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COMMERCIAL FISHERIES INVESTIGATIONS

PROGRESS REPORT ON THE FIRST YEAR STUDY
OF NORTHERN PIKE IN THE MISSISSIPPI RIVER

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ABSTRACT

Vital statistics from northern pike populations in Pools 9, 10, 13 and 14 in the Mississippi River bordering Iowa were determined to appraise the suitability of this species as a commercial food-fish. Five hundred eighty northern pike were marked with serially numbered Floy tags in 1974 and 419 during 1975. An additional 300 were marked by fin excision to measure tag loss in Pool 9. Ten marked fish were recaptured in 1974. One fish tagged in 1974 was recaptured in 1975 and 4 tagged in the concurrent season were recaptured. Male northern pike were more prevalent in net catches than females, comprising up to 70% of the catch in the upper pools. Age of fish captured ranged from I to IX with ages II-IV most numerous. Total annual mortality was estimated at 68% for male and 66% for female northern pike in all pools. Ova production averaged 28,333 per kg of body weight. Response to a questionnaire sent to commercial fishermen varied widely as to demand for a fishery. Some were uninterested, while those in the upper pools were interested. Former fishing seasons on this species produced commercial catches of 46,000 to 113,600 pounds annually. During commercial processing for food, northern pike lost up to 58% of their whole body weight. A literature review of chemical contamination of northern pike flesh was completed and proved inconclusive.

INTRODUCTION

Large populations of northern pike are known to exist in the Mississippi River bordering Iowa, particularly in the upper navigation pools. The Iowa Conservation Commission takes 2-3,000 northern pike for spawning purposes each spring in Pool 9 near Lansing. Surveys and fish distribution records by Cleary, Nord and others in annual reports of the Upper Mississippi River Conservation Committee (UMRCC) indicated northern pike are indigenous to all pools of the Mississippi River. Relative abundance diminishes in a downstream direction and populations of high density are rare south of Clinton, Iowa.

Northern pike was commercially harvested in Iowa until 1959, when pressure from organized sport fishermen groups and a move through the UMRCC toward regulation uniformity resulted in closing the fishery. Spring trap net catches in Pool 9 at the Lansing Fish Hatchery from 1955-59 compared with 1964-70 showed no significant difference in catch per unit effort. Cleary, in a 1958 administrative report to the Iowa Conservation Commission, noted there was no discernable difference in length-frequency distribution or age structure of northern pike population sample between Pool 7 and 9. The former pool is located between Minnesota and Wisconsin and was not subjected to commercial food-fish exploitation. Current sport fishing surveys indicated few northern pike are caught by anglers. Presumably, a large segment of total mortality in northern pike populations can be attributed directly to natural causes.

The main objectives of this study was to determine some of the important northern pike vital statistics including abundance, age structure, size distribution, growth, mortality, fecundity, and seasonal movement along with marketing and harvest potentials in four pools in the upper Mississippi River. These research findings will be used to evaluate the commercial fishing potential of northern pike and obtain legislative support for reopening the

fishery, estimate potential harvest and value of the fishery, and collect population data necessary to regulate a sustained commercial harvest.

The following information was collected in the first segment of a 39 month investigation in cooperation with the National Marine Fisheries Service and the Iowa Conservation Commission (PL:88-309) covering the period 1 April, 1974-30 June, 1975.

LIFE HISTORY INVESTIGATIONS

Principle objectives of the life history investigations included determination of total mortality and separate these values into natural and fishing mortality; determination of growth, age and size at maturity, fecundity, size and age structure, and seasonal movement and behavioral activity patterns.

Total mortality was determined from age structure of northern pike in trap net catches. Fishing mortality was estimated from tag returns of marked fish and natural mortality was the difference between these sources.

Marking of a segment of the population by tagging was necessary to determine sport fishing exploitation. Annual goals of 100 tagged fish were set for Pools 10, 13 and 14. A further goal of 300 was set for Pool 9 with an additional 300 to be identified by excision of various fin combinations to estimate tag loss and handling mortality.

The tags were serially numbered Floy anchor tags. International orange Number FD-67 tags were inserted near the base of the dorsal fin in 1974. Care was taken to anchor the T-bar behind neural rays at a posterior angle of 60-70° to reduce drag and retard loss.

The shank length of FD-67 tags (3/8-1/2 inch) made placement difficult on large fish, so Number FD-68 tags were used in 1975. These were colored yellow, having a shank length of 1 1/4 inches.

Fish collection was accomplished by trap netting with fyke nets constructed of 1-1 1/2 inch (bar measure) nylon web. The net frames measured 2 1/2 x 5 ft, and the hoops 30 inches in diameter. Overall length, excluding leads, measured about 15 ft. Leads varied in length from 40 to 60 ft and were constructed of 1-inch mesh material. Sets were made perpendicular to the shoreline.

Fish were captured for tagging soon after ice out because netting success was highest during the spawning season. Additional netting during mid-summer and autumn was completed to determine catch per effort (C/E) as a measure of relative abundance.

Fish were held on board a boat for tagging in a 65 gal wooden aerated live tank until 40-50 were collected. MS-222 was administered as an anesthetic. Fish were weighed to the nearest .01 kg and total body length measured in millimeters. Scale samples were collected from an area 4-6 scale rows beneath the anterior portion of the dorsal fin. Sex and maturity were determined by egg stripping or external examination of the genital pore (Demchenko, 1963).

Fecundity was determined from randomly selected females captured after tagging concluded in a pool. Entire ovary volume was measured and a sample of 25 ml preserved in 10% formalin for enumeration.

Return of tag information by sport anglers was voluntary. Tags were labeled "IA CONS COMM 0001". Posters stating the study purpose and requesting tag information were placed in 77 bait shops, boat landings, sporting goods stores and other sportsman "haunts" near study pools. Postage paid post cards were attached to each poster for reporting. Information requested included tag number, location caught, date of capture, length and weight. Space was also provided on the post card forms for the angler's name and address in order that information could be returned. Posters were examined bimonthly during the

study segment. Missing posters were replaced and post cards were added, as necessary.

NORTHERN PIKE TAGGING RESULTS

Tagging goals were achieved in all but Pool 14 in 1974 and all but Pool 9 in 1975. Tagging started in Pool 9 in the first year and proceeded in a downstream direction. Before the netting crew reached Pool 14, spawning concluded and fish were no longer vulnerable. In 1975, tagging effort began in Pool 14 and proceeded upstream. Although the spawning season was not over in Pool 9, when the netting crew arrived, spring flooding made netting virtually impossible.

The loss of tags from marked fish was estimated from the ratio of tagged/untagged recaptures with left fins removed. Mortality from tagging was to be estimated from the ratio of recaptures with left vs right fins removed. Originally, the plan was that the Iowa Conservation Commission netting crews seeking brood fish for hatchery spawning would handle large volume of fish in the study area and could watch for marked fish. Beginning in 1975, however, hatchery operations were moved from Lansing to Guttenburg and brood fish were no longer sought in Pool 9. The number of fish handled by the tagging crew simply was not sufficient to recapture fish for this purpose. As a result, only one marked fish was recovered and calculations of tag loww and tagging mortality were impossible (Table 1).

Numbers of fish returned by anglers has been low with only four fish reported in the first year. Three were from Pool 9, all before 1 July. The fourth was captured in Pool 13 in late summer. Ten fish were recaptured during the first half of 1975. Four had been tagged in 1974 and 6 in 1975 (Table 2).

Table 1. Numbers of northern pike released and recaptured by type of mark in Pool 9.

Year	Fin clipped	Tag location	Number Goal	Number Actual	Number recaptured
1974	Left pelvic	Floy left side	300	304	0
	Right pelvic	None	300	303	1
1975	Left pectoral	Floy left side	300	61	0
	Right pectoral	None	300	61	0
1976	None	Floy right side	300		

Table 2. Number of tagged northern pike reported by anglers.

Year tagged	Pool	Number tagged	1974 -30 June	1974 1 July-31 Dec	1975 1 Jan-30 June
1974	9	304	3		1
	10	111			
	13	111		1	2
	14	54			1
	Combined	580	3	1	4
1975	9	61			1
	10	137			1
	13	121			2
	14	100			2
	Combined	419			6

ESTIMATED POPULATION SIZE

Population estimates were not attempted because of the numerous immeasurable variables. However, general conclusions about relative density between pools may be drawn from the recaptured fish. Of the 999 fish tagged during 1974 and 1975, 27 were recaptured in 1975 by netting (Table 3). No fish were recaptured in Pool 9, one in Pool 10, 13 in Pool 13 and 13 in Pool 14. Considering the number of fish captured in each pool along with the number of tagged fish at large in each pool, these data strongly suggest systematically lower population density in downstream pools.

Table 3. Numbers of tagged northern pike recaptured by netting in 1975 by season and pool.

			Spring		Summer	
Area	Year	Number tagged	Number fish captured	Number recaptured	Number fish captured	Number recaptured
Pool 9	1974	304	150	0	42	0
	1975	61		---		0
Pool 10	1974	111	203	0	37	0
	1975	137		---		1
Pool 13	1974	111	259	9	86	1
	1975	121		---		3
Pool 14	1974	54	128	13	[a]	
	1975	100		---		
Pools combined	1974	580	740	22	165	1
	1975	419		---		4

[a]Not sampled.

LENGTH FREQUENCY AND SEX RATIO

Total body length from 1,369 fish ranged from 34 to 106 cm with modes ranging from 45 to 60 cm. Greater differences were noted between pools and sexes (Table 4) than between years (Table 5). Males were generally more abundant in the catch, particularly in upstream pools where they contributed up to 70%. In Pool 14 both sexes were caught in about equal numbers. Fish under 60-65 cm were predominately males, whereas, larger fish were usually females. The equal overall sex ratios noted in Pool 14 was accounted for by the presence of proportionately more large fish consisting of a high percentage of females.

Table 4. Length frequency in percent of northern pike by sex in study pools.

Length (cm)	Pool 9		Pool 10		Pool 13		Pool 14		Pools combined	
	M	F	M	F	M	F	M	F	M	F
< 40	6	7	1		1				4	3
40-44	26	12	7		5			1	17	7
45-49										
50-54	20	11	28	7	26	3	21	12	22	9
55-59	15	13	28	17	31	9	19	17	21	13
60-64	5	10	18	20	17	19	23	29	11	16
65-69	3	8	7	14	13	26	24	17	5	14
70-74	a	6	2	14		18	5	7	1	10
75-79	a	3		11	1	17	4	8	a	8
80-84		2		7		8	3	4		4
85-89		2		7				1		2
90-94		1		1						1
95-99										a
> 99								1		
Number	460	275	177	71	127	105	78	76	842	527
Sex ratio	63	37	71	29	55	45	51	49	62	38

Table 5. Length frequency in percent of northern pike captured by trap netting during spawning seasons of 1974 and 1975.

Length (cm)	Pool 9		Pool 10		Pool 13		Pool 14	
	1974	1975	1974	1975	1974	1975	1974	1975
< 40	7		2	1	1			
40-44	23	11	10	4	4	2	2	2
45-49	28	14	10	27	8	2	10	8
50-54	16	19	16	26	16	18	7	17
55-59	11	29	23	17	16	30	8	23
60-64	5	16	21	9	17	22	10	31
65-69	4	5	9	9	18	23	7	10
70-74	2	4	2	2	7	11	5	3
75-79	1	3	5	2	10	8	3	3
80-84	1		2	4	3	5	1	2
85-89	1			1				1
90-94	[a]	1						
95-99								
> 99							1	
Number	613	122	111	137	111	121	54	100

[a]Less than .5%.

AGE FREQUENCY AND MORTALITY

Scale samples were collected for age determination from 580 fish in 1974 and 419 in 1975. Aging of these samples was attempted in 1974 from plastic impressions, but due to difficulty encountered in assigning corrected ages, work was not completed. Temporarily assigned ages were tabulated for age frequency and used to compute mortality (Table 6). Though there were differences between pools and sexes, variations may have resulted from small sample size and error in age assignment and are subject to correction.

Ages ranged from I to IX with ages II-IV most abundant. Younger ages was more common among males than females. Young fish also contributed more to samples in upstream pools than in downstream pools. Pool 14 is the only pool

Table 6. Age distribution by percent, mortality, and survival of northern pike by sex in each pool based on 1974 trap net catch.

Age	Pool 9			Pool 10			Pool 13		
	Male	Female	Sexes combined	Male	Female	Sexes combined	Male	Female	Sexes combined
I							2		1
II	68	48	59	34	10	27	10		6
III	30	24	27	50	48	50	47	27	38
IV	1	20	9	16	16	16	40	44	42
V	1	8	4		19	5	2	29	13
VI		1	[a]		6	2			
VII									
VIII									
IX									
Number	169	122	291	80	31	111	62	45	107
Age at first capture	II	II	II	III	III	III	III	IV	IV
Instantaneous rate (Z)	1.582	1.015	1.289	1.124	.764	1.046	1.684	.431	1.168
Annual rate (A)	.677	.564	.695	.675	.304	.668	.556	.350	.689
Survival rate (S)	.323	.436	.305	.325	.696	.332	.444	.650	.311

[a] Less than .5%.

Table 6. (Continued).

Age	Pool 14			Pools combined		
	Male	Female	Sexes combined	Male	Female	Sexes combined
I				[a]		[a]
II	4		2	45	27	38
III	74	30	50	41	28	36
IV	22	44	34	13	27	19
V		7	4	1	14	6
VI		11	6		3	1
VII		4	2		[a]	[a]
VIII						
IX		4	2		[a]	[a]
Number	23	27	50	334	225	559
Age at first capture	III	IV	III	II	III	II
Instantaneous rate (Z)	1.223	1.099	1.008	1.709	1.040	1.647
Annual rate (A)	.705	.542	.550	.680	.662	.473
Survival rate (S)	.295	.458	.450	.320	.338	.527

[a]Less than .5%.

which fish exceeded age VI. All of these were females and contributed 4% to the catch in that pool.

Total mortality calculated from age structure for Pools 9-14 was .70, .67, .69, and .55, respectively and was .47 for combined pools. Mortality was higher for males ranging from .56 in Pool 13 to .71 in Pool 14. Mortality for females ranged from .30 in Pool 10 to .56 in Pool 9. Samples from all pools combined resulted in estimated mortality of .68 for male and .66 for female northern pike.

FECUNDITY

Northern pike spawning commenced soon after net collection began, hence collection of eggs for fecundity was limited to the first pools sampled. As a result, most samples were taken from Pool 9 in 1974 and Pool 13 in 1975. Fecundity was based on 36 fish. Small sample size precluded comparisons between years and pools and the information was combined for analysis.

Size of fish ranged from 381 mm (TL) and .37 kg to 841 mm and 4.53 kg with an array of intermediate sizes represented (Table 7). Total ova ranged from 10,560 for fish < 400 mm TL to 106,486 for fish > 799 mm TL. Size of ova appeared to increase as fish size increased from 400-600 mm and stabilized after 600 mm. Ova from fish < 400 mm measured 215 per ml and 146 in fish > 799 mm. Ova production averaged 28,333 per kg of body weight with a standard deviation of ± 6,423.

Table 7. Fecundity statistics by body length for 36 northern pike collected in 1974 and 1975.

	Size interval						
	< 400	400-499	500-599	600-699	700-799	> 799	All sizes combined
Sample size	4	8	6	6	9	3	36
$\bar{X}$ length	389	438	559	682	751	829	
$\bar{X}$ wgt (kg)	.40	.58	1.32	2.23	3.31	4.28	
$\bar{X}$ volume of ovary (ml)	50	110	267	400	593	727	
$\bar{X}$ ova/ml	215	190	165	148	141	146	166
σ	± 36	± 26	± 47	± 23	± 25	± 25	± 38
$\bar{X}$ total ova	10,560	19,777	41,245	58,923	83,364	106,486	
σ	± 2,197	± 8,262	±11,392	±12,513	±23,513	±75,395	
$\bar{X}$ ova/kg fish wgt	26,483	33,299	31,800	26,357	24,965	24,683	28,333
σ	± 5,414	± 6,026	± 7,646	± 4,084	± 5,214	± 5,479	± 6,423

COMMERCIAL FISHERY POTENTIAL AND ASPECTS

HISTORY OF COMMERCIAL HARVEST

Northern pike was commercially harvested in all states bordering the upper Mississippi River in the late 1800's. Harvest records (Table 8) show a total catch of 113,600 lbs valued at $5,750 in 1894 and 67,800 lbs valued at $2,600 in 1899. Harvest since 1922 was permitted only by Iowa where the highest recorded catch of 46,600 lbs occurred in 1954.

When the Iowa season closed in 1959 northern pike were valued at 23¢ per lbs. This is comparable to channel catfish and sturgeon, the two most highly valued species today.

Records of a Lansing, Iowa commercial fisherman who fished Pool 9 since the late 1930's provided some insite on seasonal catch and value. Most of his commercial northern pike catch was taken in pound nets, which he fished an average of 35 each year. Catch records showed an average annual harvest of about 2,500 lbs of northern pike and 100,000-150,000 lbs of other species. About one-half of the northern pike catch occurred in April, while nearly 10% were caught in March, May, September, October and November. Spring values were as much as 30% higher than autumn. He attributed this to greater abundance of fish being marketed, keeping the market firm.

MARKET DEMAND FOR NORTHERN PIKE

Market demand was surveyed by a combination of questionnaires, along with telephone and personal interviews of fishermen and wholesale fish markets. Though the survey is not complete, some trends are evident.

A questionnaire requesting information on expected benefits of a northern pike commercial fishery (see attached document) was mailed to 623 Iowa commercial fishermen. To date, nearly 60% have been returned voluntarily. Responses varied,

Table 8. Production of northern pike from the Mississippi River for some states and years between 1894-1959.

	Illinois		Iowa		Minnesota		Missouri		Wisconsin	
Year	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1894	9,865	$505	18,445	$ 820	35,395	$1,626	1,895	$170	48,008	$2,631
1899	5,475	309	25,042	1,000	23,725	840			13,535	447
1922			20,100	1,850						
1931			4,700	470						
1950			7,100	1,061						
1954			46,600	5,592						
1955			9,800	1,176						
1956			24,600	2,952						
1958			16,300	3,743						
1959			20,800	4,765						

NORTHERN PIKE COMMERCIAL FISHING QUESTIONNAIRE

1. In which pool(s) do you fish? _____

2. How many pounds of fish do you catch in an average year?
   ( ) Under 1,000 lbs
   ( ) 1,000 to 10,000 lbs
   ( ) Over 10,000 lbs

3. Do you think Northern Pike are present in sufficient numbers in your area to harvest? ( ) Yes ( ) No

4. Would you fish for Northern Pike if they could be legally taken commercially? ( ) Yes ( ) No

5. How would you market them? ( ) Yes ( ) No

6. What price per pound would you expect to receive? _____

7. Do you feel they would increase your income by a worthwhile amount? ( ) Yes ( ) No

8. Did you fish for Northern Pike before 1959 when the season was open? ( ) Yes ( ) No

9. Do you have or know of any personal logs or records dating back to the 1950's (or earlier) which would contain information on harvest or values of Northern Pike? ( ) Yes ( ) No

10. Mark one of the following:

   ( ) I want Northern Pike returned to commercial list.
   ( ) I don't want Northern Pike returned to commercial list.
   ( ) I don't care if it is returned to the commercial list or not.

Comments:

but two trends were quite pronounced. First, there is a stronger demand for the species to be placed on the commercial list among fishermen in upstream pools. This is no doubt the result of higher northern pike populations in upstream pools. Secondly, sale value is generally expected to be high.

Opinions of local market operators were as varied as the fishermen's and ranged from a passive interest, while a few were enthusiastic about the prospect of a new fishery. Most local wholesalers and market personnel indicated there was little demand locally prior to the 1959 season closing and that they usually shipped whole northern pike to Chicago, Illinois markets. Some local trade was anticipated to develop in the areas of smoked, fresh whole and filleted products.

Three large Chicago, Illinois wholesale buyers were interviewed by telephone. All handle northern pike from Canada but indicated demand was light. One related northern pike were presently of marginal value and resulted in little or no profit because of spoilage problems caused mainly by shipping delays. This buyer expressed special interest in an Iowa northern pike fishery, pointing out that Mississippi River fish are received within two days of capture compared to four days for Canadian fish. Thus, he reasoned, a better market could be established with a fresh product. Prices they paid to shippers were 18-20¢ whole and 35-45¢ dressed (headed and drawn). Volumes handled ranged from 200-300 lbs to 1,500-2,000 lbs per week.

WEIGHT LOSS IN COMMERCIAL FOOD-FISH PROCESSING

Data were collected on the incremental weight loss during processing of 18 female specimens selected from fecundity studies. Fish were dressed by removing heads and viscera as described by market personnel. Scales and fins were not removed. Dressed fish were then smoked. Measurements included lengths and weights of whole fish and weights after dressed and smoked.

Identity of individual fish was maintained by placing a number 3 monel metal band on the anterior base of the dorsal fin.

Initial size ranged from 531 mm and 1.36 kg to 841 mm and 4.83 kg. Insufficient sample size precluded statistical analysis for variation among individuals. Whole fish lost 48% of their weight when dressed and an additional 20% when smoked, meaning 100 lbs of whole fish would weigh 52 lbs dressed and 32 lbs smoked.

No attempt was made during this study segment to determine weight loss resulting from other methods of processing, but will be determined later.

CHEMICAL CONTAMINATION OF NORTHERN PIKE FLESH

A literature search was initiated to locate existing records of contamination by pesticides, PCB's, heavy metals and other chemicals which would affect the value of northern pike as a food-fish in the upper Mississippi River. There have been several programs conducted by various agencies to monitor and survey chemical contaminants in fish flesh in the Mississippi River. Generally, these investigations have been of a broad "spot check" nature for the purpose of locating problem areas. Results have indicated contamination has exceeded FDA limits only in few instances. Morris and Johnson (1970a and 1970b) found some bottom feeders exceeding safe dieldrin levels in the lower river. PCB's have also resulted in the banning of commercial fishing for some species in the St. Paul-Minneapolis, Minnesota area.

Records of analysis of northern pike, however, are sparse. The species was included in tests for chlorinated hydrocarbons (Kleinert, Degurse and Wirth, 1968; Degurse and Ruhland, 1972) and mercury (Kleinert and Degurse, 1972). These studies included fish from the Mississippi River bordering Wisconsin. Though concentrations were well within safe limits, numbers of northern pike tested were not sufficient to be conclusive.

Samples of northern pike will be examined for hazardous pollutants during future study segments, because other species in nearby areas contain chemical compounds which prevent their consumption for food.

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