Comprehensive Fisheries Survey of Lake Wisconsin, Columbia County and Sauk County, Wisconsin 2017

Waterbody Identification Code: 1260600

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EXECUTIVE SUMMARY

A comprehensive fisheries survey was conducted on Lake Wisconsin during the spring and fall of 2017. This included early spring electrofishing for Walleyes and Saugers on the Wisconsin River below the Kilbourn Dam (SE1), fyke netting in the main part of the lake for Northern Pike and Walleye (SN1), Muskellunge (SN2), late spring electrofishing for bass and panfish (SE2), and a fall electrofishing survey to assess Walleye and Sauger recruitment (FE). Walleye and Sauger were abundant. The 20 to 28-inch protected slot on Walleye, Sauger, and hybrids provides harvest opportunities for fish 15.0-19.9 inches, good catch and release opportunities for fish 20 to 28 inches, and also the opportunity to harvest large Walleyes over 28 inches. Walleyes in Lake Wisconsin exceeded 15 inches as early as age 3 and averaged 16 inches by age 4. Some Walleyes exceeded 20 inches by age 4, and Walleyes averaged over 20 inches by age 6. Some Walleyes exceeded 28 inches as early as age 8 and averaged over 28 inches by age 13. Maximum length of male Walleyes in 2017 was 23.7 inches, and maximum length of female Walleyes was 30.1 inches. The PE survey did a good job of capturing the size structure of adult Walleyes in Lake Wisconsin. During the PE, 3.2% of Walleyes ≥ 10 inches sampled were ≥28 inches, down from 5.8% in 2012. The estimated the number of Walleyes present in the first 8 miles below the Kilbourn Dam in the early spring of 2017 was 11,928 fish ≥ 12 inches and 7,261 fish ≥ 15 inches.

Bluegill, Black Crappie, and Yellow Perch were common and exhibited good growth. Bluegills as large as 9.5 inches were collected. Bluegills averaged over 6 inches by age 3 and over 8 inches by age 6, placing Bluegill growth ahead of area and state averages. Black Crappies up to 14.2 inches were collected in the survey and Black Crappie growth rates far exceeded area and state averages after age 1, likely due to the abundant forage found in Lake Wisconsin. Black Crappies averaged nearly 9 inches by age 3, and nearly 11 inches by age 4. White Crappies were collected in slightly lower numbers than Black Crappies but grew at very similar rates. Yellow Perch up to 11.3 inches were collected in the survey. Yellow Perch grew faster than the state average but total annual mortality after age 2 was high and few older individuals were sampled.

Largemouth Bass were present in areas of good habitat (shallow bays with aquatic vegetation) but were rare outside these areas. Based on fall electrofishing catch rates from 1993-2018, Largemouth Bass numbers have declined since the mid-2000s. Largemouth Bass reached the legal harvest size of 14 inches as early as age 3 and averaged over 14 inches by age 5. Largemouth Bass grew faster than the state average through age 6. Smallmouth Bass were more common than Largemouth Bass and were found in all parts of Lake Wisconsin. Smallmouth Bass in Lake Wisconsin grew slightly faster than the state average. Smallmouth Bass reached 14 inches as early as age 4 and averaged over 14 inches by age 6.

Naturally reproducing Northern Pike and stocked Muskellunge were present but not well represented in the 2017 survey. This was not necessarily a reflection of low population size, rather the survey, particularly fyke netting, which did a poor job of capturing them. Staff shortages in the spring of 2017 coupled with the size of the system, the amount of available habitat, and an unusual weather pattern during early spring made sampling all the good habitat at the appropriate time difficult.

Additional angling opportunities exist for numerous other gamefish and rough fish species in Lake Wisconsin. Also, a healthy naturally reproducing Lake Sturgeon population provides a month-long hook and line fishery each September, but harvest from Lake Wisconsin is very low with most anglers voluntarily practicing catch-and-release.

Lake and location:
Lake Wisconsin, Columbia County and Sauk County
T9NR6E Sections 12-14, 20-23, 29-31
T9NR7E Sections 6, 7
T10N R6E Sections 25, 36
T10N R7E Sections 1-5, 8-11, 17, 19, 20, 30
T10N R8E Sections 4-9, 17
T11N R7E Section 36
T11N R8E Sections 1, 12-15, 22, 23, 26-35
T11N R8E Sections 4-6
T12N R8E Sections 1-6, 10-12
T13N R6E Sections 3, 4, 10, 13-15, 24, 25, 36
T13N R7E Sections 18, 19, 30-36
T13N R8E Section 31

Lake Wisconsin is in the towns of Prairie du Sac, Merrimac, and Delton in Sauk County, and West Point, Lodi, Dekorra, Caledonia, Lewiston, and Newport in Columbia County. Lake Wisconsin is part of the Mississippi River drainage, and specifically the Wisconsin River watershed. It is a large, impounded drainage lake that receives water from the Kilbourn Flowage of the Wisconsin River via discharge from a hydroelectric generation dam located in Wisconsin Dells (Kilbourn Dam) which is owned by Alliant Energy. It also receives input from the Baraboo River and several coldwater trout streams that enter the lake at various points around its shoreline including Parfrey's Glen Creek, Prentice Creek, Duck Creek, Rocky Run Creek, Rowan Creek, and Spring Creek (Lodi Spring Creek). Several unnamed perennial and intermittent streams drain into the lake as well. Lake Wisconsin discharges to the lower Wisconsin River via the Prairie du Sac (PDS) Dam, a hydroelectric generation dam located at Prairie du Sac. The PDS Dam maintains a 38-foot head and is owned by Alliant Energy.

Physical/Chemical attributes:
Morphometry: 9,000 acres, maximum depth of 24 feet, 58.2 miles of shoreline (Poff and Threinen 1965)
Watershed: 8,950 square miles, including 485 acres of adjoining wetland (Poff and Threinen 1965)
Lake type: Drainage
Water clarity: Stained and turbid with dense algal blooms in summer and early fall.
Littoral substrate: Muck in shallow bays, sand, gravel, and rock along shoreline of main basin
Aquatic vegetation: Present in shallow bays, largely absent from the main part of the lake due to stained water and depth.
Winterkill: Periodic in shallow bays and elsewhere. Summer kills noted during periods of extreme heat and dry weather.
Boat landing: Approximately 16 public landings around the lake with parking for anywhere from 0 to 25+ vehicles with trailers. Most ramps are paved, and toilet facilities are also available at selected ramps.
Other features: Hook and line fishing is open all year for all fish species except Muskellunge, Lake Sturgeon, trout, Paddlefish, and threatened or endangered fish. Season dates and length and bag limits can be found in Table 1.

Purpose of Survey
Tier 1 assessment baseline lake survey

Dates of fieldwork
Fyke netting surveys were conducted March 20 through March 24, 2017 (SN1), and April 11 through April 14, 2017 (SN2). A spring electrofishing survey was conducted on the Wisconsin River from the Kilbourn Dam to approximately 7 miles downstream for the purpose of a Walleye population estimate from March 27 through April 9, 2017. A spring electrofishing survey in the main lake was conducted May 15 through May 25, 2017 (SE2). Fall electrofishing for annual Walleye and Sauger recruitment assessment was conducted October 2 through October 5, 2017 on the main lake and below the Kilbourn Dam in Wisconsin Dells.

Fishery
Panfish (Bluegills, Crappies, Yellow Perch, Pumpkinseed, Green Sunfish, Warmouth): Bluegills were common in areas of suitable habitat (shallow vegetated bays). Black Crappies and Yellow Perch were common and assorted other panfish species were present.

Sport fish (Walleye, Sauger, Northern Pike, Muskellunge, Largemouth Bass, Smallmouth Bass, Channel Catfish, Flathead Catfish): Sauger, Walleye, and Smallmouth Bass were common. Largemouth Bass, Northern Pike, Muskellunge, Channel Catfish and Flathead Catfish were present.

Sturgeon: A healthy population of Lake Sturgeon was present in the lake numbering approximately 1,600 adult fish ≥ 50 inches. Lake Sturgeon is the only sturgeon species present in Lake Wisconsin.

BACKGROUND

Lake Wisconsin is an impoundment of the Wisconsin River that was created in 1915, following the completion of the Prairie du Sac Dam (Marshall et al. 1985). The Prairie du Sac Dam is owned and operated by Alliant Energy and provides hydroelectric power generation. The lake is highly eutrophic, receiving elevated levels of nutrient input from the extremely large surrounding watershed of nearly 9,000 square miles, which is primarily agricultural. Algal blooms are common in summer and fall. The lake has the stained water color characteristic of the Wisconsin River, and aquatic vegetation is not common outside of shallow bays due to minimal light penetration (Marshall et al. 1985). The lake is highly accessible to the public and is a popular lake for fishing and other forms of water recreation despite the algal blooms. In an effort to address the water quality issues common to the Wisconsin River drainage the Wisconsin River Total Maximum Daily Load (TMDL) study was completed in 2019. A TMDL is the amount of a pollutant that can be present in a waterway and still allows that waterway to meet its water quality standards.

Within the Wisconsin River Basin, those pollutants are phosphorous and suspended solids. The EPA requires that Wisconsin waters not meeting water quality standards be placed on

Wisconsin's 303-d list, and these waters must have a TMDL or comparable water quality restoration plan developed. The Wisconsin River study area included 9,156 square miles across 15 counties, from Vilas County in the north down to Columbia, Sauk, and Dane counties in the south; the entire Wisconsin River drainage from the headwaters down through Lake Wisconsin, the downstream-most impoundment in the basin. Each waterbody in the study area (streams, rivers, lakes) was assessed to determine pollutant loads stemming from naturally occurring sources (forests, wetlands), runoff from the surrounding landscape including agricultural sources, and runoff from municipal and industrial wastewater sources as well as stormwater runoff. Results of the study will be used to revise current water quality standards and lead to the adoption of new standards with the goal of improving water quality across the entire watershed. For complete information on the Wisconsin River TMDL, please visit the dedicated DNR web page found at https://dnr.wi.gov/topic/tmdls/wisconsinriver/.

The fish community in the lake is characteristic of large impoundments on large northern river systems. Walleye, Sauger, and Smallmouth Bass are the dominant gamefish, and are sustained entirely through natural reproduction. Naturally reproducing Northern Pike are present in the lake, as are stocked Muskellunge. Bluegill, Black Crappie, White Crappie, and Yellow Perch provide a robust panfish fishery. Bluegill and Largemouth Bass are found in good numbers in shallow bays where aquatic vegetation is present, but are rare in deeper, rockier areas of the main body of the lake. Smallmouth Bass are abundant in these rocky areas and are sustained through good natural reproduction aided by the lake's connectivity to the Wisconsin River. The river provides an abundance of good Smallmouth Bass habitat.

Although most of the fish populations in Lake Wisconsin are sustained by natural reproduction, some minimal stocking does occur. Tiger Muskellunge (Northern Pike x Muskellunge hybrid) were stocked periodically from 1979 through 2002, but these stockings were discontinued in favor of true Muskellunge. Muskellunge (all large fingerlings) have been stocked several times between 1972 and 2018, including fish raised by the WDNR, its cooperators, and private hatcheries. State-raised muskies are stocked in even years. Lake Sturgeon have been periodically stocked into Lake Wisconsin and the Wisconsin River immediately below Kilbourn Dam since 1998. Different sizes of Lake Sturgeon have been stocked including fry, small fingerlings, large fingerlings, and yearlings and the stocked sturgeon were produced from gametes collected annually from wild broodstock below the Kilbourn Dam during the spring spawning period. Lake Sturgeon stockings occurred only in years when all other quotas were met and surplus fish were available. Additionally, Lake Sturgeon have been stocked in the Baraboo River as part of a sturgeon rehabilitation program following the removal of the last dam on the Baraboo River in 2001. The current quota is annual stocking of 500 yearlings and Lake Sturgeon stocked there have freedom of movement within the Baraboo River and the entirety of Lake Wisconsin. The only other fish stocking that has taken place between the Prairie du Sac Dam and the Kilbourn Dam since 1972 was an unknown number of small fingerling Smallmouth Bass stocked in 2004 as part of USFWS project to reintroduce Higgins eye pearly mussels in the Wisconsin River. Recent fish stocking records for Lake Wisconsin can be found in Table 2.

Man-made fish structures were added to the lake in September 1987 as part of a DNR-led fish crib project. The cribs were placed at 17 sites around the lake and each unit consisted of five 4-foot by 4-foot wood pallets fastened together and weighted with cement blocks. Twenty units were placed at each site within an area approximately 50 feet in diameter. The goal of placing these cribs was to attract crappies.

Rough fish removals have taken place on Lake Wisconsin periodically since at least 1975. The primary goal was to remove Common Carp that were having a detrimental effect on the lake. These removals ideally would have a positive impact on the lake. Rough fish removals were conducted by commercial fishermen who annually bid on and are awarded the contract to remove rough fish from the lake, typically using large-mesh (6-inch bar mesh) seines. Contract fishermen have had difficulty seining fish at times because of the amount of submerged timber and debris in the flowage; nets are often damaged or destroyed. The most recent rough fish removal effort occurred in 2015.

The City of Portage, Wisconsin relocated its wastewater treatment plant discharge from the Fox River to the Wisconsin River in 1983, following a process that began in the late 1970s that included an Environmental Impact Statement done by the United States Environmental Protection Agency. After the city began discharging effluent into the Wisconsin River, the Wisconsin Department of Natural Resources conducted its own study during 1983 and 1984 to assess possible water quality impacts from the new discharge. The results indicated that the discharge had no measurable impact on water quality of the Wisconsin River from the discharge point, downstream through Lake Wisconsin (Marshall et al. 1985).

Historically, pollutants from industry located along the Wisconsin River, particularly the paper industry, left the fish in the river with levels of contaminants which rendered them unfit for human consumption, as well as an unpleasant odor which made them unpalatable to boot. Following the Clean Water Act of 1972, reductions in pollution led to safer fish for eating and eliminated the foul odors which made the fish unpalatable. Harvest of river fish, especially Walleyes, increased considerably as a result. A statewide 15-inch minimum length limit for Walleyes was enacted in 1990, and in time the size structure of the fishery was reduced as anglers cropped the fish off soon after they reached 15 inches. However, anglers wanted a fishery with larger Walleye while still maintaining the ability to harvest fish for eating. Population modeling indicated that increases in the number of Walleye larger than 28 inches and Sauger larger than 20 inches would be possible under a new regulation. The regulation included a harvest slot from 15 to 19.9 inches and a protected slot from 20 to 28-inches for Walleye, Sauger, and hybrids. The daily bag limit was 5 fish, one of which could be larger than 28 inches. This regulation was enacted on the Wisconsin River above the Prairie du Sac Dam beginning with the 2002 fishing season. The slot was initially instituted on a temporary basis, with a sunset of 2007. At the 2006 spring hearings, it was voted on again, and extended until 2014. At the 2013 spring hearings, attendees voted again on the proposal, this time making the rule permanent.

Lake Wisconsin and the Wisconsin River upstream to Wisconsin Dells has a self-sustaining population of Lake Sturgeon that supports a hook-and-line fishery which runs from the first Saturday in September through September 30 each year. The minimum length limit is 60 inches, the bag limit is one fish per year, anglers must purchase a harvest tag to legally harvest a Lake Sturgeon, and registration of harvested fish by anglers is mandatory. The population size was estimated at 1,600 adults ≥ 50 inches in 2008, and this was essentially unchanged from the previous population estimate in the early 1980s, despite several years of high harvest prior to the minimum length limit being permanently changed to 60 inches in 2007 (Rennicke 2013). The change to the 60-inch minimum length limit along with a growing catch-and-release ethic among Lake Wisconsin sturgeon anglers has served to reduce harvest to very low levels, despite good availability of harvestable fish. Lake Sturgeon in Lake Wisconsin spawn on the fractured bedrock in the Kilbourn Dam tailrace area and this successful natural reproduction sustains the fishery without the need for stocking. Adults from this population are used as the brood stock for hatchery-reared Wisconsin River strain Lake Sturgeon currently utilized in rehabilitation efforts on the Wisconsin River upstream of Kilbourn Dam, the Baraboo River, and the Black River. In years when all quotas are filled and surplus Wisconsin River strain Lake Sturgeon are available, those surplus fish are stocked in the Kilbourn Dam tailrace area where their parents would have spawned naturally.

METHODS

Data collection-2017 Wisconsin River Walleye PE

Past WDNR surveys and anecdotal information from anglers indicated that in early spring, sexually mature Walleyes left the main body of Lake Wisconsin and entered the Wisconsin River to spawn. Early spring Walleye and Sauger sampling efforts in 2017 were concentrated in the Wisconsin River below the Kilbourn Dam in areas where spawning habitat was judged to be the best. Daytime electrofishing was conducted on March 27, and night electrofishing occurred from March 27-April 9 except for March 30 and April 5. Specific stations were not sampled, but the general sampling area was the Wisconsin River from the Kilbourn Dam downstream to Fisherman's Luck Bar. Only Walleye and Sauger were collected except for four juvenile Lake Sturgeon on April 1. Captured Walleye and Sauger that were 12.0 inches and larger were marked with a Floy FD-94 T-bar anchor tag and a top caudal fin clip, while fish smaller than 12.0 inches received a bottom caudal fin clip. Walleye, Sauger, and Lake Sturgeon were measured to the nearest 0.1 inch and sex was recorded when evident. Dorsal spines were taken from a subsample of 5 fish per half-inch group for males, females, and immature/unknown Walleyes and Saugers for age and growth analysis. Lake Sturgeon were marked with passive integrated transponder (PIT) tags.

Data collection-Lake Wisconsin, Spring 2017

Following ice-out, 7 standard 3-foot hoop fyke nets with 0.7-inch bar, 1.4-inch stretch mesh were set on March 20, 2017; these fyke nets targeted Northern Pike and Walleye (SN1). Fyke net locations (GPS coordinates) can be found in Table 3. All 7 nets were run from March 21 through March 23 when four nets were removed. The remaining three nets were removed on March 24 because the crew had to shift focus to Walleye electrofishing in the river. Staff shortages prevented two crews from running fyke nets in the lake concurrently with a third crew night electrofishing Walleyes in the river like what was done in 2012. Lingering ice coverage in portions of the lake coupled with the limited coverage that could be achieved by a single crew reduced the amount of sampling gear deployed during SN1. Nine nets were set again on April 11, marking the beginning of SN2 targeting Muskellunge. Net sets focused primarily on locations where muskies were captured in 2012. Nine nets were run each day from April 12 to

April 14 when nets were removed because conditions were becoming favorable for Lake Sturgeon spawning in the Wisconsin River and the crew had to shift its focus to sturgeon sampling.

Gamefish, as defined in Wisconsin Statutes Chapter 29.001 (41), includes all varieties of fish except rough fish and minnows. Panfish are therefore gamefish, and by definition in Wisconsin Statutes Chapter 20.03 (29), panfish includes Yellow Perch, Bluegill, Black Crappie, White Crappie, Pumpkinseed, Green Sunfish, Warmouth, and Orangespotted Sunfish (Orangespotted Sunfish are not present in Lake Wisconsin). For the purposes of this report, sport fish refers to a subset of gamefish including Walleye, Sauger, Northern Pike, Muskellunge, Largemouth Bass, Smallmouth Bass, Channel Catfish, and Flathead Catfish. During fyke netting, all fish were measured to the nearest 0.1-inch and sex was recorded when evident for Northern Pike, Muskellunge, Walleye, Sauger and Yellow Perch. Aging structures were taken from a subsample of Largemouth Bass, Smallmouth Bass, Northern Pike, Muskellunge, Walleye, Sauger, Yellow Perch, Bluegill, Black Crappie and White Crappie. The goal was to take structures from 5 fish per half-inch group, per species except for Walleye, Sauger, Yellow Perch, Muskellunge and Northern Pike where the goal was 5 structures per half-inch group for each sex. Any fish that had an aging structure removed was also weighed to the nearest gram. Muskellunge and Flathead Catfish were implanted with PIT tags. Walleyes and Saugers ≥ 12 inches were marked with Floy FD-94 t-bar anchor tags.

A WDNR standard direct current (DC) boomshocker boat was used to sample fish on the nights of May 15 through May 18 and May 25, 2017. Prior to sampling, the shockable shoreline of the lake was divided into 103 half-mile electrofishing stations beginning with Station 1 on the Columbia County shore just above the Prairie du Sac Dam. Stations were numbered sequentially moving in a counterclockwise direction around the lake with Station 103 ending just above the Prairie du Sac Dam on the Sauk County shoreline. A total of 24 half-mile electrofishing stations were sampled, including 10 all species stations and 14 sport fish-only stations. The all species stations targeted areas of good panfish habitat (shallow areas with aquatic vegetation), while the sport fish stations were chosen randomly from the remaining pool of 93 possible half-mile stations. The goal of the targeted all species effort was to determine which stations had the highest panfish abundance with the goal of establishing fixed panfish index stations to be sampled in future surveys. Common Carp were observed and counted when sampling all species stations but were not dip-netted. All gamefish (panfish, sport fish, and other gamefish species) were measured to the nearest 0.1 inch. Aging structures were collected, and weights were recorded as needed to fill out length bins for each species. Specific aging structures used for each species are presented in Table 4. Starting and ending GPS coordinates for electrofishing stations sampled during SE2 can be found in Table 5.

Fall Walleye and Sauger recruitment survey

A WDNR standard direct current (DC) boomshocker boat was used to sample fish on the Wisconsin River below the Kilbourn Dam on the night of October 2, 2017 and on Lake Wisconsin on the nights of October 3 through October 5, 2017. Established electrofishing stations have been sampled each year since 1993, including 6 stations in Lake Wisconsin and 2 stations below the Kilbourn Dam on the Wisconsin River; GPS coordinates of the beginning and ending points of each station can be found in Table 6. The purpose of the annual survey has been to assess Walleye and Sauger recruitment in Lake Wisconsin and the Wisconsin River, and to monitor trends in populations of other gamefish. All sport fish were collected and measured to the nearest 0.1 inch. Walleyes and Saugers ≥ 12 were marked with a Floy FD-94 t-bar anchor tag. Muskellunge and Flathead Catfish were marked with PIT tags.

Data analysis

The Walleye PE was calculated using the multiple-census Schnabel method where fish are marked and added to the population during multiple events over a period of time. On all visits after the first visit, captured fish were examined for marks, and returned to the population. Major assumptions of this method require that the population be constant, with no recruitment and no mortality during the experiment (Ricker 1975). These assumptions essentially hold true for this survey; the duration was short enough that no recruitment occurred, and negligible mortality relative to the total population size occurred. Results of the PE are reflective of the portion of the Walleye population using the Wisconsin River near Wisconsin Dells for spawning and should not be considered an estimate of the population size in the entire Lake Wisconsin system.

Various data analyses were completed using both Microsoft Excel and R (version 3.5.1) combined with R Studio (version 1.1.456). For SN1, SN2, SE2, and fall electrofishing, total catch and catch-per-unit effort (CPUE) were calculated by gear type. Length frequency distributions were generated for species of interest, including Walleye, Sauger, Largemouth and Smallmouth Bass, Northern Pike, Muskellunge, Bluegill, Black Crappie, White Crappie, and Yellow Perch. Length range, mean length, and median length were calculated for all species.

Proportional size distributions (PSDs) were calculated for all gamefish species with more than 100 stock-size individuals collected (Anderson and Neumann 1996, Guy et al. 2007). Length designations for stock, quality, legal or common harvest sizes, preferred, memorable, and trophy sizes of gamefish species collected from Lake Wisconsin can be found in Table 7; these values were used for calculation of PSD (Anderson and Neumann 1996). For Bluegills, separate PSD calculations were made from the fyke net catch and the SE2 catch. Possible bias toward larger fish exists for the fyke net data because fyke nets have been shown to be selective for larger Bluegills (Laarman and Ryckman 1982).

Aging structures (scales, dorsal spines, and anal fin rays/spines) were used to estimate ages of a subsample of each species, and age and length data from these fish were used to generate age-length keys to estimate the age frequency of the whole population based on the aged subsample. Age frequency distributions were then generated for each species.

Once age frequency distributions were completed for each species, inferences were made about year class strength and mortality when possible. Total annual mortality estimates were calculated using catch curves. Mean length-at-age was used to make inferences about growth of fish in Lake Wisconsin by comparing the lake to area and statewide averages. The area average was calculated from mean length-at-age values from lakes managed out of the Poynette Fisheries office and surveyed from 2006-2017 (11 lakes, 12 total surveys). Mean length-at-age was calculated using methods outlined in Bettoli and Miranda (2001), with the formula listed here:

$$\overline{Li} = \left(\sum N_{ij}\bar{l}_{ij}\right)/N_i$$

Where $\overline{L}_i$ represents the mean length of the *i*th age group, $N_{ij} = N_j(\frac{n_{ij}}{n_j})$, N_j is the number of fish in the *j*th length group, n_{ij} = number of fish of the *i*th age group subsampled in the *j*th length group, n_j is the number of fish subsampled in the *j*th length group, and $N_i = \sum N_{ij}$ over all *j* length groups. The inputs to this equation are derived from the length frequency distribution of the sample and the age-length key. The midpoints of each length group were used for the values of $\bar{l}_{ij}$. This method extrapolates length-at-age data from the subsample of aged fish to the entire sample of fish collected (Bettoli and Miranda 2001). Simply reporting the mean length-at-age as the values calculated from the subsample of aged fish does not represent the entire sample because the subsampling is not in proportion to the frequency distribution of the sample (Bettoli and Miranda 2001). Ages were then assigned to the unaged fish in the sample using methods outlined in Isermann and Knight (2005) using the FSA package in R.

Relative weights were calculated to evaluate body condition of fish. Relative weight (W_r) is a tool that compares the length of the fish to an expected weight for that length. Standard weights were calculated for individuals of each species that had weights recorded and standard weights were only calculated for individuals larger than the minimum recommended length for each species (Murphy et al. 1991, Anderson and Neumann 1996). Relative weights for each fish were calculated by dividing a fish's actual weight by the standard weight for a fish of that length. Average relative weight was then calculated for each species and was done for each sex separately when sex data were available. Relative weight values between 75 and 100 indicate normal weight for a given length. A relative weight value greater than 100 indicates that a fish is in excellent condition. A relative weight value less than 75 indicates that a fish is in poor condition.

Using the FSA package in R, a von Bertalanffy growth curve was fitted to Walleye and Sauger length-at-age data for Lake Wisconsin to provide the predictive relationship of Walleye and Sauger length based on age. The von Bertalanffy growth equation is here:

$$l_t = L_\infty(1 - e^{-K(t-t_0)})$$

Where l_t is the length of the fish at a given age, L_∞, or L infinity, is the maximum theoretical length, K is the growth coefficient, and t_0 is the time in years when length would theoretically be equal to zero. The growth curve was then plotted against observed values of mean length-at-age.

Mean size-specific Walleye and Sauger catch rates for various size categories from the fall electrofishing survey both before and after the 20 to 28-inch protected slot limit was enacted in 2002 were compared using a two-sample t-test assuming equal variances. This was done to detect changes in the fishery. Data collected in 2009 for size classes larger than age 0 were excluded from the analysis because the survey was conducted one month later than the other years in the time series and the number of Walleyes larger than 15 inches collected was nearly zero. The assumption is that larger Walleyes had left near-shore areas for deeper overwintering habitat by the time the survey was conducted. The absence of Walleyes larger than 15 inches was not noted in any other year in which the survey was conducted. Overall, recruitment data collected from 1993-2018 were included in pre-post regulation comparisons.

RESULTS AND DISCUSSION

Wisconsin River Spring Walleye Population Estimate and Sauger Population Monitoring

Walleye

During the Walleye PE survey, 2,117 Walleyes were collected, including recaptures. Catch-per-unit effort was 71.3 fish/hour of electrofishing. Electrofishing distances were not recorded, so calculation of CPUE in terms of fish per mile was not possible. A total of 1,391 Walleyes ≥ 11.8 inches were marked with a Floy tags, and 87 were recaptured during the survey. The population of Walleyes ≥ 12 inches using the section of the Wisconsin River from the Kilbourn Dam to Fisherman's Luck during the spawn was estimated at 11,928 fish (95% CI 9607 – 14,790, CV = 11.0%). The population of adult Walleyes ≥ 15 inches in the same river segment was estimated at 7,261 fish (95% CI 5,519 – 9,526, CV = 14.0%).

In total, 1,988 unique Walleyes were collected, and lengths ranged from 6.0 to 30.1 inches. The average length was 16.0 inches, and the median length was 14.4 inches (Table 8). There were three major peaks in the length frequency distribution; one at 9 inches, one at the 14 inches, and one at the 25 inches group (Figure 1). The highest peak occurs at 9 inches and is reflective of age 1 fish. Although fall survey data indicated the 2016 year class was not exceptionally strong, the 2017 spring electrofishing survey focused more effort in the area between the Kilbourn Dam and River's Edge Resort than in 2012 and juvenile fish seemed to be concentrated in this area whereas larger adults were more concentrated from River's Edge downriver to Fisherman's Luck. The peaks at 14 and 25 inches were similar to peaks in the distribution in 2012 (15 and 25 inches). Length frequency declined steadily from 14 to 20 inches, then increased slowly but steadily from 20 to 25 inches, and ultimately declined steadily again through 30 inches. The first peak and subsequent decline happens as fish reach legal harvest size and then experience low natural mortality, and a larger degree of harvest mortality until they reach the protected slot, at which time they are no longer vulnerable to harvest. Numbers increase again as fish enter the protected slot and growth of these mature fish is variable, but generally slower, until natural mortality begins to more heavily impact the population after they exceed 25 inches and numbers of these fish begin to decline. After the fish reach 28 inches, natural mortality and fishing mortality act in concert to cause a decline in numbers through 30 inches, after which very few individuals remain present.

Proportional size distribution of quality (PSD), preferred (PSD-P), memorable (PSD-M) and 28-inch fish (PSD-28) values were 57, 37, 23, and 3, respectively (Table 8). The PSD in 2017 was much lower than 2012 (56 vs. 81), the PSD-P was slightly lower than 2012 (37 vs. 44), the PSD-M was slightly higher than 2012 (25 vs. 22), and the PSD-28 was lower than 2012 (3 vs. 5).

In 2017, ages ranged from 1 to 15 years and age 1 fish produced in 2016 were the most common in the 2017 age frequency distribution (Figure 2). Recruitment was only fair in 2016 and the high proportion of age 1 fish in the catch is likely an artifact of spending more time sampling good nursery habitat in 2017 than in 2012 when catches of age 1 fish were relatively low despite a good year class in 2011. Fish were fully recruited to the gear by age 3, the most common age in the distribution after age 1. These age 3 fish were produced in 2014 which was the 11th best year class of Walleyes (age 0 CPUE = 25.4 fish/mile; Table 9) in the 26-year history of the fall electrofishing survey. After age 3, numbers at age decline through age 6 before a second peak in the distribution at age 8 followed by a steady decline thereafter through age 15. Age 4, 5 and 7 fish were produced in 2013, 2012, and 2010 which were the three worst year classes in the history of the fall survey (Table 9). Age 8 fish were produced in 2009 which was the 5th best year class (age 0 CPUE = 60.6 fish/mile; Table 9) in the history of the fall survey. The assumptions of constant mortality (fishing mortality varies greatly based on size) and constant recruitment across all years were violated (natural recruitment is too variable), therefore application of a catch curve to age frequency data is not possible. Ages also ranged from 1 to 15 in 2012 except for ages 13 and 14 which were absent.

Walleyes in Lake Wisconsin grew fast with mean length-at-age values equal to or greater than regional and state averages for all ages (Figure 3). Walleyes reached the minimum harvest size of 15 inches as early as age 3 and averaged over 15 inches by age 4 (Figure 3). In general, Walleyes entered the 20 to 28-inch protected slot as early as age 4 and averaged over 20 inches by age 6 (Figure 3). A von Bertalanffy growth model was fitted to the data, and the result is presented in Figure 4, including the parameter estimates for L_∞ (34.8 inches), k (0.1236779), and t_0 (-1.4988213).

Male Walleyes ranged from 2 to 12 years, except no age 9 or age 11 fish were present and 91% of male Walleyes were age 4 or younger (Figure 5). Males reached the minimum harvest size as early as age 3 and averaged over 15 inches by age 4 (Figure 6). Male Walleyes entered the protected 20 to 28-inch protected slot as early as age 6 and averaged over 20 inches by age 7 (Figure 6). Females ranged from 3 to 15 years with all age classes represented, but the distribution did not peak for females until age 8 (Figure 5). All mature female Walleyes exceeded the minimum length limit, averaging 17.6 inches by age 3, 18.2 inches by age 4, and 20.8 inches by age 5 (Figure 7). Female Walleyes entered the protected 20 to 28-inch slot as early as age 4 and averaged over 20 inches by age 5 (Figure 7).

Body condition was good overall based on relative weights which averaged 90.0. Females (mean relative weight = 99.9) were generally in better condition than males (mean relative weight = 83.3) or unknown/immature fish (mean relative weight = 84.1) and relative weight was positively correlated with fish size (Figure 8).

<u>Sauger</u>

In total, 391 Sauger were sampled during early spring electrofishing including recaptures; the catch rate was 13.2 fish/hour of electrofishing. In total, 192 Sauger ≥ 12.0 inches were marked with a Floy tag, and 20 were recaptured during the survey. Unique Sauger (n = 371) ranged from 6.5 to 21.1 inches in length and averaged 12.5 inches (Table 8). The length frequency distribution is represented in Figure 9. Proportional size distribution of quality (PSD), preferred (PSD-P), and memorable (PSD-M) values were 54, 17, and 0, respectively. Only one Sauger larger than 20 inches was collected in 2017 compared to 10 in 2012. The PSD in 2017 was very similar to 2012 (56 vs. 54), the PSD-P was higher in 2017 (17 vs. 8), and the PSD-M was higher in 2012 (4 vs. 0).

In 2017, ages ranged from 1 to 9 years and Saugers are fully recruited to the sampling gear by age 2 (Figure 10). Age 2 fish were produced in 2015 when the fall electrofishing survey found the 7th largest year class of Saugers in the survey's 26-year history (age 0 CPUE = 26.7 fish/mile; Table 9). Additionally, the relatively high proportion of age 6 fish in the 2017 sample reflects the 2011 year class which was the 10th strongest in the history of the fall survey (age 0 CPUE = 23.7 fish/mile).

Overall, Saugers reached the minimum harvest size of 15 inches as early as age 3 and averaged over 15 inches by age 5 (Figure 11). A von Bertalanffy growth model was fitted to the data, and the result is presented in Figure 12 including parameter estimates for L_∞ (23.2 inches), k (0.1841581), and t0 (-1.6027761). When looking at age and growth separately for each sex, some differences were evident. Males matured as early as age 2 when they are fully recruited to the sampling gear and age 5 was the oldest male age in the sample (Figure 13). Age 5 was also when male Saugers reached legal harvest size and the mean length of age 5 males was 15.4 inches

(Figure 14). Despite not being legal to harvest before age 5, mortality appeared to impact the male population significantly after age 2. Female Saugers grew faster and lived to older ages than male Saugers in Lake Wisconsin. Females matured as early as age 2 but were not fully recruited to the sampling gear until age 4 and numbers at age declined steadily after age 4 except for age 6 fish which were remnants of the strong year class in 2011 (Figure 13). Females reached the minimum harvest size of 15 inches as early as age 3 and averaged 15.5 inches by age 4 (Figure 15). Population age structure and growth were not analyzed in 2012 and offer no basis for comparison. Body condition overall was fair based on relative weights which averaged 85.4 for all Sauger. Females averaged 96.3, males averaged 78.1, and unknown sex/immature fish averaged 77.6. Relative weight was positively correlated with fish length (Figure 16).

Sauger do not grow as large as Walleye, nor are Sauger typically as long-lived as Walleye (Bozek et al. 2011). Relatively few Sauger in Lake Wisconsin reach the 20 inches necessary to receive protection from the slot limit. Once they reach 20 inches, they are highly unlikely to ever be harvested legally because despite the protection the slot limit offers, very few Saugers if any will ever reach 28 inches prior to natural mortality.

Lake Wisconsin Spring Fyke Netting and Electrofishing

General fish community

In total, 6,753 fish representing 33 different species and one hybrid from 10 families were collected or observed during spring fyke netting and electrofishing in 2017. Catch by gear type and CPUE are shown for each species collected (Table 10).

Bluegill

In total, 1,186 Bluegills were collected; the catch rates were 22.3 fish/net night during SN1, 13.0 fish/net night during SN2, and 59.8 fish/mile of shoreline during SE2 (Table 10). The SE2 catch rate ranked in the 37th percentile statewide and ranked 14th in a comparison of 18 Columbia and Sauk County lakes surveyed since 2008. This suggests that Bluegills are moderate in abundance in Lake Wisconsin relative to other lakes in the local area and statewide. In terms of the total number of fish collected during spring netting and electrofishing in Lake Wisconsin, Bluegill was the second most abundant species (Table 10). The 2017 SE2 catch rate was greatly improved from the 2012 SE2 catch rate of 19.3 fish/mile, likely as a result of targeting some areas of better panfish habitat in 2017. Panfish stations in 2012 were chosen completely at random and several were in areas of open lakeshore with no aquatic vegetation making them less likely to hold large numbers of Bluegills.

During SN1 and SN2, 887 Bluegills were collected and 673 were measured. Lengths ranged from 3.2 to 9.5 inches and averaged 6.4 inches (Table 11). The PSD, PSD-7, and PSD-P values during spring fyke netting were 65, 32, and 8, respectively (Table 11). During SE2, 299 Bluegills were collected, and lengths ranged from 2.1 to 8.3 inches averaging 5.8 inches (Table 11). The PSD, PSD-7, and PSD-P values during SE2 were 49, 26, and 2, respectively (Table 11). Length frequency distributions from spring netting and SE2 are presented in Figure 17.

Ages were estimated for 77 Bluegills and ages ranged from 1 to 8, with age 4 fish being the most common in the distribution (Figure 18). Total annual mortality was 64.3% for ages 4 through 8; the catch curve is presented in Figure 19. Bluegill growth in Lake Wisconsin was better than area and state averages with fish averaging 8.1 inches by age 6 (Figure 20). Bluegills larger than 3 inches were generally in very good condition; the average relative weight was 101 (Figure 21).

<u>Black Crappie</u>

In total, 501 Black Crappies were collected; the catch rates were 11.3 fish/net night during SN1, 6.5 fish/net night during SN2, and 11.0 fish/mile during SE2 (Table 10). The SE2 catch rate ranked in the 59th percentile statewide. Black Crappies were the third most abundant species during SN1, SN2, and SE2 (Table 10). During SN1 and SN2, lengths of 445 Black Crappies ranged from 3.4 to 14.2 inches and averaged 8.8 inches (Table 11). The PSD, PSD-9, PSD-P, and PSD-M values were 70, 37, 29, and 12, respectively (Table 11). These values were indicative of good size structure and anglers have a legitimate opportunity to catch memorable-sized Black Crappies when fishing in Lake Wisconsin. During SE2, 55 Black Crappies ranged from 4.3 to 12.8 inches, averaging 8.2 inches (Table 11). Length frequency distributions from spring netting and electrofishing are presented in Figure 22.

Ages were estimated for 119 Black Crappies, and ages ranged from 1 to 8 years. Age 2 fish were the most common in the distribution and recruitment appeared to be relatively steady (Figure 23). Black Crappies in Lake Wisconsin grew faster than area and state averages likely owing to abundant forage, specifically Gizzard Shad. Black Crappies in Lake Wisconsin reached an average length of 9.0 inches by age 3, 10.7 inches by age 4, and 12.1 inches by age 5 (Figure 24). After age 2, Black Crappies in Lake Wisconsin reached an acceptable size to be harvested by anglers, and numbers declined steadily through age 8, the oldest in the distribution. The proportion of age 5 fish in the sample relative to ages 4 and 6 indicated 2012 may have been an exceptional year for crappie recruitment. The total annual mortality rate after age 2 was 49.8% based on the catch curve (Figure 25). Black Crappies were in good condition based on relative weights; average relative weight was 100 and 53% (n = 60) of the fish had relative weight > 100 indicating excellent body condition. By contrast only 2% (n = 2) had relative weights below 75 indicating poor condition. Relative weights of Black Crappies are presented in Figure 26.

White Crappie

In total, 280 White Crappies were collected; the catch rates were 7.0 fish/net night during SN1 and 4.1 fish/net night during SN2 (Table 10). No White Crappies were collected during SE2. During SN1 and SN2, lengths of 280 Black Crappies ranged from 3.3 to 13.5 inches and averaged 8.8 inches (Table 11). The PSD, PSD-9, PSD-P, and PSD-M values were 86, 65, 25, and 5, respectively (Table 11). These values are indicative of good size structure and anglers have a legitimate opportunity to catch memorable-sized White Crappies when fishing in Lake Wisconsin. The length frequency distribution is presented in Figure 27.

Ages were estimated for 92 White Crappies and they ranged from 1 to 6 years old. Age 2 fish were the most common in the distribution and recruitment appears to be relatively steady, although slightly less so than for Black Crappies (Figure 28). The proportion of age 5 fish in the sample relative to ages 4 and 6 indicated 2012 may have been an exceptional year for crappie recruitment as was the case for Black Crappies. White Crappies in Lake Wisconsin grew faster than the area average because of the abundant forage, specifically Gizzard Shad. White Crappies in Lake Wisconsin are likely desirable for harvest by age 2 when they reached an average length of 9.2 inches, and fish average 11.1 inches by age 3 and 12.0 inches by age 4 (Figure 29). The total annual mortality rate after age 2 was 67.6% based on the catch curve (Figure 30) and this was noticeably higher than the Black Crappie mortality rate. White Crappies were in good condition based on relative weights; average relative weight was 98 and 33% (n = 30) of the fish had relative weight > 100 indicating excellent body condition. By contrast only 2% (n = 2) had relative weights below 75 indicating poor condition. Relative weights of White Crappies are presented in Figure 31.

Yellow Perch

In total, 297 Yellow Perch were collected; catch rates were 1.4 fish/net night during SN1, 9.2 fish/net night during SN2, and 3.0 fish/mile during SE2 (Table 10). Yellow Perch was the fifth most abundant gamefish by number sampled during spring netting and electrofishing (Table 10). During SN1 and SN2, lengths of 281 unique Yellow Perch ranged from 4.6 to 11.3 inches, and the average and median lengths were 7.0 and 6.9 inches, respectively (Table 11). The PSD, PSD-9, and PSD-P values were 13, 3, and 1, respectively (Table 11). The length frequency from spring netting is presented in Figure 32. During SE2, 15 Yellow Perch ranged from 3.5 to 8.3 inches and averaged 5.9 inches (Table 11).

Ages 2 through 6 were represented in the data; age 1 fish were not collected during SN1 and SN2 because they are not vulnerable to the sampling gear. Yellow Perch were fully recruited to the fyke nets by age 2 the most common age present in the catch (Figure 33). Growth was better than the state average, with fish reaching an average length of 8.1 inches by age 3, 9.3 inches by age 4, and 11.3 inches by age 5 (Figure 34). The single age 5 fish was a female measuring 11.3 inches, and the single age 6 fish was a male measuring 9.7 inches. Total annual mortality was high after age 2 at 85.7% (Figure 35). High mortality after age 2 may have been partly a product of the fish reaching an acceptable size for anglers by age 3. Yellow Perch are also one of the main food sources of Walleye and may face serious predation pressure in Lake Wisconsin. Mean length-at-age of male and female Yellow Perch are presented separately in Figure 36 and Figure 37. Yellow Perch were in good condition based on relative weight although a few males and spent females had relative weights below 75 (Figure 38). Average relative weight was 88 overall, and 88 for both males and females.

Sauger and Saugeye

In total, 341 Sauger were collected during SN1, SN2, and SE2 and 0 Saugeye were collected. Sauger catch rates were 0 fish/net night during SN1, 0.6 fish/net night during SN2, and 27.1 fish/mile during SE2 (Table 10). Sauger was the third most abundant gamefish species by number during spring netting and electrofishing after Bluegill and Black Crappie (Table 10). Sixteen Saugers collected during SN2 ranged from 9.4 to 15.7 inches averaging 11.1 inches (Table 8). The catch was made up of 13 immature fish, two small males (9.4 and 10.3 inches), and a single spent female. The 325 Saugers collected during SE2 ranged from 5.3 to 19.8 inches and averaged 10.3 inches (Table 8). The PSD and PSD-P values were 29 and 9, respectively.

The SE2 electrofishing effort was 12 miles in both 2012 and 2017, but the specific stations sampled differed between years. The SE2 CPUE, CPUE8, and CPUE15 values observed in 2017 were higher than 2012 values, while the reverse was true for CPUE<8 and CPUE12 values (Figure 39). The length frequency distributions for the 2012 and 2017 SE2 surveys are represented in Figure 40. The higher number of yearling Saugers in 2012 compared to 2017 was indicative of better recruitment in 2011 relative to 2016 as observed during fall electrofishing surveys. Conversely, the higher number of age 2 Sauger in 2017 compared to 2012 was indicative of far better recruitment in 2015 (when a near-record year class was produced) relative to 2010 which was a poor year for both Walleye and Sauger recruitment.

Walleye

In total, 321 Walleyes were collected during SN1, SN2, and SE2. Walleye catch rates were < 0.1 fish/net night during SN1, 0.5 fish/net night during SN2, and 25.5 fish/mile of shoreline sampled during SE2 (Table 10). Walleye was the fourth most abundant gamefish species by number during spring netting and electrofishing after Bluegill, Black Crappie, and Sauger (Table 10). Fifteen Walleyes collected during SN1 and SN2 ranged from 7.7 to 27.3 inches averaging 13.8 inches (Table 8). The catch was made up of 9 age 1 fish (length range 7.7 to 9.4 inches) 5 spent females (19.2 to 27.3 inches) and one possible immature female (16 inches). The 306 Walleyes collected during SE2 ranged from 5.6 to 26.9 inches and averaged 11.7 inches (Table 8). The PSD, PSD-P, and PSD-M values were 41, 5, and 1, respectively (Table 8).

Electrofishing effort was 12 miles in both 2012 and 2017, although the specific stations sampled were not the same. Size-specific Walleye CPUE values observed during SE2 in 2017 were slightly higher than 2012 values (Figure 41). The length frequency distributions for the 2012 and 2017 SE2 surveys were similar and are presented in Figure 42.

Largemouth Bass

In total, 123 Largemouth Bass were collected during spring sampling; overall catch rates were 1.0 fish/net night during SN1, 0.1 fish/net night during SN2, and 7.8 fish/mile of shoreline sampled during SE2 (Table 10). The CPUE-8 (stock size) during SE2 was 6.5 fish/mile of shoreline sampled, and this ranked in the 15th percentile in a comparison of four Wisconsin drainage basins. Based on SE2 CPUE, Largemouth Bass were not abundant compared to other lakes in southern Wisconsin. Largemouth Bass size-specific catch rates in 2017 were more than double what they were in 2012 for every metric except CPUE-18 (Figure 43). This was because the 2017 electrofishing stations sampled a larger amount of quality Largemouth Bass habitat compared to stations selected in 2012. In 2017, Largemouth Bass were collected in 16 of 24 half-mile stations sampled. Catch rates were 20.0 fish/mile or greater in three stations including Harmony Grove channels 1 and 3 (LW48 and LW44), and Moon Valley (LW82). Catch rates were between 10 and 20 fish/mile in 5 additional stations; two stations in Harmony Grove channel 4 (LW42 and LW43), one in Harmony Grove channel 5 (LW40), one along the Okee railroad grade (LW29), and one in Okee Bay east of Hwy V (LW31). All of these stations are relatively shallow, protected, and contain submersed aquatic macrophytes. Conversely, only one Largemouth Bass was collected from the six half-mile stations that covered open lake shoreline which included primarily sandy or rocky habitat devoid of aquatic vegetation.

Overall, 122 unique Largemouth Bass lengths ranged from 4.4 to 19.3 inches and averaged 12.4 inches (Table 8). The length frequency distribution is represented in Figure 44. The PSD, PSD-14, and PSD-P values were 77, 57, and 39, respectively (Table 8). Largemouth Bass larger than 6 inches were generally in excellent condition; the average relative weight was 111 (Figure 45).

Ages were estimated for 98 Largemouth Bass. The age frequency distribution was bimodal with peaks at age 2 and age 6, and recruitment appeared to be somewhat inconsistent (Figure 46). Only one fish older than 8 years, a single age 11 fish, was collected. Typical bass fisheries in the Poynette management area see fish fully recruited to the population by age 3 or age 4 with numbers at age declining steadily thereafter with the occasional deviation based on a strong or weak year class. The age frequency from the 2012 Lake Wisconsin survey followed that pattern, although the sample size was only about half of what it was in 2017. The 2012 survey also saw each age class through age 12 represented. Because of the inconsistent recruitment in Lake Wisconsin apparent in the 2017 sample, application of a catch curve to the age data to determine total annual mortality was not possible.

Based on 2017 data, Largemouth Bass grew relatively quickly in Lake Wisconsin, exceeding area and state averages and lagging slightly behind region averages through age 6 (Figure 47). The same was true in 2012 for region and state averages; the area average comparison had not been developed yet. Mean length-at-age values were very similar through age 7 when comparing 2017 to 2012 aside from slightly higher values for Largemouth Bass younger than age 4 in 2017 (Figure 48). The mean length at age 6 values were slightly higher in 2017 (15.5) compared to

2012 (14.7). Largemouth Bass reached the minimum harvest size of 14 inches as early as age 4 and averaged over 14 inches by age 6 and this did not differ from 2012.

<u>Smallmouth Bass</u>

In total, 103 Smallmouth Bass were collected during SE2 and the total catch rate was 8.6 fish/mile (Table 10). No Smallmouth Bass were collected during SN1 and SN2. The CPUE7 (stock size) during SE2 was 7.5 fish/mile, and this ranked in the 81st percentile statewide. Smallmouth Bass abundance in Lake Wisconsin compared far more favorably on a statewide basis than did Largemouth Bass abundance, and this was likely a function of the high-quality Smallmouth Bass habitat available in Lake Wisconsin and the Wisconsin River in general. Smallmouth Bass were found in 17 of 24 half-mile stations sampled during SE2 and CPUE values in 2017 did not differ remarkably from those observed in 2012 (Figure 49).

Lengths ranged from 3.7 to 16.7 inches averaging 10.8 inches (Table 8). The 2017 length frequency distribution is presented along with the data from 2012 in Figure 50. Seventy-six Smallmouth Bass larger than 6 inches were generally in good condition; the mean relative weight was 91. Six percent of fish (n = 5) had relative weights greater than 100 indicating excellent condition, and one percent of fish (n = 1) had a relative weight below 75 indicating poor condition. Relative weights are presented in Figure 51.

Ages were estimated for 88 Smallmouth Bass and age 3 fish were the most common age in the distribution with numbers declining thereafter through age 7, the oldest fish in the distribution (Figure 52). Smallmouth Bass growth in Lake Wisconsin was generally faster than area and state averages but slower than regional averages based on mean length-at-age. Fish reached the legal harvest size of 14 inches as early as age 4 and averaged over 14 inches by age 6 (Figure 53). By contrast, mean lengths-at-age of Smallmouth Bass collected in 2012 were noticeably lower compared to 2017 values for ages 2 through 5, but values were almost identical for ages 6 and 7 (Figure 54). It was noted in 2012 that Smallmouth Bass mean length-at-age values lagged behind area and state averages. However, regional and statewide values for Smallmouth Bass mean length-at-age have been updated since 2012.

<u>Northern Pike</u>

In total, 59 Northern Pike were collected during the survey; catch rates were 1.9 fish/net night during SN1, 0.2 fish/net night during SN2, and 0.6 fish/mile of shoreline during SE2 (Table 10).

Lengths of 58 unique Northern Pike ranged from 10.9 to 39.3 inches and averaged 21.6 inches (Table 8). The length frequency distribution is presented in Figure 55. In total, 21% (n = 12) of the Northern Pike sampled were larger than the 26-inch minimum size limit. Too few individuals were collected for meaningful PSD calculations. Ages were estimated for 58 fish, and ages ranged from 1 to 9 with age 3 being the most common and relatively few individuals were sampled from age classes 4 through 9 (Figure 56). The sample was too small to comment further on population age structure or mortality rates. Northern Pike growth in Lake Wisconsin appeared to be faster than the state averages but slower than region averages based on mean length-at-age (Figure 57). However, due to low sample sizes, meaningful conclusions on Northern Pike growth in Lake Wisconsin were not possible beyond age 3. Relative weights for Northern Pike were generally good to excellent (Figure 58). The average relative weight was 97 and 37% (n = 21) had a relative weight greater than 100, while no fish had a relative weight less than 75.

<u>Muskellunge</u>

In total, 13 Muskellunge were collected during spring sampling; catch rates were 0.1 fish/net night during SN1, 0.3 fish/net night during SN2, and 0.3 fish/mile during SE2 (Table 10). All unique muskies collected were first-time captures and were marked with PIT tags. One 35.4-inch female musky was captured twice during SN2. Lengths of 12 unique muskies ranged from 13.3 to 41.5 inches and averaged 25.9 inches (Table 8). Muskies ranged in age from 1 to 5 years and 6 out of the 7 mature muskies collected during the fyke netting periods came from nets in the Okee area. Muskies aged at 1, 3, and 5 years old corresponded to years when stocking occurred. Two muskies aged at 4 years old corresponded to a non-stocked year indicated either low-level natural reproduction, aging error with the fish actually being age 5, or perhaps more likely those fish represented immigration from one of the flowages located further upriver. Overall, very few individuals were captured and resultant data from which inferences about the population can be made is insufficient based on this survey. Muskies larger than 15 inches were in good condition; the average relative weight was 99. Data for all muskies collected are presented in Table 12. The sampling strategy centered on placing fyke nets in areas where muskies were collected in 2012, ignoring areas where no muskies were collected in 2012, and trying some new areas in the main lake. However, the short duration of SN2 combined with the lack of a second crew and the large size of the lake limited the amount of habitat that could be sampled.

Other gamefish species

Yellow Bass, White Bass, Pumpkinseed, Rock Bass, Flathead Catfish, and Channel Catfish were also present in Lake Wisconsin Catch and CPUE data for these species are found in Table 10.

Rough fish

In total, 2,638 Gizzard Shad were collected; catch rates were 78.3 fish/net night during SN1, 11.9 fish/net night during SN2, and 87.2 fish/mile during SE2 (Table 10). Gizzard Shad provide valuable forage for predator fish in Lake Wisconsin, but age 0 Gizzard Shad may also compete with young centrarchids (sunfishes) for food resources. Gizzard Shad may also negatively impact water quality when present at high densities by re-suspending phosphorous when they eat detritus which is high in phosphorous and then defecate into the water column. This results in re-suspension of the nutrients which are then available to help fuel algal blooms. Lake Wisconsin lies near the northern edge of the range of the Gizzard Shad which cannot handle prolonged periods of cold. Gizzard Shad die-offs have often been observed in Lake Wisconsin as the ice comes off the lake in the spring. Die-offs were observed by WDNR staff in 2013, 2014, and 2017 and may have occurred in other years as well but were not reported.

In total, 115 Common Carp were collected or observed; the catch rate was less than 0.4 fish/net night during SN1, 0.2 fish/net night during SN2, and 20.0 fish/mile (observed) during SE2 (Table 10). Fourteen Common Carp measured during fyke netting ranged from 5.5 to 29.8 inches and averaged 22.1 inches.

Lake Wisconsin and Kilbourn Dam Fall Recruitment and Sport Fish Electrofishing

Sauger

In total, 497 Saugers were collected from 6 sampling stations in Lake Wisconsin during the 2017 fall survey and the electrofishing catch rate was 34.8 fish/mile (Table 13); no saugeye were collected. Based on the length frequency distribution all Saugers smaller than 8.0 inches were considered age 0 (Figure 59). The CPUE for age 0 Sauger was 3.8 fish/mile and this was considered relatively poor, ranking in the 12th percentile of age 0 Sauger CPUE values from 1993 through 2018 (fourth worst year class; Table 9). Although Sauger recruitment was poor in 2017, excellent year classes two years prior in 2015 (26.7 age 0 fish/mile, 7th best) and one year later in 2018 (30.0 age 0 fish/mile, 5th best) will sustain the fishery moving forward. In 2017, 54 age 0 Sauger ranged from 5.4 to 7.8 inches in length and averaged 6.2 inches. Overall, Sauger lengths ranged from 5.4 to 19.1 inches, and the average length was 10.8 inches while the PSD and PSD-P values were 35 and 2, respectively (Table 13).

Prior to implementation of the current Walleye and Sauger regulation (1993-2001), Sauger recruitment in the main impoundment was excellent nearly every year (Figure 60). However, after the regulation went into effect (2002-2018), a pattern developed where excellent year classes were produced on average every 3 years (range 2 to 6 years) with generally poor recruitment years in between. Mean annual recruitment (age 0 CPUE) was significantly lower after 2002 based on the results of a two-sample t-test assuming equal variance (Table 14). Mean fall CPUE-12 was slightly lower post-regulation compared to pre-regulation, but the difference was not statistically significant (Table 14). Mean fall CPUE-15 was significantly higher post-regulation change compared to pre-regulation (Table 14). Saugers larger than 20 inches were not recorded in any fall survey prior to the regulation change but were recorded in 5 consecutive fall surveys post-regulation change (2004 through 2008). No Saugers larger than 20 inches have been recorded in fall surveys since 2008. Saugers larger than 20 inches were at least 9 years old in Lake Wisconsin based on length-at-age data from 2017. Several successive excellent Sauger year classes in the mid-late 1990s would have produced the Saugers larger than 20 inches that were collected from 2004 through 2008. Less frequent major Sauger recruitment events since the late 1990s correspond with the disappearance of 20-inch fish from the fall survey; fewer fish produced leads to fewer ultimately reaching 20 inches.

In total, 94 Saugers were collected from two sampling stations below the Kilbourn Dam in Wisconsin Dells in 2017 and the electrofishing CPUE was 28.0 fish/mile (Table 13); no saugeye were collected. A single Sauger smaller than 10 inches was collected (8.4 inches) and was considered age 0; the age 0 CPUE was 0.3 fish/mile. Sauger lengths ranged from 8.4 to 15.3 inches and averaged 12.8 inches (Table 13). The length frequency distribution is presented in Figure 59. The CPUE of age 0 Sauger at the Kilbourn Dam tailwater has been less variable than for Walleye and has generally been less than 10 fish/mile except for 1994, 1997, 2015, and 2018 (Figure 61). Sauger age 0 CPUE at the Kilbourn Dam tailwater has typically only exceeded 5 fish/mile in years when age 0 CPUE in the impoundment was ≥ 30 fish/mile.

Walleye

In total, 438 Walleyes were collected from 6 sampling stations in Lake Wisconsin during the 2017 fall survey and the electrofishing catch rate was 30.7 fish/mile (Table 13). Based on the length frequency distribution all Walleyes smaller than 10.0 inches were considered age 0 (Figure 62). The CPUE for age 0 Walleye was 19.9 fish/mile in 2017 and this is considered fair, ranking in the 36th percentile of age 0 Walleye CPUE values from 1993 through 2018 (17th strongest out of 26 year classes). The fair 2017 year class follows a fair year class in 2015 (21.1 age 0 fish/mile, 15th best) and a good year class in 2014 (25.5 age 0 fish/mile, 11th best; Table 9). Additionally, an excellent year class was produced in 2018, one year after the comprehensive survey (64.5 age 0 fish/mile, 4th best). This period of fair to excellent recruitment follows a period where the three worst year classes in the last 26 years were produced in 2013 (7.1 fish/mile), 2012 (10.6 fish/mile), and 2010 (10.9 fish/mile). Poor recruitment in 2012 and 2013 were likely heavily influenced by environmental factors, specifically spring weather patterns. Two hundred eighty-five age 0 Walleye collected in 2017 ranged from 5.3 to 9.6 inches in length and averaged 7.6 inches. Overall, Walleye lengths ranged from 5.3 to 24.3 inches, and the average length was 9.9 inches (Table 13). The PSD and PSD-P values were 39 and 2, respectively (Table 13).

Prior to implementation of the current Walleye and Sauger regulation (1993-2001), Walleye recruitment was excellent nearly every year. However, after the regulation went into effect (2002-2018), a pattern has developed where excellent year classes have been produced on average every 8 years (range 7 to 9 years) with recruitment ranging from poor to good in the interim years (Figure 63). Mean annual recruitment in the impoundment (age 0 CPUE) has been significantly lower since 2002 based on the results of a two-sample t-test assuming equal variances (Table 15). However, mean fall CPUE-15, CPUE-20, and CPUE-25 have all been higher post-regulation compared to pre-regulation and the difference is statistically significant for CPUE-15 and CPUE-20 (Table 15). The increased catch rates of larger Walleyes post-regulation change indicate the regulation has been successful in significantly increasing the number of larger Walleyes in the system.

Based on size distribution indices, larger Walleyes were poorly represented overall in the fall sample and SE2 compared to spring electrofishing in the Wisconsin River, and this was the case in 2012 as well. This is because during early spring electrofishing in the river, mature adults are concentrated for spawning activities in areas that are effectively sampled by electrofishing whereas during spring and fall these adult fish are dispersed throughout Lake Wisconsin and often occupy deeper habitats than are sampled effectively with electrofishing gear.

In total, 142 Walleyes were collected from the two sampling stations below the Kilbourn Dam in Wisconsin Dells and the electrofishing CPUE was 42.3 fish/mile (Table 13). The age 0 Walleye CPUE was 0.9 fish/mile and three age 0 Walleyes ranged from 7.9 to 9.0 inches. Overall, Walleye lengths ranged from 7.9 to 19.7 inches and averaged 14.0 inches and the PSD value was 33 (Table 13). The length frequency distribution is presented in Figure 62. Annual age 0 Walleye CPUE at the Kilbourn Tailwater sites from 1993-2018 is presented in Figure 64.

<u>Smallmouth Bass</u>

In total, 141 Smallmouth Bass were collected from Lake Wisconsin during fall electrofishing and the CPUE was 9.9 fish/mile (Table 13). The CPUE-7 (stock size) during fall electrofishing was 9.4 fish/mile and this ranked in the 85^{th} percentile when comparing Smallmouth Bass catch rates statewide. Lengths ranged from 3.1 to 17.8 inches and averaged 10.5 inches (Table 13). The PSD, PSD-P, and PSD-M values were 41, 13, and 1, respectively (Table 13). Values for PSD and PSD-P were almost identical to those observed in 2012 (PSD = 41, PSD-P = 12), while PSD-M was higher in 2012 (PSD-M = 6).

In total, 153 Smallmouth Bass were collected from the 2 river sampling stations located below the Kilbourn Dam in Wisconsin Dells, and total CPUE was 45.5 fish/mile (Table 13). The CPUE-7 (stock size) during fall electrofishing was 41.1 fish/mile (Table 13). Smallmouth Bass lengths ranged from 3.1 to 20.3 inches and averaged 10.2 inches (Table 13). The PSD, PSD-P, PSD-M, and PSD-T values were 44, 10, 2, and 1, respectively (Table 13). These values were very similar to those observed at Lake Wisconsin sampling stations. Length frequency distributions for impoundment and river sampling stations are presented in Figure 65. Smallmouth Bass catch rates for impoundment sampling stations, although somewhat variable on a year-to-year basis, have been relatively stable over the long term (1993-2018) except for a few years in the mid-2000s when there was a notable spike in catch rates (Figure 66).

<u>Largemouth Bass</u>

In total, 56 Largemouth Bass were collected from the 6 sampling stations in Lake Wisconsin, and the electrofishing CPUE was 3.9 fish/mile (Table 13). The CPUE-8 (stock size) was 3.6 fish/mile which was slightly more than half of the CPUE-8 during SE2. The higher catch rates of Largemouth Bass in the spring relative to fall was a function of more suitable Largemouth Bass habitat sampled in the SE2 stations, which included several stations chosen because they had better Largemouth Bass habitat relative to other stations in the lake. Largemouth Bass lengths from the fall survey ranged from 5.1 to 16.6 inches and averaged 11.0 inches (Table 13).

In total, 20 Largemouth Bass were collected from the two river sampling stations located below the Kilbourn Dam in Wisconsin Dells, and the electrofishing catch rate was 6.0 fish per mile (Table 13). Largemouth Bass lengths ranged from 8.2 to 18.0 inches and averaged 11.9 inches (Table 13). Quality Largemouth Bass habitat is lacking in the Wisconsin River below the Kilbourn Dam, so the low number of Largemouth Bass and general lack of large individuals sampled there was not a surprise. Length frequency distributions for Largemouth Bass collected in lake and river sampling stations are presented in Figure 67. Long term CPUE data for Largemouth Bass from the 6 impoundment sampling stations indicate a notable decrease in abundance after peaking in the mid-2000s (Figure 68), with mean CPUE from 2007-2018 being less than half of what it was from 1993-2006 (7.5 fish/mile vs. 18.1 fish/mile).

Other sport fish species

Northern Pike, Muskellunge, Flathead Catfish, and Channel Catfish were collected in low numbers relative to the other sport fish during the fall electrofishing survey; CPUE and size data for these species are summarized in Table 13.

CONCLUSIONS AND RECOMMENDATIONS

The fish assemblage in Lake Wisconsin includes gamefish species typical of impoundments of large river systems in the upper Mississippi River drainage. In terms of relative abundance based on total catch during SN1, SN2, and SE2, panfish (Bluegill, Black Crappie, Yellow Perch) were the most abundant fish. Sauger, Walleye, and Smallmouth Bass were the most abundant sport fish species. Gizzard Shad is one of the main forage species in the lake, but juvenile Freshwater Drum, White and Yellow Bass, Yellow Perch, suckers, and others help to form a robust forage fish community.

Walleye recruitment was consistently high in Lake Wisconsin prior to implementation of the current Walleye regulation (20 to 28-inch protected slot) with excellent year classes produced nearly every year. Since the regulation was implemented, excellent year classes have been produced roughly every 8 years with recruitment ranging from poor to good in between. This is most likely due to a shift in population structure from being dominated by younger smaller fish during an era of high harvest and recruitment (pre-2002) to a population with a significantly higher proportion of the biomass tied up in larger older fish with a corresponding reduction in recruitment. While population age structure data for comparison are lacking prior to 2012, significant increases in size-specific fall electrofishing catch rates of larger Walleyes (CPUE-15, CPUE-20, and CPUE-25) since 2002 combined with changes in annual recruitment over the same time period support this theory.

Overall, the range of observed Walleye ages remained unchanged since 2012, with Walleyes up to age 15 present. Males mature as early as age 2 and are fully recruited by age 3. Females mature as early as age 3 but may don't reach 100% maturity until age 4 or 5 based on the presence of unknown-sex Walleyes as large as 19.9 inches during early spring electrofishing. Also, the female Walleye age frequency distribution peaked at age 8 in 2017 which lines up directly with the last excellent Walleye year class prior to the 2017 survey (2009). Relatively few age 4 or age 5 females were collected, and those ages correspond to years of poor or failed recruitment in 2012 and 2013. Age 3 females were almost non-existent despite good a good year class in 2014 but this is likely an artifact of many age 3 females not yet reaching sexual maturity and being recorded as "unknown." The three poorest Walleye year classes recorded since the annual recruitment survey began in 1993 occurred in 2010, 2012, and 2013 with 2013 being the only year in the time series that could be considered a recruitment failure (< 10 age 0 fish/mile). The poor 2012 and 2013 year classes were likely results of environmental factors, specifically spring weather patterns.

Walleye growth remains excellent in Lake Wisconsin with mean length-at-age values outpacing the state average for all ages, and regional averages for ages 5 and older. On average, Walleyes in Lake Wisconsin reach legal harvest size by age 4 and enter the protected 20 to 28-inch slot by age 6. Looking at the sexes separately, male Walleyes average over 15 inches by age 4 and average over 20 inches by age 7 while females average over 15 inches by age 3 and over 20 inches by age 5. Females also average over 28 inches by age 12, although some exceed 28 inches as early as age 8. Male Walleyes in Lake Wisconsin have not shown the ability to live long enough to exceed 28 inches. The current harvest regulation is providing anglers with a harvest opportunity from 15 to 20 inches while protecting larger Walleyes (mostly female) from harvest, leading to a healthy population of large spawners and providing a trophy fishing opportunity once the fish exceed 28 inches.

The management goal for the Lake Wisconsin Walleye population is to provide ample harvest opportunity for anglers while also providing the opportunity to catch memorable and trophy-sized fish. One measurable objective is to maintain PSD ≥ 50, PSD-P ≥ 30, PSD-M≥20, and PSD-28≥2 as measured during early spring electrofishing in the Wisconsin River. The second objective is to maintain the 5-year running average for Walleye recruitment as measured by the fall age 0 electrofishing catch rate somewhere between 16-49 fish/mile. This is the interquartile range (middle 50%) of age 0 CPUE values from the fall electrofishing survey from 1993-2019. Fall age 0 CPUE≤16 fish/mile indicates poor recruitment while CPUE≥49 fish/mile indicates excellent recruitment. Using a 5-year time period helps to account for the year-to-year natural variability in recruitment and is likely to pick up both good and bad recruitment years that balance each other out. Shorter time periods like two or three years are not likely to capture this variability and could cause managers to make decisions based on a small number of poor year classes. Consistently poor recruitment over a 5-year period, however, is far more likely to be representative of an overall trend. If the 5-year running average falls below 16 fish/mile, it would indicate several successive years of poor or failed (<10 fish/mile) recruitment and would likely be cause for a change in management to more restrictive harvest regulations to protect the fishery. Currently, the 5-year running average for age 0 recruitment is 28.7 fish/mile (2014-2018) and recruitment is not a concern. The third objective is to maintain a CPUE-15 ≥ 2.9 fish/mile and CPUE-20 ≥ 0.6 fish/mile at the 6 stations located in the main body of Lake Wisconsin in the annual fall survey. These values correspond to the 25th percentile of CPUE-15 and CPUE-20 values observed during the fall survey since the slot regulation was put in place in 2002. If the CPUE values for these size classes fall below 2.9 or 0.6 fish/mile in three consecutive years, explaining the decreases through environmental variability becomes less likely, and Walleye size structure may be experiencing negative impacts due to harvest. Size-specific fall CPUE can be a better indicator of changes in Walleye size structure in Lake Wisconsin because although the fall survey is not as representative of the largest fish in the population as a spring survey, it is based on data collected at the same stations at the same time every year. Size structure data derived from a spring PE survey every 5 years may or may not utilize the same stations each time and can be influenced by extreme conditions such as high springtime flows on the Wisconsin River. If this happens, management personnel may have to wait an additional 5 years or longer to collect new population data, depending on work load and available funding. If environmental conditions influence the fall survey, management only must wait until the next fall to collect data again. They also have a long time series to which catch rates from individual years can be compared. Currently, size structure and recruitment objectives are being met and the current harvest regulation is providing both harvest and trophy fishing opportunities. A regulation change is not recommended at this time.

Sauger are similar in abundance to Walleyes in Lake Wisconsin as indicated by electrofishing catch rates during the 2017 SE2 and fall electrofishing surveys, although in some years Saugers outnumber Walleyes during the fall electrofishing survey by a wide margin. Saugers prefer dark, turbid conditions and Lake Wisconsin has these qualities which combine with an ample forage base and good spawning habitat to produce this excellent Sauger fishery. Early spring Sauger electrofishing PSD and PSD-P values were lower in 2017 compared to 2012, however young Saugers between 8 and 12 inches (predominantly from the massive 2015 year class) were far more abundant in 2017 than in 2012, helping to lower the PSD values. Sauger SE2 electrofishing catch rates were higher in 2017 compared to 2012, but the shoreline areas sampled were different in each survey and better habitat may have been sampled in 2017 than in 2012; direct comparison of catch rates is not possible. In general, Saugers in Lake Wisconsin take a year longer to reach the minimum harvest size than Walleyes, 5 years on average. However, that age is typically less for females (3-4 years) compared to males (5 years). Only female Saugers have shown the longevity to reach 20 inches in Lake Wisconsin, and the single fish larger than 20 inches sampled in 2017 was 9 years old. Some Saugers in the sample exceeded 19 inches as young as age 6 or 7. In any case, Saugers do not have the longevity to exceed 28 inches in Lake Wisconsin. However, some individuals do live long enough to exceed 20 inches and provide anglers with a memorable or trophy catch-and-release opportunity.

Similar to Walleye, Sauger recruitment has changed since the current harvest regulation began in 2002. Prior to 2002, Sauger recruitment was relatively steady, with good year classes produced nearly every year; age 0 CPUE exceeded 20 fish/mile in 6 of 9 years from 1993-2001. Since 2002, Saugers produce a good to excellent year class (age 0 CPUE ≥ 20 fish/mile) every 3 years on average, with fair to poor recruitment in the intervening years (age 0 CPUE ≤ 10 fish/mile). As with Walleyes, this is most likely due to a shift in population structure from being dominated by smaller fish during an era of high harvest and recruitment (pre-2002) to a population with a significantly higher proportion of the biomass tied up in larger older fish with a corresponding reduction in recruitment. While population age structure data for comparison are lacking prior to 2012, a significant increase in the size-specific fall electrofishing catch rate for larger Saugers (CPUE15) since 2002 combined with observed changes in annual recruitment over the same time period support this theory.

The management goal for the Lake Wisconsin Sauger population is to provide ample harvest opportunity for anglers while also providing the opportunity to catch and release memorable-sized fish. One measurable objective is to maintain PSD ≥ 50 and PSD-P ≥ 15 as measured during early spring electrofishing in the Wisconsin River. The second objective is to maintain Sauger recruitment as measured by the fall age 0 electrofishing catch rate somewhere in the range of 4-21 fish/mile. This is the interquartile range (middle 50%) of age 0 CPUE values from the fall electrofishing survey from 1993-2019. Fall age 0 CPUE≤4 fish/mile indicates poor recruitment while CPUE≥21 fish/mile indicates excellent recruitment. Several successive years of poor or recruitment would be indicative of population decline, as would the loss of large recruitment events at least every 3-4 years. Currently, size structure and recruitment objectives are being met and the current harvest regulation is providing a harvest opportunity while producing the occasional memorable-sized fish. A regulation change is not recommended at this time.

Panfish densities are highest in the shallow vegetated bays on the lake, but panfish are rare in main channel areas outside the bays where aquatic vegetation is sparse or absent. The recommended goal for panfish (Bluegill, Black Crappie, White Crappie, Pumpkinseed, and Yellow Perch) CPUE is 100 individuals of stock size and larger per mile of electrofishing during SE2. The value for Lake Wisconsin was 76.2 fish/mile for panfish stations sampled during SE2 in 2017. This was a vast improvement over 2012 when the catch rate was less than 30 fish/mile and the improvement can be attributed to sampling better panfish habitat in 2017. Of the 24 half-mile electrofishing stations sampled in 2017, 14 were sport fish-only stations and 10 were all species stations. The total electrofishing effort followed the statewide sampling protocol, but the percentage of total effort devoted to all species sampling was higher than what was recommended in the protocol (10/24 half-mile stations or 42% actual vs. 6/24 half-mile stations or 25% recommended). Additionally, each of the all species stations sampled in 2017 targeted areas believed to be the best panfish habitat areas in the lake. This differs from the lake sampling protocol which directs that the start point of the first station should be chosen at random with the remainder of the stations spaced equally around the shore of the lake (Simonson et al. 2008). This deviation from protocol was done to determine the stations with the highest panfish (Bluegill) catch rates to then establish panfish index sampling stations that will be repeated in future SE2 surveys of Lake Wisconsin. This will ensure that enough Bluegill data are collected during electrofishing (SE2) to generate length frequency distributions and calculate proportional size distributions, and to generate size specific CPUE values that will be comparable to other surveys. Moving forward, it is recommended that total SE2 all species effort should follow protocol guidelines (3 miles or 6 half-mile stations). Half of the all species electrofishing effort (1.5 miles or 3 half-mile stations) should occur at established index stations and half of the effort should occur at randomly chosen stations. Specifically, the index stations will be LW44 in Harmony Channel #3, LW86 in Weigand's Bay, and LW99 in Gruber's Grove Bay. The Bluegill CPUE values for these stations ranged from 70 to 120 fish/mile in 2017 and should yield sufficient Bluegill catches during future surveys to ensure calculation of population metrics that are directly comparable to past and future surveys.

The 2017 survey indicated that Lake Wisconsin provides anglers with a quality panfishing experience. Although moderate in abundance lake-wide, Bluegills are common in areas of good habitat, growth outpaces area and statewide averages, and the fish have excellent body condition. Mortality is high after Bluegills reach acceptable harvest size at age 4, but good growth rates ensure fish lost to harvest are quickly replaced. The management goal for Bluegills in Lake Wisconsin is to maintain a balanced population with good size structure. The specific objective is to maintain a PSD between 20 and 60 and a PSD-P between 5 and 20 as outlined in Willis et al. (1993) with size distribution nomenclature revised by Guy et al. (2007). Currently Lake Wisconsin meets the Bluegill PSD objective but falls slightly below the desired PSD-P range based on SE2 size distribution statistics. Bluegills larger than 8 inches were present in greater proportion in SN1 and SN2. It should be noted that 32 Bluegills were sampled during fyke netting that were larger than the largest Bluegill sampled during SE2. The largest Bluegill captured during fyke netting was 1.2 inches larger than the largest captured during SE2. Fyke net data combined with electrofishing data provides managers a more complete picture of size and age distribution of Bluegills in a given lake than electrofishing alone which can lead to underestimation of maximum size and age in the population.

Both Black and White Crappies are present in Lake Wisconsin and growth far outpaces area and state averages. Similar to surveys of other area lakes, crappies were most effectively sampled with fyke nets during SN1 and SN2 and were not well represented in the SE2 catch. Anglers in Columbia and Sauk counties have the best opportunity to catch memorable-sized crappies (≥ 12 inches) in Lake Wisconsin compared to any other area lake. Recruitment appears to be slightly more consistent for Black Crappies than for White Crappies but both species have relatively consistent recruitment overall. White Crappies are likely acceptable for angler harvest by age 2 when they average over 9 inches, while Black Crappies average 9 inches by age 3. Mortality after age 2 is markedly higher for White Crappies, and Black Crappies appear to be longer-lived than White Crappies in Lake Wisconsin. Becker (1983) identified both crappie species as being relatively short-lived, with few White Crappies surviving beyond 5 years so the lack of old fish is not surprising. Total annual mortality after age 2 for Black Crappies in Lake Wisconsin in 2017 (49.6%) was lower than recent estimates for Dutch Hollow Lake in Sauk County (57.6% after age 4 in 2016) and Crystal Lake in Dane County (82.0% after age 4 in 2015). Similar comparisons for White Crappie are limited by a lack of quality populations in the area for comparison. The management goal is to provide anglers with a quality crappie fishing experience including the opportunity to catch memorable-sized fish. The specific objective is to maintain crappie PSD between 40 and 70, PSD-P between 10 and 40, and PSD-M between 0 and 10 (Willis et al. 1993, Guy et al. 2007). Currently these objectives are being met or exceeded for both crappie species in Lake Wisconsin.

Yellow Perch were sampled most effectively during SN1 and SN2 in the area of the Harmony Channels, but very little perch data were collected elsewhere. Yellow Perch growth in Lake Wisconsin is better than the state average. Females grow faster and attain larger sizes than males, averaging 8.9 inches at age 3 compared to 7.6 inches for males. Mortality is high after age 2 likely due to a combination of harvest and predation pressure by larger gamefish. Anglers may encounter Yellow Perch suitable for harvest, but the species provides a relatively small portion of the overall panfishing experience in Lake Wisconsin. For this reason, there are no population-specific management goals for Yellow Perch. Overall, the panfish populations in Lake Wisconsin appear to be doing very well and no regulation changes are recommended at this time.

Largemouth Bass are most effectively sampled by electrofishing and SE2 CPUE in 2017 was more than double what was observed in 2012. Largemouth Bass and Bluegills have many of the same habitat requirements and panfish sampling efforts in 2017 that targeted areas of good Bluegill habitat (shallow vegetated bays and channels) led to better Bluegill catch rates and resulted in higher Largemouth Bass catch rates compared to 2012. Largemouth Bass growth was largely unchanged from 2012 in terms of mean length-at-age. Largemouth Bass in Lake Wisconsin continue to exhibit the best growth of any lake in the area. The age frequency distribution in 2017 peaked at age 6 and indicated possible poor recruitment in 2013 as evidenced by the relative lack of age 4 fish. By contrast age 4 was the most common age in the distribution in 2012. The age frequency distribution in 2012 also saw a few more large, old fish represented compared to 2017. However, none of the differences in spring bass data between 2012 and 2017 suggest a change in management is needed. Looking at long-term fall electrofishing data, fall Largemouth Bass catch rates declined significantly after 2006 and have yet to return to levels observed from 1993-2006. While it is difficult to pinpoint the exact cause of the decline, it is likely due to a variety of habitat-related factors. Losses of large woody habitat with increasing riparian development, declines in water clarity and quality due to excessive nutrient inputs, declines in aquatic macrophyte abundance, and increases in Gizzard Shad abundance (competition with age 0 bass) may all be contributing to the decline in Largemouth Bass, but supporting data are lacking.

The final report on the 2012 Lake Wisconsin comprehensive fishery survey listed a recommended Largemouth Bass fall electrofishing CPUE-8 goal of 20-30 fish/mile (Nye 2013). However, based on the available habitat and the fact that the fall electrofishing CPUE-8 has only exceeded 20 fish/mile in three out of 26 years (2003-2005), perhaps this goal is unrealistic. Further development of tools for comparing CPUE values across lake classes will help to shape more realistic CPUE goals for Largemouth Bass and other species in Lake Wisconsin and other similar large flowages (Rypel et al. 2019). The 2012 survey report also stated that Largemouth Bass PSD should be between 40 and 70, PSD-P should be between 10 and 40, and PSD-M should be between 0 and 10 (Willis et al. 1993). These general size structure objectives obtained from scientific literature are likely more reasonable than previous CPUE goals and should remain in place. However, spring data should be used instead of fall data to be more consistent with how Largemouth Bass populations are generally compared in Wisconsin. Better Largemouth Bass habitat may be targeted in spring as well, leading to a more robust sample and a better chance of collecting enough fish for meaningful PSD calculations. Based on 2017 spring electrofishing data, Largemouth Bass PSD is slightly higher than the recommended range, PSD-P falls within the recommended range, and PSD-M falls below the recommended range.

Fish sticks and tree drop projects are becoming an increasingly popular method of re-introducing large woody habitat in lakes. Implementation of these installations should be encouraged in Lake Wisconsin moving forward. Alliant Energy owns the bottom of Lake Wisconsin as well as large tracts of undeveloped riparian land and has shown interest in engaging in projects that provide benefits to fish and fish habitat in the Wisconsin River. It is recommended that the Wisconsin DNR engage Alliant Energy as a partner to spearhead implementation of Fish Sticks projects lake-wide. Alliant Energy could potentially serve as the initial applicant and install pilot projects along their shorelines. An additional partner would include the Lake Wisconsin Alliance which could be utilized as a means of raising awareness of habitat improvement efforts and recruiting riparian landowners interested in similar habitat projects from their membership. The Sauk County Conservation, Planning, and Zoning Department as well as the Columbia County Land and Water Conservation Department are also potential partners, with staff offering additional design and implementation guidance.

Additions of large woody habitat would give a boost to a variety of fish species in the lake by increasing the amount of good spawning and nursery habitat available. These habitat additions would replace some of what has been lost over time as Lake Wisconsin transitioned from relatively little development along its shoreline in the early years to the vast stretches of heavily developed shoreline existing today. Largemouth bass and crappies are likely to benefit the most from additions of this type of habitat. It is recommended that any woody habitat or other shoreline habitat enhancement program include an initial study to quantify the amount of coarse woody habitat present in the lake, as well as the amount of developed shoreline. Periodic follow-up monitoring should also occur to quantify net gains or losses in habitat restoration lake wide, as well as more localized gains or losses within specific areas of the lake. Reducing the amount of shoreline development (seawall, rock armoring, mowed grass, etc.) and returning riparian areas to a more natural condition will have numerous benefits to both fish and other aquatic life.

The Smallmouth Bass population in Lake Wisconsin is very stable in terms of both abundance and growth. Smallmouth Bass SE2 total CPUE was slightly higher than in 2017 compared to 2012, but size-specific CPUE values remained essentially unchanged over that time. Additionally, fall electrofishing data indicate that although Smallmouth Bass catch rates have some variability from year to year, the CPUE has generally been around 8 to 10 fish/mile since 1993 except for 2002-2006 when catch rates were notably higher (reasons unclear). Both 2012 and 2017 age data indicated that Smallmouth Bass reach legal harvest size in Lake Wisconsin around age 6, but mean length-at-age values for 2017 were greater compared to 2012 for ages younger than 6. Additionally, more Smallmouth Bass were collected and aged in 2017 than in 2012, leading to more robust calculations of mean length-at-age in 2017. Stability in the Smallmouth Bass population over time likely stems from the vast amount of suitable smallmouth habitat in Lake Wisconsin and the Wisconsin River, and relatively few changes in that habitat over the past 25 compared to Largemouth Bass which have seen a greater degree of habitat degradation and loss over that time with a corresponding decline in abundance observed. Recommended management goals for Smallmouth Bass in Lake Wisconsin include maintaining

PSD between 40 and 70 and maintaining an electrofishing CPUE-7 $\geq$ 5.7 fish/mile (stock size) which would place the lake in the 75th percentile or better statewide. Based on fall electrofishing data (best SMB data available for Lake Wisconsin over time), the goals for PSD and catch rate of stock size fish are currently being met in Lake Wisconsin. Because smallmouth are the dominant bass species in Lake Wisconsin, abundance compares favorably statewide, the population is very stable, and growth is good. No regulation changes are recommended for Largemouth or Smallmouth Bass at this time.

Northern Pike were not sampled extensively in 2017 due to staff limitations and ice conditions in some areas of good habitat during SN1 and few meaningful population-level conclusions are possible. Northern Pike growth was good based on mean length-at-age values with some fish exceeding the minimum length limit of 26 inches as early as age 3 and averaging over 26 inches by age 6. Anglers may encounter Northern Pike approaching 40 inches in Lake Wisconsin. Northern Pike sampling in future SN1 surveys will benefit from use of 2-foot frame fyke nets which will allow better sampling of shallow habitats. Returns to full staffing in the Poynette fisheries office and region-wide will allow for better sampling of suitable Northern Pike habitat in Lake Wisconsin by allowing two crews to operate concurrently thus covering more of the lake than a single crew could do alone. However, lingering ice coverage in areas of good Northern Pike habitat during early spring will continue to pose a challenge to data collection during SN1 surveys. No regulation change is recommended for Northern Pike at this time.

Much like in 2012, few Muskellunge were collected during SE2 in 2017. Staff limitations meant only a single crew was able to sample the lake during SN2 which limited the amount of area that could be covered. A short sampling window of one week further hampered collection efforts. Increases in staffing and new shallow-water fyke nets will hopefully lead to more effective sampling of Muskellunge in 2022. Lake Wisconsin is classified as an A1 musky water in Wisconsin (trophy potential, low density, inconsistent angling action) and is Category 3 with respect to reproduction (no known natural reproduction, all fish are of stocked origin). As such, it is recommended that Muskellunge continue to be stocked at current levels moving forward, per the stocking guidance (2,500 large fingerlings in even-numbered years). It should be noted that escapement of Muskellunge from Lake Wisconsin through the Prairie du Sac Dam continues to provide a popular tailwater fishery in the lower Wisconsin River.

Future SE2 surveys should include a total of 12 miles of sampling effort (per 2008 lake sampling protocols), but effort should be partitioned into 24 half-mile stations as was the case in 2017. Of these, six should be all species stations (three miles total effort, per protocol) and 18 should be sport fish-only stations (9 miles total effort, per protocol). Establishment of sport fish electrofishing index stations is recommended like what was described above for panfish index stations. To that end, the 24 half-mile electrofishing stations sampled during SE2 in 2017 were ranked by first summing the Walleye, Sauger, and Smallmouth Bass catch rates for each station, and then ordering the stations from highest to lowest total three-species CPUE. The top six stations from the list are proposed as sport fish index electrofishing stations to be sampled during every future SE2 survey. The stations in order of total Walleye, Sauger, and Smallmouth bass CPUE are LW71 (142 fish/mile), LW86 (120 fish/mile), LW99 (98 fish/mile), LW38 (94 fish/mile), LW82 (94 fish/mile), and LW10 (78 fish/mile). These stations were chosen because they likely represent some of the best habitat in Lake Wisconsin for the suite of three species. Tracking trends in abundance of the species at these stations over time will allow for direct comparison of catch rate metrics between surveys, as well as giving insight into long-term trends in abundance of the species. The remaining 12 sport fish-only stations sampled during each SE2 survey would be chosen at random.

One final recommendation is to continue to work collaboratively with Alliant Energy to implement fish passage at the Prairie du Sac Dam, as mandated through Federal Energy Regulatory Commission (FERC) licensing of the dam. Species such as Paddlefish, Blue Sucker, and Shovelnose Sturgeon were historically found in the Wisconsin River upstream of the dam site but are no longer found there due in part to the habitat fragmentation caused by the dam. Other species, while still found above and below the dam, face a barrier to movement of genetic material with fish found below the dam unable to mix and breed with fish above the dam. While a recent study conducted by the University of Wisconsin-Stevens Point suggested that the barrier has not caused significant genetic differentiation in populations of several species to date, such differentiation may become a reality if the separation continues for a long enough period (Ruzich et al. 2019). Compounding the issue of fish passage is the fact that the dam also serves as an impassible barrier to invasive aquatic species found in the lower Wisconsin River. Silver and Bighead Carp are two invasive fish species found in the Mississippi River system that are currently unable to spread past the Prairie du Sac Dam. Impacts to areas upstream of the dam from these species are likely to be negative and wide-ranging, and preventing their spread is another important consideration for fish passage because whatever method is chosen must minimize the possibility of spreading invasive species to areas where they do not currently exist. To that end, the United States Fish and Wildlife Service (USFWS) is conducting a study evaluating potential fish passage methods at Prairie du Sac and the risks associated with each. The study will inform the decision on what form fish passage will ultimately take, but the completion date is unclear at this time.

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TABLES AND FIGURES

Table 1. Current (2020) fishing regulations for Lake Wisconsin and the Wisconsin River between the Prairie du Sac Dam and the Kilbourn Dam.

Species	Season Dates	Length and Bag Limits
Catfish	Open All Year	No minimum length limit and the daily bag limit is 10.
Panfish (Bluegill, Pumpkinseed, Sunfish, Crappie, and Yellow Perch)	Open All Year	No minimum length limit and the daily bag limit is 25.
Largemouth Bass and Smallmouth Bass	Open All Year	The minimum length limit is 14" and the daily bag limit is 5.
Muskellunge and hybrids	First Saturday in May through December 31	The minimum length limit is 50" and the daily bag limit is 1.
Northern Pike	Open All Year	The minimum length limit is 26" and the daily bag limit is 2.
Walleye, Sauger, and hybrids	Open All Year	The minimum length limit is 15" and the daily bag limit is 5. Fish from 20" through 28" may not be kept and only one fish over 28" is allowed.
Bullheads	Open All Year	No minimum length limit and the daily bag limit is unlimited.
Rough fish	Open All Year	No minimum length limit and the daily bag limit is unlimited.
Lake Sturgeon-Hook and Line	First Saturday in September through September 30	The minimum length limit is 60" and the season bag limit is 1 with a valid fishing license and a valid harvest tag.

*Motor trolling is permitted on Lake Wisconsin with three hooks, baits, or lures per person.

Table 2. Stocking history of Lake Wisconsin and the Wisconsin River between Prairie du Sac Dam and Kilbourn Dam, 1992 to present.

Year	Species[1]	Strain[2]	Age class[3]	Number stocked	Mean length (inches)	Source type
1992	MUSKELLUNGE	UNSPECIFIED	FINGERLING	1,910	11.0	DNR HATCHERY
1993	MUSKELLUNGE	UNSPECIFIED	FINGERLING	2,263	9.0	DNR HATCHERY
1996	MUSKELLUNGE	UNSPECIFIED	FINGERLING	1,800	11.8	DNR HATCHERY
1998	MUSKELLUNGE	UNSPECIFIED	LGF	900	8.0	DNR HATCHERY
1998	MUSKELLUNGE	UNSPECIFIED	LGF	276	9.6	DNR HATCHERY
1998	MUSKELLUNGE	UNSPECIFIED	LGF	1,314	12.3	DNR HATCHERY
2000	LAKE STURGEON	LAKE WISCONSIN	FRY	87,771	0.5	DNR HATCHERY
2000	MUSKELLUNGE	UNSPECIFIED	FRY	2,500	11.5	DNR HATCHERY
2001	LAKE STURGEON	LAKE WISCONSIN	FRY	28,782	0.4	DNR HATCHERY
2001	MUSKELLUNGE	UNSPECIFIED	LGF	7,500	11.5	DNR HATCHERY
2002	LAKE STURGEON	WISCONSIN RIVER	LGF	4,950	5.5	DNR HATCHERY
2002	TIGER MUSKY	UNSPECIFIED	LGF	2,000	10.0	DNR HATCHERY
2008	MUSKELLUNGE	UPPER WIS RIVER	LGF	1,250	10.7	DNR HATCHERY
2003	LAKE STURGEON	WISCONSIN RIVER	FRY	137,906	0.6	DNR HATCHERY
2003	LAKE STURGEON	WISCONSIN RIVER	SMF	700	3.2	DNR HATCHERY
2003	LAKE STURGEON	WISCONSIN RIVER	YLG	9	12.0	DNR HATCHERY
2004	LAKE STURGEON	WISCONSIN RIVER	SMF	4,973	4.0	DNR HATCHERY
2011	MUSKELLUNGE	UNSPECIFIED	LGF	1,700	10.5	PRIVATE HATCHERY
2012	LAKE STURGEON	WISCONSIN RIVER	LGF	2,642	7.5	DNR HATCHERY
2012	MUSKELLUNGE	UPPER WIS RIVER	LGF	2,540	9.7	DNR HATCHERY
2012	MUSKELLUNGE	UNSPECIFIED	LGF	790	14.3	PRIVATE HATCHERY
2014	LAKE STURGEON	WISCONSIN RIVER	SMF	23,185	1.7	DNR HATCHERY
2014	LAKE STURGEON	WISCONSIN RIVER	SMF	6,595	3.3	DNR HATCHERY
2014	MUSKELLUNGE	UPPER CHIP RIVER	LGF	2,498	11.0	DNR HATCHERY
2014	MUSKELLUNGE	UNSPECIFIED	LGF	150	10.0	PRIVATE HATCHERY
2014	MUSKELLUNGE	UPPER WIS RIVER	SMF	1,000	3.1	DNR HATCHERY
2016	MUSKELLUNGE	UPPER WIS RIVER	LGF	2,499	10.8	DNR HATCHERY
2018	MUSKELLUNGE	UNSPECIFIED	LGF	1,343	12.0	DNR HATCHERY
2019	MUSKELLUNGE	UNSPECIFIED	LGF	1,189	11.9	DNR HATCHERY
2019	LAKE STURGEON	WISCONSIN RIVER	SMF	11,980	1.1	DNR HATCHERY
2019	LAKE STURGEON	WISCONSIN RIVER	SMF	17,518	2.4	DNR HATCHERY

[1]Tiger musky is a Northern Pike x Muskellunge hybrid
[2]Upper Wis River represents the Upper Wisconsin River strain, Upper Chip River represents the Upper Chippewa River strain.
[3] Small fingerling is abbreviated SMF, Large fingerling is abbreviated LGF, and yearling is abbreviated YLG.

Table 3. Locations of fyke nets (GPS coordinates) used during SN1 and SN2 on Lake Wisconsin in 2017.

Net number	Period	Set date	Final lift date	Lead length (feet)	Frame size (feet)	Latitude	Longitude
1	SN1	03/20/2017	03/24/2017	50	3 X 6	43.39758	-89.37229
2	SN1	03/20/2017	03/24/2017	50	3 X 6	43.39681	-89.52111
3	SN1	03/20/2017	03/24/2017	50	3 X 6	43.37317	-89.55222
4	SN1	03/20/2017	03/23/2017	50	3 X 6	43.37210	-89.55154
5	SN1	03/20/2017	03/23/2017	50	3 X 6	43.35220	-89.57063
6	SN1	03/20/2017	03/23/2017	50	3 X 6	43.35472	-89.57746
7	SN1	03/20/2017	03/23/2017	50	3 X 6	43.35853	-89.57337
1A	SN2	04/11/2017	04/14/2017	50	3 X 6	43.37317	-89.55222
2A	SN2	04/11/2017	04/14/2017	50	3 X 6	43.37210	-89.55154
3A	SN2	04/11/2017	04/14/2017	50	3 X 6	43.35844	-89.57346
4A	SN2	04/11/2017	04/14/2017	50	3 X 6	43.35492	-89.57758
5A	SN2	04/11/2017	04/14/2017	75	4 X 6	43.36541	-89.59574
6A	SN2	04/11/2017	04/14/2017	75	4 X 6	43.35682	-89.64958
7A	SN2	04/11/2017	04/13/2017	75	4 X 6	43.36019	-89.69044
8A	SN2	04/11/2017	04/12/2017	75	4 X 6	43.39586	-89.56366
9A	SN2	04/11/2017	04/12/2017	50	3 X 6	43.40060	-89.55778
10A	SN2	04/12/2017	04/14/2017	75	4 X 6	43.36324	-89.59066
11A	SN2	04/12/2017	04/13/2017	50	3 X 6	43.36323	-89.66158
12A	SN2	04/13/2017	04/14/2017	50	3 X 6	43.35555	-89.64160
13A	SN2	04/13/2017	04/14/2017	75	4 X 6	43.36614	-89.60684

Table 4. Calcified structures used to estimate age for the various fish species collected during the 2017 comprehensive fishery survey of Lake Wisconsin.

Species	Size Category	Structure
Black Crappie	All	scale
Bluegill	All	scale
Largemouth Bass	≤8 inches	scale
Largemouth Bass	≥8 inches	dorsal spine
Muskellunge	All	anal fin ray
Northern Pike	All	anal fin ray
Sauger	All	dorsal spine
Smallmouth Bass	≤8 inches	scale
Smallmouth Bass	≥8 inches	dorsal spine
Walleye	All	dorsal spine
White Crappie	All	scale
Yellow Perch	All	anal spine

Table 5. Locations of half-mile electrofishing stations (GPS coordinates) sampled during the SE2 survey of Lake Wisconsin in 2017.

Date	Start time	End time	Substation name	Target species	Water temp (F)	Start latitude	Start longitude	End latitude	End longitude
05/15/2017	23:00	23:20	LW79 - N. OF MOON	Sport fish	66.3	43.36417	-89.65040	43.36225	-89.65939
05/15/2017	23:40	23:59	LW80 - N. OF MOON	All species	65.4	43.36225	-89.65939	43.36331	-89.66549
05/16/2017	0:33	0:50	LW82 - MOON	All species	65.8	43.36921	-89.66971	43.37260	-89.66807
05/16/2017	21:23	21:39	LW66 - STONERS	Sport fish	68.3	43.39561	-89.56880	43.39561	-89.57860
05/16/2017	22:10	22:31	LW38 - HARMONY	Sport fish	65.5	43.36753	-89.56852	43.36541	-89.56018
05/16/2017	22:56	23:12	LW40 - HARMONY5	Sport fish	71.0	43.36558	-89.55165	43.36854	-89.54427
05/16/2017	23:29	23:46	LW42 - HARMONY4	All species	72.3	43.36866	-89.54887	43.36974	-89.54180
05/17/2017	0:15	0:31	LW43 - HARMONY4	Sport fish	69.8	43.36974	-89.54180	43.37031	-89.55098
05/17/2017	0:55	1:11	LW44 - HARMONY3	All species	69.1	43.37031	-89.55098	43.37102	-89.54239
05/17/2017	1:47	2:02	LW48 - HARMONY1	Sport fish	69.8	43.37266	-89.55167	43.37368	-89.55050
05/17/2017	22:48	23:06	LW14 - TURTLE	All species	66.9	43.35756	-89.65117	43.35562	-89.64541
05/17/2017	23:42	23:59	LW17 - SUNSET	Sport fish	65.3	43.35392	-89.63779	43.35127	-89.63376
05/18/2017	0:26	0:42	LW19 - SUNSET	All species	66.3	43.35190	-89.62735	43.35701	-89.63102
05/18/2017	21:05	21:22	LW71 – BREEZY PT.	Sport fish	66.0	43.38633	-89.60113	43.38393	-89.60707
05/18/2017	21:32	21:46	LW29 - OKEE	All species	66.0	43.35438	-89.57751	43.35412	-89.56292
05/18/2017	22:07	22:20	LW27 - OKEE	Sport fish	66.2	43.35880	-89.58435	43.35942	-89.57597
05/18/2017	23:10	23:26	LW31 - OKEE	All species	67.1	43.35671	-89.56762	43.35940	-89.57524
05/19/2017	0:00	0:13	LW33 - OKEE	Sport fish	65.7	43.36548	-89.57333	43.37008	-89.56998
05/25/2017	23:06	23:24	LW96 – LOWER LAKE	Sport fish	60.5	43.34243	-89.69963	43.33633	-89.70340
05/25/2017	23:42	23:59	LW99 - GRUBERS	All species	64.7	43.32638	-89.71511	43.32830	-89.72152
05/25/2017	21:23	21:48	LW86 - WEIGANDS	All species	64.1	43.36222	-89.68128	43.36375	-89.68633
05/25/2017	22:30	22:45	LW88 - WEIGANDS	Sport fish	64.7	43.36494	-89.68825	43.36394	-89.69370
05/26/2017	0:43	1:01	LW03 - LOWER LAKE	Sport fish	65.3	43.32267	-89.70970	43.32684	-89.70321
05/26/2017	1:28	1:44	LW10 – LOWER LAKE	Sport fish	60.8	43.35541	-89.68082	43.35864	-89.67313

Table 6. Locations of electrofishing stations (GPS coordinates) sampled during the fall electrofishing survey of Lake Wisconsin and the Wisconsin River in Wisconsin Dells in 2017.

Date	Station	Water temp (F)	Start latitude	Start longitude	End latitude	End longitude	Distance (miles)[1]
10/04/2017	Upper Lake Part A	66.4	43.40632	-89.54243	43.41625	-89.52888	
10/04/2017	Upper Lake Part B	66.4	43.41787	-89.54115	43.40914	-89.54582	2.14
10/04/2017	Stoner's Bay	65.4	43.39417	-89.57956	43.37915	-89.61616	2.70
10/03/2017	Moon Valley	67.7	43.36250	-89.66497	43.36289	-89.67817	2.45
10/05/2017	Okee Bay	66.8	43.36663	-89.61944	43.35795	-89.58293	2.35
10/03/2017	Weigand's Bay Part A	67.7	43.36209	-89.68103	43.36372	-89.68641	
10/03/2017	Weigand's Bay Part B	67.7	43.36293	-89.69034	43.35953	-89.68684	2.40
10/05/2017	Gruber's Grove	66.7	43.32710	-89.71078	43.32184	-89.72305	2.25
10/02/2017	Kilbourn #1 Part A	65.6	43.60742	-89.76897	43.61140	-89.77267	
10/02/2017	Kilbourn #1 Part B	65.6	43.61186	-89.77176	43.61662	-89.77359	
10/02/2017	Kilbourn #1 Part C	65.6	43.61909	-89.77318	43.62352	-89.77969	1.50
10/02/2017	Kilbourn #2 Part A	65.6	43.60545	-89.75760	43.60587	-89.76478	
10/02/2017	Kilbourn #2 Part B	65.6	43.60517	-89.75692	43.60580	-89.76794	1.65

[1]Distances listed for Upper Lake Part B, Weigand’s Bay Part B, Kilbourn #1 Part C, and Kilbourn #2 Part B are the total distances for all parts of the respective stations.

Table 7. Length categories (inches) that have been proposed for gamefish species that were collected from Lake Wisconsin in 2017 (Anderson and Neumann 1996, Guy et al. 2007).

Species	Stock	Quality	Harvest[1]	Preferred	Memorable	Trophy
Black Crappie	5	8	9	10	12	15
Bluegill	3	6	7	8	10	12
Channel Catfish	11	16		24	28	36
Flathead Catfish	14	20		28	34	40
Largemouth Bass	8	12	14	15	20	25
Muskellunge	20	30	50	38	42	50
Northern Pike	14	21	26	28	34	44
Sauger	8	12	15	15	20	25
Smallmouth Bass	7	11	14	14	17	20
Walleye	10	15	15	20	25	30
White Crappie	5	8	9	10	12	15
Yellow Perch	5	8	9	10	12	15

[1]The harvest category refers to the length at which fish are often harvested by anglers (panfish) or are legal for harvest in Lake Wisconsin according to local fishing regulations (gamefish). For some gamefish species, harvest lengths match either quality (Walleye) or preferred (Sauger, Smallmouth Bass) lengths established in literature.

Table 8. Summary of lengths (inches) and PSD values for sport fish collected during spring 2017 sampling of the Wisconsin River near Wisconsin Dells (SE1) and Lake Wisconsin (SN1, SN2, and SE2).

Species	Period	Unique fish	Length range	Mean length	Median length	PSD	PSD-H	PSD-P	PSD-M	PSD-28	PSD-T
Walleye	SE1	1,988	6.0-30.1	16.0	14.4	57	57	37	23	3	<0.1
Walleye-male	SE1	586	10.4-23.7	14.9	14.5						
Walleye-female	SE1	561	16.3-30.1	25.0	25.5						
Walleye	SN1	1		8.8							
Walleye	SN2	14	7.7-27.3	14.2	9.4						
Walleye	SE2	306	5.6-26.9	11.7	9.9	41	41	5	1		
Sauger	SE1	371	6.5-21.2	12.5	12.0	54	17	17	<0.1		
Sauger-male	SE1	202	8.6-16.0	11.8	11.8						
Sauger-female	SE1	79	11.6-21.2	15.8	15.9						
Sauger	SN2	16	9.4-15.7	11.1	10.6						
Sauger	SE2	325	5.3-19.8	10.3	10.4	29	9	9			
Smallmouth Bass	SE2	103	3.7-16.7	10.8	11.0						
Largemouth Bass	ALL	122	4.4-19.3	12.4	13.8	77	56	39			
Largemouth Bass	SN1,SN2	28	5.1-19.3	12.7	13.6						
Largemouth Bass	SE2	94	4.4-17.2	12.4	13.8						
Northern Pike	ALL	58	10.9-39.3	21.6	20.6						
Northern Pike	SN1,SN2	52	10.9-39.3	21.4	20.1						
Northern Pike-male	SN1	25	11.3-30.1	19.8	19.2						
Northern Pike-female	SN1	19	16.1-39.3	25.4	23.5						
Northern Pike	SE2	6	18.6-28.9	23.5	22.8						
Muskellunge	ALL	12	13.3-41.5	25.9	28.1						
Muskellunge	SN1,SN2	8	14.1-41.5	31.8	34.2						
Muskellunge	SE2	4	13.3-14.7	13.9	13.9						

Table 9. Mean catch rates (CPUE) of age 0 Sauger and Walleye during fall electrofishing surveys at 6 index sampling stations in Lake Wisconsin (main impoundment) 1993-2018.

Year[1]	Sauger age 0 CPUE	Percentile	Rank	Walleye age 0 CPUE	Percentile	Rank	Year
1993	7.5	36	17	35.8	64	10	1993
1994	28.0	80	6	86.1	92	3	1994
1995	16.8	52	13	48.4	72	8	1995
1996	33.4	96	2	87.9	96	2	1996
1997	38.4	100	1	89.4	100	1	1997
1998	32.3	92	3	24.7	56	12	1998
1999	31.6	88	4	48.8	76	7	1999
2000	26.3	72	8	18.7	32	18	2000
2001	17.8	56	12	23.2	48	14	2001
2002	4.4	20	21	57.8	80	6	2002
2003	23.9	68	9	42.2	68	9	2003
2004	12.4	44	15	18.3	24	20	2004
2005	2.5	1	26	18.6	28	19	2005
2006	3.2	4	25	11.7	12	23	2006
2007	3.5	8	24	14.4	20	21	2007
2008	15.3	48	14	20.4	40	16	2008
2009	22.5	60	11	60.6	84	5	2009
2010	4.1	16	22	10.9	8	24	2010
2011	23.7	64	10	23.3	50	13	2011
2012	5.3	32	18	10.6	4	25	2012
2013	4.5	23	20	7.1	1	26	2013
2014	7.8	40	16	25.5	60	11	2014
2015	26.7	76	7	21.1	44	15	2015
2016	4.6	28	19	12.5	16	22	2016
2017	3.8	12	23	19.9	36	17	2017
2018	30.0	84	5	64.5	88	4	2018

[1]Prior to 2002, the minimum length limit for Walleyes and Saugers was 15 inches and the bag limit was 5 fish/day aggregate. After 2002, the minimum length limit remained 15 inches but fish from 20 to 28 inches may not be kept, and one fish over 28 inches may be kept per day.

Table 10. Summary of catch and catch-per-unit effort (CPUE) by gear type for SN1, SN2, and SE2 in Lake Wisconsin during spring 2017.

	CATCH					CPUE				
Species	SN1	SN2	Total Fyke	SE2	Total	SN1 (fish/net night)	SN2 (fish/net night)	SN Total (fish/net night)	SE2 (fish/hr)	SE2 (fish/mile)
Gizzard Shad	1,880	322	2,202	436	2,638	78.3	11.9	43.2	143.0	87.2
Bluegill	536	351	887	299	1,186	22.3	13.0	17.4	98.0	59.8
Black Crappie	271	175	446	55	501	11.3	6.5	8.7	18.0	11.0
Sauger	0	16	16	325	341	0.0	0.6	0.3	47.8	27.1
Walleye	1	14	15	306	321	0.0	0.5	0.3	45.0	25.5
Yellow Perch	34	248	282	15	297	1.4	9.2	5.5	4.9	3.0
White Crappie	168	112	280	0	280	7.0	4.1	5.5	0.0	0.0
Freshwater Drum	18	19	37	164	201	0.8	0.7	0.7	53.8	32.8
Yellow Bass	77	45	122	53	175	3.2	1.7	2.4	17.4	10.6
Largemouth Bass	25	4	29	94	123	1.0	0.1	0.6	13.8	7.8
Common Carp	9	6	15	100	115	0.4	0.2	0.3	32.8	20.0
Smallmouth Bass	0	0	0	103	103	0.0	0.0	0.0	15.1	8.6
White Bass	72	21	93	5	98	3.0	0.8	1.8	1.6	1.0
Quillback	0	0	0	76	76	0.0	0.0	0.0	24.9	15.2
Northern Pike	46	6	52	7	59	1.9	0.2	1.0	1.0	0.6
Bowfin	39	3	42	2	44	1.6	0.1	0.8	0.7	0.4
Pumpkinseed	23	5	28	12	40	1.0	0.2	0.5	3.9	2.4
Golden Shiner	15	18	33	3	36	0.6	0.7	0.6	1.0	0.6
Spotted Sucker	3	1	4	32	36	0.1	0.0	0.1	10.5	6.4
Yellow Bullhead	14	9	23	1	24	0.6	0.3	0.5	0.3	0.2
Muskellunge	2	7	9	4	13	0.1	0.3	0.2	0.6	0.3
White Sucker	0	0	0	11	11	0.0	0.0	0.0	3.6	2.2
Bigmouth Buffalo	0	0	0	6	6	0.0	0.0	0.0	2.0	1.2
Common Shiner	5	0	5	0	5	0.2	0.0	0.1	0.0	0.0
Grass Pickerel	0	0	0	4	4	0.0	0.0	0.0	1.3	0.8
Hybrid Sunfish	1	3	4	0	4	0.0	0.1	0.1	0.0	0.0
Rock Bass	1	2	3	1	4	0.0	0.1	0.1	0.3	0.2
Shorthead Redhorse	0	1	1	3	4	0.0	0.0	0.0	1.0	0.6
Flathead Catfish	0	2	2	1	3	0.0	0.1	0.0	0.1	0.1

Table 10. Continued

Species	CATCH SN1	SN2	Total Fyke	SE2	Total	CPUE SN1 (fish/net night)	SN2 (fish/net night)	SN Total (fish/net night)	SE2 (fish/hr)	SE2 (fish/mile)
Green Sunfish	0	0	0	2	2	0.0	0.0	0.0	0.7	0.4
Logperch	0	0	0	1	1	0.0	0.0	0.0	0.3	0.2
Channel Catfish	0	0	0	1	1	0.0	0.0	0.0	0.1	0.2
Emerald Shiner	0	0	0	1	1	0.0	0.0	0.0	0.3	0.2
	3,240	1,390	4,630	2,109	6,753					

Table 11. Summary of lengths (inches) and PSD values for panfish collected during the 2017 survey of Lake Wisconsin.

Species	Period	Unique fish	Length range (inches)	Mean length	Median length	PSD	PSD-H	PSD-P	PSD-M
Bluegill	SN1, SN2	673	3.2-9.5	6.4	6.5	65	32	8	
Bluegill	SE2	299	2.1-8.3	5.8	5.9	49	26	2	
Black Crappie	SN1, SN2	446	3.4-14.2	8.8	8.4	70	37	29	12
Black Crappie	SE2	55	4.3-12.8	8.2	8.3				
White Crappie	SN1, SN2	280	3.3-13.5	8.8	9.2	86	65	25	5
Yellow Perch	SN1, SN2	281	4.6-11.3	7.0	6.9	13	3	1	
Yellow Perch-M	SN1, SN2	206	4.6-9.7	6.8	6.8				
Yellow Perch-F	SN1, SN2	70	6.0-11.3	7.8	7.6				
Yellow Perch	SE2	15	3.5-8.3	5.9	6.3				

Table 12. Individual fish data for Muskellunge collected during spring netting and electrofishing surveys of Lake Wisconsin in 2017.

Date	Sample Period	Sex	Length (in.)	Weight (lbs.)	Relative weight	Age
05/25/17	SE2	U	13.3	0.4		1
05/17/17	SE2	U	13.4	0.4		1
04/14/17	SN2	U	14.1	0.5		
05/16/17	SE2	U	14.3	0.4		1
05/15/17	SE2	U	14.7	0.5		1
04/13/17	SN2	M	27.9	5.3	93	3
04/12/17	SN2	M	28.3	6.0	101	3
03/22/17	SN1	M	33.5	10.1	97	
04/13/17	SN2	F	35.0	12.8	106	5
04/12/17	SN2	F	35.4	11.7	93	4
03/22/17	SN1	M	38.9	19.4	113	
04/12/17	SN2	F	41.5	19.4	91	4

Table 13. Catch, CPUE, and size data for sport fish collected during the fall 2017 electrofishing survey of Lake Wisconsin (impoundment) and the Wisconsin River below Kilbourn Dam in Wisconsin Dells.

Species[1]	Catch	CPUE (fish/hour)	CPUE (fish/mile)	Age 0 CPUE (fish/mile)	Length range (inches)	Mean length	Median length	PSD	PSD-P	PSD-M	PSD-T
SAU-lake	497	85.7	34.8	3.8	5.4-19.1	10.8	11.0	35	2		
SAU-river	94	28.0	67.1	0.3	8.4-15.3	12.8	12.9				
WAE-lake	438	75.5	30.7	19.9	5.3-24.3	9.9	8.1	39	2		
WAE-river	142	42.3	101.4	0.9	7.8-19.7	14.0	13.6	33			
SMB-lake	141	24.3	9.9		3.1-17.8	10.5	10.3	41	13	1	0
SMB-river	153	45.5	109.3		3.1-20.3	10.2	10.1	44	10	2	1
LMB-lake	56	9.7	3.9		5.1-16.6	11.0	11.3				
LMB-river	20	6.0	14.3		8.2-18.0	11.8	11.4				
FHC-lake	9	1.6	0.6		11.3-24.6	17.3	16.7				
FHC-river	5	1.5	3.6		10.3-19.5	14.7	13.4				
CCF-lake	7	1.2	0.5		7.8-24.5	17.5	20.2				
CCF-river	1	0.3	0.7			27.2					
MUE-lake	5	0.9	0.3		18.0-35.2	23.0	20.4				
NOP-lake	3	0.5	0.2		9.8-29.4	21.6	25.7				
NOP-river	9	2.6	6.4		23.6-36.5	28.8	28.1				

[1]Abbreviations were used for Sauger (SAU), Walleye (WAE), Smallmouth Bass (SMB), Largemouth Bass (LMB), Flathead Catfish (FHC), Channel Catfish (CCF), Muskellunge (MUE), and Northern Pike (NOP). Lake denotes fish collected from the 6 sampling stations in the main impoundment. River denotes fish collected from the 2 sampling stations below Kilbourn Dam in Wisconsin Dells.

Table 14. Results of two-sample t-tests assuming equal variances for comparing mean size-specific catch rates (fish/mile) of Sauger from annual fall electrofishing surveys before and after implementation of the current Sauger length and bag limit for Lake Wisconsin in 2002.

CPUE metric	Pre-reg mean[1]	Post-reg mean[2]	Change	Significant	% Change	t-statistic	P(T<t)
AGE 0	25.8	11.7	Decrease	Yes	-55%	3.5	<0.001
CPUE-12 (Quality)	10.3	9.7	Decrease	No	-6%	0.3	0.4
CPUE-15 (Preferred)	0.9	2.9	Increase	Yes	222%	-3.3	<0.005

[1]Pre-regulation covers the period 1993-2001.
[2]Post-regulation covers the period 2002-2018.

Table 15. Results of two-sample t-tests assuming equal variances for comparing mean size-specific catch rates (fish/mile) of Walleye from annual fall electrofishing surveys before and after implementation of the current Walleye length and bag limit for Lake Wisconsin in 2002.

CPUE metric	Pre-reg mean[1]	Post-reg mean[2]	Change	Significant	% Change	t-statistic	P(T<t)
AGE 0	51.4	25.8	Decrease	Yes	-50%	2.7	<0.01
CPUE-15 (Quality)	3.7	6.4	Increase	Yes	73%	-1.8	<0.05
CPUE-20 (Preferred)	0.5	1.2	Increase	Yes	140%	-2.6	<0.01
CPUE-25 (Memorable)	0.1	0.2	Increase	No	50%	-1.6	0.06

[1]Pre-regulation covers the period 1993-2001.
[2]Post-regulation covers the period 2002-2018.

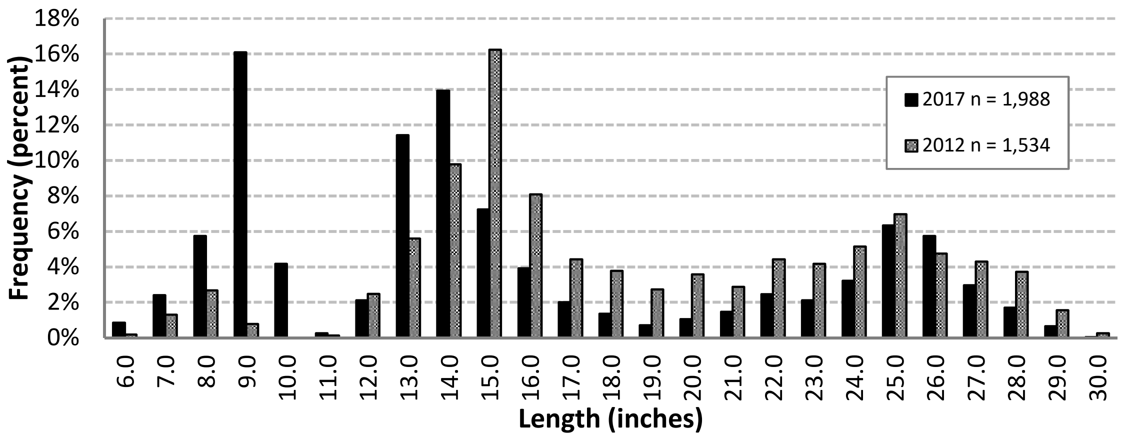

Figure 1. Length frequency distribution of Walleyes collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Data collected in 2012 are included for comparison.

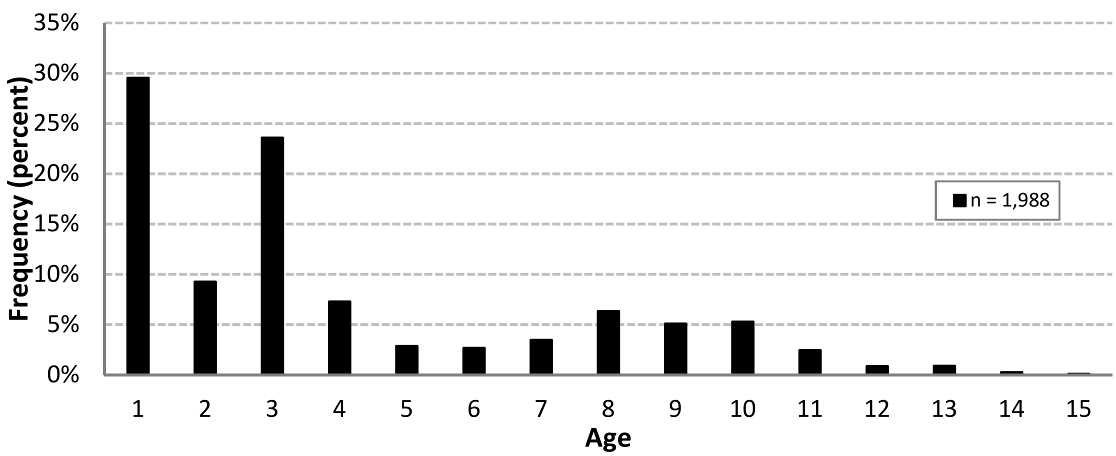

Figure 2. Age frequency distribution of Walleyes collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin.

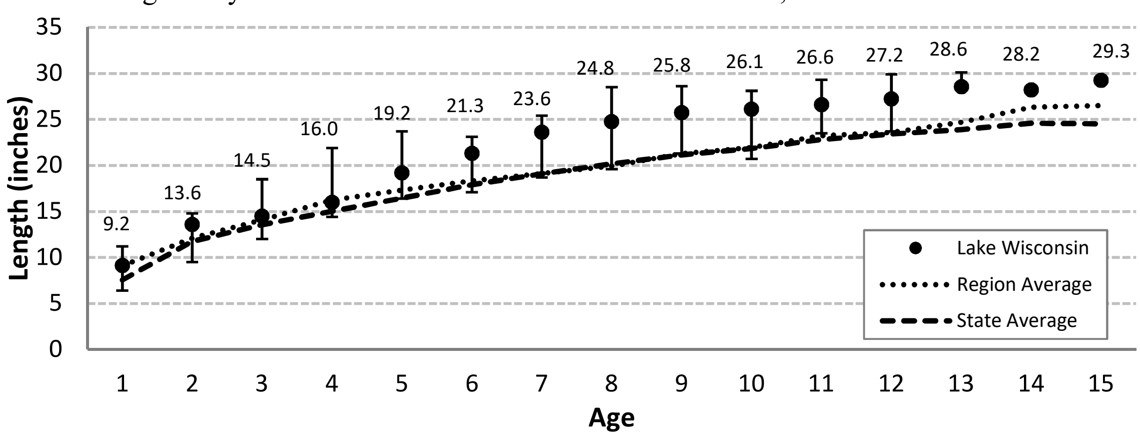

Figure 3. Mean length-at-age of all Walleyes collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Error bars represent the range of lengths for a given age.

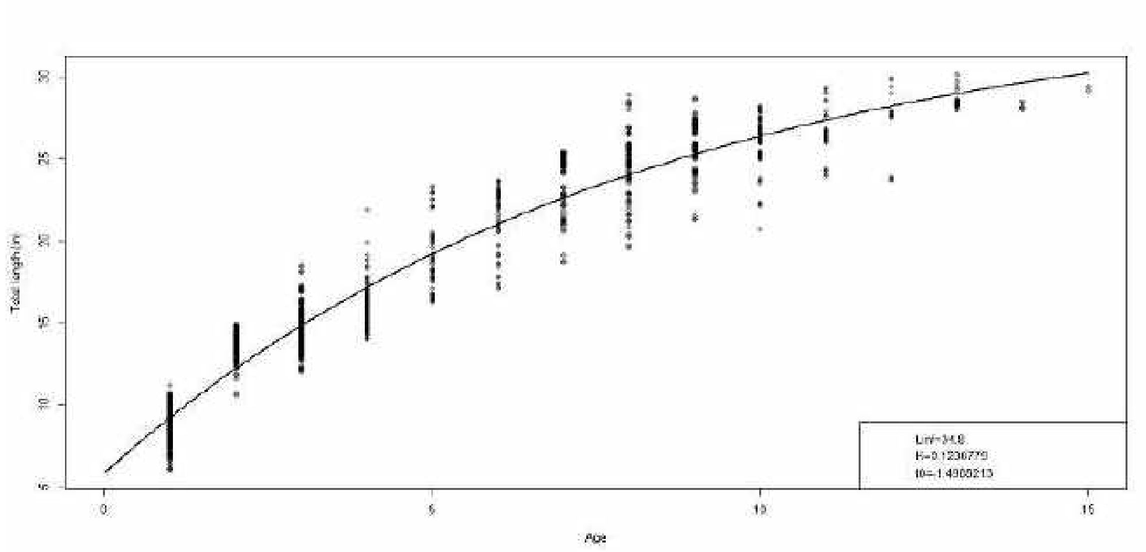

Figure 4. Observed 2017 length-at-age values for Lake Wisconsin Walleyes with a von Bertalanffy growth curve fitted to the data.

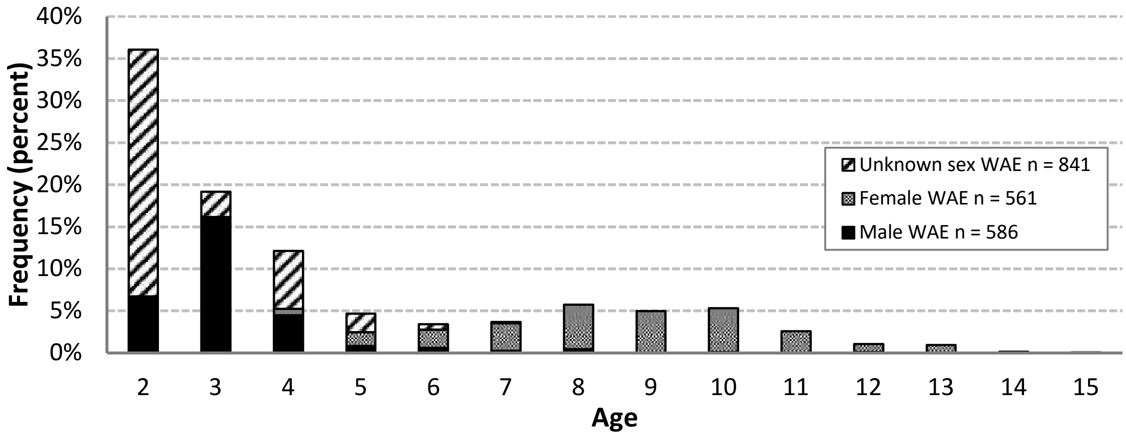

Figure 5. Age frequency distribution of Walleyes (by sex) collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin.

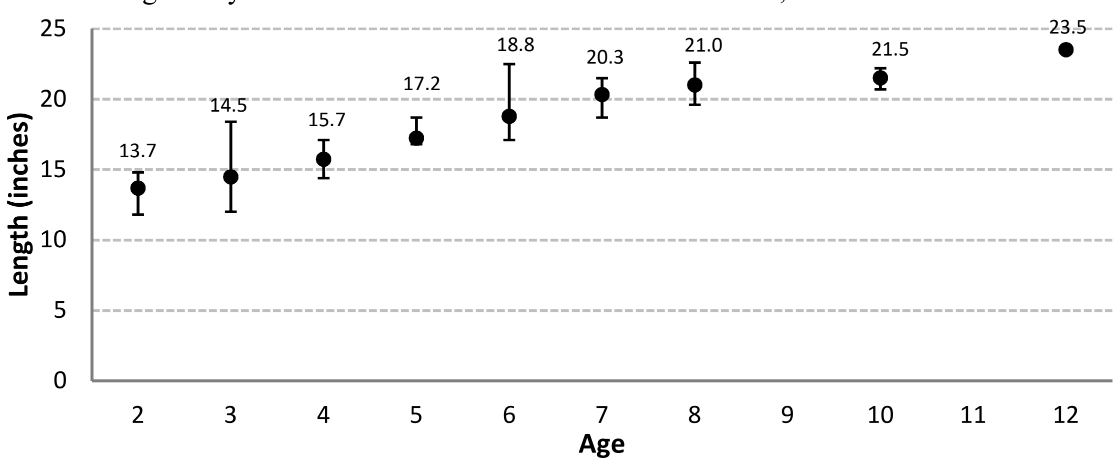

Figure 6. Mean length-at-age of male Walleyes collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Error bars represent the range of lengths for a given age.

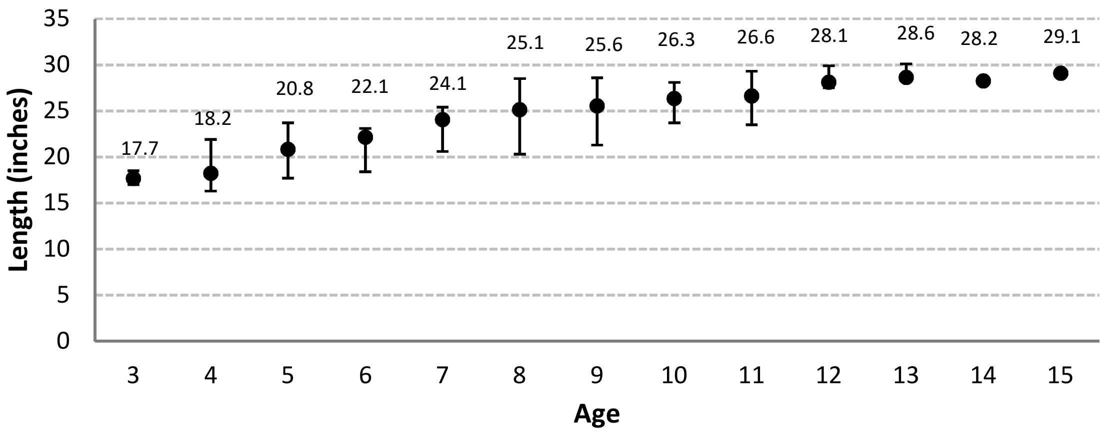

Figure 7. Mean length-at-age of female Walleyes collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Error bars represent the range of lengths for a given age.

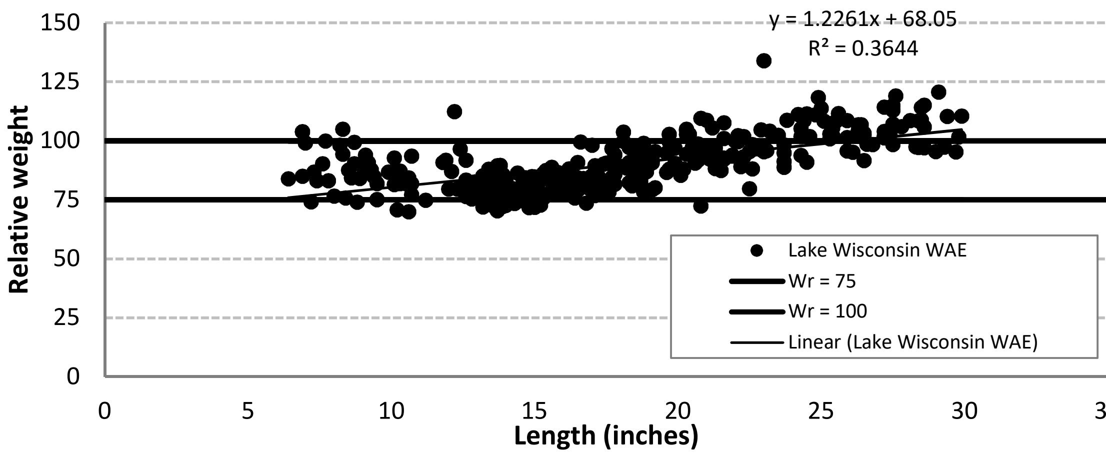

Figure 8. Relative weights of Walleyes collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin.

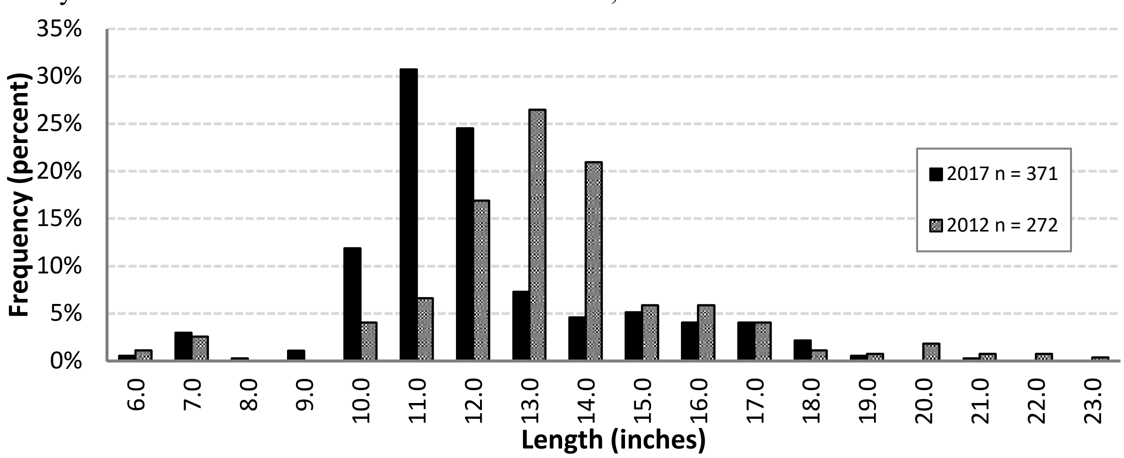

Figure 9. Length frequency distribution of Saugers collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Data collected in 2012 are included for comparison.

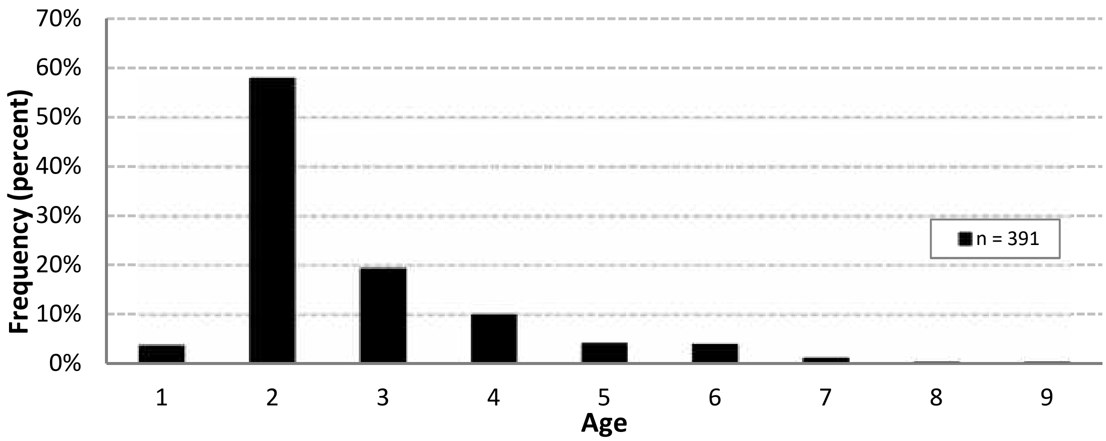

Figure 10. Age frequency distribution of Saugers collected during early spring 2017 electrofishing and netting surveys of Lake Wisconsin and the Wisconsin River near Wisconsin Dells, Wisconsin.

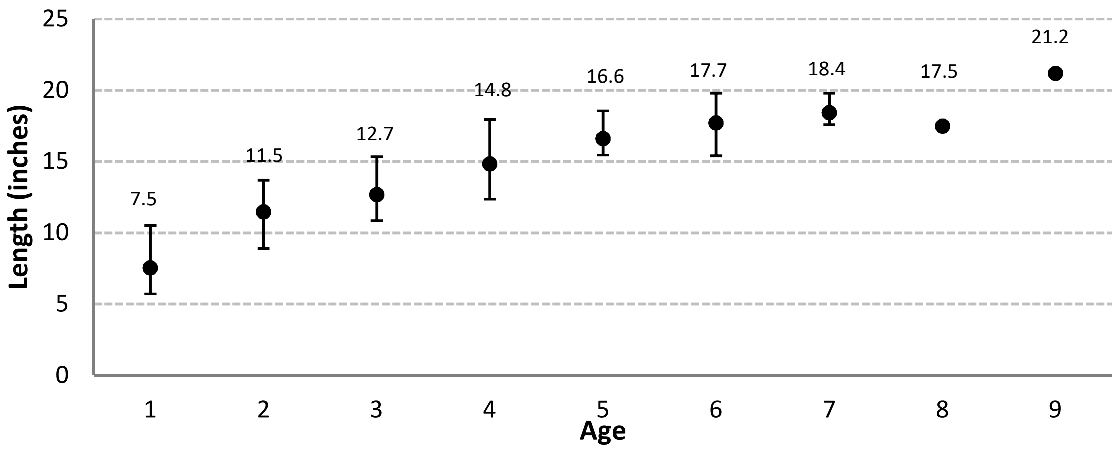

Figure 11. Mean length-at-age of Saugers collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Error bars represent the range of lengths for a given age.

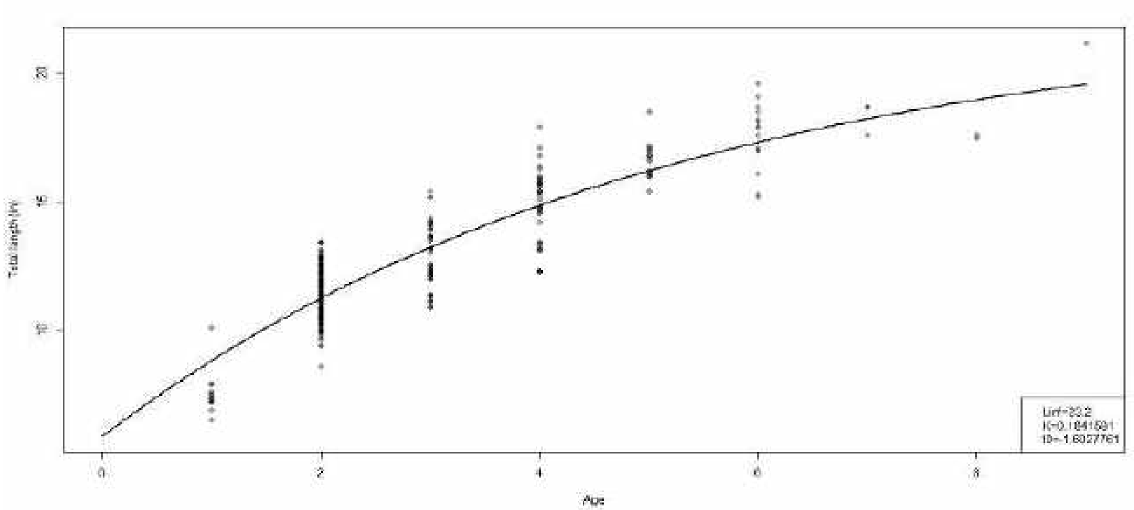

Figure 12. Observed 2017 length-at-age values for Lake Wisconsin Saugers with a von Bertalanffy growth curve fitted to the data.

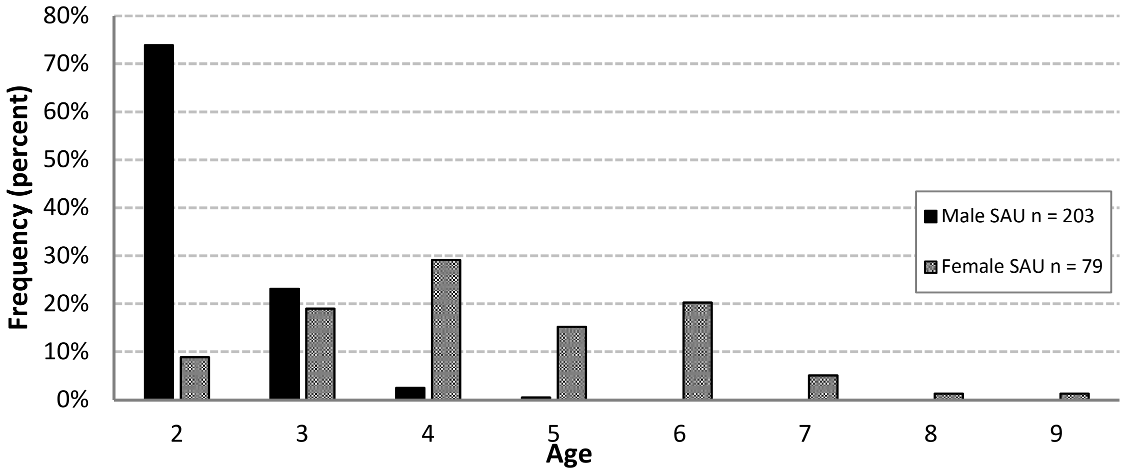

Figure 13. Age frequency distribution of male and female Saugers collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin.

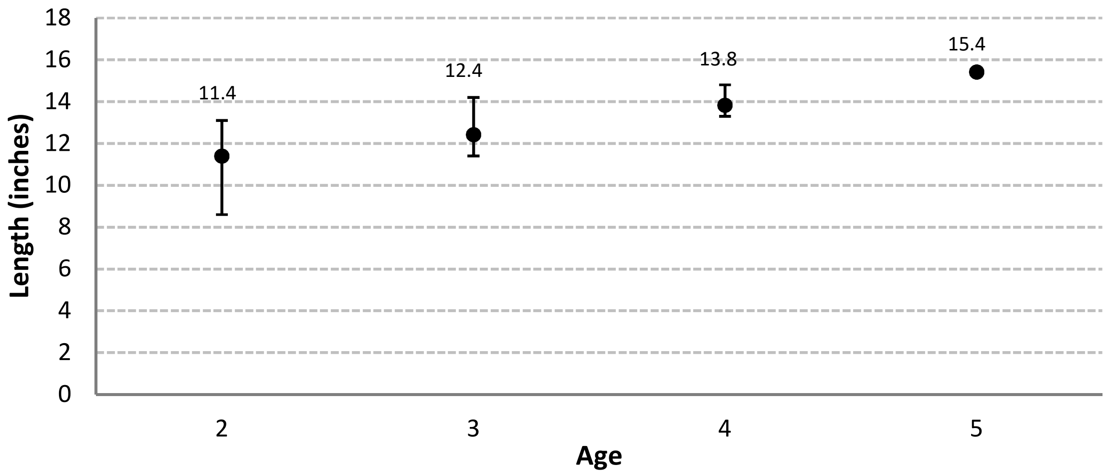

Figure 14. Mean length-at-age of male Saugers collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Error bars represent the range of lengths for a given age.

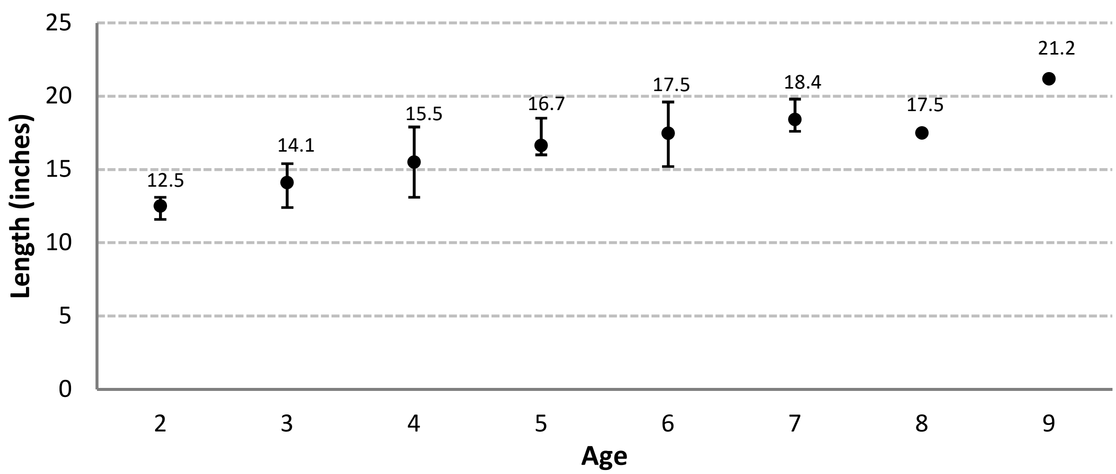

Figure 15. Mean length-at-age of female Saugers collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin. Error bars represent the range of lengths for a given age.

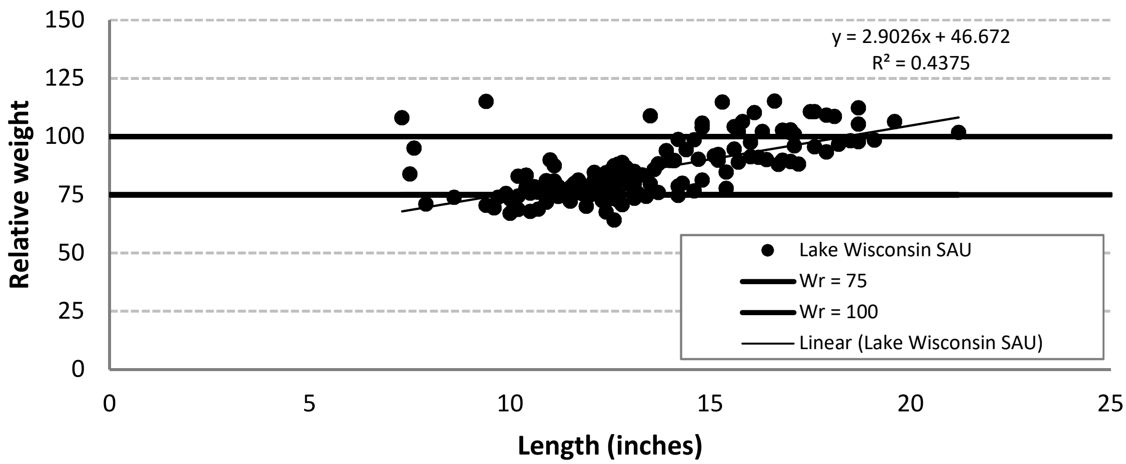

Figure 16. Relative weights of Saugers collected during the early spring 2017 electrofishing survey of the Wisconsin River near Wisconsin Dells, Wisconsin.

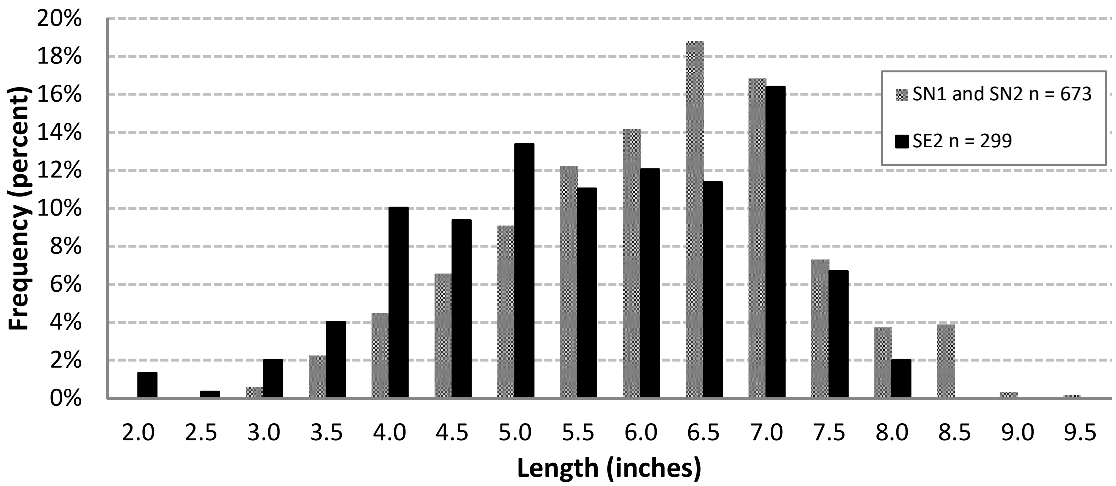

Figure 17. Length frequency distribution of Bluegills collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

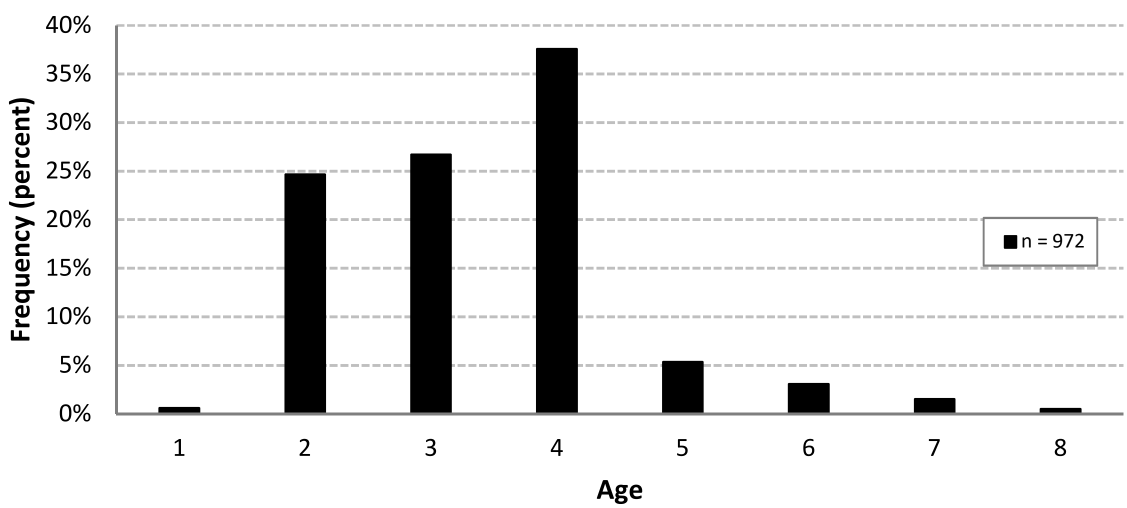

Figure 18. Age frequency distribution of Bluegills collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

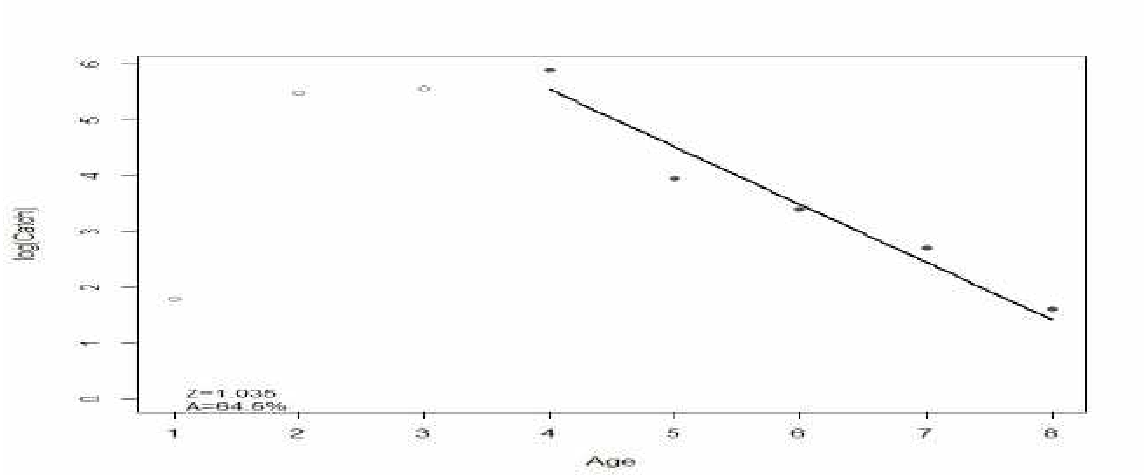

Figure 19. Catch curve for Bluegills captured during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

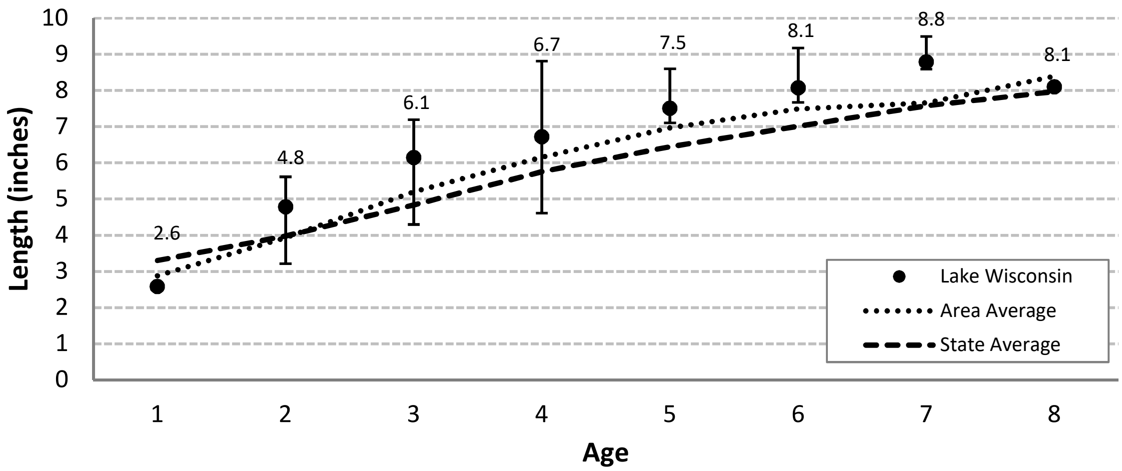

Figure 20. Mean length-at-age of Bluegills collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of lengths for a given age.

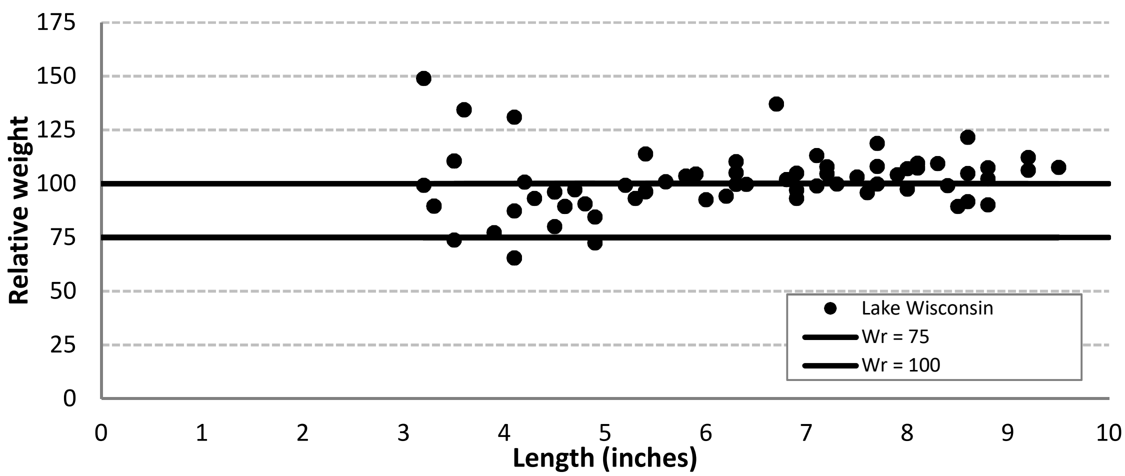

Figure 21. Relative weights of Bluegills collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

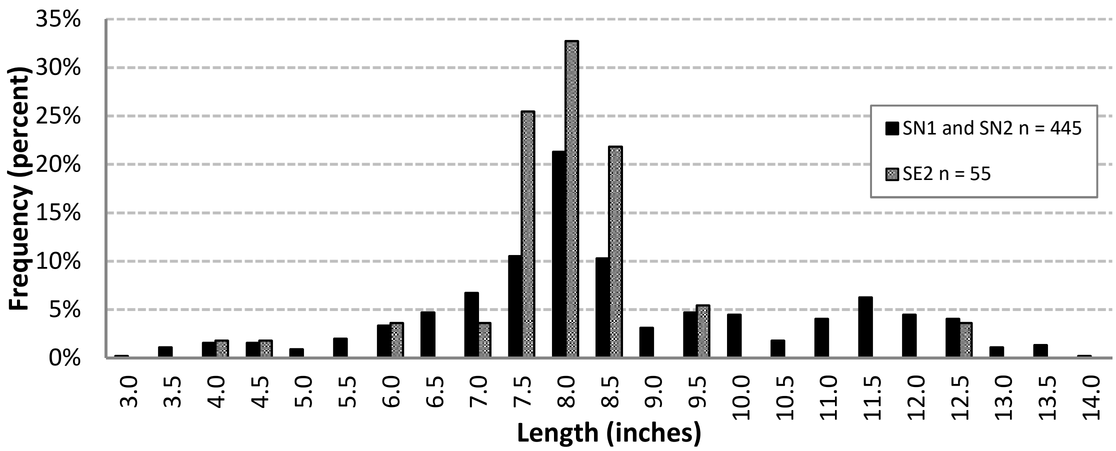

Figure 22. Length frequency distribution of Black Crappies collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

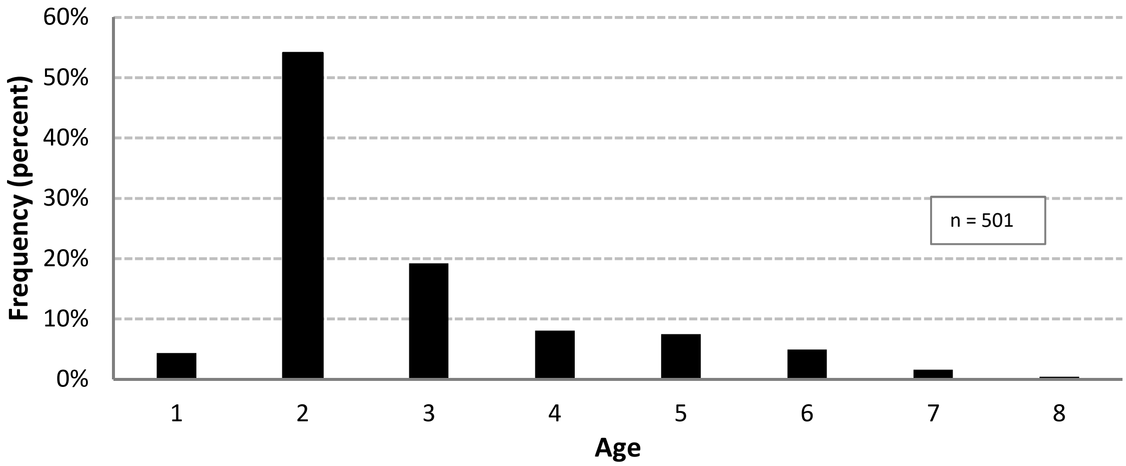

Figure 23. Age frequency distribution of Black Crappies collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

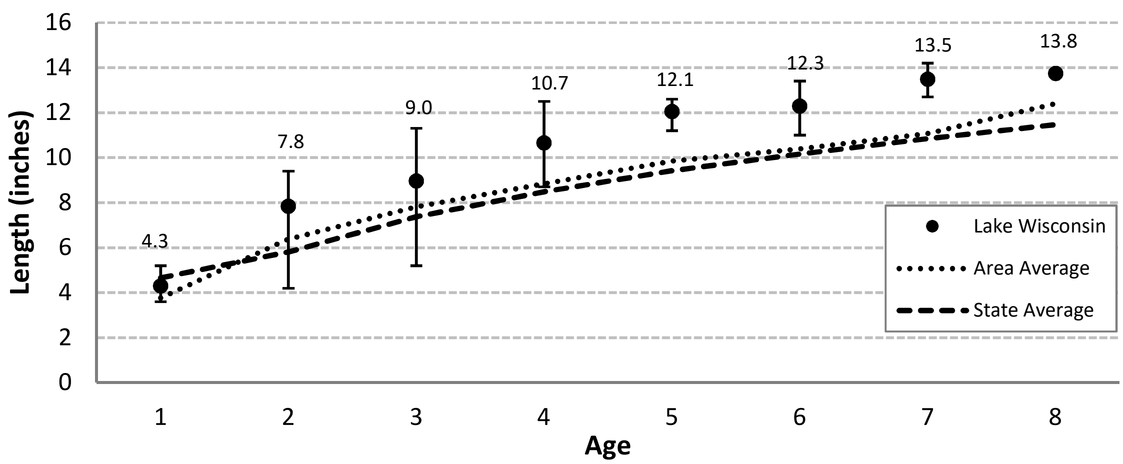

Figure 24. Mean length-at-age of Black Crappies collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of lengths for a given age.

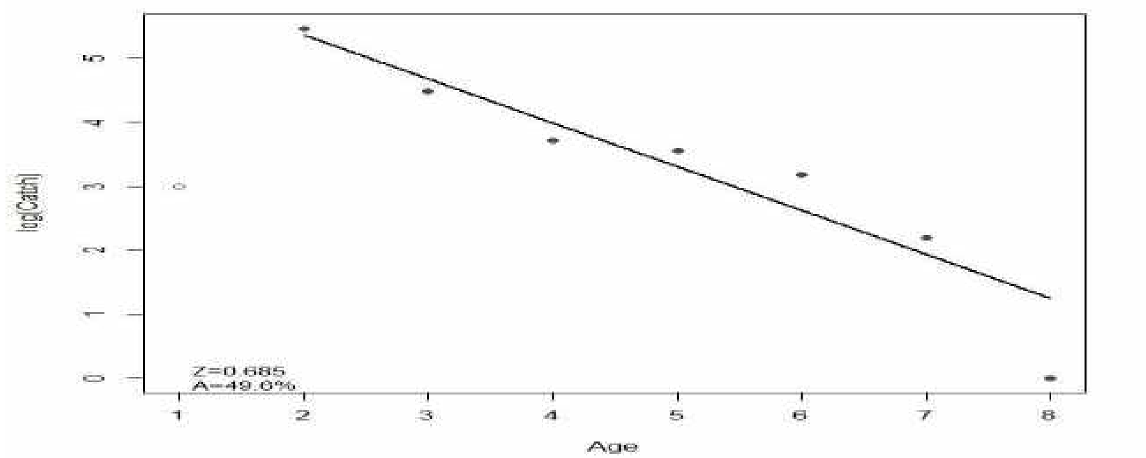

Figure 25. Catch curve for Black Crappies sampled during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

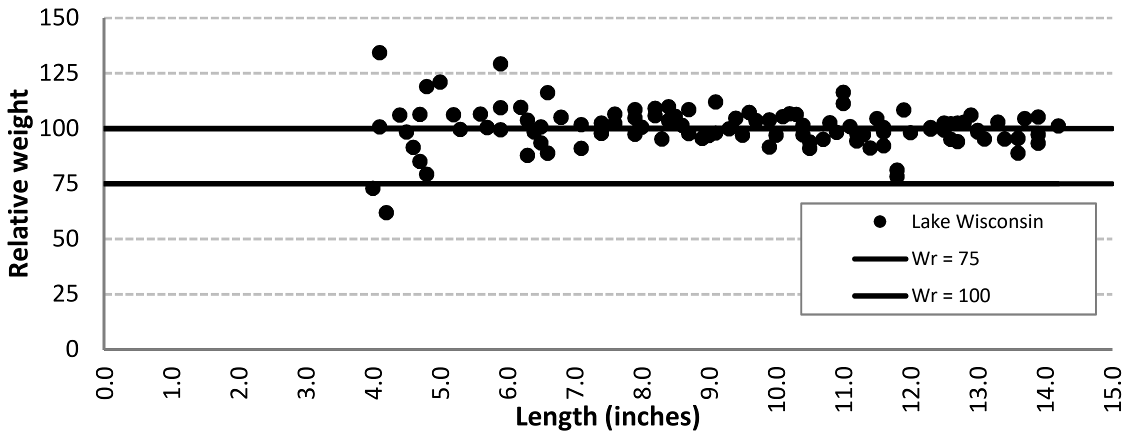

Figure 26. Relative weights of Black Crappies sampled during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

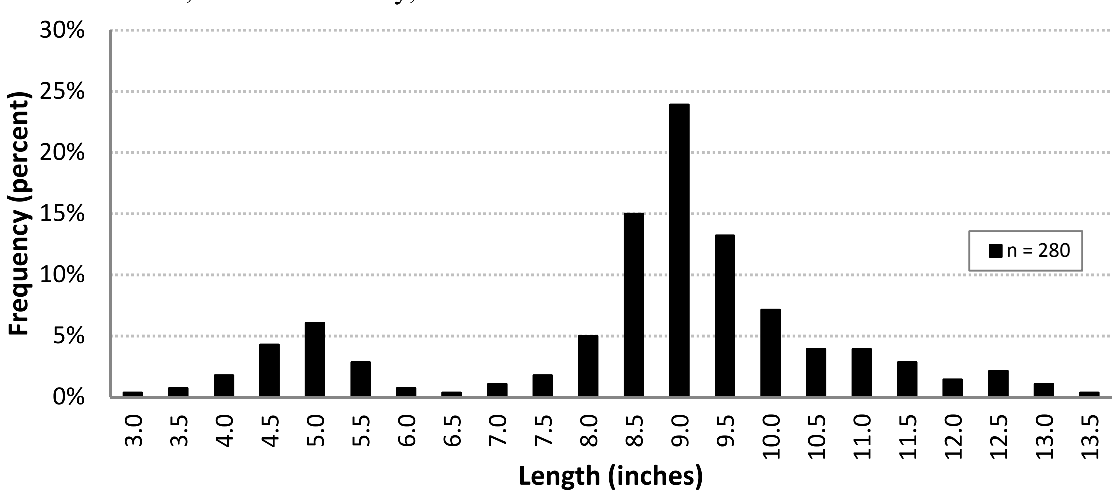

Figure 27. Length frequency distribution of White Crappies collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

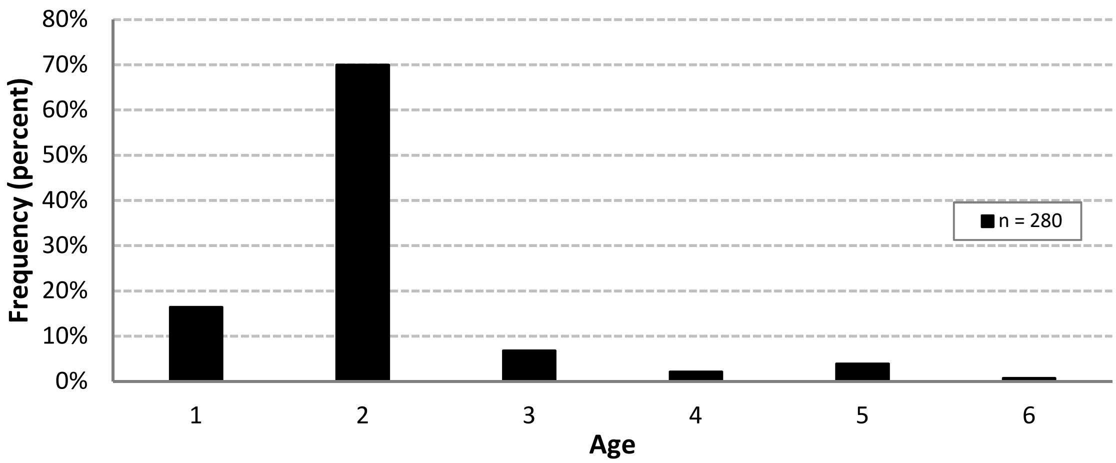

Figure 28. Age frequency distribution of White Crappies collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

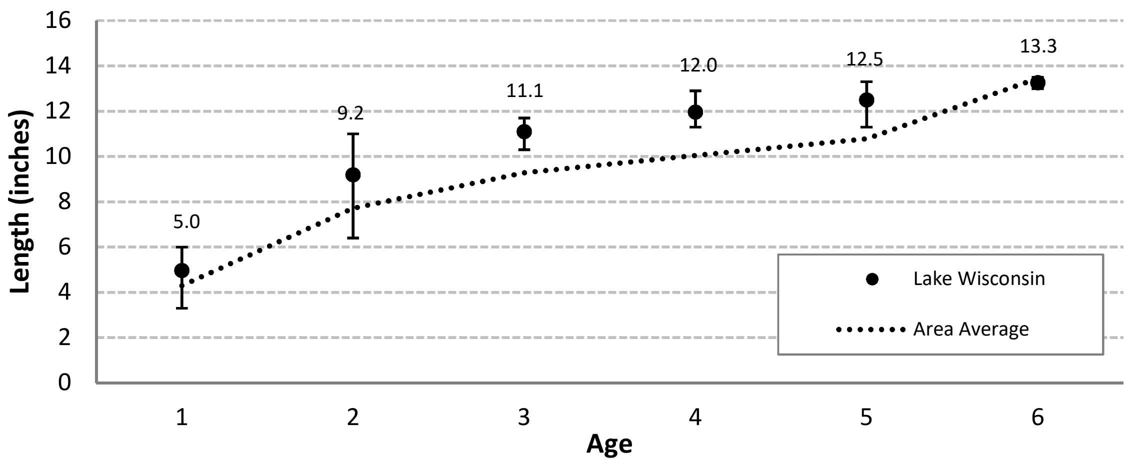

Figure 29. Mean length-at-age of White Crappies collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of lengths for a given age.

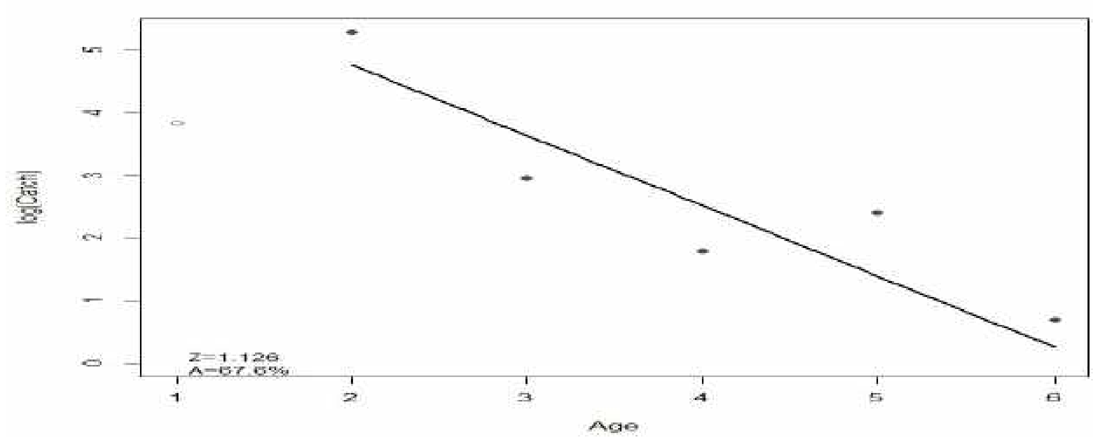

Figure 30. Catch curve for White Crappies collected during 2017 spring netting surveys of Lake Wisconsin, Columbia County, Wisconsin.

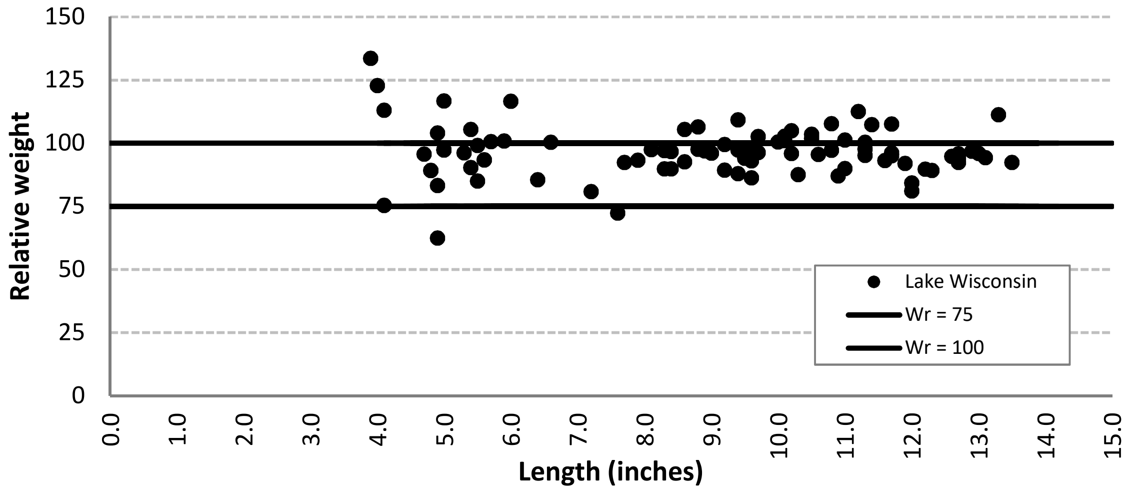

Figure 31. Relative weights of White Crappies collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

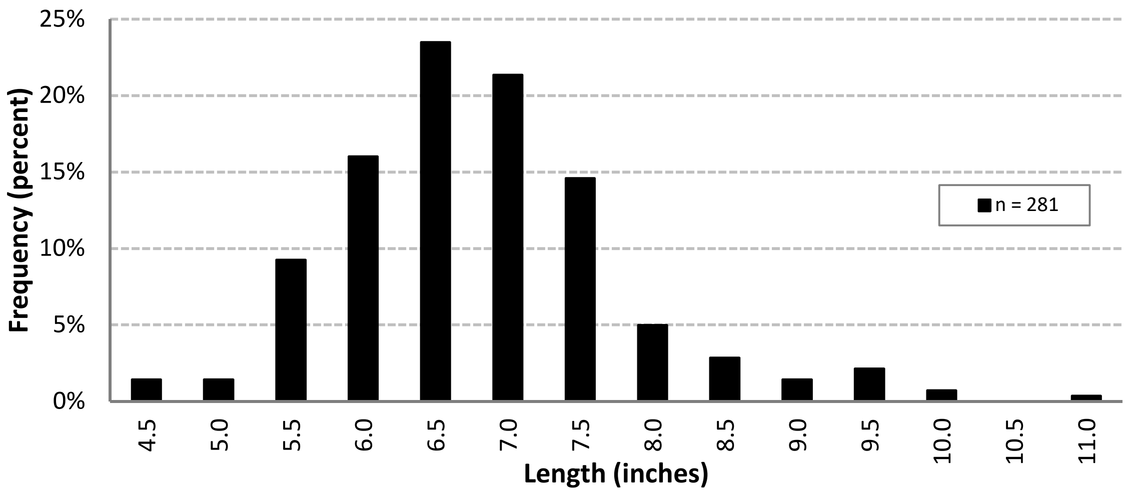

Figure 32. Length frequency distribution of Yellow Perch collected during the 2017 spring netting surveys of Lake Wisconsin, Columbia County, Wisconsin.

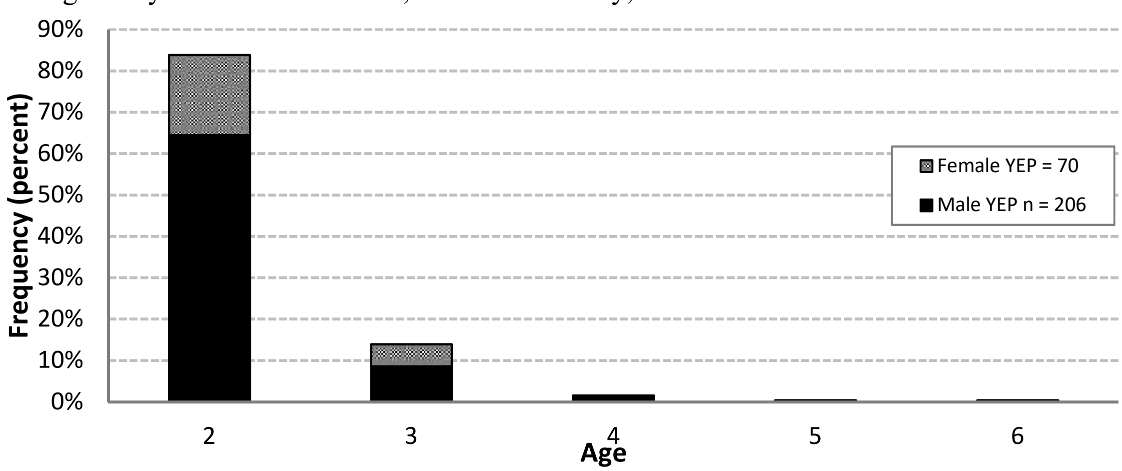

Figure 33. Age frequency distribution of male and female Yellow Perch collected during the spring 2017 netting surveys of Lake Wisconsin, Columbia County, Wisconsin.

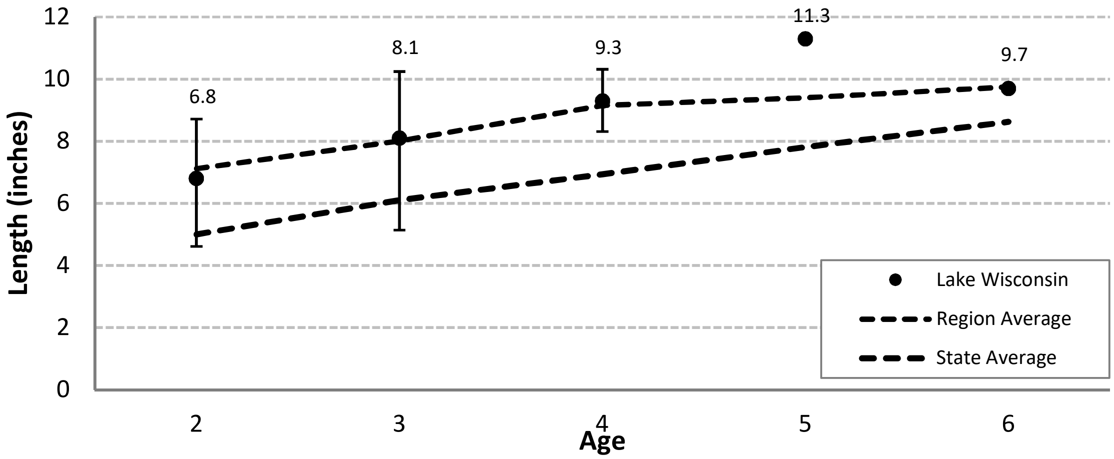

Figure 34. Mean length-at-age of Yellow Perch collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of lengths for a given age.

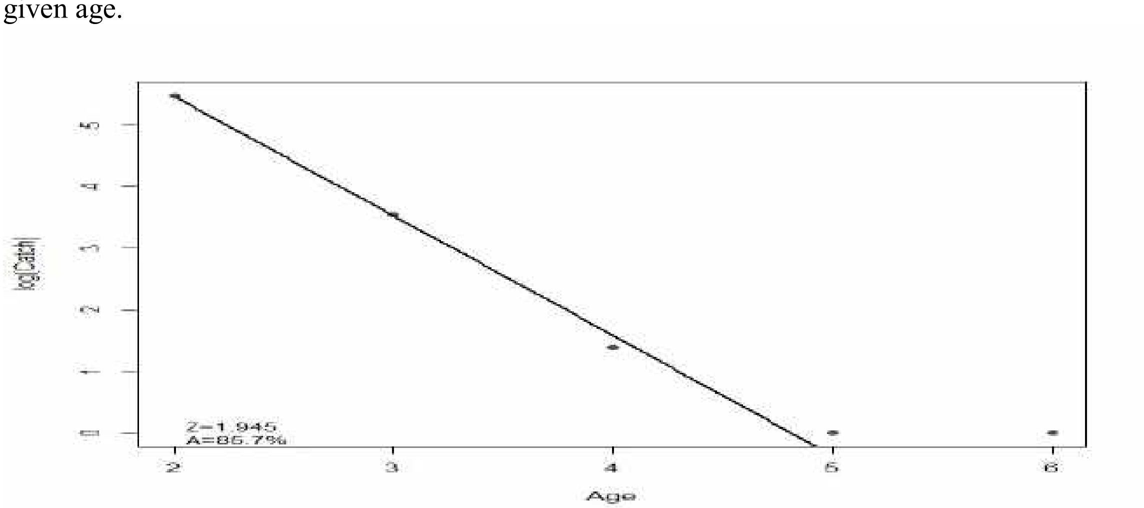

Figure 35. Catch curve for Yellow Perch collected during 2017 spring netting surveys of Lake Wisconsin, Columbia County, Wisconsin.

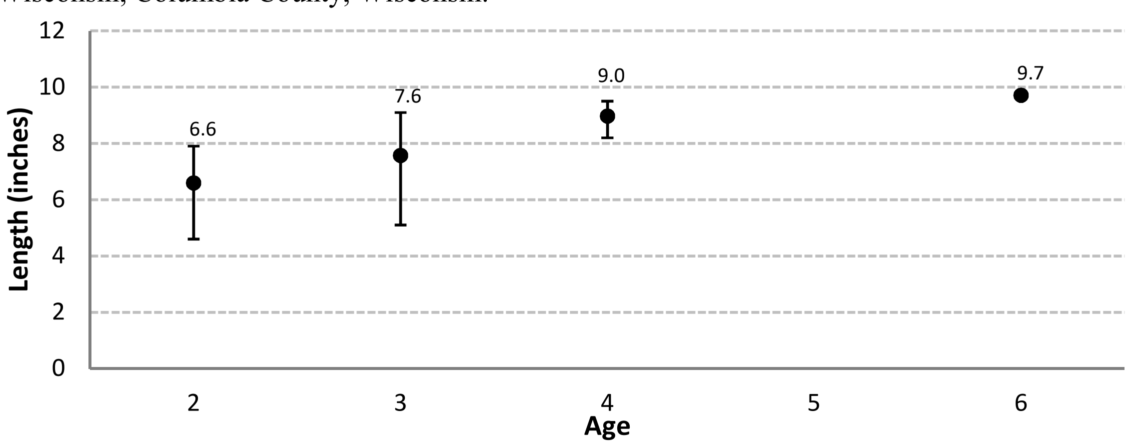

Figure 36. Mean length-at-age of male Yellow Perch collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of lengths for a given age.

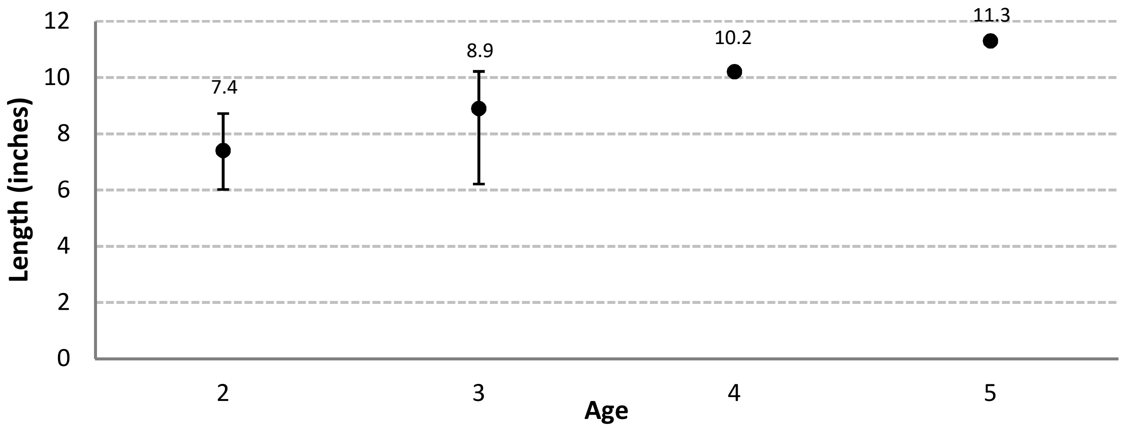

Figure 37. Mean length-at-age of female Yellow Perch collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of lengths for a given age.

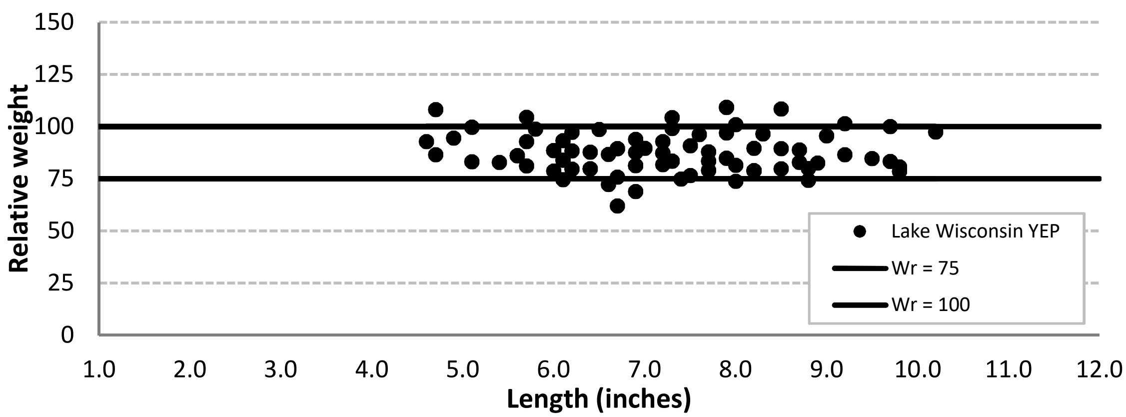

Figure 38. Relative weights of Yellow Perch collected during spring 2017 netting surveys of Lake Wisconsin, Columbia County, Wisconsin.

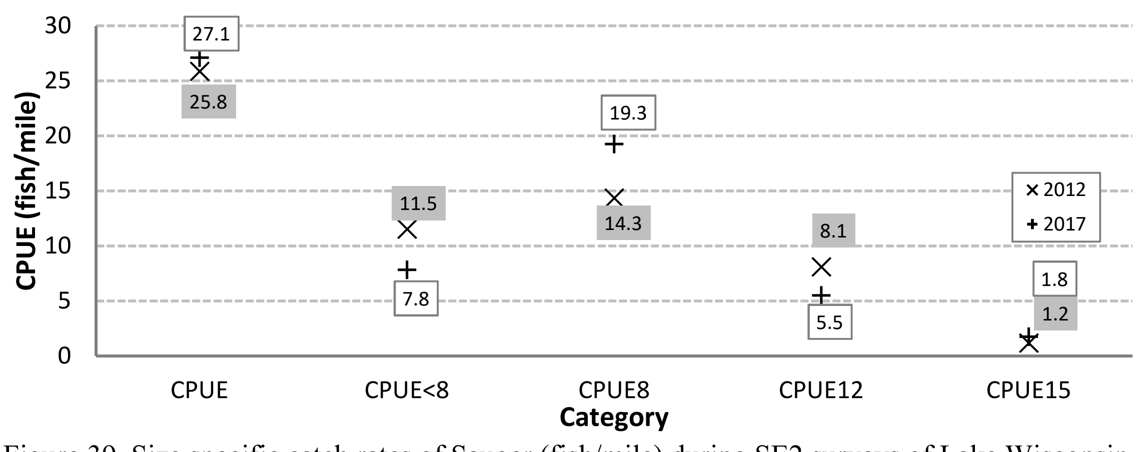

Figure 39. Size specific catch rates of Sauger (fish/mile) during SE2 surveys of Lake Wisconsin in 2012 and 2017. Values from 2012 are presented in gray boxes with no border. Values from 2017 are presented in white boxes with the black border.

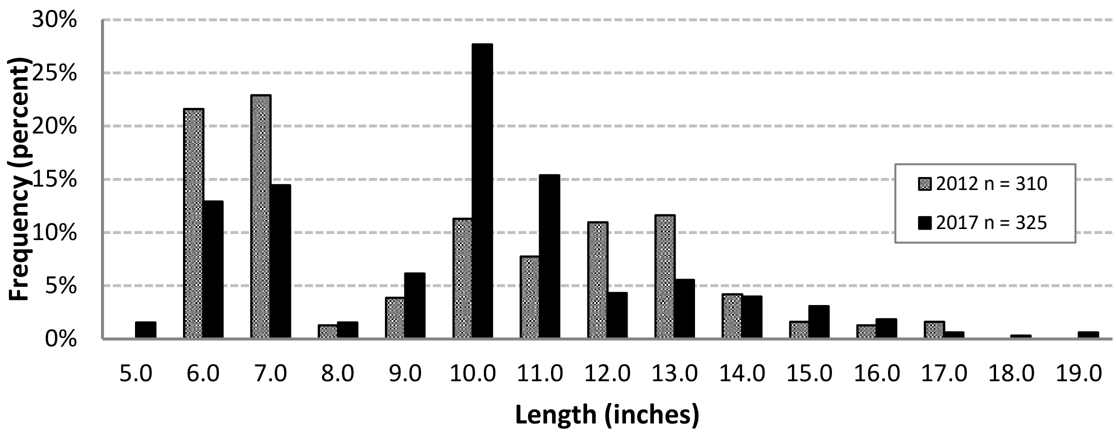

Figure 40. Length frequency distribution of Saugers collected during the 2017 SE2 survey of Lake Wisconsin, Columbia county, Wisconsin. Data collected during SE2 in 2012 are included for comparison.

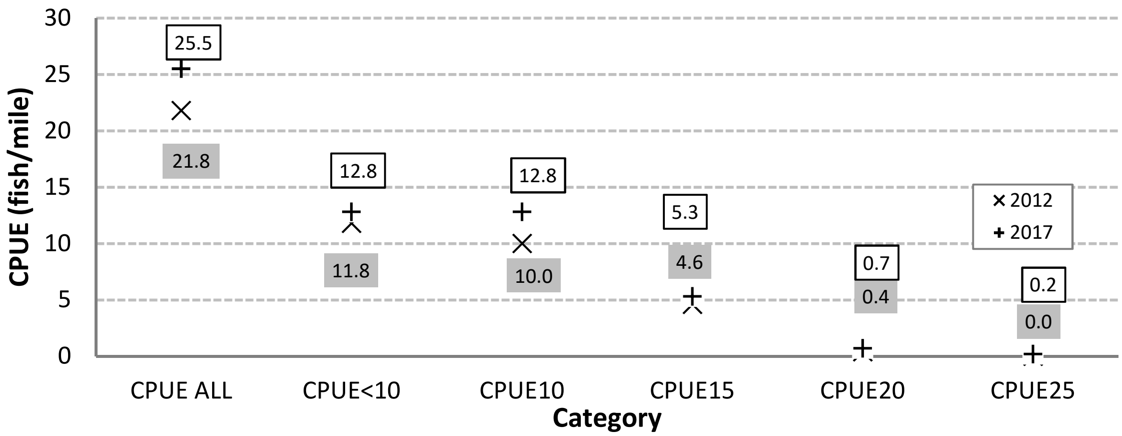

Figure 41. Size specific catch rates of Walleye (fish/mile) during SE2 surveys of Lake Wisconsin in 2012 and 2017. Values from 2012 are presented in gray boxes with no border. Values from 2017 are presented in white boxes with the black border.

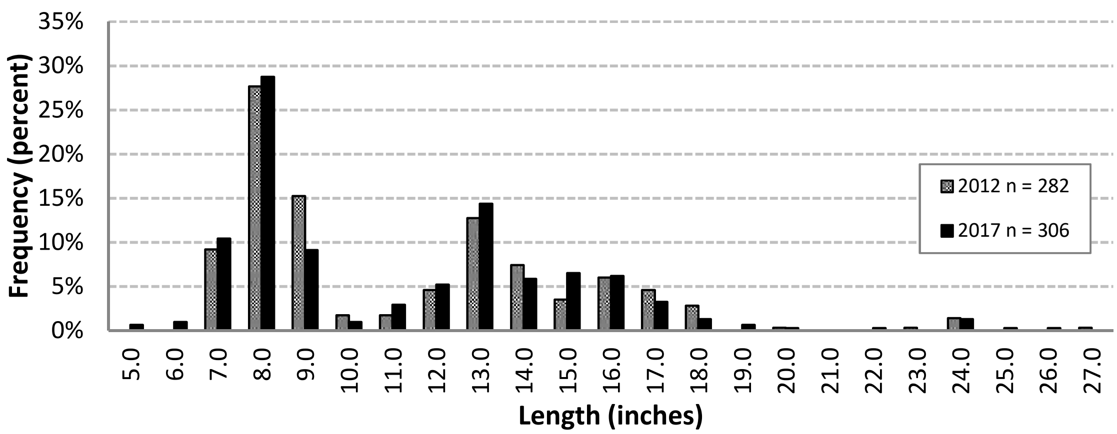

Figure 42. Length frequency distribution of Walleyes collected during the 2017 SE2 survey of Lake Wisconsin, Columbia county, Wisconsin. Data collected during SE2 in 2012 are included for comparison.

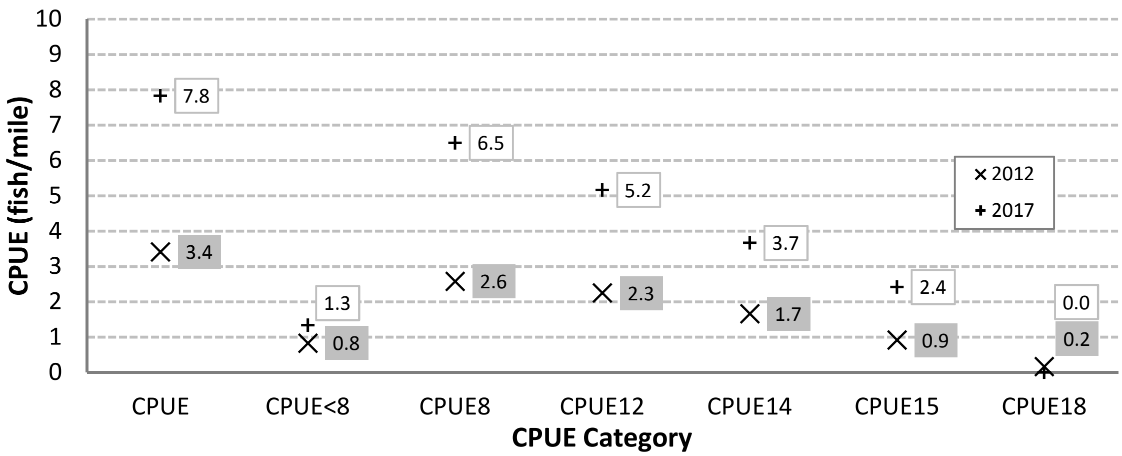

Figure 43. Size-specific catch rates of Largemouth Bass (fish/mile) during SE2 surveys of Lake Wisconsin in 2012 and 2017. Values from 2012 are presented in gray boxes with no border. Values from 2017 are presented in white boxes with the black border.

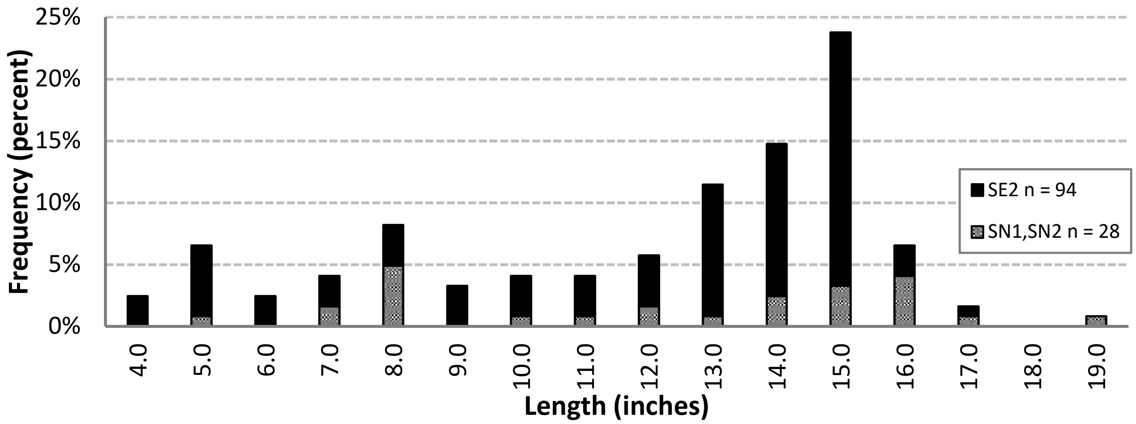

Figure 44. Length frequency distribution of Largemouth Bass collected during the spring 2017 netting and electrofishing surveys of Lake Wisconsin, Columbia county, Wisconsin.

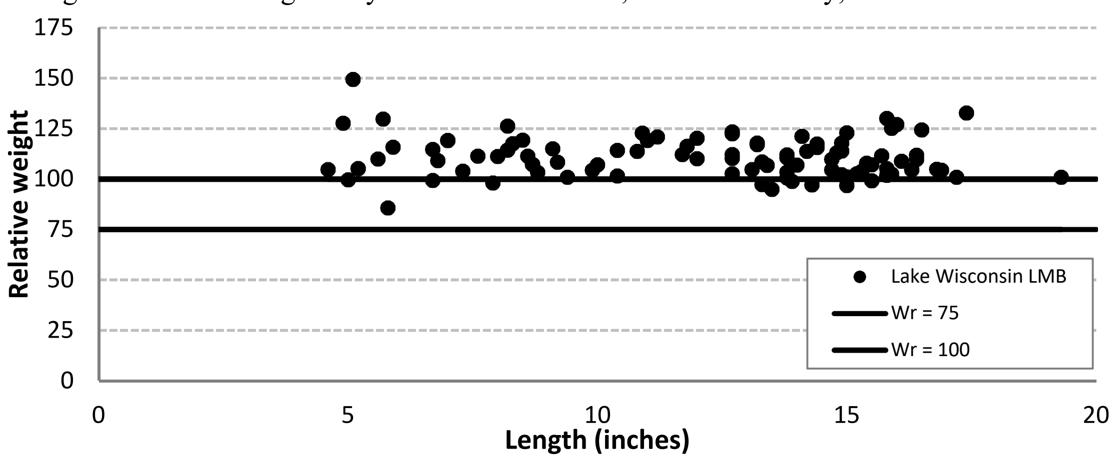

Figure 45. Relative weights of Largemouth Bass collected during the spring 2017 netting and electrofishing surveys of Lake Wisconsin, Columbia County, Wisconsin.

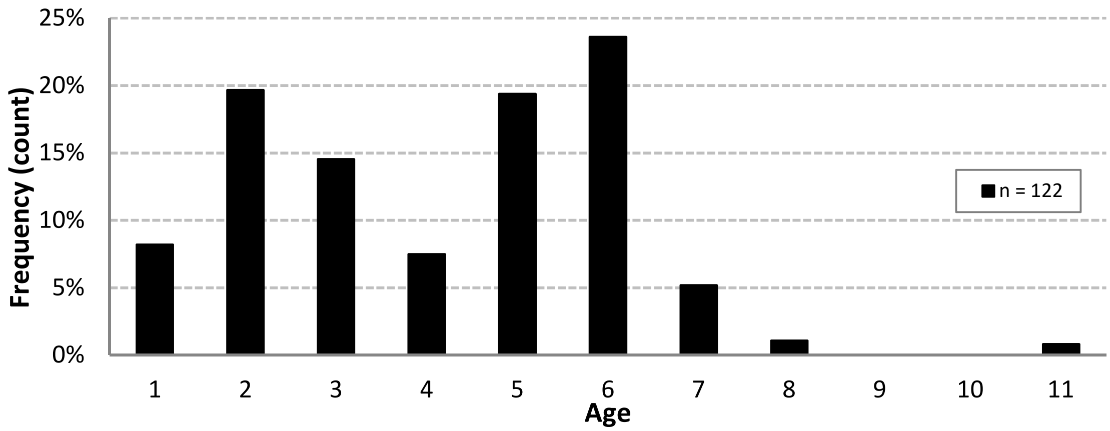

Figure 46. Age frequency distribution of Largemouth Bass collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

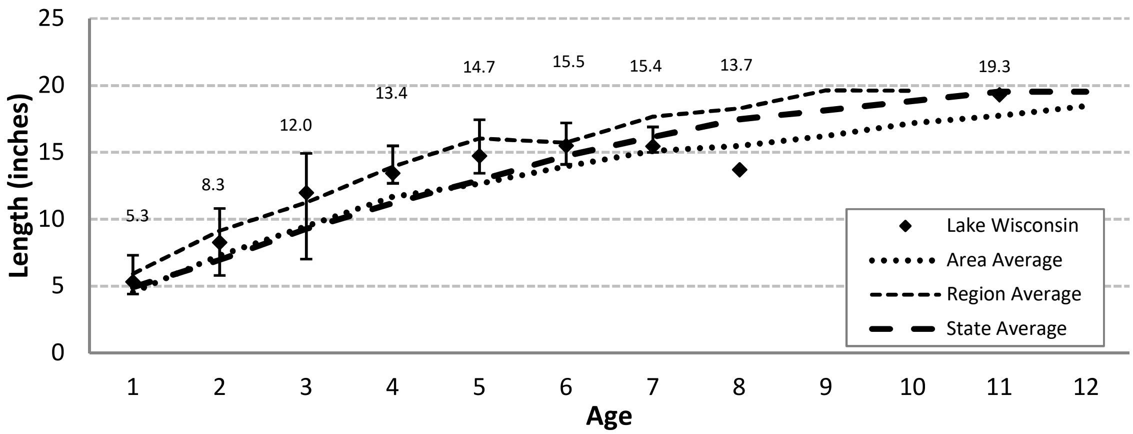

Figure 47. Mean length-at-age of Largemouth Bass collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of observed lengths for a given age.

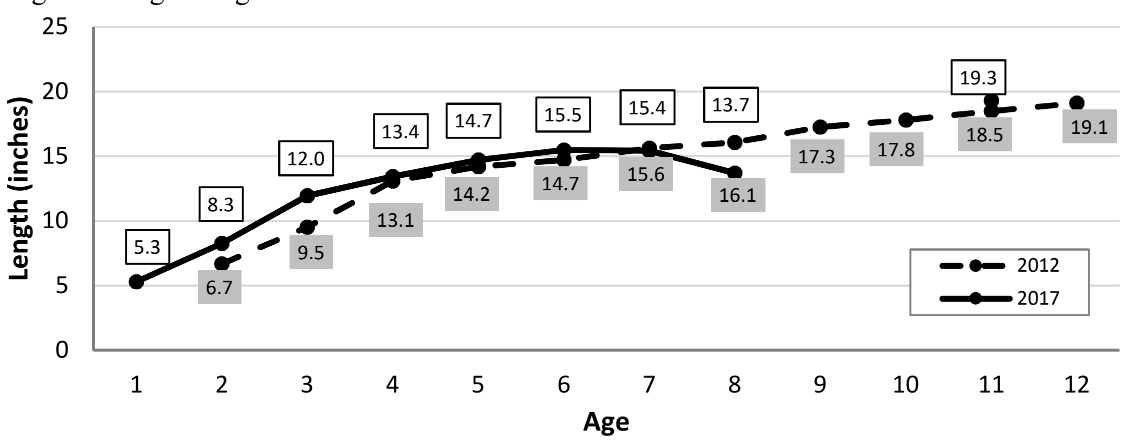

Figure 48. Mean length-at-age of Largemouth Bass in Lake Wisconsin in 2017 vs.2012. The 2012 values are presented in the gray boxes with no border and the 2017 values are presented in the white boxes with the black borders.

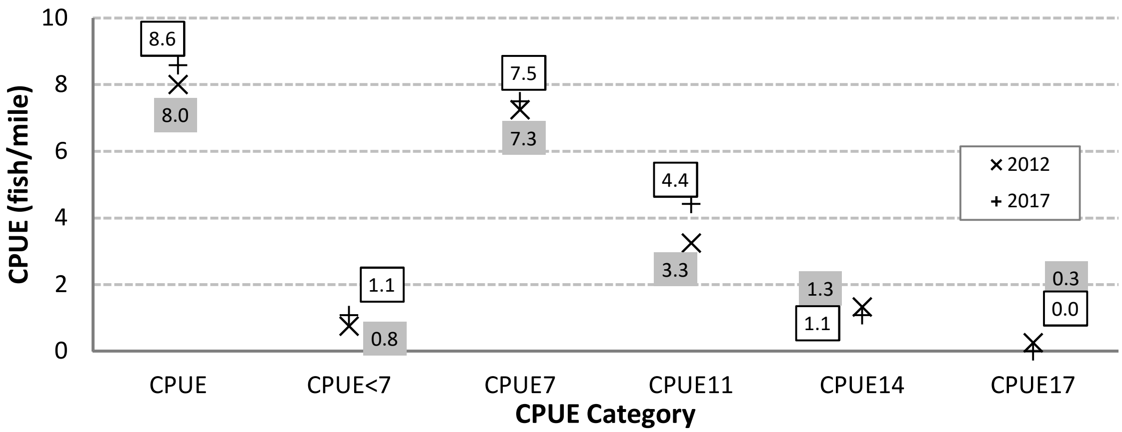

Figure 49. Size-specific catch rates of Smallmouth Bass (fish/mile) during SE2 surveys of Lake Wisconsin in 2012 and 2017. Values from 2012 are presented in gray boxes with no border. Values from 2017 are presented in white boxes with the black border.

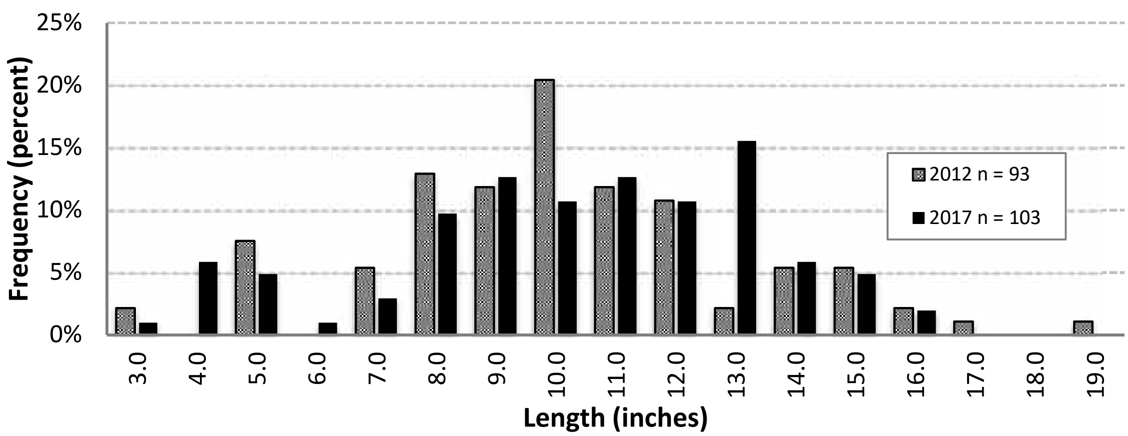

Figure 50. Length frequency distribution of Smallmouth Bass collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia county, Wisconsin. Data collected in 2012 are included for comparison.

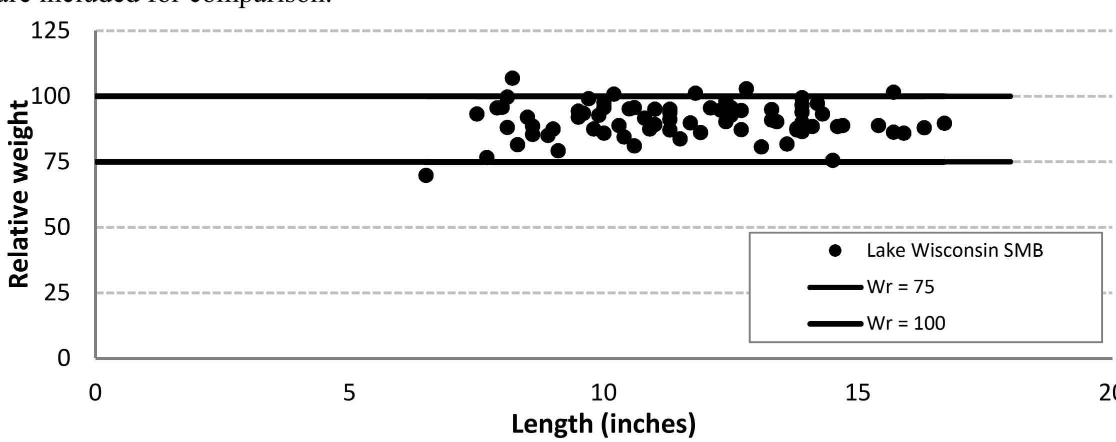

Figure 51. Relative weights of Smallmouth Bass collected during the 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin.

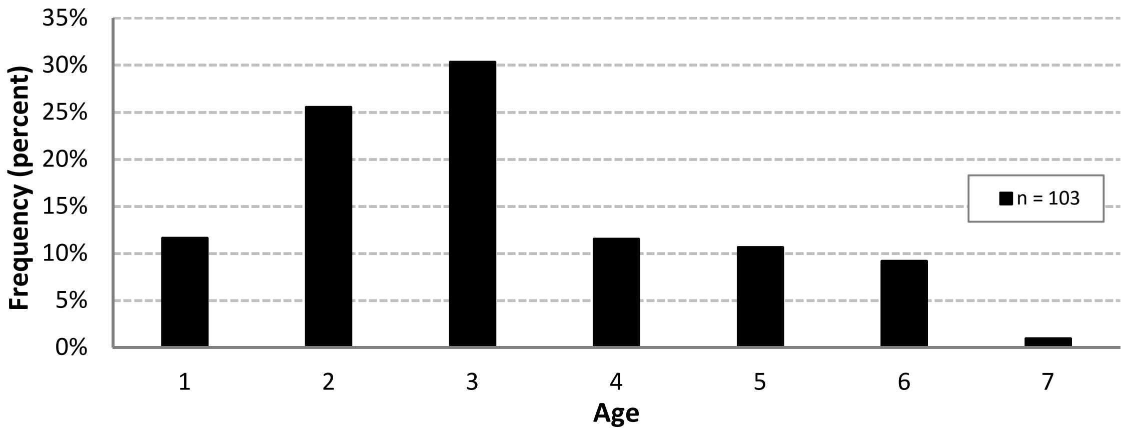

Figure 52. Age frequency distribution of Smallmouth Bass collected during the spring 2017 electrofishing survey (SE2) of Lake Wisconsin, Columbia County, Wisconsin.

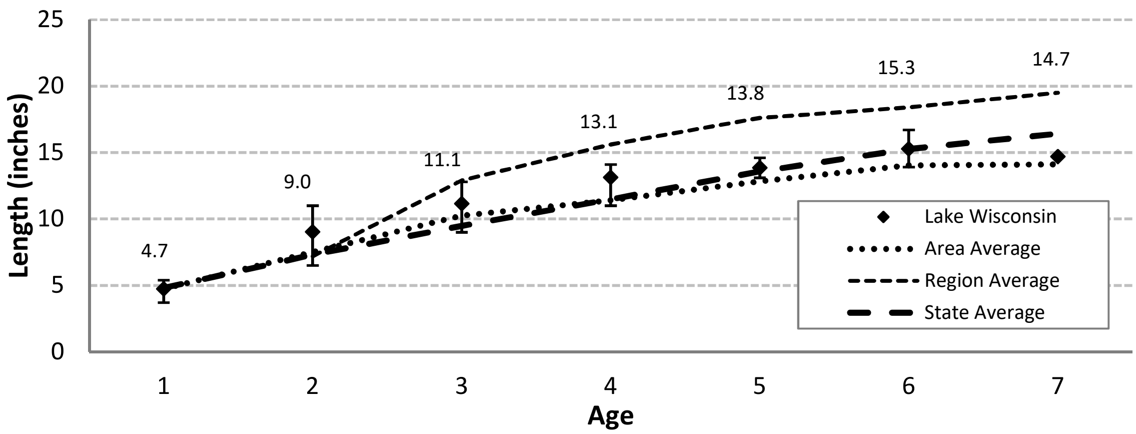

Figure 53. Mean length-at-age of Smallmouth Bass collected during 2017 comprehensive survey of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of observed lengths for a given age.

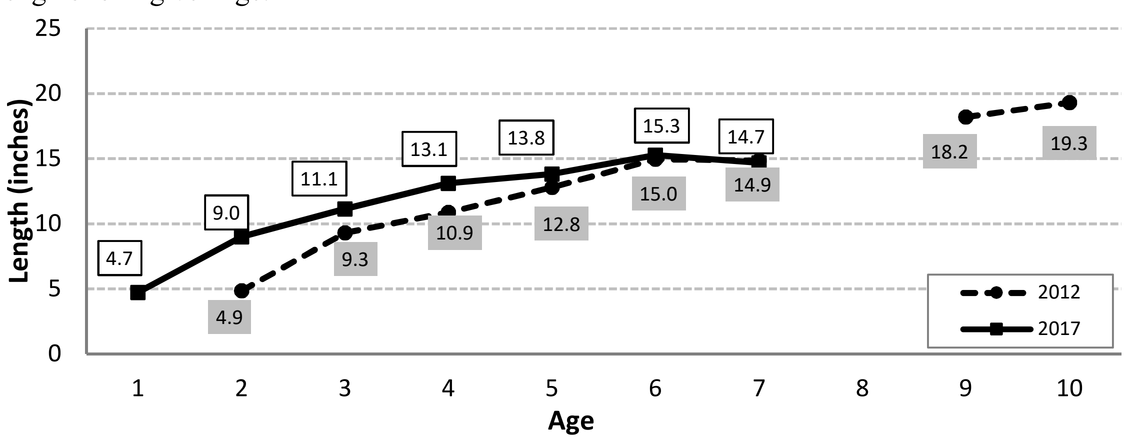

Figure 54. Mean length-at-age of Smallmouth Bass in Lake Wisconsin in 2017 vs. 2012. The 2012 values are presented in the gray boxes with no border and the 2017 values are presented in the white boxes with the black borders.

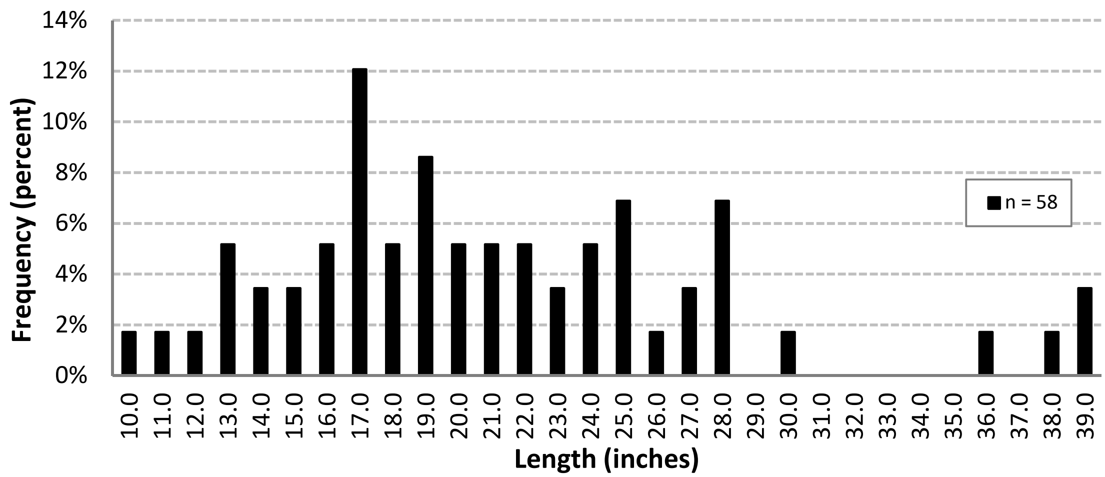

Figure 55. Length frequency distribution of Northern Pike collected during spring 2017 netting and electrofishing surveys (SN1, SN2, SE2) from Lake Wisconsin, Columbia County, Wisconsin.

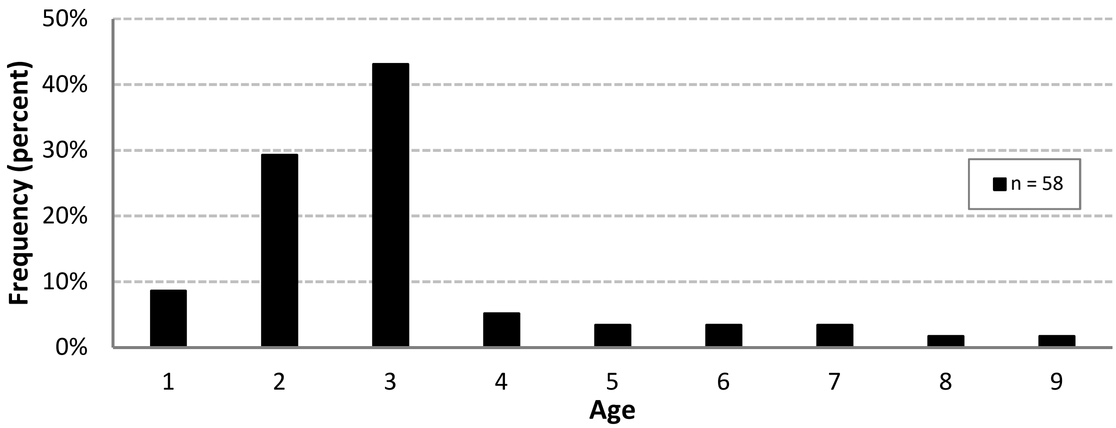

Figure 56. Age frequency distribution of Northern Pike collected during spring 2017 netting and electrofishing surveys (SN1, SN2, SE2) of Lake Wisconsin, Columbia County, Wisconsin.

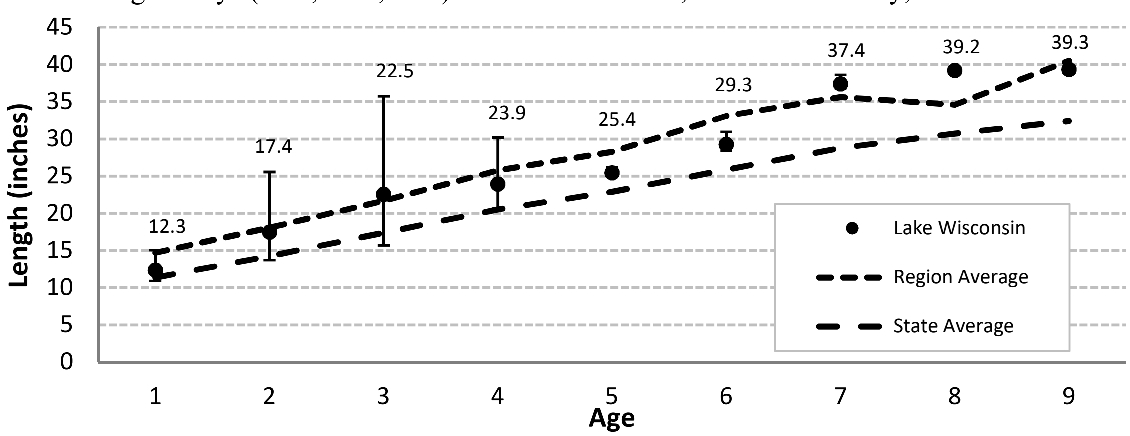

Figure 57. Mean length-at-age of Northern Pike collected during spring 2017 netting and electrofishing surveys (SN1, SN2, SE2) of Lake Wisconsin, Columbia County, Wisconsin. Error bars represent the range of observed lengths for a given age.

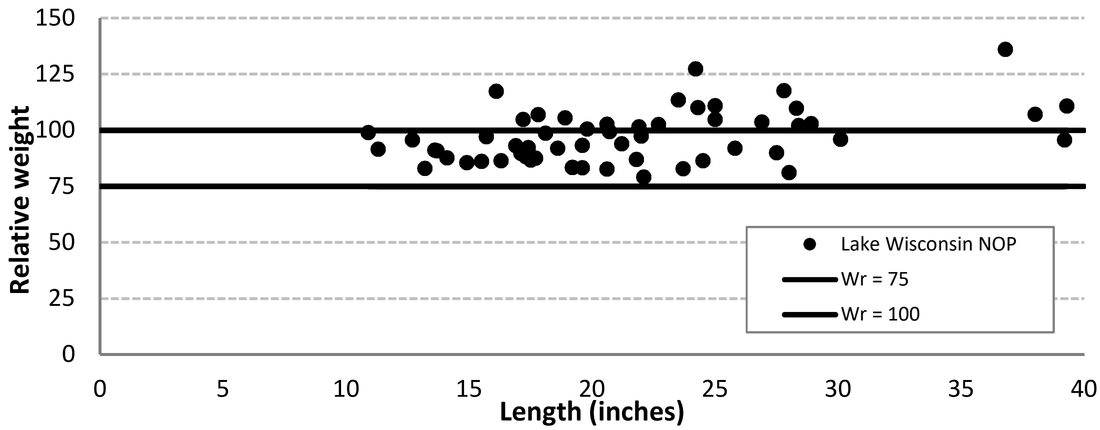

Figure 58. Relative weights of Northern Pike collected during spring 2017 netting and electrofishing surveys (SN1, SN2, SE2) of Lake Wisconsin, Columbia County, Wisconsin.

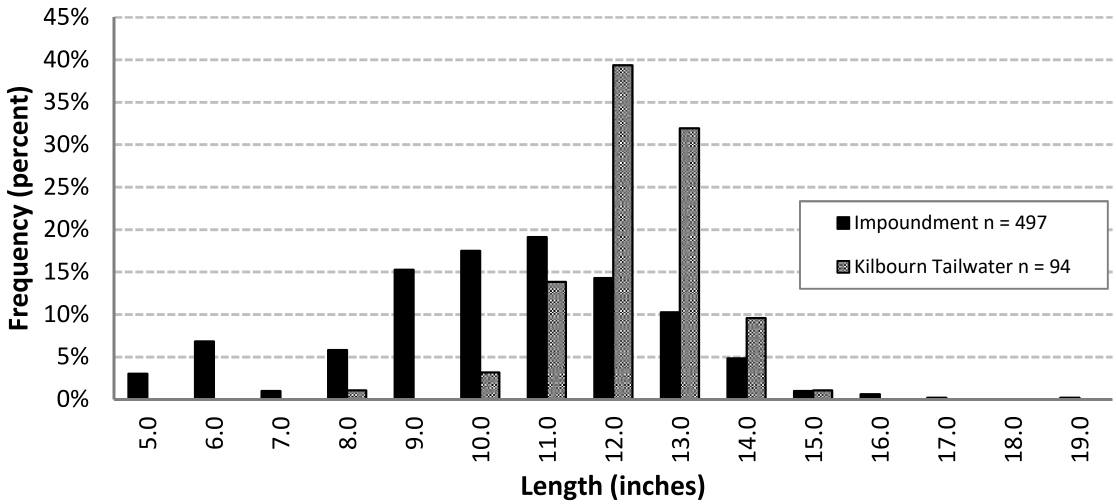

Figure 59. Length frequency distribution of Saugers collected during the fall 2017 electrofishing surveys of Lake Wisconsin and the Wisconsin River near Wisconsin Dells, Wisconsin.

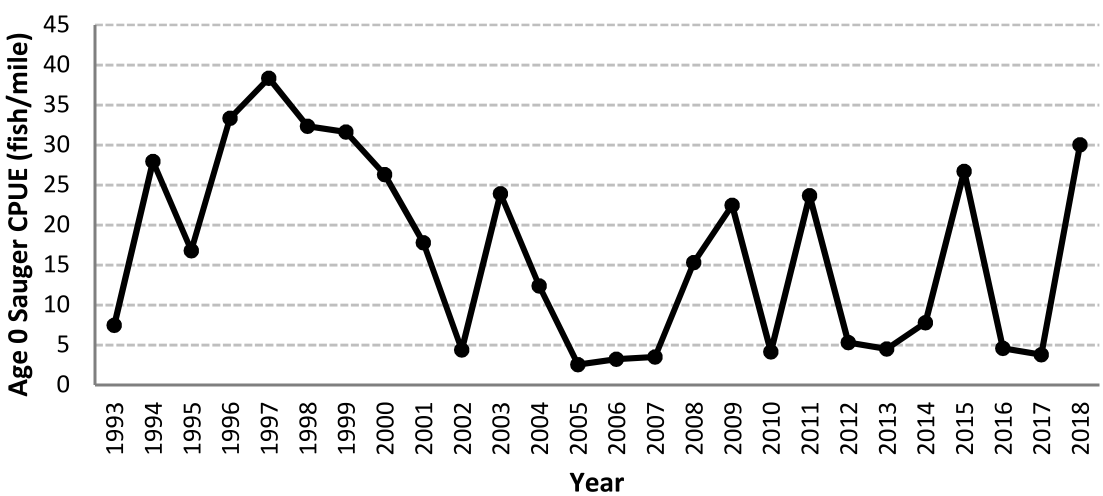

Figure 60. Catch rates of age 0 Sauger from fall electrofishing surveys of Lake Wisconsin (impoundment only), 1993-2018.

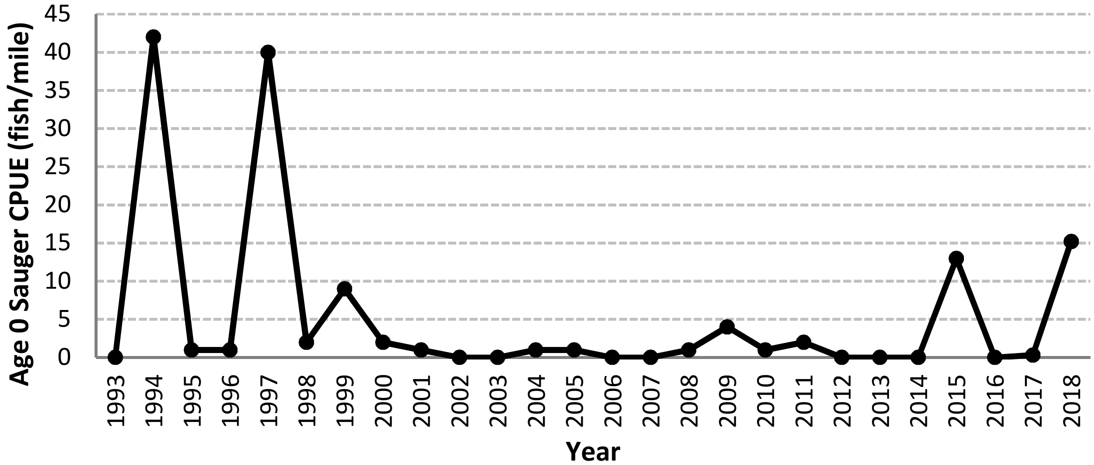

Figure 61. Catch rates of age 0 Sauger from fall electrofishing surveys of the Wisconsin River near Wisconsin Dells, 1993-2018.

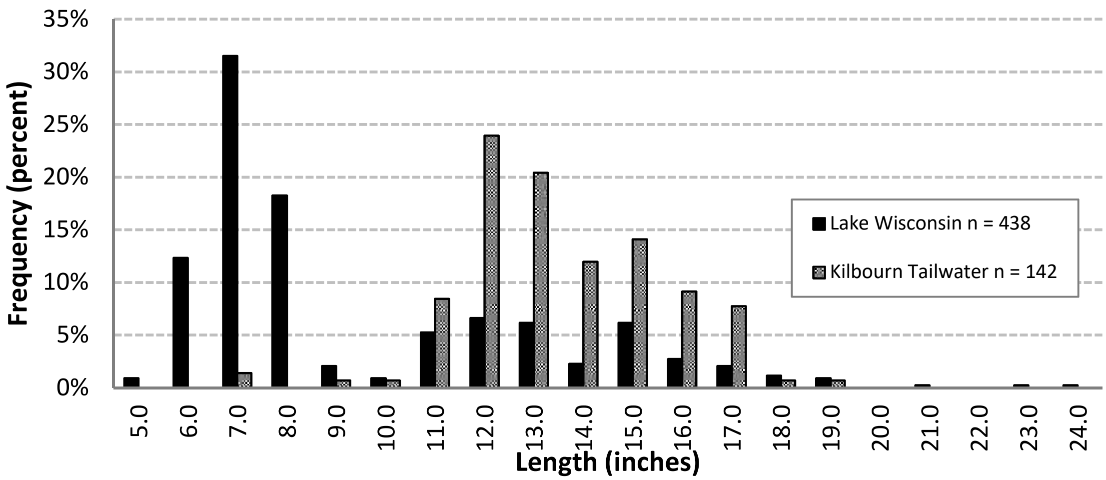

Figure 62. Length frequency distribution of Walleyes collected during the fall 2017 electrofishing surveys of Lake Wisconsin and the Wisconsin River near Wisconsin Dells, Wisconsin.

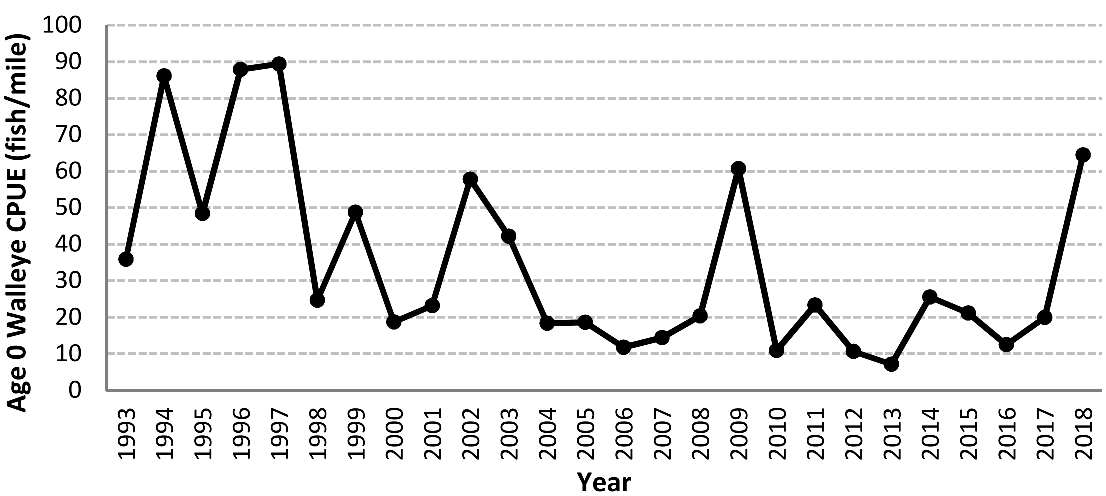

Figure 63. Catch rates of age 0 Walleye from fall electrofishing surveys of Lake Wisconsin (impoundment only), 1993-2018.

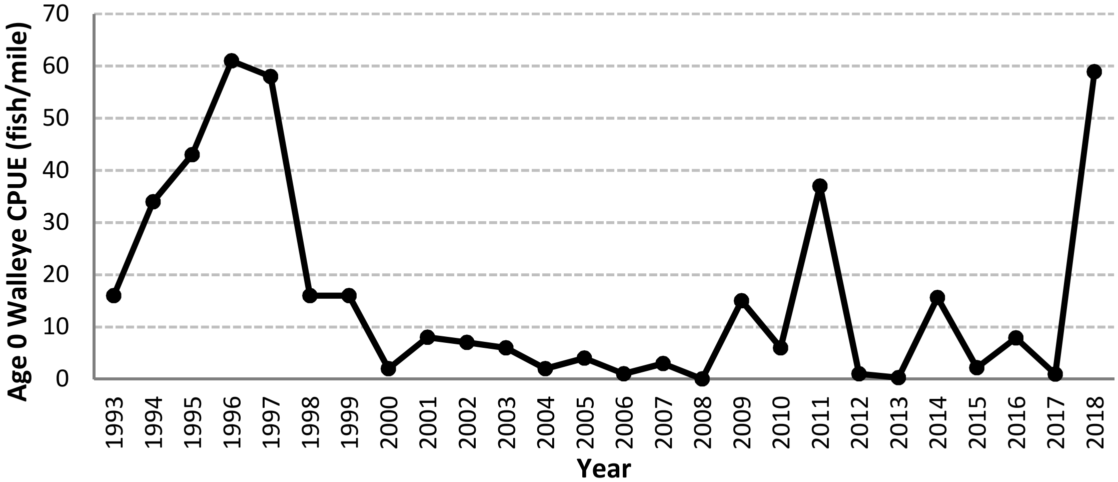

Figure 64. Catch rates of age 0 Walleye from fall electrofishing surveys of the Wisconsin River near Wisconsin Dells, 1993-2018.

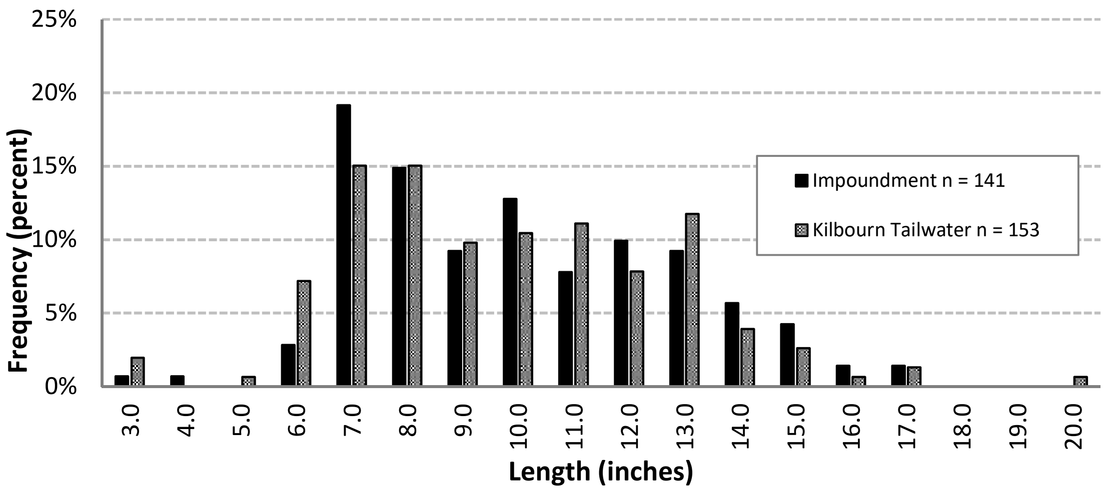

Figure 65. Length frequency distribution of Smallmouth Bass collected during the fall 2017 electrofishing surveys of Lake Wisconsin and the Wisconsin River near Wisconsin Dells, Wisconsin.

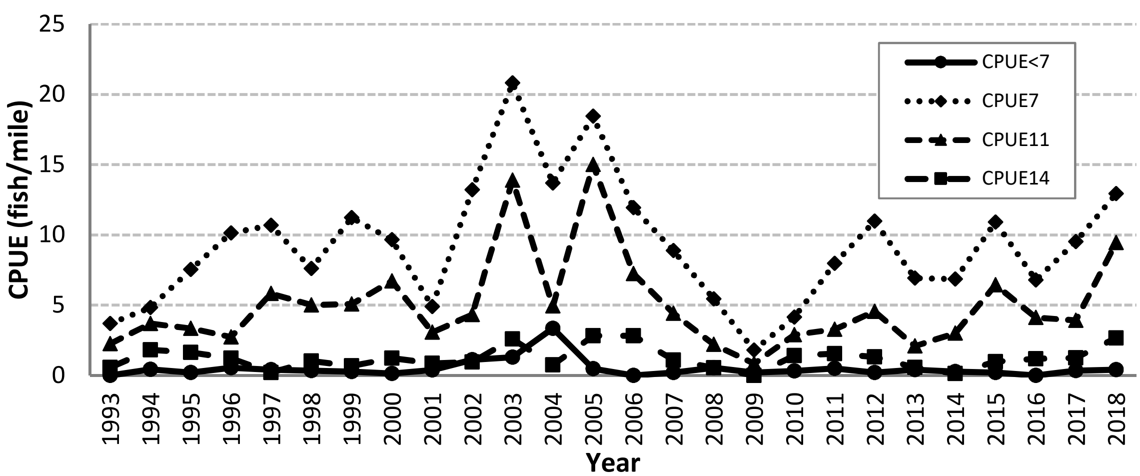

Figure 66. Size-specific catch rates of Smallmouth Bass from fall electrofishing surveys of Lake Wisconsin (impoundment only), 1993-2018.

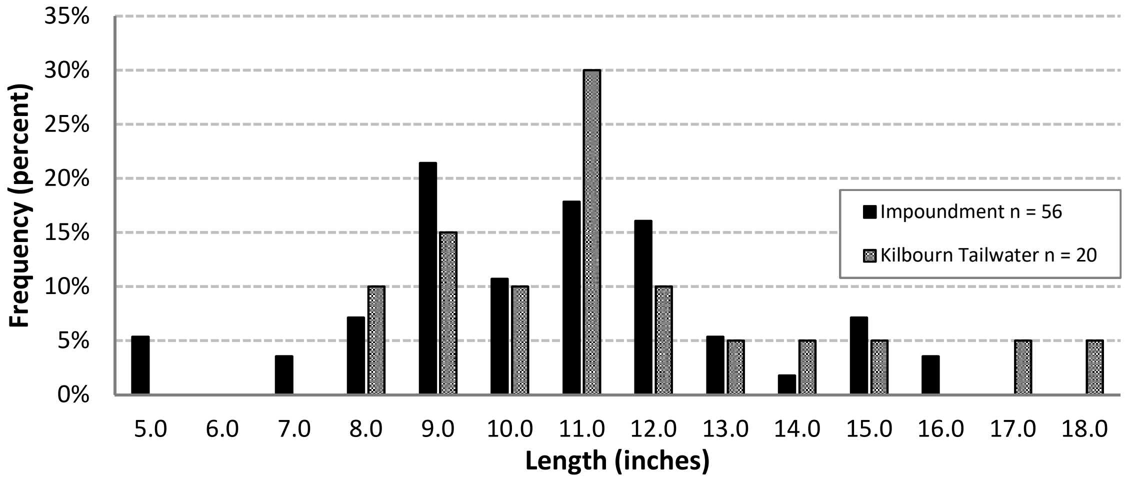

Figure 67. Length frequency distribution of Largemouth Bass collected during the fall 2017 electrofishing surveys of Lake Wisconsin and the Wisconsin River near Wisconsin Dells, Wisconsin.

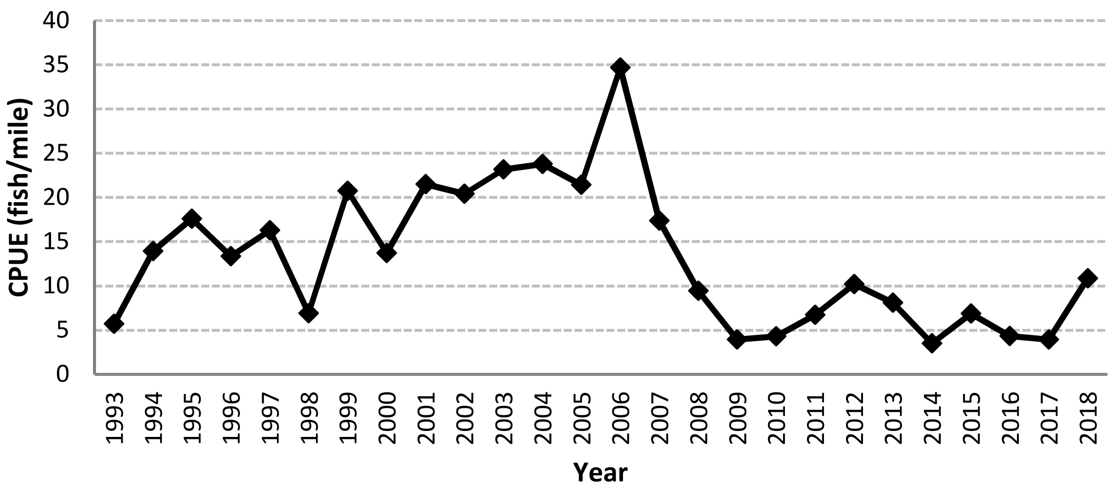

Figure 68. Catch rates of Largemouth Bass from fall electrofishing surveys of Lake Wisconsin (impoundment only), 1993-2018.