Noxon Rapids and Cabinet Gorge Reservoirs Fisheries Monitoring

Comprehensive Report: 2016-2018
Including Data From: 1999-2018

Montana Tributary Habitat Acquisition and
Recreational Fishery Enhancement Program

Appendix B
January 2020

Noxon, MT 59853

Noxon Rapids and Cabinet Gorge Reservoirs Fisheries Monitoring

Comprehensive Report: 2016-2018
Including Data From: 1999-2018

Montana Tributary Habitat Acquisition and
Recreational Fishery Enhancement Program
Appendix B

Prepared By:
Ryan Kreiner
Fisheries Biologist
Montana Fish, Wildlife and Parks
Thompson Falls, MT

Marc Terrazas
Conservation Technician
Montana Fish, Wildlife & Parks
Thompson Falls

&

Tim Tholl
Natural Resource Technician
Avista Corporation
Noxon, MT

Prepared for:

Avista Corporation
Natural Resources Field Office
PO Box 1469
Noxon, MT

January 2020

TABLE OF CONTENTS

SUMMARY

This status report of the fish communities in Noxon Rapids and Cabinet Gorge reservoirs is updated based on data collected from all monitoring activities from 2016-2018. Recent data are compared with standardized trend data collected back to 1999. A portion of this work was funded by Avista as part of the Recreational Fishery Enhancement Project (Appendix B) of the Clark Fork Settlement Agreement (1999).

Standardized annual fall gillnetting in Noxon Rapids and Cabinet Gorge reservoirs provides the most comprehensive index of relative abundance for fish species in both reservoirs. Total numbers of fish captured in gillnets in Noxon Rapids Reservoir have decreased from historic highs in 2015. Native non-game species Peamouth *Mylocheilus caurinus*, Largescale Suckers *Catostomus macrocheilus*, and Northern Pikeminnow *Ptychocheilus oregonensis* were all captured at historic lows in 2018. These species have exhibited consistent declines since gillnetting began in 2000. Despite a slight decrease in relative abundance, Yellow Perch *Perca flavescens* remained the most common fish captured in the gillnets and Pumpkinseed *Lepomis gibbosus* catch also remained high. In addition to crayfish which are not monitored, it is likely that Yellow Perch and Pumpkinseed are currently the primary prey-base in Noxon Rapids Reservoir. Walleye *Sander vitreus* have continued to increase in relative abundance, while Northern Pike *Esox lucius* and Smallmouth Bass *Micropterous dolemieu* are down from 2015. Record catches of Walleye in 2017 and 2018 are the result of a large year-class from 2015. Trends in Cabinet Gorge Reservoir were more difficult to discern due to lower sample sizes, although Peamouth were absent from all nets in 2017 and 2018.

Condition of three common non-native piscivores in Noxon have decreased recently. Relative weight of Walleye has decreased since 2014. Northern Pike show more variation in individual weight/length relationships than Walleye but have generally declined in a similar chronological pattern to Walleye. The pattern of decline for Smallmouth Bass differs from Walleye and Northern Pike but is still currently on the lower end of what has been observed. Additionally, growth (i.e., length-at-age) of Walleye has decreased since 2015 with some age-3 fish currently maturing at sizes just over 300 mm in total length as opposed to minimum spawning sizes greater than 330 mm in all other years.

Growth of age-0 Largemouth Bass *Micropterus salmoides* was monitored in 2016 and 2017. Mean observed length was highest during October of each year (2016: 61.1 mm, 2017: 66.0 mm). Based on information obtained by Saffel (2000), these year-classes are not likely to exhibit strong over-winter survival. More than 1,400 fish other than Largemouth Bass were also collected in beach seines. Pumpkinseed were the most common fish sampled and accounted for two-thirds of the bycatch. Yellow Perch were also abundant and accounted for one-quarter of the additional fish sampled. Only four SMB were sampled over the two-year period. The only native

species sampled with beach seines was Northern Pikeminnow and they accounted for 6% of the bycatch.

Bass Tournaments were monitored in each year between 2016 and 2018. Largemouth Bass comprised 71-80% of the catch during these three years. Overall, size of fish weighed in at tournaments has increased in recent years. In 2018, weigh-in mean length was 415 mm for both bass species.

Spring sampling of illegally introduced Walleye was conducted in upper Noxon Rapids Reservoir during each year between 2016 and 2018. Catch rates varied between all three years. In 2016, peak catch of 64.9 walleye per hour occurred on April 16 when water temperature was 10°C, and river flow was 20,000 cubic feet per second (cfs). Female catch rate peaked at 13.7 fish per hour on April 9 when water temperature was 10.8°C and flow was 22,000 cfs. In 2017, catch was low due to higher flows, cold temperatures, and a lack of age-3 fish. Total catch and female catch peaked on April 26 (6.0 fish per hour and 5.3 fish per hour, respectively) when temperature was 8.1°C and flow was 42,000 cfs. In 2018, total catch peaked at 29 fish per hour on May 3 when temperature was 8.6°C and flow was 62,000 cfs. Female catch remained low the entire year and peaked on April 23 at 4.9 fish per hour when water temperature was 8.6°C and flow was 34,000 cfs. Spring electrofishing sampling is biased heavily towards males which indicates it is not a realistic removal technique for Walleye. Gillnets captured Walleye at a rate of less than 2 fish per net night, and Walleye were never more than 5-10% of the total catch. Other options such as manipulations in reservoir operations need to be considered if stakeholders wish to attempt a removal.

INTRODUCTION

Noxon Rapids and Cabinet Gorge reservoirs, the two lowermost hydroelectric impoundments on the Clark Fork River in western Montana (FIGURE 1), have presented numerous and evolving challenges for fisheries management since reservoir construction was completed in the 1950s. Challenges have included blocked upriver access for migratory native species, including adfluvial Bull Trout *Salvelinus confluentus* from Lake Pend Oreille, degraded conditions in the impounded mainstem reaches for native salmonids, introductions of non-native species (authorized and unauthorized), and changes in agency objectives, angler and societal preferences, and reservoir operations. Huston (1985) documented the diverse fish introductions and management efforts through the mid-1980s, including early efforts to establish cold-water salmonid fisheries in what was viewed as increasingly marginal cold-water habitat in the Clark Fork River reservoirs. In addition to altered thermal conditions, low water retention time in the two reservoirs (about three weeks in Noxon and one week in Cabinet Gorge) and wide water-level fluctuations historically limited options for developing stable lentic fisheries, especially in Cabinet Gorge Reservoir.

Initial fisheries management efforts on the newly formed reservoirs were largely unsuccessful (Huston 1985). Noxon and Cabinet Gorge reservoirs did not emerge as relevant fisheries until after 1980. At that time, the introduction and establishment of both Largemouth Bass *Micropterus salmoides* and Smallmouth Bass *M. dolomieu* populations, two non-native predators, was facilitated by a cooperative agreement between angler groups, Montana Fish Wildlife and Parks (MFWP), and Avista which eliminated large water-level fluctuations (Huston 1985). Since that time, populations of both species, as well as native and non-native non-game fish species, became well established, and annual fishing pressure has increased considerably, from about 800 angler days per year on Noxon in 1982 to almost 33,000 angler days in 2013 (MFWP 2017).

Based on angler mail-in surveys (MFWP 2014) and a recent creel survey (Blakney and Kreiner 2017), bass remain popular target species, as well as non-native Northern Pike *Esox lucius* and Yellow Perch *Perca flavescens*. For 2019, bass tournaments were scheduled on seven separate weekends of the open water season in Noxon Rapids Reservoir. Additionally, one bass tournament and one pike tournament were scheduled for Cabinet Gorge Reservoir.

As early as the 1950s, management effectiveness in the two reservoirs was monitored at a modest level by evaluating fish community structure, mainly through gillnetting. Fish community monitoring with gillnets had been standardized by 2000 and has continued to the present time. Some creel censuses have also been conducted. A quarter century after Huston's (1985) review, Horn and Tholl (2010), and Scarnecchia et al. (2014) used slightly different durations of the historical gillnet data sets to evaluate trends in fish community composition and individual species abundance. Both studies documented statistically significant declines in

several native fishes such as Peamouth *Mylocheilus caurinus,* Largescale Suckers *Catostomus macrocheilus*, and Northern Pikeminnow *Ptychocheilus oregonensis*, species of little interest to anglers, in conjunction with an increase in the frequency of non-native piscivorous fishes (bass, pike, and Walleye *Sander vitreus*), species actively sought by those same anglers.

Walleye were illegally introduced into Noxon Rapids Reservoir in the 1980s or early 1990s (WWP 1995, Horn and Tholl 2010). Since 2000, the population of Walleye has become self-sustaining and has increased in abundance relative to other species. Stemming from the illegal introduction in Noxon Rapids Reservoir, Walleye have since become established in the downriver waterbodies of Cabinet Gorge Reservoir, Lake Pend Oreille, and the Pend Oreille River through Idaho and into Washington. Based on information obtained during a previous telemetry study (Horn et al. 2009), MFWP began spring surveys for Walleye on suspected spawning grounds in 2012. This work has continued through 2018, primarily using jet-boat electrofishing at night.

Current harvest management on the reservoirs includes the use of general regional regulations for all species except bass (MFWP 2019). Special regulations which differ from the general regulation enforced throughout the rest of the western district have been enacted on both reservoirs to protect spawning bass. Both species of bass rely on nest-guarding males to protect newly hatched broods and angling during that time may negatively influence recruitment (Suski and Phillip 2004). The general western district bass regulation protects spawning bass from the third Saturday in May until June 30. During this time, only one fish greater than 533 mm (21 inches) may be kept, whereas five fish of any size may be kept the rest of the year. However, based on findings by Saffel (2003), age-0 Largemouth Bass in Noxon hatched between June 21 and July 3 in both low-water and high-water years. Because incubation of LMB eggs is 3-5 days (Scott and Crossman 1973), it was assumed that spawning in Noxon began after June 15 even on low-water years. Therefore, the protective spawning dates in Noxon were moved to begin and end later in the season, from June 15 to July 15. This regulation provides protection by limiting harvest of spawning and nest-guarding bass, but also prevents tournaments from occurring during this time. This regulation was standardized to include Cabinet Gorge Reservoir in 2015, and a proposal is in place to include Thompson Falls Reservoir beginning in 2020. These actions reflect the importance of the bass fisheries to the angling public (Neher 2015).

As of 2019, fish community monitoring continues to be conducted in both Noxon and Cabinet Gorge reservoirs using gillnets to assess trends in fish community composition and species abundance. Additional effort is expended to track Largemouth and Smallmouth Bass, two species which have low capture vulnerability in gillnets. Specific objectives of the current reservoir monitoring plan are to:

1) Monitor trends in fish populations in Noxon and Cabinet Gorge reservoirs with emphasis on species of recreational value and potential predators of native salmonids which inhabit the reservoirs.
2) Monitor the overall status of the bass fishery in Noxon Rapids Reservoir.
3) Monitor the population and assess capture methods of the illegally-introduced Walleye population in Noxon Rapids Reservoir.

This study plan was originally approved by the Clark Fork Management Committee (MC) in March 2001 as part of the overall 2001 and 2002 Annual Implementation Plans for Appendix B, the Montana Tributary Habitat of the Acquisition and Recreational Fishery Enhancement Program of the Clark Fork Settlement Agreement (Avista 1999). The Montana Tributary Habitat Acquisition and Recreational Fishery Enhancement Program is funded by Avista pursuant to conditions of an operating license, issued by the Federal Energy Regulatory Commission (FERC), allowing continued operation of Cabinet Gorge and Noxon Rapids Hydroelectric Projects. This program is intended to offset the power peaking and reservoir operational impacts of Cabinet Gorge and Noxon Rapids Dams to native salmonid species and recreational fisheries, through tributary habitat acquisition, watershed restoration and enhancement, and recreational fishery monitoring and management support.

STUDY AREA

The Clark Fork River is Montana's largest river by discharge. It has its origins near Butte, Montana at the Continental Divide and flows for approximately 380 km before merging with the Flathead River near Paradise, Montana. The Lower Clark Fork River (LCFR) begins at the confluence with the Flathead River and continues northwestward 165 km before entering Lake Pend Oreille (LPO), a large (380 km^2), deep (350 m) natural lake in the Idaho panhandle (FIGURE 1). The historical morphology of the LCFR and the surrounding terrain was greatly affected by the Missoula Floods, a series of flood events associated with ice-dam breakup of glacial Lake Missoula (Pardee 1942; Bretz 1969; Smith 2006). Many of the surrounding tributary streams exhibit lengthy periods of intermittency due to coarse substrate deposited by Glacial Lake Missoula flood events (Sando and Blasch 2015).

The LCFR historically served as an important migratory corridor for Bull Trout and Westslope Cutthroat Trout *Oncorhynchus clarki lewisi* which spawned in Montana tributaries but matured in LPO (Huston 1985). Other native non-game species also migrated extensively through the LCFR (e.g., Catastomids, Cyprinids). However, in the 20th century, three dams were constructed that have restricted migrations of native fishes and greatly altered the hydrology and habitat of the river. Thompson Falls Dam, the uppermost of the three dams and not a focus of this report, is also the oldest, completed in 1915 by Montana Power (currently owned by NorthWestern Energy). Cabinet Gorge Dam (completed 1952) and Noxon Rapids Dam (completed 1959) are owned and operated by Avista Corporation in Washington state. Noxon Rapids Reservoir, the

middle reservoir, is the largest LCFR reservoir with a surface area of 3,200 Ha, a maximum depth of greater than 61 meters, and a length of approximately 62 km. Just inside the Idaho border, Cabinet Gorge Dam creates a reservoir that is 1,200 Ha and approximately 31 km long. All three LCFR reservoirs are considered mainstream or run-of-the-river reservoirs (Kalff 2002) and are characterized by their short water retention times. Noxon Rapids Resevoir has a water retention time of three weeks during low-water and less than one week during run-off, while Cabinet Gorge Reservoir's retention time is never greater than seven days (Huston 1985). As a result, the reservoirs retain both lotic and lentic characteristics throughout. Many of the narrow upstream channels have visible current, while many bays, flats, and lacustrine areas above the dams are lake-like in appearance. The entire lower Clark Fork River is relatively low in elevation compared to elevations in the upper watershed, with Thompson Falls Reservoir at about 730 meters, Noxon Rapids Reservoir at about 710 meters, and Cabinet Gorge Reservoir at approximately 670 meters above sea level.

The run-of-the-river nature of these reservoirs impacts most of the fish species which currently reside there. For example, during larger run-off years, high water levels and cold-water temperatures delay Largemouth Bass spawning and reduce overwinter success of age-0 bass (Saffel 2000). Additionally, low water retention time is generally associated with less successful spawning by reservoir-dwelling Walleye in North America (Willis and Stephens 1987).

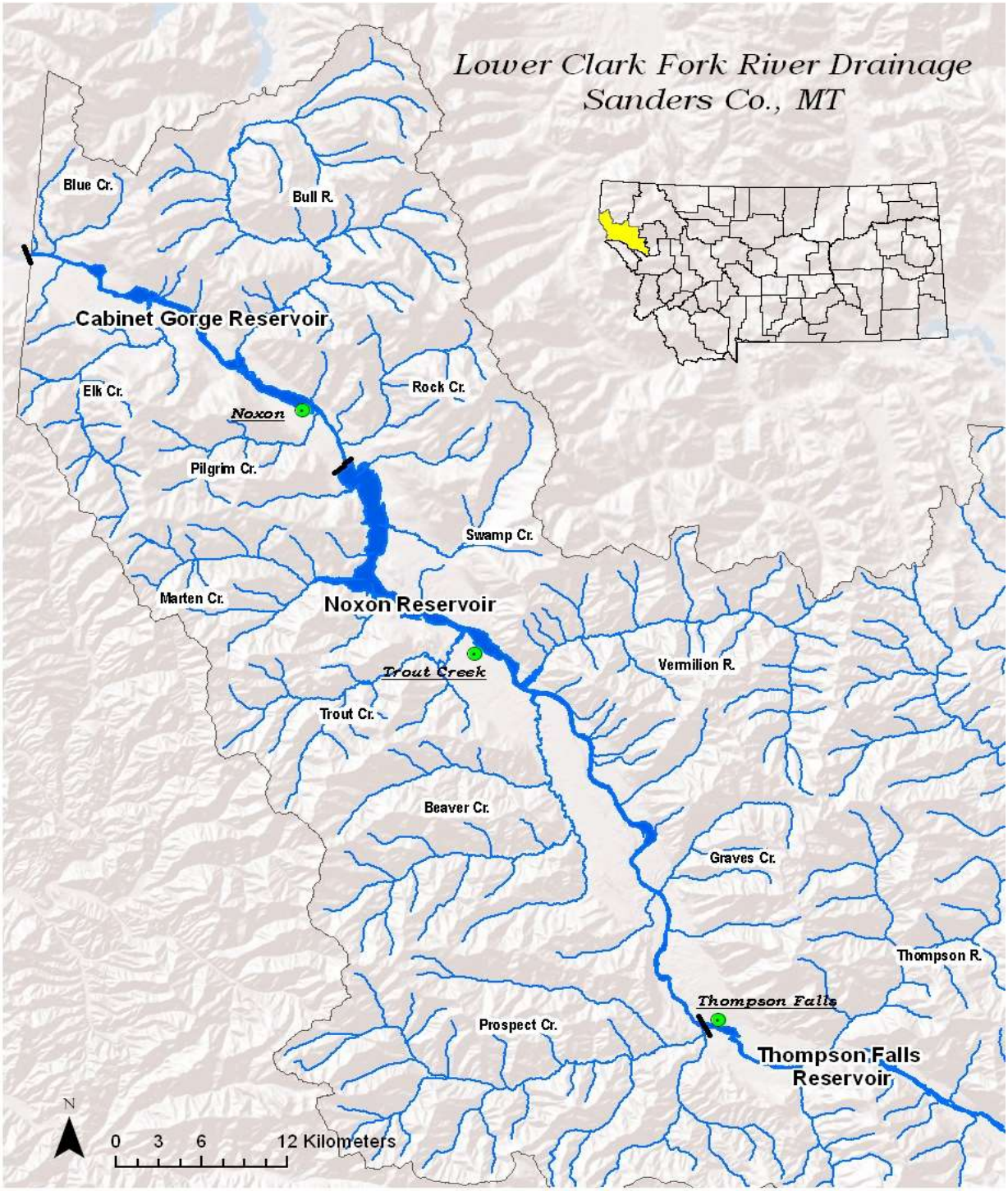


FIGURE 1. Lower Clark Fork River Drainage, Sanders County, Montana, including Noxon and Cabinet Gorge reservoirs and their major tributaries.

METHODS

Fall Gillnetting

Standard gillnet surveys are conducted annually in Noxon and Cabinet Gorge reservoirs in early October. The surveys have consisted of 45 total overnight gillnets sets, 30 in Noxon Rapids Reservoir and fifteen in Cabinet Gorge (FIGURE 2 and 3). In Noxon, 19 sites are in the lower portion of the reservoir below Beaver Creek Bay, while the remaining 11 sites are in the upper riverine portion. Originally planned as biennial sampling in 2000, annual sampling was deemed necessary in 2002 because of the expanding population of Walleye. Standardized (i.e., identical) sites have been sampled annually since then. Coldwater sites such as tributary mouths, have been intentionally avoided to reduce Bull Trout by-catch and mortality.

Nylon multifilament experimental sinking gillnets have been used during all gillnetting efforts. The nets are 38 m (125 ft) long and 1.8 m (6 ft) deep with five separate 7.6 m (25 ft) panels consisting of 1.9 cm (¾ inch), 2.5 cm (1 inch), 3.2 cm (1¼ inch), 3.8 cm (1½ inch), and 5.1 cm (2 inch) square mesh. The length and mesh sizes of these nets have been consistent throughout the duration of this monitoring and are the same specifications of standard experimental gillnets used throughout the state by MFWP. These mesh sizes are slightly different than those used by WWP (1995).

Gillnets are set in the afternoon, fished overnight and retrieved the following morning. Most nets (87%) are set perpendicular to the shoreline with the net stretched just far enough to achieve full vertical extension (1.8 m). The small mesh (1.9 cm) end of each gillnet is set closest to shore for all near-shore net sets. The other six nets (13%) are open-water sets in which the net is set parallel to shore and both the front and back of the net anchored in deep water. Depths of sets has ranged from 1.5 m to almost 35 meters but has been consistent among locations and between years. Mean soak time ranged from about 18 to 21 h (mean, 19.5 h). Although minor variation has occurred between net-set durations through the years, nets have been set and pulled in an identical order each year, resulting in little annual variation in soak times among nets set at a given site. All gillnet data are summarized as total and species-specific catch-per-unit-effort (*C/f*- i.e., number of fish per gillnet night). Species composition is based on total number of each species captured, as percent of total catch, and as a percent of total weight.

Retrieved gillnets are shuttled to a shoreline location where fish are removed from the nets and the appropriate data collected and recorded. Since the 1990s, processing of fish and nets has been a cooperative effort among MFWP, Avista, and students from Dr. Dennis Scarnecchia's University of Idaho Fisheries Management class. Data collected from each fish include its species, total length, and weight, identified separately by individual net. Since 2013, all Walleye captured have been identified to sex and their otoliths collected for age determination. In 2017 and 2018, dorsal spines and pelvic fin rays were also removed from a subset of Yellow Perch,

Northern Pikeminnow *Ptychocheilus oregonensis*, Largescale Suckers, and Smallmouth Bass for age estimation. Mean relative weights ($W_{r)}$ were calculated for all Smallmouth Bass (Kolander et al. 1993), Northern Pike (Neuman et al. 2012), and Walleye (Murphy et. al 1990) captured in fall gill nets.

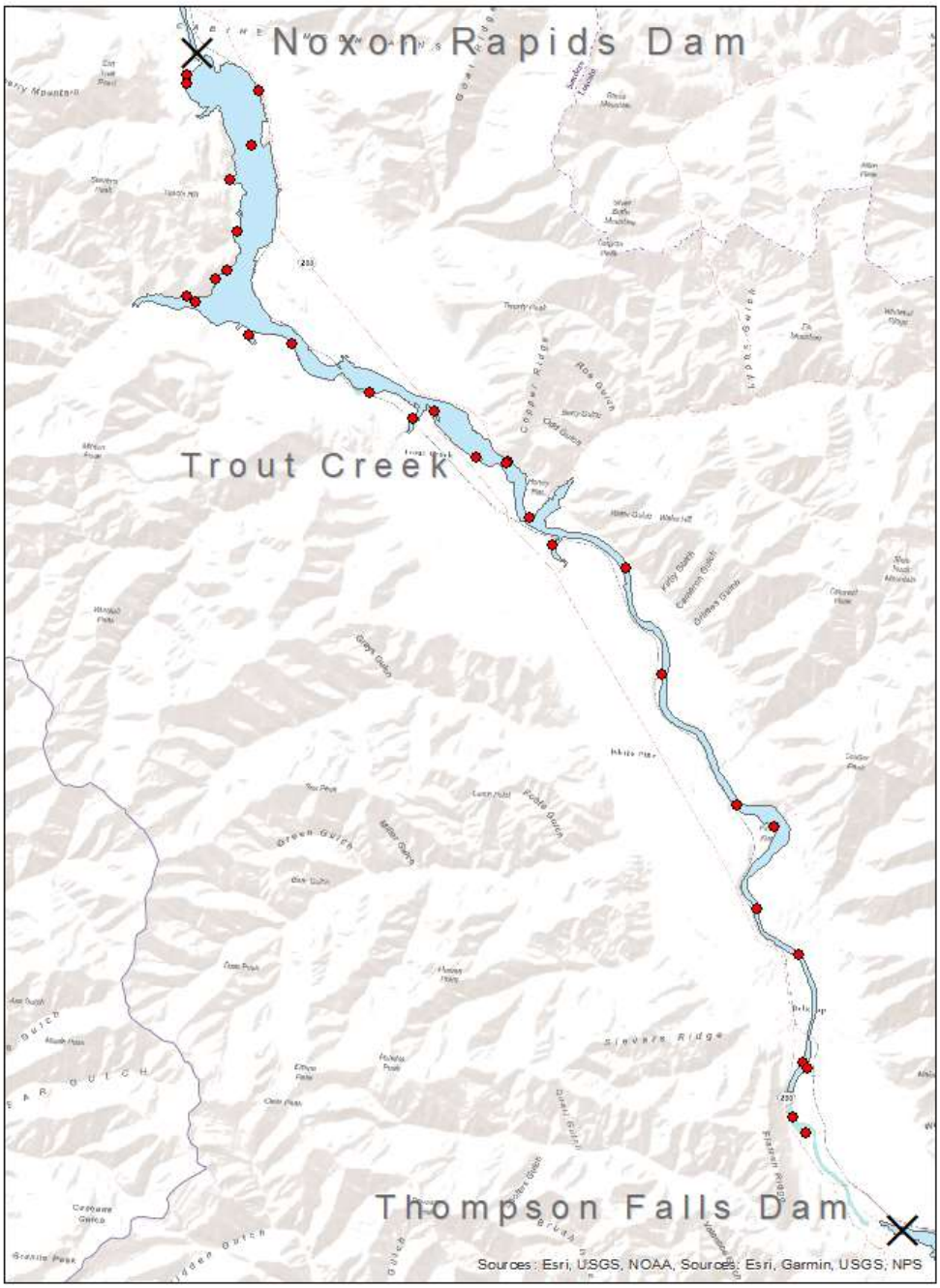


FIGURE 2. Annual fall gillnet locations (in red) on Noxon Rapids Reservoir.

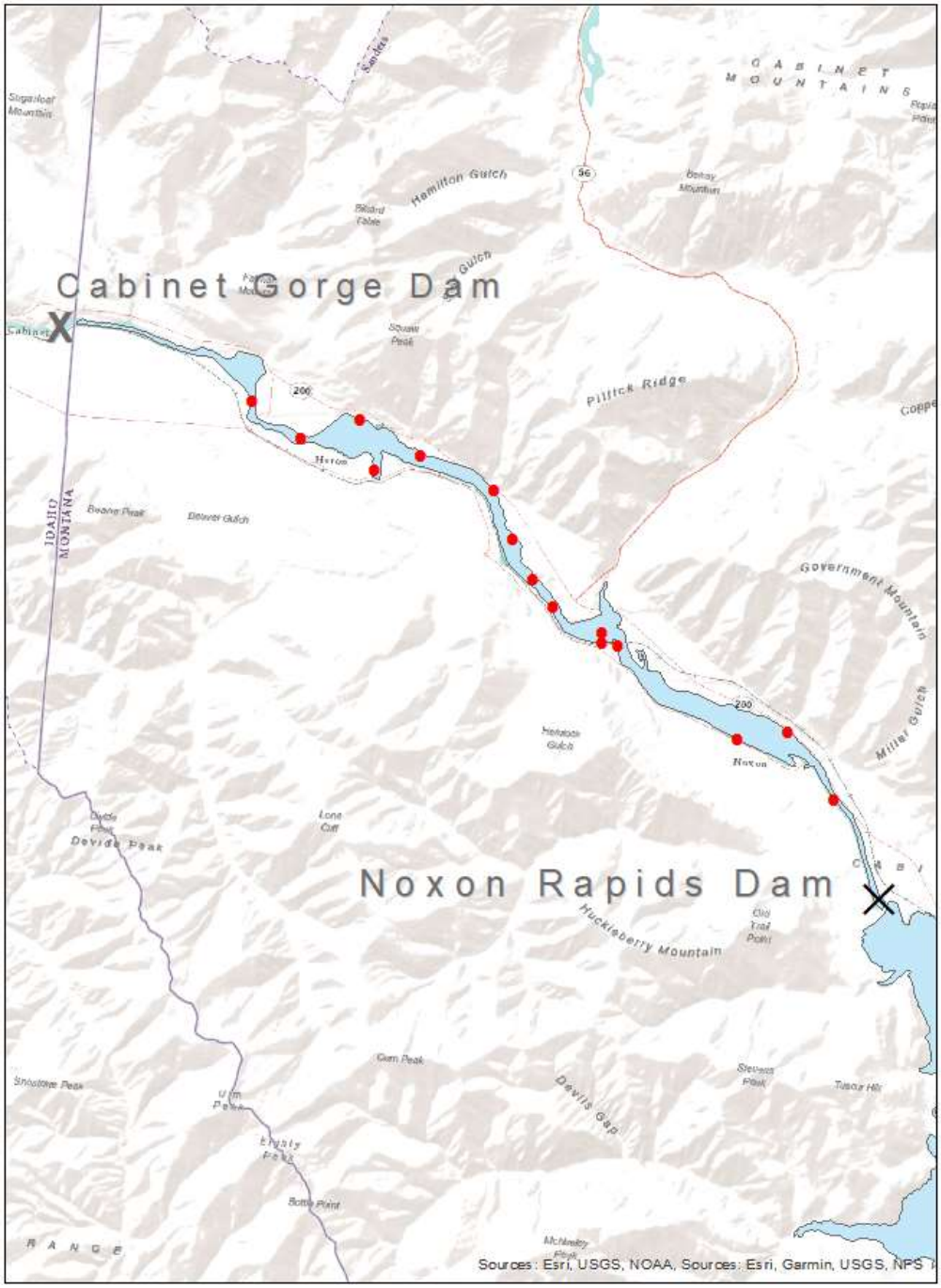


FIGURE 3. Annual fall gillnet locations (in red) on Cabinet Gorge Reservoir.

Bass Seining

Bass recruitment monitoring was conducted in 2016 and 2017 in Noxon Rapids Reservoir using beach seines to collect fish. No sampling was conducted in those years on Cabinet Gorge Reservoir. Seine dimensions were 15 m (50 ft) by 3 m (10 ft) beach with 1.0 cm (3/8 inch) mesh and a 1.2 m (4 ft) by 1.2 m pocket. Four sampling events occurred annually: mid-August, mid-

September, early October and mid-October. Eight sites were sampled on the lower half of Noxon (FIGURE 4). At a minimum, two seine hauls were made at each site. If a seine pull was deemed ineffective due to snagging or overly dense vegetation, that haul was discarded, and a third attempt made. After each seine haul, all captured bass were identified to species, measured (total length, mm), and weighed (g). Additionally, other species were identified and counted but not measured.

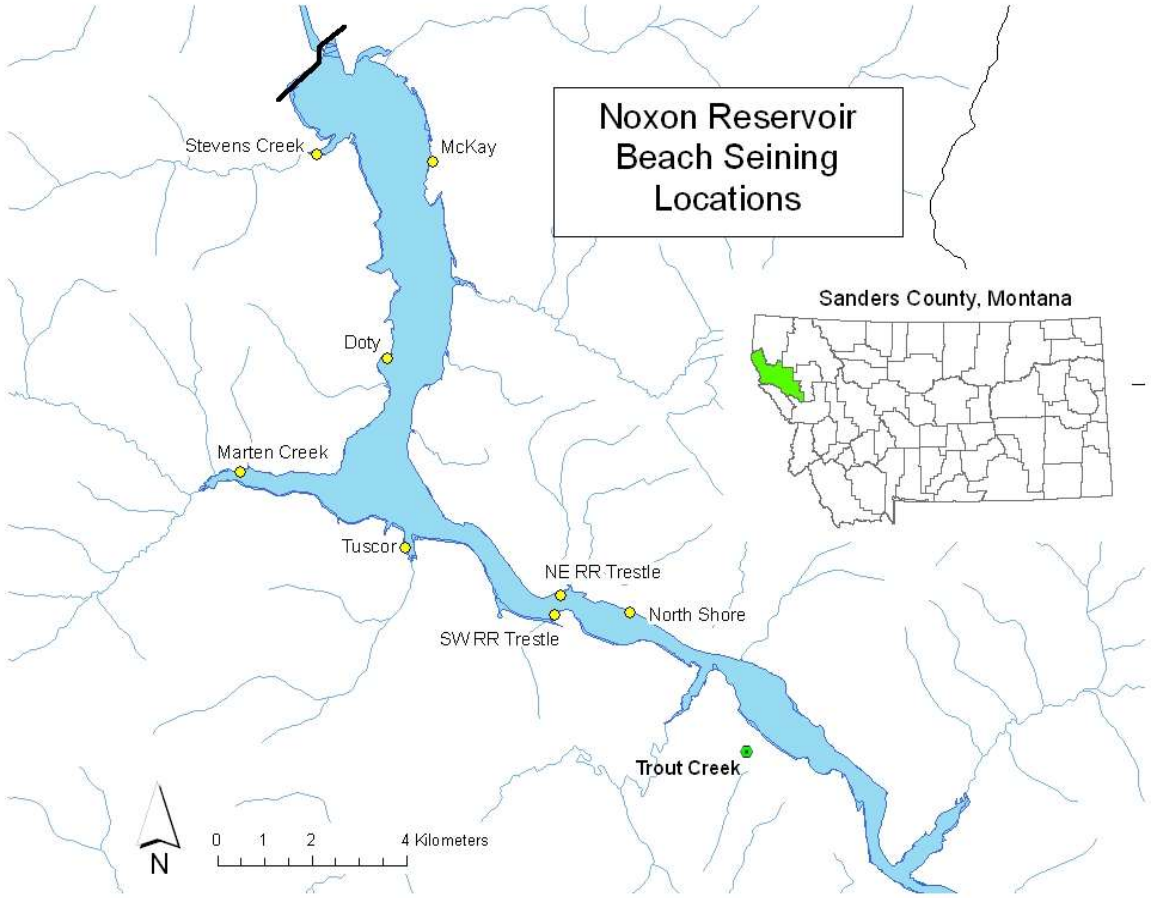


FIGURE 4. Beach seining locations for age-0 Largemouth Bass in lower Noxon Rapids Reservoir.

Beach seine data was used to predict age-0 bass overwinter survival which has been found to be a major factor in year class strength of northern Largemouth Bass populations (Newburg and Schupp 1986, Saffel 2000). Saffel (2003) found that larger size of age-0 Largemouth Bass at a given date was positively related to over-winter survival rate. Of the six year-classes of Largemouth Bass monitored in Noxon Rapids Reservoir in the past, only the two which had attained a mean length of 76 mm and 80 mm by October showed successful recruitment. The other four year classes had reached mean lengths of 62 mm or less by October and were considered unsuccessful due to a lack of representation in catches as age-1 fish the following year.

Bass Tournament Monitoring

The status of adult Largemouth and Smallmouth bass populations has been assessed annually over the period 1997-2018 through the monitoring of bass tournaments on Noxon Rapids Reservoir. In most years, between five and seven two-day bass tournaments occurred on Noxon Rapids Reservoir. From one to three tournaments were monitored per year.

Noxon Rapids Reservoir bass tournaments required that bass to be weighed-in had a minimum length of 305 mm (12”). Therefore, only bass this size or larger were monitored at tournaments. Indices collected at Noxon tournaments since the 1990s include the percentage of quality fish weighed in (fish greater than 380 mm or 15 inches) (Gabelhouse 1984), mean length of fish weighed in (>305 mm), and proportion of species brought to weigh-in (Smallmouth versus Largemouth bass). All tournaments held on Noxon Rapids Reservoir allowed high-grading or culling (i.e., the replacement of smaller fish captured with larger fish after a 5-fish limit was attained) so catch rates could not be accurately estimated.

Spring Walleye Monitoring

Additional (spring) sampling of illegally introduced Walleye was initiated in 2012 primarily to evaluate potential removal techniques of the species. With varying degrees of effort, Walleye were monitored using nighttime electrofishing during April and May over the period 2012-2018. The objectives of spring sampling were: 1) Evaluate capture techniques; 2) monitor year-class strength; and 3) collect fish for age and growth estimates. The primary sampling location was located above the highway bridge near Thompson Falls, based on information obtained from a previous telemetry study (Horn et al. 2009) (FIGURE 5). Additional sampling began near the River’s Bend Golf Course across from Flat Iron Fishing Access Site in 2016.

FIGURE 5. Map of two spring Walleye sampling locations in upper Noxon Rapids Reservoir.

Otoliths were collected from up to five Walleye of each sex from 25 mm length bins. All other fish were released alive with PIT tags. To assess yearclass composition of our total catch (both live and dead fish), live fish were measured and released, and later assigned an age using an age-length key constructed in R (Ogle 2010).

RESULTS

Fall Gillnetting

Noxon Rapids Reservoir

In 2016, 835 fish (29 fish/net) were captured, representing 12 species (TABLE 1). This total catch was down from previous years, especially 2015. Yellow Perch was the most abundant species sampled in 2016 (n=388), comprising 47% of the total catch. Most other species, including Northern Pike, Smallmouth Bass, and Pumpkinseed *Lepomis gibbosus*, which had historically high catches in 2014 or 2015, were also down in 2016. Walleye catch was identical

to 2015, but down from highs in 2012 and 2014. Largemouth Bass constituted less than 0.5% of the total catch. Catches of native Peamouth and Largescale Suckers were present as fewer than 1 fish per net, with Northern Pikeminnow catch slightly higher (1.8 per net). Each species continued its steady decline since 2000 (APPENDIX B).

In 2017, 1,101 fish were captured, representing 13 species (36.7 fish/net) (TABLE 1). Yellow Perch was the most abundant species captured (n=501), representing 45% of the total catch. Fifty-one Walleye were captured, the highest catch since standardized netting began in 2000. Thirty-eight of the 51 Walleye (75%) were from the 2015 year-class (FIGURE 7). Northern Pike and Smallmouth Bass catch rates decreased slightly from historic highs in 2015 (APPENDIX B). Native species such as Northern Pikeminnow (1.4 fish per net) and Peamouth (0.6 fish per net) were caught at historically low levels (APPENDIX B).

In 2018, 944 fish (31.5 fish/net night) were captured representing 15 species. Yellow Perch was the most abundant species captured, although numbers were the lowest since 2011. Yellow Bullhead *Ameiurus natalis* increased to account for more than 25% of the total fish caught. Pumpkinseed declined from 2017 to numbers similar to 2016. Of the three non-native predator species commonly sampled in the gillnets, Smallmouth Bass and Northern Pike remained relatively steady while Walleye numbers continued to increase. This was mostly attributable to the large 2015-year class (FIGURE 6). About five out of every six Walleye captured in 2018 were hatched in 2015. Native species such as Northern Pikeminnow and Peamouth continued to decline (APPENDIX B). The decline in catch rate since 2000 is most apparent in Peamouth, which have dropped from 11.6 fish/net night in 2000 to only 0.4 fish per net night in 2018. Length distributions of native minnows and suckers indicated a lack of younger ages and a shift towards fewer, but larger, fish. Very few small fish have been captured in recent years (FIGURE 8). No Largescale Suckers less than 425 mm were captured in 2018.

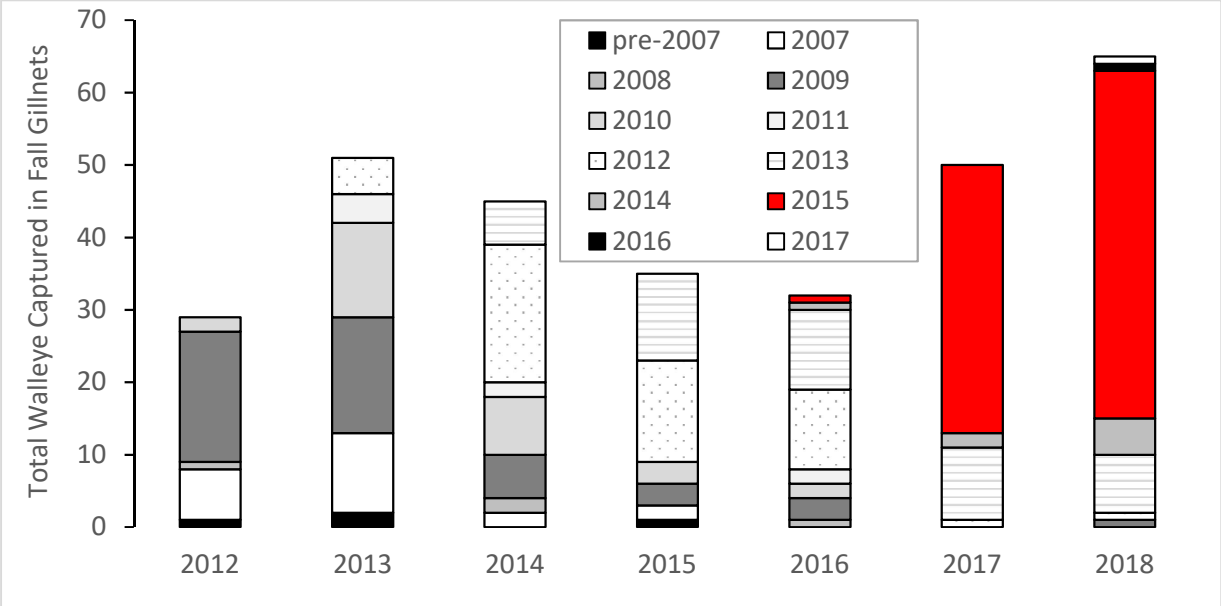


FIGURE 6. Total numbers of Walleye captured in annual fall gill nets in Noxon Rapids Reservoir, Montana, with year-classes that produced them shown. The strong year class of 2015 is in red.

TABLE 1. Total numbers of individual species captured during annual gill net sampling in Noxon Rapids Reservoir, Montana, 2016-2018. Fish species abbreviations described in Appendix A.

Species	2016			2017			2018		
	Total No. caught	Percent of Total Catch	Percent of Total Weight	Total No. caught	Percent of Total Catch	Percent of Total Weight	Total No. caught	Percent of Total Catch	Percent of Total Weight
BL BH	6	0.7	0.7	10	0.9	0.7	15	1.6	1.5
LL	0	0	0	0	0	0	2	0.2	0.4
LMB	4	0.5	0.3	5	0.5	0.7	4	0.4	0.5
LN SU	0	0	0	0	0	0	2	0.2	0.9
LS SU	22	2.6	10.2	29	2.6	10.9	11	1.2	4.9
LWF	24	2.9	7.3	25	2.3	7.0	10	1.1	4.6
NP	41	4.9	25.1	37	3.4	24.4	41	4.3	24.1
NP MN	55	6.6	15.4	41	3.7	11.4	37	3.9	13.2
PEA	20	2.4	3.0	18	1.6	2.6	11	1.2	1.6
PUMP	157	18.8	3.7	254	23.1	5.7	154	16.3	4.1
RB	0	0	0	1	0.1	0.3	1	0.1	0.1
SMB	20	2.4	2.6	18	1.6	3.0	28	3.0	5.1
WE	35	4.2	14.1	51	4.6	10.1	58	6.1	13.3
YL BH	63	7.5	4.8	111	10.1	7.8	244	25.8	15.3
YP	388	46.5	12.6	501	45.5	15.3	326	34.5	10.5

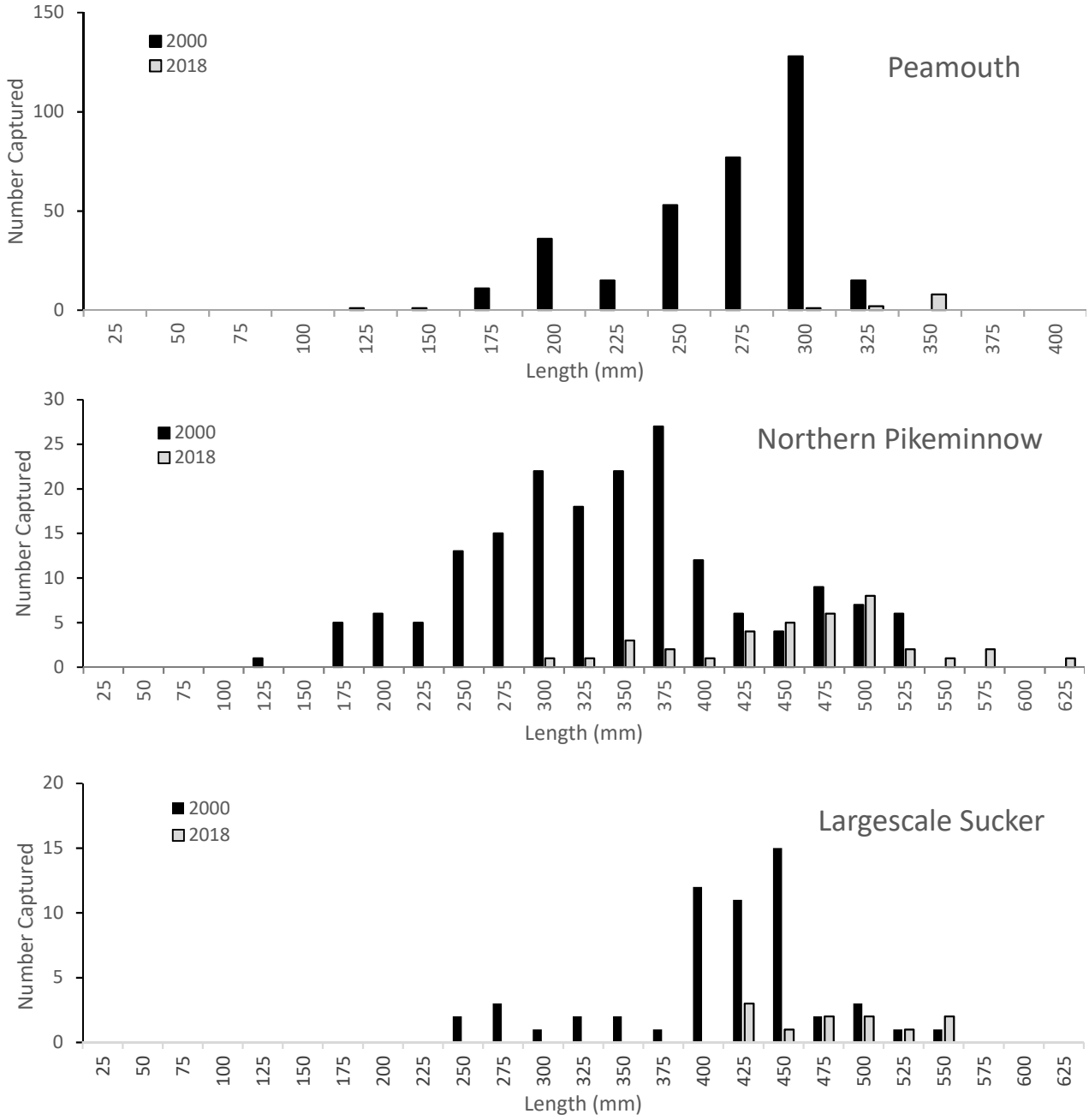


FIGURE 7. Length frequency histogram of Noxon Rapids Reservoir Peamouth, Northern Pikeminnow, and Largescale Suckers captured during fall gillnet monitoring in 2000 and 2018.

Consistent with the declines in abundance of native non-game species, the condition of the top non-native piscivorous fish in Noxon has also declined in recent years (FIGURE 8). This decline in condition is most apparent in Walleye since 2013. The species had mean relative weights near 100 for the first fifteen years of monitoring but declined to 85 by 2018. Northern Pike have exhibited more variation in weight/length relationships between individual fish but have generally declined in time similar to Walleye (FIGURE 8). The pattern of decline for

Smallmouth Bass differs from Walleye and Northern Pike, but as of 2018, is also near the lower end of past observed values.

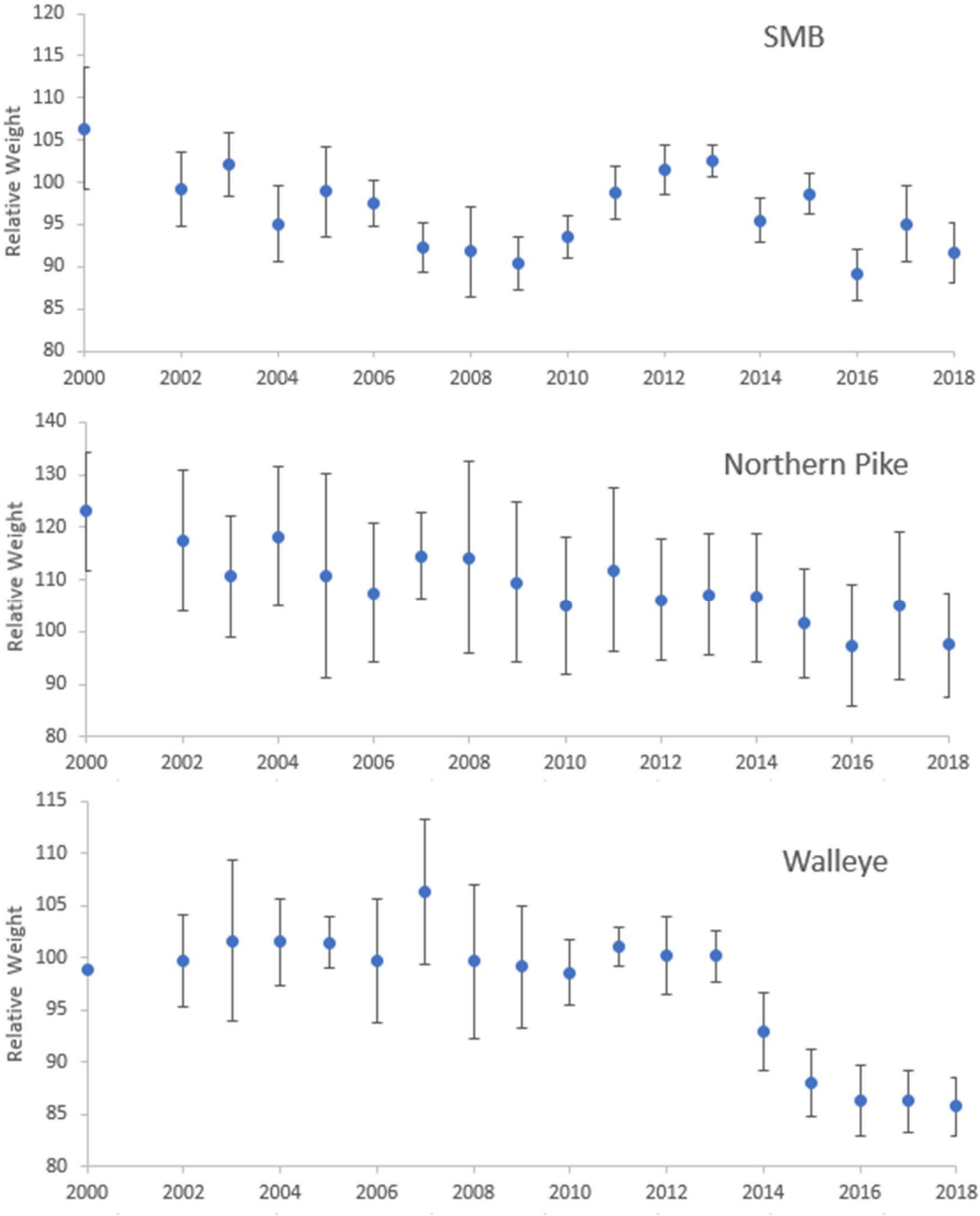


FIGURE 8. Relative weight (W_r) of Smallmouth Bass, Northern Pike, and Walleye captured in Noxon Rapids Reservoir during annual gill net surveys from 2000 through 2018.

Based on otoliths aged, Walleye length-at-age has declined between 2013 and 2018 (FIGURE 9). Mean length of age-3 male Walleye captured in the fall has decreased significantly from 450 mm in 2013 and 2014 to less than 400 mm since then (Kendall's Tau; T=-0.186; p<0.001). Age-2 and age-3 Walleye length-at-age was lower in 2017 and 2018 than in 2013 (FIGURE 10). The decline in length-at-age, an indicator of growth rate, appears to have begun about 2015 associated with the large 2015 year-class of walleye; age-2 fish in 2017 and age-3 fish in 2018 were the first fish to exhibit the lower length-at-age (FIGURE 10).

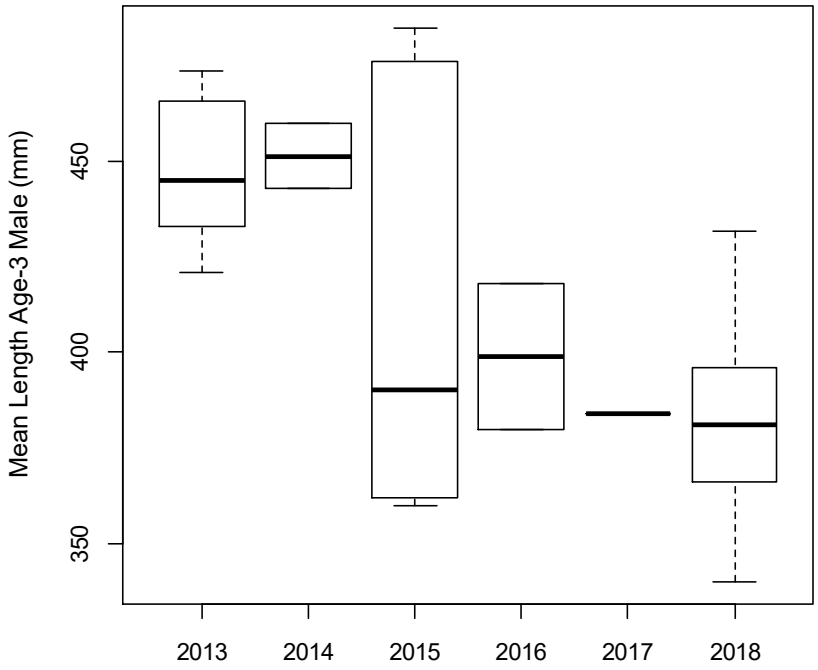


FIGURE 9. Length of age-3 males captured in fall gillnets in Noxon Rapids Reservoir. The horizontal bar within the box delineates the median value, box delineates the upper and lower quartiles, the whiskers delineate largest and smallest values within 1.5 interquartile range of the lower quartile, and individual points delineate outliers.

Lengths-at-age were also evaluated using various structures in 2018 for other species caught. Eighteen Yellow Perch were aged in 2017 with dorsal spines as 2, 3, and 4 years old and ranged in length from 136 to 222 mm (TABLE 2). In 2018, Yellow Perch aged with dorsal spines ranged in age from 2 to 6 and in length from 173 to 256 mm (TABLE 3).

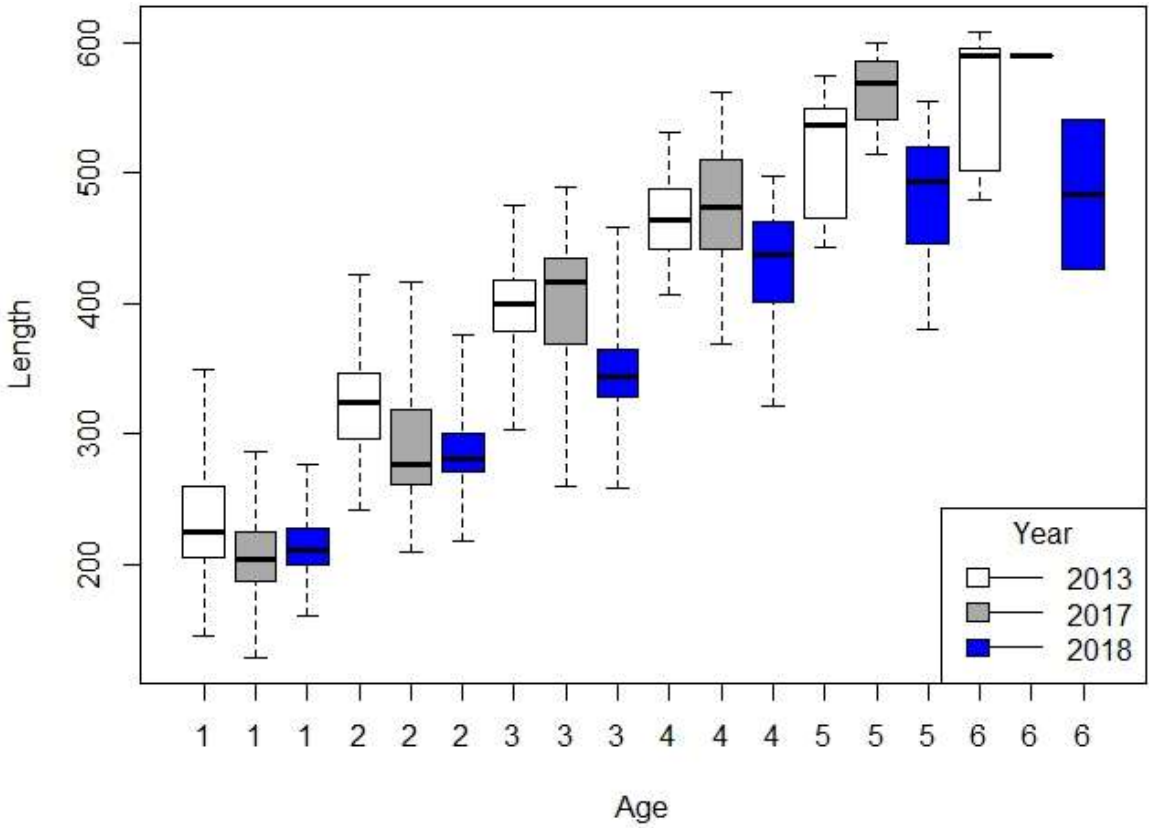


FIGURE 10. Length-at-age for Walleye captured during fall gillnetting in Noxon Rapids Reservoir from 2013, 2017, and 2018. The horizontal bar within the box delineates the median, box delineates the upper and lower quartiles, the whiskers delineate largest and smallest values within 1.5 interquartile range of the lower quartile, and individual points delineate outliers.

TABLE 2. Age estimates obtained from dorsal spines of Yellow Perch in 2017 from Noxon Rapids Reservoir.

Year	Age	n	Mean length	Min length	Max length
2017	2	8	159.9	136	196
2017	3	2	188.0	149	227
2017	4	8	209.7	195	222

TABLE 3. Age estimates obtained from dorsal spines of Yellow Perch in 2018 from Noxon Rapids Reservoir.

Year	Age	n	Mean length	Min length	Max length
2018	2	2	183.5	173	194
2018	3	41	187.4	144	217
2018	4	10	222.4	139	252
2018	5	17	223.5	139	276
2018	6	1	256.0	256	256

Twenty of 37 Northern Pikeminnow captured in the 2018 gillnets were aged using pelvic fin-rays (TABLE 4). Fish ranged in age from age-6 to age-21 and size from 361 to 540 mm. The twenty fish aged represented thirteen different year classes.

TABLE 4. Age estimates obtained from pelvic fins of Northern Pikeminnow in 2018 from Noxon Rapids Reservoir.

Age	n	Mean length	Min Length	Max Length
6	1	361.0	361	361
7	1	381.0	381	381
8	1	394.0	394	394
9	1	305.0	305	305
10	1	445.0	445	445
11	3	454.3	401	510
12	1	475.0	475	475
13	3	471.7	426	520
15	1	540.0	540	540
16	1	435.0	435	435
18	2	473.0	470	476
19	3	525.7	494	576
21	1	540.0	540	540

Twenty-seven of the 28 (96%) Smallmouth Bass captured in the 2018 Noxon gillnet series were aged using dorsal spines (TABLE 5) and ranged from age-1 to age-7. Most fish were assigned to the 2014 year class.

TABLE 5. Age estimates obtained from dorsal spines of Smallmouth Bass in 2018 from Noxon Rapids Reservoir.

Age	n	Mean Length	Min length	Max length
1	1	135.0	135	135
2	1	155.0	155	155
3	5	278.4	229	335
4	15	332.5	265	398
5	4	399.3	338	440
7	1	426.0	426	426

Cabinet Gorge Reservoir

In 2016, 184 fish (12 fish/net) representing 9 fish species were sampled in Cabinet Gorge Reservoir (TABLE 6). This total was up from recent years, mostly due to higher catches of Yellow Perch. Smallmouth Bass and Walleye numbers were up slightly, while Peamouth declined considerably.

In 2017, gillnetting in Cabinet Gorge Reservoir produced a total of 117 fish representing 10 species (TABLE 6). The catch rate of 7.8 fish/net is approximately 4 fish/net lower than the previous 2 years. Although Yellow Perch and Pumpkinseed were the two most common species captured, their numbers declined considerably since 2016. Northern Pikeminnow and Walleye numbers were similar to recent years. For the first time since standard sampling began in 2000, no Peamouth were captured in Cabinet Gorge Reservoir.

In 2018, 120 individual fish were captured from 11 different species (8.0 fish/net night) (TABLE 6). Total catch was similar to 2017. The overall decline in total fish captured between 2016 and 2018 is mostly attributable to lower Yellow Perch numbers captured in 2017 and 2018. In 2018, as in 2017, no Peamouth were captured. However, Largescale Sucker numbers increased by 111%. No weight data was collected in 2018 due to an equipment malfunction.

Bass Seining

Beach seining yielded 158 age-0 Largemouth Bass in 2016 and 171 in 2017 (TABLE 7). Maximum achieved mean length was highest in both years during the mid-October sampling; 61.1 mm in 2016, and 66.0 mm in 2017 (FIGURE 11).

The seining also yielded 58 age-1+ Largemouth Bass in 2016, and 17 in 2017 (TABLE 8). More than 1,400 fish of other species were also collected as bycatch. Pumpkinseed accounted for two-thirds and Yellow Perch one-fourth of the bycatch. Only four Smallmouth Bass were sampled over the two-year period. The only native species sampled was Northern Pikeminnow, which accounted for 6% of the bycatch.

TABLE 6. Total numbers of individual species captured during annual gill net sampling in Cabinet Gorge Reservoir, Montana, 2016-2018. The scale malfunctioned in 2018 and no weights were taken (na = not applicable).

	2016			2017			2018		
Species	Total # caught	Percent of Total Catch	Percent of Total Weight	Total # caught	Percent of Total Catch	Percent of Total Weight	Total # caught	Percent of Total Catch	Percent of Total Weight
LL	3	1.6	6.2	1	0.9	na	1	0.8	na
LNSU	0	0.0	0	0	0.0	0	1	0.8	na
LSSU	9	4.9	12.5	9	7.7	13.7	19	15.8	na
LWF	0	0.0	0	3	2.6	4.4	5	4.2	na
NP	19	10.3	40.4	12	10.3	37.8	17	14.2	na
NPMN	13	7.1	10.7	18	15.4	25.8	18	15.0	na
PEA	2	1.1	1.0	0	0.0	0	0	0.0	na
PUMP	12	6.5	0.9	27	23.1	1.7	9	7.5	na
RB	0	0.0	0	2	1.7	1.4	2	1.7	na
SMB	15	8.2	11.8	3	2.6	1.3	13	10.8	na
WE	5	2.7	6.5	6	5.1	9.7	4	3.3	na
YP	106	57.6	10.0	36	30.8	4.2	31	25.8	na

TABLE 7. Mean lengths (with 95% confidence intervals) of sampled age-0 Largemouth Bass from beach seining in Noxon Rapids Reservoir, 2016-2017.

	2016			2017		
	n	Mean Length (mm)	95% CI	n	Mean Length (mm)	95% CI
Mid-Aug	51	44.5	2.4	44	44.8	1.3
Mid-Sep	74	56.1	2.7	61	61.0	1.5
Early-Oct	33	61.1	2.3	66	66.0	1.5

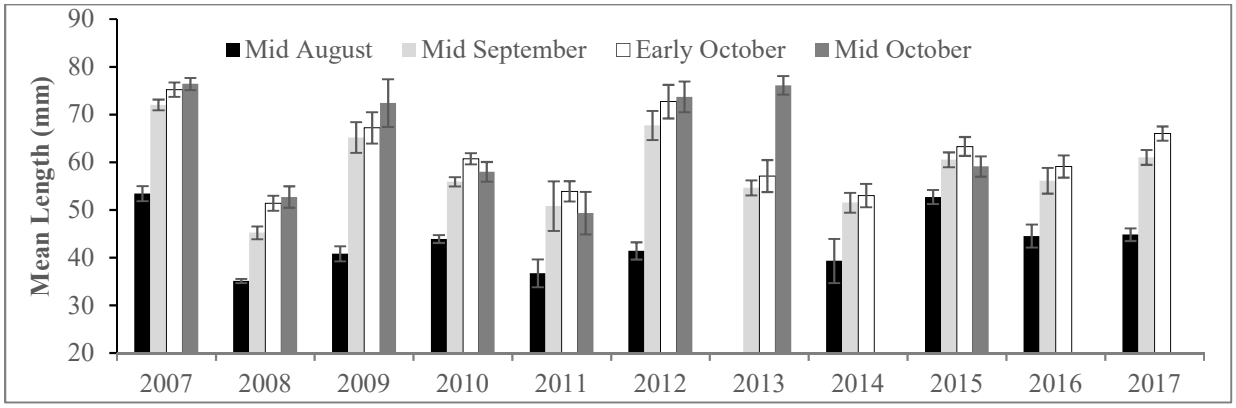


FIGURE 11. Mean length of age-0 Largemouth Bass sampled by beach seining in Noxon Rapids Reservoir from 2007-2017.

TABLE 8. Additional species captured while beach seining for age-0 Largemouth Bass in Noxon Rapids Reservoir, Montana (n=1,521).

Date	NP	NPMN	PUMP	YP	SMB	Age-1+ LMB
August 2016	0	16	197	70	1	26
August 2017	0	16	443	78	0	15
September 2016	1	2	108	8	2	11
September 2017	0	12	89	65	1	2
October 2016	0	1	75	14	0	33
October 2017	0	40	30	165	0	0

Bass Tournament Monitoring

In 2016, Largemouth Bass constituted 71% of the total fish measured. The frequency of quality-sized Largemouth Bass (≥ 380 mm) checked in at the tournaments was 80%, the highest since 2000 (TABLE 9). Mean length at weigh-in was 414 mm, also the greatest since 2000. The frequency of quality-sized Smallmouth Bass was 78%, the highest recorded in the tournaments. Mean length of Smallmouth Bass was 416 mm, also the highest recorded in the tournaments.

In 2017, only one of the seven bass tournaments held was monitored, spanning two days. Catch statistics were similar to recent years in which mean length and proportion of quality-sized fish was high for both species (TABLE 9, FIGURES 12 and 13).

In 2018, three bass tournaments were monitored. Largemouth bass constituted 80% of the bass checked in (FIGURE 14). The size of fish checked in was similar to recent years, both in mean length and percent quality fish (TABLE 9, FIGURES 12 and 13). The percentage of memorable-sized SMB decreased from an all-time high of 21% in 2017 to 14% in 2018, while memorable-sized LMB increased to their highest point since 2003 (16%) (FIGURE 15).

TABLE 9. Statistics from monitored bass tournaments on Noxon Rapids Reservoir from 2016-2018.

	Spp.	**2016**	**2017**	**2018**
Mean Length (mm)	LMB	414	406	415
	SMB	416	416	415
Percent (%)	LMB	80	72	77
Quality (≥ 380 mm)	SMB	78	78	79
Species	LMB	71	72	80
Composition (%)	SMB	29	28	20

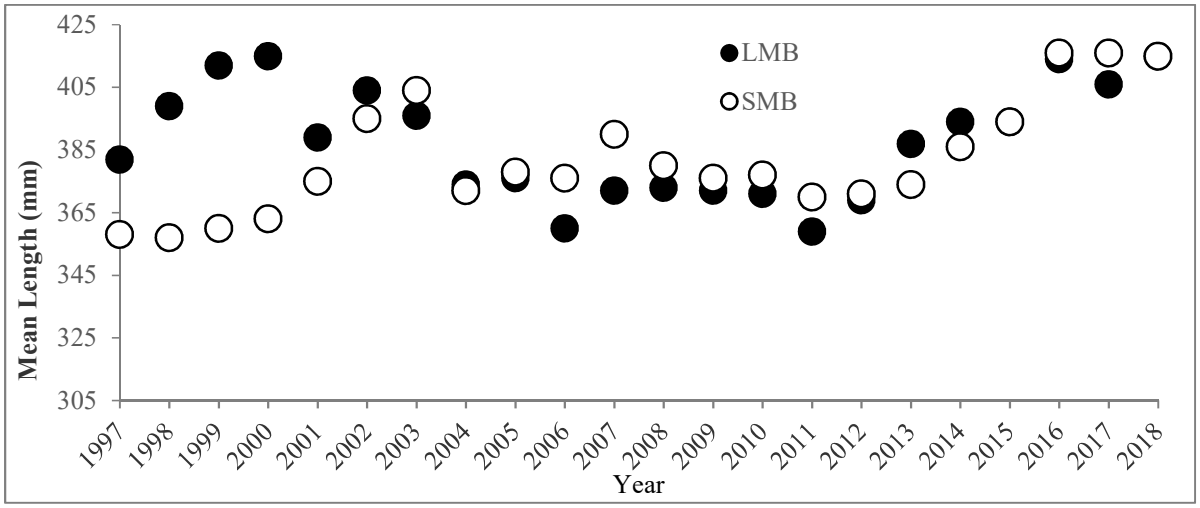


FIGURE 12. Annual mean length of Largemouth (LMB) and Smallmouth Bass (SMB) checked in at bass tournaments on Noxon Rapids Reservoir, 1997-2018.

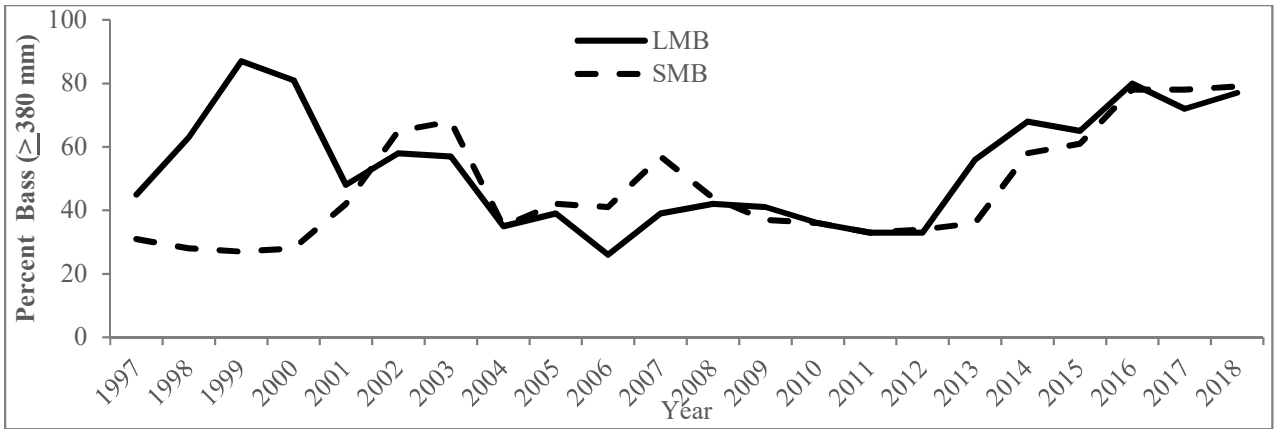


FIGURE 13. Percentage of quality sized (≥380 mm) Largemouth Bass (LMB) and Smallmouth Bass (SMB) checked in at Noxon Rapids Reservoir bass tournaments, 1997-2018.

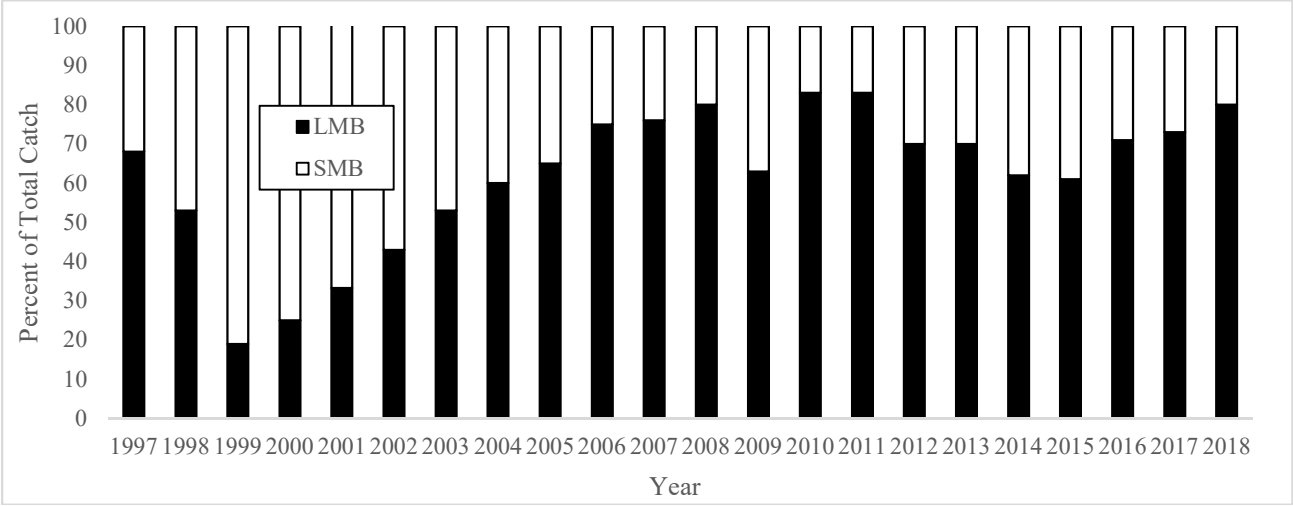


FIGURE 14. Species composition of Largemouth Bass (LMB) and Smallmouth Bass (SMB) weighed in at Noxon Rapids Reservoir bass tournaments, 1997-2018.

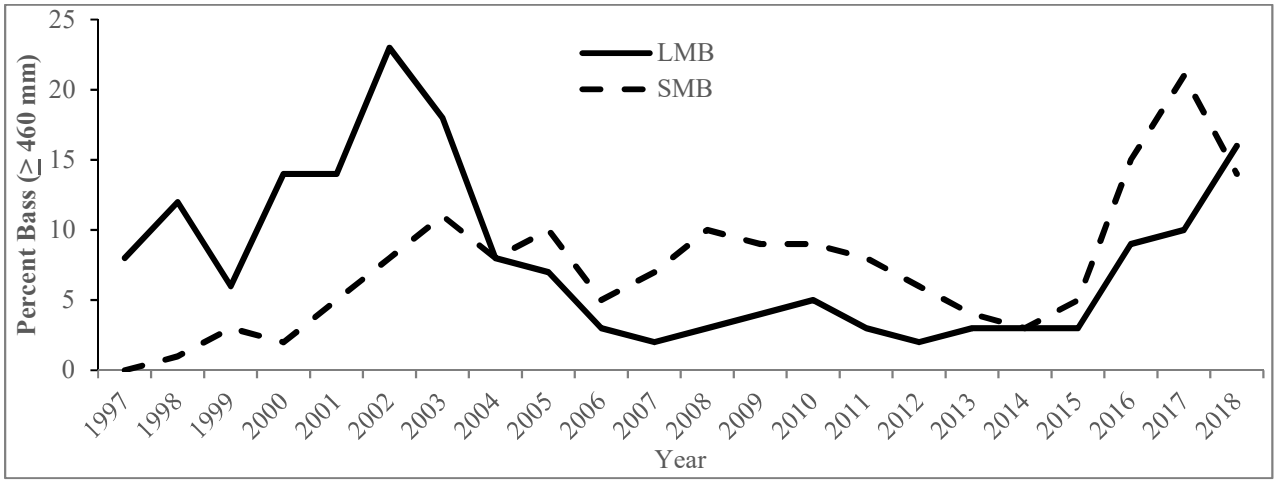


FIGURE 15. Percentage of memorable sized (≥460 mm) Largemouth Bass (LMB) and Smallmouth Bass (SMB) checked in at Noxon Rapids Reservoir bass tournaments, 1997-2018.

Spring Walleye Monitoring 2016-2018

In 2016, 317 Walleye were caught during seven nights of electrofishing (mean: 45 fish/night; FIGURE 16). Overall catch rate was 38 fish per hour, and nightly catch rate ranged from 14-64 fish per hour. Of the 317 unique Walleye captured, 261 (82%) were males (mean length, 415 mm) and 56 were females (mean length, 607 mm). Captured males represented only two year-classes, 2013 (76%) and 2012 (24%), whereas females represented at least five year-classes, but were primarily from 2012 (71%). Additionally, there were 31 within-year recaptures (Walleye which were tagged during previous sampling events in spring, 2016). Of these within year recaptures, 30 were males (97%). Eleven Walleye caught were originally tagged during spring sampling in 2014 and 2015. Ten of these recaptures (91%) were males. River conditions were low, clear, and warm during the entire sampling period (FIGURE 16). Peak catch of 64.9 walleye per hour occurred on April 16 when the water temperature was 10°C (mean daily temperature), and flow was 20,000 cfs (mean daily discharge). Female catch rate peaked at 13.7 fish per hour on April 9 when water temperature was 10.8°C and flow was 22,000 cfs.

In April and early May 2017, catch rates were lower than all previous years since sampling began in 2012. Under conditions of high flows, cold water temperatures, and a weak 2014 year class (FIGURE 16), only 30 mature Walleye were captured during nine nights of electrofishing. Three of these fish were recaptures from the previous year (1 male, 2 female). The 24 mature females averaged 623 mm in length; the six mature males averaged 398 mm. Based on this small sample size, most mature males were evidently from the 2013 year-class, whereas most females were from the 2012 year-class. Additionally, 23 immature age-2 Walleye ranging in length from 243-304 mm were captured (mean, 271 mm). Sampling was split between the reservoir area adjacent to the River's Bend golf course (26%) and the more common spawning location up-reservoir of the Highway 200 bridge (74%). Although 17 of the 24 females and only one of six males were captured above the highway in 2017, overall C/f was generally equally low between sampling locations (FIGURE 17). Total catch and female catch peaked on April 26 (6.0 fish per hour and 5.3 fish per hour, respectively) when the temperature was 8.1°C and flow was 42,000 cfs.

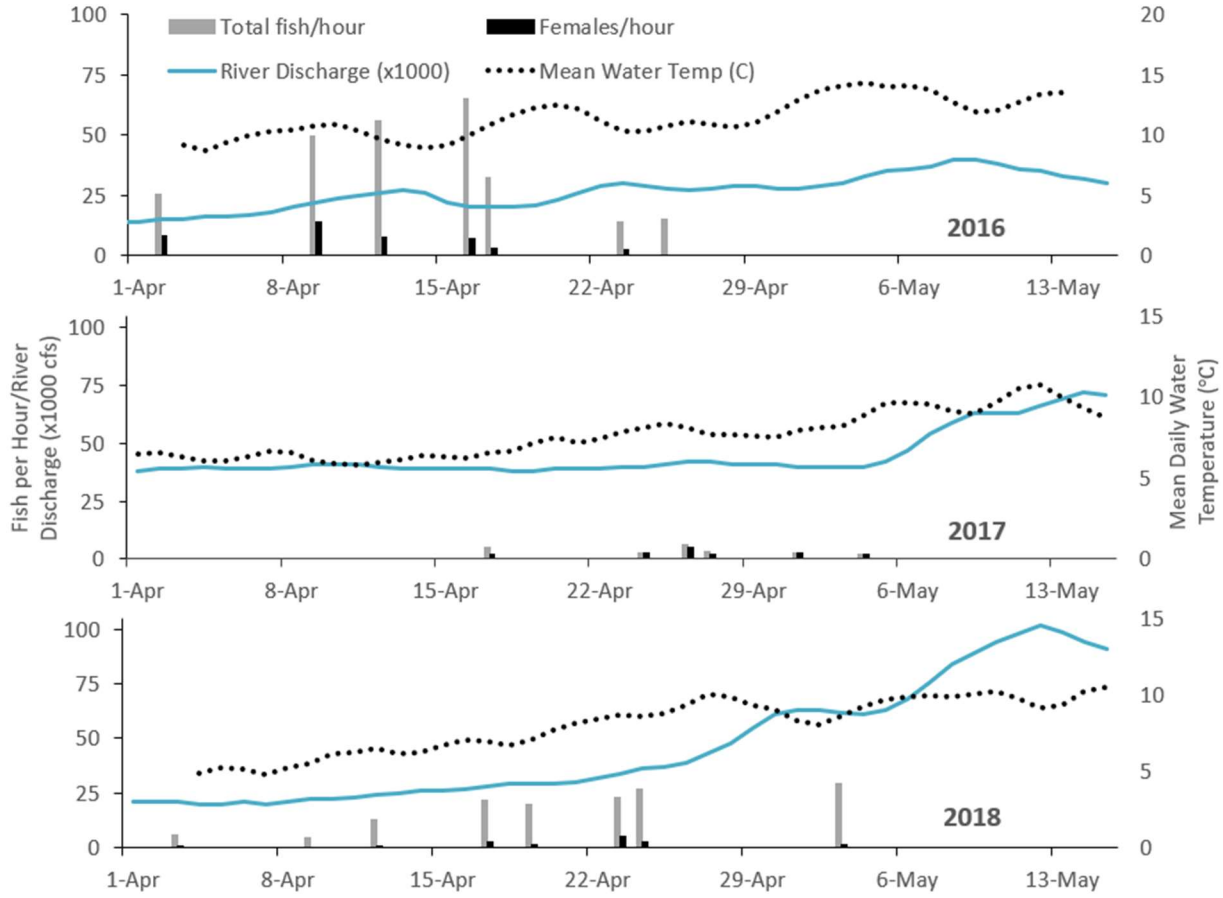


FIGURE 16. Daily catch per unit effort values with water temperature and stream discharge (cubic feet per second) during three years of spring electrofishing for Walleye in Noxon Rapids Reservoir.

During spring 2018, MFWP electrofished upper Noxon Rapids Reservoir for Walleye for a total of 8 nights. Sampling time was split approximately evenly between the area above the Highway 200 bridge (48%) and the area adjacent to the River's Bend Golf Course (52%). A total of 220 sexually mature fish were captured, of which 23 (10%) were females and 197 (90%) were males. Males were represented primarily by the 2015 year-class (89%) whereas the most abundant female year-class was 2013 (43%). Mature males were captured from five different year-classes and mature females from eight different year-classes. Additionally, nine immature age-2 Walleye were captured. Of the 91 fish released alive, three were subsequently captured during a later sampling date in 2018 (within year recaptures), and three additional fish captured in 2018 had been captured and tagged in prior years (previous year recaptures). Only 19% (n=41) of the total mature fish were captured upstream of the highway bridge; the majority were captured near the golf course (81%, n=179). Mean length of mature males captured was 351 mm (range: 302-604); only 16 males (7%) exceeded 400 mm in length; and most small males were evidently from the strong 2015 year-class. In contrast, mean length of mature females captured was 634 mm. Total catch peaked at 29 fish per hour on May 3 when water temperature was 8.6°C and flow was

62,000 cfs. Female catch remained low the entire year and peaked on April 23 at 4.9 per hour when water temperature was 8.6°C and flow was 34,000 cfs. Overall, total Walleye *C/f* was highest in 2016, but female *C/f* was more variable (FIGURE 18). The highest median female *C/f* occurred in 2016, but individual capture events were highest in 2013 (FIGURE 18).

The length distributions of annual spring Walleye catches since 2013 indicate an abundance of three-year-old fish in 2016 and 2018 (FIGURE 19). The distribution of age-3 males in these two years further corroborates findings of lower growth rates as the age-3 fish captured in 2018 were markedly smaller than previous years. In 2016, the mean length of an age-3 male was 377 mm versus only 339 in 2018 (TABLE 10). The mean length of an age-4 male in 2016 was larger than the mean length of an age-6 male in 2018. Female sample size was markedly smaller, but females captured in 2018 also had considerably shorter length-at-age than those caught in 2016. Age-4 Walleye comprised most of the spring caught females in 2016 but were absent from the sample in 2018.

Between 2013 and 2018, 595 Walleye were tagged (485 PIT tags, 110 Floy tags) and released in Noxon Rapids Reservoir during spring sampling events. As of 2018, 29 of these fish had been recaptured after at least one growing season (excluding within-year spring sampling recaptures). Seventeen tagged fish (2.9%) were recaptured during subsequent spring sampling events, seven (1.2%) were recaptured in fall gillnets, and two (0.3%) were reported caught by anglers. Recapture rates were 5.5% for PIT tagged fish (including one angler return) and 2.7% for Floy tags (including one angler return.) The 23 recaptured males grew between 0 and 62 mm per growing season with a median value of 18 mm (FIGURE 20). The seven recaptured females grew between 30 and 52 mm per year with a median value of 36 mm (FIGURE 20). Most fish were recaptured after only one growing season (77%), followed by two growing seasons (13%), three growing seasons (7%), and four growing seasons (3%).

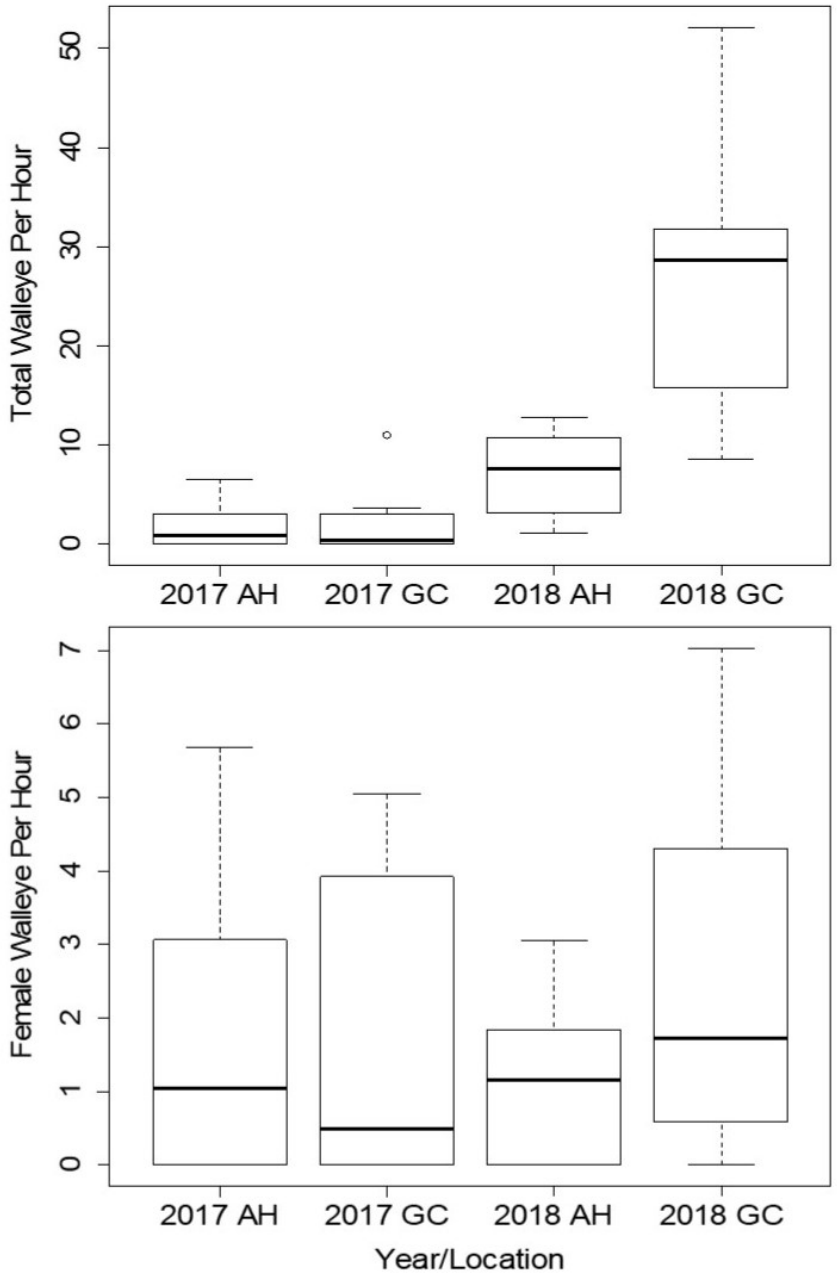


FIGURE 17. Total and female catch per unit effort *(C/f)* of spawning Walleye in upper Noxon Rapids Reservoir in two locations between years (AH: Above Highway, GC: Golf Course The horizontal bar within the box delineates the median, box delineates the upper and lower quartiles, the whiskers delineate largest and smallest values within 1.5 interquartile range of the lower quartile, and individual points delineate outliers.

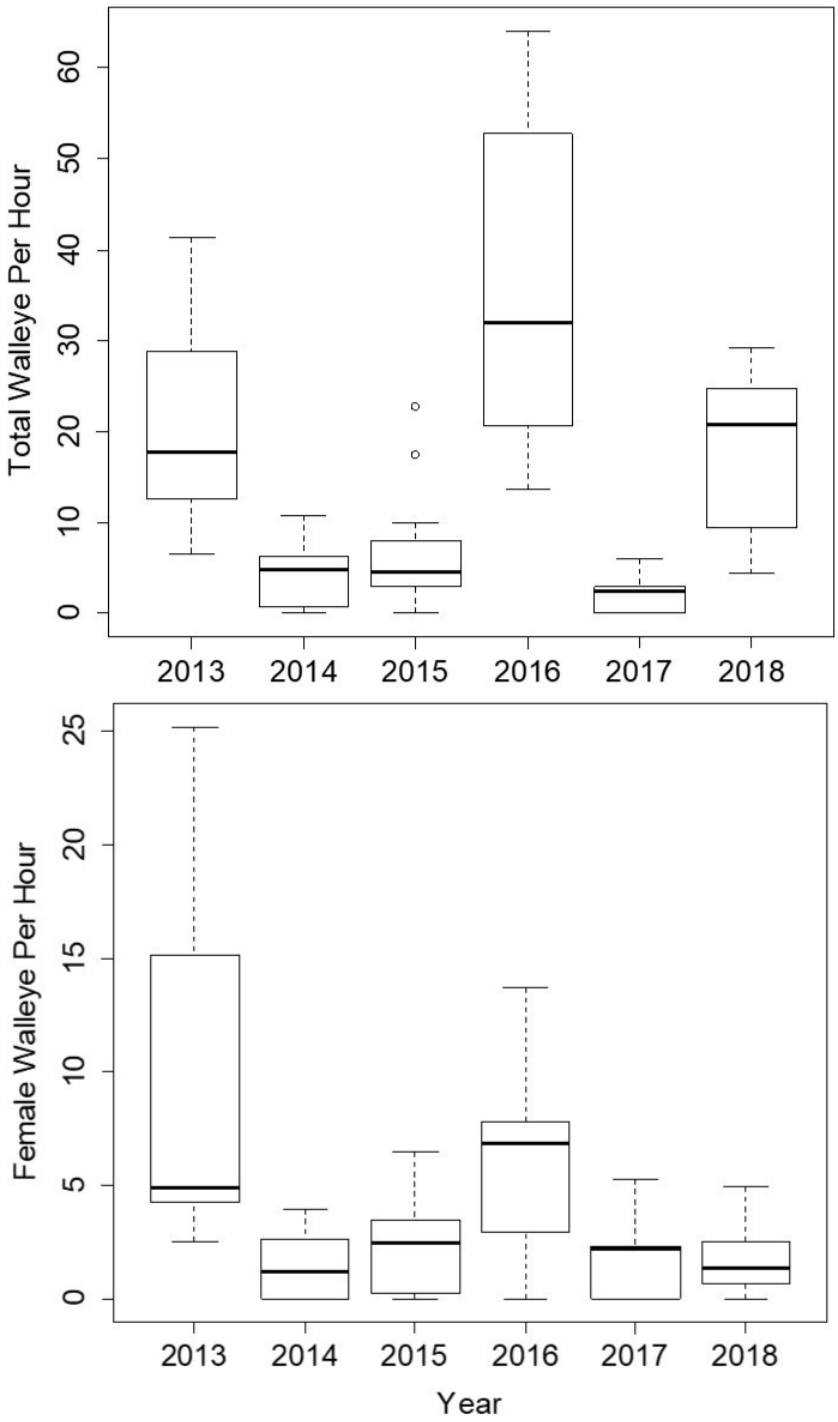


FIGURE 18. Total catch per unit effort (*C/f*) and Female *C/f* of Walleye per year during spring electrofishing in upper Noxon Rapids Reservoir. The horizontal bar within the box delineates the median, box delineates the upper and lower quartiles, the whiskers delineate largest and smallest values within 1.5 interquartile range of the lower quartile, and individual points delineate outliers.

TABLE 10. Year class representation of captured male (♂) and female (♀) Walleye during two spring seasons in Noxon Rapids Reservoir. Unknown fish ages were filled in using an age-length key created in R.

	2016						2018					
	♂			♀			♂			♀		
age	n	Mean Length	SD	n	Mean Length	SD	n	Mean Length	SD	n	Mean Length	SD
3	209	377	18.7				175	339	18.3			
4	76	514	49.4	40	564	56	2	364	2.1			
5				4	688	19.4	15	440	57.2	10	573	38.6
6				9	689	37.2	3	496	62.7	2	538	85.6
7				3	795	21.8	1	604	na			
8										4	640	8.1
9										1	703	na
10										1	739	na
11										3	767	26.2
12										1	757	na
13												
14												
15										1	722	na

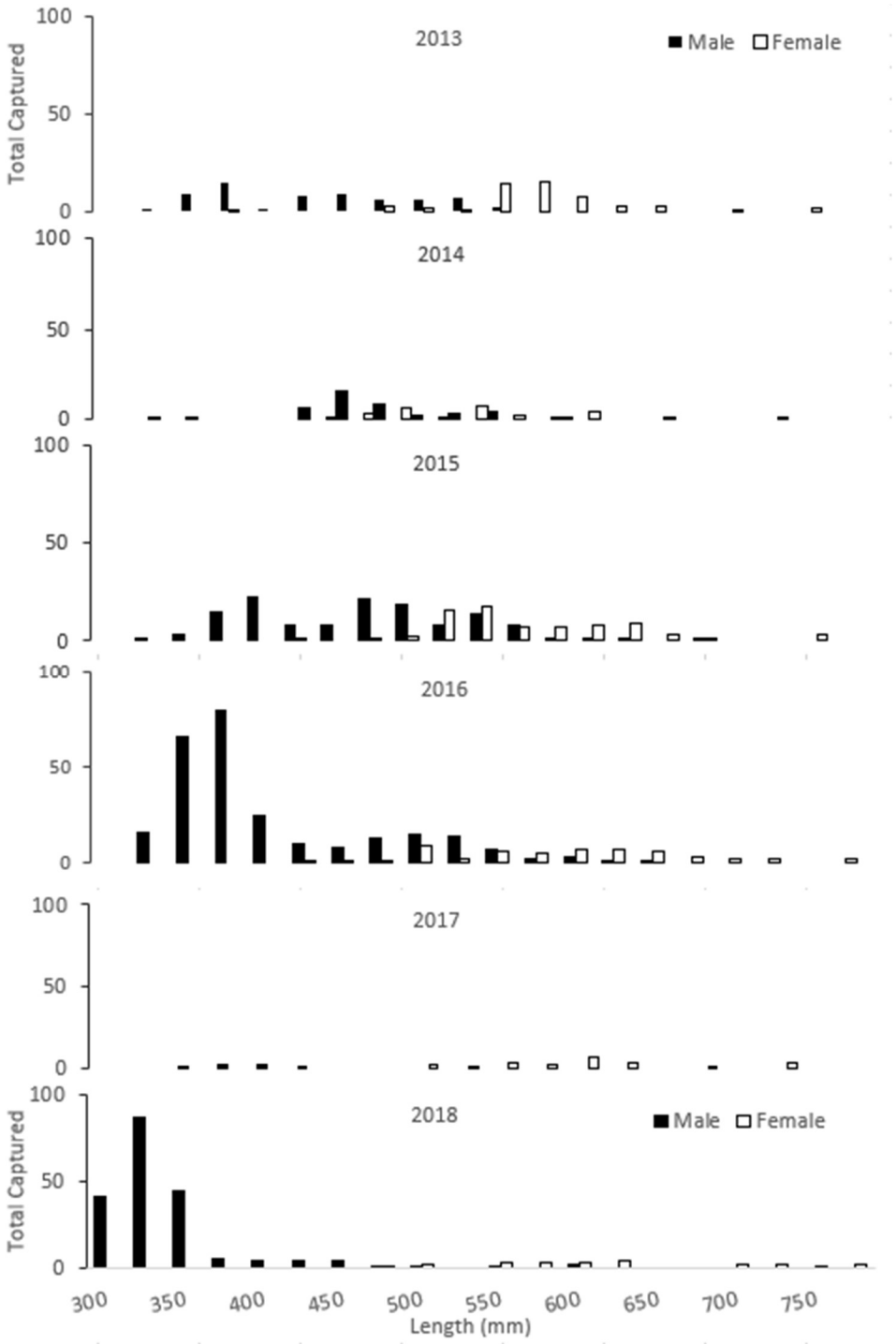


FIGURE 19. Length distributions of spawning Walleye captured during spring electrofishing in upper Noxon Rapids Reservoir.

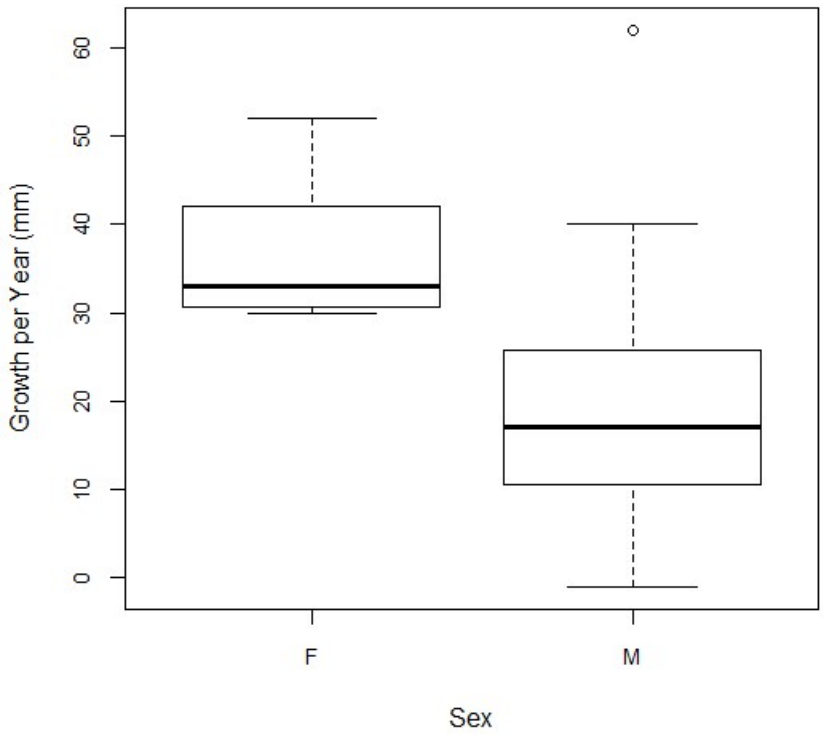


FIGURE 20. Annual growth in total length of tagged Walleye captured after at least one growing season in Noxon.

DISCUSSION

The declines in native suckers and minnow species (i.e., Largescale Sucker, Peamouth, Northern Pikeminnow) and the increase in non-native piscivores (bass, Northern Pike, Walleye) are part of a long-term trend in the two reservoirs first documented by Horn and Tholl (2010). Before 1990, when non-native piscivorous fishes were not as well established and in lower abundance, the community was composed of much larger numbers of native non-game species (Scarnecchia et al. 2014). More total fish were present in the communities and smaller individuals representing all age-classes of the population were common. While angling pressure in Noxon increased throughout the 1990s upon the establishment of the bass fishery in the 1980s (Kreiner and Tholl 2015), gillnet sampling throughout the 1990s showed continued abundance of native forage species, as well as numerous Yellow Perch. By the early 2000s, bass, Northern Pike, and Walleye had established populations in the reservoirs and condition of the non-native predators was high (W_r >100; FIGURE 8), likely due to the diverse size structure of native non-game species, the emerging Yellow Perch population, and potentially the crayfish population which also benefited from impoundment of the river (Graves 1991). At the same time, total numbers of fish in aggregate in the reservoirs were declining (Scarnecchia et al. 2014).

Within the past decade, and especially since 2016, the major change in the fish community of Noxon and Cabinet Gorge reservoirs has been the continued increase of Walleye (Kreiner and Tholl 2016) (Appendix B). Concurrently, length-frequencies of sucker and minnow species all suggest a lack of survival of young fish to reproductive age (i.e., a lack of recruitment) (FIGURE

7). Although Walleye abundance was increasing from 2005-2011 and was being carefully monitored, as of 2015, numbers appeared to be levelling off (Scarnecchia et al. 2014). Population modeling and age structure analysis (especially the lack of strong year-classes) did not indicate an irruption was imminent (Scarnecchia and Lim 2016). Several factors were suggested as potentially preventing an irruption of Walleye, including the rapid water exchange rate of both reservoirs, abundant aquatic vegetation to protect smaller fish from predation, and the lack of evidence at that time of any strong year-classes (Scarnecchia and Lim 2016).

Since 2016, however, it became apparent that the consistent absence of smaller prey fishes (FIGURE 7) and the recent (2016-2018) declines in condition of Walleye, Northern Pike, and Smallmouth Bass (W_r <100; FIGURE 8), indicate that the increase in total piscivores has ultimately resulted in a shortage of forage. The outcome has been decreasing growth rates (i.e., length-at-age) and increasingly sub-optimal condition of the piscivorous fish targeted by anglers.

It is likely that all piscivorous species including Northern Pike, Smallmouth Bass, Largemouth Bass, and Walleye have contributed to the declines of native non-game fish in Noxon Rapids Reservoir. Because native suckers and minnows are long-lived (e.g., TABLE 4), current observations of declines are indicative of changes which likely began over a decade ago. These native species may also be longer lived than previously thought (e.g., Lackmann et al. 2019), and lack of recruitment can present problems for them if their early survival is low and predation rates on young fish are abnormally high. The irruptive Walleye year-class of 2015 is not the cause of these changes, but its presence, combined with historical increases in Walleye since the mid-1990s, has exacerbated the problem of an already crowded non-native assemblage of piscivores.

Thus far, only male Walleye from the 2015 year-class have been captured at the spawning grounds in spring. Prior to 2018 (when the 2015 year-class first matured), the smallest documented sexually mature males (age-3) were greater than 330 mm in length, and fish less than 350 mm were rare. But in 2018, 25% of the mature males captured (n=50) were less than 330 mm in length (FIGURE 21).

A combination of a large spawning stock and good spawning habitat condition in the same years could further exacerbate the present problem of too many slow-growing piscivorous fish. Spring river conditions (e.g., comparatively low flow and temperatures above 10 C in mid-to-late April) seemed optimal for another strong year class of Walleye in 2016, but indications are that these fish are not a major component of the population. It is also unlikely that strong year-classes were produced during high run-off years in 2017 and 2018. However, Walleye from the 2015 year-class will persist for more than a decade and will have the opportunity to contribute to another strong year-class when conditions permit. Our monitoring has shown that even moderate year classes can make noticeable contributions to the overall population up to seven years later

(FIGURE 6). Females from 2015 should be expected to show up on the spawning grounds as age-4 or age-5 fish in the future.

FIGURE 21. A mature age-3 Walleye captured during spring electrofishing in upper Noxon Rapids Reservoir which barely exceeded 300 mm in total length. Notice large eye consistent with an emaciated fish with stunted growth. (The cooler is 300 mm across.)

If trends in condition, growth, and prey abundance continue on this trajectory, both the native species and quality of angling for non-native predators could suffer. Among the non-native piscivores, maintenance of the bass fishery is a strong management priority and falls within established agency management guidelines (MFWP 2019a). Bass were an intentional introduction into the reservoirs by MFWP, are still the number one draw for open-water anglers on Noxon Rapids Reservoir (Blakney and Kreiner 2015), and based on tournament data, bass fishing is currently good. The size of Largemouth and Smallmouth bass captured at bass tournaments in Noxon Rapids Reservoir has continued to improve over the past decade. Age estimation from this and past studies (Kreiner and Tholl 2013) reveals that it takes both bass species 5-6 years before they meet the minimum length for a bass tournament (305 mm). Once bass reach that minimum length, they may be targeted by tournament anglers for the next 8-10 years.

However, some questions remain about bass recruitment in the reservoirs and because of the limitations in sampling younger fish and the relatively long life-span of bass, our recognition of recruitment problems would be delayed and may not be obvious until some older year classes begin to die out. Size of age-0 LMB sampled during beach seine events in 2016 and 2017 revealed that sizes were on the lower end of what may be necessary for strong over-winter survival (Saffel 2003). Based on mean lengths obtained through long-term monitoring of age-0 bass, good over-winter survival was expected in only four of the last 12 year-classes. Yet, this was apparently enough recruitment to maintain a quality bass fishery to the present time. However, as numbers of other piscivorous fish species increase and typical prey species numbers decrease, recruitment to adulthood may become a more limiting factor than over-winter survival of age-0 fish in the Noxon bass fishery.

Suppression of Walleye in Noxon Rapids Reservoir was previously investigated, and capture techniques have been evaluated since 2013 (MFWP 2013). So far, an effective removal method has not been identified. Because Noxon Rapids Reservoir does not stratify, the habitats of all species overlap and there is no way to target a single species with gillnets. Walleye typically

comprise 5-7% of the fish captured in recent fall gillnets. Efforts to gill net upper Noxon Rapids Reservoir in the spring were abandoned due to high river velocities and their ineffectiveness at capturing Walleye. Trap and hoop nets set in the spring and fall 2012 did not capture any Walleye. Using spring electrofishing, species-specific sampling is more conceivable, but has thus far been heavily biased towards male fish (FIGURE 19). This is due to male Walleye's earlier maturation and migratory behavior (Ellis and Giles 1965). Horn et al. (2009) found that male Walleye approached the spawning grounds earlier and stayed longer than females in Noxon. As females from the 2015 year-class mature, spring sampling may become more effective.

Alterations in dam operations have not yet been considered to control Walleye. Noxon Rapids Dam has a maximum drawdown capacity of over 16 meters (Huston 1985). Prior to stabilization of reservoir levels in the 1980s, reproduction of introduced fish species was limited. Walleye spawn in the spring in very shallow water, so strategic drawdowns of reservoir levels could impact their reproduction through desiccation, flushing, or limitation of available habitat. It is recommended that a hydrological modeling exercise investigating the full reach of influence of Noxon Rapids Dam (on the lower end of Noxon Rapids Reservoir) and Thompson Falls Dam (on the upper end of Noxon Rapids Reservoir) be conducted in the future. Any unintended consequences of draw-downs on desirable species (e.g., Largemouth Bass) could be countered with supplemental stocking of that species.

Invasive aquatic weeds, particularly Eurasian Water Milfoil (EWM), are another contentious subject surrounding LCFR reservoirs. Recent attempts to eradicate EWM with chemical treatments were costly and the results were short-lived (e.g., Noxon sites 43 and 44 *in* Hansen 2016). Realizing that eradication was not possible, stakeholders have decided to limit chemical treatments to public access points and high use areas. Eurasian Watermilfoil is limited to shallow littoral zones (Smith and Barko 1990 so deep mid-channel areas will remain weed-free. Additionally, it is possible that fish species which depend on weeds such as Yellow Perch, Pumpkinseed, and small Largemouth Bass are persisting in the face of increasing predation only because of the cover provided by the dense weed beds in Noxon. For 2020, Avista and FWP have proposed to utilize a harvest machine in order to mechanically manipulate dense weed beds in a way that is favorable to anglers and fish.

Native salmonids, once common in the LCFR, have declined since the construction of the dams and were not a major component of the Noxon Rapids Reservoir fishery even prior to the establishment of non-native piscivorous fish (Huston 1985). High numbers of spawning Bull Trout still exist in LPO and its tributaries despite strong non-native fish populations there (Bouwens 2018). This indicates that migration barriers and altered mainstem habitat associated with the dams in Montana are the main cause of reduced migratory native salmonids. Populations of Bull Trout in Montana tributaries of the Lower Clark Fork River are currently sustained by resident fish and transport programs.

ACKNOWLEDGEMENTS

Thanks to everyone who helped collect this data including Harvey Carlsmith, Jason Blakney, and Jenna Dukovcic (FWP), Kevin Duffy (Avista), Dr. Dennis Scarnecchia and the University of Idaho students, and countless other workers and volunteers. Thanks to Marc Terrazas for age estimation. Additionally, reviews of this report were provided by Brian Stephens and Jason Blakney (FWP), Dr. Dennis Scarnecchia (University of Idaho), Sean Moran and Paul Kusnierz (Avista), USFWS, and IDF&G.

REFERENCES

Avista Corporation. 1999. Application for New License, Volume III Settlement Agreement. Avista Corporation. Spokane, Washington.

Blakney, J, and R. Kreiner. 2015. Creel Survey of Noxon Rapids Reservoir, Cabinet Gorge Reservoir, and Bull River- 2015. Prepared for: Avista Corporation, Noxon, MT.

Bouwens, K. 2018. 2017 Pend Oreille Basin Bull Trout Redd Monitoring Project Update. Idaho Tributary Habitat Acquisition and Enhancement Program, Appendix A. Prepared for Avista Corporation Noxon, MT and Idaho Department Fish and Game Boise, ID.

Bretz, J. H. 1969. The Lake Missoula floods and the channeled scablands. The Journal of Geology 77:505–543.

Ellis, D. V., and M. A. Giles. 1965. The spawning behavior of walleye, *Stizostedium vitreum vitreum*. Transactions of the American Fisheries Society 94:358–362.

Gabelhouse, D. W. 1984. A length-categorization system to assess fish stocks. North American Journal of Fisheries Management 4:273–285.

Graves, R.J. 1991. Crayfish population distribution and structure in Noxon Rapids Reservoir. University of Montana, Division of Biological Sciences. Prepared for Montana Department of Fish, Wildlife and Parks.

Hanson, E. 2016. Noxon and Cabinet Gorge reservoirs littoral survey 2016. Sanders County Aquatic Invasive Plant Task Force, Thompson Falls, Montana.

Horn, C., and T. Tholl. 2010. Noxon and Cabinet Gorge Reservoirs Fisheries Monitoring, Comprehensive Report: 1997-2009. Prepared for: Avista Corporation, Noxon MT.

Horn, C., J. Hanson, T. Tholl, and K. Duffy. 2009. Noxon Rapids Reservoir Walleye Life History. Prepared for: Avista Corporation, Noxon MT.

Huston, J. E. 1985. Thirty-two years of fish management in Noxon and Cabinet Gorge Reservoirs. Report to Montana Fish, Wildlife and Parks, Helena, MT.

Kalff, J. 2002. Reservoirs. Pages 523-538 *in* J. Kalff, editor. Limnology: Inland Water Ways. Prentice Hall. Upper Saddle River, New Jersey 07458.

Kolander, T. D., D. W. Willis, and B. R. Murphy. 1993. Proposed revision of the standard weight (W_s) equation for smallmouth bass. North American Journal of Fisheries Management 13:398–400.

Kreiner, R. 2013. A winter creel survey of Cabinet Gorge, Noxon Rapids, and Thompson Falls reservoirs. Report for Avista corporation, Noxon, Montana.

Kreiner, R. and T. Tholl. 2013. Noxon and Cabinet Gorge Reservoirs Fisheries Monitoring, Comprehensive Report: 1997-2012. Prepared for: Avista Corporation, Noxon MT.

Lackmann, A. R., A. H. Andrews, M. G. Butler, E. S. Bielak-Lackmann, and M. E. Clark. 2019. Bigmouth buffalo Ictiobus cyprinellus sets freshwater teleost record as improved age analysis reveals centenarian longevity. Communications Biology. doi.org/10.1038/s42003-019-00452-0.

MFWP (Montana Fish, Wildlife & Parks). 2013. Environmental Assessment to Investigate Suppression of Walleye in Noxon Rapids Reservoir. Montana Fish, Wildlife and Parks. 24 pp.

MFWP (Montana Fish, Wildlife & Parks). 2017. Montana Statewide Angling Pressure Surveys. http://fwp.mt.gov/fish/anglingData/anglingPressureSurveys/.

MFWP (Montana Fish, Wildlife & Parks). 2019. Montana Fishing Regulations. http://fwp.mt.gov/fishing/regulations/.

MFWP (Montana Fish, Wildlife & Parks). 2019a. Montana Statewide Fisheries Management Plan. http://fwp.mt.gov/fishAndWildlife/management/fisheries/statewidePlan/default.html.

Murphy, B. R., D. W. Willis, and T. A. Springer. 1990. Evaluation of the relative weight (W_r) index, with new application to Walleye. North American Journal of Fisheries Management 10:85–97.

Neher, C. 2016. Ecological-economic modeling of changes in fish assemblage in a western Montana cold water reservoir system. University of Montana, Department of Mathematical Sciences, Missoula, MT 59812.

Neumann, R. M., C. S. Guy, and D. W. Willis. 2012. Length, weight, and associated indices. Pages 637-676 *in* A. V. Zale, D. L. Parrish, and T. M. Sutton, editors. Fisheries techniques, 3rd edition. American Fisheries Society, Bethesda, Maryland.

Newburg, H. J., and D. H. Schupp. 1986. Shoreline seining for young of the year Largemouth Bass as a method of predicting recruitment to the angler catch. Investigational Report No. 388. Minnesota Division of Fish and Wildlife.

Ogle, D.H. 2010. Assigning individual ages with an age-length key. R Vignette.

Pardee, J. T. 1942. Unusual currents in Glacial Lake Missoula, Montana. Bulletin of the Geological Society of America 53:1569–1600.

Saffel, P. D. 2000. Survey and inventory of warmwater lakes: Northwest Montana warmwater lakes. Federal Aid in Sport Fish Restoration Project F-78-R-3 through 6, Job IV-a, progress report. Montana Fish Wildlife and Parks, Thompson Falls.

Saffel, P. D. 2003. Influence of spring runoff and water temperature on hatch date and growth of age-0 largemouth bass in a Montana Reservoir. Northwest Science 77:25–35.

Sando, R., and K. W. Blasch. 2015. Predicting alpine headwater stream intermittency: a case study in the northern Rocky Mountains. Ecohydrology & Hydrobiology15:68–80.

Scarnecchia, D. L., Y. Lim, S. Moran, T. Tholl, J. DosSantos, and K. Breidinger. 2014. Novel fish communities: native and non-native species trends in two run-of-the-river reservoirs, Clark Fork River, Montana. Reviews in Fisheries Science 22:97-111.

Scarnecchia, D.L., and Y. Lim. 2016. Potential effects of Walleye on the fish community of Noxon Rapids Reservoir, Montana. A report for Montana Fish, Wildlife and Parks. Helena.

Schmetterling D. and T. Selch. 2013. Preliminary Investigations into the Toxicity of Game Fish in the Clark Fork River downstream from the Smurfit Stone Container Mill. Montana Fish, Wildlife, and Parks Report. Helena.

Scott, W. B., and E. J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada, Ottawa. 966 pages.

Selch, T. 2015. Noxon Rapids Reservoir fish contaminant study. A report for Avista Corporation. Noxon, MT.

Smith, L. N. 2006. Stratigraphic evidence for multiple drainings of glacial lake Missoula along the Clark Fork River, Montana, USA. Quarternary Research 66:311–322.

Suski, C. D., and D. P. Philipp. 2004. Factors Affecting the Vulnerability to Angling of Nesting Male Largemouth and Smallmouth Bass. Transactions of the American Fisheries Society 133:1100–1106.

Smith, C., and J. Barko. 1990. Ecology of Eurasian Watermilfoil. Journal of Aquatic Plant Management, 28:55-64.

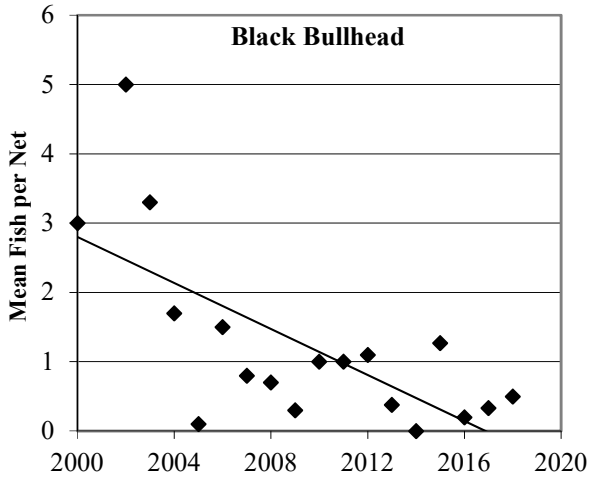
Willis, D.W. and J.L. Stephen. 1987. Relationships between storage ratio and population density, natural recruitment, and stocking success of walleye in Kansas reservoirs. North American Journal of Fisheries Management 7:279 - 282.

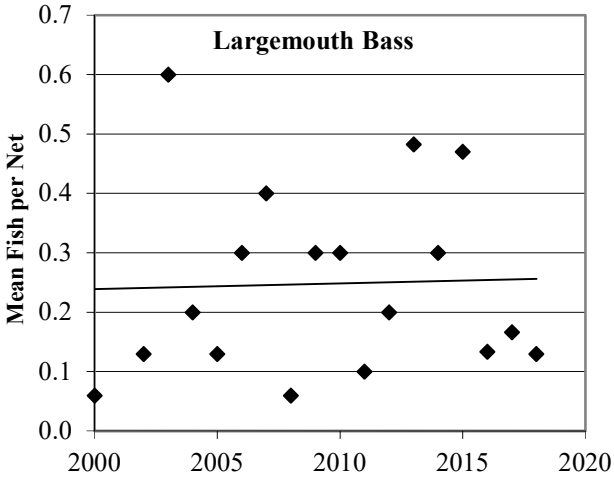
WWP (Washington Water Power). 1995. Fish community assessment on Cabinet Gorge and Noxon Rapids Reservoirs. Spokane, WA.

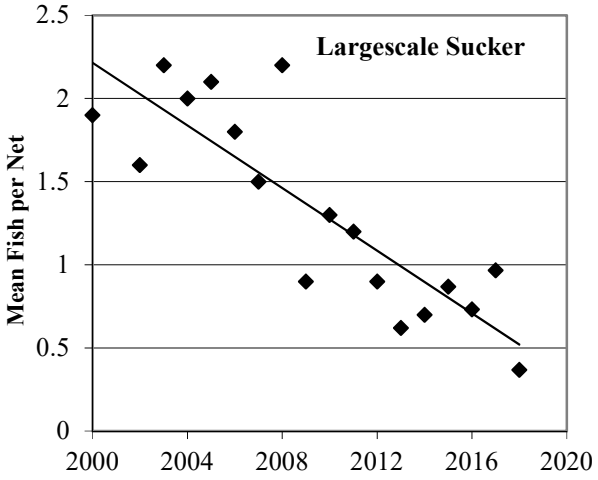
Appendix A. Species abbreviations and scientific names of fish in Noxon and Cabinet Gorge reservoirs

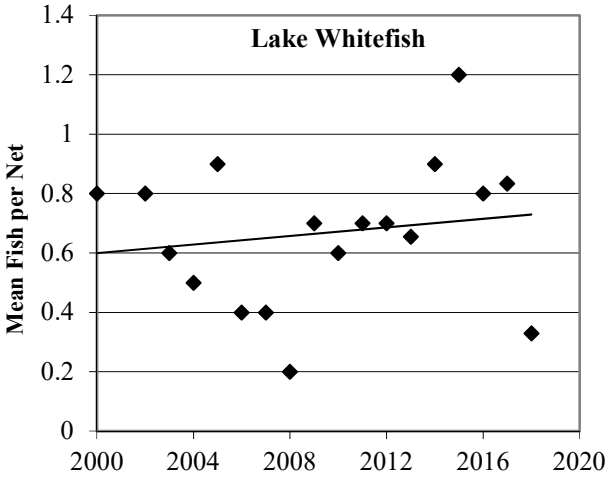
BL BH	Black Bullhead *Ameiurus melas*
LL	Brown Trout *Salmo trutta*
BULL	Bull Trout *Salvelinus confluentus*
L WF	Lake Whitefish *Coregonus clupeaformis*
LMB	Largemouth Bass *Micropterus salmoides*
LS SU	Largescale Sucker *Catostomus macrocheilus*
LN SU	Longnose Sucker *Catostomus catostomus*
MWF	Mountain Whitefish *Prosopium williamsoni*
NP	Northern Pike *Esox lucius*
N PMN	Northern Pikeminnow *Ptychocheilus oregonensis*
PEA	Peamouth *Mylocheilus caurinus*
PUMP	Pumpkinseed *Lepomis gibbosus*
RB	Rainbow Trout *Oncorhynchus mykiss*
SMB	Smallmouth Bass *Micropterus dolomieu*
WE	Walleye *Sander vitreus*
WCT	Westslope Cutthroat Trout *Oncorhynchus clarki lewisi*
YL BH	Yellow Bullhead *Ameiurus natalis*
YP	Yellow Perch *Perca flavescens*

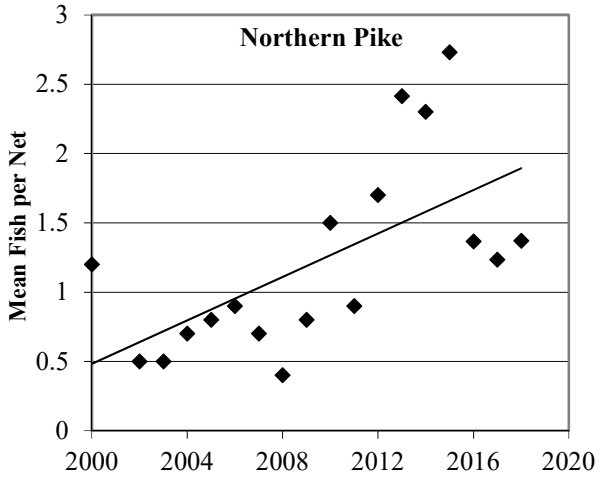
Appendix B. Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Noxon Rapids Reservoir, 2000-2018.

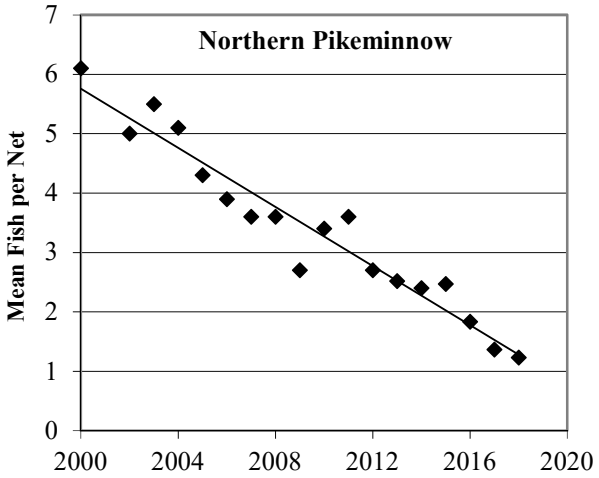


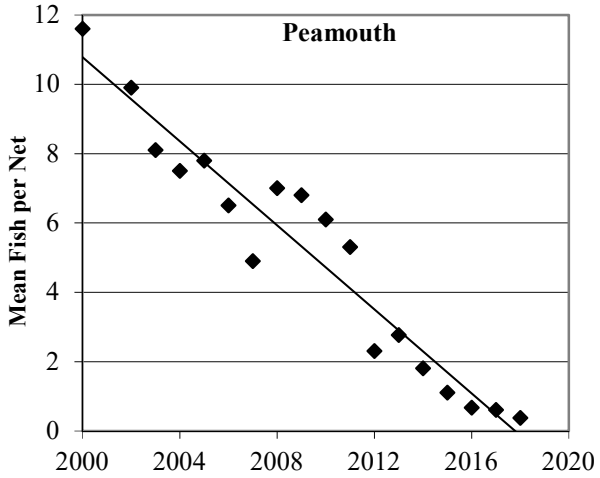


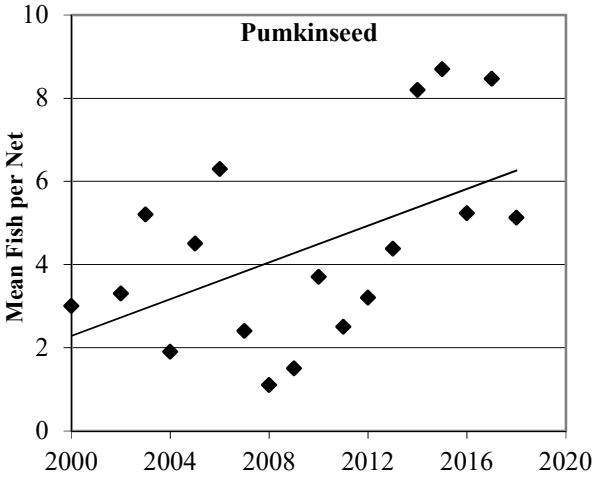


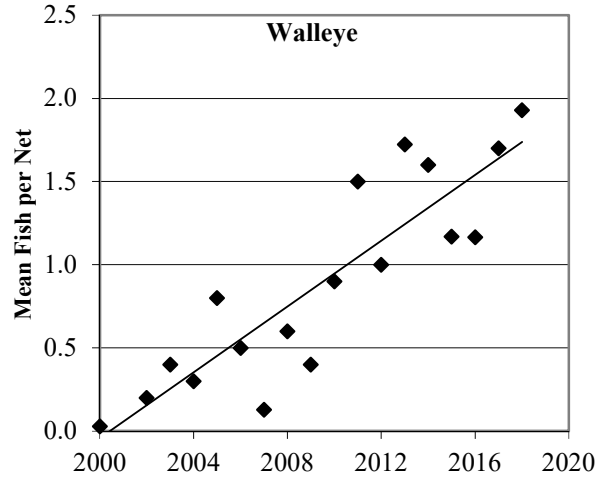


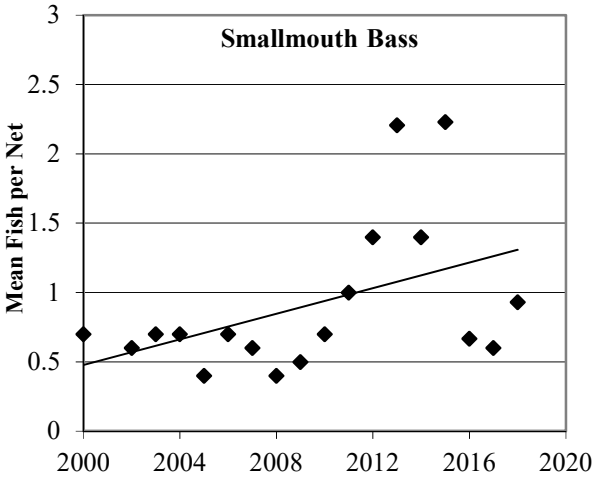

Northern Pike
Mean Fish per Net
0
0.5
1
1.5
2
2.5
3
2000
2004
2008
2012
2016
2020

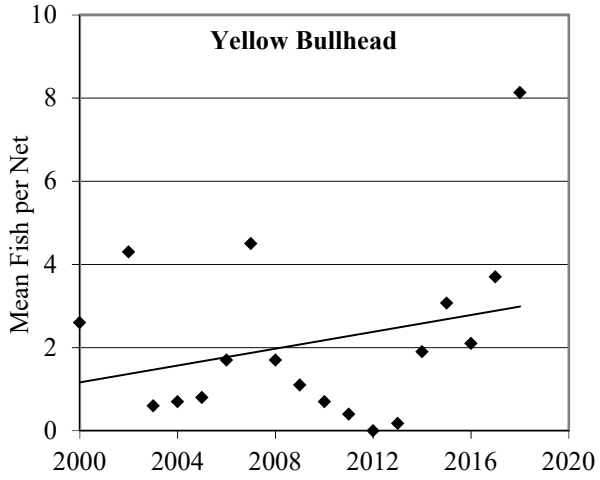

Northern Pikeminnow
Mean Fish per Net
0
1
2
3
4
5
6
7
2000
2004
2008
2012
2016
2020

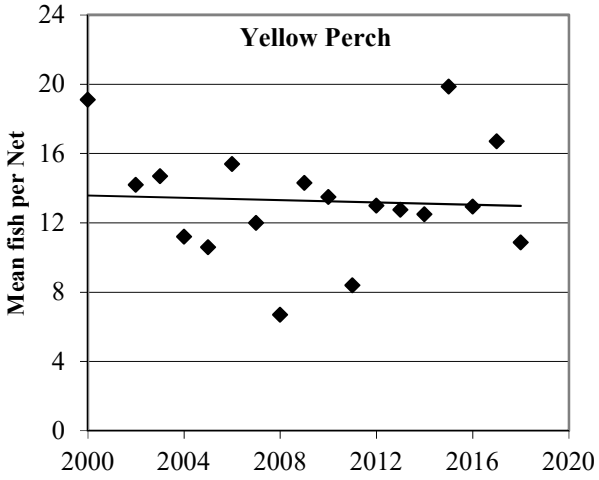

Peamouth
Mean Fish per Net
0
2
4
6
8
10
12
2000
2004
2008
2012
2016
2020


Pumkinseed
Mean Fish per Net
0
2
4
6
8
10
2000
2004
2008
2012
2016
2020

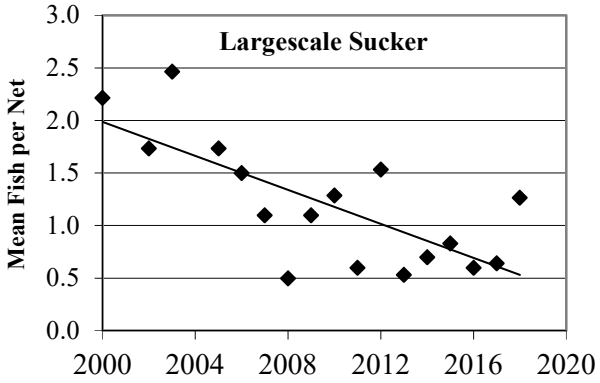

Walleye
Mean Fish per Net
0.0
0.5
1.0
1.5
2.0
2.5
2000
2004
2008
2012
2016
2020

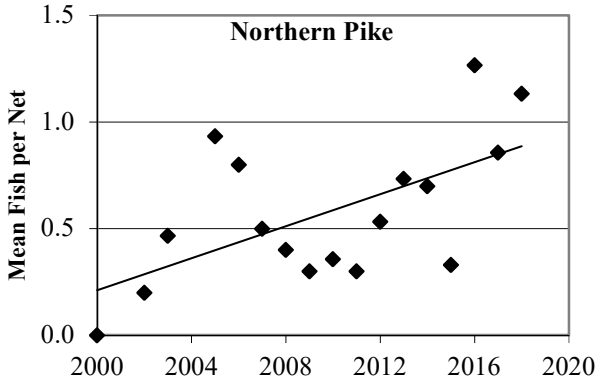

Smallmouth Bass
Mean Fish per Net
0
0.5
1
1.5
2
2.5
3
2000
2004
2008
2012
2016
2020

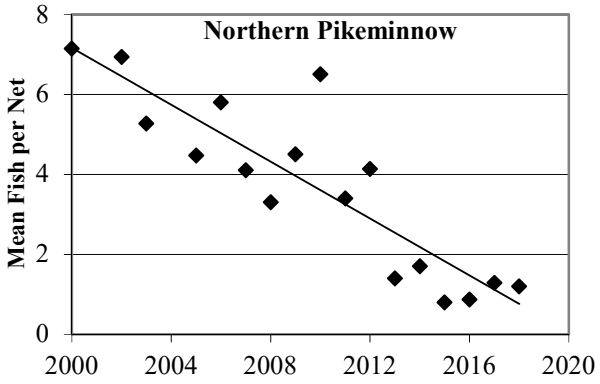


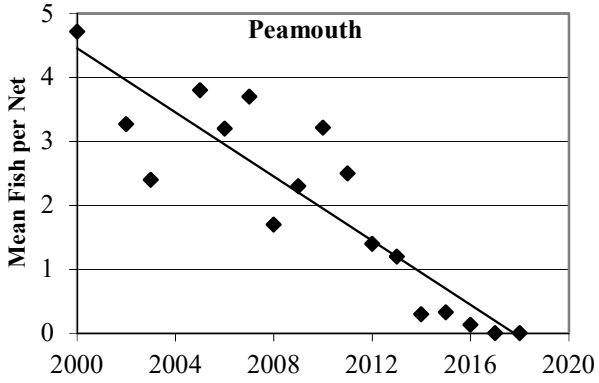


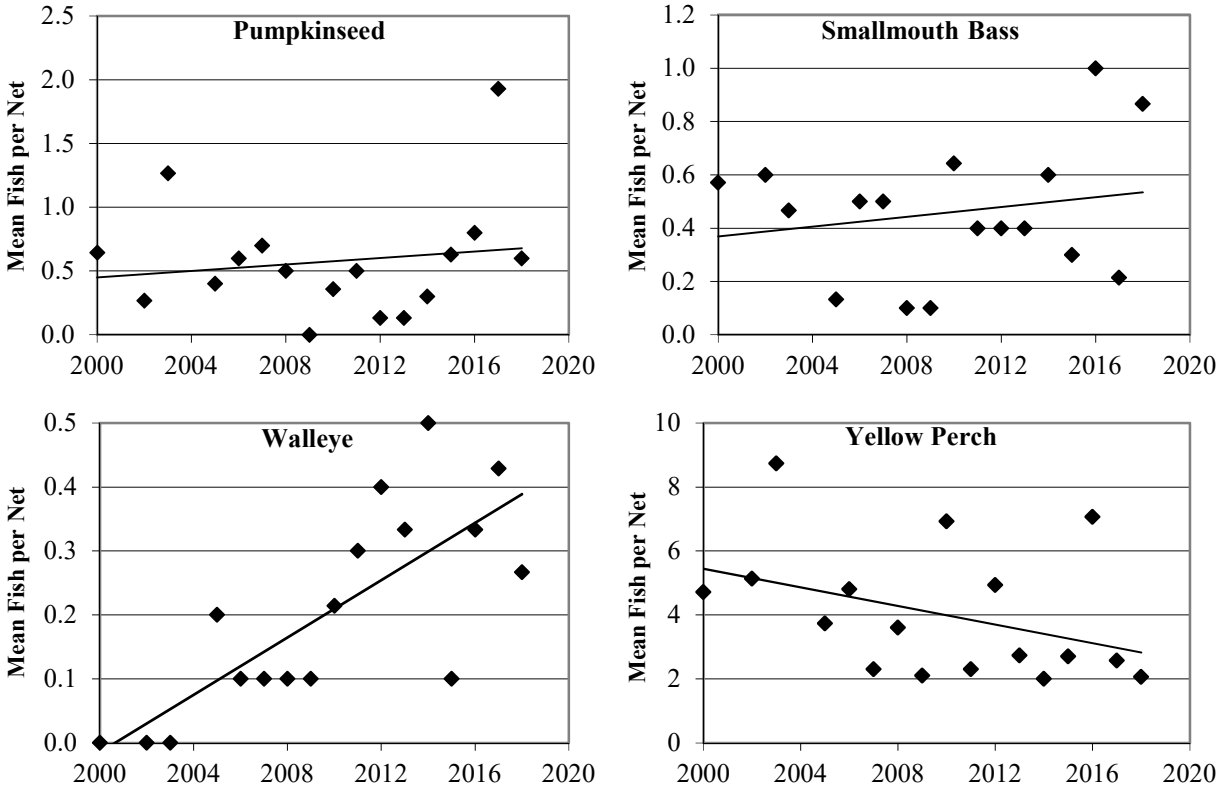
Appendix C. Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Cabinet Gorge Reservoir, 2000-2018.











Appendix D. Temperature Data from Noxon and Cabinet Gorge reservoirs.

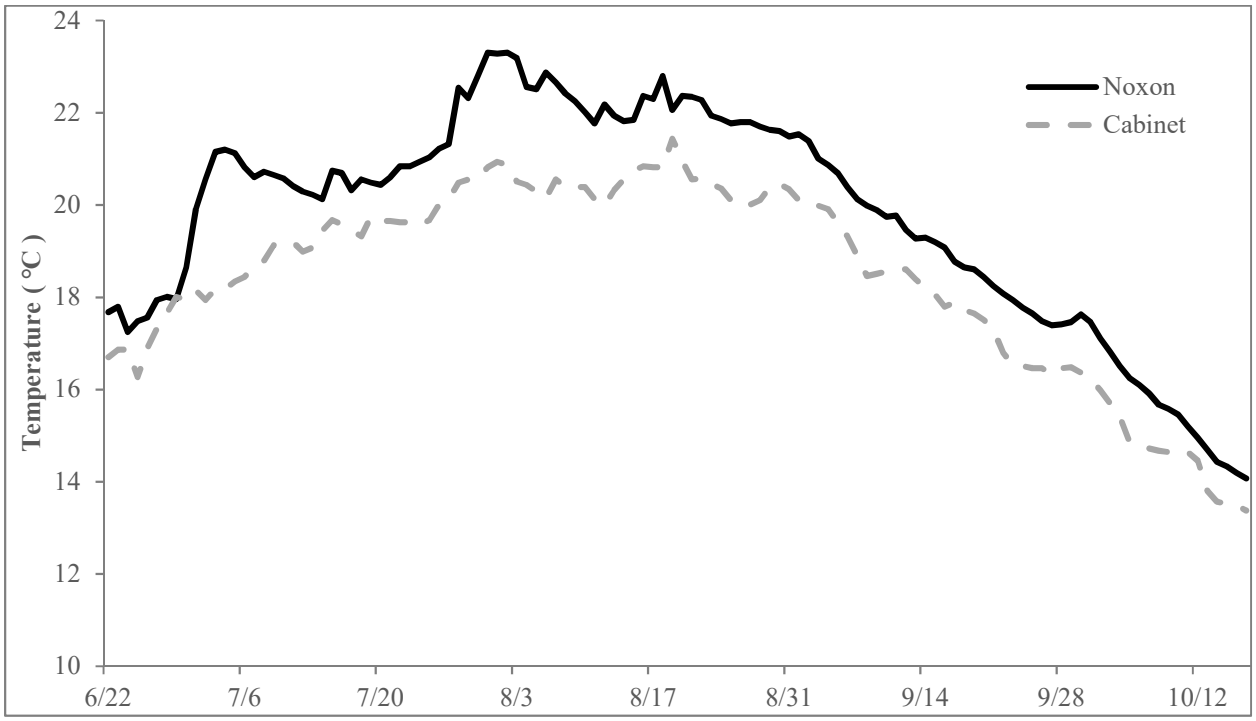


Figure D-1. Maximum daily water temperatures from lower Noxon (approximately 3.0 km upstream from Noxon Rapids Dam) and Cabinet Gorge reservoirs (approximately 3.5 km upstream of Cabinet Gorge Dam) during summer, 2016.

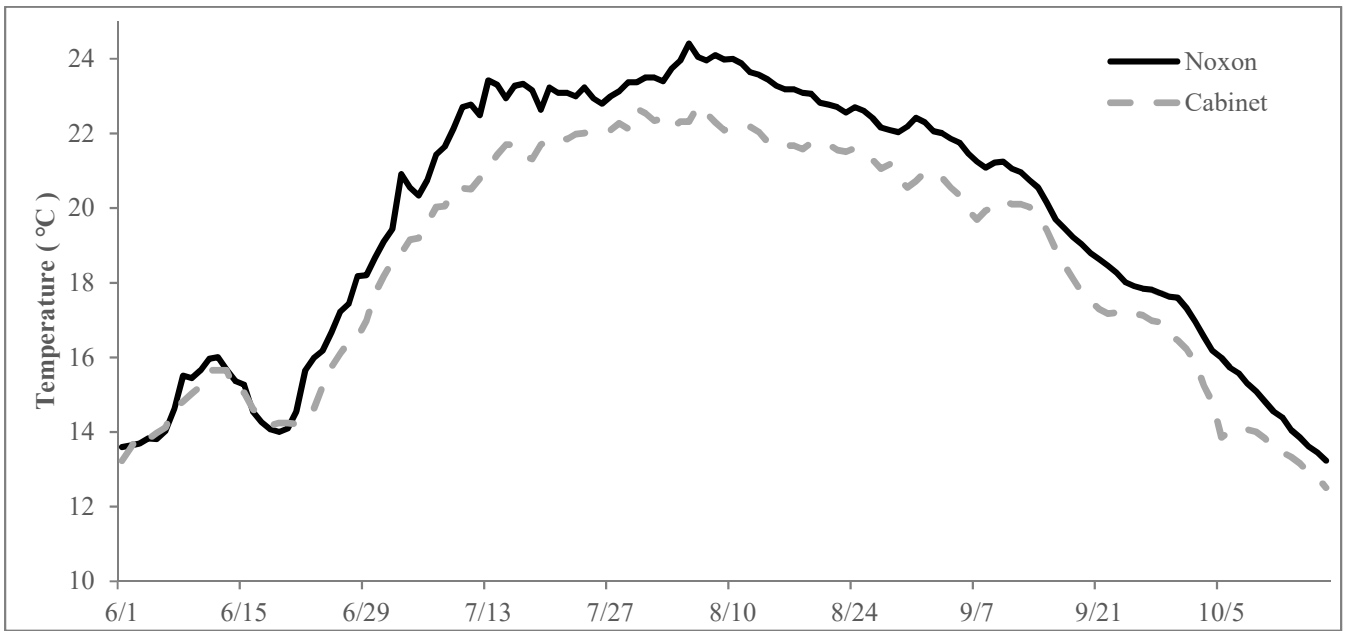


Figure D-2. Maximum daily water temperatures from lower Noxon (approximately 3.0 km upstream from Noxon Rapids Dam) and Cabinet Gorge reservoirs (approximately 3.5 km upstream of Cabinet Gorge Dam) during summer, 2017.

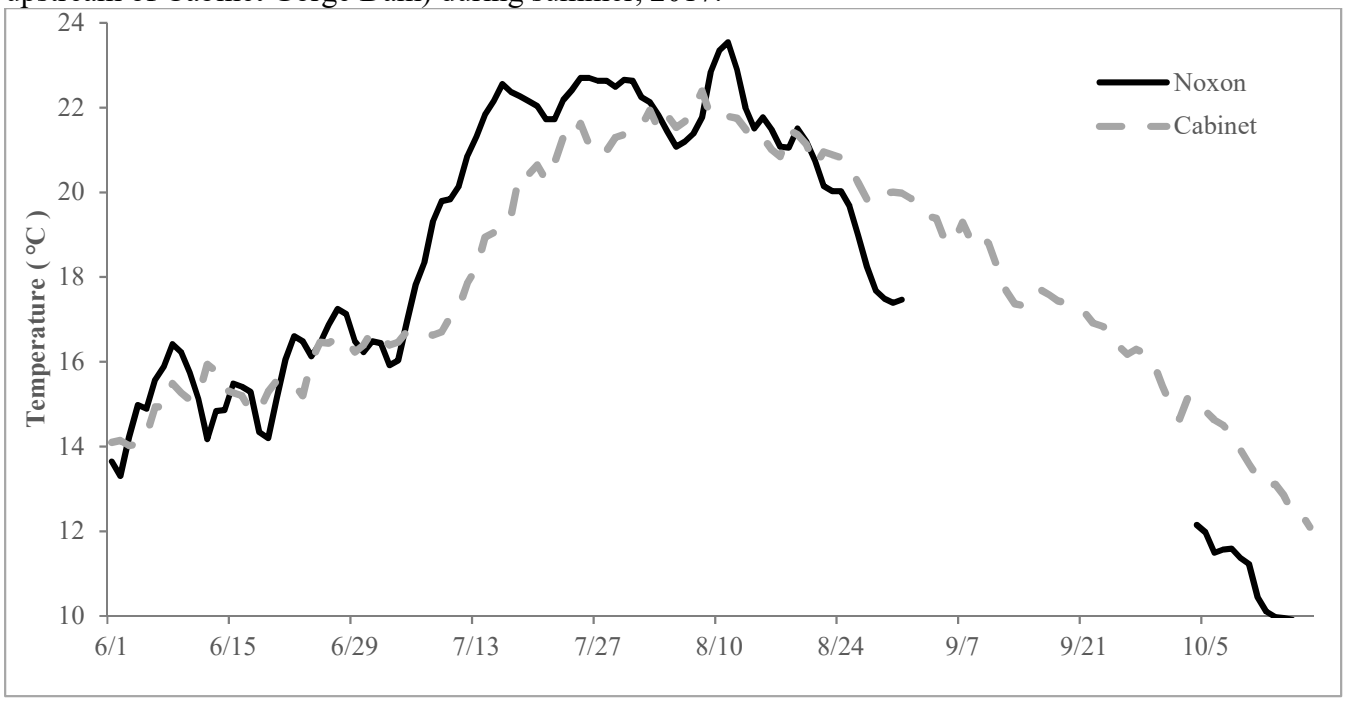


Figure D-2. Maximum daily water temperatures from lower Noxon (approximately 56km upstream from Noxon Rapids Dam) and Cabinet Gorge reservoirs (approximately 5 km upstream of Cabinet Gorge Dam) during summer, 2018.