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BIENNIAL REPORT OF THE INSTITUTE FOR FISHERIES RESEARCH, 1957-1958

The headquarters of the research section of the Fish Division are in Ann Arbor. Six field stations are located in various parts of the State. A portion of the Institute's work is done in cooperation with state-supported colleges, particularly the University of Michigan and Michigan State University.

Lake Mapping and Surveys

A total of 51 lakes were mapped during this biennium. Two crews mapped during the winter of 1956-57, and one crew in 1957-58. Men from Department of Corrections work camps assisted in this activity. Eight of the lakes were mapped on open water with the aid of an echo sounder.

Three crews in 1957 and two in 1958 conducted inventories of lakes. Generally, this work included studies of the composition of fish populations, fish growth, aquatic vegetation, temperatures and water chemistry. In 1957, a group of lakes in the Upper Peninsula were inventoried with the objective of selecting several for intensive study of problems associated with the stocking of rainbow trout in lakes containing warm-water fish populations.

The inventories and mapping were financed largely with Dingell-Johnson funds.

Stream Surveys

In addition to field crews assigned to sea lamprey investigations, one crew conducted various inventories of streams in 1957 and 1958. Fish collecting was

done mainly with a direct-current electric shocker. The work in 1957 included an inventory of streams in the Pine River drainage system (Alcona and Iosco counties), fish collecting in an experimental section of the Ford River (Dickinson County), and continuation of a study on effects of brine pollution in Mansfield Creek (Arenac and Ogemaw counties) that was begun in 1956. The crew continued to collect data on trout streams which are under special fishing regulations.

This work has been financed chiefly with Dingell-Johnson funds.

Age and Growth of Fishes

Routine age and growth determinations were made to assist in the management of lakes and streams. Such analyses also aided in the evaluation of fish population reduction programs and in the determination of mortality rates in experimental warm-water lakes.

A Fish Division pamphlet was prepared on the age and growth of Michigan fishes. Included are revisions of some of the state-wide growth-rate averages plus averages for several species not considered in an earlier compilation.

Charges of the Department of Corrections continued to prepare the scales for examination by impressing them in plastic.

Fish Mortality and Disease

Kidney disease was discovered among brook trout at several of the hatcheries in 1956. Studies since then have given no indication that the infection is transmitted to healthy fish when affected stock is planted in natural waters.

Experiments were conducted on the use of plastic bags with oxygen-charged water to transport trout. It was found that four pounds of trout could be held in these containers (within a certain temperature range) for eight hours. This method of transporting small numbers of fish has been used to advantage in many instances.

Tests are under way to determine the stamina limits of trout by holding a number of fish in flowing water of known velocity until they become exhausted. Information can be gained on the stamina of the different species, variations among the stocks from one hatchery to another, effects of various diets on the fish, the advisability of conditioning trout by increasing velocities prior to planting, etc.

Trout fry were fed pellets of various sizes to determine the size readily accepted by the fish. (The feeding of pellets that are too large results in waste; growth rate improves when pellets of the proper size are fed.)

The pathologist also began a study of the distribution of the "red worm" (Nematoda: Philonema) in perch of Lake Huron. An increase of reports from fishermen during the past two years indicate that this parasite may be becoming more common in the Saginaw Bay area.

Autopsies were performed on fish that died during hooking-loss tests, in which "hardware" lures and flies were compared, to determine whether death was due to injury from hooking or to some other cause.

Tests are in progress at the Marquette Hatchery to learn if erosion of the skin in the cranial region ("bald-headedness") of yearling lake trout is caused by sunburn.

As in the past, the pathologist visited fish hatcheries at the request of the superintendents to diagnose problems associated with diseases and to prescribe corrective treatments.

Sea Lamprey Investigations

The program begun in 1955 to determine distribution of sea lamprey larvae in streams has continued. Information obtained by these investigations should be especially useful if the recently discovered larvacide that is effective on immature lampreys is used extensively for control. Nineteen stream systems

tributary to Lake Superior were surveyed in 1957 and 11 in 1958. Fourteen Upper Peninsula streams tributary to Lake Michigan were surveyed in 1957; nine of these were examined further in 1958 to ascertain more precisely the distribution of larval lampreys. Data on fish populations were also obtained on the streams checked for distribution of larvae. A report on the occurrence of sea lamprey ammocoetes in Lake Superior tributaries was prepared for publication.

The migration of ammocoetes was studied in 1957 and 1958 in the Chocolay River, Marquette County, when 804 larvae were marked in two areas. Recoveries indicated a gradual downstream migration. In July, 1958, approximately 4,000 ammocoetes were marked in Carp Lake River, Emmet County, to further study migratory behavior.

During 1957, sampling was done for larval lampreys in 11 areas on bays or deltas along the north shore of Lake Michigan. Sea lamprey larvae were found in five of the areas. A population estimate was begun in 1958 in one of the latter (Ogonts Bay, Delta County).

The experimental barrier in the Black River, Mackinac County, was removed in the fall of 1957. It was replaced by an electrical barrier to prevent further addition to the population of sea lamprey larvae in this stream.

The operation of two weirs (one at each end of the stream) continued in Carp Lake River, Emmet County, to obtain further information on the duration of the ammocoete stage of the sea lamprey. Ammocoetes are still present here, although adults have presumably been blocked from this area since 1949. This observation suggests that the parasite has a much longer life cycle than previously believed.

Rainbow Trout Studies

Investigation of the life history of migratory rainbow trout continued on the Black River, Mackinac County. An electrical weir, installed by the U. S. Fish

and Wildlife Service, is now used to collect most of the fish. The structure is being evaluated to determine its effects on the upstream migration of rainbow trout.

An investigation begun in 1955, to determine if hatchery-reared rainbow trout will substantially supplement natural runs of rainbows from the Great Lakes, was also continued. A total of 55,000 two- and three-year-old jaw-tagged fish of three strains (domestic, Michigan wild, and West Coast steelhead) were stocked at 27 locations during 1957 and 1958. Recovery of fish from these plantings continues, but returns from the 1955 and 1956 plantings of domestic fish are apparently nearly complete. By the beginning of the 1958 trout season, capture of 3.1 percent of the 1955 plantings and 2.9 percent of the 1956 plantings had been reported by anglers. Approximately one-half of these fish averaged two pounds in weight when caught. The others were caught soon after planting and showed little increase in size. In connection with this experiment, tagged, fin-clipped, and unmarked rainbow trout are being held at the Thompson Hatchery to determine differences in mortality and growth rates.

Pike and Muskellunge Investigations

Most pike and muskellunge investigations during 1957-58 were conducted by the staff of the Hastings Station. Follow-up studies on introductory plantings of northern muskellunge have indicated very good results in three of the four lakes stocked in 1955. Fish attained legal length (30 inches) early in 1958 in Budd Lake, Clare County. Of four lakes stocked in 1956 and 1957, the survival rate has been very good in Murphy Lake, Tuscola County, the only one that has been checked adequately. Scales are being collected from known-age muskellunge in these waters to aid in the identification of annuli, which usually are not well defined in this species.

Some evaluation was made during 1958 of production of fingerling northern pike behind artificial barriers which excluded small, predatory fish and retained optimum water levels in the marshes. Investigations were made at Townline Lake, Montcalm County (production of about 16,000 2- to 4-inch fingerlings) and Rose Lake, Osceola County (production of about 4,000 fingerlings).

At the Hastings Station, experiments were conducted on food preferences of pike and on mortality of pike resulting from hooking injuries and natural causes. The pattern of natural mortality is also being studied at Turk Lake. Periodic population studies are being made in this lake, which contains an excellent population of young pike, and in which fishing for pike is prohibited.

Walleye Investigations

Investigations of the value of planting fingerling walleyes, begun in 1951, have continued. In 1957, plantings were made in 19 lakes, 10 of which were stocked on a maintenance basis, and 9 on an introductory basis. In 1958, few walleyes were produced, so only 3 of the 24 scheduled lakes were planted. Results of the plantings that have been evaluated have varied from very promising to nil. Lakes that have shown poor results have been dropped from the program, and new ones added. The program presently calls for an annual production of approximately 200,000 fingerlings, to be released in about 20 lakes. Evaluation of results will continue.

Study of exploitation rates, migration, and longevity of walleye populations through tagging experiments has been carried on in the Inland Waterway, Muskegon River and at Hamlin Lake, Mason County.

An investigation of the walleye fishery of the Bay de Noc area was initiated in 1957 in cooperation with the U. S. Fish and Wildlife Service. The objectives are to locate spawning areas and to determine growth rates, year-class composition of the population, migration patterns and extent of exploitation by sport and commercial fishermen. Already there is evidence that competition between sport

and commercial fishermen is keen, and that exploitation rates may equal or exceed those for inland waters. By August 1, 1958, the recapture of more than 6 percent of the walleyes tagged in September 1957 and May 1958 had been reported.

The relative efficiency of three tags is being tested in the Bay de Noc investigation. These are the metal-jaw, "spaghetti-anchor" and "spaghetti-loop" tags.

Hunt Creek Fisheries Experiment Station

The staff of the Hunt Creek Fisheries Experiment Station, Montmorency County, worked on the following projects: 1) Intensive creel census of the experimental brook trout waters for the 18th and 19th consecutive seasons. 2) Post-season population studies on these waters to determine extent of exploitation and annual survival rates. 3) Sampling of trout populations in experimental sections of the North and South branches and Main Stream of the Au Sable River in the fall to obtain population indices and information on growth. 4) Hooking mortality of trout resulting from the use of artificial lures. 5) Angling tests to determine the relative effectiveness of salmon eggs and night-crawlers as baits for rainbow trout. 6) Development of new research techniques and equipment.

The effectiveness of a "flies only" regulation is being tested on about one mile of Hunt Creek, and is to continue until 1960. Results to date show no marked change in either the catch or the post-season population of trout.

Following is a summary of the main features of the catch for the 1956 and 1957 seasons from the experimental sections (Z, A, B, C, D) of Hunt Creek:

Season	Fishing trips	Hours fished	Wild brook	Hatchery brook	Rainbow	Pounds	Trout per hour
1956....	880	1,599	782	108	9	159	0.56
1957....	781	1,525	757	10	29	156	0.52

East Fish Lake (16 acres) and Fuller Creek Pond (15 acres) were treated with rotenone in the fall of 1956 to remove coarse fish. Six pounds of trout and 211 pounds of coarse fish were recovered from East Fish Lake. Only 20 trout were found after treatment of Fuller Creek Pond. This pond was dry-fallowed during the 1957 season to determine if this procedure will result in better production of trout in future years.

Creel census records for East Fish Lake are as follows:

Season	Fishing trips	Hours fished	Wild brook	Hatchery brook	Pounds	Trout per hour
1956....	305	856	5	114	55	0.14
1957....	137	437	0	283	124	0.65

For Fuller Creek Pond, 49 fishing trips (121 hours) in 1956 produced 11 wild brook trout and 3 hatchery brook trout (total weight, 7 pounds), at an average rate of 0.11 trout per hour.

Partial creel census and fish collections taken with an alternating-current electric shocker furnished data which showed that there was little change from the results of previous seasons in the catch and post-season populations of trout in the North Branch of the Au Sable River. During the fall of 1957, full-scale population studies were initiated on three sample sections of this stream. These sections correspond to areas that have been under different types of regulation (7-inch, any lure, 10 trout; 10- and 9-inch, flies only, 5 trout--from the Otsego County line to Eaman's; and 10- and 9-inch, flies only, 5 trout--from Eaman's to Kellogg Bridge). The data will permit computation of the standing-crop and survival estimates for these waters. A report was prepared on the results to date.

Investigations with a direct-current shocker on the special regulation water of the South Branch of the Au Sable River were discontinued after 1956. A report was submitted on the results in this stream.

Direct-current shocker indices were calculated after the Main Stream of the Au Sable River was sampled in the fall of 1957. Excellent populations of brown trout were present. Indices were higher for the "flies only" water, but a fair comparison cannot be made because no indices prior to 1957 are available. Brook and rainbow trout populations were small in the areas sampled.

A study of the extent of mortality that resulted from the hooking of trout (brook, rainbow, and brown) with various "hardware" lures was conducted in cooperation with several other employees of the Fish Division. A report on the subject was prepared for publication.

Paired fishing tests were begun on the Sturgeon River and Burt Lake to determine the relative effectiveness of salmon eggs and night-crawlers, and of "chumming" and "not chumming", for catching rainbow trout. These tests are being continued to attain a basis for proper regulations on use of salmon eggs.

During 1957, extensive collections were taken of bottom and drift samples and stomachs of angler-caught brook trout. One objective of this study is to determine the significance of drifting organisms in the diet of trout. A net was devised for the collection of drifting material.

Pigeon River Trout Research Area

This station, located in Otsego County, is primarily concerned with experiments in progress on six miles of the Pigeon River and in seven small trout lakes. Complete angling records are obtained from these waters by a compulsory fishing permit system which facilitates collection of materials and data required for various studies.

Creel census records, plus information obtained during the annual fall fish population studies on the river, and from special population studies on both the stream and the lakes, have been used in the following projects: 1) Testing of an increased minimum size limit on trout in the Pigeon River. A 9-inch minimum was in effect on two experimental sections of the stream from 1951 through 1957, with no restriction as to bait used. In 1958, a flies-only restriction was included. 2) Fall planting of sub-legal brook and brown trout in the river to augment limited natural reproduction. This project began in 1952 and will be completed in 1958. 3) Spring planting of sub-legal trout in streams, begun in 1953, using the Pigeon River, Gamble Creek (Rifle River Area), and Hunt and Fuller creeks (Hunt Creek Station). This investigation will determine how many of these fish reach anglers' creels. 4) Effects of stream improvement structures on the density of trout populations. This study commenced in 1953. 5) Dredging of pools as a method of increasing the number of trout in streams. Pools were dredged below the experimental stretch in the Pigeon River in 1953. The last evaluation, made in the fall of 1956, indicated no increase in the size of the trout population or in growth of the fish. 6) Testing recovery and survival of trout trained by Psychological Research Services, Inc. Plantings were made in both the stream and the lakes from 1953 through 1955. The final report on this project has been written. 7) Planting of brook trout infected with kidney disease in South Twin Lake. The purposes of this experiment were to determine survival rates, change in health of infected fish, and chances of transmittal to healthy fish. 8) Planting of fingerling brook trout in lakes, begun in 1952. Determination of recovery rates and the season when mortality is the greatest are the objectives of this study. 9) Effect of a fly-fishing-only restriction on brook trout in a lake. This regulation became effective on Ford Lake in 1955. 10) Growth and harvest of brook trout fry introduced into a lake in the spring. Plantings were begun in 1952 in Section Four Lake.

The creel census data for the experimental waters of the Pigeon River Trout Research Area are presented in the following tables:

Pigeon River

Season	Fishing trips	Hours fished	Trout caught	Trout per hour
1956....	1,979	5,527	1,150	0.21
1957....	1,699	4,490	858	0.19

Seven lakes

Season	Fishing trips	Hours fished	Trout caught	Trout per hour
1956....	1,986	5,289.5	2,923	0.55
1957....	1,868	4,548.5	2,217	0.49

On May 15, 1957, after a heavy rain, the privately owned earth dam at the upper end of the experimental water of the Pigeon River washed out and flooded the river valley. Fortunately, immediate damage to the trout population in the stream was small. Of more serious consequence is the effect that the sand from the dam and impoundment, which settled mostly in the uppermost section, may exert in the future on trout reproduction and on the food supply.

Rifle River Fisheries Research Station

This station is located on the Rifle River Area in Ogemaw County. The 4,318-acre tract contains six lakes, several ponds, and about 9.5 miles of trout streams upon which a complete, year-round creel census has been taken since 1945. Permits were issued to more than 20,000 visitors annually in 1956-1957, of whom approximately 60 percent were sight-seers.

There were 9 percent fewer fishing trips on the lakes in this period than in 1954-1955, mostly because of poor accessibility that resulted from reconstruction of the county road along the north boundary of the area. The catch per hour, however, improved considerably in 1957 over that of the previous three years. Seventeen species of fish were caught in the Lakes and ponds during 1956-1957. Of the total catch, 49 percent were bluegills, 21 percent were yellow perch, and 11 percent were pumpkinseeds. A significant increase in the catch of bluegills and pumpkinseeds was responsible for the over-all improvement in fishing quality in 1957.

A brief summary of creel census data from lake fishing follows:

Season	Fishing trips	Hours fished	Fish caught	Pounds	Fish per hour
1956....	2,327	7,428	4,255	1,063	0.57
1957....	2,040	5,506	4,906	1,006	0.89

Fewer fishing trips were made on the streams of the area in 1956-1957 than in the previous biennium, principally because of the road reconstruction mentioned above. The catch of a greater number of wild trout in 1957 resulted in a significant increase in the catch per hour of trout in 1957, over that of 1956. Even so, anglers on the Rifle River (which receives most of the fishing pressure) caught only one wild brown trout for every three of legal length in the residual population at the close of the season.

Creel census data for the streams are as follows:

Season	Fishing trips	Hours fished	Trout caught*			Other fish caught	Pounds, trout	Pounds, other	Trout per hour
			Brook	Brown	Rainbow				
1956....	3,463	8,038	24	802	149	252	423	77	0.12
1957....	2,703	6,257	25	1,060	204	90	548	74	0.21

*Because of a typographical error, the column headings for brook and brown trout caught were reversed in the comparable table of the 1955-1956 Biennial Report.

Research activities of the station's staff were concentrated on analysis of creel census data from the lakes for both this biennium and the 12-year period of 1945-1956, population surveys and studies on various waters within and near the area, operation of weirs in Gamble Creek and the outlet of North Lake, analysis of weir data collected from 1952 to 1957, age and growth-rate studies, and determination of the extents of exploitation from angling. The use of compressed air for elimination or reduction of winter-kill in shallow lakes is under study. A test of the effectiveness of the Hoad-type fish shelter for improvement of fishing success in Devoe Lake was started in the spring of 1958. The remnant fish in Devil's Wash Basin and Spring Lake were eliminated with toxaphene. Redear sunfish were transplanted from Dollar Lake into Devil's Wash Basin, and a new combination of species will be tried in Spring Lake.

Marquette Fisheries Research Station

The Marquette Station is located on the Marquette Hatchery grounds. One of the activities that has been carried on from this facility is creel census on three experimental trout lakes--Moccasin, Swanzy and Airport, all in Marquette County. The objective is to determine which size of hatchery brook trout (fingerling, sub-legal, or legal) gives the best return. The second 3-year test period was completed at the close of the 1958 fishing season.

Skin-diving gear, which included both SCUBA and surface equipment, was used in conjunction with the usual survey equipment to check lakes after treatment with fish toxicants and to make various underwater observations on other lakes. This gear was also used to obtain data on the relative effectiveness of a rubber-propelled hand-spear and a rubber-propelled spear gun for capturing fish.

During the summer of 1957, 37 lakes were checked in the Upper Peninsula in search for waters suitable for intensive studies on rainbow trout. Two of these lakes, Stager in Iron County and Bass in Dickinson County, were selected for the experiment. The purposes of the study are to determine the factors which favor successful planting and maintenance of rainbow trout in lakes that contain warm-water fish, and the cause of sharp declines in trout populations that generally follow a period of good survival and growth during the first few years of stocking. A third lake (Sporley, Marquette County) has been included in the experiment, but will contain only rainbow trout. Basic data on plankton and bottom samples, fish stomachs, growth of resident fishes, and water chemistry are being collected monthly on these lakes during the summer of 1958 prior to the introduction of trout.

Other studies on rainbow trout and sea lamprey investigations were also carried on at this station. Summaries of these activities appear elsewhere in this report.

A 7-stall garage was erected in 1958 for housing the station's vehicles and for storage of equipment.

Hastings Fisheries Research Station

This station is located at Hastings in Barry County, and is concerned with research in the management of warm-water fishes. The main building was remodeled considerably during the biennium. New concrete fish-holding tanks and an aquarium room were built on the ground floor. A 2,700-foot transite pipe was installed to carry spring water to the building from Bates Pond. The second floor was remodeled to provide space for a laboratory, photographic darkroom, supply room, bedroom, bath, and two offices. A new oil furnace and a hot water heater were also added.

The most important research project of this station has been the evaluation of the bluegill-reduction program carried on by the Lake and Stream Improvement Section. The work has included sampling of fish populations with seines of various sizes (600 to 2,700 feet long) in lakes suggested for treatment, analysis of the effectiveness of applications of rotenone, and follow-up seining in the spring and fall on lakes that have been treated. The aim was to achieve a reduction of from 50 to 75 percent of the bluegill populations in the five lakes treated in 1957: Murphy, Tuscola County; Woodland, Livingston County; Mill, Washtenaw County; Townline, Montcalm County; and Bass, Kent County.

The fish population of Saddle Lake, Van Buren County, lightly reduced in 1956, was completely eliminated in 1958 because of the presence of carp. North Lake, Tuscola County, received a heavy application of rotenone in 1958, and several other lakes were scheduled for treatment later in the year.

Results of the bluegill-control program thus far indicate that a reduction of 70 to 85 percent of a population may be the ideal range. Little improvement was observed in the size or the growth rates of fish in those lakes where the extent of kill was less than 50 percent. Although sizes and growth rates were much improved in lakes that had been treated for a reduction of 90 percent of the population, angling success was rather poor. A creel census to help evaluate results was taken on Saddle Lake during the summer of 1957, and on Turk Lake, Montcalm County, in 1958.

Resuscitation of bass was practiced with all applications of rotenone, and was moderately successful on some lakes.

Townline and Woodland lakes were treated further (in shallow-water areas) during 1958 to limit the numbers of young bluegills. Also in 1958, copper sulfate crystals were applied to bluegill nests in Pine Lake, Barry County, to control reproduction.

Efforts were made to increase the numbers of predator fish in the bluegill-control lakes by stocking northern pike, muskellunge, or bowfins, or by management of pike-spawning marshes. Details on work with pike and muskellunge have been given in another section of this report.

Bowfins (dogfish) spawned naturally, and young were reared in station ponds in 1958. These fish will be used in studies on food and spawning habits and growth of the species.

Spear-fishing during winter for sturgeon on Black, Burt, and Mullett lakes, Cheboygan County, has been censused since 1956 by personnel of the Hastings Station, and fins have been collected for age determinations. Considerably fewer sturgeons were harvested in 1957 and 1958 than in 1956. Sturgeons of the Black Lake fishery are much smaller, younger, and more numerous than those of the Burt and Mullett lake fisheries.

Financing of the maintenance and operation of the Hastings Station has been under the Dingell-Johnson program since June 1958.

Studies on Fish-food Organisms

The intensive study of bottom-dwelling organisms of Sugarloaf Lake, Washtenaw County, has continued. A second report that deals with the abundance and types of food organisms in various portions of thelake was published. All of the material has been collected for a comprehensive report on the production of fish food for a 5-year period; these data are presently being analyzed.

An investigation was completed on production of bottom organisms and their utilization by trout in three streams. These are Hunt Creek in Montmorency County, Pigeon River in Otsego County, and North Branch of the Au Sable River in Crawford County. Fish as well as bottom samples were collected at the study sites. Considerable information was accumulated on the feeding habits of the trout and on the kinds and distribution of insects in these streams.

General Creel Census

Since 1927, conservation officers have secured catch records which are submitted to the Institute for tabulation and analysis. This census provides a sample of sport fishing conditions over the entire state. During 1956, officers interviewed 76,898 anglers who had fished 175,319 hours and caught 222,613 fish, a catch of 1.3 fish per hour. In 1957, the records were on 90,439 fishermen who had fished 208,636 hours and caught 248,902 fish, at the rate of 1.2 fish per hour.

Of a total of 17,769 trout reported in 1956, 9,868 (56 percent) were brook trout, 6,071 (34 percent) were rainbow trout, and 1,830 (10 percent) were brown trout. In 1957, of 20,231 trout, 10,905 (54 percent) were brooks, 6,714 (33 percent) were rainbows, and 2,612 (13 percent) were browns. The average catch per hour was 0.7 trout in both 1956 and 1957.

Bluegills constituted 36 percent (1956) and 38 percent (1957) of the total catch in non-trout inland waters. Bluegills and yellow perch combined made up 67 percent in 1956 and 65 percent in 1957 of the catch in these waters.

Yellow perch comprised 85 percent of the catch from the Great Lakes and connecting waters in 1956, and 81 percent in 1957. The average catch per hour here was 1.9 in 1956, and 1.3 in 1957.

Creel Census on Experimental Lakes

The following special regulations have been in effect since the spring of 1954 on the listed lakes:

1) No size limits on fish taken from three lakes: Big Portage, Jackson County; Duck, Calhoun County; Fine, Barry County.

2) Three lakes on which minimum size limits are greater (largemouth and smallmouth bass, 16 inches; northern pike, 24 inches) than the limits that

generally apply to Michigan waters: Fife, Grand Traverse and Kalkaska counties; Minnewaukon, St. Joseph County; Sugarloaf, Washtenaw County.

3) Year-round open season for all species on three lakes: Bear, Manistee County; Pontiac, Oakland County; Whitmore, Washtenaw and Livingston counties.

The above regulations will expire in April, 1959. Creel census data from these lakes for the first four years of experimental regulations indicate the following results and extended applications:

1) The 10-inch size limit on largemouth bass serves little purpose. The amount of harvest of largemouth bass that were over 10 inches long has either remained the same or increased during the no-size-limit period as compared to years when the 10-inch limit applied. Under liberalization, the catch of largemouth bass of less than 10 inches on these lakes constituted from 20 to 60 percent of the total catch of this species. The annual catch of bass in most instances was double of what it was with a size limit, with no apparent effect on the catch of bass over 10 inches in length.

The size limit of 14 inches on northern pike serves no purpose as the census clerks did not record the catch of a single pike of less than 14 inches on the no-size-limit lakes.

Smallmouth bass and walleyes were too few to warrant conclusions on the removal of size limits on these species.

2) If it is assumed that anglers did not strongly object to the release of about 80 percent of the bass they caught, the 16-inch size limit produced better fishing for bass. Bass populations increased under this regulation, but the goal of improving the growth of pan fish was not achieved.

Only one of the lakes (Fife) where increased size limits applied contained a sufficient number of northern pike to provide reliable evidence on the effect of the regulation on this species. Anglers on this lake removed a greater

poundage of pike by catching slightly over half as many pike as were taken under the 14-inch size limit. A 20-inch limit, as has been proposed for all State waters, would have allowed fishermen to keep about 50 percent of the pike they had to release.

3) The closed season on largemouth and smallmouth bass could be abolished, with little or no effect on the quality of fishing for these species during the summer season. The additional fishing time provided on the experimental lakes allowed an increase of 50 to 100 percent in the catch of bass. Fishing effort in the spring season doubled when anglers were permitted to catch bass as well as other species.

A creel census has been conducted on Houghton Lake, Roscommon County, beginning in December, 1956. This study has evaluated experimental removal of the possession limit on perch and a 20-inch minimum size limit on northern pike.

A creel census has continued on Birch Lake, Cass County, and on Corey Lake, St. Joseph County. Both waters are stocked with trout. Birch Lake is being planted with rainbow trout one year in three (3,000 fish of legal length in the spring and 3,000 in the fall) in an attempt to improve the rate of recovery of planted fish.

Since the winter of 1956-57, a special winter fishing season for rainbow trout has been in effect on Corey Lake. The catch taken during winter constitutes 10 to 12 percent of the annual catch of trout. The winter angling effort is 12 percent of the annual effort. Apparently the special season has eliminated the loss that resulted from hooking of rainbows by pan-fish anglers when it was illegal to keep trout in the winter. Besides this advantage, the harvest of rainbow trout stocks during the special season has not been disproportionate.

Studies on all experimental-regulation lakes became a Dingell-Johnson project in April of 1958.

Lake Fish Population Studies

The records of several population studies, conducted from 1948 through 1956, have been analyzed to learn more about life spans and mortality rates of some Michigan fishes. Data are available from 16 population studies on 5 lakes. Angler-harvest estimates are also on hand for the five lakes on which these investigations have been made.

The Institute, with the cooperation of the Lake and Stream Improvement Section, conducted a population study in the spring of 1958 on Fife Lake, Grand Traverse County, by two methods of capture--a 2,700-foot seine and trap nets.

An investigation of the effects on the fish population from a draw-down in 1958 of Haymarsh Lake, Mecosta County, is under way.

Fish Toxicants

Experimental treatments with toxaphene, an insecticide, have been made on 19 lakes. These applications, together with laboratory work, have defined quite closely the concentrations required to insure complete eradication of fish and the minimum duration of detoxification in various types of lakes. In one experiment, a low concentration of toxaphene was used to excellent advantage to eliminate small fish, without harming large fish in the population. A preliminary report on this study has been submitted for publication.

Aquatic Plant Control

At Minnewanna Lake, Lapeer County, data were collected to determine whether control of aquatic weeds can achieve a favorable balance in fish populations. These data and those from a similar experiment conducted at the Hillsdale Rearing Ponds are being analyzed.

Tests of new aquatic herbicides have continued. The biological effects of 2-4D preparations in pellet form are being studied in an experiment with which the Institute, Michigan State University, and the Huron-Clinton Metropolitan Authority are jointly concerned.

Cooperative Projects With Michigan State University

A graduate student and faculty members of Michigan State University have conducted several fishery investigations with support from the Department.

Fertilization Experiments. The initial phase of a study of biological effects from fertilization on a headwater lake (Hoffman Lake, Cheboygan County) and on its outlet (West Branch of the Sturgeon River), a trout stream, has been completed in cooperation with the Institute. Results indicate that excess marl interferes with the lake's capacity to use fertilizing elements. These results have led to a study of the mechanisms by which fertilizers are assimilated by plants in marl lakes. A report that deals with the Hoffman Lake experiment has been prepared for publication.

Fertilizing elements disappeared from the lake rapidly, and some of them moved down the stream a considerable distance. Investigation of the distribution of these nutrients in the Sturgeon River and their utilization in the food chain is being continued. Radioactive isotopes are used to trace the movement of the nutrients in the food chain. A grant of $10,000 from the Atomic Energy Commission will contribute substantially to the financial support of this work.

Effects of Pollution on Fish Production. Investigation of the effects of moderate pollution by domestic and industrial wastes on fish and fish-food organisms has continued on a warm-water stream (Red Cedar River, Ingham County). The investigator is making this study under a fellowship for an advanced degree.

Cooperative Projects with The University of Michigan

Graduate students at The University of Michigan have been engaged in a number of studies supported financially by the Department. Senior members of the Institute staff have honorary faculty status and serve on doctoral committees.

Fish Food Study. A detailed life-history study of the aquatic sow bug (Asellus intermedius) was completed and a report prepared. This crustacean is an important food of trout in some streams. In Houghton Creek, Ogemaw County, where the field investigations were made, this organism is the main item in the diet of brown trout.

Smallmouth Bass Study. The investigation of the life history of the smallmouth bass in the area off Waugoshance Point in northeastern Lake Michigan was completed in 1957. Facts were recorded on the reproduction, growth, movement, mortality rates, and numerical abundance of this species for the years of 1953 through 1955. The report was accepted as a doctoral thesis.

Growth of Bluegills. Experimental studies on the growth of bluegills have been completed and a report is in preparation. Results indicate that growth and efficiency of food conversion are directly related to the rate of food consumption, ie, as food consumption increases, growth and efficiency of conversion also increase.

Temperature and season significantly influence the rate of food consumption. Intake of food by bluegills is small at temperatures below 50° F., with little or no increase in length or weight. Between 50° and 80° F., consumption and growth rates increase directly with temperature.

The data indicate the presence of a seasonal variation in the growth potential of bluegills due to a variation in appetite. In laboratory experiments conducted in different seasons and at constant temperatures, the maximum growth was observed

in fish tested in June; the minimum growth was observed in August, when the rate of food consumption was as much as 50 percent lower than the June rate.

Enrichment of Hard-water Lakes. This investigation is concerned with the nutrient requirements of planktonic algae in hard-water lakes. The objectives are to determine the nutrients that are lacking, those that cannot be assimilated, and the conditions necessary for artificial enrichment of such lakes. As some available nutrients cannot be assimilated by algae in these waters, studies are being made on the effectiveness of chelating agents to achieve utilization. Preliminary results indicate that the presence of these agents enhances the growth of algae. Radioactive carbon-14 is used to measure the variable factors.

Coarse Fish Removal. A study of the effects of coarse fish removal from a trout stream was begun in 1958 on Canada Creek, Montmorency County. A sample of fish collected from this stream before the study began consisted of 38 percent brook trout (42 percent by weight) and 62 percent coarse fish (58 percent by weight).

INSTITUTE FOR FISHERIES RESEARCH

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