Cabinet Gorge and Noxon Reservoir Fisheries Monitoring

2021 Annual Project Update

Montana Tributary Habitat Acquisition and Recreational Fishery Enhancement Program, Appendix B

March 2022

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Recreational Fishery Enhancement Program
Appendix B

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Introduction

Noxon and Cabinet Gorge reservoirs, the two lowermost hydroelectric impoundments on the Clark Fork River in western Montana (FIGURES 1–3), 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 diversity of fish introductions and management actions from the early 1950s through the mid-1980s, including early efforts to establish cold-water salmonid fisheries in marginal habitats created by the 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.

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 the 1980s. At that time, the introduction and establishment of both Largemouth Bass *Micropterus salmoides* and Smallmouth Bass *M. dolomieu* populations, two non-native predatory sportfish, 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). The presence of Northern Pike *Esox lucius* was first documented in the 1970s, stemming from an illegal introduction in Lone Pine Reservoir of the Flathead River drainage in the late 1950's (Huston 1985). Since that time, populations of these species as well as native and non-native non-game fish species have become well-established, and annual fishing pressure has increased considerably from about 800 angler days per year on Noxon in 1982 to 33,000 angler days in 2013 (MFWP 2014).

Based on angler mail-in surveys (MFWP 2017, 2019) and a recent creel survey (Blakney et al. 2017), bass remain popular target species, as well as non-native Northern Pike and Yellow Perch *Perca flavescens*. For 2021, bass tournaments were scheduled on six separate weekends on Noxon Reservoir. Additionally, two Northern Pike tournaments were scheduled for Noxon Reservoir.

As early as the 1950s, management effectiveness in the two reservoirs was monitored occasionally 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. 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 evaluations 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 but likely important components of the food web. Contemporaneously, they observed an increase in the frequency of non-native piscivorous fishes (bass, Northern Pike and Walleye *Sander vitreus*), species actively sought by anglers.

Walleye were illegally introduced into Noxon Reservoir likely several times between the 1980s and 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 Reservoir, Walleye have since become established in the downriver waterbodies of Cabinet Gorge Reservoir, Lake Pend Oreille (LPO), 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 2021, primarily using jet-boat electrofishing at night. Spring Walleye electrofishing is conducted from late March to early May to coincide with suitable spring spawning temperature and pre-runoff flows, (Willis and Stephen 1987). Efforts occur in two spawning areas in upper Noxon Reservoir directly downstream of Thompson Falls Dam, adjacent to the River's Bend Golf Course and upstream of the Highway 200 bridge (FIGURE 4).

Current harvest management on the reservoirs includes the use of general regional regulations for all species except for Cutthroat Trout (catch and release), Largemouth Bass, and Smallmouth Bass (MFWP 2021). Special regulations 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). These protective bass regulations include all three lower Clark Fork River reservoirs and extends from the mouth of the Thompson River downstream to the Idaho border (MFWP 2021). This special regulation allows five fish to be harvested daily and in possession of any size, except between June 15 and July 15 when only one fish daily with a minimum length of 559 mm (22 inches) can be kept and in possession. This regulation provides protection by limiting harvest of spawning and nest-guarding bass and prevents tournaments from occurring during this time. Saffel (2003), found age-0 Largemouth Bass (LMB) in Noxon Reservoir 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, hence the reasoning behind the June 15 to July 15 exception.

Fish community monitoring continues to be conducted in both Noxon and Cabinet Gorge reservoirs with gillnets to assess trends in fish community composition and species abundance. Monitoring fish lengths and catch composition during bass tournaments remains an important part of the monitoring program as Largemouth and Smallmouth bass 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 Reservoir.
3) Monitor the population of illegally introduced Walleye in Noxon Reservoir.

For a more thorough description of the study area and methods, refer to: Kreiner and Tholl (2013), Kreiner and Tholl (2016), Horn and Tholl (2010), and Scarnecchia et al. 2014.

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 LPO, a large (380 km^2), deep (350 m) natural lake in the Idaho panhandle.

The LCFR historically was 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, Leuciscids). 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. Noxon 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 Reservoir 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 run-of-the-river nature of these reservoirs impacts most of the fish species, especially those that evolved in more stable lentic habitats. For example, during larger run-off years, high water levels and cold-water temperatures delay Largemouth Bass spawning and reduce overwinter survival of age-0 bass (Saffel 2000). Additionally, low water retention time associated with high runoff from snow melt across the Clark Fork basin is generally associated with less successful spawning by reservoir-dwelling Walleye in North America (Willis and Stephens 1987).

Methods

Fall Gillnetting

Standardized annual fall gillnetting in Noxon and Cabinet Gorge reservoirs provides the most comprehensive index of relative abundance for fish species and fish community composition in both reservoirs. 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 Reservoir and 15 in Cabinet Gorge Reservoir (FIGURES 1–3). In Noxon Reservoir, 19 sites are in the lower portion of the reservoir below Beaver Creek Bay (stratum 1), while the remaining 11 sites are in the upper riverine portion (stratum 2). Standardized (i.e., identical) sites have been sampled annually since 2000. Coldwater sites such as tributary mouths, have been intentionally avoided to reduce Bull Trout by-catch and mortality. Annual fall gillnetting did not occur in 2020 due to the COVID-19 pandemic.

Nylon multifilament experimental sinking gillnets have been used during all gillnetting efforts. The nets are 38 m long and 1.8 m deep with five separate 7.6 m panels consisting of 1.9 cm, 2.5 cm, 3.2 cm, 3.8 cm, and 5.1 cm 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.

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 to almost 35 m but has been consistent among locations and between years. 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 is summarized as total and species-specific catch per unit effort (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 University of Idaho Fisheries Management class. Data collected from each fish include its species, total length (TL; mm), and weight (g), identified separately by individual net. Additionally, all Walleye previously marked via dorsal spine removal are scanned for passive integrated transponder (PIT) tags.

Since 2013, all Walleye captured have been identified to sex and their otoliths collected for age determination. Otoliths of walleye were removed using the "up through the gills method" (Stevenson and Campana 1992), embedded in epoxy, and transversely sectioned using a low-speed isometric saw. Sections are then aged independently by two readers and any fish with age discrepancies are aged by a third reader (Quist and Isermann 2017). Using ages derived from otolith analysis, growth curves were fitted for both male and female Walleye populations (von Bertalanffy 1938).

Conditions of fishes were calculated as an index, using relative weight (Wr; Wege and Anderson 1978; Pope and Kruse 2007). Size structure was described using proportional size distribution, where species-specific lengths refer to stock, quality, preferred, memorable, and trophy length fish (Gabelhouse 1984; Neumann et al. 2012). Condition was compared between length groups using one-way ANOVA and Tukey's Honestly Significant Difference (Ogle 2016). Long-term trends in catch per unit effort (CPUE) and condition were investigated using linear regression.

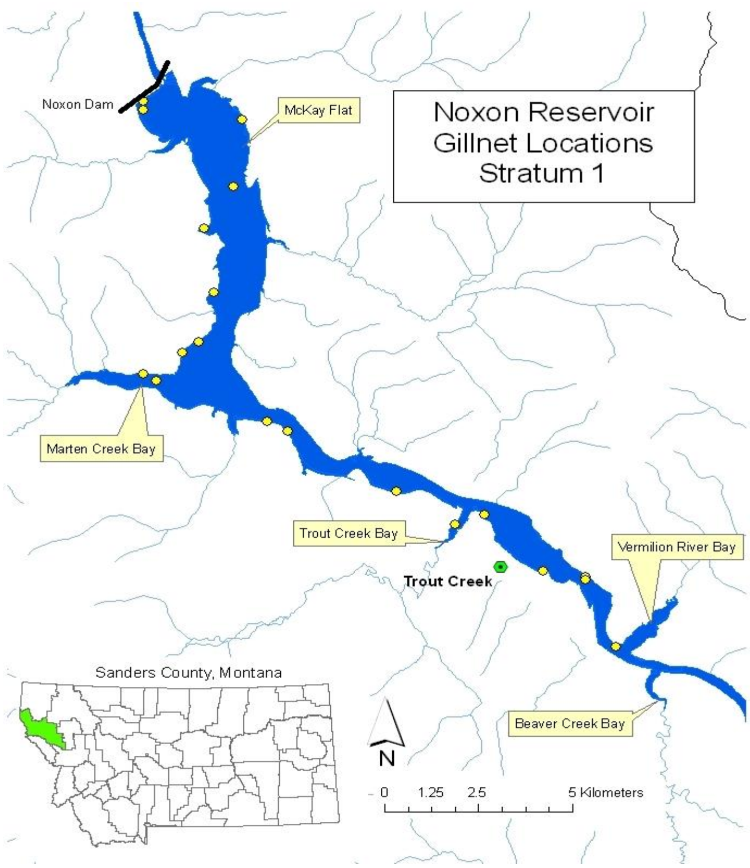

FIGURE 1. Gill net locations in Noxon Reservoir Stratum 1.

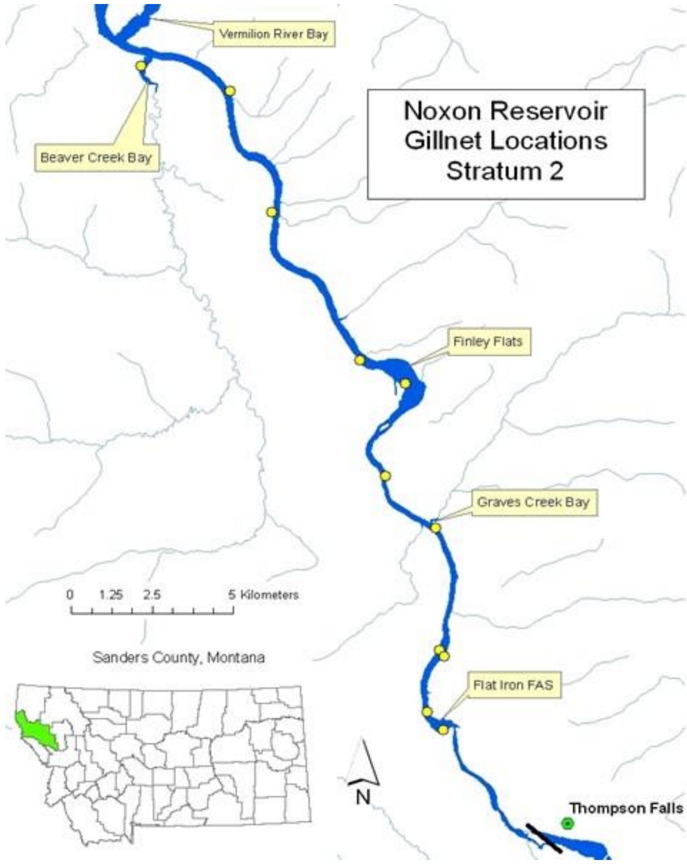

FIGURE 2. Gill net location in Noxon Reservoir Stratum 2.

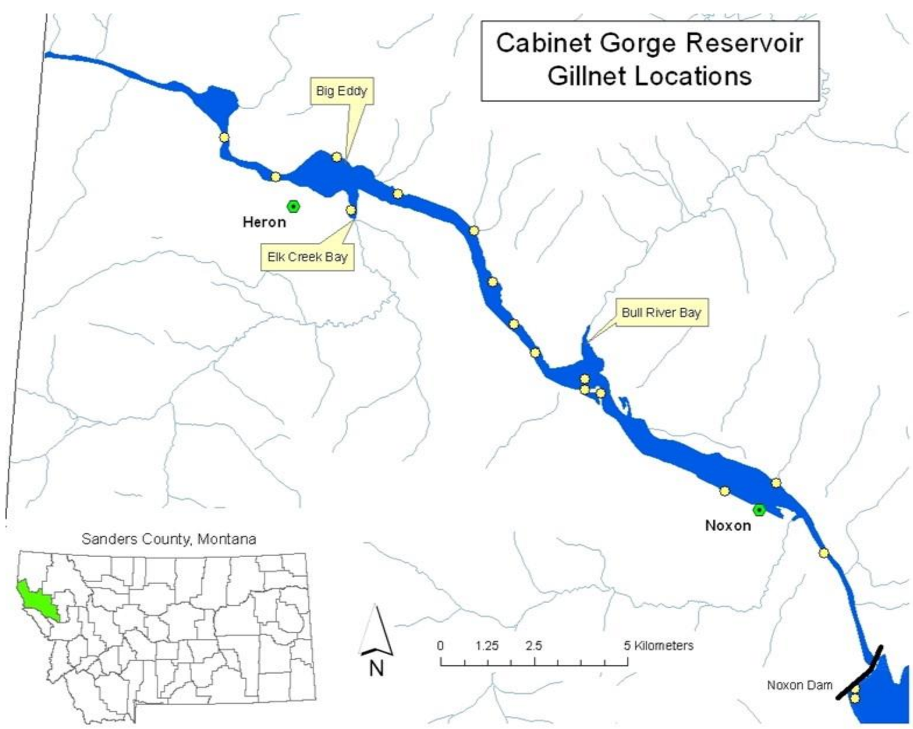

FIGURE 3. Gillnet locations in Cabinet Gorge Reservoir, Montana.

Spring Walleye Monitoring
Additional sampling of illegally introduced Walleye occurs on upper Noxon Reservoir each spring. With varying degrees of effort, Walleye have been monitored using nighttime electrofishing during late March through early May since 2012. The objectives of spring sampling are to monitor year-class strength, the spawning population, and collect fish for age and growth estimates. The primary sampling location was located above the Montana state highway 200 bridge near Thompson Falls, based on information obtained from a previous telemetry study (Horn et al. 2009; FIGURE 4). Additional sampling began near the River's Bend Golf Course across from Flat Iron Fishing Access Site in 2016.

Walleye were collected by jet-boat mounted boom electrofishing during nighttime hours from April 7th to May 3rd of 2021. Walleye captured were measured (TL; mm) and weighed (g). A subsample of up to five Walleye of each sex in 25 mm length bins for Walleye up to 500 mm and up to five Walleye of each sex in 50 mm length bins for Walleye greater than 500 mm in length were sacrificed for age analysis. Sex and maturity of Walleye was assessed by visual inspection of gonads of sacrificed fish or manipulating the abdomen following methodology outlined by Duffy et al. (2000). All remaining Walleye were scanned, and if not found to be previously tagged, were implanted with passive integrated transponders (PIT tags), the dorsal spine removed for additional identification, and the fish were released. Otoliths of sacrificed Walleye were removed using the "up through the gills method" (Stevenson and Campana 1992), embedded in epoxy, and transversely sectioned using a low-speed isometric saw. Sections were then aged independently by two readers and any fish with age discrepancies were aged by a third reader (Quist and Isermann 2017).

Ages derived from otolith analysis were used to construct age-length keys using Fisheries Stock Assessment (FSA) v0.8.12; R v3.3.2 (Ogle 2010; R Core Team 2020). Age-length keys were constructed for both female and male Walleye using 10 mm length bins and ages were assigned to all unaged fish based on the corresponding age-length keys (Isermann and Knight 2005; Ogle 2016). Using ages derived from otolith analysis we also fitted growth curves for both male and female Walleye spawning populations (von Bertalanffy 1938).

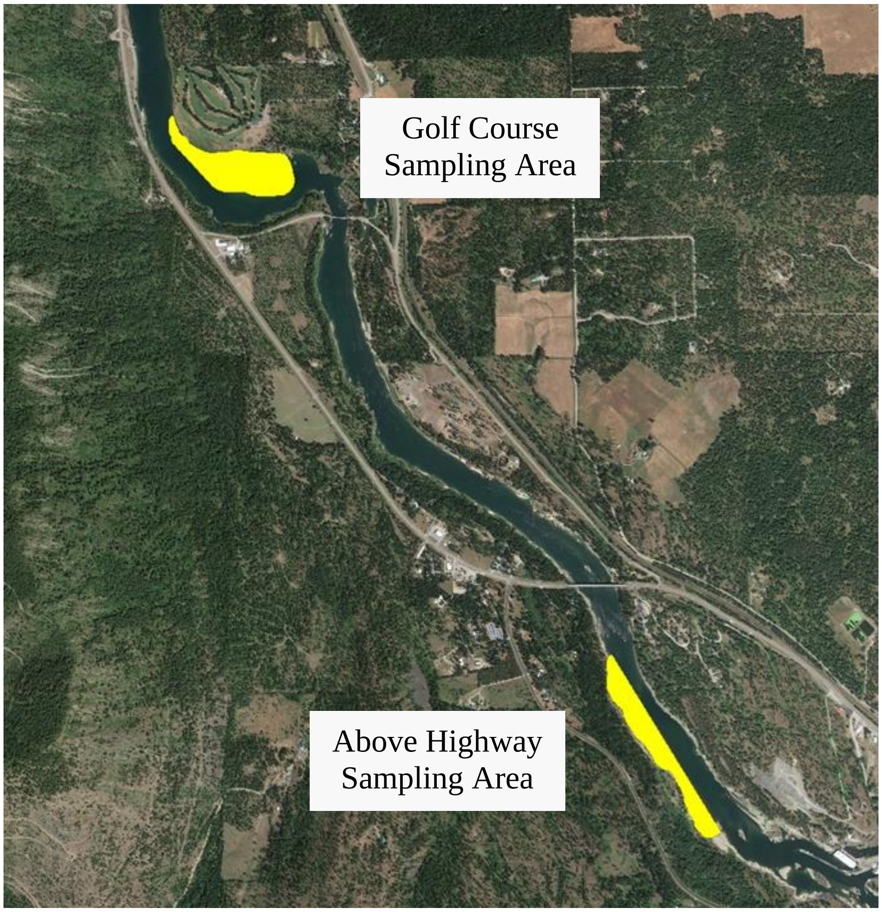

FIGURE 4. Map of two spring Walleye sampling locations in upper Noxon Reservoir.

Bass Tournament Monitoring

The status of adult Largemouth and Smallmouth bass populations has been assessed annually since 1997 by monitoring bass tournaments on Noxon Reservoir. In most years, between five and seven two-day bass tournaments occurred on Noxon Reservoir. Recently, one to three bass tournaments have been monitored per year. Monitoring of bass tournaments did not occur in 2020 due to State COVID-19 protocols.

Noxon Reservoir bass tournaments require that bass had a minimum length of 305 mm (12 inches) to be weighed-in. Therefore, only bass this size or larger were monitored at tournaments. Indices collected at Noxon Reservoir 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 Reservoir allow 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.

Results and Discussion

Fall Gillnetting

Noxon Reservoir

Gill netting was conducted in Noxon Reservoir October 10–12, 2021. A total of 884 fish representing 13 species were captured (TABLE 1). Catch per unit effort trends are shown as a function of mean fish/net in Appendix B for commonly captured fish species 2000–2021. Yellow Perch were the most abundant species captured representing over 35.4% of the total catch (n = 316). The mean number of Yellow Perch captured in 2021 was 10.5 fish/net which is less than the mean 2000-2019 catch of 12.6 fish/net (FIGURE 5). Pumpkinseed *Lepomis gibbosus* was the third most abundant fish species caught and comprised 10.8% of the total catch. The mean catch rate for Pumpkinseed was 3.2 fish/net in 2021, which is less than the mean 2000-2019 catch of 4.4 fish/net (FIGURE 5). Both Yellow Perch and Pumpkinseed are likely an important prey base for the top four predators (i.e., Largemouth Bass, Smallmouth Bass, Northern Pike, and Walleye) in Noxon Reservoir, and declines in their relative abundance over time may indicate top-down impacts in this predator-heavy system (Scarnecchia et al. 2014; Scarnecchia and Lim 2016).

TABLE 1. Mean catch rates (fish/net night), total number caught, percentage of total species composition by number and biomass (percent of total weight), mean weight, weight range, mean length, and length range for species captured in Noxon Reservoir during gill netting surveys conducted in 2021. Species abbreviations are specified in Appendix B.

Species	Mean fish/net (STDEV)	Total # caught	Species Comp. (%)	Percent of Total Weight (%)	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
LL	0.0(0.2)	1	0.1	0.2	596.0	596–96	389.0	389–389
LMB	0.4(0.7)	11	1.2	0.9	347.4	28–1133	249.8	126–460
LNSU	0.0(0.2)	1	0.1	0.3	1308.0	1308–1308	470.0	470–470
LSSU	0.5(0.8)	16	1.8	6.2	1491.1	950–2376	495.8	432–565
LWF	0.9(1.9)	28	3.1	8.1	1198.1	421–2130	478.0	345–565
NP	2.2(2.8)	67	7.5	25.8	1473.1	109–3393	578.2	276–825
NPMN	1.3(1.5)	38	4.3	8.3	882.7	55–1388	415.1	184–505
PEA	0.1(0.4)	2	0.2	0.3	505.0	472–538	365.0	360–370
PUMP	3.2(4.6)	96	10.8	1.4	54.5	15–231	131.4	90–220
SMB	1.9(2.9)	58	6.5	7.3	492.7	26–2235	300.7	130–482
WE	3.2(3.4)	96	10.8	22.9	921.2	228–5375	434.3	295–740
YLBH	5.4(8.2)	162	18.2	11.5	272.8	43–618	259.4	153–327
YP	10.5(12.4)	316	35.4	6.7	81.4	21–345	185.0	120–294

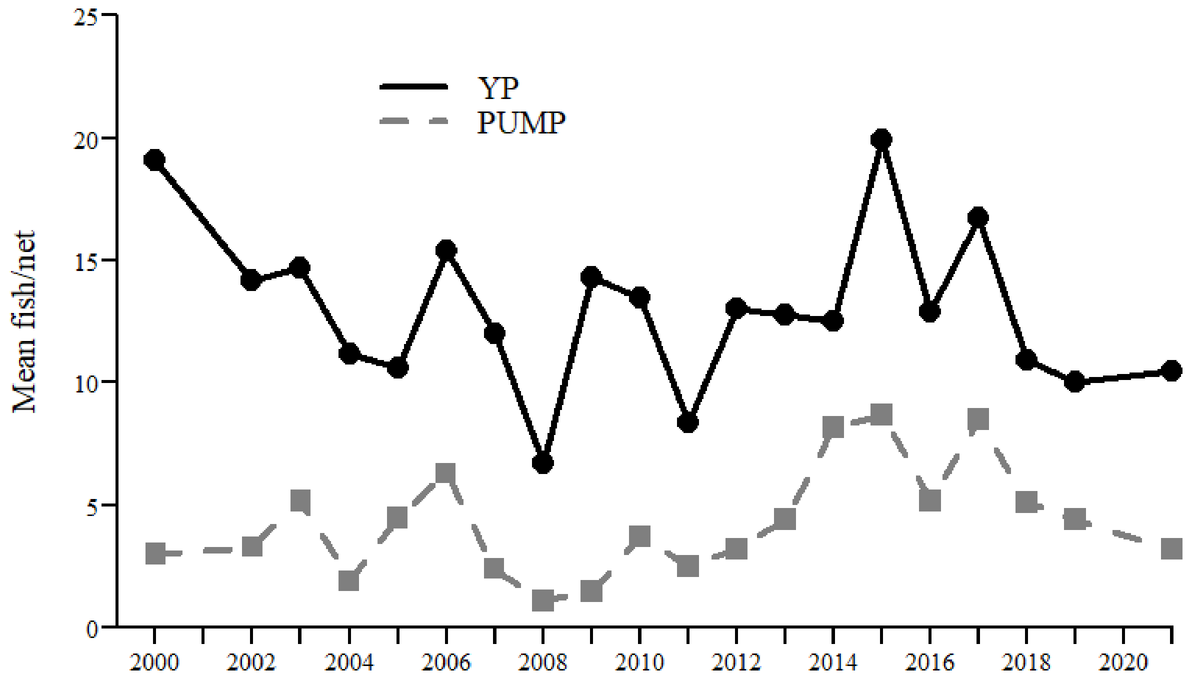

FIGURE 5. Mean number of fish per net for Yellow Perch and Pumpkinseed 2000–2021 in Noxon Reservoir during annual fall gill netting.

Gillnets are an effective method to monitor relative abundance of two of the four top predators in Noxon Reservoir: Walleye and Northern Pike. In general, bass are not suspectable to being captured in gillnets when compared to most other species in the reservoirs. Smallmouth Bass appear to be captured at a higher rate than Largemouth Bass, but both species are underrepresented to an unknown degree in relation to their abundance in the fish community.

Walleye were the most abundant top predator species captured representing 10.8% of the total catch (n = 96), which was the highest number since standardized netting began in 2000. A dramatic increase has been observed in Walleye abundance (linear regression, $r^2 = 0.79$, $p < 0.001$), mean catch was 3.2 fish/net, which is a substantial increase from 2019 (1.7 fish/net) and the mean 2000–2019 catch of 0.9 fish/net. The majority of Walleye captured were comprised of year classes 2019 (67.7%) and 2015 (19.8%; TABLE 2; FIGURE 6). The 2015 year-class continues to be well represented in the Noxon Reservoir Walleye population after six years. However, this is the first time a strong 2019 year-class has been detected. Gill netting did not occur in 2020 due the COVID-19 protocols and as of 2021 Walleye from the 2019 year-class have not yet recruited to the spawning population sampled during spring electrofishing.

TABLE 2. Mean length-at-age for male and female of fall caught Walleye from Noxon Reservoir in 2021.

	Males			Females		
Age	n	Mean Length (mm)	SD	n	Mean Length (mm)	SD
1	-	-	-	1	302	-
2	40	390	22.5	25	399	21.3
3	2	460	49.5	1	512	-
4	2	494	12	1	541	-
5	-	-	-	-	-	-
6	11	513	23.5	8	586	25
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	1	585	-
11	-	-	-	-	-	-
12	-	-	-	-	-	
13	-	-	-	1	740	-
14	-	-	-	-	-	-
15	-	-	-	-	-	-
16	-	-	-	-	-	-
17	-	-	-	-	-	-
18	1	601	-	-	-	-

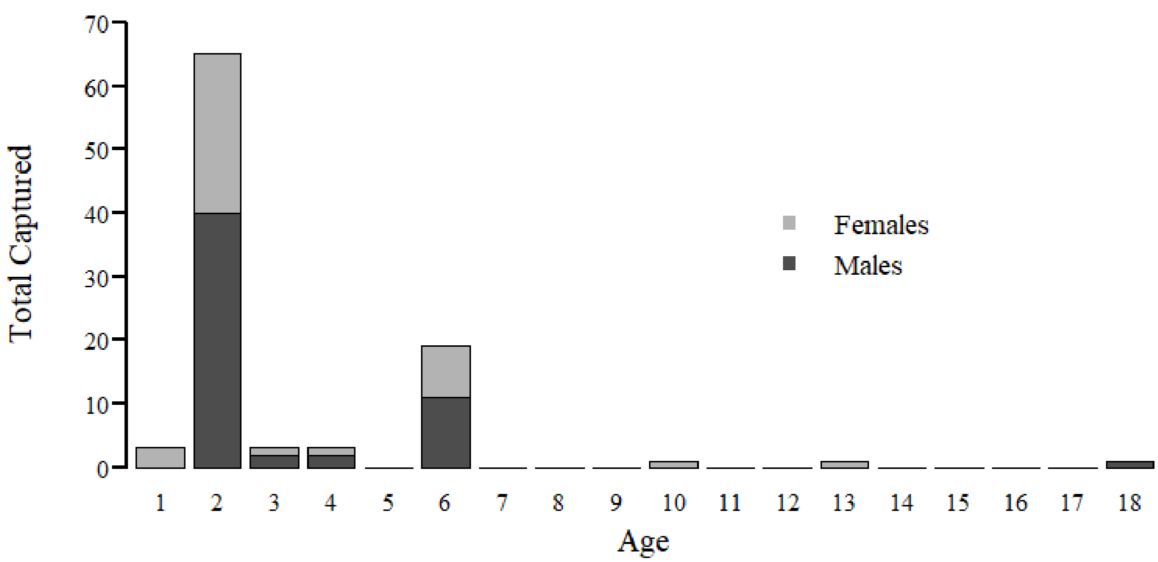

FIGURE 6. Age frequency distribution of fall caught Walleye from Noxon Reservoir in 2021.

Mean Wr for Walleye was 93.7 in 2021, which is less than the 2002–2019 mean (Wr = 97; FIGURE 7). A significant decline in mean Wr of Walleye has occurred over time (linear regression, $r^2 = 0.48$, $p < 0.001$; FIGURE 9). However, Walleye at all length groups are still above average condition when compared to Walleye caught using standardized gill nets in large standing waters in North America (FIGURE 7). We expect Walleye condition to continue to decline as the population grows and competition for forge increases. Condition of male Walleye (Wr = 95.1) was slightly higher than females (Wr = 91.7).

Proportional size distribution for Walleye captured during fall of 2021 (81) points to a relatively large size structure within Noxon that represents high mortality of young fish and moderate to low levels of mortality for adults (Anderson and Weithman 1978). Walleye condition also had a positive relationship with length (FIGURE 7). Smaller length groups showed no statistically significant difference. Whereas the memorable length group (stock = 165–213 mm, quality = 297–338 mm, preferred = 371–455 mm, and memorable = 488–528 mm) was in statistically better condition than stock and quality (memorable-stock $p = 0.03$, memorable-quality $p = 0.03$).

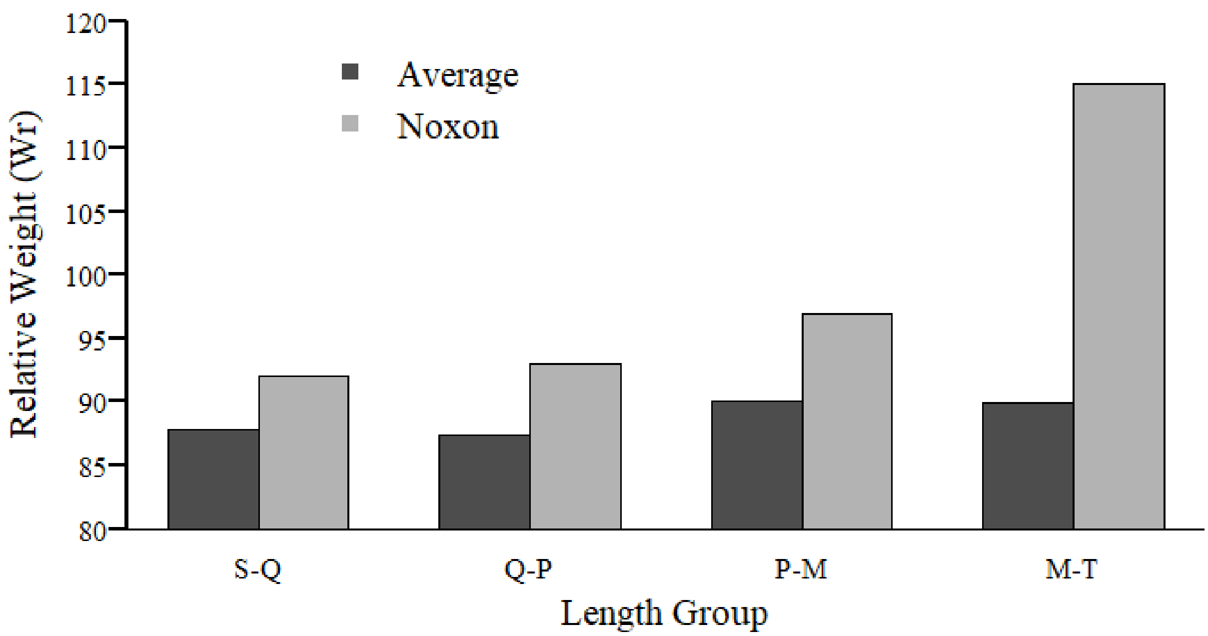

FIGURE 7. Average condition of Walleye caught using standardized gill nets in large standing waters in North America (Bonar et al. 2009) and average condition of fall caught Walleye from Noxon Rapids Reservoir in 2021. S = stock, Q = quality, P = preferred, M = memorable, and T = Trophy (Gabelhouse 1984).

Von Bertalanffy growth curves and parameters (Appendix D) were calculated for both male and female using the 94 Walleye used for age analysis (TABLE 2). Of those fish, 56 were male and 38 were female. Supporting reported mean length-at-age data, female Walleye growth rates was greater than that of males.

During 2021 gill netting seven Walleye were recaptured that had previously been tagging during spring Walleye electrofishing (TABLE 3). The initial tagging event of two recaptured Walleye could not be identified due to transcription errors. Most of the recaptured fish had been tagged in the spring of 2021 (60%), the remaining after three growing seasons (40%; TABLE 2). Recapture rates for fish PIT tagged in 2019 and 2021 were <1% and 2%, respectively. The recaptured fish grew an average of 50 mm per year (TABLE 3).

TABLE 3. Mean yearly growth of recaptured walleye sampled during fall 2021.

PIT Tag Number	Initial Capture Year	Initial Capture Length (mm)	Recapture Date	Recapture Length (mm)	Sex	Mean Yearly Growth (mm)
982000357016272	4/22/2021	515	10/11/2021	530	M	-
982000357016348	5/3/2021	308	10/11/2021	386	M	-
982000362929469	4/14/2021	464	10/12/2021	485	M	-
982000362929572	4/23/2019	378	10/11/2021	499	M	49
982000363519213	4/11/2019	407	10/12/2021	531	M	50

Northern Pike comprised 7.5% of the netted fish and were the second most abundant predator species sampled within Noxon Reservoir. Mean catch rate for Northern Pike in 2021 was 2.2 fish/net (TABLE 1) which is substantially higher than the 2002–2019 mean catch rate (1.2 fish/net). Northern Pike abundance has increased significantly since standardized gillnetting began (linear regression, $r^2 = 0.39$, $p = 0.003$). Mean Wr for Northern Pike in 2021 was 99.9; this continues a significant decline for the species since 2000 (linear regression, $r^2 = 0.71$, $p < 0.001$). While mean Wr in Northern Pike has declined from 2000–2019 (Wr = 110.4; FIGURE 8), Northern Pike condition is still considered near the 50th percentile for large standing waters of North America (FIGURE 8; Bonar et al. 2009).

Proportional size distribution for Northern Pike captured during fall of 2021 (90) points to a large size structure within Noxon Reservoir that represents high mortality of young fish and moderate to low levels of mortality for adults (Anderson and Weithman 1978). Generally, length groups showed no statistically significant difference. Although Northern Pike in the quality length category showed statistically better condition than those in the sub-stock ($p = 0.01$; sub-stock = <350 mm stock = 350–529 mm, quality = 530–709 mm, preferred = 710–859 mm, and memorable = 860–1119 mm). Trends of increasing abundance and decreasing condition observed in Northern Pike were similar to those in Walleye.

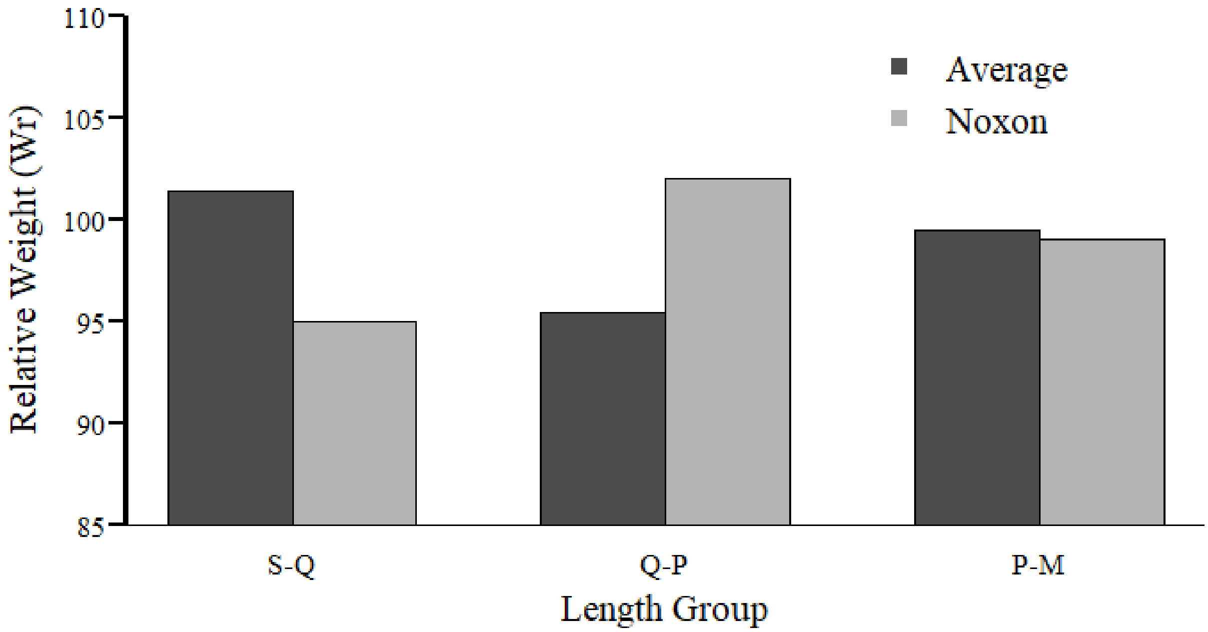

FIGURE 8. Average condition of Northern Pike caught using standardized gill nets in large standing waters in North America (Bonar et al. 2009) and average condition of fall caught Northern Pike from Noxon Reservoir in 2021. S = stock, Q = quality, P = preferred, M = memorable, and T = Trophy (Gabelhouse 1984).

Condition of Smallmouth Bass captured within Noxon Reservoir continues to be high with a mean Wr of 101.3 in 2021. Smallmouth Bass mean Wr has ranged from a low of 84.1 (n = 11) in 2008 to a high of 102.9 (n = 63) in 2013 (FIGURE 9). No decline has been detected over the sampled period (linear regression, $p = 0.89$). As stated earlier, the downward trends in Walleye and Northern Pike Wr may be indicative of increasing competition for prey resources and habitat among top predators in this complex ecosystem. It is much less clear if the Wr of Smallmouth Bass is representative of the actual population given the notable difficulty in catch the species in gillnets. Future efforts should be made to evaluate the potential for taking “snapshots” of the Noxon food web using stable isotopes and diet analysis which may provide a better understand of interactions among predators, prey, and environmental conditions in the reservoir.

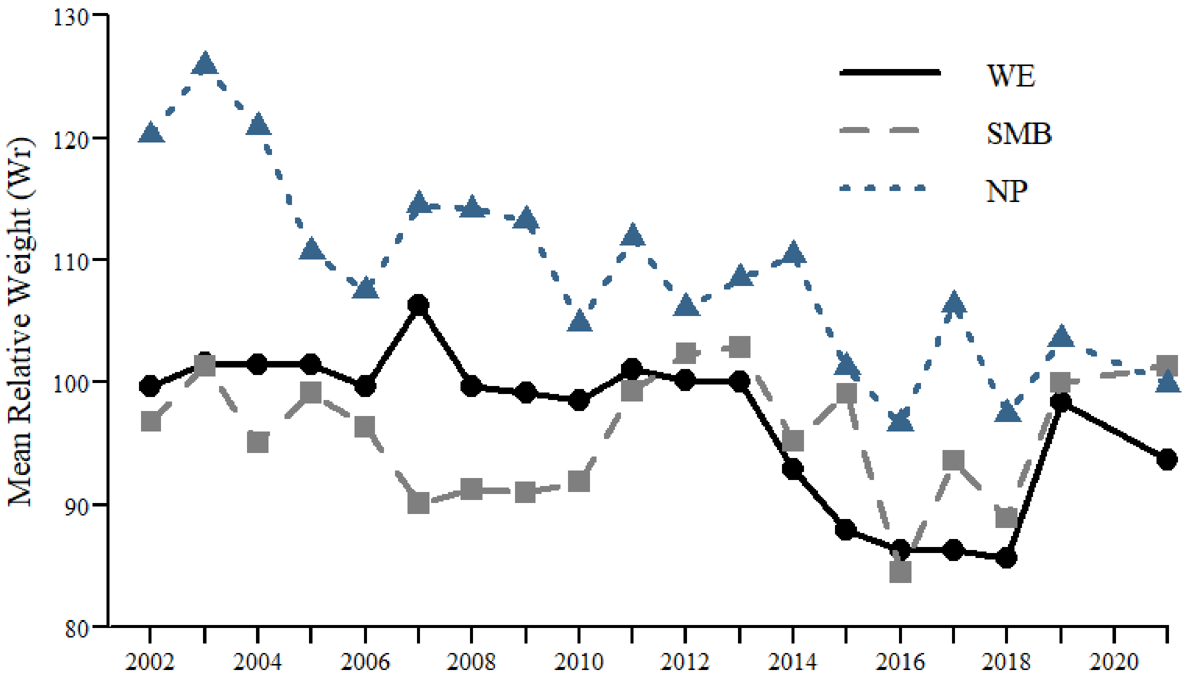

FIGURE 9. Mean relative weight of fall-captured Northern Pike, Smallmouth Bass and Walleye over time in Noxon Reservoir.

Native non-gamefish species such as Northern Pikeminnow, Peamouth, and Largescale Suckers continue to be captured at low levels. In 2021, 37 Northern Pikeminnow were captured comprising 4.3% of the total fish community (TABLE 1). A significant decline in the species has been documented since 2000 (linear regression, $r^2 = 0.93$, $p < 0.001$), where 6.1 fish/net was documented in 2000 (n = 178) compared to 1.3 fish/net in 2021 (n = 37) (Appendix B; FIGURE 10).

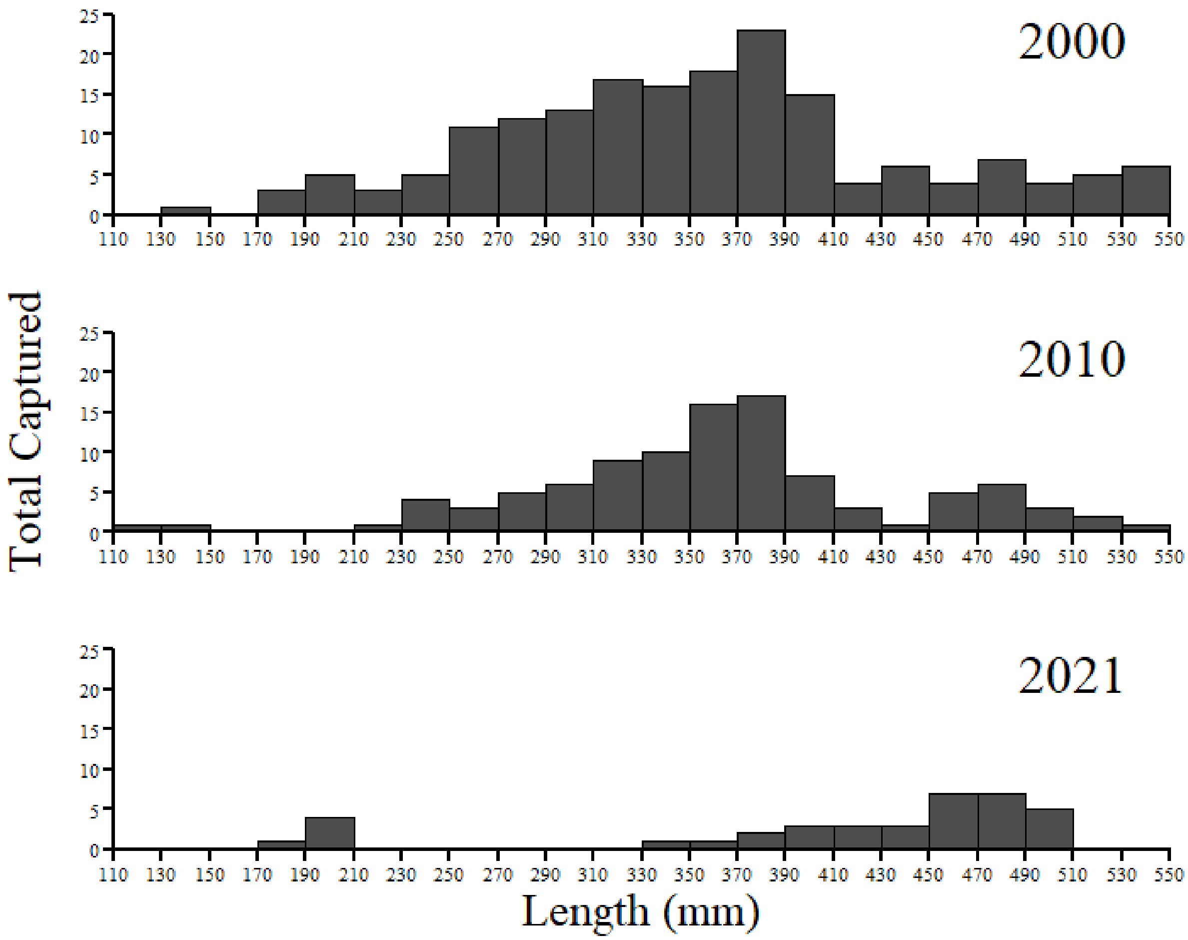

FIGURE 10. Length Frequency distribution of fall caught Northern Pikeminnow during annual gillnet monitoring in Noxon Reservoir in 2000 (n = 178), 2010 (n = 101), and 2021 (n = 37).

Sixteen Largescale Suckers were captured in 2021 (0.5 fish/net), compared to 38 fish in 2010 (1.3 fish/net) and 56 fish in 2000 (1.9 fish/net) (TABLE 1; FIGURE 11). Largescale Suckers have also shown a significant decline since standardized gillnetting began (linear regression, $r^2 = 0.77$, $p < 0.001$; Appendix B).

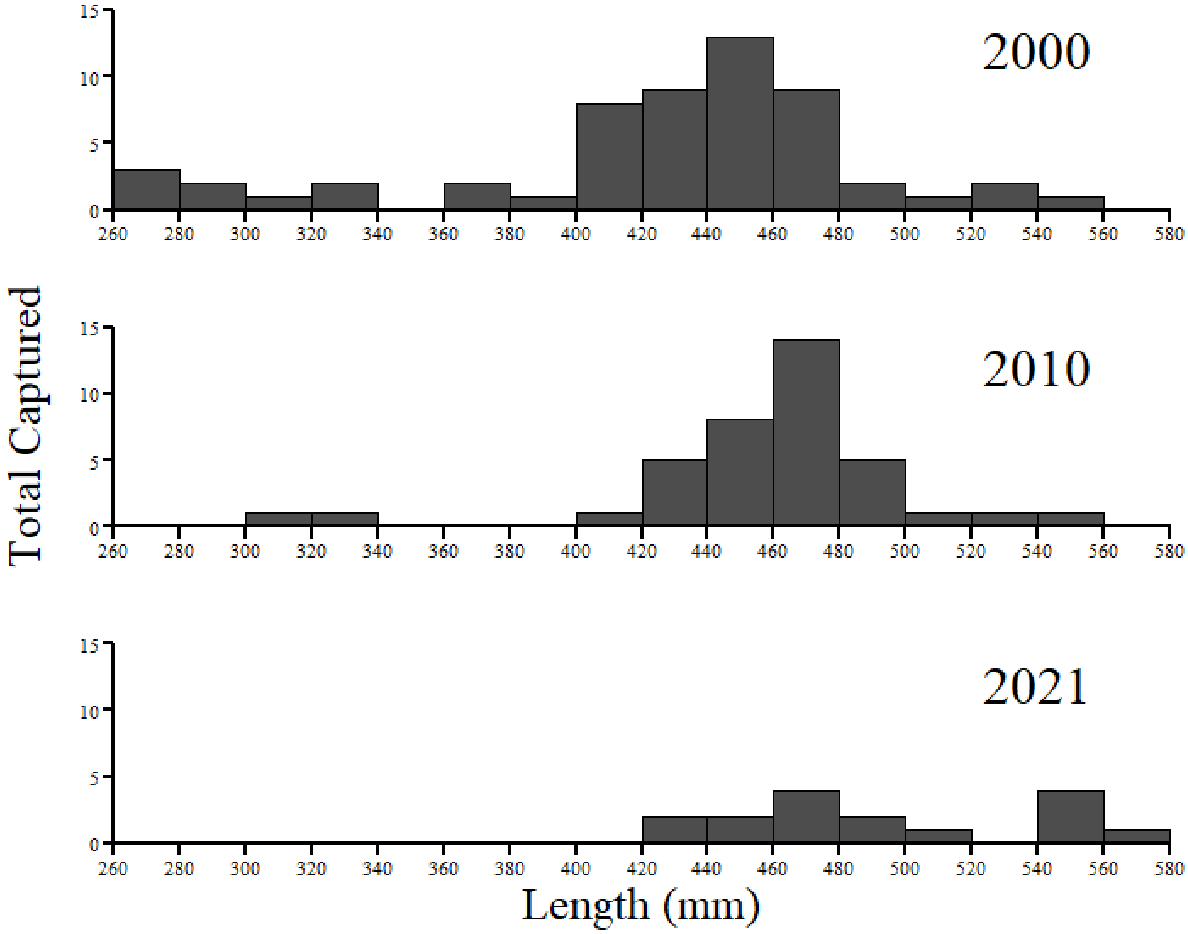

FIGURE 11. Length Frequency distributions of fall caught Largescale Suckers during annual gillnet monitoring in Noxon Reservoir in 2000 (n = 56), 2010 (n = 38), and 2021 (n = 16).

The most dramatic decline has been observed in Peamouth (linear regression, $r^2 = 0.92$, $p < 0.001$) where a mean catch of 11.6 fish/net (n = 338) was recorded in 2000, compared to 6.1 fish/net (n = 182) in 2010 and 0.1 fish/net in 2021 (n = 2; FIGURE 12; Appendix B). Size structure of each of these native minnow and sucker populations, which have likely served as an important prey resource for gamefish species, indicate little if any successful recruitment. Additionally, these populations generally appear to be comprised of historically low numbers of larger, older individuals and could be in danger of local extirpation.

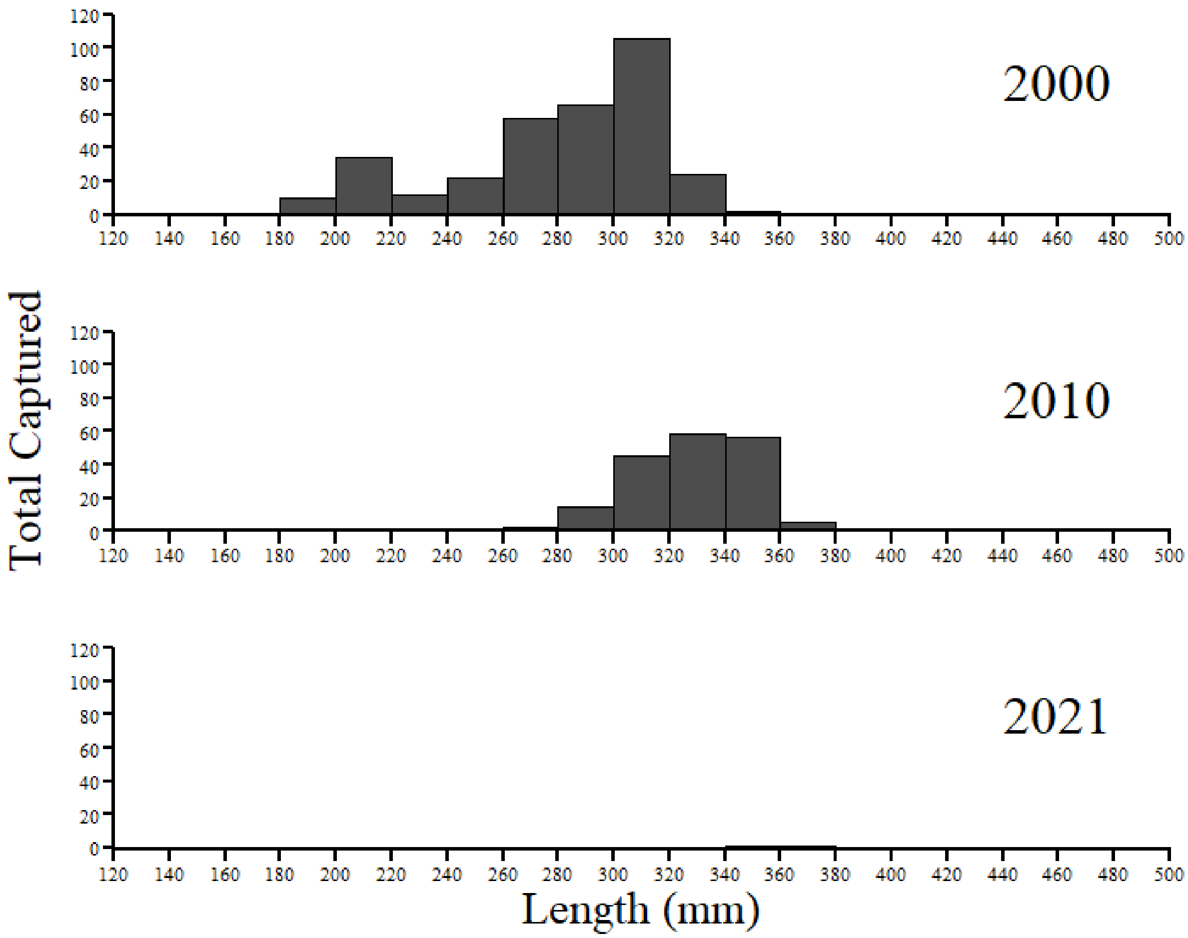

FIGURE 11. Length Frequency distributions of fall caught Peamouth during annual gillnet monitoring in Noxon Reservoir in 2000 (n = 337), 2010 (n = 182), and 2021 (n = 2).

Cabinet Gorge Reservoir

Gill netting was conducted in Cabinet Gorge Reservoir October 10–11, 2021. Gillnetting in Cabinet Gorge Reservoir produced a total of 170 fish representing 10 species (TABLE 4). Catch per unit effort trends are shown as a function of mean fish/net in Appendix C for commonly captured fish species 2000–2021. The catch rate of 11.7 fish/net is up from the 2019 historic low catch rate of 7.6 (2000–2019 mean catch 13.7 fish/net). Yellow Perch were the most abundant species captured representing over 44.3% of the total catch (n = 78). The mean number of Yellow Perch captured in 2021 was 5.2 fish/net which is greater than the 2000–2019 mean catch of 3.9 fish/net (TABLE 4).

TABLE 4. Catch rates (fish/net), total number caught, percentage of total species composition by number and biomass (percent of total weight), mean weight, weight range, mean length and length range for species captured in Cabinet Gorge Reservoir during gill netting surveys conducted in 2021. Species abbreviations are specified in Appendix A.

Species	Mean fish/net (STDEV)	Total # caught	Species Comp. (%)	Percent of Total Weight (%)	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
LL	0.1(0.3)	1	0.6	1.9	1735.0	1735–1735	400.0	400–400
LMB	0.1(0.3)	1	0.6	0.1	80.0	80–80	180.0	180–180
LSSU	1.5(1.6)	23	13.1	28.2	1122.4	838–1833	464.6	423–541
LWF	0.3(0.6)	5	2.8	4.4	804.6	492–1126	448.0	367–512
NP	1.6(2.2)	24	13.6	38.0	1450.8	170–6495	575.4	305–975
NPMN	0.9(1.1)	14	8.0	14.4	942.4	437–1642	430.9	350–513
PUMP	0.7(1.6)	11	6.3	0.5	48.2	18–81	128.5	98–153
SMB	0.9(1.2)	14	8.0	7.2	471.9	47–944	303.4	150–391
WE	0.3(0.7)	5	2.8	0.6	141.8	33–182	256.0	185–282
YP	5.2(6.8)	78	44.3	4.7	57.6	29–204	166.2	135–255

Similar to Noxon Reservoir, gillnets are an effective method to monitor relative abundance of two of the four top predators in Cabinet Reservoir: Walleye and Northern Pike. In general, bass are not as suspectable to capture in gillnets as most other species in the reservoirs. Smallmouth Bass appear to be captured at a higher rate than Largemouth Bass but both species are underrepresented to an unknown degree in relation to the abundance in the fish community.

Northern Pike were the most abundant top predator species captured representing 13.6% of the total catch (n = 24; TABLE 4), which was the highest number since standardized netting began in 2000. Mean catches were 1.6 fish/net, which is also a historic high (2000–2019 mean catch 0.6 fish/net; Appendix C). Northern Pike abundance has shown a significant increase since standardized gillnetting began (linear regression, $r^2 = 0.53$, $p < 0.001$). Mean Wr for Northern Pike was 95.7 in 2021, this continues a significant decline for the species since 2009 (linear regression, $r^2 = 0.58$, $p = 0.007$). While Wr in Northern Pike has declined from the 2000–2019 mean (113.4; FIGURE 12), Northern Pike condition is still considered near the 50th percentile in large standing waters of North America (FIGURE 13).

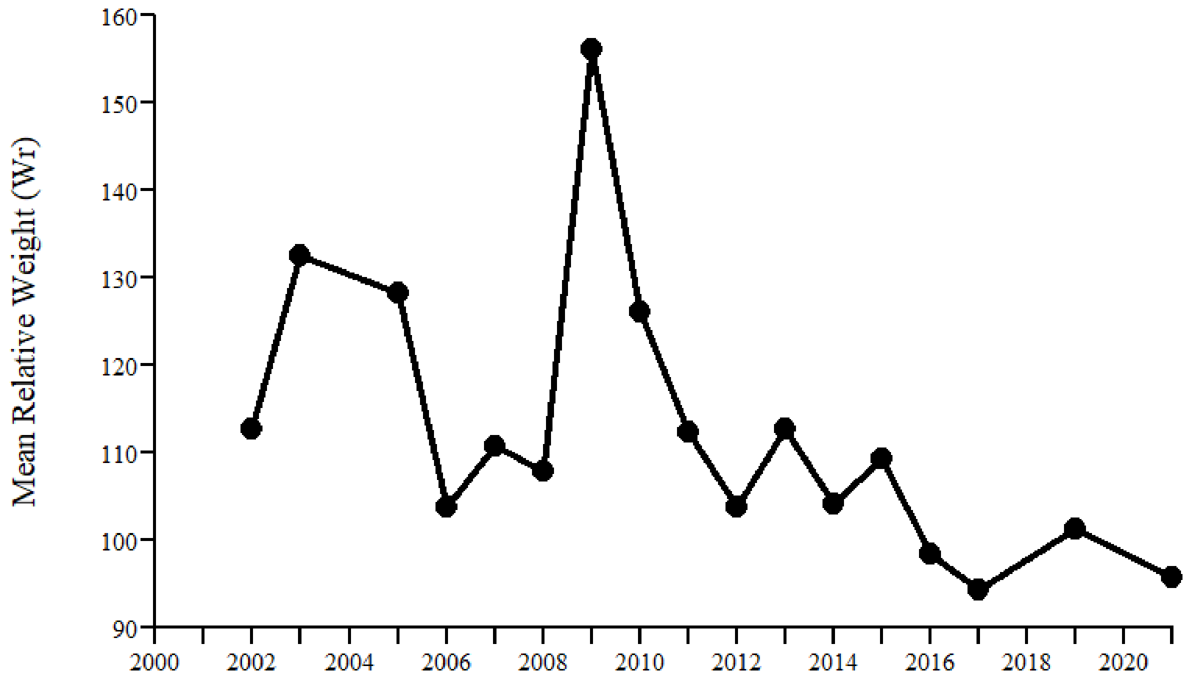

FIGURE 12. Mean relative weight of fall-captured Northern Pike over time in Cabinet Gorge Reservoir.

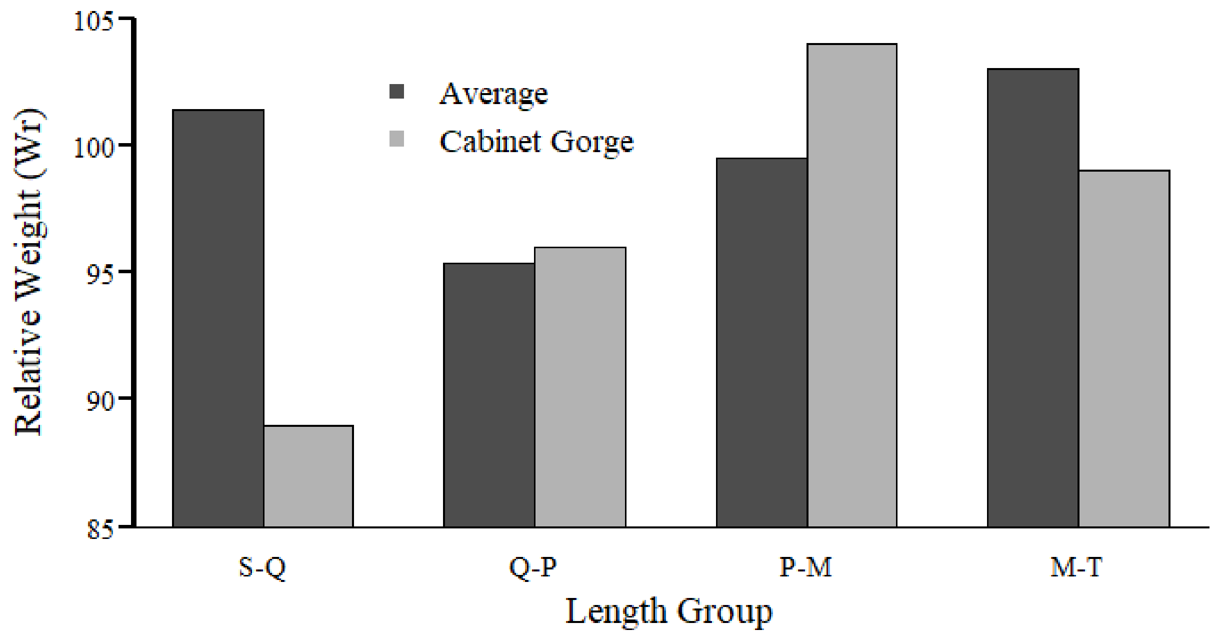

FIGURE 13. Average condition of Northern Pike caught using standardized gill nets in large standing waters in North America (Bonar et al. 2009) and average condition of fall caught

Northern Pike from Cabinet Gorge Reservoir in 2021. S = stock, Q = quality, P = preferred, M = memorable, and T = Trophy (Gabelhouse 1984).

Proportional size distribution for Northern Pike captured during fall of 2021 (79) still points to a relatively large size structure within Cabinet Gorge Reservoir. This represents high mortality of young fish and moderate to low levels of mortality for adults (Anderson and Weithman 1978). Length groups showed no statistically significant difference (sub-stock = <350 mm stock = 350–529 mm, quality = 530–709 mm, preferred = 710–859 mm, and memorable = 860–1,119 mm). Trends of increasing abundance and decreasing condition observed in Northern Pike were similar to those observed in Noxon Reservoir.

Walleye catch (0.3 fish/net, n = 5) in 2021 was similar to 2000–2019 (mean 0.2 fish/net). We have not observed the same recent dramatic increases in Cabinet Gorge Walleye as those in Noxon Reservoir. This is likely due to the lower water residence time in Cabinet Gorge and the inability of Walleye to recruit within the reservoir. We suspect Walleye captured within Cabinet Gorge are spawned and subsequently washing down from Noxon Reservoir. Walleye captured in 2021 were comprised of two year-classes 2019 (75%) and 2020 (25%). Scavenging by crayfish prevented one of the five Walleye from being aged.

Condition of Smallmouth Bass captured within Cabinet Gorge Reservoir continues to be high with a mean Wr of 100.3 in 2021. Smallmouth Bass mean Wr has ranged from a low of 88.6 (n = 3) in 2017 to a high of 112.4 (n = 8) in 2000 and no decline has been detected over the sampled period (linear regression, $p = 0.06$). The downward trend in Northern Pike Wr may be indicative of increasing competition for prey resources and habitat among top predators in this complex ecosystem. It is much less clear if the Wr of Smallmouth Bass is representative of the actual population given the notable difficulty in catch the species in gillnets. Future efforts should be made to evaluate the potential for taking “snapshots” of the Cabinet Gorge food web using stable isotopes and diet analysis which may help to provide a better understand of interactions among predators, prey and environmental conditions in the reservoir.

Native non-gamefish species such as Northern Pikeminnow, Peamouth, and Largescale Suckers continue to be captured at low levels in Cabinet Gorge. In 2021, 14 Northern Pikeminnow were captured comprising 8% of the total fish community (TABLE 4). A significant decline in the species has been documented since 2000 (linear regression, $r^2 = 0.79$, $p < 0.001$), where 7.1 fish/net was documented in 2000 (n = 99) compared to 0.9 fish/net in 2021 (n = 14) (FIGURE 14).

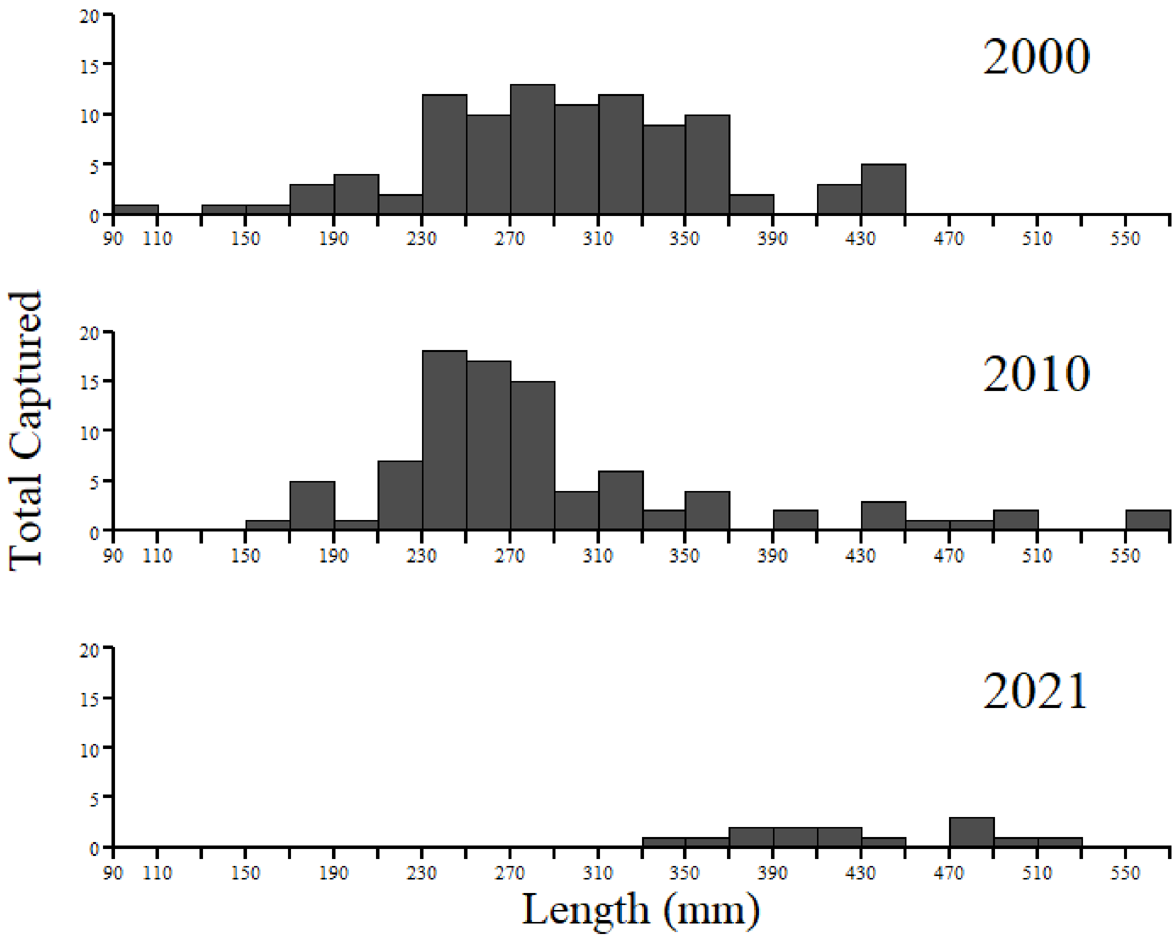

FIGURE 14. Length Frequency distribution of fall caught Northern Pikeminnow during annual gillnet monitoring in Cabinet Gorge Reservoir in 2000 (n = 99), 2010 (n = 91), and 2021 (n = 14).

Twenty-three Largescale Suckers were captured in 2021 (1.5 fish/net), compared to 31 fish in 2000 (2.2 fish/net; TABLE 1; FIGURE 15). Largescale Suckers have also shown a significant decline since standardized gillnetting began (linear regression, $r^2 = 0.77$, $p = 0.03$). Declines in the Cabinet Gorge Reservoir Largescale Sucker population have not been as prominent as other native non-gamefish species. However, length-frequency histograms still show a size structure that continues to increase, suggesting an aging population with reduced recruitment (FIGURE 15). Size structure of native minnow and sucker populations, which have likely served as an important prey resource for gamefish species, indicate little if any successful recruitment and these population generally appear to be comprised of historically low numbers of larger, older individuals and appear to be in danger of local extirpation. For the fourth consecutive year, no Peamouth were captured in Cabinet Gorge Reservoir. It appears that Peamouth have been functionally extirpated from Cabinet Gorge Reservoir.

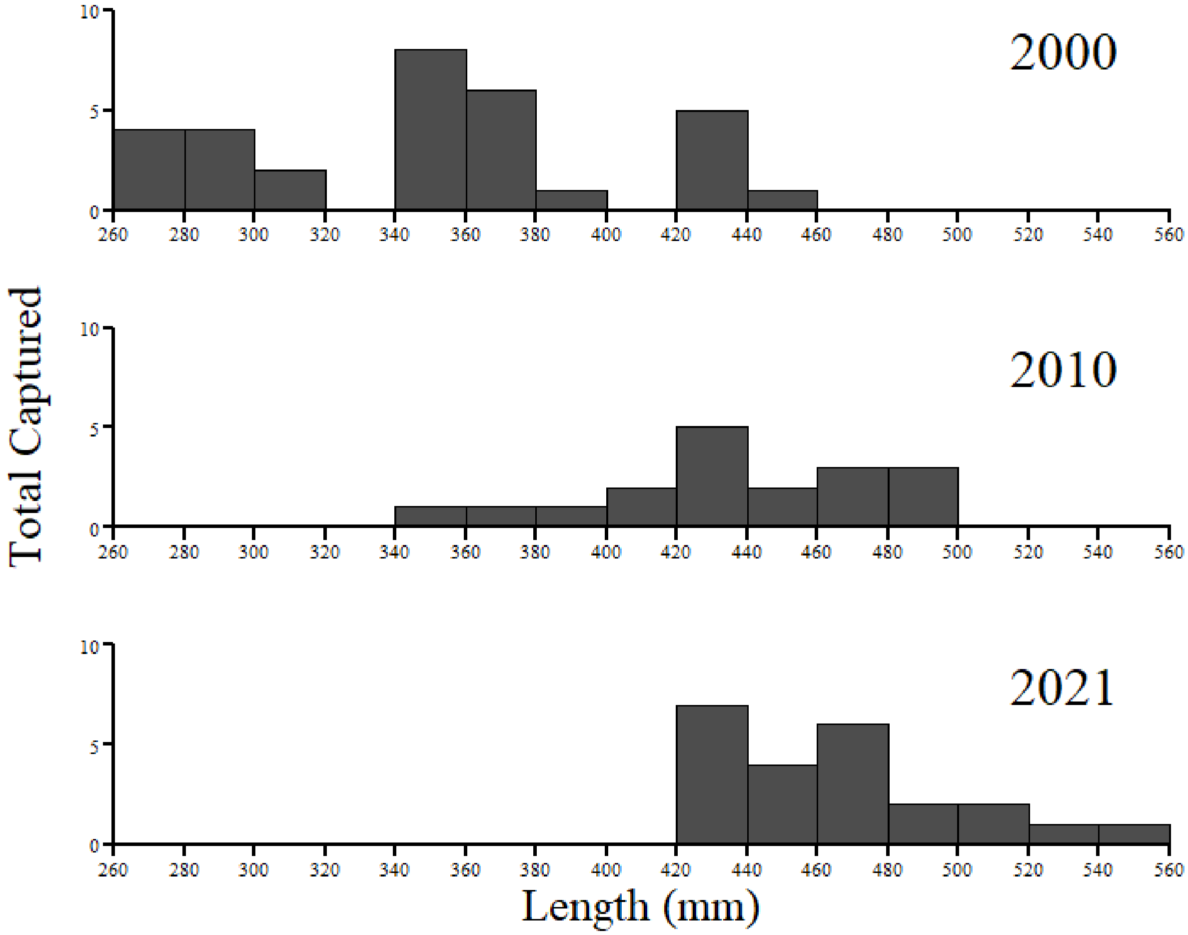

FIGURE 15. Length Frequency distribution of fall caught Largescale Sucker during annual gillnet monitoring in Cabinet Gorge Reservoir in 2000 (n = 31), 2010 (n = 18), and 2021 (n = 23).

Over the past decade, the major fish community change in Noxon and Cabinet Gorge reservoirs has been the establishment and continued increase of Walleye (Kreiner and Tholl 2016; Kreiner et al. 2020; Kreiner et al. 2021). Walleye abundance has been increasing at a rapid rate. Concurrently, abundance of native sucker and minnow species has declined. Recent declines in condition of Walleye and Northern Pike, also indicate that the increase in total piscivores has ultimately resulted in a substantial decrease of forage fishes. 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. The continued monitoring of the fish community and population of Walleye in Noxon Reservoir and Cabinet Gorge Reservoir will be paramount to informing management decisions into the future.

Spring Walleye Sampling
Montana Fish, Wildlife and Parks electrofished upper Noxon Reservoir for Walleye on seven separate occasions in 2021. Sampling effort and dates were greatly affected by boat ramp accessibility due to low reservoir levels in spring. Sampling time was split between the area above the Highway 200 bridge (77%) and the area adjacent to the River's Bend Golf Course (23%; FIGURE 4). A total of 257 sexually mature fish were captured, of which 96 (37%) were females and 161 (63%) were males (FIGURE 16). Of the 257, fish captured 61 (24%) of them were sacrificed for age analysis. The remaining 196 fish were released alive. The overwhelming majority of Walleye (253) were captured upstream of the Highway 200 Bridge while catch adjacent to the River's Bend Golf Course (4) was very low. These discrepancies in catch-rates between sampling location are not well understood.

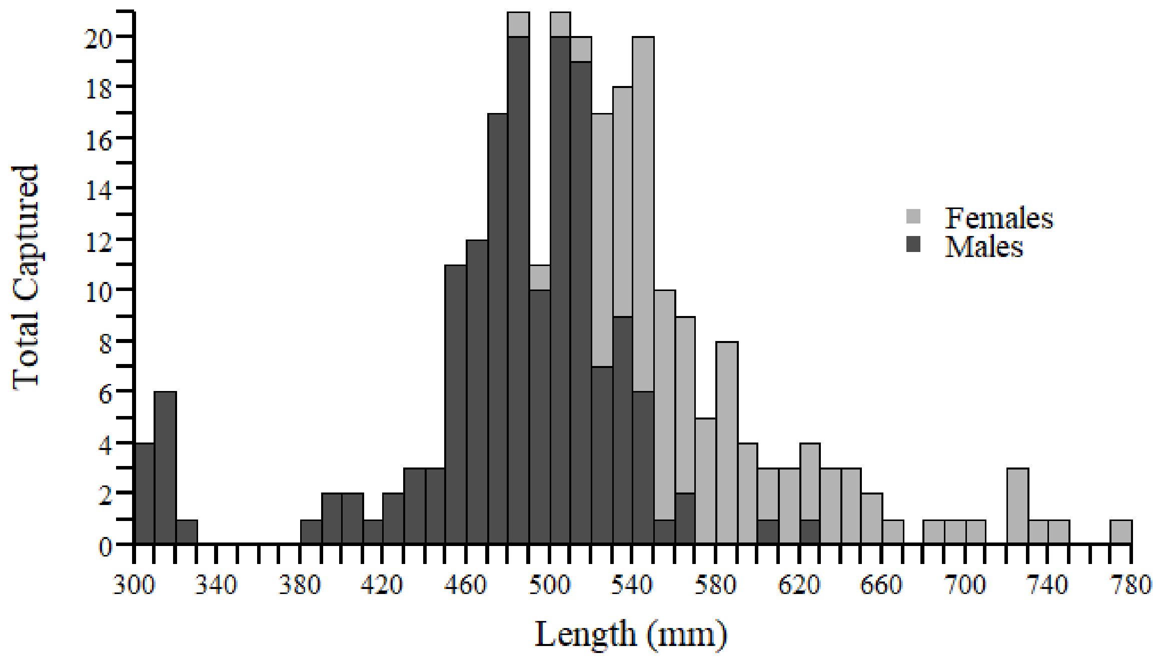

FIGURE 16. Length frequency distribution of spring caught walleye from Noxon Reservoir in 2021.

Males were represented primarily by the 2015 year-class (86%) followed by the 2018 year-class (9%; FIGURE 17). Females' most abundant year-class was also 2015 (61%) followed next by the 2016 year-class (15%; FIGURE 17). Mature males were captured from six different year-classes and mature females from seven different year-classes (TABLE 5). Spring Walleye sampling in 2021 continued to show a spawning population dominated by the 2015 year-class (age-6; FIGURE 17). Our monitoring has shown that even moderate year classes can make noticeable contributions to the overall population up to seven years later (Kreiner et al. 2020 and Blakney and Tholl et al. 2021). Walleye from the 2015 year-class will persist for several more years and will have the opportunity to contribute to another strong year-class when favorable spawning conditions permit. Walleye data collected during fall gill netting shows a strong year-class produced in 2019. We expect males of the 2019 year-class to begin showing up in spring sampling in 2022 and females in 2023 and 2024.

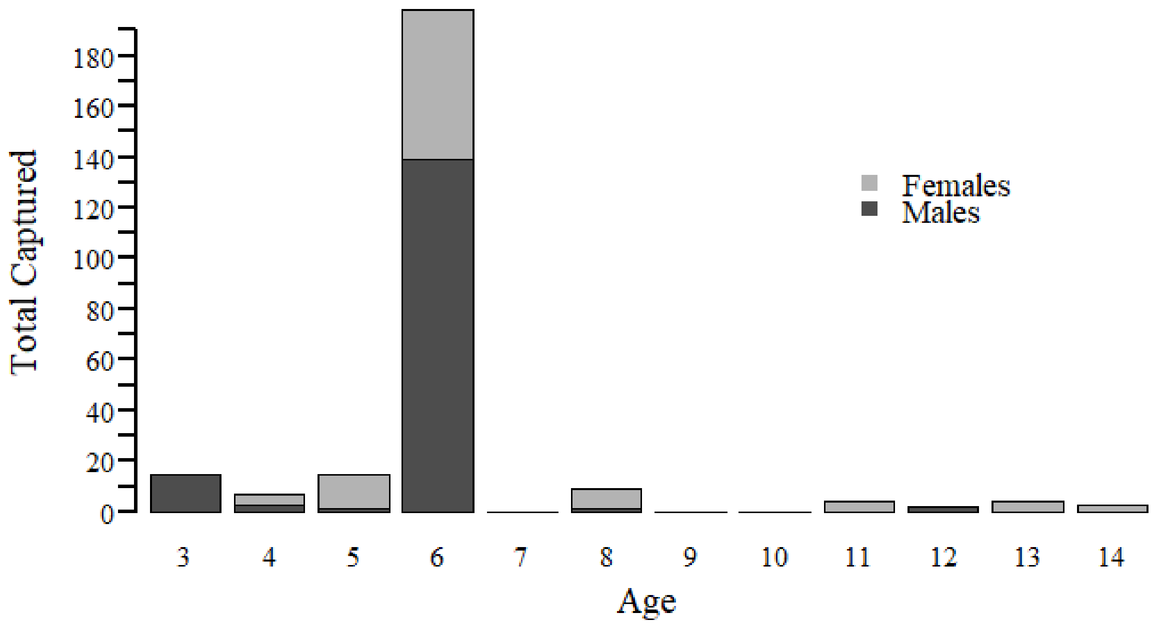

FIGURE 17. Age frequency distribution of spring caught Walleye from Noxon Reservoir in 2021

Mean length of mature males captured was 480 mm (range = 302–628; TABLE 5). Of these fish, 161 (92%) exceeded 400 mm in length, this large size structure is evidently from the strong 2015 year-class. In contrast, mean length of mature females captured was 582 mm (range = 485–774; TABLE 5). All females exceeded 400 mm in length with the majority of fish also being represented by the 2015 year-class. Size structure of the spawning population of Walleye continues to grow due to the aging of the 2015 year-class and little observed recruitment from younger year classes. Over the next couple of years, we predict that overall size structure will decrease as we expect influx of Walleye from the 2019 year-class to recruit to the spawning population. Additionally, while we have shown that Walleye can persist in Noxon Reservoir for up to 18 years (oldest aged Noxon Walleye), we expect the majority of the 2015 year-class to begin to age out the population over the coming years.

TABLE 5. Mean length-at-age for male and female of spring caught Walleye from Noxon Reservoir in 2021.

	Males			Females		
Age	n	Mean Length (mm)	SD	n	Mean Length (mm)	SD
3	15	336	41.7	-	-	-
4	3	431	6.1	4	503	13.9
5	1	449	-	14	544	2.8
6	139	494	29.4	59	567	35.3
7	-	-	-	-	-	
8	1	570	-	8	654	20.2
9	-	-	-	-	-	
10	-	-	-	-	-	
11	-	-	-	4	733	29.5
12	2	617	11	-	-	
13	-	-	-	4	619	3.3
14	-	-	-	3	735	5.5

Overall catch rate was 46.1 fish per hour and ranged 31–104.4 fish per hour. Total catch peaked at 104.4 fish per hour on April 7 when water temperature was 8.9°C and flow was 13,900 cfs (FIGURE 18). Female catch remained relatively high for most of the sampling period also peaking on April 7 at 50.4 per hour. Total fish captured was highest on the increasing limb of the hydrograph, when Walleye are responding to spring temperature and flows and moving to spawning areas (Colby et al. 1979). However, as flows continued to rise the catchability with our sampling equipment quickly declined as did catch rates.

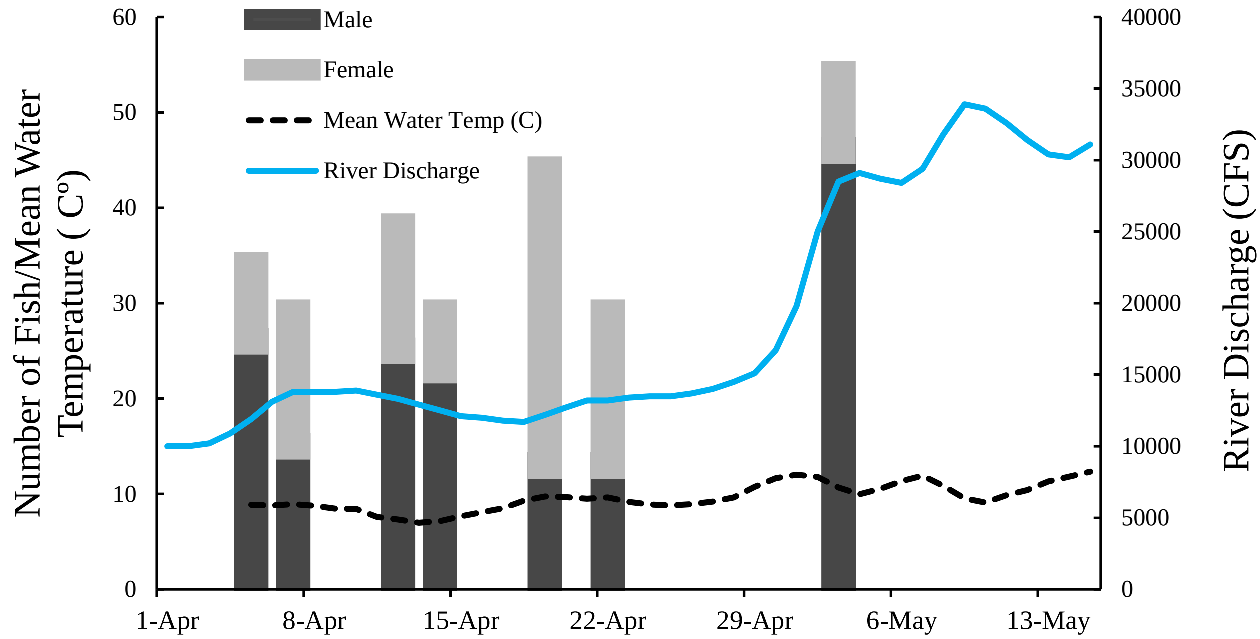

FIGURE 18. Catch per unit effort of Walleye during spring 2021, with river discharge and mean water temperature.

Of the 196 fish PIT tagged and released alive, two were subsequently captured during a later sampling date in 2021 (within year recaptures), and 37 additional fish captured in 2021 had been captured and tagged in prior years (previous year recaptures). The initial capture event for two recaptured individuals could not be identified. Most of the Walleye tagged in previous years were recaptured after only one (46%) or two (43%) growing seasons. The remaining fish were captured after three growing seasons (11%) (TABLE 6). Recapture rates for fish PIT tagged in 2019 and 2020 were 3% and 8%, respectively. The majority of tagged Walleye from previous years were male, little inferences may be drawn from this as most previously PIT tagged Walleye are also male. The mean length of recaptured fish was 494 mm. Recaptured fish grew between 22 and 67 mm per year with a mean value of 48 mm (TABLE 6).

TABLE 6. Mean yearly growth of recaptured walleye sampled during spring 2021.

PIT Tag Number	Initial Capture Year	Initial Capture Length (mm)	Recapture Date	Recapture Length (mm)	Sex	Mean Yearly Growth (mm)
982000362929624	4/25/2019	394	4/7/2021	447	M	27
982000362691613	4/30/2020	408	4/19/2021	450	M	43
982000362691598	4/28/2020	419	4/19/2021	451	M	33
982000362929580	4/25/2019	340	5/3/2021	453	M	56
982000362691613	4/30/2020	408	4/22/2021	455	M	48
982000363519162	5/3/2018	317	5/3/2021	459	M	47
982000362929586	4/25/2019	380	4/22/2021	465	M	43
982000362929617	4/25/2019	375	4/19/2021	470	M	48
989001026318213	4/20/2020	435	5/3/2021	472	M	36
982000362929434	4/30/2020	425	4/5/2021	474	M	53
989001026318152	4/20/2020	436	5/3/2021	477	M	40
989001026318184	4/13/2020	430	5/3/2021	479	M	46
982000362929584	4/25/2019	378	5/3/2021	480	M	50
982000362929406	4/30/2020	452	4/19/2021	484	M	33
982000363519223	4/22/2019	377	4/14/2021	486	M	55
982000362929579	4/29/2019	385	4/7/2021	489	M	54
982000363519372	4/18/2019	384	5/3/2021	489	M	51
989001026318151	4/20/2020	459	4/14/2021	490	M	32
982000362691445	4/10/2019	388	4/12/2021	492	M	52
982000362929524	5/5/2020	440	5/3/2021	495	M	55
982000362929432	4/28/2020	458	4/19/2021	496	M	39
982000362929377	4/28/2020	457	4/5/2021	501	M	47
982000362929602	4/29/2019	384	4/7/2021	504	M	62
982000362691436	4/11/2019	407	4/22/2021	506	M	49
982000363519199	5/3/2018	337	4/12/2021	510	M	59
982000362929428	4/30/2020	460	4/14/2021	510	M	52
982000362691010	4/19/2018	358	5/3/2021	511	M	50
982000363519286	4/17/2019	380	4/5/2021	512	M	67
989001026318166	4/20/2020	475	4/7/2021	517	F	44
982000362691010	4/19/2018	358	4/14/2021	519	M	54
982000362691466	4/10/2019	407	4/14/2021	523	M	58
982000362929483	5/5/2020	502	4/19/2021	523	F	22
982000362929565	4/23/2019	408	4/14/2021	531	M	62
982000363519262	4/18/2019	416	4/12/2021	535	M	60
982000362929609	4/24/2019	430	4/14/2021	542	M	57
982000362929397	4/30/2020	493	4/12/2021	552	M	62
989001026318145	4/20/2020	545	4/22/2021	593	F	48

Von Bertalanffy growth curves and parameters (Appendix E) were calculated for both sexes from otoliths of 34 males and 27 females. Supporting reported mean length-at-age data, female Walleye growth rate was greater than that of males (TABLE 5; Appendix E).

Bass Tournament Monitoring

Two Bass tournaments, both spanning two days, were monitored to help assess the overall status of the bass fishery in Noxon Reservoir. The first being The Bass Federation (TBF) Buddy Series Qualifier #2 (June 5^{th} and 6^{th}) and the second Tri-State Buddy Tournament (July 24^{th} and 25^{th}). Four other tournaments occurred but were not monitored in 2021. Similar to recent years, mean length and proportion of quality fish were high for both species (TABLE 7, FIGURES 19 and 20). The TBF Buddy Series Qualifier #2 weighed bass consisted of 88% LMB and 12% SMB. Tri-State Buddy Tournament weighed bass consisted of 77% LMB and 23% SMB. A total of 515 Bass were measured during the two tournaments with a mean length of 410 mm for LMB and 395 mm for SMB. Of checked-in bass, 12% of both LMB and SMB were greater than 460 mm (18 inches; TABLE 7).

TABLE 7. Catch statistics for largemouth (LMB) and smallmouth bass (SMB) caught during bass tournaments (listed by dates held) monitored in 2021.

Statistic	Species	6/5–6/6	7/24–7/25	Combined
% of Catch	LMB	88	77	82
	SMB	12	23	18
% ≥ 380 mm	LMB	87	69	77
	SMB	74	53	59
	Both	86	66	74
% ≥ 460 mm	LMB	18	6	12
	SMB	22	8	12
	Both	19	6	12
Total Caught	LMB	195	227	422
	SMB	27	66	93
	Both	222	293	515
Mean Length (mm)	LMB	421	401	410
	SMB	424	384	395

Numbers DO NOT include culled fish.

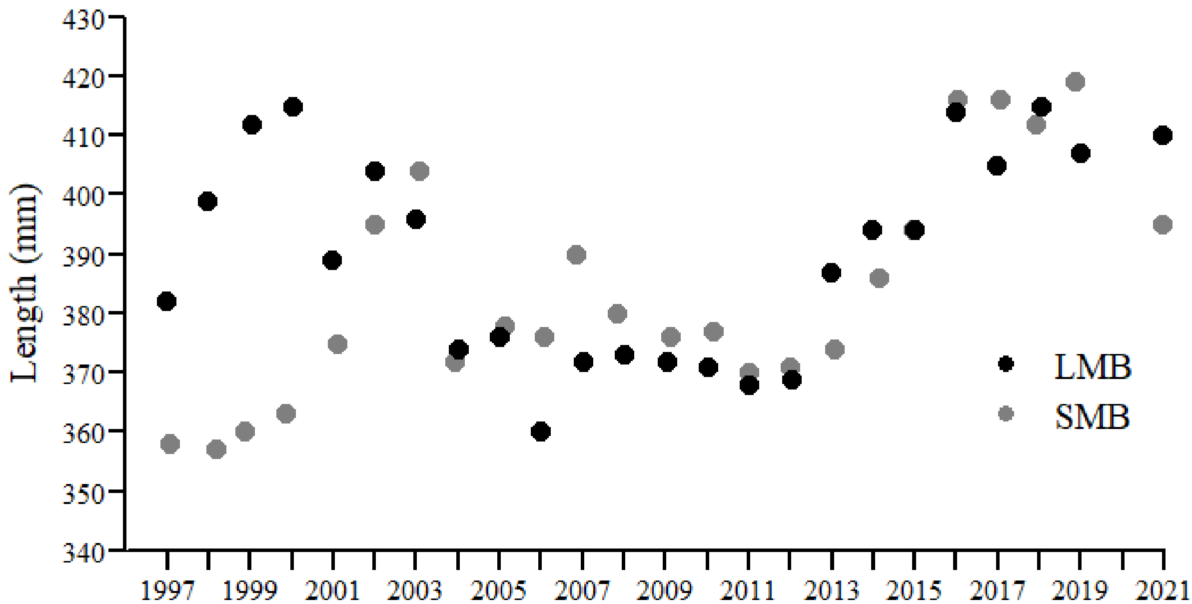

FIGURE 19. Mean length of both bass species checked in at monitored bass tournaments over time.

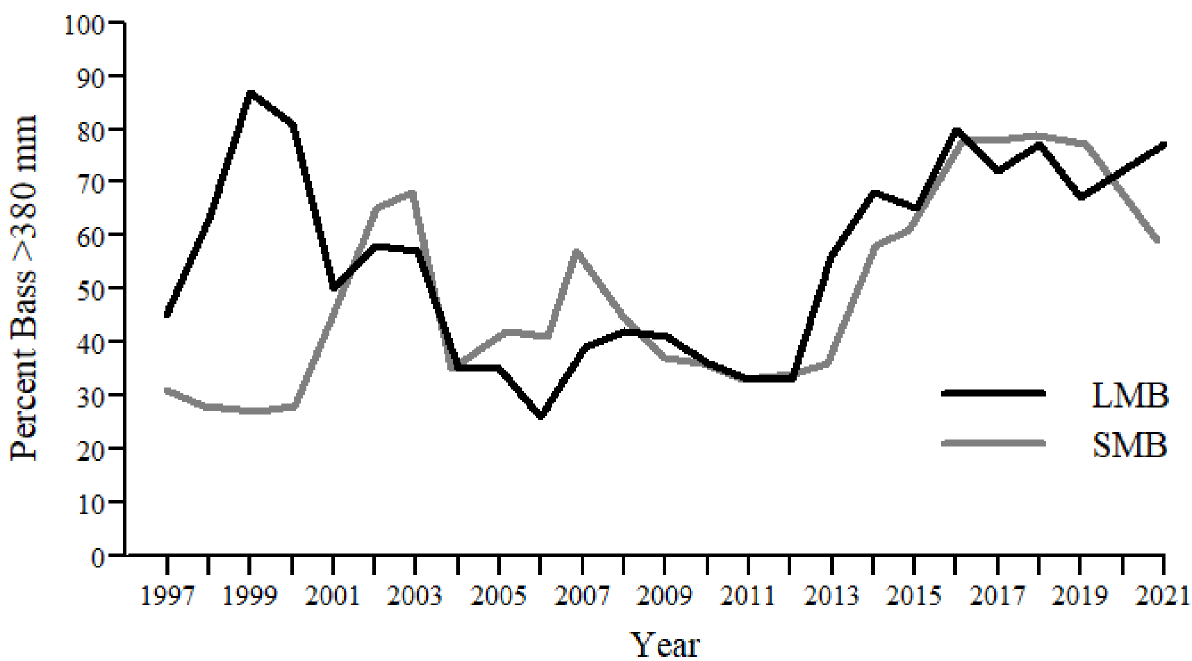

FIGURE 20. Percent ‘quality’ fish (≥380 mm) checked in at bass tournaments over time.

Bass tournament monitoring continues to show a productive bass fishery in Noxon Reservoir. Sizes and proportion of quality fish of both Largemouth and Smallmouth Bass captured during tournaments are at or near record highs. Additionally, anecdotal observations from anglers of

Noxon Reservoir have shown high satisfaction with the current bass fishery. Continued monitoring of bass tournaments will be important moving forward, particularly as abundance of other predators (i.e., Walleye and Northern Pike) within Noxon Reservoir increases.

Acknowledgements

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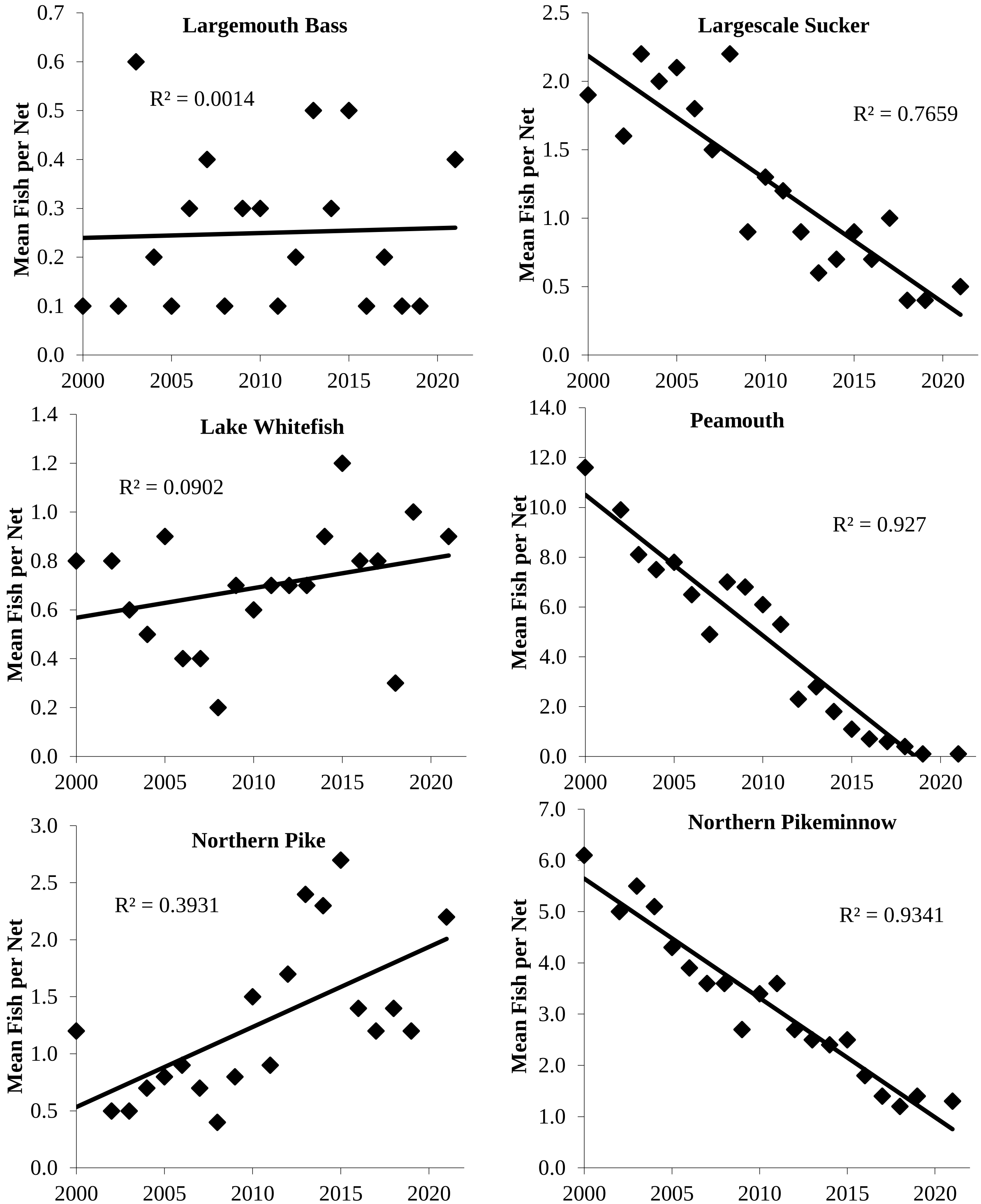
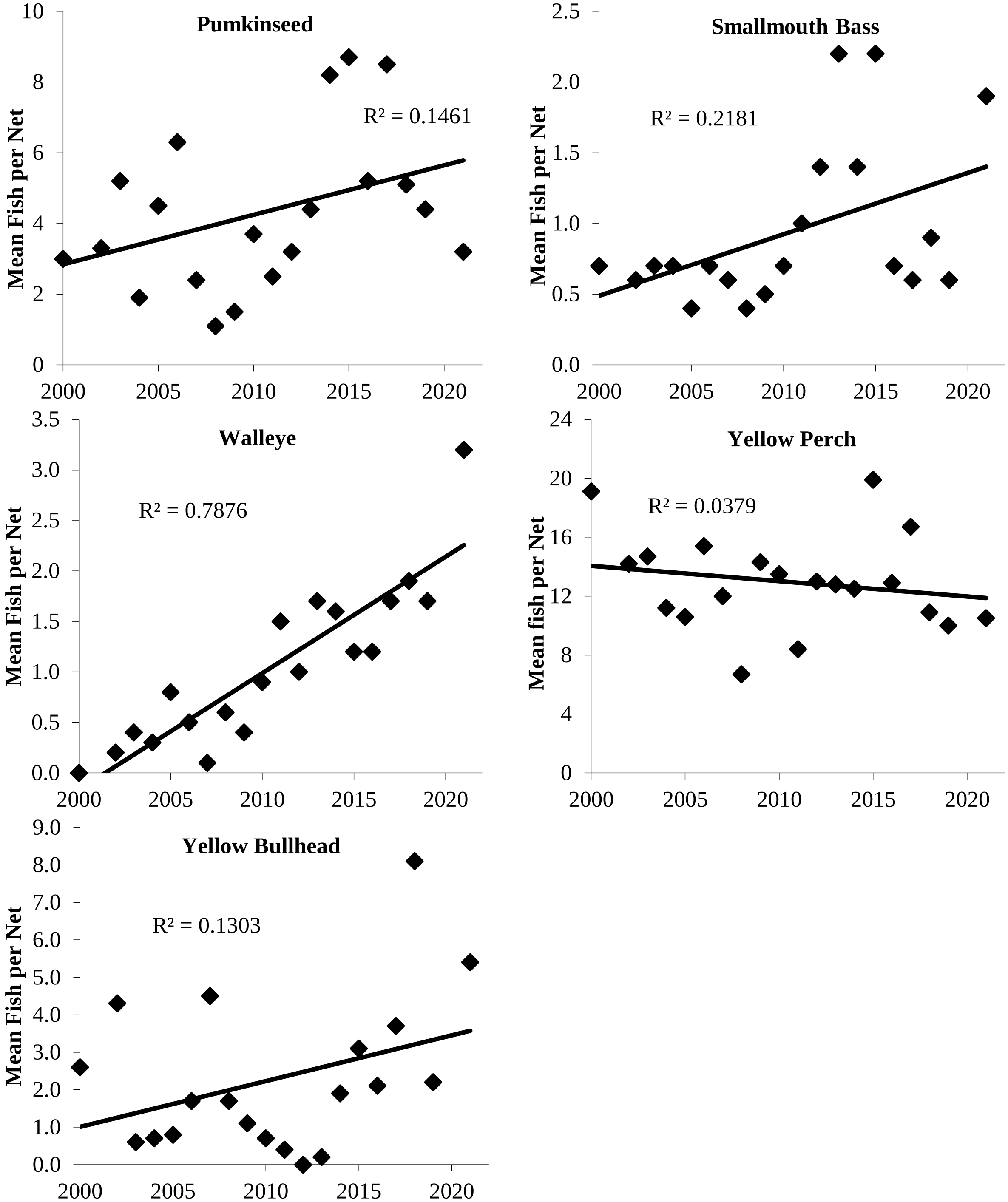
Appendix A. Species abbreviations and scientific names of fish in Noxon and Cabinet Gorge reservoirs

BLBH	Black Bullhead *Ameiurus melas*
EB	Brook Trout *Salvelinus fontinalis*
LL	Brown Trout *Salmo trutta*
LWF	Lake Whitefish *Coregonus clupeaformis*
LMB	Largemouth Bass *Micropterus salmoides*
LSSU	Largescale Sucker *Catostomus macrocheilus*
MWF	Mountain Whitefish *Prosopium williamsoni*
NP	Northern Pike *Esox lucius*
NPMN	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*
YLBH	Yellow Bullhead *Ameiurus natalis*
YP	Yellow Perch *Perca flavescens*

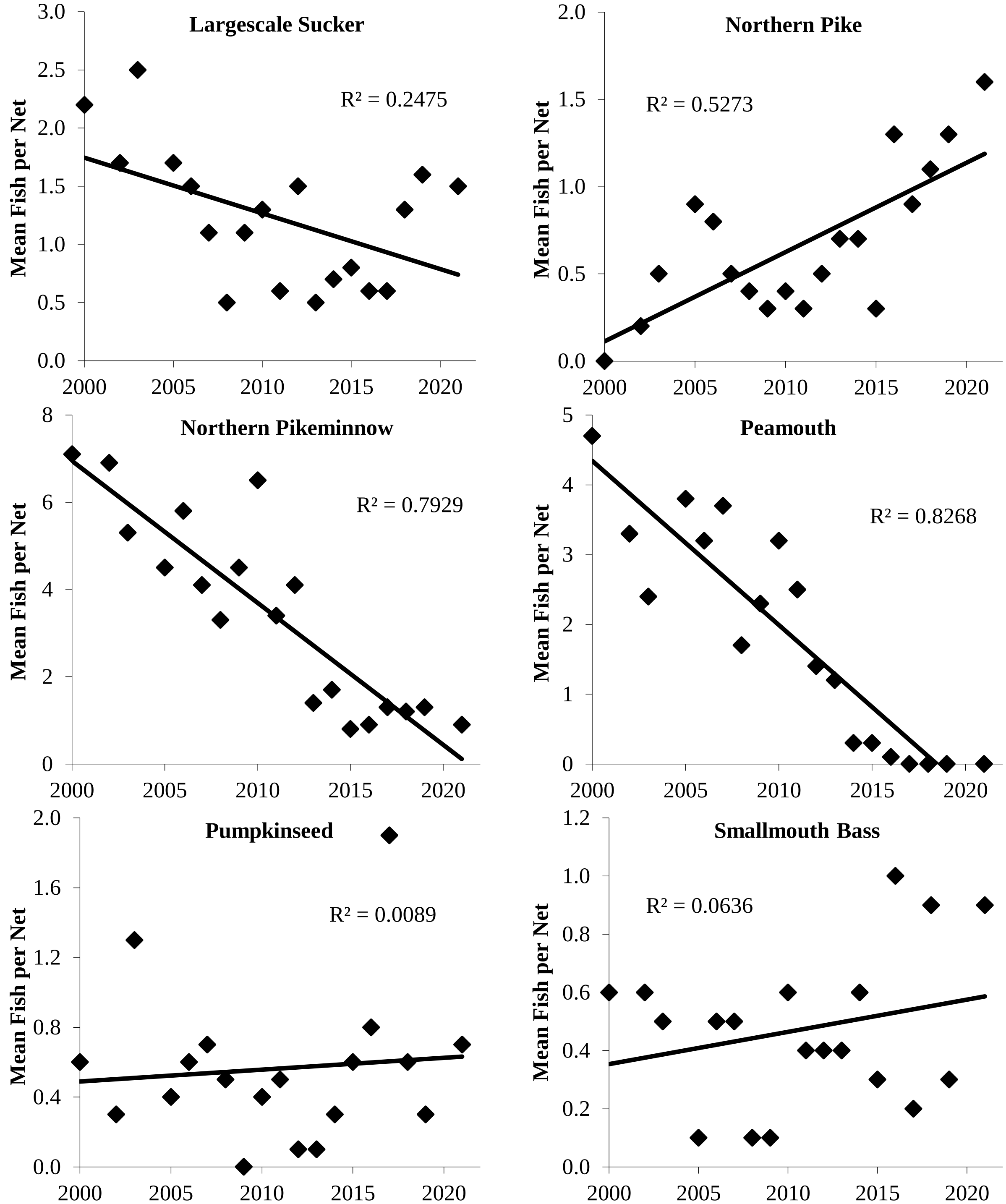
Appendix B. Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Noxon Reservoir, 2000-2021.



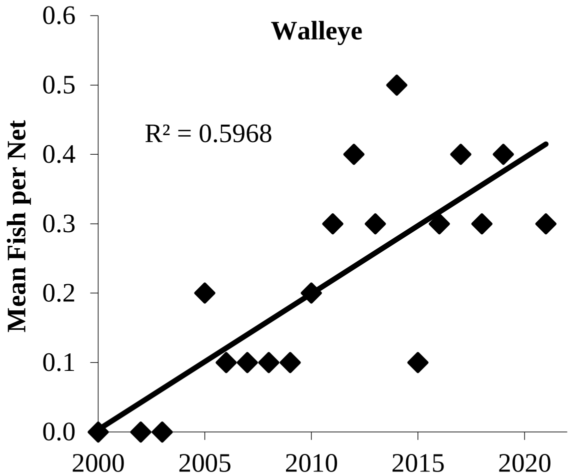
Appendix B (continued). Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Noxon Reservoir, 2000-2021.

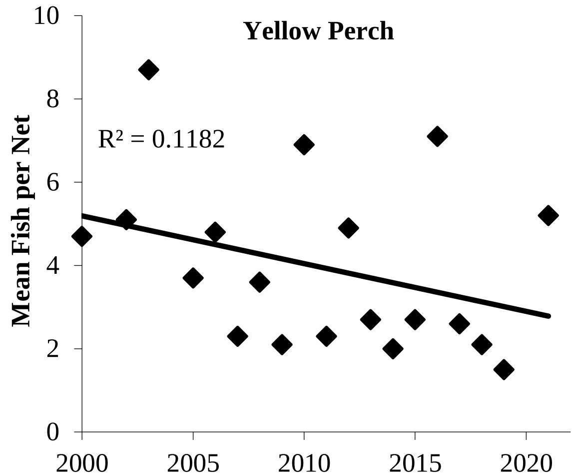


Appendix C. Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Cabinet Gore Reservoir, 2000–2021.



Appendix C (continued). Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Cabinet Gore Reservoir, 2000–2021.

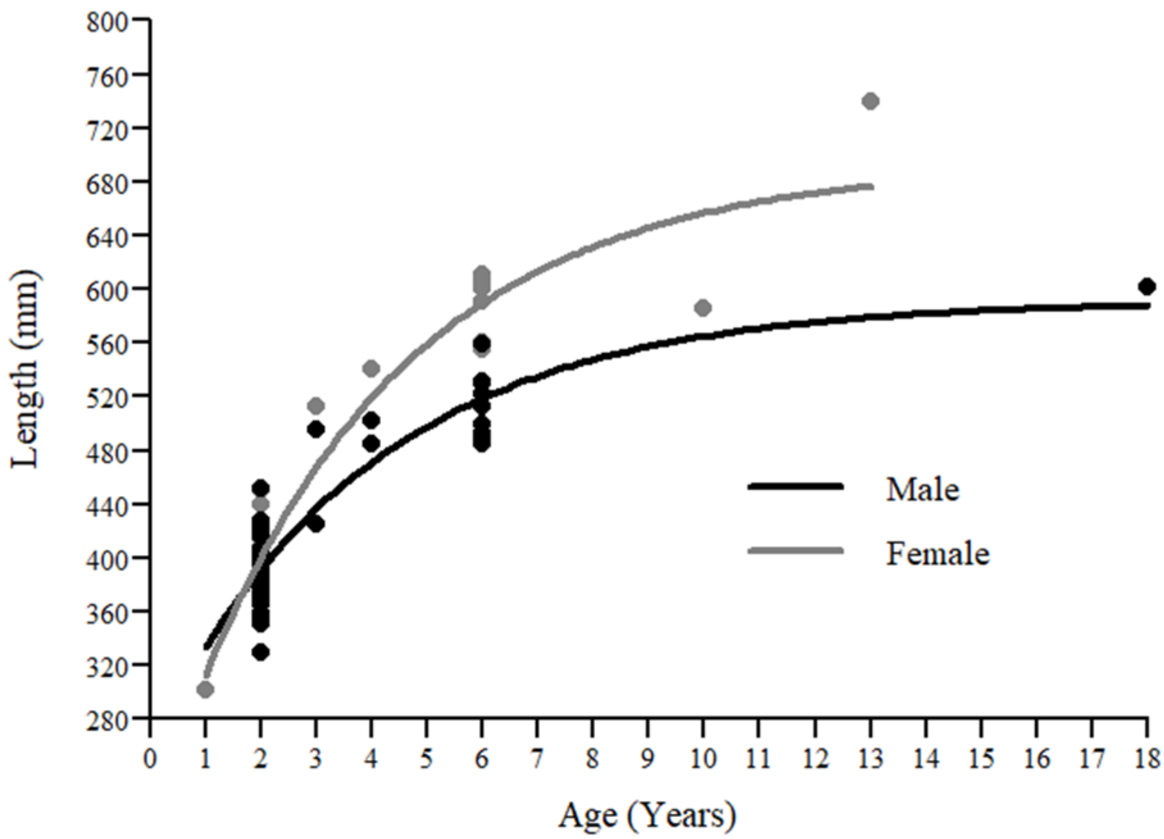




Appendix D. Von Bertalanffy growth curves and parameters for both male and female Walleye using estimates derived from Walleye collected from Noxon Reservoir in Fall 2021.

Von Bertalanffy parameter estimates derived from Walleye collected from Noxon Reservoir in Fall 2021.

von Bertalanffy parameter	Data Source					
	Female		Male		All Walleye	
	Est.	95% CI	Est.	95% CI	Est.	95% CI
L_{inf}	693	628–758	591	538–644	638	591–685
K	0.26	0.15–0.37	0.25	0.13–0.38	0.26	0.17–0.37
T_0	-1.30	-2.27– -0.32	-2.27	-3.76– -0.78	-1.63	-2.52– -0.74

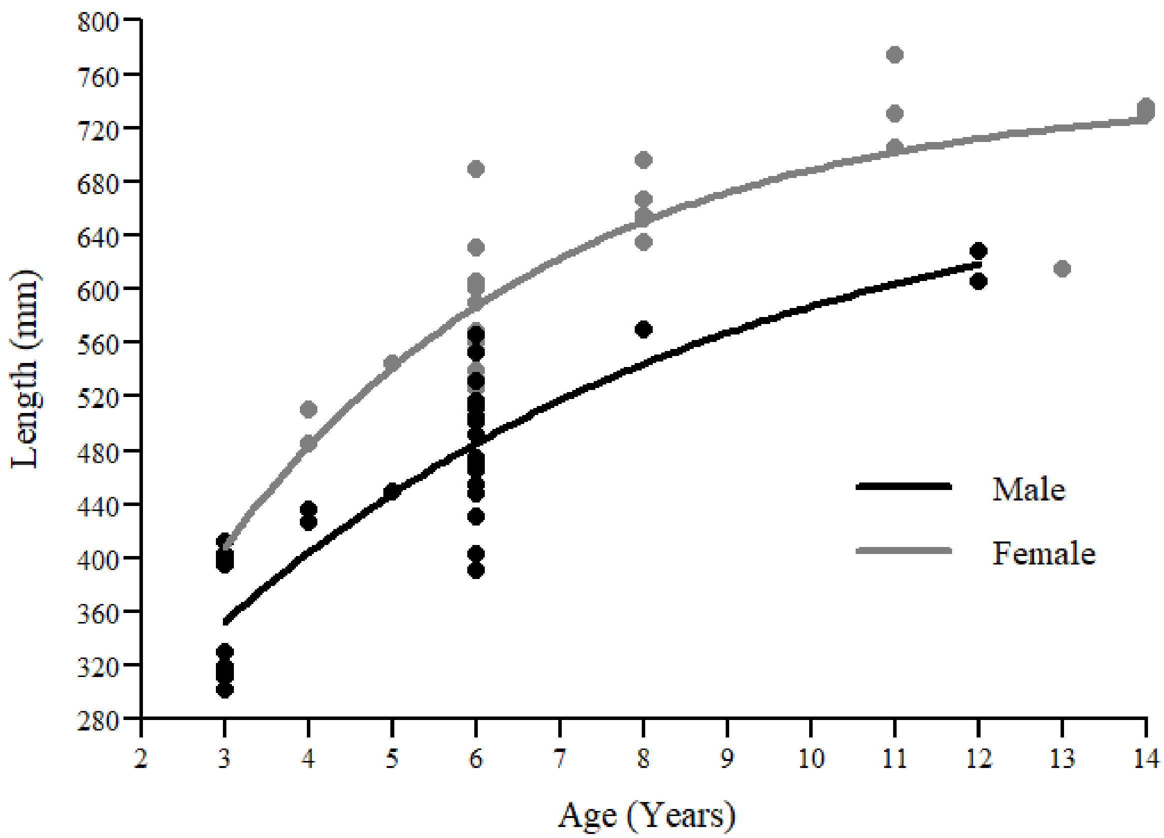


Von Bertalanffy growth curves for both male and female Walleye using estimates derived from Walleye collected from Noxon Reservoir in fall 2021.

Appendix E. Von Bertalanffy growth curves and parameters for both male and female Walleye using estimates derived from Walleye collected from Noxon Reservoir in spring 2021

Von Bertalanffy parameter estimates derived from Walleye collected from Noxon Reservoir in spring 2021.

von Bertalanffy parameter	Data Source					
	Female		Male		All Walleye	
	Est.	95% CI	Est.	95% CI	Est.	95% CI
L_{inf}	748	665–830	699	499–899	764	650–878
K	0.25	0.06–0.45	0.16	-0.02–0.30	0.19	0.09–0.29
T_0	-0.15	-3.37–3.06	-1.34	-3.75– 1.04	-0.23	-1.65– 1.19



Von Bertalanffy growth curves for both male and female Walleye using estimates derived from Walleye collected from Noxon Rapids Reservoir in spring 2021.