MONTANA FISH, WILDLIFE & PARKS

Job Progress Report

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ABSTRACT

Tongue River Reservoir provides a popular and unique fishing opportunity in Montana. Managed primarily as a crappie fishery, it attracts people from across Montana and Wyoming. Relative abundance of adult crappie in the August trend sample was 4.6 fish per gill net, near the 20-year low observed in 2011. This decline was also observed in the trap-net catch of crappie and in both gears is driven by a continued loss of White Crappie. Catch rates of Walleye in gill nets were near the 20-year high observed in 2016 (10.9 fish per gill net). Crappie and Walleye otoliths were collected again in 2020 as was done in 2019 and reported in the 2019 report. Amidst declines in combined crappie catch rates, results of otolith aging for Black Crappie was consistent with previous age study results. The population of Black Crappie continues to have representation of big old fish, have variable recruitment with missing year classes and be carried by a few year classes that had strong recruitment success. An age length key demonstrated the best represented ages for Black Crappie in the 2020 sample were age 0+ (242) and 2+ (65). An age length key demonstrated the best represented age for White Crappie in the 2020 sample was age 2+ (13). The presence of relatively old crappie (8+ to 9+) suggest overharvest is not presently occurring at Tongue River Reservoir. Walleye age results from the August 2020 trend sample are consistent with aging results from 2019 with a good age and size structure, a few missing year classes, and variable year class strength. An age length key demonstrated the best represented ages were 1+ (28), 2+ (29), and 3+ (27). The strength of these young year classes is a positive sign for future Walleye angling at Tongue River Reservoir and the presence of relatively old Walleye (8+ to 12+) suggests overharvest is not presently occurring at Tongue River Reservoir.

INTRODUCTION

Construction of Tongue River Dam was completed in 1939 and created a 3,500-surface acre impoundment known as Tongue River Reservoir. Flooding weakened the dam in 1978. The dam was rebuilt from 1996 to 1998 increasing reservoir size to 3,700 surface acres. Tongue River Reservoir provides a popular and unique fishing opportunity in Montana. Managed primarily as a crappie fishery, it attracts people from across Montana and Wyoming. Historically, crappies have been abundant, easy to catch, and with a liberal 30 crappie per day bag limit, the reservoir attracts anglers of all skill levels. It is particularly popular with families and sustains the second highest angler pressure in the region behind a section of the Lower Yellowstone River (FWP 2019). The popularity of Tongue River Reservoir with campers, anglers, and pleasure boaters has made the state park and reservoir prone to crowding. To reduce social conflicts (i.e. competition for camping space, crowding at boat ramps and on the reservoir) and minimize impacts to the fishery, fishing tournaments at Tongue River Reservoir are not permitted from May 1 to September 15. Fishing tournaments, including catch and release formats, during this period can lead to increased physiological stress (Suski et al. 2003; Ostrand et al. 2004) and nest abandonment (Philipp et al. 1997; Siepker et al. 2009; Diana et al. 2012) for some fish species, particularly Largemouth Bass.

Prior to 1996 crappie harvest was not limited. A daily limit of 15 fish was established from 1996 to 2000 to protect the population while the reservoir was held at a reduced pool level to rebuild the dam. Since 2001, the crappie daily limit has been 30 fish. After dam reconstruction, storage capacity increased from 68,040 acre-feet to the current capacity of 79,071 acre-feet. This increased capacity raised the maximum water level by approximately four vertical feet. The new maximum water level has increased both the reservoirs fishable surface area and the amount of submerged woody habitat especially in the upper half of the reservoir where the near shore areas were more densely vegetated.

Salinity has affected water management in the Tongue River drainage and Tongue River Reservoir. Irrigating crop lands with water high in salt content results in a buildup of salt in the soil over time and decreases crop yields (Staten et al. 2016). During periods of reduced discharge out of the Tongue River Reservoir Dam salts build up in the reservoir. Irrigators concerned with water quality of irrigation water stored in Tongue River Reservoir have influenced dam operations, resulting in increased discharge during the spring to flush out the saline water prior to the start of the irrigation season. Montana Department of Environmental Quality is currently developing a water quality model to evaluate salinity in the Tongue River drainage and identify levels of contribution from different activities within the drainage (Staten et al. 2016). These activities include coal bed methane production, coal mining, irrigated agriculture, and reservoir operation. Coal bed methane development has greatly diminished in recent years as current natural gas prices are not providing incentive for widespread and rapid development in the Tongue River Drainage and based on projections may not within the next few decades (USEPA 2013). Expansion of coal mining in the drainage is less certain since Cloud Peak Energy owner of the operational Spring Creek Coal Mine and the nearly permitted Youngs Creek

Mine both near Tongue River Reservoir declared bankruptcy in May 2019. Navajo Transitional Energy Company acquired Cloud Peaks assets including Spring Creek and Youngs Creek mines in October 2019. Spring Creek Mine was temporarily shut down shortly after the sale but is now operating under temporary permits while state and federal agencies work through permitting issues with the new owners. Irrigation for agriculture continues to be the primary purpose of water withdrawal from the Tongue River. Reservoir operations have changed as the board of operators comply with terms of the Wyoming and Montana water compact. Changes to fish populations because of increased salinity have not been identified but may exist as these changes are difficult to quantify.

Due to the importance of Tongue River Reservoir a monitoring program has been in place for several decades. Objectives for fisheries data collected in 2020 at Tongue River Reservoir were:

(1) Characterize relative abundance, size structure, and condition by species with emphasis on crappie and Walleye
(2) Compare trends in abundance, size structure, and condition of current sample to the overall long-term data set
(3) Determine age structure characteristics of Black Crappie, White Crappie, and Walleye.

METHODS

This report covers annual trend sampling at Tongue River Reservoir completed in 2020. Annual trend sampling was conducted during the month of August using experimental gill nets, beach seine hauls, trap nets (i.e. modified fyke nets), and night electrofishing. Adult fish were sampled using experimental sinking gill nets with 25 ft panels of 0.75, 1.0, 1.25, 1.5, and 2.0-inch mesh (bar measure) for an overall length of 125 feet. Gill nets were set at standardized locations and fished overnight for approximately 24 hours. Juvenile and forage-sized fish were sampled using a 100 ft beach seine, 8 ft deep, with 0.25-inch mesh (bar measure). The seine was set from a boat and hauled to shore in a half circle pattern to capture fish. Both gill-netting and seining consisted of 10 net sets/seine hauls per year and were distributed between the upper and lower halves of the reservoir taken at standardized locations. Trap nets used have 4 x 6 ft frames with 1/2-inch mesh (bar measure) and a 4 x 50 ft lead. Trap-net effort for annual trend sampling consisted of 10 net sets selected from a suite of 33 sample sites stratified by reservoir location (e.g. upper and lower halves). Night electrofishing was completed with an 18 ft aluminum boat equipped with a Smith Root GPP 5.0 rectifier and two booms with cable dropper arrays. The unit of effort for gill-net and trap-net net sampling was one net night (approx. 24 hr. period). One seine haul was one unit of effort for seine sampling. Number of fish per hour of shock time was the unit of effort used for night electrofishing. All fish were identified to species and enumerated. Catch per unit effort (CPUE) was used to describe the relative abundance of sampled fish. All fish of game species (e.g. Black Crappie, White Crappie, Walleye, Smallmouth Bass, and Northern

Pike) were weighed (g), and measured (total length, mm) whereas only a subsample of 25-50 individuals were weighed and measured when appropriate (e.g. when processing non-target species like Shorthead Redhorse Sucker, or abundant small bodied fishes and young-of-the-year game fishes from the seine catch). Length and weight summary statistics were calculated for each species by gear type.

Black and White Crappie catches were combined when comparing trap net catch rates to gill net catch rates. Crappie less than 100mm total length were excluded from analysis to eliminate the influence of young-of-the-year (YOY) crappie on catch rates. Relative abundance for crappie caught in trap nets and in gill nets was compared using a two-sample *t*-test to determine if relative abundance differed as a function of gear using August 2010 to 2020 data (Excel 2007).

Proportional size distribution (PSD) and incremental PSDs were applied to describe the length structure of all game fishes sampled in gill nets, trap nets, and electrofishing. Relative weight (W_r) was calculated for all game fish to describe the body condition of all game fishes sampled with gill nets, trap nets, and electrofishing.

Age structures were collected according to Devries and Frie (1996). Otoliths from up to 15 individuals per 10mm length class per species were collected from a sub-sample of the crappie and Walleye caught August 12-13, 2020. Age-length keys were used to apply age results from the subsampled population to the entire sampled population.

Reservoir storage (acre-ft) and water level (ft) were obtained from the Montana Department of Natural Resources and Conservation website and personnel (i.e. Sam Johnson; DNRC). Discharge (ft^3/sec) and specific conductance (µS/cm at 25º C) values for the Tongue River upstream and downstream of the reservoir were obtained from the United States Geologic Survey website (USGS). A Secchi disc tube was used to measure water clarity (i.e. transparency). A water quality meter (YSI Pro 1030) was used to record temperature, dissolved oxygen, specific conductance and salinity in Tongue River Reservoir. A Garmin handheld GPS unit was used to record latitude and longitude in decimal degrees NAD 1983 projection for all fish and water quality sample locations.

RESULTS AND DISCUSSION

Sample locations were spread throughout the reservoir so that sub-sample results could be expected to be representative of the populations present in Tongue River Reservoir during 2020 (Figure 1). A total of 421 fish were caught in gill nets during the August 2020 sample (Table 1). Gill nets provided the largest samples of Walleye, White Crappie, and Northern Pike. A total of 632 fish were caught in 1 hour of night electrofishing on August 12-13, 2020 (Table 2). Night-electrofishing provided the largest samples for Smallmouth Bass. A total of 2,558 fish were caught in beach seine hauls during the August 2020 sample (Table 3). Beach seine hauls provided the largest samples of YOY bass, YOY crappie, and YOY perch as well as other small bodied

fishes. A total of 457 fish were caught in trap nets during the August 2020 sample (Table 4). Trap nets provided the largest sample of Black Crappie.

Crappie

Relative abundance of adult crappie in the August trend sample was 4.6 fish per gill net, near the 20-year low observed in 2011. This decline was also observed in trap nets where the relative abundance of adult crappie was 5.9 fish per trap net, the lowest catch rate since trap nets were added to the trend sampling methodology in 2010 to improve relative abundance estimates and size structure analysis of Tongue River Reservoir crappie (Boxrucker and Plosky 1989; Schorr and Miranda 1991; Guy et al. 1996). Results of concurrent gill-net and trap-net sampling in August from 2010 to 2020 indicate trap nets provide larger sample sizes of Black Crappie than gill nets (t = 4.84, df = 11, P = 0.001) and similar sample sizes of White Crappie (Figure 2). The traps also sample a broader size distribution of the crappie population than gill nets, including YOY crappie (Figure 3). Of crappie caught in trap nets from 2010 to 2020, 87% were Black Crappie. This dominance of trap-net catch by Black Crappie was not observed in Elser's 1972-1975 data summarized in the 1976 report. There are plausible explanations for the differences observed in species composition of the crappie catch in Elser's time compared to more contemporary samples, for example perhaps Black Crappie had not fully established at the time, or there has been a species-specific shift in response to reservoir aging (Ney 1996). Ney reported Black Crappies are most abundant under more oligotrophic reservoir conditions while this condition does not appear to be optimal for White Crappie peak abundance (1996). Analysis of Black Crappie relative abundances from gill nets pre-dam rebuild (1975-1995) compared to post-dam rebuild (1999-2020) demonstrates Black Crappie catch rates have not significantly changed, however using the same analysis we see that White Crappie catch rates are lower since the dam rebuild (t = 6.15, df = 30, P = 0.00001). White Crappie were the dominant species in gill-net catches comprising 89% of the combined crappie catch from 1975 to 1995. White Crappie were also the dominant species in gill-net catches from 1999 to 2020, comprising 72% of the crappie catch. Despite the percentage of White Crappie catch from gill nets staying high between 1999-2020, the annual catch rate continues to trend down. Between 1975-2020 the percentage of White Crappie has always exceeded Black Crappie except in 2015, 2019 and 2020 which was 37.2%, 44.4% and 43.5% respectively. The average gill-net crappie catch rate from 1975 to 1995 (22 per net, $\pm$ 2 SE) was greater than those observed from 1999 to 2020 (11 per net, $\pm$ 1 SE; Figure 5). Long term gill-net data and verbal history from anglers seem to agree that crappie abundance was higher in the 1980's and early 1990's than it has been in recent decades. The large-scale habitat change that occurred when the dam was rebuilt is correlated with the decline in crappie relative abundance but the causative mechanisms at play are not well understood. The last creel survey conducted on Tongue River Reservoir ran from May 1, 2006 to April 30, 2007 (Riggs and Trickel 2007). Creel data would be particularly helpful in connecting angler satisfaction to observed changes in sample data.

Tongue River Reservoir was not used as a donor water for any Wild Fish Transfers in 2020 and likely will not be used again until trap net catch rates improve. May and June trap-net samples provide a targeted sample of older, larger crappie

(Boxrucker and Ploskey 1989). May and June samples are ideal for collecting numbers of adult crappie for Wild Fish Transfers but with other regional responsibilities on the Yellowstone River, routine trend sampling during this time of year is not practical. However, August trap-netting is easily added to existing trend work and August catch rates are higher than October and July, as high as April and May and just slightly lower than June (Figure 4). Trap-netting for wild crappie transfers should be conducted during late May or early June while catch rates are highest and water temperatures are around 16° C (60° F).

Seine hauls throughout the reservoir suggest annual crappie spawning success has been variable (Figure 6). The magnitude of crappie YOY catch rates is inconsistent and is likely related to a combination of reservoir pool level and other environmental variables during the May-July spawning and nursery period. Correlations between crappie catch rates (adults from gill nets, YOY from seines) and water surface elevations (May, June, August, and annual average) were examined in the 2017 report. Water surface elevations were a poor predictor variable for adult crappie abundance in gill nets and YOY crappie abundance in seines (Bollman 2017). Vegetation in backwater areas important for spawning may be flooding too early and reducing the quality of the submerged spawning habitat (Dagel and Miranda 2012). Other environmental variables that have been found to disrupt spawning and reduced year class strength include fluctuating water temperature and increased turbidity from high rates of flow through the reservoir (Mitzner 1991). In 2018 seine hauls caught few YOY crappie suggesting poor production while trap nets caught a relatively large number suggesting successful production. Furthermore, analysis of YOY abundance and recent age data suggests that high reproduction does not equate to high recruitment into adulthood for crappie at Tongue River Reservoir nor does perceived poor reproduction (i.e. low CPUE of YOY crappie in seine hauls) preclude recruitment of that year class. This inability to predict adult crappie recruitment using YOY relative abundance was observed by Parsons et al. for lakes in Minnesota (2004). The inability to predict crappie year class strength based on YOY counts makes identification of age 1+ and 2+ crappie through age structure analysis important for predicting when mature adult crappie selected by anglers (i.e. 260-320mm TL, generally age 4+) will be available in the fishery (Miranda and Dorr 2000).

Proportional size distribution (PSD) values indicate Black and White Crappie up to memorable size are available (Table 5) and angler harvest occasionally documents crappie of trophy size (Figure 7). However, fish of this size represent a small percentage of the catch with most of the catch for both species falling into the stock size category in the 2020 sample (Figures 8 and 10). Incremental PSD calculations for crappie from gill-net data, trap-net data, and electrofishing data were similar although trap-net data consistently provides the best data for Black Crappie based on sample size. Incremental PSD values vary from year to year as strong year classes move through the fishery, at present most Black Crappie are in the stock size category (Figure 8). Mean relative weight (W_r) values in 2020 for Black Crappie were high, ranging from 90 to 128 depending on size category (Figure 9). White Crappie were only caught in gill nets in 2020. Most White Crappie are in the preferred PSD size category at present (Figure 10). Mean relative weight (W_r) values in 2020 for White Crappie ranged from 89 to 105

depending on size category (Figure 11). Relative weights suggest crappie at all size categories are in good condition and not forage limited. Both crappie species are managed together under a single bag and possession limit in Tongue River Reservoir but it is recognized that they cannot be assumed to exist in equal abundances, grow at the same rate, prefer the same habitat, select the same food items, and respond comparably to environmental conditions within the reservoir (Guy et al. 1996; Ney 1996; Ellison 1984).

Otoliths were collected from crappie again in 2020. These otoliths were collected during trend sampling in August like previous years (e.g. 2017-2019). Reader agreement for crappie aged in 2020 was high. Readers agreed 98% of the time and were within 1 year 100% of the time (Appendix 1). Results from the 2020 age study found crappie from 0+ to 9+ years old (Tables 6 and 7). Year class strength was variable, and White Crappie had fewer year classes represented than Black Crappie. Age frequency histograms demonstrate both species only had one or two well represented year classes per species and both had missing year classes (Figures 12 and 13). Comparison of crappie length frequency histograms and results of aged otoliths suggests assigning age based on length frequency alone would be difficult. Age assignment of crappie age 3+ and younger by length frequency distribution alone may be fairly accurate but is made difficult by missing cohorts. Crappie older than three years old cannot be accurately assigned by length frequency because overlap in mean length at age is common and sample sizes are low (Figures 14 and 15). Using methods described by Devries and Frie (1996) for allocating ages determined by hard part analysis for a sub-sample of fish to the entire sampled distribution based on the age-length relationship produces age-length keys (Appendix 2). Age-length keys allow for a less biased analysis of dominant year classes in the sampled population (Devries and Frie 1996). Age-length keys indicate the dominant recruited age class for both Black Crappie and White Crappie in 2020 was 2+ or the 2018-year class (Appendix 2). Crappie in this 2018-year class ranged in size from 6.0 inches (153mm) to 8.9 inches (227mm), with White Crappie mean length at age 2+ about an inch (30mm) longer than Black Crappie (Tables 6 and 7). As Age 1+ crappie this 2018-year class ranged in size from 3.6 inches (91mm) to 6.9 inches (175mm), with White Crappie mean length at age 1+ about an inch (20mm) longer than Black Crappie (Tables 6 and 7). This year class was observed as age 0+ in 2018 (Tables 6 and 7). The age length key also demonstrated age 0+ (242) Black Crappie were well represented in the 2020 age study (Appendix 2). Young-of the-year fish were only identified as Black Crappie in the 2020 age study but not all small crappie from the seine catch were identified to species and some YOY White Crappie may have been present. Black Crappie year classes observed in the 2019 age study but not present in 2020 included the 2013 and 2019-year classes. This is not surprising given the low abundance of fish in these year classes. The only White Crappie year class observed in the 2019 age study not still present in 2020 was the 2017-year class that should have been age 3+ in 2020. There continue to be older crappie found in the 2020 study (ages 8+ to 9+) which suggests tough angling conditions for crappie at Tongue River Reservoir is less likely to be the result of angling exploitation but is the result of poor recruitment. Maximum age and mean length at age observed in age studies at Tongue River Reservoir very closely match results from other age studies in northern states and Canadian provinces (Scott and Crossman 1973; Schneider 2000; McInerny and Cross 2008).

Walleye

Walleye have consistently been sought after by anglers at Tongue River Reservoir since conversion of the fishery to warm-water species (Bianchi 1969). Walleye were first stocked in Tongue River Reservoir as fry from 1950 to 1951 (Table 8). Anglers first reported catching Walleye in 1969 following a second attempt at fry stocking from 1965 to 1969 and a fingerling stocking in 1969 (Bianchi 1969). Walleye continue to be a sought-after target species at Tongue River Reservoir with anglers often desiring higher catch rates and more big fish. This desire for increased abundance and size structure has led to anglers requesting a variety of length-based limits (i.e. minimum size limit, protected slot limit, harvest slot limit, or one over limits). These types of regulations have been widely used across North America but meaningful evaluation and reporting in the scientific literature has been rare. Perhaps the best summary of these length-based Walleye regulations was given by Isermann in 2007 finding that these regulations often failed to improve catch rates and size structure (Fayram et al. 2001, Isermann 2007). Some have reported improvement in size structure (Stone and Lott 2002, Munger and Kraai 1997) but these studies did not provide control lakes to test for improvements in abundance or size structure that are attributable to regional conditions rather than lake specific regulations (Beard et al. 2003, Fedor 2008, Fincel et al. 2015) or account for the influence of variable recruitment producing singularly strong year classes that may confound results (Isermann 2007).

Walleye were sampled with gill nets, trap nets, electrofishing, and seines in 2020, but gill nets provided the largest sample size (Table 5). Catch rates of Walleye in gill nets was double the 20-year average (4.5 fish per gill net) second only to the 20-year high of 10.1 fish per gill net observed in 2016 (Figure 20). Otoliths were collected from Walleye during sampling in August and were aged using methods described by Isermann et al. (2003). An age length key demonstrated the best represented ages were 1+ (28), 2+ (29), and 3+ (27) with only two unrepresented year classes between ages 0+ to 12+ in the sample (Appendix 2). The strength of these young year classes is a positive sign for future Walleye angling at Tongue River Reservoir and the presence of relatively old Walleye (8+ to 12+) suggests overharvest is not presently occurring at Tongue River Reservoir. Walleye were found up to memorable size in 2020 (Table 5). The majority of Walleye in the gill-net catch ranged from stock to preferred and mean relative weight (W_r) values ranged from 86 to 93 (Table 5). Lack of trophy sized Walleye in the gill-net catch (Table 9) is partially explained by the small mesh sizes used on the experimental gill nets and should not be interpreted as a complete absence from the Walleye population. Trophy size fish are inherently rare, low in abundance and infrequently handled in most populations (Wilde and Pope 2004). While larger mesh size gill nets could be used to target trophy Walleye at Tongue River Reservoir it is undesirable due to the mortality rate associated with gill nets and low likelihood that capture data from this size class would be informative and useful. Trophy size Walleye in Tongue River Reservoir are periodically documented by anglers and that is sufficient evidence of their existence in the population.

Northern Pike

After attempts to manage Tongue River Reservoir as a trout fishery for its first decades, including a chemical treatment of both the reservoir and part of the river in 1957 and trout stocking from 1939 to 1965, focus shifted toward management of warm-water species (Elser 1971). Northern Pike was one of the first species stocked to establish a naturally reproducing population of warm-water sport fish. Northern Pike fry and fingerlings stocked from 1963 to 1966 established the population (Table 8). Intermittent stocking maintained a population characterized by low abundances but good growth, producing the standing State record fish (37.5 lbs.) in 1972. An intensive effort to augment the Northern Pike population was undertaken from 1978 to 1985 using a 21-acre spawning/rearing marsh constructed adjacent to the reservoir in 1977 (Elser 1980). This cooperative project between Decker Coal Company, United States Fish and Wildlife Service, Montana Cooperative Fisheries Unit, and FWP attempted to provide habitat that would facilitate natural pike reproduction. Northern Pike use of the constructed marsh was not observed as intended for spawning habitat and focus of the project shifted toward growing up hatchery stocked fry to fingerling size, a sort of in situ rearing pond. This approach also proved unsuccessful. Hatchery stocking of Northern Pike fingerlings and/or fry continued when available until 1993. Since the dam was rebuilt between 1996-1998, Northern Pike relative abundance in August gill-net surveys has been steadily increasing without hatchery augmentation (Figure 16). Relative abundance was 2 pike per gill net in 2020 (Table 1). Catch rates are low compared to Walleye and crappie but are increasing and can be expected to continue to increase as it appears the new reservoir level now provides suitable spawning and rearing habitat. Size structure of adult fish from the modest sample sizes appears to be well balanced with Northern Pike up to memorable size and mean relative weight (W_r) values from 91 to 107 (Table 5). Lack of trophy size fish in gill-net catch is probably a result of the mesh sizes used on experimental gill nets and not an indicator of their absence from the population. This is a known and acceptable gear bias. Northern Pike age structures (cleithra) were aged and reported in the 2017 federal aid report. Objectives for future age study of Northern Pike at Tongue River Reservoir should include obtaining a larger sample size and aging whole cleithra which seems to be the more contemporary methodology (Laine et al 1991; Maceina et al 2007; Faust et al 2013).

Smallmouth and Largemouth Bass

Gill nets, trap nets, seine hauls and electrofishing all captured Smallmouth Bass during trend sampling in August 2020 (Tables 1-4). Trap nets provided relatively low catch rates for adults compared to electrofishing and gill-netting (Table 5). Electrofishing gear is more effective for targeted samples of bass although it has known size related sampling bias (Beamesderfer and Rieman 1988). Beamesderfer and Rieman conducted a gear selectivity study on a Columbia River reservoir about five times as large as Tongue River Reservoir and found that while electrofishing provided larger sample

sizes than gill nets, trap nets, and rod and reel; electrofishing sampling efficiency gradually decreased as Smallmouth Bass size increased causing their size structure estimates to be biased low and their annual mortality estimates to be biased high (1988). At Tongue River Reservoir electrofishing is capturing primarily Smallmouth Bass with adult Largemouth Bass rarely caught (Figure 17). Annual production was documented for both species by August seine hauls. Bass young-of-the-year along with crappie and perch young-of-the-year make up the majority of small forage fish sampled with the seine in Tongue River Reservoir (Figure 18). Mean relative weight (W_r) values for bass sampled in gill nets, trap nets, and electrofishing had consistently high relative weight values ranging from 90 to 113 for Smallmouth Bass (Table 5). Smallmouth Bass were sampled up to memorable size but most were stock size, which may be partially explained by the sampling efficiency phenomenon described by Beamesderfer and Rieman (1988). Relative weight values suggest Smallmouth Bass are not forage limited. Angler reports indicate that bass are increasingly a targetable species offering a quality angling opportunity at Tongue River Reservoir. Increased submerged woody debris in the reservoir since the dam rebuild was expected to lead to the expansion of the Largemouth Bass population (Keith 1975) but sampling efforts have failed to detect any such response at least in the adult population. In contrast, Largemouth Bass YOY production has been documented annually since 2008 (Figure 18), it was sporadic at best between 1983-2007. The electrofishing catch rates suggest a positive trend for Smallmouth Bass (Figure 17). Electrofishing in the spring when bass are in shallow water staging for spawning or on spawning beds would likely provide better samples of larger size fish.

Channel Catfish

Channel Catfish are caught sporadically and in low abundances in August gill-net samples (Table 1). Less than two dozen Channel Catfish were collected in seines from 1989 to 2011 and not all of those were YOY. Four Channel Catfish were collected in seines in 2011, the first sampled since 1996. Four yearling size Channel Catfish were collected in seines in 2012 and one YOY Channel Catfish was collected in seines in 2013. Only one adult catfish was caught in the seine from 2014 to 2020. Consistent relative abundance values for adults through the years indicate limited spawning and recruitment are occurring but it is unknown if this occurs in the river upstream or the reservoir itself (Figure 16). Channel Catfish trend electrofishing catch rates in the river above the reservoir are consistently lower than the other trend areas found downstream of the reservoir and tend to be skewed toward larger size fish (Bollman 2018). Three Channel Catfish were collected in 2020. Low sample sizes preclude analysis of size structure and body condition.

Sunfish

Pumpkinseed Sunfish, and Green Sunfish were observed in 2020. Pumpkinseed Sunfish have increased in abundance over the last two decades in both gill nets and seine hauls in Tongue River Reservoir (Figure 19). All Pumpkinseed Sunfish in 2020 from gill nets, and trap nets had incremental PSD values in the stock size category. Mean W_r

values for Pumpkinseed were often greater than 100 indicating that they were in extremely good condition (Table 5). Few YOY Green Sunfish were observed in seine hauls in 2020. Historically, Rock Bass have been present in low abundance in Tongue River Reservoir but were not sampled in 2020. No Bluegill Sunfish were collected during the study period making observations of YOY Bluegill in the 2012 trap net set at the swim beach and a 2013 seine haul at Pearson Creek Bay appear to be misidentifications of YOY Pumpkinseed. Bluegill sunfish have not been consistently documented in Tongue River Reservoir but there are a few other instances where they were recorded but may have been misidentifications of Green or Pumpkinseed Sunfish (Elser 1983).

Other Sport Fish

Adult Yellow Perch were abundant prior to completion of the dam rebuild (1980-1995) but declined after completion (2000-2009) and recently (2011-2020) experienced a modest increase in abundance (Figure 20). Observation of the relative abundance trends over time for Yellow Perch and Walleye appear to suggest reservoir conditions that are good for one are good for the other. Young-of-the-year Yellow perch accounted for 64% of the seine haul catch by number in 2020 (Table 3). Annual production from Yellow Perch, crappie, and bass provide the forage base for Tongue River Reservoir.

No Sauger were collected in 2020 during trend sampling at Tongue River Reservoir. Sauger are believed to be native to the Tongue River including above the present-day location of Tongue River Reservoir. Chuck Sowards, Wyoming fisheries biologist in Buffalo conducted electrofishing surveys in the reach of river from Ranchester, Wyoming to Tongue River Reservoir Dam from 1951 to 1955, no Sauger were found but he suggests angler accounts claim the species was abundant in that location some time previous (1956). Wyoming stocked 234 adult Sauger in the Tongue River above the reservoir from 1962 to 1964 (Backes 2004). Elser et al. (1977) noted the first appearance of Sauger in the reservoir in 1973, and Riggs (1978) documented high abundance of Sauger in sampling efforts. However, Sauger abundance has been low since the late 1980s. Gill nets have only collected two Sauger in the last 10 years (Table 10). Sauger are a very small component of the reservoir fishery. Sauger of this population likely prefer the Tongue River habitat above the reservoir through the growing season and overwinter in the reservoir. Catch rates from electrofishing methods in the reach of the Tongue River above the reservoir demonstrate a similar trend with consistent observations of Sauger in low abundance (M. Backes, MTFWP, personal communication). In 2011, the combined Sauger-Walleye bag limit was modified above Tongue River Reservoir Dam. The regulation reduced the possible number of Sauger from 5 fish daily and in possession to 1 daily and in possession. This was done to protect the small remnant population that exists in the reservoir and the reach of the Tongue River above.

Bullhead catch rates have been low recently (<15 fish/net) in gill-net catches compared to catch rates during the 2000's that averaged 39 fish/net (Figure 20). Bullheads comprised a small percentage of the overall catch from trap netting and

electrofishing and were not observed during seining. Mean relative weight (W_r) values for bullheads ranged from 88 to 113 (Table 5).

Several rare and unusual fish observations were documented at Tongue River Reservoir in recent years. An angler caught a Tiger Muskie on January 14, 2018 through the ice near Rattlesnake Point. The fish was 42 inches long and weighed 15 pounds. Another was caught on January 13, 2019 (Figure 21). Paul Mavrakis (Wyoming Fish Manager in Sheridan WY) revealed a likely source of these fish. In 2013, Wyoming Fish and Game stocked fifty 10-inch-long Tiger Muskie into Ranchester Pond located in Ranchester, Wyoming. A couple of years later the pond flooded briefly (30 days at most) creating a potential escape route into the Tongue River. The pond is approximately 300 to 400 feet from the Tongue River. Paul did not know how many of the original 50 fish escaped from or remain in the pond. The only other evidence of the original stocking was a dead fish that was 35 inches long observed in the spring of 2017. A second unusual species was observed caught in an experimental gill net off the point across from Marina Bay. This single Burbot *Lota lota* also known as Freshwater Ling is a rare occurrence in spite of the Tongue River in Wyoming and Montana being part of the species historic range and routine observations in the Yellowstone River (Elser et al 1977, Krueger and Hubert 1997, Jones-Wuellner and Guy 2004).

Water

Reservoir storage during 2020 was slightly above the post-dam reconstruction (1999-2020) historical average until the month of August at which point it remained well below through the rest of the year (Figure 22). Tongue River Reservoir spilled briefly during May exceeding storage capacity during peak runoff. Discharge as measured by USGS gauging station 06306300 Tongue River at State Line is dependent on mountain snowpack and local rainfall. Discharge as measured by USGS gauging station 06307500 Tongue River at Tongue River Dam is within control of dam operators until storage capacity is exceeded and water begins to flow over the spillway. Snowpack and/or rainfall was adequate in 2020 for Tongue River discharge to exceed 1,000 cfs (cubic feet per second) for only 10 days in early June with peak discharge of 1,700 cfs on June 2, 2020 (Figure 23). The recent settlement of the Wyoming-Montana water compact has influenced how Tongue River Reservoir Dam is operated. The practice of dumping water and reducing pool level in March and April as observed in 2011, 2012, and 2014 is no longer likely to occur as a result of the recent compact settlement. In 2020, discharge coming into the reservoir exceeded release rates February through June capturing runoff. Water released out of the reservoir closely matched the discharge rate of water coming into the reservoir in June and October. Dam releases exceeded reservoir inflows during January and during the irrigation season, July through September. The compact has reduced Tongue River Water Users flexibility in operating the dam and reduced their ability to dump high salinity, high conductivity water prior to the irrigation season. Specific conductance is inversely related to discharge, building during periods of low discharge and diminishing as discharge increases. Beam found floodwater releases can reduce crappie year class strength depending on timing, magnitude, and duration (1983). Mitzner found a positive relationship between young-of-the-year crappie abundance and

the amount of floodwater stored from April through August in Rathburn Lake, a south-central Iowa reservoir similar to Tongue River Reservoir in both size and use (1991). Mitzner also found turbidity to limit larval crappie production in Rathburn Lake with a geometric relationship when water clarity was less than 64cm and found no production when water clarity was less than 5cm (1991). Water temperature reached 16ºC by May 27th in 2020 (Figure 24). Fayram et al (2015) reported this as the lower threshold for most crappie spawning. Water temperatures did not consistently exceed 20ºC, which Fayram et al (2015) reported as the upper threshold for most crappie spawning until late June in 2020 (Figure 24). Water temperature within the spawning window appears to be erratic at Tongue River Reservoir with multiple dips and spikes that can push crappie out of the shallows and likely lead to nest abandonment and poor reproductive success (Fayram et al. 2015). This variability in temperature may also explain the bimodal length distribution often observed in August collected young-of-the-year crappie as spawning events for an individual year class at Tongue River Reservoir could occur as much as a month apart in years like 2019 (Figure 25). A summary of water quality measurements taken during sampling at Tongue River Reservoir in 2020 can be found in Table 11.

MANAGEMENT RECOMMENDATIONS

Survey and inventory of the Tongue River Reservoir fishery has been conducted since the 1950's. The sampling methodology and management objectives have remained relatively unchanged until recently with the consistent addition of trap net and electrofishing methods. The change in sampling methodology has provided valuable data that enhances analysis of existing trend data collected with gill nets and seines and has started to fill data gaps for some important sport species. The addition of trap net sampling has increased sample sizes for analysis of size structure and condition factor of crappie. Trap nets are also providing samples of YOY fish to compare with seine haul data when estimating annual reproduction. The addition of night electrofishing shows early signs that it will provide adequate sample sizes of Smallmouth Bass to evaluate relative abundance, size structure, and condition factor for this species that other methods do not. Incorporating collection of aging structures has allowed improved analysis of crappie population dynamics in Tongue River Reservoir. Scales were collected and aged in 1983, 1989, and 2001 with results presented in the 2001-2002 report. Scales were collected in 2003 and summarized but have not been reported. Otolith aging for a sample of White Crappie was summarized in Phil Stewart's 1983 report. Otoliths were collected again in 2013, 2014, 2017, 2018, and 2019 with results presented in the 2014-2017, 2018 and 2019 reports. Otoliths were collected again in 2020 and discussed in this report. Development of age-length keys allowed identification of dominant year classes and improved interpretation of size structure and condition indices. This latest round of age study with multiple years within a relatively brief period has allowed tracking of dominant year classes as they moved through time. Otoliths are the preferred aging structure for accurate age and growth estimation (Hammers and Miranda 1991). It is recommended that crappie otoliths be collected again in 2021 and be analyzed and reported with age data from 2017-2019. Efforts to get known age fish in the population to validate aging methods while important (Beamish and McFarlane 1983, Campana

2001) are likely unjustifiable (i.e. cost to benefit) however a good first step toward validation of aging methods could be using marginal increment analysis (Fowler 1990; Rugg et al. 2014). This would require upgrading Miles City's lab equipment with a dissection scope/microscope and camera system. This may be done in the future as other regional work could benefit from age analysis. A general recommendation in future collections for any species is to collect structures during a concise temporal period like was done in 2013, and 2017-2020 for crappie. Collecting structures over a broader period (3 months) like was done with all species in 2014 confounds aging and increases variance of calculated length at age. It is recommended that one hour of night electrofishing become a permanent addition to the trend sampling methodology in August. Effort should continue to focus on finding appropriate transects throughout the reservoir for effective bass electrofishing. It is recommended that an hour of electrofishing for bass be completed during their spawning window (e.g. late May to early June) to explore if it could improve sample size for larger individuals. A sampling methodology including a suite of gear types (gill nets, seines, trap nets, and electrofishing) will increase the probability of accurately detecting shifts in the fish assemblage and will afford fisheries managers the data needed to make sound decisions.

Waters referred to: Tongue River Reservoir 7-21-9000-06

Key Words: Crappie, Walleye, Trap net, Length at Age

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Table 1. Results of 10 overnight experimental gill-net sets at Tongue River Reservoir, August 2020.

Species	Number Caught	Average per Net	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black Bullhead	4	0.4	331	573	287 - 360	360 - 800	1.0
Black Crappie	26	2.6	194	134	158 - 291	40 - 400	6.2
Channel Catfish	3	0.3	638	3330	530 - 832	1640 - 6700	0.7
Common Carp	4	0.4	509	1600	145 - 658	50 - 3440	1.0
Northern Pike	20	2.0	626	1903	142 - 910	30 - 4800	4.8
Pumpkinseed	7	0.7	118	39	93 - 140	20 - 60	1.7
Shorthead Redhorse Sucker	7	0.7	480	1327	433 - 520	1060 - 1600	1.7
Smallmouth Bass	76	7.6	251	361	80 - 443	30 - 1350	18.1
Walleye	90	9.0	447	1103	235 - 727	100 - 4000	21.4
White Crappie	20	2.0	217	167	153 - 333	30 - 570	4.8
Yellow Bullhead	53	5.3	271	327	196 - 358	100 - 720	12.6
Yellow Perch	111	11.1	175	69	138 - 480	30 - 1080	26.4
Total	421						

Table 2. Results of night electrofishing at Tongue River Reservoir, in August 2020 for a cumulative shock time of 1 hour.

Species	Number Caught	Average per Hour	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black Crappie	1	1	186	120	-	-	0.2
Common Carp	5	5	-	-	-	-	0.8
Green Sunfish	4	4	121	45	105 - 140	20 - 80	0.6
Northern Pike	3	3	507	1253	207 - 752	40 - 2560	0.5
Pumpkinseed	14	14	121	32	108 - 140	30 - 70	2.2
Smallmouth Bass	226	226	186	131	118 - 460	20 - 1620	35.8
Spottail Shiner	70	70	100	-	82 - 117	-	11.1
Walleye	22	22	226	254	110 - 654	10 - 2800	3.5
Yellow Perch	91	91	162	60	117 - 212	10 - 140	14.4
Black Crappie YOY	9	9	68	-	60 - 78	-	1.4
Green Sunfish YOY	3	3	76	-	72 - 78	-	0.5
Pumpkinseed YOY	8	8	84	-	72 - 102	-	1.3
Largemouth Bass YOY	2	2	96	-	85 - 107	-	0.3
Smallmouth Bass YOY	96	96	87	-	59 - 112	-	15.2
Yellow Bullhead YOY	1	1	38	-	-	-	0.2
Yellow Perch YOY	77	77	69	-	50 - 86	-	12.2
Total	632						

Table 3. Results of 10 seine hauls at Tongue River Reservoir, August 2020.

Species	Number Caught	Number per Seine Haul	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percent of Catch (%)
Black Crappie	1	0.1	190	100	-	-	0.0
Common Carp	1	0.1	668	4310	-	-	0.0
Green Sunfish	4	0.4	114	25	109 - 120	20 - 30	0.2
Largemouth Bass	1	0.1	151	40	-	-	0.0
Northern Pike	9	0.9	184	27	161 - 205	10 - 40	0.4
Pumpkinseed	4	0.4	126	47	121 - 132	40 - 60	0.2
Smallmouth Bass	38	3.8	168	89	117 - 400	20 - 1000	1.5
Spottail Shiner	5	0.5	54	-	48 - 62	-	0.2
Yellow Perch	65	6.5	131	26	105 - 176	10 - 60	2.5
Bullhead YOY	2	0.2	38	-	26 - 50	-	0.1
Black Crappie YOY	126	12.6	54	-	25 - 70	-	4.9
Crappie YOY	43	4.3	58	-	32 - 70	-	1.7
Common Carp YOY	9	0.9	95	15	56 - 115	10 - 20	0.4
Green Sunfish YOY	39	3.9	79	-	62 - 97	-	1.5
Largemouth Bass YOY	91	9.1	87	-	50 - 120	-	3.6
Northern Pike YOY	5	0.5	111	-	95 - 126	-	0.2
Pumpkinseed YOY	91	9.1	70	-	56 - 92	-	3.6
Smallmouth Bass YOY	374	37.4	76	-	46 - 99	-	14.6
Walleye YOY	3	0.3	145	20	140 - 150	-	0.1
Yellow Perch YOY	1647	164.7	68	-	55 - 86	-	64.4
Total	2558						

Table 4. Results of 10 overnight trap net sets at Tongue River Reservoir in August 2020.

Species	Number Caught	Average per Net	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black Crappie	59	5.9	210	177	153 - 335	40 - 550	12.9
Common Carp	7	0.7	627	3083	572 - 683	2460 - 4200	1.5
Green Sunfish	7	0.7	122	57	98 - 160	20 - 120	1.5
Northern Pike	3	0.3	672	1983	627 - 730	1740 - 2570	0.7
Pumpkinseed	89	8.9	120	41	104 - 138	10 - 80	19.5
Shorthead Redhorse Sucker	10	1.0	491	1333	456 - 515	1120 - 1520	2.2
Smallmouth Bass	39	3.9	175	88	106 - 332	10 - 560	8.5
Walleye	16	1.6	393	746	187 - 595	80 - 2020	3.5
Yellow Bullhead	3	0.3	300	473	221 - 340	180 - 640	0.7
Yellow Perch	4	0.4	88	-	86 - 91	-	0.9
Black Crappie YOY	61	6.1	68	-	59 - 83	-	13.3
Green Sunfish YOY	2	0.2	71	-	70 - 72	-	0.4
Largemouth Bass YOY	41	4.1	92	-	78 - 110	-	9.0
Pumpkinseed YOY	75	7.5	85	-	66 - 98	-	16.4
Smallmouth Bass YOY	17	1.7	89	-	78 - 102	-	3.7
Walleye YOY	7	0.7	99	-	81 - 140	-	1.5
Yellow Perch YOY	17	1.7	151	46	100 - 205	10 - 120	3.7
Total	457						

Table 5. Summary of proportional size distribution (PSD), incremental PSDs, and mean relative weight (W_r) values for game fish sampled with gill nets, trap nets and electrofishing during August 2020.

Gill nets

		PSD					Wr				
Species	N	S-Q	Q-P	P-M	M-T	T	S-Q	Q-P	P-M	M-T	T
Black Bullhead	3	-	33	67	-	-	-	89	88	-	-
Black Crappie	25	72	20	8	-	-	122	110	93	-	-
Channel Catfish	3	-	67	-	33	-	-	103	-	102	-
Northern Pike	19	11	68	16	5	-	107	95	107	91	-
Pumpkinseed	7	100	-	-	-	-	110	-	-	-	-
Smallmouth Bass	50	48	18	26	8	-	98	111	97	90	-
Walleye	83	30	39	23	8	-	86	91	93	92	-
White Crappie	19	26	58	5	11	-	104	105	89	100	-
Yellow Bullhead	53	9	91	NA	NA	NA	95	99	NA	NA	NA
Yellow Perch	93	85	15	-	-	-	80	83	-	-	-

Trap nets

		PSD					Wr				
Species	N	S-Q	Q-P	P-M	M-T	T	S-Q	Q-P	P-M	M-T	T
Black Crappie	59	68	12	10	10	-	112	106	101	90	-
Northern Pike	3	-	67	33	-	-	-	94	96	-	-
Pumpkinseed	76	100	-	-	-	-	114	-	-	-	-
Smallmouth Bass	17	88	12	-	-	-	92	95	-	-	-
Walleye	14	21	57	21	-	-	100	89	97	-	-
Yellow Bullhead	3	33	67	NA	NA	NA	113	97	NA	NA	NA
Yellow Perch	12	92	8	-	-	-	88	100	-	-	-

Electrofishing

		PSD					Wr				
Species	N	S-Q	Q-P	P-M	M-T	T	S-Q	Q-P	P-M	M-T	T
Black Crappie	1	100	-	-	-	-	128	-	-	-	-
Northern Pike	2	-	50	50	-	-	-	98	87	-	-
Pumpkinseed	20	100	-	-	-	-	89	-	-	-	-
Smallmouth Bass	116	91	3	3	2	-	113	111	104	104	-
Walleye	5	60	20	-	20	-	91	91	-	88	-
Yellow Perch	85	96	4	-	-	-	100	96	-	-	-

Table 6. Age and size at age of White Crappie collected in August of 2017, 2018, 2019, and 2020 at Tongue River Reservoir.

2017

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
1+	2	127	-	-
2+	86	207	2	171 - 240
3+	3	246	4	242 - 254
5+	15	291	2	276 - 305
8+	1	285	-	-

2018

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
0+	1	75	-	-
1+	3	149	13	132 - 175
3+	37	233	2	200 - 256
4+	3	248	7	240 - 263
6+	1	291	-	-
7+	3	305	5	296 - 312

2019

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
1+	41	151	2	106 - 176
2+	5	222	3	215 - 230
4+	7	247	4	228 - 256
8+	3	323	12	307 - 346

2020

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
1+	3	160	3	153 - 163
2+	11	213	2	200 - 227
5+	1	259	-	-
8+	1	313	-	-
9+	1	333	-	-

Table 7. Age and size at age of Black Crappie collected in August of 2017, 2018, 2019, and 2020 at Tongue River Reservoir.

2017

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
0+	7	66	3	52 - 74
2+	80	179	2	136 - 225
3+	16	235	6	209 - 303
4+	1	310	-	-
5+	40	269	2	237 - 316
6+	5	291	10	263 - 323
9+	1	302	-	-

2018

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
0+	51	68	1	32 - 86
1+	56	131	2	109 - 166
2+	2	183	1	182 - 183
3+	89	209	2	178 - 252
5+	3	279	9	266 - 295
6+	16	285	2	275 - 310
7+	5	281	2	275 - 285
8+	1	288	-	-

2019

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
0+	9	69	6	53 - 113
1+	127	131	2	91 - 166
2+	71	187	1	160 - 211
3+	5	209	2	202 - 217
4+	65	226	2	195 - 289
5+	1	247	-	-
6+	1	265	-	-
7+	5	283	7	267 - 305
8+	23	293	3	272 - 347

2020

Age	Number Aged	Mean Length (mm)	Standard Error of Mean	Length Range (mm)
0+	64	59	1	25 - 83
2+	57	183	2	153 - 214
3+	3	228	4	210 - 236
4+	1	224	-	-
5+	3	267	2	264 - 270
6+	1	335	-	-
8+	6	301	4	286 - 313
9+	3	306	10	288 - 321

Table 8. Stocking history for Tongue River Reservoir 1939-2020.

Species	Initial Year of Stocking	Size (in)	Stocking Years
Rainbow Trout	1939	2-8	1939, 1958-1960, 1965
Brown Trout	1940	2	1940
Walleye	1950	0.2-0.3	1950-1951, 1965-1968, 1980, 1984, 1986-2018, 2020
	1969	1-2	1969, 1985-1986, 1990-2020
Northern Pike	1951	0.3-0.5	1951, 1969, 1970-1971, 1978, 1986, 1991-1993
	1963	1-4	1963-1966, 1969, 1972-1977, 1986, 1990
Channel Catfish	1963*	2-3	1963-1964,
Largemouth Bass	1964	1-2	1964, 1972-1973
Spottail Shiner	1990	4	1990**
White Crappie	1990*	1	1990
Sauger	2003*	0.1-0.2	2003-2004
		1-2	2003-2004

*Species present prior to stocking effort

**Wild Fish Transfer from Ft. Peck Reservoir

Table 9. Summary of sample size (N), proportional size distribution (PSD), incremental PSDs, mean relative weight (W_r) values, mean length (inches), max length (inches), and max weight (pounds) for Walleye sampled with gill nets during August 2005-2020.

		PSD					Wr					Size		
												Length (in)		Weight (lb)
Year	N	S-Q	Q-P	P-M	M-T	T	S-Q	Q-P	P-M	M-T	T	Mean	Max	Max
2005	15	73	7	13	7	-	85	78	85	84	-	14.4	26.0	6.1
2006	30	53	43	-	3	-	86	96	-	96	-	14.6	27.4	8.2
2007	23	87	9	-	4	-	84	95	-	90	-	12.1	25.4	6.0
2008	27	77	23	-	-	-	83	90	-	-	-	13.4	19.3	2.6
2009	18	67	28	6	-	-	80	84	82	-	-	14.3	21.3	3.1
2010	11	64	36	-	-	-	89	83	-	-	-	12.2	20.0	2.8
2011	51	73	22	6	-	-	88	86	89	-	-	14.4	22.0	3.7
2012	59	42	54	2	2	-	84	86	99	88	-	14.8	26.2	6.5
2013	77	75	9	13	3	-	88	80	82	86	-	14.6	29.4	9.7
2014	66	80	15	2	3	-	87	84	82	87	-	14.3	26.8	6.9
2015	60	60	32	8	-	-	93	92	89	-	-	10.4	24.3	5.0
2016	98	19	60	17	3	-	80	84	89	75	-	17.0	26.7	6.4
2017	57	28	47	23	2	-	88	84	84	90	-	17.9	25.9	6.4
2018	35	31	23	40	6	-	106	92	92	85	-	16.9	25.4	5.7
2019	63	24	35	35	6	-	85	93	91	84	-	17.8	26.5	6.6
2020	83	30	39	23	8	-	86	91	93	92	-	17.6	28.6	8.8

Table 10. Sauger gill-net catch rates from 1980-2020.

Year	Count	CPUE (fish/gill net)
1980	9	0.5
1981	8	0.5
1982	5	0.3
1983-1984	0	0.0
1985	8	0.7
1986	3	0.3
1987	2	0.2
1988	8	0.8
1989	2	0.2
1990-1996	0	0.0
1997	2	0.2
1998	3	0.3
1999-2000	0	0.0
2001	2	0.2
2002-2004	0	0.0
2005	1	0.1
2006	0	0.0
2007	1	0.1
2008	0	0.0
2009	1	0.1
2010-2011	0	0.0
2012	1	0.1
2013-2018	0	0.0
2019	1	0.1
2020	0	0.0

Table 11. Summary of water quality measurements including water temperature (°C), clarity measured with Secchi tube (cm), specific conductivity (µS/cm at 25º C), salinity (ppt), and dissolved oxygen (mg/L) taken during August 2020. Sites listed in descending order beginning with northern most site on the lake and ending with southernmost site.

Location	Water Temperature (°C)	Clarity Secchi Tube cm	Conductivity (µS/cm at 25º C)	Salinity (ppt)	Dissloved Oxygen (mg/L)	Sample Size N
Dam Road Gate	24.8 - 25.2	105 - 120+	469 - 474	0.2	6.9 - 8.8	2
Lost Net Point	24.0	-	472	0.2	6.5	1
Barrel Bay	24.7 - 26.4	106	449 - 475	0.2	7.0 - 7.5	2
Cabin Bay	24.7 - 26.9	120+	478	0.2	7.2	2
Neck Bay	24.2	-	475	0.2	11.0	1
Swim Beach	24.6 - 26.1	-	472 - 475	0.2	6.8 - 7.3	2
Sandy Point	24.5	82	476	0.2	7.9	1
Across from Marina Bay	24.4 - 29.0	120+	474 - 483	0.2	7.5 - 8.2	3
Marina Bay	25.0	89	477	0.2	8.6	1
Little Gravel Point	24.4	102	482	0.2	7.9	1
Timberline Point	24.9	47	490	0.2	10	1
Car Body Bay	24.9 - 26.0	80 - 110	484 - 491	0.2	9.2 - 10.0	2
Rock Points	24.9 - 25.4	76 - 81	496 - 501	0.2	8.6 - 9.4	2
Antelope Hill	25.3 - 26.1	23 - 39	503 - 506	0.2	10.3 - 10.9	2
Pearson Creek Point	25.5	50	490	0.2	10.3	1
Sunken Island	25.9	95	491	0.2	9.6	1
Coal Creek Culvert	27.0	35	518	0.2	14.7	1

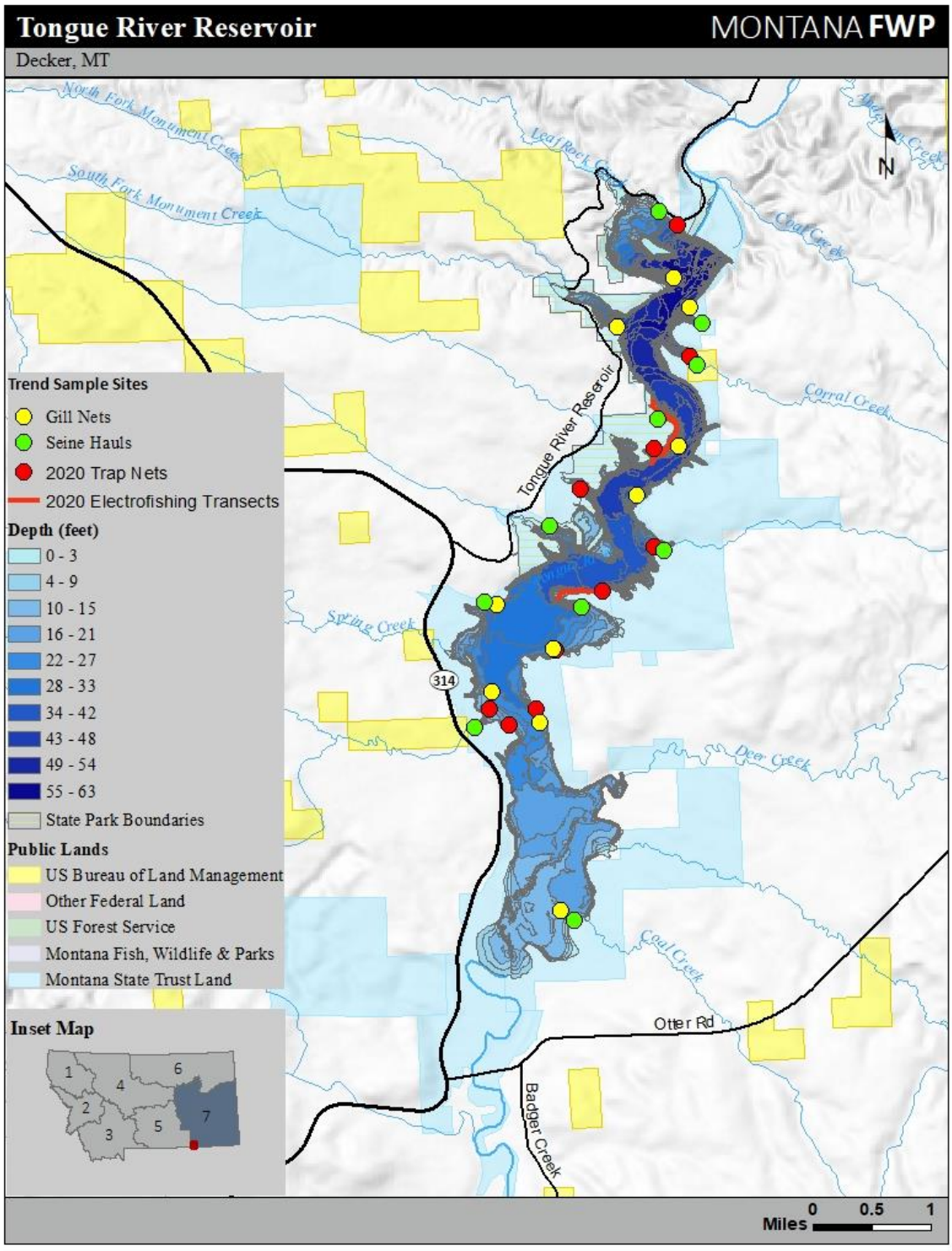

Figure 1. Map of Tongue River Reservoir, Decker, MT with sample locations from August 2020.

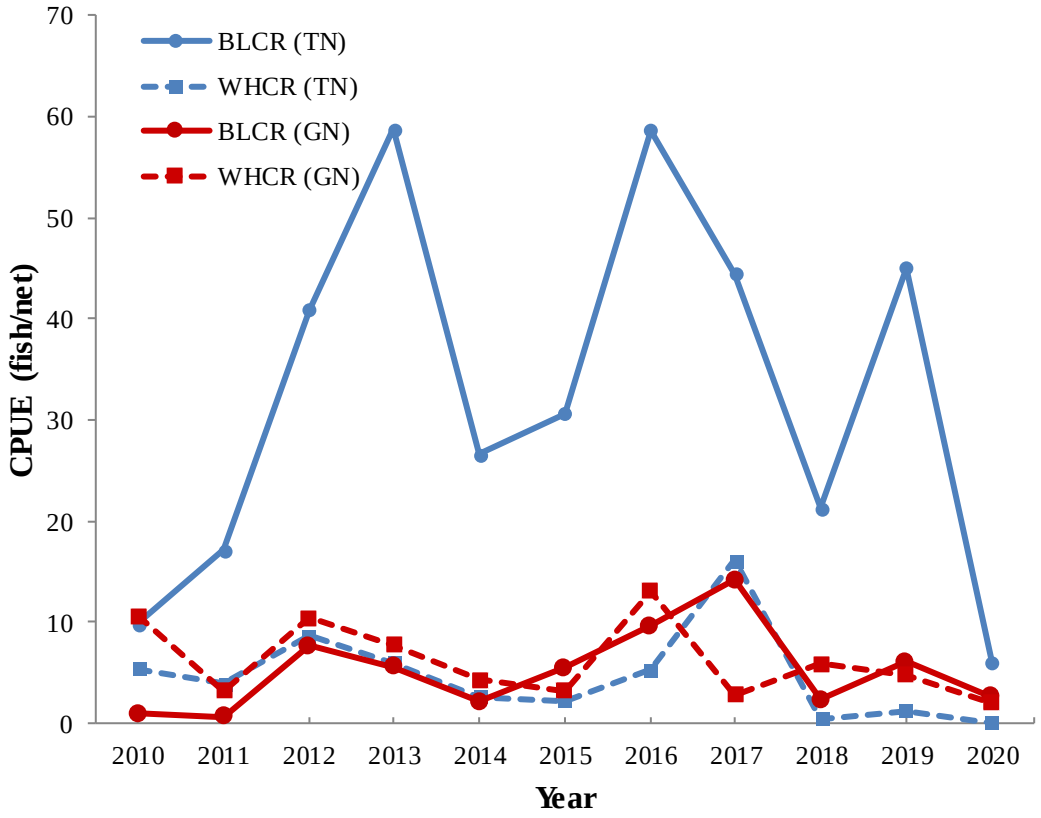

Figure 2. Relative abundance measured in CPUE (fish/net) of Black Crappie (solid lines) and White Crappie (dashed lines) from Tongue River Reservoir August gill-net (red) and trap net (blue) samples 2010-2020.

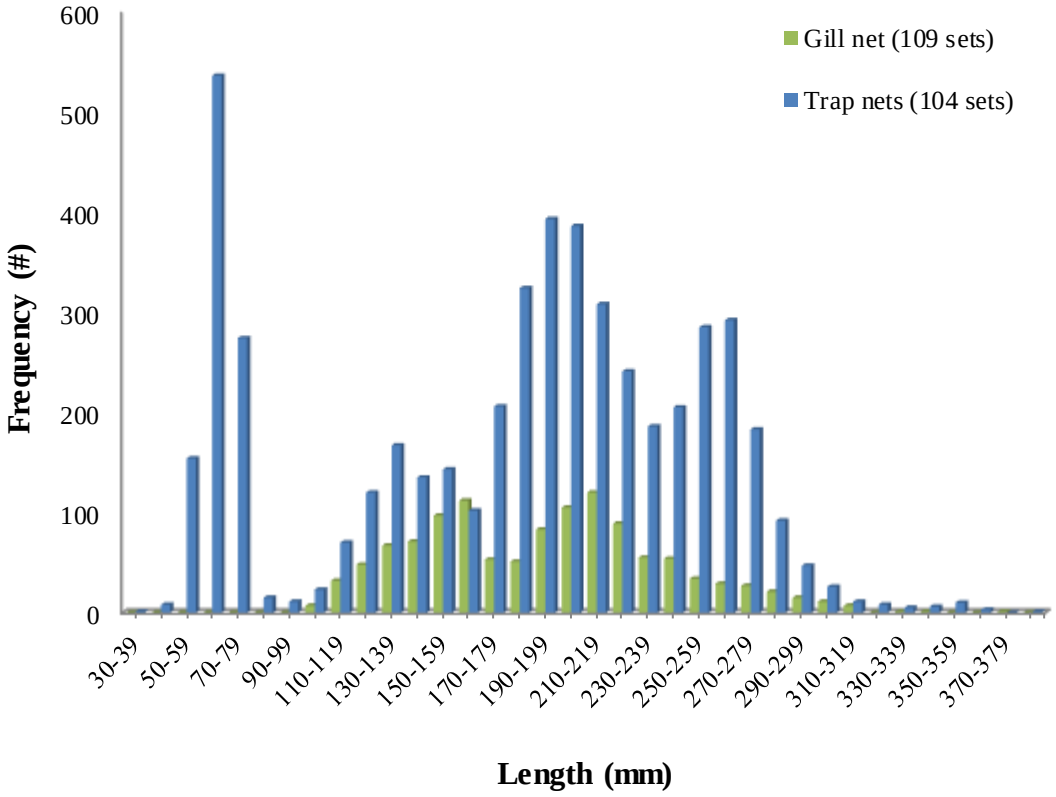

Figure 3. Length frequency distribution of crappie caught in gill nets and trap nets in the month of August 2010-2020.

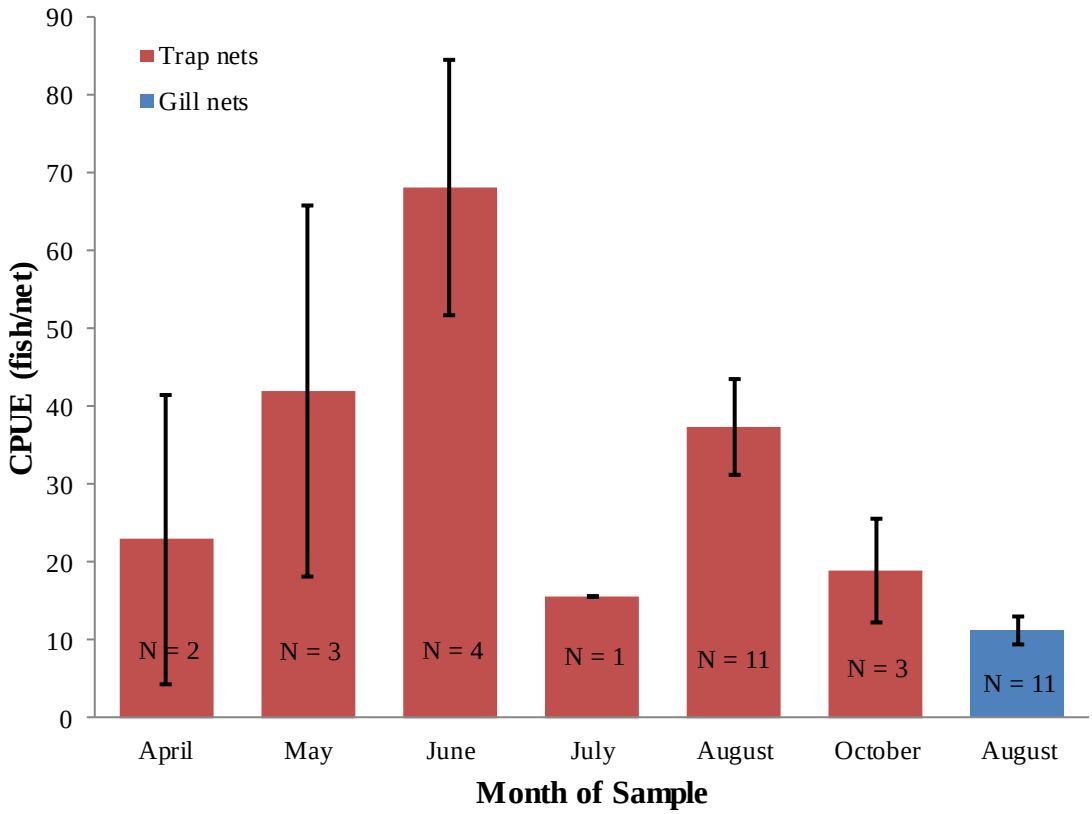

Figure 4. Relative abundance of crappie (Y-axis) captured in trap nets (red bars) and gill nets (blue bar) with standard error and sample size (N) as a function of month of sample (X-axis) in Tongue River Reservoir 2010-2020.

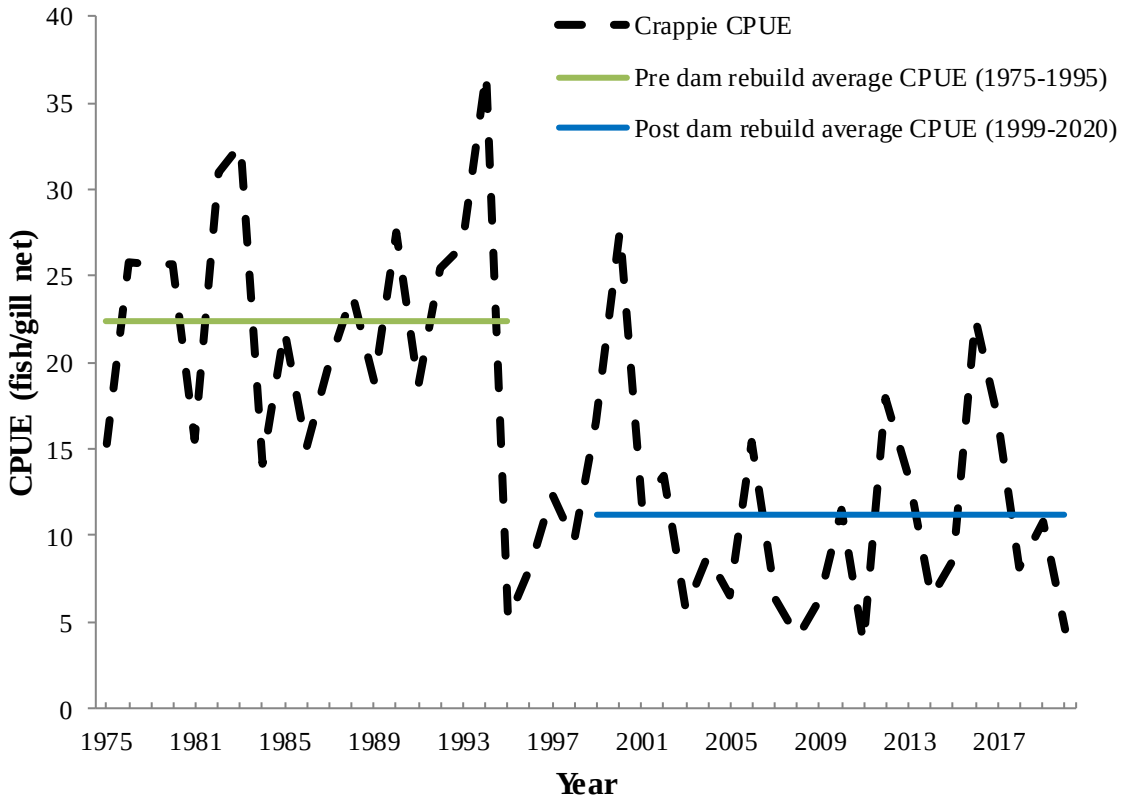

Figure 5. Relative abundance measured in CPUE (fish/gill net) of crappie (dashed black line) on the Y-axis as a function of year on the X-axis from Tongue River Reservoir gill nets, 1975-2020 with indicator lines for average CPUE pre (1975-1995) and post (1999-2020) dam reconstruction.

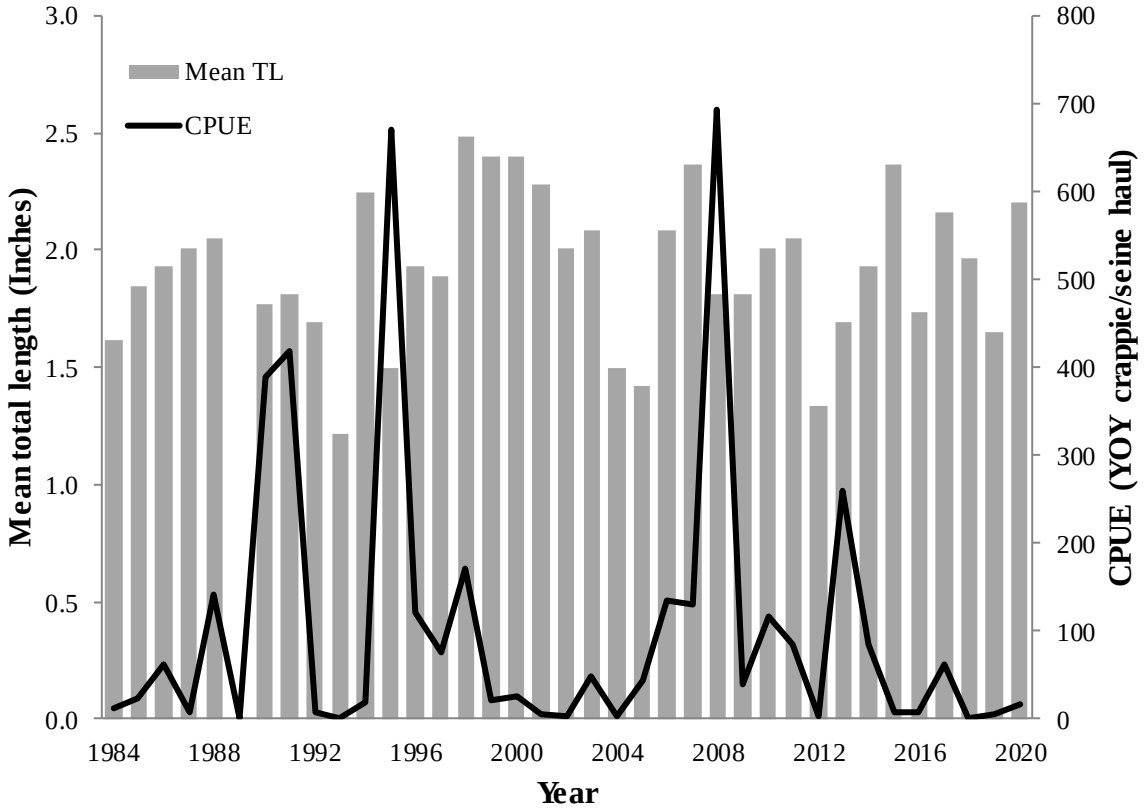

Figure 6. Mean total length (mm) of young-of-the-year (YOY) crappie (primary Y-axis) and relative abundance of YOY crappie measured in CPUE (crappie per seine haul) (secondary Y-axis) as a function of year (X-axis) from Tongue River Reservoir 1984-2020.

Figure 7. Facebook posts of anglers with trophy size White Crappie caught through the ice on Tongue River Reservoir January 2019.

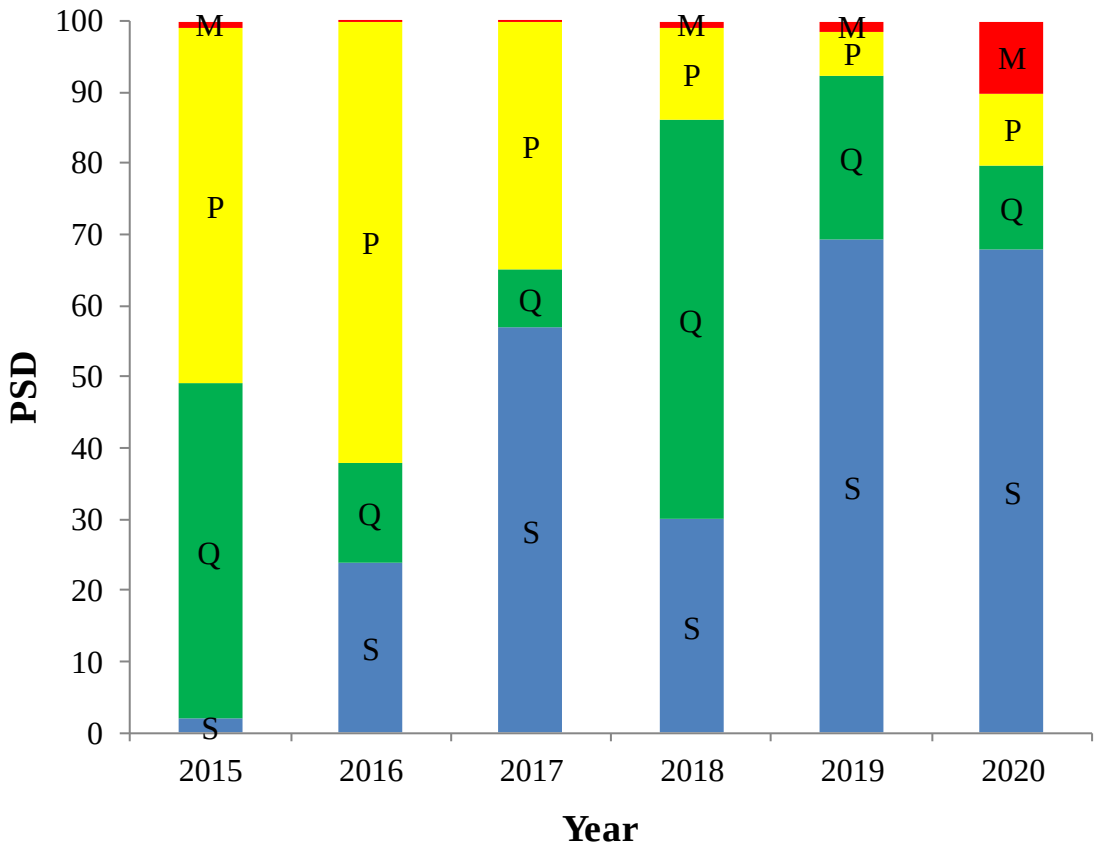

Figure 8. Black Crappie proportion size distribution (PSD) by year.
S=Stock 5-8”, Q=Quality 8-10”, P=Preferred 10-12”, and M=Memorable 12-15”.
Black Crappie caught in trap nets during august 2015-2020.

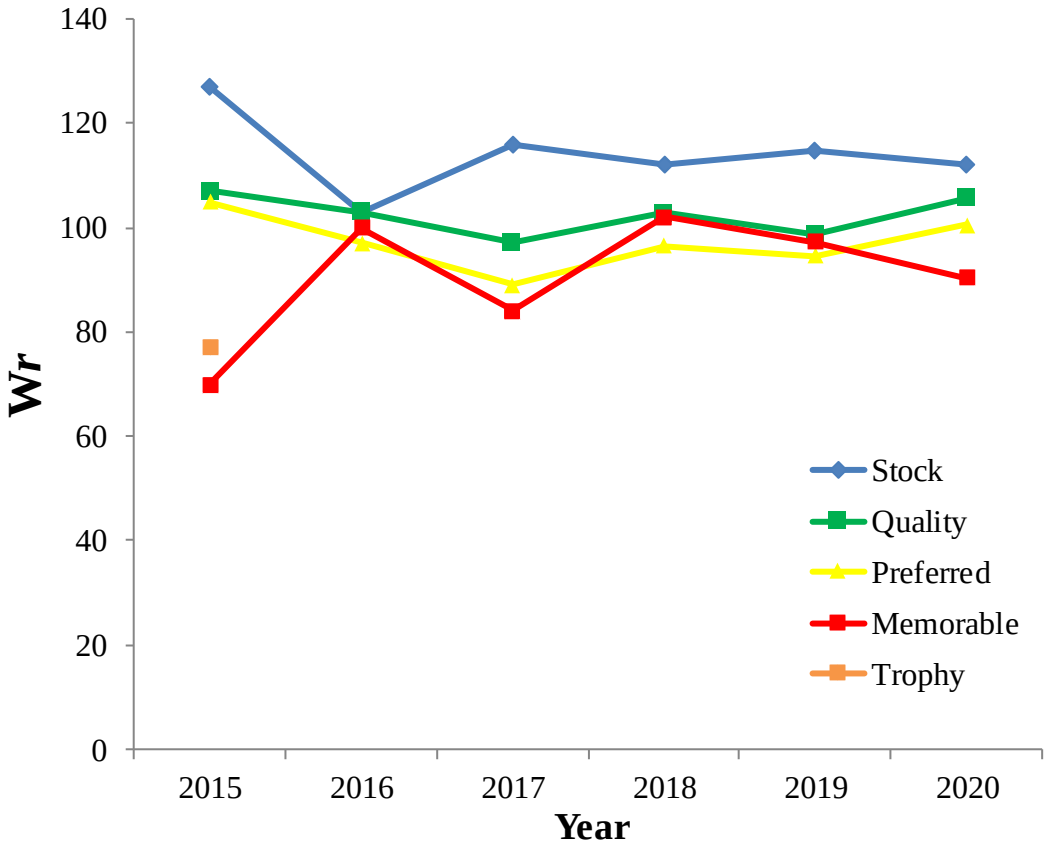

Figure 9. Black Crappie relative weights by year.
S=Stock 5-8”, Q=Quality 8-10”, P=Preferred 10-12”, and M=Memorable 12-15”.
Black Crappie caught in trap nets during august 2015-2020.

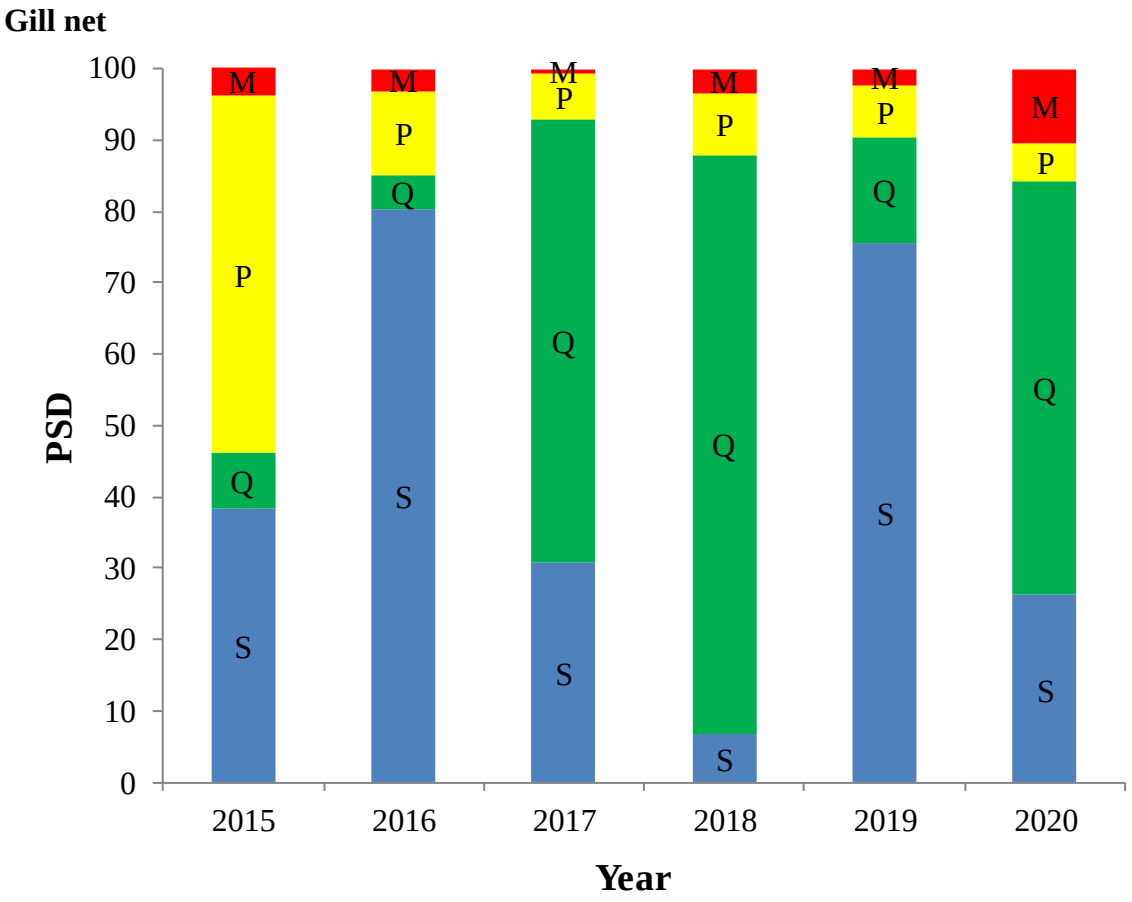

Figure 10. White Crappie proportion size distribution (PSD) by year.
S=Stock 5-8”, Q=Quality 8-10”, P=Preferred 10-12”, and M=Memorable 12-15”.
White Crappie caught gill nets during august 2015-2020.

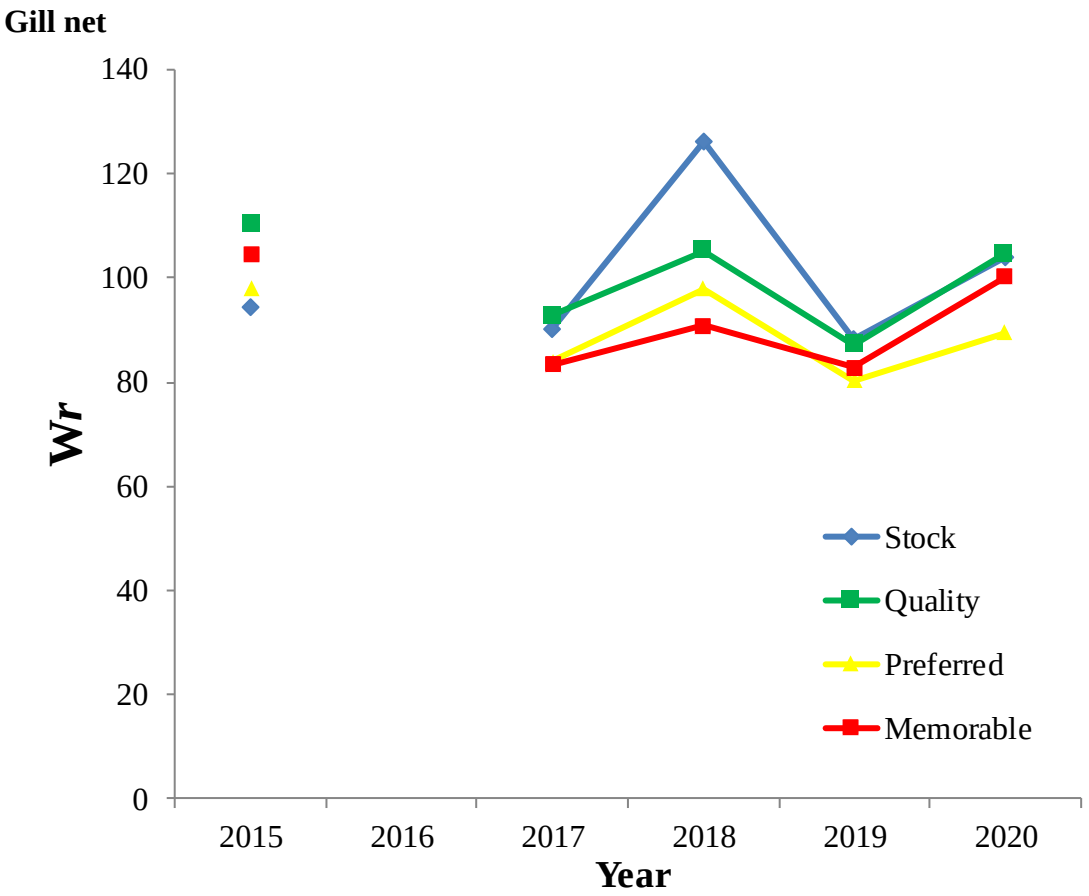

Figure 11. White Crappie relative weights by year.
S=Stock 5-8”, Q=Quality 8-10”, P=Preferred 10-12”, and M=Memorable 12-15”.
White Crappie caught in gill nets during august 2015-2020.

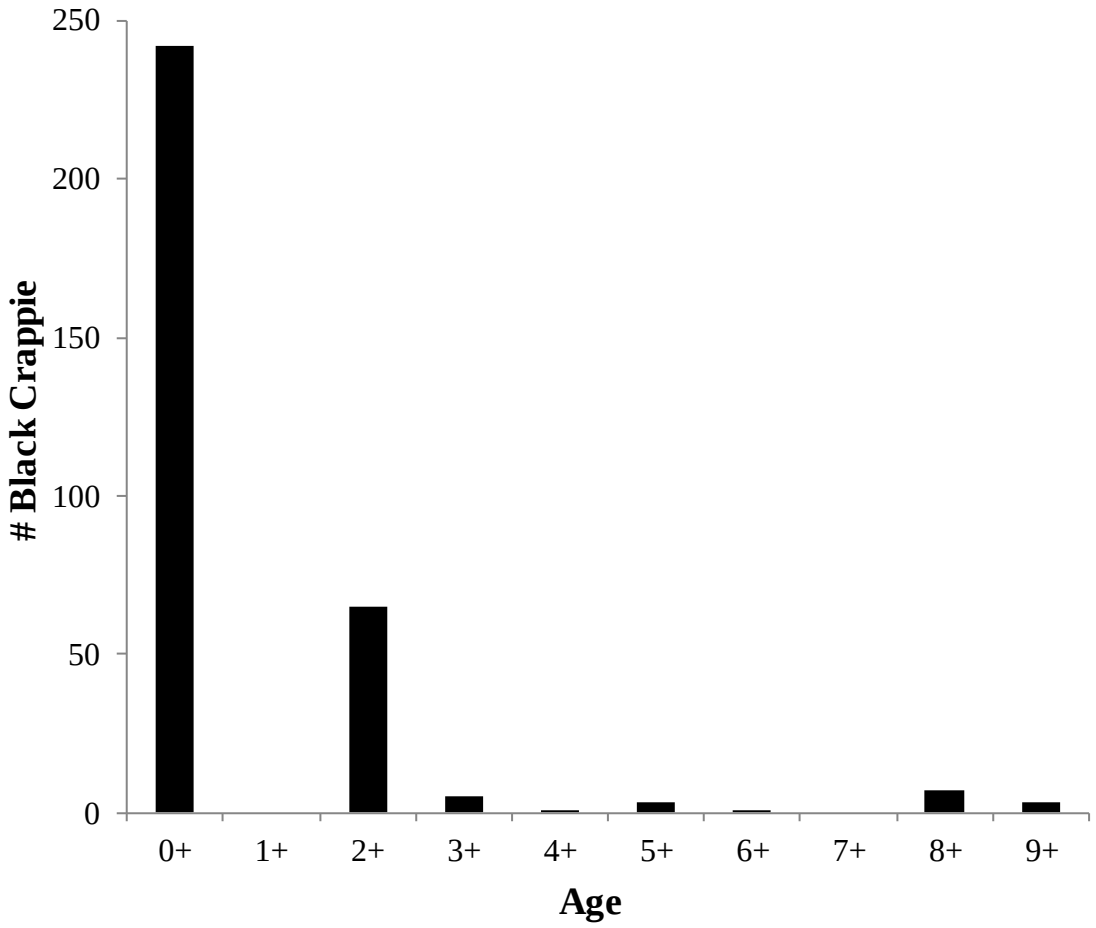

Figure 12. Age frequency histogram for Black Crappie from aging studies at Tongue River Reservoir in 2020. Frequencies calculated from age-length keys (Appendix 2).

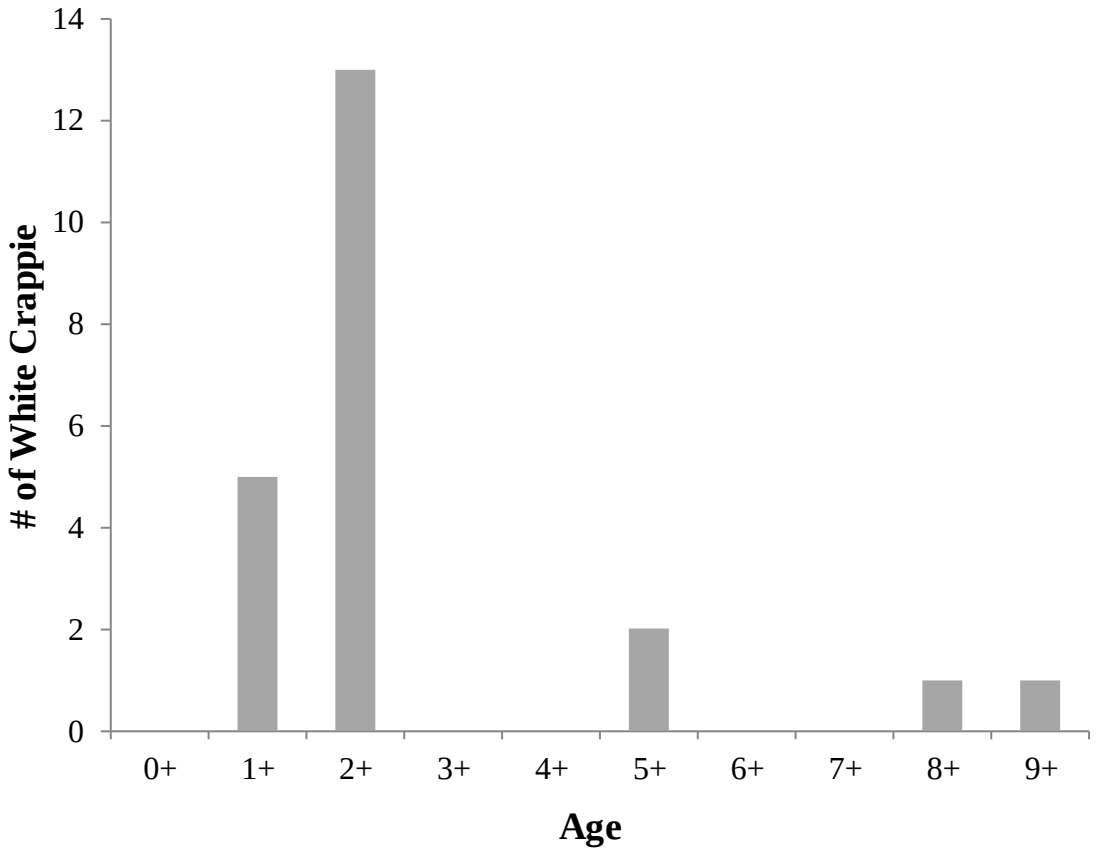

Figure 13. Age frequency histogram for White Crappie from aging studies at Tongue River Reservoir in 2020. Frequencies calculated from age-length keys (Appendix 1).

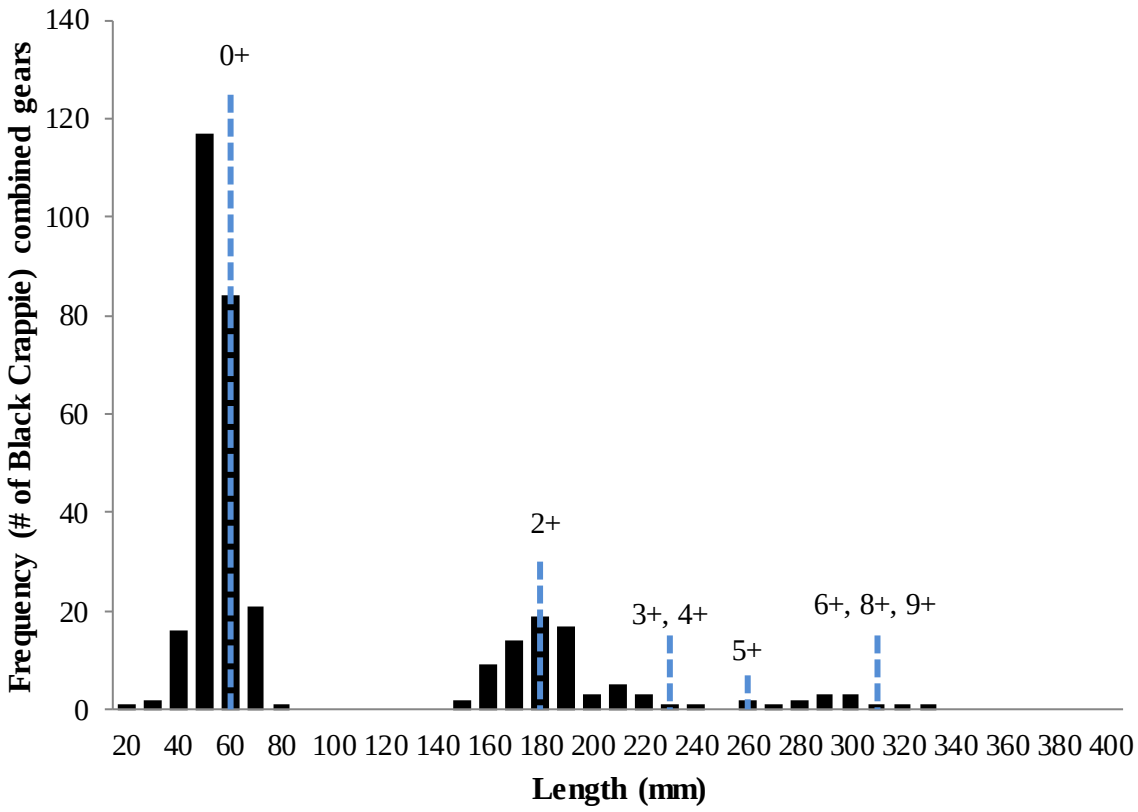

Figure 14. Length frequency histogram of Black Crappie (#) sampled in August 2020 with mean length at age markers from subsample of otolith aged crappie. Gill-net, trap-net, seine, and electrofishing catches combined.

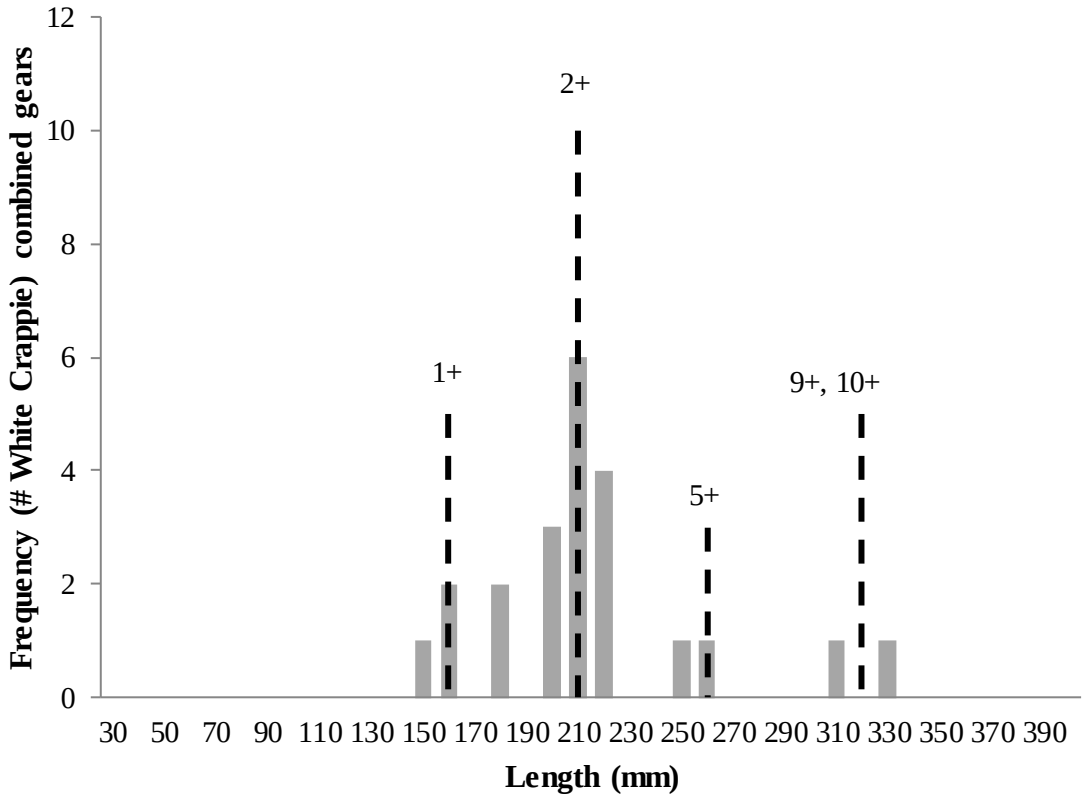

Figure 15. Length frequency histogram of White Crappie (#) sampled in August 2020 with mean length at age markers from subsample of otolith aged crappie. Gill-net, trap-net, seine, and electrofishing catches combined.

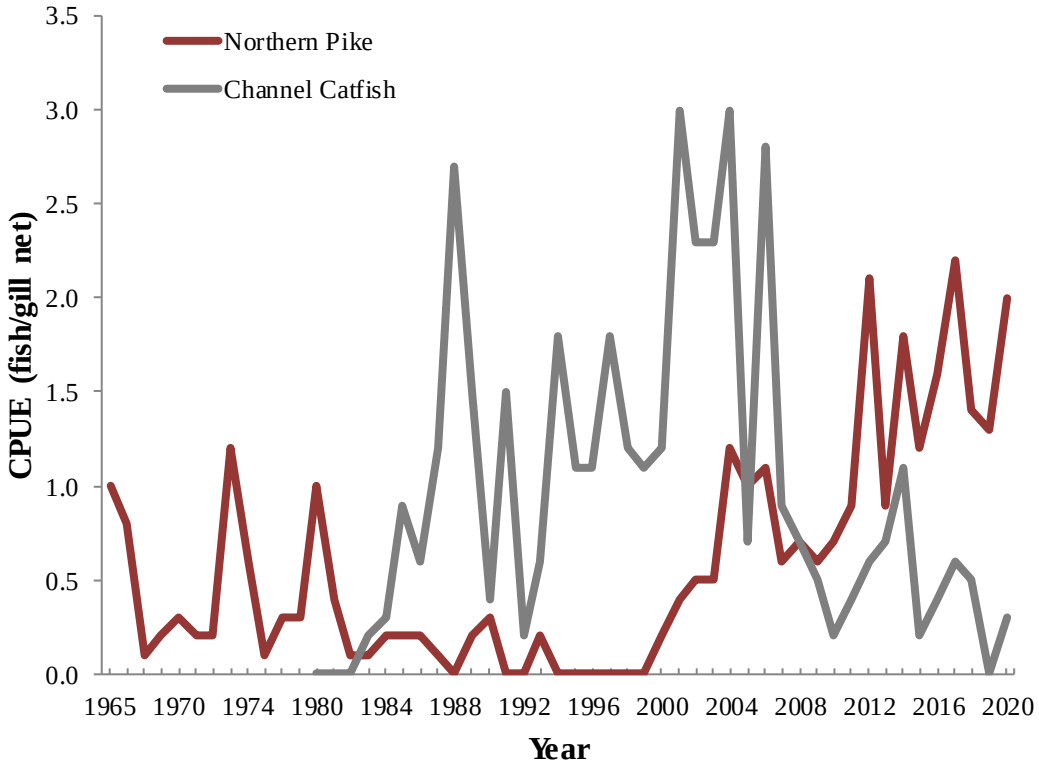

Figure 16. Relative abundance of Channel Catfish and Northern Pike (Y-axis) measured in CPUE (fish/gill net) as a function of year (X-axis) in Tongue River Reservoir 1965-2020.

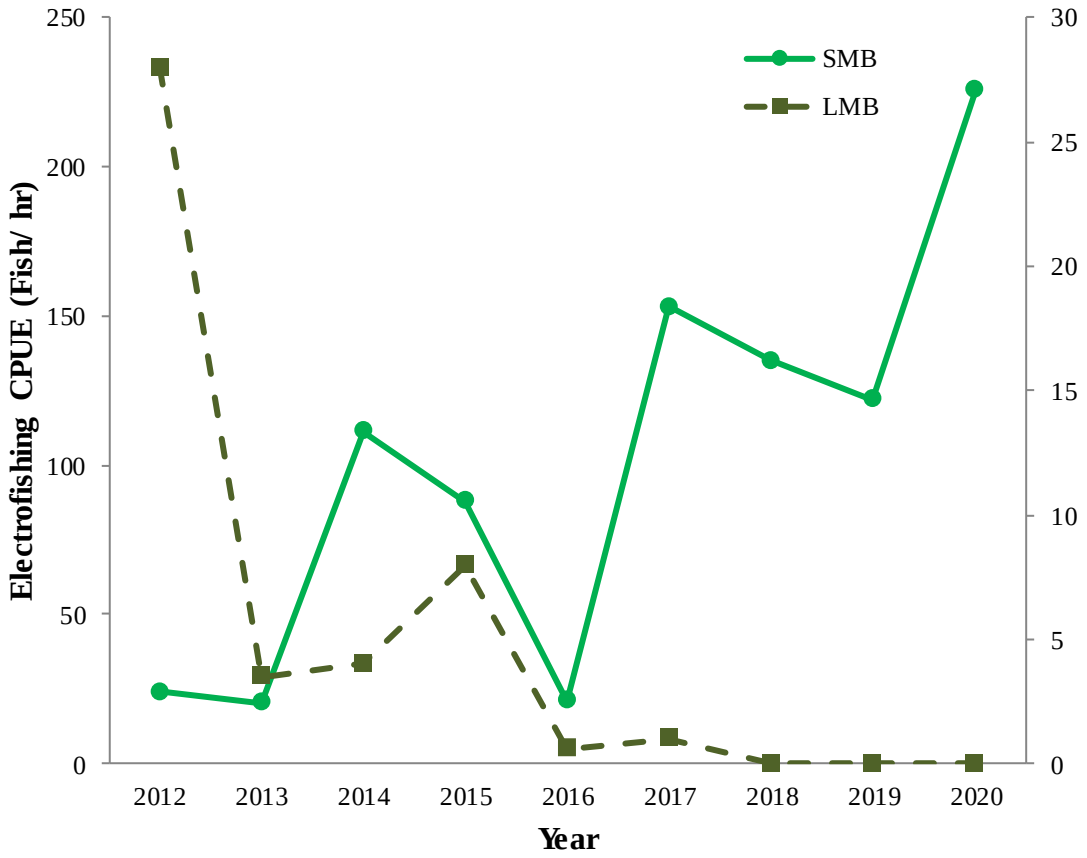

Figure 17. Relative abundance of Smallmouth Bass (primary Y-axis) and Largemouth Bass (secondary Y-axis) measured in CPUE (fish/hr) as a function of year (X-axis) from Tongue River Reservoir electrofishing 2012-2020.

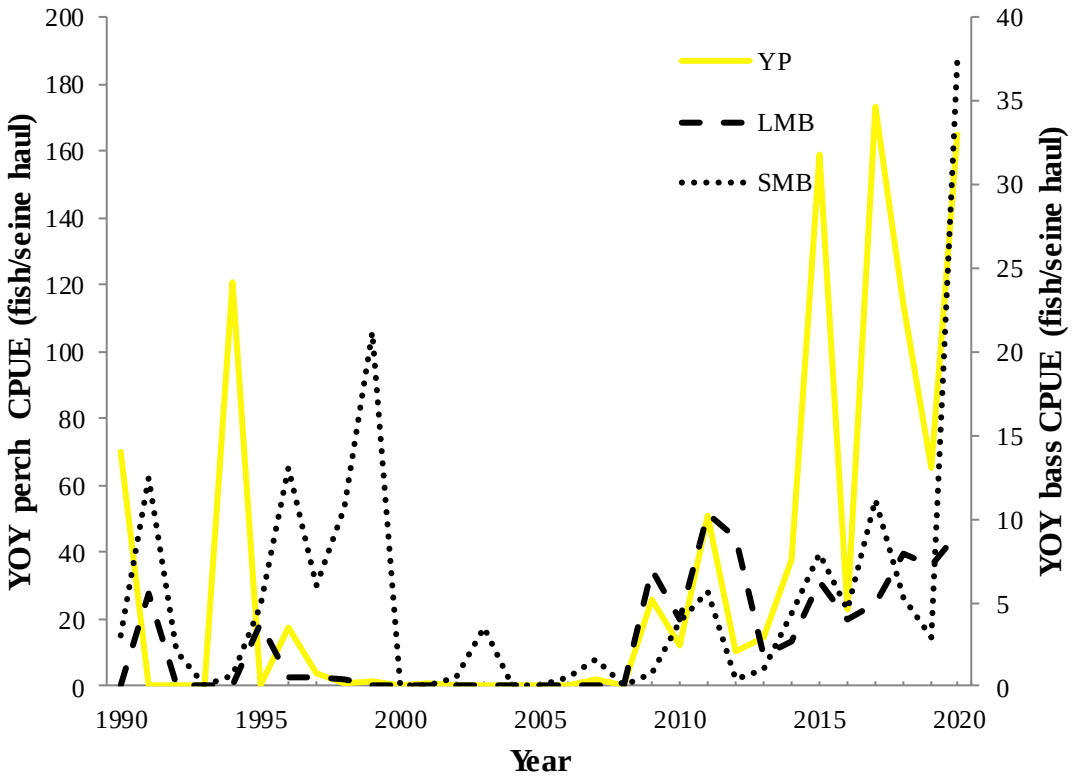

Figure 18. Relative abundance of young-of-the-year (YOY) Yellow Perch (primary Y-axis), Largemouth Bass, and Smallmouth Bass (secondary Y-axis) measured in CPUE (fish/seine haul) as a function of year (X-axis) from Tongue River Reservoir seines, 1990-2020.

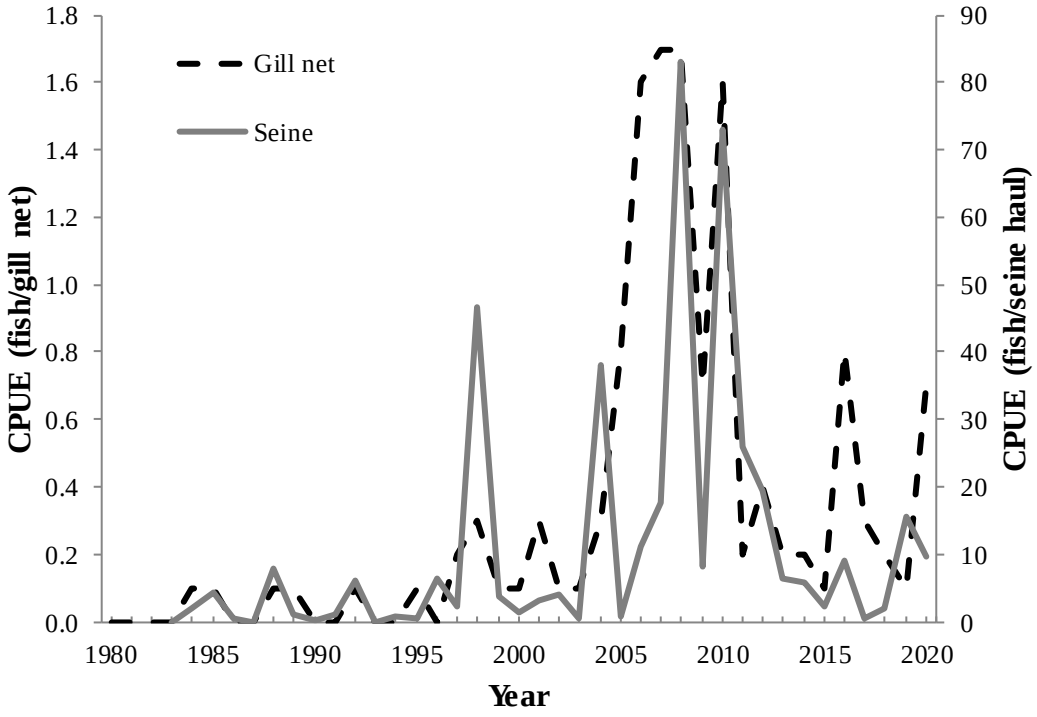

Figure 19. Relative abundance of all Pumpkinseed Sunfish caught in gill nets (primary Y-axis) and seine hauls (secondary Y-axis) measured in CPUE as a function of year (X-axis) in Tongue River Reservoir 1980-2020.

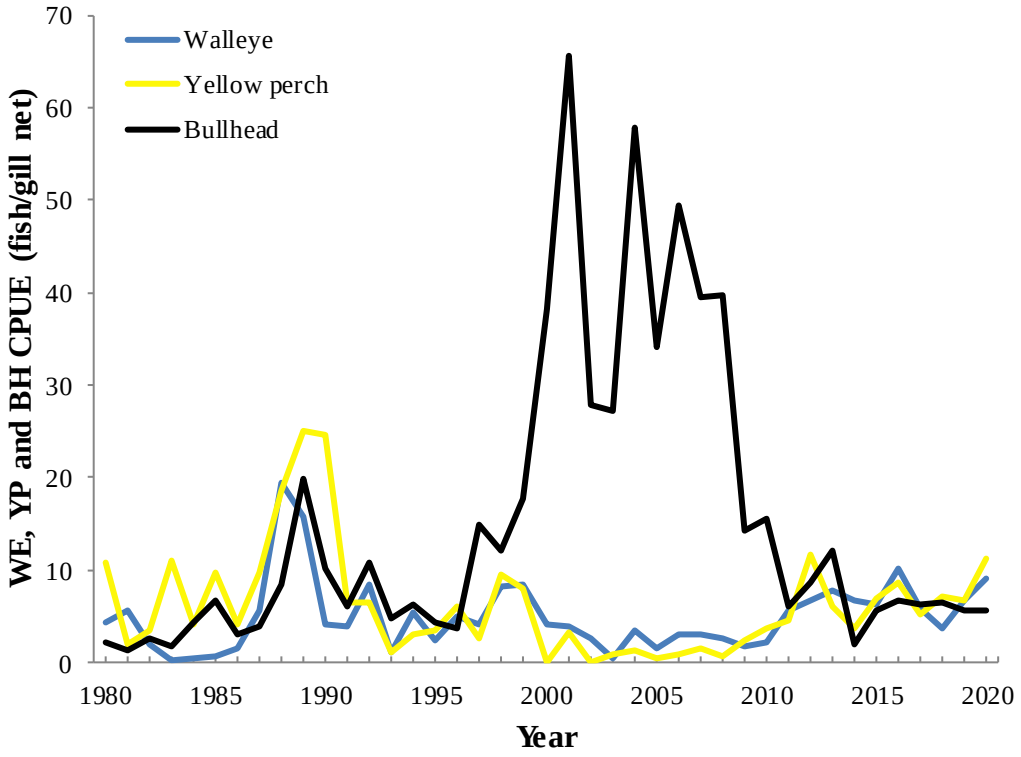

Figure 20. Relative abundance of Walleye, Yellow Perch and bullheads caught in gill nets (primary Y-axis) measured in CPUE as a function of year (X-axis) in Tongue River Reservoir 1980-2020.

Figure 21. Facebook post of angler with Tiger Musky caught through the ice on Tongue River Reservoir January 2019.

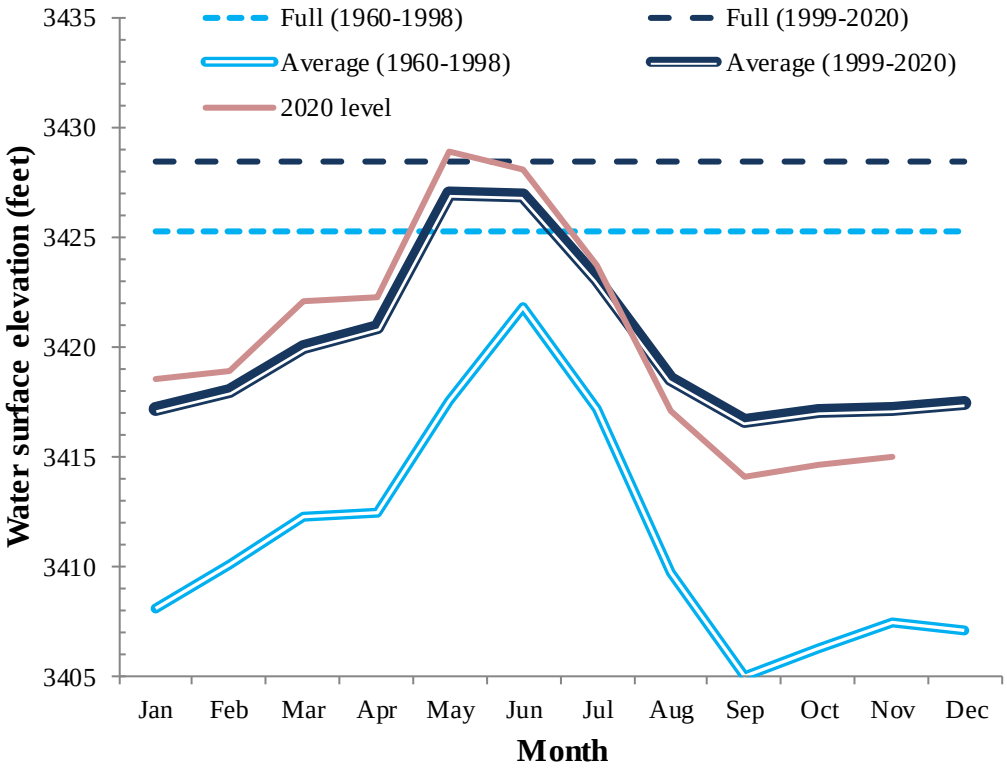

Figure 22. Tongue River Reservoir 2020 water surface elevation in feet by month with full pool reference lines and historical mean storage level pre (1960-1998) and post (1999-2020) dam reconstruction, data provided by DNRC website.

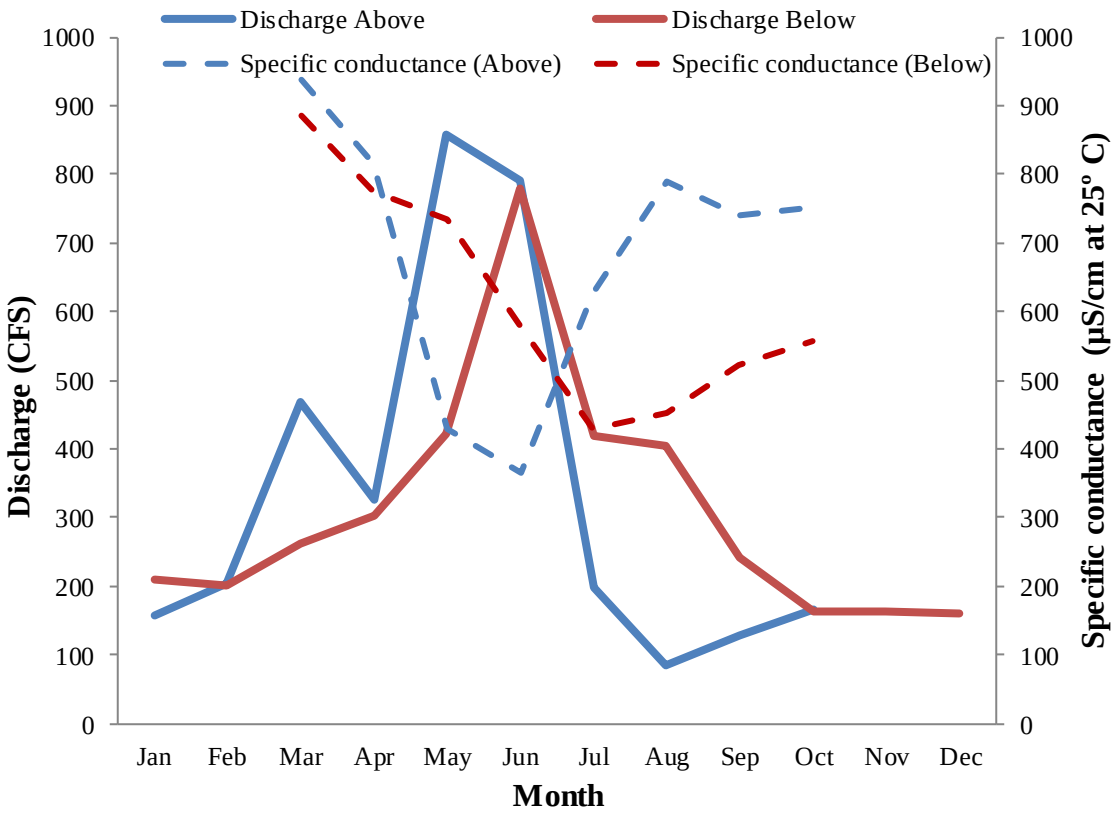

Figure 23. Monthly mean discharge measured in cubic feet per second (primary Y-axis) and specific conductance measured in µS/cm at 25º C (secondary Y-axis) by month (X-axis) from USGS gauging stations 06306300 Tongue River at state line (Above) and 06307500 Tongue River at Tongue River Dam (Below), Decker MT during 2020.

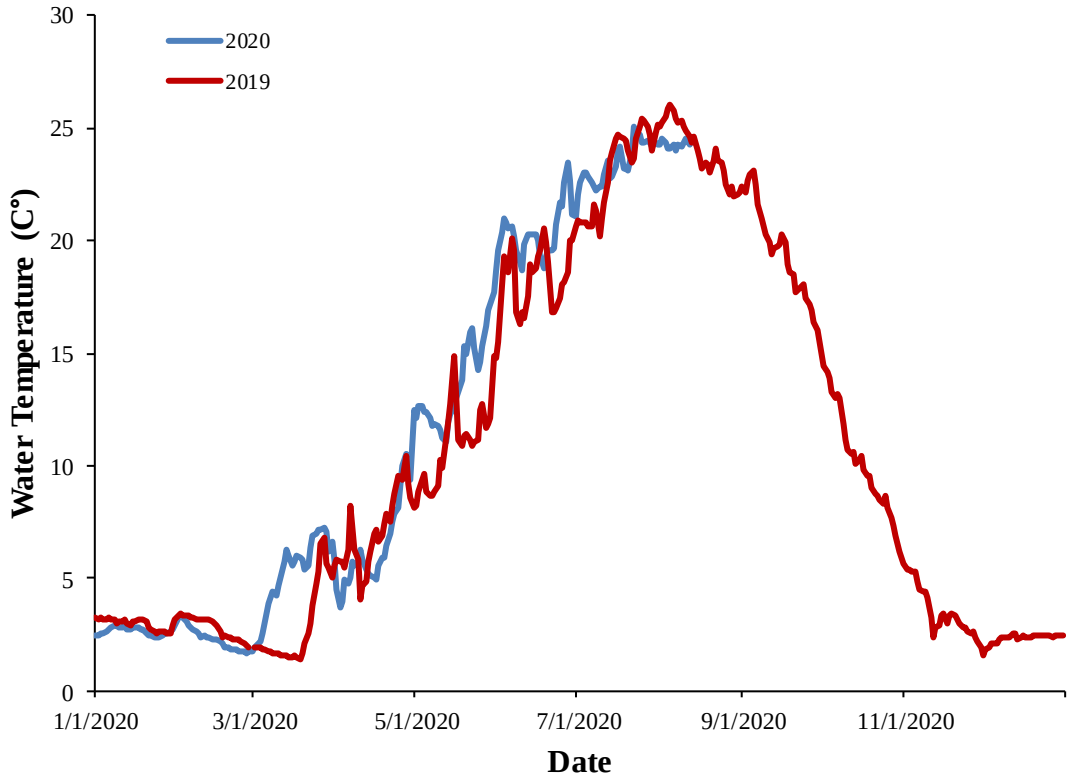

Figure 24. Daily mean water temperature measured in degrees Celsius (C°) on the Y-axis by day on the X-axis for 2019 and 2020 at Tongue River Reservoir, Decker, MT.

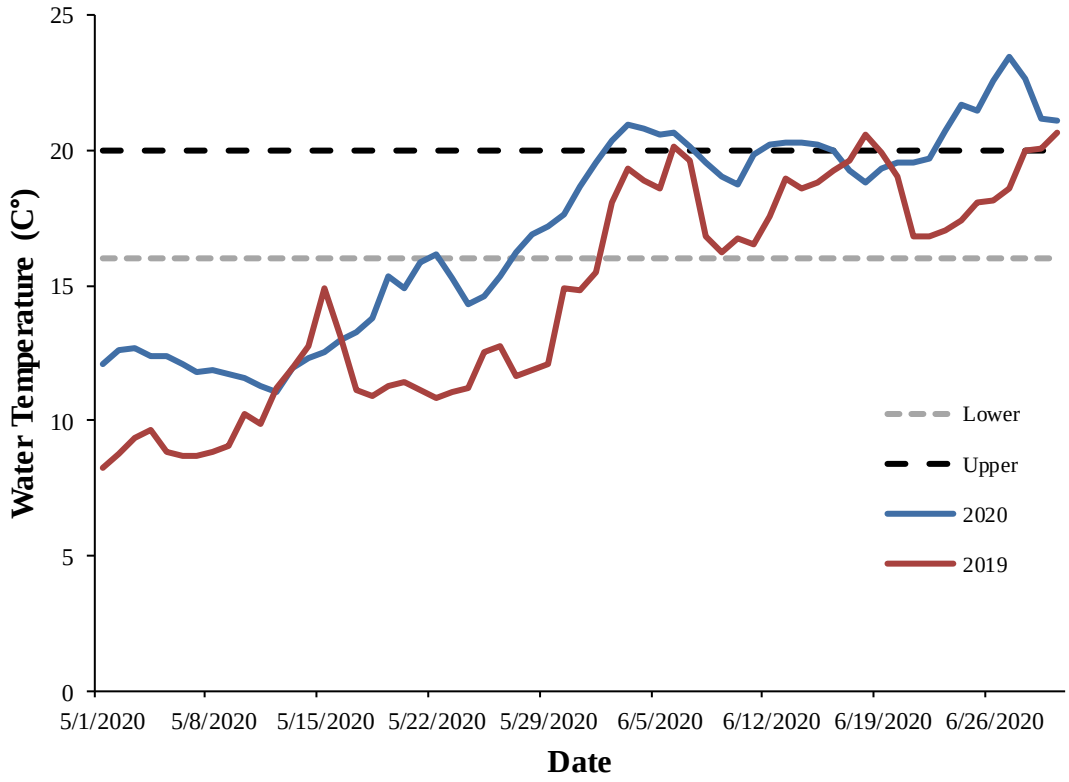

Figure 25. Daily mean water temperature measured in degrees Celsius (C°) on the Y-axis by day during May and June on the X-axis for 2019 and 2020 with 16°C lower and 20°C upper spawning limit at Tongue River Reservoir, Decker, MT.

Appendix 1. Age study summary of reader agreement

			Reader Agreement		
Year	Species	Readers	Agreed	Within 1 Year	Within 2 Years
2013	Crappie	University of Idaho, FWP (Caleb Bollman)	96%	100%	-
2014	Crappie	FWP (Caleb Bollman), FWP (Drew Wallace)	89%	99%	-
2014	Walleye	University of Idaho, FWP (Caleb Bollman)	83%	97%	-
2014	Northern Pike	University of Idaho	47%	76%	93%
2014	Smallmouth Bass	FWP (Caleb Bollman), FWP (Drew Wallace, Niall Clancy)	63%	91%	98%
2017	Crappie	FWP (Caleb Bollman), FWP (Drew Wallace)	95%	100%	-
2018	Crappie	FWP (Caleb Bollman), FWP (Kevin McKoy)	99%	100%	-
2019	Crappie	FWP (Caleb Bollman), FWP (Kevin McKoy)	97%	100%	-
2019	Walleye	FWP (Caleb Bollman), FWP (Kevin McKoy)	96%	100%	-
2020	Crappie	FWP (Caleb Bollman), FWP (Kevin McKoy)	98%	100%	-
2020	Walleye	FWP (Caleb Bollman), FWP (Kevin McKoy)	98%	100%	-

Appendix 2. Age-length Keys

2020 Black Crappie Age-Length Key

*Corresponding year class designation			2020	2018	2017	2016	2015	2014	2012	2011
Length	Number	Number (age)	Sample allocation per age-group							
Group (cm)	in sample	in subsample	Age 0+	Age 2+	Age 3+	Age 4+	Age 5+	Age 6+	Age 8+	Age 9+
2	1	1(0)	1							
3	2		2							
4	16	16(0)	16							
5	117	15(0)	117							
6	84	15(0)	84							
7	21	16(0)	21							
8	1	1(0)	1							
9										
10										
11										
12										
13										
14										
15	2	1(2)		2						
16	9	7(2)		9						
17	14	14(2)		14						
18	19	19(2)		19						
19	17	13(2)		17						
20	3									
21	5	3(2), 1(3)		4	1					
22	3	2(3), 1(4)			2	1				
23	1	1(3)			1					
24	1				1					
25										
26	2	2(5)					2			
27	1	1(5)					1			
28	2	1(8), 1(9)							1	1
29	3	2(8)							3	
30	3	2(8), 1(9)							2	1
31	1	1(8)							1	
32	1	1(9)								1
33	1	1(6)						1		
34										
All	330		242	65	5	1	3	1	7	3

2020 White Crappie Age-Length Key

*Corresponding year class designation			2019	2018	2015	2012	2011
Length	Number	Number (age)	Sample allocation per age-group				
Group (cm)	in sample	in subsample	Age 1+	Age 2+	Age 5+	Age 8+	Age 9+
7							
8							
9							
10							
11							
12							
13							
14							
15	1	1(1)	1				
16	2	2(1)	2				
17							
18	2		2				
19							
20	3	3(2)		3			
21	6	6(2)		6			
22	4	2(2)		4			
23							
24							
25	1	1(5)			1		
26	1				1		
27							
28							
29							
30							
31	1	1(8)				1	
32							
33	1	1(9)					1
34							
All	22		5	13	2	1	1

2020 Walleye Age-Length Key

*Corresponding year class designation ---			2020	2019	2018	2017	2016	2015	2014	2012	2011	2009	2008
Length	Number	Number (age)	Sample allocation per age-group										
Group (cm)	in sample	in subsample	Age 0+	Age 1+	Age 2+	Age 3+	Age 4+	Age 5+	Age 6+	Age 8+	Age 9+	Age 11+	Age12+
8	3		3										
9	2		2										
10													
11	1	1(0)	1										
12	6	6(0)	6										
13	2	2(0)	2										
14	3		3										
15	1		1										
-													
18	1			1									
19	1	1(1)		1									
20	1	1(1)		1									
21													
22	3	2(1)		3									
23	5	5(1)		5									
24	7	7(1)		7									
25	6	4(1)		4									
26	3	3(1)		3									
27													
28	1	1(1)		1									
29													
30	2	1(2)			2								
31	1				1								
32	3	3(2)			3								
33	3	1(1), 2(2)		1	2								
34	1	1(2)			1								
35	4	4(2)			4								

2020 Walleye Age-Length Key…continued

*Corresponding year class designation ---			2020	2019	2018	2017	2016	2015	2014	2012	2011	2009	2008
Length	Number	Number (age)	Sample allocation per age-group										
Group (cm)	in sample	in subsample	Age 0+	Age 1+	Age 2+	Age 3+	Age 4+	Age 5+	Age 6+	Age 8+	Age 9+	Age 11+	Age12+
36	3	1(1), 2(2)		1	2								
37	4	4(2)			4								
38	1	1(2)			1								
39	3	2(2)			3								
40	3	2(2)			3								
41	3				2	1							
42	2	1(3)				2							
43	3	1(3)				3							
44	1	1(3)				1							
45	2	1(2), 1(5)			1			1					
46	4	3(3)				4							
47	5	3(3), 1(4), 1(5)				3	1	1					
48	3	1(3)				3							
49	5	4(3), 1(5)				4		1					
50	6	3(3), 1(4), 1(5)				4	1	1					
51	3	1(3), 1(6)				2			2				
52	2	1(5)						2					
53	2	1(8), 1(9)								1	1		
54	1	1(6)							1				
55	1	1(6)							1				
56	3	1(5)						3					
57	2	2(5)						2					
58	2	2(5)						2					
59	1							1					
60	3	1(6), 1(8)							2	2			

2020 Walleye Age-Length Key…continued

*Corresponding year class designation ---			2020	2019	2018	2017	2016	2015	2014	2012	2011	2009	2008
Length	Number	Number (age)	Sample allocation per age-group										
Group (cm)	in sample	in subsample	Age 0+	Age 1+	Age 2+	Age 3+	Age 4+	Age 5+	Age 6+	Age 8+	Age 9+	Age 11+	Age12+
61													
62	2	1(6), 1(8)							1	1			
63	1									1			
64													
65	2	1(8), 1(9)								1	1		
-													
68	1										1		
69	2	1(9), 1(12)									1		1
70	1	1(11)										1	
71													
72	1	1(12)											1
All	138		18	28	29	27	2	14	7	6	4	1	2