Upper and Lower Clam Comprehensive Fishery Survey

Burnett County, Wisconsin 2017

WBIC (Upper Clam Lake – 2656200, Lower Clam Lake- 2655300)

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Executive Summary

A comprehensive survey of Clam Lake, Burnett County, was conducted during the 2017 sampling season. The primary objective of this study was assessing the status of gamefish and panfish populations in Clam Lake. The secondary objective was to assess the population of invasive common carp.

Gamefish collected included walleye, northern pike, largemouth bass, smallmouth bass and channel catfish. Panfish and common carp were also collected. Walleye were captured upstream of the lake in the Clam River at catch per unit effort (CPE) of 42.6 fish/mile. Adult walleye ranged in length from 11.5 to 28.5 inches (in). CPE for northern pike increased from 12.0 fish/net night (2011) to 33.2 fish/net night. Largemouth bass CPE decreased when compared with past surveys. Smallmouth bass CPE increased from 2011 (0.2 fish/mile) to 2017 (3.2 fish/mile). Channel catfish averaged 24.7 in. Bluegill CPE has improved to 22.8 fish/mile since 2011 (2.2 fish/mile). Black crappie electrofishing CPE was 12.0 fish/mile, a decrease from 2011 (27.3 fish/mile). Yellow Perch electrofishing CPE went from 0 in 2011 to 23.0 fish/mile in 2017. Two common carp were collected this season in nets. One common carp was observed during late-spring night electrofishing for a catch rate of 0.16 fish/mile, a large decrease from 2011 (12.5 fish/mile).

Summary and management recommendations include: 1) Work with St Croix Tribe, Resorts, Anglers, and other interested stakeholders to develop a Clam Lake Fisheries Management Plan. 2) The current Ceded territory regulation is sufficient for walleye in Clam Lake. 3) Northern pike have rebounded creating a new harvest opportunity for anglers. 4) Largemouth and smallmouth bass are at low densities and no regulation change is needed. 5) Bluegill densities have improved, but this recovery is fragile. 6) Black crappie densities have

decreased. 7) Yellow perch densities have increased. 8) Channel catfish are low density and the regulation does not impact their population. 9) Adult common carp appear to be low density. 10) Habitat preservation/reestablishment should be encouraged. 11) Preventing the establishment of new invasive species and monitoring of established invasive species should continue.

Introduction

Upper Clam Lake and Lower Clam Lake are St. Croix basin drainage lakes located in south central Burnett County. Upper Clam Lake is 1,253 acres with an average depth of 5 feet (ft) and a maximum depth of 11ft. Lower Clam Lake is 337 acres with an average depth of 7 ft and a maximum depth of 14 ft. The two lakes are connected by a channel which runs under state highway 70 allowing fish passage. For this report, the two lakes will be considered one waterbody - Clam Lake (as seen in Wendel (2011)).

Clam Lake is considered a eutrophic or highly productive lake based on recent water quality data (Peacher and Roesler 2014). Clam Lake has a high watershed to lake surface area ratio (116 acres watershed: 1-acre lake) which increases the likelihood of it being highly eutrophic (Peacher and Roesler 2014). Clam Lake's substrate is mainly composed of sand and muck.

Aquatic vegetation was once very abundant throughout Clam Lake. Historically, the lakes supported diverse, dense aquatic plant communities (Cahow et al. 1997) including large stands of wild rice (Johnson and Havranek 2010). Aquatic vegetation often reached nuisance levels for recreation, leading to mechanical and chemical controls in 1960s through early 2000s.

In 2006, aquatic plant densities dropped dramatically. Wild rice beds saw an 80 percent reduction between 2001 and 2010 (Johnson and Havranek 2010).

In addition to wild rice/aquatic vegetation decline, Clam Lake's common carp *Cyprinus carpio* population increased dramatically in 2005. Common carp have been present in the system since 1940 or earlier (DNR correspondence 1980). The 2005 carp population increase led to dramatic shifts in the fish community (Wendel 2011). The most notable changes were corresponding increases in the walleye *Sander vitreus* and channel catfish *Ictalurus punctatus* populations. At the same time, there were dramatic decreases in bluegill *Lepomis macrochirus* and northern pike *Esox lucius*. The main driver in these shifts were common carp altering the aquatic vegetation density and increasing the turbidity within the lakes.

Since this ecosystem shift, Wisconsin Department of Natural Resources (WDNR) and St. Croix Environmental and Natural Resource Department (SCE) began exploring ways to address overabundant common carp. SCE started by studying how the carp population was impacting the wild rice bed in Clam Lake (Johnson and Havranek 2010). This work led to carp removals on Clam Lake, utilizing the "Judas technique" (described in Bajer et al. 2011). Commercial fishing was permitted by WDNR in 2011 and has continued through 2017. The estimated total poundage of carp removed is 656,378 lbs (Appendix Figure 1). However, the carp population is still viable and future management actions are being considered for the lake.

Despite common carp, Clam Lake continues to support a very diverse fish community. Gamefish include: walleye, northern pike, largemouth bass *Micropterus salmoides*, smallmouth bass *Micropterus dolomieu*, channel catfish, lake sturgeon *Acipenser fulvescens*, and brown trout *Salmo trutta* (present during winter season). Panfish include: bluegill, black crappie *Pomoxis nigromaculatus*, yellow perch *Perca flavescens*, pumpkinseed *Lepomis gibbosus*, and rock bass

Ambloplites rupestris. Other common species include: common carp, bowfin *Amia calva*, redhorse species *Moxostoma* spp., bullhead species *Ameiurus* spp., and white sucker *Catostomus commersoni*. No fish have been stocked in Clam Lake since 1989. Regulations have generally followed the statewide regulations (Table 1).

Past comprehensive fish surveys were conducted on Clam Lake in 1995, 2004, and 2011. An angler creel survey was also conducted in 1995-1996. Many targeted surveys have also taken place during this time mostly focused on recruitment of gamefish, panfish, and common carp. This survey focused on assessing the gamefish and panfish populations. The secondary goal was to assess the population of invasive common carp.

Methods

Field Sampling

Spring sampling started in late March following WDNR lake sampling protocols (Simonson et al. 2008). After ice-out, five fyke-nets (4 x 6 ft frame) were set on 29 March. Nets were placed on shorelines favorable for northern pike spawning. Five to seven nets were fished until 1 April for a total of 26 net nights. Catch of all species in nets was recorded. Length data was collected on northern pike, walleye, channel catfish, and common carp. All northern pike and walleye were given a right ventral (RV) fin clip. Panfish were measured and aging structures collected from a subsample of nets on 31 March and 1 April (five per half inch group).

The primary walleye sampling effort took place approximately 2.0 mi upstream of Clam Lake in the Clam River using daytime pulsed direct current (DC) boat electrofishing. Sampling took place for days from 31 March until 7 April. Adult walleye were marked with a RV fin clip.

Late spring electrofishing took place 1 June within Clam Lake. Three two-mile gamefish stations were sampled with a focus on collecting both bass species. Each two-mile station had a ½ mile index station embedded within it where panfish were collected in addition to gamefish.

Fyke-nets and hoop nets were set on 1 August to assess channel catfish populations in Clam Lake. Standard fyke-nets were next to the shoreline (as described above). Hoop nets were set mid-water in depths at 6 ft or greater. Six mini-fyke nets were set to assess the juvenile/non-game fish community.

Fall electrofishing took place 12 September to assess natural recruitment of walleye in Upper and Lower Clam Lake. This sampling took place once surface water temperature dropped below 70° F.

Age and Statistical Analysis

All walleye, smallmouth bass, largemouth bass, northern pike, channel catfish, and common carp were measured to the nearest half inch. Panfish were measured to the nearest tenth of an inch. Age structures were collected from walleye, smallmouth bass, largemouth bass, bluegill, and black crappie. Scale samples were taken on walleye less than 15 in and bass less than 12 in. Dorsal spines were taken on all larger walleye, bass, channel catfish, and common carp sampled. Only scales were taken on bluegill and black crappie.

Size structure quality of species sampled was determined by using the index proportional stock densities (PSD) (Neumann et al. 2013). The PSD value for a species is the number of fish of a specified length and longer divided by the number of fish of stock length or longer, the result multiplied by 100. Catch per unit effort (CPE) was calculated as the number of fish captured divided by the appropriate unit of sampling effort for that species (i.e. net night, mile of shoreline). The descending limb of a catch curve regression was used to estimate total annual mortality for walleye (Ricker 1975). A random aging sample was used to assess year class strength for common carp. An age-length key was applied for bluegill using fish sampled from fyke-nets and electrofishing (aging structures were collected from both gears). This age-length key was used to assess bluegill year class strength (i.e. Figure 11).

Results

Gamefish

Walleye. A total of 345 adult walleye (sexable or ≥15.0 in) were captured during netting and electrofishing. There were 333 males and 11 females collected (30:1 male to female ratio). CPE for walleye ≥ 10 in was 0.3 fish/net. This catch rate was a decrease from 2011 (3.34 fish/net, but similar to 2004 (0.3 fish/net)). Most adults sampled were captured upstream of the lake in the Clam River at 42.6 fish/mile. PSD and PSD-15 were both 72. This value is similar to 2011 (PSD=68; PSD-15=68). A population estimate was not calculated due to low sample size of females, which would have made the estimate very inaccurate.

Adult walleye ranged in length from 11.5 to 28.5 in (Figure 1). Mean length of male and female walleye was 16.9 in (standard deviation (SD) =2.4) and 22.6 in (SD =4.0), respectively. Both male and female walleye average length was smaller in 2011 (male=16.1 in; female=20.4 in) (Figure 2). Growth for both walleye sexes was similar to 2011 and above the Northwestern Averages (Figures 3 & 4). Walleye survival increased from 2011 (54%) to 2017 (73%).

Northern pike. A total of 848 northern pike were collected in Clam Lake during 2017. They ranged in length from 9.0 to 35.0 in (Figure 5). Mean length of male and female northern pike was 18.5 in (SD =2.6) and 20.4 in (SD=3.0). Adult average length decreased from 19.8 in (SD=3.3; 2011) to 18.8 in (SD =3.3; 2017) (Figure 6). Northern pike PSD was 26 and PSD-28 was 1. Both values are similar to 2011 (PSD=27; PSD-28=3). CPE for northern pike increased 12.0 fish/net night (2011) to 33.2 fish/net night. This catch rate is similar to 2004 (34.1 fish/net night).

Largemouth bass. A total of 13 largemouth bass were collected electrofishing in 2017. They ranged in length from 10.5 to 17.5 in. Average length has remained stable in 2004 (14.6 in; SD=2.1), 2011 (14.2 in; SD=1.0), and 2017 (14.4; SD=2.4). The catch rate has decreased when compared with past surveys (Table 2). PSD was not calculated due to very low sample sizes. Age-1 to Age-6 largemouth bass grew above average, while all older largemouth bass grew at or below average. This trend is similar to 2011 (Figure 7).

Smallmouth bass. A total of 19 smallmouth bass were collected electrofishing in 2017. They ranged in length from 6.0 to 17.0 in and averaged 12.2 in (SD = 3.0). Only one smallmouth bass was collected in 2011 and eight in 2004 (average 11.2 in; SD = 1.7). Catch rate increased from 2011 (0.2 fish/mile) to 2017 (3.2 fish/mile). PSD was not calculated for smallmouth bass due to small sample size. Smallmouth bass grew above Northern Region averages in both 2011 and 2017 (Figure 8).

Channel Catfish. A total of 16 channel catfish were collected electrofishing and 2 fish were collected in fyke and hoop nets (summer sampling). Channel catfish ranged in size from 15.8 to 28.5 in and averaged 24.7 in (SD=2.9). The electrofishing CPE was 2.7 fish/mile. Netting catch rates and PSD were not calculated due to low sample size. Catfish data was not collected in prior surveys.

Panfish

Bluegill. A total of 137 bluegill were collected electrofishing and 223 bluegill were measured in a subsample of nets. Average size was 5.6 in (SD=1.0) which is smaller than 2011 (7.2 in avg.)

and 1995 (6.3 in avg.) (Figure 9). Bluegill CPE was 22.8 fish/mile. The rate increased from 2011 (2.2 fish/mile). Numbers of bluegill over 3 in and 6 in increased, while catch decreased for fish over 8 in (Table 3). PSD and PSD-7 for bluegill was 19 and 3 when looking at electrofishing data. These values are lower than the 1995 survey (PSD=58, PSD-7=34). The 2011 sample was not used for comparison due to the very low sample size (n = 13). Mean length-at-age was above the northern region average for bluegill in both 2011 and 2017 (Figure 10). Two-year old bluegill represented a majority of fish collected with both gears. An estimated 85% of the sample was from the 2015 year class(Figure 11).

Black Crappie. A total of 18 black crappie were collected electrofishing and 84 black crappie were measured in a subsample of nets. Average size was 7.3 in (SD=2.3) which is larger than 2011 (5.6 in avg.) and 1995 (6.6 in avg.). The electrofishing CPE was 12.0 fish/mile, a decrease from 2011 (27.3 fish/mile).

Yellow Perch. A total 139 yellow perch were collected electrofishing and 60 yellow perch were measured in a subsample of nets. Average size was 4.4 in (SD=1.1) and was larger than in 1995 (3.4 in) (no perch were measured/collected in 2011). PSD for Yellow Perch was 12, an increase from 1995 (6). CPE for Yellow Perch went from 0 in 2011 to 23 fish/mile in 2017.

Other Panfish. No other species of panfish were collected electrofishing. Fyke net subsamples measured four pumpkinseed (5.6 in avg.), three rock bass (6.6 in avg.), and one hybrid bluegill (8.8 in).

Common Carp

Two common carp were collected this season in nets. They measured 9.4 in and 25.2 in. Both were captured in early-spring fyke nets. The catch rate for common carp was much lower dropping from 15.3 fish/net (2011) to 0.1 fish/net (2017). One common carp was observed during late-spring night electrofishing for a catch rate of 0.16 fish/mile, a large decrease from 2011 (12.5 fish/mile). A random subsample of 52 adult common carp were weighed (50), measured, and aging sample taken during commercial removals in January 2017. Fifty-two percent of the carp aged comprised 12 year-old fish from the 2005-year class (Figure 12). The next largest year classes collected were 2010 and 2012 at 15.4%. The 2005-year class was the largest in 2009 representing 42% of aged carp. Average length of common carp collected was larger in 2017 (27.6 in) vs. 2011 (26.2 in). Mean length-at-age remained similar between 2011 and 2017 for age classes represented (Figure 13). A subsample of 20 juvenile carp were also collected during commercial removals. Age-0 common carp averaged 10.9 in (SD = 0.5) and Age-1 common carp averaged 15.1 in (SD = 1.2).

Fish community sampling

Early spring fyke-netting. Twenty-three species of fish were collected with early-spring fyke nets in 2011 and 20 species in 2017. Ten of these species showed increases or decreases in catch/net night over 1.5 fish/net night since 2011 (Figure 14). The largest shifts occurred with northern pike (+ 21.2 fish/net night), common carp (- 12.5 fish/net night), and brown bullhead (- 10.5 fish/net night).

Mini-fyke netting. Most fish species sampled between 1995 and 2017 have shown no noticeable trends (Table 4). Since the significant increase in carp abundance (2005), juvenile bluegill numbers have ranged between 0.5 to 1641.8 fish/net night. Juvenile largemouth bass numbers have stayed below 10.0 fish/net night. Juvenile common carp catch rates have steadily increased since 2014, reaching 33.2 fish/net night in 2017. Juvenile common carp collected in mini-fyke nets ranged from 2.0 to 4.2 in.

Fall Electrofishing

The catch rate of young-of-year (YOY) walleye was 6.9 fish/mile for Upper Clam Lake and 8.9 fish/mile for Lower Clam Lake. Both catch rates are below the Ceded Territory average for walleye populations sustained by natural reproduction (17.1 fish/mile in Cichosz 2017). These catch rates are lower than the two previous surveys (Figure 15). Age-1 walleye catch was 2.1 fish/mile for Upper Clam Lake and 1.1 fish/mile for Lower Clam Lake, also lower than previous surveys (Figure 16). A total of 16 adult common carp were observed as catchable. If captured they would have had a catch rate of 2.8 fish/mile. Many juvenile common carp were observed as well, a subsample of 37 were collected, ranging from 3.4 to 6.4 in (Avg. = 4.5 in; SD = 0.8). These juveniles were much smaller than juvenile carp collected in 2016 that were 7.7 and 9.1 in.

Discussion

The Clam Lake fish community and ecosystem has shown that it can be very dynamic with drastic changes happening in a relatively short timeframe. This fact has been demonstrated by the large shifts in the fish, wildlife, and aquatic vegetation from 2005 to present. While this survey focused on the fisheries of Clam Lake, the implications of the data collected can suggest ecosystem changes that may occur in other parts of the system. This survey is the second survey since the common carp population increased dramatically in Clam Lake and drastically reduced the bluegill and wild rice densities in the lake. It is also the first survey following several large carp removals (see Appendix Figure 1). Below, I discuss the potential impacts on the fisheries and what the data suggests about the entire Clam Lake system.

Walleye in Clam Lake have shown that they can survive/thrive in a shallow turbid system. The population has naturally improved since common carp abundance increased in 2005 and seem to benefit from the high levels of turbidity. This scenario makes sense since walleye are low light predators and adapt well to lakes associated with a river (Bozek et al. 2011). Spawning activities are primarily occurring in the Clam River with some fish being river residents and others traveling back to the lake after the spring spawn. Unfortunately, we could not calculate an accurate population estimate due to low female numbers.

Northern pike densities have rebounded since the 2011 fish survey and they are now the most abundant piscivore in the lake. Their relative abundance increased by 64%. This dramatic increase suggests that aquatic vegetation used by northern pike for habitat/spawning has improved. If the amount of aquatic vegetation in the lake continues to improve, I would expect the pike to increase or remain stable into the future.

Largemouth bass remain at low densities in Clam Lake. Bass catch rates were low prior to carp establishment based on the 2004 survey. However, the adult abundance appears to be at its lowest during 2017. Low numbers of bluegill, high turbidity, and poorer reproduction may explain the lower numbers of largemouth bass in Clam Lake. First, bluegill are a very important prey item for largemouth bass and bass/bluegill densities effect the abundance and size structure of each species. Low bluegill abundance may be causing lowered bass abundance also. Turbidity is another potential issue, bass are sight predators so higher turbidity may limit their capability to feed. Last, common carp likely impact nest success by either predating on bass eggs, or reducing egg hatching with bottom disturbance. Smallmouth bass appear to be at low densities in Clam Lake based on the past three surveys. They are likely transient in the lakes moving in/out of the Clam River.

Channel catfish abundance proved difficult to estimate in Clam Lake. Electrofishing gave us the best sample, even though it is generally considered less effective for channel catfish sampling than tandem hoop nets (Bodine et al. 2013). Based on the data collected, they appear to be at low densities in Clam Lake. Wendel (2011) noted approximately 1,000 catfish in a seine haul during a spring carp removal in 2011. It is possible that the catfish densities have decreased since that time.

Bluegill relative abundance has improved since 2011. This increase in abundance is fragile, with most bluegill being two years old. The bluegill have likely benefitted from a recent increase in aquatic vegetation (i.e. bluegill habitat). However, the bluegill catch is still lower than pre-carp densities, especially for bluegill 6 in or greater. Bluegill growth continues to be very good in Clam Lake, with fish growing to 6 in in three growing seasons. This excellent growth is tied to high productivity, but also suggests that bluegill densities are still low in Clam Lake. Unfortunately, we do not have age-growth data for bluegill pre-carp, but one would think growth was slower at the higher densities. Bluegill are the most important panfish in the lake for potential carp control. Bajer et al. (2012) have documented the importance of bluegill for controlling common carp populations in the Upper Midwest. For Clam Lake to reach a full recovery, it will require a healthy and abundant bluegill population.

Black crappie abundance decreased since 2011. This change indicates that conditions are becoming less favorable for crappie. Rypel (et al. 2018) found that black crappie can do well in a dark/turbid system in Wisconsin. Recent reduced crappie electrofishing and fyke net CPEs may support a recent shift toward clearer water/more aquatic vegetation. Yellow perch densities have increased greatly since 2011. This response may be tied to more available vegetation for spawning habitat. However, the current instability of clear/turbid states in Clam Lake makes black crappie and yellow perch population trends difficult to predict.

The adult common carp population appears to be at low levels based on the 2017 fisheries survey of Clam Lake. This decline is a large shift from 2011, where carp were prevalent in netting and electrofishing samples. Based on aging data, the 2005-year class continues to be the most common in Clam Lake, suggesting this one year-class is still having a strong impact 12 years later. It also appears that the remaining adults have produced a very large year class in 2017. The DNR mini-fyke CPE of 33.2 carp/net night is the highest that has been recorded since the first DNR mini-fyke net survey in 1995. In addition, experimental mini-fyke sets placed by SCE recorded CPEs as high as 400 fish/net night in 2017 (SCE unpublished data; Appendix Table 1). These findings suggest that common carp will likely become abundant again in Clam Lake.

Common carp removals have been permitted since 2011 with an estimated 656,378 lbs of carp removed from Clam Lake. The associated benefits of removals have been seen in the following parts of the ecosystem: reduced adult carp density, improved bluegill densities, and improved aquatic vegetation density. However, removals have not addressed recruitment of carp from the remaining adults in the lake. Clam Lake has internal recruitment, meaning carp can spawn successfully within the lake. Lechelt and Bajer (2016) predicted that this type of recruitment requires 90% biomass reduction of common carp (adults and juveniles) yearly to cause a sustained population crash. Currently, removal efforts have not addressed the juvenile carp and have not removed large amounts of biomass yearly. The large 2017 year-class in the Clam Lake system supports research that common carp may exhibit a compensatory response (a response of a population with increased recruitment/survival to maintain the stability of the population) when only adults are harvested (Weber et al. 2016). Removals have been solely focused on adult common carp and this fact may make carp difficult to reduce to low enough levels to see long term benefits.

Clam Lake currently has shown it has two states: clearer/abundant aquatic vegetation and turbid/without vegetation. The state it resides in affects the ecosystem in many ways (Appendix Table 2). Currently, Clam Lake likely resides somewhere between a clear, vegetated state and a turbid, non-vegetated state. The current trajectory based on 2017 carp recruitment data suggests that Clam Lake will head back to a turbid state.

Management Recommendations

1. Work with St. Croix Tribe, Resorts, Anglers, and other interested stakeholders on the lake to create an updated/active **Clam Lake Fisheries Management Plan** for Upper and Lower Clam Lake. Set realistic/scientific goals based on data collected since carp became abundant in 2005.
2. Walleye are at moderate densities in Clam Lake. Due to the potential instability of this population the current Ceded Territory regulation (Table 1) is adequate to protect adult females while allowing harvest of smaller fish in the system.
3. Northern pike have rebounded since the 2011 survey and are present for anglers. The regulation allows for a harvest opportunity.
4. Both Largemouth and Smallmouth Bass are at low densities in Clam Lake. This current regulation is likely having a low impact on both bass species since their densities have been and remain low.

5. Bluegill abundance has improved since 2011. However, the population is largely supported by the 2015 year class. A more restrictive panfish regulation could help increase the population and help control carp recruitment. To be more effective, this regulation would need to be coupled with several consecutive years of successful carp control.
6. Black crappie relative abundance decreased since 2011 based on fyke-net catch data. Their densities are likely driven by ecosystem changes in the lake and year class strength. Since we have limited data on black crappie, no regulation change is recommended.
7. Yellow perch relative density has increased since 2011. Perch are likely benefitting from a resurgence of aquatic vegetation coupled with turbid water. Like crappie, perch abundance is driven by good year classes, so management is difficult in an unstable system.
8. Channel catfish appear to be at a low density. The statewide regulation adequately protects this low-density species.
9. Adult common carp appear to be at low densities at this time. However, there is a large 2017-year class of juvenile carp. If this year class has good survival it will likely cause a resurgence in carp densities in Clam Lake. Potential management of carp should be re-evaluated in a **Clam Lake Fisheries Management Plan**. Management options should not focus solely on adult carp removal.
10. Efforts to increase habitat complexity in Clam Lake should be strongly encouraged. Input of coarse woody debris, protection of aquatic vegetation, and maintenance or restoration of 35 foot vegetative buffers are some examples of work that can increase habitat complexity.

11. Exotic species monitoring and control programs should continue. Efforts to keep aquatic invasive species out of a waterbody are much more effective than controlling these species once they are established.

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Table 1. General Fishing Regulations for Upper and Lower Clam Lake, Burnett County, Wisconsin, in 2016.

Fish Species	Daily Limit	Minimum Length (in)
Walleye	3	15, 20-24 protected, 1 fish > 24
Largemouth and Smallmouth Bass	5	NONE
Northern Pike	5	NONE
Channel Catfish	10	NONE
Panfish	25	NONE

Table 2. Catch rates of largemouth bass sampled during spring electrofishing.
* 2004 used recapture run as a surrogate for typical late-spring electrofishing sample.

	2004*	2011	2017
Miles sampled	5	6	6
Fish/mile	6.4	3.5	2.2

Table 3. Number of bluegill sampled during spring electrofishing.
* 1995 used a one sample date as a surrogate for typical late-spring electrofishing sample.

	1995	2011	2017
≥3in	178	8	137
≥6in	111	7	26
≥8in	8	4	1

Table 4. CPE (fish/net night) of juvenile fish collected in mini-fyke nets in Clam Lake, August 2017. Data included if species was present during every survey or common carp. The black line denotes the dramatic increase in the Clam Lake carp population.

	BLACK CRAPPIE	BLUEGILL	COMMON CARP	LARGEMOUTH BASS	YELLOW PERCH
1995	41.0	898.0	0	20.5	83.3
2003	280.4	26.0	0.1	6.9	15.1
2011	32.3	506.2	0	20.3	11.0
2012	57.6	1122.0	0.8	8.8	1.2
2014	13.7	0.5	0	1.3	641.2
2015	14.0	1641.8	3.2	1.8	23.0
2017	19.5	39.8	33.2	9.3	0.3

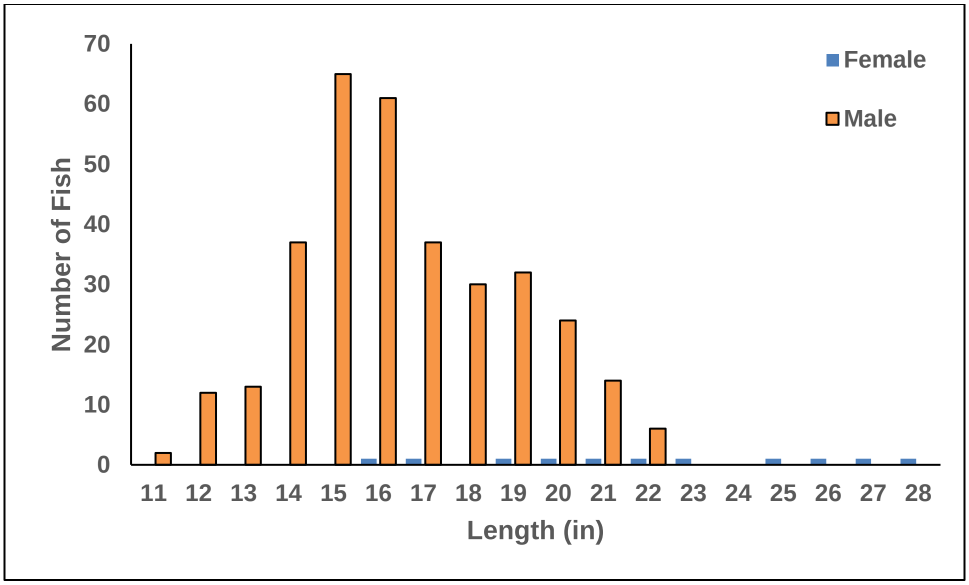


Figure 1. Length frequency of adult walleye captured during spring 2017 in Clam Lake, Burnett County, Wisconsin.

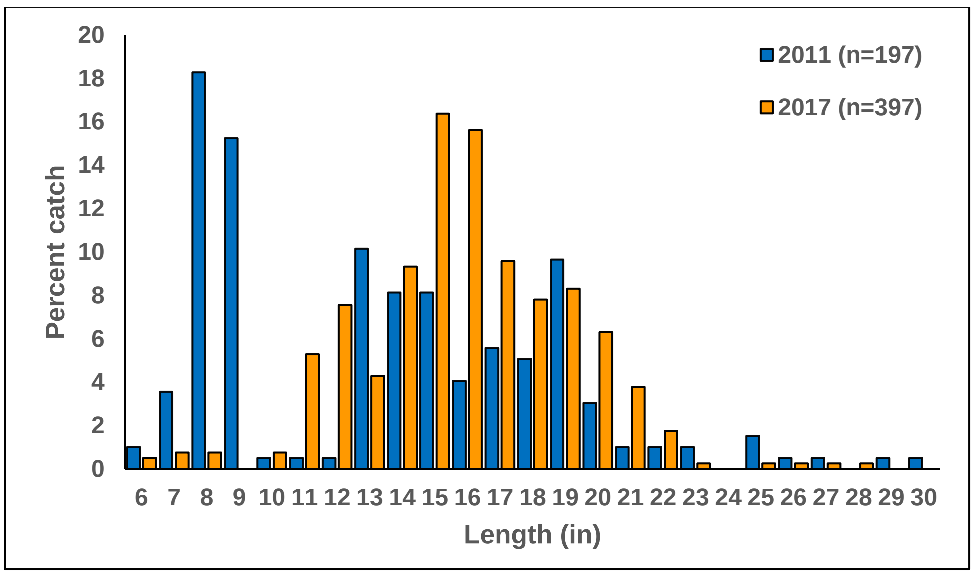


Figure 2. Length frequency of all walleye captured during spring 2017 netting and electrofishing in Clam Lake and Clam River, Burnett County, Wisconsin.

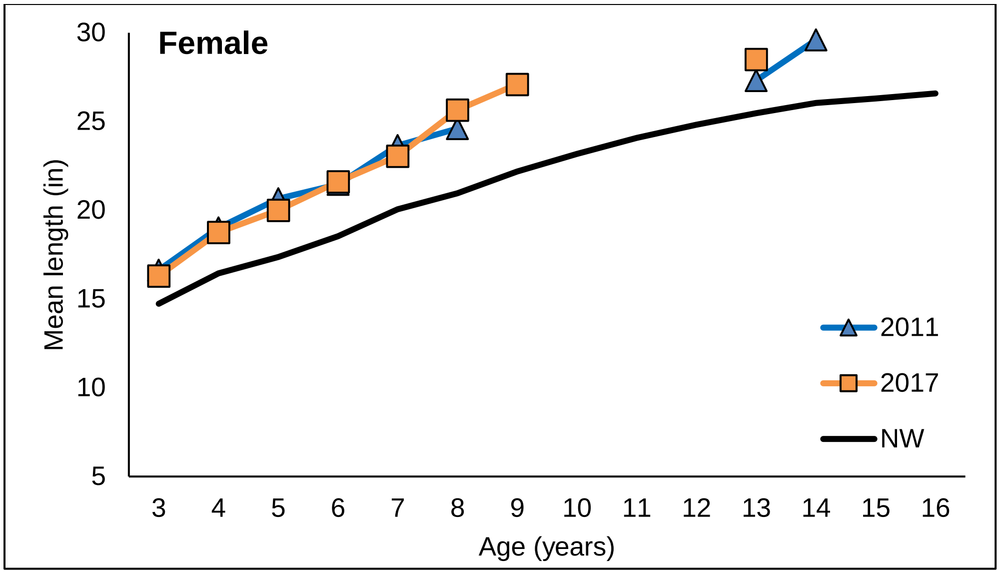


Figure 3. Mean length-at-age for female walleye captured during spring surveys on Clam Lake and Clam River, Burnett County, Wisconsin compared with the Northwest Wisconsin average (NW).

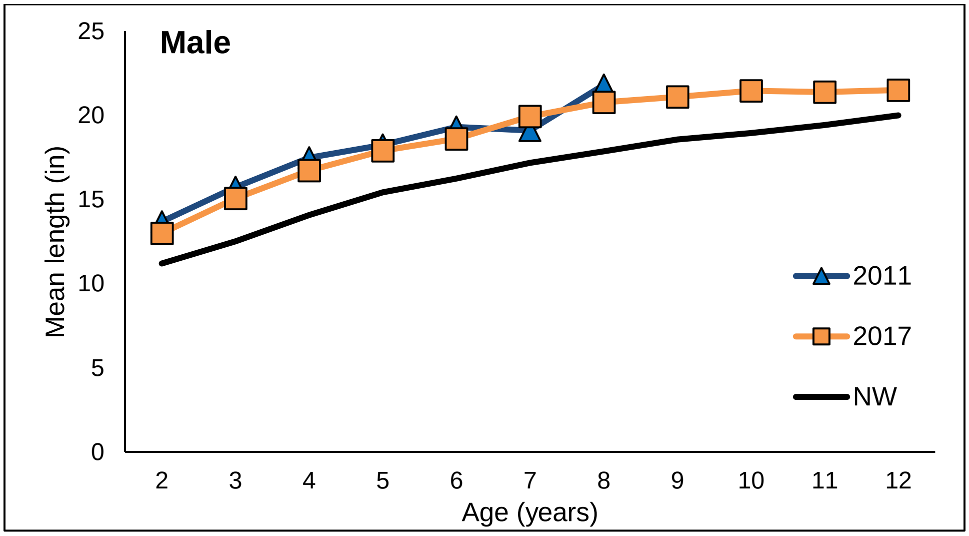


Figure 4. Mean length-at-age for male walleye captured during spring surveys on Clam Lake and Clam River, Burnett County. Northwestern (NW) averages are present for comparison.

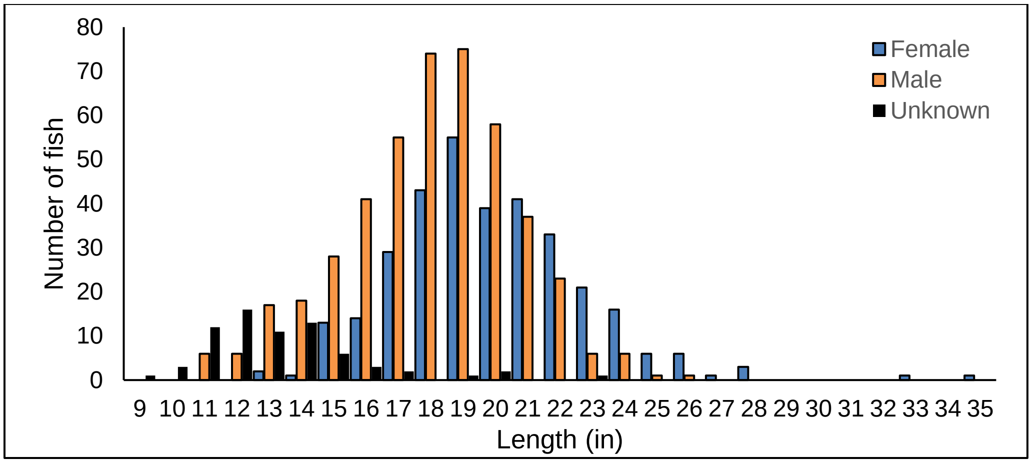


Figure 5. Length frequency of adult northern pike captured (fyke-nets) during spring 2017 in Clam Lake, Burnett County, Wisconsin.

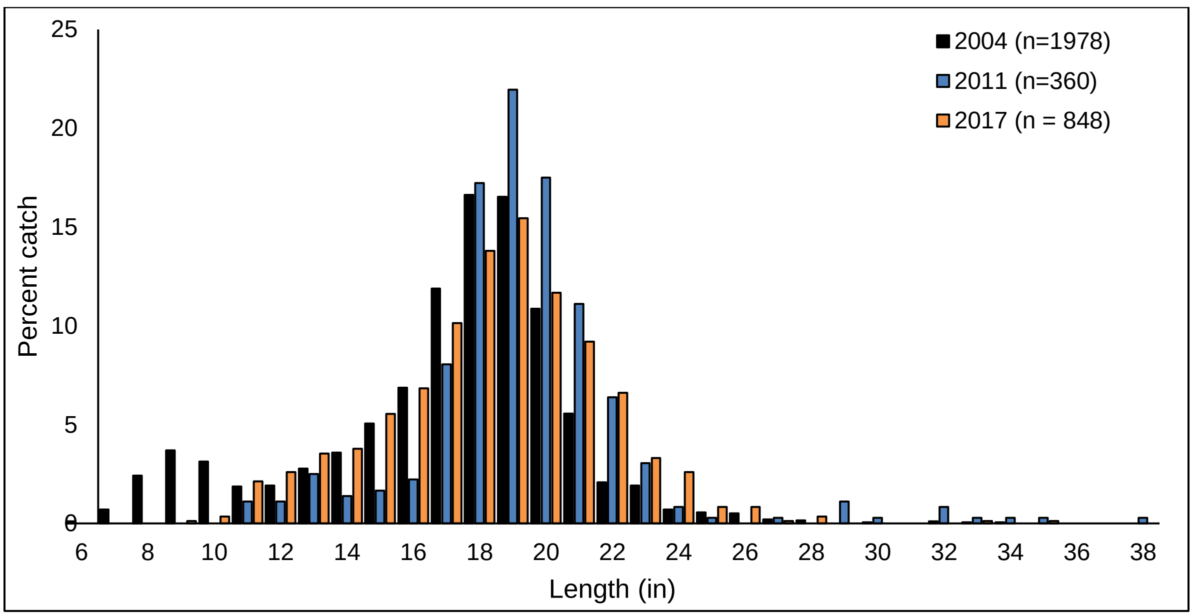


Figure 6. Relative length frequency of northern pike captured (fyke-nets) in 2004, 2011, and 2017 in Clam Lake, Burnett County.

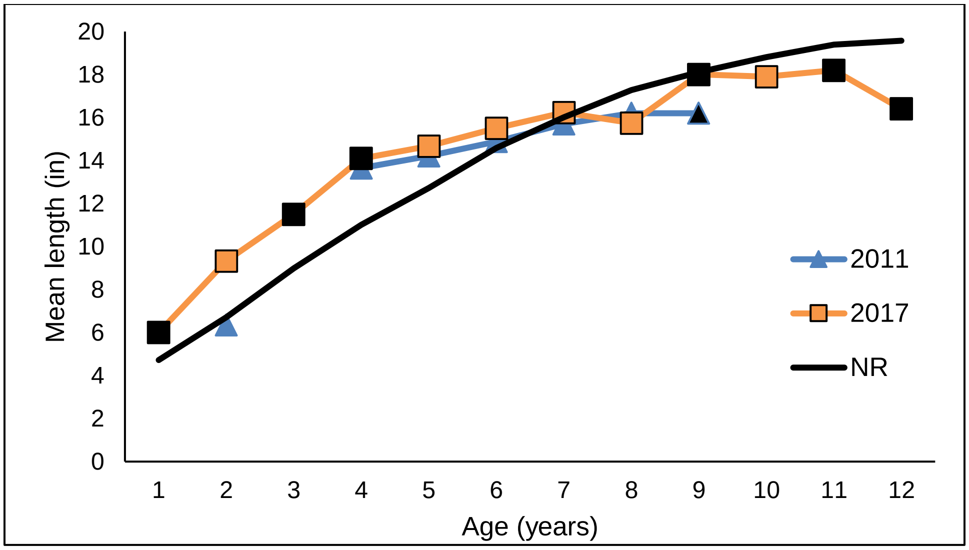


Figure 7. Mean length-at-age for largemouth bass in Clam Lake, Burnett County, Wisconsin compared with Northern Region average (NR). A black symbol represents a single fish aged.

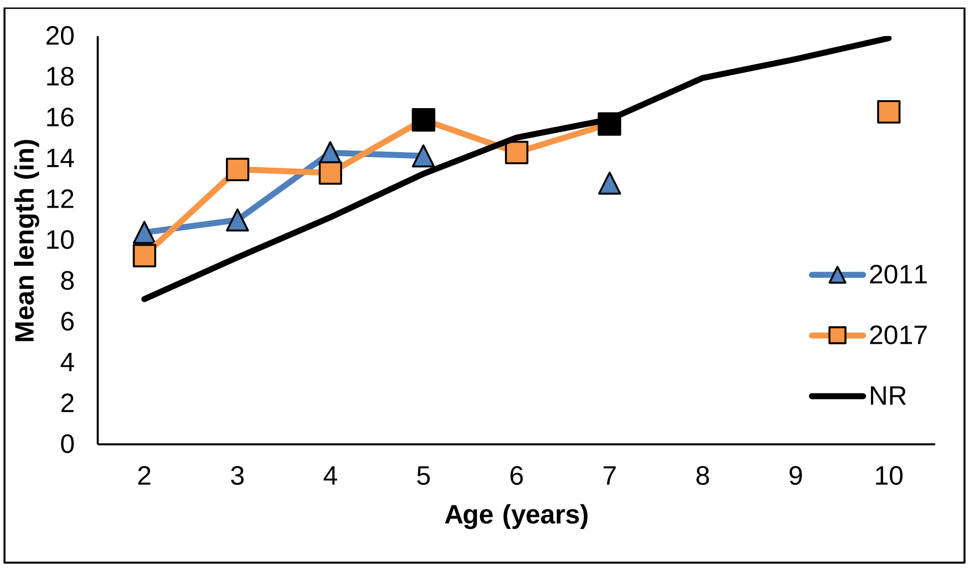


Figure 8. Mean length-at-age for smallmouth bass in Clam Lake, Burnett County, Wisconsin compared with Northern Region average (NR). A black symbol represents a single fish aged.

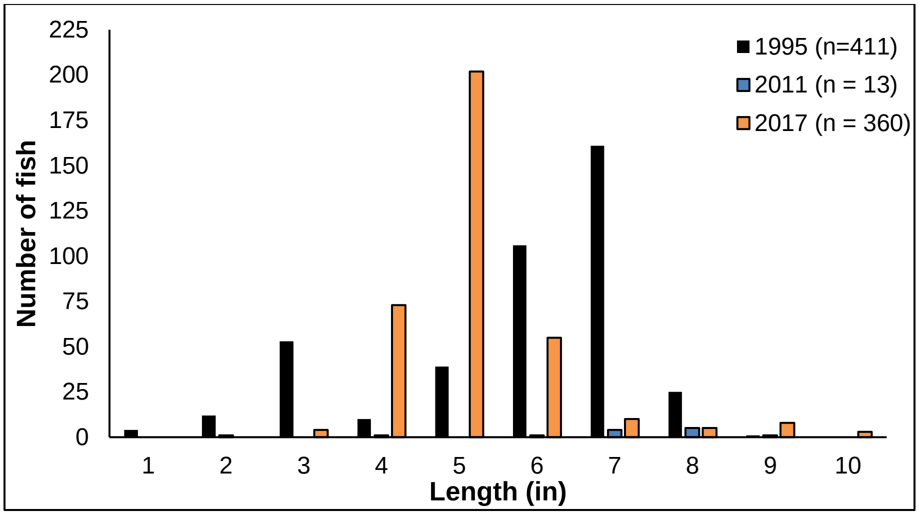


Figure 9. Number of bluegill captured during spring netting/electrofishing in Clam Lake, Burnett County, Wisconsin.

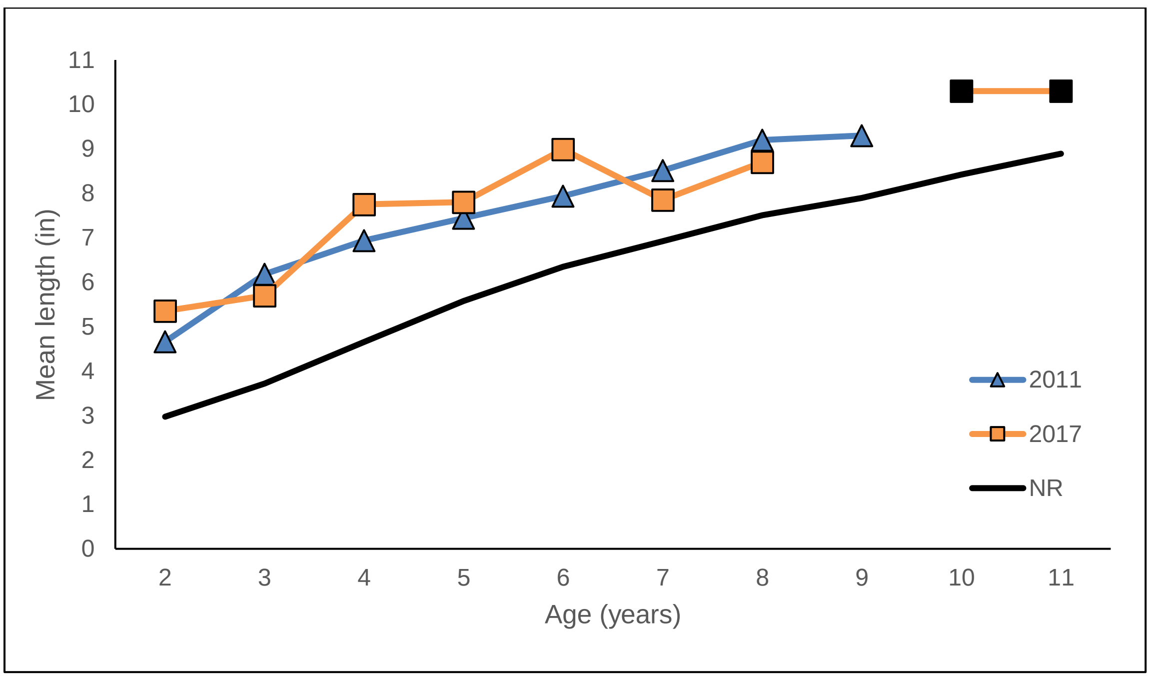


Figure 10. Mean length-at-age for bluegill in Clam Lake, Burnett County, Wisconsin compared with the Northern Region average (NR). A black symbol represents a single fish aged.

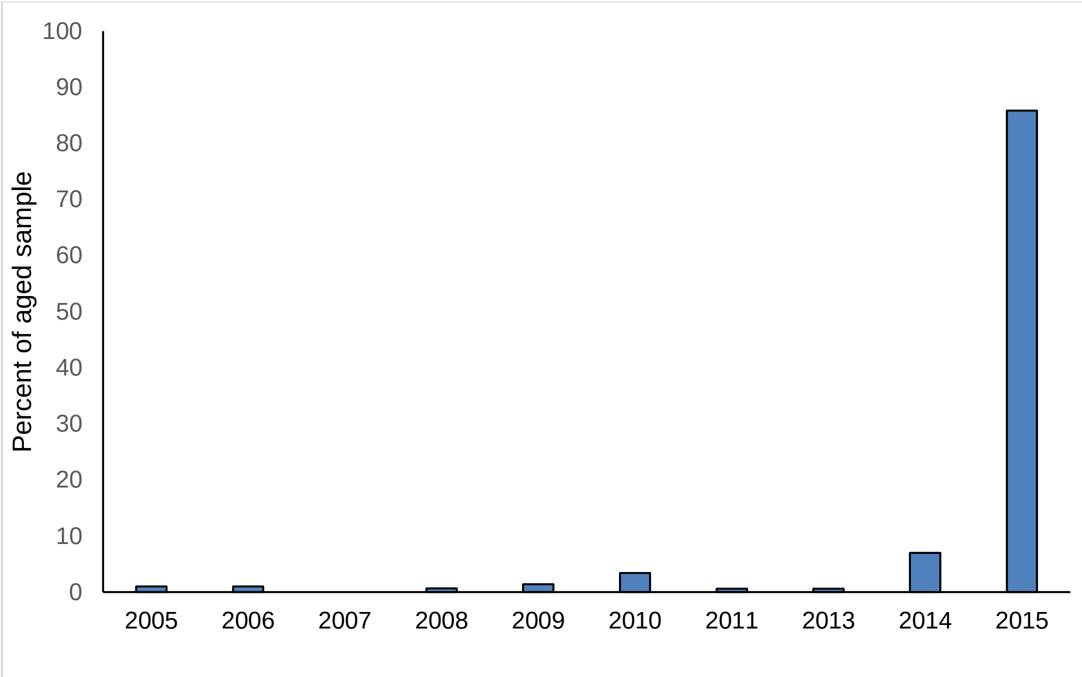


Figure 11. Percent of bluegill sample taken from netting/electrofishing and applied to age-length key in 2017 from Clam Lake, Burnett County.

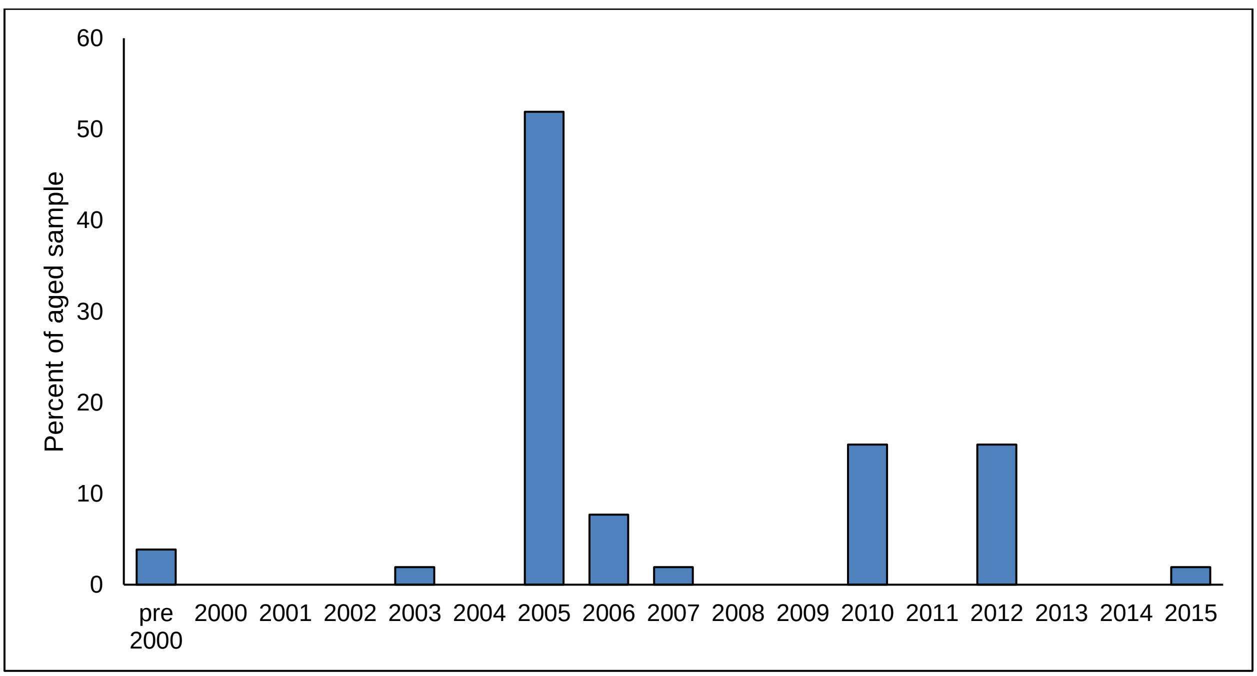


Figure 12. Percent of aged carp sample taken from commercial fishing in January 2017 from Clam Lake, Burnett County. Sample is based on 52 fish.

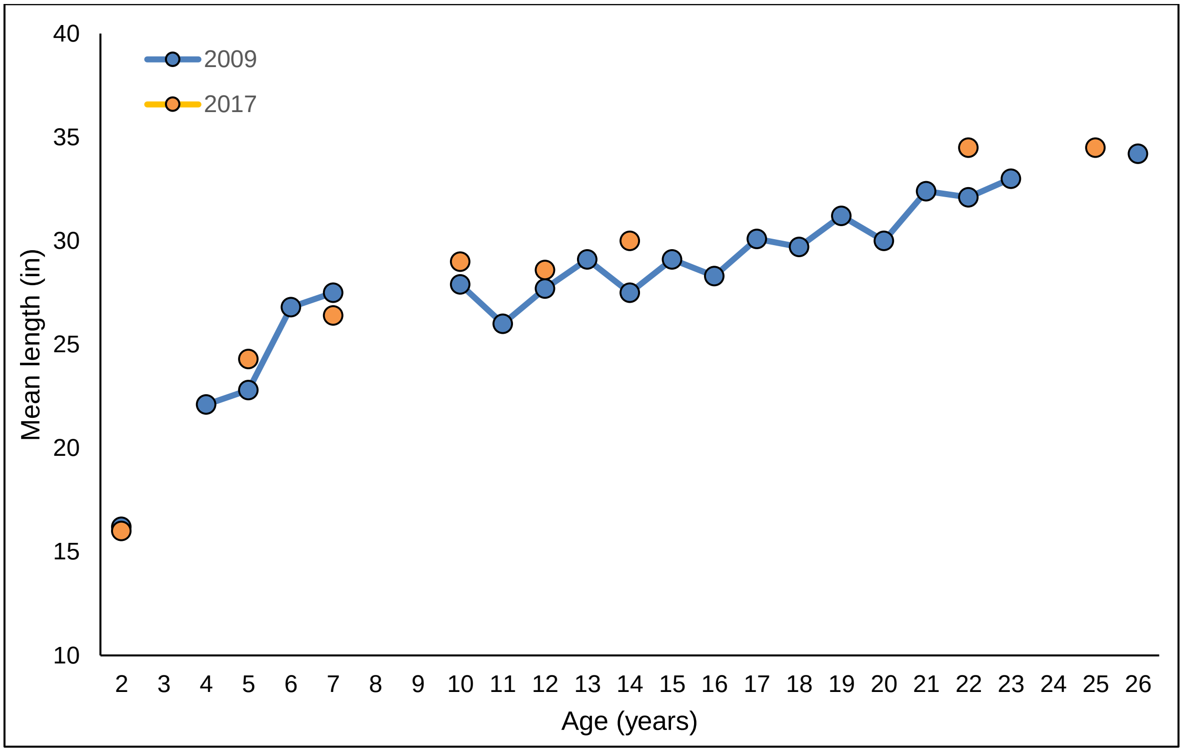


Figure 13. Mean length-at-age for common carp collected in 2009 and 2017 from Clam Lake, Burnett County.

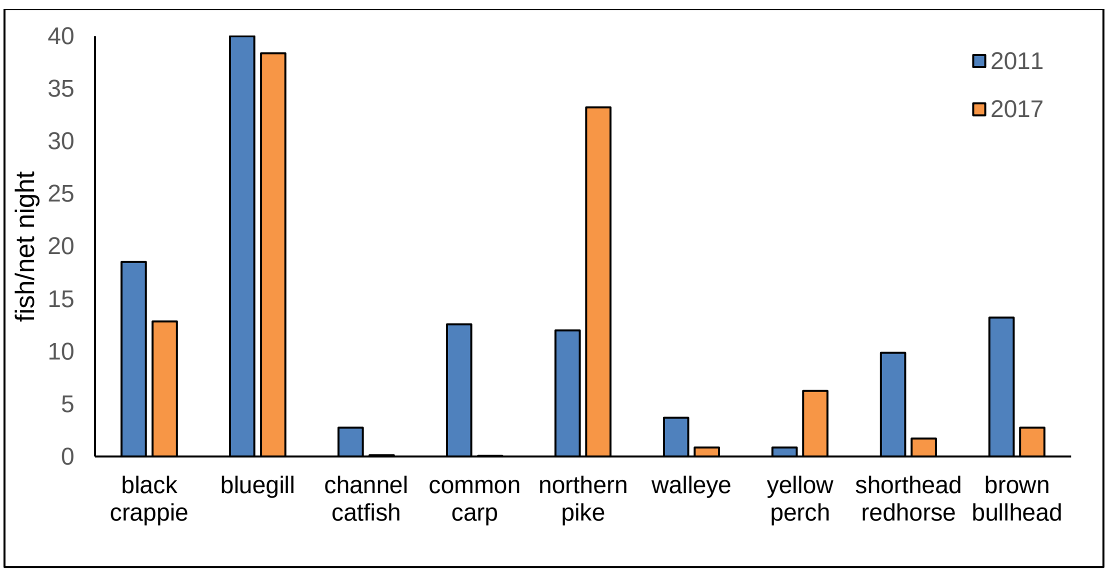


Figure 14. Early spring fyke net CPE for most common species collected.

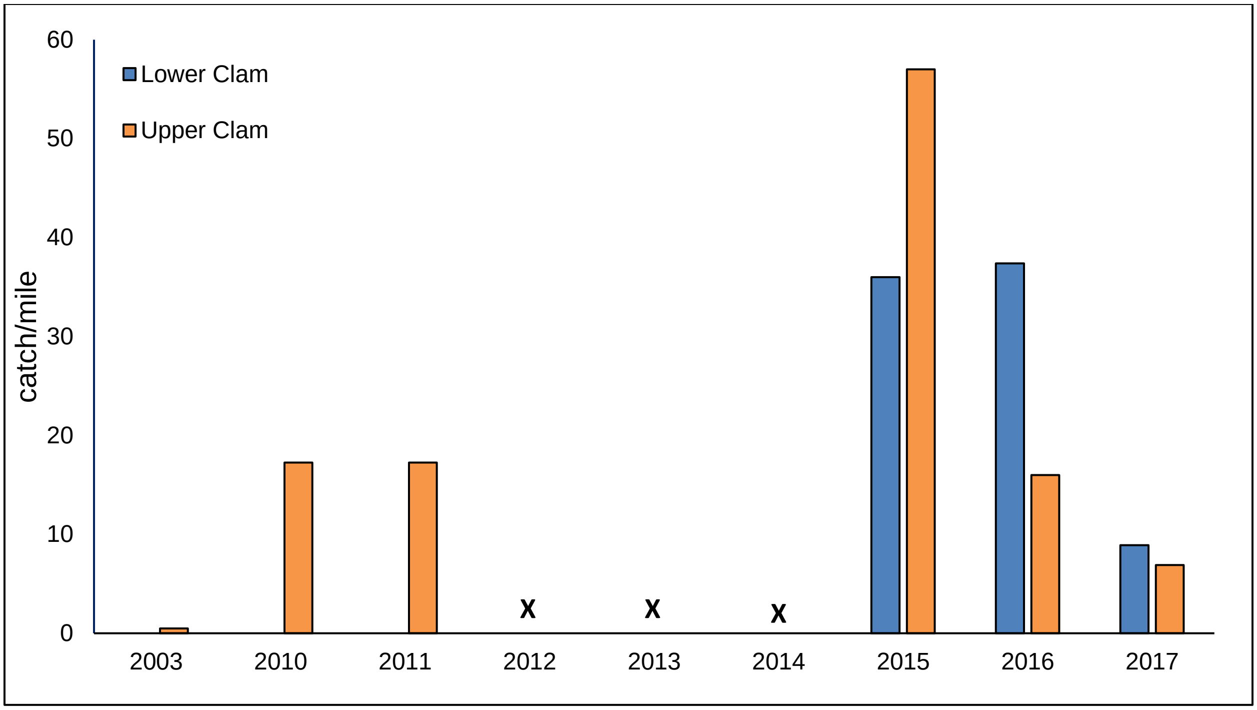


Figure 15. Young-of-year walleye relative abundances determined by fall electrofishing surveys in Upper and Lower Clam Lake, Burnett County, Wisconsin. **X** -represents years without a fall survey.

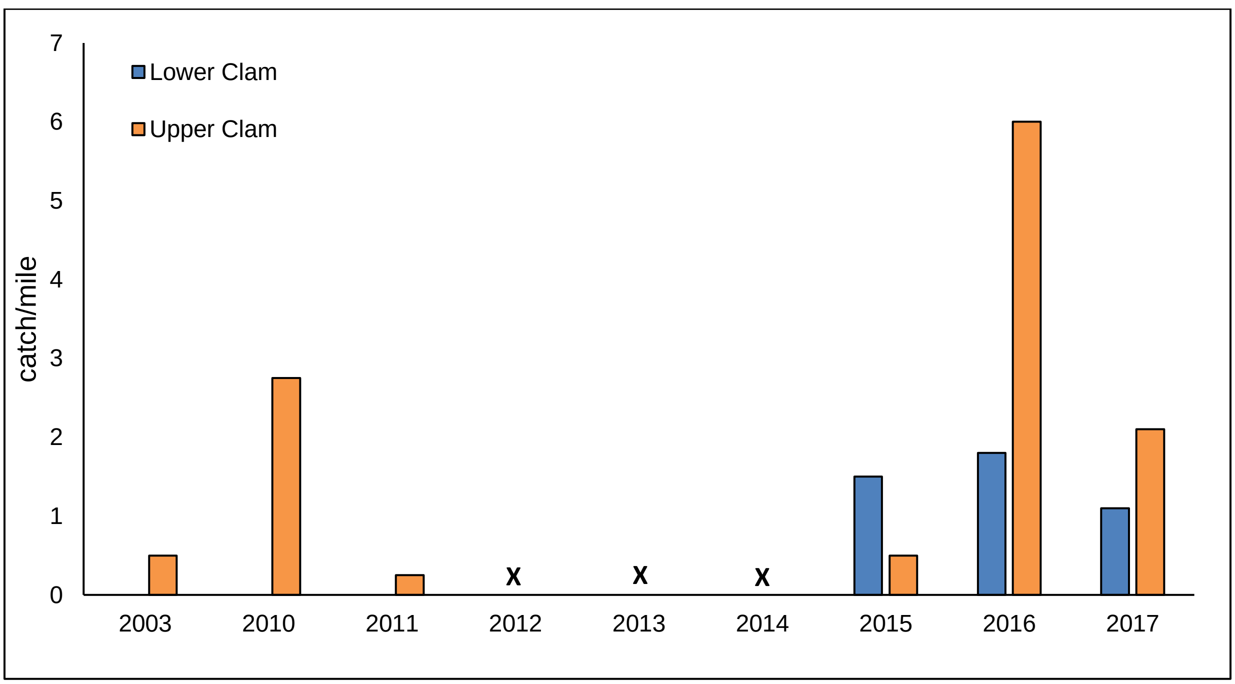


Figure 16. Age-1 walleye relative abundances determined by fall electrofishing surveys in Upper and Lower Clam Lake, Burnett County, Wisconsin. **X** -represents years without a fall survey.

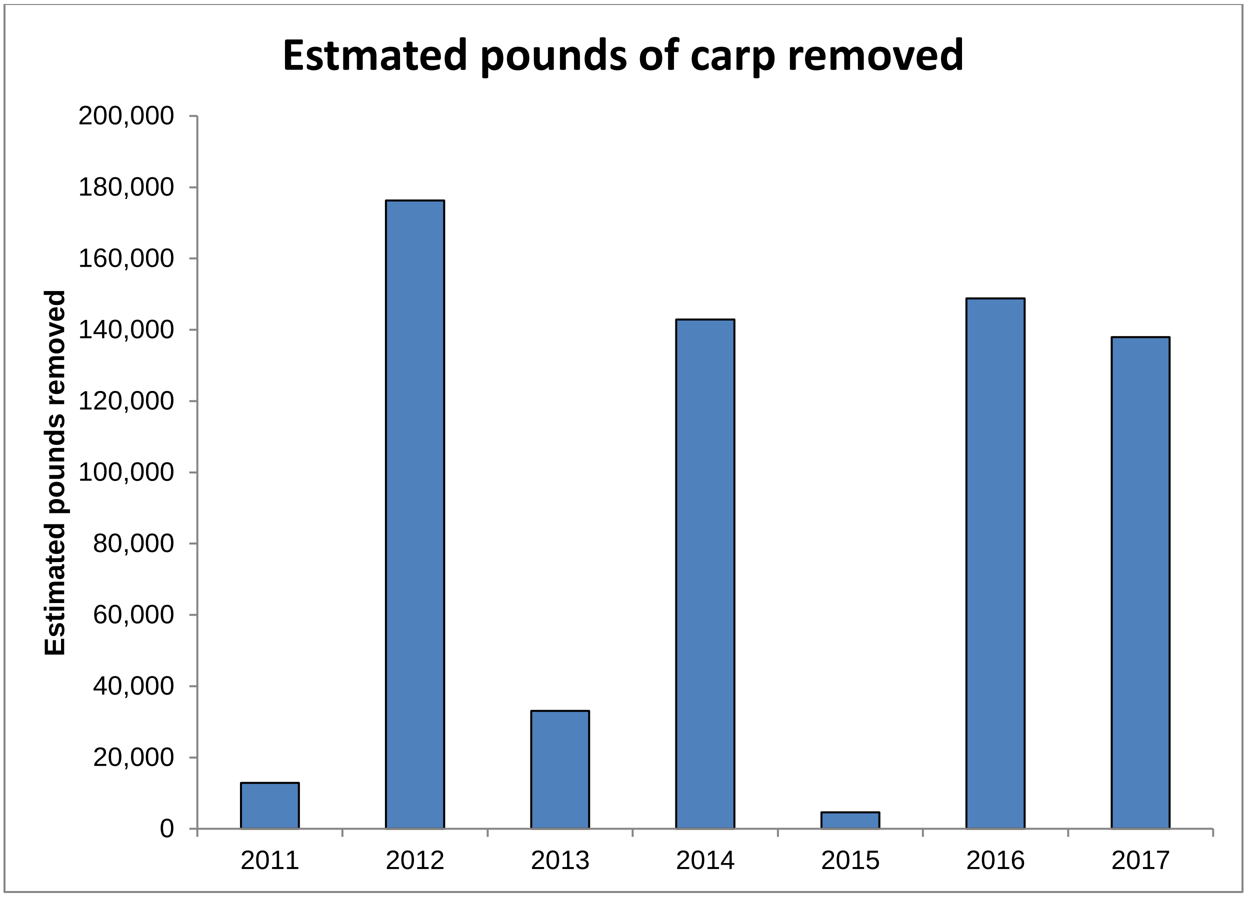
Appendix

Appendix Table 1. Catch rates of juvenile common carp observed during targeted mini-fyke net sampling in 2017. Data provided by SCE.

Date	Catch/net
12-Jul-18	10.1
13-Jul-18	404.5
14-Jul-18	129.0
8-Aug-18	224.0
9-Aug-18	95.7
Total	129.3

Appendix Table 2. Observed differences between turbid and clear states for Clam Lake, Burnett County, WI based on fisheries data and past research.

Lake State	**Abundant Gamefish Species**	**Carp Abundance**	**Aquatic Vegetation Density**	**Wild Rice Density**	**Waterfowl Density**
Turbid	Walleye, Channel Catfish, Yellow Perch	High	Low	Low	Low
Clear	Bluegill, Northern Pike, Largemouth Bass	Low	High	High	High



Appendix Figure 1. Estimated pounds of common carp removed from Clam Lake, Burnett County, WI 2011 – 2017.