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CONTRIBUTION OF NORTHERN PIKE FINGERLINGS RAISED IN A MANAGED MARSH TO THE PIKE POPULATION OF AN ADJACENT LAKE[1]

By George B. Beyerle and John E. Williams

Abstract

A yearly average of 4,827 marked fingerling northern pike were stocked from a managed marsh into a 289-acre adjacent lake for 3 consecutive years. Estimated mean yearly survival of these pike through fall of the first year was 1,339 (28%). Estimated mean yearly survival of naturally produced pike was 821, making a total of 2,160 young-of-the-year pike surviving to fall of each year. Growth of both stocked and naturally raised pike was well above Michigan state average:--after 3 years of growth, stocked pike averaged 3.5 inches longer than state average, and naturally raised pike averaged 2.1 inches longer. This rapid growth would indicate that the stocking rate of pike could be increased substantially with significant benefit to the fishery.

We were unsuccessful in using Bergman-Jefferts magnetic tags to mark fingerling pike for long-term experiments. Although the tagging operation caused no obvious mortality, the inconsistency of response of supposedly tagged pike, when checked on the tag detector, was unexplained.

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Introduction

Natural fluctuations in abundance of northern pike (Esox lucius) have concerned fisheries investigators for many years (Carbine, 1942; Franklin and Smith, 1963). Within the past 20 years an accelerated decline in fisheries for northern pike has occurred in many midwestern states. This decline is attributed to two main causes: high fishing pressure and destruction of spawning areas for pike. Pike can normally be caught rather easily with modern sport fishing gear, and intensive fishing pressure can soon depress even large populations of pike. Accelerated development into home sites of marshy areas around or adjacent to lakes has greatly reduced potential pike spawning areas. To compensate for loss of natural pike spawning grounds, attempts have been made to raise pike to fingerling size in drainable hatchery ponds (Bryan, 1967; McCarraher, 1957). Although this method has been more or less successful, not nearly enough ponds are available to produce the quantity of pike necessary to maintain high populations in lakes throughout an entire state. A more feasible approach has been the development of artificial pike spawning and/or rearing areas by annual flooding of marshy land, adjacent to lakes (Williams, 1962; Williams and Jacob, 1971; Forney, 1968). As with natural marshes, there is great variability in success with managed marshes. Even the same marsh can vary considerably in productivity from year to year. Some important variables that influence productivity are number of spawning pike, water temperature, water level, food supply, and size of predator populations. However, fish

management techniques have been developed that can control to a large extent most of these variables in intensively managed marshes. The most significant recent development in Michigan is raising pike to swim-up fry stage in hatchery troughs, then stocking the fry in managed marshes to grow to fingerling size. With this method, equal numbers of hatched fry can be stocked in a marsh year after year, minimizing fluctuations in initial size of year classes.

Counts of the number of pike fingerlings obtained from managed marshes have often been made, but the eventual contribution of these fingerlings to the pike populations of lakes has not been estimated. What still needs to be determined is the contribution of a managed marsh, both empirically and in relation to what is produced by natural spawning areas. Thus, the objective of this study was to evaluate the relative contribution to the pike population of a lake, of northern pike fingerlings raised in a managed marsh. A secondary objective was to evaluate Bergman-Jefferts magnetic wire fish tags as identification devices for northern pike.

Methods

Long Lake is located in T 2 N, R 9 W, Secs. 15, 16, 20 and 21, Barry County; it has an area of 289 acres; and about 50% of the lake is less than 15 feet deep. Maximum depth is 48 feet. Methyl orange alkalinity averages about 150 ppm. Water is clear. Vegetation (mostly Chara, Potamogeton, Elodea, and water lilies--Nymphaeaceae) is moderately abundant in shoal areas. Long Lake has a reputation as a

moderately good fishing lake for largemouth bass, northern pike, bluegills and yellow perch. In 1967 and 1968, the 5-acre pike marsh at Long Lake produced an estimated 15,000 3- to 4-inch fingerlings each year. In early April of 1969, pike fry from Wolf Lake Hatchery were stocked in the marsh. In May of 1969, the marsh was pumped out and all pike fingerlings over 2.0 inches in length were collected. One method used to "mark" young pike for later identification was to "pull" a ventral or pelvic fin. This fin and the supporting pelvic bone can simply be pulled from the body wall of the fish, and the fin will not regenerate (Patrick and Haas, 1971; Churchill, 1963). The right ventral fin was pulled on half of the fingerlings, while with the remaining fingerlings the left ventral fin was pulled and a Bergman-Jefferts ferromagnetic wire tag was inserted into the rostrum between the eyes (Jefferts, Bergman, and Fiscus, 1963). Each tagged fingerling was then passed through a device which magnetized the tag. The tagged fish were checked with a magnetic detector for tag retention; and they were retagged if necessary. David R. Wolfert, Bureau of Commercial Fisheries, Sandusky, Ohio, provided the necessary hardware to tag the fingerling pike and to test fish for tag retention. He also designed several plastic head molds so the fingerling pike could be tagged. All marked fingerlings were distributed by spot planting around the shoreline of Long Lake. No other fingerlings that were raised in the marsh were allowed to enter the lake. This same general procedure was followed in 1970. By 1971 a decreasing ability to detect micro-wire tags in pike with pulled left ventral fins led to a decision to discontinue tagging

fingerling pike. Consequently all fingerlings collected from the marsh in 1971 were marked by the single method of pulling the right ventral fin.

From the fall of 1969 through the fall of 1971, electrofishing gear was used for 3-4 weeks in both spring and fall to collect as many northern pike as possible. All pike were anesthetized, measured, scale sampled if age was in doubt, and examined for missing ventral fins. From the fall of 1969 through the spring of 1971 all pike with a missing left ventral fin were passed through a magnetic tag detector to determine if the micro-wire tag had been retained. Combinations of the collected data were used to determine relative growth of marsh-raised pike and native pike, to estimate survival of marsh-raised pike, to estimate relative abundance of marsh-raised and native pike, to estimate potential angler harvest of pike, to determine if tagging pike with Bergman-Jefferts micro-wire tags caused significant mortality, and to determine if the tag was potentially useful for marking large numbers of pike for long-term studies.

Results

The number and mean length of pike fingerlings released from the managed marsh into Long Lake during the study is shown in Table 1. It was hoped that each year the marsh would produce 10,000 fingerlings with a mean length of about 3.5 inches. In 1969 not enough food was present in the marsh, and upon release, the 8,000 fingerlings averaged only 2.5 inches in length. In 1970 an unexplained high mortality of fry

shortly after stocking in the marsh resulted in a harvest of only 1,385 fingerlings, but they averaged 3.6 inches in length. In 1971 the 5,097 released fingerlings averaged 3.4 inches.

The number of tagged and untagged pike captured with electrofishing gear throughout the study is presented in Table 2. A total of 72 tagged and 76 untagged pike were collected, indicating that the tagging process had no effect on survival of stocked fingerlings. In a further test of tagging mortality and also of tag retention, 50 tagged and 50 untagged fingerling pike were stocked in a pond at the Hastings Fisheries Research Station in May 1970. The pond was drained in October of 1970, and 25 pike ranging in total length from 11.7 to 17.3 inches were recovered, of which 11 were tagged and 14 untagged, Six pike (55%) could not be identified as having retained their tag.

Two previous checks of tag retention were made at Hastings in 1969. A sample of 111 fingerlings collected from the Long Lake marsh in May of 1969, was kept in concrete tanks for 1 week and then examined for tag retention. During the week 19 pike were eaten by other pike and 12 pike were found dead in the tanks. Of the 92 fish examined only 4 (4.3%) had lost their tags. Based on previous experience, Mr. Wolfert had estimated that 8 to 10% of pike might lose tags and that most tag loss would be in the first 2 days following tagging. As an additional check on tag retention, 200 tagged fingerlings were placed in a pond at Hastings in May 1969. The pond was drained in November 1969, and 28 pike ranging in total length from 9.0 to 12.7 inches were collected.

Only two pike (7.1%) failed to give a positive response on the tag detector.

The process of tag identification consists of passing the rostrum of a tagged pike through the magnetic field of a tag detector. If the tag is still intact and is passed through the field in a certain way, an audible "beep" is produced by the detector. In 1969 and 1970 all tagged fingerling pike were checked to make sure they gave an audible reaction, before they were stocked in Long Lake. In the fall of 1969, 64% of recaptured tagged pike gave a positive reaction; in the fall of 1970, only 3% (one pike) "beeped," and in the spring of 1971, none of 13 tagged pike responded. Throughout the study the correct operation of the tag detector was checked repeatedly by passing the preserved head of a tagged fingerling pike through the magnetic field, and the preserved specimen always gave a positive reaction. Various manipulations of the heads of the recaptured pike were tried so the tagged area would move through the magnetic field at different angles and at different places in the field, but no increase in positive reactions could be obtained. Since 64% of young-of-the-year pike gave a positive reaction in 1969 and no noticeable difference in tagging operations occurred in the following year, there is no obvious answer to the discouraging results obtained with recaptured pike in 1970 and 1971. Perhaps a different configuration of the magnetic field of the tag detector is necessary for larger pike, although only 1 of 9 young-of-the-year pike gave a positive reaction in the fall of 1970. None of the tagged pike that failed to give a positive reaction were

dissected so it is not known if a tag was present in any of these fish. Perhaps the bony rostrum of pike is not as desirable a location for a small tag as is the more fleshy rostrum of young salmon or other similar fishes, upon which the tag was developed.

In summary, the trial of Bergman-Jefferts magnetic tags to mark pike for long-term experiments was not successful. Although the fish tagging operation caused no obvious mortality, the inconsistency of response of supposedly tagged pike when checked on the tag detector was unexplained and extremely discouraging.

A summary of the number and mean length of marked (marsh-raised) and unmarked (naturally produced) pike collected in Long Lake with electrofishing gear during the study is shown in Table 3. In the three fall collections, 95 (62%) of 154 young-of-the-year pike were marked, while 59 (38%) were unmarked. The percentage of marked pike varied from 50% in 1969 to 77% in 1971. Despite the fact that only 1,385 marked fingerlings were stocked in 1970, 54% of young-of-the-year pike collected in fall of 1970 were marked fish. In two fall collections (1970 and 1971), 53 (56%) of 94 yearling pike were marked, and 41 (44%) were unmarked. In the 1971 collection only 6 (30%) of 20 2-year-old pike were marked, and 14 (70%) were unmarked. This gradual reduction in percentage of marked pike could logically have been the result of differential angling harvest, since in all three age groups marked pike averaged larger than unmarked pike (Table 4).

During the study a total of 204 pike of the 1969 year class were collected, of which 104 (51%) were marked. The total of 76 pike of the 1970 year class included 44 (58%) marked fish, while 61 pike of the 1971 year class included 47 (77%) marked fish. Of the total of 341 pike collected throughout the study from the 1969 through 1971 year classes, 195 (57%) were marked.

Marked young-of-the-year pike in fall averaged 3.2 inches longer than unmarked pike (Table 4). Similarly, marked yearling pike averaged 1.9 inches longer than unmarked yearlings, and marked 2-year-old pike averaged 1.4 inches longer than unmarked pike. Unmarked 2-year-old pike averaged 2.1 inches longer than Michigan state average (Laarman, 1963), while marked 2-year-old pike were 3.5 inches longer.

So few marked pike older than young-of-the-year were recaptured that no population estimates of these fish could be made. However, Petersen population estimates (Ricker, 1958) were made of marked young-of-the-year pike each fall during the study. The same territory in Long Lake, as close to shore as reasonably possible, was covered night after night with the electrofishing gear. It was calculated that one complete trip around the lake would cover 9.6 acres. In addition, it was assumed that pike were more or less territorial and that all young-of-the-year pike would be in water less than 15 feet deep (over 145 acres of Long Lake the water is less than 15 feet deep). The population estimates shown in Table 5 are based on these calculations and assumptions. Estimated survival to fall of marked young-of-the-year pike varied widely from 6% in 1969 to 63% in 1971 (Table 5). Beyerle

(1971) also found wide variation in survival of 3.5-inch fingerling pike stocked in two small lakes with bluegills as the only other fish species present. After 3 years, survival of the oldest pike (age group II) ranged from 44 to 60%, while survival of younger pike (0 and I) was only 0.8 to 9.2% respectively. In Long Lake, as would be expected, survival of pike that averaged 3.5 inches when stocked in 1970 and 1971, was much higher than survival of the 2.5-inch pike stocked in 1969. However, there was no correlation between number of pike fingerlings stocked and estimated survival. The percentage of marked pike recaptured in the fall varied from 0.4% in 1969 to 1.4% in 1970. Although the lowest recapture rate (1969) coincided with the lowest estimated percentage survival, there was no positive correlation between recapture rate and estimated survival in 1970 or 1971.

Over the 3-year study period, an average of 4,827 fingerling pike per year (17 per acre) with a mean length of 2.9 inches, were raised in the managed marsh and stocked in Long Lake (Table 5). Based on the population estimates, an average of 1,339 of these pike per year (4.6 per acre) survived to fall of their first year. The mean survival rate was 28% per year. Since young-of-the-year pike raised in the marsh made up 62% of the total catch of young pike, it can be assumed that an average of 821 other young pike per year (38%) also survived, making a total average yearly recruitment of 2,160 young-of-the-year pike (7.4 per acre) each fall. Reported yearly natural mortality of pike has ranged from 26 to 56%, and fishing mortality has varied from 12 to 50% (Latta, 1971). If it is assumed that natural mortality of pike

beyond the first year is 50% per year and that angler harvest is 25% per year additional mortality, beginning with 508 mm (20 inches) pike, then the projected year-to-year survival of a typical year class of marked and unmarked pike in Long Lake is approximately as shown in Table 6 (with adjustments made for differential entry of marked and unmarked pike into the fishery). Total angler harvest of a typical year class of marked and unmarked pike throughout its existence is also shown in Table 6. A total of 250 pike would be harvested, of which 166 would be marked and 84 unmarked. The 166 marked pike represent 3.4% return to the angler from the average number of fingerlings stocked. Groebner (1964) reports a return to the angler of 3.2 to 5.4% for two year classes of pike stocked as fingerlings in a Minnesota lake.

In summary, an average of 4, 827 fingerling pike per year were marked and stocked in Long Lake for 3 consecutive years. An estimated average of 1, 339 of these pike per year survived to fall of their first year. Together with an estimated yearly recruitment of 821 young-of-the-year pike from natural reproduction, an average of 2, 160 young-of-the-year pike existed in Long Lake each fall. Assuming an annual 50% natural mortality beyond the first year and a 25% angling harvest of pike 508 mm (20 inches) and over in length, it can be calculated that during the life span of one year class of marked pike, 166 fish (3.4% of the fingerlings stocked) will be harvested by anglers. During the same period 84 of the unmarked pike will be harvested, making a total contribution to the fishery of 250 pike of each year class, and a total yearly harvest of 250 pike. After 3 years of growth, marked pike in Long Lake averaged 3.5 inches longer than the

State average, and unmarked pike were 2.1 inches longer. This rapid growth plus the calculated yearly harvest of less than one pike per acre would seem to indicate that the stocking rate of fingerling pike in Long Lake could be increased substantially with great benefit to the fishery.

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Table 1.--Pike fingerlings from a managed marsh, marked and released into Long Lake, each spring of 1969 through 1971

	1969	1970	1971
Tagged, and left ventral fin pulled	4,000	686	-
Untagged, right ventral fin pulled	4,000	699	5,097
Total released	8,000	1,385	5,097
Mean length in inches	2.5	3.6	3.4

Table 2.--Marsh-raised pike collected with electrofishing gear from Long Lake. Fish had been marked by "pulling" left ventral fin (LV) or right ventral fin (RV); LV fish also had received a snout tag.

Age group, fin pulled		Fall 1969	Spring 1970	Fall 1970	Spring 1971	Fall 1971	Total
0	LV	11	-	9	-	-	20
	RV	18	-	10	-	-	28
I	LV	-	6	21	4	7	38
	RV	-	7	15	4	10	36
II	LV	-	-	-	9	5	14
	RV	-	-	-	11	1	12
Per cent retaining snout tag		64	50	3	0	-	-

Table 3.--Length in inches, and number in sample, of marsh-reared pike and other pike from Long Lake

Age group	Origin	Fall 1969	Spring 1970	Fall 1970	Spring 1971	Fall 1971
Length in inches:						
0	Marsh-reared	12.9	-	13.8	-	12.6
	Other	10.4	-	9.9	-	9.4
I	Marsh-reared	-	15.0	19.9	15.0	20.8
	Other	20.2	13.4	18.5	11.6	18.5
II	Marsh-reared	-	-	-	20.9	24.2
	Other	21.0	20.3	24.1	19.4	22.8
III	Marsh-reared	-	-	-	-	-
	Other	25.4	23.5	26.7	23.1	28.6
IV-VI	Marsh-reared	-	-	-	-	-
	Other	33.6	27.7	27.8	26.9	-
Number in sample:						
0	Marsh-reared	29	-	19	-	47
	Other	29	-	16	-	14
I	Marsh-reared	-	13	36	8	17
	Other	27	11	27	2	14
II	Marsh-reared	-	-	-	20	6
	Other	5	33	14	19	14
III	Marsh-reared	-	-	-	-	-
	Other	2	11	2	4	1
IV-VI	Marsh-reared	-	-	-	-	-
	Other	1	1	2	1	0
Total	Marsh-reared	29	13	55	28	70
	Other	64	56	61	26	43

Table 4.--Mean length in inches of marked and unmarked pike of age-groups 0 through II taken in three fall collections, compared with average lengths for pike in Michigan

Age group	Marked	Unmarked	Michigan average
0	13.1	9.9	11.7
I	20.4	18.5	17.7
II	24.2	22.8	20.7
Growth index* for age-group II	+3.5	+2.1	-

* Growth index is deviation from State average.

Table 5.--Young pike marked and stocked in spring, young recaptured in the fall, and estimated fall population--of pike in Long Lake

Population parameters	Year 1969	1970	1971	Mean
Pike fingerlings stocked in spring				
Total	8,000	1,385	5,097	4,827
Per acre	27.7	4.8	17.6	16.7
Mean length, inches	2.5	3.6	3.4	2.9
Stocked pike recaptured in fall				
Number	29	19	47	-
Per cent of those stocked	0.4	1.4	0.9	-
Fall population estimate* of survivors from spring stocking				
Number	483	302	3,231	1,339
Confidence limits (-)	257	211	2,023	-
(+)	1,525	755	6,568	-
Pike per acre	1.7	1.0	11.2	4.6
Per cent survival	6	22	63	28

* Bailey modification of Petersen formula used to estimate population size.

Table 6.--Calculated mean survival of young marsh-reared pike and other pike. Figures are estimated populations (Pop.) and estimated angler catches (Catch), assuming 50% natural mortality plus 25% angling mortality per year.

Age group, season		Marsh-reared		Other		Total	
		Pop.	Catch	Pop.	Catch	Pop.	Catch
0	Spring	4,827	-	-	-	-	-
	Fall	1,339	-	821	-	2,160	-
I	Fall	654	16	406	4	1,060	20
II	Fall	198	129	139	64	337	193
III	Fall	50	16	35	12	85	28
IV	Fall	12	4	9	3	21	7
V	Fall	3	1	2	1	5	2
VI	Fall	1	0	0	0	1	0
Total		-	166	-	84	-	250

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George B. Beyerle and John E. Williams

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