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COMPARATIVE GROWTH, SURVIVAL, AND VULNERABILITY TO ANGLING OF NORTHERN PIKE, MUSKELLUNGE, AND THE HYBRID TIGER MUSKELLUNGE STOCKED IN A SMALL LAKE [1]

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ABSTRACT

Northern pike, muskellunge, and tiger muskellunge fingerlings were stocked in equal numbers for 3 consecutive years in Daggett Lake (14 acres). After 3 years, mean lengths of age-II esocids were as follows: pike, 21.0 inches; tiger muskellunge, 22.9 inches; muskellunge, 28.0 inches. Survival of the three year classes of pike was unusually high (45 to 79%), tiger muskellunge survival was intermediate (9 to 28%), and muskellunge survival was extremely low (0 to 0.4%). It is suggested that the poor survival of muskellunge fingerlings was more likely the result of an inherited intolerance for some environmental factor, rather than the result of differential predation by larger esocids. The total standing crop of esocids in this study was 64.0 pounds per acre; it was 57.8 pounds per acre in a previous study when only pike were stocked in Daggett Lake. From this similarity, it is judged that, in the present study, high survival of pike compensated for low survival of muskellunge, to produce a standing crop of esocids that closely approached carrying capacity for Daggett Lake.

In 131.5 man hours of fishing in Daggett Lake, anglers caught 25.1% of the stocked pike and 9.4% of the tiger muskellunge. If it is assumed that all esocids were equally available, it follows that the pike were 2.7 times more vulnerable to angling than were the tiger muskellunge.

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[1] A contribution from Dingell-Johnson Project F-29-R-7, Michigan.

Introduction

The naturally occurring hybrid between muskellunge (Esox masquinongy) and northern pike (Esox lucius), called the "tiger musky," was first reported in Illinois in 1927, according to Crossman and Buss (1965). In 1939, tiger musky were produced in hatcheries in Minnesota (Eddy, 1944), and Wisconsin (Black and Williamson, 1947). In both places no morphological differences occurred between tiger musky produced from muskellunge males and pike females, and those produced from muskellunge females and pike males. Tiger musky eggs often showed greater vitality than muskellunge eggs; and tiger musky fry and fingerlings were hardier and usually grew faster during their first year, than either muskellunge or pike. Eddy (1944) reported holding several hybrids until their fourth year, when the females became distended with eggs; however, the eggs did not ripen and the fish did not release them.

In Wisconsin (Black and Williamson, 1947), the "hard" eggs of a female tiger musky were induced to ripen by injection of carp pituitary. The eggs were back-crossed with sperm of both muskellunge and pike. The tiger-x-muskellunge back-cross produced only a few fry, which soon died; the tiger-x-pike back-cross produced a somewhat better hatch and survival, and several progeny were kept alive for at least 5 weeks. All male tiger musky which I examined had testes in an arrested state of development, and the fish was incapable of producing sperm. In summary, young tiger musky grow faster and are hardier than either parent. Adult tiger musky seemingly are sterile for all practical purposes.

Scott (1964) found increased thermal resistance in tiger musky compared to the parent species. In recent years Michigan has produced and reared tiger musky at the Wolf Lake Hatchery, and stocked them in several lakes. Field observations and angling reports have indicated that, generally, tiger musky have survived at higher rates and have been more easily caught than muskellunge. The tiger musky is considered to be more exciting to catch than the pike.

The present study was designed to compare the growth, survival, and vulnerability to angling of northern pike, northern muskellunge, and the hybrid tiger musky when all three esocids were stocked in equal numbers in a small lake.

Procedure

Daggett Lake (14 acres), Barry County, was chosen for this study because previously it had been used for experiments with northern pike populations. Therefore I could, with some confidence, predict total standing crop and growth rates for the three esocids. Daggett Lake was treated with rotenone to remove the existing fish population in the fall of 1969. In May of 1970, about 100 pounds of golden shiners (Notemigonus crysoleucas) and fathead minnows (Pimephales promelas) were stocked. In June, 225 fingerlings of each of the three esocids were stocked. This stocking rate was equivalent to the 675 northern pike fingerlings that were stocked each year in previous studies in Daggett Lake. In the spring of 1971 and 1972, identical plantings of fingerling esocids were made. In the fall of 1970 and 1971, samples of the esocids were collected with electrofishing gear to compare growth. In August and September of 1972, research personnel fished Daggett Lake with casting lures for 131.5 man hours to determine the comparative vulnerability of the esocids to angling. Daggett Lake was then treated with rotenone on September 11, 1972, and all esocids were recovered. From the data obtained, the standing crop, survival, and growth of each year class of the three esocids were calculated.

Results and discussion

Growth and survival of northern pike, muskellunge, and tiger musky in Daggett Lake are shown in Table 1. Stocked fingerling pike were usually as large as, or larger than, the other fingerling esocids, and they were stocked from 1 to 4 weeks before the others. Thus the pike always had an initial size advantage, and this advantage was

maintained through the first year of growth (Table 1). After 2 years, the muskellunge had surpassed the pike in mean length. Tiger musky of the 1970 year class had also grown to a larger size than pike after 2 years, but pike of the 1971 year class were larger than tiger musky by fall of 1972. At the end of the third year, muskellunge of the 1970 year class were 7 inches longer, and tiger musky were 2 inches longer, than pike. The order of ultimate size attained by the three esocids was to be expected. However, it is not known what effect, if any, differential stock densities had on the magnitude of growth, since stock density was inversely proportional to the ultimate size attained by each of the three esocids.

Survival of stocked northern pike was relatively high for all year classes, varying from 45% for the 1971 year class to 79% for the 1970 year class (Table 2). In contrast, only 3 of the 675 stocked muskellunge survived, 2 from the 1970, and 1 from the 1971 planting. Survival of tiger musky was intermediate between that for the parental species, varying from 9% of the 1971 year class to 28% of the 1970 year class.

During the study, northern pike fingerlings were stocked from 7 to 22 days (mean, 14 days) before the tiger musky were stocked, and were 0.0 to 0.3 inch longer than the tiger musky. Tiger musky were stocked from 0 to 8 days (mean, 4 days) before muskellunge. In 1970 and 1972, tiger musky averaged 0.4 inch longer than muskellunge, but in 1971, muskellunge were 0.1 inch longer than tiger musky (Table 1). Assuming that the larger esocid fingerlings preyed selectively on smaller esocids, it is feasible that a combination of differential size of fingerlings and time of stocking contributed to the observed variation in survival. However, considering the relatively low stock density (16 fish per acre) of each esocid fingerling group, and the observed large population of small minnows available as food, it is not likely that the extremely large divergence in survival resulted solely from selective predation by larger esocid fingerlings. The fact that survival of pike

fingerlings was relatively high in 1971 and 1972 would indicate that predation by age-I and age-II esocids was not a major factor in survival of esocid fingerlings.

The consistency of the pattern of survival--high for pike, extremely low for muskellunge, and intermediate for tiger musky--suggests the functioning of some genetic factor common to muskellunge, and inherited in reduced measure by tiger musky. The apparent low survival of muskellunge stocked in lakes by fish management personnel, compared to the greater success obtained with stocks of tiger musky, is further evidence of an inherited intolerance by muskellunge for a particular environmental condition existing in many lakes.

A standing crop of 64 pounds per acre of esocids was collected from Daggett Lake in the fall of 1972 (Table 2). Northern pike constituted 81% (51.8 pounds per acre) of the population, including 35.1 pounds of stocked pike and 16.7 pounds resulting from natural reproduction. Tiger musky made up 18% (11.3 pounds) and muskellunge, 1% (0.9 pound per acre). The standing crop of age-0 and age-I pike resulting from natural reproduction was greater, both in numbers and weight, than the standing crop of stocked pike (Table 2). Assuming that the mortality was considerably greater for naturally produced age-0 pike than for stocked pike, a substantial number of pike fry must have been produced in Daggett Lake in both 1971 and 1972.

The total standing crop of esocids of each age group in the present study was similar to the population of northern pike collected from Daggett Lake in a previous study (Table 3). This is evidence that during each year of the present study, relatively high survival of pike compensated for relatively low survival of muskellunge, to produce a standing crop of esocids that closely approximated the carrying capacity for Daggett Lake.

Although the standing crop of minnows was not measured, it was estimated by observation to be very similar, in both total weight and composition, to the minnow population found in a previous study in Daggett Lake (Beyerle, 1973). In that study, I found 103 pounds of

minnows per acre, including 94 pounds or 19,600 fish under 4 inches in length, and 9 pounds (140 fish) over 4 inches in length.

In 131.5 man hours of fishing in Daggett Lake just prior to chemical treatment in late summer of 1972, we caught by hook and line 100 northern pike from a population of 398 stocked fish, 10 tiger musky from a population of 106 stocked fish (Table 4); but we caught no muskellunge. By age group the 100 pike consisted of 63 (35%) of 178 age-II fish, 31 (30.4%) of 102 age-I fish, and 6 (5.1%) of 118 age-0 fish.

Here, in addition to the above records on stocked pike, are angler records on pike from natural reproduction in the lake. We caught 32 (18.8%) of 170 age-I pike, and 2 (0.2%) of 872 age-0 fish.

Our angler catch of legal-sized pike (over 20 inches) was 54 (38.0%) of 142 fish.

Of the 10 tiger musky caught by angling, 9 (14%) were from the 64 age-II fish, and 1 out of 20 was an age-I fish. No age-0 "tigers" were hooked.

The catch by angling amounted to 25.1% of the available stocked pike, and 9.4% of the tiger musky. Thus, if it is assumed that all esocids were equally available, the stocked pike were 2.7 times more vulnerable to capture than were the tiger musky.

In summary, the comparative growth of the three esocids stocked in Daggett Lake was as expected. After 3 years, pike averaged 21.0 inches, tiger musky 22.9 inches, and muskellunge 28.0 inches. Survival of pike was high (45 to 79%), tiger musky intermediate (9 to 28%), and musky low (0.0 to 0.4%). Evidence indicates that the observed variation in esocid survival was more likely due to genetic differences than to differential size and time of stocking of the three esocid types. In Daggett Lake stocked northern pike of all sizes were 2.6 times more vulnerable to angling than tiger musky.

Table 1.--Growth and survival of northern pike, muskellunge, and tiger musky in Daggett Lake

Year class, event, and date		Number, and esocid group	Fish per acre: Number	Fish per acre: Pounds	Mean length (inches)	Percent survival
1970						
Stocked	6/10/70	225 pike	16.1	....	3.5	..
	6/17/70	225 musky	16.1	....	2.7	..
	6/17/70	225 tiger	16.1	....	3.2	..
Examined						
	10/6/70	5 pike	....	....	14.2	..
	10/6/70	3 musky	....	....	13.7	..
	10/6/70	8 tiger	....	....	13.8	..
	9/7/71	2 pike	....	....	17.6	..
	9/7/71	1 musky	....	....	22.0	..
	9/7/71	6 tiger	....	....	20.0	..
Recovered*	9/11/72	178 pike	12.7	23.6	21.0	79
	9/11/72	2 musky	0.1	0.8	28.0	2
	9/11/72	64 tiger	4.6	9.6	22.9	28
1971						
Stocked	6/2/71	225 pike	16.1	....	3.3	..
	6/22/71	225 musky	16.1	....	3.4	..
	6/14/71	225 tiger	16.1	....	3.3	..
Examined	9/7/71	2 pike	....	....	12.3	..
	9/7/71	1 pike**	....	....	10.6	..
	9/7/71	0 musky	....	....	....	..
	9/7/71	1 tiger	....	....	11.2	..
Recovered*						
	9/11/72	102 pike	7.3	8.1	17.7	45
	9/11/72	170 pike**	12.1	11.8	17.0	..
	9/11/72	1 musky	0.1	0.1	19.7	<1
	9/11/72	20 tiger	1.4	1.2	16.5	9
1972						
Stocked	5/25/72	225 pike	16.1	....	2.6	..
	6/21/72	225 musky	16.1	....	2.2	..
	6/16/72	225 tiger	16.1	....	2.6	..
Recovered*	9/11/72	118 pike	8.4	3.4	12.4	52
	9/11/72	872 pike**	62.3	4.9	5.4	..
	9/11/72	0 musky	0.0	0.0	0.0	0
	9/11/72	22 tiger	1.6	0.5	10.7	10

* Totals include fish caught by angling or collected after chemical treatment.

** These pike were the result of natural reproduction.

Table 2.--Standing crop of esocids in Daggett Lake in the fall of 1972

(Total standing crop of all esocids was 64.0 pounds per acre)

Species and age group	Fish per acre		Mean length (inches)	Percent survival
	Number	Pounds		
Northern pike				
0	8.4	3.4	12.4	52
I	7.3	8.1	17.7	45
II	12.7	23.6	21.0	79
Total	28.4	35.1		
Northern pike*				
0	62.3	4.9	5.4	..
I	12.1	11.8	17.0	..
II	0.0	0.0	....	..
Total	74.4	16.7		
Muskellunge				
0	0.0	0.0	....	0
I	0.1	0.1	19.7	<1
II	0.1	0.8	28.0	2
Total	0.2	0.9		
Tiger musky				
0	1.6	0.5	10.7	10
I	1.4	1.2	16.5	9
II	4.6	9.6	22.9	28
Total	7.6	11.3		

* Natural reproduction.

Table 3.--Comparison between standing crop of esocids collected from Daggett Lake in the present study and in a previous study

Age	Fish per acre	
	Number	Pounds
Present study (northern pike, muskellunge, and tiger muskellunge)		
0	72.3	8.8
I	20.9	21.2
II	17.4	34.0
Total	....	64.0
Previous study (northern pike only)		
0	62.2	5.2
I	17.1	15.8
II	26.4	36.8
Total	....	57.8

Table 4.--Comparative vulnerability to angling of northern pike and tiger musky

	Northern pike	Tiger musky
Man hours fished	131.5	131.5
Total stocked fish in population	398	106
Total stocked fish caught	100	10
Fish caught per man hour	0.76	0.08
Percent of fish caught	25.1	9.4
Comparative vulnerability	2.6	1.0

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