PROGRESS REPORT ON THE FIRST YEAR STUDY OF SHOVELNOSE STURGEON IN THE MISSISSIPPI RIVER

By

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Annual Progress Report for Project 2-156-R-1

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ABSTRACT

Field operations of Federal Aid Project 2-156-R-1 were started July 1971 at the Mississippi River bordering Iowa. The study was designed to investigate commercial shovelnose sturgeon harvest, study the life history and evaluate the present reporting system. Samples totaling 3,188 commercially harvested sturgeon were examined. An additional 2,156 were captured for life history studies. One thousand eight hundred eighty-two were tagged, and Schnabel population estimates, movement and harvest information was obtained from 168 recaptures. Age and growth, length-weight relationships and condition factors were calculated. Preliminary information is also presented on maturation and fecundity. Extensive larval fish sampling by meter netting techniques were unsuccessful in capturing larval sturgeon, however, young measuring 1.8 inches were collected by other methods.

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INTRODUCTION

Shovelnose sturgeon is a valuable commercial food fish in the Upper Mississippi River basin. Harvest inventories indicated the commercial catch bordering Iowa ranged as high as 60,000 lbs and has a wholesale market value of more than $15,000. Most of the catch is processed by smoking and demand greatly surpasses supply. Wide fluctuations occur in the catch from year to year. Helms (1970) reported 58,591 lbs taken by Iowa fishermen in 1958 and 5,249 lbs in 1962. This appeared as a result of variability in year class abundance rather than fluctuation in market price culminating in lower fishing pressure.

Sufficient knowledge for proper management and utilization of this resource is not presently available. As a result, Iowa entered into a 3-year contract with the National Marine Fisheries Service (PL:88-309) to investigate shovelnose sturgeon in the Mississippi River bordering Iowa.

The project was comprised of three parts. The first dealt mainly with the commercial catch of shovelnose sturgeon, particularly total estimated harvest, age and size structure and economic contribution of shovelnose sturgeon caught for commercial marketing. The second was to complete a comprehensive study of the life history of this species in the Mississippi River. This segment included abundance, distribution, fecundity, spawning habits and location, age and size structure, growth rate and other important biological parameters. The final objective was to evaluate the present commercial catch reporting system. There is a compulsory reporting system for all commercial fishermen in Iowa. However, the reliability of this system was questionable since it relied mainly upon memory of fishermen and on honor reporting rather than wholesale and retail market receipts. Most fishermen did not report their total catch, and under

reporting of shovelnose sturgeon was greatly magnified. Since it is not the primary species caught, much was simply forgotten.

The shovelnose sturgeon studies will provide all states bordering the upper Mississippi River with information vital to the management of commercial shovelnose sturgeon fisheries. The following is the first annual report of these studies.

COMMERCIAL HARVEST INVENTORY

Much of the commercial sturgeon harvest effort on the Mississippi River is directed toward the spring run in tailwater areas during May and June. Earlier studies by Helms (1970) showed 43% of the annual harvest was taken during these two months. A second peak occurred later in the summer.

The most popular fishing method below dams during this period is "dead" setting trammel nets. More specifically, nets are anchored with a heavy weight near the dam (900 ft is the minimum legal distance) and trailed downstream parallel with the current on the river bottom. The downstream end is usually bouyed with plastic jugs. Nets are tended once daily. Dimensions of nets fished for sturgeon in this manner are usually 6-ft deep and 100 yds long with the inner web of 2-2 1/2 inches bar measure, No. 178 or finer twine.

Occasional catches of 300 lbs or more were often observed, but the average lift would be 50-75 lbs. Normally, three or fewer nets were fished simultaneously.

Other methods of fishing include "dead" setting nets either parallel or perpendicular to the current in the main channel border (Sternberg, 1971) just outside the main channel habitat during periods of low flow and drifting. Nets used for drifting are similar except they are usually much shorter. Length of the net usually depends on the size of areas in which they are fished.

Drifting requires river current and clean bottom. Fishermen using this technique usually choose gravel or sand bottom areas with few obstructions. Most are located in main channel or main channel border habitats and drifted repeatedly once they are cleared of snags.

Drifting trammel nets are fished by laying the net perpendicular to the current at the upstream end of a drift area. The nets are slightly demersal and drag lightly along the bottom as they move with the current. Sometimes nets are attached by about 75 ft of rope to a float at each end. The floats, termed "mules" by commercial fishermen, are designed to deflect the current in such a way as to pull the net downstream and keep it stretched out. These are used most often during periods when stream velocity is insufficient to carry the net.

Drifting nets are given constant attendance and fished singly or paired. This method of fishing is currently popular with a number of commercial fishermen in Pool 17. Sturgeon harvested by other types of gear appear to be incidental to other primary species (Helms, 1970).

Samples totaling 3,188 commercially harvested sturgeon were examined during the first year of study. Most fish were captured from Pool 13. A large portion of the harvest was by a single fisherman, however, catches from several pools were also examined.

All fish examined were measured. The resulting length-frequency distributions are summarized in Table 1. Although there is no legal size-limit < 5% measured are < 19 inches fork length. The most prevalent class interval was 20 inches, and 63% were 19-23 inches. Less than 1% exceeded 29 inches.

Subsamples were collected for aging, length-weight relationship, fecundity, and maturity. Analyses of these parameters are incomplete at this time or will be presented in the next section of this report.

Table 1. Length-frequency distribution of shovelnose sturgeon in the commercial catch sampled during the first year of study

Class interval (FL)	Pool 9	Pool 12	Pool 13	Pool 17	Weighted average
12.0-12.9			< .1		
13.0-13.9					
14.0-14.9			.1		
15.0-15.9			.2		.1
16.0-16.9			.2		.1
17.0-17.9			.6		.2
18.0-18.9	.4	5.4	5.3	3.8	3.7
19.0-19.9	4.4	10.8	17.1	23.1	13.9
20.0-20.9	13.5	10.8	22.7	23.1	17.5
21.0-21.9	14.4	16.2	18.9	15.4	16.2
22.0-22.9	18.3	27.0	12.8	3.8	15.5
23.0-23.9	17.0	13.5	8.9		9.9
24.0-24.9	11.8		4.6	11.5	7.0
25.0-25.9	5.7	2.7	2.5	11.5	5.6
26.0-26.9	6.7	2.7	2.4	7.7	4.9
27.0-27.9	4.4	8.1	1.5		3.5
28.0-28.9	2.2	2.7	1.3		1.6
29.0-29.9	.4		.5		.2
30.0-30.9	.9		.2		.2
31.0-31.9			.1		
32.0-32.9			< .1		
Number in sample	229	37	2,935	26	

ECONOMIC ASPECTS OF PROCESSING SHOVELNOSE STURGEON

Shovelnose sturgeon are highly valued along the Iowa section of the Mississippi River, and supply seldom meets demand. As a result, market values are among the highest for any commercial species. It was the intent of this study segment to analyze weight loss and changes in value during processing and determine differential profits between sizes.

The study is based on data collected from 123 specimens. Fish were individually marked before processing by placing a No. 3 monel wing band tag

on the dorsal base of the caudal fin. They were weighed, measured, dressed, weighed again, smoked and weighed a third time. In addition, 43 were stripped of all edible portions after smoking and weighed a fourth time.

Table 2 provides information on the numbers of fish by quarter pound increments, mean length, weight, condition and weight losses during processing. The mean weight loss for all sizes combined are 28.6% from whole to dressed and 31.4% from dressed to smoked or 51% from whole to smoked.

There was no relationship between size and weight loss as the result of dressing. There was, however, greater loss in smoking smaller fish. It was assumed this resulted from higher evaporation loss because of greater surface area to body weight at smaller sizes.

Sturgeon values varied considerably in all stages of processing. Whole sturgeon bring from 25-40¢ per lbs but more commonly sell for 35¢. Dressed sturgeon ranged from 55-70¢ per lbs while 60-65¢ were common values. By dressing the fish, a sturgeon fisherman can increase the value of his catch by a considerable margin. Most choose this because experienced individuals can dress a hundred lbs of sturgeon in 15-30 minutes. Table 3 expressed the margin of profit when outlets for both whole and dressed fish were available.

After sturgeon were smoked, 58.4% of the fish by weight was not edible. Since market prices for smoked sturgeon ranged from 90¢-$1.45 per lbs, the cost of edible portions was quite high. Figure 1 illustrates the cost of smoked sturgeon with edible portions.

LIFE HISTORY INVESTIGATIONS

Most of the life history studies were conducted at Pool 13. In addition to examining commercially caught fish 2,156 were captured for study. Most of these were tagged and released for population estimates, determination of

Table 2. Preliminary information and weight loss during processing of 123 shovelnose sturgeon from the upper Mississippi River

	Size group (lbs)								
	.50-.75	.76-1.00	1.01-1.25	1.26-1.50	1.51-1.75	1.76-2.00	2.01-2.25	4.51-4.75	Means
Number sampled	19	28	38	21	10	4	2	1	123 (total)
Mean FL (inches)	17.5	18.9	20.5	21.6	22.2	23.0	24.2	30.6	
Mean condition (C)	17.86	12.80	13.54	13.88	14.98	14.98	14.70	16.54	
Mean live weight	.66	.86	1.11	1.37	1.58	1.88	2.08	4.74	
Mean dressed weight	.47	.59	.76	.97	1.16	1.35	1.52	3.50	
Mean smoked weight	.28	.38	.49	.65	.84	1.06	1.12	2.40	
Dressed/ whole (percent)	71.2	68.6	68.5	70.8	73.4	71.8	73.1	73.8	71.4
Smoked/ whole (percent)	42.4	44.2	44.1	47.4	53.2	56.4	53.8	50.6	49.0
Smoked/ dressed (percent)	59.6	64.4	64.5	67.0	72.4	78.5	73.7	68.6	68.6

Table 3. Value changes associated with processing shovelnose sturgeon

Stage in processing	Price per lbs	Value per 100 lbs of whole fish	Value per 100 lbs of dressed fish
Whole	.25	25.00	
	.30	30.00	
	.35	35.00	
	.40	40.00	
Dressed	.55	39.27	55.00
	.60	42.84	60.00
	.65	46.41	65.00
	.70	49.98	70.00
Smoked	.90	44.10	61.74
	.95	46.55	65.17
	1.00	49.00	68.60
	1.05	51.45	72.03
	1.10	53.90	75.46
	1.20	58.80	82.32
	1.25	61.25	85.75
	1.35	66.15	92.61
	1.45	71.05	99.49

movements and verification of aging techniques. Data was also collected on early life stages, fecundity, age and size at maturity, length-weight relationships and other important biological parameters.

Two basic types of gear were used for collecting sturgeon. These were trammel net and trawl. Trammel nets were fished by drifting and were designed for this purpose. Nets measured 100 ft x 6-ft with 1-1/2 inches (bar measure) inner web, No. 178 twine. Walling was 10 inches (bar measure), No. 9 twine. Float lines contained standard sized plastic floats 2-ft apart. Lead lines had 3 leads per float. Inner web was hung relatively tight as a loosly hung inner web tends to drag on the bottom collecting much debris, muscle, shells and rocks. Methods of drifting were comparable to those used by commercial

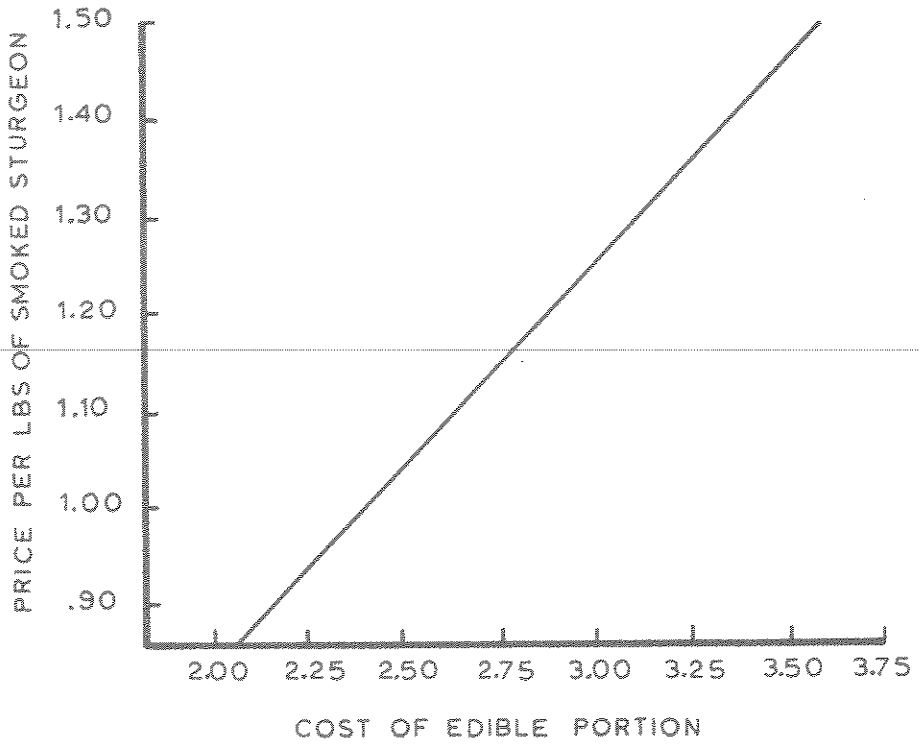

Figure 1. Cost of edible portion of smoked shovelnose sturgeon compared to whole smoked fish when 58.4% is not edible.

fishermen described earlier.

The trawl was a standard 16 ft semi-balloon design modified by the attachment of a 6-ft extension of 1/8 inch Ace web. Towing direction was usually upstream. Downstream or around current towing was only done in areas known to be free of snags.

During periods of maximum effort, two trammel nets were fished simultaneously, either one behind the other or side by side. While they were drifting, one or two trawl hauls could be made either behind or between trammel nets. A standard trawl was 2-11/2 minutes pulled at full throttle by a 16 ft boat powered with a 40 hp motor. Trammel nets were permitted to drift until they became "snagged" or approached known obstacles. Drifts were

subjectively labeled short, medium or long. Short drifts were usually < 200 ft while long drifts were .5-1 mile and took as long as 30 minutes. Fish were held in a live tank and processed after the nets were reset. Using this technique, up to 20 drifts and 15 tows could be made during an 8-hr day.

TAGGING STUDIES

Two methods were used to tag sturgeon in 1971 which involved serially numbered Floy dart tags. Initially, the tagging was accomplished by anchoring a tag in the mid-section midway between the dorsal and lateral rows of bony plates. After tagging 447 fish in this manner, it became apparent tag loss was quite high and resulted in changing the anchoring locations between plates on the lateral line. Three hundred ninety fish were tagged in this manner. Tag shedding was not as rapid but was observed. Recaptured fish showed progressive erosion posteriorly through the plates until the tag simply fell out.

Beginning in 1972 tagging methods were again altered. Schmulbach[1] (personal communication) indicated high success with monel tags attached to the pectoral fin. Tags were placed over the anterior fin rays close to the body. This method was used in combination with a Floy tag anchored through the pectoral girdle dorsal to the fin. Examination of 13 recaptured fish indicated little chance of tag loss from either method. After 502 fish were tagged in combination the monel tag was discontinued.

Several sturgeon were also tagged by the "lateral plate" method in other pools in conjunction with commercial harvest studies. In all, 1,882 have been tagged, and 168 have been recaptured (Table 4).

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[1] Schmulbach, James C. University of South Dakota, Vermillion. Letter dated 18 October, 1971 relating to tagging methods.

Table 4. Shovelnose sturgeon tagging effort and numbers recaptured by commercial fishermen and state crews during the first year of study

Pool	Number tagged	Number of state recaptures	Number of commercial recaptures	Total recaptures
9	108	1	2	3
11	108	2	1	3
13	1,380	100	45	145
14	27	0	2	2
15	1	0	0	0
16	37	0	1	1
17	97	4	6	10
18	3	0	0	0
19	121	0	4	4
Total	1,882	107	61	168

Detailed analyses have not been completed for recaptured sturgeon, but preliminary observations indicate rapid growth and little movement. The maximum distance between capture and recapture points was 13 miles, while most were recaptured within 5 miles of the release point, and none have been recaptured outside the pool in which they were tagged.

Of the 168 recaptures, two fish were recaptured three or more times. One of these had a tag scar when captured on 5 June, 1972, indicating it had been tagged during 1971. It was retagged and captured twice more. Fork length on 5 June was 23 inches and increased to 23.1 on 13 June and to 23.2 on 21 June. Distances traveled were downstream .5 miles and upstream 2.4 miles. A second fish measured 12.6 inches on 11 August, 1971. The following 6 June, FL increased 2.9 inches and was captured .2 miles upstream. On 28 July, 22 days later, it was recaptured at the original capture site and had increased an additional .7 inches. Such length increases and distances traveled were typical of recaptures.

POPULATION ESTIMATES

Two population estimates based on the Schnabel formula (Lagler, 1961) were initated in Pool 13 near Bellevue. The first is based on 43 recaptures of 835 fish tagged in 1971 by the two methods of side tagging described previously. Estimates initially stabilized between 6,000 and 7,000, then increased to 13,000 near the end of the 1971 fishing season (Table 5).

Table 5. Population estimates of shovelnose sturgeon by side tagging in Pool 13 near Bellevue, Iowa

Date (1971)	N fish captured	N recaptures	Marked fish in population	Population $\hat{N}$
6-24	16	2	84	1,954
6-28	47	0	97	4,234
6-29	117	2	144	6,329
7- 6	16	1	259	5,892
7- 7	1	0	274	5,946
7- 8	5	0	275	6,222
7- 9	7	0	280	6,614
7-12	2	0	287	6,728
7-13	58	6	290	4,587
7-14	152	8	340	5,376
7-15	53	4	438	5,450
7-16	55	2	483	6,077
7-19	8	1	536	6,008
7-30	14	0	543	6,300
8- 2	15	1	557	6,377
8-10	5	0	571	6,482
8-11	67	3	576	7,120
8-16	3	1	637	6,952
8-27	11	1	639	6,955
9- 8	34	0	838	7,633
9-20	45	1	672	8,318
9-28	86	2	716	9,602
10-14	112	4	716	10,673
10-15	27	1	825	10,963
10-29	94	3	827	12,006
11- 4	41	0	827	12,795

Recruitment, imigration of tagged fish and tag loss were three possible explanations. Since recruitment was minimized by adjusting for growth, and tag returns indicated little movement, the increasing estimate was attributed to tag loss. Seven sturgeon were recaptured with sears or lesions where tags had been lost. Some were difficult to recognize by mid-August and it is highly probable that some were overlooked.

The second estimate is based on 13 recaptures of 502 fish double tagged in 1972 as previously described. No tag loss was noted from using this method and population estimates ranged from 12,995 to 19,773 averaging 16,066 (Table 6).

Table 6. Population estimates of shovelnose sturgeon by double tagging in Pool 13 near Bellevue, Iowa

Date (1972)	N fish captured	N recapturéd	Marked fish in population	Population $\hat{N}$
6- 5	64	1	129	19,475
6- 6	109	2	179	12,995
6-12	39	0	272	16,532
6-13	47	1	299	15,912
6-14	39	1	327	15,280
6-16	120	1	352	19,773
6-21	25	1	434	18,498
6-27	37	3	453	14,625
6-29	7	0	468	14,953
7- 7	49	2	468	14,372
7-12	27	1	501	14,307

The larger second estimate resulted from expanding the fishing grounds. Tagging during 1971 was over a 4-mile stretch of river, while fishing effort in 1972 was covered 10 miles of the river downstream from the Bellevue Dam.

LIFE HISTORY

Anterior pectoral fin rays and body measurements were collected from 110 shovelnose sturgeon captured 29 October-5 November, 1971. Fork length ranged from 7.4 to 23.7 inches and weight ranged from .06 to 2.02 lbs.

Pectoral fin rays were sectioned and aged by conventional methods. Mean lengths at time of capture were 8.9, 13.7, 18.9 and 22.0 inches for ages 0, I, II and III, respectively (Table 7). Aging by this technique agreed closely with length frequency (Table 8).

Table 7. Calculated fork lengths and increments for each year of life for 100 shovelnose sturgeon from Pool 13

Year Class	Age Group	N	Year of life 1	2	3	4
1971	0	9	(8.9)*		Growth	
1970	I	59	7.8	(13.7)		
1969	II	22	8.4	14.4	(18.9)	
1968	III	20	8.5	14.0	18.7	(22.0)
Mean est. FL			8.2	14.2	18.7	
					Increments	
1971	0	9	(8.9)**			
1970	I	59	7.8	(5.9)		
1969	II	22	8.4	6.0	(4.5)	
1968	III	20	8.5	5.5	4.7	(3.3)
Mean increments			8.2	5.8	4.7	
Sum of increments			8.2	14.0	18.7	

*Observed FL at time of capture.

**Calculated growth increment during current growing season.

Table 8. Length-frequency distribution of 110 aged shovelnose sturgeon collected from Pool 13

Class interval (FL)	Age group 0	I	II	III	All combined
5.0- 5.9					
6.0- 6.9					
7.0- 7.9	1				1
8.0- 8.9	2				2
9.0- 9.9	6				6
10.0-10.9					
11.0-11.9		2			2
12.0-12.9		12			12
13.0-13.9		20			20
14.0-14.9		16			16
15.0-15.9		8			8
16.0-16.9			1		1
17.0-17.9		1	4		5
18.0-18.9			9		9
19.0-19.9			3		3
20.0-20.9			4	4	8
21.0-21.9			1	5	6
22.0-22.9				8	8
23.0-23.9				3	3
Total	9	59	22	20	110

Length-weight relationship for the sample was estimated as

$$\log_{10} W = -4.292 + 3.3076 \log_{10} FL$$

with standard deviation for the regression coefficient of ±.046 and ±.038, respectively. Correlation coefficient for this fit was 0.986. Condition factors ranged from 9 to 17 with a mean of 11.6.

Only two mature fish were included in the sample. Both were males measuring 22 inches.

SIZE AT MATURITY, SPAWNING TIME AND FECUNDITY

Beginning 5 April, 1972, biweekly samples of 10 fish were selected from catches for examination. Supplemental samples were secured commercially. Fork length and weight were recorded before disection. Gonads were removed, measured volumetrically and described by estimating amount of fat attached, sex and development. Males were placed in three categories: immature, mature and ripe. Gonads of immature males appeared as orange to pale yellow, narrow, longitudinal,homogenous bands on the dorsal surface of the gonadal fat. Gonads of mature males were larger white to grey homogeneous bodies. Males were considered ripe only when milt could be stripped by gently moving a thumb posteriorly along the abdomen.

Females were classed as immature, with eggs and spent. The gonads of all females have a laminated appearance along the dorsal surface of the fat body. In "early immature" individuals, this area is lighter than the surrounding fat. As the fish mature the laminated area expands into the fat body. Those with eggs are described by egg color as yellow, salt and pepper or black eggs. Spent females had much grey fluid within the body cavity and the gonad are somewhat reduced in size and bloodshot. Egg counts were made in all specimens with black eggs.

Data collection for this phase of study is continuing and analyses are incomplete, however, some preliminary observations are as follows. Immature males and females have occurred through 25 inches FL. The smallest mature male measured 22 inches and the smallest female 24 inches. Ripe males were observed 24-29 May. The first spent females was taken 29 May, but fish with mature eggs were collected as late as 12 June.

Although numerous fish were examined, few were carrying eggs and data on fecundity was limited. Five fish ranging from 26.2 to 28 inches FL had egg counts ranging from 21,807 to 43,814 with a mean of 32,662. Ovaries averaged 19.4% of the body weight, and fat and connective tissue comprised 4.9-20.8% of the gonad volume. Eggs were black in color and measured 87-140 per ml (Table 9).

Table 9. Total egg counts and ovarian-body weight ratios of five shovelnose sturgeon collected in Pool 13 from 3 May to 7 June, 1972

Date	FL	Wgt (lbs)	$\frac{\text{Ovary wgt}}{\text{body wgt}}$ (%)	Fat in gonad (%)	Number of eggs/ml	Est. N of eggs/ female
3 May	28.8	4.32	16.4	4.9	87	25,000
17 May	26.2	3.32	15.9	18.5	112	21,807
24 May	27.2	3.49	19.7	16.3	140	36,624
29 May	28.0	3.72	19.4	20.8	139	36,063
7 June	28.8	4.61	25.7	17.7	97	43,814
Mean		(3.89)	(19.4)	(15.5)	(115)	(32,662)

These results differed considerably from findings at the Missouri River near Vermillion, South Dakota. Zweiacker (1967) reported a mean of 9,210 eggs per fish with a range of 6,709-15,637 for 30 fish. These fish were much smaller than those from the Mississippi River, ranging from 780 to 312 g (.7-1.7 lbs). Eggs taken from Missouri River fish were often grey colored and gonads contained little or not fat (Schmulbach, personal communication)[2].

[2]Schmulbach, James C. Verbal communication 15 April, 1972, relating to egg color and fat content of gonads.

EARLY LIFE HISTORY STUDIES

Investigations of the early life stages were attempted from collections of larval fishes using meter netting techniques during 1971. Collecting attempts were unsuccessful in 1971 and efforts were expanded and modified in 1972. A report on the 1971 larval fish collections were presented at the 1972 Dubuque, Iowa meeting of the Upper Mississippi River Research Consortium.

Sampling was conducted by towing a cone-shaped net one mm in diameter, 10-ft in length and having 32 meshes per inch at full throttle behind a 16-ft boat powered with a 40 hp outboard motor. The direction of towing was always upstream. Three, 5-minute samples were collected at each of two sampling stations, three times a week. Station 1 was in the tailwaters of Lock and Dam 12 and Station 2 was located seven miles downstream in main channel border at the lower end of a one mile long gravel bar known locally as the Sand Prairie. Sampling was initiated on 5 May and terminated on 12 July. One hundred eighty samples were collected.

Field samples were preserved in 5% buffered formalin. Larval fish were later sorted from debris, stained with Alazarin Red S and examined under 7 to 30 power magnification. Larval fish keys by May and Gasaway (1967) and Mansuetti and Hardy (1967) were the primary reference materials used for identification. Generally, species not identifiable by use of these keys were grouped as unknowns. However, some were identified by following growth until a recognizable stage was reached.

All fish were counted and sub-samples consisting of a maximum of 25 fish of a species in each sample were measured in mm. Species represented by sufficient numbers were analyzed statistically to determine if differences between tows, stations, days within weeks and weeks were significant.

Fish were classified into 16 identifiable groups including 14 genera, and a composite group including minnows and suckers and an unknown category. No young sturgeon were observed in the hauls. Identifiable genera were: *Aplodinotus*, (freshwater drum); *Cyprinus*, (carp); *Dorosoma*, (gizzard shad); *Esox*, (northern pike); *Hiodon*, (mooneye); *Ictalurus*, (channel catfish); *Lepisosteus*, (gar); *Lepomis*, (blue gill and sunfish species); *Micropterus*, (largemouth bass); *Noturus*, (stone cat and/or madtoms); *Percina*, (log perch and darters); *Pomoxis*, (black and white crappie); *Roccus*, (white bass); and *Stizostedion*, (walleye and sauger).

Table 10 lists the data of first collection, modes of occurrence and the total number collected for each group in descending order of abundance.

Table 10. Dates of initial collections, modes of occurrence and numbers of larval fish collected in Pool 13 of the Mississippi River in 1971

Group	First collection		Mode of occurrence		Number collected
	Week	Date	Week	Date	
Aplodinotus	4	26 May	8	23 June	35,489
Minnows and suckers	1	5 May	3 & 7	19 May & 16 June	18,369
Cyprinus	2	12 May	8	23 June	6,659
Lepomis	5	2 June	8	23 June	699
Pomoxis	2	12 May	3 & 7	19 May & 16 June	646
Dorosoma	3	19 May	7	16 June	560
Roccus	2	12 May	8	23 June	507
Hiodon	1	5 May	3	19 May	466
Percina	1	5 May	2	12 May	391
Stizostedion	1	5 May	2	12 May	246
Ictalurus	8	23 June	8	23 June	7
Micropterus	5	2 June	8	23 June	4
Noturus	7	16 June	8	23 June	2
Esox	2	12 May	2	12 May	1
Lepisosteus	8	23 June	8	23 June	1
Unknowns	1	5 May	2 & 6	12 May & 9 June	478
All combined	1	5 May	3 & 7	19 May & 16 June	63,525

There were sufficient numbers of carp, crappie, white bass and the minnow-sucker group test by analysis of variance of catch mean. No statistical difference at the 99% level of confidence was found between tows, sites, or days within weeks for any species. There was significant difference between sites for crappie at the 95% confidence level. All species showed significant differences between weeks ($P < .05$).

Drum

The total number of drum collected was 35,489. First occurrence was during the fourth week (26 May) and measured 4 mm in body length. The numerical peak occurred during the eighth week (23 June), at which time the most abundant size was 5 mm. Since large numbers of this size were being captured during the final week of sampling (7 July), it is obvious this species was highly vulnerable to capture during the initial stages of life and had a long spawning period.

Minnow-sucker

A total of 18,369 minnows and suckers were captured. This group was represented in all samples collected, but exhibited two peaks in frequency of occurrence. Length-frequency distributions indicate both resulted from recruitment. Since suckers generally spawn earlier than minnows, it is highly probable the first mode was mostly suckers and the second minnows.

Carp

Carp was first observed during the second week (12 May) and peaked during the eighth week (23 June). Length-frequency indicated like drum, carp have a long spawning season and are most vulnerable to sampling during early stages. We collected 5,659 individuals.

Bluegill - Sunfish

Although 699 of this group were collected, the pattern of collection was somewhat sporadic and was insufficient for statistical analysis. In general the tailwater station produced only small fish, whereas, the Sand Prairie station produced a wider range in sizes during the last weeks of sampling. Distribution of this sort indicated once the fish become larger, they avoid turbulence in the tailwaters.

Crappie

Crappie also exhibited bimodal abundance distribution. These appear to have resulted from two spawning peaks. They occurred on 19 May and 16 June. Like bluegill, crappie appeared to avoid the turbulent tailwater station once they reached 15 mm in body length. As a result, statistical tests indicated slightly greater abundance in the Sand Prairie samples to be within the 95% confidence limits.

White bass

White bass, an important game species in the area, first occurred during the third week of sampling (19 May) and peaked during the eighth week (23 June). Length-frequency data indicated spawning occurs over a 5-week period. Four mm fish were present in samples from 12 May through 9 June.

EVALUATION OF THE PRESENT COMMERCIAL FISHERY REPORTING SYSTEM

The reporting system of commercial fishing statistics in Iowa are currently being revised. Until 1972, fishermen had been furnished with report forms which were filled out and returned under the threat of withholding licenses.

Under the new system, fishermen are furnished with pre-paid post card forms which must be submitted monthly. If not received within a reasonable

period, a reminder is mailed to the fishermen. This system will result in more accurate information than has been obtained under the previous system. One of the disadvantages of both systems remains; species such as sturgeon, paddlefish, etc. that are often caught incidental to the primary species go unreported. It is highly probable that more sturgeon go unreported than are reported.

During the first year of study, known sturgeon fishermen were contacted personally. Purposes of the study were discussed and all were urged to cooperate by reporting their harvests accurately. Most expressed willingness to permit examination of captured fish.

Samples of sturgeon were tagged in representative pools for the purpose of determining harvest. A goal of 100 fish was established in the six odd numbered pools bordering Iowa. Fish actually tagged were as follows: 108 in Pool 9; 108 in Pool 11; 1,380 in Pool 13; 27 in Pool 14; 1 in Pool 15; 37 in Pool 16; 97 in Pool 17; 3 in Pool 18 and 121 in Pool 19.

The tagging goal was reached in all but Pool 15. Several attempts at tagging in this pool were unsuccessful because the bottom contained many obstructions preventing fishing by both drifting trammel nets and trawling. After tagging began, letters were distributed to Iowa, Illinois, Wisconsin and Minnesota commercial fishermen informing them of the tagging program and requesting information from recaptures. Requested information included tag number, date of capture, location and gear used.

In addition to the usual information on movement, the resulting data was applicable to computation on minimal harvest rates, fishing grounds, gear used and seasonal distribution of harvest. To date, 61 tags have been returned by fishermen. Recaptures have been taken in all pools except 15 and 18.

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