Lower Missouri River and Yellowstone River Pallid Sturgeon Study

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ABSTRACT

A total of 23 pallid sturgeon ranging in weight from 8.8 to 32.0 kg and an average of 18.8 kg were captured by drift netting in the Missouri and Yellowstone rivers during 1994 and 1995. Mean fork length was 1405 mm and ranged from 1222-1613 mm. Ten were recaptures from previous years and 13 were "new" fish. No pallid X shovelnose sturgeon hybrids were suspected based on character index measurements. Shovelnose sturgeon were the most abundant species captured during both years and were found in all sections sampled in both rivers. A total of 1,121 were netted and tagged. Mean fork length and weight were 589 mm and 883 gms, respectively. A total of 36 recaptures were netted and 63.9% were caught within 5 miles of the original capture site in both rivers. Larval fish sampling in the Missouri River above the Yellowstone River confluence during 1994 collected four sturgeon and three paddlefish larvae and no sturgeon/paddlefish eggs. In 1995, 22 sturgeon and 63 paddlefish larvae and 31 sturgeon/paddlefish eggs were collected, primarily in the Missouri River below the confluence and in the lower 15 miles of the Yellowstone River. Beach seining in both rivers captured 30 fish species in 1994 and 25 species in 1995. Flathead chub were the most abundant species caught in both years. Sicklefin chub and sturgeon chub were also seined in both years. A trawl was used in 1995 to sample deep, main channel habitat in both rivers. Ten fish species were captured with sicklefin and sturgeon chubs comprising 65.2% of the total fish caught. Four mesolarval sturgeon (44-50 mm) were collected in the Missouri River above the confluence at river mile 1589.5. Aquatic macroinvertebrates were collected in both rivers during both years. Seven orders of insects, representing 30 families, were identified. Ephemeroptera and Trichoptera were the most common orders found.

ACKNOWLEDGEMENTS

I would like to thank the Western Area Power Administration and the Bureau of Reclamation for providing funding to conduct the research for this project. I would also like to extend a special thanks to the following: Mike Ruggles for aid in collection and identification of aquatic macroinvertebrates and Dr. Daniel Gustafson for help in macroinvertebrate identification; Matt Baxter for sorting samples and identifying larval fish; Jimmy Schultz, Bill Viste and Jeff Remus for help in gathering field data, and Sue Ireland for her editing skills.

DISCLAIMER

Mention of commercial products in this report does not imply endorsement by Montana Fish, Wildlife & Parks.

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INTRODUCTION

Since the listing of pallid sturgeon as an endangered species in 1990, research efforts have been directed toward gathering information concerning various life history aspects of this species and their interrelationship with other species of fish in the lower Missouri River and Yellowstone rivers. Prior to 1989, Gardner and Stewart (1987) completed a comprehensive investigation of fishes present in the Lower Missouri River but did not report the capture of any pallid sturgeon. Beginning in 1989, research emphasis was shifted toward the capture of pallid sturgeon in order to assess their population structure, follow movements using radio telemetry, collect blood and tissue samples for genetic analysis, take morphological measurements to determine if hybridization with shovelnose sturgeon had occurred, and investigate the relationship of pallid sturgeon to various riverine habitat and other fish species (Clancy 1990, 1991, 1992; Tews and Clancy 1993; Tews 1994; Bramblett and White 1992, 1993).

This report covers field work completed during 1994 and 1995 on the Missouri River below Fort Peck Dam and the Yellowstone River below Intake Diversion Dam. Funding for this project was provided by the Western Area Power Administration and the Bureau of Reclamation both years. Objectives of the study were: 1) Investigate the relationships between distribution and abundance of shovelnose sturgeon, pallid sturgeon, and other fish species relative to river reach, discharge, habitat type, season, and physical characteristics of the lower Missouri and Yellowstone rivers; 2) Measure physical habitat characteristics at standard sampling and pallid sturgeon capture locations; 3) Monitor drift of larval sturgeon in both rivers; 4) Attempt to identify pallid sturgeon spawning locations in the Missouri River above the Yellowstone River confluence; 5) Assess population status of pallid sturgeon; 6) Collect macroinvertebrates in both rivers; 7) Sample for young of the year sturgeon in both rivers; and 8) Sample for species of special concern in both rivers.

STUDY AREA

The study area is comprised of approximately 370 km (250 miles of the Missouri River from Fort Peck Dam to the headwaters of Lake Sakakawea, North Dakota, and 114 km (71 miles) of the Yellowstone River from its mouth to Intake Diversion Dam. The Missouri River was divided into seven study sections and the Yellowstone River into two sections (Figure 1). A detailed description of the study area is provided by Tews (1994), and additional information on the physical characteristics of the Missouri River is provided by Gardner and Stewart (1987). Locations of study sections and river miles (RM) are shown in Table 1.

Mean discharge from Fort Peck Dam was about 1500 cfs greater from April through October 1995 than in 1994, reflecting higher average inflows into the reservoir and a higher pool level during 1995. The peak reservoir level was over five feet higher in 1995 than in 1994. Maximum discharge averaged higher in 1995 than in 1994. Over 10,000 cfs was released in September and increased to the 14,000 cfs range during October and November 1995 in order to decrease the level of Fort Peck Reservoir. Sampling efforts proved to be quite difficult under these high flow conditions. The Yellowstone River was dramatically higher during 1995 than the previous year. The mean discharge was 18,603 cfs from April through October. This compared to 8,999 cfs in 1994, with the peak flow occurring in June at 56,600 cfs. The peak flow in 1994 was 33,400 cfs and occurred in May. The maximum average discharge was approximately 11,000 cfs greater in 1995 than in 1994 for the same period of time. Sampling efforts again proved to be quite challenging during the higher flow conditions. Comparison of discharge in the Missouri and Yellowstone rivers between 1994 and 1995 is shown in Table 2. Daily hydrographs from USGS gauging stations in the Missouri River at Fort Peck,

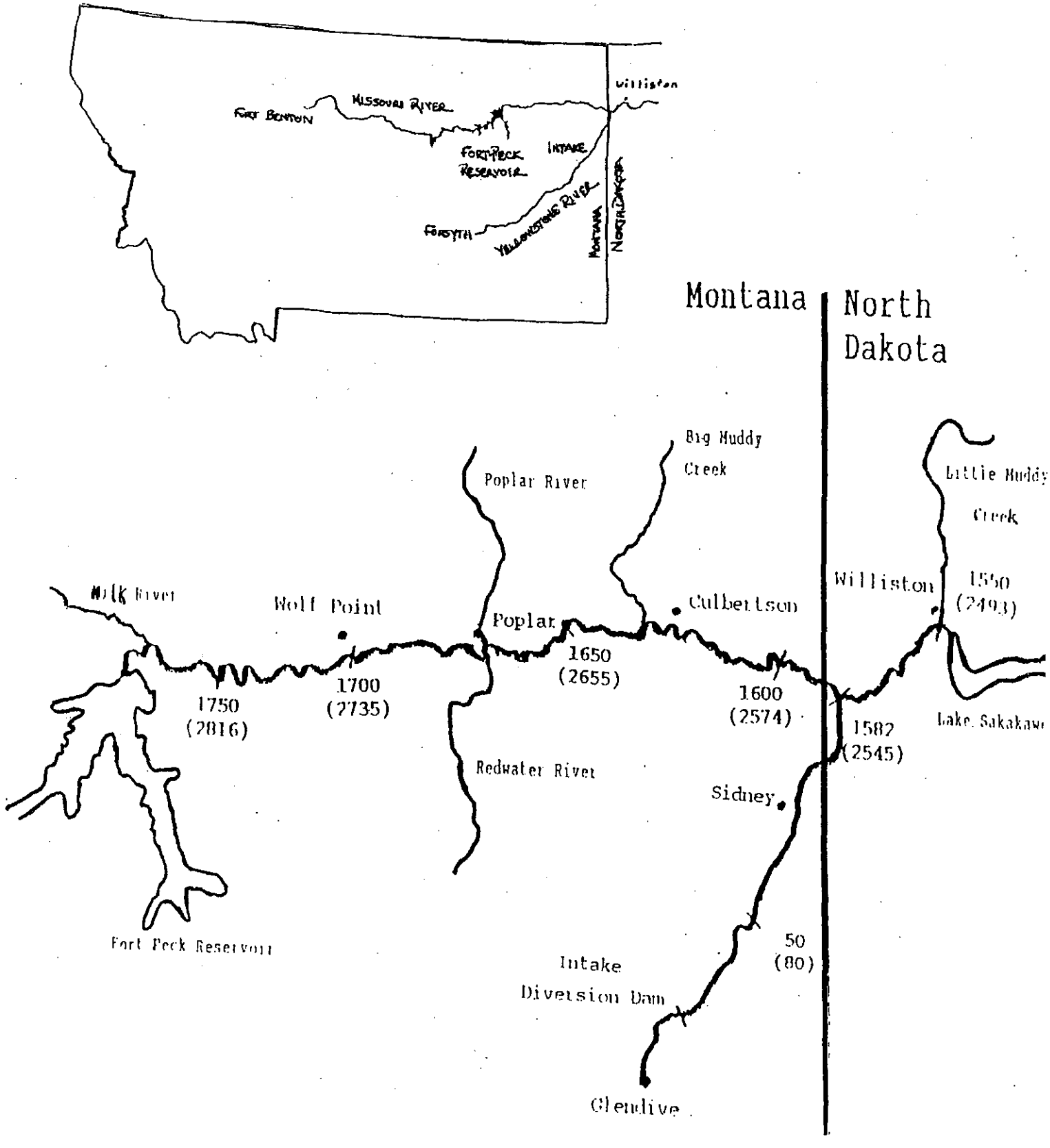


Figure 1. Map of Lower Missouri and Yellowstone river pallid sturgeon study area with river miles (kilometers).

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

Section	Location
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 1760 to 1708
3	Wolf Point to mouth of Redwater River River Mile 1707 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 1629 to 1582
6	Mouth of Yellowstone River to highway 85 bridge River Mile 1581 to 1553
7	Highway 85 bridge to Lake Sakakawea River Mile 1552 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 29 to 0

Wolf Point and Culbertson and the Yellowstone River at Sidney for 1994 and 1995 are shown in Figure 2.

METHODS

Drift Netting

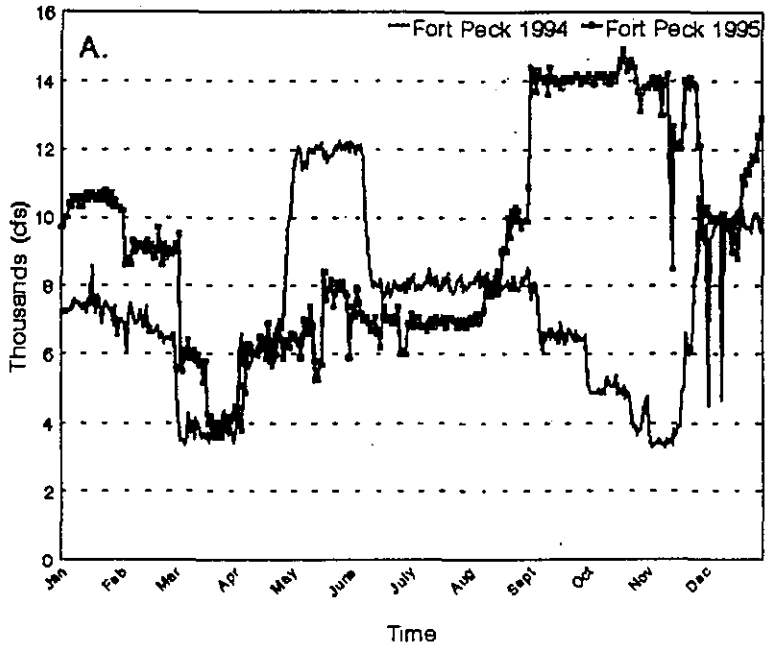
A variety of sinking multifilament gill and trammel nets and monofilament gill nets were used for drift netting during both years (Table 3). Different net types were tried in order to determine which were the most effective in capturing various species and sizes of fish in the Missouri and Yellowstone rivers.

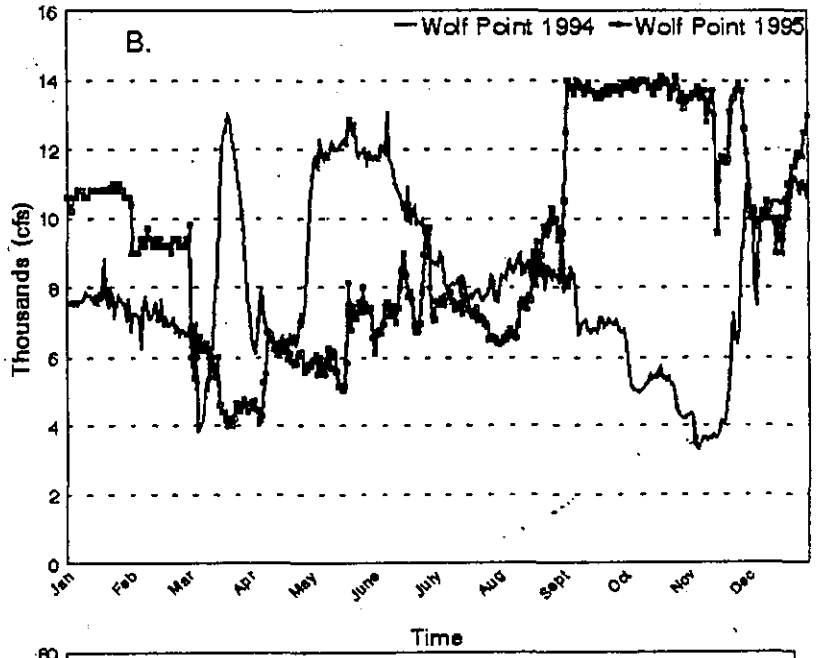
Table 2. Mean average maximum and minimum flows in the Missouri and Yellowstone rivers from April through October during 1994 and 1995 with maximums and minimums in parentheses.

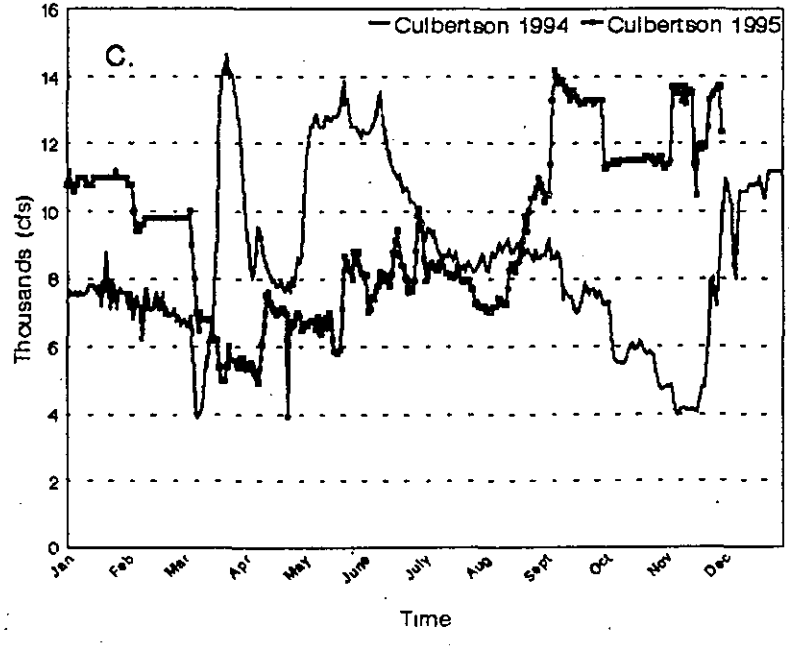
		Mean Discharge (cfs)	Average Maximum (cfs)	Average Minimum (cfs)
Missouri River Fort Peck	1994	7584	9071 (May, June 12200)	6537 (October 2960)
	1995*	9030	10000 (October 14900)	7529 (April 3800)
Missouri River Wolf Point	1994	8058	10124 (June 13100)	6589 (October 4210)
	1995*	8886	10116 (October 14100)	7286 (April 4160)
Missouri River Culbertson	1994	9053	10363 (May 13600)	7789 (October 4740)
	1995*	8991	10267 (September 14200)	7649 (April 4940)
Yellowstone River Sidney	1994	8999	15087 (May 33400)	5537 (August 2040)
	1995*	18603	25994 (June 56600)	10726 (April 5320)

* Provisional Flow data obtained from the Fort Peck USGS field office.

Figure 2. 1994 and 1995 hydrographs of the Missouri River at: A. Fort Peck tailwaters; B. Wolf Point; C. Culbertson; and D. Yellowstone River at Sidney.







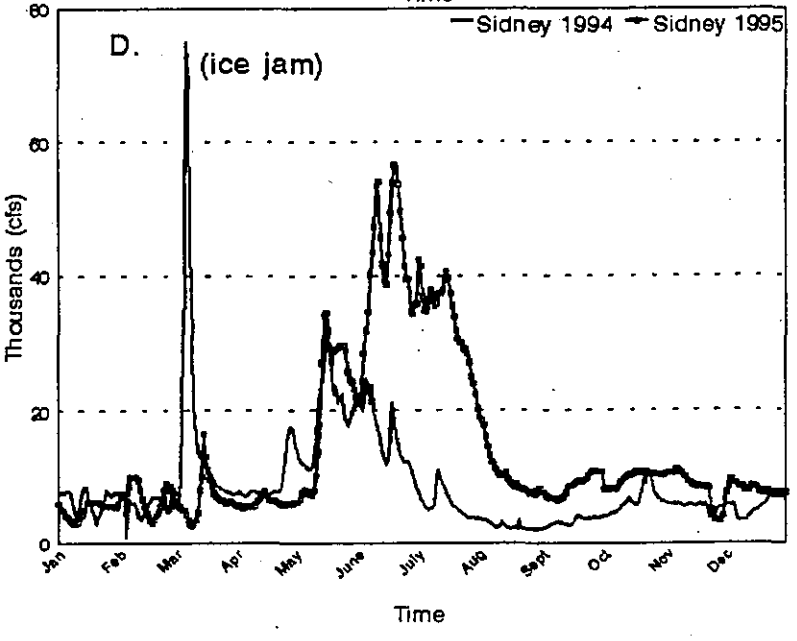


Table 3. Summary of net types used in 1994 and 1995 field seasons.

Net type	Mesh type	Net length	Net depth	Number of panels	Bar mesh sizes	Lead core line weight	Year used
Trammel	Multifilament	22.9 m	1.8 m	1	2.5 cm inner 20.3 cm outer	13.6 kg	1994 1995
Trammel	Multilfilament	22.9 m	1.8 m	1	5.1 cm inner 25.4 cm outer	13.6 kg	1994 1995
Trammel	Multilfilament	45.7 m	1.8 m	1	5.1 cm inner 25.4 cm outer	13.6 kg	1995
Gill	Multifilament	36.6 m	2.4 m	4	5.1-7.6-10.2-12.7 cm	22.7 kg	1995
Gill	Multifilament	38.1 m	1.8 m	5	1.9-2.5-3.2-3.8-5.1 cm	13.6 kg	1994 1995
Gill	Multifilament	24.3 m	1.8 m	4	2.5-5.1-2.5-5.1 cm	13.6 kg	1994 1995
Gill	Monfilament	30.5 m	1.8 m	4	1.9-2.5-3.8-5.1-7.6 cm	13.6 kg	1995
Gill	Monofilament	36.6 m	2.4 m	4	5.1-7.6-10.2-12.7 cm	22.7 kg	1995

* All nets with poly foamcore float line

Nets were drifted for an average of 8.9 minutes in 1994 and 9.5 minutes in 1995. Average distance covered was approximately 300 meters for both years. Timing of drifts began when the net was completely out and on the river bottom. A float was attached to each end of the float-line with enough extra rope to allow the net to remain on the bottom in varying depths of water. Additional weights of 0.2 to 0.5 kilograms were usually added, one at each end and middle with carabiners to nets with 13.6-kilogram lead line to insure the lead-line remained on the bottom. Setting the net was done by tossing the end float out from the bow with the boat in reverse and moving across the current. When completely out, the net was briefly stretched and allowed to sink. The float-line was then either hand-held or tied to the bow railing. Upon completion of the drift, the net was pulled into a tub and fish were removed on shore and placed in a live car. All fish were weighed and measured to the nearest 50 gram (0.1 pound) and 2.5 mm (0.1 inch). If snagging of the net occurred, the drift was either terminated or continued, depending on severity

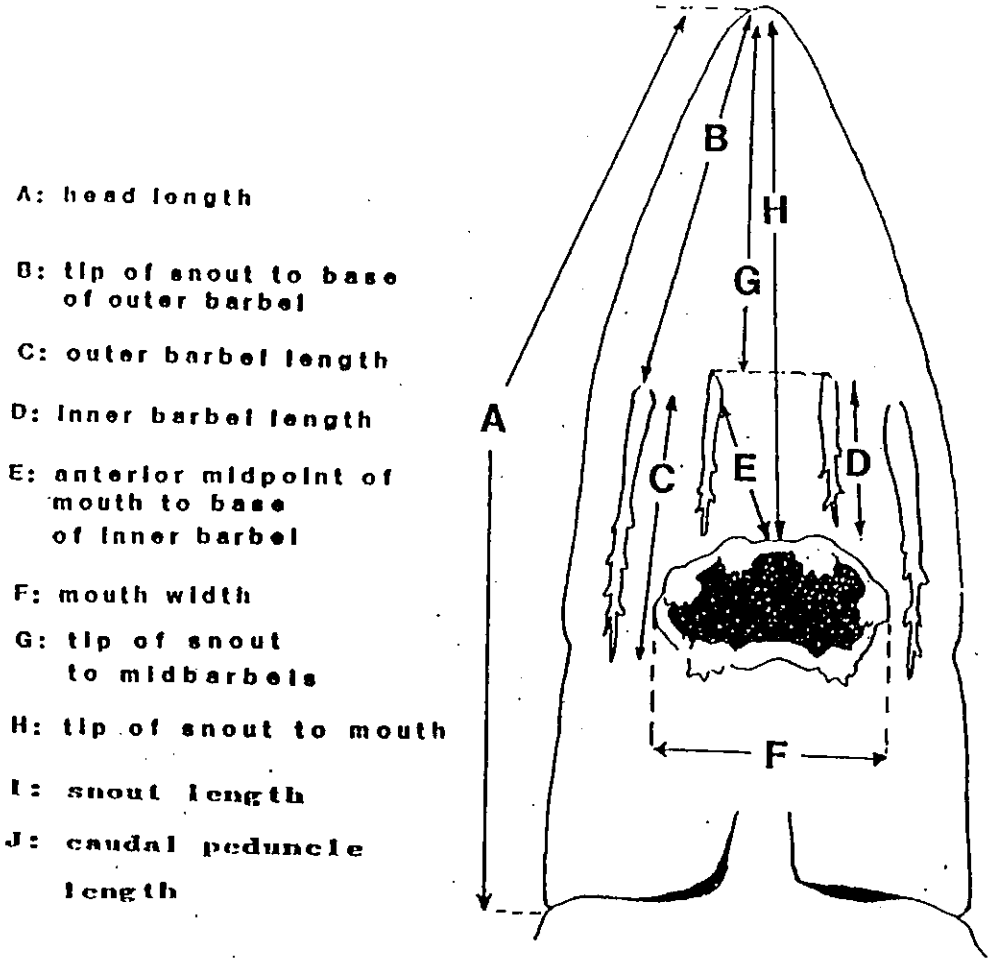
of the snagging. Depth and water temperature were recorded at all drift net sites. Catch rate was tabulated as catch per unit of effort (CPUE) per hour.

All shovelnose sturgeon captured in section 1 during both years were from overnight stationary 38 m experimental gill nets set in the tailwater area and dredge cuts.

Measurements and Tagging of Sturgeon

Figure 3 shows the morphological measurements taken on all pallid sturgeon in 1994 and on 10 of 13 in 1995. The percent of standard length (SL) was calculated from the measurements. This was done to evaluate the possible presence of pallid x shovelnose hybrids in the population. Methodology is based on work done by Tews and Clancy (1992) and Gardner (1992) and similar to methods developed by Carlson and Pflieger (1981). All pallid sturgeon and shovelnose sturgeon were weighed and fork lengths were also recorded for each shovelnose sturgeon.

A Biosonic(R) 400 kilohertz (KHz) passive integrated transponder (PIT) tag was inserted at the left base of the dorsal fin on pallid sturgeon during 1994 on those not previously captured. A numbered endangered species spaghetti tag was also attached through the dorsal fin. During 1995, 125 KHz PIT tags were implanted on both sides of the dorsal fin for "new" fish and only the right side for recaptures. Double tagging was done as a back-up, since external tags were no longer used to mark pallid sturgeon and PIT tags could be expelled. Numbered yellow spaghetti tags were attached through the dorsal fin of all shovelnose sturgeon weighing 0.2 kilograms or larger.



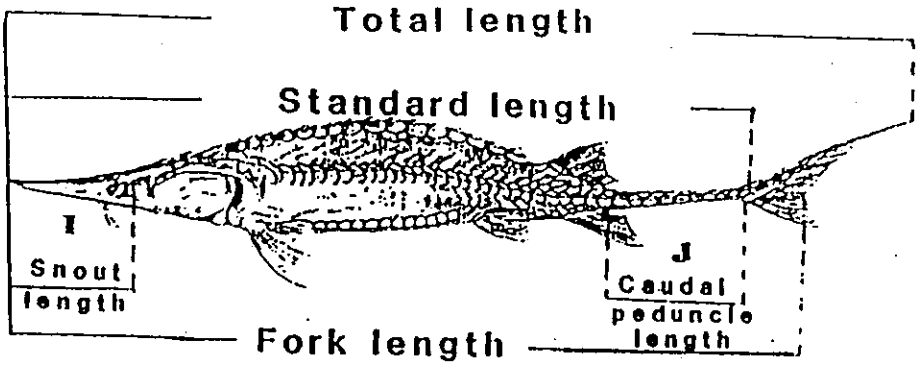


Figure 3. Morphological measurements taken from pallid sturgeon for calculation of character indexes.

Standardized Sampling

Attempts were made to conduct monthly standardized sampling procedures developed by Tews (1993) at selected sites in all sections of the Missouri and Yellowstone rivers beginning in June, 1994. Sites were established based on access, river morphology and incidence of snags. Sampling procedures included drift netting deep and shallow main channel borders, larval fish and macroinvertebrate sampling, beach seining, and habitat measurements. However, several sites in both rivers had to be altered or abandoned due to rapid decreases in flows as the summer progressed. Efforts were made to monitor standard locations in 1995, but again, problems were encountered at some sites due to varying river stages between sampling periods.

Habitat Measurements

Habitat measurements were taken at all standard sites during each sampling period and also at all pallid sturgeon capture sites. Measurements included the following: depth and surface temperature (Impulse 2000 Plus fish finder); secchi disk; conductivity (Yellow Springs Model 33 S-C-T meter); turbidity (HACH 2100 P); current velocity (G.O. Environmental Model 2040 R) and digital flow meter (Marsh Mcbirney Model 2000-11 Flo-mate 2000); channel width (KVH Datascope); location (Garmin GPS 75); and substrate composition.

Larval Fish Sampling

In 1994, sampling for larval sturgeon was done bimonthly from June to mid-August at all standard sites. Other sites were sampled on a random basis. Sampling began mid-May and continued into August during 1995. Efforts were concentrated in the Missouri River above the confluence in 1994 and expanded to include the lower 15 miles of the Yellowstone River and section 6 in the Missouri River in 1995. It was felt these areas, particularly in the Yellowstone River, had the most promise for successful pallid sturgeon spawning based on previous netting and radio telemetry information. Larval fish were sampled with two circular 1/2 m x 1.8 m long and one 0.8 m x 3.8 m D-net (750 um Nitex mesh) with attached plankton buckets. All nets had a

digital flowmeter (2030R G.O. Environmental, Inc.) suspended in the mouth of the net by 0.080 diameter monofilament line for calculation of water volume sampled. Average sampling time was about seven minutes but varied from four to 20 minutes depending on debris load. The half-meter nets were released off each side of the boat and weighted with a 9 kg lead ball. One D-ring net was lowered from the stern and a 4.5 kg lead ball attached to each corner of the frame. Right and left channel borders were sampled in the main channel at sampling sites with both types of nets at an average depth of 2.1 m. Only single samples per net type were taken at side channel locations. Collecting buckets were removed after net retrieval and contents transferred to pint or quart glass canning jars and preserved with a 10 percent formalin solution containing Phloxine-B dye for specimen staining. All samples were labeled and sorted later at the Fort Peck field station. Labels listed river side (left or right, as one would look upstream), site location, date, net type, and sample number.

Beach Seining

Seining was done in most sections during both years along main channel borders and some side channels. A 15.4 m x 1.2 m,, 3 mm Ace mesh, with a weighted lead line was initially used in 1994. However, use of this seine was discontinued due to the lead line digging into softer bottoms. The replacement seine was of the same dimensions but constructed with 3 mm Delta mesh and a many ends bottom line. Fewer problems were encountered over a greater variety of substrate than with the lead line seine. Length of hauls depended on shoreline configuration and depth but most hauls were approximately 45.8 meters long, parallel to the bank and at depths less than 1.5 meters. Upon completion of each haul, fish were identified except for very small young-of-the-year (YOY) species, counted and released. Depending on number captured, all or a sub-sample of species of concern e.g., flathead chub, *Hybognathus* (Western silvery/plains minnow), sturgeon and sicklefin chubs, were weighed and measured in 1995 to the nearest 1 gram and 1 millimeter.

Trawl Sampling

A benthic trawl, 2.0-x 0.5-x 5.5 m with 0.3175 cm inner mesh, 3.81 cm outer chafing mesh and a 16.5 cm cod end opening, equipped with roller "rock hoppers" on the lead line, was used to sample deep, main channel habitat during 1995. Methods were similar to those developed by Grisak (1994). Trawls were of four minutes duration unless snagging occurred. Average estimated distance trawled was 224 meters. Contents were usually emptied into a 19 liter bucket of water and fish and invertebrates sorted with the aid of sieves (U.S. Standard Sieve Series). All fish were identified, weighed, and measured, unless very small, and released at capture site. Very few mortalities were evident and most of the released fish appeared to be in excellent condition. Selected specimens of fish and invertebrates were preserved for further examination at the Fort Peck laboratory.

Aquatic Invertebrate Sampling

Sampling during 1994 and 1995 was directed towards developing qualitative information. Invertebrates were collected by the traveling kick or two minute stationary kick method using an aquatic kick net (45.7 x 45.7 x 25.4 cm, 800 x 880 um mesh) in a variety of channel edge habitats, including gravel, rubble, sand, silt, and macrophyte substrates. Specimens were also captured in deep, main channel areas from larval and trawl sampling efforts. A Ponar Dredge (15 x 15-cm, 11 kg) was used only in 1994 to sample deeper areas but was not effective in collecting invertebrates. Specimens collected in the larval and some kick samples were sorted from debris at the Fort Peck laboratory. Many kick and all trawl samples were picked in the field. Specimens were preserved in 10% formalin and identified to the lowest taxonomic level possible using aquatic invertebrate keys by Merritt and Cummins (1984 and 1996), and Pennak (1953) at the laboratory. Seventy specimens were sent to Dr. Daniel Gustafson (Montana State University) for verification or further identification.

RESULTS AND DISCUSSION

Pallid Sturgeon

Twenty-three pallid sturgeon were captured by drift netting trammel nets in both years and monofilament gill nets in 1995 (Appendix 1). Twenty-one were netted in section 6 of the Missouri River (RM 1553-1582) and two were caught in section 9 of the Yellowstone River (RM 0.0-29.5). The majority (78%) were captured during September and October and nine were netted from the same "run" at approximately RM 1579 in 1995. The largest pallid, a 32 kg fish, was also caught at this location in 1994. The overall CPUE was 0.3 per hour for both rivers and years (Appendices 7 and 8). Fork length (FL) ranged from 1222-1613 mm and averaged 1405 mm. Weights ranged from 8.8-32.0 kg and averaged 18.3 kg. Ninety-six percent of the pallids were longer than 1200 mm (Figure 4) and only one (4%) weighed less than 10 kg (Figure 5). These are identical findings with those of Tews (1993), based on 56 pallid sturgeon. Ten pallids were recaptures as evidenced by the presence of PIT tags and 13 were "new" fish. Data from recaptures showed that a 10.5 kg sturgeon captured in the tailwater area (RM 1769) with the aid of SCUBA by Pat Clancy on February 10, 1991, was recaptured October 15, 1994, 312.2 km (194 miles) downstream (RM 1575) and weighed 11.3 kg (Table 4).

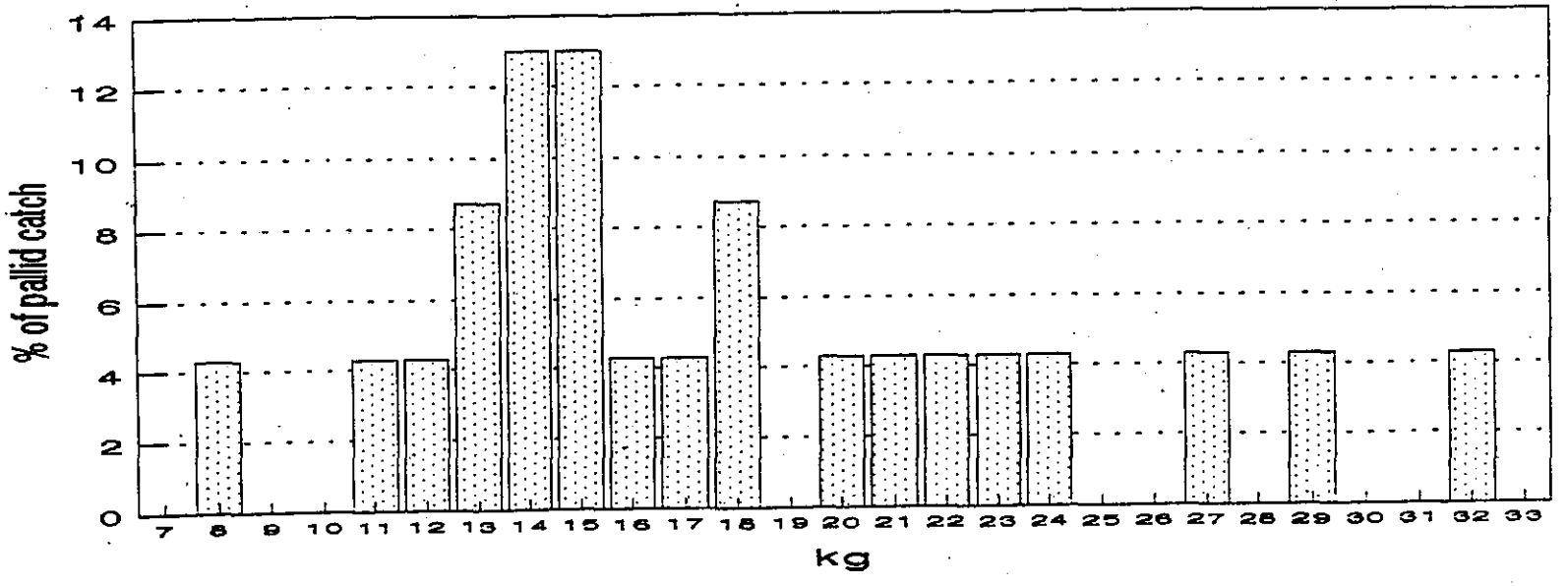


Figure 4. Fork length distribution of 23 pallid sturgeon captured in the Missouri and Yellowstone river during 1994 and 1995.

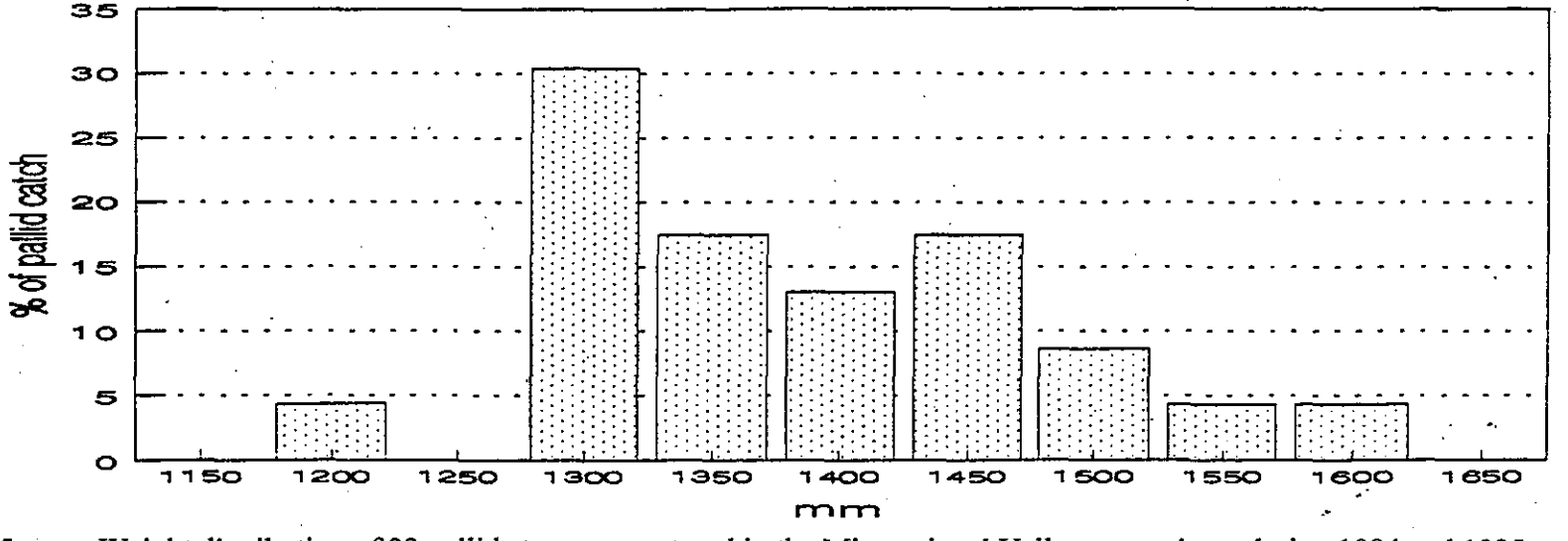


Figure 5. Weight distribution of 23 pallid sturgeon captured in the Missouri and Yellowstone rivers during 1994 and 1995.

Table 4. Pallid sturgeon recaptures from the Missouri and Yellowstone rivers during 1994 and 1995.

PIT Left Dorsal	Capture Date	RM	FL mm	Weight kg	Recapture Date	RM	FL mm	Weight kg
7F7F066471	02-10-91	1769	1248	10.5	10-05-94	1575	1312	11.3
7F7F066440	09-22-91	1564	1320	17.0	09-22-94	1577	1409	16.8
7F7F054773	09-30-92	1573	1524	22.2	10-05-94	1578	1495	23.1
7F7D4A7758	10-06-92	1573	1334	12.2	10-06-94	1575	1315	14.1
7F7D7B1607	04-15-93	1566	1514	13.8	10-06-94	1574	1319	13.2
7F7E427F69	10-06-92	1573	1539	19.5	10-12-95	1579	1507	27.2
7F7B020D71	10-21-92	1566	1486	19.3	08-25-95	1579	1477	20.0
7F7B08162E	04-24-93	0. 00	1365	14.5	09-29-95	1579	1384	14.7
7F7E55466D	04-30-94	10. 5	1405	17.2	10-11-95	1577	1399	18.1
7F7D376F73	09-25-94	1564	1310	15.0	10-10-95	1577	1330	13.6

This fish exhibited the furthest movement of all the recaptures. One other pallid captured October 6, 1992, weighed 19.5 kg and was again caught October 12, 1995, and weighed 27.2 kg, an increase of 7.7 kg, which was the largest weight gain of all recaptures.

Habitat measurements were taken at all pallid sturgeon capture sites (Appendix 2). Minimum and maximum depths averaged 1.7-4.1 m and ranged from 0.9-6.7 m in 1994, and averaged 2.4-5.4 m and ranged from 1.5-6.7 m in 1995. Current velocities averaged 0.74 m/sec and ranged from 0.65 to 0.90 m/sec in 1994, and averaged 0.66 m/sec and ranged from 0.59 to 0.94 m/sec in 1995. All pallid sturgeon captured were associated with sandy substrate.

Population estimates by USFWS from 1991-1995, based on 160 fish, indicated approximately 250 (range 183-340) pallid sturgeon inhabit the Missouri River from Fort Peck Dam to the headwaters of Lake Sakakawea and the Yellowstone River below Intake Dam (Krentz, 1995). A population estimate of pallid sturgeon in the middle Missouri River above Fort Peck Reservoir was calculated at 45 (range 27-144), based on 27 different fish from 1990-1995 (Gardner, pers. comm.). Rough estimates of pallid sturgeon inhabiting the lower channelized Missouri and Mississippi rivers indicated 3,175 to 15,850 may be present in these river sections (Duffy, et al., 1994).

Six morphological measurements were taken on 19 of the pallid sturgeon captured to develop a character index (CI) in order to detect the possible presence of shovelnose x pallid hybrids. The index measurements and calculations are based on those used by Tews and Clancy (1992) and Tews (1993). The morphometrics used for the index are head length, mouth width, mouth to inner barbel, snout to outer barbels, and inner barbel and outer barbel lengths. These measurements were then converted to percent of standard length so differences in sizes of individual fish were standardized. The CI values for pallid sturgeon measured ranged from 437 to 519 which indicates these fish were pure pallid sturgeon (Appendix 1). Tews (1993) calculated CI values for 53 pallid and 607 shovelnose sturgeon and found values ranging from 368 to 478 for pallids and 164 to 307 for shovelnose sturgeon.

Past genetic analyses of shovelnose and pallid sturgeon have failed to detect enough significant genetic differences to conclude these fish are separate, distinct species (Phelps and Allendorf, 1983; Morizat, 1994). However, the most recent genetic study, based on control region (D-loop) sequences of mitochondrial DNA, supported the genetic distinction of shovelnose, pallid, and Alabama sturgeon as well, based on their apparent reproductive isolation and microevolutionary divergence (Campton, et al., 1995).

Shovelnose Sturgeon

A total of 894 shovelnose sturgeon were captured by drift netting in all sections sampled in the lower Missouri and Yellowstone rivers during 1994 and 1995. An additional 237 were caught in stationary gill nets in the Fort Peck tailwaters and dredge cut complex in section 1. The combined mean fork length was 589 mm and ranged from 216-904 mm for 1121 fish (Figure 6). Shovelnose sturgeon from 500-700 mm (666 fish) comprised 75.3 percent of those netted in all other sections. Those in the 550-600 mm range were the most abundant, making up 29.3 percent (259 fish) of the total. Shovelnose sturgeon from 500-700 mm in the tailwater\dredge cuts comprised 88.6 percent (210 fish) of the total with the most common range from 600-650 mm. This size group made up 35 percent (83 fish) of the total. No shovelnose sturgeon less than 450 mm and only three between 450-500 mm were sampled in the tailwater\dredge cuts compared to

79 and 69, respectively, in the downstream sections. This is apparently a reflection of the presence of younger age classes of sturgeon in the downstream areas of both rivers.

The mean weight for all shovelnose sturgeon sampled was 883 grams and ranged from 41-3583 grams (Table 5). The heaviest mean weight of 998 grams was from sturgeon netted in section 1 and ranged from 408-2586 grams. Shovelnose sturgeon captured in section 6 exhibited the greatest weight range of 41-3583 grams and averaged 960 grams.

Table 5. Length and weight of shovelnose sturgeon captured by drift netting and stationary gill net sets by section during 1994 and 1995.

	Fork length (mm)			Weight (kg)	
Section	N	Mean	Range	Mean	Range
1	237	624	493-861	1.0	0.4-2.6
2	130	591	439-833	0.8	0.3-2.3
3	46	555	406-762	0.6	0.2-1.9
4	9	510	351-617	0.5	0.1-0.8
5	55	571	216-742	0.8	0.0-1.9
6	366	594	239-904	1.0	0.0-3.6
7	0				
8	37	561	389-800	0.8	0.2-2.4
9	241	564	254-823	0.8	0.1-2.9
Average	1121	589	216-904	0.9	0.0-3.6

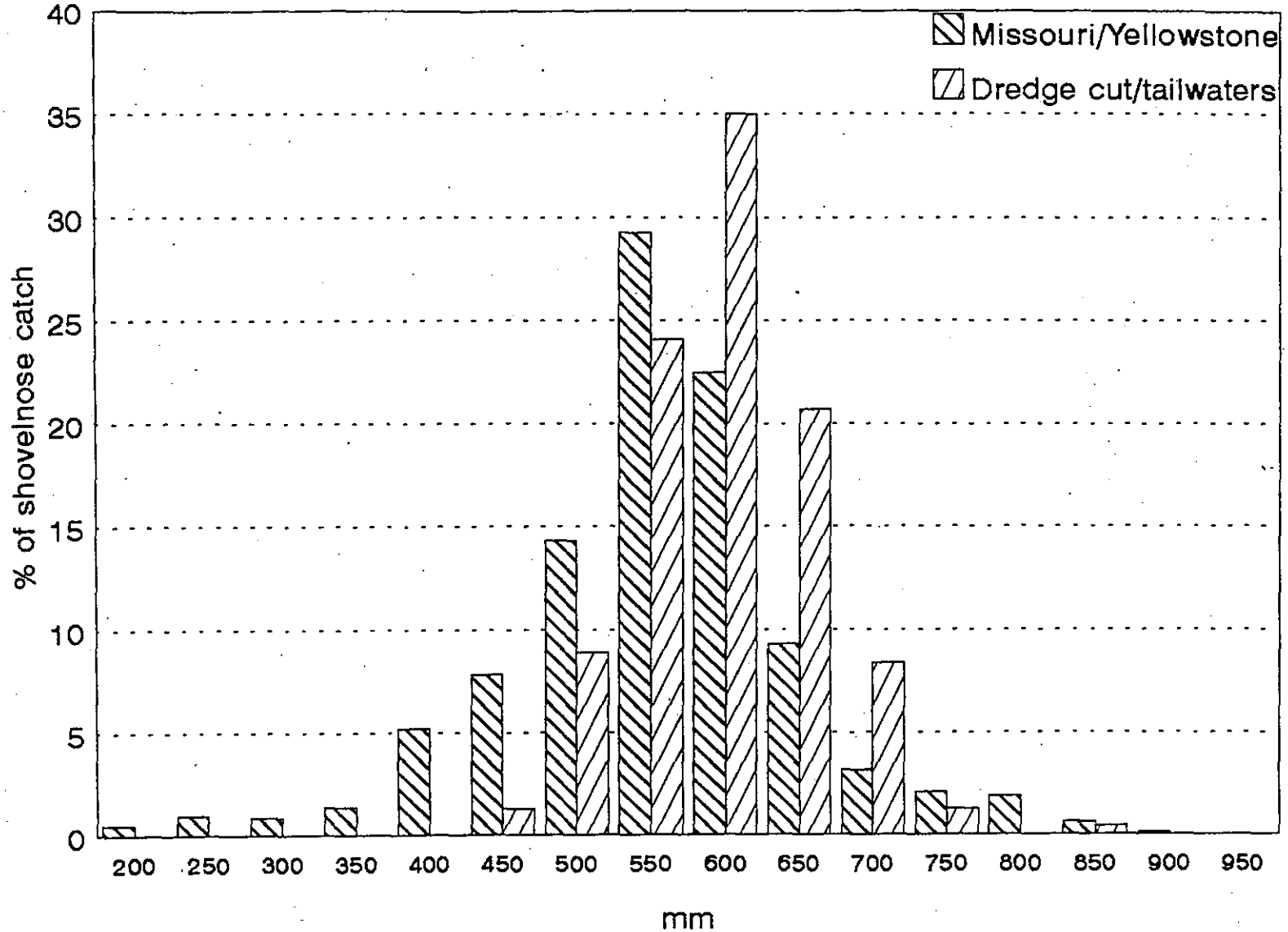


Figure 6. Fork length distribution of 884 shovelnose sturgeon captured in the Missouri and Yellowstone rivers and 237 captured in the dredge cuts and Fort Peck Dam tailwaters during 1994 and 1995.

Shovelnose Sturgeon Recaptures

A total of 36 tagged shovelnose sturgeon were recovered during 1994 (11 recaptures) and 1995 (25 recaptures) as shown in Table 6. Twenty-three (63.9%) of the tagged fish were caught within five miles of the original capture site in the same year or the following year in both the Missouri and Yellowstone rivers. However, four of five shovelnose tagged at the Intake Diversion Dam (RM 71) moved downstream into the Missouri River several miles below the confluence. One shovelnose sturgeon tagged at Intake during June, 1994, was recaptured in the Milk River in July 1995. This represents a distance of approximately 405 km (252 miles) and is the furthest documented movement of all the recaptures during this study.

Shovelnose sturgeon tagged in the tailwater\dredge cut complex exhibited no movement out of the area based on seven recaptures from 1993 through 1995. One other shovelnose tagged in the Missouri River in June, 1994, at RM 1702, was recaptured in the dredge cuts in September, 1995, a distance of about 109 km (68 miles) upstream. Three of the tag returns were caught by anglers; one at Intake, one from the Yellowstone confluence area, and one from the Fort Peck tailwater area.

Gardner and Stewart (1987), tagged 338 shovelnose sturgeon between 1979-1984, primarily in the Missouri River, and had three recaptures. All three moved distances greater than 16.1 km (10 miles) and two tagged in the Yellowstone River traveled 418.4 km (260 miles) or more down the Yellowstone River and up the Missouri River to the upper reaches.

Although no clear movement patterns of shovelnose sturgeon were discovered from the tag recapture data, it appeared the majority of the tagged sturgeon tended to remain in or near the area of original capture. This was particularly true of shovelnose sturgeon in the Fort Peck tailwater\dredge cut complex. This tendency also seemed to be supported by the relatively high percentage of recaptures recovered within 5 miles of their original capture site.

Table 6. Shovelnose sturgeon recaptures from the Missouri and Yellowstone rivers during 1994 and 1995.

Tag No.	Capture Date	RM	FL mm	Wt. grams	Recapture Date	RM	FL mm	Wt. grams
5194	04-08-93	Y-2	597	998	10-04-94	Y-2	602	952
5201	04-15-93	Y-0.5	600	726	07-28-94	M-1577	607	862
7-466	06-12-93	Y-71.1	765	1905	10-11-95	M-1579	767	1678
5323	06-15-93	DC	615	998	04-13-95	DC	620	1043
5304	07-13-93	M-1575	582	680	10-05-94	M-1579	582	771
5370*	09-16 93	M-1573	554	635	09-22-94	M-1576	528	635
5445	10-13-93	Y-51	688	1179	07-02-95	Y-71.1	Angler	
7-434	05-21-94	Y-71.1	770	1542	08-24-94	M-1577	752	1860
5474	06-02-94	M-1702	622	861	09-13-95	DC	622	862
7-2701	06-21-94	Y-71.1	691	1497	09-27-95	M-1574	693	1678
7-3006	06-28-94	Y-71.1	704	1452	07-07-95	Milk-2	706	1497
7-3168	07-05-94	Y-71.1	754	1633	10-11-95	M-1579	777	2223
5499	07-05-94	DC	587	998	08-30-95	DC	579	998
5500	07-05-94	DC	617	907	07-18-94	DC	Angler	
5738	07-05-94	DC	653	1043	08-29-95	DC	650	1089
5547	07-25-94	M-1761	551	635	05-03-95	M-1761	554	680
5565	07-28-94	M-1585	592	816	08-23-94	M-1584	592	771
5606	08-11-94	M-1579	422	227	08-25-94	M-1578	422	227
5614	08-19-94	M-1760	467	363	09-24-94	M-1761	470	363
5638	08-23-94	M-1584	508	499	08-24-95	Y-5	538	635
5640	08-23-94	M-1584	577	862	09-28-95	Y-1	752	953
5646	08-24-94	M-1574	602	998	07-25-95	M-1579	605	907
5651	08-24-94	M-1574	605	1043	09-26-95	M-1576	566	907
5722	09-23-94	M-1578	569	816	10-19-94	M-1579	569	816
5763	09-23-94	M-1578	620	1043	09-27-95[T]	M-1574	612	862
5777	09-23-94	Y-2	574	771	09-28-95	Y-1	561	771
5793	09-24-94	M-1584	546	635	04-24-95	Y-3	551	635
5865	10-04-94	Y-2	648	1043	10-06-94	M-1578	648	1043
5846	10-05-94	M-1577	569	726	05-18-95	M-1582	Angler	
5940	04-23-95	Y-3	605	1043	04-24-95	Y-3	605	1043
5963	04-24-95	Y-3	577	772	09-27-95	1558.5	USFWS	
5994	05-03-95	M-1761	650	953	08-17-95	M-1760	648	998
6039	06-20-95	DC	678	1497	08-29-95	DC	638	1406
6062	06-20-95	DC	566	590	10-04-95	DC	566	635
6058	06-21-95	DC	579	680	10-05-95	DC	584	816
6077	07-13-95	M-1585	704	1406	08-10-95	M-1589	701	1452

RM-River mile
FL-fork length
Wt.-Weight
Y-Yellowstone River
M-Missouri River
Milk-Milk River
USFWS-US Fish and Wildlife Service
DC-Fort Peck Dredge Cuts and Tailwater
*-Actual tag number missing in 1993 file with previous and post tags used on the date indicated. Therefore, this fish may not be the actual speciment recaptured.
[T]-Tag was removed and replaced with 6414.

Drift Netting

Seventeen and 21 species of fish were captured by drift netting in the Missouri and Yellowstone rivers during 1994 and 1995, respectively (Table 7). Comparison of CPUE between net types is not valid because all net types were not used in all sections or both years and some nets were fished with greater frequency than others e.g., trammel nets. Both 2.5- and 5-cm bar mesh trammel nets captured the most species of fish, 21, but were also used more frequently (73.9% for both years combined) than other net types. It was surmised these nets were more efficient for capturing deep bodied fish such as buffalo and river carpsucker, as well as sturgeon. All 10 pallid sturgeon in 1994 and seven of 13 in 1995 were caught in trammel nets. Multifilament and monofilament experimental gill nets were each used about 12 percent of the time and captured 12 and 16 species, respectively. Six of the pallid sturgeon netted in 1995 were captured in monofilament gill nets (5-,8-,10-,13-cm bar mesh). Shovelnose sturgeon were the most abundant species captured in all net types in all sections sampled during both years. A total of 444 were netted in 1994 and 452 in 1995. The highest CPUE was in the Yellowstone River during both years with 19.8 and 13.0 in 1994 and 1995, respectively.

Greater numbers of smallmouth buffalo, bigmouth buffalo and river carpsucker were netted in 1994 than 1995. River carpsucker was the most numerous catastomid species captured with 82 and 41 netted in 1994 and 1995, respectively. Sixty-three (77%) were caught in section 9 of the Yellowstone River in 1994 compared to 16 (39%) during 1995. The reduced flows in both rivers in 1994 may have been at least partially responsible by concentrating some fish species in certain areas resulting in greater netting efficiency. The majority of these species were caught in trammel nets. Other catastomid species, except for blue sucker, were captured rather infrequently. A total of 16 shorthead redhorse sucker, 24 longnose sucker and only one white sucker were netted during both years. Sixty blue sucker, 21 in 1994 and 39 in 1995, were captured with over 50 percent netted in the Missouri River above the confluence during 1995. This species was caught in all sections sampled except section 3. Blue sucker are also being considered as a candidate endangered or threatened species (Werdon, 1993c).

Table 7. Catch rates by section for species captured with drift nets in the Missouri and Yellowstone rivers during 1994 and 1995 (CPUE fish\hour).

		Missouri River		Yellowstone River	
		Sections 1,2,3,4,5	Section 6	Sections 8,9	Total
Hours	1994	12.9	16.5	6.1	35.5
	1995	14.5	19.7	12.3	46.5
Drifts	1994	91	106	41	238
	1995	97	125	71	293

SPECIES		CPUE	#	CPUE	#	CPUE	#	Total
Pallid sturgeon	1994	0	0	0.5	9	0.2	1	10
	1995	0	0	0.6	12	0.1	1	13
Shovelnose sturgeon	1994	11.2	144	10.8	179	19.8	121	444
	1995	6.7	97	9.9	195	13.0	160	452
Paddlefish	1994	0.1	1	0.1	2	0.5	3	6
	1995	0	0	0.1	1	0.2	2	3
Goldeye	1994	2.2	28	1.7	28	3.6	22	78
	1995	3.2	46	0.3	6	3.6	44	96
Lake whitefish	1994	0	0	0	0	0	0	0
	1995	0.1	1	0	0	0	0	1
Rainbow trout	1994	0	0	0	0	0	0	0
	1995	0.1	2	0	0	0	0	2
Brown trout	1994	0	0	0	0	0	0	0
	1995	0.1	1	0	0	0	0	1
Carp	1994	0.5	6	0.1	2	0.5	3	11
	1995	0.1	2	0.2	3	0.2	2	7
Flathead chub	1994	0.4	5	0.1	2	0	0	7
	1995	1.2	18	0.1	2	0.2	3	23
River carpsucker	1994	0.2	3	1.0	16	10.3	63	82
	1995	0.2	3	1.1	22	1.3	16	41
Blue sucker	1994	0.4	5	0.5	9	1.1	7	21
	1995	1.4	20	0.5	9	0.8	10	39
Smallmouth buffalo	1994	0.2	2	0.9	15	2.3	14	31
	1995	0.4	6	0.2	4	0.2	3	13
Bigmouth buffalo	1994	0.2	3	1.0	17	1.6	10	30
	1995	0.3	5	0.4	8	0.4	5	18
Shorthead redhorse	1994	0.5	7	0	0	0	0	7
	1995	0.6	9	0	0	0	0	9
Longnose sucker	1994	1.4	18	0	0	0	0	18
	1995	0.4	6	0	0	0	0	6
White sucker	1994	0.1	1	0	0	0	0	1
	1995	0.4	6	0	0	0	0	6
Channel catfish	1994	0.7	9	2.1	35	4.6	28	72
	1995	0.7	10	3.6	71	13.2	162	243
Burbot	1994	0	0	0	0	0	0	0
	1995	0	0	0.1	1	0	0	1
Sauger	1994	0.4	5	0.5	8	1.8	11	24
	1995	2.0	29	0.6	12	1.4	17	58
Walleye	1994	0.2	2	0.1	1	0	0	3
	1995	0.1	1	0.2	3	0.1	1	5
Freshwater drum	1994	0.1	1	0	0	0.3	2	3
	1995	0.3	4	0	0	0	0	4

Channel catfish were the second most abundant species captured by drift netting during 1995 with a total of 243 fish. The majority, 162 (66.7%), were caught in section 9 of the Yellowstone River with a CPUE of 13.2, the second highest catch rate for all species netted. Seventy-one (29%), were caught in section 6 of the Missouri River below the confluence. Only 72 were captured in 1994 and 63 of these fish were caught in sections 6 and 9. Trammel nets, particularly with 2.5-cm bar mesh, were the most effective net for capturing this species.

Over twice as many sauger were captured in 1995 with 58 as compared to 24 the previous year. Twenty-nine were netted in the Missouri River above the confluence in 1995 as compared with five in 1994. Only eight walleye were captured during both years.

Goldeye were relatively common throughout both river systems and sampled in all sections during both years. Only six were netted in section 6 during 1995 compared to 28 in 1994; this may have been due to higher flows in this section during 1995.

One each of lake whitefish and brown trout and two rainbow trout were caught in 1995 in sections 2 and 3. These upper sections of the Missouri River are influenced to a greater degree by the hypolimnial releases from Fort Peck Dam than further downstream sections, thereby providing more favorable habitat for salmonid species.

Table 8 lists all fish species captured during this study. Average lengths, weights and ranges of all species captured during both years in the Missouri and Yellowstone rivers are shown in Appendices 3 and 4.

Larval Fish Sampling

Larval fish sampling was done in the Missouri River only above the confluence of the Yellowstone River in 1994 (Table 9). Eighty-seven samples were taken in sections 1, 2, 3, 4, 5, and in the Milk River about one-half mile from its confluence with the Missouri River sampling

took place from June 23 - August 10. Flow patterns were relatively stable during the sampling period ranging from 8,200-10,300 cfs. A total of four sturgeon were collected, three on July 14 and one on July 28, 1994 in section 5 at RM 1589 (Highway 58 Bridge area). Three larval paddlefish were also collected at this site. No sturgeon or paddlefish eggs were identified at any of the sampling locations and only 15 other eggs were collected. Apparently the flow patterns experienced in 1994 resulted in rather minimal spawning efforts by sturgeon and paddlefish.

Sampling efforts were expanded during 1995 to include the Missouri River below the Yellowstone confluence and the lower 15 miles of the Yellowstone River (Table 10). One hundred-two samples were taken in section 9 of the Yellowstone River and 74 were taken in sections 5 and 6 of the Missouri River from May 18 through July 28. Flow patterns ranged between 6,000-10,000 cfs in the Missouri River at Culbertson and 21,000-56,000 cfs in the Yellowstone River at Sidney during the sampling period (USGS, Fort Peck). A total of 22 sturgeon and 63 paddlefish larvae were collected. Twelve of the sturgeon were captured in section 6, nine in section 9, and one in section 5. The highest number of sturgeon larvae, 16, was collected during the July 11-13 sampling period. Eleven of these were captured in section 6 which would seem to indicate downstream drift from the Yellowstone River after hatching.

Based on length measurements, 15 of the sturgeon captured during 1995 ranged in age from one to nine days and were from 7.4-17.8 mm in length (Snyder, 1994) as shown in Table 11. The first larvae were captured June 15 at RM 9.0 and RM 16 in the Yellowstone River and were three to four days old. The oldest larvae were collected July 11-13 and ranged from 7-9 days old. Four of these were captured in section 6 and one in section 9. Several 1-2 day old larvae were also collected July 11-12 in the same sections. The last sturgeon caught was on July 26 in section 6 (RM 1580); no age information is available. In addition, 24 sturgeon/paddlefish eggs were collected from section 9 and seven were collected in section 6; eggs were found between May 30 and July 13 in section 9 and between June 15 and July 13 in section 6. Also, 7,361 other eggs were collected and were primarily goldeye eggs. Flows in the Yellowstone River ranged from about 38,000-40,000 cfs during the sampling periods.

Table 8. List of fish species caught in the Missouri and Yellowstone rivers during 1994 and 1995.

Pallid sturgeon (*Scaphirhynchus albus*)
Shovelnose sturgeon (*S. platorynchus*)
Paddlefish (*Polyodon spathula*)
Goldeye (*Hiodon alosoides*)
Lakewhitefish (*Coregonus clupeaformis*)
Cisco (*C. artedii*)
Chinook salmon (*Oncorhyncus tshawytscha*)
Rainbow trout (*O. mykiss*)
Brown trout (*Salmo trutta*)
Rainbow smelt (*Osmerus mordax*)
Northern pike (*Esox lucius*)
Carp (*Cyprinus carpio*)
Creek chub (*Semotilus atromaculatus*)
Flathead chub (*Platygobio gracilis*)
Sicklefin chub (*Macrhybopsis meeki*)
Sturgeon chub (*M. gelida*)
Lake chub (*Couesius plumbeus*)
Emerald shiner (*Notropis atherinoides*)
Brassy minnow (*Hybognathus hankinsoni*)
Plains minnow (*H. placitus*)
Silvery minnow (*H. argyritis*)
Longnose dace (*Rhinicthys cataractae*)
River carpsucker (*Carpiodes carpio*)
Blue sucker (*Cycleptus elongatus*)
Smallmouth buffalo (*Ictiobus bubalus*)
Bigmouth buffalo (*I. cyprinellus*)
Shorthead redhorse sucker (*Moxostoma macrolepidotum*)
Longnose sucker (*Catastomus catastomus*)
White sucker (*C. commersoni*)
Channel catfish (*Ictalurus punctatus*)
Stonecat (*Notorus flavus*)
Burbot (*Lota lota*)
White bass (*Morone chrysops*)
Yellow perch (*Perca flavescens*)
Sauger (*Stizostedium canadense*)
Walleye (*S. vitreum*)
Freshwater drum (*Aplodinotus grunniens*)

Table 9. Comparison of total larval catch by sampling period for Missouri River above confluence section 5 (Highway 58 Bridge), section 3 (Highway 13 Bridge), and section 2 (Mouth of Milk River) during 1994.

RIVER LOCATION	SECTION #	SAMPLE PERIOD	NUMBER OF SCAPHIRHYNCHUS	NUMBER OF POLYODON	OTHER LARVAE ICTALURID CATASTOMID CYPRINID STIZOSTEDION HIODON	SCAPHIRYNCHUS/ POLYODON EGGS	OTHER EGGS
HIGHWAY 58	5	6/23-6/29	0	2	2	0	5
BRIDGE		7/8-7/14	3	1	0	0	4
		7/21-7/28	1	0	3	0	4
		8/2-8/10	0	0	3	0	2
TOTALS			4	3	8	0	15
WOLF POINT	3	6/23-6/29	0	0	4	0	7
		7/8-7/14	0	0	1	0	2
		7/21-7/28	0	0	5	0	12
		8/2-8/10	0	0	0	0	3
TOTALS			0	0	10	0	24
MOUTH OF MILK	2	6/23-6/29	0	0	1	0	2
		7/8-7/14	0	0	3	0	0
		7/21-7/28	0	0	0	0	0
		8/2-8/10	0	0	0	0	0
TOTALS			0	0	4	0	2
OVERALL TOTALS			4	3	22	0	41

Table 10. Comparison of total larval catch by sampling period between Missouri River above confluence (section 5), Missouri River below confluence (section 6), and the Yellowstone River (section 9) during 1995.

RIVER LOCATION	SECTION #	SAMPLE PERIOD	NUMBER OF SCAPHIRHYNCHUS	NUMBER OF POLYODON	OTHER LARVAE ICTALURID CATASTOMID CYPRINID STIZOSTEDION HIODON	SCAPHIRYNCHUS/ POLYODON EGGS	OTHER EGGS*
MISSOURI	5	5/18	0	0	2	0	2
ABOVE CONFLUENCE		5/30-6/1	0	0	15	0	149
		6/15-6/16	0	0	21	0	25
		6/27-6/29	0	3	18	0	86
		7/11-7/13	1	12	58	0	12
		7/20	0	0	3	0	4
		7/26-7/28	0	0	2	0	6
TOTALS			1	15	118	0	284
MISSOURI	6	5/18	0	0	0	0	2
BELOW CONFLUENCE		5/30-6/1			NO SAMPLES TAKEN		
		6/15-6/16	0	0	20	2	270
		6/27-6/29	0	9	2	2	241
		7/11-7/13	11	6	42	3	60
		7/20	0	1	1	0	4
		7/26-7/28	1	0	2	0	33
		8/2-8/10	0	0	0	0	3
TOTALS			12	16	67	7	610
YELLOWSTONE	9	5/18			NO SAMPLES TAKEN		
		5/30-6/1	0	7	6	1	1379
		6/15-6/16	3	7	66	8	2233
		6/27-6/29	2	12	18	8	2717
		7/11-7/13	4	5	30	7	104
		7/20	0	1	1	0	6
		7/26-7/28	0	0	5	0	28
TOTALS			9	32	126	24	6467
OVERALL TOTALS			22	63	311	31	7361

* Primarily Hiodon alosoides

A total of 63 paddlefish larvae were collected. The greatest number, 32, was sampled in section 9 with the peak occurring June 28 when 11 were captured. Fifteen and 16 were captured in section 5 and 6, respectively. The highest numbers of larvae collected were 12 in section 9, 12 in section 5 and nine in section 6; sampling periods were June 27-29, July 11-13, and June 27-29, 1995, respectively.

Other larval fish collected and identified were sucker, minnow, *Stizostedion* and *Hiodon* species. The highest number captured was 66 and occurred June 15-16 in section 9. The next highest peak was 58 during July 11-13 in section 5. The peak in section 6 was also during July 11-13 when 42 larvae were sampled.

Table 11. Capture date, river mile, length, and age of larval sturgeon sampled in 1995 from the Missouri and Yellowstone rivers.

Date	Rivermile	Length (mm)	Days old
6/15	9.0	10.5	3-4
6/15	16.0	11.0	3-4
6/16	2.5	8.5	1-2
6/28	9.0	10.2	2-3
6/28	16.0	9.4	2-3
7/11	1579.0	14.5	7-8
7/12	9.0	16.0	6-7
7/12	9.0	7.4	1
7/12	16.0	7.5	1
7/12	1579.0	7.8	1
7/12	1579.0	7.9	1
7/12	1579.0	----	1
7/13	1579.0	8.3	1-2
7/13	1579.0	16.3	7-8
7/13	1579.0	17.8	8-9

Beach Seining

All sections of the study area were seined except sections 4 and 7 during 1994 and 1995 with results shown in tables 12 and 13, respectively. In 1994, a total of 89 hauls were made and captured 30 species. Fifty-four hauls were made in 1995 and captured 25 species. Fewer hauls were made in 1995 due to time diverted to trawling efforts. Only 20 hauls were made in the Missouri River upstream from the Yellowstone confluence (sections 1-5) in 1995 compared with 61 in 1994. Much higher flows during late summer and fall in these sections resulted in the lack of suitable shoreline habitat where many of the minnow and YOY species are normally found.

Flathead chub were the most abundant species captured in both years averaging 36.9 and 19.7 per haul in 1994 and 1995, respectively. Section 3 had the highest average catch rate of 139.8 per haul in 1994 compared to 5.7 in 1995, which is a reflection of higher flow conditions. Flathead chub were also the most abundant species seined in the Yellowstone River during both years. Tews (1993), reported flathead chubs were the most common species captured in both rivers based on seining efforts. Section 1, from Fort Peck Dam to the Milk River confluence (RM 1770 to 1761.5) was the only section where flathead chub were not seined. This section represents the coldest, least turbid section of the river and is apparently not suitable flathead chub habitat.

Catches of adult *Hybognathus spp.* (Western silvery/plains minnow), YOY smallmouth buffalo and bigmouth buffalo, YOY longnose sucker and white sucker, and YOY sauger and walleye were combined due to difficulty of positive identification in the field. The combined catch of longnose and white suckers averaged 38.7 per haul in 1994 and 98.0% were captured in sections 1,2, and 3 (RM 1170 to 1683). This would appear to indicate a preference by these species for cooler, less turbid waters. Catch rates for longnose suckers and white suckers markedly decreased in the warmer, more turbid sections of the Missouri and Yellowstone rivers. This trend was again evident in 1995 as 97.1% of these species were seined in the same three sections but in much fewer numbers.

Table 12. Number of fish captured and CPUE per seince haul in the Missouri and Yellowstone rivers during 1994.

Section	1		2		3		5		6		8		9			total	
Number of hauls	25		14		12		10		13		3		12			89	
	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE		#	CPUE
Shovelnose sturgeon									5	0.4			1	0.1		6	0.1
Goldeye			10	0.7			2	0.2	27	2.1	10	3.3	62	5.2		111	1.2
Cisco			2	1.1									1	0.1		3	<0.1
Rainbow trout	165	6.6	10	0.7												175	2.0
Northern pike	2	0.1			3	0.3							1	0.1	6	0.1	
Carp	3	0.2	2	0.1	19	1.6	3	0.3	2	0.2	2	0.7	1	0.1		32	0.4
Creek chub							1	0.1								1	<0.1
Flathead chub			108	7.7	1678	139.8	801	80.1	228	17.5	150	50.0	321	26.8		3286	36.9
Sicklefin chub							6	0.6	22	1.7			2	0.2		30	0.3
Sturgeon chub							3	0.3	29	2.2			44	3.7		76	0.9
Lake chub					1	0.1										1	<0.1
Emerald shiner	7	0.3	24	1.7	29	2.4	5	0.5	50	3.8			89	7.4		204	2.3
Spottail shiner	12	0.5														12	0.1
Brassy minnow			1	0.1	46	3.8	2	0.2								49	0.6
Hybognathus spp.[1]			26	1.9	2	0.2	58	5.8	12	0.9	10	3.3	46	3.8		154	1.7
Longnose dace	15	0.6	7	0.5	3	0.3					6	2.0	1	0.1		32	0.4
River carpsucker			18	1.3	267	22.3	97	9.7	10	0.8	3	1.0	244	20.3		639	7.2
Blue sucker			1	0.1												1	<0.1
Buffalo spp.[2]							17	1.7								17	0.2
Shorthead redhorse			2	0.1					2	0.2			6	0.5		10	0.1
Sucker spp.[3]	1249	50.0	474	33.9	1653	137.8	2	0.2	3	0.2	38	12.7	25	2.1		3444	38.7
Channel catfish							2	0.2	10	0.8	59	19.7	9	0.8		80	0.9
Stonecat											1	0.3				1	<0.1
burbot													1	0.1		1	<0.1
White bass													1	0.1		1	<0.1
Stizostedium spp.[4]			1	0.1	1	0.1	29	2.9	30	2.3			14	1.2		75	0.9
Unknown fry	72	2.9	18	1.3			8	0.8	13	1.0	3	1.0	26	1.9		140	1.6
Total	1526	61.0	703	48.4	3702	308.5	1036	103.6	443	34.1	282	94.0	895	74.6		8587	96.5

1-*Hybognathus spp.*-Western silvery minnow and plains minnow
2-Buffalo spp.-smallmouth buffalo and bigmouth buffalo
3-Sucker spp.-white sucker and longnose sucker
4-*Stizostedium spp.*-walleye and sauger Table 12

Table 13. Number of fish captured and CPUE per seince haul in the Missouri and Yellowstone rivers during 1995.

Section	1		2		3		5		6		8		9Total			
Number of hauls	3		7		6		4		9		12		13		54	
	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE
Shovelnose sturgeon							1	0.3			4	0.3			5	0.1
Goldeye					2	0.3	1	0.3	13	1.4	14	1.2	66	5.1	96	1.8
Cisco			2	0.3											2	<0.1
Rainbow trout	4	1.3	5	0.7											9	0.2
Rainbow smelt									11	1.2			48	3.7	59	1.1
Northern pike													1	0.1	1	<0.1
Carp							2	0.5	1	0.1	3	0.3	1	0.1	7	0.1
Flathead chub			1	0.1	34	5.7	50	12.5	331	36.8	305	25.4	344	26.5	1065	19.7
Sicklefin chub									1	0.11					1	>0.1
Sturgeon chub			1	0.1	1	0.2	3	0.8	28	3.1	30	2.5	25	1.9	88	1.6
Lake chub					1	0.1									1	<0.1
Emerald shiner			8	1.1	1	0.2	2	0.5	27	3.0	16	1.3	8	0.6	62	1.1
Hybognathus spp.[1]			1	0.1			1	0.3	14	1.6	73	6.1	164	12.6	253	4.7
Longnose dace									5	0.6	17	1.4	1	0.1	23	0.4
River carpsucker					3	0.5	2	0.5	1	0.11	33	2.8	10	0.8	49	0.9
Shorthead redhorse							9	2.3	5	0.6	6	0.5	4	0.3	24	0.4
Sucker spp.[2]	4	1.3	16	2.3	180	30.0	1	0.5	3	0.3	2	0.2			206	3.8
Channel catfish									2	0.2	13	1.1			15	0.3
Stonecat											3	0.3	1	0.1	4	0.1
White bass													1	0.1	1	<0.1
Yellow perch					1	0.2									1	<0.1
Sauger and *Stizostedium spp.*[4]							4	1.0	11	1.2	11	0.9	37	2.9	63	1.2
Unknown fry											90	7.5	190	14.6	280	5.2
Total	8	2.6	34	4.9	224	37.3	76	19.0	454	50.44	620	51.7	901	69.3	2316	42.9

1-*Hybognathus spp.*-Western silvery minnow and plains minnow
2-Sucker spp.-white sucker and longnose sucker
3-*Stizostedium spp.*-walleye and sauger

Sicklefin chub and sturgeon chub, both species of special concern, were captured with some frequency in sections 5 and 6 in the Missouri River and Section 9 in the Yellowstone River during 1994. A total of 30 sicklefin chub were seined, primarily from section 6 below the confluence of the Yellowstone River. Twenty-nine sturgeon chub were also caught in this section and 44 were seined in section 9. Tews (1993) reported sturgeon chub were the second most abundant species captured (47) in 18 seine hauls. Concern over the status of sicklefin chub and sturgeon chub populations in these portions of the study area have been expressed in USFWS documents (Werdon, 1993a, 1993b). Populations of these species have been greatly reduced or entirely extirpated from much of their historic range.

A total of 88 sturgeon chub were captured in 1995 and were present in all sections seined except section 1. Twenty-eight and 30 were captured in sections 6 and 8, respectively. Only one sicklefin chub was caught by seining in 1995 (section 6) but this was probably due to the much higher flow patterns and water levels than in 1994. Also, this species apparently prefers more deep and swift main channel habitats (Grisak, personal communication). This was further corroborated based on our trawling efforts (reported later in this document).

Only one YOY blue sucker was captured during the two years of the study. This fish is also a species of special concern (Werdon, 1993c). This specimen was 64 mm in length and was caught about 1 mile below the Milk River confluence in 1994.

Western silvery and plains minnows are two other species of concern, particularly in the lower channelized portions of the Missouri River. These species were sampled in all sections seined except section 1 in 1994 and averaged 1.7 fish per haul. They were most abundant in sections 5 and 9 averaging 5.8 and 3.8 fish per haul, respectively. In 1995, the average number per haul was 4.7 and they were most abundant in section 9 with 12.6 fish per haul. It would appear the status of these species in the lower Missouri and Yellowstone rivers is quite good and not of concern at this time.

A total of 11 sturgeon were captured by seining during 1994 and 1995. Ten of these fish were

considered age 1+ shovelnose sturgeon and one was a 35 mm sturgeon seined from a shallow side channel in section 8 of the Yellowstone River near Elk Island (RM 50) in 1995. This is believed to be the first recorded capture of a mesolarval sturgeon in either the lower Yellowstone or Missouri rivers and was sent to the USFWS Larval Fish Identification Laboratory in Fort Collins, CO for positive identification.

A run of rainbow smelt from Lake Sakakawea was evident in 1995 as a total of 59 were captured, but only in sections 6 and 9. None were sampled in 1994.

It is interesting to note Gardner and Stewart (1987), sampled yellow perch in sections 2, 3, 4, and 5 and white crappie in sections 3, 4, and 5 during their seining efforts. Tews (1993), reported neither species captured by seining. No crappie and only one yellow perch (1995, section 3) was seined during this study.

Trawling

A trawl was used during July and August, 1995 in an attempt to capture YOY sturgeon and also species of special concern. A total of fifty trawls were made and captured 10 species and 158 fish for an average of 0.83 fish per trawl (Table 14). Sixteen and 20 trawls were made in sections 6 and 9 of the Missouri and Yellowstone rivers, respectively, and represented 72 percent of the trawling effort. Greater emphasis was committed to these sections since it was felt these areas afforded the best opportunity to capture YOY sturgeon, assuming they continue to drift downstream after hatching. Information based on sturgeon telemetry suggests adult pallid and shovelnose sturgeon move into the lower reaches of the Yellowstone River during the spring, presumably for spawning purposes (Bramblett, pers. comm.). Collection of larval sturgeon from section 9 further supported this premise. The fact that only one YOY sturgeon (56mm in length) was collected in section 9 and none in section 6, may be an indication that the majority of YOY sturgeon had already drifted downstream of the sampling areas or were in other habitat locations not suitable for trawling.

Table 14. Fish species captured by trawling in the Missouri and Yellowstone rivers during 1995.

	Missouri River						Yellowstone River				Total	
Section	2		5		6		8		9			
Minutes	**8.0**		**33.5**		**62.0**		**12.0**		**76.0**		**191.5**	
Trawls	**2**		**9**		**16**		**3**		**20**		**50**	
Species	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#
Shovelnose sturgeon			0.12	4	0.02	1			0.01	1	0.03	6
Rainbow trout	0.25	2									0.01	2
Carp									0.01	1	0.01	1
Flathead chub					0.02	1					0.01	1
Sicklefin chub			0.18	6	0.10	6	0.25	3	0.53	40	0.29	55
Sturgeon chub			0.03	1			1.17	14	0.43	33	0.25	48
Hybognathus spp.[1]			0.03	1							0.01	1
Longnose dace									0.01	1	0.01	1
Channel catfish			0.09	2	0.02	1	0.33	4	0.14	11	0.09	18
Stonecat			0.63	21					0.01	1	0.12	22
unknown fry							0.08	1	0.03	2	0.02	3
Total	0.25	2	1.07	35	0.15	9	1.83	22	1.18	90	0.83	158

1-*Hybognathus spp.*-Western silvery minnow and plains minnow

Four mesolarval sturgeon (44-50mm in length) were captured in section 5 at RM 1589.5 (Nohly Bridge area), two each in two trawl attempts, on July 28, 1995. River depths ranged from 3.7 to 4.9 meters and current velocity averaged 0.92 meters per second; substrate was primarily sand, cobble and boulders (Table 15). No other YOY sturgeon were captured at this site in subsequent sampling efforts. Specimens were preserved and sent to the larval fish laboratory in Fort Collins for species identification. Twenty-one of 22 total stonecat were also sampled at this location and averaged 0.63

Table 15. Summary of 1995 habitat measurements averaged by section and month for trawling sites.

		Average						
Section	Month	Secchi cm	Turbidity NTU	Velocity m/s	Conductivity uMHOS	Depth m	m	Substrate type
2	August	198	3	0.65	489	2.1	2.7	sand/gravel
5	July	16	114	0.92	590	3.7	4.9	sand/gravel/cobble/boulder
	August	13	118	0.66	526	3.3	4.0	sand/gravel/cobble/boulder
6	July	15	136	0.84	465	4.3	6.4	sand
	August	11	208	0.74	550	3.0	5.5	sand
8	August	17	82	0.89	580	1.8	3.3	gravel/cobble
9	July	11	135	1.08	482	3.3	6.1	sand
	August	16	155	0.66	418	2.7	3.7	sand

fish per trawl. This was the highest CPUE of fish caught by trawling for all sections.

The most abundant species captured by trawling were sicklefin chub and sturgeon chub with 55 and 48 sampled, respectively. Together, these species comprised 65.2 percent of the total fish captured. Sicklefin chub averaged 0.29 fish per trawl and sturgeon chub averaged 0.25 fish per trawl. The greatest numbers of both species, 40 and 33, were sampled in section 9 of the Yellowstone River. This would seem to indicate relatively good populations of these species are present, at least in the lower reaches of the Yellowstone River. Depths at sampling sites ranged from an average of 3.7 to 4.9 meters in July and 3.4 to 4.0 meters in August; current velocities averaged 0.92 and 0.66 meters per second, respectively (Table 15). Sand was the primary substrate.

Only nine fish, including six sicklefin chub and one sturgeon chub, were captured in 16 trawls below the Yellowstone confluence. This was probably a reflection of the higher flows which resulted in more available habitat and greater dispersion of target species.

Other species captured included 18 channel catfish, three unknown fry, two rainbow trout, and one each of carp, flathead chub, Western silvery/plains minnow, and longnose dace.

Aquatic Invertebrate Sampling

Aquatic invertebrate sampling in the Missouri and Yellowstone rivers during 1994 and 1995 collected seven orders of aquatic insects and one terrestrial insect order (Table 16). Ephemeroptera and Trichoptera were the most common orders. Twelve families and 21 genera of Ephemeroptera and six families and 10 genera of Trichoptera were identified. Other orders identified included: Hemiptera, three families and four genera; Diptera, four families; Coleoptera, two families and two genera; Plecoptera, one family and two genera; Odonata, one family and one genus. One family of the order Homoptera, a terrestrial form, was also collected in aquatic sampling efforts. A number of noninsect invertebrates including Hydra, scuds, water mites, crustaceans, and several others were also identified.

Table 16. Aquatic insects collected during 1994 and 1995 noted as present (P) by section in the Missouri and Yellowstone rivers. Asterisk entries indicate verified specimens by Dr. Daniel L. Gustafson at Montana State University.

INSECTS

		Missouri River Sections					Yellowstone River Sections	
		1	2	3	5	6	8	9
EPHEMEROPTERA								
Acanthametropodidae								
*	Analetris eximia				P			P
Siphlonuridae								
	Ameletus spp.			P				
Baetidae								
*	Baetis spp.	P	P	P	P	P	P	P
	Centroptilum spp.			P	P			
*	Camelobaetidius cepheus				P			
Ametropodidae								
*	Ametropus neavei				P			
Oligoneuridae								
*	Isonychia campestris			P	P	P	P	P
*	Homoeoneuria alleni				P	P		P
Heptageniidae								
*	Stenonema spp.		P	P	P	P	P	P
	Cinygma spp.				P			
*	Heptagenia spp.			P	P		P	P
*	Rithrogena undalate							P
*	Raptoheptagenia cruentata				P			
Ephemerellidae								
*	Ephemerella inermis	P	P	P				
	Serratella spp			P				
Tricorthidae								
*	Tricorythodes spp.							P
Caenidae								
	Brachycerus spp.				P			
Leptophlebiidae								
*	Traverella albertana			P	P	P	P	P
*	Choroterpes albiannulata							P
Ephemeridae								
*	Hexagenia limbata			P				
Polymitarcidae								
*	Ephoron album			P	P	P	P	P
TOTAL GENERA	21	2	3	11	14	6	6	11
ODONATA								
Gomphidae								
*	Gomphus graslinellus				P	P	P	P
TOTAL GENERA	1				1	1	1	1

Table 16. Continued.

		Missouri River Sections					Yellowstone River Sections	
		1	2	3	5	6	8	9
PLECOPTERA								
Perlodidae								
* Isogenoides colubrinus								P
* Isoperla longiseta					P	P	P	P
TOTAL GENERA	2				1	1	1	2
HEMIPTERA								
Macrovellidae								
Oravellia spp.			P					
Velidae								
Paravellia spp.			P					
Corixidae								
Hesperocorixia spp.		P	P	P				
* Sigara lineata					P			
TOTAL GENERA	4	1	3	1	1			
COLEOPTERA								
Dytiscidae								
* Stictotarsus griseostratus			P					
Hydrophilidae								
* Berosus spp			P					
TOTAL GENERA	2		2					
DIPTERA								
Simullidae		P	P	P	P	P	P	P
Chironomidae		P	P	P	P	P	P	P
* Muscidae		P						
* Stratiomyidae						P		
TOTAL FAMILIES	4	3	2	2	2	3	2	2
TRICHOPTERA								
Polycentropodidae								
Cyrnellus spp					P			
* Neureclipsis spp				P				
* Polycentropus spp				P	P			
Hydropsychidae								
Cheumatopsyche spp		P	P	P	P	P		
* Hydropsyche spp		P	P	P	P	P	P	P
Glossosomatidae								
* Glossosoma spp			P					
Hydroptilidae								
* Hydroptila spp				P				
Brachycentridae								
* Brachycentrus occidentalis			P	P	P	P		
Leptoceridae								
* Ceraclea								P
* Nectopsyche								P
TOTAL GENERA	10	2	4	6	5	3	1	3

The Nohly Bridge area (RM 1589.5) in section 5, had the greatest apparent diversity of aquatic insects. Twenty four genera were collected during 1994 and 1995 in this area. Only eight genera were collected in section 1, but in sections 2, 3, 6, 8, and 9, genera ranged from 11 to 20. The results were similar to those reported by Gardner and Stewart (1987), who collected 19 genera in the Nohly Bridge area, 12 genera in the Highway 13 Bridge area (RM 1701), and 6 genera in section 1.

Ephemeroptera (mayflies) were the most common insects collected in all sections except section 1. Twenty one genera were sampled during 1994 and 1995 in the study area (Table 16). Gardner and Stewart (1987), reported 13 genera. One genus of Siphlonuridae, was identified in 1994 and 1995, but Gardner and Stewart (1987), reported finding four. This discrepancy represents revisions in taxonomy rather than actual absence of the genera in this family. Only three Ephemeroptera genera were collected in section 2. However, they were more abundant overall than any other macroinvertebrate. Diversity was greatest in sections 3, 5, and 9, with 11, 14, and 11 genera, respectively. Genera collected in the Missouri River in 1994 through 1995, but not collected by Gardner and Stewart (1987), were: Siphlonuridae-*Ameletus spp*; Baetidae-*Centroptilum spp.* and *Camelobaetidius cepheus*; Oligoneuridae-*Homoeoneuria alleni*; Heptageniidae-*Cinygma spp.* and *Raptoheptagenia cruentata*; Ephemerellidae-*Serratella spp.*; Tricorythidae-*Tricorythodes spp.*; Leptophlebiidae-*Choroterpes albiannulata*. The additional genera identified may be due to sampling with deep water gear such as the trawl and larval nets rather than kick nets only.

Odonata (dragonflies) were represented by one species, *Gomphus gradlinellus*. They appeared to be common in sections 5, 6, and 9 during both years. Gardner and Stewart (1987), collected this species only near the Highway 16 bridge (RM 1621), and therefore considered it rare. This genus of Gomphidae are typically predatory burrowers and were frequently collected in shallow areas around sandbars.

Plecoptera (stoneflies) belonging to the Perlodidae family were common in the lower sections.

The genus *Isoperla longiseta,* was collected in sections 5, 6, 8, and 9 and the species *Isogenoides columbrinus,* was collected in section 9 (Table 16). Gardner and Stewart (1987), reported *Isoperla sp.,* to be common in section 3 and abundant in section 5; *Isogenoides sp.,* were reported rare in section 3, and *Isogenus sp. (now Isogenoides).*, in section 5, with fewer than two specimens collected.

Hemiptera (true bugs), were collected in sections 1, 2, and 3 and were represented by three families and four genera. Macrovellidae- *Oravellia spp.*, Velidae-*Paravellia spp.*, Corixidae-*Hesperocorixia spp.,* and *Sigara lineata,* were identified. Corixidae were collected in sections 1, 2, 3 and 5. Few samples were taken in water with velocities less than 0.1 meters per second. This limits the collection of many hemiptera that are present in backwater areas.

Coleoptera (beetles), were represented by two genera and found in section 2 below the Milk River confluence. Single specimens of Dytiscidae-*Liodessus sp.,* and Hydrophilidae-*Berosus sp.,* were identified.

Diptera (true flies), were represented by two genera and were found in all sections. Simuliidae and Chironomidae were most common in the upper three sections but were collected throughout the study area. Single specimens belonging to the Muscidae and Stratiomyidae families were collected. Gardner and Stewart (1987), collected representatives from four families and further identified 14 genera of Chironomidae. Muscidae were reported as common in section 1 and rare in section 2 by Gardner and Stewart (1987).

Trichoptera (Caddisflies) were represented by 10 genera and six families (Table 16). Gardner and Stewart (1984), collected three families and four genera. The most common trichopteran collected was Hydropsychidae-*Hydropsyche spp.* in 1994 and 1995. This was also the case in sampling by Gardner and Stewart (1987). Other genera collected were more common in section 3, with six of the 10 total genera represented. Gardner and Stewart (1987) reported this order to be the second most abundant in sections 3, 4, and 5. The other genera identified were generally

uncommon in the collections with many being represented by less than five specimens. The additional families and genera identified, compared to Gardner and Stewart (1987), were from larval and trawl samples.

A terrestrial homopteran from the family Cicadellidae occurred throughout the study area and was collected in larval tow and kick net samples. This insect lives on vegetation near the banks and frequently becomes part of the drift. Some specimens were collected at depths greater than 2 meters.

A marked increase in the number of Ephemeroptera genera, 11, was evident in section 3 (Wolf Point area) of the Missouri River, approximately 113 km (70 miles) downriver from Fort Peck Dam. Only three genera were found in sections 1 and 2. Section 3 is considered a transition zone from the cold, hypolimnial releases of the dam to warmer water temperatures and thus appears more favorable to this Order of insects. This area also had the highest number of Trichoptera genera, 6, identified in all sections sampled. Aquatic insect diversity was greatest in section 5 (Nohly Bridge area), about 309 km (190 miles) downstream from Fort Peck Dam. A total of 24 genera were identified, including 14 Ephemeroptera, five Trichoptera, and was the first area where Plecoptera were collected.

The Yellowstone River also showed a healthy diversity of aquatic insects with a total of five Orders and 11 and 19 genera identified in sections 8 and 9, respectively.

Non-insect invertebrates were common in sections 1 and 2 (Table 17). Hydra were found in both sections and Amphipods were also present in both sections in areas of low current. Aceri (water mites), were represented by two genera with both found in section 2 below the Milk River confluence. Crustaceans, such as Cladocera, were primarily found in the Fort Peck tailwaters, particularly Daphnidae. One large cladoceran, *Leptodora kindti,* was collected downstream as far as section 5 and was also common in sections 1, 2, and 3. Hirudinea (leeches), were represented by one species, *Helobdella stagnalis*. This species was collected in the mouth of the Milk River.

Parasitic leeches were noted on catfish, goldeye and suckers, but were not further identified. Oligocheata and Nematoda were frequently found in samples throughout the study area.

CONCLUSIONS

The apparent absence of any recent recruitment in the Missouri/Yellowstone river pallid sturgeon population during the course of this study continues to be mystifying as well as exasperating. There is presently no reasonable explanation, only conjecture, as to why no small or young pallid sturgeon have been captured. Suspicions of pesticide, heavy metal, and/or other contaminant interference with successful reproduction are in order but may not necessarily be the case. Young age classes of shovelnose sturgeon are common in both rivers. This species is also relatively long-lived as shown by Gardner and Stewart (1983), who aged 57 shovelnose sturgeon from seven to 33 years old. It would seem if the bio-accumulation of contaminants was interfering in pallid sturgeon reproduction, it would similarly affect shovelnose sturgeon.

Table 17. Aquatic invertebrates collected during 1994 and 1995 noted as present (P) by section in the Missouri and Yellowstone rivers.

NONINSECT INVERTEBRATES

	Missouri River					Yellowstone River	
	1	2	3	5	6	8	9
Hydroida							
Hydridae							
Hydra spp	P	P					
Amphipoda							
Talitridae							
Hyalella azteca	P	P	P				
Aceri [order]							
Thyasidae							
Thysus spp		P					
Hydracarinia							
Limnesia spp			P		P		
Cladocera [order]							
Daphnidae							
Daphnia pulex	P	P					
Daphnia dubia	P	P					
Leptodoridae							
Leptodora kindti	P	P	P	P			
Hirudinia [class]							
Rhynchobedellidae							
Glossiphoniidae							
Helobdella stagnalis	P						
Oligocheata [class]	P	P	P	P	P	P	P
Nematoda [class]	P	P	P	P	P	P	P

The high flows in the Yellowstone River during 1995 appeared to have been ideal for successful sturgeon reproduction. This was in fact somewhat corroborated by the capture of relatively high numbers of larval sturgeon below the confluence of the Yellowstone River, assuming larval drift of sturgeon from the Yellowstone River into the Missouri River. Samples sent to the Larval Fish Identification Laboratory for possible species identification have not been examined to date so it is not known if any potential pallid sturgeon larvae were collected.

The evident abundance of sicklefin chub and sturgeon chub, both species of concern, as well as *Hybognathus spp.* and flathead chub in the Yellowstone River, would seem to bode well for these species, at least for the present. Flathead chub also appear to have adapted quite well to the cooler, less turbid water of the Missouri River above the confluence considering the high numbers captured during 1994 in comparison to other species. Blue sucker, another species of concern, were generally sampled throughout the study area and included obvious different age classes. It is puzzling why only one YOY blue sucker was sampled during this study, since a wide variety of riverine habitats were sampled by seining and trawling. There is some speculation the Milk River may be the most important tributary of the Missouri River below Fort Peck Dam in Montana for blue sucker spawning.

RECOMMENDATIONS

1. The capture of ripe pallid sturgeon for hatchery spawning continues to be of utmost importance. It appears this will be the only method other than genetic analysis to determine key morphological differences to aid in the identification of larval pallid sturgeon and shovelnose sturgeon.

2. Continue sampling for pallid sturgeon in the lower Missouri and Yellowstone rivers to better assess population size and structure, collect blood and tissue samples for genetic analysis, and determine age and growth factors.

3. Continue sampling for larval sturgeon in both rivers for future species identification, either morphologically and/or genetically.

4. Capture one to three pallid sturgeon in the Fort Peck tailwaters or elsewhere in the Missouri River above the confluence for telemetry purposes.

5. Continue monitoring and tagging of shovelnose sturgeon in both rivers to assess population

structure and movements.

6. Continue monitoring species of special concern, particularly sicklefin chub, sturgeon chub, and blue sucker in both rivers.

7. Investigate factors which may be limiting the successful spawning and/or recruitment of pallid sturgeon, i.e. lack of natural hydrograph in the Missouri River, pesticide and/or other contaminant accumulation.

8. Monitor usage of lower 15 miles of Milk River by various fish species and investigate reproductive use by larval sampling and seining for YOY fishes.

9. Continue working with other agencies involved in the pallid sturgeon recovery program to exchange ideas and information and coordinate research efforts relative to the recovery of this species.

10. A long term funding commitment is needed for this project in order to provide financial stability and allow for future planning efforts.

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APPENDIX

Appendix 1. Statistics of pallid sturgeon captured in 1994 and 1995.

Date	River mile	Nettype	Total length cm	Fork length cm	Stand. length cm	Head length cm	Mouth width cm	outer Barbel cm	Snout to inner barbel cm	Mouth to outer barbel cm	inner barbel cm	weight kg	Pit tag 1	Pit tag 2	Recap	CI[1]
09/07/94	1575	TM 1[2]	144.2	135.8	127.5	42.9	12.5	19.0	6.3	12.5	3.8	12.5	7F7B082C14		N	458
09/07/94	1579	TM 1	171.3	161.3	151.0	49.0	13.7	22.5	5.7	14.7	5.0	32.0	7F7B082C10		N	458
09/22/94	1576	TM 2[3]	162.0	148.9	141.5	48.4	12.5	22.3	5.3	13.0	4.5	22.7	7F7B016070		N	473
09/22/94	1577	TM 2	153.0	140.9	132.1	0.0	0.0	0.0	0.0	0.0	0.0	16.8	7F7F066A40		Y	
09/23/94	2	TM 2	132.4	122.2	116.3	38.3	10.0	17.9	5.3	9.5	2.8	8.8	7F7D7C2447		N	437
10/05/94	1578	TM 2	160.8	149.5	143.1	47.7	13.8	21.3	6.0	14.0	4.0	23.1	7F7F054773		Y	471
10/05/94	1575	TM 2	164.5	152.4	144.7	43.4	13.2	19.8	6.0	19.8	5.0	24.9	7F7B025D51		N	466
10/05/94	1575	TM 1	142.0	131.2	124.6	42.9	12.1	20.0	5.5	10.7	4.4	11.3	7F7F066471		Y	465
10/06/94	1574	TM 1	142.2	131.9	125.5	42.5	11.6	19.0	5.2	11.0	3.2	13.2	7F7D7B1607		Y	466
10/06/94	1575	TM 2	140.0	131.5	126.4	40.6	12.7	17.9	5.9	8.8	4.2	14.1	7F7D4A7758		Y	439
04/24/95	3	MONO2[4]	152.0	143.0	135.0	45.2	13.5	22.4	6.2	12.2	3.8	18.1	7F7D437250	7F7D3C555D	N	496
04/24/95	1579	MONO2	156.4	147.5	139.0	47.2	12.9	20.8	5.9	10.8	4.1	21.8	7F7D441774	7F7D400B19	N	494
08/24/94	1579	TM 1	140.8	130.6	123.3	42.0	12.2	19.4	5.6	11.7	3.7	14.5	1F5330401E	1F521F363A	N	490
08/24/95	1579	TM 1	145.0	134.6	126.4	42.8	12.2	19.1	6.0	13.8	5.6	17.0	1F55776D28	1F520F7C04	N	482
08/24/95	1579	TM 2	156.4	147.7	136.5	47.5	13.9	22.0	6.3	14.0	3.9	20.0	7F7B020D71	1F541B4A25	Y	519
09/29/95	1579	MONO1[5]	151.9	138.4	132.5	44.1	13.0	20.5	5.5	12.7	4.9	14.7	7F7B08162E	1F54715E3E	Y	485
09/29/95	1579	TM 2	151.0	141.2	133.5	42.0	13.0	19.5	5.9	13.5	4.6	15.4	1F52167900	1F53312736	N	465
09/29/95	1578	MONO2	147.4	136.5	127.7	42.6	12.2	20.0	5.2	11.8	5.7	15.6	1F521B1B56	1F54696C38	N	484
10/10/95	1579	TM 2	141.0	133.0	125.5	42.5	12.0	19.5	5.5	13.0	4.5	13.6	7F7D376F73	1F54714656	Y	494
10/10/95	1579	TM 2	141.0	134.0	127.0	42.0	12.0	17.5	5.6	11.5	4.0	15.9	1F5569653E	1F557B761B	N	453
10/11/95	1577	MONO2		139.9		42.0	5.6	13.2	4.2	18.1			7F7E55466D	1F557B2071	Y	
10/12/95	1579	TM 2	160.0	150.7	144.4	46.0	6.2	13.5	6.2	27.2			7F7B427F69	1F555C367A	Y	
10/12/95	1579	MONO2	166.7	155.0	149.0	50.7	6.2	12.5	5.1	29.0			1F54756038	1F5420727B	N	

1. CI-Character index value.
2. 23-meter trammel net, 3-cm inner mesh and 15-cm outer mesh.
3. 23-and 46-meter trammel nets, 5-cm inner mesh and 25-cm outer mesh.
4. 37-meter monofilament gill net with 5-, 8-, 10-, 13-cm mesh panels.
5. 31-meter monofilament gill net with 2-, 3-, 4-, 5-, 8-cm mesh panels.

Appendix 2. Habitat measurements of pallid sturgeon capture sites for 1994 and 1995.

Date	Sec.	Depth Min m	Depth Max m	Temp °C	Turbidity NTU	Secchi cm	Conductivity umhos	Velocity m/s
9/07/94	6	2.4	4.0	16.0		34.0	620	0.70
9/07/94	6	1.2	3.3	17.0		26.0	560	0.65
9/22/94	6	1.8	6.7	14.0		16.0	590	0.67
9/22/94	6	2.4	3.0	13.0		10.0	590	0.66
9/23/94	9	1.5	3.3	16.0		11.0	660	0.90
10/05/94	6	1.8	5.2	11.0		39.0	505	0.78
10/05/94	6	0.9	3.7	11.0		39.0	505	0.78
10/05/94	6	1.5	3.7	11.0		23.0	505	0.75
10/06/94	6	2.4	4.6	11.0		23.0	505	0.75
10/06/94	6	1.5	3.7	11.0		23.0	505	0.75
Average		1.7	4.1	13.1		24.4	555	0.74
4/24/95	9	1.5	4.0	10.0		20.0	650	0.68
4/25/95	6	2.1	4.0	11.0		16.0		
8/24/95	6	2.4	4.6	20.0	144.0	16.0	554	0.75
8/24/95	6	2.7	6.1	20.0	144.0	16.0	554	0.75
8/25/95	6	2.1	6.1	20.0	144.0	16.0	554	0.75
9/29/95	6	1.5	3.7	13.3	56.5	33.0	480	0.90
9/29/95	6	2.4	4.3	13.3	56.5	33.0	480	0.90
9/29/95	6	2.4	5.5	13.3	29.7	39.0	489	0.94
10/10/95	6	2.4	4.9	11.5	78.3	27.0	490	0.57
10/10/95	6	3.3	6.1	11.5	78.3	27.0	490	0.57
10/11/95	6	2.1	7.6	11.5	78.3	27.0	490	0.57
10/12/95	6	3.3	6.7	11.5	78.3	27.0	490	0.57
10/12/95	6	3.3	6.7	11.5	78.3	27.0	490	0.57
Average		2.4	5.4	13.7	87.8	24.9	517	0.66

Appendix 3. Average length weight and ranges of fish, excluding sturgeon species, captured in the Missouri River during 1994 and 1995.

1994		Average	Range		Average	Range	
Species	N	Length	Low	High	Weight	Low	High
		cm	cm	cm	gms	gms	gms
Goldeye	56	30.1	21.6	34.8	263.1	90.7	535.3
Carp	8	43.7	38.4	50.0	1034.2	771.1	1587.6
Flathead chub	11	24.5	23.1	27.2	136.1	90.7	181.4
River carpsucker	18	47.0	35.8	58.4	1528.6	657.7	2721.6
Blue sucker	14	65.8	41.4	81.3	2590.1	453.6	5443.2
Smallmouth buffalo	17	61.5	50.3	76.2	3406.5	2177.3	4354.6
Bigmouth buffalo	20	66.9	59.4	77.7	5270.8	3764.9	9534.7
Shorthead redhorse	9	33.1	22.4	41.9	530.7	136.1	680.4
Longnose sucker	18	43.1	25.4	49.0	934.4	226.8	1315.4
White sucker	1	25.1	0.0	0.0	158.8	0.0	0.0
Channel catfish	43	28.6	19.1	51.6	213.2	45.4	1270.1
Sauger	11	37.9	28.4	46.0	489.9	136.1	816.5
Walleye	3	44.9	37.3	53.3	943.5	444.5	1519.6
Freshwater drum	1	30.2	0.0	0.0	372.0	0.0	0.0

1995		Average	Range		Average	Range	
Species	N	Length	Low	High	Weight	Low	High
		cm	cm	cm	gms	gms	gms
Goldeye	52	31.0	21.3	35.1	258.6	45.4	453.6
Lake whitefish	1	43.7	0.0	0.0	771.1	0.0	0.0
Rainbow trout	2	47.9	45.7	50.0	1020.6	907.2	1134.0
Brown trout	1	24.6	0.0	0.0	99.8	0.0	0.0
Carp	4	49.4	15.7	59.9	1995.8	45.4	1814.4
Flathead chub	20	23.8	17.3	29.0	122.5	45.4	204.1
River carpsucker	25	47.4	32.3	58.7	1551.3	544.3	3265.9
Blue sucker	30	65.2	40.1	75.7	2304.1	453.6	4127.8
Smallmouth buffalo	10	60.1	50.5	79.5	3279.5	1714.6	6531.8
Bigmouth buffalo	9	67.4	59.4	74.9	5552.1	3764.9	8142.1
Shorthead redhorse	9	29.4	22.1	37.8	290.3	136.1	544.3
White sucker	6	30.0	25.1	36.3	331.1	181.4	544.3
Longnose sucker	6	32.9	26.7	39.9	376.5	181.4	725.8
Channel catfish	79	29.8	21.6	40.1	217.7	68.0	499.0
Burbot	1	70.6	0.0	0.0	2041.2	0.0	0.0
Sauger	39	35.7	20.8	56.4	399.2	68.0	1633.0
Walleye	4	46.4	21.1	59.7	1297.3	68.0	2358.7

Appendix 4. Average length, weight and ranges of fish, excluding sturgeon species, captured in the Yellowstone River during 1994 and 1995.

1994 Species	N	Average Length cm	Range Low cm	Range High cm	Average Weight gms	Range Low gms	Range High gms
Goldeye	22	30.9	22.4	34.8	285.8	90.7	453.6
Carp	5	42.6	35.3	46.5	997.9	544.3	1270.1
River carpsucker	62	48.2	29.7	58.2	1601.2	362.9	2744.3
Blue sucker	7	62.7	37.3	77.0	2118.3	340.2	3311.3
Smallmouth buffalo	12	49.0	40.9	58.9	1850.7	975.2	3084.5
Bigmouth buffalo	10	64.4	55.6	70.4	4667.5	3220.6	6123.6
Longnose sucker	1	28.7	0.0	0.0	181.4	0.0	0.0
Channel catfish	28	26.4	20.3	34.5	163.3	90.7	362.9
Sauger	11	35.4	25.9	43.7	390.1	113.4	839.3
Freshwater drum	2	29.5	27.4	31.5	322.1	272.2	362.9

1995 Species	N	Average Length cm	Range Low cm	Range High cm	Average Weight gms	Range Low gms	Range High gms
Goldeye	47	28.4	18.3	36.1	204.1	45.4	453.6
Carp	2	50.4	70.1	56.1	1542.2	1088.6	1995.8
Flathead chub	3	24.6	23.1	26.2	113.4	90.7	136.1
River carpsucker	10	49.5	43.9	561.8	1646.6	1224.7	2449.4
Blue sucker	9	64.6	43.2	77.4	2385.9	535.3	3628.8
Smallmouth buffalo	4	55.6	46.0	71.9	2798.7	1270.1	6441.1
Bigmouth buffalo	4	63.9	62.2	65.5	4626.7	4082.4	4989.6
Channel catfish	159	27.7	21.6	41.1	172.4	68.0	544.3
Sauger	14	38.2	28.7	48.8	462.7	172.4	952.6
Freshwater drum	4	27.3	16.5	42.7	322.1	45.4	816.5

Appendix 5. Catch rates by month and section for species caught in the Missouri and Yellowstone rivers by drift netting during 1994 (CPUE fish/hour).

				Species																	
				Pallid sturgeon		Shovelnose sturgeon		Paddlefish		Goldeye		Carp		Flathead chub		River carpsucker		Blue sucker	
Month	Sect.	Hrs.	Dfts.	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#
April	2	0.3	5			39.0	13											3.0	1
All		0.3	5			39.0	13											3.0	1
June	2	1.4	10			2.9	4												
	5	0.6	4			1.8	1			14.5	8	5.5	3	1.8	1				
	6	0.7	4			12.0	8			12.0	8	3.0	2						
	9	0.5	4			15.0	8			15.0	8	1.9	1					1.9	1
All		3.2	22			6.7	21			7.6	24	1.9	6	0.3	1			0.3	1
July	2	0.6	5			42.7	26												
	3	1.0	8			4.9	5												
	5	0.7	4			1.5	1			4.5	3								
	6	0.8	5			8.4	7			2.4	2					1.2	1		
	8	1.4	10			14.4	20											0.7	1
	9	0.6	4			13.2	8									3.3	2		
All		5.1	36			13.2	67			1.0	5					0.6	3	0.2	1
August	1	0.6	5																
	2	1.2	11			14.2	17			0.8	1								
	3	0.7	4			4.5	3			3.0	2					1.5	1		
	5	0.8	5			19.2	16			1.2	1					1.2	1		
	6	4.0	26			12.2	49			0.5	2			0.5	2	1.0	4	0.5	2
	9	1.3	8			22.5	30	0.8	3	1.5	2	0.8	1			3.0	4	1.5	2
All		8.6	59			13.3	115	0.3	3	0.9	8	0.1	1	0.2	2	1.2	10	0.5	4
Sept.	2	0.7	4			30.0	20												
	3	1.3	8			6.8	9			1.5	2			0.8	1			0.8	1
	5	1.3	8			8.7	11	0.8	1	4.7	6	2.4	3						
	6	3.5	24	1.1	4	12.1	43	0.3	1	1.7	6					0.6	2	0.6	2
	9	1.0	6	1.0	1	33.0	33			2.0	2					18.0	18	3.0	3
All		7.8	50	0.6	5	14.9	116	0.3	2	2.0	16	0.4	3	0.1	1	2.6	20	0.8	6
October	3	1.2	7			14.8	17			0.9	1			2.6	3				
	5	0.5	3			2.0	1			8.0	4					2.0	1	6.0	3
	6	7.5	47	0.7	5	9.6	72	0.1	1	1.3	10					1.2	9	0.7	5
	9	1.3	9			16.9	22			7.7	10	0.8	1			30.0	39		
All		10.5	66	0.5	5	10.6	112	0.1	1	2.4	25	0.1	1	0.3	3	4.7	49	0.8	8
Total		35.5	238	0.3	10	12.5	444	0.2	6	2.2	78	0.3	11	0.2	7	2.3	82	0.6	21

Appendix 5. Continued. Catch rates by month and section for species caught during drift netting effort 1994 (CPUE fish/hour).

				Species											
				Smallmouth Buffalo		Bigmouth Buffalo		Shorthead redhorse		Longnose sucker		White sucker		Channel catfish	
Month	Sect.	Hrs.	Dfts.	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#
April	2	0.3	5							48.0	16				
All		**0.3**	**5**							**48.0**	**16**				
June	2	1.4	10												
	5	0.6	4												
	6	0.7	4											7.5	5
	9	0.5	4	1.9	1									13.1	7
All		**3.2**	**22**	**0.3**	**1**									**3.8**	**12**
July	2	0.6	5					3.3	2						
	3	1.0	8												
	5	0.7	4												
	6	0.8	5	1.2	1										
	8	1.4	10											0.7	1
	9	0.6	4	8.2	5									6.6	4
All		**5.1**	**36**	**1.2**	**6**			**0.4**	**2**					**1.0**	**5**
August	1	0.6	5												
	2	1.2	11	0.8	1			0.8	1	1.7	2				
	3	0.7	4									1.5	1		
	5	0.8	5			1.2	1	4.8	4					2.4	2
	6	4.0	26											0.8	3
	9	1.3	8	0.8	1					0.8	1			3.0	4
All		**8.6**	**59**	**0.2**	**2**	**0.1**	**1**	**0.6**	**5**	**0.3**	**3**	**0.1**	**1**	**1.0**	**9**
Sept.	2	0.7	4												
	3	1.3	8											0.8	1
	5	1.3	8	0.8	1	1.6	2							3.2	4
	6	3.5	24	1.1	4	1.4	5							0.6	2
	9	1.0	6	2.0	2	6.0	6							4.0	4
All		**7.8**	**50**	**0.9**	**7**	**1.7**	**13**							**1.4**	**11**
October	3	1.2	7												
	5	0.5	3											4.0	2
	6	7.5	47	1.3	10	1.6	12							3.3	25
	9	1.3	9	3.8	5	3.1	4							6.2	8
All		**10.5**	**66**	**1.4**	**15**	**1.5**	**16**							**3.0**	**35**
Total		**35.5**	**238**	**0.9**	**31**	**0.9**	**30**	**0.2**	**7**	**0.5**	**19**	**0.03**	**1**	**2.0**	**72**

Appendix 5. Continued. Catch rates by month and section for species caught during drift netting effort 1994 (CPUE fish/hour).

				Species					
				Sauger		Walleye		Freshwater drum	
Month	Sect.	Hrs.	Dfts.	CPUE	#	CPUE	#	CPUE	#
April	2	0.3	5						
All		0.3	5						
June	2	1.4	10						
	5	0.6	4						
	6	0.7	4						
	9	0.5	4	1.9	1				
All		3.2	22	0.3	1				
July	2	0.6	5						
	3	1.0	8						
	5	0.7	4						
	6	0.8	5						
	8	1.4	10	0.7	1				
	9	0.6	4	3.3	2				
All		5.1	36	0.6	3				
August	1	0.6	5						
	2	1.2	11						
	3	0.7	4						
	5	0.8	5						
	6	4.0	26	0.8	3				
	9	1.3	8	0.8	1				
All		8.6	59	0.5	4				
Sept.	2	0.7	4						
	3	1.3	8						
	5	1.3	8	2.4	3	1.6	2	0.8	1
	6	3.5	24						
	9	1.0	6	3.0	3			2.0	2
All		7.8	50	0.8	6	0.3	2	0.4	3
October	3	1.2	7	0.9	1				
	5	0.5	3	2.0	1				
	6	7.5	47	0.7	5	0.1	1		
	9	1.3	9	2.3	3				
All		10.5	66	1.0	10	0.1	1		
Total		35.5	238	0.7	24	0.1	3	0.1	3

Grand Total 849 fish with a CPUE of 23.9.

Appendix 6. Catch rates by month and section for species caught in the Missouri and Yellowstone rivers by drift netting during 1995 (CPUE fish/hour).

				Species																	
				Pallid sturgeon		Shovelnose sturgeon		Paddlefish		Goldeye		Mountain whitefish		Rainbow trout		Brown trout		Carp	
Month	Sect.	Hrs.	Dfts.	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#
April	6	1.2	8	0.8	1	1.7	2			0.8	1							0.8	1
	9	2.3	17	0.4	1	24.8	57	0.4	1	0.9	2								
All		3.5	25	0.6	2	16.9	59	0.3	1	0.9	3							0.8	1
May	2	0.8	4			12.5	10												
	3	1.3	8			3.8	5			1.5	2								
	5	1.2	7			0.8	1			16.7	20								
	6	0.2	2																
	9	0.6	4			3.3	2	1.7	1	1.7	1								
All		4.1	25			4.4	18	0.2	1	5.6	23								
June	5	1.0	7							5.0	5							2.0	2
All		1.0	7							5.0	5							2.0	2
July	2	0.7	5			5.7	4			25.7	18			2.9	2				
	3	0.6	4			1.7	1					1.7	1						
	5	1.3	9			6.2	8												
	6	0.7	4			22.9	16											1.4	1
	8	0.5	4			6.0	3												
	9	0.7	5			5.7	4												
All		4.5	31			8.0	36			4.0	18	0.2	1	0.4	2			0.2	1
August	2	1.1	7			30.0	33												
	3	0.8	5			7.5	6									1.3	1		
	5	0.3	2			16.7	5												
	6	2.7	16	1.1	3	6.7	18			0.4	1								
	8	1.0	8			14.0	14	0.4	1										
	9	3.8	12			9.2	35			7.4	28							0.5	2
All		9.7	50	0.3	3	11.4	111	0.1	1	3.0	29					0.1	1	0.2	2
Sept.	2	0.9	6			4.4	4												
	4	2.7	21			3.3	9			0.4	1								
	5	1.8	12			6.1	11												
	6	10.1	66	0.3	3	10.3	104			0.4	4							0.1	1
	9	2.7	17			12.6	34			4.8	13								
All		18.2	122	0.2	3	8.9	162			1.0	18							0.1	1
October	6	4.8	29	1.1	5	11.6	55												
	9	0.7	4			15.7	11												
All		5.5	33	0.9	5	12.0	66												
Total		46.5	293	0.3	13	9.7	452	0.1	3	2.1	96	0.02	1	0.04	2	0.02	1	0.2	7

Appendix 6. Continued. Catch rates by month and section for species cuaght during drift netting 1995 (CPUE fish/hour).

				Species																	
				Flathead chub		River carpsucker		Blue sucker		Smallmouth buffalo		Bigmouth buffalo		Shorthead redhorse		Longnose sucker		White sucker	
Month	Sect.	Hrs.	Dfts.	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#
April	6	1.2	8			5.0	6	0.8	1	0.8	1								
	9	2.3	17			3.9	9	0.9	2	0.4	1	1.7	4						
All		3.5	25			4.3	15	0.9	3	0.6	2	1.1	4						
May	2	0.8	4					15.0	12	1.3	1								
	3	1.3	8	4.6	6	0.8	1							0.8	1			0.8	1
	5	1.2	7					0.8	1										
	6	0.2	2																
	9	0.6	4																
All		4.1	25	1.5	6	0.2	1	3.2	13	0.2	1			0.2	1			0.2	1
June	5	1.0	7																
All		1.0	7																
July	2	0.7	5					1.4	1	1.4	1							7.1	5
	3	0.6	4	6.7	4	1.7	1												
	5	1.3	9	0.8	1			0.8	1	2.3	3			3.8	5	2.3	3		
	6	0.7	4																
	8	0.5	4	1.0	1			2.0	2										
	9	0.7	5									1.4	1						
All		4.5	31	1.3	6	0.2	1	0.9	4	0.9	4	0.2	1	1.1	5	0.7	3	1.1	5
August	2	1.1	7											2.7	3	1.8	2		
	3	0.8	5	7.5	6	1.3	1									1.3	1		
	5	0.3	2																
	6	2.7	16	0.7	2	0.7	2			0.4	1								
	8	1.0	8	1.0	1			2.0	2										
	9	3.8	12	0.3	1			0.5	2	0.5	2								
All		9.7	50	1.0	10	0.3	3	0.4	4	0.3	3			0.3	3	0.3	3		
Sept.	2	0.9	6																
	4	2.7	21	0.4	1			1.5	4	0.4	1								
	5	1.8	12					0.6	1			2.8	5						
	6	10.1	66			1.0	10	0.8	4	0.2	1	0.8	4						
	9	2.7	17			2.2	6	1.4	1										
All		18.2	122	0.1	1	0.9	16	0.5	10	0.1	2	0.5	9						
October	6	4.8	29			0.8	4	0.8	4	0.2	1	0.8	4						
	9	0.7	4			1.4	1	1.4	1										
All		5.5	33			0.9	5	0.9	5	0.2	1	0.7	4						
Total		46.5	293	0.5	23	0.9	41	0.8	39	0.3	13	0.4	18	0.2	9	0.1	6	0.1	6

Appendix 6. Continued. Catch rates by month and section for species cuaght during drift netting 1995 (CPUE fish/hour).

				Species									
				Channel catfish		Burbot		Sauger		Walleye		Freshwater drum	
Month	Sect.	Hrs.	Dfts.	CPUE	#	CPUE	#	CPUE	#	CPUE	#	CPUE	#
April	6	1.2	8	51.0	61			1.7	2	0.8	1		
	9	2.3	17	4.3	10			3.0	7	0.4	1		
All		**3.5**	**25**	**20.3**	**71**			**2.6**	**9**	**0.6**	**2**		
May	2	0.8	4										
	3	1.3	8	0.8	1			7.7	10				
	5	1.2	7	1.7	2			8.3	10				
	6	0.2	2										
	9	0.6	4	10.0	6								
All		**4.1**	**25**	**2.2**	**9**			**4.9**	**20**				
June	5	1.0	7	1.7	2			6.0	6				
All		**1.0**	**7**	**1.7**	**2**			**6.0**	**6**				
July	2	0.7	5					2.9	2				
	3	0.6	4										
	5	1.3	9	3.1	4			0.8	1				
	6	0.7	4										
	8	0.5	4	2.0	1								
	9	0.7	5									1.4	1
All		**4.5**	**31**	**1.1**	**5**			**0.7**	**3**			**0.2**	**1**
August	2	1.1	7										
	3	0.8	5	1.3	1					1.3	1		
	5	0.3	2										
	6	2.7	16	0.4	1			0.4	1				
	8	1.0	8	7.0	7			1.0	1				
	9	3.8	12	23.2	88			0.8	3			0.3	1
All		**9.7**	**50**	**10.0**	**97**			**0.5**	**5**	**0.1**	**1**	**0.1**	**1**
Sept.	2	0.9	6										
	4	2.7	21										
	5	1.8	12										
	6	10.1	66	0.8	8	0.1	1	0.7	7	0.1	1		
	9	2.7	17	18.5	50			2.2	6			0.7	2
All		**18.2**	**122**	**3.2**	**58**	**0.1**	**1**	**0.7**	**13**	**0.1**	**1**	**0.1**	**2**
October	6	4.8	29	0.2	1			0.4	2	0.2	1		
	9	0.7	4										
All		**5.5**	**33**	**0.2**	**1**			**0.4**	**2**	**0.2**	**1**		
Total		46.5	293	5.2	243	0.02	1	1.2	58	0.1	5	0.1	4

Grand total of 1041 fish with a CPUE of 22.4