Comprehensive Fisheries Survey of Lake Wisconsin
Columbia County, Wisconsin 2012

Waterbody Identification Code: 1260600

Nathan Nye
Fisheries Biologist
Wisconsin Department of Natural Resources
Poynette, Wisconsin

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EXECUTIVE SUMMARY

A comprehensive fisheries survey was conducted on Lake Wisconsin during the spring and fall of 2012. This included a walleye population estimate (PE) conducted on the Wisconsin River below the Kilbourn Dam (Dells Dam), as well as fyke netting in the main part of the lake for northern pike and walleye (SNI), muskellunge (SNII), and late spring electrofishing for bass and panfish (SEII). A fall electrofishing survey which has occurred annually since 1993 was also conducted on the main lake and below the Kilbourn Dam during fall 2012 to assess walleye and sauger recruitment, as well as to sample other gamefish populations in the lake and river. Walleye and sauger are abundant, and provide an excellent fishery. Saugeye are present in low numbers and grow similarly to walleye. 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. The average walleye in Lake Wisconsin is nearly 15 inches long by the end of its third growing season, and is 18 inches by the end of its fourth. By the end of its fifth growing season, the average walleye enters the protected slot at 20 inches. It will take the average walleye around 11 growing seasons (the fall after it reaches 10 years old) to exceed the upper limit of the protected slot which is 28 inches, but it may happen as early as the end of the 9th growing season for fast-growing fish. The PE survey did a good job of capturing the size structure of adult walleyes in Lake Wisconsin. During the PE, 5.4 percent of walleyes sampled were 28 inches or larger. The PE estimated walleye density at 0.9 adults larger than 15 inches per acre, but this value is almost certainly low. This was the first attempt at a walleye PE on Lake Wisconsin, and the size of the lake and connected river, along with an abnormally early warm onset of spring made it difficult to effectively sample and estimate the population size. Lessons learned in 2012 will be employed in the next PE survey scheduled for 2016.

Bluegill, black crappie, and yellow perch are abundant and grow faster than the state average, but slower than the regional average. Bluegill up to 8.0 inches, black crappie up to 14.4 inches, and yellow perch up to 11.7 inches are present in the lake. Largemouth bass are common in areas of good habitat (shallow vegetated bays), but rare outside these areas. Largemouth bass reach the legal harvest size of 14 inches as early as age 4, and average over 14 inches by age 5. Largemouth bass grow faster than the state average through age 6, but slower than the state average after that. Smallmouth bass are abundant in Lake Wisconsin and the Wisconsin River between the lake and the Kilbourn Dam. Smallmouth bass in Lake Wisconsin grow slower than state and regional averages throughout their life. Smallmouth bass reach 14 inches by age 6. The slow growth of bass is likely a function of reduced visibility for these sight-feeding predators during the summer and fall when algal blooms are common.

Naturally reproducing northern pike and stocked muskellunge are present, but were not well represented in the 2012 survey. This is not necessarily a reflection of low population size, rather the survey, particularly fyke netting, did a poor job of capturing them. The size of the system and amount of available habitat, along with unusual weather conditions contributed to this. Additional angling opportunities exist for the white crappie, pumpkinseed, warmouth, green sunfish, freshwater drum, white bass, flathead catfish, yellow bass, and channel catfish in Lake

Wisconsin. A good lake sturgeon population provides a month-long hook and line fishery each September, but harvest from Lake Wisconsin is very low. The lake sturgeon population reproduces naturally, and is supplemented with stocked fish that are derived from parent stock that live in the lake.

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 several coldwater trout streams that enter the lake at various points around its shoreline including Manley 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 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 also 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, 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 ramps 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, minimum lengths, and bag limits can be found in Table 1.

Purpose of Survey
Tier 1 assessment baseline lake survey

Dates of fieldwork
Fyke netting survey conducted March 12 through March 16, 2012 (SNI), and March 28 through April 4, 2012 (SNII). A spring electrofishing survey was conducted on the riverine portion of Lake Wisconsin (from the upper end of the main lake to the Kilbourn Dam) for the purpose of a walleye population estimate from March 12 through March 22, 2012. A spring electrofishing survey in the main lake was conducted May 21 through May 23, 2012 (SEII). Fall electrofishing conducted as part of annual gamefish monitoring and walleye and sauger recruitment assessment was conducted September 24 through September 27, 2012 on the main lake and below the Kilbourn Dam in Wisconsin Dells.

Fishery
Bluegill are abundant in areas of good habitat (shallow vegetated bays). Black crappie, yellow perch, sauger, walleye, and smallmouth bass are also abundant. Largemouth bass, northern pike, muskellunge, channel catfish, flathead catfish and assorted other panfish are present. A healthy population of lake sturgeon is also present in the lake.

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 surrounding watershed, 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. 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 compose most of the 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 spawning 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 pure muskellunge. Muskellunge (all large fingerlings) were stocked several times between 1972 and 2012, including fish raised by the WDNR, its cooperators, and private hatcheries. 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. The stocked sturgeon were produced from gametes collected annually from wild broodstock below the Kilbourn Dam during the spring spawning period. 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. The fish stocking record 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 goal is to remove common carp and other species that are having a detrimental effect on the lake. These removals ideally will have a positive impact on the lake. Rough fish removals are 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 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).

A protected 20 to 28 inch slot limit was put in place on walleye, sauger, and hybrids in the Wisconsin River above the Prairie du Sac Dam beginning with the 2002 fishing season. Fish 15.0-19.9 inches could still be kept, as could one fish per day over 28 inches with a total daily bag limit of 5 fish. This was done in response to anglers who wanted a fishery with larger walleye, but also one that would still allow harvest. Population modeling indicated that increases in the number of walleye larger than 28 inches and sauger larger than 20 inches would be possible under such a regulation. 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 to make the rule permanent.

METHODS

Data collection-Wisconsin River Walleye PE

Past WDNR surveys and anecdotal information from anglers indicated that in early spring, sexually mature walleyes leave the main body of Lake Wisconsin and enter the Wisconsin River to spawn. A walleye population estimate for Lake Wisconsin had not been attempted prior to 2012. Efforts 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 from March 12 through March 16, 2012 to find concentrations of walleye for marking. Specific locations were not recorded but the general sampling area was the Wisconsin River from approximately 1.2 miles downstream of the CTH O/Fox Run boat landing, upstream to the Kilbourn Dam in Wisconsin Dells. Electrofishing was changed from daytime to nighttime from March 18 through March 23 in order to increase catch rates. Walleye, sauger, northern pike, muskellunge, and lake sturgeon were collected, but bass, panfish, and nongame fish were not. Captured walleye and sauger that were 12.0 inches and larger were marked with a Floy FD-94 t-bar anchor tag, while fish smaller than 12.0 inches received a bottom caudal fin clip. Walleye and other gamefish were measured to the nearest 0.1 inch and sex was recorded when evident. Northern pike were weighed to the nearest 0.01 pound. Muskellunge were implanted with passive integrated transponder (PIT) tags. Aging structures were taken from a subsample of walleye for age and growth analysis; scales were removed from walleye 12 inches and larger, and dorsal spines were removed from walleye 15 inches and larger. Aging structures were not taken from sauger. Anal fin rays were removed from all northern pike and muskellunge for aging.

Data collection-Lake Wisconsin, Spring 2012

Following ice-out, 11 standard 3-foot hoop fyke nets with 0.7 inch bar, 1.4 inch stretch mesh were set on March 12, 2012; these fyke nets targeted northern pike and walleye (SNI). Fyke net locations (GPS coordinates) can be found in Table 3. All 11 nets were run on March 13, but only 10 were re-set. Ten nets were lifted and re-set on March 14th, and an additional 8 nets were set. Eighteen total nets were lifted each day on March 15 and March 16, and all 18 nets were pulled on March 16. Ten nets were set again on March 28, marking the beginning of SNII targeting muskellunge. Ten nets were run each day from March 29 through April 2, when 4 of the nets were pulled. Six nets were run on April 3 and two were pulled, with the remaining 4 nets being run and pulled on April 4. Gamefish were measured to the nearest 0.1 inch, and a subsample of each species was weighed to the nearest 0.01 pound. Sex was recorded when evident for northern pike, walleye, yellow perch, and black crappie. Aging structures were taken from a subsample of largemouth bass, northern pike, muskellunge, walleye, yellow perch, black crappie, and smallmouth bass. The goal was to take structures from 5 fish per half-inch group, per species with the exception of muskellunge and northern pike where the goal was 5 structures per half-inch group for each sex. Muskellunge and flathead catfish were implanted with PIT tags. Walleyes that were 12 inches and larger 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 21 through May 23, 2012. A total of six electrofishing stations were chosen at random, equally spaced around the lake. Each station was 2 miles of shoreline in length and within each station, panfish and gamefish were collected during the first 0.5 mile, while gamefish only were collected for the remaining 1.5 miles. Rough fish and other non-game fish were observed and counted while sampling panfish stations, but were not dip netted. All gamefish and panfish were measured to the nearest 0.1 inch. Black Crappie, bluegill, largemouth bass, and smallmouth bass were weighed to the nearest 0.01 pound, and aging structures were taken from a minimum of 5 fish per half-inch group. Starting and ending GPS coordinates for electrofishing stations can be found in Table 4.

<u>Data collection-Lake Wisconsin and Wisconsin River, Fall 2012</u>

A WDNR standard direct current (DC) boomshocker boat was used to sample fish on Lake Wisconsin on the nights of September 24 through 26, 2012, and on the Wisconsin River below the Kilbourn Dam on the night of September 27, 2012. The purpose of the survey was to assess walleye and sauger recruitment in Lake Wisconsin and the Wisconsin River, and also to assess populations of other gamefish. The survey was first conducted in 1984, and has been conducted every year from 1993 through 2012. Established electrofishing stations are repeated each year, including 6 stations on Lake Wisconsin and 2 stations below the Kilbourn Dam; GPS coordinates of the beginning and ending points of each station can be found in Table 5. All gamefish were collected and measured to the nearest 0.1 inch. Walleye and sauger that were 12.0 inches and larger were marked with a Floy FD-94 t-bar anchor tag. Muskellunge and flathead catfish were marked with PIT tags. Aging structures have been collected from walleye and sauger in some years (including 2011), but were not collected in 2012.

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.

For SNI, SNII, and SEII, total catch and catch per unit of effort (CPUE) was calculated by gear type for all species. Data for both gear types was then combined, and length frequency distributions were generated for panfish and gamefish species with 50 or more individuals collected. Length range, mean length, median length, and mode length were calculated for all species. Proportional stock density (PSD), and relative stock density of preferred length fish (RSD-P) were calculated for all panfish and gamefish species with more than 100 individuals collected (Anderson and Neumann 1996). Length designations for stock, quality, preferred, memorable, and trophy sizes of the panfish and gamefish species collected from Lake Wisconsin can be found in Table 6 (Anderson and Neumann 1996). Aging structures were used to estimate ages of a subsample of each species, and age and size data of these fish were used to generate age-length keys to assign ages to the unaged fish in the sample. In the case of walleye, collection of aging structures began during the annual fall electrofishing survey in 2011, and spring 2012 fish were used to fill out length bins for aging. Walleye aged from 2012 had one year subtracted from their age to match what it would have been if they had been sampled and aged in 2011. Growth between October 2011 and early March 2012 was assumed to be zero.

Once age frequency distributions were completed for each species, inferences were made about year class strength and mortality when possible. Length-at-age data were also used to make inferences about growth of fish in Lake Wisconsin by comparing the lake to regional and statewide averages.

A von Bertalanffy growth curve was fitted to walleye length at age data for Lake Wisconsin to provide the predictive relationship of walleye 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. Fishery Analysis and Modeling Simulator software (FAMS 1.0, Slipke and Maceina 2010) was used to estimate the model parameters. The growth curve was then plotted against observed values of mean length at age.

Relative weights were calculated to evaluate body condition of fish. Relative weight (W_r) is a tool biologists use to look at body condition of fish by comparing 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 (Murphy et al. 1991; Anderson and Neumann 1996). Standard weights were only calculated for individuals larger than the minimum recommended length for each species. 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.

Mean walleye 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 improvements in the fishery. Data collected in 2009 was 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.

RESULTS AND DISCUSSION

Wisconsin River/Lake Wisconsin Spring Walleye Population Estimate

Walleye

During the population estimate, 1,673 walleye were collected, including recaptures. Catch per unit effort was 59.5 per hour of electrofishing. Electrofishing distances were not recorded, so calculation of CPUE in terms of fish per mile was not possible. A total of 1,459 walleye 11.9 inches and larger were marked with a Floy tags, and 128 were ultimately recaptured. Several fish were also kept for contaminant analysis. The adult population was estimated at 8,227 walleye 15 inches and larger (95%CI 6865 - 10,273, Schnabel estimate) for a density of 0.9 per acre, based on the 9,000 acre impounded surface area. This density is below average for both a stocked fishery and naturally reproducing fishery, which are 1.7 and 3.3 fish larger than 15 inches per acre, respectively. The density of walleye in Lake Wisconsin was originally thought to be approximately 3 fish per acre, and the goal was to mark around 3,000 fish when the survey began. Ultimately, only about half the number of desired fish were marked. One possible explanation for the low population estimate is that this aggregation of spawning fish sampled, though large, represented only a part of the spawning population of walleye, and other aggregations that were not sampled may be present at other points further downriver closer to the lake, or in tributary streams. Also, catch rates likely would have been higher during the first 5 sampling events had they been conducted at night. Catch rates increased approximately two-fold for 4 consecutive sampling events once the switch was made from daytime to nighttime electrofishing. The walleye catch rate had begun to decline significantly by the last sampling event, and the water temperature had been 51 to 52°F for 3 consecutive nights. The walleye spawn was likely winding down at this point and sampling was discontinued. It was noted that increasing numbers of sauger were present in the catch by the time sampling concluded, consistent with the slightly later timing of sauger spawning relative to walleye (Becker 1983, Bozek et al. 2011).

The walleyes collected ranged from 6.4 to 30.2 inches in length. The average length was 19.1 inches, the median length was 17.4 inches, and the mode was 15.2 inches (Table 7). Proportional stock density (PSD), RSD-P, and RSD-28 values were 81, 44, and 5, respectively. There were two major peaks in the length frequency distribution; one for the 15.0 to 15.4 half-inch group, and the other for the 25.0 to 25.4 inch group (Figure 1). Numbers of fish declined steadily from 15 to

20 inches, then increased slowly but steadily for 20 to 25 inch fish, 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. The walleye age frequency distribution shows a similar trend to the length frequency distribution (Figure 2). There is a high peak in the distribution at age 2 when fish average 14.9 inches, followed by smaller peaks at ages 6 and 8 when walleye average 23.1 and 26.0 inches, respectively (Table 8). Walleye in Lake Wisconsin grow faster than the regional average from ages 1 through 8, the last year of regional average data available (Figure 3). Walleye grow faster than the state average for ages 1 through 12. No age 13 or 14 walleye were collected, and age 15 walleye appear to grow more slowly than the state average, but this value was based on a single male fish.

Walleyes in Lake Wisconsin reach legal harvest size (15 inches) as early as the end of their second growing season (the fall after they turn 1 year old), and reach 20 inches as early as the end of their third growing season (the fall after they turn 2 years old). Walleyes average nearly 15 inches by the end of their third growing season, 18 inches by the end of their fourth growing season, and average over 20 inches by the end of their fifth growing season. Faster growing walleyes begin to exceed the upper limit of the 20 to 28 inch protected slot by the end of their ninth growing season (the fall after they turn 8 years old), and average over 28 inches by the fall after they turn 10 years old. Length at age data for walleye are found in Table 8.

The von Bertalanffy growth equation does an excellent job of describing growth of walleyes in Lake Wisconsin through age 12 (Figure 4). When solving for the model parameters, L_∞ was held constant at 31 inches. This value was chosen by rounding the length of the largest fish in the sample (30.2 inches) up to the next highest inch, and assuming this would be the largest length possible in the system. The decision to do this was made after initially solving for L_∞ yielded a theoretical maximum length of 28.1 inches, which ultimately caused the growth function to underestimate lengths of age 9 and 10 walleye by nearly 2 inches. There were 79 walleye larger than 28 inches sampled during the survey. These large fish are not rare and assuming a larger maximum length was warranted. Walleye older than age 12 were represented by a single age 15 fish, so applicability of the von Bertalanffy growth curve to these older ages is limited for this dataset.

Sauger and Saugeye

Altogether, 291 sauger were sampled including recaptures, the catch rate was 10.4 fish per hour of electrofishing, and 272 were measured. Electrofishing distances were not recorded, so calculation of CPUE in terms of fish per mile was not possible; the catch rate was 10.4 per hour of electrofishing. In total, 233 sauger 12.0 inches and larger were marked with a Floy tag, and 18 were recaptured. A Schnabel population estimate was not calculated because not enough of the population was sampled before sampling was discontinued, and also a sauger population estimate was not the primary goal of this survey. Sauger ranged from 6.6 to 23.1 inches in length and the length frequency distribution is represented in Figure 5. The average length was 13.8 inches, the median length was 13.6 inches, and the mode was 13.2 inches (Table 7). Proportional stock density, RSD-P, and RSD-M values were 89, 22, and 4, respectively. Following the peak in the length frequency distribution for the 13.0 to 13.4 inch group, sauger numbers begin to decline steadily due to natural mortality, before a precipitous decrease in numbers for the 15.0 to 15.4 half-inch group. This decrease coincides with fish that are now vulnerable to harvest and are being removed from the population by anglers. Sauger do not grow as large as walleye, nor are sauger typically as long-lived as walleye (Bozek et al. 2011). Relatively few sauger grow to 20 inches and 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 grow to 28 inches prior to natural mortality.

A total of 20 saugeye were caught during the PE survey, including 1 recapture; the catch rate was 0.7 per hour of electrofishing. The saugeye ranged from 17.2 to 27.9 inches in length, and the average, median, and mode lengths were 24.4, 25.2, and 26.6 inches, respectively (Table 7). Saugeye are present but not common in Lake Wisconsin, and will grow to more than 28 inches in length. The Wisconsin state record saugeye was caught on the Wisconsin River in Columbia County on October 14, 2009.

Northern Pike

A total of 57 northern pike were sampled; the catch rate was 2.0 fish per hour of electrofishing. The northern pike were predominantly captured in Dell Creek below the Lake Delton Dam. Lengths ranged from 16.2 to 34.2 inches and the length frequency distribution is represented in Figure 6. The average length was 25.9 inches, the median length was 26.0 inches, and the mode was 26.9 inches (Table 7). Ages ranged from 2 to 5 years, with age 3 fish being the most common, as represented in Figure 7. Northern pike in the Wisconsin River show faster growth than the regional and state averages for ages 2 and 3, and almost identical growth to the regional average for age 4 (Figure 8). There was only one age 5 fish in the sample; it was a male that was smaller than the regional and state averages. Relative weights for northern pike were generally within the normal range, and averaged 98.0, 91.5, and 93.5 for females, males, and unknown sex fish, respectively (Figure 9).

Muskellunge

A total of 3 muskellunge were sampled; the catch rate was 0.1 fish per hour of electrofishing. One muskellunge was a 36.8 inch male that was aged at 7 years, and a second male measured 37.5 inches and was aged at 8 years. The third muskellunge was 36.8 inches long, sex was unknown, and the fish was not aged.

Lake Wisconsin spring fyke netting and electrofishing

General fish community

A total of 3,860 fish representing 32 different species and 2 hybrids from 11 families were collected or observed during spring fyke netting and electrofishing in 2012. Catch by gear type are shown for each species collected (Table 9).

Bluegill

In total, 1,149 bluegills were collected; the catch rates were 10.2 per net night during fyke netting and 19.3 per mile of shoreline during SEII (Table 9). The SEII catch rate ranked in the 17th percentile statewide. This suggests that bluegills are not very abundant, but in terms of the total number of fish caught during spring netting and electrofishing, bluegill were the most abundant species (Table 9). The bluegills collected during fyke netting (N = 1,091) were not measured, only counted. Each of the 58 bluegills collected during SEII was measured, and aging structures were taken from a subsample of 45 fish. Lengths ranged from 2.5 to 8.0 inches, and the average, median, and mode lengths were 6.1, 6.6, and 7.0 inches, respectively (Table 10, Figure 10). Ages ranged from 2 to 6, with age 3 fish being the most common in the distribution (Figure 11). Bluegill growth in Lake Wisconsin appears to be moderate, as they grow faster than the state average, but not quite as fast as the regional average (Figure 12). Size structure in this small sample tends toward larger fish with the 6.5 and 7.0 half-inch groups having more fish than the other groups. Bluegills reach an average length of 5.3 inches by age 3, 6.9 inches by age 4, and 7.2 inches by age 5. Bluegills larger than 3 inches were generally in excellent condition; the average relative weight was 129.7 (Figure 13).

Deep inferences into bluegill size structure on Lake Wisconsin should be avoided, however, due to the small sample size of measured fish relative to the total number of bluegills collected. This prevented meaningful calculations of PSD and RSD. Measuring more fish and collecting more aging structures during spring fyke netting when large numbers of bluegills were captured would have allowed for a more thorough evaluation of bluegill growth, size structure, and age structure. This could also have led to a sampling bias toward larger fish. A better solution for future surveys would be to sample targeted bass/panfish stations during spring electrofishing II in areas of good habitat (shallow vegetated bays) in addition to randomly chosen stations (which may encompass less suitable panfish habitat) to ensure that sufficient bluegill size and age data is collected. Another solution for future surveys would be to conduct late spring fyke netting (SNIII) for panfish in late May if SEII does not yield enough bluegills.

Black Crappie

In total, 763 black crappies were collected; the catch rates were 6.9 per net night during fyke netting and 8.7 per mile of shoreline during SEII (Table 9). The SEII catch rate ranked in the 52nd percentile statewide. Black crappies were the second most abundant sport fish species by total number during spring netting and electrofishing (Table 9). Ninety-five crappies were measured, and lengths ranged from 3.9 to 14.7 inches. The average, median, and mode lengths were 9.4, 9.4, and 9.6 inches, respectively (Table 10). The length frequency distribution for black crappie shows a bulk of the fish in the 8.5, 9.0, and 9.5 half-inch groups (Figure 14). Very few small fish and moderate numbers of large fish were present in the sample. Fewer than 100 individuals were measured, preventing meaningful calculations of PSD and RSD values. Very few weights were taken relative to the number of black crappie measured; relative weights were not calculated.

Ages ranged from 1 to 8 years; ages 3 through 5 were the most adequately represented in the distribution, with age 3 fish being the most common (Figure 15). Fish younger and older than this segment of the population are represented by few individuals per age group, and thus have limited value for state and regional growth comparisons. Age 2 and older black crappie grew faster than the state average, and age 3 and older crappie grew at or near regional averages as well. Black crappies in Lake Wisconsin reach an average length of 8.9 inches by age 3, 10.0 inches by age 4, and 10.6 inches by age 5 (Figure 16). After age 3, black crappie have reached an acceptable size to be harvested by anglers, and numbers decline steadily through age 8, the oldest in the distribution. Future surveys should allow for more black crappie data collection during spring fyke netting (SNI and SNII) to generate a more representative sample of age and growth data. This would include measuring, weighing, and taking aging structures from more fish, as opposed to simply counting and releasing them.

Yellow Perch

A total of 727 yellow perch were collected; catch rates were 6.7 per net night during fyke netting and 2.9 per mile of shoreline during SEII (Table 9). The SEII catch rate ranked in the 19th percentile statewide. Yellow perch were the third most abundant sport fish by number during spring netting and electrofishing (Table 9). Lengths ranged from 3.6 to 11.7 inches, and the average, median, and mode lengths were 7.1, 6.6, and 6.1 inches, respectively (Table 10, Figure 17). Of the yellow perch greater than 5 inches in length (stock size), fish 8 inches and larger were present (PSD = 25), and fish 10 inches and larger were rare (RSD-P = 4). Very few weights were taken relative to the number of yellow perch measured; relative weights were not calculated.

Age 1 fish were not present in the sample, and this is most likely due to them not being vulnerable to the sampling gear. Nearly all of the yellow perch collected were caught in fyke nets, and age 1 perch are too small to be contained by the fyke net mesh used in the survey. Age 2 and 3 fish were the most common ages present in the catch, with numbers of fish age 4 and older declining to almost zero (Figure 18). Growth was modest, with fish reaching an average length of 6.2 inches by age 2, which is faster growth than the state average but slower growth than the regional average. Yellow perch were slightly larger than the state and regional averages by age 3, averaging 8.3 inches (Figure 19). Growth of age 4 and older fish appears to be generally faster than state and regional averages, but these values represent only one or two individuals per age group, and thus have limited value for state and regional comparisons. Mortality after age 3 is high, and may be due to these fish reaching acceptable size to be kept by anglers; by age 4 these fish are around 10 inches in length.

Walleye

A total of 284 walleye were collected from the main body of the lake; catch rates were 0.2 per net night during fyke netting and 22.0 per mile of shoreline sampled during SEII (Table 9). The SEII catch rate of fish 10 inches and larger (CPE10) was 10.3 per mile, ranking in the 59th percentile for Wisconsin lakes 190.5 acres and larger. Walleye were the fifth most abundant sport fish by number during spring netting and electrofishing (Table 9). Lengths ranged from 7.2 to 27.3 inches, and the average length was 11.6 inches (Table 10). The median and mode lengths were 9.3 and 8.6 inches, respectively (Table 10). The length frequency distribution for walleyes sampled in the main body of the lake is represented in Figure 20. The PSD and RSD-P values calculated from SEII were 41 and 5, respectively (Table 10). Age 1 fish (≤10 inches) appear to be well represented in the distribution of fish sampled from the main part of the lake, while large fish are poorly represented. Large mature fish are better represented in the sample collected during the walleye PE on the Wisconsin River below the Kilbourn Dam.

Sauger and Saugeye

A total of 310 sauger were collected; catch rates were 0.1 per net night during fyke netting and 25.2 per mile of shoreline sampled during SEII (Table 9). Sauger were the fourth most abundant sport fish species by number during spring netting and electrofishing (Table 9). Lengths ranged from 6.0 to 17.6 inches, and the average length was 9.9 inches (Table 10). The median and mode lengths were 10.0 and 6.8 inches, respectively (Table 10). The length frequency distribution for sauger sampled during SNI, SNII, and SEII is represented in Figure 21. As was the case for walleye, large mature fish were better represented in the sample collected during the walleye PE on the Wisconsin River below the Kilbourn Dam. A single saugeye was collected during spring fyke netting; it measured 11.7 inches.

Largemouth Bass

A total of 59 largemouth bass were collected; overall catch rates were 0.2 per net night during fyke netting and 3.4 per mile of shoreline sampled during SEII (Table 9). The catch rate of fish 8 inches and larger (stock size) during SEII was 2.6 per mile of shoreline sampled, and this ranked in the 1st percentile in a comparison of four Wisconsin drainage basins. This indicates that based on SEII CPUE, largemouth bass densities in Lake Wisconsin compare poorly with other drainage basins in the state. The overall low largemouth bass densities could be partly a reflection of the quality of largemouth bass habitat that was sampled. Reported densities would have been higher if better habitat were sampled, specifically shallow protected bays with ample aquatic vegetation instead of rockier, deeper, less protected areas with little to no aquatic vegetation. Electrofishing stations in this survey were chosen at random. The largemouth bass population of Lake Wisconsin could be better represented in future surveys if targeted bass/panfish stations were sampled in addition to the randomly chosen stations.

Largemouth bass lengths ranged from 5.2 to 19.1 inches, and the average, median, and mode lengths were 12.9 inches, 14.0, and 14.0 inches, respectively (Table 10). The length frequency distribution is represented in Figure 22. Too few largemouth bass were collected to provide meaningful PSD and RSD values. A total of 53% (N = 31) of the largemouth bass sampled were larger than the 14 inch minimum size limit. Largemouth bass larger than 6 inches were generally in excellent condition; the average relative weight was 113.9 (Figure 23).

Altogether, 56 largemouth bass were included in the age analysis. Age 4 fish were the most common age in the sample, with numbers declining steadily thereafter through age 12, the oldest fish in the distribution (Figure 24). Largemouth bass growth in Lake Wisconsin is moderate; bass generally grow faster than the state average but slower than the regional average through age 6. Largemouth bass begin to reach legal harvest size (14 inches) as early as age 4, and by age 5 they average 14.2 inches, while age 6 fish average 14.7 inches, and all fish age 7 and older exceeded 14 inches. Growth of age 7 and older fish appears to be slower than the state and regional averages (Figure 25). This may simply be an artifact of very few fish present in each age group in this analysis. If the trend of relatively slow growth of older fish compared to other waters truly exists, it would not be due to a lack of forage. Young gizzard shad, freshwater drum, white bass, and other forage fishes were present in good numbers. Small centrarchids, and particularly bluegills, also are certainly present in areas of good habitat. Foraging success of largemouth bass may be limited, especially during summer and fall, by dense algal blooms which reduce visibility for sight feeding predators.

Smallmouth Bass

A total of 96 smallmouth bass were collected; overall catch rates were less than 0.1 per net night during fyke netting and 7.8 per mile of shoreline sampled during SEII (Table 9). The catch rate of fish 7 inches and larger (stock size) during SEII was 7.3 per mile of shoreline sampled, and this ranked in the 80th percentile statewide. Smallmouth bass abundance in Lake Wisconsin compares much more favorably on a statewide basis than does largemouth bass abundance, and this is likely a function of the amount of good smallmouth bass habitat available in Lake Wisconsin and the Wisconsin River upstream to the Kilbourn Dam.

Lengths ranged from 3.7 to 19.3 inches, the average length was 10.9 inches, and the median and mode lengths were 10.5 and 10.1 inches, respectively (Table 10). The length frequency distribution is represented in Figure 26. Smallmouth bass larger than 6 inches were generally in good condition; the average relative weight was 99.9 (Figure 27).

A total of 81 smallmouth bass were included in the age analysis. Age 3 fish were the most common age in the sample, with numbers generally declining steadily thereafter through age 10, the oldest fish in the distribution (Figure 28). One exception was an apparent gap in the distribution at age 5; few age 5 individuals were present relative to ages 4 and 6. This could be indicative of a poor year class of smallmouth bass produced in 2007. Smallmouth bass growth in Lake Wisconsin is relatively slow compared to statewide and regional averages (Figure 29). Smallmouth bass begin to reach legal harvest size (14 inches) at age 6. Smallmouth bass averaged 10.9 inches at age 4, 13.9 inches at age 6, and 14.9 inches by age 7. Inferences on growth of age 7 and older fish are relatively weak, with 3 or less individuals per age group represented in the sample. Based on growth of ages 2 through 6, however, it does appear that the trend of slower growth of smallmouth bass in Lake Wisconsin relative to regional and statewide averages is plausible. As for largemouth bass, poor smallmouth bass growth should not be due to a lack of forage. Rather, it is a case of foraging success being limited in the main lake, especially during summer and fall, by dense algal blooms which reduce visibility for sight feeding predators.

Northern Pike

A total of 26 northern pike were collected; catch rates were 0.2 per net night during fyke netting and 0.1 per mile of shoreline during SEII (Table 9). Lengths ranged from 11.4 to 39.2 inches, the average length was 23.7 inches, and the median length was 21.8 inches (Table 10). A total of 35% (N = 9) of the northern pike sampled were larger than the 26 inch minimum size limit. Relative weights for northern pike were generally good to excellent, and were 118.2, 97.8, and 99.4 for females, males, and unknown sex fish, respectively (Figure 30).

One possible explanation of why few northern pike were collected in the main body of Lake Wisconsin is that fyke net locations did not match up with actual northern pike spawning sites. The pike may have left the main body of the lake to spawn, running up the Wisconsin River into the Baraboo River, or one of the other tributary streams that drain into the lake such as Duck Creek, Rocky Run Creek (Davies Slough), or Rowan Creek that feeds into the lake at Whalen's Grade. Northern Pike are not stocked into Lake Wisconsin, and the population is supported entirely through natural reproduction.

Muskellunge

A total of 11 muskellunge were collected; catch rates were 0.1 per net night during fyke netting and 0.2 per mile during SEII (Table 9). Lengths ranged from 11.4 to 42.5 inches, and the average length was 30.1 inches (Table 10). A total of 18% (N = 2) of the musky sampled were larger than the 40 inch minimum size limit. Musky ranged in age from 3 to 8 years. Very few individuals were captured and resultant data from which inferences about the population can be made is insufficient based on this survey. One possible explanation of why few musky were collected is that fyke net locations did not match up with actual musky spawning sites. Musky may have left the main body of the lake to spawn, running up the Wisconsin River into the Baraboo River, or one of the other tributary streams that drain into the lake such as Duck Creek or Rocky Run Creek (Davies Slough).

Other panfish and gamefish species

White crappies were present in low numbers up to 10.3 inches in length. Age 2 white crappie averaged 8.3 inches and age 3 fish averaged 8.4 inches based on a sample of 15 aged fish, most of which were age 2. Pumpkinseed, warmouth, green sunfish, freshwater drum, white bass, flathead catfish, yellow bass, and channel catfish were also present in Lake Wisconsin and offer additional opportunities for anglers. Catch per unit effort data for these species can be found in Table 9 while descriptive statistics for lengths of these species (excluding white bass) can be found in Table 10.

Rough Fish

A total of 31 common carp were collected or observed; the catch rate was less than 0.1 per net night during fyke netting and 8.7 observed per mile of shoreline during SEII (Table 9). No common carp were measured. A total of 131 gizzard shad were observed during SEII; the catch (observation) rate was 43.7 fish per mile, and none were measured (Table 9). Gizzard shad provide valuable forage in Lake Wisconsin, and are not nearly at the nuisance level that they are at in other lakes in Columbia County such as Park Lake. Other rough fish species included quillback carpsucker, spotted sucker, smallmouth buffalo, golden redhorse, shorthead redhorse, and white sucker. For a complete listing of fish species collected and observed in this survey, please refer to Table 9.

Lake Wisconsin and Kilbourn Dam Fall Recruitment and Gamefish Electrofishing

Walleye

A total of 411 walleyes were collected from the main body of the lake and the electrofishing catch rate was 28.8 fish per mile (Table 11). Because no aging structures were taken, the length frequency distribution (Figure 31) was examined for a natural break in lengths that would represent the break between YOY and age 1 fish. The break was placed at 10.5 inches, and all fish less than 10.5 inches were considered to be YOY. The electrofishing catch rate for YOY walleye in the main body of the lake was 10.6 per mile of shoreline sampled, and this was rounded to 11 fish per mile for long term trend analysis. Young of the year walleye averaged 8.1 inches in length in 2012 compared to 7.6 inches in 2011 (WDNR unreported data). Compared to previous years (1984, 1993 through 2011; Figure 32), walleye recruitment was relatively low in 2012 based on the YOY catch rate. The running average YOY catch rate for the entire time series of the fall survey (1993-2012, excludes 1984) is 39 fish per mile, and this number was inflated by a few very strong years of recruitment in the mid-late 1990s with YOY catch rates at or near 100 per mile. The 3-year average is 14 fish per mile, and two of the worst years for recruitment occurred in 2010 and 2012. It must be noted that water clarity was very poor during the fall 2012 survey due to an algal bloom and this may have impacted YOY catch rates due to stunned fish not being visible for fisheries personnel to dip-net.

Overall, walleye lengths ranged from 5.3 to 25.5 inches, and the average length was 12.6 inches (Table 12). The median and mode lengths were 13.1 and 13.8 inches, respectively (Table 12). Large fish are poorly represented, as was the case during SEII. Large mature fish are better represented in the sample collected during the walleye PE (spawning period) on the Wisconsin River below the Kilbourn Dam.

Fall catch rates of 4 length categories of walleye sampled from the main body of Lake Wisconsin before and after the enactment of the 20 to 28 inch protected slot limit in 2002 were compared to assess improvements in the fishery (Table 13, Figure 33). The mean catch rate of walleyes less than 10 inches in length has improved from 9.1 prior to 2002, to 16.8 per mile since 2002. This improvement, though notable, is not statistically significant ($P = 0.08$). There was a significant decline ($P = 0.02$) in the mean catch rate of walleyes measuring 10.0 to 14.9 inches, from 27.6 per mile prior to 2002, to 12.1 per mile since 2002. The high catch rate of this length group prior to 2002 was heavily influenced by the years 1996 through 1998 when the catch rates were 41.5, 56.9, and 35.5 per mile, respectively. The catch rates recorded from 1999 through 2001 were much more in line with what was observed from 2002 through 2012. There was a modest increase in the mean catch rate of 15.0-19.9 inch walleye, from 4.4 per mile prior to 2002, to 5.7 per mile since 2002. There was a significant increase ($P < 0.01$) in the mean catch rate of walleye 20.0 inches and larger from 0.5 per mile prior to 2002, to 1.4 per mile since 2002. Seven of the 10 years sampled from 2002 through 2012 (excluding 2009) saw the catch rate exceed one per mile, with a high of 2.4 per mile in 2005.

A total of 57 walleye were collected below the Kilbourn Dam and the electrofishing catch rate was 18.1 fish per mile (Table 11). A total of 3 YOY walleye were collected for a catch rate of 1.0 per mile. Walleye lengths ranged from 9.3 to 24.5 inches, the average length was 13.9 inches, and the median and mode lengths were both 13.4 inches (Table 14, Figure 34). Numbers of YOY walleye at the Kilbourn Dam tailwater have been variable over the time series of the survey, and generally less than 10 fish per mile since 1999 with the exception of 2009 and 2011 when the catch rates were 15 and 37 YOY walleye per mile, respectively (Figure 35).

Sauger and Saugeye

A total of 463 saugers were collected from the main body of the lake and the electrofishing catch rate was 32.4 fish per mile (Table 11). As for walleye, aging structures were not taken and the length frequency distribution (Figure 36) was examined for a natural break in lengths that would represent the break between YOY and age 1 fish. The break was placed at 9.0 inches, and all fish less than 9.0 inches were considered to be YOY. The electrofishing catch rate for YOY sauger in the main body of the lake was 5.3 per mile, and this was rounded to 5 fish per mile for long term trend analysis. Young of the year sauger averaged 7.1 inches in length in 2012 compared to 6.3 inches in 2011 (WDNR unreported data). Compared to previous years (1984, 1993-2011; Figure 32), sauger recruitment was relatively low in 2012, as was the case for walleye. Overall, lengths ranged from 5.6 to 17.8 inches, and the average length was 11.3 inches (Table 12). The median and mode lengths were 11.3 and 10.8 inches, respectively (Table 12). Large fish were poorly represented in the fall sample, as was the case during spring electrofishing II. Large mature fish are better represented in the sample collected during the walleye PE (spawning period) on the Wisconsin River below the Kilbourn Dam. Four saugeye were collected; the catch rate was 0.3 fish per mile (Table 11). The saugeye ranged from 15.0 to 22.7 inches in length and averaged 18.4 inches (Table 12).

A total of 78 sauger were collected below the Kilbourn Dam and the electrofishing catch rate was 24.8 fish per mile (Table 11). A total of zero (0) YOY sauger were collected at the Kilbourn Dam sampling sites. Sauger lengths ranged from 11.1 to 16.3 inches, the average length was 12.8 inches, and the median and mode lengths were 12.1 and 11.7 inches, respectively (Table 14, Figure 37). Numbers of YOY sauger at the Kilbourn Dam tailwater have been less variable than walleye and generally less than 10 per mile, with the exception of 1994 and 1997 when the catch rates were 42 and 40 YOY sauger per mile, respectively. No saugeye were collected from the Kilbourn Dam sampling sites.

Low recruitment of walleye and sauger in 2012 relative to previous years is not surprising because of the extremely early, warm start to the spring compared to other years, and possible corresponding disruptions to walleye and sauger spawning. Similar decreases in recruitment were noted below the Prairie du Sac Dam in 2012 relative to other years (Lyons 2012). Size of YOY walleye and sauger, however, was larger in 2012 relative to 2011 for Lake Wisconsin, and this is likely a function of reduced competition for resources along with warmer water temperatures throughout the spring, summer, and fall of 2012.

Smallmouth Bass

A total of 160 smallmouth bass were collected from the 6 sampling stations in the main body of Lake Wisconsin, and the electrofishing catch rate was 22.2 fish per mile (Table 11). The catch rate of fish 7 inches and larger (stock size) during fall electrofishing was 11.0 per mile of shoreline sampled, and this ranked in the 87th percentile statewide. Lengths ranged from 4.5 to 19.8 inches, the average length was 10.8 inches, and the median and mode lengths were 10.5 and 12.2 inches, respectively (Table 12, Figure 38). Of the smallmouth bass greater than 7 inches in length (stock size), fish 11 inches and larger were present in moderate numbers (PSD = 41), and fish 14 inches and larger were somewhat less abundant (RSD-P = 12). Fish 17 inches and larger were also present (RSD-M = 6).

A total of 274 smallmouth bass were collected from the 2 sampling stations located immediately below the Kilbourn Dam, and the electrofishing catch rate was 87.0 fish per mile (Table 11). The catch rate of fish 7 inches and larger (stock size) during fall electrofishing was 79.0 per mile of shoreline sampled. Smallmouth bass lengths ranged from 4.1 to 18.4 inches, the average length was 9.1 inches, and the median and mode lengths were 8.5 and 8.3 inches, respectively (Table 14). Of the smallmouth bass greater than 7 inches in length (stock size), fish 11 inches and larger were present in low numbers compared to the main body of the lake (PSD = 20), and fish 14 inches and larger were also less abundant (RSD-P = 2). Smallmouth bass were abundant below the Kilbourn Dam, but were predominantly small to medium sized fish 7 to 12 inches in length (Figure 39). Most of these fish were captured in shallow rocky areas of shoreline upstream of Dell Creek. This area appears to be vital nursery water for younger smallmouth bass. Gizzard shad and other forage were abundant in these areas, which were being heavily utilized by smallmouth bass, as well as largemouth bass, northern pike, and channel catfish on the night the sampling occurred.

Largemouth Bass

A total of 148 largemouth bass were collected from the 6 sampling stations in the main body of Lake Wisconsin, and the electrofishing catch rate was 10.2 fish per mile (Table 11). The catch rate of fish 8 inches and larger (stock size) during fall electrofishing was 9.0 per mile of shoreline sampled which was noticeably higher than during SEII, and ranked in the 19th percentile statewide. The higher catch rates of largemouth bass in the fall relative to spring was a function of more suitable largemouth bass habitat sampled in the fall gamefish survey stations, which were different from the randomly chosen spring electrofishing stations.

Largemouth bass lengths ranged from 5.5 to 18.8 inches, the average length was 11.1 inches, and the median and mode lengths were 10.4 and 10.0 inches, respectively (Table 12, Figure 40). Of the largemouth bass greater than 8 inches in length (stock size), fish 12 inches and larger were present in moderate numbers (PSD = 37), and fish 15 inches and larger were somewhat less abundant (RSD-P = 16). Largemouth bass PSD calculated from the fall survey fell slightly below the range of 40 to 70 recommended for a balanced population, although the RSD-P did fall within the acceptable range of 10 to 40 (Gabelhouse 1984, Willis et al. 1993).

A total of 32 largemouth bass were collected from the 2 sampling stations located immediately below the Kilbourn Dam, and the electrofishing catch rate was 10.2 fish per mile (Table 11). Largemouth bass lengths ranged from 5.3 to 15.8 inches, the average length was 9.7 inches, and the median and mode lengths were both 9.9 inches (Table 14). Quality largemouth bass habitat is lacking in the Wisconsin River immediately below the Kilbourn Dam, so the low number of largemouth bass and general lack of large individuals sampled there is not a surprise.

Other Gamefish and Non-Gamefish

Channel catfish, flathead catfish, muskellunge, northern pike, and tiger muskellunge were collected in low numbers relative to walleye, sauger, smallmouth bass, and largemouth bass during the fall electrofishing survey; CPUE and size data for these species are summarized in Tables 11, 12, and 14. Observations and counts of several rough fish species were made during sampling at the 6 sites on the main body of Lake Wisconsin, and this data is summarized in Table 11. Species counted (but not dip netted) included common carp, freshwater drum, quillback carpsucker, and smallmouth buffalo.

Angler Returns of Tagged Walleye and Sauger

Overall in 2012, WDNR Fish Management tagged a total of 1,801 walleyes and 430 saugers between the Prairie du Sac Dam and the Kilbourn Dam. These fish were tagged during the spring walleye PE, spring netting and electrofishing on the main part of Lake Wisconsin, and the fall electrofishing survey. Of these, 81 tagged walleyes and 8 tagged saugers were reported caught by anglers. This equates to a tag return rate of 4.5% for walleye and 1.9% for sauger. For walleyes, size at capture and harvest status was known for 75 of the recaptured fish, and 54 of these were legal harvest size; 15.0-19.9 inches (N = 49), and >28 inches (N = 4). Overall, 63% (N = 34 out of 54) of the harvestable walleyes were kept, 37% (N = 19 out of 54) were released, and one fish was found dead along the shore. Sixty-five percent of harvestable fish 15.0-19.9 inches in length were kept (N = 32 out of 49), while only 50% of fish >28 inches were kept (N = 2 out of 4).

For sauger, size at capture and harvest status was known for 7 fish, and 4 of these were of legal harvest size, 15.0-19.9 inches. All 4 of the harvestable saugers were kept, and no sauger was reported that was larger than 20 inches. Based on this information, anglers who catch harvestable walleye are likely to keep the fish if it is between 15.0-19.9 inches, but are just as likely to release the fish as they are to keep it if it is over 28 inches. If an angler catches a harvestable sauger, the likelihood that the fish will be kept increases to 100%, although this is based on a very small sample size. Based on anecdotal information gathered from anglers who reported tags, it is known that tagged fish are caught more frequently than they are reported, and good estimates of the tag non-reporting rate, angler catch, and angler effort are not possible without creel census data. This information would be used to calculate the exploitation rate of the walleye population. Additionally, no effort was made to estimate tag-loss by tagged walleye and sauger. Tag loss may be a factor influencing the number of tagged fish reported by anglers, but uncertainty is too high to speculate on the degree tag loss is influencing the return rate.

CONCLUSIONS

The fish assemblage in Lake Wisconsin includes panfish and gamefish species typical of large impoundments on large river systems in the midwestern United States. In terms of relative abundance based on total catch during SNI, SNII, and SEII, panfish (bluegill, black crappie, yellow perch) were the most abundant fish. Sauger, walleye, and smallmouth bass were the most abundant gamefish species. Panfish densities are highest in the shallow vegetated bays on the lake, but panfish are rare in areas of poor habitat. Too few individuals were measured during the 2012 survey to assess stock density indices for bluegills and both crappie species.

The amount of poor bass-panfish habitat relative to good habitat sampled during spring electrofishing II accounts for the poor bluegill and largemouth bass spring electrofishing catch rates and resultant poor performance when using this metric in comparisons against other lakes statewide. Targeted sampling of good bass-panfish habitat during spring electrofishing II would enable a better analysis of bass and panfish populations in the lake, particularly for bluegill and largemouth bass, and should be considered for the next comprehensive survey. Panfish generally grow faster than the state average in Lake Wisconsin, but not quite as fast as the regional average. Although meaningful inferences on panfish recruitment are limited from this survey, bluegill, black crappie, and yellow perch are present in good numbers. The fall largemouth bass catch rate, although notably better than the spring catch rate, was still relatively low compared to other lakes statewide. Also, largemouth bass PSD should be between 40 and 70, RSD-P should be between 10 and 40, and RSD-M should be between 0 and 10 for a balanced population (Willis et al. 1993). Based on fall electrofishing data, largemouth bass PSD is slightly lower than this range, RSD-P falls within this range, and RSD-M falls at the lower bound of the range.

Lake Wisconsin overall is a better lake for smallmouth bass because of an abundance of good to excellent habitat, including the connection to the riverine portion above the lake upstream of the main basin. Smallmouth bass are abundant in Lake Wisconsin relative to other lakes in the state. The catch rates of smallmouth bass 7 inches and larger (stock size) in the spring and fall surveys ranked in the 80^{th} and 87^{th} percentiles statewide, respectively. Smallmouth bass PSD and RSD-P values from the fall survey were similar to those for largemouth bass (PSD = 41, RSD-P = 12). Growth of age 7 and older largemouth bass, and all ages of smallmouth bass was equal to, or slower than the state and regional averages. This should not be due to a lack of forage because several prey fish species are abundant. Rather it is hypothesized that foraging success may be reduced in summer and fall when algal blooms reduce visibility for sight feeding predators. Smallmouth bass are also abundant in the Wisconsin River immediately below the Kilbourn Dam. Smallmouth bass size structure is not as good in this area as in the main lake; the fish averaged 9.1 inches and most were between 7 and 11 inches. The Kilbourn Dam tailwater area is an excellent nursery area for smallmouth bass, but also provides an angling opportunity for the occasional fish over 18 inches.

The PE survey likely underestimated the density of adult walleye in Lake Wisconsin at 0.9 per surface acre. Despite the low population estimate, walleyes are abundant and appear to grow faster than state and regional averages. Walleye PSD and RSD-P values calculated from the PE survey are higher than those calculated from SEII. This is because the PE survey sampled a spawning aggregation of mature fish, where the largest fish in the system were present in relatively large numbers in near-shore areas, making them more vulnerable to electrofishing. The SEII survey was not as reflective of the largest fish in the population as these fish were not concentrated in shallow near-shore areas of the lake during the SEII sampling period.

The average walleye in Lake Wisconsin will exceed 15 inches some time during their fourth growing season, and will have entered the protected slot by the end of their fifth growing season. It will take the average walleye 11 growing seasons to exceed the upper limit of the protected slot which is 28 inches, and 5 percent of the adult spawning population sampled in the spring of 2012 were 28 inches or larger. The protected slot is providing an excellent walleye fishery, with good harvest opportunities for fish 15.0-19.9 inches, good opportunities to catch and release walleye over 20 inches, and increasing opportunities to catch fish larger than 28 inches. Because of the excellent fishery it has created, the protected slot on walleyes is very popular with anglers, and voters at the Spring 2013 Conservation Congress hearings voted 3,305 to 938 in favor of making the regulation permanent; 70 counties voted to approve the regulation, and 2 voted to reject it.

The fact that almost no walleyes or saugers were caught in fyke nets during SNI and SNII lends support to the idea that these fish leave Lake Wisconsin to spawn in the river. Walleye recruitment is variable from year to year, but generally good. The year 2012 saw lower walleye and sauger recruitment relative to other years (but not year class failure) and this was also true on the lower Wisconsin River. Growth of YOY walleye and sauger was slightly better in 2012 relative to other years. The early warm spring and hot summer that followed are factors that determined reduced walleye recruitment with correspondingly good growth of surviving recruits. Walleye and sauger populations continue to thrive entirely through natural reproduction and no stocking is needed. Anglers are likely to harvest legal size walleye, and are almost certain to harvest legal size sauger from Lake Wisconsin. If a good estimate of exploitation of walleye is desired, future information needs could be satisfied in part through a creel survey. A method to estimate tag loss should also be incorporated into future tagging efforts.

Size-specific fall CPE 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 PE, 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 4 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 4 years or longer to collect new population data, depending on work load and available funding. If environmental conditions influence the fall survey, management only has to 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. Values for PSD, RSD-P, and RSD-28 values during the spring electrofishing PE on the Wisconsin River (which will only occur every 4 years at most) still have value, and should approach levels seen in 2012, which were 81, 44, and 5, respectively.

Walleye recruitment in an average year should fall between 18 and 46 YOY per mile of electrofishing in the fall survey. This represents the interquartile range (middle 50%) of YOY catch rates from 1993-2012. For Lake Wisconsin, a catch rate less than 18 per mile could be considered below average to poor recruitment, and a catch rate greater than 46 per mile could be considered good to excellent recruitment. The WDNR walleye management team considers a YOY catch rate of 10 per mile attained once in a three-year time period successful natural reproduction. Lake Wisconsin has had a fall catch rate of at least 10 YOY walleye per mile every year since 1993, with the exception of 2010 when the catch rate was 9 per mile.

Sauger are abundant in Lake Wisconsin and there is ample harvest opportunity for fish 15.0-19.9 inches in length. Saugers in Lake Wisconsin do not appear to grow to 28 inches in length, although they do grow to at least 23 inches, and probably larger. Sauger enter the protected slot at 20 inches but never come out larger than 28 inches, therefore a portion of the sauger population will never be available for anglers to harvest as long as the current slot limit exists. The idea of reducing the protected slot on sauger down to 20 to 24 inches while keeping the slot on walleye and hybrids at 20 to 28 inches should be evaluated.

Northern pike and muskellunge are present, although very few individuals were sampled during the 2012 survey. Meaningful inferences on northern pike and muskellunge abundance, size structure, age structure, growth, and mortality are not possible with the limited amount of data collected on these fish during this survey. Effective sampling of these species is difficult on a water body this size with the many possible spawning locations for these species, both in the lake and in tributary streams. The early warm spring of 2012 that began with ice-out in early March was another possible factor that confounded efforts to sample northern pike and muskellunge. Hopefully the 2016 comprehensive survey will yield better results. Currently, northern pike appear to be supported entirely through natural reproduction. The proportion of the northern pike population 21 inches and larger (PSD) should fall between 30 and 60 (Willis et al. 2003). Stocked muskellunge are surviving in the lake and providing an opportunity for anglers.

Opportunities exist for anglers to catch other desirable species including bullheads, channel catfish, flathead catfish, freshwater drum, white bass, and white crappie. Sportsmen also have bow fishing opportunities for rough fish species including common carp, quillback carpsucker, and smallmouth buffalo.

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TABLES AND FIGURES

Table 1. Current 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	May 5, 2012 to December 31, 2012	The minimum length limit is 40" 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 (September 1, 2012) to September 30, 2012	The minimum length limit is 60" and the season bag limit is 1 with a valid fishing license and a valid harvest tag.
Trout	First Saturday in May to September 30, 2012	The minimum length limit is 9" and the daily bag limit is 3.

*Motor trolling is permitted on Lake Wisconsin.

Table 2. Stocking history of Lake Wisconsin and the Wisconsin River between Prairie du Sac Dam and Kilbourn Dam, 1972 to present.

Year	Waterbody	Species	Strain (Stock)	Age Class	Number Fish Stocked	Avg. Fish Length (inches)
1972	WISCONSIN RIVER	MUSKELLUNGE	UNSPECIFIED	FINGERLING	514	12.0
1977	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,034	11.0
1979	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,000	9.0
1980	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	5,610	7.5
1981	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,000	6.0
1982	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,500	9.0
1983	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,500	7.0
1984	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,800	8.0
1985	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,500	10.0
1986	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	2,500	9.0
1987	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	7,500	7.0
1988	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	232	7.0
1989	WISCONSIN RIVER	MUSKELLUNGE	UNSPECIFIED	FINGERLING	1,714	7.0
1990	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	FINGERLING	5,000	9.0
1992	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	FINGERLING	1,910	11.0
1992	WISCONSIN RIVER	MUSKELLUNGE	UNSPECIFIED	FINGERLING	1,660	8.0
1993	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	FINGERLING	2,263	9.0
1996	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	FINGERLING	1,800	11.8
1998	WISCONSIN RIVER	LAKE STURGEON	WIS. RIVER	FRY	30,000	
1998	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	1,314	12.3
1998	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	1,176	9.1
2000	LAKE WISCONSIN	LAKE STURGEON	LAKE WISCONSIN	FRY	87,771	0.5
2000	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	1,100	11.1
2000	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	1,400	12.0
2001	LAKE WISCONSIN	LAKE STURGEON	LAKE WISCONSIN	FRY	28,782	0.4
2001	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	2,500	12.0
2001	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	5,000	10.9
2001	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	LARGE FINGERLING	240	9.3

Year	Waterbody	Species	Strain (Stock)	Age Class	Number Fish Stocked	Avg. Fish Length (inches)
2002	LAKE WISCONSIN	LAKE STURGEON	WISCONSIN RIVER	LARGE FINGERLING	4,950	5.5
2002	WISCONSIN RIVER	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	1,500	11.4
2002	LAKE WISCONSIN	NOP X MUE	UNSPECIFIED	LARGE FINGERLING	2,000	10.0
2002	WISCONSIN RIVER	NOP X MUE	UNSPECIFIED	LARGE FINGERLING	135	9.6
2003	WISCONSIN RIVER	LAKE STURGEON	WISCONSIN RIVER	FRY	137,906	0.6
2003	WISCONSIN RIVER	LAKE STURGEON	WISCONSIN RIVER	YEARLING	9	12.0
2003	WISCONSIN RIVER	LAKE STURGEON	WISCONSIN RIVER	SMALL FINGERLING	700	3.2
2003	WISCONSIN RIVER	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	2,500	10.9
2004	WISCONSIN RIVER	LAKE STURGEON	WISCONSIN RIVER	SMALL FINGERLING	4,973	4.0
2004	WISCONSIN RIVER	SMALLMOUTH BASS	UNSPECIFIED	LARGE FINGERLING		4.0
2005	WISCONSIN RIVER	MUSKELLUNGE	UPPER CHIPPEWA R.	LARGE FINGERLING	2,500	10.5
2008	LAKE WISCONSIN	MUSKELLUNGE	UPPER WISCONSIN R.	LARGE FINGERLING	1,250	10.7
2010	WISCONSIN RIVER	MUSKELLUNGE	UPPER WISCONSIN R.	LARGE FINGERLING	948	12.9
2011	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	1,700	10.5
2011	WISCONSIN RIVER	MUSKELLUNGE	UPPER WISCONSIN R.	LARGE FINGERLING	1,250	9.4
2012	WISCONSIN RIVER	LAKE STURGEON	WISCONSIN RIVER	LARGE FINGERLING	2,642	7.5
2012	LAKE WISCONSIN	MUSKELLUNGE	UNSPECIFIED	LARGE FINGERLING	790	14.3
2012	LAKE WISCONSIN	MUSKELLUNGE	UPPER WISCONSIN R.	LARGE FINGERLING	2,540	9.7

Table 3. Locations of fyke nets (GPS coordinates) used during SNI and SNII on Lake Wisconsin in 2012.

Net Number	Date First Set	Period Fished	Latitude	Longitude
1A	03/12/2012	SNI	43.39691	-89.52132
2A	03/12/2012	SNI	43.39735	-89.52135
3A	03/12/2012	SNI	43.4003	-89.5219
4A	03/12/2012	SNI	43.39233	-89.52159
5A	03/12/2012	SNI	43.36839	-89.54807
6A	03/12/2012	SNI	43.36982	-89.54176
7A	03/12/2012	SNI	43.37208	-89.5514
8A	03/12/2012	SNI	43.37355	-89.54678
9A	03/12/2012	SNI	43.35522	-89.57804
10A	03/12/2012	SNI	43.35833	-89.57156
11A	03/12/2012	SNI	43.35913	-89.57411
12A	03/14/2012	SNI	43.35193	-89.57076
13A	03/14/2012	SNI	43.39678	-89.52202
GALLUS	03/14/2012	SNI	43.37413	-89.66765
GRUBERS POINT	03/14/2012	SNI	43.3264	-89.71772
GRUBERS POWERLINE	03/14/2012	SNI	43.32762	-89.71859
SELWOOD POINT	03/14/2012	SNI	43.32738	-89.70213
SUNSET	03/14/2012	SNI	43.3514	-89.62798
TURTLE BAY	03/14/2012	SNI	43.35656	-89.64964
WEIGANDS @ 78	03/14/2012	SNI	43.36354	-89.69463
WEIGANDS SPRING	03/14/2012	SNI	43.36607	-89.6885
LW1	03/28/2012	SNII	43.36588	-89.67474
LW2	03/28/2012	SNII	43.3629	-89.67852
LW3	03/28/2012	SNII	43.36359	-89.68989
LW4	03/28/2012	SNII	43.36032	-89.69057
LW5	03/28/2012	SNII	43.32599	-89.7174
LW6	03/28/2012	SNII	43.35746	-89.65015
LW7	03/28/2012	SNII	43.36339	-89.59071
LW8	03/28/2012	SNII	43.36649	-89.60447
LW9	03/28/2012	SNII	43.37107	-89.62191
LW10	03/28/2012	SNII	43.37973	-89.61504
LW11	03/28/2012	SNII	43.38508	-89.60482
LW12	03/28/2012	SNII	43.39403	-89.57923
LW14	03/30/2012	SNII	43.3674	-89.61708
LW15	03/30/2012	SNII	43.35857	-89.57439
LW16	04/01/2012	SNII	43.36511	-89.59502
LW17	04/02/2012	SNII	43.3676	-89.5717
LW18	04/02/2012	SNII	43.35007	-89.57343
LW19	04/02/2012	SNII	43.45918	-89.44817
LW20	04/03/2012	SNII	43.45995	-89.44277

Table 4. Locations of electrofishing stations (GPS coordinates) sampled during SEII on Lake Wisconsin in 2012.

Date	Station	Distance (miles)	Start Latitude	Start Longitude	End Latitude	End Longitude
05/21/2012	PANFISH #1	0.5	43.39696	-89.54299	43.40064	-89.54320
05/21/2012	GAMEFISH #1	1.5	43.40064	-89.54320	43.41563	-89.52982
05/21/2012	PANFISH #6	0.5	43.38901	-89.59140	43.38694	-89.59934
05/21/2012	GAMEFISH #6	1.5	43.38694	-89.59954	43.37627	-89.61863
05/22/2012	PANFISH #5	0.5	43.36463	-89.68828	43.36336	-89.69431
05/22/2012	GAMEFISH #5	1.5	43.36336	-89.69431	43.35963	-89.69021
05/22/2012	PANFISH #4	0.5	43.31897	-89.71565	43.32284	-89.70877
05/22/2012	GAMEFISH #4	1.5	43.32284	-89.70877	43.33628	-89.69793
05/23/2012	PANFISH #2	0.5	43.36973	-89.57064	43.36807	-89.57883
05/23/2012	GAMEFISH #2	1.5	43.36807	-89.57883	43.36711	-89.36794
05/23/2012	PANFISH #3	0.5	43.35718	-89.63002	43.36028	-89.63496
05/23/2012	GAMEFISH #3	1.5	43.36028	-89.63496	43.36717	-89.61565

Table 5. Locations of electrofishing stations (GPS coordinates) sampled during fall electrofishing on Lake Wisconsin and the Wisconsin River in Wisconsin Dells in 2012.

Date	Station	Start Latitude	Start Longitude	End Latitude	End Longitude	Total Distance-All Parts (miles)
09/24/2012	Upper End of Lake-Part A	43.40632	-89.54243	43.41625	-89.52888	
09/24/2012	Upper End of Lake-Part B	43.41787	-89.54115	43.40914	-89.54582	2.14
09/24/2012	Stoner's Bay	43.39417	-89.57956	43.37915	-89.61616	2.70
09/25/2012	Moon Valley	43.36250	-89.66497	43.36289	-89.67817	2.45
09/25/2012	Okee Bay	43.36663	-89.61944	43.35795	-89.58293	2.35
09/26/2012	Weigand's Bay-Part A	43.36209	-89.68103	43.36372	-89.68641	2.40
09/26/2012	Weigand's Bay-Part B	43.36293	-89.69034	43.35953	-89.68684	
09/26/2012	Gruber's Grove	43.32710	-89.71078	43.32184	-89.72305	2.25
09/27/2012	Kilbourn Dam Station 1-Part A	43.60742	-89.76897	43.61140	-89.77267	
09/27/2012	Kilbourn Dam Station 1-Part B	43.61186	-89.77176	43.61662	-89.77359	
09/27/2012	Kilbourn Dam Station 1-Part C	43.61909	-89.77318	43.62352	-89.77969	1.50
09/27/2012	Kilbourn Dam Station 2-Part A	43.60545	-89.75760	43.60587	-89.76478	
09/27/2012	Kilbourn Dam Station 2-Part B	43.60517	-89.75692	43.60580	-89.76794	1.65

Table 6. Length categories (inches) that have been proposed for the fish species that were collected from Lake Wisconsin in 2012 (Anderson and Neumann 1996).

Species	Stock	Quality	Preferred	Memorable	Trophy
Black crappie	5	8	10	12	15
Bluegill	3	6	8	10	12
Channel catfish	11	16	24	28	36
Flathead catfish	14	20	28	34	40
Largemouth bass	8	12	15	20	25
Muskellunge	20	30	38	42	50
Northern pike	14	21	28	34	44
Sauger	8	12	15	20	25
Smallmouth bass	7	11	14	17	20
Walleye	10	15	20	25	30
White crappie	5	8	10	12	15
Yellow perch	5	8	10	12	15

Table 7. Summary of lengths (inches) of gamefish sampled during spring 2012 walleye PE on the Wisconsin River below Kilbourn Dam.

Species	N	N Measured	Minimum Length	Maximum Length	Mean Length	Median Length	Mode	PSD (15)	RSD-P (20)	RSD-28	Minimum Age	Maximum Age
Walleye-All	1,534	1,534	6.4	30.4	19.1	17.4	15.2	81	44	5	2	16
WAE Female	602	602	14.9	30.2	24.6	25.1	25.6				2	13
WAE Male	707	707	7.1	26.6	16.5	15.7	15.2				2	16
Sauger-All	272	272	6.6	23.1	13.8	13.6	13.2	89	22			
Northern Pike	57	57	16.2	34.3	25.9	26.0	26.9				2	5
Saugeye	20	19	17.2	27.9	24.4	25.2	26.6					
Muskellunge	3	3	36.8	37.5	37.0	36.8	36.8				7	8

Table 8. Lake Wisconsin walleye mean length at age with length ranges. Compiled from fall 2011 and spring 2012 sampling data with 2012 fish ages scaled back to what they would have been in fall 2011.

Age	Number of Growing Seasons	N	Average Length	Minimum Length	Maximum Length
0	1	26	7.7	6.0	9.1
1	2	46	11.8	8.7	16.6
2	3	67	14.9	11.9	20.6
3	4	27	18.2	13.8	21.6
4	5	22	20.8	17.9	24.2
5	6	12	21.6	19.1	23.9
6	7	18	23.1	20.5	25.5
7	8	9	25.0	23.4	26.9
8	9	16	26.0	18.9	30.2
9	10	9	27.8	26.5	30.1
10	11	9	28.5	27.0	29.4
11	12	5	27.6	26.5	28.6
12	13	7	27.1	22.8	28.7
13	14	0			
14	15	0			
15	16	1	24.6		

Table 9. Summary of catch by gear type for SNI, SNII, and SEII on Lake Wisconsin, spring 2012. Catch per unit of effort is abbreviated CPUE.

	CATCH			CPUE		
Species	SNI+SNII	SEII	Total	Fish/net night	Fish/hour	Fish/mile
Bluegill	1,091	58	1,149	10.2	32.2	19.3
Black Crappie	737	26	763	6.9	14.4	8.7
Yellow Perch	720	7	727	6.7	3.9	2.3
Sauger	8	302	310	0.1	45.5	25.2
Walleye	20	264	284	0.2	39.8	22.0
Gizzard Shad	0	131	131	0.0	72.8	43.7
Smallmouth Bass	3	93	96	0.0	14.0	7.8
Largemouth Bass	18	41	59	0.2	6.2	3.4
Yellow Bullhead	58	0	58	0.5	0.0	0.0
White Crappie	42	0	42	0.4	0.0	0.0
Freshwater Drum	3	35	38	0.0	19.4	11.7
White Bass	5	30	35	0.0	16.7	10.0
Common Carp	5	26	31	0.0	14.4	8.7
Northern Pike	25	1	26	0.2	0.2	0.1
Quillback Carpsucker	0	26	26	0.0	14.4	8.7
Pumpkinseed	10	3	13	0.1	1.7	1.0
Channel Catfish	8	3	11	0.1	0.5	0.3
Muskellunge	9	2	11	0.1	0.3	0.2
Yellow Bass	0	9	9	0.0	5.0	3.0
Flathead Catfish	6	1	7	0.1	0.2	0.1
Warmouth	7	0	7	0.1	0.0	0.0
Green Sunfish	5	1	6	0.0	0.6	0.3
Bowfin	5	0	5	0.0	0.0	0.0
Grass Pickerel	4	0	4	0.0	0.0	0.0
Brown Bullhead	3	0	3	0.0	0.0	0.0
Bluegill x unknown	1	0	1	0.0	0.0	0.0
Brown Trout	1	0	1	0.0	0.0	0.0
Golden Redhorse	0	1	1	0.0	0.6	0.3
Golden Shiner	0	1	1	0.0	0.6	0.3
Saugeye	1	0	1	0.0	0.0	0.0
Shorthead Redhorse	0	1	1	0.0	0.6	0.3
Smallmouth Buffalo	0	1	1	0.0	0.6	0.3
Spotted Sucker	1	0	1	0.0	0.0	0.0
White Sucker	1	0	1	0.0	0.0	0.0

Table 10. Summary of size and age data for panfish and gamefish sampled from Lake Wisconsin during SNI, SNII, and SEII. Lengths are reported in inches.

Species	N	N Measured	Minimum Length	Maximum Length	Mean Length	Median Length	Mode Length	PSD	RSD-P	Minimum Age	Maximum Age
Bluegill	1,149	58	2.5	8.0	6.1	6.6	7.0			2	6
Black Crappie	763	95	3.9	14.4	9.4	9.4	9.6			1	8
Yellow Perch	727	102	3.6	11.7	7.1	6.7	6.6	25	4	1	7
Sauger	310	310	6.0	17.6	9.9	10.0	6.8	56	8		
Walleye	284	282	7.2	27.3	11.6	9.6	8.3	41	5		
Smallmouth Bass	96	96	3.7	19.3	10.6	10.5	10.1			2	10
Largemouth Bass	59	59	5.2	19.1	12.9	14.2	14.2			2	12
White Crappie	42	19	3.6	10.3	8.1	8.3	8.0			2	3
Northern Pike	26	26	16.8	39.2	23.7	21.8	16.9			2	8
Pumpkinseed	13	3	2.6	5.2	4.3	5.0					
Channel Catfish	11	9	9.8	30.2	19.3	18.6					
Muskellunge	11	11	11.4	42.5	30.1	35.3				3	8
Flathead Catfish	7	7	16.9	45.4	37.0	38.4					
Green Sunfish	6	1			5.2						
Brown Trout	1	1			7.9						
Saugeye	1	1			11.7						

Table 11. Summary of electrofishing CPUE during fall sampling on Lake Wisconsin and the Wisconsin River in Wisconsin Dells.

	Main Lake			Dells		
Species	Number Caught	CPUE Fish/hour	CPUE Fish/mile	N Dells	CPUE Fish/hour	CPUE Fish/mile
Walleye	411	57.1	28.8	57	36.1	18.1
Sauger	463	64.3	32.4	78	49.4	24.8
Smallmouth Bass	160	22.2	11.2	274	173.4	87.0
Largemouth Bass	146	20.3	10.2	32	20.3	10.2
Northern Pike	9	1.3	0.6	16	10.1	5.1
Channel Catfish	3	0.4	0.2	5	3.2	1.6
Flathead Catfish	8	1.1	0.6	1	0.6	0.3
Saugeye	4	0.6	0.3			
Muskellunge	2	0.3	0.1			
Tiger Muskellunge	2	0.3	0.1			
Quillback Carpsucker	100	13.9	7.0			
Freshwater Drum	72	10.0	5.0			
Common Carp	71	9.9	5.0			
Smallmouth Buffalo	27	3.8	1.9			

Table 12. Summary of size data for gamefish sampled from Lake Wisconsin during fall 2012 electrofishing. Lengths are reported in inches.

Species	N	Minimum Length	Maximum Length	Mean Length	Median Length	Mode Length	PSD	RSD-P
Sauger	463	5.6	17.8	11.3	11.3	10.8	40	9
Walleye	411	5.3	25.5	12.6	13.1	13.8	39	7
Smallmouth Bass	160	4.5	19.8	10.8	10.5	12.2	41	12
Largemouth Bass	146	5.5	18.8	11.1	10.4	10.0	37	16
Northern Pike	9	23.3	30.8	26.3	26.5			
Flathead Catfish	8	10.5	13.9	12.3	12.5			
Saugeye	4	15.0	22.7	18.4				
Channel Catfish	3	14.6	18.3	15.9	14.7			
Muskellunge	2	21.2	21.3	21.3				
Tiger Muskellunge	2	21.8	40.0	30.9				

Table 13. Catch per unit of effort expressed in fish per mile of shoreline sampled for different size classes of walleye during fall electrofishing surveys on Lake Wisconsin, 1996 through 2012. The year 2009 was excluded due to the sampling being conducted one month later than in the other years. The 20 to 28 inch protected walleye slot limit was instituted beginning with the 2002 fishing season.

Year	Pre or Post Regulation	CPE <10.0 inches	CPE 10.0-14.9 inches	CPE 15.0-19.9 inches	CPE ≥ 20.0 inches
1996	Pre	9.7	41.5	3.9	0.3
1997	Pre	8.6	56.9	7.1	0.4
1998	Pre	24.0	35.5	3.9	0.1
1999	Pre	12.3	16.7	4.9	0.1
2000	Pre	0.1	10.7	3.6	1.2
2001	Pre	0.0	4.3	3.0	0.8
2002	Post	0.0	12.4	2.7	1.2
2003	Post	38.6	8.0	1.1	0.9
2004	Post	18.3	8.3	2.3	0.6
2005	Post	20.0	7.6	11.2	2.4
2006	Post	12.4	12.1	2.6	1.1
2007	Post	14.3	6.8	9.9	2.3
2008	Post	20.1	6.7	3.3	0.7
2010	Post	10.3	31.4	6.3	1.4
2011	Post	23.3	16.2	11.5	1.9
2012	Post	10.4	11.1	5.9	1.3
Average CPE Pre Reg		9.1	27.6	4.4	0.5
Average CPE Post Reg		16.8	12.1	5.7	1.4
Percent Change		84%	-56%	29%	179%
t-statistic		-1.521	2.223	-0.755	-2.951
P(T≤t)		0.08	0.02	0.23	0.005

Table 14. Summary of size data for gamefish sampled from the Wisconsin River below Kilbourn Dam during fall 2012 electrofishing. Lengths are reported in inches.

Species	N	Minimum Length	Maximum Length	Mean Length	Median Length	Mode Length	PSD	RSD-P
Smallmouth Bass	274	4.1	18.4	9.1	8.5	8.3	20	2
Sauger	78	11.1	16.3	12.8	12.1	11.7		
Walleye	57	9.3	24.5	13.9	13.4	13.4		
Largemouth Bass	32	5.3	15.8	9.7	9.9	9.9		
Northern Pike	16	12.4	30.0	23.5	23.9	24.3		
Channel Catfish	5	17.8	22.5	21.0	21.6	22.5		
Flathead Catfish	1			22.2				

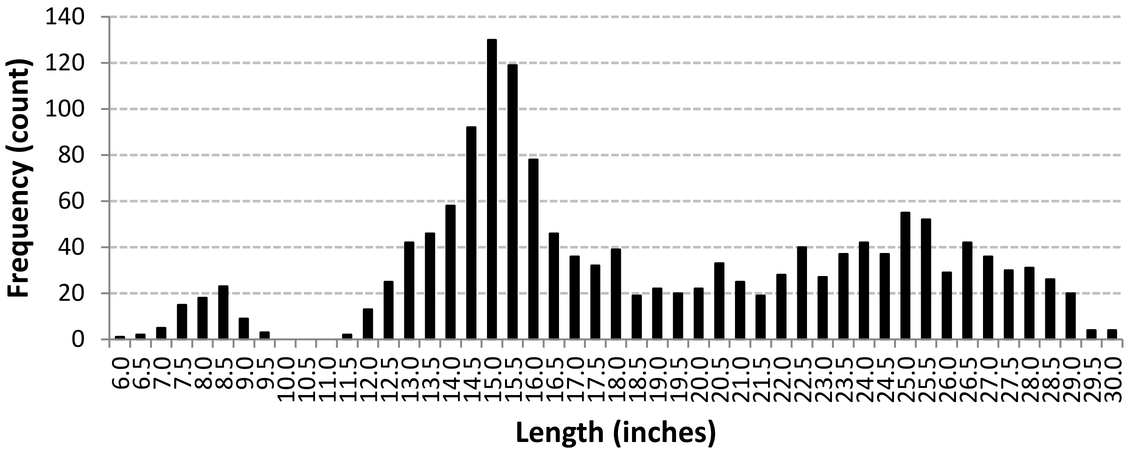

Figure 1. Length frequency distribution of walleye collected during the spring 2012 PE survey on the Wisconsin River near Wisconsin Dells, Wisconsin.

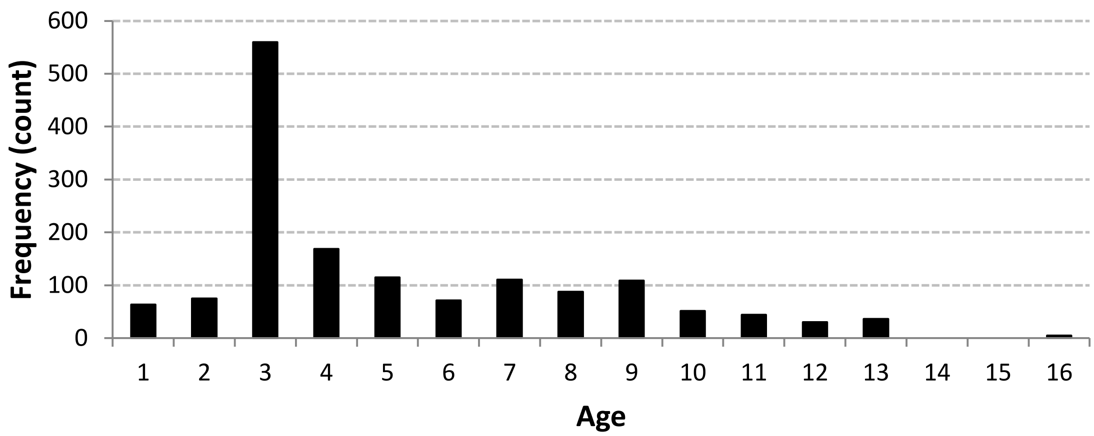

Figure 2. Age frequency distribution of walleye collected from the Wisconsin River during the walleye PE survey, spring 2012.

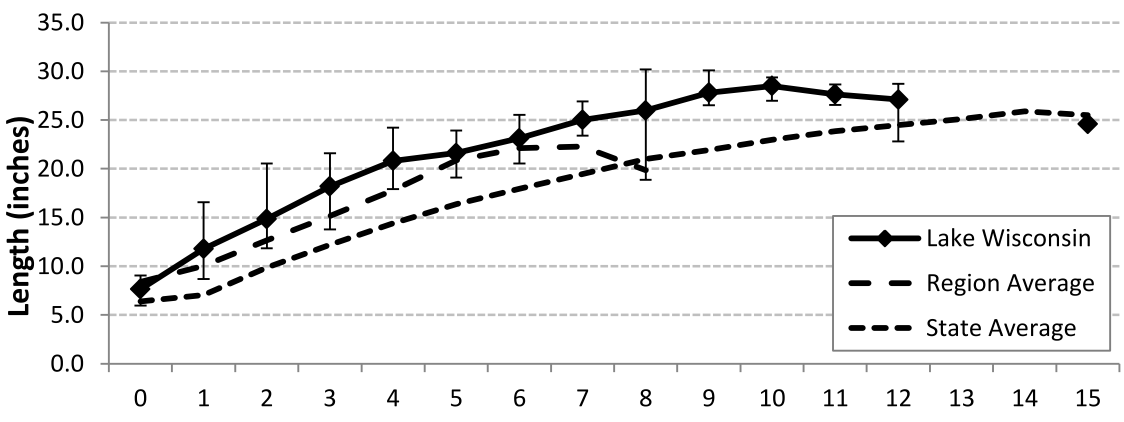

Figure 3. Mean length at age of walleye collected from Lake Wisconsin during electrofishing surveys in fall 2011 and spring 2012. Adjusted so that all fish reflect fall 2011 ages. Error bars represent the range of lengths for a given age.

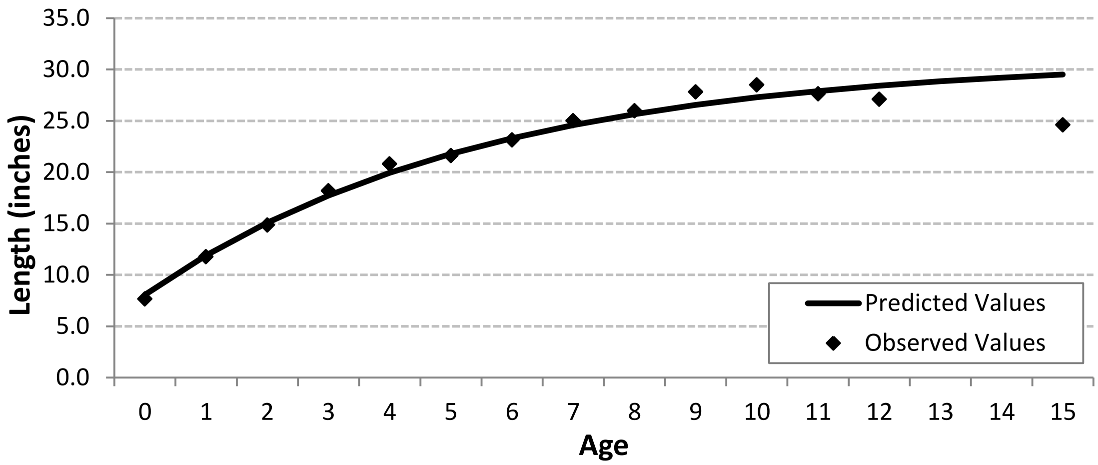

Figure 4. Observed values for mean length at age of Lake Wisconsin walleye with predicted von Bertalanffy growth curve fitted to the data.

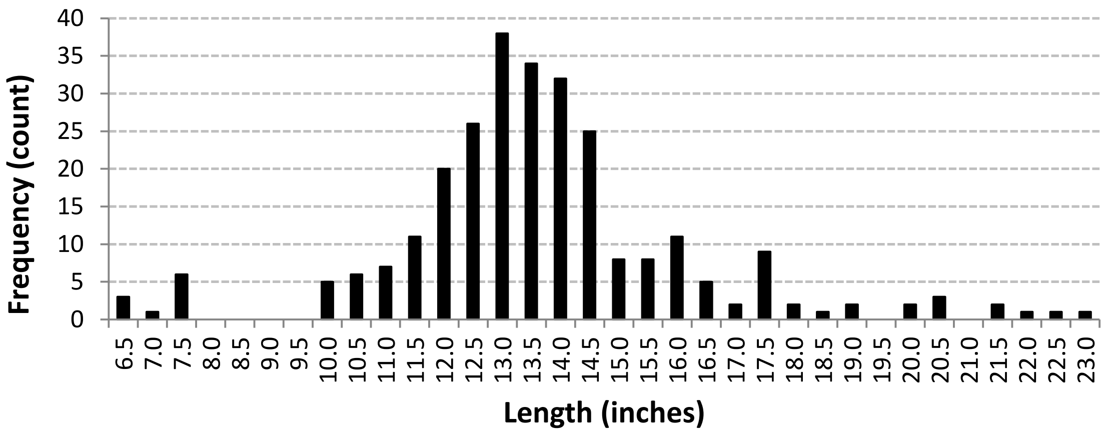

Figure 5. Length frequency distribution of sauger collected during the spring 2012 walleye PE survey on the Wisconsin River near Wisconsin Dells, Wisconsin.

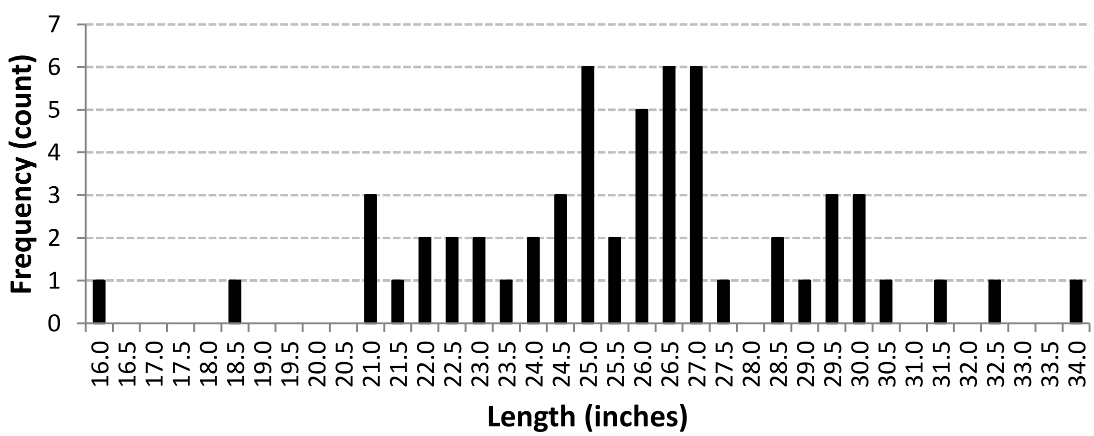

Figure 6. Length frequency distribution of northern pike collected during the spring 2012 walleye PE survey on the Wisconsin River near Wisconsin Dells, Wisconsin.

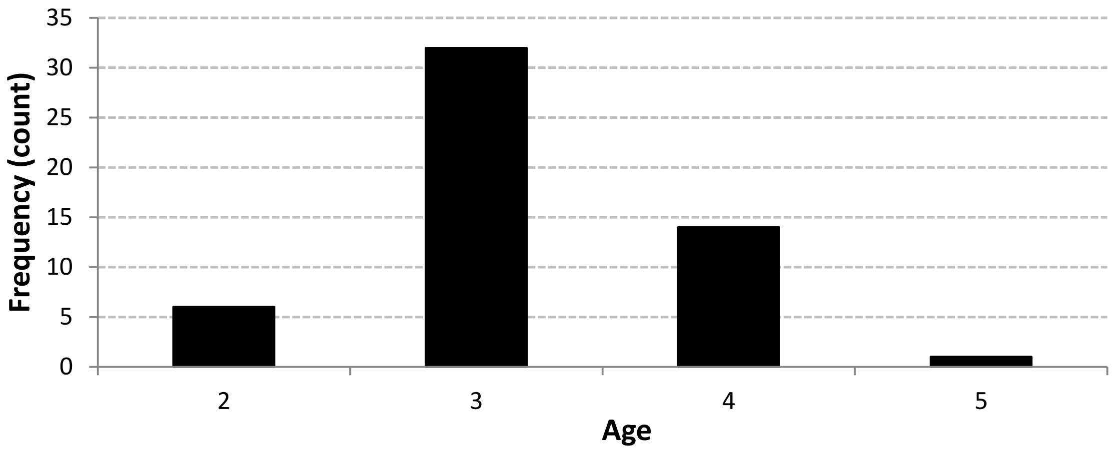

Figure 7. Age frequency distribution of northern pike collected during the spring 2012 walleye PE survey on the Wisconsin River near Wisconsin Dells, Wisconsin.

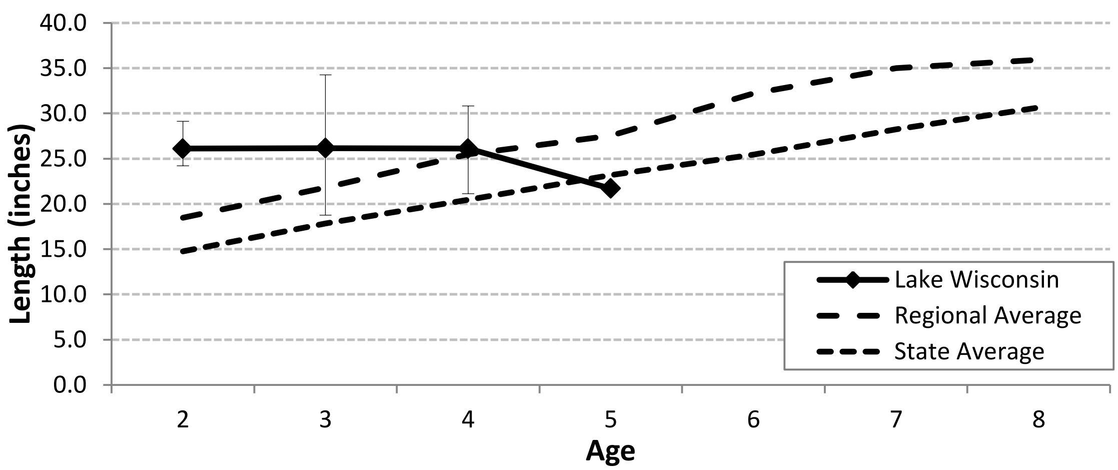

Figure 8. Mean length at age of northern pike collected during the spring 2012 walleye PE survey on the Wisconsin River near Wisconsin Dells, Wisconsin.

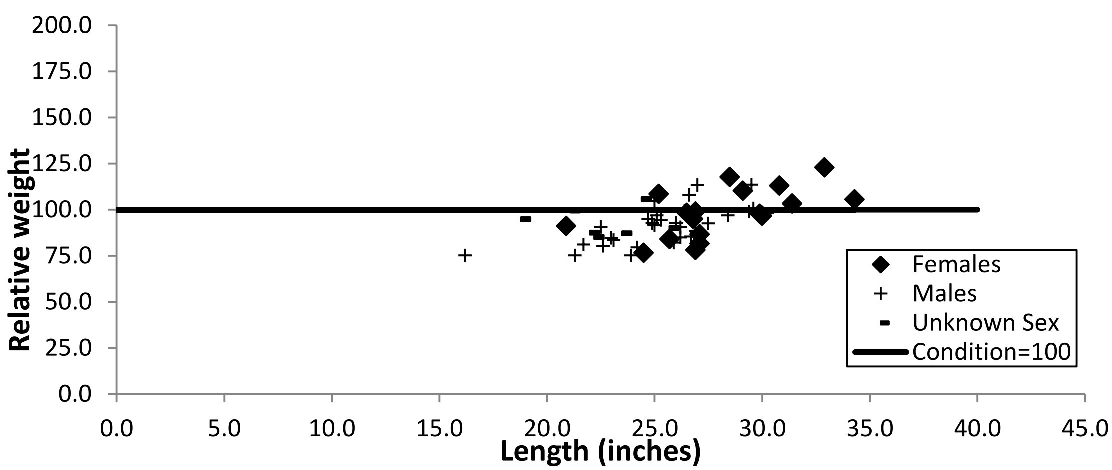

Figure 9. Relative weight of northern pike collected during the spring 2012 walleye PE survey on the Wisconsin River near Wisconsin Dells, Wisconsin.

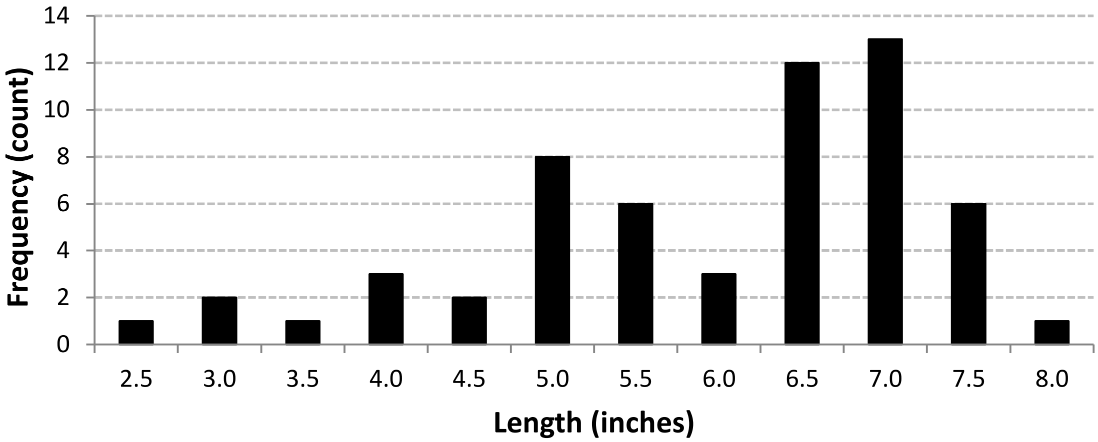

Figure 10. Bluegill length frequency distribution from Lake Wisconsin, spring 2012.

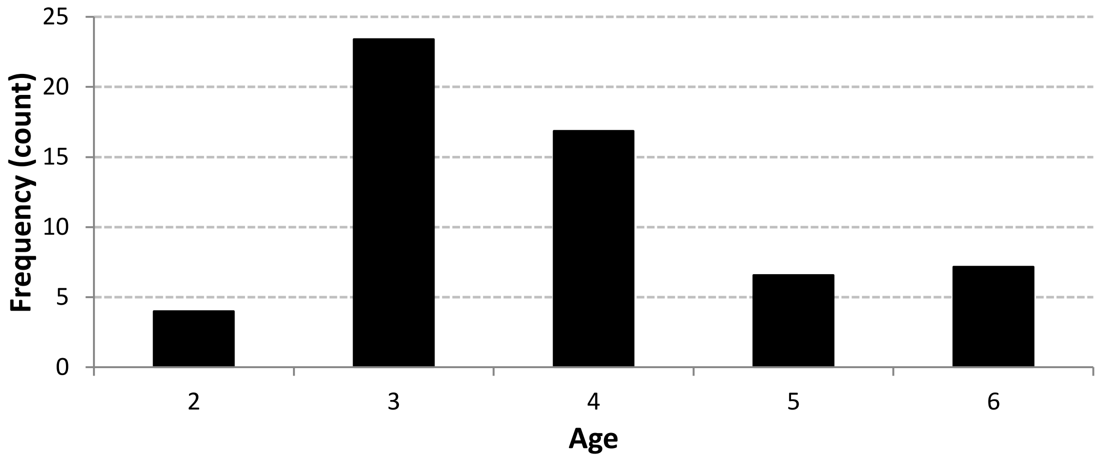

Figure 11. Bluegill age frequency distribution from Lake Wisconsin, spring 2012.

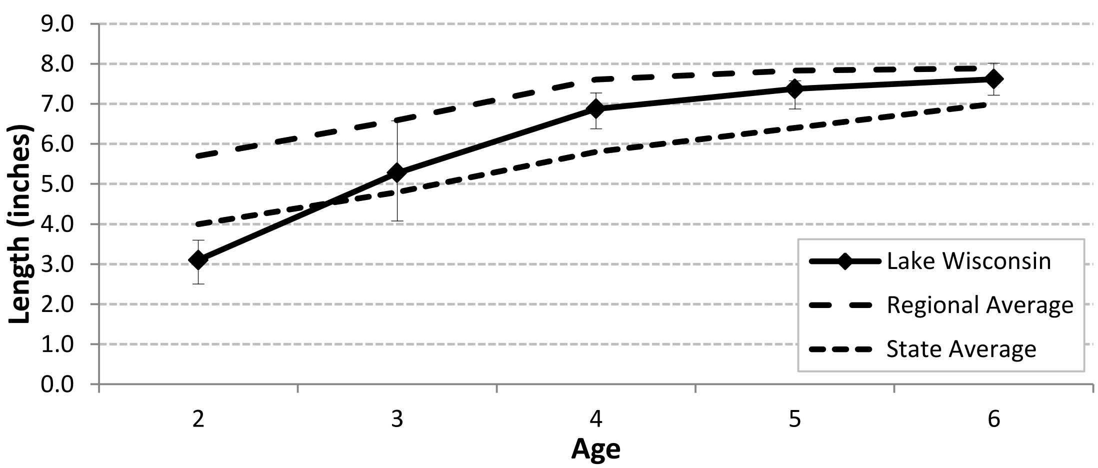

Figure 12. Bluegill mean length at age from Lake Wisconsin, spring 2012. Error bars represent the range of lengths for each age.

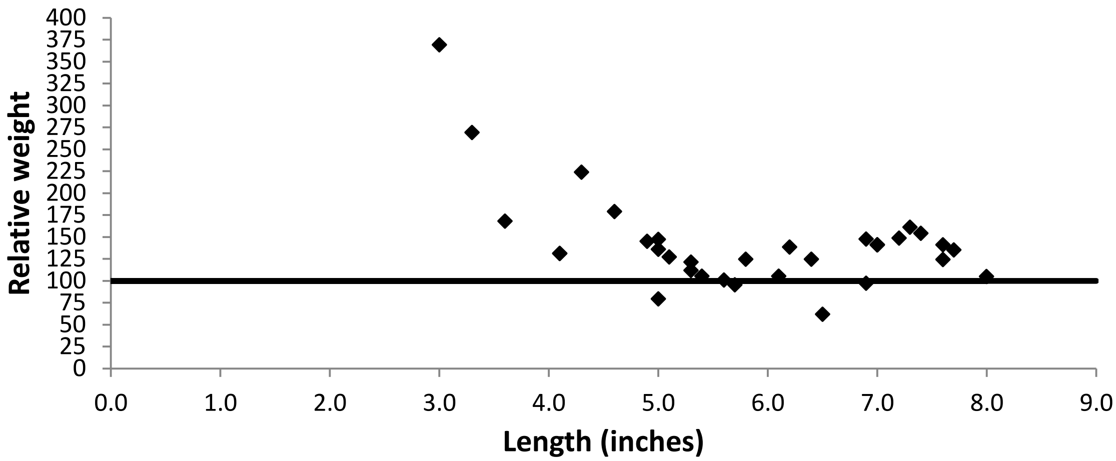

Figure 13. Bluegill relative weight from Lake Wisconsin, spring 2012.

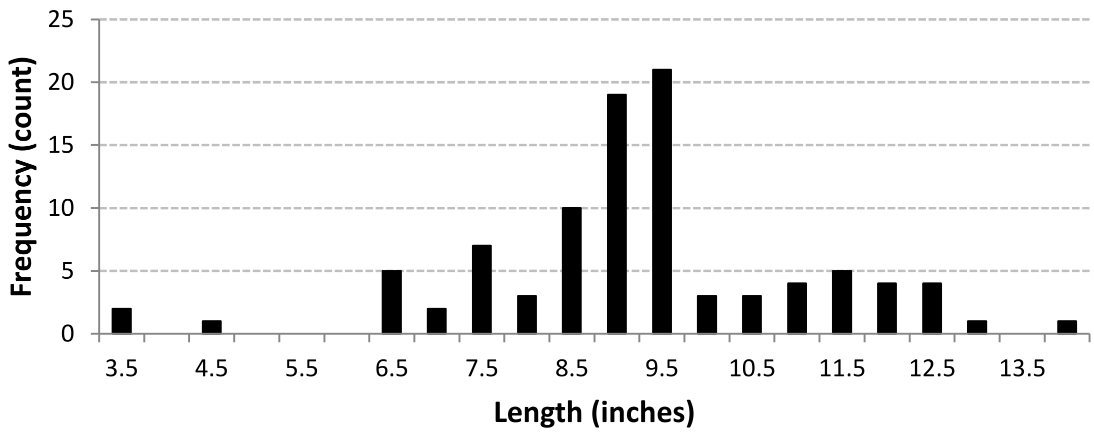

Figure 14. Black crappie length frequency distribution from Lake Wisconsin, spring 2012.

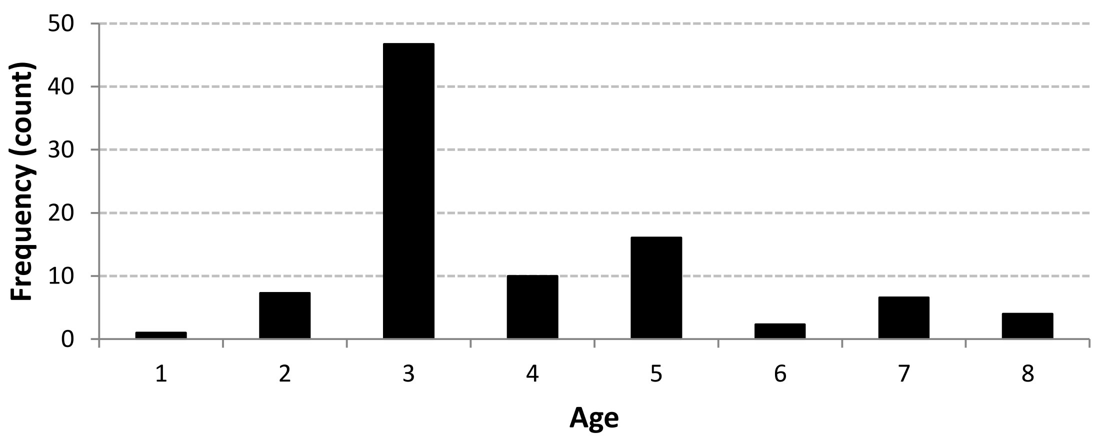

Figure 15. Black crappie age frequency distribution from Lake Wisconsin, spring 2012.

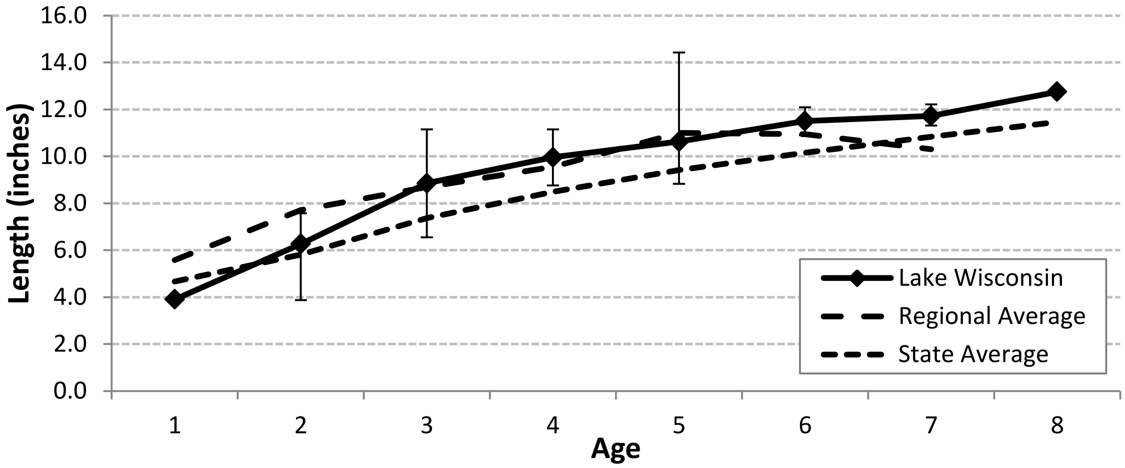

Figure 16. Black crappie mean length at age from Lake Wisconsin, spring 2012. Error bars represent the range of lengths for each age.

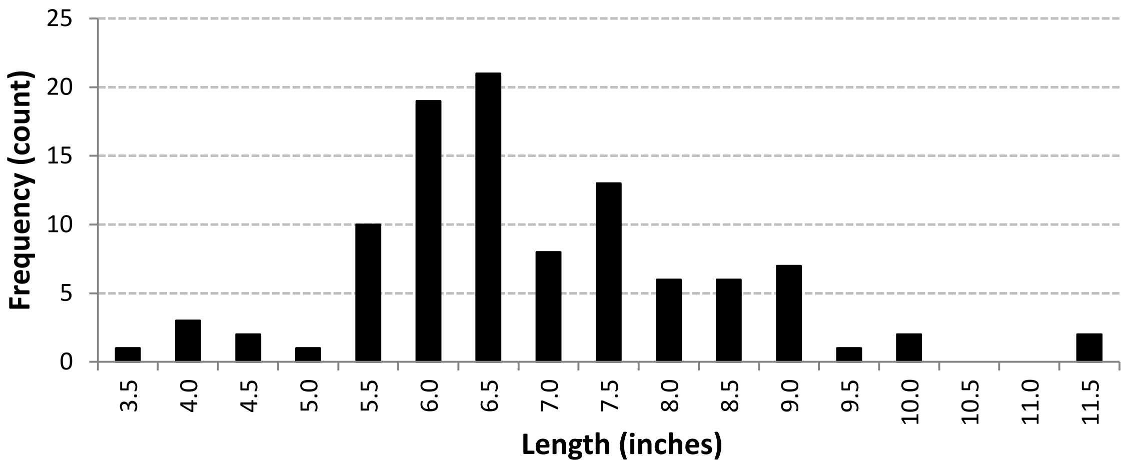

Figure 17. Yellow perch length frequency distribution from Lake Wisconsin, spring 2012.

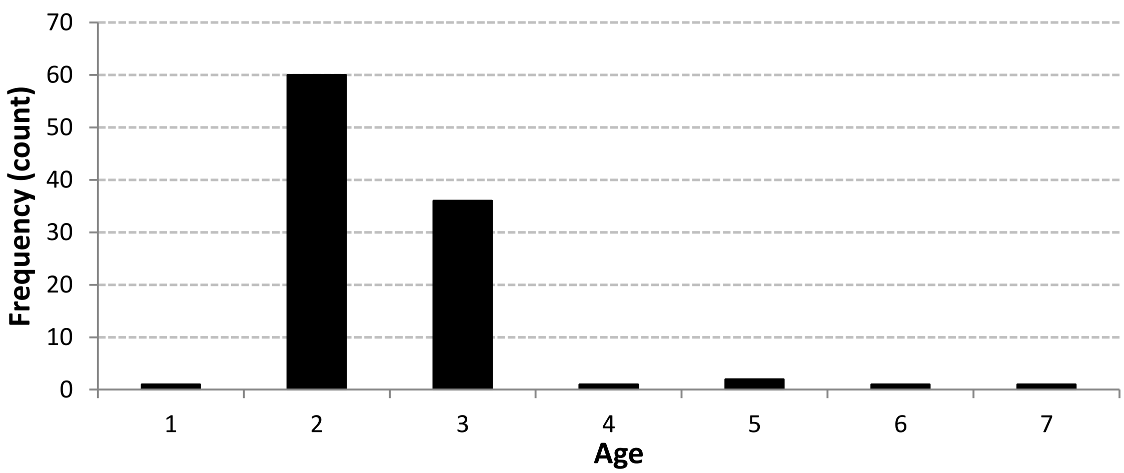

Figure 18. Yellow perch age frequency distribution from Lake Wisconsin, spring 2012.

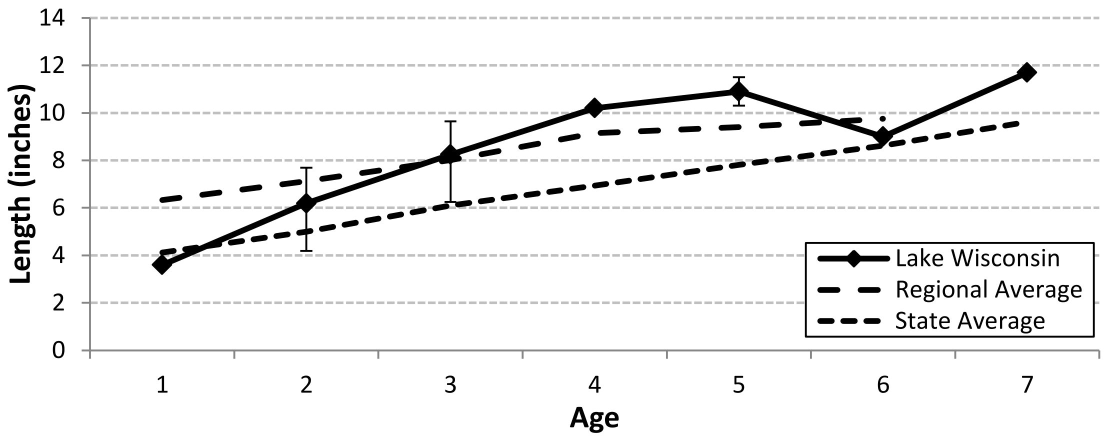

Figure 19. Yellow perch mean length at age from Lake Wisconsin, spring 2012. Error bars represent the range of lengths for each age.

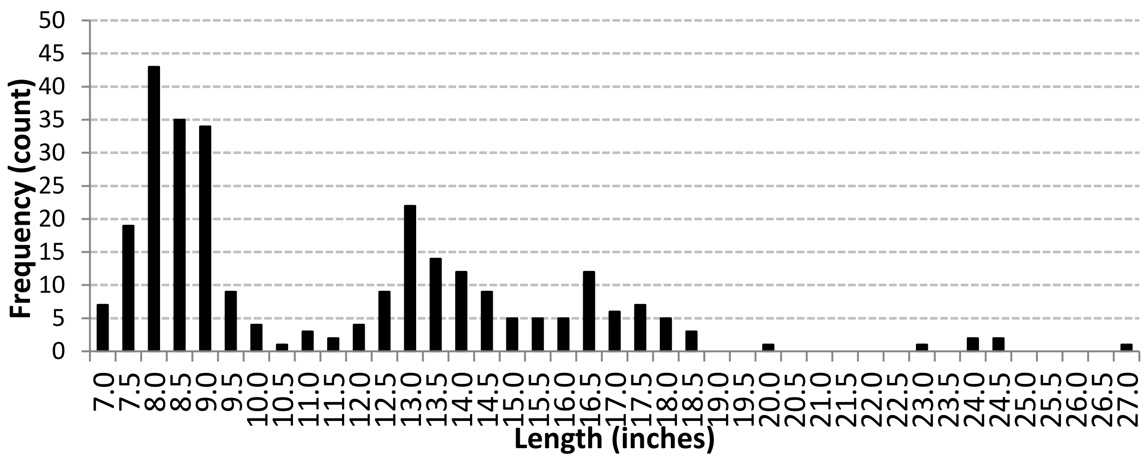

Figure 20. Walleye length frequency distribution from Lake Wisconsin during SNI, SNII, and SEII, 2012.

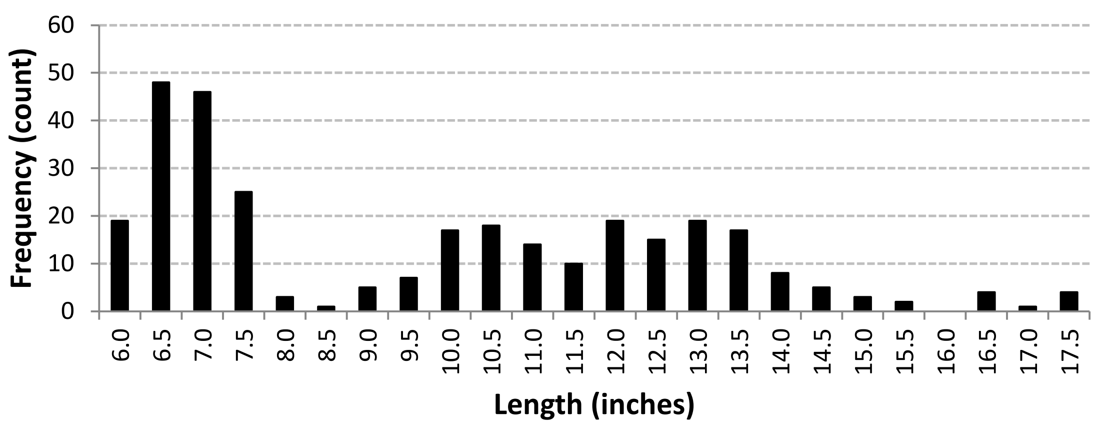

Figure 21. Sauger length frequency distribution from Lake Wisconsin during SNI, SNII, and SEII 2012.

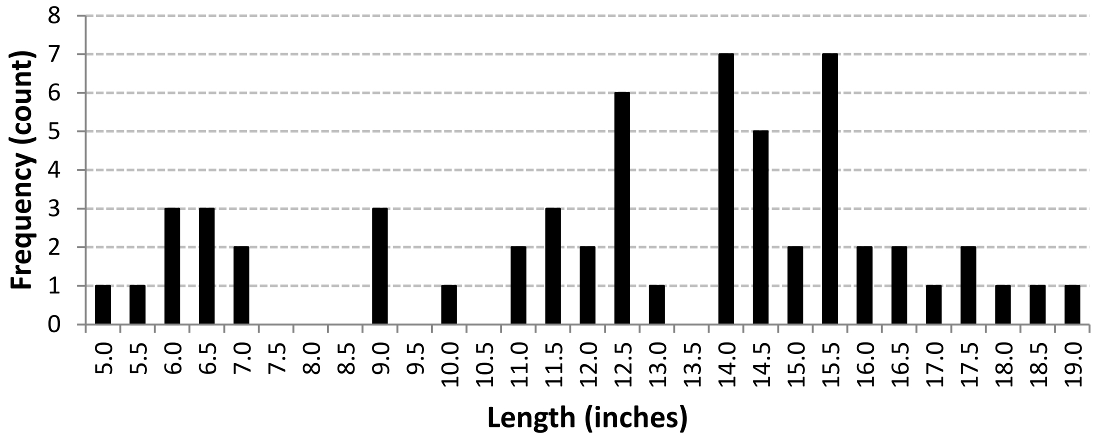

Figure 22. Largemouth bass length frequency distribution from Lake Wisconsin, spring 2012.

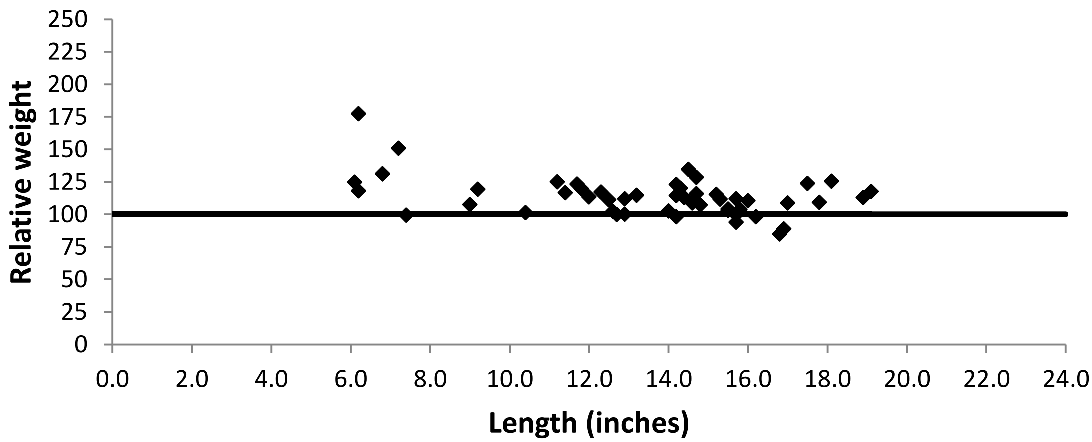

Figure 23. Largemouth bass relative weight from Lake Wisconsin, spring 2012.

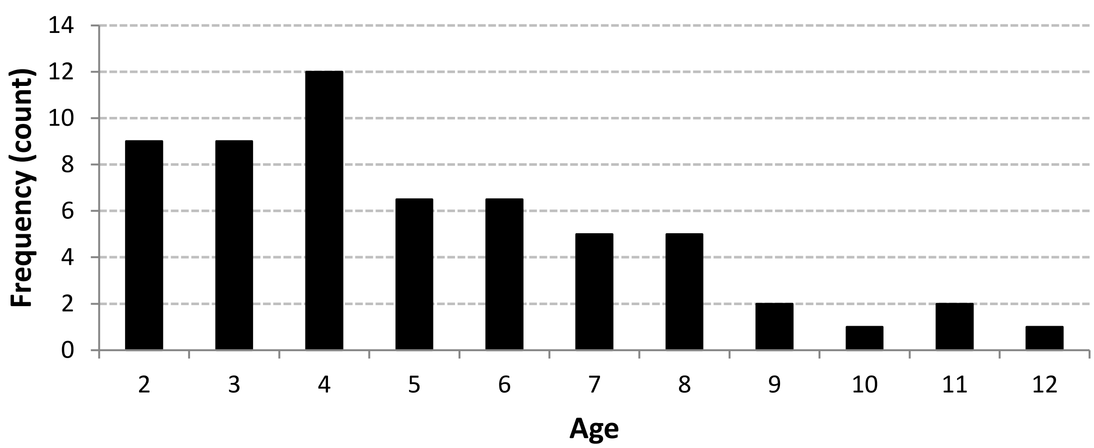

Figure 24. Largemouth bass age frequency distribution from Lake Wisconsin, spring 2012.

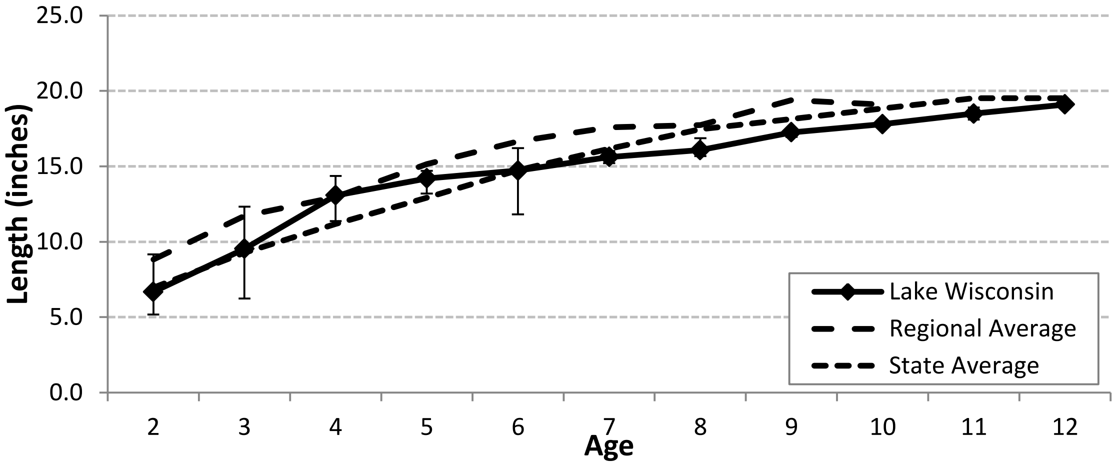

Figure 25. Largemouth bass mean length at age from Lake Wisconsin, spring 2012. Error bars represent the range of lengths for each age.

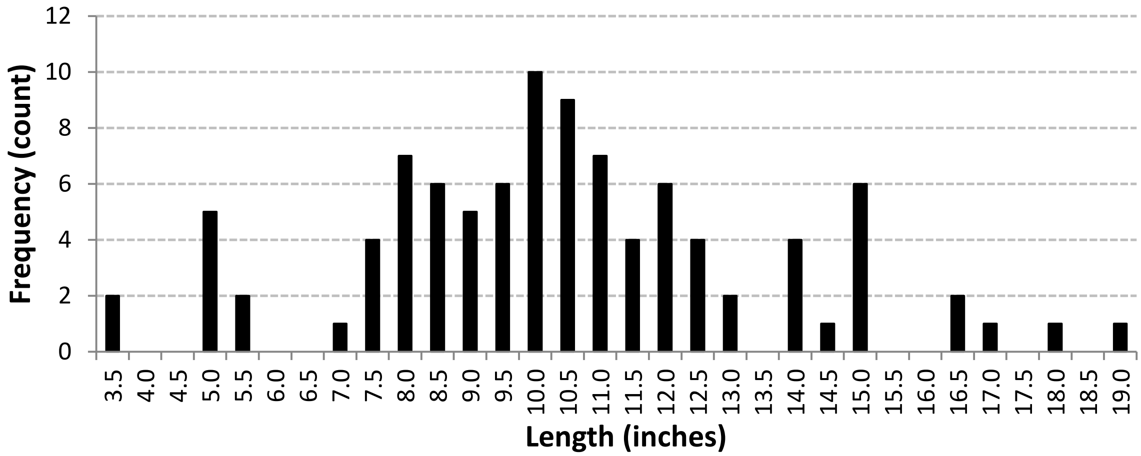

Figure 26. Smallmouth bass length frequency distribution from Lake Wisconsin, spring 2012.

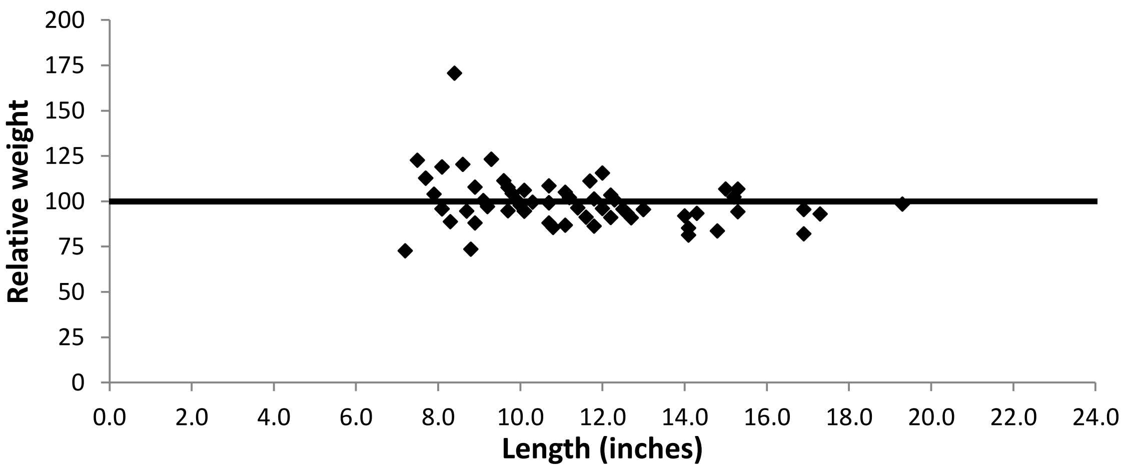

Figure 27. Smallmouth bass relative weight from Lake Wisconsin, spring 2012.

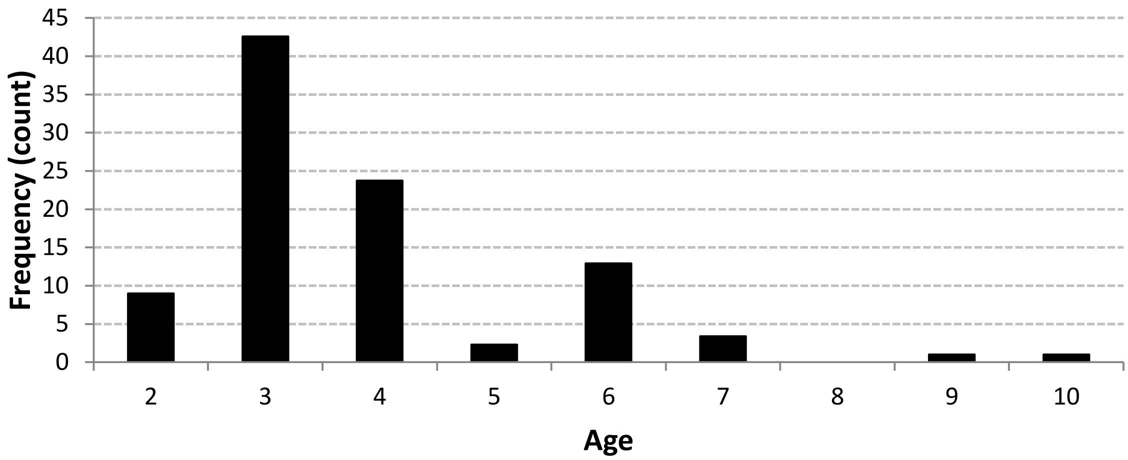

Figure 28. Smallmouth bass age frequency distribution from Lake Wisconsin, spring 2012.

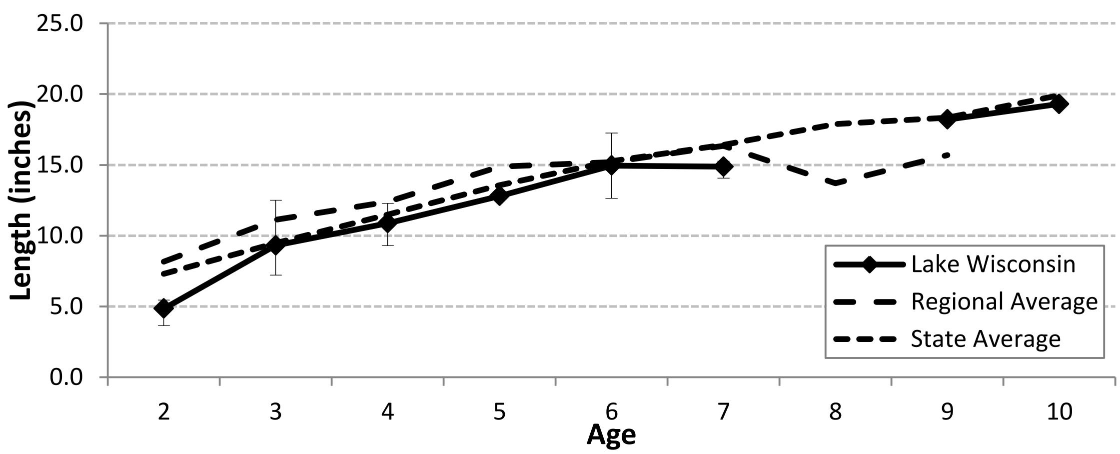

Figure 29. Smallmouth bass mean length at age from Lake Wisconsin, spring 2012. Error bars represent the range of lengths for each age.

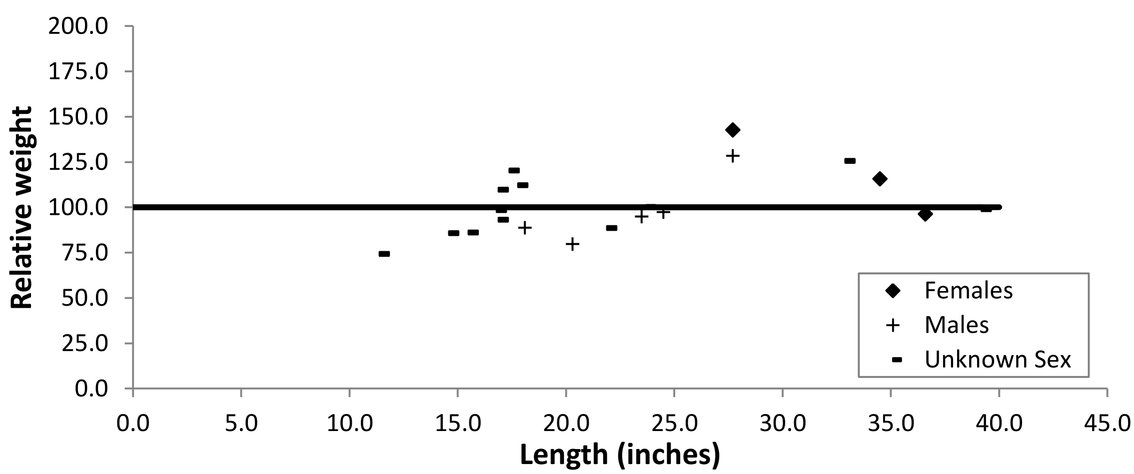

Figure 30. Northern pike relative weight from Lake Wisconsin, spring 2012.

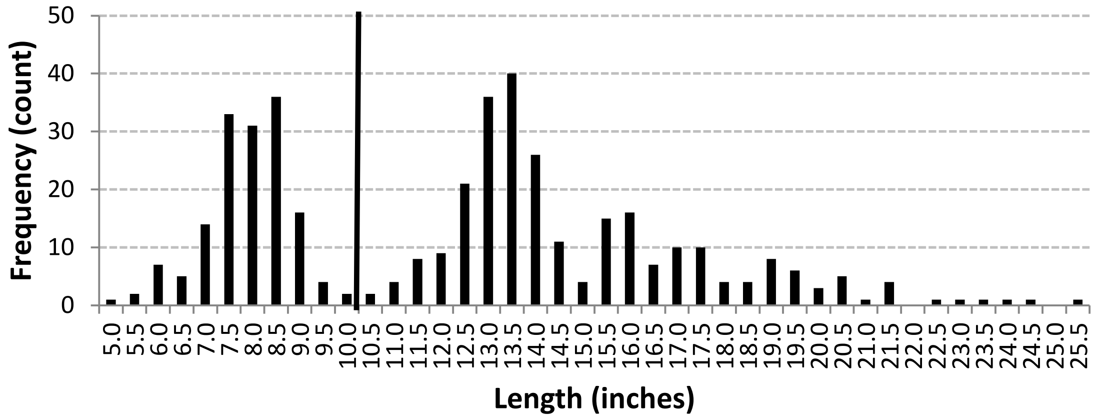

Figure 31. Walleye length frequency distribution from Lake Wisconsin fall electrofishing, 2012. The vertical line is the estimated cutoff between age 0 and age1 fish.

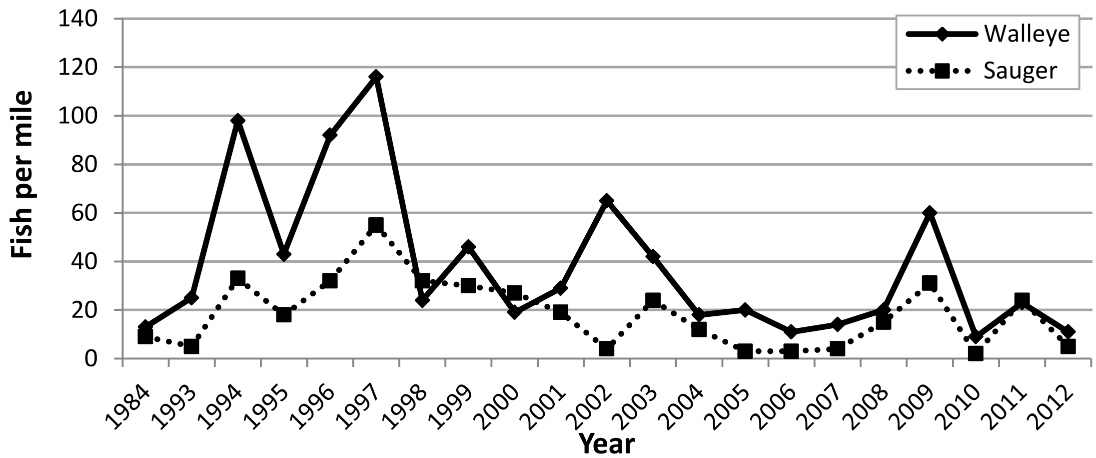

Figure 32. Catch rate of young-of-year walleye and sauger during annual fall electrofishing surveys of Lake Wisconsin, 1984 and 1993 through 2012.

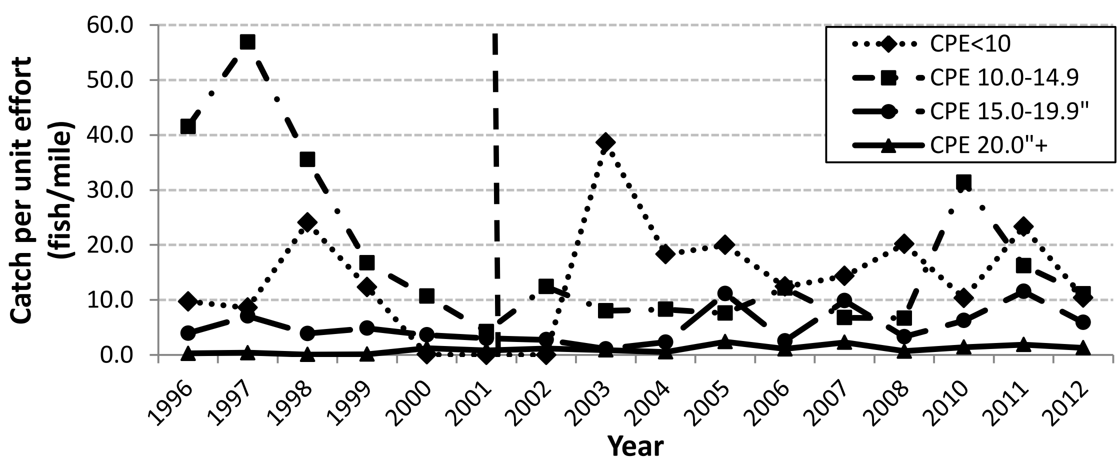

Figure 33. Catch rate of different size categories of walleye during fall electrofishing surveys of Lake Wisconsin, 1996 through 2012.

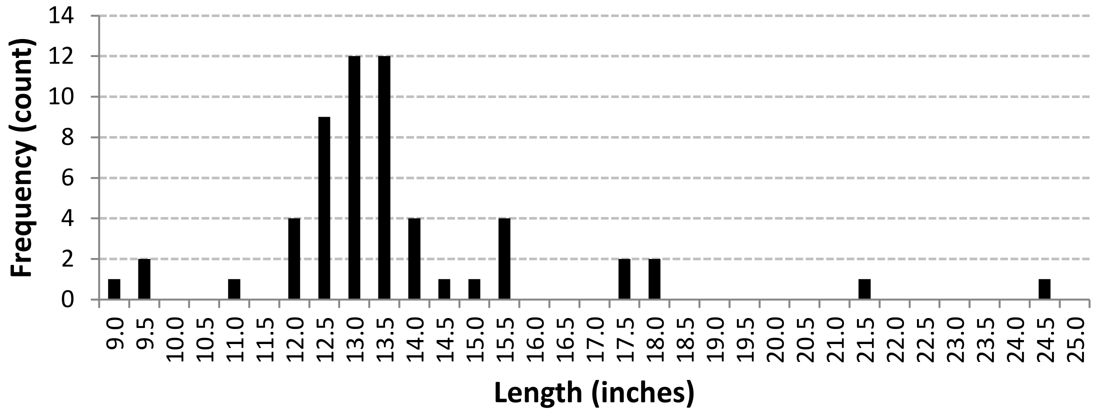

Figure 34. Walleye length frequency distribution from fall electrofishing survey of the Wisconsin River near Wisconsin Dells, 2012.

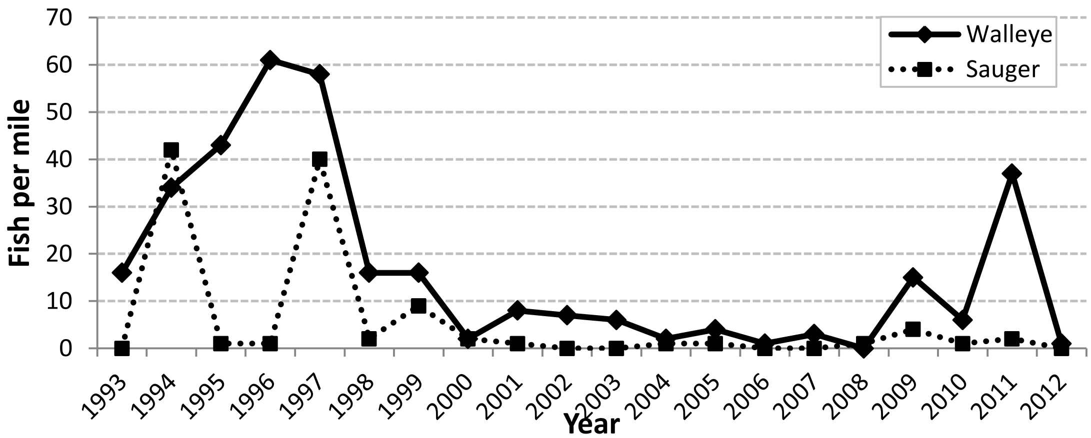

Figure 35. Catch rate of young-of-year walleye and sauger during annual fall electrofishing surveys of the Wisconsin River near Wisconsin Dells, 1993 through 2012.

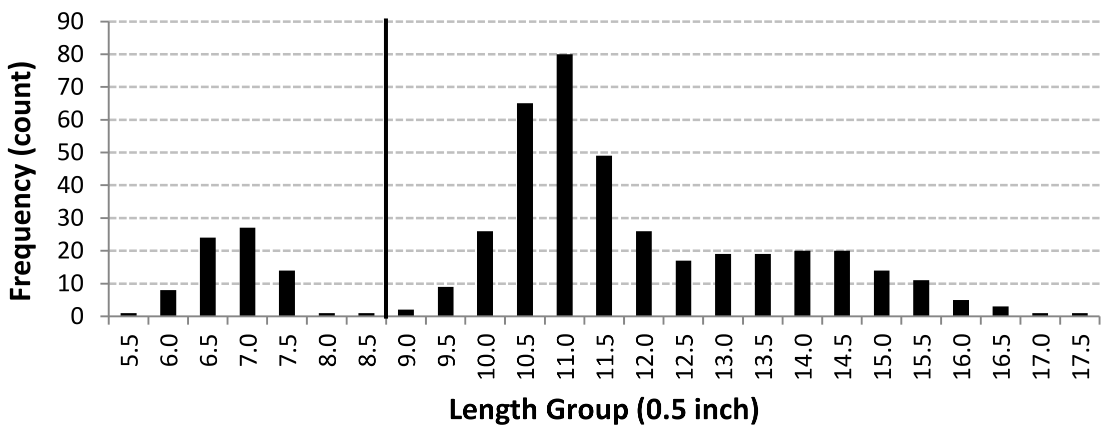

Figure 36. Sauger length frequency distribution from Lake Wisconsin fall electrofishing, 2012. The vertical line is the estimated cutoff between age 0 and age 1 fish.

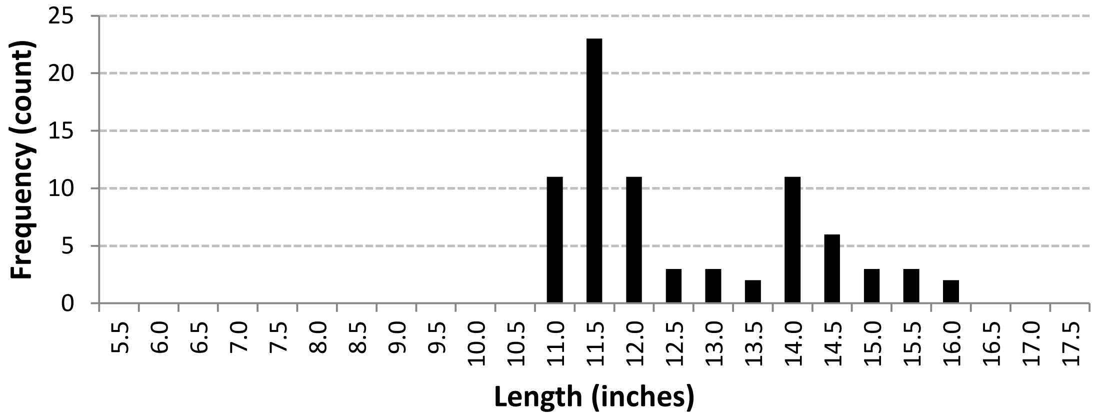

Figure 37. Sauger length frequency distribution from fall electrofishing survey of the Wisconsin River near Wisconsin Dells, 2012.

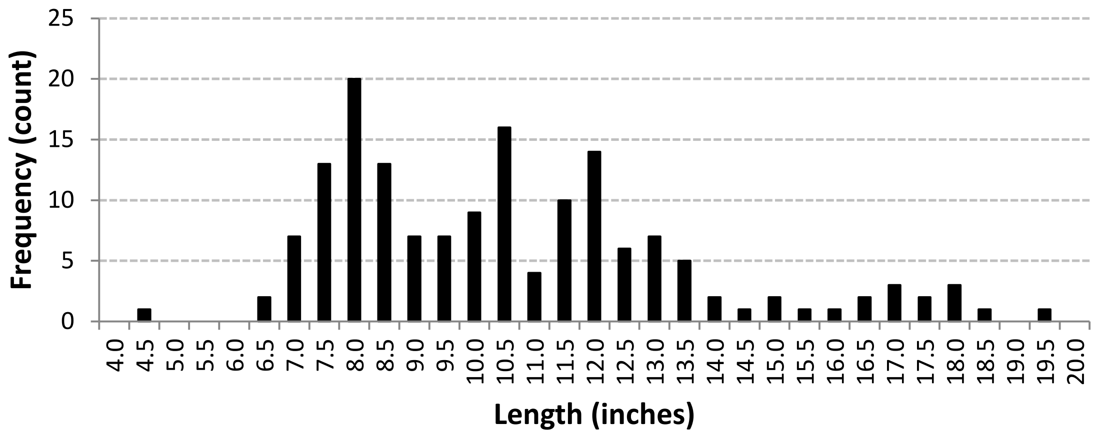

Figure 38. Smallmouth bass length frequency distribution from Lake Wisconsin fall electrofishing, 2012.

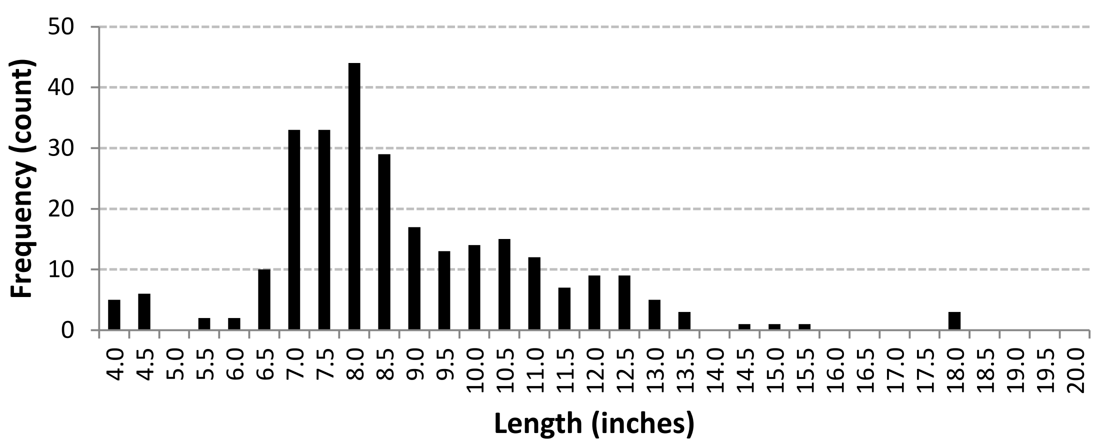

Figure 39. Smallmouth bass length frequency distribution from fall electrofishing survey of the Wisconsin River near Wisconsin Dells, 2012.

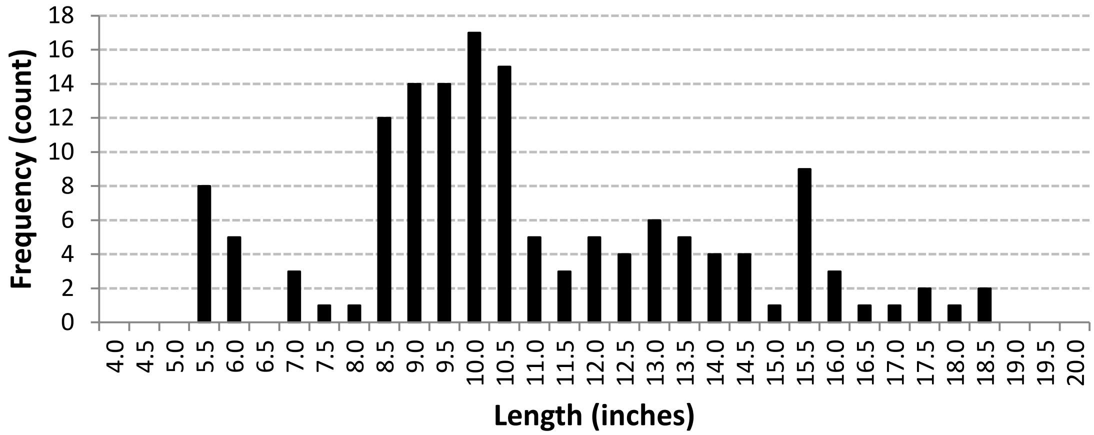

Figure 40. Largemouth bass length frequency distribution from Lake Wisconsin fall electrofishing, 2012.