Survival, Growth, and Vulnerability to Angling of Walleyes Stocked as Fingerlings in a Small Lake with Minnows

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Fisheries Research Report No. 1853
November 18, 1977

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

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SURVIVAL, GROWTH, AND VULNERABILITY TO ANGLING OF WALLEYES STOCKED AS FINGERLINGS IN A SMALL LAKE WITH MINNOWS [1]

By George B. Beyerle

Abstract

Walleyes stocked as 4-inch fingerlings in 15-acre Daggett Lake, Barry County, from 1973 through 1975, produced a total standing crop of 35.5 walleyes per acre (35.6 pounds per acre) by September 1976. Survival was somewhat higher and growth was significantly faster than for walleyes stocked in a small lake containing bluegills.

In 8.8 angling hours per acre of fishing, 17.3% of the standing crop of walleyes was caught. The catch rate for legal size (15-inch and over) walleyes was 0.26 fish per angler hour and for walleyes of any size, 0.70 fish per angler hour. During the angling test in summer 1976, fishing was enhanced because the walleyes were confined to weedy areas in less than 8 feet of water. For at least part of the season sufficient oxygen excluded walleyes from the deeper waters.

The results of this study indicate that large fingerling walleyes stocked in small lakes with a suitable food supply will survive and grow to the extent that a significant fishery can be anticipated.

[1] Contribution from Dingell-Johnson Project F-35-R, Michigan.

Introduction

This study was the second in a series of tests of survival and growth of walleye (Stizostedion vitreum vitreum) fingerlings in small lakes containing different forage fishes. In the first test, 4-inch walleye fingerlings were stocked for 3 consecutive years (1972 through 1974) in 5.6-acre Emerald Lake, Barry County, over an established population of bluegills as the only other fish species (Beyerle 1976). In Emerald Lake survival of the 1972 and 1973 year classes of walleyes through summer 1975 was surprisingly high (35.2 and 21.2%, respectively), producing a standing crop of 25.2 walleyes per acre (15.1 pounds per acre) by September 1975.

In the present study the growth and survival of walleye fingerlings stocked in a small lake containing minnows (golden shiners, Notemigonus crysoleucas, and fathead minnows, Pimephales promelas) as the only other fishes were determined. The angling vulnerability of walleyes in a small lake was tested also.

Procedure

Daggett Lake, Barry County, contains 15 surface acres, has a maximum depth of 20 feet, and no inlet or outlet. The water is unusually soft for southwestern Michigan. Methyl-orange alkalinity averages 17 ppm. Extensive growths of water lilies (Nymphae sp.) and spatterdock (Nuphar advens) occur around the shore in shallow water. The large leaf pondweed (Potamogeton amplifolius) is the dominant higher aquatic plant. It grows along with curly leaf pondweed (P. crispus) and Chara in beds in 6 to 12 feet of water. Approximately half of the bottom is deeper than 12 feet and contained no vegetation in August 1976.

Daggett Lake has been used for various research studies since 1963. Before 1963 the lake contained an assemblage of fishes typical of southern Michigan lakes. Slow-growing bluegills (Lepomis macrochirus) were the predominant fish but significant numbers of largemouth bass (Micropterus salmoides), pumpkinseeds (Lepomis gibbosus), black crappies

(Pomoxis nigromaculatus), yellow perch (Perca flavescens), golden shiners, and bullheads (Ictalurus sp.) were present.

Daggett Lake was treated with rotenone in September 1972, to remove an existing fish population. Adult fathead minnows (100 pounds) were stocked in April 1973 and adult golden shiners (150 pounds) were stocked in March 1974. In October 1973, 675 fingerling walleyes (45 per acre), with a mean length of 4.03 inches, were stocked. Additional plantings of 675 walleyes were made in August 1974 (3.86 inches mean length) and September 1975 (4.13 inches mean length). Walleyes were identified as follows: 1973 year class--no mark; 1974 year class--right pelvic fin clip; 1975 year class--left pelvic fin clip.

In a previous test of angling vulnerability of esocids in Daggett Lake, Michigan Department of Natural Resources personnel fished a total of 131.5 angler hours (Beyerle 1973). For comparative purposes the present test also was conducted for 131.5 angler hours. The fishing again was done by various Department of Natural Resources personnel, on 14 dates extending over the period June 22 through August 26, 1976. All captured walleyes were measured and scale sampled, if necessary, to determine their age. Stomach contents were analyzed for the majority of the angler-caught walleyes.

Daggett Lake was treated with rotenone on September 13, 1976, and all visible walleyes were collected daily through September 18. The walleyes were measured, weighed, and scale sampled (if necessary). From the collected data the survival, growth, and vulnerability to angling of walleyes were determined.

Results and discussion

The survival and growth of walleyes in Daggett Lake as of September 1976 are given in Table 1. As anticipated, survival was highest for the 1973 stock and lowest for the 1975 stock. Survival of the three age groups (42.1, 29.3, and 7.6%, respectively) was higher than, but remarkably proportional to, survival of identical age groups of walleyes in Emerald Lake with bluegills (35.2, 21.2 and 0.0%). The standing crop of walleyes in

Daggett Lake was a very respectable 35.5 fish per acre, compared with 25.2 walleyes per acre in Emerald Lake.

Growth of all three year classes of walleyes in Daggett Lake was greater than state average (Table 1). By contrast, growth of walleyes in Emerald Lake was consistently below state average. As a result of the combination of higher survival and more rapid growth, the standing crop of walleyes in Daggett Lake totaled 35.6 pounds per acre, considerably more than the total of 15.1 pounds per acre in Emerald Lake.

In a previous study at Daggett Lake with northern pike and minnows (Beyerle 1973a) 103 pounds per acre of minnows were collected following the application of rotenone. The standing crop of minnows in the present study was not calculated, but was judged to be somewhat less than in the previous study, or about 75 pounds per acre. It was estimated that 85% of the minnows were less than 4 inches in length.

In 131.5 angler hours of fishing at Daggett Lake in summer 1976, Department of Natural Resources personnel caught and kept 92 walleyes (0.70 per angler hour, 2.3 per acre) or 17.3% of the total standing crop (Table 2). The captured walleyes ranged in size from 8.8 to 18.6 inches. Thirty-four fish (37.0%) were legal size (15 inches or over), and 86 fish (93.5%) were 13 inches or over. Anglers caught 16.1% of the available legal-size walleyes, or 0.26 walleye per angler hour. Mean length of angler-caught age-III walleyes was 0.3 inch greater than the mean length (15.5 inches) for the age group. However, age-I and age-II walleyes caught by anglers averaged 1.3 and 0.5 inches, respectively, less than the mean length for each individual age group. Despite the fact that more than 17% of the standing crop of walleyes had been harvested through August 26, there was no proportional decline in the catch per angler hour (Fig. 1).

When the angling test began on June 22, the fishermen soon found that no walleyes could be caught by casting and retrieving lures close to the bottom in deeper water, a technique that had been very successful in the previous angling study with esocids in 1972. By noontime on June 22, it was discovered that walleyes could be caught by trolling small spoons at a

depth of 5 to 8 feet in close proximity to the outer edges of the Potamogeton beds. On subsequent angling days the technique of casting spoons into openings in the Potamogeton and lily pads proved to be the most consistent method of catching walleyes.

On August 26, the final day of angling, it was discovered that water below the 8-foot contour was essentially devoid of dissolved oxygen (Table 3). Thus an explanation was provided for the success of angling in relatively shallow water. The obvious effect of a lack of oxygen in deeper water was to concentrate nearly all the walleyes into the outer edges of the lily pads and all of the beds of Potamogeton.

Although the scarcity of oxygen in water deeper than 8 feet was not documented until August 26, the fact that no walleyes could be caught in deeper water during the entire angling test is an indication that oxygen may have been lacking there as early as June 22. Ryder (1977) has provided evidence that between the hours of 10 AM and 2 PM walleyes are most active in waters where the transparency (Secchi disc) ranges from 3.3 to 6.2 feet. In Daggett Lake the transparency varied from 4 to 5 feet and all fishing was done from 10 AM to 3 PM. Thus it seems likely that in Daggett Lake, where ambient light conditions in the water were optimum for walleye activity, that the walleyes were occupying the shallow weedy areas in June not because of any avoidance of light but because of the lack of oxygen in the deeper waters. The crowding of walleyes into the relatively shallow areas undoubtedly had a beneficial effect on the catch per unit effort during most of the test.

A comparison can be made between angling success for Age II and III walleyes in the present study and Age I and II northern pike in the previous study at Daggett Lake (Beyerle 1973). Length range of the walleyes was 12.8 to 18.6 inches, while the pike ranged from 14.8 to 24.6 inches. Standing crops were very similar: 482 walleyes compared with 450 pike. Both species were subjected to 131.5 angler hours of fishing, during which time 18.0% of the walleyes and 28.0% of the pike were caught. If all other factors were equal, then pike were 1.6 times more vulnerable to angling than walleyes. However, one obvious variable was the fact that the walleyes were confined to the upper 8 feet of water while, as mentioned

previously, in the study with pike many fish were caught by retrieving lures close to the bottom in 8 to 15 feet of water. In a similar comparison of angling vulnerability in Emerald Lake pike were found to be 5.8 times more vulnerable than walleyes to angling (Beyerle 1976).

Stomach contents of 75 walleyes taken by angling were analyzed (Table 4). Food was found in 38 stomachs (49.3%). Crayfish (17 stomachs) and minnows (14 stomachs) were the predominant food items. Dragonfly nymphs (5 stomachs), plant segments (3 stomachs) and tadpole remains (1 stomach) were also present. Unidentified remains were found in 4 stomachs. The fact that more crayfish than minnows were found, that the mean length of eaten minnows was only 2.2 inches, and that dragonfly nymphs were being consumed, all tend to confirm that the walleyes were confining themselves to the relatively shallow, weedy waters. While angling we observed that most of the larger, adult minnows seemed to inhabit the open water away from the weed beds, while smaller minnows stayed in relatively shallow water.

In summary, walleyes stocked as 4-inch fingerlings in a small lake with minnows survived at a consistently higher rate and grew significantly faster than walleyes stocked with bluegills. In 8.8 hours per acre of fishing, anglers caught 17.3% of the standing crop of walleyes, for a catch rate of 0.70 fish per angler hour. The catch rate for legal size walleyes was 0.26 fish per angler hour. Stomach contents of captured walleyes (mainly crayfish and small minnows) tended to support the contention that during the angling test walleyes were confined to weedy shoreline areas because of a lack of oxygen in water deeper than 8 feet.

The results of this study support and enhance the theory that large fingerling walleyes stocked in small lakes with an acceptable food supply will survive, grow and produce a moderate to large standing crop of catchable walleyes within 3 years of the initial stocking.

Table 1.--Survival and growth of walleyes in Daggett Lake, September 1976. Data include fish caught in angling vulnerability test.

Year	Survival			Growth in inches			
	Percent	Number per acre	Pounds per acre	Mean total length		State average	Growth index[a]
				Stocked	Recovered		
1973	42.1	18.9	22.0	4.0	15.5	15.2	+0.3
1974	29.3	13.2	11.7	3.9	14.4	13.3	+1.1
1975	7.6	3.4	1.9	4.1	12.2	9.5	+2.7
Totals		35.5	35.6				

[a] Difference from the state average.

Table 2.--Standing crop and angler harvest of walleyes in Daggett Lake during 131.5 hours of angling by Department of Natural Resources personnel in summer 1976. Number of walleyes per acre are in parentheses.

	Year class			Total
	1973	1974	1975	
Standing crop				
Total walleyes	284 (18.9)	198 (13.2)	51 (3.4)	533 (35.5)
Legal-size walleyes	173 (11.5)	38 (2.5)	0	211 (14.1)
Percent legal size	60.9	19.2	0.0	39.6
Angler harvest				
Total walleyes	45 (3.0)	42 (2.8)	5 (0.3)	92 (6.1)
Legal-size walleyes	32 (2.1)	2 (0.1)	0	34 (2.3)
Percent legal size	71.1	4.8	0.0	37.0

Table 3.--Summary of some physical characteristics of Daggett Lake in August 1976.

Water depth (feet)	In deepest part of lake (total depth 20 feet)			In weeds where fish were located (total depth 10.5 feet)	
	Water temperature (F)[1]	Dissolved oxygen[2]	Relative light intensity (percent)[1]	Water temperature (F)[1]	Dissolved oxygen[2]
Surface	77	8.8	90	75	9.0
5	75	8.8	77	75	8.6
7	73	6.5		75	6.8
8	72	6.5		75	1.2
9	72	1.0		74	0.2
10	72	0.2	38		
15	63	0.1	2		
19	56	0.1	trace		

[1] Measured with Waller "Fish Hawk" temperature and light intensity meter.

[2] Measured with Weston and Stack dissolved oxygen analyzer.

Table 4.--Stomach contents of walleyes taken from Daggett Lake by angling, 1976.

	Year class			Total
	1973	1974	1975	
Stomachs examined	41	31	3	75
Stomachs with food	21	16	1	38
Stomachs empty	20	15	2	37
Percent with food	51.2	51.6	33.3	49.3
Analysis of stomach contents				
Number of stomachs containing:				
minnows	6	8	0	14
crayfish	12	5	0	17
insects	1	4	0	5
tadpoles	0	1	0	1
plants	3	0	0	3
unidentified	2	1	1	4
Percent of feeding walleyes with fish	28.6	50.0	0.0	36.8
Percent of feeding walleyes with crayfish	57.1	31.2	0.0	44.7
Mean number of food items in stomachs with food	1.5	1.6	1.0	1.5
Mean length of minnows (inches)	2.2	2.2		2.2
Length range (inches)	1.0-3.4	2.0-2.4		1.0-3.4

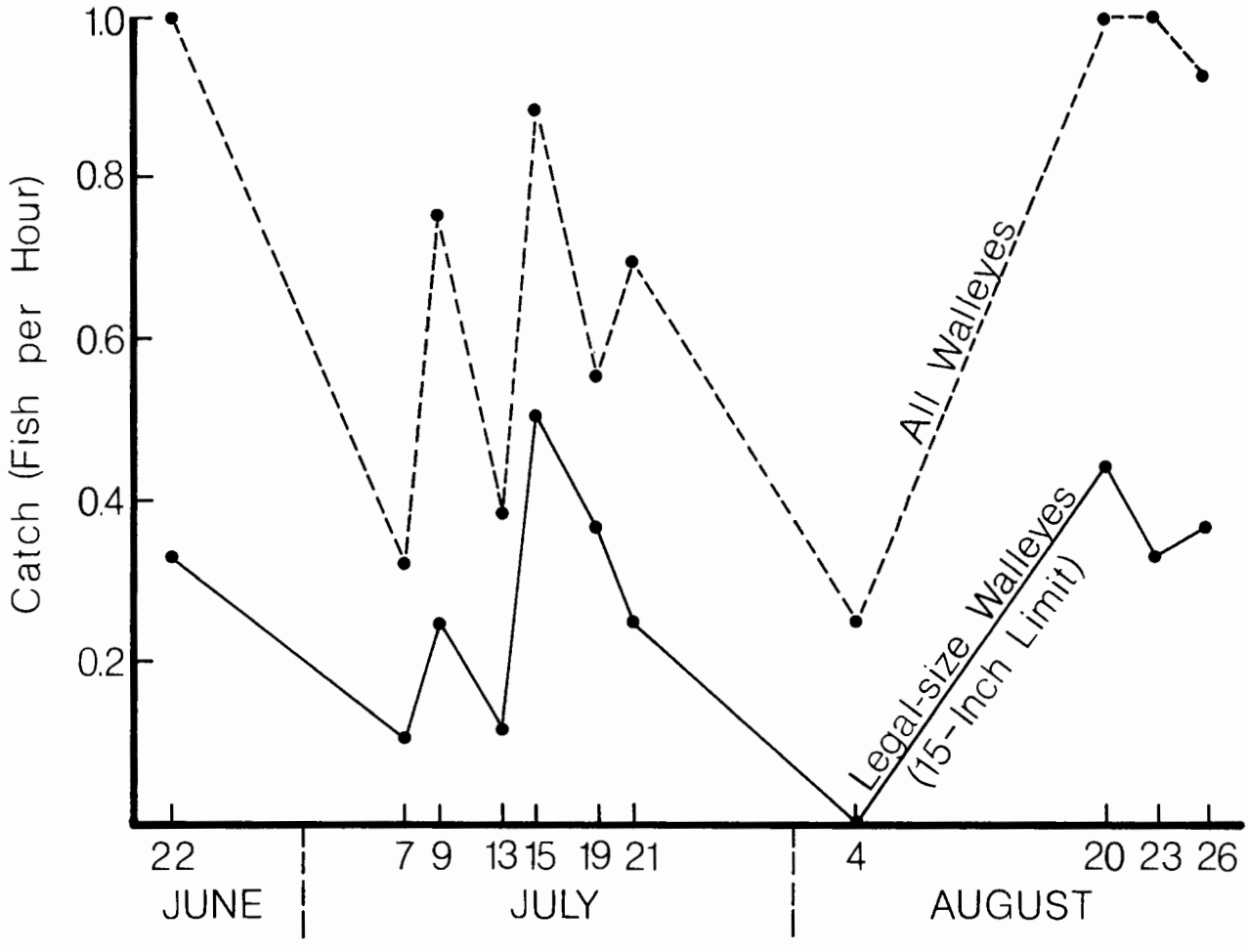

Figure 1.--Angler catch of walleyes in Daggett Lake, June-August, 1976.

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Report approved by W. C. Latta

Typed by M. S. McClure