1894

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George B. Beyerle

Fisheries Research Report No. 1894
April 30, 1981

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION

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# COMPARATIVE SURVIVAL AND GROWTH OF 8.9- AND 17.8-CM (3.5- AND 7.0-INCH) TIGER MUSKELLUNGE PLANTED IN A SMALL LAKE WITH FORAGE FISHES [1]

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## Abstract

For three consecutive years identical numbers of "early-plant" (about 8.9 cm total length) and "normal-plant" (about 17.8 cm total length) tiger muskellunge fingerlings were stocked in 6.1-ha Daggett Lake with bluegills and minnows as forage. Survival of all three early plants was considerably higher (mean 36.0%) than survival of normal plants (mean 15.1%), and was comparable with the survival of northern pike planted at 8.9 cm. There was no significant difference in the mean lengths of surviving early- and normal-plant tiger muskies at age I and II. In fish populations with low predator densities (less than 15 fish per hectare), it may be biologically and economically sound to stock tiger musky fingerlings at 8.9 cm rather than at a larger size.

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

## Introduction

Annually since 1966 the Michigan Department of Natural Resources has raised and planted increasing numbers of tiger muskellunge fingerlings (northern pike, Esox lucius × northern muskellunge, Esox masquinongy immaculatus) in designated waters. Prior to 1976, Michigan tiger muskellunge were raised in ponds on minnows and usually planted out between July 10 (at a mean length of 17 cm) and August 10 (mean length 24 cm). Survival from these plants frequently was high and many excellent fisheries developed. In 1975 a limited number of fingerlings were raised in hatchery troughs on formulated food. Intensive rearing techniques were improved and, beginning in 1976, all tiger musky fingerlings (over 100,000 annually) have been raised on formulated pellets at a cost considerably less than for minnow-raised fingerlings.

Examination of planting records revealed that pellet-raised tiger muskies usually were planted at a smaller size and a later date than minnow-raised fish. The size of the pellet-raised fish at planting varied from 13 to 19 cm, averaging 4 to 7 cm less than for minnow-raised fish on the same planting date. In addition, the mean planting date for pellet-raised fingerlings was 30 days later than for minnow-raised fingerlings. This size and time difference became important when data collected in 1977 and 1978 from several southern Michigan lakes revealed that pellet-raised tiger muskies planted after 1975 survived in significantly lower numbers than minnow-raised tiger muskies planted in 1973 through 1975 (Beyerle unpublished data).

When comparing the available growth data from the Wolf Lake Hatchery it was discovered that both minnow-raised and pellet-raised tiger musky fingerlings averaged 8.9 cm (3.5 inches) in early June. Thus the size difference at normal stocking time occurred after the fingerlings reached 8.9 cm. Northern pike planted as 8.9-cm fingerlings in early June have survived to the anglers' creel at rates varying from 15.8 to 36.3% (Beyerle 1980). It is assumed that high survival of these pike occurred principally because the fingerling pike were planted at a time

of year (June) when many small food fishes were available and water temperatures were favorable to intensive feeding and rapid growth. Fingerling tiger muskies planted in June probably would feed intensively and grow rapidly also. Thus, in waters where predation is not likely to be a serious problem, it may be more beneficial to plant pellet-raised tiger muskies in June at 8.9 cm than to plant them in August at 17.8 cm. It is estimated that the cost of raising 8.9-cm tiger muskies would be only half that of raising 17.8-cm tiger muskies.

In one test of this hypothesis equal numbers of "early-plant" (8.9-cm) and "normal-plant" (17.8-cm) tiger muskies were stocked for 2 consecutive years in three lakes where tiger muskies had been established. The largemouth bass (Micropterus salmoides) was the most important piscivorous fish in these lakes. Of the six early and six normal plants, only one of the normal plants resulted in relatively high survival. So few fish were recovered from the other plants (in autumn with electrofishing gear), that no significant difference in survival could be shown. It was concluded that early-plant tiger muskies did not survive at a higher rate than normal-plant fish (Beyerle unpublished data).

In the present test the objective was to compare the survival and growth of early-plant (about 8.9 cm total length) and normal-plant (about 17.8 cm total length) fingerling tiger muskellunge in a small lake with no other predatory fish species.

## Procedure

In April 1978 about 920 adult (9- to 18-cm) bluegills (Lepomis macrochirus), weighing 45 kg, were stocked in 6.1-ha Daggett Lake, Barry County. The young bluegills produced by this parent stock plus unexpected populations of fathead minnows (Pimephales promelas) and golden shiners (Notemigonus crysoleucas) supplied forage for the tiger muskellunge. The plan was to make "early plants" of tiger musky fingerlings in early June, and "normal plants" in July or August, in 1978 through 1980. However, in 1978, the early-plant tiger muskies (from the usual Michigan cross)

did not reach the desired size until July 14. In 1979, tiger musky eggs were obtained from Ohio and the early plant was made on May 30. In 1980, the early plant (Michigan cross) could not be made until June 30. The annual normal plants were made more or less on schedule in July or August, but mean lengths were 1.2 to 2.2 cm less than anticipated. Each plant was made at the rate of 12.3 fingerlings per hectare.

Survival and growth of the tiger muskies were determined when Daggett Lake was treated with rotenone on September 15, 1980. The lake was searched for dead fish for 8 days and it is believed that virtually all the tiger muskies present were collected.

An interesting sidelight to the experiment was the discovery of rotenone-resistant minnows. In July 1979, a large number of young and adult fathead minnows and a few adult golden shiners were observed in Daggett Lake. Apparently these minnows survived a rotenone treatment in September 1976. On September 15, 1980, the lake was treated with Nusyn-Noxfish (2.5% rotenone) at a calculated concentration of 1 ppm. It was noticed that a considerable number of adult golden shiners had not succumbed to the rotenone. A second application of Nusyn-Noxfish at 1.35 ppm on September 23 killed only a small percentage of the remaining shiners. No newly killed bluegills or tiger muskellunge were found after the second treatment. A sample of the Nusyn-Noxfish was tested against samples of Noxfish and Pro-Noxfish and found to be of normal toxicity to fathead minnows (Philip A. Gilderhus personal communication). Thus it appears likely that the minnows surviving in Daggett Lake have developed a resistance to poisoning by rotenone.

## Results and discussion

The survival and growth of early- and normal-plant tiger muskellunge are shown in Table 1. Survival of all three early plants was considerably higher (mean, 36.0%) than for normal plants (mean, 15.1%). Predictably, survival of each early and normal plant was inversely proportional to the standing crop of older tiger muskies. The 50.7% survival of the 1978 early plant was similar to survival

rates of 32-60% for first-year plants of 8.9-cm northern pike fingerlings stocked into populations of bluegills (Beyerle 1971) or minnows (Beyerle 1973). However, survival of the 1979 and 1980 early plants of tiger muskies (29.3% and 28.0%, respectively) was considerably higher than the average for second- and third-year plants of northern pike fingerlings in lakes with bluegills (mean 3.6%) or minnows (mean, 16.8%). In the tests involving northern pike, a larger population of predatory esocids (the annual plant was 111 fingerlings per hectare) may explain the lower survival of plants in the second and third years.

It is noteworthy that in this study the higher survival of the smaller early-plant fingerlings over the larger normal-plant fingerlings was maintained in 1979 and 1980 even in the face of an increasing population of older tiger muskies.

For the 1980 year class, the surviving early-plant tiger muskellunge were significantly larger than normal-plant survivors (Table 1). However, there was only an insignificant difference in the respective mean lengths of the surviving fish for the 1978 and 1979 year classes. Probably by fall of each year the survivors of that year's early plant had attained a greater mean length than the normal-plant survivors. In the succeeding year or years the difference in mean length could feasibly have been reduced by a combination of differential mortality (by cannibalism) of the smallest normal-plant fish plus growth compensation by the survivors.

This study provided evidence that, at least in fish populations with low predator densities (probably less than 15 fish per hectare), it may be biologically as well as economically beneficial to stock tiger musky fingerlings at 8.9 cm rather than at a larger size.

Table 1.--Survival and growth of early- and normal-plant tiger muskellunge in Daggett Lake as of September 1980, for plantings made in 1978-80.

| Year and plant | Planting date | Survival | | | Mean total length (cm) | |
|---|---|---|---|---|---|---|
| | | Percent | Per hectare | | | |
| | | | Number | kg | Planted | Recovered |
| 1978 | | | | | | |
| Early | July 14 | 50.7 | 6.2 | 7.5 | 8.7 | 57.8 |
| Normal | August 23 | 20.0 | 2.5 | 2.2 | 15.6 | 57.3 |
| Total | | 35.4 | 8.7 | 9.7 | 12.2 | 57.7 |
| 1979 | | | | | | |
| Early | May 30 | 29.3 | 3.6 | 1.8 | 8.9 | 45.2 |
| Normal | July 26 | 14.7 | 1.8 | 0.7 | 15.7 | 44.6 |
| Total | | 22.0 | 5.4 | 2.5 | 12.3 | 45.0 |
| 1980 | | | | | | |
| Early | June 30 | 28.0 | 3.4 | 0.4 | 8.8 | 28.6 |
| Normal | August 14 | 10.7 | 1.3 | 0.1 | 16.6 | 22.7 |
| Total | | 19.1 | 4.7 | 0.5 | 12.7 | 27.0 |
| Total population | | | 18.8 | 12.7 | | |

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Report approved by W. C. Latta

Typed by M. S. McClure