MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

STATE: MONTANA **PROJECT TITLE: Statewide Fisheries Investigations**

PROJECT: F-78-R-3 **STUDY TITLE: Survey and Inventory of Warmwater Streams**

JOB NO: III-B **JOB TITLE: Southeast Montana Warmwater Streams Investigations**

PROJECT PERIOD: July 1998 through December 2017

ABSTRACT

The Lower Yellowstone River fish assemblage has been sampled annually since 1998 with a suite of gears including boat-mounted electrofishing equipment, trammel nets, and trot lines. The Lower Yellowstone River was assigned trend areas consisting of five different locations that would be sampled annually: Forsyth (downstream of Cartersville Diversion), Miles City (above and below the Tongue River confluence), Fallon (above and below the O' Fallon Creek confluence), Intake (downstream of Intake Diversion) and since 2003, Hysham (downstream of Rancher Diversion). Trend areas are approximately 9.6 river km in length and are sampled by means of single pass electrofishing in August, September and October. Additional sampling of the Lower Yellowstone included: Sauger and Walleye tagging in March and April, Pallid Sturgeon targeted sampling and telemetry from April to September, and native species telemetry (Rugg 2018b) from April to October. All species encountered are collected, enumerated, measured, and weighed. An index of abundance (catch per effort) was calculated for all species captured.

Catch per effort was calculated by trend section for Sauger, Channel Catfish, Smallmouth Bass, Walleye, and Northern Pike. Indices of population structure (incremental relative stock density) and condition (relative weight) were calculated for Sauger, Channel Catfish, Smallmouth Bass, Shovelnose Sturgeon, Burbot, and Walleye.

Pallid Sturgeon catch per effort was calculated to compare yearly catch trends as well as to compare catch between sites.

Environmental conditions have varied widely during the study period. Yellowstone River daily water discharge during 2017 near Glendive, MT was at or above the historic median daily discharge (Figure 1). The spring-pulse onset began early, in February, and remained above historic median flows through the mid-June peak (57,300 cfs) largely due to increased flows out of the Bighorn River. Extreme snowpack and resulting spring discharge out of the Bighorn River drainage in 2017 was 2-4 times greater than the historic average discharge, and discharge remained above historical averages throughout the entirety of 2017.

STUDY AREA

The study area consists of the 473 km of the Yellowstone River downstream of the Big Horn River confluence (Figure 2). River geomorphology varies throughout the study area in direct response to valley geology; straight, sinuous, braided, and irregular-meander channel patterns occur (Silverman and Tomlinsen 1984). The channel is often braided or split and long side channels are common. Islands and bars range from large vegetated islands to unvegetated point and mid-channel bars (White and Bramblett 1993). Substrate is primarily gravel and cobble upstream of river kilometer 50 and is primarily fines and sand below (Bramblett and White 2001).

The fish assemblage is comprised of 49 species from 15 families, including eight state-listed Species of Special Concern and one federally listed endangered species (White and Bramblett 1993; Carlson 2003). The primary deleterious anthropogenic effects on the fish assemblage are associated with water withdrawal for agriculture and associated entrainment of fish (White and Bramblett 1993). About 90% of all water use on the Yellowstone River is for irrigation, which corresponds to annual use of 1.5 million acre-feet (White and Bramblett 1993). Six mainstem low-head irrigation diversions dams occur in the study area. The largest and downstream-most of these, Intake Diversion, diverts about 1,374 cfs at peak water demands and historically entrained about 600,000 fish of 34 species during the mid-May to mid-September irrigation season (Hiebert et al. 2000).

Intake Diversion Dam impedes fish movement and migrations. Some species display limited seasonal passage ability while the dam acts as a nearly complete barrier to other species, most notably preventing the upstream migration of endangered Pallid Sturgeon. The Pallid Sturgeon was listed as an endangered species in 1990. The listing of the species initiated efforts to prevent entrainment and create passage at Intake Diversion. The Bureau of Reclamation (Reclamation) owns the diversion dam and canal structure; however, the Water Resources Development Act of 2007 SEC. 3109. LOWER YELLOWSTONE PROJECT, MONTANA stated, "The Secretary may use funds appropriated to carry out the Missouri River recovery and mitigation program to assist the Bureau of Reclamation in the design and construction of the Lower Yellowstone project of the Bureau, Intake, Montana, for the purpose of ecosystem restoration" thereby the US Army Corps of Engineers (Corps) has funded recovery efforts. Construction of a new screened headworks structure to prevent entrainment was completed in 2012. Screens were designed to prevent the entrainment of fishes greater than 40 mm total length.

Restoration efforts to create fish passage at Intake Diversion Dam are ongoing. The Corps and Reclamation had identified a bypass channel design as their preferred action in an attempt to improve passage for endangered Pallid Sturgeon and other native fish in the lower Yellowstone River (Corps 2014). Designs for the bypass channel alternative were near completion. However, in February 2015, Defenders of Wildlife (DOW) and Natural Resource Defense Council (NRDC) filed a lawsuit against Corps, Reclamation and U.S. Fish & Wildlife Service (Service) for their failure to comply with the Endangered Species Act (ESA) and failure to modify the operations of the two dams (i.e. Intake Diversion Dam and Fort Peck Dam) (DOW 2015.) A contract for the construction of the bypass channel was awarded by Corps in August 2015, and the litigants filed an injunction in October 2015 to stop any construction at the site. The litigants and the federal agencies (i.e. Corps, Reclamation, Service) signed an agreement to begin an Environmental Impact Statement (EIS) in November 2015; the judge approved the agreement in December 2015. Corps and Reclamation completed an expedited EIS examining multiple alternatives. A final draft was completed in October 2016, and a record of decision selecting the bypass channel as the preferred alternative was signed on December 5, 2016.

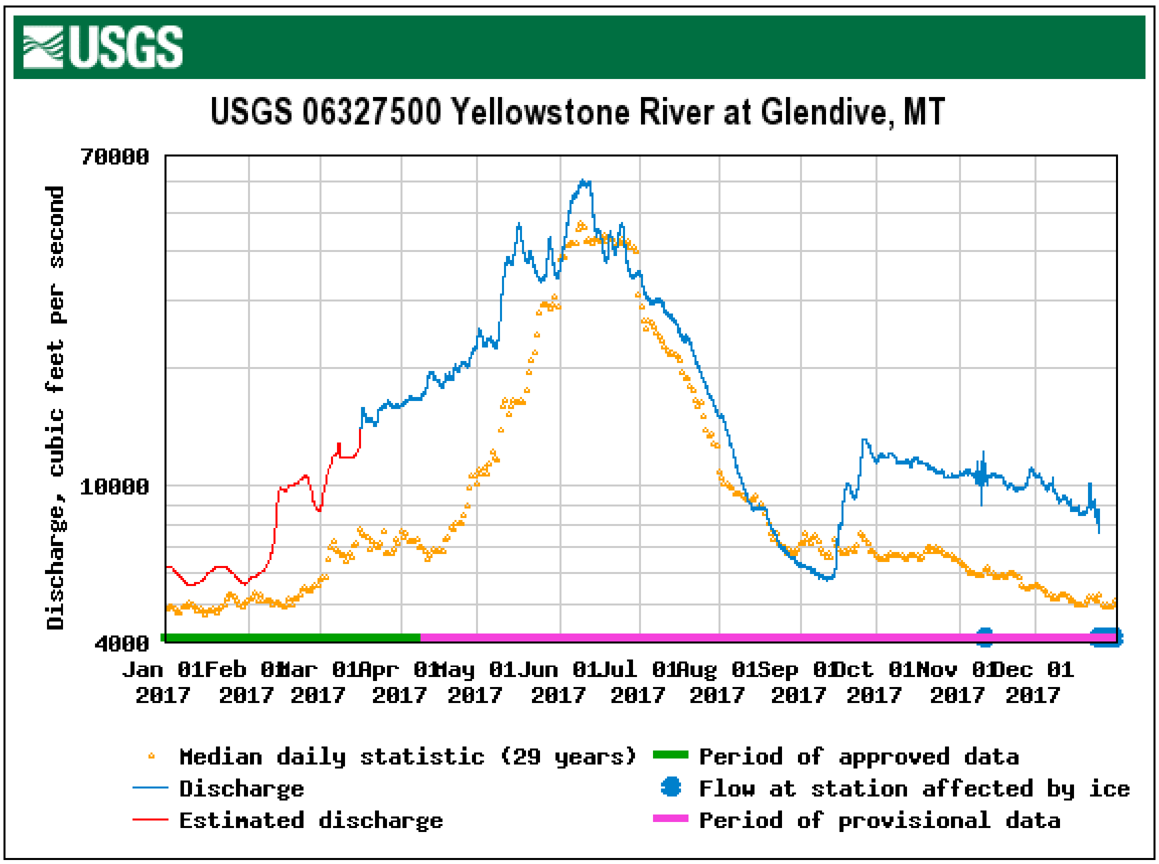

Figure 1. Yellowstone River daily mean discharge for 2017 and historic daily median discharge near Glendive, MT (USGS gaging station 06327500). Data provided by USGS.

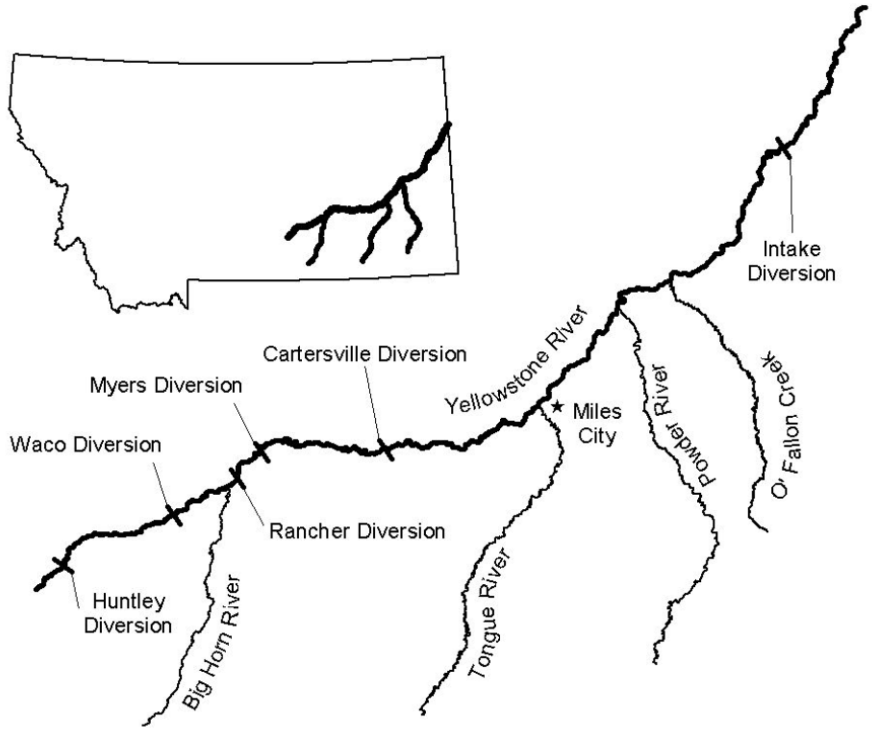

Figure 2. The Yellowstone River, its major tributaries, and diversion dams.

METHODS

The Yellowstone River fish assemblage was sampled using a suite of gears each year between spring and autumn. At ice-off of each year, generally March, drifted trammel nets, electrofishing, and angling gears have been used to capture and tag Sauger and Walleye. Pallid Sturgeon sampling using trammel nets occurred from April to October, with the majority of the netting effort occurring in August and September. Trend sampling was completed each August, September, and October, with boat-mounted electrofishing equipment. Coffelt electrofishing equipment with a single boom and cable dropper was used from 1998 to 2007 and in 2009. In 2008 and from 2010 to present, the electrofishing system changed to a Smith-Root unit with double boom cable droppers. Sampling occurred in the following five trend areas: Forsyth (downstream of Cartersville Diversion), Miles City (above and below the Tongue River confluence), Fallon (above and below the O' Fallon Creek confluence), Intake (downstream of Intake Diversion) and since 2003, Hysham (downstream of Rancher Diversion). Trend areas are approximately 9.6 river km in length. All fishes encountered were collected, identified to species, enumerated, measured (fork length for sturgeon and total length for all other species), and if length was greater than 100 mm, weighed.

An index of abundance (catch per effort) was calculated for all species captured. Catch per effort was also calculated by trend section for Sauger, Channel Catfish, and Smallmouth Bass and by location relative to Intake Diversion Dam (e.g. upstream or downstream). Indices of population structure (incremental relative stock density) and condition (relative weight) were calculated for Sauger, Channel Catfish, Smallmouth Bass, Shovelnose Sturgeon, Burbot, and Walleye (Anderson and Neuman 1996). Length frequency histograms were developed for Sauger and Shovelnose Sturgeon to compare populations upstream and downstream of Intake Diversion. Population structure and condition for Sauger, Shovelnose Sturgeon, and Walleye were described using 1) only data from autumn trend sampling (autumn trend data) and 2) all data collected during a given year (all data). Autumn trend data are less biased and provide the best insight into population structure and condition among years because consistent timing, location, and methodology during the study period. However, low catch rates of some species during autumn trend surveys preclude making inferences thus inclusion of all data was helpful.

RESULTS AND DISCUSSION

To date, 43 species have been captured on the Lower Yellowstone River during the annual autumn trend surveys. Catch by section during 2017 is summarized in Appendix I. It is important to note that electrofishing gear varied during the duration of the study. Due to gear variability and associated sampling efficiency between Coffelt and Smith-Root electro-fishers, direct comparison of catch rates between years of different gears is cautioned. High variability between sampling condition and year is inherent; therefore, trends observed for populations over time were more useful than trends in any given year. Beginning in 2009, as a result of the Pallid Sturgeon survival investigations conducted in August and September, inference accuracy for Shovelnose Sturgeon analysis were improved because of the substantial increase in the number of Shovelnose Surgeon sampled.

Sauger

Sauger continue to be one of the most commonly observed game fish during the annual Yellowstone River trend sampling. Catch rates from 1998 to 2007 averaged over 8 fish per hour. In recent surveys, the catch rates have trended upward and average nearly 16 fish per hr from 2008 to 2013. Catch rate of Sauger in 2017 (10.3 fish/hr) decreased from the previous three years and dropped below the long-term average (12.3 fish/hr) (Figure 3). Catch rates averaged about 12 fish per hour in the 1970s and 1980s but declined to about 2 fish per hour from 1990 to 1997, leading to the listing of Sauger as a Species of Special Concern in Montana (McMahon and Gardner 2001). Catch rates have since improved and are greater than pre-decline levels. In 9 of the last 10 years, catch rates of over 10 fish per hour have been observed, and 6 of the last 10 years catch rates have been over 15 fish per hour. Catch rates of about 10 fish per hour support a good Sauger fishery (McMahon 1999). In 2017, catch rates of Sauger decreased at all trend sections (Figure 4); decreases of 50 percent or more were observed at Intake (54% decrease) and Hysham (50% decrease). However, Intake (17.85 fish/hr), Forsyth (10.9 fish/ hr) and Fallon (10.3 fish/hr) were still at or above the 10 fish per hour described by McMahon (1999) as a good Sauger Fishery (Figure 4).

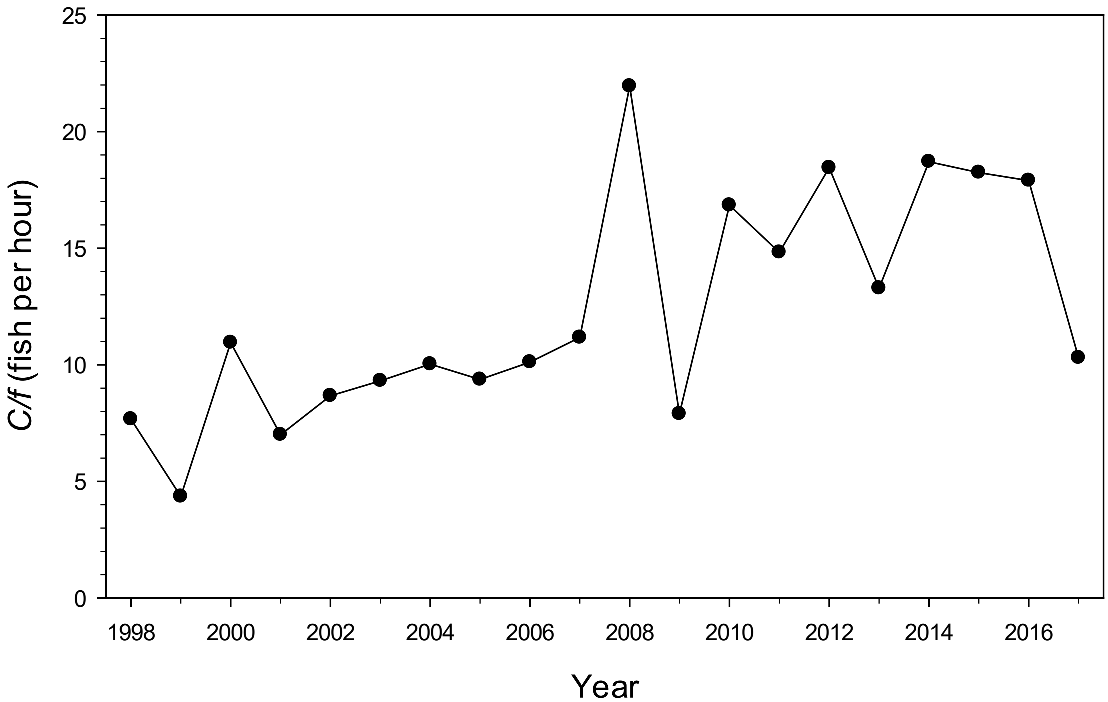

Figure 3. Catch per effort of Sauger in the Yellowstone River, 1998 to 2017.

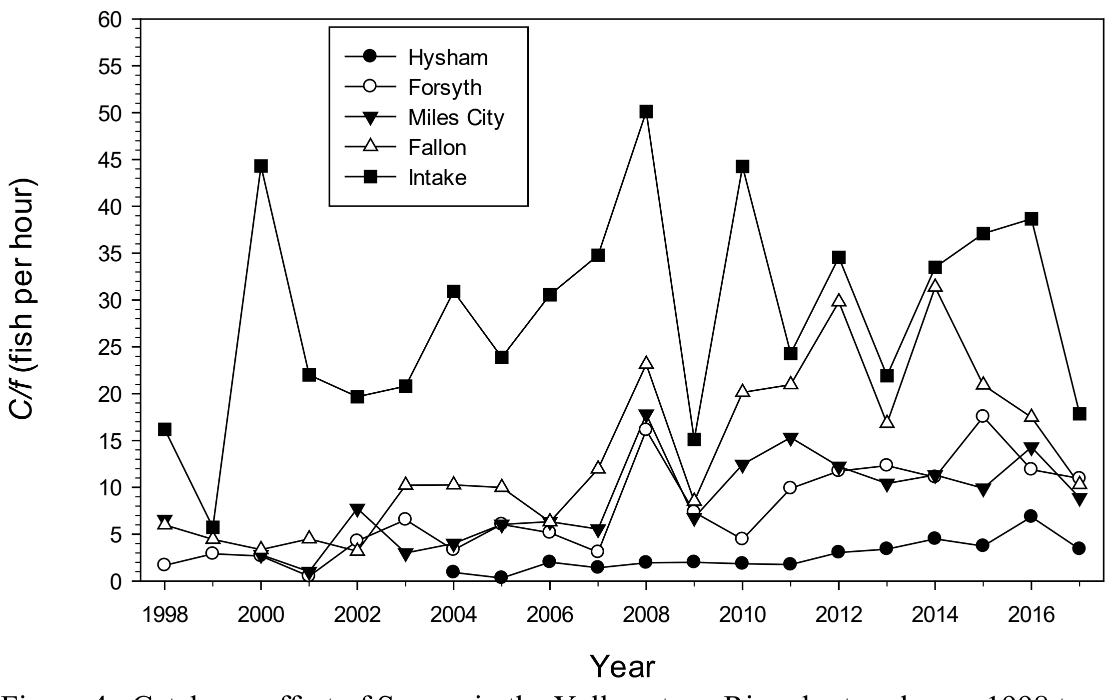

Figure 4. Catch per effort of Sauger in the Yellowstone River by trend area, 1998 to 2017.

Population structure in 2017 was dominated by quality to memorable-sized Sauger. (Figure 5). In 2015, stock to quality-sized Sauger comprised a larger portion (37%) of the total Sauger catch. Historically, there have been several years where the Sauger catch was predominately stock to quality-sized individuals (i.e. 1999, 2001, 2002, 2004, 2011, 2015) and in subsequent years the quality to memorable-sized category has dominated the catch. This may be indicative of strong year-classes of Sauger persisting throughout the lower Yellowstone. The collection of aging structures from Sauger captured during the electrofishing trend efforts would provide valuable insights into the inter-annual periodicity of high recruitment and strong year-classes. Relative weight of all Sauger captured was 88. Size-specific relative weight was highest for stock-sized fish (102) and lowest for preferred-sized fish (85) (Figure 5). Decreased relative weight from 2016 to 2017 was observed in both preferred and memorable-sized Sauger (Figure 5).

Sauger are a highly sought-after species on the Yellowstone River and despite the observed upward trend in catch rate, the population should continue to be monitored. Research concluding in 2004 documented that exploitation (18.6%) is unlikely to significantly affect this population during most years but is high enough that angler harvest should be closely monitored (Jaeger 2004). Additionally, anecdotal observations would indicate that the number of river boat owners has increased in recent years. The potential for increased fishing pressure and harvest further supports the need to closely monitor trends in the Yellowstone River.

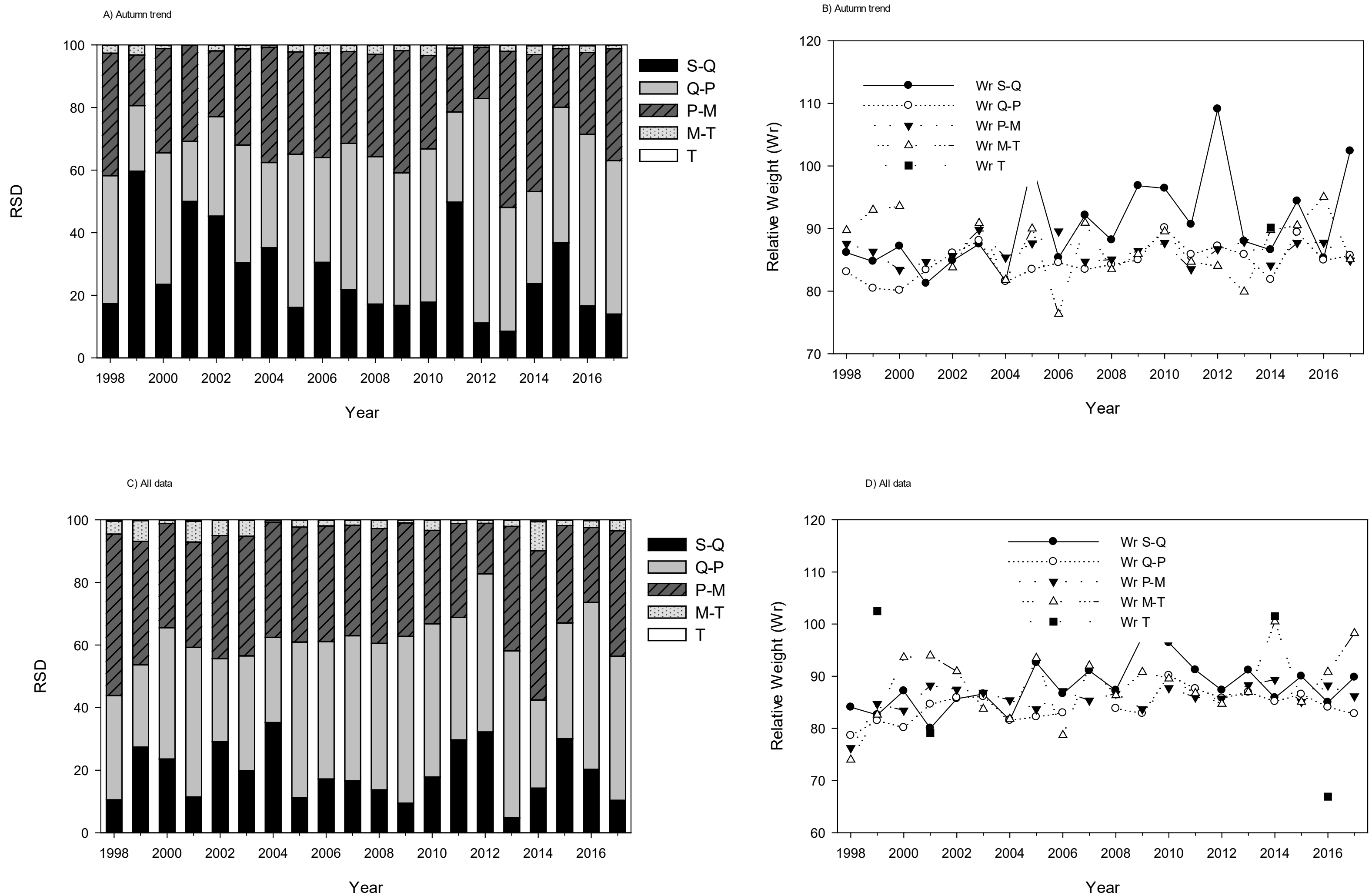

Figure 5. Incremental relative stock density (RSD) and relative weight (Wr) of Sauger captured during autumn trend sampling (panels A and B) and by all sampling (panels C and D) in the Yellowstone River, 1998 to 2017.

Sauger have been marked with Floy T-bar tags since 1997. Tagging occurred during spring and fall from 1997 to 2004. Since 2005 Sauger have only been tagged during the spring spawning season. It was assumed that spring tagged fish randomly redistribute in the Yellowstone River, decreasing tag return bias. Since 2005, spring tagging efforts have resulted in 6,366 tagged Sauger. Voluntary angler tag return information documented that 23 tagged Sauger were caught by anglers during 2017 of which 20 (87%) of these fish were harvested (Table 1).

In 2012, prior to the onset of irrigation at Intake Diversion, a new Intake head gate structure with screens was constructed to prevent entrainment of fishes greater than 40 mm total length into the canal. It was estimated that about 600,000 fish of 34 species were entrained in Intake canal each year during the mid-May to mid-September irrigation season and Sauger account for roughly 67,000 of the total number of fish entrained each year (Hiebert et al. 2000). Historically this would have corresponded to a loss of over 13,000 five-fish angler limits annually. Investigations of the screens entrainment protection efficiency were completed by the BOR in 2001-2015, and these results should be available by Horn et al. by Spring 2017.

Entrainment protection was phase one of a two-phase fishery restoration effort at Intake. Phase two of the project, of which construction has not yet began, has two objectives 1) to provide fish passage at Intake Diversion Dam 2) and deliver the irrigation district their full water right. Sauger are found in aggregations from Miles City downstream to Glendive during the spawning season. Most juvenile Sauger likely rear downstream of Intake Diversion (Penkal 1992). Intake Diversion Dam is a recognized barrier to fish movement and migrations most notably restricting adult Pallid Sturgeon to the lower river. Evidence also suggests that the dam may restrict passage of Sauger (Rugg 2016), especially those less than 275 mm in length. Length frequency analysis of 2017 autumn trend sampling reflects this. Sauger less than 275 mm only account for 1.8% of the total catch upstream of Intake while these smaller Sauger represented 24.2% of total catch downstream of Intake (Figure 6). This observed length dimorphism suggests the sustainable presence of Sauger in the reach of river upstream of Intake is dependent upon upstream migration of Sauger from the reach of river downstream of

Intake. Recent studies (Rugg 2017b, 2018b) have demonstrated that approximately 50% of Sauger encountering Intake successfully pass upstream. Sauger move upstream over the dam during times of low discharge; they move upstream through the existing side-channel during times of high discharge. The result of Intake influence on Sauger movement is a tenuous link between the upstream reach of river containing important spawning and the lower reach of river where young Sauger rear and grow to maturity. Exacerbation of passage problems at Intake would reduce or eliminate the ability of Sauger to recruit upstream and would likely result in a swift and severe decline in the population. The future stability of the Lower Yellowstone River's robust Sauger population depends on connectivity throughout the system and demonstrates the need to attain unimpeded passage at Intake.

Table 1. The number of Sauger tagged in the Yellowstone River that were recaptured by anglers from 1998-2017. The total number of tagged Sauger recaptured by anglers and the total number of tagged Sauger harvested by anglers (in parentheses) are listed.

Yr tagged	Number tagged	Angler Recaptures of Tagged Sauger															
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1997	39	0	2 (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	545	36 (5)	14 (1)	3 (2)	3(2)	1(1)	1(1)	0	0	0	0	0	0	0	0	0	0
1999	493	-	52(8)	7(7)	2(10	2(1)	1(1)	1(1)	1(1)	0	0	0	0	0	0	0	0
2000	426	-	-	12(3)	15(7)	9(2)	4(1)	2(2)	3(3)	1(0)	0	0	1(0)	0	0	0	0
2001	409	-	-	-	49(21)	24(16)	9(5)	6(4)	2(1)	1(0)	0	1(0)	0	0	0	0	0
2002	621	-	-	-	-	62(39)	46(38)	13(12)	10(9)	3(1)	1(1)	1(0)	0	0	0	0	0
2003	344	-	-	-	-	-	36(19)	14(13)	4(2)	3(1)	2(1)	2(2)	0	0	0	0	0
2004	44	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0
2005	422	-	-	-	-	-	-	-	3(3)	4(3)	3(3)	18(12)	2(0)	5(3)	0	0	0
2006	309	-	-	-	-	-	-	-	-	7(7)	10(10)	7(5)	3(2)	0	0	0	0
2007	734	-	-	-	-	-	-	-	-	-	23(21)	16(8)	15(10)	8(5)	5(4)	0	0
2008	627	-	-	-	-	-	-	-	-	-	-	16(9)	19(6)	9(6)	3(3)	2(1)	0
2009	596	-	-	-	-	-	-	-	-	-	-	-	20(12)	12(8)	5(3)	1(0)	0
2010	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	682	-	-	-	-	-	-	-	-	-	-	-	-	-	13(9)	12(7)	0
2012	549	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6(4)	8(6)
2013	504	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3(2)
2014	310	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	531	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	466	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Yr tagged	Number tagged	Angler Recaptures of Tagged Sauger			
		2014	2015	2016	2017
1997	39	0	0	0	0
1998	545	0	0	0	0
1999	493	0	0	0	0
2000	426	0	0	0	0
2001	409	0	0	0	0
2002	621	0	0	0	0
2003	344	0	0	0	0
2004	44	0	0	0	0
2005	422	0	0	0	0
2006	309	1(0)	0	0	0
2007	734	0	3(3)	0	0
2008	627	0	0	0	0
2009	596	0	0	0	0
2010	0	-	-	-	-
2011	682	5(4)	3(1)	0	0
2012	549	2(2)	7(6)	3(2)	3(3)
2013	504	4(2)	5(4)	1(1)	1(1)
2014	310	13(11)	11(7)	9(9)	4(4)
2015	531	-	19(13)	10(7)	7(6)
2016	466	-	-	9(5)	3(2)
2017	636	-	-	-	5(4)

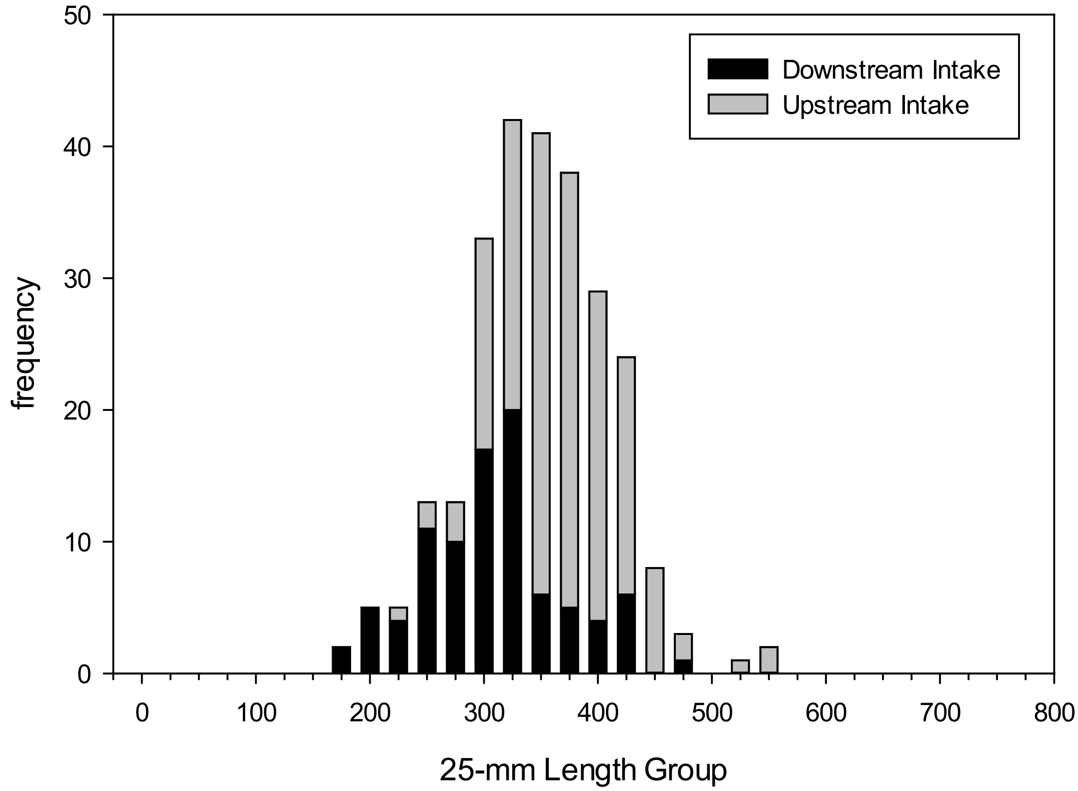

Figure 6. Length frequency distribution of Sauger captured in the Yellowstone River during 2017 during fall electrofishing trends downstream and upstream of Intake Diversion Dam.

Scouring spring ice flows and rocking of Intake Diversion Dam for water diversion have led to variable crest heights over the diversion dam. Historic river flows observed in the Yellowstone River during 2011 caused substantial scouring of the placed rock on the crest of Intake Diversion Dam. This combined with drought conditions in 2012 and the initial operation of the new screened head gate required extensive addition of rock to the Intake Diversion Dam in July and August 2012 to deliver the Lower Yellowstone Irrigation Project's full water right. The irrigation district added rock to the crest of Intake Dam for 21 days resulting in 543 loads estimated to be 1900 cubic yards of rock. This effort and quantity of rock was about 3 to 4 times the amount of rock annually required. No pre and post crest elevations were documented but anecdotal reports and observations suggests this activity increased the dam's height. Conversely, extreme ice flows during the spring of 2014 likely removed a substantial amount of rock from the crest of the dam and may have provided additional passage opportunity for fish capable of navigating the turbulent water, between voids in the rock field. Yearly variation in crest height, due to the amount of rock on the crest, will be minimized if/when a new concrete weir is constructed in the mainstem of the Yellowstone River as a part of the Intake Diversion Dam Modification project.

Another threat to the Sauger population in the Yellowstone River is nonnative Smallmouth Bass. In other waters, populations of nonnative Smallmouth Bass adversely affected Sauger relative abundance. Smallmouth Bass replaced Sauger as the most common top predator in the Tongue and upper Missouri rivers following impoundment as bass capitalized on decreases in turbidity and alteration of natural hydrographs (McMahon and Gardner 2001). Stable isotope analysis investigation on the Yellowstone River documented near identical carbon and nitrogen signatures that suggest very similar foraging habits between Sauger and Smallmouth Bass (Rhoten 2010). Loss of the natural hydrograph and warm, turbid prairie stream character of the Big Horn River combined with increasing prevalence of stream bank armoring of the Yellowstone River likely create conditions that favor Smallmouth Bass over Sauger upstream of the Powder River confluence. Incremental relative stock density (RSD) and relative weight were compared between Sauger captured upstream and downstream of the Powder River (Figure 7). The size distribution of Sauger downstream of the Powder River confluence was shifted towards smaller fish relative to the distribution upstream of the Powder River (Figure 7). Relative weight of Sauger captured downstream of the Powder was greater for stock to quality-sized fish, but was similar for quality to memorable-sized fish (Figure 7). High relative abundance of Smallmouth Bass at Hysham (18.1 fish/hour), Forsyth (6.3 fish/hour), and Miles City (3.5 fish/hr) may in part play a role in the reduced condition of stock to quality-sized Sauger upstream of the Powder River confluence. However, 2016 comparison of Sauger condition upstream and downstream of the Powder River confluence revealed the inverse of 2017. That is, relative weight of Sauger captured downstream of the Powder tended to be lower for all incremental RSD groups when compared to those captured upstream of the Powder River (Rugg 2017). Inter-specific competition between Sauger and Smallmouth does likely occur; however, other biotic and/or abiotic factors likely also play a role in Sauger condition in the Yellowstone River. The Smallmouth Bass daily bag limit on the entire Yellowstone River was increased to 10, from 5 in 2015, for the 2016 fishing regulation season. The increased bag limit was aimed at reducing inter-specific competition between Smallmouth Bass and other native species, particularly Sauger, as well as providing additional opportunity for anglers wanting to harvest Smallmouth Bass.

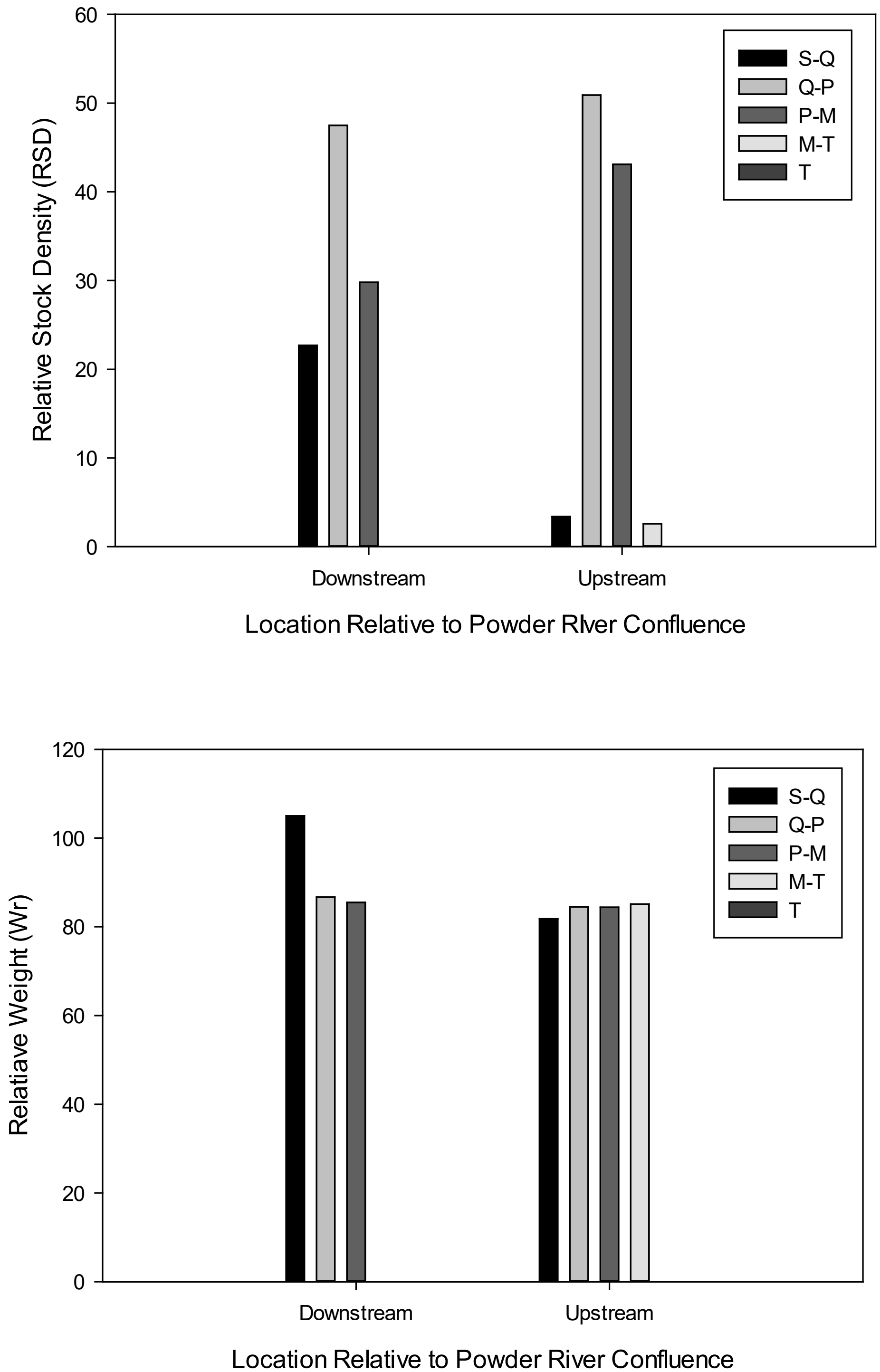

Figure 7. Relative weight (Wr) and incremental relative stock density (RSD) of Sauger captured downstream and upstream of the Powder River confluence during 2017 sampling.

The high sediment load and associated turbidity of the Powder River could likely act as a habitat barrier for further downstream expansion of Smallmouth Bass and provide valuable habitat for Sauger and other native species. The Powder River is one of the last remaining tributaries to the Yellowstone River that has not been altered by a dam and maintains some semblance of its historic hydrograph. High catch abundances near the Powder River confluence likely reflect its significance to the Yellowstone River fish assemblage. For example, one Sauger that was tagged in the Yellowstone River near the Powder River confluence in 2012 was recaptured in 2014 having moved over 233 river miles upstream in the Powder River and Clear Creek in Wyoming. This individual also managed to navigate past Kendrick Dam on Clear Creek. The near natural hydrograph of the Powder River plays an important role in the conservation of native species that have a life-history strategy reliant on these warm and highly turbid systems.

Hybridization with nonnative Walleye represents another potential threat to the Sauger population. Sauger/Walleye hybridization has been documented on the Yellowstone River with highest frequency in the reach around the mouth of the Tongue River (Bingham et al 2012). High catch rates of walleye downstream of Intake Diversion Dam during spring tagging efforts and subsequent tag returns indicate that there is a segment of the Lake Sakakawea walleye population that regularly uses the Yellowstone River for spawning.

Channel Catfish

Channel Catfish are among the most commonly sampled game fish during the autumn trend. Catch rates have decreased since the record high catch in 2011, yet the Channel Catfish catch rate remains above the historical average (Figure 8). An increasing trend of catfish relative abundance is believed to be in response to relief of drought conditions and an increase in sampling efficiency resulting from the switch to Smith Root's GPP 5.0 electrofisher system. When tested side by side, the current electrofishing system a Smith Root GPP electrofisher appears to outperform the previously used Coffelt VVP 15 electrofisher and may be partly responsible for increased catch rates since 2008.

Catch rates have been consistently highest in the Hysham trend area and lowest in the Intake trend area (Figure 9).

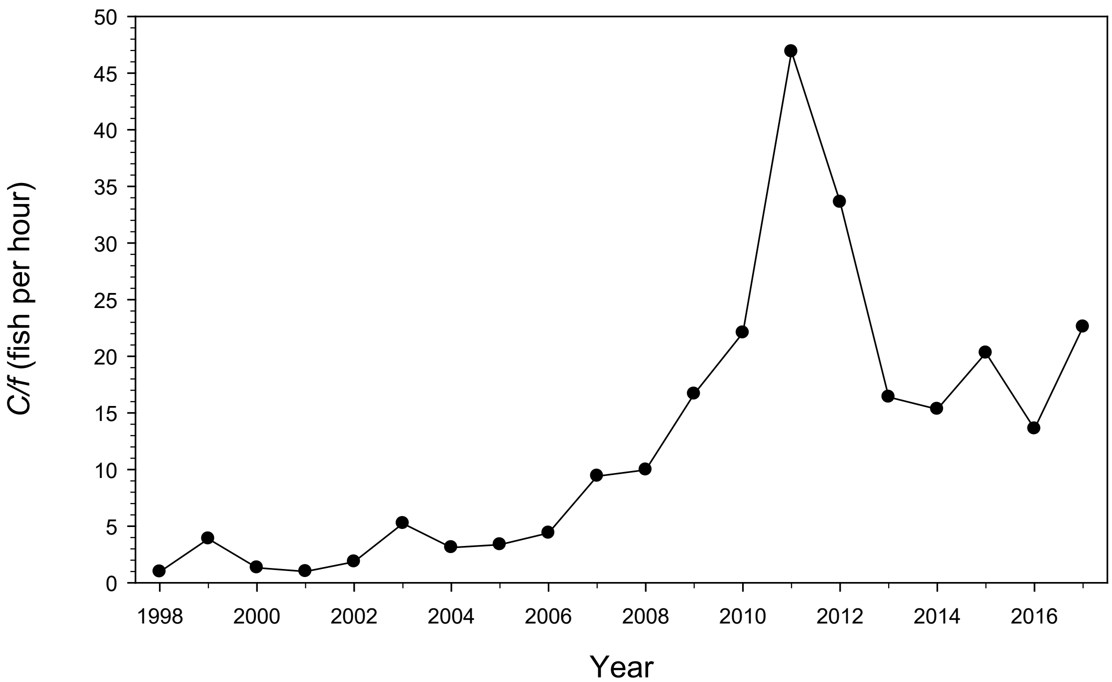

Figure 8. Catch per effort of Channel Catfish in the Yellowstone River, 1998 to 2017.

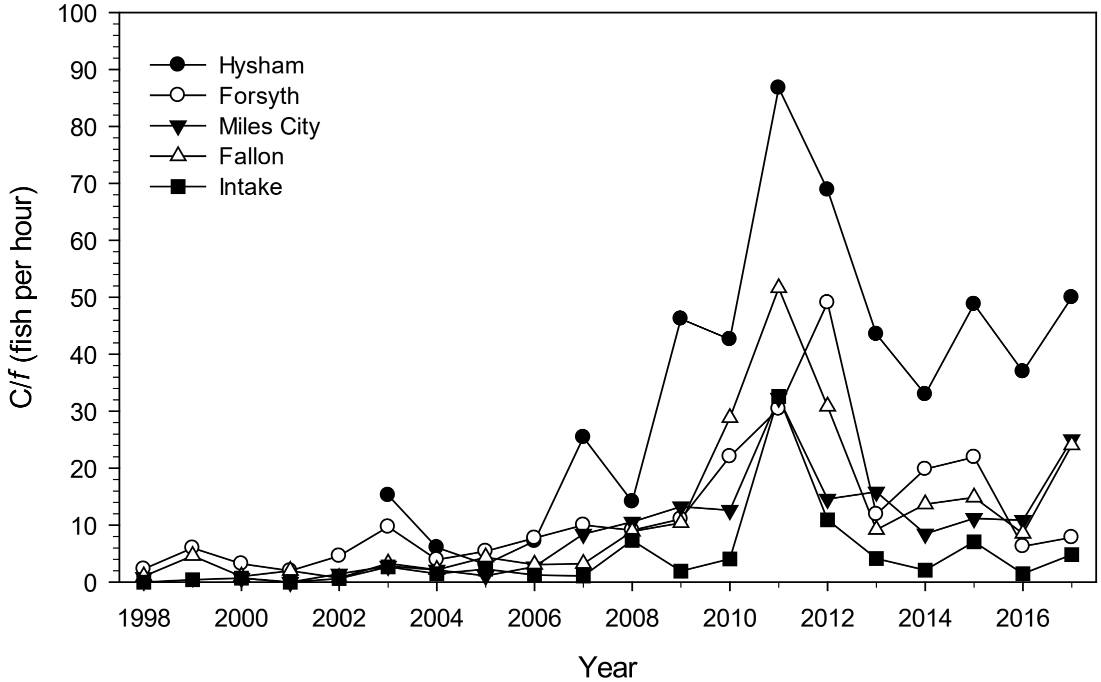

Figure 9. Catch per effort of Channel Catfish in the Yellowstone River by trend area, 1998 to 2017.

Channel Catfish population structure remains stable (Figure 10). Consistent low proportions of stock to quality size fish suggests that smaller size classes are not fully recruited to the sampling gear (i.e. larger fish are more susceptible to electrofishing) or rear in un-sampled areas (i.e. deep pools, tributaries). Nonetheless, the stability of the observed population structure suggests that recruitment is not limiting. Fish were predominately quality to preferred size (410-610 mm) but approximately 6% were preferred to memorable (610-710 mm) and 1% were memorable to trophy size (710-910 mm). Relative weight of Channel Catfish in the Yellowstone River has displayed large inter-annual variation. Increased relative weights of all size categories were observed between 2016 and 2017 sampling (Figure 10). Hydraulically, discharge levels in 2016 were extremely low whereas they were well above the historic average for most of 2017 (Figure 1). Above average discharges throughout much of the year during 2014, during the Spring of 2015, and throughout much of 2017 inundated much of the floodplains and provided connectivity with the main channel. Floodplain connectivity has been identified as a crucial component of large river systems by increasing production and providing off-channel habitat (Junk et al. 1989) for foraging, spawning, and rearing (Poff et al 1997).

Catfishing contests and leagues continue to gain popularity on the Yellowstone River.

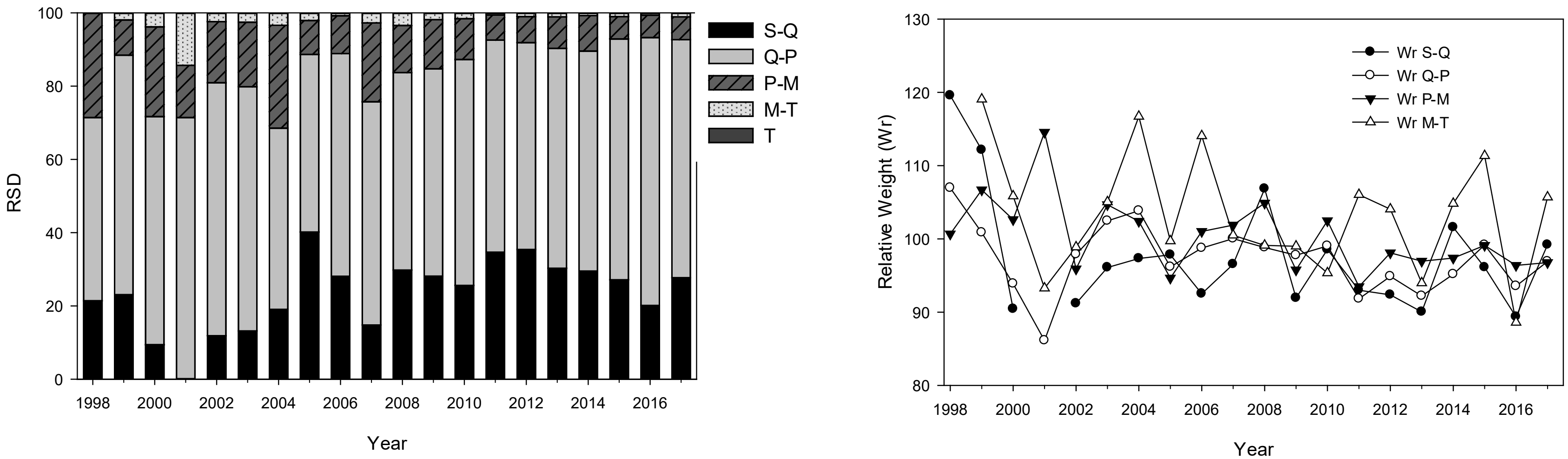

Figure 10. Incremental relative stock density (RSD) and relative weight (Wr) by length category of Channel Catfish captured during fall electrofishing trends in the Yellowstone River, 1998 to 2017.

Smallmouth Bass

Smallmouth Bass catch rate has been highly variable since the inception of the autumn trend monitoring, particularly from the mid 2000's to present (Figure 11). Relative abundance in each year appears to coincide with water levels that year. For example, with the return of above average flows in 2009, Smallmouth Bass catch rates trended downward. Below average flows and increased water clarity returned in 2012 and 2013 and again the Smallmouth Bass catch rate increased. Flows in 2014 were above average, and the Smallmouth Bass catch rate declined once again through 2015. Flows in the Yellowstone River during the fall of 2016 were near historic lows, and the Smallmouth Bass catch rate nearly doubled from 2015 to 2016. Discharge in 2017 was well above the historic average for much of the year, and the catch rate decreased significantly; the 2017 catch rate was the lowest observed in the past 15 years (Figure 11). The drastic decrease in Smallmouth Bass catch rate in 2017 may have been driven by poor gear efficiency due to above average flows; however, they should be closely monitored to decipher whether changes in catch rate reflect population level changes or are merely artifacts of variable sampling efficiencies. Smallmouth Bass relative abundance decreases from upstream to downstream in the Lower Yellowstone River, and they are rarely captured in any trend section downstream of the confluence with the Powder River (Fallon section, and Intake section) (Figure 12). The population structure was dominated by smaller size classes with most fish in the stock to quality (60%) and quality to preferred (30%) length categories (Figure 13). While sampling data suggests the size structure is dominated by shorter Smallmouth Bass, anecdotal evidence suggests Smallmouth Bass effectively avoid electrofishing gear when turbidity is low. Condition of Smallmouth Bass residing in the Yellowstone River is and has been consistently high for all size-classes (Figure 13). Exceptional length-specific weight of Smallmouth Bass in the Yellowstone River provides an excellent angling opportunity upstream of Miles City.

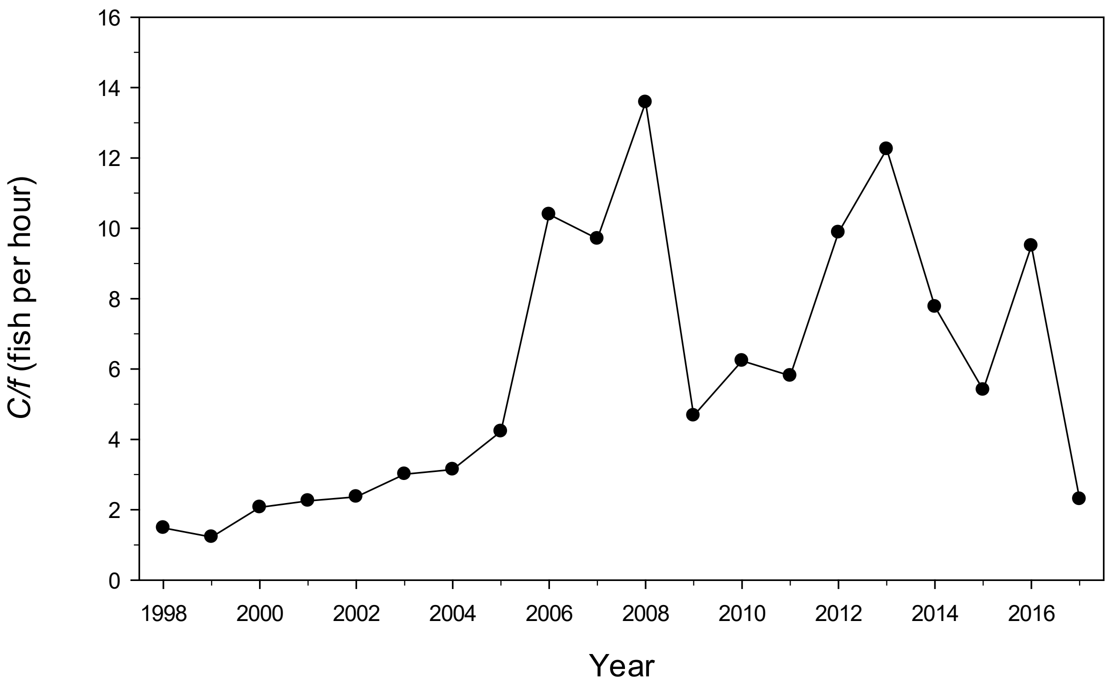

Figure 11. Catch per effort of Smallmouth Bass in the Yellowstone River, 1998 to 2017.

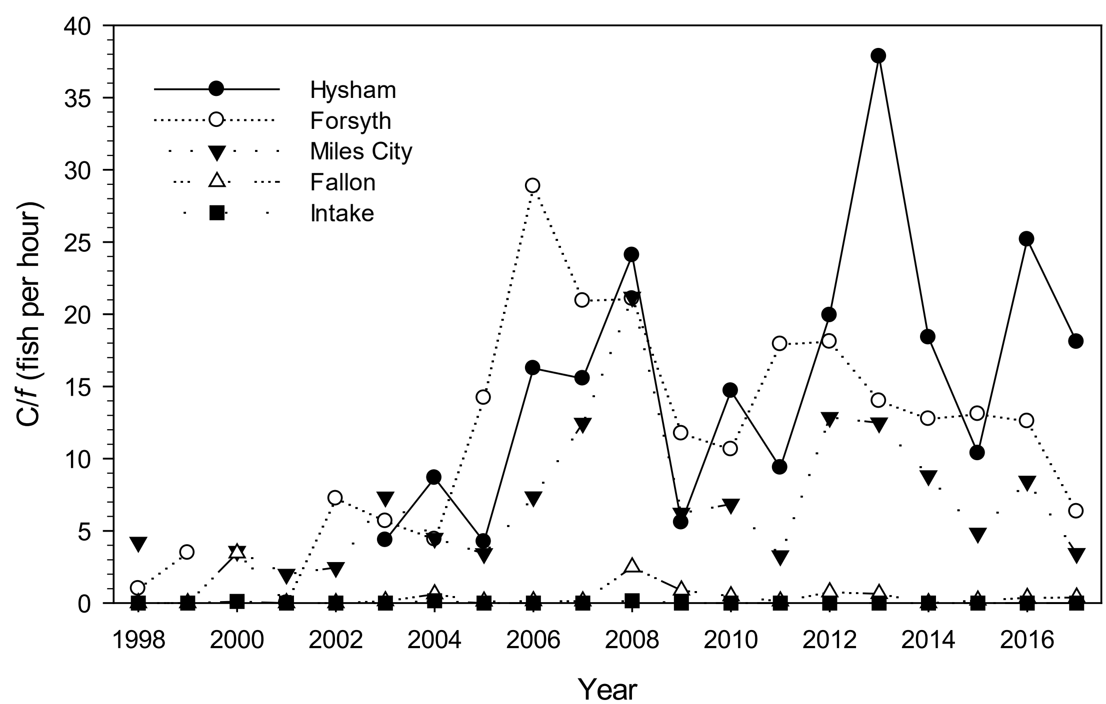

Figure 12. Catch per effort of Smallmouth Bass in the Yellowstone River by trend area, 1998 to 2017.

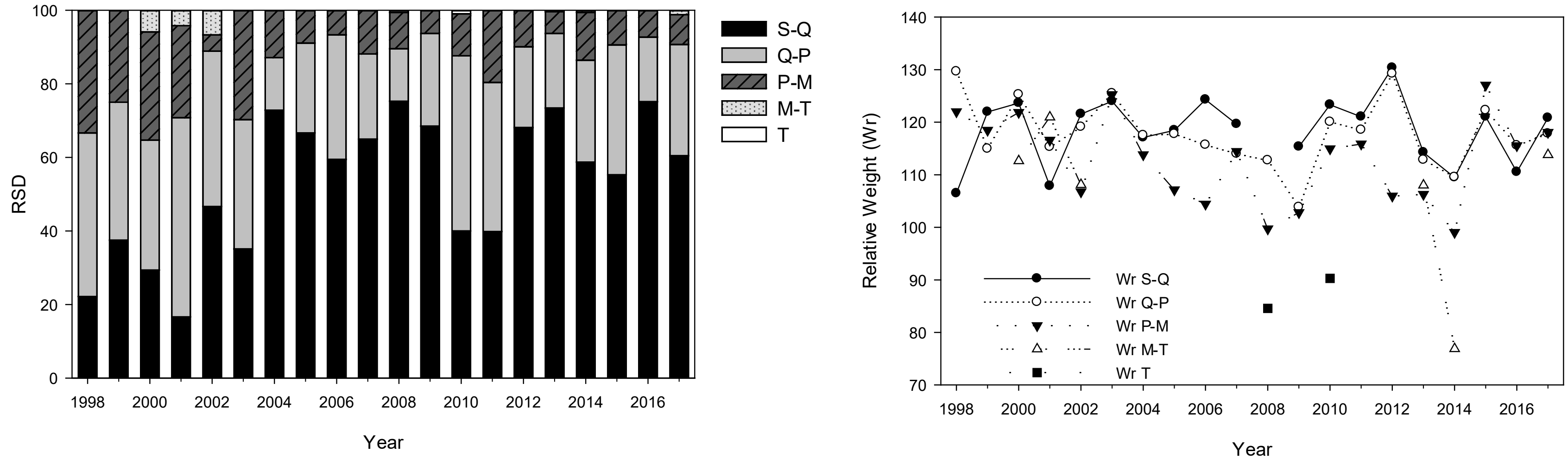

Figure 13. Incremental relative stock density (RSD) and relative weight (Wr) by length category of Smallmouth Bass captured in the Yellowstone River, 1998 to 2017.

Shovelnose Sturgeon

Shovelnose Sturgeon abundance during autumn trend surveys has been variable throughout the study period (Figure 14) and limited inferences can be drawn from electrofishing trend data as the gear is a relatively inefficient sampling method for this species. Nonetheless, current trend sampling and incidental netting efforts suggest that Shovelnose Sturgeon are present and widely distributed downstream of Cartersville Diversion.

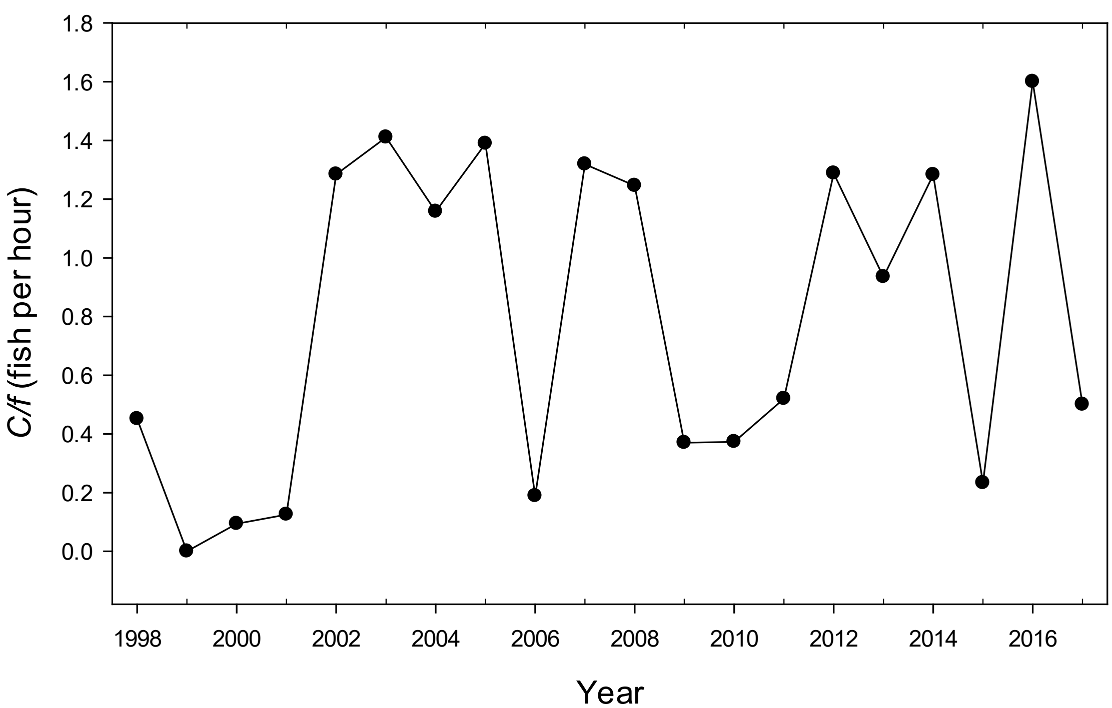

Figure 14. Autumn trend survey catch per effort of Shovelnose Sturgeon in the Yellowstone River during autumn trend survey, 1998 to 2017.

Trend sampling using more efficient gears, such as drifting trammel nets (e.g. Backes and Gardner 1994), would allow more robust estimates of population trends. Shovelnose Sturgeon sample size has increased beginning in 2009 with the onset of juvenile Pallid Sturgeon monitoring. This monitoring utilizes trammel nets, primarily in

August and September, to capture Pallid Sturgeon and as a byproduct efficiently sample Shovelnose Sturgeon. Most netting effort is conducted at sites downstream of Intake. However, sites as far upstream of Intake as Cartersville Diversion Dam at Forsyth have been sampled. All Shovelnose Sturgeon are enumerated and a daily subsample are measured and weighed during the Pallid Sturgeon survival monitoring. One-inch trammel nets drifted during the survival analysis captured 4,441 Shovelnose Sturgeon during 2017. Catch per distance trended downward between 2009 and 2011 and has since remained relatively steady from 2011 to present (Figure 15). Pallid Sturgeon sampling traditionally had taken place in large, bluff pools. Shovelnose Sturgeon catch rates seem to be lower in these bluff pools and higher in habitats associated with riffles and runs. During 2014, catch rates of Pallid Sturgeon were low in bluff pools; thus, netting effort was spread out across multiple habitat types including riffle and run habitat. Pallid sturgeon sampling in bluff pools during 2015 yielded many captures, and thus the sampling was directed at these habitats for much of the 2015 season. 2016 sampling efforts included a combination of bluff pool and riffle/run habitats. Sampling efficiencies are ever-changing with highly variable discharges across years. In 2011, above average discharge made it difficult and dangerous to sample some locations. Conversely, below average discharges during 2012 and 2013 hampered the ability to drift trammel nets because of low current velocity. If Shovelnose Sturgeon population monitoring is a management objective, sampling protocols should be devised that would specifically target Shovelnose Sturgeon (e.g. repeated, yearly sampling in designated riffle and run habitats). Currently, graduate research is being conducted to assess Yellowstone River carrying capacity for Pallid Sturgeon. As a part of this research, a mark-recapture Shovelnose Sturgeon population estimate model will be devised. A population estimate model would be a good supplement for relative abundance calculations and would provide a "check" to verify if relative abundance calculations are accurately tracking the population status.

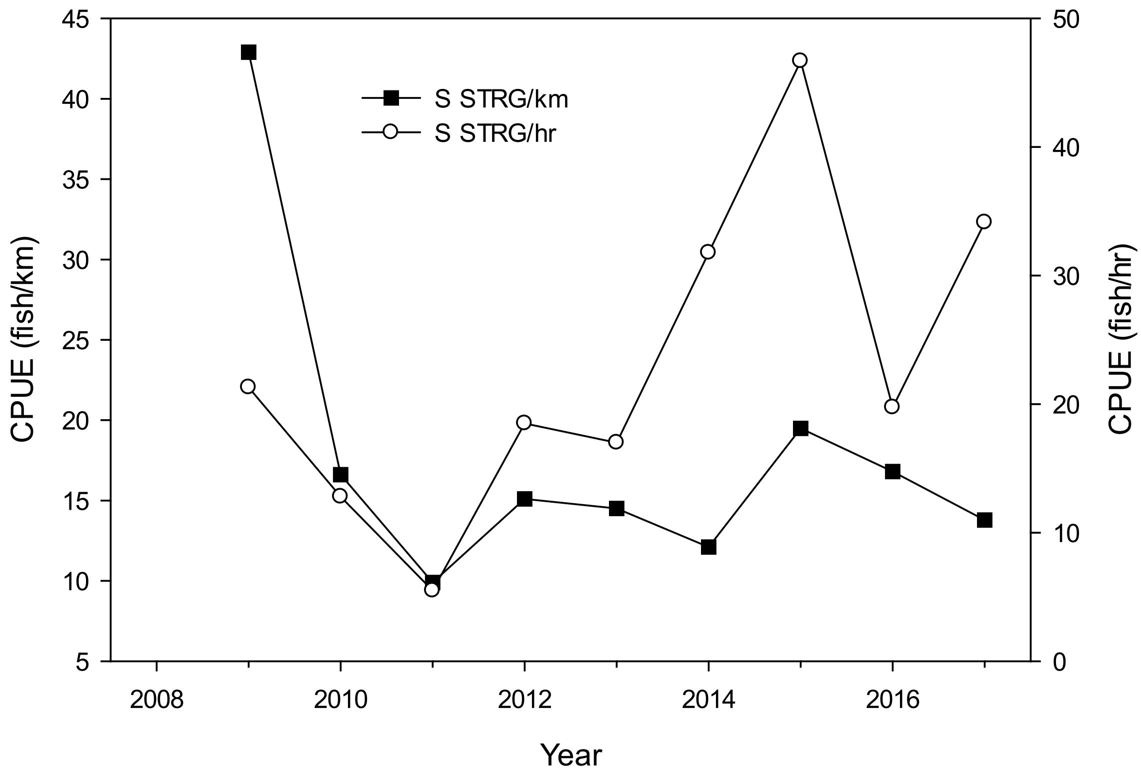

Figure 15. Catch rates of Shovelnose Sturgeon in the Yellowstone River from 2009 to 2017 during the Pallid Sturgeon survival analysis monitoring effort.

Highly variable catch rates and low sample size observed during trend sampling resulted in limited population structure and condition information precluding drawing inferences from shovelnose trend data (Figure 16). However, combining all available data for a given year significantly bolsters sample size and analysis of this more robust dataset indicates that population structure is stable and balanced (Figure 16). Size-specific relative weight across all size-classes was near 100 (Figure 16).

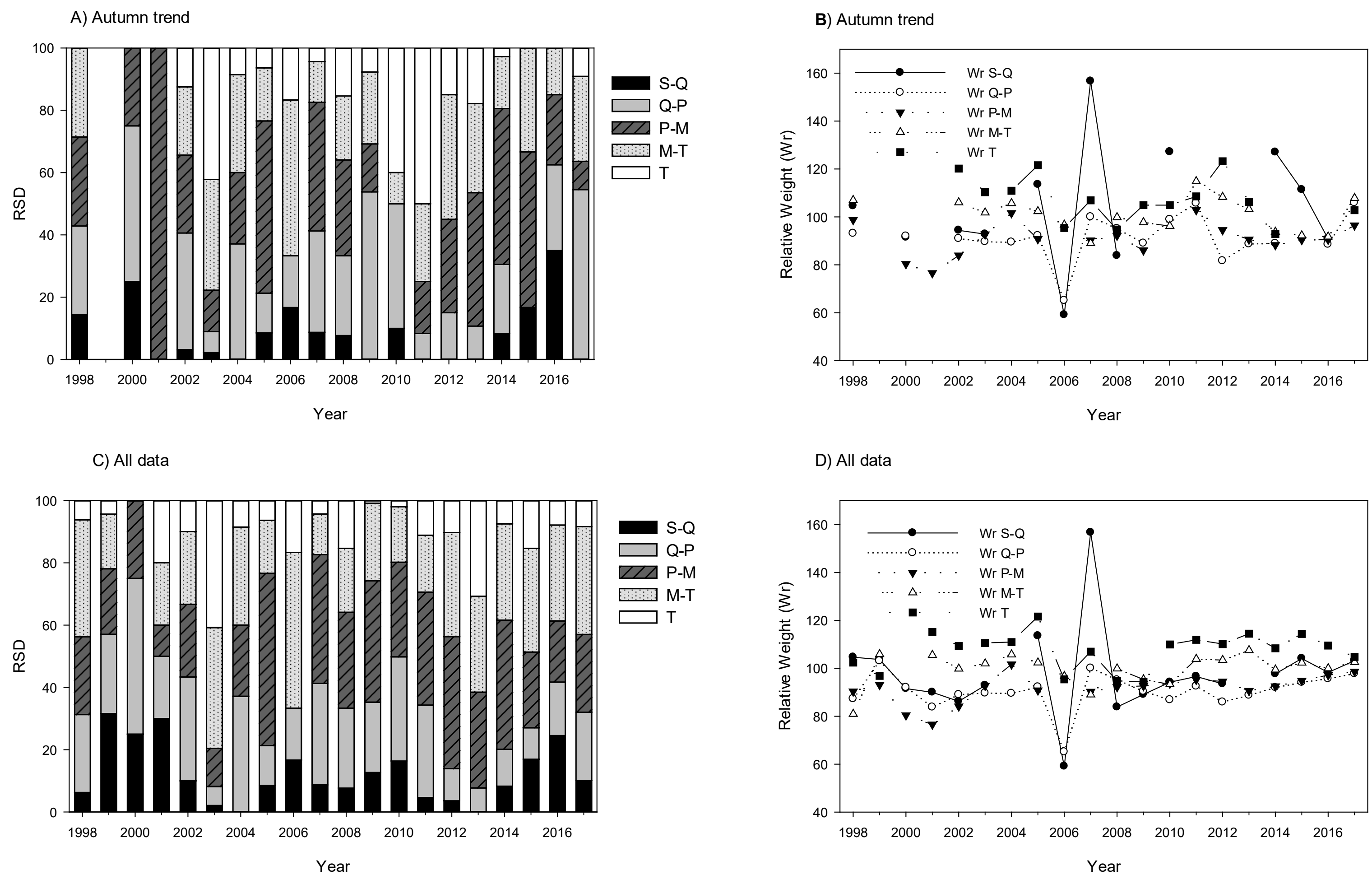

Figure 16. Incremental relative stock density (RSD) and relative weight (Wr) by length category of Shovelnose Sturgeon captured in the Yellowstone River, 1998 to 2017.

As previously described, restoration efforts are currently underway to attain fish passage at Intake. Passage alternative exploration prompted investigative analysis of length frequency distribution of Shovelnose Sturgeon upstream of Intake compared to those downstream of Intake. In 2017, the total catch indicated a divergent size distribution between Shovelnose Sturgeon captured upstream and downstream of Intake Diversion Dam (Figure 17) similar to the trend observed in Sauger. Shovelnose Sturgeon shorter than 400 mm comprised 15.6% of the total catch downstream of Intake, yet only 1.4% of the total catch upstream of Intake (Figure 17). Further exploration is needed to determine the rate of exchange of Shovelnose Sturgeon upstream and downstream of Intake Diversion Dam. Rugg (2017b, 2018b) found that 12-23% of radio-telemetered Shovelnose Sturgeon that encountered Intake Dam successfully passed upstream over the dam or through the side-channel. It is possible that there are source/sink dynamics between the stocks upstream and downstream of Intake Diversion Dam.

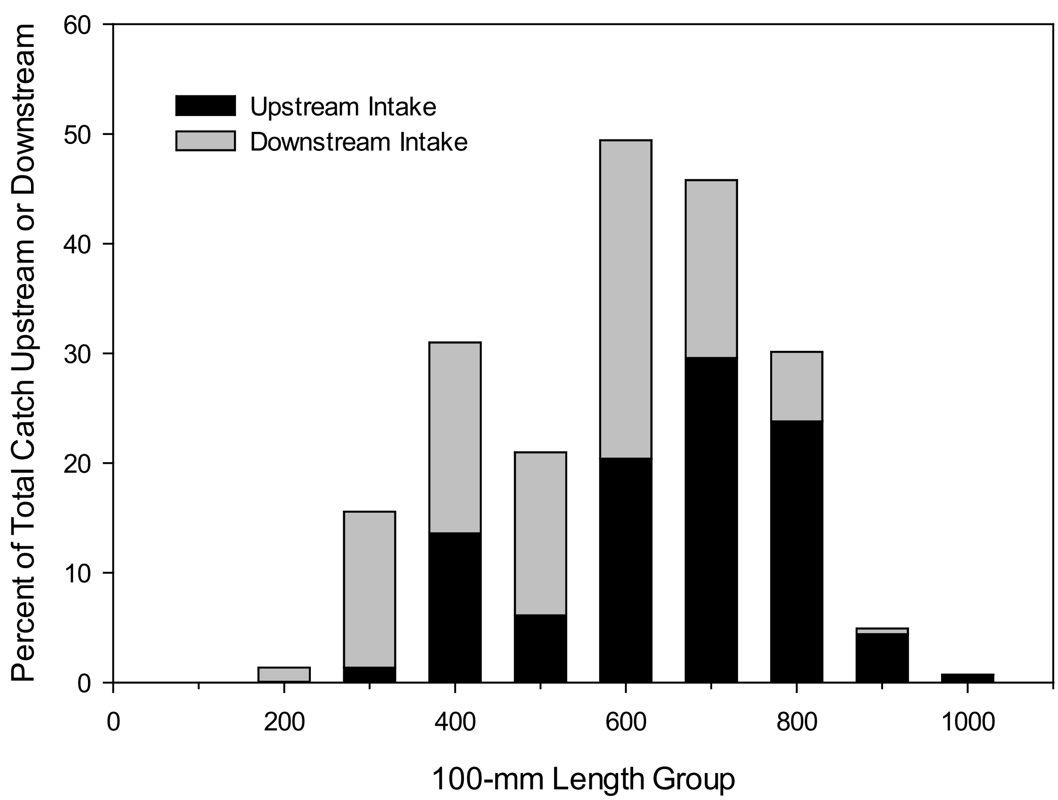

Figure 17. Percentage of the total Shovelnose Sturgeon catch by length group upstream and downstream of Intake Diversion Dam during survival analysis sampling 2017.

Pallid Sturgeon

Multiple Pallid Sturgeon research and recovery activities occurred on the Yellowstone River during 2017 including: telemetry tracking of adults and juveniles to assess spawning, habitat use, and passage limitations, and juvenile sampling to continue historical trend data and aid in the computation of survival estimates of hatchery stocked individuals. See Rugg 2018 for detailed report of Pallid Sturgeon recovery efforts in the Lower Yellowstone River, 2017.

Burbot

The total number of Burbot captured each year is low. The catch rate from 2014 to 2017 was approximately half of what was observed in the previous two years (Figure 18); however, catch rate calculations based on low sample sizes can be greatly affected by only minor changes in catch frequency. Low catch rates are attributed to the timing and gear used for trend sampling. Burbot are most effectively sampled with baited hoop nets in the early spring and late autumn (Jones-Wuellner and Guy 2004). However, it is also possible that Burbot are limited by the relatively high summer temperatures, especially in August when the natural water supply is lowest and withdraws for irrigation needs are greatest, of the lower Yellowstone River (e.g. Nikcevic et al. 2000) and the low catch rates observed accurately reflect low abundances. These autumn trend data likely only provide an indication of presence or absence since electrofishing is an inefficient method for capturing Burbot.

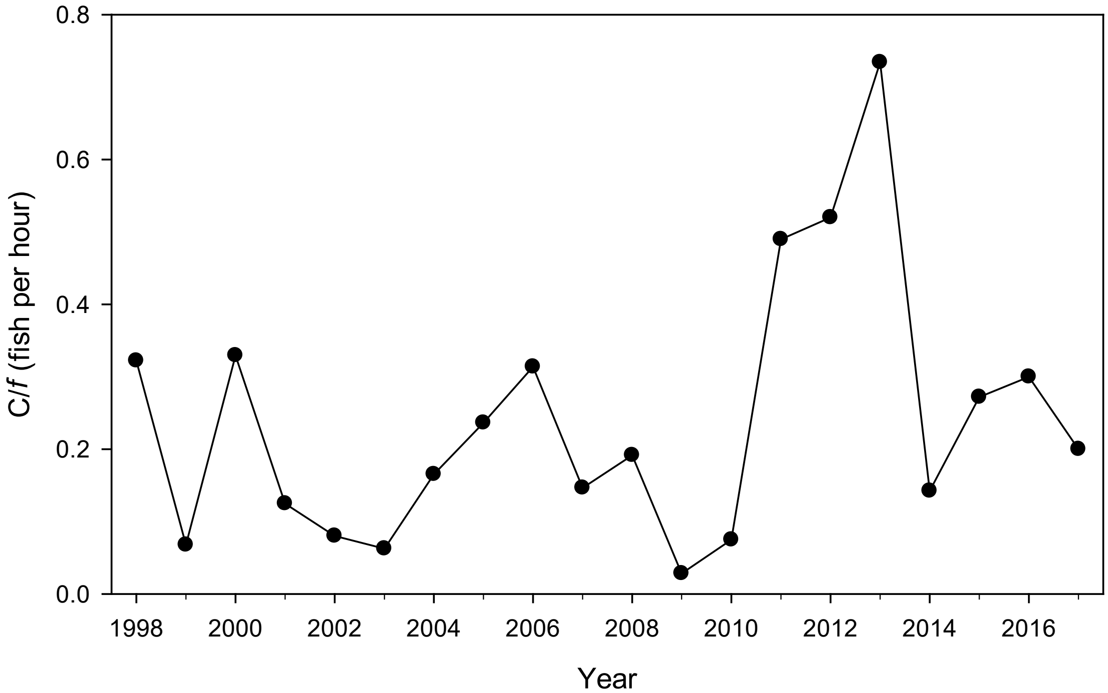

Figure 18. Autumn trend survey catch per effort of Burbot in the Yellowstone River, 1998 to 2017.

Low catch rates also preclude inferences related to population structure and condition. The few Burbot sampled during the autumn trend surveys were relatively small and of poor condition (Figure 19). Different gear types and sampling times are necessary to obtain an adequate sample size to characterize abundances, structure, and condition of this population. Research conducted in 2004 and 2005 to investigate the presence and distribution of Burbot in the Yellowstone River documented that Burbot catch rates increased as river km increased (Rhoten 2010). Additional efforts are warranted to develop sampling methods that allow for population trend and size structure comparisons between collection years, and to determine the function of the Yellowstone River in the life-history of Burbot.

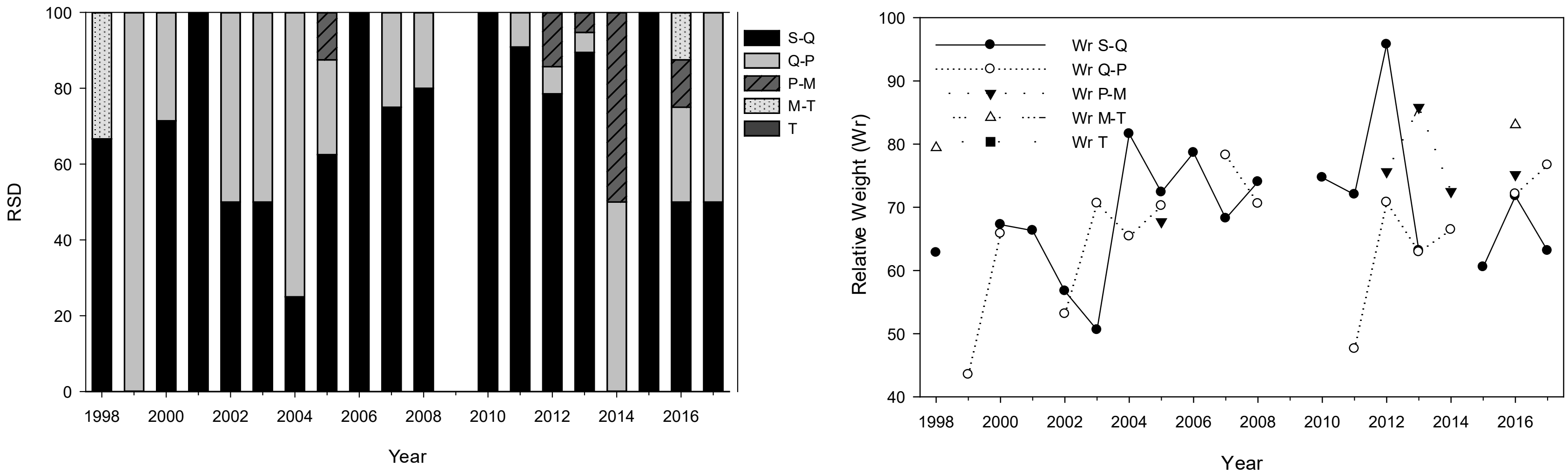

Figure 19. Incremental relative stock density (RSD) and relative weight (Wr) by length category of Burbot captured in the Yellowstone River, 1998 to 2017.

Walleye

Catch rates of Walleye have consistently trended upward since the inception of fall electrofishing trend sampling (Figure 20). The observed catch rate coincides with anecdotal angler reports of increased Walleye abundances. Most Walleye in the Yellowstone River were thought to be part of an adfluvial population residing in Sakakawea Reservoir (Penkal 1992). Adults move into the Yellowstone River from late autumn to early spring, spawn during April, and return to the reservoir (Penkal 1992). Recent floy tag return data supports these hypotheses. Of the 210 Walleye tags returned from Yellowstone River tagging efforts during the period 2011 to 2015, 73% were returned on Lake Sakakawea, and only 21% were returned on the Yellowstone River. The increased catch rates of Walleye in the lower Yellowstone River coincide with increased water levels of Sakakawea Reservoir; therefore, it has been hypothesized that recent Yellowstone River upward trends may be resultant of elevated water levels and booming Walleye population in Sakakawea Reservoir.

Catch rates of Walleye in all trend sections have generally trended upward since 2005 with the highest catch rates at Intake, the most downstream trend section (Figure 21). The 2017 Walleye catch rate at all trend sections except for Miles City remained fairly similar to 2016. At Miles City, the catch rate from 2016 to 2017 decreased by 80 percent. Similarly, decreased catch of Sauger and Smallmouth Bass at Miles City were observed during 2017 and may indicate decreased gear efficiency on days sampled at Miles City rather than decreased abundance.

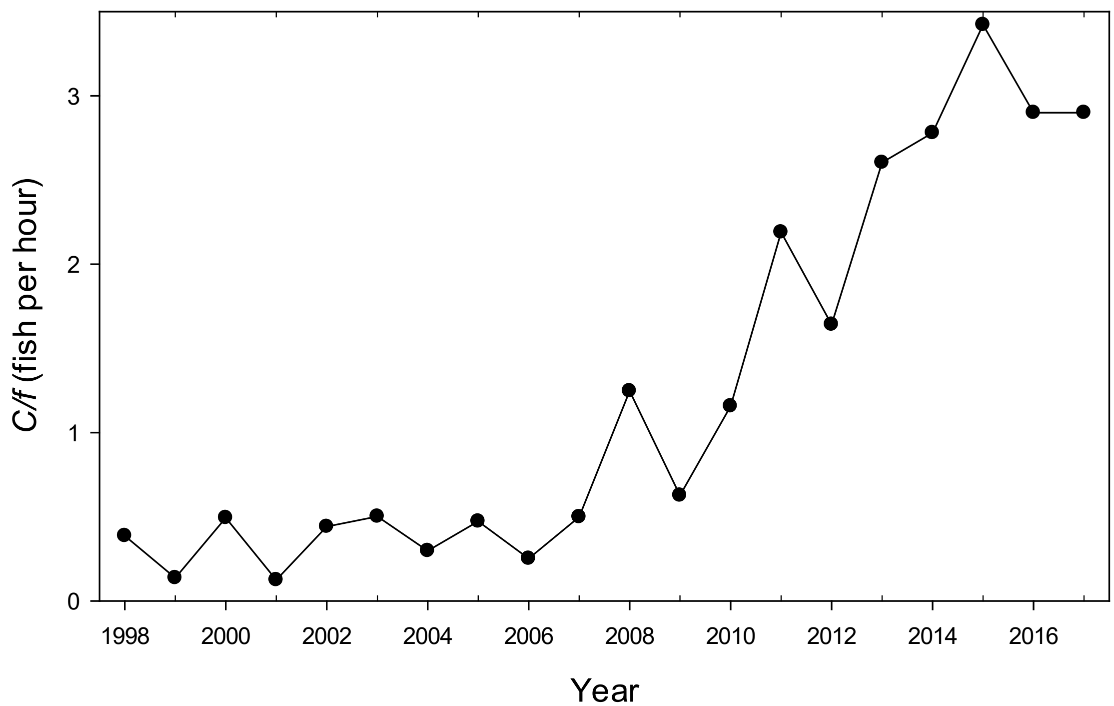

Figure 20. Catch per effort of Walleye in the Yellowstone River, 1998 to 2017.

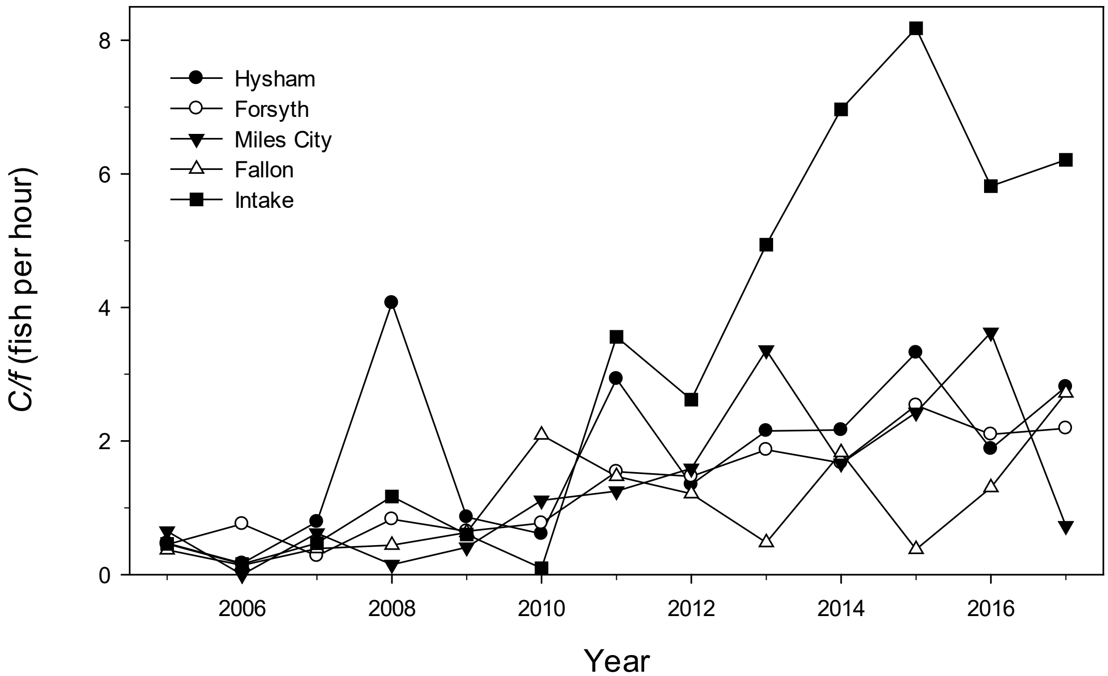

Figure 21. Catch per effort of Walleye in the Yellowstone River by trend area, 2005 to 2017.

The Walleye population structure was unbalanced and skewed towards smaller fish when trend surveys began, but in recent years the population has become more balanced (Figure 22). The Relative Weight of all Walleye captured during the fall electrofishing trend sampling was 92. Size-specific condition of Walleye tends to increase as size-class increases. That is, stock to preferred-sized fish captured between 2010 and 2017 have generally had lower condition than preferred to trophy-sized fish (Figure 22).

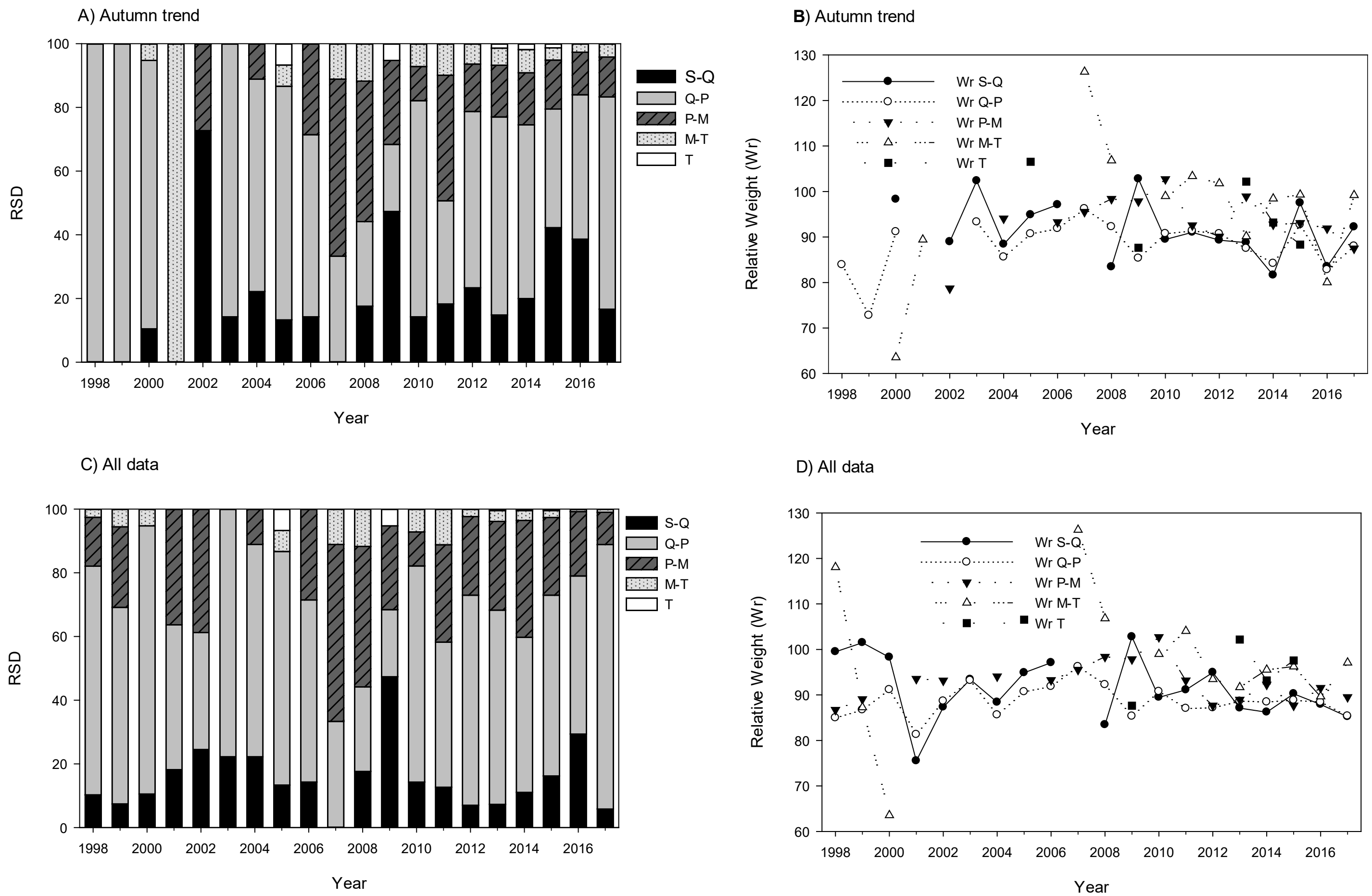

Figure 22. Incremental relative stock density (RSD) and relative weight (Wr) by length category of Walleye captured in the Yellowstone River, 1998 to 2017.

Rare game fishes

Abundances of game fish that were traditionally rarely captured appear consistently low throughout all years with the exception of Northern Pike (Figure 23). Recent Northern Pike catch rates have increased two to five times that of historic catch rates between 1998 and 2009. Increased catches during trend sampling mimic anecdotal reports from anglers suggesting abnormal increased Northern Pike abundances. The catch rates in 2012 and 2013 were the two highest on record for Northern Pike. Catch rates decreased in 2016 and 2017 but remained well above those observed at the early onset of trend sampling (Figure 23). Northern Pike catch rate was highest at Intake, low at Fallon, and Miles City, and none were captured at Forsyth nor Hysham trend sections (Figure 24).

Northern Pike abundances are continually the highest at the Intake trend section. It is assumed the majority of Northern Pike are visitors to the Yellowstone River who originated in Sakakawea Reservoir. To investigate such assumptions 56 Northern Pike were equipped with floy tags in 2012. A very limited number of tags have been returned, thus the small sample size and short duration at large limits inferences at this time. It was hypothesized that the observed population increase would not persist for a number of reasons but mainly because the lotic and seasonally high turbidity waters in the Yellowstone River create unfavorable conditions for the species. Hypotheses associated with increased Northern Pike abundances echo those for increased Walleye abundance. As mentioned above, the elevated water levels in recent years bolstered the reservoir fishery and as a result, it is probable catch rates within the Yellowstone River simply reflect increased abundances within Sakakawea Reservoir. Additionally, a North Dakota biologist reported that with rapid water elevation loss, Sakakawea was not as productive in 2012. Low productivity and increased predator abundance may have resulted in increased reservoir emigration, thereby increasing Northern Pike catch rates in the Yellowstone River. Future trend surveys should help further explain catch rate fluctuations.

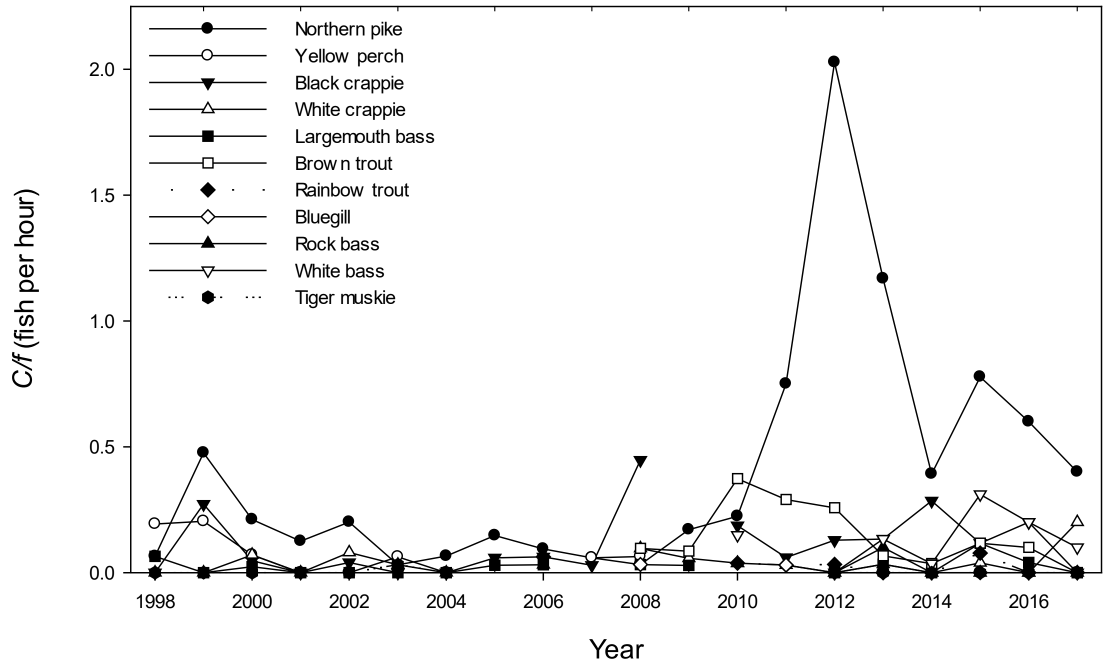

Figure 23. Catch per effort of rare game fishes in the Yellowstone River, 1998 to 2017.

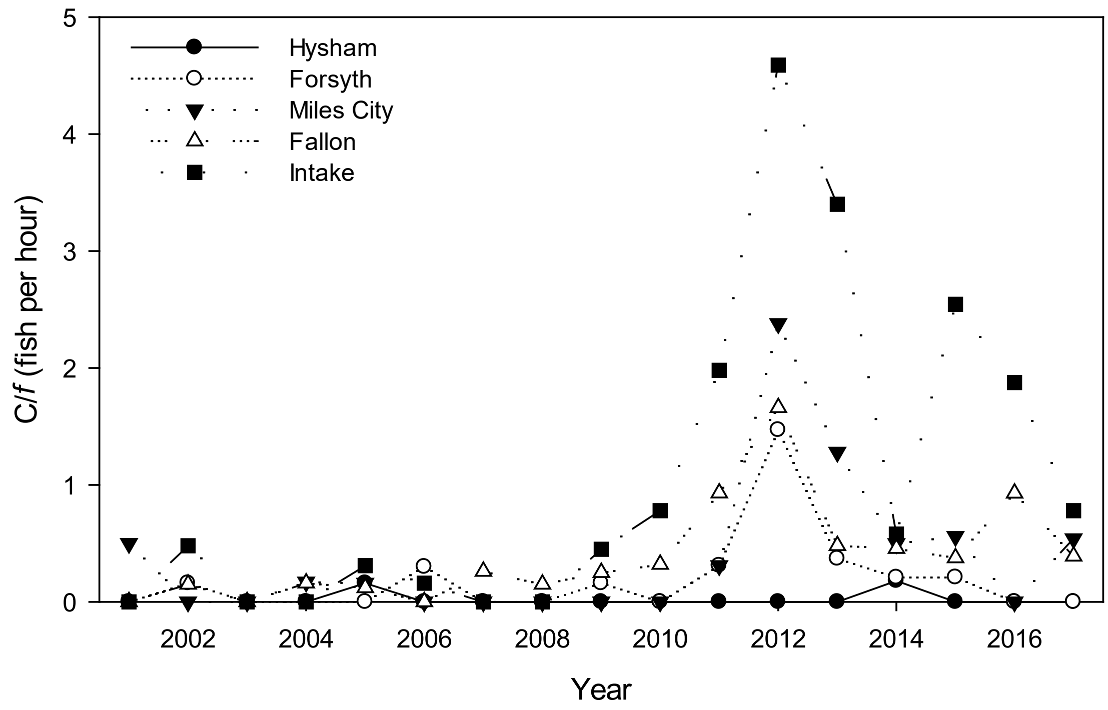

Figure 24. Catch per effort of Northern Pike in the Yellowstone River by trend area, 2001 to 2017.

Common non-game fishes

The majority of common non-game fishes abundances have experienced a trend increase or relatively stability (Figure 25). Shorthead Redhorse Sucker has remained the most abundant species sampled since 2007. The abundance of Shorthead Redhorse Sucker, Goldeye and River Carpsucker began to trend upward in 2004 and has remained at the relatively high abundance since that time.

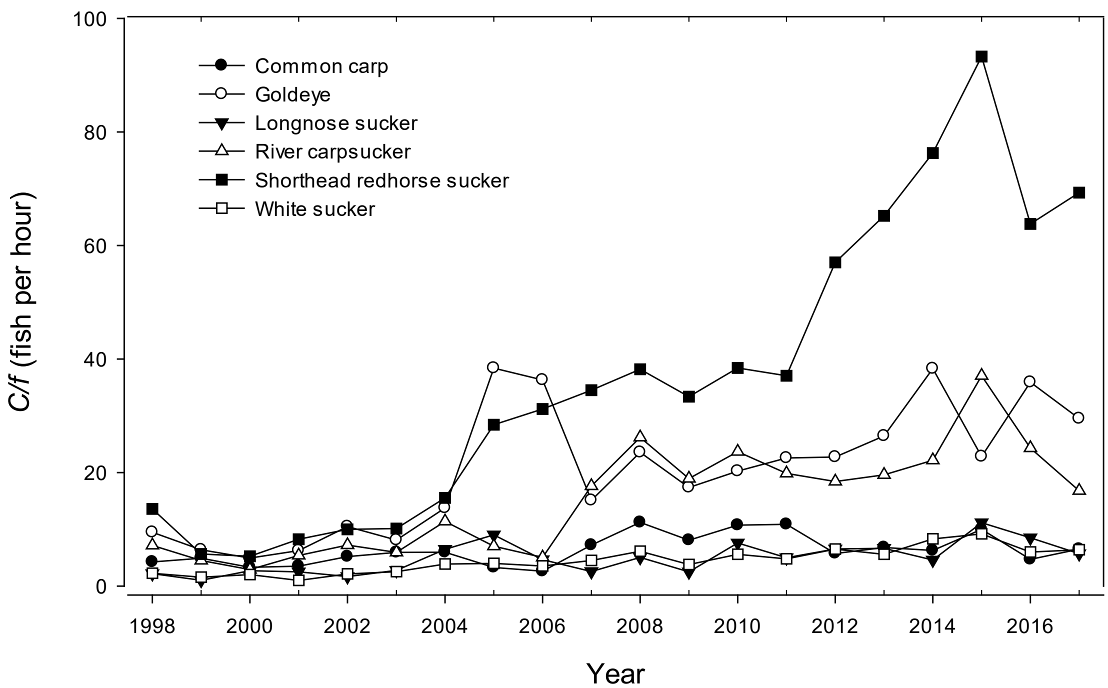

Figure 25. Catch per effort of common non-game fishes in the Yellowstone River, 1998 to 2017.

Rare non-game fishes

Most of rare, non-game fish abundances have remained low but stable since 1998 (Figure 26). However, Freshwater Drum catch rates have increased in abundance from 2006 to present. Relative abundance of Freshwater Drum was below one fish per hour until 2008. The 2017 trend survey catch rate of Freshwater Drum was near the record high. Abundances of Blue Sucker, a Species of Special Concern in Montana, exhibited proportionally large fluctuations from 1998 to 2000 and displayed the second highest catch rate on record in 2012. The catch rate of Blue Sucker decreased by over 50 percent from 2012 to 2014, yet still remained above the historic average. Catch rates increased to record highs from 2015 to 2016 (1.7 fish/ hr), but declined in 2017 (0.5 fish/hr) (Figure 26). A large portion of the 2016 Blue Sucker catch came from the Miles City trend section (Miles City Blue Sucker = 5.0 fish/hr); however, that specific trend section saw a significant decrease in Blue Sucker relative abundance in 2017 (Miles City Blue Sucker = 0.7 fish/hr). The small sample size of Blue Sucker captured during fall electrofishing precludes drawing many conclusions about the population. Opportunistic bycatch of Blue Sucker during Pallid Sturgeon survival netting does however provide a larger sample size to make inferences about the population. For example, 121 Blue Sucker were captured in 2017 during this netting effort (Figure 27). Converse to electrofishing sampling, the catch rate during netting efforts increased from 2016 to 2017 (Figure 27). The length distribution of Blue Sucker captured is dominated by larger individuals (Figure 28) and the lack of smaller (i.e. young) Blue Sucker should be closely monitored. Little is known about the rate of Blue Sucker recruitment and where those young might rear. Shortnose Gar, also a Species of Special Concern in Montana, are rarely sampled during the trend survey. In 2011 the catch rate of Shortnose Gar was an all-time high of 0.17 fish per hour. Interestingly, all six Shortnose Gar captures in 2011 occurred downstream of Intake on September 26, 2011. No Shortnose Gar were captured between 2012 and 2014 trend sampling. However, anglers near Miles City have reported catching gar from 2011 to 2013. A single Shortnose Gar was captured in the Intake trend section during 2015 sampling. No shortnose Gar were captured during 2016 or 2017 sampling efforts.

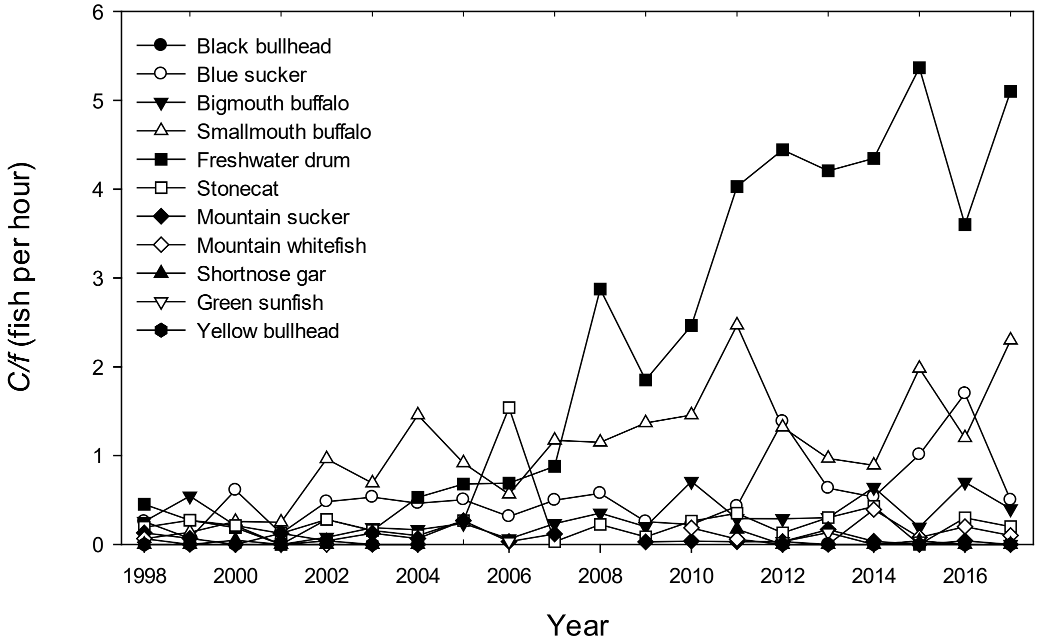

Figure 26 Catch per effort of rare non-game fishes in the Yellowstone River, 1998 to 2017.

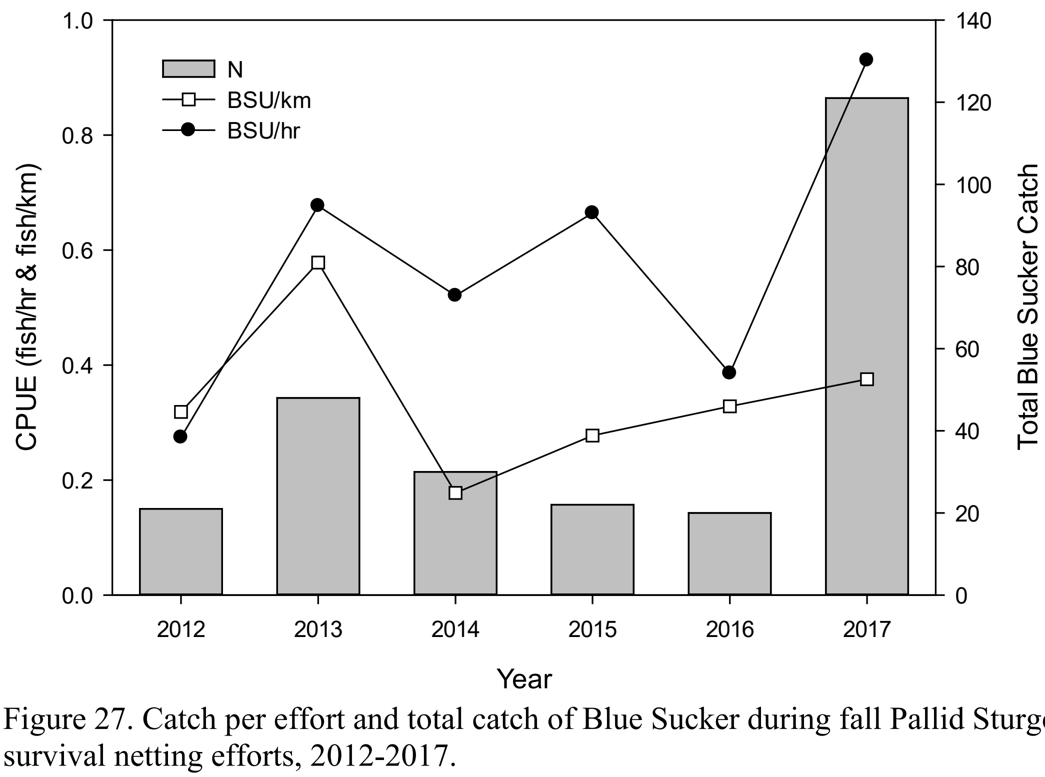

Figure 27. Catch per effort and total catch of Blue Sucker during fall Pallid Sturgeon survival netting efforts, 2012-2017.

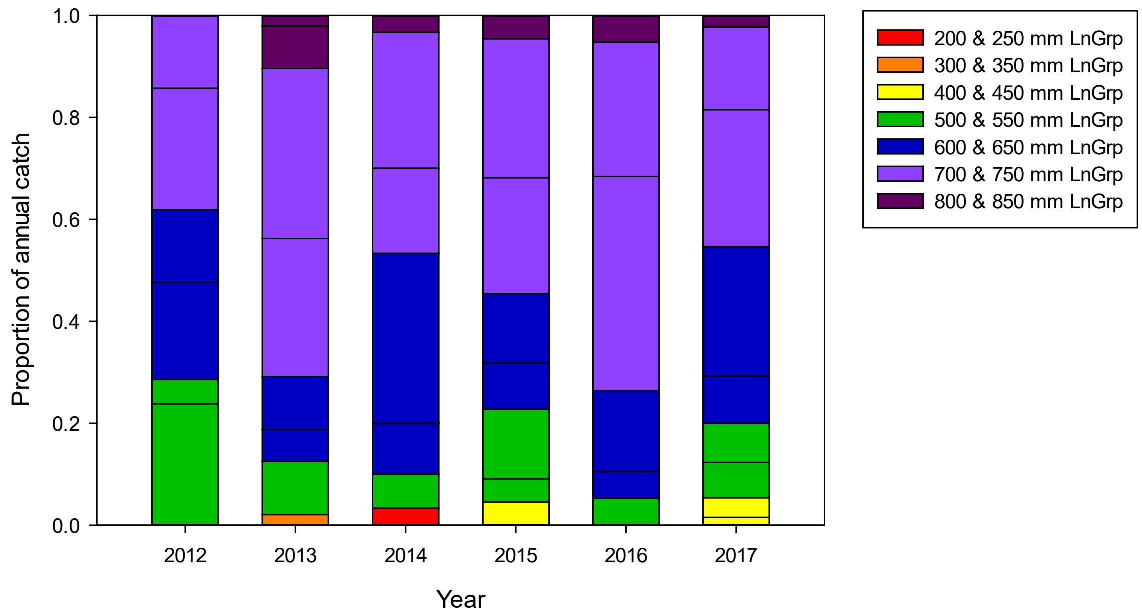

Figure 28. Blue Sucker proportionate length frequency distribution by 50-mm length group captured in the Yellowstone River during fall netting, 2012-2017.

Cyprinids

Only three cyprinids (i.e. Flathead Chub, *Hybognathus spp*., Emerald Shiner) are commonly encountered during the annual trend sampling. Catch rates of these species has been variable from year-to-year (Figure 29). Electrofishing is an inefficient method to accurately track abundance trends in these small-bodied species. The mesh size of the dip nets used precludes the capture of the vast majority of individuals observed. Seining, trawling, and/or mini-fyke nets should be added to the standard gear if reliable relative abundance estimates are desired for small-bodied fish.

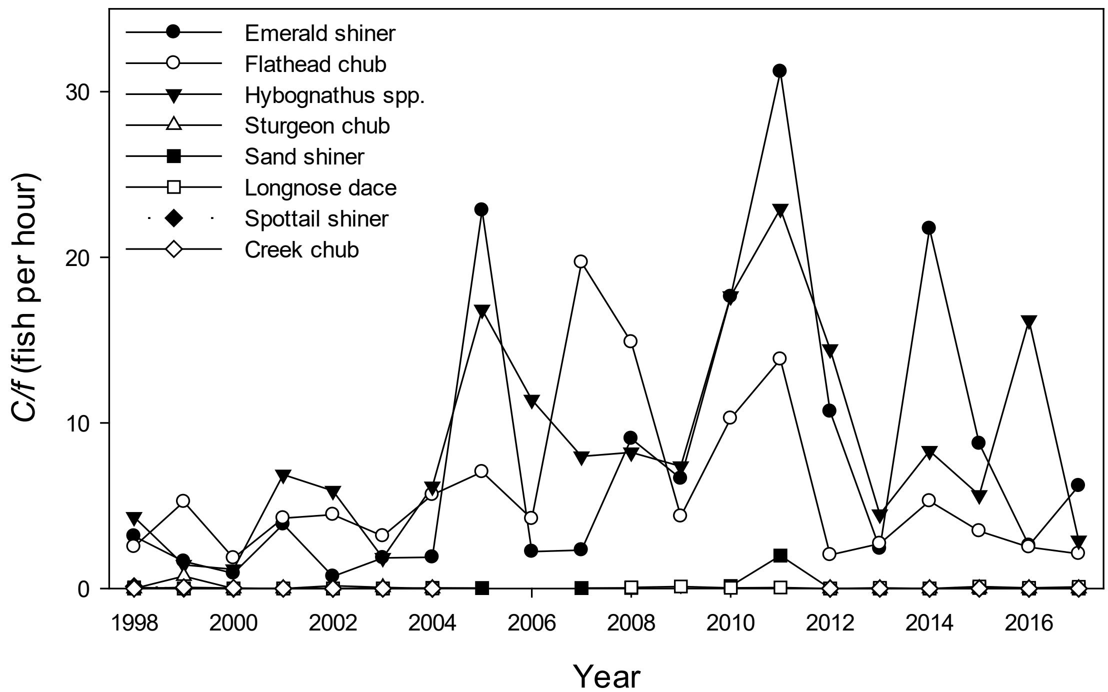

Figure 29. Catch per effort of cyprinids in the Yellowstone River, 1998 to 2017

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LITERATURE CITED

Anderson, R. O. and R. M. Neuman. 1996. Length, weight, and associated structural indices. Pages 447-481 *in* B. R. Murphy and D. W. Willis, editors. Fisheries techniques, second edition. American Fisheries Society, Bethesda.

Backes, K. M. and W. M. Gardner. 1994. Lower Yellowstone River Pallid Sturgeon study III and Missouri River Pallid Sturgeon creel survey. Montana Department of Fish, Wildlife, and Parks Report, Helena.

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

Brown, C. J. D. 1971 Fishes of Montana. Big Sky Books, Bozeman.

Carlson, J. 2003. Montana animal species of special concern. Montana Natural Heritage Program and Montana Fish, Wildlife and Parks Report, Helena.

Corps. 2014. Intake Diversion Dam Modification Lower Yellowstone Project, Draft Supplement to the 2010 Final Environmental Assessment. Omaha District, Omaha, Nebraska.

Defenders of Wildlife. 2015. Feds place hurdles too high for "Dinosaur Fish" recovery. Public press release on February 2, 2015. http://www.defenders.org/press-release/feds-place-hurdles-too-high-%E2%80%9Cdinosaur-fish%E2%80%9D-recovery.

Hiebert, S. D., R. Wydoski, and T. J. Parks. 2000. Fish entrainment at the lower Yellowstone diversion dam, Intake Canal, Montana, 1996-1998. USDI Bureau of Reclamation Report, Denver, Colorado.

Jaeger, M. E. 2004. An empirical assessment of factors precluding recovery of Sauger in the lower Yellowstone River: movement, habitat use, exploitation and entrainment. Master's thesis. Montana State University, Bozeman.

Jones-Wuellner, M. R. and C. S. Guy. 2004. Status of Burbot in Montana. Montana Fish, Wildlife and Parks Report, Helena.

McMahon, T. E. 1999. Status of Sauger in Montana. Montana Fish, Wildlife and Parks Report, Helena.

McMahon, T. E., and W. M. Gardner. 2001. Status of Sauger in Montana. Intermountain Journal of Science 7:1-21.

Nikcevic, M., A. Hegedis, B. Mickovic, D. Zivadinovic, and R. K. Andjus. 2000. Thermal acclimation capacity of the Burbot lota lota l. Pages 71-77 *in* V. Paragamian and D. Willis, editors. Burbot biology, ecology, and management. American Fisheries Society, Publication Number 1, Fisheries Management Section, Bethesda.

Penkal, R. F. 1992. Assessment and requirements of Sauger and Walleye populations in the Lower Yellowstone River and its tributaries. Montana Department of Fish, Wildlife and Parks Report, Helena.

Rhoten, J.C. 2010. Southeast Montana Warm Water Streams Investigations 2010. Statewide Fisheries Investigations. Job progress Report. F-78-R-3, Montana Department of Fish, Wildlife and Parks, Helena.

Rugg 2016. Native Fish Species Movements at Intake Dam on the Yellowstone River, 2015. Missouri River Natural Resource Committee. Great Falls, MT.

Rugg 2017. Southeast Montana Warm Water Streams Investigations 2016. Statewide Fisheries Investigations. Job progress Report. F-78-R-3, Montana Department of Fish, Wildlife and Parks, Helena.

Rugg 2017b. Native Fish Species Movements at Intake Dam on the Yellowstone River, 2016. Missouri River Natural Resource Committee. Nebraska City, NE.

Rugg 2018. Lower Yellowstone River Pallid Sturgeon Progress Report. Montana Fish, Wildlife and Parks. 2017. Glendive, MT.

Rugg 2018b. Native Fish Species Movements at Intake Dam on the lower Yellowstone River, Montana 2017. Montana Fish, Wildlife and Parks. 2018. Glendive, MT.

Silverman, A. J., and W. D. Tomlinsen. 1984. Biohydrology of mountain fluvial systems: the Yellowstone (part I). U. S. Geologic Survey, Completion Report G-853-02, Reston.

Stewart, P. A. 1996. Southeast Montana warmwater streams investigations. Montana Department of Fish, Wildlife, and Parks Report F-78-R-2, Helena.

Stewart, P. A. 1997. Southeast Montana warmwater streams investigations. Montana Department of Fish, Wildlife, and Parks Report F-78-R-4, Helena.

U.S. Department of Interior. 2013. Intake Diversion Dam Modification Lower Yellowstone Project, Montana Draft Supplement to the 2010 Final Environmental Assessment Army Corps of Engineers Omaha, Nebraska and Bureau of Reclamation Billings Montana.

White, R. G., and R. G. Bramblett. 1993. The Yellowstone River: its fish and fisheries. Pages 396-414 *in* L. W. Hesse, C. B. Stalnaker, N. G. Benson, J. R. Zuboy, editors. Restoration planning for the rivers of the Mississippi River ecosystem. Biological Report 19, National Biological Survey, Washington, D.C.

Key words:

Population abundance, structure, and condition.

Sauger, Channel Catfish, Smallmouth Bass, Shovelnose Sturgeon, Burbot, Walleye, game fish, non-game fish, cyprinids.

Prepared by: Mathew Rugg

Date: January 19, 2018

APPENDIX I

SUMMARY OF ANNUAL CATCH BY TREND SECTION

Table 1. Summarized results of Yellowstone River trend sampling, 2017.

Species	N	C/*f* (fish/hour)	Mean Length (mm)	Mean Weight (g)
		Hysham		
Bigmouth Buffalo	2	0.4	473.5	1880.0
Channel Catfish	249	50.0	475.1	1146.1
Common Carp	33	6.6	508.7	1853.9
Emerald Shiner	29	5.8	88.7	-
Flathead Chub	5	1.0	132.6	-
Freshwater Drum	9.0	1.8	343.1	568.9
Goldeye	55	11.0	348.3	377.6
Hybognathus spp.	15	3.0	111.8	-
Longnose Sucker	54	10.8	313.1	391.5
Mountain Whitefish	2	0.4	167.5	45.0
River Carpsucker	105	21.1	405.3	895.5
Sauger	17	3.4	410.4	547.6
Shorthead Redhorse Sucker	486	97.6	356.3	563.9
Smallmouth Bass	90	18.1	210.9	280.3
Smallmouth Buffalo	6	1.2	628.5	3985.8
Stonecat	1	0.2	137.0	20.0
Walleye	14	2.8	499.8	1627.7
White Crappie	2	0.4	171.0	60.0
White Sucker	88	17.7	368.7	580.0
		Forsyth		
Bigmouth Buffalo	1	0.2	511	2000.0
Black Crappie	1	0.2	203.0	140.0
Blue Sucker	1	0.2	751.0	3660.0
Burbot	2	0.4	447.5	530.0
Channel Catfish	36	7.9	432.3	870.3
Common Carp	48	10.5	528.7	2082.2
Emerald Shiner	12	2.6	90.5	-

Flathead Chub	3	0.7	156.0	-
Freshwater Drum	18	3.9	329.8	495.6
Goldeye	113	24.7	338.8	317.0
Hybognathus spp.	41	9.0	100.3	-
Longnose Dace	1	0.2	77.0	-
Longnose Sucker	34	7.4	343.7	477.1
River Carpsucker	99	21.7	391.2	780.3
Sauger	50	10.9	370.1	412.8
Shorthead Redhorse Sucker	560	122.5	335.3	451.5
Shovelnose Sturgeon	2	0.4	808.0	2490.0
Smallmouth Bass	29	6.3	202.2	163.1
Smallmouth Buffalo	17	3.7	556.9	2871.9
Walleye	10	2.2	448.7	875.0
White Sucker	48	10.5	351.6	484.4

	Miles City			
Bigmouth Buffalo	1	0.2	582.0	1090.0
Blue Sucker	4	0.7	743.8	3945.0
Channel Catfish	138	25.0	468.5	1144.9
Common Carp	49	8.9	513.8	1911.4
Emerald Shiner	23	4.2	84.6	-
Flathead Chub	6	1.1	147.2	-
Freshwater Drum	33	6.0	337.9	509.4
Goldeye	260	47.2	340.8	367.3
Hybognathus spp.	10	1.8	106.2	-
Longnose Dace	2	0.4	59.0	-
Longnose Sucker	55	10.0	348.2	483.8
Northern Pike	3	0.5	574.7	1326.7
River Carpsucker	123	22.3	395.0	824.4
Sauger	49	8.9	379.4	457.1
Shorthead Redhorse Sucker	489	88.7	353.5	536.6
Smallmouth Bass	19	3.4	267.7	480.0
Smallmouth Buffalo	14	2.5	521.1	2571.2
Stonecat	1	0.2	90.0	-
Walleye	4	0.7	436.5	765.0
White Crappie	3	0.5	218.3	206.7
White Sucker	22	4.0	362.1	588.6

	Fallon			
Bigmouth Buffalo	2	0.4	718.0	7910.0
Blue Sucker	5	1.0	697.2	3078.0
Channel Catfish	124	24.1	425.4	810.5
Common Carp	21	4.1	545.4	2421.0
Emerald Shiner	35	6.8	86.5	-
Flathead Chub	15	2.9	143.7	-
Freshwater Drum	48	9.3	346.7	578.3
Goldeye	160	31.1	331.3	336.1
Hybognathus spp.	3	0.6	92.3	-
Longnose Sucker	2	0.4	324.0	390.0
Northern Pike	2	0.4	646.5	1820.0
River Carpsucker	54	10.5	407.7	951.1
Sauger	53	10.3	380.9	459.4
Shorthead Redhorse Sucker	168	32.6	336.7	519.6
Smallmouth Bass	2	0.4	312.0	590.0
Smallmouth Buffalo	12	2.3	486.3	1995.0
Stonecat	2	0.4	141.5	20.0
Walleye	14	2.7	441.9	780.7
White Sucker	4	0.8	326.5	472.5

	Intake			
Bigmouth Buffalo	4	0.8	687.5	5295.0
Blue Sucker	2	0.4	698.5	2875.0
Burbot	2	0.4	237.5	70.0
Channel Catfish	25	4.9	458.7	1130.0
Common Carp	15	2.9	540.1	2308.7
Emerald Shiner	57	11.1	80.3	-
Flathead Chub	24	4.7	135.1	-
Freshwater Drum	21	4.1	329.4	498.5
Goldeye	159	30.8	301.2	306.5
Hybognathus spp.	4	0.8	91.8	-
Northern Pike	4	0.8	751.0	2470.0
River Carpsucker	45	8.7	437.0	1334.9
Sauger	92	17.8	319.4	288

Shorthead Redhorse Sucker	54	10.5	264.8	256.9
Shovelnose Sturgeon	10	1.9	550.6	1043.0
Smallmouth Buffalo	9.0	1.7	642.0	4542.2
Stonecat	2	0.4	119.5	25.0
Walleye	32	6.2	409.5	700.6
White Bass	2	0.4	319.5	525.0
Yellow Perch	1	0.2	82.0	-