MONTANA FISH, WILDLIFE & PARKS

2020 Missouri River – Holter Dam Tailwater Monitoring

Status Report for NorthWestern Energy
FERC Project 2188

Project #2020-2

Prepared by:

Jason Mullen, Montana Fish, Wildlife & Parks

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At the November 2019 Missouri River Technical Advisory Committee (MoTAC) meeting, Montana Fish, Wildlife & Parks (MFWP) was awarded $27,921 from NorthWestern Energy (NWE) for monitoring of the Missouri River and the fishery below Holter Dam as part of the Federal Energy Regulatory Commission (FERC) license 2188. This report summarizes the results of the 2020 monitoring.

Methods

Two sections of the Missouri River downstream from Holter Dam were electrofished at night using aluminum jet boats. The Craig section is 5.6 miles long and located from river mile (RM) 2,199.5 (measuring from its confluence with the Mississippi River) at Wolf Creek Bridge to RM 2,193.9 at Craig Bridge (Figure 1). The Cascade section is 4.1 miles long and is located from the power lines at RM 2,177.6 to an irrigation pump at RM 2,173.5 (Figure 2). The Pelican Point Fishing Access Site is located approximately halfway through the site. Jet propelled boats were equipped with headlights and fixed boom electrofishing systems using stainless steel cable droppers suspended from each boom. Electricity from 240-VAC generators was converted to smooth DC using Smith-Root rectifying units. Brown Trout *Salmo trutta* estimates were conducted in each section in spring from the 27th of April through the 13th of May. Two jet boats were used in the Craig section, and one jet boat was used in the Cascade section with two nights of marking runs and two nights of recapture runs in each section. Rainbow Trout *Oncorhynchus mykiss* estimates were conducted in fall from the 5th of October through the 20th of October and two jet boats were used in each section. Three nights of marking runs and two nights of recapture runs were completed in the Craig section, and two nights of marking and two nights of recapture runs were completed in the Cascade section. Data were uploaded into MFWP Fisheries Information System (aka, Godzilla) making the data publicly available through the MFWP FishMT website. Data were analyzed using FA+ statistical software (MFWP 2004). Population estimates were calculated using the partial Log-likelihood or modified Petersen's methods and are reported as number of trout per mile 10 inches long and greater.

Missouri River Population Monitoring

Rainbow Trout and Brown Trout

The estimate of Brown Trout 10 inches long and greater in the Craig section was 422 (SD 10.4) per mile in spring 2020 (Figure 3). The 2020 estimate was 75% of the long-term average of 563 per mile for years when population estimates were calculated based on data since 1982 (n = 36) (Figure 3). The most abundant size class of Brown Trout sampled was 17 to 20 inches in 2020, which is the same cohort that was predominant in 2018 as 12 to 15-inch fish and 2019 as 15 to 17-inch fish.

The estimate of Rainbow Trout 10 inches long and greater in the Craig section was 3,247 (SD 100.5) per mile in fall 2020 (Figure 3). The estimate of 3,247 fish per mile was 96% of the long-term average of 3,387 fish per mile based on annual estimates since 1982 (n = 39). The 2020 estimate was an increase over 2019 when the estimate was below average after 8 consecutive years of above average estimates. Rainbow Trout condition was the second highest on record in 2020 in the Craig section, as measured by average relative weight (110.3). Of the Rainbow Trout handled greater than 10 inches, 18 to 20-inch fish were most abundant. Rainbow Trout less than 10 inches were extremely abundant during sampling in fall 2020, with the highest percentage of fish handled between 6 and 10 inches (primarily between 6 and 8 inches) over the period of record.

The estimate of Brown Trout 10 inches long and greater in the Cascade section was 291 (SD 38.1) per mile in spring 2020 (Figure 4). The 2020 estimate is 75% of the long-term average of 386 per mile. The most abundant size class of Brown Trout was 12 to 14 inches. Flows were low in 2020 during spring

electrofishing in the Cascade section, ranging from approximately 4,630 to 5,050 cfs during sampling compared to high flows in 2019 ranging from 9,500 to 11,400 cfs as measured at the gage below Holter.

The estimate of Rainbow Trout 10 inches long and greater in the Cascade section was 1,698 (SD 132.2) per mile in fall 2020 (Figure 4). This estimate was 107% of the long-term average of 1,591 per mile and represents an increase after below average estimates in 2018 and 2019. The most abundant size classes of Rainbow Trout were 9 to 12 inches and fish over 18 inches. In contrast to the Craig section, 6 to 8-inch rainbow trout were not abundant during sampling.

Mountain Whitefish

While Mountain Whitefish are also present in the Missouri River, they have typically not been handled during electrofishing surveys due to logistical constraints and the potential negative effects of stress on the fish, which is greater than for trout. However, some surveys were conducted over the first 2.5 miles of the Craig section in 2004 and 2005. While an effort was made to calculate a population estimate using Mark-Recapture techniques, the low abundance of Mountain Whitefish encountered resulted in poor estimates and the data being suitable only for general catch per unit effort (CPUE). A similar effort to evaluate CPUE of Mountain Whitefish was conducted in 2020 during the spring Brown Trout estimate. All Mountain Whitefish encountered 6 inches and greater during the first 2.5 miles of the Craig section were netted, counted, and measured during the first marking run. For all subsequent runs (second marking run and two recapture runs), all Mountain Whitefish were counted, but not netted, to reduce stress.

The average number of Mountain Whitefish counted per electrofishing run in 2004, 2005, and 2020 was 205, 183, and 107, respectively. While the CPUE data cannot be interpreted with the same level of confidence as population estimates, approximately half as many Mountain Whitefish were handled in 2020 as in 2004 and 2005. The size distribution of Mountain Whitefish was similar between 2004 and 2005, but resulted in a lower average length in 2020 (2004 – min=6.5, max=19.1, ave=15.7; 2005 – min=9.1, max=19.5, ave=16.6; 2020 – min=6.0, max=20.5, ave=14.0), because of an abundance of Mountain Whitefish between 9 and 12 inches in 2020 (Figure 5). A yearlong creel survey was completed from March 2015 through February 2016 on the Missouri River (Mullen and Schilz 2017). Catch rates from the 2015 creel survey were similar to those observed in 1993, but less than rates observed in 2002 and 1988 (Leathe et al. 1988; Horton and Liknes 2003; Horton and Clark 2004). The 2020 Mountain Whitefish sampling effort will be continued in future years to collect more data for trend analysis.

Burbot, Walleye, and Northern Pike

Walleye *Sander vitreus* and Burbot *Lota lota* are also handled during spring and fall electrofishing surveys. In the Craig Section, 29 Burbot and 36 Walleye were sampled in spring and 37 Burbot and 13 Walleye in fall. In the Cascade section, 9 Burbot and 2 Walleye were sampled in spring and 18 Burbot and 8 Walleye in fall. The largest burbot was 27.3 inches and 4.04 pounds, and the largest walleye was 29.5 inches and 10.4 pounds.

Typically, more Walleye and Burbot are handled during fall surveys than spring surveys and in the Craig section than the Cascade section, thus only fall results from the Craig section are presented here. Burbot were most abundant from 1997 through 2001 and to a lesser degree from 2010 through 2014 during fall electrofishing surveys (Figure 6). In recent years, the number of Burbot handled was near the long-term average of 74 in 2018 and 2019, and below the long-term average in 2017 and 2020. Walleye were most abundant in the Missouri River in 2010 and 2011 following high flow events (Figure 6) and

corresponding with a period of relatively abundant populations in Holter Reservoir. Somewhat higher numbers of Walleye were collected in fall 2018 and 2019 following a high flow event in 2018. But densities in Holter Reservoir were lower at this time than around 2010 and 2011, which may explain the smaller increase in numbers. The numbers of Burbot and Walleye handled are substantially less than the number of trout handled. The mean number of Burbot and Walleye handled during fall electrofishing in the Craig section is 74 and 28, respectively, compared to a mean of 4,309 Rainbow Trout (during fall) and 1,580 Brown Trout (during spring) handled.

Most Walleye harvest tag returns were reported by the year after tagging with few tags reported two years after tagging or longer (Appendix A, Tables A1 and A2). In the Holter tailrace section, since 2006, an average of 14% of tagged Walleye were reported as harvested by the following year (min = 2%, max = 36%) (Appendix A, Table A1). Similarly, 18% of tagged Walleye were reported as harvested by the following year in the Missouri River below Holter (min = 6%, max = 40%), excluding the tailrace section (Appendix A, Table A2). Despite relatively few Walleye harvest tag returns beyond the year after tagging, the tagging program has allowed us to document Walleye up to 23 years old in the Missouri River, based on the age of the fish at tagging and angler reported catch.

Walleye regulations were changed by the Commission from the standard 5 daily and 10 in possession regulation in 2010 to no limit in 2011 through 2019. While the percent of anglers reporting tagged fish is unknown, based on harvest tag return rates from Walleye tagged in the Holter tailrace (Appendix A, Table A1) and those tagged primarily in the Craig section (Appendix A, Table A2), there was no apparent increase in the harvest tag return rate with the change in regulations. In fact, Walleye harvest return rates tended to be higher before 2011 than after with a combined 29% (50 of 175 tagged fish) returned as harvested within one year for fish tagged from 2004 through 2009 compared to 15% (137 of 924 tagged) returned as harvested within one year for fish tagged from 2011 through 2018 (Appendix A, Tables A1 and A2). A creel survey was completed from March 2015 through February 2016 (Mullen and Schilz 2017). Of the 75 Walleye that were documented as harvested during the survey based on angler interviews, 8 total Walleye (angler harvest of 6 to 8 Walleye) were in excess of what the prior standard regulation allowed (Mullen and Schilz 2017). Four of twenty-five (16%) anglers who harvested Walleye, harvested in excess of the old standard regulation (Mullen and Schilz 2017). The no limit regulation was removed in 2020 and replaced with 20 daily and 40 in possession from Holter Dam to Cascade and 10 daily and 20 in possession from Cascade to Great Falls.

FWP has conducted seining surveys between Cascade and Great Falls for twelve consecutive years to evaluate young of year (YOY) Walleye production in a 47-mile reach of the Missouri River between Cascade and Great Falls. The protocol and site descriptions have been described by Grisak and Tribby (2011). In 2020, 47 seine hauls at 12 sites were conducted. Overall, the number of YOY Walleye has been highly variable, but relatively low in most years. The most YOY Walleye were collected in the first two years of sampling in 2009 and 2010 with 213 and 235 individuals collected over the 12 sites (Figure 7). In most other years, the number of YOY Walleye has been approximately 50 or less with no individuals collected in 2016 and 2017. In 2020, 40 YOY Walleye were collected from 7 of the 12 sites with the most individuals collected at in the mouth of Bird Creek (Figure 7). Young of the year Walleye abundance may be related to flow events that flush Walleye into the Missouri River from Holter Reservoir and flows that provide suitable spawning and rearing conditions. Young of the year Walleye were generally highest with moderately high peak flows in 2009 and 2010 and lowest during the low flow years of 2013, 2015, and 2016. However, YOY Walleye abundance was also relatively low during 2011, the year with the highest peak flow.

During the annual seining surveys for YOY Walleye, one juvenile Northern Pike *Esox lucius* was sampled in 2019 and one in 2020, representing the first Northern Pike sampled during these surveys. Several other Northern Pike have been observed by FWP personnel and anglers have also reported catching numerous Northern Pike from the Missouri River between Holter Dam and Ulm in 2018 through 2020. Most of the angling reports have come from the stretch of river from Cascade to Ulm, but a few reports have come from immediately downstream of Holter Dam. One Northern Pike was collected in the Craig section during spring 2020 electrofishing but was subsequently lost before measurements could be collected. This represents the first Northern Pike encountered during the annual monitoring surveys. In 2019, the MFWP Commission approved changes to the Northern Pike regulations downstream of Holter Dam that went into effect March 1, 2020. Northern Pike regulations on the Missouri River from Holter Dam downstream to Black Eagle Dam were changed from the standard regulation of 10 daily and in possession to No Limit. This regulation change is intended to encourage harvest of Northern Pike given the increased abundance throughout the system and is consistent with regulations already in place in the Missouri River and reservoirs upstream of Holter Dam.

Flow Monitoring

Mean daily flow for 2017, 2018, 2019, and 2020 compared to mean daily flow for the period of record are shown in Figure 8. Overall, the mean annual discharge and the peak annual discharge was near or slightly below average in 2017, 2019, and 2020 (Figures 9 and 10). Flows in 2018 were well above average with a mean annual discharge of 6,963 cfs and a peak discharge of 20,000 cfs (Figures 9 and 10). The most recent four years illustrate the variability in the magnitude and timing of the peak discharge as the peak varied from the end of April to the beginning of July. A 2008 study documented that a flow of approximately 15,000 cfs was sufficient to mobilize streambed substrates in the Missouri River (Strainer and Grisak 2009). Over the last 20 years (2001 through 2020) peak flows have met or exceeded 15,000 cfs only four times (2008, 2010, 2011, and 2018) compared to nine times from 1981 through 2000, and 12 times from 1961 through 1980 (Figure 10).

For the 2020 calendar year, the Missouri River below Holter Dam had an estimated mean discharge of 4,857 cfs, which was 91% of the 74-year mean (Figure 9). The maximum discharge in 2020 occurred on July 2 and was 11,400 cfs (Figure 10), which was 81% of the 75-year mean.

Temperature Monitoring

When monitoring water temperature of the Missouri River, regional personnel rely on the information provided from the USGS gauging stations as the 'first line' of notification. When temperature reaches the critical threshold of 70^{o} F, we switch to data monitored by several thermographs located at strategic locations in the Missouri River. These thermographs are used in making management decisions that could include instituting time of day angling restrictions of certain fisheries to reduce stress from angling on the trout populations. It is the policy of MFWP that such closure requests may be made when temperatures reach established thresholds, which for salmonids includes "…daily maximum water temperature reaches or exceeds 73°F (23°C) for at least some period of time during three consecutive days…" The drought policy also recognizes that some waters (e.g., Missouri River) will not reach the established threshold levels but may require action to protect the fisheries anyway.

In 2020, the USGS gauging station below Holter Dam recorded a maximum daily temperature of 68.5^{o}F and a maximum daily mean temperature of 64.8°F on August 6th (Figure 11, Table 1). The maximum water temperatures in the Missouri River below Holter Dam have been below the 73°F threshold the last four years (Figure 11). From 2017 through 2020 the maximum daily water temperature was 68.9°F in August 2018 at the Holter gage (Figure 11).

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Strainer, A. C. and G. G. Grisak. 2009. An evaluation of trout spawning substrate composition and substrate changes following spring run-off in the Missouri River below Holter Dam. Status report for Northwestern Energy, FERC Project 2188. Montana Fish, Wildlife & Parks. Great Falls, MT.

Figures

Figure 1. The Craig section (highlighted by the red polygon) of the Missouri River near Craig, Montana. This section is 5.6 miles long from Wolf Creek Bridge to Craig Bridge and is electrofished annually at night for Brown Trout and Rainbow Trout population estimates.

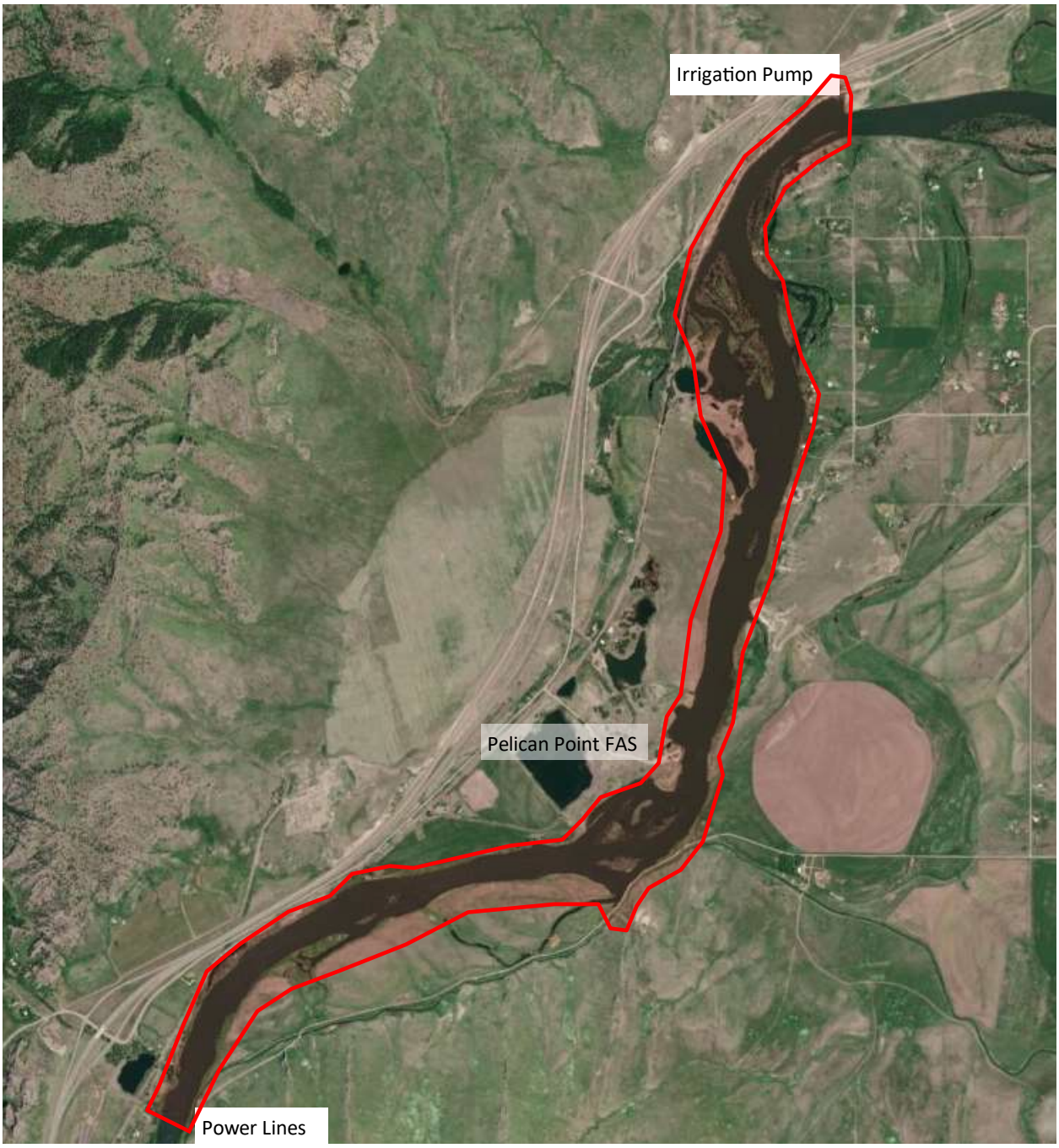

Figure 2. The Cascade section (highlighted by the red polygon) of the Missouri River near Cascade, Montana. This section is 4.1 miles long from the Power Lines to the Irrigation Pump and is electrofished annually at night for Brown Trout and Rainbow Trout population estimates.

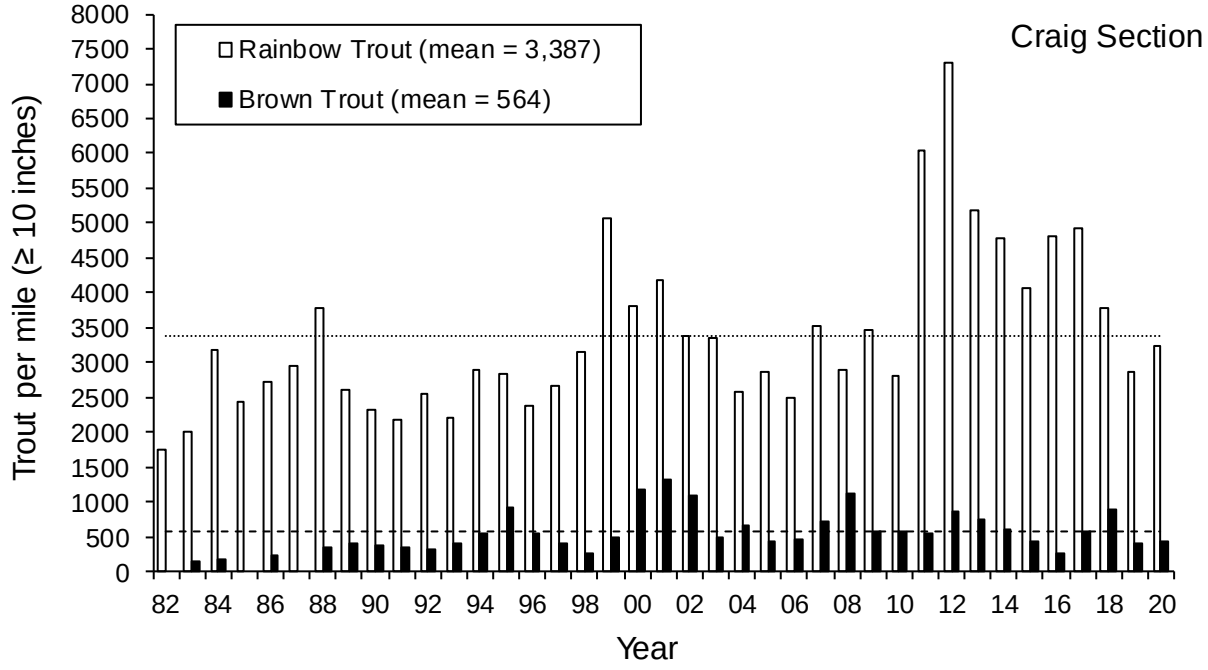

Figure 3. Population estimates of Rainbow Trout and Brown Trout 10 inches and greater per mile in the Missouri River, Montana within the Craig sampling section from 1982 through 2020. Long-term average number of Rainbow Trout and Brown Trout per mile are designated by horizontal dashed lines and 2020 estimates were 3,247 and 422, respectively.

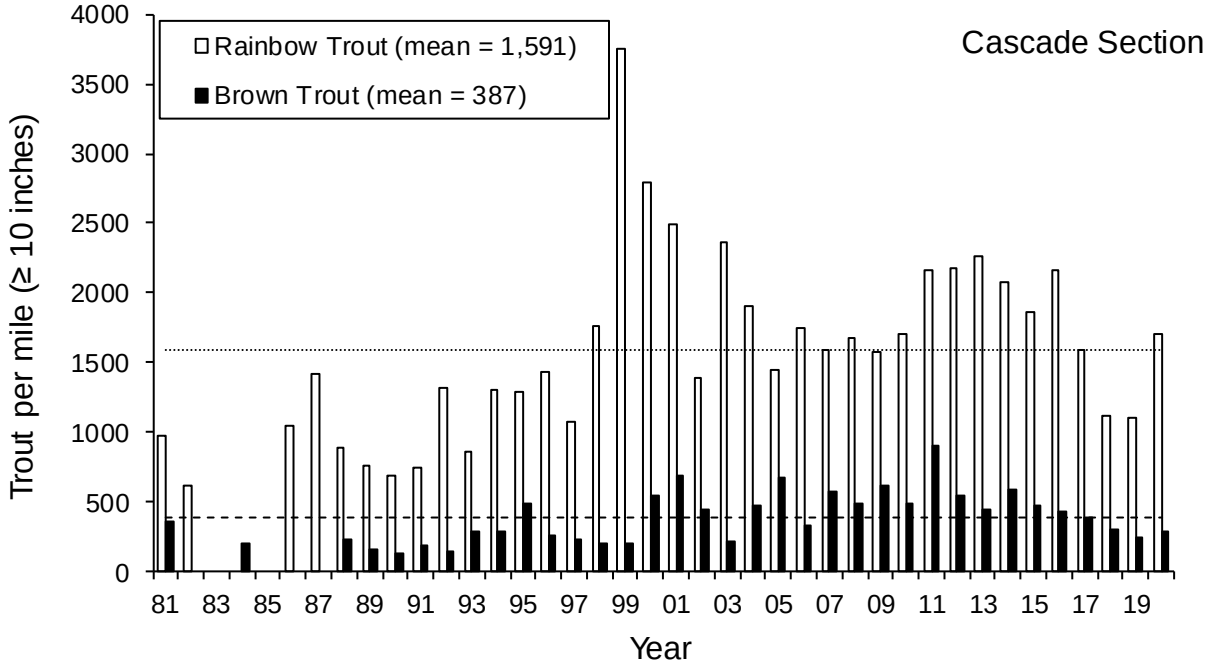

Figure 4. Population estimate of Rainbow Trout and Brown Trout 10 inches and greater per mile in the Missouri River, Montana within the Cascade sampling section from 1982 through 2020. Long-term average number of Rainbow Trout and Brown Trout per mile are designated by horizontal dashed lines and 2020 estimates were 1,698 and 291, respectively.

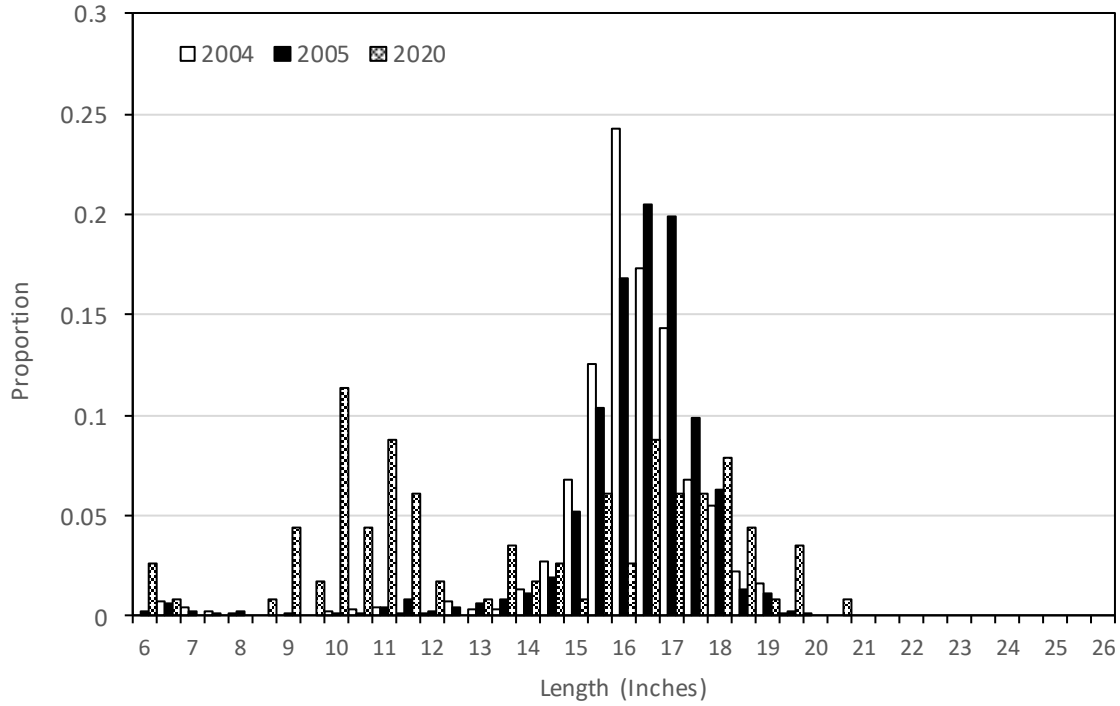

Figure 5. Length-frequency histogram for Mountain Whitefish collected in 2004 (n=821, 4 runs), 2005 (n=733, 4 runs), and 2020 (n=114, 1 run) during spring electrofishing of the first 2.5 miles of the Craig section of the Missouri River. Proportion of fish for each year is shown on the y-axis as a function of length (inches) on the x-axis.

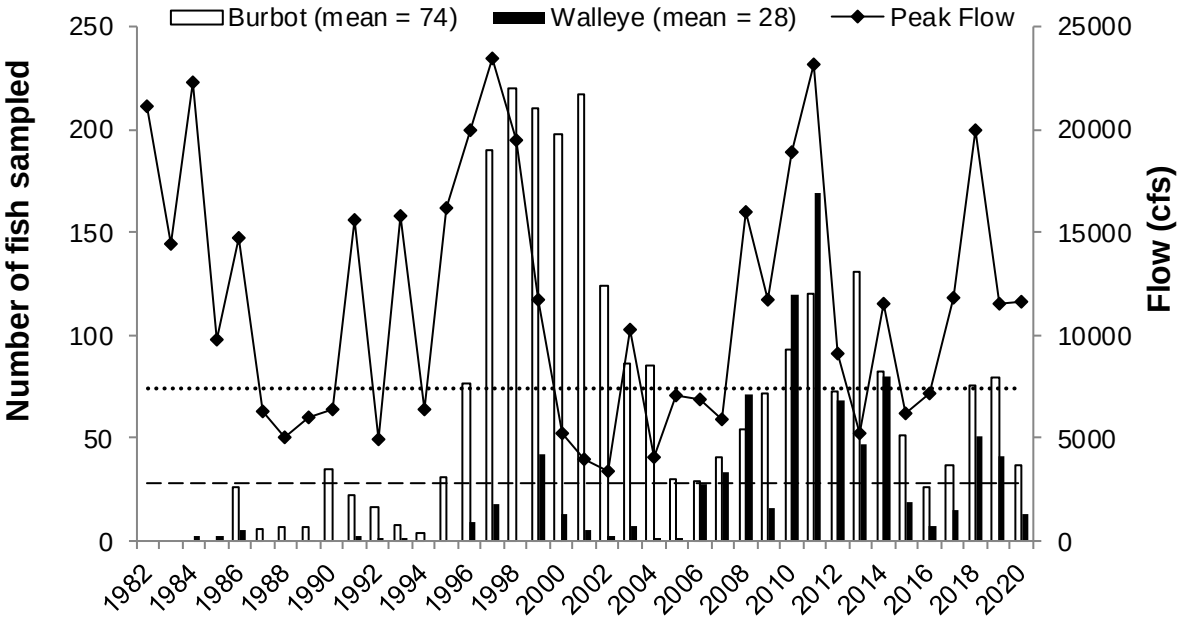

Figure 6. Number of Burbot and Walleye handled during standardized fall electrofishing surveys from 1982 through 2020 in the Craig section of the Missouri River. The peak annual flow of the Missouri River from USGS gage 06066500 (below Holter) is graphed on the right y-axis. The horizontal dotted line represents the mean number of Burbot handled and the horizontal dashed line represents the mean number of Walleye handled.

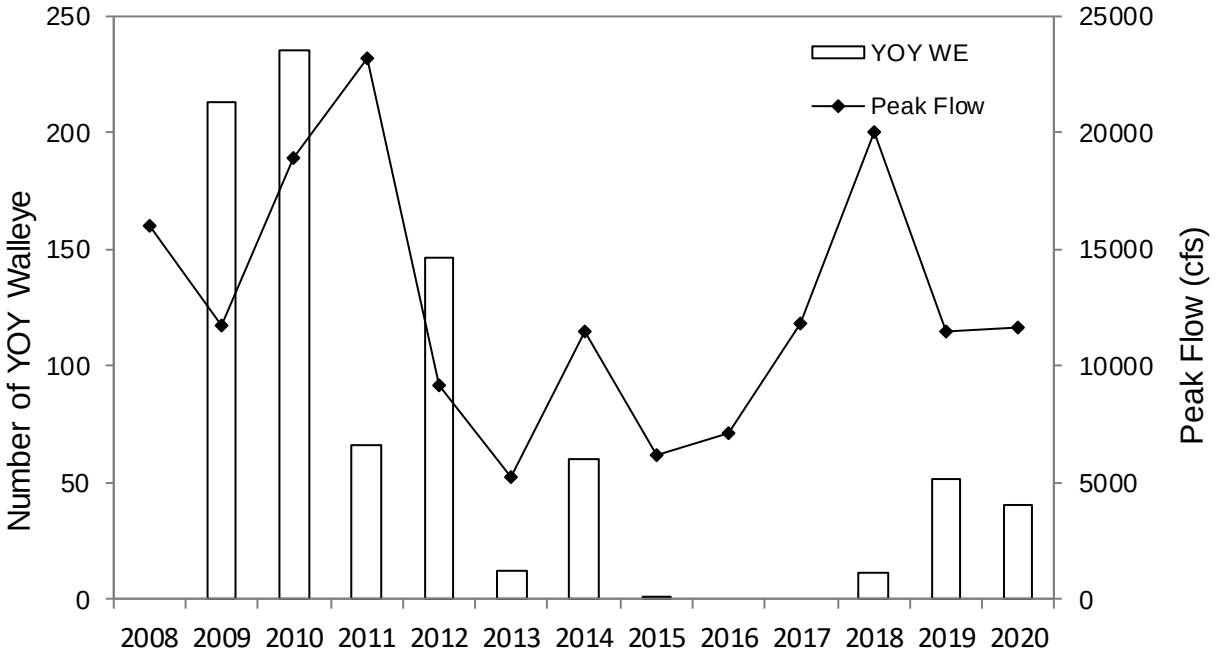

Figure 7. Total abundance of young of the year Walleye from seining sites along the Missouri River from Cascade to Great Falls from 2009 through 2020 (left y-axis) and the peak annual flow of the Missouri River from USGS gage 06066500 from 2008 through 2020 (right y-axis). Zero young of the year Walleye were collected in 2016 and 2017.

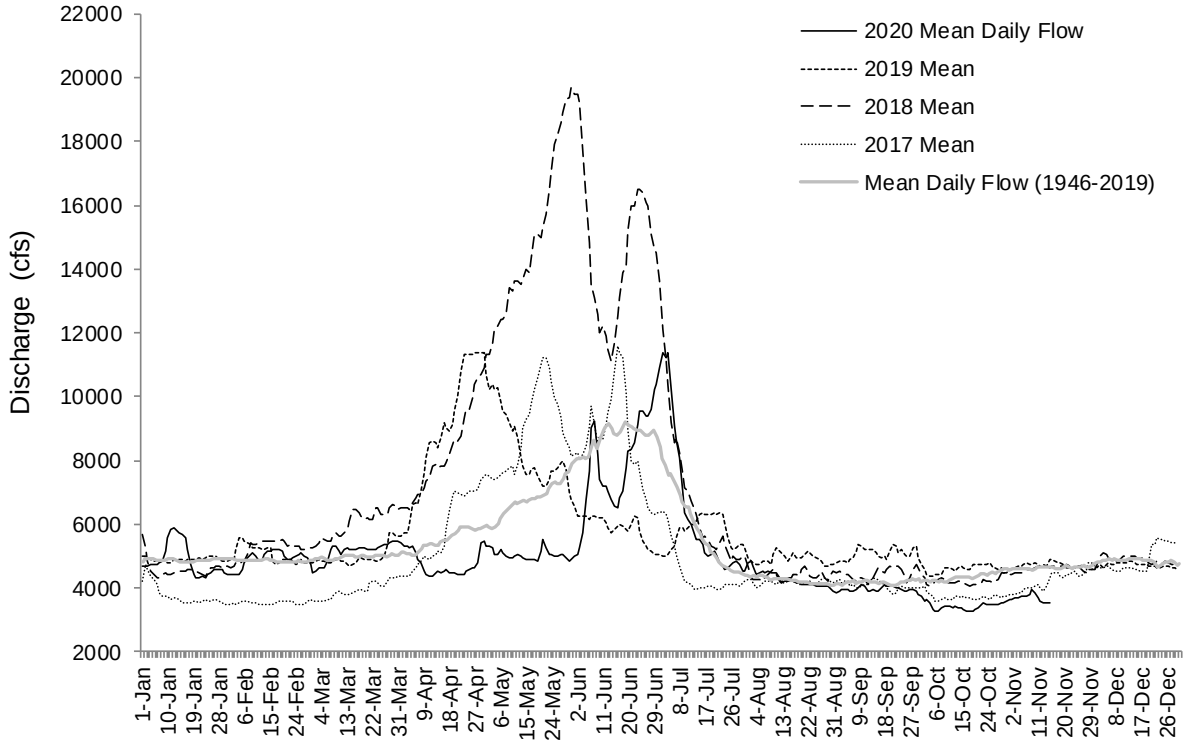

Figure 8. Mean daily flow for the Missouri River below Holter Dam at USGS gaging station 06066500 (below Holter Dam) for 2017, 2018, and 2019, 2020, and for the period of record from 1946 through 2019.

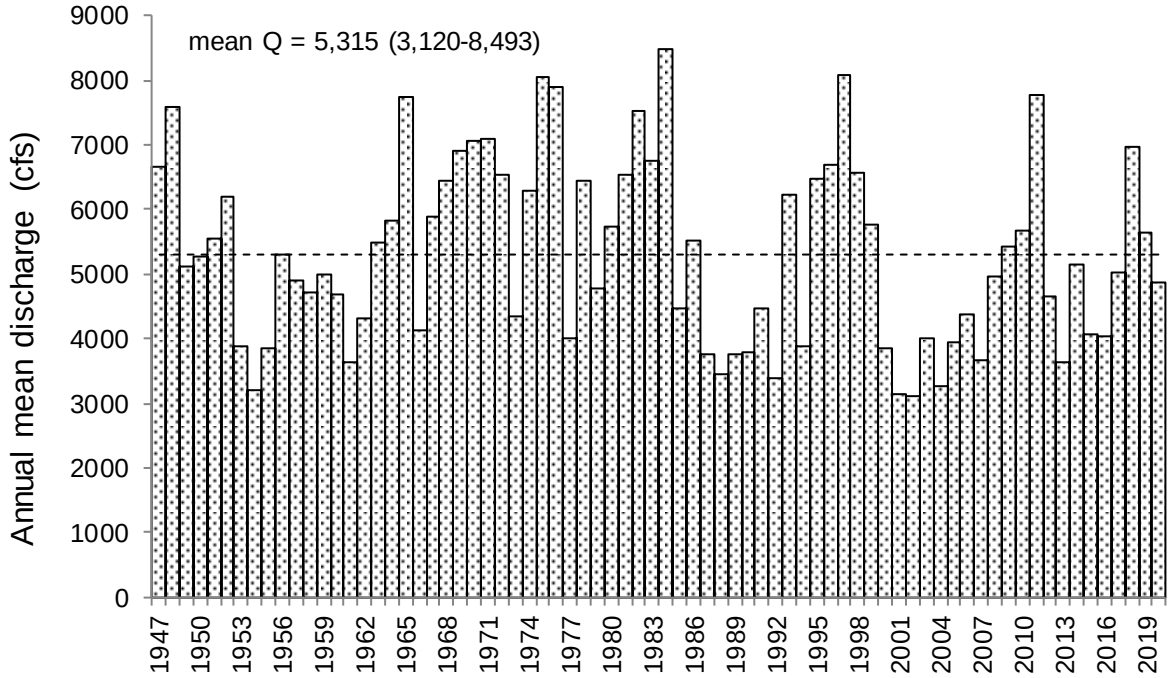

Figure 9. Mean annual flow for the Missouri River below Holter Dam at USGS gaging station 06066500 from 1947 through 2020, by calendar year. Horizontal dashed line represents the mean annual flow.

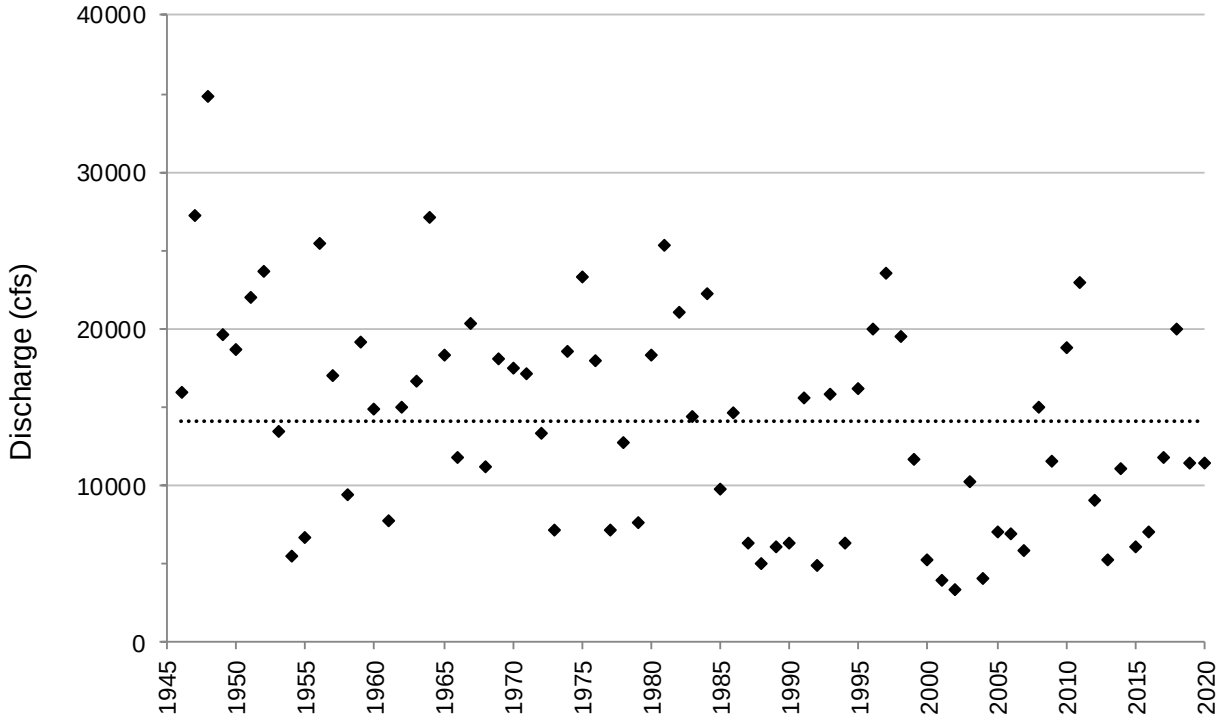

Figure 10. Peak annual flow for the Missouri River below Holter Dam at USGS gaging station 06066500 from 1947 through 2020. Horizontal dotted line represents the mean annual peak flow of 14,061 cfs.

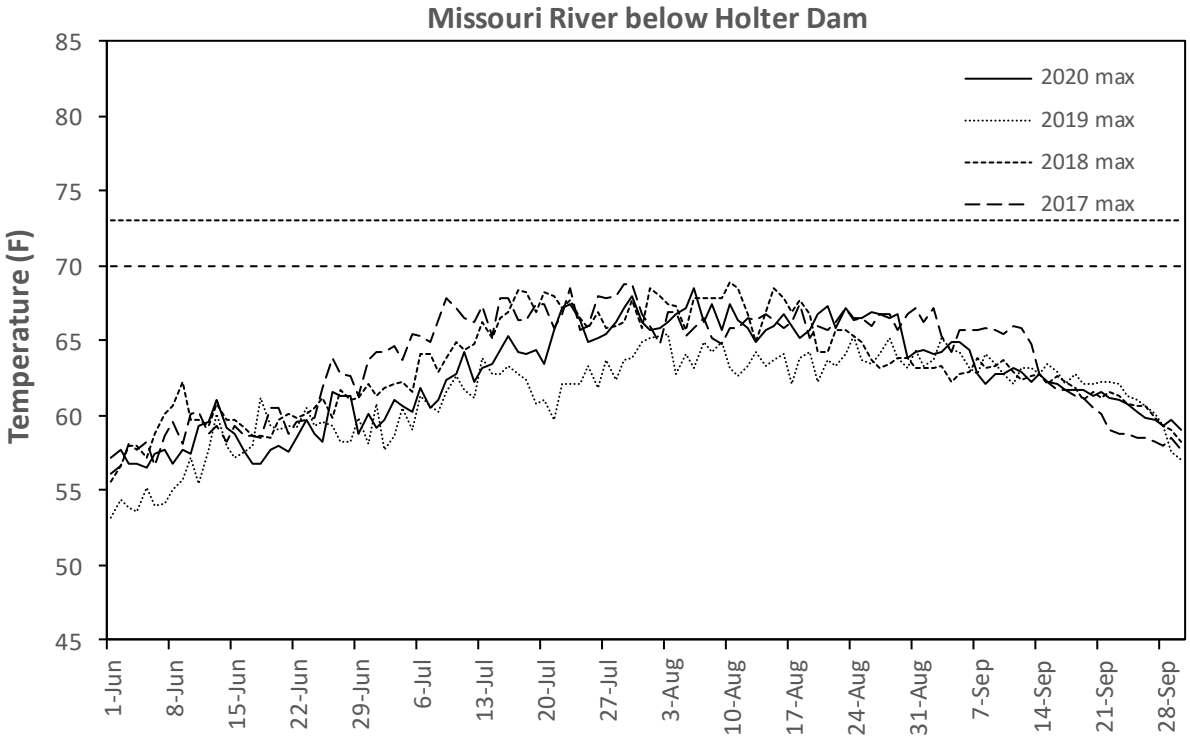

Figure 11. Maximum daily temperatures for the Missouri River below Holter Dam at USGS gaging station 06066500 for 2017, 2018, 2019, and 2020.

Tables

Table 1. Mean, min, and max of daily mean temperature (°F) and daily river discharge (cfs) of the Missouri River below Holter Dam, Montana by month for 2020 (USGS Gauge 06066500).

Missouri River		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Mean	34.3	34.7	35.9	39.8	48.8	55.9	61.2	63.5	60.7	53.6	42.8	36.6
Temperature (°F)	Min	34.2	34.3	35.1	36.7	45.3	54.0	58.1	62.2	57.9	47.1	39.2	34.7
	Max	34.7	35.1	36.7	46.0	53.2	58.9	64.4	64.8	62.8	57.9	47.1	39.2
	Mean	4,871	4,913	5,146	4,741	5,042	7,817	6,472	4,273	3,959	3,438	3,828	3,819
Discharge (cfs)	Min	4,320	4,420	4,480	4,350	4,830	4,980	4,520	3,910	3,770	3,260	3,630	3,710
	Max	5,880	5,210	5,490	5,470	5,520	10,400	11,400	4,850	4,110	3,730	4,090	4,020

Appendix A – Missouri River Walleye Tagging Harvest Tables

Table A1. Number and percent of Walleye harvested (columns) and number tagged (rows) by year in the Missouri River Holter tailrace section (Holter Dam to Wolf Creek Bridge).

Tagging Year		**Harvest Year**																			
		2004-2005		**2006-2007**		**2008-2009**		**2010-2011**		**2012-2013**		**2014-2015**		**2016-2017**		**2018-2019**		**2020-2021**		**Totals**	
Year	**# Tagged**	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2004	**4**	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
2006	**11**			4	36%	0	0%	1	9%	0	0%	0	0%	0	0%	0	0%	0	0%	5	45%
2008	**42**					9	21%	0	0%	0	0%	0	0%	0	0%	1	2%	0	0%	10	24%
2010	**57**							5	9%	6	11%	0	0%	0	0%	0	0%	0	0%	11	19%
2012	**52**									9	17%	1	2%	0	0%	0	0%	0	0%	10	19%
2014	**43**											3	7%	0	0%	0	0%	0	0%	3	7%
2016	**35**													2	6%	2	6%	0	0%	4	11%
2018	**48**															1	2%	0	0%	1	2%
2020	**17**																	0	0%	0	0%
Total	**309**			**4**		**9**		**6**		**15**		**4**		**2**		**4**		**0**		**44**	**14%**

Table A2. Number and percent of Walleye harvested (columns) and number tagged (rows) by year in the Missouri River below Holter Dam. Most Walleye were tagged during monitoring in the Craig section. Table excludes tags from the Holter Tailrace (Holter Dam to Wolf Creek Bridge) section.

Tagging Year		**Harvest Year**																									
		2008		**2009**		**2010**		**2011**		**2012**		**2013**		**2014**		**2015**		**2016**		**2017**		**2018**		**2019**		**2020**		**Totals**	
Year	**# Tagged**	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
2008	**61**	20	32%	5	8%	0	0%	2	3%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	27	43%
2009	**57**			12	21%	0	0%	0	0%	1	1%	1	1%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	14	23%
2010	**107**					7	6%	2	2%	2	2%	2	2%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	13	12%
2011	**185**							10	12%	18	10%	8	4%	1	1%	0	0%	0	0%	0	0%	0	0%	0	0%	37	27%
2012	**140**									21	15%	2	1%	5	4%	0	0%	1	1%	0	0%	0	0%	0	0%	29	21%
2013	**93**											16	17%	2	2%	1	1%	0	0%	0	0%	0	0%	0	0%	19	20%
2014	**142**													14	10%	9	6%	0	0%	0	0%	0	0%	0	0%	23	16%
2015	**44**															11	25%	1	2%	0	0%	1	2%	0	0%	13	29%
2016	**21**																	3	14%	0	0%	0	0%	0	0%	3	14%
2017	**30**																			0	0%	2	6%	0	0%	2	6%
2018	**91**																					6	7%	7	8%	14	16%
2019	**94**																							8	9%	11	12%
2020	**54**																							4	7%	4	7%
Total	**1119**	**20**		**17**		**7**		**14**		**42**		**29**		**22**		**21**		**5**		**0**		**9**		**15**		**8**		**209**	**19%**