MONTANA FISH, WILDLIFE & PARKS

Job Progress Report

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JOB TITLE: Yellowstone River Paddlefish Investigations-3740

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ABSTRACT:

Each spring Paddlefish migrate upstream out of the headwaters of Lake Sakakawea with rising river discharge to reach river spawning grounds. Discharge leading up to the May 15, 2018 opener of Paddlefish season was similar to what led to high catch rates and less than four days of harvest season in 2017 on the lower Yellowstone River. This above average discharge came from a combination of area precipitation and Bighorn Reservoir (Yellowtail Dam) releases. This contributed to a measured Yellowstone River discharge (USGS station #06329500 Sidney, MT) approaching 30,000 CFS by May 2nd when migrating Paddlefish were first observed breaking the surface at Intake Fishing Access Site (FAS). Flows continued to rise and by the Paddlefish opener on May 15th exceeded 48,000 CFS. Despite similar Yellowstone River discharge anglers harvested Paddlefish at less than a quarter of the rate observed in 2017. This slower harvest rate was likely a result of a combination of factors including attractive flows in the Missouri and Milk rivers that likely drew a higher percentage of migrating fish into that arm of the system in 2018 than in 2017. To a lesser extent after the first week of harvest season Yellowstone River discharge reached levels at which angling becomes much more difficult. The harvest season lasted 15 days with an in-season closure on June 8th. Catch and release fishing continued for an additional 10 days at Intake FAS and closed June 18th. Fish, Wildlife & Parks (FWP) staff tagged 493 Paddlefish with jaw tags in 2018 during catch-and-release fishing. During the month of May, FWP staff surgically implanted 10 adult Paddlefish with radio

telemetry transmitters in the 10-mile-long reach downstream of Intake FAS as part of an ongoing native fish passage study that began in 2015. Telemetered Paddlefish had left the Yellowstone River by late-July.

INTRODUCTION:

Paddlefish *Polyodon spathula* are a highly sought-after sport-fish in the Yellowstone and Missouri rivers. They also garner commercial interest for their eggs that are suitable for the caviar trade (Carlson and Bonislawsky 1981). They are native to Montana and are an integral part of the aquatic community in the Lower Yellowstone River (Holton and Johnson 2003). Paddlefish have highly developed gill rakers that facilitate filter feeding of zooplankton in large river systems and reservoirs (Meyer 1960, Rosen and Hales 1981). Paddlefish are sexually dimorphic. Males become sexually mature earlier and at a smaller size than females (Scarnecchia et al 1996; Scarnecchia and Stewart 1997). Paddlefish of the Yellowstone/Sakakawea stock reside in the slow and quiet waters of Lake Sakakawea as juveniles. After the onset of sexual maturity, approximately age 10 for males and age 14 for females, they make spawning runs out of the reservoir up the Missouri River to its confluence with the Yellowstone River. Many Paddlefish spend the spawning season in the immediate vicinity of this confluence area while others continue to migrate up the Missouri River below Ft. Peck Dam or up the Yellowstone River. They spawn on clean gravel bars during the high flow period in May and June (Purkett 1961, Rehwinkel 1978; Carlson and Bonislawsky 1981). The Yellowstone/Sakakawea stock is sustained primarily through natural recruitment although hatchery stocking has occurred periodically with the specific purpose of introducing known age fish into the stock for validating aging methods. It has also been observed that some Paddlefish immigrate from the Fort Peck stock that resides in Fort Peck Lake and the Missouri River upstream of Fort Peck Dam. Similarly, it has been observed that Paddlefish emigrate and are permanently lost from the Yellowstone Sakakawea population by passing over Garrison Dam into the Garrison reach of the Missouri River below the Dam (e.g. as observed in 2011 during historic Missouri River flows).

The harvest of Paddlefish at Intake, MT has been documented for over a century and as knowledge of the fishery has improved some important management decisions have been made particularly in the last two decades (Scarnecchia et al. 2008). The Montana-North Dakota Paddlefish Management Plan (Scarnecchia et al. 2008) establishes the goals and objectives guiding the management of the Yellowstone/Sakakawea Paddlefish population. Currently a 2,000 Paddlefish harvest cap is shared by North Dakota and Montana (1,000 fish each). In 2017, the Montana legislature passed a bill that extended the statute allowing production of caviar from the roe of harvested Paddlefish at Intake Fishing Access Site (FAS) until 2028. Since 1990, the Glendive Chamber of Commerce, a non-profit organization, has been allowed to offer onsite fish cleaning services in exchange for roe from female Paddlefish under a memorandum of understanding with Fish, Wildlife & Parks (FWP) because of this legislation. Proceeds from the sale of caviar fund community improvement grants, as well as Paddlefish research, monitoring and management (Scarnecchia et al. 2008). This arrangement and regulated management of the

fishery has prevented over-commercialization and subsequent exploitation that plague fisheries of other roe bearing species worldwide (Speer et al. 2000).

In Montana, the harvest of Paddlefish at Intake FAS is closed instantaneously when FWP staff estimates that harvest is approaching the 1,000-fish harvest cap. Paddlefish harvest closes elsewhere 24 hours after the closure at Intake. After the instantaneous harvest closure at Intake FAS catch-and-release fishing is permitted at Intake FAS for an additional 10 consecutive days. Regulation changes in 2007 created the current season structure with harvest (mandatory) on Tuesday, Wednesday, Friday and Saturday and catch-and-release (mandatory and only at Intake FAS) on Sunday, Monday and Thursday. Legal fishing hours are from 6 a.m. to 9 p.m. mountain time.

Objectives for the 2018 season were as follows: 1) keep harvest under the 1,000 fish harvest cap, while spreading harvest over more days to increase angler satisfaction and maintain opportunity, 2) provide additional Paddlefish angling opportunity with catch-and-release days, and use this opportunity to increase number of tagged fish in the river, 3) characterize size distribution, condition of fish, and sex ratio of the population, 4) document movements of radio tagged Paddlefish with emphasis on passage at Intake FAS.

METHODS:

The 2018 Paddlefish season was the third season requiring mandatory report of harvested Paddlefish by either phone or in person at the Intake cleaning station. The data collected by this hotline was used to document Paddlefish harvest that was not detected by the physical data collection station at Intake FAS. A post season Paddlefish telephone creel has been conducted since 2003 to obtain harvest estimates for the Yellowstone/Sakakawea Paddlefish population. The content of the annual phone creel has varied over the years as regulations and management concerns have changed. Estimation of total harvest is the one component of the phone creel that has remained consistent since 2003. The structure of the phone creel has been consistent enough since 2008 to provide useful annual estimates of angler participation, effort, and catch rates for both harvest fishing and catch and release fishing. The 2018 phone creel included 7 questions about angler harvest, angler effort, use of Glendive Chamber of Commerce fish cleaning services, and participation in catch-and-release fishing. The phone creel was used to provide the final estimate of harvest.

University of Idaho and FWP staff ran a biological check station to collect data from harvested Paddlefish brought by anglers to Intake FAS to be cleaned by the Glendive Chamber of Commerce Caviar Contractors. Harvested fish were weighed to the nearest pound, measured to the nearest inch (front of eye to fork of the caudal fin), and inspected for tags (i.e. jaw, radio, coded wire, etc.). Gender of harvested fish was recorded by FWP staff and confirmed when filleted by caviar staff. A portion of the Paddlefish caught during designated catch-and-release fishing by anglers were measured and tagged by FWP creel clerks. Fish sex was estimated based on length, abdominal shape and presence of tubercles on rostrum and head. Monel metal bands (National Band and Tag Co., Size 16, ½ inch inside diameter) have been used to tag Paddlefish around the dentary bone since 1997. Recent runs of the bands have been corroding badly, so that the numbers are not discernible after just a few years. This lack of longevity for tags being put on fish that could be at large after tagging for half a century poses a problem. In 2016 FWP staff began using an aluminum version of the metal jaw tags. North Dakota Game and Fish

Department (NDGF) staff annually attempt to jaw tag roughly 500 Paddlefish below the confluence prior to both the North Dakota and Montana Paddlefish seasons. The NDGF tagging effort functions as the mark event and the harvested fish from both states function as the recapture events used to model population (Scarnecchia et al. 2008). Both states collected jaw sections from harvested Paddlefish to be aged by the University of Idaho. This age data was used to model population (Scarnecchia et al. 2014) and recruitment (Scarnecchia et al. 2008) so the fishery can be managed sustainably (i.e. balance fish harvested out with fish recruited into the population). To test a hypothesis that expanding catch-and-release opportunity has resulted in FWP staff increasing the number of Paddlefish tagged annually a single factor analysis of variance and TukeysHSD post hoc test was used to test for differences in the average number of Paddlefish tagged per year between three distinct management periods, no formal catch-and-release fishing (1984-1994), limited formal catch-and-release fishing (1995-2006) and expanded catch-and-release fishing (2007-2018).

Paddlefish length and weight data were used to determine relative weight (W_r), an index of condition (Murphy and Willis 1996). Length frequency histograms were calculated to describe the length distribution of harvested Paddlefish (Murphy and Willis 1996, Brouder et al. 2009). These indices provide a metric for analysis of the size and condition of the Yellowstone/Sakakawea population relative to other Paddlefish across the species range.

Sex identification of harvested Paddlefish was used to infer future trends. Inferences are made using the combination of knowledge of dominant year classes and differing age at maturity. Consideration of sex ratio, population modeling, and knowledge of strong year classes (i.e. identified by dentary bone aging, Scarnecchia et. al 2006) are used to ensure harvest from this Paddlefish population is sustainable (Scarnecchia et. al 2008).

During the month of August NDGF staff conducted transects in the upper end of Lake Sakakawea counting young-of-the-year Paddlefish with methods as described by Fredericks and Scarnecchia (1997). While conducting these visual transects from a boat it is also common for NDGF staff to observe sub-adult Paddlefish. This effort provides an indication of the relative strength of reproduction from the current year as well as recruitment of the previous few year classes to sub-adulthood.

Additionally, since the 2015 season FWP and the Bureau of Reclamation (BOR) have conducted a telemetry study using radio tagged native species (Pallid Sturgeon, Shovelnose Sturgeon, Blue Sucker, Sauger, and Paddlefish) to evaluate passage at Intake Diversion Dam under current conditions. Only a description of the movements of telemetered Paddlefish will be summarized in this report. Paddlefish were surgically equipped with Lotek MCFT2-3L radio transmitters adapting methods described by Ross and Kleiner (1982). Incisions were made on fishes left just offset from the abdominal midline and closed with wax coated braided silk sutures (Photo 1). Relocations of telemetered fish were made weekly by boat and continuously with a network of ground receivers.

RESULTS / DISCUSSION:

Yellowstone River discharge was nearing 30,000 cubic feet per second (CFS) by May 2, 2018 (USGS station #06329500 Sidney, MT) when Paddlefish were first observed at Intake FAS and discharge continued to increase exceeding 40,000 CFS for the season opener. Discharge

during the 2018 Paddlefish season was very similar to what was observed in 2017 until May 19th after which discharge continued to increase exceeding 50,000 CFS by Memorial Day weekend. Discharge peaked on June 2nd at 79,900 CFS and stayed above 50,000 CFS for the rest of the season (Figure 1). Rate of harvest was about a quarter of that observed in 2017 and lasted for 15 full days of harvest with an in-season closure at Intake FAS at 9pm on June 8th. Catch-and-release fishing for Paddlefish was allowed for 10 additional days at Intake FAS, ending June 18th. The Yellowstone/Sakakawea telephone creel estimated total harvest at 890 Paddlefish for 2018 (Skaar and Selby 2018, Appendix A).

Harvest has been kept under the harvest cap 9 of the last ten years. An estimated 2,257 anglers participated in the 2018 Paddlefish season on the Lower Missouri and Yellowstone Rivers, generating 4,806 harvest fishing angler days and 1,175 catch-and-release fishing angler days (Table 1). Phone creel results indicate that staying under the harvest cap and increasing catch-and-release opportunity has been successful, but regulations have not increased the average number of harvest days per season (Figure 2). An estimated 88.3% of fish harvested were cleaned by the Glendive Chamber of Commerce in 2018 (Table 1). Phone surveys have estimated 80-88% of the annual harvest over the period 2008-2018, mean 84.4% has come through the Chamber of Commerce fish cleaning station at Intake (Table 1).

A special phone creel survey was completed in 2012 and numerical results as well as angler comments can be found in the 2012 report (Bollman 2012). The survey found 89% of Paddlefish anglers surveyed are satisfied with the current season structure. Anglers surveyed liked having the option to catch-and-release in addition to, but not in place of a harvest opportunity and would not be in favor of a lottery style draw for Paddlefish tags. The survey results also indicate anglers would support mandatory reporting of harvest if it provided more efficient population management. Mandatory reporting became a requirement for harvested Paddlefish in 2016. In the 2016 phone survey, several questions were used to gauge the use and importance of gaffs for Paddlefish harvest. The intent was to determine if eliminating gaffs (i.e. eliminating the risk of incidental gaffing of Pallid Sturgeon) could be done without infringing on the opportunity of Paddlefish anglers. Thousands of Paddlefish are landed during catch and release fishing annually without the use of gaffs (Table 1). The 2016 phone survey indicated that 60% of Paddlefish anglers use a gaff while harvest fishing and believe their harvest ability would be reduced if gaffs were eliminated. While catch-and-release fishing suggests gaffs are not necessary to land Paddlefish the 2016 phone creel results strongly demonstrate that the opportunity to use a gaff is important to harvest anglers. Since the risk of incidental gaffing is quite low at this time, the benefit of eliminating the use of gaffs is outweighed by the cost to angler opportunity.

Tag sales for the Lower Yellowstone Paddlefish fishery suggest more participation prior to the last bundle of regulation changes in 2007 than from 2007 to 2018 (Figure 3). In 2006 anglers could purchase both a yellow and white tag giving them the opportunity to harvest two fish in Montana. Beginning in 2007, anglers had to choose one area, this eliminated everyone that preferred the Fort Peck fishery but were previously in the habit of buying the yellow tag purely as second opportunity. Monitoring tag sales for this Paddlefish population in Montana demonstrates license sales have responded to management of the Intake fishery and reinforces a continued need to strive for ways to increase angler satisfaction when taking biologically necessary measures to maintain a healthy Yellowstone/Sakakawea Paddlefish stock.

The change to harvest days and catch-and-release days in 2007 sought to maintain opportunity without increasing harvest. Phone creel results demonstrate anglers have responded to the increased catch-and-release fishing opportunity that has been available three days a week since 2007 (Figure 4). Since catch-and-release is only allowed at Intake FAS angler participation is strongly influenced by how available Paddlefish are at Intake. In good water years (e.g. 2013, 2014, 2015, and 2017) phone creel results demonstrate higher participation in catch-and-release than observed in a poor water year (e.g. 2012). An estimated 21.1% of anglers participated in catch-and-release fishing in 2018 and landed a cumulative total of 2,476 Paddlefish at a rate of 4.6 Paddlefish caught per angler and fished a total of 1,175 catch-and-release angler days (Table 1). The percentage of anglers participating in catch-and-release fishing was lower than observed in 2017. The number of angler days generated in 2018 was also lower than in 2017. Catch-and-release fishing has provided an opportunity for FWP staff to tag angler caught Paddlefish at Intake FAS three days a week during the harvest season and 10 days immediately after the season closure since 2008. During catch-and-release fishing at Intake FAS in 2018, FWP staff tagged 493 Paddlefish, which is under the 20-year average number of Paddlefish tagged per year of 637 (Figure 5). Additionally, the average number of tagged Paddlefish has been greater in the period 2007-2018 which included three full days of mandatory catch-and-release at Intake FAS during the harvest season plus 10 additional days after an in-season closure than either of the two previous management periods 1984-1994 or 1995-2006 (Figure 6). From 1984 to 1994 there was no consistent catch and release opportunity but on occasion anglers were used by FWP staff to catch-and-release fish to assist with staff jaw tagging fish. From 1995 to 2006 there were two catch-and-release periods per week during the harvest season on Sunday and Wednesday from 3 to 9pm. Single factor ANOVA identified a statistically significant difference in the number of Paddlefish tagged between the periods. A Tukeys HSD post hoc test identified that while the average number of Paddlefish tagged per year in the period 1984-1994 did not differ from the period 1995-2006, there was a higher average number of Paddlefish tagged per year in the period 2007-2018 than in either previous period (Figure 6).

The sex ratio of harvested Paddlefish during 2018 was 66 percent female and 34 percent male (Table 2). As expected when harvest is associated with a spawning run, harvested fish are mature and some individuals are of trophy size (Figure 7). The relative weight (Wr) of females was greater than that of males (Figure 8). A regression of relative weight against length gave a similar indication of the size distribution of the Yellowstone/Sakakawea stock compared to other populations across the range (Figure 8). Fish collected at Intake FAS demonstrated condition factor at or just slightly below other populations.

The 1995-year class continued to be the best represented single cohort in the Paddlefish harvest in 2018. Male Paddlefish from the 1995-year class had skewed the sex ratio of harvested Paddlefish toward male fish for much of the past decade (Figure 9). These male fish from the 1995-year class began showing up in 2003, at age eight, and were the dominant year class in male harvest by 2005 (Scarnecchia 2017). The sex ratio began to shift back toward one to one in 2013 as the 1995-year class females became sexually mature and joined spawning runs. However, in recent years the harvest of Paddlefish has been skewed toward females (Figure 9).

Population estimates for the Yellowstone/Sakakawea stock developed by Dr. Dennis Scarnecchia of the University of Idaho using tagging information from Montana and North Dakota have been fairly consistent over 20 years (Figure 10). These closed population estimates represent a subset of the population of spawning adults. In any given year there are off-year

spawners and sexually immature fish residing within Lake Sakakawea that are not estimated. A strong class of young-of-the-year (YOY) fish were documented during reservoir transects in 2011. Sakakawea transects in 2012 and 2013 suggested that little reproduction occurred during those years, but these surveys showed an unprecedented presence of sub-adult fish assumed to be the 2011-year class (Fred Ryckman, personal communication). During the 2017 season several small male Paddlefish were harvested that were suspected to be leading edge fish from the 2011-year class. Age analysis confirmed this and in 2018 the 2011-year class males comprised 15% of the male catch in Montana (Photo 2). The 2011 year-class males are expected to account for about 30% of male harvest in 2019 and begin a shift back towards male dominance in the catch until females from this year class begin to recruit 8-10 years later (approx. 2026-2028). It is still too early to determine how substantial the size of this year class will be, but early indications suggest this year class will be similar in magnitude to the 1995-year class. The 1995-year class has provided a buffer to the harvest of other recruited year classes and allowed managers to maintain a consistent harvest cap for more than a decade.

Paddlefish have been included in a native species telemetry study to evaluate the current level of fish passage at Intake Diversion Dam under existing conditions conducted jointly by the U.S. Bureau of Reclamation and Montana FWP since 2015. During the month of May in 2015, 40 adult Paddlefish were surgically implanted with radio telemetry transmitters in the 10-mile reach downstream of Intake FAS as part of this study. The movements of telemetered Paddlefish in 2015 demonstrate passage over or around Intake Diversion Dam (Figure 11). Five Paddlefish migrated upstream of Glendive. Four continued upstream to the Powder River area, with one male Paddlefish migrating as far as Rosebud, MT. During the month of May in 2016, 58 adult Paddlefish were surgically implanted with radio telemetry transmitters in the 10-mile reach downstream of Intake FAS. Newly tagged and previously tagged (2015) Paddlefish were relocated during 2016 telemetry and ground station tracking (Figure 12). In 2016, 0 of 53 Paddlefish that encountered Intake Diversion Dam passed over or around as flows were inadequate to make passage available. During the month of May in 2017, 13 adult Paddlefish were surgically implanted with radio telemetry transmitters in the 10-mile reach downstream of Intake FAS. Newly tagged and previously tagged (2015, 2016) Paddlefish were relocated during 2017 telemetry and ground station tracking (Figure 13). Forty-nine telemetered Paddlefish encountered Intake Diversion Dam in 2017 with just 12 passing (24%) upstream, mostly through the side channel (9 Paddlefish) but also over the dam (3 Paddlefish). During the month of May in 2018, 10 adult Paddlefish were surgically implanted with radio telemetry transmitters in the 10-mile reach downstream of Intake FAS. Newly tagged and previously tagged (2015, 2016, 2017) Paddlefish were relocated during 2018 telemetry and ground station tracking with a total of 52 telemetered Paddlefish observed in the Yellowstone River during 2018 (Table 3). Forty-one telemetered Paddlefish encountered Intake Diversion Dam in 2018 with 19 passing (48%) upstream, mostly through the side channel (14 Paddlefish) but also over the dam (5 Paddlefish). Five Paddlefish reached the Powder River Confluence with three moving beyond this point (Figure 14).

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Key Words: Catch-and-release, Harvest, Paddlefish sex ratio, Paddlefish caviar, Phone creel survey, Paddlefish tagging

Table 1. Yellow Paddlefish tags sold by year (Automated License System Data) and number of anglers fished, number of Paddlefish harvested, angler days (harvest fishing), percent of yellow tag holders participating in catch and release, number of catch and release anglers, angler days (catch and release fishing), number of Paddlefish landed during catch and release, and number of Paddlefish landed per angler during catch and release estimated by phone creel by year 2008-2018.

			Harvest Fishing			Catch and Release Fishing				
Year	Yellow Tags Sold	Anglers Fished	Harvest	Angler Days	% Cleaned by Chamber	% PF Anglers C&R Fished	Anglers Fished	Angler Days	Total Landed	PF per Angler
2008	3017	2481	1102	4474	83	19.4	481	1123	4180	8.7
2009	3189	2704	967	1823	88	29.7	949	1889	3474	3.7
2010	2508	2125	1027	3126	88	42.6	1069	2189	8116	7.6
2011	2772	2173	949	3535	85	25.7	712	1326	2738	3.8
2012	2931	2261	599	6070	81	14.4	408	779	330	0.8
2013	2515	2015	770	6194	84	23.4	568	1279	5217	9.2
2014	2535	2063	788	3940	84	28	699	3113	4431	6.3
2015	2778	2397	995	5561	82	19.3	530	6398	3990	7.5
2016	2841	2441	945	5523	80	27.1	760	1955	4317	5.7
2017	2473	2031	972	2577	87	35.8	866	1891	4744	5.5
2018	2571	2257	890	4806	88	21.1	537	1175	2476	4.6

Table 2. Sex Ratio by year for Paddlefish of the Yellowstone Sakakawea stock.

Year	N	%Females	%Male
1963	46	0.0	100.0
1964	920	2.8	97.2
1965	453	2.9	97.1
1966	28	0.0	100.0
1967	123	0.0	100.0
1968	149	4.3	95.7
1969	499	3.7	96.3
1970	700	11.4	88.6
1971	1136	45.4	54.6
1972	1678	48.2	51.8
1973	1696	44.1	55.9
1974	1910	51.2	48.8
1975	1158	67.8	32.2
1976	940	67.8	32.2
1977	1003	64.0	36.0
1978	809	68.0	32.0
1979	637	67.5	32.5
1980		80.2	19.8
1981	2528	75.1	24.9
1982	2004	71.2	28.8
1983	1400	82.6	17.4
1984	2691	69.1	30.9
1985	628	78.7	21.3
1986	1462	63.3	36.7
1987	1412	77.2	22.8
1988	1780	61.0	39.0
1989	1583	70.0	30.0
1990	1493	65.4	34.6
1991	2558	57.2	42.8
1992	670	67.3	32.7
1993	1659	35.1	64.9
1994	309	62.8	37.2
1995	1448	43.6	56.4
1996	1120	42.1	57.9
1997	797	38.7	61.3
1998	580	47.9	52.1
1999	1345	54.0	46.0
2000	541	55.3	44.7
2001	344	52.9	47.1
2002	713	44.6	55.4
2003	831	52.8	47.2
2004	221	54.3	45.7
2005	1051	26.8	73.2
2006	1194	29.3	70.7
2007	867	20.3	79.7
2008	946	28.9	71.1
2009	800	32.5	67.5
2010	821	23.6	76.4
2011	713	35.1	64.9
2012	468	35.6	64.4
2013	747	48.7	51.3
2014	699	70.5	29.5
2015	766	68.0	32.0
2016	752	58.8	41.2
2017	804	72.3	27.7
2018	709	66.1	33.9

Table 3. Summary of movements of telemetered Paddlefish in Yellowstone River and tributaries during 2018.

Upstream Movements	**Total**	**Date Range**
Total Number Recorded in YSR	**52**	
To Intake	41	
Move Past Intake	19	
Over Dam	*5*	*5/24/18 - 7/7/18*
Via Joe's Island Side Channel	*14*	*5/11/18 - 6/9/18*
To Gibbs Station	15	
Move Past Gibbs Station	11	
To Powder River	5	
Move Past Powder River	3	

Photo 1. Example of Paddlefish surgery, abominal insertion on fishes left of Lotek MCFT2-3L radio transmitter on frequency 148.480, closure with silk sutures.

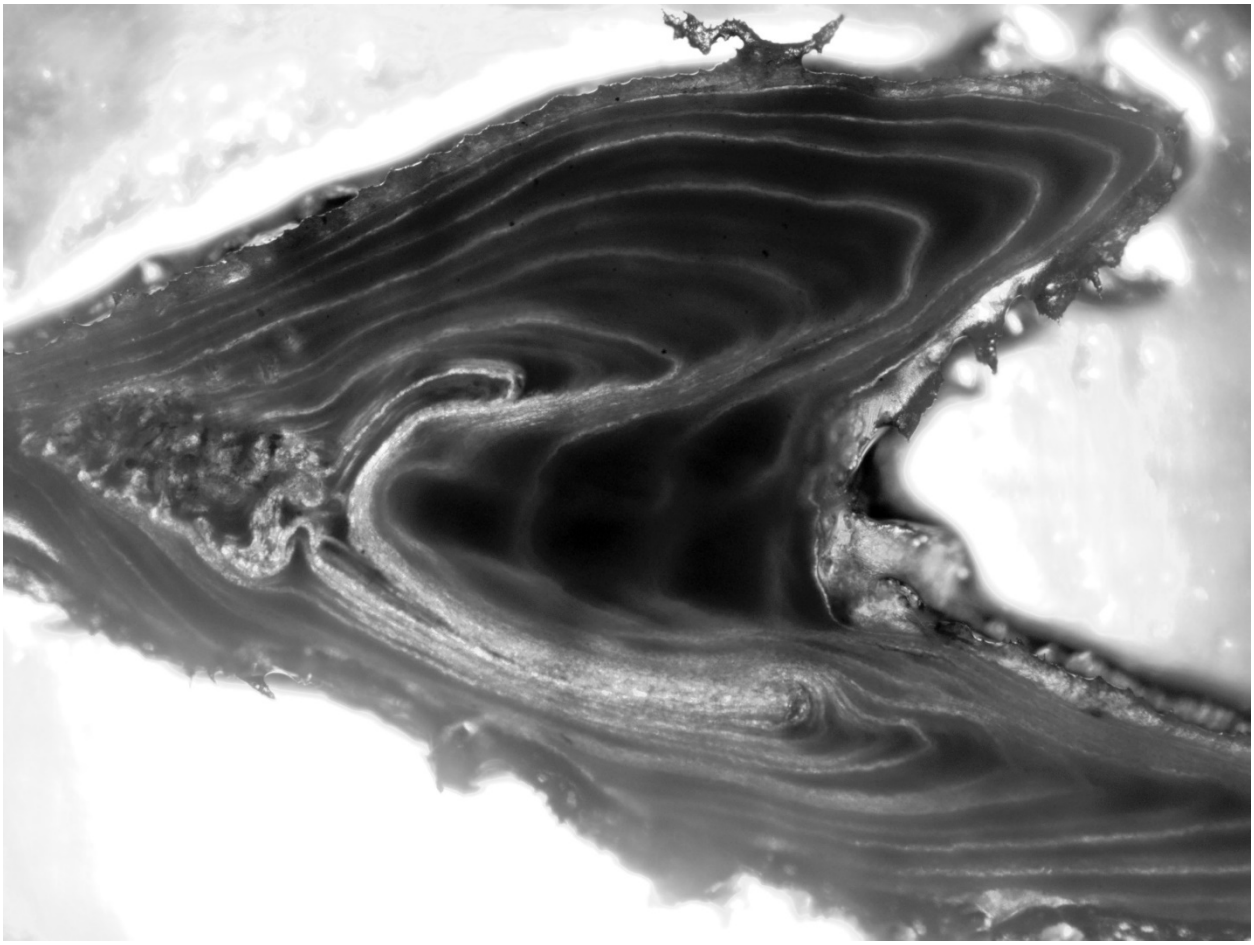

Photo 2. Example of dentary section from male Paddlefish MT_4594 harvested in 2018 in Montana, aged at 7 years old (2011-year class) from Dr. Dennis Scarnecchia, Univeristy of Idaho.

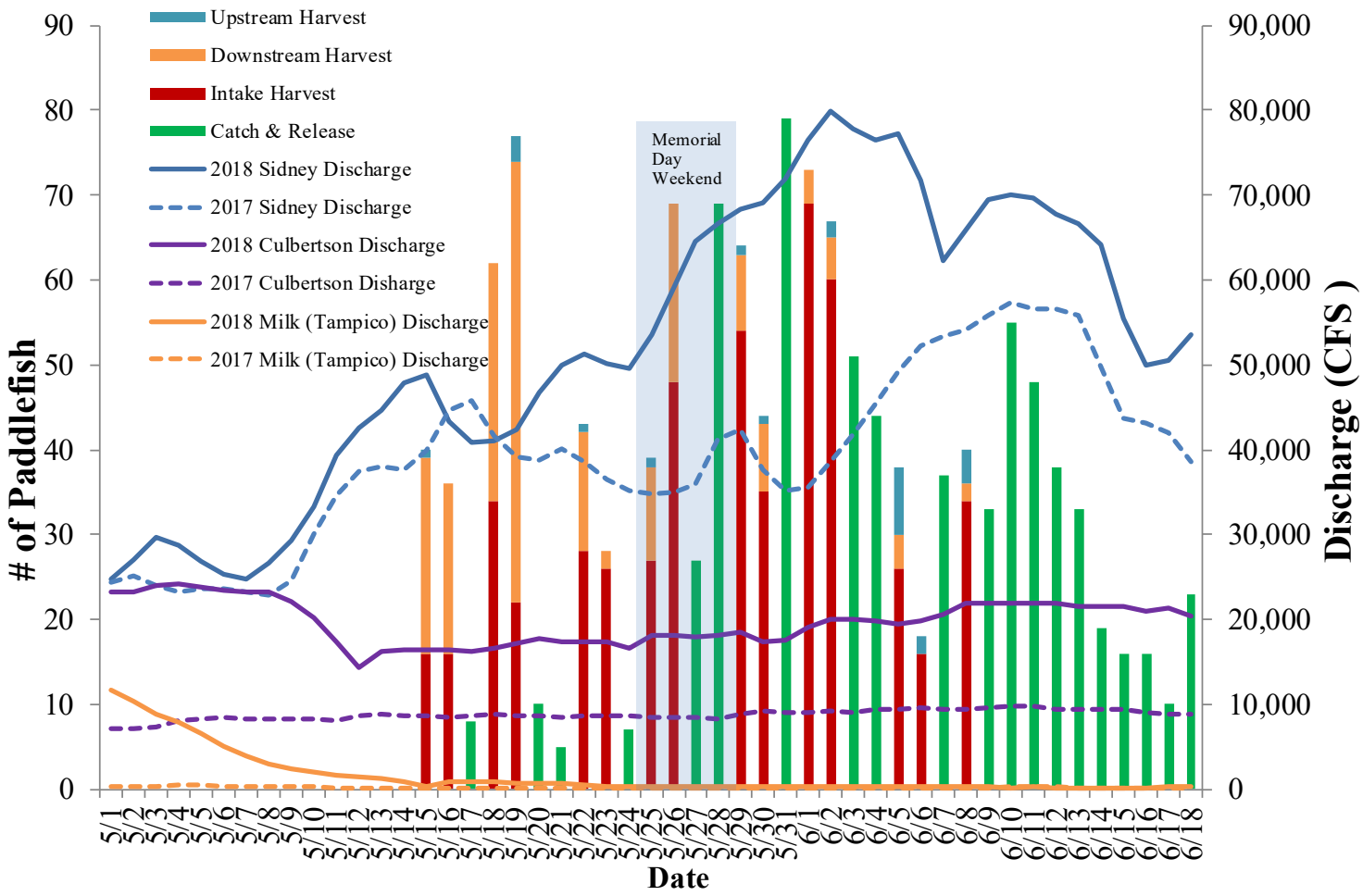

Figure 1. Observed Paddlefish harvest at Intake, upstream of Intake, and downstream of Intake, and catch and release at Intake during the 2018 Paddlefish season. Discharge (flow measured in cubic feet per second) recorded at USGS gauging stations; Yellowstone River at Sidney, Missouri River at Culbertson and Milk River at Tampico during the 2017 and 2018 Paddlefish seasons.

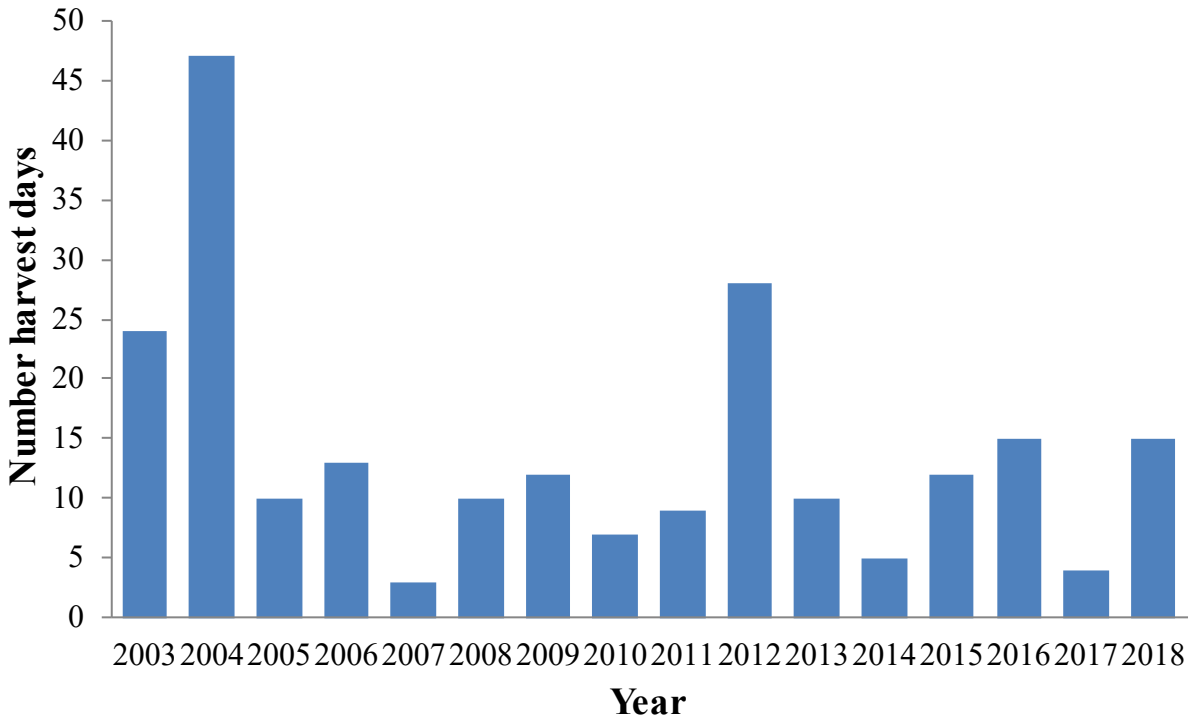

Figure 2. Number of harvest days per season for the Lower Missouri and Yellowstone Rivers.

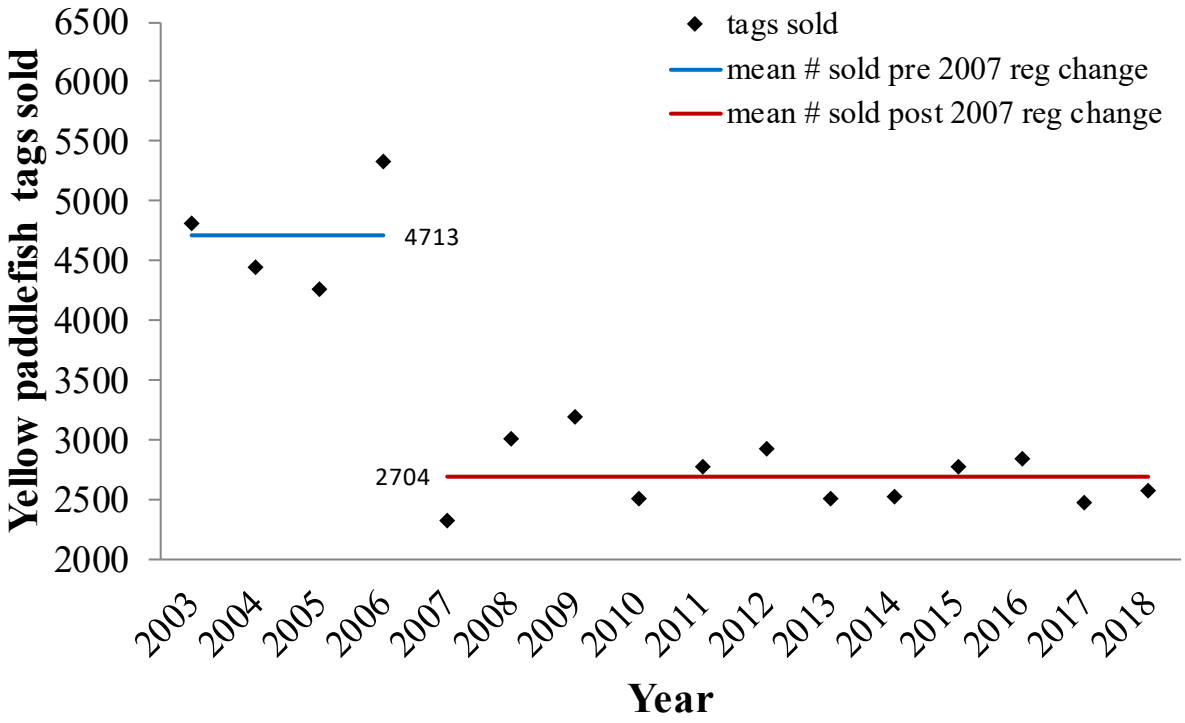

Figure 3. Number of Paddlefish tags sold for the Lower Missouri River and Yellowstone River in Montana by year with mean tag sales from 2003 to 2006 indicated by the blue line and mean tag sales from 2007 to 2018 indicated by the red line.

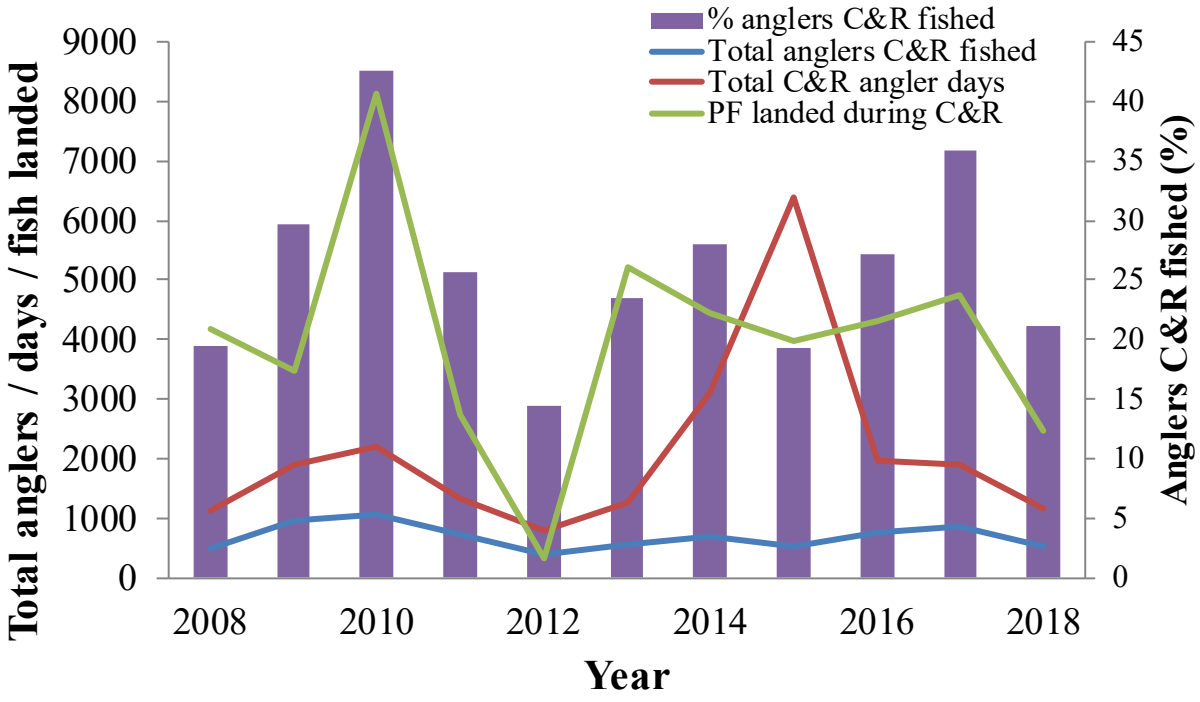

Figure 4. Phone creel catch-and-release (C&R) data by year including anglers fished, angler days, total fish landed and percent anglers participating in catch-and-release for Paddlefish of the Lower Missouri River and Yellowstone River in Montana from 2003 to 2018.

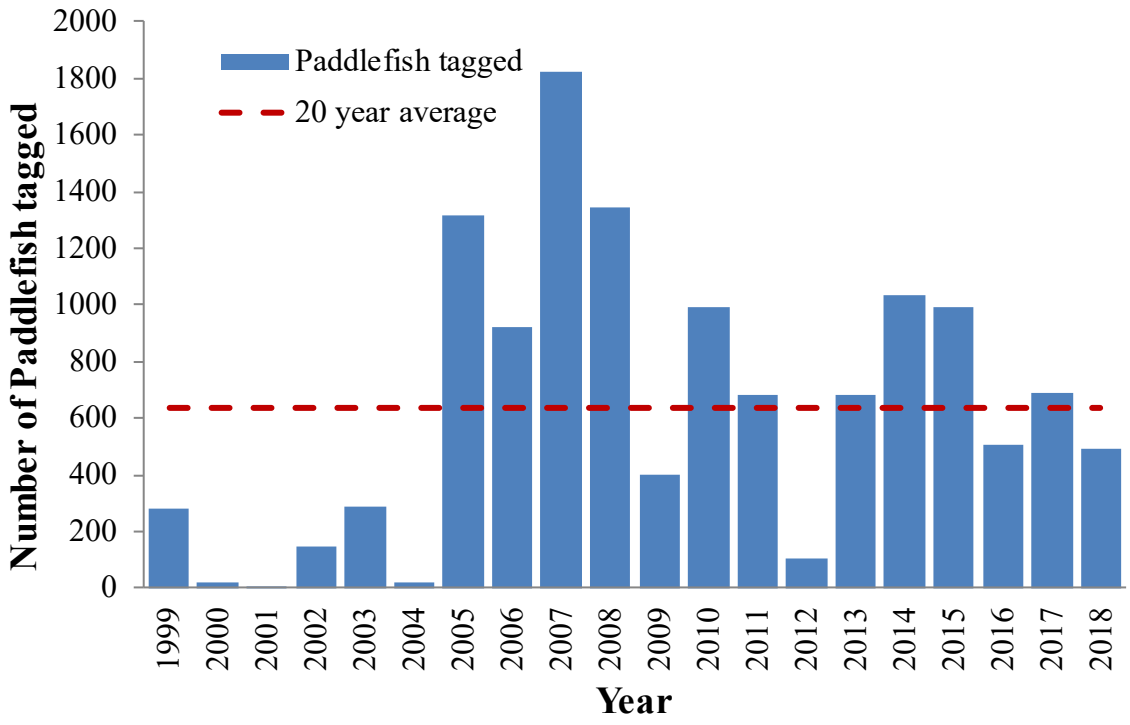

Figure 5. Number of Paddlefish tagged by year from 1997 to 2018, catch-and-release opportunity has been available since 1995, 3 days/week during the harvest season and an additional 10 days post harvest closure of catch-and-release only fishing has been available since 2007.

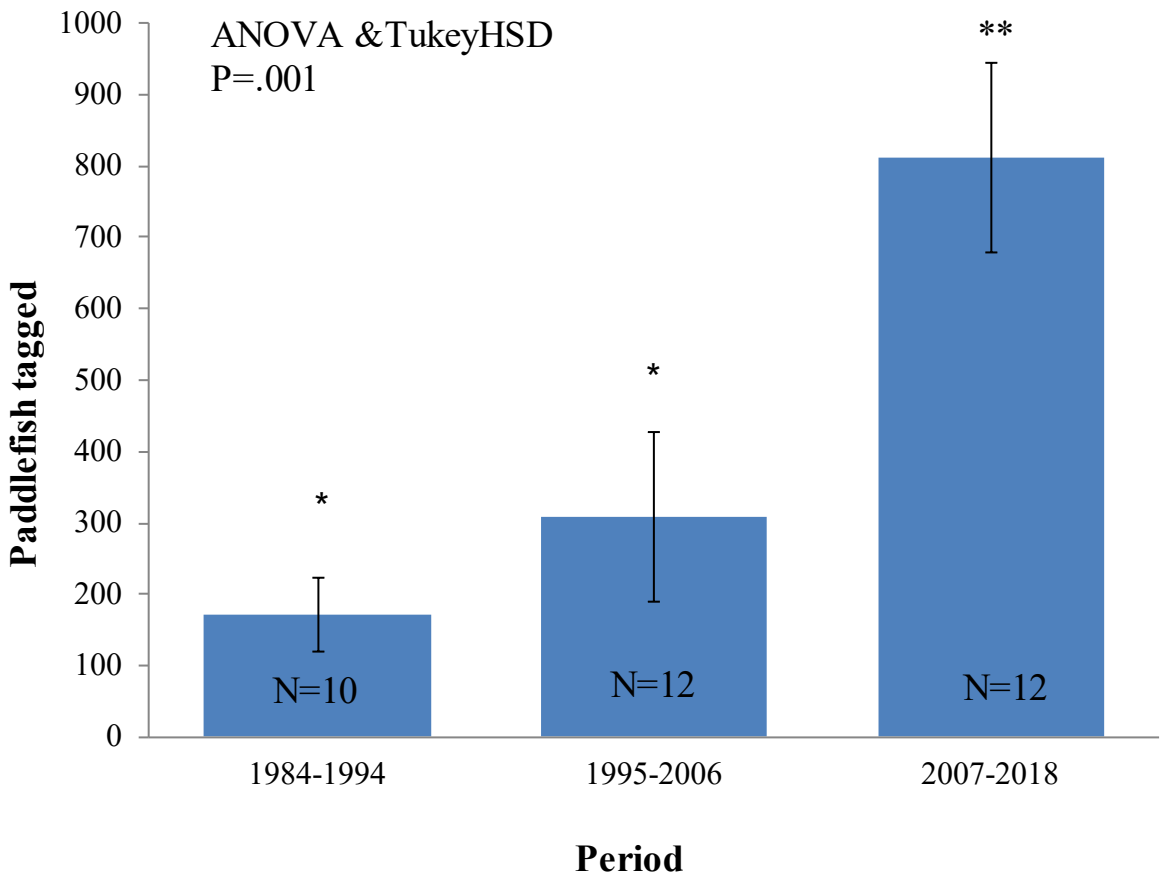

Figure 6. Number of Paddlefish tagged by period pre catch-and-release fishing (1984-1994), C&R Sundays and Wednesdays 3-9pm (1995-2006), and Sunday, Monday, Thursday and 10 days post harvest season 6am-9pm (2007-2018).

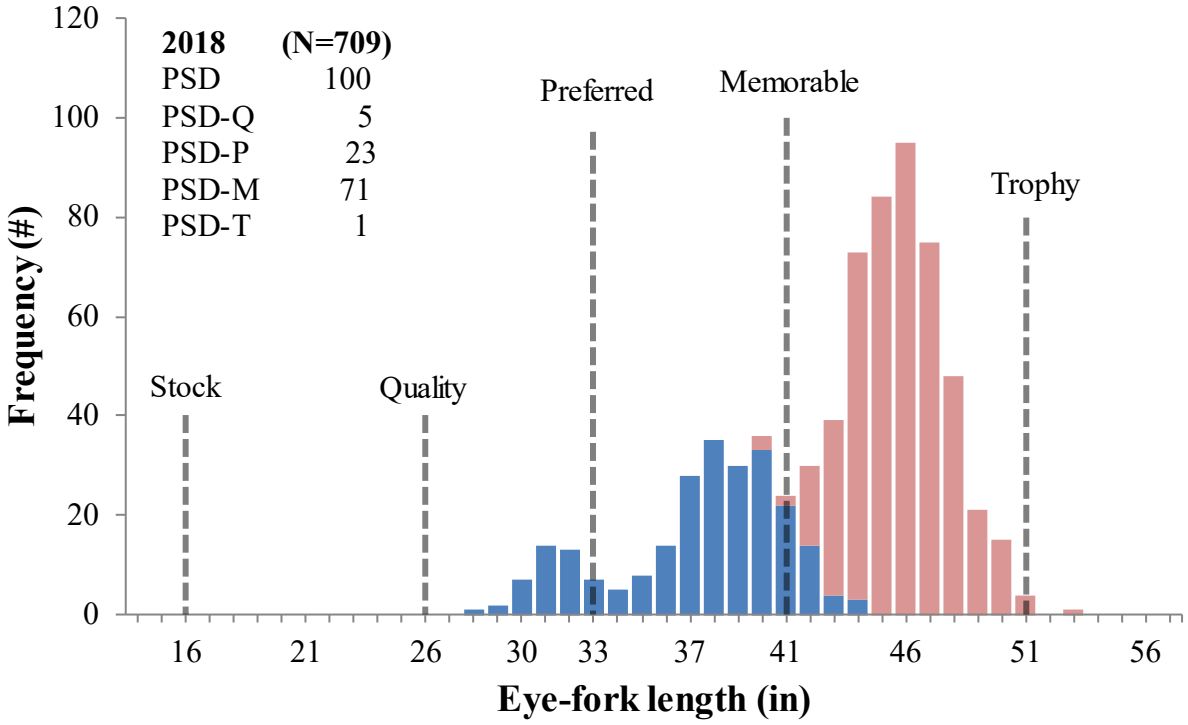

Figure 7. Length frequency histogram with proportion size distribution of Lower Missouri River and Yellowstone River Paddlefish harvested in Montana during 2018, blue bars represent male Paddlefish and pink bars represent female Paddlefish.

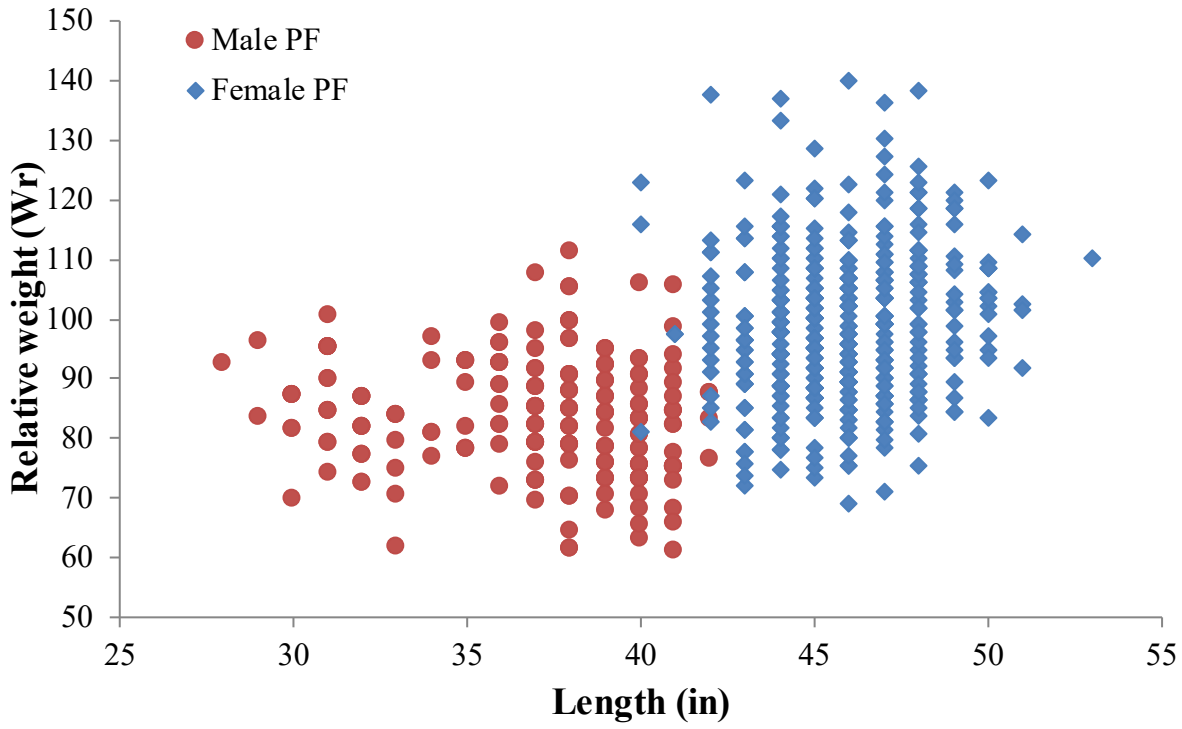

Figure 8. Relative weight by eye-fork-length (in) of Lower Missouri River and Yellowstone River Paddlefish harvested in Montana during 2018 season.

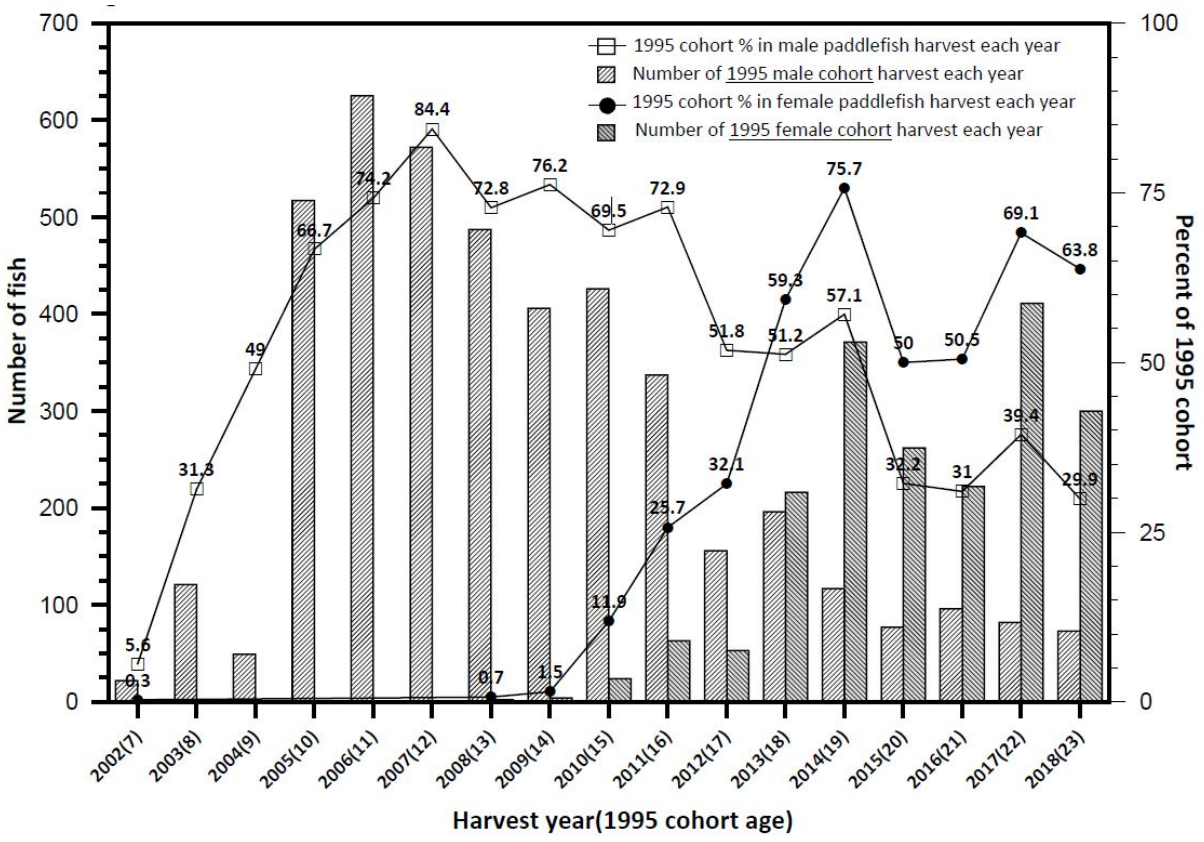

Figure 9. Percent of 1995 cohorts in male and female harvest in the Montana Paddlefish data, 2000-2018 (from Scarnecchia 2018)

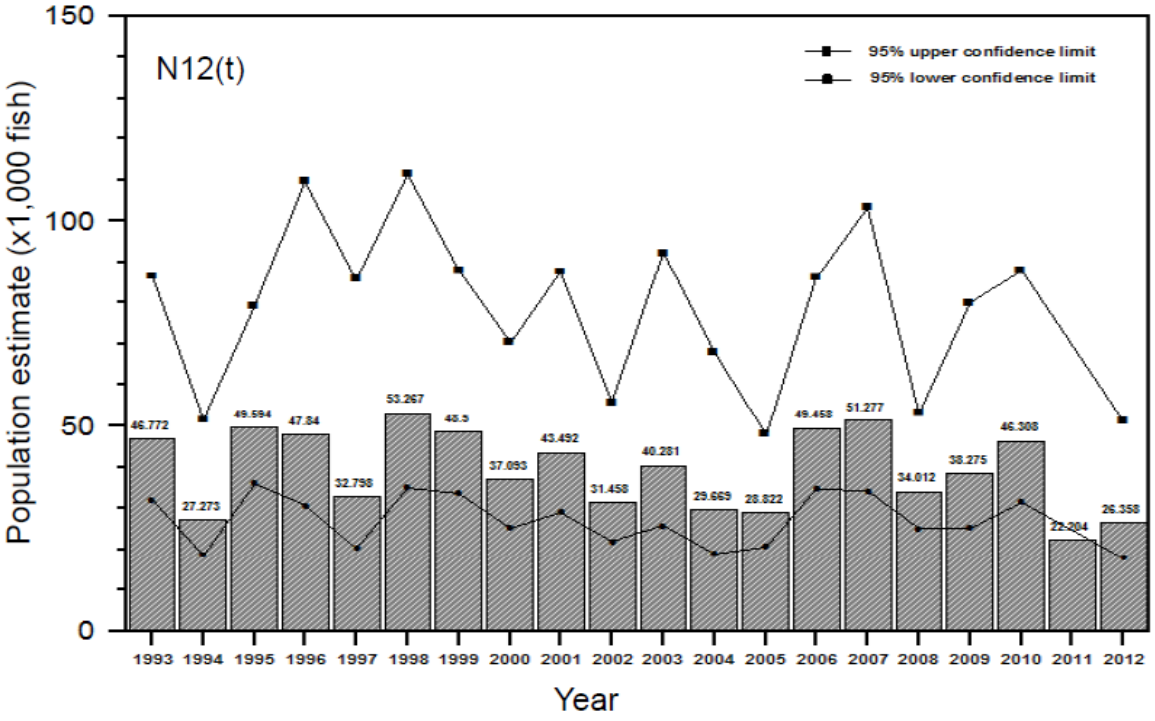

Figure 10. Petersen-Lincoln estimates of paddlefish population size with 95% confidence intervals, using scheme M1(*t*) with R12(*t*) and C12(*t*), where M1(*t*) = Count of: (1) ND-tagged paddlefish in Spring of year *t*, and (2) ND-tagged paddlefish from previous years (*t*-1, *t*-2, …) which were recaptured and released in Spring of year *t*, and the number of ND-tagged fish randomly recaptured from both ND and Montana (MT) water (R12(*t*)), and the number of paddlefish in combined ND and MT harvest in year *t* (i.e., C12(*t*)). (from Scarnecchia 2013)

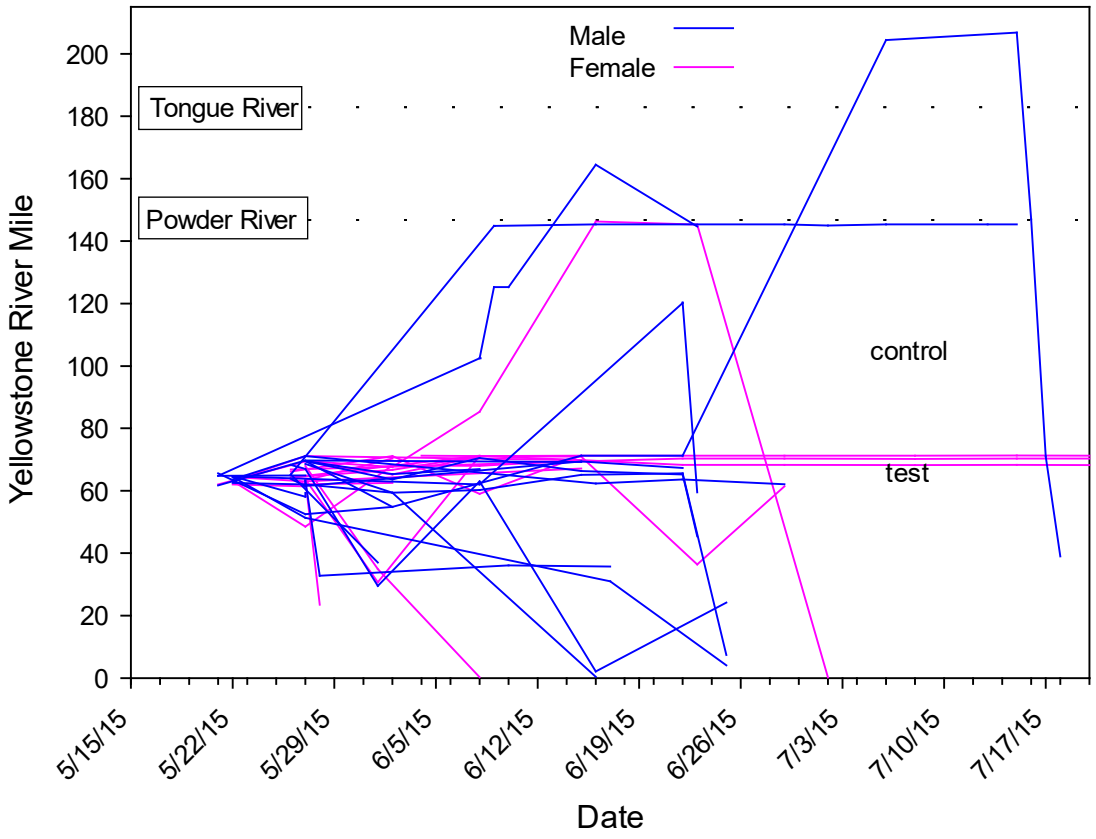

Figure 11. Movements of 40 telemetered Paddlefish in the Yellowstone River by sex during 2015. Yellowstone river mile on the y-axis and date on the x-axis with reference markers for test reach (Intake), control reach (Glendive), Powder River, and Tongue River (by Mat Rugg from Native Species Telemetry presentation to Upper Basin Pallid Sturgeon Workgroup 2015)

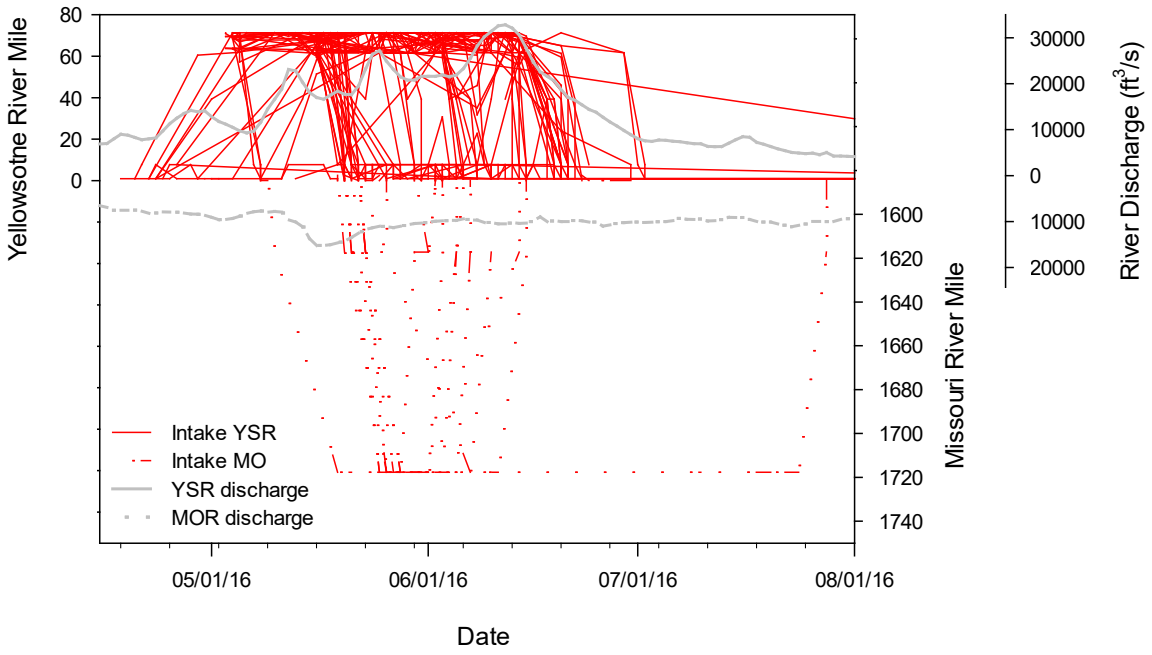

Figure 12. Movements of 58 telemetered Paddlefish in the Yellowstone and Missouri Rivers during 2016. Yellowstone river mile on the primary y-axis, Missouri river mile on the secondary y-axis, river discharge (CFS) on tertiary y-axis, and date on the x-axis with reference marker for test reach (Intake) shown in gray (by Mat Rugg from Native Species Telemetry presentation to Upper Basin Pallid Sturgeon Workgroup 2016)

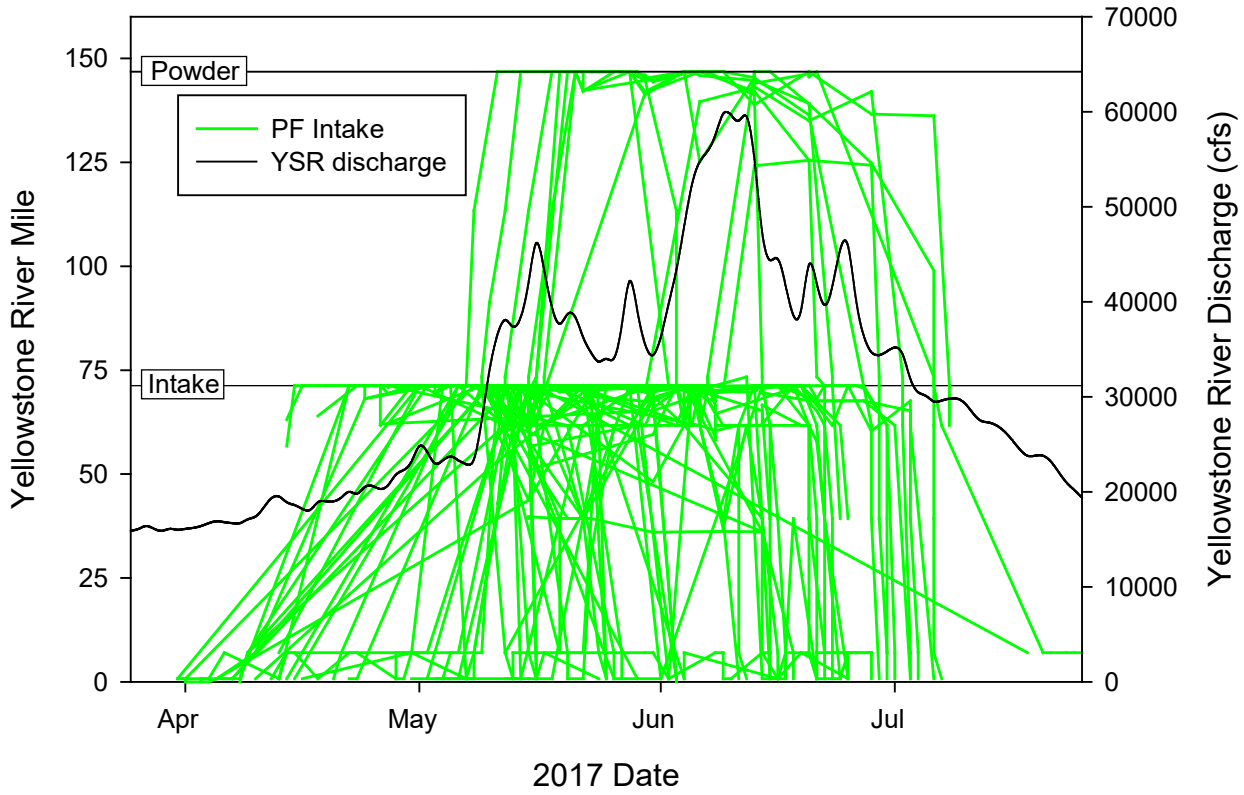

Figure 13. Movements of 49 telemetered Paddlefish in the Yellowstone and Missouri Rivers during 2017. Yellowstone river mile on the primary y-axis, Yellowstone River discharge (CFS) on the secondary y-axis, and date on the x-axis with reference marker for control reach and test reach (Intake) shown in gray (by Mat Rugg from Native Species Telemetry presentation to Upper Basin Pallid Sturgeon Workgroup 2017)

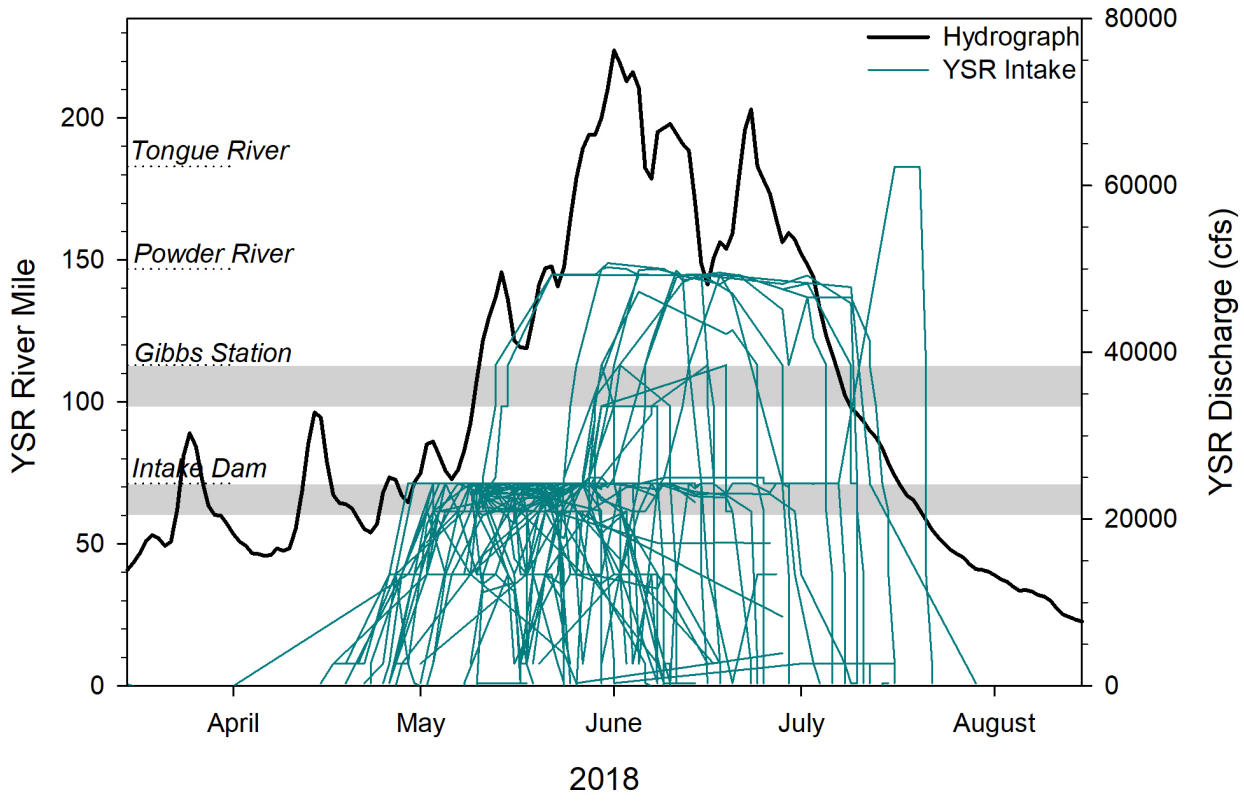

Figure 14. Movements of 52 telemetered Paddlefish in the Yellowstone River during 2018. Yellowstone river mile on the primary y-axis, Yellowstone River discharge (CFS) on the secondary y-axis, and date on the x-axis with reference marker for control reach (Gibbs Station) and test reach (Intake Dam) shown in gray (by Mat Rugg from Native Species Telemetry presentation to Upper Basin Pallid Sturgeon Workgroup 2018)

APPENDIX A

Yellowstone/Missouri River (Yellow Tag) Paddlefish Phone Survey – 2018

Compiled by Don Skaar and Corrine Selby, February 20, 2019

Number of tags sold:	**2,571**
Number tag holders sampled:	**900**
Number respondents:	**491**
Response rate:	491/900 = **58.45%**
Percent respondents fished	431/491 = **87.78%**
Percent fished on Yellowstone	426/431 = **98.94%**
Percent fished on Missouri	5/431 = **1.2%**
Total Anglers Fished	(.8778)(2,571) = **2,257 anglers**

Harvest Fishing

Fish harvested:	(2,257)(170/431) = **890 paddlefish**
Average days fished to harvest:	361/170 = **2.17 days**
Average days fished to no harvest:	586/264 **= 2.22 days**
Average hrs/day harvest fishing:	
-Yellowstone River	**2.02 hr/day**
-Missouri River	**1.17 hr/day**
Total Angler Days (harvest fishing):	(2.17)(2,215) = **4,806 days**
Catch rate (harvested fish):	170/955 = **0.18 pf/day**
Percent cleaned at chamber:	136/154 = **88.31%**

Catch and Release Fishing

Percent anglers c/r fishing:	90/426 = **21.1%**
Total anglers c/r fishing	(.211)(.9884)(2,571) = **537 anglers**
Average days c/r fishing	197/90 = **2.19 days**

Total days c/r fishing	(2.18)(537) = **1,175 days**
Average number of fish landed	415/90 = **4.61 pf/angler**
Total fish landed	(4.61)(537) = **2,476 paddlefish**
Catch rate c/r fishing	2,476/1,175 = **2.11 pf/day**
Interest in purchasing a C & R only license	**28.7%**

General Location of Harvest

Powder River	2
Powder River Confluence	2
Intake	121
Savage	1
Private land near sidney	1
Sidney Bridge	26
Richland Park	6
Private land near wibaux	1
Between Richland Park and state line	1
Fairview	1
State line	1
Not indicated	5