IOWA CONSERVATION COMMISSION

FISHERIES SECTION

COMMERCIAL FISHERIES INVESTIGATIONS

ANNUAL PERFORMANCE REPORTS

Project No. 2-225-R: Paddlefish Investigations (Segment 1)
Period Covered: 1 April, 1975-30 June, 1976

Project No. 2-255-R: Northern Pike Investigations (Segment 2)
Period Covered: 1 July, 1975-30 June, 1976

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ANNUAL PERFORMANCE REPORT

COMMERCIAL FISHERIES INVESTIGATIONS

STATE: Iowa

TITLE: Paddlefish Investigations

PROJECT NO.: 2-255-R

PERIOD COVERED: 1 April, 1975 through 30 June, 1976

SEGMENT NO.: 1

ABSTRACT: Paddlefish investigations in the Mississippi River were initiated for the purpose of evaluating exploitation and harvest potential of this species and to obtain information on basic life history necessary to formulate suitable regulations. Over 1,000 paddlefish from various sources were examined in the first year of study. Six hundred fourteen were tagged and released in Pool 13. Preliminary tag return information indicated high exploitation rates, particularly by sport fishing. Tag returns from commercial fish landings indicated the fish move throughout the pool with some inter-pool exchange. Initial population estimates stabilized at 10,000 fish, 40 cm long and larger in Pool 13. Two hundred thirty-four aged jaw samples included most year classes through age 18. Preliminary calculations of annual mortality from age distribution was 54% for male and 32% for female paddlefish.

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INTRODUCTION

Paddlefish are indigenous to Iowa and found throughout the boundary waters of the Mississippi and Missouri Rivers and lower reaches of larger interior rivers including the Des Moines and Iowa Rivers. In the Mississippi, commercial food-fish statistics show considerably higher catches in lower pools, presumably indicating increasingly higher numerical populations downstream.

Regulations governing harvest on the upper Mississippi differ considerably between states. Wisconsin has established a precautionary "watch" status on this species in their portion of the river and prohibit harvest by any method. In Iowa and Illinois, paddlefish have long been considered both a sport and commercial food-fish. Until recently, however, sport fishing regulations have been quite restrictive and harvest has been almost exclusively by commercial methods. Commercial harvest, though virtually unrestricted, is minimal with Iowa waters producing under 30,000 lbs in most years. Supply as a commercial food-fish has been far below the potential market demand.

In November, 1973, Illinois legalized snagging, and in November, 1974, Iowa adopted similar regulations. The legalization of snagging greatly increased total harvest. Many of these fish are being commercially sold as a food-fish.

Since exploitation rates, harvest potential and the compatability of this species to fit into both a sport and commercial category in the upper Mississippi River is unknown, it was imparative that an investigation of these parameters be conducted to formulate sound regulations with which to manage the paddlefish resource.

Such investigations were initiated on 1 April, 1975, in cooperation with the National Marine Fisheries Service and the Iowa Conservation Commission under authority of PL 88:309. Studies are under contract to continue through 30 September, 1978. The following is a report of the first segment of study conducted during the period through 30 June, 1976.

Study objectives are to determine exploitation and harvest potential of paddlefish in the Mississippi River and collect basic life history and market information from which regulations can be formulated to optimize the fishery in all regions of the river.

LIFE HISTORY INVESTIGATIONS

The primary objective of life history investigations was to determine mortality rates of paddlefish. Total mortality was calculated from age distribution and tag return rates, while contribution by sport and commercial fishing were determined from tag returns. Natural mortality was estimated as the difference between fishing and total mortalities.

In addition, information was compiled on numerical population abundance, age and size structure, growth, age and size at maturity, fecundity and other important biological parameters.

The study area includes all pools of the Mississippi River bordering Iowa with special emphasis on Pool 13 near Bellevue.

TAGGING STUDIES

Tagging of paddlefish was conducted in Pool 13 to determine the rate of harvest by commercial and sport fishermen. Recaptured fish were also used to estimate numerical abundance and calculate growth and movement. Experimental fishing effort was recorded to determine seasonal changes in density of fish.

A goal to tag 25-50 fish was set for each month. Most were captured in the tailwaters of Lock and Dam 12 by snagging. When adequate numbers could not be captured by this method, gill nets were drifted on the surface in areas known to be inhabitated by paddlefish. The latter was accomplished in two areas, seven and eight miles, respectively, downstream from the tailwaters. Netting in other areas including the tailwaters were attempted but without success.

Netting was not a desirable method of collecting because of the inability to the control numbers captured. In one instance, 13 fish were captured in a single drift. When this occurred, the last fish removed from the net was under sufficient stress to lessen its chance for survival. Snagged fish could be handled more quickly. Gill netting was also size selective.

Snagging gear consisted of standard heavy weight sport fishing tackle. A lead sinker was attached to the end of the line with two No. 8/0 treble hooks attached at 1-2 and 4-8 feet above the sinker. Sinker weight varied from 3-8 oz, depending on river conditions such as depth and stream velocity. Lines were fished by jigging while trolling perpendicular to the current. Snagging effort was confined to an area 100-500 feet below the dam.

When landed, fish were measured for FL and TL in cm and weighed to the nearest .01 kg. Observations were recorded concerning severity and location of hook wounds, number of lampreys present, presence of unhealed lamprey wounds, scars and other abnormalities. Two yellow FD 688 Floy anchor tags having a 1 1/4 inch shank and 2 inch spaghetti were inserted into the dorsal surface of the rostrum at a 45° angle with a modified FD 68 Dennison tag gun. Each tag was serially numbered (0001-3000) and identified by the letters "IA CONS COMM". Most fish could be examined, tagged and released in less than two minutes after landing.

Postage-paid post cards requesting desired information were distributed to all commercial fishermen, wholesale fish markets and landings, and bait and tackle shops in the area. All fishermen observed snagging were also provided with cards. An effort was also made to make the public aware of the importance of reporting tagged fish by newspaper articles.

During the study segment 614 paddlefish were tagged. Size ranged from 40-.6 cm in FL (.22 kg) to 156.2 cm (24.10 kg). Monthly length frequency of tagged fish are presented in Table 1. Recaptures totaled 86 or 14% of the marked fish. Commercial fishing accounted for 16 (19%) and sport fishing accounted for 51 (59%), while 19 (22%) were recaptured through experimental fishing.

Table 1. Monthly length frequency of paddlefish tagged during the first study segment at Lock & Dam 12.

FL (CM)	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Total
40- 49								2		5	2	2	1	2		14
50- 59								4	8	5	9	7		9	2	44
60- 69		1		1	1		1		1	1	1				1	8
70- 79	14	1	10	1	8	1	3	2	4	2	4	6	1		3	60
80- 89	11	6	5	7	13	4	13	11	16	22	12	15	1	1	7	144
90- 99	11	8	19	13	15	1	18	12	10	8	14	7	2	7	12	157
100-109	5	5	12	9	8	3	10	8	6	4	4	12	1	3	10	100
110-119	2	3	6		1	1	2	4	3		1		1	1	7	32
120-129	2	1	4	4	2		2	2	2		2			1	1	23
130-139								4		1					3	8
140-149	1			1		1	1								1	5
No length*	2	3		1	3	1		1		2	1	1		1	3	19
Total	48	28	56	37	51	12	50	50	50	50	50	50	7	25	50	614

*Specimens not measured include fish with damaged rostrums.

Both commercial and sport fishing tag returns indicated seasonal variation in fishing pressure. A high proportion of commercial returns occurred during winter and late fall, whereas sport tag returns were more numerous in spring.

Size distributions of fish from which tags were returned showed size selectivity of fishing gear. Although smaller fish were observed in the catch, no recaptures under 80 cm were reported by either sport or commercial sources. This could indicate low survival of small fish, but is probably related to size selectivity of gear. Size selection by commercial fishing resulted from mesh size used in gear and sorting, whereas sport fishermen were probably sorting. The recapture rate by experimental fishing was similar for all sizes in the population.

Distances moved as indicated by recaptured fish were strongly biased by sport and experimental fishing because of the distribution in fishing effort. Most of this type of effort was exerted close to the tag release site. In contrast, commercial fishing occurred throughout the area. Of the 16 fish reported by commercial fishing, all but three were recaptured within the pool. Two were taken in the adjoining upstream pool and the third in the adjoining downstream pool. Other commercial fishing recaptures were throughout Pool 13.

CATCH PER EFFORT

Catch per effort (C/E) was recorded as the number of fish per pole hour for all fishing effort expended by experimentally snagging in the tailwater area to assess seasonal changes in relative densities and seasonal vulnerability. Five hundred seventy pole hours of effort resulted in the capture of 716 paddlefish, 710 of which were large enough to be tagged (40 cm FL). Highest C/E for paddlefish was attained during the months of December-March (Table 2), while low catch rates were common during spring and summer months. High winter catches were attributed to increased vulnerability caused by schooling behaivor and a tendency to remain near bottom in specific areas. During spring and early summer in 1965 high water resulted in poor sampling conditions at the tailwaters. Paddlefish were generally less vulnerable when they were not near the bottom, and during warmer months they were often observed surfacing. Inconsistent changes in catch rate during summer months also suggested frequent mass movement to and from the tailwater area.

In addition to the 710 paddlefish, 24 fish of other species were snagged. These included 5 mooneye, 4 shovelnose sturgeon, 3 gizzard shad, 3 channel catfish, 2 flathead catfish, 1 freshwater drum, 1 buffalo, 1 carp, 1 carpsucker, 1 redhorse, 1 gar, and 1 walleye.

AGE DISTRIBUTION AND MORTALITY

Jaw samples were collected from 234 fish for age determination. Although the majority were from Pool 13, varying numbers were also collected from Pools 9, 16 and 17 (Table 3). Sources included sport fishermen, commercial markets and experimental fishing. Care was taken to sample all available fish at any given time or place to reduce bias in age and size distribution. Information recorded with jaw collection included fork and total lengths, weight, sex and maturity. Notes were also taken on abnormalities such as missing rostrum.

Table 2. Monthly effort in pole hours and catch rates for paddlefish, April, 1975-June, 1976.

Month	Pole hours of effort	Paddlefish captured	Catch per effort
April	65	74	1.14
May	11	2	.18
June	36	26	.72
July	65	37	.57
August	53	61	1.15
September	41	10	.24
October	62	61	.98
November	41	55	1.34
December	18	60	3.33
January	21	68	3.24
February	18	70	3.89
March	24	86	3.58
April	11	7	.64
May	72	24	.33
June	32	69	2.16
Months combined	570	710	1.25

Table 3. Source of paddlefish specimens used for age determination in selected pools.

	Source			
Pool	Commercial	Sport	Experimental	Combined
9	1			1
13	21	41	87	149
16	77			77
17	7			7
Pools combined	106	41	87	234

Methods used in age assessment were similar to those described by Adams (1942) using sectioned dentary bones. A thin vertical section was removed from the jaw lateral to the medial symphasis. Sections were magnified 60 X for aging; however, no attempt was made to measure annular increments for back calculating growth. Sexes were analyzed separately, but small sample size precluded meaningful evaluation of differences for location and source.

Males ranged through age 9 and the oldest female was estimated at 18 years. All ages were represented except at the upper and lower ends of the range for females.

Age distributions by sex in 5 cm length increments are presented in Tables 4 and 5. Age 5 appears to be the youngest age at which all fish are vulnerable to capture (N_o) for both sexes.

Calculations of mortality using the Robson and Chapman method (Ricker, 1975) by sex for N_o = 5 and A = .542 for males and A = .322 for females.

AGE AT MATURITY AND FECUNDITY

In addition to length, weight and age determinations, egg development was noted in adult females and fecundity was determined when possible. Ovaries from fish used for fecundity were measured for volume and 25 ml subsamples were preserved in 10% formalin for enumeration. Although several gravid females were examined, only two fish carried eggs which could be separated for fecundity counts.

The larger fish (1,391 mm, 20.3 kg) was collected 12 January and was estimated at 18 years of age. Volume of ovaries was 4,555 ml and total ova were estimated at 506,516. The second fish (1,295 mm, 12.9 kg) was collected 18 March and was estimated to be 12 years old. Volume of ovaries was 1,970 ml with total ova estimated at 241,916.

Superficially, appearance of gonads at various stages was similar to sturgeon as reported by Helms (1975). Immature male gonads consisted largely of a longitudinal body of fatty tissue with testicular tissue appearing as a narrow creamy-yellow band extending the length of the dorsal surface. At maturity, the dorsal band enlarges forming a homogenous convoluted organ several times larger than the associated fatty tissue.

Gonads of immature females were similar in size to those of males. They differed by being markedly laminated and lacked the creamy yellow band on the dorsal surface. Early developmental stages were confusing until eggs appeared. When eggs were present, stage of development was described by egg size and color.

One hundred twenty-four aged males were examined for maturity. All fish at age 3 and younger were immature. Two age 9 fish were both mature. Both mature and immature fish were found at ages 4-8 (Table 6). One hundred six females were examined for maturity. All age 5 and under were immature and all age 9 and over were mature.

Table 4. Summary of length distribution by age for males.

		Age								
Fl (cm)	Sample number	1	2	3	4	5	6	7	8	9
40- 44	1	1								
45- 49	2		2							
50- 54	4	1	3							
55- 59	5	1	3	1						
60- 64	2			2						
65- 69	2			2						
70- 74	7			7						
75- 79	17			15	2					
80- 84	26			9	17					
85- 89	22				5	15	1	1		
90- 94	18					14	2	2		
95- 99	7					1	3	3		
100-104	9						2	5	2	
105-109	1									1
110-114	1									1
No length	2				2					
Total	126	3	8	36	26	30	8	11	2	2

Table 5. Summary of length distribution by age for females.

		Age										
Fl (cm)	Sample size	3	4	5	6	7	8	9	10	11	12	> 12
65- 69	2	2										
70- 74	6	6										
75- 79	14	13	1									
80- 84	24	4	18	2								
85- 89	13		7	6								
90- 94	14			12	2							
95- 99	7				7							
100-104	8				3	5						
105-109	5					3	2					
110-114	2						2					
115-119	2							1	1			
120-124												
125-129	4							2	1		1	
130-134	1										1	
135-139	3											3
> 140	1											1
No length	2											
Total	108	25	26	22	12	8	4	3	2		2	4

Table 6. Age at maturity for male and female paddlefish.

	Male			Female		
Age	Immature	Mature	% Mature	Immature	Mature	% Mature
1	3					
2	9					
3	36			25		0
4	20	2	9	29		0
5	23	9	28	17		0
6	1	6	86	10	1	9
7	5	7	58	8	1	11
8	1			2	2	50
9		2	100		3	100
10					2	100
11						
12					2	100
13						
14					2	100
15						
16					1	100
17						
18					1	100
Total	98	26		91	15	

NUMERICAL POPULATION ESTIMATE

Mark and recapture data were used to make a preliminary estimate of numerical abundance. From 7 to 56 paddlefish were marked by tagging during each of the 15 months. During this period, 775 fish were captured, 614 were marked and released and 20 were recaptured. Numbers of tagged fish at large in the population were adjusted each month to account for a known loss of 66 fish to sport and commercial fishing. No adjustment was made for recruitment.

Since recaptures reported by commercial fishing were distributed throughout the pool, it was assumed the estimate was for the entire pool's population. Some emigration from the pool was demonstrated by 3 to 16 commercial recaptures being reported from outside the pool. However, since this was a preliminary estimate, movement to and from the pool was disregarded.

Both individual monthly and cumulative monthly estimates (Table 7) were calculated using the Schnabel method (Rounsefell, 1953). Individual monthly estimates ranged from 4,575-17,802. Cumulative estimates tended to stabilize at about 10,000 fish. The final estimate was 10,569. Confidence intervals (P = .05) were 7,205-19,830.

LOCALIZED PADDLEFISH MOVEMENT

Observations were attempted on 13 fish to determine localized movement. Methods involved attaching floats to fish and observing movements of the floats. Numerous problems were encountered, and success was limited to trial and error development of a suitable technique.

Small fish were unable to maintain normal orientation in strong current when a float was attached. Lines became entangled in snags. Small floats were submerged when swift water was encountered. Balloons worked well but were subject to breaking and were strongly affected by wind. Also, interested observers and fishermen became entangled in float lines.

These experiences resulted in development of a standard technique reducing the problems encountered. This included attachment of a half inflated good quality balloon to the anterior base of the dorsal fin by a small hook and 100 ft of 8 lbs test monofilament line. Only large fish (> 5 kg) were used and observations were only made on calm days.

By following 5-10 fish for a period of 24 hrs or longer, it was expected that valuable information concerning diurnal activities would be established.

COMMERCIAL FISHERY ASPECTS

Aspects of the study relating directly to the commercial fishery include compilation of historical and current harvest statistics and evaluating the distribution of market values. Harvest statistics were obtained from various sources including NMFS records, UMRCC Annual Reports, and unpublished Iowa Conservation Commission data.

Table 7. Numerical population estimates of paddlefish in Pool 13 based on tag and recovery of fish in the tailwaters.

	Number captured	Number marked in population	Number recaptured	Monthly estimate	Cumulative estimate
April	74	47			
May	29	75	0	∝	
June	61	128	1	4,575	5,938
July	37	159	0	∝	10,674
August	61	200	1	9,699	10,186
September	12	212	0	∝	11,386
October	61	261	2	6,466	8,926
November	55	308	2	7,205	8,352
December	60	358	3	6,160	2,621
January	68	408	4	6,086	7,149
February	70	449	0	∝	9,346
March	86	485	5	7,722	8,895
April	7	491	0	∝	9,083
May	25	516	0	∝	9,765
June	69	548	2	17,802	10,569

Pyramid of values and distribution of profits will be evaluated by applying information obtained interviewing fishermen and marketing personnel to weight changes during processing.

COMMERCIAL FOOD-FISH HARVEST

Historically, all five states bordering the upper Mississippi River have permitted commercial paddlefish harvest. Minnesota and Wisconsin, however, only reported moderate harvest compared to Illinois, Iowa and Missouri (Table 8) and removed paddlefish from their list of commercial species prior to the construction of navigation dams in the 1930's. During this early period, the latter three states each reported high catches. After construction of the dams Missouri experienced a sharp decline in production, but Iowa and Illinois maintained a high rate of harvest until the late 1950's. The years following were comparatively low, particularly for Illinois. Though the cause of this change in catch is not well documented, it was probably related to dam construction. Pooling the river no doubt destroyed major spawning grounds. Continued good production through the 1950's in Iowa and Illinois probably resulted from increased survival and growth of fish spawned prior to impoundment of the river.

Current production appears to be moderate but relatively stable indicating sufficient recruitment to maintain the population.

Average annual harvest in Iowa from 1960-74 was 17,993 with downstream pools producing more than upstream (Table 9). Mean harvest in Pool 9 was 347 lbs, while harvest in Pool 19 was 4,083. Pool 15 is small and not a productive area for paddlefish. Pools bordering Illinois, Iowa reported 28.7% of the harvest.

Paddlefish values and harvest have increased since 1960 (Table 10). Price per pound remained relatively constant at 11-12¢ through 1970 with a dip in 1964 to 9¢, but rose to 15¢ in 1972 where it has remained through recent years.

Coupled with a trend toward consistantly higher harvest during the past five years, total annual value is now ranging near $4,000 for Iowa fishermen.

In comparison to the total fishery, paddlefish contributed 1% of the overall value of Mississippi River fishery in Iowa and 1% of the total weight harvested. Contribution to the total weight varied from .04% in Pool 9 to 2.79% in Pool 16.

Table 8. Production of paddlefish in thousands of pounds from the Mississippi River by state for the years, 1894-1973.

Year	Illinois	Iowa	Minnesota	Missouri	Wisconsin
1894	117	45	13	45	16
1899	148	21		107	
1922	81	49		16	29
1931	23	9		37	
1950	42			5	
1954	65	6		8	
1955	123	6		4	
1956	181	6		5	
1957	107	27		3	
1958	243	24		7	
1959	71	19		9	
1960	29	11		8	
1961	32	9		7	
1962	23	9		10	
1963	59	3		3	
1964	74	21		3	
1965	60	6		3	
1966	49	23		3	
1967	2	10			
1968	86	23		9	
1969	60	19		7	
1970	89	39		9	
1971		18		13	
1972	72	32		10	
1973	70	23		13	

Table 9. Iowa commercial paddlefish harvest from the Mississippi River by pool for the 15-year period 1960-1974.

Year	9	10	11	12	13	14	15	16	17	18	19	Pools combined
1974	1,483	5,366	138	2,872	5,582	3,610	1,081	1,127	1,478	595	3,414	26,746
1973	490	1,291	171	7,360	3,079	1,355	1,647	2,640	1,876	1,083	2,144	23,136
1972	120	3,000	602	4,290	1,787	3,451	2,447	6,839	4,585	2,275	3,609	32,005
1971	100	748		1,163	761	1,469	15	5,648	3,101		4,923	17,928
1970	201	1,485	103	1,232	2,990	1,816	151	12,117	3,986	10,877	4,280	39,238
1969	317	2,672	57	2,066	545	1,812	218	1,238	7,432	344	2,667	19,368
1968	756	842	292	1,372	181	2,446	678	505	3,284	66	12,144	22,566
1967	20	1,165	183	729	1,253	1,680	149	586	3,064	40	717	9,583
1966	436	306	20		92	3,253	23	2,781	5,272	4,249	6,673	23,105
1965	627	100	78		265	850	43	172	1,149	2,202	326	5,630
1964	225	750	109	36	417	117		1,400	3,391	84	13,914	20,443
1963	316		65	9				16	310	232	2,191	3,139
1962					157	30		177	240	5,000	3,111	8,715
1961	8	801		2,257	578	804			2,675	1,125	50	8,298
1960	105	55		447	641	1,134	384	249	3,811	2,093	1,078	9,997
15-year average	347	1,172	121	1,589	1,182	1,588	456	2,366	3,044	2,006	4,083	17,993

Table 10. Commercial value of paddlefish to Iowa fishermen.

Year	Harvest in lbs	Price per lbs	Total commercial value
1974	26,746	.15	4,011.90
1973	23,136	.15	3,470.40
1972	23,005	.15	4,800.75
1971	17,928	.13	2,330.64
1970	39,238	.11	4,316.18
1969	19,368	.11	2,130.48
1968	22,566	.11	2,482.26
1967	9,583	.11	1,054.13
1966	23,105	.12	2,772.60
1965	5,630	.11	619.30
1964	20,443	.09	1,839.87
1963	3,139	.10	313.90
1962	8,715	.12	1,045.80
1961	8,298	.11	912.78
1960	9,997	.12	1,199.64
15-year average	17,993	.12	2,225.78

MARKETING INTERVIEWS

Most of the commercially harvested paddlefish along the upper Mississippi River basin are consumed locally where demand is moderate. Nearly all are prepared for retail sales by smoking.

A survey of value changes associated with the various steps in processing was conducted to determine monetary gain as paddlefish were passed from fisherman to consumer. Values were obtained by interviewing fishermen and market operators and were applied to weight changes resulting each stage in processing to assess monetary gain.

Results of this survey were tabulated but will not be included in the present report.

WEIGHT LOSS IN PROCESSING

Samples of fish representing a range of sizes were processed as if being prepared for sale. Fish were dressed for smoking by removing the head and tail, eviscerating and trimming a portion of the belly. Large fish were steaked in 3 inch chunks and smaller ones were split lengthwise or left whole. Whole fish were measured and weighed. Weights were again taken after dressing and smoking. After smoking, a subsample was further examined to determine ratio of edible to inedible portions. Identity of individual fish was maintained by placing a No. 2 monel wing-band tag at the anterior base of the dorsal fin.

Results were analyzed by fish size in 1 kg increments. Size ranged from .25 kg (438 mm, FL) to 19.55 kg (1,410 mm, FL). Ninety-eight fish were dressed, 78 were smoked and 68 were examined to determine the edible fraction.

Dressed paddlefish averaged 41.4% of whole weight, but large fish yielded more than small ones (Table 11). Fish under 1 kg dressed to 37.2%.

Table 11. Weight loss of paddlefish during commercial food-fish processing expressed as percent of whole weight remaining with (±) standard deviations and sample size by weight increments.

	Size (kg)	Sample size (n)	Mean ($\overline{x}$)	Standard deviation (s_x)
Dressed	< 1	12	37.2	± 2.47
	1-1.9	14	41.2	± 2.64
	2-2.9	25	41.2	± 2.31
	3-3.9	20	42.3	± 3.16
	4-4.9	12	43.6	± 3.29
	> 4.9	16	43.5	± 4.08
	Combined	98	41.4	± 3.95
Smoked	< 1	4	18.8	± 2.74
	1-1.9	12	26.2	± 4.55
	2-2.9	20	25.0	± 3.92
	3-3.9	17	25.0	± 4.66
	4-4.9	11	27.0	± 4.34
	> 4.9	14	26.8	± 4.55
	Combined	78	25.4	± 4.54
Edible	< 1	4	14.1	± 3.66
	1-1.9	8	21.0	± 3.88
	2-2.9	18	21.0	± 3.03
	3-3.9	17	20.5	± 3.37
	4-4.9	10	22.1	± 5.07
	> 4.9	11	20.5	± 4.63
	Combined	68	20.6	± 4.17

When smoked, paddlefish yielded 25.4% of their whole weight. Again small paddlefish yielded less than large ones. This reflected differences on dressing as loss from dressed to smoking was consistent for all sizes.

Only a small portion of the smoked product was inedible and resulted in 20.6% of the whole fish being edible.

RECOMMENDATIONS

Although data collections were completed and compiled in limited disciplines such as commercial catch statistics, life history studies are incomplete. Preliminary estimates of such parameters as mortality and estimation of numerical abundance were not based on sufficient data to make reliable projections and continued study is recommended. Tag return results are of a magnitude to make satisfactory evaluations by the end of the study period with the continued present level of effort.

Continued effort should be made to determine localized movement to locate concentrations of fish to thereby reducing catch effort in obtaining fish for tagging. Consideration should be given to the use of sonic equipment devices. It is not feasible to implant radio tracking devices. Turbulence of the tail-waters, static background from barge traffic and wide ranging movement habits of the species would preclude use of this equipment in the present study.

Population estimates should be refined and include adjustments for recruitment and tag loss.

Intensification of effort will also be required in sampling commercially caught fish for determination of age and size distribution of catch, age and size at maturity and fecundity. Special effort is needed to obtain a satisfactory sample size of mature female fish during January-April for fecundity.

LITERATURE CITED

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ANNUAL PERFORMANCE REPORT

COMMERCIAL FISHERIES INVESTIGATIONS

STATE: Iowa

PROJECT NO.: 2-225-R

SEGMENT NO.: 2

TITLE: Northern Pike Investigations

PERIOD COVERED: 1 July, 1975 through 30 June, 1976

ABSTRACT: Vital statistics of northern pike populations in four selected pools of the Mississippi River bordering Iowa were determined to appraise suitability of the species as a commercial food-fish. Re-examination of age determinations were made for 1974 and 1975 scale samples and age and growth was computed. An additional 619 northern pike were tagged in 1976 bringing the total number of fish marked with serially numbered Floy tags to 1,618. Only 21 have been recaptured by sport fishermen indicating annual mortality from this source is < 1%. Total mortality calculated from age distribution was 80% for male fish and 58.4% for female. Natural mortality was quite high leaving a wide margin for additional harvest. These and other parameters including length-weight relationships, coefficients of condition, and fecundity were found to be statistically similar between pools and years. Response to a questionnaire indicated upstream commercial fishermen with large operations highly favored returning northern pike to the commercial list. Tests for the chemical pollutants dieldrin, DDE, DDD, DDT, heptachlor epoxide, chlordane, atrazine, PCB and mercury in northern pike flesh showed only trace amounts with all parameters well below the FDA tolerance levels. Weight change resulting from food-fish processing indicated small fish did not loose as much in processing as large fish. Processed weight for the entire sample expressed as percent of whole weight were: headed and drawn, 72%; smoked (headed and drawn), 37%; and filleted, 47%.

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INTRODUCTION

Investigations of northern pike populations in four Mississippi River pools was initiated in 1974 (Helms, 1975) to determine suitability of present regulations governing harvest of this species in the river. It was the general concensus that northern pike populations were under-utilized and regulations should be changed to promote use of the resource, principally through a commercial fishery.

Objectives of the study included determination of important vital statistics such as abundance, age structure, size distribution, growth, mortality, fecundity, and seasonal movement along with marketing and harvest potentials. Research findings will be used to evaluate 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 is a progress report containing information collected in the second year of a 42-month investigation in cooperation with the National Marine Fisheries Service and the Iowa Conservation Commission (PL:88-309) covering the period 1 July, 1975-30 June, 1976.

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 50°-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 and 1976. These were yellow, having a shank length of 1 1/4 inches.

Fish collection was accomplished by trap netting with fyke nets constructed of one 1 1/2 inch (bar measure) nylon web. The net frames measure 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 (Casselman, 1974a and 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.

TAGGING RESULTS

Tagging goals were achieved in all pools in 1976 with 305 fish tagged in Pool 9 and over 100 in each of Pools 10, 13, and 14.

Tag returns by sport fishermen indicate this source of mortality is minimal and perhaps negligible compared to total mortality. Of the 1,618 fish tagged to date, only 21 or 1.3% are known to have been captured.

Preliminary analysis of these returns and observations of tags in fish recaptured by experimental netting indicate the tags are holding well and although bias resulting from tag loss is not considered a large factor, it will be calculated in the last study segment. Rate of tag returns by fishermen is unknown.

Numbers of fish recaptured are small, but similarities and differences between pools and years are evident. Time at large appears to have varied consistantly by location. Mean time at large was greatest in Pool 10 followed by Pools 13, 14 and 9 for fish tagged both in 1974 and 1975. Only two fish have been returned by sport anglers from the 619 tagged in 1976, so no pattern could be established for that year (Table 1).

Sixty-seven percent of the marked fish moved upstream and 19% moved downstream, while 14% were captured near the release site. Overall distance moved was 4.9 miles upstream with a standard deviation of ± 8.0 miles. There were wide variations between pools, but small sample size accounts for much of the observed differences (Table 2).

AGE AND GROWTH

Because of a number of inconsistencies in the data, scales collected from 988 fish tagged in 1974 and 1975 were re-aged during the current study segment.

Accuracy was evaluated by comparing subsamples with clethria (Casselman, 1974b) collected from fish used in fecundity and weight loss studies. Both methods resulted in similar age assignment and the author is highly confident in the accuracy.

Annuli were tabbed for back calculation of growth by computer program using a direct proportion linear relationship with the origin centered at zero. Separate calculations were made for each sex by pool and year.

Males were found to grow slower than females, but since grand average lengths at each annulus were statistically identical ($P > .05$) between pools and years within pools, means for each year and location were pooled to calculate an overall average growth rate.

Resulting pooled lengths at each annulus for the 586 males were 348, 497, 586, 654 and 704 mm (13.7, 19.6, 23.1, 25.7 and 27.7 in). Lengths at each annulus for the 402 females were 390, 551, 648, 728, 794, 839 and 935 mm (15.4, 21.7, 25.5, 28.7, 31.3, 33.0 and 36.8 in).

AGE FREQUENCY

Age frequency (Table 3) differed between sexes more than between pools. Young males were more numerous than young females and females lived longer.

The oldest age among males was Age V which made up 1% of samples of that sex. In contrast, 14% of the females were Age V or older. The oldest female examined was Age VII.

Younger fish were more abundant in Pool 9 samples, but this is probably reflective of sampling techniques. The 1974 sample was obtained largely from netting crews who were collecting fish for brood stock. Some bias was introduced in those samples by the inclusion of smaller fish as they used slightly smaller meshed nets.

Table 1. Time of capture and mean days at large for northern pike tagged in each pool by year of tagging.

Year tagged	Pool	Number tagged	Number recovered	1974 30 June	1974 1 July-31 Dec	1975 1 Jan-30 June	1975 1 July-31 Dec	1976 1 Jan-30 June	$\bar{X}$ Time out
1974	9	304	4	3		1			149
	10	111	1				1		548
	13	111	4		1	2		1	456
	14	54	2			1	1		342
	Combined	580	11	3	1	4	2	1	332
1975	9	61	1			1			30
	10	137	3			1	2		120
	13	121	2			2			81
	14	100	2			2			58
	Combined	419	8			6	2		83.5
1976	9	305	1					1	16
	10	105							
	13	103							
	14	106	1					1	13
	Combined	619	2					2	14.5

Table 2. Movement of tagged northern pike determined from angler caught fish.

Pool	Number of recaptured	Upstream direction %	Downstream direction %	Non-movement %	Overall movement Mean distance	S.D.
9	6	83	0	17	5.7 mi	± 6.4
10	4	25	50	25	0.0 mi	± 1.6
13	6	67	17	17	3.3 mi	± 4.5
14	5	80	20	0	9.8 mi	±14.2
Combined	21	67	19	14		

Table 3. Age distribution of 988 northern pike by sex and pool.

		Age						
Pool	Number	I	II	III	IV	V	VI	VII
Male								
9	209	8	55	32	5			
10	177	2	23	55	19	1		
13	122	1	33	48	16	2		
14	78	2	36	45	16	1		
Combined	586	3	37	45	14	1		
Female								
9	151	8	31	33	20	7	1	
10	71		2	40	36	17	5	
13	105		5	38	47	8	1	
14	75	2	23	38	26	6	3	2
Combined	402	3	15	37	31	10	3	1

MORTALITY AND SURVIVAL

Mortality and survival rates were calculated by two procedures from age distribution. Data from 1974 and 1975 were pooled to reduce bias resulting from differing recruitment between years and increase sample size. Data for males and females were again analyzed independently for each location.

Initial analysis was by Heincke's method (Ricker, 1975) according to the ratio:

$$A = \frac{N_0}{\Sigma N}$$

where N_0 = age at which all fish are vulnerable to capture. Since difficulty in age assignment increased with age, this equation was particularly appropriate as it was not necessary to assign age to older fish.

Age III was assigned to value of N_0 since it was the most abundant of all ages sampled in both sexes.

Mortality rates calculated by this method (Table 4) ranged from 72.0-87.5% for males with 76.5 for combined pools. The range among females was 40.0-53.4% with 45.1 for pools combined.

The second equation:

$$S = \frac{T}{\Sigma N + T-1}$$

with sampling variance estimated as:

$$S(S - \frac{T}{\Sigma N + T-2})$$

where

$$T = N_1 + 2N_2 + 3N_3 + \cdot\cdot\cdot$$

$$\Sigma N = N_0 + N_1 + N_2 + \cdot\cdot\cdot$$

by Robson and Chapman (Ricker, 1975) requires age assignment to older fish. Mortality rates calculated by this equation (Table 5) are somewhat higher than by Heincke's method, but the results are considered to be a better estimator because it takes into consideration the possibility of changing mortality rate with increasing age.

Mortality among males for combined pools was 79.9 with a range of 74.7-88.7. Mortality among females was 58.4 with a range of 56.4-59.4.

LENGTH-WEIGHT RELATIONSHIPS

Length-weight relationship expressed by the transformed linear equation:

$$\log_{10}W = a + b \log_{10}L$$

Table 4. Mortality and survival rate for northern pike by pool and sex determined by Heincke's method using Age III as number.

	Number at Age III	Age III and over	Annual mortality (A)	Survival (S)	Instantaneous mortality (Z)
Male					
Pool 9	49	56	87.5	12.5	2.08
10	99	133	74.4	25.6	1.36
13	59	82	72.0	28.0	1.27
14	40	52	76.9	23.1	1.46
Combined	247	323	76.5	23.5	1.45
Female					
Pool 9	31	63	49.2	50.8	.70
10	26	63	41.3	58.7	.53
13	40	100	40.0	60.0	.51
14	31	58	53.4	46.6	.76
Combined	128	284	45.1	54.9	.60

Table 5. Mortality and survival rates for northern pike by pool and sex determined by Robson and Chapman's method.

	Survival (S)	S_x	Annual mortality (A)	Instantaneous mortality (Z)
Male				
Pool 9	.113	.045	.887	2.18
10	.210	.033	.790	1.56
13	.243	.045	.757	1.41
14	.203	.055	.797	1.59
Combined	.201	.020	.799	1.61
Female				
Pool 9	.406	.045	.594	.90
10	.436	.051	.564	.83
13	.424	.032	.576	.86
14	.406	.045	.594	.90
Combined	.416	.023	.584	.88

where W = weight in kg and L = total length in mm was computed for each pool by sex for 1974 and 1975 samples (Table 6). Testing the coefficients in a t-distribution showed no significant differences ($P > .05$) between b-values by sex, year or location. Therefore, values for all samples were combined by pooling into the equation.

$$\log_{10}W = -8.068 + 2.96 \log_{10}L$$

Pooled standard deviation for the regression coefficients were ± .308 and ± .111. The correlation coefficient for fit was .96.

Table 6. Regression coefficients, standard error of coefficients, and correlation coefficients of length-weight relationship for northern pike by sex and year from four pools of the Mississippi River.

		Pool 9	Pool 10	Pool 13	Pool 14	Mean
1974						
Male	Intercept (a)	-7.64	-8.08	-8.09	-8.34	-8.04
	Standard error (S_a)	.23	.15	.20	.55	.28
	Slope (b)	2.80	2.97	2.96	3.05	2.94
	Standard error (S_b)	.09	.05	.07	.20	.10
	Correlation coefficient (r)	.93	.99	.98	.95	.96
Female	Intercept (a)	-8.17	-7.79	-8.01	-8.12	-8.02
	Standard error (S_a)	.19	.61	.39	.19	.35
	Slope (b)	3.01	2.88	2.96	2.98	2.96
	Standard error (S_b)	.07	.22	.14	.07	.12
	Correlation coefficient (r)	.97	.93	.96	.98	.96
1975						
Male	Intercept (a)	-8.47	-7.92	-8.85	-7.97	-8.30
	Standard error (S_a)	.34	.14	.22	.37	.27
	Slope (b)	3.09	2.90	3.11	2.92	3.01
	Standard error (S_b)	.12	.05	.08	.13	.10
	Correlation coefficient (r)	.97	.99	.98	.95	.97
Female	Intercept (a)	-8.65	-7.61	-7.46	-7.92	-7.91
	Standard error (S_a)	.28	.31	.39	.37	.34
	Slope (b)	3.16	2.80	2.77	2.92	2.91
	Standard error (S_b)	.10	.11	.14	.13	.12
	Correlation coefficient (r)	.99	.97	.94	.96	.96

COEFFICIENT OF CONDITION

Coefficients of condition (K) were also calculated for each pool and year by sex. Computations were made from grouped means of fish in 25 mm length increments.

Testing in a t-distribution showed no significant difference between K-values by year or location, so data were combined by pooling years and location.

Neither males nor females exhibited significant differences in K-values by length, but values were higher and more varied in females than in males (Table 7). This was attributed to spawning condition and whether individual fish had spawned at time of sampling.

Table 7. Coefficients of condition (K) for male and female northern pike by length increment.

Length group	Male	Female
350-374	.64	.71
375-399	.64	.82
400-424	.63	.61
425-449	.65	.70
450-474	.64	.68
475-499	.64	.69
500-524	.67	.70
525-549	.66	.70
550-574	.63	.70
575-599	.63	.76
600-624	.63	.72
625-649	.65	.69
650-674	.62	.70
675-699	.67	.62
700-724	.63	.73
725-749	.62	.70
750-774		.74
775-799		.69
800-824		.72
825-849		.70
850-874		.72
875-899		
900-924		.66
925-949		.80
950-974		
975-999		
> 999		.68
Mean	.64	.71

FECUNDITY

Fecundity data were collected in Pools 9, 13 and 14 in years 1974-1976, respectively from 58 fish ranging in size from 381 mm (3.7 kg) to 845 mm (4.54 kg). Ova were counted in single, 15 ml aliquots from ovaries preserved in 10% formalin. Total estimated ova ranged from 4,046 to 139,548. Overall egg production averaged 29,924 ova/kg of fish with a standard deviation of ± 2,337.

Linear regression equations for total length and weight on ova were completed in the simple functions Y = a + b TL and Y = a + b Wgt, where Y = total ova, TL = total body length in mm, and Wgt = body weight in kg. Coefficients for solution of the equations were as follows: Ova = -80,473.4 + 221.7 TL and Ova = 5,510.76 + 27.01 Wgt. Eighty percent of the variation in ova counts were explained by length and 85% by weight.

Multiple linear regression of TL and Wgt on ova ($Y = a + b_1 TL + b_2 Wgt$) was: Ova = -10,216.09 + 39.03 TL + 22.57 Wgt. Eighty-six percent of the variation was explained by the independent variables.

COMMERCIAL FISHERY POTENTIAL AND ASPECTS

FISHERMAN RESPONSE TO QUESTIONNAIRE

A questionnaire requesting information on expected benefits of a northern pike commercial fishery was mailed to 623 commercial fishermen. Voluntary responses were obtained from 302. No attempt was made to encourage additional response.

Results were analyzed by pool in which the fishermen operated and size of the business. Size of fishing operation was determined by estimated average annual harvest and was categorized as < 1,000, 1,000-10,000 and > 10,000 lbs. In general, responses were fairly evenly distributed among pools, but the proportion of large operators decreased progressively downstream (Table 8). Sixteen percent reported 710,000 lbs; 20% reported > 1,000-10,000 lbs, and 56% reported less than 1,000 lbs. Responses to individual questions are presented in Tables 9 and 10.

Forty percent indicated northern pike were present in sufficient quantities in their locality to commercially harvest. Response varied from 17% to 86% with more fishermen upstream than downstream responding to the affirmative. This trend was expected as population density diminishes progressively downstream. Responses also varied with size of fishing operation; a greater percentage of large operators answered yes than small operators.

Percentages of fishermen indicating they would fish for northern pike if placed on the commercial list followed a similar trend with 43% answering affirmative.

Table 8. Questionnaire response in each pool by fishermen based on weight of fish caught in average year.

		Percent			
Pool	Number	> 10,000 lbs	1,000-10,000 lbs	< 1,000 lbs	Not indicated
9	35	37	49	14	-
10	34	21	26	50	3
11	23	13	26	61	-
12	14	29	21	43	7
13	39	15	23	62	-
14	21	19	14	57	10
15	13	--	23	69	8
16	20	5	20	70	5
17	22	14	23	54	9
18	51	12	25	63	-
19	30	6	17	77	-

Table 9. Percent of affirmative responses to questions posed to commercial fishermen pertaining to northern pike with responses grouped according to pool in which the fishermen operated.

	Pool											
Question	9	10	11	12	13	14	15	16	17	18	19	Combined Pools
Do you think northern pike are present in sufficient numbers in your area to harvest commercially?	86	68	48	50	47	41	27	24	32	17	21	40
Would you fish for northern pike if they could be legally taken commercially?	71	56	48	46	29	48	54	32	32	33	28	43
Do you feel they would increase your income by a worthwhile amount?	58	50	41	33	17	33	17	7	18	29	7	28
Did you fish for northern pike before 1959 when the season was open?	28	12	18	25	10	15	8	10	5	2	3	12
Would you expect to market your northern pike locally or by shipping to Chicago? (answer in % local).	79	30	62	13	82	85	89	91	83	96	92	72

Table 10. Percent of affirmative responses to questions posed to commercial fishermen pertaining to northern pike with responses grouped according to size of fishing business.

Question	Size of fishing business expressed as average annual harvest		
	< 1,000 lbs	1,000-10,000 lbs	> 10,000 lbs
Do you think northern pike are present in sufficient numbers in your area to harvest commercially?	26	51	71
Would you fish for northern pike if they could be legally taken commercially?	31	53	71
Do you feel they would increase your income by a worthwhile amount?	13	36	61
Did you fish for northern pike before 1959 when the season was open?	4	12	39
Would you expect to market your northern pike locally or by shipping to Chicago? (answer in % local).	87	68	50

More upstream and large operators stated northern pike would increase their income by a significant amount, but only 28% of the overall number held this opinion.

Fishermen were asked if they had fished for northern pike when they were on the commercial list (prior to 1959). Twelve percent gave confirmation. Response to this question was biased by longevity of the fishing operation. As a result more large, well established operators had more experience than small operators. More upstream fishermen had fished for northern pike than downstream fishermen.

Most fishermen expected sales of northern pike to be local rather than shipment to distant markets. This opinion was especially prevalent among downstream fishermen and small operators.

Condition of fish at time of sale (i.e., whole, dressed, drawn, etc.) was not specified on the questionnaire and response in expected value per pound varied widely. There was no significant difference between pools, but there was a difference by size of operator. The greater portion of fishermen landing over 10,000 lbs annually expected only 11-25¢/lbs. A high percentage of those landing 1,000-10,000 lbs expected 26-50¢/lbs while a large portion of those landing less than 1,000 lbs expected 51¢-$1.00/lbs.

CHEMICAL CONTAMINATION OF NORTHERN PIKE FLESH

A literature research conducted during the first year of investigation indicated the presence of various contaminants in some species of food fishes in the Mississippi River. Records of analyses of northern pike, however, were sparse. As a result, samples were tested for possible contaminants.

Composite flesh samples from 18 fish in Pool 9 and 22 fish in Pool 14 were collected during March, 1976. Pool 9 fish were captured 2-4 miles upstream from Lansing and Pool 14 fish were captured 2-4 miles downstream from Camanche. Both sampling stations were on the Iowa side of the river.

Fish size ranged from 489 mm (.84 kg) to 817 mm (4.23 kg) and averaged 1.64 kg in Pool 9 and 384 mm (.37 kg) to 845 mm (4.55 kg) and averaged 2.09 kg in Pool 14.

Three 25-30 gm samples of flesh consisting of vertical bands were removed from each fillet near the mid-section, anterior to the dorsal fin. Disposable surgical gloves were worn during the sampling process. The three samples from each fish were pooled with other like samples for replication. Pooled samples were double wrapped in aluminum foil which had been prewashed by rinsing with ether and frozen. Analytical work was conducted by the Iowa State Hygenic Laboratory.

Tests were conducted to determine chlorinated hydrocarbon pesticides, Atrazine, PCB's and mercury. Analysis for phenols were not attempted due to lack of an acceptable method.

Test results indicated substantial differences between stations (Table 11), but both were well below FDA tolerance levels in all parameters tested.

Table 11. Concentrations of chemical contaminants in composite northern pike flesh samples from two Mississippi River locations.

Pool	Replicate	Dieldrin (ppb)	DDE (ppb)	Heptachlor epoxide (ppb)	Chlordane (ppb)	PCB[a] (ppm)	Mercury (ppm)
9	1	2	1	-	-	.22	.12
	2	2	2	-	-	.16	.27
	3	2	1	-	-	.29	.19
	Mean	2.0	1.3	-	-	.22	.19
14	1	14	6	3	7	.11	.17
	2	15	7	3	8	.10	.16
	3	12	4	2	6	.10	.17
	Mean	13.7	5.7	2.7	7.0	.10	.17

[a]Parts per million as arochlor 1254.

Pesticides were quite low. PCB was well below the tolerance level. Atrazine was not detected, however, because the analytical method is significantly less sensitive than for other pesticides listed, this compound could only be tested down to a lower detection limit of about 100 ppb.

These samples are consistant with others tested from the Mississippi River in the past, showing higher levels of pesticides in Pool 14 samples. This indicates significant inflow from sources between Pools 9 and 14. PCB showed the opposite effect, strongly suggesting that the major sources of PCB in the Mississippi are upstream from both sampling sites.

WEIGHT LOSS IN COMMERCIAL FOOD-FISH PROCESSING

Weight change resulting from various processing methods were determined from 29 fish during the second study segment. These combined with 15 fish processed during the first segment resulted in an adequate sample for statistical analysis to determine differences in weight change by fish size.

Individual fish were marked by placing a No. 2 Monel Wing Band Tag at the base of the dorsal fin measured in mm and weighed to the nearest .01 kg before processing. Weights were determined again after each step in processing. Fish were dressed by removing the head anterior to the clethria and eviserated.

Scales and fins were left intact. A sample of 9 fish of various sizes were further dressed by filleting. Those not processed for fillet weight were smoked. Fish size ranged from 105 mm (.75 kg) to 1,010 mm (6.70 kg).

Small fish did not loose as much weight when dressed as did large fish. Dressed weight expressed as percent of whole weight decreased 79.7% to near 70% for fish .50-2.00 kg and remained at 70% for larger fish. Dressed weight expressed as a percent of whole weight for the entire sample was 72%. Smoked weight was 37% and fillet weight was 47.4% of whole weight.

COMMERCIAL HARVEST

Commercial harvest statistics for northern pike are available annually for the period 1954-1959. The initiation of joint data collection by the UMRCC was in 1954, then in 1959, commercial harvest of this species was terminated. Iowa was the only state permitting commercial harvest of northern pike.

Harvest averaged 27,000 lbs with a high of 48,000 reported in 1954, and low of 13,000 in 1957.

Value per pound remained 22-23¢/lbs except for one year. Value in 1959 was only 12¢/lbs. Since this figure does not fall in line with remaining years, a recording error is suspected. Total value ranged from $3,000-$11,000 with an average of $5,500.

Compared with the total commercial fishery, northern pike contributed 1.4% to the harvest value in Iowa and 1.0% of the total weight.

Upstream pools consistantly produced more northern pike than downstream pools. Pool 9 produced 58.5% while Pools 10 and 11 produced 27.4% and 10.3%. The other nine pools bordering Iowa contributed the remainder. Northern pike were not reported from some pools during the 6-year period.

Interviews with commercial fishermen indicated that low harvest of northern pike in downstream pools increased reporting error. Too few fish were produced to establish a market. As a result northern pike were frequently weighed with other species, usually carp, and sold at the same price, making separate records impractical.

In Pools 9, 10, and 11, northern pike contributed 2.1%, 4.1%, and 1.9% of the total fishery.

Entrapment devices were the most effective gear. This gear accounted for 89.9% of the catch. Seines, entanglement and set lines followed with 7.9%, 1.0% and .2% of the catch, respectively. One percent was not assigned a method of capture.

Though records do not specify monthly harvest, fishermen interviews indicated most of the harvest occurred in March and April during the spawning run. A secondary peak in harvest occurred in the fall (September and October) with the remainder of the catch scattered throughout the summer. Few were taken under ice cover.

Fishing records kept by a Lansing fisherman indicated seasonal value followed a similar trend, increasing as sufficient supply became available to establish a market.

RECOMMENDATIONS

At the present stage of the investigation, data strongly suggests harvest on northern pike could be substantially increased. Total mortality rates for males and females are 79.9% and 58.4%, respectively. Since sport fishing mortality is estimated at < 1%, natural mortality is quite large and could be reduced by a significant amount by increasing harvest.

Recovery by experimental netting, however, indicates netting is extremely effective and less fishing pressure could be tolerated in downstream pools where habitat is confined and population exist in diminished numbers. Continued investigation of these aspects are recommended in order to better define extent of harvest the population can support on a sustained yield.

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