

**LOWER MISSOURI RIVER AND YELLOWSTONE RIVER
PALLID STURGEON STUDY**

1999 REPORT

by

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ABSTRACT

A total of 11 adult and four hatchery-reared juvenile (released in 1998) pallid sturgeon were captured by drift netting in the lower Missouri and Yellowstone rivers during 1997. Six of the adults were "new" fish and the remaining five were recaptures from previous years capture efforts. Five of the adults were transported to the Garrison National Fish Hatchery, North Dakota, for gonadal examination and potential use for hatchery spawning later in the spring. The adults ranged in size from 1245 centimeter fork length and 10.0 kilograms to 1553 centimeter fork length and 23.1 kilograms. Character index values of the new fish indicated they were all pure pallid sturgeon. Shovelnose sturgeon were the most abundant species captured by stationary gill and trammel nets and drifting trammel nets with a total 750 caught. Drifting trammel nets captured 384, 32, and 112 shovelnose sturgeon in the Milk, Missouri and Yellowstone rivers, respectively. Stationary net sets caught 322 shovelnose sturgeon only in Section 1 of the Missouri River. The combined mean fork length of these fish was 608 millimeters (range 99-905 mm) and 1008.4 grams (range 3.2 to 4400.0 gms). A total of 64 recaptures from previous years tagging were recovered. Over 67 percent of the recaptures netted in the Fort Peck tailwater/dredge cut complex were again recovered in this area. One fish tagged in the Missouri River (RM 1702) was recaptured in the tailwater area (RM 1771), a distance of about 68 miles, during 1999. Twenty adult shovelnose sturgeon were captured in the Milk River and 10 each, implanted with radio and sonic transmitters. Six radioed fish were located one to three times in the Missouri River, up to 47 miles downstream from the Milk River confluence. It was suspected at least five of these fish had suffered mortality since no movement was apparent after initial location. Only one sonic tagged fish was located, 9.1 miles downstream from the confluence and was only located once. Alimentary canal analysis was done on 10 adult shovelnose sturgeon captured in the Milk River. Food items consisted of an average of 429 fish ova per fish and six to 29 percent of the total volume. Invertebrates (diptera, trichoptera, ephemeroptera) were present in all samples and ranged from one to 10 percent of the total contents. Inorganic composition (fine gravel) ranged from 28 to 80 percent of the total volume. Four small cyprinids were found in three of the samples. A total of 161 trammel net drifts were made in the Milk, Missouri and Yellowstone rivers and captured 1,054 (6.55 CPUE) fish. Shovelnose sturgeon were the most common species captured. The Milk River had the highest CPUE of 23.11 fish and 16.71 shovelnose sturgeon were captured per net drift. Larval fish sampling was done in the Milk, Missouri, and Yellowstone rivers. One larval paddlefish and no larval sturgeon were collected in the Milk River. One larval sturgeon and three larval paddlefish were found in the Missouri and Yellowstone river samples, respectively. No paddlefish/sturgeon eggs were identified in the Milk or Missouri river samples but two were present in the Yellowstone River samples. Benthic trawling was done in Section 7 of the Missouri River for the purpose of collecting live YOY shovelnose sturgeon for shipment to UC-Davis for iridovirus testing; eighty-six YOY shovelnose sturgeon were sent. Channel catfish were the most abundant species captures (66percent of a total of 1193 fish) and 132 sturgeon chub and 103 sicklefin chub were also collected and were next most abundant species captured.

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INTRODUCTION

This report summarizes 1999 field research of the lower Missouri River and Yellowstone River Pallid Sturgeon Project. Funding was provided by the Western Area Power Administration. Original project objectives were to: 1) Release 120 hatchery-reared age II pallid sturgeon in the lower reaches of the Milk River; 2) Release 400 hatchery-reared juvenile pallid sturgeon in the Missouri and Yellowstone rivers during August; 3) Sample fish in the Missouri, Milk and Yellowstone rivers at standard and random sites by drift and stationary gill and trammel nets; 4) Sample for larval fish in the Missouri, Milk, and Yellowstone rivers during May through July; 5) Capture one to three pallid sturgeon by SCUBA in the Fort Peck tailwaters during March-April and implant sonic transmitters. Two additional objectives were added and involved the capture of 20 adult shovelnose sturgeon in the Milk River and surgically implant 10 radio transmitters and 10 sonic transmitters during June; the other was to capture age 0 sturgeon in the lower Missouri River for viral testing at UC-Davis, California.

Objectives 1 and 2 could not be met due to suspected iridovirus outbreak affecting pallid sturgeon progeny at the Gavins Point hatchery. The hatchery was placed under quarantine which prevented the release of any hatchery-reared pallid sturgeon in the wild during 1999. Objective 5, the capture of pallid sturgeon by SCUBA in the Fort Peck dam tailwaters, was not attempted.

STUDY AREA

The study area was comprised of the Missouri River from Fort Peck Dam at river mile (RM) 1770 to the headwaters of Lake Sakakawea, RM 1538, the Yellowstone River from Intake Diversion Dam, RM 71.1, to the Missouri River, RM 0.0, and the lower 10 miles of the Milk River (Figure 1). The Missouri River was divided into seven study sections, the Yellowstone into two, and the Milk River, one section (Table 1). A description of the Missouri and Yellowstone rivers study area is found in report by Tews (1994) and Gardner and Stewart (1987) and of the Milk River by Liebelt (1996).

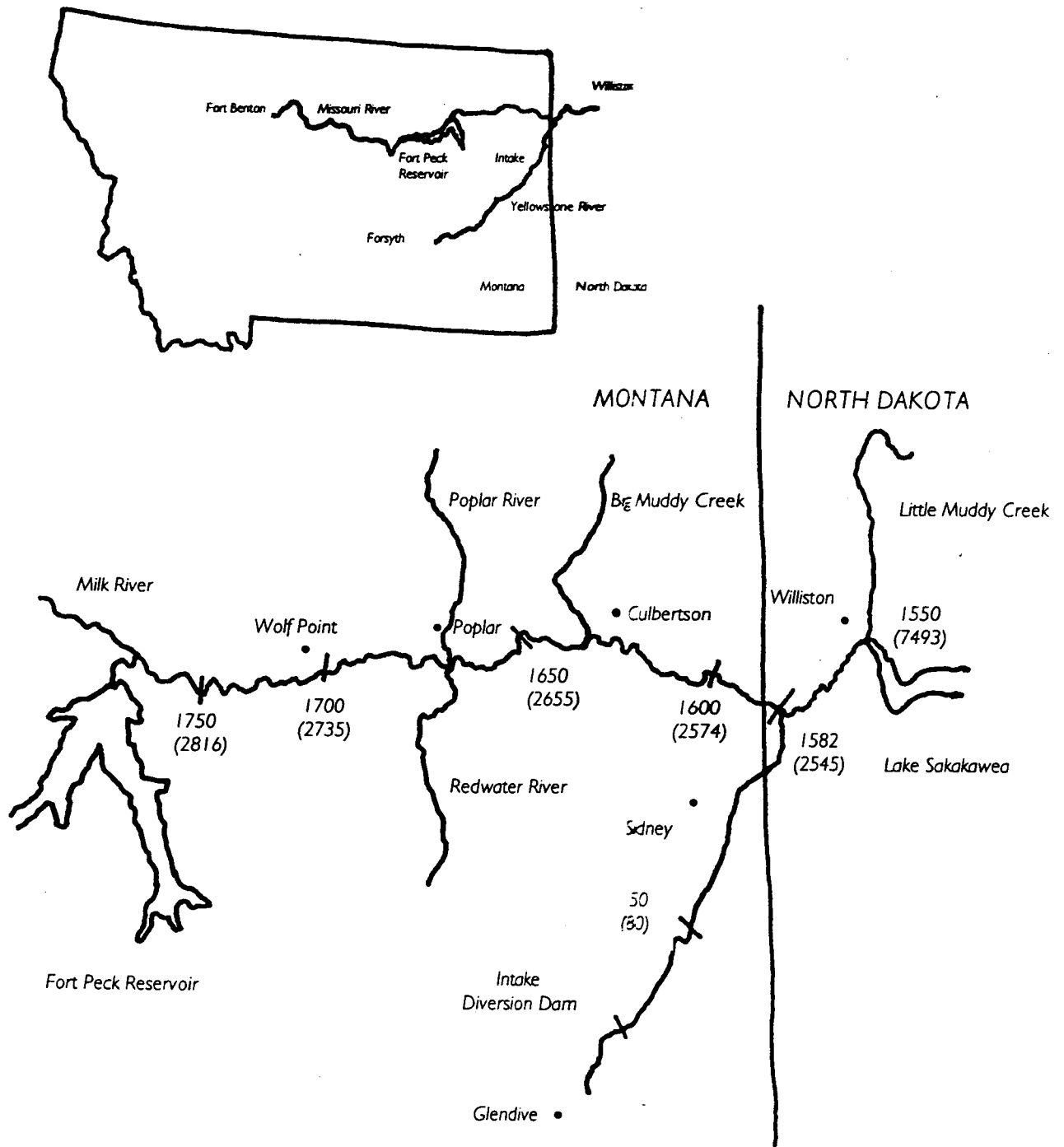


Figure 1. Map of lower Missouri River and Yellowstone River pallid sturgeon study area in river miles (kilometers).

Table 1. Section number and location by river mile and physical features.

Section	Location
0	Lower 15 miles of Milk River
1	Fort Peck Dam to the mouth of Milk River, River Mile 1770 to 1761
2	Mouth of Milk River to Wolf Point, River Mile 1761 to 1708
3	Wolf Point to mouth of Redwater River, River Mile 1708 to 1683
4	Mouth of Redwater River to mouth of Big Muddy, River Mile 1683 to 1630
5	Mouth of Big Muddy to mouth of Yellowstone River, River Mile 1630 to 1582
6	Mouth of Yellowstone River to highway 85 bridge, River Mile 1582 to 1553
7	Highway 85 bridge to Lake Sakakawea, River Mile 1553 to 1530
8	Yellowstone River from Intake to highway 23 bridge, River Mile 71 to 30
9	Highway 23 bridge to mouth of Yellowstone River, River Mile 30 to 0

METHODS

Netting

Multifilament trammel nets were used the majority of the time for drift netting in the Milk, Missouri and Yellowstone rivers and also used for stationary sets at standard locations in the tailwaters of Fort Peck Dam. Nets were 22.9 meters long by 1.8 meters deep with 2.5 centimeter inner mesh and 20.3 centimeters outer mesh and 13.6 kilogram lead core bottom line. Multifilament experimental gill nets were also used, primarily for overnight sets in the Fort Peck dredge cut complex. These nets measured 38.1 meters long by 1.8 meters deep with five equal panels of 1.9, 2.5, 3.2, 3.8, and 5.1 centimeter bar mesh and 13.6 kilograms lead core bottom line. Monofilament nets were infrequently used under certain circumstances and conditions for drift and stationary netting. Nets were drifted for up to 10 minutes per drift and covered approximately 300 meters unless snags were encountered. Average drift time for the Milk River was about three minutes and covered approximately 100 meters. Catch rate is reported as catch per unit of effort (CPUE).

Measurements and Tagging of Sturgeon

Standard morphological measurements were taken on all "new" pallid sturgeon captured in the Missouri and Yellowstone rivers in order to develop a character index. The index is used to

determine if the pallid sturgeon are genetically pure or possibly a shovelnose/pallid sturgeon hybrid. Measurements are also taken on recaptures to compare growth characteristics.

Passive integrated transponders (PIT) tags were implanted on both sides at the base of the dorsal fin on new pallid sturgeon and in some cases, a second PIT tag was implanted on recaptures. Numbered cinch tags were placed through the dorsal fin base of shovelnose sturgeon not previously captured and weighing a minimum of 200 grams.

Larval Fish Sampling

Sampling for larval fish was done in the Milk River during May and June and in the Missouri and Yellowstone rivers from May through July. Samples were collected near the bottom using paired, 1/2 m x 1.8 m long conical nets (750 um Nitex mesh) with attached buckets and weighted with a 4.5 kg. Lead ball. A digital flow meter (230 OR G.O. Environmental Inc.) was suspended in the mouth of the net for calculation of volume sampled. Average sampling time was about seven minutes but varied from four to 20 minutes depending on debris load. Contents of collecting buckets were transferred to jars and preserved in 10 percent formalin solution containing Phloxine-B dye for specimen staining.

Trawl Sampling

A modified benthic trawl as described by Grisak (1994) was used to capture young-of-the-year (YOY) sturgeon and other species in the Missouri River during August. The primary purpose was to capture YOY sturgeon for viral analysis at the University of California-Davis (UC-Davis). Trawls averaged about four minutes duration, primarily over sand substrate in 6 to 12 foot depths. The average estimated distance trawled downstream was about 224 meters. Samples were emptied into a bucket of water and fish were sorted with the aid of sieves (U.S. Standard Sieve Series). Sturgeon were transferred to a cooler of water, later bagged with oxygen added, and shipped by air in coolers to UC-Davis.

Radio/Sonic Telemetry

Twenty adult shovelnose sturgeon were captured by drift-netting in the Milk River during June and one-half surgically implanted with radio and the other half with sonic transmitters at the capture site. The radios weighed approximately two-grams with individual frequencies and had a duty cycle eight-hours "on" and 16 hours "off" with a 20-day life on consecutive days. Radios were manufactured by Advanced Telemetry Systems (ATS). The sonic tags weighed approximately 18 grams (dry weight) and have a two-year life cycle. Fish were tracked by boat using an ATS receiver and a Lotech receiver (model STR1000). Antennas were mounted on the bow and on the console of the boat; after fish were located a hand-held quad-angle ATS antenna was used to pinpoint fish locations. Some transmitters were located using a Sonotronic hydrophone and a Sonotronic ultrasonic receiver (model USR-5W). Headphones were also used as an aid in locating both transmitter types. GPS coordinates were recorded at location sites; depth and water temperatures were also recorded.

River Discharges

Mean discharges from Fort Peck Dam (RM 1770.1) during the period April through October were 7,553 cubic feet per second (cfs) and ranged from a mean of 9,048 cfs in July to 4,658 cfs in October. The maximum discharge was 9,400 cfs and occurred June 6 and September 1. Data obtained from the U.S. Army Corps of Engineers at Fort Peck.

Flows in the Missouri River at Culbertson (RM 1621) ranged from a mean of 11,256 cfs in April to 5,550 cfs in October and an overall mean of 9,291 cfs. The maximum flow was 18,900 cfs on April 1 and the minimum flow was 5,370 cfs on October 15.

Flows in the Milk River near Nashua (RM 22.7) had an overall mean of 617 cfs and ranged from a mean of 1,438 cfs in May to 207 cfs in July. The maximum flow was 5,360 cfs on June 17 and the minimum flow was 40 cfs on October 24. Flows in the river are greatly compromised due to irrigation demands.

The Yellowstone River at Sidney (RM 29.5) had a mean discharge of 17,084 cfs from April through October with a mean range of 43,433 cfs in June to 8,624 cfs in October. Flows ranged from a maximum of 53,500 cfs on June 26 to a minimum of 7,070 cfs on April 26.

River discharges for the period April through October, 1999 for the Missouri, Milk, and Yellowstone rivers is shown in Table 2. Monthly mean and maximum and minimum discharges are shown in Appendix 1. Data for the Missouri River at Culbertson, the Milk and Yellowstone rivers provided by the USGS at Fort Peck. October discharges are provisional.

Table 2. Mean, maximum and minimum discharges (cubic feet per second) for the Missouri River at Fort Peck and Culbertson, the Milk River at Nashua, and the Yellowstone River at Sidney from April through October, 1999. Dates of maximums and minimums for the time period are shown in parentheses.

	Mean Discharges (cfs)	Average Maximums(cfs)	Average Minimums(cfs)
Missouri River Fort Peck RM 1771.0	7,553	9,400 (06/06, 09/01)	4,300 (10/11)
Missouri River Culbertson RM 1621.0	9,291	18,900 (04/01)	5,370 (10/15)
Milk River Nashua RM 22.7	617	5,360 (05/17)	40 (10/24)
Yellowstone River Sidney RM 29.5	17,084	53,500 (06/26)	7,070 (04/21)

RESULTS

Pallid Sturgeon

A total of 11 adult pallid sturgeon and four hatchery-reared juveniles released in 1998 were captured by drift netting in the Missouri and Yellowstone rivers. Nine of the adult pallid sturgeon were captured in April in the Missouri/Yellowstone confluence area (RM 1583.5), one was captured during May in the Yellowstone River (RM 5.2), and one was captured in the confluence area during August. Six of these fish were "new" fish and the remaining five were recaptures from previous years (Table 3). Five of the fish captured in April were transported to the Garrison

National Fish Hatchery (GNFH) for gonadal examination and potential use for hatchery spawning later in the spring. The other adult and juvenile pallids were released at capture sites.

The adults ranged in size from 1245 cm fork length and 10.0 kg to 1553 cm fork length and 23.1 kg in weight. Character index (CI) values of the new fish indicated they were all pure pallid sturgeon (Appendix 2). Six morphological measurements were taken on these fish to develop a CI in order to detect the possible presence of pallid/shovelnose sturgeon hybrids. The morphometric measurements used for the CI are fork length, head length, mouth to inner barbel, interrostral distance, and outer and inner barbel lengths. The measurements are converted to percent of fork length so differences in size of individual fish are standardized. The CI values of the new pallids ranged from 446.8 to 529.7. Krentz (1996), found CI values ranging from 358 to 636 with a mean of 509 for pallid sturgeon based on 167 fish. These fish were all captured in the Missouri River in North Dakota and Montana. Shovelnose sturgeon CI values ranged from 154 to 293 with a mean of 230. These values were based on a sample of 95 fish from the Missouri River in North Dakota and Montana.

Table 3. Pallid sturgeon captured in the Missouri and Yellowstone rivers during 1999.

Date	RM	Fork Length	Weight kg	PIT tag #1	PIT tag #2	Recap	Sex	Original Capture
4/13/99*	1583.5	1296	13.6	220C700429	2204523542	N	U	
4/14/99*	1583.5	1397	15.4	1F4A111C6A		N	U	
4/14/99*	1583.5	1546	22.7	1F4A27214F		N	M	
4/14/99*	1583.5	1365	16.3	1F477B3A65		N	U	
4/14/99*	1583.5	1553	23.1	115553544A		N	F	
4/15/99	1583.5		21.3	1F477B4E51		Y	M	10/15/97
4/15/99	1583.5		13.6	1F4A363031		Y	U	4/16/98
4/15/99	1583.5			1F4772396F		Y	M	4/27/97-9/28/94
4/15/99	1583.5	1476	23.1	220F01755C	2204657963	Y	U	4/16/98
5/19/99	Y-5.2	1245	10.0	220E3F2578	220E3F7046	N	U	
8/26/99	1583.5	1445	19.0	7F7FD66963	220E5B3803	Y	M	9/13/89

* - Transported to Garrison National Fish Hatchery

Y - Yellowstone River

Pallid sturgeon appear to be quite vulnerable to drift netting in the confluence area during April. Flows in the Yellowstone River averaged 8,390 cfs and 10,400 cfs in the Missouri River during the sampling period. It may be the confluence is a prespawn staging area prior to movement upstream for spawning, particularly in the Yellowstone River. It is doubtful any appreciable numbers move up the Missouri River to spawn due to cooler water temperatures, reduced turbidity (sediment load), and lack of a significant spring rise compared to the Yellowstone River.

Four hatchery-reared juvenile pallid sturgeon released at the confluence and lower Yellowstone and Missouri rivers in 1998 were recaptured by drift netting. Two others were reported caught by anglers, one in the Missouri River, the other in the Yellowstone River. Four family groups were identifiable by elastomere dye (injected at the hatchery prior to release) marking on the ventral side of the rostrum. All fish had been injected with a Passive Integrated Transponder tag at the hatchery prior to release in the wild. Results are shown in Table 4.

Two of the recaptures exhibited interstream movement, one from the blue family (Missouri River into Yellowstone River) and the other from the green family (Yellowstone River into Missouri River). Both fish moved a minimum distance of approximately 35 kilometers (km) from the original release site to the recapture site. The orange family recapture was originally released with an internal radio transmitter. This fish was recaptured about 12 km downstream from the release site in the Yellowstone River. The radio was no longer emitting signals but there was little evidence of surgical implantation around the antenna exit area. This fish had increased in length 21 mm and 20 grams in weight. Original lengths and weights of non-radioed pallid sturgeon are unknown.

Table 4. Hatchery-reared juvenile Pallid sturgeon recaptured in the Missouri and Yellowstone rivers during 1999.

PIT#	Family Color	Release Date	Release Location	River Mile	Release Length(mm)	Release Weight(g)	Recapture Date	Recapture Location	River Mile	Recapture Length(mm)	Recapture Weight(g)
4108615164	Red	8/11/98	Confluence	1581.3			5/04/99	Upper End Prescription	3.0	303	86.7
4109062517	Blue	8/11/98	Nohly Bridge	1589.1			5/04/99	Upper End Prescription	3.0		
41093F771C	Green	8/11/98	Big Bend	16.0			5/05/99	Head Big Isl. Fairview Brg.	11.1	337	127.6
Angler		8/11/98					5/19/99	Below Fairview Bridge			
Angler	Green	8/11/98					5/20/99	Nohly Bridge	1589.1		
40640B5B4C*	Orange	8/11/98	Big Bend	16.0	426	258.0	7/07/99	Fairview Bridge	8.5	447	278.3

* Radioed Fish #48.401

Shovelnose Sturgeon

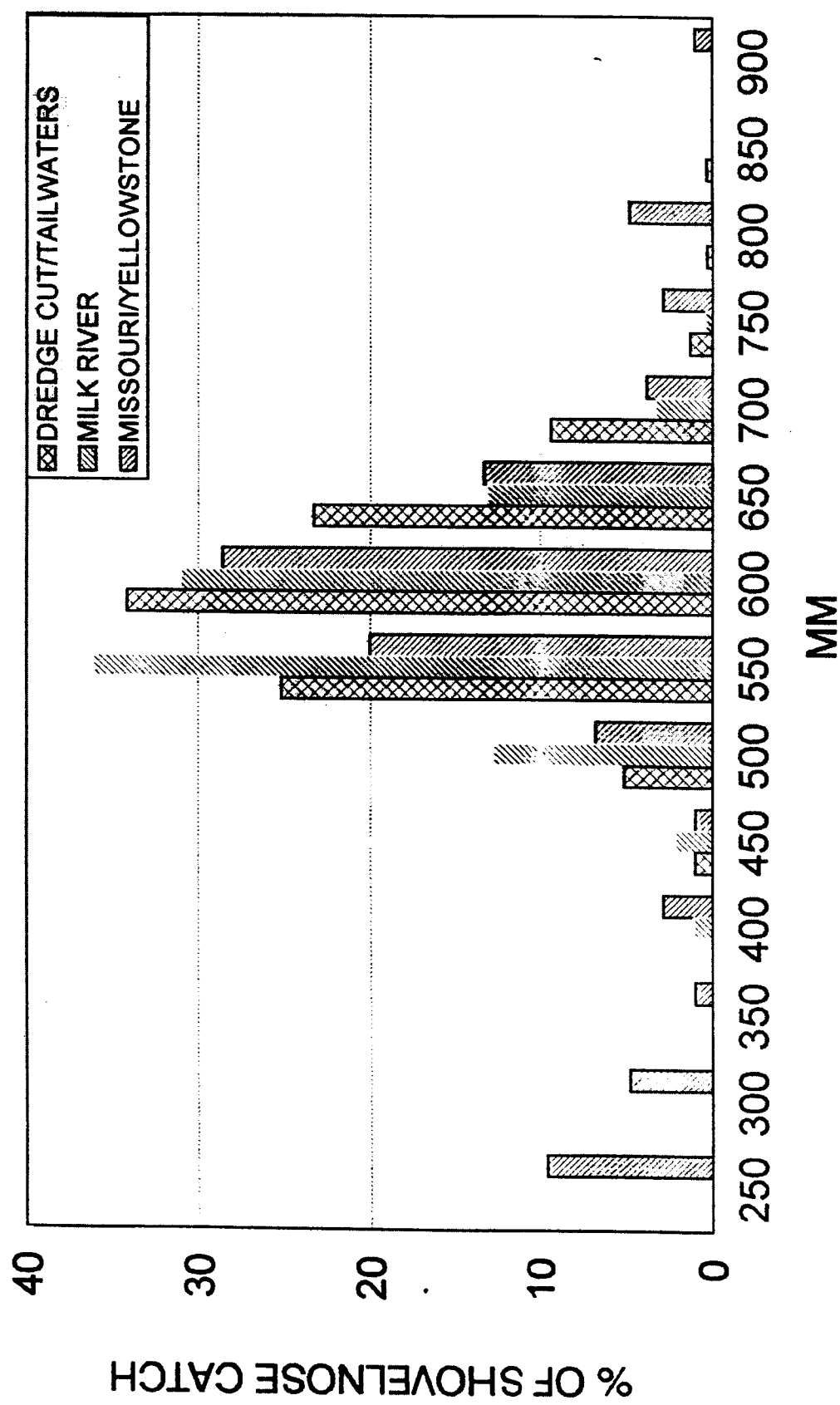
A total of 750 shovelnose sturgeon were captured in the Milk, Missouri, and Yellowstone rivers by stationary gill net sets (only in Section 1) and drifting trammel nets during 1999. Sections 3 and 4 of the Missouri River and Section 8 of the Yellowstone River were not sampled due to time constraints. Drifting trammel nets caught 284 shovelnose sturgeon in the Milk River, 32 in the Missouri River, and 112 in the Yellowstone River. Stationary gill and trammel net sets captured 322 shovelnose sturgeon only in Section 1.

The combined mean fork length and weight of those fish was 60.8 mm (range 98-905 mm) and 1008.4 grams (range 3.2-4400.0 gm). Excluding only two fish captured in Section 5 of the Missouri River, shovelnose sturgeon captured in Section 9 of the Yellowstone River had the smallest mean length and weight of 566 mm and 50.6 gm but also had the greatest range of 251 to 905 mm and 50.6 gm to 4400.0 gm. Shovelnose sturgeon from the Missouri River (Section 2) had the greatest mean length of 645 mm and mean weight of 1225.0 gm based on a sample of only 10 fish. The largest sample of sturgeon, 313 fish captured in the tailwater-dredge cut complex of the Missouri River (Section 1), had a mean length and weight of 630 mm and 1088.5 gm (Table 5). Length frequency distribution (Figure 2) indicated shovelnose sturgeon in the Milk River had the greatest percentage (36.1%) of fish in the 550 to 559 mm length group. Almost 79 percent of the sturgeon netted from all areas sampled were in the 550 to 700 mm size range. No shovelnose smaller than 250 mm and only two over 850 mm were captured.

Table 5. Number, mean fork length, mean weight, and range of shovelnose sturgeon captured by river section in the Milk, Missouri and Yellowstone rivers during 1999.

	Section N	Fork Length (mm)		Weight (g)	
		Mean	Range	Mean	Range
0	274	600	423-772	945.1	100.0-2200.0
1	313	630	459-895	1088.5	300.0-3600.0
2	10	645	515-832	1225.0	700.0-2550.0
5	2	98	98	3.5	3.2-3.7
6	8	602	480-680	987.5	450.0-1250.0
7	3	585	563-620	825	750.0-950.0
9	88	566	251-905	927.3	50.6-4400.0
Total	698	608	98-905	1008.4	3.2-4400.0

Figure 2. Length-frequency distribution of shovelnose sturgeon captured in the Fort Peck dam tailwaters-dredge cut area, Milk, Missouri, and Yellowstone rivers during 1999.



Tagging and Recaptures

A total of 607 shovelnose sturgeon from the Milk, Missouri, and Yellowstone rivers were tagged during 1999 (Table 6). Sixty-four recaptures from previous years tagging and 12 shovelnose sturgeon tagged in 1999 and recaptured at a later date during the year were recovered (Table 7). The majority of the sturgeon tagged, 518 fish, were captured in the Milk River (Section 0) and the dredge cut-tailwater complex in the Missouri River (Section 1). Eleven recaptures were netted in the Milk River. Six of these had been originally tagged in the dredge cut-tailwater area, three were tagged in the Milk River during May and recaptured during June, and one was first tagged several miles downstream in the Missouri River at RM 1759.5 in 1997. Forty-three recaptures, originally tagged in the dredge cut-tailwater complex, were again netted in the same area. The oldest tag recovery was from a fish first tagged June 15, 1993 and recaptured September 13, 1999. This fish had grown in length by 10 mm and 204 gm in weight. Four shovelnose sturgeon tagged approximately five miles downstream of the tailwaters, one in 1996, two in 1997, and one in 1998, were recaptured in the dredge cut-tailwater area. Also, one fish tagged in 1996 and one tagged in 1998 in the tailwater area were recaptured five miles downstream (RM 1766). A shovelnose sturgeon tagged June 12, 1994, in the Missouri River near Wolf Point (RM 1702) was recaptured June 24, 1999 in the tailwater area (RM 1771), a distance of approximately 68 miles upriver. The only other fish showing significant movement was tagged in Section 6 of the Missouri River (RM 1568) September 19, 1996 and was recaptured May 5, 1999 in the Yellowstone River (RM 5), a distance of about 19 miles.

It appears, based on tag return information, a significant number of shovelnose sturgeon tagged in the dredge cut-tailwater area tend to remain in this area over a relatively long period of time. Considering the life history of shovelnose sturgeon, this seems to be somewhat incongruous. The upper reaches of the river below Fort Peck Dam are relatively clear and cold. The dredge cuts do provide, perhaps a more suitable environment for sturgeon, since this area is generally more turbid due to wave action and runoff events, and also warmer during the summer and fall months. No apparent reason, other than the presence of the dam, would seem to account for the long term presence of shovelnose sturgeon in this area.

Table 6. River section and number of shovelnose sturgeon captured and tagged and number of recaptures from the Milk, Missouri, and Yellowstone rivers during 1999.

River Section	Number Captured	Number Tagged	Number of Recaptures
0	284	258	11
1	322	261	61
2	10	10	0
3	0	0	0
4	0	0	0
5	2	0	0
6	17	8	0
7	113	3	0
8	0	0	0
9	112	68	4
Totals	860	608	76

Table 7. Shovelnose sturgeon recaptures from the Milk, Missouri, and Yellowstone rivers during 1999.

Tag No.	Capture Date	RM	FL mm	Wt grams	Recapture Date	RM	FL mm	Wt grams
5622	6/15/93	DC	610	771	9/13/99	DC	621	975
5474	6/12/94	M-1072	622	861	6/24/99	DC	636	900
5732	9/15/94	DC	546	636	6/21/99	DC	563	850
6285 ¹	9/08/95	DC	625	1089	5/24/99	DC	643	1125
6302	9/08/95	DC	559	703	8/17/99	DC	690	900
6481	10/04/95	DC	605	975	5/24/99	DC	614	1000
6493	10/04/95	DC	737	1565	6/08/99	DC	727	1650
6761	6/18/96	DC	665	1135	6/22/99	M-1766	665	1425
6817	6/18/96	DC	675	1362	6/21/99	DC	681	1550
6796	6/19/96	M-1766	584	704	4/29/99	DC	630	1050
7076	9/19/96	M-1568	550	700	5/19/99	Y-50	53	700
7301	10/09/96	DC	660	1300	5/25/99	K-4.5	671	1500
7435	4/23/97	Y-5.0	627	975	5/20/99	Y-16.0	650	1025
7460 ²	5/05/97	DC	594	800	7/08/99	DC	595	900
7481	5/05/97	DC	732	1650	6/24/99	DC	733	1700
7485	5/05/97	DC	553	700	8/17/99	DC	555	750
7487	5/05/97	DC	765	2000	5/24/99	DC	767	2000
7492	5/05/97	DC	590	752	6/07/99	DC	591	875
7492	5/05/97	DC	590	752	6/8/99	DC	591	875
7507 ³	5/05/97	DC	528	850	5/24/99	DC	627	875
7508	5/05/97	DC	637	1050	6/24/99	DC	639	1150
7517	5/08/97	DC	620	1000	6/21/99	DC	620	1100
7670 ⁴	5/15/97	DC	670	1300	6/07/99	DC	675	1500
7670 ⁴	5/15/97	DC	670	1300	6/08/99	DC	675	1500
7670 ⁴	5/15/97	DC	670	1300	6/21/99	DC	675	1525
7690	5/15/97	DC	588	1040	6/21/99	DC	589	1100
7734 ⁵	5/15/97	DC	575	800	5/24/99	DC	589	960
7737 ⁶	5/15/97	DC	655	990	5/24/99	DC	664	1025
7745	6/02/97	DC	559	650	5/27/99	K-4.5		850
7828	6/11/97	DC	637	850	6/21/99	DC	642	975
7883	6/19/97	DC	580	725	6/21/99	DC	589	775
7899	6/19/97	DC	617	950	6/08/99	DC	619	950
201	6/22/97	DC	619	1050	6/27/99	DC	ANGLER	
7924	6/23/97	DC	572	800	6/21/99	DC	586	850
7925 ⁷	6/23/97	DC	543	600	6/24/99	DC	565	725
7943 ⁸	6/23/97	DC	583	900	5/24/99	DC	578	875
7108	6/24/97	DC	580	900	6/16/99	K-4.5	679	975
7113	6/24/97	DC	544	650	6/08/99	DC	582	750
7973 ⁹	6/24/97	M-1766	714	1650	5/24/99	DC	725	1790
7117	7/02/97	DC	595	800	5/27/99	K-4.5	601	900
7620	7/09/97	DC	584	750	5/24/99	DC	584	750
7621	7/09/97	DC	626	1200	6/24/99	DC	622	750
7641	7/09/97	DC	630	1050	6/22/99	M-1766	628	1050
7647	7/09/97	DC	571	750	6/24/99	DC	563	700
7779	7/09/97	DC	608	850	7/08/99	DC	605	950
7787 ¹⁰	7/09/97	DC	575	700	5/24/99	DC	576	725
7788	7/09/97	DC	535	600	6/16/99	K-4.5	548	725
7592	7/15/97	M-1759.5	669	1365	5/26/99	K-4.5	680	1300
8014	9/17/97	M-1766	617	1050	8/17/99	DC	618	900
8046	9/30/97	DC	615	950	5/24/99	DC	605	800
98	10/20/97	DC	579	690	5/25/99	K-4.5	590	900
322	6/22/98	DC	610	1150	8/17/99	DC	615	1025
7003 ¹¹	6/22/98	DC	615	1100	6/08/99	DC	615	1050
317	6/23/98	DC	660	1500	6/08/99	DC	655	1500

Table 7 (Con't)

Tag No.	Capture Date	RM	FL mm	Wt grams	Recapture Date	RM	FL mm	Wt grams
497	7/21/98	Y-50.0	570	718	5/27/99	Y-39	ANGLER	
601	9/21/98	DC	643	1225	7/08/99	DC	636	1250
602	9/21/98	DC	569	680	6/21/99	DC	573	700
8054	6/24/98	M-1766	650	1500	6/07/99	DC	660	1450
332	7/29/98	DC	560	650	6/07/99	DC	557	650
8137	10/08/98	Y-10.5	645	1080	5/19/99	Y-5.0	645	1075
8135	4/29/99	DC	743	1800	5/24/99	DC	741	1800
8170	4/29/99	DC	635	950	10/20/99	DC	638	1050
8173	4/29/99	DC	585	875	6/21/99	DC	590	875
8173	4/29/99	DC	585	875	10/20/99	DC	590	850
7484	5/05/99	DC	595	800	5/24/99	DC	595	800
748	5/24/99	DC	645	1250	6/24/99	DC		
764	5/24/99	DC	580	875	6/24/99	DC		
832	5/26/99	K-4.5	632	1170	6/14/99	K-4.5		
558	5/27/99	K-4.5		1050	6/14/99	K-4.5		
592	5/27/99	K-4.5	675	1250	6/14/99	K-4.5		
8270	6/07/99	DC	619	1000	6/24/99	DC		
8607	6/21/99	DC	673	1400	8/17/99	DC	671	1250
609 ¹²					8/17/99	DC	678	1525
958 ¹³					6/07/99	DC	643	1250
8098 ¹⁴					6/24/99	DC		
8619 ¹⁵					6/21/99	DC	621	1100

RM - Rivernile

FL - Fork Length

Wt - Weight

Y - Yellowstone River

M - Missouri River

K - Milk River

DC - Fort Peck Dredge Cuts and Tailwaters

1 - Tag 6285 removed and replaced with tag 775

2 - Tag 7460 removed and replaced with tag 656

3 - Tag 7507 removed and replaced with tag 715

4 - Tag 7670 removed and replaced with tag 963

5 - Tag 7734 removed and replaced with tag 793

6 - Tag 7737 removed and replaced with tag 749

7 - Tag 7925 removed and replaced with tag 8463

8 - Tag 7943 removed and replaced with tag 778

9 - Tag 7973 removed and replaced with tag 719

10 - Tag 7787 removed and replaced with tag 758

11 - Tag 7003 removed and replaced with tag 310

12 - Original capture data unknown

13 - Original capture data unknown

14 - Original capture data unknown

15 - Original tag number not visible; replaced with tag 8619

Shovelnose Sturgeon Radio/Sonic Telemetry

Twenty adult shovelnose sturgeon were surgically implanted, 10 each, with 20-day radio and two-year sonic transmitters. The fish were captured in the Milk River June 16, and averaged 637.7 mm in length (range 548 to 725) and 1101.3 gm (range 725 to 1975). Transmitters were implanted at the capture site about 6.4 kilometers from the confluence with the Missouri River. Fish were held in a live car after surgery for up to 0.5 hours and released at the capture site. Water temperature was 23.9 degrees Celsius and river flow was about 1,000 cfs and rapidly dropping.

Initial efforts to locate the radio/sonic shovelnose sturgeon after release were unsuccessful. Finally, on July 1, a sonic transmitter was located in the Missouri River 9.1 miles downstream from the release site. This was the only sonic tagged fish located and was only identified once. Six radioed fish were located from one to three times. It is suspected at least five of these fish

suffered mortality since multiple locations were at the same site up to 49 days later. Indeed, one radioed and partially decomposed fish was recovered buried in sandy substrate. This fish was first located July 13 and recovered August 20. The furthest downstream movement of located fish from release site was 47 miles. Results are shown in Table 8.

Table 8. Relocation date and radio/sonic frequency of implanted transmitters in shovelnose sturgeon captured and released in the Milk River during 1999.

Radio Freq.	Date	GPS	River Mile of Location	Miles from Release Pt.	Physical Location
49.521	7/07/99	48°02.457 105°45.939	1719	47	2.5 miles above mouth of Sand Creek
49.521	7/21/99	48°02.517 105°45.976	1719	47	
49.641	7/07/99	48°02.835 105°46.293	1719.5	46.5	3 miles above mouth of Sand Creek
49.641	7/21/99	48°02.835 105°46.293	1719.5	46.5	
49.671	7/13/99	48°00.599 106°02.591	1741.3	24.7	200 yds below boat launch at Grandchamps
49.671	7/21/99	48°00.595 106°02.666	1741.3	24.7	
49.671*	8/20/99	48°00.595 106°02.666	1741.3	24.7	
49.691	7/13/99	48°00.244 106°01.776	1740.3	25.7	1 mile below boat launch at Grandchamps
49.691	7/21/99	48°00.244 106°01.776	1740.3	25.7	
49.691	8/20/99	48°00.244 106°01.776	1740.3	25.7	
49.781	7/01/99	48°01.581 106°13.388	1755.8	10.2	Foot of 1 st island below Nickels Ferry
49.781	7/13/99	48°01.581 106°13.388	1755.8	10.2	
49.781	8/19/99	48°01.581 106°13.388	1755.8	10.2	
49.801	7/21/99	48°01.759 105°59.649	1736.5	29.5	1/4 mile below Frazer Pumping station

49.671*-dead fish radio recovered

Sonic Freq#	Date	GPS	River Mile of Location	Miles from Release Pt	Physical Location
2.6.7	7/01/99	48°01.825 106°14.751	1756.9	9.1	Head of 1 st Island below Nickels Ferry

It appears the radio/sonic tagged shovelnose sturgeon rapidly dispersed downstream since initial tracking efforts in the Milk River and several miles upstream and downstream from the confluence in the Missouri River failed to locate any of the transmitted fish. Surgical procedures were the same as used in successful implants of radios in hatchery-reared and wild juvenile shovelnose sturgeon in 1997 and hatchery-reared juvenile pallid sturgeon in 1998 (Liebelt 1997, 1998). The warm water temperature in the Milk River during surgery and release may have negatively influenced survivability of these fish. Any other factor is unknown.

Stomach Analysis

Ten adult shovelnose sturgeon, captured by drift netting in the Milk River 6.4 kilometers from the confluence with the Missouri River, were sacrificed and the alimentary canal extracted (Table 9). The canal was preserved in 10 percent formalin and later examined for total contents. The fish averaged 633.4 mm fork length (range 566 to 698 mm) and 1102.5 gm (800 to 1675 gm).

Examination of the gut tube revealed all fish had consumed an average of 428 fish eggs (range 206 to 748 eggs). Three types of eggs were apparent but the majority appeared to be from river carpsucker which were spawning in the area at the time. Invertebrates were also present in all canals examined and were primarily diptera, trichoptera and ephemeroptera. Invertebrates comprised one to 10 percent and other miscellaneous organic material made up 10 to 47 percent of the gut contents. Four small unidentified cyprinids were also present in three of the sturgeon. A surprising aspect of the analysis was the finding of fine gravel material in all digestive tracts which averaged 56.6 percent (range 28 to 80 percent) by volume and 15.7 gm (range 6 to 34 gm, dry weight) of the total contents. Megargle and White (1997) reported inorganic matter comprised 24.4 percent in 1993 and 25.5 percent in 1994 of shovelnose sturgeon stomach contents (143 samples) from the Missouri River upstream of Fort Peck Reservoir.

Table 9. Results of alimentary canal analysis of shovelnose sturgeon captured in the lower Milk River during 1999. Percentages by volume.

Sample#	Fork Length mm	Weight grams	Sex	Number of Identified	Inorganic				Percent Composition	Percent Composition	Percent Composition	Percent Composition	Fish
					Eggs	Dry grams	Eggs	Inverts	Inorganics	Misc			
101	640	950	M	348		6	18	3	32	47			1 cyprinid
102	638	1000	M	226		13	6	2	74	18			
103	566	800	M	206		2	28	10	28	34			
104	678	1375	F	396		34	8	2	74	17			
105	634	925	M	343		24	9	1	80	10			
106	698	1675	F	522		18	18	2	56	24			
107	647	1150	U	712		25	16	1	64	19			2 cyprinids
108	644	1200	M	748		8	29	2	46	22			
109	566	800	M	349		17	14	2	63	21			1 cyprinid
110	623	1150	F	433		10	17	2	49	33			
Avg.	633.4	1102.5		428		15.7							

Notes:

1. Samples - collected June 16, 1999
2. Eggs - Three types
3. Invertebrates - diptera, trichoptera, ephemeroptera
4. Miscellaneous - egg shells, invertebrate exoskeletons, unknown digested material
5. Inorganics - primarily fine gravel
6. Water temperature - 20.9C°
7. Conductivity - 743 micromhos
8. Turbidity - 441 NTU
9. Flow - 1070 cfs
10. Substrate - cobble, gravel, sand

FISH SPECIES CAPTURED BY DRIFT AND STATIONARY TRAMMEL NETTING

Drifting trammel nets and stationary trammel net sets were used to sample the Milk, Missouri and Yellowstone rivers. The stationary sets were used only in the tailwater area of Fort Peck Dam at three standard sampling sites. Thirteen species were captured in the Missouri River, ten in the Milk River, and twelve in the Yellowstone River (Table 10). The highest catch per unit of effort (CPUE) occurred in the Milk River with an average of 23.11 fish per net drift. Shovelnose sturgeon were the most abundant species captured with a CPUE of 16.71 followed by goldeye at 1.41, shorthead redhorse sucker and channel catfish at 0.94 each, and smallmouth buffalo with an average of 0.76 fish per net. Sauger were the most abundant species captured in the Yellowstone River with a CPUE of 2.09, followed by shovelnose sturgeon and channel catfish at 1.79 and 1.69 fish per net, respectively. Channel catfish had the highest CPUE in the Missouri River at 0.72 followed by shovelnose sturgeon at 0.54 and sauger at 0.17 fish per net. A total of 161 net drifts were made in the three rivers and captured 1,054 fish for an average of 6.55 fish per net. Overall, shovelnose sturgeon were the most abundant species captured with 439 fish and a CPUE of 2.73. The average length and weight of all species captured, excluding sturgeon species, for the Milk, Missouri, and Yellowstone rivers are shown in Appendix 3. A list of fish species captured during 1999 is shown in Appendix 4.

Table 10. Catch rates (CPUE fish/net) for drifting trammel nets in the Milk, Missouri, and Yellowstone rivers during 1999.

River	Milk 17		Missouri 82		Yellowstone 62		Total 161	
Species	Total	CPUE	Total	CPUE	Total	CPUE	Total	CPUE
PS	0	0	10	0.12	4	0.06	14	0.09
SNS	284	16.71	44	0.54	111	1.79	439	2.73
PF	0	0	7	0.09	1	0.02	8	0.05
GE	24	1.41	7	0.09	41	0.66	72	0.45
CP	4	0.24	6	0.07	15	0.24	25	0.16
FHC	4	0.24	0	0	4	0.06	8	0.05
RCS	19	1.12	5	0.06	53	0.85	77	0.48
BSU	0	0	4	0.05	0	0	4	0.02
SMB	13	0.76	9	0.11	0	0	22	0.14
BMB	0	0	5	0.06	0	0	5	0.03
SHR	16	0.94	0	0	0	0	16	0.10
LNS	0	0	3	0.03	0	0	3	0.02
WS	0	0	3	0.03	0	0	3	0.02
CC	16	0.94	59	0.72	105	1.69	180	1.12
SC	3	0.18	0	0	3	0.05	6	0.04
BUR	0	0	1	0.01	0	0	1	<0.01
SG	10	0.59	14	0.17	130	2.09	154	0.96
WE	0	0	2	0.02	14	0.23	16	0.10
STZ	0	0	0	0	1	0.02	1	<0.01
Totals	393	23.11	179	2.18	482	7.77	1054	6.55

PS-Pallid Sturgeon
 SNS-Shovelnose Sturgeon
 PF-Paddlefish
 GE-Goldeye
 CP-Carp
 FHC-Flathead Chub
 RCS-River caprsucker
 BSU-Blue Sucker
 SMB-Smallmouth Buffalo

BMB-Bigmouth Buffalo
 SHR-Shorthead Redhorse Sucker
 LNS-Longnose Sucker
 WS-White Sucker
 CC-Channel Catfish
 SC-Stonecat
 BUR-Burbot
 SG-Sauger
 WE-Walleye

STZ-Sauger/Walleye

Larval Fish Sampling

Sampling for larval fish was done in the Milk (Section 0), Missouri (Sections 5 and 6), and Yellowstone rivers during 1999. Results are shown in in Tables 11 and 12.

Thirty larval fish samples were taken in the lower 10 miles of the Milk River from April 27 through July 1. Only one larval paddlefish and no larval sturgeon or paddlefish/sturgeon eggs were identified. The larval paddlefish was found in the June 14 sample along with 141 unidentified larval fish (due to damage of specimens) and 11,555 eggs. Other species captured included 928 catostomid, 80 cyprinids (24 identified carp), 9 goldeye, and 105 freshwater drum. The majority (70.6 percent) of the larval fish were captured in the June 14 and June 19 samples. The freshwater drum were collected only in the June 24 samples. (The peak flow of 5,360 cfs occurred May 17 and may account for the relatively high numbers of larval fish captured during the June sampling periods) The greatest number of eggs (3,748) were found in samples from June 7, and the second highest number (3,270) in the May 26 samples. Flows during May ranged from 162 cfs to 5,360 cfs and averaged 1,438 cfs; June flows ranged from 265 cfs to 2,980 cfs and averaged 1,123 cfs.

Fourteen larval fish samples were taken in Section 5 of the Missouri River upstream of the Yellowstone River confluence and four samples were collected in Section 6 below the confluence between June 7 and July 16. Only one larval sturgeon, one unknown larval fish, 183 eggs (no paddlefish/sturgeon eggs), 35 catostomids, and one sauger/walleye larval were captured in Section 5. Section 6 yielded one larval paddlefish, no eggs, one larval catostomid, and two larval carp. Flows in Section 5 during may ranged from 9,270 cfs to 12,600 cfs and averaged 10,639 cfs. Flows in Section 6 averaged about 29,800n cfs in May and 53,000 cfs in June.

Thirty-eight larval fish samples were collected in Section 9 of the Yellowstone River between May 19 and June 16. Three larval paddlefish, two paddlefish/sturgeon eggs, and 15 other eggs were identified in the June 29 sample. Other samples yielded five goldeye, four sauger/walleye, two cyprinid, and one ictalurid larval fish. Flows ranged from 8,240 cfs to 37,600 cfs and averaged 19,077 during May; June flows ranged from 33,800 cfs to 53,500 cfs and averaged 42,433 cfs.

Table 11. Comparisons of total larval catch for sturgeon and paddlefish by sampling period between the lower 10 miles of the Milk River (Section 0), Missouri River above confluence (Section 5), and Missouri River below confluence (Section 6, and Yellowstone River (Section 9) during 1999.

River Location	Section#	Number of samples	Sample Period	Volume M ³ Sampled	Numbers of					Per 100 M ³ P/S Eggs	Per 100 M ³	Per 100 M ³
					Polyodontidae	Acipenseridae	Unknown	Eggs	Eggs			
Milk River	0	2	4/27	139								
		4	5/24	350				2552	729.1			
		4	5/26	268				6270	1220.1			
		4	6/2	357			41	257	72.0			
		4	6/7	341				3748	1099.1			
		4	6/14	515	1	0.2	75	1226	238.1			
		4	6/18	432			22	376	87.0			
Total		2	6/24	324			3	123	38.0			
		2	7/01	38				3	7.9			
		30		2764	1	<0.1	141	5.1	11555	418.1		
Missouri River Above Confluence	5	4	6/07	216				140	64.8			
		2	6/14	248				40	16.1			
		4	6/30	393			1	0.3				
		4	7/16	247			1	0.4				
Total		14		1104	1	<0.1	1	<0.1	183	1.2		16.6
Missouri River Below Confluence	6	4	6/30	93	1	1.1						
Totals		4		93	1	1.1						
Yellowstone River	9	8	5/19	157				2	1.3			
		4	5/20	81								
		14	6/29	498	3	0.6		15	3.0	2	0.4	
		8	7/15	311			1	0.3	15	4.8	1	0.3
		4	7/16	153				6	3.9			
Totals		38		1200	3	0.3	1	<0.1	38	3.2	3	0.3
Overall Totals		86		5161	5	<0.1	143	2.8	11776	228.2	3	<0.1

^a P/S eggs-paddlefish/sturgeon eggs

Table 12. Comparison of total larval catch for various species by sampling period between the lower 10 miles of the Milk River (Section 0). Missouri River above confluence (Section 5), Missouri River below confluence (Section 6), and Yellowstone River (Section 9) during 1999.

River Location	Section#	Number of Samples	Sample Period	Volume M ³ Sampled	Per 100 M ³ Catostomid	Per 100 M ³ Cyprinid	Per 100 M ³ Camp	Per 100 M ³ Hiodon	Per 100 M ³ Ictalurid	Per 100 M ³ Stizostedion	Per 100 M ³ Sciaenidae	Per 100 M ³
Milk River	0	2	4/27	139								
		4	5/24	350	2	0.6						
		4	5/28	288	1	0.4						
		4	6/02	357	148	41.5	8	2.2				
		4	6/07	341	26	7.6	1	0.3	14	4.1		
		4	6/14	515	432	83.9	23	4.5	7	1.4	4	0.8
		4	6/18	432	300	68.4	23	5.3	2	0.5	5	1.2
		2	6/24	324	19	5.9	1	0.3	1	0.3		
		2	7/01								105	32.4
Totals		30		2764	928	33.6	56	2.0	24	0.9	9	0.3
											105	3.8
Missouri River Above Confluence	5	4	6/07	216	5	2.3						
		2	6/14	248	28	11.3						
		4	6/30	393	1	0.3				1	0.4	
		4	7/16	247	1	0.4						
Totals		14		1104	35	3.2				1	<0.1	
Missouri River Below Confluence	6	4	6/30	93	1	1.1		2	2.2			
Totals				83	1	1.1		2	0.2			
Yellowstone River	9	8	5/19	157							4	2.6
		4	5/20	81								
		14	6/28	498				5	1.0			
		8	7/15	311	2	0.6	2			1	0.3	
		4	7/16	153	1	0.7						
Totals		38		1200	3	0.3	2	0.2	5	0.4	4	0.3
									1	<0.1		
Overall Totals		86		5161	9637	18.7	58	1.1	26	0.5	14	0.3
									1	<0.1	5	<0.1
											105	2.0

Most of the Catostomidae sampled are probably river capsucker, shorthead redhorse sucker or white sucker.

Benthic Trawling

Benthic trawling was concentrated in Section 7 of the Missouri River near Williston, North Dakota to the headwaters of Lake Sakakawea. During August 1999, one trawl was made in the Yellowstone River in Section 9, but due to low flows, further attempts were not made. The primary purpose of this effort was to capture young-of-the-year (YOY) shovelnose sturgeon for live shipment to the University of California-Davis where testing was done to try and isolate and identify a suspected iridovirus. It was thought a virus of this type was responsible for prior mortality of hatchery-reared juvenile pallid sturgeon at the Garrison Point National Fish Hatchery, North Dakota and the Valley City National Fish Hatchery, North Dakota.

A total of 1193 fish in the Missouri River and two in the Yellowstone River were captured (Table 13). Channel catfish YOY were the most abundant species caught and comprised 66.1 percent of the total catch. One hundred thirty-two sturgeon chub and 103 sicklefin chub were the next most abundant species. One sicklefin chub was also caught in the Yellowstone River sample. Ninety-seven shovelnose sturgeon in the Missouri River and one in the Yellowstone River were captured. Eighty-six of these fish were shipped live to UC-Davis for viral testing. Other YOY species captured included 44 freshwater drum, six walleye-sauger, four black/white crappie, one goldeye, and 14 non-identifiable fish.

Trawling appears to be an effective method for capturing a variety of species, particularly YOY channel catfish and sturgeon as well as juvenile and adult sicklefin and sturgeon chubs. However, timing and sampling location are of critical importance for capturing sturgeon. All but two of the YOY sturgeon were caught during the first two weeks of August in the RM 1552 area. Later sampling during the last week of August in this area and downstream to the headwaters of Lake Sakakawea, failed to capture any YOY sturgeon. It is surmised the sturgeon had drifted into the reservoir or had vacated the area for unknown reasons.

Table 13. Results of benthic trawling in the Missouri and Yellowstone rivers and total catch per unit of effort (CPUE) during 1999.

River	Missouri		Yellowstone		Total	
Total minutes	452.0		4		456.0	
Species	Total	CPUE	Total	CPUE	Total	CPUE
SNS	98	0.22	1	0.25	99	0.22
GE	1	<0.01	0	0	1	<0.01
FHC	1	<0.01	0	0	1	<0.01
SFC	103	0.23	1	0.25	104	0.23
STC	132	.29	0	0	132	0.29
CC	788	1.74	0	0	788	1.73
SC	1	<0.01	0	0	1	<0.01
CRP	4	<0.01	0	0	4	<0.01
WE	1	<0.01	0	0	1	<0.01
STZ	6	0.01	0	0	6	0.01
FWD	44	0.10	0	0	44	0.10
UNK	14	0.03	0	0	14	0.03
Totals	1193	2.63	2	0.50	1195	2.62

SNS-Shovelnose Sturgeon
 GE-Goldeye
 FHC-Flathead Chub
 SFC-Sicklefin Chub
 STC-Sturgeon Chub

CC-Channel Catfish
 SC-Stonecat
 CRP-Crappie Spp.
 WE-Walleye
 STZ-Stizostedion spp.

FWD-Freshwater Drum
 UNK-Unknown

Appendix 1. Monthly mean minimum and maximum discharges from April through October for the Missouri River at Fort Peck and Culbertson, the Milk River and Yellowstone River during 1999.

River	Month	Mean Discharge	Minimum Discharge	Maximum Discharge
Missouri River at Fort Peck RM 1763.5	April	7945	7600	9100
	May	8026	7400	8600
	June	8745	7800	9400
	July	9048	8600	9300
	August	8994	8700	9200
	September	5530	4400	9400
	October	4568	4300	4400
Missouri River at Culbertson RM 1621.0	April	11526	9480	18900
	May	10747	9100	14400
	June	10693	9270	12600
	July	9960	9560	10700
	August	9719	9080	10100
	September	7206	5520	10300
	October	5550	5370	5730
Milk River at Nashua RM 22.7	April	662	58	4330
	May	1438	162	5360
	June	1123	265	2980
	July	342	125	617
	August	207	81	353
	September	305	171	446
	October	247	40	407
Yellowstone River at Sidney RM 29.5	April	8631	7070	9590
	May	19077	8240	37600
	June	42433	33800	53500
	July	21968	12500	34200
	August	10156	7170	13500
	September	8979	7440	10600
	October	8264	7960	8960

Appendix 2. Morphological measurements of pallid sturgeon captured in 1999.

Date	RM	Head Length mm	Fork Length mm	Interrostral Length mm	Mouth to Inner Barbel mm	Outer Barbel mm	Inner Barbel mm	Dorsal Fin rays	Anal Fin rays	WT (KG)	Pit Tag #1	Pit Tag #2	Recap	CI ¹
4/13/99*	1583.5	425	1296	196	64	131	52			13.6	220C7D0429	2204523542	Y	515.8
4/14/99*	1583.5	449	1397	202	68	152	52	37		15.4	1F4A111C6A		N	529.7
4/14/99*	1583.5	476	1546	207	72	133	50	38	22	22.7	1F4A27214F		N	481.6
4/14/99*	1583.5	438	1365	185	68	131	49	37	25	16.3	1F477B3A65		N	493.3
4/19/99*	1583.5	463	1553	203	72	146	50	35	23	23.1	115553544A		N	489.3
4/15/99	1583.5	455	1476	214	69	125	52	36	23	23.1	220F01755C	2204657963	Y	482.9
4/15/99	1583.5										1F4A363031		Y	
4/15/99	1583.5										1F4772396F		Y	
4/15/99	1583.5	369	1245	147	63	109	39	36	21	10.0	1F477B4E51		Y	446.8
5/19/99	5.1	429	1445	189	53	131	40	35	20	19.1	2200E3F2578	220E3F7046	N	
8/26/99	1581.5										7F7FD66963	220E5B3803	Y	524.9

¹-CI Character Index Value

*-Transported to Garrison National Fish Hatchery

Appendix 3. Average length, weight, and ranges of fish, excluding sturgeon species, captured in the Milk, Missouri, and Yellowstone rivers during 1999.

Milk River							
Species	N	Average	Range		Average	Range	
		Length mm	Low mm	High mm	Weight gms	Low gms	High gms
Goldeye	20	277	212	365	157.5	75	500.0
Carp	4	582	516	722	2825.0	1100.0	4750.0
Flathead chub	1	234		234	100.0		100.0
River carpsucker	7	486	438	515	1367.9	775.	21100.0
Smallmouth buffalo	4	643	595	702	3525.0	2800.0	4275.0
Shorthead redhorse	16	323	225	467	395.3	100.0	1025.0
Channel catfish	14	372	260	470	400.0	50.0	1000.0
Stonecat	3	163	107	205	55.0	15.0	100.0
Sauger	10	310	264	401	200.0	100.0	450.0
	79						

Missouri River							
Species	N	Average	Range		Average	Range	
		Length mm	Low mm	High mm	Weight gms	Low gms	High gms
Goldeye	3	298	270	333	183.3	100.0	250.0
Cisco	13	238	213	271	90.4	25.0	150.0
Northern pike	3	727	606	857	5966.7	1400.0	4800.0
River carpsucker	22	448	383	542	1308.6	750.0	2000.0
Blue sucker	6	634	589	674	2125.0	1650.0	2600.0
Smallmouth buffalo	5	602	515	708	3150.0	2250.0	4850.0
Shorthead redhorse	4	449	402	496	1106.3	775.0	1250.0
Longnose sucker	3	430	399	452	993.3	750.0	1075.0
White sucker	16	382	223	501	795.3	125.0	1350.0
Channel catfish	53	407	273	501	548.8	200.0	950.0
Burbot	9	573	360	718	1311.1	250.0	2500.0
Sauger	17	377	261	475	423.5	100.0	800.0
Walleye	5	505	346	598	1240.0	250.0	1900.0
	159						

Yellowstone River							
Species	N	Average	Range		Average	Range	
		Length mm	Low mm	High mm	Weight gms	Low gms	High gms
Flathead chub	2	230	216	243	89.8	86.3	93.3
Channel catfish	9	327	227	470	352.8	125.0	900.0
Stonecat	1	158		158	34.9		34.9
Sauger	105	356	256	462	343.3	122.6	950.0
Walleye	7	444	376	526	851.0	457.1	1500.0
	124						

Appendix 4. List of fish species caught in the Milk, Missouri and Yellowstone rivers during 1999.

Pallid sturgeon (*Scaphirhynchus albus*)
Shovelnose sturgeon (*S. platyrhynchus*)
Paddlefish (*Polyodon spathula*)
Goldeye (*Hiodon alosoides*)
Lake whitefish (*Coregonus clupeaformis*)
Cisco (*C. artedii*)
Rainbow smelt (*Osmerus mordax*)
Northern pike (*Esox lucius*)
Carp (*Cyprinus carpio*)
Flathead chub (*Platygobio gracilis*)
Sicklefin chub (*Macrohybopsis meeki*)
Sturgeon chub (*M. gelida*)
Emerald shiner (*Notropis atherinoides*)
Spottail shiner (*N. Hudsonius*)
Plains minnow (*Hybognathus placitus*)
Silvery minnow (*H. argyritis*)
River carpsucker (*Carpionodes carpio*)
Blue sucker (*Cycleptus elongatus*)
Smallmouth buffalo (*Ictiobus bubalus*)
Bigmouth buffalo (*I. cyprinellus*)
Shorthead redhorse sucker (*Moxostoma macrolepidotum*)
Longnose sucker (*Catostomus catostomus*)
White sucker (*C. commersoni*)
Channel catfish (*Ictalurus punctatus*)
Stonecat (*Noturus flavus*)
Burbot (*Lota lota*)
Crappie species (*Pomoxis*)
Yellow perch (*Perca flavescens*)
Sauger (*Stizostedion canadense*)
Walleye (*S. vitreum*)
Freshwater drum (*Aplodinotus grunniens*)

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