

**Contribution to the Anglers' Creel  
of Marsh-Reared Northern Pike  
Stocked as Fingerlings in Long Lake,  
Barry County, Michigan**

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MICHIGAN DEPARTMENT OF NATURAL RESOURCES  
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CONTRIBUTION TO THE ANGLERS' CREEL OF MARSH-  
REARED NORTHERN PIKE STOCKED AS FINGERLINGS  
IN LONG LAKE, BARRY COUNTY, MICHIGAN<sup>1</sup>✓

By George B. Beyerle

Abstract

From 1973 to 1975 marsh-reared northern pike were stocked into Long Lake, Barry County, at the average rate of 40 fingerlings per hectare, per year, at a cost of \$0.20 each. Survival of these fish to the anglers' creel varied from 15.8 to 36.3% (mean, 23.7%). The harvest of each year class was essentially complete 4 years after stocking. Marsh-reared fish provided 65.1% of the total harvest from the 1973-75 year classes of northern pike. The cost to produce the harvested marsh-reared northern pike was \$0.87 per fish, or \$0.70 per kilogram.

During the study the growth of panfish remained within the anticipated range for southern Michigan lakes. There was no fluctuation in harvest of panfish or largemouth bass that could be related to abundance of northern pike. It was suggested that the stocking rate of northern pike could be increased to 8,000 fingerlings (68.4 per hectare) with no detrimental effect on other fish species in Long Lake.

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<sup>1</sup>✓ Contribution from Dingell-Johnson Project F-35-R, Michigan

## Introduction

Well managed spawning or rearing marshes are a successful and reasonably efficient means of significantly increasing the yearly recruitment of northern pike (Esox lucius) in lakes with relatively little natural reproduction (Forney 1968; Williams and Jacob 1971; Fago 1977).

Factors which are crucial to the success of a northern pike marsh are: maintenance of a constant (usually maximum) water level, elimination of predators, control of stocking rate, stimulation of food production to optimize fingerling survival and growth, and removal and stocking of fingerling northern pike before excessive cannibalism occurs. Because food items are concentrated, fingerling northern pike in a managed marsh normally grow rapidly and, when stocked, are significantly larger than fingerlings produced naturally in the adjacent lake. Thus relatively high survival of marsh-reared fingerlings can be anticipated after stocking in the lake.

Typically, northern pike rearing marshes are evaluated by comparing the production cost with the number of fingerlings produced. More accurate evaluations could be made from data on the contribution of marsh-reared fish to the total northern pike population of a lake, or to the anglers' creel. Groebner (1964) estimated that anglers ultimately harvested only 3.2 to 5.4% of the northern pike stocked from a managed spawning marsh in Minnesota. However, in that case young pike as small as 2.0 cm were allowed to leave the marsh, and it was discovered that bluegills (Lepomis macrochirus) in the outlet channel contained as many as 17 young northern pike per stomach (Franklin and Smith 1963).

Long Lake is a 117-ha lake located in T. 2 N., R. 9 W., sections 15, 16, 20, and 21, Barry County, Michigan. It contains northern pike, largemouth bass (Micropterus salmoides), bluegills, and other panfish. The water is clear and its methyl orange alkalinity averages 150 ppm. Maximum depth is 14.6 m, but 50% of the bottom depth is less than 4.5 m deep. Chara, Potamogeton, Elodea, Nuphar, and Nymphaea are moderately abundant in most shoal areas.

In 1966, a marshy area adjacent to Long Lake was dammed to create a 2.8-ha northern pike rearing marsh. The marsh has been utilized each year since 1967 to supplement the natural production of northern pike in Long Lake. In a previous study, Beyerle and Williams (1973) estimated that survival to the first fall was 28% for marsh-reared fingerlings that had been spot planted around the shore of Long Lake at a mean length of 7.4 cm. The marsh-reared fish constituted an average of 62% of the fall Age-0 northern pike population.

In the present study, the objectives were to estimate the contribution to the anglers' creel of three consecutive annual plantings of marsh-reared northern pike and to measure the effect of the stocked pike on the harvest and growth of the other fishes in Long Lake.

### Procedure

In 1973 and 1974, the Long Lake rearing marsh was stocked with its normal yearly complement of 50,000 northern pike fry. In 1975, 41,785 fry were stocked. Each May or June, when the fry had grown to fingerling size and exhausted the available food, water was pumped from the marsh and the surviving fingerlings were collected with a seine, marked by pulling a ventral fin, and spot planted around the shore of Long Lake.

In the fall of each year, northern pike were captured over a period of approximately 2 weeks with an AC boom shocker to determine the relative growth and abundance of marsh-reared and indigenous fish. In 1973 and 1975, survival of marsh-reared Age-0 fish was determined from Schumacher-Eschmeyer multiple census population estimates (Ricker 1958).

Marsh-reared fingerlings stocked in 1973 began reaching harvestable size (50.8 cm, or 20 inches) in the summer of 1974. A stratified random creel census for all species of fish was begun on July 1, 1974, and was continued intermittently through August 1978. The census periods were July 1-October 2, 1974; May 15-Labor Day, 1975 and 1976; May 15-last week in August, 1977 and 1978; and

December 1-March 31 (as safe ice conditions permitted), 1974-78. These periods covered nearly all of the pike and bass fishing, and only a few of the pike stocked in 1973-75 might have been caught after the census ended. Relatively little fishing occurred in other periods, but rough estimates were made for those periods to give a complete picture of annual pressure and catch at Long Lake. As used in this report, "summer" creel census refers to April 1-November 30 (except for 1974, in which it refers to July 1-November 30), and "winter" creel census refers to December 1-March 31.

Length and scale samples were obtained from all northern pike seen in the census. In addition, several fishermen volunteered to measure and scale sample all northern pike that they harvested. Data from both sources were used to monitor the age composition of the catch and ultimately, the total catch for each year class. A length-weight table (Beckman 1946) was used to estimate the yield in weight for each year class. Lengths and scale samples were taken during the winter censuses from bluegills, black crappies (Pomoxis nigromaculatus) and yellow perch (Perca flavescens) to monitor possible changes in growth.

## Results and discussion

### Pike marsh operation

The number of marsh-reared northern pike fingerlings stocked into Long Lake varied from 8,406 in 1973 to 2,502 in 1975 (Table 1). On the average, 4,678 (40.0 per hectare) were stocked annually, representing a survival of 9.7% from the fry plants. The fingerlings averaged 9.2 cm long. During a previous 3-year study (Beyerle and Williams 1973), production of fingerlings from the Long Lake marsh also was extremely variable but the average yearly stocking rate was 41.3 fish per hectare--almost identical with the present study.

The average annual cost to collect, fertilize, and hatch enough northern pike eggs to deliver 50,000 fry to the Long Lake marsh was estimated to be \$80 (J. C. Copeland personal communication). The cost

to operate the marsh was estimated to be \$1,424 in 1973, \$436 in 1974, and \$512 in 1975 (K. E. Dodge personal communication). Thus the yearly cost per stocked fingerling varied from \$0.17 in 1974 to \$0.24 in 1975 (mean, \$0.20).

### Electrofishing

In the fall of 1973, the electrofishing survey for Age-0 northern pike, captured 157 marsh-reared and 13 indigenous pike in the equivalent of six complete trips around the shore of Long Lake (Table 2). Thus it was estimated that 92.4% of the 1973 year class was produced in the rearing marsh. The number of marsh-reared northern pike was estimated at 840 (95% confidence limits, 571-1,590). However, this estimate was lower than the estimated number of these fish caught by anglers in later years. Evidently, the electrofishing survey did not adequately sample a portion of the population or harvest was overestimated.

In the fall 1974 survey of Age-0 northern pike, only 28 marsh-reared and 15 indigenous pike were captured in nine complete trips around Long Lake. Thus it was estimated that 65.1% of the 1974 year class was produced in the rearing marsh. A population estimate could not be made because none of these fish were recaptured.

In fall 1975, a total of 71 Age-0 northern pike were taken, 81.7% of which were marsh reared. The population of marsh-reared northern pike was estimated at 500 (215-∞). As in 1973, this estimate was considerably lower than the subsequent estimated angler harvest of adults.

The relatively large 1973 year class predominated in the electrofishing catch all three years, despite the fact that many of these fish were susceptible to angling harvest in late 1974 and in all of 1975. The relative abundance of marsh-reared northern pike in the 1973 year class declined from 92.4% in fall 1973 to 80.0% in fall 1975, probably due to angler harvest of the larger fish.

For Age-0 northern pike, each fall the mean length of marsh-reared fish was greater than indigenous fish. However, in fall 1973, some marsh-reared fish were smaller than the smallest lake-reared fish, a size

relationship that continued to exist within the 1973 year class through 1975 (Table 2). This fact, along with selective cropping of the larger fish by anglers, may explain why by 1975, the mean length of indigenous fish of the 1973 year class exceeded that of marsh-reared fish.

### Creel census

The estimates of fishing pressure and angler harvest of all fishes at Long Lake from July 1974 through November 1978 are shown in Table 3. Considerable annual variation occurred in summer angler trips (34.6 to 107.5 trips per hectare), fishing pressure (95.5 to 263.3 hours per hectare), and catch rate (0.60 to 1.61 fish per hour). Fishing pressure in summer tended to be directly proportional to catch per hour. Annual variations of similar proportions occurred in winter angler trips (9.3 to 27.0 per hectare), fishing pressure (21.5 to 80.2 hours per hectare), and catch rates (0.69 to 1.35 fish per hour). However, fishing pressure in winter tended to be inversely proportional to catch per hour. This phenomenon could occur if ice fishing success was best during mild winters with relatively little ice fishing opportunity; however, there was no correlation between length of the ice fishing season (in days) and catch per hour.

Estimated angler harvest, by species, during summer and winter is presented in Tables 4 and 5, respectively. Panfish made up 90.3% of the summer harvest and 96.9% of the winter harvest. Most of the difference can be attributed to the summer harvest of largemouth bass. Bluegills comprised 61.9% of the total catch in summer but only 46.4% in winter. Conversely, the harvest of black crappies averaged 6.5% in summer and 27.4% in winter. The only other important panfish, yellow perch, provided 13.5% of the summer catch and 20.4% of the winter catch.

Samples from angler-caught panfish in the winters of 1974-75 through 1977-78, and the summer of 1960 reveal panfish growth was at or below the state of Michigan average (modified from Laarman 1963) with no meaningful trends (Table 6). During the study the mean growth index (i.e., the deviation of observed length from the state average) for bluegills

decreased from 1.3 cm below average to 3.2 cm below average. In contrast, the growth index of black crappies remained relatively constant. The growth index of yellow perch declined from +1.3 cm to -1.0 cm.

The harvest of game fish in summer (Table 4) was about equally divided between largemouth bass (4.7%) and northern pike (4.9%). The estimated summer harvest of northern pike (Table 7) varied from 4.94 kg (4.2 fish) per hectare in 1977 to 26.65 kg (20.2 fish) per hectare in 1975 (not including the July-November 1974 data). The catch rate (based on total angler hours) was relatively uniform at 0.035 to 0.055 northern pike per hour in all years except 1975, when it increased to 0.077 fish per hour (Table 3). The high harvest and catch rate of northern pike in 1975 was due to the relatively abundant 1973 year class.

No largemouth bass were reported caught by winter anglers, but northern pike provided 3.1% of the total winter harvest (Table 5). Winter harvest of northern pike varied only slightly, from 1.39 kg (1.1 fish) per hectare in 1976-77 to 2.21 kg (1.8 fish) per hectare in 1977-78 (Table 8). The winter catch rate was relatively low (0.016 pike per hour) in 1974-75, but was similar to the summer catch rate in all other years (Table 3).

Marsh-reared northern pike stocked in 1973 were harvested from July 1974 through November 1977 (Tables 7 and 8). About 1,588 were harvested, or 18.9% of the number of fingerlings stocked (Table 9). Summer anglers accounted for 93.6% of the total harvest. The highest annual harvest (79.8% of the total harvest) occurred in 1975, when the fish were Age II (Table 10).

The marsh-reared northern pike of the 1974 year class did not enter the fishery until the 1976 summer season (Table 7). By November 1978, 493 (15.8%) of these fish had been harvested (Table 9) and it was projected (Table 10) that this was essentially the total harvest for this group. Summer anglers caught 90.7% of the total harvest, and 53.1% of the total catch was taken in 1976, during Age II.

The marsh-reared northern pike stocked in 1975 entered the fishery in summer 1976. By the end of the census, 783 had been harvested--83.4% of them during the summer seasons. It was projected



(Tables 9 and 10) that another 126 would be caught before the harvest was completed in November 1979. Thus, the projected total harvest was 909, or 36.3% of the fingerlings stocked. The greatest catch did not occur in 1977, as anticipated, but in 1978, when 59.0% of the fish were taken at Age III.

The ratio between estimated weight of marsh-reared northern pike eventually harvested by anglers and weight of fingerlings stocked was about 43:1 for the 1973 year class, 72:1 for the 1974 year class, and 126:1 for the 1975 year class (Table 11). Based on the previously itemized expenses, the cost to produce the angler-harvested northern pike averaged \$0.87 per fish, or \$0.70 per kilogram.

The mean growth indices of northern pike caught by anglers were 5.0 cm or more above the Michigan state average (Table 12), suggesting that the lake could support more northern pike. There was relatively little difference in growth between marsh-reared and indigenous northern pike, or among the 1973-75 year classes. Limited data on largemouth bass (not shown) indicated that from 1974 to 1976 mean lengths increased from 1 cm below, to 2 cm above state average. As noted earlier, growth of panfish remained within the anticipated range for southern Michigan lakes. The fluctuations in the harvest of panfish and largemouth bass did not seem to be related to the abundance of northern pike (Tables 4 and 5). Based on the number of fingerling pike stocked each year in Long Lake in the past (this study, and Beyerle and Williams 1973) and the growth of the fishes involved, it is concluded that an annual stocking rate as high as 8,000 fingerlings (68.4 per hectare) would have no important effect on other fish species in Long Lake.

### Summary

During 1975-78, northern pike provided 3.1% of the winter harvest and 4.9% of the summer harvest in Long Lake. Summer anglers caught 88.8% of the yearly harvest of northern pike. Seasonal harvest of northern pike varied from 1.1 to 1.8 fish per hectare in winter to 4.2 to 20.2 fish

per hectare in summer. For the most part, the catch rate remained relatively uniform (0.035 to 0.055 fish per angler hour) in both summer and winter.

In 1973-75, northern pike were stocked into Long Lake at an average rate of 40.0 fingerlings per hectare per year, at a cost of \$0.20 per fingerling. Survival of these fish to the anglers' creel varied from 15.8 to 36.3% (mean, 23.7%) and the harvest of each year class was essentially complete 4 years after stocking. Stocked fish comprised 65.1% of the northern pike harvested from the 1973-75 year classes. The cost to produce the harvested marsh-reared northern pike was \$0.87 per fish, or \$0.70 per kilogram.

During the study the growth of bluegills and yellow perch slowed moderately while growth of black crappies remained essentially unchanged. As of 1978 the three species of panfish averaged 3.2, 1.0, and 1.3 cm, respectively, less than state average length for Michigan. Northern pike averaged 5.0 cm or more above state average length. It is suggested that stocking 8,000 northern pike fingerlings (68.4 per hectare) annually would not seriously affect other fish species in Long Lake.

Table 1. --Summary of marsh-reared northern pike fingerlings stocked into Long Lake, 1973-75.

Date	Number stocked		Survival from fry plant (%)	Total length		Cost per fingerling (dollars)
	Total	Per hectare		Mean (cm)	Range (cm)	
<u>1973</u>						
May 29-June 5	8,406	71.8	16.8	10.0	6.1-11.9	0.18
<u>1974</u>						
May 31-June 1	3,125	26.7	6.2	8.4	4.3-14.0	0.17
<u>1975</u>						
June 11, 12	2,502	21.4	6.0	9.3	6.9-17.8	0.24
Mean	4,678	40.0	9.7	9.2	-	0.20

Table 2. --Summary of marsh-reared (M) and indigenous (I) northern pike captured with an AC boom shocker in fall 1973-75. Recaptured fish are not included in totals. One unit of effort equals one complete trip around Long Lake.<sup>a</sup>

Sample year, year class, and source	Total length (cm)		Number captured		Relative abundance (percent)	
	Mean	Range	Total	Per unit effort	Within year classes	Among year classes
<b>1973</b>						
1973 (M)	31.0	18.5-37.8	157	26.2	92.4	
1973 (I)	26.3	20.1-30.5	13	2.2	7.6	66.9
All others			84	14.0		33.1
Total			254	42.3		100.0
<b>1974</b>						
1974 (M)	30.8	25.1-36.6	28	3.1	65.1	
1974 (I)	22.8	16.3-27.9	15	1.7	34.9	32.1
1973 (M)	46.7	35.8-55.9	59	6.6	90.8	
1973 (I)	46.4	40.6-53.3	6	0.7	9.2	48.5
All others			26	2.9		19.4
Total			134	14.9		100.0
<b>1975</b>						
1975 (M)	32.5	23.6-40.4	58	9.7	81.7	
1975 (I)	27.8	19.3-37.6	13	2.2	18.3	39.9
1974 (M)	50.1	42.9-58.7	14	2.3	66.7	
1974 (I)	43.6	36.1-51.3	7	1.2	33.3	11.8
1973 (M)	53.1	40.1-64.0	64	10.7	80.0	
1973 (I)	55.4	48.5-62.5	16	2.7	20.0	44.9
All others			6	1.0		3.4
Total			178	29.7		100.0

<sup>a</sup> Because of rounding off, some totals may not add up exactly.

Table 3.--Estimated fishing pressure and angler harvest at Long Lake, 1974-78. Per-hectare data are in parentheses.

Year, and season	Length of season (days)	Angler trips	Angler hours	Total catch	Catch per hour	
					All fish	Northern pike
1974 Summer <sup>a</sup>	153	2,893 (24.7)	13,066 (111.7)	9,817 (83.9)	0.75	0.037
1974-75 Winter	58	3,157 (27.0)	9,385 (80.2)	6,454 (55.2)	0.69	0.016
1975 Summer	244	12,575 (107.5)	30,806 (263.3)	49,657 (424.4)	1.61	0.077
1975-76 Winter	38	1,086 (9.3)	2,512 (21.5)	3,048 (26.1)	1.21	0.043
1976 Summer	244	5,261 (45.0)	18,385 (157.1)	18,325 (156.6)	1.00	0.035
1976-77 Winter	56	1,085 (9.3)	2,913 (24.9)	3,934 (33.6)	1.35	0.045
1977 Summer	244	4,043 (34.6)	11,172 (95.5)	6,660 (56.9)	0.60	0.044
1977-78 Winter	71	1,739 (14.9)	5,145 (44.0)	5,715 (48.8)	1.11	0.041
1978 Summer	244	8,659 (74.0)	22,397 (191.4)	21,088 (180.2)	0.94	0.055

<sup>a</sup> July-November only.

Table 4. --Estimated angler harvest, by species, from Long Lake during summer, 1974-78. Fish per hectare are in parentheses.

Species	Summer of year					Mean per year <sup>b</sup>	
	1974 <sup>a</sup>	1975	1976	1977	1978	Number	Per- cent
Bluegill	5,590 (47.8)	30,500 (260.7)	12,942 (110.6)	4,346 (37.1)	11,419 (97.6)	14,802 (126.5)	61.9
Sunfish <sup>c</sup>	319 (2.7)	3,500 (29.9)	1,018 (8.7)	321 (2.7)	1,250 (10.7)	1,522 (13.0)	6.4
Rock bass	98 (0.8)	195 (1.7)	223 (1.9)	41 (0.4)	1,422 (12.2)	470 (4.0)	2.0
Black crappie	806 (6.9)	3,421 (29.2)	937 (8.0)	169 (1.4)	1,676 (14.3)	1,551 (13.3)	6.5
Yellow perch	1,625 (13.9)	7,079 (60.5)	1,970 (16.8)	518 (4.4)	3,313 (28.3)	3,220 (27.5)	13.5
Bullhead	99 (0.8)	95 (0.8)	105 (0.9)	9 (0.1)	0	52 (0.4)	0.2
<b>Total, panfish<sup>d</sup></b>	<b>8,537 (73.0)</b>	<b>44,790 (382.8)</b>	<b>17,195 (147.0)</b>	<b>5,404 (46.2)</b>	<b>19,080 (163.1)</b>	<b>21,617 (184.8)</b>	<b>90.3</b>
Largemouth bass	798 (6.8)	2,500 (21.4)	494 (4.2)	764 (6.5)	769 (6.6)	1,132 (9.7)	4.7
Northern pike	482 (4.1)	2,367 (20.2)	636 (5.4)	492 (4.2)	1,239 (10.6)	1,184 (10.1)	4.9
<b>Total, game fish</b>	<b>1,280 (10.9)</b>	<b>4,867 (41.6)</b>	<b>1,130 (9.7)</b>	<b>1,256 (10.7)</b>	<b>2,008 (17.2)</b>	<b>2,315 (19.8)</b>	<b>9.7</b>
<b>Total, all species</b>	<b>9,817 (83.9)</b>	<b>49,657 (424.4)</b>	<b>18,325 (156.6)</b>	<b>6,660 (56.9)</b>	<b>21,088 (180.2)</b>	<b>23,932 (204.5)</b>	<b>100.0</b>

<sup>a</sup> July - November only.

<sup>b</sup> Does not include 1974 data

<sup>c</sup> Includes pumpkinseed (Lepomis gibbosus) and bluegill-pumpkinseed hybrids.

<sup>d</sup> Because of rounding off, some totals may not add up exactly.

Table 5. --Estimated angler harvest, by species, from Long Lake during winter, 1974-75 through 1977-78. Fish per hectare are in parentheses.

Species	Winter of year				Mean per year	
	1974-75	1975-76	1976-77	1977-78	Num- ber	Per- cent
Bluegill	2,561 (21.9)	2,022 (17.3)	2,140 (18.3)	2,158 (18.4)	2,220 (19.0)	46.4
Sunfish <sup>a</sup>	166 (1.4)	161 (1.4)	45 (0.4)	144 (1.2)	129 (1.1)	2.7
Rock bass	0	0	5 ( $<0.1$ )	0	1 ( $<0.1$ )	$<0.1$
Black crappie	1,906 (16.3)	471 (4.0)	502 (4.3)	2,363 (20.2)	1,310 (11.2)	27.4
Yellow perch	1,675 (14.3)	286 (2.4)	1,111 (9.5)	839 (7.2)	978 (8.4)	20.4
Total, panfish <sup>b</sup>	6,308 (53.9)	2,940 (25.1)	3,803 (32.5)	5,504 (47.0)	4,639 (39.6)	96.9
Northern pike	146 (1.2)	108 (0.9)	131 (1.1)	211 (1.8)	149 (1.3)	3.1
Total, all species	6,454 (55.2)	3,048 (26.1)	3,934 (33.6)	5,715 (48.8)	4,788 (40.9)	100.0

<sup>a</sup> July - November only.

<sup>b</sup> Because of rounding off, some totals may not add up exactly.

Table 6.--Mean length (centimeters) of panfish harvested by anglers from Long Lake in winter, 1974-75 through 1977-78, and taken by seining in summer 1960 (unpublished data). Number of fish measured is in parentheses.

Species and age <sup>a</sup>	Summer 1960	Winter of year			
		1974-75	1975-76	1976-77	1977-78
<u>Bluegill</u>					
II	10.2(14)	---	---	---	---
III	13.0(38)	---	11.8(2)	---	12.0(8)
IV	15.2(17)	15.3(9)	15.0(27)	15.3(8)	13.8(54)
V	16.8(9)	16.9(28)	16.9(43)	16.6(32)	15.4(12)
VI	18.3(1)	18.0(6)	18.6(6)	17.5(21)	16.1(4)
VII	---	20.8(1)	17.4(2)	---	---
Mean growth index <sup>b</sup>	-1.4	-1.3	-2.3	-2.0	-3.2
<u>Black crappie</u>					
I	12.7(2)	---	---	---	---
II	16.8(16)	---	18.5(7)	---	19.8(1)
III	21.8(2)	20.5(6)	21.2(11)	21.8(2)	20.8(6)
IV	---	22.8(6)	23.0(15)	22.9(2)	23.0(16)
V	---	23.6(2)	25.7(5)	25.1(4)	24.6(18)
VI	---	---	25.4(1)	24.8(2)	25.2(18)
VII	---	---	---	---	26.2(1)
Mean growth index	-0.8	-1.6	-0.9	-1.2	-1.3
<u>Yellow perch</u>					
I	---	---	---	15.0(15)	12.7(1)
II	16.3(5)	---	---	15.7(9)	15.3(8)
III	19.8(10)	18.5(3)	18.5(1)	18.1(8)	18.3(2)
IV	23.9(7)	21.5(3)	20.6(2)	18.8(6)	20.3(1)
V	---	---	21.3(3)	23.4(4)	23.1(1)
VI	---	33.3(1)	28.4(1)	24.9(1)	---
IX	30.7(1)	29.5(1)	---	---	---
Mean growth index	+1.4	+1.3	-0.5	-0.8	-1.0

<sup>a</sup> Age on December 31 for angler-harvested panfish

<sup>b</sup> The growth index for each age group is the difference between the observed mean length and Michigan state average length (modified from Laarman 1963).



Table 7. --Estimated angler harvest, by weight (kilograms) and number (in parentheses), of marsh-reared (M) and indigenous (I) northern pike from Long Lake during summer, 1974-78.

Year class and source	Summer of year				
	1974 <sup>a/</sup>	1975	1976	1977	1978
1977 (M, I)					46.1 (52)
1976 (M, I)				3.8 (5)	216.2 (207)
1975 (M)			16.9 (17)	218.0 (197)	617.3 (439)
1975 (I)			15.1 (17)	76.2 (77)	499.4 (362)
1974 (M)			283.5 (262)	96.3 (82)	216.3 (103)
1974 (I)			70.7 (73)	139.8 (115)	105.9 (52)
1973 (M)	56.3 (62)	1310.3 (1231)	286.2 (183)	23.2 (11)	0.0 (0)
1973 (I)	38.7 (42)	491.0 (459)	57.3 (46)	0.0 (0)	100.9 (26)
1972 (M, I)	249.4 (214)	483.9 (263)	51.1 (34)	20.4 (5)	0.0 (0)
1971 (M, I)	182.6 (129)	471.8 (225)	0.0 (0)	0.0 (0)	0.0 (0)
1970 (M, I)	71.7 (30)	271.0 (150)	27.1 (6)	0.0 (0)	0.0 (0)
1969 (M, I)	26.5 (6)	89.9 (38)	0.0 (0)	0.0 (0)	0.0 (0)
Total	625.2 (483)	3117.9 (2366)	807.9 (638)	577.7 (492)	1802.1 (1241)
Per hectare	5.34 (4.1)	26.65 (20.2)	6.91 (55.0)	4.94 (4.2)	15.40 (10.6)

<sup>a/</sup> July-November only.

Table 8. --Estimated angler harvest, by weight (kilograms) and number (in parentheses), of marsh-reared (M) and indigenous (I) northern pike from Long Lake during winter, 1974-75 through 1977-78.

Year class and source	Winter of year			
	1974-75	1975-76	1976-77	1977-78
1976 (M, I)				66.8 (72)
1975 (M)			34.2 (33)	135.0 (97)
1975 (I)			8.4 (8)	19.7 (18)
1974 (M)			29.3 (22)	36.5 (24)
1974 (I)		9.2 (11)	43.4 (39)	0.0 (0)
1973 (M)	32.8 (37)	64.5 (44)	35.3 (20)	0.0 (0)
1973 (I)	58.9 (55)	67.3 (31)	6.8 (6)	0.0 (0)
1972 (M, I)	38.5 (18)	20.5 (11)	0.0 (0)	0.0 (0)
1971 (M, I)	38.3 (18)	30.9 (11)	0.0 (0)	0.0 (0)
1970 (M, I)	27.3 (18)	0.0 (0)	5.4 (3)	0.0 (0)
<b>Total</b>	<b>195.8 (146)</b>	<b>192.4 (108)</b>	<b>162.8 (131)</b>	<b>258.0 (211)</b>
<b>Per hectare</b>	<b>1.67 (1.2)</b>	<b>1.64 (0.9)</b>	<b>1.39 (1.1)</b>	<b>2.21 (1.8)</b>



Table 10. --Calculated annual harvest (in percent) from the 1973-75 year classes of marsh-reared northern pike. Cumulative harvest is in parentheses. 1974-75 winter harvest is included in 1975 totals, etc. <sup>a</sup>✓

Year class	Percent harvest during					
	1974	1975	1976	1977	1978	1979 <sup>b</sup> ✓
1973	3.9 (3.9)	79.8 (83.7)	14.3 (98.0)	2.0 (100.0)	0.0	
1974		0.0 (0.0)	53.1 (53.1)	21.1 (74.2)	25.8 (100.0)	0.0
1975			1.9 (1.9)	25.3 (27.2)	59.0 (86.2)	13.9 <sup>c</sup> ✓ (100.0)

<sup>a</sup>✓ Because of rounding off, some totals may not add up exactly.

<sup>b</sup>✓ Projected 1979 harvest.

<sup>c</sup>✓ Equivalent to the mean percent harvest at Age IV for the preceding two year classes. For the 1975 year class, 13.9% is equivalent to 126 fish harvested.

Table 11. --Cost-benefit analysis for the managed pike marsh at Long Lake.

Year class	Total weight of fingerlings stocked (kg)	Calculated angler yield (kg)		Ratio (harvest weight to stock weight)	Cost in dollars per harvested <sup>a/</sup> Fish Kilogram	
		Total	Per hectare		Fish	Kilogram
1973	42.0	1808.6	15.5	43.1:1	0.95	0.83
1974	9.2	661.9	5.7	71.9:1	1.05	0.78
1975	10.1	1269.7 <sup>b/</sup>	10.9 <sup>b/</sup>	125.7:1	0.65	0.47
Mean per year	20.4	1246.7	10.7	80.2:1		
Mean, weighted					0.87	0.70

<sup>a/</sup> Based on cost to produce fry and operate marsh (see text).

<sup>b/</sup> Yield data for the 1975 year class include a projected harvest of 126 fish in 1979 (see Table 9).

Table 12. --Mean length and growth index (see Table 6), in centimeters, for marsh-reared (M) and indigenous (I) northern pike caught by anglers. (Number of fish in parentheses.)

Year class and source	Year of harvest								Mean growth index
	1975		1976		1977		1978		
	Mean length	Growth index	Mean length	Growth index	Mean length	Growth index	Mean length	Growth index	
1973 (M)	56.4 (34)	+7.1	62.0 (36)	+5.6	67.6 (9)	+5.1	--	--	+5.9
1973 (I)	56.9 (15)	+7.6	62.0 (12)	+5.6	57.9 (2)	-4.6	85.1 (1)	+11.7	+5.1
1974 (M)			56.9 (47)	+7.6	59.2 (23)	+2.8	67.1 (8)	+4.6	+5.0
1974 (I)			55.1 (14)	+5.8	58.4 (35)	+2.0	69.8 (2)	+7.3	+5.0
1975 (M)					56.9 (48)	+7.6	63.5 (32)	+7.1	+7.4
1975 (I)					55.1 (17)	+5.8	60.7 (17)	+4.3	+5.0

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