Montana Department of Fish, Wildlife and Parks
Fisheries Division

Job Progress Report

STATE: Montana **PROJECT: Yellowstone River Drainage Investigations**

STUDY TITLE: Tongue River Reservoir Investigations

PROJECT NO. F-2013-R-7

PROJECT PERIOD: April 1, 2012 through March 30, 2014

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 was above the 10 year (1994-2013) average in 2012 and 2013. Young-of-the-year (YOY) crappie relative abundance in 2012 indicated poor reproduction. Relative abundance of YOY crappie in 2013 was the third highest in 20 years and is likely to contribute a strong year class to the fishery. Catch rates of walleye continue to exceed the management objective (2 fish per gill net) and historical average (4.6 fish per gill net). Walleye, crappie, and yellow perch accounted for 70% of gill-net catch in 2012 and 60% of gill-net catch in 2013. Crappie YOY, and yellow perch YOY accounted for 22% of the seine catch in 2012 and 46% in 2013. Catch rates of largemouth bass YOY and yellow perch YOY have been increasing since the dam rebuild in 1998. Changes to fish populations as a result of coal bed natural gas production have not been documented but may exist as they are difficult to quantify. Modified fyke nets (trap nets) were added to the annual August trend sample in 2010. Trap nets have been used in April, May, June, and October to increase crappie sample size, and explore seasonal variation in catch rates. Night electrofishing samples were done in 2012 and 2013 to target bass and crappie and diversify sampling methods. Trap netting and electrofishing efforts have improved data available for evaluation of the Tongue River Reservoir fishery and should be continued and standardized.

INTRODUCTION

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. Crappies are abundant, easy to catch, and with a liberal 30 crappie per day limit, the reservoir attracts anglers of all skill levels. It is particularly popular with families and sustains some of the highest angler days per surface acre of any reservoir in the state (McFarland and Meredith 2004, McFarland 2009). Overall angler satisfaction is

moderate and comparable to Fort Peck Reservoir (McFarland 2009). Tongue River Reservoir offers angling opportunity in both summer and winter but use and satisfaction are higher in the summer (McFarland 2009). 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 (crowding at boat ramps and on the reservoir, competition for camping space) 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 time 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 species, particularly largemouth bass.

There was no daily limit on crappie prior to 1996. From 1996 to 2000 a daily limit of 15 fish was established to protect the population while the reservoir was held at a reduced pool level to facilitate rebuilding the dam. Since 2001, the crappie daily limit has been 30 fish. After completion of the dam rebuild, 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 six 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.

The development of coal bed methane has had an impact on the Tongue River drainage and reservoir. Wastewater from methane extraction is discharged into the Tongue River above the reservoir. This wastewater is generally of higher salinity and electro conductivity and if contributions are large enough, may change the overall salinity and conductivity of water stored in the reservoir. Irrigators concerned with changes in water quality 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. Changes to fish populations as a result of methane production have not been documented 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. Species specific management objectives for Tongue River Reservoir are:

(1) 20% of adult crappie from overnight gill nets > 250 mm (10 inches),
(2) Two walleye per overnight gill-net set, and
(3) Maintain viable populations of other game fish species.

In meeting these objectives Montana Fish, Wildlife and Parks ensures that quality sport fishing opportunities are available at Tongue River Reservoir. Tongue River Reservoir is sampled annually with a suit of gears to monitor if goals are being met and evaluate effect of management actions.

METHODS

This report covers annual trend sampling and additional exploratory sampling efforts at Tongue River Reservoir completed in 2012 and 2013. Annual trend sampling was conducted during the month of August using experimental gill nets, beach seines, trap nets (i.e. modified fyke nets), and night electrofishing. Additional sampling to explore seasonal gear efficiency was conducted in May 2013 using trap nets and night electrofishing. The results of additional sampling efforts will be used to determine the most effective and logistically concise protocol for future trend sampling. 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 quarter circle pattern to capture fish. Both gillnetting and seining consisted of 10 net sets/seine hauls distributed between the upper and lower halves of the reservoir taken at standardized locations (Figure 1). Trap nets had 4 x 6 ft frames with 0.5-inch mesh (bar measure). Trap net sample locations are randomly selected from a stratified set of 33 sample sites (Figure 2). Night electrofishing was completed in 2012 and 2013 with a 14ft aluminum boat equipped with a Smith Root VVP 15B rectifier and a single boom with a cable dropper array. All fish were identified to species, weighed (g), and measured (total length, mm). For abundant species, lengths and weights were collected from a sub-sample of 25-50 individuals. Relative abundance for crappie caught in trap nets and crappie caught in gill nets were compared using a two-sample *t*-test to determine if relative abundance differed as a function of gear using August 2010 to 2013 data (Excel 2007).

Length and weight summary statistics were calculated for each species. Catch per unit effort (CPUE) was used to describe the relative abundance of sampled fish. Black and white crappie catches were combined for relative abundance analysis. The unit of effort for gill-net and trap net sampling was one net night (approx. 24 hr period). One seine haul was one unit of effort for seine sampling. 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 in gill nets, trap nets, and electrofishing. Otoliths were aged from 102 crappie (black and white combined) collected in August samples. Crappie in the age study ranged from 157mm (6 in) to 357mm (14 in) and were sub sampled with otoliths from 10 crappie kept per 10mm length class according to Devries and Frie (1996).

Reservoir storage (acre-ft) and water level (ft) were obtained from the Montana Department of Natural Resources and Conservation (DNRC) website and personnel (Sam Johnson). 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 US Geologic Survey (USGS) website. A Secchi disc tube was used to measure water clarity

(i.e. transparency). A water quality meter (YSI 85) was used to record temperature, dissolved oxygen, specific conductance and salinity in Tongue River Reservoir. A Hanna pH meter was used to record pH. A Garmin hand held GPS unit was used to record latitude and longitude for all fish and water quality sample locations.

RESULTS AND DISCUSSION

A summary of the annual gill-netting sample from 2012 can be found in table one. A total of 465 fish was sampled using gill nets in August 2012. Results from the 2012 gill-net sample come from nine net sets due to one net being unrecoverable. Efforts to recover the net were made in the area surrounding its set location with a grapple. A summary of the annual gill-netting sample from 2013 can be found in table two. A total of 451 fish was sampled using gill nets in August 2013. A summary of the annual seine sample from 2012 can be found in table three. A total of 653 fish was sampled using seines in August 2012. A summary of the annual seine sample from 2013 can be found in table four. A total of 4,854 fish was sampled using seines in August 2013. A summary of trap net sample data can be found in table five. A total of 646 fish was sampled using trap nets in August 2012. A summary of trap net sample data can be found in table six. A total of 790 fish was sampled using trap nets in August 2013.

Crappie

Gill-net and trap net catch rates indicate the relative abundance of crappie in Tongue River Reservoir was above average in 2012 and 2013. This data is encouraging after an all time low gill-net catch rate in 2011 (Figure 3). Trap net catch rates indicate a larger increase in relative abundance than the gill-net data over the period 2010 to 2013 (Figure 4). The five-year (2009 through 2013), 10-year (2004 through 2013) and 20 year (1994 through 2013) average catch rates for adult crappie were 11, 9, and 12 fish per gill net respectively. Crappie catch rates exceeded these bench marks in both 2012 and 2013 gill-net samples (Tables 1 and 2). Higher catch rates in 2012 and 2013 were driven by 200-240mm (8-9 in) crappie from the 2010 and 2011 year classes that only appeared to be modest cohorts when first observed as YOY (Figures 5 and 6). Crappie from 2 to 10 years old were found in the 2013 age study (n=102). Stewart found crappie from 1 to 5 years old in the 1983 age study (n=59). Comparison of the crappie length frequency histogram and results of aged otoliths suggests cohorts can be assigned accurately to age 3 by length frequency (Figure 6). In Tongue River Reservoir by the time crappie reach the size (260 to 320mm total length) that Miranda and Dorr (2000) found anglers select for with rod and reel there is substantial overlap in length between cohorts ranging from 4 to 10 years old. Data from crappie caught and aged in 2013 indicates 137-254mm (6-10 in) fish were aged at 2 to 3 years old coming from the 2011 and 2010 year classes (Figure 6). Crappie that were 237-357mm (10-14 in) fish were aged at 4 to 8, and 10 years old coming from the 2009 to 2007, and 2003 year classes (Figure 6). The YOY crappie catch rate in the 2013 seine sample was the third highest in 20 years indicating there is the potential for a strong 2013 year class (Figure 5).

On average crappie longer than 250mm (total length) in reservoirs are four or more years old (McInerny and Cross 2008). Percentage of adult crappie greater than 250mm (total length) from gill nets was 7% in 2012 and 5% in 2013, below the management objective (20%) that has not been met since 1998 (Table 9). Calculation of the percentage of adult crappie greater than 250mm (total length) caught in trap nets during the same sample period demonstrates a similar trend (Figure 7). The management objective has only been met in six of the last 34 years. Analysis of the long term trend for gill-net data, short term trend for trap net data and historical data for crappie size structure indicate the management goal will not be met often and the goal itself may be unrealistic.

Proportional size distribution (PSD) values indicate preferred and memorable crappies are available but generally represent less than 15% of the sample. Incremental PSD calculations for crappie from gill-net data, trap net data, and electrofishing data were similar (Tables 10 and 11). Although the two species of crappie are managed together in Tongue River Reservoir, they are not caught in equal proportions. Gill nets and trap nets caught similar numbers of white crappies but differed in the number of black crappie caught (Tables 10 and 11). The two species likely prefer different habitat types within the reservoir. Ellison (1984) found white crappie grow faster than black crappie and have a tendency to shift to piscivory at a smaller size. Identifying differences in growth rate for the two species in Tongue River Reservoir would require consecutive years of age structure collection and analysis of the resulting age and growth data. Mean relative weight (W_r) values for both crappie species were high and ranged from 81 to 137 (Tables 10 and 11).

Seine hauls throughout the reservoir have indicated crappie spawning success has been variable (Figure 5). Crappie YOY abundance is cyclic and is likely related to a combination of reservoir water level and other environmental variables during the May-July spawning and nursery period. Annual rises in reservoir water levels in recent years should have been conducive for spawning success (Groen and Schroeder 1978, Beam 1983). However, 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 may have disrupted spawning in recent years and reduced year class strength include fluctuating water temperature and increased turbidity from high rates of flow through the reservoir (Mitzner 1991).

A trap net component has been added to the annual trend sampling in August to improve relative abundance estimates and size structure analysis of Tongue River Reservoir crappie (Guy et al. 1996, Schorr and Miranda 1991, Boxrucker and Plosky 1989). Ten net sets were completed in both 2012 and 2013. Results of concurrent gill-net and trap net sampling in August from 2010 to 2013 indicate trap nets provide larger sample sizes than gill nets (t = -3.07, df = 806, P = 0.002). The traps also sample a larger segment of the crappie population capturing fish that gill nets do not, including YOY crappie and caught more individuals in nearly every size class with less total effort than gill nets (Figure 8). Additional sampling with trap nets was done in May 2013 to continue exploring temporal variation in catch rates and size structure. Catch rate was high in the May trap net sample and provided a view of the size and condition of adult crappie

available for the year's spawning season (Figure 9). An early May sample should be repeated because it is logistically achievable and provides a targeted sample of older larger crappie (Boxrucker and Ploskey 1989). Additional years of samples in May and October will reduce the standard error around these catch rates and may demonstrate that sampling during one or both of these time periods may be worth the additional effort.

Walleye

Catch rates of walleye were above the management objective (2 fish per gill net) and historical average (4.6 fish per gill net) in 2012 and 2013. This management objective has been met for the last 10 years (Table 4). Walleye were sampled with all gears in 2012 and 2013 but gill nets were the most effective (Tables 10 and 11). Walleye sampled in 2012 and 2013 were generally small with the majority of fish in the stock-quality and quality-preferred categories and relative weights ranged from 77 to 99 (Tables 10 and 11).

Other Game Fish

There were fewer bullheads than crappie, yellow perch, and walleye in 2012 gill-net catches (Table 1) and fewer bullheads than crappie in 2013 gill-net catches (Table 2). Bullheads comprised a small percentage of the overall catch from each of the other gears (seines, trap nets and electrofishing). Bullhead relative abundance has averaged 11.3 fish per gill net over the last five years (2009-2013). This is a much lower relative abundance than the 2004 to 2008, five year average of 44.2 fish per gill net but similar to the relative abundances documented through the 1990s (Figure 10).

Channel catfish continue to be caught in low numbers in August gill-net samples, with only five fish caught in 2012 and seven fish caught in 2013 (Tables 1 and 2). 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 (Tables 2 and 4). Consistent relative abundance values for adults through the years indicate limited spawning and recruitment are occurring (Figure 10). Sample sizes of channel catfish preclude analysis of size structure and body condition.

Gillnetting and seining in 2012 and 2013 indicate presence of both adult and juvenile largemouth and smallmouth bass (Tables 1 through 4). The relative abundance of adult smallmouth bass in the gill-net samples has been low but consistent. Largemouth bass YOY and smallmouth bass YOY were not as abundant in seine samples in 2012 and 2013 as during 2010 and 2011 (Figure 11). Bass sampled in gill nets, trap nets, and electrofishing had consistent incremental PSD and relative weight values (Tables 10 and 11). The majority of bass were in stock-quality and quality-preferred length categories and had high relative weights. Relative weight values suggest bass are not forage limited at stock size, are competing for resources at quality size, then upon reaching preferred

size are again not forage limited. Angler reports indicate that bass are increasingly a targetable species offering 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). Sampling efforts have not yet documented expansion in either largemouth or smallmouth bass populations.

Northern pike, a species that was the dominant game species during the 1970's (Elser 1980), and produced the standing State record fish (37.5 lbs) in 1972, were found in low abundance in 2012 and 2013. Relative abundance was 2.1 fish per gill net in August 2012 and 0.9 fish per gill net in 2013 (Tables 1 and 2). Catch rates are low but appear to be stable (Figure 10). Adult and juvenile catch rates suggest limited natural reproduction has occurred at Tongue River Reservoir in the last decade. Sample sizes of northern pike preclude analysis of size structure and body condition.

Pumpkinseed sunfish, green sunfish, rock bass, and bluegill sunfish were observed during 2012-2013 sampling efforts on Tongue River Reservoir. Pumpkinseed sunfish have increased in abundance over the last two decades in both gill nets and seine hauls in Tongue River Reservoir (Figure 12). Incremental PSD values calculated from gill nets, trap nets and electrofishing were consistent with most pumpkinseed found in stock and quality size categories. Mean W_r values for pumpkinseed were often greater than 100 indicating that they were in extremely good condition (Tables 10 and 11). Low numbers of adult green sunfish were observed with trap nets in both 2012 and 2013 as well as with electrofishing in 2013. Low numbers of YOY green sunfish were observed with seines and electrofishing in 2012. Historically, rock bass have been present in low abundance in Tongue River Reservoir but have not been sampled in August gill nets or seines since 2000. A rock bass was collected electrofishing along the camper's point break wall in August 2013. A YOY bluegill sunfish was collected in a trap net set at the swim beach in August 2012. Another YOY bluegill sunfish was collected in a seine haul in 2013 at Pearson Creek Bay. Bluegill sunfish have not previously been documented in Tongue River Reservoir.

One sauger was collected in gill nets in 2012. No other sauger were collected in 2012 or 2013 efforts. 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 four sauger in the last 10 years (Table 12). Sauger are a 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 numbers (M. Backes, MTFWP, personal communication). In 2011 the combined sauger-walleye bag limit was modified above Tongue River Reservoir Dam. The modification 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.

Adult yellow perch were abundant prior to completion of the dam rebuild (1992-1999), but initially declined after completion (2000-2002) and then remained at a reduced level for several years (2003-2008) (Figure 10). Yellow perch relative abundance appears to have steadily increased since 2009 with 11.6 fish per gill net in 2012 and 6.1 fish per gill net in 2013 (Tables 1 and 2). Yellow perch reproduction has also been on the rise since 2008 (Figure 11). Catch rates of YOY yellow perch continues to be similar to crappie YOY in 2012 and 2013 and combined are the most abundant component of seine hauls by number in 2012 and 2013 (Tables 3 and 4)

Water

Reservoir storage was above the post dam reconstruction historical average (1999-2011) in 2012 and 2013 except during September and October in 2012 (Figure 13). Tongue River Reservoir spilled briefly in both years exceeding storage capacity during peak runoff (Figure 13). Excess water stored from the abundant water year in 2011 influenced the water storage elevation in 2012. Water released out of the reservoir in April 2012 exceeded discharge above prior to the irrigation season. Floodwater releases can reduce crappie year class strength depending on timing, magnitude, and duration (Beam 1983). Mitzner found a positive relationship between young of the year crappie abundance and the amount of floodwater stored from April to 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 63.5cm with no production when water clarity was less than 5cm. Specific conductance is inversely related to discharge, building during periods of low discharge and diminishing as discharge increases (Figure 14 and 15). If coal bed methane extraction increases in the watershed, the increased activity may alter water quality. Response of fish populations will be difficult to quantify, as data collected from the reservoir is inherently variable.

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 the last few years with the 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 and pumpkinseed sunfish. 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 largemouth and smallmouth bass to evaluate relative abundance, size structure, and condition factor for these two sport species that existing methods neglected. Incorporating collection of aging structures would allow for 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. Crappie otoliths were collected in 2012 but were crushed during shipping and were not readable upon arrival at the University of Idaho. Otoliths were collected again in 2013and results are found in this report. Age data allows additional analysis and provides managers the ability to calculate length-age relationships, follow cohorts through time, estimate growth rates, and natural mortality. With these tools managers can better evaluate management objectives and develop realistic expectations of crappie size and abundance. Otoliths are the preferred aging structure for accurate age and growth estimation (Hammers and Miranda 1991). It is recommended that otoliths be collected again in 2014 and be analyzed and reported with past scale aging data. It is recommended that at least 5 trap net sets and one hour of night electrofishing be completed in May and October 2014. It is recommended that one hour of night electrofishing become a permanent addition to the trend sampling methodology in August. 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 facilitate fisheries managers with the data needed to make sound decisions.

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

Key Words: Crappie, Walleye, Trap net, Coal-bed Methane

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Table 1. Results of 9 overnight experimental gill-net sets at Tongue River Reservoir, August 2012.

Species	Number Caught	Average per Net	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black bullhead	23	2.6	245	263	121 - 311	30 - 450	4.9
Black crappie	67	7.4	154	67	106 - 262	10 - 320	14.4
Channel catfish	5	0.6	491	1984	218 - 713	70 - 3940	1.1
Common carp	5	0.6	586	2646	550 - 672	1940 - 3760	1.1
Largemouth bass	5	0.6	242	230	172 - 340	60 - 520	1.1
Northern pike	19	2.1	643	1834	290 - 915	130 - 4240	4.1
Pumpkinseed	4	0.4	142	63	120 - 170	50 - 80	0.9
Sauger	1	0.1	389	180	-	-	0.2
Shorthead redhorse sucker	9	1.0	407	839	277 - 515	220 - 1550	1.9
Smallmouth bass	12	1.3	308	532	153 - 442	50 - 1310	2.6
Walleye	61	6.8	377	587	242 - 665	70 - 2950	13.1
White crappie	94	10.4	178	94	116 - 310	20 - 400	20.2
Yellow bullhead	55	6.1	241	219	144 - 312	40 - 390	11.8
Yellow perch	105	11.7	193	100	137 - 265	30 - 200	22.6

Table 2. Results of 10 overnight experimental gill-net sets at Tongue River Reservoir, August 2013.

Species	Number Caught	Average per Net	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black bullhead	38	3.8	254	252	180 - 330	80 - 500	8.4
Black crappie	55	5.5	202	135	173 - 228	80 - 200	12.2
Channel catfish	7	0.7	315	553	202 - 627	60 - 2900	1.6
Common carp	9	0.9	608	2878	542 - 678	1960 - 3740	2.0
Largemouth bass	2	0.2	245	240	212 - 278	140 - 340	0.4
Northern pike	9	0.9	665	1842	508 - 795	600 - 2800	2.0
Pumpkinseed	2	0.2	149	110	138 -160	100 - 120	0.4
Shorthead redhorse sucker	23	2.3	455	1138	262 - 528	170 - 1600	5.1
Smallmouth bass	5	0.5	280	370	187 - 390	60 - 760	1.1
Walleye	78	7.8	372	577	245 - 746	100 - 4400	17.3
White crappie	77	7.7	220	152	188 - 311	80 - 400	17.1
White sucker	2	0.2	424	955	392 - 455	760 - 1150	0.4
Yellow bullhead	83	8.3	233	183	178 - 311	50 - 420	18.4
Yellow perch	61	6.1	200	97	167 - 225	50 - 140	13.5

Table 3. Results of 10 seine hauls at Tongue River Reservoir, August 2012.

Species	Number Caught	Number per Seine Haul	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percent of Catch (%)
Black bullhead	1	0.1	290	330	-	-	0.2
Black crappie	19	1.9	135	35	101 - 178	10 - 70	2.9
Channel catfish	4	0.4	134	20	110 - 155	20 - 20	0.6
Common carp	6	0.6	551	2060	387 - 639	20 - 2150	0.9
Largemouth bass	30	3	170	63	140 - 206	20 - 130	4.6
Northern pike	1	0.1	203	40	-	-	0.2
Pumpkinseed	52	5.2	121	37	108 - 135	20 - 65	8.0
Smallmouth bass	26	2.6	163	56	127 - 231	20 - 150	4.0
Spottail shiner	21	2.1	76	-	52 - 89	-	3.2
Walleye	5	0.5	261	144	257 - 270	140 - 160	0.8
White crappie	13	1.3	171	62	130 - 247	20 - 180	2.0
Yellow perch	90	9	135	30	116 - 250	15 - 170	13.8
Crappie YOY	37	3.7	34	-	24 - 91	-	5.7
Green sunfish YOY	6	0.6	71	-	54 - 90	-	0.9
Largemouth bass YOY	89	8.9	73	-	50 - 102	-	13.6
Pumpkinseed YOY	142	14.2	84	-	67 -99	-	21.7
Smallmouth bass YOY	4	0.4	57	-	55 - 63	-	0.6
Yellow perch YOY	107	10.7	57	-	47 -70	-	16.4

Table 4. Results of 10 seine hauls at Tongue River Reservoir, August 2013.

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	200	110	-	-	0.0
Common carp	2	0.2	568	2485	539 - 597	2120 - 2850	0.0
Largemouth bass	4	0.4	233	175	222 - 245	160 - 220	0.1
Northern pike	4	0.4	231	60	195 - 255	40 - 70	0.1
Pumpkinseed	11	1.1	124	39	100 - 144	10 - 70	0.2
Shorthead redhorse sucker	2	0.2	133	22	121 - 145	15 - 30	0.0
Smallmouth bass	61	6.1	192	100	127 - 387	20 - 830	1.3
Spottail shiner	36	3.6	55	-	45 - 63	-	0.7
Yellow perch	143	14.3	163	53	110 - 211	10 - 100	2.9
Bluegill YOY	1	0.1	67	-	-	-	0.0
Bullhead YOY	1	0.1	40	-	-	-	0.0
Channel catfish YOY	1	0.1	48	-	-	-	0.0
Common carp YOY	2	0.2	73	-	71 - 75	-	0.0
Crappie YOY	2596	259.6	43	-	21 - 78	-	53.5
Largemouth bass YOY	18	1.8	79	-	58 - 120	-	0.4
Pumpkinseed YOY	53	5.3	68	-	17 - 96	-	1.1
Smallmouth bass YOY	10	1.0	64	-	48 - 76	-	0.2
Walleye YOY	3	0.3	61	-	58 - 67	-	0.1
Yellow perch YOY	1905	190.5	60	-	45 - 74	-	39.2

Table 5. Results of 10 trap net sets at Tongue River Reservoir, August 2012.

Species	Number Caught	Average per Net	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black bullhead	15	1.5	284	347	222 - 306	180 - 600	2.3
Black crappie	409	40.9	186	127	108 - 369	10 - 770	63.3
Channel catfish	1	0.1	721	5000	-	-	0.2
Common carp	8	0.8	557	2378	495 - 621	1800 - 2940	1.2
Green sunfish	1	0.1	154	30	-	-	0.2
Largemouth bass	1	0.1	520	2630	-	-	0.2
Northern pike	2	0.2	856	3750	798 - 913	3400 - 4100	0.3
Pumpkinseed	66	6.6	124	51	102 - 171	15 - 120	10.2
Shorthead redhorse sucker	5	0.5	503	1464	476 - 536	1340 - 1710	0.8
Smallmouth bass	12	1.2	189	118	132 - 307	40 - 350	1.9
Walleye	7	0.7	508	1376	444 - 726	900 - 3400	1.1
White crappie	86	8.6	178	83	117 -295	20 - 340	13.3
Yellow bullhead	6	0.6	217	163	180 - 266	80 - 280	0.9
Yellow perch	12	1.2	182	85	130 - 241	20 - 170	1.9
Bluegill YOY	1	0.1	76	-	-	-	0.2
Largemouth bass YOY	7	0.7	90	-	84 - 95	-	1.1
Pumpkinseed YOY	7	0.7	92	-	83 - 99	-	1.1

Table 6. Results of 10 trap net sets at Tongue River Reservoir, August 2013.

Species	Number Caught	Average per Net	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black bullhead	7	0.7	278	353	239 - 307	250 - 390	0.9
Black crappie	588	58.8	200	138	157 - 357	80 - 660	74.4
Channel catfish	1	0.1	774	5868	-	-	0.1
Green sunfish	1	0.1	62	-	-	-	0.1
Northern pike	2	0.2	917	-	715 - 1115	-	0.3
Pumpkinseed	8	0.8	151	85	119 - 169	20 - 140	1.0
Shorthead redhorse sucker	9	0.9	499	1401	431 - 532	950 - 1580	1.1
Smallmouth bass	7	0.7	195	140	130 - 311	20 - 510	0.9
Walleye	7	0.7	407	658	294 - 535	180 - 1260	0.9
White crappie	59	5.9	217	143	185 - 284	100 - 230	7.5
Yellow bullhead	13	1.3	253	271	210 - 297	170 - 405	1.6
Yellow perch	10	1.0	203	99	175 - 238	80 - 140	1.3
Crappie YOY	72	7.2	69	-	54 - 81	-	9.1
Largemouth bass	6	0.6	67	-	58 - 73	-	0.8

Table 7. Results of night electrofishing at Tongue River Reservoir, 1 hour in August 2012.

Species	Number Caught	Average per Hour	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black bullhead	1	1.0	282	370	-	-	0.3
Black crappie	63	63.0	161	80	111 - 330	20 - 550	20.2
Common carp	6	6.0	559	2430	490 - 606	1820 - 3000	1.9
Largemouth bass	28	28.0	201	160	162 - 380	60 - 920	9.0
Pumpkinseed	10	10.0	124	48	105 - 162	40 - 120	3.2
Shorthead redhorse sucker	1	1.0	456	1000	-	-	0.3
Smallmouth bass	24	24.0	201	130	130 - 334	40 - 500	7.7
Spottail shiner	15	15.0	90	-	77 - 110	-	4.8
Walleye	4	4.0	261	145	250 - 268	130 - 170	1.3
White crappie	23	23.0	147	64	105 - 305	20 - 360	7.4
Yellow bullhead	2	2.0	266	295	241 - 290	210 - 380	0.6
Yellow perch	107	107.0	144	39	117 -202	20 - 100	34.3
Green sunfish YOY	1	1.0	55	-	-	-	0.3
Largemouth bass YOY	16	16.0	81	-	63 - 95	-	5.1
Pumpkinseed YOY	3	3.0	78	-	73 - 80	-	1.0
Smallmouth bass YOY	5	5.0	73	-	67 - 82	-	1.6
Yellow perch YOY	3	3.0	57	-	55 - 60	-	1.0

Table 8. Results of night electrofishing at Tongue River Reservoir, 1 hour in each month, May and August 2013.

Species	Number Caught	Average per Hour	Mean Length (mm)	Mean Weight (gm)	Length Range (mm)	Weight Range (gm)	Percentage of Catch (%)
Black bullhead	5	2.5	277	358	235 - 312	220 -420	1.1
Black crappie	263	131.5	191	119	137 - 280	40 - 400	58.1
Channel catfish	1	0.5	635	3220	-	-	0.2
Common carp	6	3.0	595	2925	550 - 710	2300 - 4700	1.3
Green sunfish	2	1.0	131	40	130 - 132	40 - 40	0.4
Largemouth bass	7	3.5	249	263	196 - 335	120 - 580	1.5
Northern pike	1	0.5	812	3450	-	-	0.2
Pumpkinseed	1	0.5	126	50	-	-	0.2
Rock bass	1	0.5	120	40	-	-	0.2
Shorthead redhorse sucker	6	3.0	475	1222	411 - 520	780 - 1540	1.3
Smallmouth bass	41	20.5	242	260	130 - 443	100 - 1540	9.1
Spottail shiner	6	3.0	75	-	55 - 85	-	1.3
Walleye	7	3.5	366	751	230 - 700	120 - 3500	1.5
White crappie	41	20.5	205	123	158 - 267	50 - 260	9.1
Yellow bullhead	4	2.0	222	190	190 - 296	80 - 400	0.9
Yellow perch	45	22.5	179	77	114 - 233	15 - 160	9.9
Crappie YOY	3	1.5	69	-	63 - 73	-	0.7
Pumpkinseed YOY	3	1.5	79	-	76 - 85	-	0.7
Smallmouth bass YOY	3	1.5	76	-	72 - 80	-	0.7
Yellow perch YOY	7	3.5	67	-	60 - 70	-	1.5

Table 9. Summary of management objective results in Tongue River Reservoir. Walleye gill-net catch rates and mean length. Percentage of crappie greater than 250 mm total length caught in gill nets, 1980-2013.

Year	Walleye Catch rate	Walleye Mean Total Length (mm)	Percent of Crappie greater than 250 mm Total Length
1980	4.3	319.0	11.4
1981	5.6	377.0	27.8
1982	2.0	397.0	1.7
1983	0.2	427.0	3.4
1984	0.4	417.0	1.2
1985	0.6	463.0	2.7
1986	1.6	273.0	0.0
1987	5.6	279.0	4.2
1988	19.4	332.0	18.9
1989	15.7	343.0	12.8
1990	4.1	349.0	2.9
1991	3.9	383.0	19.9
1992	8.4	325.0	0.8
1993	1.1	308.0	0.7
1994	5.3	349.0	2.2
1995	2.4	335.0	21.2
1996	5.0	395.0	20.0
1997	4.2	384.0	24.2
1998	8.3	341.0	25.0
1999	8.5	411.0	13.5
2000	4.0	424.0	2.9
2001	3.9	438.0	7.5
2002	2.5	449.0	0.0
2003	0.5	447.6	7.0
2004	3.5	422.7	3.4
2005	1.6	366.7	4.6
2006	3.1	371.0	2.7
2007	3.0	308.0	7.9
2008	2.7	341.0	1.0
2009	2.0	364.0	5.8
2010	2.2	311.0	11.3
2011	5.6	369.2	18.2
2012	6.8	377.0	7.0
2013	7.8	372.5	4.7

Table 10. 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 in August 2012.

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	20	30	40	30	-	-	87	91	87	-	-
Black crappie	55	89	7	4	-	-	122	96	103	-	-
Channel catfish	4	25	50	-	25	-	87	143	-	99	-
Largemouth bass	3	33	67	-	-	-	104	89	-	-	-
Northern pike	17	12	53	29	6	-	84	92	86	79	-
Pumpkinseed	4	75	25	-	-	-	120	73	-	-	-
Sauger	1	-	-	100	-	-	-	-	31	-	-
Smallmouth bass	10	30	30	20	20	-	93	94	97	96	-
Walleye	59	42	54	2	2	-	84	86	99	88	-
White crappie	91	81	9	8	2	-	122	81	88	87	-
Yellow bullhead	54	33	67	NA	NA	NA	92	94	NA	NA	NA
Yellow perch	100	60	37	3	-	-	108	91	70	-	-

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 bullhead	15	7	73	20	-	-	98	84	92	-	-
Black crappie	365	58	23	15	4	-	114	97	91	80	-
Channel catfish	1	-	-	-	100	-	-	-	-	122	-
Largemouth bass	1	-	-	-	100	-	-	-	-	114	-
Northern pike	2	-	-	50	50	-	-	-	96	77	-
Pumpkinseed	73	95	5	-	-	-	122	107	-	-	-
Smallmouth bass	4	25	75	-	-	-	106	83	-	-	-
Walleye	7	-	86	-	14	-	-	92	-	77	-
White crappie	84	81	8	11	-	-	106	86	86	-	-
Yellow bullhead	6	50	50	NA	NA	NA	103	102	NA	NA	NA
Yellow perch	12	67	33	-	-	-	112	85	-	-	-

Electrofishing

		PSD					Wr				
Species	N	S-Q	Q-P	P-M	M-T	T	S-Q	Q-P	P-M	M-T	T
Black bullhead	1	-	100	-	-	-	-	96	-	-	-
Black crappie	52	87	10	2	2	-	124	111	95	86	-
Largemouth bass	7	71	14	14	-	-	117	130	112	-	-
Pumpkinseed	12	83	17	-	-	-	116	110	-	-	-
Smallmouth bass	15	93	7	-	-	-	97	90	-	-	-
Walleye	4	100	-	-	-	-	85	-	-	-	-
White crappie	18	94	-	-	6	-	137	-	-	83	-
Yellow bullhead	2	-	100	NA	NA	NA	-	99	NA	NA	NA
Yellow perch	29	97	3	-	-	-	93	87	-	-	-

Table 11. Summary of proportional size distribution (PSD), incremental PSDs, and mean relative weight (W_r) values for game fish sampled with trap nets, and electrofishing in May and August and gill nets in August 2013.

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	37	22	59	19	-	-	77	88	82	-	-
Black crappie	54	39	61	-	-	-	113	104	-	-	-
Channel catfish	3	67	-	33	-	-	94	-	112	-	-
Largemouth bass	2	100	-	-	-	-	191	-		-	-
Northern pike	9	22	22	56	-	-	79	85	87	-	-
Pumpkinseed	2	50	50	-	-	-	179	133	-	-	-
Smallmouth bass	5	60	-	40	-	-	79	92	83	-	-
Walleye	77	75	9	13	3	-	88	80	82	86	-
White crappie	73	11	81	5	3	-	107	102	84	90	-
Yellow bullhead	82	40	60	NA	NA	NA	87	92	NA	NA	NA
Yellow perch	59	47	53	-	-	-	89	84	-	-	-

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 bullhead	7	-	86	14	-	-	-	98	78	-	-
Black crappie	932	49	37	10	4	-	117	109	98	87	-
Channel catfish	1	-	-	-	100	-	-	-	-	113	-
Northern pike	2	-	-	50	50	-	-	-	90	NA	-
Pumpkinseed	15	33	67	-	-	-	87	104	-	-	-
Smallmouth bass	17	35	35	29	-	-	95	95	93	-	-
Walleye	19	53	16	26	5	-	79	87	83	89	-
White crappie	154	46	42	6	6	-	114	103	94	99	-
Yellow bullhead	13	23	77	NA	NA	NA	109	105	NA	NA	NA
Yellow perch	17	35	65	-	-	-	85	82	-	-	-

Electrofishing

		PSD					Wr				
Species	N	S-Q	Q-P	P-M	M-T	T	S-Q	Q-P	P-M	M-T	T
Black bullhead	5	-	80	20	-	-	-	101	80	-	-
Black crappie	263	63	35	3	-	-	111	112	97	-	-
Channel catfish	1	-	-	100	-	-	-	-	119	-	-
Largemouth bass	6	83	17	-	-	-	117	106	-	-	-
Northern pike	1	-	-	100	-	-	-	-	93	-	-
Pumpkinseed	2	100	-	-	-	-	120	-	-	-	-
Smallmouth bass	37	78	16	-	5	-	106	91	-	107	-
Walleye	6	67	17	-	17	-	91	90	-	89	-
White crappie	41	46	44	10	-	-	113	101	90	-	-
Yellow bullhead	4	75	25	NA	NA	NA	106	98	NA	NA	NA
Yellow perch	41	63	37	-	-	-	94	90	-	-	-

Table 12. Sauger gill-net catch rates from 1988-2013.

Year	Count	CPUE (fish/gill net)
1988	8	0.8
1989	2	0.2
1990	0	0
1991	0	0
1992	0	0
1993	0	0
1994	0	0
1995	0	0
1996	0	0
1997	2	0.2
1998	3	0.3
1999	0	0
2000	0	0
2001	2	0.2
2002	0	0
2003	0	0
2004	0	0
2005	1	0.1
2006	0	0
2007	1	0.1
2008	0	0
2009	1	0.1
2010	0	0
2011	0	0
2012	1	0.1
2013	0	0

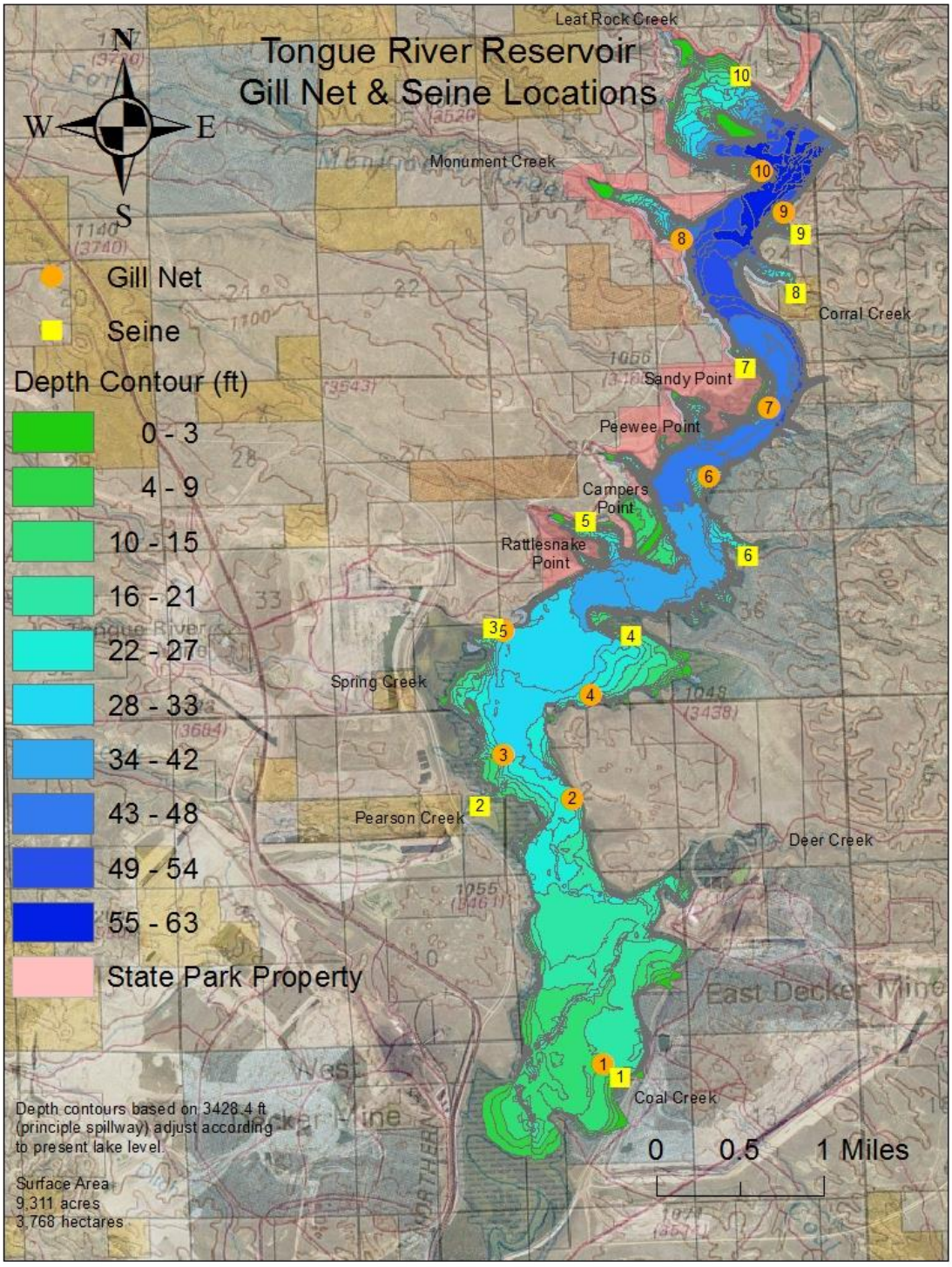

Figure 1. Map of Tongue River Reservoir, Decker, MT with August gill-net and seine haul trend sample locations.

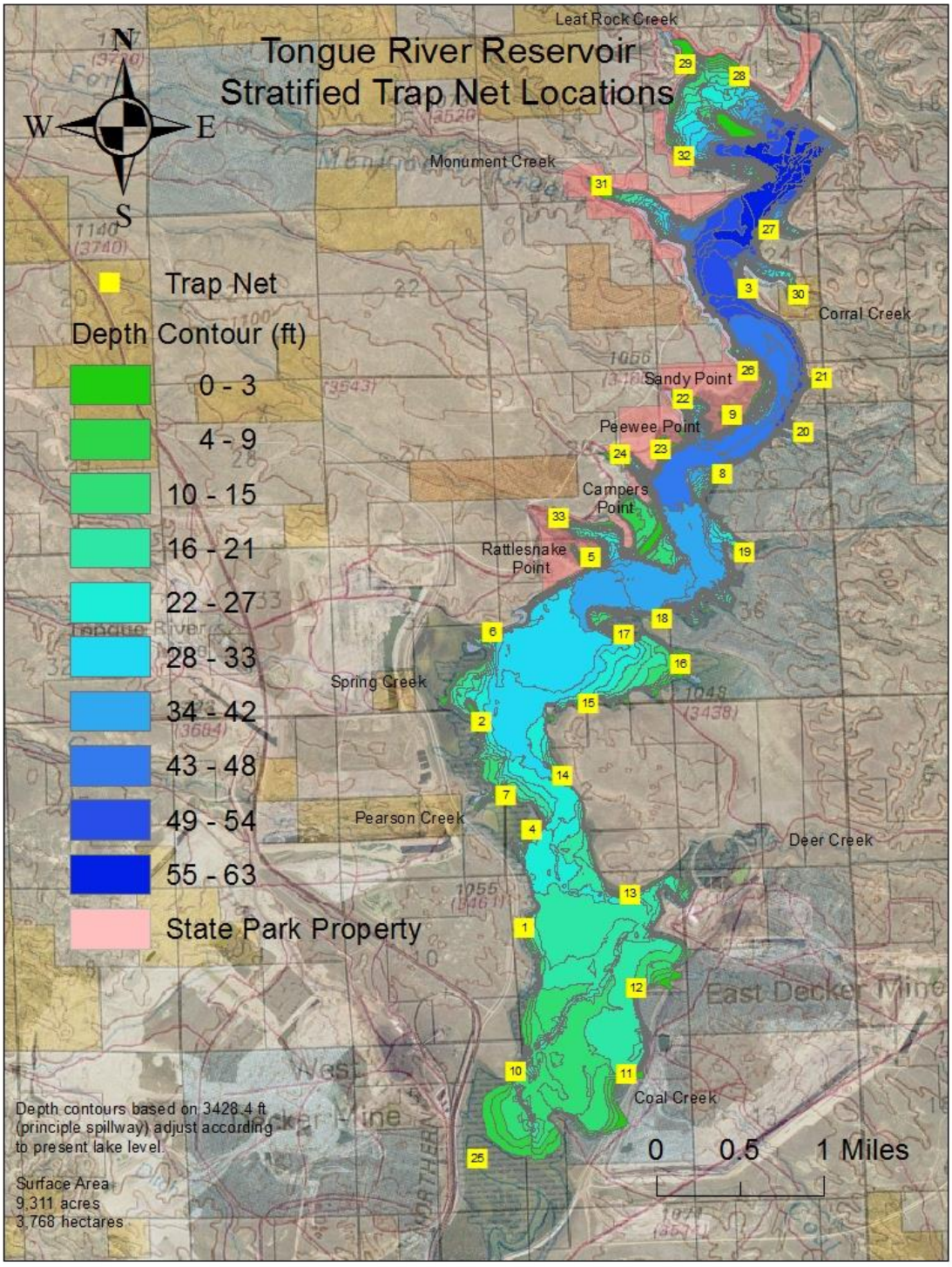

Figure 2. Map of Tongue River Reservoir, Decker, MT with possible trap net sample locations.

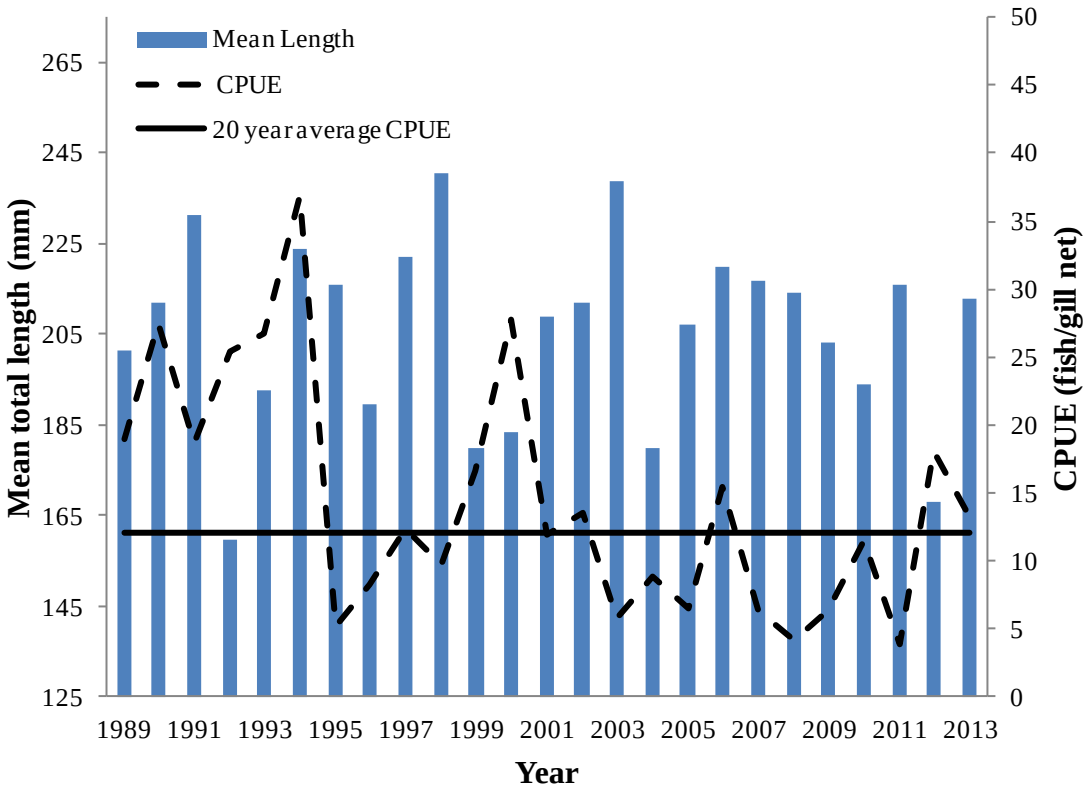

Figure 3. Mean total length (mm) of crappie (blue bars) on the primary Y-axis; and relative abundance measured in CPUE (fish/gill net) of crappie (dashed black line) 20 year average CPUE (black line) on the secondary Y-axis as a function of year on the X-axis from Tongue River Reservoir gill nets, 1989-2013.

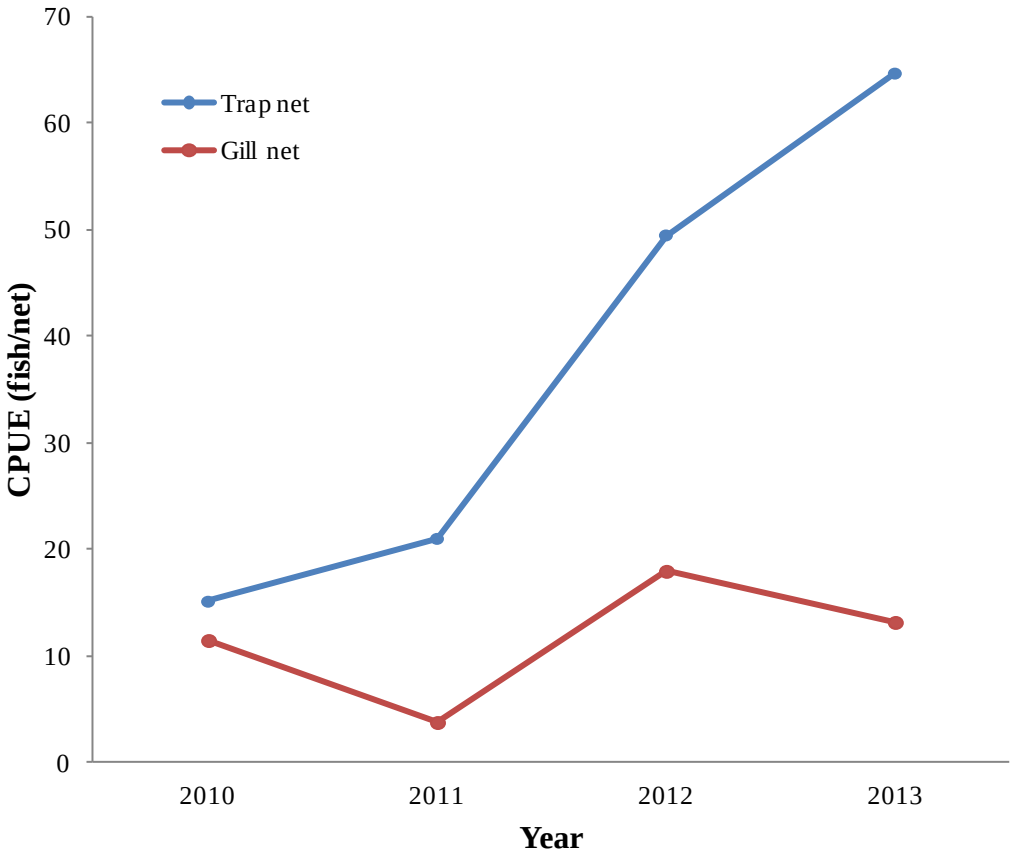

Figure 4. Relative abundance measured in CPUE (fish/net) of crappie on the Y-axis as a function of year on the X-axis from Tongue River Reservoir August gill-net and trap net samples, 2010-2013.

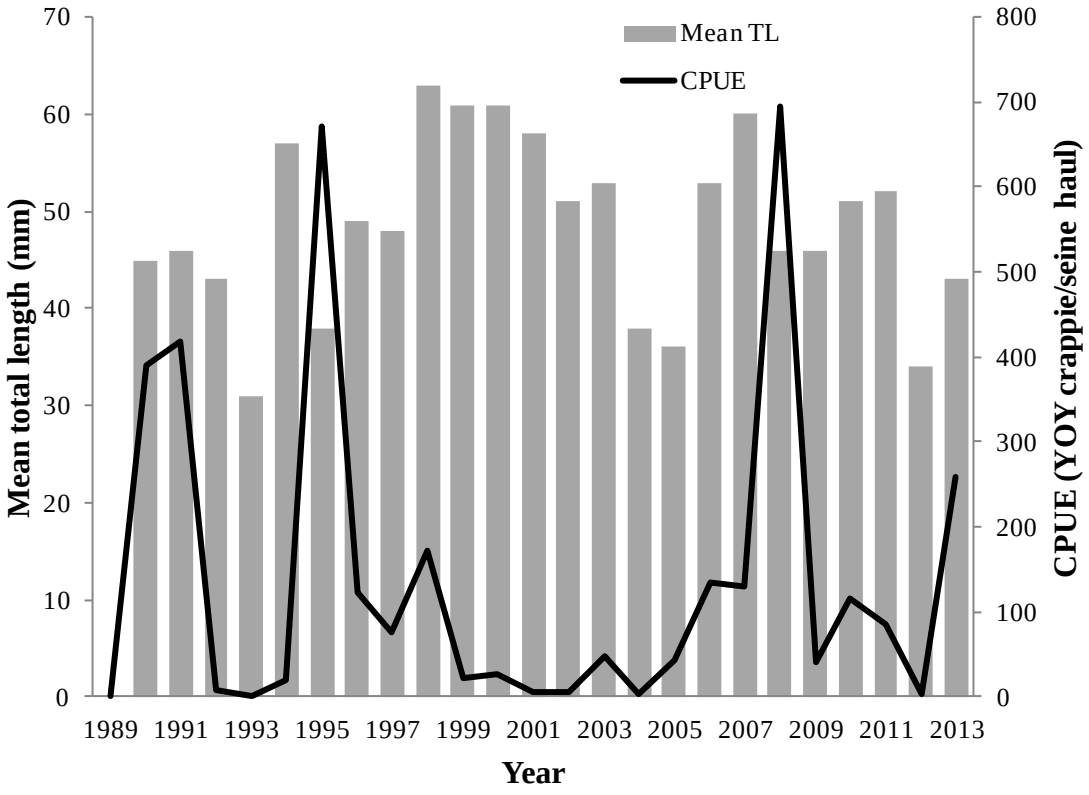

Figure 5. Mean total length (mm) of young-of-the-year (YOY) crappie (primary Y-axis) and relative abundance of YOY crappie measured in CPUE (fish per seine haul) (secondary Y-axis) as a function of year (X-axis) from Tongue River Reservoir 1989-2013.

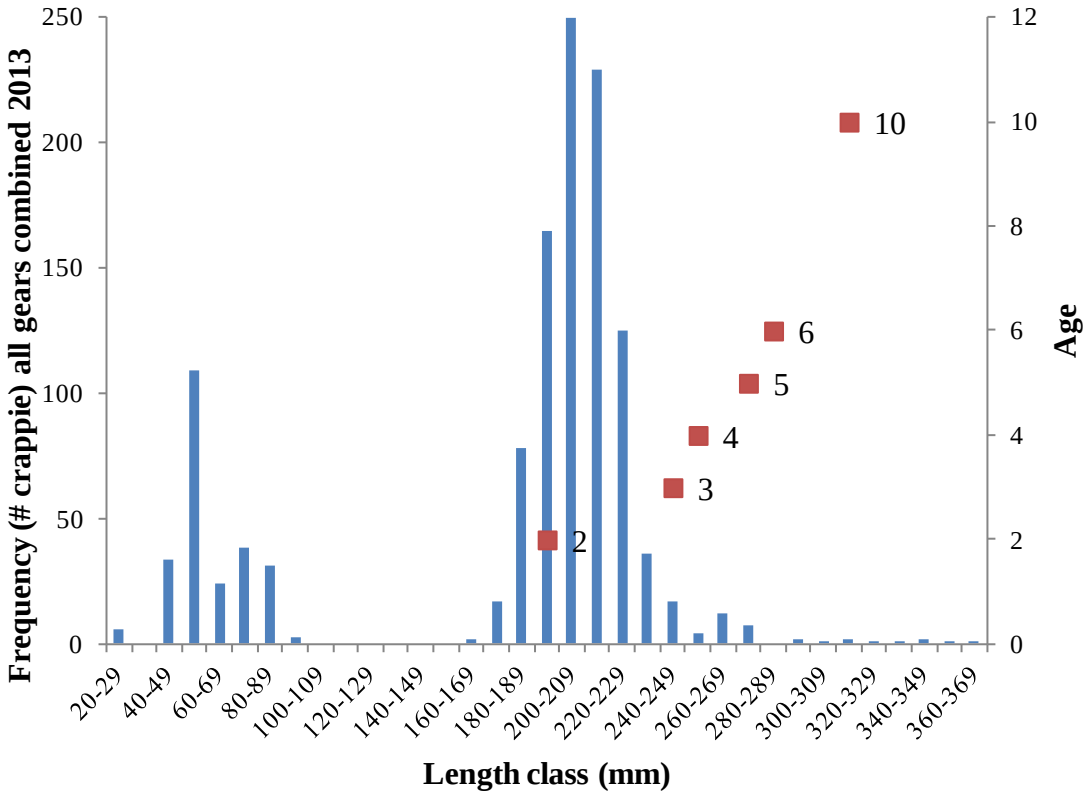

Figure 6. Length frequency distribution of crappie caught in gill nets, trap nets, seines, and electrofishing in August 2013 with length at age data from 2013 otoliths age study.

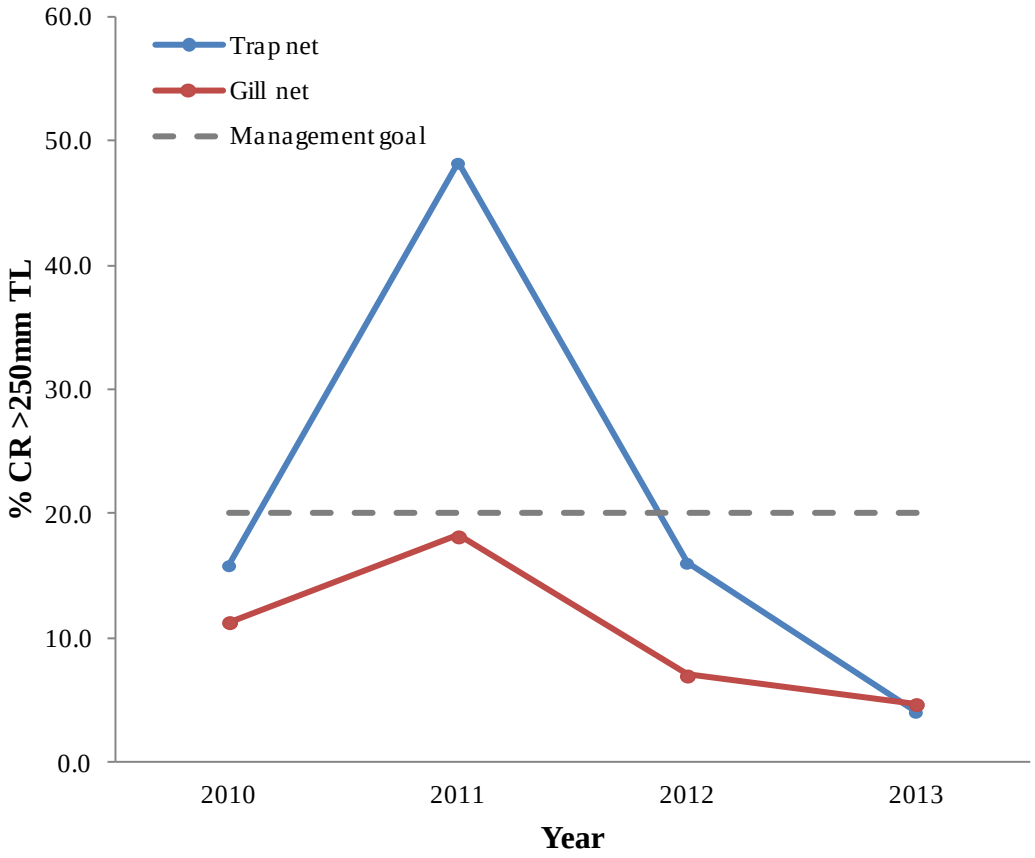

Figure 7. Percent of crappie greater than 250 mm TL on the Y-axis as a function of year on the X-axis from Tongue River Reservoir August gill-net and trap net samples and current gill-net specific management goal, 2010-2013.

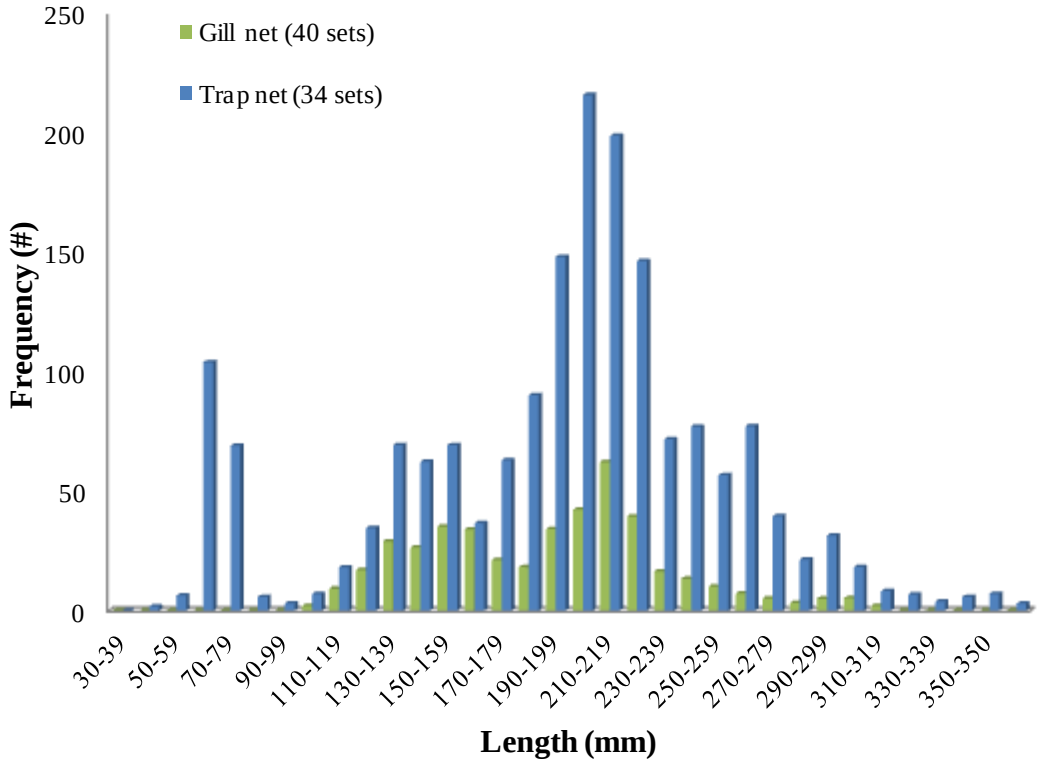

Figure 8. Length frequency distribution of crappie by gear, gill-net and trap net data combined for the August sample periods 2010-2013.

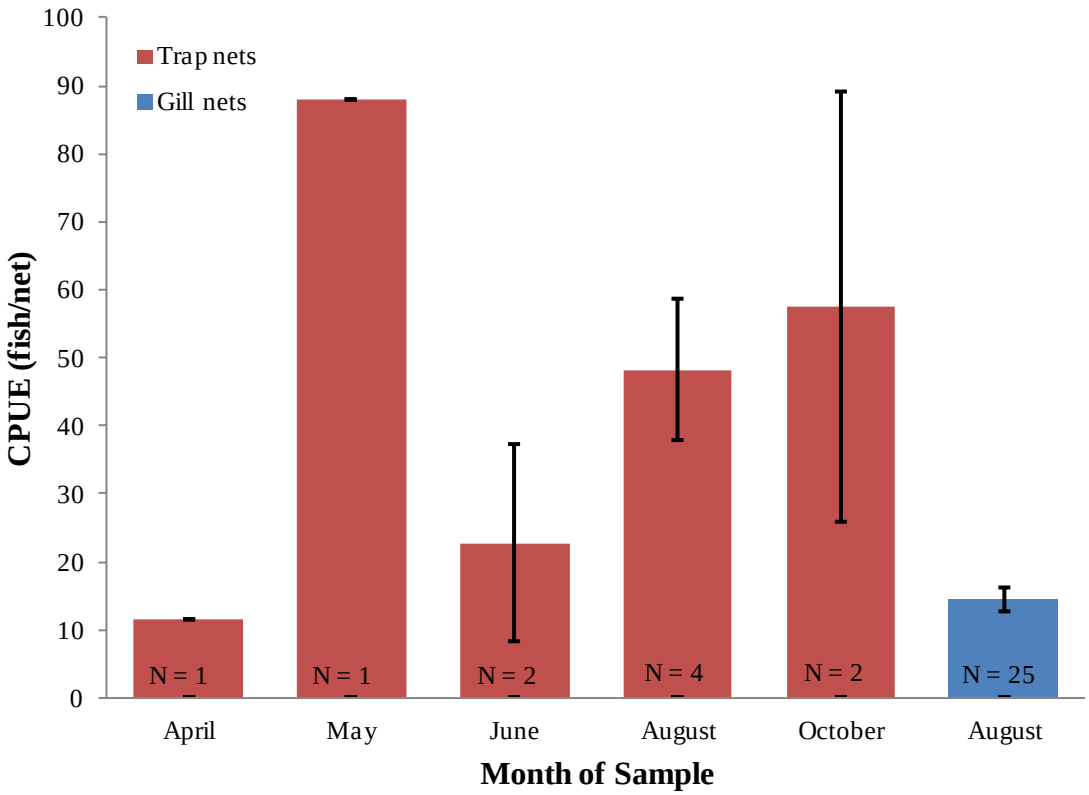

Figure 9. Relative abundance of crappie (Y-axis) measured in CPUE (fish/net) with standard error and sample size (N) as a function of month of sample (X-axis) in Tongue River Reservoir 2010-2013 (Trap nets) 1989-2013 (Gill nets).

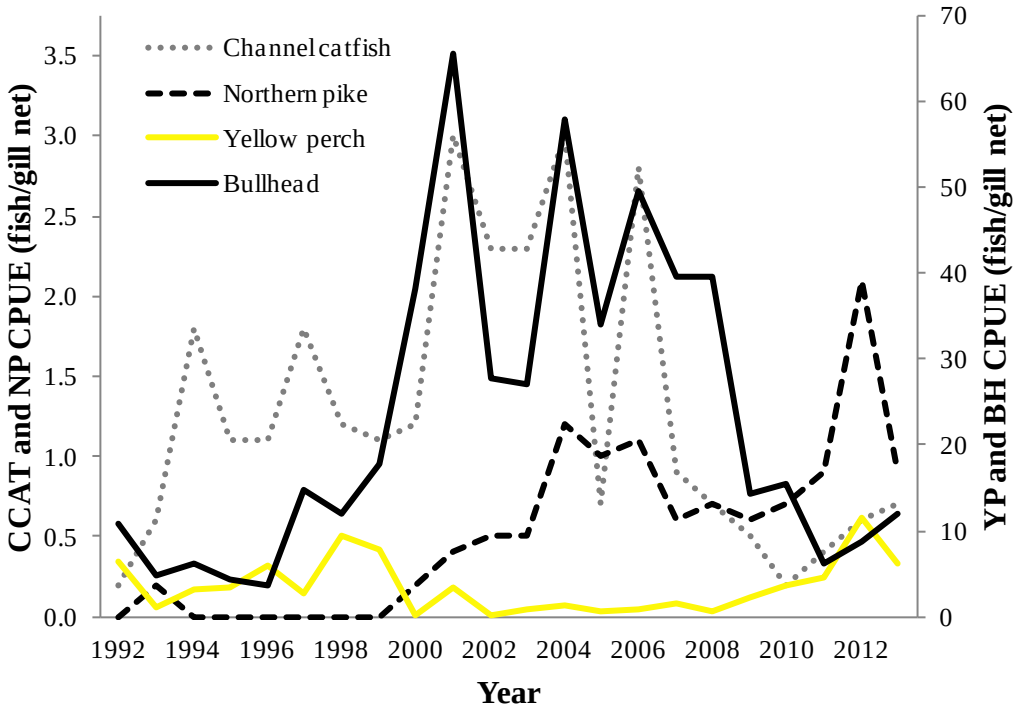

Figure 10. Relative abundance of channel catfish and northern pike (primary Y-axis) and yellow perch (secondary Y-axis) measured in CPUE (fish/gill net) as a function of year (X-axis) in Tongue River Reservoir 1989-2013.

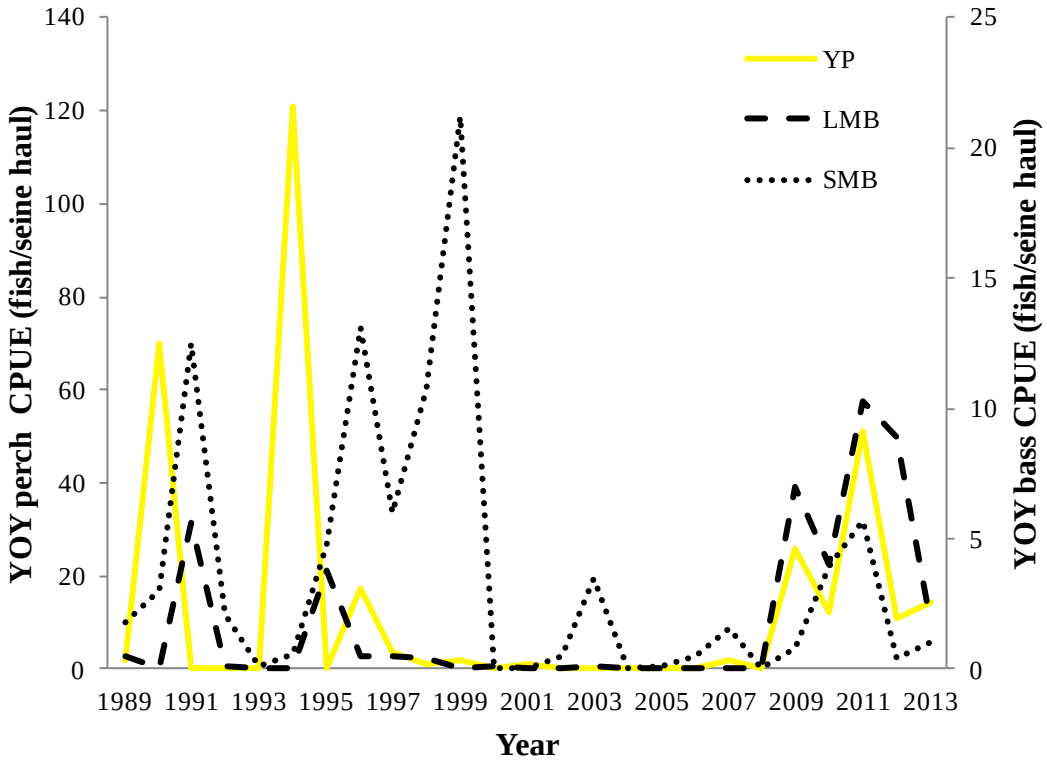

Figure 11. Relative abundance of young-of-the-year (YOY) yellow perch (primary Y-axis), largemouth bass, and smallmouth bass (secondary Y-axis) measured in CPUE (fish/seine haul) as a function of year (X-axis) from Tongue River Reservoir seines, 1989-2013.

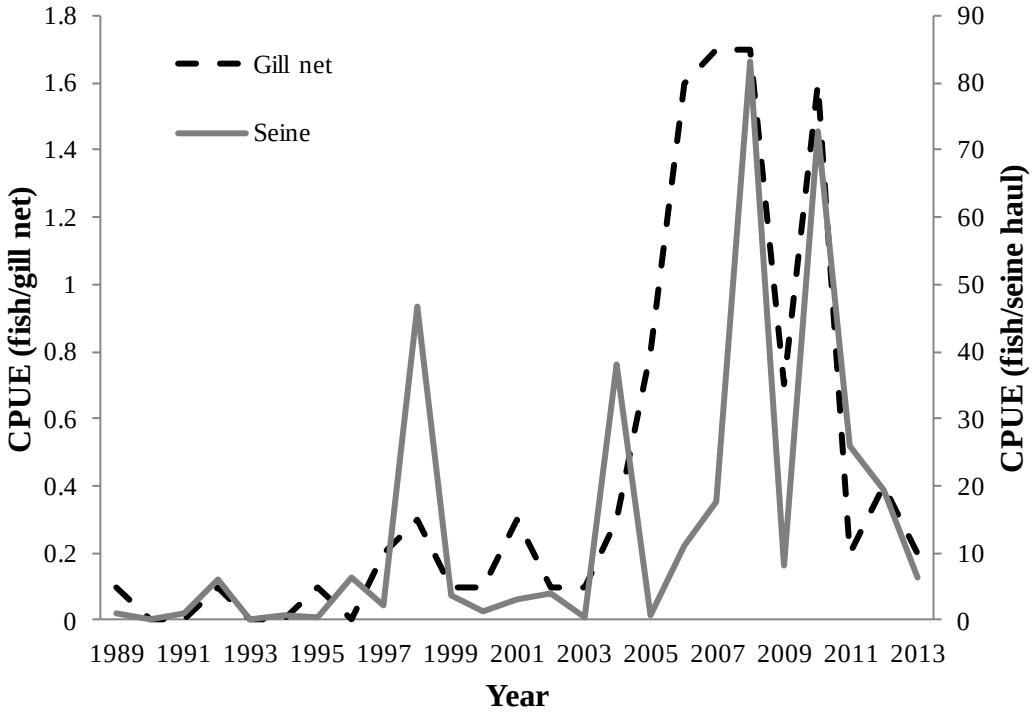

Figure 12. Relative abundance of all pumpkinseed sunfish caught in gill nets (primary Y-axis) and seine hauls (secondary Y-axis) measured in CPUE as a function of year (X-axis) in Tongue River Reservoir 1989-2013.

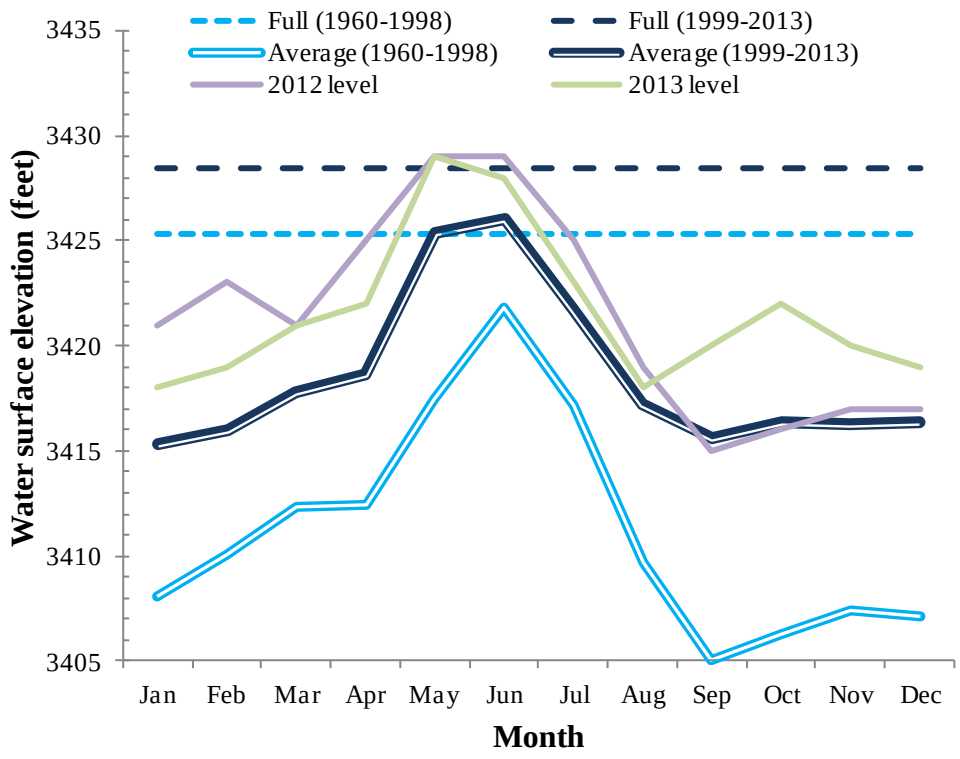

Figure 13. Tongue River Reservoir 2012 and 2013 water surface elevation in feet by month with full pool reference lines and historical mean storage level pre (1960-1998) and post (1999-2013) dam reconstruction, data provided by DNRC website.

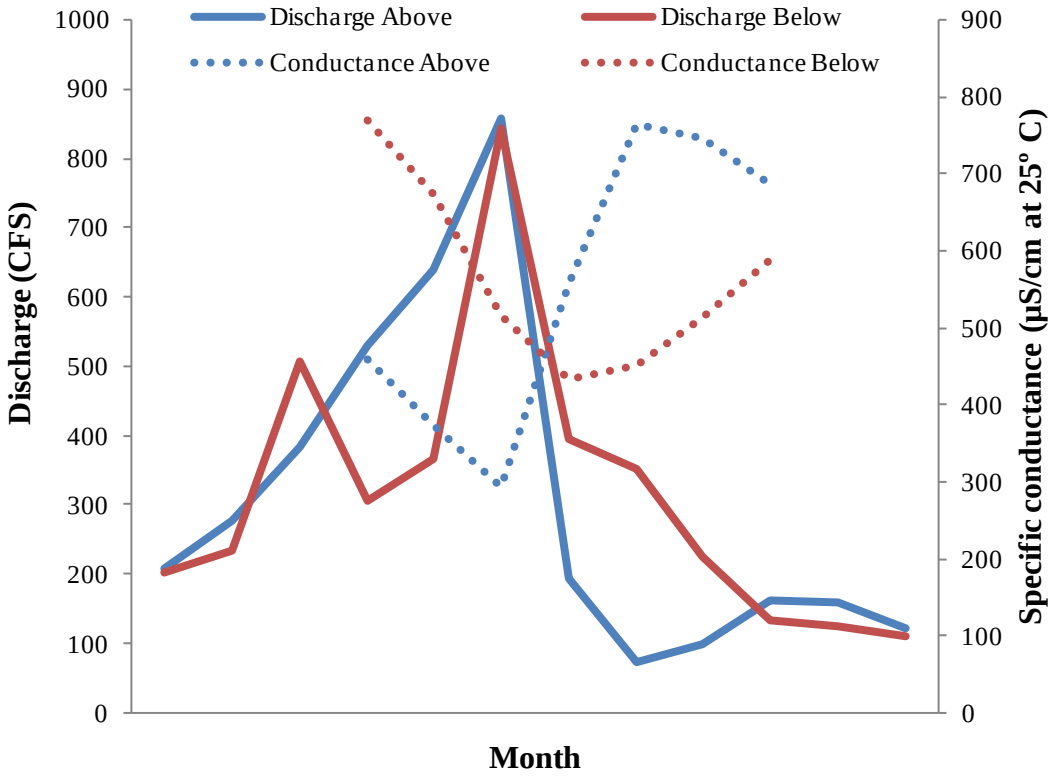

Figure 14. 2012 Monthly mean discharge measured in cubic feet per second (primary Y-axis) and specific conductance measured in microseimens per cm at 25º C (secondary Y-axis) by month (X-axis) from USGS gauging stations 06306300 Tongue River at state line and 06307500 Tongue River at Tongue River dam, Decker MT.

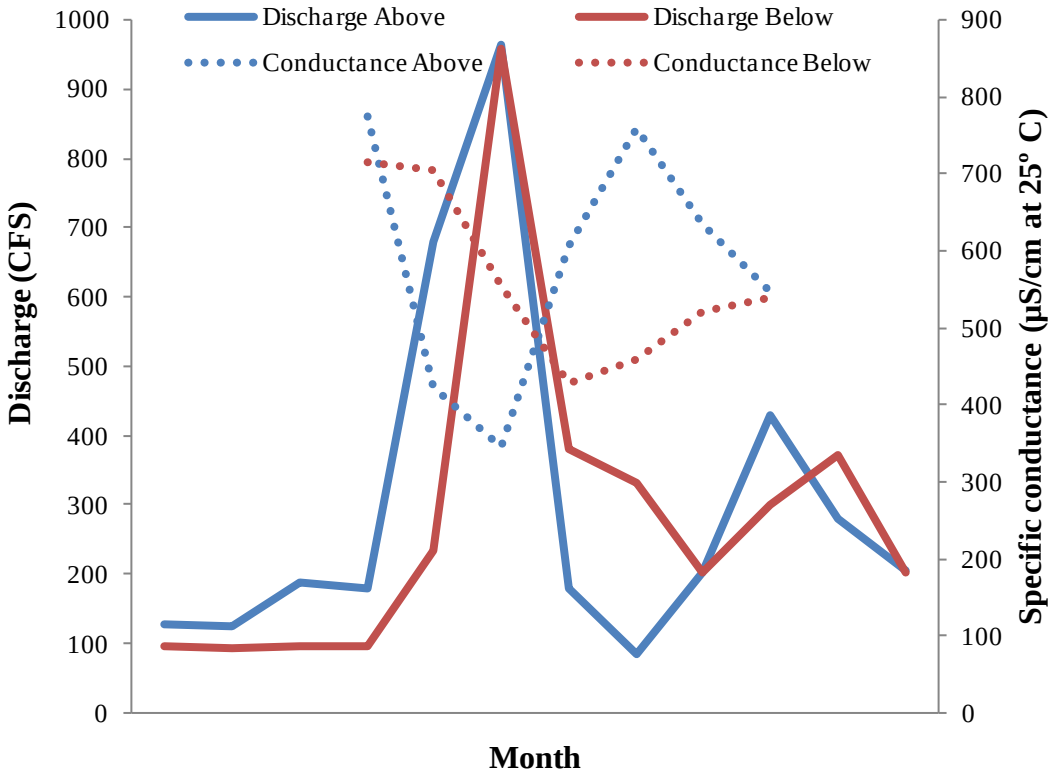

Figure 15. 2013 Monthly mean discharge measured in cubic feet per second (primary Y-axis) and specific conductance measured in microseimens per cm at 25º C (secondary Y-axis) by month (X-axis) from USGS gauging stations 06306300 Tongue River at state line and 06307500 Tongue River at Tongue River dam, Decker MT.