Examination of pallid sturgeon use, migrations and spawning in Milk River and Missouri River below Fort Peck Dam during 2014

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Background

The lower Yellowstone River and Missouri River between Fort Peck Dam and Lake Sakakawea is inhabited by a wild adult population of federally endangered pallid sturgeon (*Scaphirhynchus albus*). 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 (e.g., Bramblett and White 2001; Fuller et al. 2008; Fuller and Braaten 2012).

The USGS and MTFWP conducted collaborative studies during 2011- 2014 which focused on examining migrations, habitat use, and spawning of pallid sturgeon in the Yellowstone River. This is a very similar focus for the upper Missouri River/Milk River area. Information is being collected to determine what flows are needed to trigger migrations and spawning of pallid sturgeon in the Missouri River below Fort Peck Dam. This study will focus on evaluating use, migrations, and spawning of pallid sturgeon in the Milk River and Missouri River downstream from Fort Peck Dam.

Scope and Objectives

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 Milk River and 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.

Study Area

The Missouri River study area extended from Fort Peck Dam located at river mile (RM)1770 (rkm 2,850) downstream to RM 1553.5 (rkm 2,500) (near Williston, North Dakota; Figure 1). The study area also included the lower 115 miles of the Milk River from Vandalia Dam to its confluence with the Missouri River.

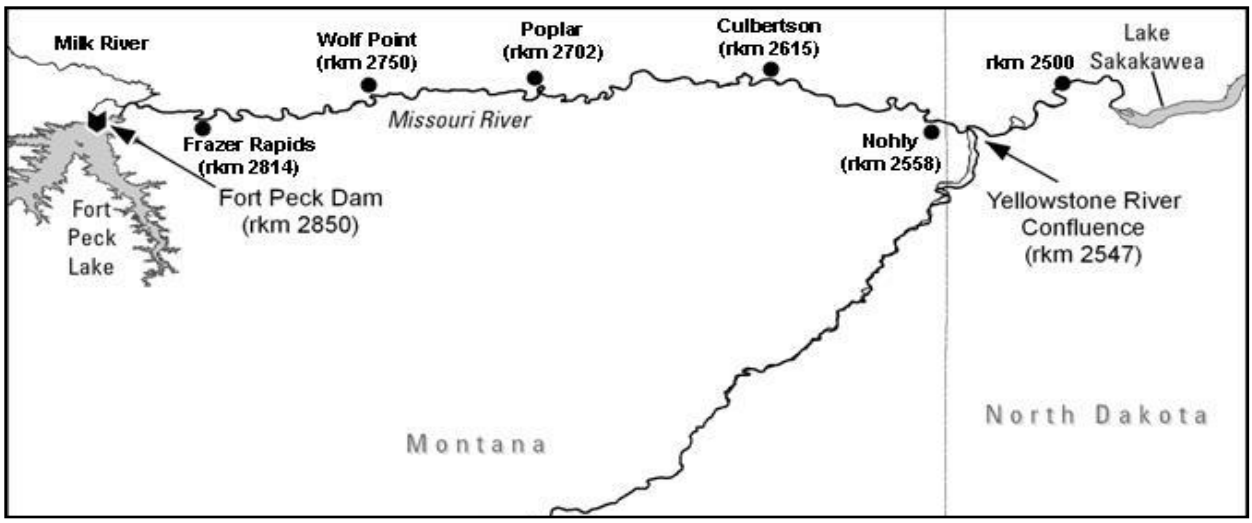

Figure 1. Study area of the Missouri River, Milk River and lower Yellowstone River.

Methods

Pallid sturgeon were sampled using drifted trammel nets and were implanted with radio tags (MCFT-3L tags, 16 mm x 73 mm, air weight = 26 g, 2,929-day longevity, 5-second pulse interval, 149.760 Mhz, Lotek Wireless Incorporated, New Market, Ontario). The coded signal emitted by each tag is unique to facilitate identification of individual fish. Surgical procedures followed methods outlined in Braaten and Fuller (2005). Most fish were collected in prior years during brood stock collection near the confluence of the Missouri and Yellowstone rivers.

Manual tracking of fish by boat during 2014 was initiated in April. The Missouri River between Fort Peck Dam and Wolf Point (70 m) was tracked from April through October. The Milk River was only manually tracked when the ground-based telemetry station, located near the mouth, detected a pallid sturgeon . One radio frequency (149.760 MHz) was monitored during the boat-tracking run using a 4-element Yagi antennae. Several variables (e.g, radio frequency, fish code, latitude, longitude, time-of-day) were recorded at fish locations.

Stationary telemetry logging stations were deployed in April 2014 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 mentioned later in this report (see Braaten portion). The logging stations were placed on shore with two 4-element Yagi antennae facing upstream and 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.

Sampling for free embryos and larvae was conducted in the lower Milk River and Missouri River near Wolf Point following methods outlined in Braaten et al. (2010). Sampling was conducted two times per week at multiple replicate locations. After sampling was completed, net contents were transferred to black rubber trays where Acipenseriformes free embryos (sturgeon and paddlefish) were extracted from the detritus. Extracted Acipenseriformes free embryos were then placed immediately in 95% non-denatured ethanol for genetic analysis.

Targeted sampling for larval and young-of-year pallid sturgeon followed trawling methods outlined in Braaten and Fuller (2007) and was conducted every week from late-July through early-September. Sampling for young-of-year sturgeon (*Scaphirhynchus* spp.) was conducted with a benthic (beam) trawl in the Missouri River above the Yellowstone River confluence (i.e., ATC) and Missouri River below the Yellowstone River confluence (i.e., BTC). 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 (IOCX) associated with a river bend. Fin clips were obtained for all *Scaphirhynchus* spp. collected, stored in 95% ethanol. Both larvae and young-of-year samples were genetically processed by Ed Heist at Southern Illinois University to distinguish individuals as pallid sturgeon or shovelnose sturgeon. If identified as a pallid sturgeon, further analysis to determine parentage was performed.

Results

Discharge and temperature

Discharge from the Yellowstone River averaged 15,000 ft^3/sec. greater in the April/May pre-spawn migration season than in the Missouri River. There was minimal contribution from the Milk River during this time; however, the Milk River augmented regulated releases from Fort Peck Dam during late august and early September resulting from rainfall in the watershed. This was reflected in elevated discharge conditions at Wolf Point and Culbertson (Figure 2). Water temperature warmed with increasing distance from Fort Peck Dam due to tributary inputs and increased exposure to ambient temperature (Figure 3). Water temperature at Wolf Point averaged 4.3 ^oC warmer than the School Trust site (~5 miles downstream Fort Peck Dam) from April 15 – Aug 31 and averaged 7.8^oC warmer at Culbertson than School Trust during this same time frame. However, thermal suppression from the Dam remained evident as temperatures remained about 1.5^{o}c cooler at Culbertson than the Yellowstone River. Temperature in Fort Peck Reservoir averaged 20.5^oC from June 15 - July 15 (time of spawning and larval drift) which is 10.4^oC warmer than the School Trust temperature during this time, suggesting that surface released water over the spillway would have a positive effect on river temperature.

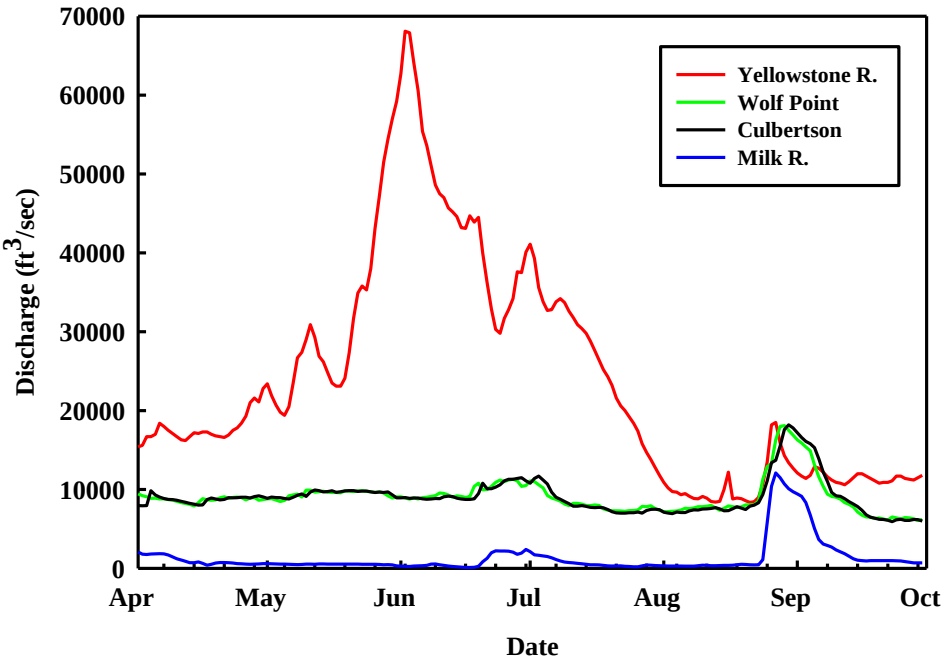

Figure 2. Mean daily discharge (ft^3/s) in the Missouri River at Culbertson, Montana (gage 06185500), Missouri River at Wolf Point, Montana (gage 06177000), in the Milk River at Nashua, Montana (gage 06174500) and in the Yellowstone River at Sidney, Montana (gage 06329500) during 2014.

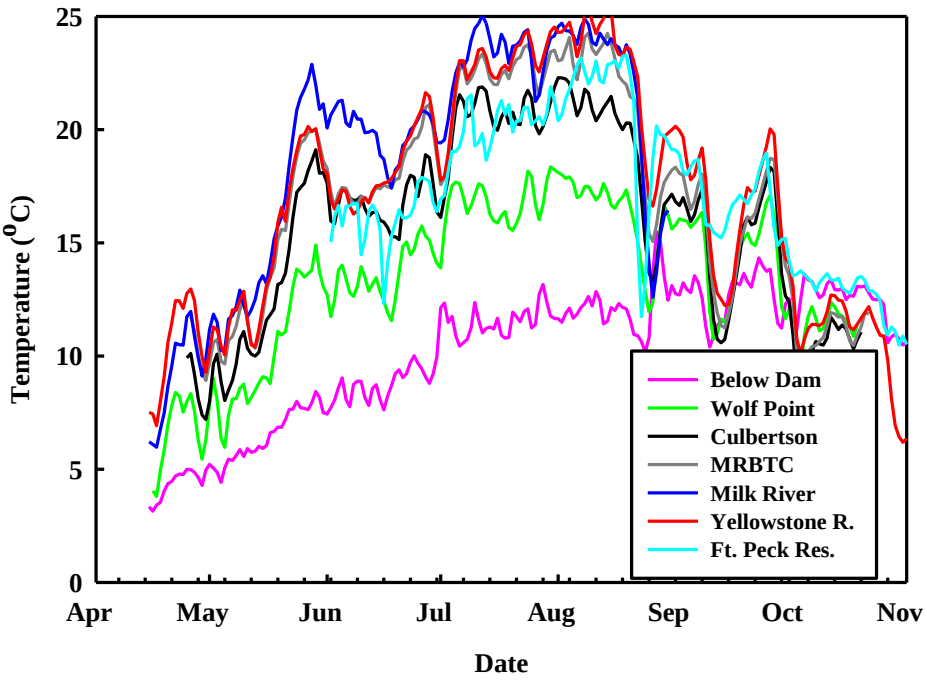

Figure 3. Temperature (°C) Below Ft. Peck Dam, Wolf Point, Culbertson and below the Yellowstone River confluence (MRBTC) in the Missouri River, Milk River, Yellowstone River and Ft. Peck Reservoir during 2014.

Migration Patterns

Telemetered wild adult pallid sturgeon (n=43) were manually tracked in the Missouri River ATC to Fort Peck Dam. Of these fish, 4 were gravid females, 1 was a non-gravid female and 38 were males. The Missouri River ATC had minimal use during 2014 (Figure 4).

Similar to most years, very little use occurred in the Missouri River ATC during the spawning season. During June, approximately 2.5% (1 fish) was present in the Missouri River ATC and was located near Culbertson (RM 1,618). Use of the Missouri River ATC increased in July, similar to other years, 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.

Most forays into the Missouri River ATC were in lower portions of the river. A total of eight fish migrated beyond the Culbertson ground station (~25 miles) and only two fish migrated beyond the Wolf Point ground station (~140 miles). Seven of these eight fish made their upstream migration late in the season, after spawning occurred in the Yellowstone River (See Braaten et al. portion). The greatest use occurred in mid September due to an increase in discharge following a large rain event (Figure 5).

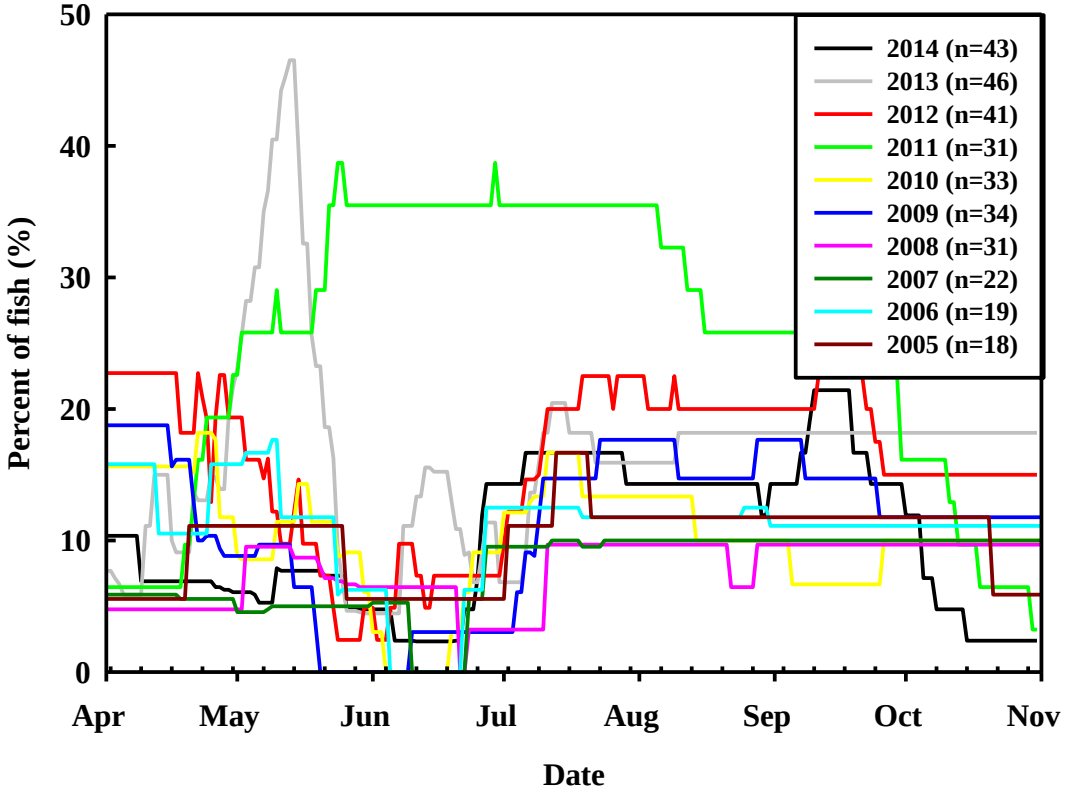

Figure 4. Percentage (%) of telemetered adult pallid sturgeon located in the Missouri River above the confluence of the Yellowstone River by date from 2005 – 2014. N = number of implanted individuals.

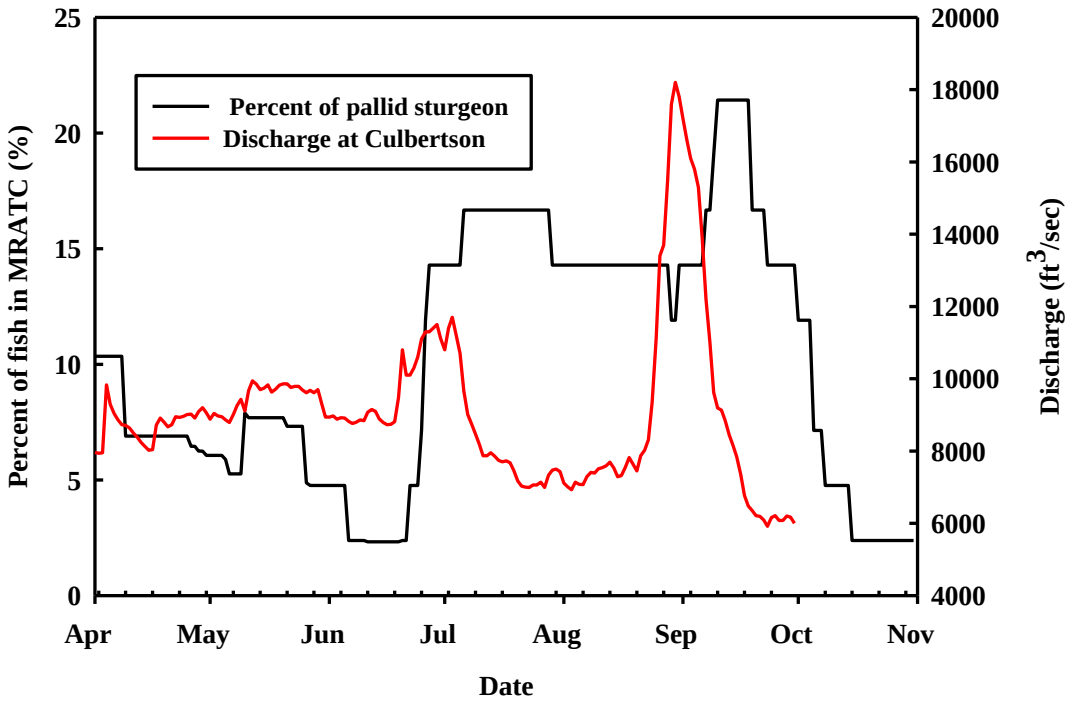

Figure 5. Percentage of telemetered adult pallid sturgeon in MRATC and discharge at Culbertson, MT in 2014.

Free embryo sampling

Sampling for free embryos was conducted in the Milk River during 13 events spanning from June 2 through July 17, 2014. Only one paddlefish free embryo was collected (July 3) and no sturgeon free embryos were collected.

Free embryo sampling was conducted on the Missouri River near Wolf Point during 21 events from June 3 through August 14, 2014. A total of 9 paddlefish and 9 *Scaphirynchus* free embryos was collected (Table 1). Genetic analysis of these specimens has not yet been conducted and identification of paddlefish versus *Scaphirynchus* larvae is tentative based on identification in the laboratory.

Table 1. Sampling dates and paddlefish and sturgeon larvae collected in the Missouri River near Wolf Point in 2014.

Date	**6-3**	**6-5**	**6-9**	**6-12**	**6-16**	**6-18**	**6-24**	**6-26**	**7-1**	**7-3**	**7-10**
Paddlefish	0	0	0	0	0	0	0	0	0	3	3
Sturgeon	0	0	0	0	0	0	0	0	0	0	0
Date	**7-14**	**7-16**	**7-22**	**7-25**	**7-28**	**7-31**	**8-4**	**8-8**	**8-11**	**8-14**	**Total**
Paddlefish	3	0	0	0	0	0	0	0	0	0	9
Sturgeon	0	0	0	1	2	0	1	3	0	2	9

Larvae/young-of-year sampling

Beam trawling for young-of-year sturgeon was conducted weekly from July 23 through September 10, 2014. Channel catfish (*Ictaluris punctatus*), sturgeon chub (*Macrohybopsis gelida*) and sicklefin chub (*Macrohybopsis meeki*) and made up 65.3%, 13.9% and 5.4% of the catch, respectively (Table 2). A total of 141 young-of-year sturgeon (4th most abundant) were collected in the MRBTC while 1 was collected in the MRATC. There were 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. A total of 134 sturgeon were sent to Southern Illinois University, Carbondale for genetic analysis.

Table 2. Total catch of fish by 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 23 to Sept 10, 2014.

Species	(ATC)	(BTC)	Total
Bigmouth buffalo	0	3	3
Burbot	0	4	7
Common carp	3	0	3
Channel catfish	49	1,729	1,778
Cisco	0	1	1
Emerald shiner	5	23	28
Flathead chub	11	16	27
Fathead minnow	0	2	2
Freshwater drum	0	16	16
Goldeye	0	8	8
Hybognathus spp.	1	20	21
Longnose dace	2	5	7
No fish	20	25	45
Pallid sturgeon (Hatchery-reared)	3	8	11
River carpsucker	2	3	5
Sicklefin chub	64	84	148
Sturgeon chub	87	292	379
Sauger	5	33	38
Shorthead redhorse	1	0	1
Shovelnose sturgeon	5	30	35
Shovelnose sturgeon (YOY)	1	141	142
Stonecat	3	29	32
Walleye	1	3	4
White Bass	0	3	3
White crappie	0	6	6
Yellow perch	0	1	1
Total	263	2,458	2,721

Table 3. Number of larval or young-of-year sturgeon collected in standard trawls, targeted trawls, minimum length (mm), maximum length (mm), and mean length (mm) in 2014 by date.

Date	Total (n)	Standard (n)	Targeted (n)	Min. Length	Max Length	Mean Length
7-23-14	4	3	1	31	67	46.3
7-29-14	25	7	18	21	138	47.0
8-6-14	44	15	29	30	97	43.4
8-12-14	35	5	30	33	103	57.8
8-20-14	13	4	9	46	124	79.2
8-27-14	15	5	10	52	134	101.5
9-3-14	6	4	2	56	128	79.3
9-9-14	0	0	0	n/a	n/a	n/a

Genetic results from 2013

Genetic analysis of free embryos (n=61) and larvae or young-of-year sturgeon (n=107) collected from the Missouri River in 2013 were all identified as shovelnose sturgeon.

Discussion

In the absence of flow enhancements very few wild adult pallid sturgeon use the Missouri River downstream Fort Peck Dam, particularly during the spawning season. Higher flows in the Yellowstone River triggered pre-spawn migrations and fish maintained residency throughout May and June (see Braaten et al.this report). Milk River discharge was low and there was no use of the Milk River by adult pallid sturgeon this year. Given the low number of Acipenseriformes free embryos collected, the lack of warm turbid inputs from the Milk River likely had a negative effect on paddlefish and shovelnose production as well.

Genetic analysis on the *Scaphirhnchus* larvae/young-of-year will be very intriguing with the rare documentation of a gravid female in the Powder River this year (See Braaten portion).

Documentation of use, spawning and reproduction in the Missouri River in 2011(Fuller and Haddix, 2012) indicates that the Missouri River is used by pallid sturgeon when flow regimes are suitable regardless of temperature. 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 severely impacted river system. Verification of successful reproduction by wild pallid sturgeon has provided information that shows spawning, fertilization, egg survival, and hatch can occur in the Missouri River when flows deviate from baseline operations.

Several years of information exist on movements when there are no flow enhancements and one year (2011) when there was severe flooding. There is the potential for improving conditions for pallid sturgeon, as well as the native fish community without flooding. Further studies on trigger flows required to cue pallid sturgeon to migrate into the Missouri River are essential. Additionally, further information on flow regimes that would retain fish in this reach through the act of spawning is also warranted. Since very few sexually mature adult pallid sturgeon have been observed in the Missouri River, limited data exists that details the flow parameters required to stimulate wild pallid sturgeon migrations and spawning.

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