MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION
JOB PROGRESS REPORT

STATE: **Montana** **PROJECT TITLE:** **Statewide Fisheries Investigations**

PROJECT NO.: **F-78-R-3** **STUDY TITLE:** **Survey and Inventory of Warmwater Streams**

STUDY NO.: **III** **JOB TITLE:** **Yellowstone River Paddlefish Spawning Study**

JOB NO.: **E**

Period Covered: **July 1, 1996 through June 30, 1997**

ABSTRACT

A study to determine the locations of paddlefish spawning sites and evaluate spawning success in the lower Yellowstone River was continued for the seventh year. Larval fish sampling with plankton nets collected a total of 98 paddlefish larvae. Fifty-four percent of the paddlefish larvae were collected during the June 12 sampling period. Similar to last year, larval paddlefish densities were uneven and varied according to location, indicating that certain areas were sources for paddlefish larvae.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. Locate paddlefish spawning areas. Efforts towards this objective were made and results are reported.

2. Evaluate paddlefish spawning success. Efforts towards this objective were accomplished and results are reported.

3. Determine effect of commercial roe harvest, if any, on the paddlefish population. This is discussed under the heading "Results and Discussion".

4. Report amount of roe harvested commercially. This is reported under the heading "Results and Discussion".

PROCEDURES

Larval fish sampling was used to evaluate paddlefish spawning success and locate spawning sites. Larval samples were obtained using boat mounted, round and D-shaped plankton net samplers. The round samplers consisted of a 6 foot long Nitex net (750 micron mesh) attached to a 20 inch diameter metal ring. Two nets were used in tandem so that duplicate samples could be taken simultaneously. The nets had a 3-rope harness that was fastened to and suspended off a weighted line attached to each side of the bow of the boat.

Samples were collected near the channel bottom while drifting slightly downstream. This allowed the nets to filter the water without addition of excess weights. Most of the sampling occurred in strong current areas of the river, at a depth range of 6-19 feet, and therefore power was provided by an outboard motor to decrease the downstream drift rate. The nets were positioned and weighted in the river usually for a duration of 6-15 minutes, depending on the amount of debris suspended in the river. The volume of water filtered was determined using General Oceanic flow meters (Model 2030) tied to the ring of the net and positioned at one-third of the net diameter.

In an effort to improve on the sampling efficiencies a different net configuration was tested and compared to the round plankton nets. This net consisted of a frame shaped in a "D" configuration, 29.5 inches wide and 21.3 inches high. The net length was 10 feet and consisted of 1/32 inch (800 micron) mesh. The surface area of the D-net opening was 3.67 ft^2 compared to 2.11 ft^2 for the round net. Only one D-net was sampled at a time off the stern of the boat due to the net length. The net was weighted with a 10 lb. weight at each bottom corner so the frame would rest on the channel bottom.

Larval samples were preserved with formalin in the field and later sorted in the laboratory. Retained larvae were identified to family using taxonomic keys by Auer (1982) and Wallus (1990).

INTRODUCTION

Every year during the late spring paddlefish from Lake Sakakawea Reservoir migrate up the Yellowstone River to spawn. The Yellowstone contains one of five known natural paddlefish spawning areas within their geographical range (U.S. Fish and Wildlife Service, 1990). Although a few paddlefish larvae have been previously collected in the river (Penkal 1981), exact spawning sites and habitat preferences have not been determined.

In 1989 the Montana Legislature passed House Bill 289 which allows for the commercial sale of paddlefish eggs from paddlefish harvested only in the Yellowstone River at the Intake vicinity. The bill emphasized protection of the paddlefish population from overharvest. One of the methods of protection was to collect more information on spawning success and locate spawning sites so that effects of potential increased harvest of female paddlefish could be better evaluated.

DESCRIPTION OF STUDY AREA

The study area consists of a 67-mile reach of the lower Yellowstone River in southeastern Montana, from Intake to the confluence with the Missouri River at Fort Buford, ND. The Yellowstone is one of the few remaining free-flowing rivers. The river is fairly large with a mean annual flow of 12,430 cfs (Koch et al. 1977). The headwaters of Lake Sakakawea Reservoir begin about 35 miles downriver of the confluence. Intake Diversion Dam is the only major diversion in the study area. This diversion is constructed of scattered boulders and spans the width of the river. The drop is approximately 4 feet in 100 feet and is characterized by very turbulent water (Graham and Penkal, 1978). The diversion acts as a partial barrier for upstream travel to most fish species.

Nineteen sampling stations were established at 16 sites on the lower Yellowstone in the study area (Figure 1 and Table 1). The distances between successive sampling sites averaged 1.3 miles with the minimum distance being 0.2 and maximum 3.4 miles. Only 3 sites were sampled on both sides left (L) and right (R). Since past sampling results indicated that greater densities of paddlefish larvae were found on specific sides of the river (Gardner 1994-95), I sampled on these favored sides to maximize results.

RESULTS AND DISCUSSION

The Yellowstone River experienced above normal run-off during the 1996 paddlefish spawning season. The average monthly flows for May, June and July, 1996 were 133, 128 and 115% of average

(USGS 1997 and Koch et al. 1977). The peak flow of 65,600 cfs occurred on June 17 and was slightly higher than normal for spring peak flows in the Yellowstone. Water temperatures gradually warmed during June with daily average temperatures ranging from 57 to 69 F (Mr. Jason Lee; personal communication).

Paddlefish Spawning Success and Spawning Locations

From previous years' information it was determined that a 20-mile reach near the Highway 200 Bridge area had particularly greater densities of paddlefish larvae in the drift samples than other areas. Therefore, the sampling effort continued to be directed in this reach so that specific spawning sites could be located.

Larval fish were sampled in the Yellowstone River from late May through mid-July, 1996, to determine timing and location of paddlefish hatching and emergence.

A volume of 558,053 ft^3 of water was filtered for both net types combined. Physical parameters and sampling effort for each station are presented in Appendix A and B. A total of 536 larvae were collected in 289 samples representing 7 taxonomic families (Tables 2 and 3). The minnow family was the most common larval fish group sampled, comprising 36% of all the larvae collected. Average total larval densities ranged from a low of 2.6 for the "D"-net samples at station RM-18.8 to a high of 24.1 larvae/10,000 ft^3 for the round net samples at station RM-6.2 .

The 1996 paddlefish spawning migration conditions were assumed to be better than normal this year because of exceptional run-off in the Yellowstone River basin occurring in May and June. Paddlefish spawning migrations are generally influenced by the magnitude of the spring run-off (Russell 1986). During years with higher spring run-off conditions a greater number of spawners will migrate upriver to spawning locations. Indices of adult paddlefish numbers in the Yellowstone River did or (did not) confirm this assumption. "Phil could you add the stats that are applicable here. 1996 Intake catchrate and the spring test netting at the Intake index station and compare with previous years for relevance". (See my 1996 DJ report for format).

A total of 98 paddlefish larvae were sampled during 1996 (Tables 2-5). Paddlefish larvae were sampled at all stations in the lower 22.4 miles of the Yellowstone River and they comprised 18% of the total larvae collected.

From Tables 4 and 5 it is evident that paddlefish larvae were found in the Yellowstone River samples from the second sampling period, June 5, through July 2, however, 54% of the total were sampled during the June 12 sampling period. Highest larval paddlefish catches occurred within 10 days after the Yellowstone River reached a flow of 40,000 cfs and 5 days prior to the peak flow of 65,000 cfs. Based on these observations and assuming a 7-10 day incubation period (Yeager and Wallus 1982 and Ballard and Needham 1964) it can be concluded that peak paddlefish spawning occurred during the period June 2-5.

Figure 2. depicts the longitudinal distribution of paddlefish larvae in a 20-mile reach of the study area. This reach is where nearly all of the larvae were sampled during previous years. Paddlefish larvae were not found uniformly throughout this reach but were found in higher concentrations at RM-12.7 and RM-8.7. Average paddlefish densities for the entire sampling period were 4.16 and 4.66 paddlefish/10,000 ft^3, respectively (Table 4). At site RM-20.3, another site where paddlefish larvae were sampled at high densities, the paddlefish density averaged 3.93. The uneven density distribution may be the result of proximity to egg deposition sites. The three sites where paddlefish larvae were found in the greatest numbers were associated with some sort of rock substrate nearby in a reach of river where gravelly substrates are rare and a sandy river channel is the norm. Paddlefish eggs require some sort of hard surface to adhere to for successful incubation (Wallus 1990). This information strongly implicates the areas near RM-8.7, RM-12.7 and probably RM-20.3 as paddlefish spawning sites.

The Yellowstone River is not the only spawning stream for the Lake Sakakawea paddlefish population. The Missouri and Milk rivers are also known paddlefish spawning streams (Gardner and Stewart 1987). A total of 7 paddlefish larvae were collected in the 34-mile reach of Missouri River above the Yellowstone River confluence during 1996 (Jim Liebelt; personal communication; 1997). Most of the paddlefish collected in the Missouri were sampled later than that found in the Yellowstone. Liebelt sampled 6 of 7 paddlefish larvae from July 9 to July 26.

A different shaped net was tested for sampling paddlefish larvae. Researchers studying larval white sturgeon have found that a "D" shape net was more efficient at sampling sturgeon larvae than the conventional round type because the shape of the D-net enables it to rest closer to the bottom where larval white sturgeon are known to occur while drifting to rearing areas (Mr. Lance Beckman, USFWS). During the 1994 and 1995 tests using the D-nets, catch rates of paddlefish larvae averaged better for the D-nets compared to the smaller round nets, however, the D-nets were not as consistent in sampling paddlefish (Gardner 1995 and 1996).

It was decided to again test the D-net for sampling paddlefish larvae in 1996. Table 6 compares the catch statistics for the two nets. The larger D-net filtered over twice as much water per sample effort as the round nets. This was due to its larger size and greater net velocities. The reason for greater net velocities of the D-nets was related to the procedure of how the net was sampled. While sampling with the D-net enough power was used so that the boat did not drift down river more than 50 yds., whereas, for the round nets the boat and nets commonly drifted down river over 100 yds. while completing a larval fish sample. Therefore, the net velocities were reduced and the nets remained near the bottom. During the 1996 sampling year larval catch rates were nearly twice as high for the round net compared to the D-net samples. Paddlefish, the target species, were collected in both types of nets. The round-net sampled paddlefish at a greater density averaging 9.0 paddlefish/10,000 ft^3 compared to 0.5 paddlefish/10,000 ft^3 for the D-net. Last years sampling showed that the D-nets were slightly better at sampling paddlefish larvae (Gardner 1996). This year only 21 D-net samples were completed and this low effort could be a reason why the D-net sampling was not as productive as the previous year.

Paddlefish Caviar

The Glendive Chamber of Commerce and Agriculture continued their collection of paddlefish roe at Intake for the seventh consecutive year. They also continue to clean fish for anglers in return for roe donation. The cleaning service is very popular and the Glendive Chamber in excess of 90% of the fish caught in the Intake area.

The Chamber cleaned x,xxx fish of which xxx (xx%) were females. From those fish x,xxx pounds of raw ovaries were collected. This yielded x,xxx pounds of processed roe from which x,xxx pounds of caviar were sold for $xxx,xxx or $xx.xx per pound.

RECOMMENDATIONS

1. It would be beneficial to have more information about paddlefish spawning. The larval drift study has identified 3 areas as potential spawning sites. Collecting eggs at these spawning sites with artificial substrates and dredges should be attempted. Once eggs are collected, important information about paddlefish spawning habitat preferences can be

gathered.

2. There are probably other spawning areas in the lower Yellowstone River that have not been determined, especially from rivermile (RM) 20 upriver to RM 30. More intensive work needs to be done in this reach sampling for paddlefish larvae.

ACKNOWLEDGEMENTS

The author wishes to recognize the assistance that Cathy Weigand provided sampling for paddlefish larvae and sorting most of the collections. Jason Lee, North Dakota Game and Fish Department, provided the temperature data.

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Date Prepared: September, 1997
Waters Referred to:

Yellowstone River Section 1   21-1350-02

Figure 1. Map of the study area

Figure 2. Paddlefish density distribution ....

Table 1. Locations of sampling stations in the Yellowstone River, 1995.

Station Number	Locality		Legal Description		
RM - 2.3	Confluence	ND	T152N	R104W	Sec 26
RM - 5.7		ND	T151N	R104W	Sec 14
RM - 6.2		ND	T151N	R104W	Sec 14
RM - 7.5		ND	T151N	R104W	Sec 23
RM - 8.7	Blw. Hwy 200 Bdg	ND	T151N	R104W	Sec 26
RM - 8.9	Abv. Hwy 200 Bdg	ND	T151N	R104W	Sec 35
RM - 9.2	Abv. Cartright Bdg	ND	T151N	R104W	Sec 35
RM - 12.2	Blw. Second Hay Cr.	ND	T150N	R104W	Sec 16
RM - 12.7	Blw. Horse Cr.	ND	T150N	R104W	Sec 16
RM - 14.2	Blw. First Hay Cr.	ND	T150N	R104W	Sec 17
RM - 16.0		MT	T24N	R60E	Sec 31
RM - 17.5		MT	T23N	R60E	Sec 6
RM - 18.8	Estes School	ND	T150N	R104W	Sec 30
RM - 20.3		MT	T23N	R60E	Sec 18
RM - 21.4		MT	T23N	R59E	Sec 13
RM - 22.4	Richland Park	MT	T23N	R59E	Sec 24

Table 2. Numbers of larval fish collected with the round plankton net in the Yellowstone River, 1996.

Station[1]	Paddlefish	Sturgeon	Goldeye	Sucker	Minnow	Sauger/We	Total # Larvae	Avg.[2] Density	Total# Samples
RM-2.3	6	1	12	14	47	0	25	15.1	30
RM-5.7	5	0	8	5	25	1	44	17.4	14
RM-6.2	5	0	6	9	42	0	62	24.1	14
RM-7.5	4	0	7	6	1	2	21[3/]	8.2	14
RM-8.7	14	0	3	11	4	0	32	6.0	28
RM-8.9	6	0	7	15	2	0	30	11.7	14
RM-9.2	6	2	4	5	5	0	22	8.5	14
RM-12.2	5	0	7	10	1	0	23	9.2	14
RM-12.7	11	1	5	7	5	0	29	11.1	14
RM-14.2	2	0	2	9	5	0	18	6.0	14
RM-16.0	2	0	5	8	6	0	21	8.4	14
RM-17.5	4	1	0	2	4	0	11	4.5	14
RM-18.8	6	0	2	15	3	0	26	6.1	28
RM-20.3	7	1	6	5	11	0	30	15.2	14
RM-21.4	3	0	2	6	4	1	16	5.8	14
RM-22.4	5	0	11	4	6	0	26	10.5	14

[1] Stations are labeled in river miles above the confluence.

[2] Density of larval fish expressed as number per 10,000 ft^3 of water filterd.

[3] One channel catfish larva included in the total.

Table 3. Numbers of larval fish collected with the D-shape plankton net in the Yellowstone River, 1996.

Station[1]	Paddlefish	Sturgeon	Goldeye	Sucker	Minnow	Catfish	Sauger/We	Total # Larvae	Avg.[2] Density	Total# Samples
RM-2.3	3	1	2	3	13	0	0	22	8.9	7
RM-8.7	2	0	1	2	10	0	0	15	3.9	7
RM-18.8	2	0	2	3	1	0	0	8	2.6	7

[1] Stations are labeled in river miles above the confluence.

[2] Density of larval fish expressed as number per 10,000 ft^3 of water filtered.

Table 4. Average densities (.....) and total number of paddlefish larvae......

Table 5. Average densities (number/10,000 ft^3) and total number of paddlefish larvae sampled with D-nets in the Yellowstone River, 1996.

Station	Sampling Period 5/31	6/5	6/12	6/19	6/27
RM-2.3(L)		8.7			
RM-8.7(L)		3.8	1.6		
RM-18.8(L)					4.1
Total # Larvae -	0	3	1	0	2
Total # Samples -	3	3	3	3	3

Table 5. (Continued)

Station	Sampling Period 7/2	7/12	Total # Larvae	Number of Samples
RM-2.3(L)	3.1		3	7
RM-8.7(L)			2	7
RM-18.8(L)			2	7
Total # Larvae -	1	0	7	--
Total # Samples -	3	3	--	21

Table 6 Comparisons of performance parameters between the D-configuration net and the round larval net, Yellowstone River, 1996.

Parameter	D-shaped net	Round net
Net Opening Size	3.67 ft^2	2.11 ft^2
No. of Samples	21	268
Avg. Volume of water filtered (ft^3)	4,120	1,758
Total No. Larvae	45	491
Avg. Larval Density (No./ 10,000 ft^3)	5.1	10.3
Total No. of Paddlefish Larvae	7	91
Avg. Pdlfsh Density (No./10,000 ft^3) during June 12 prd.[1]	0.5	9.0

[1] Period with the greatest paddlefish larval drift. Only results from samples taken on the same side of the river channel are compared.

Appendix A. Physical measurements accompanying larval fish samples collected with round nets in the Yellowstone River, 1996.

Station Number	Number Samples	Avg. Depth at Station (ft.)	Average Net Velocity (ft/s)	Average Net Volume (ft^3)	Average River Flow (cfs)	Avg. Temp. (F)	Avg. Secchi (ft)
RM-2.3 (L)	14	13.5 (7.5 - 18.0)	2.3 (1.5 - 2.9)	1,677 (1080 - 2119)	42,686 (28000 - 63200)	67 (58-71)	0.2 (0.1-0.4)
RM-2.3 (R)	16	9.4 (6.5 - 12.0)	2.6 (1.9 - 3.3)	1,921 (1405 - 2422)	42,686 (28000 - 63200)	67 (58-71)	0.2 (0.1-0.4)
RM-5.7 (R)	14	10.4 (9.0 - 12.0)	2.5 (1.4 - 3.3)	1,843 (1070 - 2408)	42,686 (28000 - 63200)	67 (58-71)	0.2 (0.1-0.3)
RM-6.2 (R)	14	9.0 (7.0 - 10.5)	2.4 (1.5 - 2.9)	1,751 (1133 - 2129)	42,686 (28000 - 63200)	67 (58-71)	0.2 (0.1-0.3)
RM-7.5 (R)	14	12.1 (10.5 - 15.0)	2.3 (1.1 - 2.9)	1,709 (802 - 2172)	42,686 (28000 - 63200)	67 (58-71)	0.1 (0.1-0.3)
RM-8.7 (L)	14	9.4 (7.0 - 12.0)	2.2 (1.0 - 2.8)	1,649 (752 - 2034)	42,686 (28000 - 63200)	67 (58-71)	0.1 (0.1-0.3)
RM-8.7 (R)	14	14.2 (11.5 - 19.0)	2.2 (1.7 - 2.7)	1,610 (1246 - 2009)	42,686 (28000 - 63200)	67 (58-71)	0.1 (0.1-0.3)
RM-8.9 (L)	14	11.9 (8.0 - 16.0)	2.4 (0.9 - 3.2)	1,758 (646 - 2387)	42,686 (28000 - 63200)	67 (58-71)	0.1 (0.1-0.3)
RM-9.2 (L)	14	14.7 (8.5 - 17.5)	2.4 (2.0 - 2.9)	1,797 (1462 - 2133)	42,686 (28000 - 63200)	67 (58-71)	0.1 (0.1-0.3)
RM-12.2 (L)	14	9.2 (7.5 - 11.0)	2.4 (1.8 - 3.2)	1,758 (1349 - 2373)	42,686 (28000 - 63200)	66 (55-71)	0.2 (0.1-0.3)
RM-12.7 (L)	14	10.6	2.4	1,762	42,686	66	0.2

		(9.5 - 13.0)	(1.8 - 2.8)	(1349 - 2076)	(28000 - 63200)	(55-71)	(0.1-0.3)
RM-14.2 (L)	14	10.3	2.8	2,055	42,686	66	0.2
		(7.5 - 13.0)	(1.9 - 3.9)	(1381 - 2874)	(28000 - 63200)	(55-71)	(0.1-0.3)
RM-16.0 (L)	14	9.1	2.5	1,854	42,686	66	0.2
		(6.5 - 11.0)	(1.4 - 3.4)	(1066 - 2479)	(28000 - 63200)	(58-70)	(0.1-0.3)
RM-17.5 (L)	14	10.2	2.3	1,713	42,686	66	0.2
		(9.0 - 11.0)	(1.5 - 3.0)	(1088 - 2214)	(28000 - 63200)	(57-70)	(0.1-0.3)
RM-18.8 (L)	14	11.7	2.4	1,780	42,686	66	0.2
		(9.5 - 17.0)	(1.2 - 3.3)	(893 - 2415)	(28000 - 63200)	(56-70)	(0.1-0.3)
RM-18.8 (R)	14	11.4	2.1	1,589	42,686	66	0.2
		(10.0 - 13.0)	(1.0 - 3.1)	(745 - 2323)	(28000 - 63200)	(57-70)	(0.1-0.3)

Appendix A. (Continued).

RM-20.3 (L)	14	9.8	2.1	1,518	42,686	66	0.2
		(8.0 - 11.0)	(0.9 - 2.9)	(650 - 2157)	(28000 - 63200)	(56-70)	(0.1-0.3)
RM-21.4 (L)	14	13.1	2.6	1,949	42,686	66	0.2
		(10.0 - 17.5)	(1.4 - 3.7)	(1045 - 2715)	(28000 - 63200)	(56-70)	(0.1-0.3)
RM-22.4 (L)	14	12.6	2.3	1,713	42,686	66	0.2
		(10.0 - 16.5)	(1.9 - 3.3)	(1370 - 2419)	(28000 - 63200)	(56-70)	(0.1-0.3)

Appendix B. Physical measurements accompanying larval fish sampled collected with D-nets in the Yellowstone River, 1996.

Station Number	Number Samples	Avg. Depth at Station (ft.)	Average Net Velocity (ft/s)	Average Net Volume (ft^3)	Average River Flow (cfs)	Avg. Temp. (F)	Avg. Secchi (ft)
RM-2.3 (R)	7	10.2	3.1	3,972	42,686	67	0.2
		(7.2 - 14.0)	(1.8 - 4.1)	(2285 - 5289)	(28000 - 63200)	(58-72)	(0.1-0.4)
RM-8.7 (L)	7	9.6	3.2	4,025	42,686	66	0.1
		(8.5 - 10.5)	(2.0 - 3.0)	(2613 - 6370)	(28000 - 63200)	(58-70)	(0.1-0.3)
RM 18.8	7	13.6	3.4	4,364	42,671	66	0.2
		(11.0 - 15.5)	(2.7 - 3.9)	(3482 - 5003)	(28000 - 63200)	(56-70)	(0.1-0.3)