Progress Report MIDDLE MISSOURI RIVER FISHERIES MONITORING, MITIGATION AND ENHANCEMENT STUDIES 2017 March 26, 2018

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Funded in Part by Federal Aid Federal Aid Report F113- R17 and R18; Report Period January 1, 2017 – December 31, 2017.

ABSTRACT

This report includes information for 2017 fisheries monitoring on the 240-mile reach of the Missouri River between Great Falls, Montana and Fort Peck Reservoir. In 2017, 22,995 fish were sampled in five survey sections representing 39 of the 50 fish species known to occur in this area. The study design relied on five sampling techniques; electrofishing, seining, trammel netting, set lining and trawling to sample a variety of Missouri River fish communities.

During electrofishing surveys, 9,539 fish were captured. Channel Catfish and Sauger were the most abundant game fish with more than 400 individuals of each species captured. Sauger appear to have had excellent reproduction in 2017. A total of 274 Smallmouth Bass and 152 Walleye >150 mm were caught. Black Crappie had a record high CPUE of 7.0/hr. Shorthead Redhorse and Goldeye were the most common non-game fish and were 48% and 11% of the electrofishing catch, respectively. In the early 2000's, many native fish species experienced declines associated with low water conditions. River Carpsucker, Goldeye and Freshwater Drum were at record lows in 2007 – 2008 but rebounded in recent years. Freshwater Drum and Smallmouth Buffalo had record high CPUE of 8.2 and 2.2 per hour in 2017. In 2017, standardized trammel netting was completed in the Coal Banks, Judith Landing and Robinson Sections with 736 fish representing 22 species captured. An additional 799 fish were captured during 50 drifts in the Lower Marias River. Shovelnose Sturgeon CPUE in the Middle Missouri River has consistently been highest in the Coal Banks Section but in 2017, CPUE in that sections was the lowest on record and was lower than in the other two sections. The low catch rate was likely due to netting in mid-July, instead of in late summer. Setlines captured 605 fish in 2017. Pallid Sturgeon, a federal Endangered Species, had the highest CPUE, a record high of 2.9/set. All were hatchery raised Pallid Sturgeon (HRPS). Channel Catfish had the second highest catch rate at 1.6/set. In 2017, seining captured 10,927 individuals of 21 species. CPUE was twice that of 2016 due to high abundance of Emerald Shiners, which accounted for more the 50% of the catch. Flathead Chub was the second most common species at 7.8% of the catch. *Hybognathus sp.* catch was the second lowest recorded. In 2017, 417 fish were captured in the beam trawl, the primary method to capture Sicklefin Chub and Sturgeon Chub, two species of concern. Sturgeon Chub CPUE at 1.3/haul, was the highest observed since 2007. Sicklefin Chub CPUE was 0.2/haul, the second lowest on record. Flathead Chub CPUE (0.4/haul) was the highest since 2011.

In 2017, endangered fish species and Montana Species of Special Concern captured included, 21 Blue Sucker, 414 Pallid Sturgeon, 593 Sauger, 135 Sturgeon Chub and 18 Sicklefin Chub. The yearling HRPS population estimate in September 2016 in the study area was about 4,109 fish.

Spiny softshell turtles (SST) were sampled in a 10-mile reach of the Missouri River downstream from the Judith River in 2017. A total of 215 SST (156 females; 59 males) were captured during 80 trap-nights. Forty-four females were recaptured at least once and 8 males were recaptured once. Sixteen female SST tagged 5-10 years ago were recaptured during this study and exhibited very slow growth. Based on observed growth, it is possible that Missouri River SST live far longer than the 50 years observed in other studies.

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INTRODUCTION

The middle Missouri River supports a diverse warm water fishery and is relatively unaltered compared to the Missouri River downstream. This reach still has a spring pulse, most of the riparian/area and shoreline is protected by special designation and temperatures are adequate for native fish. However, the spring freshet is much smaller than prior to water development and fish migration has been blocked by dams. Water and irrigation management also reduce tributary run-off. The native fish species that historically occurred here are still found in this reach, including the federally listed endangered Pallid Sturgeon (Tews and Gardner 2014). An inventory conducted over 30 years ago (Berg 1981), concluded the fishery had exceptional aesthetic and recreational values. Today, most of the reach is a Wild and Scenic River, a National Monument or a National Wildlife Refuge. In 2000, PPL-Montana (PPL) was re-issued a 40-year operating license by the Federal Energy Regulatory Commission (FERC) for the company's Great Falls hydroelectric dams located on the Missouri River just upstream of the study area. PPL was required by FERC to develop and implement a comprehensive fish monitoring and evaluation program for the protection, mitigation and enhancement of the fisheries resources in this reach of the Missouri River. PPL contracted with MFWP to conduct this work starting in 2001, to help meet the requirements of PPL's federal operating license (FERC Project 2188) for five dams on the Missouri River in the Great Falls area. The objectives for this project are detailed in five-year fisheries protection, mitigation and enhancement plans which were developed by PPL in cooperation with state and federal resource agencies and approved by FERC. The current agreement is in effect until 2018. The hydroelectric dams were purchased by Northwestern Energy (NWE) in 2014. NWE is following the fisheries monitoring and evaluation program previously contracted by PPL. NWE also provides funds for radio telemetry and additional Pallid Sturgeon work in this reach.

OBJECTIVES

- 1. Monitor the relative abundance of the most common fish species in the Missouri River downstream of Morony Dam.
- 2. Implement adaptive management practices to mitigate fisheries impacts associated with the operation of the Great Falls dams.
- 3. Protect and provide for the recovery of threatened and endangered species, and other aquatic species of special concern in the Missouri River below Morony Dam.
- 4. Provide assistance for ongoing evaluation of Pallid Sturgeon in the Missouri downstream of Morony Dam.

DESCRIPTION OF STUDY AREA

The middle Missouri River study area is a 240-mile reach between Morony Dam and Fort Peck Reservoir (Figure 1). The U.S. Bureau of Land Management manages the 148 miles within the Wild and Scenic Missouri River and the Upper Missouri River Breaks National Monument. In addition, 54 miles of the study area are bordered by the CMR National Wildlife Refuge, administered by the U. S. Fish and Wildlife Service (USFWS). Four major tributaries enter the Missouri in this reach; the Marias River/Teton River, Judith and Musselshell. The present flow regimen is modified by regulation and storage at several upriver dams (Brunmond 2015). For study purposes, the river was divided into five sections (Appendix 1, Appendix 2). The middle Missouri River is generally entrenched within the Missouri River Breaks



Figure 1. Map of the Middle Missouri study area.

topography and is contained in a moderate to narrow valley. Habitat characteristics of the study sections are described in Appendix 2. Fisheries information collected from the 80 miles of the lower Marias River downstream from Tiber Dam is discussed in this report due to its importance for migratory fish in the Missouri River.

PROCEDURES

Target fish species were chosen to represent of a variety of habitat and trophic guilds. Game and non-game fish species were used as biological indicators as part of the comprehensive fisheries monitoring and evaluation program. Twenty target species were divided into groups based on life cycle guilds and sampling method (Table 1). These groups were; shallow water game fish, shallow water non-game fish, deep water large fish, deep water small fish and shallow water small fish. Small fish consisted of minnows and age-0 fish. Five sampling methods were used to sample these fish communities (Table 2). Fall electrofishing sampling was completed in 6-mile reaches to evaluate adult fish populations in shallow water habitats (Appendix 1). Trammel drift netting was used to sample sturgeon in deep water habitats. Long lines (set lines) were used to sample fish near large woody debris in early spring. Summer seining was used in the shallow river habitats to evaluate the juvenile fish and the cyprinid portion of the fish communities. The seining protocol was revised in 2013 to provide for comparable sampling between years and staff (Appendix 3). Finally, small fish in deep-water habitats were sampled with a benthic trawl. To facilitate data analysis, only information from the more common target species was analyzed in detail and over time to determine if any environmental changes could be tied to these observations.

Fish were measured to the nearest 1 mm (fork length for sturgeon and total length for other species) and weighed to the nearest 5 grams. Blue Suckers and Pallid Sturgeon were checked for 125 kHz PIT tags. PIT tags (125 kHz) were installed in new captures of these two species. In 2017, 134.2 kHz PIT tags were installed in some fish as part of a Marias River PIT tag study (Tews et al. 2018). The black stripe/dot in the caudal peduncle was used to differentiate Sicklefin Chub (*Macrhybopsis meeki*) and Sturgeon Chub (*Macrhybopsis gelida*). Western Silvery Minnows (*Hybognathus argyritis*) and Plains Minnows (*H. placitus*) were delineated in the field by eye size and body shape (Bramblett 2017). These species were combined as *Hybognathus spp*. prior to 2012, so long-term comparisons in this report do not separate the two species. Nearly 100% *Hybognathus spp*. from 2012 – 2017 were identified as Western Silvery Minnow; most fish of this genus are likely that species. Relative weight (Wr) (Neuman et al. 2012) was calculated for most species. Blue Sucker Wr was calculated from the linear equation in Neely et al. (2008). MFWP collected temperature data at four locations on the Missouri, at RM 30.5 on the Marias and at RM 2.3 on the Teton.

Spiny Soft-Shell Turtles

Spiny softshell turtles (Apalone spinifera) (SST) were sampled in a 10-mile reach of the Missouri River downstream from the Judith River during the summer of 2017. The goal of this sampling was to obtain a population estimate for SST in a representative section of the river to follow up on earlier work (Dood et al. 2009, Tornabene 2014) and to initiate long-term population monitoring of this aquatic species of special concern. This sampling section was chosen because it has good motorboat access and because it is located in the center of an approximate 80-mile reach that was previously identified as having the highest density of SST between Morony Dam and Fort Peck Reservoir (Dood et al. 2009). The test section was also long enough to encompass the average summer linear home range (approximately 3 mi) and average weekly movements (0.06 - 0.2 mi) of SST in this area (Tornabene 2014). Human presence is higher in the test area than in the rest of the approximate 80miles of 'core' SST habitat. SST are known to be sensitive to human disturbance during nesting (Bolton 2007) and are also often caught by anglers; hence it is reasonable to assume that the river-wide SST population will be secure if the population remains stable in this test section. SST trapping methods were the same as those employed by Dood et al (2009). Six-foot long nylon turtle nets (Memphis Net and Twine Co.) with 3-foot hoops and 2-inch mesh were set overnight at each trap location. Traps were generally set close to shore in areas with relatively low current velocity and the top portion of each trap was exposed above water to allow trapped SST's to breathe and avoid drowning. Traps were baited with several pieces of frozen Shorthead Redhorse (obtained from river electrofishing surveys) enclosed in a metal can suspended and partially submerged in each trap. Twenty trap sites spaced at approximate 0.5-mile intervals on alternate sides of the river were located from RM 1971 (approximately 0.7 miles upstream from Stafford Ferry) to RM 1981 (approximately 3 miles downstream from the mouth of the Judith River). An overnight trap set was made at each trap location on four different trapping occasions from 24 July - 3Aug 2017. Each trapping occasion consisted of two days of trapping, with the uppermost 10 traps set on the first day and fished overnight and the lower 10 traps set on the second day and fished overnight. Traps were re-baited and moved after each overnight set.

All captured turtles were weighed to the nearest gram and the curved carapace length (CCL) was measured to the nearest mm using a plastic measuring tape. Sex of each turtle was determined based on carapace coloration and texture as well as tail characteristics. Turtles larger than approximately 175mm CCL were tagged with numbered monel metal self-piercing fish tags (National Band & Tag Co; #1005-681) and smaller turtles were tagged with smaller metal self-piercing tags (National Band & Tag Co;

#1005-4). Tags were attached to the posterior (trailing) margin of the carapace. Each tagged turtle also received a 12mm HDX+ PIT tag (134.2 kHz; Oregon RFID Inc.) injected just under the skin in the thigh area of the right rear leg. The insertion area was disinfected with alcohol prior to tag insertion and the small injection-site wound was covered with liquid "New-Skin" to seal the wound and prevent tag ejection. PIT tags were read and recorded using 'Bi-Hex' format. All captured turtles were released 50-100 yds downstream from each trap site.

RESULTS

In 2017, peak mean daily discharge was near the median at Fort Benton and above the median at Landusky (henceforth called Robinson Bridge). Discharge peaked at both locations in May, one month earlier than average (Figure 2). In 2017, winter and fall discharge was about 500 cfs in the Marias River but the USBR released 2,000 cfs from mid May – mid June (Figure 3). MFWP (1989) developed flow recommendations for four seasons on the Missouri River. In 2017, the recommended side channel and base flows were achieved 100% of the time. Spring discharge was attained for part of the recommended time-period (Figure 4). Daily mean, maximum and minimum temperature data in the study area are listed in Appendix 4. A 15-year summary is available in Tews 2017.

Electrofishing (shallow water large-fish group)

A total of 9,359 fish of 32 species were sampled during fall electrofishing in the Middle Missouri River. See Table 3 and Appendices 5 – 9 for catch rates and size statistics by section. Table 4 compares catch from 2007 – 2017. Table 5 compares average CPUE, length, weight and Wr for 2001 – 2017 by section with 2017 sampling statistics for 11 species of interest. Overall trends for the Middle Missouri River for nine common species are shown in Figure 5. Long term trends by section including catch rate, average length and Wr for Sauger (*Sander canadense*), Walleye (*Sander vitreus*), Channel Catfish (*Ictalurus punctatus*), Smallmouth Bass (*Micropterus dolomieu*), Freshwater Drum (*Aplodinotus grunniens*), River Carpsucker (*Carpiodes carpio*), Common Carp (*Cyprinus carpio*), Shorthead Redhorse (*Moxostoma macrolepidotum*), Goldeye (*Hiodon alosoides*), Longnose Sucker (*Catostomus Catostomus*) and Smallmouth Buffalo (*Ictiobus bubalus*) are shown in Figures 6 - 10.

In 2017, Channel Catfish was the most common game species, followed by Sauger, Smallmouth Bass and Black Crappie (*Pomoxis nigromaculatus*) (Table 4). In 2016, the legal harvest doubled to two fish for Sauger, a popular native game fish and a Montana Species of Concern. Catch rates declined from 2016 in three of five sections (Figure 6) but overall CPUE was the highest since 2010 (Figure 5). Wr remained low and was about 80 for all sections except Morony. Age data was not collected from Sauger in 2017 but catch rates and size structure indicate it was an excellent year for Sauger reproduction. Age data from previous years (Tews 2017) and a size histogram (Figure 11) both indicate that the 89 Sauger less than 200 mm long, captured in 2017, were Age 0 fish. From 2012 – 2016 the most Age 0 fish captured was 48 in 2012 (Tews 2017). Sauger < 200 mm were captured in both the Judith Landing and Robinson Sections. Channel Catfish CPUE was the highest observed since 2013 and the second highest on record (Figure 5). Channel Catfish mean length was near average with Wr above 100 in all sections, except for Robinson Bridge (Figure 7).

Non-native game species

Catch rates of non-native shallow water game species remained above average. Walleye CPUE has increased over the last decade but declined in 2017 (Figure 5). However, it was above average in all sections except Coal Banks (Figure 6, Table 5) in 2017. Average total length and Wr for Walleye in 2017 were similar to the previous year and typically exceeded Sauger Wr (Figure 6). Thirty Walleye <200 mm long were captured in 2017. These small Walleye were found in all sections and were likely Age 0 fish based on past analysis (Tews 2017).

Northern Pike (*Esox lucius*) CPUE increased slightly in 2017 but remained above the long-term average despite a decline from the 2014 peak (Table 4, Figure 5). Black Crappie (*Pomoxis nigromaculatus*) were only captured in high abundance in the lower two sections and had a record overall high CPUE of 7 per hour (Figure 5), a 7-fold increase from 2016 and 1.5 times the previous high. Smallmouth Bass CPUE from 2014 – 2017 was more than twice that of previous years (Figure 5). In 2017, Smallmouth Bass CPUE was well above average in all sections (Table 5) but dropped substantially in the Morony Section (Figure 7). Smallmouth Bass exhibited a strong linear trend with the highest CPUE in the upstream Morony Section and a low CPUE at Robinson (Figure 7, Tables 3 and 5). Smallmouth Bass Wr in 2017 was similar to the long-term average at 120 (Table 5).

Native non-game shallow water species

Shorthead Redhorse and Goldeye were the most common non-game fish in the study area (Table 4). Shorthead Redhorse were 48% of the total catch and Goldeye, 11% of the catch. Other common non-game fish were Freshwater Drum, Common Carp, River Carpsucker, Longnose Sucker and White Sucker (*C. commersoni*). Minnow species, such as Emerald Shiner (*Notropis atherinoides*) and *Hybognathus sp.* had low CPUE in 2017 (Table 4), likely due in part to personnel changes and reduction in netting very small fish. In the early 2000's, during drought (Figure 4), many native species experienced declines. River Carpsucker, Freshwater Drum and Goldeye had record low CPUE in 2007 – 2008 but rebounded in recent years (Figure 5). In 2017, Freshwater Drum and Smallmouth Buffalo had record high CPUE (Figure 5). Freshwater Drum CPUE was at record highs in the upper river (Figure 8) and had above average CPUE in all but the Coal Banks Section (Table 5). Catch rates of Smallmouth Buffalo were extremely high in the Morony and Fort Benton sections and were above average in most other sections (Figure 10, Table 5). River Carpsuckers had record high CPUE in the Morony and Fort Benton sections. In 2017, mean length and Wr of River Carpsuckers was similar in all 5 sections (Figure 8). Shorthead Redhorse and Common Carp CPUE and mean length were highest in the Upper River sections (Figure 9).

	C	Habitat use	Trophic		Monit	oring
Species	Origin	Guild	Status	Life stage	Method	Group
1	C	Fluvial		U	Electrofish/	1
Blue Sucker	Native	Specialist	Invertivore	Adult	Trammel net	Deep water
		Macrohabitat	Invertivore/			Non game
Common Carp	Non-native	generalist	Detritivore	Adult	Electrofish	Shallow
1		U				
		Macrohabitat	Invertivore/	Age-0/	Electrofish/	Game fish
Channel Catfish	Native	generalist	Carnivore	Adult	Trawl/Setline	Shallow
		Macrohabitat		Age-0/		Non game
Emerald Shiner	Native	generalist	Planktivore	Adult	Seine	Shallow
		U				
		Fluvial		Age-0/		Non game
Flathead Chub	Native	Specialist	Invertivore	Adult	Seine	Shallow
		1				
		Fluvial		Age-0/	Electrofish/	Non game
Goldeye	Native	Dependent	Invertivore	Adult	Seine	Shallow
•						
		Fluvial		Age-0/		Non game
Hybognathus spp.	Native	Dependent	Detritivore	Adult	Seine	shallow.
		Fluvial				Non game
Longnose Sucker	Native	Dependent	Invertivore	Adult	Electrofish	Shallow
-		Fluvial				Game fish
Mountain Whitefish	Native	Specialist	Invertivore	Adult	Electrofish	Shallow
		Fluvial	Carnivore/		Trammel net/	
Pallid Sturgeon	Native	Specialist	Invertivore	All	set line	Deep water
•		Fluvial	Planktivore/			Non game
River Carpsucker	Native	Dependent	Detritivore	Adult	Electrofish	Shallow
-		-				
		Macrohabitat		Age-0/	Electrofish/	Game fish
Sauger	Native	generalist	Carnivore	Adult	Seine	Shallow
		Fluvial			Trammel net/	
Shovelnose Sturgeon	Native	Specialist	Invertivore	All	Trawl/set line	Deep water
		Fluvial				Non game
Shorthead Redhorse	Native	generalist	Invertivore	Adult	Electrofish	Shallow
		Fluvial		Age-0/		
Sicklefin Chub	Native	Specialist	Invertivore	Adult	Benthic trawl	Deep water
		Macrohabitat		Age-0/	Seine/	Game fish
Smallmouth Bass	Non-native	generalist	Carnivore	Adult	Electrofish	Shallow
Smallmouth		Macrohabitat	Invertivore/		Electrofish/	
Buffalo	Native	generalist	Herbivore	Adult	Trammel net	Deep water
		Fluvial		Age-0/		
Sturgeon Chub	Native	Specialist	Invertivore	Adult	Benthic trawl	Deep water
		Macrohabitat				Game fish
Walleye	Non-native	generalist	Carnivore	Adult	Electrofish	Shallow
		Fluvial	Invertivore/			Non game
White Sucker	Native	Dependent	Detritivore	Adult	Electrofish	Shallow

Table 1.	A list of 20	monitored species	and their l	life history	status and	l sampling	method used.	(Revised
from Gal	at et al. 200	5 and Bergsted et a	ıl. 2004).					

	Electrofishing	Trammel netting	Set line	Seining	Beam Trawl
Fish life history (Table 1)	Large shallow water	Large deep water	Large fish near debris such as submerged logs	Small shallow water	Small deep water
Target species	Large species except Sturgeon. All game and 100 non-game fish of each species measured.	Sturgeon	Sturgeon, Channel Catfish	Cyprinids Age 0 fish	Sicklefin Chub Sturgeon Chub
Equipment Details	Smith Root VVP 15 with pulsed CPS or straight DC at 8 – 10 amps; using the 300 or 600 volt setting. Honda 5,000 or 6,500- watt generator; 3/8 in mesh dip net. Metal boat served as the negative. The positive set up consisted of 2 fiberglass booms with 4, 18 in droppers.	$150 \ge 6 \ \text{ft nets}; 1 - 2$ inch inner mesh, 10 inch outer mesh; Large floats attached by long ropes at each end.	100 ft lines with 20, 18 inch heavy mono- filament leaders with one hook attached by trotline clips. Hook sizes 3/0l, 2/0 and 1//0. Large weights attached at each end and one float on the inner end.	Beach seine with bag; 50 ft long x 4 feet high with ¹ / ₄ inch mesh.	Benthic trawl; 6 ft wide x 1.5 ft high rectangular metal frame on skids with an 18 ft long outer chafing net with a 1/8 in inner mesh liner. Boat backed downstream with net off the front of the boat on the bottom.
Sampling Sections	5 sections sampled in fall; alternated sides every mile.	Robinson Section and two other sections	Robinson Section	5 sections; See Appendix 3.	Robinson Section
Site selection	Standard Sites (Appendix 1)	Robinson – Random sites selected RM 1925.3 -1907 with 20 sites from Pallid Sturgeon "hot spots." Other sections; 5 drifts at four random locations, including inside bend, outside bend, and channel crossovers. (Appendix 2)	Random sites selected and stratified by reach (RM 1913.5 – 1930); (RM 1896.9 - 1913.4); (RM 1880-1896.8). 50% were chosen from Pallid Sturgeon "hot spots."	See Appendix 3.	Robinson Section; Random sites chosen from RM1913 – 1883 with 50% upstream of 1899.
Sampling intensity	Sites were about 6 miles long sampled about 10 hours each for 50 hours of VVP time.	50 drifts at Robinson 20 Drifts at other sites. Nets drifted for about 7 minutes; typically 50 – 400 yards.	90 set lines; set for 12 – 20 hours.	100 seine hauls. 20 in each river section for thirty yds each.	100, 2 minute hauls; 3 hauls (left, right and center) at each random location. Typically 150 to 200 yds at 2000 RPMs.
Catch rate	# of fish/hr	# fish/net	# fish/set	# fish/haul	#fish/haul

Table 2. Annual standard monitoring protocol for the study area. See Tews and Gardner (2014) for details.



Figure 2. Mean daily flow statistics for 2017 for two locations on the Middle Missouri River compared with median flows, USGS Web interface, 2018.



Figure 3. Mean daily flow statistics on the Marias River at Chester in 2017 compared with median flows, USGS Web interface, 2018.



Figure 4. Percent of time discharge at Robinson Bridge met or exceeded the MFWP requested minimum instream flows, compared with Fort Peck Pool level. Methods described in Tews and Gardner (2014).

Species	Morony	Fort Benton	Coal Banks	Judith Landing	Robinson
Bigmouth Buffalo	0.2	0.4			0.2
Black Crappie ¹			0.8	6.3	24.2
Blue Sucker	0.1		0.1	0.1	0.1
Bluegill ¹			0.3	0.4	1.6
Brown Trout	0.2	0.4			
Brown Trout <150	0.1	0.1			
Burbot		0.2		0.1	0.3
Channel catfish	13.9	14.6	9.7	6.9	8.0
Cisco					
Common Carp	11.7	9.6	2.8	4.7	3.0
Common Carp <150					0.3
Emerald Shiner ¹					0.1
Flathead Chub ¹	0.1			2.6	2.1
Freshwater Drum	19	11.1	2.7	6.2	4.8
Goldeye ¹	25.5	29.3	14.0	15.7	23.1
Longnose Dace ¹		0.1			
Longnose Sucker	11.9	9.1	1.4	2.0	
Longnose Sucker < 150		0.1		0.3	0.2
Mountain Sucker ¹	0.2				
Mountain Whitefish	0.6		1.3		
Northern Pike	0.5	0.4	0.9	0.4	2.4
Pallid Sturgeon	0.1	0.1	0.1		
Rainbow Trout	0.7				0.1
Pumpkinseed ¹	0.2		0.2		
River Carpsucker	10.5	7.2	5.3	5.8	7.9
Rocky Mtn Sculpin ¹	0.1				
Sauger	1.4	8.6	4.9	17.1	14
Sauger <150				0.4	0.5
Shorthead Redhorse ¹	187.2	147	48.3	66.9	24.2
Shovelnose Sturgeon	0.1		0.9	0.4	0.1
Smallmouth Bass	14.5	9.7	4.2	1.6	0.2
Smallmouth Bass <150	2.3	0.6	2.3	3.3	0.7
Smallmouth Buffalo	4.5	4.5	1.0	1.3	0.7
Smallmouth Buffalo <150				0.1	
Stonecat ¹	0.6				
Walleye	4.2	4.1	1.2	2.9	2.9
Walleye <150		0.1	0.1	0.3	0.1
Western Silvery Minnow			0.4	1.3	0.4
White Sucker	7.8	18.8	1.9	0.2	
White Sucker <150	0.1	0.1	0.2	0.1	
Yellow perch ¹			0.2	0.2	0.1
Total Fish	2,645	2,651	1.032	1,651	1,380
Hours	8.3	9.6	9.8	11.2	11.3

Table 3.	Avera	ge fish catch rate	es (#/hr)) for e	lectrofishi	ing at tren	d areas in	the Middle	Missouri	River,
MT. fall	2017.	For fish >150 m	m. ¹ Inc	ludes	fish <150	mm.				

Spacios	20171	2008	2000	2010	2011	2012	2013	2014	2015	2016	2017
Digmouth buffelo	2007	1	2009	2010	1	2012	1	17	46	2010	2017
Digiliouul Dullaio		1		0	1 61	2 121	1	220	40	9 51	252
Diack chappie		3		3	01	151	30 1	229	42	21	552 26
Bluegill ¹	1	4	7	0	3	1	1	0	2	2 10	20
Blue sucker	1	4	/	9	13	/	8	8	3	10	4
Brook stickleback ¹	10	1	<i>.</i>	20	0	0.1	1.4	10	-	1.6	0
Brown trout ¹	19	11	6	20	8	21	14	13	1	16	8
Burbot	2	l	7	7	9	4	1	5	4	9	6
Channel catfish	114	60	77	236	267	265	578	446	445	550	517
Cisco							10	9	1	39	
Common carp ¹	237	177	221	295	420	266	291	229	234	375	306
Emerald shiner ¹	349	660	769	1236	1146	2492	1040	765	338	42	1
Fathead minnow ¹	2										
Flathead chub ¹	151	117	578	176	225	254	74	134	114	145	54
Freshwater drum	88	61	104	275	269	224	314	290	353	361	414
Goldeye ¹	550	526	565	856	1244	957	1587	1354	1143	2237	1067
Green sunfish ¹							4				
Hybognathus spp. ¹	214	755	230	730	392	519	754	275	95	39	23
Lake chub ¹								1			
Longnose dace ¹	2	1	2			1	5	1			1
Longnose sucker ¹	153	73	89	246	154	371	363	258	435	356	228
Mtn whitefish ¹	37	92	13	10	33	22	13	4	17	19	18
Mountain sucker ¹	57	12	15	10	55	5	7	22	1	3	2
Northern nike	15	8	9	17	28	69	52	115	53	33	19
Pallid sturgeon	15	0		17	20	0)	2	115	55	1	3
Pumpkinsood ¹	5				1	1	1		2	1	1
Painbow trout	72	20	10	56	25	10	1	10	$\frac{2}{22}$	21	+ 7
Rainbow trout	122	52 71	10	100	23	201	202	244	242	21 524	262
River carpsucker	155	/1	141	199	181	291	293	244	545	324	302
Rocky Mui. Scuipin	2 1	0	19	10	/	19	0	10	0	4	1
Sand shiner	1	2	240	(10	410	161	450	120	276	505	400
Sauger	489	3/6	340	610	410	464	450	429	3/6	505	492
Sauger <150	2	2206	3/	2	4100	39	3	29	l	1	10
Shorthead redhorse ¹	2687	2306	2194	4560	4192	4042	4152	4448	4666	4381	4461
Shovelnose sturgeon	8	9	9	14	13	6	13	19	11	6	15
Sicklefin chub		2		l				1	• • • •		
Smallmouth bass	109	114	114	188	133	114	135	375	388	399	274
S. bass <150	106	11	57	41	19	260	159	89	52	58	93
Smallmouth buffalo	36	40	53	66	70	39	30	44	13	40	114
Spottail shiner ¹		1	13		384	46	4	1			
Stonecat ¹	19	12	3	10	12	7	7	11	4	12	5
Sturgeon chub ¹		7	7			3					
Walleye	71	70	68	95	128	161	134	180	181	206	152
Walleye <150		2	4			9	2	31	2		6
White crappie				1	1					1	
White sucker ¹	249	106	63	254	264	285	327	267	232	308	271
Yellow perch ¹	3		6	2	16	24	3	2	7	5	5
Total fish	5,927	5,720	5,815	10,233	10,129	11,440	10,894	10, 370	9,638	10,769	9,359
Total hours	50	48.6	51.7	51.6	48.9	51	51.3	50.1	51.3	55.0	50.2

Table 4. Fall electrofishing catch (number of fish) for the 5 combined sections on the Middle Missouri River, 2007 - 2017 for fish ≥ 150 mm. ¹Includes fish < 150mm.

	1	<u> </u>	+						
	*	Average	2001 to	2017			2017		
			Length	weight			Length	weight	
Section	Species	CPUE	(mm)	(g)	Wr	CPUE	(mm)	(g)	Wr
Morony	Channel Catfish	6.4	577	2500	109.2	13.9	585	2366	109.4
	Common Carp	9.9	647	3969	101.5	11.7	649	3863	101.8
	Freshwater Drum	7.5	398	969	107.3	19.0	358	659	102.8
	Goldeye	22.9	324	324		25.5	323	298	
	Longnose Sucker	14.9	311	457		11.9	366	636	
	River Carpsucker	2.4	491	1826	109.4	10.5	442	1253	102.4
	Sauger	2.9	360	475	87.5	1.4	416	748	85.1
	Shorthead Redhorse	124	429	1027	105.3	187.2	448	1100	103
	Smallmouth Bass	11.3	269	387	118.8	16.7	229	299	114.4
	Smallmouth Buffalo	1.7	611	4553	93	4.5	590	3846	92.7
	Walleye	2.6	400	816	93.5	4.2	359	489	88.8
East									
FUIL Benton	Channel Catfish	65	576	2301	107.6	14.6	579	2317	109.3
Denton	Common Carn	6.1	632	3609	107.0	9.6	640	2517	107.5
	Erashwatar Drum	0.1 4 7	384	825	101.5	9.0	248	5042	102.8
	Goldova	4.7 20.2	204	02J 222	105.8	20.2	226	210	102.8
	Longnoso Sucker	20.3	320	507		29.3	320	510 662	
	Longhose Sucker	0.9	549 169	1402	102.4	9.2	374 420	1200	101
	River Carpsucker	2.8 6 7	408	1492 560	105.4 94.4	1.2 9.6	439	500	101
	Sauger	0./	394	500	84.4	8.0 1.47	394	509	80.2
	Shorthead Rednorse	103.5	423	966	101.4	14/	427	924	97.5
	Smallmouth Bass	3.8	284	468	121.9	10.3	292	586	122.1
	Smallmouth Buffalo	0.9	612	4351	92.4	4.5	622	4506	90.6
	Walleye	2.5	392	644	90.1	4.2	368	490	89
Coal									
Banks	Channel Catfish	3.5	569	2266	105.0	9.7	547	1992	111.4
	Common Carp	4.0	564	2469	95.0	2.8	563	2632	100.7
	Freshwater Drum	3.8	355	619	104.6	2.7	342	550	108.6
	Goldeye	22.9	317	298		14.0	315	288	
	Longnose Sucker	2.9	327	461		1.4	314	379	
	River Carpsucker	5.8	453	1277	98.5	5.3	446	1274	102.7
	Sauger	6.7	369	416	78.9	4.9	364	392	78.6
	Shorthead Redhorse	61.3	346	557	93.0	48.3	302	430	96.8
	Smallmouth Bass	2.3	278	480	121.4	6.5	222	568	125.6
	Smallmouth Buffalo	1.1	578	3422	87.8	1.0	551	3190	95.1
	Walleye	2.0	366	527	85.7	1.3	306	386	89.8

Table 5. Fall electrofishing statistics for 11 species of interest on five sections of the Middle Missouri River 2017 compared with averages for the period 2001 - 2017. Includes fish <150 mm

Table 5. continued. Fall electrofishing statistics for 11 species of interest on five sections of the Middle Missouri River 2017 compared with averages for the period 2001 - 2017.

		Average	2001 -	2017			2017		
			Length	weight			Length	weight	
Section	Species	CPUE	(mm)	(g)	Wr	CPUE	(mm)	(g)	Wr
Judith									
Landing	Channel Catfish	4.1	585	2516	104.6	6.9	551	1995	106.6
	Common Carp	3.9	528	2158	95.6	4.7	509	1955	96.5
	Freshwater Drum	3.0	350	587	103.5	6.2	325	451	103.1
	Goldeye	21.9	309	280		15.7	314	286	
	Longnose Sucker	2.2	303	359		2.2	311	465	
	River Carpsucker	5	462	1409	100.7	5.8	440	1209	101.5
	Sauger	11.7	352	384	79.0	17.4	320	319	79.6
	Shorthead Redhorse	46.2	329	503	93.2	66.9	286	372	92.6
	Smallmouth Bass	1.1	284	580	124.9	4.9	188	813	133.2
	Smallmouth Buffalo	0.8	639	4632	87.8	1.4	567	3735	87
	Walleye	2.6	372	548	84.6	3.2	294	268	84.9
Robinson	Channel Catfish	4.5	534	1782	95.3	8.0	540	1515	87.7
	Common Carp	2.8	501	1828	94.0	3.3	454	1589	95
	Freshwater Drum	3.5	321	460	104.5	4.8	314	390	101.5
	Goldeye	21.5	298	250		23.1	298	227	
	Longnose Sucker	0.3	161	124		0.2	108		
	River Carpsucker	5.9	479	1608	101.6	7.9	452	1364	105.5
	Sauger	11.7	330	328	78.1	14.5	311	291	79.3
	Shorthead Redhorse	22.0	308	391	92.5	24.2	316	446	95
	Smallmouth Bass	0.1	113	254	132.6	0.9	119	120	118.6
	Smallmouth Buffalo	0.4	601	3025	83.9	0.7	540	2718	88.9
	Walleye	1.8	373	686	85.6	3.0	340	435	81.



Figure 5. Electrofishing catch per hour summaries for all sections combined for ten common Middle Missouri River species, 2001 – 2017.



Figure 6. Electrofishing summaries for Sauger and Walleye, for CPUE, total length and Wr trends from 2001 - 2017, Middle Missouri River, Montana. Note different scales.



Figure 7. Electrofishing summaries for Channel Catfish and Smallmouth Bass, for CPUE, total length and Wr trends from 2001 – 2017, Middle Missouri River, Montana. Note different scales.



Figure 8. Electrofishing summaries for Freshwater Drum and River Carpsucker, for CPUE, total length and Wr trends from 2001 – 2017, Middle Missouri River, Montana. Note different scales.



Figure 9. Electrofishing summaries for Common Carp and Shorthead Redhorse, for CPUE, total length and Wr trends from 2001 – 2017, Middle Missouri River, Montana. Note different scales.



Figure 10. Electrofishing summaries for Goldeye, Longnose Sucker and Smallmouth Buffalo, for CPUE, total length and Wr trends from 2001 – 2017, Middle Missouri River, Montana. Note different scales.

Trammel net drifting (deep water large fish group).

Trammel netting was used to evaluate Pallid and Shovelnose Sturgeon population trends. Standard drifts captured 736 fish representing 22 species (Table 6). Size statistics by section are listed in Appendices 10 – 12. An additional 799 fish were captured during 50 drifts in the Lower Marias River (Tews et al. 2018). Shovelnose Sturgeon CPUE in the Middle Missouri River has consistently been highest in the Coal Banks Section and, in 2016, CPUE was the highest observed since 2006 (Figure 12). In contrast, 2017 Shovelnose Sturgeon CPUE at Coal Banks was the lowest on record, and lower than in the other two sections (Figure 12, Table 6). In 2017, all Coal Banks drifts were conducted downstream of RM 2042 between 7/12 - 7/20. Radio tagged Shovelnose Sturgeon remained further upstream (near RM 2050) until the last week of July (Tews et al. 2018). Therefore, the relatively early trammel netting dates (mid-July) and location of the Coal Banks netting (below RM 2042) likely account for the low CPUE.

Shovelnose Sturgeon Wr, was near 100 in all sections (Figure 12). For the last 15 years, average Shovelnose Sturgeon fork length has been shorter in the Robinson Section than elsewhere (Figure 12). In 2017, average length followed this trend. Average length was 760 mm in the Coal Banks Section (Appendix 10), 749 mm in the Judith Landing Section (Appendix 11), and only 719 mm in the Robinson Section (Appendix 12). Mean fork length in the Robinson Section has changed little over the last 17 years (Figure 12), however, size structure has changed (Figure 13). Recruitment of the 2015 and/or 2016 Shovelnose Sturgeon year classes appears to be excellent. In 2017, the proportion of Shovelnose Sturgeon under 550 mm captured at the Robinson Section was much higher than in 2001, 2009 or 2015 (Figure 13). Shovelnose Sturgeon age data from 2004 – 2008 (Tews and Gardner 2014) indicates fish under 400 mm are likely age 1+ fish (N=7 in 2017) and 400 - 500 mm fish (N=5 in 2017) are likely age 2+. Small Shovelnose Sturgeon have been rarely captured in the study section. Therefore, the 2015/2016-year classes may be important for long-term population success. During standard trammel net sampling near Robinson Bridge, CPUE for Pallid and Shovelnose Sturgeon were the highest observed since 2013. Between 2016 and 2017, CPUE increased from 3.1 – 3.6 per drift for Shovelnose Sturgeon and from 1.2 to 2.6 per drift for HRPS (Figure 14, Table 7). Despite a relatively high percentage of small Shovelnose Sturgeon (Figure 13), mean Shovelnose Sturgeon weight was the highest observed since 2011 and the second highest on record (Table 7).

Set lines

In 2017, 605 fish were caught with 90 standard set lines (Table 8, Appendix 13). Pallid Sturgeon CPUE was at record high at 2.9/set (Figure 15). Shovelnose Sturgeon CPUE was average while Channel Catfish and Walleye CPUE were above average (Figure 15, Appendix 13). Sauger CPUE was below average and the lowest observed since 2013. Channel Catfish CPUE has typically been higher when mean water temperatures exceeded 49° F (Table 8).



Figure 11. Sauger size structure during fall electrofishing, 2017.

Table 6. Average CPUE (#/drift), number of fish sampled and sampling statistics for standard trammel nets, 2017.

		CPUE	
Species	Coal Banks	Judith Landing	Robinson
Bigmouth Buffalo	0	0	0
Black Crappie	0	0	< 0.1
Blue Sucker	0.15	0.2	< 0.1
Bluegill	0	0	< 0.1
Burbot	0	0.05	0
Channel Catfish	0.35	0.15	0.28
Common Carp	0.25	0	< 0.1
Flathead Chub	0	0.05	0.28
Freshwater Drum	0	0	< 0.2
Goldeye	0.5	0.8	0.42
Longnose Sucker	0.55	0.75	0.06
Paddlefish	0	0	< 0.1
Pallid Sturgeon	0.3	0.35	2.06
Rainbow Trout	0	0	< 0.2
River Carpsucker	0	0.05	0.08
Sauger	1.05	0.3	0.28
Shorthead Redhorse	2.65	2.55	0.32
Shovelnose Sturgeon	2.9	3.65	3.6
Smallmouth Bass	0.05	0	0
Smallmouth Buffalo	0	0	< 0.1
Walleye	0.05	0.05	< 0.1
White Sucker	0.1	0	0
Total fish	178	179	379
Mean Depth	5.5	5.4	6.1
Mean Distance (yds)	333	264	295



Figure 12. Shovelnose Sturgeon catch rates, mean fork length and Wr from trammel net drifts completed in five sections of the Middle Missouri River in summer/fall 2001 - 2017; some sections sampled on alternate years.



Figure 13. Shovelnose Sturgeon size structure near Robinson Bridge for 2001, 2009, 2015, and 2017.



Figure 14. Pallid Sturgeon and Shovelnose Sturgeon catch rate trend for fall trammel netting surveys conducted in the Robinson Section (RM 1925 – 1907), 1996 – 2017.

	(1996-										
Year	2007)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
				I	Pallid St	turgeon	1				
# Sampled	6.8	28	42	39	39	99	106	14	67	61	103
# Wild	0.6	0	0	0	0	0	0	0	0	0	0
#HRPS	6.0	28	42	25	39	99	106	14	67	61	103
Mean #/drift	0.13	0.56	0.82	0.50	0.78	1.98	2.12	0.21	1.34	1.22	2.06
# Pallid Sturgeon captured (N)		146	271	347	302	334	451	217	257	229	414
_				<u>Sho</u>	velnose	e Sturge	eon				
#sampled	210	222	227	173	125	226	253	80	108	155	181
Average weight	1477	1693	1612	1838	1924	1884	1871	1862	1842	1797	1904
(g)											
number/drift	4.2	4.4	4.4	3.5	2.5	4.5	5.1	1.25	2.2	3.1	3.6
			Drift	net san	npling i	nforma	tion (n	nean)			
Drift time (min)	6.8	6.8	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
# of drifts		50	50	50	50	50	50	64	50	50	50
Drift distance (m)	262	262	303	291	272	215	278	376	320	284	354
Depth (m)	19	16	17	2.0	24	2.0	17	27	18	19	18

Table 7. Sampling statistics for the annual Pallid Sturgeon assessment, near Robinson Bridge, in the Middle Missouri River, MT, 1996-2017, compared with Pallid Sturgeon captured by FWP 2008 – 2017.



Figure 15. Catch rate of frequently caught species during standardized spring set lining, Robinson Section 2008 - 2017.

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Bigmouth Buffalo						1				
Burbot	1			1	1	2	6	3	4	3
Channel Catfish	25	38	139	28	182	99	154	160	52	148
Common Carp	5	12	14	1	3	2	2	15	10	3
Flathead Chub	39	31	35	8	38	25	4	6	11	2
Freshwater Drum		6	10		1			5		8
Goldeye	50	14	63	15	19	104	63	70	95	44
Longnose Sucker					1					
Northern Pike						2				
Pallid Sturgeon	59	132	228	116	206	232	125	96	112	259
Rainbow Trout	1		1			1		1		
Sauger	19	14	62	3	37	63	34	51	73	34
Shorthead Redhorse	1	1	7	1	6	25	13	13	18	15
Shovelnose										
Sturgeon	13	9	26	9	13	7	15	16	10	14
Sicklefin Chub			1							
Stonecat	5	21	41	17	40	22	39	23		35
Walleye	5	9	14		12	19	17	45	48	39
White Sucker									1	
Yellow Perch			1						1	
Total fish	223	284	642	199	559	602	472	504	435	605
Total sets	45	90	90	43	90	90	91	90	90	90
Mean hours/set	14.1ª	16.9	19.2	11.4	19.1	19.7 ª	18.9ª	19.7	20.5 ª	20.0
Sampling dates		4/13-	3/31-	4/12-	4/13-		4/14-	3/23-	3/14-	3/28-
	4/8-5/12	5/20	4/27	5/4	4/18	4/2-5/1	4/23	4/13	3/30	4/12
Mean cfs during										
sampling	7472	12491	6880	12217	9074	6094	7193	7406	5666	8670
Mean Water temp	44.6	54.0	49.9	48.1	49.1	47.6	49.3	49.2	45.0	49.1
(r) Kange	(40.2-	(48.5-	(41-	(44.3-	(46.8-	(42-	(43.8-	(42.0-	(41.5-	(46.8-
Meen denth (ft)	50)	59.7) 5.6	39.3) 4.8	52.1) 68	51.0) 6.1	52.0)	57.1)	55.U) 5.0	48.3) 18	51.8) 54

Table 8. Number of fish sampled and sampling conditions during standard spring set lines 2008 - 2017 in the Robinson Section.

^a a subset (most of the sets) of total sets were used in the calculation of the mean

Seining

Seining surveys were conducted to assess cyprinid populations and game fish reproduction in shallow water habitats. In 2017, seining captured 10,927 individuals of 21 species (Table 9). Size statistics are presented in Appendix 14. CPUE was twice that of 2016 and the highest since the new protocol was implemented (Appendix 3) but species diversity was the lowest. High CPUE was due to Emerald Shiners; more the 50% of the catch was Emerald Shiners in every section, and they exceeded 80% of the catch in the upper two sections (Table 10). Flathead Chub was the second most common species at 7.8% of the catch. *Hybognathus sp.* catch was the second lowest recorded (Table 9). Overall seine catch was highest in the Fort Benton Section, followed by Morony and Coal Banks (Table 10). In 2017, Emerald Shiner, Longnose Sucker and Shorthead Redhorse were sampled in all sections. Most other species exhibited a longitudinal distribution, consistent with past years; suckers and Smallmouth Bass were most common in the upstream sections with Flathead Chub most abundant in the lower sections (Table 9).

Trawling

A beam trawl is the primary method to capture Sicklefin and Sturgeon Chub, Montana Species of Special Concern. Age 0 Channel Catfish, age 0 Shovelnose Sturgeon, juvenile HRPS and Flathead Chub are also often captured by this method. In 2017, 417 fish of 21 species were sampled with the trawl (Table 11). Sturgeon Chub at 1.3/haul, had the highest catch rates and the highest CPUE since 2007 (Figure 15). Several other species had CPUE of 0.3 – 0.5 per haul (Table 11). Sicklefin Chub CPUE decreased slightly from 2016 to the second lowest on record. Flathead Chub CPUE was the highest since 2011. YOY Shovelnose Sturgeon were not caught and HRPS had the lowest CPUE since 2009 (Figure 16). In 2017, little debris was collected during trawl sampling, which may have contributed to the near record-low numbers of YOY channel catfish. Two YOY sauger were caught in the trawl.

In 2017, the USFWS determined that a status review of Sicklefin Chub and Sturgeon Chub was warranted (Federal Register 2017). The last status review in 2000 (Federal register 2001), determined that listing was not warranted. Since 2000, MFWP has completed 1,753 beam trawl hauls near Robinson Bridge (81 – 135 hauls annually). A total of 1,765 (1.0/haul on average) Sturgeon Chub and 1,450 Sicklefin Chub (0.8/haul) were collected between 2001 - 2017. Both species were collected every year, except 2014, when Sturgeon Chub were not collected (Figure 15). During 2001 – 2017 Sicklefin Chub were only found as far upstream as 10 miles above the Robinson Bridge, but Sturgeon Chub were captured much further upstream, to above the mouth of the Marias. From 2003 – 2010, 275 beam trawl hauls, conducted 50 -100 miles upstream of the Robinson Bridge captured 128 Sturgeon Chub, 0.5/haul on average (Gardner 2005, Gardner 2006, Gardner 2008, Tews and Gardner 2014). Forty-five beam trawl hauls were also completed from 2004 – 2010 on the lowest 2 miles of the Marias River; they captured 18 Sturgeon Chub. It is apparent that seining does not effectively sample these two species. From 2007 – 2017 MFWP conducted 800 seine hauls, including 160 in the Robinson Section and only one Sturgeon Chub and five Sicklefin Chub were captured (Table 9).

Threatened, endangered and species of special concern

A plan to protect and provide for the recovery of threatened and endangered fish species, as required by FERC, Articles 417 and 421, has been completed. The number of Montana Species of Special Concern sampled from 2007 – 2017 is provided in Table 13. Paddlefish catch was low because that species is evaluated in other studies and is best sampled with other gear types. Sauger, Sicklefin Chub and Sturgeon Chub trends have been previously discussed.

For Pallid Sturgeon, a federally listed endangered species, the plan includes monitoring dispersal, survival and distribution of HRPS. Formal population estimates of yearling HRPS survival in RPMA 1 (this project area) have been conducted since 2007 (Rotella 2012). The most recent estimate, for 2016, was 4,109 HRPS. There were 1,707 (1,631 - 1,770) 1 to 5 years old, 1,957 (1,556 - 2,362) 5 – 10 years old, 302 (197 - 408) 10 – 15 years old and 143 (105 - 182) 20 years old. The estimate was 7,935 yearlings (95 CI 6,231-9,630) in 2012 (Rotella 2015) and 9,139 (6397 - 11853) yearling HRPS in 2010 (Rotella 2012). Rotella (2017) only evaluated survival of yearling fish, so actual HRPS numbers are higher. Over 90,000 stocked fingerlings were not included in the survival estimates due to low recapture rates. Recaptures of fingerlings in RPMA 1 have exceeded 10% since 2013 and up to 35% of recaptures from a single year class have been fingerlings (Table 14). The current HRPS stocking plan

maximizes genetic variability (Heist et al. 2013). In 2017, 329 yearlings from each family were stocked. This number was based on past stocking history to maximize the effective population size. This stocking strategy is founded on the premise that wild Pallid Sturgeon recruitment will eventually occur. In 2017, one wild adult male Pallid Sturgeon and two wild female Pallid Sturgeon were taken from RPMA1 to the Garrison Dam fish hatchery and their genetics were incorporated into the brood stock program. One female died at the hatchery.

Radio telemetry has been used to monitor Pallid Sturgeon in the study area since 1992 (Gardner 1994). In 2006, the study expanded to include remote passive receivers and a telemetry system using codes instead of individual frequencies (Gardner and Jensen 2007). In 2017, 8 wild Pallid Sturgeon, 65 PS-97, 2 PS-05 and 1 PS-09 HRPS had active radios. In 2017, MFWP obtained 629 Pallid Sturgeon relocations during 1,961 miles of boat travel and 1,237 Pallid Sturgeon relocations from the 14 remote land based stations. The re-locations in 2017 indicated that Pallid Sturgeon occupy the Middle Missouri from Fort Peck Reservoir to above Fort Benton. Radio telemetry information for Pallid Sturgeon and other species is summarized in Tews et al. 2018.

Pit tag antennae arrays were installed at RM 1.0 on the Marias River to monitor movements of Shovelnose Sturgeon. The arrays were successful; over 20% of Shovelnose Sturgeon tagged near Coal Banks and 50% of Shovelnose Sturgeon tagged in the Marias River were recorded at the station. The results are described in Tews et al. 2018. We view the 2017 work on Shovelnose Sturgeon as a Pilot Study for HRPS. PIT arrays can provide passive monitoring of HRPS and would allow monitoring of thousands of fish to provide researchers with a better understanding of sturgeon ecology and assist in recovery goals.

In 2017, 21 Blue Suckers were captured. They had an average length of 761 mm (range 657 – 854) with a size distribution like that from 2007 – 2016 (Figure 18). Blue Suckers were PIT tagged to evaluate age and growth. Some were tagged with 134.2 kHz tags to evaluate movement patterns; one Blue Sucker was recorded on the Marias River PIT array in 2017. The size structure in the study area differs substantially from that seen in the Yellowstone River. In 2017 about 20% of the Blue Suckers captured in the Yellowstone River (N about 120) were 400 - 600 mm long and less than 5% exceeded 800 mm (Mat Rugg, 2018 personal communication). In contrast, in this study area, only 3% of the Blue Suckers caught from 2007 - 2015 (N= 275) were less than 600 mm and 36% were greater than 800 mm. The ecology of Blue Suckers from the larval stage until adulthood is not understood in the study area. Therefore, it is not known if Blue Sucker recruitment is non-existent or if young fish were not sampled due to habitat preferences or locations not sampled under the Middle Missouri sampling protocol (Table 2). Under that protocol, trawling is the only method used to sample small fish downstream of Robinson Bridge. Additional funding and a carefully designed study may provide insight into the early life history of Blue Suckers upstream of Fort Peck Reservoir. Adult Blue Suckers are also challenging to capture. We have had the most success spring electrofishing near known concentration areas. However, few of the many individuals seen are captured with this method. Trammel netting has occasionally captured several Blue Suckers in a single net; but it is challenging to know when and where they are concentrated. More than five Blue Suckers were captured in a single net at RM 0.6 in the Marias on 7/6/17, at RM 2038.3 on 8/16/16 and at RM 1982 on 7/27/15. These locations may be good areas to sample additional Blue Suckers.

Spiny Soft-shell Turtles (SST)

A total of 215 individual SST (156 females; 59 males) were captured during four trapping occasions (80 trap-nights). Forty-four females (~28% of total marked) were recaptured at least once; 11 females were recaptured twice; and one female was recaptured three times during the survey, for a total of 56 recapture events. The recapture rate for males was lower than for females. Only eight males (~14% of total marked) were recaptured and no males were recaptured more than once. There was no evidence of loss of metal tags or PIT tags during the study period. Mark-recapture data has been sent to Dr. Jay Rotella (MT State University) to estimate SST populations using closed-population models, Program MARK, and other software. Dr. Rotella will make recommendations for design and frequency of future surveys when data analysis is completed.

We were able to evaluate across-river movements and overall distances moved during this survey because traps were set on alternate sides of the river at approximate 0.5-mile intervals. Females crossed the river fairly regularly, with 28 of 44 recaptured females crossing the river at least once. Two of the eight male recaps crossed the river at least once. Fifteen female recaptures were at traps upstream from the original tagging location, 11 were at the same trap where originally tagged, and 30 were at downstream traps. The average distance moved for females to upstream traps (n=15) was 1.5 miles, with a maximum upstream movement of 7.5 miles observed. Females recaptured at downstream sites (n=30) moved an average of 1.0 mile downstream traps, one was at the same trap where originally tagged, and three were at downstream traps. The average distance moved for males to upstream trap sites was 1.8 miles (n=4), with a maximum observed upstream movement of 2.5 miles. All three males recaptured at downstream sites moved 1.0 mile downstream.

Several SST tagged in this area 5-10 years ago were recaptured during this study. Dood et al. (2009) set individual traps at 2-mile intervals and fished them for three consecutive nights at each location during their river-wide survey. Sixty-one SST (44 females; 17 males) were tagged as part of that study in 2008 at 5 trap sites located within the current 2017 survey section. We recaptured none of the males tagged in 2008, but we did recapture 10 of the 44 females (~23%) previously tagged in our study section. We also recaptured six additional females that were tagged in nearby areas during 2007-2012. Those six females were originally tagged no more than 27 miles downstream or 15 miles upstream of the 2017 study section. The 16 SST tagged 5-10 years ago and recaptured in 2017 exhibited very slow growth (Table 15). Growth rates were slower for SST >300 mm at time of initial tagging than for smaller SST (average growth rate 1.6 mm/year for SST >300mm vs 9.3 mm/year for turtles <300mm). The observed slow growth rate for larger turtles is probably related to attainment of sexual maturity and investing more energy into egg production and survival compared to growth. We do not know the size at first maturity for Missouri River SST and this can vary regionally. Size at first maturity for female SST has been estimated at 18-20 cm (plastron length) in several other areas of the US (Robinson and Murphy 1978; Webb 1962; Plummer and Mills 2015). Researchers on the Yellowstone River in MT have found that plastron length is consistently 70% of curved carapace length (personal communication with Kayhan Ostovar, Rocky Mountain College, Billings, MT). Using this conversion, females in other areas first matured at approximately 257-286 CCL, which corresponds closely to the size at which we observed substantial growth declines in Missouri River SST (Table 15).

The high rate of recapture of females previously tagged in the study section and the observed slow growth rates suggests Missouri River SST may be longer-lived than previously described in the literature. SST do not have hardened scutes, which can be examined for growth rings, and age

estimation is apparently limited to observations of growth of recaptured individuals (Plummer and Mills 2015). Ernst & Lovich (2009) urged caution when attempting to determine age by counting rings in SST femur bones. Interpretation of age based on growth of recaptured individuals is further complicated by the observation that cessation of growth occurs in some females (Plummer and Mills 2015). Despite these problems, it is important from a management standpoint to understand SST age and longevity. Ernst & Lovich (2009) summarized information suggesting SST in Minnesota might live to be 53 years old and they cited a captive female that lived 25 years. Based on observed growth, it is possible that Missouri River SST live far longer than 50 years.

One problem with age estimation for Missouri River SST is the lack of early growth information. We know that SST are approximately 40mm CCL at hatching, and the smallest female documented in river surveys over the past decade was approximately 80mm CCL (Figure 19). Assuming the 80mm turtle was a yearling with a growth rate of 20-30mm per year, a 200mm turtle (the smallest original length of SST recaptured in 2017) is probably in the range of 5-7 years old. Application of average observed growth rates thereafter (Table 15) suggests possible ages of 15-18 years for 300mm SST's (approximate size at first maturity) and 80+ years for SST >400mm. Plummer and Mills (2015) estimated that female SST in Arkansas matured at 12-13 years of age. There have been more than 30 female SST >400mm CCL captured in Missouri River turtle surveys since 2002, with the largest being a 461mm female (16.1 pounds) captured two miles below Fort Benton in 2006. These age estimates should be viewed with caution and will probably only be verified with long-term monitoring of tagged individuals, including individuals from younger age classes, unless other aging techniques are developed in the future.

It would be advisable to measure plastron length as well as CCL in future surveys because some important published studies use the former. It would also be beneficial to determine the size at first maturity for females. Plummer and Mills (2015) X-rayed females to determine if eggs were present and perhaps ultrasound devices could be used to do the same, although females would need to be captured in May or June, prior to nesting, to make this determination. Investigation of early growth would be valuable as well. Unfortunately, the trap type and typical trap locations used in this study were ineffective at catching females <140mm CCL. For instance, only three of the 156 females caught in 2017 were <140mm and those three ranged from 130-135mm. Observations made by several individuals over the past decade suggest smaller Missouri River SST inhabit very shallow areas (especially backwaters) with very low or zero current velocity. Sampling those habitats with small nets (such as mini-fykes) could enhance the catch of small females and generate useful early age/growth information.



Figure 16. Beam trawl trends for common minnow species in the Robinson Section, compared with mean August flow at Robinson Bridge for 2001 - 2017.

Species	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Black crappie	2007	2000	2009	1	3	133	2010	5	7	2010	7
Brook stickleback				1	5	100		U	1	2	,
Bigmouth buffalo	7	2				1				-	
Channel catfish vov	184	4	24		1	7	138	11	5	20	4
Common carp vov	282	126	27	116	508	14	49	8	100	38	12
Emerald shiner	621	3744	314	10080	1118	2724	1187	353	5778	1525	8503
Flathead chub	1238	611	543	1651	678	718	32	44	129	535	854
Fathead minnow	185	305	93	264	375	130	106	2	4	6	4
Freshwater drum							2	3			
Goldeye yoy	1	8			64	1	9	8	30	9	
Hybognathus spp.	1133	1837	328	1818	2854	2132	497	204	1483	98	164
Iowa darter										1	
Lake chub	2			1	147	6		1		2	
Longnose dace	4	6	12	185	233	48	28	44	57	21	45
Longnose sucker	3	30	98	215	32	101	80	22	960	227	267
Mountain sucker				1							
Mountain whitefish						1	2				
Northern pike						2		11			5
Northern redbelly dace							6				
Pumpkinseed	6	60		2		3	1	1		8	
River carpsucker yoy	122	92		10	3178	36	4	2	5	11	1
Rocky mtn sculpin	1					1	3		2	1	1
Sand shiner	165	51	6	31	44	35	20	16		33	32
Sauger yoy	1						2		1		3
Shorthead redhorse	948	309	416	1187	552	608	873	170	567	589	336
Sicklefin chub		1	2					2			
Smallmouth bass	1196	299	130	239	269	676	933	200	405	773	251
Smallmouth buffalo yoy	9	17	27	30			3	2	1	2	
Spottail shiner	3	1	1	34	205	102	29	18	11	26	41
Stonecat							10	6	8	8	2
Sturgeon chub			1								1
Walleye yoy		15	9			7		1			8
White sucker	983	683	339	883	1408	793	1471	184	305	1029	345
Yellow perch	11	7		20	5	8	2	17			2
Crayfish	13	5	6				85	14		67	18
sucker unidentified						88	56	41	553	395	18
minnow unidentified						81	29	2	7	39	3
other unidentified			42		3490	172	97				2
# identified fish species	22	21	19	19	17	23	24	25	22	23	21
Total catch	7118	8213	2417	16768	15164	8459	5669	1386	10419	5467	10927
Catch per haul	142	164	48	335	303	169	57	14	104	55	109
Total # of seine hauls	50	50	50	50	50	50	100	100	100	100	100

Table 9. Number of fish captured during seine hauls for 5 sections of the Middle Missouri River for 2007-2017. Sampling protocol was changed in 2012/2013 (see Appendix 3).

Species	Morony	Fort Benton	Coal Banks	Judith Landing	Robinson	Total
Black crappie					7	7
Channel catfish	0		1		3	4
Common carp	4	2			6	12
Emerald shiner	2274	2575	1067	1553	1034	8503
Flathead chub			54	688	112	854
Fathead minnow		3		1		4
Longnose dace	4	1	12	28		45
Longnose sucker	8	23	49	152	35	267
Northern pike	2	2			1	5
River carpsucker yoy				1		1
Rocky mtn sculpin				1		1
Sand shiner			11	14	7	32
Sauger yoy					3	3
Shorthead redhorse	138	40	87	50	21	336
Smallmouth bass	81	152	14	4		251
Spottail shiner	34		6		1	41
Stonecat	1			1		2
Walleye yoy	1	5		2		8
Western Silvery Minnow	56	3		1	104	164
White sucker	75	139	131			345
Yellow perch		2				2
minnow unidentified					3	3
sucker unidentified	5		3	6	4	18
unknown		2				2
Crayfish	9	3	6			18
Total catch	2692	2952	1441	2502	1341	10927
Total # of seine hauls	20	20	20	20	20	100

Table 10. Number of Fish sampled by seining in the middle Missouri River, 2017, by section. For fish < 150mm.

Table 11. Number of fish captured with a benthic trawl in the Robinson Section RM 1899	1913 in	the
Middle Missouri River for 2007- 2017.		

Species	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total/ Average
Black crappie	0	0	0	1	0	1	0	0	0	0	45	47
Burbot	0	0	0	0	15	0	0	0	0	0	0	15
Channel catfish	93	21	103	153	725	52	162	66	191	109	31	1,706
Common Carp	0	0	0	0	0	0	0	0	0	0	1	1
Emerald shiner	0	0	1	5	4	5	6	7	18	28	33	107
Flathead chub ¹	52	24	42	44	46	33	13	15	13	5	44	331
Freshwater drum	0	0	0	0	4	0	0	0	0	0	1	5
Goldeye	1	2	0	2	125	2	2	6		1	3	144
Hybognathus	1	3	4	0	0	0	0	6	5	6	19	44
Lake chub	0	0	0	0	1	0	0	0	0	0	0	1
Longnose dace	2	1	8	3	2	1	7	0	0	0	0	24
Longnose sucker	0	1	0	0	0	0	0	2	0	0	1	4
Mottled sculpin	0	0	0	0	1	0	0	0	0	0	0	1
Pallid sturgeon ¹	3	8	1	20	11	12	7	3	4	3	2	74
River carpsucker	2	0	0	0	0	1	5	0	0	0	1	9
Sauger	3	1	1	1	1	0	5	14	0	0	4	30
Shorthead redhorse	0	5	3	5	3	1	3	14	2	6	17	59
Sicklefin chub	43	86	48	136	76	28	30	48	10	31	18	554
Smallmouth Bass	0	0	0	0	0	0	0	0	0	0	1	1
Spottail shiner	0	0	0	2	3	2	1	0	0	1	54	63
Stonecat	19	4	60	16	45	10	68	29	35	41	3	330
Sturgeon chub	200	67	43	35	15	90	98	0	44	107	135	834
Shovelnose sturgeon	0	0	2	1	4	0	0	1	0	4	0	12
Walleye	0	0	0	0	0	4	0	0	0	0	3	7
White Sucker	0	0	0	0	0	0	0	0	0	0	1	1
Unidentified	0	0	2	9	4	9	1	5	0	0	0	30
Number species	11	12	13	15	19	15	14	12	9	12	21	26
Total catch	419	223	318	433	1085	251	408	216	322	342	417	4,434
Total trawl tows	100	99	102	117	99	100	104	102	93	102	102	1120
Mean August cfs	4960	6953 8/26	6648 8/5	7275	10620	5700	5357	8700	5534	5534 8/0	6241 8/15	6684
Sample dates	8/1- 8/7	8/20- 9/2	8/3- 8/11	8/9- 10/28	8/9- 8/16	8/1- 8/16	8/7- 8/4	8/4-8/6	8/3- 8/4	8/9- 8/11	8/13- 8/16	
Mean water temp (F°)	75.7	62.5	70	69.1	71	72.2	71.6	70	74.8	69.9	69.8	70.6
Mean secchi depth (ft)	1.4	1	0.6	1.5	1	1.8	0.5	1	0.4	0.2	1.7	1
Mean depth (ft)	6.1	7	-	6.8	11.5	6.6	6	7.7	8.6	6.6	7.5	7.4

				Length	(mm)
Species	Ν	CPUE	Mean	Min	Max
Black Crappie	45	0.4	51	25	152
Channel Catfish	31	0.3	53	20	274
Common Carp	1	0.0	139	139	139
Emerald Shiner	33	0.3	44	32	78
Flathead Chub	44	0.4	93	47	207
Freshwater Drum	1	< 0.1	256	256	256
Goldeye	3	< 0.1	110	105	114
Longnose Sucker	1	< 0.1	74	74	74
Pallid Sturgeon	2	< 0.1	440	380	500
Plains Minnow	1	< 0.1	80	80	80
River Carpsucker	1	< 0.1	50	50	50
Sauger	4	< 0.1	223	119	336
Shorthead Redhorse	17	0.2	51	30	115
Sicklefin Chub	18	0.2	73	60	115
Smallmouth Bass	1	< 0.1	84	84	84
Spottail Shiner	54	0.5	54	35	65
Stonecat	3	< 0.1	47	39	53
Sturgeon Chub	135	1.3	28	16	74
Walleye	3	< 0.1	181	129	281
Western Silvery					
Minnow	18	0.2	52	30	93
White Sucker	1	< 0.1	82	82	82
Total	417	4.1	55	16	500

Table 12. Average trawling catch rates (#/tow) for and size statistics fish species sampled in the middle Missouri River, 2017, Robinson Section RM 1880 – 1913, for 102 hauls

Table 13. Number of state species of concern sampled in the middle Missouri River during the 2007-2017 field seasons by MFWP.

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Blue sucker	37	32	35	30	18	16	58	28	21	58	21
Paddlefish	9	0	18	6	0	3	2	0	0	17	11
Pallid sturgeon	180	146	271	347	302	334	451	217	257	224	414
Sauger	714	674	796	620	436	594	576	597	487	663	593
Sicklefin chub	51	88	49	138	76	28	32	51	10	31	18
Sturgeon chub	228	75	56	35	17	93	100	0	44	107	135

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Figure 17. Sturgeon catch rates with a beam trawl, 2001 - 2017.



Figure 18. Blue sucker size structure for three different time periods; 2017, 2007 – 2016 and 1993 – 1995.

Table 14. Percent of HRPS known fingerlings compared to known yearlings, captured by year and by year class for fish captured 2005 - 2017.

		% Fingerlings
Capture Type	Ν	by year
Capture year		
2006	3	3.7
2007	3	1.8
2008	1	0.7
2009	4	1.5
2010	23	6.8
2011	24	8.3
2012	29	9.0
2013	53	13.1
2014	32	17.0
2015	47	16.2
2016	35	13.0
2017	91	23.9
Total	345	
Year class		
2005	15	2.8
2006	0	0
2007	23	7.7
2008	60	13.0
2009	133	24.3
2010	53	39.5
2012	0	0.0
2013	9	19.6
2014	13	25.4
2015	36	53.7
2016	3	15.4
Total	345	



Figure 19. Photos of a newly hatched (left photo; captured in September 2011) and the smallest documented female (approximately 80mm CCL; right photo) spiny softshell turtles from the Missouri River. The 80mm female was caught in a mini-fyke net near the mouth of 2-Calf Creek in August 2012.

Table 15. Growth of female spiny softshell turtles recaptured during 2017 in the Missouri River between the Judith River and Stafford Ferry. Average annual growth of suspected subadults (<300mm when tagged) and adults (>300mm when tagged) is indicated with standard deviation in parenthesis.

Year Tagged	Year Recaptured	Length when orig tagged (mm)	Years since orig tagged	Length when recapped (mm)	Length gain per year (mm)
2008	2017	204	9	307	11.4
2008	2017	218	9	315	10.8
2009	2017	218	8	290	9.0
2012	2017	234	5	270	7.2
2008	2017	234	9	337	11.4
2008	2017	260	9	308	5.3
2008	2017	262	9	348	9.6
ļ	Ave growth fo	or turtles <	:300mm = 9).3mm/yr (s	sd 2.3mm)
2008	2017	301	9	325	2.7
2007	2017	324	10	325	0.1
2008	2017	327	9	341	1.6
2008	2017	328	9	343	1.7
2008	2017	341	9	360	2.1
2008	2017	347	9	364	1.9
2008	2017	359	9	373	1.6
2008	2017	375	9	382	0.8
2008	2017	391	9	406	1.7
ŀ	Ave growth fo	or turtles >	-300mm = 1	6mm/yr (s	sd 0.7mm)

RECOMMENDATIONS

- 1) Continue standardized sampling for comparisons between years.
- A review of data collected since 2001 is warranted to evaluate long term trends and determine if NWE operations are influencing fish populations. This is necessary for Species of Concern and to make recommendations for flow management.
- 3) Consider additional sampling gear or techniques to evaluate Iowa Darter distribution and abundance.
- 4) Blue Sucker ecology, age and recruitment should be evaluated. This will require additional funding and a detailed study design (See Tews 2017 for more information).
- 5) Pallid Sturgeon distribution should continue to be monitored. Pallid Sturgeon occupy the Missouri River even upstream of Fort Benton. Sampling throughout their habitat will require additional sampling effort above the Robinson Section.
- 6) Incorporate fingerlings into future HRPS population estimate
- 7) Develop a SST monitoring study plan.

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ACKNOWLEDGMENTS

This study could not have been completed without the expert field help of Rob Beattie, Mike Schilz, Grant Grisak, Nate Beckman and Mary Schvetz of MFWP. Brian Tornabene of the University of Montana assisted with the SST fieldwork and provide valuable review of the study. Funding was provided by NWE and MFWP. MFWP and NWE also partnered with Montana State University, U. S. Bureau of Reclamation and the USFWS for fisheries research on this reach. The excellent cooperation of these resource agencies has been important for the long-term success of this and companion studies.

APPENDICIES

Appendix 1. Locations and river mile boundaries of electrofishing trend areas in the middle Missouri River study area.

Section	River mile	Location
Morony	2097.0 to 2102	N47.688° / W110.985° to N47.632° / W111.032°
Fort Benton	2073.5 to 2079.2	N47.816° / W110.668° to N47.787° / W110.724°
Coal Banks	2029.5 to 2035.5	N48.032° / W110.207° to N48.018° / W110.281°
Judith Landing	1980.5 to 1987.0	N47.747° / W109.575° to N47.731° / W109.687°
Robinson	1925.5 to 1931.5	N47.646° / W108.752° to N47.705° / W108.816°

Appendix 2. Locations, river mile boundaries and habitat information (Gardner 1994) for general sections on the middle Missouri River.

	D'		Mean	M		D
a	River	-	Velo-	Mean	<i>a</i> .	Dominate
Section	mile	Location	city	Depth	Geography	substrate
					Sandstone/	
	2079.0 to	47.60229°; 111.0480° to			Shale	Cobble/
Morony	2104.0	47.79090; 110.72560°	Fast	Shallow	canyon	boulder
Fort	2078.9 to	47.79090°; 110.72560° to	3.0ft/s	6.1 ft	Moderately	Gravel/
Benton	2052.3	47.92840°; 110.49078°			Wide valley	cobble
					Narrow	
Coal	2052.2 to	47.92840; 110.49078° to	3.0ft/s	6.1 ft	sandstone	Gravel/
Banks	1994.4	47.71624 °: 109.82484 °			canvon	cobble
		,			j	
					Narrow	Small to
Judith	1994.3 to	47.71624°: 109.82484° to	3.8ft/s	5.4 ft	sandstone	large
Landing	1944 0	47 78848 °· 108 93754 °	0.010		canyon	cobble
Landing	17110	11.10010 , 100.55751			curryon	counc
					Wide valley	
Robinson	1943 9 to	47 78848 ° · 108 93754 ° to			lake delta	
Roomson	1867.0	47 45098 ° 107 89330 °	3 0ft/s	7.6 ft	lower end	Sand
	1007.0	17.15070, 107.07550	5.0105	7.0 It	10 wer end	Suna

Appendix 3. Instructions for monitoring minnow abundance in 10-mile sections with 50 foot bag seine with ¼ inch mesh starting in 2013. This protocol was developed in, and generally followed in 2012.

Section	Location
Morony	RM 2086 – 2096
Fort Benton	RM 2068 – 2078
Coal banks	RM 2026 – 2036
Judith Landing	RM 1977 – 1987
Robinson	RM 1918 – 1928

- Conduct two seine hauls every mile in representative habitat that can be sampled effectively. 20 seine hauls total for each ten mile section.

-Measure 10 random fish of each species from each seine haul. Include all sized fish identified to species including those <40mm.

-Classify unknown YOY fish as Sucker, Minnow or RCSU/Buff. Count these fish, estimate a length range, and list on a separate line of the data sheet (i.e. YOY Sucker 35-45mm, N=20).

-For fish \geq 6 inches (150mm) record in comment field.

-Objective is <u>not</u> to catch maximum number of minnows. Objective is to determine minnow species composition and abundance in representative habitats that can be sampled effectively with the seine in a repeatable fashion year after year. This new methodology may reduce overall catch rates since it reduces sampling in some minnow haves such as backwaters.

- Low catches (or even catches of zero) are OK if representative habitats are sampled with reasonable effectiveness.

- Aim for 100 ft long seine hauls, measured with a rangefinder or tape. If haul exceeds +/- 10% of 100 ft record exact distance on data sheet comment field.

- Most samples should be taken in channel crossovers and inside bends as these are usually the most common habitats on the middle Missouri. Outside bends usually cannot be sampled effectively due to deep and fast water.

- Seine hauls should always start at an upstream location and move in a downstream direction, even in backwaters and non-connected secondary channels.

- Avoid using bank or habitat features to "trap" minnows because this artificially inflates the catch and will adversely affect statistical analysis by causing huge increases in sample-to-sample variation.

In rare instances it may be necessary to conduct seining by beginning at the downstream end and moving in an upstream direction. In such rare events, be sure to avoid seining towards a habitat feature (such as the upstream end of a backwater or side channel) that will trap and concentrate minnows and artificially inflate the catch. Record any upstream seine hauls as such in the comment field.
No more than one sample can be taken in secondary channel or backwater habitat types in each 1-mile subsection of the 10-mile sampling reaches.

Manar	Dar					25.0															
Moroi	iy Dai	n, Miss	souri f	kiver I	$\mathbf{K}\mathbf{N}\mathbf{I}\mathbf{Z}\mathbf{I}\mathbf{V}$	J 5 .0															
2017		April			May			June			July			Aug			Sept			Oct	
_		-															-				
Date	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1				49.2	49.9	50.5	63.1	63.5	63.8	65.7	67.2	69.0	72.1	73.3	74.2	66.5	67.3	68.1	56.8	57.7	58.6
2				50.3	51.1	51.9	61.0	61.8	63.2	66.7	68.2	69.6	71.0	71.8	73.0	66.3	67.2	68.2	53.1	55.0	56.8
3				50.9	51.6	52.4	60.4	60.8	61.3	68.7	70.3	71.6	69.6	70.5	71.1	66.5	67.1	67.9	49.3	51.2	53.1
4				51.9	52.8	53.7	60.3	61.1	62.4	69.8	70.8	71.9	68.9	69.8	70.5	65.9	66.6	67.2	47.6	48.2	49.2
5				53.1	55.1	56.3	61.4	62.0	62.7	69.9	70.9	72.1	67.4	68.4	69.6	64.8	65.4	66.2	47.0	47.7	48.4
6				55.9	57.8	59.1	61.9	62.4	63.0	70.4	71.7	73.0	66.4	67.3	68.3	64.2	65.0	66.0	47.7	48.6	49.3
7				56.3	58.1	59.0	62.7	63.3	64.5	70.7	72.0	73.2	66.6	68.2	69.5	64.2	65.0	65.9	49.3	49.9	51.0
8				54.3	55.1	56.2	64.5	64.9	65.6	71.3	72.5	73.8	68.2	69.0	69.7	64.2	64.8	65.4	49.7	50.0	50.3
9				53.6	54.3	54.9	64.5	65.1	65.9	71.8	73.0	73.9	67.5	68.5	69.2	64.5	65.2	66.0	49.0	49.4	50.1
10				53.7	54.8	55.9	62.1	63.1	64.6	72.0	72.8	73.5	67.2	68.3	69.1	65.1	65.7	66.6	48.2	48.7	49.4
11				55.9	58.0	59.0	60.0	60.6	62.0	70.4	71.1	72.0	67.3	68.0	68.9	65.0	65.7	66.7	48.2	48.6	49.2
12	44.7	45.8	46.9	58.5	58.8	59.1	60.6	60.9	61.4	69.5	70.6	71.5	66.8	67.8	68.5	64.4	65.1	65.7	47.8	48.2	48.9
13	46.7	47.8	48.9	55.9	57.7	59.1	61.3	61.6	62.0	69.5	71.1	72.5	66.9	67.7	68.7	64.6	65.1	65.9	47.2	47.6	48.0
14	48.5	49.5	50.5	53.6	54.5	55.9	61.1	61.5	62.1	71.3	72.5	73.6	66.9	67.7	68.7	62.3	63.4	64.7	46.8	47.3	48.1
15	48.4	49.3	50.0	52.2	53.0	53.9	60.0	60.6	61.5	72.9	73.9	74.9	66.4	67.5	68.3	58.5	60.3	62.2	46.3	47.0	47.7
16	47.6	48.3	48.8	53.1	53.7	54.6	59.9	60.4	61.0	73.1	73.7	74.6	66.3	67.5	68.5	55.3	56.9	58.5	46.6	47.3	48.0
17	48.0	48.4	49.1	52.0	53.4	54.9	58.9	59.9	60.9	71.7	72.6	73.2	66.6	67.5	68.4	54.1	54.7	55.3	47.4	48.2	49.1
18	47.4	48.5	49.3	50.7	51.2	51.9	60.8	61.2	61.5	70.7	71.9	72.6	67.0	68.0	69.3	53.5	54.0	54.4	48.2	48.7	49.2
19	48.9	49.9	50.8	51.3	51.8	52.6	60.7	61.9	63.9	70.6	71.8	72.7	67.4	68.2	68.9	54.2	54.6	55.3	49.1	49.7	50.4
20	50.0	51.0	51.9	52.5	53.1	54.3	62.6	63.4	64.2	70.7	72.0	73.3	66.7	67.3	68.2	53.7	54.1	54.5	50.0	50.1	50.5
21	49.9	51.0	51.5	53.5	54.5	56.4	63.6	64.6	65.9	70.5	71.4	72.2	66.0	66.7	67.5	53.1	53.7	54.2	48.6	49.4	50.0
22	49.4	49.8	50.2	55.1	55.7	56.4	64.2	64.7	65.8	69.6	70.8	71.8	65.9	66.8	67.5	52.5	52.8	53.5	47.6	48.2	48.9
23	49.2	49.7	50.0	55.6	56.9	59.3	63.5	63.9	64.4	69.7	71.3	72.8	66.3	67.4	68.2	52.1	52.5	53.3			
24	49.1	49.9	50.6	57.4	58.2	59.3	63.9	64.2	64.5	70.8	71.9	72.8	67.1	67.4	67.8	51.5	52.5	53.5			
25	50.3	50.8	51.5	55.3	56.2	57.3	64.1	64.6	65.4	70.7	71.6	72.4	67.3	67.9	68.9	52.5	53.3	54.0			
26	50.3	50.6	51.2	55.1	55.8	56.9	65.4	66.4	66.9	70.2	71.6	72.5	66.7	67.7	68.4	53.5	54.3	55.1			
27	49.3	50.3	51.0	54.1	55.2	57.1	66.8	67.4	68.0	71.2	72.2	73.1	66.5	67.6	68.6	55.0	56.1	57.1			
28	47.6	48.6	49.2	57.0	57.9	59.4	66.7	67.4	68.1	71.6	72.7	73.5	66.9	68.0	68.9	56.8	57.8	58.6			
29	47.4	48.2	49.0	58.8	59.7	61.5	66.1	66.7	67.3	71.6	73.1	74.0	67.4	68.1	68.8	57.9	58.8	59.6			
30	48.6	49.4	50.0	61.0	61.6	62.5	65.4	66.2	67.3	72.4	73.7	74.6	67.2	67.9	68.7	58.4	58.9	59.3			
31				61.8	62.5	63.3				72.5	73.6	74.6	66.8	67.4	68.2						

Appendix 4. Minimum, Average and Maximum daily water temperatures (F°) for the Missouri, Marias and Teton Rivers, 2017.

Appendix 4 continued. Minimum, Average and Maximum daily water temperatures (F°) for the Missouri, Marias and Teton Rivers, 2017.
Loma Bridge, Missouri River 2053 0

Loma Bridge, Missouri River 2053.0																					
2017		April			Мау			June			July			Aug			Sept			Oct	
Date	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1	46.5	47.1	47.7	49.9	51.0	51.9	63.3	65.4	67.0	67.7	69.7	71.6	73.2	75.1	76.7	67.1	68.6	70.2	54.5	56.5	58.1
2	46.0	46.8	47.6	50.6	51.6	52.5	63.0	64.8	66.6	69.3	70.9	72.7	70.4	72.1	75.0	67.0	68.9	71.1	48.1	51.7	54.4
3	42.8	44.9	47.0	50.8	52.9	54.9	61.1	63.3	65.0	70.0	71.7	73.6	68.4	71.1	74.0	67.2	68.6	70.4	46.3	47.0	48.0
4	42.1	44.3	47.0	53.3	55.4	57.7	61.6	63.7	65.5	71.1	72.8	74.2	70.6	71.9	73.5	65.3	66.7	68.5	46.6	48.0	50.0
5	44.6	45.8	46.7	55.7	57.5	59.4	61.7	63.4	65.1	71.4	73.1	75.0	68.2	69.7	71.0	63.9	65.9	68.1	47.3	48.4	49.9
6	46.4	47.0	47.8	58.6	59.5	60.3	61.0	63.3	65.4	72.5	74.2	76.0	66.8	68.9	71.4	63.4	65.5	68.0	47.8	49.2	50.9
7	47.2	47.7	48.2	56.9	58.9	60.3	61.9	64.6	67.5	73.1	75.0	77.0	67.3	69.8	72.4	63.7	65.9	68.5	48.4	49.5	50.5
8	46.3	48.3	50.4	55.5	57.3	59.3	64.0	66.6	69.3	73.7	75.1	76.6	68.9	70.1	71.8	64.2	66.0	68.0	46.9	47.9	48.7
9	46.5	48.3	50.1	55.3	57.2	58.7	64.9	66.8	68.9	73.6	75.4	77.1	67.7	70.1	72.7	64.8	66.4	68.5	45.7	47.5	49.3
10	45.4	47.1	48.7	55.3	57.5	59.0	63.3	64.9	66.6	73.7	74.4	75.6	67.3	68.9	70.2	65.9	67.0	68.6	47.8	49.1	50.9
11	45.8	47.3	48.4	56.3	58.8	61.9	60.9	63.2	65.3	71.9	73.3	75.1	67.2	68.7	70.3	64.7	66.5	68.6	47.6	48.5	49.7
12	46.9	47.8	48.4	59.3	61.3	62.9	60.4	62.3	64.5	71.0	73.1	75.2	66.8	69.2	71.6	64.7	66.3	68.1	46.5	47.5	49.0
13	47.5	49.2	51.1	58.5	59.7	62.2	61.5	63.0	64.1	71.0	74.3	77.4	67.5	69.1	70.7	63.4	64.7	66.3	45.8	46.7	48.0
14	49.5	50.6	51.7	54.9	56.7	58.4	59.8	61.9	63.5	73.7	75.7	78.0	67.9	69.4	71.1	59.4	62.1	63.4	45.2	46.2	47.5
15	48.4	49.1	50.2	53.4	55.5	56.9	60.7	62.2	63.5	73.3	75.2	77.5	67.2	69.1	71.4	56.7	57.8	59.3	44.6	46.4	48.4
16	47.6	49.2	51.1	52.3	54.3	56.2	60.3	62.2	64.0	74.1	75.6	78.0	67.5	69.1	71.2	55.9	56.6	57.4			
17	47.1	48.2	50.1	53.3	54.0	55.1	60.3	61.7	63.0	72.2	74.2	76.3	66.8	68.8	71.0	54.6	56.1	57.5			
18	47.7	49.9	52.4	51.8	53.3	54.7	59.9	61.9	64.0	71.1	72.9	74.6	67.5	69.4	71.7	55.0	56.0	56.7			
19	50.8	51.9	52.9	51.0	53.6	56.0	61.1	63.2	65.4	72.6	74.3	76.3	68.1	69.6	71.4	54.0	54.8	55.9			
20	50.6	51.9	52.9	52.2	54.4	56.0	62.8	64.7	66.9	72.3	74.1	76.6	66.4	67.9	69.3	52.2	53.4	54.4			
21	50.4	51.7	53.1	53.2	55.5	57.7	63.7	65.6	67.6	71.4	73.1	74.9	66.0	67.7	69.7	52.2	53.4	54.8			
22	50.1	51.6	53.4	55.0	57.0	59.1	64.2	65.4	66.6	70.7	73.0	75.3	66.3	68.7	71.3	50.8	52.2	53.3			
23	50.6	51.4	52.9	55.5	57.9	60.3	62.7	64.8	66.9	72.1	74.5	77.2	67.6	69.3	71.4	50.3	51.7	53.2			
24	49.8	51.2	52.8	58.1	59.4	60.5	63.6	65.8	67.6	72.2	74.3	76.4	67.7	68.9	70.1	51.9	53.2	55.0			
25	49.8	50.8	51.8	55.8	56.6	58.6	64.1	66.3	68.5	70.2	72.5	75.1	66.0	68.4	71.1	51.5	53.4	55.6			
26	50.2	51.5	52.8	55.1	57.0	58.9	65.6	67.6	69.8	70.9	73.3	75.6	67.1	69.0	70.9	53.9	55.8	57.9			
2/	50.8	51.4	52.7	55.6	57.3	58.6	67.2	68.7	69.8	72.8	/3.6	/4.6	66.6	68.7	71.0	55.4	57.0	59.0			
28	49.7	50.4	51.1	55.9	58.1	60.5	67.0	68.5	69.4	71.9	74.4	77.3	67.3	69.5	71.8	55.9	57.6	59.6			
29	48.2	49.9	51.1	58.0	60.6	63.6	66.6	67.4	68.7	73.9	15.1	11.5	68.5	/0.1	72.0	56.9	58.5	60.5			
30	49.5	50.6	51.6	60.1	62.8	65.6	65.7	67.7	69.9	73.6	75.5	77.5	68.1	69.5	71.2	57.9	58.9	60.7			
31				61.5	64.2	66.9				72.9	75.2	77.4	68.3	69.6	71.6						

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Judith	Judith Landing, Missouri River 1984.0 2017 April May June July Aug Sort Oct																				
2017		April			Мау			June			July			Aug			Sept			Oct	
Date	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1				51.3	52.6	53.7	64.8	66.7	68.9	67.2	70.3	73.6	74.0	76.2	78.3	68.5	70.5	72.1	55.4	57.1	58.8
2				51.9	52.5	53.3	66.1	67.1	68.2	70.8	73.2	75.9	72.2	73.5	76.5	68.1	70.5	72.7	46.9	51.7	55.4
3				51.3	53.5	55.9	64.8	66.3	67.6	72.2	74.5	76.7	69.6	72.0	74.6	67.8	69.8	71.6	43.0	44.6	46.8
4				54.4	56.7	59.4	64.7	66.3	67.7	72.3	74.8	77.2	69.0	71.3	73.3	67.1	68.5	70.4	41.0	43.4	45.9
5				57.5	59.8	62.2	64.8	65.9	66.7	72.5	75.2	77.6	68.7	69.9	71.3	63.7	66.2	68.5	44.0	45.7	47.6
6				60.5	62.2	64.2	62.9	64.6	66.3	73.9	76.1	78.6	67.4	69.9	72.8	63.0	65.9	68.7	45.8	47.8	49.6
7				58.7	61.4	62.8	63.6	65.0	66.4	74.2	77.1	80.0	67.7	70.7	73.5	63.7	66.5	69.2	48.2	48.8	49.3
8				57.2	59.0	60.9	64.8	66.7	68.7	75.4	77.4	79.7	68.8	70.8	72.8	64.0	66.4	68.4	47.0	47.8	48.8
9				57.3	59.4	61.5	66.9	67.4	68.4	74.9	77.3	79.6	68.7	71.3	74.0	64.1	66.4	68.4	44.6	46.3	47.6
10				59.1	60.5	62.1	65.5	66.5	67.2	75.2	76.6	78.1	68.2	70.3	71.9	66.1	67.8	69.6	44.6	46.5	48.2
11				59.9	61.5	63.1	63.5	65.2	66.7	73.0	75.1	77.1	67.4	69.7	72.0	65.3	67.6	69.9	46.0	47.3	48.4
12				61.1	62.3	63.3	63.6	64.7	65.9	72.1	74.8	77.5	67.0	69.8	72.6	64.8	66.9	68.4	46.3	47.6	48.9
13	48.6	50.8	53.3	60.9	62.1	63.2	63.6	65.1	66.9	72.2	75.6	78.9	68.5	70.4	72.4	64.6	66.0	67.8	45.6	46.7	47.9
14	50.1	51.7	53.3	58.4	59.2	60.9	62.1	63.5	65.8	74.3	77.4	80.6	67.8	69.6	71.4	60.8	62.9	64.8	45.0	46.1	47.2
15	49.0	50.1	51.5	56.4	57.5	58.5	61.5	62.9	64.0	75.6	77.1	78.7	67.9	70.4	72.8	56.9	58.5	60.7	43.7	45.7	47.8
16	47.0	49.2	51.6	56.0	56.8	57.7	63.2	64.1	65.4	73.2	75.8	78.6	67.8	70.6	73.1	55.4	56.1	56.9			
17	46.9	48.1	49.6	54.0	54.9	56.3	61.8	63.2	64.3	72.8	75.5	78.3	68.0	70.3	72.4	53.5	55.6	58.0			
18	46.8	49.3	52.0	53.1	54.4	55.9	62.8	63.7	64.5	71.9	74.8	77.2	67.9	70.7	73.5	54.5	56.1	57.7			
19	50.3	52.2	54.2	53.9	55.2	56.6	62.6	64.3	66.4	72.9	75.3	77.6	68.2	70.4	72.0	55.3	56.5	57.7			
20	51.7	53.6	55.4	54.3	56.2	57.9	64.6	66.0	67.3	72.8	75.7	78.6	66.9	68.8	70.1	54.0	54.7	56.2			
21	52.2	52.9	54.0	54.8	56.9	58.7	65.4	67.1	68.7	73.2	75.0	76.6	66.0	68.4	70.7	52.4	53.8	55.3			
22	51.5	53.0	54.9	56.3	58.5	60.8	65.9	66.7	67.8	71.4	74.3	76.9	66.5	69.2	71.8	51.7	52.6	53.8			
23	52.0	52.7	53.3	57.8	59.6	61.2	63.6	65.2	66.6	72.4	75.9	79.4	67.2	70.1	73.0	50.8	51.9	53.4			
24	52.0	53.1	54.5	59.1	60.1	61.5	63.9	65.6	67.1	73.5	76.2	78.4	69.0	70.2	71.7	50.7	52.5	54.5			
25	51.1	52.0	53.3	56.8	57.6	59.6	65.2	67.2	69.3	73.0	75.5	78.2	67.3	69.8	72.3	50.3	52.8	55.1			
26	49.6	50.6	51.5	55.1	56.7	58.4	66.9	68.4	70.1	71.8	74.8	77.4	67.6	70.0	72.1	53.2	55.1	57.2			
27	50.8	52.1	53.6	56.4	58.4	60.6	67.9	68.9	70.2	73.2	75.7	78.3	66.8	69.6	72.2	55.0	57.1	59.5			
28	51.0	52.0	53.3	58.8	60.3	61.8	68.4	69.7	71.1	73.9	76.5	79.2	67.2	70.2	72.8	56.3	58.5	60.6			
29	50.4	51.7	53.2	58.5	60.8	63.1	67.5	68.7	70.0	73.9	76.9	79.7	68.8	71.0	73.0	56.4	58.7	60.6			
30	50.9	52.0	53.2	61.1	63.0	65.2	66.1	68.5	71.1	75.1	77.9	80.5	68.6	70.8	72.7	57.0	58.8	60.4			
31				62.5	64.4	66.5				74.4	77.0	79.2	69.1	71.1	73.0						

Appendix 4 continued. Minimum, Average and Maximum daily water temperatures (F°) for the Missouri, Marias and Teton Rivers, 2017.

Appendix 4 continued. Minimum, Average and Maximum daily water temperatures (F°) for the Missouri, Marias and Teton Rivers, 20	017.
Ernd Dahingan Bridga Miggouri Divar 1026 6	

Fred F	Robins	on Bric	lge, M	lissou	ri Rive	r 1926	5.6														
2017		April			Мау			June			July			Aug			Sept			Oct	
Date	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1				52.5	53.7	55.0	65.2	67.3	69.4	68.4	71.2	73.9	73.9	76.3	78.2	69.6	71.6	73.1	57.0	58.6	59.7
2				52.6	53.8	55.3	67.1	68.7	70.2	70.0	73.2	76.3	72.0	73.0	75.1	68.9	71.1	72.8	48.3	53.1	56.9
3				52.0	54.2	56.2	66.3	68.2	69.6	73.3	75.9	78.2	69.3	71.7	74.0	68.7	70.8	72.6	44.9	46.1	48.3
4				54.4	57.0	59.8	66.6	68.2	69.5	74.0	76.4	78.6	69.7	72.1	74.6	68.1	69.3	70.7	42.8	44.3	45.6
5				58.1	60.5	63.0	66.6	67.6	68.3	73.9	76.4	78.4	70.1	71.6	73.2	64.9	67.3	69.0	43.5	45.1	46.7
6				61.2	63.5	66.1	65.1	66.9	68.4	74.9	77.0	79.1	68.5	71.2	73.6	64.2	66.6	68.5	44.5	46.4	48.4
7				61.9	64.0	65.2	64.5	66.4	68.0	75.3	77.8	80.1	68.4	71.3	73.5	64.1	66.7	68.7	47.2	48.1	49.3
8				59.4	60.7	62.1	65.5	67.6	69.4	75.9	78.2	80.2	69.6	71.2	72.6	64.3	66.8	68.4	46.9	47.9	49.2
9				58.8	60.7	62.8	67.7	68.3	69.0	76.6	79.1	81.2	68.7	71.3	73.7	64.7	66.9	68.9	45.3	47.0	48.5
10				59.7	61.8	63.8	66.0	67.2	68.2	76.8	78.2	79.9	68.9	70.8	72.5	66.7	68.2	69.6	45.4	46.8	48.2
11				61.4	63.3	65.2	64.9	66.6	67.9	74.1	76.2	78.2	67.5	69.5	70.9	65.5	67.9	69.9	45.2	46.6	47.9
12				63.2	64.4	65.4	64.8	66.4	67.7	73.7	76.1	78.4	67.5	70.6	73.5	65.7	67.4	68.7	46.6	47.5	48.7
13				61.4	62.5	64.4	65.3	66.6	68.1	73.5	76.5	79.2	69.5	71.4	73.0	64.9	65.7	67.1	46.0	47.1	48.5
14	51.5	53.1	54.6	59.6	61.0	62.0	64.1	65.2	67.0	76.2	78.7	81.3	69.4	70.7	71.9	62.3	63.4	64.9	45.1	46.3	47.7
15	50.6	51.6	53.3	57.6	59.1	60.9	62.5	64.1	65.3	75.6	77.4	78.9	67.9	70.6	72.7	57.8	59.9	62.2	44.8	46.4	47.8
16	48.1	49.9	51.6	56.5	58.0	59.2	63.3	64.5	65.5	75.6	78.3	81.5	68.6	71.2	73.4	55.6	56.7	57.7			
17	47.6	48.6	50.4	55.8	57.2	58.3	63.7	64.7	65.8	74.3	76.8	78.9	69.0	71.4	73.3	54.1	55.8	57.4			
18	47.0	49.5	52.1	54.0	55.4	56.8	62.9	64.5	66.0	73.1	75.8	78.1	68.4	71.5	73.9	54.6	56.2	57.6			
19	51.1	52.6	54.2	54.3	56.0	57.8	64.2	65.5	66.8	74.1	76.6	79.0	69.6	71.7	73.4	55.9	56.7	57.4			
20	51.5	53.6	55.3	55.7	57.1	58.6	64.9	66.6	68.5	73.9	76.8	79.4	68.4	70.0	71.3	54.3	55.6	56.4			
21	53.1	54.5	55.9	56.2	57.9	59.6	66.6	68.3	69.9	74.3	76.2	78.0	66.6	68.7	70.6	54.1	55.2	56.1			
22	52.8	54.1	55.0	57.6	59.4	61.3	66.8	67.7	68.7	72.7	75.5	77.9	66.6	69.4	71.8	52.8	53.5	54.8			
23	52.6	53.4	54.1	58.5	60.6	62.6	64.8	66.1	67.3	73.4	76.6	79.3	68.1	70.8	73.2	51.8	52.6	53.6			
24	51.9	53.4	55.3	60.3	61.2	62.0	64.1	65.7	67.0	75.2	77.4	79.3	69.2	70.8	72.8	50.8	52.3	53.8			
25	50.9	51.9	53.9	56.9	58.3	60.4	64.2	66.9	69.7	73.9	76.0	77.8	68.3	70.8	72.9	51.1	53.1	55.0			
26	49.9	51.2	52.8	55.9	57.2	58.2	67.2	68.9	70.5	73.1	76.0	78.5	68.3	70.7	72.6	52.8	54.5	56.4			
27	50.5	51.5	52.2	56.5	58.5	60.4	69.0	70.0	71.0	74.3	76.9	79.1	67.6	70.2	72.1	54.7	56.7	58.5			
28	51.3	52.8	54.8	59.3	61.2	63.0	68.4	70.1	71.7	75.6	78.1	80.6	68.0	70.6	72.8	56.0	58.1	60.0			
29	51.3	52.5	53.5	60.3	62.1	63.8	69.1	70.1	71.4	75.5	77.4	79.0	69.3	71.5	73.5	57.2	58.9	60.3			
30	51.9	53.1	54.4	60.9	63.2	65.3	67.0	69.3	71.3	75.3	78.2	80.6	69.4	71.3	72.7	57.9	59.5	61.1			
31				62.5	64.8	66.9				75.6	78.4	80.7	69.8	71.5	72.9						

Appendix 4 continued. Minimum, Average and Maximum daily water temperatures (F°) for the Missouri, Marias and Teton Rivers, 2017.

Marias	s Rive	r at Loi	ma, U	3031	7071810	onal D	ala														
2017		April			Мау			June			July			Aug			Sept			Oct	
Date	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1	45.0	47.6	49.5	49.6	52.7	56.1	61.7	63.5	65.7	63.9	69.4	75.0	70.3	74.4	78.4	63.7	67.7	71.4	52.2	54.1	57.4
2	44.8	47.0	49.6	50.5	52.9	54.9	60.4	62.7	64.4	67.1	71.9	77.0	67.6	69.8	74.5	63.9	68.3	72.5	41.4	47.2	52.2
3	40.6	42.6	46.0	48.9	53.9	59.0	59.2	62.4	64.9	67.8	72.9	77.7	64.4	69.2	74.1	63.9	67.7	71.4	37.2	38.9	41.2
4	38.1	42.2	46.9	52.0	57.5	63.1	61.9	64.4	67.5	68.0	73.0	76.8	65.5	69.5	73.4	62.6	66.0	70.0	34.0	38.2	42.4
5	39.4	44.1	47.8	55.8	60.0	64.4	62.6	64.2	65.5	67.8	73.0	77.9	65.3	67.1	70.0	59.7	64.6	69.1	37.2	40.3	43.9
6	44.1	47.4	51.4	58.8	60.6	63.0	59.9	62.7	64.9	69.1	73.9	78.8	61.5	66.4	71.6	59.4	64.0	68.4	39.4	43.6	48.0
7	47.5	49.4	50.9	54.0	58.0	60.1	61.2	63.8	66.7	69.6	74.9	80.1	63.5	68.4	73.6	58.8	64.1	69.3	45.1	46.4	47.3
8	45.7	49.5	53.2	51.1	54.0	57.0	62.8	65.5	68.2	71.6	75.2	79.5	65.8	69.2	72.7	59.7	64.6	68.9	43.0	44.2	45.7
9	46.6	48.4	50.9	52.3	55.9	60.1	64.2	65.5	66.7	70.5	75.7	80.6	64.4	69.6	74.7	62.1	65.9	70.2	40.5	44.1	48.0
10	42.8	46.9	50.9	55.9	58.9	62.2	61.2	62.6	64.4	72.0	74.8	77.0	64.6	68.4	72.1	64.0	66.8	70.0	43.0	46.0	49.5
11	43.3	48.2	53.2	57.4	60.5	64.2	58.6	61.4	64.4	69.1	73.1	76.8	64.4	68.2	72.5	60.8	65.7	70.3	43.9	46.2	48.4
12	46.2	49.6	53.1	60.1	61.8	64.6	59.9	62.2	64.6	68.2	73.2	78.3	63.5	69.0	74.3	60.8	64.7	68.4	43.2	45.8	48.7
13	48.4	52.6	57.9	54.7	58.4	60.6	62.1	63.1	64.4	69.3	74.9	80.6	64.8	68.5	72.1	59.9	63.4	66.6	42.4	44.8	46.9
14	49.8	53.2	56.8	52.0	53.9	55.6	59.5	60.7	62.1	71.2	76.4	81.5	65.8	69.1	73.4	55.9	59.0	62.4	40.8	43.9	46.8
15	46.6	49.4	52.0	51.1	53.2	55.6	58.6	61.0	63.1	71.6	75.1	78.8	63.7	68.6	73.6	52.0	53.5	55.8	41.4	44.9	48.9
16	42.6	48.4	54.7	51.3	53.7	55.6	61.2	62.8	64.9	70.7	74.6	78.6	63.7	68.6	73.0	50.0	51.2	52.3			
17	44.1	46.5	49.8	51.4	53.2	54.7	61.3	62.7	64.2	67.8	72.7	77.4	64.2	68.9	73.2	47.3	51.2	55.6			
18	42.8	48.2	54.1	50.4	52.3	55.0	60.8	62.6	64.8	66.2	71.3	76.1	64.4	69.3	73.9	51.3	53.7	56.1			
19	47.7	52.6	57.6	50.5	54.1	57.7	61.2	64.2	67.5	68.4	72.8	77.7	65.5	69.1	72.0	52.3	54.7	57.6			
20	48.0	53.2	58.1	54.3	56.6	58.8	64.2	65.6	67.3	68.5	73.1	78.1	63.1	66.6	69.1	49.6	52.6	55.2			
21	50.4	52.2	54.9	55.2	57.4	59.5	63.9	65.8	67.8	67.5	71.7	75.7	62.1	66.4	70.7	49.5	52.4	55.4			
22	49.1	53.2	58.3	56.7	58.7	61.2	62.6	64.1	65.7	66.6	71.8	76.8	63.0	67.9	72.9	49.8	50.4	52.7			
23	51.3	52.5	54.3	56.3	59.3	62.1	60.1	62.1	64.0	68.2	73.9	79.5	63.7	68.7	73.4	47.8	50.7	54.1			
24	48.2	52.2	57.0	57.4	59.9	61.3	60.4	62.9	65.8	69.6	74.4	78.6	66.0	68.3	70.2	47.5	51.3	55.2			
25	49.1	51.1	53.1	53.8	55.1	57.2	62.2	65.3	68.7	67.3	72.4	77.4	64.4	68.7	73.6	47.7	52.3	56.7			
26	46.9	50.1	53.1	52.2	54.7	57.2	64.4	66.5	69.1	67.5	72.6	77.5	63.5	68.2	72.5	52.9	56.2	60.1			
27	49.1	50.1	51.3	55.6	58.4	61.5	65.1	66.4	68.0	69.6	72.4	75.7	62.2	67.6	72.5	54.7	58.8	63.1			
28	46.0	48.5	51.1	59.0	60.8	63.0	64.6	67.2	70.7	69.4	74.2	79.3	63.1	68.5	73.6	54.7	59.1	63.3			
29	44.6	49.0	53.2	57.4	60.7	63.3	64.2	66.4	69.1	69.8	74.9	80.1	65.5	69.9	74.3	54.7	59.2	63.3			
30	48.2	51.1	54.3	59.7	62.1	64.8	61.2	66.6	71.4	70.3	75.2	79.5	65.5	69.5	73.2	55.2	58.2	61.0			
31				59.5	62.6	65.5				69.4	74.6	79.7	66.2	69.4	72.9						

Marias River at Loma, USGS Provisional Data

Maria	s Rive	er at Be	ssette	Ranch	n, Maria	as Riv	er RM	1 30.5													
2017		April			Мау			June			July			Aug			Sept			Oct	
Date	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1							59.8	61.2	63.0	63.4	68.3	73.0	67.6	71.0	74.4	62.2	65.6	69.1	52.0	54.5	57.2
2							59.1	60.6	62.1	64.8	69.5	74.0	64.5	66.3	70.2	62.6	66.4	70.2	38.0	46.1	51.9
3							58.5	61.2	63.7	65.9	70.6	74.7	62.1	66.2	70.7	63.0	66.2	69.2	34.2	36.8	39.8
4							61.1	63.0	65.6	65.7	69.9	73.2	63.7	66.2	68.9	61.5	64.4	67.9	34.6	38.2	42.0
5							60.7	62.3	63.1	64.8	69.6	74.0	62.1	63.9	65.8	59.1	62.9	66.5	39.2	42.7	47.1
6							59.4	61.7	64.3	66.0	70.7	75.2	60.3	64.1	68.4	58.7	62.5	66.3	42.9	46.1	49.2
7							60.1	62.4	64.8	67.0	71.6	76.0	62.4	66.3	70.8	58.7	63.2	67.9	46.0	47.6	49.4
8							61.5	63.8	66.2	68.0	72.2	76.7	65.3	67.7	70.3	60.0	63.7	67.4	45.8	47.1	49.0
9							61.1	63.6	65.3	69.2	73.2	77.0	62.5	66.9	71.4	61.3	64.6	68.3	43.1	46.2	49.6
10							58.6	60.8	63.1	69.0	71.4	73.7	62.9	66.3	70.0	62.4	65.0	68.2	45.3	48.0	51.1
11							56.9	60.3	63.7	66.4	69.7	72.8	63.3	65.5	67.9	60.3	64.4	68.9	46.8	48.6	50.5
12							59.6	61.9	64.0	65.7	70.2	74.7	62.2	66.8	72.0	60.5	63.7	67.0	45.1	47.1	49.6
13							59.3	61.6	62.8	67.7	71.9	76.4	63.1	66.2	69.0	59.1	61.8	65.1	43.4	45.5	47.7
14							57.5	59.7	63.1	69.3	73.2	77.2	64.8	67.2	70.5	53.3	56.5	59.5	42.5	45.2	48.0
15							58.6	60.9	63.5	69.3	72.2	74.9	61.9	66.4	71.0	50.4	51.3	53.2	42.8	46.0	49.8
16							60.0	61.9	64.3	68.8	71.8	75.2	62.8	66.7	70.4	49.4	50.5	52.2	46.0	48.9	52.4
17							59.9	61.5	63.4	65.2	69.1	73.0	63.7	67.3	71.2	47.9	52.1	56.9			
18							59.4	61.7	64.4	63.8	67.9	71.7	63.4	67.7	71.9	53.3	55.6	58.4			
19							60.2	63.2	66.7	66.0	69.5	73.1	63.9	66.9	69.1	53.3	55.3	57.9			
20							62.5	64.2	66.5	66.4	69.9	73.7	61.3	64.5	66.8	50.0	52.9	55.7			
21							61.5	64.0	66.4	65.9	68.8	71.7	61.1	64.2	67.6	50.2	52.9	56.0			
22							60.7	62.6	64.1	64.2	68.7	73.2	61.3	65.5	70.1	50.0	50.8	52.8			
23				54.6	57.8	61.5	58.6	60.9	63.3	66.9	71.3	75.6	63.6	67.7	71.8	48.5	50.8	53.7			
24				54.9	58.2	60.2	59.7	62.9	66.6	67.5	71.3	74.9	64.7	66.9	68.9	49.1	52.4	56.9			
25				52.9	53.7	54.8	61.1	64.4	67.9	65.3	69.2	73.0	61.8	65.5	69.9	50.4	54.0	57.3			
26				52.6	55.5	58.8	61.8	64.5	67.8	65.1	69.2	73.2	62.1	65.9	69.5	54.6	57.7	61.9			
27				56.8	58.7	61.1	63.0	65.2	68.1	67.3	70.1	73.0	61.6	65.9	70.1	55.9	59.5	63.6			
28				57.5	59.1	60.4	62.1	65.5	69.2	66.5	70.5	74.6	62.7	66.8	70.9	55.8	59.5	63.3			
29				56.7	59.4	62.7	61.2	64.4	67.4	68.0	71.8	75.4	64.6	68.0	71.7	55.5	59.0	62.8			
30				58.2	60.2	62.2	59.8	64.8	69.6	68.4	71.9	74.9	64.6	67.4	70.3	55.7	58.1	60.4			
31				58.5	60.8	63.3				66.9	71.2	75.4	64.8	67.1	70.1						

Appendix 4 continued. Minimum, Average and Maximum daily water temperatures (F°) for the Missouri, Marias and Teton Rivers, 2017.

Teton	Teton River, Teton River RM 2.3																				
2017		April			May			June			July			Aug			Sept			Oct	
D .																					
Date	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
1	44.9	48.0	50.6	50.7	54.8	59.5	67.6	72.4	78.8	64.7	74.3	84.5	71.4	76.9	82.2	<u>65.7</u>	<u>69.5</u>	72.4			
2	44.4	47.5	50.7	52.2	55.1	57.9	61.3	68.6	72.9	68.7	76.8	86.3	67.8	70.9	77.7	66.1	69.7	73.0			
3	40.4	42.7	46.7	50.1	57.3	64.9	62.2	69.9	77.0	68.6	76.8	85.7	64.0	72.3	81.6	65.8	<u>69.1</u>	71.7			
4	37.3	43.5	50.9	54.5	62.4	71.0	67.3	72.9	81.4	68.0	76.6	84.9	66.3	72.9	78.9	62.9	66.1	<u>69.6</u>			
5	40.3	46.2	51.4	59.2	67.0	75.1	67.3	69.9	72.9	67.7	77.1	87.1	65.7	69.3	73.1	<u>59.7</u>	64.8	69.3			
6	45.3	49.2	53.5	63.9	68.5	73.9	62.3	68.8	75.3	70.2	79.3	89.8	61.1	70.1	80.1	<u>59.4</u>	64.3	67.8			
/	47.8	50.4	52.2	56.8	62.4	67.4	63.4	70.1	77.2	70.1	80.1	90.8	<u>64.2</u>	73.1	82.6	58.8	64.6	<u>68.7</u>			
8	45.1	50.8	57.5	51.2	59.4	68.2	67.5	73.3	79.5	72.8	79.9	88.7	<u>66.6</u>	72.4	78.6	<u>59.5</u>	64.9	68.3			
9	46.3	49.0	52.6	56.5	63.4	71.2	68.1	71.1	74.0	70.7	79.8	89.4	63.0	72.2	82.0	62.4	66.6	70.7			
10	41.7	47.4	53.3	58.2	66.0	74.3	62.2	66.5	71.6	71.6	77.0	81.5	63.7	70.9	78.3	<mark>64.5</mark>	<mark>67.9</mark>	71.5			
11	43.5	49.7	56.4	61.0	68.5	/6.3	59.3	66.1	/3.6	67.5	/4./	82.8	63.5	70.2	/6.9						
12	47.2	51.4	55.6	65.2	69.7	76.0	62.0	67.0	72.5	65.6	75.4	86.4	62.4	/1.6	81.6						
13	49.2	54.5	61.1	58.9	62.9	66.3	64.4	67.6	71.3	69.4	<mark>79.6</mark>	90.5	65.7	71.8	78.4						
14	50.8	54.8	58.9	53.3	58.2	62.9	61.4	64.7	68.8	71.9	80.9	90.4	67.4	72.7	79.5						
15	46.1	49.6	53.4	53.9	59.3	65.6	60.3	65.3	69.7	72.3	<mark>78.6</mark>	86.5	62.9	70.9	80.1						
16	41.8	48.6	56.2	54.9	59.2	63.7	62.7	67.5	73.0	70.3	77.3	85.6	62.7	70.7	79.2						
17	44.4	47.3	50.3	53.2	55.9	58.5	62.7	66.1	69.6	64.9	74.0	84.1	63.3	70.8	<mark>79.0</mark>						
18	44.2	50.8	58.1	51.6	56.8	63.4	62.3	66.5	71.4	<u>63.7</u>	<mark>73.5</mark>	<mark>83.9</mark>	<u>62.7</u>	71.0	<mark>79.6</mark>						
19	51.1	55.9	62.0	53.5	60.8	68.8	62.2	68.5	75.2	<mark>69.3</mark>	<mark>76.8</mark>	<mark>85.4</mark>	<mark>64.8</mark>	<mark>70.6</mark>	<mark>76.2</mark>						
20	48.7	55.0	60.9	58.2	63.2	67.6	66.6	70.6	75.1	<mark>68.2</mark>	<mark>76.4</mark>	<mark>86.5</mark>	<u>61.5</u>	<mark>68.0</mark>	<mark>73.7</mark>						
21	50.6	53.0	56.2	58.2	63.5	68.1	66.3	71.3	76.6	<mark>66.8</mark>	<mark>74.1</mark>	<mark>82.2</mark>	<mark>61.8</mark>	<mark>68.9</mark>	<mark>76.5</mark>						
22	48.8	54.4	61.8	60.3	63.8	67.7	64.8	67.7	71.1	<mark>65.0</mark>	<mark>74.6</mark>	<mark>84.9</mark>	<mark>62.4</mark>	<mark>71.0</mark>	<mark>80.1</mark>						
23	52.7	54.6	56.5	57.6	64.3	70.7	61.0	65.9	71.9	<mark>68.1</mark>	<mark>78.3</mark>	<mark>88.9</mark>	<mark>63.9</mark>	<mark>71.9</mark>	<mark>79.7</mark>						
24	49.5	55.0	62.7	60.0	64.7	68.3	62.1	67.8	74.3	<mark>69.4</mark>	<mark>77.4</mark>	<mark>86.0</mark>	<mark>66.4</mark>	<mark>70.3</mark>	<mark>74.9</mark>						
25	50.6	52.8	55.2	54.9	57.0	59.7	62.1	70.2	79.0	<mark>65.1</mark>	<mark>74.3</mark>	<mark>84.5</mark>	<mark>64.4</mark>	<mark>71.1</mark>	<mark>78.7</mark>						
26	48.6	53.0	57.7	53.2	58.5	63.7	65.4	73.0	81.6	<mark>66.9</mark>	<mark>76.4</mark>	<mark>86.4</mark>	<mark>63.4</mark>	<mark>70.5</mark>	<mark>76.6</mark>						
27	51.5	53.0	54.6	57.2	62.6	68.0	68.8	72.5	77.5	<mark>70.5</mark>	<mark>75.8</mark>	<mark>81.2</mark>	<mark>61.1</mark>	<mark>69.1</mark>	<mark>76.2</mark>						
28	48.9	51.7	54.4	61.5	65.5	70.4	65.4	71.4	79.0	<mark>68.9</mark>	<mark>77.8</mark>	<mark>87.0</mark>	<mark>63.2</mark>	<mark>69.9</mark>	<mark>75.9</mark>						
29	47.1	52.6	58.3	59.6	67.0	74.7	64.4	68.4	72.9	<mark>69.9</mark>	<mark>78.6</mark>	<mark>87.2</mark>	<mark>66.0</mark>	<mark>70.2</mark>	<mark>73.2</mark>						
30	51.2	54.9	59.0	63.6	69.7	76.2	61.5	70.1	78.6	<mark>70.7</mark>	<mark>78.3</mark>	<mark>84.5</mark>	<mark>65.8</mark>	<mark>69.2</mark>	<mark>72.0</mark>						
31				63.9	71.0	79.1				<mark>69.3</mark>	<mark>76.5</mark>	<mark>83.1</mark>	<mark>67.0</mark>	<mark>70.3</mark>	<mark>73.3</mark>						

Appendix 4 continued. Minimum, Average and Maximum daily water temperatures (F°) for the Missouri, Marias and Teton Rivers, 2017.

Highlighted data shows days where extreme low flows (less than 10 cfs) likely impacted data logger accuracy.

			Le	ength (mi	m)	V	Weight (g)	mean
Species	Ν	CPUE	mean	min	max	mean	min	max	Wr
Blue Sucker	1	0.1	728	728	728	3260	3260	3260	83.7
Bigmouth Buffalo	2	0.2	656	651	661	4278	4175	4380	82.7
Brown Trout	2	0.2	286	235	336	255	160	350	95.9
Brown Trout <150	1	114.0	114	114					
Channel Catfish	115	13.9	585	475	722	2366	885	4600	109.4
Common Carp	97	11.7	649	563	769	3863	2360	5960	101.8
Freshwater Drum	158	19.0	358	270	605	659	250	3185	102.8
Flathead Chub	1	0.1	165	165	165	40	40	40	
Goldeye	212	25.5	323	279	386	298	195	490	
Longnose Sucker	99	11.9	366	221	500	636	115	1455	
Mountain Sucker	2	0.2	164	163	164	55	50	60	
Mountain Whitefish	5	0.6	329	145	481	491	30	1040	112.9
Northern Pike	4	0.5	776	684	945	3200	2075	5810	92.5
Pallid Sturgeon	1	0.1	530	530	530	560	560	560	107.8
Pumpkinseed	2	0.2	88	87	88				
Rainbow Trout	6	0.7	313	190	511	396	75	1090	85.8
River Carpsucker	87	10.5	442	376	610	1253	685	3475	102.4
Rocky Mtn Sculpin	1	0.1	92	92	92				
Stonecat	5	0.6	166	156	173	33	15	55	
Shovelnose Sturgeon	1	0.1	878	878	878	3560	3560	3560	108.8
Sauger	12	1.4	416	302	565	748	145	1710	85.1
Shorthead Redhorse	1554	187.2	448	250	561	1100	210	2110	103.0
Smallmouth Bass	120	14.5	248	150	405	306	40	1030	114.4
Smallmouth Bass <150	19	106.8	93	149	32	15	60		
Smallmouth Buffalo	37	4.5	590	478	783	3846	1630	9356	92.7
White Sucker	65	7.8	326	163	478	505	35	1330	99.6
White Sucker <150	1	95.0	95	95					
Walleye	35	4.2	359	153	605	489	35	2065	88.8
Total	2645								

Appendix 5. Electrofishing statistics for Morony Section, Fall 2017, for all sizes of fish, 8.3 hours electrofishing.

Appendix 6.	Electrofishing	statistics for Fe	ort Bentor	Section,	Fall 2017	, for all s	sized fish,	9.6 h	iours
electrofishing	g.								

			Le	ngth (m	m)	V	Veight (g	g)	mean
Species	Ν	CPUE	mean	min	max	mean	min	max	Wr
Bigmouth Buffalo	4	0.4	734	671	790	6848	5540	9340	92.1
Brown Trout	4	0.4	282	198	325	233	80	325	85.6
Brown Trout <150	1	0.1	106	106	106				
Burbot	2	0.2	527	523	531	530	510	550	50.6
Channel Catfish	140	14.6	579	410	815	2317	545	6070	109.3
Common Carp	92	9.6	640	530	711	3642	2030	5500	100.0
Freshwater Drum	107	11.1	348	274	515	574	280	1850	102.8
Goldeye	281	29.3	326	282	385	310	200	500	
Longnose Dace	1	0.1	87	87	87				
Longnose Sucker	87	9.1	377	198	508	662	80	1370	
Longnose Sucker <150	1	0.1	118	118	118				
Northern Pike	4	0.4	642	316	805	2084	205	3550	93.9
Pallid Sturgeon	1	0.1	497	497	497	415	415	415	98.7
River Carpsucker	69	7.2	439	391	553	1200	790	2020	101.0
Sauger	83	8.6	394	302	534	509	205	1315	80.2
Shorthead Redhorse	1411	147.0	427	178	531	924	75	1750	97.5
Smallmouth Bass	93	9.7	303	155	444	590	60	1450	122.1
Smallmouth Bass <150	6	0.6	113	105	133	193	193	193	
Smallmouth Buffalo	43	4.5	622	456	824	4506	1780	9605	90.6
White Sucker	180	18.8	326	165	500	500	50	1235	96.5
White Sucker <150	1	0.1	96	96	96				
Walleye	39	4.1	374	161	482	503	35	1030	89.0
Walleye <150	1	0.1	133	133	133	15	15	15	
Total	2760								

			Le	ngth (m	m)	V	Veight (g	<u>(</u>)	mean
Species	Ν	CPUE	mean	min	max	mean	min	max	Wr
Black Crappie	8	0.8	224	192	256	171	105	235	95.8
Blue Sucker	1	0.1	737	737	737	3960	3960	3960	97.4
Bluegill	3	0.3	129	103	158	85	85	85	
Channel Catfish	95	9.7	547	369	754	1992	435	6250	111.4
Common Carp	27	2.8	563	377	677	2632	750	5820	100.7
Freshwater Drum	26	2.7	342	283	419	550	350	965	108.6
Goldeye	137	14.0	315	267	370	288	175	480	
Longnose Sucker	14	1.4	314	205	445	379	95	830	
Mountain Whitefish	13	1.3	229	189	312	135	60	305	102.1
Northern Pike	9	0.9	591	345	762	1495	280	2735	90.7
Pallid Sturgeon	1	0.1	613	613	613	795	795	795	94.8
Pumpkinseed	2	0.2	95	78	111				
River Carpsucker	52	5.3	446	386	885	1274	730	3980	102.7
Shovelnose Sturgeon	9	0.9	803	738	905	2536	1925	3460	103.2
Sauger	48	4.9	364	248	491	392	100	935	78.6
Shorthead Redhorse	473	48.3	302	138	485	430	30	1145	96.8
Smallmouth Bass	41	4.2	285	156	425	568	75	1455	125.6
Smallmouth Bass <150	23	2.3	111	80	149				
Smallmouth Buffalo	10	1.0	551	467	727	3190	1730	7200	95.1
White Sucker	19	1.9	269	153	415	325	40	870	93.9
White Sucker <150	2	0.2	106	80	131				
Walleye	12	1.2	320	172	482	386	35	1110	89.8
Walleye <150	1	0.1	136	136	136				
Western Silvery Minnow	4	0.4	108	104	111				
Yellow Perch	2	0.2	165	150	180	65	50	80	107.4
Total	1032								

Appendix 7. Electrofishing statistics for Coal Banks Section Fall 2017, for all sized fish, 9.8 hours electrofishing.

Appendix 8.	Electrofishing	statistics for the	e Judith La	nding Section,	Fall 2016,	for all s	ized fish,	11.2
hours electro	fishing.							

			Lei	ngth (m	lm)	W	/eight (g)	mean
Species	Ν	CPUE	mean	min	max	mean	min	max	Wr
Black Crappie	71	6.3	198	173	249	114	75	245	97.8
Blue Sucker	1	0.1	658	658	658	2415	2415	2415	87.9
Bluegill	5	0.4	112	102	125				
Burbot	1	0.1	393	393	393	265	265	265	59.3
Channel Catfish	77	6.9	551	190	803	1995	95	5645	106.6
Common Carp	53	4.7	509	262	771	1955	260	5500	96.5
Freshwater Drum	69	6.2	325	262	418	451	230	925	103.1
Flathead Chub	29	2.6	147	95	209	38	20	75	
Goldeye	176	15.7	314	198	384	286	170	460	
Longnose Sucker	22	2.0	338	223	442	465	120	910	
Northern Pike	5	0.4	594	482	755	1237	685	1860	84.8
River Carpsucker	65	5.8	440	351	556	1209	630	2160	101.5
Shovelnose Sturgeon	4	0.4	802	782	834	2539	2280	2960	104.3
Sauger	191	17.1	324	150	513	319	20	1130	79.6
Shorthead Redhorse	749	66.9	286	128	500	372	20	1235	92.6
Smallmouth Bass	18	1.6	346	215	421	942	195	1820	133.2
Smallmouth Buffalo	15	1.3	598	466	785	3735	1870	8085	87.0
White Sucker	2	0.2	359	308	410	615	315	915	97.4
Walleye	33	2.9	308	157	427	283	25	665	84.9
Western Silvery Minnow	14	1.3	104	90	122				
Yellow Perch	2	0.2	143	83	202	125	125	125	108.8
Longnose Sucker <150	3	0.3	111	95	135				
Sauger <150	4	0.4	139	132	146				
Smallmouth Bass <150	37	3.3	111	79	140	40	35	45	
Smallmouth Buffalo <150	1	0.1	95	95	95				
White Sucker <150	1	0.1	90	90	90				
Walleye <150	3	0.3	144	137	149	23	20	25	
Total	1651								

			Length	n (mm)		Weigh	t (g)		mean
Species	Ν	CPUE	mean	min	max	mean	min	max	Wr
Bigmouth Buffalo	2	0.2	776	738	814	8913	7425	10400	100.9
Black Crappie	273	24.2	190	102	247	108	25	245	95.5
Blue Sucker	1	0.1	724	724	724	2975	2975	2975	77.8
Bluegill	18	1.6	114	97	130	43	35	50	
Burbot	3	0.3	457	365	600	518	200	1040	62.4
Channel Catfish	90	8.0	540	327	850	1515	235	6590	87.7
Common Carp	34	3.0	482	348	668	1634	595	3635	95.0
Common Carp <150	3	0.3	139	134	143	40	40	40	
Emerald Shiner	1	0.1	44	44	44				
Flathead Chub	24	2.1	136	105	213	46	20	105	
Freshwater Drum	54	4.8	314	264	397	390	235	740	101.5
Goldeye	261	23.1	298	186	376	227	60	415	
Longnose Sucker <150	2	0.2	108	103	112				
Northern Pike	27	2.4	333	261	375	227	115	345	95.9
Rainbow Trout	1	0.1	465	465	465	1055	1055	1055	88.2
River Carpsucker	89	7.9	452	370	563	1364	750	2745	105.5
Sauger	158	14.0	317	150	498	291	25	930	79.3
Sauger <150	6	0.5	142	135	147				
Shorthead Redhorse	274	24.2	316	156	480	446	40	1350	95.0
Shovelnose Sturgeon	1	0.1	813	813	813	2440	2440	2440	96.3
Smallmouth Bass	2	0.2	196	190	202	120	115	125	118.6
Smallmouth Bass <150	8	0.7	100	90	108				
Smallmouth Buffalo	8	0.7	540	479	680	2718	1840	5035	88.9
Walleye	33	2.9	346	181	670	435	40	2870	81.7
Walleye <150	1	0.1	143	143	143				
Western Silvery	5	0.4	101	47	119				
Minnow									
Yellow Perch	1	0.1	165	165	165	60	60	60	100.4
Total	1380								

Appendix 9. Electrofishing statistics for Robinson Section Fall 2017, for all sized fish, 11.3 hours electrofishing.

Middle Missouri Fisheries Monitoring -	2017 March 26, 2018
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				Length	(mm)		Weight	(g)	
Species	Ν	CPUE	Average	Min	Max	Average	Min	Max	Wr
Blue Sucker	3	0.15	762	657	850	4313	2800	5240	93.7
Channel Catfish	7	0.35	526	473	632	1574	850	2825	102.9
Common Carp	5	0.25	475	350	632	1669	555	3450	95.6
Goldeye	10	0.5	311	263	337	238	170	285	
Longnose Sucker	11	0.55	398	266	453	668	185	860	
Pallid Sturgeon	6	0.3	763	519	1122	2641	430	8250	99.7
Sauger	21	1.05	385	289	515	474	160	1100	77.7
Shorthead Redhorse	53	2.65	402	269	484	701	180	1135	90.7
Shovelnose Sturgeon	58	2.9	760	375	940	2088	185	3590	98.6
Smallmouth Bass	1	0.05	352	352	352	690	690	690	104.5
Walleye	1	0.05	401	401	401	650	650	650	97.3
White Sucker	2	0.1	342	274	409	490	220	760	87.9
Total	178	8.9	536	263	1122	1283	160	8250	93.1

Appendix 10. Tramme	l net fish size	statistics at Coal	Banks Section	2017 (20 drifts).
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Appendix 11. Trai	mmel net fish size sta	tistics from Judith	Landing Section in	2017 (20 drifts).
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				Length	(mm)		Weight	(g)	
Species	Ν	CPUE	Average	Min	Max	Average	Min	Max	Wr
Blue Sucker	4	0.2	761	681	820	3914	2300	5190	83.3
Burbot	1	0.05	686	686	686	1570	1570	1570	69.9
Channel Catfish	3	0.15	750	706	824	4828	4190	5645	103.7
Flathead Chub	1	0.05	246	246	246	125	125	125	
Goldeye	16	0.8	315	241	362	253	125	415	
Longnose Sucker	15	0.75	357	296	449	513	250	1025	
Pallid Sturgeon	7	0.35	545	400	760	577	185	1420	89.3
River Carpsucker	1	0.05	415	415	415	960	960	960	97.3
Sauger	6	0.3	382	279	472	458	140	830	76.2
Shorthead Redhorse	51	2.55	334	205	498	474	105	1100	94.9
Shovelnose Sturgeon	73	3.65	749	236	881	2031	35	3855	98.3
Walleye	1	0.05	275	275	275	180	180	180	89.4
Total	179	8.95	531	205	881	1251	35	5645	95.2

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				Length	(mm)	\-	Weight	(g)	
Species	Ν	CPUE	Average	Min	Max	Average	Min	Max	Wr
Black Crappie	1	0.02	152	152	152	55	55	55	114.8
Blue Sucker	1	0.02	703	703	703	2745	2745	2745	79.5
Bluegill	1	0.02	121	121	121	45	45	45	
Channel Catfish	14	0.28	339	230	550	423	100	1515	97.4
Common Carp	2	0.04	566	538	593	2458	2395	2520	99.2
Flathead Chub	14	0.28	242	218	273	130	100	170	
Freshwater Drum	1	0.02	334	334	334	500	500	500	107.6
Goldeye	21	0.42	292	255	366	206	135	320	
Longnose Sucker	3	0.06	268	246	306	222	170	320	
Paddlefish	1	0.02							
Pallid Sturgeon	103	2.06	495	275	1215	667	63	8765	92.8
Rainbow Trout	1	0.02	465	465	465	1135	1135	1135	94.9
River Carpsucker	4	0.08	421	401	435	1144	975	1215	111.4
Sauger	14	0.28	349	272	503	344	135	1100	75.8
Shorthead Redhorse	16	0.32	244	195	324	174	90	375	98.9
Shovelnose Sturgeon	180	3.6	719	316	1020	1914	125	4700	106.2
Smallmouth Buffalo	1	0.02	476	476	476	1900	1900	1900	97.0
Walleye	1	0.02	351	351	351	415	415	415	94.8
Total	379	7.58							

Appendix 12. Trammel net fish statistics from the Robinson Section in 2017 (50 drifts).

Appendix 13. Size statistics and catch rates for fish caught with standard spring setlines (90 sets) in the Robinson Section, 2017 compared with average catch per set 2008 - 2017.

	2008 - 2017	•		Length (mm)		Weight (g)				
Species	CPUE	Ν	CPUE	Mean	Min	Max	Mean	Min	Max	Wr
Burbot	< 0.1	3	< 0.1	543	462	671	912	252	1600	
Channel Catfish	1.2	148	1.6	542	310	971	1838	220	9660	92.0
Common Carp	0.1	3	< 0.1	521	493	561	1807	1610	2170	91.2
Flathead Chub	0.3	2	< 0.1	193	179	206	75	60	90	
Freshwater Drum	< 0.1	8	0.1	315	281	367	366	265	450	94.9
Goldeye	0.7	44	0.5	328	285	399	270	185	485	
Longnose Sucker	< 0.1	1	< 0.1	305	305	305	265	265	265	
Pallid Sturgeon	1.9	259	2.9	473	281	917	366	60	4760	93.0
Sauger Shorthead	0.5	34	0.4	383	290	532	453	160	1320	76.5
Redhorse	0.1	15	0.2	364	305	434	527	260	905	90.6
Shovelnose										
Sturgeon	0.2	14	0.2	701	609	825	1728	1205	2880	111.1
Stonecat	0.3	35	0.4	167	122	217	54	15	110	
Walleye	0.2	39	0.4	350	261	585	491	135	2100	82.3
Total	5.5	605	6.7	449	122	971	756	15	9660	91.3

				Length	
Section	Species	Ν	Average	Min	Max
Morony	Common carp	4	73	36	110
	Emerald shiner	2274	66	55	78
	Longnose dace	4	36	25	42
	Longnose sucker	8	60	46	71
	Northern pike	2	262	230	293
	Shorthead redhorse	138	38	25	73
	Smallmouth Bass	81	60	32	156
	Spottail shiner	34	82	49	96
	Stonecat	1	162	162	162
	Sucker	5	44	42	46
	Walleye	1	61	61	61
	Western Silvery Minnow	56	88	78	95
	White sucker	75	54	38	181
	Total				
		2695	59	25	293
Fort Benton	Common carp	2	112	98	125
	Emerald shiner	2575	68	59	80
	Fathead minnow	3	42	35	54
	Longnose dace	1	37	37	37
	Longnose sucker	23	71	56	83
	Northern pike	2	233	208	257
	Shorthead redhorse	40	58	29	153
	Smallmouth Bass	152	65	35	157
	unknown	2	28	25	30
	Walleye	5	110	104	119
	Western Silvery Minnow	3	80	75	84
	White sucker	139	74	37	252
	Yellow perch	2	66	61	70
	Total				
		2952	69	25	257
Coal Banks	Channel catfish	1	27	27	27
Landing	Emerald shiner	1067	66	53	85
U	Flathead chub	54	41	18	121
	Longnose dace	12	36	26	46
	Longnose sucker	49	50	35	71
	Sand shiner	11	35	30	52
	Shorthead redhorse	87	49	21	145
	Smallmouth Bass	14	48	39	75
	Spottail shiner	6	42	36	50
	Sucker	3	19	16	21
	White sucker	131	50	33	135
	Total	1441	51	16	145

Appendix 14. Size statistics for seine hauls conducted in 2017.

			Length			
Section	Species	Ν	Average	Min	Max	
Judith Landing	Emerald shiner	1553	64	48	91	
	Fathead minnow	1	48	48	48	
	Flathead chub	688	68	22	116	
	Longnose dace	28	32	24	39	
	Longnose sucker	152	49	32	64	
	River Carpsucker	1	35	35	35	
	Rocky mtn Sculpin	1	36	36	36	
	Sand shiner	14	51	41	61	
	Shorthead redhorse	50	83	22	141	
	Smallmouth Bass	4	46	27	56	
	Stonecat	1	87	87	87	
	Sucker	6	27	21	38	
	Walleye	2	70	45	94	
	Western Silvery Minnow	1	65	65	65	
	Total					
		2502	61	21	141	
Robinson	Black crappie	7	120	78	181	
	Channel catfish	3	39	32	45	
	Common carp	6	77	60	87	
	Emerald shiner	1034	70	55	92	
	Flathead chub	112	61	27	111	
	Longnose sucker	35	51	22	71	
	Minnow	3	27	24	30	
	Northern pike	1	172	172	172	
	RC SU/BUFF	2	40	34	46	
	Sand shiner	7	53	50	55	
	Sauger	3	106	92	114	
	Shorthead redhorse	21	34	24	60	
	Spottail shiner	1	52	52	52	
	Sucker	2	26	19	32	
	Western Silvery Minnow	104	72	57	119	
	Total	1341	65	19	181	

Appendix 14 continued. Size statistics for seine hauls conducted in 2017.