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REGION 4

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

STATE: Montana **Project No.:** F-78-R-2

PROJECT TITLE: Statewide Fisheries Investigations

JOB TITLE: Missouri River Pallid Sturgeon Inventory

Period Covered: July 1, 1995 through June 30, 1996

ABSTRACT

A study to evaluate the status of the pallid sturgeon in the middle Missouri River was continued. A total of 4 pallid sturgeon were captured, one of which was a sexually mature female. Three of these pallids were "new" fish. A preliminary population estimate indicated there are only 45 pallids left in the study area. Radio telemetry tracking of 3 pallids indicated that an 8-mile river reach may be an important pallid sturgeon spawning area. Shovelnose sturgeon densities in the Loma section were estimated to equal 1,242 fish/mile. Twenty-eight young-of-year shovelnose sturgeon were sampled trawling and 21 post-hatch larval sturgeon were captured during larval fish sampling.

INTRODUCTION

Pallid sturgeon are found in the Wild and Scenic portions of the Missouri River in Montana. They exist in low numbers throughout their geographic range (Pflieger 1975) as is the case in this section of the Missouri River. In 1990 the U.S. Fish and Wildlife Service listed the pallid as "endangered" under the Endangered Species Act 1973. Reasons for listing are habitat modification and apparent lack of reproduction. Reports of pallid sturgeon sightings have also declined dramatically in the last 20 years (U.S. Fish and Wildlife Service, 1989). The pallid sturgeon has been listed as a class A "species of special concern" in Montana since 1973 (Holton, 1980).

The Montana Department of Fish Wildlife and Parks (FWP) initiated a fisheries study during 1989 to determine the past and present status of the pallid sturgeon in the 175 mile reach of river between Fort Benton and Fort Peck Reservoir. Results from the study will be used to develop a status report. This report will aid in devising management and recovery plans to maintain and enhance the pallid population in the river.

OBJECTIVES AND DEGREE OF ATTAINMENT

1. **To locate and define pallid sturgeon spawning, juvenile and adult habitat areas in the Missouri River between Great Falls and Fort Peck Reservoir.** Sampling for pallid sturgeon was continued and information on habitat use is presented.

2. **To document population size, seasonal movements and evidence of most recent reproduction.** Drift netting, trawling and larval fish sampling for pallid sturgeon were completed and results are presented.

3. **To review projects proposed by state, federal and local agencies and private parties which have potential to affect fisheries resources and aquatic habitats. Provide technical advice or decisions to reduce or mitigate resource damage.** (state funded). Two stream alteration projects were evaluated and recommendations were submitted to the applicants.

PROCEDURES

Setlines and trammel nets were used to capture sturgeon. The setlines were 100 - 200 ft long with 10 - 20 hooks. Circular-type hooks were attached to the one-quarter inch diameter groundline with 16 inch long staging lines. The hooks ranged in size from 11/0 to 14/0. The setline was anchored in position with a 40 lb cement block at each end; a steel stake and block were used as anchors when the lines were set from the river bank. The terminal end was usually marked with a buoy. Setlines were positioned in the river either parallel, perpendicular or angled to the current and left overnight. Catch per unit effort for setline sampling was expressed as number of fish caught for an overnight set. This sampling method has been used with satisfactory results for white sturgeon in the Kootenai River (personal communication, Kim Apperson, Idaho Fish and Game Dept.).

Trammel nets were 150 ft. long and 6 ft. deep. Two mesh sizes were used: 1 inch inner walls with 10 inch outer walls, and 2 inch inner walls with 10 inch outer walls. Mesh material for both inner and outer walls were light-weight for better fish tangle characteristics and to insure that the net could be retrieved off submerged objects in the event that net material had to be torn

free. The trammel nets were set in snag-free areas of the river and allowed to drift with the current along the bottom. Distances of the drift varied from 50 to 400 yds. Catch per unit effort for drift netting was expressed as number of fish caught per drift.

All sturgeon were measured to the nearest 0.1 inch, fork length and weighed to the nearest 0.1 pound. Other fish species were measured to the nearest 0.1 inch total length and 0.01 pound. A numbered plastic spaghetti tag was attached to the keel of the dorsal fin of shovelnose sturgeon for identification purposes. For pallid sturgeon a coded PIT tag was inserted into the keel of the dorsal fin for identification purposes. Morphometric measurements recorded from pallid sturgeon were: total, fork and standard lengths, head length, barbel lengths, mouth width, distance between inner barbel and mouth; and distance between outer barbel and snout tip. These measurements were then used for a Character Index, as modified by Carlson and Pflieger (1981), to test for hybridization.

A 6 ft. wide, beam "rockhopper" trawl was used for sampling young-of-the-year (YOY) sturgeon. The trawl consists of a 6 x 1½ ft. rectangular metal frame with skids, 18 ft. long outer chafing net with an 11 ft. long, 1/8 inch mesh inner liner. The trawl was towed downstream off the bow of the boat usually for a distance of 150-200 yds. A 50 ft. length of rope was attached to each side of the trawl and at the end the run the trawl was retrieved by hand by a person at the end of each rope. This was a scaled-down version of the trawl used by the white sturgeon researchers in the lower Columbia River (Lance Beckman, USFWS).

To facilitate interpretation of rearing area and forage fish data, the river channel was categorized into 5 major habitat types that could be effectively trawled. The habitat types were main channel border, main channel pool, main channel run, side channel border and side channel pool. Habitat types were determined based on location, current velocities and water depths. The main channel and side channel border habitat types were defined as the zone adjacent to the channel where average current velocities were greater than 0.5 ft/sec. and depths less than 3 ft. Main channel pools were slow flowing areas with a wide range of depths. Main channel run habitat type was an open water habitat with variable depths and moderate current velocities, usually greater than 1.5 ft/sec. Side channel pools were sections of a side channel with average current velocities less than 0.5 ft/sec and depths less than 3 ft.

Larval fish sampling was used to evaluate pallid sturgeon 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 were 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 4-12 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 front 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 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 because of the large size of the net. 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. Larvae were identified to family using taxonomic keys by Auer (1982) and Wallus (1990). Mr. Darrel Snyder, director of the Colorado State University Larval Fish Laboratory, examined a sample of tentatively identified Polydon and Scaphirhynchus larvae to insure that these two taxonomically similar fish were correctly identified. Further distinguishing of Scaphirhynchus to pallid or shovelnose sturgeon could not be made because the taxonomic differences between these two have not been adequately describeded.

A radio telemetry system was used to follow and re-locate pallid sturgeon. A low frequency band receiver along with omni-directional and directional antennas were used to make contact with the transmittered fish. An internal transmitter with the antenna incorporated in the capsule was surgically implanted into the sturgeon's body cavity. Surgical procedures used are previously described by Gardner (1994). The 36 gram transmitter was 4 inches long with a 0.8 inch diameter and had a 90-day battery life.

The other type of transmitter used was considerably smaller and included a microprocessor so the radio was transmitting for only 6 hours a day, for 20 days, and then completly off for 20 days. This on/off pattern would repeat itself until the battery would expire, which was about 90 days. These mini-transmitters were surgically implanted into the body cavity of small shovelnose sturgeon weighing approximately 1 lb. The 2.4 gram transmitter was 0.8 inches long with a 0.2 inch diameter and had an external whip antenna 8 inches long. These methods of transmitter attachments have been successfully used by several other researchers including Tyus (1988).

The shovelnose and pallid sturgeon populations were estimated in the Missouri River near Virgelle using the multiple-census (Schnabel) estimator:

$$N = \frac{E^{n}_{t=1}\ C_t\ M_t}{E^{n}_{t=1}\ R_t}$$

Where:

E^{n} signifies summation function and n is the number of the sampling periods.

C_t is the total sample taken on day t.

M_t is the total number of marked fish at large at the start of the t^{th} day.

R_t is the number of recaptures in the sample C_t.

Confidence intervals for the shovelnose estimate were calculated for the 95% level. This estimator was chosen because marking and recapture are done concurrently, thereby increasing the odds of recovering a marked fish for a given amount of sampling effort.

DESCRIPTION OF STUDY AREA

The pallid sturgeon study area consists of a 175 mile reach of the mainstem middle Missouri River in northcentral Montana between Fort Benton and the headwaters of Fort Peck Reservoir near Lewistown (Fig. 1). There are two major tributaries entering the Missouri in this reach; the Marias River from the north and Judith River from the south. The present flow regimen of the Missouri River in the study area is not entirely natural because of regulation and storage at several upriver dams. The study area was divided into 5 study sections and the boundaries for each are given in Table 1.

Table 1. Locations of study sections on the middle Missouri River.

SECTION	RIVER MILE upper	lower	LOCATION					
Fort Benton	175	154	T24N	R8E	Sec26	to	T25N R10E	Sec18
Loma	154	127	T25N	R10E	Sec18	to	T26N R12E	Sec13
White Rocks	127	88	T26N	R12E	Sec13	to	T23N R16E	Sec26
Stafford F.	88	50	T23N	R16E	Sec26	to	T23N R22E	Sec 6
Robinson Bg.	50	0	T23N	R22E	Sec6	to	T21N R27E	Sec10

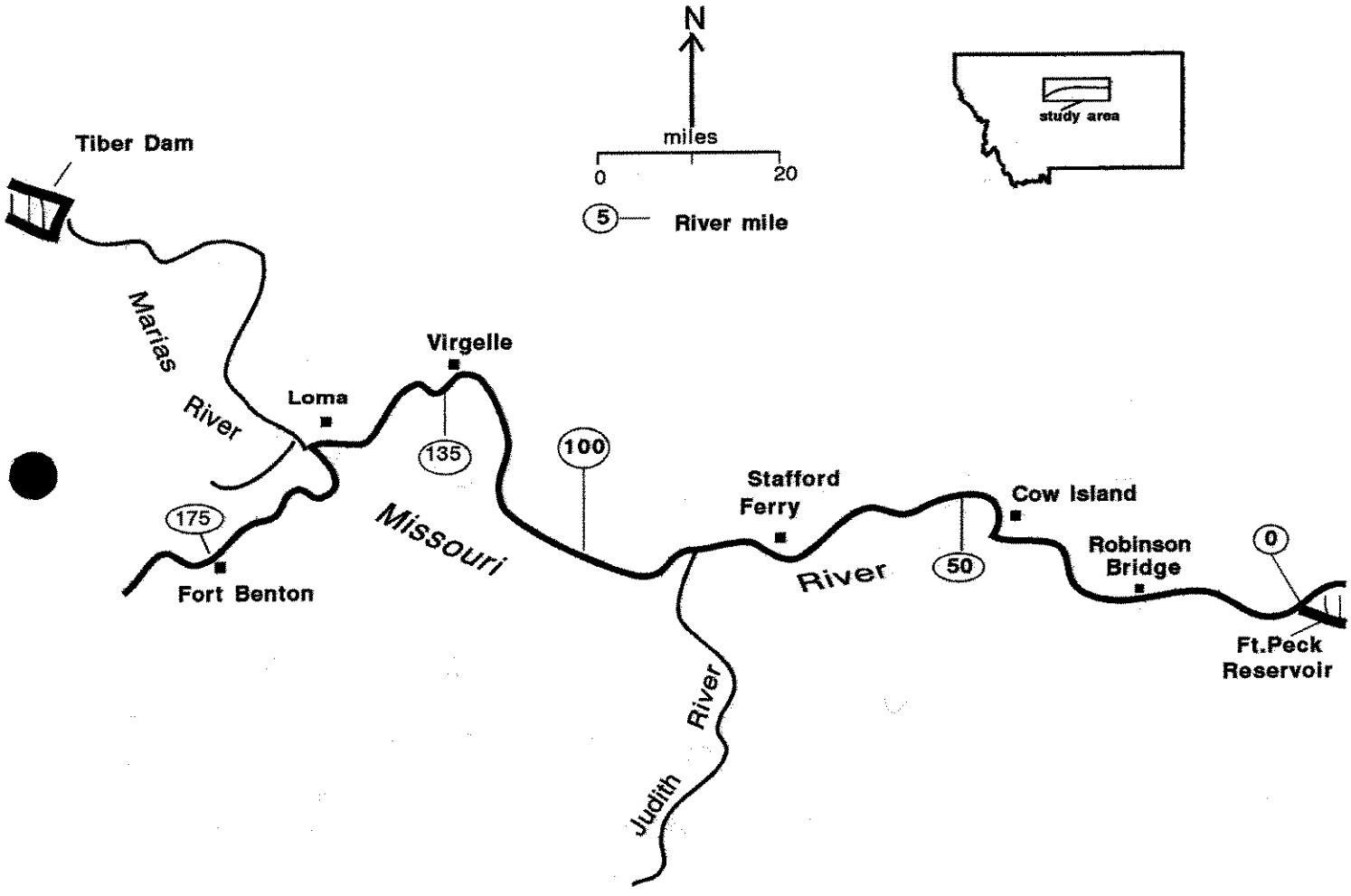

Figure 1. Map of study area.

FINDINGS

The upper Missouri River experienced above normal flows during 1995 spring run-off period. The average monthly flows at the Robinson Bridge gauge for May, June and July were 134, 164 and 227% of normal, respectively (USGS 1996). The peak flow of 32,000 cfs occurred on June 8. The Marias River experienced nearly normal flows for April, May and August and exceptionally higher than normal flows for the months of June and July. The average monthly flows at Tiber Dam for April - August were 101, 104, 610, 277 and 135% of normal, respectively (USGS 1996). The peak flow of 4,090 cfs occurred on June 22. The reason for the different run-off pattern of the Marias River in 1995 was because the FWP requested that water releases from Tiber resemble more natural run-off conditions.

Continuous water temperature recordings were collected in the Marias River near the confluence and the thermograph is shown in Appendix A-1. This information is of interest because of concerns dealing with coldwater releases from Tiber Dam. The Marias River temperatures were considerably cooler compared to the 1994 summer water temperatures (Gardner, 1995). The maximum temperature of 75.1 F occurred on June 4 and during the rest of the summer temperatures rarely surpassed 70 F. This probably was the result of the unusually cool summer and greater summer flows than normal. The drastic temperature drop of over 15 ° in early June was related to a sharp decline in air temperatures. A similarly unusual temperature decline was also observed for the Yellowstone River during this time (Gardner 1996).

Present Status of the Pallid Sturgeon Population

A total of 4 different pallid sturgeon were captured in the study area during the period April 1 - October 15, 1995. One of these sturgeon had previously been caught in 1990 (Table 2). All pallids were caught in the deep water areas and within 45 miles of the upper end of Fort Peck Reservoir. Pallid number 9430445 is suspected as being a hybrid because of its low character index score of 371. For all the sturgeon that were scored using the character index the 23 pallids had an average score of 551; the 162 shovelnose averaged 244; and the 4 suspected pallid/shovelnose averaged 381. Pallid #7080203 was classified as a sexually mature female because eggs could be stripped from the fish while being measured. This indicates that a few pallids are attempting to spawn in the study area.

Table 3 is a summary of pallid catches for 6 years of this study. The lower number of pallids caught in 1994 was the result of expanding the sampling effort to include YOY and juvenile sampling, thereby reducing the sampling effort towards adults. The recapturing of previously tagged pallids can be of value to compute a very preliminary population estimate using the Schnabel estimator. The population density of pallid sturgeon was

determined for a period over 6 years when a total of 35 pallids were captured including 8 recaptures. The population density of pallid sturgeon in this segment of the Missouri River was estimated to be 45 pallids/mile. This estimate is considerably less than the closest downriver population, Missouri River, ND, that is estimated to have a density of 250 pallids/mile (Krentz 1995).

Appendix Table B-1 lists all the pallid sturgeon captured since 1990 and a record of the recapture history. Thus far, a total of 27 different pallid sturgeon have been captured since this study commenced in 1989.

Table 2. Measurements and capture information for pallid sturgeon sampled in the upper Missouri River, MT, 1995.

	Pallid Sturgeon			
Tag Number	9430445	2317830	7080203	S-07398
Fork Length	43.9	53.5	58.0	52.0
Weight	16.0	31.5	41.0	30.0
Sex	--	--	Rp♀	--
Char. index	371	628	602	518
Capture Date	Apr 26	Apr 19	Jun 14	Apr 26
Rivermile	22.5	45.1	33.8	22.5
Method	SetL	SetL	Net	SetL
Depth	15.5	7-9	9	15.5
Velocity	Moderate	Moderate	Moderate	Moderate
Substrate	Sand	Snd/Cbl	med gvl	Sand
Temperature	53	53	67	53
Secchi	0.8	0.7	0.2	0.8
Recap Record	new	new	new	Tagged 6/15/90

Table 3. Summary of pallid sturgeon catches for years 1990-95, upper Missouri River. (Suspected hybrid pallids included).

Year	Total Number	Number "New" Fish
1990	5	5
1991	3	2
1992	15	11
1993	9	6
1994	5	0
1995	4	3
Total	-	27

Both drift net and setline sampling methods captured pallids in 1995, with setlines used in the capture of 3 pallids. The difference in catch between gear types is probably related to the more intensive use of the setlines in the Robinson Bridge section compared to the use of trammel nets. A total of 53 setlines were set in this section compared to 55 trammel net drifts.

Trammel net sampling was especially effective for catching shovelnose sturgeon. Table 4 summarizes the results for the 1995 field season. Fifty-four percent of the 2,145 fish netted were shovelnose with shorthead redhorse the next most abundant fish, representing 16% of the sample. The greatest shovelnose catchrate occurred in the Loma study section followed by White Rocks, Robinson Bridge and Marias River sections. Setline fishing sampled a total of 31 fish (Table 5). Channel catfish was the most common species captured representing 52% of the sample. The size statistics for all the fish sampled by trammel nets, setlines and gill nets are given in Appendix tables C-E. Average sizes of shovelnose sturgeon varied according to location with the Marias River and the Loma section exhibiting the largest sizes.

Shovelnose sturgeon population density was estimated in the study area to establish baseline abundance information for this population. This knowledge could be of value for assessing the pallid sturgeon population because inferences can be made regarding limiting factors affecting both sturgeon species based on the population levels. For example if the population estimate revealed that shovelnose were at sub-standard levels then it could be inferred that possibly the same factor limiting shovelnose could be affecting the pallid sturgeon population.

The shovelnose sturgeon population was estimated for a 6½-mile reach located in the Loma section near Virgelle. This site was

selected because shovelnose are known to occur in the greatest abundance here (Berg 1981). The boundaries of the study section are located from ½ mile upstream of Six-mile Coulee to 1 mile downstream of Jackson Coulee and is representative of habitat conditions found in this reach. The sampling period was relatively short extending from mid-August through September. During this period a total of 4 sampling runs were completed. During the first run the emphasis was only to mark fish and thoroughly cover the entire section. Because of man-power limitations, the 3 subsequent sampling runs could not be as thorough and therefore a stratified-random sampling plan was devised for the selection of netting sites. The section was divided into 130 sampling sites (at 0.1 mile intervals = 65/side) and stratified into 2 types based on the catchrate results from the first sampling run; sites with sturgeon catches greater than 2 fish/drift and catch sites with less than 2 fish/drift. To maximize the sampling effort and insure good coverage, seventy-five percent of the sampling effort occurred in the better catchrate sites with the balance of the drifts occurring in the poor catchrate sites. Fifty-six trammel net drifts were completed during the first run and 30, 25 and 15 trammel net drifts were completed for the 3 subsequent runs.

A total of 984 shovelnose were sampled with 42 of the total being recaptured fish. The population density in the section was estimated to be 8,073 shovelnose with a 95% confidence interval of 6,211 to 11,494. The density of shovelnose/mile, therefore, is 1,242 with a biomass estimate of 6,831 lbs./mile. Keenlyne (1994) reports that the abundance of shovelnose appears to be related to the size of river in which they live and to human activities. Densities range from 161 fish/mile in the small Red Cedar River, WI to 4,023 fish/mile in the large Missouri River, near Yankton, SD. On a per unit area and biomass basis this studys' estimates are 17 shovelnose/acre or 93.5 lbs./acre compared to 14 shovelnose/acre or 14 lbs./acre for the Missouri River at Yankton, SD, the previously highest reported shovelnose density (Schmulbach 1974). From this comparison it appears that the shovelnose sturgeon population in the Missouri River near Virgelle, MT are at an exceptional density.

An attempt was made to locate sturgeon rearing areas. All the sampling effort was directed in the Robinson Bridge study section because it was felt the best opportunity to find young sturgeon was in these areas. Trawling was used for sampling a variety of deep open-water habitats in the river. A total of 197 hauls sampled 817 fish, representing at least 16 species (Table 6). Young-of-the-year channel catfish was the most abundant fish sampled in the main channel run and side channel pool habitats, while sturgeon chub were most common in the main channel pool habitats. All of the 28 YOY shovelnose sturgeon sampled by trawling were found in an eight-mile reach encompassing the delta area and immediately above the headwaters of the reservoir. The specific habitat conditions where sturgeon were sampled compared to the conditions at all sites

where trawling occurred are shown in Table 6. This comparison shows that YOY shovelnose were found in deep water areas but at sites with slightly less depth than the average sampling site; slower than average mean column velocities; always in main channel run habitat areas; and most frequently sampled with YOY channel catfish.

Table 4. Average catch rates (no./drift) and number of fish sampled with trammel nets in the upper Missouri and Marias rivers, MT, 1995.

	Marias River	Loma	White Rocks	Stafford Ferry	Robinson Bridge	Total Number
Blue Sucker	0.4	0.3	0.5	0.1	0.1	46
Carp	0.2	0.2	0	0.2	0.4	50
Channel catfish	0.5	0.1	0.5	0.1	0.6	51
Goldeye	0.1	0.4	0	0.1	0.1	54
Longnose sucker	0.2	1.7	0	0.4	0	232
Pallid sturgeon	0	0	0	0	tr.	1
River carpsucker	2.2	0.1	2.5	0.2	1.5	144
Sauger	0	0.1	0	1.2	0.2	23
Shorthead redhorse	0.5	2.5	0.5	0.6	tr.	336
Shovelnose sturgeon	2.0	8.1	3.5	1.0	2.0	1168
Smallmouth bass	0	tr.	0	0	0	1
Smallmouth buffalo	0.6	0.1	0	0.5	0.2	30
Walleye	0	0	0	0	0.2	9
White sucker	0	tr.	0	0	0	6
Total no. fish	120	1662	15	58	290	2145
Total no. sets	18	123	2	20	55	218

Table 5. Average catch rates (no./line) and number of fish sampled with setlines in the upper Missouri River, MT, 1995.

	White Rocks	Stafford Ferry	Robinson Bridge	Total Number
Channel catfish	1.0	0	0.6	16
Pallid sturgeon	0	0	0.1	3
Sauger	0	0.1	0.1	4
Shovelnose sturgeon	0	0.2	0.1	6
Walleye	0	0.1	0	1
Total no. fish	1	4	26	31
No. of sets	1	11	41	53
Avg depth (ft)	12	8	9	

Table 6. Habitat conditions where young-of-the-year shovelnose sturgeon were sampled compared to conditions at all trawl sampling sites in the Robinson Bridge section, Missouri River, 1995.

Condition	Tows with Shovelnose present	all tows [1]
Number of tows	17	102
Average depth	10.7	11.8
Average column velocity	1.6	2.2
Average substrate	sand	sand
Occurrence in main channel run	100%	100%
Average number of taxa	4	2
Taxa association: Occurrence with YOY channel catfish	76%	30%

[1] Includes samples collected at sites only in the reach from RM -10 to RM 5, the reach where YOY shovelnose were captured.

Sturgeon radio telemetry studies were continued to a limited degree during 1995. The objectives were to monitor pallid sturgeon during the spawning season and develop a mini radio tag system that would be suitable for juvenile sturgeon.

Three adult pallid sturgeon were equipped with internal transmitters and monitored from April through September. Each fish was relocated 9 to 11 times. Figure 2 shows the locations of all 3 fish converging within an eight mile reach during June and early July, the anticipated spawning period. Pallid #203 was a sexually mature female and captured in this area while most likely spawning. The presence of several pallids in this area along with the capture of a spawning female pallid indicates that this reach is important for pallid sturgeon spawning.

Mini radio transmitters were tested for their signal performance along with the suitability for use in small juvenile sturgeon. The radios transmitted a signal over a period of 91 days during 3, 20-day cycles, or a total on-time of 41 days. The signal could reasonably be received in water depths up to 10 feet. Transmitters were surgically implanted into two small (0.85 and 1.05 lbs.) shovelnose sturgeon. The sturgeon seem to accept the implanted transmitters well, maintaining their location and eventually moving slightly upriver.

Larval fish sampling was used for determining the occurrence and location of sturgeon spawning in the study area. A total of 130 samples contained 440 larvae, representing at least 6 species (Table 7). The sucker group comprised the largest portion of the sample constituting 78% of the total. A total of 21 sturgeon larvae were collected, and were sampled at all 4 stations. These larvae were examined by Mr. Darrel Snyder, however, none could be identified below the genus Scaphirhynchus because of the identification difficulties associated with early developmental stages.

RECOMMENDATIONS

1. Discontinue with the pallid sturgeon population status studies and initiate recovery priority 3.3, reintroduce pallid sturgeon and/or augment existing populations (Dryer and Sandvol 1993). A final report summarizing the 6 years of population status studies in the upper Missouri River should be completed. Emphasis should be directed at evaluating the reintroduction effort. This includes development of effective sampling methods for sampling YOY and juvenile pallid sturgeon and development of a radio telemetry system that could be used for monitoring the reintroduced young pallid sturgeon.

2. Initiate a 5 year fisheries study in the lower Marias River to evaluate the effects of providing more natural high spring flows from Tiber Dam.

Table 6. Average catch per trawl (number) for fish sampled in the Robinson Bridge section, 1995. (Only fish less than 8 inches were included.)

Channel type	Main channel Run	Main channel Pool	Side channel Pool	Total
# hauls	161	28	8	197
Carp	<0.1 (8)	0	0	<0.1 (8)
Channel cat	1.5 (247)	0	8.3 (66)	1.6 (313)
Emerald shiner	<0.1 (1)	0	0	<0.1 (1)
Flathead chub	0.4 (58)	0.3 (8)	0.9 (7)	0.4 (73)
Freshwater drum	<0.1 (3)	0	0	<0.1 (3)
Goldeye	<0.1 (2)	0	0	<0.1 (2)
Western silvery/ plains minnow	0.1 (13)	0	0	0.1 (13)
Longnose dace	0.3 (41)	0.2 (5)	0	0.2 (46)
River carpsucker	<0.1 (2)	0 (0)	0 (0)	<0.1 (2)
Sauger/walleye	<0.1 (6)	0	0	<0.1 (6)
Shorthead redhorse	0	<0.1 (1)	0	<0.1 (1)
Shovelnose sturgeon	0.2 (28)	0	0	0.1 (28)
Sicklefin chub	0.7 (106)	0.4 (11)	0.8 (6)	0.6 (123)
Stonecat	0.2 (35)	<0.1 (1)	0	0.2 (28)
Sturgeon chub	0.8 (133)	1.0 (27)	0.1 (1)	0.8 (161)
White crappie	<0.1 (1)	0	0	<0.1 (1)
Total catch	4.2 (684)	1.9 (53)	10.0 (80)	4.1 (817)
# species	15	6	4	16

Figure 2. Movement patterns of three radio transmitted pallid sturgeon monitored in the upper Missouri River, 1995.

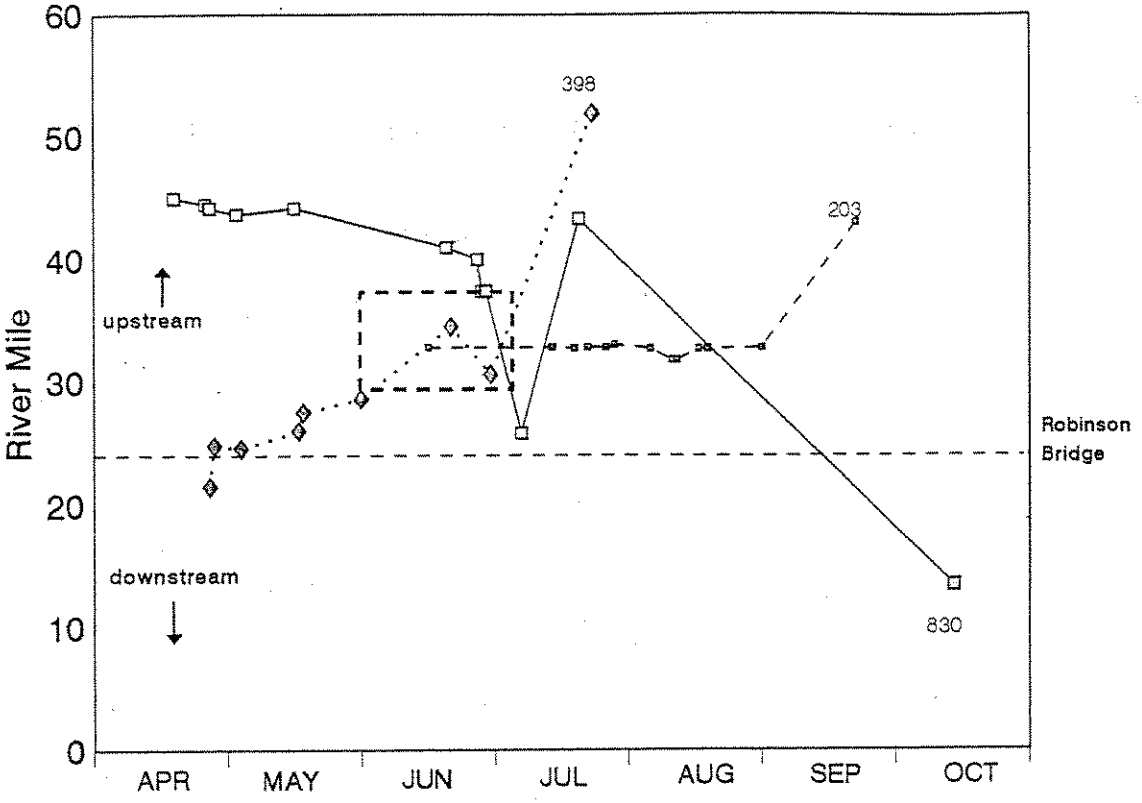

Table 7. Numbers of larval fish sampled in the upper Missouri River, 1995.

Station[1]	Goldeye	Minnow	Paddlefish	Sauger[2]	Sturgeon	Sucker	Total # Larvae	Avg.[3] Density	Total# Samples
Round Net									
RM-38	5	2	1	0	0	97	105	5.9	28
RM-34	2	1	0	0	4	39	39	6.8	16
RM-25	4	0	2	6	5	110	127	6.5	32
RM-10	0	8	4	5	3	66	86	6.1	28
D-Net									
RM-38	1	1	0	0	3	15	20	1.8	7
RM-34	12	0	0	0	2	5	19	3.5	4
RM-25	1	0	6	0	2	8	17	1.6	8
RM-10	2	2	10	0	2	4	20	3.3	7

[1] - RM indicates rivermile; RM-0 is the end of river and headwaters of Fort Peck Reservoir .
[2] - This group includes both sauger and walleye.
[3] - Density of larval fish expressed as number per 10,000 ft^3 of water filtered.

ACKNOWLEDGEMENTS

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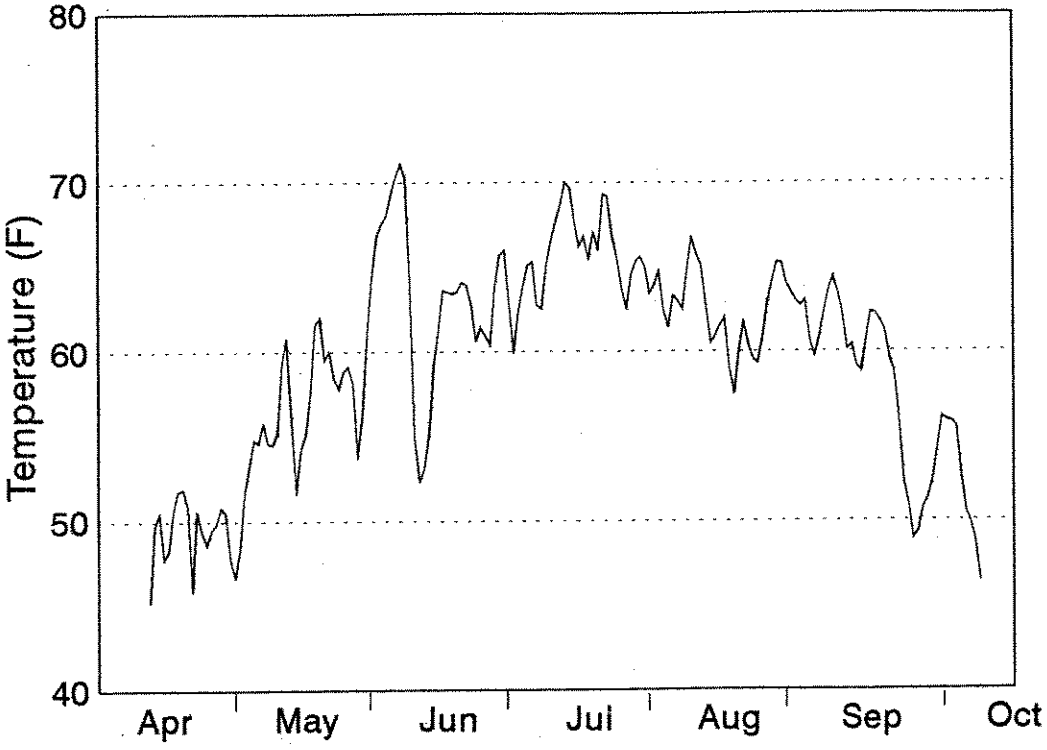
Date: September, 1996

Code numbers of waters referred to in this report are:

16-2520	Missouri River	Section 06
16-2522	Missouri River	Section 06B
17-4864	Missouri River	Section 07
14-3240	Marias River	Section 01

Appendix A. Average daily temperatures of the Marias River near Loma, MT, April 15 - October 10, 1995.



Appendix B. Size data (in. and lbs.) and capture information for pallid sturgeon sampled in the middle Missouri River, MT, 1990-95.

Tag number	FL	WT	Capture date	River mile	Recapture record
S-07479	50.0	30.0	5/16/90	14.3	RM-22 5/12/92;
S-07398	52.0	30.0	6/15/90	34.8	RM-22 4/26/95
6640988	54.0	37.0	10/3/90	46.8	RM-17 11/3/93; RM-22 4/11/94
6643419	60.0	50.0	11/1/90	14.3	RM-17 11/10/92;
S-00162	53.8	37.0	11/1/90	14.3	
G-01352	55.0	38.0	7/10/91	41.8	
6642911	50.3	28.5	8/13/91	75.5	RM-17 5/20/92; RM-14 10/13/94
4641585	55.5	37.5	5/6/92	23.0	RM-27 5/21/92; RM-22 5/6/93; RM-29.7 5/20/94
6645642	50.5	28.5	5/12/92	23.0	
4134091	51.3	29.5	5/13/92	25.2	
4400923	52.0	29.5	5/28/92	22.8	
6641735	42.7	17.5	6/23/92	42.0	
4689429	54.9	40.0	7/22/92	72.2	
4239794	54.3	32.0	10/1/92	20.2	
4595877	51.3	31.5	10/2/92	18.3	
4625237	56.5	40.0	10/13/92	16.5	
4025646	56.3	37.0	10/28/92	16.3	RM-22 4/26/93;
7314755	54.0	41.0	10/30/92	13.0	RM-14.1 10/13/94
6642865	43.0	13.2	4/21/93	25.2	
7316960	56.0	41.0	4/27/93	26.5	
4616385	43.0	19.5	5/19/93	41.2	
4185048	44.7	22.0	6/17/93	33.6	
6643283	60.0	47.0	9/22/93	25.2	
4239778	59.5	45.0	10/26/93	25.2	RM-24 5/12/94
89430445	43.9	16.0	4/26/95	22.5	
72317830	53.5	31.5	4/19/95	45.1	
77080203	58.0	41.0	6/14/95	33.8	

Appendix Table C. Summary size statistics for fish sampled with trammel nets in the upper Missouri and Marias rivers, MT, 1995.

Species/Station	Number	Total Length (inches)	Range	Weight (pounds)	Range
Blue sucker					
Loma	31	28.6	(24.5 - 31.8)	8.0	(5.0 - 11.4)
White Rocks	1	27.8	--	6.0	--
Stafford Ferry	3	32.0	(31.3 - 33.4)	10.3	(9.0 - 12.1)
Robinson Brdg.	4	32.1	(30.2 - 33.0)	10.7	(9.3 - 11.5)
Carp					
Loma	19	22.0	(19.1 - 24.8)	5.06	(3.50 - 7.40)
Stafford Ferry	3	20.1	(18.4 - 20.0)	3.67	(2.60 - 4.70)
Robinson Brdg.	24	20.2	(17.6 - 26.5)	3.95	(2.40 - 8.20)
Marias River	4	17.8	(12.3 - 21.7)	2.76	(0.52 - 4.50)
Channel catfish					
Loma	9	14.2	(11.3 - 18.2)	1.04	(0.45 - 2.20)
White Rocks	1	16.2	--	1.60	--
Stafford Ferry	1	11.4	--	1.20	--
Robinson Brdg.	31	14.5	(10.0 - 20.1)	1.17	(0.30 - 3.30)
Marias River	9	17.0	(13.4 - 29.2)	2.38	(0.80 - 10.2)
Goldeye					
Loma	49	12.0	(11.0 - 13.2)	0.59	(0.44 - 0.80)
Stafford Ferry	2	12.1	(11.5 - 12.6)	0.70	(0.40 - 1.00)
Robinson Brdg.	2	11.8	(11.5 - 12.1)	0.48	(0.40 - 0.55)
Marias River	1	13.0	--	0.60	--

Appendix Table C. (continued)

Longnose sucker					
Loma	215	16.2	(9.3 - 20.1)	1.82	(0.30 - 3.20)
Stafford Ferry	7	18.0	(15.8 - 25.3)	1.81	(1.10 - 2.60)
Marias River	4	16.2	(15.8 - 16.8)	1.83	(1.70 - 1.90)
Pallid sturgeon					
Robinson Brdg.	1	58.0 [1]	--	41.0	--
River carpsucker					
Loma	13	17.6	(15.8 - 22.5)	2.47	(1.90 - 6.50)
White Rocks	5	20.6	(17.6 - 22.2)	4.72	(2.80 - 6.20)
Stafford Ferry	4	18.3	(17.1 - 19.0)	3.05	(2.70 - 3.30)
Robinson Brdg.	83	19.8	(17.0 - 24.0)	3.73	(2.30 - 7.30)
Marias River	39	19.2	(15.9 - 21.2)	3.26	(1.80 - 4.50)
Sauger					
Loma	7	15.4	(13.5 - 19.8)	1.17	(0.80 - 2.40)
Stafford Ferry	3	15.3	(13.9 - 16.5)	1.25	(0.75 - 1.80)
Robinson Brdg.	13	16.3	(12.5 - 24.5)	2.74	(0.50 - 5.00)
Shorthead redhorse					
Loma	312	16.3	(7.9 - 20.6)	1.86	(0.20 - 3.20)
White Rocks	1	14.1	--	1.30	--
Stafford Ferry	13	16.4	(14.2 - 18.6)	1.88	(1.35 - 2.50)
Robinson Brdg.	1	15.9	--	1.60	--
Marias River	9	17.1	(15.6 - 19.0)	2.20	(1.70 - 2.80)

Appendix Table C. (continued)

Smallmouth bass					
Loma	1	14.0	--	1.90	--
Smallmouth buffalo					
Loma	7	24.0	(22.6 - 25.2)	7.74	(6.10 - 8.60)
Stafford Ferry	1	20.1	--	5.55	--
Robinson Brdg.	11	25.4	(21.0 - 28.5)	9.13	(4.80 - 13.4)
Marias River	11	25.5	(19.5 - 29.0)	8.87	(4.10 - 12.1)
Shovelnose sturgeon					
Loma	993	31.2 [1]	(14.0 - 38.2)	5.50	(0.85 - 11.4)
White Rocks	7	29.0 [1]	(23.3 - 34.4)	4.73	(4.73 - 7.40)
Stafford Ferry	21	26.3 [1]	(13.8 - 33.7)	3.53	(1.50 - 6.30)
Robinson Brdg.	111	26.7 [1]	(18.7 - 39.8)	3.43	(0.85 - 9.90)
Marias River	36	29.6 [1]	(24.5 - 38.2)	4.93	(2.20 - 10.2)
Walleye					
Robinson Brdg.	9	23.4	(20.3 - 26.0)	4.51	(2.90 - 6.20)
White sucker					
Loma	6	16.5	(15.5 - 17.3)	1.97	(1.70 - 2.20)

[1] Denotes a fork length measurement.

Appendix Table D. Summary size statistics for fish sampled with setlines in the upper Missouri River, MT, 1995.

Species/Station	Number	Total Length (inches)	Range	Weight (pounds)	Range
Channel catfish					
White Rocks	1	27.4	--	9.7	--
Robinson Brdg.	15	18.7	(12.1 - 28.0)	3.5	(0.8 - 9.8)
Pallid sturgeon					
Robinson Brdg.	3	49.8 [1]	(43.9 - 53.5)	25.9	(16.0 - 31.5)
Sauger					
Stafford Ferry	1	19.2	--	2.3	--
Robinson Brdg.	4	17.8	(15.3 - 22.0)	2.0	(1.0 - 3.6)
Shovelnose sturgeon					
Stafford Ferry	2	31.0 [1]	(29.3 - 32.8)	5.4	(4.5 - 6.2)
Robinson Brdg.	6	31.4 [1]	(28.2 - 35.4)	5.1	(3.0 - 6.8)
Walleye					
Stafford Ferry	1	23.2	--	3.8	--

[1] Denotes a fork length measurement.

Appendix Table E. Summary size statistics for fish sampled with experimental gill nets in the upper Missouri River, MT, 1995.

Species/Station	Number	Total Length (inches)	Range	Weight (pounds)	Range
Cisco					
Stafford Ferry	4	11.6	(10.4 - 12.5)	0.49	(0.45 - 0.53)
Robinson Brdg.	18	11.6	(10.6 - 12.6)	0.52	(0.40 - 0.80)
Carp					
Robinson Brdg.	2	21.1	(20.3 - 21.8)	4.22	(4.10 - 4.35)
Channel catfish					
Robinson Brdg.	21	14.2	(10.3 - 19.9)	1.10	(0.35 - 3.00)
Freshwater drum					
Robinson Brdg.	2	9.4	(9.3 - 9.5)	0.38	(0.35 - 0.40)
Goldeye					
Stafford Ferry	42	11.5	(9.9 - 12.6)	0.48	(0.45 - 0.60)
Robinson Brdg.	99	11.6	(6.4 - 14.2)	0.59	(0.23 - 0.85)
Northern pike					
Stafford Ferry	3	17.7	(16.8 - 18.7)	1.27	(1.00 - 1.55)
Robinson Brdg.	9	17.3	(15.2 - 19.0)	1.34	(0.80 - 1.70)

Appendix Table E. (continued)

River carpsucker					
Stafford Ferry	2	18.3	(16.0 - 20.6)	3.15	(1.85 - 4.45)
Robinson Brdg.	13	16.7	(8.9 - 21.1)	2.60	(0.45 - 4.90)
Sauger					
Stafford Ferry	12	11.0	(8.0 - 12.6)	0.29	(0.08 - 0.40)
Robinson Brdg.	31	13.4	(8.2 - 21.6)	0.80	(0.25 - 2.95)
Shorthead redhorse					
Stafford Ferry	1	11.0	--	0.40	--
Robinson Brdg.	11	15.3	(10.2 - 16.9)	1.52	(0.45 - 2.30)
Shovelnose sturgeon					
Robinson Bridge	10	26.8 [1]	(22.2 - 31.9)	3.09	(1.30 - 5.30)
Walleye					
Robinson Brdg.	5	10.8	(7.1 - 13.0)	0.46	(0.10 - 0.70)
White sucker					
Stafford Ferry	2	15.6	(15.4 - 15.8)	1.55	(1.20 - 1.70)

[1] Denotes a fork length measurement.