ANNUAL REPORT

GREAT LAKES FISHERY COMMISSION

1962

GREAT LAKES FISHERY COMMISSION

MEMBERS — 1962

CANADA	UNITED STATES
A. O. Blackhurst	D. L. McKernan
J. R. Dymond	Claude Ver Duin
A. L. Pritchard	Lester P. Voigt

SECRETARIAT

N. S. Baldwin, Executive Secretary
Robert Saalfeld, Assistant Executive Secretary
Edith McPherson, Secretary

GREAT LAKES FISHERY COMMISSION

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

ANNUAL REPORT

FOR THE YEAR

1962

NATURAL RESOURCES BUILDING
THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN,
U. S. A.

LETTER OF TRANSMITTAL

The Chairman of the Great Lakes Fishery Commission takes pleasure in transmitting to the Contracting Parties an Annual Report of the Commission's activities during 1962.

A. L. PRITCHARD, *Chairman*

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1962 ANNUAL REPORT

INTRODUCTION

The Great Lakes Fishery Commission was established in 1955 by the Convention on Great Lakes Fisheries between the United States and Canada. It has two major reponsibilities: the first, to formulate programs of research and, on the basis of findings, recommend measures to improve the yield of stocks of fish of common concern; the second, to eradicate or minimize sea lamprey populations which have seriously reduced desirable species, particularly lake trout.

When the Commission began its work in 1956, attempts to control sea lamprey were already underway in both countries. At that time electrical barriers were being used to prevent the parasites from spawning in streams. Progress was being made, however, in the search for chemicals which could be used selectively to destroy young lamprey in streams. In 1957, years of intensive research by the U.S. Bureau of Commercial Fisheries culminated in the successful chemical treatment of a small Lake Huron stream. Increasing emphasis was placed on the use of the chemical method in Lake Superior and barrier operations were reduced in Lake Michigan to provide the necessary funds. By the end of 1960, all Lake Superior streams known to produce sea lamprey, and some streams in Lake Huron and Lake Michigan, had been treated. In 1961, treatments were continued on the latter lakes and three newly discovered lamprey streams in Lake Superior were promptly disposed of.

A significant decrease in the incidence of trout with lamprey wounds was noted in the fall of 1961 on Lake Superior. This observation was followed by a reduction in the 1962 catch of lamprey at electrical barriers operated on a reduced scale to evaluate the effects of treatments. The catch in the United States was 9,204 compared to 68,197 in 1961 and the catch in Canada 788 compared with 2,883. The reduction in lamprey was accompanied by signs of recovery in the lake trout population. The average size of fish in the commercial catch increased as a result of improved survival. Young fish, however, continued to be relatively scarce, because of inadequate spawning after 1958. Hatchery fish, planted in increasing numbers each year have shown good survival and in some areas comprised most of the juvenile trout population. In order to accelerate recovery of the lake trout population, the Commission recommended in 1961 that the catch of trout from Lake Superior be restricted to that needed by research

ANNUAL MEETING

PROCEEDINGS

The Seventh Annual Meeting of the Great Lakes Fishery Commission was held in Ann Arbor, Michigan, on June 19 and 20, 1962.

Call to order. The Chairman, Mr. Claude Ver Duin, called the meeting to order and introduced the members of the Commission and its Scientific Advisory Committee. Advisors and observers from both countries were introduced by the Chairmen of the national sections, Dr. A. L. Pritchard (Canada) and Mr. L. P. Voigt (United States). A list of participants appears on page 12.

Adoption of agenda. The tentative agenda, issued in advance of the meeting, was adopted by the Commission.

Approval of minutes of previous meeting. The Summary Minutes of the Interim Meeting, held in London, Ontario, November 29 and 30, 1961 were approved by the Commission.

Release of information on meeting. A committee was appointed by the Chairman to prepare news releases to be issued through the University of Michigan News Service.

Report of the Chairman. The Chairman reviewed the progress made by the Commission since its first meeting in 1956. Efforts to reduce sea lamprey by stream treatments appeared to be meeting with considerable success in Lake Superior. Although the lamprey spawning run was not over, the 1962 catch was well below previous catches. He pointed out that the ultimate success of the control program depended on the recovery of the lake trout fishery. All reasonable measures should therefore be taken to reduce the lamprey population further and hold it at a low level. He drew attention to the implementation of restrictions by the states and province in response to the Commission's recommendation that the lake trout catch in Lake Superior be limited to the amount necessary to determine the status of the population. The prompt response of these agencies was most gratifying.

He reported that the Commission with the help of fishery agencies was assembling information on other fishery problems not concerned with sea lamprey with the intention of developing programs and recommendations to encourage and guide investigations in the future.

Progress reports on sea lamprey program. Reports on the progress of sea lamprey control and research were presented by the Commission's agents, the U. S. Bureau of Commercial Fisheries and the

Fisheries Research Board of Canada. The Wisconsin Conservation Department and the Michigan Department of Conservation also reported on their sea lamprey investigations.*

Particular note was taken of the catch of spawning lampreys at electrical barriers. The catch in United States streams of Lake Superior, with the run judged to be three-quarters over, was 6,191 compared to 51,628 for the same period in 1961. The catch in Canada, with the run about half over, was 454 compared with 1,555 in 1961.

Recent changes in the status of lake trout. Three agencies, the U.S. Bureau of Commercial Fisheries, Wisconsin Conservation Department, and Fisheries Research Board of Canada reported a decrease in the incidence of trout with lamprey wounds, an increase in the catch of trout per unit of effort, and an apparent improvement in trout survival, particularly in Wisconsin waters. Better fishing was also noted in the northern portion of Lake Superior. There was some improvement in Ontario waters generally, but the data did not permit a rigorous comparison with earlier years. In both Wisconsin and Michigan waters larger lake trout (21–29 inches) showed increased survival, but there was a shortage of small native fish, presumably due to lack of spawning in recent years. A large proportion of the sublegal trout taken were from plantings. The Ontario Department of Lands and Forests reported that replies to its questionnaires for May indicated the lowest incidence of wounded trout since 1954.†

Review of 1962–63 program. The Commission reviewed the 1962–63 program approved at the Interim Meeting, November 29–30, 1961. The program proposed the following activities:

Lake Superior: Operate 37 barriers to follow further changes in lamprey abundance; resurvey potential lamprey-producing streams and habitat off stream mouths; treat 8 newly discovered lamprey streams and re-treat 16 streams to dispose of residual ammocete populations.

Lake Michigan: Operate 3 barriers on Green Bay streams to provide a comparison with catches on Lake Superior; continue surveys to determine ammocete distribution; treat lamprey streams entering Green Bay and several streams on east shore.

Lake Huron: Continue surveys on United States shore to locate lamprey streams and determine ammocete distribution.

Research: Continue search for more effective selective toxicants and chemicals which would cause ammocetes to emerge from the bottom and aid in locating them; investigate seasonal changes in lampricide effectiveness and discover causes; determine the effects on ammocetes of sublethal exposures to lampricide.

Consideration of the 1963–64 program. The Commission considered two alternative programs for sea lamprey control and research

* Final reports for 1962 are given on pages 25 and 40.

† Final report on status of lake trout in 1962 is given on page 46.

in 1963–64, one providing for an expansion of the treatment program on Lake Michigan and extension to Lake Huron, the other limiting treatments to Lake Superior. The Scientific Advisory Committee, asked to comment on the proposed programs, submitted the following statement:

> Although the effectiveness of operations to control sea lamprey cannot be fully assessed at the moment, there is evidence that they have reduced the sea lamprey population to 10–20 percent in Lake Superior. It is not known, however, whether lamprey have been reduced sufficiently to insure recovery of the lake trout population. Therefore, every effort should be made to discover and promptly dispose of residual ammocetes before they contribute to the lake population. The Scientific Advisory Committee recommends that the highest priority be given necessary treatments and re-treatments in Lake Superior. Meanwhile attempts should be made to determine the level of lamprey abundance which can be tolerated by the fishery.
>
> The Committee believes that there is as yet no good reason to reduce the number of assessment barriers in the United States from 29 to 13 in 1964, and recommends that the complete network be operated until there is evidence that the information provided by certain barriers is no longer useful.
>
> In view of the high cost of present methods, the Committee recommends continued investigation of potential toxicants and further urges that the Commission encourage the development of new and imaginative approaches to lamprey control by research groups not necessarily involved in its program.
>
> It has also to suggest that the Commission's agents be encouraged to continue studies of sea lamprey behavior so that survey techniques can be made more dependable and quantitative.

The Scientific Advisory Committee stated that it could not recommend one of the alternative programs over the other.

The Commission agreed that the evidence of lamprey reduction in Lake Superior was very encouraging and although it would like to proceed with treatments on the three upper Great Lakes, approval by governments of a program of this magnitude (estimated cost $1,860,000) would be difficult to obtain. A program based on a budget of about $1,500,000 would be more likely to receive approval. This amount would permit treatments to continue on Lake Michigan at a rate which would allow re-treatments to begin within 4 years without reducing treatments and assessment barrier operations required on Lake Superior. The Chairman asked the Secretariat to prepare such a program and submit it to the Commissioners for approval.

Report of the Lake Trout Rehabilitation Committee. The Commission received a preliminary report on lake trout rehabilitation activities in 1962.*

The selective breeding of trout being carried out by the Ontario Department of Lands and Forests and the difficulties experienced in

* Final report of the Lake Trout Rehabilitation Committee is given on page 46.

holding numerous small lots of fish for this purpose were discussed. The Commission recommended that the experimental program for the rearing and planting of splake (brook trout x lake trout hybrids) be continued with increased vigor.

Development of research prospectus. The Chairman reported that the Secretariat had requested the Great Lakes States and the Province to describe the major fishery problems on each lake and the areas of investigation which might prove most rewarding. Meetings had been held with state and provincial representatives to obtain general agreement on the relative importance of these problems on two lakes. Meetings to discuss problems on the other lakes would be held immediately after the Annual Meeting. A draft report on the investigations required should be ready for review by the fall of 1962.

Uniformity of fishing regulations. The Chairman stated that the Commission had been asked to investigate the possibilities of achieving greater uniformity in fishing regulations on the Great Lakes. It had suggested a procedure and asked the agencies involved for their opinions. The replies received indicated that too much importance was being attached to uniform regulations and not enough emphasis placed on establishing uniform objectives in the management of the fishery. A better understanding of the fishery was required before more effective regulations were proposed. He believed that the program of investigations being developed by the Commission would help deal with this problem.

Administrative matters. The Chairman reported that minor adjustments had been made in the proposed 1962–63 program to provide more chemical for the treatment of 6 newly discovered lamprey streams on Lake Superior in Canada.

Time and place of next meeting. The Commission agreed to hold its Interim Meeting in Ottawa, Ontario, on or about November 27–28.

Election of officers. The Commission held its biennial election of officers. Dr. A. L. Pritchard was elected Chairman and Mr. D. L. McKernan Vice-Chairman.

Adjournment. The Chairman adjourned the Seventh Annual Meeting at 3:30 p.m., June 20, 1962.

ANNUAL MEETING

PARTICIPANTS

OFFICERS

Chairman: A. L. Pritchard, Canada
Vice Chairman: D. L. McKernan, United States

MEMBER GOVERNMENTS

CANADA

Commissioners:	*Advisors:*	*Scientific Advisors:*
A. O. Blackhurst	H. V. Sutton	G. C. Armstrong
J. R. Dymond		J. Brubacher
A. L. Pritchard		R. G. Ferguson
		F. E. J. Fry
		W. A. Kennedy
		A. H. Lawrie
		K. H. Loftus[1]
		R. A. Ryder
		G. F. M. Smith[1]
		J. J. Tibbles
		W. H. R. Werner

UNITED STATES

Commissioners:	*Advisors:*	*Scientific Advisors:*
D. L. McKernan	C. F. Clark[2]	W. F. Carbine
Claude Ver Duin	Wm. J. Harth	G. P. Cooper
L. P. Voigt	Martin Hosko	M. J. DeBoer
	Roy A. Jensen	W. R. Dryer
	J. H. Kitchel	L. F. Erkkila
	W. M. Lawrence	P. H. Eschmeyer
	J. W. Leonard[3]	A. L. McLain
	Donald Leedy	J. V. Manz
	S. S. Sivertson	J. W. Moffett[1]
	H. O. Swenson	P. R. Nelson
	G. Trembley[4]	R. L. Pycha
		Edw. Schneberger
		B. H. Smith
		S. H. Smith

Observers: Wm. Herrington Raymond Johnson H. F. Weckley

Others:

D. C. Chandler	Ray Full	Karl F. Lagler
Horace Clark	Melvin R. Greenwood	Al Ming
Walter Crowe	Ralph Hile	H. Seagran
W. E. Elkins	Walter Jones	

SECRETARIAT

Norman S. Baldwin,[1] *Executive Secretary*
Robert W. Saalfeld, *Asst. Executive Secretary*

[1] Member of Scientific Advisory Committee
[2] Representating L. N. Roach
[3] Representing G. E. Eddy
[4] Representing A. S. Hazzard

INTERIM MEETING

The Commission held an Interim Meeting in Ottawa, Ontario, November 27–28, 1962 to consider information collected on the recent decline of walleye in Lake Erie, and the progress of sea lamprey control and lake trout rehabilitation. Progress made in developing the program of investigations for the Great Lakes fisheries was discussed and suggestions for revising the preliminary draft made to the Secretariat.

Lake Erie walleye. A general description of the walleye fishery since 1915 was presented by the Secretariat and detailed reports describing changes since 1945 in catches by area, month, and gear, and catch per unit of effort were given by the Ontario Department of Lands and Forests and the Ohio Division of Wildlife. The composition of the catch in Ohio and the relative strength of year classes in the fishery since 1943 were reported by the U.S. Bureau of Commercial Fisheries. Movements and growth of the 1959 year class, the strength of the 1962 year class, and changes in environmental conditions since 1930 were also described by the Bureau. The Ontario Department of Lands and Forests and the Ohio Division of Wildlife presented information on walleye spawning. After discussing the reports, the Commission agreed that further study was required before any recommendations could be made. The Secretariat was instructed to consolidate the information, including such conclusions as the agencies were prepared to draw from their own data. The Commission would consider the final report at its 1963 Annual Meeting to determine if certain measures should be taken to improve the walleye fishery.

Progress of lamprey control and research. Reports on operations during the last half of the 1962 season were given by the Fisheries Research Board of Canada and the U.S. Bureau of Commercial Fisheries.

A discussion was held on the significance of ammocetes found in the lake bottom off rivers and in estuaries and means of controlling them. Bureau biologists believed, on the basis of sampling with an electrified trawl, that the populations in Lake Superior, off streams in the United States, were not significant. Biologists of the Fisheries Research Board did not believe that the drift into the lake was as extensive as previously supposed. They suggested, however, that anual treatments of streams with a suspected drift be continued until more information was obtained on ammocete abundance in the lake.

Agencies studying the lake trout fishery reported no significant improvement in the fall of 1962, compared with the same period in 1961. Considerable difficulty was encountered in assessing relatively small changes, particularly in the incidence of lamprey wounds, because of restrictions on the catch and the small samples of trout available for examination. The Commission was advised that it had been necessary to exceed the catch limit set in Canada by 26,000 pounds to provide adequate data on the trout population.

Consideration of 1962–63 and 1963–64 programs. The Commission reviewed the 1962–63 program and the effect of a reduction in United States contributions.* It authorized, as an emergency measure, the use of contributions to the 1963–64 program to complete purchase of lampricide.

The Commission suggested no changes be made in the 1963–64 program of sea lamprey control and research approved by correspondence in July. The following activities were proposed:

Lake Superior. Operate 30 electrical barriers to follow changes in lamprey abundance and measure effectiveness of program; re-treat 30 streams; examine potential lamprey streams to detect new populations; investigate re-established populations to determine time for re-treatment.

Lake Michigan. Operate 3 electrical barriers in Green Bay to follow changes in adult lamprey population; treat 15 streams on east shore; examine potential lamprey streams for new populations; examine streams to determine effectiveness of initial treatments; assess the abundance of ammocetes in estuaries and drift into the lake habitat.

Lake Huron. Complete surveys of ammocete distribution in United States streams and collect information to facilitate chemical treatments.

Research. Continue screening of selective chemicals for use as lampricides; examine potential synergists; investigate toxicants and methods to deal with ammocete populations in deep water; conduct laboratory studies of the effects of various factors on ammocete development and survival; develop radioactive marking techniques for quantitative studies of ammocete abundance.

Lake trout rehabilitation. The Commission considered a proposal by the Lake Trout Rehabilitation Committee that 100,000 yearling lake trout, reared for planting in Lake Superior, be planted instead in Lake Ontario in 1963 and 1964. The Commission, on being advised that this planting would have no significant effect on the program in Lake Superior, approved the transfer. The subsequent investigation of lake trout survival in Lake Ontario, where native trout and lamprey co-existed until recently, could provide useful information for the program in Lake Superior.

Other business. The Commissin recommended that the States of Minnesota, Michigan and Ohio again be asked to give discretionary power for the regulation of their fisheries in the Great Lakes to their appropriate government agencies.

* See Administrative Report page 15.

ADMINISTRATIVE REPORT FOR 1962

Officers and staff. At its Seventh Annual Meeting in Ann Arbor on June 19–20, 1962 the Great Lakes Fishery Commission elected Dr. A. L. Pritchard to succeed Mr. Claude Ver Duin as Chairman. Mr. D. L. McKernan succeeded Dr. Pritchard as Vice Chairman.

The permanent staff consisted of the Executive Secretary, the Assistant Executive Secretary and a secretary-stenographer. A typist was employed half-time and in September a graduate student was engaged to review certain papers published since 1960 for inclusion in the Great Lakes Bibliography maintained by the Commission. Some papers listed in other bibliographies were also added.

Accounts and audit. The accounts of the Commission for fiscal year 1961–62 were audited by the Ann Arbor firm of Icerman, Johnson, and Hoffman (page 20).

Contributions to the 1961–62 program. The 1961–62 program and budget were approved by the Commission at its Annual Meeting in 1960. The program was reviewed at the 1961 Annual Meeting and the decision was made to continue the operation of 29 barriers on United States streams of Lake Superior in 1962 instead of the 10 "index barriers" proposed. Provision was also made for further testing of TFM toxicity to mammals by the Wisconsin Alumni Research Foundation.

Requests for funds, credits and contributions for fiscal year 1961–62 were as follows:

	Canada	*United States*	*Total*
Sea lamprey control and research			
Share of program costs	$424,213.00	$944,287.00	$1,368,500.00
Credits from FY 1959–60	10,283.57	22,889.24	33,172.81
Contributions	$413,929.43	$921,397.76	$1,335,327.19
Administration and General Research			
Share of program costs	$ 23,000.00	$ 23,000.00	$ 46,000.00
Credits from FY 1960–61	3,895.16	3,895.15	7,790.31
Contributions	$ 19,104.84	$ 19,104.85	$ 38,209.69

Expenditures in 1961–62. Agreements made in 1961 with the Fisheries Research Board of Canada ($337,080) and the U.S. Bureau of Commercial Fisheries ($734,686) continued in force until March 31 and June 30, 1962, respectively. The Commission also supplied 46,000 pounds of lampricide (purchased in Canada) to the Board, and 65,000 pounds (purchased in the United States) to the Bureau. A small lot of 12,494 pounds was purchased in June from a chemical company in the United States with funds returned from the 1961–62 agreement by the Bureau. The total cost of the chemical was $322,561. The Commission also retained the services of the Wisconsin Alumni Research Foundation to carry out further testing of toxicity of TFM to mammals.

The program in Canada was carried out with minor adjustments. Provision was made for the treatment of 2 newly discovered streams in Lake Superior. Five were subsequently treated. In Lake Huron, 6 streams scheduled for later treatment were substituted for 7 streams with Commission approval. A statement of expenditures is given on page 23.

The program in the United States provided for the treatment of lamprey-producing streams on the north shore of Lake Huron in conjunction with treatments in Canada. A decision at the Interim Meeting, November 29–30, 1961, to restrict Canadian treatments in 1962 to Lake Superior, led to a shift in Bureau operations from Lake Huron. Three tributaries to the St. Mary's River were treated in Lake Huron, but 14 streams, 7 more than scheduled, were re-treated in Lake Superior. In addition, East Bay at the mouth of the Sucker River, was treated with toxaphene. High water delayed treatment of 2 streams in Lake Superior, but 3 other newly discovered streams were disposed of. Treatments on the north shore of Lake Michigan were completed on schedule with the exception of the Manistique and Sturgeon Rivers. Other activities carried out by the Bureau, not specified in the Agreement, included: the operation of fyke nets in Lake Michigan and Lake Superior spawning streams to obtain information on the movement of transformed sea lampreys into the lake; development of an electrified trawl to sample ammocetes in deep water; and studies of growth and dispersion of a single year class of sea lamprey in a test stream. Activities carried out in FY 1962 were described in the Bureau's reports to the Commission at the 1962 Annual Meeting. A statement of expenditures is given on page 24.

The tests carried out by the Wisconsin Alumni Research Foundation on the toxicity of TFM to mammals indicated that no significant difference existed in the relative toxicity of pure TFM and the two formulations used in the field. Ingestion of 1.1 g/kg pure TFM proved lethal (LD 50) to test rats. In tests of subacute toxicity, no reduction in food consumption or growth was noted for rats consuming TFM in their water (highest level 750 ppm). Blood and urine analysis and subsequent histological examination of organs revealed no changes or abnormalities attributable to TFM. Consumption by cattle of a 15 ppm concentration produced no spillage into milk and no effect on food consumption or growth of calves. The reports were submitted for study to the public health and water quality agencies in both countries that expressed interest in the toxicity of chemicals used in the lamprey program.

Underexpenditures in FY 1961–62 in the Sea Lamprey Control and Research Fund totalled $20,745.95 due mainly to a postponement of some chemical treatments on Lake Huron streams. Expenditures for Administration and General Research totalled $39,873.96. The underexpenditure of $6,126.04 was largely due to limited travel of staff and delay in publishing two reports.

Contributions to the 1962–63 program. The 1962–63 program, approved by the Commission in July 1962, was subsequently revised at the Interim Meeting on November 29–30 to permit surveys and earlier re-treatments on Lake Superior. The total cost was maintained at the FY 1961–62 level.

In July, the Commission received ¾ of its total Canadian contribution to the 1962–63 program, but learned that the U.S. contribution would be delayed pending approval of appropriations. Meanwhile, obligations were held at the previous year's level. An interim contribution of $242,000 (¼ of the amount requested) was made in July and an equal amount in November. Agreements were executed with the Commission's agents and orders placed for 117,000 pounds of lampricide required (47,000 from Hoechst Chemical Company, Montreal, and 70,000 from Maumee Chemical Company, Toledo). On October 29, the Commission was advised that the United States had approved a contribution of $919,000 to the Commission's 1962–63 program, $48,220 less than the previous year's appropriation and $47,800 less than the Commission's request. The total reduction, including an obligatory reduction of $21,475 in the Canadian contribution to maintain the cost sharing ratio, was $69,275.

The Commission's agents were asked to review their expenditures and determine if the reduction could be met without serious alteration of the program. A reduction in lampricide purchases was considered, but manufacture and delivery had reached an advanced stage and no reduction in amount specified in the purchase contract could be made. At the Interim Meeting, November 27–28, 1962, the Commission agreed that a request be made to the Canadian Government for payment of its first installment contribution to the 1963–64 program on April 1, instead of July 1. The Commission also suspended Financial Regulation IV(b) (as authorized by Financial Regulation XIIIa) to permit the use of the funds thus provided to complete the purchase and delivery of the lampricide ordered.

Salary increases amounting to $13,459 were granted in October to employees of the U.S. Bureau of Commercial Fisheries engaged in the Commission's program. As increases to the Commission's agent in Canada had previously been covered for the fiscal year by direct supplemental appropriations from the Canadian Government, it was suggested that increases in the United States should be similarly met to preserve, as far as possible, the established sharing of program costs.

The United States Government was accordingly asked to accept credits on contributions reduced by this amount, thereby assuming the full cost of the increase. The Commission was subsequently advised that credits from the previous fiscal year could not be used in this manner.

Agreements with agents in 1962–63. The Commission made Agreements with the Fisheries Research Board of Canada and the U.S. Bureau of Commercial Fisheries to carry out the 1962–63 program of lamprey control and research, as revised at the Interim Meeting, November 29–30, 1961.

Costs of agreements with agents were as follows:

U.S. Bureau of Commercial Fisheries		
Amount of contract	$695,400	
Charge for contract administration—6%	41,700	
Total	$737,100	(U.S.)
Fisheries Research Board of Canada		
Amount of contract	$307,700	
Charge for contract administration—6%	18,462	
Total	$326,162	(Canadian)
	$302,803	(U.S.)

Meetings. The Commission held two meetings in 1962, an Annual Meeting in Ann Arbor on June 22–23, and an Interim Meeting in Ottawa, November 27–28. The Scientific Advisory Committee met on June 7 in Ann Arbor and the Lake Trout Rehabilitation Committee on March 5–6 in Milwaukee, Wisconsin. Four meetings were called by the Secretariat to discuss the major fishery problems on Lake Erie, Lake Huron, Lake Michigan, and Lake Superior. Fishery problems on Lake Ontario were discussed at the annual meeting of the Ontario–New York Committee.

Other meetings and conferences attended by the Commission staff were:

Annual Meeting Ontario Council of Commercial Fisheries
Conference on Great Lakes Research
Staff Conference Michigan Department of Conservation
Annual Meeting Michigan Fish Producers Association
Wildlife Society Meeting (Minnesota Section)
Lake Superior Advisory Committee Meeting
American Fisheries Society Annual Meeting
International Limnological Congress
Seminar on Biological Problems in Pollution
Lake Erie Fish Management Committee Meeting
Tri-State Fisheries Conference

Reports and publications. Nine technical reports and three popular articles published in 1962 were:

"Commercial fish production in the Great Lakes 1867–1960" by Norman S. Baldwin and Robert W. Saalfeld. Great Lakes Fishery Commission, Tech. Rep. No. 3, 166 p.

"Estimates of the brook and sea lamprey ammocete populations of three streams" by Bernard R. Smith and Alberton L. McLain. Great Lakes Fishery Commission, Tech. Rep. No. 4, 1–18.

"A photoelectric amplifier as a dye detector" by Wesley J. Ebel. Great Lakes Fishery Commission, Tech. Rep. No. 4, 19–26.

"Collection and analyses of commercial fishery statistics in the Great Lakes" by Ralph Hile. Great Lakes Fishery Commission, Tech. Rep. No. 5, 31 p.

"Spring and summer temperatures of streams tributary to the south shore of Lake Superior, 1950–60" by Bernard R. Smith. U.S. Fish and Wildlife Service, Special Scientific Report: Fisheries. No. 410, 57 p.

"Use of mobile bioassay equipment in the chemical control of sea lamprey" by John H. Howell and Willman M. Marquette. U.S. Fish and Wildlife Service, Special Scientific Report: Fisheries. No. 418, 9 p.

"Three portable feeders for metering chemical into streams" by Gaylord A. Anderson. Progressive Fish Culturist, Vol. 24, No. 4, 190–192.

"Exposure of several developmental stages of the sea lamprey, *Petromyzon marinus*, to selective larvicide" by George W. Piavis. Copeia, 1962, No. 3, 652–653.

"Comparative toxicity of 3-trifluormethyl-4-nitrophenol (TFM) to larval lampreys and eleven species of fish" by Vernon C. Applegate and Everett L. King, Jr. Trans. Am. Fish. Soc., Vol. 91, No. 4, 342–345.

"The Sea Lamprey in the Great Lakes" by W. A. Kennedy. Fish. Res. Bd. of Canada, Biol. Stn. and Tech. Unit, London, Ontario, Circ. No. 5, 7–20.

"Chemical treatment, a technique designed to control sea lampreys" by B. G. H. Johnson and J. J. Tibbles. Fish. Res. Bd. of Canada, Biol. Stn. and Tech. Unit, London, Ontario, Circ. No. 5, 21–43.

"Closing in on a silent killer" by Norman S. Baldwin. The Conservationist, State of New York Conservation Dept. Vol. 17, No. 3, 30–32.

Auditors Report to Commission

ICERMAN, JOHNSON & HOFFMAN
Certified Public Accountants
303 National Bank and Trust Building
Ann Arbor, Michigan

September 18, 1962

Great Lakes Fishery Commission
Natural Resources Building
Room 106
The University of Michigan
Ann Arbor, Michigan

We have examined the accounts of the Great Lakes Fishery Commission Administration and General Research Fund and Lamprey Control Operation Fund for the year ended June 30, 1962.

Our examination included tracing of receipts to the depository, verification of the bank balances by direct confirmation, tracing of expenditures to supporting vouchers, and such other tests of the accounting records as we considered appropriate in the circumstances. We did not verify receipts by communication with the payors.

In our opinion, the attached statements of receipts and expenditures present fairly the position of the designated funds of the Great Lakes Fishery Commission at June 30, 1962, and the results of operations for the year then ended.

Icerman, Johnson & Hoffman

Great Lakes Fishery Commission

Administration and General Research Fund

Statement of Receipts and Expenditures

Year Ended June 30, 1962

Receipts

	Actual	*Budget*
Canadian Government	$19,104.84	$19,104.84
United States Government	19,104.85	19,104.85
Total	$38,209.69	$38,209.69

Expenditures—B

Communication	$ 764.78	$ 900.00
Equipment	214.16	200.00
Insurance, bonding, and audit	674.95	300.00
Rents and utilities	158.20	100.00
Reproduction and printing	2,911.51	4,000.00
Salaries (including F.I.C.A. and pension)	31,339.14	33,700.00
Supplies and equipment maintenance	1,637.14	1,900.00
Transportation	133.09	300.00
Travel	2,040.99	4,600.00
Total	$39,873.96	$46,000.00A
Excess of expenditures over receipts	$(1,664.27)	
Fund balance, July 1, 1961	7,790.31	
Fund balance, June 30, 1962	$ 6,126.04	

Note A—A total of the beginning fund balance plus the anticipated receipt is equal to the anticipated expenditures:

Cash balance, July 1, 1961	$ 7,790.31
Anticipated receipts	38,209.69
Total anticipated available funds	$46,000.00

Note B—Expenditures include $2,254.73 recorded on the books in July, August, and September 1962 as applicable to the fiscal year ended June 30, 1962.

Great Lakes Fishery Commission

Lamprey Control Operation Fund

Statement of Receipts and Expenditures

Year Ended June 30, 1962

Receipts

	Actual	*Budget*
Canadian Government	$ 413,929.43	$ 424,213.00
United States Government	921,397.76	944,287.00
Returned by United States Fish and Wildlife Service for purchase of additional lampricide	27,000.00A	-0-
Currency exchange	10,725.05	-0-
Refund from Bureau for 1959–60 under expenditures	33,172.81	-0-
Total	$1,406,225.05	$1,368,500.00

Expenditures

Canadian Department of Fisheries	$ 337,080.00	$ 337,080.00
United States Fish and Wildlife Service	734,686.00	734,686.00
Lampricide purchases	293,825.31	294,150.00
Obligated for unpaid commitments of 1961–62	39,787.30B	-0-
Total	$1,405,378.61	$1,365,916.00
Excess of receipts over expenditures	$ 846.44	
Fund balance, July 1, 1961	1,627.75	
Fund balance, June 30, 1962	$ 2,474.19	

Note A—Refund by the Bureau of Commercial Fisheries for 1961–62 underexpenditure (partial) for purchase of additional lampricide in 1961–62—recorded July 2, 1962 but applicable to the fiscal year ended June 30, 1962.

Note B—This commitment is composed of the following items:

Wisconsin Alumni Research Foundation for tests not completed	$ 5,400.00
Hoechst Chemicals Company—part of material returned for refiltering and change in formulation	34,387.30*
	$ 39,787.30

* Actual amount $28,736.20; reduction due to loss of active ingredient in reprocessing.

Fisheries Research Board of Canada

Financial Report to Great Lakes Fishery Commission

April 1, 1961 to March 31, 1962

Administration in field (46.8% of cost of London Headquarters)	($106,899.55)	$ 50,289.89
Operations:		
Operation of Electric Barriers		44,635.51
Chemical Treatment Operations		
(a) Funds from 1961–62 contract	169,483.34	
(b) Funds carried over from 1960–61	48,617.04	218,100.38
Surveys		40,865.48
Research:		
Ammocete Studies		9,793.21
Temperature Tolerance Studies		5,408.05
		$369,092.52
Contributions to Superannuation:		
6½% of Permanent Salaries	($104,388.67)	6,785.26
		$375,877.78
Contract Administration:		
6% of Total Disbursements		22,552.67
		$398,430.45
Funds provided by Commission:		
Carried over from 1960–61	48,617.04	
Payments under 1961–62 Contract	337,080.00	
Total funds available	$385,697.04	
Cost applicable to 1961–62	398,430.45A	

Note A—Additional amount ($12,733.41) required absorbed in Contract Administration charge.

Bureau of Commercial Fisheries
Sea Lamprey Control and Research Program

Report of Expenditures for All Activities
July 1, 1961 through June 30, 1962

Activity	*Funds Programed*	*Salaries*	*Expenses*	*Total*	*Unobligated Balance*
	Expenditures and Obligations Incurred to Date				
Program Costs					
Ann Arbor, Mich.					
Laboratory					
Research	$101,210.93	$ 78,227.25	$ 25,539.49	$103,766.74	$—2,555.81
Chemical Control	352,376.75	233,213.86	104,198.12	337,411.98	14,964.77
Electrical Control	200,950.33	136,282.23	62,786.86	199,069.09	1,881.24
	654,538.01	447,723.34	192,524.47	640,247.81	14,290.20
Washington, D.C.	20,600.00	15,300.73	5,226.29	20,527.02	72.98
General Administration					
Ann Arbor, Mich. (Regional Office)	35,000.00	32,748.91	2,201.43	34,950.34	49.66
Totals	$710,138.01	$495,772.98	$199,952.19	$695,725.17	$ 14,412.84

Bureau of Commercial Fisheries
Sea Lamprey Control and Research Program
Report of Expenditures for All Activities
July 1, 1961 through June 30, 1962

Activity	*Funds Programed*	*Expenditures and Obligations Incurred to Date*			*Unobligated Balance*
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Totals	$710,138.01	$495,772.98	$199,952.19	$695,725.17	$ 14,412.84

LAMPREY CONTROL AND RESEARCH IN THE UNITED STATES

by

Leo F. Erkkila

Bureau of Commercial Fisheries

U. S. Fish and Wildlife Service

A decline in numbers of spawning-run sea lampreys in Lake Superior occurred in 1962. The decrease was sharp enough to leave little doubt as to the ultimate success of chemical control. The 1962 take of 9,204 sea lampreys at the Lake Superior barriers represents an 87-percent decline from the 1961 figure of 68,197. Further marked decrease is not to be expected in 1963, but effects of second treatments could begin to show in 1964.

All phases of the sea lamprey program advanced well in 1962. Adverse weather delayed the start of chemical treatment of U.S. streams tributary to the Great Lakes until May 10. However, the work then continued through to the last of October except for a few weeks in August and early September when the seasonal change of water quality reduced the effectiveness of the larvicide. During the season, 29 streams, discharging 2,070 cfs of water, were treated with 40,758 pounds of TFM (3-trifluormethyl-4-nitrophenol). Nineteen of the streams were on the south shore of Lake Superior, 8 in the Green Bay area of Lake Michigan, and 2 were tributaries of the St. Mary's River, Lake Huron. The chemical control operations in United States waters since 1958 are summarized in Table 1. Surveys of tributaries of Lakes Superior, Michigan, and Huron were made on schedule. Sea lamprey research at the Hammond Bay Laboratory and in the field is increasing our understanding of the parasite; the search for new selective toxicants is beginning to show great promise.

Lake Superior surveys and bioassays

Stream surveys were conducted on 626 streams of which 300 were dry at the time of survey or contained only small amounts of runoff from recent rains. Sea lampreys were discovered in 8 streams, increasing the number of lamprey-infested tributaries to 69. All 8 are marginal producers of sea lampreys. Surveys of ammocete distribution were completed on 37 streams in preparation for re-treatments. Post-treatment surveys were finished on 25 streams. Only the Huron River had a population of residual sea lampreys requiring immediate treatment. All but one of the residual sea lampreys were in a spring area where chemical concentrations had been reduced.

TABLE 1.—Summary of chemical control in the United States waters of the Great Lakes, 1958–1962.

Year	Number of streams	Discharge at mouth (cfs)	Stream miles treated	Amount of active ingredient (pounds)
Lake Superior				
1958	10	619	178	6,265
1959	29[1]	1,616	286	19,147
1960	16[1]	3,651	397	51,400
1961	9[2]	453	139	9,653
1962	19[3]	1,567	366	22,471
Total	83	7,906	1,366	108,936
Lake Michigan				
1960	7	140	70	1,751
1961	26	1,094	252	24,689
1962	8	422	342	15,173
Total	41	1,656	664	46,613
Lake Huron				
1961	1	10	14	318
1962	2	81	38	3,114
Total	3	91	52	3,432
Grand total	127	9,653	2,083	158,981

[1] Includes 1 re-treatment
[2] Includes 8 re-treatments
[3] Includes 14 re-treatments

Bioassays were made on water from 54 tributary streams. Bioassays prior to 1962 showed a fairly clear correlation between alkalinity and conductivity and the minimum lethal and maximum allowable concentrations of TFM. A table of values from the earlier results was used in 1962 to determine the range over which bioassays were made. For 67 bioassays, the minimum lethal concentrations (100-percent lamprey mortality in 9 hours or less) were predicted to within 0.5 ppm 57 times (85 percent). The maximum allowable concentrations were predicted to within 1.0 ppm. 41 times (61 percent). The ability to predict approximately the bioassay results made it possible to lessen the number of individual tests.

Lake Superior chemical treatments

Floods resulting from the late spring thaw prohibited stream treatments on Lake Superior until May 10. Treatments continued with minor interruptions until "deactivation" forced suspension of the work in August. Favorable bioassays in September permitted the treatment of two more streams. During 1962, 19 streams with a total discharge of 1,567 cfs were treated chemically (Table 2). Five streams received initial treatments and 14 were re-treated. Residual populations of sea lamprey ammocetes were low in all re-treated streams except the East Sleeping River. A collection from the lower river contained 1,527 sea lampreys, of which 370 were survivors from the initial treatment.

TABLE 2.—Details on the application of sea lamprey larvicide to 19 streams tributary to Lake Superior, 1962.

Stream	Date	Discharge at mouth (cfs)	Concentration (ppm) Minimum effective	Concentration (ppm) Maximum allowable	Amount of active ingredient (pounds)
Brule River	May 10	240	2.0	8.0	3,492
Au Train River	May 21	426	3.0	6.0	6,876
Five Mile Creek	May 27	4	1.0	2.0	12
Miners River	May 29	40	4.0	9.0	1,566
Little Two Hearted River	June 5	56	1.5	4.0	752
Three Mile Creek[1]	June 5	3	1.5	2.5	18
Two Hearted River	June 12	205	1.0	4.0	2,619
Betsy River	June 26	55	1.0	5.0	1,512
Nemadji River[1]	July 13	150	2.0	7.0	2,034
Amnicon River	July 16	20	2.0	6.0	207
Arrowhead River[1]	July 16	260	1.0	2.0	774
Middle River	July 17	5	2.0	6.0	270
Poplar River	July 17	2	1.5	4.0	36
Harlow Creek	July 25	6	2.0	6.0	81
Iron River	July 27	40	2.5	6.0	540
Pilgrim River[1]	August 4	12	3.5	8.0	156
Boston-Lilly Creek[1]	August 5	2	3.0	5.0	68
Misery River	Sept. 28	28	4.0	10.0	1,152
East Sleeping River	Sept. 30	13	2.0	6.0	306
Total	...	1,567			22,471

[1] Initial treatment

The 1962 treatments caused no serious fish mortality. Losses that did occur were among a few highly susceptible fishes and invertebrates. There was no apparent change from previous years in numbers adversely affected.

Lake Michigan surveys and bioassays

Ammocete-distribution surveys in all streams tributary to Lake Michigan were completed. The 1962 surveys included 836 stations on 139 streams. Most of the work was on seven large rivers: St. Joseph, Kalamazoo, Black, Grand, Pere Marquette, Ford, and Cedar Rivers. Examinations of 357 Lake Michigan tributaries, since 1958, showed 96 streams to contain sea lamprey populations. These streams have a combined discharge of approximately 14,000 cfs.

Initial posttreatment surveys on three streams (Squaw, Hock, and Portage Creek) treated in 1962 revealed no residual sea lamprey ammocetes. Five streams, treated in 1961, were examined for re-established ammocete populations. Sea lamprey larvae were abundant in one stream and rare in the other four.

Twenty-nine bioassays on streams tributary to northern Green Bay disclosed that the biological activity of TFM can vary considerably within a single stream system. The concentrations required in the Days River, for example, were lower near the mouth than in the upper section. It was therefore necessary to use a higher concentration of chemical than was desirable in the lower part of the river. The bioassay ranges for Werners Creek (Whitefish River) varied from a minimum lethal of 0.5 ppm and a maximum allowable of 2.0 ppm in the upper section to a range of 2.5 to 7.0 ppm at the mouth. Here it was necessary to establish additional application points to increase concentrations.

Lake Michigan chemical treatments

Treatment of streams tributary to Lake Michigan was resumed in late July. Unusually low water and late summer "deactivation" halted operations 3 weeks in August. Eight streams in the northern Green Bay area, with a total discharge of 422 cfs were treated successfully (Table 3). Distribution of sea lamprey ammocetes is more complex in Lake Michigan streams than in Lake Superior tributaries. The volume and velocity of flow in the headwaters of some streams were often so low that a single treatment required several weeks. Differences in biological activity between sections of a stream, beaver ponds, difficult access, changes in temperature and flow, and dilution all created difficulties in the 1962 treatments. It was necessary in some streams to treat tributaries, parts of tributaries, and portions of the main stream separately. Although additional chemical was required this added cost was offset by savings in personnel costs. The numbers

of dead lampreys collected or oberved during the treatments in late fall indicated that a substantial recruitment of sea lampreys into Lake Michigan was occurring.

TABLE 3.—Details on the application of sea lamprey larvicide to 8 streams tributary to Lake Michigan, 1962.

Stream	Date	Discharge at mouth (cfs)	Concentration (ppm) Minimum effective	Concentration (ppm) Maximum allowable	Amount of active ingredient (pounds)
Squaw Creek	July 30	1	4.0	8.0	50
Hock Creek	July 31	3	2.5	5.0	27
Portage Creek	August 2	6	4.0	10.0	62
Days River	September 11	22	5.0	17.0	887
Tacoosh River	September 16	12	3.5	10.0	202
Bark River	September 19	44	4.0	12.0	1,395
Rapid River	October 5	56	4.0	10.0	1,624
Whitefish River	October 10	278	6.0	17.0	10,926
Total		422	..		15,173

Lake Huron surveys and treatments

Surveys of the distribution of sea lamprey ammocetes were completed on 32 streams on the west shore of Lake Huron between Mackinaw City and Saginaw Bay. Twenty streams contained sea lampreys. Preliminary studies of the Cheboygan River system indicated a wide distribution of sea lamprey ammocetes in all major tributaries. Thirty-seven sea lamprey-producing streams have been found on the United States side of Lake Huron with approximately 157 streams still to be surveyed along Saginaw Bay and to the south.

Two streams, Carlton Creek and Munuscong River, tributary to the St. Mary's River were treated in 1962. These streams had a total discharge of 81 cfs at the time of treatment (Table 4). Posttreatment surveys of the 3 lamprey-producing tributaries to the United States side of the St. Mary's River were completed in October. No residual ammocete populations were discovered.

Electric barrier operations

Electric barriers were operated on 29 streams along the south shore of Lake Superior as an index to the abundance of spawning sea lampreys. The barriers were placed in operation on schedule and without installation problems. Operational difficulties were few during the season. Barrier operations were terminated July 13. A total of 9,204 sea lampreys was taken during the season (Table 5). This

TABLE 4.—Details on the application of sea lamprey larvicide to 2 streams tributary to Lake Huron (St. Mary's River), 1962.

Stream	Date	Discharge at mouth (cfs)	Concentration (ppm)		Amount of active ingredient (pounds)
			Minimum effective	Maximum allowable	
Carlton Creek ...	April 26	43	3	10	612
Munuscong River...	June 22	38	6	13	2,502
Total	...	81	...	...	3,114

number represents a reduction of 87 percent from the record catch of 1961 and is 82 percent below the average catch for the past 5 years. Numbers of sea lampreys declined in all streams throughout Lake Superior, with the exception of Harlow Creek.

The first adult sea lamprey was captured March 26 in the Chocolay River. The run developed erratically. An early peak (10.3 percent of the total run) appeared May 16–20, but the largest 5-day catches occurred June 10–14 (11.2 percent) and June 15–19 (15.0 percent). A total of 7,929 sea lampreys or 80 percent of the run was taken from May 1 to June 29. The run declined slowly through late June and early July; the last week of operation produced 330 sea lampreys or 3.6 percent of the total catch. Eleven streams produced 8,410 adult sea lampreys or 91 percent of the total. The 21 barriers east of the Keweenaw Peninsula contributed 63 percent of the season's total and the 8 barriers to the west accounted for the remaining 37 percent. Wide annual variation continued in the contribution to the total catch by individual streams.

The 3 index barriers on streams tributary to northern Green Bay, Lake Michigan, were placed in operation April 2. The sea lamprey run developed slowly until May 16–20, when warm weather brought about a sudden surge in the migration. This period accounted for 46 percent of the total run. The catch declined rapidly until operation of the barriers was terminated July 2. A total of 8,089 adult sea lampreys was captured at the 3 barriers (Table 5). This figure represents a decline of 37 percent from the 1961 catch and a reduction of 29 percent from the average catch for the past 5 years.

The sea lampreys were larger this year. The average length and weight of lampreys from 11 Lake Superior streams were 16.7 inches and 5.6 ounces—an increase over 1961 of 0.6 inch and 0.8 ounce. The sex ratio of adult sea lampreys of Lake Superior, expressed as number of males per 100 females, increased from 214 in 1961 to 229 in 1962—the highest recorded. The sex ratio east of the Keweenaw Peninsula increased from 187 in 1961 to 200 in 1962; west of the Keweenaw the

TABLE 5.—Catches of adult sea lampreys to mid-July at barriers on 29 Lake Superior streams and to the end of June on 3 Lake Michigan streams.

Stream	1957	1958	1959	1960	1961	1962
Lake Superior						
Waiska River .	55	70	42	122	87	10
Pendills Creek	46	16	38	30	74	10
Betsy River .	768	1,061	999	696	1,366	316
Little Two Hearted River	693	417	410	668	558	68
Two Hearted River	7,570	3,388	3,950	4,290	7,498	1,757
Sucker River	3,496	1,613	2,436	4,683	3,209	474
Hurricane River . .	171	29	63	80	96	6
Miners River	417	94	127	399	220	64
Furnace Creek	246	38	350	2,211	1,012	132
Au Train River . .	709	337	164	74	181	179
Rock River	2,510	1,403	1,170	2,598	3,660	399
Laughing Whitefish River	37	9	18	37	267	8
Chocolay Creek .	8,088	6,133	3,486	4,173	4,201	423
Harlow Creek . .	2	1	15	10	22	89
Iron River . . .	708	391	250	317	2,430	1,161
Salmon-Trout River	.	. .	40	5	12	1
Pine River	28	22	39	28	70	2
Huron River .	2,809	3,447	1,408	1,237	4,825	70
Ravine River	5	4	12	4	6	2
Silver River . .	2,748	2,000	753	1,271	5,051	267
Sturgeon River	31	28	539	161	427	397
Elm River . .	1	1	2	7	9	0
Misery River .	758	830	2,433	696	962	80
Firesteel River . . .	1,003	1,532	2,044	250	1,118	70
Cranberry River		0	5	22	12	1
Brule River . .	3,969[1]	22,637	19,156	9,539	22,478	2,026
Poplar River . .	126	575	8	57	103	2
Middle River .	4,273	4,829	3,598	2,815	3,502	311
Amnicon River .	11,024	7,622	968	1,094	4,741	879
Total . .	52,291	58,527	44,523	37,574	68,197	9,204
Lake Michigan						
Sturgeon River .	3,503	1,271	731	903	2,378	1,650
Bark River . .	2,478	1,238	1,041	1,063	1,085	710
Cedar River . . .	12,159	8,113	6,834	4,648	9,423	5,729
Total	18,140	10,622	8,606	6,614	12,886	8,089

[1] Operated May 10—July 18 to test direct-current diversion unit, not indicative of total run.

increase was from 254 in 1961 to 268 in 1962. The predominance of males on the Brule River (296 males per 100 females) continues to be the highest in any stream on Lake Superior.

Biological data from Lake Michigan in 1962 were limited to those collected on the Bark River. Sea lampreys were 0.2 inch longer and 0.8 ounce heavier in 1962 than in 1961. Males per 100 females decreased for the second consecutive year—from 189 in 1961 to 178 in 1962.

Catches of fish at the barriers have continued without trend. The 1962 season produced the largest run of mature rainbow trout encountered at the barriers. The proportion of trout with fresh lamprey wounds declined for the second consecutive year, but scarring still was at the 1959 level. The numbers of white and longnose suckers were below average but not the lowest in the 7-year period.

Fyke-net operations

The fishing of fyke nets in tributary streams provides information on the extent of downstream movement of transforming and larval lampreys. The catches also provided an estimate of the results of chemical treatments. Fyke-net fishing was expanded in 1962 to include 29 streams tributary to Lake Superior and 7 streams entering northern Green Bay, Lake Michigan. The streams selected had a wide range of stream flows and environmental conditions. Fishing was started as early as January and continued as late as mid-December.

The catches of lampreys in Lake Superior tributaries that had been treated once greatly exceeded those in streams treated twice (Table 6). From January to August transforming and larval sea lampreys were taken at the rate of 5.9 per 100 days of fishing as compared with only 0.3 per 100 days in streams treated twice—a nearly 30-fold difference. For all species of lampreys during this period, average catches of 16.6 and 0.3 lampreys per 100 days of fishing were obtained in one-and two-treatment streams respectively. This is a 53-fold difference. During the latter part of the year there was only a 4.5-fold difference. Records for the entire year demonstrate conclusively that second treatments destroyed a major portion of the small residual population surviving the earlier treatment. Reasons for the survival of small numbers of lampreys in some streams have been described in previous reports.

The mean catches in Lake Michigan tributaries demonstrated the effect of the first chemical treatment on lamprey-producing streams. The catch per 100 days of fishing through July in untreated streams was 47.2 transforming and 63.6 larval sea lampreys and 122.8 lampreys of all species. During this period no lampreys were taken in streams that had been treated once. Each 100 days of fishing in untreated streams after July produced 340.7 transforming and 45.6 larval sea lampreys and 423.1 lampreys of all species. Catches in treated streams were 9.0 transforming sea lampreys and 9.5 lampreys of all species; no sea lamprey ammocetes were taken. The catch of transforming sea lampreys in untreated streams was 38 times that in treated streams and the take of all species in untreated streams was 45 times that in treated ones.

Extreme variations in the catch in different streams and probable differences in the efficiency of fyke nets are major difficulties in making precise quantitative interpretations of these data. Wide variation in the catch from different streams is to be expected, since lamprey production differs greatly among streams. Information on sampling efficiency is limited. However, in large streams it was found that the position of a fyke net affected the take of lampreys. In smaller streams the latitude for choice of the position of a net is so limited that its location probably has little influence on the catch. It is believed, therefore, that quantitative interpretation of the data for groups of streams is quite reliable. The fact that the relationship between average catches for untreated streams, streams treated once, and streams treated twice is so consistent tend to substantiate this.

TABLE 6.—Numbers of downstream-migrant lamprey caught per 100 days of fyke-net fishing in tributaries of Lake Superior and northern Green Bay, Lake Michigan, 1962.

	Sea lamprey		American brook lamprey ammocetes	*Ichthyomyzon* ammocetes	Total
	Transforming	Ammocetes			
Lake Superior					
Through July [1]					
Streams treated once	0.1	5.8	4.8	5.9	16.6
Streams treated twice	0.0	0.3	0.0	0.0	0.3
After July [2]					
Streams treated once	13.1	0.3	1.7	0.7	15.8
Streams treated twice	2.9	0.1	0.0	0.1	3.1
Lake Michigan					
Through July [1]					
Untreated streams ..	47.2	63.6	8.9	3.1	122.8
Streams treated once	0.0	0.0	0.0	0.0	0.0
After July [2]					
Untreated streams .	340.7	45.6	7.2	29.6	423.1
Streams treated once	9.0	0.0	0.0	0.5	9.5

[1] Covers latter half of 1961-62 downstream migration.
[2] Covers first half of 1962-63 downstream migration.

Experimental population of ammocetes

A single year class of larval sea lampreys was established in the Big Garlic River in 1960 to provide information on the length of larval life. The ammocetes are contained in a portion of the river above a dam and a series of waterfalls that prevent passage of spawners from Lake Superior.

Collections from this known-age stock have provided data on their length distribution and rate of growth. The lengths of ammocetes taken in October 1960 averaged 13 millimeters and ranged from 10 to 19 millimeters. One year later, the larvae had a mean length of 39 millimeters and ranged from 25 to 54 millimeters. Collections in October 1962 revealed an even greater variability in the size of individuals—37 to 107 millimeters—and an increase in mean length to 63 millimeters. The ranges of length increased from 10 millimeters in the first year to 30 millimeters in the second and 70 millimeters in the third. The annual increments of length for the first, second, and third years were 13, 26, and 24 millimeters.

During the fall of 1962, 318 of the larger ammocetes were marked with a subcutaneous injection of insoluble dye and returned to the stream. An additional group is scheduled for marking during 1963. This marking will provide information on the downstream drift; recaptures may also provide data for estimating the size of the population and survival rates.

The downstream trap, designed to capture the first ammocetes to undergo transformation, was modified to increase its efficiency. The alterations have greatly reduced fish mortality and have increased the ability of the screens to pass large volumes of water. Uninterrupted winter operation has been attained by mounting a small heated enclosure over the inclined screens. This improvement has permitted ice-free operation when outside temperatures were far below 0°F. Only 9 ammocetes have been taken at the trap since it was placed in operation in the fall of 1961.

Reestablishment in treated streams

The study of larval populations which have become established in streams following chemical treatment was continued. Reestablished populations are known to exist in 41 U.S. streams tributary to Lake Superior. Seven Mile Creek is the only stream which contains a remnant population of the 1959 year class. The 1960 year class is present in 17 streams, but is common or abundant in only 5. A total of 26 streams have ammocetes of the 1961 year class; larvae are rare in 15 of them and common to abundant in the remaining 11. Surveys since the 1962 spawning have revealed young-of-the-year in 26 streams. This group appears, however, to be common or abundant in only 11 streams.

Ammocetes in estuaries and lakes

An electric beam trawl was developed during 1961 to assess populations of sea lamprey larvae inhabiting bays, estuaries, and lakes within stream systems. Results from preliminary work indicate the electric trawl is a practical device for sampling ammocete populations in deep water.

The experimental trawl was operated in 1962 in all areas along the south shore of Lake Superior most likely to harbor sea lamprey ammocetes. No ammocetes were caught at 17 of 23 trawling stations; larvae were found in three new locations and in two (West Bay and Huron Bay) from which they had been taken previously. The new locations were off the mouths of the Brule River and Furnace Creek and in Otter Lake (Sturgeon River).

Personnel of the Michigan Department of Conservation reported the presence of sea lamprey larvae in Ogontz Bay of Lake Michigan in 1957. The Ogontz River, which is believed to have been the source stream, was treated in 1961. A series of tows in the Bay in 1962 failed to produce ammocetes of any species. In cooperation with personnel of the Fisheries Research Board of Canada, trawling was conducted also in the Kaministikwia River and in Batchawana Bay off the mouths of the Sable, Batchawana, and Chippewa Rivers.

The 1962 trawling indicates that bay or estuarine populations along the south shore do not make a significant contribution to the population of parasitic lampreys in Lake Superior. It is believed the eradication of the population from East Bay in 1961 eliminated the largest concentration of ammocetes remaining on the south shore.

Evaluation of the East Bay treatment

East Bay, a 78-acre lake near the mouth of the Sucker River, was treated with toxaphene in October 1961 to destroy a resident population of sea lamprey ammocetes. The final evaluation of the success of this treatment could not be made until the spring and fall of 1962. Fyke-net catches from the outlet of the bay, and the results of fishing with the electric trawl in the bay, indicate almost complete eradication of lamprey ammocetes. No lampreys were taken with the trawl and only one sea lamprey ammocete was taken in fyke nets. This individual could have come from the river above East Bay. The gill-net sampling of the fish population of East Bay in the fall of 1962 indicated that fish were again plentiful, but that a change occurred in species composition. Small yellow perch, the most abundant game species in 1961 (33 percent of the total catch), accounted for only 4 percent in 1962. Fifty percent of the fish in the 1962 sample were small rainbow trout (under 12 inches long) as compared to 2 percent in 1961.

Sea lamprey research

Remodeling of the old section of the main laboratory building at Hammond Bay was completed during the year. The new facilities provide expanded capacity for bioassay—8 constant-temperature troughs, with space for 132 additional test units. The assay of new compounds and study of various aspects of the toxicity of TFM continued to be the main projects. A number of quality-control assays were conducted also on formulations of TFM purchased by the Commission. Experiments were carried out to determine the effects of fluctuating temperatures and TFM on the development of sea lamprey eggs. Other projects included observations on preference of ammocetes for different types of bottom and the effect of food on growth and transformation.

Screening of new chemical compounds. The search was continued for new compounds selectively toxic to the sea lamprey. Over 80 chemical manufacturers were requested to submit samples of chemicals exhibiting biological activity; 400 compounds were received and tested during the year. New materials first were tested against sea lamprey larvae and rainbow trout at a concentration of 10 ppm at 55° F. over a period of 24 hours. Survivors were transferred to fresh water and held for 10 days or to death. On the basis of these tests, compounds were divided into the following three classes: compounds which showed toxicity during 24-hour exposure; compounds which showed toxicity within 10 days following the exposure period; compounds which showed no toxicity during or after exposure. Of the compounds tested 303 were nontoxic, 15 were toxic after exposure, and 82 were toxic during the exposure. Compounds toxic during the exposure period were tested further to determine the minimum concentrations required to kill ammocetes during exposure or cause death later. Materials that were toxic after the exposure period were evaluated only with respect to postexposure mortality.

Several compounds were highly toxic to sea lamprey larvae; 65 were toxic at 1.0–9.0 ppm, 25 at 0.1–0.9 ppm, and 3 at 0.01–0.09 ppm. Compounds of the halo-nitro-salicylanilide group were highly toxic and also selective for larvae. Further testing of these compounds has been scheduled.

Bottom toxicants. Treatment of lamprey infested estuaries and inland lakes with TFM is made prohibitively costly by the large volumes of water in which lethal concentrations must be established. The costs could be reduced greatly if toxic materials could be distributed along and kept on the bottom. Possible bottom poisons are being tested in an open-top, 300-gallon, oval-shaped, 6-foot-deep tank.

The tank is equipped with portholes for observations of the effect of test materials on fish and larvae. Spigots were installed at depth intervals of 1 foot for removal of water samples to determine the vertical dispersion rate of materials. Rubber plugs, also spaced at these intervals, make possible the introduction of test chemicals at various depths by hypodermic needles. Materials tested in this tank have included copper sulfate and lime, rotenone formulations of high specific gravity, and heavy oils such as chlorinated benzene. None of these materials was satisfactory. Either the vertical dispersion was too rapid or the amount required to kill larvae was too great. Tests with TFM in "oil form" indicated that it might be used as a bottom poison. Application of this formulation to the bottom in water-soluble capsules is being investigated.

Toxicity of TFM to aquatic invertebrates. To gain further knowledge on the effects of TFM on common aquatic invertebrates during stream treatments, assays were completed with 14 groups representing 5 phyla. Tests conducted according to standard procedures included a control and concentrations from 2–20 ppm of TFM for each species. Mortality was insignificant at exposures to 20 ppm among isopods, gammarids, crayfish, dragonflies, water boatmen, and case-building caddisflies. Concentrations below 10 ppm were harmless to leeches in the family Glossiphonidae, stoneflies, bloodworms, and snails; the mortality for this group was 10–55 percent for concentrations between 10 and 20 ppm. Mortality was significant with Hydra at 2.0 ppm, leeches (Herpobdellidae) at 8 ppm, burrowing mayflies at 6 ppm, net-building caddisflies at 13 ppm, blackflies at 3 ppm, and clams at 8 ppm.

Effect of TFM on embryology of sea lamprey. Sea lamprey at all stages of embryonic development were exposed to 10 ppm of the larvicide for 24 hours. After exposure the eggs or larvae were washed and placed in fresh water. Exposures and subsequent incubation were at a constant temperature of 65° F. Exposure from stage 1 through prehatching stage 13 resulted in disintegration of the embryo before it reached stage 18 (larva). Embryos exposed during the prolarval stages, 14 to 17, all died during or immediately following exposure to TFM. Stage 18 larvae died within hours after exposure. Abnormalities produced by exposure to TFM were of three main types: the sloughing or fragmenting of cells from the dorsal lip of the blastopore during stages 9 and 10; the prolongation of stage 13 which produced pigmented, spirally curved embryos within the egg membrane; and the failure of stage 15 embryos to develop hemoglobin. The first type of abnormality appeared in embryos exposed during stages 5, 6, and 7.

Embryos exposed to TFM prior to stage 14 showed the second type most commonly. Abnormalities of the third type appeared in some individuals in all batches exposed to TFM prior to stage 14. Embryos that failed to develop hemoglobin appeared to suffer an almost complete lack of development of respiratory and excretory functions of the blood.

Effects of fluctuating temperature on development. Batches of eggs were subjected to fluctuating temperatures over 10 ranges, 4 with a low of 50° F.; 3 with a low of 55° F.; 2 with a low of 60° F; and 1 with a low of 65° F. The high temperatures of each range were varied by 5° increments starting 10° above the low but not exceeding 75° F. Each test had a control in which eggs from the same lot were maintained at 65° F. Diurnal fluctuation of temperature was produced by changing the thermostat settings each morning and evening. The temperature change from one extreme to the other was attained in 2 to 4 hours. The temperature ranges, 55–70°, 60–70°, 65–70°, all produced stage 17 (burrowing) prolarvae. All embryos reared at the other ranges died.

Experimental feeding of ammocetes. Two groups of sea lamprey ammocetes were held in aquaria supplied with running water from Lake Huron. One group was provided yeast twice a week, the water shut off for 24 hours, and the aquaria aerated. The second group was treated in the same manner, but no yeast was added. Ammocetes were measured every 6 weeks.

After 48 weeks the mean length of the group fed yeast had increased from 105.1 mm. to 120.6 mm., while the length of the unfed group decreased from 103.1 to 93.5 mm. Mortalities in the fed and unfed groups were 8 percent and 6 percent respectively. Transformation in the fed group began between the 48th and 68th week. Average length increased and no significant mortality was observed up to 78 weeks. The average length of ammocetes in the unfed group, on the other hand, continued to decrease, none transformed, and mortality reached 94 percent by the 78th week.

Further experiments with distinctively marked individuals were begun in 1962 to determine the relation between (1) initial size and changes in lengths, (2) rate of shrinkage and mortality, and (3) rate of growth and transformation.

Bottom preference of ammocetes. The preference of sea lamprey ammocetes for various bottom materials was studied for four common bottom types: pea-size gravel, sand, silt, and clay. Tests were made in running-water troughs 10 feet long, 9½ inches deep, and 11½ inches wide. Velocities through the troughs were slow, from 0.035 to 0.064

foot per second. Bottom materials were placed in quart paper milk cartons, cut uniformily into containers 5½ inches high. Half the cartons were filled with sand and the other half with one of the alternate bottom materials in a checkerboard arrangement. Water level was maintained at 3 inches above the filled cartons.

Nine hundred sea lamprey larvae (70–120 mm.) were released at random in each of the troughs and their distribution checked after 30 days. In the sand-gravel comparison, cartons with sand contained 89.9 percent of the test animals; 76.7 percent were in sand in the sand-silt combination; clay was avoided completely by the test animals in the sand-clay series.

LAMPREY CONTROL EXPERIMENT IN CANADA

by

J. L. Kask

Fisheries Research Board of Canada

The following report is based on work carried out by the Fisheries Research Board's Biological Station at London, Ontario.

Lamprey-run Assessment

Electrical barriers were operated on eight Lake Superior tributaries in 1962 for the purpose of assessing the relative size of the spawning population of sea lampreys. Each barrier was activated as soon as stream conditions permitted, the earliest April 30 and the latest May 16. All were operated continuously, for all practical purposes, from the day activated until August 1. The numbers of sea lampreys collected at each barrier between May 15 and July 31 inclusive in each of the years 1956 to 1962 inclusive are tabulated in Table 1. Since it shows only counts taken between May 15–July 31, it differs from some previously published tables which give counts for a longer period of time. Six of the electrical barriers are on streams which flow into Whitefish Bay, the other two on streams which flow into Nipigon Bay. For purposes of comparing counts, the two groups of streams are treated separately in Table 1.

TABLE 1.—Number of sea lampreys collected annually at electrical barriers on eight Canadian tributaries to Lake Superior during the period May 15–July 31 between 1956 and 1962.

Tributary	1956	1957	1958	1959	1960	1961	1962
			Whitefish Bay				
Big Carp	23	23	11	15	20	6	5
Harmony	22	15	6	7	19	14	3
Chippewa	825	353	171	290	1,045	453	123
Batchawana	382	408	301	467	626	561	136
Sable	58	63	36	138	241	88	10
Pancake	657	1,051	750	804	1,286	931	187
Subtotal	1,967	1,913	1,275	1,721	3,227	2,053	464
			Nipigon Bay				
Pays Plat	4	3	4	30	10	31	9
Big Gravel	8	101	152	537	626	799	315
Subtotal	12	104	156	567	636	830	324
Total	1,979	2,017	1,431	2,288	3,873	2,883	788

The Whitefish Bay barrier subtotals during 1956–1961 inclusive suggest a fairly stable condition with annual counts fluctuating moderately from the average for the period, the fluctuations being comparable to variations in the annual production of many stable fisheries. On the other hand, the count in 1962 was only 23% of the average for 1956–1961. There is every reason to believe that the number of lampreys counted at an electrical barrier in any year is roughly proportional to the corresponding spawning run of sea lampreys. Therefore, the decreased count in 1962 presumably reflects a comparable decrease in the spawning population. It seems unlikely that a decrease of that magnitude could represent a natural fluctuation.

Lampricide was applied to the main lamprey-producing streams tributary to Whitefish Bay in 1960. The expected result from treating in 1960 would be a reduction in the strength of those year classes of sea lampreys which would spawn in 1962 and in several subsequent years. Also, electrical barriers were operated for the first time on most Whitefish Bay streams in 1955. The expected result from electrical barrier operations is hard to assess, because of doubt about duration of the ammocoete stage. One reasonable interpretation of the data is that more ammocoetes transform when five years old than at any other age. If this interpretation is accepted, then the operation of barriers in 1955 would be expected to have more effect on the year class that would spawn in 1962 than on any other. It therefore seems reasonable to regard the low 1962 counts for Whitefish Bay as indicating a decrease in a pertinent segment of the lamprey population resulting from control activities—either lampricide application or barrier operation or both.

It is not clear whether the decrease in count from 1960 to 1961 is significant. It could be regarded as an extreme fluctuation from the average or it could be regarded as the result of control activities, since lampricide was applied to some Whitefish Bay streams in 1959. Since, some ammocoetes mature earlier than others, the operation of electrical barriers in 1955 could also have had some effect on the 1961 run.

The Nipigon Bay counts increased many-fold between 1956 and 1961, as is consistent with evidence from other sources that the sea lampreys were relatively scarce in Nipigon Bay until about 1955 and have increased rapidly since that time. The 1962 count was only 39% of the 1961 count, a definite reversal of the upward trend. In the absence of an alternative explanation, the lower 1962 count is attributed to control efforts, namely, the treatment of all known lamprey-producing tributaries in 1959 and 1960 or the operation of electrical barriers since 1956, or both.

Stream Surveys

In 1962 all Lake Superior streams between the Agawa and Steel Rivers, which were regarded as potential sea lamprey producers but where ammocoetes had not previously been found, were surveyed—a total of 175 streams. Ammocoetes were found in eight, the Agawa, Sand, Dog, White, Big Pic, Little Pic, Prairie and Steel Rivers; the eight were then surveyed in detail as a basis for later treatment. Detailed pre-treatment surveys were also carried out on three Lake Huron streams, the Garden, Kaskawong and Thessalon Rivers.

At present two high dams on the Severn River prevent sea lampreys from reaching Lake Simcoe from Lake Huron. A proposal to build navigation locks around these dams is under consideration. Since locks would make access to Lake Simcoe easy for sea lampreys, it was considered advisable to survey all streams in the Lake Simcoe-Severn River watershed. Accordingly, 107 streams in the watershed were surveyed in 1962. Of these, 19 appeared suitable for sea lamprey spawning and for ammocoete production. Since Lake Simcoe itself appears to be suitable for adult sea lampreys, there is every reason to believe that the proposed locks would result in a resident sea lamprey population in Lake Simcoe. No evidence was found that sea lampreys are already present.

Chemical Treatment

Lampricide was applied to a total of 13 Lake Superior tributaries in 1962. Details are shown in Table 2. The Board is indebted to the Ontario Department of Lands and Forests for assistance with some of the treatments, particularly for air transport of chemicals during the Little Pic and Steel River treatments. The friendly cooperation of the Algoma Central Railways, of Marathon Paper Mills and of the Ontario Hydro Electric Power Commission is gratefully acknowledged.

Welland Canal

Presumably sea lampreys reached the upper Great Lakes from Lake Ontario by means of the Welland Canal. The extent to which sea lampreys continue to use the Canal was recently assessed. In 1959, in 1961 and in 1962 investigators were present when canal locks were drained for the winter. Standard survey methods were also used to look for ammocoetes during the appropriate season. Also, extensive enquiries were made among people likely to see lampreys, or to have lampreys reported to them.

No sea lamprey adults or ammocoetes were collected from the Canal system. Several cases of lamprey-like organisms in the system were reported, but only one reported case seemed an authentic sea lamprey; it was taken from the Welland River near the Canal, so it

TABLE 2.—Canadian streams treated with lampricide, Lake Superior, 1962.

Stream	Date of treatment	Discharge (cfs)	Stream miles treated	Pounds of active ingredient	Ammocoete abundance
Agawa	May 30–June 1	645	14.5	2,345	Scarce
Sand	June 4	250*	0.5	510	Scarce
Steel	June 13–14	1,090	5.0	6,058	Few
Prairie	June 28–29	146	4.5	1,051	Scarce
Little Pic	June 30–July 4 July 12	568	60.0	8,091	Scarce
Wolf	July 5–6	149	8.5	749	Nil
Big Gravel	July 9–10	106	7.0	1,068	Moderate
Kaministikwia	July 28–Aug. 14	1,248	77.0	13,077	Moderate
Chippewa	Aug. 27–28	120*	1.5	1,057	Scarce
Batchawana	Aug. 31–Sept. 2	222	10.0	2,632	Scarce
Sable	Sept. 4–6	63*	14.5	316	Scarce
Goulais	Sept. 11–18	227	105.5	5,029	Moderate
Big Carp	Oct. 14–18	8	8.5	289	Scarce
Total		4,842	317.0	42,272	

* Flow estimated.

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could have reached the point of capture from Lake Erie without entering the Canal. If sea lampreys were migrating through the Welland Canal in numbers, these investigations should have found more convincing evidence than was uncovered. It is therefore concluded that few sea lampreys, if any, migrate through the Welland Canal in any given year. This conclusion is consistent with the fact that over 100 years elapsed between the time the first Welland Canal was opened and the time the first sea lamprey was recorded from above Niagara Falls.

LAMPREY CONTROL AND RESEARCH

by Co-operating Agencies

Michigan Department of Conservation

In 1961 the Institute for Fisheries Research began a study of the ammocete population in MacKay Creek and MacKay Bay, Lake Huron. In 1961 estimates were made of the population in the stream and in 1962 studies were extended to beaver ponds and to the bay to compare population densities. During the winter of 1961–62, however, dams washed out leaving small ponds and connecting channels where large ponds previously existed. Since the situation had changed radically, work in 1962 was limited to estimates of populations in the residual ponds.

Two evaluations were made of techniques for sampling ammocete populations. To determine the efficiency of the Teredo shocker used in sampling the population, a known number of marked sea lamprey larvae were released in six enclosed areas. Two hours later the shocker was used to collect larvae. The recovery rate varied from 16 to 0 percent and a correction factor for "undersampling" was established.

Sampling in MacKay Bay was done with a drum into which larvicide was introduced. Although the device was 80 percent effective in laboratory tests it failed to capture sea lamprey ammocetes in the bay where they had been collected previously with an orange-peel dredge. The efficiency of the drum will be tested further in 1963.

Wisconsin Conservation Department

The Wisconsin Conservation Department continued to operate a barrier on Hibbards Creek (Lake Michigan) which has provided counts of spawning sea lampreys since 1946. The catch in 1962 was 1,320 compared with 975 in 1961. A record catch of 12,640 sea lampreys was made in 1951, but in recent years the catch has been less than 3,000. Hibbards Creek is a small stream and the number of sea lamprey entering it to spawn are probably influenced by the flow and the development of gravel bars at the mouth.

LAKE TROUT REHABILITATION

Lake trout rehabilitation, carried out by state, provincial, and federal agencies in the United States and Canada, continued to be devoted mainly to Lake Superior in 1962. Plantings of fin-clipped trout by the Ontario Department of Lands and Forests, Bureau of Sport Fisheries and Wildlife, and the conservation departments of Wisconsin, Michigan, and Minnesota reached a record total of slightly more than 1.8 million—an increase of nearly 600,000 over 1961. Investigations on the status of native lake trout and the success of hatchery plantings were continued by the Bureau of Commercial Fisheries, Wisconsin Conservation Department, and the Fisheries Research Board of Canada.

Propagation

A total planting of 1,853,000 fingerling and yearling lake trout was made in Lake Superior in 1962 (Table 1). Slightly more than 0.5 million yearlings were planted in Canadian waters by the Ontario Department of Lands and Forests and over 1.2 million in the United States waters by the Bureau of Sport Fisheries and Wildlife and the conservation departments of Wisconsin, Michigan, and Minnesota. The plantings in 1962 brought the total stocking of fingerling and yearling trout in Lake Superior since 1958 to nearly 6 million fish.

In addition to the large plantings in Lake Superior, small experimental plantings of lake trout and unselected hybrid trout have been made in Lake Michigan and Lake Huron, respectively. The last of a series of five small test plantings of lake trout was made in Lake Michigan in 1962 to obtain further information on their dispersion, growth, and ability to survive lamprey predation in the years immediately following introduction. Returns from the earlier plantings have shown wide dispersal and excellent growth, but it appears that after about 2 years these trout become fully vulnerable to sea lamprey attack and are destroyed rapidly. The stocking of hybrids in Lake Huron by the Ontario Department of Lands and Forests was continued in 1962 with plantings of 3,000 yearlings from hybrids back-crossed to lake trout and 20,000 yearlings from hybrids back-crossed to brook trout in South Bay and 54,000 F_1 hybrids (brook trout x lake trout) in the North Channel. Returns from all plantings since 1954 indicate that few hybrids are surviving beyond age III in Lake Huron. Only a few females are capable of spawning at age II and lamprey predation at the present level appears to be severely reducing the chances of natural reproduction. The selective breeding program of the Department of Lands and Forests was also extended

TABLE 1.—Plantings of lake trout in Lake Superior, 1962.

Agency	Area planted	Number planted	Fin-clip
Bureau of Sport Fisheries and Wildlife	Apostle Islands (spring)	121,000	dorsal-left pectoral
	Apostle Islands (fall)	116,000	dorsal-left ventral
	Keweenaw Bay	323,000	right pectoral
	Shelter Bay	295,000	left pectoral
Wisconsin Conservation Department	Apostle Islands	256,000	adipose-both ventrals
Michigan Department of Conservation	Whitefish Bay	70,000	dorsal-both ventrals
	Ontonogan	87,000	adipose-left pectoral
Minnesota Department of Conservation	Little Marais	77,000	dorsal
Ontario Department of Lands and Forests	Rossport to St. Ignace Island	258,000	adipose-right ventral
	Montreal River to Coldwater Creek	250,000	adipose-left ventral
Total		1,853,000	

in 1962. Individuals that have the ability to maintain themselves in deep water and to mature at least by age III were selected from among second generation hybrids. Selection was repeated on the progeny of these fish, i.e., third generation hybrids, and will continue for as many generations as required to establish a deep-swimming, early-maturing strain of hybrid. Selection for deep-swimming is made by a flotation test which separates individuals with the ability to retain gas in their swim bladders when held for prolonged periods under considerable hydrostatic pressure. This ability is characteristic of lake trout. Flotation selection has been carried out on the 1957, 1958, and 1959 year classes. The numbers of selected brood fish now available from these 3 year classes are 30, 150, and 300.

Lake trout egg collections by state, provincial and federal agencies totalled over 9.5 million in 1962—80 percent from brood fish in hatcheries. More than 54,000 brood fish, selected from various stocks of both Lake Superior and Lake Michigan origin, are available in various hatcheries. These fish include 10 year classes and cover an age range from 2 to 14 years.

Catch restrictions

At the request of the Great Lakes Fishery Commission, the States of Michigan, Wisconsin, and Minnesota, and the Province of Ontario inaugurated restrictions on their commercial lake trout fisheries in 1962 to limit the catch to the amount required to produce the biological data needed by the research agencies. For administrative reasons the methods of bringing about the restrictions varied from agency to agency and they could not be brought into effect until mid-year. Wisconsin closed its fishery on July 1 and for the remainder of the year carried out experimental fishing entirely with its own vessel and personnel. Minnesota closed its fishery on June 1 and subsequently permitted fishing only in certain areas under special permits (3 permits were issued, but only 2 were used). Michigan closed its fishery on June 1 and authorized the Bureau of Commercial Fisheries to contract with 8 fishermen to carry out a specified amount of fishing in certain areas at certain times. The Province of Ontario established a total allowable catch with district quotas, which permitted a limited catch that was sampled by the Fisheries Research Board of Canada. The Canadian fishery was closed on October 15 when the bulk of the desired sampled had been obtained.

The estimated landings in 1962 by states and the province, both before and after the application of restrictions are recorded in Table 3, while the U.S. and Canadian landed catches in 1950–62 are listed in Table 4. The imposition of restrictions on the commercial catch prevents direct comparison of the records of lake trout landings for 1962 with those of previous years.

If the fishery had not been restricted in 1962, it is estimated that the full-year production for the entire lake might have reached 600,000 pounds.

Status of lake trout stocks

Lake trout populations in Lake Superior responded sharply to the reduction in the numbers of sea lamprey. United States and Canadian data both indicated improved survival, particularly of larger and older trout, accompanied by increases in average size and abundance. The extent of these changes, however, varied in different areas of the lake.

The most striking improvements were in Wisconsin waters. The abundance index of legal-size trout (over 17 inches) over the entire

TABLE 3.—Estimated landings of lake trout in Lake Superior by state and the province, before and after restriction on fishing, 1962.

State or Province	Landings (pounds)	
	Before restriction	After restriction
Michigan	109,928	25,172
Wisconsin	106,694	13,007
Minnesota	1,500	500
Ontario	69,587	
Totals	287,709	38,679

TABLE 4.—Commercial landings of lake trout in Lake Superior by states and province, 1950–1962.

Year	Landings (thousands of pounds)				
	Michigan	Wisconsin	Minneota	Ontario	Entire lake
1950	2,400	591	202	1,506	4,699
1951	2,174	504	233	1,273	4,184
1952	2,074	521	243	1,389	4,227
1953	1,746	450	217	1,371	3,785
1954	1,609	436	211	1,266	3,522
1955	1,378	553	170	1,003	3,104
1956	1,224	479	109	527	2,304
1957	849	287	55	238	1,429
1958	767	259	33	366	1,426
1959	671	186	11	238	1,106
1960	269	109	2	122	503
1961	218	103	2	45	368
1962	135	120	2	70	326

year increased 68 percent over the 1959 figure and the average dressed weight rose to 3.0 pounds—an increase of 0.5 pound over 1961. The abundance of fish 21 inches long and longer in the spring catches increased 233 percent over the same period in 1961. The abundance of sublegal fish (less than 17 inches) in the early winter catches, nearly all fin-clipped hatchery fish, increased almost to the 1959 level. Moreover, the incidence of wounded trout in the catches over the year remained unchanged from the very low level of 1961.

The improvements were less spectacular in Michigan waters and occurred mainly among the larger and older trout. The average size of legal-size trout over the entire year increased 20 to 35 percent at all Michigan ports and the abundance of large trout (25 inches and longer) was several times greater than in 1961. However, the abundance of the smaller legal-size fish (17.0 to 24.9 inches) continued to decline due to lack of recruitment. Except in areas where hatchery trout were abundant, the sublegal fish were almost completely absent. The incidence of wounded trout in the Michigan catches remained at a level well below that in 1959 or 1960, but was slightly higher than in the fall of 1961 at most ports east of the Keweenaw Peninsula. The rate of wounding west of the Keweenaw was the lowest observed over the past 4 years.

Findings in Canadian waters were similar. Over the entire year and the entire lake the average dressed weight of legal-size lake trout was only 0.16 pound or 7.0 percent greater than in 1961 (2.34 in 1962; 2.18 pounds in 1961). The number of trout captured per unit of effort increased 13.0 percent. As in United States waters, these changes were not uniform throughout the lake. Changes were slight in the average size of trout captured from the isolated populations on off-shore banks, but the poundages of these fish per 1000 yards of net lifted increased. The 1962 figures on catch per unit of effort—97 to 124 pounds dressed weight per 1000 yards—were generally comparable to those of the pre-lamprey fishery. The inshore populations exhibited a general trend toward increasing average size of fish and, depending upon area, various upward and downward changes in the poundage per 1000 yards of net lifted. The 1962 catch per unit of effort generally ranged from 15 to 5 pounds per 1000 yards (20 to 50 percent of pre-lamprey values), except in Whitefish Bay where the fishery yielded barely 2 pounds per 1000 yards. The low percent of trout bearing lamprey wounds, first observed in the fall catches of 1961, persisted through 1962.

The percentage of hatchery-reared trout in the catches continued to increase over the entire lake, especially among sublegal fish. In Wisconsin waters during the year, 33 percent of the legal-size fish and 66 percent of the sublegal fish came from hatcheries. In Michigan waters, planted trout contributed less to the legal portion of the catch than in Wisconsin, but 80 to 100 percent of the sublegal fish had been planted. The contribution of hatchery-reared trout to the Canadian catches rose from 9 percent in 1961 to 33 percent in 1962.

Experimental fishing by the Bureau of Commercial Fisheries research vessel *Siscowet* in 1962 was undertaken to determine the distribution and abundance of native and hatchery-reared lake trout. Most of the fishing was in western Lake Superior where 1,873 trout under 17 inches in length were captured over the year. Slightly over

98 percent of these fish came from hatcheries. The best represented plants were those made near Bayfield in 1962 and 1961. The 1960 plant continued to show signs of good survival, but fish from the 1959 plant were relatively scarce. The experimental fishing in the Apostle Island region has shown marked changes in the past 5 years. The average number of small lake trout taken per 15-minute trawl tow since 1958 is as follows:

Year	*Trout caught*	*Catch per tow*
1958	3	1.5
1959	73	2.8
1960	85	3.0
1961	439	7.6
1962	1,808	12.6

The percentage of planted trout in the catches of both trawls and experimental gill nets increased from 25 percent in 1958 to over 98 percent in 1962.

Further evidence of improvement of the lake trout population comes from catches of spawning trout in Wisconsin waters. Prior to 1961, the Wisconsin Conservation Department set nets on spawning reefs to collect eggs for its lake trout hatchery. The fishing was abandoned after 1960 when the total catch was only 21 spawning fish. In 1961, the research vessel *Siscowet* fished the reefs and caught only 17 males. The catch in 1962, however, was 96 males and 3 females—a modest increase over 1960 and1961. The age and length distribution of the 1962 catches suggest that another increase in the number of spawners on the reef is likely in 1963 and possibly a much greater increase in 1964.

A SUMMARY OF FISHERY RESEARCH ON THE GREAT LAKES IN 1962

Lake Ontario

Investigations in Lake Ontario during 1962 were concerned mainly with the fisheries for walleye and whitefish and with the status of planted lake trout.

The Canadian commercial fishery for whitefish is being seriously affected by increasing variability in the strength of year classes. Poor representation of young fish in the spring commercial and experimental catches in 1962 suggests that the 1959 and 1960 year classes are weak. A significant decline in the fishery is expected in 1963 and 1964.

A hypothesis relating whitefish recruitment to stock density levels was proposed in 1961 after a study of data collected since 1944. It is being tested by closing fall fishing grounds on the south shore of Prince Edward County to reduce the catch of mature fish. The south shore is believed to be the major spawning area since the decline of the spawning run into the Bay of Quinte. Tagging was carried out to investigate racial differences in these two stocks. Studies of natural mortality rates of young whitefish also continued.

Small plantings of lake trout have been made annually since 1953 by the Province of Ontario and the State of New York to reestablish the species in Lake Ontario. Although the survival of young trout has been good, few fish have reached maturity and there is no indication of natural reproduction. Plantings of 100,000 yearling trout are planned for 1963 and 1964 as well as a closure on trout fishing to improve the chances for re-establishment and to increase opportunities to study survival.

Walleye are taken in eastern Lake Ontario by commercial fishermen and anglers. The sport fishery for this species has been concentrated in the Bay of Quinte where a creel census has been maintained since 1957. The angling season was opened two weeks earlier in 1962 to increase the catch of large fish which are rarely taken by anglers later in the season. The fishing was generally disappointing, however, perhaps because of the unusually cold and windy weather.

Walleye tagging was continued during the spring in the Bay of Quinte and in the main lake using two types of tags. Observations on the growth, maturation, and fecundity of the walleye are being analysed.

Other investigations in 1962 included movements of American eel, incidence of sea lamprey scarring, and coregonine hybridization.

Lake Erie

Sampling of the Lake Erie commercial catch at major fishing ports was carried out by the Ontario Department of Lands and Forests and the U.S. Bureau of Commercial Fisheries. Yellow perch of the 1959 year class made up the major portion of the catch. This group was so abundant that fishermen in Ontario voluntarily restricted operations to maintain price.

Sampling of fish stocks with trawls and gill nets, continued by those agencies, showed an extraordinary abundance of young-of-the-year perch and a relatively good hatch of walleye. The young of most species, with the exception of smelt, appeared more abundant in 1962 than in 1961.

Smelt spawning and distribution received special attention in Canadian waters. Egg deposition was studied in some detail off Pelee Point, where spawning was concentrated on gravel bottom at depths less than 10 feet. Young of the year were found to be concentrated during the summer south of Pelee Point and east of the islands, north of Long Point, and at the eastern end of the lake. Older smelt appeared to move eastward in late spring and early summer, out of the central basin, as bottom waters were depleted of oxygen. In late summer smelt in the central basin were concentrated in the thermocline.

Investigations on walleye in 1962 included analysis of tagging data. A study by the Bureau of Commercial Fisheries, based on the recovery of tagged fish of the 1959 year class, was completed and a report submitted for publication. Walleye spawning ground studies were continued by the Ohio Division of Wildlife and major and minor spawning areas sampled for eggs, using a pumping device. Conditions on spawning grounds were recorded, but no single factor influencing viability of eggs was identified. Shortly after hatching young walleye appear to disperse rapidly from spawning reefs and move inshore.

A number of life history and behavior studies on smelt, sheepshead, and yellow perch were continued.

Extensive collections of bottom organisms in western Lake Erie in 1961 by the Bureau of Commercial Fisheries were identified, counted, and comparisons made with a previous survey in 1930. The study confirmed observations that mayflies had decreased and tubificid worms and midge larvae had increased greatly. On the basis of the abundance of tubificids, heavy pollution was indicated off the mouth of the River Raisin, Maumee Bay and the Detroit River. The western shore of the lake also appeared to be heavily polluted.

Rapidly changing biological conditions in Lake Erie in recent years have resulted in an increasing interest in basic environmental studies by a number of agencies. Fishery agencies have been particularly concerned with the sharp decrease in dissolved oxygen below the thermocline in the western portion of the central basin. Investigations by the Bureau of Commercial Fisheries have shown a rapid initial uptake of oxygen by sediments, which appears due to a chemical reaction. A more gradual further decrease appears to be the result of biological action. The decrease in oxygen is accompanied by the release of relatively large amounts of iron and phosphorus from the sediments.

Lake Huron

Sampling of the commercial catch of whitefish was continued in Georgian Bay, and of whitefish, walleye and sturgeon in the North Channel, by the Ontario Department of Lands and Forests. Substantial catches of whitefish in southern Georgian Bay were composed largely of relatively strong 1957 and 1958 year classes. The U.S. Bureau of Commercial Fisheries sampled the spring and fall catches of principal species in Saginaw Bay.

Fifty lifts of commercial gill nets, at stations in Georgian Bay, took chubs (deepwater ciscoes), alewife, and smelt in increasing order of abundance. No lake trout or hybrid trout were caught. The experimental fishery in South Bay took 42,388 pounds of fish—78 percent alewife. Smelt spawning runs were sampled and progress was made on the analysis of smelt data collected since 1947. The sport fishery for smallmouth bass in South Bay improved in 1962 with the entrance of the predicted strong 1959 year class into the fishery. Limited study of the bass fishery in Parry Sound on the east shore of Georgian Bay showed a similar year-class composition with minor differences due to slower growth.

Replies to monthly questionnaires on the incidence of lamprey scars indicated that scarring of whitefish in Georgian Bay was the lowest in seven years. No lake trout were reported taken on survey dates.

Work on the temperature regimen in South Bay, to provide a basis for comparing temperatures at various depths for the years since 1953, was continued. Water exchange between South Bay and Lake Huron was investigated. Current observations were made simultaneously at the Little Current Channel, Owen Channel and Russell Channel in northern Georgian Bay. A number of reports on the physical limnology of Saginaw Bay, by the U.S. Bureau of Commercial Fisheries, were reported close to completion. Laboratory work on Saginaw Bay bottom fauna was completed by the Michigan Institute for Fisheries Research.

Lake Michigan

Investigations on Lake Michigan during 1962, by the U.S. Bureau of Commercial Fisheries, were concerned largely with ciscoes in the main lake and walleye in Green Bay. General hydrological and bacteriological observations were made in cooperation with the U.S. Public Health Service study of water quality.

In the cisco studies there was evidence that the changes in abundance and composition of species and subspecies components have led to genetic changes. It appears that present and future species will not be identical with those of the past and new criteria for recognition will be required. Progress has been made in distinguishing species groups through antigen-antibody reactions. Antisera were prepared for a number of species. Species identification by acrylamide electrophoresis of blood sera of four coregonids has shown similar if not identical patterns of protein migration for two species and similarities between two other species.

A study of the seasonal bathymetric distribution of ciscoes, mainly bloaters, *C. hoyi*, and associated species was also carried out by the Bureau. Studies of the temperature tolerance of ciscoes, carried out in cooperation with the Research Branch of the Ontario Department of Lands and Forests and the University of Toronto, indicated tolerance to temperatures approaching 80° F, despite the low (45° F.) temperatures selected in the lake. A study of the food habits of *C. hoyi* showed that fish under seven inches fed heavily on zooplankton, while large fish fed on amphipods.

In Green Bay spring and fall sampling of the commercial catch was continued. The annual spring sampling of young fish with trawls indicated that the 1962 year class of walleye was relatively weak. Some additional tagging of spawning walleye was carried out in the spring by the Bureau of Commercial Fisheries and the Michigan Institute for Fisheries Research. Recaptures continue to indicate little movement of walleye out of northern Green Bay. A report on the year-class contribution of yellow perch to the commercial fishery of southern Green Bay, 1948–1962, was completed.

Lake Superior

Investigations on Lake Superior were concerned primarily with lake trout and their response to the reduction in sea lamprey. Information was obtained mainly through the limited fishery. Restrictions on the catch of trout in mid-season necessitated some minor changes in sampling procedure. In Wisconsin, assessment fishing was continued systematically by the Wisconsin Conservation Department vessel *Salmo*. In Michigan waters eight fishermen were permitted to continue fishing under contract with the Bureau of Commercial Fisheries. The Fisheries Research Board sampled the catch of Canadian fishermen operating under quotas. Additional information, particularly on young trout, were collected by the research vessels *Siscowet* and *Cottus*, operated by the Bureau and the Board, respectively. The information on lake trout abundance is summarized in the report on lake trout rehabilitation (page 46).

An analysis of data collected in 1959 by the *Cisco* on the depth distribution of lake trout in relation to ciscoes was completed. Lake trout and cisco *C. artedii* were most abundant at 25 fathoms. Trout were less numerous but larger below 25 fathoms where species of deepwater ciscoes were abundant. Observations by the *Siscowet* on the depth distribution of fish food indicated that copepods and amphipods were most abundant from 20 to 25 fathoms where young trout were concentrated. Two series of drift bottle releases were made during the summer to investigate the relationship between movements of marked trout and littoral currents.

A late fall cruise of the *Siscowet* provided information on the spawning of several species of coregonids. Eggs were collected for hatching and subsequent study of morphology and family and subfamily relationships. Some progress was made in the difficult problem of identifying certain Lake Superior coregonids. A preliminary analysis of morphological characteristics suggests that the subspecies *C. reighardi dymondi*, found in northern Lake Superior, is the result of hybridization or a "mixture" of two morphologically similar but genetically distinct forms.

Returns of tagged whitefish in the Apostle Islands continued to show little movement by this population. Reports on the age and growth of whitefish and round whitefish were completed for publication and papers on the life history of lake herring and smelt were nearing completion at the end of 1962. The Fisheries Research Board continued routine sampling of commercial landings of whitefish at Canadian ports.

A study of lake-run rainbow trout and the sports fishery developing for them on the northwest shore of Lake Superior was continued by the Minnesota Department of Conservation in 1962. Rainbow trout have been found in 46 of the 72 streams surveyed and population estimates of up to 11,000 fish per mile reported. Trapping and marking were carried out on three streams to determine the number of spawners entering from the lake. Electro-fishing, trapping, and marking were also carried out to determine density, composition and movements of juvenile fish. Having established the distribution of fishing pressure in previous years, an intensive creel census was carried out on three streams during the spring.

A study of the migration of brown and rainbow trout from Lake Superior into the Brule River, was continued in 1962 by the Wisconsin Conservation Department. A new trap, which could be removed when adverse conditions threatened, was constructed and operated from mid-August to early December. Among the 482 brown trout and 28 rainbows taken were 10 fish tagged in the previous year which showed an average increase of 1.65 inches and 1.35 pounds. The low catch in 1962 appeared to be due to a late start in operations, escapement through a canoe by-pass, and an increase in the spacing of vertical rods in the weir gates in September.

Heavy mortality of brown trout from furunculosis was again observed. Approximately 616 fish, mainly males, weighing 2,940 pounds, were collected. Recovery of tagged individuals among the dead and dying brown trout indicated a population in excess of 2,000.

During the fall trout season anglers reported a catch of 380 rainbows and 134 brown trout from the Brule River. Anglers also reported the capture of tagged brown and rainbow trout up to 100 miles from the Brule.