Prepared for the
American Fisheries Society
Sept., 1940

Original: Am. Fish. Society
cc: Fish Division
Education-Game
Mr. Greenbank

REPORT NO. 611

SELECTIVE POISONING OF FISH [1]

[1] Contribution from the Michigan Institute for Fisheries Research.

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Abstract

When derris root was applied to the warmer surface waters of two small trout lakes, comparatively little seemed to penetrate to the colder, deeper water. Apparently the perch, rock bass, and largemouth black bass were destroyed, with very slight damage to the trout population. Study of the poisoned fish yielded information on fish populations and on habitat selection. The method of selective poisoning is suggested as a means of ridding certain trout waters of undesirable species of fish.

Introduction

Workers in fish management are recognizing more and more that many bodies of water might be of greater value to the sport fisherman if populations of certain undesirable fish were destroyed (Hubbs and Eschmeyer, 1938). These fish may be predators, such as gars or

dogfish; they may be coarse fish, such as carp or goldfish, held to be of little value, and possibly detrimental to game fish because of competition for food; or they may be fish of game species, which are out of place ecologically, as perch, rock bass and largemouth black bass are in certain northern trout lakes. These warm-water fish generally make a poor growth in cold waters. If present in large numbers, they may be of distinct harm to the trout, because of food competition and possibly by their destruction of trout fry and fingerlings.

Often these objectionable fish, of one kind or another, are species that have been introduced, in well-meant, but mistaken, attempts to improve fishing. Once the harm is done, usually it is difficult to undo. If the body of water is small, it is sometimes feasible to destroy the existing fish population, and to start over by restocking with desirable species. Usually such methods as seining, dynamiting, and spearing have not proved successful in killing all of the fish. Some small ponds can be drained. However, by far the most generally efficient method thus far devised is the use of some kind of fish poison.

In one of the first attempts to eliminate by poison an unwanted population of fish, copper sulphate was applied to a lake in Vermont, and a large, but not entirely complete, destruction of fish was effected (Titcomb, 1914). In more recent years many lakes and ponds have been poisoned, some of them quite successfully. Copper sulphate has been used with fairly good results in Nova Scotia (Catt, 1934; Smith, 1935, 1938). In Michigan (Eschmeyer, 1937, 1938),

as well as elsewhere, many lakes have been poisoned with derris root. One advantage of derris over copper sulphate is the much smaller destruction of fish food organisms (Leonard, 1939; Smith, 1940).

Where the size of the body of water or some other factor renders impracticable the complete destruction of a fish population, an effort often has been made to eradicate or control undesirable species of fish without killing the more desirable ones present. Various methods, such as spearing, netting, and destruction of young fish, have been used, but usually with little effect. In certain localities in the southern part of the United States, control of gars by the use of electric shock has been tried, with some degree of success (Burr, 1932).

Probably the first reported experiment in using poison to kill one kind of fish in a lake, while sparing the other fish, is that being performed by Stillman Wright at Fish Lake, in Utah (Davis, 1940). In this lake the Utah chub, which is thought to be detrimental to the brook trout, is killed in large numbers by the application of derris to the shoal water at the time of year when the chubs are congregated there in large numbers, to spawn. The trout, being in deeper water, are little affected.

In the lakes with which the present paper deals, derris was used in an attempt to destroy the fish. Because of the small amount of poison used in proportion to the depths and volumes of the lakes and because of low water temperature, the kill was not complete, but was confined to those portions of the lakes in which the poison occurred in lethal concentrations. Certain fish undesirable in trout

lakes, namely rock bass, perch, and largemouth black bass, apparently were destroyed entirely, with only a small kill of trout.

Advantages other than those of a direct management nature may accrue from killings of fish populations. As in the present instance, a study of the specimens killed may furnish information of value regarding fish populations, growth, habitat selection, and migrations.

Lakes Treated

Two small lakes and a pond on the estate of R. F. Grant, near Vanderbilt, Otsego County, Michigan, were treated with powdered derris root on August 15-17, 1939, by a field party of the Michigan Institute for Fisheries Research. Mr. Grant furnished the derris used in poisoning these lakes, as well as board and room for four men for several days, and in all other ways cooperated with the Institute in performing the work.

Berry Lake has a surface area of 17.8 acres, and Fitzek Lake an area of 6.2 acres. In each lake the maximum depth is slightly over 50 feet; there is an abrupt drop-off, with little shoal area; and the bottom contains considerable marl. Ground seepage and several small spring-fed streams supply the lake.

Connected to Fitzek Lake by an open channel about 300 feet long, is a small body of water, known as Pond 4, with a surface area of 1.6 acres, and a maximum depth of about 10 feet. The bottom consists largely of muck, and supports a fairly dense growth of rooted aquatic plants. Pond 4 drains into Berry Lake, but a weir prevents the passage of fish from this lake into the pond.

At the time of poisoning, the lakes contained rock bass (Ambloplites rupestris), largemouth black bass (Huro salmoides), and yellow perch (Perca flavescens), as well as rainbow trout (Salmo gairdnerii irideus), brook trout (Salvelinus fontinalis), and brown trout (Salmo trutta). Some years ago lake trout (Cristivomer namaycush) had been introduced, and at the time of poisoning a few were present in Berry Lake, and possibly a few in Fitzek Lake. Suckers (Catostomus c. commersonnii) were fairly abundant. Other species of fish present in one or both lakes included the pumpkinseed (Lepomis gibbosus), creek chub (Semotilus atromaculatus), mud minnow (Umbra limi), blunt-nosed minnow (Hyborhynchus notatus), brook stickleback (Eucalia inconstans), Iowa darter (Poecilichthys exilis), barred killifish (Fundulus diaphanus menona), golden shiner (Notemigonus crysoleucas auratus), and brook lamprey (Entosphenus lamottenii).

Application of the Poison

On the morning of August 15, 1939, approximately 175 pounds of powdered derris root (5 per cent rotenone content) were put in Fitzek Lake. The material was mixed with water to form a very thin suspension, which was poured onto the surface of the lake from a motorboat. The boat was run in a crisscross pattern, so that the lake's area was rather uniformly covered. During the following four days the dead fish were nearly all recovered from the margin of the lake.

Pond 4 received a small amount of derris root in the overflow from Fitzek Lake, plus an application of 10 pounds on the afternoon of August 15. The dead fish from the pond also were picked up.

On August 17, about 350 pounds of powdered derris root were applied to Berry Lake. Because of the brushy shoreline and abrupt drop-off, no attempt was made at a complete recovery of the fish killed in this lake.

It was not determined to what extent the poison penetrated the lower depths of water. However, a relatively very small number of suckers and trout, which presumably were in the deeper water or at the mouths of spring tributaries, were killed. Not only is derris much less effective in colder water (Leonard, 1939), but it probably does not reach the lower depths in any very appreciable amounts. It is likely that a thermocline prevents the penetration of the poison to the deeper water.

The concentration of derris used therefore may be computed in two ways. Following the usual procedure, the weight of derris may be divided by the total weight of water in the lake, giving the theoretical concentration if the material were distributed uniformly throughout the body of water. However, since most of the derris presumably remained in the upper layers of water, probably a more accurate method would be to calculate the concentration, assuming uniform distribution above some arbitrary level (in the present case, 20 feet). On this basis, the following comparative theoretical concentrations are obtained: In Berry Lake, 350 pounds of derris

root would give a concentration in the total water volume of 0.27 p.p.m., or in the volume above 20 feet of 0.44 p.p.m. In Fitzek Lake, 175 pounds of derris would be equivalent to 0.35 p.p.m. in the total volume, or 0.62 p.p.m. in the volume above 20 feet. In Pond 4, which is all shallow, the 10 pounds of derris used would yield a concentration of 0.56 p.p.m. for the entire volume. The lake volumes were computed from depth-contour maps, based on soundings made through the ice in the winter.

Fish Killed

No attempt was made to count the fish killed in Berry Lake. Large numbers of rock bass and perch were destroyed; also many largemouth black bass and a few suckers, as well as miscellaneous numbers of various forage fishes. No dead trout were found.

Table 1 enumerates all of the fish which were picked up from Fitzek Lake and Pond 4. It is probable that a nearly complete recovery of dead fish was made, for very few were observed on the bottom, which was clearly visible at depths to 20 feet.

In view of the results of later netting operations, to be described below, and because the pond is small and shallow, it seems highly probable that all of the fish in Pond 4 succumbed, with the possible exception of some mud minnows or other small species. It seems likely that all or nearly all of the pumkinseeds, rock bass, largemouth black bass, and perch in Fitzek and Berry lakes were killed. It is believed that only a small proportion of the suckers and trout, and possibly of the creek chubs, were affected. It is not known how complete was the kill of the small species of fish, but it is possible

Table 1. Fish Recovered from Fitzek Lake and Pond 4

Species	Numbers	Total weights, pounds
Fitzek Lake		
Rock bass	632	36.6
Largemouth black bass	197	25.7
Yellow perch	398	28.4
Subtotals	1,227	90.7
Brook trout	12	0.5
Common sucker	40	11.6
Golden shiner	22	1.4
Creek chub	15	0.2
Blunt-nosed minnow	4,082	12.6
Mud minnow	286	1.9
Stickleback	19	0.1
Iowa darter	61	0.1
Killifish	1	...
Brook lamprey	1	...
Pond 4		
Rock bass	688	42.2
Largemouth black bass	173	12.9
Yellow perch	241	29.1
Subtotals	1,102	84.2
Brook trout	4	1.1
Rainbow trout	1	0.5
Pumpkinseed	4	0.1
Common sucker	271	70.2
Golden shiner	147	9.5
Creek chub	48	4.6
Blunt-nosed minnow	50	0.4
Mud minnow	1,678	10.6
Stickleback	34	0.1
Iowa darter	27	0.1
Totals (Pond 4)	3,366	181.4

that the percentages were fairly large, since most of these fish would have been in shallow water at the time of poisoning.

Therefore, in considering Table 1, it may be assumed that the numbers and weights of fish from Pond 4 represent fairly accurately the actual numbers and weights present in the pond at that time. Likewise, the figures for rock bass, largemouth black bass, and perch from Fitzek Lake probably are substantially correct values for these fish in the lake; the values for suckers and trout are not (as these fish were taken in subsequent netting); and those for the remaining species are doubtful. Therefore, for this lake, totals would be somewhat meaningless, and hence are omitted from the table. The subtotals for the three first-named species are given, for purposes of comparison with Pond 4.

It is of interest that at the time of poisoning the pond, even though it is much smaller, contained more total pounds of rock bass and perch than did the lake, and of rock bass there was a larger number in the pond. Apparently at that time the conditions in the warmer, more shallow, pond were more favorable to these three fishes than were those in the lake.

Furthermore, very many more mud minnows and golden shiners were taken from Pond 4 than from Fitzek Lake. Possibly some mud minnows in the lake were not killed or were not recovered, but it is presumed that most of the golden shiners in the lake were in the shallow water at the time of the poisoning, and therefore probably were killed. Thus it seems that there was a decided preference on the part of the golden shiners for ecological conditions of the pond.

On the other hand, the blunt-nosed minnow was much more abundant in the lake than in the pond. This fish is known to favor waters with scanty vegetation; and the vegetation in the lake was quite sparse in comparison with that in the pond.

Effectiveness of the Selective Poisoning

Three 125-foot gill nets, of mesh graded from 1 1/2 to 4 inches stretched measure, were fished in Berry Lake during the night of August 18-19, 1939, about 30 to 40 hours after the derris root had been put into the lake. These nets took only two small perch, one brook trout, and about thirty suckers.

From October 16 to October 18, 1939, a total of ten individual overnight sets of the same type gill net was made in Berry Lake, in addition to one set of a small fyke net. Altogether, several suckers, three brook trout, two brown trout, and two lake trout were taken. During the same period, three gill-net sets in Fitzek Lake yielded four rainbow trout, three brown trout, one brook trout, and several suckers. One gill net set overnight in Pond 4 took no fish.

During the night of July 1-2, 1940, two gill nets of the same type and one fyke net were fished in Berry Lake, and two gill nets were set in Fitzek Lake. A few suckers were the only fish taken in Berry Lake, and the nets in Fitzek Lake yielded ten brook trout, one rainbow trout, one brown trout, and a few suckers.

Except for the two perch that were taken in gill nets shortly after the poisoning, no perch, rock bass, or largemouth black bass have been taken in either of the lakes or the pond since the poisoning,

nor have fish of these species been observed in several careful inspections of shoal areas. Apparently the fish of these three species were almost entirely, if not entirely, eliminated by the poison.

Thus the partial poisoning of Berry and Fitzek lakes seems to have been rather successful. It is believed that this method of killing a selected part of the fish population of a lake will become a very useful tool in fish management, particularly in certain trout waters which are now overrun with warm-water fish. If a lake is of sufficient depth that a definite segregation of the two types of fish occurs, it appears to be feasible to destroy the warm-water species largely or completely without doing serious damage to the cold-water fishes. Experiments are planned to determine more precisely the depth preferences of various fishes, and the effect of stratification of the water on the dispersion of powdered derris root.

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(All have been checked against original publications)

8/14/40