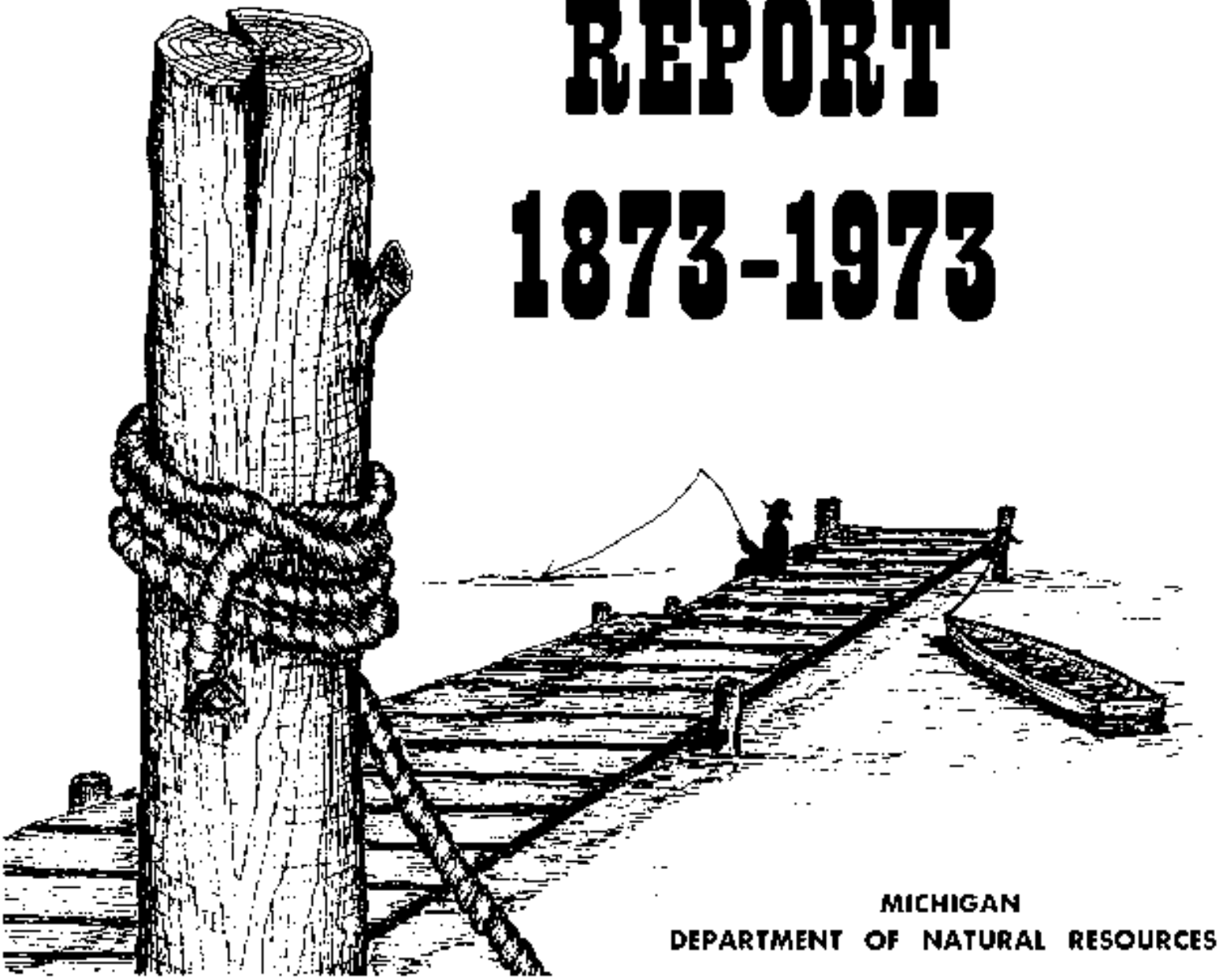
MICHIGAN FISHERIES

CENTENNIAL REPORT 1873-1973



MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

FISHERIES MANAGEMENT REPORT NO. 6 APRIL, 1974

MICHIGAN FISHERIES CENTENNIAL REPORT

1873 - 1973

COMPILED BY

DNR STAFF AND OTHERS

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

FISHERIES DIVISION

STEVENS T. MASON BUILDING
LANSING, MICHIGAN 48926

Preface

Of Michigan's fishery resources, the sport fishery makes, by far, the greater contribution to the State's economy, and this has been the case for perhaps the last 50 years. In planning the content of this Centennial volume, we tried for broad coverage of fish management and history, without, you might say, giving proportionate space to sport fishing. In the above preface photos we call attention to the new, salmon, sport fishery and, at the same time, pay tribute to two former fishery administrators: the late August Scholle, member of the Commission of the Department of Natural Resources--on left, with an 8-lb coho salmon--; and the late Dr. Ralph A. MacMullan, department Director, Off Manistee, Sept. 4, 1970.

Wayne H. Tody

MICHIGAN FISHERIES CENTENNIAL, 1873 - 1973

Table of Contents

Substantive Reports ✓

Title	Author	Page
On the history of trout planting and fish management in Michigan	F. A. Westerman	15
Comments on fish management	G. P. Cooper	39
Whitefish, sturgeon, and the early Michigan commercial fishery	W. H. Tody	45
Sport fishermen and licenses	H. J. Vondett	61
Michigan sport fishing regulations	D. P. Borgeson	67
The productivity and regulation of Michigan's commercial fisheries	J. A. Scott	75
The introduction of fishes into Michigan	W. C. Latta	83
The sea lamprey and its control	R. W. Saalfeld and J. H. Howell	97
A history of fish culture in Michigan	H. Westers and T. M. Stauffer	107
Lake and stream improvement	D. E. Reynolds	126
Public access on lakes and streams	F. G. Fanselow	134
Fisheries research	G. P. Cooper	141
Biographical profiles	C. M. Taube	153
Chronology of important events in Michigan's fisheries history	A. W. DeClaire	178

Miscellanea

	Page		Page
Resolution by Legislature	4	Michigan record fish	42
Governor's declaration	5	Heddon award	43
Employee rosters	6	Commerce award	54
Commissioners	9	Historical markers	186
Division chiefs	11	Jerome letters	190
Administrative personnel	12	Centennial picnic	194
Fish planting units	38	Acknowledgments	199
All Division chiefs	41	Photograph	200

✓ Except where indicated otherwise in each report, all authors are currently employed in the Fisheries Division

STATE OF MICHIGAN JOURNAL OF THE SENATE
No. 100, pp. 1657-1658,
77th Legislature Regular Session of 1973

Senator Bouwsma offered the following concurrent resolution:

Senate Concurrent Resolution No. 217.

A concurrent resolution commemorating the 100th anniversary of the Department of Natural Resources Fisheries Division.

Whereas, A century ago, on April 19, 1873, the State's first fish commission was appointed. The same year the first fish hatchery in the State of Michigan was built at Pokagon and named Crystal Springs for the clear water supply found there; and

Whereas, The Michigan Fish Commission Board was established by Public Act No. 124 of 1873, and the first members of the Board were Governor John H. Bagley; George Clark, a commercial fisherman from Ecorse; and George H. Jerome of Niles, who later became Michigan's first Chief of Fisheries; and

Whereas, The first Fish Commission was established primarily to promote the cultivation of fish for food rather than for sport, or recreation, which led to the first attempts nationally to introduce Atlantic Salmon and chinook salmon in Michigan and the successful incubation of 200,000 whitefish eggs at Pokagon in 1874; and

Whereas, The general concept of our fishery resources was one of inexhaustibility in the late 1800's, the early fish commission recognized the perilous position of the Great Lakes food fishes and the Michigan grayling, and made many valiant attempts to save these resources from becoming extinct; and

Whereas, The development of the hatching car by Oren M. Chase in 1873 and other major fish culture techniques in Michigan led to improvements which todays fish culturists across the world still benefit; and

Whereas, Over the years the fisheries program grew as more and more fish were planted in Michigan streams and in the Great Lakes. By 1892 brook trout had been planted in all the counties of the Lower Peninsula except six, and California rainbow trout and European brown trout had been introduced into Michigan streams; and

Whereas, By the turn of the century, fish culture as a science was well established in Michigan and had obtained considerable popularity. Today's Fisheries Division ranks high among the nation's fish management organizations. Its modern fish hatchery facilities and scientific management techniques are a far cry from the early days when the first fish hatchery with hatching house and ponds cost a total of $1,200.00; now therefore be it

Resolved by the Senate (the House of Representatives concurring), That the members of the Michigan Legislature take this opportunity to congratulate the Fisheries Division of the Department of Natural Resources on the occasion of its 100th anniversary and to commend the Fisheries Division on the progress and development in fish management it continues to make.

Pending the order that, under rule 32, the concurrent resolution be referred to the Committee on Senate Business.

Senator Pitzenger moved that rule 32 be suspended.

The motion prevailed, a majority of the Senators serving having voted therefor.

Adopted by the Senate, October 24, 1973; by the House of Representatives, November 14, 1973.

William G. Milliken

Governor of the State of Michigan

presents this

Executive Declaration

in Observance of

William G. Milliken

THE FIRST FISH COMMISSION EMPLOYEES

1873-1875 The first biennium

G. H. Jerome	A. J. Kellogg*
J. P. Clark	Charles Michael
N. W. Clark	E. R. Miller*

*Commissioners reimbursed for some expenses

FISHERIES DIVISION EMPLOYEES

1921, about Mid-Centennial
(First year of the new Department of Conservation)

Central Office

Seymour Bower
Dwight Lydell
A. T. Stewart
Genevieve Forbes
Ethel Fraser

Paris Station

Oliver Palmer
Ed Colisan
Chas. Davenport
John Donley
Harry Getings
G. C. Mapletoft
M. M. Marks
Jess Parker
John Romine
Chas. Saltzer
Webb Terry
A. J. Wolcott

Hastings Station

Claude Lydell

Mill Creek Sta.

A. E. Host
T. W. Bonser
A. Brown
Richard Host
Henry Kremers
John McEwan
Frank Tubbs

Manistee R. Sta.

Jess Parker
M. J. Bailey
Jesse Clements
G. Hamilton
Walter Hamilton
Henry Johnson

Harrisville Station

G. W. Colwell
Sherman Wilson
Calvin Cherritree

Drayton Plains Sta.

J. L. Brass
Walter Hughes

Grayling Station

P. G. Zalsman
Charles Craig
A. W. Harrington
Leslie Harrington
Frank Lydell
Earl Whipple
Frank Whipple
Elsie Zalsman

Oden Station

Charles Plumb
S. P. See
F. J. Host

Bay Port Station

Richard Host
John Hang

Detroit Station

E. D. Schu

Harrietta Station

J. H. Westerman
John Collins
B. F. Craig
C. W. Craig
J. H. Larcom

Sault Ste. Marie Sta.

M. J. DeBoer
Rose Barry
William Woodhall
Sadie Thompson

Benton Harbor Sta.

Frank Horr

Fish Car "Wolverine"

F. A. Westerman
Byron Aldrich
Joseph Duchene
Kenneth Morford

MICHIGAN'S FISHERIES CHALLENGE

ROSTER OF EMPLOYEES DURING 1973

Governor William G. Milliken
Lt. Governor James H. Brickley

STATE SENATE STANDING COMMITTEE ON CONSERVATION, ENVIRONMENT AND TOURISM

Gordon Rockwell(R)Chm.
Oscar Bouwsma(R)V-Chm.
L. Harvey Lodge(R)
Basil W. Brown(D)
Stanley Novak(D)

STATE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON CONSERVATION AND RECREATION

Thomas J. Anderson(D)Co-Chm.
Warren N. Goemaere(D)Co-Chm.
Alma G. Smallworth(D)V-Chm.
Raymond L. Baker(R)V-Chm.
Jack L. Gingrass(D)
David S. Holmes, Jr. (D)
Raymond W. Hood(D)
Jeh Stetsema(D)
Loren Armbruster(R
Ralph Osling(R)
Wayne B. Sackett(R)
Raymond J. Smit(R)
Robert D. Young(R)

COMMISSION, DEPARTMENT OF NATURAL RESOURCES

R. M. Bouderman
C. T. Johnson
E. M. Laitala
H. F. Snell
H. H. Whiteley
Joan L. Wolfe
C. G. Younglove

DIRECTOR AND STAFF

A. G. Gazlay
D. H. Jenkins
C. D. Harris
W. W. Shapton
C. J. Guenther
D. G. Zettle
C. T. Yoder
W. E. Laycock

FISHERIES--LANSING STAFF

Technical

W. H. Tody
J. D. Bails
D. P. Borgeson
G. P. Cooper
G. L. Coopus
T. R. Doyle
N. E. Fogle
L. Frankenberger
J. R. Hammond
D. E. Reynolds
J. M. Robertson
L. D. Schrouder
J. A. Scott
E. J. Vondot
H. Westers

Business and Clerical

A. W. DeClaire
R. C. Barber
G. J. Ream
R. N. Schafer
Darla Bunker
Eleanor Allen
Dolly Beard
Sue Kingsland
Deborah Pline
Kathy Savoie
Barbara Walker

RESEARCH (7 STATIONS)

Ann Arbor

W. C. Latta
G. E. Burgoyne
M. G. Galbraith
P. W. Laarman
R. N. Lockwood
L. W. May
J. W. Merna
D. E. Parsons
M. H. Patriarche
J. S. Richards
J. R. Ryckman
J. C. Schneider
F. E. Simonis
A. D. Sutton
C. M. Taube
Barbara Lowell
Margaret McClure
Janice Weiss

Marquette

T. M. Stauffer
P. R. Hannuksela
J. W. Peck
W. C. Wagner
Doris Greenleaf

Hastings

G. B. Beyerle
R. N. Cobb
R. E. Fitch
R. Schelma
Dolores Bleam

Hunt Creek

G. R. Alexander
H. Gowing
J. D. Rodgers
O. H. Williams

Grayling

E. E. Schultz
W. G. Yoder

Pigeon River

G. F. Myers

(Roster, 1973, concluded)

REGION I--UPPER PENINSULA

T. B. Durling | L. R. Anderson | R. L. Jacob | C. F. Long

Inland Fisheries		Hatcheries	
L. R. Babbitt	R. G. Schorfhaar	M. L. Archey	R. A. Martin
G. E. Bailey	D. H. Siler	H. Brady	M. C. Miller
W. J. Gruin		C. E. Carlson	J. E. Potvin
R. P. Jacobson	Great Lakes	G. H. Chvala	R. M. Poynter
T. A. Moatt	R. T. Jamsen	T. E. Halvorsen	K. M. Pratt
N. J. Murphy	B. R. Miller	G. W. Hansen	Lillian Houghton
J. H. Peterson	A. T. Wright	R. C. Hubbell	Ruth John
R. Reichardt	G. J. Zorza	H. H. Mokinen	Angeline Phillips

REGION II--N. LOWER PENINSULA

J. M. MacGregor | D. R. Peterson | G. T. Schnicke | S. C. Swan | B. R. Ylkanen

Inland Fisheries		Hatcheries	
A. A. Allen	M. F. Shoudel	L. C. Allenbaugh	D. G. MacLean
M. D. Bonham	S. R. Syrowicze	G. E. Bailey	J. V. Mania
P. C. Bowden	F. H. Wininger	L. J. Bailey	L. W. Mania
H. H. Brado		D. E. Bedrick	O. G. Myers
W. J. Bue	Great Lakes	V. E. Bennett	L. O. Newton
W. H. Bullen	C. E. Belfy	F. E. Bilkey	J. J. Pelkie
W. C. Erber	Charles W. Cross	C. V. Boyer	W. Raymond
V. C. Fox	Clarence W. Cross	J. F. Cook	E. L. Rayner
E. M. Hamilton	C. A. Cutler	R. L. Cooper	M. D. Reist
R. L. Hay	R. L. Eshenroder	W. L. Evens	J. P. Robbins
W. D. Horsell	M. Keller	S. A. Fitzner	W. O. Rose
W. F. Jokes	G. S. Kwiecien	D. W. Galvin	T. L. Rudman
R. D. Kent	J. V. Manz	S. J. Gazinski	R. L. Russell
K. R. Lake	J. B. Meggison	J. G. Heath	L. O. Sherman
W. R. Larkins	L. V. Moffitt	W. C. Houghton	J. R. Thompson
S. C. Lazar	R. W. Rybicki	D. A. Houseworth	F. V. Wabanimkee
W. McClay	R. F. Svoboda	Basil Hubbell	T. L. Wolfe
L. E. Mroziński	H. J. Wilson	C. A. Jeffrey	Ruth Blake
G. A. Reeves	Jane Anders	F. B. Knight	Linda Johnson
G. A. Sanders	Elberta Glatz	E. Kreig	Ruby Naunes
		D. G. Lonsignan	Pamela Ostling

REGION III--S. LOWER PENINSULA

D. L. Weaver | E. H. Bacon | D. C. Johnson | W. E. Mason | R. J. Spitler | E. J. Trimberger

Inland Fisheries		Great Lakes	Hatcheries
W. D. Alward	D. E. Miller	W. C. Bryant	T. G. Coles
D. H. Anson	D. R. Ogle	L. C. Forge	K. P. Confer
V. O. Craft	W. L. Rupright	R. C. Haas	J. A. Copeland
K. E. Dodge	P. H. Scheppelman	M. P. Sadecki	T. S. Ellis
J. E. Drew	R. E. Shepherd	L. F. Shubel	B. H. Leedy
D. D. Gordon	D. W. Smith		C. J. Sidman
D. A. Havens	E. J. Teggerdine		B. H. Smith
D. J. Korz	J. M. Timmons		R. B. Wilson
R. S. Lincoln			Edith Burns

FIRST FISH COMMISSION *

* THE MICHIGAN FISH COMMISSION BOARD WAS ESTABLISHED BY ACT 124 OF THE MICHIGAN STATE LEGISLATURE. IT CONSISTED OF THREE MEMBERS -- GEORGE CLARK, GEORGE B. JEROME (ALSO FIRST SUPERINTENDENT OF FISHERIES), AND GOVERNOR JOHN BAGLEY. JEROME SERVED FOR ABOUT A MONTH BEFORE BECOMING SUPERINTENDENT. HE WAS REPLACED ON THE COMMISSION BY ANDREW J. KELLOGG OF ALLEGAN.

GEORGE CLARK

Commercial fisherman from Lodge and member of Michigan's first Fish Commission

GOVERNOR JOHN J. BAGLEY

Governor of Michigan and member of Michigan's first Fish Commission

REPRESENTATIVE COMMISSIONERS

(Years shown are those spent on the Conservation Commission)

HAROLD T. TUS

1927-1949

WILLIAM H. LOUTIT

1927-1941

GEORGE A. GRIFFITH

1950-1961

FISH CHIEFS

GEORGE M. JEROME
1873-1879
The First

FRED A. WESTERMAN
1925-1959
The Longest Tenure

DR. WAYNE W. TODY
1966-present
The Latest

FISHERIES DIVISION SENIOR PERSONNEL

September 1928

Back Row (left to right): Wardon Goodwin, Jess P. Marks, William Lobdell, Jay Marks, Charles Montague, Fred A. Westerman, George R. Hogarth, Robert Burns

Front Row: Capt. Robert Ellsworth, William Lovitt, Jan Metzelaar, Hildegarde Cornske, Anna Body, Oliver Palmer, M. J. DeBour, Gay Lincoln, Arvin Walcott, Stanley Schast, Philip G. Zalsman, A. T. Stewart, Frank Tubbs

ADMINISTRATION AND EXPERIMENTAL MANAGEMENT

A. B. COOK

ADMINISTRATOR
FISH DIVISION
1929-1964

DIVISION CHIEF
1959-1964

DR. ALBERT S. HAZZARD

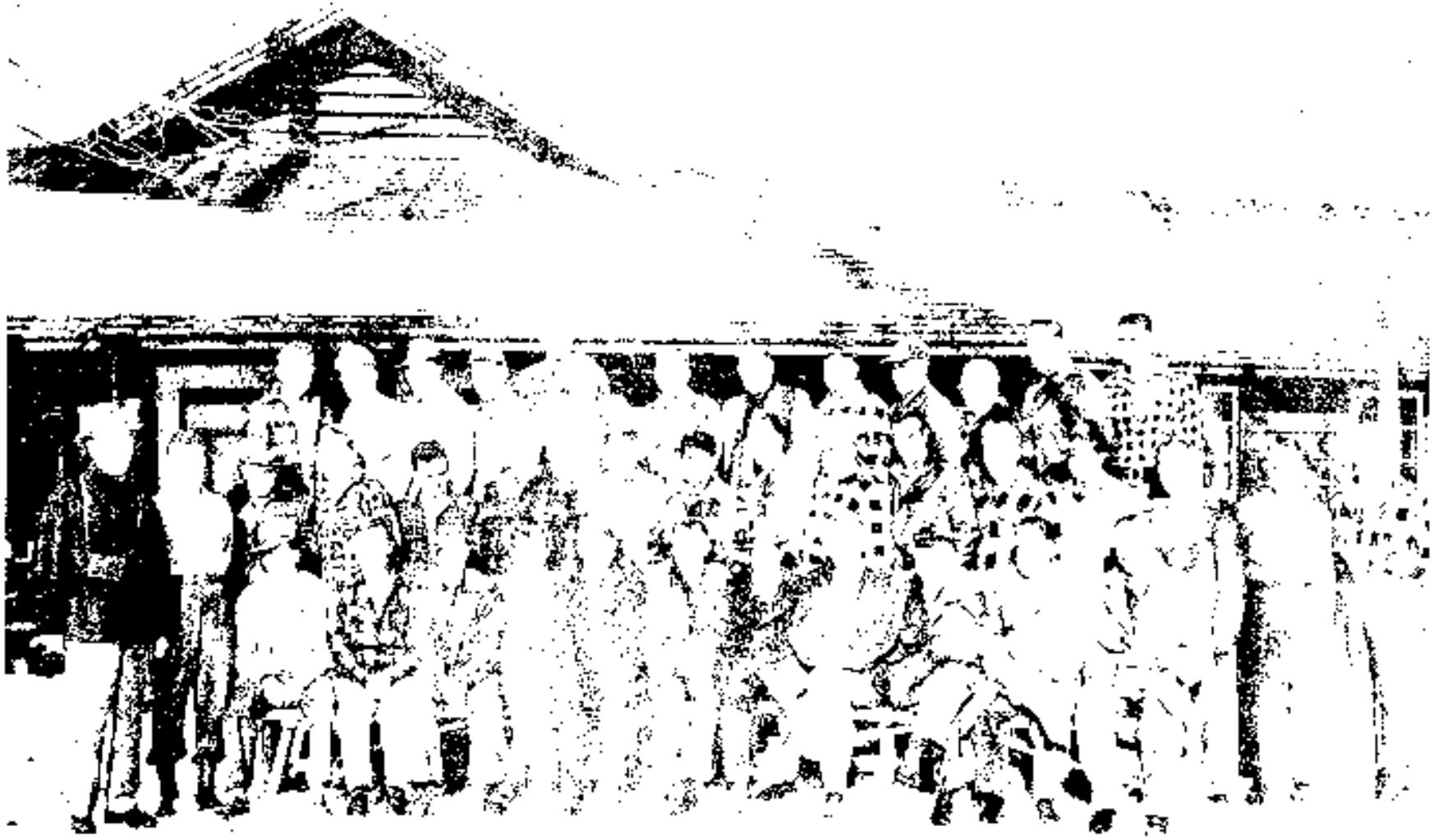
DIRECTOR, INSTITUTE FOR
FISHERIES RESEARCH
1935-1955

SCIENTIFIC FISH MANAGEMENT

MARSTON J. DeBOER

NEARLY 50 YEARS WITH
THE FISH DIVISION
1915-1964

FISH HATCHERY ADMINISTRATION



FISH DIVISION CONFERENCE
Higgins Lake, December 13, 1948

Back Row (left to right): Willard Hall, M. J. DeRoer, L. B. Hoodmaker, D. S. Shetter, L. R. Anderson, O. H. Clark, Joe Southwick, Grant Thompson, C. Troy Yoder, Harold Hughes, Florin Warren, J. A. Scully, Edwin Basford

Middle Row: F. A. Westerman, J. T. Wilkinson, Hans L. Peterson, Ted Monti, G. P. Cooper, F. A. Fatzlow, A. B. Cook, W. R. Crowe, Clifford Long, Claude Lydell, Arthur H. Feldhauser, L. N. Allison, Paul Eschenroyer, W. E. Moore, Erwin C. Moody, Henry Hall

Front Row: Harold L. Thompson, Emerson Kring, Fred Owens, S. J. Lievense, J. F. Gauss, Russell Robertson, Clifford J. Fuller, R. S. Marks, A. S. Hazzard, Richard Bohland, Clarence M. Taube

ON THE HISTORY OF TROUT PLANTING AND FISH MANAGEMENT IN MICHIGAN

March 10, 1961

By F. A. Westerman
Fisheries Division Chief, January 1, 1925-July 11, 1959

(The reader should bear in mind that Mr. Westerman retired in 1959. He wrote the following account in 1961, and made a few corrections in 1962. Thus he does not describe Michigan's outstanding success with the coho and chinook salmon and other recent changes in the fish-cultural program. His article appeared, in installments, in the Grand Rapids Press. It is reproduced here with a moderate degree of editorial change. See also, the editorial comments by G. P. Cooper, and further historical accounts of some of the important fish species by W. H. Tody, both immediately following the Westerman report.--Ed.)

Early trout propagation in the United States had its roots put down first in several of the states other than Michigan. A "Historical Sketch" written by a Miss Stilwell with the Division of Fish Culture, U.S. Bureau of Fisheries, under date of October 5, 1918, points out that, "The first published record to produce fish by artificial methods in this country dates from the year 1855, when Rev. John Bachman, the naturalist who was associated with Audubon in his work on the quadrupeds of North America, read a paper before the State Agricultural Society, at Columbia, South Carolina, wherein he related his successful efforts when a boy, in the year 1804, in fertilizing and incubating the eggs of the corporal (probably the fish known as the bullfish) and of the brook trout. He claimed that the eggs of both species hatched, and that the trout attained some growth while held in ponds which he had constructed for the purpose."

Miss Stilwell's review sets forth that "The second attempt at fish culture by artificial means in the United States appears to have been undertaken in 1853, when Dr. Theodatus Garlick and Professor H. A. Ackley, of Cleveland, Ohio, began operations with the brook trout, the outcome of which appeared in a series of numbers of the Ohio Farmer, and was afterward gathered into a volume. To these gentlemen should be ascribed the merit of inaugurating interest in fish culture in this country."

"It is recorded that E. C. Kellogg, of Hartford, Connecticut, and Dr. D. W. Chapman, of New York, began the artificial breeding of fish at Simsbury, Connecticut, in 1855, and the results of their experience were given in a paper read before the Connecticut Agricultural Society in the following year."

"The first of the State governments to take up artificial fish culture was Connecticut, the Legislature of which in 1857 passed an act making financial provision therefore."

"In 1858, Mr. Stephen M. Ainsworth began operations with the brook trout, the fish being obtained from a small stream at West Bloomfield, New York. In 1864, the first hatchery house in this country large enough to demonstrate the importance of fish culture as a pecuniary investment was established at Caledonia Springs, near Rochester, New York, by Seth Green. Only a short time was required to prove its success financially, and from the interest aroused in its operation, through the medium of various newspapers and magazines, fish culture gained a great impetus and numerous plants sprang up, most of them dealing solely with the brook trout."

Among the more prominent of the early pioneers mentioned, in addition to the renowned Seth Green, were Dr. J. M. Stack, located at Bloomsbury, New Jersey, in 1867; Livingstone Stone at Charleston, New Hampshire, 1866; and N. W. Clark, who started a trout hatchery at Clarkston, Oakland County, Michigan, in 1867.

It is related that about this time active fish-cultural work was taken up by all of the New England states excepting Vermont, and by the States of New York, Pennsylvania, New Jersey and California, also by the Canadian authorities. An act of Congress approved February 9, 1871, carrying with it an appropriation of $5,000 for the establishment of the United States Fish Commission, did not contemplate fish-cultural work, but provided simply for an inquiry into the causes of the growing scarcity of the commercial fishes, with a view of adopting such remedial measures as might appear to be effective. Propagation as a means of restoring the fisheries was given no serious attention until the following year.

At a meeting of the American Fish Culturists Association held in Buffalo, New York, in 1872, it was suggested that steps be taken to induce the United States Government to cooperate with the association in its great project of building up the shad, salmon, and other valuable fisheries of the country. A fund of $15,000 was appropriated in June 1872, to be placed at the disposal of the United States Commissioner of Fisheries, for the purpose of taking up the propagation of fish, and before the end of that year the United States Fish Commission became actively engaged in the propagation of shad, Atlantic salmon, chinook salmon, and whitefish.

Quoting another paragraph, "So efficiently did the Commissioner, Professor Spencer F. Baird, and his associates labor in devising fish-cultural methods and in applying them to the practical work of maintaining

and increasing the supply of food fishes that at the International Fisheries Exhibition held in Berlin in 1880 the grand prize was awarded to the Commissioner as 'The first fish culturist in the world', and at the International Fisheries Exhibition held in London in 1883 the statement was made by Professor Huxley that he did not think any nation at the present time had comprehended the question of dealing with fish in so thorough, excellent, and scientific a spirit as the United States."

An act of Congress approved February 14, 1903, established the Department of Commerce and Labor under which the activities of the United States Fish Commission were incorporated as the Bureau of Fisheries effective July 1, 1903. As a bureau it continued to grow and expand its usefulness in fish-cultural work and other branches of fisheries management.

As time went on, other organizational changes were made. In 1912, the Department of Commerce and Labor was reorganized into separate departments, with the Bureau of Fisheries activities maintained under the Department of Commerce. On June 30, 1940, the U.S. Fish and Wildlife Service was organized by consolidating the Bureau of Fisheries and the Bureau of Biological Survey under the Department of the Interior to which both bureaus had been transferred on July 1, 1939, the former from the Department of Commerce, and the latter from the Department of Agriculture. (It was told that when the order was before President Franklin D. Roosevelt for signature, the agency name as entered read "the U.S. Wildlife Service." But on his own - and before signing the order, the President inserted after "U.S." the words "Fish and.")

On November 3, 1956, by authority of the reorganization act of 1956 signed by the President on August 8, an Assistant Secretary for Fish and Wildlife was named in the Department of Interior, with a Bureau of Commercial Fishing, and a Bureau of Sport Fishing and Wildlife. Regional offices for the first named bureau are at Ann Arbor - Michigan, and for the latter at Minneapolis, Minnesota. The present incumbents are Ross L. Leffler, Assistant Secretary; Daniel H. Janzen, Director, Bureau of Sports Fishing and Wildlife; and Donald L. McKernan, Director, Bureau of Commercial Fishing.

Over all those years a very close relationship has been maintained between the federal and the state fisheries organizations in Michigan. This includes the personnel as well as the physical plants and equipment. This is true today - it was even more true in the early days when both agencies were often only a jump ahead of the sheriff for funds with which to carry on. Because of this close association, any attempt to review the history of trout planting in this state would be quite incomplete if the federal agency were left out of the picture. Also, especially as concerns the early days, references to some other species of fish cannot well be avoided.

It appears impossible to definitely determine who first in Michigan undertook the artificial propagation of fish, or with what species. Without

question, private enterprise was responsible. This honor could well belong to Mr. N. W. Clark with his small brook trout hatchery established in 1867, at Clarkston, Oakland County. In 1874, Mr. Clark established a hatchery at Northville, Wayne County, on a spring water supply tributary to the Middle Branch of the Rouge River. Here he constructed a series of ponds and raceways, built a one-story frame hatchery 30 X 80 feet, and equipped it with an apparatus of his own invention, which was afterward to be universally known as the Clark Hatching Box and Tank, which is still in use today (1959). The review by Miss Stillwell records that, until 1880, the plant was operated as a private enterprise by Mr. Clark and his son Frank N. Clark, and that most of the product was sold to the federal and state governments. During that year the United States Fish Commission secured a lease of the property and engaged the services of Mr. Frank N. Clark to superintend its operations. This arrangement continued until 1890, when the plant was purchased by the U.S. Fish Commission together with ten acres of land. Mr. Clark served as its superintendent until his death in December, 1910. During his lifetime, further expansions to the water supply, pond system and rebuilding of the hatchery occurred. Frank N. Clark was recognized nationwide as an outstanding fish-culturist. The Northville station was a training ground for many young fish-culturists who afterward moved to far distant hatcheries in the service of both federal and state governments. Northville continued to function as a trout and pond-fish hatchery until about 1955. At present (1959) it is serving a useful purpose on a cooperative basis with the University of Michigan. Northville therefore has been in operation longer than any other hatchery in Michigan, either federal or state, and perhaps longer than any fish cultural establishment on the American continent. In addition, the Fish and Wildlife Service maintains stations now at Charlevoix, Pendill's Creek and Sullivan Creek, both of the latter near Raco, Chippewa County. These are now engaged, in cooperation with the state of Michigan, in the lake trout rearing program.

As already indicated, the state of Michigan did not pioneer in fish-cultural operations. In fact the first report of the Michigan Board of Fish Commissioners records the names of the commissioners then officiating in seventeen other states, in addition to the United States and the Dominion of Canada.

Under date of April 19, 1873 Act No. 124 was approved to establish a Board of Fish Commission comprising the Governor and two residents of the State to be appointed by him with the consent of the Senate, to hold their office until the expiration of the next regular session of the Legislature, "whose duty it shall be to select a suitable location for a State fish-breeding establishment, for the artificial propagation and cultivation of White Fish and such other kinds of the better class of food-fishes as they may direct . . . ." The sum of $7,500 was appropriated for the year 1873, and a like sum for the year 1874. This act represented the united efforts of many friends of the measure, including: Mr. Eli R. Miller of Kalamazoo, who introduced the Act, Mr. George Clark of Detroit, Mr. George H. Jerome of Niles, Rev. J. G. Portman of Berrien, and Mr. N. W. Clark of Clarkston.

In the spring of 1873, the U.S. Fish Commission, through Prof. Baird, presented to the state 40,000 salmon ova, already in a forward stage of incubation. These were hatched in the private hatchery of Mr. N. W. Clark near Clarkston, Oakland County. This was before the appointment of the Michigan Commission.

Governor John J. Bagley of Detroit appointed Andrew J. Kellogg of Allegan and George Clark of Coopersville to serve with him. The Board first met and organized on May 12, 1873. One of the first official acts was to order the distribution of the salmon fry being carried at Clarkston. The first plants were made as follows:

May 14, 1873	Lord's Lake	Oakland County		250
" " "	Orchard Lake	"	"	500
" " "	Walled Lake	"	"	500
" 19, "	Muskegon River	Mecosta	"	3,000

There were eleven other plants, ending on May 30, 1873. So, the State was in the fish business!

Mr. George H. Jerome of Sabine Farm, Niles, Michigan, was appointed as the first Superintendent. Born at Pompey, N.Y., in 1818, he had practiced law in Niles, spent five years in Chicago, then removed to Des Moines, Iowa. There he became the proprietor and managing editor of the Iowa City Republican. Also, he was an assessor for four years in an internal revenue district embracing twelve counties, at the personal insistence of President Abraham Lincoln, before returning again to Niles. Actually Mr. Jerome had been appointed to the first Commission but difficulty in choosing a competent superintendent led to his being induced to resign his position as Commissioner, and he was at once chosen as Superintendent.

Perhaps Jerome's greatest contribution was the first report of the Michigan Fish Commission published in 1875, "Which was such a clever work as to call forth the most flattering notices from all parts of the Union, and which contributed more to bringing the State of Michigan to the front as a fish-cultural state than the effort of any other one individual"--see minutes of the State Board of Fish Commissioners, December 15, 1885, in memory of George H. Jerome. It may well be said that he lit the torch of fish culture in Michigan with this work.

Credit is due Jerome also in his sagacity and ability to bring Orin M. Chase, who was trained by the eminent fish culturist, Mr. Seth Green in New York state, to Michigan. Chase was placed in charge of the whitefish station in Detroit, where he developed the "Chase Hatching Jar" for the incubation of whitefish and walleyes; his jar was used in many hatcheries on the Great Lakes in later years.

The first State fish hatchery in Michigan was located at Crystal Springs in Cass County on lands leased from the camp meeting grounds of the Methodist association of the Niles District, about three miles from the

Pokagon station on the Michigan Central railroad and about six miles from Niles. The site was leased on October 1, 1873, and a 20-foot by 60-foot hatchery, several ponds, and a residence for the overseer were constructed immediately. The first brook trout planted by the state were hatched here in 1878. They were planted as follows:

Mechanicsburg Creek, Cass Co.	3,000	by J. E. Wood, Summerville, 3/28
Blue Creek, Berrien Co.	3,000	by J. G. Portman, Watervliet, 3/29
Spring Brook, Kalamazoo Co.	2,500	by T. S. Cobb, Kalamazoo, 3/31
Wait Brook, Kalamazoo Co.	1,000	" " " " " "
Four Brooks, Kalamazoo Co.	1,500	" " " " " "
Dowagiac River, Cass Co.	1,000	by C. H. Brownell, Pokagon, 4/2

This was an unimpressive total of 12,000 fry, but we must keep in mind that the main directive under the act creating the Board of Fish Commissioners was the propagation of whitefish. The 1880 plant of brook trout fry aggregated 50,400 and was distributed over fourteen counties--as far away as Clare, Oceana and Wexford counties.

In the meanwhile an important reorganization in the Board of Fish Commissioners had occurred. Act 71, approved April 8, 1875, provided that the Governor, with the consent of the Senate should appoint three persons, residents of this state, who shall constitute a board of fish commissioners: "The persons so appointed shall hold their office, one for two years, one for four years, and one for six years; and their successors to be appointed at the expiration of the several terms of office, shall each hold their term of office for six years." The act was given immediate effect and thus provided for a staggered term of office which continued through the years until 1921, when the Board of Fish Commissioners lost its identity on the enactment of Act 17, P.A. 1921, signed by Governor Alexander Groesbeck, March 30 with immediate effect, thereby creating a department of conservation. It may be well to point out here that this act authorized the Governor of the State to appoint seven members, subject to confirmation by the Senate, as a Commission of Conservation: "The governor shall designate which member of the commission shall act as chairman thereof." The act further provided that each member shall hold his office until the appointment of his successor. Also that the governor shall, subject to the confirmation by the senate, appoint a director of conservation. This organizational plan, the weakness of which soon became apparent, was greatly improved under Act 23, P.A. 1929 which provided for the appointment of three commissioners for a term of two years, two for a term of four years, and two for a term of six years, with appointments for a term of six years as each term expired. This act required that two of these members shall reside in the Upper Peninsula. The act further provided: "The commission, after having qualified, shall within thirty days and annually thereafter meet at its office in Lansing and organize by electing a chairman and a secretary." The commission is also ordered to appoint and employ a director of conservation at a salary established by law. Members of the commission draw no salary, only expenses.

This plan of organization has stood the acid test of time and functions to this day. The major activities channel through divisions under a division head and staff. So we have the division of fisheries responsible for fisheries management under the general supervision of the director and the commission.

Grayling

Before proceeding further with the development of trout fishing, a word about the grayling seems called for. Among piscatorially minded people the fame of the grayling spread widely. As railroads were projected northerly through the lower peninsula, streams in which grayling were found became more readily accessible. This greatly intensified the angling pressure on these beautiful fish, which for sheer beauty and gameness could not be excelled by any other fish. The range of the Michigan grayling, Thymallus tricolor, was restricted to that part of the lower peninsula north of a line drawn from Muskegon across the state to Tawas Bay, and to a single upper peninsula stream, the Otter River in Houghton County. The most famous grayling streams were the Au Sable, Manistee, Muskegon, Boardman, Pine and the Hersey, the latter a tributary of the Muskegon River. No fish responded more avidly to the artificial fly. Long leaders to which three and even four flies were attached often yielded successive catches of three and even four fish at a cast. Many were wasted; in a few years their numbers dwindled; and soon the question arose, "What had become of the grayling?"

Wm. J. Montague was one of the pioneers at Paris. His father and large family came there from Kent County in 1855. The last time I saw him about thirty years ago (i.e., about 1930) I made some enquiry as to his experience with these fish. Even then his eyes sparkled as he recalled, "One spring the grayling were running up the Hersey. We noted they had some difficulty in passing an obstruction in the stream, so we placed a canoe crosswise at that point and caught over seven hundred one afternoon."

Various reasons were advanced as being responsible for the decline of the grayling. Many people blamed the running of logs in the rivers where grayling were found during the three or four decades following the close of the Civil War. This was the time when most of the pine was cut and floated to huge sawmills built at the mouths of the principal streams in which the grayling lived. Incidental to the log running, the "sweepers" that lay interlaced from either bank and furnished cover for the fish in the headwaters of these streams were removed. Both the bed of the stream and the banks were scoured and eroded by the untold millions of logs that often completely filled the channel from bank to bank for many miles. Raging forest fires repeatedly followed the axe, which brought damaging changes to the watershed that further disturbed the habitat of the grayling.

Some were inclined to lay the blame on the introduction of trout. The ease with which grayling were taken in incredible numbers by greedy

fisherman has already been alluded to. It appears that the grayling completely vanished from the lower peninsula around 1905, except for some attempted reintroductions, and from the Otter River by 1935. I was with the expedition to the Otter River in September 1935 when we took 180 grayling with seines for transfer to the Cedar River in Gladwin County and to the fish hatchery at Grayling, in one of the last endeavors made to perpetuate this doomed species. I had the good fortune of taking two grayling with my fly-rod one evening while we were there. Both the State and some private fish hatcheries undertook repeatedly to artificially propagate the Michigan grayling at various times. Failure concluded all of these endeavors. Perhaps the grayling did belong to the pine! When the pine went the grayling failed to survive. I'm inclined to think that environmental changes were chiefly, but not solely, responsible for their disappearance. Attempts to introduce the closely related Montana grayling have also met only with failure.

Fish Cars

Dependable transportation has always been recognized as a vital factor in the handling of fish from hatcheries to the waters to be stocked. Until motor trucks became available, most transportation was by the railroads. Many hatchery sites were by-passed solely because they were too far from railroad tracks. Railroads granted considerable concessions in carrying cans of fish in the baggage cars of regular trains and in leasing baggage cars to the state for the sole purpose of transporting cans of young fish during the busy spring season.

On August 1, 1888 the State acquired its first fish car named "Attikumaig," being the Chippewa name for the whitefish, as given by Schoolcraft. This car was built by the Litchfield Car Company of Litchfield Illinois for the sum of $3,300. It was fifty-five feet long, nine feet, eight inches wide and equipped with five upper berths, a hot water heating system, a kitchen in one end, and a small office in the other. Lockers with hinged wooden covers were installed on either side of the center aisle running the full length of the car to accommodate three rows of ten-gallon milk cans in which the fish were carried. Side doors in the center of the car facilitated loading and unloading. Windows came down to the top of the can lockers and were spaced on the same pattern as passenger cars of that era. In bold letters across the length of the top panel, on both sides of the car, was emblazoned in gold, MICHIGAN FISH COMMISSION. With this car, the Commission was well equipped to transport live fish throughout the state. Seven years later the car was badly damaged, a load of fish was lost, and the crew painfully injured when a switch was thrown ahead of the rear trucks causing the car to fall down an embankment along the Pere Marquette tracks near Traverse City. Repairs were undertaken to make the car serviceable again. Sometime afterward the car was renamed "Fontinalis," honoring the brook trout. This car remained in service until about 1912, then so completely worn out it could no longer be safely used.

In 1913 the legislature appropriated $4,000 for a new car. This amount was inadequate, so the Fish Commission purchased what was originally a Pullman sleeping car for $1,600. This car was then rebuilt in Chicago for the state service at a total cost of $3,879, which included overhauling, furniture, bedding, and dishes--all complete in the purchase price. This car was eighty-one feet long. Seven upper berths were left in; the smoking room served for dining and lounging quarters; and the state room, with davenport, served as an office. All lower berths were removed, and lockers in which to rank the ten-gallon fish cans were built on either side of the aisle. Full capacity was 181 cans. For convenience in loading and unloading, side doors were installed near the center of the car. It was in every sense a side-door Pullman. It bore the name "Wolverine." The home station was Upper Paris where the Pennsylvania Railroad maintained a siding over which the state built a car-house for shelter.

The "Wolverine" left Upper Paris on its initial trip February 22, 1916 and I was indeed happy as the junior messenger in a crew of four. Unanticipated events transpired rapidly that found me in charge of the car when it went to the Upper Peninsula early in April that year to distribute brook trout from the hatchery at Sault Ste. Marie. Except for a year during World War I until the spring of 1923, hardly a wheel turned when I wasn't aboard.

Early April of that same year marked the time when Joe Duchene first came aboard the car as cook. Many of the older men in the Fish Division, especially those who, like myself have retired to the rocking chair, will remember "Old Joe." He was indeed a colorful character. A French Canadian from Montreal, who came to Big Rapids, he told me of driving through the solid uncut pine on a lumber wagon from Big Rapids to Mecosta to cook in a lumber camp. For a number of years he cooked on the floats that were built on the ice at Houghton Lake. As soon as the ice melted, the log drive started down the Muskegon River for the sawmills at its mouth. He said one year they reached only Bridgeton when winter set in again. Afterward he tended bar for many years in Big Rapids, and he cooked in the Pan-Joe's Restaurant there just before he was employed by the State. His pancakes, his raisin pie, and his "Hurry boys, daylight in the swamp" will never be forgotten by those associated with him. He outlasted even me on the "Wolverine."

This story would not be complete without paying tribute to the service rendered by the railroads of Michigan. The fish car found its way into nearly every corner of the state, and nearly all of the railroads carried both the car and the regular crew of four men at no cost to the State. Until 1924, these cars averaged about 25,000 miles a year in the distribution of young fish, mostly fry, from hatcheries to lakes and streams. During about five months of the year, the car was a home for the crew. Eight-hour days and forty-hour weeks were not even thought of. When fish were aboard, or when the car was part of a train, at least one person was on duty. Frequently a messenger with thirty cans of fish would be dropped off at some spooky

junction like Au Sable-Oscoda in the jack pine, with the cemetery across the tracks and the depot a mile from town, on the night run of the Detroit & Mackinac, to await the morning train going up the River Branch. Often there were empty cars to be picked up on the return trip. Escanaba was a bad spot. Arriving on Soo Line No. 87 at 7:00 P.M., we would sometimes have to unload up to thirty cars of fish for a C. & N.W. train departing at 4:00 A.M., because the car would be switched to the yards a mile away and made up in the train leaving at 6:15 A.M.

We often had problems in keeping our fish alive and healthy. I almost turned gray one night in Grand Rapids when we had a full cargo of baby fish aboard. We were due to leave for Kalamazoo about midnight and were already in the train when a car-tinker came aboard and announced the car would have to be set out on account of a cracked tire on one of the wheels. I felt better some two hours later after a special crew had been called out to change this pair of wheels in the yards and we were switched back into the train in time.

Then the character (MDD) who was first approached about doing this piece will never forget the occasion when he relieved himself by disgorging about a pint of tobacco juice out of the open side door, which caught a passing brakeman flush in the face. You never saw a more apologetic fish mechanic anywhere anytime.

Early in the year 1915, when the car was still nice and shiny, it was on a six-day trip from Lansing to carry the members of the Fish Committees in the legislature on a tour to visit the fish hatcheries over the state, in connection with considering budgetary requirements for the ensuing two years. Sleeping accommodations were much overtaxed, but no one slept too much anyway on those junkets, as they were known. This trip got me into a lot of trouble also, for, while the fish car wasn't again impressed into this mission for which it obviously was not equipped, I was tagged each two years thereafter to accompany these committees, traveling in a Pullman sleeping car commissioned for the trip, to look after their welfare. The last such trip was made in January, 1927.

Those were great days, a lot of work and a lot of fun; but like all good things, they come to an end. Changes come and adjustments are called for. The "Wolverine" began to rust, as the motor trucks started to roll over the highways. That was about 1924. More hatcheries had been established, and this eliminated most of the longer runs. The final movement of the car was aptly expressed by Robert G. Forney, District Fisheries Supervisor as follows: "The old fish car'Wolverine' like the 'Leviathan' only using a different means of travel, left Paris February 2, 1938 at 4:20 P.M. for the same ultimate destination--the scrap yard."

Brook Trout

There is some uncertainty as to when and where brook trout first appeared in lower peninsula streams. A pertinent paragraph taken from the Seventh Report of the State Board of Fish Commissioners for 1885-1886 is of interest: "Douglas Houghton, the eminent scientist, and the surveyor of a great part of the wild lands of this State, said of the streams of the lower peninsula, based on personal observation and examination, that they contained no brook trout. Mr. Bela Hubbard, an associate of Houghton, in his Memorials of a Half Century, makes the same statement, and they are corroborated by the early settlers, woodsmen and sportsmen." The time of these observations was around 1840. Thirty years later however, brook trout were recognized in numerous streams in the northern part of the lower peninsula. It appears quite probable that the first brook trout were migrants across the relatively shoal waters separating the two peninsulas. Brook trout were recognized as widely dispersed in the upper peninsula streams at that time. However south of a line drawn roughly from Traverse City to Rogers City brook trout were evidently established through some planting from private hatcheries, but most importantly by the state. The Commission reluctantly came to the conclusion that even before 1885 the grayling had disappeared from the Au Sable. The first recorded planting of 20,000 brook trout was therefore made in that stream in Grayling Township, Crawford County by R. S. Babbitt March 6, 1885. The same year a plant of 20,000 brook trout was made in Menominee County by O. D. Marks on April 29th, of interest only because it was the first plant of brook trout made in the upper peninsula by the state. The numbers of brook trout planted in those early years were relatively small, but the results were spectacular. The seventh report for 1885-1886, already referred to, comments further: "Now the streams of every county in the state but three, whose waters are not suited to this fish, furnish excellent trout fishing. The streams of some of our river basins, like the Pere Marquette and the Au Sable, furnish trout fishing not to be excelled in this country." It may well be that the next twenty years witnessed the heyday of brook trout fishing in Michigan. At any rate Harold Smedley makes the observation that by 1905 the decline had set in.

An important factor in this widespread distribution of brook trout was the hatchery at Paris. The water supply at Pokagon proved to be unsatisfactory and inadequate. This led to a decision to abandon this station in 1881. After an extended search of prospective sites, a meeting of the State Board of Fish Commissioners was held at Paris, Mecosta County, July 30, 1881, at which time they selected Chaney Creek, a tributary to the Muskegon River which the Grand Rapids and Indiana railroad crossed one mile north of the depot. Here a hatchery building 20 X 60 feet was constructed on the west side of the highway. Several ponds were built, and the overseer's residence was constructed that year. The hatchery building became over-crowded to such a degree that, in 1887, a second hatchery building 40 X 80 feet was built on the east side of the highway. A. B. Crane, architect, of Detroit designed both this building, and the hatchery building of similar size constructed at Sault Ste. Marie in 1894.

The Soo hatchery and several ponds for carrying brood stock were built on what was then known as Island No. 3 and on 700 feet of the river bed immediately below it, under a lease from the Secretary of War. It was located where the third and fourth locks now stand on premises owned by the United States Government known as the Canal Reserve. The hatchery remained here until August 1911, when the building was moved to the northeast corner of the Fort Brady Reservation to make way for the new locks. This placed the building on the mainland just above the slip where the ferries leave for Canada. The American Legion Hall now occupies this site. The hatchery continued to function here for the incubation of trout and whitefish ova until abandoned in 1938. In its original location, which was immediately below the electric power dam, a gravity flow supplied all of the water needed except for the whitefish battery to which the water had to be pumped because of the height of the battery. Practically all trout for stocking the waters of the upper peninsula were hatched at the Sault station until 1924. All fish distributed from here went out as fry.

In the lower peninsula nearly all of the trout planted came from the hatchery at Paris, until 1905 when the hatchery established in 1901 at Harrietta, Wexford County, came into production.

Then followed the hatchery at Grayling. Established in 1914 by the Grayling Fish Hatchery Club for the hatching of trout to stock streams in the vicinity. The station received considerable support from the State for operating expenses. In 1921, it was leased, and then operated by the Department of Conservation. On June 3, 1926 the property was purchased by the State for $10,000. This hatchery is located on the East Branch of the Au Sable River within the limits of the village of Grayling. An extensive pond system has been developed here to meet the changing programs in the rearing of trout.

A relatively small hatchery was established on Blue Creek near Benton Harbor in 1920 which, since that time, has propagated trout for stocking streams in the southwestern part of the state. Many people do not appreciate how many trout streams are to be found in this very interesting section of Michigan. Dave Jones, Chief Deputy when John Baird was the Director of Conservation, and who had a widespread knowledge of the State, told me he thought that more trout fishermen started out from Kalamazoo on the opening of the season than from any other place in the state. And they didn't go far from home either. Many anglers still are sad about the despoilation that occurred about forty years ago when the Dowagiac River, a beautiful brook trout stream, was converted into an open ditch to drain some mark land on its headwaters.

Rainbow Trout

The establishment of rainbow trout in Michigan virtually brought rainbows into the eyes of many anglers. It appears that Daniel C. Fitzhugh, Jr. of Bay City brought the first rainbow trout eggs from the West Coast in

1876 and, after hatching them, they were planted in the Au Sable River. Harold Hinsdill Smedley, in his Trout of Michigan, 1938, records this also that two years later, in 1878, Frank N. Clark purchased 125 yearling McLoud River rainbow trout from a private hatchery in San Francisco, part of which survived the trip to his private hatchery at Northville. Smedley relates that the first rainbow eggs taken in Michigan came from those fish, and that a second planting was made in the Au Sable River. So private initiative may well have been responsible for the first introduction of the "California trout," as they were known at that time, in Michigan.

Soon thereafter the first small shipment of California eggs from the McLoud River species was sent to the Pokagon state fish hatchery by the United States Fish Commission as part of its experimental work. This shipment reached the hatchery on April 14, 1880. From the 2,000 eggs received, 1,800 fish were produced, one-third of which were planted in the North Branch of the Paw Paw River near its headwaters in Almena Township, Van Buren County, by C. Eagle; one-third in the Boyne River, Charlevoix County, between Elmira and Boyne Falls; and one-third were kept in the hatchery ponds. From another lot of eggs sent by Prof. Baird from California, 6,000 "fingerlers" from the McLoud were produced in 1882, at Paris.

Beaver Creek, Ottawa County was stocked with 6,000 California trout in 1884, and the Pere Marquette River with 25,000 in 1885. In 1886 Walter D. Marks, Superintendent at Paris, reported catching "about a dozen of the Mountain trout, which in thirteen months had grown to seven and eight inches in length, and were strong, active and well fleshed." He also reports that because of the overcrowded condition, 240 adults were deposited in the Muskegon River at Paris, and that in the following spring on May 14, nine or ten of these fish came into Cheney Creek and spawned naturally. He also indicated they were being caught with hook and line in the river. On March 22, 1887, the U.S. hatchery at Northville shipped 25,000 eggs of this trout to Paris. They were hatched by April 20, and on May 17, 1887 a total of 20,000 were planted in tributaries of the Muskegon River near Paris.

By the end of 1890 a total of 83,175 California trout had been planted by the State, but a degree of pessimism prevailed. Difficulties were encountered in maintaining a brood stock at Paris, and the evidence of success following plantings was limited. However, additional supplies of fry were brought in from California in 1894. In 1895 the state received 50 adult females and 100 yearlings from the New York Fish Commission through an exchange, and 900 two-year-old rainbow were received as a gift from Wisconsin in 1897. On June 25 of that year, the first plant of 5,000 rainbow trout was made in the Sault Rapids by the State, and a like number were planted there on June 3, 1898. By this time reports began to trickle in of rainbows being caught in the Great Lakes where none had been planted. Also these fish were beginning to gain the approbation of more sportsmen. In 1903 the planting of rainbow trout fry reached a figure of 792,000; the following year the figure was 714,000. They were widely distributed in about fifty counties of the state.

In 1908 over 1,000,000 rainbow trout were planted, and in 1909 the distribution reached a total of 2,611,500, of which 156,000 were fingerlings. In 1910 the number planted was nearly double any previous year--a total of 4,954,000 fry and 3,200 fingerlings.

This marks the period when most of the rainbow eggs were obtained from wild fish that were taken below the Stronach Dam on the Pine River near Wellston. The building of this dam in 1911-1912 provided concrete evidence that large numbers of rainbow trout were ascending this stream during March and April on their spawning run. Rube Babbitt, game warden who had been transferred there from Grayling to help protect the fish from poachers, was responsible for the suggestion that spawn could be obtained there. During the next ten years, millions of rainbow trout eggs were obtained annually at various field stations in that locality. While the building of Junction Dam (later changed to Tippy Dam) below the confluence of the Pine and Manistee rivers was in progress, the collection of rainbow spawn was transferred to field stations located on Pine Creek, near Wellston, and on the Little Manistee at Fox's Bridge. After Junction Dam was completed, most of the eggs were obtained at the field station established in 1918 just below the dam. There, several ponds were built in which the fish could be held until ripe and ready to spawn. These were beautiful fish running in size from about three pounds to eighteen or twenty pounds in weight. This period probably pin-points the time when lake-run rainbows reached the peak of their abundance in Michigan. From the Muskegon River on the south to the Straits of Mackinaw on Lake Michigan and on Lake Huron south to and including the Rifle River on Saginaw Bay, all of the trout streams witnessed runs of rainbow trout. Upper Peninsula streams had their runs too, although the high period appears to have occurred a few years later, especially in streams tributary to Lake Superior. The Sault Rapids became world famous for its rainbow trout fishing.

For this establishment of rainbow trout in Michigan, I give credit to dedicated fish-men, to our state officials, and to Prof. Spencer Baird of the U.S. Fish Commission for his wisdom and foresight in forwarding eggs from California to Michigan. He had faith in Michigan and a stout heart.

Originally it was thought that the rainbow was non-migratory, but it soon developed otherwise. The young fish stay in streams having a suitable environment, from which they move downstream to enter the Great Lakes during their second year of life. Here they grow rapidly, and then return to streams to spawn. It has not yet been fully determined that they return to the stream of origin, or that they return to the same stream in successive years. The rainbow, unlike the salmon, may spawn for several years after reaching maturity.

The rainbow is now recognized as the most migratory fish in Michigan. Only a few years ago a tagged rainbow was released at the mouth of the Black River near Naubinway, Mackinac County, and was recovered less than a year later from Lake Erie near its eastern extremity at Long Point, Ontario. A number of other rainbows tagged and released in streams tributary to Lake Huron have been taken from Lake Erie.

Many of these fish from the Great Lakes move into tributary streams during the fall months and provide considerable sport during the extended season established for taking them. The strength of these runs has greatly diminished during the past decade.[1] This apparently has been due, in large measure, to predation from the sea lamprey, and to some degree by the interference with free upstream movement where electric screens for lamprey control have been operated. In a number of rivers the construction of dams for generating electric power has also interfered with the free movement of these fish. The stocking of rainbows in streams, or portions of streams, to which spawning runs have access, has been largely suspended for the past thirty years, though some experiments are now in progress to determine if these runs may be strengthened by releasing hatchery reared rainbows in their second year at or near the mouths of such streams. With the possible exception of the rapids in the St. Mary's River, all spawning of rainbows appears to occur in the tributary streams of the Great Lakes in which they have become established.

The range of rainbow fishing waters has been greatly expanded through the planting of legal or near-legal sized fish into inland lakes having an environment suitable to support them. In most of these lakes continuous planting is required, as there is little or no reproduction in such waters. Burt Lake is an exception, where there is a fall movement and a spawning run into the Sturgeon River.

Brown Trout

It appears that Mr. Fred Mather, superintendent of the New York State Fish Commission, was responsible for the introduction of brown trout to Michigan, if not to America. Smedley relates that Mather was impressed by the trout he caught while fishing in the Black Forest in Germany and, while there, made arrangements to have some of the eggs sent to this country. In 1883 about 100,000 brown trout eggs were sent to Mr. Mather in New York by Herr von Behr, Berlin, Germany. Mather in turn sent some of these to his friend Frank N. Clark, then with the U.S. Fish Commission at Northville where they were reported as "doing well." A second shipment from Germany, of 5,000 eggs, went to Northville on February 16, 1884. Mr. Frank Clark reported that "They hatched about the middle of March and were taken April 11, in Car No. 2, and planted in a branch of the Pere Marquette River in northern Michigan." This seems to have been the first planting of brown trout in Michigan. Early in 1885 the U.S. Fish Commission received 100,000 Loch Leven (brown trout) eggs from Scotland, sent by Sir James Gibson Maitland, of the Howietown fishery, Sterlingshire. Of these, 42,500 were sent to the Northville, Michigan, station. In turn, 10,000 were sent to the Michigan Fish Commission who planted them on April 11, 1885 in Coldspring Lake, one of the sources of the Tobacco River, near Harrison, Clare County. On April 16 the U.S. Fish Commission delivered 5,000 to

[1] But since 1960, they have been increasing.

L. S. Hall & Company and 1,500 to G. H. Dalrymple at Grand Rapids, and on April 23 planted 20,000 in Crooked Lake near Flint and in the Pere Marquette River.

The Northville station gave 25,000 German (brown) trout eggs to the Michigan Fish Commission in March 1887. These were hatched and kept at Paris for brood stock. Another gift of German trout was made by the U.S. Fish Commission in December 1887, consisting of 500 yearling fish and 5,000 eggs, brought to Paris in the U.S. Fish Car. Thus, through the small numbers of brown trout eggs from Germany and Scotland that the U.S. Fish Commission, through its Northville station, made available to the Michigan Fish Commission, a small brood stock of these fish was established at the Paris Fish Hatchery. It seems that the first plant into Michigan waters from this stock was on March 28, 1889 when 20,000 were planted in an inlet to Deer Lake near Boyne Falls, Charlevoix County. The following year, 60,000 were planted in four creeks near Walton Junction, Grand Traverse County, and in the next six years--1891 to 1896--larger numbers were planted and a wide distribution took place. The first plantings in the main stream of the Au Sable were of 10,000 fish planted in Frederic Township by Elijah Flagg on April 8, and 15,000 fish released in Grayling Township by D. H. Fitzhugh on April 17, 1892. In 1892 brown trout were planted in the Baldwin Creek, the South Branch Pere Marquette River, Au Sable River, South Branch Au Sable River, East and West branches of Big Creek (tributary to the Au Sable), Muskegon River, and the Green Sauble River in Mason County, and in 1893 and 1894 most of these waters were stocked again. Plants of brown trout in the Upper Peninsula started on April 26, 1894 when Horatio Seymour planted 20,000 in the Dead and Chocolay rivers in Marquette County. On April 27, 1894 Willis F. Sayer planted 30,000 in the Flint Steel River in Ontonagon County, and 10,000 were planted in the Slate River, Gogebic County by C. L. Ryder.

By the close of the 1896 planting season, i.e., in 9 years, a total of 1,747,000 brown trout had been planted in Michigan. Then the Commission concluded that, even though a number of streams had been successfully stocked with brown trout, "They were inferior in every respect to either the brook or the rainbow, with few exceptions. This verdict is in harmony with the verdict of anglers and epicures everywhere. The stock of adult brown trout has therefore been turned adrift and no further distribution will be made." This was a decided change from the opinion expressed seven years prior with regard to several species of foreign fish introduced into the waters of this country that "few have given the promise of success which the German trout furnishes."

Eventually new interest was awakened in the brown trout, in part due to the dwindling numbers of brook trout in many of the streams. However thirteen years passed before the next plants of brown trout were made--50,000 in Paris Creek, Mecosta County, and 30,000 in the Little South Branch Pere Marquette River, Newaygo County--both on June 27, 1909. In the next five years 1,655,000 were planted as fry, a relatively small number in comparison

with the numbers of brook and rainbows planted. During 1915 only 12,000, and in 1916 only 14,000 were planted from the Harrietta hatchery. Since biennial reports were not published from 1915 to 1921, no explanation is available for the second curtailment in the planting of brown trout. World War I hysteria was responsible for dropping the name "German," formerly associated with the designation of this fish, which henceforth came to be known only as "Brown trout." The year 1917 brought an increase in planting of brown trout to 135,500; the 1918 plant was 631,000; and in 1919 it reached 1,310,000.

Since 1920, brown trout have become highly important in the Michigan trout picture. To many sportsmen the species presents a major challenge. The "caddis hatch" in June is eagerly awaited. On a right night, when all the flies seem to be dancing on the water--this is the brown trout fisherman's paradise--when the fish go crazy! Brown trout grow to great size. One weighing 15 pounds 6 ounces was caught in Dowagiac Creek, Berrien County, June 7, 1940 by Burrell C. High of Niles. Another weighing 17 pounds 5 ounces was caught in Houghton Creek, Ogemaw County, June 30, 1952 by Harold Crawford of Coss City, Michigan. I'm confident the largest one hasn't been caught yet. (Right! A brown trout of 22 pounds 12 ounces was caught in Lake Michigan during 1973. --Ed.)

But brown trout compete more closely with the brook trout than does the rainbow. Both the brown and the brook spawn in the fall, and they inhabit much the same type of stream. But the brown is more carnivorous, it grows to a much larger size, and it seems to monopolize choice pools. In some instances a prize brown trout may hold down a "claim" for several years. There are small streams where the brown trout has taken over to the complete exclusion of the brook trout, for the principal reason that the brown is the more aggressive and the stronger of the two. The brown is considered to be more wary; therefore, it is not so closely cropped from a stream as the more gullible brook trout. Because of these traits in the brown trout, we have been reluctant in planting them in waters where brook trout have continued to be abundant. Many times, though, the barrier has broken down through accident or design. So far the brown has made less inroads in Upper Peninsula waters, but he is expanding his range there also.

Lake Trout

The propagation of lake trout has also been carried on for many years by both state and federal agencies. Until about ten years ago, lake trout spawn for hatchery culture was obtained from the waters of the Great Lakes through the cooperation of commercial fishermen. The first plants were made in 1885, when 285,000 lake trout fry were planted in nine inland lakes. Thereafter, some lake trout were planted nearly every year. Until 1927 only fry were planted; these in the aggregate reached hundreds of inland lakes, but with mediocre results. It seems that the great majority of these lakes were in no sense suitable for this deep-water denizen. Further the

planting of lake trout as fry gave poor returns in most lakes. Even lake trout fingerlings under two years of age gave questionable results. Only in Elk, Torch, Glen, Crystal, Higgins and possibly Walloon lakes have lake trout become established. Even in some of these there are unanswered questions today as to whether there is any successful natural reproduction. At this time, when the lake trout has become so seriously depleted in the Great Lakes, largely because of sea lamprey predation, some of these inland lakes are providing a source of lake trout eggs that may prove invaluable in helping to restore the species in the Great Lakes--providing the lamprey can be brought under control. This now appears as at least a possibility. (Thirteen years later it is an accomplished fact. --Ed.) The Marquette state fish hatchery has developed a large brood stock of lake trout. It is difficult to provide suitable conditions at a hatchery for these large fish which do not reach maturity until six or more years of age.

A Note Regarding Other Salmonids

In addition to the rainbow trout from the Pacific Coast, and the brown trout from Europe, many attempts have been made to introduce other species of the Salmonidae into Michigan waters. Most of these attempted introductions have been undertaken through the cooperation of the United States Fish Commission, now the Fish and Wildlife Service, and the states of Maine and Montana. Introductions have included Atlantic salmon, land-locked salmon, chinook salmon, cutthroat trout, and Montana grayling. Of these the land-locked salmon and the Montana grayling seemed the most likely to succeed, yet all failed to become established. We have to conclude that they are not adapted to the environment of this region. (Here again the editor must interpolate the fact that, had Mr. Westerman written his account ten years later, he would have recorded the outstanding success of coho salmon and chinook salmon introduced into the Great Lakes.)

Forty Years Under the Department of Conservation

This marks the fortieth year that management of the state fisheries has been under jurisdiction of the Department of Conservation. The eight-hour day and the 44-hour week had arrived. The motor car already had replaced the horse and buggy. Roads over which cars could travel were taking more and more sportsmen into areas hitherto not available. An increasing burden was placed on trout streams and there were increasing demands for more hatchery planting. Several hatcheries were only partially completed due to increased construction costs following World War I.

The years 1922 and 1923 witnessed the completion of hatchery buildings at Harrisville in Alcona County, and at Thompson in Schoolcraft County. New hatcheries were located and built near Marquette, Sidnaw, and Watersmeet in the Upper Peninsula and north of Wolverine in Cheboygan

County. Nearly all trout were still planted as fry, and most of the brook trout eggs were purchased from commercial hatcheries outside Michigan.

The application system for fish plantings was still in vogue. Any interested citizen could apply for trout for stocking his favorite stream, provided he would agree to meet the fish car at the railway station of his choice, and at the hour specified in the notice of shipment of fish; typically the notice was mailed to him a week or so in advance of shipment. To those applicants fell the responsibility of providing transportation from the railway station to the water to be stocked, of planting the fish, and of returning the empty ten-gallon cans to the baggageman at the railway station. Thousands of sportsmen during the early years gave freely of their time. There were abuses too, in that sometimes the fish were planted in waters other than those noted on the application. Much fortitude was called for. In the nature of things, the brook and the brown trout hatched during the latter part of the winter. Fry were ready to plant during March and April in the Lower Peninsula, and in April and May in the Upper Peninsula. Streams were usually at high levels, which added to the problem of reaching favorable places to deposit the fry. In those days, between 25,000,000 and 30,000,000 or more brook, brown and rainbow trout were planted during a season.

A break with tradition came in 1924 when each of the trout hatcheries was supplied a truck capable of hauling 40 cans of fish. Also an order went out from Lansing that henceforth the trout planting would be carried out by hatchery crews. It was a forward step, and placed the responsibility where it belonged.

Angling Regulations

While perhaps this shouldn't be a part of my story, regulations have long been recognized as an important tool in fisheries management. One of the most important and used tools in this kit was the adoption of Act 230, P.A. 1925, which empowers the Conservation Commission to draw orders, governing the management or taking of both fish and game, that are more restrictive than the statutes when, in the opinion of the commission, any species of fish or game is threatened with depletion or extinction.

One of the first orders adopted under this act, on September 21, 1925, closed all of the streams of the state to the taking of brook trout for a period of five years from the first day of May, 1926, except those streams or portions of streams declared by the Director of Conservation to be open. This was the period used to close so-called feeder streams. It was aimed at providing protection to brook trout in the small spring-fed streams, often unnamed, that have always been recognized as having a great potential in the life history of the brook trout. The fact that hundreds of those feeder streams have completely disappeared, as the plow followed the axe in the trout country, had much to do with the disappearance of brook trout in many streams. Many such streams have been dammed, or ditched, or otherwise mutilated, so as to

render them ineffective as trout nurseries. With the closing order under Act 230, some thousands of streams were closed. At its expiration, the closing order was renewed in 1931 for another five-year period. It was terminated however at the close of the 1933 season, on the finding that brook trout fishing had not benefited enough to justify continuing such a regulation. Several problems developed that will not be spelled out here.

Another order, adopted at the same time, limited fishing in portions of a few streams in Crawford and Lake counties to fly fishing only. The Pine River in Lake County and the Pere Marquette from the fork of the Middle and Little South branches of the Pere Marquette to the Mason County line came under this order. Mr. John Baird, the first Director under the Department of Conservation, personally conducted a public hearing in Baldwin on January 28, 1926 primarily to confer with the sportsmen of eight west Michigan counties upon the streams to be opened to trout fishing for that year. It was a well attended meeting with spirited discussion during which the propriety of the proposed fly order came up frequently, particularly as concerned the portion of the Pere Marquette to be closed. At this hearing Mr. A. W. (Paddy) Miles, then Postmaster at Big Rapids and a life-long resident of that vicinity said: "The thing that is depleting streams today is not the fly fisherman or the bait fisherman. It is the automobile. The automobile makes it possible for thousands to fish where dozens fished twenty years ago, it makes it possible for the expert in the city to visit the stream ten or twenty times a season, where he had been able to come but twice or three times." The fly order, unpopular when adopted, was rescinded after one year. The Collins-Gerhardt case, challenging the right of the public to fish in the waters of the Pine River as it flowed over the lands of one Frank Collins in northern Lake County, was "on the fire."

The establishment of more trout hatcheries provided an opportunity to rear increasing numbers of trout beyond the fry stage. The first trout rearing station, at Baldwin, was established in 1927. The following year witnessed a major expansion in the trout fingerling program when trout fingerling stations were developed on the North Branch Pentwater River, Oceana County; White River, Newaygo County; Bear Creek, Manistee County; Platte River, Benzie County; Advance Creek, Charlevoix County; Hunt Creek, Montmorency County; and the Escanaba River, Marquette County. During the years 1929-1930, additional fingerling rearing stations were put into operation on the Sturgeon River, Cheboygan County; and the East Branch Tahquamenon River, Chippewa County.

In 1929, Thompson Hatchery No. 2 was built about one mile from Hatchery No. 1, near Manistique in Schoolcraft County. Here a splendid spring of crystal clear water, with a flow of 1,375 gallons per minute and a stable temperature of 45 degrees Fahrenheit, supplied the 352 standard hatchery troughs. This is considered to be the finest and most abundant water supply of any hatchery in the state for incubating trout eggs and carrying young trout.

In 1931, the hatchery building at Wolf Lake, located ten miles west of Kalamazoo in Van Buren County, was completed; this, for the first time,

provided substantial facilities for hatching and rearing trout in southwestern Michigan. Also this year a splendid trout rearing station was developed on the East Branch Fox River north of Seney in Schoolcraft County. By this time the so-called fingerling program was considered to be on a substantial basis. Improvements were made at those fingerling stations which gave the best results, whereas others were discontinued after a trial period.

Some changes in hatcheries were made also at this time. Several hatcheries built in 1923 for hatching fry were found to be unsatisfactory under the fingerling program. In 1931 the hatcheries at Sidnaw and near Wolverine were abandoned. The hatchery on Fuller Creek near Watersmeet was moved about two miles to the east, to a new location at the Longyear Spring, for a better water supply; at the first location a rearing station was developed using both Fuller Creek and the Middle Branch Ontonagon River.

The period around 1930 witnessed the development of the tank-truck for the transportation of live fish; the ten-gallon can, suitable for handling fry, became outmoded in carrying larger sized fish.

Of the nearly 11,000,000 trout planted in 1931, approximately 61% were brook trout, 29% were brown trout, and 10% rainbow trout. And, of the 9,845,000 trout planted in 1936, brook trout accounted for 54%, brown trout 31%, rainbow trout 13%, and lake trout 2%. At this time practically all brook trout eggs were purchased from commercial hatcheries. Brown trout eggs were produced from brood stock at the Paris hatchery. Most of the rainbow eggs were purchased, while a few were taken from wild fish. Rainbow trout produced from hatchery reared brood stock were thought to be less migratory than those obtained through wild fish.

In 1932, a trout-rearing station was built on the Otter River west of the Ilo School in Houghton County. It was located on that portion of the river where the grayling made its last stand. The following year, construction of a trout-rearing station was undertaken on Cook's Run in the western part of Iron County. Incidentally no state fish hatcheries or trout-rearing stations have been built since that time (i.e., from 1933 to 1960.--Ed.) During the period from 1932 to 1936 many improvements were made to buildings and pond facilities for rearing trout at nearly all hatcheries, through the splendid cooperation received from the various federal relief agencies that functioned during these depression years.

In the mid-thirties fisheries management began to broaden out to encompass habitat improvement of trout streams, and to undertake an extensive fisheries research program. Various creel census studies were in progress too. Through the surveys of inland lakes it was found that many have adequate oxygen supplies and safe water temperature ranges to support either brook trout or rainbow trout. To a degree then this permitted an expansion of our trout waters. Brown trout have not been favored for planting in lakes, as generally anglers have had little success in taking them from lakes.

The following paragraph is taken from a 1938 report: "While the brook trout is unquestionably still the most important trout taken by hook and line, the brown continues to grow in favor with the sportsmen. The Pere Marquette yielded some wonderful brown trout fishing during the last season."

In 1942 all brown trout eggs were being produced at Paris; and nearly all of the rainbow eggs at Harrietta. Brook trout eggs were still being purchased from commercial hatcheries outside the state, none being available within the state.

Through experience gained over the years, it was found desirable to transfer eyed trout eggs to hatcheries where water temperatures were relatively high in winter, to stimulate early hatching and development which meant larger trout by planting time. As the hatcheries where incubation of the eggs was carried on became crowded, the small trout were transferred to the rearing stations, most of them into outdoor ponds. For a time most of the planting was carried on during autumn after the close of the trout fishing season. Numerous investigations were carried on by the fisheries research section of the fish division in the interest of determining at what size and what season trout should be planted to give the best returns. The results from fingerlings, or even legal-sized fish, planted during the fall months were not very satisfactory, while planting legal-sized trout during the fishing season resulted generally in such fish being quickly removed from the streams, frequently in an unsportsmanlike manner.

The peak of fingerling production was reached in 1943, a time when the percentage of brown trout planted reached an all-time high. The trout plant that year was 8,564,000 fish, of which 26.1% were brook trout, 39.2% were brown trout, and 34.7% were rainbow trout.

The trend under the fingerling program was continually in the direction of rearing trout to larger size before planting.

By 1945, emphasis was on rearing trout to the legal size of 7 inches. In January, 1946, the Conservation Commission approved a program calling for the planting of 1,000,000 legal-sized trout. This goal was first reached in 1947 when, of 2,110,000 trout planted, 1,010,000 were 7 inches and over. Of the 7-inch trout, 40.4% were brook trout, 26.8% brown trout, 28% rainbow trout, and 4.8% lake trout. It was recognized that trout of fingerling and sub-legal sizes still had a place in the program, especially in stocking lakes found suitable for brook or rainbow trout. Since that year a million or more legal-sized trout have been planted each year.

From 1951 to 1954 more than 600,000 legal-size browns were planted each year, with an all-time high of 730,419 in 1953. The brown trout had reached a high pinnacle, in contrast to the time he was an outcast about sixty years previously. After 1954, brown trout planting was reduced markedly, to 181,686 in 1956, and 125,743 in 1957.

Planting of rainbow trout peaked in 1955 with 1,246,142 seven-inch fish; the figure was over one million each year during 1956, 1957 and 1958.

Legal-sized brook trout plants were around 650,000 per annum from 1952 to 1957, with a high of 844,007 in 1955.

For the three species of trout combined, the planting of legal-size fish peaked in 1956 with 1,860,765; in addition there were 538,600 fingerlings and 324,650 sub-legal trout planted. In 1957 the planting of legal-size trout was 525,091 brook, 125,743 browns, and 1,063,567 rainbows, for a total of 1,735,301 fish weighing 440,490 pounds. In 1958, the total was 1,806,862 legals. Planting of legal-size trout dropped some after 1958, to 1,610,949 in 1959, and 1,603,674 in 1960.

The large production of hatchery trout, which we see today, could never have been brought about except for the development of efficient diets. Packing house products, principally liver, still used in feeding fry, have not been available in the quantities required to support fingerling programs, much less in feeding large trout. Trout foods used today are a mixture of wholesome fish and cottonseed meals, wheat middlings, dried skim milk, brewers and Torula yeast, distillers solubles, and iodized salt. These ingredients are formed into pellets of varying size and then dried for shipment and storage.

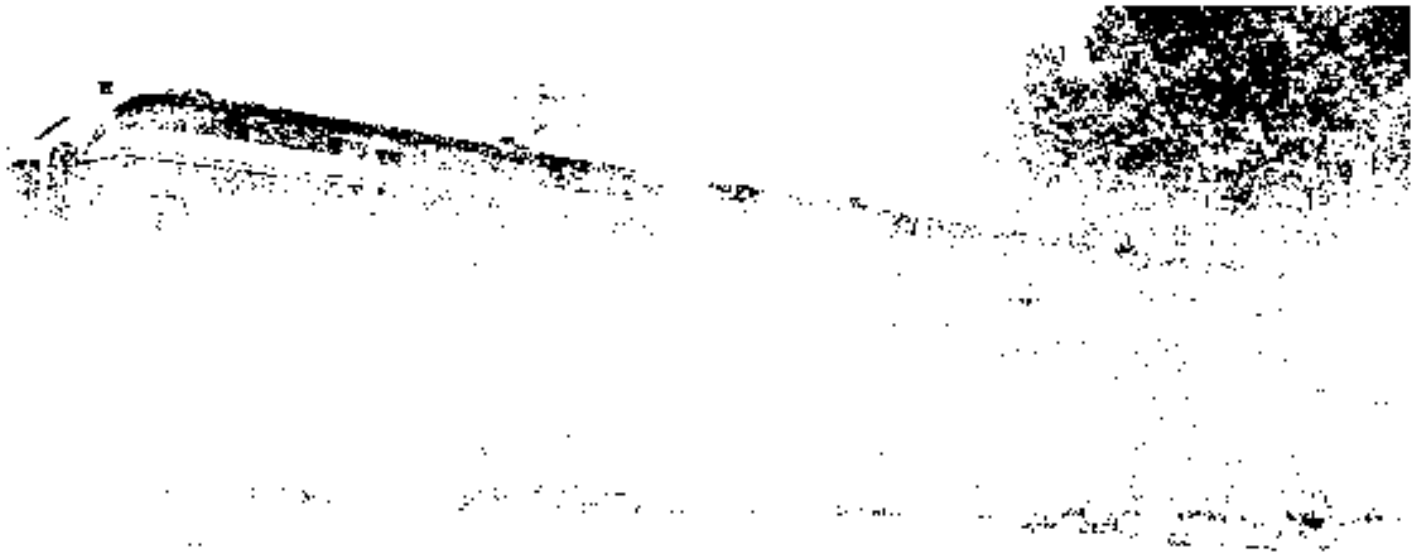
In my account of fish-cultural activities in Michigan, no attempt has been made to chronicle the U.S. Fish and Wildlife Service fish plantings. These have continued down through the years, and, more importantly, a close relationship has been maintained between State and Federal agencies in a free interchange of services.

In summary, we may say that the planting of fry predominated during the first fifty years of trout planting in Michigan, the planting of fingerling trout for approximately fifteen years, and finally a period of fifteen years under the so-called legal-size program. Each period served a purpose and contributed to a program that has brought pleasure to millions of sportsmen from Michigan and many other states. The economic values have been very high, and no one can put a price on the recreational values.

Fry planting spread the range of the brook trout to nearly all of the lower peninsula; it brought about the introduction of the rainbow trout from the Pacific Coast, and the brown trout from Europe. With the planting of fingerlings, we were at the crossroads, seeking methods to do things better, and much was accomplished. Through the legal-size program, it has been demonstrated that top quality trout can be reared successfully under more or less artificial conditions. It may be that we have not yet learned how to use such fish to the best advantage. Many investigations, now in progress, by well trained scientists, should eventually point the way.

In conclusion then, eighty years of trout planting in Michigan has helped fill the creels of unnumbered thousands, yes millions of anglers. We can look to the future with confidence that the wonderful sport of angling for trout is still full of promise in the years that lie ahead. The largest trout, in all probability, hasn't yet been caught!

TRANSPORTATION OF HATCHERY FISH



(above)

WOLVERINE FISH CAR –

Used to transport fish (1885–1930). Total cost of this car in 19 5 was about $4,000.

(left)

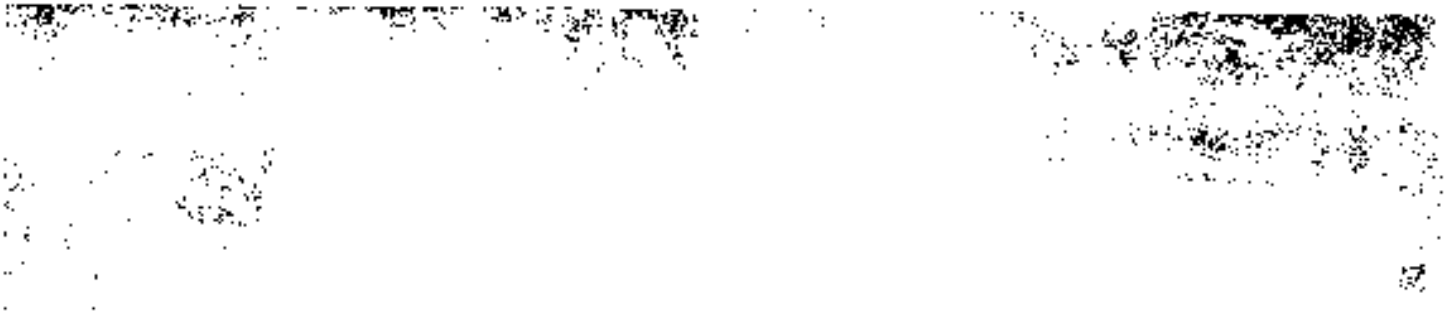
TRUCK WITH FISH CANS

Are metres used to transport fish – around 1875–1940.

(below)

MODERN HATCHERY TRUCK

Capacity of 6,000 lbs. of fish, or 100,000 5" – 6" fingerlings.



COMMENTS ON FISH MANAGEMENT

By G. P. Cooper

Mr. F. A. Westerman was Chief of the Fisheries Division during the longest period of Chief tenures (1925-1959), and many of us "grew up" in the division under his friendly guidance. Shortly after he retired (on July 31, 1959) he was prevailed upon to write a history of fish management in Michigan. He completed the preceding account on March 10, 1961, with acknowledged help from M. J. DeBoer and S. M. Bower. Mr. Westerman's account is reproduced here in its entirely (after very minor editing) to retain its historical value.

There is some duplication between the "Westerman story" and other reports included in this Centennial volume, but we do not choose to edit out this duplication. A very significant fact which the reader should keep in mind is that much has happened in Michigan in new fish management during the final decade of the centennial period, after Mr. Westerman wrote his account. These new developments have involved mostly trout and salmon, their management in the Great Lakes, and the related salmon hatchery program.

The professional historian will surely be somewhat confused over the changes, and the apparent contradictions in program, that have characterized the fish management program in Michigan (and the nation, for that matter) during this 100-year period. First came the introduction of exotic species from distant places--trout, carp, eels, etc. This went on for a quarter century. Some introductions were good, others bad. At the time, no one was suspicious of any bad introductions. Perhaps now we all agree that the carp was a mistake. There is little unanimity of opinion that any of the others were bad, except perhaps for the smelt. Certainly, the brown trout and rainbow trout turned out well.

Next came the era of taking some of our native species and spreading them all over the state, whereas originally they may have been either very local in distribution, or were confined to a limited number of waters. The brook trout is a good example; it was spread state-wide from a restricted distribution in the Upper Peninsula. Likewise, many warmwater fish were spread around, although the record is not so clear for them. The largemouth bass and bluegill were spread to countless new lakes. The yellow perch got the greatest attention; fingerlings by the millions were transferred from a few concentration points on the Great Lakes to countless waters state-wide. The perch transplants were a demonstration of a trait which has been common to fish managers. Whatever new activity has been decided upon, it has been pursued with unbounded enthusiasm on a large scale.

Along with introductions came fish hatcheries and rearing stations, for both trout and warmwater species. Emphasis on hatcheries reached a peak in the 1920's and 1930's. Twenty years later we were getting rid of warmwater hatcheries and trout rearing stations, and were consolidating into a few big production units. We greatly curtailed the planting of small pan fish in warmwater lakes. The new and highly successful program with salmonids in the Great Lakes, and with muskies and other predators in inland lakes, brought out the need for new hatcheries with large capacity. A recreational bond program, approved by Michigan's citizens, provided the necessary funds. The result has been a big new salmon hatchery on the Platte River, plans for remodeling several existing hatcheries, and plans for a big new warmwater hatchery.

Along with the evolution of the hatchery system over some 50 years, there has been a sequence of changes in philosophy on fish-planting policies, especially as to best species of fish and size of fish for planting. The very first hatcheries were designed just to hatch fish eggs, and the new fry were planted directly into natural waters. The old bell jar hatcheries for whitefish and walleyes never got beyond the fry stage. With trout, it became easy to hand-feed the fish and rear them to most any size. The first step was from fry to fingerlings, then to yearlings, then sublegals, and finally to legal size fish ready for the angler's creel. Research showed a progressive increase in returns with an increase in size of fish planted, from fry, to fingerlings, and then to legals. During the past decade or so, the policy has backed away somewhat from legal-size plantings, and more attention is being given to planting smaller fish in selected favorable habitats where good survival and growth will compensate for the smaller planting size. We have not gone "full-circle" in size of hatchery fish, but the pendulum has swung back substantially.

A further word about the big new hatchery program. The planting of salmon and lake trout in the Great Lakes--especially Lake Michigan--has been an outstanding success, and that success is completely dependent on a large forage base of alewives, chubs and other small fishes. The future rate of plantings, and thus the need for more hatchery capacity, will depend on how well the food supply holds up. If food becomes the limiting factor, then competition between salmon, lake trout and steelhead will take on significance. Another consideration will be the question of eliminating commercial fishing for alewives [redacted] (in Lake Michigan) so that the entire forage base is available to the salmonids, and for the sole benefit of sport fishing. Protecting the forage base could be readily justified by the economics of sport fishing, based on the outlook in 1973.

Sport fishing regulations have undergone broad changes which were mostly directional. Generally they are designed to assure natural

reproduction, by a closed spawning season and a size limit. Other regulations are designed to prevent over-cropping. With increase in number of anglers, there has been a long-time reduction in the daily creel. In addition, for trout, bass, pike and other large predators there has been some increase in size limit. On the other hand, liberalization for the abundant bluegill, perch and other pan fish has come by dropping of size limits and the closed season.

Lake and stream improvement (the physical aspects) has had its ups and downs, as well as the stream-related watershed improvement program. The activity got started in the early 1930's and received much attention for a quarter of a century. This was followed by some lack of support, until 1972 when a sizeable stream improvement was again in effect.

The above, rather rambling review of some of the highlights of our fish-management program may help to stimulate an interest in reading the more comprehensive treatments of these subjects in the present centennial report.

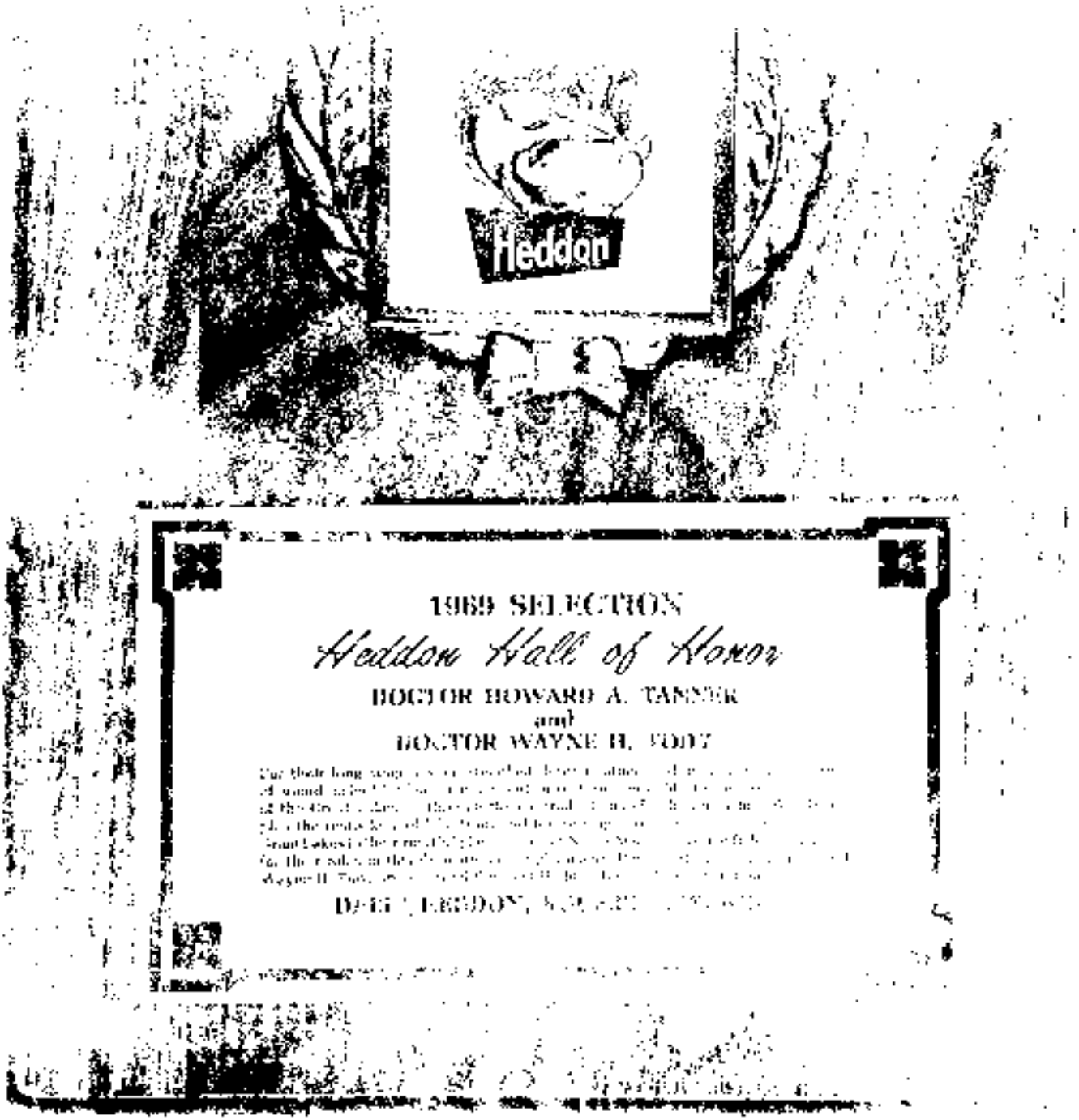
FISH DIVISION CHIEFS

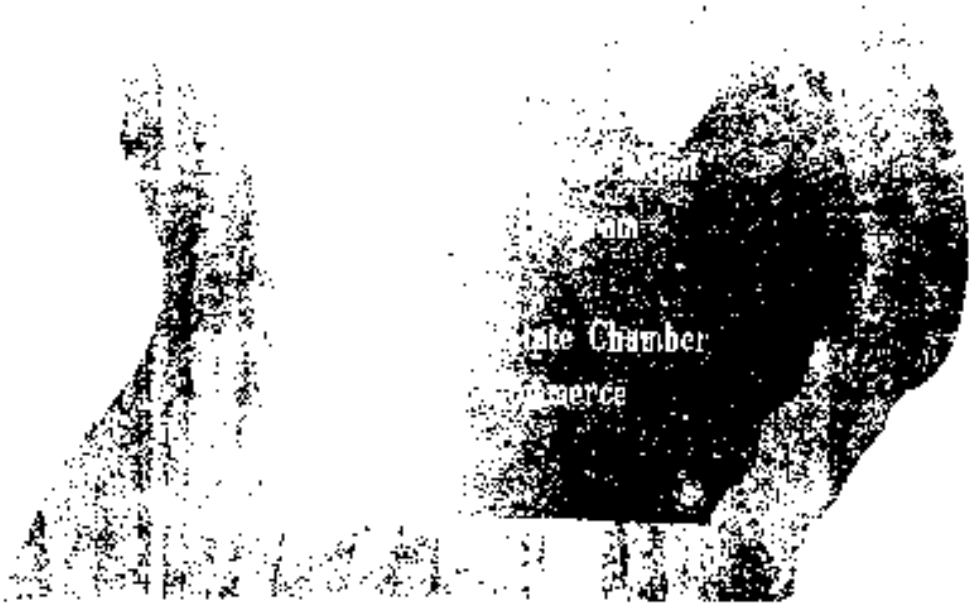
(The First 100 Years)

George H. Jerome	1873 to 1879
James G. Portman	1879 to 1882
Oren M. Chase	1882 to 1883
Walter D. Marks	1884 to 1893
Seymour Bower	1893 to 1921
A. T. Stewart	1921 to 1924
F. A. Westerman	1925 to 1959
A. B. Cook	1959 to 1964
J. T. McFadden	1964
H. A. Tanner	1964 to 1966
W. H. Tody	1966 to present

MICHIGAN'S RECORD FISH (Sport fishing only)

Species	Weight Lb	Weight Oz	Length, Inches	Year	Water where caught; county	Fisherman, and home town
Bass, LM	11	15	27	1934	Pine Isl. L.; Kent	Wm. Maloney, Gr. Rapids
Bass, Rock	3	10	20	1965	Lenawee Co.	Ed. Arnold, Flint
Bass, SM	9	4	27¾	1906	Long L.; Cheboygan	W. F. Shoemaker
Bass, White	2	8	17¼	1970	Pentwater L.	James Jousma, Holland
Bluegill	2	10	12	1945	Silver L.; Cheboygan	F. M. Brooks, Bloomfield Hills
Carp	61	--	43	1971	Klinger L.; St. Joe.	E. Gray, White Pigeon
Catfish, Chan.	47	8	--	1937	Maple R.	Elmer Rayner, Ionia Co.
Crappie, Black	4	2	--	1947	Lincoln L.; Kent	E. F. Lee, Conklin
Herring, Lake	3	7	20⅝	1973	Big Traverse Harb.; Houghton	Ronald McGregor, Houghton
Musky, G.L.	62	8	59	1940	L. St. Clair; Wayne	Perry Haver, Detroit
Musky, No.	36	8	47	1973	Thornapple L.; Barry	D. Ossenheimer, Nashville
Musky, Tiger	28	3	48	1973	Croton R.; Newaygo	Sherman Mercer, Newaygo
Perch, Yellow	3	12	21	1947	L. Independence; Marquette	E. P. Jezinski
Pike, No.	39	--	51½	1961	Dodge L.; Schoolcraft	Larry Clough, Ludington
Salmon, Atl.	4	7	24⅛	1973	Van Etten Cr.; Iosco	Denis Sparks, Oscoda
Salmon, Chin.	43	3	47	1972	Muskegon L.	Brad Owens, Muskegon
Salmon, Coho	30	8	41⅜	1971	Gr. Traverse Bay	G. Adema, Southfield
Salmon, Pink	2	6	19	1973	Ford R.; Delta	L. Michael, Escanaba
Sauger	6	6	25⅛	1973	Torch L.; Houghton	J. Neuman, Bay City
Sheepshead	26	--	37½	1973	Muskegon L.	J. Black, Muskegon
Splake	9	11	26¾	1973	L. Bellaire; Antrim	O. Dewey, Bellaire
Sturgeon	175	--	86	1955	Mullet L.; Cheboygan	W. Spray, Cheboygan
Trout, Brook	6	1	22⅜	1934	Whitefish Bay, L. Superior	C. Shipman, Flint
Trout, Brown	23	12	34½	1973	L. Michigan; Muskegon	L. Ramsey, Muncie, IN
Trout, Lake	53	--	48	1944	L. Superior	K. Boyer, E. Watson; Marquette
Trout, R'bow	22	6	35	1971	L. Michigan; Manistee	H. Huttas, Buffalo Grove, IL
Walleye	17	3	35	1951	Pine R.; Manistee	R. Fadely, Yorktown, IN


Heddon
1969 SELECTION
Heddon Hall of Honor
DOCTOR HOWARD A. TANNER
and
DOCTOR WAYNE H. FODT


ate Chamber
merce

WHITEFISH, STURGEON, AND THE EARLY MICHIGAN COMMERCIAL FISHERY

By Wayne H. Tody

In 1830 the fish wealth of the Great Lakes was considered inexhaustible. A great food supply for the new free-to-develop young nation, and what a food supply it was! Lake whitefish, the primary Great Lakes species, was one of the highest quality food fishes ever discovered throughout the world. In its own way, the resource rivaled the great forest of white pine or the buffaloes on the western plains. Whitefish were everywhere--in all the lakes and on all the shores. Great schools of the fish abounded. There was not a port, in the early fishery, that did not share in this great bounty of nature. For fifty years the catch increased; but like all other great resources of North America, the supply was not boundless, for mankind knows no limits. Such was the case with the whitefish.

Before the resource was fully measured by the exploitive fishery and the peak of production reached, the yield was astounding. From what records are available, we can estimate that between 1830 and 1880 at least 1.2 billion pounds of fish were marketed for food from the Michigan waters of Lake Superior, Lake Michigan, and Lake Huron. The commercial catch was not entirely whitefish, but for these six decades whitefish was king, and as a single species it dominated the catch. It was not a conservative fishery, but one pursued with aggressive abandon. Only the saleable fish were shipped. Fish too small for the market, all species that did not command a high price, and troublesome fish like the sturgeon were simply dumped overboard or on land and wasted. Other fish spoiled while waiting for a favorable market.

By 1860 the Great Lakes commercial fishery had reached a production estimated at 17 million pounds. These fish had a value to the fishermen of over $600,000, and were rated at that time as the fifth most important industry in the state. Led by the fabulous whitefish, commercial fishing on the Great Lakes was comparable with Michigan's other great extractive industries--mining and timber. Copper had reigned supreme in the Michigan mining industry from about 1847 to 1887, a period of some forty years. Here, too, we had been favored with an unusual natural resource--native copper in the Precambrian rocks of the Upper Peninsula. For seventeen years Michigan's copper production led the world. The great timber resource of Michigan was another wonder to behold. Liquidating the vast stands of virgin white pine, the logging industry from 1860 to 1890 either led or rivaled production in any other part of the world.

The theme of the day, in the late 1800's, was production. It mattered little whether it was native copper, white pine saw timber, or whitefish. The resources were there for the taking, and let no market go unfilled! It was a competitive affair of "let me get mine and let the deluge take the rest." All of these extractive industries were colorful pursuits for rugged outdoor men. They bided no interference from outsiders--government or "conservationist." They called their own shots, built their own traditions, and developed their own technology.

Commercial fishing was a specialized activity and had its share of interesting technological developments and internal revolutions along the way. From the standpoint of gear the commercial fishery had rather a humble beginning. Back in 1810 the population of Michigan territory was estimated at 4,800 people. Outside markets had not been developed, so the only use of fish was by those few early inhabitants. What fish were needed were taken by seines along the shoreline or in river mouths near the settlements. Twenty years later, in 1830, when the state's population was some 32,000 people, shallow-water seining still provided all the fish that could be sold locally, and also did a reasonably good job of supplying the newly developing export trade to Ohio and New York. From 1830 on, however, the American population increased rapidly. By 1840, Michigan's population had skyrocketed to 212,000. To serve this new market, gill nets were pressed into use.

The early gill nets were crude affairs. Descriptions of them reveal that these nets were made by hand. Stones were used as weights on the bottom line, while boards or whittled pieces of cedar were used as floats. All webbing in the nets was "tied" during the off season. The nets had to be reeled frequently for drying in the sun to combat rapid deterioration. Not long after the widespread innovation of gill nets in the upper lakes, lead weights replaced stones on the bottom line and cedar and cork floats replaced the wooden strips on the float line. Still later, suppliers offered prefabricated webbing and other components necessary for the fisherman to assemble nets according to his option, a development that revolutionized the effectiveness of the fishery.

Gill nets can be set in any depth of water simply by providing longer lines at the ends for hauling and for attachment of marker buoys. In the early fishery, however, nets were set within sight of shore because it was necessary to locate and tend them either with row boats or small sailing schooners. Generally, gill nets in the cold waters of the upper lakes were left set for four or more days, before tending them to remove the fish. Generally, the fish taken were dead, and there was some waste in sorting fish for the market, especially when storms interfered with lifting, or when the nets were set in warmer waters.

A far-reaching innovation came into the fishery with the introduction of the pound net to the upper Great Lakes. This net was introduced from Scotland in about 1836 and was first fished in Lake Ontario. From there its use spread to Lake Erie by 1850, and to Lake Huron by 1854. By 1860, the pound net, as a supplement to seines and gill nets, was revolutionizing the whitefish fishery at all of the principal centers as far north as the Straits of Mackinac. It came into use in the Naubinway area by 1857, Green Bay and Menominee by 1858, and Beaver Island by 1859. The first recorded use of the pound net in Lake Superior was in 1864 on Whitefish Bay.

The pound net is an exceptionally effective piece of gear. It is constructed of heavy cotton netting and consists of four parts--lead, heart, tunnel, and pot or crib. In a normal setting, the webbing of this net, except that of the tunnels, extends from near the bottom of the lake to about two feet above the surface of the water. The webbing is held erect by attachment to long stakes or poles driven into the lake bottom. The maximum depth at which a pound net can be set is about 80 or 90 feet. The net is set with the lead near the shoreline and the pot in deeper water. Pound nets are set either singly, or in strings of usually less than five but sometimes as high as twenty nets. In a string of nets, the lead of one net is attached to the back of the adjacent net toward the shoreline. In lifting pound nets, a boat gets inside the open pot or crib, and the twine of the sides and bottom is hauled in. When fish are contained in the net at the surface of the water, they are scooped out with dip nets and placed in boxes or simply shoveled into the bottom of the boat.

By the end of the Civil War, pound nets were in general use throughout the Great Lakes. They resulted in greatly increased production, and were credited by commercial fishermen and other observers of the fishery as heralding the era of general decline of fish populations in the Great Lakes. Fears that a decline was underway were brought to the attention of the State Capitol--the Governor and Legislature--in 1862.

The pound net fishery during the era from 1860 to 1890 was a controversial one among the fishermen themselves. Many of the old-time gill net fishermen would have liked to see the pound nets entirely barred from the fishery. The reason was not only their general effectiveness in taking fish, but the fact that small webbing was used in the pots. With this small webbing, very few young whitefish or any other small fish escaped alive. The destruction of young fish was appalling, even to the operators. Despite repeated attempts to establish and enforce a mesh size, the wasteful pound net fishery continued for many years. Undoubtedly the taking of a vast quantity of small whitefish did affect production of the larger fish. The situation created a paradox for the early work of the State Fish

Commission. The early charge of this agency was to plant whitefish fry to augment production. Their consternation in seeing this gross destruction of small whitefish by pound netters, in areas where they were planting whitefish fry, is easy to understand.

Following the pound net, the next major innovation of the Great Lakes fishery, which greatly increased the fishing capability of the fleet, was the steam fishing tug. Recall that the early fishery was conducted exclusively out of sail boats or smaller craft propelled by hand! The first steam tug to make an appearance in the Michigan fishery was out of Mackinac Island in 1860. Its ability to operate in any weather, its labor-saving capabilities, and its ability to navigate the waters far offshore completely revolutionized the fishery. Steam tugs were in general use on Lake Michigan shortly after 1869, and by the early 1870's they were taking over the fishery on Lakes Huron and Superior. There is little question that production would have fallen off more than it did by the 1870's and 1880's, were it not for the advent of the steam tug. Fish Superintendent Walter D. Marks had the following comment in the Sixth Biennial Report[1] of the Fisheries Commission, 1881, p. 12:

> "The fishing grounds are one after the other fished out, and then new places sought where the same process is repeated. If each ground, as it becomes unprofitable for large operations was actually abandoned and allowed to rest, it would unmoubtedly be slowly restored to productiveness by natural processes, because the fishing would become unprofitable before the last fish was taken, but this seldom happens."

The steam tug was a major innovation of the commercial fishery on the upper Great Lakes in the 1870's and 1880's, and led rapidly to a fishery capable of gross over-exploitation.

Up until 1890, gill nets were pulled by hand. In 1891 another invention shook the fishery. This was the power gill-net lifter. Its arrival was like a modern automatic washer to the pioneer housewife who had always scrubbed her clothes by hand. The automatic lifter was an ingenious piece of apparatus, hauling the gill nets aboard over a drum worked by the power of the vessel's engine. This device enabled the crews to handle a much larger quantity of nets, and it played an important part in maintaining the yield of an otherwise dwindling fishery. The lifter, as it evolved, consisted of a revolving drum bearing along its circumference two rows of teeth which interlock

---

[1] Several long quotations in the balance of this report, all from early biennial reports of the Fisheries Commission, are identified by report number and page references.

or bite together, and then separate again as the drum revolves. The cork and lead lines of the gill net pass over a roller and are then caught by several interlocking teeth of the drum. The net is carried along about half a revolution of the drum, when each pair of teeth separates and releases the lines. Two or three men tend the nets as they are delivered by the lifter. One arranges the nets in a box for resetting, and the others remove or clear the fish from the netting, throwing the fish taken into separate boxes for each marketable kind. The speed of revolution of the drum is controllable, and the nets can be lifted according to any requirement (Van Oosten, 1936). There were other innovations to come, but not until after the turn of the century did the submarine trap net, the gasoline engine, and nylon and other synthetic fibers, continue to revolutionize the capability of the industry in putting ever increased pressure on the stocks of Great Lakes fish.

From 1830 to 1890, the fishery attracted more and more operators, as markets for the products were developed and as the fishery became more effective in taking fish, with each new technological development in gear. The trend is shown by the following annual catch statistics for total catch of all commercial fish from Michigan waters of the Great Lakes, selected for 10-year intervals. The figures were from various estimates and censuses made by the federal government and the state over the years:

1830	1,000,000 pounds	From points on a catch curve
1840	7,000,000 pounds	
1850	12,000,000 pounds	
1860	17,500,000 pounds	
1870	23,000,000 pounds	
1880	28,000,000 pounds	
1890	30,000,000 pounds	

These data indicate a steady increase in production over the 60-year period. By Civil War times (1860), it was a very intensive and exploitive fishery, primarily for the high-quality lake whitefish. During the early years even such choice species as the lake trout were largely ignored, except as their catch was made in nets otherwise set for whitefish, or where the fisherman had to depend upon these other species while new stocks of whitefish were being located. After 1890, the catch of whitefish declined precipitously, and the catch shifted rapidly to other species.

By 1870, the decline of whitefish in western Lake Erie, the Detroit River, Lake St. Clair and southern areas of Lake Huron was well recognized. So, too, were changes in other fish populations around southern Michigan subjected to heavy fishing. At the same time fish culture (hatchery operation) was gaining recognition both in western

The Lake Whitefish, Coregonus clupeaformis, one of the most important commercial fish in the Great Lakes.

This species also occurs naturally in a few large inland lakes, but is not to be confused with the cisco of many inland lakes. The four whitefish shown here were caught in Crystal Lake, Benzie County, in May of 1964 by Stanley J. Lievense, fishing with wigglers. These fish weighed about 2 lbs each.

Europe and in the eastern states. It was time to offset shortages of whitefish and other species in prime fishing areas. In 1873 the Michigan Board of Fish Commissioners was established by legislative Act 124. Under the leadership of George H. Jerome, the new "Michigan Fisheries Commission" tackled the job of management by: taking inventory of the state's waters and fisheries; recommending changes in regulations; and, above all, building a State fish hatchery system. From these, and federal stations, billions of whitefish fry were stocked, in a noble effort to offset depletion, before operations were switched to more promising practices.

Let's leave the whitefish for a few moments and consider another abundant Great Lakes species. The lake sturgeon was a companion of the whitefish--in time and abundance. The largest of the original fishes in the Great Lakes, the sturgeon is a living relic of an ancient stock which dates back over 50 million years. The Great Lakes sturgeon commonly reached a weight of 50 pounds; the largest authenticated individual weighed well over 300 pounds. During their heyday, lake sturgeon of 9 feet in length and 400 pounds in weight were frequently reported. Most Great Lakes fish have relatively short lives--four to twelve years--but sturgeon live much longer. They first mature at an age of about 15 to 25 years. After that, they produce eggs only infrequently, probably at intervals of about 5 years. It follows that a sturgeon 50 years of age has spawned only about five times. Obviously the very large sturgeon, which we occasionally see, have lived in the Great Lakes for a half century or more.

No one will ever know just how abundant the lake sturgeon was in lakes Michigan, Superior, and Huron before commercial fishing activities started in earnest in 1830. They were taken in nets--millions of pounds of them--for many years. Allowing for their slow growth and their great age, we can estimate their original standing crop in the tens of millions of pounds. So here, as with the whitefish, we find the sturgeon in the Great Lakes to be one of North America's greatest single natural resources. Today, we deplore the slaughter of the passenger pigeon, the American bison, and other species of our wildlife heritage. But, very likely, no single animal was ever subjected to such deliberate wanton destruction as was the lake sturgeon. By the time it finally became recognized as a valuable fish, it had been largely destroyed as a troublesome nuisance. The large sturgeon, covered with bony plates, raised havoc with gill and pound nets, tearing and entangling the webbing. Also, fishermen had the idea that sturgeon, being bottom feeders, ate the spawn of valuable species. Thus fishermen killed the sturgeon taken in their nets just to get rid of them. Accounts of this destruction are long and varied. Prior to 1860 there was no commercial market for sturgeon. Some fish enclosed by seines were released because they were too large to handle. But judging from early accounts, sturgeon were more

The Lake Sturgeon, Acipenser fulvescens, formerly abundant in the Great Lakes.

The same species occurs in a few large inland lakes, where, free from persecution, fair numbers have survived. The fish in this picture was 68 lbs (estimated length 5½ feet), was speared from an ice shanty on Black Lake, Cheboygan County, by Herbert Guinor of Cheboygan during 1948.

commonly gaffed out of the net and injured sufficiently so that they would soon die. Other fish were taken ashore and thrown away or buried, with the remark that "we'll have no trouble with that beast in the future." As the commercial fishery expanded, there are accounts of sturgeon being hauled ashore, piled up in long rows like cord wood, and dried in the sun long enough for the "fat to run." They were then set afire and burned, much in the manner that settlers on southern farms disposed of tree stumps in clearing their lands. It is reported that sturgeon, because of their rich oil content, were piled on the docks, taken aboard boats, and burned in the boilers. And, of course, there are always the stories of attempts to dig them into the ground for use as fertilizer. Some sturgeon were rendered for oil. In Detroit in 1850, sturgeon oil for paint sold at 75 cents a gallon. Sturgeon flesh and quantities of eggs were sold to farmers for hog feed. In those early days, the preparation of sturgeon roe for caviar was unknown, and the flesh was considered as inferior food fit only for "servants and slaves."

Before 1860, with no established market, anyone could get sturgeon at the dock free, or perhaps for 10 cents apiece. In 1860 an entrepreneur in Sandusky, Ohio commenced smoking sturgeon. He offered 25 cents a fish, provided they were over four feet in length. As his business grew, Indians in Michigan gathered sturgeon, piled them on wagons, and hauled them to Detroit dealers; the price by then had reached 50 cents each. A large demand was easily met by the abundant supply of sturgeon in Lake Erie. In 1872 the fishery reported that 13,880 sturgeon averaging 16 pounds each were smoked. By 1880 the smoked sturgeon fishery had spread throughout the Great Lakes.

If only these early Americans could have appreciated the future potential of the sturgeon, the many millions of pounds that were wasted between 1830 and 1880 would have been worth a fortune to them. The smoked fish industry was followed by the development of caviar, and finally by the production of isinglass. The latter product was in high demand for carriage windows. Isinglass is made from gelatin obtained from the swim bladders of sturgeon (and a few other kinds of fish). Somewhat later, sturgeon hide was found to be valuable for the making of leather and, of course, the oil came into more and more demand in the market. Thus from 1875 to 1880, sturgeon from the upper Great Lakes rapidly increased in value. The following statement is from page 44 of the Ninth Report of the State Fish Commission (1880):

> "The once despised sturgeon has become one of the most valuable, commercially, of the many fish that are caught in the great lakes and deep rivers of this State . . . . Nearly every part of it is utilized in some way. The flesh is eaten, either fresh or pickled,

and when dried and smoked is sold as halibut . . . . The bladder, which is large, is used in making isinglass and glue. Every bit of waste is tried out for oil. The head is frequently cooked and eaten, and accounted a delicacy. In some countries the skin is tanned for harness leather, and the Chinese prize even the dorsal chord, which is cut in slices and dried and used as food. Much the most valuable part of the fish, however, is the roe from which caviare is made, a dish formerly prized chiefly by the Russians and their neighbors, but now often finding a place on the menu of the best hotels and restaurants. The roe in the mature fish weighs from fifteen to forty pounds and upwards, and frequently constitutes nearly one-third the weight of the fish . . . . It finds a ready market in most of the large cities of the United States."

The following statement from the Seventh Biennial Report (p. 12) of the Michigan Fish Commission in 1888 sheds further light on the sturgeon in Lake Michigan.

"As stated above, the sturgeon catch represents about 50 per cent of the total catch of this shore, and prices are as good as for whitefish. The meat is both smoked and frozen, and at various places the spawn is manufactured into caviar. It was impossible for me to ascertain the number of pounds of this article prepared, owing to the fact that much of it was sold for cash, and no account made of it either by buyer or fisherman. One manufacturer had a record of 14,000 lbs. made by him during the year, and there were others more extensively engaged in the business than was he. As an example of the astonishing yield of eggs per fish, I saw 70 lbs. taken from two fish, and it was not considered anything remarkable either. A comparatively new industry is winter fishing for sturgeon with hooks. These hooks, with snoods about 16 inches in length, are strung on set lines, being placed from six to eight feet apart. The hooks are baited with minnows or larger fish cut in pieces, and are sunk to the bottom. It has these advantages over other forms of winter fishing--the rig costs but little, and it lies at the bottom, where ice and sea has but little effect on it, while the fish do not die and decay if they are left sometime in the water after being caught. No less than 300,000 hooks have been or are been [sic]

fished this season between St. Joseph and Ludington. Sturgeon gill nets, from nine to fifteen inch mesh, are also largely used."

It is then pathetically unfortunate that sturgeon markets were not discovered until the great standing crops of this fish had been destroyed. Prior to 1880 we have no books on the catch; but available records indicate a Michigan catch of sturgeon in 1880 of 4,300,000 pounds. By 1890 the catch had declined to 1 1/2 million pounds, and by 1900 to a mere 140,000 pounds. Most of the Michigan catch came from Lake Michigan, with only small quantities coming out of lakes Huron, Superior and Erie. However, it appears that the original sturgeon populations in Lake Huron had been destroyed almost completely before the market was established. This is indicated by their relative abundance somewhat later in Canadian waters of Lake Huron and their former abundance in Lake Erie.

The obituary of the Sturgeon as a commercial species could hardly have been expressed better than these words of Walter D. Marks of the Fish Commission in 1898 (Thirteenth Biennial Report, p. 26):

"When they were the most abundant, little attention was given to their capture, their market value being the lowest of all kinds of fish, but for the past ten years or more, the curing and smoking of their meat, together with caviare made from ova, has made them one of the most profitable fish taken from the fishing grounds of our State. Detroit river seems to be a favorite place for the sturgeon, especially during the spawning season and the device most extensively used in their capture is most barbarous. Their well known habit of keeping near the bottom, makes the set lines with hooks the cheapest and easiest method of taking them, much less laborious and expensive than hauling seines. In the use of hooks, the sturgeon come rolling along and are caught. However, many of them tear loose and get away, but the laceration made by the hooks in most cases means death in a short time. The pound nets fished in Lake Erie verify this statement, by getting a number of the wounded sturgeon every season in such a putrid condition that they are entirely worthless.

"Of my own personal knowledge, the catch of young sturgeon as small as two pounds in weight, is of frequent occurrence on the fishing grounds of the State. It should not be tolerated. The taking of immature fish of all kinds is the most destructive agency in depleting the commercial fisheries of the State, and should be abandoned by the fishermen, thereby preserving their own means of livelihood, and also for a reason greater than all else, the preservation of our commercial fisheries."

Today the Great Lakes sturgeon has been declared an endangered species by the U.S. Department of the Interior, as well as by Michigan. Efforts will be made to perpetuate this species in our nation and allow it to exist on this earth. It is a sorrowful commentary that the sturgeon could exist and thrive in North America for 50 million years, before tangling with the greatest of all predators--man--and is now on the brink of extinction. It is especially sad when we recall that a little more than a century ago this great fish existed in a population that could only have been measured in tons of millions of pounds.

Turning back to the whitefish, we recognize that depletion occurred by the time of the Civil War; and by 1880 the situation was becoming critical. Unfortunately for the whitefish--but fortunately for the historical records--the decline of the whitefish has been fairly well documented. The pound net, the steam tug, and the efficient gill net combined to speed up the end of the whitefish era.

Walter Koelz, in his summary of the Great Lakes fishery in 1925, posts the 1880 catch of whitefish from American waters of Lakes Superior, Michigan, and Huron at 17 million pounds. He reports the 1890 catch at one-half this rate, or 9.7 million pounds. In 1900 the catch was only 3.4 million pounds. Most of the decline occurred in the productive waters of Lake Michigan, where the catch declined from 12 million pounds in 1880 to 2 million pounds in 1900.

The decline in catch of whitefish did not go unnoticed by the men of the Michigan Fish Commission. Superintendent Walter D. Marks in 1892 (Tenth Biennial Report, p. 11) stated:

> "But the commercial fishes have never had half a chance. The appliances for catching these fish have been so improved, and the fishermen are so eager to take and sell all that comes to their nets, that but few of the fry planted are allowed to reach anything like maturity. There are over two thousand miles of nets fished in Michigan waters alone, and nearly all of them send immature white-fish to the market."

Charles Moore, the statistical agent for the Fish Commission, in the Tenth Report, p. 36, had this to say:

> "Visiting these fisheries in June, 1892, I have a personal knowledge of what they are doing in this locality. Tons of immature whitefish were taken in the pound nets here, many of them so small they could not be salted, neither could they be put upon the market and sold fresh, and as a last resort they

were smoked. Could the millions of whitefish plants made by the hatcheries each year escape this most shameful manner of fishing, not only here, but in many other localities, until they attain a spawning age and a commercial size, the fruits of artificial propagation would be realized."

Moore (Tenth Report, p. 47) further had comments about the commercial fishery for whitefish and other species in the Saginaw area:

"So much has been said concerning the manner in which fishing has been conducted in Saginaw bay and river for years past in former reports that it seems hardly necessary to go over the ground again, but being an eye witness to the large catches here of wall-eyed pike so small that they are not sold by weight, but by the dozen, I feel that it is a matter of too much importance to be passed by without a word. During the fall and winter season the Saginaw river and the mouth of the Shiawassee river are completely lined with small pound nets, fykes and goblers. The little pins, as the fishermen call them, seeking shelter in the river during this season of rough weather are caught by the tons. Many of them are left on the ice, being too small for any kind of use. Here again rises the necessity of some well considered law efficiently enforced for the protection of this valuable fish which is nearly, if not quite, equal in value to the whitefish, and which are propagated with less expense."

The whitefish depletion was not restricted to lakes Michigan and Huron. Statistical agent Moore (Tenth Report, pp. 38-39) had this to say for the far western reaches of the Michigan shore on Lake Superior:

"I proceeded from this point to Copper Harbor, Eagle Harbor, Eagle river, Misery bay, Ontonagon (all being noted at one time as fishing stations of considerable importance) and then on to the Montreal river, where the Michigan coast terminates. The catches for 1891 were very light. Nowhere on this lake did I find the depletion of the waters of the whitefish more marked."

In summarizing the status of the commercial fishery for the entire state in 1892, Walter D. Marks had these final statements to offer (Tenth Biennial Report, p. 45):

"The cupidity of the selfish fisherman should give away to his judgement, if he reflects and understands that a few years more of present modes of fishing must leave

the waters of the great lakes nothing but mere waterways for the passage of our lake commerce, their valuable fisheries having passed into that stage of decay which now distinguishes Lake Ontario.

"It is only within the last five or six years that the states and provinces bordering these waters have done anything like adequate work in restocking, and yet it is unquestionably the fact that had it not been for their efforts the fisheries would have reached a much lower ebb than that to which they have fallen.

"If the State is willing to devote its money to the restocking of its waters, it should also take steps by the passage of just laws to protect this work, and fishermen who are not actuated by selfish motives should be willing to be governed by just and fair laws for the protection and preservation of the fisheries.

"Let the fishermen understand that the public proprietorship in these fisheries is paramount to any right he may exercise or enjoy in them, and that it is against public policy that he should pursue methods of fishing which will in his lifetime ruin the industry he follows."

Elsewhere in the same report (Tenth Report, pp. 9-10) Superintendent Marks commented more extensively:

"Hand in hand with the restocking of waters must go the prevention of the wasteful capture of immature fish, or the work is almost as bad as thrown away. The State cannot afford to hatch and plant fish fry to have them seized by greedy fishermen before they have half attained their growth, and when they are almost worthless for food. The only way to reap the full benefit of the work of fish culture is to prevent the taking or marketing of the fish until they have reached a reasonable maturity.

"No valuable food fish ought to be allowed to be taken, killed, or sold on the market until after it has reached an age to have cast its first crop of eggs--which means a growth of from three to five years.

"We believe it is becoming to be the opinion of a vast majority of the commercial fishermen that adequate and suitable laws should be enacted and enforced for the protection and maintenance of the whitefishing industry; that these laws should be such as to disturb as little as possible and interfere in the smallest degree with the nets and fishing outfits of the smaller fishermen whose

entire capital is very likely to be invested in the single net and outfit that he owns.

"The fishermen generally seem to be of the opinion that this would best be accomplished by a law fixing the size of the whitefish that might be lawfully taken from the waters and sold in our markets, and providing for the confiscation of all whitefish of smaller than the lawful size wherever found; whether in the possession of the fisherman or of the dealer. This matter may be worthy of careful consideration for there is no doubt that any protective measure that has the cordial support of the fishermen will be more easy of enforcement than those that meet their hearty disapproval.

"The question of a close season for whitefish has been much considered and is a very difficult one owing to the difference of dates of the spawning season in different localities. There can be no question that a thirty or even a twenty days' close season, at the proper time, would be of great benefit, and would add largely to the success of the work done by this Board . . ."

To conclude our saga of the whitefish fisheries of 1830 to 1890, it is well to quote a summary that Statistical Agent Charles H. Moore published in 1894. He summarizes whitefish production in Michigan waters of the three upper Great Lakes as follows: "1885--8,144,000 pounds; 1891--8,110,000 pounds; 1892--6,346,000 pounds; 1893--5,345,000 pounds." The reader will note that these data suggest only a decline of about 3 million pounds--not a very impressive change. Statistical Agent Moore, however, had amazing insight. He noted, for example, that the catch per net declined from 315 pounds in 1885, to 222 pounds in 1891, 165 pounds in 1892, and only 127 pounds per net in 1893. In other words, only a third as many whitefish were being caught per net in 1893 as had been taken eight years earlier in 1885. He also noted that in 1885 the fishery was conducted by 58 steamers and 733 smaller boats. In 1891 the catch had been made by 70 steamers and 1,423 boats. The fishery had been maintained only by a very significant increase in the total number of boats and nets engaged. To further document this, he found that 25,830 nets were in use in 1885, whereas the number had increased to 42,073 eight years later in 1893. Obviously the total abundance of whitefish in the lakes, and especially in Lake Michigan, had declined drastically.

It had become painfully clear to the men of the Fisheries Commission that the once bountiful Great Lakes with their "inexhaustible" supply of whitefish had finally been measured by man. The "Resource without bounds" concept was a myth! New species might come along to replace the whitefish, or management efforts might become successful in restoring them,

but the uncontrolled growth of a fishery depending simply upon the bounty of nature had finally come to the edge of the precipice, and was tottering on the brink of disaster. The fishery was to continue, but on a "break even" or poverty level for many of the fishermen. Never again (and a century has transpired) was the whitefish to regain its former abundance and its predominant role in production and value in the Great Lakes fishery. We can only marvel over the fact that the fabulously productive whitefish maintained its numbers so long and so efficiently as the evidence indicates.

In 1897, for one last time, the Fisheries Commission took the fight against depletion to the State Capitol. After a long battle the cause for effective regulations went down to total defeat. Limitations on the number of fishermen, and direct controls on the amount of gear or amount of catch, were all ruled out. In addition the budget of the Fish Commission was cut by nearly one-half. Eight years later the funds of the Fish Commission were restored but with the stipulation ". . . that no part thereof should be expended for the production of so-called commercial fishes, or for commercial fishing waters."

Today--some seventy years later--we realize the full impact of this early action. We have seen the valuable species of Great Lakes fish, like the whitefish, largely replaced by inferior species. We have seen sport fishing build to fabulous levels on inland waters while the Great Lakes were essentially ignored, and we have witnessed the virtual collapse of the Great Lakes fisheries during the 1950's and 1960's.

It is against this background that one can fully appreciate the value of present day lake trout, steelhead, brown trout and salmon planting programs. Many significant things have happened. The applied research and control of sea lampreys by international treaty and the cooperation of federal, provincial, and state agencies. The upsurge of sport fishing interest in the Great Lakes. And finally, the trend to sound scientific management of the commercial fisheries with quota control over harvestable stocks, utilizing selective gear, to optimize and perpetuate the yield for a total fishery.

We can close this saga with a final optimistic note. Sturgeon are endangered but are still present in the Great Lakes. Whitefish are responding to management, and are increasing annually; the current annual catch is 4,000,000 pounds, and yields within a few years of twice this amount are predicted.

SPORT FISHERMEN AND LICENSES

By Henry J. Vondett

Although a rod license was proposed around the turn of the century, a license fee for sports fishing did not come into existence until 1913. It was made effective starting in 1914. Even then, it was required of only non-residents, although a license had been recommended for Michigan residents. Persons under 18 years of age were exempt from the requirement. An early proposal was that one-half the net revenue be used by the Board of Fish Commissioners for the propagation of fish, and the other half by the State Game and Fish Warden for the enforcement of laws for fish protection. The early attitude on licensing was shown in the proposed exemptions for a resident license for persons under 18 years of age and all persons fishing in waters flowing through, or bordering their own lands.

The basis for the license proposal was that all who fished public waters should justly contribute a small sum towards perpetuating the supply of fish. It was believed that a small fee for residents, considering the exemptions and privilege, and a larger fee for non-residents could not be considered excessive or burdensome. Practically all anglers from outside the state should be more than willing to pay the license fee for the mere privilege of taking home one day's catch of trout, especially since most of them were from Ohio, Indiana or Illinois where few brook or rainbow trout were available. Fishing in Michigan's famous trout water would serve as excellent advertisement, and the exaction of a license that permits this privilege would increase, rather than decrease the number of visiting anglers. (At least, this point of view was expressed.) When a non-resident spends from $50 to $500 for the outing, a small license fee for the privilege would be a trifling.

Legislative appropriations for fish propagation started with $5,000 in 1873, were increased to an average of $28,000 annually in 1895-1900; $31,000 from 1900 to 1910, and $35,000 in 1911.

License revenue collected in 1914 was estimated to be $20,000; for the two years, 1914 and 1915, it amounted to a total of $40,167.88. The fee, restricted to non-residents, was $2 for a general license which included taking fish of the trout family, and $1 for taking fish excluding the trout family. The law stated that all license revenue shall be used in the work of fish culture and distribution.

The Board of Fish Commissioners continued to recommend that the license act be amended to cover resident anglers. The Board expressed absolute conviction that, if a resident license were enacted, the annual revenue would be ample to carry on all work of propagation and distribution, maintenance of hatcheries, and in fact, every kind of current and special

expense. Any additional appropriation by the Legislature or direct tax of any kind would not be necessary. The work of the Board would then be wholly self-sustaining. The license fee for residents was proposed at $1, with exemption for all residents under 21 years of age. The purpose of the adult license was not to prohibit or restrict fishing, but to require those who fish to contribute towards the maintenance of fish supplies. A comparable situation occurs with the automobile owner who pays a tax for the upkeep of the highways he uses.

The licensing of only non-residents sustained revenue until 1927 when (finally) resident anglers were required to have a trout fishing license. Annual cost for this trout license was $1. Non-resident fees varied during the period of 1914 to 1927, to include a $5 general license fee in 1917, up from $3 in 1914, reduced again to $3 in 1919, raised to $4 in 1921 along with a special trout fee increase to $2, and the general non-resident license was raised again to $5 in 1923.

During the early part of the century a different philosophy apparently existed concerning the license for taking of game animals. The first deer license was required in 1895, with a resident fee of $0.50, and a non-resident fee of $25. These fees increased steadily until 1921 when they reached $2.50 and $50, respectively. Resident game hunters were first licensed at $1 in 1914, at which time the non-resident paid $10.

During the early years, permits were required for other activities including the taking of clams, spearing rainbow trout, spearing cisco, and netting cisco. The latter activity apparently was confined to Cass and St. Joseph counties.

In 1933 the first general resident fishing license was instigated. (The resident license in 1927 was for trout only.) Its 50¢ fee was accompanied by elimination of the trout license, and a general revision of non-resident licensing, to offer a 10-day license at $1, an annual at $2, and a wife's license at 50¢.

In 1939, under Act 337, the resident license fee was raised to $1, with 40 cents earmarked for land acquisition, lake and stream improvement, and research. Fishing license sales at this time were greater than in any other state--665,733 resident licenses and 20,803 non-resident licenses in Michigan.

The reimbursement of a license-issuing fee to the dealer who sold the license, so common today, was started in 1941. First-year disbursement at 5 cents per license issued, amounted to $41,862.42. This issuing fee was raised periodically--to 15 cents in 1957 and to 25 cents in 1968.

Various sport-fishing license modifications have taken place over the years; a non-resident license for wives in 1933 was eliminated in 1945, reinstated, and again eliminated in 1948. Clam or mussel licenses were

continued, but declined in number almost yearly. The Conservation Commission closed the mussel season in 1944 and 1945 due to a scarcity of shells; it reopened the season in 1946, but interest had declined and in 1948 only 15 licenses were issued. Other licenses or permits that came on the scene were gamefish breeders license, wholesale fish licenses, noxious fish permits, and minnow licenses.

Up until 1944-45, revenue from the various fishing and hunting licenses was sufficient to finance not only the fish and game programs, but also, in part, the related activities of administration, education, and law enforcement. The idea that licenses could finance these related activities, which was actually done for about 15 years, must be credited to foresight of the early administrators.

In 1947, for the first time, the number of resident and non-resident fishing licenses exceeded a million--779,371 resident and 284,757 non-resident licenses--confirming the opinion of early administrators of the great economic and recreational value of our game fish.

The 1947-48 biennium witnessed the accumulation of proof that supplies of most species of fish are replenished naturally in waters where they are established, and that curtailment of the program of planting hatchery fish in such waters was justified. Recommendations were offered to remove the size limit on panfish species. On the other hand, pressures to emphasize trout planting continued, and resulted in 1948 in a one-dollar "trout stamp" fee to be used for trout propagation and planting. This special fee raised $169,498 in 1948.

Numbers of fishermen remained relatively constant, at around one million, for the 10-year period 1948-1958, then gradually declined until 1965 when only 887,000 licenses were sold. Sports fishing interest took an upswing again following the introduction of coho and chinook salmon in 1964 and the revelation that the program of Great Lakes reclamation and lamprey control was proving successful. In 1969, a mail census showed that one million angler days were spent on Lake Michigan alone for trout and salmon, and at this time licensed fishermen state-wide had increased again to slightly over one million. Of these, 306,422 purchased trout stamps.

At the close of the 100-year period--i.e., in 1973--approximate license sales were 800,000 resident, 126,000 non-resident, 290,000 trout stamps, and about 100,000 temporary licenses covering one-, three-, and seven-day periods.

Following is a resume of Fishing Licenses and their costs that were in effect during the centennial period.

Michigan sports-fishing license sales 1914-1973

YEAR	RESIDENT ANNUAL	RESIDENT SENIOR	RESIDENT 7 DAY	NON-RESIDENT ANNUAL	NON-RESIDENT TEMPORARY	NON-RESIDENT WEEK	TROUT STAMP RES	TROUT STAMP NON RES	TROUT STAMP UNL DAY	TROUT STAMP THREE DAY
1914				15,008						
1915				22,160						
1916				25,579						
1917				27,863						
1918				27,392						
1919				32,231						
1920				52,338						
1921				55,534						
1922				49,245						
1923				61,747						
1924				53,077						
1925				60,005						
1926				61,654						
1927				60,666						
1928	56,726			59,480						
1929	72,375			64,795						
1930	87,950	[illegible]		54,996						
1931	81,571			39,725						
1932	44,707			19,947						
1933	290,055			21,213	27,567	12,709				
1934	445,[illegible]			24,234	45,972	[illegible]				
1935	473,[illegible]			28,370	59,465	27,[illegible]				
1936	570,[illegible]			35,497	70,[illegible]	30,[illegible]				
1937	586,[illegible]			43,517	92,550	45,[illegible]				
1938	665,[illegible]			47,110	95,057	47,[illegible]				
1939	656,[illegible]			50,2[illegible]	95,895	[illegible]				
1940	557,[illegible]			51,272	[illegible]	[illegible]				
1941	601,[illegible]			55,[illegible]	117,[illegible]	[illegible]				
1942	569,[illegible]			51,[illegible]	102,[illegible]	59,[illegible]				
1943	531,[illegible]			39,264	51,354	[illegible]				
1944	542,[illegible]			47,572	61,754	[illegible]				
1945	569,[illegible]			58,[illegible]	94,[illegible]	[illegible]				
1946	725,[illegible]			105,[illegible]	15[illegible]					
1947	774,[illegible]			111,324	171,[illegible]					
1948	807,[illegible]			121,745	160,[illegible]		[illegible]			
1949	811,[illegible]			127,430	154,[illegible]		[illegible]			
1950	7[illegible]			133,376	136,[illegible]		[illegible]			
1951	847,[illegible]			140,507	[illegible]		[illegible]			
1952	[illegible]			156,[illegible]	[illegible]		[illegible]			
1953	[illegible]			164,[illegible]	[illegible]		[illegible]			
1954	[illegible]			156,[illegible]	[illegible]		[illegible]			
1955	[illegible]			143,[illegible]	[illegible]		[illegible]			
1956	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]			
1957	[illegible]			131,461	[illegible]	[illegible]	[illegible]			
1958	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]			
1959	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]			
1960	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]			
1961	[illegible]			[illegible]	[illegible]		[illegible]			
1962	[illegible]			[illegible]	[illegible]		[illegible]			
1963	[illegible]			[illegible]	[illegible]		[illegible]			
1964	[illegible]			[illegible]	[illegible]		[illegible]			
1965	[illegible]			[illegible]	[illegible]		[illegible]			
1966	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]			
1967	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]			
1968	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
1969	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
1970	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
1971	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
1972	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]		[illegible]	[illegible]
1973*	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]		[illegible]	[illegible]

*[illegible] dealers on December 31, [illegible] subject to [illegible] adjustment.
[illegible] portion [illegible] 22,[illegible] [illegible] licenses were issued.

Year	Kind	Cost
1914	Nonresident fish (General)	$3.00
	Nonresident fish (except Trout)	1.00
1917	Nonresident fish (General) raised to	5.00
1919	Nonresident fish (General) reduced to	3.00
1921	Nonresident fish (General) raised to	4.00
	Nonresident fish (Special Non-trout) raised to	2.00
1923	Nonresident fish (General) raised to	5.00
1927	Resident trout license	1.00
1929	Nonresident fish (General--including trout) changed to	3.00
1931	Resident trout license raised to	1.75
1933	Trout license eliminated.	
	Resident fish (General)	0.50
	Nonresident fish (10-day)	1.00
	Nonresident fish (annual)	4.00
	Nonresident fish (wife)	0.50
1939	Resident fish (40¢ earmarked for improvements) raised to	1.00
1945	Wife nonresident fishing license eliminated.	
1948	Resident fish raised to	1.50
	Nonresident fish (10-day) raised to	2.00
	Nonresident fish (annual) raised to	3.00
	Trout stamp (both resident and nonresident)	1.00
1954	Temporary nonresident fish changed from 10 to 15 days.	
1956	Temporary nonresident fish raised to	3.00
	Annual nonresident fish raised to	4.00
1958	Resident fish raised to	2.00
	Temporary nonresident fish raised to	4.00
	Annual nonresident fish raised to	5.00
	Trout stamp raised to	2.00
1966	First senior citizens fishing license	0.50
1968	Fishing license required for All waters, and all licenses include wives	3.00
	Resident fish license raised to	3.00
	Resident 7-day fish license for all fish	3.00
	Annual nonresident fish raised to	6.00
	Nonresident trout stamp (now)	3.00

Year	Kind	Cost
1968	Temporary nonresident raised to (and days reduced to 7)	$5.00
	1-day resident or nonresident Great Lakes trout license	1.00
1972	Resident fish raised to	3.25
	Senior resident fish raised to	0.75
	Annual nonresident fish raised to	6.25
	7-day nonresident fish raised to	5.25
	Trout stamp raised to (and eliminated separate stamp for nonresidents)	3.25
	3-day resident or nonresident fish, good for all species in all waters	2.25
	1-day fish raised to	1.25
	Eliminated resident 7-day fish.	

Attempts to measure the total amount of sport fishing in Michigan have been made only in recent years. Surveys performed in 1970 indicated approximately 1.1 million licensed anglers (wives and persons under 17 years of age not licensed) fishing 15.4 million man days. Of this effort, 72% was spent on inland waters, 16% on the Great Lakes, and 12% on salmon and steelhead tributaries. The estimated sport catch was 60 million fish weighing 31 million pounds. Total value of the fishery resource is not known; however, the value of the 1970 salmon and steelhead fishery alone--essentially 28% Great Lakes and tributary fishing--was estimated at 39 million dollars. The value of Michigan's sport fishery as a whole includes an important element in the value of the fish as food. For example, as of 1973, if Michigan's one million "fishing families" ate sport-caught fish once a week, at $2.00 a mess, that's 100 million dollars a year.

MICHIGAN SPORT FISHING REGULATIONS 1820-1973

by David P. Borgeson

The following annotated list of sport fishing regulations is chronological, as a matter of historical interest. Early rules were by legislative act; in recent years, some are by either Commission or Director's order as provided for by legislation, notably Act 230 and Act 165. This list contains many phrases which are abbreviated for economy of space, but it is easy to interpret the meaning.

The list has two types of entries. In one, a year is given at the left margin, followed by comments or phrases which describe the result of a particular legislative act. The other type of entry is for relatively recent legislative acts which cover broad areas of fisheries or apply to some activity state-wide. In this second type of entry, the year, the act number, and the title are given, followed by notations on regulations of significant interest.

1820. Territorial law. Illegal to obstruct passage of fish up or down streams.

1859. Prevented fishing with nets and seines in twelve counties of southern Michigan. The purpose was to eliminate commercial fishing in inland waters.

1861. Fish chutes mandatory on all dams, to allow free passage of fish.

1865. Board of Supervisors in each county given right to regulate fishing.
Brook trout not to be taken from inland waters with nets or seines; to prevent commercial fishing for the species.
Non-resident license for commercial fishing, $50.00, levied by county supervisors.
No fish offal to be dumped into natural waters.

1869. No fish weir or net to obstruct free passage of fish--a restriction on commercial fishing.

1873. On brook trout and grayling, open season April through September, no nets or seines.

1872. Thirteen northern counties closed to fishing except with hook and line.

1875. Season on brook trout, May 1-August 31; on grayling, June 1-October 31; these species may be taken with hook and line only.
Permit system for private fish culture.

1879. Spears, firearms and nets (except dip nets) illegal, March-May.

1881. Six-inch size limit on grayling and brook trout.
California or rainbow trout, just introduced, protected for 4 years.

1887. Brook trout and landlocked salmon, open season May-August.
Grayling and California trout, open season, June-October.
No spearing on inland waters, March-June.
Hook-and-line fishing only, on St. Clair River after 1889.
Dynamite and stupifying material prohibited in fishing.
No nets or seines near fish chutes or ladders, which would hinder fish from free passage.
Grayling and brook trout, illegal to sell or catch for sale.
Black, strawberry, green or white bass not lawful to take except with hook and line, and not lawful between March 1 and June 15. Muskellunge may not be taken by any means during same period. Nor may such fish be bought and sold during same period.
First game and fish warden.

1889. For speckled trout, land-locked salmon, grayling and rainbow trout, open season, May-August.
Spearing and dip-netting of mullet, grass pike, and suckers lawful during March-June (exception to 1887 law).
Muskellunge to be taken by hook and line only.
Largemouth, smallmouth and white bass, and crappie by hook and line only.
Explosives, fish toxins, seines and traps illegal.
Spears illegal, March 1-July 1.
Hook-and-line only legal fishing method for brook, brown and rainbow trout; landlocked salmon; grayling; black, strawberry, green or white bass; in all waters of state.

1893. Act 196. Fish and game the property of the state.

1897. Legal to spear all fish except brook, rainbow, brown trout; landlocked salmon; and black bass in inland waters and Lake St. Clair during December-March.
No commercial netting in Wildfowl Bay or Les Cheneaux Channels.
Lawful to take German carp in Black or Macatawa Lake, with permission and under supervision of game warden.

1899. Nine-inch size limit on bass; fingerling lake trout protected.
Hamlin Lake closed to spearing and snagging.
OK to spear carp in Budd Lake.
Bass protected in Bear Lake, Charlevoix Co., November 1-June 14.

1901. Eight-inch size limit on trout, Au Sable River.
Closed season on largemouth and smallmouth bass, April 1 to May 30.

1903. Bag limit of 25 black bass, calico bass, striped bass, strawberry bass, perch, bluegills, roach, sunfish or walleye in any combination.
No sunfish less than 3 inches, perch or bluegills less than 5 inches, walleye or bass less than 8 inches may be taken in Lyon, Long, Pine and Fish lakes.
Unlawful to take brown trout except by hook and line.
Minimum size limit 7 inches for brook, brown and rainbow trout, landlocked salmon, and grayling.
No fishing in streams for 4 years, in which trout or salmon have been recently introduced by the Fish Commission where they were not native.
Not more than 50 trout, bass, panfish, etc, per day, and not over 100 in possession.

1905. Commercial trout breeders license, plus $500 bond.
Screens at lake outlets to prevent emigration of game fish.
Fish peddlers may sell without a license.

1907. Budd Lake closed to carp seining.
Flies-only and an 8-inch size limit on trout in North Branch Au Sable River.
Illegal to sell bass.

1909. Closed season on trout, September-April.
Bass (largemouth and smallmouth) size limit 10 inches, creel limit 10, open season June 15-February 1.
White and calico bass, 7-inch size limit.

1911. No netting in inland waters, except dip-nets for suckers and carp.

1913. Repealed flies-only on North Branch Au Sable.
Open season on frogs, June-October.
Non-resident license, all fish except trout $1.00, all fish $3.00.

1915. First Inland Fishing Act.
Restricted fishing mostly to hook and line. Limit of 5 ice lines or 2 from boat. Set limited rules for spearing.
Creel limits: 35 brook trout; 25 panfish, bass, walleye and pike.
Size limits: 5 inches on panfish, 6 inches on perch, 10 inches on bass and walleye.
First scientific collectors permit.
Possession of illegal gear, prima facia evidence of use.
Sport-caught fish may not be sold.

1917. Bag limit on walleye, down to 10.
Defined powers and duties of game warden.
Increased license for non-resident, all fish $5.00.
New closed seasons: smallmouth bass March 1-July 1, largemouth bass March 1-June 15, walleye February 1-May 1.

1919. Act 247. Cisco netting November-December in inland lakes designated by Director.
Trout season May to August; bass season June 16 to February 28.

1921. Act 17. Creating Department of Conservation.
Defines duties of the Commission and Director.
Protect and conserve natural resources.
Provide facilities for recreation.
Foster the protection and propagation of game and fish.
Set rules for the use of public lands.
Under authority of Act 17 the Commission or Director may regulate fishing in a number of ways, examples being:
Certain streams were closed to fishing to prevent the spread of whirling disease.
Regulations on use of public access site at Singing Bridge.
Requiring permit to fish on South Branch Au Sable, to provide for a special study.
Open season on bass June 16 to March 31.
Age limit for non-resident license dropped to 18.
Size limit on bluegills 6 inches, on other panfish 7 inches.

1923. Taking of fish prohibited from any inland lake which was stocked at public expense unless lake is open to public fishing. (Lakes over 250 acres excluded, if stocking was done without written permission of riparian.)
Bait minnows not to be transported away from trout streams.
Walleye closed season, January-February.
Unlawful to drive fish by pounding on ice.
Areas to be fenced to preserve fish and wildlife, not over 15,000 acres.

1925. Act 230. Discretionary power act. (Amended in 1945)
Commission can further restrict the harvest of species threatened with depletion. The act, as amended, also allows designation of not more than 10 streams and 20 lakes for setting experimental regulations for the purpose of fish research.
The provision for experimental research on up to 10 lakes and 20 streams has been utilized continuously since 1945.
Many actions by the Commission have been taken under Act 230 to protect species threatened with depletion or extermination, such as the following:
Increasing the size limit on trout and salmon to 10 inches.
Decreasing the creel limit on salmon to 5 fish.
Increasing the size limit on sturgeon to 50 inches.
Banning the spearing of lake trout.
Closing certain waters to pike spearing.

1929. Act 84. The commercial fishing law of 1929.
Covered licenses, legal gear, mesh size, closed seasons, size limits, protected species.
Many bays closed, or restricted, to commercial fishing; reserved for sport fishing.

1929. Act 123. Fish chutes and ladders.
Fish ladders required at dams, unless Director deems them unnecessary.

1929. Act 165. Michigan sportsmen fishing law.
All fish declared the property of the State.
Defines: game fish and non-game fish, trout streams, non-trout streams, trout lakes, pike lakes.
Set fishing license fees; resident license required at age 18.
Established open seasons by species, opened certain waters to fall trout fishing.
Defined legal devices for sport fishing.
Established new size limits: pike and walleye 14 inches, musky 30 inches, perch 7 inches; and new creel limits: brook trout 15; bass, pike and walleye 5.
Rules and license fees for collectors of live bait (minnows and wigglers).
Under authority of Act 165, many sport fisheries are regulated by "Order of the Director" with a list of waters where a particular type of fishing is permitted. Such lists include:
- Waters open to spearing of ciscoes, whitefish, suckers and carp.
- Lakes subject to excessive fish mortality (e.g., winterkill) open to unrestricted fishing.
- Streams open to dip-netting for smelt, carp and suckers.
- Streams open to spears and bow and arrow for carp and suckers.
- Streams open to fishing for steelhead, brown, and lake trout, and salmon during an extended season.
- Waters where pike may be taken at any size.
- Waters open to taking wigglers for commercial purposes.
- Waters open on "quality trout fishing"; up to 100 miles of stream.
- Waters open to rubber- or spring-propelled spears for carp, suckers, dogfish and gars.
- Waters open to taking of minnows for commercial purposes.
- Sections of rivers, below dams and weirs, closed to fishing.
- Designated trout streams, state-wide.
- Issuance of scientific and cultural fish collecting permits.

1929. Act 245. Stream Control Commission.
Commission to control water pollution, control use of flood plains.

1931. Director given authority to close fish spawning areas to motor boats.
First trout license, $1.75, for residents 18 years and over.
License in form of a button.
Creel limits: 15 brown trout, 15 rainbow trout.

1933. Act 156. Protection of frogs.
Establishes closed seasons.
Outlaws spearing with artificial lights.

1933. Permit required to plant fish in State waters.
Resident fishing license for persons over eighteen, $0.50.

1935. Director's permit needed to remove caddis larva from streams. Fee $3.00.
Heavy penalty for using dynamite on fish: $100-$300, or 90-120 days.

1937. Resident license. 17 years and older. 50¢ for man and wife, trout license $1.00; non-resident license $2.00.

1939. Creel limit on smallmouth bass in the Great Lakes. 10 fish.
Ten-day non-resident license $1.00 (wife 50¢).
Resident license not required for owner to fish on a private lake (no inlet or outlet).
Unlawful for non-resident to ice fish in Branch, Cass, Van Buren, and Berrien counties, January 1 to opening day of trout season.
Illegal to ice fish for bluegills or sunfish between 6 pm and 6 am.

1943. Act 154. Removal of fish shanties.
Requires identification of ice-fishing shanties, and removal from lake before ice breakup.

1945. Creel limit on brook, brown and rainbow trout, 15 fish or 10 pounds and one fish.
Creel limit on panfish--25 in aggregate, but not over 15 bluegills.
Year-around open season on lakes north of highway M-46.

1947. Resident license $1.50, trout $1.00; non-resident $3.00, trout $1.00.

1949. Act 158. Reciprocal fishing agreements.
Allows reciprocal agreements with neighboring states on fishing regulations for boundary waters.
No size limit on bluegills, sunfish, perch or other panfish.

1951. Act 111. Dingell-Johnson enabling act.
Authorizes department to receive D-J federal funds for fish restoration and research.

1951. All lakes open to year-around fishing for species not protected by a closed season.

1953. Non-resident trout stamp good only if signed across face of stamp by holder.
Sturgeon season on inland lakes set for January-February.

1954. Bow and arrow fishing season for rough fish, April 1-May 31 in Lower Peninsula, May 1-31 in Upper Peninsula.

1955. Act 218. Discretionary power, commercial fishing.
Commission may modify regulations to better protect and utilize commercial species.

1955. Act 247. Great Lakes submerged lands act.
Authority to convey privately occupied lake bottom lands to private ownership and determine sale price.

1955. Illegal to fish within 100 feet of lamprey weir.
Size limits: walleye 13 inches, sturgeon 42 inches.
Trout in inland lakes, creel limit of 5 fish.
Illegal to snag fish.
Non-resident fishing license $4.00, trout stamp $1.00.
Illegal to discharge wastes harmful to aquatic life or public health.

1956. Finance hatcheries for Great Lakes fish, from game and fish funds.

1957. Act 196. Fish breeders.
Director to license and regulate private breeders of game fish.

1957. Fishing licenses: resident $2.00, trout stamp $2.00; non-resident $5.00, trout stamp $2.00.

1958. Sturgeon declared a game fish.

1959. Year-around open season on bluegills and sunfish.
Pike size limit 20 inches.
No insect larvae to be removed from a trout stream, except to use on the same stream.

1961. Open season on bass: state-wide, June 1-December 31; in St. Clair River to Detroit River, third Saturday in June to December 31.

1963. Director can issue special fishing license to non-resident for boundary water.

1964. A 14-inch size limit on pike in several Upper Peninsula waters.
Free fishing license to retarded persons and disabled veterans, upon request.
Trout stream defined: any stream containing brook, brown or rainbow trout.
Director may designate up to 100 miles of trout streams with special restrictions on lures, creel limits, and size limits. (See quality trout fishing on 80 miles in 1973.)

1965. Act 291. Inland lakes and streams act.
Protects public interest in navigable inland waters.
Regulates dredging and filling.
Protects rights of riparian owners.

1965. License for age 65 and older: 50¢ plus $2.00 for trout stamp.
The TROUT designated as the State Fish of Michigan.

1966. Act 345. Inland lake improvement act.
Authorizes lake improvements by county boards, with cost assessments to local property owners.

1966. Acceptance of federal fish for restocking: State cannot refuse.
New rules for salmon and striped bass may be set by the Commission.
Free license to military personnel on furlough.

1967. Size limits on trout: 7 inches in inland lakes, 10 inches in Great Lakes.
Licenses: Resident $3.00; Non-res. $6.00, non-res. trout stamp $3.00; non-res. 7-day $5.00; 1-day license Great Lakes only, $1.00.
Definition of trout stream changed to: "significant population of trout or salmon."

1968. Illegal to take fish for use of only their eggs.
Penalty for possession of illegal fish set at $5.00-$10.00 per pound.

1969. License for chartering and guiding fishing parties.

1970. Indians exempt from certain fishing laws.
A new Sportsmens License introduced.

1971. A 25¢ issuance fee added to license cost.
New 3-day license at $2.00.
Out-of-state guides may guide in Michigan if licensed in their state.
Catch-record forms distributed to licensed sport fishermen.

1972. Bag limit on whitefish, 12.
Bass season: Saturday immediately preceding Memorial Day to December 31.

1973. Penalty for illegal fish extended to non-game species.

A HISTORICAL REVIEW OF THE PRODUCTIVITY AND REGULATION OF MICHIGAN'S COMMERCIAL FISHERIES, 1870-1970

By John A. Scott

Prior to creation of the Michigan Fish Commission in 1873, there existed a well developed and expanding commercial fishery on the Great Lakes utilizing gill nets, haul seines, and pound nets. The introduction of the pound net into the Great Lakes was a profound innovation and, in great part, resulted in nearly doubling the commercial catch between 1850 and 1870 (from 12 to 23 million pounds).

With the advent of the pound net, the State enacted the first law requiring a commercial fishing license. This act, passed in 1865, required that non-residents apply to the County Board of Supervisors for written permission, i.e., a license, to use pound nets, and set an annual fee of fifty dollars for each net. Licenses for residents were not required until much later, as will be subsequently shown.

Although accurate statistics are not available, in 1873 the commercial catch had reached nearly 28 million pounds of fish--principally whitefish, lake trout, and herring.

Despite the high production of fish in 1873, there were indications that the fishery was making inroads in the whitefish stocks. We find, for example, on page 10 in the first report of the State Commissioner and Superintendent of State Fisheries (1873-74) the following:

> ". . . These [Great] lakes in former years, and even now after years of improvidence and waste, produce millions [of whitefish] annually. Yet the catch is very appreciably diminishing, to the evident alarm of the States that border on the lakes and of the country at large. The causes of this decrease are too transparent for enumeration or designation. The simple mention of the naked fact opens a volume replete with bitter recollections and reproof. Avarice, human greed, regard neither the times nor the modes of capture, and ignorance is their stupid associate and ally."

A few years later the Fish Commission expressed concern over a problem still extant today--that of unlimited participation in the fisheries and management of common property resources. In the third report of the Commission for the years 1877-1878 we find:

> " . . . Every state is participant, and the richer for the riches which [the lakes] yield. The Great Lakes are free to all. No doubly-barred nor bolted doors and combination locks frown upon any American citizen desirous of sharing in their husbandry. Capital and labor are as free to enter upon their broad areas, in the hope of returns and dividends. . . . Since American enterprise and pluck have won, and despite of jealous, or envious, or covetous neighbors, hold them all."

The Commission took further note of the increased participation in the fisheries and expanded fishing effort during the decade of the 1870's. In a special investigation the Commission compared the fisheries on Lake Michigan (all jurisdictions) in 1879 with those as reported by the United States Fish Commission in 1870. During that ten-year period the number of steam tugs in use increased from 4 to 30; there was an increase in the number of pound nets used; the number of gill nets increased from 450 to nearly 24,600; and, obviously, the number of commercial fishermen also increased considerably.

By 1880 the commercial landings from Michigan's Great Lakes waters had reached over 28 million pounds, half of which is estimated to have been whitefish and lake trout. However, there were more indications that fish stocks were becoming depleted. The Commission noted, by 1883, that the size of fish had greatly decreased; and that " . . . in many localities the yield has partially or wholly failed, and to keep up the product the range of waters fished over has been greatly extended, and the size of the mesh of gill nets and trap or pound nets has also been materially diminished."

Apparently unable to effectively check increasing participation in the fisheries--a concern expressed in earlier years--the Commission in 1883 did recommend increasing the size of the mesh in the nets and further proposed that the length of pound nets, gill nets, and seines should be regulated.

For many years the Commission had expressed an interest in conducting a fishery census, and in June of 1883 the Michigan legislature enacted the first law requiring all fishermen residing in the State to furnish to the Superintendent of Fisheries " . . . a full report of the amount and value of their catch for each season." This, then, was the first effort that had ever been made by State authority in Michigan to gather fishery statistics. A statistical agent was hired to explain the new law to fishermen and to conduct the census. However, the agent estimated that only two-thirds of the fishermen reported. If, then, the reported statistics were expanded by one-third, an estimate can be derived that indicates the magnitude of the fisheries by 1883:

Number of men employed	1,500
Number of sailboats	390
Number of steam tugs	24
Number of pound net boats	200
Number of pound nets	450
Number of gill nets	19,000 (450 ½ miles)

The Legislature did not appropriate sufficient funds in 1884 to hire a statistical agent, and the Commission sent out a special questionnaire requesting information about the fisheries. It concluded that the extent of the grounds fished over had increased since 1883; that the product had decreased; and that more men, boats and nets were employed in the fisheries. As a point of special interest, in 1884 there were 500 commercial fishermen between Charlevoix and Cheboygan.

Also in 1884 the Commission first directed its attention to licensing commercial fishermen. In the Sixth report of the State Board of Fish Commissioners, it said:

> ". . . [the] cost of replenishing the public waters for industrial fisheries should be borne by the persons immediately benefited by it. That the business of fishing should be licensed by the State, and the fees paid for the license should be devoted to the hatching and distribution of the best varieties of fish and to pay the cost of State regulation and inspection."

However, the Commission apparently did not press for the license requirement because it wanted an Inspector of Fisheries appointed first to gather a "perfect census and reports of all fishing statistics."

In October of 1883, and again in October of 1884, conferences of Fishery Commissioners from the states bordering the Great Lakes were convened in Detroit and Milwaukee. They agreed that a

> ". . . license be laid upon nets used in fishing . . . the standards for license being: 1. seine and gill nets by the fathom 2. Trap or pound nets by the heart or crib, and by the fathom of lead beyond 25 rods."

The efforts of the Commissioners were countered by strong lobbies in the State Legislature and their recommendations were not enacted into law.

By 1885 the commercial fisheries in Michigan were approaching the zenith of production--at least of lake trout and whitefish--and the estimated catch of the two species is placed at 12-13 million pounds. In that year there were over 27,000 gill nets in use, 1,100 pound nets, and over 300 fyke nets

and seines. Also, nearly 70 steam tugs and over 1,800 men were employed in the fisheries. In his report for the year 1885, the statistical agent of the Fish Commission took note that the amount of gear ". . . if placed in a continuous string [would] be long enough to completely reach around our 2000 miles of lake coast."

Between 1886 and 1888, bills introduced in the Legislature for regulation of the industrial fisheries and enforcement of the fishery laws were defeated. Specifically, a bill calling for adoption of a system of licensing the fishing industry was defeated.

The peak commercial catch probably was attained in the early 1890's reaching an estimated 30 million pounds of all species. Landings of whitefish and lake trout in 1890 totaled probably between 16 and 18 million pounds. The total catch could well have exceeded 30 million pounds, because the Commission noted another difficulty that is still prevalent today --the inaccuracy of the reported catch. The Statistical agent in 1890 questioned the accuracy of the reports and stated that they (the reports) were ". . . left to the judgment of the fishermen, and the question of whether they would report or not was left to their inclination." And further, ". . . The data which was sent in voluntarily was found to be very meagre."

The amount of fishing effort by 1890 was indeed prodigious. An estimated 35,000 nets were in use; about 1500 vessels were used on the grounds; and nearly 4000 men were employed in the fisheries.

If, during the early 1890's, the catch was nearing its zenith, so must have been the confrontations between the fishermen and the Board of Fish Commissioners. More interstate conferences were held calling for mutual controls on the fisheries and, again, pleas were made for licensing the industry. All were defeated at the hands of powerful lobbies, however.

Still, nearing the end of the century, the fisheries were continuing to expand, but catches of whitefish and lake trout were beginning to decline. The Commission expressed grave concern about the increased number of fishermen, boats and gear; but again, as in several previous attempts, efforts toward regulation went down to defeat in the face of pleadings by the fishermen that the laws would ruin their business.

In a report for 1894-96, the statistical agent took particular note of the decline of whitefish and lake trout, even though fishing effort increased greatly between 1885 and 1895 (Table 1).

By 1898 employment in the fisheries reached 4500 men, who used about 40,000 nets and nearly 2000 boats. The catch composition--probably about 25 million pounds of all species in aggregate--had changed, however. Whereas, in 1885 landings of lake trout and whitefish were estimated at 12-13 million pounds, in 1898 the catch of these two species had dropped to 11 million pounds.

Table 1.--Catches of whitefish and estimated catches of lake trout in relation to fishing effort, 1885-1895

Year	Whitefish	Lake trout (estimated)	Number of nets
1885	8,143,626	5,000,000	25,839
1891	8,110,387	9,132,770	36,514
1892	6,347,535	8,859,899	38,283
1893	5,345,800	8,859,500	42,073
1894	4,469,755	7,207,295	42,231
1895	3,355,187	6,293,545	40,452

From Eleventh Biennial Report of the Michigan State Board of Fish Commissioners, Lansing, 1895.

Proceeding over a decade of budget reductions, the Fish Commission issued its last statement on regulation of the fisheries in 1898. In the report for 1897-98 the Board stated:

> "We believe that commercial fishing should be allowed only under a license issued or authorized by the State, and that a light tax on such fishing be imposed."

Fourteen years after the Commission first suggested a license, the Legislature in 1907 passed Act 153 requiring all boats, except rowboats, to be registered and licensed if their purpose was for commercial fishing and offering fish for sale.

Efficiency, however, was apparently penalized in this first of several license requirements. Residents using sailboats paid one dollar per year (non-residents, $2.00). The resident fee for boats without steam net lifters was $10 per year ($100 for non-residents); and vessels with steam lifters required a fee of $25 (non-residents, $200 per year). Licenses expired on the first day of April following their issue.

Over 2100 boats and 74,000 nets were in use in 1907, and the fisheries employed about 6500 men. The total catch of lake trout and whitefish increased by only about 3 million pounds over that of 1898 despite a near doubling of fishing effort.

Two years later, in 1909, the Legislature changed the 1883 law requiring reporting of the commercial catch. The new law required fishermen to keep an account of the number of pounds of each kind of fish taken and report them annually to the State Game, Fish and Forestry Warden. Until about 1918, reports of the Fish Commission were virtually silent on

the matter of commercial fishing. Owing to a long era of budget reductions, the Commission ceased planting fish in the Great Lakes, and funds were not available for maintenance of good statistics on the fisheries. By 1919 some records were made, however, and we find that at the time there were about 100,000 gill nets and almost 4500 pound nets in use. The number of licensed boats had declined from 2100 in 1907 to just over 1300 by 1919. Landings of whitefish and lake trout declined to about 10 million pounds--down by four million pounds from that reported for 1907.

License fees were increased by act of the Legislature in 1923 and were based on the gross vessel tonnage. Residents were charged $10 per year for powered boats under 5 tons, and $2 per ton for vessels over 5 tons. A fishing license for a sailboat cost $5 for residents and $50 for non-residents; and a "nets only" license was $1 for residents contrasted to $200 for non-residents.

Again, in 1929, license fees were changed, but only slightly and only for residents. Also, other revisions in the commercial fishing statute required fishermen to report their catch monthly, as is presently the case. In 1930 the number of gill nets had dropped to about 62,000, and pound nets to approximately 3500,--contrasted to about 100,000 gill nets and 4500 pound nets eleven years earlier.

The commercial fishing license fee structure was revised four times between 1929 and 1938, namely in 1933, 1935, 1937 and 1938. Basically, these revisions did not affect non-residents. The fee charged to residents was based on the length of their boats over 18 feet, and the tonnage base was changed from 5 tons to 10 tons. The fee for "nets only" was the same in 1938 as in 1929, i.e., $10.

One significant change did occur in 1937 when, by act of the Legislature, individuals sport trolling for lake trout for hire were required to purchase a $10 annual license. Apparently, this license grew out of a controversy between commercial fishermen and sport trollers--the latter group taking advantage of available markets and selling their considerable sport catch. Except for more recent times, the number of sport trolling licenses issued in any one year did not exceed 116.

From the late 1890's through the 1930's, there were many interstate and international meetings of fisheries officials to seek agreement on uniform commercial fishing regulations. As indicated earlier, agreements reached at these meetings seldom were enacted into law. In 1937 Michigan enacted a law which, apparently, sought to force the issue. Act 276, briefly stated, prohibited the Director of Conservation from issuing a license to persons from any other state whose laws on fishing gear, and on size and weight of fish, did not conform to those of Michigan.

From 1929 until about 1942 the amount of commercial fishing effort remained relatively stable--averaging about 68,000 nets and 1100 vessels in

use annually. During this period there was an average of 23,000 small mesh gill nets, 40,000 large mesh gill nets, 3,300 trap nets, and 1,000 pound nets being fished in the Great Lakes each year.

The years 1929-1942 have been inappropriately designated as the "normal period" in the history of the Great Lakes commercial fisheries. It was "normal" only in the sense of sustained harvest of about 27 million pounds of fish annually. And this statistic is entirely misleading. Clearly, recorded fishing effort in terms of nets in use during this period was considerably higher than for any other similar period in the history of the fisheries; and it seems reasonable to assume that the gear was more efficient in catching fish than in earlier times. Also, the highly effective deep-water trap net was introduced into the fisheries in 1928, and there were over 3,000 of them in use by 1930. Utilization of this gear was largely responsible for the increased catch of lake trout and whitefish which was 11 million pounds in 1929 and about 13.8 million pounds in 1930. The catch of lake trout and whitefish, in spite of intensive and sustained fishing, declined from the approximately 13.8 million pounds in 1930, to 10.4 million pounds in 1935, to 6.9 million in 1940, and 7 million in 1942. The relatively high sustained production in total commercial catch was maintained through successive exploitation of alternative, lesser-value species. It is difficult, therefore, to reconcile the "normaley" of the 1929-1942 era with the historical record of the commercial fisheries.

The rapid demise of the lake trout in the early forties was due both to the depredation of the sea lamprey, and to a tremendous increase in fishing effort. The following indicate the magnitude of this effort. In 1942, the fishery employed about 43,000 large-mesh gill nets, 2800 trap nets, and a total of 70,000 for all nets. In 1943 the approximate figures were 100,000 large-mesh gill nets, about 3500 trap nets, and 130,000 for total nets! This high level of fishing effort persisted from the early 1940's until the mid-1950's, with at least 70,000 nets in use each year. Production of the principal species--lake trout, whitefish, herring, walleye and perch--declined somewhat, from 14 million pounds in 1940 to about 12 million pounds in 1955, but this relatively high production was maintained only through the introduction of highly efficient synthetic gear in the fisheries, through the exploitation of one or two relatively strong year classes of fish, and through the catching of lesser-value species.

In 1947, in 1951, and again in 1957, commercial fishing license fees were increased by legislative acts. The "nets only" and sport trolling licenses for residents were increased to $15 in 1947, and to $16 in 1951. In 1951, non-residents were required to pay $350 per year for vessels under 10 tons, and $35 per ton for vessels over 10 tons. In 1957 this license structure for non-residents was changed to what it is today: five times the amount paid by residents.

By the mid-1960's both fish stocks and commercial fisheries had nearly collapsed. Landings of the high-value species (lake trout, whitefish, perch, walleye and herring) declined from about 12 million pounds in 1955, to 10 million pounds in 1960, and to 7 million pounds in 1965.

There is an interesting comparison between the fishery of the 1960's and that of the earlier "normal" period, 1929-1942. During the 1929-1942 period when fishing effort was relatively stable, total landing of all species was about 27 million pounds annually; during 1963-1967, annual production was about 22 million pounds, for a drop of 20%. However, this small drop is misleading because the decline in production was accompanied by change of species in the catch. In the earlier, so-called "normal period," the high-value species comprised 75% of the catch, and lesser-value species--like suckers and carp--made up 17% of production; during 1963-1967 the high-value fish were down to 64% of the landings, and the lower-value species made up the remainder or 36%.

Commensurate with the biological decline of the fisheries resources, the commercial fisheries industry experienced economic stress. This was reflected in the drop in license sales, from about 900 in 1963 to around 660 by 1967. During the late 1960's, 82% of the licensees reported gross sales of less than $5000; 7% reported sales between $5000 and $10,000; and only 12% reported sales exceeding $10,000.

In 1966 Michigan's fisheries officials developed a management policy which recognized that the Great Lakes offered tremendous potential for both commercial and recreational fishing. It was concluded that any rational management program for the Great Lakes must still include, as an objective, a profitable and progressive commercial fishing industry. After nearly a century of abuse, it was obvious that unlimited harvest, open-entry participation in the fisheries, use of non-selective gear, and indirect controls regulating the fisheries--these could not continue if the fisheries resources were to be restored.

The new management plan of the 1960's for commercial fisheries was developed under legislative authority. Act 218, Public Acts of 1965, authorized the Conservation Commission to suspend, abridge, or otherwise modify the commercial fishery provisions of Act 84, Public Acts of 1929 (which had largely regulated the fishery) or such provisions in any other statute. Under Act 218, for example, a trawl fishery was authorized under permit, the gill net fishery was regulated more closely, and commercial fishing for lake trout in Lake Superior was stopped. Finally, by Act 336, Public Acts of 1968, the Legislature granted authority to the Director of the Department of Natural Resources to directly regulate the commercial fisheries. Under this further authority, steps have been taken to provide for limited entry into the fishery, to specify the kind and amount of fish that could be harvested, to designate areas and depths to be fished, and to delimit the methods and gear that could be employed. The limited entry provisions were implemented in 1970, and this reduced the number of commercial licenses to about 250. Also, that year, stringent controls were placed on the use of gill nets and, combined with effective control of the sea lamprey, enhancement of water quality, and massive plantings of lake trout and other salmonids, the task of rehabilitating the Great Lakes fisheries resources was commenced in earnest.

A HISTORY OF THE INTRODUCTION OF FISHES INTO MICHIGAN

By W. C. Latta

The establishment of the Michigan State Board of Fish Commissioners, usually called the Michigan Fish Commission, was the beginning of the extensive introductions of fish into Michigan. The Fish Commission was created by the Michigan Legislature on April 10, 1873, and Mr. George H. Jerome of Niles, Michigan, was appointed as Superintendent of Fisheries for the State. In that same year the first state fish hatchery was constructed "in the Town of Pokagon, Cass County, about two miles from Pokagon Station, on the Michigan Central Railroad" (Jerome, 1875). Although there were private hatcheries in the state, Pokagon was the first state facility. The fish cultural program in Michigan was spurred by the creation in 1871 of the United States Fish Commission and the appointment of James D. Milner to investigate the decline in the fisheries of the Great Lakes region (Baird, 1874). The fisheries philosophy of the period is well described in a letter in 1874 to Superintendent Jerome from George Clark of Alpena, one of the first three fish commissioners appointed. Mr. Clark wrote, "I would recommend the propagation of White Fish as the principal commercial food fish. There seems to be more food adapted to the White Fish than to any other variety of fish, as they feed partly by suction on the bottom of the lakes. I would commence and plant the young fry at favorable points in the lakes and rivers of this state, and in the largest and deepest of the inland lakes, and, as the black bass are a gamy fish, and seem to find food and to adapt themselves to most of our waters, they will feed on almost any kind of animal life found in or on the water, different in some respects from any other fish I know. I would plant them and some other varieties in the smaller inland lakes.

"We should continue to introduce the salmon and the shad . . .

" . . . it would be well to introduce the eels for a double purpose, for food and as a scavenger."

The introduction of fish not native to the waters of Michigan started in the 1870's and continues on today. The introduction of native fishes into waters within Michigan where they were not present is not considered here. For example, the widespread distribution of whitefish as suggested by Commissioner Clark and implemented by Superintendent Jerome is not reported. The brook trout is considered an introduction because its original range was so limited in Michigan. The names of fishes used follow the American Fisheries Society Special Publication No. 6, 1970.

Species of fish introduced

The identified species of fish introduced into Michigan through the years are listed in Table 1. In addition to the 22 species given here, two other names appear in the planting reports--the Rocky Mountain whitefish and the Swiss Lake trout--neither of which have been identified as to species. Two other species of fish present in Michigan waters because of man building canals are the sea lamprey (Petromyzon marinus Linnaeus) and the alewife (Alosa pseudoharengus (Wilson)). These fish, which have played major roles in the fisheries of Michigan, are called invaders rather than introductions. They are treated in detail in subsequent chapters.

American eel. --The eel is found in the coastal streams of North America and in the interior of United States in the Mississippi drainage. Originally it never got beyond the barrier at Niagara Falls in the Great Lakes, but with the construction of canals it is now occasionally found as far west as Lake Michigan. The adults leave fresh water and return to the Atlantic Ocean southwest of Bermuda to spawn and then die. The young slowly migrate back to fresh water.

Jerome (1879) reported that in 1877, a crew from the Michigan Fish Commission captured 243,700 American eels in the Hudson River below the dam at Troy, New York. Between June 7 and 13, 1877, a total of 265,000 eels were stocked in 22 Michigan ponds and lakes and in 11 streams. In 1878, an additional 460,000 were planted in 60 lakes and ponds and 10 rivers. The total planting in 5 additional years between 1877 and 1881 amounted to 2,211,000 eels (Holcomb, 1964).

American shad. --The shad belongs to the herring family. It is native to the Atlantic Ocean from Labrador to Florida. In the Great Lakes it is confined to the Lake Ontario basin. It has been successfully introduced into the Pacific Ocean where it ranges from southern California to southern Alaska. Adult shad enter the coastal rivers in the spring to spawn. After their first summer in the stream the young migrate downstream to the sea. The adults return to the ocean after spawning.

In June 1873, 210,000 shad fry were stocked in the Grand, Detroit, Flint, Raisin and St. Joseph rivers, and in Long Lake, Kalamazoo County. About half of the fry were obtained at Cheap Green, on the Hudson River, and the remainder at South Hadley Falls, Massachusetts. In June 1874, 50,000 shad were planted in the Shiawassee River near Corunna and on July 31, 1874 75,000 were stocked in the Detroit River at Detroit. The species apparently did not show up in the catch of fish from Michigan or in any other state of the upper Great Lakes (Holcomb, 1964).

German whitefish. -- In 1877, a shipment of 1,700 eggs of the German whitefish was received from a hatchery at Lubbinchen, in Silesia, Germany. From this 1,400 fry survived. They were planted in Gardiner Lake, Otsego County, on April 14, 1877 (Jerome, 1879). The introduction was experimental and apparently was unsuccessful.

Table 1.--Fishes introduced into Michigan from 1873 through 1972

Common name	Scientific name	Year of introduction	Successful
American eel	Anguilla rostrata (LeSueur)	1877	No
American shad	Alosa sapidissima (Wilson)	1873	No
German whitefish	Coregonus maraena (Bloch)	1877	No
Pink salmon	Oncorhynchus gorbuscha (Walbaum)	1956	Yes
Chum salmon	Oncorhynchus keta (Walbaum)	1945	No
Coho salmon	Oncorhynchus kisutch (Walbaum)	1923[a]	Yes
Kokanee	Oncorhynchus nerka (Walbaum)	1966	No
Chinook salmon	Oncorhynchus tshawytscha (Walbaum)	1873[a]	Yes
Japanese salmon	Oncorhynchus masu (Brevoort)	1929	No
Cutthroat trout	Salmo clarki Richardson	1895	No
Rainbow trout	Salmo gairdneri Richardson	1876	Yes
Atlantic salmon	Salmo salar Linnaeus	1873	No
Brown trout	Salmo trutta Linnaeus	1883	Yes
Brook trout	Salvelinus fontinalis (Mitchill)	1879	Yes
Arctic grayling	Thymallus arcticus (Pallas)	1903	No
Rainbow smelt	Osmerus mordax (Mitchill)	1906[b]	Yes
Goldfish	Carassius auratus (Linnaeus)	1878	Yes
Carp	Cyprinus carpio Linnaeus	1879	Yes
Oriental weatherfish	Misgurnus anguillicaudatus (Cantor)	1939	Yes
Marginal madtom	Noturus insignis (Richardson)	1956[c]	Yes
Mosquitofish	Gambusia affinis (Baird and Girard)	1941	Yes
Redear sunfish	Lepomis microlophus (Günther)	1947[c]	Yes

[a] Planting of coho smolts in Great Lakes from 1966 until present has created an excellent sport fishery; some natural reproduction is occurring. Likewise the plantings of chinook in 1967 have contributed to the fishery. Natural reproduction for chinook was reported in 1971.

[b] Creaser (1926) claimed smelt populations originated from 1912 planting.

[c] Year of discovery; undoubtedly entered Michigan many years prior.

Pink salmon.--The pink salmon is an extremely important commercial species of the Pacific Ocean, particularly in Asia and Alaska. In the eastern portions of the Pacific, pink salmon occur from California to Alaska. It is the least migratory salmon, spawning in the coastal streams only a few miles from the ocean. They mature, spawn and die in their second year. Spawning occurs in late September through October. Like all salmon the females fan out a saucer-shaped depression in the bottom in which the eggs are deposited and covered with gravel. After emergence from the gravel in the spring, the fry drift downstream into the sea where they spend two summers before they return to the streams to complete their life cycle (Fukano et al., 1964).

In 1956, the Ontario Department of Lands and Forests planted about 20,000 fingerlings in a tributary to Thunder Bay on Lake Superior, as reported by John W. Parsons at the 1971 Midwest Fish and Wildlife Conference. Small spawning populations were observed in Minnesota streams in 1959 and 1961 (Schumacher and Hale, 1962).

In 1971, Parsons further reported that the pink salmon, although not abundant, had completed eight generations of natural reproduction and spread throughout much of Lake Superior and into northern Lake Huron. The species has contributed little to sport or commercial fishing.

Chum salmon.--The chum is another salmon of the north Pacific. In North America it occurs from California to Alaska. The chum grows to an average size of 13 pounds, about twice as large as the average pink salmon (Ricker, 1954). The adults mature in 4 to 6 years; they spawn in the fall in streams. The young, upon emergence, migrate immediately to the ocean, as do the young pink salmon (McPhail and Lindsey, 1970).

Only one small stocking of chum salmon has been made in Michigan. On March 27, 1945, 185 chum salmon fingerlings, about 2 inches long, were planted in Deep Lake, Oakland County, along with 2,230 fingerling chinook and 775 coho salmon. Only a few chinooks were subsequently caught (Fukano et al., 1964).

Coho salmon.--The coho in the Pacific waters of North America ranges from California to Alaska. The adults mature at 3 to 4 years of age. They spawn in the fall in small streams and then die. The young emerge from the gravel in the spring and live in the streams until the following spring before descending to the ocean. After two summers or sometimes longer in the open water, they return to the parent stream to complete the cycle. Although there are records of coho eggs being received in Michigan in 1906 and 1915, they apparently did not survive to be planted (Holcomb, 1964). The 1923-24 Biennial Report of the Michigan Department of Conservation lists the planting of 341,000 "silver trout" fingerlings; presumably these could have been coho but no records of success or failure of the stocking were found. The next known planting was the 775 fingerlings placed in Deep Lake (as indicated above).

In 1966, 394,760 coho fingerlings were planted in Bear Creek and 261,000 in the Platte River, streams running into Lake Michigan; also 192,400

were released into Big Huron River which flows into Lake Superior. Growth and survival of the stocked fish were excellent particularly in Lake Michigan. Millions of coho have been stocked in the Great Lakes since 1966. A thriving sport fishery has developed (Ellefson and Jamsen, 1971). The fishery is maintained largely by annual plantings of hatchery salmon, although the coho has reproduced successfully in many streams (Peck, 1970).

Kokanee.--The kokanee, which is a landlocked form of the sockeye salmon, occurs in a few drainages along the Pacific Coast of North America. The life cycle varies from 2 to 7 years, but 4 years is most common. The average size of an adult is about 14 inches or a pound in weight. They spawn from August through January, depending upon the race of kokanee. Redds or nest depressions are made in the gravel of tributary streams or along the shore of the lake at areas of spring seepage. Adults die after spawning. Kokanee thrive in large cold-water lakes where there is an abundance of zooplankton which is their preferred food. In 1965, they were stocked in Higgins and Torch lakes, which have the cold-water environment. Higgins Lake received 717,740 fingerlings and Torch 1,122,360. Additional plantings have been made in these and other lakes but to date survival and growth have been unsatisfactory. No sport fishery has developed. Some natural reproduction may have been successful.

Chinook salmon.--The chinook is the largest of the five species of Pacific salmon. The adults average about 20 pounds in weight. They mature in 3 to 7 years, but most frequently at 4 years of age. The young upon emerging from the gravel in the spring, migrate downstream to the ocean. From 1873 to 1878, the Michigan Fish Commission received eyed chinook salmon eggs from the McCloud River, California. Plantings were made in 35 counties. In December 1873, a total of 45,200 fry were released in four streams and two lakes in southern Michigan; and in early 1874, some 28,330 chinooks were planted in two ponds and two streams in the southern part of the state (Fukano et al., 1964). Holcomb (1964) reported that at least 1,332,576 chinook were planted between 1873 and 1917. The next known planting was 2,230 fingerlings planted in Deep Lake, Oakland County, in 1945. In 1967, 33,460 salmon fry were planted in the Big Huron River which flows into Lake Superior; in addition 580,830 fry were released in the Little Manistee River and 210,560 fry in the Muskegon River, both in the Lake Michigan drainage. Growth of planted fish has been excellent, survival has been satisfactory, and a good sport fishery has developed. Some natural reproduction has been reported but the fishery is sustained by plantings. None of the plants prior to 1967 survived.

Japanese salmon.--The masu or Japanese salmon is found in the Asian waters of the North Pacific. In 1928-29, 15,000 fry of the masu were reduced by mortality in the hatchery to 200, 18-month-old fingerlings. These salmon were planted in the Boyne River, Charlevoix County. Apparently none survived (1971 correspondence in files, Institute for Fisheries Research).

Cutthroat trout.--The cutthroat trout occurs in coastal streams from northern California to Alaska, and east to the headwaters of the Missouri River.

The cutthroat may be either resident or sea-run. As a resident this species reaches a size of 8 to 12 inches and sexual maturity in 3 to 4 years. They spawn in the spring in shallow riffles of small streams. The first planting of cutthroat trout in Michigan was 8,000 fish into the waters of Newaygo County in 1895 (Anon., 1897). Michigan plantings of this species from 1895 to 1940 totaled 105,000 fish (Holcomb, 1964). Apparently, no populations were established.

Rainbow trout.--The rainbow is also native to the Pacific Ocean from southern California to southern Alaska. It ascends coastwise streams to spawn but also has resident populations. Today it is present in many of the trout waters of North America (MacCrimmon and Gots, 1972). The steelhead trout in Michigan is a rainbow trout that lives as an adult in a large lake, usually one of the Great Lakes, and returns to a stream to spawn. They spawn in the early spring over gravel bottoms in streams. The young fish, after emergence from the gravel, may spend a few months to 4 years in the stream before they return to the Great Lakes. In the open water they grow rapidly and may mature in one year. Average size of steelhead taken by anglers in the Great Lakes is 3 to 4 pounds.

Mr. Daniel C. Fitzhugh, Jr. of Bay City, is said to have brought the first rainbow trout eggs to Michigan in 1876 (Smedley, 1938). The fry were stocked in the Au Sable River. The Michigan Fish Commission first received eggs on April 14, 1880, when the Pokagon Hatchery obtained 2,000 eggs from the McCloud River, California. Of the 1,800 fish that hatched, 600 were released in the north branch of the Paw Paw River, 600 in the Boyce River and 600 were kept as brood stock. From a batch in 1884, 6,000 rainbows were planted in Beaver Creek, Ottawa County. In June 1885, 25,000 were stocked in the South Branch of the Pere Marquette River. In 1886, 210 adults from overcrowded hatchery ponds were released in the Muskegon River (Fukano et al., 1964). Since 1880, rainbow trout have been planted almost every year, although many populations in the State are self-sustaining.

Atlantic salmon.--The Atlantic salmon occurs in the north Atlantic Ocean. In North America it originally ranged from southern Greenland and Labrador south to the Hudson River and in the Lake Ontario Basin. At present the range extends south to Maine but it is extinct in Lake Ontario. The landlocked race of Atlantic salmon is found in certain cold lakes in New England and the Maritime Provinces. The Atlantic salmon spawns in streams in the fall. The young fish after emergence from the gravel in the spring remain in the stream for 2 or more years before descending to the ocean for food. They return to the spawning grounds 1 to 3 years later. Unlike the Pacific salmon they may live to spawn more than once.

In the spring of 1873, 40,000 Atlantic salmon eggs were presented to Michigan by the U.S. Fishery Commission. The eggs were hatched at the private hatchery of N. W. Clark near Clarkston. The very first introductions, consisting of 1,250 fry, were made in three lakes in Oakland County, on May 14, 1873 (Jerome, 1875). In that month a total of 21,250 fry were planted in eight inland lakes and seven streams. In 1874, some 130,000 fry were stocked. On March 6, 1875, 320,000 eggs arrived at Niles and were moved to the Pokagon Hatchery. Survival was low and the few fry that hatched were released in Dowagiac Creek which flowed by the hatchery (Jerome, 1876). These are the only records of the

Atlantic salmon in the Reports of the Michigan Fish Commission (Fukano et al., 1964).

Landlocked salmon were first planted on June 20, 1874, into Dowagiac Creek (Jerome, 1875). Records of the Michigan Fish Commission and Department of Conservation list 774,829 Atlantic and landlocked salmon planted between 1873 and 1932 (Holcomb, 1964). Neither of the two forms became established in Michigan waters.

In 1972, another attempt was made to establish the Atlantic salmon in Michigan. On May 5, 10,000 smolts were released in the Boyne River above Lake Charlevoix in the Lake Michigan drainage, and another 9,000 were stocked in the Au Sable River below Foote Dam in the Lake Huron drainage. The smolts came from Quebec's Gaspe Peninsula. Because of the earlier success in 1966-1967 with Pacific salmon, it is expected that the Atlantic salmon will survive and grow equally well. First runs of adults are expected in the fall of 1974.

Brown trout. --The brown trout which is native to Europe has been introduced in suitable habitat throughout the world (MacCrimmon and Marshall, 1963). Typically they live in coldwater streams. Adults spawn at a length of 12 to 14 inches on gravel riffles in the fall (Brynildson et al., 1963). On February 18, 1883, a lot of 5,000 eggs was received in Michigan at the Northville federal hatchery, and on April 11, 1883, 4,900 fry were planted in a branch of the Pere Marquette River (Clark, 1883). This is believed to be the first stocking of brown trout in Michigan. The first recorded planting of this species by the State Board of Fish Commissioners was made on April 11, 1885, at Coldspring Lake, Clare County, when 8,000 fry were released. Between 1885 and 1890, some 1,754,000 fry were stocked by the Fish Commission. In 1897, it discontinued the stocking of brown trout because members of the Commission believed that the brown trout was inferior to either the brook or rainbow trout. However, in February 1903, the Commission planted 90,000 brown trout fry in five creeks in Kent County. Then there was another abandonment of this species until March 1909, when regular releases were resumed (Fukano et al., 1964). Today plantings of brown trout continue in marginal habitats, although there are widespread self-sustaining populations in suitable environments.

Brook trout. --The range of the brook trout is from Labrador southward along the Appalachians to Georgia; in the interior to the Great Lakes basin and in a few northern headwaters of the upper Mississippi River system; also in southeastern Minnesota and northeastern Iowa; northward to Hudson Bay (MacCrimmon and Campbell, 1969). In Michigan, it was native to Lake Superior and tributaries and to the northern tip of the Lower Peninsula only. Brook trout attain greatest abundance in clear spring-fed streams. They spawn in the fall over gravel bottoms. Maturity is reached as yearlings at a size of about 6 inches.

The first plantings of brook trout in Michigan were made in 1873 in southern streams. A total of 11,500 fry were deposited in streams in Cass, Berrien and Kalamazoo counties from the state hatchery at Pokagon. The following year 50,400 fry were stocked in 47 localities in 14 counties (Fukano et al., 1964). The brook trout has been the fish most extensively planted in the inland waters of the state and no doubt will continue to be stocked in certain waters. Most stream populations are self-sustaining.

Arctic grayling.--The original range of the grayling in Michigan was the Otter River of the Lake Superior drainage and the streams of the Lower Peninsula from the Jordan River to the Muskegon and from the Cheboygan River to the Rifle (Hubbs and Lagler, 1947). The Michigan, Montana and Arctic grayllings are considered a single species, and place names are used here only to differentiate locality of origin. The habitat of this fish in Michigan was similar to that of the brook trout. It spawned in the spring in the main channel of streams. The causes suggested for the extermination of this species in Michigan are: (1) detrimental effects of logging on the stream environment--log driving, sawdust pollution and increased stream temperatures with the loss of bank vegetation; (2) over-harvest because they were so easily caught; (3) competition from the introduced brook and brown trout; and (4) the fact that the grayling was at the southern edge of its geographic distribution (Creaser and Creaser, 1935; Vincent, 1962). Its last stand was in the Otter River where it became extinct in the late 1910's. Grayling had received year-round protection in the State since about 1919.

Various attempts were made to extend the natural range of the Michigan grayling. On May 18, 1877, 300 grayling, caught by hook and line from the Manistee River near Grayling, were planted in three streams and one lake in the southern part of the state. In 1880, Dowagiac Creek was stocked with 50 adults, and Mill Creek, a branch of the Paw Paw River, was stocked with 32 adults. In September 1925, a tributary of the Tittabawassee River on the Gladwin State Game Refuge was planted with 100 grayling taken from the Otter River (Okkano et al., 1964).

The Montana grayling was brought into Michigan in 1903. The Michigan Fish Commission reported plantings made in 1903, 1904, 1905, 1906, 1913 and 1914. On May 15, 1914, 25,000 fish were stocked in the Otter River, Houghton County. Thousands of Montana grayling have been planted by the state but none of these have resulted in self-sustaining populations. There is little information on the results of these plantings except for gill-net records from O'Brien Lake, Alcona County and Manganese Lake, Keweenaw County, and J. W. Leonard's studies of the food habits of grayling in Ford Lake, Ottawa County. The latest attempts to reintroduce the grayling were those made at Manganese Lake in 1958 and 1959 (Okkano et al., 1964).

Rainbow smelt.--The rainbow smelt was found originally from Labrador to the vicinity of New York along the Atlantic Coast and in the basins of Lake Champlain, the St. Lawrence River and Lake Ontario. It is now established through introductions in all of the other Great Lakes and in some of the inland lakes (Okkano et al., 1964).

The Michigan State Board of Fish Commissioners obtained smelt eggs from the United States Bureau of Fisheries hatchery at Green Lake, Maine. The first eggs arrived in 1906 at the Soo Hatchery and were planted in the St. Marys River. Although the U.S. Bureau of Fisheries record the Michigan Fish Commission as receiver of large numbers of smelt eggs in 1909, 1912, 1914, 1915 and 1916, only two plantings are in the Reports of the Michigan Fish Commissioners. On April 4, 1912, 6,000,000 eggs were stocked in Torch Lake, Antrim County and on April 6, 1912, 16,400,000 eggs were placed in Crystal Lake, Benzie County.

Creaser (1926) gives good evidence to document the claim that the Crystal Lake stocking was responsible for the spread of smelt into most of the upper Great Lakes. Van Oosten (1937) recorded the spread of this fish throughout the Great Lakes. Today smelt provide recreation and food for thousands of fishermen who net them during the spawning migrations into tributaries of the Great Lakes (Fukano et al., 1964). In addition, some inland lakes now contain populations which provide good hook-and-line fishing during the winter.

Goldfish.--The goldfish was originally native to eastern Asia but widely introduced elsewhere. It was brought into Europe in the latter part of the sixteenth or early seventeenth century. It is reported that Captain Henry Robinson first brought goldfish and carp into the United States in 1831 (MacCrimmon, 1968). In June 1878, goldfish were first brought into Michigan from Troy, New York (Jerome, 1879). It did not appear again in the Michigan records until 1895 and 1896, when 306 and 487 fish were distributed to 15 and 36 applicants, respectively (Anon., 1897). In 1896, the State Fish Commission decided to discontinue raising goldfish because it was ornamental and not a food-fish. Thereafter only a few were provided to cities for ponds in parks (Anon., 1897). The goldfish is now locally abundant in Michigan. In western Lake Erie where it is particularly abundant, it hybridizes with carp. In the wild it can be found in gold and wild colors (Holcomb, 1964).

Carp.--The carp like the goldfish is native to Asia, but it has been widely introduced throughout the world. The husbandry of carp in ponds as a practical and economical means of raising food had its origin in Asia. The practice spread to Europe in the mid-14th century (Fukano et al., 1964). The carp was introduced into North America in 1831 (MacCrimmon, 1968). Carp were first planted in Michigan in 1879. Eight different applicants received a total of 40 carp. In 10 different years the State Fish Commission planted carp. The last plant was in 1921. About 30,000 carp were released from 1881 to 1921 (Holcomb, 1964). The carp did not become an accepted food fish in this country as it did in Europe. Where it is abundant, it is generally considered to be detrimental to the favored sport species and the environment.

Oriental weatherfish.--The oriental weatherfish is a native of eastern Asia. It was discovered in Michigan in 1958 (Schultz, 1960). Further collections in 1959 and 1960 indicated that the species was established in the headwaters of the Shiawassee River. Presumably the weatherfish escaped from an aquarium supply pond. The fish had been imported in 1959 from Kobe, Japan. The size range of fish collected (1.2 to 7.1 inches total length) proved that they were reproducing successfully. This represents the first successful introduction of any species of the family Cobitidae in the New World.

Margined madtom.--The margined madtom is a small catfish about 5 inches long that occurs mostly east of the Appalachian Mountains from New York to Georgia (Taylor, 1969). It was found in October 1966, in Clark Lake, Gogebic County. Clark Lake until 1966 was in private ownership as part of the Sylvania Tract. The 14,000-acre tract contains 36 lakes, many of which,

originally devoid of fish, were stocked with game species around the turn of the century (Chaly, 1970). Presumably the madtom was brought in accidentally with a game fish such as the smallmouth bass, either stocked as a forage fish or used for bait. Some of the previous Sylvania owners lived in the eastern United States where the margined madtom is a common species.

Mosquitofish.--The natural range of the mosquitofish extends from the Gulf coast of northeastern Mexico, Texas and Louisiana through the Mississippi River and its tributaries as far north as the southern parts of Illinois and Indiana (Krumholz, 1944). In June 1941, and August 1943, Krumholz (1948) planted mosquitofish in Michigan as part of a project in mosquito control. The fish came from a hardy strain established in the Chicago area. Local populations of the mosquitofish continue to exist in the Ann Arbor area of Michigan.

Redear sunfish.--The redear is a southern fish that ranges from Missouri to southern Indiana and south to Florida and Texas. It has been widely introduced in Illinois, Indiana and Ohio. Redear sunfish were first collected in Michigan on July 11, 1947. A total of 103 fish which ranged from 3.7 to 7.5 inches were caught in a 30-foot seine in Silver Lake, Branch County (Fukano et al., 1964). These fish apparently originated from plantings made by the Indiana Conservation Department in Lake George which is located in both Indiana and Michigan. The redear presumably moved into Silver Lake via a stream that connects with Lake George.

Redear sunfish have been stocked in about 11 lakes and ponds throughout the state but only one of these plantings, Crooked Lake, Washtenaw County, is known to have been successful (Patriarche, personal communication).

Conclusions

Since the late 1800's about 26 species of fishes have been introduced or have invaded the waters of Michigan (Table 2). Fifteen of these, or 58%, have been successful in that they have established self-sustaining populations (or are expanding). However, a review of the failures indicates that many of these cannot be considered as valid attempts to introduce the species in that the number of fish involved was very small or the water chosen for introduction was not appropriate. For these reasons, the American eel, German whitefish, chum salmon and Japanese salmon may be deleted from the failure list. In addition it would seem reasonable to delete the two unidentified species because of lack of information. The Atlantic salmon, although not successful in the early plants, may be successful in this latest attempt where the introduced fish were small size rather than fry and the environment appears receptive, indeed by survival of other salmonids. This leaves only four presumed failures out of 19 valid introductions or a 79% success rate.

Of the 15 species that have been successful, only 4 are considered wholly or partially detrimental to the fisheries at the present time. These

Table 2.--Number and species of fishes successfully introduced into Michigan and the failures

Successful; distribution limited	Successful; distribution widespread	Failures: no population established
Pink salmon	Rainbow trout	American eel
Oriental weatherfish	Brown trout	American shad
Margined madtom	Brook trout	German whitefish
Mosquitofish	Rainbow smelt	Chum salmon
Redear sunfish	Goldfish	Kokanee
	Carp	Japanese salmon
		Cutthroat trout
		Atlantic salmon
	Planters	Arctic grayling
	Coho salmon	
	Chinook salmon	
		Unidentified
		Rocky Mountain whitefish
	Invaders	Swiss lake trout
	Sea lamprey	
	Alewife	
Number of species 5	10	11

offenders are the goldfish, carp, sea lamprey and alewife. The rainbow, brown and brook trout, the coho and chinook salmon and the rainbow smelt are all considered to have contributed greatly to the existing fisheries. The remaining 5 species have such a limited distribution or are so few in number that they contribute little or nothing to fishing.

Introduced fish have contributed greatly to the fishing in Michigan, however, new introductions should be considered with caution because of (1) the potential for detrimental results and (2) the high success rate of introduced species.

Literature cited

Anonymous. 1897. Twelfth biennial report of the State Board of Fish Commissioners. Mich. State Bd. Fish Comm., Twelfth Biennial Rep.: 5-135.

Baird, Spencer F. 1874. Investigations in 1871 and 1872 on the Great Lakes. U.S. Comm. Fish and Fish. Rep. of Commissioner for 1872 and 1873. Pt. II: 14-16.

Brynildson, Oscar M., Vernon A. Becker, and Thomas A. Klick. 1963. Brown trout--its life history, ecology and management. Wisc. Cons. Dep., Publ. 234. 14 p.

Cady, Michael D. 1970. Regulation of fish populations in three highly exploited lakes in northern Michigan. PhD thesis. Univ. Mich., 86 p.

Clark, Frank N. 1883. XXIII. Report of operations at Northville and Alpena stations for the season of 1883-84. U.S. Comm. Fish and Fish. Rep. of Commissioners for 1883: 975-986.

Crosser, Charles W. 1926. The establishment of the Atlantic smelt in the upper waters of the Great Lakes. Pap. Mich. Acad. Sci., Arts and Lett., VI(1925): 405-424.

Crosser, Charles W., and Edwin P. Crosser. 1935. The grayling in Michigan. Pap. Mich. Acad. Sci., Arts and Lett., XX(1934): 589-608.

Ellefson, Paul V., and Gale C. Jamson. 1971. Michigan's salmon-steelhead trout fishery: an economic evaluation. The Michigan Academician. 4(2): 237-244.

Eikano, K. G., H. Gowing, M. J. Hansen, and L. N. Allison. 1964. Introduction of exotic fish into Michigan. Mich. Dep. Cons., Inst. Fish. Res. Rep. No. 1689. 50 p. (unpublished).

Holcomb, Dennis E. 1964. A history of intentional introductions of exotic fishes in Michigan. M.S. thesis, Univ. Mich., 33 p.

Hubbs, Carl L., and Karl F. Lagler. 1947. Fishes of the Great Lakes Region. Cranbrook Inst. Sci., Bull. No. 26. 186 p.

Jerome, George H. 1875. Report of the superintendent. Mich. State Bd. Fish Commissioners. Fish Rep.: 5-12

Jerome, George H. 1876. Second report of the superintendent of the Michigan State Fisheries. Mich. State Bd. Fish Commissioners, Second Rep.: 3-45.

Jerome, George H. 1879. Third biennial report of the superintendent of the Michigan State Fisheries. Mich. State Bd. Fish Commissioners, Third Biennial Rep.: 3-69.

Krumholz, Louis A. 1944. Northward acclimatization of the western mosquitofish, Gambusia affinis affinis. Copeia, 2(1944): 82-85.

Krumholz, Louis A. 1948. Reproduction in the western mosquitofish, Gambusia affinis affinis (Baird and Girard), and its use in mosquito control. Ecol. Monogr., 18: 1-43.

MacCrimmon, Hugh R. 1968. Carp in Canada. Fish. Res. Bd. Canada Bull. 165. 93 p.

MacCrimmon, Hugh R., and J. L. Marshall. 1968. World distribution of brown trout, Salmo trutta. J. Fish. Res. Bd. Canada, 25(12): 2527-2548.

MacCrimmon, Hugh R., and J. Scott Campbell. 1969. World distribution of brook trout, Salvelinus fontinalis. J. Fish. Res. Bd. Canada, 26(7): 1699-1725.

MacCrimmon, Hugh R., and Barra Lowe Gots. 1972. Rainbow trout in the Great Lakes. Ontario Ministry of Nat. Res. Sport Fish. Branch. 66 p.

McPhail, J. D., and C. C. Lindsey. 1970. Freshwater fishes of northwestern Canada and Alaska. Fish. Res. Bd. Canada Bull. 173, 381 p.

Peck, James W. 1970. Straying and reproduction of coho salmon, Oncorhynchus kisutch, planted in a Lake Superior tributary. Trans. Amer. Fish. Soc., 99(3): 591-595.

Ricker, W. E. 1954. Pacific salmon for Atlantic waters? Canadian Fish Cult., 16: 6-14.

Schultz, Edward E. 1960. Establishment and early dispersal of a loach, Misgurnus anguillicaudatus (Cantor), in Michigan. Trans. Amer. Fish Soc., 89(4): 376-377.

Schumacher, Robert E., and John G. Hale. 1962. Third generation pink salmon, Oncorhynchus gorbuscha (Walbaum), in Lake Superior. Trans. Amer. Fish. Soc., 91(4): 421-422.

Smedley, Harold Hensdill. 1938. Trout of Michigan. 40 p.

Taylor, William Ralph. 1969. A revision of the catfish genus Noturus Rafinesque with an analysis of higher groups in the Ictaluridae. Smithsonian Institution, U.S. National Mus. Bull. 282. 315 p.

Van Oosten, John. 1937. The dispersal of smelt Osmerus mordax (Mitchill), in the Great Lakes region. Trans. Amer. Fish. Soc., 66: 160-171.

Vincent, R. E. 1962. Biographical and ecological factors contributing to the decline of Arctic grayling, Thymallus arcticus Pallas, in Michigan and Montana. PhD thesis. Univ. Mich., 169 p.

THE SEA LAMPREY AND ITS CONTROL

By Robert Stauffer[1] and John H. Howell[2]

The sea lamprey (Petromyzon marinus), a native fish of the Atlantic Ocean, is found along the North American coast from the Maritime Provinces of Canada to Florida. The landlocked form in the Great Lakes is thought to be derived from these sea dwelling stocks. Lampreys and their close relatives, the hagfishes, are often referred to as living fossils. They are the only living representatives of the "jawless fishes" (cyclostomes) and their ancestry dates back 450 million years.

Lampreys are found worldwide, and about 30 species have been described. In addition to the sea lamprey, the Great Lakes contain four native species---two non-parasitic and two parasitic. The American brook lamprey (Lampetra lamottei) and the northern brook lamprey (Ichthyomyzon fossor) remain in streams during their entire life without parasitizing fish. The silver lamprey (I. unicuspis) and the chestnut lamprey (I. castaneus) are parasitic for about a year before they spawn and die. The silver lamprey was once abundant but is rarely encountered now. The chestnut lamprey generally remains in rivers, and is abundant in several.

Although the sea lamprey had direct access to Lake Ontario via the Gulf of St. Lawrence and the St. Lawrence River, the species apparently did not enter Lake Ontario by this route; reports concerning the fish and fisheries of Lake Ontario prior to the late 1800's make no mention of it. The opening of the Erie Canal in 1817 may have provided access via the Hudson River, the Finger Lakes of upstate New York, and the Oswego River. Once the sea lamprey became established in Lake Ontario, it spread to the upper Great Lakes through the Welland Canal, a waterway built in 1829 to bypass Niagara Falls and provide a navigational link between lakes Erie and Ontario. Sea lampreys were first recorded from Lake Erie in 1921. Subsequent dispersal and establishment were rapid. Spawning lampreys were observed in a tributary of Lake St. Clair in 1934 and in tributaries of lakes Huron and Michigan in 1936. The rapids and ship locks at the lower end of Lake Superior apparently hindered the lamprey invasion; the first confirmed record in Superior was an immature adult taken off Isle Royale in 1946.

At first, the sea lamprey in the Upper Great Lakes was considered as a scientific curiosity. Although several scientists warned of its ability to destroy valuable fishes, few, if any, anticipated that it would trigger such a devastating series of biological changes in the upper lakes and have such far-reaching consequences on the fishery resources. The valuable lake trout (Salvelinus namaycush) which supported a long-term average annual commercial catch of 15.5 million pounds, was reduced to only a remnant of its former abundance. The fisheries for lake whitefish (Coregonus clupeaformis), walleye (Stizostedion vitreum vitreum), burbot (Lota lota), and rainbow (steelhead) trout

---

[1] Executive secretary, Great Lakes Fishery Commission, Ann Arbor, MI 48107.

[2] Fishery biologist, Hammond Bay Biological Station, Millersburg, MI 49759.

(Salvelinus gairdneri) were also reduced to complete or relative insignificance. The ecological balance among species that existed in these lakes was upset completely. For example, one of the small coldwater species (the bloater, Coregonus hoyi), which had been a favored food of the lake trout, became very abundant as lake trout declined. Simultaneously, the alewife (Alosa pseudoharengus) entered the Upper Great Lakes. The alewife population increased tremendously because large predators were lacking and the alewife is capable of inhabiting all depths of the lake. This parvenu caused serious consequences to the entire resource base. The abundance of other species such as lake herring (Coregonus artedii), deep-water chubs (including the bloater), emerald shiners (Notropis atherinoides), and perch (Perca flavescens) was reduced. Even the plankton crop was affected by the alewife, and some of the larger zooplankters were eliminated by alewife predation. Fishery scientists and managers concluded that the best hope for restoration of the fishery resource lay in control of the sea lamprey and the establishment of populations of large predatory species, especially the lake trout.

The first serious studies on the sea lamprey in the Great Lakes were initiated by the State of Michigan in the mid-1940's on Lake Huron and one of its tributaries, the Ocqueoc River. These studies resulted in the publication of a major paper on the natural history of the sea lamprey in the Great Lakes. In 1949, when the United States Fish and Wildlife Service began research on methods to control sea lampreys, the Hammond Bay Biological Station was established on the shore of Lake Huron. This laboratory, which is still in operation, has been instrumental in developing the techniques that were eventually used in attempts to control the sea lamprey.

The magnitude of the sea lamprey control problem can be better understood if we consider the size of the area involved. The upper three Great Lakes form a truly immense body of water (one of them, Lake Superior, is the world's largest freshwater lake). They have a combined area of 65,230 square miles and a total shoreline of 7,856 miles. Their drainage area of 262,390 square miles covers a considerable part of the mid-northeast portion of the North American continent. There are thousands of tributary streams ranging in size from intermittent brooks to major rivers. The sea lamprey control problem is also complicated by divided governmental jurisdictions--the Great Lakes and their fishery resources are shared by the United States and Canada; only Lake Michigan lies entirely within the United States, and it is broadly linked with Lake Huron. Political boundaries divide the Great Lakes into areas administered by eight states and one province. But these divisions are obviously no obstacle to fish movements. The size of the lakes, their diversity, and the presence of political subdivisions not only added to the problems of sea lamprey control but emphasized the need for close national and international cooperation in solving common fishery problems. The United States and Canada both realized the compelling need to work together to control the lamprey and to revitalize the fishery in all the lakes. In 1955, the two nations established by treaty the Great Lakes Fishery Commission to formulate and coordinate research programs, to advise governments on measures to improve the fishery, and to develop and implement a program to control the sea lamprey.

Because of the urgency of controlling the sea lamprey, the Commission set forth immediately to develop and implement a program to minimize or eradicate sea lamprey populations. The Commission believed that the key to control would be found through careful study of lamprey habits and behavior. The life history, distribution, and movements of the sea lamprey during each phase of its life cycle were intensively studied during the early years. Although much information has already been obtained, these studies are continuing with the hope that control methods may be further improved.

The sea lamprey must enter streams to spawn, and often travels many miles upstream to find spawning grounds. Most spawning takes place from April to July. To spawn successfully, the lamprey requires unidirectional water flow, stream-bed formations of gravel in riffles or patches extensive enough to permit nest building, and water temperatures of 59 to 70 F during the spawning and hatching period. After eggs are released by a female, they are fertilized by a male and carried by the current into a crescent-shaped gravel ridge. The vigorous activity accompanying successive spawning acts stirs up fine sand which is swept downstream by the current, lodges in the gravel ridge, and covers the eggs. Egg counts from ovaries of spawning lampreys have ranged from 25,000 to 100,000 and averaged 61,500.

Lamprey eggs take about 20 days to develop and hatch. At the end of this period, the larvae, which are only 1/4-inch long, emerge from the nest and are swept downstream by the relatively swift currents into backwaters, eddies, or deep pools where the current is sluggish. Here they burrow into the soft bottom. Larval lampreys feed mainly on aquatic microorganisms which they filter from the water. During this larval period of life, downstream movement commonly results from floods and freshets or from willful change of habitat. Larvae may move from stream mouths into stream deltas and along some lake shores adjacent to stream mouths.

The length of the larval stage of life for the sea lamprey is not firmly established. Studies indicate that its duration is not a function of time, but is dependent primarily on nutrition and stream water temperatures, which undoubtedly influence growth rate and hence time of metamorphosis. In a controlled population where all larvae were of the same age, some lived 5 years and others up to 11 years in the larval stage. In some streams the duration of larval life of individual lampreys is known to be as short as 3 years. When transformation from the larval to adult form does take place, it begins in mid-July and continues through September. Bodily changes occur which adapt the sea lamprey for the free-swimming, parasitic phase of its life. The larval hood and sleeve are replaced by the tooth-lined sucking mouth and rasp-like tongue of the adult. Body color changes from dull brown to a bright blue-gray above and a silvery-white below. The rudimentary eyes of the larvae are replaced by the functional eyes of the adult.

After metamorphosis, lampreys leave the streams and enter the lakes. The downstream migration begins in late October and is completed by early May. It takes place throughout this period, but the greatest numbers of lampreys migrate at times of high water caused by fall rains and the spring breakup melting snow in the spring.

Once the sea lamprey enters the Great Lakes, it spends 12 to 20 months feeding on other fishes. The attachment to the host fish is made by the tooth-lined, disc-shaped mouth and is maintained by suction. The flesh of the fish is then ripped by action of the tongue until blood starts to flow. Lampreys secrete a saliva which keeps the blood from coagulating and helps to maintain and enlarge the wound. Fish may sometimes survive a single attack but multiple attacks are usually fatal.

Research demonstrated that the average lamprey held in laboratory aquariums killed 18.5 pounds of fish during the parasitic period of its life. These experimental animals, however, attained only half the weight of wild sea lampreys that spend their parasitic life in the lakes; therefore, the destruction of fish by lake-dwelling lampreys may be in the order of 35-40 pounds. When this figure is applied to spawning runs of as many as 25,000 individuals in a single Lake Huron tributary, the enormous destructive potential of the sea lamprey becomes apparent. After feeding in the lakes for about a year, lampreys begin to congregate off the mouths of spawning streams in late winter; they become sexually mature; and during the following spring they enter streams to spawn and die.

Knowledge of the sea lamprey's life history suggested that control could best be achieved by blocking spawning streams with mechanical or electrical barriers or by destroying larval populations during their prolonged stay in the streams. The Great Lakes Fishery Commission abandoned the use of barriers for control in 1958 when it became apparent that a method of destroying the larval populations with a selective chemical was proving to be far more effective. However, electrical barriers are still operated on certain streams in Lakes Superior and Huron to measure changes in lamprey abundance.

At first, controlling the sea lamprey by destroying larval populations seemed the least promising approach to the problem. However, as information on the life history of Great Lakes' lampreys accumulated, it became clear that control during the larval stage would have two major advantages: all generations of lampreys in the stream would be subject to destruction at one time, and before any reached the parasitic stage and once control was initiated, it could be maintained on a periodic basis because any new generations that became established in a stream would not become parasitic for at least 3 years. Because of these obvious advantages, the decision to attempt to destroy larval populations was made. The control of lamprey larvae is complicated by the fact that many of the streams harboring lampreys also contain valuable sport fish and may serve as spawning and nursery areas for important lake fishes. Therefore, methods to control larval lampreys must be specific for them. Among 10,000 chemicals tested since 1953, two have proven to be useful in the sea lamprey control program. One compound, which has no known use outside the lamprey control program, is 3-trifluoromethyl-4-nitrophenol--referred to as TFM.

Further testing of chemicals led to the discovery that under some treatment situations TFM could be synergized with a molluscicide, 5,2'-dichloro-4'-nitrosalicylanilide, which when added in small amounts (3% by

weight) doubles the toxicity of TFM without reducing its selectivity. This molluscicide also has been used in surveys for lampreys in deep water areas. Sand granules coated with the synergist are spread over the surface and sink to the bottom where the chemical coating slowly dissolves. Lampreys, irritated by the chemical, emerge from their burrows in 15 to 30 minutes and can be collected easily.

The treatment of streams to destroy populations of lamprey larvae requires considerable preparation. First a survey is made with portable electric shocking equipment or the molluscicide which causes the ammocoetes hidden in the mud to emerge. These are collected and identified, for it is necessary to distinguish the larvae sea lamprey from those of the native species of lampreys usually present. This survey provides information on the distribution of sea lampreys within the stream system, and delineates those areas that must be treated to ensure destruction of all the sea lamprey larvae.

Tests are next conducted to determine the amount of TFM that must be applied to obtain a proper concentration throughout the stream being treated. These tests are necessary because changes in water chemistry modify the action of TFM. It is not unusual for the required concentration to vary widely in neighboring streams or even in the same stream during the treatment, or from season to season. A mobile laboratory (housed in a trailer) is set up near the stream to be treated. Sea lamprey larvae and small fish of other species (often rainbow trout) are placed in jars filled with water from the stream, and varying amounts of TFM are added to expose the animals to a wide range of concentrations. In this way the lowest concentration required to kill lampreys and the highest concentration tolerated by fish are determined. A suitable concentration between these limits is used during the actual treatment.

The next step in preparing for a treatment is the measurement of the volume of water. Once stream flow has been measured and the correct concentration determined, it is possible to figure the rate of TFM application necessary to give any desired concentration.

The lampricide is introduced into the stream by a pump which accurately delivers the required amount through a perforated plastic hose over a period of 8 to 18 hours. In small streams, a constant head, drip-type applicator may be used. For larger streams, pumps of different types that vary from small electric pumps to large precision proportioning devices, such as those used in the chemical industry, are employed. As the treated water moves downstream, periodic samples are taken and analyzed to determine the amount of TFM present. This analysis is based on the yellow color produced by TFM--the color of samples of treated stream water is compared with the color of known standards. During an application, continuous observations are made on the effect of the chemical on lamprey larvae and other stream organisms. Soon after the treated water passes through a section of stream, considerable numbers of larvae may be seen emerging from the bottom and swimming erratically. Within a short period, they die. Samples of dead and dying larvae are collected and preserved to determine the relative percentage of sea lamprey larvae and native lamprey larvae in each stream. The final step in all treatments is a post-treatment survey to learn if

[illegible] ACTIVATING AN [illegible]
[illegible] GARDNER, IRON RIVER, [illegible]

DR. V. C. APPLEGATE, PIONEER IN DEVELOPING LAMPREY-CONTROL METHODS, 1958.

significant numbers of sea lamprey larvae have survived. This post-treatment survey is similar to the survey described earlier that precedes each treatment.

More than a decade of experience with TFM has confirmed its efficacy as a selective toxicant for larval lampreys. Stream treatments result in almost complete kills of sea lamprey larvae and the larvae of native species. By judicious timing of treatments, kills of sensitive fishes such as fall spawning brown trout (Salmo trutta) and spring spawning white suckers (Catostomus commersoni) are avoided. A few fish other than lamprey are killed in almost every treatment, but measurements of fish populations after treatments usually indicate that these kills are insignificant.

The effect of toxic substances on invertebrates, such as snails, leeches, crayfish, and insects, is extremely difficult to evaluate under field conditions. Studies with sea lamprey larvicides have indicated, however, that concentrations used in stream treatments are generally nontoxic to other animals. Collections made before and after treatments revealed that most invertebrates had not been affected. Those few species that had been reduced returned to pre-treatment levels of abundance within one year.

Safety tests with TFM have been conducted on rats, rabbits, dogs, mice, whitetail deer, hamsters, and mallard ducks. Acute and chronic toxicities were found negative when the animals were exposed to concentrations comparable with those ordinarily present in stream waters during treatments.

Of the 3,000 tributaries entering the Great Lakes, 371 have been found to contain sea lamprey larvae: 121 in Lake Superior, 109 in Lake Michigan, 85 in Lake Huron, 43 in Lake Ontario, and 12 in Lake Erie (where surveys have not been completed).

Federal fishery agencies (currently the U.S. Bureau of Sport Fisheries and Wildlife and the Canadian Department of the Environment) under contract with the Great Lakes Fishery Commission began chemical treatment of streams tributary to Lake Superior in 1958. The treatment program was extended to Lake Michigan and Huron in 1960, but was suspended in the latter lake when it became apparent that funds would not be available to establish control on those two lakes simultaneously while maintaining control on Lake Superior. With provision of additional funds, the program was reactivated on Lake Huron in 1966 and extended to Lake Ontario in 1971.

The first indication of the effectiveness of the control program was the reduction in lamprey wounding of lake trout, lake whitefish, and steelhead trout in Lake Superior in 1961, three years after all of the main lamprey-producing streams had been treated. In the following spring (1962) the catch of spawning lampreys at electrical assessment barriers fell to one-fifth of the average catch of the preceding five years. By the end of the second round of treatments in 1969, the catch of lampreys dropped to one-tenth of the pre-control level. Comparable figures are not available on Lake Michigan because assessment barriers have not been operated in that lake, but there is ample indirect evidence that reduction in sea lamprey abundance has been equally dramatic. Similar

Adult sea lamprey, dead after spawning

Young sea lamprey, feeding on a splake

Surveying for ammocoetes, with backpack shocker, St. Marys R.

(Photos courtesy of Sea Lamprey Control Center, Sault Ste. Marie, Ont.)

trends are also appearing in Lake Huron and are expected to occur soon in Lake Ontario where the first round of treatments was completed in 1972.

The degree of control achieved thus far in lakes Superior and Michigan has made it possible to begin the rehabilitation of stocks of lake trout, lake whitefish, and steelhead trout, and to introduce successfully the valuable Pacific salmon. As the sea lamprey yields to control in these lakes, planted lake trout, salmon, and other species have exhibited excellent growth and high rates of survival. Stocks of immature lake trout (17 to 24 inches in length) have been restored to pre-lamprey abundance. Older mature trout are becoming more abundant and spawning has resumed, although survival to sexual maturity has not been sufficient yet for natural reproduction to make significant contributions to the population. In Lake Michigan, total returns from annual plantings of coho salmon (Oncorhynchus kisutch) have ranged from 19 to 32%--spectacular survival by any standards. Substantial increases have also been noted in the abundance of lake whitefish and steelhead trout. Commercial production of lake whitefish in Lake Michigan, which fell to an all-time low of 25,000 pounds in 1957, increased to 2.9 million pounds in 1971. The number of steelhead trout counted at the Little Manistee River weir during spawning runs increased from 17 fish in 1957 to 7,300 in 1971.

The benefits realized through sea lamprey control have been great, but the ultimate success of the program must be judged on its ability to hold losses from lampreys at levels that permit lake trout, lake whitefish, and steelhead trout to maintain themselves through natural reproduction and provide viable sport and commercial fisheries. An important by-product of sea lamprey control should be the control of the alewife populations by lake trout, coho salmon, and steelhead trout, and that control may prove to be the pivotal point in the restoration of the ecological balance in the lakes.

Optimism thus far generated by the success of the sea lamprey control program should be tempered by the fact that careful study of the sea lamprey must continue, so that control methods can be modified to compensate for changes in the habits of the parasite. The extensive research and planning that led to the development of a control method must be continued if the method is to be kept fully effective.

Electrical assessment barrier, Brule River, Wisc.

Chemical feeder applying TFM, Brevort River, Mich.

Mobile bioassay laboratory, to test larvicide

(Photos courtesy of U.S. Bur. Sport Fish. and Wildlife, Marquette, Mich.)

A HISTORY OF FISH CULTURE IN MICHIGAN

by Harry Westers and Thomas M. Stauffer

It was about in the mid 1860's that fish culture finally started in North America, with such pioneers as Dr. Theodatus Garlick and Prof. H. A. Ackley, of Cleveland, Ohio, Dr. D. W. Chapman and Seth Green of New York, and finally N. S. Clark in Michigan. Mr. Clark, in 1867, started a brook trout hatchery of his own at Clarkston, in Oakland County. In 1874 he established another hatchery at Northville which was operated later for the U.S. Fish Commission by his son Frank N. Clark (1880). In the meantime (1873) the Michigan Fish Commission was established, with three board members: Governor John H. Bagley, George Clark (a commercial fisherman from Ecorse) and George H. Jerome of Niles. Mr. Jerome was a colorful personality who was encouraged shortly to accept the position of Superintendent and thus became Michigan's first Chief of Fisheries. Governor Bagley appointed Andrew J. Kellogg of Allegan as replacement for Jerome on the Board.

It is interesting to get some feeling of the early thoughts and visions regarding fish culture. Fish culture, when the Fish Commission was established, was a totally new endeavor in Michigan. If it had not been for a few farsighted men of faith, Act 124, creating the Michigan Fish Commission Board, would not have happened. Almost universal apathy prevailed. In 1877 the Board reflected back upon 1873 and said: "The law of that year, creating a Board of Fish Commissioners, was born in unfaith. Legislator said to legislator, and neighbor to neighbor, what possible good is to come of it? What! Can you rob (yes that was the word in frequent use) the fish of their spawn- fecundate them, and take them away from their native waters to your homes, and shops, and factories, and there hatch and rear them artificially?"

Three basic questions were asked and answered by George Jerome in the very first biennial report: (1) Can waters abounding with fish be depleted by excessive fishing? (2) If so, can they be restored by reasonable effort? And (3) is fish culture the answer? He answered the three questions affirmatively. Of fish culture he said that, as it is now understood and practiced, it can assure an increased food production. Of this there can no longer exist a remaining doubt.

Three years later Jerome wrote: "Here and there, too, we have encountered a wry physiognomy, and witnessed a hitch and a shrug of the muscles at the base of the neck, because everything has not been an absolute an hundred percent--success. Well, does the land farmer each season get his forty bushels of wheat, or his hundred bushels of corn, or his three tons of hay per acre?...As with our dry brother, so even is it with the wet....Natural physical laws are never lax in his business, shaping or balking each earnestly sought-for result...." In the biennial report of 1884-1886 we can read further about some need to either restore faith in fish culture or reassure the people of its justification for existence. "The demonstration of what fish culture can do for the State is not generally understood. There are sufficient reasons why it has not yet been able to make a complete demonstration of what it can ultimately do by accomplishing all the results that some of its enthusiastic friends have looked for. To satisfy any reasonable man that fish culture can again restore our fisheries and fill the Great Lakes with marketable fish, it is not necessary that that fact should be actually done. If it is possible to restore the fisheries at two or three

average places, there is no reason to doubt that when carried on upon a sufficient scale, it will be able to work the same beneficial results, at least for all waters similarly situated. In the sense that a complete demonstration can only be made by accomplishing the whole result sought, fish culture has not yet had a fair chance." An additional, significant comment is made when it is further stated that: "Artificial propagation alone cannot accomplish the result. Neither can legal regulation do it alone, within a period that will avail anything for one generation, and possibly not even then. The two things are mutually dependent conditions. They must concur to assure valuable and lasting success."

In 1898, John H. Bissell, one of the Fish Commissioners wrote that fish culture has passed from the purely experimental stage, and that its definitely ascertained results, which are now unquestioned, fully warrant the recognition it receives from the States and the United States. Shortly after the turn of the century fish culture entered an era of considerable popularity and few questioned the value of such enterprise. Much support came from the commercial fishermen who continued to resist any type of regulation upon their activities. We can read in the sixteenth biennial report which covers 1902-1904, "In short, the work of artificial propagation of food fishes is now a demonstrated success. It has spread all over the United States and beyond a doubt will be carried on for all time, because its benefits to the people have become so apparent to all who take the trouble to inquire into the matter."

The first fish management act of the first Fisheries Commission was to distribute over 20,000 fry of the Atlantic salmon which were incubated and hatched at the private hatchery of N. W. Clark, near Clarkston. The eggs of these Atlantic salmon were presented to the State in 1873 through Prof. Baird of the U.S. Fisheries Commission. Their origin was Maine. The fry were distributed over 15 locations; 3,300 were put in the Au Sable River on May 30, 1873.

Obviously Michigan needed its own hatchery, and in 1875 $1200 was appropriated to build a hatching house and ponds at Pokagon, near Niles in Cass County. This first State fish hatchery, named Crystal Springs, was built on a spring water supply of 300 gallons per minute, on property belonging to the Methodist Church. In March of 1874, a shipment of 180,000 Atlantic salmon eggs was received at Pokagon from Bucksport, Maine. The fry were stocked in May, as far away as the Sault Ste. Marie Shipping Canal.

The first efforts of the Michigan Fish Commission were directed at "exotics". Salmon from both the East and the West were brought into the State during the early years. In 1874, 750,000 king salmon eggs were shipped to Pokagon from California. The long journey was a disaster to about 150,000 of these eggs; however, 600,000 good eggs constituted a remarkably significant number, especially in these days.

We must remember that the Commission was established to promote the cultivation of food fishes rather than sport or recreational fish. The only species of fish mentioned in Act 124 of 1873 was the whitefish, as seen in the following quote: "for the propagation and cultivation of whitefish and such other kind of the better class of food fishes as they may direct".

The salmon were brought to Michigan in order to add to the potential food fish resources, and at the same time the propagation of whitefish was undertaken. Along with the large lot of king salmon eggs, 200,000 whitefish eggs were incubated in 1874 at Pokagon. The introduction of Atlantic and Pacific salmon required space, so that in 1875 it was proposed to build a separate hatchery for

whitefish in Detroit. For less than $700 a building 20' x 50' was erected on Atwater Street in Detroit, and in 1876 ten million whitefish eggs were incubated there.

Mr. George Jerome searched for an experienced fish culturist. He traveled to New York in 1875 to see Mr. Seth Green about hiring one of his employees to run the new Detroit Whitefish Hatchery. Mr. Green introduced his work force to Jerome and told him to "take his pick." Jerome, "with seemingly prophetic judgment" selected Oren M. Chase, which prompted Seth Green to make the significant remark that "he would rather he had taken any other one in the lot".

The culture of whitefish became the greatest work during these early years. Mr. Chase was highly successful and accomplished many advances in the art of fish culture. His greatest contribution, while employed by the Board, was most likely the development in 1879 of the "Chase automatic hatching jar". Before this new jar came into existence, whitefish eggs were incubated and hatched on screen or cloth. Great effort was needed to keep the eggs free of silt and fungus. The Chase jar reduced the manpower requirement by a factor of 75 to 1, or rather increased the capability to hatch eggs from one million to 75 million without increasing the manpower demand. In 1880, six of the Chase jars were sent to the International Exhibition in Berlin, for which Chase received the "golden medal of honor". Even today, this method of incubation is still used extensively, particularly for the eggs of various warmwater species. Glass has been replaced by clear plastic, but the principle of this incubator is unchanged!

Whitefish production steadily increased, and in 1883 a new hatchery was built in Detroit at the corner of Lafayette and Jos. Campau Avenue. A hatchery building of 40' x 80' was constructed, along with a 50' x 40' barn. That same year a whitefish hatchery was started in Petoskey. It was the original intent to put one at Sault Ste. Marie, since the distribution of fry became a big problem. However, the proposed site at Sault Ste. Marie was on Federal property and Congressional action was needed to secure it for a hatchery.

In the meantime, the village of Petoskey offered a site and the Commission went ahead to locate the second whitefish hatchery there. The geographical location was advantageous as well as the fact that there were whitefish spawning grounds in Little Traverse Bay. The Commission soon realized that it had made a fateful decision to build the hatchery there. In the fall of 1883, when attempts were made to ready the hatchery for the upcoming whitefish spawning season, serious difficulties were encountered. The source of water was the village of Petoskey water supply. The extended 1½ inch line from the 8-inch main in Lake Street delivered insufficient flow to the hatchery. Mr. Armstrong, who was appointed the overseer of this hatchery, telegraphed Mr. Chase who immediately came to Petoskey. Considerable effort was exerted to remedy the problem but they were unsuccessful.

In the meantime, crates at the mouth of Bear Creek were filled with mature whitefish from the spawning grounds near Harbor Springs, where commercial fishermen were netting. Mr. Chase decided to sail across the Bay to notify the commercial fishermen of the problems at Petoskey, and he, Messrs. Armstrong and Brownell, his assistant, sailed across with the boat of a Mr. Detweiler, who operated it with his two sons and a grandson. This was on Sunday morning of November 11. A great storm started that morning and was in full force in the afternoon, when Mr. Chase wanted to sail back to Petoskey to catch the train to

Detroit. The captain had some hesitancy about sailing in this weather but was persuaded by Chase to go anyway. The boat capsized in the Bay and all on board were drowned. Only the body of the elderly Detweiler was recovered.

The loss of Mr. Chase was a heavy blow to the work force of the Fish Commission. It took 2 years before the water supply problem was solved for Petoskey. Whitefish production increased to some 40 million at Detroit and 30 million at Petoskey around 1885.

In the meantime, problems with water quality and quantity occurred at the Pokagon Hatchery and in 1881 a search was made for a new hatchery site. Paris in Mecosta County was chosen. It had good railroad connections and had an "abundant" water supply. The railroads played an important function in the transportation of the fry. Without them, distribution would have been impossible. The Paris Hatchery was built in 1881 with an appropriation of $5,000. It had a fry capacity of one million trout or salmon.

Pokagon had continued its role of a trout and salmon hatchery. Brook trout were first hatched in 1879, a total of 12,000 fry, which were all planted in streams of southwestern Michigan. These functions were taken over by the new hatchery at Paris, which was to become one of the show places of the State hatcheries.

The brook trout quickly became one of the most important fish for inland stocking. Success was remarkable, and streams in virtually all the southern counties were stocked with this fish which had been considered non-native to Michigan until the mid 1870's. In the first biennial report of the Fish Commission it is written of the brook trout, "Until attention was called to the general subject of fish propagation, it was currently reported that the genuine Salmo fontinalis had no domicilium in the State. But later investigations verify the fact that he not only exists here, and that, too, in many portions of the State, but that he is here in all the inimitable investiture of his prime and glory."

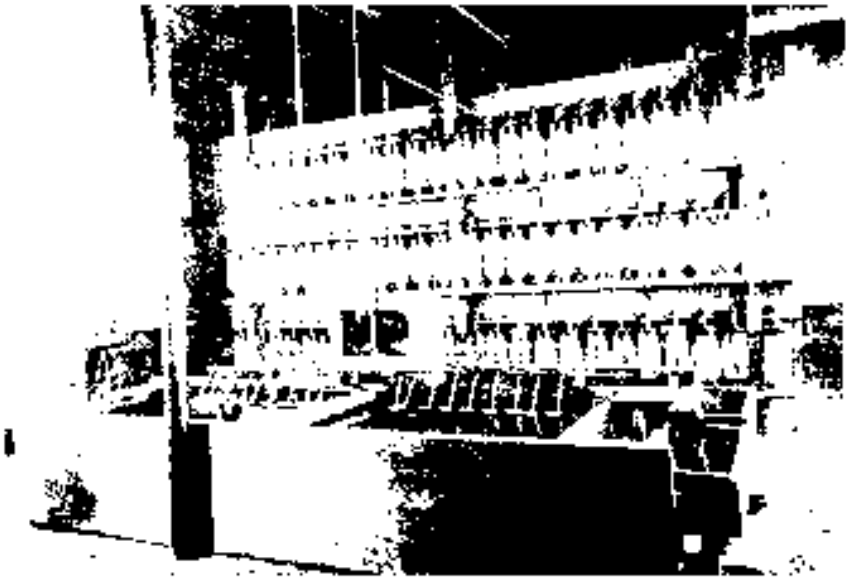
The Detroit hatchery around 1890 increased its capacity to 100 million whitefish eggs and was used in the spring to incubate up to 350 million walleye eggs. Some close calls caused by breakdowns of the water supply resulted in the installation of a standby, steam operated pump, capable of delivering 10" gpm. Steam pressure had to be kept up uninterruptedly and even then it took 15 minutes to get the pump going. This was later reduced to a mere five minutes!

At Paris a new hatching house was built around 1888. This station was the pride of the local citizenry, and the entire legislative body paid it a visit in 1886.

In 1888 the Petoskey station was closed. All jars were transferred to Detroit. The well water at Petoskey was too warm, resulting in fry at the planting stage before the ice was gone from the lakes. Since the Detroit Station could absorb readily the production of Petoskey, it was decided to centralize whitefish production here. However, it was also decided to establish the proposed whitefish station at Sault Ste. Marie, and soon it was equipped to handle 50 million whitefish eggs and 500,000 brook trout fry. The station was built where No. 4 lock is now located. It soon became a modern station, with output increased to 8" million (500-jar battery). Other progress was a whitefish station at Charlevoix with a capacity of 30 to 40 million eggs and a bass station at Cascade Springs in Kent County. All these expansions were accomplished in the early 1890's.

WHITEFISH HATCHERY NO. 1
1888
Located at corner of Lafayette and Joseph Campau, Detroit

EARLY FISH COMMISSION DAYS
WATCHING CREW STRIPPING
WHITEFISH--DETROIT NO. 1
FISH HATCHERY
from
9th Biennial Report 1890



CHASE FISH EGG HATCHING JARS
The Chase Automatic Hatching Jar, developed by Oren M. Chase in 1879, received the "golden medal of honor" in 1880 at the International Exhibition, Berlin.

Brook trout

Planting brook trout throughout Michigan became quickly successful. They were popular because of high nutritional value which would vary the monotony of food products, because they provided a healthful sport, and because they attracted tourists and provided an economic boost to the State. By 1892, brook trout had been planted in all except six counties of the Lower Peninsula and in three counties of the Upper Peninsula. Some persons believed that the brook trout might compete with the grayling, so the policy was adopted to avoid stocking it in the major grayling rivers. That the brook trout gave impetus and support to fish culture as a whole can be understood from the following quotes about its culture: "There is such a wide field still uncultivated that only needs clear seeing eyes and brains to yield results of untold beauty." (Biennial report 1888-1890)...and..."A better object lesson of the success of the artificial propagation and planting of brook trout is not presented anywhere in any country than in Michigan." (Biennial report 1894-1896). In 1893 the production level was up to nearly three million fry.

Rainbow trout

In 1880, the Fish Commission obtained rainbow trout eggs from California which were hatched at Pokagon. However, these were not the first "California trout" in this state. A private individual, Daniel C. Fitzhugh of Bay City, placed fry in the Au Sable River in 1876. Several years later Frank N. Clark at Northville, obtained 125 yearling rainbows of the McLoud River strain from a private hatchery in San Francisco; fry from their eggs were also stocked in the Au Sable.

Rainbow trout received at Pokagon were also of the McLoud River variety. Fry from here went into the Paw Paw and Boyne Rivers. Pokagon and Paris hatcheries continued to produce rainbow fry. In 1884, the Pere Marquette received 25,000. Rainbow trout broodstock was maintained at Paris. The production of rainbows continued at a modest level. In 1903, 702,000 fry were stocked and distributed over about 50 counties. These fish were now making some impact in the State. The biennial report of 1903-1904 states: "Rainbow trout have come to the front more rapidly in this state, in proportion to the number distributed, than any kind of fish propagated by this board." In 1907, the record steelhead weighed 16 pounds and was caught in the St. Mary's River. However, there was some opposition to stocking them in brook trout waters. In 1914, the stocking level had gone up to nearly five million fry and 3,200 fingerlings.

Grayling

The Michigan Grayling, unique to Michigan, made famous the Au Sable, Manistee, Muskegon, Boardman, and Pine Rivers. In the Upper Peninsula, it occurred in only the Otter River in Houghton County. The First Fish Commission soon recognized its perilous position, and numerous attempts were made to propagate this beautiful fish--but without success. Special broodstock ponds were constructed at Paris, but expeditions to the Manistee River to collect broodstock fish were in vain. Some optimism, expressed in 1892, that the grayling might "hold out" in feeder streams, and thereby outlast the log drives and deforestation, was ill founded. By about 1935, the grayling had completely vanished from Lower Peninsula streams, although it "hung on" in the Otter River until 1955. In 1925, 130 fish were collected from the Otter River and transferred to the Cedar River in Gladwin County and to the hatchery at Grayling, but this effort did not save the species.

Brown trout

Introduction of the brown trout followed that of the rainbow trout in 1883, when fry were planted in 1881 in the Pere Marquette River. Brown trout eggs were subsequently imported from Scotland and Germany. From 1881 to 1896, relatively large numbers were stocked and distributed widely. The Au Sable River received its first plant of 25,000 in 1891. By the end of 1896, a total of 1,747,000 brown had been planted. Then came an evaluation after some success had been attained, and the Commission gave the following appraisal of the brown trout as: "inferior in every respect to either the brook or the rainbow, with few exceptions. This verdict is in harmony with the verdict of the anglers and epicures everywhere. The stock of adult brown trout has therefore been turned adrift and no further distribution will be made." Not until 13 years later was the interest in the brown trout revived and planting resumed.

Commercial Fishing

The Fish Commission was established to propagate whitefish and other valuable food fishes. The original thrust was on commercial fishing. Throughout the early decades we encounter in the biennial reports the plea for regulations which were invariably opposed by the commercial fisherman. In 1855 the State's Gazetteer of Michigan reported the following concerning the fish resources of Michigan: "Their quantities are surprising and apparently so inexhaustible as to warrant the belief that were a population of millions to inhabit the lake shores, they would furnish ample supplies of this article of food without sensible diminution." But in 1871 this account was given of the whitefish: "Formerly as many as 8,000 fish have been taken at a single haul of a seine. At present (1871) 1,000 is considered a big haul." This was the fishing at Detroit which by 1885 produced less than 2,000 fish for an entire season! During that time as reported in the seventh biennial report of 1885, "the fishing in the St. Clair River is practically a thing of the past."

George Clark, a commercial fisherman from Genoa and a member of the first board of Fish Commissioners, wrote to George Genaw, the State Superintendent of Fisheries: "In the Detroit River, about a mile below Woodward Avenue, in the month of May, 1820, and a number of years after, S. Elliot caught and packed five hundred barrels yearly of walleyed pickerel, besides what were used and sold fresh." Most of the fishing was done by the French, with canoes and small nets. In 1858, George Clark recalls: "I remember at one haul I caught whitefish that weighed from one fourth of a pound to fifteen pounds, and from this haul (single haul) I picked out whitefish enough that weighed two pounds and upwards to make twenty odd barrels." Now in 1875, expressing his concern he says: "It is thought, by the best judges, they are not catching twenty five percent of what they were catching a few years ago.

Despite vigorous efforts by the Michigan Fish Commission to replenish the depleted supplies of whitefish, the declines continued rather rapidly. To counteract the reduced catches, better and more commercial gear was constantly employed and the exploitation became even more intensified. By 1890 the Commission finally succeeded in employing a so-called statistical agent in a first attempt to obtain some kind of catch records. In 1891 the Detroit Free Press published an article with the following heading: "Lake Erie overfished. Sandusky fishermen are going North for the supplies."

In another paper, the Fishing Gazette, we can read in the April 5 issue of 1891: "The cause of the great decrease lies in the systematic efforts of the

fishermen to get the greatest amount of fish possible. The pound netters, with their inside nets, catch great numbers of small fry not large enough for food, and in Sandusky alone a year ago, thousands of tons of these small fish were ground up for fertilizers, and then, what the pound netters leave, the gill netters take."

A sense of futility is noticed when we read in the biennial report of 1892-94: "It is expected that the Fish Commission will restock the Great Lakes and maintain profitable fishing, and yet the fisherman prosecutes his work of destruction without let or hindrance, in season and out of season, with all manner of devices of the most destructive character, and the wholesale slaughter of the young fish which are too young to have yet spawned, still goes on. The task thus set for us is too great to be accomplished without the assistance of natural conditions to aid us. Not only are the young whitefish taken which have been hatched naturally, but those put into the water by the Commission are also captured before they have come to spawning age, and thus are the efforts of nature and the ingenuity of man both overcome."

A rather cart statement made by the Commission in 1894 sums up rather well their feelings regarding over-exploitation by commercial fishermen: "The history of commercial fishing in the Great Lakes for the past twenty-five years is the history of an abuse." Despite repeated attempts to provide for certain restricted regulations and a license fee for fishing commercially, action was too slow in coming, and in the year of 1897, all cultural activities relating to commercial fishing were suspended and the Detroit whitefish hatchery was closed. However this attitude was of short duration. Shortly after the turn of the century, the U.S. Fisheries Commission took over the Detroit hatchery and the propagation of commercial species, including the whitefish. In addition, each spring the Michigan Commission used the Detroit facility for production of walleyes. Thus, after the turn of the century, fish culture again became quite popular. Optimism prevailed and in 1910 we can read: "This board is fully of the belief that it need not be long before every inland lake and stream can be made to produce food in quantities sufficient to meet all reasonable demands for it." As we notice, the emphasis was upon the food value, but now to be produced in the inland lakes and the streams. That the Board had become quite disenchanted with the Great Lakes program we have just noted, but no doubt under pressure from commercial fishing enterprises, stocking of the Great Lakes was continued.

Inland fisheries

By 1910, there was more interest in inland waters, and we will see the development of the hatchery system to meet those demands as much as possible. The railroads, near the end of the nineteenth century, rapidly opened up new territory yearly and it was considered important to stock new streams as an aid in developing wilderness areas. By 1890 the brook trout had been stocked in 50 counties and 100 streams. The policy was adopted that private waters will no longer be stocked, and the applications for fish would be better scrutinized. The fish car "Attikamaig" traveled over 21,000 miles in 1893 and although it was providing very good service, the heavy demands on it required much maintenance due to excessive wear and tear. It was felt that the car was underdesigned for its herculean task, and requests to the legislators were made from year to year to provide the funds for a new unit. About 1911 the car was derailed near Traverse City, and it rolled down an embankment. It was badly damaged, and its load of fish was lost. It was once more rebuilt and the name was changed to "Fontinalis" in honor of the brook trout. The basic structure of the car remained the same and yearly requests for a new car continued to be submitted.

In final desperation the Commission wrote that hardly a stitch of the original material was left on the fish car, and not only that, but even the name had been changed. Finally, in 1914 the "Fontinalis" went permanently out of commission and was dismantled. Since no funds were available for another car, a baggage car was rented for stocking. The next season a used Pullman sleeper was purchased for $1600 and rebuilt to specifications of the Fish Commission. The total cost was less than $4000. It was named the "Wolverine" and had a capacity to handle about 200 cans and 9 people.

The Hatcheries

Around the turn of the century the following six fish cultural units were operated by the board:

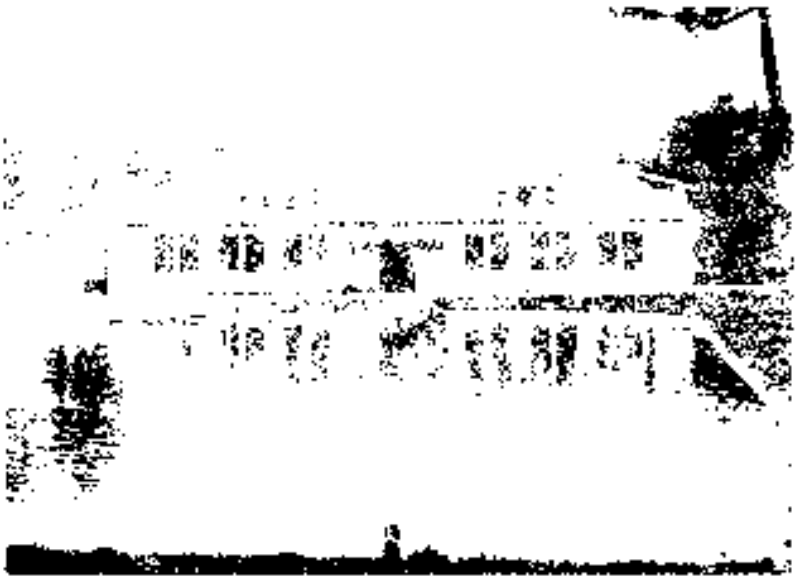
1. Detroit for walleye.
2. Drayton Plains for bass.
3. Mill Creek near Grand Rapids for bass and walleyes.
4. Paris for trout.
5. Harrietta for trout broodstock.
6. Sault Ste. Marie for whitefish.

The annual expenditure was $55,000. By now brook trout had been released into 1300 different streams! The demand for fish was considerably greater than the supply, and in 1908 the Commission recommended that a large hatchery be built in the Upper Peninsula.

The appropriations to the Board were not at all commensurate with the optimism reflected by the Fish Commission. To have the users of the resource pay their fair share, a rod license was recommended but was not accepted until about 1913, and then for non-residents only. The cost was $5.00 for trout and $1.00 for non-trout. The revenue received the first year was $20,000. Immediately the Commission repeated their recommendation for a license for residents as well, but it was not accepted. About this time the Commission showed a renewed interest in the propagation of commercial species, especially whitefish, lake trout and wall eye. A hatchery was recommended for the Saginaw Bay area.

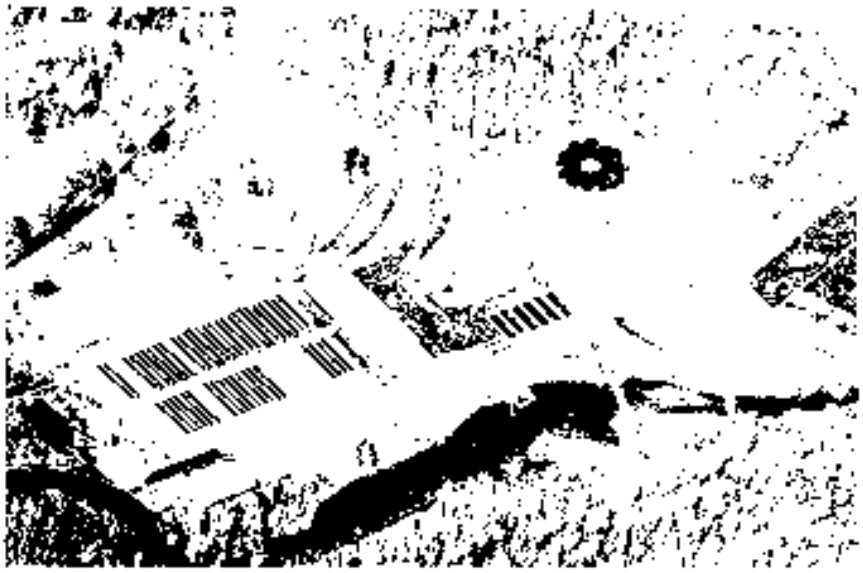
When the Department of Conservation was established in 1921, the State had ten fish hatcheries and five additional ones under construction. Yet more were to come, at least if the recommendations of the Fish Division were to be followed. They wrote: "We cannot stop here, additional hatcheries will have to be erected throughout every section of Michigan within the coming years."

No longer was the Department in favor of introducing into Michigan waters any more foreign game or food fish. However, those were the years of statewide transfers of smallmouth bass and perch from the Great Lakes to numerous inland lakes. Millions of young were transplanted. The hatchery programs continued their heyday, and by 1930 there were some 15 hatcheries, 13 rearing stations and 23 rearing ponds. Most of the hatcheries were built around 1920. Research (the Institute for Fisheries Research was established in 1930) studied the returns from fish stockings, and proposed a fingerling trout program. This resulted in complications with transportation. The small 10-gallon cans could support relatively few fingerlings, and railroad services were curtailed. Thus out of necessity fish transport units were designed. The first such unit was a 600 gallon capacity unit with a circulating system induced by a small engine. The "Wolverine" was removed from service in 1935. It had traveled an average of 25,000 miles per year from 1914 to 1935.



HARRIETTA TROUT HATCHERY
ESTABLISHED IN 1901
REARING HOUSE AND POND IN THE
1920'S

PARIS TROUT HATCHERY
ESTABLISHED IN 1881
NEW BUILDING, ABOUT 1886



PLATTE RIVER HATCHERY
(FOR SALMONIDS)
INITIAL CONSTRUCTION IN 1967.
PRODUCTION CAPACITY: ABOUT
400,000 LBS. OF FISH, OR 4
MILLION FINGERLINGS PLUS 5
MILLION YEARLINGS.

Many hatcheries were re-built, improved and expanded by the CCC during the early 30's.

The hatching and stocking of fish has always been a major activity in our fish management. Thus, in spite of some duplication within our paper, and some repetition with a preceding report by F. A. Westerman, we here recapitulate the 100-year fish cultural effort. At first the program was to plant fry; later this was stepped up to planting fingerlings; and finally legal size fish, especially trout. Finally, there is a negative reaction to fishing for legal-sized hatchery trout. Thus we recognize four eras: fry, fingerlings, legals, and the modern era.

Fry Era (1875-1930)

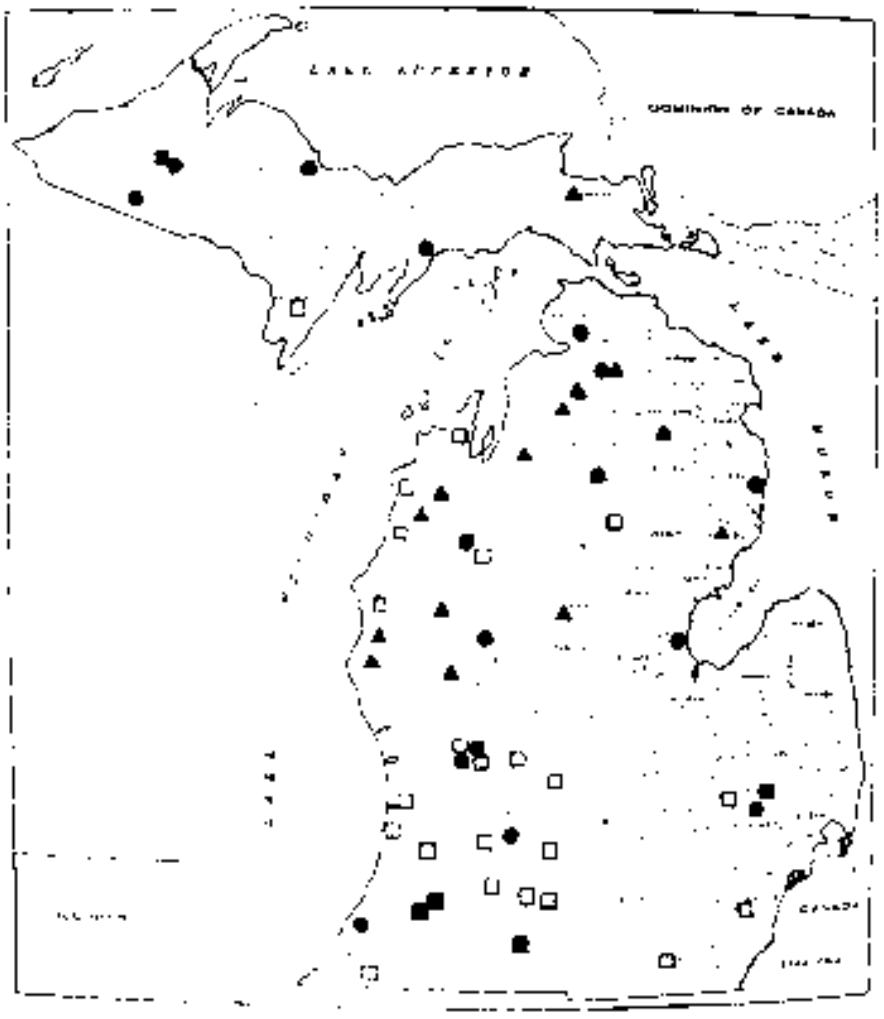
In artificial propagation it was logical to start with hatching eggs and planting the fry. Furthermore the initial interest was mostly in food fish, so the early years saw large plantings of whitefish and walleye fry. Trout fry were handled in much smaller numbers, reflecting basic differences in egg size, fecundity, hatching time, etc.

Generally, in the hatcheries, young were produced in one of three ways. First, eggs of certain species could be easily taken from ripe fish, fertilized, placed in chase jars with circulating water, and hatched. They were held in adjoining tanks until the egg yolk was absorbed, and were then stocked. These species included walleye, whitefish, and perch. Walleye and whitefish needed to be planted immediately after egg absorption because sufficient food could not be found for them. Perch could be transferred to natural ponds and reared to fingerling size without artificial feeding. The second method, which has been adopted universally for trout and salmon, is to take the eggs from mature fish, fertilize them, and then incubate them on trays in well-aerated running water. The fry were held on trays until they absorbed the egg yolk. Finally, adults of warmwater species such as black basses, bluegills and carp were held in ponds, where they spawned. The young could be seined for stocking, or transferred to other ponds for growth to a desired planting size.

Both adult trout (brood stock) and the young were fed ground meat packing products. Dried freshwater mussels were also used. Warmwater fish were raised in natural ponds and were not artificially fed. Disease prevention was by providing more water. In the Biennial Report of 1923-24, it is stated "If our hatchery fish are sick, we do not want a doctor, but more water." Thyroid goitre was an exception; this was controlled by feeding "Atlantic fish meal" which apparently was rich in iodine. Female brook trout, after spawning, were given a salt bath which checked excessive mortality. Diseases of fish and sanitary conditions in hatcheries were first investigated in depth in 1920.

Enough has been said elsewhere about transportation of fish fry for planting. Mostly they were transported in aerated milk cans in a railroad "fish car."

With relatively little effort the small eggs of whitefish and walleyes can be handled by the millions, and correspondingly by the thousands with trout. Thus annual fry plantings were recorded in millions. As typical records, we quote a few statements from early biennial reports. In the 1870's some 7 million whitefish fry were planted annually in numerous inland lakes. During 1880-1887, some 70 million whitefish fry were planted annually in the Great Lakes. There was a



State fish-cultural stations and cooperative fish-rearing ponds, in 1929-30. Shown by symbols are 15 fish hatcheries, 14 state trout feeding (rearing) stations, 6 state bass and bluegill rearing ponds, and 23 cooperative bass and bluegill rearing ponds. From Fifth Biennial Report of Michigan Department of Conservation, for 1929-1930, p. 218.

stock period because of budget cuts, but the State continued to produce whitefish fry on a large scale throughout the 1920's; the peak year was 1929 with a production of 83 million.

Walleye fry were first planted in appreciable numbers in 1882. Adult walleyes were secured from commercial fishermen in the Great Lakes (Saginaw Bay) spawned, and the eggs hatched at the Detroit and Bay City hatcheries. When they grew to the fry stage, they were distributed to innumerable inland lakes. This went on until about 1920, by which time one billion fry had been stocked. Stocking continued at a similar rate through 1928, but the Bay City hatchery produced most of the fry and some were planted in the Great Lakes.

Lake trout eggs were hatched at the Sault Ste. Marie and Paris hatcheries during much of the era. The trout were planted as fry, mostly in inland lakes. Planting began in 1875, and averaged less than one-half million in the 1890's. The stocking rate picked up after the turn of the century and averaged about 2 million per year.

Stocking of brook trout fry began in 1879, when 12,000 were stocked. During the next 20 years, 2-3 million fry per year were stocked in inland streams. This was an attempt to fill the void created by the decline of the grayling in many of our best streams. It was eminently successful. Hatchery production of brook trout fry increased to an average of 8 million during 1900-1920 and to 16 million in the middle and late 1920's. The eggs of brook trout, for rearing, were obtained either from brood stock maintained at state hatcheries or were purchased from commercial hatcheries. Paris was the principal brook trout hatchery prior to 1900. During 1900-1920, four stations hatched brook trout, and by the 1920's eight stations were involved.

Stocking of rainbow trout fry in Michigan was done on a very limited scale during 1887-1900. As it became evident that stocking was very successful, the number of fry stocked increased to 1 million in 1903, and to about 4 million fry in 1920. Rainbow eggs were obtained from other states and from brood stock.

Planting of brown trout fry was on a small scale from 1889 to 1897. During the next 18 years, none were planted; the Fish Commission had misgivings about this "interior" trout. By 1910, back in favor, brown trout fry were put back in production. Fry plants reached 6 million per year by 1926, but then dropped in favor of fingerlings. A brood stock of brown trout had been developed at the hatcheries.

Other cold-water fish planted as fry in the early years included Atlantic salmon during 1873-1880, chinook salmon in 1873-1880, and grayling brought in from Montana during 1903 to the late 1920's. American eel fry (elvers) were shipped in from the Hudson River during 1877-1891. The warm-water fish received some attention during the early years. Some 1/2 million smallmouth bass fry per year were planted during 1890-1920, along with 1 million largemouth bass, 10 million perch fry, and some 2 million bluegills all during this same period.

Fingerling Era (1930-1939)

In 1921, stocking policy changed with the establishment of the Fish Division, which opposed culture and stocking of non-native fish. By the middle 1920's, the planting of fingerlings, instead of fry, was stressed, and in 1929 it was stated, primarily for trout, that "the fingerling program is no longer an experiment, rather

it is an established fact." The change to stocking larger trout was brought about by the suspicion of fish culturist and sportsman alike that few trout fry survived to the creel. Early research substantiated this suspicion. Researchers made another significant contribution during this era that eventually altered the planting program drastically. They discovered that a fish toxicant (rotenone) could be used to kill fish in small inland lakes. Then when trout were introduced, there were no competing species so planted trout survived very well indeed. An additional advantage of planting in fishless lakes was that smaller trout survived nearly as well as did larger trout.

The change to planting larger fish required a greater investment in fish food. In fact, by 1940, the cost of fish food rose to $70,000 per year. Meat-packing by-products such as beef and sheep liver and pork spleen were first used in this era and found to be satisfactory. However, these products became increasingly scarce and expensive, and other foods were tried. These included ground carp, canned fish, dry meals with meat by products, offal from commercial fish species, horse meat liver and hearts, frozen ocean herring and poultry foods. By the end of this era, the problem of fish food had somewhat stabilized.

During the "fingerling era" the brook trout was the major species produced. Some 6 million fingerlings were released per year in the early 1930's. The trend was to grow fish to a larger size, so fingerling were held over one winter to become large fingerlings (or yearlings). Production of yearling brook trout reached 1/4 million in 1943. Production of fingerling brown and rainbow trout reached several million by 1940-1943. An increasing percentage of hatchery production of fingerling trout went into reclaimed inland lakes. In 1933, very little of the total production was for lakes, but by the late 1940's, nearly 90% lakes were stocked annually. One half of the rainbow produced, 1/4 of the brook trout, and 1/8 of the brown trout were released in inland lakes. For lakes, as for streams, larger and larger fish were released as time went on.

Inland lakes have been planted with lake trout at least since 1925. During the "fingerling era," about 15 lakes were planted annually. In the 1930's, fry and fingerlings were used and about 30,000 were released each year. In the 1940's, yearlings and legals were used at the rate of 25,000-100,000 per year.

Among warm-water fish, bluegill fingerling production increased to a high of 14 million in 1930, but declined to near zero in the late 1940's. Yearling production reached 1/2 million in 1944, but it, too, subsequently was severely reduced. Production of bass fingerlings (largemouth and smallmouth) was about 1 million per year during much of the era, but very few were raised after 1943. Perch formerly had been raised in hatcheries to fingerling size for planting. This practice was discontinued in 1931 and perch fingerlings were seined from certain Great Lakes tributaries, such as the Kass River, and stocked in inland waters until 1943. The peak number was 11 million in 1941. Production of walleye fry averaged an astounding 100 million per year during 1932-42, but had dropped to zero by 1947. Attempts were made to rear walleyes to fingerling size for stocking, but these failed.

Legal-size trout era (1950-1964)

Michigan's fish planting policies during 1950-1964 were significantly influenced by research on the returns of planted fish to the fishermen. Planted fish had been marked and anglers were subsequently checked to see how many marked fish they caught. Survival to the creel was weighed against cost of rearing fish

to various planting sizes. It was discovered that less than 2% of the fingerling trout (1-6 inches) released in streams survived to the fisherman's creel. Obviously, returns were not commensurate with the cost of the plantings. Experiments with legal-sized trout (7 inches or longer) in 11 streams showed that six times more brook trout, four times more rainbow trout, and twice as many brown trout were recovered by anglers from early spring and open season plantings as were harvested from comparable fall releases. Comparing species, it was found also that with legal sized brown trout anglers got back only one out of six fish planted, one of three brook trout, and one of three rainbow trout. Other experiments showed that fingerlings did well in small lakes when competition from other fish was low, and that legal-sized trout were desirable in large lakes where predatory fish were present. So, during the era, the general trout planting policy was to stock legal-sized trout in streams during the early spring and open season, fall fingerlings in small lakes, and legal sized trout in large lakes.

Policy for warm-water fish stocking also changed drastically as a result of studies of returns from planted fish. It was found that few planted fish survived to be caught, and warm-water fish produced plenty of young by natural reproduction. Hence, stocking of warm-water fish was restricted to: (1) waters lacking these fish and where careful biological investigations indicated that introduction of a new species would be beneficial, (2) waters where winterkill, pollution or other catastrophe had wiped out the stock, (3) experimental plantings to learn if heavy stocking of predatory species would balance stunted panfish populations, and (4) stocking of walleye fingerlings to maintain this species in lakes where natural spawning was lacking.

The rainbow trout received prime attention during the "era of legals." A million legals and sublegals were produced annually. A high of 1.2 million legals was reached in 1936. About half of the rainbow trout were released in streams and half in lakes. Some 300,000 legal brook trout and 200,000 brown trout were also stocked, which gives an annual total of nearly 2 million legal fish. Most legal brook and brown trout were released in streams. Rainbow trout were stocked in 200 inland lakes, brook trout in 100, and browns in 26.

During 1950-1964, warm water fish received relatively little attention by hatcheries. Production of bluegill fry and perch fingerlings was severely reduced from the millions stocked annually in the previous era. Stocking of smallmouth and largemouth bass also declined to practically zero. Walleye fry plantings had been abandoned, but in 1951, a program of stocking fingerlings was begun because their survival was expected to be better. The switch in demand from fry to fingerlings resulted in problems for the fish culturists. In contrast to trout, walleyes seem to demand live food, and it was prohibitively expensive to catch enough food organisms to feed walleyes raised exclusively in hatchery raceways. The problem was finally solved by raising walleyes in large ponds. Spawn was taken from wild walleyes, the eggs hatched in the hatcheries and the resultant fry transferred to ponds which had been previously fertilized to produce large numbers of small crustaceans upon which the fry fed. Young walleyes were seined from the ponds and planted as soon as they reached suitable size. Fingerling walleyes were planted in 60-70 lakes during 1964-1965. Some plants represented new introductions, while others were to maintain populations in lakes where walleye reproduction was inadequate. The plants met with variable, and frequently unsatisfactory success.

Northern pike were held in low regard prior to 1930, and were not considered an acceptable game fish. In fact, in the late 1880's, the state Fish Commission called them fresh-water devil fish and advocated a "policy of extermination for pike." By the 1930's, the angling public and fish managers alike had discovered

that pike were an excellent game fish and also showed promise of controlling stunted panfish. Unfortunately, the pike population was declining due to destruction of their spawning grounds and possibly to overfishing. To increase populations of northern pike in inland lakes, plants of fingerlings began in 1950 and several thousand were planted annually thereafter. Rearing procedures were much the same as for walleyes.

Northern muskellunge were experimentally introduced into lakes of the Lower Peninsula during 1955-1957. About 10,000 fingerlings were planted per year. Hatchery production of muskies proved to be difficult and costly. Eggs were obtained from wild muskies in lakes along the Wisconsin border, hatched at Lower Peninsula hatcheries, transferred to ponds and provided with food in the form of zooplankton and small minnows. Because muskie production was so difficult, stocking was terminated to allow time to reveal the degree of success of the three years of planting. Stocking of fingerling muskies was resumed in 1962-64, because muskies survived and grew exceptionally well in two of the stocked lakes.

History of the lake trout in the Great Lakes is an interesting part of our story. In lakes Michigan and Huron the species was exterminated by sea lamprey predation and overfishing; in Lake Superior, lamprey control saved the species. With lamprey control↓ extended to lakes Michigan and Huron, and with a cooperative program of lake trout restocking by federal and state agencies, and the Great Lakes Fisheries Commission, the lake trout has been reestablished in Lake Michigan and its stock increased in Lake Superior.

Initially as the lake trout declined, and almost disappeared, there was the problem for the fish-culturist of getting an egg supply for a large hatchery production. The problem was solved largely through the foresight of Russell Robertson, superintendent at the Marquette hatchery. In the late 1940's, he began building up a brood stock of lake trout at the hatchery. A portion of each year class of lake trout, beginning with that for 1949, was kept and reared to maturity. This was not without problems because lake trout had not previously been raised to maturity, and many doubted that it could be done. The first of the brood stock reached sexual maturity in 1954, when 16 females were spawned. The mature brood stock increased each year until 1964, when 3,000 female lake trout produced 11 million eggs. From 1958 to 1964, state and federal hatcheries stocked about 1/2 million yearlings annually in Michigan waters of Lake Superior. Yearlings were used because studies had shown that they survived much better than fingerlings. The increased survival justified the increased cost of raising larger fish. Eggs came mostly from the brood stock at the Marquette hatchery.

As return to inland waters, another change in policy occurred toward the end of the era. Both anglers and fish managers were becoming more and more disenchanted with planting legal-sized trout in streams and lakes. Aesthetics appeared to be a major factor. People objected to catching tame hatchery fish. Legal plants attracted large crowds of anglers who quickly caught out the planted fish under circumstances that could hardly be called "sport." Further, studies of the cost of production of trout and the numbers caught by fishermen showed that the cost of a legal-sized trout in the creel was a minimum of $1.00, which even as late as 1960 seemed too high. With these considerations in mind, a new policy was drawn up in 1961, which began the new and modern era.

↓ For the story on sea lamprey control, see the article by Smith and Howell elsewhere in this Centennial report.

Modern Era (1965-1973)

The early years of this era were characterized by much soul searching, analysis of research on stocking and evaluation of needs of anglers to mesh hatchery production into a sound management program. Much of the planning and thought was directed toward management of the Great Lakes for sports fisheries rather than for commercial fisheries and how sports fishing could be improved by introduction and maintenance stocking of salmon and trout.

First, Acting Chief James T. McFadden was instructed in 1964 by Director Ralph A. MacMullan to draw up a "Management Program for Michigan's Sport Fisheries." In this program, major changes were suggested for artificial propagation and stocking of brook, brown and rainbow trout in inland waters. In summarizing his report, McFadden stated: "Plantings of legal-sized trout should essentially be eliminated because of heavy waste. Trout plantings in the future should be made only in those waters that return at least as many pounds to the creel as are planted. This would mean that the planting effort would shift from streams to lakes and that primarily sub legals would be planted." Streams and lakes were categorized as follows, and the type of planting program was outlined for each, to put stocking on a scientifically sound basis. Trout streams included: (a) Streams capable of supporting an acceptable sport fishery through natural reproduction. These streams should not be stocked. (b) Streams capable of supporting a fishable trout population except for absence of natural reproduction or over-abundance of competing species. These streams should be managed through maintenance stocking (defined as the introduction of hatchery trout with the expectation of considerable growth and prolonged survival). Brown trout should be the usual species. (c) Streams not capable of supporting trout over extended periods of time. If managed for trout, this should be on a put-and-take basis, using rainbow trout. Trout lakes included: (a) Trout-only lakes maintained by stocking; usually waters from which all species have been removed by chemical treatment. Use fall plantings of sub-legal trout. (b) Two story lakes maintained by stocking; lakes which contain self sustaining populations of warm-water fish in addition to stocked trout. Use fall plants of sub legal fish. (c) Lakes maintained by natural reproduction. Rainbow trout plants justifiable if natural recruitment alone does not support acceptable fisheries.

Dr. Howard Tanner succeeded Dr. McFadden as Chief in 1965, and he and Dr. Wayne Tody realized that the Great Lakes had an almost unlimited potential for recreational angling. However, the Great Lakes were in a sorry state, even though sea lampreys were nearly under control in Lakes Superior and Michigan. In Lakes Michigan and Huron, alewives dominated the fish populations, to the detriment of nearly every other species except the steelhead. There were no large populations of predatory fish in either lake to feed on and control the alewife. Lake trout were practically extinct in both lakes. Lake Superior was in somewhat better shape because it lacked a large population of alewives. Even so, lake trout numbers were far below those present before the heavy sea lamprey predation. In studying the conditions of the Great Lakes, Drs. Tanner and Tody noted a significant fact, namely that steelhead were doing very well in Lake Michigan where alewives were very abundant. They considered likely reasons, and favorable factors in the ecological situation became clearly discernible. Steelhead ascend cold trout streams well away from the alewives to spawn. The young remain in the upper river areas for an average of two years before descending to the Great Lakes at a length of 6 inches or more. At this size they are unaffected by alewife competition. Indeed they are large enough to begin to feed at once on the younger and smaller alewives. Here, then, was the key to the future management of the fishery and a possible solution to the alewife problem: namely, to increase, through management, the upstream runs of predacious fish such as steelhead which will then

enter the Great Lakes at a size large enough to consume alewives. Along with the existing species, new species of equal value should be introduced that can be brought to an even greater level of abundance. In addition hatchery propagation should be undertaken as necessary to supplement natural reproduction. The goal must be to build a predator fish population of sufficient magnitude to utilize, to the greatest possible degree, the alewife and other low-value species as forage. Maximum advantage can be derived through selection and propagation of game fish with the highest sporting qualities to support a recreational fishery. Several species of predators were considered, and it was decided that Pacific salmon were most likely to achieve the desired results.✓

McFadden's and Tanner's recommendations, plus subsequent input, had a profound effect on hatcheries and stocking policy. These were implemented by Dr. Toby, who succeeded Dr. Tanner. First, the stocking of legal-sized trout in inland streams and lakes was severely curtailed, and emphasis was placed on planting fingerling and yearling trout in these waters. Secondly, the plan for the Great Lakes was set in motion, calling for many millions of trout and salmon to be planted annually. In fact, the emphasis on hatchery production was for Great Lakes waters, and a new $3 million salmon hatchery was started on the Platte River in 1966.

The coho salmon was selected as the species most likely to convert the unpalatable alewife into highly desirable game fish, and at the same time reduce the alewife population to an acceptable level in the Great Lakes. For introductory plants in 1966-68, coho eggs were obtained from the West Coast. Adults from these plants produced an adequate supply of eggs for the subsequent main tenance stocking. Eggs were hatched in Michigan hatcheries, reared to yearling size, then released during the spring into Great Lakes tributaries. Introductory plantings averaged 1-2 million salmon annually, and maintenance plantings totaled 1 million per year. Survival of these planted salmon generally has been phenomenally high. In Lake Michigan, coho fed mostly on alewives and grew from 1 ounce to 10 pounds in 17 months. Lake Superior plants were also successful, but not to the extent as in Lake Michigan. In Lake Superior their diet has been mostly insects and smelt. Adults have averaged around 5 pounds. Lake Huron plantings did not produce such a good sport fishery; a commercial fishery in Canada and high lamprey predation may have been partly responsible.

Chinook salmon were introduced in 1967. Eggs from the West Coast were hatched in Michigan hatcheries; the young were reared for 6 months, then planted as 5 inch fingerlings in Great Lakes tributaries during spring. Introductory plants of 1967-69 totaled 1 million fish annually. Later, from eggs produced in Michigan, some 2.5 million were planted annually. As with the coho, the chinook did best in Lake Michigan, no doubt due to the great supply of alewives for food. Growth was very good: 6 pounds by the end of the second summer in the lake, 10 pounds by the third, and 25 pounds by the end of the fourth. About 8% of the 1967 plant survived to return to streams. Survival in lakes Huron and Superior was disappointing, perhaps due to severe lamprey predation in Lake Huron and to a scarcity of food in Lake Superior.

The planted coho and chinook salmon achieved the desired management goals. First, they have generated a large fresh-water sports fishery. A mail

✓ Excerpted from Fisheries Division publications.

survey showed that in 1970 some 650,000 coho and 200,000 chinook were caught by anglers who fished 5 1/2 million angler-days; most of this catch was from Lake Michigan and its tributaries. Principal food of the salmon in Lake Michigan has been alewives, and significantly there has been no large die-off of alewives in Lake Michigan since 1967.

Early critics of the salmon program have objected to the "fish scenes" of anglers at certain stream sites, and some stream pollution due to dead salmon. After the experiences gained from the early introductions, these situations were avoided by the judicious selections of planting locations, and by the use of weirs to intercept and remove surplus salmon. Dedicated trout anglers were fearful that spawning salmon would destroy brook and brown trout nests and that young salmon in streams would replace native trout. A research project, so far has shown no change in trout populations in streams where adult salmon have successfully spawned.

A more serious problem has been the contamination of Lake Michigan salmon by DDT. With 10 ppm or more of DDT, and a Food and Drug Administration tolerance limit of 5 ppm in the edible portion of the salmon, the fish could not be sold for human consumption. Health agencies in the Great Lakes area have tried to get the level raised above 5 ppm, but were unsuccessful. However, the public has been assured that consumption of these fish on a once-a week basis would not pose a problem to their health. A favorable development has been that the DDT content in fish in Lake Michigan decreased somewhat during the early 1970's.

Prevention of a large die-off of alewives is a secondary benefit--and major one--from the salmon plantings in Lake Michigan. Planting rainbow or steelhead trout has the same two benefits. Beginning in 1968, some 200,000 to 800,000 fingerlings and yearlings have been stocked annually, usually at the mouths of tributary streams. Like salmon, the steelhead has made excellent growth on an alewife diet, up to 5-20 pounds after 2-3 years in the big lake. Plants made directly into Great Lakes bays have also provided excellent fishing.

In inland waters, since 1965, there have been these changes in the fish planting program. With brook, brown and rainbow trout, 1-3 million fingerlings per year have replaced the 1-2 million legals. These plants have been in some 250 lakes and 100 streams. Lake trout are being planted in some 18 lakes--large, clear and cold-water lakes. Splake (brook trout by lake trout) are being planted in about 40 lakes, to the extent of 1/2 million fingerlings and yearlings per year.

Plantings of warm-water fish in inland waters have been mostly of the predatory species--musky, tiger musky, northern pike and the walleye. These predators are difficult to raise in fingerling size, and planted fish number mostly about 20 to 40 thousand per year.

Rehabilitation of the lake trout in the Great Lakes has been accomplished by a combination of lamprey control and planting yearling trout from hatcheries. The brood stock at the Marquette hatchery has been producing some 10 million eggs annually from which 1-2 million yearlings were planted in Lake Superior and 1 million were planted in Lake Michigan. The program has been very successful. It brought the lake trout in Lake Superior back from certain extinction, and reestablished the species in Lake Michigan. Both of these populations now support sizable sport fisheries, all for fish of hatchery origin. In 1978, some 400,000 lake trout of hatchery origin were caught in lakes Superior and Michigan.

STREAM IMPROVEMENT

CURRENT DEFLECTORS, CLAM RIVER, 1955

DEFLECTORS TO STABILIZE SAND BANK.
PERE MARQUETTE RIVER

NORTH BRANCH AU SABLE RIVER Before After

DREDGING TO MAKE A NARROW AND DEEPER CHANNEL

LAKE AND STREAM IMPROVEMENT

By Donald E. Reynolds

Michigan has had a distinguished history in improvement of trout streams and lakes. Such Michigan names as Hubbs, Tarzwell, Eschmeyer, Clark and Rifle River Watershed are well known among those interested in stream and lake improvement work and watershed management. There is a long list of dignitaries and technicians from a large number of states and foreign countries that have toured Michigan to observe techniques and organizational procedures used in our development projects.

Stream Improvement

Dr. Jan Metzelaar, first professionally trained Michigan fisheries biologist, in 1927 carried out the first stream improvement work in this state. This first effort was termed re-snagging, in which streamside trees were cut and dropped into the stream, then logs and stumps were tossed into the stream to lodge against the downed trees. These efforts created deep pools and dense shelter for trout.

Experimental stream improvement was conducted through 1929 by Dr. Metzelaar. Following his untimely death in October 1929, an arrangement was made with the University of Michigan to continue the State's fishery research work. Thus, under the Institute for Fisheries Research (IFR) and with Dr. Carl L. Hubbs as director, stream improvement work was continued, in 1930, by Clarence M. Tarzwell. The Little Manistee River received early attention; here over 200 hole-producing barriers were placed in the stream. Another major effort was a recheck on some 300 identified stream structures which had been installed in streams the previous three years by Dr. Metzelaar. In the fall of 1930 experimental work was initiated on a small bass stream, the Huron River near Ann Arbor, and a small southern Michigan trout stream, the Middle River Rouge near Northville.

In 1932, "Methods for the Improvement of Michigan Trout Streams," by Hubbs, Greeley and Tarzwell was published as the first bulletin of the Institute for Fisheries Research. This classic bulletin stimulated interest and provided techniques leading to a great expansion of stream improvement work in the nation. For example, in 1933, Tarzwell made a survey of Iowa trout streams and introduced Michigan methods of stream improvement to that state. Later the same year Tarzwell, Kuhne and Rodeheffer went to work for the U.S. Bureau of Fisheries on federal projects in lake and stream surveys and habitat improvements.

The Emergency Conservation Work and Civil Conservation Corps were organized in 1933 to provide relief of the unemployment condition in the United States. The program established a series of work camps, manned by selected individuals for the purpose of construction and maintenance of a variety of conservation measures, including lake and stream improvement. It was the responsibility of the various federal and state conservation agencies to provide work projects, supervisory personnel, equipment, and supplies for the camps. As many as 42 camps were active in Michigan at one time during the 7-year tenure of the program.

With planning provided by IFR staff members, and utilizing the methods developed in Michigan, an intensive lake and stream improvement program was initiated as a part of the overall conservation work program. By 1940, when the Civilian Conservation Corps was disbanded, thousands of man hours had been spent on stream habitat improvement work, primarily on some 3900 miles of trout streams in the northern two-thirds of Michigan.

Act 337, P.A. 1939 reserved forty cents from each resident fishing license for fisheries research, for land purchase and water access, and for lake and stream improvement. With a funding level established, Mr. O. H. Clark was appointed in January of 1940 to direct a lake and stream improvement program. A policy was formulated which limited improvement activities to state-owned or state-controlled land to assure adequate public benefits.

Projects were initiated throughout the state with the dual purpose of improving fish habitat and testing new techniques and devices on a variety of stream types. Pre-molded cement blocks were strategically placed in the Dowagiac Drain, Cass County; the cement block was designed to provide back eddies and baffles, as well as shelter for fish. The Cadillac Big Game Club cooperated in obtaining easements on 20 miles of the Clam River, so improvement work could be done there. Work on the Clam emphasized narrowing the stream channel, providing pools, and erosion control. In addition, white cedar, maple and other species of trees were planted to provide shade and prevent erosion. On the Little Manistee River a 110-ft earthen barrier was built to divert water into the original channel; this effort provided an additional 1,700 feet of fishing water on the stream. The Gratiot River in Keweenaw County was selected for improvement because of unique problems in this widely fluctuating, bedrock-floored stream; heavy stone dams with spillways were placed carefully along the stream to form deep pools in low-water conditions to allow for fish movement.

Two stream research projects were initiated. The first, at Hunt Creek, Montmorency County, was concerned with improvement of a trout stream. The second, on the Red Cedar River in Ingham

County, was a cooperative study with the Zoology Department of Michigan State College. The Red Cedar is a warmwater stream with widely fluctuating flow.

Construction work on improvement projects was limited throughout the war years (early 1940's) because of the shortage of manpower and materials. The emphasis was placed on repair and maintenance of stream work completed previously, and on various research projects. Much was done in planning and preparation for an expanded effort in the post-war period. Following the war, the field staff was expanded in regions I and II to assist in project planning and supervision. As many as 24 foremen supervised field construction crews during this period. Perhaps unavoidably, the work was on a piecemeal basis, and the type and quality of work were largely dependent on the expertise of the foreman. The improvement work was mostly within channel and on the banks. Physical structures were mostly sheet-piling deflectors, digger logs, log covers, and sheet-piling seawalls. Vegetative seeding and tree planting were done along the streams.

The policy limiting stream improvement work to lands controlled or owned by the State was modified to permit work on privately owned lands if an easement for public access could be obtained. Under this modification, much additional improvement work was done on streams where private lands had formerly been barriers to an effective program.

Just as Metzelaar, Tarzwell and other pioneer fishery biologists had realized that fish stocking alone was not the ultimate solution to poor fishing, so O. H. Clark and W. E. Tody saw the limitations of a stream improvement program, if restricted to stream channel work. They had long advocated a total watershed approach, to eliminate the associated upland problems, as the best way to increase trout production in streams.

In 1950 the Rifle River in Ogemaw County was selected for one of the first watershed development projects in the nation. Here, the program was directed at correcting trout problems at the source--namely the uplands. Modern soil conservation practices were adopted, including contour plowing, farm fish ponds to retard runoff, gully control, tree and shrub plantings, grass waterways, and ground-recharge ponds. Stream bank stabilization, fencing, and installation of instream habitat structures also became an integral part of the total project.

Because of the success of the Rifle River Project, the Conservation Commission approved extension in 1952, of the watershed management program to the Pine River in Lake, Osceola, Wexford and Manistee counties. The Pine became not only the first operational

watershed; it was the first stream improvement project funded under D-J Federal Aid. The Dingell-Johnson Act (P.L. 81-681), also known as the Federal Aid in Fish Restoration Act, was authorized on August 9, 1950, to appropriate revenue from federal taxes on fishing tackle to the states for fish management and research.

Dingell-Johnson funds can be spent only on work having a direct bearing on fish habitat. Mr. Norman Brown, a fish-oriented agriculture specialist who had worked on the Rifle River Project, coordinated the fish habitat development work on the Pine River with the efforts of other land management agencies. Mutual cooperation between the Department and such land management agencies as Soil Conservation districts, Soil Conservation Service, U.S. Forest Service, Cooperative Extension Service, and private power, mining, and lumber companies, resulted in a coordinated watershed development program with a minimum of overlapping in effort and responsibility. The publication "Organizational Techniques used with Michigan's Conservation Watershed Management Projects," by Norman J. Brown, aptly describes the cooperative techniques used in this program.

The watershed approach to improving trout streams brought about many changes in techniques and program. In programming, a technical staff of fisheries, soil and water management specialists was organized, under the direction of Roger G. Wicklund. Their job was to conduct the preliminary watershed surveys and formulate improvement recommendations and cost estimates for the study areas. The staff also prepared the development plans and inspected the work upon completion. In techniques, the emphasis was put on work designed both to be functional and to blend in with the natural surroundings. Construction was mechanized to improve both efficiency and quality.

Over a 10-year period, some 13 watershed development projects were completed. These involved over 1,500,000 acres of land and 1,300 miles of stream.

Stream and lake improvement was one of the programs selected by the Department for a major reduction in 1962-63 due to a shortage of funds. Field work was cut in half, and the program was transferred from staff to the regional field organization. In 1963, stream improvement again received a "shot in the arm," with implementation of an Accelerated Public Works Program. The added federal funds restored the program to pre-austerity level, but without additional technical force to handle the extra work. Although the quantity of the work completed was great, the quality suffered due to a lack of planning and supervision. As the APW Program ended in 1965, stream improvement work came to an abrupt halt. Reorganization of the Department and implementation of a new fisheries management plan were involved.

Formation of a Resource, Conservation and Development District administered by the Soil Conservation Service provided the opportunity in 1970 for the Department to renew its efforts in stream improvement. The RC & D District, located in a 13-county area of northwest Michigan, selected the Betsie River in Benzie and Manistee counties for a pilot project on erosion control. Due to the success of the pilot project, work was begun in 1971 on an additional 25 miles of the Betsie River. Planning was also started on other streams within the District which had critical erosion problems. Planning has been completed on the Manistee and Pere Marquette rivers, and on a portion of the Maple River. In addition, erosion control work was completed in 1973 on the Cedar River in Antrim County, and construction work was started on a 6-mile stretch of the Hersey River in Osceola County. RC & D districts being formed in the Upper Peninsula, and in northeast lower Michigan, will provide the opportunity for additional erosion control work on streams in these areas of the state.

A renewed Dingell-Johnson Federal Aid Program for habitat development was implemented in 1972. This program will provide funding for both lake and stream habitat projects, including maintenance on stream work done previously, and new projects in critical areas.

Lately other activities to benefit stream habitat are being considered. These include the removal of dams to improve water quality and to add stream habitat; the construction of barriers to control rough fish and lampreys; the modification of dams to underspill cold water for trout streams; and the development of techniques to prevent environmental damage caused by intensive angler use. In addition, we are taking a new look at warmwater streams and rivers to improve fish habitat and public access.

Lake Improvement

The concept of lake improvement as a broad fish management tool developed out of the results of the first comprehensive lake surveys conducted in the early 1930's, which included complete physical, chemical and biological inventories, and recommendations for improving fish stocks in the study lakes. This lake inventory was first urged by Earl C. Doyle, then secretary of the Michigan Division of the Izaak Walton League of America. A project for the inventory was approved in the spring of 1930 by the annual convention of the state division of the Izaak Walton League. Mr. Harry F. Harper of Lansing, president of the division, financed the project.

The early theory of lake improvement involved enhancement of the living conditions, or environment, of inland lake fish to increase survival and growth and subsequently yield to the angler. The initial work included placement of brush shelters for protection of young fish; installation of gravel spawning beds; planting of aquatic vegetation on barren shoals; and placement of wood slabs to facilitate spawning of certain minnows.

The experimental lake improvement was started in 1931. The first evaluation of lake improvement structures was done on Crystal Lake, Oceana County. Because of the promising results of this early work, experimentation was continued and demonstration devices were installed in a number of lakes. In 1938 Carl L. Hubbs and R. W. Eschmeyer put out the first publication on lake improvement in this country. It was Bulletin No. 2 of the Institute for Fisheries Research, entitled "The Improvement of Lakes for Fishing." This publication and the bulletin on stream improvement published in 1938 are believed to be the first technical publications concerning environmental control work on fishing waters in the United States.

The formation of the Civilian Conservation Corps in 1933 provided the opportunity to expand lake improvement work. The IFR staff assisted in planning and supervision. Thousands of man hours were spent installing various lake improvement and spawning devices, in addition to the construction of numerous ponds and impoundments. This massive work program lasted until 1940, when the C.C.C. was disbanded.

Research lagged behind development during the C.C.C. years. However, in 1937 a major effort was organized at Douglas Lake, in cooperation with the University of Michigan summer biological station. L. A. Rulifson, the principal biologist on this project, researched the utilization of numerous types of structures by various fish species. Included in the work was testing of structures at various depths; artificial chemical fertilization of structure sites; and study of the movement of fish in relation to shelter devices. Because of the shortage of manpower and materials throughout the war, lake improvement was limited to research, and to pre-planning for a major development program after the war.

In 1945 the long-awaited development program was initiated under the direction of O. H. Clark. In view of new findings in research conducted during the war, the emphasis of lake improvement was changed from improving living conditions for young fish to concentrating adult fish for better angler harvest. Lakes selected for such improvement were those of large size with extensive shoal areas barren of cover. A variety of shelter types and designs have been tested through the years,

including whole trees, logs, stumps, rocks, and brush tied to square frames, circular frames, ladder-shaped frames, and on single log frames. Most structures proved to be functional to some degree, but many were discarded over the years because of high cost, poor design, or short life span. By the early 1950's, structure design had evolved to the log-crib shelter developed in Wisconsin. The shelter consisted of a number of logs stacked on a square frame in log-cabin type construction. The interior was usually filled with brush to form a dense cover. These shelters were constructed on the ice, then dropped through a hole in the ice, or left to settle when the ice broke up in the spring. The shelters were usually placed in 10-15 feet of water, a depth suitable for concentration of large fish, but shallow enough to be seen from the surface.

The most recent shelter design was devised by Professor W. C. Hoad, of the University of Michigan, in 1958 for the Lake and Stream Improvement Section. Called a "jack" because of the resemblance to the jack in a child's game, the shelter consisted of a concrete cylinder 6 inches by 12 inches, perforated with three holes and three 2- by 2-inch sticks 8 feet long. With the sticks driven through the holes, the structure resembled a 6-legged jack. Several of these "jacks" were placed together in 10-15 feet of water to form a "colony." The "Hoad-jacks" were easy to install, but were rather costly because of the special concrete blocks. Some 5,000 of these shelters were placed in 25 lakes, before curtailment of the lake improvement program in 1959.

Budget limitations, and new management techniques aimed at population manipulations rather than at environmental enhancement, contributed to the end of the physical aspect of the lake improvement program. However, other methods are being employed. The use of chemicals to remove undesirable fish populations in their entirety, or on a partial basis, has become a major tool in fisheries management of our public waters. Artificial spawning marshes for northern pike are being managed to sustain the populations of this fine predator and game fish. Further implementation of a major inland fisheries management program was deferred during recent years, while more attention was given to the restoration of a sport fishery in the Great Lakes.

Renewed use of Dingell-Johnson Federal Aid Program in 1972 is giving new life to the inland fisheries program. While a major emphasis will continue on population control with chemicals, a new look will be taken at environmental control measures. A segment of the lake improvement program will include installation of shelters as fish attractors, experimental construction of spawning reefs, development of rearing marshes and ponds, and new management techniques.

PUBLIC FISHING SITES

ON LAKE CHEMUNG, 1959

ON WOODLAND LAKE, 1959

PUBLIC ACCESS SITES ON LAKES AND STREAMS

By Floyd G. Fanselow [1]

Time was when man had to be a real adventurer to find his way to the beauty spots and fishing holes of the country. Only the fortunate few were privileged to enjoy nature's wonderland or to harvest her crop of game and fish. However, today, in this country at least, the majority of our people have the opportunity to enjoy a wide variety of fishing, hunting, and general outdoor recreation.

It was the automobile that started to change the cramped old way of life, the invisible walls that bound people to their environment. At the turn of the century a few cars, then thousands, then millions, pushed roads out from the cities like thrusting fingers, until the whole nation has been "spiderwebbed" with the tremendous network of good roads. Thus the American automobile broke through the old-fashioned city limits, letting the people out of town into the great green world beyond.

This revolutionary change in transportation during the last half century has made it possible for the people to reach their favorite fishing haunts a sufficient number of times each year to justify the ownership of a parcel of water frontage and in many instances a cabin. Year-round commuting from cities and towns to homes on nearby lakes and streams was also made possible. As a consequence a good share of shoreline on most of our lakes and streams has been taken up in private ownerships. In most states this very definitely limits the fishing opportunities for the great hordes of fishermen with no riparian rights.

This problem is of paramount importance in the field of conservation. Otherwise, how can the programs of law enforcement, research, fish planting, and environmental improvement be justified without an opportunity being provided the public to catch their fair share of fish. Let us look at the progress which is being made in this respect in the State of Michigan.

Primitive man's existence depended upon game and fish and the ability to protect his rights. From the beginning of recorded history, kings and sovereigns, being the strongest power in the land, owned the game and fish as they owned all property. They were their own enforcement agent in protecting their rights.

When William the Conqueror imposed his rule upon England in 1066, the concept that all property vested in the king crossed the English Channel. In 1215, King John of England surrendered many of the kingly prerogatives to his barons and nobles. Present concepts of land ownership and property rights in game and fish have their beginnings in this action.

---

[1] Formerly a Fisheries Division employee, now retired; in charge of the public fishing site program 1940-1965.

With the American Revolution, the colonies confiscated the English crown property and many crown grants. By the Acts of Confederation, the ownership of land was ceded to the federal government. Virginia, New York, Maryland and Connecticut had claims to lands of the Northwest Territory. Virginia's claim to the Michigan area seems to have been the strongest, which may explain frequent references in the record of territorial jurisprudence to Virginia procedure, and interpretation to the common law of England.

At the close of the Revolutionary War, certain crown grants, including a few from the King of France, were recognized and patents were issued by the federal government. Grants of land were made as military bounty warrants to soldiers and sailors. A definite land policy was later established by the United States and large areas were conveyed to colonizers. These new owners displaced the sovereign except they did not acquire ownership of the game and fish which passed to the states.

Game and fish, being migratory in their habits, disregard property boundaries and pass over the lands of many owners. If all land was owned by the state, the problem would be simple.

The land owner is conceded to have exclusive rights in the taking of game, either by hunting or trapping, upon his own property and in open seasons. This right, being a property right originating in ownership of land, may be sold or transferred. Thus, one may own the land but sell the right to take game. A parallel is the sale of mineral rights by the land owner who may continue to occupy and use the land, while mining by others is in progress.

Water is like air, owned by no one and yet owned by all. Therefore, no one can claim an exclusive right to take fish on the basis of water ownership. In Michigan, the riparian owners on inland waters have title to the land under the water; but the right to take fish is shared by all who have legal access. It was therefore necessary to provide a legal expedient to convey rights which would provide public fishing over private lands.

During the lumbering days most of the rivers and many of the lakes in this state were used as logging highways and the waters of these streams carried millions of logs from the forests to the mills. It was early decided that these streams were public in nature and as a result the Legislature passed laws regulating the manner of their use. Fishing in those days was an incidental thing and nobody chose to challenge the right of the public freely and without hinder to fish.

The first test case came about over the ownership of the beds of the Great Lakes in the St. Clair Flats area. Numerous persons had squatted on the shallow waters of this area for vantage points from which to fish and hunt. Finally the state challenged the right of people to own this lake bottom land and claimed that it was state property impressed with an inalienable public trust of fishing, navigation and hunting. The controversy culminated in the case of Nedtweg vs. Wallace, 237 Mich. 14, decided in 1926. The court, in an historical opinion, dug

deep into ancient law in order to trace the public's title and established that "the state is sovereign of the navigable waters within its boundaries, bound, however, in trust, to do nothing in hindrance of the public right of navigation, hunting and fishing."

Apparently it was thought that this decision applied only to the beds of the Great Lakes for within a short time our Supreme Court decided Collins vs. Gerhardt, 237 Mich. 38. The question was whether Mr. Gerhardt became a trespasser by wading and angling in the waters of the Pine River in Lake County. Many years ago our Supreme Court had held that the beds of the inland rivers and lakes belong to the riparian owners. Were these beds subject to a public trust of navigation and fishing? It was decided that although Mr. Collins was the owner of the soil lying under the waters of Pine River, nevertheless it was "impressed with a perpetual trust to secure to the people their rights of navigation, fishing, and fowling . . . . It is immaterial who owns the soil in our navigable rivers, the trust remains. From the beginning the title was impressed with this trust for the preservation of the public right of fishing and other public rights which all citizens enjoy in tidal waters under the common law."

Although this decision was handed down in 1926, the Pine River was not actually opened to the public for ten more years because of other complications involved in ownership and management on the stream. Downstream from the Collins' property were the considerable holdings of the No-Bo-Shore Association which was incorporated in the State of Ohio. This club had encouraged the development of natural log jams across the river and had felled trees into and across the stream making it difficult and dangerous for fishermen to wade or boat the river without trespass on the banks. Feeling that the opinion of the court in the Collins-Gerhardt case had been frustrated by the action of the club, the State was about to bring action to force removal of the obstructions when the association moved first and asked for an injunction in the U.S. Circuit Court at Grand Rapids to restrain the Conservation Commission from removing these jams. The same issues of navigability and the right of the public were again raised and witnesses once more testified as to the use which had been made of the river in the floating of logs. Judge Raymond's decision in this case (No-Bo-Shore Ass'n. Inc. vs Hogarth, et al., 81 Federal Reporter, 2nd Series, p. 70) went further than that of the state court. He stated: "It is difficult to see why the right to navigate should include as an incident thereto the right to take fish. It is the view of this court that the right to take fish is not an incident of navigation but a right arising from the fact that the waters in which the right is claimed are public waters. Both rights arise from the fact that the waters are public, not private. The rights coexist. Neither finds its source in the other."

This opinion may have forestalled many cases of dispute which otherwise would later have reached the courts. However, until this precedent is more firmly established, the rule of navigability, which has long been accepted, would seem to be the surest determination of the public character of a lake or stream. Michigan courts have repeatedly held that the public has a right to fish in

navigable waters which have been defined as "any water which in its natural state is capable of and has been used for the purpose of commerce, travel and trade by the customary and ordinary modes of navigation." The floating of logs during the lumbering days was held to be an act of commerce, consequently any lake or stream used for this purpose would be considered navigable within the meaning of this term as defined. The floating of logs has thus largely become the yardstick in Michigan to determine the character of a water, that is, whether public or private.[2]

Thus, a navigable lake or stream becomes a public highway by water. The fact that a water is boatable does not make it navigable within the meaning of the term as defined. The right to public use of navigable lakes and streams includes the right of trespass upon the submerged soil but does not extend to the uplands of riparian owners while in such waters or in entering or departing from them.

It may be seen then that the public has the right to fish in navigable lakes and streams if access is gained without trespass upon privately-owned property. However, the public can fish in non-navigable waters too, but only with permission of a riparian owner, unless riparian rights are publicly owned and accessible without trespass upon private property. In the latter case, the public enjoys the same rights and privileges of the private owners.

Public ownership of riparian lands is, therefore, the best assurance of public access, particularly to non-navigable waters.

In 1938, the Michigan Legislature became sufficiently alarmed over the plight of the anglers to make provision for use of a portion of the resident fishing license money for the acquisition and improvement of water frontage sites. From 1938 to 1968, the Conservation Department acquired by purchase, gift, easement and tax reversion approximately 800 access sites of which 550 are on lakes and 250 on streams. From 1951 to 1968, three-fourths of the purchase price of these sites was returned to the game-protection fund from federal tax on fishing tackle as authorized under the Dingell-Johnson Act. These 800 sites comprise a total of 50,000 acres with a frontage of a little over 200 miles. These are in addition to the water frontages included within the borders of state forests, parks and other state and federal lands. The latter consist mainly of so-called wild lands, and very little money has been made available for their development. From 1938 to 1968, an aggregate of close to $1,500,000 was expended for acquisition, and $4,000,000 for development and maintenance of sites.

Inasmuch as the public fishing sites were largely acquired with fishermen's money, a general policy was adopted in the beginning of limiting their size to the practical requirements for the parking of cars and boat trailers and the launching of boats. Some sites are larger in extent because of the lay of the land and the advisability of acquiring isolated parcels to prevent possible future interference with and from adjoining ownerships. It was felt that the relatively limited areas

---

[2] These opinions on access to waters, which applied during early years of the public fishing site program, have been modified by recent public acts and court opinions.

would serve every purpose for which they were acquired and would prevent the possibility of their becoming small parks with the consequent encumbering maintenance costs which might eventually embarrass the program. A frontage of 200 feet on lakes was generally considered to be sufficient. More frontage was usually acquired on streams, particularly in the northern part of the state where whole sections or quarter-sections were obtained. First consideration was given to the more popular lakes and streams. However, as other suitable frontages became available at a reasonable price they were acquired insofar as the yearly budget permitted.

Policies were also adopted limiting the improvements to rather simple ones. The general plan was to keep the sites in a more or less natural condition commensurate with the uses for which they were acquired. Unfortunately most water frontages available for public access at this late date were not suitable in their natural condition for the convenient launching of boats. Each site presented a different problem for development. High banks were sometimes sloped to the water's edge and stabilized to support cars. On other sites it was possible to construct long sloping ramps where there was room for a turn-around and boat landing at the water's edge. In some places it was more practicable to dredge boat slips through a marshy shore to float the boats to firm land for loading on cars or trailers. In general the improvements made on stream sites were less extensive than those on lake sites.

Sites were surveyed and the boundaries were well marked with monuments and signs. Wherever required, boundaries were fenced or accentuated with plantings of trees or shrubs. Standard signs were placed at strategic locations on adjoining roads to guide fishermen to the landing. Sanitary facilities were provided. Consideration was also given to the esthetic values by preserving wherever possible all existing trees and shrubs and by planting other trees when necessary for shade or for screening along boundaries. Most sites provide a pleasant place for mother and the children to relax or play while dad is out fishing. Camping has been permitted on most sites in the northern part of the state. Those in the southern portion are either too small or too close to nearby cottages or homes to allow this privilege. To keep these sites in a sanitary and presentable condition, special maintenance crews visit them at regular intervals commensurate with the use and popularity of the various sites.

The Department of Conservation recognized its responsibility both to fishermen and to neighboring riparian owners in providing these sites. Extensive studies were made before a site was purchased, in an attempt to not only acquire frontage which lent itself well to proper development at a reasonable cost in a spot on the lake or stream which would best serve the boaters, but also to obtain land whose use would not cause undue inconvenience to other property owners.

In 1964, Public Fishing Sites were re-named to Public Access Sites, to more accurately reflect the multiple uses of the sites by the boating public. The "boating boom" hadn't started when the program began. At this time the Legislature approved the diversion of $200,000 to this program from marine fuel tax revenues being collected by the Waterways Commission. A major reorganization

of State government, required by a new constitution, prompted transfer of the Waterways Commission to a Department of Natural Resources. In 1967, when the Waterways Commission was making plans to seek increased marine fuel tax revenues, it was recognized that no increases could be justifiably sought without including the funding needs of the Public Access Site Program. It was therefore agreed by the Natural Resources Commission that the access site program would be transferred to the Waterways Commission at such time as the required additional appropriations were available. When the Legislature approved the marine fuel tax allocation increase from 0.5% to 1.5% in January 1968, the path was cleared for the transfer.

At first there was a shortage of sites in metropolitan areas. To assure the capability of acquiring sites where required, the Commission instituted an expanded land acquisition program. Under this, the Legislature has provided $400,000 annually since 1968 to purchase new sites.

In administering this program, the Commission tries to anticipate boating demands and to develop sites accordingly. The acquisition program is, to the greatest extent possible, predicated upon the demands for the period beginning 15 years hence. This means, for example, that action taken in 1972 was based upon boating demands anticipated for 1987.

Potential new sites are investigated by Commission staff to determine suitability for development. If the site is acceptable, a physical review of the lake is conducted to determine configuration, water depths, land elevations, wind fetches, and related factors. The shore of the lake is classified according to desirability for access site development, and this information is provided to the Lands Division together with details on the amount of property required to permit acquisition action. The Lands Division is responsible for all matters relating to land acquisition.

A new site is given a development priority. Actual development can be accomplished either by Waterways regional personnel or on a contract basis, depending upon the nature and size of the site. An engineering plan for site development is prepared either by the Commission's staff, or by a consulting engineer on a contract basis. Such plans are reviewed by a landscape architect, to assure that ecological and aesthetic considerations in the site design are adequate.

Developed sites are maintained by Waterways regional personnel. One of the primary goals of the Commission is for each site to be visited frequently, so as to maintain acceptable standards. With increased appropriations, sites are now visited about every four days, with high-use sites visited more frequently. From 1963 to 1972, approximately $1,850,000 was expended for the acquisition of sites, $4,000,000 for development, and $5,000,000 for administration and maintenance. Approximately 1,000 sites are now dedicated and maintained for public access to lakes and streams in Michigan.

Considering the scope of the public access program, it is significant that most Michigan people have accepted it wholeheartedly. It not only opened up additional fishing and boating waters to the public, but minimized trespass problems over private riparian ownerships.

FISHERIES RESEARCH

By Gerald P. Cooper

Over these 100 years the concept of just what is research has changed, and perhaps a few comments in this regard are important as background. The earliest workers conducted field surveys and described it as research. It was inventories of fish populations and physical conditions of the habitat, in lakes and streams. Other early studies dealt with hatchery propagation and related embryology of species like the walleye and smallmouth bass. Other studies were concerned with fairly intensive biological examinations of individual waters --Lake St. Clair, Lake Michigan, and Walnut Lake, as examples--in modest attempts to describe fish-oriented ecosystems. With time, the individual and superficial studies became more intensive, and attempted to answer more specific questions. So that by now, we like to believe, we have reached a fairly high degree of sophistication in fisheries research.

Early Lake Inventories

When the Michigan State Board of Fish Commissioners was established by legislative act in 1873, it did not immediately start on a research program. It was charged with goals involving fish culture and the introduction of foreign species. These were the Board's principal activities during the first decade. Atlantic salmon were introduced from New England, Pacific salmon from the West Coast, the eel from the East Coast, and the carp from Europe. As to native species, brook trout were hatched and planted widely to new waters throughout the state, and whitefish fry were planted in the Great Lakes and a few inland lakes. After this decade of fish planting, the Board decided to undertake its first "fish research" project. It started a systematic survey of biological data on inland lakes, especially those in which fish had been planted during the first decade. The Sixth Biennial Report on page 30 contains a short paragraph on the subject, including:

> "It is [in 1883] the intention of the commissioners to make a complete and systematic investigation by the use of nets of all lakes that have been stocked, or where that has been attempted, by the state, in order to determine whether they were suitable for the fish planted in them, and if not to learn the conditions existing that are favorable for the development of other kinds of fish."

A critic might be quick to point out that they "got the cart before the horse"--they should have studied the waters first, as a guide to where to plant the fish. But considering the times, the few persons available to do any work, and, their primary charge by the legislative act, they can hardly be criticized. They did

start a checkup on their work in that first decade. Even after a hundred years, fish managers are still doing some things without being sure of the outcome.

From 1883 to 1885, some of the larger inland lakes were examined to check on native whitefish; many streams were examined to judge their suitability for brook trout and other checks were made on introductions of salmon, eels, and carp. The "formal" fisheries survey of lakes was started in 1885 by Mr. S. H. Case, under the direction of the Board. He studied four lakes. More extensive surveys were started in 1886, with two crews under the direction of A. W. Marks and O. D. Marks.

Rules for the routine examination of inland lakes were spelled out by Commissioners John H. Bissell and Herschel Whitaker, and printed on the back of field survey data forms dated June 25, 1886. Summarized, the field parties were to: (1) make soundings and locate deep places on a lake map; (2) take water temperatures at surface and bottom; (3) set gill nets in deep water, on banks and off banks; (4) dredge for bottom food and weeds, and identify kinds; (5) examine fish stomachs and compare with bottom food samples; (6) do test fishing; (7) identify fish; (8) write reports on blanks provided; and (9) mail in reports weekly.

In 1888, the Michigan Commission asked the U.S. Fish Commission for assistance in the inventory work; the latter commission employed Mr. Charles H. Bollman, a fisheries student under David Starr Jordan at Indiana University. Mr. Bollman joined the Michigan lake inventory party in 1888 as a naturalist. He was the first college-trained fisheries student to work for the Michigan Commission.

During the (second) decade, 1883-1892, the Commission's two field inventory parties studied about 425 lakes in 34 counties: a few lakes and streams in 1883-85, 40 lakes in 1886, 80 in 1887, 20 in 1888, 35 in 1889, 72 in 1890, 90 in 1891, and 75 in 1892. The great majority of these lakes were in the southern half of the lower peninsula. During each lake survey, notes were written up with meticulous care, in longhand. These field records are in five hard-covered notebooks, on file in the library of the Institute for Fisheries Research in Ann Arbor. The accounts include physical description of the lake, bottom soils, aquatic weeds, inlets, and depth soundings. There is a simple map of each lake showing 30 to 100 individual depth records, numbers of each species of fish caught, and stomach contents of the fish in relation to natural foods found in the lake. The field parties made judgments on adequacy of fish food supply, degree of overfishing by anglers, suitability of each lake for different kinds of game and food fish (including the carp and eel), and recommendations on kinds of fish to be planted.

Personnel on the lake survey field parties included many who stayed with the Fish Commission as their lifetime occupation, and their names are familiar to persons now working in this field. They included W. D. Marks, A. W. Marks, and O. D. Marks. (Later, several more members of the Marks family were to work for the Fish Division.) J. W. Powers, D. Lydell, C. H. Price, W. D. Sargeant, and Eli Tinkin were others.

Perhaps strange to our new generation of college-trained fisheries biologists, these early hatchery biologists had essentially the same insights on many fish management problems as we do today. Although they did recommend some plantings of carp and eels--in which they were "victims" of the times--they were nevertheless discerning as to special requirements of salmon (introduced), lake trout, brook trout, walleyes and bass--among other species. Remarks about individual lakes show the diversity of their thinking, such as: "there is plenty of food for fish . . . the fish taken were in good condition, well fed . . . recommend no planting because of so many perch . . . lake has an abundance of native fish, only protection needed . . . " etc.

The Fish Commission went early to the universities for technical help. Professor Jacob E. Reighard of the University of Michigan Zoology Department was the first highly trained field ichthyologist who worked for the Board. The Ninth Report of the Board (1890) has a scholarly paper (66 pages, 10 plates) by him on the embryological development of the wall-eyed pike. In 1893, Reighard led a field party in a biological survey of Lake St. Clair, which resulted in Fish Commission Bulletins Number 2, 3, 4, and 5, on the plants of Lake St. Clair (by Pickers), the rotifers of the Great Lakes (Jennings), a biological examination of Lake St. Clair (Reighard), and the copepods of Lake St. Clair (Marsh)--all published during 1894-1895. Next came a biological examination of the Traverse Bay portion of Lake Michigan during the summer of 1894, by H. B. Ward, an illustrious limnologist from the University of Nebraska, as Bulletin Number 6 (1896). Bulletin Number 7 (with 73 pages, 2 plates), in the 16th Board report (1905), was again by Jacob Reighard, on the breeding habits, development and propagation of the black basses. These bulletins on the early development of walleyes and black bass were intended to aid the fish-cultural effort. The studies of Lake St. Clair and northern Lake Michigan were to obtain habitat information on the most favorable time and place for planting hatchery reared whitefish fry. The final "bulletin" (not so numbered) in the Board of Fish Commissioner series was a 45-page catalog of Michigan fish, by E. L. Michael, published (1905) in the 18th Board report.

In research and technical studies there was a long "dry spell" during the period from 1900 to 1921. Hatchery personnel conducted and reported on several minor experiments to improve fish cultural techniques (culture and planting of trout, bass and perch). Dwight Lydell wrote a short paper (pp. 194-196 in the 19th report for 1909-1910) describing his observations in raising smallmouth bass at the Comstock Park hatchery, and Seymour Bower (19th report, pp. 197-204) wrote a history of the rainbow trout and its first 35 years in Michigan. But during 1900-1921, the Board was concerned primarily with hatcheries and fish plantings, and paid little attention to fact finding.

The new Conservation Department in 1921 had some initial contact with biologists at the University of Michigan. In 1923-24 (the 2nd biennial report, pp. 210-217), Dr. A. G. Ruthven of the University wrote a "Report of the Biological Staff." Museum people, prior to 1921, had made some biological studies for the Michigan Geological and Biological Survey, but starting in 1921,

the cooperation was with the new Conservation Department. That department hired its first full-time technically trained fisheries biologist in 1923--Dr. Jan Metzelaar, a fisheries official of the Dutch government, who was trained in the European tradition. He was given laboratory facilities at the U. of M. in Ann Arbor, and he worked partly under Ruthven's direction.

Ruthven's report on the biological studies during 1923-24 referred to the following: field checks on potential new hatchery sites by C. W. Creaser, C. L. Hubbs, and J. Metzelaar; Boardman River survey by T. L. Hankinson and J. N. Lowe; trout foods by Metzelaar; survey of Traverse Bay by Walter Koch and John Van Oosten; and a comprehensive fish survey of the Au Sable River system by Hankinson, Hubbs, Creaser, Metzelaar and T. H. Langlois. The second biennial report does not record the Department's expenses in this biological work, but knowing the persons and their home agencies, it is obvious that the University of Michigan, Michigan State Normal College, and the U.S. Bureau of Fisheries made substantial contributions to the total effort.

The 3rd biennial report of the Department of Conservation (1925-26) shows T. H. Langlois as a full-time Department "fisheries expert," joining Dr. Metzelaar on the biological staff. Langlois and Hubbs continued their ichthyological surveys in the Cheboygan-Alpena-Gaylord area. John N. Lowe of Marquette Normal College, who was doing the ichthyological surveys of the Upper Peninsula, reported (pp. 126-127) on the status of the Michigan grayling in the Otter River where it was making its last stand. In 1925, Lowe estimated that there were about 600 to 700 grayling remaining in the Otter River system. Some of Lowe's critics have subsequently suggested, unofficially of course, that his ardent interest and persistent collecting of the grayling had much to do with its final demise. But not so! No biologist is that efficient with a scine! The grayling was already doomed!

During the two bienniums of 1927-1930, scientific fisheries still centered around Metzelaar and Langlois. Expenditures on "scientific" work now show up in annual expenditure records: $8,763 for July 1, 1927 to June 30, 1928; $12,159 in 1928-29; and $15,444 in 1929-30. During this period a number of things happened which are of special concern to our story.

Dr. Jan Metzelaar (age 37) was drowned in Grand Lake, Alpena County on October 4, 1929, while engaged in lifting gill nets. Just two days earlier he had been admitted as a citizen of this--his newly adopted--country.[1]

The State-wide general creel census was started on July 1, 1927. Commissioner Harold Titus of Traverse City was its main promoter. The census was a cooperative effort in which Conservation Officers, as they contacted fishermen on lakes and streams, filled out records on their fishing: place, date, hours fished, bait used, fish caught, etc. During the last half of 1927, the officers obtained 4,400 records, and for the first full year (1928) some 8,700

---

[1] Hubbs, Carl L. 1930. Fishery research in Michigan. Trans. Amer. Fish. Soc., Vol. 60, pp. 182-186.

records were obtained. The fish research staff summarized the records by state geographical district and type of water. The census was continued through 1964, and regularly the officers obtained close to 50,000 records per year state-wide. Related studies showed that the census had a systematic bias--the officers tended to visit waters, and concentrations of fishermen, where the fishing was better than elsewhere. Thus their average catch per hour was too high. But we assume that the bias was a fairly constant factor, for the index of fishing quality over the 38 years was remarkably constant.

The systematic collection of statistics on the commercial fisheries in the Great Lakes was initiated in 1879 and has involved several agencies.[2] Typically the State Fish Division and the U.S. Bureau of Commercial Fisheries cooperated in the collection, compilation and interpretation of the records. Agencies which collected the data from commercial fishermen, for several periods, were:

U.S. Bureau of Fisheries, scattered years, 1879 to 1904.
State Board of Fish Commissioners, 1883 to 1908.
State Game, Fish, and Forestry Warden, 1911 to 1913.
State Game, Fish, and Forest Fire Department of the Public Domain Commission, 1914 to 1919.
State Department of Conservation, 1920 to 1968.
State Department of Natural Resources, 1968 to present.

Michigan in 1927 introduced the system of converting catch statistics to catch per unit of effort, as the best index for keeping track of abundance of stocks of commercial species.

We in fisheries research like to believe that the outstanding event in our story was the establishment in 1930 of the Institute for Fisheries Research. This formalized the cooperation between the Department of Conservation and the University of Michigan which had been going on since 1921. This cooperative venture was approved by the University Board of Regents on February 7, 1930, as recorded on page 167 of the printed proceedings by the regents for 1929-1932, as follows:

> Present: President Ruthven, Regent Beal, and Regent Sawyer.
>
> With the express approval of the President the committee voted that a research bureau affiliated with the Museum of Zoology should be established to carry on certain scientific work for the Michigan Department of Conservation. The work of the staff is to be under the supervision of the Museum of Zoology and it is understood that the Department of Conservation will transfer to the University $10,000 for 1930 and at least an equal amount in subsequent years to provide salaries for those employed.

---

[2] Van Oosten, John, 1938. Michigan's commercial fisheries of the Great Lakes, Michigan History Magazine, Vol. 22, No. 1, pp. 107-145.

MUSEUMS ANNEX BUILDING

Museums Annex Building on University of Michigan campus in Ann Arbor. Home of the Institute for Fisheries Research since 1936. Photo May 12, 1942.

HUNT CREEK STATION

Hunt Creek Trout Research Station. One of the first such stations in the nation. On headwaters of Thunder Bay River, in Montmorency County. Station established in 1939. Photo on April 11, 1942.

SHOCKING CREW

Stream fish shocking crew, on Black River, Montmorency County, summer of 1948. Making trout population estimates. (L to R) Howard Gosing, D. S. Shetter, H. J. Vondett, Hugh McMillin, E. L. Cooper and W. H. Crowe.

Dr. Carl L. Hubbs selected the Institute's name and was its first director. He worked part-time with the Institute, and received part of his salary from the Department. The University contributed office, laboratory and library facilities for the Institute staff, and still does. The Izaak Walton League of America contributed research funds during the early years of the Institute.

Cooperation by the State Department of Conservation was spelled out in a letter of January 22, 1930, to Carl L. Hubbs by Department Director George R. Hogarth, with a commitment of $16,000 for the first year. F. A. Westerman, in a Memorandum to the Conservation Commission, February 5, 1931, requested continued Department support of the work to the extent of $21,000 per year for fiscal 1931-32 and 1932-33. Greatly increased support of fisheries research has been continued ever since.

Fisheries research in our department has always been strongly oriented to solving practical fish-management problems. Director Hogarth, in his organizational letter of January 22, 1930, to Hubbs, stated: "The proposed personnel should permit a continuation of the investigations of a number of the practical problems which confront this Department . . ." and ". . . your investigation should stress practical application." F. A. Westerman, C. L. Hubbs, and A. S. Hazzard all kept faith with this early directive.

The Institute for Fisheries Research, with Hubbs as its organizer and first director, saw many new faces during 1930-31. Wendell H. Krull replaced Langlois as fish pathologist for state hatchery problems. Dr. John R. Greeley came from New York to become assistant director under Hubbs. Eight younger men joined as assistants and fellowship holders. Their assignments illustrate the practical character of the work. L. M. Ashley had a fellowship to work on aquatic plants as related to inland fisheries; S. N. Jones worked on stunted perch populations; R. W. Eschmeyer on lake habitat improvement; C. M. Tarzwell on trout stream improvement; and J. C. Salyer on mergansers and other fish predators. Two to three years later G. P. Cooper started studies on forage fishes, D. S. Shetter began his studies on brook trout growth and migrations; and J. W. Leonard joined the staff full time to work on stream improvement and aquatic insects.

In 1935, Dr. A. S. Hazzard came from the U.S. Bureau of Fisheries to take over as full-time director of the Institute, replacing Carl Hubbs who returned more intensively to his work in ichthyology but never lost interest or contact with fish management problems. In 1936, J. W. Leonard became assistant director of the Institute, the staff was enlarged, and the strong fellowship program was continued. Growth in the organization is fairly well depicted by budget allotments (if, in the process, one makes a major "correction" for inflation) and by number of full-time research biologists involved. Selecting representative years, the fisheries research allotment was $25,428 for fiscal July 1, 1936 to June 30, 1937; $70,707 for 1939-40; dropping some during the war years of the early forties, it was $61,158 in 1944-45; then $171,763 in 1946-47; $272,134 in 1951-52; $313,115 in 1955-56; and approximately $500,000 during the 1960's.

Two significant happenings affected expenditures for fisheries research. Michigan Legislative Act 337, Public Acts of 1939, earmarked 40¢ of each resident fishing license fee for three activities--public access, habitat improvement, and research; the three shared about equally, and this accounted for one of the substantial increases in the research effort. The second development was the Dingell-Johnson Act of August 9, 1950, by the United States Government, for federal aid to sport fisheries restoration and management. Federal tax on fishing tackle is apportioned back to the states by a formula related to the state's size and its sale of fishing licenses. For fiscal July 1, 1952 to June 30, 1953, Michigan received $140,520 D-J income, some of which went to research. This figure was around $200,000 per year during the fifties, $300,000 during the early sixties, and with some fluctuation it is now around $400,000 per year.

Two organizational developments of recent years might be mentioned. The fisheries research section was separated, administratively, from the Fish Division during the last nine years of our centennial period. It started when a special committee studying the Department of Conservation recommended extensive reorganization, including the establishment of a Research and Development Division separate from the parent divisions. Thus, as of April 6, 1964, fish research was taken from fish division, wildlife research from the game division, and along with biometrics and some supporting people, these constituted the new Research and Development Division. Still, fish research related its efforts to fish division problems, and we do not regard the break as a disruption in our part of the fisheries centennial. The Research and Development Division was disbanded and fish research transferred back to Fisheries Division on January 14, 1973.

Having the Institute (the main effort in fisheries research for 30 years) located at the University in Ann Arbor was good from the standpoint of association with fishery scientists in that institution, but it caused some problems in intra-departmental relations. Our critics often accused us of an "ivory tower" attitude and of being non-practical. The latter misconception I have already dispelled (above). For the historical record I would add that most of the critics of research were in fields of fish culture or law enforcement, to which research had appeared on the scene as a new competitor--for money, people, and recognition. By now, major differences have diminished, pecking-orders have been re-established, and things are going well.

As indicated earlier, the Institute has been a cooperative enterprise. The University of Michigan at Ann Arbor provides free office and laboratory space in the Museums Annex building, along with heat, lights, and water, and free access to University libraries and other facilities. Starting with the Hazzard era in 1937, all personnel--biologists, fellowship holders, clerical staff, etc.--have been employees of the Conservation Department, with salaries, field expenses and equipment financed by the State and all budget allotments appropriated by the State Legislature. The criticism by some that we have been biologists hiding in an ivory tower, unresponsive to fishermen's interests, is entirely unwarranted.

In early years it was easy to identify the fish research effort with the Institute (in Ann Arbor), because practically all of the research people operated out of Ann Arbor. Later, as a number of field research stations were established in other parts of the state, financed entirely by the Department, it made less sense to identify the whole operation with the Institute, and by the time the Research and Development Division was operating out of Lansing, the Institute had become one of the field stations of the fisheries research section of the R and D Division. Still, to maintain continuity in a long series of formal reports, and in a catalog of reprints of published papers in scientific journals, we retain the Institute name as a significant part of the system. Furthermore it is an appropriate recognition of continued cooperation with the University.

During the 40-year period of fish research, starting in 1930, thirty-five persons have held Institute fellowships and earned doctoral degrees while working on fish-management problems in Michigan. Another four persons completed their PhD while working full time for fisheries or fisheries research. There have been only four persons who started on a PhD fellowship commitment, but settled for only a Masters degree along the way. Thirty-three persons, while working for our Department, earned a Masters degree on a fish-management problem; mostly these people were fish division employees who took formal course work on their own time, and could use job-related research data as a basis for a masters thesis. During the first ten years, all but one of the fifteen fellowships were at the University in Ann Arbor; since 1941, about half of the fellowships have been at the sister University in East Lansing. The formal doctoral fellowship in fisheries and wildlife research, offered by our Department, has been a financially attractive set-up for the candidate. It has also been a "good deal" for the Department in getting high-quality research done at a very reasonable cost. The cost is relatively low because guidance and consultation are contributed free by scientists on university faculties. At present, the fellowship holders are paid 65% of full pay while completing academic courses and examinations, and then 80% of full pay while working full time on their research projects. The fellowship program in fisheries research has made a substantial contribution in the training of fisheries scientists, not only for our own department, but for other Michigan institutions, and for agencies beyond our borders--both national and international. Of the 76 persons who pursued their graduate educations on fellowships, 13 now work in fisheries for our department, and a more were recently retired or deceased; another 22 in Michigan are on university faculties, or work for other government agencies; and 36 are out-of-state, working for governments or universities. In short, Michigan, through its Institute for Fisheries Research, has made a substantial contribution to fishery science nationwide.

Much of the growth of our fisheries research section, and the expansion of its philosophy and detail of interest, occurred under the careful guidance of Albert S. Hazzard, who was Director of the Institute for Fisheries Research from September 1, 1935 to November 29, 1955. Successors have been G. P. Cooper, F. F. Hooper, and W. C. Latta. Hazzard, throughout his 20 years here, had full support from F. A. Westerman, chief of the Fisheries Division, and in later years, of J. W. Leonard, the department's research administrator.

In 1931, the initial staff of the fisheries research unit (IFR) was ten people: a part-time director and a part-time assistant director (42 years later these two men are still active and in good health), a full-time fish pathologist, five fellows (fellowship holders), an assistant, and a stenographer. Seven of the ten had college degrees. By 1933, the staff was down to eight, but included a full-time investigator of beaver-trout relationships. By 1936, there was a full-time director (A. S. Hazzard) with a staff of eight--five of them full time. Then, 12 employees by 1938, 18 by 1939, 25 by 1940, 16 in 1942, 12 in 1944 (but with an additional 13 on military leave), 11 in 1945 (13 on leave), 58 positions in 1947 (including part time, clerical, and service men returned), 73 in 1948, 81 in 1957, 76 in 1964 (when fish research was transferred to R and D) and down to 37 in 1973 (when fish research was transferred back from R and D to Fisheries Division). Since January 1, 1941, all have been employees under the State Civil Service Commission.

Fish research personnel (particularly A. S. Hazzard) took an active role in early experimental fish management, which involved many individual lakes and streams throughout the state. As a natural development, the district fisheries biologists were first under the fish research section. In 1948, there were six district fisheries biologists assigned to six of the 11 fisheries districts, all under research. Within a short time these district men, working in fish management, were transferred to their own administrative unit.

Fish research in our department has dealt mostly with fish populations in their natural environment, as opposed to studies of fish confined in laboratory aquaria. Most management problems dictate this approach. Therefore there was an early interest in the establishment of field research stations and office-laboratories considerably removed from the Institute in Ann Arbor. The Hunt Creek Station was built "from scratch" on a stream watershed which is mostly State-owned. Three other stations were at facilities given up by other administrative units in the Department. One came by State purchase of a large private estate. Station locations and dates of operation are as follows:

Hunt Creek Trout Research Station	Montmorency Co.	1939 to date
Grayling Pathology (at hatchery)	Crawford Co.	1942 to date
Rifle River Area (Dowell estate)	Ogemaw Co.	1945 to 1963
Pigeon River Trout Research Area	Otsego Co.	1949 to date
Marquette Station (at hatchery)	Marquette Co.	1952 to date
Hastings Station (former hatchery)	Barry Co.	1955 to date
Saline Station (ponds)	Washtenaw Co.	1966 to date

Administration of the Rifle River Area was turned over to the Parks and Recreation Division after 19 years of fish inventory data on lakes and streams. Gaylord is a center for fish pathology, and is now named a Hatchery Biology Service Center. Hastings and Marquette are primarily office headquarters for nearby field research studies. Work has been curtailed at the Pigeon River Station. Saline is a new facility with warmwater ponds. Hunt Creek has outstanding records on brook trout populations, and has excellent potential for further research on trout.

Prior to 1930, fish research was represented by the lake surveys of the 80's, some biology of hatchery fish, and the ichthyological surveys of Hubbs and his associates in the 20's. The outstanding contributions by the Institute in its first decade were in stream and lake improvement, by Farrwell, Greeley, Eschmeyer, and Hubbs, and the preparation of pioneer bulletins on these two subjects. Later came work on beaver-trout management, trout stream biology and forage fish investigations, to name a few. Soon, efforts were expanded to cover lake and stream biological surveys, lake mapping, creel census of angling quality, life history studies of many of the game species, the sea lamprey problem, aquatic insects as fish food, fish diseases, slow growth in fishes, testing fishing regulations--in effect, the whole array of fish-management problems in the state. Results, conclusions and recommendations from the work are given in some 1,800 formal typewritten reports and 75 graduate theses, and most of the definitive information is published in 410 articles in scientific journals, 3 bulletins and 14 miscellaneous publications.

Over the years our fish research section has cooperated with, or had help from, quite a number of institutions and agencies, in addition to the University of Michigan, Michigan State University, and various divisions in the Department of Natural Resources. Central Michigan, Wayne State, and Northern Michigan are among the schools. The Izaak Walton League helped during early years. Other cooperators have been Consumers Power, Detroit Edison, Upjohn, and Dow. Funds received under the Pittman-Robertson Act has been most important. Finally, we have had excellent cooperation from the U.S. Bureau of Commercial Fisheries and Sport Fisheries and Wildlife, and their successors, and by their employees in Michigan, stationed mostly in Ann Arbor. Early in this report it is mentioned that the U.S. Fish Commission sent Michigan its first fish eggs, and sent a biologist to help out in the first lake surveys in the 1890's.

About 1930, there was the dual development of the Institute for Fisheries Research and a research office of the United States Bureau of Commercial Fisheries; these two units had adjoining rooms in the fish wing of the Museum of Zoology at the University. Although by gentleman's agreement their two fields of interest were separated rather precisely into sport fisheries (mostly inland waters) and commercial fisheries (confined to the Great Lakes), there was, and still is, much cooperation between the two agencies.

A number of research activities have been turned over to other units, as management and field personnel have become oriented more to resource inventory.

Lake and stream surveys and lake mapping (after some 3,000 lakes) were turned over to fisheries field staff. Supervision of district fisheries supervisors was relinquished at an early stage. The Rifle River area was turned over to Parks because of its great potential for public recreation.

As field inventories and scientific fish culture have expanded, and been taken over by other units, there has been a substantial decrease in the research staff. The continuous attrition, over the last 15 years, of increased costs in doing business has also been a factor. The research staff still consists of some 15 research biologists and a good supporting team of assistants and clerical staff. We are looking into the first part of the second century with interest, knowing that there are still many problems to be solved.

BIOGRAPHICAL PROFILES

Persons Notably Engaged in Michigan's Fisheries

By Clarence M. Taube

Among the hundreds of persons Michigan has employed in fisheries within the span of 100 years, there obviously is room for biographical information on only a few. Who were they to be? Settlement of this question was the first task in the preparation of this chapter.

The first decision reached, after much thought, was to include only those persons who have terminated regular employment. This procedure appeared justified because: (1) it automatically assured priority to former workers who rightfully (we think) should be given first consideration; (2) it afforded the highly desirable perspective of time for making judgments in instances requiring choice.

The next decision made was to include in these sketches all the occupants of the top position of responsibility (Superintendent of Fisheries, and Chief of the Fisheries Division) from the beginning of such position, in 1874, to 1973. This decision was based on the opinions that an agency's leader most strongly influences the agency's achievements, and that people naturally are interested in facts related to the lives of such persons. For the same reason, past directors of major units within the Division (research, habitat improvement, etc.) have automatically been included also.

The other people who are subjects of these sketches were chosen either because of the uniqueness of their jobs, or because their job performance was considered outstanding. Evidently, performance usually was extraordinary also in the unique and top positions.

Finally, we think many more persons merited inclusion. But somewhere there must be an ending, and this is but one of several chapters in the history of fisheries conservation and management in Michigan.

GEORGE H. JEROME (1819-1885): fisheries administrator

George H. Jerome was Michigan's first Superintendent of Fisheries. He, George Clark of Ecorse, and Governor John J. Bagley in 1873, became the first members of the governmental unit that was soon to become known as the State Board of Fish Commissioners. On June 15, 1874, Jerome resigned from his post of Commissioner to become Superintendent and Secretary.

Jerome was born at Pompey, Onondaga County, New York. He attended Hamilton College, in his home state, and later earned a degree in law. Soon after

marriage and completion of law studies, he moved with his wife to Niles, Michigan, where a sister of his wife resided.

Judging from his various occupations, this man apparently was an adventurer. He practiced law briefly in Berrien County before abandoning this profession for a magisterial office. In 1851, however, he gave up this position also, to enter the real estate business in Chicago. After about five years, he went to Iowa City, bought a newspaper, and became its managing editor. While engaged in this enterprise, Jerome was state chairman of the Republican Party for several years. President Lincoln appointed him Assessor of Federal Revenue for an Iowa district; he held this appointment four years. Then he returned to Michigan, where he established a home. "Sabine Farm," in a southern suburb of Niles; the location overlooked the city and the St. Joseph River, and afforded a view of the grounds of a Potawatomi reservation. It was while he lived here that he became Fisheries Commissioner, and then Superintendent.

Jerome was Superintendent of Fisheries when the State's first hatchery, located at Pokagon, began operation in 1874 with the incubation of whitefish and chinook salmon eggs. The N. W. Clark Hatchery at Clarkston, which produced the first fish planted by the Commission, continued to provide the State with fry (lake trout and whitefish) for several years. The more distinctive developments during Jerome's term as Commissioner and Superintendent were introduction of Atlantic and chinook salmon, shad, and eels into Michigan waters for the first time, hatching and release of large and increasing numbers of whitefish, and establishment of the Detroit Hatchery in 1876.

Some mention should be made of George Clark, of Decorso, a commercial fisherman. Evidently a far-sighted man, he served on the Fish Commission until his death in 1877; the Commission's eleventh biennial report carries a photograph of him. The following excerpt is from a eulogy on Clark, obviously written by Jerome, that is in the third biennial report:

> He brought, too, to his official position a special intelligence, the very thing which the Board as a board lacked. Theoretically his associates of the Board were well enough [qualified], but in that special intelligence with which their duties and their usefulness stood so intimately connected, they were at best but novices and certified probationers. They leaned upon their friend to help them through many a breaker and over many a shoal, and the confidence and trust so reposed never failed them. In the early sessions of the Board questions which arose of a doubtful augury or of a tangled web, were handed over to him as a thing of course, and by him were solved with a promptness and a facility equaled only by the simplicity of his statements and the modesty with which he voiced his conclusions. In short, he was just the man to found a new industry of the State, and to him more than to any one else belongs the credit of whatever of symmetry and grace and excellence there now appears, or shall appear in the superstructure.

The eulogy is evidence of Jerome's magnanimity; had he not publicized this praise, the credit he properly assigns might have in error been accorded to Jerome himself in future years. Further, other evidence shows that he also was well deserving of his position in the State's fishery agency, despite much less experience with fish than Clark possessed. Someone wrote (in the eleventh report) of Jerome:

> What a figure he was in the early history of fish culture in Michigan! His reports, which cover the first six years of the operations of the board, are permeated with enthusiasm and read like novels. What the particular results lacked in realization was more than compensated for by the eloquence of the superintendent, who wrote with more method even than he knew. Who can read those reports without being stirred with his enthusiasm? While his style may be open to the charge of being turgid, his enthusiasm and his perception of what the future held in store for the work are plainly manifest, and we of a later time have seen his prediction realized. He was a pioneer in fish culture, and the new enterprise was full of discouragements and disappointments, but like all pioneers he possessed that sturdy and strong individuality which makes its possessor conspicuous amongst his fellows.

A portrait of Jerome, in full beard and under a broad-brimmed hat, appears in the Fish Commission's eleventh report.

JAMES G. PORTMAN (1872-1884): fisheries administrator

The successor to George H. Jerome as Superintendent of State Fisheries (and also Secretary) was the Reverend James G. Portman. His tenure was brief and information on him is scant.

This man's father settled in the vicinity of Vicksburg in 1836. James Portman spent two years at Meadville Academy in Pennsylvania. He was Captain of a company from Calhoun County that went to the Civil War, and afterwards he became a chaplain for a regiment. Following the war, he entered the Baptist ministry, and had churches at Marshall, Dowagiac, Lyons, Benton Harbor, and Waterville. He is reported to have been a very effective speaker.

He left the ministry in 1879, when he was appointed Superintendent of Fisheries. We do not know what influenced his appointment. Evidence which points toward his having been an angler is that he was an early distributor of brook trout into a Berrien County stream. He was one of the men (together with Jerome, George Clark, and others) who encouraged enactment of the law that created the State Board of Fish Commissioners, and this activity probably favored his later appointment to the position of Superintendent.

The fish stocking program during Portman's three years of administration differed little from that of Jerome's tenure. As the facilities at Pokagon had

been deemed inadequate, he and Oren Chase looked for a new hatchery site in the summer of 1881. One was chosen near Paris, on Cheeny Creek in Mecosta County, and a hatchery building was erected there that fall.

No record has been found to show why Portman's service as Superintendent was so brief. He died in Benton Harbor the second year after his departure from the position, in 1884, and his body was interred at Marshall.

OREN M. CHASE (1840-1883): fish-culturist and fisheries administrator

The third Superintendent of Fisheries, Oren M. Chase, was the first man to bring a background of hatchery experience to the position. Besides work under Seth Green in New York, he had been a fish culturist in Michigan for seven years.

He was born at Rochester, New York. Around the age of 20 he moved to Michigan. After several years of farming near Dimondale, he returned to Rochester and worked for the New York Central Railroad.

While with the railroad, Chase became acquainted with Seth Green (1817-1888), who perhaps was the foremost American pioneer of fish culture. Eventually Green influenced him to take a job with the New York Fish Commission, at which he soon became proficient.

When in 1875, Superintendent Jerome was looking for a man to work with whitefish in Detroit, he solicited Seth Green for a candidate. Evidently Jerome knew of Chase's good qualifications, as it is reported that his preference was for him. Chase was hired, and after working at the Detroit Hatchery a short while, was put in full charge of operations there. He had this responsibility when appointed Superintendent of State Fisheries in September 1882.

Service in his new position was destined to be extremely brief. In November 1883, he went to Petoskey to help correct a deficiency in the water system of the whitefish hatchery located there. While working on this problem, need arose for him to go to the north side of Little Traverse Bay. The trip was made in a sailing vessel. Before it was time to return to Petoskey, a severe storm had come up on Lake Michigan. On the return trip the vessel was swamped by huge waves and all the passengers drowned. Besides Chase, these were George W. Armstrong and Charles H. Brownell (overseer and assistant at the Petoskey Hatchery) and the owner of the boat. The tragedy happened on November 11. By strange coincidence, another storm such as this one must have been like, tore over Lake Michigan exactly 57 years later, on November 11, 1940.

Oren Chase's main accomplishment in fish culture was his invention of a glass hatching jar that greatly improved and simplified the incubation of eggs of whitefish, walleyes, and several other species. This item came to be known as the Chase jar. With some refinement of the original model, it still is in use today.

WALTER D. MARKS: fish culturist, fisheries administrator

Walter D. Marks served as Superintendent of State Fisheries during 1883-1893. He was in charge (overseer) of the Paris Hatchery in 1883. Oren Chase's accidental death in November resulted in Marks' elevation to Superintendent.

He was a son of Lathrop Marks, a commercial fisherman at Sacketts Harbor and Chaumont, New York. Previous to moving to Michigan, Walter worked at Caledonia Springs, New York, in the private hatchery owned by Seth Green. The two men became well acquainted when Marks guided Green on duck hunting trips shortly after the Civil War. The following were among the more noteworthy accomplishments of the State Board of Fish Commissioners while Marks was Superintendent of Fisheries: production and distribution of whitefish and brook trout fry expanded appreciably; culture and planting of walleyes, rainbow trout, and brown trout began and progressively expanded; the State's first railroad car for fish distribution, the "Atikumaig," was purchased (1888); biological examination of lakes was commenced (1885); and a hatchery was established at Sault Ste. Marie (1891).

Continued planting of three species of fish during the decade of 1883-1893 would eventually prove ill-advised for one species and unsuccessful for the other two. These were the carp, Atlantic salmon, and chinook salmon. The stories of them are told in another chapter.

Related to the outcome of these introductions are the insight and modesty revealed by this refreshing comment in the Commission's seventh biennial report (1885-86):

> It will be noticed that, while we speak sometimes with certainty and assurance on these subjects [the natural requirements of various fish, the need for lake inventory, etc.], we are often compelled to qualify our statements. The reason is, there are still very many things which we do not know about the culture and habits of fishes. As the work goes on, we are learning gradually one fact after another, and the knowledge which comes from experience is always guiding the students of fish culture, as it does all students of nature, to better methods and larger measures of success.

Following his resignation from the position of Superintendent, Walter Marks returned to New York where he became affiliated with the Big Moose Lake Hatchery.

JACOB G. REIGHARD (1861-1942): educator, research biologist, education administrator

Jacob Reighard did advisory work and occasionally carried out biological investigations for the Michigan Fish Commission from 1890 to 1895. He was the first scientist employed by the State to do research on fish.

He was born in LaPorte, Indiana. He received a Ph.D. degree from the University of Michigan in 1882, and attended the medical school there in 1885-86. From 1886 to 1927, Reighard taught, did research, and served in several administrative positions at the University. He was largely responsible for the development of its zoology department, was in charge of it until 1925, was Director of the Museum of Zoology during 1895-1913, founded the U. of M. Biological Station in 1909, and directed it from 1909 to 1914.

While employed by the Fish Commission, he was scientific advisor for the biological examination of lakes. A report he prepared on the early embryology of walleye eggs appears as the Commission's Bulletin No. 1 in its tenth biennial report (1891-92). Also, he wrote Bulletin No. 4, "A Biological Examination of Lake St. Clair" (eleventh report), and Bulletin No. 7, "The Breeding Habits and Propagation of the Black Bass" (sixteenth report). Besides his numerous academic accomplishments, he launched fisheries research in Michigan with a highly commendable start.

The University of Michigan in 1934 gave Reighard the honorary degree of Doctor of Science. A plaque bearing a life-size bas-relief of him is mounted on a hallway wall in the Museum of Zoology, appropriately located in the area of the Fish Division.

SEYMOUR BOWER (1853-1924): fish culturist, fisheries administrator

Seymour Bower became the fifth Superintendent of Fisheries, in 1893. He served in this position for longer than any of the predecessors, until 1921, when the newly organized Department of Conservation absorbed the assets and responsibilities of the State Board of Fish Commissioners.

Bower was born on a farm near Clarkston. After he reached manhood, he went into the drug business at Deerfield. Frank N. Clark, who with his father, Nelson W. Clark, had operated a private trout hatchery at Clarkston, and later another at Northville, influenced him in 1880 to take a job at the Northville Hatchery, which had been leased by the U. S. Bureau of Fisheries that year. He also worked in other Federal hatcheries at Duluth, Minnesota, Put-in-Bay, Ohio, and Green Lake, Maine. When appointed State Superintendent of Fisheries, he was overseer of the Detroit Hatchery.

Work in fisheries was highly active during Bower's employment as Superintendent. Although trout and whitefish propagation and planting continued to be important functions, warmwater fish received increased attention. Planting of walleyes expanded further, pond culture of smallmouth and largemouth bass was begun, and planting of pike, yellow perch, and the smaller species of centrarchid fishes commenced. The smelt was successfully introduced into Michigan.

Although fish culture and distribution continued in these years to be the primary function of the Fish Commission, other matters (such as legal regulations and research) received increasing attention. Six of the seven scientific bulletins that the Commission published during its existence appeared in print within this period. The Superintendent himself directly contributed to this progression of expanding interests by publishing three papers in the Transactions of the American Fisheries Society ("Fish Protection and Fish Production," "The Rainbow Trout in Michigan," and "Fishery Conservation") and by his other activities in the Society. He served as its secretary in 1900-01, and as its president in 1909-10. At the International Fisheries Exposition in London in 1883, he was awarded a medal for his inventions of fish cultural equipment.

Several other members of the Bower family engaged in fisheries work. A son of Seymour's, Ward T. Bower, was with the U.S. Bureau of Fisheries for many years, and at one time served as Chief of its Alaska Division. Another son, Harold, worked in the Lansing office of the Fisheries Division during the early years of the Department of Conservation. A son of Harold's, Spencer M. Bower, was later also employed in the Division's Lansing office, retiring in 1964.

In 1932, the books and other publications concerning fish and fisheries in Seymour Bower's personal library were transferred to the State Library. This Collection became the nucleus of a special section there which was named the Seymour Bower Memorial Library. It has grown through gifts from various sources.

HERSCHEL WHITAKER (1847-1900): fish commissioner

Members of the Board of Fish Commissioners are among the numerous forgotten people of the early years of this State's work in fisheries. Even though Herschel Whitaker was one of the more active Commissioners and served longer than any of the others during the Board's 48-year existence, probably few people of the present time have ever heard of him.

Whitaker was born at Turin, Lewis County, New York. He attended Cazenovia College (New York) and Poughkeepsie Business College. At the age of 21 he went to Waterloo, Iowa, where he engaged in grain and brokerage transactions. In 1872, he returned to his native state and studied phonography (a system of shorthand) while residing in New York City. He came to Detroit in 1874, and lived here the rest of his life.

He commenced a career as stenographer right after he came to Detroit. He was official stenographer for the U.S. Circuit and District courts for the Eastern District of Michigan for five years, then for the Wayne County Probate Court for two years, and he also worked at his profession privately.

Various evidence indicates that Whitaker was an ardent angler. In February 1883, he became the first Secretary of the Fish Commission; the secretarial duties to this time had been included with other duties of the Superintendent

of State Fisheries. In June 1884, he relinquished this salaried position to take the unsalaried position of Commissioner, exchanging posts with Andrew J. Kellogg. After completing Kellogg's term, he was successively reappointed three times to the 6-year office.

The biennial reports of the State Board of Fish Commissioners tell little of what the individual Commissioners said or did; the minutes of the Board's meetings may have been more revealing, but these records have probably disappeared. Therefore, to learn of Whitaker's interests and efforts as Commissioner, one must refer to his writings and comments in the Transactions of the American Fisheries Society. Five of his papers appear in this journal. He was the Society's president for two 1-year terms (1892-93 and 1896-97) and its recording secretary one term (1898-99).

Apparently his major concern as Commissioner was that of seeking control of commercial fishing on the Great Lakes, which he contended was wantonly depleting the resources. He repeatedly sought good legislation and its enforcement to conserve these fisheries. Other than this concern, his interests in fisheries were varied. Of his papers in the Transactions, "The Grayling in Michigan" (Vol. 15, 1886) may hold the most enduring interest. Other members of the Fish Commission may have had as dedicated interest in their agency's functions, but if they did, they left much less evidence of it than Whitaker.

He had completed about half of his last 6-year appointment when he died of heart failure on May 5, 1900. An obituary reveals that club and lodge work were among the sideline interests of this busy, robust man; it also reported that he had been an adept entertainer.

In 1942, his daughter, Mrs. Hedley Richardson of Detroit, presented to the Detroit Public Library, 102 rare books he had collected on subjects related to the Northwest Territory. They were added to the Library's Burton Historical Collection under the separate designation of the Horsdal Whitaker Collection.

A. T. STEWART (1870-1946): fish culturist, fisheries administrator

A. T. Stewart was placed in charge of the state's fisheries operations after the Department of Conservation was organized in 1921. He had previously been engaged in fish cultural work a long time.

He commenced employment in this field at the Federal hatchery in Northville in 1893, and remained in fisheries all but a few years thereafter. From Northville he moved to the hatchery at Charlevoix; he was in charge of this facility when he transferred to employment with the state, after 28 years in the Federal service.

The section concerned with fish in the newly formed Department of Conservation was originally called the Division of Fish Cultural Operations; the title of its chief was Superintendent of Fish Hatcheries. A. T. Stewart received

the first appointment to this position. This unit was renamed Division of Fisheries within the second biennium, and except for minor variations, it has retained this title to the present time.

Stewart was in charge of this Division from 1921 to 1925. Within this period, hatcheries were built at Marquette and Watersmeet (both in 1922) and at Bay City in 1923; rearing stations at Sidnaw and Wolverine began operating in 1922.

Stewart became overseer of the Drayton Plains Hatchery in 1925, and several years later was designated also supervisor of the fisheries district which covered the counties in the southeastern corner of the State. In the 1930's, the facilities at Drayton Plains were enlarged and improved through a quarter-million-dollar program under a Federal public works agency. "A. T." (as Stewart was familiarly known) retired in 1944.

THE MARKS FAMILY: a remarkable group

Not to delegate space in this chapter for members of a family whose combined service in fisheries work for Michigan has amounted to over 150 years would be an unfortunate omission.

This story has its beginning with Lathrop Marks, the commercial fisherman in New York State, who was the father of Walter D. Marks. Lathrop had at least three other sons, one of whom was Aaron W. Orem Chase selected Aaron and Walter from Seth Green's hatchery staff to assist him in Michigan. Aaron worked in hatcheries, became overseer of the Petoskey Hatchery, and later supervised whitefish culture operations at Detroit; finally, he became manager of a private hatchery at Munising.

Two of Walter's sons, Orr D. and Floyd C., were employed under the Fish Commission's program also, as were three of Aaron's sons, Harry H., Jesse P., and Jay G. Harry worked in the hatcheries at Detroit, Paris, and Sault Ste. Marie, and became Superintendent of the latter hatchery. Jesse and Jay continued their service under the Department of Conservation when this agency in 1921 absorbed the functions of the Fish Commission. Jesse resigned in 1930 after 46 years of State service. Jay retired in 1946 (at the time he was Superintendent of the Wolf Lake Hatchery and Fisheries Supervisor for the southern half of the Lower Peninsula), after approximately 25 years in fish culture with the State, and 9 years in private hatcheries.

Harry H. Marks had two sons who carried on the unique tradition of their clan. They were Harry A. and Ralph S. Harry A. Marks worked but briefly in fisheries; he was a tug captain for many years on the Great Lakes. Ralph was employed 43 years in the Fisheries Division, last as Regional Fisheries Supervisor for the southern half of the Lower Peninsula. With his death in 1961, the long, continuous span of service by members of this family in Michigan fisheries work came to an end. The line of succession might have continued

unbroken even longer had "Bill" Marks (son of Harry A.) not chosen employment in a different field of conservation. He is Chief of the Water Development Services Division, Bureau of Water Management, in the Department of Natural Resources. Hence the Marks family's continuous employment with the State in some kind of conservation work does remain unbroken, and now amounts to almost 100 years.

DWIGHT LYDELL (1861-1927): fish culturist

Dwight Lydell was employed at several jobs under the Fish Commission and in the Fisheries Division of the Department of Conservation, but his main efforts and accomplishments were in fish culture. In this activity he is remembered best for his work with bass.

He was another of Michigan's fisheries men who originated in the Empire State, on a farm in Chautauqua County. His family moved to a farm in Michigan when he was yet a child. He worked here until the age of 22, when he became an apprentice at the Paris Hatchery, in 1883. Later he assisted in lake investigations during the summer months, and at collecting whitefish eggs on the Detroit River in the fall. During 1901-08, he was in charge of the whitefish fishery at Belle Isle for the U.S. Bureau of Fisheries.

When the Fish Commission commenced pond culture of black bass, at Cascade on the Thornapple River in 1896, Lydell took charge of this work. He continued with it after the operation was transferred to Comstock Park, on Mill Creek, in 1897, and kept at it here the rest of his life. Besides this assignment, he was Assistant Superintendent of Hatcheries during 1915-1925. Results of observations and experiments he conducted at the Mill Creek (later renamed Comstock Park) Hatchery are described in nine scientific papers of his that were published in the Transactions of the American Fisheries Society.

Perhaps the most remarkable feature of Dwight Lydell's achievements was that he had only a country school education. Jacob Reighard commented in an obituary on this man's exceptional abilities (The Progressive Fish-Culturist, March-April 1937). In his report on the breeding habits and reproduction of bass (Fish Commission Bulletin No. 7), Reighard credits Lydell with having originally made a number of the observations described in the bulletin.

The appreciation that his home community had for Dwight Lydell was memorialized by the naming of the Grand Rapids chapter of the Izaak Walton League in his honor.

FRED A. WESTERMAN (1890-): fisheries administrator

Fred A. Westerman was the second man to be in charge of fisheries activities under the Department of Conservation (now the Department of Natural Resources), and he served far longer in this capacity than has anyone else, including the Chairman for the State Fish Commission. He witnessed drastic changes during the 34 years he directed the unit responsible for proposing and executing fish management practices.

REPRESENTATIVE HATCHERY SUPERINTENDENTS

HARRY H. MARKS

(1872 - 1913)

SUPT. OF SAULT STE. MARIE HATCHERY 1896-1913. ALSO LONG-TIME CAPTAIN OF THE FISH CAR.

ARVIN J. WALCOTT

SUPT. OF PARIS HATCHERY

1925-1938

DWIGHT LYDELL

(1861 - 1927)

SUPT. OF CONSTOCK PARK HATCHERY 1897-1927

He was born and grew up near Paris. His father, John H. Westerman, worked at the Paris Hatchery, beginning in 1892. The elder Westerman, better known by his second name, Henry, than by his first, became overseer of the Harrietta Hatchery in 1913 and held this position to the time he died in 1923. Not as one would expect, the father tried to discourage his son in entering fisheries work.

The younger Westerman worked on the family farm, served several years as a substitute rural mail carrier, and attended Ferris Institute (now Ferris State College) three winters. He took employment as a laborer at the Harrietta Hatchery in 1913. The following year he was assigned to the job of messenger on the Commission's railroad fish car, "Wolverine." Soon afterwards he was appointed Car Superintendent. Except for a year spent in military duty during World War I, he stayed with this job until 1923. During 1923-1924 he was overseer of the Harrietta Hatchery, and on January 1, 1925, became Chief of the Fisheries Division.

Many developments in construction, methods, and administration occurred during the period Mr. Westerman had top responsibility for the management of the State's fisheries. Some of the more important developments were: considerable further expansion in the late 1920's of fish cultural facilities; adoption of research on a full-time basis, followed by broad expansion of it; acquisition and improvement of public access sites on lakes and streams; sharp curtailment of planting the small species of warm-water fish; fish population reduction where need for it was demonstrated; broad expansion of the practice of planting trout at fingerling and legal sizes; and fish habitat improvement in lakes and streams. The more difficult years of this period were those of the Great Depression in the 1930's when funds were scarce, and of World War II in the 1940's, when many of the Division's employees were in military service.

Close associates of Mr. Westerman, with their positions at that time, included these men: Harold Bower, administrative assistant, a son of Seymour Bower; A. H. Cook, Assistant Chief of the Fisheries Division; Marston J. DeBoer, administrative assistant; Carl L. Hubbs and Albert S. Hazzard, research directors; Stanley Shust, Ralph S. Marks, James T. Wilkinson, and C. Troy Yoder, regional fisheries supervisors; Justin W. Leonard, Department Assistant Deputy Director; O. Horace Clark, in charge of fish habitat improvement; Spencer Bower, administrative assistant, son of Harold Bower; and Floyd Fanselow, the Division's civil engineer. He also had close business ties with John Van Oosten, in charge of Great Lakes investigations for the U.S. Bureau of Commercial Fisheries, and with Van Oosten's successor, James W. Moffett.

Mr. Westerman has been a member of the American Fisheries Society for many years. Three papers written by him appeared in the Society's Transactions: "Progress in Trout Propagation in Michigan" (Vol. 59); "The Deep Water Trap Net and its Relation to the Great Lakes Fisheries" (Vol. 62); and "Exploring New Fields in Fisheries Management" (Vol. 67). He served as president of the Society in 1933-34.

Mr. Westerman retired [illegible] 1950. He carries his considerable accumulation of years very well [illegible] lively, clear in mind, and optimistic in spirit.

JAN METZELAAR (1891-1929): fisheries research biologist

Jan Metzelaar was Michigan's first full-time fisheries biologist. When he died after only four years in this job, this man with a European background was still acquiring a basic understanding of the problems he was charged to help solve.

He was born at Slushing in the Netherlands. He obtained his later education at the University of Amsterdam (Sc.D., 1919), and worked in the fisheries service of Holland for several years before coming to the United States in 1923. This same year the University of Michigan employed him for duties in the Fish Division of the Museum of Zoology. Ichthyology was his speciality, but he also had an interest in genetics; two reports he wrote on inheritance factors in domestic pigeons were published.

In 1925, he was made honorary custodian of Michigan fishes in the Museum; also this year he commenced work with the State from his location in the Museum. He investigated numerous lakes and streams, and drew up management recommendations for them. Judged on the basis of today's standards, these surveys were rather superficial and seem to be of small importance. However, one should keep in mind that he had but little experience of previous workers to draw from, and that equipment and techniques presently used were developed in later years. Perhaps an unfortunate characteristic of this man was his inclination to be brash in dealings with people whose occupational business intermeshed with his.

A concept that Metzelaar favored was that the fishery of each body of water ought to be managed individually rather than under a blanket system for various waters. This concept has since then been adopted into practice in Michigan and elsewhere, although perhaps not to the detailed extent that he conceived its application. Two technical papers resulted from his specialized research, both published in the Transactions of the American Fisheries Society. These are "The Food of the Rainbow Trout in Michigan" (Vol. 58) and "The Food of the Trout of Michigan" (Vol. 59).

While working with nets on Grand Lake, Presque Isle County, on October 4, 1929, Metzelaar drowned. This happened two days after he was granted American citizenship. A bay of Grand Lake, presumably the area in which he lost his life, was subsequently given his name.

JOHN N. LOWE (1886-1938): biologist, educator

This man worked for the Department of Conservation seasonally several years. He had the unique experience of observing and collecting specimens from the last existing population of the fabulous Michigan grayling.

John N. Lowe was born at Princeton, Wisconsin. He acquired his advanced education at Ripon College and at the University of Wisconsin, receiving his doctorate at the latter school. He taught biology at Ripon College, the University of California, the University of Wisconsin, Texas College, and beginning in 1919, at Northern State Teachers College (now Northern Michigan University). The breadth of his interests was similar to that of his teaching experience. Besides fishes, he studied birds, insects, mammals, flowers, and rocks.

He took employment with the Department of Conservation as Biological Advisor in the summer of 1925. It was then also that he began his observations for the Department on the grayling of the Otter River in the Keweenaw Peninsula. His subsequent activities included collecting fishes on Isle Royale, extensive surveys of waters in Keweenaw and Menominee counties, random collecting in various other parts of the Upper Peninsula, and resumption of work on the grayling in 1929. Information on this and earlier collecting, dating from 1920 through 1938, appears in W. R. Taylor's paper, "Records of Fishes in the John N. Lowe Collection from the Upper Peninsula of Michigan" (Miscellaneous Publication No. 87, Museum of Zoology, the University of Michigan).

Lowe's main contributions to the knowledge of Michigan fishes were the assembling of collections and the notation of records that provided information on distribution in the early 1900's of the various species in the Upper Peninsula, including the distribution and habits of the grayling in the Otter River. He did not publish his findings on the grayling, but did record some of them in notebooks. Despite the great abundance of this fish in streams of the northern Lower Peninsula into the later 1800's, only superficial studies were made of it then. Hence Lowe's investigations of it hold considerable interest, although they were not anywhere near as intensive as they might have been.

John Lowe met the final, unavoidable challenge "with his boots on." He suffered a fatal cerebral embolism while returning with his students from a field trip to Hogback Mountain near Marquette, on July 27, 1938.

CARL L. HUBBS (1894-): biologist, educator, fisheries research administrator

Carl Hubbs came into the employment period of his lifetime when government conservation agencies were beginning to include research work in their programs on a significant scale. When the Institute for Fisheries Research was established in 1930, as the Fisheries Division's research unit, he was appointed its director.

He was born in Williams, Arizona. He obtained his university education at Stanford and at Michigan, receiving the doctoral degree from the latter institution. Before coming to the University of Michigan in 1920, he had been Assistant Curator of Ichthyology and Herpetology at the Field Museum of Natural History in Chicago. At Michigan, he taught and was Curator of Fishes in the Museum of Zoology; at this time he also periodically performed assignments for the State. Then in 1930, he was placed in charge of fisheries research for the State.

Projects of the Institute for Fisheries Research under the directorship of Dr. Hubbs included: biological inventories of lakes and streams; lake mapping; investigation of fish mortalities and water pollution; studies of predation on fish, and of age, growth, and stunting; fish tagging; and pioneering efforts to develop methods of improving fish habitat.

PROF. JACOB E. REIGHARD

Zoology Department, University of Michigan, Did biological research for the Fish Commission, 1890-1895.

PROF. CARL L. HUBBS

Museum of Zoology, University of Michigan, Founder of the Institute for Fisheries Research, and its first director (1930-1935).

DR. JAN METZELAAR

(1891-1928)

First full-time fisheries scientist to work for the Fish Division

One of his first associates at the University was Alexander G. Ruthven, Director of the Museum of Zoology, who later became President of the University; Dr. Hubbs worked under Ruthven also for the State. Other close associates in his work for Michigan were R. W. Eschmeyer, J. R. Greeley, Walter Koelz, Thomas H. Langlois, Jan Metzelaar, J. C. Salyer, C. M. Tarzwell, Milton Trautman, and John Van Oosten.

He resigned from the directorship of the Institute for Fisheries Research in 1935 and from his connections with the University of Michigan in 1944. In 1944, he became affiliated with Scripps Institution of Oceanography (La Jolla, California), a part of the University of California at San Diego.

Besides his direct and administrative work in research, Dr. Hubbs guided the advanced education of numerous students, and has written prolifically on various subjects of science. Fishes of the Great Lakes Region, which he prepared with Dr. Karl F. Lagler, Professor of Fisheries at the University of Michigan, has been a highly useful reference for workers in Michigan.

Dr. Hubbs retired from the Scripps Institution in 1969.

WILLIAM H. LOUTIT (1867-1948): conservation commissioner

Since 1921, when the Conservation Commission (now the Natural Resources Commission) was established, its members have in numerous ways promoted fish conservation and management. Therefore it seems quite proper to include a sketch of a representative of this body. One of the members who was particularly interested in the activities of the Fisheries Division was William H. Loutit, Commissioner from 1927 to 1941.

Loutit was a lifelong resident of Grand Haven. The farthest extent of his formal education was training he received at a business college. Afterwards he became associated with a tool manufacturing business in Grand Haven.

He had many civic interests. At various times he was an official in two highway associations, a member of the State Board of Corrections and Charities, on the governing board of Grand Haven's first hospital, and mayor of the city for five years, among other similar affiliations. Republican Governor Fred Green appointed him, a staunch Democrat, to the Conservation Commission in 1927.

Loutit's interest in conservation matters was broad. Even so, and also amid the highly varied business transacted by the Commission, he indicated special interest in matters pertaining to fish, which likely stemmed from his hobby of fishing. He belonged to an anglers' club, and had been active in the Izaak Walton League long before his appointment as Commissioner. Correspondence between him and people in the Fisheries Division shows how keen his concern was in the functions of this unit. He often visited installations and examined field projects to see what was being done. He was inclined to give such close attention to details that ordinarily would not be expected of a person in his position. He was outspoken

on his opinions and convictions, sometimes very bluntly so. One can marvel on the amount of time he gave his unsalaried job.

He was chairman 12 of the 14 years he served on the Conservation Commission. (This was before the chairmanship came to be rotated regularly.) While still a Commissioner, writers on outdoor subjects frequently praised the quality and quantity of his effort for the conservation cause. But contrary to these rewards, Loutit was to experience disappointment near the close of his stewardship.

As the end of his last term of duty approached in 1941, he desired re-appointment to the Commission for two more years to complete a particular segment of work. He was, however, bypassed. It was said at the time that Democratic Governor Murray Van Wagoner did not reappoint him because he had opposed efforts, supported by the Governor, to introduce political control into the Conservation Department. So Loutit concluded his service with the Conservation Commission as paradoxically as he had begun it.

One of the more tangible monuments to William H. Loutit's many contributions to social progress is Grand Haven's public library, which he and his family were responsible for, which still receives support from their estate, and which bears the family's name. He, his wife, and their son (all deceased) are still contributing to the welfare of their home town and Michigan through numerous annual grants from a foundation, whose history is very briefly outlined in its fifth (1970-71) report with these words:

> The Loutit Foundation established by William R. Loutit in 1957 is a living memorial to his parents, William H. and Maude Loutit who worked untiringly for Grand Haven and the State of Michigan and to Capt. William R. Loutit, his grandfather a lumber and shipping pioneer in the Spring Lake-Grand Haven area.

ALBERT S. HAZZARD (1901-): biologist, fisheries research administrator

Albert S. Hazzard in 1935 succeeded Carl L. Hubbs as Director of the Institute for Fisheries Research.

He was born at Buchanan, New York, and received all of his advanced education at Cornell University, which granted him the doctoral degree in 1931. While at Cornell he was also instructor in zoology and worked during summers for the New York Conservation Department, first as a member and later in charge of the stream unit of the Biological Survey. In 1931-35 he was in charge of fisheries investigations in the inter-mountain region of the West for the U.S. Bureau of Fisheries.

These were among the projects and accomplishments of the Institute for Fisheries Research under Dr. Hazzard's directorship: continuation and expansion of the lake mapping and lake and stream biological inventory programs; performance

of numerous detailed studies on fisheries problems and fish; investigation of the need for and development of improved techniques for eradicating undesirable fish populations; development in 1945, with other units of the Fisheries Division, of new fish stocking policies; research to determine realistic fishing regulations; encouragement of fisheries students through an expanded fellowship program; and establishment of field research stations at Hunt Creek, Rifle River, Pigeon River, and Marquette, and a fish pathology laboratory at Grayling.

Among Dr. Hazzard's full-time biologist associates in the Institute were these persons, including the present (or latest) employment affiliation: C. J. D. Brown, Montana State University, retired; G. P. Cooper, MDNR[1]; E. L. Cooper (brother of G. P. Cooper), Pennsylvania State University; J. W. Leonard, the University of Michigan, and Fannie Leonard, Michigan State University, retired; R. W. Eschmeyer, Sport Fishing Institute, deceased; P. H. Eschmeyer (brother of R. W. Eschmeyer), USBSFW[2]; D. S. Shetter, MDNR, deceased; W. F. Carbine, USBCF[3], deceased; W. C. Beckman, FAO, United Nations; J. W. Moffett, USBCF, deceased; R. C. Ball, Michigan State University; E. W. Roelofs, Michigan State University; John Funk, Missouri Department of Conservation; L. N. Allison, MDNR, retired; W. R. Crowe, Great Lakes Fishery Commission; O. H. Clark, MDNR, deceased; S. J. Lievense, MDNR, retired; L. A. Krumholz, University of Louisville; G. N. Washburn, USBSFW, retired; L. R. Anderson, MDNR; C. T. Yoder, MDNR; D. B. Reynolds, MDNR, deceased; K. G. Fukano, USBCF; H. S. Predmore, MDNR, deceased; W. E. Mason, MDNR; H. J. Vondell, MDNR; F. F. Hooper, the University of Michigan; R. V. Hughes, MDNR, lake mapping supervisor, retired; K. E. Christensen, MDNR; J. E. Williams, MDNR, deceased; W. H. Tody, MDNR; T. M. Stauffer, MDNR; C. M. Taube, MDNR; E. S. Bacon, MDNR; W. C. Latta, MDNR; M. G. Galbraith, MDNR; E. E. Schultz, MDNR; M. J. Whalls, California State Polytechnic College.

Close cooperative relationships were maintained with these institutions or agencies: the University of Michigan (R. M. Bailey, R. R. Miller, K. F. Lagler, P. S. Welch); Michigan State University (R. C. Ball, P. L. Tack); U.S. Bureau of Commercial Fisheries (Ralph Hile, J. W. Moffett, John Van Oosten).

Late in 1955, he resigned from employment in Michigan[1] to become Assistant Executive Director of the Pennsylvania Fish Commission. He retired from this position in 1968. Since then he has resided near Cadosia, New York.

[1] Michigan Department of Natural Resources.

[2] U.S. Bureau of Sport Fisheries and Wildlife.

[3] U.S. Bureau of Commercial Fisheries.

[4] After Dr. Hazzard resigned from the directorship of the Institute for Fisheries Research, Gerald P. Cooper filled this position. Dr. Cooper had been Assistant Director since 1945, and had contributed much to the development and execution of investigations. When the Department of Conservation was reorganized in 1964, the Institute's functions were transferred from the Fisheries Division to the newly formed Research and Development Division, Dr. Cooper's title now being Supervisor of Fisheries Research. When research was returned to the jurisdiction of the Fisheries Division in January 1973, Dr. Cooper continued as Supervisor, in Charge of Fisheries Research.

Dr. Hazzard, long an active member and now an honorary member of the American Fisheries Society, was president of this organization in 1950-51. He has had a number of papers published in the Society's journal and elsewhere. He now does fisheries consulting to the extent that fishing, hunting, gardening, attending his own fish ponds, and participating in various conservation activities will allow. He has been on the Board of Scientific Advisors of Trout Unlimited for a number of years, and received the organization's first annual Trout Conservation Award. Recently one of the New York chapters was named for him. He also has been active in local conservation affairs. He received the non-farmer award for soil conservation practices that he applied on his farm. He is a charter member and honorary vice president of the Delaware County Conservation Association.

ORTON HORACE CLARK (1897-1972): fisheries administrator (habitat improvement)

When the Lake and Stream Improvement Section was established in the Fisheries Division in 1940, Horace Clark was placed in charge of it. The State had done some fish habitat work early in the 1930's, and the Civilian Conservation Corps (CCC) continued it later in that decade.

Clark was born at Kalamazoo. He was a plane pilot in France during World War I. The University of Michigan provided his advanced education. Between 1923 and 1937, he worked in various jobs and in businesses of his own. The agencies he was employed with during this period included the Geological Survey Division of the Department of Conservation and the U.S. Geological Survey; in 1935, he was with the National Park Service, working on the Waterloo Project, involving land which eventually formed the Waterloo Recreation Area, in Jackson and Washtenaw counties, which is administered by the Parks Division of the Department of Natural Resources. In 1937-40, he was with the Institute for Fisheries Research. He moved to the Lansing office of the Fisheries Division in 1940.

As habitat improvement was still a new facet of fisheries management by 1940, considerable experimentation was undertaken on structures and practices. Exploration was expanded further in 1950, when environmental improvement on streams began to be applied to entire drainage systems. Work was done in many parts of the State--on lakes, on individual streams, and on stream systems.

In 1962, Clark retired from the Department of Natural Resources, then still known as the Department of Conservation. After this he and his wife practiced their hobby of collecting and raising orchids more intensively, travelled abroad frequently, and he taught part-time in the geography department at the University of Michigan. The Clark home for many years, and to the time he died, was situated next to a golf course (Ann Arbor's first public course) which he had developed in 1923. Since 1929, this has been the University of Michigan's golf course.

A. B. COOK (1901-): fisheries administrator

A. B. Cook followed F. A. Westerman as Chief of the Fisheries Division. Before this time, he had been Assistant Chief approximately 14 years preceded by a lengthy span of other assignments in the Division.

He was born at Owosso and has resided in Shiawassee County all but a few years of his lifetime. He graduated from Michigan State College (now Michigan State University), and taught agriculture and biology courses in secondary schools about five years. He came to the Fisheries Division in 1929.

In the early years, "A. B." was mainly concerned with the administration of fish cultural operations, in which he constantly endeavored to improve efficiency in the hatchery systems. He served in the Army during World War II, attaining the rank of Lieutenant Colonel; upon his return to the Fisheries Division in 1945, he was promoted to the position of Assistant Chief. He became Chief in mid-1953.

The Division's programs while he was in charge were similar to those in effect at the close of Mr. Westerman's administration. Mr. Cook had of course, contributed to the formulation of them. Management practices that were accelerated during 1959-1964, were pike marsh development, fish removal and restocking in lakes that contained undesirable populations, and muskellunge culture and planting. The accumulation of lake trout brood stock and the planting of young in the upper Great Lakes, to undo the ravages of the sea lamprey, were augmented.

Mr. Cook's professional associates included most of Mr. Westerman's plus these men in the fish cultural section: Roy Johnston, Guy Lincoln, Jay Marks, John Brass, Jack F. Brass (son of John), Robert G. Fortney, Walter Hughes, Harold Hughes (brother of Walter), L. B. Hoodmaker, Urvin Moody, Hans L. Peterson, James A. Scully, Joseph Southwick, Harrell L. Thompson, Emerson Krieg, Henry Hart, Claude Lydell, Lyle Newton, Fred Owens, Russell Robertson, Martin Miller, Ted A. Monti, Clifford Long, Richard Brodrick, Barney Engel, Donald Gilbert, and Floyd Warren. Another associate was Ernest Batterson, architect, who had much to do with hatchery building development in the 1930's.

Mr. Cook retired in February 1964 [1]. He continues to live in the Owosso area on a plot of land that was a part of the farm he grew up on.

[1] After Mr. Cook's retirement, occupants in the position of Chief, Fisheries Division have been these men: James T. McFadden served temporarily as Chief, from February to July 1964, while the Department of Conservation (now titled Department of Natural Resources) was undergoing reorganization. Dr. McFadden resigned to take a teaching position at the University of British Columbia; then he went to the University of Michigan to teach in the School of Natural Resources, and presently he is Dean of this school. Howard A. Tanner, originally a Michigander who was employed as Chief of Fisheries Research by Colorado, followed Dr. McFadden. In July 1966, Dr. Tanner resigned to become Director of the Department of Natural Resources at Michigan State University. Wayne H. Tody, the present Chief of the Fisheries Division, succeeded Dr. Tanner. Dr. Tody has been employed with the Division since 1947. He has worked in research, habitat improvement (in charge of this section several years), and as a fish-management specialist before becoming Chief.

MARSTON J. DeBOER (1897-1968): fish culturist, fisheries administrator

Marston DeBoer spent nearly 50 years in fisheries work for Michigan.

Grand Rapids was his birthplace. In 1915, at the age of 17, he became a messenger on the State's railroad fish car "Wolverine." He was on the car for five years, either as messenger or in charge, working at the Paris Hatchery when the car was not in transit. He also worked in the hatcheries at Comstock Park, Thompson, and Sault Ste. Marie, and spent time in military service during World War I. He was superintendent of the Sault Ste. Marie Hatchery from 1922 to 1928.

DeBoer became an administrator in the Lansing office of the Fisheries Division in 1928, and remained at this location until retirement. He held various positions of responsibility. He was Assistant Chief of the Fisheries Division during 1940-1945. At various other times he was supervisor of hatchery operations, of hatcheries and public fishing sites, and of the field management section. He retired in 1964.

Much of "Marty" DeBoer's service was representative of that of many men and women (clerks, typists, technicians, and at times, even supervisors) who work in government agencies. That is, their duties are largely routines, and their efforts are seldom (if ever) recognized by the public; even so, successful completion of important programs usually depends strongly on good performance in these seemingly jobs.

ROGER G. WICKLUND (1924-1966): fish habitat specialist

Michigan pioneered in stream improvement, and in this, Roger Wicklund had an important role. Wicklund was born on a farm near Scottville in Mason County. He spent a large amount of his spare time fishing the Pere Marquette and Pentwater rivers. After World War II he attended The University of Michigan where he received professional training in forestry, fisheries, and wildlife management. Following his father's early death, Roger was the chief supporter of his family.

Roger was employed as the first planner on the Rifle River Watershed development project, where one of his achievements was the development of master plans for large-scale projects on trout streams. He was very effective in designing structures for trout cover which blended well with natural features of streams. He also led field parties on trout stream surveys to evaluate improvement projects and put the work on a scientific basis. Perhaps his main achievement was that of training younger habitat biologists for successful careers with the Fisheries Division. Roger's very successful career was cut short at the peak of his capability at the age of 41 by a heart attack in his home.

DAVID S. SHETTER (1910-1970): fisheries research biologist

David Shetter began his employment with the Institute for Fisheries Research the year this unit was established, and stayed with it the entire length of his professional career.

Pueblo, Colorado, was his birthplace. The University of Michigan afforded him all his advanced education, including a doctoral degree. He took a seasonal job with the Institute in the summer of 1930. He worked there part-time on a fellowship from 1934 into 1937, and went into a full-time job the latter year.

Most of Shetter's assignments concerned trout. Because fisheries research in this country was still in its infancy when he entered the field, several of the investigations were of the pioneering kind. In this category was the tagging of fish to assist study of their movements. So also was the early use of electricity for collecting fish. He and associates conducted numerous studies on trout populations and harvest, carried out experiments to determine desirable regulations on trout fishing, and performed much other research besides.

In the early years, he worked at and out from headquarters in Ann Arbor. Beginning in 1943, he was located at, and was in charge of the Hunt Creek Trout Research Station. Many of his studies were done here, although he continued to work in other parts of the State also. Finally, his supervision generally covered all research on cold-water fishes. He wrote prolifically on the results of the research he conducted and supervised. He was highly active in the community affairs of his home town of Lewiston. He loved the northland, where he spent so much of his life. "Dave" died suddenly of a heart attack on December 23, 1970.

LEONARD N. ALLISON (1910-): fish pathologist

The State employed several men at different times, beginning in 1927, to diagnose and treat fish diseases. Continuous attention to these responsibilities commenced in 1948, when Leonard Allison was designated Fish Pathologist.

He was born at Lowellville, Ohio. He obtained his later education at Grove City College (Pennsylvania), the University of Buffalo, and at the University of Michigan (PhD, 1942). He served as a biologist in 1939 for the Stream Control Commission (later designated the Water Resources Commission) in the first work done in Michigan on the problem of "swimmers' itch."

His employment with the Institute for Fisheries Research began in 1942. From this time into 1944, he was stationed at the Grayling Hatchery as a district biologist, but his duties included a considerable amount of work on fish diseases. During military service in 1944-46, he was in charge of a malaria control unit. He returned to the district position at Grayling in 1946. Beginning in 1948, his assignments almost entirely concerned diseases and parasites of fish and tests on fish diets.

Allison now bore a sizable share of the responsibility for the health of fish at all the State's hatcheries, with help from hatchery workers in disease prevention and treatment programs. The problems from diseases and parasites were more significant now than they had been in earlier years, for one reason because trout were now grown to larger sizes before they were planted. Appearance of several diseases new to Michigan complicated matters also. Besides attending to the well-being of hatchery stock, he also investigated problems that arose in natural fish populations. Allison accumulated a considerable store of knowledge on his specialty. This appears in the reports he wrote, a number of which were published. "Len" retired in 1974, continuing residence in Grayling.

RUSSELL C. ROBERTSON (1907-): fish culturist

Like numerous other employees of the Fisheries Division, Russell Robertson made fisheries work his lifetime career.

He was born at Manistee. He began hatchery work as a laborer at the Grayling Hatchery in 1927. After nine years at Grayling, he spent a year each at the Bay City Hatchery, at the Hunt Creek Trout Rearing Station, and with investigators from the U.S. Bureau of Commercial Fisheries checking the effects of deep trap nets in lakes Michigan and Huron. Then after three years of other work he resumed employment with the State in 1943 at the Marquette Hatchery. After a spell of military duty during World War II, he returned to this hatchery in 1945 and became its superintendent.

Work at the Marquette Hatchery took on special importance soon afterwards because of a particular turn of events. The sea lamprey was rapidly depleting lake trout populations in the upper Great Lakes. It was decided that brood stock would have to be accumulated to provide trout for restocking the lakes when the lampreys were brought under control. The project was assigned to the Marquette Hatchery, and Mr. Robertson's prime responsibility was to carry it out. The first eggs that were to develop into the nucleus of this brood stock were taken from Lake Superior lake trout in 1948. The previous functions of this hatchery were hatching and rearing brook trout and relatively small numbers of lake trout, the latter for inland lakes. From 1948 on, however, the hatchery's staff put all but a small part of its effort into accumulating and caring for brood lake trout, distributing some to other stations, and eventually providing eggs for production used to restock the depleted Great Lakes. One other activity at Marquette then was crossing brook trout with lake trout to produce the hybrid splake; in Michigan, this was done the first time in 1954 at the Marquette Hatchery.

A singular honor was bestowed on Mr. Robertson as a result of the work with lake trout brood stock. The Great Lakes Fishery Commission at its annual meeting in 1968 at Toronto, Canada, presented a plaque to him in recognition of his accomplishments. He was the first person to receive such an award from the Commission. "Russ" Robertson retired in November 1972. He continues to reside in the Marquette area.

References used for "Biographical Profiles"

American Biographical History of Eminent and Self-made Men (Michigan volume). Western Biographical Publ. Co., Cincinnati, 1878; JEROME.

American Men of Science: The Physical and Biological Sciences (12th edition, 1972, titled American Men and Women of Science): ALLISON (12th ed.), CLARK (10th), HAZZARD (11th), HUBBS (12th), LOWE (7th), METZELAAR (4th), REIGHARD (6th), SHETTER (11th).

The Ann Arbor News: CLARK (1/10/72, obit.), METZELAAR (10/5/29, obit.), SHETTER (10/24/70, obit.), WESTERMAN (4/30-7/9/61; series of 11 stories on history of trout culture and planting in Michigan, by F. A. Westerman on outdoors page; also in other Booth newspapers).

Copeia: METZELAAR (1930, No. 1, obit.), REIGHARD (1942, No. 1, obit.).

Detroit Free Press: WHITAKER (3/13/42, library gift).

The Detroit News: WHITAKER (5/6/1900, death notice).

The Grand Haven Daily Tribune: LOUTIT (6/26/48, obit.).

A History of the Northern Peninsula of Michigan and its People, A. L. Sawyer, Vol. 3, Lewis Publ. Co., Chicago, 1911; MARKS FAMILY.

Jack-Pine Warbler (bulletin, Mich. Audubon Soc.): LOWE (V. 16, No. 1, 7/38, obit.).

Landmarks of Detroit: A History of the City, R. B. Ross and G. B. Catlin (revised by C. W. Burton), The Evening News Ass'n., 1898; WHITAKER.

Leaders of American Conservation, edited by Henry Clepper, Ronald Press Co., New York, 1971; HAZZARD, HUBBS.

Letters, LOUTIT, to and from the Fisheries Division, MDC, plus others, 1929, 1933, 1935-37, 1939, Michigan Archives.

Letters, LOWE, to and from the Fisheries Division, MDC, 1926-27, Michigan Archives.

Letters, METZELAAR, to and from the Fisheries Division, MDC, 1924-28, 1929, Michigan Archives.

The Louis Foundation, 5th report, 1970-71, Grand Haven (6-page brochure); LOUTIT.

Michigan Conservation, MDC: LOUTIT (V. 17, No. 8, 8/48, obit.). MARKS FAMILY (V. 7, No. 5, 1/38; V. 13, No. 7, 8/46). STEWART (V. 15, No. 3, 3-4/46, obit.).

Michigan Department of Conservation Biennial Reports: ALLISON (20-25), CLARK (11-21), COOK (5-22), HAZZARD (8-10), HUBBS (5-7), METZELAAR (3-5), SHETTER (12-25), STEWART (1-3), WESTERMAN (1-19).

Michigan Department of Conservation, Monthly Bulletin: BOWER (V. 2, No. 10, 10/32, Bower Library).

Michigan Historical and Pioneer Collections. Wyncoop, Hollenbeck, Crawford Co., Lansing: JEROME (V. 4, address; V. 9, death).

Michigan History (bulletin, Mich. Historical Comm.): PORTMAN (V. 31, No. 3, biogr.).

Michigan State Board of Fish Commissioners, Biennial Reports: BOWER (11-13 and 16-21), CHASE (5-6), JEROME (1-3 and 7, memor.), LYDELL (11-21), W. D. MARKS (6-11), PORTMAN (4-5), REIGHARD (10, 11, 16) WHITAKER (6-13).

Museum of Zoology, Univ. of Michigan. Miscellaneous Publication No. 37, "Records of Fishes in the John N. Lowe Collection from the Upper Peninsula of Michigan," W. R. Taylor, 1954: LOWE.

Museum of Zoology, Univ. of Michigan, Occasional Paper No. 1944, "Further Experiments in Inheritance of Color in Domestic Pigeon," Jan Metzelaar, 1928: METZELAAR.

Pennsylvania Angler, Penn. Fish Comm.: HAZZARD (V. 32, No. 4, 4/63 biogr.).

Pontiac Daily Press: BOWER (7/25/24, obit.).

The Progressive Fish-Culturist: CLARK (V. 15, No. 2, 1953, paper). LYDELL (No. 28, 3-4/37, obit.).

Transactions of the American Fisheries Society: ALLISON, BOWER, COOK, HAZZARD, HUBBS, LYDELL, METZELAAR, SHETTER, WESTERMAN, WHITAKER.

The University of Michigan: An Encyclopedic Survey, (in 4 vols.), Univ. of Michigan Press, 1958: HUBBS, METZELAAR, REIGHARD (all in Vol. 4).

CHRONOLOGY OF IMPORTANT EVENTS IN MICHIGAN'S FISHERIES HISTORY

By Arthur W. DeClaire

1830 Commercial fishing was confined to Indians and fur traders.

1838 Commercial fishing report for 1830 published in 1838.

1852 Decline in Great Lakes fisheries noticed.

1865 Michigan grayling recognized as an important game fish, distinct from trout.

1867 N. W. Clark started a trout hatchery at Clarkston in Oakland County.

1869 First attempt made in the artificial propagation of whitefish (by N. W. Clark).

1873 Legislative Act No. 124 established the first "State Board of Fish Commissioners."

Chinook salmon unsuccessfully introduced into E. Branch Kalamazoo River and about a dozen other localities in lower Michigan.

First appropriation for original Fish Commission $7,700.

Fish Commission's second report: "Realized ignorance of the subject of fish culture was perfectly appalling."

Assistant U.S. Fish Commissioner made trip to headwaters of the Au Sable to study grayling.

1873 First state fish hatchery established at Crystal Springs near the village of Pokagon in Cass County.

1875 Uniform laws on Great Lakes for commercial fishing urged.

The first Fish Commission attempt to establish Atlantic salmon in Michigan waters.

1876 Over 9,000,000 whitefish fry planted.

1877 First recorded plantings of brook trout were made during March and April, from the hatchery at Pokagon; 12,000 fry were planted in Cass, Berrien and Kalamazoo counties.

1880 Brook trout were planted in fourteen counties.

First official shipment from California to Michigan of 2,000 rainbow trout eggs. They were hatched and planted in the Paw Paw River (Van Buren County) and Boyne River (Charlevoix County), and a brood stock was retained.

U.S. Fish Commission secured a lease of the Northville State Fish Hatchery property and engaged Frank N. Clark to superintend its operations. This was the first Federal hatchery in Michigan.

1880-90 Fish Commission planted 67,000 rainbow fry in Michigan streams during the decade.

Attempts at artificial propagation and planting of Grayling, to replenish a dwindling supply, had no noticeable effect.

1881 Paris State Fish Hatchery established on Cheney Creek, Mecosta County.

Sault Ste. Marie State Fish Hatchery built on Island No. 3.

First State fish hatchery at Pokagon abandoned because of inadequate water supply.

1883 University of Michigan began cooperating, in an informal way, with the Fish Commission on technical problems.

1884 Excellent trout fishing in many counties, where trout were never known to occur prior to planting, attested to success of brook trout hatchery program.

1885 Brown trout introduced into the State; eggs from Germany were hatched at Northville and planted in Michigan waters.

1888 Brook trout plantings extended to 40 counties.

Fish Commission had a special railroad car built for transporting fry. It was named "Attikumaig"; one end of the car had an office and the other a kitchen and five bunks. After some years, and an accident, the "Attikumaig" was rebuilt and renamed the "Fontinalis."

1890 Northville State Fish Hatchery was purchased outright by the U.S. Fish Commission.

1893 An experimental station for hatching smallmouth bass was established at Cascade Springs, Kent County.

1893-95 A new bass hatchery was built at Mill Creek, Kent County.

Largely through the work and efforts of Dwight Lydell, Michigan was a leader in the artificial propagation of black bass.

1896 Au Sable and Pere Marquette rivers were rated the two best trout streams in the United States.

The first migration of rainbow trout into the Great Lakes was noticed.

1897 A total of 1.75 million brown trout had been planted, when adverse public opinion forced a stop to its propagation.

1897-1912 Brook trout fishing declared on the decline.

1898 Rainbow trout permanently established as a game fish.

1899 Jesse P. Marks was placed in charge of the Paris State Fish Hatchery, an important installation in the State's fisheries program.

1901 Harrietta State Fish Hatchery established in Wexford County.

1906 First plantings of landlocked salmon and smelt as forage, neither of these plantings (salmon or smelt) was believed successful. Later plantings of smelt in Crystal, Howe and Trout lakes are thought to be responsible for the smelt runs of later years.

1909 Brown trout again planted, to offset a depletion of brook trout.

1911-23 A decline of 38% in the commercial fish catch over this 12-year period.

1913 The "Wolverine" was purchased from the Pullman Company and rebuilt to transport cans of fry.

1914 First non-resident fishing license: $3.00 general, or $1.00 (except trout).

Grayling Fish Hatchery established by Grayling Fish Hatchery Club.

1917 Act No. 372 put State Board of Fish Commissioners in a Game, Fish and Forest Fire Department under the Public Domain Commission.

1920 Brown trout planting again opposed: program ceased.

Benton Harbor State Fish Hatchery established on Blue Creek.

Marquette State Fish Hatchery established.

1921 Conservation Department organized, first Conservation Commission formed. Fish Division was one of nine divisions under the Department.

Grayling Hatchery leased by the Conservation Department.

New Department policy on introduction of exotic fish. Approval requires more than simply a request by individual or a group.

1922 New state fish hatcheries established at Harrisville, Thompson, Sidnaw, Watersmeet, and Wolverine.

1925 A few grayling seined from the Otter River, held at a hatchery, died in a few years without reproducing.

1926 Grayling Fish Hatchery purchased outright by State of Michigan.

Propagation of Montana grayling again was tried. In the next decade, some 2 1/2 million fry and yearlings were planted in Michigan waters.

1927 The issue of public and private fishing rights was becoming acute because of increased posting of privately owned lands. The first trout-stream improvement was done in Michigan by Jan Metzlaar. Creel census started by the Fisheries Division.

Largest commercial fish catch in the last 10 years. The catch of whitefish exceeded that of any other species for the first time since 1889.

First trout rearing station established, at Baldwin.

1928 Trout rearing stations were established on North Branch Pentwater River, White River (Newaygo County), Platte River (Benzie County), Bear Creek (Manistee County), Advance Creek (Charlevoix County), Hunt Creek (Montmorency County), and Escanaba River (Marquette County).

1929 Thompson State Fish Hatchery No. 2 was built, about 1 mile from No. 1.

Sault Ste. Marie State Fish Hatchery abandoned.

Institute for Fisheries Research established at University of Michigan, with funds for operation provided by the Conservation Department.

Rearing stations established at Sturgeon River (Cheboygan County), and East Branch Tahquamenon River (Chippewa County).

Sea lamprey arrived in Michigan.

1931 First appearance of alewife in Lake Erie.

Fingerling planting program well established.

All time high commercial catch of whitefish--8,500,000 pounds.

Wolf Lake State Fish Hatchery established.

East Branch Fox River Rearing Station established.

Sidnaw State Fish Hatchery abandoned.

Wolverine State Fish Hatchery abandoned.

Watersmeet Hatchery (on Fuller Creek) moved to Longyear Springs.

1932 Otter River Rearing Station established.

1933 First appearance of alewife in Lake Huron.

Cook's Run Rearing Station established.

First resident fishing license (general) $.50. Trout license eliminated.

Fishing for lake trout and whitefish under permit during closed seasons to obtain spawn was discontinued so fish might spawn naturally without disturbance.

The first formal report on creel census for 1927-1932. It was the first real inventory of game fish by any state.

1935 Last report of grayling being taken by fishermen.

Fish railroad car "Wolverine" fitted with conservation exhibit.

Trap nets outlawed in lakes Michigan and Superior.

1938 Resident fishing license raised to $1.00; $0.40 from each license earmarked for public access, habitat improvement, and research.

1939 Michigan issued a greater number of fishing licenses than in any previous year and more than any other state.

The Hunt Creek Trout Research Station was established, near Lewiston.

1940 Board of Inquiry established for Great Lakes fisheries.

First District Fisheries Biologist appointed.

Twenty-eight public fishing sites acquired from fishing license funds.

1941 All time low commercial catch of whitefish--1,500,000 pounds.

1942 New hatchery policy: to plant fewer but larger fish.

A new fish pathology laboratory was established at the Grayling hatchery.

1945 The Rifle River Area, purchased by the Department, was used for fish research.

1946 Treaty for uniform conservation laws on the Great Lakes negotiated with federal government, eight states and Canada.

Sea lamprey control in the upper Great Lakes was started by our State and the U.S. Fish and Wildlife Service.

1947 Public fishing sites now numbered 105 on streams and 230 on lakes.

1949 First appearance of the alewife in Lake Michigan.

The Pigeon River Area, transferred from Forestry Division to Fish, used for research.

A committee to guide sea lamprey control and research was formed, with representatives from U.S. Fish and Wildlife Service, province, and states on the Great Lakes.

1950 Size limits on bluegills, sunfish, yellow perch, crappies, rock bass and warmouth bass were removed.

Rifle River Watershed improvement program, approved, and financed by the Legislature ($50,000).

1951 Commercial catch of lake trout in Lake Michigan dropped to 2,207 pounds in 1951, compared with 1 million pounds in 1947, over 2 million pounds for prior years. Only Lake Superior production remained normal (2,173,953 pounds) in 1951.

An experimental a-c electrical barrier was installed in the Ocqueoc River to block the spawning run of sea lampreys.

1953 Closed season dropped on bluegills and sunfish.

1954 Introduction of pellet fish food at 11 fish hatcheries resulted in a savings to the Department of $41,500 in 1954.

First appearance of alewife in Lake Superior.

1955 The Hastings Fish Hatchery was turned over to the Institute for Fisheries Research for warmwater fish investigations.

1956 Alewife is now abundant in lakes Michigan and Huron.

1957 A selective chemical larvicide for lamprey larvae was used successfully under stream conditions for the first time.

1959 Sea lamprey control in Lake Superior (by chemicals and electrical weirs) shows promise of success.

Increased management effort in (a) chemical treatment of trash fish, (b) restocking lakes with trout, and (c) operating pike spawning marshes (total of 14).

1960 During 1948-1960 the commercial catch of high-value lake trout, whitefish, and walleyes declined 23 million pounds, while catch of low-value chubs, carp, smelt and yellow perch increased 27 million pounds.

Commercial trawls were legalized in 1960 for chubs and alewives in Lake Michigan, where over abundant.

1961 Cook's Run Rearing Station property deeded to Iron County for a park.

Fox River Rearing Station closed.

Emphasis in fish management now on inland lakes, rather than on trout streams.

Sturgeon River Watershed Project was completed.

A new disease of hatchery trout, infectious pancreatic necrosis, found in Michigan.

Work started on Tobacco River Watershed project.

Commercial catch of lake trout from Lake Superior continued to decline in all areas of the lake.

Success indicated in control of sea lampreys in Lake Superior.

1962 Pilgrim River Watershed development project was completed.

Commercial fishing for lake trout in Lake Superior closed by Conservation Commission.

1963 Public fishing sites now: 252 on streams, 548 on lakes, total 800.

New policy is to favor introduction of exotics for sport fishing, after careful study. Kokanee and coho salmon deemed acceptable.

Projects to improve fish habitat were increased.

1964 Research and Development Division was established. Fisheries research was transferred April 6, 1964, to this new division.

Commercial fishing licenses now about 1,000, down 600 since 1949.

Fish propagation discontinued at Benton Harbor, Paris and Watersmeet.

1965 New management plans and stocking policies for trout water.

Under Act 218, the Commission established some new regulations for commercial fishing:

No lake trout to be taken in Lake Michigan.
November each year closed for whitefish in Huron, Michigan and Superior.
Can fish trap and pound nets at any depth in Huron, Michigan and Superior, in areas not otherwise closed.
Can take yellow perch at any time in Lake Erie (Mich. waters).

1966 Under Act 218, the Commission made further rules on commercial fishing in the Great Lakes:

Removed the closed seasons, size limits and weight limits on yellow perch, in waters not otherwise closed to fishing.
Portions of Saginaw Bay were closed to commercial nets.
No commercial fishing for pike, or for coho salmon.

Legislature passed a bill, on non-resident commercial fishermen in lakes Huron or Erie.

An increase in license fees for commercial fishing; a decrease in number of licensees.

Started a creel census of lake trout sport fishing in Lake Superior.

Sea lamprey control in Lake Superior deemed effective.

Muskellunge and tiger muskies stocked in inland lakes.

Coho salmon planted in Great Lakes waters.

A policy change--to cease put-and-take planting of hatchery trout.

A new $3 million hatchery for salmon started on the Platte River.

Commission approved special fishing regulations for Sylvania lakes.

Commission given authority to regulate harvest of salmon

New ponds at Saline, acquired for fish research.

1967 Sea lamprey control effective in Lake Michigan.

Dramatic sport fishery for coho salmon in Great Lakes.

Legislative authority received to regulate the commercial fishery through controls on catch and methods, and to manage fishery on the principle of limited entry.

Surplus coho salmon were made available for sale by commercial fishermen and fish dealers.

State record for steelhead trout was broken three times, with top at 22 lbs 2 1/2 oz.

Introduced chinook salmon showed remarkable growth and survival.

1968 Great Lakes fishery stations established at Marquette, Charlevoix, Alpena, and New Baltimore. The 60-foot survey vessel STEELHEAD was acquired, equipped and staffed.

First fishing license required for sport fishing on the Great Lakes.

First successful reproduction by the introduced coho salmon.

Operation of public fishing sites given to the Waterways Division.

Warmwater hatchery production emphasized 6¼ muskellunge.

Whirling disease introduced into the Tobacco River and Jose Creek.

Department of Conservation renamed Department of Natural Resources.

A creel census recorded one-half million man-days of fishing on Lake Michigan and its tributaries in 1968.

1969 Lake trout are making a major comeback, with lamprey control, and restricted commercial fishing.

Limited entry imposed on the commercial fishery to adjust capability and capitalization of the industry.

Zone management on the Great Lakes, established Sport Fishing Zones closed to commercial fishing; Rehabilitation Zones with gill nets restricted; and Commercial Fishing Zones open to all types of gear.

Over 5 million eggs were obtained from Michigan's chinook salmon.

A record 430,000 steelhead were stocked in 1969 in Great Lakes and tributaries.

Governor established a Great Lakes Fishery Advisory Committee.

Newaygo Dam was removed, to open 14 miles of river to salmonids.

1970 World's record coho salmon, 33 lbs., 3 oz., taken by Fisheries Division in spawn operations on Little Manistee River.

With the mercury pollution scare, Governor Milliken closed St. Clair River, Lake St. Clair and Lake Erie to all fishing.

1971 Fish Division renamed Fisheries Division.

1972 Gill nets banned in Lake Huron, except 8-inch carp gill nets.

Atlantic salmon planted in Boyne and Au Sable rivers, following a 1,300-mile transport from Domtar Hatchery in Quebec.

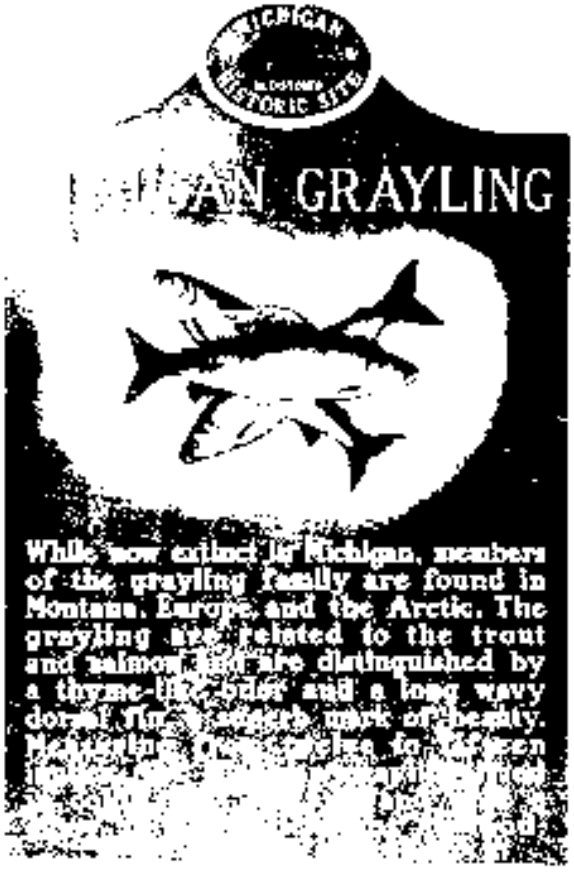
1973 Michigan Fisheries Centennial celebrated.

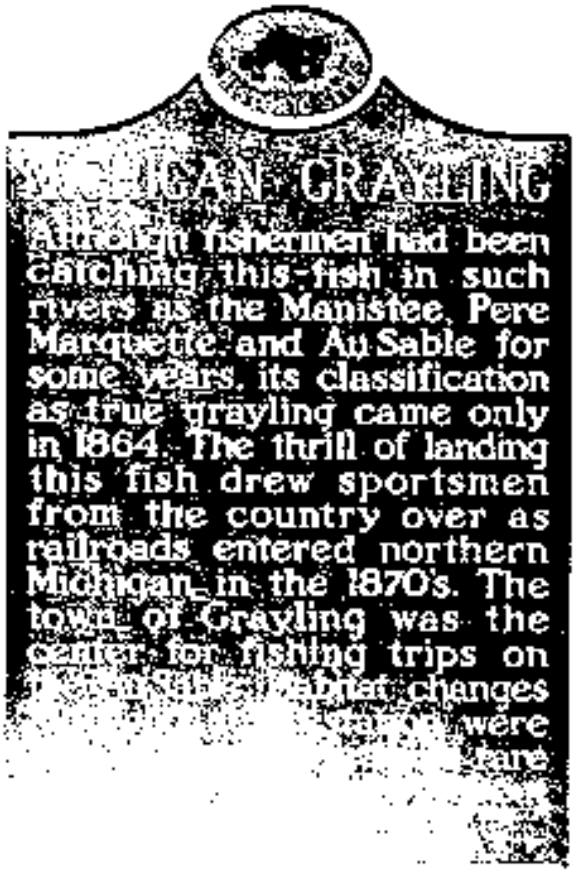
Master Angler Award program initiated.

First Atlantic salmon caught, in Van Etten Creek, Iosco County, by Dennis Sparks.

Research and Development Division disbanded, and the Fisheries Research section was reassigned to the Fisheries Division.

A historical marker honoring the grayling (see next page) is located on the bank of the fish display ponds at the Grayling fish hatchery, at Michigan Historical Commission Registered Site No. 144. A famous photograph (below) shows a creel of grayling reportedly caught in Bear Creek, Manistee County, about 1896.





HISTORICAL MARKERS COMMEMORATING THE CENTENNIAL

Grayling

A historical marker, in honor of the grayling, located at the Grayling Fish Hatchery in Crawford County, was dedicated on June 12, 1958. Its text is as follows:

> "Although fishermen had been catching this fish in such rivers as the Manistee, Pere Marquette, and Au Sable for some years, its classification as true grayling came only in 1864. The thrill of landing this fish drew sportsmen from the country over as railroads entered northern Michigan in the 1870's. The town of Grayling was the center for fishing trips on the Au Sable. Habitat changes following deforestation were making Michigan grayling rare by about 1900, and by about 1930 they were extinct.
>
> "While now extinct in Michigan, members of the grayling family are found in Montana, Europe, and the Arctic. The grayling are related to the trout and salmon and are distinguished by a thyme-like odor and a long wavy dorsal fin, a superb mark of beauty. Measuring from twelve to fifteen inches, the Michigan grayling lived in cold, swift streams and were a gamy fish and delicious as food."

Other Markers Suggested

It would be appropriate to prepare and dedicate several other markers in honor of fish and fishery events. The following are suggested. Statements printed here are subject to revision by the Michigan Department of State, History Division.

Rainbow and Brown Trout

Proposed site near Frederick

> Both are exotic to Michigan. The rainbow was brought from western United States in 1876 and planted in the Au Sable River. The brown came from Europe in 1883, and was planted in the Pere Marquette. Both species put a strain on the native brook trout, replaced it to a large degree, and perhaps have also declined under heavy angling pressure. The rainbow and brown are a good matching pair for best use of trout habitat; the first spawns in the spring, and makes most of its growth in the Great Lakes; the brown trout spawns in the fall and adults stay mostly in the larger rivers. As trophy fish, they both surpass the brook trout.

Smelt

Proposed site at Beulah

This slender, silvery fish was brought from Green Lake, Maine, and planted in Crystal Lake, Benzie County, in 1912 to provide food for the introduced landlocked salmon. Six years later the population had so increased that a heavy spawning run ascended Cold Creek. With the creek teeming with smelt, fishermen thronged to the banks to net the unfamiliar fish by the bushelful. By the 1930's smelt had spread from Crystal Lake throughout the Great Lakes. Dozens of communities held smelt festivals during the annual spring runs, and railways ran special excursions to smelt streams. It is estimated today that tons of smelt are taken in Michigan each year, providing food and sport for thousands.

Sea Lamprey Control

Proposed site at Hammond Bay

The sea lamprey, a native of the Atlantic Ocean, invaded the Great Lakes above Niagara Falls by way of the Welland Canal. It reached Lake Erie in 1921, Lake Huron in 1932, Lake Michigan in 1949, and Lake Superior in 1954. Becoming very abundant in lakes Michigan, Huron, and Superior, it made great inroads into the populations of lake trout and other large species in these lakes. Lamprey control was initiated in time to save the lake trout in Lake Superior but not elsewhere. The international Great Lakes Fishery Commission, established in 1955, has the direct responsibility for control of the lamprey. This is done by contract with federal agencies in Canada and the United States from funds allocated to it by both countries. Extensive screening of chemicals at the U.S. federal laboratory at Hammond Bay on Lake Huron led to a selective lampricide which is applied to tributary streams for the control of this parasite. The control program was successfully instituted on lakes Superior, Michigan, and Huron and is now being implemented in Lake Ontario. The reduction in the lamprey population has been accompanied by greatly improved survival of lake trout, steelhead and other game fishes, and presumably it also made possible the establishment of the popular salmon sport fishery.

Lake Trout Restoration

Proposed site, Marquette Hatchery

The lake trout, about 50 years ago, supported a commercial fishery of 10-15 million pounds per year in the three upper Great Lakes. Due to a combination of sea lamprey predation and commercial fishing, the species was eliminated in Lake Huron and Lake Michigan, and nearly so in Lake Superior. Increased hatchery production and plantings, coupled with intensive lamprey control, together saved the species in Lake Superior, and large populations were re-established in Lake Michigan. Large-scale plantings were first made in Lake Superior in 1958; in Lake Michigan in 1965. Nearly all lake trout taken since (i.e., to 1973), either commercially or by sport fishing, have been survivors of fin-clipped hatchery plants. Credit for restoration of the lake trout belongs to the lamprey-control effort, to state and federal fish culturists, and to foresight at the state hatchery at Marquette where a large brood stock of lake trout was developed while the species was still generally available on spawning reefs in Lake Superior.

Pacific Salmon

Proposed site, Platte River Hatchery

Of the five species of Pacific salmon, four are now established in Michigan. The coho and chinook, planted since 1965, provide a good sport fishery, largely from continued hatchery plants of several million fish each year. Several plantings were made before 1950, but without success. The Platte and Manistee rivers received first attention in the salmon program. Some 10 million pounds of salmon are being taken each year by Michigan anglers. The good survival and growth of salmon, especially in Lake Michigan, are the result of an abundant food supply--alewives and chubs. Successful angling requires a large concentration of salmon, hence the large hatchery plants. All Pacific salmon die after one spawning.

(The village of Honor has contributed $375 toward the cost of a historical marker for salmon, to be installed at the Platte River hatchery at a hatchery dedication ceremony on June 12, 1974.)

LETTERS BY GEORGE H. JEROME

Three 100-year-old letters, from George H. Jerome to H. E. Sargent (Superintendent, Michigan Central Railroad--his office presumably in Chicago), were given by John R. W. Sargent to F. A. Westerman with a transmittal letter dated May 12, 1959. The letters are photo-reproduced on the three following pages. They give interesting insight about fish management business during the first year of the fish commission, and reveal much about the character of our first fish chief. For those who find Jerome's longhand a little difficult, here are typed verbatim copies:

Letter of May 20, 1873

Dear Sir: Unluckily for me, and with grave apprehensions, as I think for the State, I have been created a State Fish Commissioner. I yesterday placed in a little lake near Niles 25,000 herring salmon, and next Thursday and Friday I am to place four thousand salmon trout in the Kalamazoo River--4,000 in the St. Joseph, one thousand in Diamond Lake & 1,000 in Barron Lake, all the gift of the Gen. Government. I am giving my time & almost undivided energies to do what I can towards placing Michigan in the very front rank as a game & food fish state. To the accomplishment of such result, we have the promise of the hearty cooperation of the general government. And it is in this interest I desire to see you. When and where will it best suit your convenience to see me for a few minutes? Very truly I am yours. George H. Jerome

Letter of Dec. 13, 1873

Dear Sir: Do you know anything concerning the salmon I planted in Diamond Lake the 28th of May last? Those I placed in Barron Lake & in the St. Joseph River on the same day have been heard from and are doing finely. If not knowing anything of them yourself, can you give me the name or names of some person or persons who may possibly supply me with the desired information. I am quite anxious to hear from my Diamond Lake pets. I expect to leave soon to look after another lot of the Atlantic Coast salmon. We have now, all hatched, some 50 or 60 thousand California salmon, very healthy and promising, & which will be ready in a few days to deposit in our Michigan streams & waters. The Commission are now hatching between one and two millions white fish & expect from their tip-top results. The Pokagon State Hatchery is completed and ready for its intended work. We have there most excellent water, & all the conditions give promise of perfect success. Shall here the coming season to show you & your friends some of our work. Very truly I am yours. George H. Jerome

Letter of June 5, 1874

Dear Mr. Sargent: The grayling came on the Sunday Express at 5 AM. One dead & the rest only in passable condition--they had no ice aboard, & the water on their arrival at 68°. I had ice & was every way duly prepared to take them in charge, & we immediately went to work reducing the temperature of the water & soon had it at 50°, reviving the fish most wonderfully. Taking on to my wagon about 100 pounds of ice, we started at 1/2 past 5 for the hatchery, & had them in the ponds at about 8 o'clock AM. Eighteen in number, & all "gay & festive." The cold, pure, & restorative virtue of the water there I have no doubt will bring them all through, though 5 of them are minus an eye each, destroyed in the catching. I left them about noon doing admirably. I instructed Mr. Michael to take the best of care of them & I have no doubt he will. They are a most charming beautiful fish. I have today written an article concerning them for the "American Sportsman" which if published I will send you a copy. I write in the greatest haste, as I have a good deal of preparation to make for attending a meeting of our Fish Board in Detroit tomorrow. When returned I will say in write you. Very sincerely I am yours. George H. Jerome.

Michigan Fish Commission

[illegible] May 20th [illegible]

H. E. Sargent
Supt. M.C.R.R.

Dear Sir:

Unlucky for me, and with great apprehension as I think for the State, I have been [illegible] to State Fish Commissioner.

I yesterday placed in a little lake near Niles 25,000 Herring Salmon and [illegible] I am to place four thousand Salmon Trout in the [illegible] 1000 in the St. Joseph [illegible] in [illegible] Lake 1000 in Beeson Lake, all the gift of the Gen. Government. I am giving my time to almost undivided energies to [illegible]

[illegible] Michigan [illegible] Fish State. [illegible] the [illegible] of the [illegible] Government [illegible] it is [illegible]

When I [illegible] will it [illegible] your [illegible] to see me for a few minutes?

Very truly I am
Yours
George H. Jerome

Michigan Fish Commission

[illegible]

The Commission [illegible]

The [illegible] Hatchery is [illegible]

[illegible]

Michigan Fish Commission.

[illegible]

[illegible] ... Grayling ... [illegible]

[illegible] ... making preparations to take them in charge ... [illegible]

[illegible] ... the temperature of the water ... [illegible]

[illegible]

[illegible] ... Grayling ... [illegible]

[illegible]

[illegible] ... for the American Sportsman ... [illegible]

[illegible]

When ... [illegible]

[illegible]

Very truly yours ... [illegible]

[illegible]

CENTENNIAL PICNIC

A highlight of the Centennial Year, for current employees of the Fisheries Division, was a picnic and program held at the Higgins Lake Conservation School on August 18. Attendance was 188 (see list on next page), and there was a short formal program. An invitation to the picnic, sent out earlier by Division Chief Wayne H. Tody read as follows:

Invitation

To all present and former Michigan Fish Commission and Fisheries Division personnel:

On April 18, 1973, the Fisheries Division marked one hundred years of Fisheries Management in Michigan. An official "family" celebration for our Centennial is planned for August 18, 1973, at the Ralph A. MacMullan Conservation School at Higgins Lake. We cordially invite all present and former members of our Fisheries Division, and their spouses, to join us on this occasion.

Celebrants should plan to arrive at the school between 1:00 and 1:30 p.m. A short commemorative program is scheduled for 2:00 p.m., followed by a social hour and steak dinner at 4:30. A cost of $6.50 per person will include the dinner and "beverage du jour" which will be served from the traditional barrels.

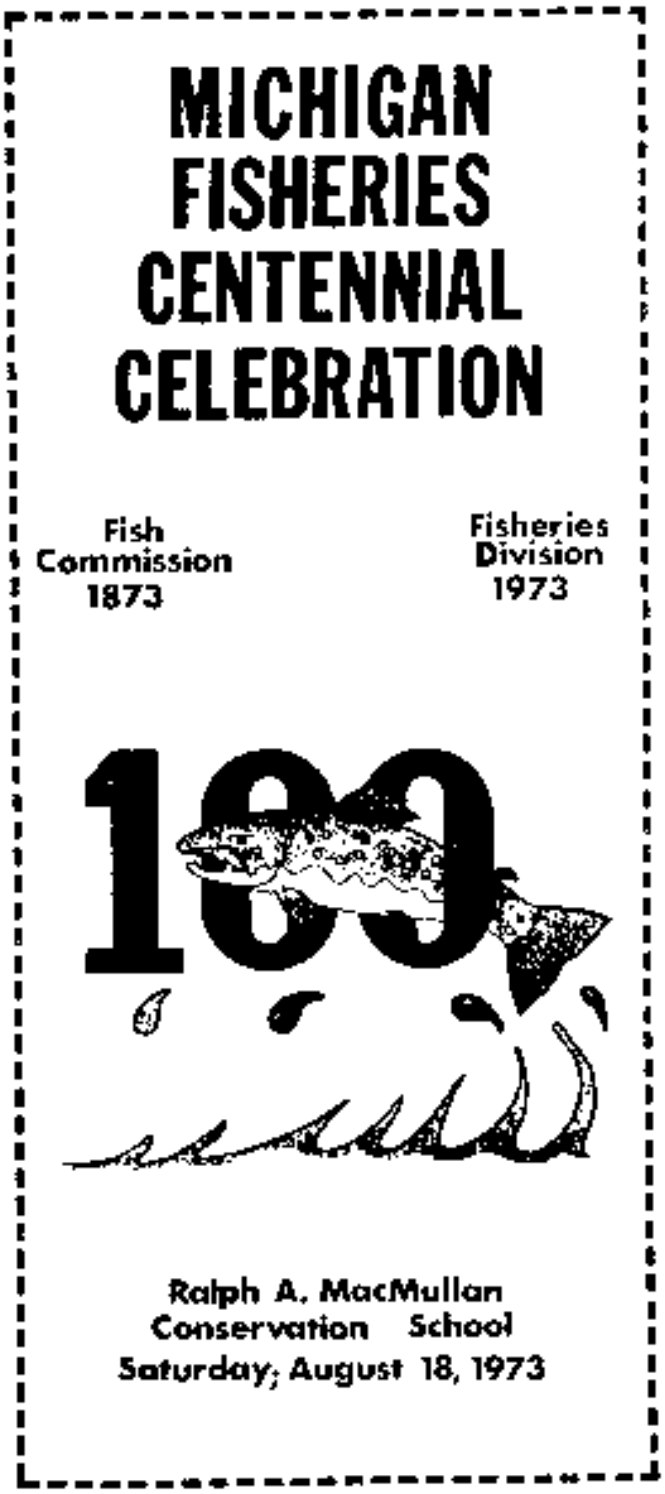
Come join the celebration, renew old friendships, and get acquainted with the whole group. There won't be an event like this for another hundred years!

Your remittance should be sent to Fisheries Division, Lansing, Michigan, by July 15, 1973.

See you there,

. . . . .

A modest number of photos taken during the celebration are reproduced on following pages. We did not concentrate too well on individual identification, but some of you will "spot" either yourself or a few friends.



Fisheries Division Centennial Picnic
held at
Ralph A. MacMullan Conservation School, Higgins Lake
(H. E. Johnson, Supt.)
August 18, 1973 1:30 to 7:00 pm
Formal meeting, 2:00-3:30 pm C. T. Yoder, M.C.

Program

W. H. Tody . . . . . introductions
H. Westers . . . . . early history
F. A. Westerman . . experiences
A. S. Hazzard . . . fisheries research
F. G. Fanselow . . public access program
J. W. Leonard . . . recent highlights
K. L. Peterson . . . Grayling hatchery records

Followed by liquid refreshments on the shore of Higgins Lake (fine weather), and an out-door barbecued steak dinner. The following 188 people attended:

Alfred & Marie Allen
Lee & Tekla Anderson
Leroy & Velma Babbitt
Ed Bacon
Jack & Janis Bails
Bob & Betty Ball
Bob & Betty Barber
Dolly Beard
Joel & Barb Bonham
[illegible] Borgeson
Norm & Audrey Brown
Bill & Carol Bullen
Darla Bunker
Larry Bush
Jerry & Alma Cooper
Gary & Susan Coopes
Jim & Jill Copeland
Bill & Donna Cross
Walt & Allene Crowe
Art DeClaire
Tom Doyle
Brad & Pat Durling
Paul Earl
Barnie & Treva Engel
Paul Eschmeyer
Randy & Gladys Eshenroder
Floyd & Helen Fanselow
Ned & Phyllis Fogle
Lud & Dorothy Frankenberger
Gene Gazlay
Wayne & Maude Gilmore
Howard & Lillian Gowing
Charlie & Freida Guenther
Bob & Pamela Haas
Jerry & Jill Hamelink
Bud & Alice Hamilton
Jack & Marilyn Hammond
Chuck & Shirley Harris
Ralph Hay
Al & Florence Hazzard
Walt & Sybil Houghton
Bud Jacob
Myrl & Joanee Keller
Arlie & Doreen Kinnee
Charlie & Helen Kohn
Emerson & Ruth Krieg
Jerry Kwiecien
Karl & Mary Jane Lagler
Carl & Harriet Latta
Bill & Helen Laycock
Doc & Fannie Leonard
Stan Lievense
Chuck & Mildred Lloyd
Ken Lowe
John & Delores MacGregor
Jerry & Alice Manz
Bill & Doris Mason
Bill & Sigrid McClay
Jerry & Kathleen Meggison
Harold & Peggy Miller
Walter & Jeanette Momot
Leo Mrozinski
Jerry & Ginny Myers
Harold & Louise Nauman
Clark & Harriet Oliver
Fred & May Owens
Don & Mary Parsons
Mercer & Melba Patriarche
Don & Dixie Peterson
Ken & Gwendolyn Peterson
Debbie Pline
George & Marilyn Reeves
Don & Karen Reynolds
Russ Robertson
Ron & Marge Rybicki
Melvin & Donna Sadecki
Paul & Marie Scheppelman
James & Alice Schneider
Gary & Carolyn Schnicke
Dick Schorfhaar
John & Pam Schrouder
Ed & Faith Schultz
Jack & Sue Scott
Warren & Ernestine Shapton
Ray & Katherine Shepherd
Mason & Jenny Shouder
Dell Siler
Floyd Simonis
Delyn Simonis
Dave & Elaine Smith
Ron & Gloria Spitler
Steve & Joan Swan
Pete & Elizabeth Tack
Howard Tanner
Clarence Taube
Shorty Thompson
Wayne Tody
Jeanne Tody
Nancy Tody
John & Diana Trimberger
Hank & Shirley Vondett
Barb Walker
Fred Westerman
Harry & Jolie Westers
Jim & Ann Wilkinson
Harold & Barbara Wilson
Mildred Wolfe
Asa Wright
Bernie & Sharon Ylkanen
Troy Yoder
Don Zettle

CENTENNIAL CELEBRATION HIGGINS LAKE

AUGUST 18, 1973

THE NEWLY APPOINTED STURGEON CLUB -

(L to R, standing) F.G. Funselow, C.J. Kohn, G.P. Cooper, F.A. Westerman, H.A. Tanner (partially hidden), W.R. Crowe, Russell Robertson, H.C. Ball, Fred Owens, J.W. Leonard, P. J. Tack, P.H. Eschmeyer. (kneeling, L to R) K.F. Lagler, Dolly Beard, A.S. Hazzard.

THE DIRECTOR AND STAFF

(L to R) C.D. Harris, W.H. Laycock, C.T. Yoder, A.G. Gazlay, W.H. Tody, G.J. Barrett, C.J. Guenther, J.G. Zettle, W.W. Shapton

AT THE ROSTRUM -

W. H. TODY

CENTENNIAL PICNIC, HIGGINS LAKE

CENTENNIAL PICNIC, HIGGINS LAKE

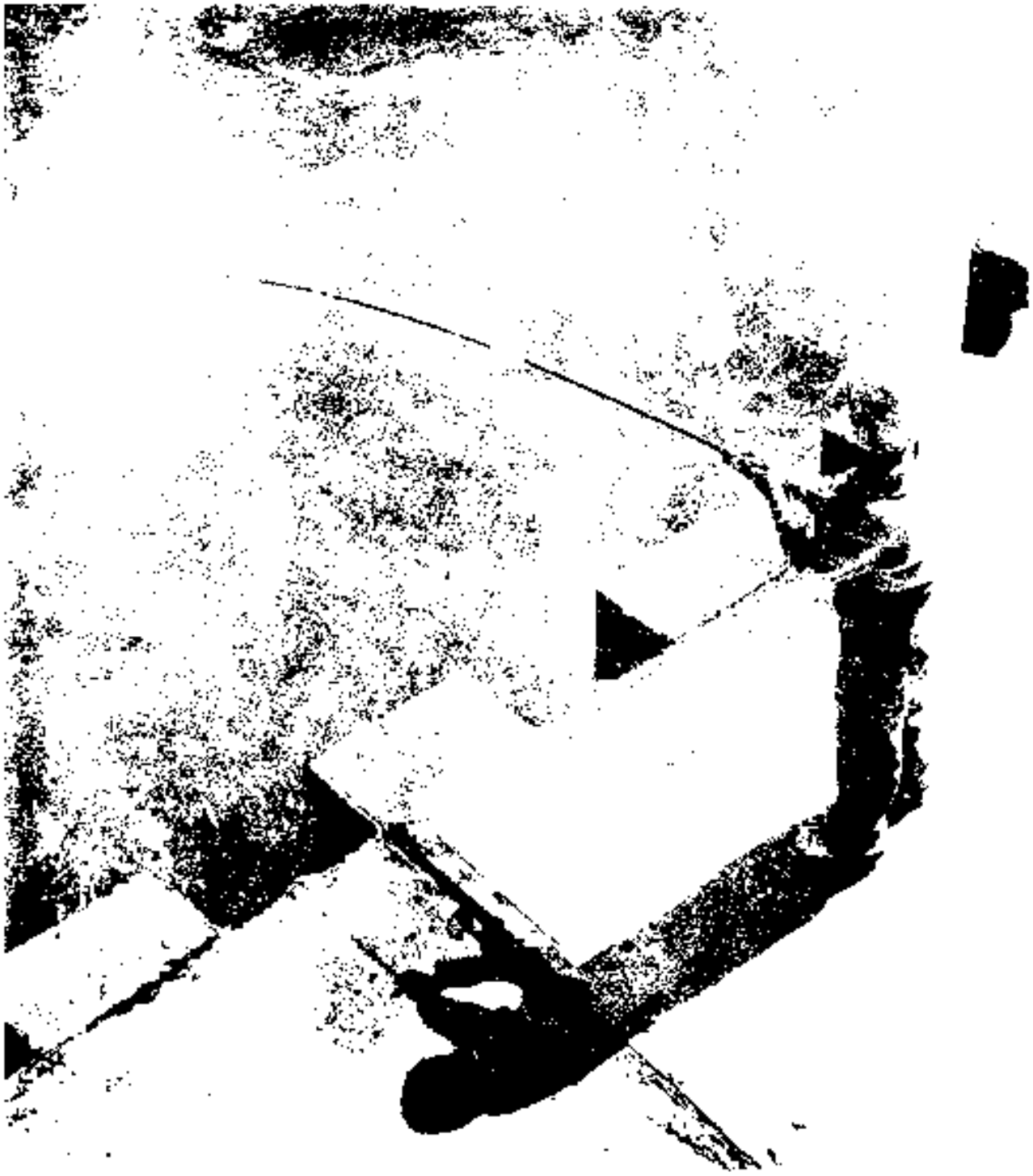
ACKNOWLEDGMENTS

About the authors: Among the authors in this report (see Table of Contents) are a number of persons outside the Fisheries Division whose contributions were solicited. Employment agency and position for these people are given at the start of their individual reports. Other contributors are currently in the Fisheries Division; their positions are: W. H. Tody, division chief; H. J. Vondett, program coordinator; D. P. Borgeson, in charge of inland fisheries section; J. A. Scott, in charge of Great Lakes fisheries section; W. C. Latta, biologist in charge at the Institute for Fisheries Research; H. Westers, hatchery planning specialist; T. M. Stauffer, fisheries research biologist, Marquette station; D. E. Reynolds, habitat improvement specialist; G. P. Cooper, in charge of fisheries research section; C. M. Taube, fisheries research biologist; and A. W. DeClaire, business manager.

Contributions by others in the Fisheries Division: cover art by Gerry J. Ream, centennial picnic records by Darla J. Bunker, typing by Margaret S. McClure, and editing by G. P. Cooper.

Contributions by other DNR people: review of manuscript on public access sites, by E. E. Eckart of Waterways Division; review of manuscript on sport fishing regulations, by G. H. Bruso of Law Enforcement Division; arrangement of photographs and report format by Ruth Iwanik of Information and Education Division.

Credit for photos: The Department of State, Historical Archives provided photos of H. H. Marks, Dwight Lydell, A. J. Walcott, and J. E. Reighard; the Department of Environment of Canada, photos of sea lamprey control on p. 104; the United States Bureau of Sport Fisheries and Wildlife, photos of sea lamprey control on p. 106; the Detroit News, photo of Harold Titus; Institute for Fisheries Research files, photo of the Museums Annex building; Ebb Warren, Hunt Creek Station; J. W. Leonard, fish shocking crew on the Black River; K. F. Lagler, photo of C. L. Hubbs; Robert Harrington, salmon award plaques; R. J. Bernard, photos at centennial picnic; G. P. Cooper, preface photos; copied from the journal Copeia, Jan Metzelaar; copied from 1924 Yearbook of Northern Michigan State Teachers College, John H. Lowe; and Michigan Department of Natural Resources, Information and Education Division, all other photographs.



A fabliau of his finest — out [illegible] . . . . . A. W. Jacot

100
YEARS OF
FISHERIES
MANAGEMENT
1873-1973