RECLAMATION
Managing Water in the West

Lower Yellowstone River Pallid Sturgeon Translocation Project 2017

Technical Memorandum – ENV-2019-001

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Pallid Sturgeon (*Scaphirhynchus albus*)

Lower Yellowstone River Pallid Sturgeon Translocation Project 2017

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Citation:

Fullard, C. and E. Best. 2018. Lower Yellowstone River Pallid Sturgeon Translocation Project 2017. Technical memorandum of the United States Bureau of Reclamation, Technical Service Center, Denver, Colorado. Technical Memorandum – ENV-2019-001.

ACRONYMS AND ABBREVIATIONS

PSCAP:	Pallid Sturgeon Conservation Augmentation Program
USACE:	United States Army Corps of Engineers
USFWS:	United States Fish and Wildlife Service
USGS:	United States Geological Survey
FWP:	Montana Fish, Wildlife & Parks
Reclamation:	United States Bureau of Reclamation
HFSC:	High flow side channel
MT:	Montana
BiOp:	Biological Opinion
FAS:	Fishing Access Site
PIT:	Passive Integrated Transponder
SIMS:	Sturgeon Information Management System
PRM:	Powder River Mile
HOPS:	Hatchery-Origin Pallid Sturgeon

Units:

cfs	cubic feet per second
ft/s	foot (feet) per second
km	kilometer(s)
mm	millimeter(s)
m	meter(s)
NTU	nephelometric turbidity units
RM	River mile(s)
MHz	Megahertz
FL	fork Length

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INTRODUCTION

Pallid sturgeon (*Scaphirhynchus albus*) are federally endangered (United States Fish and Wildlife Service (USFWS) 1990; 55 FR 36641-36647) large bodied fish native to the Missouri and Mississippi river basins. Pallid sturgeon are well adapted to large, free-flowing, warm-water, turbid rivers with diverse and dynamic physical habitats characteristic of the historical conditions of the Mississippi River basin (i.e., free-flowing with natural hydrologic conditions and temperature regimes; USFWS 2016). The pallid sturgeon has a flattened shovel-shaped snout and a long, slender, and completely armored caudal peduncle (Forbes and Richardson 1905). As with other sturgeons, the mouth is toothless, protrusible, and ventrally positioned under the head. Instead of bone, the skeletal structure is primarily composed of cartilage.

Pallid sturgeon were historically found throughout much of the Mississippi and Missouri Rivers, as well as many tributaries (Figure 1). This project focused on the population located upstream of Garrison Dam and Lake Sakakawea in the lower Yellowstone River. The Yellowstone River provides a nearly unaltered flow regime and retains the characteristic of a natural hydrograph (DeLonay et al. 2016), however Intake Dam near Glendive, Montana presents an impediment to upstream passage of pallid sturgeon, as well as other fishes.

Wild adult pallid sturgeon typically move into the Yellowstone River from the Missouri River and Lake Sakakawea during early to mid-April. Between 60 and 90% of the telemetered population is usually present in the system during May and June (DeLonay et. al. 2014). After migrating into the Yellowstone River from the Missouri River, a portion of the population remains in the lower reaches, while others exhibit broad-scale pre-spawn migrations. Unimpeded upstream migration is possible throughout the lower Yellowstone River up to the location of Intake Dam (~ river mile 72.0), where further upstream movement is mostly halted.

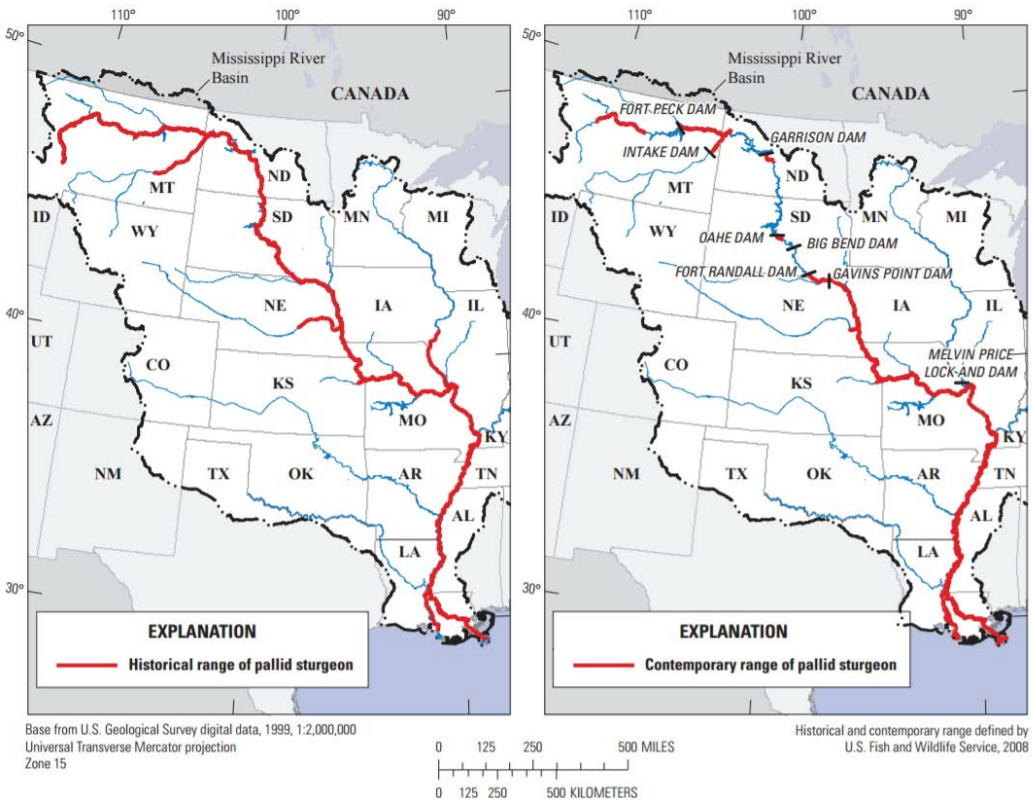

Figure 1. Maps of the historical (left) and current (right) range of pallid sturgeon in the United States. Major locks and dams which impede migration of pallid sturgeon are noted. Map is from DeLonay et al. 2016.

Though a single ecological constraint limiting recovery of pallid sturgeon populations has not been identified (DeLonay et al. 2016), habitat fragmentation due to the construction of dams is the most obvious ecological barrier to pallid sturgeon biological success upstream of Garrison Dam on the Missouri and Yellowstone rivers. Currently, it is thought that there is a lack of available continuous river to allow for free embryos of pallid sturgeon to naturally drift and mature before entering reservoirs (Braaten et al. 2012). To assist with the recovery of the pallid sturgeon, habitat rehabilitation (fish passage) and stock restoration efforts in the upper Missouri River basin are major areas of focus for fisheries biologists. Natural recruitment of pallid sturgeon has been low to non-existent throughout its range for decades (DeLonay et al. 2016), including the Yellowstone-Missouri River section. An estimated 125 wild sturgeon remain in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea, including the lower Yellowstone River (Jaeger et al. 2009). Fewer fish likely remain since this estimate was published, as these adults are ageing, and natural mortality is slowly reducing their numbers each year (USFWS 2015).

Based on recent research (Braaten et al. 2014), 12-26% of the telemetered (i.e., implanted with radio transmitters) population of wild adult pallid sturgeon migrates to the reach affected by Intake Dam annually. The exceptionally high

flows of 2011 are attributed to encouraging the higher estimate of 26% of the telemetered population to migrate up to Intake Dam. Research in 2014 and 2015 revealed that pallid sturgeon can migrate beyond Intake Dam using the natural high-flow side channel (HFSC) to bypass the dam. Passage through the HFSC has been documented at mainstem flows from 39,500 – 68,000 cubic feet per second (cfs) (United States Geological Survey (USGS) stream gauge 06327500, Yellowstone River at Glendive, MT) which provide suitable conditions in some years. However, the presence of elevated flows does not assure that a significant proportion of migrants close to Intake Dam will utilize the HFSC as other factors (e.g., location of HFSC entrance, individual motivation, detection of attraction flows from the HFSC, other unknown factors) may cue HFSC passage.

Restoration of the Yellowstone-Missouri population of pallid sturgeon by providing fish passage at Intake Dam is hypothesized to enable: 1) continued upstream migration for reproductively motivated adult and non-reproductive juvenile pallid sturgeon, 2) spawning in upstream reaches, 3) successful incubation of embryos, 4) increased drift distance for developing free embryos, and 5) survival of young life stages. The current proposed fish passage project at Intake Dam includes installation of a concrete weir, construction of a bypass channel to facilitate passage around the weir, filling in the natural HFSC, and implementation of a monitoring and adaptive management plan (Bypass Channel Alternative). The existing HFSC has been documented to attract native fish and provide passage at greater mainstem flows, but unlike the existing HFSC, the downstream entrance of the constructed bypass channel would be located just downstream from the constructed weir to attract sturgeon and other fishes at lower mainstem flows in close proximity to the dam.

The United States Bureau of Reclamation (Reclamation) and the United States Army Corps of Engineers (USACE) consulted with the USFWS in 2016 on the construction and implementation of the Bypass Channel Alternative (Reclamation and Corps 2016). The USFWS concluded in a Biological Opinion (2016 BiOp; USFWS 2016):

> "*there are limited minor adverse effects to the [pallid] sturgeon, the action is not likely to jeopardize the continued existence of the pallid sturgeon. And in fact, we believe the proposed action implements a high priority goal of the recovery plan and constitutes a substantial improvement to the outlook for the survival and recovery of this ancient fish in the Upper Missouri River"*

Currently, construction of the Bypass Channel Alternative is on hold due to an on-going litigation challenge. However, Reclamation and USACE continue to implement actions and requirements from the 2016 BiOp (USFWS 2016). One of the requirements being the translocation of "motivated spawning adults and

juvenile pallid sturgeon above Intake Dam until construction of a fish passage project is complete" (USFWS 2016; Incidental Take Statement pg. 65).

Fish translocation past barriers is not a novel concept (Lusardi and Moyle 2017), though attempts to translocate sturgeons have been limited. Translocation of pallid sturgeon across passage barriers has not previously been attempted but has been implemented in other sturgeon species. McDougall et al. (2013) captured 12 pre-spawn Lake Sturgeon (1,165-1,500 mm; 6 males, 6 females) downstream from a hydroelectric facility and released them 500 m upstream of the dam. The authors noted that all of the translocated individuals moved rapidly upstream to a known potential spawning reach, and no fallback was observed during initial upstream ascents. Their report cautioned the potential for mortality or injury of translocated fish from downstream passage through hydroelectric facilities. Concerns regarding outmigration and probable navigation over Intake Dam are less of a threat due to known survival of past pallid sturgeon descending over the dam, albeit in low numbers, and concern still exists. In addition, the authors cautioned on suitability of upstream habitat to support year-long residency in the event that out-migration does not occur. Limited observations from telemetry studies suggest that adults will out-migrate to reaches downstream from Intake Dam, so this is not a significant concern. In addition, Rust (2011) translocated 25 mature pre-spawn white sturgeon from one river reach to another, about 50 kilometers (km) upstream in an attempt to link fish with more suitable spawning, incubation, and rearing habitat. Results varied, as some fish out-migrated downstream after only a few days, while other individuals exhibited longer residency in the translocated reach. Rust (2011) suggested that the timing of translocation or unknown behavioral and physiological factors may control the upstream migration extent and residency of sturgeons released in new habitats.

In cooperation with the USFWS, the USGS, USACE, and Montana Fish, Wildlife, & Parks (FWP), Reclamation translocated migratory pallid sturgeon around Intake Dam in spring 2017. The protocol for translocation was developed in cooperation with partner agencies on how to safely capture, transport, and release motivated adult pallid sturgeon (Braaten et al. 2017). The goals for the 2017 efforts were to relocate telemetered pallid sturgeon upstream of the Intake Dam and document the effect of translocation on behavior and movements into upstream habitats.

METHODS

The initial range of dates for translocation efforts to take place were between 5/1/2017 and 6/15/2017. This timeframe encompassed the period when most pallid sturgeon were likely to arrive at Intake Dam, based on past observations. Efforts would continue until June 15th or until the Yellowstone River flows reached a level of 45,000 cfs where it is believed that reduced capture efficiency and safety concerns could become problematic. Prior to the start of the 2017 pallid sturgeon translocation operation, two Reclamation fish biologists observed

FWP biologists as they captured and processed pallid and shovelnose sturgeon with standardized techniques. This training included on-boat instruction on the use of the following gears and sampling protocols: trammel nets, radio localization, fish handling, egg extraction, blood sampling, passive integrated transponder (PIT) tagging, genetic sampling, scute removal, overview of FWP data sheets, and identification of elastomer marks. Guidance on FWP protocols was then relayed to other Reclamation biologists as they arrived on site through the sampling season.

Pallid sturgeon utilizing the Yellowstone River may have varying degrees of motivation to migrate past Intake Dam, thus sturgeon were not targeted for translocation at great distances from Intake Dam. Rather, a "catch zone" was developed (Figure 2) which a) excluded the area immediately downstream of Intake Dam to minimize risk of net entanglement on boulders that have migrated downstream off the dam structure; b) reduce the possibility of disturbing paddlefish anglers; and c) excluded areas downstream of the HFSC so that sturgeon ascending the river would first have the opportunity to use the natural HFSC for passage around the dam. The catch zone was ~ 2 km long, beginning 0.5 km downstream of Intake Dam and ending at the downstream terminus of the HFSC. Thus, the catch zone was delineated to focus on fish that were most likely motivated to travel upstream but were unable to do so as a result of impeded upstream passage from Intake Dam.

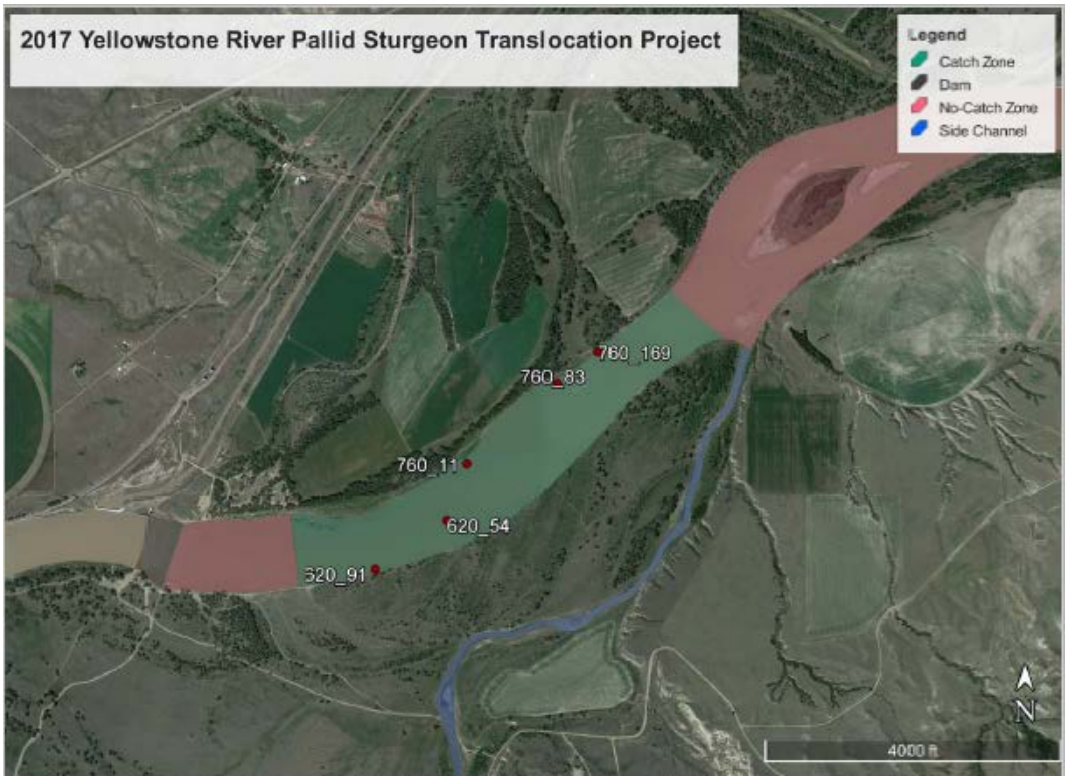

Figure 2. Project area for pallid sturgeon translocation project. Red points indicate capture locations of pallid sturgeon which were translocated in 2017. Point labels describe frequency and code of radio transmitters. Gray shade is the rock dam, red shade is the no-catch zone, green shade

is the catch zone, and blue shade is the high-flow side channel. All fish were truck-transported upstream to Stipek fishing access site, except 760_11, which was transported by boat up the high flow side channel.

Prior to capture attempts, a two-compartment (175 gallons each) truck bed-mounted haul tank was filled with water obtained from Miles City Fish Hatchery to comply with recently adopted Aquatic Invasive Species regulations. For our study, these regulations were waived on 5/8/2017 and river water was utilized by employing a submersible water pump to fill the tanks. The haul tank compartments were filled with water in the morning, prior to sampling efforts. Water temperature and dissolved oxygen were closely monitored before transport and adjusted as needed with bagged ice (Williams et al. 2009) and supplemented oxygen to match ambient river conditions when needed. Water quality was monitored with a YSI™ handheld multiparameter meter. The haul tank was inspected by FWP aquatic invasive species technicians prior to use in 2017.

Efforts to translocate pallid sturgeon began on May 5th, 2017. Fish tracking was done using open watercraft (6 meters (m) in length) with a bow mounted 4-element Yagi antenna and Lotek SRX600 or SRX400 VHF radio receiver. Radio transmitters for pallid sturgeon operate at the frequencies of 149.760 and 149.620 MHz. Crews monitored both frequencies to locate any pallid sturgeon in the sampling area. Tracking began daily at ~ 0730 starting at the Intake Fishing Access Site (FAS) boat launch and continuing downstream. If no pallid sturgeon were found in the catch zone, the boat crew would look for telemetered fish upstream (near the dam) and downstream of the catch zone to monitor movement of pallid sturgeon in the near vicinity. Downstream tracking from the Intake FAS boat launch was ended just upstream of the Elk Island FAS boat launch. Once pallid sturgeon were located, GPS locations were recorded for both translocation eligible and ineligible fish, along with depth, water temperature, turbidity, dissolved oxygen, and conductivity as close to the fish as possible. Water quality was monitored using a YSI™ handheld multi-parameter meter, and turbidity was measured using a Hatch® portable turbidimeter.

Pallid sturgeon that had no history of genetic contribution to the Pallid Sturgeon Conservation Augmentation Program (PSCAP) were prioritized for hatchery propagation over translocation. Information, including whether they were needed for the PSCAP, was kept on board the boat for the entire telemetered population of pallid sturgeon in the Missouri-Yellowstone segment. Once a radio signal was identified, the sampling crew would examine the history of that fish before attempting capture to determine whether it was translocation-eligible or needed for reproduction at a hatchery. We coordinated via on-board cell phone with partners at FWP and USGS during encounters with fish destined for the hatchery, or if there were questions on eligibility for translocation.

Fish were targeted for capture using 6’ tall trammel nets of either 1” or 4” inner panel square mesh and 8” outer panel, depending on last known size of target fish. Nets were deployed upstream of pallid sturgeon once they were located. The on-

board livewell was filled prior to trammel netting. The trammel nets were buoyed on each end and contained continuous lead lines. They were set in a cross-stream manner. After one end of the net was deployed in the water, the boat would run in reverse to pay out the remaining net. Lines were held on board to maintain control of the net while it fished. If the buoys bobbed or fish were seen in the net, it would be retrieved immediately, and fish removed. Non-target fishes were released immediately. Paddlefish encountered during trammel netting were examined for length, weight, and jaw tag ID. When a pallid sturgeon was captured, all other fish were released and the livewell was constantly maintained with fresh river water while performing post-capture assessment and transport.

Pallid sturgeon were examined for length, weight, sex, and reproductive condition. Syringes were used to draw blood from the anal fin crease of pallid sturgeon greater than or equal to 800 mm fork length (FL) and stored in vacutainers. Red blood cells and plasma were separated, and the plasma was extracted using a pipette and frozen in a separate container. A syringe-style egg extractor was used for gonad inspection. Eggs were stored in 10% neutral buffered formalin (Protocol brand, Cat# 032-059). All pallid sturgeon were examined for PIT tags. Pectoral fin clips were to be taken for genetic investigation on all pallid sturgeon without PIT tags or other marking, and all pallid sturgeon greater than or equal to 700 mm FL. Following post-capture assessment, pallid sturgeon were to be transported with the truck-mounted haul tank, or via boat through the HFSC if flows allowed (>35,000 cfs). The paddlefish angling season (May 15 – June 15) overlapped with our sampling season. Our protocol stated that if pallid sturgeon were caught and qualified for translocation during the paddlefish angling season, they were to be loaded for truck transport at the furthest downstream location at Intake FAS campground to avoid interruption of anglers who heavily use the boat ramp during the limited paddlefish harvest season.

Following translocation, USGS and FWP partners were contacted to inform them of the details of the move which included, radio frequency and code number, time, and location of release. Detections from automated telemetry logging stations as well as from manual tracking runs via boat or plane-mounted telemetry gear were used to assess the extent of continued upstream migrations and potential out-migration from the translocated reach. As observed in 2014, the spawning location may occur at or near the apex of the female migration trajectory. If a reproductive female (i.e., full of eggs) were to have been translocated, her reproductive condition can be assessed at various intervals along the river to validate successful spawning (e.g., loss of weight due to egg deposition, change in reproductive hormones from pre-spawn assessments). Similarly, if one or more males along with a reproductive female are translocated, unity of both sexes at a location and time may signal a spawning event. If spawning was suspected to have occurred, sampling for free embryos was to be initiated by USGS and FWP in an attempt to verify hatch and drift entry of free embryos. In addition, if spawning sites are determined or highly suspected, two

USGS Columbia Environmental Research boats were to be deployed to characterize the site. One boat equipped with DIDSON/ARIS acoustic imagery system was set to document pallid sturgeon locations, behaviors, and spawning substrate conditions. The second boat, equipped with multibeam bathymetry system, singlebeam bathymetry system, and acoustic Doppler current profiler, was to map the spawning site to quantify hydraulics and bed conditions using established USGS protocols.

RESULTS

Capture efforts occurred on 25 days beginning on 5/5/2017 and ending on 6/5/2017. Sampling was scheduled through mid-June, but high flows (> 45,000 cfs at USGS gauge 06327500) and high debris loads rendered trammel netting ineffective and unsafe. On sampling days in which no translocation-eligible sturgeon were detected in the catch zone, the 15 to 20 river mile (RM) reach of river below Intake Dam was monitored for pallid sturgeon in which habitat and location data were recorded to add to the Sturgeon Information Management System (SIMS) database. On average, 5.5 sturgeon were detected during tracking events (range 1 to 16).

Five pallid sturgeon (range 740 mm – 1420 mm FL) were captured and translocated above Intake Dam. These fish were captured in the catch zone on 5/6, 5/8, 5/9, 5/10, and 5/14 (Figure 3). Three of the five were males, one was female and one of unidentified sex (Table 1). One additional pallid sturgeon was also captured (350 mm FL; 0.13 kg; PIT – 0A1408345) received a post-capture assessment, and was released on-site, as it did not have a radio tag. Four fish were boated to shore and transferred to the haul tank truck, and one was boat transported upstream via the HFSC. Pallid sturgeon translocated via haul tank truck were released at the Stipek Boat Launch (47.26065, -104.56656; RM 83) after truck transport, and one was released upstream ~1.5 km from the upstream end of the HFSC (47.26065, -104.56656; RM 73.9) after boat transport. Handling and transport times for translocated fish averaged 63 minutes (range 50-75 minutes). Fish were then monitored for a short period to assess post-release movement, and further tracking was conducted by FWP and USGS as well as fixed radio receiver stations (Figure 4). All fish stayed in place or moved upstream immediately after release. No largescale downstream fallback was observed immediately after translocation.

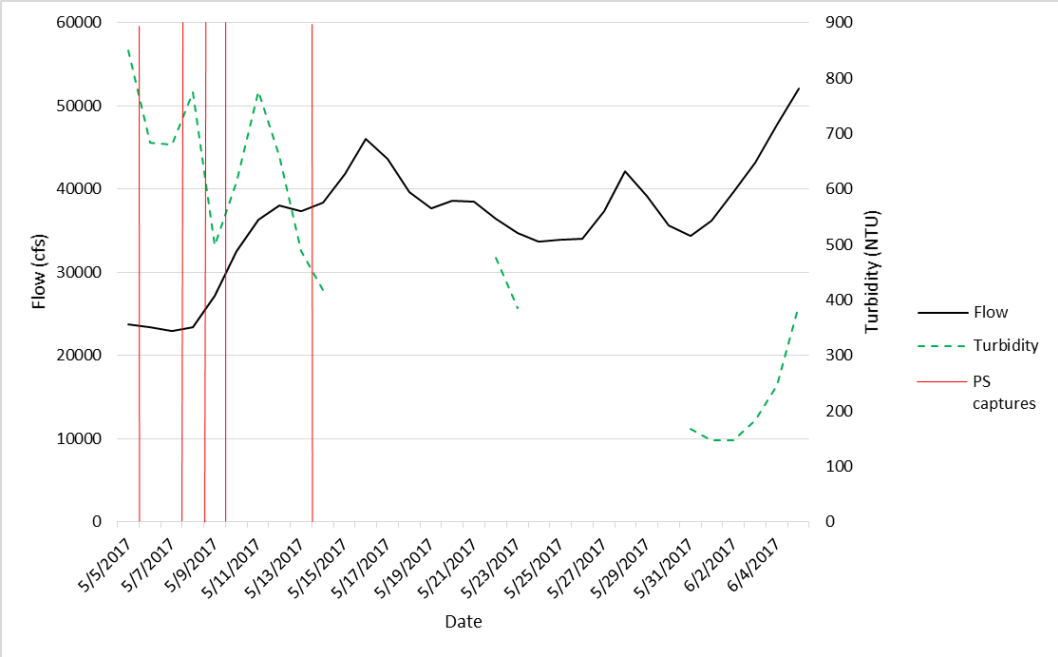

Figure 3. Discharge (cfs) and turbidity (NTU) data during the 2017 pallid sturgeon translocation effort. Turbidity measurements are not continuous throughout the monitoring effort. Red vertical lines indicate dates on which pallid sturgeon were successfully captured and translocated above Intake Dam.

Table 1. Summary of translocated pallid sturgeon from the 2017 Reclamation sampling season (5/5/2017 through 6/5/2017). Five pallid sturgeon were captured and identified as translocation candidates and moved to locations upstream of the Intake Dam via truck (n = 4) or boat transport (n = 1).

Date of Pallid Sturgeon Translocation	Radio Frequency	Code	Fork Length (mm)	Weight (kg)	Sex	Year Class	PIT Tag #
5/6/2017	149.620	54	1170	8.30	Female	1997	4109457D44
5/8/2017	149.760	83	1420	16.51	Male	Wild	7F7F065834
5/9/2017	149.760	169	740	1.49	Unknown	2007	4A473F300B
5/10/2017	149.620	91	1040	5.20	Male	2002	4C3C6F0208
5/14/2017	149.760	11	1230	8.80	Male	Wild	7F7D7C2447

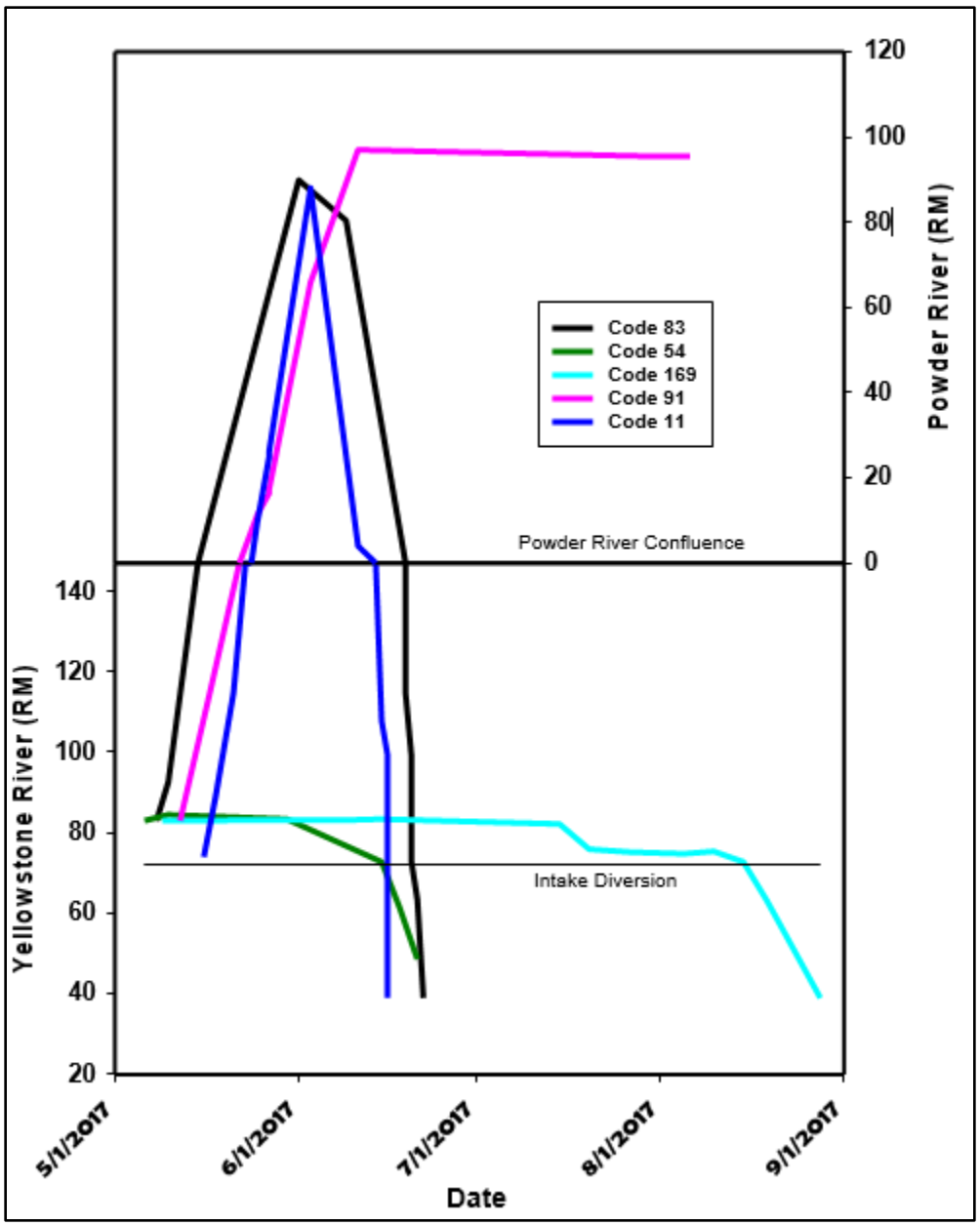

Figure 4. Movements by river mile for 2017 translocated pallid sturgeon in the Yellowstone River and Powder River, MT.

Code 83 (frequency149.760) was translocated via haul truck to Stipek FAS on May 8. This was a wild male. Code 83 was 1420 mm and 16.51 kg at time of translocation. Blood sample analysis (T ng/ml=35.8, E2 ng/ml= not detected) for this fish indicated steroid levels were low and that this fish was most likely non-reproductive this year. This fish was later detected on May 10th by Region 7 FWP at RM 92.6; on May 15th at the RM 147 Ground station at the confluence of Powder and Yellowstone River; on June 1st by Region 7 FWP telemetry flight at Powder River mile (PRM) 89.9; then again by telemetry flight on June 9 at PRM 80.4; on June 19th at the RM 147 Ground station at the confluence of Powder and

Yellowstone River when it is thought to have exited the Powder River; again on June 19th at the Gibbs ground station at RM 114.7; on June 20th Code 83 was detected at Hoff ground station at RM 99.1: by Region 7 FWP at RM 85.7; at the upstream high flow side channel ground station at RM 75; then at the Intake Dam ground station at RM 72.8. Code 83 was then detected by Region 7 FWP on June 21st downstream of Intake Dam at RM 63.4.

Code 54 (frequency 149.620) was translocated via haul truck to Stipek FAS on May 6th. This was a hatchery-origin female fish from the 1997 year class. Blood steroid results (T ng/ml=17.2, E2 ng/ml= 1.1) predicted this fish to be at a reproductive stage though biologists were unable to detect eggs during assessment. Code 54 was 1170 mm and 8.3 kg at time of translocation. This fish was later detected by Region 7 FWP on May 10 at RM 84.5 and again on May 30 at RM 83.4. Code 54 was then detected on the Intake Dam ground station (RM 72.8) on June 15. Code 54's downstream descent continued and was detected on June 17 on a ground station at RM 61.5.

Code 169 (frequency 149.760) was translocated via haul truck to Stipek FAS on May 9th. This was of unknown sex from the 2007 hatchery year class. Code 169 was 740 mm and 1.49 kg at time of translocation. Blood steroid results (T ng/ml=not detected, E2 ng/ml= not detected) predicted that this fish was non-reproductive and sex is unknown. This fish was detected during manual tracking activities on May 18th at RM 83.1 and remained in this general area until July 13th. It was later detected on July 18th at RM 75.9 where it remained in the general area until August 8th. On August 13th Code 169 was detected on the Intake Dam ground station at RM 72.8 and was detected downstream of Intake Dam by Region 7 FWP on August 17th at RM 63.1.

Code 91 (frequency 149.620) was translocated via haul truck to Stipek FAS on May 10th. This fish was a hatchery-origin male from the 2002 year class. Code 91 was 1040 mm FL and 5.2 kg at the time of translocation. Blood steroid results (T ng/ml=147.4, E2 ng/ml= not detected) predicted this fish to be at a reproductive stage. This fish was detected at the Gibbs ground station on May 15th at RM 114.7; on May 20th at the RM 147 Ground station at the confluence of Powder and Yellowstone River. Code 91 then ascended the Powder River and was detected by Region 7 FWP on May 23rd at PRM 11.3 and on May 25th at PRM 17.3. Telemetry flights conducted by Region 7 FWP located Code 91 on June 1st at PRM 65.9, on June 9th at PRM 97 and on July 29th at PRM 95.5. On August 4th FWP crews located this tag and the tail of Code 91 on the shore of the Powder River and confirmed that it was a mortality. The cause of mortality is unknown.

Code 11 (frequency 149.760) was translocated via the HFSC to approximately 1.25 km upstream of the HFSC entrance on May 14th. This fish was a wild male. Code 11 was 1230 mm and 8.8 kg at the time of translocation. Blood steroid results (T ng/ml=77.1, E2 ng/ml= not detected) predicted this fish to be at a reproductive stage. This fish was detected by FWP on May 16th at RM 89.1; on

the Gibbs ground station on May 19th at RM 114.7; on May 21st and 22nd at the RM 147 Ground station at the confluence of Powder and Yellowstone River; Region 7 FWP detected this fish in the Powder River on May 23rd at PRM 9.4 and on May 25th at PRM 24.9. Telemetry flights conducted by FWP detected Code 11 on June 1st at PRM 88.1 and on June 9th at PRM 4.0. Code 11 was then detected at the RM 147 Ground station at the confluence of Powder and Yellowstone River on June 12th. Region 7 FWP detected this fish on June 13th in the Yellowstone River at RM 107.8. Code 11 was then detected several times on June 14th : at the Hoff ground station at RM 99.1, the Upper HFSC ground station at RM 75, the Intake Dam ground station at RM 72.8, Region 7 FWP at RM 62.7, the Rock ground station at RM 61.5 and finally the 7 Sisters ground station at RM 39 – a distance of roughly 60 RM in 14 hours.

Two pallid sturgeon were detected in the HFSC by Reclamation during our monitoring effort. Pallid sturgeon (Code 60 frequency 149.620 MHz) was found in the HFSC on 5/13/2016, and another (Code 154 frequency 149.620) was found on 6/5/2017. Code 60 was not detected via manual tracking efforts or ground stations upstream of Intake Dam indicating that this fish did not pass through the HFSC. Code 154 was detected in the HFSC on the last day of our monitoring effort, and manual tracking efforts or ground stations upstream of Intake Dam did not detect this fish indicating it did not pass through the HFSC.

Tracking runs downstream of Intake Dam detected 28 individual radio tagged pallid sturgeon over 25 tracking days (Table 2) and resulted in 106 detections to be added to the SIMS database. Average depth of radio-located pallid sturgeon was 2.02 m. Channel types noted for fish include 11 fish located within side channels, 38 in split channels, and 66 in single channel.

Table 2. Frequency and code of radio tag detections from 5/5/2017 to 6/5/2017, including river mile migration apex. Red denotes fish that were translocated and green denotes that that passed Intake Dam via the HFSC.

Freqeuncy 149.620 MHz			Frequency 149.760 MHz		
Code	# Detections	Apex RM	Code	# Detections	Apex RM
54	2	84	11	1	PRM 88
60	1	71	34	5	67
62	3	72	42	1	71
63	1	63	49	4	99
66	9	75	61	2	75
68	4	72	69	2	66
72	9	72	83	1	PRM 89
74	4	64	117	1	72
90	7	72	169	2	83
91	2	PRM 97	180	5	62
93	6	69	185	2	63
123	5	66			
124	8	72			
154	4	71			
155	7	72			
156	4	65			
160	1	123			

Discharge in the Yellowstone River during the 2017 monitoring season varied between 23,500 cfs and 54,200 cfs (Figure 5). Telemetered fish were located and captured within the catch zone between 22,800 cfs and 41,500 cfs. No fish were captured in the catch zone above 41,500 cfs. The HFSC was deemed navigable by boat on 5/14/2017 at 37,000 cfs.

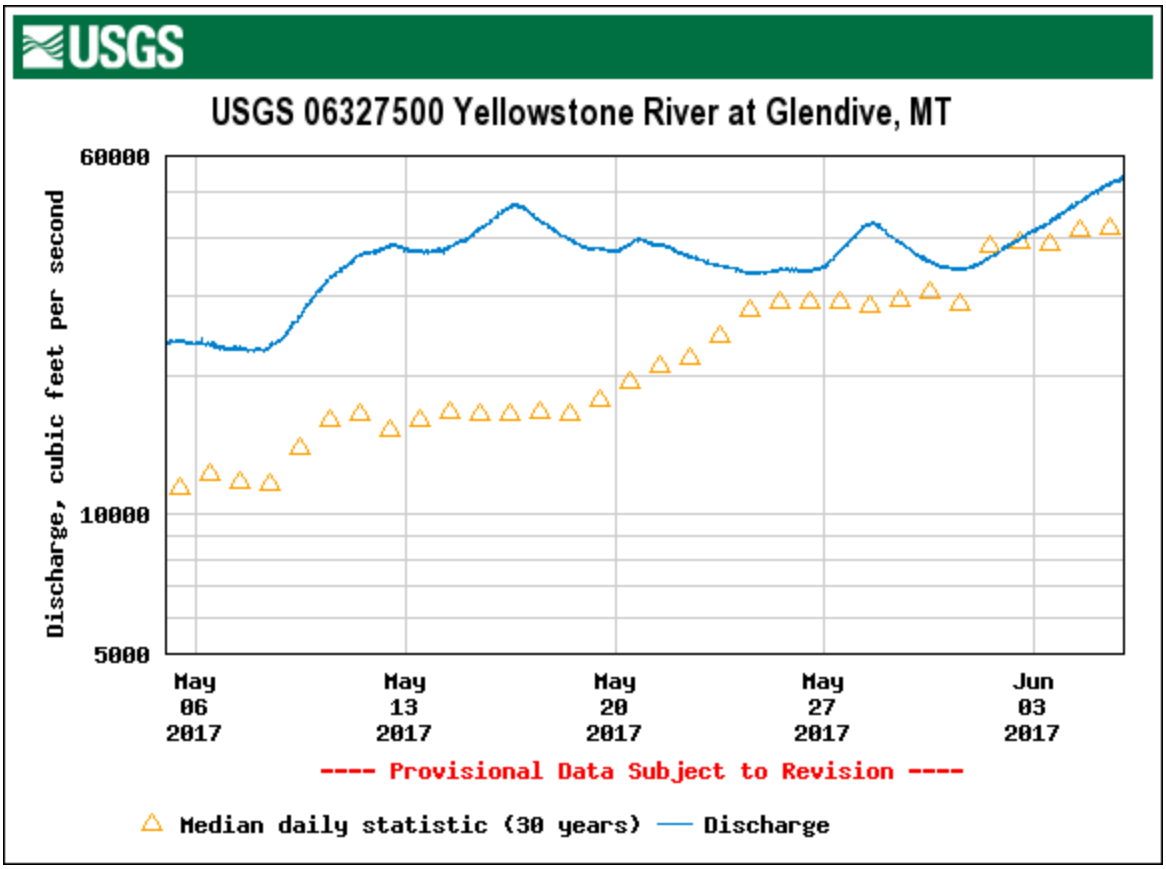

Figure 5. USGS hydrograph of Yellowstone River discharge at Glendive gauge 06327500 from 5/5/2017 to 6/5/2017. Monitoring efforts were abandoned after 6/5/2017 when discharge was over 55,000 cfs. Graph is from the National Water Information System, available at nwis.waterdata.usgs.gov.

Paddlefish were captured as by-catch during pallid sturgeon sampling. Paddlefish captures were recorded when time allotted otherwise were thrown back immediately. A total of 19 paddlefish were recorded between 5/9/2017 and 5/24/2017 (Table 3). All recorded paddlefish were released in good condition, and all were assessed for length, weight, and examined for jaw tags. Tag information was relayed to FWP.

Table 3. List of all paddlefish captured as by-catch during the 2017 pallid sturgeon translocation sampling effort. Jaw tagged paddlefish are reported as Recap, and jaw tag number is reported as Tag ID.

Date	Length (mm)	Weight (kg)	Recap (y/n)	Tag ID
5/7/2017	1110	28.12	N	-
5/7/2017	1010	11.34	Y	MT15776
5/7/2017	910	14.06	N	-
5/7/2017	960	13.15	Y	MT11336
5/8/2017	1130	23.59	N	-
5/8/2017	1090	21.77	N	-
5/8/2017	1190	34.93	Y	ND6657
5/8/2017	1100	27.67	N	-
5/8/2017	1100	26.31	Y	MT13193
5/8/2017	930	14.97	N	-
5/8/2017	1140	29.03	N	-
5/9/2017	920	12.25	N	-
5/11/2017	1115	20.96	N	-
5/14/2017	1240	30.44	N	-
5/14/2017	990	13.47	N	-
5/15/2017	1170	26.76	N	-
5/21/2017	1130	23.04	Y	MT16193
5/23/2017	1220	34.84	N	-
5/24/2017	1050	29.85	Y	MT13056

DISCUSSION

In 2017, 57 radio-tagged wild adult pallid sturgeon (91% of the radio tagged population) used the Yellowstone River during the spawning season (May 1 – July 1). Of those 57 fish, five (~9%) wild adults migrated upstream to Intake Dam (Braaten 2018) (since 2011, 12 – 26% have migrated upstream to Intake Dam). In addition to the five wild fish, 14 hatchery-origin pallid sturgeon (HOPS) migrated up to Intake Dam during the spawning season (May 1-July 1) (Braaten 2018) which is consistent with past years (Rugg 2014; 2015). These numbers suggest the Yellowstone River with its near natural hydrograph and sediment regime is preferred by most adult wild and hatchery origin pallid sturgeon over the colder less turbid Missouri River during the spring runoff/spawning season.

Until 2017, pallid sturgeon had never been captured downstream of a barrier and released upstream with the hopes that they continue their upstream migration after being released. This is no longer the case, as Reclamation crews successfully translocated five pallid sturgeon upstream of Intake Dam during the 2017 field season. Of the five translocated fish, three (two wild males and a 2002 hatchery origin male) were observed to ascend the Yellowstone River over 65 river miles

(Stipek FAS to Powder River confluence) before entering the Powder River and ascending over an additional 90 - 100 river miles. These fish traveled approximately 155 - 165 miles upstream after being released, suggesting translocation of pallid sturgeon could be an effective tool for providing supplemental passage and additional drift distance for embryos spawned upstream of Intake Dam.

Currently, the lack of pallid sturgeon free embryo drift distance is thought to be a major reason why natural recruitment is not occurring in the upper Missouri River Basin. By providing passage around the Intake Dam, it could open up major tributaries such as the Powder River for additional pallid sturgeon spawning and allow for longer larval drift distance. These additional miles (potentially 180 miles based on 2017 translocation results described above) could give pallid sturgeon enough additional river miles for the free embryos to drift and mature before floating into the headwaters of Lake Sakakawea where they are not known to survive (Bramblett and Scholl 2015).

This was not the first documented use of the Powder River in recent years. In 2014, five pallid sturgeon were documented successfully utilizing the HFSC, of which three (2 males and 1 female) were documented to have entered the Powder River (Rugg 2015). These sturgeon utilized the HFSC once flows in the Yellowstone River were over 46,000 cfs in late May and early June. Four pallid sturgeon passed Intake Dam by utilizing the HFSC in 2017, one fish passed in mid-May (YSR flows 46,000 cfs) while the other three passed in early to mid-June (YSR flows ranged from 51,000-58,000 cfs). The 2017 translocated sturgeon were moved upstream of Intake Dam in early to mid-May when flows in the Yellowstone River were below 40,000 cfs. The 2017 translocated fish that ascended the Powder River were already at the apex of their ascent around the times that the 2014 and 2017 fish were utilizing the HFSC (excluding the single sturgeon that utilized the HFSC in mid-May). This “head start” due to translocation may allow for sturgeon to make longer upstream migrations (distances of 2014 fish up the Powder River were 5, 8 and 20 river miles) or utilize the reaches of river over a varying array of river conditions that may allow for preferable conditions for spawning events. Sample size and high variation of conditions during events when pallid sturgeon have had access to the Yellowstone River above Intake Dam are limited but providing passage as early as fish are willing to utilize may be of significant importance.

It is important to assess pallid sturgeon behavior post translocation to both refine techniques for future translocation activities, as well as to determine what may be expected if pallid sturgeon are again allowed uninterrupted migration beyond Intake Dam via construction of the proposed Intake Dam Bypass Channel Alternative project. We were pleased with 2017 translocation efforts and a few changes will be made before conducting 2018 efforts. These changes will be highlight in the 2018 protocol/translocation plan.

ACKNOWLEDGEMENTS

Mat Rugg and Mike Backes (Region 7 Montana Fish Wildlife and Parks) and Pat Braaten (USGS Columbia Environmental Research Center) provided valuable information on site specifics and logistics, field training and support. The USFWS provided expedited review of permits. U.S. Bureau of Reclamation, Montana Area Office provided funding for efforts.

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