (711)

Table 5. Tributaries of Lake Superior with reestablished populations of sea lampreys, and the maximum number collected per hour with an electric shocker.
[B indicates the presence of a year class recovered with Bayer 73.]

Stream	Date of last treatment	Year class 1977	1978	1979	1980
Waiska River	9/30/76	1	9	42	3
Pendills Creek	7/27/73	0	15	9	0
Grants Creek	7/21/63	3	0	1	0
Galloway Creek	10/6/76	0	2	0	0
Betsy River	6/8/78		30	98	49
Little Two Hearted River	7/7/79			51	0
Two Hearted River	7/9/79			60	37
Beaver Lake Outlet	9/11/79				1
Miners River	9/5/77		12	49	6
Munising Falls Creek	9/3/64	0	0	3	0
Anna River	5/18/65	0	0	1	1
Five Mile Creek	8/31/77		1	14	14
Chocolay River	9/12/73	4	1	5	3
Harlow Creek	11/3/78			16	26
Little Garlic River	6/26/78		43	48	8
Iron River	6/12/78		0	2	1
Salmon Trout River (Mqt. Co.)	6/21/79		157	70	16
Sturgeon River	10/1/78			34	6
Trap Rock River	8/5/63	1	0	0	0
Traverse River	10/7/78			97	36
Salmon Trout River (Htn. Co.)	10/11/78			36	4
Elm River	9/10/64	0	15	0	0
Misery River	8/13/78			63	15
Firesteel River	9/18/77		35	82	72
Ontonagon River	7/29/78		1	9	1
Cranberry River	9/16/77		18	13	2
Black River	7/14/76	B	B	B	–
Montreal River	7/12/75	0	B	0	–
Sand River	10/16/64	–	0	9	0
Nemadji River	9/23/78			61	1
Split Rock River	8/1/76	1	0	0	0
Arrowhead River	7/7/77	0	1	1	0
Total number of streams in which year class was collected		6	16	26	20

Table 6. Tributaries of north and west shores of Lake Michigan with reestablished populations of sea lampreys, and the maximum number collected per hour with an electric shocker.
[B indicates the presence of a year class recovered with Bayer 73.]

Stream	Date of last treatment	Year class 1977	1978	1979	1980
Brevort River	6/24/77	1	32	120	20
Paquin River	6/8/78		0	1	0
Hog Island Creek	5/15/79			7	0
Black River	6/10/78		61	114	41
Millecoquins River	6/23/77	3	23	93	21
Rock River	6/27/77	0	2	0	0
Point Patterson Creek	9/23/75	0	10	0	0
Hudson Creek	7/16/78		0	44	0
Milakokia River	10/23/78			132	105
Bulldog Creek	6/9/77	22	72	121	3
Gulliver Lake Outlet	6/12/77	0	15	0	0
Marblehead Creek	6/11/77	2	75	26	0
Manistique River	8/10/74	B	B	B	B
Johnson Creek (Sch. Co.)	6/13/77	0	65	0	0
Deadhorse Creek	6/28/77	0	7	25	0
Bursaw Creek	7/13/78		0	15	8
Parent Creek	7/14/78		25	71	0
Poodle Pete Creek	9/4/75	1	2	5	0
Fishdam River	10/14/76	28	76	74	3
Sturgeon River	6/23/79			60	19
Ogontz River	10/18/78			62	6
Hock Creek	6/23/71	12	8	0	0
Whitefish River	5/16/80				18
Rapid River	8/4/77		57	17	0
Portage Creek	9/2/78			8	0
Ford River	5/31/80				108
Cedar River	6/10/79			123	3
Menominee River	8/21/77		B	B	–
Peshtigo River	6/23/78		B	B	0
Hibbards Creek	5/13/79			12	3
Kewaunee River	5/10/75	1	2	3	0
East Twin River	5/12/75	0	10	0	0
Total number of streams in which year class was collected		9	20	24	14

Table 7. Tributaries of north shore of Lake Huron with reestablished populations of sea lampreys, and the maximum number collected per hour with an electric shocker.

Stream	Date of last treatment	Year class			
		1977	1978	1979	1980
Little Munuscong River	6/9/77	95	56	9	26
Munuscong River	5/17/78		0	11	0
Caribou Creek	5/13/78		3	9	0
Albany Creek	10/3/79				37
Trout Creek	5/29/79			2	21
Beavertail Creek	5/23/75	14	35	9	2
McKay Creek	5/24/79			20	0
Nuns Creek	9/21/74	0	11	23	2
Pine River	5/27/77	30	23	59	42
McCloud Creek	10/25/72	0	0	3	0
Carp River	5/27/78		12	192	74
Total number of streams in which year class was collected		3	6	10	7

Table 7. Tributaries of north shore of Lake Huron with reestablished populations of sea lampreys, and the maximum number collected per hour with an electric shocker.

Stream	Date of last treatment	Year class 1977	1978	1979	1980
Little Munuscong River	6/9/77	95	56	9	26
Munuscong River	5/17/78		0	11	0
Caribou Creek	5/13/78		3	9	0
Albany Creek	10/3/79				37
Trout Creek	5/29/79			2	21
Beavertail Creek	5/23/75	14	35	9	2
McKay Creek	5/24/79			20	0
Nuns Creek	9/21/74	0	11	23	2
Pine River	5/27/77	30	23	59	42
McCloud Creek	10/25/72	0	0	3	0
Carp River	5/27/78		12	192	74
Total number of streams in which year class was collected		3	6	10	7

Table 8. Details on the application of lampricides to tributaries of Lake Superior, 1980.
[Lampricides used are in kilograms and pounds of active ingredient.]

Stream	Date	Discharge at mouth		TFM used		Bayer powder used		Stream treated	
		m^3/s	cfs	kg	lb	kg	lb	km	miles
Washington Creek	June 3	1.27	45	79.8	176	0.0	0.0	3.2	2
Tahquamenon River	July 25	9.91	350	2,235.3	4,928	0.0	0.0	48.3	30
Brule River	Aug. 8	4.53	160	808.3	1,782	0.0	0.0	104.6	65
Bad River	Aug. 22	22.37	790	4,031.6	8,888	0.0	0.0	183.5	114
Silver River	Sept. 5	0.91	32	129.7	286	0.0	0.0	4.8	3
Ravine River	Sept. 6	0.08	3	20.0	44	0.0	0.0	8.0	5
Fish Creek (Eileen Twp.)	Sept. 6	3.96	140	389.2	858	0.0	0.0	19.3	12
Slate River	Sept. 7	0.08	3	10.0	22	0.0	0.0	1.6	1
Falls River	Sept. 8	1.42	50	109.8	242	0.0	0.0	1.6	1
Poplar River	Sept. 9	0.42	15	39.9	88	0.0	0.0	12.8	8
Middle River	Sept. 9	0.85	30	79.8	176	0.0	0.0	24.1	15
Sturgeon River									
Otter River	Sept. 10	5.66	200	1,087.7	2,398	0.0	0.0	19.3	12
Amnicon River	Sept. 18	1.84	65	199.6	440	0.0	0.0	16.0	10
Potato River	Sept. 23	0.99	35	179.6	396	0.0	0.0	38.6	24
Huron River	Oct. 3	3.54	125	369.2	814	0.0	0.0	9.6	6
Sucker River	Oct. 3	2.27	80	369.2	814	0.0	0.0	17.7	11
Furnace Creek	Oct. 6	0.37	13	89.8	198	0.0	0.0	3.2	2
Big Garlic River	Oct. 8	0.57	20	89.8	198	0.0	0.0	4.8	3
Au Train River	Oct. 15	3.40	120	878.2	1,936	5.6	12.0	19.3	12
Total	...	64.44	2,276	11,196.5	24,684	5.6	12.0	540.3	336

Table 9. Details on the application of lampricides to tributaries of Lake Michigan, 1980.
[Lampricides used are in kilograms and pounds of active ingredient.]

Stream	Date	Discharge at mouth		TFM used		Bayer powder used		Stream treated	
		m³/s	cfs	kg	lb	kg	lb	km	miles
Whitefish River	May 16	7.65	270	1,965.9	4,334	0.0	0.0	322.0	200
Ford River	May 31	4.96	175	3,053.6	6,732	11.0	24.0	338.0	210
Millecoquins River									
McAlpine Creek	July 14	0.40	14	99.8	220	0.0	0.0	3.2	2
Boardman River									
Hospital Creek	July 25	0.28	10	99.8	220	0.0	0.0	4.8	3
Lower Boardman	July 26	7.08	250	928.1	2,046	4.5	10.0	1.6	1
Upper Boardman	July 28	7.36	260	1,287.3	2,838	7.6	17.0	4.8	3
Good Harbor Creek	Aug. 9	0.65	23	169.6	374	0.0	0.0	4.8	3
Elk Lake Outlet									
North Channel	Aug. 11	7.08	250	3,053.6	6,732	0.0	0.0	1.6	1
Big Manistee River									
Blacksmith Bayou	Aug. 21	–	–	349.3	770	0.0	0.0	0.2	<1
Total	...	35.46	1,252	11,007.0	24,266	23.1	51.0	681.0	424

Table 10. Details on the application of lampricides to tributaries of Lake Huron, 1980.
[Lampricides used are in kilograms and pounds of active ingredient.]

Stream	Date	Discharge at mouth		TFM used		Bayer powder used		Stream treated	
		m³/s	cfs	kg	lb	kg	lb	km	miles
Pine River	May 10	0.91	32	209.6	462	0.0	0.0	25.7	16
Swan River	May 31	1.08	38	214.6	473	0.0	0.0	16.0	10
Cheboygan River									
Maple River	June 3	3.57	126	678.6	1,496	0.0	0.0	20.9	13
Rifle River									
Dedrich Creek	June 26	0.08	3	29.9	66	0.0	0.0	4.8	3
Campbell Creek	June 26	0.17	6	49.9	110	0.0	0.0	16.0	10
Mansfield Creek	June 27	0.14	5	59.9	132	0.0	0.0	8.0	5
Prior Creek	June 28	0.57	20	289.4	638	0.0	0.0	12.8	8
Klacking Creek	June 28	0.99	34	289.4	638	0.0	0.0	8.0	5
Eddy Creek	June 29	0.34	12	139.7	308	0.0	0.0	16.0	10
AuSable River	July 12	36.81	1,300	7,234.9	15,950	22.9	51.0	19.3	12
Ocqueoc River	Aug. 25	1.10	39	269.4	594	0.0	0.0	3.2	2
Albany Creek	Sept. 18	0.14	5	20.0	44	0.0	0.0	1.6	1
Carp River	Sept. 21	4.53	160	518.9	1,144	7.5	16.0	16.0	10
Total	...	50.43	1,780	10,004.2	22,055	30.4	67.0	168.3	105

SEA LAMPREY CONTROL IN CANADA

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This report summarizes the activities of the Canadian Sea Lamprey Control Unit during the period April 1, 1980 to March 31, 1981, 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 one electrical barrier and a number of weirs and traps; treatments of streams and other bodies of water require the controlled application of selective toxicants; surveys for larval lampreys (ammocoetes) are carried out with the use of electricity or chemicals, while biological studies are focused upon the distribution, movement, abundance, and growth of sea lamprey.

Electrical Barrier, Weir and Trap Operations

The barrier operated on Kaskawong River, a tributary of Lake Huron, to assess sea lamprey runs, captured a total of 263 sea lamprey—slightly fewer than the figure for the previous year (302). This was the last season of operation for this electrical barrier. Examination of specimens for size, sex and maturity revealed no significant differences from the values obtained in the previous year.

Mechanical weirs and traps were operated on Great Lakes tributaries to capture spawning phase sea lamprey, with the results shown in Table 1. Compared with the 1979 figures, catches at these devices in 1980 were lower in some cases and higher in others, with no clear trends in numbers

observable. Similarly there were no significant changes in mean sizes or sex ratios between 1979 and 1980.

Trawling for Sea Lamprey in St. Marys River

This annual project monitors the temporary concentration of adult sea lamprey that occurs each fall below the International Rapids in St. Marys River. In 1980 the catch was only nine sea lamprey, with a catch rate of 0.05 per hour—a marked decrease from the 1979 figures (see Table 2).

Sea Lamprey from Commercial Fishermen

In response to the reward offered to commercial fishermen for predatory-phase sea lamprey and related catch data, a total of 363 specimens were submitted from the 1980 fishery. Most of these were from Lake Huron's main basin and the North Channel, with a much smaller number from Lake Superior. No trends in mean sizes or sex ratios for sea lamprey obtained at comparable periods, and from similar fishing gear, have been apparent for several years. A predominance of females characterizes the offshore catches of predatory sea lamprey during most of the year, and the mean size of specimens obtained from fisheries for large fish is greater than is the case for smaller fish.

Stream Surveys

During surveys for ammocoetes in 1980 no new sea lamprey producing tributaries were found. In the Lake Superior drainage, the Canadian Control Unit conducted routine surveys of one stream having no previous record of sea lamprey occurrence, re-establishment surveys of nine streams previously treated with lampricide, distribution surveys of seven streams to define the extent of sea lamprey populations, treatment-evaluation surveys of seven previously treated streams and part of one bay, and population studies on 13 streams.

In the Lake Huron drainage the following surveys were carried out: routine surveys of 117 streams, re-establishment surveys of 21 streams, distribution surveys on 10 streams, treatment-evaluation surveys of eight streams and one inlet, and a population study on 14 streams.

On the Canadian side of Lake Ontario routine surveys of 73 streams, re-establishment surveys of 13 streams, distribution surveys of 10 streams, treatment-evaluation surveys of 12 streams and population studies on nine streams were carried out; while on the United States side re-establishment surveys of 12 streams, distribution surveys of six streams, treatment-evaluation surveys of seven streams and population studies on four streams were carried out.

In the Lake Erie drainage routine surveys were performed on 120 Canadian streams. No new sea lamprey populations were discovered. Lake

Erie is the only one of the Great Lakes in which sea lamprey control measures have not yet been implemented.

In addition to the foregoing, granular Bayer 73 was applied to selected areas of embayments in the Lake Superior drainage (Batchawana, Mountain, Mackenzie, and Cypress Bays), and in the St. Marys River.

Lampricide Treatments

In the Lake Superior drainage, four (Stokely, Chippewa, Wolf and Batchawana) of the five scheduled stream treatments were completed. The Nipigon River treatment was postponed owing to the inability to obtain the desired controlled flow of water. Details of these treatments are shown in Table 3.

In the Lake Huron drainage all of the six scheduled stream treatments were completed. These were Root, Echo, Naiscoot and Magnetawan Rivers and Brown and Sucker Creeks. Table 4 lists details of these treatments.

All of the five scheduled treatments on the Canadian side of Lake Ontario (Bowmanville, Shelter Valley, Bronte, Credit and Wilmot), and in addition two unscheduled treatments (Graham and Duffin) were completed. All of the seven scheduled treatments of streams on the United States side of Lake Ontario (Snake, Catfish, South Sandy, First, Skinner, Lindsey and Black) were completed. The Lake Ontario treatments are summarized in Table 5.

Sea Lamprey Barrier Dams

During 1980 low-head barrier dams were built on Kaskawong River (Lake Huron), Duffin Creek (Lake Ontario) and Stokely Creek (Lake Superior). Improvements were made on the previously built Gimlet Creek and Sturgeon River structures while major repairs were undertaken at Reid's Dam on the Credit River (Lake Ontario) washed out in the spring of 1980.

Table 1. **Spawning phase adult sea lamprey biological data collected from assessment units fished in Canadian tributaries to the Great Lakes, 1980.**

Lake	Tributary	Unit	Number Collected	Number Sampled	Percent ♂	Mean Length (cm) ♂	Mean Length (cm) ♀	Mean Weight (gm) ♂	Mean Weight (gm) ♀
SUPERIOR	Sable R.	W	18	17	47	43	40	172	153
	Pancake R.	T	20	20	40	42	40	160	163
	Little Gravel R.	W	2	2	50	49	44	219	162
	Cypress R.	W	9	7	29	37	42	109	175
	Mackenzie R.	T	1	1	0	–	36	–	106
			50	47	40	42	40	163	160
HURON	St. Marys R.	T	2	2	100	47	–	222	–
	Echo R.	T	4	4	25	40	42	128	173
	Sucker Cr.	T	7	7	29	48	45	234	194
	Kaskawong R.	E	263	262	35	45	47	205	231
	Thessalon R.	T	272	272	43	46	46	209	222
	Mindemoya R.	T	3	3	33	52	44	309	188
	Blue Jay Cr.	W	91	90	39	48	49	219	224
	Silver Cr.	W	8	8	25	58	48	300	195
	Beaver R.	T	1	1	0	–	48	–	237
	Saugeen R.	T	1	1	0	–	51	–	316
	Lucknow R.	T	1	1	0	–	53	–	292
			653	651	38	46	47	210	225
ERIE	Big Cr.	T	92	92	58	50	50	276	280
	Fisher Cr.	T	1	1	0	–	50	–	344
	Young Cr.	T	115	115	53	50	48	258	234
			208	208	55	50	48	266	254
ONTARIO	Bronte Cr.	T	2	2	50	46	44	220	245
	Credit R.	T	3	3	33	52	50	260	278
	Humber R.	T	104	101	54	48	47	219	232
	Lynde Cr.	T	4	4	50	50	52	220	278
	Bowmanville Cr.	T	28	28	46	49	47	262	253
	Wilmot Cr.	T	67	67	60	48	46	238	232
	Graham Cr.	W	160	133	59	51	51	262	284
	Shelter Valley Br.	T	12	11	36	51	48	293	236
	Salmon R.	T	4	4	25	42	45	160	191
			384	353	55	49	49	245	253

E — electrical barrier T — trap W — mechanical weir

Table 1. Spawning phase adult sea lamprey biological data collected from assessment units fished in Canadian tributaries to the Great Lakes, 1980.

Lake	Tributary	Unit	Number Collected	Number Sampled	Percent ♂	Mean Length (cm) ♂	Mean Length (cm) ♀	Mean Weight (gm) ♂	Mean Weight (gm) ♀
SUPERIOR	Sable R.	W	18	17	47	43	40	172	153
	Pancake R.	T	20	20	40	42	40	160	163
	Little Gravel R.	W	2	2	50	49	44	219	162
	Cypress R.	W	9	7	29	37	42	109	175
	Mackenzie R.	T	1	1	0	–	36	–	106
			50	47	40	42	40	163	160
HURON	St. Marys R.	T	2	2	100	47	–	222	–
	Echo R.	T	4	4	25	40	42	128	173
	Sucker Cr.	T	7	7	29	48	45	234	194
	Kaskawong R.	E	263	262	35	45	47	205	231
	Thessalon R.	T	272	272	43	46	46	209	222
	Mindemoya R.	T	3	3	33	52	44	309	188
	Blue Jay Cr.	W	91	90	39	48	49	219	224
	Silver Cr.	W	8	8	25	58	48	300	195
	Beaver R.	T	1	1	0	–	48	–	237
	Saugeen R.	T	1	1	0	–	51	–	316
	Lucknow R.	T	1	1	0	–	53	–	292
			653	651	38	46	47	210	225
ERIE	Big Cr.	T	92	92	58	50	50	276	280
	Fisher Cr.	T	1	1	0	–	50	–	344
	Young Cr.	T	115	115	53	50	48	258	234
			208	208	55	50	48	266	254
ONTARIO	Bronte Cr.	T	2	2	50	46	44	220	245
	Credit R.	T	3	3	33	52	50	260	278
	Humber R.	T	104	101	54	48	47	219	232
	Lynde Cr.	T	4	4	50	50	52	220	278
	Bowmanville Cr.	T	28	28	46	49	47	262	253
	Wilmot Cr.	T	67	67	60	48	46	238	232
	Graham Cr.	W	160	133	59	51	51	262	284
	Shelter Valley Br.	T	12	11	36	51	48	293	236
	Salmon R.	T	4	4	25	42	45	160	191
			384	353	55	49	49	245	253

E — electrical barrier T — trap W — mechanical weir

Table 2. Numbers of sea lamprey caught per hour of trawling at the Edison Sault Electric plant in St. Marys River in 1978, 1979 and 1980.

Week Ending			Trawling Time (Hours)			No. of Lamprey			No. of Lamprey per hour		
1978	1979	1980	1978	1979	1980	1978	1979	1980	1978	1979	1980
	Oct. 20		30.1	13.2			4			0.3	
Oct. 28	Oct. 27	Oct. 25	30.1	15.8	21.1	2	5	0	0.1	0.3	0.0
Nov. 4	Nov. 3	Nov. 1	29.8	21.1	25.3	8	12	0	0.3	0.6	0.0
Nov. 11	Nov. 10	Nov. 8	30.2	30.7	28.2	0	6	3	0.2	0.2	0.1
Nov. 18	Nov. 17	Nov. 15	24.2	18.8	24.9	6	1	3	0.2	0.1	0.1
Nov. 25	Nov. 24	Nov. 22	27.1	27.9	31.1	7	9	2	0.3	0.3	0.1
Dec. 2	Dec. 1	Nov. 29	12.2	30.0	30.9	2	13	1	0.2	0.4	0.0
Dec. 9	Dec. 8	Dec. 6	14.8	31.2	8.1	0	0	0	0.0	0.0	0.0
Dec. 16			–			–			–		
Dec. 23			6.0			0			0.0		
TOTALS &/OR AVERAGES			174.6	188.8	169.6	31	50	9	0.2	0.3	0.05

Table 3. Summary of streams and bay areas treated with lampricide on Lake Superior, 1980.

Stream	Date	FLOW		TFM Act. Ingr.		Bayer 73 Act. Ingr.		Granular Bayer 73		*/Sea lamprey collected	Area Treated	
		m^3/s	f^3/s	kg	lbs.	kg	lbs.	kg	lbs.		km	miles
Stokely Cr.	June 25–26	0.4	15	70	154	–	–	–	–	S / 153	10.9	6.8
Chippewa R.	July 10–11	6.9	245	384	847	6.1	13.5	–	–	M/ 203	2.9	1.8
Wolf R.	July 18–19	5.3	186	716	1,579	10.7	23.5	3	7	M/ 430 (3)	11.3	7.0
Batchawana R.	Sept. 10–12	8.2	290	826	1,820	–	–	–	–	S / 398 (4)	14.5	9.0
BATCHAWANA BAY											Ha	acres
—Batchawana R.	July 30	–	–	–	–	–	–	1,179	2,600	A / 1,474 (72)	5.2	12.6
—Sable R.	July 31	–	–	–	–	–	–	363	800	M/ 368 (9)	1.9	4.6
—Chippewa R.	July 31 & Aug. 6	–	–	–	–	–	–	658	1,450	M/ 931	3.2	7.9
—Harmony R.	Aug. 1	–	–	–	–	–	–	272	600	S / 70 (2)	1.1	2.8
—Stokely Cr.	Aug. 1	–	–	–	–	–	–	340	750	M/ 276 (1)	1.5	3.8
MOUNTAIN BAY												
—Gravel R.	Aug. 20	–	–	–	–	–	–	1,145	2,519	S / 390 (1)	4.5	11.0
MACKENZIE BAY												
—Mackenzie R.	Aug. 21	–	–	–	–	–	–	286	630	S / 18 (1)	1.1	2.8
CYPRESS BAY												
—Cypress R.	Aug. 23	–	–	–	–	–	–	334	735	M/ 228 (2)	1.3	3.2
Totals		20.8	736	1,996	4,400	16.8	37.0	4,579	10,091		19.8 Ha	49.0 acres
											39.6 km	24.6 miles

*/ Larval sea lamprey abundance rating: S = Scarce; M = Moderate; A = Abundant
( ) indicates number of transforming sea lamprey larvae in collection

Table 4. Summary of streams treated with lampricide on Lake Huron, 1980.

Stream	Date	FLOW m³/s	FLOW f³/s	TFM Act. Ingr. kg	TFM Act. Ingr. lbs.	Bayer 73 Act. Ingr. kg	Bayer 73 Act. Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	*/Sea lamprey collected	Area Treated km	Area Treated miles
Magnetawan R.	May 30– June 4	22.4	790	1,900	4,188	–	–	–	–	S / 409	15.0	9.0
Brown Cr.	June 17, 18	0.1	3	21	47	–	–	–	–	M/ 320	3.2	2.0
Root R.	June 23–25	2.0	70	179	395	–	–	–	–	S / 507	30.6	19.0
Sucker Cr.	July 3, 4	0.1	3	36	79	–	–	–	–	S / 4	0.8	0.5
Echo R.	July 7–9	1.0	34	83	182	–	–	–	–	S / 434	29.7	18.4
Naiscoot R.	July 16–20	1.1	39	65	142	–	–	–	–	S / 41	10.5	6.5
St. Marys R.											Ha	acres
—Whitefish Is.	Aug. 15	–	–	–	–	–	–	945	2,080	A / 3,670(9)	4.0	10.0
—Root R.	July 24 Aug. 6	–	–	–	–	–	–	345	760	M/ 626	1.7	4.0
—Garden R.	Aug. 7 & 25	–	–	–	–	–	–	445	980	A / 1,640	1.7	4.0
Totals		26.7	939	2,284	5,033	–	–	1,735	3,820		7.4 Ha	18.0 acres
											89.8 km	55.4 miles

*/Larval sea lamprey abundance rating: S = Scarce; M = Moderate; A = Abundant
( ) indicates number of transforming sea lamprey larvae in collection

Table 5. Summary of streams treated with lampricide on Lake Ontario, 1980.

Stream	Date	FLOW m³/s	FLOW f³/s	TFM Act. Ingr. kg	TFM Act. Ingr. lbs.	Bayer 73 Act. Ingr. kg	Bayer 73 Act. Ingr. lbs.	Granular Bayer 73 kg	Granular Bayer 73 lbs.	*/Sea lamprey collected	Area Treated km	Area Treated miles
CANADA												
Bowmanville Cr.	May 2, 3	2.6	91	650	1,430	9.5	21.0	–	–	S / 32	9.2	5.5
Shelter Valley Br.	May 5, 6	0.9	31	268	590	–	–	–	–	A / 2,936	18.7	11.2
Bronte Cr.	May 8, 9	4.4	157	1,046	2,301	7.6	16.8	–	–	M/ 672	31.8	19.0
Credit R.	May 12, 13	7.7	274	1,109	2,439	8.7	19.2	–	–	S / 118	16.0	9.6
Wilmot Cr.	June 9, 10	1.0	36	509	1,123	–	–	–	–	M/ 681	18.2	11.3
Graham Cr.	Sept. 17–19	0.2	7	309	680	–	–	64	140	A / 2,330(124)	17.4	10.8
Duffin Cr.	Sept. 21–23	1.3	45	804	1,768	–	–	–	–	A / 983	33.3	20.7
UNITED STATES												
Snake Cr.	May 2–5	0.3	10	92	202	–	–	–	–	M/ 676	15.4	9.6
Catfish Cr.	May 5–6	1.9	68	343	757	–	–	–	–	S / 177	11.9	7.4
South Sandy Cr.	May 8–9	5.7	200	641	1,414	–	–	–	–	S / 120	11.9	7.4
First Cr.	May 11–13	0.1	4	41	90	–	–	–	–	S / 148	4.8	3.0
Skinner Cr.	May 29–June 1	0.3	12	119	262	–	–	–	–	M/ 312	12.6	7.8
Lindsey Cr.	June 2–4	0.6	20	139	306	–	–	–	–	S / 122	14.2	8.8
Black R.	Aug. 18–20	48.1	1,700	3,899	8,596	60.0	133.0	–	–	A / 1,913(222)	15.0	9.3
TOTALS		75.1	2,655	9,969	21,958	85.8	190	64	140	11,220	230.4	141.4

*/Larval sea lamprey abundance rating: S = Scarce; M = Moderate; A = Abundant
( )Indicates number of transforming sea lamprey larvae in collection

ALTERNATIVE METHODS OF SEA LAMPREY CONTROL

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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, more economical, and ecologically safe. The Great Lakes Fishery Laboratory, under contract with the GLFC, performs research on the development of alternative methods for control of the sea lamprey. Part of this research is conducted at the Hammond Bay Biological Station (HBBS) located on Lake Huron near Rogers City, Michigan; additional research is conducted at the Monell Chemical Senses Center (MCSC), Philadelphia, Pennsylvania, and the National Fish Health Research Laboratory (NFHRL), Leetown, West Virginia.

Development of Methods to Sterilize Adult Sea Lampreys

Studies were continued to determine if male, spawning-run sea lampreys can be sterilized by the injection of 100 mg/kg of B-Estradiol or 100 or 200 mg/kg of 50:50 mixtures of B-Estradiol and Depo-testosterone cypionate (DTC). We injected 10 males at each dose rate (30 total) and released them in an artificial stream in the laboratory with 40 normal (untreated) males and 40 normal females. Female lampreys observed spawning

with a treated male were also spawned with a normal male to provide a control on the fertility of the female. Test groups of eggs from the different spawnings were held in glass battery jars partially immersed in constant temperature troughs held at 18.3°C. Dead embryos were periodically removed. After 21 days of incubation, at which time embryos would normally have developed to stage 17 (the burrowing stage), all remaining embryos were fixed in 4% formalin. Microscopic examination of these preserved specimens revealed that the hormones injected into male spawning-run sea lampreys had no effect on the number of normal larvae produced, and therefore had no sterilizing action at the dose rates tested.

Burst Swimming Speed of Spawning-Run Sea Lampreys

The installation of low-head barrier dams to prevent the upstream movement of spawning-run sea lamprey on certain streams is part of the integrated sea lamprey control program endorsed by the Great Lakes Fishery Commission and its cooperators. One concern is that such dams could be rendered ineffective as barriers to the upstream movement of spawning-run sea lampreys during periods of high stream flow and flooding. As a result, consideration is being given to the design of low-head dams that will, during high stream flow, create a velocity field in the stream channel that would serve as a barrier to the upstream movement of sea lampreys. The information needed to determine the size and strength of the velocity field that would serve as an effective barrier to the upstream movement of spawning-run sea lampreys was not available and required studies of the maximum (burst) swimming speed of spawning-run sea lampreys.

We constructed a 10 ft. long flow-through flume, at the sea lamprey weir site on the Ocqueoc River, where swimming performance could be measured. During May–June 25, 1980 we conducted nineteen 10-hour swimming speed tests in the flume. In each test freshly caught spawning-run sea lampreys from the Cheboygan or the Ocqueoc rivers were placed in a reservoir into which the test flume discharged. The lampreys were confined to the reservoir until about 1400 hours on the following day when a screen at the discharge end of the flume was lifted. The lampreys then had access to the flume until about 2400 hours, when the screen was replaced and the test was concluded.

The results of these tests suggest that spawning-run sea lampreys were less motivated to enter and ascend the flume when water temperatures were below 15°C, than when temperatures were higher. We were unable to obtain sufficient numbers of lampreys for testing at temperatures below 10°C. but the results of 6 tests conducted at about 10–15°C, at water velocities of 5–13 ft/s, showed only 4 of 202 lampreys in the reservoir entered and attempted to ascend the test flume. In 13 tests conducted at about 16–24°C and water velocities of 9–13 ft/s, however, 98 of the 590 lampreys in the reservoir entered and attempted to ascend the flume.

Because the distance lampreys were able to ascend the flume in a single (uninterrupted) swimming effort did not appear to be related to water temperature, the data obtained at all water temperatures tested were combined for presentation. The average and maximum distances lampreys swam up the flume and the numbers of lampreys that were able to swim the entire length of the flume (10 feet) in a single effort, or incrementally (by alternatively swimming and attaching to the sides or bottom of the flume to rest) are as follows:

Water velocity (ft/s) in test flume	Total number of tests	Total number of lampreys tested	Total number of single swimming efforts observed	Distance (ft) lampreys ascended flume in a single swimming effort		No. of lampreys swimming the entire length of flume	
				Average	Maximum	In a single effort	Incre-mentally
5	3	108	1	–	≥ 10	1	0
9	6	241	221	2.5	≥ 10	5	49
10	1	45	6	1.5	3.5	0	1
11	2	89	99	0.7	4.3	0	6
12	2	101	165	1.2	6.0	0	19
13	5	208	111	0.4	4.5	0	0

As expected, the test results show that the average distance spawning-run sea lampreys swam upstream in the test flume was inversely related to water velocity. Some lampreys swam the entire length of the flume in a single effort against water velocities of 5 and 9 ft/sec, but none did so at velocities of 10 ft/sec or higher. Most of the lampreys that swam the entire length of the flume at water velocities of 9–12 ft/sec did so incrementally, indicating that an effective velocity barrier would be difficult to establish unless lampreys were denied attachment sites within the velocity barrier field.

Although the results of this study suggest a water velocity of 12 ft/sec (maintained over a distance of at least 6 ft) would be required to create a completely effective velocity barrier for spawning-run sea lampreys, our observation that few lampreys attempted to ascend the flume at temperatures below 15°C suggests that a much lower water velocity might serve as an effective barrier during the early portion of the spawning run, when low-head barrier dams would most likely be rendered ineffective by flooding.

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

Studies continued to provide data needed to establish more fully the relation between sea lamprey wounding and sea lamprey-induced mortality in lake trout. A better understanding of the wounding-mortality relation is

needed to estimate the impact of residual sea lamprey populations on lake trout stocks and to determine the optimum level of sea lamprey control. In the past, attempts have been made to determine lethal lamprey attack rates from the observed frequency of wounds and scars in samples of surviving fish. Most of this evidence linking wounding and mortality is circumstantial, however, because trout killed in the wild by lampreys are seldom found and most of the methods tried or considered to circumvent this problem involved assumptions than cannot be fully met or required bias-free data that are difficult to obtain. Therefore we are conducting tests designed to produce basic information on the wounding-mortality relation as it is influenced by: (1) size of trout, (2) size of lampreys, (3) predator-prey ratio, and (4) water temperature.

Result of studies conducted in 1979 were summarized earlier. In 1980 sixty small lake trout of the 1977 year class (mean length, 420 mm; mean weight, 686 g) were divided into two groups and held at 10°C. One group was then exposed to 10 small lampreys (mean length, 247 mm; mean weight, 21.8 g); the other group served as a control. The test was terminated after 92 days, when 26 of the lamprey-exposed trout had died and all lampreys had voluntarily detached from the 4 surviving trout. None of the unexposed (control) trout died during the test suggesting that the mortality among the lamprey-exposed trout can be attributed to the effects of lamprey attack. Forty attack marks were observed on the 26 trout that died; 34 of these were classified as type A, (exhibiting a break through the skin), and 6 as type B, (no visible break through the skin). The four surviving trout carried 11 marks; 5 were type A, and 6 were type B. The sea lampreys exhibited a mean increase in length and weight respectively of 90 mm and 42.6 g, during the test.

Although our data base is not yet large enough to permit extensive generalization, it appears that the results of the current test are in general agreement with those obtained in earlier tests, which collectively suggest that attacks from large lampreys on small trout are more rapidly lethal than are attacks by small lampreys on large trout, and that attacks are more rapidly lethal at higher water temperatures than at lower ones.

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

We continued to explore the possibility that metamorphosed sea lampreys (transformers) on their downstream migration can be imprinted to an environmentally safe odorant such as phenethyl alcohol (PA) that can be used as a lure to facilitate their capture when they return as adults to spawn. During the spring of 1979, 100 metamorphosed sea lampreys taken from the big Garlic River, a tributary to Lake Superior, were marked, exposed to 5×10^{-5} mg/L PA for 96 hours in Lake Huron water, and released in the Ocqueoc River, a tributary to Lake Huron. Throughout the spawning run of 1980, PA was metered into the Ocqueoc River sea lamprey weir trap at a rate that produced a concentration of about 5×10^{-5} mg/L in the river.

Two marked spawning-run sea lampreys from the group of 100 transformers that had been exposed to PA and released in the Ocqueoc River in 1979, were captured in the weir trap on that river in 1980; one of these was captured in the compartment of the trap receiving PA and the other was taken in the compartment of the trap that was not receiving PA. Four other marked lampreys, exposed to PA and released in the Ocqueoc River in 1979, were recaptured in other rivers in 1980; three of these were taken in the Cheboygan River, a nearby tributary to northern Lake Huron, and the fourth lamprey was captured in the Manistique River, a tributary to northern Lake Michigan. Neither the Cheboygan nor the Manistique rivers received PA during the 1980 spawning run.

The two marked lampreys previously exposed to PA and captured in the Ocqueoc River weir trap were subjected to 2-hour preference tests (together with control lampreys) in water pumped from the Ocqueoc River above the weir trap. PA was metered randomly into one channel or the other of a two-choice chamber at a concentration of 5×10^{-5} mg/L. Nine tests conducted with these animals revealed no attraction to the candidate imprintant to which they had been exposed one year previously. This study was terminated during the period and a final report is in preparation.

Tolerance of Sea Lamprey Larvae to TFM: Effect of Previous Exposure to a Sublethal Concentration

In an earlier study we tested (and rejected) the hypothesis that the tolerance of certain sensitive, non-target fishes to TFM could be increased by exposing them to sublethal concentrations of that lampricide, prior to exposing them to the stronger concentrations required to kill sea lamprey larvae; an unexpected result of this earlier study was the apparent increase in tolerance to TFM among lamprey larvae subjected to the same TFM-exposure regime as the non-target fishes.

In response to a request from the United States sea lamprey control unit, we initiated a follow-up study to confirm or reject the possibility that exposure of lamprey larvae to sublethal concentrations of TFM could increase their tolerance to the lampricide. In the follow-up study we placed two groups of 100 sea lamprey larvae (60–80 mm total length) in standing Lake Huron water at 7.2°C; one of the groups was then "pre-exposed" to 0.5 mg/L TFM for 24 hours. No mortality occurred in either group during this period. Each group was then divided into 5 subgroups and each subgroup was exposed for 9 hours to one of a series of 5 concentrations of TFM previously determined to be lethal to larvae that had not been pre-exposed to the larvicide. A plot of mortality against concentration yielded the following significant mortality values for the two groups:

	Pre-exposed group	*Control group*
LC_{50} mg/L TFM	3.3	3.5
$LC_{99.9}$ mg/L TFM	4.8	5.0

These results indicate that pre-exposure to 0.5 mg/L TFM for 24 hours did not increase the tolerance of the larvae. Additional tests are scheduled to cover the full range of pre-exposure regimes that might be expected to occur when TFM is applied in the field.

Efficacy of New Formulations of Registered Lampricides Against Larvel Sea Lamprey

Testing was continued to determine the effectiveness of pelleted-clay (bentonite) formulations of TFM and Bayer 73 as bottom release toxicants for sea lamprey larvae. Burrowed sea lamprey were exposed in a 6-hour standing-water bioassay at 12.6°C to a pelleted-clay formulation containing a mixture of TFM and Bayer (98 parts TFM to 2 parts Bayer; 5% total active ingredient by weight). This material was applied at the rate of 100 lbs. total formulation per acre. The results of these bioassays indicate that the pelleted-clay mixture of TFM and Bayer performed at least as well as the granular Bayer. Higher initial emergence and mortality were obtained with the granular Bayer, but the pelleted-clay formulation produced higher emergence and mortality by the end of the test period. Replicate tests are planned to determine the relative effectiveness of the two formulations under a range of conditions representative of those encountered in the field.

Identification of Sea Lamprey Pheromones

This report summarizes research conducted during 1980 at the Monell Chemical Senses Center and the Hammond Bay Biological Station to identify and characterize intraspecific chemical signals (pheromones) involved in sea lamprey migration and reproductive behavior. Such substances may prove to be useful as highly specific lures to help capture spawning-run lampreys or as agents for disrupting normal pheromone communication so that successful spawning is prevented or reduced.

The results of approximately 3500 two-choice preference tests, conducted during the 1977–1980 spawning seasons, indicate that at least three different chemical signals may be involved in sea lamprey migration and spawning behavior. Two of the presumed pheromones, one released by sexually mature males and the other by sexually mature females, may be classified as sex attractants. The male pheromone, which elicits a preference response in spawning-run females, is present in the urine of sexually mature, but not immature (i.e., not showing secondary sex characteristics) males. The female pheromone elicits a preference response in spawning-run males and appears to be present in ovarian fluid (and perhaps urine) of sexually mature females. The third chemical signal is released by sea lamprey larvae and appears to attract sexually immature spawning-run adults.

During the 1980 spawning season, approximately 800 preference tests were conducted in an attempt to isolate and identify the behaviorally active compounds released by sea lamprey larvae and by sexually mature males.

Male sex attractant—Urine collected from sexually immature spawning-run male sea lampreys failed to elicit a preference response in spawning-run females at concentrations up to 25.6 uL/L of water in the stimulus compartment of the preference tank. Urine from sexually mature males, however, evoked a preference response in females at concentrations between 6.4 and 12.8 uL/L, depending upon the sample. These results confirm earlier tests which indicated that sexually immature males do not release the sex attractant, at least in sufficient quantities to elicit a preference response in females. The precise relationship between the amount of pheromone released and the degree of sexual maturation of the males has not been determined because a simple, accurate method for assessing sexual maturation has not been available. In addition, the bioassay (two-choice preference test) is not sensitive enough to detect differences in the responses of females resulting from small changes in the concentration of the attractant in male urine. Changes in the responsiveness of females as they become more mature have been difficult to assess for the same reasons. Early in the spawning season, immature females show preferences for urine from sexually mature males, however, it is unclear whether the response is stronger later in the season when the females are more mature.

The major, behaviorally active compounds in urine from sexually mature males are, as expected, fairly water soluble and relatively nonvolatile. They can be concentrated by Sep-pak reverse-phase chromatography or lyophilization and frozen samples retain their behavioral activity for at least 9 months. Although recent tests did not confirm the loss of activity of male urine when heated to 70°C for 1 h as observed in earlier tests, procedures involving temperatures in excess of 45°C are being avoided. Preliminary chromatography on Sephadex G-15 columns indicates that the major active component(s) in male urine has a molecular weight between 300 and 1000. This is consistent with the estimated molecular weight of less than 1500 obtained by ultrafiltration.

Gas chromatographic analysis (GC) of samples of urine from sexually immature and sexually mature males showed several qualitative and quantitative differences, particularly in steroids. One GC peak, which was much larger in behaviorally active urine than in inactive urine (i.e. from immature males) was tentatively identified as testosterone. The concentration of testosterone in active urine was estimated to be about 0.75 ng/ml based on the size of this peak. Although confirmation of the identity of this peak has not been possible because of extensive repairs to our mass spectrometer, testosterone has been found in behaviorally active urine at a concentration of about 0.04 ng/ml using radioimmunoassay (RIA). The discrepancy in the concentrations obtained with the two methods may indicate that compounds other than testosterone are contributing to the observed GC peak. Using RIA, a number of other steroids, including progesterone (0.025 ng/ml), androstenedione (0.09 ng/ml), dihydrotestosterone (0.025 ng/ml), and estrone (0.62 ng/ml), have been found at higher concentrations in behaviorally active male urine than in inactive urine. Enzymatic hydrolysis of male urine with B-glucuronidase and sulfatase resulted in increases in the concentrations of the various steroids, ranging from a 30% increase for estrone to a 10-fold increase for dihydrotestosterone. These results indicate that most of the steroids present in lamprey urine are, as might be expected, conjugated (glucuronides and sulfates), which makes them more water soluble.

Testosterone was found to elicit a preference response in female sea lampreys, but only at concentrations about 1000 times higher than have been detected in behaviorally active urine. Preferences were observed with testosterone at final concentrations in the preference tank of 2.884 pg/ml and 28.84 pg/ml; however, concentrations higher (288.4 and 2884 pg/ml) or lower (0.2884 pg/ml) evoked no observable response in females. The concentration of testosterone in behaviorally active male urine determined by RIA is at most 125 pg/ml (hydrolyzed sample). Since 1 ml of urine in the stimulus compartment of the preference tank (12.8 uL/L) elicits a response in females, the final concentration of testosterone in the tank would be no greater than about 0.0016 pg/ml. Additional experiments will be necessary to determine what role, if any, testosterone plays in the response of females to urine from sexually mature males.

Ammocete pheromone—Although the preference of sexually immature spawning-run lampreys for water in which sea lamprey larvae have been held is quite variable in intensity, sufficient data are available to conclude that the observed preference is a real phenomenon. The variability in the response may be the result of changes in the sensitivity of the responding animals as they become more sexually mature or to changes in the amount of the attractant released by the ammocetes, as the result of uncontrolled environmental or physiological factors.

The active compound(s) released by sea lamprey larvae can be concentrated on columns packed with Amberlite XAD-2 resin and eluted with organic solvents. This technique is currently being used to concentrate the organic compounds present in ammocete holding water for further fractionation by various chromatographic techniques.

The primary difficulty in isolating and identifying the active compounds released by ammocetes is the very short period of time during upstream migration that the adults appear to be responsive to these substances. It may be possible to extend this period somewhat by maintaining lampreys captured early in the season at 5°C.

REGISTRATION-ORIENTED RESEARCH ON LAMPRICIDES

Fred P. Meyer, Director
National Fishery Research Laboratory
U.S. Fish and Wildlife Service
La Crosse, Wisconsin 54601

ABSTRACT

The Fish and Wildlife Service (FWS) responded to requests from the Environmental Protection Agency (EPA) regarding microbiol degradation, residue dynamics, and chronic effects of exposure to TFM. The Service also responded to requests for data and information, and negotiated all proposed requirements pertaining to the continued use of lampricides.

EPA issued an Experimental Use Permit (EUP) to the Service to authorize SLC crews to apply TFM in a solid bar formulation. TFM bars will be ready for field testing this summer.

TFM concentrations in water from garage drains at Ludington Biological Station were nondetectable.

Toxicity of TFM in combination with each of the following water contaminants was tested and was found to be additive: chloropyrifos (Durabar), toxaphene, carbaryl, endrin, mirex, malathion, and hexachlorobenzene.

Eggs of the mayfly, *Hexagenia* sp., are not sensitive to TFM:Bayer at field treatment concentrations. TFM was more toxic to 16-mm animals than to newly hatched nymphs. Bayer 73 was nontoxic to both eggs and nymphs at concentrations used by field crews.

REGISTRATION ACTIVITIES

The Fish and Wildlife Service received a letter from the Environmental Protection Agency dated March 18, 1981 concerning the results of their review of the environmental chemistry data for TFM submitted by FWS on February 10, 1978. The FWS submission was a response to environmental questions raised in an EPA letter dated October 22, 1976. The La Crosse National Fishery Research Laboratory (LNFRL) developed answers to EPA's questions regarding the microbial degradation, residue dynamics, and chronic effects of exposure to TFM and negotiated many of the points being raised by a new generation of EPA personnel. Many of the questions raised by EPA related to current guidelines and not to the guidelines that were in effect when the studies were run in the early and mid 1970's under protocols that had been approved by EPA.

EPA also sent letters concerning additional requirements for food additive tolerances in potable water, milk and meat tolerances, tolerances in fish, and label restrictions regarding irrigation. LNFRL personnel responded to the latest requests for data and information and negotiated all proposed requirements. Negotiations are continuing with EPA regarding treatments on streams used for irrigation. A teratology study in a second species will be required but may be submitted at a later date. The teratology study should be initiated at an early date and is expected to cost approximately $30,000 at current prices.

SOLID BAR FORMULATION OF TFM/BAYER 73

Development of the solid bar formulation concept for lampricides continued. The rationale for TFM bars is that solids are easier to handle and measure than liquids and eliminate the need for mechanical pumps and personnel to monitor the pumps.

The liquid formulation of TFM was used in developmental work on the bars. Later tests involved bars formed with technical TFM (powder). These bars are very hard and under comparable conditions dissolve slower than those made with liquid TFM. Small amounts of Bayer 73 were found to be soluble in the polymer matrix so bars with the 98:2 combination of TFM:Bayer 73 could be easily produced.

TFM (35% active ingredient) is extracted and concentrated from the formulated product by partitioning with chloroform after acidification with hydrochloric acid. The chloroform is removed by evaporation to yield approximately 80% active TFM. This material is then used to produce a bar formulation of the lampricide.

A 9″ × 12″ × 1″ bar will treat 0.5 cfs of water at 1 mg/L for 8 hours at 18°C. The bar will dissolve in 9.5 to 10 hours at 12°C. An Experimental Use Permit to field test the TFM bars was issued by the EPA.

Very small bars were made using both liquid and technical TFM in combination with Bayer 73. Tests in flowing water and subsequent analysis showed that the release of TFM:Bayer 73 in their relative proportions are quite constant over time. Larger quantities of technical TFM and Bayer 73 than are now available would be needed to further explore this concept.

ANALYSIS OF TFM AND BAYER 73 EXPERIMENTAL FORMULATIONS

Experimental formulations of TFM and Bayer 73 on sand and clay were received from Hammond Bay Biological Station for analysis of active ingredient. The clay sample was first ground; then both the clay and the sand formulations were suspended in methanol, distilled water, or well water and analyzed by high performance liquid chromatography (HPLC) using an MCH 10 reverse phase column and methanol:0.01 M acetate buffer (87:13) at 2 mL/min. Active ingredient levels of the formulations were very near the stated amount when extracted with methanol, but complete recovery was not achieved from either formulation when extracted with distilled water. Well water provided relatively efficient extraction of the lampricides from the clay formulation (Table 1).

Bisazir Residues in Sea Lamprey

Bisazir with a ^{14}C label in the aziridinyl ring was ordered and received from Pathfinder Laboratories. The material is being evaluated for purity, and preparations are under way to run a study of residues in sexually mature sea lampreys after injection and after bath exposure to bisazir.

TFM Soil Binding Study

TFM and reduced TFM labeled with ^{14}C was obtained from Pathfinder Laboratories. The material is being evaluated for purity, and preparations are being made for the soil binding study of TFM and reduced TFM, its major metabolite.

Analysis of Water from Garage Drains at the Ludington Biological Station

Due to concerns that water draining from the garage at the Ludington Biological Station may contain residues of TFM, samples of water from the drain have been sent to a private contractor for analysis. The LNFRL was also asked to analyze six samples of garage drain water as a double check on the analysis. The analyses were run using Waters Sep Pak C_{18} disposable cartridges to concentrate the samples and high performance liquid chromatography (HPLC) with UV detection was used to quantitate the samples. Concentrations of TFM were below detection (< 0.01 mg/L) in all six samples.

Influences of Contaminants on Toxicity of Lampricides

Contaminants in the aquatic environment are suspected to alter the activity of lampricides. Past experimental work at the LNFRL suggested that the toxicity of mixtures of lampricides and nitrite nitrogen was additive or greater than additive, and that toxicity of mixtures of lampricides and heavy metals were additive. Additive toxicity essentially means that toxicity of a mixture of components is the sum of expected effects for each

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

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

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

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

component, and that the toxicity is neither synergistic (greater than additive) or antagonistic (less than additive). However, components displaying additive toxicity can still pose a hazard to nontarget organisms because the summation of additive effects of sublethal components can produce a lethal effect.

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

Toxicity of Lampricides to Mayflies

Concern over possible toxic effects of lampricide treatments on mayfly populations led to laboratory testing of the lampricides against various life stages of the mayfly, (*Hexagenia* sp.). Eggs collected during the summer of 1980 were exposed to TFM and Bayer 73 individually and to a 98:2 mixture of the two. Embryological development during incubation and hatching success were used to determine the survival of exposed and unexposed eggs. Survival rates of exposed and unexposed eggs were similar in concentrations up to 10 mg/L of TFM and 0.2 mg/L of Bayer 73. Viability of unexposed eggs ranged from 50 to 75%. This may be related to handling stress or to lack of a natural substrate, or it may approximate natural mortality among eggs. Generally, mortality increased as exposure time and concentrations increased. We concluded that eggs of mayflies are not susceptible to concentrations of lampricides generally applied during field treatments.

Newly hatched nymphs and older (16 mm) nymphs were exposed to the lampricides TFM and Bayer 73 and the 98:2 mixture of the two. Bayer 73 can probably be considered nontoxic to the three life stages of *Hexagenia* sp. at concentrations up to 0.5 mg/L at 17°C. TFM was more toxic to 16-mm nymphs than to newly hatched nymphs or to eggs. In fact, TFM killed all exposed 16-mm nymphs at 2.5 mg/L, a concentration that could be exceeded in field treatments. The 98:2 mixture of TFM and Bayer 73 produced results very similar to TFM alone in 24-and 96-hour exposures. The 16-mm size nymphs were more sensitive than younger life stages to the lampricide mixture. The exact life stage (instar) of mayflies is difficult to determine, and molting can occur during a 96-hour exposure, so we propose to expose nymphs of known age cultured at our laboratory and nymphs from the wild until emergence takes place. Therefore, toxicity testing will continue through June or July.

Literature on Lampricides

Dawson, V. K. 198 . Rapid HPLC method for simultaneously determining concentrations of TFM and Bayer 73 in water during lampricide treatments. Canadian Journal of Fisheries and Aquatic Sciences. (In journal review)

Dawson, V. K., J. B. Sills, and C. W. Luhning. 198 . Accumulation and loss of 2′, 5-dichloro-4′-nitrosalicylanilide (Bayer 73) by fish: Laboratory studies. Investigations in Fish Control. (In press)

ADMINISTRATIVE REPORT FOR 1980

Meetings

The Commission held its 1980 Annual Meeting in Duluth, Minnesota on 3–5 June, and its Interim Meeting in Toronto on 2–3 December 1980. In addition, both Canadian and U.S. sections met in plenary session on 4 June in conjunction with the Annual Meeting in Duluth. The Commision also held executive meetings of commissioners and staff as follows:

19 February	Detroit, Michigan
2 June	Duluth, Minnesota
16 September	Ann Arbor, Michigan
1 December	Toronto, Ontario

Meetings of standing committees during 1980 were:

Sea Lamprey Control and Research, Ann Arbor, Michigan, 5 February
Lake Superior Committee, Marquette, Michigan, 26–27 February
Lake Ontario Committee, Gananoque, Ontario, 4–5 March
Lake Huron Committee, Windsor, Ontario, 11–12 March
Lake Erie Committee, Ann Arbor, Michigan, 18–19 March
Lake Michigan Committee, Michigan City, Indiana, 25–26 March
Council of Lake Committees, Detroit, Michigan, 15 April
Great Lakes Fish Disease Control Committee, Ann Arbor, Michigan, 23–24 April
Board of Technical Experts, Duluth, Minnesota, 2–4 June and Detroit, Michigan, 3–4 November

Attendance at other Commission-related meetings included the Stock Concept Symposium, Sea Lamprey Wounding Committee, Sea Lamprey Audit Team, Lake Trout Distribution, Infectious Pancreatic Necrosis (IPN), Sea Lamprey International Symposium Steering Committee and Work Group, and sea lamprey control agents' annual sea lamprey conference.

Officers and Staff

Chairman K. H. Loftus and Vice-Chairman R. L. Herbst continued their terms of office through the 2 June Executive Meeting at which time elections were held. The following officers were elected for two year terms

beginning June 1980: R. L. Herbst, Chairman; H. D. Johnston, Vice-Chairman; M. G. Johnson, Canadian Section Chairman; and C. Ver Duin, U.S. Section Chairman. Two changes in Commission membership occurred during 1980. Dr. H. A. Regier, Professor of Environmental Studies and Zoology, University of Toronto, was appointed 1 May 1980; he replaced Dr. F. E. J. Fry whose resignation was accepted on the same date.

Several changes in staff structure occurred during 1980. R. L. Eshenroder, a long time employee of the Michigan Department of Natural Resources, accepted a position with the Commission as senior scientist for fishery resources on 31 March. Staff promotions were adopted effective 1 March 1980 for B. S. Biedenbender from administrative assistant to administrative officer, and M. A. Ross from biological assistant to fishery biologist.

Internal operating committee assignments established in June 1979 remained unchanged through June 1980. New appointments were made at the Annual Meeting and 1980 ended with the following Commission membership on internal operating committees.

Finance and Administration

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

Sea Lamprey Control and Research

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

Fisheries and Environment

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

Staff Activities

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

During 1980 the staff participated in the following conferences, meetings, and activities:

Predator Prey Workshop
Winter navigation meetings
Lake Erie Regulation Study
American Eel Workshop
Midwest Fish and Wildlife Conference
Treaty fishing meetings
Michigan Sea Grant
OMNR Assessment Units meeting
National Hunting and Fishing Survey Conference
Wisconsin Sea Grant
Michigan Fish Producers Association
Ontario Council of Commercial Fishermen
IJC Science Advisory Board
American Fisheries Society
International Association for Great Lakes Research
Great Lakes Marine Pollution
Genetic Identification Sea Lamprey Coordination meeting
Lake Erie Walleye meeting
Lake trout stocking meeting
Great Lakes Seaway Task Force

Reports and Publications

In 1980 the Commission published an Annual Report for 1977 and the following paper in its Technical Reports Series.

Minimum size limits for yellow perch (*Perca flavescens*) in Lake Erie, by *W. L. Hartman, S. J. Nepszy*, and *R. L. Scholl*. March 1980. 32 pp.

Accounts and Audits

The Commission accounts for the fiscal year ending 30 September 1980 were audited by Icerman, Johnson, and Hoffman of Ann Arbor. The firm's reports are appended.

Program and Budget for FY 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 for larval sea lampreys, use of 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, including biological controls, and continuation of barrier dam construction on selected streams to prevent sea lamprey access to problem areas and reducing application costs and the use of expensive lampricides. A budget of $363,000 was adopted for administration and general research for a total program cost of $5,909,600. Requests to governments 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

Sea lamprey control and research in Canada in fiscal year 1980 was carried out under agreement with the Canadian Department of Fisheries and Oceans ($1,745,600) and in the United States with the U.S. Fish and Wildlife Service ($3,801,000), including lampricide purchases, contingency funding for registration-oriented research on lampricides, and construction of barrier dams. At the end of the fiscal year the Canadian agent refunded $16,693 and the U.S. agent $91,354. The Commission also earned $375,000 bank interest during FY 1980. These monies were used to further the Commission's mandate in the Great Lakes such as the Stock Concept Symposium (STOCS) and several research projects, as well as reducing future requests for funding.

Program and Budget for FY 1981

At the 1979 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1981 estimated to cost $6,079,300. The program calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate and monitor sea lamprey populations, continuing field research in direct support of control operations, the operation of portable assessment weirs on all the Great Lakes, continuing research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, including biological controls, and continuation of barrier dam construction on selected streams to prevent sea lamprey access to problem areas, thus reducing the use of expensive lampricides and application costs. A budget of $404,600 was adopted for administration and general research for a total program cost of $6,483,900. But the Commission is requesting no increase over fiscal year 1980 levels since it is using unobligated funds to make up the difference. The Commission, however, has urged the governments to recognize the fiscal year 1981 requirement as the budget base for determining future budgets.

The Canadian agent has scheduled 29 lampricide treatments: 10 tributaries to Lake Superior, 7 to Lake Huron, and 12 to Lake Ontario (6 in the United States and 6 in Canada). In addition, stream surveys to monitor larval lamprey populations will be continued. Several problem areas involving major applications of granular Bayer 73 also are scheduled. In addition, an assessment network of weirs and portable assessment traps will be operated on selected tributaries to monitor sea lamprey spawning runs to measure changes in abundance and biological characteristics.

The U.S. agent has scheduled 63 lampricide treatments; 27 tributaries to Lake Superior, 21 to Lake Michigan, and 15 to Lake Huron. The U.S. agent also will maintain stream surveys to monitor larval lamprey populations, will maintain studies on the growth and time to metamorphosis of selected larval populations, and will operate a network of portable assessment traps on selected Great Lakes tributaries to monitor sea lamprey spawning runs to measure changes in abundance and biological characteristics.

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

The Commission negotiated a Memorandum of Agreement with its U.S. agent, the U.S. Fish and Wildlife Service, for work involving $3,076,800 and expects to provide lampricides valued at $605,750. A Memorandum of Agreement has also been executed which provides the Commission's Canadian agent, the Department of Fisheries and Oceans, with $2,046,700 which includes lampricides valued at $468,250. The Commission also held $15,000 in reserve for contingency funding for registration-oriented research on lampricides. Funding was also approved for the construction of barrier dams on carefully selected streams to prevent sea lamprey access to hard-to-treat areas and to reduce costs of control: $335,000 was approved for use on the U.S. side and $150,000 on the Canadian side. In addition, the Commission reviewed its administration and general research budget for fiscal year 1980.

The increase in program cost over FY 1980—$574,300 was absorbed by the Commission using unobligated funds derived from bank interest and unexpended monies returned by the contract agents. Consequently, the funding by governments for FY 1981 is as follows:

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

Program and Budget for Fiscal Year 1982

At the 1980 Annual Meeting, the Commission adopted a program and budget for sea lamprey control and research in fiscal year 1982 estimated to cost $6,359,000. The program calls for continuation of sea lamprey control on Lakes Ontario, Huron, Michigan, and Superior, stream surveys to locate and monitor sea lamprey populations, continuing field research in direct support of control operations, the operation of assessment weirs on all the Great Lakes, required research to assess immediate and long-term effects of lampricides in the environment, research to improve present control techniques, including biological controls, and construction of barrier dams on selected streams to prevent sea lamprey access to problem areas, thus improving control and reducing the use of expensive lampricides and application costs. A budget of $448,400 was adopted for administration and general research for a total program cost of $6,807,400 of which $4,611,900 is being requested from the U.S. Government and $2,195,500 from Canada.

ICERMAN, JOHNSON & HOFFMAN
Certified Public Accountants
303 NATIONAL BANK AND TRUST BUILDING
ANN ARBOR, MICHIGAN 48104
(313) [illegible]

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Great Lakes Fishery Commission
Ann Arbor, Michigan

We have examined the combined balance sheet of Great Lakes Fishery Commission as of September 30, 1980, and the related statements of revenues, expenditures, and changes in fund balances for the year then ended. Our examination was made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

As described more fully in Note 1, the financial statements referred to above do not include the financial statement of the General Fixed Asset Group of Accounts, which should be included to conform with generally accepted accounting principles.

In our opinion, except that the omission of the financial statement described above results in an incomplete presentation as explained in the preceding paragraph, the financial statements referred to above present fairly the financial position of the Great Lakes Fishery Commission as of September 30, 1980 and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

Icerman, Johnson & Hoffman

Ann Arbor, Michigan
December 15, 1980

GREAT LAKES FISHERY COMMISSION

COMBINED BALANCE SHEET
September 30, 1980

ASSETS	Administration and General Research Fund	Sea Lamprey Control and Research Fund	Totals (Memorandum Only)
Cash, including certificates of deposit of $2,345,778	$495,670	2,011,870	2,507,540
Accounts receivable - United States Fish and Wildlife Service	-0-	91,354	91,354
Accounts receivable - Canadian Department of Fisheries and Oceans	-0-	16,693	16,693
Accounts receivable - other	4,377	-0-	4,377
Due from Sea Lamprey Control and Research Fund (Note 2)	156,940	-0-	156,940
Total Assets	$656,987	2,119,917	2,776,904
LIABILITIES AND FUND BALANCES			
Liabilities:			
Accounts payable	$ 3,911	529,367	533,278
Due to Administrative and General Research Fund (Note 2)	-0-	156,940	156,940
Accrued wages	5,903	-0-	5,903
Total Liabilities	9,814	686,307	696,121
Fund Balances:			
Reserved for specific projects (Note 3)	285,175	-0-	285,175
Reserved for lampricide purchases	-0-	92,200	92,200
Reserved for barrier dam projects	-0-	100,000	100,000
Unreserved:			
Designated for subsequent years' expenditures (Note 4)		1,142,238	1,142,238
Undesignated	361,998	99,172	461,170
Total Fund Balances	647,173	1,433,610	2,080,783
Total Liabilities and Fund Balances	$656,987	2,119,917	2,776,904

See Notes to Financial Statements.

GREAT LAKES FISHERY COMMISSION

STATEMENT OF REVENUES, EXPENDITURES, AND CHANGES IN FUND BALANCE
Year Ended September 30, 1980

ADMINISTRATION AND GENERAL RESEARCH FUND

	Budget	Actual	Variance - Favorable (Unfavorable)
Revenues:			
Canadian government	$191,900	191,900	-o-
United States government	181,500	181,500	-o-
Interest earned	-o-	374,650	374,650
Refund from SLIS research project	-o-	18,835	18,835
Miscellaneous	-o-	1,057	1,057
	373,400	767,942	394,542
Expenditures:			
Administrative	277,600	269,062	8,538
General research	120,434	224,878	(104,444)
	398,034	493,940	(95,906)
Excess of Revenues Over (Under) Expenditures	(24,634)	274,002	298,636
Other Financing Sources (Uses):			
Operating transfer from Sea Lamprey Control and Research Fund (Note 2)	-o-	156,940	156,940
Excess of Revenues and Other Sources Over (Under) Expenditures	(24,634)	430,942	455,576
FUND BALANCE - October 1, 1979	216,231	216,231	--
FUND BALANCE - September 30, 1980	$191,597	647,173	455,576

See Notes to Financial Statements.

GREAT LAKES FISHERY COMMISSION

STATEMENT OF REVENUES, EXPENDITURES, AND CHANGES IN FUND BALANCE
Year Ended September 30, 1980

SEA LAMPREY CONTROL AND RESEARCH FUND

	Budget	Actual	Variance - Favorable (Unfavorable)
Revenues:			
Canadian government:			
Operating revenues	$1,802,000	1,438,845	(363,155)
United States government:			
Operating revenues	3,827,200	3,827,200	-o-
Refund of unexpended funds - Michilot dam project	-o-	4,695	4,695
	5,629,200	5,270,740	(358,460)
Expenditures:			
Canadian Department of the Fisheries and Oceans	1,344,662	1,182,827	161,835
United States Fish and Wildlife Service	2,703,068	2,611,714	91,354
Lampricide purchases	1,287,400	1,804,389	(516,989)
Special studies - contingency	15,032	-o-	15,032
Barrier Dams	222,000	-o-	222,000
	5,572,162	5,598,930	(26,768)
Excess of Revenues Over (Under) Expenditures	57,038	(328,190)	(385,228)
Other Financing Sources (Uses):			
Operating transfers to Administration and General Research Fund (Note 2)	-o-	156,940	(156,940)
Excess of Revenues Over (Under) Expendiutres and Other Uses	57,038	(485,130)	(542,168)
FUND BALANCE - October 1, 1979	1,918,740	1,918,740	--
FUND BALANCE - September 30, 1980	$1,975,778	1,433,610	(542,168)

See Notes to Financial Statements.

GREAT LAKES FISHERY COMMISSION

NOTES TO FINANCIAL STATEMENTS

Note 1. NATURE OF BUSINESS AND SIGNIFICANT ACCOUNTING POLICIES

The Commission is an international organization created by convention between the United States and Canada, established to find a means to control Sea Lamprey and improve fish stock. The Commission contracts the Sea Lamprey control program to the United States Fish and Wildlife Service and the Canadian Department of Fisheries and Oceans.

The Commission's September 30 fiscal year end corresponds with the United States government's fiscal year. The Canadian government has a March 31 fiscal year, consequently amounts budgeted for Canadian revenue and expense represent 50% of both the 1979-80 and 1980-81 Canadian fiscal years.

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

The books of account for the Commission are maintained on a modified accrual basis of accounting. Revenues are recognized when received except that balances of budgeted receipts that have been promised by the Canadian or United States governments are set up as receivables at September 30, 1980.

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. INTERFUND TRANSFERS AND LIABILITIES

Unused funds from United States Fish and Wildlife Service and Canadian Department of Fisheries and Oceans are refunded to the Sea Lamprey Control and Research Fund and subsequently transferred to the Administrative and General Research Fund. The total transfer of $156,940 to the Administrative and General Research Fund for fiscal year ending 1980 consists of $16,693 in Canadian refunds and $140,247 in United States refunds.

NOTES TO FINANCIAL STATEMENTS (Concluded)

Note 3. FUND BALANCE RESERVES

Commitments related to incomplete projects are recorded as reserves of the fund balance. As of September 30, 1980, the Commission had the following commitments relating to specific projects which are to be funded by the Administrative and General Research Fund.

Project Name	Total Budgeted	Expenditures through 9-30-79	Expenditures during year ended 9-30-80	Reserved @ 9-30-80
SGLFMP	$100,000	3,401	29,720	66,879
SGLFMP - Ontario Work Group	20,000	-0-	-0-	20,000
STOCS	151,000	34,302	89,732	26,966
SLAT	11,500	-0-	3,242	8,258
Brussard - 1979 project	13,937	10,453	-0-	3,484
U.S. Fish & Wildlife slide/tape show production	10,000	-0-	-0-	10,000
Dept. of Fisheries & Oceans slide/tape show production	10,000	-0-	-0-	10,000
CJFAS - Publication of SLIS	55,000	-0-	-0-	55,000
Ecosystem Health Workshop	7,300	-0-	-0-	7,300
Monroe	10,550	-0-	1,520	9,030
GLERR II Study	59,000	-0-	44,517	14,483
Atlantic Salmon Planning Conference	1,275	-0-	-0-	1,275
Gorbman	52,500	-0-	-0-	52,500
	$502,062	48,156	168,731	285,175

Note 4. UNRESERVED FUND BALANCE DESIGNATIONS

The excess of expenditures over revenues budgeted for the fiscal years ending September 30, 1981 and 1982 is to be funded by the fund balance in the Sea Lamprey Control and Research Fund. The budgeted excess of expenditures over revenues is approximately $574,300 for the year ending September 30, 1981 and $200,000 for the year ending September 30, 1982. Funds in the amount of $367,938 have been designated for future barrier dam construction. Total funds designated for subsequent years expenditures are $1,142,238.

Note 5. PENSION PLAN

The Commission currently holds a group annuity policy with Sun Life Assurance Co. covering permanent employees. Plan expense for the fiscal year ended September 30, 1980 was $15,908. There are no past service costs.

Note 6. INCOME TAXES

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

COMMITTEE MEMBERS—1980

Commissioners in Italics

BOARD OF TECHNICAL EXPERTS

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

SEA LAMPREY CONTROL AND RESEARCH

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

COUNCIL OF LAKE COMMITTEES

CANADA	UNITED STATES	
R. M. Christie, Chm.	W. Pearce, V-Chm.	B. Muench
L. Affleck	J. T. Addis	R. Scholl
D. E. Gage	D. Borgeson	W. Shepherd
A. Holder	D. R. Graff	A. Wright
	W. James	

LAKE COMMITTEES

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

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

GREAT LAKES FISH DISEASE CONTROL COMMITTEE

J. W. Warren, Chm.	B. Gress	C. Lakes
T. G. Carey, Secy.	R. H. Griffiths	V. A. Mudrak
T. Amundson	J. R. Hammond	L. Pettijohn
D. Bumgarner	J. E. Harvey	P. J. Pfister
J. Byrne	J. G. Hnath	N. Robbins
J. Cady	R. W. Horner	H. J. Sippel
J. B. Daily	G. E. Hudson	S. F. Snieszko
V. Duter	W. James	B. W. Souter
P. Economen	T. Johnson	W. Thompson
D. Goldthwaite		