MICHIGAN DEPARTMENT OF NATURAL RESOURCES
Research and Development Report No. 194*

February 20, 1970

A STUDY OF TWO NORTHERN PIKE-BLUEGILL POPULATIONS [1]

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Abstract

Northern pike and bluegill populations were established and maintained for 3 years in two small lakes closed to fishing. Growth of pike was slightly less than the average for pike in the state of Michigan; growth of bluegills ranged from 3.6 to 7.4 cm (1.4 to 2.9 inches) below state average. High densities of pike did not control an abundance of bluegills. Survival of pike from the initial stocking was extremely high (44-60%), whereas survival from subsequent plantings was low (0.8-9.2%).

Introduction

Northern pike (Esox lucius) have been used in southern Michigan lakes as predators, in fish-management attempts to reduce excessive numbers of small bluegills (Lepomis macrochirus). We have had populations of from 69 to 131 pike per hectare of water seined (28 to 53 per acre) which may have controlled bluegill populations

* Institute for Fisheries Research Report No. 1762.

[1] Contribution from Dingell-Johnson Project F-29-R, Michigan. The report has been submitted for publication in Transactions of the American Fisheries Society.

for 1 or 2 years in lakes following chemical treatment to reduce fish populations. However, there is no evidence in Michigan that lesser pike populations have prevented bluegills from surviving in excessive numbers (Hooper et al., 1964).[2]

Reports from other states on tests of northern pike-bluegill populations have been somewhat inconclusive. McCarraher (1959) had pike-bluegill combinations in two Nebraska farm ponds. He found that over a 4-year period the growth of pike was less than in Nebraska's sandhill lakes, and that there was "no evidence of excessive utilization of young-of-the-year bluegills by pike." Growth of bluegills was considered "fair." The size range for age-group III bluegills in one pond was 14.2-17.0 cm (5.6-6.7 inches). In Indiana, Doxtater (1967) stocked one small pond with bluegills which were 7.6 to 14.0 cm (3.0-5.5 inches) and northern pike which were 38 to 51 cm (15-20 inches). After approximately 2 years the total weight of pike had increased 27%, whereas the weight of bluegills had decreased 30%.

Beyerle and Williams (1968) found that northern pike in aquaria were selective in feeding. Soft-rayed fishes (e.g., minnows and chubsuckers) were selected over spiny-rayed fishes (e.g., centrarchids and percids). Most southern Michigan lakes contain at least some soft-rayed fishes. Here, such fishes could be acting as a buffer between northern pike and bluegills, and the pike could exist with little dependence on bluegills as food.

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[2] Hooper, F. F., et al. 1964. Status of lake and stream rehabilitation in the United States and Canada with recommendations for Michigan waters. Institute for Fisheries Research Report No. 1688, 56 p.

For the present study, it was hypothesized that if no soft-rayed fishes were present in a lake, the pike would have no alternative but to feed on young bluegills. Thus the objective of this study was to determine the extent to which pike would control the numbers of small bluegills in lakes with only the two species present. A related interest was in the survival and growth of pike.

Description

Two small lakes in southwestern lower Michigan were used for this study. Daggett Lake, in T. 3N, R. 10W, Sec. 1, Barry County, is 5.0 ha (12.3 acres) in area and is spring fed. It has no inlet or outlet. Maximum depth is 4.6 m (15 feet) and the average depth is 2.1 m (7 feet). The entire bottom is muck and peat. A moderate growth of Elodea sp. occurs in patches over about 50% of the bottom. Methyl orange alkalinity is 19 ppm.

Emerald Lake, in T. 2S, R. 8W, Sec. 14, Calhoun County, is 2.3 ha (5.6 acres) in area. It was recently dredged to its present maximum depth of 2.7 m (9 feet) and average depth of 1.8 m (6 feet). Dominant aquatic vegetation on the peat bottom is Chara sp., Elodea sp., and Potamogeton crispus. The lake receives its water from springs and via a pipeline from an adjacent lake. There is no outlet. Methyl orange alkalinity is 114 ppm.

Methods

Fish in the lakes prior to study were eliminated using rotenone; bluegill-only populations were then established; and, finally, specified numbers of fingerling pike were introduced into the lakes each year for three consecutive years. All pike were given a distinctive fin clip each year so that each year class could be identified without resorting to scale samples. Both lakes were closed to angling during the study. In the fall of the third year, the lakes were again treated with rotenone and all fish were collected. Growth, survival, and population structure of the bluegills and pike were determined from the terminal collections.

Daggett Lake was first treated with rotenone to eliminate existing fishes in October 1962. The standing crop of all fishes was 280 kg/ha (250 lb./acre). Since this was a large standing crop, I chose the rather high annual stocking rate for fingerling northern pike of 136 pike/ha (55 pike/acre); this amounted to 675 fish per year for the lake.

In June 1963, Daggett Lake was inadvertently stocked with an excessive number of pike, and so it was again treated with rotenone (the same month). In July of 1963, 45 kg (100 lb.) of adult bluegills were stocked. These fish produced a large 1963 year class. From 1964 through 1966, the 675 fingerling pike were stocked each year. In the fall of 1964, and again in 1965, a boom shocker was used to collect samples of pike to determine yearly growth. In September 1966,

the lake was treated with rotenone and all fishes were collected. A scuba diver checked the bottom in deeper water to assure a complete pickup of fish. Stomach contents of pike were of no value in determining normal food habits, since pike in chemically treated lakes typically gorge themselves on dying fish before they (the pike) succumb to the chemical. Each northern pike was measured, sexed, scale-sampled and aged by size and/or by fin clip. All pike of the same age group were weighed together, after their stomach contents were removed. If the age of a pike was in doubt, its weight was recorded separately until the scale sample could be examined. Growth and survival of northern pike are presented in Table 1. All bluegills were collected and weighed en masse. Then a random sample of over 300 bluegills was weighed, measured and scale sampled individually for age and growth analyses.

The pre-study fish population in Emerald Lake was removed by rotenone in October 1965. Since the lake had recently been dredged, only a small fish population was present. However, it was estimated that the normal carrying capacity would be only slightly lower than that of Daggett Lake. Therefore it was decided to stock northern pike fingerlings at the fairly high annual rate of 111 pike/ha (45 pike/acre); or 250 per year for the lake. Fish barrier screens were placed over both ends of the pipeline leading into Emerald Lake to keep out unwanted fish. In March 1966, 11 kg (25 lb.) of adult bluegills and 11 kg (25 lb.) of juvenile bluegills were stocked; the latter were 5-8 cm (2-3 inches)

in length. From 1966 through 1968, the 250 fingerling pike were stocked each year. Use of Emerald Lake for fish research had been granted by the lake residents, and in return we agreed to chemically treat and control the aquatic vegetation in the lake. Aquathol Plus (endothal and silvex) and copper sulphate crystals were applied once each summer, successfully controlling the vegetation. In the fall of 1966 through 1968, pike were collected (by angling) to determine yearly growth and food habits. In September 1968, the lake was treated with rotenone and all fish were collected. Again, scuba gear was used to assure that all fish were picked up. The fish were processed as at Daggett Lake. Growth and survival of pike in Emerald Lake are summarized in Table 2.

Results

Growth of northern pike in Daggett and Emerald lakes was quite similar (Tables 1 and 2). Mean lengths were approximately 28-30 cm (11-12 inches) in autumn of the first year, 41-43 cm (16-17 inches) after 2 years, and 46-48 cm (18-19 inches) after 3 years. In Michigan, according to Laarman (1963),[3] average lengths for northern pike in September are: age-group 0, 26.7 cm (10.5 inches); age-group I, 42.7 cm (16.8 inches); age-group II, 51.1 cm (20.1 inches).

Survival of the first year class of northern pike stocked in both lakes was extremely high (44-60%), while survival of succeeding stocks was much lower (0.8-9.2%) (see Tables 1 and 2).

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[3] Laarman, P. W. 1963. Average growth rates of fishes in Michigan. Institute for Fisheries Research Report No. 1675, 9 p.

The standing crops of bluegills in the two lakes at the time of poisoning are given in Table 3. The adult bluegills, 8-18 cm (3-7 inches), stocked in Daggett Lake produced a very large year class in 1963. This 1963 year class evidently completely inhibited reproduction and/or survival of young-of-the-year bluegills from 1964 through 1966. In Emerald Lake the stocking of 50% adults and 50% juveniles in 1966 had an entirely different result. Bluegills from year classes 1966 through 1968 were relatively equal in numbers at the time of poisoning.

Even though there was a big difference in abundance of small bluegills by year classes in the two lakes, the number available as food for pike was similar in the two lakes. Pike of the size present in these lakes could eat bluegills up to about 10 cm (4 inches), according to studies by Beyerle and Williams (1968). Bluegills under 10 cm (at time of poisoning) numbered 40,081/ha (16,233/acre) in Daggett Lake; 35,457/ha (14,360/acre) in Emerald Lake. Similarly, the ratio of weight of small bluegills to weight of pike was about the same in the two lakes: 3.8 to 1 in Daggett, and 4.4 to 1 in Emerald Lake.

Growth was slow among bluegills which came from natural reproduction in the two lakes. Furthermore, the big 1963 year class in Daggett had slower growth than the smaller year classes in Emerald Lake. Those in Daggett averaged 7.4 cm (2.9 inches) less than the state average for Michigan (Laarman, 1963).[3] In Emerald Lake, bluegills of the 1967 year class averaged 3.3 cm (1.3 inches) less than

state average, and those of the 1966 year class averaged 3.8 cm (1.5 inches) less than the state average.

In Daggett Lake in July 1964, stomachs were examined from four northern pike with lengths of 18.3-23.9 cm (7.2-9.4 inches). Three stomachs contained food; one was empty. The food consisted of three bluegills and one dragonfly nymph. In Emerald Lake in 1967 and 1968, stomachs were examined from 26 northern pike, of lengths 38.1-57.7 cm (15.0-22.7 inches). Food was contained in 14 stomachs; the other 12 were empty. Stomach contents included 7 bullfrog tadpoles, 4 bluegills, 1 northern pike 27.2 cm (10.7 inches) long, 1 crayfish, and 3 unidentified items. Both Daggett and Emerald lakes contained large populations of frog tadpoles (mostly bullfrog, Rana catesbeiana).

Conclusions

An adequate supply of bluegills of edible size was available to northern pike in both Daggett and Emerald lakes. Despite the availability of bluegills as food, the stomach contents suggest, for Emerald Lake at least, that northern pike fed as much on tadpoles as on bluegills. In both lakes, growth rate of pike after 3 years was somewhat less than state average, and certainly nowhere near potential growth considering the amount of food present. Likewise, growth rate of the bluegill was slow. Age-III bluegills in Daggett were 7.4 cm (2.9 inches) below state average, and Age-I plus Age-II fish in Emerald were 3.6 cm (1.4 inches) below average, supporting the conclusion that northern pike were not adequately harvesting the

bluegill. Thus it appears that in small lakes with a population of only bluegills, northern pike stocked at a relatively high rate will not grow rapidly and will not by themselves control an overabundance of small bluegills.

The very high survival of initial stocks of northern pike in both lakes, and the very low survival of subsequent stocks, suggest that it is unwise to stock young pike in a lake containing a substantial population of older, larger pike.

Acknowledgments

John E. Williams gave much useful advice throughout the study and assisted in fish pickup. Raymond E. Fitch, Rhyner Scholma, Richard N. Cobb, and Harley E. St. Ours built and maintained fish screens and assisted in the various tasks involved in the study. Personnel at the Wolf Lake Hatchery raised the young pike to fry stage. The Willard Woods Association kindly volunteered the use of Emerald Lake for this research. John E. Williams, W. C. Latta, and Gerald P. Cooper reviewed the manuscript.

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INSTITUTE FOR FISHERIES RESEARCH

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Report approved by G. P. Cooper

Typed by M. S. McClure

Table 1.--Growth and survival of northern pike in Daggett Lake

Year class, event	Date of event	Number of pike	Pike per hectare (per acre)		Mean length in cm (inches)	Per cent survival
			Number	Kilograms (Pounds)		
1963						
Stocked	6/--/63	-	-	-	-	-
Examined	10/13/64	0	-	-	-	-
Examined	10/15/65	0	-	-	-	-
Recovered	9/12/66	13*	2.7 (1.1)	5.4 (4.8)	70.4 (27.7)	?
1964						
Stocked	6/ 1/64	675	136 (55)	-	8.6 (3.4)	-
Examined	10/13/64	31	-	-	30.0 (11.8)	-
Examined	10/15/65	22	-	-	43.4 (17.1)	-
Recovered	9/12/66	298	59.8 (24.2)	40.7 (36.3)	48.8 (19.2)	44.1
1965						
Stocked	6/12/65	675	136 (55)	-	8.4 (3.3)	-
Examined	10/15/65	0	-	-	-	-
Recovered	9/12/66	18	3.7 (1.5)	2.5 (2.1)	47.8 (18.8)	2.7
1966						
Stocked	6/ 2/66	675	136 (55)	-	8.6 (3.4)	-
Recovered	9/12/66	10	2.0 (0.8)	0.7 (0.6)	35.1 (13.8)	1.5

* These pike survived the rotenone treatment of June 1963 (see text).

Table 2.--Growth and survival of northern pike in Emerald Lake

Year class, event	Date of event	Number of pike	Pike per hectare (per acre)		Mean length in cm (inches)	Per cent survival
			Number	Kilograms (Pounds)		
1966						
Stocked	6/ 3/66	250	111 (45)	-	8.4 (3.3)	-
Examined	9/17/66	2	-	-	28.7 (11.3)	-
Examined	9/26/67	10	-	-	43.4 (17.1)	-
Collected	9/13/68	151	66.7 (27.0)	31.9 (28.3)	45.7 (18.0)	60.4
1967						
Stocked	6/ 8/67	250	111 (45)	-	8.6 (3.4)	-
Examined	9/26/67	0	-	-	-	-
Collected	9/13/68	2	1.0 (0.4)	0.3 (0.3)	40.1 (15.8)	0.8
1968						
Stocked	5/21/68	250	111 (45)	-	8.9 (3.5)	-
Collected	9/13/68	23	10.1 (4.1)	1.0 (0.9)	27.2 (10.7)	9.2

Table 3.--Standing crops of bluegills in Daggett Lake and Emerald Lake at time of poisoning

Lake and year class	Number of fish per hectare (per acre)	Kilograms of fish per hectare (Pounds of fish per acre)	Mean total length in cm (inches)	Length range in cm (inches)
Daggett				
Adult*	7 (3)	2.0 (1.8)	23.9 (9.4)	22.6-26.9 (8.9-10.6)
1963	40,474 (16,392)	219.5 (195.6)	7.4 (2.9)	6.1-21.8 (2.4- 8.6)
1964-1966	No survival	-	-	-
Emerald				
Adult*	178 (72)	22.5 (20.1)	-	14.0-25.4 (5.5-10.0)
1966	12,247 (4,960)	85.9 (76.6)	7.9 (3.1)	6.6-10.2 (2.6- 4.0)
1967	12,790 (5,180)	44.2 (39.3)	6.4 (2.5)	5.8- 6.9 (2.3- 2.7)
1968	10,420 (4,220)	16.5 (14.7)	4.8 (1.9)	2.5- 5.3 (1.0- 2.1)
Total 1966-1968	35,457 (14,360)	146.7 (130.6)	6.6 (2.6)	2.5-10.2 (1.0- 4.0)

* Adult indicates fish from original stocking in 1963 for Daggett Lake and 1966 for Emerald Lake.