LOWER MISSOURI AND YELLOWSTONE RIVERS

PALLID STURGEON STUDY

2001 ANNUAL REPORT

by

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ABSTRACT

A total of 17 adult pallid sturgeons were captured in drifted trammel nets in the lower Missouri and Yellowstone rivers during 2001. Eight of the adults were "new" untagged fish. Four adult pallids were transported to the Miles City State Fish Hatchery, Miles City, MT, for gonadal examination and potential use for hatchery propagation efforts. The adult pallids ranged from 1,092- to 1,615 mm fork length (FL) and 5- to 30 kg in weight. The smallest individual sampled was likely a pallid x shovelnose hybrid as indicated by its character index value of 343.7. Intensive sampling efforts aimed at recapturing hatchery-reared juvenile (HRJ) pallid sturgeons were mostly unsuccessful. A single HRJ pallid was captured in 241 trammel net drifts. Four other HRJ pallids were sampled incidentally in other sampling efforts with drifted trammel nets. All HRJ sampled were stocked in 2000 and average 420-mm FL at time of capture. Catch-per-unit-effort (CPUE) rate for HRJ pallids was one individual per 103 net drifts. Shovelnose sturgeons were commonly sampled in all river sections. A total of 1,122 were sampled in various gears; measurement data were collected from 1,080. Size distributions of shovelnose sturgeons sampled in drifted trammel nets were similar throughout the study area. However, juvenile shovelnose were most abundant at the confluence area. CPUE rates for shovelnose sturgeon captured in drifted trammel nets ranged from 5.2 to 53.5 shovelnose per hour drift time at Culbertson and the confluence area, respectively. Recapture rate of tagged shovelnose sturgeon was 2.7% of the total sampled. Most tagged individuals demonstrated little movement from where originally tagged. Catch rates of most species varied by individual gear types and temporally in standardized sampling. A total of 28 species were sampled. Goldeye was the most common specie, representing 38% of the 2,632 fish handled. Juvenile fishes were not commonly sampled at any sites. Densities of larval fishes at standardized sites were low, but diversity increased at sites below the mouth of the Milk River. Catastomid was the most common larvae sampled. A single sturgeon larva was captured at each Wolf Point and Poplar on 11 July and 25 June, respectively. Water temperatures measured in the Missouri River above Fort Peck Reservoir were consistently warmer than all sites in our study area.

INTRODUCTION

Pallid sturgeon *Scaphirhynchus albus* are a federally protected endangered species native to the Missouri and Yellowstone rivers in Montana. This report summarizes the first year of a five-year study investigating pallid sturgeon recovery efforts in the lower Missouri and Yellowstone rivers. Funding was provided by Western Area Power Administration (WAPA).

Research efforts were directed at evaluating ongoing short and long-term recovery efforts aimed at restoring pallid sturgeon in their historic range. Short-term recovery efforts are directed at maintaining the genetic viability of pallids by augmenting the current population with progeny produced from wild brood fish. Hatchery-reared juvenile (HRJ) pallid sturgeons were released into the lower Missouri and Yellowstone rivers in 1998 and 2000. To date, little effort has been directed at evaluating the success of these augmentation efforts. The persistence of this species in Recovery Priority Management Area (RPMA) #2 is dependent upon the survival of these introduced juvenile pallids and their subsequent recruitment into the adult population. This is becoming more evident as the adult pallid population senesces and the number of adults in RPMA #2 declines. Thus, determining the survival of these stocked juveniles should be a critical component of recovery efforts. Long-term recovery actions are aimed at restoring critical habitat components of the Missouri River altered by the closure of Fort Peck Dam in 1937. These actions, as outlined in the Missouri River Biological Opinion (U. S. Fish and Wildlife Service 2000), propose to modify Fort Peck Dam operations to increase discharge and enhance water temperatures during May and June. It is hypothesized that enhanced flows and water temperature may provide a spawning cue for pallid sturgeon. Other native species will likely benefit from these flow modifications as well.

Our 2001 field research focused on evaluating both short and long-term pallid sturgeon recovery efforts. Specific project objectives were: 1) Capture adult pallid sturgeon for spawning and hatchery propagation efforts; 2) Evaluate stocking success of HRJ pallid sturgeon released in 1998 and 2000; 3) Monitor relative abundances and population characteristics of other native fish species in the study area; and 4) Implement a comprehensive monitoring plan for the Missouri River below Fort Peck Dam to evaluate responses of native fishes to proposed Fort Peck Dam flow modifications. All objectives were successfully met.

STUDY AREA

The study area was comprised of the Missouri River from Fort Peck Dam (RM 1,770) to the headwaters of Lake Sakakawea (RM 1,538), the Yellowstone River from Intake Diversion Dam (RM 71) to its confluence with the Missouri River (RM 0), and the mouth of the Milk River (RM 1,761; Figure 1). The Missouri River was divided into seven study sections, the Yellowstone into two, and the Milk River into one section (Table 1). These study sections were previously

described by Gardner and Stewart (1987), Tews (1994), Liebelt (1996), and Bramblett and White (2001).

Table 1. Section number, physical location, and location by river mile (RM) of individual river sections on the Milk, Missouri, and Yellowstone rivers.

Section	Location
0	Lower 15 miles of Milk River
1	Fort Peck Dam to the mouth of Milk River (RM 1,770 to 1,761)
2	Mouth of Milk River to Wolf Point (RM 1,761 to 1,708)
3	Wolf Point to mouth of Redwater River (RM 1,708 to 1,683)
4	Mouth of Redwater River to mouth of Big Muddy Creek (RM 1,683 to 1,630)
5	Mouth of Big Muddy Creek to mouth of Yellowstone River (RM 1,630 to 1,582)
6	Mouth of Yellowstone River to Highway 85 bridge (RM 1,582 to 1,553)
7	Highway 85 bridge to Lake Sakakawea (RM 1,553 to 1,530)
8	Yellowstone River from Intake to Highway 23 bridge (RM 71 to 30)
9	Highway 23 bridge to mouth of Yellowstone River (RM 30 to 0)

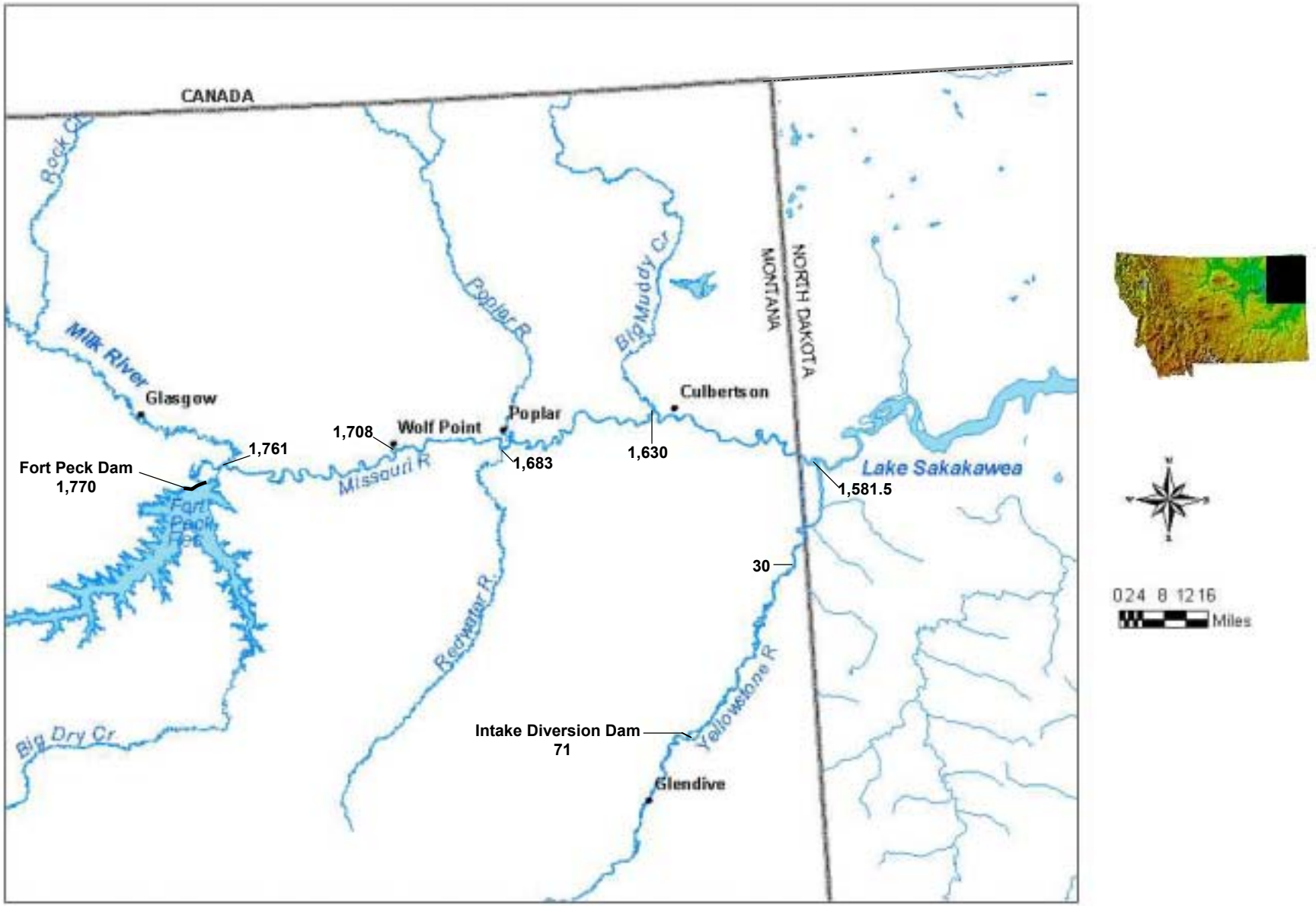

Figure 1. Map of lower Missouri and Yellowstone rivers pallid sturgeon study area and associated river miles.

Mean monthly discharge of the Missouri River below Fort Peck Dam during 2001 ranged from 3,858 cubic feet per second (cfs) during October to 11,3000 cfs in January (Appendix 1). The highest mean daily discharge was 11,800 cfs and occurred on three different occasions in January. The lowest mean daily discharge observed in the Missouri River below Fort Peck Dam was 3,000 cfs and occurred on 22 September. River flows in the Yellowstone River at Sidney were much more variable, but greatly reduced relative to historic levels due to continuing drought in the basin (Figure 2). Mean monthly discharges ranged from a minimum of 2,215 cfs in August to a maximum of 15,010 cfs during June. The mean daily discharge of the Yellowstone River at Sidney peaked at 23,900 cfs on 17 June; 1,010 cfs was the minimum mean daily discharge recorded on 26 and 27 August. Milk River flows were minimal relative to those observed in Missouri and Yellowstone rivers. The Milk River hydrograph peaked during June (inserted graph in Figure 2). Mean monthly discharges for the Milk River at Nashua ranged from 12 cfs in May to 700 cfs in June. Mean daily flow in the Milk River peaked at 3,160 cfs on 16 June. This flow pulse was evident a day later in the Missouri River at Wolf Point when flows peaked at 10,200 cfs. No flow was measured in the Milk River on several occasions during late May and early June.

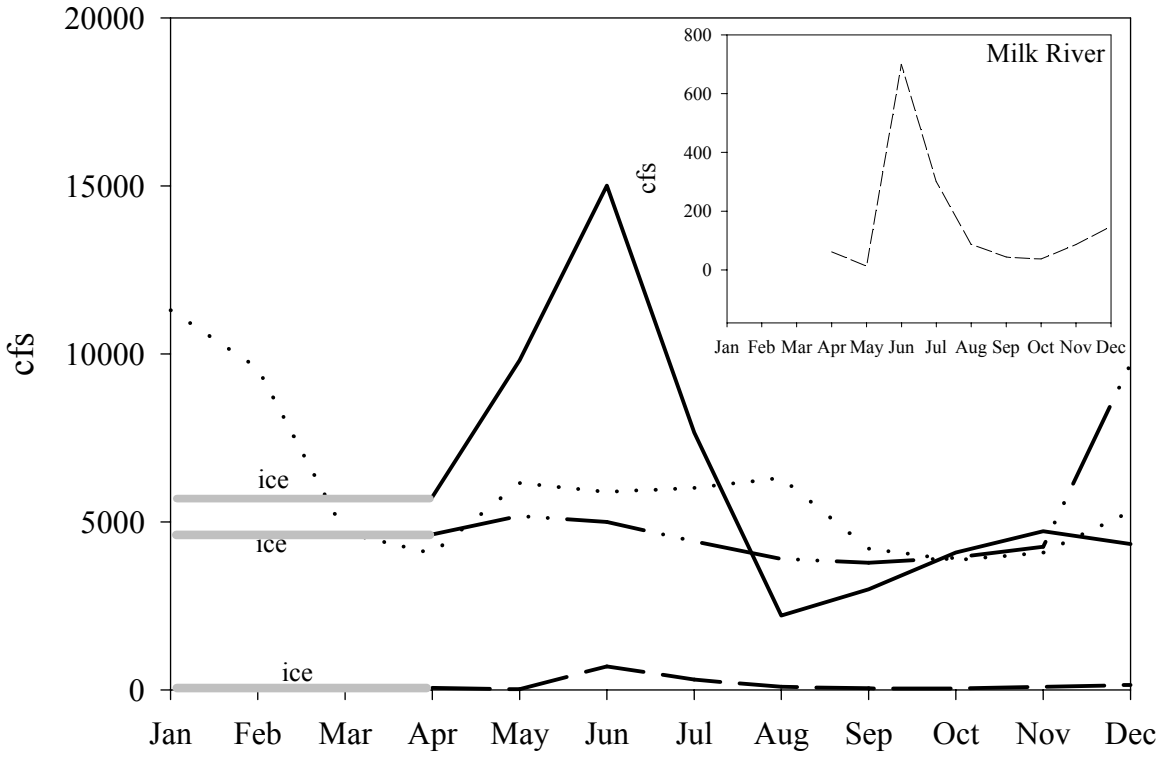

Figure 2. Mean monthly discharges during 2001 for the Yellowstone River at Sidney (solid line), Missouri River below Fort Peck Dam (dotted line), Missouri River above Fort Peck Reservoir at Landusky (dashed dot-dot line), and the Milk River at Nashua (dashed line). Inserted graph shows the Milk River data at a smaller scale. Provisional data provided by USGS, Fort Peck Field Office, Fort Peck, MT.

METHODS

Adult Pallid Sturgeon Sampling

Multi-filament trammel nets (1.8- by 30.5- or 45.7-m with a 22.7-kg lead core bottom line, 15.2-cm inner mesh and 25.4-cm outer mesh) were used to sample adult pallid sturgeon at the confluence of the Missouri and Yellowstone rivers, North Dakota, during late April. Nets were drifted with the aid of a boat for up to 10 minutes, depending on current velocities and snags encountered. Net drifts were timed using a stopwatch. All other species captured were enumerated. Catch-per-unit-effort (CPUE) rates were determined for individual species by calculating the mean number sampled per individual net drift and net drift time (hours).

Juvenile Pallid Sturgeon Sampling

Sampling for HRJ pallid sturgeon was completed with multi-filament trammel nets (1.8- by 45.7-m with a 13.6-kg lead core bottom line, 2.5-cm inner mesh and 15.2-cm outer mesh) during early May and August. Locations sampled in the Missouri River included above and below its confluence with the Yellowstone River, Nohly, Culbertson, Poplar, and Wolf Point. Sampling was completed in the Yellowstone River from Fairview to the confluence area during May, but low flows prevented river access during August. Nets were drifted with the aid of a boat. Duration of net drift was timed using a stopwatch. All fish captured were identified, weighed, and measured for total length (TL) or fork length (FL). Shovelnose sturgeon greater than 425-mm FL were tagged with individually numbered Floy cinch tags. CPUE rates were determined for individual species by calculating the mean number sampled per individual net drift and net drift time (hours).

Measurement and Tagging of Pallid Sturgeon

All pallid sturgeons captured were handled following established protocol. Six standard morphological measurements were taken on all adult pallid sturgeon to determine a character index (CI) value for detection of possible pallid-shovelnose sturgeon hybrids. Morphometric measurements used for the CI included fork length (FL), head length, mouth to inner barbel, interrostral (tip of snout to front edge of outer barbel) distance, and outer and inner barbel lengths. Measurements were converted to percent of FL so differences in size of individual fish were standardized (Krentz 1996). Measurements were also taken on recaptured pallid sturgeon to compare growth characteristics. ‘New’ pallid sturgeon were implanted with a Biosonic 125 kHz passive integrated transponder (PIT) tag in the left side of the base of the dorsal fin.

Standardized Sampling to Evaluate Warm Water Releases

Methods for completing standardized sampling in the Missouri River to evaluate responses of native and introduced fishes to proposed surface water releases from Fort Peck Reservoir were described previously (Yerk and Baxter 2001). Sampling was completed at established sites including Anderson Island (RM 1,765.8), Spillway (RM 1,762.8), Milk River confluence (RM 1,761.0), Nickels Rapids (RM 1,757.5), Frazer Rapids (RM 1,741.5), Wolf Point (RM 1,701.5), and Poplar (RM 1,679 – 1,681). Liebelt (2000b) described these sites in detail. All sites were sampled with several different gear types on six different occasions between mid May and August . Onset Computer Corporation Optic StowAway® temperature loggers were installed on the north and south banks at each sampling site and programmed to record water temperatures at one-hour intervals. Additional loggers were installed in the Spillway channel, mouth of the Milk River, Nohly Bridge (RM 1,589), and the lower Yellowstone River (RM 10). Habitat parameters including depth, velocity, turbidity, conductivity, and substrate type were recorded at each station concurrent with sampling efforts.

Dredge Cut Ponds Standardized Netting

Standardized netting was completed in the dredge cut pond complex below Fort Peck Dam to monitor recreational and native fisheries. Netting was completed during June and September at 10 standardized sites with experimental-mesh (1.8- x 38.1-m with equal length panels of 19-, 25-, 38-, 45-, and 51-mm bar mesh) sinking gill nets. All fish captured were identified, weighed, and measured for total or fork length. Adult (greater than 425-mm FL) shovelnose sturgeon were tagged with individually numbered Floy cinch tags. Net catch summaries for these sampling efforts are reported in Montana Fish, Wildlife and Parks' (MTFWP) annual job progress reports. This report summarizes all measurement data and tagging information for shovelnose sturgeon and sauger sampled in these nets.

Population Characteristics of Sauger

Descriptive statistics of sauger were compared among individual river sections. Aging of sauger was completed using dorsal spine cross sections and scales. The first two anterior spines were removed at the base of the dorsal fin from each sauger with side-cutting pliers. Care was taken to make a perpendicular cut across both spines so that no annuli were lost. A Buehler isomet saw was used to cut several spine cross-sections within 0.5 cm from the base of the spine. Scales were removed from below the lateral line and above the posterior insertion of the left pectoral fin and impressed on acetate sheets by Wayne Black, MTFWP Scale Laboratory, Bozeman, MT. Both spine sections and scales were used to determine ages of individual sauger.

RESULTS AND DISCUSSION

Adult Pallid Sturgeon Sampling

Similar to our sampling success during the 2000 field season, 17 adult pallid sturgeons were captured in drifted trammel nets in the Missouri and Yellowstone rivers during 2001. Eleven individuals were captured during late April at the confluence of the Missouri and Yellowstone rivers (RM 1,581.5; Table 2). Four of these 11 pallids were transported to the Miles City State Fish Hatchery, Miles City, MT, for use as brood fish for the hatchery augmentation program. The remaining six adult pallids sampled during 2001 were captured while drifting small-meshed (2.5-cm inner mesh) trammel nets to sample HRJ pallid sturgeon. Five of these adults were captured one week following our efforts to collect brood fish at the confluence area; one was captured in August at the confluence area. The five captured during the first week of May were netted just a short distance (5.5- to 6.5 miles) up the Yellowstone River from the confluence, indicating they were possibly ascending the Yellowstone to spawn as suggested by Liebelt (2000a) and Bramblett and White (2001).

Eight of the 17 adult pallid sturgeons sampled were "new" fish; nine were previously handled and marked with PIT tags (Table 2). This recapture rate of previously tagged fish was similar to last year's findings (Yerk and Baxter 2000). The others were released in the vicinity of their capture site after measurement data were collected.

The adult pallid sturgeons captured ranged from 1,092- to 1,615-mm and 5- to 30-kg in FL and weight, respectively. The smallest pallid sampled was similar in length to one captured in 2000 (FL=1,060) that was determined to be a hybrid based on its CI value of 346.1 (Yerk and Baxter 2000). Although the smaller individual sampled this year had all the phenotypic characteristics of a pallid, it had a mid-range CI value of 343.7, indicating it also was possibly a hybrid. However, it is important to note that this character index has not been validated for sub-adult sturgeons. All other adult pallids sampled during 2001 had CI values (range: 497.4 to 562.9) characteristic of pure pallid sturgeon (Appendix 2).

Relatively low and stable flows in both the Missouri and Yellowstone rivers (about 5,500 and 5,400 cfs, respectively) resulted in optimal netting conditions during the adult pallid sampling period in late April. Similar to previous year's findings, by-catch of other species in the large-mesh (15.2-cm inner mesh and 25.4-cm outer mesh) trammel net was minimal. Catches of other species, including shovelnose sturgeon, common carp, bigmouth buffalo, and sauger were incidental. Pallid sturgeons accounted for over 50% of the total catch. CPUE rates of pallid sturgeons averaged 0.5 pallids per net drift or 3.7 pallids captured per hour net drift time (Table 3). Drifting large-mesh trammel nets pre-runoff in the confluence area has proven to be a refined and effective technique for capturing adult pallid sturgeons in RPMA #2.

Table 2. Capture and descriptive statistics of adult pallid sturgeon sampled in the Missouri and Yellowstone rivers during 2001.

Date	RM	FL (mm)	Weight (kg)	PIT tag #1	PIT tag #2	Recapture?	Sex	Original capture date
24 April*	1,581.5	1,405	13.6	1F4A111C6A		Y	M	14 April, 1999
24 April*	1,581.5	1,615	26.8	220E345E09		N	F	
25 April	1,581.5	1,455	16.8	220F107A6F		N	M	
25 April	1,581.5	1,448	17.7	1F4A363031		Y	M	16 April, 1998
25 April	1,581.5	1,092	5.3	220E587576		N	U	
25 April	1,581.5	1,420	17.7	115679374A		N	U	
25 April	1,581.5	1,356	14.8	115529097A		N	U	
25 April	1,581.5	1,365	13.2	1F482F3F2B		Y	U	12 April, 1999
26 April*	1,581.5	1,541	22.7	1F4A27214F		Y	M	14 April, 1999
26 April	1,581.5	1,465	18.6	220E5F4928		N	U	
26 April*	1,581.5	1,394	19.5	7F7D3C5708		Y	M	22 Oct., 1992
05 May	Y: 6.5	1,533	21.8	1F477B4E51		Y	M	15 Oct., 1997
05 May	Y: 6.5	1,473	20.0	7F7B026102		Y	U	19 Oct., 1992
05 May	Y: 6.5	1,500	15.9	220F0F7677		N	U	
05 May	Y: 6.5	1,254	10.0	7F7D7C2447		Y	U	23 Sept., 1994
05 May	Y: 5.5	1,424	15.4	2224076523		N	U	
13 August	1,581.5	1,599	30.2	1F54756038	1F5420727B	Y	F	12 Oct., 1995

* Transported to Miles City State Fish Hatchery
Y-Yellowstone River

Table 3. Total captured, mean (SE) catch per net and hour drift time, and percent of total catch for individual species sampled in drifted trammel (15.2-cm inner mesh and 25.4-cm outer mesh) nets targeting adult pallid sturgeon at the confluence of the Missouri and Yellowstone rivers, North Dakota, during April, 2001.

Date	Number of nets	minutes	Pallid sturgeon	Shovelnose sturgeon	Paddlefish	Common carp	Bigmouth buffalo	Sauger
24 Apr	11	66	2	2	2	0	2	0
25 Apr	6	41	6	0	0	0	0	3
26 Apr	7	42	3	0	0	1	0	0
Total	24	149	11	2	2	1	2	3
N / drift			0.5 (0.20)	0.1 (0.08)	0.1 (0.08)	<0.1 (0.04)	0.1 (0.08)	0.1 (0.09)
N / hour drift time			3.7 (1.53)	0.5 (0.50)	1.7 (1.67)	0.2 (0.25)	1.0 (1.00)	1.1 (0.88)
% of total catch			52.4	9.5	9.5	4.8	9.5	14.3

Juvenile Pallid Sturgeon Sampling

Intensive sampling efforts to evaluate previous pallid sturgeon augmentation efforts (1998 and 2000 stockings) in RPMA #2 were mostly unsuccessful. A total of 241 trammel net drifts were completed specifically targeting juvenile pallid sturgeons in the confluence area of the Missouri and Yellowstone rivers and in the Missouri River near Culbertson, Poplar, and Wolf Point. A single HRJ pallid sturgeon was sampled near Wolf Point (RM 1,700.5) on 14 September in these netting efforts. Six adult pallid sturgeons were captured in sampling completed near the confluence of the Missouri and Yellowstone rivers (see Adult Pallid Sturgeon Sampling Section).

Shovelnose sturgeon was the most common specie sampled at all sites except for the confluence area during early May. CPUE rates for shovelnose sturgeon ranged from 5.2 per hour drift time at Culbertson to 53.5 per hour drift time at the confluence area in August (Tables 4-8). The high catch rates observed at the confluence area may be correlated to very low flows in the Yellowstone River, which may have displaced shovelnose sturgeon into the Missouri River near the confluence. Shovelnose sturgeon exhibited a broad size distribution at each of the areas netted (Figure 3).

Sauger and walleye dominated the net catches at the confluence area in early May (Table 4). Most of these fish were sampled in the Yellowstone River and were in spawning condition. Based on their excellent condition, it is likely the walleye were migrants from Lake Sakakawea. Catch rates for most species were generally higher at the confluence area than at sites sampled at Wolf Point, Poplar, and Culbertson on the Missouri River (Tables 4-8).

Table 4. Total captured, mean (SE) catches by net and drift time, and percent of total catch for individual species sampled in drifted trammel (2.5-cm inner mesh and 15.2-cm outer mesh) nets targeting juvenile pallid sturgeon at the confluence area of the Missouri and Yellowstone rivers, North Dakota, during May, 2001.

Date	Number of nets	Minutes drifted	Pallid sturgeon	Shovelnose sturgeon	Paddlefish	Goldeye	Northern pike	Common carp	Flathead chub	River carpsucker
08 May	6	39	0	32	0	3	0	1	0	3
09 May	16	91	5	109	1	11	1	3	3	10
10 May	25	129	1	26	0	41	0	3	0	7
11 May	15	84	0	23	1	10	0	0	0	5
Total	62	343	6	190	2	65	1	7	3	25
N / drift			0.1 (0.05)	3.1 (0.54)	<0.1 (0.02)	1.0 (0.26)	<0.1 (0.02)	0.1 (0.04)	<0.1 (0.03)	0.4 (0.12)
N / hour drift time			1.3 (0.70)	32.7 (4.97)	0.4 (0.27)	14.6 (4.37)	0.2 (0.19)	1.2 (0.46)	0.4 (0.25)	6.1 (2.97)
% of catch			0.9	30.3	0.3	10.4	0.2	1.1	0.5	4.0

Table 4. Continued.

Date	Number of nets	Minutes drifted	Blue sucker	Smallmouth buffalo	Bigmouth buffalo	Shorthead redhorse sucker	White sucker	Channel catfish	Sauger	Walleye
08 May	6	39	0	0	0	0	0	6	81	16
09 May	16	91	2	0	0	1	0	22	65	29
10 May	25	129	1	5	1	1	2	6	42	12
11 May	15	84	0	3	0	0	0	6	23	4
Total	62	343	3	8	1	2	2	40	211	61
N / drift			<0.1 (0.03)	0.1 (0.06)	<0.1 (0.02)	<0.1 (0.02)	<0.1 (0.03)	0.6 (0.16)	3.4 (0.88)	1.0 (0.20)
N / hour drift time			0.5 (0.27)	2.0 (0.99)	0.2 (0.16)	0.68 (0.52)	0.6 (0.64)	8.1 (1.95)	36.2 (7.89)	13.5 (3.37)
% of catch			0.5	1.3	0.2	0.3	0.3	6.4	33.6	9.7

Table 5. Total captured, mean (SE) catches by net and drift time, and percent of total catch for individual species sampled in drifted trammel (2.5-cm inner mesh and 15.2-cm outer mesh) nets targeting juvenile pallid sturgeon at the confluence area of the Missouri and Yellowstone rivers, North Dakota, during August, 2001.

Date	Number of nets	Minutes drifted	Pallid sturgeon	Shovelnose sturgeon	Goldeye	Common carp	Flathead chub	River carpsucker	Blue sucker
13 Aug	10	85	1	83	5	1	0	0	2
14 Aug	24	248	0	123	23	8	1	1	4
15 Aug	24	204	0	150	7	2	0	4	4
16 Aug	11	88	0	145	5	1	0	2	3
Total	69	625	1	501	40	12	1	7	13
N / drift			<0.1 (0.01)	7.3 (1.15)	0.6 (0.09)	0.2 (0.07)	<0.1 (0.01)	0.1 (0.04)	0.2 (0.06)
N / hour drift time			0.1 (0.14)	53.5 (8.46)	4.1 (0.72)	1.0 (0.39)	0.1 (0.07)	0.65 (0.24)	1.3 (0.40)
% of catch			0.2	74.2	5.9	1.8	0.2	1.0	1.9

Table 5. Continued.

Date	Number of nets	Minutes drifted	Smallmouth buffalo	Shorthead redhorse sucker	Channel catfish	Burbot	Sauger	Walleye
13 Aug	10	85	0	0	11	0	2	0
14 Aug	24	248	2	0	23	0	6	1
15 Aug	24	204	0	2	12	1	9	0
16 Aug	11	88	0	0	28	0	3	0
Total	69	625	2	2	74	1	20	1
N / drift			<0.1 (0.02)	<0.1 (0.03)	1.1 (0.43)	<0.1 (0.01)	0.3 (0.07)	<0.1 (0.01)
N / hour drift time			0.2 (0.11)	0.2 (0.17)	7.2 (3.01)	0.1 (0.10)	2.2 (0.55)	0.1 (0.10)
% of catch			0.3	0.3	10.9	0.2	2.9	0.2

Table 6. Total captured, mean (SE) catches by net and hour drift time, and percent of total catch for individual species sampled in drifted trammel (2.5-cm inner mesh and 15.2-cm outer mesh) nets targeting juvenile pallid sturgeon in the Missouri River at Wolf Point, MT, during July, August, and September, 2001.

Date	Number of nets	Minutes drifted	Pallid sturgeon	Shovelnose sturgeon	Goldeye	Lake whitefish	Common carp	Flathead chub	River carpsucker
17 July	9	80	0	11	1	0	0	4	3
18 July	13	128	0	15	0	0	2	3	5
01 Aug	12	87	0	10	5	0	4	5	2
02 Aug	11	109	0	13	2	0	2	0	4
14 Sept	4	45	1	35	19	1	0	3	3
Total	49	449	1	84	27	1	8	15	17
N / net			<0.1 (0.02)	1.7 (0.46)	0.6 (0.37)	<0.1 (0.02)	0.2 (0.09)	0.3 (0.08)	0.3 (0.09)
N / hr drift time			0.1 (0.12)	10.5 (2.80)	3.8 (1.92)	0.1 (0.12)	0.9 (0.49)	2.0 (0.59)	2.0 (0.53)
% of catch			0.5	44.9	14.4	0.5	4.3	8.0	9.1

Table 6. Continued.

Date	Number of nets	Minutes drifted	Blue sucker	Smallmouth buffalo	Shorthead redhorse sucker	Channel catfish	Burbot	Sauger
17 July	9	80	0	0	1	0	1	4
18 July	13	128	1	1	1	0	0	1
01 Aug	12	87	0	0	2	2	0	2
02 Aug	11	109	0	1	0	0	0	0
14 Sept	4	45	0	0	3	1	1	12
Total	49	449	1	2	7	3	2	19
N / net			<0.1 (0.02)	<0.1 (0.03)	0.1 (0.06)	0.1 (0.04)	<0.1 (0.03)	0.4 (0.18)
N / hr drift time			0.2 (0.20)	0.2 (0.17)	0.9 (0.39)	0.3 (0.22)	0.3 (0.18)	2.2 (0.88)
% of catch			0.5	1.1	3.7	1.6	1.1	10.2

Table 7. Total captured, mean (SE) catches by net and hour drift time, and percent of total catch for individual species sampled in drifted trammel (2.5-cm inner mesh and 15.2-cm outer mesh) nets targeting juvenile pallid sturgeon in the Missouri River near Poplar, MT, during August, 2001.

Date	Number of nets	Minutes drifted	Shovelnose sturgeon	Goldeye	Common carp	Flathead chub	River carpsucker	Shorthead redhorse sucker	Sauger
28 Aug	10	104	18	9	1	6	1	2	3
Total	10	104	18	9	1	6	1	2	3
N / net			1.8 (0.71)	0.9 (0.31)	0.1 (0.10)	0.6 (0.31)	0.1 (0.10)	0.2 (0.13)	0.3 (0.15)
N / hr drift time			10.0 (4.20)	5.4 (1.75)	0.5 (0.46)	3.5 (1.83)	0.6 (0.60)	1.0 (0.67)	1.6 (0.82)
% of catch			45.0	22.5	2.5	15.0	2.5	5.0	7.5

Four additional HRJ pallid sturgeons were sampled incidentally in other netting completed in RPMA #2 during 2001. One individual was sampled near Wolf Point (RM 1,701.0) on 12 July in standardized sampling, and three were sampled in drift netting completed to meet research objectives of the Fort Peck Flow Modification Project (Patrick Braaten, U.S. Geological Survey, personal communication). These other three individuals were sampled at Wolf Point (RM 1,699.5), near Nohly (RM 1,591.5), and just below the confluence of the Missouri and Yellowstone rivers (RM 1,581.0).

All five HRJ pallids sampled were stocked in 2000 (1999 year class) and averaged 420-mm FL at time of capture. No HRJ pallids from the 1998 stocking were captured. It is interesting to note that the three juvenile pallids sampled at Wolf Point were captured within one river mile of where they were originally stocked (Table 9). The other two juveniles moved downriver about 30 miles from their stocking location. All HRJ pallids sampled exhibited some growth in the approximate one year they were at large. Estimated annual growth ranged from 34 to 89 mm (Table 9).

The HRJ pallid sturgeons sampled during 2001 were captured in drifted trammel (2.5-cm inner mesh and 15.2-cm outer mesh) nets. A total of 515 net drifts were completed with this type net in RPMA #2 during 2001, including 241 specifically targeting juvenile pallid sturgeons and 274 completed to meet other research objectives. Thus, 515 total net drifts resulted in the capturing of five HRJ pallid sturgeons in RPMA #2 during 2001, or a CPUE rate of one HRJ pallid per 103 nets drifted. This was an extensive effort that provided little information to evaluate the stocking success of the pallid sturgeon augmentation program. The "Stocking / Augmentation Plan for the Pallid Sturgeon (*Scaphirhynchus albus*) in Recovery Priority Management Areas 1 & 2 in Montana and North Dakota" states that "….population size and survival /mortality rates will be calculated using recapture information of tagged fish" (Krentz et al. 1997). Currently, we can not recapture enough juvenile pallids in RPMA #2 to evaluate survival and population size. This may be attributed to the low numbers of HRJ released into RPMA #2 thus far, poor survival of stocked fish, ineffective sampling gears, or a combination of these.

Table 8. Total captured, mean (SE) catches by net and drift time, and percent of total catch for individual species sampled in drifted trammel (2.5-cm inner mesh and 15.2-cm outer mesh) nets targeting juvenile pallid sturgeon in the Missouri River near Culbertson, MT, during August, 2001.

Date	Number of nets	Minutes drifted	Shovelnose sturgeon	Goldeye	Common carp	Flathead chub	Blue sucker	Bigmouth buffalo	Shorthead redhorse sucker	Channel catfish	Sauger	Walleye
20 Aug	17	178	6	33	1	14	1	1	0	3	4	0
21 Aug	20	211	36	89	2	11	1	0	1	6	8	1
22 Aug	14	141	9	28	2	3	0	0	3	0	3	0
Total	51	530	51	150	5	28	2	1	4	9	15	1
N / net			1.0 (0.23)	2.9 (0.37)	0.1 (0.05)	0.5 (0.12)	<0.1 (0.03)	<0.1 (0.02)	0.1 (0.05)	0.2 (0.07)	0.3 (0.08)	<0.1 (0.02)
N / hr drift time			5.2 (1.05)	17.9 (2.66)	0.9 (0.61)	3.4 (0.80)	0.2 (0.14)	0.1 (0.12)	0.3 (0.20)	0.9 (0.38)	1.6 (0.46)	0.1 (0.12)
% of catch			19.2	56.4	1.9	10.5	0.7	0.4	1.5	3.4	5.6	0.4

Table 9. Release and recapture statistics of hatchery-reared juvenile pallid sturgeon sampled in Recovery Priority Management Area #2 since 1999. 'NA' indicates measurement data was not available at time of release; arrows denote upstream and/or downstream movement.

		Release			Recapture					
PIT number	Year class	Date	RM	FL (mm)	Date	RM	FL (mm)	Years at large	Movement (mile)	Estimated annual growth (mm)
4108615164	1997	11 Aug, 1998	1,581.5	NA	04 May, 1999	Y: 2.5	303	0.7	2.5 ▲	—
4109062517	1997	11 Aug, 1998	1,589.0	NA	04 May, 1999	Y: 2.5	286	0.7	10.0 ▼▲	—
41093F771C	1997	11 Aug, 1998	Y: 17.0	NA	05 May, 1999	Y: 11.5	337	0.7	6.5 ▼	—
40640B5B4C	1997	11 Aug, 1998	Y: 17.0	426	07 July, 1999	Y: 8.0	447	0.9	9.0 ▼	23
4109077E55	1997	11 Aug, 1998	Y: 17.0	NA	17 Aug, 2000	Y: 8.0	361	1.0	9.0 ▼	—
4109501201	1997	11 Aug, 1998	Y: 25.0	NA	22 Aug, 2000	Y: 7.5	372	1.0	17.5 ▼	—
4109470755	1997	11 Aug, 1998	Y: 17.0	NA	22 Aug, 2000	Y: 7.5	339	1.0	9.5 ▼	—
411D077350	1998	11 Oct, 2000	1,701.5	470	12 July, 2001	1,701.0	497	0.7	0.5 ▼	39
424E2C054C	1999	17 Oct, 2000	1,701.5	400	12 Sept, 2001	1,699.5	431	0.9	2.0 ▼	34
424D7B0E7C	1999	17 Oct, 2000	1,701.5	300	14 Sept, 2001	1,700.5	361	0.9	1.5 ▼	68
424E3F352E	1999	17 Oct, 2000	1,620.8	360	24 Sept, 2001	1,591.5	440	0.9	29.3 ▼	89
411D15473C	1999	17 Oct, 2000	Y: 29.5	320	02 Oct, 2001	1,581.0	370	1.0	29.5 ▼	50

Y – Yellowstone River

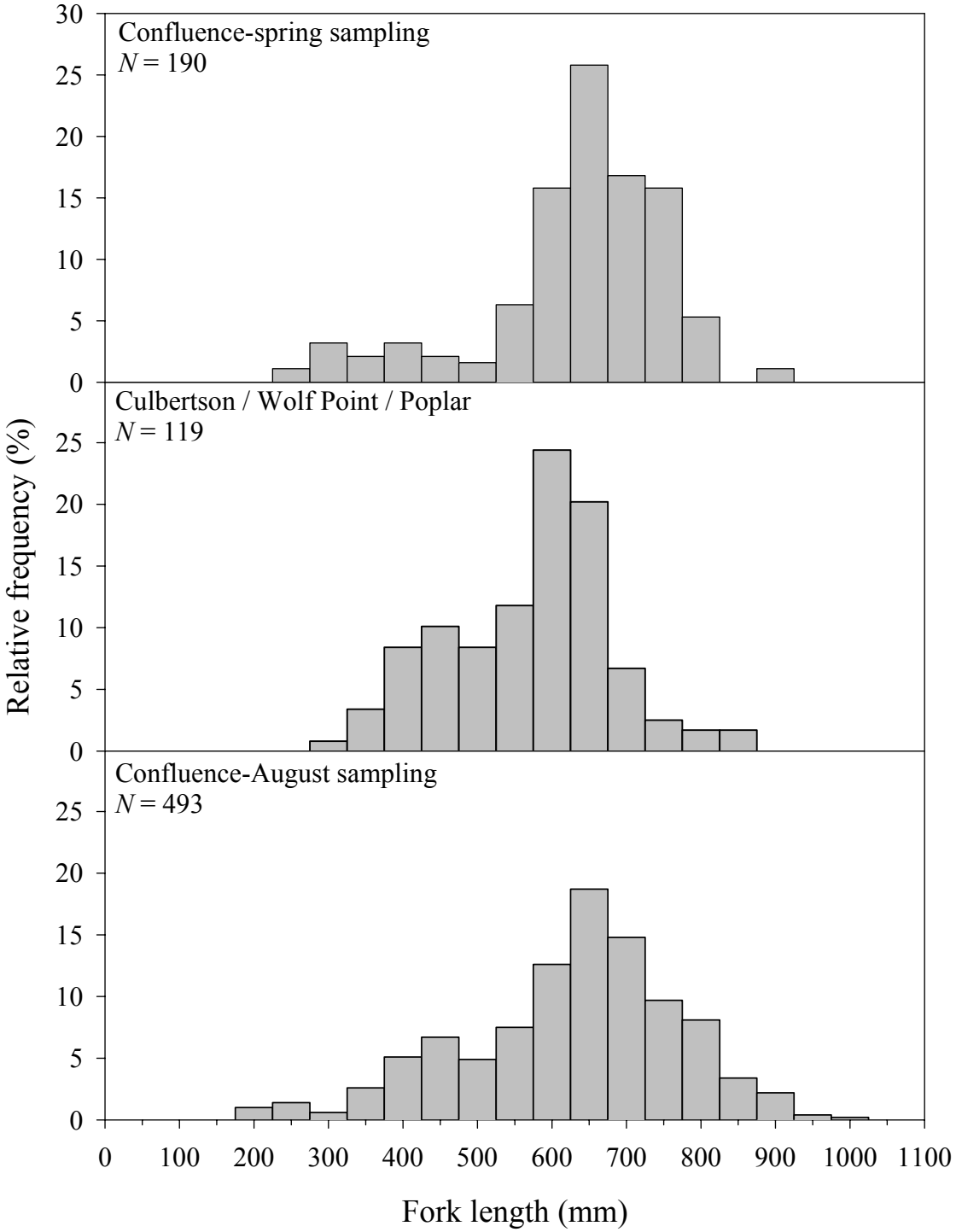

Figure 3. Length-frequency distributions of shovelnose sturgeon captured while sampling for hatchery-reared pallid sturgeon in the Missouri and Yellowstone rivers during 2001.

It has been suggested that the nets currently used to sample HRJ pallid sturgeons are too large to effectively capture them (Steve Krentz, U.S. Fish and Wildlife Service, personal communication). Size distribution of shovelnose sturgeons captured in these trammel nets (2.5-cm inner mesh and 15.2-cm outer mesh) during 2001 ranged from 168- to 974-mm FL. We estimated size of HRJ pallid sturgeon in RPMA #2 during 2001 likely ranged from approximately 350- to 600-mm FL based on the growth observed for recaptured fish. Although the actual size structure of the shovelnose population is unknown relative to the capture efficiency of the trammel nets, individuals were effectively sampled in the 350- to 600-mm FL range (Figure 4).

One limitation of our 2001 HRJ pallid sampling efforts was the lack of netting completed in the Yellowstone River. Just 31 net drifts were completed in the Yellowstone during May. Large catches of other fish (e.g., sauger, walleye, and shovelnose sturgeon) limited the amount of sampling we were able to complete. Furthermore, low flows in August prevented boat access. All HRJ pallids recaptured prior to 2001 ($N = 7$) were sampled in the Yellowstone.

Anglers did not report catching any HRJ pallids in the study area during 2001.

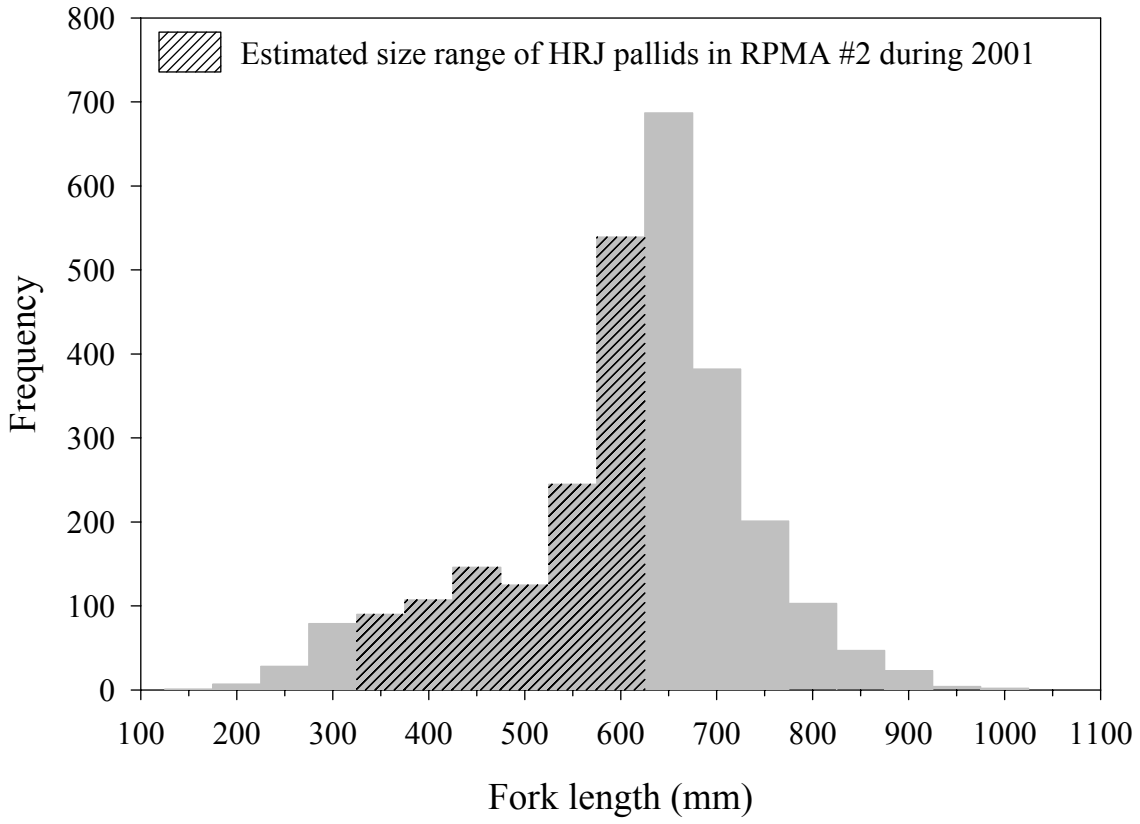

Figure 4. Capture efficiency of shovelnose sturgeon in 2.5-cm mesh drifted trammel nets relative to estimated size range of hatchery-reared juvenile pallid sturgeon in RPMA #2 during 2001.

Shovelnose Sturgeon

Measurement data were collected from 1,080 of 1,122 shovelnose sturgeon captured in the Milk, Missouri, and Yellowstone rivers in stationary gill net sets, drifted trammel nets, benthic trawl tows, hoop nets, and electrofishing during 2001. The greatest number were captured while sampling for HRJ pallid sturgeon in the Missouri River in section 6 (N = 423; 38% of total; Table 10). This sampling occurred at and just below the Missouri's confluence with the Yellowstone River. This river section and the section immediately upstream (section 5) were the only two areas that juvenile shovelnose sturgeons (< 200 mm-FL) were readily sampled. Relatively few shovelnose were sampled in river sections 0, 1, and 4. This is attributed to limited sampling efforts in sections 0 and 4. River section 1 is the cold-water habitat immediately downstream of Fort Peck Dam that is mostly unsuitable for shovelnose sturgeon. The few individuals sampled in this section were larger adults.

Size distribution of shovelnose sturgeons sampled in drifted trammel nets (2.5-cm inner mesh and 15.2-cm outer mesh) did not differ greatly between general areas nor seasons (Figure 3). However, the broadest size ranges were sampled at the confluence area (Figure 3; Table 10). This is similar to previous year's findings, which suggested the importance of this area in meeting the life history requirements of shovelnose sturgeon (Yerk and Baxter 2000).

Table 10. Number, mean fork length (mm), mean weight (g), and respective ranges of shovelnose sturgeon sampled in individual river sections in the Milk, Missouri and Yellowstone rivers during 2001. Standard deviations of means are listed in parentheses.

		Fork Length		Weight	
Section	*N*	Mean	Range	Mean	Range
0	18	613.7 (81.1)	503-793	951.4 (448.2)	450-2,025
1	19	638.0 (59.6)	496-767	1,107.9 (430.4)	400-2,250
2	190	633.6 (67.2)	450-974	1,043.9 (424.0)	110-3,350
3	91	561.2 (92.7)	294-737	716.0 (381.5)	98-1,850
4	26	507.8 (97.2)	355-710	551.0 (340.3)	150-1,625
5	150	576.1 (148.8)	196-870	996.9 (811.5)	25-3,700
6	423	601.6 (147.3)	168-965	1,127.2 (798.6)	15-4,250
9	163	622.2 (110.2)	246-870	1,176.7 (588.7)	25-3,400
Total	1,080	602.0 (126.4)	168-974	1,050.1 (682.5)	15-4,250

Recapture Rates and Movements of Tagged Shovelnose Sturgeon

A total of 478 shovelnose sturgeons were tagged in the Milk, Missouri, and Yellowstone rivers during 2001 (Table 11). Most shovelnose were tagged in river sections 2 (*N*=174; 36%), 6 (*N*=163; 34%), and 9 (*N*=138; 29%).

Of the 1,122 shovelnose sturgeons sampled during 2001, 30 (2.7%) were recaptures bearing tags from 2000 or earlier. This recapture rate is similar to previous year's findings (Yerk and Baxter 2000). The greatest numbers of recaptures were sampled in river sections 2 and 6. In the past, many more shovelnose were tagged in the Milk River and Fort Peck Dam tailwater-dredge cut complex (Liebelt 2000a). Thus, it is likely more tagged fish were available for capturing in this reach of the Missouri River. In general, recapture rates (relative to total number sampled) of shovelnose sturgeon were higher in the upper river than in the lower river.

Table 11. Total number of shovelnose sturgeon captured, tagged, and recaptured in individual river sections during 2001.

River section	Number captured	Number tagged	Number of recaptures
0	18	18	0
1	19	16	3
2	190	174	9
3	125	98	0
4	26	4	1
5	150	16	1
6	431	163	10
9	163	138	6
Total	1,122	478	30

Most recaptured shovelnose sturgeon exhibited little movement from where they were originally tagged (Table 12). Three individuals recaptured between Fort Peck Dam and the mouth of the Milk River were originally tagged there. Of the nine shovelnose recaptured in river section 2, two were originally tagged in that section while the other seven were tagged upstream in either section 0 (Milk River) or section 1. Some recaptured shovelnose exhibited greater movement. Six shovelnose sturgeons originally tagged in sections 8 and 9 were recaptured in section 6, demonstrating intra-river movement from the Yellowstone River into the Missouri. One shovelnose tagged below Fort Peck Dam was recaptured in the lower Yellowstone River, exhibiting movement of at least 179 river miles. Original tagging data was not available for three shovelnose sturgeons that were recaptured.

Table 12. Recapture location (by river section) of tagged shovelnose sturgeon in the Missouri, Yellowstone, and Milk rivers during 2001.

River section	Number of recaptures	Originally tagged (river section)										
		0	1	2	3	4	5	6	7	8	9	no data
0	0	0	0	0	0	0	0	0	0	0	0	0
1	3	0	3	0	0	0	0	0	0	0	0	0
2	9	5	2	2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	1	1	0	0	0	0	0	0	0	0	0	0
5	1	0	1	0	0	0	0	0	0	0	0	0
6	10	1	0	0	0	0	0	1	0	1	5	2
9	6	0	1	0	0	0	0	1	0	0	3	1
Total	30	7	7	2	0	0	0	2	0	1	8	3

Standardized Sampling

A total of 28 species were captured in standardized sampling (excluding larval fish sampling) efforts during 2001, consisting of 20 native and 8 introduced fishes. This was slightly less than the 31 total species observed in standardized sampling efforts during 2000 (Yerk and Baxter 2001) and the 37 species observed in the entire study area in 2001 (Appendix 4). Similar to 2000 findings, the most common specie sampled was goldeye (N = 1,009), comprising 38% of the 2,632 total fish sampled (Table 13). Catostomidae was the dominant family represented in sampling efforts. Combined numbers of river carpsucker, white sucker, longnose sucker, blue sucker, bigmouth buffalo, and smallmouth buffalo accounted for 23% of all fish sampled. Thus, over 60% of the total catch was represented by goldeye and sucker species.

Juvenile fishes were not commonly sampled at any of the standardized sites. Age-0 common carp, fathead minnow, emerald shiner, flathead chub, goldeye, longnose sucker, white sucker, river carpsucker, shorthead redhorse, yellow perch, and rainbow trout were sampled in limited numbers, primarily in bag seine hauls. The productivity of the Milk River relative to the other standardized sites on the Missouri River was evident in one particular seine haul completed at the mouth of the Milk River during July— over 350 individual fish representing 14 species were captured.

A single HRJ pallid sturgeon was captured in standardized sampling efforts during 2001 at the Wolf Point site. This is the first pallid sampled in the two field seasons standardized sampling has been completed. Several Montana 'Species of Special Concern' including blue sucker, sicklefin chub, sturgeon chub, and sauger were sampled at some of the standardized sites. Limited numbers of sturgeon (N = 1) and sicklefin (N = 2) chubs were captured, but sauger (N = 41) and blue suckers (N = 108) were more common (Table 13). Catches of blue suckers were especially high (30/stationary gill net night) at the mouth of the Milk River in June. These fish were apparently staging before ascending the Milk to spawn.

The diversity of species sampled in individual gear types varied greatly between sites and temporally (Figure 5). No clear patterns were evident in the number of species collected at sampling sites with specific gear types. Catch rates of individual species were equally variable among sites and gear types (Figures 6-9), but generally low compared to catch rates observed in sampling completed in the lower river at the confluence area (Tables 4 and 5). These data will be analyzed more thoroughly in a future report as more sampling information becomes available.

Table 13. Number sampled, mean total length (mm), mean weight (g), and respective ranges of fish sampled at standardized sampling sites on the Missouri River, Montana, during 2001. Standard deviations of means are listed in parentheses.

Species	*N*	Mean total length		Range	Mean weight		Range
Bigmouth buffalo	11	538.9	(95.3)	391-690	2,738.6	(1,471.7)	1,000-5,150
Blue sucker	108	695.1	(54.2)	557-796	2,882.9	(839.0)	1,400-5,500
Brown trout	1	735.0			5,650.0		
Burbot	4	450.5	(157.5)	302-673	638.5	(679.6)	194-1,650
Channel catfish	169	398.0	(72.2)	244-649	590.2	(426.7)	100-2,875
Cisco	1	222.0			50.0		
Common carp	83	514.3	(62.9)	178-665	1,744.7	(567.5)	178-3,250
Emerald shiner	31	76.1	(13.5)	39-98	3.4	(2.0)	0.4-8.5
Flathead chub	40	224.1	(55.9)	66-284	1,18.9	(65.8)	3-250
Fathead minnow	2	48.0	(8.5)	42-54	0.8	(0.6)	0.3-1.2
Freshwater drum	3	297.7	(21.1)	285-322	4,41.7	(184.3)	300-650
Goldeye	1,009	270.1	(45.8)	75-394	1,91.6	(87.3)	6.2-450
Hybognathus spp.	6	115.5	(14.0)	103-142	14.5	(6.2)	8.9-26.6
Lake whitefish	6	469.8	(21.7)	445-494	1083.3	(138.4)	925-1,275
Longnose sucker	36	420.8	(64.8)	138-498	835.8	(305.8)	23-1,425
Northern pike	135	645.9	(170.9)	293-1,014	2,173.2	(1,769.8)	150-8,050
Pallid sturgeon*	1	497.0			396.0		
Rainbow trout	3	432.0	(202.7)	198-554	891.7	(699.3)	100-1,425
River carpsucker	325	457.4	(68.4)	50-591	1,435.7	(674.3)	50-3,500
Sauger	119	319.8	(56.8)	212-545	276.5	(179.8)	50-1,325
Shorthead redhorse	110	367.5	(72.3)	90-504	631.1	(310.9)	22-1,875
Shovelnose sturgeon*	276	619.8	(79.5)	294-974	989.2	(436.2)	98-3,350
Sicklefin chub	2	105.5	(0.7)	105-106	7.7	(0.6)	7.2-8.1
Smallmouth buffalo	43	570.4	(72.2)	448-718	2,761.6	(1,239.4)	1,300-6,800
Sturgeon chub	1	86.0			4.0		
Walleye	14	349.5	(121.1)	141-566	529.4	(455.1)	17.8-1725
White sucker	89	362.6	(99.4)	48-507	694.5	(364.9)	0.3-1500
Yellow perch	4	142.0	(8.4)	131-151	58.3	(61.8)	20-150

* fork length reported for pallid and shovelnose sturgeon

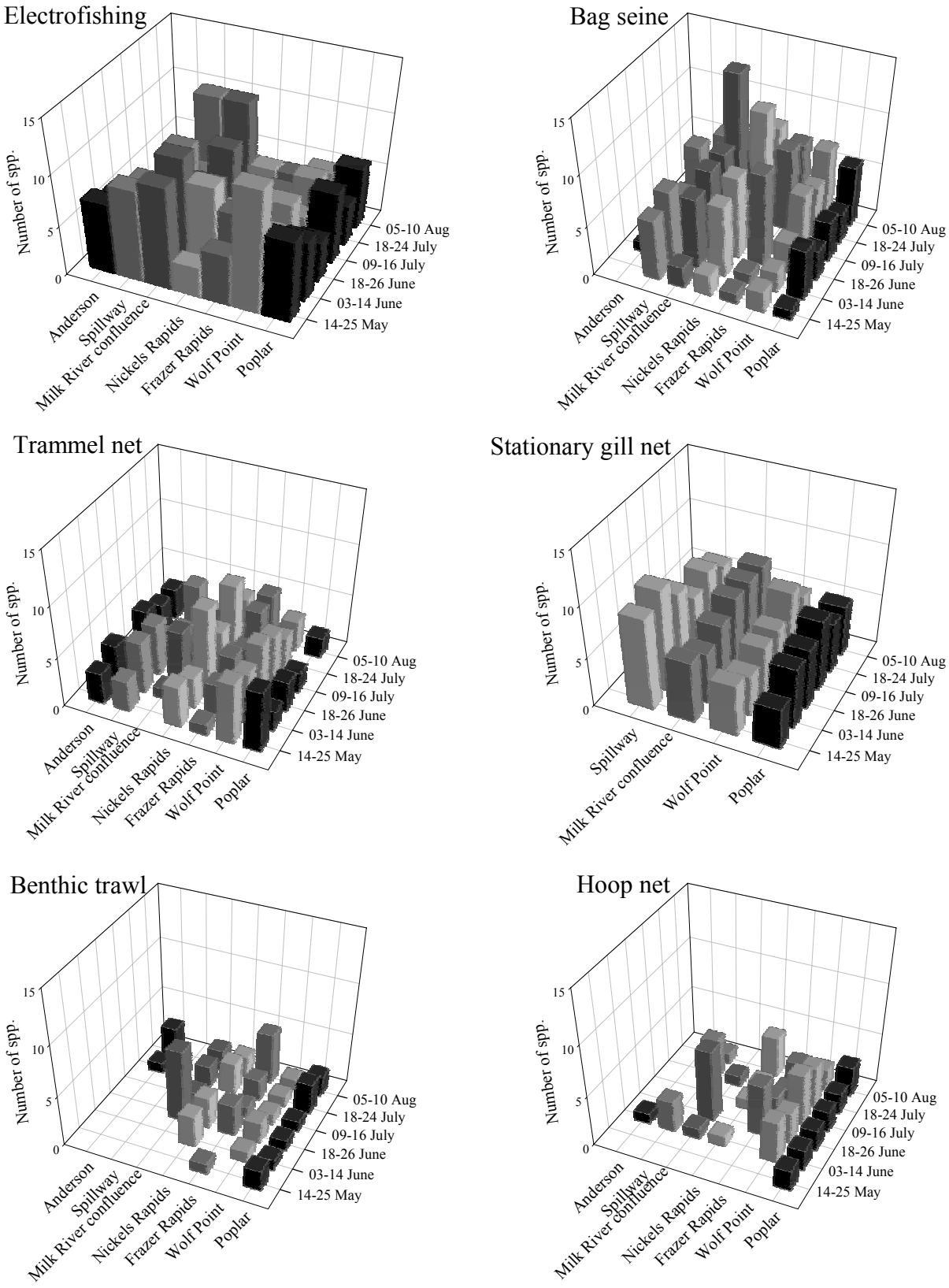

Figure 5. Number of individual species sampled in different gear types at standardized sites on the Missouri River, MT, during 2001.

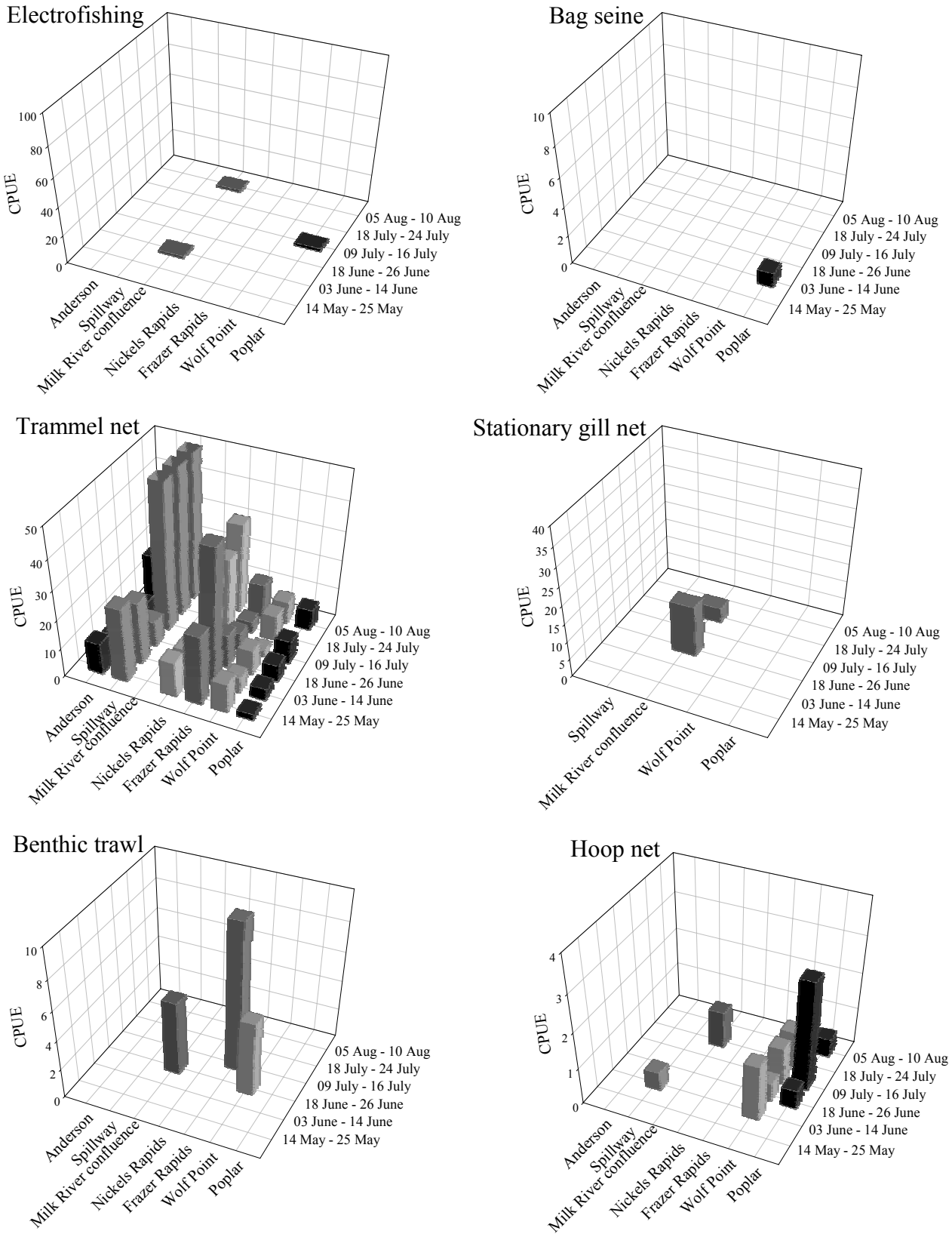

Figure 6. CPUE rates of shovelnose sturgeon captured in individual gear types at standardized sampling sites on the Missouri River, Montana, during 2001. CPUE rate for trammel net, benthic trawl, and electrofishing is *N*/hour sample time, stationary gill net is *N*/net, and bag seine is *N*/haul.

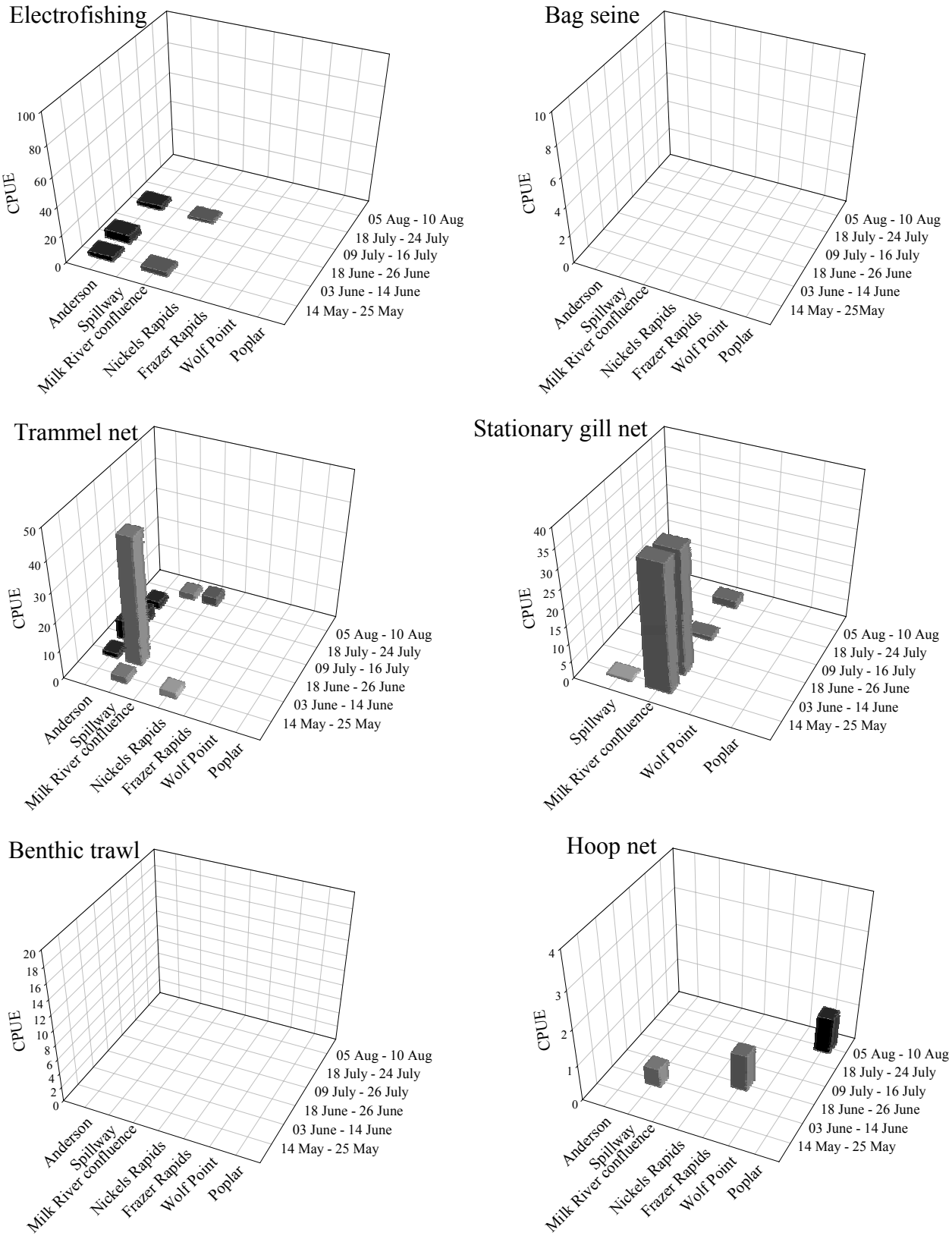

Figure 7. CPUE rates of blue suckers captured in individual gear types at standardized sampling sites on the Missouri River, Montana, during 2001. CPUE rate for trammel net, benthic trawl, and electrofishing is *N*/hour sample time, stationary gill net is *N*/net, and bag seine is *N*/haul.

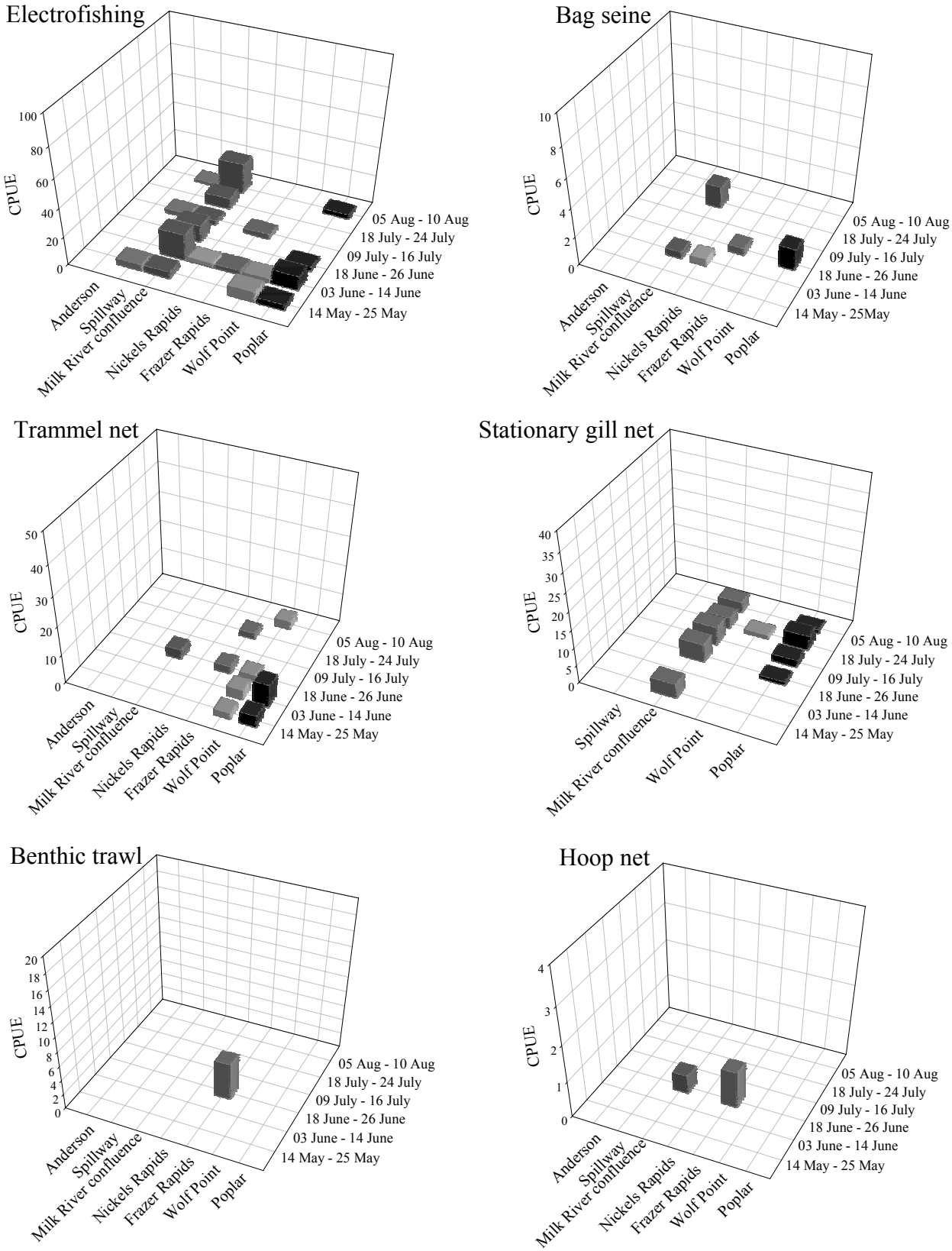

Figure 8. CPUE rates of sauger captured in individual gear types at standardized sampling sites on the Missouri River, Montana, during 2001. CPUE rate for trammel net, benthic trawl, and electrofishing is *N*/hour sample time, stationary gill net is *N*/net, and bag seine is *N*/haul.

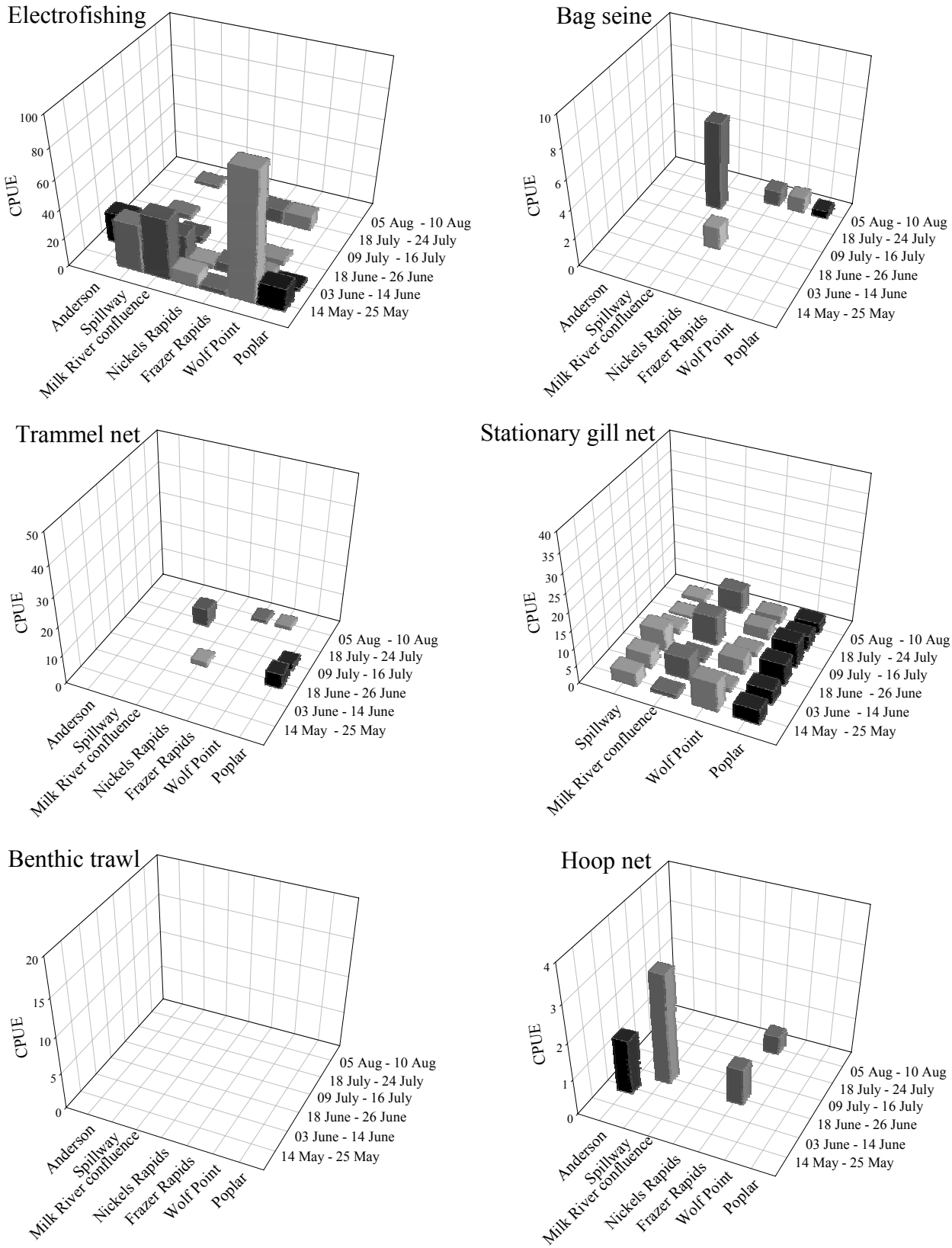

Figure 9. CPUE rates of river carpsuckers captured in individual gear types at standardized sampling sites on the Missouri River, Montana, during 2001. CPUE rate for trammel net, benthic trawl, and electrofishing is *N*/hour sample time, stationary gill net is *N*/net, and bag seine is *N*/haul.

A total of 24 larval samples were collected from each standardized sampling site during 2001, except at Frazer Rapids where only 20 samples were collected. Total volume of water sampled was 8,737 m^3, which resulted in a total catch of 329 larval fish and 429 eggs (Tables 14 and 15). A single sturgeon larva was captured at each Wolf Point and Poplar on 11 July and 25 June, respectively (identification verified by D. Snyder, Colorado State University, Fort Collins, CO). Additionally, several paddlefish larvae were sampled at the Wolf Point and Poplar sites during late June and early July (Table 14).

The number of species sampled and total larva sampled was highest at the sites immediately below the mouth of the Mile River and at Nickels Rapids and Frazer Rapids sites (Table 15). This is probably a result of production that occurred in the Milk River, and the subsequent downstream drift into the Missouri. Catostomids were the dominant larvae sampled and were present at all sites. Other larval fish collected included channel catfish, miscellaneous cyprinids including common carp, percids, hiodons, and sciaenids. Larval fish were essentially absent at the Anderson site samples except for a few individuals.

Water Temperature Monitoring

Mean daily water temperatures observed in the Missouri River immediately below Fort Peck Reservoir were similar to previous year's findings (Yerk and Baxter 2001). At no time during the year did water temperatures exceed 18 C in the upper 26 miles of river from Fort Peck Dam to Frazer Rapids. Water temperature variances were much greater at downstream sites, and obvious warming of the dam's discharge was not evident until Poplar (Figure 10). Water temperatures from Poplar downstream to Nohly were generally 5 to 10 C warmer than those recorded just below the dam from June through September. The effects of ambient temperature on river temperature was evident as similar warming and cooling patterns were observed at most stations. Water temperatures measured in the Missouri River above Fort Peck Reservoir were consistently warmer than all sites in our study area. It is interesting to note that water temperatures recorded at Nohly were considerably warmer than those observed in the lower Yellowstone River from July through mid-September.

Differences in north and south bank water temperatures were not as great in 2001 as during 2000 (Figure 11). Water temperatures recorded on the north bank during 2000 were consistently 2.0 to 2.5 C warmer than river temperatures on the south bank at Nickels Rapids (RM 1,759) during the summer months (Yerk and Baxter 2001). This was not as evident in 2001 even though peak run-off events in the Milk River were similar between the two years. The warmer Milk River discharge was fully assimilated with the colder, denser Missouri River water by Frazer Rapids and Wolf Point (Figure 11).

Physical Habitat Parameters

Turbidity, conductivity, velocity, and substrate data were collected at standardized sites during sampling. This information will be summarized in subsequent reports when more data become available.

Table 14. Total catch and densities of sturgeon and paddlefish larva and eggs sampled at standardized sites on the Missouri River below Fort Peck Dam, Montana, during 2001.

Sample site	Sample period	Number of samples	Volume sampled (m^3)	Number sampled									
				Polyodontidae	per 100 m^3	Acipenseridae	per 100 m^3	Unknown	per 100 m^3	Eggs	per 100 m^3	P/S Eggs	per 100 m^3
Andersons	18 May	4	223										
	05 June	4	230										
	19 June	4	233							1	0.4		
	12 July	4	240							1	0.4		
	23 July	4	311										
	07 August	4	274							1	0.4		
Total		24	1,511							3	0.2		
below	18 May	4	200					1	0.5				
Spillway	05 June	4	133										
	20 June	4	211							29	13.7		
	16 July	4	80							5	6.3		
	23 July	4	199					1	0.5	2	1.0		
	06 August	4	234							3	1.3		
Total		24	1,057					2	0.2	39	3.7		
below	18 May	4	165							2	1.2		
Milk	05 June	4	49										
	20 June	4	162							32	19.8		
	16 July	4	206							1	1.8		
	23 July	4	160					1	0.6	1	0.6		
	06 August	4	155							5	3.2		
Total		24	897					1	0.1	39	4.3		
Nickels	18 May	4	196					5	2.6	1	0.5		
Rapids	05 June	4	91							7	7.7		
	20 June	4	112							57	50.9		
	16 July	4	168							25	14.9		
	23 July	4	97										
	06 August	4	193							6	3.1		
Total		24	857					5	0.6	96	11.2		

Table 14. Continued.

Sample site	Sample period	Number of samples	Volume sampled (m^3)	Number sampled: Polyodontidae	per 100 m^3	Acipenseridae	per 100 m^3	Unknown	per 100 m^3	Eggs	per 100 m^3	P/S Eggs	per 100 m^3
Frazer	05 June	4	132							8	6.1		
Rapids	20 June	4	182							107	58.8		
	16 July	4	167							30	18.0		
	23 July	4	172							3	1.7		
	06 August	4	229							2	0.9		
Total		20	882							150	17.0		
Wolf	22 May	4	262										
Point	04 June	4	286							5	1.7		
	26 June	4	302	2	0.7			1	0.3	10	3.3		
	11 July	4	387	1	0.3	1	0.3			6	1.6		
	24 July	4	361					2	0.6	10	2.8		
	08 August	4	239							11	4.6		
Total		24	1,837	3	0.2	1	0.1	3	0.2	42	2.3		
Poplar	23 May	4	285										
	07 June	4	279							4	1.4		
	25 June	4	236	3	1.3	1	0.4	1	0.4	13	5.5		
	10 July	4	246	1	0.4			2	0.8	14	5.7		
	24 July	4	384							5	1.3		
	08 August	4	266					1	0.3	24	9.0		
Total		24	1,696	4	0.2	1	0.1	4	0.2	60	3.5		

Table 15. Total catch and densities of various larval fishes sampled at standardized sites on the Missouri River below Fort Peck Dam, Montana, during 2001.

				Number sampled													
Sample site	Sample period	Number of samples	Volume sampled (m^3)	Channel catfish	per $100m^3$	Catostomid	per 100 m^3	Cyprinid	per 100 m^3	Common carp	per 100 m^3	Hiodon	per 100 m^3	Percid	per 100 m^3	Sciaenid	per 100 m^3
Andersons	18 May	4	223					2	0.9								
	05 June	4	230											1	0.4		
	19 June	4	233			1	0.4										
	12 July	4	240														
	23 July	4	311			1	0.3										
	07 August	4	274														
Total		24	1,511			2	0.1	2	0.1					1	0.1		
below	18 May	4	200					4	2.0								
Spillway	05 June	4	133			1	0.8										
	20 June	4	211			2	0.9			1	0.5						
	16 July	4	80			10	12.5	2	2.5								
	23 July	4	199					1	0.5								
	06 August	4	234			2	0.9										
Total		24	1,057			15	1.4	7	0.7	1	0.1						
below	18 May	4	165			1	0.6	2	1.2								
Milk	05 June	4	49														
	20 June	4	162			8	4.9	1	0.6	27	16.7					1	0.6
	16 July	4	206	2	1.0	17	8.3	2	1.0	2	1.0					4	1.9
	23 July	4	160					1	0.6							2	1.3
	06 August	4	155														
Total		24	897	2	0.2	26	2.9	6	0.7	29	3.2					7	0.8
Nickels	18 May	4	196					4	2.0								
Rapids	05 June	4	91														
	20 June	4	112			4	3.6			5	4.5						
	16 July	4	168	3	1.8	16	9.5	6	3.6	2	1.2	4	1.5			3	1.8
	23 July	4	97			1	1.0										
	06 August	4	193					1	0.5								
Total		24	857	3	0.4	21	2.5	11	1.3	7	0.8	4	0.5			3	0.4
Frazer	05 June	4	132											1	0.8		
Rapids	20 June	4	182			26	14.3	4	2.2	48	26.4						
	16 July	4	167			8	4.8	1	0.6			1	0.6			2	1.2
	23 July	4	172														
	06 August	4	229			4	1.7										
Total		20	882			38	4.3	5	0.6	48	5.4	1	0.1	1	0.1	2	0.2

Table 15. Continued.

Sample site	Sample period	Number of samples	Volume sampled (m^3)	Number sampled: Channel catfish	per $100m^3$	Catostomid	per $100\ m^3$	Cyprinid	per $100\ m^3$	Common carp	per $100\ m^3$	Hiodon	per $100\ m^3$	Percid	per $100\ m^3$	Sciaenid	per $100\ m^3$
Wolf	22 May	4	262					1	0.4					1	0.4		
Point	04 June	4	286			5	1.7							3	1.0		
	26 June	4	302			19	6.3	2	0.7								
	11 July	4	387			2	0.5	2	0.5								
	24 July	4	361			5	1.4	1	0.3								
	08 August	4	239			1	0.4	3	1.3								
Total		24	1,837			32	1.7	9	0.5					4	0.2		
Poplar	23 May	4	285					1	0.4					8	2.8		
	07 June	4	279			1	0.4							6	2.2		
	25 June	4	236			11	4.7	1	0.4	1	0.4	2	0.8				
	10 July	4	246			2	0.8	1	0.4								
	24 July	4	384			4	3.7	1	0.3								
	08 August	4	266			1	0.3	2	0.8								
Total		24	1,696			19	1.1	6	0.4	1	0.1	2	0.1	14	0.8		

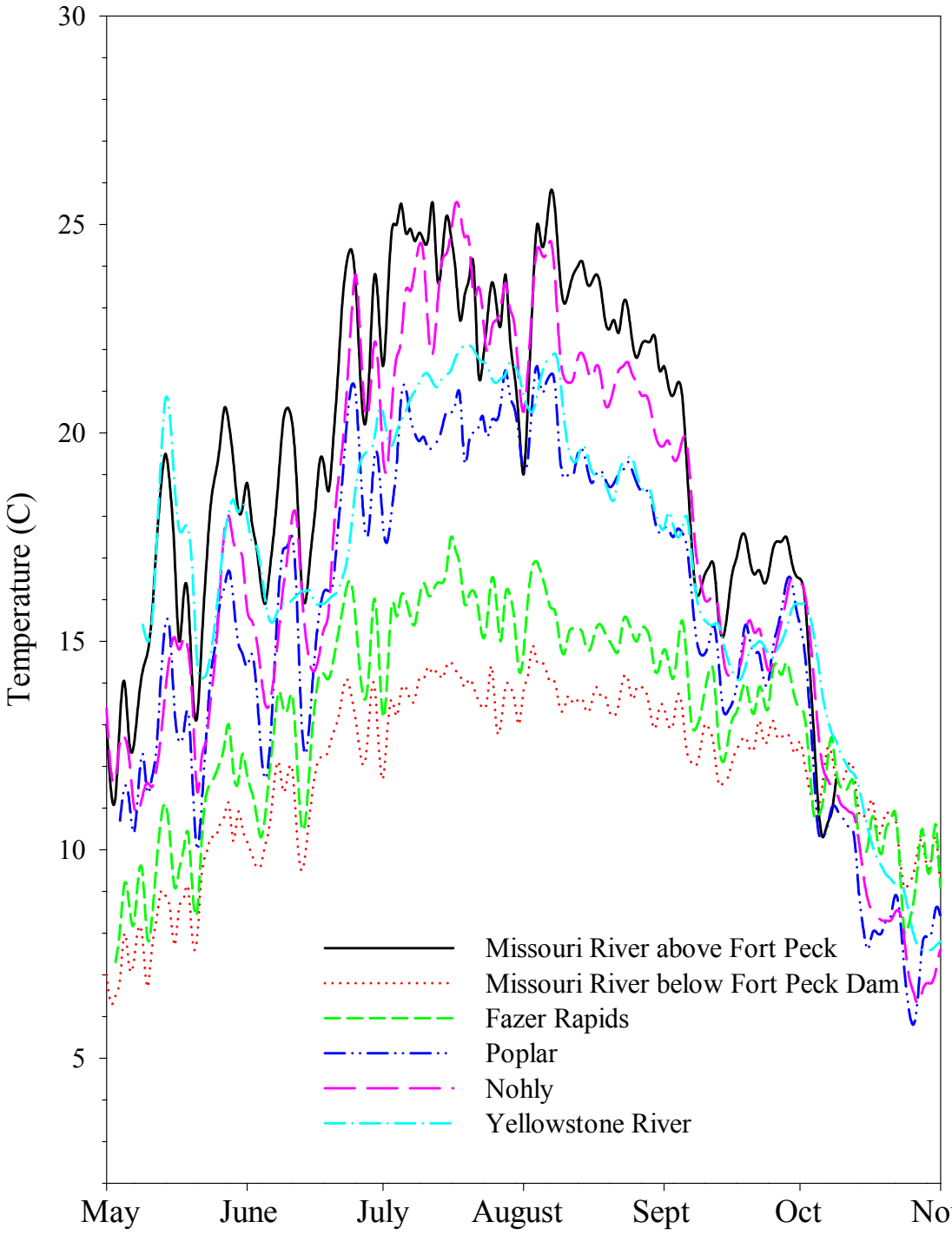

Figure #. Mean daily water temperature at selected sites on the Missouri and Yellowstone rivers, Montana, during 2001.

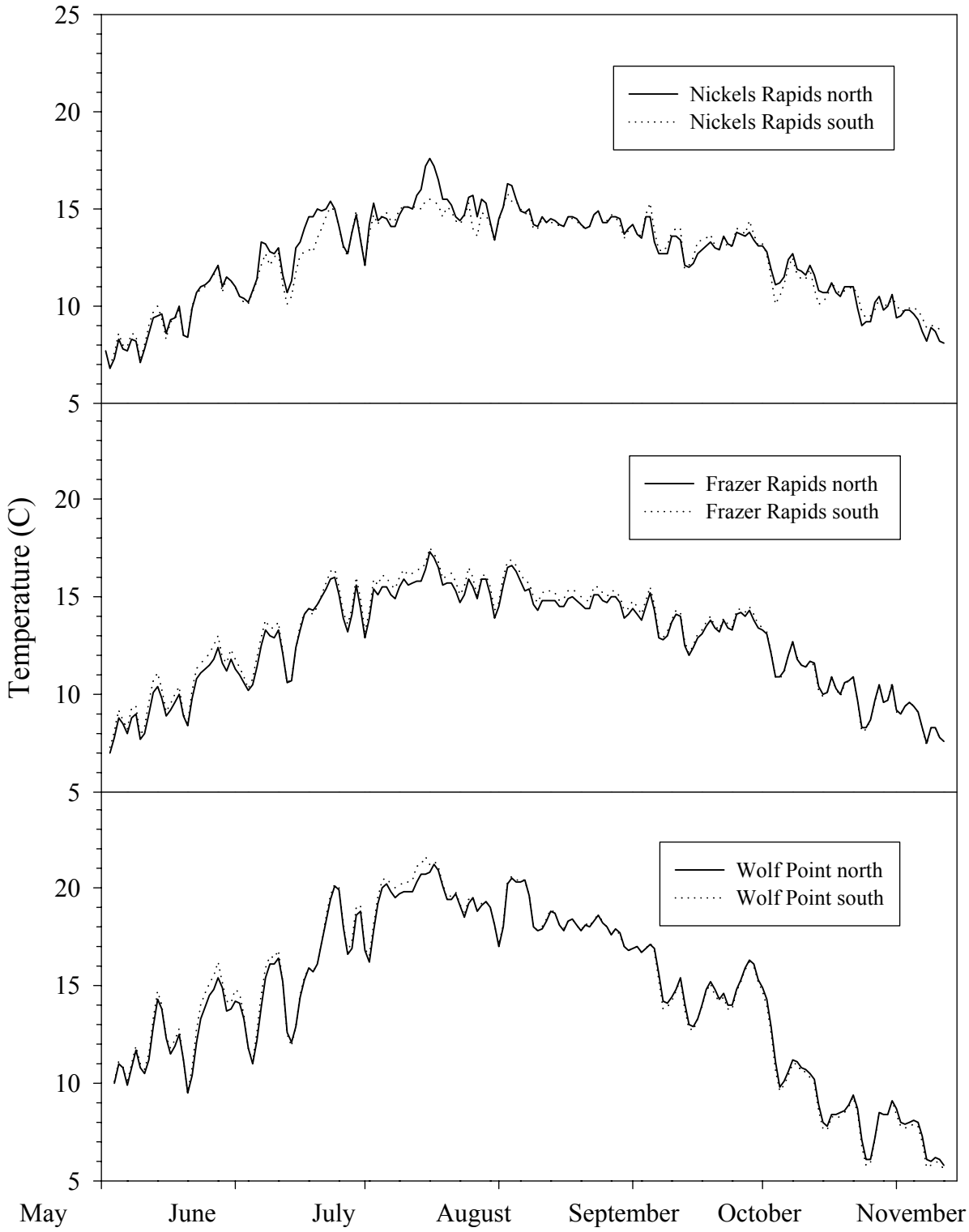

Figure 11. Comparison of north and south bank mean daily water temperatures at Nickels Rapids (RM 1,759), Frazer Rapids (RM 1,744), and Wolf Point (RM 1,708) during 2001.

Sauger Population Characteristics

A total of 404 sauger were captured in our sampling efforts during 2001. Measurement data were collected from 387 sauger. Over 40% of the sauger measured were sampled in the lower Yellowstone River (section 9) during May in drift nets targeting HRJ pallid sturgeons. Most of these fish were in spawning condition at that time. Length and weight distributions were similar in all river sections, although this information is somewhat biased by the types of sampling gears used (Table 16).

A total of 98 sauger were aged using scales and dorsal spine cross sections. Ages determined for sauger ranged from age 1 to age 6 (Table 17). Lengths at age of sauger determined during this study were similar to those reported by Gardner and Stewart (1987) for sauger sampled in the Missouri River during 1979 and 1981. Sauger sampled in the Missouri and Milk rivers during 2001 appeared to be in good condition and growing; growth was evident among all age classes.

Table 16. Number, mean total length (mm), mean weight (g), and respective ranges of sauger sampled in individual river sections in the Milk, Missouri and Yellowstone rivers during 2001. Standard deviations of means are listed in parentheses.

		Total Length		Weight	
Section	*N*	Mean	Range	Mean	Range
0	30	314.7 (47.5)	225-400	262.0 (108.6)	50-475
1	13	382.4 (70.3)	274-545	496.4 (311.4)	265-1,325
2	54	314.2 (46.3)	212-432	252.7 (123.2)	75-675
3	27	334.7 (72.3)	222-531	324.7 (237.2)	75-1,150
4	19	336.8 (64.4)	220-454	313.4 (174.7)	100-625
5	41	343.5 (57.4)	189-477	340.0 (175.5)	50-900
6	38	361.3 (49.3)	267-511	386.8 (201.7)	150-1,100
9	165	365.1 (43.0)	200-526	390.3 (159.9)	125-1,400
Total	387	348.5 (54.5)	189-545	350.7 (181.0)	50-1,400

Table 17. Number, mean total length (mm), and respective ranges of aged sauger sampled in the Milk, Missouri and Yellowstone rivers during 2001. Standard deviations of means are listed in parentheses.

Age	1	2	3	4	5	6
N	2	27	37	24	5	3
Mean	228.5 (12.0)	274.1 (21.5)	337.4 (33.9)	380.8 (27.8)	433.0 (37.4)	473.7 (35.6)
Range	220-237	222-310	278-441	325-426	384-483	440-511

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Appendix 1. Mean, minimum, and maximum monthly discharges for the Missouri River below Fort Peck Dam and at Culbertson, the Milk River at Nashua, and Yellowstone River at Sidney during 2001.

		Discharge (cfs)		
Location	Month	Mean	Minimum	Maximum
Missouri River below Fort Peck Dam (RM 1,763.5)	January	11,300	10,100	11,800
	February	9,575	6,700	11,500
	March	4,674	3,700	6,700
	April	4,060	3,700	4,500
	May	6,155	5,800	6,900
	June	5,890	5,700	6,100
	July	6,010	5,500	6,400
	August	6,306	5,500	7,000
	September	4,203	3,000	6,200
	October	3,858	3,700	4,100
	November	4,083	3,600	5,300
	December	5,300	4,700	5,600
Missouri River at Culbertson (RM 1,621.0)	January	Ice	Ice	Ice
	February	Ice	Ice	Ice
	March	Ice	Ice	Ice
	April	6,041	5,190	7,340
	May	6,506	4,890	7,570
	June	7,335	6,250	9,740
	July	6,875	6,200	8,300
	August	6,194	5,900	6,710
	September	4,623	3,870	6,430
	October	4,243	3,840	4,580
	November	4,909	4,400	9,850
	December	10,230	7,750	12,400
Milk River at Nashua (RM 22.7)	January	Ice	Ice	Ice
	February	Ice	Ice	Ice
	March*	453	90	1,520
	April	62	34	102
	May	12	0	35
	June	700	0	3,160
	July	301	23	1,320
	August	87	12	599
	September	43	17	103
	October	36	28	43
	November*	86	45	192
	December*	148	16	386
Yellowstone River at Sidney (RM 29.5)	January	Ice	Ice	Ice
	February	Ice	Ice	Ice
	March*	6,967	4,300	9,000
	April	5,740	5,000	6,620
	May	9,817	5,110	20,100
	June	15,010	8,820	23,900
	July	7,662	5,090	14,100
	August	2,215	1,010	12,300
	September	2,990	1,220	4,710
	October	4,088	3,440	4,800
	November	4,722	3,470	5,020
	December	4,340	3,100	5,800

* incomplete daily discharge data for month due to ice or equipment failure

Appendix 2. Morphological measurements and Character Index (CI) values of pallid sturgeon captured during 2001.

Date	RM	Head length (mm)	Fork length (mm)	Interrostral length (mm)	Mouth to inner barbel (mm)	Outer barbel (mm)	Inner barbel (mm)	WT (kg)	Pit tag #1	Pit tag #2	Recapture?	CI
24 Apr	1,581.5	455	1405	211	67	165	60	13.6	1F4A111C6A		Y	541.3
24 Apr	1,581.5	486	1615	202	70	143	38	26.8	220E345E09		N	510.6
25 Apr	1,581.5	457	1455	222	73	142	49	16.8	220F107A6F		N	517.8
25 Apr	1,581.5		1448					17.7	1F4A363031		Y	
25 Apr	1,581.5	332	1092	142	72	90	55	5.3	220E587576		N	343.7
25 Apr	1,581.5	462	1420	226	63	149	49	17.7	15679374A		N	562.9
25 Apr	1,581.5	425	1356	200	66	138	57	14.8	115529097A		N	497.4
25 Apr	1,581.5	427	1365	205	68	136	52	13.2	1F482F3F2B		Y	504.9
26 Apr	1,581.5	490	1541	219	75	139	47	22.7	1F4A27214F		Y	508.4
26 Apr	1,581.5	478	1465	233	68	140	42	18.6	220E5F4928		N	557.9
26 Apr	1,581.5	438	1394	198	61	142	52	19.5	7F7D3C5708		Y	521.6
05 May	Y 6.5	485	1533	233	74	148	56	21.8	1F477B4E51		Y	513.0
05 May	Y 6.5	463	1473	213	65	135	52	20.0	7F7B026102		Y	508.9
05 May	Y 6.5	476	1500	227	75	162	62	15.9	220F0F7677		N	516.1
05 May	Y 6.5	405	1254	197	64	109	40	10.0	7F7D7C2447		Y	511.4
05 May	Y 5.5	450	1424	205	61	145	52	15.4	2224076523		N	530.4
13 Aug	1,581.5	505	1599	233	67	140	61	30.2	1F54756038	1F5420727B	Y	499.5

Appendix 3. Capture statistics of tagged shovelnose sturgeon recaptured in the Milk (K), Missouri (M), and Yellowstone (Y) rivers during 2001.

Tag No.	Capture date	RM	FL (mm)	WT (g)	Recapture date	RM	FL (mm)	WT (g)
647[1]	09/29/93	M-1,573	602	908	05/10/01	Y-2.5	615	950
5818	09/29/94	M-1,761	572	772	06/04/01	M-1,748	630	1,000
398	04/29/99	M-1,770	585	900	06/28/01	M-1,766	588	900
384	05/19/99	Y-4.5	618	875	05/08/01	Y-8	630	1,150
770	05/20/99	Y-11.6	513	690	05/11/01	M-1,580	611	925
750	05/24/99	M-1,770	658	1,025	08/06/01	M-1,761	662	1,050
805	05/25/99	K-4.5	624	1,050	07/19/01	M-1,757.5	626	925
535	05/26/99	Y-7.5	681	1,350	05/09/01	Y-7.5	642	1,350
513	05/27/99	K-4.5	578	800	07/12/01	M-1,681	578	775
571	05/27/99	K-4.5	645	1,300	06/04/01	M-1,748	646	1,150
572	05/27/99	K-4.5	691	1,550	08/06/01	M-1,761	684	1,275
588	05/27/99	K-4.5	730	1,800	08/16/01	M-1,581.5	735	1,725
955	06/07/99	M-1,770	615	840	06/27/01	M-1,770	620	825
917	06/14/99	K-4.5	583	950	08/06/01	M-1,761	601	925
8612	06/21/99	M-1,770	710	1,425	08/22/01	M-1,622	680	1,300
9567[2]	08/11/99	Y51.5	590	850	08/14/01	M-1,581.5	625	925
8347	09/13/99	M-1,770	711	1,925	05/09/01	Y-8	715	1,800
8370	04/28/00	M-1,770	641	950	08/06/01	M-1,761	654	1,000
9008	05/04/00	Y-11.6	921	4,300	08/16/01	M-1,581.5	930	4,075
8825	08/03/00	M-1,770	634	1,050	09/25/01	M-1,770	637	1,000
8931	08/16/00	Y-11.0	504	450	05/09/01	Y-8	512	500
9911	08/16/00	Y-7.5	624	950	08/15/01	M-1,577	632	1,000
9822	05/08/01	Y-7.0	705	1,975	08/14/01	M-1,581.5	718	1,650
9830	05/09/01	Y-7.0	764	2,200	08/15/01	M-1,579	750	2,000
9825	05/11/01	M-1,576	650	950	08/13/01	M-1,581.5	650	975
8934	06/05/01	M-1,757.5	605	975	07/19/01	M-1,757.5	597	1,050
9628	06/12/01	K-0	764	1,975	07/19/01	M-1,761	754	1,800
434[3]					08/13/01	M-1,581.5	793	2,100
8116[3]					05/08/01	Y-8	612	1,250
8389[3]					04/24/01	M-1,581.5	776	1,950

[1]-Tag 5385 replaced by tag number 647
[2]-Tag 8382 replaced by tag number 9567
[3]-Original tagging data unavailable

Appendix 4. Phylogenetic list of fish species sampled in the Missouri and Yellowstone rivers during 2001. Asterisks denote introduced species.

Pallid sturgeon (*Scaphirhynchus albus*)
Shovelnose sturgeon (*S. platorynchus*)
Paddlefish (*Polyodon spathula*)
Channel catfish (*Ictalurus punctatus*)
Stonecat (*Noturus flavus*)
River carpsucker (*Carpiodes carpio*)
Longnose sucker (*Catostomus catostomus*)
White sucker (*C. commersoni*)
Blue sucker (*Cycleptus elongatus*)
Smallmouth buffalo (*Ictiobus bubalus*)
Bigmouth buffalo (*I. cyprinellus*)
Shorthead redhorse (*Moxostoma macrolepidotum*)
Common carp* (*Cyprinus carpio*)
Western silvery minnow (*Hybognathus argyritis*)
Plains minnow (*H. placitus*)
Sturgeon chub (*Macrohybopsis gelida*)
Sicklefin chub (*M. meeki*)
Flathead chub (*Platygobio gracilis*)
Emerald shiner (*Notropis atherinoides*)
Spottail shiner* (*N. hudsonius*)
Fathead minnow (*Pimephales promelas*)
Longnose dace (*Rhinichthys cataractae*)
Creek chub (*Semotilus atromaculatus*)
Goldeye (*Hiodon alosoides*)
Cisco* (*Coregonus artedii*)
Lake whitefish* (*C. clupeaformis*)
Rainbow smelt* (*Osmerus mordax*)
Rainbow trout* (*Oncorhynchus mykiss*)
Brown trout* (*Salmo trutta*)
Northern pike* (*Esox lucius*)
Burbot (*Lota lota*)
Green sunfish* (*Lepomis cyanellus*)
Black crappie* (*Pomoxis nigromaculatus*)
Yellow perch* (*Perca flavescens*)
Sauger (*Stizostedion canadense*)
Walleye* (*S. vitreum*)
Freshwater drum (*Aplodinotus grunniens*)