IFR Report #1427

Biennial Report - 1952

SEVENTEENTH BIENNIAL REPORT

1953 - 1954

THE DEPARTMENT OF CONSERVATION

STATE OF MICHIGAN

BY AUTHORITY

SCHOOLCRAFT COUNTY. Gulliver Lake (T 41, 42 N, R 14 W). One hundred and fifty-four shelters installed in 1953.
Bear Lake (Nineteen Lake) (Section 34, T 44 N, R 18 W). This lake treated in 1953 to remove all fish and restocked with trout.

In addition to the above projects, state-wide maintenance was performed on all previously installed stream improvement structures.

Dams

Work was started on Hoister Lake and Foch Lake dams. Both are of the reinforced concrete drop inlet type with earth filled dykes.

Hoister Lake Dam is located in the headwaters of Cedar River in Gladwin County. The dam will increase the present pond of 13 acres to one of 22 acres and provide a more desirable depth. The lake will be treated upon the completion of the dam to remove all fish present and will be restocked with trout.

Foch Lake Dam is located in the northwest part of Montmorency County. This dam will increase the present lake area from eight to approximately 50 acres. It will provide added depth to the present shallow lake and increase the shoal area as well for a more desirable habitat for largemouth bass, bluegills, northern pike and perch.

Timber and Post Cutting Project

Winter work in 1953 was confined to the procuring of cedar posts for next season's stream work. During the winter of 1952-53, 15,000 cedar posts were cut from the Bark River area and 12,000 cedar posts and stringers from the Roscommon area.

During the winter of 1953-54 the following amounts of lumber and posts were obtained: 166 MBM of lumber from the northern Luce county area and 94 MBM from Cheboygan and Ogemaw counties; 22,000 cedar posts and stringers from Delta and Schoolcraft counties and 19,000 from Roscommon County.

INSTITUTE FOR FISHERIES RESEARCH

Investigation of sport fishery problems continued to be the chief function of this, the research branch of the Division. The period was marked by progress in the collection of data and their interpretation.

Seventy formal reports were prepared.

Lake Mapping and Surveys

Lake mapping over open water with an echo sounder was begun in the spring of 1953. One two-man crew worked with the echo sounder in 1953 and 1954. Use of this instrument with lake outlines traced from aerial photo maps was found to be an efficient method of mapping. A drawback at present on more intensive use of the echo sounder is that the instruments now available are not well adapted for work on shallow water.

Four crews during the winters of 1952-53 and 1953-54 and the one crew that worked with the echo sounder in 1953 mapped a total of 187 lakes. Biological survey crews and other Division personnel prepared 16 additional maps. Total number of lakes mapped to date is 2,400. Men from state prison work camps gave considerable assistance in mapping, especially during the 1953-54 winter season.

Lake inventories that included studies of fish populations, fish growth, aquatic vegetation, water chemistry, etc. were made by two field parties in the summers of 1953 and 1954. The larger lakes inventoried in 1953 were Austin, Kalamazoo County; Millecoquins, Mackinac County and Hess, Newaygo County. Large lakes scheduled for study in 1954 were Margrethe, Crawford County; Twin Falls Flowage, Dickinson County; and Crooked Lake, Emmet County.

Biological inventories and mapping of lakes were financed principally with Dingell-Johnson funds.

Stream Surveys

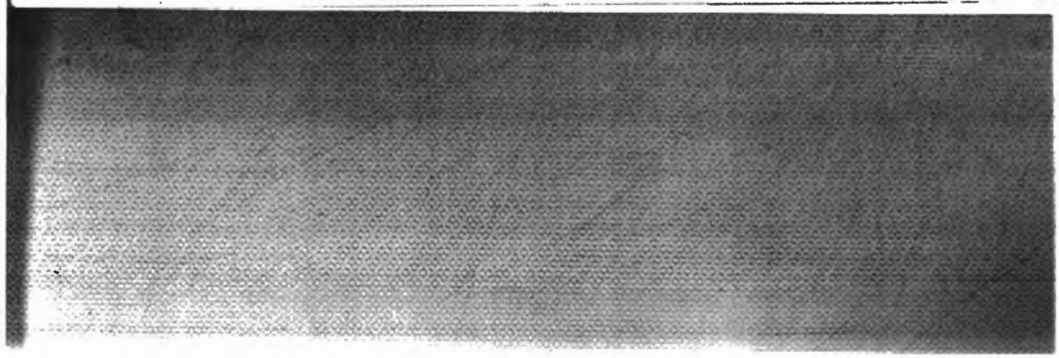
Intensive surveys of streams continued in 1953 and 1954. Most of these investigations were carried out on entire stream systems. The work included fish collecting (done almost entirely with electric shocking machines), notation of physical data and recording of temperatures during warm spells. Scale samples were taken from game fishes for growth analysis. The main purpose of this project has been to collect basic information on stream systems that either have been designated or considered for habitat improvement. The data will aid in the evaluation of the improvement.

Two three-man crews worked on surveys of streams during the summer and early fall seasons. In 1953, a survey of the Otter River system, Houghton and Baraga counties was completed. Work on the Paint River drainage, Marquette and Iron counties was begun. A study of the Ford River system, Iron, Dickinson, Marquette, Menominee and Delta counties, was started. Temperature surveys of the Chocolay River system, Marquette County and Pine River system, Chippewa and Mackinac counties were completed. Work begun in 1952 on the Kalamazoo River and its tributaries continued in 1953. Temperature surveys were completed on the Pine River system in Alcona and Iosco counties and on the Pine River system in Manistee, Wexford, Lake and Osceola counties.

Collecting at certain stations on the Rifle River and several of its headwater tributaries (Ogemaw County), begun in the fall of 1950, continued. This study concerns fish population fluctuations and growth rates of trout in streams included under the Rifle River Watershed Development Program. Also, population checks were continued in experimental sections on the Pine River, Lake County, where increase of the minimum legal size of trout to 10 inches is being studied.

Preliminary population studies were scheduled in 1954 on sections of trout streams where additional experimental regulations on fishing are planned. These streams are: East Branch of the Fox River, Schoolcraft County; Boardman River, Grand Traverse County; Little South Branch of the Pere Marquette River, Newaygo County. The Cedar River system, Clare and Gladwin counties; on which a watershed improvement program has begun, was scheduled for a biological survey in 1954. Also listed for survey was the Blind River-Dead Sucker River system, Luce County. Surveys were to continue on the Paint, Ford, and Kalamazoo river systems.

Stream survey work has largely been financed with Dingell-Johnson funds since June of 1952.



Age and Growth of Fishes

Research begun in 1950 on aging members of the pike family (*Esocidae*) was to be concluded near the end of the biennium. Known-age muskellunge were not available, hence study was concentrated on northern pike.

Tentative averages were set up on the growth rates of brook, brown and rainbow trout. Figures were compiled from 11,706 samples collected in various parts of the state. These averages are as follows:

	Age								
Species	0	I	II	III	IV	V	VI	VII	VIII
Brook	2.6	5.8	8.2	10.4	13.9				
Brown	3.0	6.4	9.1	11.7	15.4	19.2	21.3	23.6	
Rainbow	2.3	6.3	9.5	13.7	24.9	26.3	27.8	30.7	31.8

Compilation of state-wide growth rate averages for those species of Michigan warm-water game fish whose growth rates have not been established, and revision of current averages for other species, are expected to be completed by the end of 1954.

Routine age and growth studies have continued in connection with lake and stream survey work. Scales collected through various investigations now average around 20,000 samples a year. A new model roller press has been secured for preparation of impressions of scales on plastic strips. Each of the field stations will be supplied with a press.

Fish Mortality and Disease

Studies on improving fish cultural operations and on mortalities and diseases were continued at the fish pathology laboratory.

Experiments have been conducted with two barbiturates (amytal sodium and seconal sodium) to develop another practical method for transporting fish. Use of these drugs may permit two or three times the normal load of fish to be carried per transporting unit, resulting in a substantial reduction in cost of transportation.

The pathologist cooperated in planning and supervising tests carried out at Michigan State College and financed by the Department of Conservation, on development of new diets for trout.

Autopsies were made on trout killed in hooking experiments conducted through the Hunt Creek Fisheries Experiment Station.

Photographs in color are being taken by the pathologist to record fish diseases and methods of applying treatments at hatcheries. The photos will be used in the in-service training program to acquaint fish culturists with diseases that may be encountered at hatcheries and with equipment and methods used to combat diseases. A series of slides will also be made of common fish parasites for use in talks to the public.

An aquarium room was completed at the Grayling Hatchery for use by the pathologist. The aquariums will be used for experiments in fish diseases and other problems that require close observation of fish.

Sea Lamprey Investigations

Substantial contributions were made toward research on the sea lamprey and its control.

An experimental sea lamprey barrier on the Black River, Mackinac County has continued in operation. In 1953 the steel lip on the barrier

was modified from a half circle overhang to a straight sheet that projected downstream at a 30° angle from vertical. While this modification apparently was quite effective in preventing lampreys from passing over the barrier, it also prevented many rainbow trout from migrating to upstream spawning sites. Inability of the trout to surmount the dam presumably was caused by extreme turbulence created by the modified lip. In 1954, the barrier was operated as in 1953. It remained effective against lampreys, and rainbows were somewhat more successful in jumping the dam than they had been in 1953 as a result of a reduction of the head.

Another lamprey barrier (a modification of the trap invented by Philip Wolf) was maintained on the Carp Lake River, Emmet County. Here records are kept on newly transformed adults and larvae moving toward Lake Michigan, and on spawning migrants moving upstream. This experiment has shown that in some individuals it takes longer than four years (the time formerly thought required) for sea lamprey larvae to transform into the adult stage.

An investigation was carried out in 1952 on 19 inland lakes where lampreys and lamprey-scarred fish had been reported.[1] Sea lampreys were found in only five of these lakes—Burt, Mullett, Charlevoix, Big Platte, Benzie County and Devoe, Ogemaw County. In each of these waters the sea lamprey population was small and did not offer any cause for alarm. Fortunately, the vast majority of the inland lakes do not provide suitable habitat for this parasite.

The Lands Division of the Conservation Department obtained leases on property for the installation of lamprey control devices by the U. S. Fish and Wildlife Service.

Rainbow Trout Studies

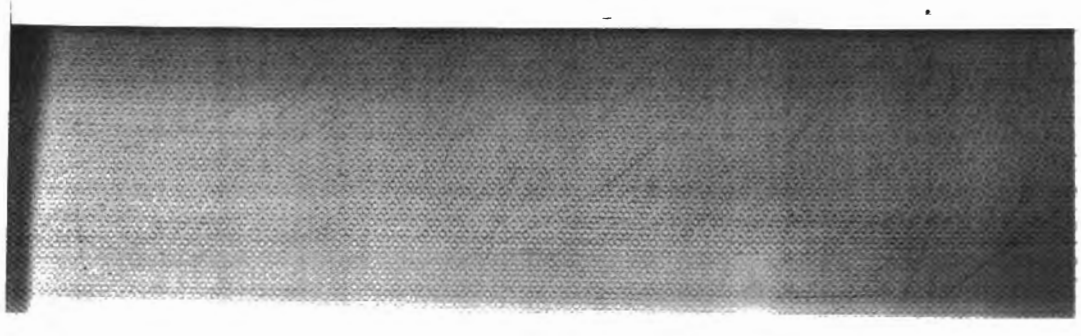
Studies on migratory rainbow trout in the Black River, Mackinac County begun in 1950, were continued. Traps operated at a barrier dam were employed in this research. Fish captured in the traps were tagged and detailed data were recorded.

Creel census, taken to determine the effect of special seasons on rainbow trout population, revealed that lake-run rainbows are caught at a rate of 0.05 to 0.1 per hour. Average size of fish taken in 1953 was 14 inches. Since the beginning of work on the Black River, there has been a decline in the number and size of rainbow trout that have entered the stream from Lake Michigan to spawn. Indications are that heavy angling pressure, sea lamprey predation, and possibly natural fluctuation in the population have in combination been responsible for this decline.

Age determinations and observations on degree of maturity of rainbows indicate that 30% of the males mature at the age of two years, 67% at three years, and that all are mature at four years. Females do not reach maturity until the age of three years, when approximately 31% are ready to spawn. Virtually all are mature at the age of four years.

Plantings of hatchery rainbow trout were made in the Black River and in Lake Michigan. The purposes of these plantings are to determine whether the fish put into the stream will migrate to the lake and whether those stocked in the lake will remain there. Results are inconclusive to

[1]Guard, Truman T. 1953. The sea lamprey in inland waters. Mich. Cons., May-June Issue, pp. 14, 15, 19, 20.



date. Tag returns show that rainbows stocked in Lake Michigan have ranged widely in the lake.

Pike and Muskellunge Investigations

Investigations continued on spawning requirements for northern pike, and studies were made on pike spawning grounds. Final court decrees were secured by the Department's legal section which forbid the filling of pike spawning areas at Otsego Lake, Otsego County and Whitmore Lake, Washtenaw and Livingston counties.

Improvement of production of pike in a marsh by destruction of perch and other fish that prey on pike eggs and fry are being tested at Otsego Lake. Obstacles to reintroduction of the predators are also being tested.

Observations were made on muskellunge spawning activities on Torch River, Antrim and Kalkaska counties; Indian River, Cheboygan County Lac Vieux Desert, Gogebic County and Lake St. Clair. Muskellunge were found to spawn in various habitats. In Torch and Indian rivers they spawned along marshy or log-littered banks in a slight current from mid-May until early June. At Lac Vieux Desert spawning occurred in shallow, mucky bays early in May. In Lake St. Clair spawning apparently takes place in weed beds at the mouths of streams during the first half of June.

Creel census information was obtained on muskellunge during the spawning period and during the winter spearing season.

Walleye Investigations

An investigation of the value of planting fingerling walleyes, started in 1951, has continued. Several lakes were chosen for fingerling stocking of two types—introductory and maintenance. Walleye fingerlings were introduced into seven lakes while seven other lakes are receiving maintenance plantings at four-year intervals.

Results of maintenance planting were carefully followed at East Twin Lake, Montmorency County where the program shows considerable promise. Reports from Mitchell Lake, Iron County, and Barlow Lake, Barry County were also encouraging.

Research on walleyes in the Muskegon River system continues. Young, native walleyes were captured, tagged, and released in Hardy Pond during 1952, 1953 and 1954 for information on movement. Another group of small, native walleyes from Hardy Pond were tagged in 1954 and released in the Muskegon River below Newaygo Dam. Observations will be made to learn if any of these fish will appear in spawning migrations in future years.

Estimates, derived from tagging operations in Muskegon Lake, indicated that spawning runs of walleyes in the Muskegon River were composed of over 100,000 fish both in 1953 and 1954 and that the "Newaygo Transfer" involved less than 10% of these walleyes.

A walleye tagging program was carried out on the Inland Waterway during 1952, 1953, and 1954. Recoveries show that the spawning run of walleyes in the Black River below Alverno Dam originates in the connecting lakes (Mullett, Burt, Crooked) and that fish return to the lakes after they have spawned.

A report was prepared summerizing results of all walleye tagging experiments from 1929 through 1953.[2]

Hunt Creek Fisheries Experiment Station

Research activities at the Hunt Creek station in Montmorency County included: (1) Continuation of intensive creel census on experimental brook trout waters for the 14th and 15th consecutive seasons. (2) Hooking experiments on the three species of stream trout under natural conditions for information on mortality caused by fly fishing and bait fishing. (3) Postseason population studies on the station's waters with electric shocker and trap nets to determine extent of angler exploitation. (4) Collection and analysis of fish and scale samples taken annually in the fall from experimental sections on the North and South branches of the Au Sable River. (5) Assistance to outside investigators, such as the staff of Psychological Research Services, in studies on trained trout and the investigator working on midge-trout relationships.

Following are creel census data on fishing done on Hunt Creek during 1952 and 1953:

Season	Fishing Trips	Hours Fished	Trout Caught: Wild Brook	Hatchery Brook	Hatchery Rainbow	Pounds	Trout per Hour	Pound per Hour
1952	676	1,765	777			137	0.44	0.08
1953	881	2,153	755	477	77	234	0.56	0.11

When the weight of 46 fish less than seven inches is added, the total poundage removed by angling in 1952 was 142 pounds, or 20.25 pounds per acre. In 1953, the total weight of trout caught by fishermen was 236 pounds; in addition, 350 brooks and rainbows that totalled 14 pounds were removed for a food habits study.

Hatchery rainbow trout taken were those involved in a survival study on tagged, fin-clipped and normal fingerlings. The hatchery brook trout originated from plantings of sublegal fish released in April, 1953 and from plantings of trained and untrained fish made by Psychological Research Services in August, 1953.

Fuller Creek Pond, operated under a daily creel limit of five fish with a minimum size of 10 inches, continued to yield brook trout of above-average proportions. In 1952, 88 trips involving 239 hours of fishing produced 43 trout that weighed 24 pounds. The average length of these fish was 11.3 inches. In 1953 the catch declined to 33 fish, taken in 60 trips and 172 hours; average size of the fish was 11.6 inches.

The effect of impoundment at Fuller Creek Pond on water temperatures downstream was studied in detail.[3]

East Fish Lake was fished under restrictions similar to those for Fuller Creek Pond. The records are shown below:

Season	Fishing Trips	Hours Fished	Brook Trout Caught	Pounds	Trout per Hour	Pound per Hour
1952	174	596	37	22	0.06	0.04
1953	125	446	49	28	0.11	0.06

[2]Eschmeyer, Paul H. and Walter R. Crowe. The movement and recovery of tagged walleyes in Michigan, 1929-1953. Ms.

[3]Shetter, David S. and Marvin J. Whalls. The effect of an impoundment on the temperatures of Fuller Creek, Montmorency County, Michigan. Jour. Wildl. Mgt. In Press.

Average size of the trout taken from the lake was 11.8 and 11.7 inches for the respective years.

Control of white suckers and creek chubs in East Fish Lake has been attempted since the spring of 1952 with the hope that their reduction will improve trout angling quality. Removed during 1952 were 1,292 suckers and 569 chubs that weighed 545 pounds. Taken from the lake in 1953 were 2,336 suckers and 475 chubs weighing 389 pounds.

In hooking experiments, worm-baited hooks (sizes 2, 4, 6 and 8, all long-shank) killed 14 times as many brook trout, three times as many rainbow trout, and at least 10 times as many brown trout than did No. 12 and No. 14 artificial flies.[4]

Study continued on effects of restrictive angling regulations on trout in experimental sections of the South and North branches of the Au Sable River. On the North Branch results of a partial creel census and population counts indicated an increase in brook trout population and also an increase in the anglers' catch of trout at least 10 inches long.[5] Judged on the basis of population counts and scattered reports on fishing returns, trout population and angling results on the South Branch follow a pattern similar to that for the North Branch.

A major addition to the Hunt Creek Station's facilities was completed in January, 1954 when a new building housing an office, a checking station, laboratory and garage was occupied. Alterations to the former office in the original building provided two additional bedrooms.

Pigeon River Trout Research Area

Under study at the Pigeon River Trout Research Area in Otsego County are approximately six miles of trout stream (a new section, 1.2 miles in length, was added in 1953) and seven small trout lakes. A complete census of fishing is taken under a compulsory permit system. As in the past, scale samples are collected from all angler-caught fish for growth analysis, and postseason population estimates on the stream continue.

Experimental sections of the Pigeon River for 1951, 1952, and 1953 have averaged 2,082 fishing trips per year, equivalent to 186 hours of fishing annually per acre of water. Hatchery trout from various experimental plants made up 59 per cent of the total catch for this period. The fishermen who made only one trip to the area each year comprised over 60% of all anglers.

A report was prepared on an investigation carried out during the preceding biennium on mortality rates of brook trout and brown trout in the Pigeon River.[6] Based on estimates derived from the number of fingerlings surviving and potential egg production, percentage of wild brook trout survival ranged from 2.5 to 5.1; the percentage range for wild brown trout was 1.4 to 5.8. Wild brook and brown trout showed better survival rates than hatchery fingerlings.

Attempt was made to find reasons for the complete disappearance of planted hatchery fish that evidently died. Dead trout were staked out in the stream. It is thought that snapping turtles were largely responsible

[4]Shetter, David S. and Leonard N. Allison. 1954. Fly fishing only? Mich. Cons., March-April Issue, pp. 12-13.

[5]Shetter, David S., Marvin J. Whalls and O. M. Corbett. The effect of changed angling regulations on a trout population of the Au Sable River. Trans. 19th N. Amer. Wildl. Conf. In Press.

[6]Cooper, Edwin L. 1953. Mortality rates of brook trout and brown trout in the Pigeon River, Otsego County, Michigan. Prog. Fish. Cult., Vol. 15, No. 4, pp. 163-169.

for early disappearance of the test fish. After three days in the stream, silt and detritus had coated the body surface sufficiently to camouflage the remaining fish. None of the dead trout were ever reported by anglers.

Results were published of a study on the influence of ground water on trout which was conducted in 1952. Apparently ground water seepage is the main limnological factor that controls wild brook and brown trout populations in the Pigeon River. This factor determines location of spawning sites and affects the numbers in all sizes and age groups.[7]

A paper dealing with feeding habits of brook trout in the Pigeon River was prepared.[8] Data resulting from this study suggested a close relationship among periodicity of growth, condition and mean volume of stomach contents. Stream temperatures were 55° to 66° F. When the fish were in the best condition and had eaten the most food.

Findings from research, and research activities currently in progress, include the following:

1.) Rates of exploitation of wild brook trout continue higher than those for wild brown or rainbow trout.

2). Worm fishermen catch most of the hatchery trout and fly fishermen catch most of the native trout.

3). Fin-clipped trout are more readily recovered than jaw-tagged trout.

Experiments with marked fingerling trout, for further information on the possibility of utilizing this economical size of fish, are in progress in both the lakes and streams.

Creel census facilities of the area are also used in current experiments with trained trout being conducted by Psychological Research Services, Inc.

Rifle River Area

Collection of data on fish and fishing continued on the 4,318-acre Rifle River Area in Ogemaw County. This experimental area has 10 lakes (eight of which are fished) and 9.17 miles of trout streams.

Fishing pressure on the trout streams was somewhat less in 1952 than it had been the two preceding seasons; the total catch of trout was also appreciably reduced. In 1953 there was a marked increase in the number of anglers on the streams, time spent fishing, and number of trout caught. The bulk of this increase occurred on the Rifle River. Good returns from plants of hatchery trout (59.7% of the total catch of trout) doubtless influenced this upswing. Hatchery fish comprised 19.6% of the total take of trout in 1952. Creel census figures for the streams appear in the following table:

Season	Fishing Trips	Hours Fished	Trout Caught			Other Fish Caught	Pounds, Trout	Pounds, Others	Trout per Hour
			Brown	Brook	Rainbow				
1952	2,218	5,054.0	500	28	109	364	341	99	0.13
1953	3,036	7,846.5	1,766	21	230	137	691	81	0.26

Fishing activity was also greater on the area lakes in 1953 than in 1952. Devoe Lake showed the largest portion of this increase which probably was due to good fishing provided by planted rainbow trout. Stocking here in the spring and fall of 1951 produced only two rainbows during

[7]Benson, Norman G. 1953. The importance of ground water to trout populations in the Pigeon River, Michigan. Trans. 18th N. Amer. Wildl. Conf., pp. 269-281.

[8]Benson, Norman G. Seasonal fluctuations in the feeding of brook trout in the Pigeon River, Michigan. Trans. Amer. Fish. Soc. In Press.

the 1952 season; stocking in the spring of 1953 resulted in a catch that season of 440 rainbows (213 pounds) comprising 11.1% of all fish caught from Devoe Lake in 1953.

More fishing also was done in 1953 on North Lake where no trout were taken. There was an appreciable decrease in angling pressure on Dollar Lake in 1953 from 1952 but no significant drop in the catch. Due to winterkill in Spring Lake during 1952-53, there were 69% fewer angler days, 83% fewer hours fished, and 91% fewer fish caught on this lake in 1953 than in 1952. Creel census data for the lakes follow:

Season	Fishing Trips	Hours Fished	Fish Caught	Pounds	Fish per Hour
1952	1,983	5,925.0	7,036	1,542	1.19
1953	2,270	7,246.5	7,630	1,667	1.05

Other activities on the area included the following:

Scale samples were collected from game fish in connection with the creel census for age and growth analysis.

Weirs were installed in lower Gamble Creek in the fall of 1952 to study the movement of fish between Gamble Creek, Devoe Lake, and Rifle River.

Fish sampling and population studies in the Rifle River drainage, begun in the fall of 1950, were carried on in 1953 and 1954 to evaluate effects of watershed development program.

Experimental planting of sublegal brown trout in the Rifle River for a three-year period, to afford a check on survival rates of small browns, began in the fall of 1952.

Creel census data on the Rifle River for the period, 1945-1952, were reviewed, particularly to study the effect of increasing the minimum size limit on trout from seven to eight inches, first effective in 1948. During these eight years of census there was a general upward trend in angling intensity, but there apparently was no relationship between angling intensity and annual harvest of wild trout. There was no significant difference in the mean total length of the catch nor in the number of trout caught in the two periods when different size limits were in effect.

Experiments in encouraging aquatic plant growth in marl-bottomed lakes and fertilization of marl lakes continue.

The Game Division also uses the Rifle River Area for research. Many people who visit the grounds register only as sight-seers. There were 13,478 visitors in 1953.

Studies of Fish Food Organisms

A study of the quantity of fish food organisms produced in eight southern Michigan lakes was started in 1953. The lakes are included in the intensive creel census program that tests liberalized fishing regulations. Fish population studies were made on three of these waters. The aim of this investigation is to determine how food supplies are related to growth and harvest of fish in these typical warm-water lakes.

A study completed on Weber Lake, Cheboygan County, indicated that insufficient chemical nutrients in the water limited production of fish foods.[9] This scarcity of minerals appears to be due to drainage and ground water conditions.

[9]Hooper, Frank F. 1954. Limnological features of Weber Lake, Cheboygan County, Michigan. Pap. Mich. Acad. Sci., Arts, and Lttrs., Vol. 39, pp. 229-240.

An investigation of the midge population of Hunt Creek, Montmorency County was made during the summer and fall of 1952.[10] Qualitative samples were taken from the stream and also from East Fish Lake and Fuller Creek Pond. Totals of 15 genera and 34 species of midges were found that represented stream fauna.

During 1953 and 1954, monthly collections of bottom samples and sublegal fish were taken for the midge study from Hunt Creek, North Branch of the Au Sable River, Crawford County, and Pigeon River, Otsego County. Concurrently, during the trout season, stomachs were taken from legal fish caught at Hunt Creek and Pigeon River. Examination of these materials remains to be done. The goal is to find what correlation there is between the specific organisms found in bottom samples and the food items in the trout stomachs. Also, specific studies will be made on stomach samples and midges found on the bottom.

General Creel Census

Conservation officers obtain records of individual fish catches which are submitted to the Institute for tabulation and analysis. This census furnishes a valuable index to the quality of fishing, since most of the important waters of the state are sampled. The census has operated continuously since 1927. During 1952, the officers interviewed 50,396 anglers who had fished 122,841 hours and caught 170,980 fish at a rate of 1.4 fish per hour. In 1953, the officers contacted 62,289 fishermen who had fished 148,108 hours, and took 191,486 fish, a catch of 1.3 fish per hour.

Of a total of 18,577 trout reported in 1952 from trout waters, 12,702 (68.4%) were brook trout, 3,623 (19.5%) were rainbow trout and 2,252 (12.1%) were brown trout. In 1953, of 18,109 trout, 11,241 (62.1%) were brooks, 4.484 (24.7%) were rainbows, and 2,384 (13.2%) were browns. The catch per hour was 0.69 trout in 1952 and 0.63 trout in 1953.

The bluegill was the species caught in greatest numbers in non-trout waters, where it constituted 40.0% (1952) and 43.6% (1953) of the total catch. Bluegills and yellow perch together made up 73.1% in 1952 and 70.3% in 1953 of the catch in non-trout waters. The catch per hour was 1.4 fish during these two years. In the Great Lakes and connecting waters, yellow perch made up the bulk of the total catch, 84.1% in 1952 and 85.1% in 1953. The fishing quality, as indicated by the catch per hour, was highest in the Great Lakes and connecting waters—2.6 fish in 1952 and 3.0 fish in 1953.

Liberalized Fishing Experiments

Experimental fishing regulations for largemouth and smallmouth bass, northern pike, and walleyes were put into effect on nine lakes in the spring of 1954. Purpose of these experiments is to determine whether more liberal or more restrictive laws on these species can result in better management for Michigan's warm-water lakes.

Size limits have been removed on bass, pike, and walleyes in three lakes: Big Portage, Jackson County; Duck, Calhoun County and Fine, Barry County.

Larger size limits (largemouth and smallmouth bass, 16 inches; north-

[10]Curry, LaVerne L. Notes on the ecology of the midge fauna *(Diptera: Tendipedidae)* of Hunt Creek, Montmorency County, Michigan. Ecology. In Press.

ern pike, 24 inches) are in effect on three other lakes: Fife, Grand Traverse and Kalkaska Counties; Minnewaukan, St. Joseph County; Sugarloaf, Washtenaw County.

There is no closed season on any species of fish in Bear Lake, Manistee County; Pontiac Lake, Oakland County and Whitmore Lake, Washtenaw and Livingston Counties.

Creel census has continued on the waters named above. All except Bear Lake have been censused since 1946, when earlier experimental regulations began. Bear Lake has had a creel census since June, 1951. Data collected from the test lakes prior to 1954 will be used to evaluate any changes in fishing results that may occur due to recent changes in regulations. Plans are to conduct the latest experiment for five years—through the winter of 1958-59.

Devils Lake, Lenawee County and Bear Lake, Hillsdale County have been discontinued as sites for regulation change experiments. A creel census was conducted on Otsego Lake, Otsego County since the spring of 1952, excepting the winter of 1953-54 when the lake was closed to fishing from December 1, 1953 to May 15, 1954. Purpose of this closing was to protect planted northern pike. Creel census was resumed on Birch Lake, Cass County in April, 1954. Main purpose of this study is to measure the effect of a new planting program for rainbow trout. Plantings are to be made at four-year intervals instead of annually to determine whether the lake will again produce fast-growing rainbows under this plan.

Results of the creel census taken on 12 lakes from 1946 through 1950 have been published.[11] The following regulations that were tested have been incorporated into the fishing laws: removal of size limits on all warm-water fish except largemouth and smallmouth bass, pike, muskellunge, and sturgeon; year around fishing in lakes south of Highway M-46; year-around fishing for bluegill and pumpkinseed.

Lake Fish Population Studies

Population estimates of legal size game fish were continued on a few representative lakes. These lakes are also the subject of study of liberalized fishing regulations, and of basic limnology. Estimates were based on captures of fish by commercial-type trap nets and the mark-and-recapture method of computation. Trap netting at 173 stations on Sugarloaf Lake, Washtenaw County during the fall of 1952 showed a population of 95 legal game fish per acre.[12] Similar estimates on 677-acre Whitmore Lake, Washtenaw and Livingston Counties during the spring of 1953 gave 80 legal game fish (35 pounds) per acre, and showed great dominance of an individual year class among the bluegills, black crappies, rock bass, and pumpkinseeds.[13] Estimates were also made on Big Portage Lake, Jackson County during the fall of 1953 and the spring of 1954, and again on Whitmore Lake in the spring of 1954. The results are yet to be analyzed.

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[11]Christensen, Kenneth E. 1953. Fishing in 12 Michigan lakes under experimental regulations. Inst. Fish. Res. Misc. Pub. No. 7, 46 pp.

[12]Cooper, Gerald P. and William C. Latta. 1954. Further studies on fish population and exploitation by angling in Sugarloaf Lake, Washtenaw County, Michigan. Pap. Mich. Acad. Sci., Arts, and Lttrs. Vol. 39, pp. 209-223.

[13]Cooper, Gerald P. and Robert N. Schafer. Studies on population of legal-size fish in Whitmore Lake, Washtenaw and Livingston Counties, Michigan. Trans. 19th N. Amer. Wildl. Conf. In Press.

A report was prepared on the rise and decline of the bluegill population in Big Bear Lake, Otsego County.[14]

Aquatic Plant Control

In a cooperative project with the Detroit Edison Company and the University of Michigan, tests were made on six commercial herbicides to determine their value in controlling water weeds. Only sodium arsenite proved effective. Recently a new algaecide, dehydroabietylamine (RADA), has been tested in two southern Michigan ponds. Preliminary results show this chemical to be very effective against filamentous green algae. Laboratory tests have indicated, however, that the concentration must be carefully controlled in order to avoid killing of fish.

Cooperative Projects with Michigan State College

Investigations were conducted by graduate students at Michigan State College under joint supervision of faculty members and senior Institute workers. The Department provided financial support. Members of the faculty also made a number of contributions.

Experiments on Lakes. An experiment in which the water of West Lost Lake on the Pigeon River Trout Research Area was artificially circulated was conducted by College and Institute personnel.[15] The bottom water was pumped to the surface in midsummer. After 10 days, temperature and oxygen conditions in the entire lake had been made suitable for trout. Immediately after pumping, there was a tenfold increase in the phytoplankton of the lake, indicating the lake's capacity to produce fish food had been increased.

Experiments on methods for improving fish production and angling in marl lakes were in progress on the Rifle River Area. Two types of studies were carried on: (1) Experiments to determine effect upon the growth of rooted aquatic plants of adding various organic materials to marl soils. (2) Experiments to determine value of fertilizing marl lakes.

Another investigation would find the reasons for low productivity in bog lakes and means of improving productivity.

Farm Fish Pond Management. Investigations continued on proper management of farm ponds and best utilization of the fish these ponds produce. Experiments were conducted at the Wolf Lake Hatchery to determine extent of mortality in draining operations, proper ratios for stocking farm ponds and desirable methods for harvesting the crop.[16]

Tests have been made on the suitability of redear sunfish *(Lepomis microlophus)* for farm ponds. The value of this species looks promising.

Results of recent farm pond research are outlined in two publications that came out during the biennium.[17, 18]

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[14]Crowe, Walter R. The bluegill population in Big Bear Lake, Otsego County, Michigan. Pap. Mich. Acad. Sci., Arts, and Lttrs. In Press.

[15]Hooper, Frank F., Robert C. Ball and Howard A. Tanner. 1953. An experiment in the artificial circulation of a small Michigan lake. Trans. Amer. Fish. Soc., Vol. 82, 1952, pp. 222-241.

[16]Grassl, Edward F. 1953. Production and harvest of farm pond fish. M.S. thesis.

[17]Ball, Robert C. 1952. Farm pond management in Michigan. Jour. Wildl. Mgt., Vol. 16, No. 3, pp. 266-269.

[18]Ball, Robert C. and John R. Ford. 1953. Production of food-fish and minnows in Michigan ponds. Mich. Agr. Exp. Sta. Quart. Bull., Vol. 35, No. 3, pp. 384-391

Bait Fish Investigations. A considerable amount of experimentation was carried on in past years on methods of rearing and harvesting, and economic evaluation of bait fish production in ponds. The outcome of one of these studies appeared in published form in 1953.[19] A report was prepared on the use of pituitary material in bait fish culture.[20] It is estimated that the results of the latter investigation saved the Fish Division in one year more than the cost of developing the process.

Findings from a survey made in 1950 of the line bait industry in Michigan are being brought up to date. Tied in with the bait industry investigation report will be an outline of earthworm culture methods.

Improvement of Hatchery Diets. A study is under way to find new diets for hatchery fish. The goal is to find foods that are economical as well as nutritional. Tests with meat, meat-mix and pellets as diets for trout demonstrated that pellets made under several formulas developed in Michigan have certain advantages, chief of which are lower cost and better quality fish.

Cooperative Projects with University of Michigan

Close cooperation between the Institute and the University of Michigan continued. In addition to the employment of advanced students in fisheries work, senior members of the staff have honorary faculty status and serve on doctoral committees. As at Michigan State, graduate fellowships with Department support are available to University students.

Southern Michigan Trout Streams. A report was prepared on results of investigations carried out on southern Michigan trout streams to learn what some of the factors are that limit trout production in this part of the state.[21] The field work was done in 1949 and 1950. The streams intensively studied were: Wilder Creek, Calhoun County; Spring Brook, Kalamazoo County; Paint Creek, Washtenaw County and north branch of the Saline River, Washtenaw County. In addition, an evaluation was made of the techniques and equipment in use in electrical censusing of stream fish populations.[22]

Size of the trout population in Wilder Creek appeared to be limited by fishing pressure and dredge-caused turbidity; in Spring Brook by fishing pressure; in Paint Creek by shifting bottom materials and scarcity of spawning areas; in the North Branch of Saline River by floods, siltation and shifting of the bottom, and by competition from other fish species for food and space.

Beaver-Trout Investigation. A study was completed on physico-chemical effects of beaver dams on trout streams.[23] Investigations were carried out primarily on four streams in the Ontonagon River drainage, Gogebic and Ontonagon Counties—middle branch of the Ontonagon, east branch of Bluff Creek, McGinty Creek and Morrison Creek.

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[19]Hedges, Sheldon B. and Robert C. Ball. 1953. Production and harvest of bait fishes in Michigan. Inst. Fish. Res. Misc. Pub. No. 6, 30 pp.

[20]Ball, Robert C. and Edward H. Bacon. 1954. Use of pituitary material in the propagation of minnors. Prog. Fish Cult., Vol. 16, No. 3, pp. 108-113.

[21]Pratt, Virgil S. 1953. Populations, ecology, and management of marginal trout streams in southern Michigan. Ph.D. thesis.

[22]Pratt, Virgil S. 1952. A measure of the efficiency of alternating and direct current fish shockers. Trans. Amer. Fish. Soc., Vol. 81, 1951, pp. 63-68.

[23]Adams, Arthur K. 1953. Some physico-chemical effects of beaver dams upon trout streams in the Watersmeet area. Ph.D. thesis.

Warming of the water and depletion of dissolved oxygen were found to be the two most serious effects exerted by beaver dams on trout streams. Some streams are affected much more than others. Some streams show little adverse effect. It was found that the character of the ground water supply is an important factor in determining the influence of beaver on trout in that dams have less unfavorable effect where there is a good supply of ground water. This investigation disclosed the need for careful investigation of the particular situations to determine whether beaver are or are not harming trout streams. Also, it showed that biological factors as well as physical and chemical factors should be considered in this evaluation.

Creel Census Statistics. A study has been completed on sampling procedures for use in creel census work.[24] Methods that have been employed in census projects were examined, and adoption of certain statistical procedures for such programs have been proposed.

Fish Food Study. An investigation of possible changes in the quantity and make-up of invertebrate populations in Houghton Creek, a tributary of the Rifle River, continued. Field work on this problem was completed by the end of 1953. Specific identification of the organisms collected was started shortly thereafter. A check on the effects of the watershed control program in operation in this area has been one of the aims of this study. Also under investigation is the effect that a small volume of domestic pollution has upon the trout population of the stream through the pollution's influence on the bottom fauna.

Smallmouth Bass Study. A research project on smallmouth bass in Great Lakes waters, that is centering in the area off Waugoshance Point in northeastern Lake Michigan, was begun in 1953. Activities have consisted of trap netting and tagging, determining extent of the harvest, age and growth studies, and observations on spawning behavior. Indications to date are that individuals of this population confine themselves to small areas of range and that growth rate is appreciably slower than in smallmouths that inhabit inland waters.

COMMERCIAL FISHERIES

The following review and pertinent tables of commercial fisheries on Michigan waters of the Great Lakes cover the calendar years of 1952 and 1953.

The annual catch for the period averaged 27,122,306 pounds as compared with an average catch of 26,026,152 pounds for the period, 1920-1951. Yearly production of fish and estimated values are shown in a table at the end of this section. The increase may be attributed to larger catches of lake herring, smelt, chubs and carp. Production of lake whitefish remained constant while lake trout production continued to decline. The latter are now produced almost entirely in Lake Superior waters where a marked decline of nearly 330,000 pounds was noted in 1953 as compared with 1952.

Prices received for fish remained only fairly high with indications that further downward trends may be expected. Continued improvements were noted in freezing and packing methods.

[24]Tait, Howard D. 1953. Sampling problems in the Michigan creel census. Ph.D. thesis.