2016 Field-based Biotic Assessments of Migration and Spawning – Upper Missouri River and Milk River

Background

The lower Yellowstone River and Missouri River between Fort Peck Dam and Lake Sakakawea is inhabited by a wild adult population of pallid sturgeon. Over the last two decades, pallid sturgeon in this section of the upper Missouri River Basin have been the focus of several studies examining movements, migrations and habitat use (for example, Bramblett and White, 2001; Fuller and others, 2008; Fuller and Braaten, 2012; DeLonay and others, 2014).

The USGS and MTFWP collaborated on studies during 2011–2016 which focused on examining migrations, habitat use, and spawning of pallid sturgeon in the Yellowstone River. A similar approach is used for the upper Missouri River and Milk River area. Information is collected to determine what flows are associated with migrations and spawning of pallid sturgeon in the Missouri River downstream from Fort Peck Dam. This study will evaluate use, migrations, and spawning of pallid sturgeon in the Milk River and Missouri River downstream from Fort Peck Dam.

The objectives of this work were to (1) assess pallid sturgeon migrations and use of the Milk River and Missouri River between Fort Peck Dam and the Yellowstone River confluence; (2) quantify reproductive products (eggs, free embryos, larvae) and potential spawning reaches in the Missouri River below Fort Peck Dam; and (3) assess and quantify settlement of pallid sturgeon larvae from the drift based on collections of young-of-year pallid sturgeon in lower reaches of the Missouri River.

In 2016, several telemetered fish, including all gravid females were removed from the river and taken to Garrison National Fish Hatchery, to be artificially spawned and have their progeny used to conduct a larval drift study.

Methods

The Missouri River study area extends from Fort Peck Dam located at RM1,770.0 downstream to RM 1,553.5 (near Williston, North Dakota; fig 1). The study area also included the lower 115 miles of the Milk River from Vandalia Dam to its confluence with the Missouri River.

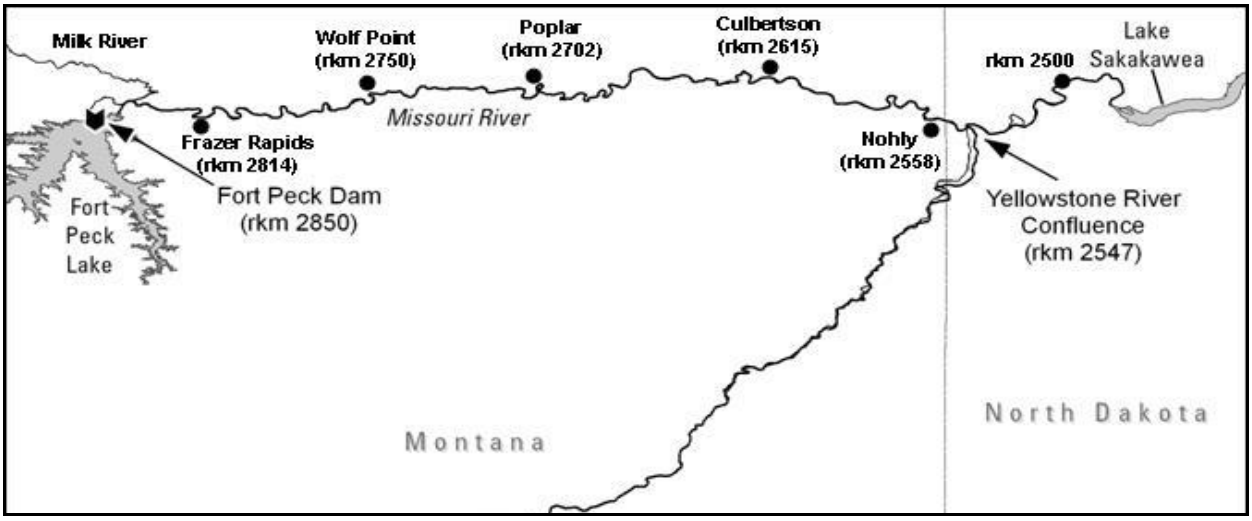

Figure 1. Study area of the Missouri River, Milk River and Lower Yellowstone River.

Pallid sturgeon were sampled using drifted trammel nets and were implanted with radio-telemetry transmitters (MCFT-3L tags, 16 mm x 73 mm, air weight = 26 g, 2,929-day longevity, 5-second pulse interval, 149.760 megahertz (Mhz), Lotek Wireless Incorporated, New Market, Ontario). The coded signal emitted by each transmitter is unique to facilitate identification of individual fish. The signal from each transmitter is encoded with a digital identification code (code). New transmitters used at reimplantation may have a different code than the expired tags

they replace. Sturgeon reimplanted multiple times could have multiple codes through time. Surgical procedures followed methods outlined in Braaten and Fuller (2005). Most fish were collected in prior years during broodstock collection near the confluence of the Missouri and Yellowstone Rivers.

Manual tracking of fish by boat during 2016 was initiated in April. The Missouri River between Fort Peck Dam and Wolf Point (70 miles) was tracked sporadically from April through October. The Milk River was only manually tracked when the ground-based telemetry station, located near the mouth, detected a wild adult pallid sturgeon. One radio frequency (149.760 MHz) was monitored during the boat-tracking run using a 4-element Yagi antennae. Several variables including, radio frequency, code, latitude, longitude, and time-of-day were recorded when a fish was located.

Stationary telemetry logging stations were deployed in April 2016 at four sites on the Missouri River (Nickels, RM 1,760; near Wolf Point, RM 1,720; near Culbertson, RM 1,618; at RM 1,584 just upstream from the Yellowstone River confluence) and one site on the Milk River (RM 2.5). Additionally, there were several sites on the Yellowstone River which are discussed in the previous section of this report. The logging stations were placed on shore with two 4-element Yagi antennae, one facing upstream and one downstream. Each logging station was equipped with a battery powered receiver (Lotek SRX- 400), solar panel, an environmental enclosure kit containing dual 12-volt batteries, and an antenna switchbox. Data recorded by the logging stations were downloaded to a laptop computer two times per month between April and October. Coupled with manual tracking efforts, the array of telemetry logging stations facilitated detection of dates and times of movement events between and within rivers and river reaches.

The Missouri River near Wolf Point was sampled for *Acipensiformes* free embryos and larvae following methods outlined in Braaten and others (2010). Samples were collected two times per week at multiple locations. After sampling was completed, net contents were transferred to black rubber trays where *Acipensiformes* free embryos (sturgeon and paddlefish) were extracted from the detritus. Extracted *Acipensiformes* free embryos were then placed immediately in 95 percent nondenatured ethanol in preparation for genetic analysis. Specimens were sent for genetic analysis following methods outlined in Eichelberger and others (2014). The Milk River was only sampled if Adult pallid sturgeon were present in the river.

Targeted sampling for larval and young-of-year pallid sturgeon followed trawling methods outlined in Braaten and others (2007). Samples were collected every week from late-July through early-September. Sampling for young-of-year sturgeon (*Scaphirhynchus* spp.) were collected using a benthic (beam) trawl in the Missouri River upstream from the Yellowstone River confluence and in the Missouri River downstream of the Yellowstone River confluence. Four replicate sampling locations were established at each site where each replicate was comprised of an inside bend, outside bend, and channel crossover habitat complex associated with a river bend. Fin clips were obtained for all sturgeon species collected, and stored in 95 percent ethanol. The larvae and young-of-year samples were sent for genetic analysis to distinguish individuals as pallid sturgeon or shovelnose sturgeon. If a specimen was identified as a pallid sturgeon, further analysis was done to determine parentage.

Progress

Discharge and temperature

Although discharge from the Yellowstone River averaged only 12,573 ft^3/s in the April–May pre-spawn migration season, this was still much greater than the Missouri River at Culbertson (9,086 ft^3/s) during this same time (fig. 2). The Yellowstone river peaked on June 12 at a discharge of 31,400 cfs. The Milk River reached a maximum of nearly 8,400 cfs on May 14. This resulted in a maximum discharge in the Missouri River at Culbertson to be 15,200 cfs on May 16-17. The Milk River was greater than 1,000 cfs during 53 days in May through July, this was mostly due to the lowering of Nelson Reservoir (an off-storage reservoir which is part of the Milk River Irrigation Project). Water temperature warmed with increasing distance from Fort Peck Dam due to tributary inputs and longitudinal warming (fig. 3). Water temperature at Wolf Point averaged 5.1 °C warmer than at a site five miles downstream from Fort Peck Dam (School Trust site) from May-July and averaged 8.1 °C warmer at above the Yellowstone River confluence compared to School Trust during this same time frame. However, thermal suppression from the Dam remained evident as temperatures remained about 2.3 °C cooler in the Missouri River above the Yellowstone River confluence (Nohly) compared to the Yellowstone River. Temperature in Fort Peck Reservoir averaged 18.9 °C from June 15–July 15 (time of spawning and larval drift) which is 7.8 °C warmer than the School Trust temperature during this time.

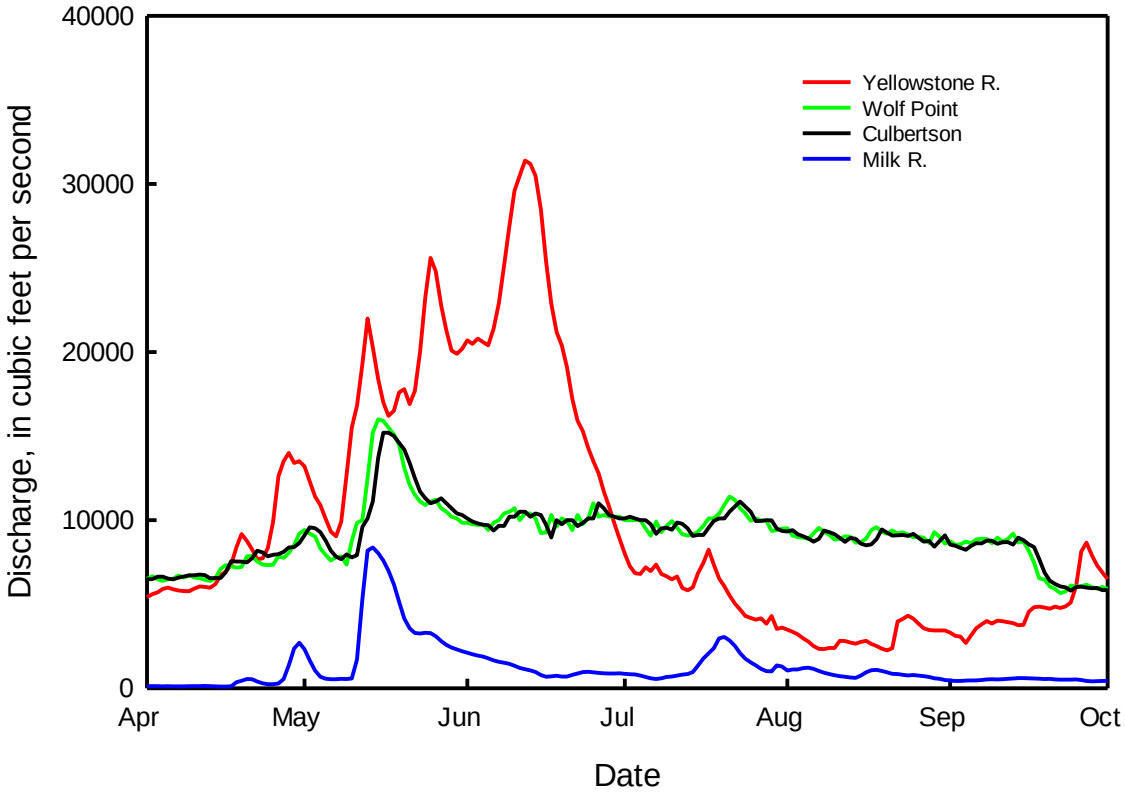

Figure 2. Mean daily discharge (in cubic feet per second) in the Missouri River at Culbertson, Montana (streamgage 06185500), Missouri River at Wolf Point, Montana (streamgage 06177000), in the Milk River at Nashua, Montana (streamgage 06174500) and in the Lower Yellowstone River at Sidney, Montana (streamgage 06329500) during 2016.

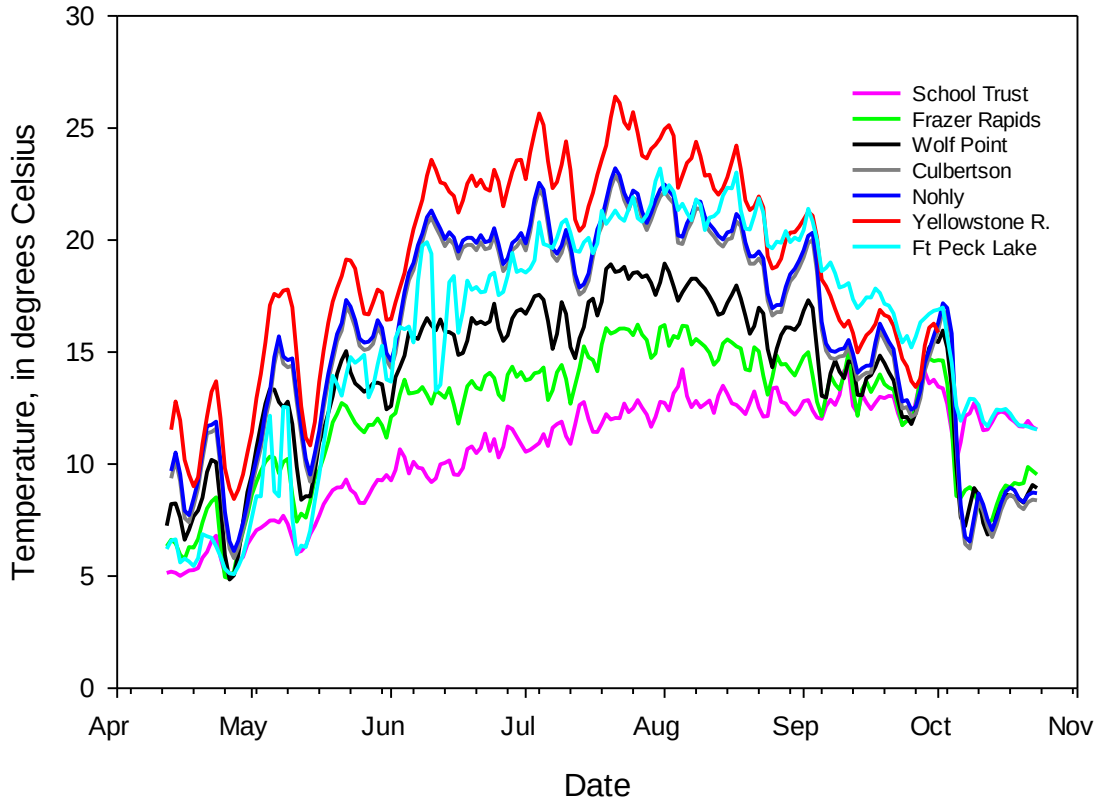

Figure 3. Water temperature (in degrees Celsius) for Missouri River sites (below Ft. Peck Dam, Frazer Rapids, Wolf Point, Culbertson, Nohly, Lower Yellowstone River and Ft. Peck Reservoir during 2016.

Migration Patterns

Telemetered wild adult pallid sturgeon (*n*=41) were manually tracked in the Missouri River ATC to Fort Peck Dam. Of these fish, 3 were non-gravid females and 38 were males. No gravid females were available for this study this year as the priority for these fish was for the larval drift test. Use in the Missouri River ATC had a maximum of 30% of fish in mid-May following a large discharge event from the Milk River (figs. 4). However, most forays into the Missouri River ATC were in lower portions of the river and of short duration. A total of 14 fish migrated beyond the Culbertson ground station (about 25 miles). Ten of these fish made this

migration during these higher flows in mid-May. Fish quickly emigrated out of the Missouri as flows receded and entered the Yellowstone River. Then, as in most years, use of the Missouri River increased in late June, as fish completed spawning in the Yellowstone River and migrated to post-spawn areas in the Missouri River above and below the confluence of the Yellowstone River, where most would eventually over-winter (Fig. 5).

Only three fish were located above the Wolf Point ground-based telemetry station (RM 1,720; about 140 miles upstream) in 2016. These were all males and made this long migration at different times of the year. One fish came up above the Wolf Point ground station for two days in May, another migrated above the ground station in late July and lastly, a male that over-winters below Fort Peck Dam migrated to upper areas of the Missouri River in October

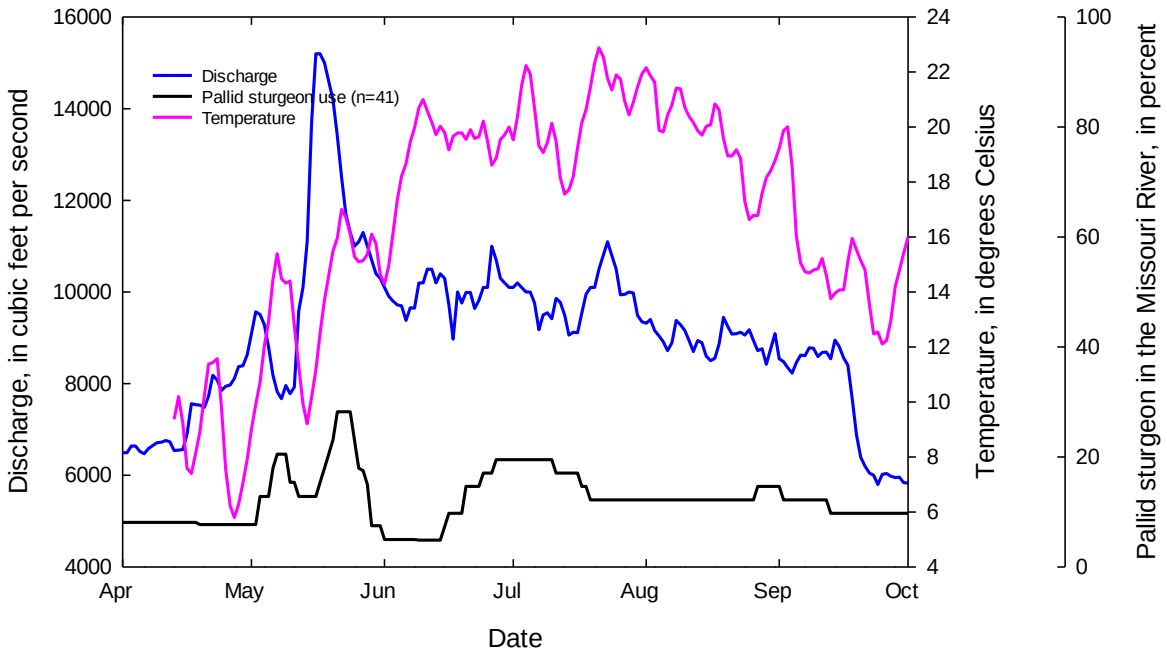

Figure 4. Percentage of telemetered adult pallid sturgeon located in the Missouri River upstream of the confluence with the Yellowstone River and discharge and temperature at Culbertson, Montana in 2016.

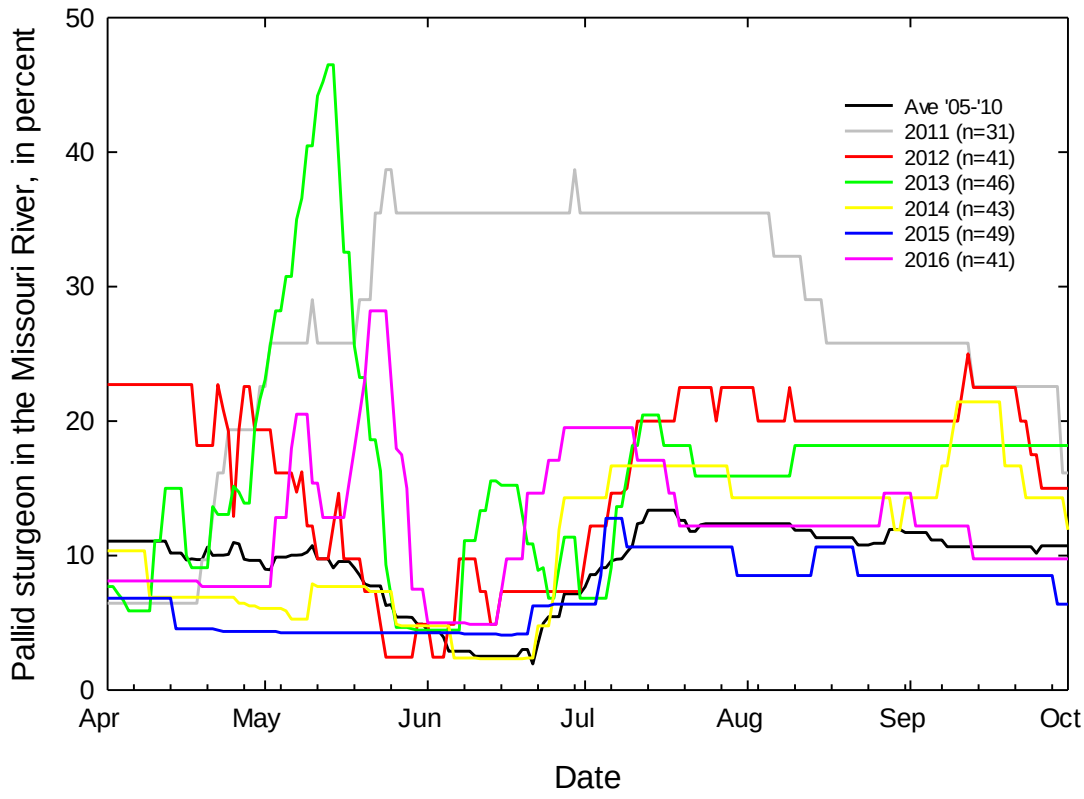

Figure 5. Percentage of telemetered adult pallid sturgeon located in the Missouri River upstream of the confluence with the Yellowstone River by date from an average of 2005 – 2010 and individually from 2011 - 2016. N = number of implanted individuals.

Free-embryo sampling

The Milk River was not sampled for free embryos during 2016 since no telemetered adult pallid sturgeon were detected.

The Missouri River near Wolf Point was sampled for free-embryos during 13 events from June 3 through July 28, 2016. A total of 62 paddlefish, 16 sturgeon and 5 unknown free embryos

were collected (table 1). Standard free-embryo sampling was not conducted in early July as all crews were assisting with the larval drift test.

Table 1. Numbers of *Acipenseriformes* free embryos collected by date in the Missouri River near Wolf Point in 2016.

Date	3-Jun	6-Jun	9-Jun	13-Jun	16-Jun	21-Jun	24-Jun	28-Jun
Paddlefish	28	3	1	4	0	0	1	4
Sturgeon	0	0	0	0	0	0	0	0
unknown	0	0	0	0	0	0	0	0

Date	12-Jul	18-Jul	21-Jul	25-Jul	28-Jul	Total
Paddlefish	0	1	2	6	12	62
Sturgeon	0	0	1	9	6	16
Unknown	0	0	0	0	5	5

Table 1. Numbers of *Acipensiformes* free embryos collected by date in the Missouri River near Wolf Point in 2016.

Larvae and young-of-year sampling

Beam trawling for young-of-year sturgeon was conducted weekly from July 20 through September 8, 2016. Channel catfish (*Ictalurus punctatus*), emerald shiner (*Notropis atherinoides*), sicklefin chub (*Macrhybopsis meeki*), and young-of-year sturgeon made up 39.1, 18.9, 13.3, and 12.6 percent of the catch, respectively (table 2). A total of 395 young-of-year sturgeon was collected in the Missouri River downstream of the Yellowstone River confluence and 15 were collected in the Missouri River upstream of the confluence. There was a wide range of cohorts indicating that there was a prolonged spawn, likely from the Missouri River (table 3). Additionally, several large, earlier spawned individuals were collected and are likely of Yellowstone River or Powder River origin. All 410 sturgeon (*Scaphirhynchus* sp.) samples were sent to Southern Illinois University for genetic analysis.

Table 2. Fish collected with the benthic trawl in the Missouri River above the confluence of the Yellowstone River (ATC), Missouri River below the confluence of the Yellowstone River (BTC), and total catch from July 22 to September 9, 2015.

Species	Missouri River ATC	Missouri River BTC	Total
Number of trawls without fish	37	25	62
Common carp (*Cyprinus carpio)*		4	4
Channel catfish (*Ictalurus punctatus)*	26	1,251	1,277
Emerald shiner (*Notropis atherinoides)*	3	613	616
Fathead minnow (*Pimephales promelas)*		2	2
Flathead chub (*Platygobio gracilis)*	5	9	14
Freshwater drum (*Aplodinotus grunniens)*	1	54	55
Goldeye (*Hiodon alosoides)*		18	18
Unidentified chub *(Hybognathus* spp.*)*		3	3
Longnose Dace *(Rhinichthys cataractae)*	1	1	2
Longnose sucker *(Catostomus catostomus)*		1	1
Pallid sturgeon *(Scaphirhynchus albus)*[1]	1		1
River carpsucker (*Carpiodes carpio)*		6	6
Sand shiner *(Notropis stramineus)*		1	1
Sauger (*Sander canadensis)*	3	6	9
Shorthead redhorse *(Moxostoma macrolepidotum)*	1	1	2
Shovelnose sturgeon *(Scaphirhynchus platorynchus)*	1	13	14
Shovelnose sturgeon (young-of-year)	15	395	410
Sicklefin chub *(Macrohybopsis meeki)*	82	180	262
Smallmouth buffalo *(Ictiobus bubalus)*		1	1
Sturgeon chub (*Macrhybopsis gelida)*	36	398	434
Stonecat *Noturus flavus)*	19	45	64
White Bass (*Morone chrysops)*		3	3
White crappie (*Pomoxis annularis)*		1	1
Total	231	3,031	3,262

[1]Nonwild, hatchery-origin.

Table 2. Fish collected with the benthic trawl in the Missouri River above the confluence of the Yellowstone River (ATC), Missouri River below the confluence of the Yellowstone River (BTC), and total catch from July 20 to September 8, 2016.

Table 3. Number of larval and young-of-year sturgeon collected in standard trawls, targeted trawls, minimum length, maximum length, and mean length by date in 2016.

Date	Total number	Standard number	Targeted number	Minimum length, in millimeters	Maximum length, in millimeters	Mean length, in millimeters
7/20/2016	1	1	0	n/a	n/a	55
7/27/2016	19	5	14	18	28	20.1
8/3/2016	172	23	149	15	44	25.6
8/9/2016	24	24	0	22	106	33.9
8/17/2016	60	16	44	17	64	40.6
8/24/2016	86	19	67	21	113	43.8
8/29/2016	12	5	7	34	87	54.9
9/8/2016	36	14	22	33	101	77.8

Table 3. Number of larval and young-of-year sturgeon collected in standard trawls, targeted trawls, minimum length, maximum length, and mean length by date in 2016.

Genetic results from 2015

Genetic analysis of free embryos (*n*=27), larvae and young-of-year sturgeon (*n*=46) collected from the Missouri River in 2015 was completed during 2016. No specimens were identified as pallid sturgeon (Dr. Edward Heist, University of Illinois Carbondale, written commun., 2016).

Discussion

Under present hydrologic conditions in the Upper Missouri River, very few wild adult pallid sturgeon use the Missouri River downstream from Fort Peck Dam, particularly during the spawning season. As in most previous years, higher flows in the Yellowstone River triggered pre-spawn migrations upstream into the Yellowstone River and most fish maintained residency

there throughout May and June in 2016. Even though Milk River discharge was relatively high this year, and did attract 30% of the population into the Missouri River ATC, it was not high enough to result in the long migrations up to the Milk River as they did in 2011 and 2014. In both of those years, cumulative discharge was greater than 20,000 cfs. The highest discharge of the Missouri River in 2016 was 15,200 cfs.

Unlike pallid sturgeon, there is a resident population of shovelnose sturgeon in the upper reaches of the Missouri River. There was a secondary pulse in the Milk River on July 20th of over 3,000 cfs. This warm, turbid pulse of water likely resulted in a trigger for shovelnose sturgeon to spawn in areas of the Missouri River. To support this hypothesis, the last two sampling dates, on July 25 and July 28, yielded 15 of the 16-sturgeon free-embryo's, there was likely reproduction (or at least hatch) continuing into August as well. Additionally, the capture of 410 young-of-year sturgeon is the highest since these methods became standardized in 2003. Given the small size of these fish relative to when they were captured, most of them likely originated from the Missouri River.

Documentation of use, spawning and reproduction in the Missouri River in 2011 indicates that the Missouri River may be used by pallid sturgeon under some hydrologic conditions regardless of water temperature (DeLonay and others, 2014). Temperature is still a very important variable as it would shorten embryonic development time, resulting in shorter drift distance, as well as increase the overall productivity of this dam-affected section of the Missouri River. Verification of successful reproduction by wild pallid sturgeon in 2011 demonstrated that spawning, fertilization, egg survival, and hatch can occur in the Missouri River when flows deviate from conventional reservoir operations (DeLonay and others, 2014). Additional information may develop understanding of how flow releases from Fort Peck Dam

could be managed to increase attraction and retention of pallid sturgeon into this section, without flooding. Since very few sexually mature adult pallid sturgeon have been observed in the Upper Missouri River to date, limited data exist to specify the flow parameters required to stimulate wild pallid sturgeon migrations and spawning.