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Survival and Growth of 5-, 10-, and 15-cm Walleye Fingerlings Stocked in Ponds with Bluegills

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SURVIVAL AND GROWTH OF 5-, 10-, AND 15-CM WALLEYE FINGERLINGS STOCKED IN PONDS WITH BLUEGILLS[1]

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Abstract

Over a period of 6 years walleye fingerlings of 5, 10, and 15 cm were planted in three ponds with bluegills so that each size of fingerling had a chance to survive and grow for 2 years in each pond. Percent survival and final mean length of the walleyes were not related to size at planting. Variations in forage density seemed to be more important than fingerling size in determining survival of walleyes. Apparently small fingerling walleyes (5 cm) will survive as well as larger fingerlings when forage density is adequate and predators are absent.

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

Introduction

During the past decade Department of Natural Resources biologists have increasingly been involved with attempts to establish or enhance walleye (Stizostedion vitreum vitreum) populations throughout Michigan. In many localities, but especially in southern Michigan, scarcity of natural reproduction requires that walleye enhancement programs be supported by periodic plants of fingerlings. To maximize the results of this effort, information is needed on the conditions under which a fisheries manager can anticipate optimum survival and growth of planted walleye fingerlings.

Attempts to establish walleye populations in lakes dominated by bluegills (Lepomis macrochirus) have been particularly unsuccessful. However, in one bluegill lake (Beyerle 1976), survival of 10-cm walleye fingerlings planted at 111 per hectare in 1972 and 1973 to fall 1975 was 35.2% and 21.2%, respectively. Survival of the walleyes evidently was enhanced by the presence of an adequate supply of food (young bluegills) and absence of predators. Thus there is evidence that, given an abundant food supply and a minimum of predators, good survival of relatively large walleye fingerlings can occur. Because of the various difficulties in raising large quantities of walleye fingerlings to 10 cm or larger, the present study compared the survival and growth of three sizes of walleye fingerlings in ponds with bluegills, with the aim of determining the feasibility of planting smaller (5 cm) walleyes.

Procedure

In fall 1975, all fish were removed from three research ponds at Belmont, Kent County. In April 1976, all three ponds were restocked with adult bluegills (22 per kg) at the rate of 23 kg per ha. In June-September, 390 5-cm walleye fingerlings were stocked in Pond 2 (2.6 ha), 115 10-cm walleyes in Pond 3 (1.0 ha), and 196 15-cm walleyes in Pond 1 (1.8 ha). The stocking date was determined by the availability of fingerlings of the desired size from the Wolf Lake State Fish Hatchery. Prior to each walleye introduction, ponds were examined to assure that age-0 bluegills (expected to be the primary food of the walleyes) were present. Survival and growth of walleyes were determined after two growing seasons when the ponds were drained in fall 1977. Unexpectedly, large pond-to-pond variations occurred in the final abundance of forage-sized bluegills. Since variable abundance of forage obviously would have a major influence on survival and growth of walleyes, this study was extended through two additional cycles, so that walleyes of each length would have a chance to survive and grow in each pond. In an attempt to minimize variations in forage density, the initial stock of adult bluegills was increased to 30 kg/ha in cycle two, then to 33 kg/ha in cycle three.

Three two-way analyses of variance were made for data on walleye survival, growth, and standing crop to determine effects related to size of fingerling stocked versus effects due to the ponds themselves. The results were examined from two perspectives: (1) which fingerling size was the best performer within each of the three ponds (eliminates the variation due to inherent differences in productivity among the ponds); (2) which fingerling size was the best performer for each cycle (eliminates the variation due to year-to-year differences in weather).

Results

The 5-cm fingerling walleyes generally performed as good or better than the 10- or 15-cm fingerlings in terms of final standing crop, survival, and growth (Table 1); but the differences were not statistically significant. The variation in the data set was large, and as will be discussed later, much of it was because walleye survival and standing crop were significantly better in Pond 2 than in Ponds 1 or 3.

Small fingerlings produced larger fall standing crops than medium or large fingerlings in each one of the three ponds, and in two out of the three cycles. Fall standing crops (in kg/ha ± 95% confidence limits) for the three ponds averaged 19.0 ± 6.6 for 5-cm fingerlings, 9.8 ± 6.6 for 10-cm fingerlings, and 9.5 ± 6.6 for 15-cm fingerlings.

Small fingerlings survived better than walleyes of other sizes in two out of three of the ponds, but in only one out of three of the cycles. Survival (in percent) for the three ponds averaged 53.9 for small, 31.2 for medium, and 37.5 for large fingerlings.

Small fingerlings grew better than medium or large fingerlings in two of the ponds, but in only one of the cycles. Average lengths (in mm) at draining were similar--32.7, 32.7, and 28.0 for fingerlings stocked at 5, 10, and 15 cm, respectively. However, for Ponds 1 and 2, superior growth was coupled with good survival, and for Pond 3 satisfactory growth was coupled with good survival. Thus the 5-cm walleyes tended to demonstrate a desirable combination of good survival and growth. Their advantage may have been related to stocking in June rather than July-September.

In each cycle, survival was highest for walleyes planted in Pond 2 (mean, 67.1%). Mean survival was considerably lower in Pond 3 (33.3%) and Pond 1 (22.1%), although the only significant difference (95% level) was between Pond 2 and Pond 1. Pond 2 also developed higher standing crops of walleyes than Ponds 1 or 3. Pond 2 has a history of being the most productive of the Belmont Ponds. During a 4-year study with bluegills as the only fish species, mean fall standing crop of young-of-the-year bluegills was highest in Pond 2 (Beyerle 1977). Pond 2 also seemed to be the best producer of burrowing mayfly nymphs (Hexagenia sp.), a food item that may have been important to both walleyes and adult bluegills. For some reason (possibly differential poaching), in each cycle of the present study the final standing crop of adult bluegills was lowest in Pond 2 (mean, 15.0 kg/ha). Schneider (1975) found that lowest survival of young walleyes occurred in ponds with large populations of sunfishes as competitors. Thus, the combination of more food initially and fewer competitors may explain the relatively good survival and high standing crop of walleyes in Pond 2.

Throughout the study one factor that undoubtedly affected the performance of individual walleye plants was variable density of food (age-I bluegills). At the start of each cycle densities (by weight) of adult bluegills in each pond were equal. However, the final standing crops of age-0 and age-I bluegills varied considerably (Table 2). In cycle one adequate densities of young bluegills apparently were produced in Ponds 2 and 3, while relatively few young survived in Pond 1. Thus, inadequate forage may be the reason for very poor survival (7.1%) of 15-cm walleyes in Pond 1. In Pond 3 a very large forage base of bluegills was associated with only moderate survival of walleyes (20.9%). A fairly large standing crop of bluegills (and probably a large complement of aquatic insects) was associated with very high survival (72.4%) of walleyes in Pond 2.

In cycle two, the final standing crop of age-I bluegills was lowest in Pond 2, coincident with the highest survival of walleyes (49.7%). In Pond 1, the final standing crop of age-I bluegills was 2.3 times greater in cycle two over cycle one and survival of walleyes was five times greater (36.2%). In Pond 3, age-I bluegills were about as dense as in Pond 1 and survival of walleyes was also similar (26.1%).

In cycle three, final density of age-I bluegills in Pond 1 was intermediate between the bluegill standing crops in the previous cycles. Survival of walleyes was also intermediate (23.0%). Final densities of age-I bluegills in Ponds 2 and 3 were considerably lower than in the previous cycles. In contrast, survival of walleyes in Pond 2 (79.3%) and Pond 3 (53.0%) was the highest of the three cycles.

Within each cycle there was a strong tendency for relatively high survival of walleyes to be associated with relatively low final standing crops of age-I bluegills and relatively high standing crops of age-0 bluegills. This was a good indication that walleyes were utilizing age-I bluegills as a major forage item. Consumption of age-I bluegills probably indirectly encouraged relatively high survival of age-0 bluegills.

When, however, the walleye survival versus bluegill standing crop values are combined into a single table, the above stated walleye-bluegill relationships are still valid for age-0 bluegills, but much less valid for age-I bluegills (Table 3). This would indicate that cycle-to-cycle variations in density of young bluegills may have been as important as pond-to-pond variations in determining survival and growth of walleyes.

Throughout the study there was a tendency for 5-cm walleyes to out-perform the larger walleyes. These tendencies may have been masked to some extent by year-to-year and pond-to-pond variations in density of both competitors (adult bluegills) and food supply (young bluegills and aquatic insects). Thus, it seems safe to say that this study has provided evidence that, in the absence of predators, small fingerling walleyes (5 cm) will survive as well as larger fingerlings when forage density is adequate at time of stocking.

Table 1. Survival and growth of walleyes stocked as different sized fingerlings in the Belmont Ponds during three, 2-year, experimental cycles.

Cycle and pond	Walleyes stocked			Walleyes recovered			Percent survival
	Date	Number per ha	Length (mm)	Number per ha	Length (mm)	Weight (kg/ha)	
Cycle 1 (1976-77)							
1	9-2	196	168	14	271	1.4	7.1
2	6-23	290	55	210	341	27.7	72.4
3	7-30	115	111	24	364	9.9	20.9
Cycle 2 (1978-79)							
1	6-14	196	52	71	330	12.9	36.2
2	8-1	290	99	144	312	13.4	49.7
3	9-13	115	154	30	243	3.4	26.1
Cycle 3 (1980-81)							
1	7-25	196	102	45	306	6.0	23.0
2	9-12	246	167	195	326	23.8	79.3
3	6-27	115	52	61	309	16.5	53.0

Table 2. Number, weight, and mean length of bluegills recovered at the end of each cycle from initial adult plantings of 23, 30, and 33 kg per ha for cycles 1, 2, and 3, respectively.

Cycle and pond	Age O			Age I			Adult	Total weight (kg/ha)
	Number per ha	Weight (kg/ha)	Length (mm)	Number per ha	Weight (kg/ha)	Length (mm)	Weight (kg/ha)	
Cycle 1								
1	0	0	--	9,446	101	88	30.5	132
2	trace	trace	42	43,994	90	62	16.1	106
3	0	0	--	116,077	159	49	23.4	182
Cycle 2								
1	5,680	2	28	22,278	174	78	33.8	209
2	296,000	47	24	5,303	25	67	21.9	94
3	13,560	16	44	18,314	188	87	26.9	231
Cycle 3								
1	trace	trace	--	11,000	75	77	30.0	105
2	78,345	25	28	1,925	48	120	6.9	80
3	124,800	56	31	4,377	24	70	16.2	97

Table 3. Survival and growth of walleyes in relation to final standing crops of bluegills.

Walleyes recovered		Bluegill final standing crops	
Percent survival	Total weight kg/ha	Age I Number per ha	Age 0 Number per ha
7.1	1.4	9,446	0
20.9	9.9	116,077	0
23.0	6.0	11,000	trace
26.1	3.4	18,314	13,560
36.2	12.9	22,278	5,680
49.7	13.4	5,303	296,000
53.0	16.5	4,377	124,800
72.4	27.7	43,994	trace
79.3	23.8	1,925	78,345

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