Prepared for
Trans. Am. Fish. Soc.

Original: Am. Fisheries Society
cc: Fish Division
Education-Game
Dr. Ball

December 12, 1946

Report No. 1079

# Recovery of marked fish following a second poisoning of Ford Lake, Michigan [1]

[1] Contribution from the Institute for Fisheries Research

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## Abstract

In 1936, a 10.7-acre lake in Otsego County, Michigan, was treated with rotenone to eliminate a population of stunted yellow perch. An attempt to recover the entire population yielded 4,817 stunted perch, 27 trout in poor condition, and four species of minnows. The weight of what was assumed to be the total population was 516 pounds or slightly more than 50 pounds per acre. In 1937, an experimental planting of Montana grayling was made which was not successful owing to unauthorized introduction of bluegills about the same time. In 1941, 5,000 fingerling brook trout were stocked, but proved unable to compete with the rapidly increasing bluegill population and disappeared four years later.

In 1943, walleyed pike were introduced in the hope of reducing the bluegill population to a point where survivors could make satisfactory growth.

In 1946, when rotenone re-appeared on the civilian market, the lake was poisoned again, and an attempt made to recover the entire population. The total weight of fish recovered was 1,293 pounds, or 111.5 pounds per acre, more than twice the poundage found in 1936, perhaps explained by bluegills being closer to the primary food chain than perch.

Of greater interest were the findings on completeness of recovery. Four and three days, respectively, prior to poisoning, 246 bluegills and 210 brook trout were fin-clipped and planted. Only 58.9 percent of the marked bluegills, and 44.7 percent of the marked trout were recovered despite careful search. Considerable doubt is thereby cast on the prevalent practice of assuming practically complete recovery of fish populations following rotenone treatment, and on total fish production figures derived by this method.

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During the past decade, 35 lakes in Michigan have been treated with rotenone, (as available in powdered derris and cube roots), to eliminate or reduce undesirable fish populations. Subsequent checks on these waters reveal that several of them have been repopulated with species of fish not well suited to the waters, thus defeating the purpose of the poisoning.

Ford Lake, Otsego County, Michigan, a 10.7-acre lake in the heart of the Pigeon River State Forest, is one of Michigan's potential trout lakes that had become worthless to anglers due to the

presence of a population of stunted yellow perch (Perca flavescens). In 1936, the Ford Lake fish population was killed by means of rotenone and dynamite, and an analysis of the population at that time was made (Eschmeyer, 1938).

In 1937, an experimental planting of Montana grayling (Thymallus montanus) was made which did not prove to be successful due, presumably, to the unauthorized introduction of bluegills (Lepomis macrochirus) made at the same time or shortly following that of the grayling (Leonard, 1939, 1940).

By 1939, it was obvious that the grayling were not able to live and grow successfully in a small lake that harbored another highly competitive species. In September, 1941, a planting of 5,000 fingerling brook trout (Salvelinus fontinalis) was made, but they too were unable to thrive in the face of the active competition of the bluegill and were last reported from a gill net set in September, 1944. No trout were taken in gill net sets in 1945.

As a result of their natural fecundity and the absence of predatory fish, the bluegills increased prodigiously in numbers and populated the lake beyond its capacity to support a growing population. In September, 1943, walleyed pike (Stizostedion vitreum) were introduced as a possible means of reducing the large numbers of stunted bluegills to a point where growth would result in legal-sized fish.

With the anticipation of rotenone again being available, plans were made to re-poison Ford Lake and, since conditions were favorable, to establish it as a trout lake. Such an undertaking would make possible a comparison of standing fish crops on the same lake at different times and with a different species composition. The survival of a limited number of known-age walleyes in a lake having

no other predacious species and an ample food supply in the form of a stunted bluegill population could be determined. There would be an opportunity to check on the recovery of fish marked immediately prior to poisoning, thus shedding some light on the validity of poisoning as a means of determining total populations. With these data as a goal, Ford Lake was poisoned for the second time, by the writer and four other biologists of Michigan's Institute for Fisheries Research staff, on the afternoon of August 26, 1946. During the six days following every effort was made to recover all fish that came to the surface or were within reach of the surface with long-handled scap nets.

## Method of applying rotenone

The actual poisoning differed from other similar projects carried out in Michigan in the past only in the method of application of rotenone to the lake. The 300 pounds of derris (producing a concentration of 0.6 p.p.m. of derris root of 5 percent rotenone content) applied to the lake were mixed and distributed by means of a small centrifugal pump. This pump, purchased especially for the work, has a capacity of 3,000 gallons per hour, a 2-inch intake and discharge, weighs less than 100 pounds (including the 1 1/2-horsepower motor and the 10-foot intake and discharge hoses), and, with the fire-hose nozzle used, throws a stream approximately 40 feet. The working unit consisted of a 55-gallon drum with the head removed placed in the front end of a rowboat and the pump located in the rear end. A 5-horsepower outboard motor was used to propel the unit. In actual operation, 5 pounds of derris powder were poured into the drum, the intake hose of the pump dropped overboard, the discharge hose directed into the drum, and the pump started. The forced stream from the hose nozzle

served to fill the drum completely and thoroughly mix the derris powder in one minute. When the drum was full the end of the intake was placed in the drum, the discharge directed onto the lake, and the distribution of the mixture effected with the boat moving at slow speed. As the pump was capable of throwing a jet of water-derris mixture approximately 40 feet, it was possible to treat shoal areas that were blocked by deadheads or too shallow to permit operation of the outboard motor. Two men can operate the unit with ease and, if desired, the entire operation can be carried out without stopping either the pump or outboard motor. Eighty of the 300 pounds of derris were pumped into the deeper water of the lake with the same equipment, but using a 1/2-inch garden hose attached to the discharge hose of the pump weighted sufficiently to discharge at a depth of approximately 15 feet.

Following application of the poison, the fish were collected as they came to the surface or were found in distress, taken to shore, and individually examined for excised fins. Measurements were taken from random samples, and weights were taken in lots of 200. The last live bluegill was seen on the morning of August 29, two and a half days after the poisoning; the last fish seen alive was a mud minnow (Umbra limi) on the afternoon of the same day. Both fish were in a dying condition when found. No live fish were seen after this time and no fish were taken in a 32-hour experimental gill net set on August 29-30. The fish were picked up each day for the six days following the application of rotenone and the few fish recovered towards the last were reaching a point of disintegration that made picking them up as whole fish quite difficult. Only a very few fish were taken in the last 24 hours.

Only five species of fish were recovered at the time of the poisoning: brook trout, walleyed pike, bluegills, mud minnows and one specimen of the northern mimic shiner, Notropis volucellus. The trout had been introduced three days prior to the poisoning and all trout recovered were from this planting. The 17 walleyes (Stizostedion vitreum) were the survivors of a planting of 168 made in September, 1943. All were marked by removal of the left pelvic fin when planted and all recoveries were so marked. The walleyes when planted were young-of-the-year fish having a size range 5 3/4-10 1/4 inches in total length and on recovery ranged from 17 to 19 3/4 inches in total length and 1 1/2 to 2 1/4 pounds in weight.

The mud minnow (Umbra limi) was apparently well established and reproducing in the lake.

The most important species from the standpoint of both numbers and weight was the bluegill, (Lepomis macrochirus).

## Comparison of the 1936 and 1946 fish populations

The poisoning of Ford Lake was of special interest as it offered an opportunity to compare the standing fish crop at the present time with that of the same body of water 10 years previous.

In the late summer of 1936, the fish population of Ford Lake was removed by poisoning with rotenone and the action of a heavy charge of dynamite. At that time a complete kill was reported and all fish accounted for by actual count or accurate estimates based on partial counts. The fish present in the lake at that time were perch, trout, and four species of minnows. The 4,817 perch recovered, believed to be the total number in the lake, had been growing slowly; the 27 trout were survivors of plantings from earlier years and were not in good condition. The bulk of the minnows were

Chrosomus eos, a species that apparently was doing well in the lake. The total fish population at that time weighed only 516 pounds, or about 50 pounds per acre.

The population as determined in the second poisoning was very different from that of the first. No perch were present and the only trout were those stocked immediately prior to the poisoning to check on the completeness of kill and recovery. The only species of minnow common to both was the mud minnow, Umbra limi. The bluegill dominated the 1946 poisoning with a total of 37,383 specimens weighing 1,222.2 pounds. That this was a severely stunted population was indicated by the presence of only 18 legal-sized individuals (6 inches or longer) in the entire group, or one legal specimen for each 2,000 bluegills. The average length of the bluegills recovered was 100 millimeters and the average weight 15 grams.

Seventeen walleyes weighing 34.2 pounds, the remnants of 168 young-of-the-year planted in 1943, were recovered. Twenty-four and a half pounds of mud minnows were weighed and measured. Although the kill is believed to have been complete, it is estimated that no more than 50 percent of the dead mud minnows were recovered. The weights, numbers, number of marked fish, and number of marked fish recovered are shown in Table 1.

The total weight of fish recovered from Ford Lake in 1946 was 1,293 pounds, or 2.4 times the weight of fish recovered from the same lake following a complete kill 10 years previously. The reasons for this difference in weight of fish recovered are not too well understood but perhaps may be accounted for by the differences in the feeding habits of the fish making up the dominant species in the lake at the time of the poisonings. The perch, dominant in the 1936

Table 1.--Number and weight of fish recovered, number of fish marked, and number of fish recovered after poisoning, August 26, 1946.

| | Total number recovered | Weight in pounds | Number marked | Number of marked fish recovered |
|---|---|---|---|---|
| Bluegill | 37,383 | 1,222.2 | 246 | 145 |
| Walleyes | 17 | 34.2 | 0 | 0 |
| Trout | 0 | 0 | 1/210 | 94 |
| Mud minnows | 2/4,293 | 24.5 | 0 | 0 |

1/ Only trout in lake were those planted from hatchery immediately before poisoning.

2/ Estimated to be less than half of mud minnows in lake.

poisoning, are generally piscivorous in their feeding habits, whereas the bluegill, the major component in the second poisoning, is largely dependent upon invertebrates for food, and is thus closer to the primary food chain.

## Recovery of marked fish

Shortly before application of the rotenone, 456 marked fish were introduced into the lake as a means of checking the proportion of the total fish population recovered following poisoning. Four days prior to poisoning, 240 bluegills averaging 104 millimeters total length were caught by hook and line, their dorsal fins removed, and the fish released. In addition, the anal fins of six bluegills of less than 90 millimeters total length were clipped and the fish released. Three days prior to poisoning, 210 brook trout, ranging from 4 to 11 inches in total length, obtained from a nearby State Fish Hatchery, were marked by removal of their dorsal fin and placed in the lake. These trout were seen in all areas of the lake the morning prior to the poisoning.

A recovery of 145 of the 246 marked bluegills was made in the six-day period following the treatment of the lake with rotenone. They constituted 58.9 percent of all marked bluegills presumed to be alive in the lake at the time the rotenone was applied. Ninety-four (44.7 percent) of the 210 trout were recovered. The percent recovery of all groups of fish was lower than anticipated and poses a question as to the validity of population estimates derived from the pick-up of fish following poisoning.

Checks on the recovery of marked fish present in a lake have been made in three previous poisonings in Michigan. Following the

poisoning of Third Sister Lake (Ball, in press) 23.4 percent of the 1,395 fish that had been marked by tagging or fin clipping were recovered. These fish had been in the lake from 9 to 22 months prior to their removal and natural mortality had undoubtedly reduced the number of marked fish. Since no estimate of the natural mortality can be given, these figures cannot be considered as indicative of the proportion of the total population recovered. The fish marked were bluegills, largemouth bass, bullheads, and pumpkinseed sunfish. More bluegills were marked than all other species combined.

Carbine (unpublished) found that 13.7 percent of 699 marked fish (10 species) were recovered following removal of the fish population of Deep Lake, Michigan. These marked fish also had been in the lake for varying periods of time up to two years. Krumholz (1940) reported on a population study of Twin Lake, Michigan. In this study, a population estimate was made based on the recovery by nets of known numbers of marked fish. The validity of calculation was then checked by poisoning, and 86 percent of all marked fish assumed to be alive in the lake were recovered. The population of this lake was of the bass-bluegill type.

The fate of the marked fish and the portion of the entire population they represented in Ford Lake can be only a matter of conjecture at the present. The weed beds of the bottom were visible through the clear water to a depth of 18 feet, which was the lower limit of the vegetation. Once the power of locomotion was lost as a result of the effect of the rotenone, a majority of the fish sank to the bottom where many could be seen in the dense, compact mat of Chara carpeting the lake bottom. By the end of the fourth day all fish that had been on the bottom within the range of visibility had floated

to the surface. There is the possibility that many of them, after becoming affected by the rotenone, had buried themselves in the Chara mat as a result of the uncontrolled, erratic dashing about that is a characteristic reaction to the poison. Many fish that were partially buried in this manner were seen to rise to the surface when bloated, often with enough force to bring strands of Chara and other algal growth with them. Still another possibility, and perhaps the most likely one, is that they sank into the deep water and did not come to the surface before they disintegrated. At the time of poisoning the lower waters of Ford lake were devoid of oxygen, the carbon dioxide content of the water was 12 p.p.m., and the pH 6.6. The bottom was covered with a layer of pulpy and fibrous peat.

## Summary

The results of this study indicate strongly the need for further investigation into the fate of that portion of the fish population that does not float to the surface in the few days following poisoning of a lake with rotenone. If the 54 percent of the marked fish recovered in Ford Lake signified that only that proportion of the entire population was recovered, the estimates of total fish production of inland lakes, which have been made largely on the results of poisoned lake populations, will have to be revised sharply upwards. This is, of course, assuming that the percent of recovery in other lakes is comparable to Ford Lake. This may not be a tenable assumption, but only a thorough check on future poisonings will clarify that point.

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