Examination of pallid sturgeon use, migrations and spawning in Milk River and Missouri River below Fort Peck Dam during 2013

Prepared by:

David B. Fuller and Tyler M. Haddix

Montana Department of Fish, Wildlife and Parks

East Kansas Street

Fort Peck, MT 59223

Prepared for:

United States Geological Survey

Columbia Environmental Research Center

December 2013

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).

In 2011, record setting snowfall coupled with record spring rains resulted in rapid filling of Fort Peck Reservoir above full pool and subsequent, releasing water over the Fort Peck Spillway. The hydrologic regime in the Missouri River downstream Fort Peck Dam during 2011 was unique among the last several years due to these spillway releases, increased discharge from the Fort Peck Powerhouses and elevated discharge conditions during spring and early summer from the Milk River. This resulted in an increased use of adult pallid sturgeon (Fuller and Haddix 2012) and hatchery reared juvenile pallid sturgeon (Hunziker et al. 2013) in the reach of the Missouri River from Fort Peck Dam to Wolf Point. Additionally, an aggregation of adult pallid sturgeon was located just downstream of the Milk River and the first genetically confirmed wild produced pallid sturgeon larvae was collected in this reach as a result of these flows (Fuller and Haddix 2012). Additional 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.

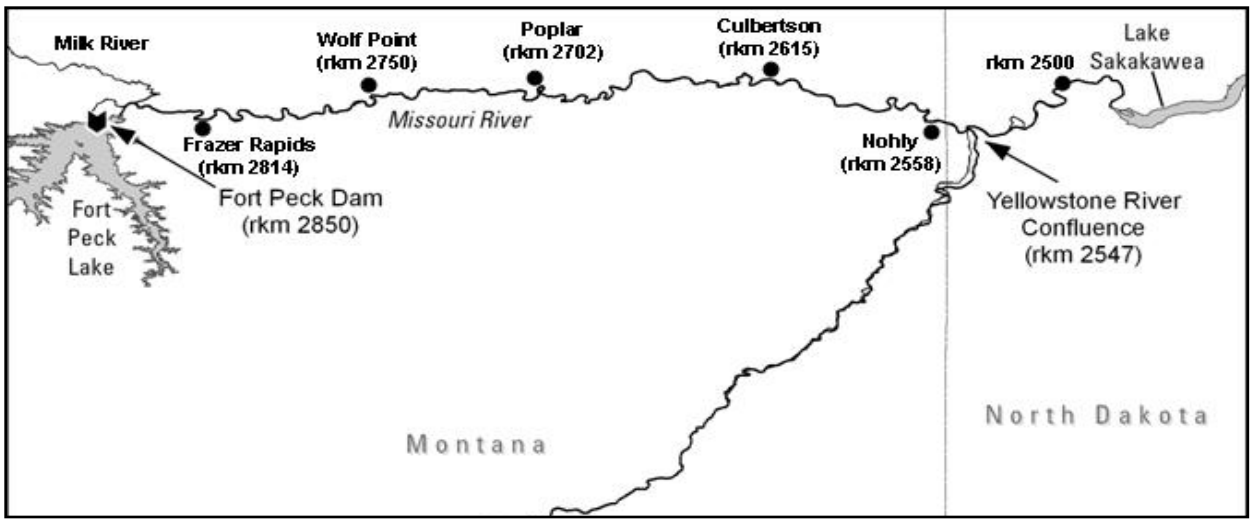

Figure 1. Study area of the Missouri River, Milk River and lower Yellowstone River.

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 2013 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, indicated that a fish had crossed it (see results). 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 2013 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 in task 2 in this report. 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 larvae (sturgeon and paddlefish) were extracted from the detritus. Extracted Acipenseriformes larvae were placed immediately in 95% non-denatured ethanol for genetic analysis. After extracting these larvae, the remaining sample was placed in a 10% formalin solution containing phloxine-B dye and contents were separated and identified in the lab.

Targeted sampling for 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

Contributions from the Milk River augmented regulated releases from Fort Peck Dam and had a major influence on seasonal flow patterns in the Missouri River (Figure 2). For example, elevated discharge in the Milk River during June resulting from rainfall in the watershed was reflected in elevated discharge conditions at Wolf Point and Culbertson. Discharge >20,000 ft^3/sec was recorded at Culbertson during this period which is a rare event. In addition to discharge patterns, Milk River contributions had a strong influence on water temperature and turbidity regimes in the Missouri River (Figure 3). During the increased June discharge from the Milk River, temperature in the Missouri River at Nickels increased from 7^{o}C t0 15^{o}C.

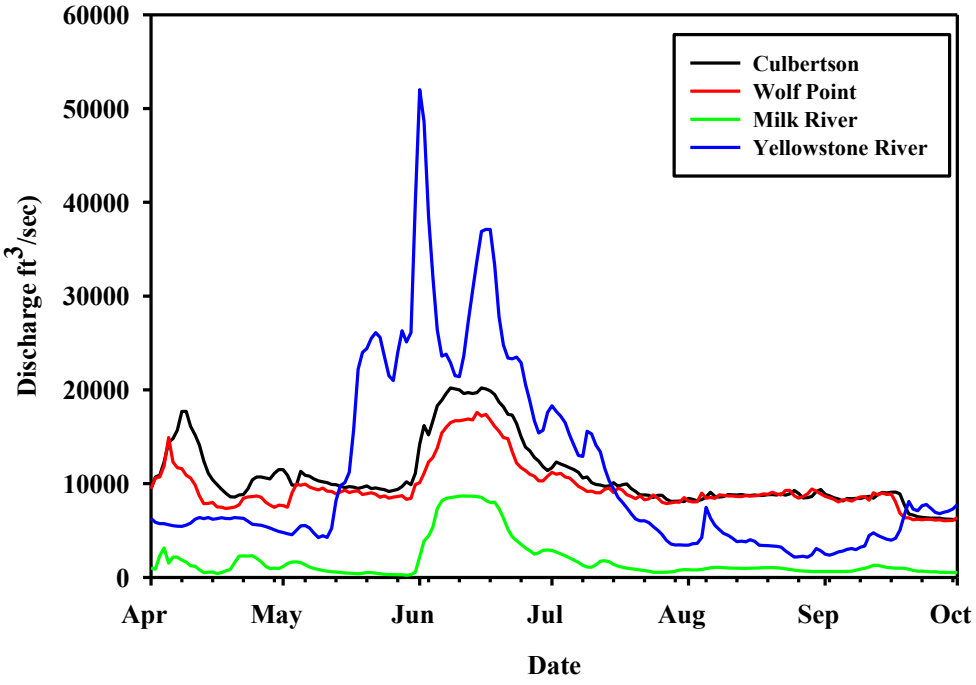

Figure 2. Mean daily discharge (ft^3/s) in the Missouri River at Culbertson, Montana (gage 06185500), Missouri River at Wolf Point, Montana (gage 06177000), in the Milk River at Nashua, Montana (gage 06174500) and in the Yellowstone River at Sidney, Montana (gage 06329500) during 2013.

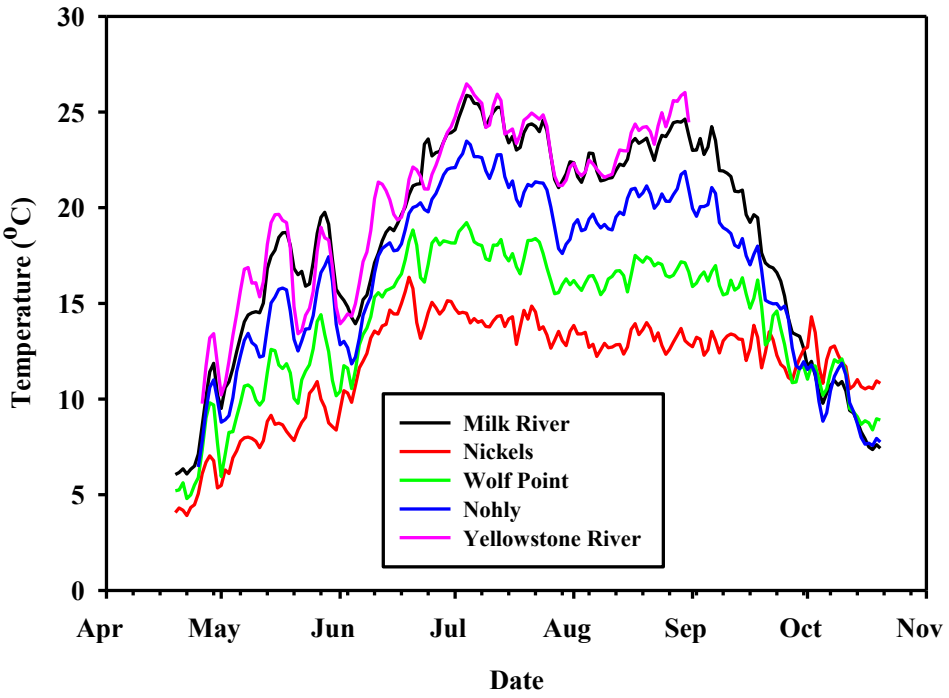

Figure 3. Temperature (^oC) at Nickels, Wolf Point and Nohly in the Missouri River, Milk River and Yellowstone River during 2013.

For objective 1, telemetered wild adult pallid sturgeon (n=46) were manually tracked in the Missouri River ATC to Fort Peck Dam. Of these 46 fish, 2 were gravid females, 5 were non-gravid females and 39 were males. The Missouri River ATC had three periods of increased use (Figure 4).

First, during early May, approximately 46% of individuals were located in this reach. This is the highest proportion of fish that has been documented in the past decade; However, most forays into the Missouri River ATC were generally less than 40 miles (Figure 5). This occurred when Yellowstone River discharge was approximately 5,000 ft^3/sec and Missouri River discharge was 10,000 ft^3/sec (Figure 2).

Second, in mid-June, when discharge of the Missouri River was approximately 20,000 ft^3/sec, upstream migrations of greater distances (120-180 miles) occurred. Four males and the two gravid females (codes 40 and 41) migrated up the Missouri River during this time. Code 41 was initially assessed in the Missouri River BTC on 25-April and her eggs had a polarity index (PI) of 0.196. She was assessed on 17–June upstream of Wolf Point (rm 1709) and had not spawned (eggs had a PI .07). This fish emigrated out of the Missouri River ATC and spawned in the Yellowstone River on 21-June, see task 2 for details. Code 40 was initially assessed on 15-May in the Missouri River just upstream of the Yellowstone River and her eggs had a PI of 0.10. She migrated 72 miles to Intake Diversion Dam on the Yellowstone River on 4-June, out of the Yellowstone River, 180 miles up the Missouri River and into the Milk River on 18-June. She was recaptured, assessed, and determined to not have spawned as she was exiting the Milk River on 21-June (eggs had a PI of .05), she then migrated out of the Missouri River and was caught in the act of spawning in the Yellowstone River on 25-June, see task 2 for details. In addition to code 40, elevated discharge in the Milk River during mid-June resulted in a male (code 15) and a telemetered hatchery-reared juvenile pallid sturgeon using the Milk River.

Lastly, 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.

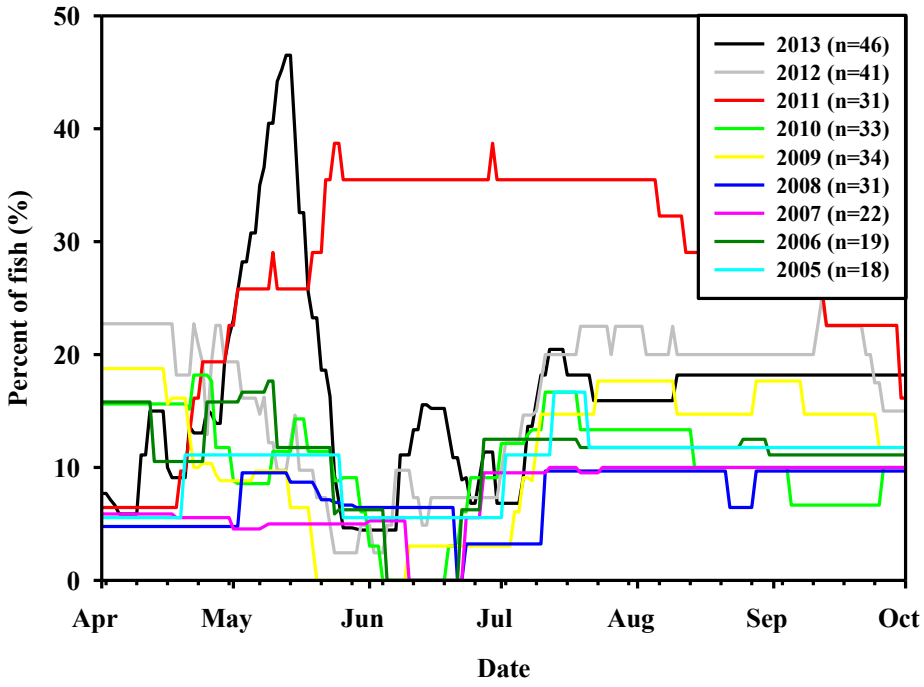

Figure 4. Percentage (%) of telemetered adult pallid sturgeon located in the Missouri River above the confluence of the Yellowstone River by date from 2005 – 2013. N = number of implanted individuals.

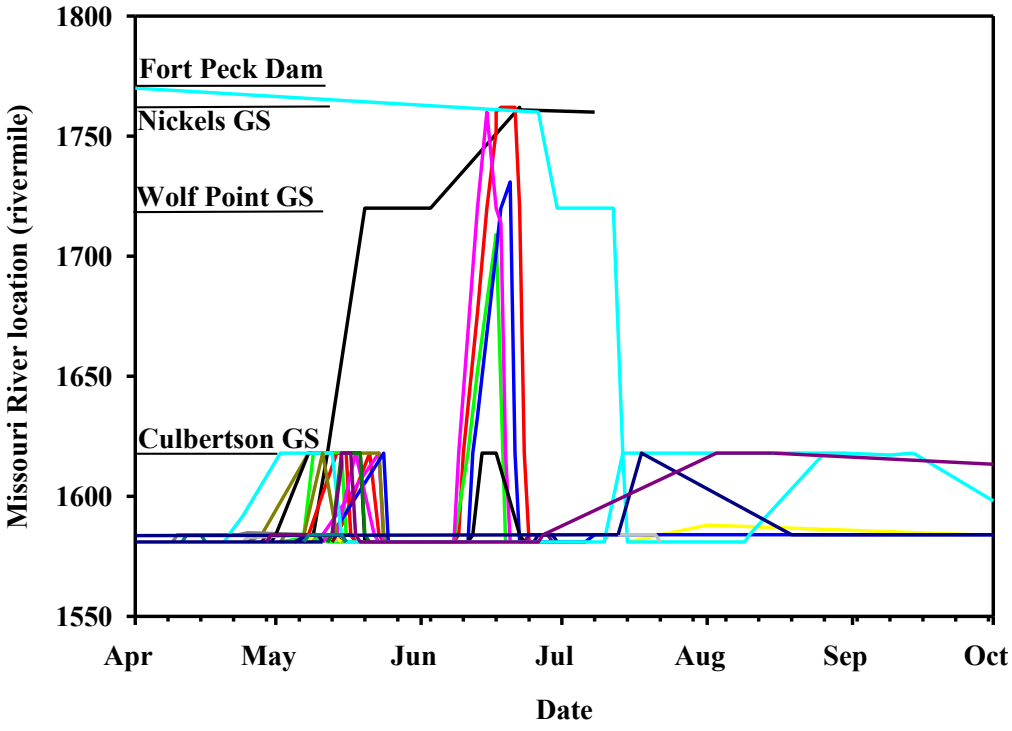

Figure 5. Locations (river mile) of 29 different telemetered pallid sturgeon that used the Missouri River ATC in 2013. River mile 1581 is the confluence of the Yellowstone River, RM 1762 is the Milk River confluence, and RM 1770 is Fort Peck Dam.

For task 2, sampling for larvae was conducted in the Milk River during 9 events spanning from 10-June through 12-July, 2013. No sturgeon larvae were collected during this time; however, 90 paddlefish were collected, 86 of these were collected on 21-June (Table 1).

Larval sampling was conducted on the Missouri River near Wolf Point during 18 events from 4-June through 9-August. A total of 205 paddlefish larvae and 61 *Scaphirynchus* larvae was collected (Table 2). Although not corrected for effort at this time, these are the highest collections of paddlefish and sturgeon larvae from the Missouri River since 2001 when an intense larval sampling protocol has taken place. Genetic analysis of these larvae 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 larvae collected in the Milk River near Wolf Point in 2013.

Date	**6-10**	**6-12**	**6-21**	**6-25**	**6-27**	**7-2**	**7-4**	**7-9**	**7-12**
Paddlefish	0	1	86	3	0	0	0	0	0

Table 2. Sampling dates and paddlefish and sturgeon larvae collected in the Missouri River near Wolf Point in 2013.

Date	**6-4**	**6-6**	**6-11**	**6-20**	**6-24**	**6-26**	**7-1**	**7-3**	**7-8**
Paddlefish	0	0	0	93	37	44	5	17	2
Sturgeon	0	0	0	0	0	0	7	9	3
Date	**7-10**	**7-15**	**7-17**	**7-22**	**7-24**	**7-29**	**8-2**	**8-5**	**8-9**
Paddlefish	7	0	0	0	0	0	0	0	0
Sturgeon	3	1	4	14	8	3	3	1	5

For task 3, beam trawling for young-of-year sturgeon was conducted weekly from 31-July through 3-September, 2013. Channel catfish (*Ictaluris punctatus*), sicklefin chub (*Macrohybopsis meeki*) and sturgeon chub (*Macrohybopsis gelida*) made up 54%, 13% and 12% of the catch, respectively (Table 3). A total of 85 young-of-year sturgeon were collected in the MRBTC while 26 were collected in the MRATC. A total of 107 sturgeon was sent to Southern Illinois University, Carbondale for genetic analysis.

Although some of the young-of-year sturgeon were a larger cohort and likely produced in the Yellowstone River, most fish were smaller and were likely produced in the Missouri River (Table 4). This theory is further supported by the fact that larvae were still being collected in the Missouri River into August whereas; no larvae were found in the Yellowstone River after mid-June.

Table 3. 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 31 - July to 4 - Sept, 2013.

Species	(ATC)	(BTC)	Total
Common carp	1	5	6
Channel catfish	44	888	932
Emerald shiner	5	12	17
Flathead chub	4	13	17
Fathead minnow	0	1	1
Freshwater drum	2	3	5
Goldeye	1	35	36
Green sunfish	2	1	3
Hybognathus spp.	2	4	6
Longnose dace	1	2	3
No fish	14	9	23
Pallid sturgeon (Hatchery-reared)	2	9	11
River carpsucker	1	1	2
Sicklefin chub	58	170	228
Sturgeon chub	78	139	217
Sauger	2	10	12
Shorthead redhorse	1	0	1
Shovelnose sturgeon	2	24	26
Shovelnose sturgeon (YOY)	26	85	111
Stonecat	7	76	83
Unidentified Cyprinid	0	1	1
Walleye	0	1	1
Total	253	1489	1742

Table 4. Number of young-of-year shovelnose sturgeon collected in standard trawls, targeted trawls, minimum length (mm), maximum length (mm), and mean length (mm) in 2013 by date.

Date	Total (n)	Standard (n)	Targeted (n)	Min. Length	Max Length	Mean Length
7-31-13	13	9	4	19	71	47.3
8-7-13	15	8	7	29	85	66.4
8-13-13	26	10	16	27	105	68.8
8-20-13	26	6	20	16	138	45.6
8-26-13	9	4	5	17	27	22.6
9-3-13	22	6	16	21	116	41

Discussion

During 2013, high June flows from the Milk River augmented Missouri River discharge and reached 20,000 ft^3/sec. near the Yellowstone River confluence. Adult pallid sturgeon responded by migrating above Wolf Point and some forays into the Milk River. It is intriguing that pallid sturgeon responded to flows of this magnitude. The only other year when significant migrations were made into the Missouri River ATC was 2011. Although discharge exceeded 100k ft^3/sec. in 2011, fish began their migration up the Missouri River with discharges of 25-30k ft^3/sec.

Gonadal biopsies from the two telemetered gravid pallid sturgeon indicated that they did not spawn in the Missouri or Milk River; however, males were present and there were likely

other non-telemetered fish present. Genetic analysis of the larvae could provide evidence that other pallid sturgeon may have successfully spawned in 2013.

Documentation of use, spawning and reproduction in the Missouri River in 2011 indicates that the Missouri River is used by pallid sturgeon when flow regimes are suitable regardless of temperature. Results of the 2011 study added substantial new information on pallid sturgeon movement, river use, and behavior. 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 spawning 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.

References

Braaten, P. J., and D. B. Fuller. 2005. Fort Peck Flow Modification Biological Data Collection Plan – Summary of 2004 Activities. Report prepared for the U. S. Army Corps of Engineers. Montana Department of Fish, Wildlife and Parks, Fort Peck.

Braaten, P. J., and D. B. Fuller. 2007. Growth rates of young-of-year shovelnose sturgeon in the upper Missouri River. Journal of Applied Ichthyology 23: 506-515.

Braaten, P. J., D. B. Fuller., and R. D. Lott 2009. Fort Peck Flow Modification Biological Data Collection Plan – Summary of 2008 Activities. Report prepared for the U. S. Army Corps of Engineers. Montana Department of Fish, Wildlife and Parks, Fort Peck.

Braaten, P. J., and D. B. Fuller. 2010. Fort Peck Flow Modification Biological Data Collection Plan – Summary of 2009 Activities. Report prepared for the U. S. Army Corps of Engineers. Montana Department of Fish, Wildlife and Parks, Fort Peck.

Bramblett, R. G., and R. G. White. 2001. Habitat use and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri Rivers in Montana and North Dakota. Transactions of the American Fisheries Society 130:1006-1025.

Fuller, D. B. and P. J. Braaten. 2012. For Peck Flow Modification Biological Collection Plan compendium; a summary of 2001 - 2009 activities. Report prepared for the U.S. Geological Survey and the U.S. Army Corps of Engineers, Omaha District. Montana Fish Wildlife and Parks, Fort Peck.

Fuller, D. B. and T. M. Haddix. 2012. Examination of pallid sturgeon use, migrations and spawning in the Milk River and Missouri River below Fort Peck Dam during 2011. Report prepared for the U.S. Geological Survey and the U.S. Army Corps of Engineers, Omaha District. Montana Fish Wildlife and Parks, Fort Peck.

Fuller, D. B., M. E. Jaeger, and M. A. Webb. 2008. Spawning and associated movement patterns of pallid sturgeon in the lower Yellowstone River. Report submitted to the Western Area Power Administration, Upper Basin Pallid Sturgeon Work Group, and U. S. Army Corps of Engineers. Montana Fish, Wildlife and Parks, Fort Peck, Montana.

Hunziker, J. R., T. M. Haddix, L. D. Holte, R. D. Lott. 2013. Pallid Sturgeon Population Assessment and Associated Monitoring for the Missouri River: Segment 2, 2012 Annual report. Report prepared for the U. S. Army Corps of Engineers-Missouri River Recovery Program. Montana Fish, Wildlife and Parks. Fort Peck, MT.