2017 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 2011–2017 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.

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.

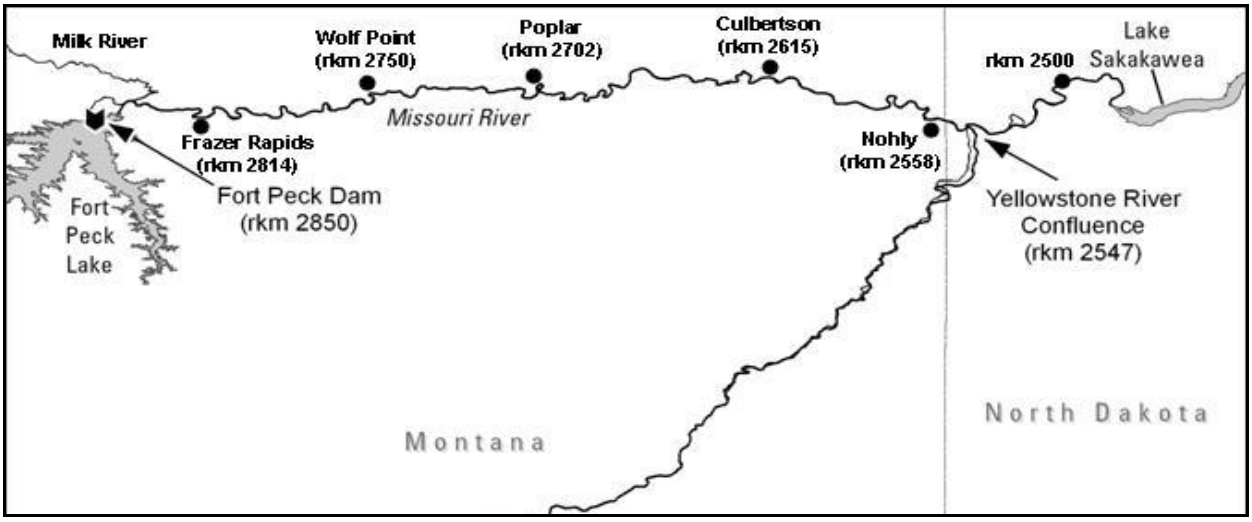

Figure 1. Study area of the Missouri River, Milk River and Lower Yellowstone River.

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 2017 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 before April 2017 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

Discharge from the Yellowstone River averaged much greater (26,700 cfs) than in the Missouri at Culbertson (8,230 cfs) during the April – May pre-spawn migration season (fig. 2). The Yellowstone River peaked on June 10 at a discharge of 57,300 cfs. The Milk River did not exceed 1000 cfs after April 9 and did not exceed 500 cfs after April 23. The Missouri River was

had very little variance in discharge at Culbertson and ranged from 7,090 cfs to 9,830cfs during May through July. Water temperature warmed with increasing distance from Fort Peck Dam due to tributary inputs and longitudinal warming (fig. 3). From May – July, water temperature averaged 10.0 ^{o}C below Fort Peck Dam, 15.6 ^{o}C near Poplar and 18.3 ^{o}C in the Missouri near the confluence with the Yellowstone River. However, thermal suppression from the Dam remained evident as temperatures remained about 1.2 °C cooler in the Missouri River above the Yellowstone River confluence (Nohly) compared to the Yellowstone River. Temperature in Fort Peck Reservoir averaged 19.1 °C from June 15–July 15 (potential time of spawning and larval drift) which is 7.9 °C warmer than the School Trust temperature during this time, thus suggesting temperatures can be increased with releases over the spillway.

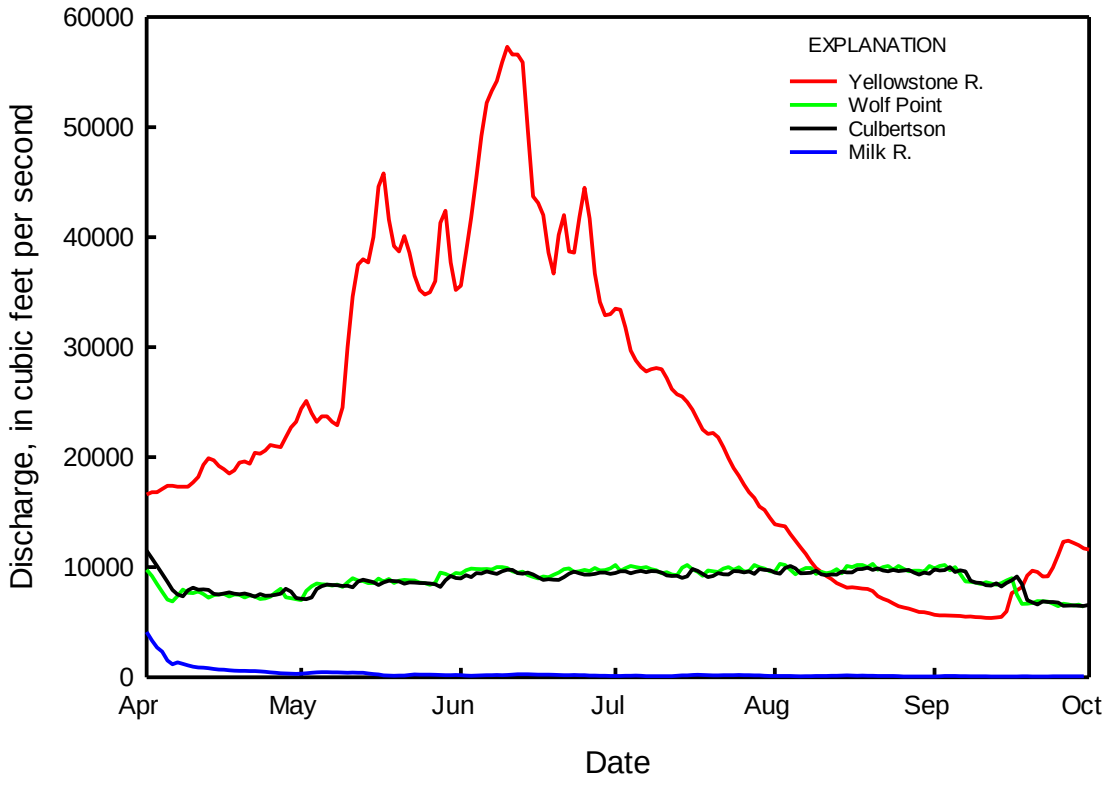

Figure 2. Mean daily discharge (in cubic feet per second) in the Missouri River at Culbertson, Montana (streamgage 06185500), Missouri River at Wolf Point, Montana (streamgage 06177000), in the Milk River at Nashua, Montana (streamgage 06174500) and in the Lower Yellowstone River at Sidney, Montana (streamgage 06329500) during 2017.

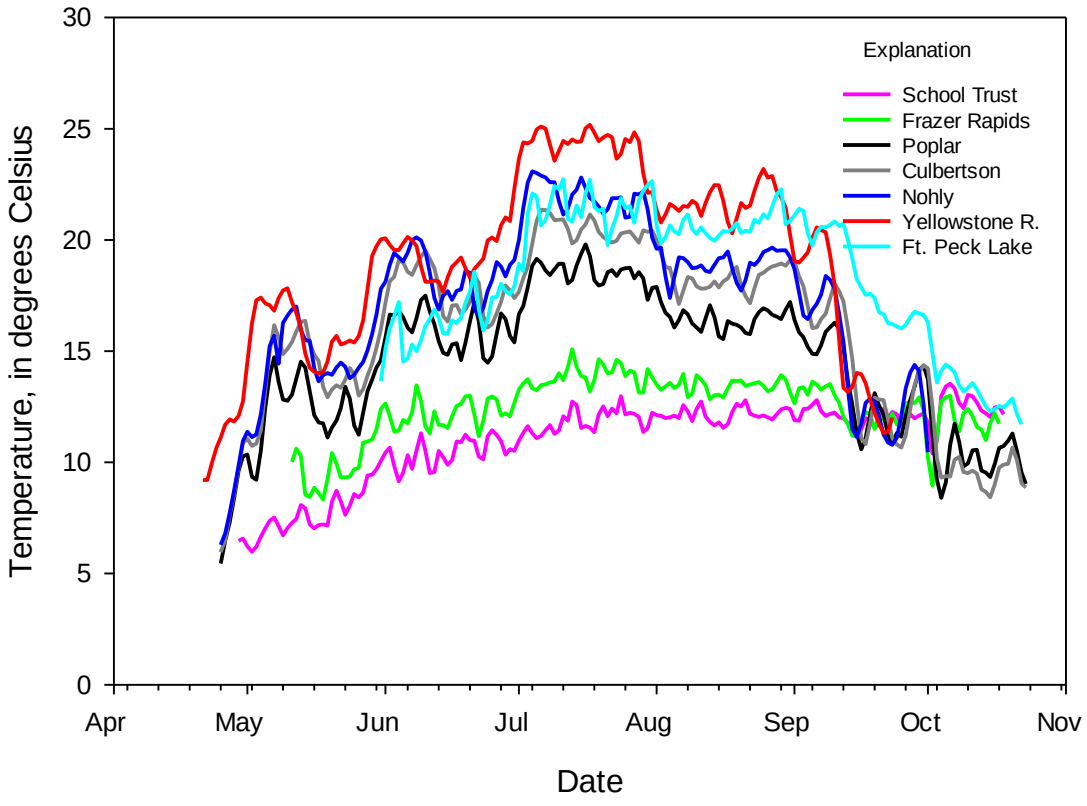

Figure 3. Water temperature (in degrees Celsius) for Missouri River sites (below Ft. Peck Dam, Frazer Rapids, Poplar, Culbertson, Nohly, Lower Yellowstone River, and Ft. Peck Reservoir during 2017.

Migration Patterns

Telemetered wild adult pallid sturgeon (*n*=57) were manually tracked in the Missouri River ATC to Fort Peck Dam. Of these fish, 3 were gravid females, 5 were non-gravid females 48 males and one unknown. Use in the Missouri River ATC had a maximum of 17% of fish in

early April and continually decreased to 3.5 % through most of June (figs. 4 and 5). Then, as in most years, use of the Missouri River increased slightly 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 2017. These were two males and an unknown sex fish. The two males over-wintered in upper reaches of the Missouri River and made downstream migrations to the Yellowstone River in mid-May. The unknown sex fish came up the Missouri R. in April to the RM 1720 and then emigrated out of the Missouri R. at the end of June.

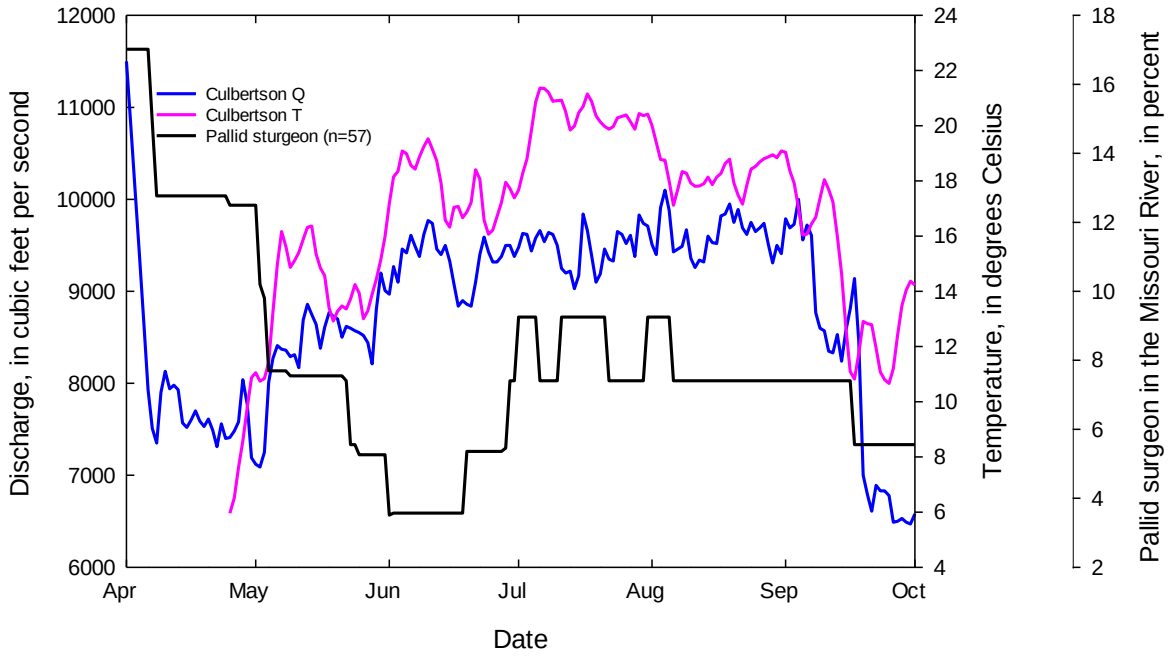

Figure 4. Percentage of telemetered adult pallid sturgeon located in the Missouri River upstream of the confluence with the Yellowstone River and discharge and temperature at Culbertson, Montana in 2017.

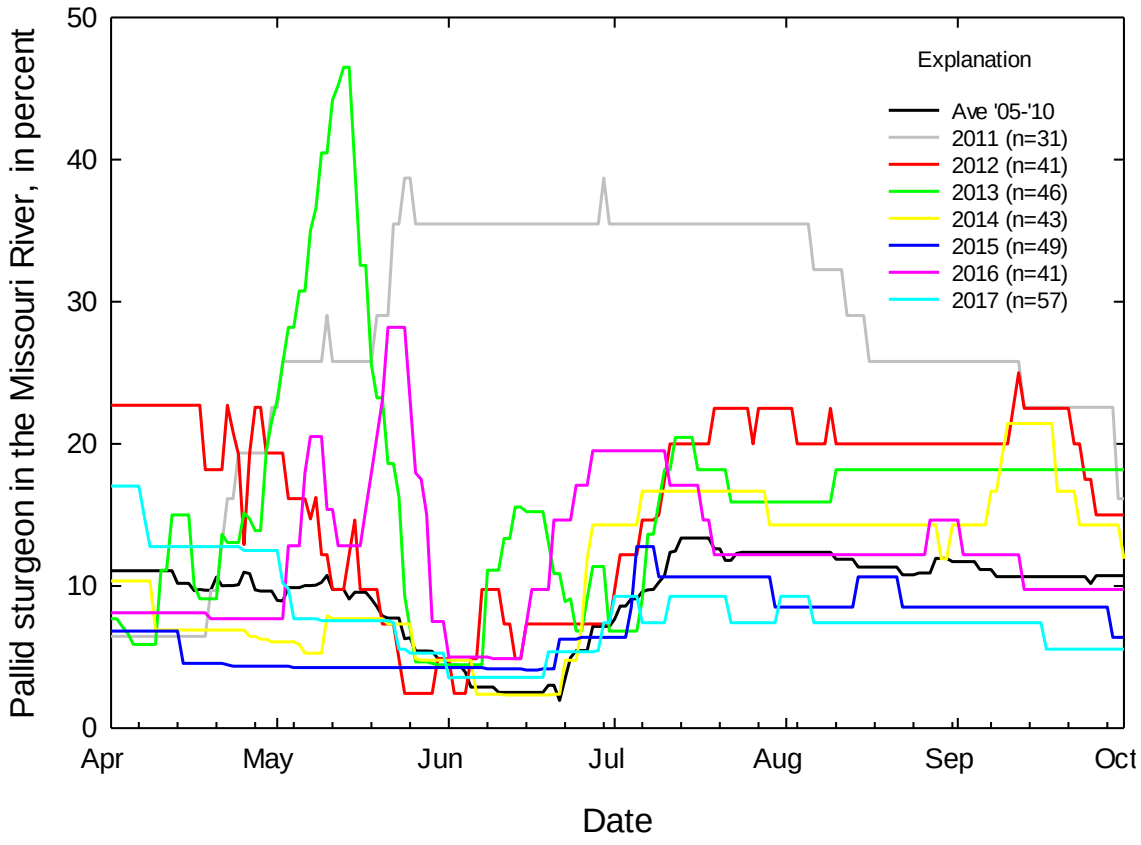

Figure 5. Percentage of telemetered adult pallid sturgeon located in the Missouri River upstream of the confluence with the Yellowstone River by date from an average of 2005 – 2010 and individually from 2011 - 2017. N = number of implanted individuals.

Free-embryo sampling

The Milk River was not sampled for free embryos during 2017 since no telemetered adult pallid sturgeon were detected.

The Missouri River near Wolf Point was sampled for free-embryos during 17 events from May 31 through August 3, 2017. A total of 5 paddlefish, 5 sturgeon and 1 unknown free embryos were collected (table 1).

Date	**31-May**	**6-Jun**	**9-Jun**	**15-Jun**	**19-Jun**	**22-Jun**	**26-Jun**	**28-Jun**
Paddlefish	0	0	0	0	0	0	0	0
Sturgeon	0	0	0	0	0	0	0	0
unknown	0	0	0	0	0	0	0	0
Date	**3-Jul**	**6-Jul**	**10-Jul**	**13-Jul**	**17-Jul**	**19-Jul**	**24-Jul**	**27-Jul**
Paddlefish	3	0	0	1	0	0	1	0
Sturgeon	0	0	0	1	0	1	2	1
Unknown	0	0	0	0	0	0	1	0
Date	**3-Aug**							**Total**
Paddlefish	0							**5**
Sturgeon	0							**5**
Unknown	0							**1**

Table 1. Numbers of *Acipensiformes* free embryos collected by date in the Missouri River near Wolf Point in 2017.

Larvae and young-of-year sampling

Beam trawling for young-of-year sturgeon was conducted weekly from July 17 through September 6, 2017. Channel catfish (*Ictalurus punctatus*), sturgeon chub (*Macrhybopsis gelida*), and sicklefin chub (*Macrhybopsis meeki*) made up 61.7, 22.1, and 9.2 percent of the catch, respectively (table 2). A total of 69 young-of-year sturgeon was collected in the Missouri River downstream of the Yellowstone River confluence and 5 were collected in the Missouri River upstream of the confluence. All 74 sturgeon (*Scaphirhynchus* sp.) samples were sent to Southern Illinois University for genetic analysis.

Species	Missouri River ATC	Missouri River BTC	Total
Number of trawls without fish	18	3	21
Burbot *(Lota lota)*	3	10	13
Common carp (*Cyprinus carpio)*	1	2	3
Channel catfish (*Ictalurus punctatus)*	139	2,090	2,229
Emerald shiner (*Notropis atherinoides)*	2	10	12
Flathead chub (*Platygobio gracilis)*	12	4	16
Freshwater drum (*Aplodinotus grunniens)*		10	10
Goldeye (*Hiodon alosoides)*		3	3
Unidentified chub *(Hybognathus* spp.*)*		1	1
Longnose Dace *(Rhinichthys cataractae)*	4		4
Longnose sucker *(Catostomus catostomus)*	1		1
Pallid sturgeon *(Scaphirhynchus albus)*[1]		2	2
Sauger (*Sander canadensis)*	1	4	5
Shorthead redhorse *(Moxostoma macrolepidotum)*	3		3
Shovelnose sturgeon *(Scaphirhynchus platorynchus)*	4	28	32
Shovelnose sturgeon (young-of-year)	5	69	74
Sicklefin chub *(Macrohybopsis meeki)*	120	214	334
Sturgeon chub (*Macrhybopsis gelida)*	80	719	799
Stonecat *Noturus flavus)*	19	39	58
Walleye *(Sander vitreum)*	2	7	9
White Bass (*Morone chrysops)*		1	1
White crappie (*Pomoxis annularis)*		1	1
White Sucker *(Catostomus commersoni)*	1		1
Total	397	3,214	3,611

[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 17 to September 6, 2017.

Genetic results from 2016

Genetic analysis of *Acipensiformes* free embryos (*n*=83), larvae and young-of-year sturgeon (*n*=410) collected from the Missouri River in 2016 was completed during 2017. No specimens were identified as pallid sturgeon (Dr. Edward Heist, University of Illinois Carbondale, written commun., 2017).

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. This is not surprising since maximum discharge was less than 10,000 cfs at Culbertson 2017. In 2011 and 2013, discharge exceeded 20,000 cfs which resulted in long migrations of pallid sturgeon up the Missouri River with some fish entering the Milk River. During these years, discharge exceeded 20,000 cfs. As in most previous years, lack of Missouri discharge resulted in fish spawning in the lower Yellowstone 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.

New research has demonstrated that there may also be enough drift distance for some free embryos to transition out of the drift since a 2016 larval drift survivor was found on 8/25/2017. This fish was released as a several hour post hatch larvae and released near the confluence of the Milk River (where spawning was suspected to occur in 2011). 8/25/2017, an unmarked 412mm sturgeon was collected at RM 1580.8 of the Missouri River just below the confluence of the Yellowstone River. Genetic results confirmed this individual originated from a family cross that was ONLY used for the drift study, released on 6/27/2016 (1F497F1801 x 0A180E0E7E) and spawned on 6/21/2016.