Noxon Rapids and Cabinet Gorge Reservoirs Fisheries Monitoring

Comprehensive Report: 2013-2015

Including Data From: 1999-2015

Montana Tributary Habitat Acquisition and Recreational Fishery Enhancement Program
Appendix B

December, 2016

Clark Fork River

Montana Fish, Wildlife & Parks

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SUMMARY

This report presents data collected from all monitoring activities in Noxon Rapids (Noxon) and Cabinet Gorge reservoirs from 2013-2015 and also uses data collected back to 1999. Much of this work was funded by Avista as part of the Recreational Fishery Enhancement Project of the Clark Fork Settlement Agreement (1999).

Annual fall gillnetting in Noxon and Cabinet Gorge reservoirs continues to provide the most comprehensive index of relative abundance of fish species in both reservoirs. Total numbers of fish captured in gillnets in Noxon Reservoir have increased over the past four years. This is in contrast to the trend observed from 2000-2011. Record catches of Yellow Perch *Perca flavescens* and Pumpkinseed *Lepomis gibbosus* in recent years have contributed substantially to the reversal of this trend. Other trends previously observed, such as the increase in certain non-native predators have continued, while declines have continued in many native forage species such as Peamouth *Mylochelius caurinus*, Northern Pikeminnow *Ptychochelius oregonensis*, and Largescale Suckers *Catostomus macrochelius*. Little to no recruitment of Peamouth and Largescale Suckers has occurred recently in Noxon Reservoir based on our analysis of length frequency distributions for these species. In Cabinet Gorge Reservoir, catch rates were three to four times lower than catch rates in Noxon, making trends less obvious. However, catch rates of several native species such as Largescale Suckers and Northern Pikeminnow actually increased in 2015. Additionally, non-native predators in Cabinet Gorge were sampled less frequently than in Noxon.

Between 2013 and 2015, growth of age-0 Largemouth Bass *Micropterus salmoides* was variable. The mean length of fall caught age-0 Largemouth Bass was highest in 2013 which likely translated into a strong cohort from that year. Despite low flows, warmer temperatures, and higher early season growth, mean October length did not approach 70 mm in 2015. It appears that the larger bass sampled early in the year were not present during later sampling events. Objectives and sampling design for bass recruitment monitoring should be re-evaluated for the future and include tabulations of catch per unit effort of all captured species. Additional capture methods should also be investigated in order to effectively sample dense stands of macrophytes.

Noxon Reservoir currently hosts more permitted bass tournaments than any waterbody in the state. The mean length and percent quality fish (>379 mm) checked in for both species of bass increased between 2013 and 2015. In 2015, mean length of a tournament caught bass was the highest for both species since 2003. The proportion of Smallmouth Bass *Micropterus dolomieu* checked in at tournaments has also increased from a low of 17% in 2010 and 2011 to almost 40% in 2015.

Spring sampling of illegally introduced Walleye *Sander vitreus* was conducted in Noxon Reservoir during each year between 2013 and 2015. Catch rates varied greatly between all three years. In 2014, cool water temperatures and a lack of age-3 males kept catch rates low. Total

catch per unit effort and female catch per unit effort was highest in 2013, and peaked in late-April. In 2015, catch per unit effort was highest in early-May.

Finally, results from two of three contracted studies related to Walleye in Noxon Reservoir indicate that by themselves, Walleye may not increase to a level which dominates the fish assemblage of Noxon Reservoir. The current Noxon fishery has a more balanced relationship of prey and predator species than was present in the mid-nineties. However, as a group, non-native predators in Noxon could potentially reach levels which may jeopardize the existing sport fishery and native salmonid restoration efforts. Because specific food-web interactions are not understood, the threshold at which this may occur is unknown. The economic analysis on the potential effect of the illegal introduction of Walleye to Noxon Reservoir is currently being reviewed.

Recommendations for future actions include: 1) Continue additional Walleye sampling in order to collect adequate sample sizes, evaluate year-class strength, and evaluate gear effectiveness. Potentially include different sampling techniques as a comparative for gear efficiency. Additional consideration should be put into sampling design which may provide a more thorough understanding of overall population size; 2) Document numbers of all fish sampled during beach seine events in order to track *C/f* of age-0 Largemouth Bass and prey species fish over time. Additional sampling gears should be considered, especially for sampling in dense stands of macrophytes.

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INTRODUCTION

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 Corporation (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.

Since the construction of Noxon Rapids and Cabinet Gorge Dams in the 1950's, fisheries management on the reservoirs has varied considerably. For a thorough review of historical reservoir management activities, see previous reports (Huston 1985, Horn and Tholl 2010). Current management on the reservoirs consists mainly of monitoring and the use of general regional regulations for all species except bass. In Noxon Rapids Reservoir (hereafter: Noxon), there is a special regulation to protect spawning bass, which differs from the general western district regulation. In order to protect spawning Largemouth Bass *Micropterus salmoides* and Smallmouth Bass *Micropterus dolomieu*, only one fish greater than 533 mm (21 inches) may be kept between June 15 and July 15, whereas five fish of any size may be kept the rest of the year. Prior to 2005, this closure ran from May 15 through June 30, which was more consistent with the current general western district regulation (third Saturday in May through June 30). This regulation change was based on findings by Saffel (2003) that age-0 Largemouth Bass in Noxon Reservoir began to hatch between June 21 and July 3 during low and high water years, respectively. Incubation of Largemouth Bass eggs takes between three to five days (Scott and Crossman 1973), so it was assumed that even on low-water years, spawning began after June 15. Up until 2015, the closure on Cabinet Gorge Reservoir had been managed under general regulations (i.e., third Saturday in May through June 30). However, due to the similar water temperatures between Noxon and Cabinet Gorge reservoirs and the desire to form more consistent regulations on the lower Clark Fork River, Cabinet Gorge Reservoir is now managed with the closure from June 15-July 15 beginning in 2016 (FWP 2016).

Noxon and Cabinet Gorge reservoirs (Figure 1) did not emerge as relevant fisheries until the 1980's. At that time, the establishment of both Largemouth and Smallmouth Bass populations was facilitated by a cooperative agreement between angler groups, Montana Fish Wildlife and Parks (FWP), and Avista that eliminated large water level fluctuations. Since that time, annual fishing pressure has drastically increased from about 800 angler days per year on Noxon in 1982 to almost 33,000 angler days in 2013 (FWP 2014). Based on angler mail-in surveys (FWP 2014) and a recent creel survey (Blakney *In Preparation*), bass species remain a popular target, as well as Northern Pike *Esox lucius* and Yellow Perch *Perca flavescens*. For 2016, there are bass tournaments scheduled on seven separate weekends for the open water season in Noxon Reservoir.

Walleye *Sander vitreus* were illegally introduced into Noxon 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 relative abundance. Stemming from the illegal introduction in Noxon Reservoir, Walleye have since become established in the downstream waterbodies of Cabinet Gorge Reservoir, Lake Pend Oreille, ID, and the Pend Oreille River, ID and WA. Based on information obtained during a previous telemetry study (Horn et. al 2009), Montana Fish, Wildlife and Parks (FWP) began spring surveys for Walleye on suspected spawning grounds in 2012. This work has continued through 2015, primarily using nighttime jet-boat electrofishing.

In February, 2013, FWP released an Environmental Assessment (EA) which proposed an Investigation of Walleye Suppression in Noxon Rapids Reservoir (FWP 2013a). The need for such an action was cited as: 1) The illegal nature of the introduction and the existing state laws to act upon such an introduction, 2) Perceived decreases in reservoir prey populations, and 3) Perceived threats to existing native and sport fisheries in Noxon. Primary objectives for this project were: 1) Suppress Walleye in Noxon Reservoir to minimize future impacts to the sport and native fisheries and conform with Montana's Illegal and Unauthorized Introductions of Aquatic Species policy, 2) Evaluate the effectiveness of individual suppression techniques, location, and timing, and 3) Evaluate the effectiveness of suppression efforts. However, this proposal was met with significant opposition and in June, 2013, FWP issued a decision notice stating that further research was needed before any management action could be considered (FWP 2013b). Since that time, FWP has begun to address some of the significant issues raised during the EA process, as well as beginning to answer some of the EA's original questions.

Specifically, in 2014 and 2015 three studies were contracted with outside researchers in order to update existing literature and potentially predict the future of the reservoir fisheries. Dr. Bob Bramblett and Dr. Alexander Zale from Montana State University were contracted to update the four case histories used in the original Environmental Assessment of the introduction of Walleye beyond their current range in Montana (Colby and Hunter 1989). During the Noxon Reservoir Walleye EA process, FWP received many comments claiming that this report was outdated. Bramblett and Zale (2016) provided current information on the original case histories with the addition of the recently changed Canyon Ferry Reservoir fishery. They also provided current biological data and the status of nine Walleye populations throughout Montana.

A second contract was awarded to Dr. Dennis Scarnecchia and Dr. Youngtaik Lim of the University of Idaho in order to create a predictive model which examines the potential future effects of a Walleye population left unchecked in Noxon. This project was similar to McMahon (1992) which applied the biological requirements and characteristics of Walleye to the existing physical conditions of Canyon Ferry Reservoir in order to predict the future should Walleye be introduced. Finally and partially based on the findings of Scarnecchia and Lim (2016), an economic study was contracted with Dr. John Duffield and Dr. Chris Neher from the University of Montana. The objective of this study was to quantify the value of the current fishery in Noxon Reservoir and contrast with predicted future fisheries for an estimate of potential economic gain or loss.

In addition to these outside work products, FWP has continued to answer questions with its own research. In 2014 and 2015, a Walleye study plan was created and distributed which outlined FWPs specific Walleye sampling goals and objectives for the current year. These study plans aimed to help FWP answer questions related to capture efficiency using different techniques, relative year-class strength, female fecundity, angler exploitation, and an estimate of effective population size of breeding Walleye in Noxon Reservoir. As previously mentioned, nighttime boat-mounted electrofishing in the spring continues to be our most effective capture technique for Walleye in Noxon Reservoir. Additionally, a quantitative creel survey was conducted during the open water fishing season on Noxon and Cabinet Gorge reservoirs in 2015 (Blakney *In Preparation*). One of the objectives of this creel survey was to look at angler exploitation of game fish, including Walleye. A previous ice fishing creel survey in 2011 and 2012 indicated that Walleye are not a significant component of the winter fishery (Kreiner 2013). Finally, in order to estimate effective number of breeders (N_b) of Walleye in Noxon, genetic samples from approximately fifty fish from the 2010 and 2012 cohorts were collected in 2014 and 2015 (Ruzzante et al. 2016).

Another change in reservoir management since the last comprehensive report was an update of consumption guidelines based on recent sampling efforts for PCBs, dioxins/furans, and mercury. In 2013, elevated levels of dioxins, furans, and PCBs were found in Northern Pike in the middle Clark Fork River downstream of Missoula (Schmetterling and Selch 2013). This finding resulted in a “Do Not Eat” advisory on all Northern Pike and Rainbow Trout *Oncorhynchus mykiss* in that section of the Clark Fork River. This prompted a survey of common game fish in Noxon Reservoir in 2014 (Selch 2015). Although levels of dioxins, furans, and/or co-planar PCBs were found in certain size groups of Smallmouth Bass, Walleye, and Northern Pike, only the levels found in large Northern Pike (>30 inches) warranted more restrictive guidelines over pre-existing mercury consumption guidelines. However, no large Walleye were collected (>26 inches) during this survey. In 2015, based on a five-year sampling rotation, Noxon and Cabinet Gorge reservoirs were again sampled in order to update mercury consumption guidelines. In an attempt to boost sample size over past events and establish consistent consumption guidelines between lower Clark Fork Reservoirs, over 360 samples were collected from both reservoirs in the spring and fall. These results will be added to existing consumption guidelines and will be available on FWPs web-site at some point in the future.

Based on current reservoir sampling methods, salmonids do not account for a significant portion of the Noxon and Cabinet Gorge reservoir fish community. However, past sampling targeted cold water bays and other thermal refuges which produced higher catches of salmonids (Huston

1985, Horn and Tholl 2010). Additionally, between 2011 and 2015, a fish ladder at Thompson Falls dam has passed over 2,000 salmonids from Noxon Reservoir into Thompson Falls Reservoir (>400 per year). Therefore, one must consider the current abundance of all salmonids in the reservoirs, including native Bull Trout *Salvelinus confluentus* and Westslope Cutthroat Trout *Oncorhynchus clarki lewisi*, to be unknown but higher than detected during reservoir sampling activities.

Current reservoir monitoring is conducted in both Noxon and Cabinet Gorge reservoirs to assess trends in fish abundance and species composition. Additional effort is expended to monitor populations of important recreational value (e.g., Largemouth and Smallmouth Bass). Specific objectives of the current reservoir monitoring plan were:

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 recruitment and the overall status of the bass fishery in Noxon Reservoir.
3) Monitor the population and assess capture methods of the illegally introduced Walleye population in Noxon Reservoir.

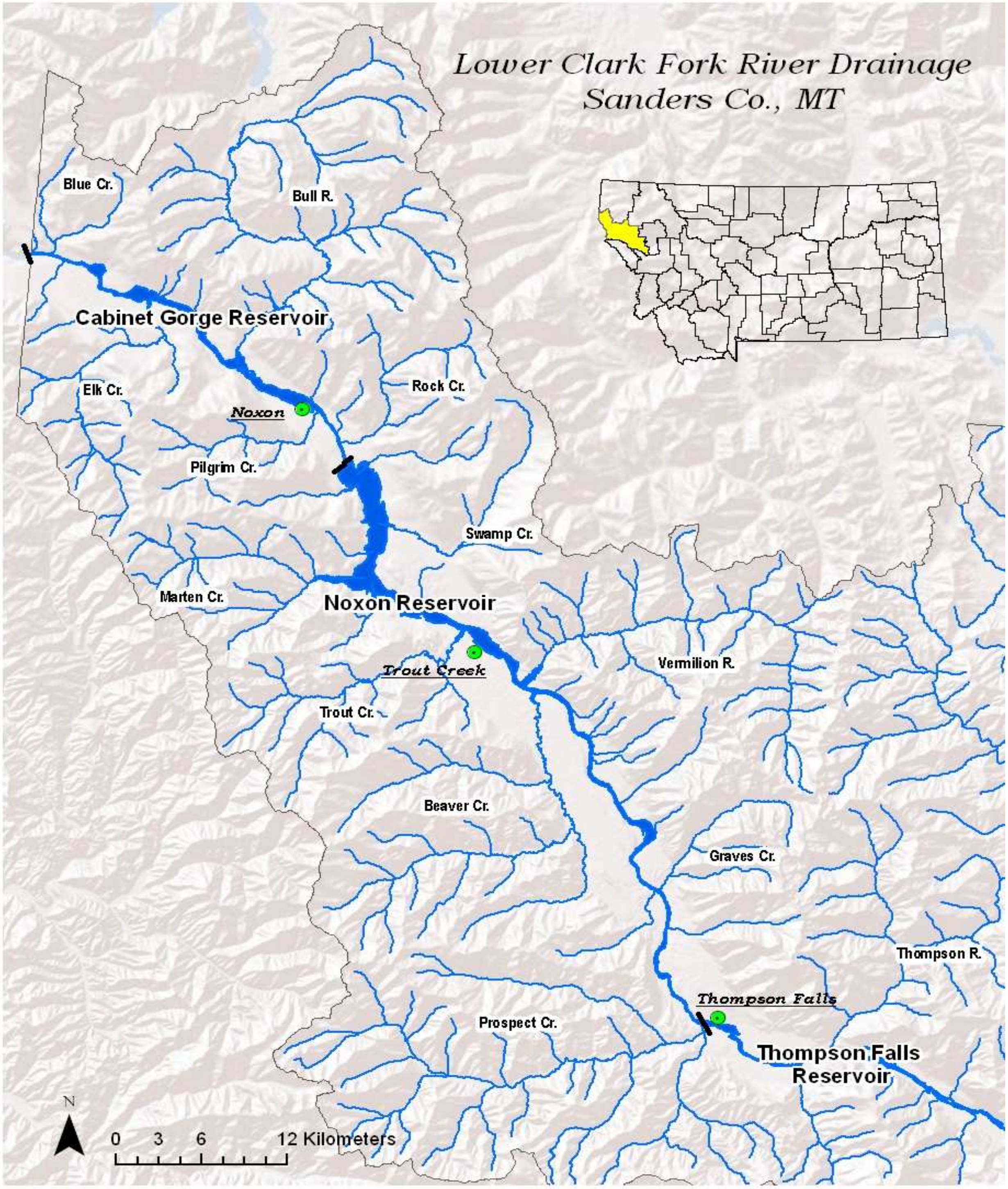

Figure 1. Lower Clark Fork River Drainage, Sanders County, MT: including Noxon and Cabinet Gorge reservoirs and their major tributaries.

METHODS AND STUDY AREA

FALL GILLNETTING

Gillnet surveys took place annually in Noxon and Cabinet Gorge reservoirs in early October. The surveys consisted of 45 overnight gillnets set throughout both reservoirs. Thirty of these nets were set in Noxon Reservoir, which was separated into two strata. Stratum 1 (NS1) consisted of 19 gillnet sites in the lower reservoir, below Beaver Creek Bay (Figure 2). The lower portion of the reservoir was approximately 6,200 surface hectares (78% of total) and defined by slow moving waters, the presence of shallow littoral zones and relatively diverse aquatic habitats. It represented more of a lacustrine environment than the upper reservoir. Stratum 2 (NS2) was within the upper portion of Noxon Reservoir, where eleven gillnets were set overnight (Figure 3). This portion included the area from Thompson Falls Dam to Beaver Creek Bay, and represented a more riverine environment. Characteristics within this reach were variable. In general, water velocity decreased and mean depth increased further downstream of Thompson Falls Dam. The riverine portion of Noxon Reservoir was roughly 1,700 hectares (22% of the total). Fifteen nets were also set in Cabinet Gorge Reservoir (Figure 4), a much narrower reservoir with a surface area of approximately 1,300 hectares. All net sites in Cabinet Gorge were summarized and analyzed as one stratum.

Gillnet locations were selected from a larger set sampled by WWP (1995) (Figures 2-5). WWP (1995) distinguished habitat types based on slope, percent vegetation, average substrate size, and water velocity and recognized four specific habitat types: silt, gravel, cobble/boulder, and riverine. An additional habitat type entitled “open water” was included to represent reservoir habitat located outside of littoral areas. Annual replication of WWP’s effort was not possible due to the large number of sampling locations, so a random subset of these sampling locations was selected for monitoring (N=45). The same sites have been sampled annually since 2000, except for 2001. At that time, annual sampling was deemed necessary because of the recently expanding population of illegal Walleye. Sites previously sampled by Montana Fish, Wildlife and Parks (FWP) were given preference during selection; however, a majority of the sites previously monitored by FWP were located in coldwater sites to monitor trout abundance. Coldwater sites, such as the mouth of tributaries, were intentionally avoided in these sampling efforts to reduce Bull Trout by-catch and mortality.

Nylon multifilament experimental sinking gillnets were used during all gillnetting efforts. These 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 were identical to those used by FWP to monitor Noxon and Cabinet Gorge reservoirs in the past and also maintain the same specifications of standard experimental gillnets used throughout Montana. These mesh sizes are slightly different than those used by WWP (1995).

Gillnets were set in the afternoon, fished overnight (approximately 19.5 hours) and retrieved the following morning. Near-shore nets (all nets except for open water sets) were set perpendicular to the shoreline with the shoreline end of the net pulled out just far enough to achieve full vertical extension (1.8 m/6 ft). The small mesh (1.9 cm) end of each gillnet was set closest to shore for all near shore net sets for consistency. Data recorded included: set and retrieval times, water temperature, water depth at each end of net, and latitude / longitude from GPS. Retrieved gillnets were shuttled to a convenient shoreline location where fish were removed from the nets and the appropriate data recorded. Processing of fish and nets was conducted by FWP and Avista personnel with assistance from University of Idaho Fish and Wildlife students and Dr. Dennis Scarnecchia. Specific data collected from each fish included species, total length, and weight. Data was recorded from each individual net. Walleye otoliths are currently collected from all captured Walleye to obtain ages.

Although some variation between net-set durations does exist, nets are set and pulled in an identical order each year, and therefore very little annual variation exists amongst specific net soak times. Additionally, no meaningful relationship between total soak time and increased catch rates exists over the fifteen year study period. Therefore, all gillnet data was summarized as total and species-specific catch-per-unit-effort (*C/f*- i.e., number of fish per gill net night). Species composition was calculated based on total number of each species captured and also as percent of total weight sampled. Historically, Walleye ages were determined by counting annuli on cross sections of dorsal spines, and examining broken and burnt otoliths. Spines were sectioned using an Isomet low speed saw, and cross sections were read by three individuals under 40x magnification. Length at age was estimated from this data, but no back-calculation of length at age was undertaken. In 2012, otoliths were also removed from all Walleye mortalities in order to obtain age estimates and were compared with dorsal spines. Based on discrepancies between the two techniques, beginning in 2015, only otoliths were used for the aging of Walleye because of the greater confidence associated with that method. Total length (mm) and weight (g) were taken off all fish species captured. Walleye were also identified to sex. Mean relative weights ($W_{r)}$ were calculated for all Smallmouth Bass (Kolander et al. 1993), Northern Pike (Anderson and Neuman 1996), and Walleye (Murphy et. al 1990) captured in fall gill nets.

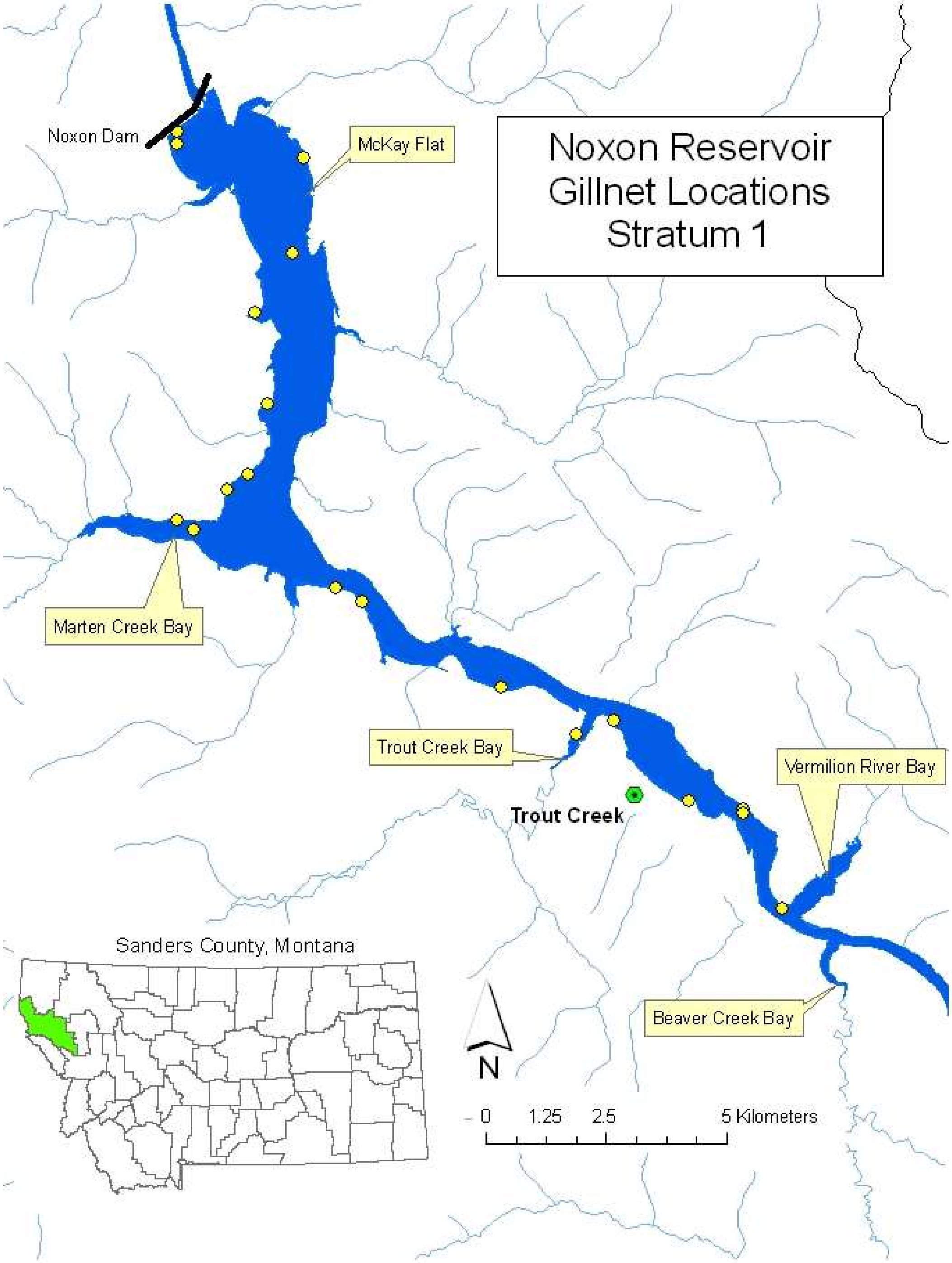

Figure 2. Annual fall gillnet locations in Noxon Stratum 1.

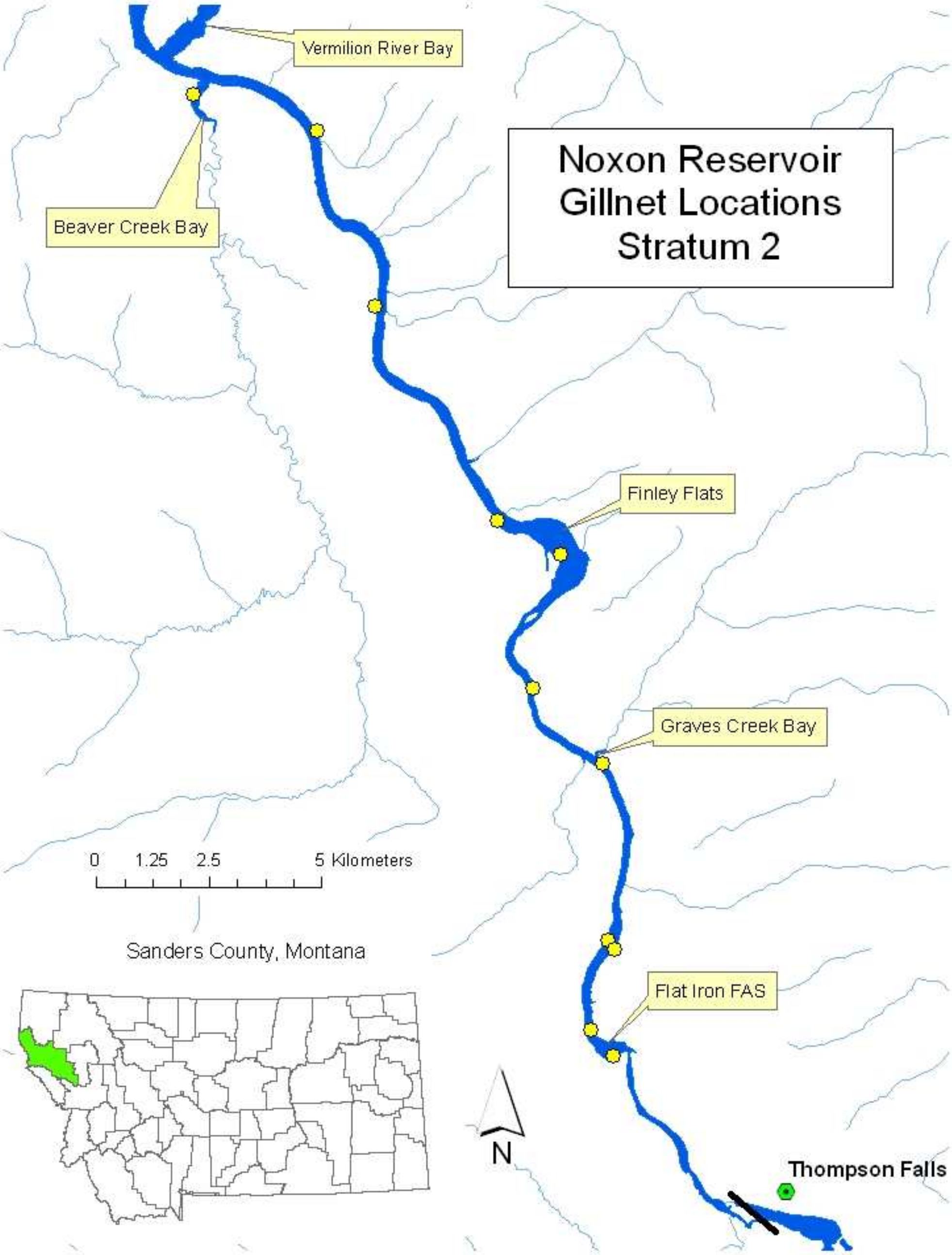

Figure 3. Annual fall gillnet locations in Noxon Stratum 2.

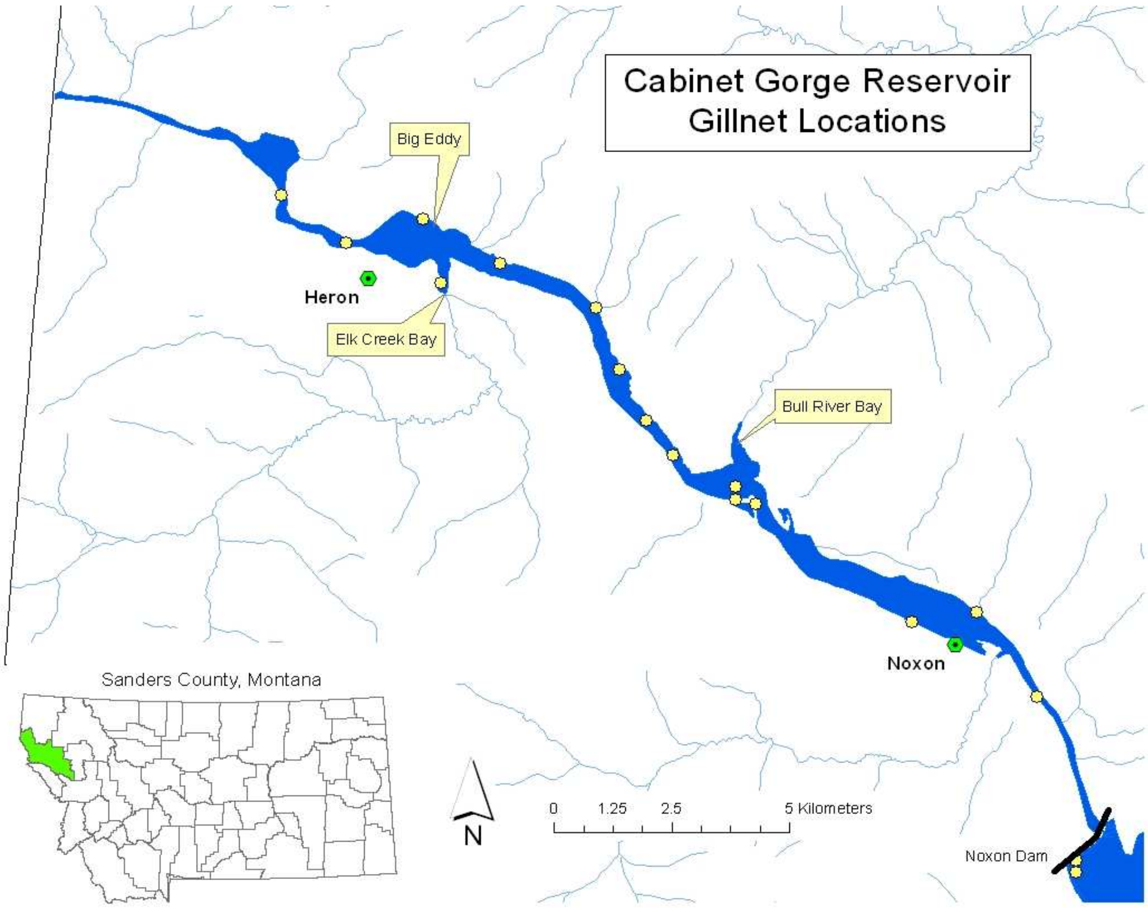

Figure 4. Annual fall gillnet locations in Cabinet Gorge Reservoirs.

BASS SEINING

Bass recruitment monitoring was conducted annually in lower Noxon Reservoir using beach seines to collect fish. Such sampling has not been conducted on Cabinet Gorge Reservoir. Sampling was conducted using a 15 m (50 ft) long by 3 m (10 ft) deep beach seine 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. The following sites were sampled on each occasion: North Shore boat launch, northeast of railroad trestle downstream of North Shore, southwest of railroad trestle downstream of North Shore, Tuscor Bay, Marten Creek Bay, Doty Flat, Stevens Creek Bay, and McKay Flats (Figure 5). At a minimum, two seine hauls were made at each site. If a particular haul event was deemed ineffective due to snagging or overly dense vegetation, that haul would be discarded and a third attempt made. After each seine haul, all captured bass were identified to species, measured (total length, mm), and weighed (g).

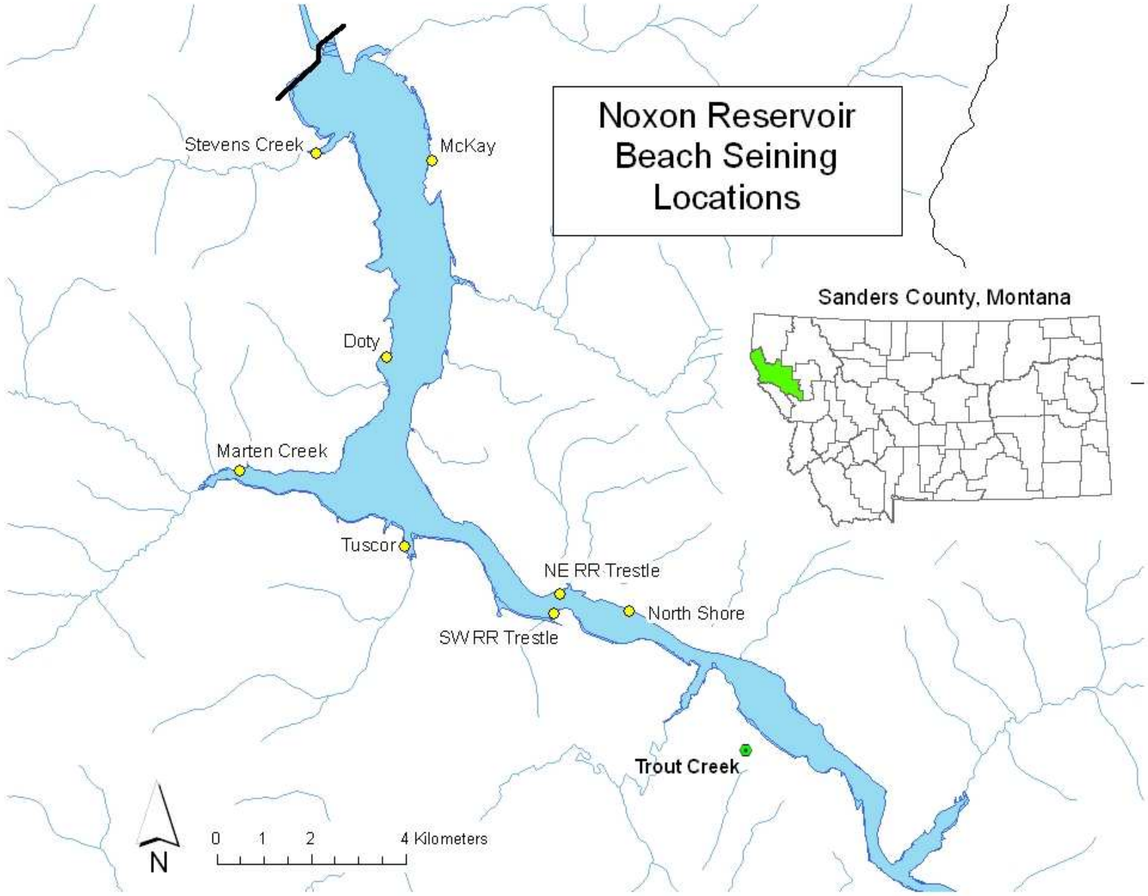

Figure 5. Beach seining locations for age 0 largemouth bass in lower Noxon Reservoir.

Size of age-0 Largemouth Bass is considered a predictor of potential over-winter survival (Saffel 2003). Saffel (2000) monitored six year-classes of age-0 Largemouth Bass in Noxon Reservoir. Of these, only the two which had attained a mean length of 76 mm and 80 mm by October were successful. The other four had reached mean lengths of 62 mm or less by October. These year classes were not documented in substantial numbers in the following years and were considered unsuccessful. Between 2000 and 2003, counts of all species captured during beach seine hauls were tabulated and lengths and weights of Largemouth Bass and Smallmouth Bass were collected. Beginning in 2004, no data on species other than Largemouth and Smallmouth Bass were collected.

BASS TOURNAMENT MONITORING

The status of adult Largemouth and Smallmouth Bass populations was assessed annually through the monitoring of bass tournaments on Noxon Reservoir. In most years, between five and seven weekend-long bass tournaments occur on Noxon Reservoir. In 2014, one permitted bass tournament also occurred on Cabinet Gorge Reservoir. It was not monitored.

Noxon Reservoir bass tournaments required a minimum length of 305 mm (12 in) on all fish brought to weigh in. Therefore, only bass this size or larger were monitored at tournaments. Indices which have been collected at Noxon tournaments since the 1990s include the percentage of quality fish (fish greater than 380 mm or 15 inches) weighed in (Gabelhouse 1995), mean length of fish weighed in (>305 mm), and proportion of species brought to weigh in (Smallmouth vs. Largemouth Bass). All tournaments held on Noxon Reservoir allowed culling or the replacement of smaller fish captured with larger fish after a limit (usually 5 fish) was attained, hence a catch rate could not be obtained.

WALLEYE MONITORING

Although Walleye relative abundance and year class strength is tracked through annual fall gillnetting, additional sampling was initiated in 2012. With varying degrees of effort, Walleye have been monitored using nighttime boat-mounted electrofishing during April and May from 2012-2015. The objectives of this sampling were: 1) Evaluate capture techniques for this species; 2) Additional monitoring of year-class strength; 3) Collection of fish for contaminant studies; and 4) Relative fecundity measurements. Sampling location was chosen based on information obtained from a previous telemetry study (Horn et al. 2009) (Figure 6). In some cases, relative fecundity of female Walleye was estimated by enumerating total egg numbers in a 1-2 g sample and extrapolating over the total weight of the gonads. Weights were taken in tenths of a gram.

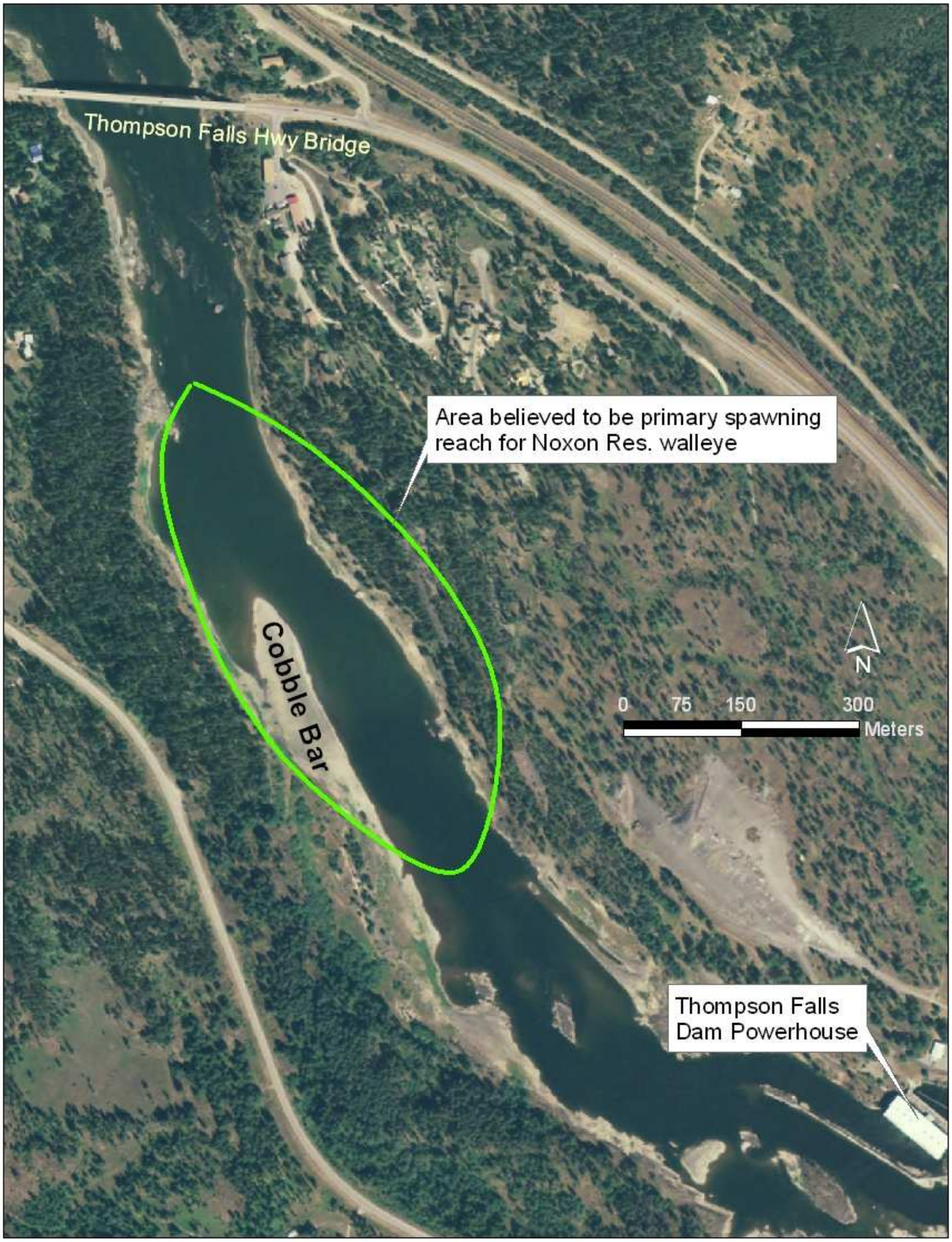

Figure 6. Aerial photo of concentrated spring Walleye sampling location.

ANNUAL RESULTS: 2013-2015

FALL GILLNETTING – Noxon Stratum 1

The total number of fish captured in gillnets in NS1 increased steadily from 721 fish in 2013, to 811 fish in 2014, and 928 fish in 2015 (Tables 1-3). Yellow Perch accounted for most of this change as their numbers increased by more than 50% over that time period. In 2015, Yellow Perch comprised almost 50% of the total NS1 catch. Other notable increases were Pumpkinseed *Lepomis gibbosus* (+80%) and the Bullhead group (either yellow or black- +423%). Two native fish continued a discouraging trend with Peamouth *Mylochelius caurinus* declining considerably (65%) and Northern Pikeminnow *Ptychochelius oregonensis* remaining steady. Lower numbers of Northern Pike, Smallmouth Bass, and Walleye were captured in NS1 in 2015 than in 2013.

Table 1. Catch rates, associated statistics, and length data for species captured in Noxon Stratum 1 during gill netting surveys conducted in 2013. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
BLBH	0.4 (0.8)	8	1.1%	0.8%	278	142-355	262	220-287
LMB	0.7 (0.9)	13	1.8%	1.0%	219	86-647	231	182-343
LS SU	0.3 (0.7)	6	0.8%	2.3%	1122	211-1496	450	271-522
LWF	0.5 (1.0)	10	1.4%	2.0%	564	293-1043	384	315-466
NP	2.5 (2.0)	48	6.7%	28.1%	1685	504-3736	601	418-775
NPMN	3.3 (2.4)	62	8.6%	17.1%	794	62-1842	420	195-566
PEA	3.7 (3.4)	70	9.7%	8.6%	353	145-509	330	262-382
PUMP	5.6 (6.3)	107	14.8%	2.6%	69	15-160	145	93-190
SMB	3.2 (3.7)	61	8.5%	11.7%	551	47-1187	318	159-419
WCT	0.1 (0.2)	1	0.1%	0.1%	353	353-353	320	320-320
WE	1.7 (2.4)	33	4.6%	15.0%	1307	198-3381	466	288-655
YLBH	0.3 (0.9)	5	0.7%	0.5%	312	190-430	272	236-300
YP	15.6 (12.9)	297	41.2%	10.1%	98	29-310	198	136-282

Table 2. Catch rates, associated statistics, and length data for species captured in Noxon Stratum 1 during gill netting surveys conducted in 2014. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
BL BH	0.1 (0.2)	1	0.1%	0.2%	437	437-437	294	294-294
BULL	0.1 (0.2)	1	0.1%	0.6%	1580	1580-1580	580	580-580
LMB	0.4 (0.8)	7	0.9%	0.4%	131	70-220	205	162-236
LS SU	0.4 (0.6)	7	0.9%	3.8%	1344	980-1855	498	423-570
LWF	0.6 (1.6)	12	1.5%	3.7%	758	270-1025	408	297-478
NP	1.9 (2.3)	36	4.4%	29.6%	2016	405-5028	630	410-832
NP MN	3.1 (3.4)	58	7.2%	14.8%	624	47-1647	380	180-542
PEA	2.5 (3.5)	47	5.8%	7.4%	387	81-595	336	211-400
PUMP	11.1 (10.9)	211	26.0%	4.0%	47	15-151	124	87-184
SMB	1.9 (2.8)	37	4.6%	8.1%	538	95-1421	317	204-433
WE	1.5 (2.1)	28	3.5%	12.9%	1130	111-2664	465	250-696
YL BH	2.3 (2.9)	43	5.3%	4.2%	241	43-525	244	155-320
YP	17.0 (17.8)	323	39.8%	10.3%	78	24-260	182	120-262

Table 3. Catch rates, associated statistics, and length data for species captured in Noxon Stratum 1 during gill netting surveys conducted in 2015. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
BLBH	1.6 (3.9)	31	3.3%	2.7%	225	80-452	245	181-316
LMB	0.6 (1.2)	11	1.2%	0.9%	224	90-726	238	185-361
LSSU	0.5 (0.8)	9	1.0%	5.4%	1568	1000-2550	509	449-602
LWF	0.7 (2.3)	14	1.5%	4.1%	770	290-1600	406	293-540
NP	1.6 (1.8)	31	3.3%	23.0%	1947	770-4635	638	501-848
NPMN	3.2 (3.3)	60	6.5%	16.8%	732	60-2050	401	189-591
PEA	1.3 (2.0)	24	2.6%	3.7%	401	156-518	341	255-392
PUMP	9.8 (11.4)	186	20.0%	4.1%	58	16-166	136	92-197
SMB	2.7 (3.6)	52	5.6%	11.9%	600	84-2105	324	172-494
WE	1.2 (2.1)	23	2.5%	11.3%	1283	260-3225	487	314-652
YLBH	1.9 (2.7)	37	4.0%	2.7%	190	49-423	232	149-305
YP	23.7 (22.2)	450	48.5%	13.4%	78	16-258	185	109-276

FALL GILLNETTING – Noxon Stratum 2

Gillnetting in NS2 (Beaver Creek Bay to Birdland Bay Bridge) consisted of 11 overnight gill net sets throughout the sample area in each year between 2013 and 2015. The total number of fish captured in those nets nearly quadrupled between 2013 and 2015, from 184 in 2013, to 207 in 2014, and finally 427 in 2015 (Figures 4-6). Similar to NS1, much of this change could be accounted for by substantial increases in species such as Yellow Perch (100%), Pumpkinseed (275%), and the Bullhead group (1,967%). However, in contrast to trends in NS1, Northern Pike and Smallmouth Bass increased dramatically as well (132% and 400%, respectively). Walleye in NS2 increased slightly from 2013 to 2014, but declined in 2015. Peamouth and Northern Pikeminnow remained at a consistently low abundance.

Table 4. Catch rates, associated statistics, and length data for species captured in Noxon Stratum 2 during gill netting surveys conducted in 2013. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
BL BH	0.3 (0.5)	3	1.6%	0.8%	256	110-332	286	199-384
LL	0.2 (0.4)	2	1.1%	1.2%	553	498-608	394	385-402
LMB	0.1 (0.3)	1	0.5%	0.2%	180	180-180	235	235-235
LS SU	1.2 (1.4)	12	6.5%	13.0%	1028	810-1288	458	430-500
LWF	0.9 (1.9)	9	4.9%	7.5%	788	587-1037	441	390-484
NP	2.2 (3.0)	22	12.0%	28.5%	1223	275-4767	516	345-762
NP MN	1.1 (1.2)	11	6.0%	9.3%	796	306-1267	423	324-505
PEA	1.0 (1.6)	10	5.4%	4.2%	394	271-477	342	326-356
PUMP	2.0 (4.1)	20	10.9%	1.5%	70	15-144	142	92-183
RB	0.1 (0.3)	1	0.5%	0.4%	363	363-363	332	332-332
SMB	0.3 (0.7)	3	1.6%	1.3%	421	141-607	291	220-339
WE	1.7 (2.9)	17	9.2%	24.0%	1335	401-3223	473	345-639
YP	7.3 (11.4)	73	39.7%	8.2%	106	33-281	202	109-280

Table 5. Catch rates, associated statistics, and length data for species captured in Noxon Stratum 2 during gill netting surveys conducted in 2014. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
BULL	0.1 (0.3)	1	0.5%	0.7%	870	870-870	508	508-508
LMB	0.1 (0.3)	1	0.5%	0.1%	100	100-100	180	180-180
LS SU	0.9 (1.2)	14	6.8%	13.6%	1211	835-1650	467	430-520
LWF	1.1 (2.3)	16	7.7%	10.1%	783	540-1100	432	397-470
NP	2.1 (2.8)	32	15.5%	38.3%	1491	150-4691	547	230-807
NP MN	0.9 (1.6)	13	6.3%	8.1%	779	56-1545	413	190-542
PEA	0.5 (1.3)	7	3.4%	2.4%	427	260-520	342	301-359
PUMP	2.4 (4.8)	36	17.4%	1.6%	55	15-125	124	90-174
SMB	0.3 (0.7)	4	1.9%	2.3%	714	165-1500	342	237-443
WE	1.3 (2.3)	19	9.2%	14.7%	963	238-2190	432	300-570
YL BH	0.9 (2.4)	13	6.3%	2.9%	278	161-420	258	210-290
YP	3.4 (4.9)	51	24.6%	5.2%	126	35-227	207	138-260

Table 6. Catch rates, associated statistics, and length data for species captured in Noxon Stratum 2 during gill netting surveys conducted in 2015. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
BLBH	0.6 (1.8)	7	1.6%	0.8%	180	88-333	220	181-264
LMB	0.3 (0.5)	3	0.7%	0.6%	342	31-695	253	135-351
LNSU	0.1 (0.3)	1	0.2%	1.0%	1755	1755-1755	516	516-516
LSSU	1.5 (1.6)	17	4.0%	12.7%	1251	962-1762	475	440-545
LWF	2.0 (2.6)	22	5.2%	10.8%	827	193-1247	435	238-495
NP	4.6 (4.0)	51	11.9%	36.5%	1201	103-3580	525	260-788
NPMN	1.3 (2.1)	14	3.3%	8.6%	1032	544-1452	457	380-517
PEA	0.8 (1.0)	9	2.1%	2.4%	440	317-526	353	320-373
PUMP	6.8 (9.2)	75	17.6%	2.3%	51	13-111	130	86-172
SMB	1.4 (3.3)	15	3.5%	6.6%	740	19-1496	351	123-456
WE	1.1 (1.2)	12	2.8%	5.0%	706	369-3400	403	358-680
YLBH	5.0 (14.0)	55	12.9%	4.6%	140	42-421	211	141-299
YP	13.3 (13.6)	146	34.2%	8.0%	92	31-315	193	128-280

FALL GILLNETTING– Cabinet Gorge Reservoir

Gillnetting in Cabinet Gorge Reservoir consisted of 15 annual overnight sets. The total number of fish captured remained relatively stable between 2013 (120) and 2014 (114) but increased considerably in 2015 (183) (Table 7-9). Similar to Noxon Reservoir, this was largely due to increases in Yellow Perch and Pumpkinseed. Numbers of Northern Pike, Smallmouth Bass, and Walleye were consistent and low.

Table 7. Catch rates, associated statistics, and length data for species captured in Cabinet Gorge Reservoir during gill netting surveys conducted in 2013. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
EB	0.1 (0.3)	1	0.8%	0.2%	97	97-97	221	221-221
LL	0.1 (0.5)	2	1.7%	2.2%	705	300-1109	383	295-471
LS SU	0.5 (1.0)	8	6.7%	11.8%	929	830-1062	452	436-467
LWF	0.3 (0.5)	4	3.3%	3.3%	527	362-680	394	362-425
NP	0.7 (1.3)	11	9.2%	35.4%	2026	69-4210	569	230-775
NP MN	1.4 (1.4)	21	17.5%	14.9%	447	100-1277	342	240-482
PEA	1.2 (1.7)	18	15.0%	5.5%	191	110-407	277	240-351
PUMP	0.1 (0.4)	2	1.7%	0.2%	62	478-715	116	89-143
RB	0.1 (0.3)	1	0.8%	1.2%	777	146-235	420	420-420
SMB	0.4 (1.3)	6	5.0%	4.9%	515		320	260-356
WE	0.3 (1.0)	5	4.2%	14.9%	1871	1076-4546	556	
YP	2.7 (3.9)	41	34.2%	5.6%	86	32-144	192	

Table 8. Catch rates, associated statistics, and length data for species captured in Cabinet Reservoir during gill netting surveys conducted in 2014. (Abbreviations are given in Appendix A.)

Species	Mean fish/net (STDEV)	Total # caught	Percent of Total Catch (%)	Percent of Total Weight	Mean Weight (g)	Weight Range (g)	Mean Length (mm)	Length Range (mm)
LL	0.2 (0.8)	3	2.6%	7.8%	1580	1220-1780	547	515-567
LMB	0.1 (0.3)	1	0.9%	0.1%	44	44-44	150	150-150
LS SU	0.7 (1.1)	11	9.6%	15.1%	832	480-990	436	393-477
LWF	0.2 (0.8)	3	2.6%	2.2%	453	420-470	373	356-386
NP	0.7 (0.8)	11	9.6%	27.4%	1513	173-3890	555	314-820
NP MN	1.7 (2.3)	26	22.8%	16.8%	393	40-1350	320	142-515
PEA	0.3 (0.6)	5	4.4%	1.8%	217	127-370	281	253-333
PUMP	0.3 (0.8)	4	3.5%	0.2%	30	19-34	113	101-121
RB	0.2 (0.4)	3	2.6%	3.7%	741	123-1200	391	229-491
SMB	0.6 (1.1)	9	7.9%	9.4%	632	38-1050	331	149-385
WE	0.5 (0.9)	8	7.0%	11.9%	903	370-1670	447	359-564
YP	2.0 (2.8)	30	26.3%	3.8%	77	35-216	182	122-254

Table 9. Catch rates, associated statistics, and length data for species captured in Cabinet Gorge Reservoir during gill netting surveys conducted in 2015. (Abbreviations are given in Appendix A.)

Species	Fish/Net (STDDEV)	Total # Caught	Percent of Total Catch	Percent Total Weight	Mean Weight	Weight Range	Mean Length	Length Range
LL	0.1 (0.3)	1	0.5%	0.2%	154	154-154	260	260-260
LSSU	1.7 (1.5)	25	13.7%	31.0%	887	629-1600	442	393-533
LWF	0.1 (0.3)	1	0.5%	0.9%	632	632-632	426	426-426
NP	0.7 (0.7)	10	5.5%	26.9%	1924	257-3700	614	345-750
NPMN	1.6 (1.4)	24	13.1%	20.7%	616	62-1448	365	201-515
PEA	0.7 (1.2)	10	5.5%	3.0%	214	148-334	282	260-315
PUMP	1.3 (3.2)	19	10.4%	0.9%	34	13-61	114	85-143
SMB	0.6 (0.8)	9	4.9%	7.8%	620	136-933	345	203-410
WE	0.2 (0.4)	3	1.6%	2.7%	649	391-1117	405	350-485
YP	5.4 (5.9)	81	44.3%	5.9%	52	28-232	161	110-255

BASS SEINING

2013

A total of 400 age-0 Largemouth Bass were captured during beach seining in 2013. Mean lengths ranged from 54.6 mm in mid-September to 76.1 mm in early October (Table 10). No sampling occurred in mid-August.

Table 10. Mean lengths (with 95% confidence intervals) of sampled age-0 Largemouth Bass from beach seining in Noxon Reservoir, 2013-2015.

	2013 Mean Length (mm)	95% CI	2014 Mean Length (mm)	95% CI	2015 Mean Length (mm)	95% CI
Mid-Aug	N/A		39.3	4.6	52.7	1.5
Mid-Sep	54.6	1.6	51.5	2.1	60.5	1.6
Early-Oct	57.1	3.4	53.0	2.5	63.3	2.0
Mid-Oct	76.1	1.9	N/A		59.1	2.1

2014

A total of 236 age-0 Largemouth Bass were captured in 2014. Mean lengths ranged from 39.3 mm in August to 53.0 mm in early October (Table 10). No sampling occurred in mid-October.

2015

A total of 452 age-0 Largemouth Bass were sampled by beach seine on four separate events throughout 2015. Mean lengths ranged from 42.8 mm to73.7 mm (Table 10).

BASS TOURNAMENT MONITORING

2013

Five bass tournament events were monitored in 2013. Largemouth Bass accounted for 70% of the catch with Smallmouth Bass comprising the remainder. Approximately 56% of Largemouth Bass and 36% of Smallmouth Bass observed were quality sized fish (≥380 mm) (Table 11). Mean length and proportion of quality-sized fish was highest for Largemouth Bass during the early-June tournament, which was likely representative of the vulnerability of large pre-spawn fish to angling.

2014

Four bass tournament events were monitored in 2014, each spanning 2 days. Overall, 68% of Largemouth Bass and 58% of Smallmouth Bass brought to the weigh-in were quality sized bass (≥ 380mm TL) (Table 11). However, during the early-June tournament, approximately 80% of Smallmouth Bass checked in were quality-sized. Largemouth Bass comprised 62% of all fish weighed in for all tournaments combined. Overall mean length of largemouth bass was 394 mm, while Smallmouth Bass averaged 386 mm.

2015

Two bass tournament events were monitored on Noxon Reservoir in 2015 (Table 11). The percentage of quality fish (≥ 380mm) was similar to 2014 for Largemouth Bass (65%) and Smallmouth Bass (61%).

Table 11. Statistics from monitored bass tournaments on Noxon Reservoir from 2013-2015.

	Spp.	**2013**	**2014**	**2015**
Mean Length	LMB	387 mm	394 mm	394 mm
	SMB	374 mm	386 mm	394 mm
Percent Quality (≥ 380 mm)	LMB	56%	68%	65%
	SMB	36%	58%	61%
Species Composition	LMB	70%	62%	61%
	SMB	30%	38%	39%

WALLEYE MONITORING

2013

A total of 105 unique Walleye were sampled over the course of five nights of electrofishing in 2013 (21 fish/night) (Figure 7). Of these, 57 were male and 48 were female (Figure 8). All fish were released alive with floy tags. Twelve of these fish were recaptured over the course of spring sampling in 2013 (within year recaptures). Seven males were recaptured an average of seven days later, while five females were recaptured an average of five days later. Total catch per unit effort (*C/f*) varied from 6.60 fish per hour on April 22, to 41.34 fish per hour on April 29 (Figure 9). Total female *C/f* also peaked on April 29 at a rate of 25.21 females per hour. Although no thermograph was deployed during spring 2013, water temperature in the fish ladder on April 29 was 9.8°C and likely surpassed 10.0°C that day. Flow measured at the USGS gauge in Plains that day surpassed 25,000 cubic feet per second (cfs).

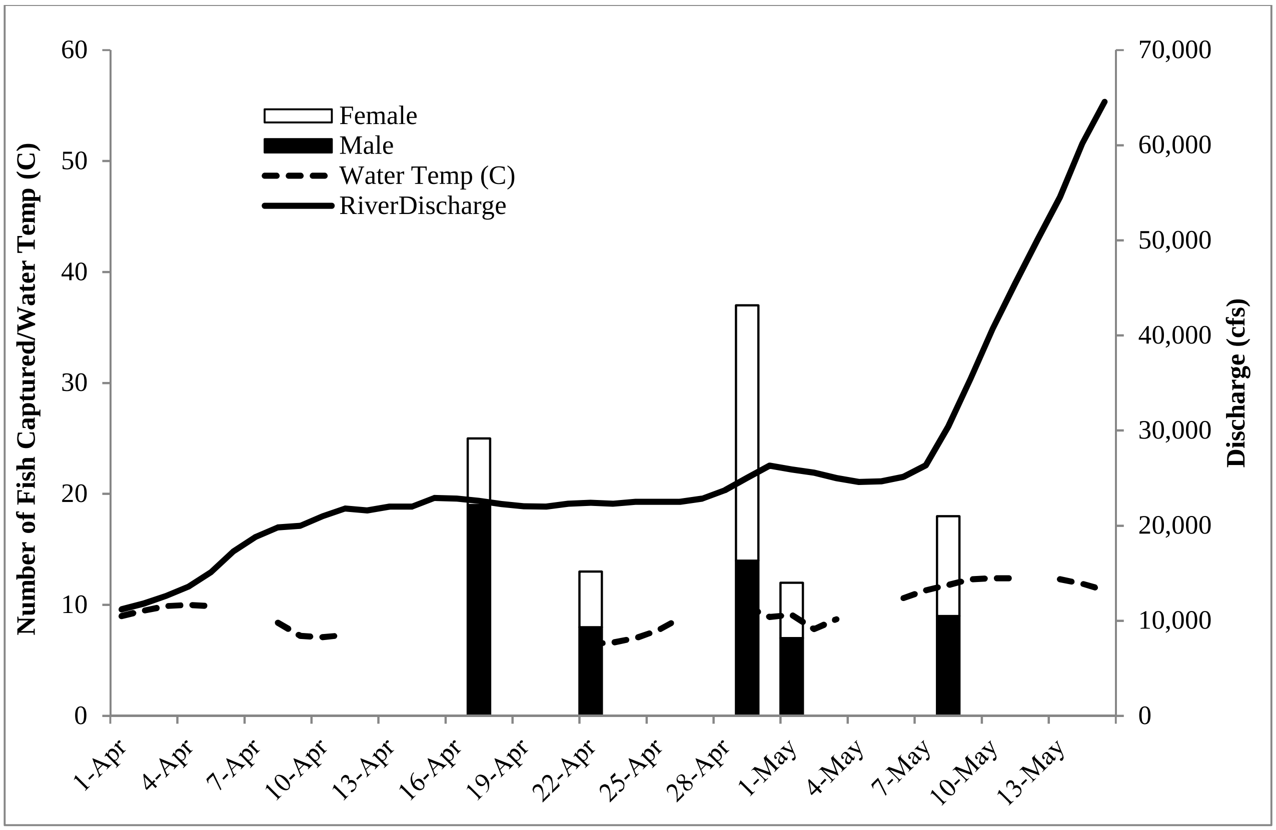

Figure 7. Spring electrofishing catch per night of male and female Walleye in relationship to river discharge and water temperature in 2013 (no thermograph was deployed in 2013, temperature data is taken from the Thompson Falls fish ladder).

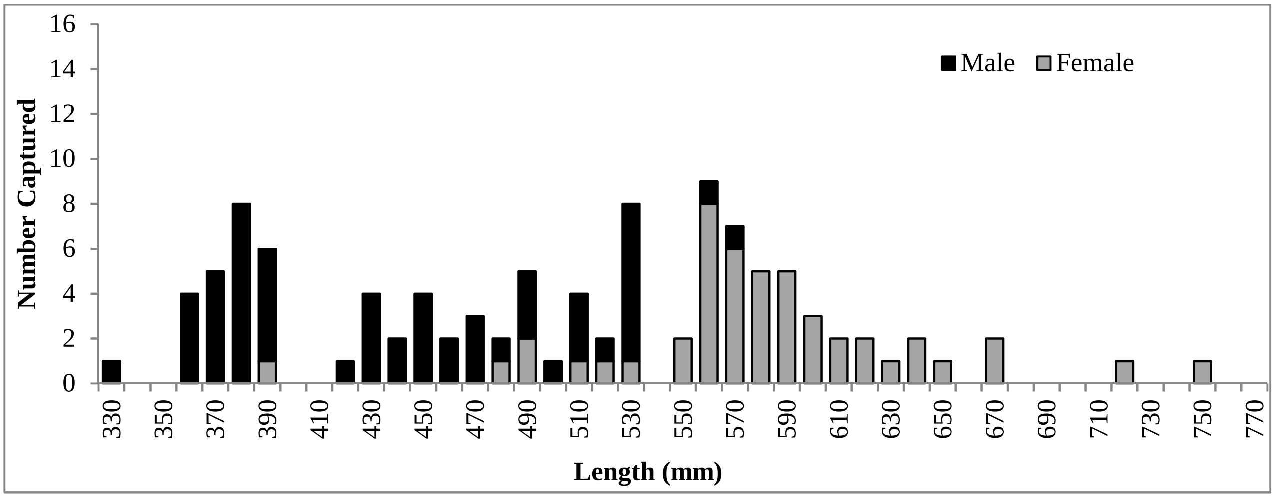

Figure 8. Length frequency histogram of male and female Walleye captured during spring sampling in 2013.

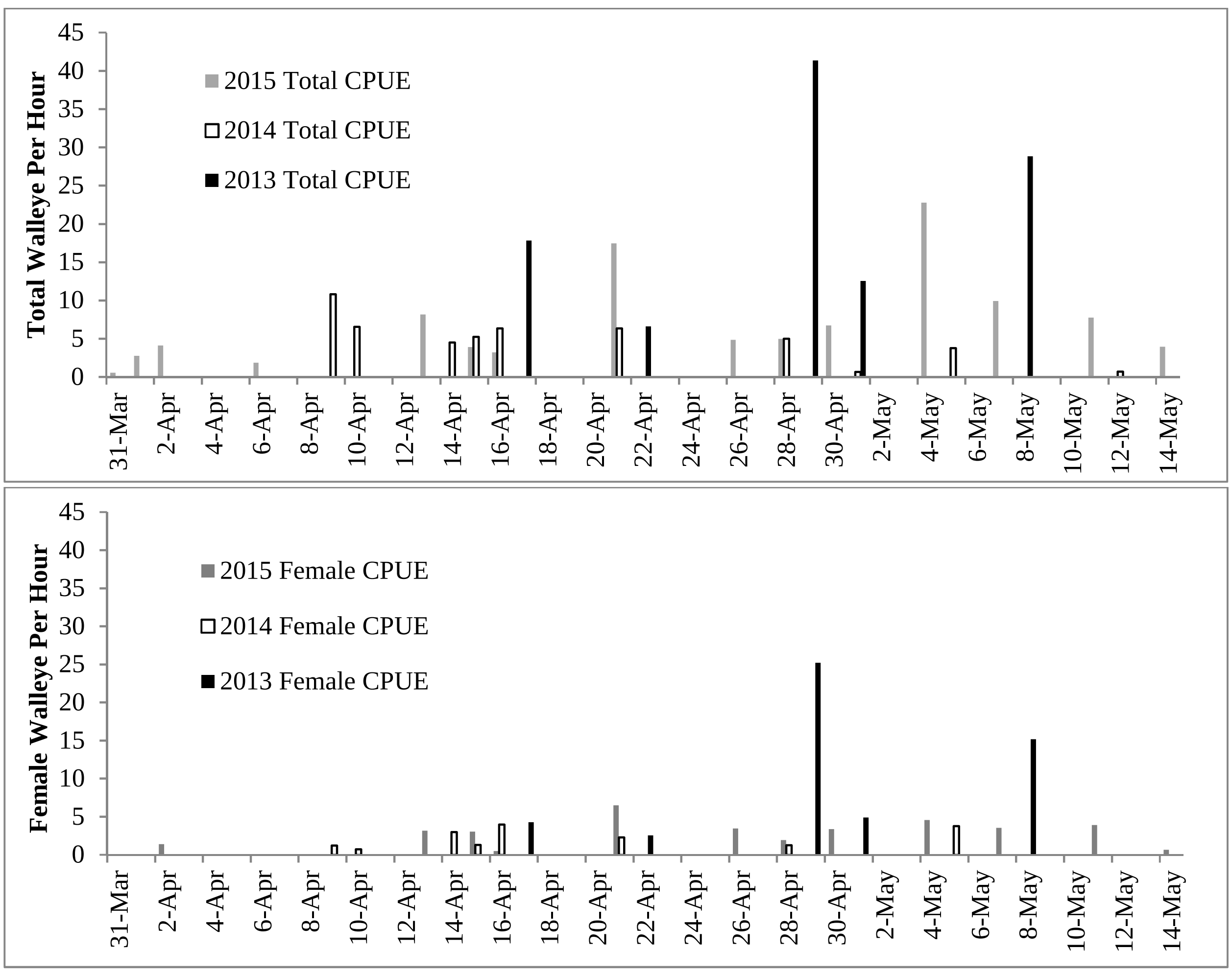

Figure 9. Catch per unit effort *(C/f)* of total Walleye and female Walleye during nighttime spring electrofishing (2013-2015).

During fall gillnetting in 2013, 50 Walleye were sampled in 29 nets (1.72 fish/net night) (Figure 10). This was the highest Walleye catch on record. Based on ages estimated from otoliths, this catch was comprised of at least nine fish from four different cohorts (2007, 2009, 2010, and 2012). Only two fish from the 2011 cohort, and no fish from the 2008 cohort were captured.

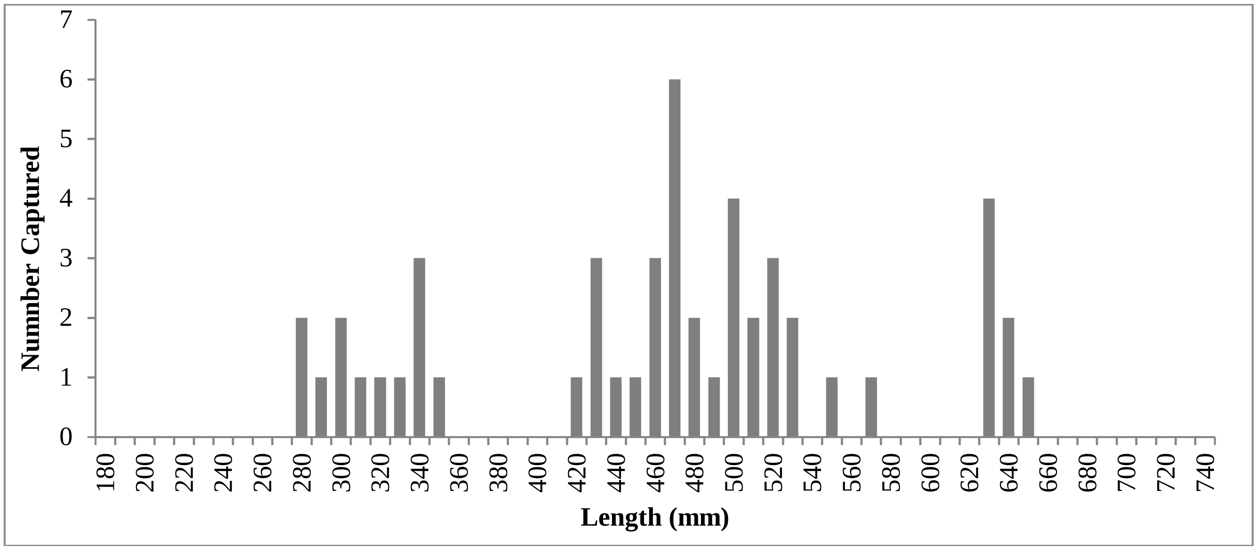

Figure 10. Length frequency histogram for Walleye captured during 2013 annual fall gill netting of Noxon Reservoir.

2014

In 2014, spring sampling for illegally introduced Walleye was again conducted using nighttime boat-mounted electrofishing in upper Noxon Reservoir. Catch rates were lower than the previous two seasons. Only 69 Walleye were caught during 12 nights of electrofishing (5.8 fish/night) (Figure 11). Of these, 26 were females (mean length- 564 mm), while 43 were males (mean length- 480 mm) (Figure 12). Thirty-four fish were released alive with PIT tags. Total *C/f* ranged from 0.00 fish per hour on April 22 and May 9 to 10.80 fish per hour on April 9 (Figure 9). Female *C/f* peaked at 3.96 fish per hour on April 16. Mean water temperature remained below 10°C for the entire month of April, 2015. Clark Fork River discharge as measured at the USGS gauge site in Plains climbed continuously throughout the study period, from approximately 17,000 cfs on April 1, to over 55,000 cfs on May 5. The relative fecundity of 21 female Walleye was estimated in 2014 (Figure 13). Female Walleye averaged 59,000 eggs per kg of body weight (Figure 13).

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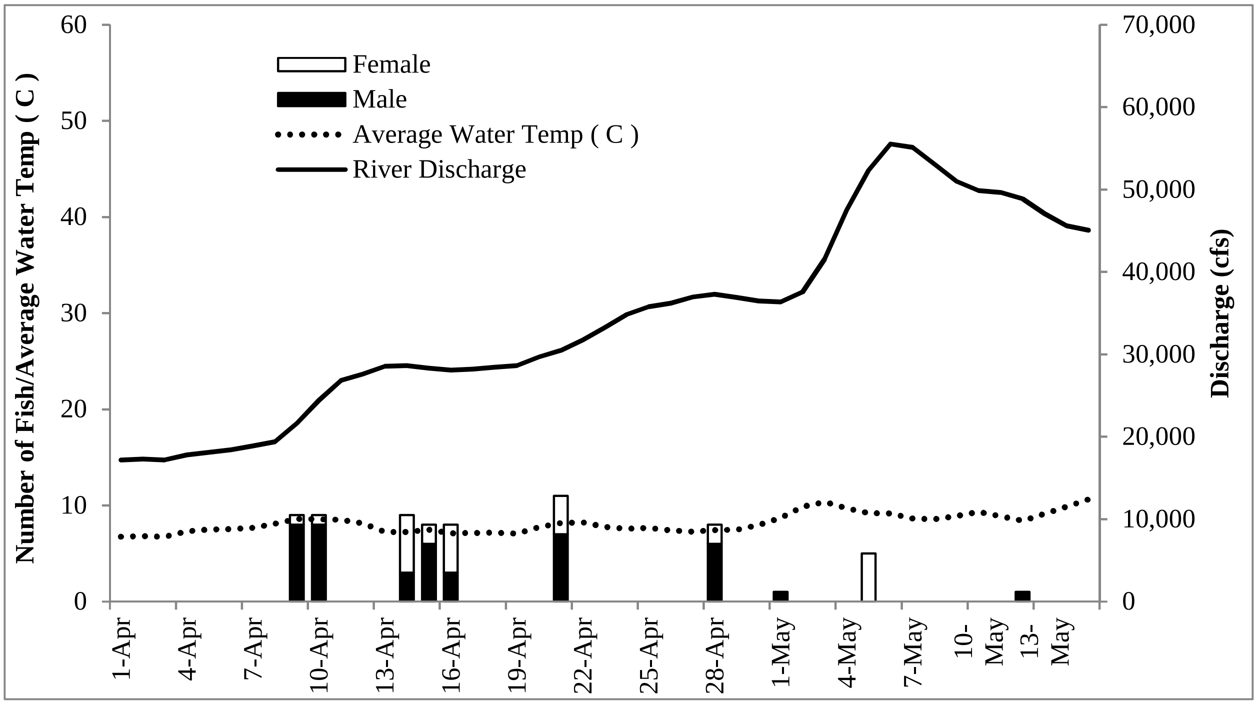

Figure 11. Spring electrofishing catch per night of male and female Walleye in relationship to river discharge and water temperature in 2014.

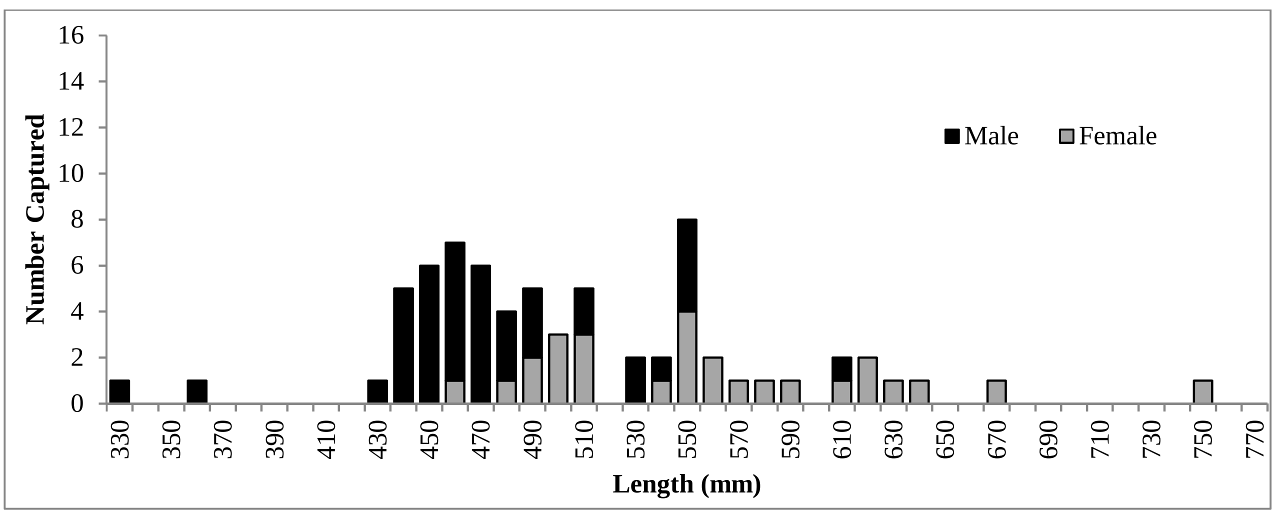

Figure 12. Length frequency histogram of male and female Walleye captured during spring sampling in 2014.

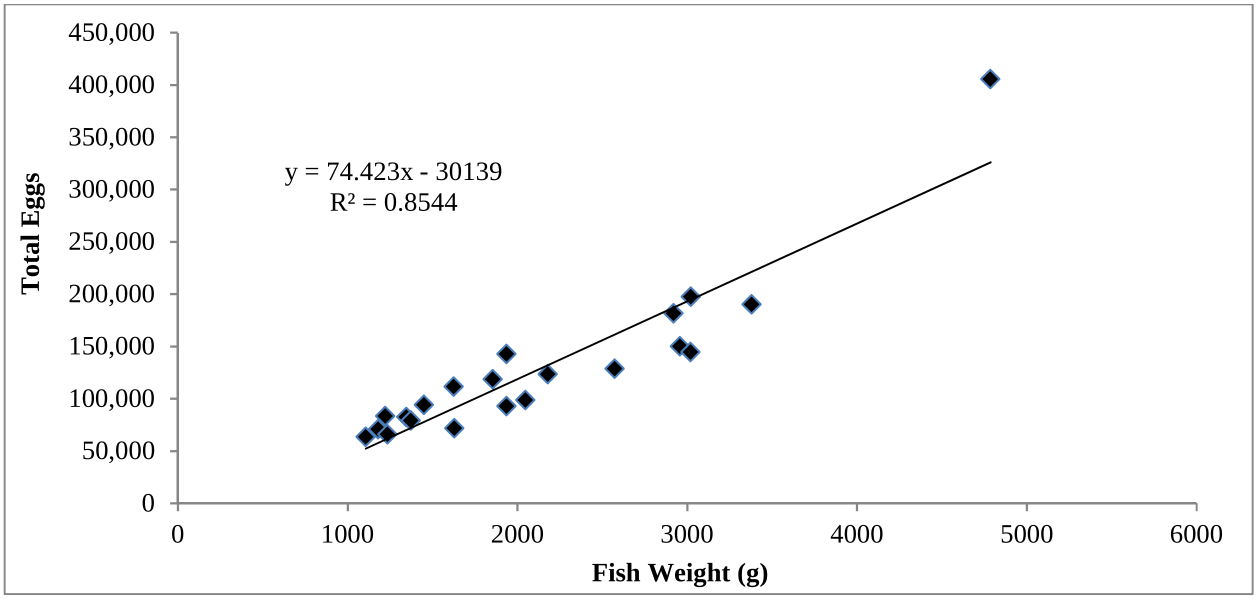

Figure 13. Relative fecundity estimates of 21 female Walleye captured in spring, 2014.

During fall gillnetting in 2014, 47 Walleye were captured in 30 nets (1.57 fish/net night) (Figure 14). Based on otolith ages, approximately 40% of these fish were age-2. Two Walleye released with PIT tags during spring, 2014 were recaptured in fall gill nets in the lower reservoir later that year. One had grown 35 mm and 305 g (Fall capture: 476 mm, 1,070 g), and the other had grown 40 mm and 693 g (Fall capture: 545 mm, 1,680 g). Only two age-3 fish were captured.

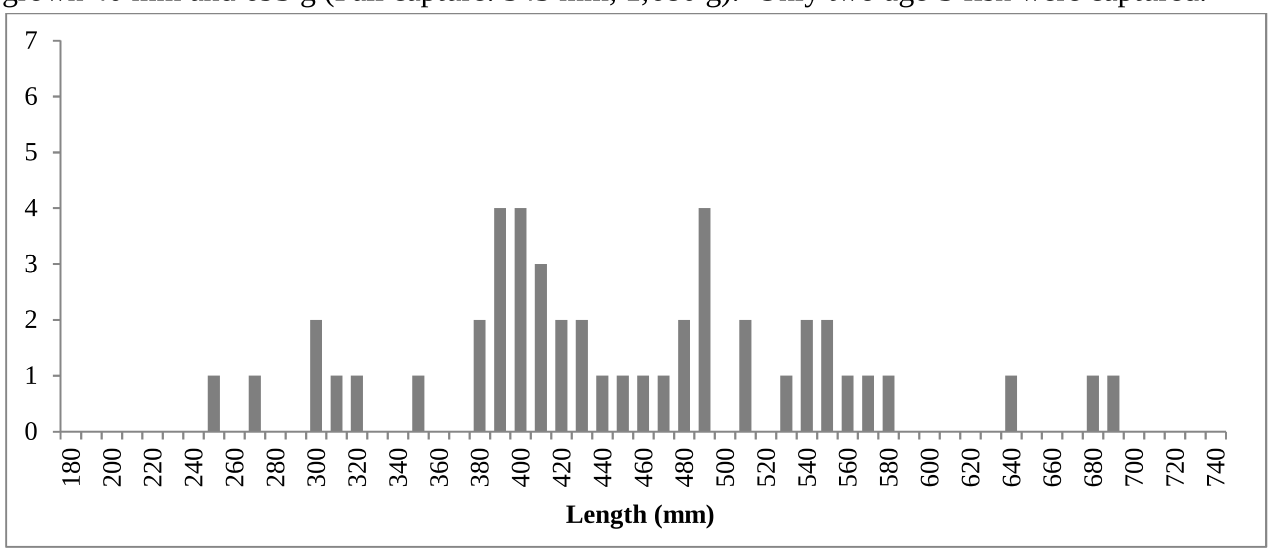

Figure 14. Length frequency histogram for Walleye captured during 2014 annual fall gill netting of Noxon Reservoir.

2015

A total of 208 unique Walleye were sampled during 16 nights of electrofishing during spring, 2015 (Figure 15). Of these, 131 were male, 76 were female, and one was unknown (Figure 16). One hundred twenty seven (61%) were released alive with a PIT tag. Eight of the released fish were recaptured at a later sampling date in the spring. Of these, five males were recaptured an average of two weeks after the original capture, and the two females were recaptured 13 and 20 days later. One fish which was released with a PIT tag in April, 2015, and was recaptured in a fall gillnet upstream from the town of Trout Creek later that year. This fish had not grown in length, but had gained 81 g in weight (Fall capture: 539 mm, 1,793 g). The relative fecundity of 28 female Walleye sacrificed for mercury sampling was estimated in 2015 (Figure 17). Female Walleye averaged over 70,000 eggs per kg of body weight.

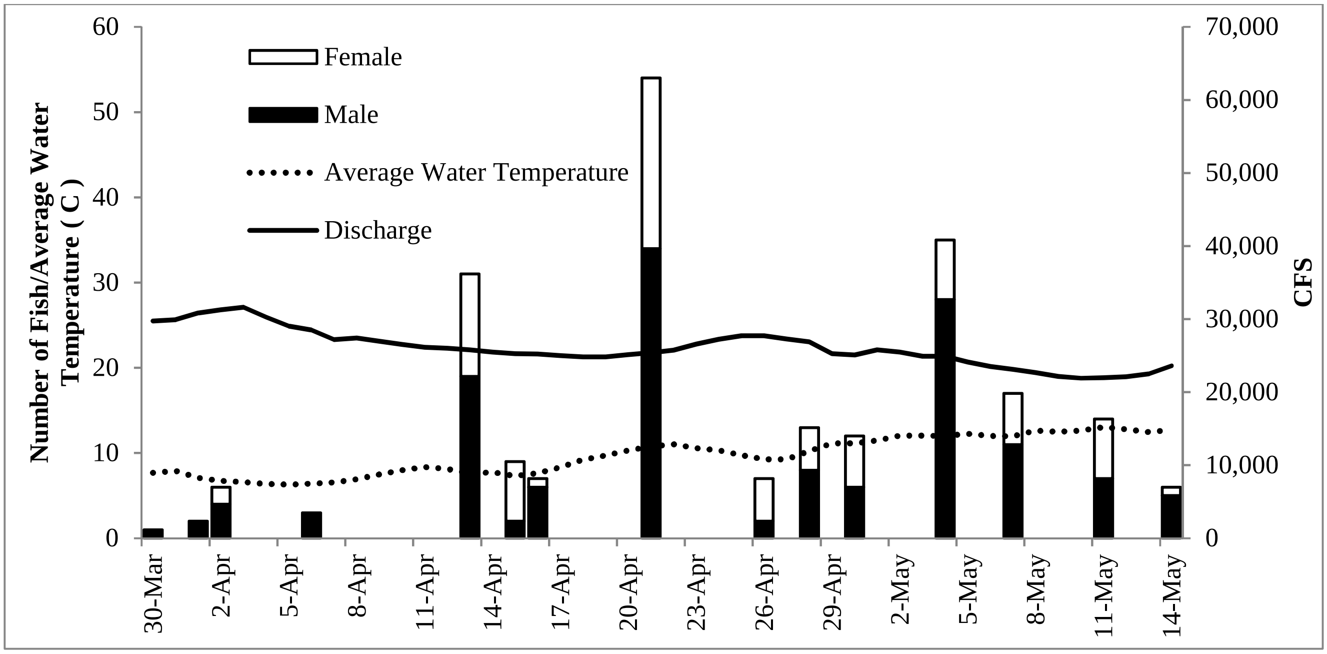

Figure 15. Spring electrofishing catch per night of male and female Walleye in relationship to river discharge and water temperature in 2015.

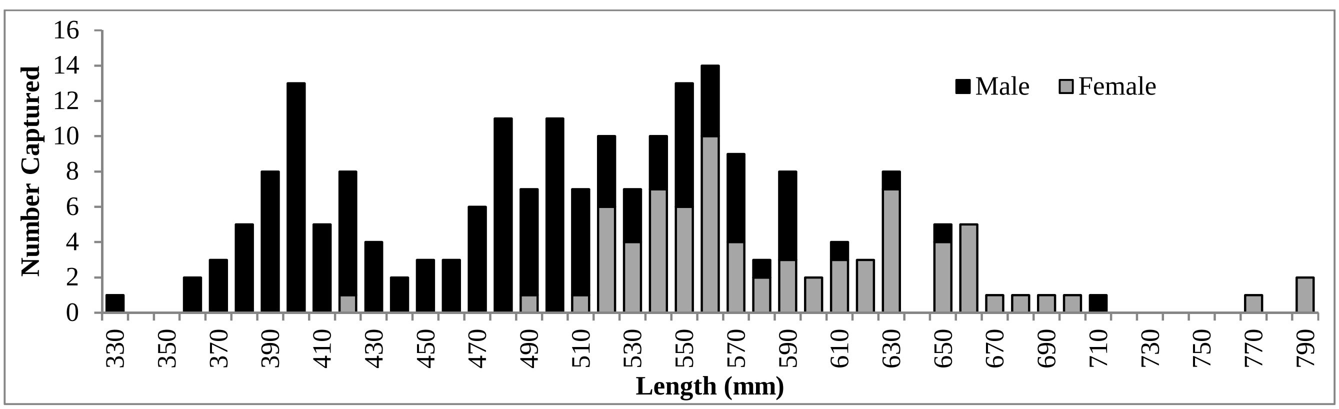

Figure 16. Length frequency histogram of male and female Walleye captured during spring sampling in 2015.

During annual gillnetting in 2015, 35 Walleye were captured in 30 nets (1.17 fish/net night) (Figure 18). Although this number was lower than the previous two years, it is still the fourth highest catch on record. Based on otolith ages, approximately 60% of these fish were age-2 or age-3.

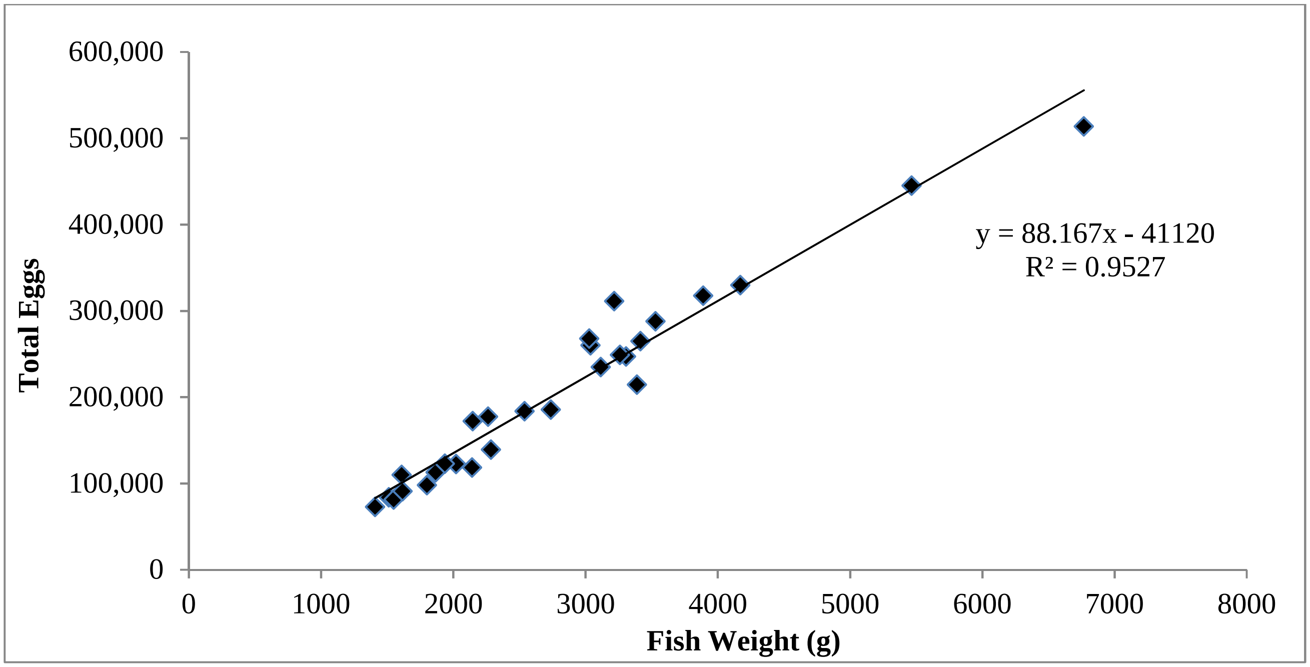

Figure 17. Relative fecundity of 28 female Walleye captured in spring, 2015.

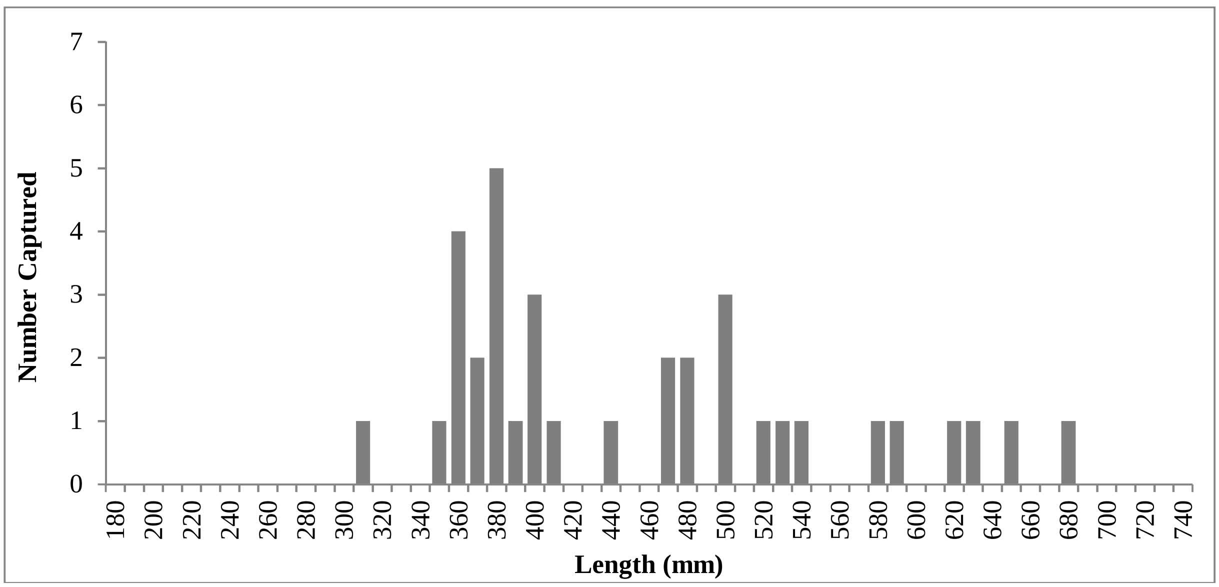

Figure 18. Length frequency histogram for Walleye captured during 2015 annual fall gill netting on Noxon Reservoir.

Also in 2015, genetic samples were collected from two separate cohorts of Walleye in an attempt to estimate effective number of breeders (DeHaan et al. 2016.) The results indicated N_b estimates were 61.3 (95% C.I. = 30.4-239.7) for the 2010 cohort and 91.3 (95% C.I. = 40.5-2292.7) for the 2012 cohort (DeHaan et al. 2016). Results also indicated that despite samples being collected from areas distributed throughout the reservoir, all samples came from a single breeding population.

COMPREHENSIVE RESULTS

FALL GILLNETTING: 2000-2015

Total fish captured in fall gill nets in Noxon Reservoir has increased for the past four years and was the second highest of all time in 2015 (Figure 19, Appendix B). This observation is in contrast to recent reports which showed consistent overall declines in fish numbers (Kreiner and Tholl 2013, Scarnecchia et al. 2014). Declining trends of several individual species documented in past reports remain true (e.g., Peamouth, Northern Pikeminnow, Largescale Suckers *Catostomus macrochelius*), however, recent increases in *C/f* of Yellow Perch and Pumpkinseed have shifted the reduction in the prey: predator ratio. In Cabinet Gorge Reservoir, total number of fish per net night increased in 2015 only (Figure 20). As mentioned previously, this increase was also due to higher catches of Yellow Perch and Pumpkinseed (Appendix C).

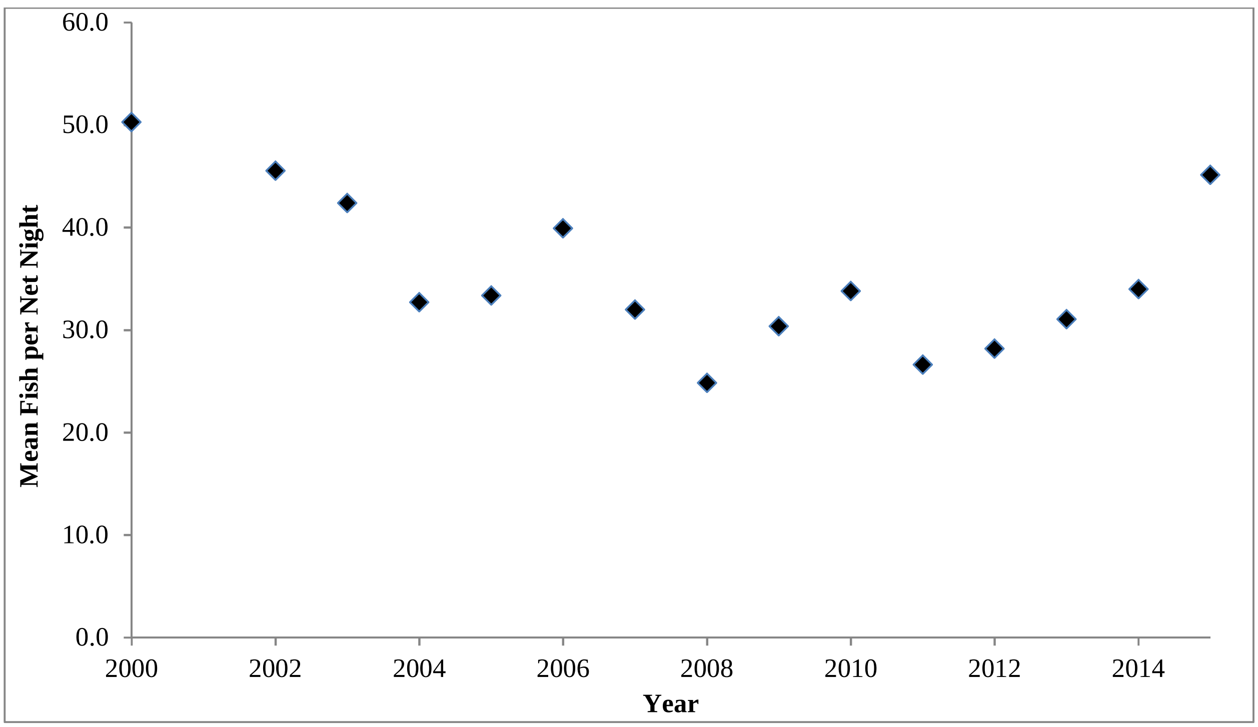

Figure 19. Mean fish per net night sampled in fall gillnets in Noxon Reservoir (both strata) since 2000.

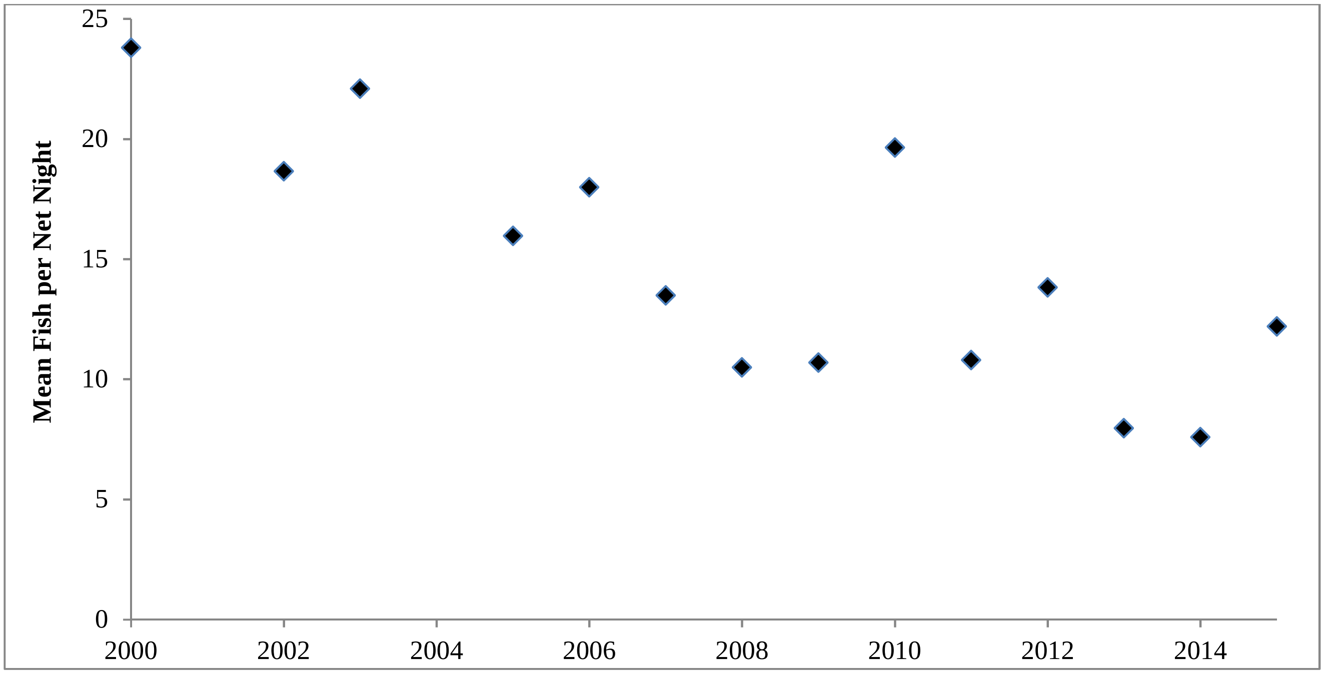

Figure 20. Mean fish per net night sampled in fall gillnets in Cabinet Gorge Reservoirs since 2000.

With the exception of recent increases in Yellow Perch and Pumpkinseed, all trends previously reported remain true. Many native forage species continue to decline, while non-native predators have increased. One example of a forage species which has consistently declined in Noxon Reservoir is the Peamouth (Figure 21). In 2000, approximately 11.6 Peamouth were caught per net night and in 2015 that number had declined to 1.1. Based on lengths of captured fish, very few young Peamouth currently exist in Noxon Reservoir.

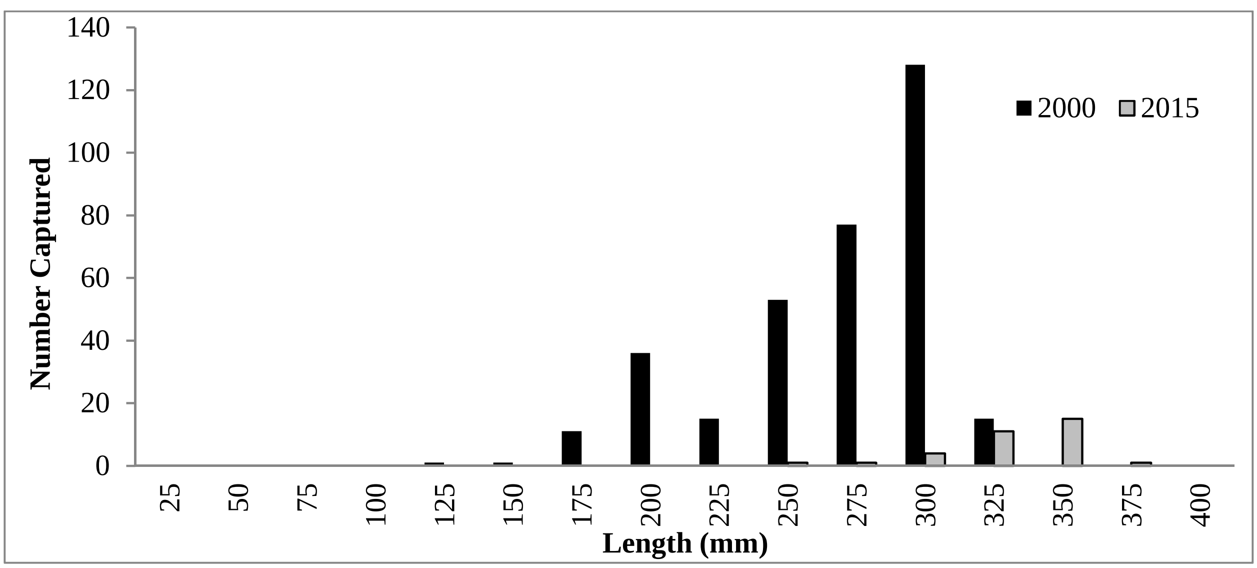

Figure 21. Length frequency histogram of Noxon Reservoir Peamouth captured during fall gillnet monitoring in 2000 (n= 337, mean length- 279 mm) and 2012 (n=33, mean length=344 mm).

Northern Pikeminnow and Largescale Suckers are other native species which have declined since 2000, although to a lesser degree than Peamouth. The relative abundance of Northern Pikeminnow has remained consistently around 2.5 fish per net night since 2009. Additionally, the presence of some smaller size classes indicates that there is at least some recruitment of this species (Figure 22). Largescale Suckers averaged about 1.9 fish per net night from 2000 through 2009, but catch rate decreased to about 0.9 fish per net night between 2010 and 2015. The current size distribution indicates that very few small Largescale Suckers are present (Figure 23). In 2000, the catch of Largescale Suckers was approximately double that of 2015, but nearly half of those fish were under 440 mm. In 2015, no Largescale Suckers under 440 mm were captured, indicating a lack of recruitment in this species as well.

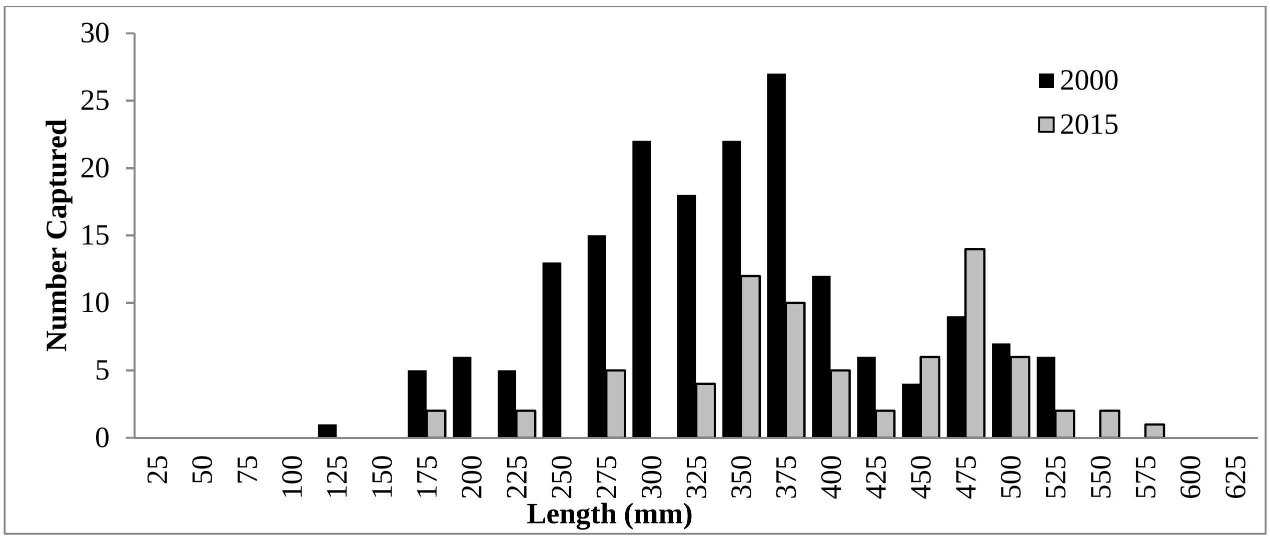

Figure 22. Length frequency histogram of Noxon Reservoir Northern Pikeminnow captured during fall gill net monitoring in 2000 (n=178, mean length- 355 mm) and 2015 (n=74, mean length- 411 mm).

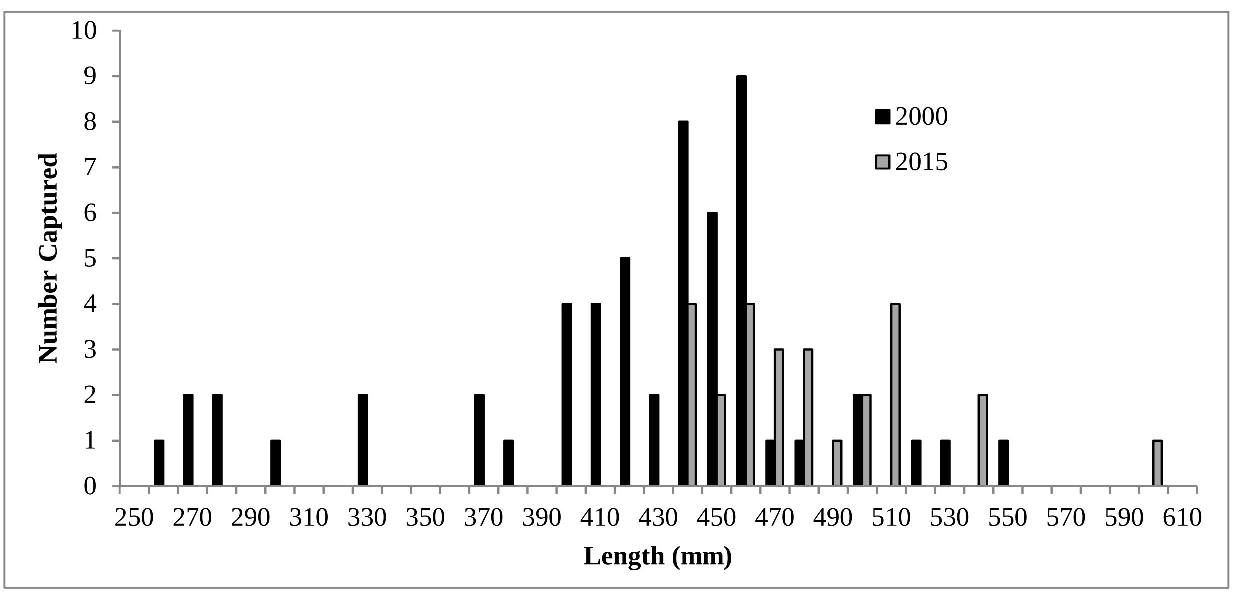

Figure 23. Length frequency histogram of Noxon Reservoir Largescale Suckers (LS SU) captured during fall gill net monitoring in 2000 and 2015.

Yellow Perch and Pumpkinseed are two forage species which appear to have had several recent years of successful recruitment in Noxon Reservoir. Both of these species are highly connected to aquatic vegetation during nearly all stages of life (Scott and Crossman 1973) and are commonly encountered during beach seine events for age-0 Largemouth Bass. Based on length distribution, the increase in Pumpkinseed can mostly be attributed to an increase in larger fish (Figure 24). Yellow Perch length distribution is nearly identical to the population fifteen years ago and year classes are difficult to discern based on length alone (Figure 25). However, during times of lower relative abundance, size distribution of Yellow Perch has fluctuated annually.

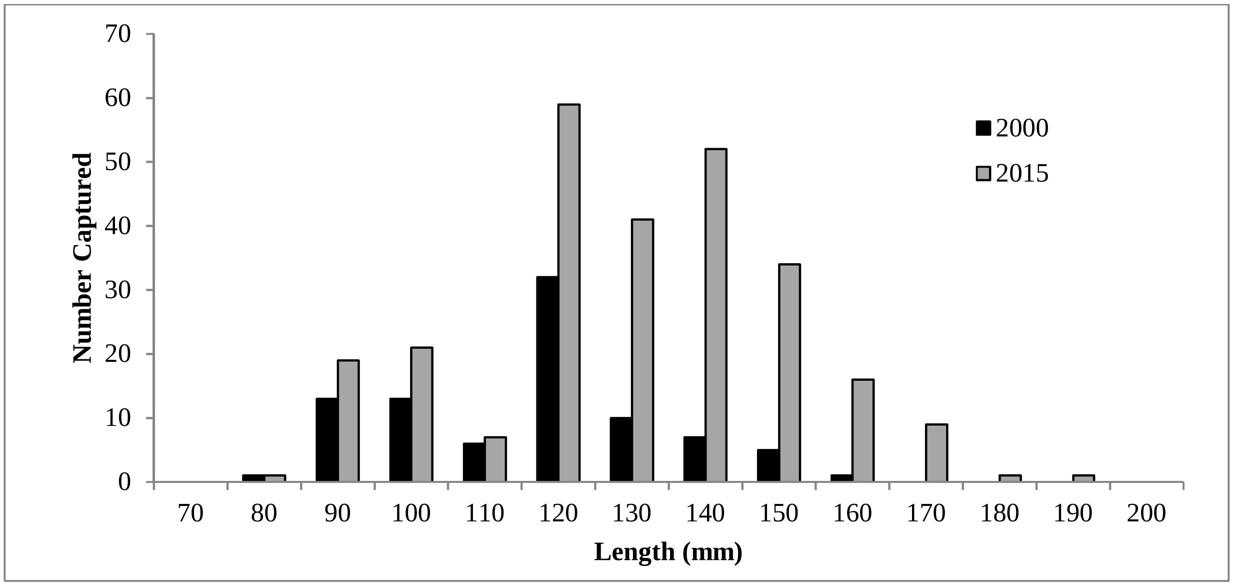

Figure 24. Length frequency histogram of Noxon Reservoir Pumpkinseed (PUMP) captured during fall gillnet monitoring in 2000 and 2015.

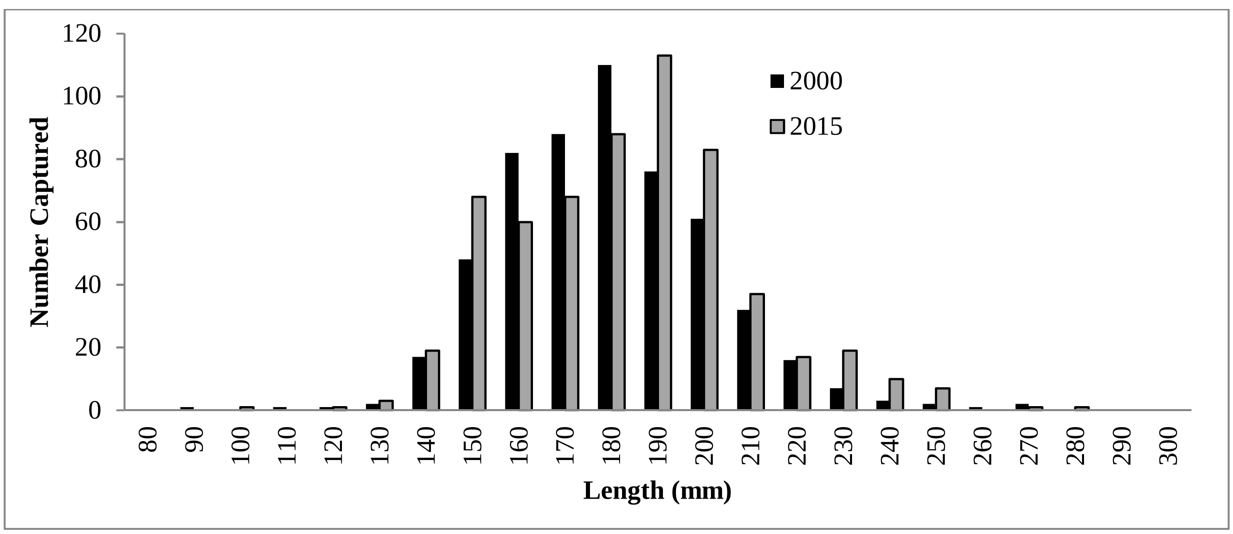

Figure 25. Length frequency histogram of Noxon Reservoir Yellow Perch (YP) captured during fall gill net monitoring in 2000 and 2015.

Northern Pike and Smallmouth Bass are two predator species which appear to have increased in abundance over the past several years. Between 2000 and 2009, relative abundance of both species appeared stable or even slightly decreasing. However, since that time, catch rates of both species in the fall gillnets have increased dramatically (Appendix B). Based on length frequency comparisons between 2000 and 2015, there has been an increase in both large and small Northern Pike and Smallmouth Bass (Figure 26 and Figure 27). Relative weight (W_r) in 2015 was still near 100 for both species (SMB-99.1, NP- 101.2) (Figure 28). However, that represents the lowest W_r of Noxon Reservoir Northern Pike since 2002, while Smallmouth Bass have fluctuated greatly. Over this same time period, relative weight of fall-caught Walleye has declined as well (Figure 28).

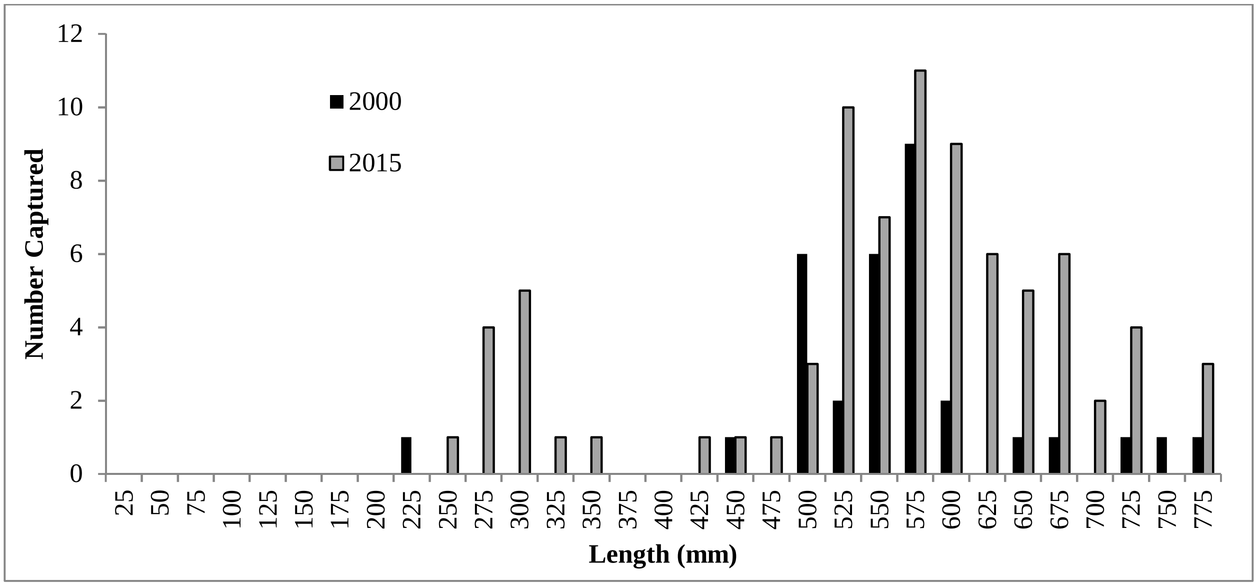

Figure 26. Length frequency histogram of Noxon Reservoir Northern Pike (NP) captured during fall gill net monitoring in 2000 and 2015.

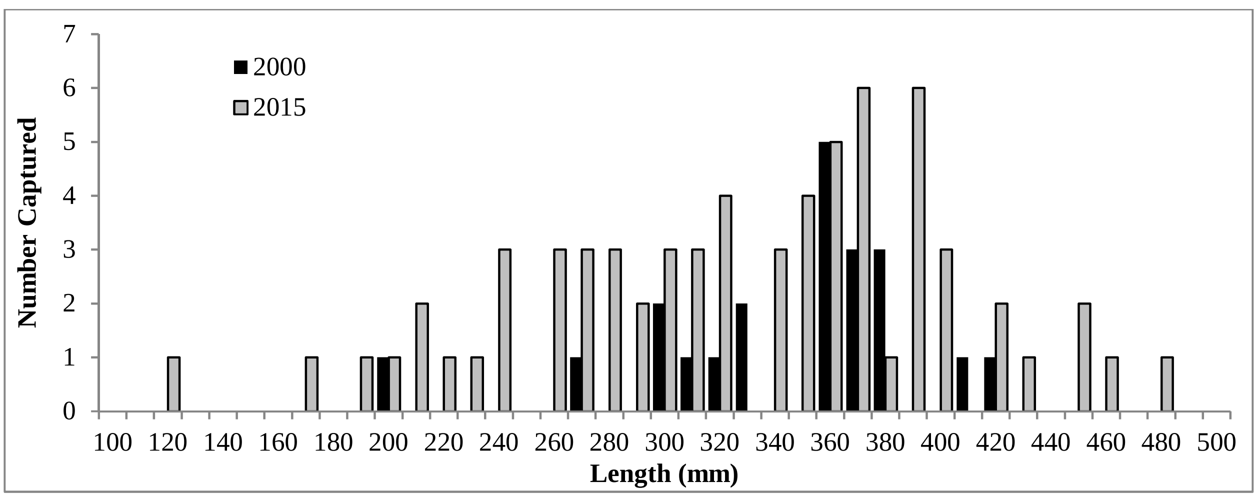

Figure 27. Length frequency histogram of Noxon Reservoir Smallmouth Bass (SMB) captured during fall gill net monitoring in 2000 and 2015.

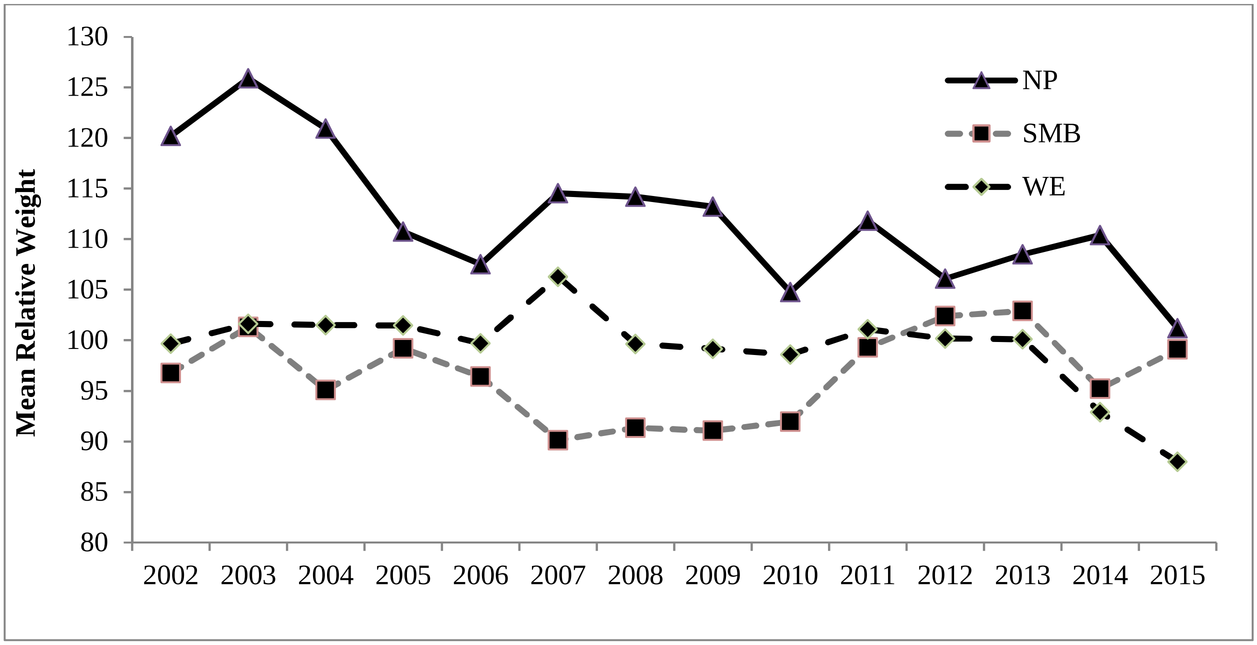

Figure 28. Relative weight (W_r) of Walleye (WE), Northern Pike (NP), and Smallmouth Bass (SMB) captured in Noxon Reservoir during annual gill net surveys from 2002 through 2015.

BASS SEINING: 2001-2015

Mean length of age-0 bass was compared between years since standardized sampling began in 2001 as a tool to predict year class strength. Since 2007, beach seine events have taken place in mid-August, mid-September, early-October, and mid-October of most years. Maximum mean length exceeded 70 mm in four of these years (2007, 2009, 2012, and 2013) indicating a high likelihood of successful over-winter survival (Saffel 2003) (Figure 29). A separate report from Northern Minnesota documented that strong age-classes were produced when age-0 Laregemouth Bass reached 50 mm total length by early August (Newburg and Schupp 1986). Mean length of mid-August fish exceeded 50 mm only twice (2007, 2015) and failed to approach 40 mm in two years (2008, 2011). Despite having the second highest mid-August mean length, October sampled fish in 2015 had only the fifth highest mean October length and likely would not have made the over-winter threshold established by Saffel (2003). Because growth of age-0 Largemouth Bass does not decrease throughout the summer, it is clear that fish sampled later in the year were different fish with different hatch dates. Although water temperatures recorded in 2015 were not the highest on record, Noxon Reservoir reached 20°C (June 11) and 24°C (July 2) a full three weeks earlier than all other years (Appendix D). This combined with low magnitude of run-off probably resulted in a successful early spawn of bass (i.e, pre-run-off). Because our sampling design does not identify or mark individual fish, it is impossible to know at which point fish may move to deeper water.

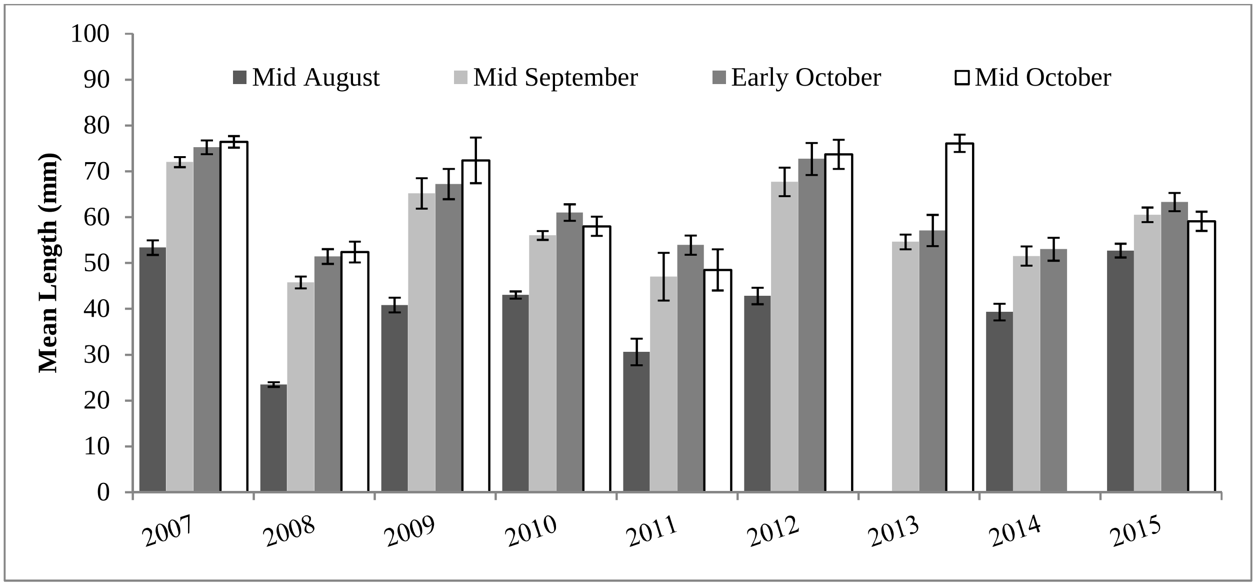

Figure 29. Mean length of young of the year largemouth bass sampled by beach seining in Noxon Reservoir from 2007-2015.

BASS TOURNAMENT MONITORING: 1997 -2015

Species composition has varied greatly over the past 18 years of bass tournaments on Noxon Reservoir (Figure 30). The highest percentage of tournament caught Smallmouth Bass occurred in 1999 with Smallmouth Bass comprising 81 percent of all bass brought to the weigh-in. By 2008, species composition was completely reversed with 82 percent of weighed-in bass consisting of Largemouth Bass. It is unknown whether this reflects the actual composition of the bass population in Noxon Reservoir, or more likely, if anglers preferred to target Largemouth Bass for their size.

The percentage of "quality" bass (≥380mm) (Gabelhouse 1984) has also fluctuated during this 16 year period. The proportion of quality Largemouth Bass brought to weigh-ins peaked at 87% in 1999, while the lowest percentage occurred in 2006 (26%) (Figure 31). In 2015, over 60% of both species at weigh-ins were quality-sized. Mean length of Largemouth Bass weighed in was highest in 2000 at 415 mm and lowest in 2011 at 359mm (Figure 32). Smallmouth Bass had a maximum mean length of 404 mm in 2003 and a minimum mean length of 357 mm in 1998. Mean length of both species at bass tournaments has increased annually since 2011 and is currently at 394 mm.

Although Gabelhouse (1984) defined a 'Trophy" Largemouth Bass as one which is 635 mm or greater, the Montana state record was only 570 mm. In Noxon, we defined a "large" fish as 460 mm or greater. Over the same time period that proportions of quality bass have increased, the proportion of "large" bass has decreased (Figure 33). For Largemouth Bass, the proportion of fish greater than 460 mm peaked at 23% in 2002. Since 2003, it has ranged between 3 and 8%. For Smallmouth Bass, that number peaked at 11% in 2003, and has been below 10% since 2009.

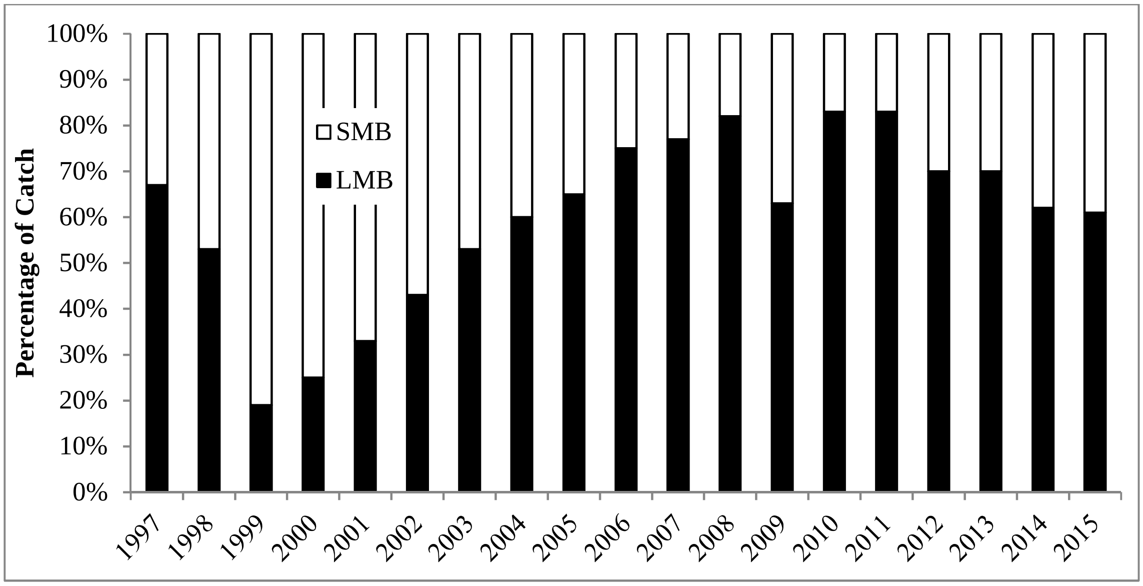

Figure 30. Species composition of bass weighed in at Noxon Reservoir bass tournaments between 1997 and 2015.

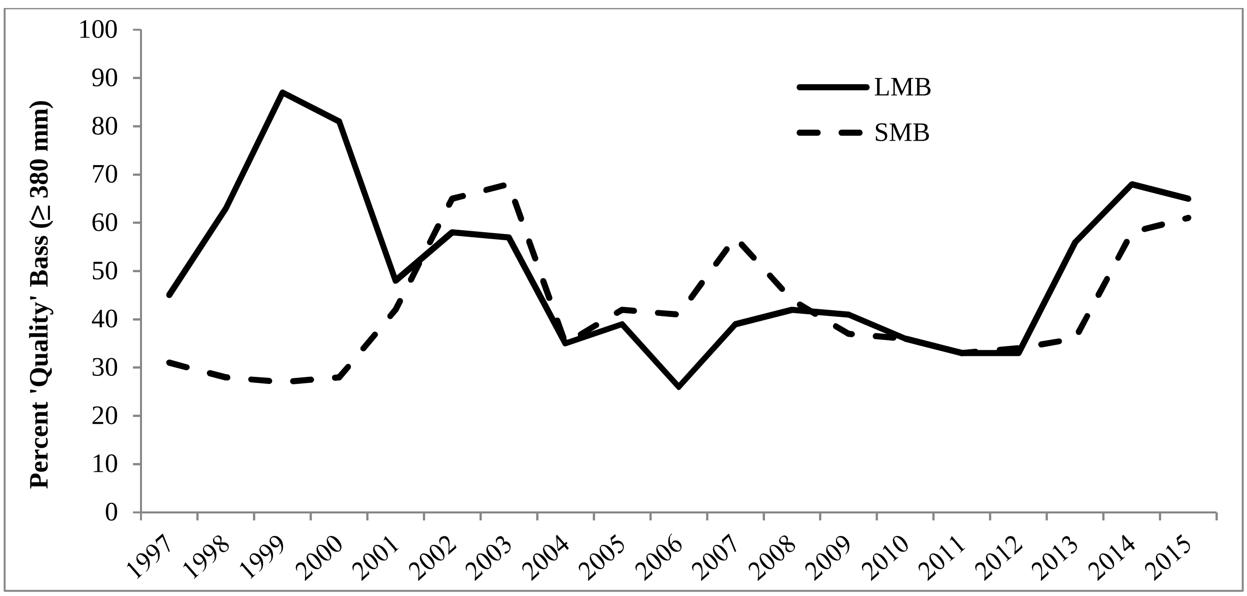

Figure 31. Proportion of quality sized bass (≥380 mm) checked in at Noxon Reservoir bass tournaments.

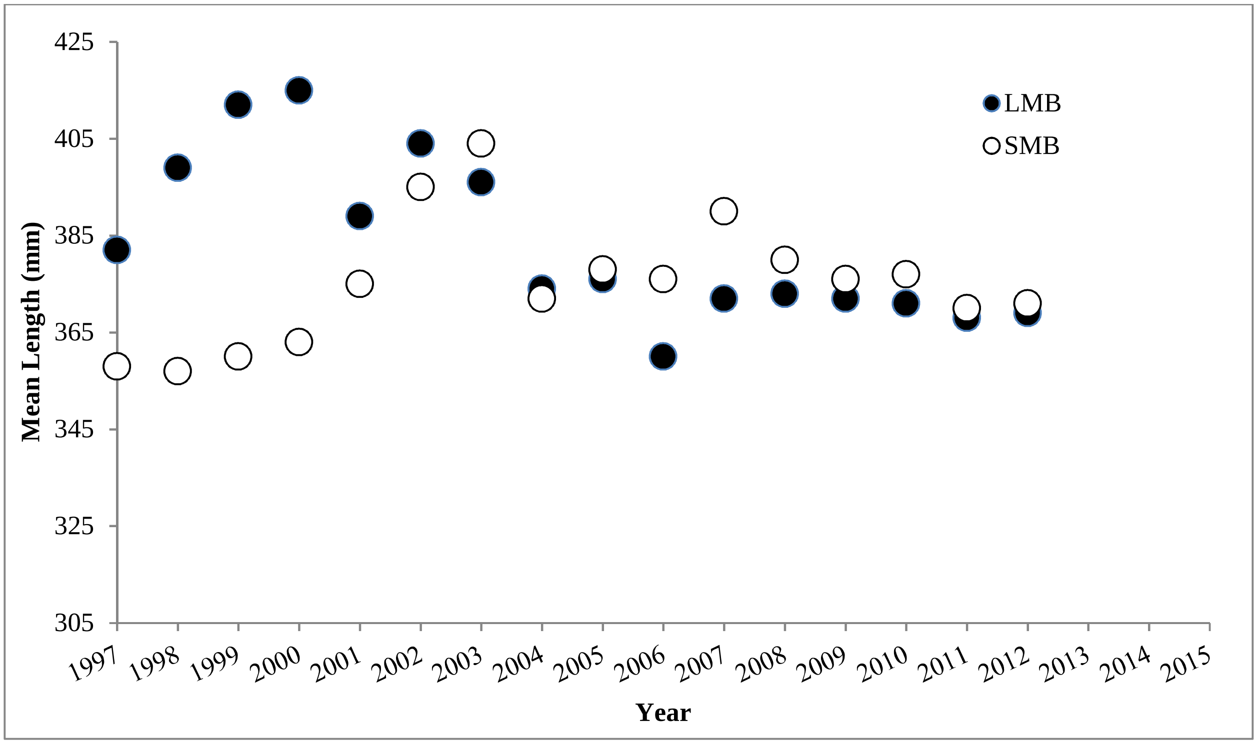

Figure 32. Annual mean length of largemouth and smallmouth bass checked in at bass tournaments on Noxon Reservoir 1997-2015**.**

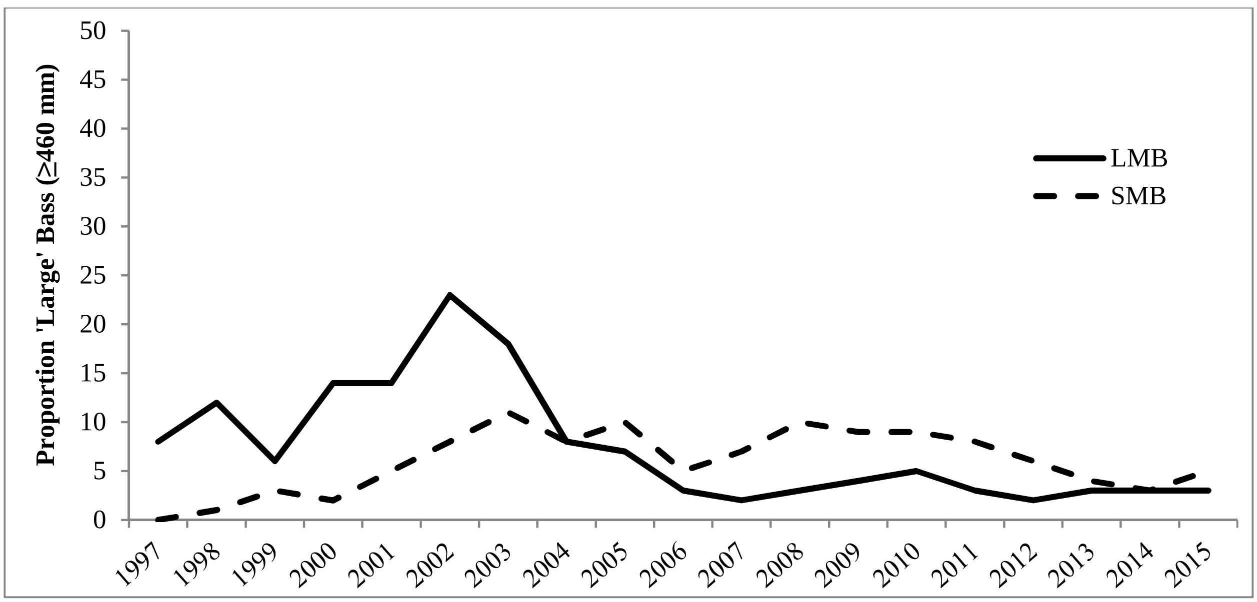

Figure 33. Proportion of large bass (≥460 mm) checked in at Noxon Reservoir bass tournaments.

WALLEYE MONITORING

Walleye in Noxon Reservoir have increased since 2000 when standardized netting began (Figure 33). Since 2002, mean length of fall caught Walleye has ranged between 400 and 500 mm. The W_r of fall-caught Walleye remained at or near 100 through 2013, but has declined over the past two years (Figure 28). This decline was consistent across size-classes of Walleye.

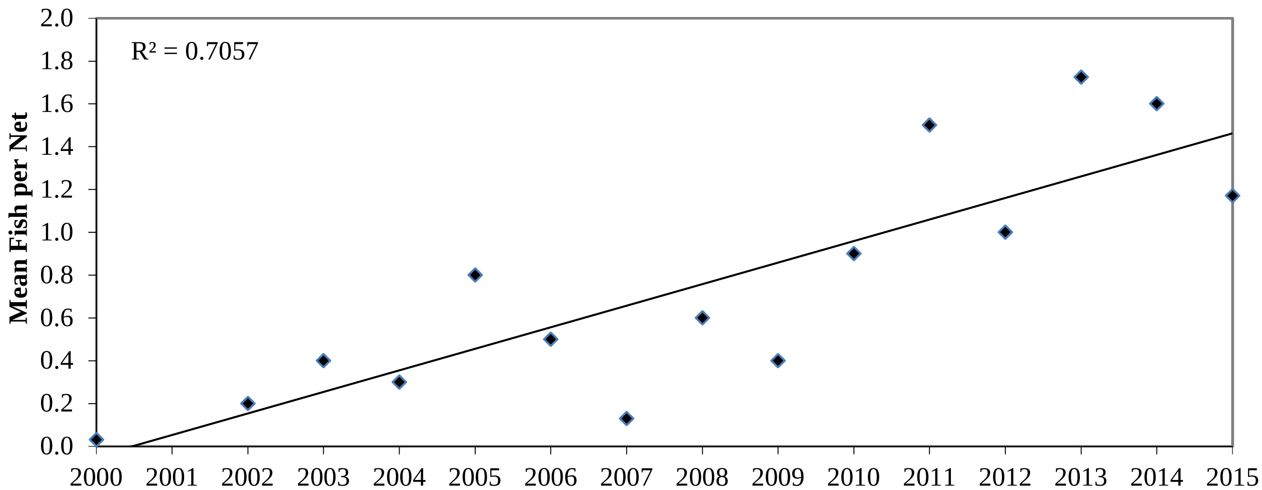

Figure 33. Mean Walleye per net night captured in standardized gill net sets in Noxon Reservoir since 2000.

Based on length-at-ages estimated with otoliths of fall-caught fish, the growth of male and female Walleye differ greatly past age-2 (Figure 34). Additionally, variation in the mean lengths of older Walleye is high (Figure 35).

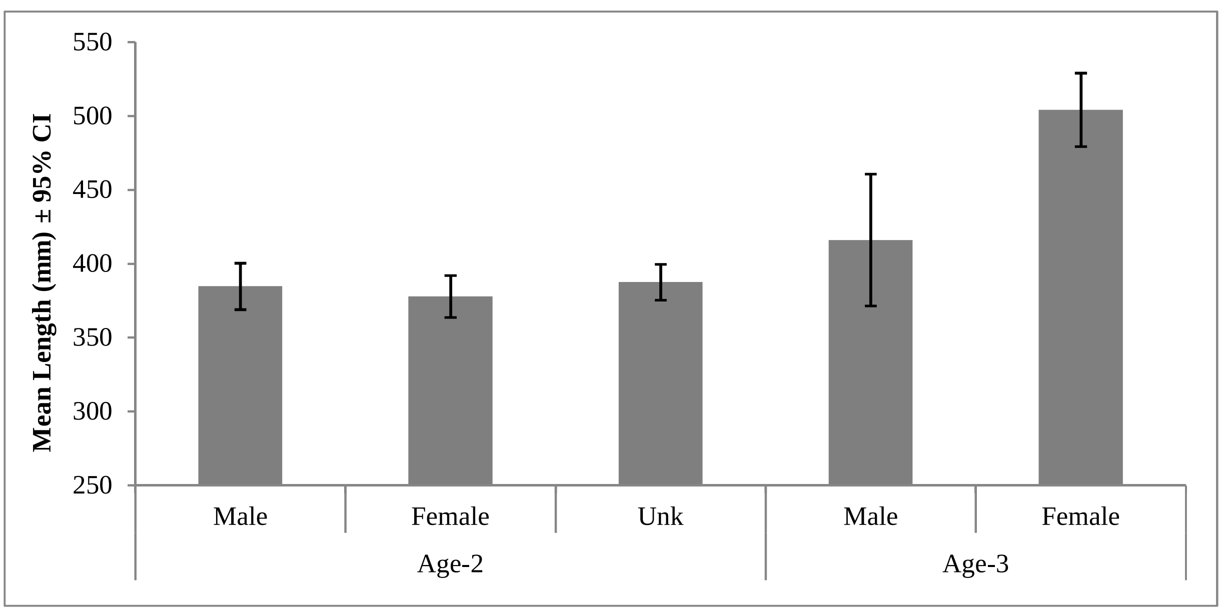

Figure 34. Mean length at age of fall-caught Walleye in 2015 from both sexes.

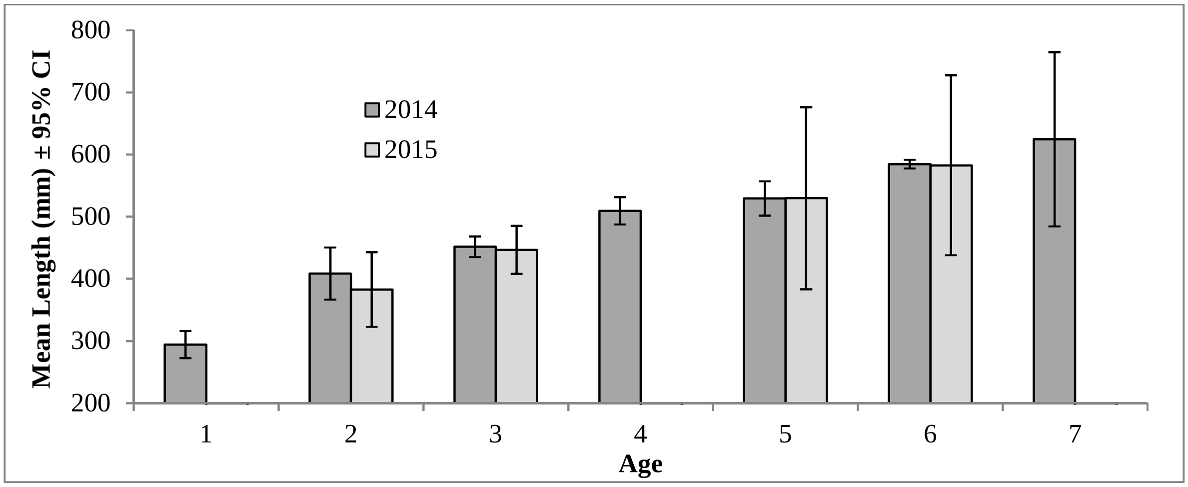

Figure 35. Mean length at age of Walleye in Noxon Reservoir captured in fall gill nets in 2014 and 2015.

Early attempts to quantify Walleye year-class strength and the factors which drive them were limited due to low sample sizes of fish captured. Based on recent survey results, 2012 and 2013 appear to have produced relatively strong year classes, while 2011 appears to have been a poor year for Walleye spawning or recruitment (Figure 36, Table 12). Only 2 (4%) of the total fish captured in fall gill nets in 2014 were from the 2011 cohort, while no age-4 Walleye were captured in 2015 (Figure 36). Also in 2015, no fish were captured from the 2014 year-class. This cohort will continue be tracked over time as age-2 and age-3 Walleye are the most common age-classes captured in fall gill nets and these fish will begin to show up during spring spawning in 2017.

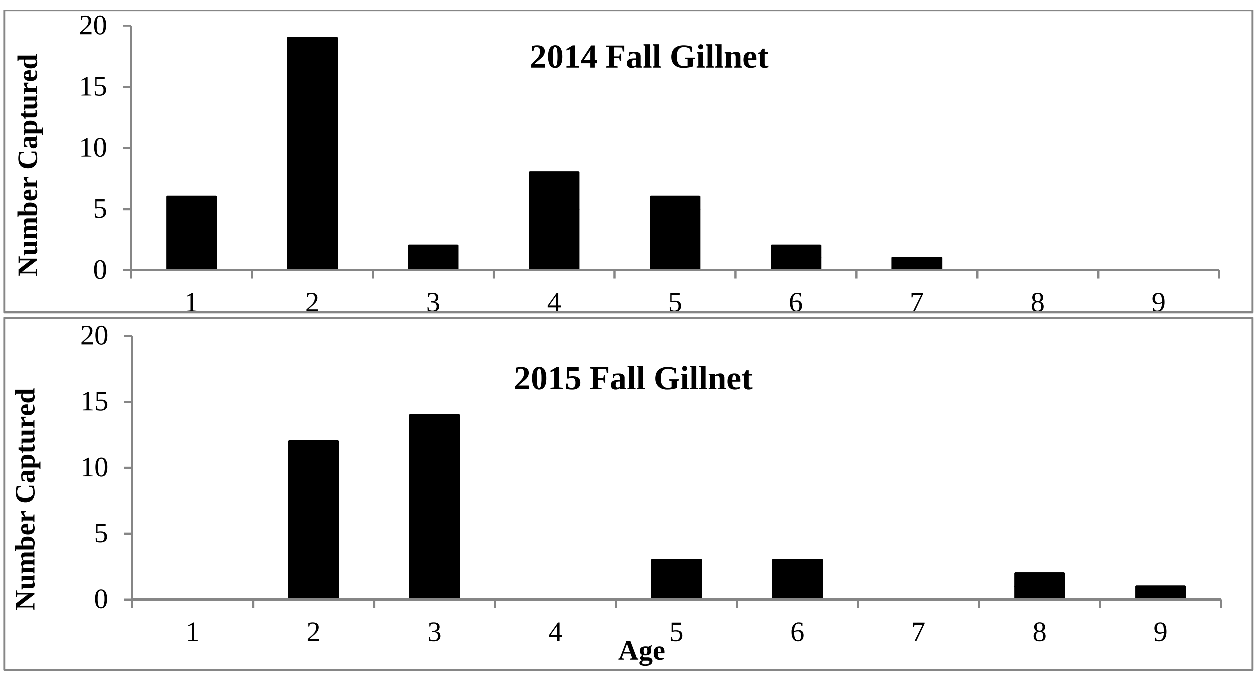

Figure 36. Year-class abundance from fall gillnets in Noxon Reservoir from 2014 and 2015.

Table 12. Numbers of fall-caught Walleye from separate cohorts captured in annual fall gillnetting events.

Survey Year	n	Age Group 1	2	3	4	5	6	7
2012	29	0	2	18	0	8	1	0
2013	50	9	2	20	9	0	8	2
2014	47	6	19	2	10	5	2	2
2015	35	0	12	14	0	3	3	0
	Recruitment Year	2014	2013	2012	2011	2010	2009	2008
	Yearly Mean	3.8	8.8	13.5	4.8	4	3.5	1

Additional spring sampling for Walleye began in 2012, but became a replicable measure of Catch per Unit Effort *(C/f)* in 2013. Since then, catch rate and timing have varied by year, but *C/f* is highest in late-April and early-May (Figure 9).

Contracted Research Projects

In 2016, the Noxon Reservoir predictive model was finalized (Scarnecchia and Lim 2016). This report used long-term gill net data first presented in Scarnecchia et al. (2014), and applied simple logistic growth models in order to predict future trends in Walleye, as well as other reservoir species. Basic conclusions were that, by themselves, Walleye were not likely to increase to a level which dominates the fish assemblage of the reservoir. The authors conclude that the current fish community has reached a new and healthier balance of prey and predator species than was present in the mid-nineties. However, there remains uncertainty of whether or not the predator group will exceed the capacity of the prey group. When combined with other species (i.e., Smallmouth Bass and Northern Pike), the non-native predator group could potentially reach a level that the current forage base could not sustain. It is unknown at what level this would be since little is known about specific food-web interactions in Noxon Reservoir. The report called for continued monitoring of predator and forage species and the knowledge that management intervention for any species may be called for in the future.

The update of the case histories used in the original Colby-Hunter EA was completed in 2016 (Bramblett and Zale 2016). In two of the four case histories, different stocking strategies of trout were used to mitigate the effects of introduced Walleye (Upper Missouri River, Montana, North Platte River, Wyoming). In John Day Reservoir, Washington, only small Walleye were found to consume salmonids and management strategies are now aimed at reducing large Northern Pikeminnow. In Escanaba Lake, Wisconsin, Smallmouth Bass have again entered the harvest after having been virtually extirpated in the mid-1960s due to an introduction of Walleye and Northern Pike. This report also included information on the status of nine reservoir Walleye fisheries in Montana. Factors that generally appeared to limit Walleye populations in Montana reservoirs were forage fish abundance, widely fluctuating reservoir water levels, and short water retention times. In Canyon Ferry Reservoir, Montana, proportions of anglers targeting Walleye initially increased, however angler satisfaction with the overall fishery was low.

The final contracted study was an economic analysis of the Noxon Reservoir fishery. A draft of this project is currently under review by Montana Fish, Wildlife and Parks.

DISCUSSION

FALL GILLNETTING

Recent trends (2013-2015) obtained from fall gill nets in Noxon Reservoir reveal that overall fish numbers have increased for the past four years. This is in contrast to previous reports which reported decreases in all forage species (Kreiner and Tholl 2013, Scarnecchia et al. 2014). This change can mostly be accounted for by recent increases in Yellow Perch and to a lesser degree, Pumpkinseed. These two species are closely associated with aquatic vegetation, and the dense beds of macrophytes in Noxon Reservoir may allow them better survival and recruitment than many native species which evolved in a more riverine environment or large oligotrophic lakes.

Although the declines in many native species have been consistent since 2000, trends of other species have not. Perch and Pumpkinseed were caught in higher numbers in the early 2000s, followed by declines, and more recently all-time highs. It is unknown what may have triggered those initial declines, followed by recent increases. Smallmouth Bass and Northern Pike *C/f* began to increase dramatically around 2010. The relationship between bass, Yellow Perch, Pumpkinseed, and macrophyte densities in Noxon Reservoir warrants further study.

Scarnecchia and Lim (2016) cautioned that Noxon Reservoir has potential to fall into a "predator trap" if Northern Pike, Smallmouth Bass, and/or Walleye continued recent increases in population and depleted the current prey base. However, because specific food-web interactions in Noxon are unknown, it is unknown at what level the threshold would be. Certainly, the native minnows and suckers have decreased dramatically concurrent with increases in predator numbers. However, the prey base appears to have been maintained by recent increases in Yellow Perch and Pumpkinseed. Other species such as Signal Crayfish *Pacifastacus leniusculus* have been documented as prey for Smallmouth Bass in Noxon Reservoir, and their population status is presumed to be good.

The overall mean relative weight of Northern Pike and Walleye declined in recent years (Figure 28). In both species, this decline was observed equally across all size-classes. A decline in relative weight can be an indication of a decline in prey availability (Neumann et. al 2012). However, during that same time period, Smallmouth Bass relative weight has fluctuated separately, but remains near 100, indicating that other factors or different prey species may influence Smallmouth Bass than Northern Pike and Walleye.

In Cabinet Gorge Reservoir, the fish community was similar to Noxon Reservoir, but gill net catch was lower for all species. This was similar to a recent creel survey which showed that angler catch rates, total catch, and pressure were also lower in Cabinet Gorge than in Noxon Reservoir (Blakney *in preparation)*. Some factors which contribute to this could be Cabinet Gorge Reservoir's lower water retention time (1/3 that of Noxon), lower proportion of littoral habitat than Noxon, and wider daily reservoir fluctuations than Noxon.

BASS TOURNAMENTS

Based on bass tournament data collected since 1997 in Noxon Reservoir, the bass fishery has improved over the past several years. The mean lengths and the proportion of quality fish has increased since 2003. This increase in bass size is in spite of greater fishing and tournament pressure on the reservoir.

Based on the proportion of large fish (>460 mm) checked in over time, current proportions are lower than in the recent past. A common scapegoat is angler harvest. However, a recent creel survey on Noxon Reservoir in 2015 documented low harvest of both bass species, especially Largemouth Bass (Blakney *In Preparation)*. Only 4% of the Largemouth Bass caught were harvested, while 14% of Smallmouth Bass were harvested. Of all bass harvested, less than one percent of each species was greater than 460 mm. Even if harvest of large bass was high, regulation changes would likely not be popular with bass anglers. Current Montana State fishing regulations require that tournament anglers only possess a number of fish which is at or below the legal daily limit. Therefore, limiting the harvest of large fish would limit bass anglers from possessing those fish in their live wells during tournaments and would not be supported by competitive bass anglers. It is possible that increased densities of bass species and other predatory game fishes have affected growth rates through competition. However, overall mean relative weight of fall-caught Smallmouth Bass remained near 100 in 2015, and growth rates are unknown.

BASS SEINING

Beach seining for age-0 Largemouth Bass continues to show variability in growth which coincides with overall year-class strength. However, limitations with this sampling method have been observed. For example, in 2015 the mean length of sampled Largemouth Bass during the mid-August time period was above the long-term average at 52.7 mm. However, mean lengths at all other sampling events in 2016 barely exceeded 60 mm. It is possible that the elevated early-season temperatures and low magnitude of run-off in 2015 led to successful pre-run-off spawning of Largemouth Bass. The progeny of these early spawn events would likely have been larger than average by mid-August. Ideal growing conditions in 2015 should have allowed for continued growth throughout the season. Perhaps due to the low magnitude of run-off, Largemouth Bass continued to sp[awn through the month of June and July which resulted in smaller than average young-of-the-year fish being captured late in the season. Brown et al. (2009) reports that bass growth does not slow down until water temperatures hit 7-10°C, which typically occurs in November in Noxon. Therefore the decline in mean length observed from

August through September indicates that different fish from later spawn events were sampled in September and October, 2015.

Another limitation to bass seining is that dense beds of aquatic macrophytes can inhibit a successful haul, despite the fact that these areas likely hold the highest densities of young bass. Interestingly, Hanson and Tholl (2007) documented these circumstances in 2004 and 2005, before Eurasian Water Milfoil (EWM) was known to be present in Noxon Reservoir. This observation indicates that dense macrophyte beds were common in Noxon Reservoir prior to EWM establishment (i.e., 2004 and 2005). No studies in Noxon have been conducted which attempt to link age-0 Largemouth Bass (or prey species) to specific species of macrophytes. Based on observations in Noxon Reservoir, it is clear the vegetation is beneficial to the survival of young fish.

Despite limitations, it is recommended the beach seining for young Largemouth Bass continue. Trends of Largemouth Bass adults are difficult to track with other sampling methods (e.g., gill nets). In the future, it is recommended that catch per unit effort data for Largemouth Bass, Yellow Perch, and Pumpkinseed be collected as well. With slight adjustments in sampling procedures, it will be possible to track year-class strength of Largemouth Bass and forage species over time in relation to changing environmental conditions (e.g., macrophyte communities and densities, water temperature, river discharge) as well as increasing predator populations.

WALLEYE SAMPLING

Since 2013, additional spring sampling of Walleye has afforded another gauge of Walleye year-class strength and to some degree, abundance. However, spring sampling can also be greatly affected by environmental conditions such as run-off and water temperature, so catch rates may not always be an accurate indication of abundance. Standardized *C/f* of both female Walleye and total Walleye was highest in 2013. Overall catch was highest in 2015, but effort was also much higher. Total catch of spring Walleye may be used to determine year-class strength, but caution must also be given if ages are assigned to fish based on length alone. There is a high degree of confidence in determining Walleye age based on length of young fish (age-2 or less). For sexually mature fish, age-3 males tend to be less than 400 mm, but data collected in 2016 has shown that the size of age-4 males is highly variable and may have some overlap with adjacent year-classes. Additionally, the growth of male and female Walleye differs greatly past age-2 (Figure 34), and variation in the mean lengths of older fish is high (Figure 35). It is recommended that individual sexes be combined with otolith ages and that as many fish as possible or allowable be used to determine cohort strength.

Results from spring sampling may be used to support observations obtained during fall gill netting. For example, in April 2016, high catch rates of small males were observed on the spawning grounds consistent with numbers of fall caught age-2s in 2015 (Figure 26). Based on lengths alone (<400 mm), it is believed that these fish were primarily age-3 males. Approximately 22 of these small males will be aged with otoliths to verify hatch year. If these are indeed all age-3 fish, it coincides with the high female catch rate observed in spring, 2013 (Figure 37).

The factors which contribute to year-class strength in Noxon are not entirely clear. Higher reservoir retention time has been linked to successful Walleye recruitment in other systems (Willis and Stephen 1987, McMahon 1992). Presumably, this is due to the poor swimming ability of Walleye fry (Scott and Crossman 1973), and the likelihood of being flushed from the reservoir. The incubation period of Walleye is less than three weeks and young-of-the-year Walleye disperse into the upper levels of open water shortly after hatching and do not move toward the bottom until the latter part of the summer (Hartman 2009, Scott and Crossman 1973). Based on past research (Horn et al. 2009) and current sampling in Noxon, Walleye spawning is believed to peak from mid-April to early-May, which suggests that most fry emerge in early to mid-May and begin to drift during that month. In almost all cases, it appears that higher sustained flows during June and July may contribute to a decrease in Walleye year-class strength. Of the past nine years, five of the six seemingly “strong” year classes (2007, 2009, 2010, 2013, and 2014) have been associated with June and July discharge below the mean value, and conversely three of the “weak” year classes (2008, 2011, and potentially 2014) can be linked to years with above average June and July flow (Figure 38, Table 11, Table 12). The 2012 cohort is a potential exception since it has had substantial representation in fall gill nets over the past two seasons, including a record number of age-2s in 2014 (Table 11). Mean June and July flows in 2012 were above average (Figure 38). Other factors documented to impact Walleye success, such as water temperature during early development may factor in as well. Spring water temperature in Noxon Reservoir was not monitored until 2013, but we will continue to monitor this and other potential variables in the future.

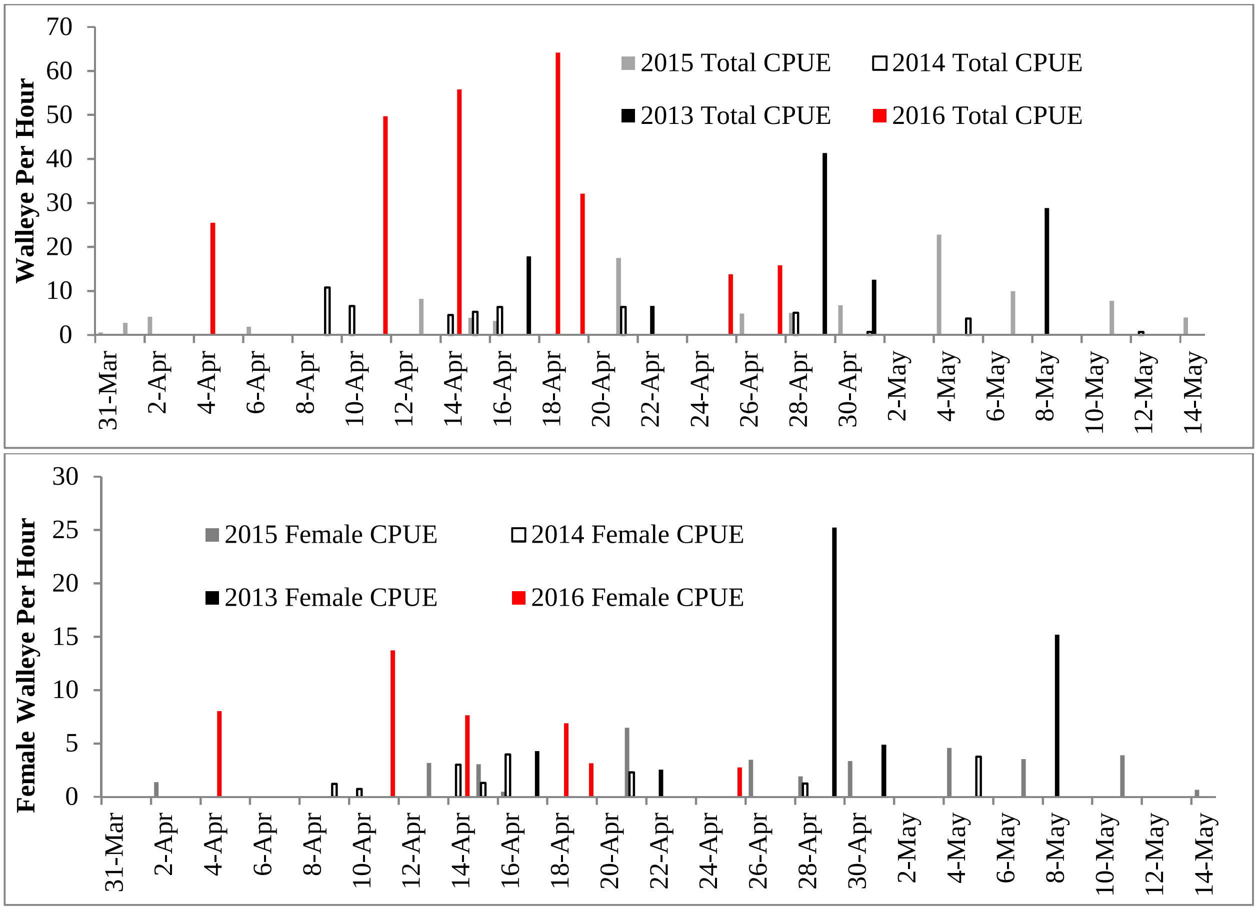

Figure 37. Total and female Walleye CPUE from nighttime jet-boat electrofishing during spring, 2013-2016.

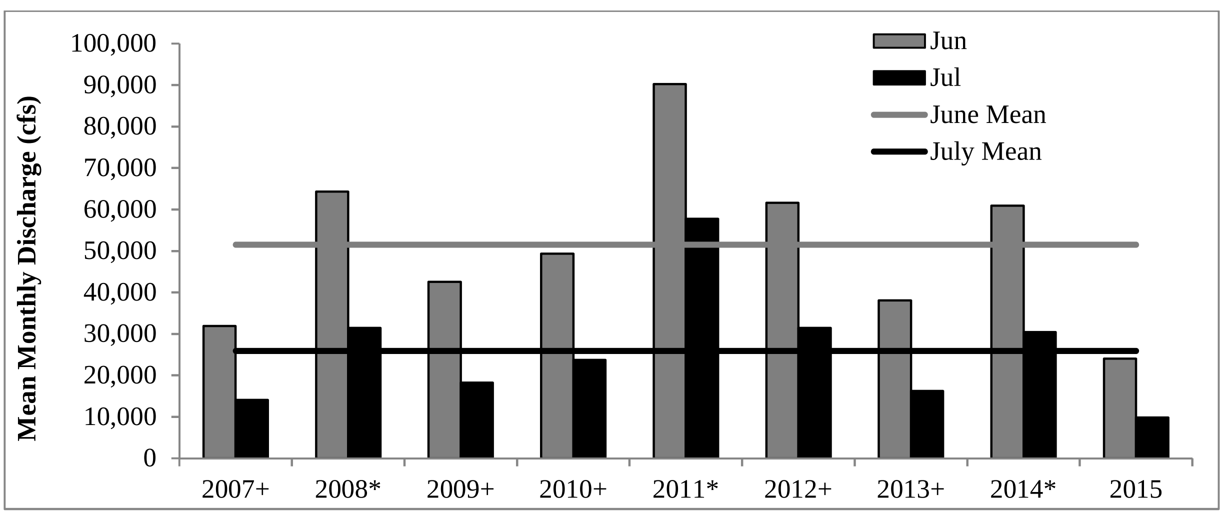

Figure 38. Mean June and July monthly discharge of the Clark Fork River near Plains, MT during spring and summer- 2007-2015. (+ indicates a year which has had relatively strong representation of Walleye in annual fall gill nets, * indicates a year which has had relatively weak representation of Walleye in annual fall gill nets.)

Compared to other Montana reservoirs which contain Walleye, relative abundance in Noxon is low. Gill net catch of Walleye per net night in nine other Montana reservoirs ranged from 3.3 per net night in Tiber Reservoir to 30.0 per net night in Cooney Reservoir, with an average of 9.5 per net night (Dalbey et al. 2013). Based on gill net catches in Noxon, Walleye relative abundance was as high as 1.7 per net night in 2013 and is currently at 1.2 per net night (Figure 33). Holter Reservoir had a similar retention time to Noxon, but had a relative abundance of 11.3 per net night, although these numbers are likely inflated by Walleye which are flushed downstream from Hauser and Canyon Ferry Reservoirs (FWP 2010). All other reservoirs had retention times of at least six times greater than Noxon.

The use of genetics may provide a convenient tool to monitor the effective number of breeding Walleye in Noxon over time. Initial estimates were that less than 100 breeders produced two separate cohorts (2010 and 2012) (DeHaan et al. 2016). However, this should not be substituted for an actual census as total population is often much greater than N_b (Ruzzante et al. 2016). Beginning with data collected in spring, 2016, attempts will be made to estimate actual Walleye abundance using either a maximum likelihood removal model based on catch rates in the spring, or a Jolley-Seber type mark-recapture study using tagged fish from the spring which are recaptured throughout the reservoir in the fall. The fact that N_b estimates in Noxon Reservoir are lower than the actual number of spawning fish may partially indicate the inconsistency of conditions which exist for spawning Walleye in April on the Clark Fork River. Snowmelt drives water temperature and retention time, both of which may affect spawning success. For cohorts which are perceived to have been negatively impacted by high run-off events (e.g., 2011), it may be impossible to collect enough individuals for a genetic-based estimate of N_b. Therefore, genetic samples will be biased towards stronger cohorts. However, samples will continue to be collected in order to track potential trends over time.

Several more years of monitoring in Noxon Reservoir will provide insight on the Walleye population. The recent decline in Walleye W_r observed over the past two years may indicate a decrease in forage base or some type of competition. In Noxon Reservoir, mean Walleye W_r increases with increasing body length, indicating that food may be more limited for smaller fish. However, the recent decrease in overall mean W_r was observed equally across all size classes which may indicate a reduction in forage at all sizes. Additionally, recent observations on year-class strength will be further verified with increased sampling in spring and fall.

ADDITIONAL RESERVOIR SAMPLING

Since 2011, additional sampling of Noxon Reservoir fish has occurred at the fish ladder at Thompson Falls Dam. Although data collected at this facility are not indicative of trends in reservoir populations, they do afford additional sampling methods for reservoir species including many which are not regularly sampled in other techniques. One major discrepancy is the sampling of salmonids in the fish ladder. Noxon Reservoir does not provide exceptional habitat for salmonids, but the fish ladder has captured an average of more than 400 salmonids per year at the head end of Noxon Reservoir. These are primarily Rainbow Trout *Oncorhynchus mykiss*, Brown Trout *Salmo trutta*, Mountain Whitefish *Prosopium williamsoni*, and Westslope Cutthroat Trout, but have also included Bull Trout, Brook Trout and Lake Trout. None of these species are captured in significant numbers during other reservoir sampling events. This indicates that while sampling methods such as gill nets are useful indices of abundance, no single technique should be used to infer overall species composition due to gear specific biases associated with all gear types.

Additionally, in five years of operation the ladder has passed close to 7,000 adult Northern Pikeminnow, and almost 14,000 Largescale Suckers. In contrast, the ladder had not passed a single Peamouth until 2015. At that point it passed 122 adult Peamouth upstream. There is potential that allowing passage of these native species from the more predator-heavy Noxon Reservoir into Thompson Falls Reservoir could increase recruitment by allowing for successful spawning and rearing upstream. Because of the sheer numbers of fish passed, a positive response would likely be most notable in the Largescale Sucker populations. Several more years of monitoring may indicate whether fish passage is positively influencing native species in Noxon Reservoir or upstream in Thompson Falls Reservoir. As of now, the relationship between the Thompson Falls fish ladder and Noxon Reservoir fish populations remains unknown.

RECOMMENDATIONS

1. Continue additional Walleye sampling in order to collect adequate sample sizes, evaluate year-class strength, and evaluate gear effectiveness. Potentially include different sampling techniques as a comparative for gear efficiency. Additional consideration should be put into sampling design which may provide a more thorough understanding of overall population size.
2. Document numbers of all fish sampled during beach seine events in order to track *C/f* of age-0 Largemouth Bass and prey species fish over time. Additional sampling gears should be considered, especially for sampling in dense stands of macrophytes.

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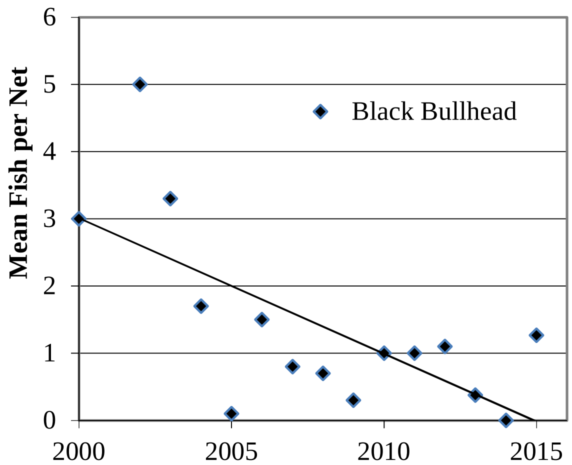
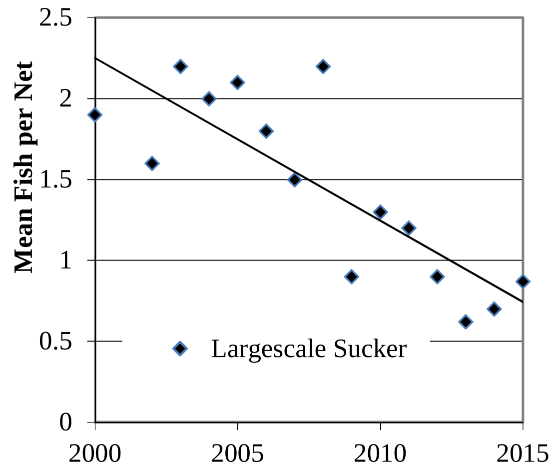
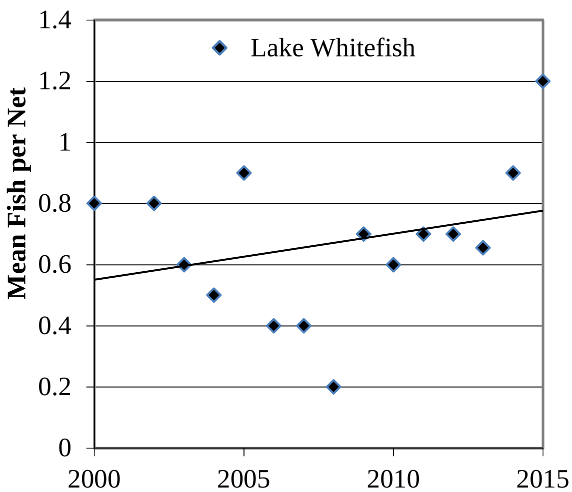
Appendix A. Species abbreviations and scientific names of fish in Noxon and Cabinet Gorge reservoirs

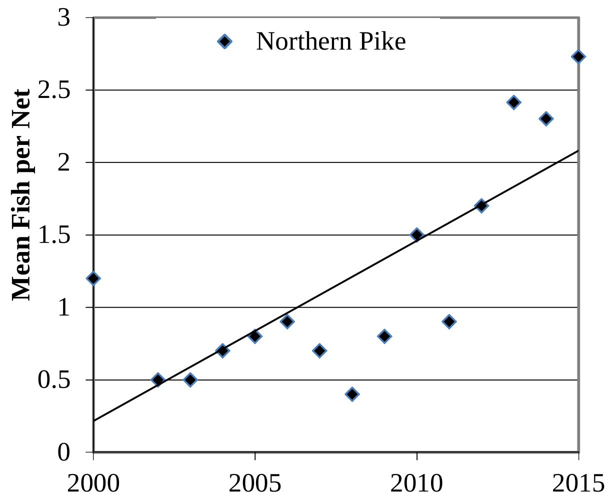
BL BH	Black Bullhead *Ameiurus melas*
LL	Brown Trout *Salmo trutta*
BULL	Bull Trout *Salvelinus confluentus*
L WF	Lake Whitefish *Coregonus clupeaformis*
LMB	Largemouth Bass *Micropterus salmoides*
LS SU	Largescale Sucker *Catostomus macrocheilus*
LN SU	Longnose Sucker *Catostomus catostomus*
MWF	Mountain 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*

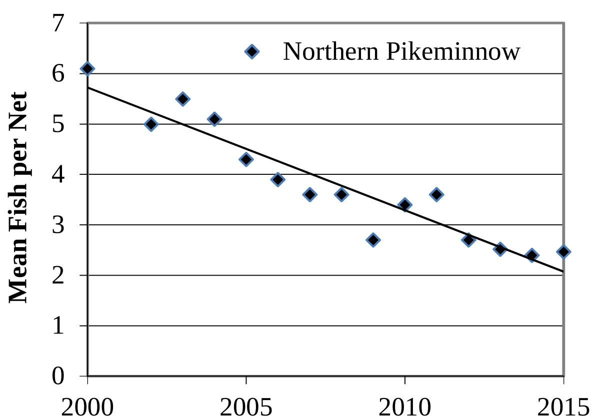
Appendix B. Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Noxon Reservoir, 2000-2015.

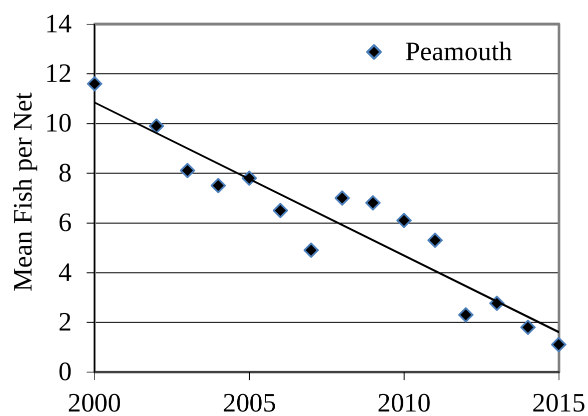

Mean Fish per Net
Black Bullhead
0
1
2
3
4
5
6
2000
2005
2010
2015

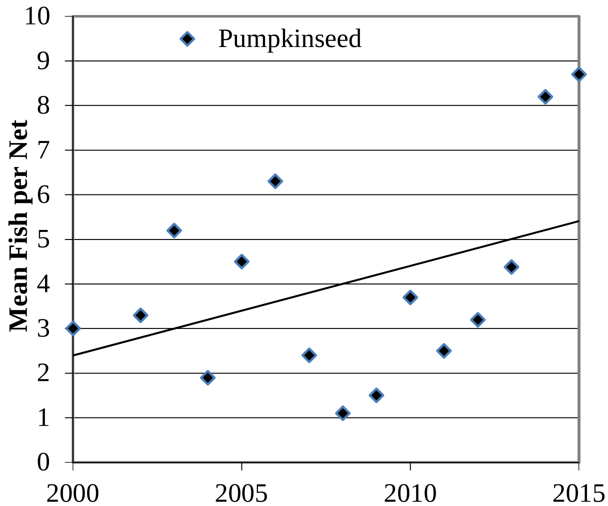

Mean Fish per Net
Largescale Sucker
0
0.5
1
1.5
2
2.5
2000
2005
2010
2015

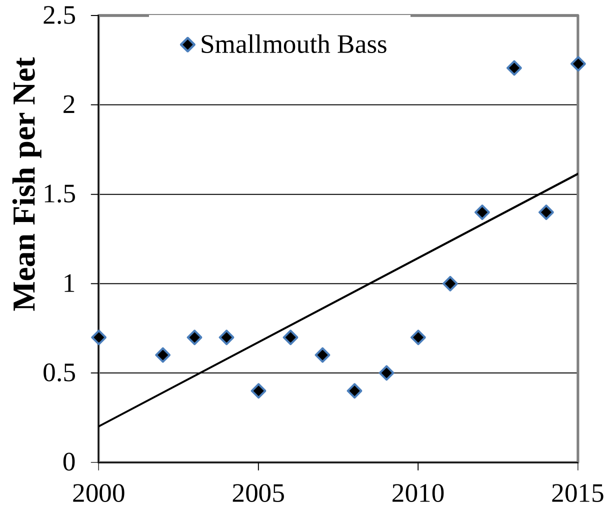

Mean Fish per Net
Lake Whitefish
0
0.2
0.4
0.6
0.8
1
1.2
1.4
2000
2005
2010
2015

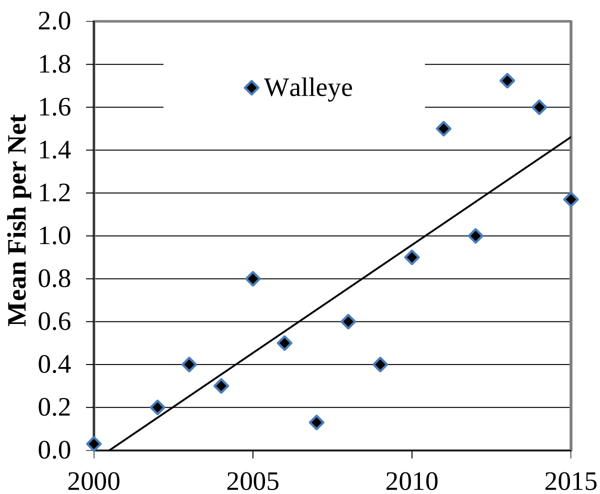

Mean Fish per Net
Northern Pike
0
0.5
1
1.5
2
2.5
3
2000
2005
2010
2015

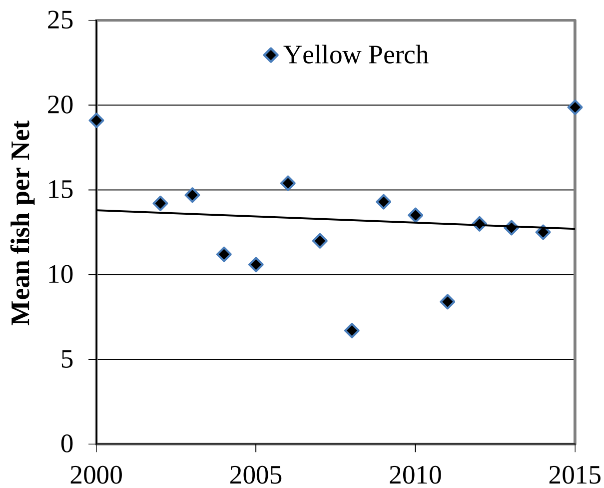

Mean Fish per Net
Northern Pikeminnow
0
1
2
3
4
5
6
7
2000
2005
2010
2015


Mean Fish per Net
Peamouth
0
2
4
6
8
10
12
14
2000
2005
2010
2015

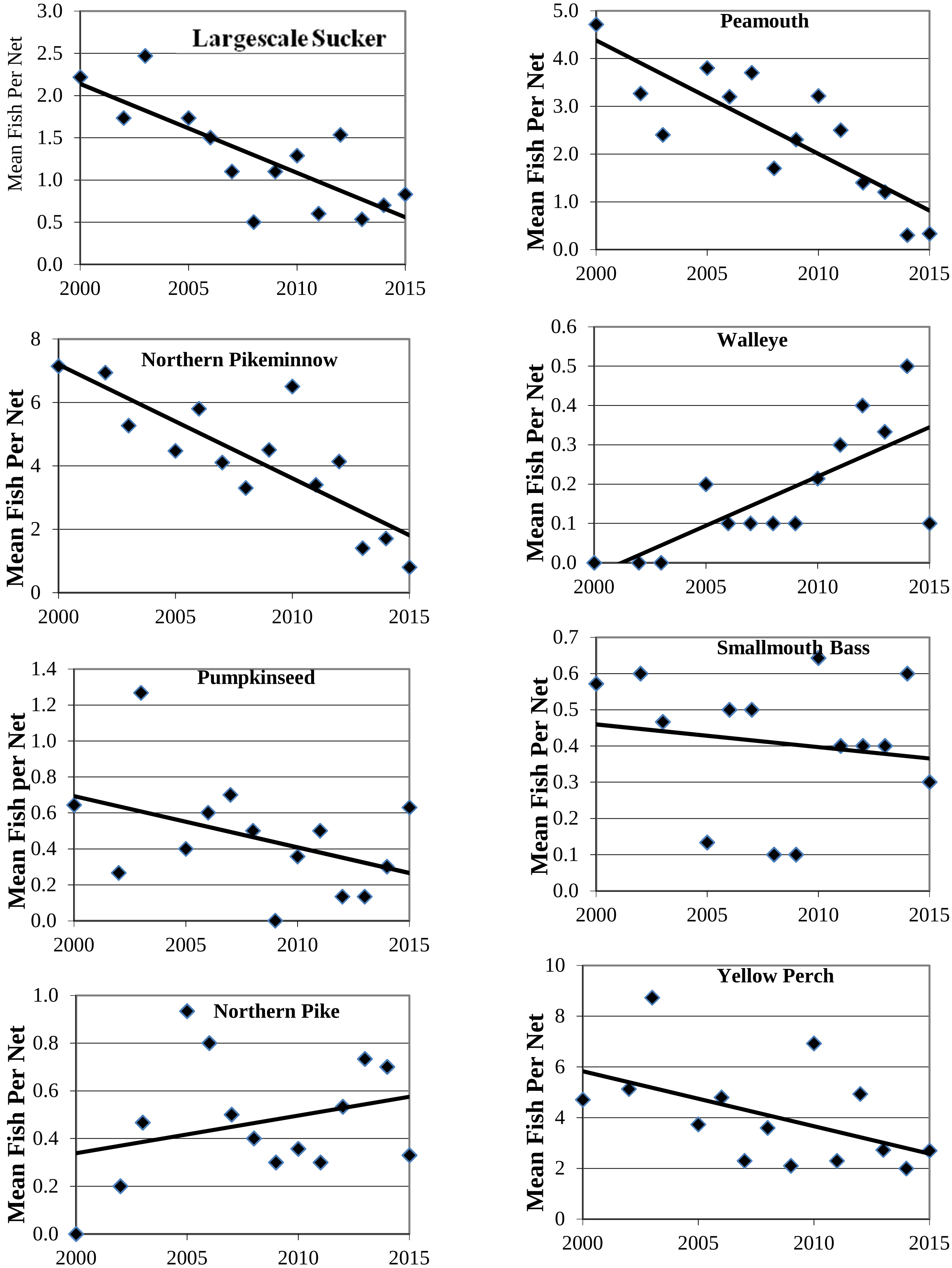

Pumpkinseed
Mean Fish per Net
10
9
8
7
6
5
4
3
2
1
0
2000
2005
2010
2015


Smallmouth Bass
Mean Fish per Net
2.5
2
1.5
1
0.5
0
2000
2005
2010
2015


Walleye
Mean Fish per Net
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2000
2005
2010
2015


Yellow Perch
Mean fish per Net
25
20
15
10
5
0
2000
2005
2010
2015

Appendix C. Catch per Unit Effort (CPUE) trends of selected fish from annual gill net surveys in Cabinet Gorge Reservoir, 2000-2015.



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

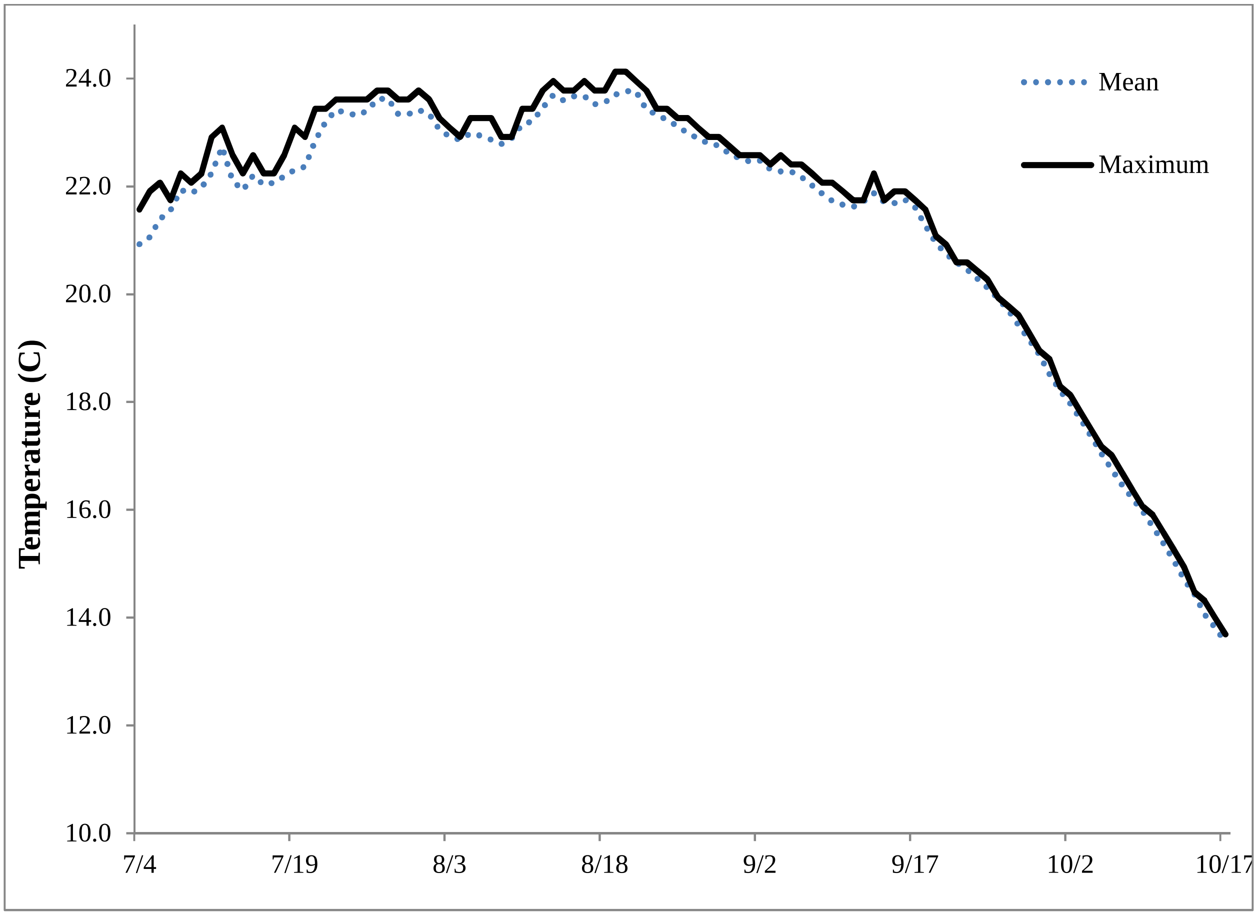


Figure D-1. Maximum and mean daily water temperatures from lower Noxon Reservoir (approximately 3.0 km upstream from Noxon Rapids Dam) during Summer, 2013.

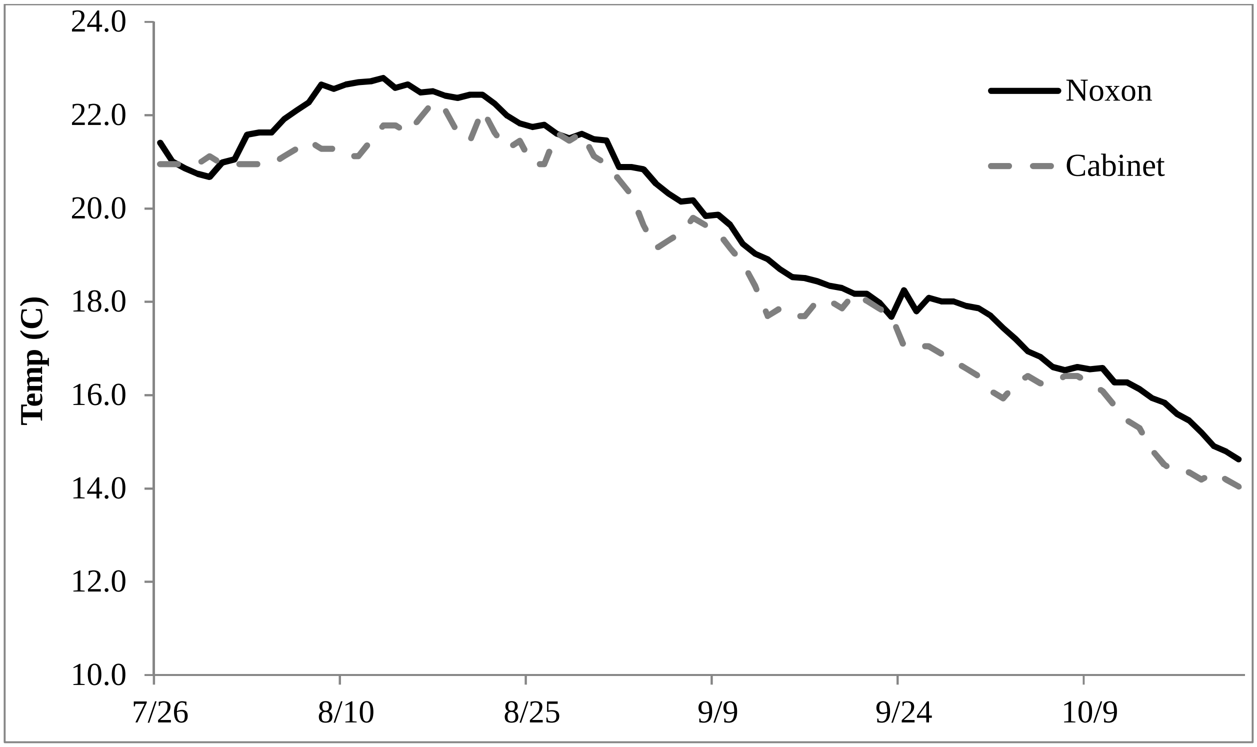


Figure D-2. Maximum daily water temperatures from lower Noxon (approximately 3.0 km upstream from Noxon Rapids Dam) and Cabinet Gorge reservoirs (approximately 3.5 km upstream of Cabinet Gorge Dam) during Summer, 2014.

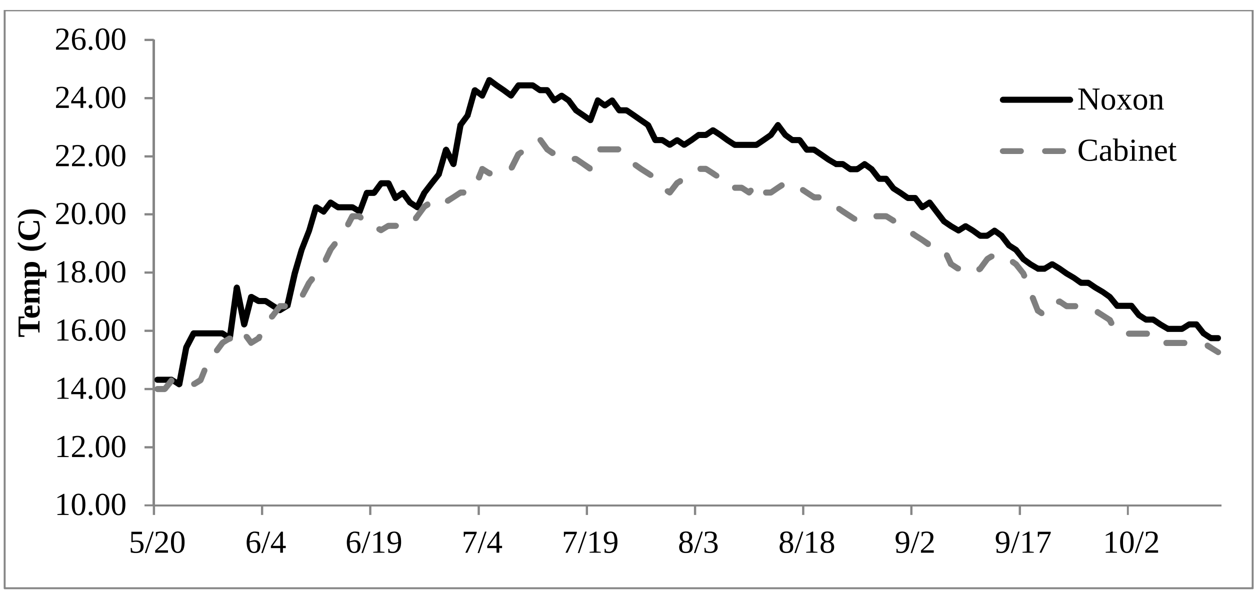


Figure D-3. Maximum daily water temperatures from lower Noxon (approximately 3.0 km upstream from Noxon Rapids Dam) and Cabinet Gorge reservoirs (approximately 3.5 km upstream of Cabinet Gorge Dam) during Summer, 2015.