Silver Lake
Fisheries Assessment, 2017
Barron County, WI
(MWBIC: 1881100)

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Executive Summary

Silver Lake was surveyed during 2017 to assess the abundance and population demographics (i.e., size and age structure, growth, and recruitment) of sport fish, and make comparisons with previous surveys. Overall, the fishery was in good condition and the fish community was similar to the 2009 survey. The adult walleye population estimate for Silver Lake was 2.2 fish/acre, which was a slight improvement from the 2009 survey when it was estimated at 1.7 fish/acre. The walleye population in this survey was the highest estimate ever documented on Silver Lake. Silver Lake has maintained low to moderate levels of walleye natural reproduction with occasional strong year classes. The walleye population appears to be largely driven by natural reproduction despite extensive stocking efforts of fry and small fingerling walleye which have had negligible returns based on age-0 catch rates during fall evaluations and OTC analyses. Silver Lake continues to have respectable populations of largemouth and smallmouth bass and both offer popular fisheries among anglers. Largemouth bass were more abundant (4.4 fish/ac) than smallmouth bass (0.8 fish/ac). We were unable to get a reliable population estimate (CV=0.44) on smallmouth bass, but based on angler reports, there continues to be a popular smallmouth bass fishery present which provides a unique angling opportunity to the area. Northern pike and panfish species had lower abundances with respectable size structure. The lower abundance of these species is likely due the lack of shallow vegetated areas and overall lower productivity compared to other Barron and Polk County lakes.

Introduction

Silver Lake is a 337-acre lake located in northern Barron County, roughly 5 miles east of the City of Cumberland. It is a deep (91 ft maximum depth), softwater lake with a small littoral zone. Littoral substrate is primarily sand, gravel, and rock. There is limited macrophyte growth. Silver Lake is a seepage lake and the water levels can vary by as much as 12 feet over the course of a decade. There are 4.4 miles of shoreline and nearly all of which is developed and in private ownership.

The watershed is lightly developed and a mixture of forest (76%), wetlands (7%), and pasture/grass land/agriculture (9%; Homer et al. 2007). The watershed area for Silver Lake is 1,800 acres. In 1934, a manmade ditch was made between Sylvan Lake and Silver Lake, which diverted water from the Sylvan Lake watershed to Silver Lake to increase the water level of Silver Lake during low water periods. This more than doubled the watershed size for Silver Lake (4,490 acres) which negatively affected the water quality of Silver Lake. This ditch was permanently plugged in 2003.

Typically, Silver Lake has excellent water quality where summer Secchi disk readings commonly exceed 12 ft. However, the trophic status of Silver Lake can change with the water level. During the summer months, Silver Lake is typically considered mesotrophic based on Trophic State Index (TSI); however, during low water periods, Secchi disk TSI values can reach oligotrophic levels. Conversely, during high water periods Chlorophyll TSI values reach eutrophic levels. Phosphorus TSI values typically stay in the mesotrophic range. In general, the water quality of Silver Lake is considered very good and is one best lakes in Barron County in terms of water quality.

Silver Lake is considered a "complex two-story lake" in the Wisconsin Lakes Classification (Rypel et al. 2019). The fish community consists of walleye *Sander vitreus*, northern pike *Esox lucius*, largemouth bass *Micropterus salmoides*, smallmouth bass *Micropterus dolomieu*, bluegill *Lepomis macrochirus*, black crappie *Pomoxis nigromaculatus*, yellow perch *Perca flavescens*, rock bass *Ambloplites rupestris*, white sucker *Catostomus commersoni*, and cisco *Coregonus artedi*.

Historic fish stocking has primarily consisted of walleye and trout species (Appendix Table 1). Walleye stocking was reinitiated in 1988 after a nearly four-decade hiatus when the walleye fishery was maintained by natural reproduction (Cornelius

1990). Walleye stockings have mainly consisted of fry and small fingerlings. Despite the extensive small fingerling walleye stocking program from the late 1980s and 1990s, it did not bolster the population and was considered unsuccessful (Cornelius 1998). Since 2007, walleye stockings have exclusively been fry stockings from the Walleyes for Tomorrow portable hatchery (i.e., "walleye wagon") where walleye brood stock were collected from Silver Lake, spawned by volunteers and the fertilized eggs were reared in the portable hatchery next to the lake. All fry from this program were subsequently stocked back into Silver Lake from 2007-2017. In addition to walleye, there has also been a considerable amount of trout stocked into Silver Lake. Rainbow trout were the most stocked trout species, but limited brown and brook trout stockings also occurred. Trout have not been stocked into Silver Lake since 2003. Smallmouth bass were introduced into Silver Lake in 1978 by a single stocking of 6,016 fingerlings. The initial smallmouth bass stocking event has been considered a "success story" (Cornelius 1990) and has developed a popular sport fishery.

There is county park with a boat landing, picnic area, and swimming beach on the south shore. With the good water quality, the lake receives considerable recreational activity (i.e., swimming, boating, skiing, etc.). All fish species in Silver Lake are managed under the Wisconsin statewide fishing regulations (Appendix Table 2). In general, fishing regulations on Silver Lake have closely followed the base regulations, other than a 28 in minimum length limit and one fish daily bag limit walleye regulation that was in effect for the 2014 fishing season. This regulation was implemented following high harvest during the 2009 survey, but the regulation was replaced in 2015 during the broadscale walleye regulation changes and implementation of the Ceded Territory walleye base regulation of 15 in minimum length limit where 20-24 in is protected, 3 fish daily bag limit.

Silver Lake is now on a 9-year rotation for comprehensive surveys. Previous fish surveys, which included walleye population estimates were conducted in 1992 (GLIFWC) and 2009 (WDNR). Historic fall electrofishing surveys from 1989-2019 were used to assess walleye recruitment and stocking efficacy.

The objectives of this survey were to assess the status of the walleye population as part of the treaty assessment sampling rotation of lakes for the Ceded Territory of

Wisconsin and assess the abundance and population demographics (i.e., size and age structure, growth, and recruitment) of other sport fish Silver Lake and make comparisons with previous surveys.

Methods

Field Sampling:

The sport fisheries in Silver Lake were sampled in 2017 with early spring fyke netting, early spring and late spring electrofishing, and fall electrofishing (Table 1).

Population abundance of adult walleye was estimated using mark and recapture methodology during the early spring netting and early spring electrofishing surveys. Walleye were considered adult fish if they were ≥15 in or otherwise sexable (i.e., extrusion of eggs or milt; Cichosz 2019). Abundance of adult walleye was estimated using Chapman's modification of the Petersen single-census method (Ricker 1975):

$$N = \frac{(M+1)(C+1)}{(R+1)}$$

where N = population estimate; M = the number of fish marked in the first (marking) sample; C = the total number of fish (marked and unmarked) captured in the second (recapture) sample; and R = the number of marked fish captured in the second sample.

Walleye were captured with fyke nets set at ice out. Fyke nets were set April 3, 2017 and checked every 24-h for 10 days. All walleye collected in fyke nets were measured to the nearest 0.5-in TL and sexed. Aging structures were collected from five walleye of each sex per 0.5-in length group. Scales were taken from walleye <12 in and dorsal spines were taken from fish ≥12.0 in. For the recapture period, walleye were collected by boat AC electrofishing along the entire shoreline of the lake with two dip netters at night. All walleye were measured, sexed, and checked for marks.

Population abundance of adult (≥ 8in) largemouth bass and smallmouth bass were estimated using mark and recapture methodology. Bass were marked during the early spring netting survey, early spring electrofishing survey, and by additional daytime electrofishing events. The late spring electrofishing survey served as the recapture event. The entire shoreline was sampled and all bass were measured and checked for marks.

Abundance of adult largemouth and smallmouth bass were also estimated using Chapman's modification of the Petersen single-census method (Ricker 1975).

Bass and panfish were assessed by boat AC electrofishing at night along the shoreline on May 31, 2017 with two dip-netters. There was three 1.5-mile (or less) gamefish transects in which only gamefish were collected, and two 0.5-mile index transects in which all species were collected. Weights and aging structures were collected from five fish per 0.5-in length group for age and growth analysis.

The year-class strength of age-0 walleye was assessed with fall boat AC electrofishing at night with two dip-netters. The entire shoreline was sampled and all juvenile (<12 in) walleye were netted. Scale samples were collected from walleye for age and growth. The catch per effort (CPE) of age-0 walleye and age-1 walleye was determined by catch per mile and compared to previous fall evaluations. Comparisons were made with previous fall electrofishing surveys.

Population Demographics:

Scale samples were pressed on acetate slides and age was assessed on a microfiche reader by a single interpreter. Dorsal spines were mounted in plastic, cut with a Dremel saw and age interpreted on a microfiche reader by a single interpreter. Mean length-at-age comparisons were made with previous surveys, the Barron and Polk County averages, and the regional (18 county WDNR Northern Region) averages obtained from the WDNR Fisheries and Habitat database. Sex-specific aging data were pooled for making comparisons with county and regional averages.

Proportional size distribution (PSD) indices were used to describe population size structure of walleye, largemouth bass, and bluegill (Guy et al. 2007). PSD values represent the percent of fish stock length or larger that are also longer than a specified length (Appendix Table 3). The Fisheries Assessment Classification Tool (FACT) was used to determine how PSD values for largemouth bass and walleye compared to those from similar waterbodies throughout Wisconsin. The catch rates of all species were compared to other complex two-story lakes in Wisconsin (Rypel et al. 2019). In addition, the CPE for 8, 12, and 15 in (i.e., CPE8, CPE12, and CPE15) largemouth bass were compared to similar waterbodies in Wisconsin. Relative Weight (*Wr*) was used to assess

the condition level of gamefish species using their standard weight equations (Anderson and Neumann 1996). Relative weight is the ratio of a fish's weight to the weight of a ''standard'' fish of the same length.

Results

Early spring fyke netting and electrofishing

Walleye. The adult walleye population estimate for Silver Lake was 731 or 2.2 fish/acre (95% C.I. = 1.6-2.8 fish/acre; Figure 1), which was a slight improvement from the 2009 survey when it was estimated at 588 or 1.7 fish/acre (95% C.I.= 1.3-2.2 fish/acre). The walleye catch rate was 3.6 fish/net-night, which was less the median catch rate (6.6/net night) for complex two-story lakes in Wisconsin. There were 270 males, 43 females, and 28 unknown sex walleye in the sample (Figure 2). The male:female ratio was 6.3:1.

Size structure of walleye was considered low to moderate. Walleye PSD-15 from netting was 67 ± 5, PSD-20 was 7 ± 3, and PSD-25 was 1 ± 1 (Figure 3). These size structure indices were similar to previous netting surveys. When compared to statewide trends, the indices were moderate for smaller classes and low for higher size classes; walleye PSD-15 was in the 59th percentile, PSD-20 was in the 18th percentile, and PSD-25 was in the 25th percentile. Mean length of adult walleye (sexes pooled) from fyke netting was 16.7 in. The mean length of male walleye was 16.0 in and the mean length of female walleye was 20.6 in. Walleye *Wr* was 87, which suggested walleye were in below average condition.

Walleye ages ranged from 1 to 13 and the mean length at age for walleye (sexes pooled) closely followed those from the 2009 survey (Table 2). In general, Silver Lake walleye were slower growing when compared to the Barron and Polk County mean length at age and were less for age 5 and older but were slightly better for age 1 to age 4. When compared the Northern Wisconsin averages, Silver Lake walleye were fairly similar to the regional averages and were slightly higher at ages 1-8 but were less at ages 9-13.

Northern Pike. Catch of northern pike was low during the spring fyke netting surveys. There were 55 northern pike collected (Figure 4). The catch rate was 0.7 fish/net-night,

which was less than median catch rate (1.1 fish/net-night) for complex two-story lakes in Wisconsin, and also less than the 2009 fyke netting catch rate (1.4 fish/net-night). Northern pike ranged from 9 to 35.5 inches. There were 18 males, 28 females, and 9 northern pike of unknown sex. Northern pike PSD was not calculated due to low sample size.

Late spring electrofishing

Largemouth Bass. The adult (≥ 8 in) largemouth bass population estimate for Silver Lake was 1,495 or 4.4 fish/acre (95% C.I. = 3.4-5.5 fish/acre; Figure 5), which was an insignificant decrease from the 2009 survey when it was estimated at 1,769 or 5.2 fish/acre (95% C.I. = 3.8-6.7 fish/acre). We collected and marked 402 adult (≥ 8 in) largemouth bass by fyke netting and electrofishing (Figure 6). There were 205 largemouth bass collected during the late spring electrofishing survey for a catch rate of 46.6 fish/mile, which was well above the median catch rate (3.3 fish/mile) for complex two-story lakes in Wisconsin.

The catch rate of largemouth bass in Silver Lake was high for all sizes of largemouth bass compared to similar waterbodies in Wisconsin. The CPE8 (44.1 fish/mile), CPE12 (37.5 fish/mile), and CPE15 (4.5 fish/mile) were in the 86th, 98th, and 74th percentiles, respectively.

The largemouth bass population had decent size structure. Largemouth bass PSD-12 was 90 ±3, and the PSD-15 was 7 ±2 (Figure 7). The PSD-12 and PSD-15 both increased from the 2009 survey. When compared to similar waterbodies in Wisconsin, largemouth bass PSD-12 was good and was in the 92nd percentile. Similarly, the PSD-14 (43) was also considered high and was is in 80th percentile. Largemouth bass ranged in length from 6.7 to 19.5 in, and the mean length was 13.6 in. Largemouth bass *Wr* was 101, which suggests largemouth bass were in good condition.

Largemouth bass had slow growth rates but were similar to the 2009 survey. The mean length at age from age-4 to age-8 largemouth bass averaged 0.2 in more than those from 2009 (Table 3). Compared to regional averages, the mean length at age from age-4 to age-8 largemouth bass averaged 0.7 in less than the Barron and Polk County average,

and 1.4 in less than the Northern Region average. Largemouth bass did not reach 14 in until age 7.

Smallmouth Bass. Smallmouth bass were less abundant than largemouth bass. There were 29 adult (≥ 8 in) smallmouth bass marked during early spring netting, early spring electrofishing, and early spring supplemental bass marking, and there was 32 collected during the late spring electrofishing survey and one of the fish was marked (Figure 8). The adult smallmouth bass population estimate for Silver Lake was 264 fish or 0.8 fish/acre (95% C.I. = 0.1-1.5 fish/acre; Figure 5). However, due to the low number of fish collected, this is not a precise estimate (CV=0.44). There were 38 smallmouth bass collected during the late spring electrofishing survey for a catch rate of 8.6 fish/mile, which was well above the median catch rate (2.7 fish/mile) for complex two-story lakes in Wisconsin, and is also greater than the 2009 catch rate (4.5 fish/mile). The catch rate of smallmouth bass in Silver Lake was above average when compared to similar waterbodies in Wisconsin. The CPE8 (7.3 fish/mile), CPE12 (3.9 fish/mile), and CPE15 (0.7 fish/mile) were in the 81st, 79th, and 65th percentiles, respectively.

Smallmouth bass PSD was not calculated due to low sample size. Smallmouth bass ranged in length from 7.3 to 17.5 in, and the mean length was 12.8 in. Smallmouth bass *Wr* was 94, which suggests the smallmouth bass were in good condition.

Smallmouth bass had good growth rates. The mean length at age from age-3 to age-6 smallmouth bass averaged 1.3 in more than those from 2009 (Table 4). Compared to regional averages, the mean length at age from age-3 to age-6 smallmouth bass averaged 1.7 in more than the Barron and Polk County average, and 1.5 in more than the Northern Region average.

Bluegill. There were 97 bluegill collected during the late spring electrofishing survey (Figure 9). The catch rate of (≥3 in) bluegill was 78 fish/mile which was above the median catch rate (51.7 fish/mile) for complex two-story lakes in Wisconsin. Total length of bluegill ranged from 2.1 to 9.2 in, and the mean length was 5.8 in.

The size structure and growth rates of bluegill in Silver were fair. The PSD was 46 ± 11 and PSD-P was 9 ± 6. Bluegill mean length at age were higher than the 2009

survey (i.e., most recent survey with bluegill aging data) and was lower than the Barron and Polk County average and the Northern Wisconsin average across nearly all ages (Table 5).

Other panfish. There were 7 rock bass collected for a catch rate of 7.0 fish/mile. The mean length was 8.3 in with a range of 7.5 to 9.5 in. One 6.6 in pumpkinseed was also collected.

Fall Electrofishing

Walleye recruitment. The fall 2017 age-0 walleye catch rate was 28.2 fish/mile, and the age-1 walleye catch rate was 0.9 fish/mile. The 2017 age-0 walleye catch was above average for Silver Lake where the average catch was from 1989-2019 was 17.9 fish mile and the median was 7.3 fish/mile (Figure 10).

In general, Silver Lake has maintained a low level of walleye recruitment, but has had years of higher recruitment, especially since 2003. Walleye recruitment appears to be mostly driven by natural reproduction. From 1989-2012, low levels (<10 age-0/mile) of walleye recruitment occurred on Silver Lake except for the large 2003 and 2004 year classes. The low walleye recruitment during this period occurred despite extensive walleye stocking efforts (i.e., fry and small fingerlings). The 2004 year class was the highest age-0 catch rate (103.6 fish/mile) recorded on Silver Lake. Although a small fingerling stocking event occurred in 2004, the 2004 year class was largely from natural reproduction, as documented by the oxytetracycline (OTC) marking study in 2004, where 97% of analyzed fish were considered to be from natural reproduction. Similarly, the second highest age-0 catch rate was in 2018 (53.0 fish/mile), which was entirely from natural reproduction because 2018 was a non-stocked year. Other years that had higher levels (≥15 fish/mile) of age-0 catch rates included 2003, and 2013-2017. Since OTC analyses were not conducted during any of those years the relative levels of stocking success and natural reproduction are unknown. However, natural reproduction likely played a large role during those years due to the low stocking success from previous fry and small fingerlings on Silver Lake and the two highest years of age-0 catch rates (i.e., 2004 and 2018) were essentially entirely from natural reproduction.

Summary and Discussion

Overall, the Silver Lake fishery was in a desirable condition during this survey. The fish community appeared quite similar to 2009, especially in terms of gamefish populations. Silver Lake is a relatively clear lake, with deep water and low-to-moderate primary productivity. It is one of a few lake lakes in Barron County with cisco, a naturally reproducing walleye population, and a fishable smallmouth bass population.

The walleye population estimate (2.2 adults/ac) was the highest recorded estimate for Silver Lake. There have been three walleye population estimates completed on Silver Lake and the estimates have steadily increased during each survey, which is a good finding because many other walleye lakes in Barron and Polk counties have declined over that same timeframe. The lower fyke netting catch rate (3.6 fish/net-night) of this survey compared to the median for complex two-story lakes (6.6 fish/net-night) should not be of concern because the 2017 netting survey was a long survey due an extended spawning season. The walleye population had a good male:female ratio (6.3:1), where males outnumbered females, which is indicative of a healthy naturally reproducing population. The low walleye *Wr* (87) is a bit concerning and should be monitored in future surveys. This finding could mean the population is high for the lake. Silver Lake is a low fertility lake, unlike most other waterbodies in Barron and Polk counties. Walleye should be managed for a target density of 1-3 adults/ac. This is a lower density for a naturally reproducing population but is a realistic density, since Silver Lake has lower fertility and is unlikely to support high adult densities.

Silver Lake has maintained some level of natural reproduction through fall shocking surveys, which is encouraging to see. It is one of few lakes in Barron and Polk counties with a naturally reproducing walleye population and is the only clear water walleye lake with natural reproduction in Barron and Polk counties. Ideally, walleye will maintain their population in Silver Lake through natural reproduction. However, the walleye population will likely go through years of low or no natural recruitment, as documented in the past. If 10 consecutive years pass by without a natural year class greater than 7.3 age-0/mile (the median age-0 catch rate for Silver Lake), a large fingerling stocking could be considered because fry and small fingerling stockings have provided little contribution, which follows a previous finding and recommendation by

Cornelius (1998). Silver Lake has been extensively stocked with fry and small fingerling walleye but based on age-0 catch rates and OTC analyses, those stockings have had minimal contribution. There have been six years in which stocked walleye were marked with OTC prior to stocking, three years were small fingerling stockings, and three years of fry stocking. Past OTC studies have not significantly raised the number of age-0 walleye/mile in fall. Based on the percentage of marked age-0 walleye found each fall, small fingerling stockings raised the age-0 walleye by 1.8 fish/mile on average. Similarly, fry stocking raised the age-0 catch rate by 0.2 fish/mile on average. Both have had negligible returns. Silver Lake appears to be a lake where walleye fry and small fingerling stockings do little good, and eventually the walleye population produces large year classes under the right conditions.

Walleye often have variable recruitment in most lakes. The fluctuating water level likely further complicates walleye recruitment in Silver Lake. The variation in water levels also likely impacts walleye spawning success where prime walleye spawning areas are either dewatered or deeply submerged. Walleye recruitment on Silver Lake appears best during periods when water levels were decreasing or when the lake level remained at lower levels (78.75-81.55 ft; Figure 10). Typically, walleye are thought to have high recruitment years during high water levels; however, this likely depends on the frequency of high water years. In the case of Silver Lake, high water years are fairly infrequent so when the water level rises after a low water period, the water floods trees and terrestrial vegetation, which are not suitable nearshore walleye spawning habitat. This may explain the low recruitment when the lake level is rising. However, like walleye recruitment in most systems, patterns are seldom cut and dry. Additional lake level and walleye recruitment surveys are recommended, especially now as water levels appear to be on the rise. Annual fall recruitment surveys and lake level surveys would improve our understanding of water level and walleye recruitment on Silver Lake. Identifying and protecting high-quality walleye spawning habitat such as nearshore areas with gravel and rubble substrates is of high importance in naturally reproducing walleye lakes (Raabe et al. 2020). On a seepage lake like Silver Lake, the quality and availability of walleye spawning habitat varies based on the lake level. Therefore, it is imperative

that landowners not alter gravel and rubble substrates under the ordinary high-water mark on Silver Lake.

The walleye regulation on Silver Lake was changed to the Ceded Territory base walleye regulation in 2015. This regulation should be good fit from a biological standpoint for Silver Lake. It will protect the 20-24 in walleye and hopefully keep exploitation in check which was documented to be 39.1% during the 2009 creel survey, which is greater than the 35% exploitation threshold (Hansen et al. 1991).

Despite Silver Lake having a naturally reproducing walleye population, there has been only three walleye population estimates conducted. Silver Lake is now on a 9-year sampling rotation for comprehensive surveys, which will include walleye population estimates. Annual age-0 and age-1 walleye fall electrofishing surveys should be done to assess walleye recruitment on the naturally reproducing fishery.

Silver Lake continues to have respectable fisheries for both largemouth and smallmouth bass and both offer popular fisheries among anglers. Although the Silver Lake smallmouth bass population has proved difficult to get a reliable (CV<0.35) population estimate, the population does provide a unique angling opportunity to the area. The smallmouth bass fishery is popular among anglers, as smallmouth bass were the most targeted gamefish species in Silver Lake during the 2009 creel survey and received 27.7% of the open water angling effort. Largemouth bass have been more abundant than smallmouth in Silver Lake during each of the last two surveys. A robust largemouth bass population with moderate size structure was present in Silver Lake. The largemouth bass population density was similar to the 2009 survey, and their size structure improved slightly. Largemouth bass reached the 14 in minimum length limit at age-7, which is one year later than the northern Wisconsin standard. Bass population estimates should be conducted again during the next comprehensive survey. Special attention should be paid to the age, growth, and size structure of largemouth bass to assure the largemouth bass population does not transition to high density, low size structure. Otoliths should be considered for the aging structure for largemouth bass to get better aging sample. If the largemouth bass population would increase during future surveys, a no minimum length limit for largemouth bass could be considered to prevent a high density, low size structure largemouth bass population from developing.

Silver Lake continues to have a lower density northern pike population which is to be expected due to the limited amount of shallow vegetated habitat. Silver Lake has a lack of pike spawning habitat, especially during low water periods. During high water periods, the availability of spawning habitat increases due to the presence of flooded terrestrial vegetation and trees. Silver Lake will likely maintain a low-density pike population with moderate to higher size structure. The abundant cisco population should provide some larger northern pike in Silver Lake. Northern pike catch per net lift was roughly half of what it was compared to the 2009 survey. The net locations were primarily walleye spawning sets, so low pike catch is not unusual.

Panfish species have lower density populations in Silver Lake. Of the panfish species, bluegill were the most abundant panfish species based on our sampling; however, black crappie and yellow perch are likely present in greater numbers than observed during this survey. With the lower abundance, some quality-sized bluegill are present. Since Silver Lake is a lower fertility lake, the panfish populations are likely to stay at lower levels and continue to have lower growth rates than the Barron and Polk County average.

We did find one black crappie during our fyke netting survey that appeared to be affected by a condition referred to as "black crappie sarcoma", which results in raised red lesions on the sides of crappies. This was the first documentation of black crappie sarcoma in Silver Lake. Currently, little is known on black crappie sarcoma. We currently recommend anglers not consume crappie that display symptoms of crappie sarcoma, but instead keep and discard infected crappie away from the lake. Removing infected crappies from the population should help decrease the spread of the virus to healthy fish.

With the natural variation in the water levels of Silver Lake, there are likely some changes to the fish community. When the lake is high it is more productive (Homer et al. 2007), when it is low it is less productive and has less volume to support. Also, when the lake is high and there is flooded terrestrial vegetation which changes littoral habitat and spawning habitat, especially for species like walleye, northern pike, largemouth bass, and panfish.

Silver Lake has excellent water quality and is one of the best lakes in Barron County for water clarity. The good water quality has made it desirable for water recreation and lakeshore development. Protecting the existing natural habitat, restoring developed shoreline, and minimizing future lakeshore development will greatly benefit the Silver Lake fish community, and help maintain the good water quality into the future.

Management Recommendations

1. Maintain a naturally-reproducing walleye population with an adult density between 1-3 fish/acre.
2. The walleye fishery should be maintained through natural reproduction. However, if 10 consecutive years pass by without a natural year class greater than 7.3 age-0/mile (the median age-0 catch rate for Silver Lake), a large fingerling stocking could be considered.
3. Continue annual fall electrofishing surveys on Silver Lake to closely follow and trends in walleye recruitment.
4. Conduct another bass population estimate in the 2024 survey. Monitor the abundance, size structure, growth and mortality rates of the largemouth bass and smallmouth bass populations.
5. At this time, no changes are recommended to the fishing regulations.
6. Identify and protect walleye spawning areas at different water levels. Small rock and gravel on these areas should not be altered at any water level.
7. Lakeshore property owners should be encouraged to minimize disturbance to the lakeshore and littoral zone, to protect both fish and wildlife habitat, and water quality.
8. Invasive species monitoring and control programs should continue. Efforts to keep aquatic invasive species out of a waterbody are much more effective than controlling invasive species once they are established.

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Table 1. Sampling effort for the 2017 Silver Lake comprehensive fisheries survey.

Date	Gear	Survey type	Effort
Apr. 3, 2017 to Apr. 13, 2017	Fyke nets	Walleye netting	80 net nights
Apr. 13, 2017	Electrofishing	Walleye recapture	4.4 miles
May 4 & 11, 2017	Electrofishing	Bass marking	4.2 hours
May 31, 2017	Electrofishing	Bass-Panfish electrofishing	4.4 miles
Oct. 3, 2017	Electrofishing	Age-0 walleye electrofishing	4.4 miles

Table 2. Mean length (in) at age for walleye (sexes pooled) in Silver Lake, 2009-2017, the Barron and Polk County average, and the northern Wisconsin (NOR) average.

Age	2009	2017	Barron & Polk	NOR
1	–	9.6	7.5	6.4
2	11.3	11.46	10.9	9.5
3	13.2	14.0	13.9	11.7
4	14.2	15.8	15.6	13.8
5	15.9	17.3	17.8	15.8
6	17.8	18.6	19.0	17.5
7	20.6	19.8	20.8	19.1
8	20.4	21.5	21.8	20.5
9	24.1	20.3	22.5	21.6
10	20.6	22.0	23.3	22.7
11	23.7	22.4	23.9	23.7
12	–	23.0	25.1	24.4
13	22.7	28.2	25.2	25.2
14	–	–	24.8	25.8
15	22.2	–	25.6	25.6

Table 3. Mean length (in) at age for largemouth bass in Silver Lake, 2009-2017, the Barron and Polk County average, and the northern Wisconsin (NOR) average.

Age	2009	2017	Barron & Polk	NOR
1	—	—	4.2	4.7
2	6.4	7.7	6.8	6.7
3	9.2	9.6	8.9	9.0
4	10.9	10.4	10.9	11.0
5	11.9	11.8	12.5	12.7
6	13.0	12.2	13.9	14.6
7	13.6	14.6	14.9	16.0
8	14.2	15.8	16.0	17.3
9	—	15.4	17.0	18.1
10	—	16.4	17.5	18.8
11	—	19.5	18.5	19.4

Table 4. Mean length (in) at age for smallmouth bass in Silver Lake, 2009-2017, the Barron and Polk County average, and the northern Wisconsin (NOR) average.

Age	2009	2017	Barron & Polk	NOR
2	—	8.1	6.8	6.7
3	10.3	11.0	8.9	9.0
4	11.7	11.6	10.9	11.0
5	12.6	14.1	12.5	12.7
6	13.2	16.5	13.9	14.6
7	—	17.5	14.9	16.0

Table 5. Mean length (in) at age for bluegill in Silver Lake, 2009-2017, the Barron and Polk County average, and the northern Wisconsin (NOR) average.

Age	2009	2017	Barron & Polk	NOR
1	—	—	2.3	2.4
2	—	2.7	3.4	3.7
3	3.6	3.7	4.3	4.7
4	3.8	4.7	5.4	5.6
5	4.7	5.4	6.2	6.5
6	5.5	7.0	6.9	7.1
7	6.8	7.7	7.4	7.7

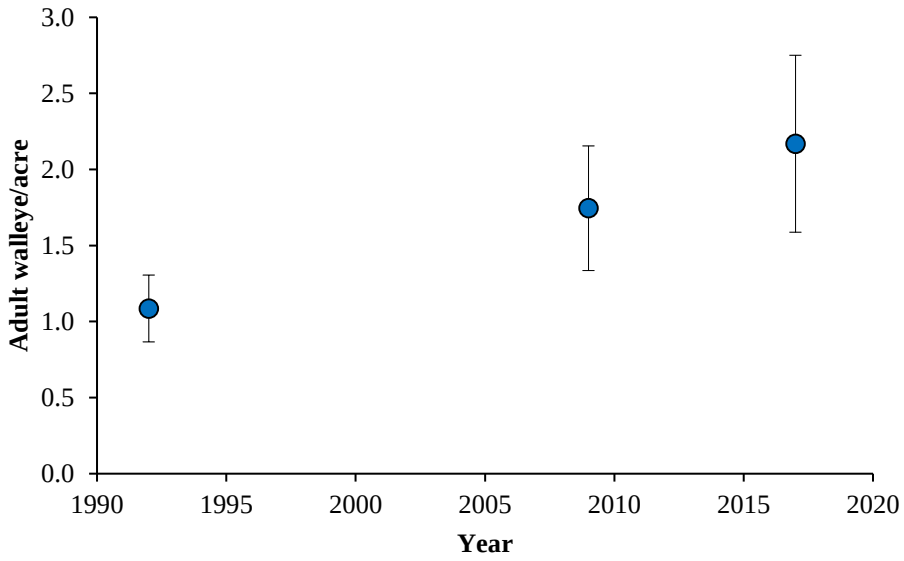

Figure 1. Population estimates for adult walleye (with 95% confidence intervals) in Silver Lake, Barron County, WI, 1992-2017.

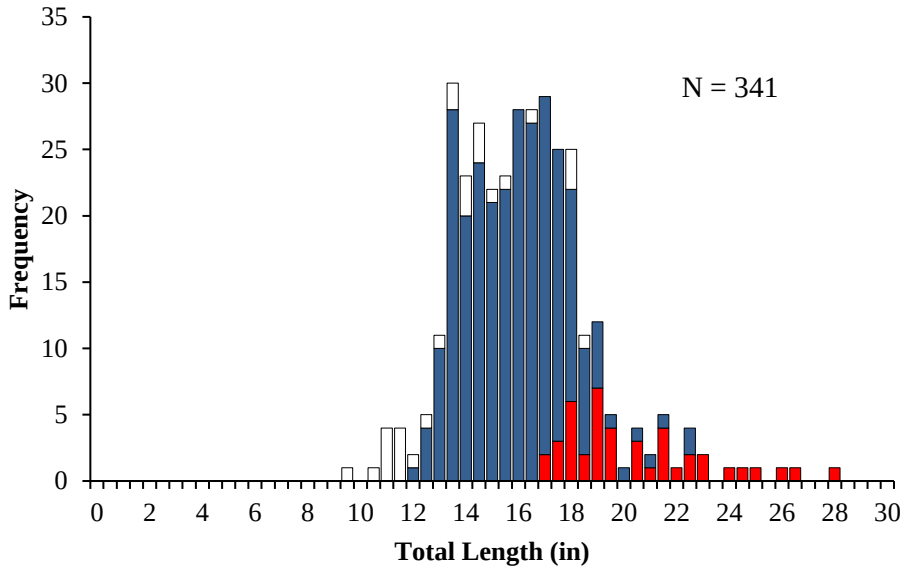

Figure 2. Length frequency histogram for walleye captured during the walleye population estimate in Silver Lake, Barron County, WI, 2017. White bars represent walleye of unknown sex, blue bars represent male walleye, and red bars represent female walleye.

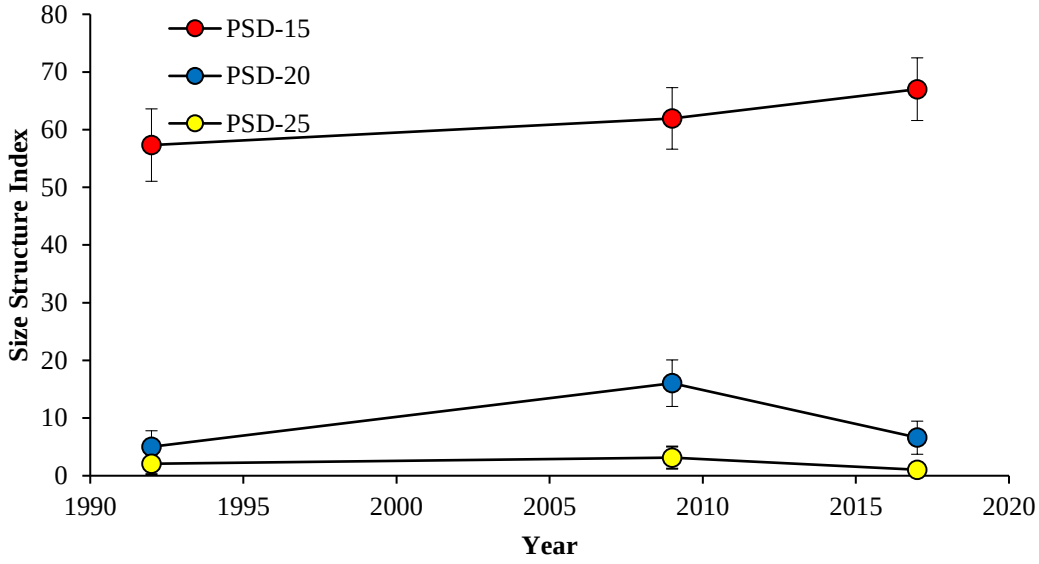

Figure 3. PSD-15, PSD-20, and PSD-25 size structure index values (with 95% confidence intervals) for walleye collected from fyke nets Silver Lake, Barron County, WI, 1992-2017.

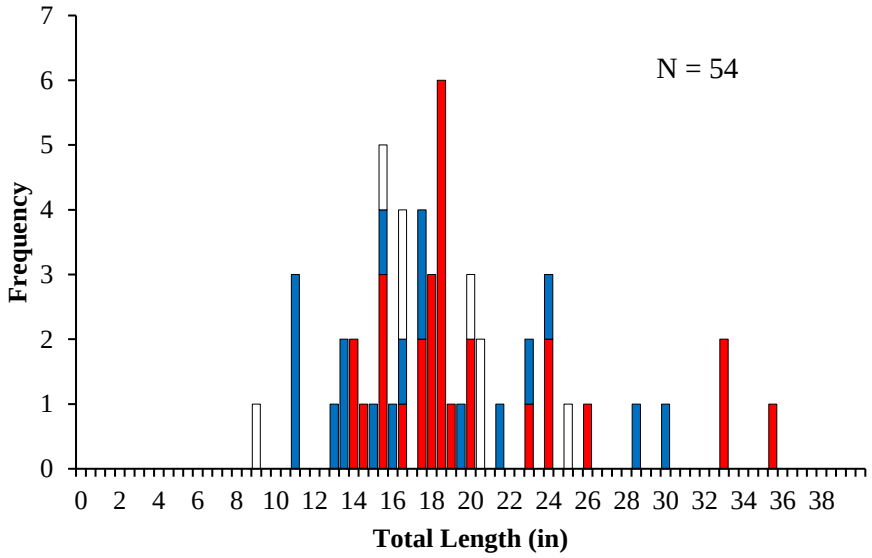

Figure 4. Length frequency histogram for northern pike captured with fyke nets in Silver Lake, Barron County, WI, 2017. White bars represent northern pike of unknown sex, blue bars represent male northern pike, and red bars represent female northern pike.

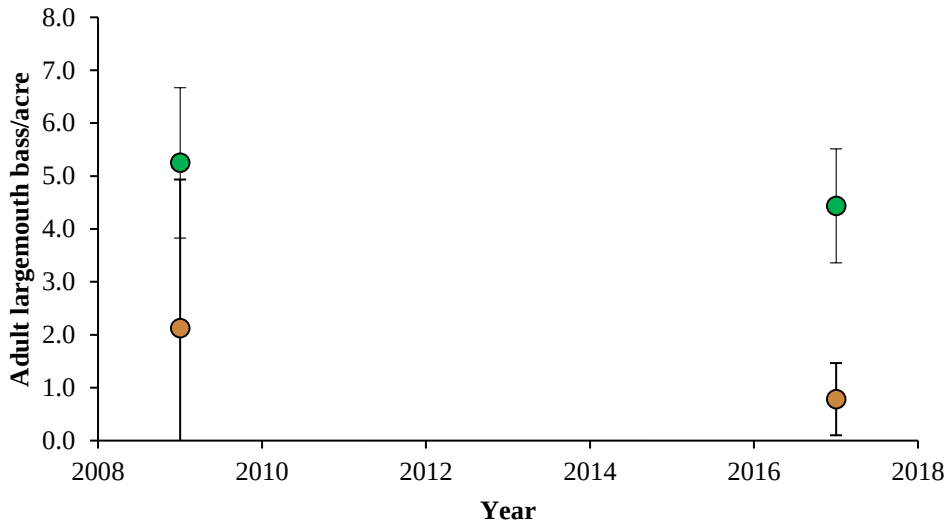

Figure 5. Population estimates for adult (≥ 8 in) largemouth bass (green circles) and smallmouth bass (brown circles; with 95% confidence intervals) in Silver Lake, Barron County, WI, 2009-2017.

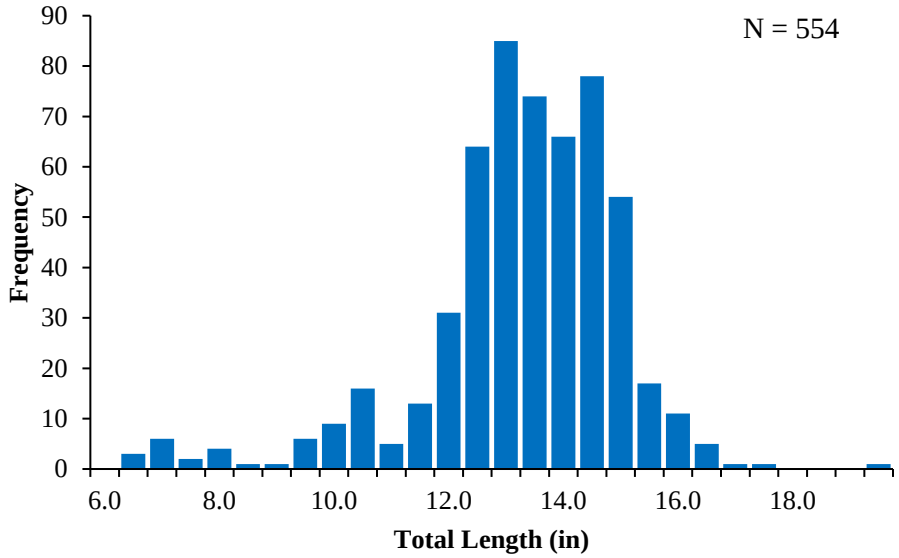

Figure 6. Length frequency histogram for largemouth bass captured during spring fyke netting, bass electrofishing, and unmarked largemouth bass collected during late spring electrofishing in Silver Lake, Barron County, WI, 2017.

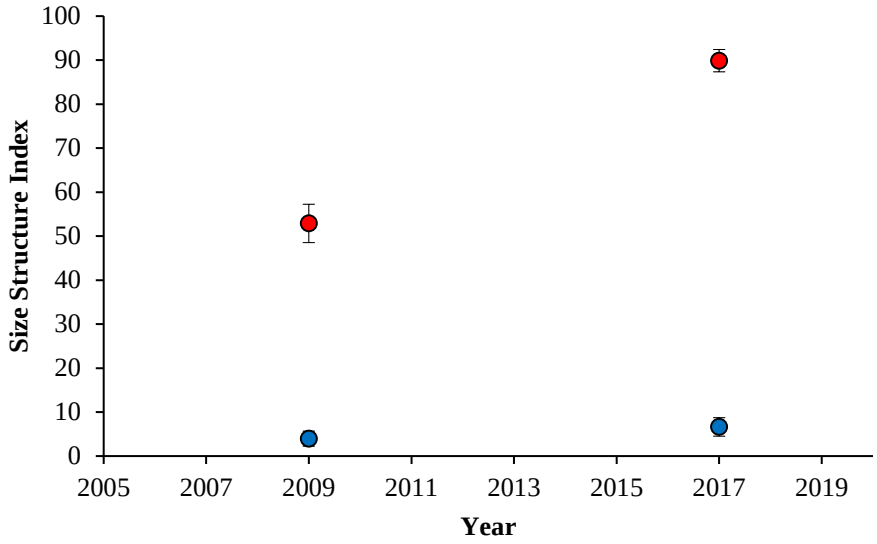

Figure 7. PSD-12 (red circles) and PSD-15 (blue circles) size structure index values (with 95% confidence intervals) for largemouth bass collected electrofishing in Silver Lake, Barron County, WI, 2009-2017.

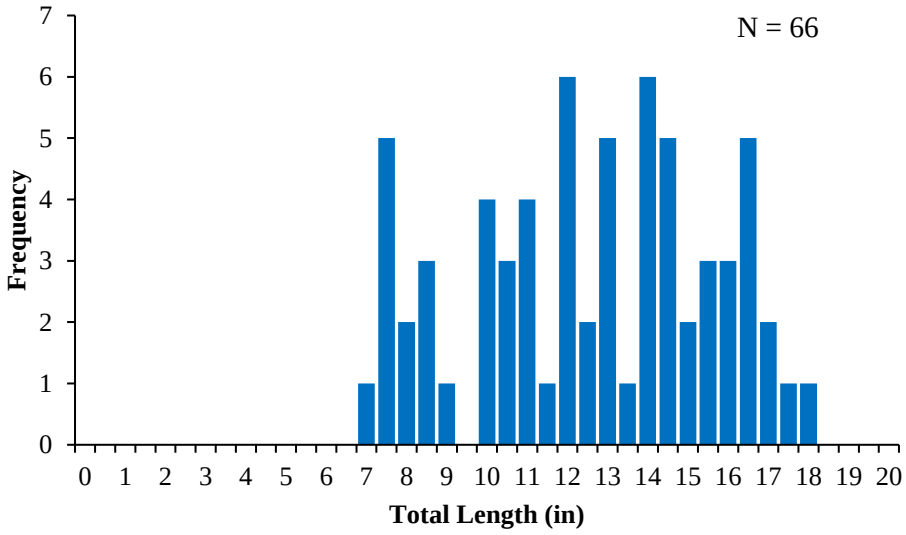

Figure 8. Length frequency histogram for smallmouth bass captured during spring fyke netting, bass electrofishing, and unmarked largemouth bass collected during late spring electrofishing in Silver Lake, Barron County, WI, 2017.

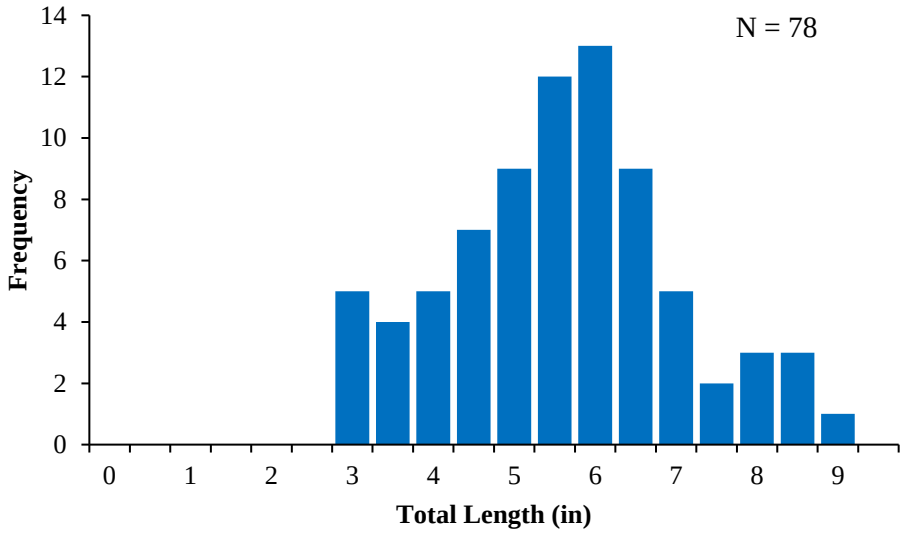

Figure 9. Length frequency histogram for bluegill captured during late spring electrofishing in Silver Lake, Barron County, WI, 2017.

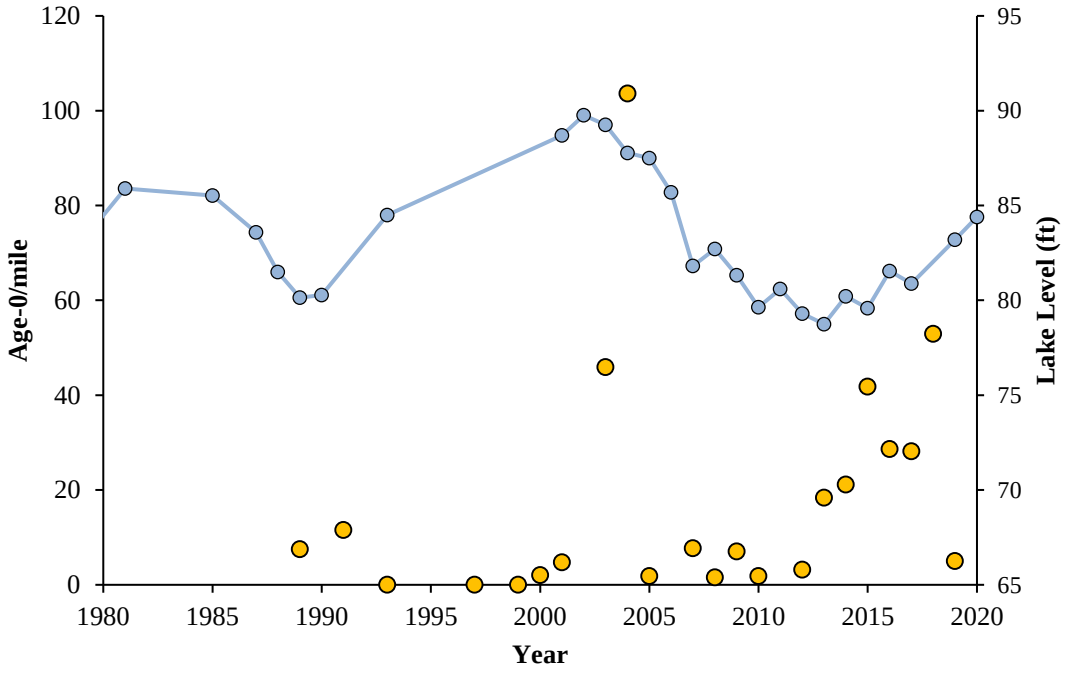

Figure 10. Fall electrofishing catch rates of age-0 walleye (orange circles) and lake level elevation (blue circle; ft.) for Silver Lake, Barron County, WI, 1980-2020.

Appendix Table 1. Stocking history for Silver Lake, Barron County, WI, 1988-2017.

Stocking Year	Species	Size	Number Stocked	Avg. Length (in)
1988	Walleye	Fry	337,000	1
1989	Rainbow Trout	Yearling	5,000	7.5
1989	Walleye	Fingerling	16,850	3
1989	Walleye	Fry	337,000	3
1990	Brown Trout	Adult	366	14
1990	Rainbow Trout	Yearling	4,000	8
1990	Walleye	Fingerling	16,965	3
1991	Brown Trout	Adult (Broodstock)	1,671	14.3
1991	Rainbow Trout	Adult (Broodstock)	200	20
1991	Rainbow Trout	Yearling	3,000	7.9
1992	Brook Trout	Adult (Broodstock)	756	14
1992	Brown Trout	Adult (Broodstock)	186	18
1992	Rainbow Trout	Adult (Broodstock)	100	13
1992	Rainbow Trout	Yearling	3,000	8.7
1992	Walleye	Fingerling	16,850	2
1993	Brook Trout	Adult (Broodstock)	166	13.5
1993	Rainbow Trout	Yearling	3,000	8
1994	Rainbow Trout	Yearling	3,250	10
1994	Walleye	Fingerling	16,850	1.9
1995	Rainbow Trout	Yearling	5,000	8.6
1996	Brook Trout	Fingerling	45,000	3.1
1996	Rainbow Trout	Yearling	2,000	8.1
1996	Walleye	Fingerling	16,835	2.4
1997	Rainbow Trout	Adult (Broodstock)	100	15.8
1997	Rainbow Trout	Yearling	2,428	10
1997	Walleye	Large Fingerling	6,740	4.3
1998	Brook Trout	Yearling	10,000	2.6
1998	Brown Trout	Adult (Broodstock)	11	20
1998	Rainbow Trout	Yearling	3,320	8.4
1998	Walleye	Small Fingerling	6,426	2.2
1999	Brook Trout	Large Fingerling	14,168	5.4
1999	Brown Trout	Large Fingerling	25,913	5.5
1999	Rainbow Trout	Adult (Broodstock)	40	21.4
1999	Rainbow Trout	Yearling	3,600	8.7
2000	Brown Trout	Adult (Broodstock)	146	18.4
2000	Brown Trout	Yearling	1,150	10
2000	Rainbow Trout	Adult (Broodstock)	90	21.9
2000	Rainbow Trout	Yearling	3,000	8.5
2000	Walleye	Small Fingerling	16,850	1.7
2001	Brook Trout	Large Fingerling	2,000	6.4
2001	Rainbow Trout	Yearling	4,000	7.7
2002	Brown Trout	Large Fingerling	13,532	5.3
2002	Rainbow Trout	Adult (Broodstock)	150	13.5
2002	Rainbow Trout	Yearling	3,560	8.2
2002	Walleye	Small Fingerling	16,825	1.7
2003	Rainbow Trout	Yearling	4,000	8.2
2003	Walleye	Small Fingerling	16,987	1.6
2004	Walleye	Small Fingerling	25,313	1.2
2005	Walleye	Small Fingerling	16,847	1.4
2009	Walleye	Fry	750,000	0.2
2010	Walleye	Fry	750,000	0.2
2011	Walleye	Fry	200,000	0.2
2012	Walleye	Fry	700,000	0.5
2013	Walleye	Fry	600,000	0.5
2014	Walleye	Fry	600,000	0.5
2015	Walleye	Fry	670,000	0.5
2016	Walleye	Fry	640,000	0.5
2017	Walleye	Fry	680,000	0.5

Appendix Table 2. Regulation history for Silver Lake, Barron County,1980 to 2020. *A sliding bag limit for walleye (1-5 fish) was in place from 1986 to 2014. **28 in minimum length limit and 1 fish daily. *** the Ceded Territory walleye base regulation was 15” minimum length limit, 20-24” protected, and one fish over 24” may be taken and 3 fish bag limit.

Species	1980	1985	1990	1995	2000	2005	2010	2015
Walleye	No MLL, 5 fish daily bag limit*			15" MLL, 5 fish daily bag limit*			**	CT base***
Northern Pike	No MLL, 5 fish daily bag limit							
Bass	No MLL, 5 daily bag limit			14" MLL, 5 fish daily bag limit				
Panfish	No MLL, 50 fish daily bag limit				No MLL, 25 fish daily bag limit			

Appendix Table 3. Lengths (in) used in proportional size distribution (PSD) indices for stock, quality, preferred, and memorable-sized bluegill, largemouth bass, and walleye.

Fish Species	Stock	Quality	Preferred	Memorable
Bluegill	3	6	8	—
Largemouth bass	8	12	15	—
Walleye	10	15	20	25