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Survival and Growth of Early– and Normal–Plant Tiger Muskellunge Stocked in a Small Lake with Forage Fish and Largemouth Bass

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SURVIVAL AND GROWTH OF EARLY- AND NORMAL-PLANT TIGER MUSKELLUNGE STOCKED IN A SMALL LAKE WITH FORAGE FISH AND LARGEMOUTH BASS[1]

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

Abstract

Survival was extremely low for tiger muskellunge fingerlings stocked for 3 consecutive years in a 15-acre lake with bluegills, golden shiners and an average population of largemouth bass. Survival averaged 4.1% for early-plant (about 3.5-inch) fingerlings and 1.8% for normal-plant (about 7.0-inch) fingerlings. Mean length attained by each early plant exceeded the mean length of the equivalent normal plant.

The relatively low survival of all plants was typical of other plants of similar sized fingerlings made into lakes containing established populations of bass and bluegills. Considerably higher survival (15 to 36%) resulted when tiger muskellunge were stocked in a lake with adequate forage (minnows) and few or no predator fishes.

Introduction

In recent years many states have added to their fish management practices the hatchery culture and subsequent stocking of fingerling tiger muskellunge (hybrids between northern pike, Esox lucius, and muskellunge, Esox masquinongy). In Michigan and other states, concern has been expressed over the frequent low survival of these fingerlings in the wild (Johnson 1978; Stein el al. 1981; Beyerle 1982).

Results of 7 years of tiger muskellunge research in Michigan (Beyerle 1984) led to the conclusion that survival of tiger muskellunge fingerlings was controlled by four interacting factors; time of stocking, size at stocking, forage density, and predator density.

In one 3-year study (Beyerle 1981), identical numbers (5 per acre) of early plant (average length about 3.5 inches) and normal plant (average length about 7.0 inches, typical production size) tiger musky fingerlings were stocked in a 15-acre lake with bluegills (Lepomis macrochirus) and minnows as forage but with no other predator fishes. Survival of all three early plants (mean, 36.0%) was considerably higher than survival of normal plants (mean, 15.1%) and was similar to or higher than survival of 3.5-inch northern pike stocked under similar conditions (Beyerle 1971 and 1973).

In another study (Beyerle, unpublished data) 3.5- and 7.0-inch tiger muskies were stocked for 2 years in three lakes (168 to 215 acres) with existing populations of tiger muskies and largemouth bass (Micropterus salmoides). So few fish were recovered from five of these six plants that no significant difference in survival could be shown.

In a third study (Beyerle 1984), 6-inch tiger muskies were stocked in small ponds (about 3.7 acres) with and without adult largemouth bass. Survival of these normal-plant, production-size tiger muskies was inversely

correlated to the density of largemouth bass 12.0 inches and larger.

This study compared the survival of early- and normal-plant tiger muskies in a lake with forage fish and an average population of adult largemouth bass.

Methods

Daggett Lake, Barry County, is closed to fishing and has been the site of research on various cool-water predatory fishes since 1963. The lake is landlocked, covers 15 acres, has a maximum depth of 15 feet, and has a methyl orange alkalinity of 19 ppm. Weed growth is only moderate and in recent years the lake has tended, in July and August, to become turbid and deoxygenated at depths greater than 8 feet.

In September 1980, Daggett Lake was treated with rotenone to eliminate the existing fish population. In spring 1981 the lake was stocked with adult bluegills (mean length 6.6 inches) at a rate of 24.1 pounds per acre and largemouth bass (mean length 11.5 inches) at a rate of 7.3 pounds (10.1 bass) per acre. Also, it was known that an unknown density of golden shiners (Notemigonus crysoleucas) had survived the chemical treatment of September 1980 (Beyerle 1981).

Early- and normal-plant tiger muskellunge fingerlings were stocked annually from 1981 through 1983. Each plant was given a distinctive fin clip. Invariably the temperature of the water in the fish transportation unit was cooler than that of the lake, so before stocking the fingerlings were tempered to within 6 F of the prevailing lake temperature. No fingerlings were observed to be in distress following any of the plantings.

In 1981 no observations were made of the density of forage fish or young bass. In July 1982, while stocking tiger muskellunge, small to moderate numbers of age-0

bluegills and golden shiners were observed, plus a few adult golden shiners and several age-I largemouth bass. In June 1983, at the stocking site, a small to moderate number of various sized bluegills (probably age 0, I, and II) were observed but no shiners or bass.

On October 17, 1983, Daggett Lake was treated with Nusyn-Noxfish (2.5% rotenone) at an estimated concentration of 2.8 parts per million to kill all fish. On October 17-21 and October 28 all visible tiger muskellunge, largemouth bass 10 inches and longer, and bluegills 5 inches and longer were picked up. Length frequencies were obtained for bluegills smaller than 5 inches and bass between 5 and 10 inches in length. Visual estimates were made of bass smaller than 5 inches and of golden shiners.

Results and Discussion

Survival of all stocks of tiger muskellunge was extremely low (Table 1). The 1981 early plant had the highest survival (9.6%), compared with only 2.7% survival for the 1981 normal plant and 1.3% survival for each of the remaining four plants. As in a previous study (Beyerle 1981), final mean length of each year class of early-plant tiger muskellunge was larger than the normal-plant equivalents.

The fact that all six stocks suffered high mortality makes it somewhat difficult to identify the factors that most affected survival. An added complication was a report that during the study poachers had harvested an unknown number of bass from Daggett Lake. Thus, the average population density of bass during the second and third year of the study was probably somewhat higher than the chemical treatment data indicated (Table 2).

Since 12-inch and larger largemouth bass are the primary consumers of normal-plant (7-inch) tiger muskellunge (Beyerle 1984), it seems logical to assume that 9-inch and

larger largemouth bass are the primary consumers of early-plant (3.5-inch) tiger muskellunge. In the absence of bass, survival of early-stock tiger muskellunge in Daggett Lake averaged 36.0% (Beyerle 1981), whereas in this study survival was 4.1% in the presence of population density of 6.6 to 10.1 largemouth bass 9 inches and larger per acre (Table 2). This bass density would be typical of average lakes in Michigan. Survival of normal-stock tiger muskellunge averaged 15.1% without bass and 1.8% with a population density of 2.3 to 2.6 largemouth bass 12.0 inches and larger per acre. Thus, largemouth bass reduced musky fingerling survival about nine-fold in Daggett Lake experiments. In two larger study lakes, also containing average populations of largemouth bass, the mean survival of normal stock muskellunge was also low, 4.4% (Beyerle 1981).

However, muskie survival in Daggett Lake was even lower than expected. Earlier (Beyerle 1984) it was estimated that, in the presence of adequate forage, survival of normal-stock tiger muskellunge would be 40 to 50% with a density of 2 largemouth bass 12.0 inches and larger per acre and 20 to 35% with a density of 6 to 10 bass 12.0 inches and larger per acre. Therefore, with a density of 6 to 10 largemouth bass 9.0 inches and larger per acre, survival of the smaller early-stock tiger muskellunge should vary from 20 to 35%. Even if the mean density of bass was assumed to be twice the numbers shown, allowing for the alleged poaching of bass, survival of early- and normal-plant muskellunge should have been 10 to 20% and 30 to 40%, respectively. Thus, the observed survival of both early-stock (4.1%) and normal-stock (1.8%) tiger muskellunge in Daggett Lake was considerably below what would be predicted if predator density was the only controlling factor.

Indications are that the density of forage fish suitable for muskie fingerlings to eat was also limiting survival. As stated previously, small to moderate numbers of young bluegills and golden shiners were observed in July

1982 and a small number of young bluegills, but no shiners were seen in June 1983. The chemical treatment in September 1983 revealed small to moderate numbers of age-0, -I, and -II bluegills but no young shiners and very few age-I or age-II (4.0- to 4.9-inch) shiners (Table 3).

The population of largemouth bass probably played a major role in reducing the density of golden shiners (a preferred food item). Age-0 bluegills apparently were available in moderate quantities all 3 years, but bluegills are not a preferred food item for esocids (Beyerle 1968). Thus, in this study the survival of all plantings of tiger muskies was probably influenced strongly by the scarcity of a preferred food item, the golden shiner. The fact that survival of tiger muskies in this study was similar to survival in average Michigan lakes, which usually do not contain large minnow populations, would indicate that in most lakes both predator density and density of preferred forage fishes (not bluegills) are equally critical to survival of tiger muskies.

Management Implications

Both early-plant (3- to 5-inch) and normal-plant (production-size) tiger muskellunge fingerlings will survive well when stocked in lakes with adequate forage (minnows) and a minimum of predators. Neither early- nor normal-plant tiger muskellunge fingerlings will survive well when stocked in most lakes dominated by bass and bluegills.

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R. E. Fitch and R. N. Cobb collected and stocked predator and forage fish. J. B. Gapczynski and District 12 fisheries field personnel participated in the chemical treatment and subsequent fish pick-up. J. C. Schneider and W. C. Latta critically reviewed the manuscript.

Table 1. Survival and growth of early- and normal-plant tiger muskellunge in Daggett Lake, as of October 1983, for plantings made in 1981-83. Number of fish is in parentheses.

Year and planting	Stocking		Survival			Mean length (inches)	
				Per acre			
	Date	Number per acre	Percent	Number	Pounds	Stocked	Recovered
1981							
Early	6/18	4.9	9.6	0.46	1.99	4.2(73)	28.6(7)
Normal	8/13	5.0	2.7	0.13	0.44	6.3(75)	25.3(2)
1982							
Early	7/9	5.0	1.3	0.07	0.29	3.6(75)	27.4(1)
Normal	8/5	5.0	1.3	0.07	0.09	5.7(75)	19.6(1)
1983							
Early	6/9	5.0	1.3	0.07	0.03	3.7(75)	14.7(1)
Normal	8/4	5.0	1.3	0.07	0.01	7.0(75)	12.5(1)
Total population				0.87	2.85		

Table 2. Standing crop in number per acre of largemouth bass in Daggett Lake by inch group at beginning (1981) and ending (1982) of experiment.

Inch group	Number per acre	
	Beginning	Ending
0.0 - 5.9	0	22.0
6.0 - 8.9	0	1.9
9.0 - 9.9	0	2.3
10.0 - 10.9	1.6	1.1
11.0 - 11.9	5.9	0.9
12.0 - 12.9	2.2	0.7
13.0 - 13.9	0.3	0.0
14.0 - 14.9	0.0	0.4
15.0 - 15.9	0.1	0.7
16.0 -16.9	0.0	0.5
9.0 and larger	10.1	6.6
12.0 and larger	2.6	2.3

Table 3. Standing crops of bluegills and golden shiners collected from Daggett Lake, fall 1983.

Species and age	Length (inches)		Number		Weight (pounds)	
	Mean	Range	Total	Per Acre	Total	Per acre
Bluegill						
0	1.72	1.4-1.9	small to moderate		---	---
I	2.58	2.1-3.1	numbers of each age		---	---
II	3.65	3.2-4.7	group		---	---
Adult	9.14	8.7-9.6	249	16.6	122.8	8.2
Golden shiner						
		<4.0	0	---	---	---
		4.0-6.9	small to moderate		---	---
		>7.0	population mostly		---	---
			larger than 7.0 inches			

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