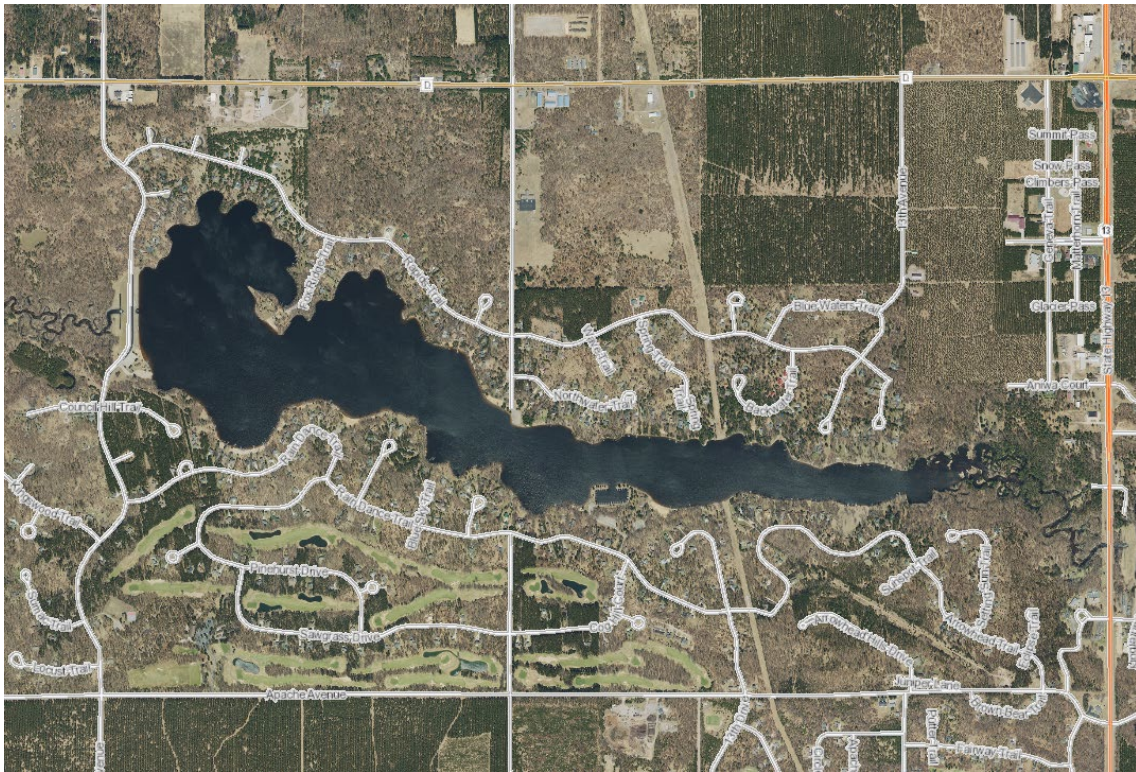


**WISCONSIN DEPARTMENT OF NATURAL RESOURCES**  
**Fisheries Survey Report for Lake Arrowhead**  
**Adams County, Wisconsin**  
**2022**  
WATERBODY IDENTIFICATION CODE 1377700



**JENNIFER BERGMAN**  
DNR Fisheries Biologist  
Wisconsin Rapids, Wisconsin

**JASON SPAETH**  
DNR Fisheries Technician  
Wisconsin Rapids, Wisconsin

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## Introduction

Lake Arrowhead, located in Adams County, Wisconsin, is a 295-acre man-made lake that was constructed in 1978, yet the history of this development goes back to at least 1971 (Figure 1). Archived newspaper articles describe the planning of this lake development, which was the third lake built on Fourteenmile Creek. Construction of the earthen dam was finalized in 1978. Prior to filling the lake, potentially up to 80 piles of trees were stacked and anchored at the 10-to-20-foot depth contour to provide fish habitat. The DNR chemically treated Fourteenmile Creek from below the Lake Sherwood dam to the Lake Arrowhead dam to eradicate common carp. Lake Arrowhead was filled with water and fish stocking started in the spring of 1979. Some common carp evaded the chemical treatment and successfully reproduced. In 1981, Lake Arrowhead was lowered to a stream channel and another chemical treatment took place to kill the common carp. Fish stocking resumed in 1982 to create a fishery with walleye, largemouth bass, northern pike, bluegill, crappie, and yellow perch (Table 1).

In 1993, the lake was drawn down to repair the dam. Pictures in historic files show fish cribs on the lake bottom and how many fish cribs were installed. Where and when is not known, yet commonly used sonar technology could be used to find them. The fisheries manager promoted the need for fisheries habitat due to the sand bottom of the lake and the lack of aquatic vegetation at the time. When the lake was refilled in 1994, additional fish stocking took place due to concerns that fish may have gone downstream with the drawdown. Periodic fisheries surveys took place in the mid-1980s and '90s to evaluate the fish stocking and the fishery. Walleye stockings were recommended to continue to create a fishery due to the lack of natural reproduction. Largemouth bass, northern pike, bluegill, yellow perch and crappie stockings were all eventually discontinued due to evidence of natural reproduction.

In 2014, Lake Arrowhead was incorporated into the Wisconsin Walleye Initiative ([The Wisconsin Walleye Initiative 2022](#)) which has the goal of expanding the stockings of extended growth walleye. Extended growth walleyes are larger in size (6.5-6.8 inches) than small fingerlings (2.3 inches) and have a better chance of surviving (Table 1). DNR fisheries staff conducted fall or spring electrofishing surveys to evaluate those walleye stockings, looking for signs of natural reproduction and fish stocked from previous years.

On April 1, 2016, Lake Arrowhead became part of a large statewide panfish study to evaluate special panfish regulations ([Panfishing in Wisconsin 2022](#)). The special panfish regulation that went into effect for Lake Arrowhead is a daily bag limit of 25 panfish, yet only 10 of each panfish species may be kept. The objective of this special fishing regulation is to improve size structure of panfish. 2010 fisheries survey results showed that bluegill growth was good, yet size structure was poor. Research has shown that the only way to improve size structure when growth is not an issue, especially for bluegill, is to reduce harvest as anglers are known to selectively remove larger sizes of bluegill, yellow perch, and crappie.

In the spring of 2022, a comprehensive fisheries survey was completed by the DNR fisheries staff out of Wisconsin Rapids. The goal of this survey was to evaluate the status of the northern pike, walleye, largemouth bass, yellow perch, crappie, and bluegill fishery. The status of the fishery can be compared to past fisheries survey information. In addition, Lake Arrowhead's fishery can be compared to other lakes in the state that have similar productivity levels and fish communities, especially Camelot Lake and Lake Sherwood. These lakes are impoundments upstream from Lake Arrowhead and are also on Fourteenmile Creek.

Lake Arrowhead is classified as a complex-warm-dark lake. Analysis of trends and comparisons to other similar lakes will be used to help guide future management.

## Methods

On April 8, 2022, eight fyke nets were set on Lake Arrowhead with a water temperature of 41°F. Fyke nets are a sampling gear used in fisheries management to target northern pike, walleye, yellow perch and crappie during their spawning period. These nets are set in locations that have an appropriate depth for the gear and locations that fish utilize for spawning or to reach places to spawn. A lead net is attached to shore and the net is stretched out into the lake, perpendicular to shore. At the end of the lead is a series of hoop/box nets that will trap the fish. Fyke nets are passive in that they rely on fish moving into the lead and following the lead into the series of hoop/box nets where they are trapped until being removed. Nets are checked after 24 hours of fishing. All fish are dipped out of the cod end of the net and put into a tank of water on a boat. After fish collection, the net is tied and reset to continue fishing. Lake Arrowhead's depth drops off fast from the shore for much of the lake, making locations limited for net sets throughout the lake. Nets were set mainly at the lower end by the dam and at the upper end, with a few set in the middle part of the lake. Fyke nets were checked and pulled out of the lake on April 21, 2022. One fyke net that is fished in a 24-hour period is called one net-night. The survey had a total of 72 net-nights. Two other fyke net surveys took place in the past for Lake Arrowhead for data comparisons (Table 2).

All fish caught in the fyke nets were counted and additional information was collected for some species. All walleye, northern pike and largemouth bass were measured in length to the nearest 0.1 inch. A subsample of black crappie, bluegill, yellow perch, and white suckers were measured to the nearest 0.1 inch. All walleye, northern pike, and largemouth bass were given a mark by clipping a fin. These fish species were examined for a fin clip, and if not clipped they were given a clip. If a fish was recaptured from a previous day, the fish's length was measured, sexed and the fish was noted as a recapture. All walleye, northern pike and yellow perch were noted as female, male or unknown. A subsample of walleye and northern pike were weighed (to the nearest 0.1 grams or 0.5 pounds) and a structure was collected to estimate age. The third dorsal spine was removed for walleye and the first three pectoral fin rays were removed for northern pike. A subsample of yellow perch, black crappie and bluegill were sacrificed for estimating age using the otolith (fish ear bone). Those subsampled fish were weighed to the nearest 0.1 gram when processed in the lab. Genetic tissue samples were collected for walleye and northern pike for statewide project requests. Walleye tissue samples will be used to evaluate the walleye stockings and northern pike samples will be used to examine genetic diversity of northern pike in the state to improve stocking guidance.

On the night of April 21, 2022, the entire shore of Lake Arrowhead was electrofished using a maxi-boom. Water temperature was 47.4°F. Two dippers collected walleye only. The purpose of this electrofishing survey was to estimate the abundance of walleye in the lake. The number of marked walleyes recaptured and the number of unmarked walleyes caught were used with the netting data to estimate the number of walleyes in the lake using a mark-recapture model. The survey took 2 hours and 45 minutes, not including processing time for fish. A total of 8.25 miles were surveyed. Pulsed direct current was used with a pulse rate of 50%, duty cycle of 25, 165 volts and 8 Amperes. All walleyes were measured to the nearest 0.1 inch, sexed and examined for a fin clip.

On the night of June 1, 2022, much of the shore of Lake Arrowhead was electrofished using a maxi-boom. The goal of this survey was to assess the largemouth bass and bluegill populations. The water temperature was 68.9°F, within the temperature range that bass and bluegill are on their spawning beds. Electrofishing is active (not passive like fyke nets) in that we seek out the spawning fish. Two dippers collected fish. Panfish were collected at three transects totaling 1.5 miles and 45 minutes of effort. Largemouth bass and other gamefish species were collected at 6 transects totaling 6 miles and 2 hours and 48 minutes of effort. All panfish and gamefish were counted and measured to the nearest 0.1 inch by transect. A subsample of largemouth bass were sacrificed to estimate age using otoliths (fish ear bones). Those fish were weighed to the nearest 0.1 gram in the lab. Common carp were counted during the survey. Electrofishing surveys took place in the past for Lake Arrowhead and can be used for comparison and assessing changes to the fishery (Table 3).

Relative abundance was calculated for all species caught. Relative abundance is catch per unit of effort (CPE). Catch is the number of fish captured and the unit of effort is net-night or miles. Largemouth bass CPE with the electrofishing data is for those fish equal to or greater than 8 inches, whereas CPE for bluegill are those equal to or greater than 3 inches. These CPE values are compared to values for lakes that are like Lake Arrowhead and past surveys for the lake.

Walleye abundance was estimated with 95% confidence intervals using mark-recapture data and a single census estimator (Ricker 1975).

Size structure was evaluated for all panfish and gamefish species using descriptive statistics (average length, minimum length, maximum length), a length frequency distribution, and Proportional Stock Density (PSD; Neumann et al., 2012). PSD is an index used to describe size structure of fish. PSD is calculated by dividing the number of quality or preferred size fish by the number of stock size fish for a given species. For largemouth bass, 14 inches is a common length for evaluating size structure, so Relative Stock Density of 14-inch fish (RSD-14) was calculated. RSD-14 is the percentage of 14-inch fish in the population that are at least stock size.

Growth was evaluated using mean length-at-age for a given species and comparing it to statewide growth information for that species.

Body condition was evaluated using relative weight and the relationship between length and weight (Neumann et al., 2012). Relative weight is the weight of a fish divided by a weight standard for the fish species. The basic concept of relative weight is that the weight standard should describe the inherent shape of a fish in good condition. When relative weight values are well below 100, problems may exist in feeding conditions or food supply. Relative weight values well above 100 indicate that fish may not be making best use of a surplus of prey. Length-weight relationships can be described using a power function ( $W=aL^b$ ), where the parameter  $b$  describes the plumpness of a fish. If  $b$  is 3.0, the fish is growing isometrically where weight is proportional to length. If  $b$  is greater than 3.0, the fish is growing plumper with length. If  $b$  is less than 3.0, the fish is getting skinnier as it grows in length.

# Results

## WALLEYE

The adult ( $\geq 13$  inches) walleye population was estimated to be 347 (95% CI 193-693) fish, so 1.2 adult walleye per acre (95% CI 0.7-2.3). Relative abundance was 2.6 walleyes per net-night and 7.0 walleyes per mile (Table 4-7). A total of 179 walleyes were measured during the fyke netting and early spring electrofishing surveys: 36 females, 91 males and 52 of unknown sex. Walleyes ranged in length from 8.9-23.7 inches, with an average length of 14.3 inches (Figure 2). 51% of the walleyes were 15 inches or larger and 5% were 20 inches or larger. Growth indexed using mean length-at-age was about the same as a state average walleye, within the  $\pm 1$  standard deviation of the average (Figure 3). Walleyes were growing plumper with length ( $b = 4.3$ ). Relative weight ranged from 78-299 with an average of 164, indicating that fish may not be making best use of a surplus of prey. However, some of the plumpness and weight of the walleyes could be due to spawning condition and whether they are spawned out or not.

Adult walleyes were surveyed in 2005 using fyke nets and in 2010 using early spring electrofishing. Mark-recapture surveys were not conducted to estimate population size, but we can look at CPE and size (Tables 2-12). In 2005 and 2010, the relative abundance of walleyes was greater than what was observed in 2022. In 2005, 6.1 walleyes per net night were caught. In 2010, 10.5 walleyes per mile were caught. Size structure was a bit better in 2005 compared to 2022, but 2022 had a high percentage of walleyes over 15 inches compared to 2010. In 2005, walleyes ranged in length from 7.0-28.0 inches with a mean length of 15.1 inches. 53% of the walleyes were 15 inches or greater, 9% were 20 inches and greater and 1% were 25 inches or greater. In 2010, walleyes ranged in length from 8.5-21.5 inches with an average length of 12.2 inches. In 2010, 33% of walleyes were 15 inches or greater and 7% were 20 inches and greater. Age samples were collected in 2005 (scales were used for smaller walleyes and spines used for larger walleyes) and 2010 (the structure used was scales). Overall, the walleyes were growing the same as the average walleye in Wisconsin and like the walleyes of 2022. Weight data was not collected in these years to evaluate body condition.

Walleye stocking has been consistent, yet there are gaps, and some changes were made (Table 1). Small fingerling ( $\sim 2.3$  inches) walleyes were stocked consistently by the DNR on even years from 1988-2004 with an additional stocking event in 2003. Two private stocking events of large fingerling ( $\sim 6.7$  inches) walleyes occurred in 1994 and 1995. DNR stocking records do not exist from 2005-2013, potentially indicating no stocking occurred. Camelot Lake and Lake Sherwood, upstream of Lake Arrowhead, were stocked with walleyes in this period. The 2010 survey did capture walleyes from 8.0-13.0 inches, indicating that stocking may have occurred or that the lake was not stocked and these fish moved through the Lake Sherwood dam into Lake Arrowhead. Based on the 2022 age estimation work, walleyes collected were from age-2 up to age-11. Walleye were not stocked annually (only even years) from 2011-2019 to have fish in the system with the ages found. A private walleye stocking of large fingerling walleyes occurred in 2013 and the DNR stocked extended-growth, large fingerling walleye in the fall on even years from 2014-2020. Past survey work has showed no evidence of natural reproduction. Again, walleye may have come from the lakes upstream that were stocked on odd years as fish do move through dams. The only public launch on Lake Sherwood, upstream of Lake Arrowhead, is located right by the Sherwood Dam. Age

estimation error is also likely as dorsal spines are less accurate than otoliths that require sacrificing the fish. Walleye genetic samples collected may shed light on origin, as Lake Sherwood and Camelot Lake walleyes have unique genetic markers from their broodstock and there are unique genetic markers for all fish stocked for some years.

## NORTHERN PIKE

During the fyke netting survey, 48 northern pike were handled. The CPE was 0.7 fish per net night. Lakes that are like Lake Arrowhead (Lake class is complex-warm-dark), have a northern pike 25<sup>th</sup> percentile CPE of 0.6 fish per net night and a median of 1.2 fish per net night. The 2022 CPE for northern pike in Lake Arrowhead is therefore just above the 25<sup>th</sup> percentile. Northern pike ranged in length from 16.0 to 34.0 inches (Figure 4). 93% of the fish were of quality length (21 inches) or greater, 13% were preferred length (28 inches) or greater, and 4% of the fish were of memorable size (34 inches) or greater. Growth was indexed, where age-3 northern pike are growing the same as the average northern pike in Wisconsin (Figure 5). Relative weight ranged from 96 to 116 with an average of 105, indicating the fish were in good body condition.

Northern pike were also sampled in 2005 with a spring fyke netting survey. Thirteen northern pike were caught, and length ranged from 23.8 to 29.7 inches. The 29.7-inch fish was a female, and the rest were unknown. This survey likely missed the northern pike spawning window because most fish in this length range should have been sexually mature and identifiable as male or female. Water temperature ranged from 47-56°F, which is at the end of or past the northern pike spawning window. Northern pike need to be surveyed as soon as ice goes off the lake, as pike are first to spawn and have been known to spawn underneath the ice if ice off is late. The 2005 survey likely targeted walleye, which spawn later than northern pike.

## LARGEMOUTH BASS

During the late-spring electrofishing survey, 272 largemouth bass were caught. The CPE was 36 fish per mile (Table 8). This CPE value for largemouth bass is high and just below the 75<sup>th</sup> percentile for lakes that are like Lake Arrowhead (Lake class is complex-warm-dark).

Largemouth bass ranged in size from 5.7 to 17.0 inches, and 10.8 inches was the average (Figure 6). For PSD, 48% of the largemouth bass caught were of quality size (12 inches) or larger, 5% were of preferred size (15 inches) or larger, and 13% were 14 inches or larger. Generally accepted PSD index values for balanced fish populations have a largemouth bass PSD that ranges from 40-70 and PSD-P values of 10-40, so Lake Arrowhead is missing the mark with the numbers of 15 inch and larger sized largemouth bass. The percentage of 14-inch fish is low compared to other lakes like Lake Arrowhead. Growth was indexed using 7.8-10.5-inch fish. Growth was the same as the state average yet may be slower than the state average bass starting at age-4 (Figure 7). Fish were growing isometrically with  $b=3.0$ . Relative weight ranged from 75-116, average of 102.

Late-spring electrofishing surveys also took place in 2004, 2010 and 2021. Relative abundance of largemouth bass was considered low in 2004 (7 per mile) yet high (Above the median to the 75<sup>th</sup> percentile) for 2010 (29 per mile) and 2021 (45 per mile). Size structure was likely not better in 2010 compared to 2022. 61% of the fish were 12 inches or greater, 9% were 15 inches or greater, and 18% were 14 inches or greater. Yet this percentage of 14-inch largemouth bass is still low compared to other waters like Lake Arrowhead. The 95% confidence intervals for

PSD (quality size) values overlap and aren't significantly different. Growth appears to have been faster in 2010 compared to 2022. However, scales were used in 2010 to estimate age. Compared to spines and otoliths, scales tend to underestimate age and it is likely growth was slower than estimated.

## BLUEGILL

Bluegills were sampled with late-spring electrofishing. 215 bluegills were caught for a CPE of 143 fish per mile (Table 8). This relative abundance was above the median (117 per mile) compared to other lakes like Lake Arrowhead.

Fish ranged in length from 3.0 to 9.1 inches with an average length of 5.4 inches (Figure 8, Table 10). 27% of the bluegills were at least quality length (6 inches) and 1% were preferred size (8 inches) or larger.

During the fyke netting survey, 291 bluegills were measured and 995 total were caught. The CPE was 13.8 per net night (Table 4). Bluegills in the nets ranged from 3.2 to 9.5 inches, average length was 5.4 inches (Figure 8, Table 10). 35% of the bluegills were at least quality length, and 3% were of at least preferred size.

Generally accepted PSD index values for balanced fish populations have bluegill PSD that ranges from 20-60 and PSD-P values of 5-20, so Lake Arrowhead is missing the mark with the numbers of 8-inch and larger sized bluegills.

Relative weight ranged from 42 to 129 with an average of 111. The most observed weight was 117. Most of the fish are above 100, indicating that they're in good body condition. Growth was the same as the average bluegill in Wisconsin or within 1 standard deviation (Figure 9). Bluegill were getting plumper with length ( $b=3.9$ ).

## PUMPKINSEED

Pumpkinseeds are in the sunfish family like the bluegill, but they're two distinct species. They were surveyed with late-spring electrofishing. In 2022, 74 pumpkinseeds were caught with a CPE of 49 per mile. Pumpkinseed ranged in length from 3.7 to 7.2 inches with an average length of 5.8 inches (Figure 10). 45% of fish were quality length (6 inches) or larger, and no fish were caught of preferred length (8 inches). Growth was indexed using fish in the 5.0 to 6.4-inch length bin. They were found to be growing the same as the average pumpkinseed in Wisconsin (Figure 11). Relative weight ranged from 97 to 154, with an average of 124. Overall, the fish were in good body condition.

Late-spring electrofishing surveys also took place in 2010 and 2021. In 2010, 25 pumpkinseeds were caught, and CPE was 25 per mile. These fish ranged in length from 3.5 to 7.5 inches. In 2021, 78 pumpkinseeds were caught with a CPE of 52 per mile. These fish ranged in length from 3.3 to 7.3 inches. 45% of the fish were quality length (6 inches) or larger, and no fish of preferred length (8 inches) were caught. All fish were of similar sizes to those caught in 2022.

## YELLOW PERCH

Yellow perch were surveyed using fyke nets. 1166 yellow perch were caught, of which 488 were measured. Relative abundance was 11.5 fish per net night. In 2005, 232 yellow perch

were caught in the fyke net survey. Relative abundance was 5.3 fish per net-night, fewer than 2022.

Yellow perch ranged in length from 4.1 to 9.9 inches with an average size of 6.2 inches (Figure 12). The percentage of yellow perch that were quality length (8 inches) or larger was 10%. No fish of preferred length (10 inches) or larger were caught. Yellow perch were not measured during the 2005 survey.

Growth was found to be within one standard deviation of the average yellow perch, yet growth rate tapered off and was below average as fish reached 7-8 years old (Figure 13). Fish were getting a bit plumper with length ( $b=3.3$ ), which could be due to spawning condition. Relative weight ranged from 45 to 122, average relative weight was 89, and most often observed was 86. A relative weight value of 100 means that the fish are in good condition, the yellow perch were in poor body condition.

During the late-spring electrofishing survey, 47 yellow perch were caught with a CPE of 31 fish per mile, and lengths ranged from 3.4 to 8.6 inches. Late-spring electrofishing surveys also took place in 2010 and 2021. CPE was 45 and 38 fish per mile, respectively. Yellow perch caught in 2010 ( $n=45$ ) ranged in length from 2.7 to 7.6 inches, Age and weight data were not collected to evaluate growth or body condition. In 2021, yellow perch ( $n=57$ ) ranged in length from 3.7 to 9.0 inches.

## BLACK CRAPPIE

Black crappies are most effectively sampled using fyke nets. During the 2022 survey, 637 black crappies were caught, resulting in a relative abundance of 8.8 fish per net-night. 161 of the crappies were measured. They ranged in length from 4.1 to 11.0 inches with an average length of 5.5 inches (Figure 14). 7% of the fish were of quality length (8 inches) or larger, and 1% were of preferred length (10 inches) or larger. Crappie recruitment can be cyclical, and there was a good year class produced in 2020. Most fish caught were 2 years old (4.5 to 6.0 inches). Growth was found to be within one standard deviation of the average black crappie, yet overall slower than the average crappie (Figure 15). Relative weight ranged from 41 to 114 and the average was 86, indicating that most of the fish were in poor body condition. They were getting plumper with length ( $b=3.6$ ).

There is limited historical black crappie data. In 2005, 55 black crappies were caught in fyke nets resulting in a CPE of 1.3 per net-night. 49 of those crappies were measured and ranged in length from 4.2 to 10.8 inches. These fish were growing faster than the black crappies of 2022. Age was estimated using scales, which may underestimate the age of the fish and bias growth to be faster.

## OTHER SPECIES

Other fish species caught during the 2022 survey included common carp, golden shiner, white sucker, and yellow and black bullhead. Common carp were not noted in the other surveys yet were observed during fall electrofishing surveys that targeted walleye. The carp counted during the 2022 late-spring electrofishing surveys were very large and likely very old. The most dramatic change was with the white sucker numbers. In the 2005 spring fyke netting survey, 564 white suckers were caught with a CPE of 12.8 per net-night. In 2022, 10 white suckers were caught with a CPE of 0.1 per net-night. White suckers were not measured in



2005. In 2022, white suckers ranged in length from 10.9 to 21.3 inches. White suckers are likely reproducing, yet their numbers are much lower than in the past.

## **Discussion and Recommendations**

Fisheries staff completed fall nighttime electrofishing surveys of the entire shoreline in 2016, 2017, 2018, 2019, 2020 and 2022 prior to fish stocking to look for evidence of natural reproduction and survival of stocked walleyes. The number of walleyes caught during these surveys ranged from 2 to 13 with an average of 5.6 walleyes. These low numbers and the absence of young of year captured indicated that walleyes are likely not naturally reproducing. We also had the initial impression that the stocked walleyes were not surviving well. However, the 2022 spring survey revealed that the stocked walleye have created a low-density fishery, and fall sampling is not an effective survey for assessing adult walleye abundance.

Walleye stocking has created a fishery of 1.2 adult walleye per acre. Typically for stocked walleye fisheries we'd like the adult abundance to be 2-3 per acre. The adult walleye abundance is similar to Camelot Lake, which also had an adult walleye estimate at 1.1 per acre. The CPE of adult walleye was also similar to Lake Arrowhead and Camelot Lakes, at 2.6 and 2.7 fish per net night, respectively. These CPEs are just above the median (2.0 fish per net night) for walleye in other lakes that are classified as complex-warm-dark. The stocking rate for walleye is currently at 10 fish per acre. It can be increased to 15 per acre and evaluated to see if adult walleye numbers could reach the 2.0-3.0 fish per acre target.

The fishing regulation for walleye is the general inland walleye regulation: a 15-inch minimum length limit with a daily bag limit of 5 fish. There is a rule proposal going through the rulemaking process that will change the daily bag limit to 3 for all inland waters unless a bag limit is more restrictive. If this rule is signed into law by the governor, the 3 daily bag limits would be in place for the 2024 spring opener.

The largemouth bass population is abundant, growth is average, and size structure could use improvement as not many bass were found over 15 inches. There are limited past fisheries surveys for Lake Arrowhead, yet the largemouth bass population does not appear to be significantly different in terms of size structure with the 2010 survey. The current fishing regulation for largemouth bass is the statewide regulation: a minimum length limit of 14 inches with a daily bag limit of five. The management objective of this regulation is to sustain or increase densities. This regulation could continue to be used to maintain the abundant, quality largemouth bass population. Fisheries management has a fishing regulation in our toolbox to improve size structure and allow for consumption of largemouth bass. This special regulation is geared toward high density, slow growing populations and is a 14–18-inch protected slot with a daily bag limit of five, only one of which can be over 18 inches. The largemouth bass population in Lake Arrowhead would be a good candidate for this fishing regulation if anglers want to try to improve the numbers of 14–18-inch largemouth bass in the population and allow for consumption of smaller bass. The effectiveness of this special regulation is dependent on anglers harvesting bass.

Northern pike relative abundance is low, while growth and size structure are good. The current regulation is a minimum length limit of 26 inches with a daily bag limit of two fish. The objective of this regulation is to create a quality northern pike fishery and appears to be

working with our metrics for size structure at acceptable levels. Stocking of northern pike may be an option to improve abundance and, if implemented, should be evaluated for efficacy.

Bluegills are abundant, growth is average, and body condition is good, yet size structure is not great as the population has few 8-inch and larger bluegills. 1995 was the only surveyed year that had 9% of the bluegills 8 inches or greater. Since, it's ranged from 0-3% (Table 6 and Table 10). Size structure of bluegill has potentially improved since 2010. In 2010, the largest bluegill caught in a survey was 6.9 inches, and 12% of bluegills were 6 inches or greater (Table 10). In 2021 and 2022, bluegills 8 inches or larger were caught (1-2%), maximum sizes were 9.0 and 9.1 inches, and 18% and 27% of bluegills were 6 inches or greater (Table 10). The special panfish regulation currently in place will be sunseting in 2026 and revert to the statewide daily bag limit of 25. Average length is the primary metric for evaluating special panfish regulations. The special regulation for Lake Arrowhead appears to have worked; the change in average length between 2010 and 2022 was 0.8 inches. This fell short of the 1.0-inch goal by 0.2-inches, yet with more time under the regulation the bluegill population may have reached the 1.0-inch objective. The special regulation that is currently in place will not be an option in 2026. Lake Arrowhead would be a candidate for a 10 panfish daily bag limit or a daily bag limit of 15 with no more than 5 of any panfish species. Since a reduced panfish bag limit has worked for Lake Arrowhead, one of the reduced panfish regulation options for 2026 could maintain or improve the size structure for bluegill.

Yellow perch are abundant, growth is average yet slows with age, body condition is poor, and size structure is poor as there are few (10%) of at least quality size (8 inches). Limited historical data does not give us a picture of changes to the yellow perch population. The fyke netting shows a potential increase in abundance where electrofishing survey data shows no change.

Black crappies are abundant, growth is average, and body condition poor. Size structure is being driven by a good year class from 2020.

## **Acknowledgements**

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# Appendix

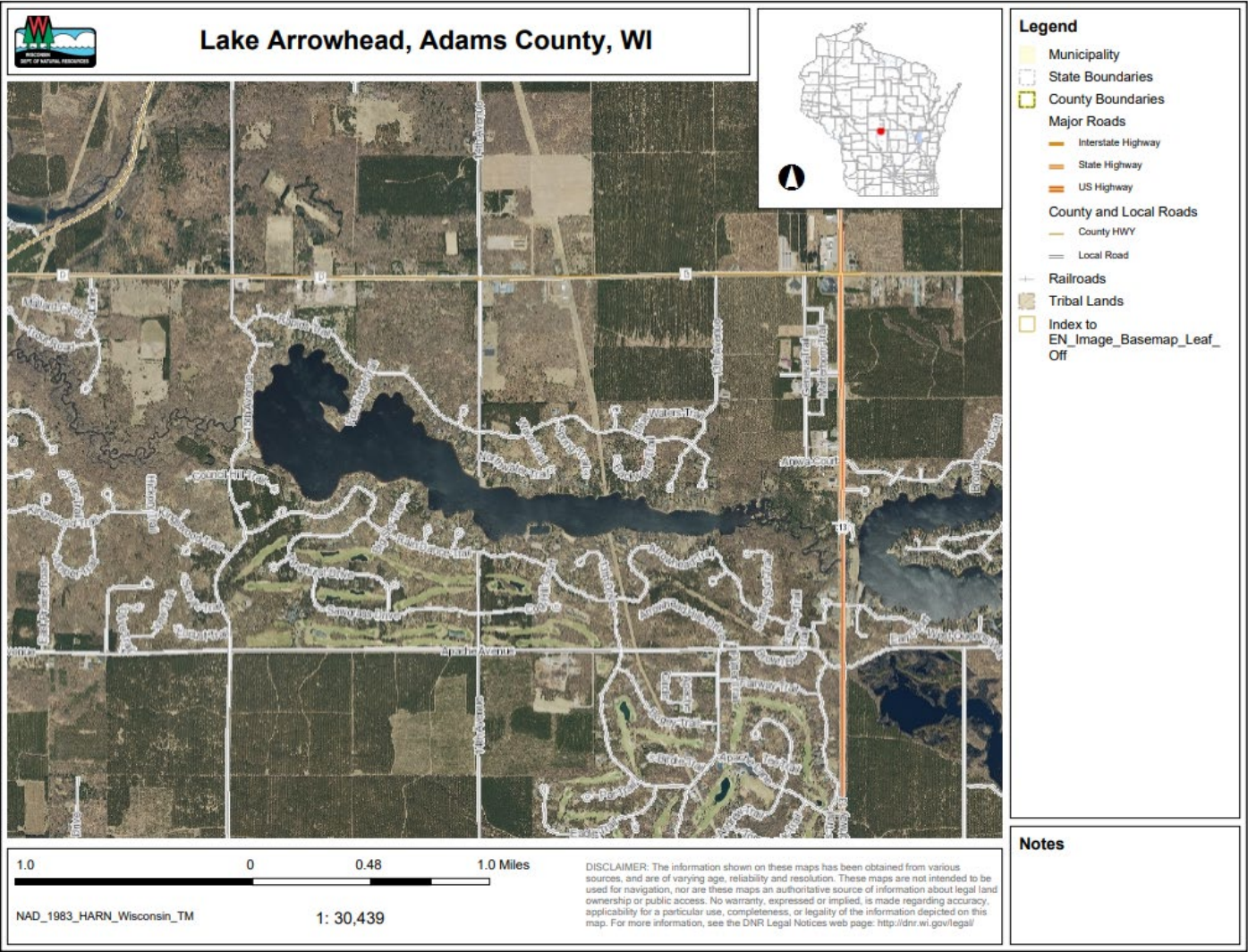


Figure 1. Map of Lake Arrowhead

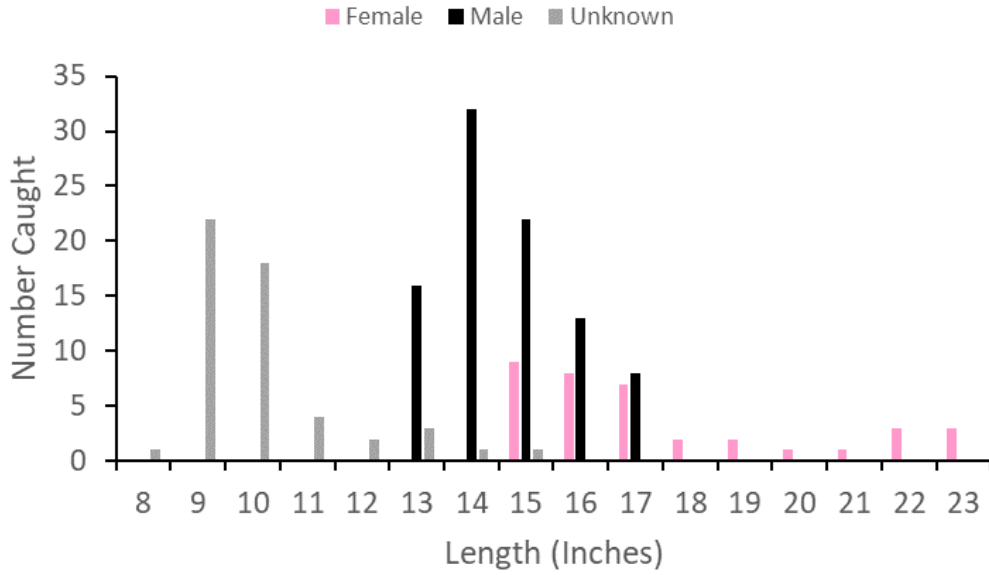


Figure 2. – Length frequency of walleyes captured using fyke nets and electrofishing in Lake Arrowhead, Wisconsin in 2022 (n=179).

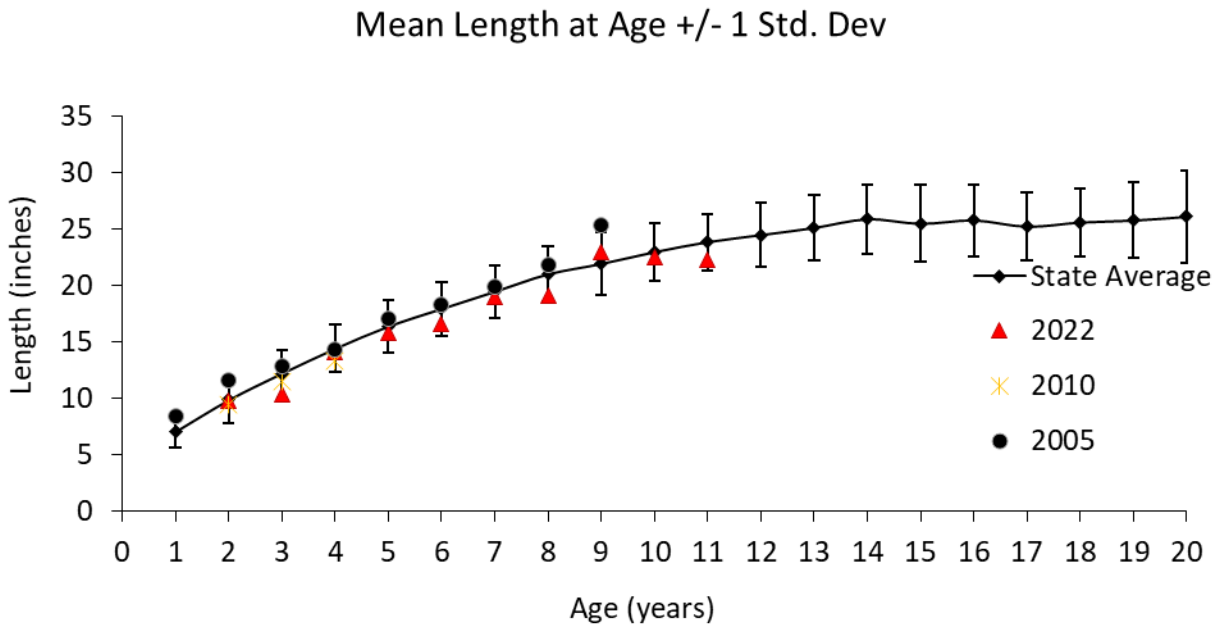


Figure 3. – Mean length at age of walleyes captured in Lake Arrowhead in 2005 (Structure=scales and spines), 2010 (structure=scales) and 2022 (structure=spines) compared to the statewide average walleye.

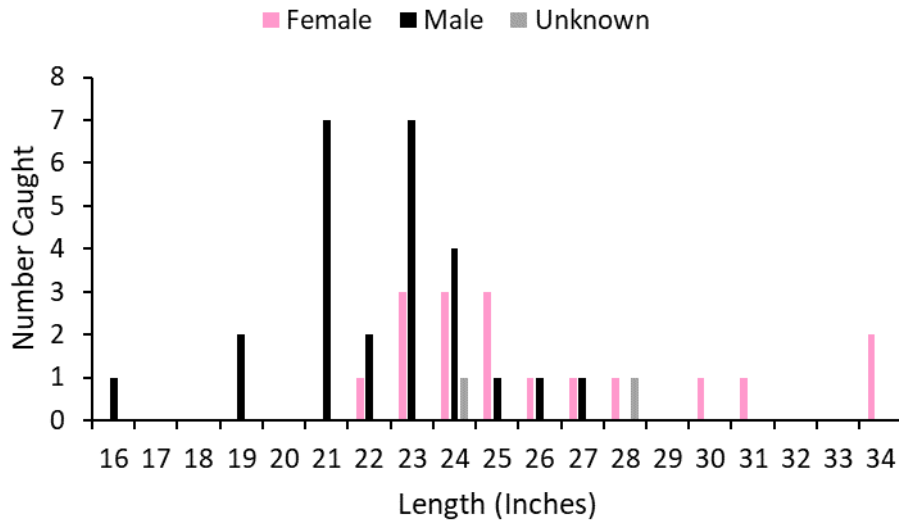


Figure 4. – Length frequency of northern pike captured using fyke nets in Lake Arrowhead in 2022 (n=48).

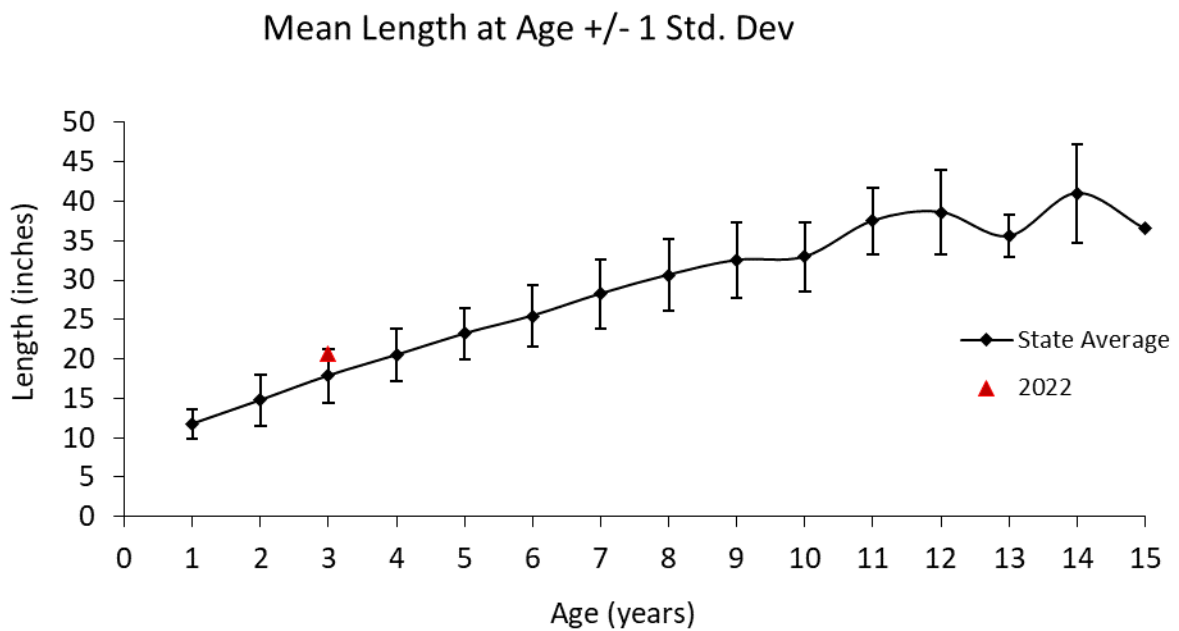


Figure 5. – Mean length at age-3 for northern pike (structure=pectoral fin ray) captured in Lake Arrowhead in 2022 compared to the statewide average northern pike.

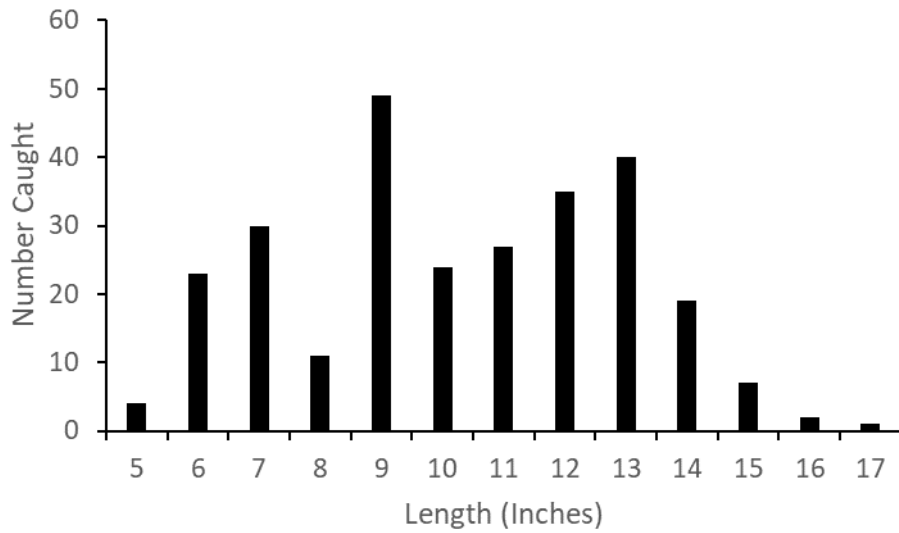


Figure 6. - Length frequency of largemouth bass captured in Lake Arrowhead in 2022 using electrofishing (n= 272).

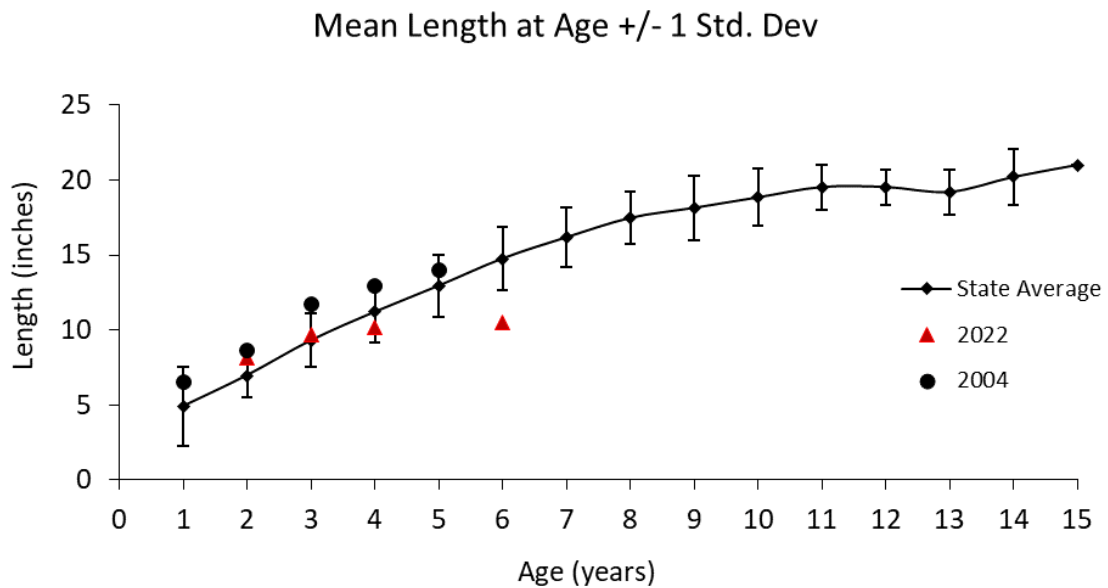


Figure 7. - Mean length at age of largemouth bass captured in Lake Arrowhead in 2004 (structure=scales) and 2022 (structure=spines) compared to the statewide average largemouth bass.

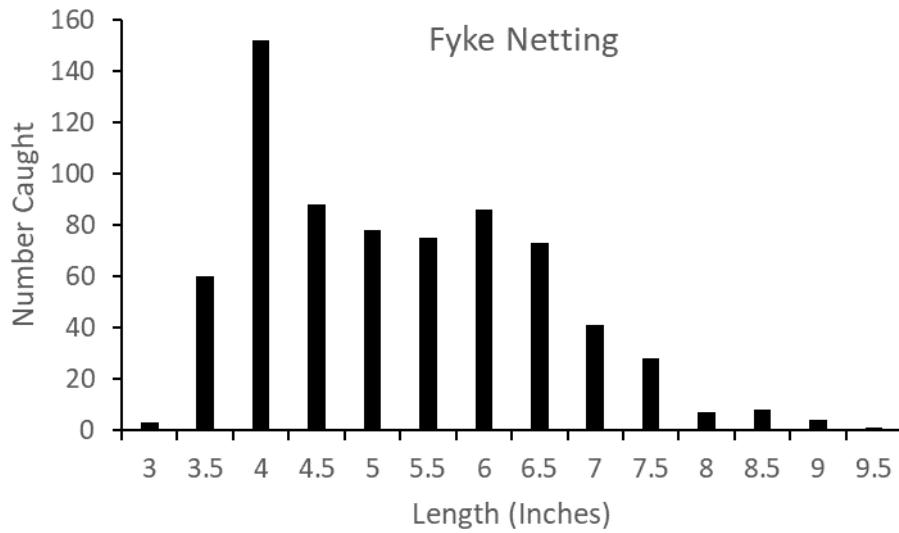
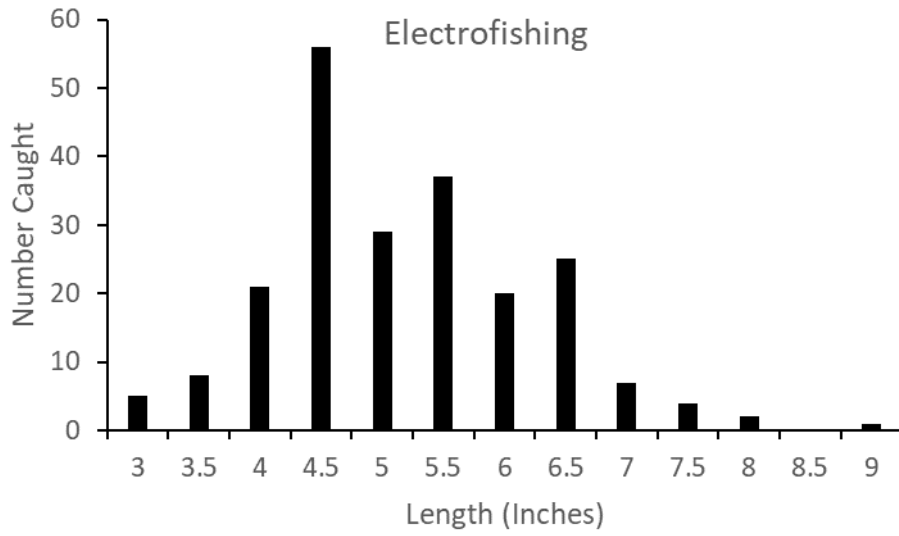


Figure 8. – Length frequency of bluegills captured in Lake Arrowhead in 2022 with electrofishing (n=215) and fyke netting (n=291).



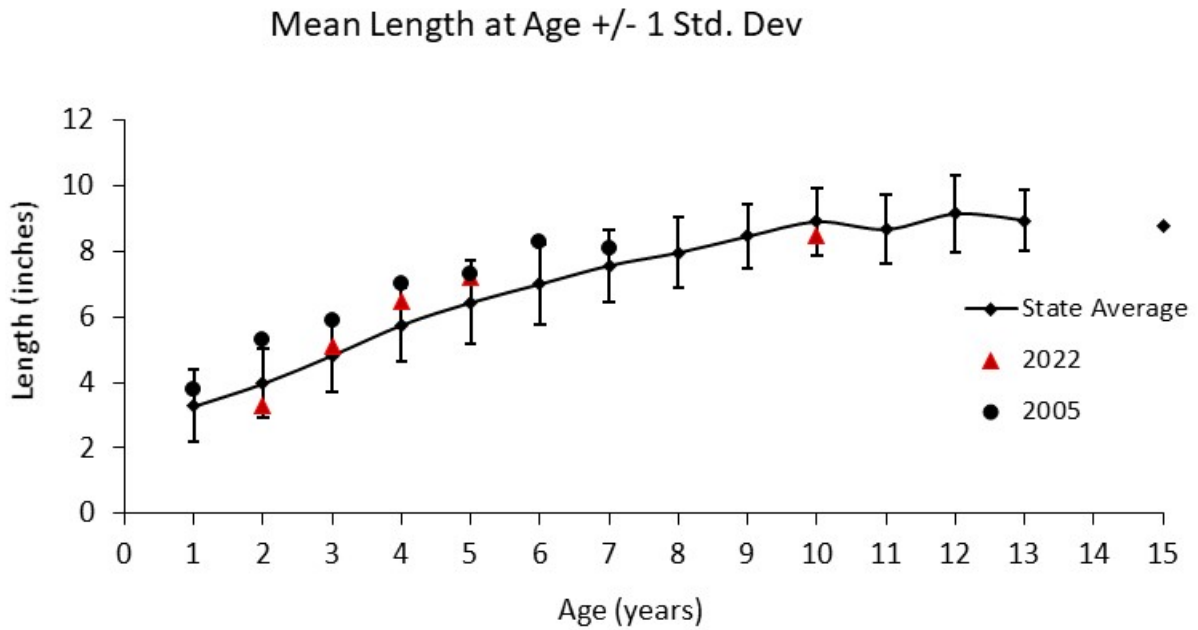


Figure 9. – Mean length at age of bluegills captured in Lake Arrowhead in 2005 (structure=spines) and 2022 (structure=otoliths) compared to the statewide average bluegill.

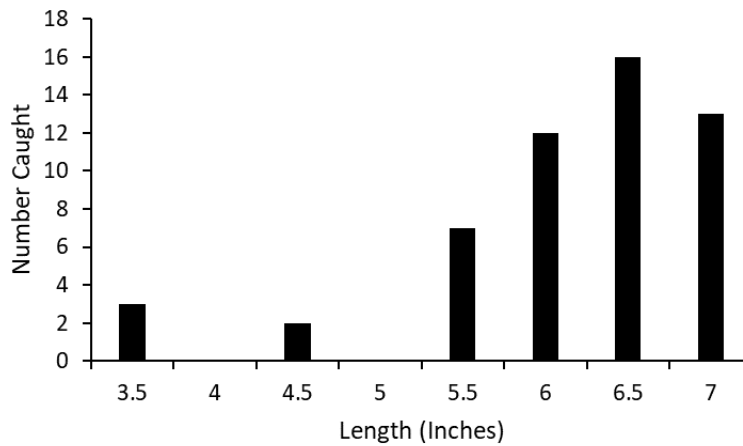


Figure 10. – Length frequency of pumpkinseeds captured using fyke nets in Lake Arrowhead in 2022 (n=53).

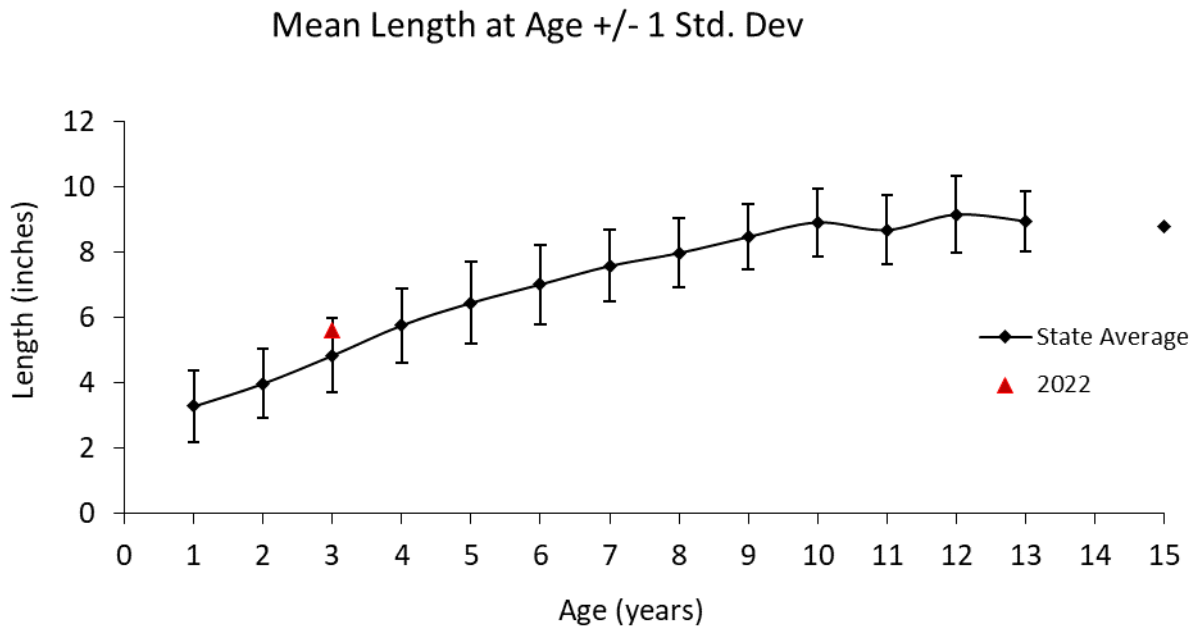


Figure 11. – Mean length at age-3 for pumpkinseeds (structure=otolith) captured in Lake Arrowhead in 2022 compared to the statewide average pumpkinseeds.

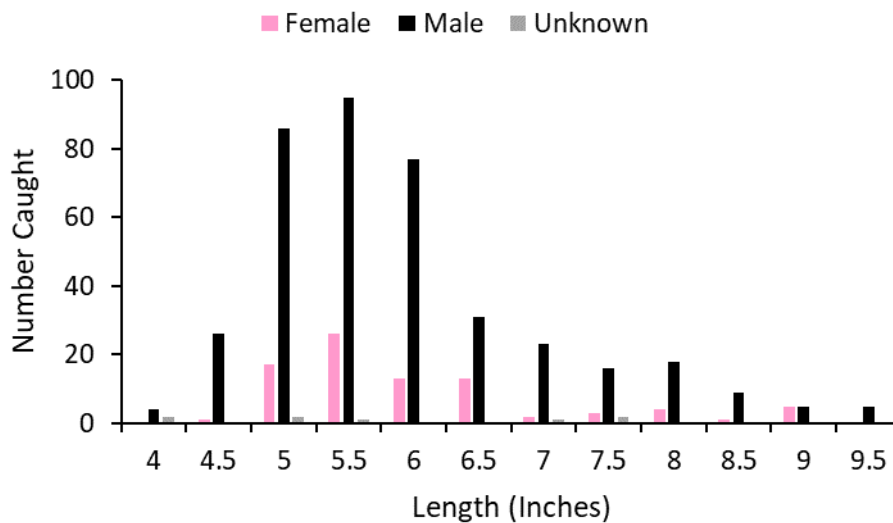


Figure 12. – Length frequency of yellow perch captured using fyke nets in Lake Arrowhead in 2022 (n=488).

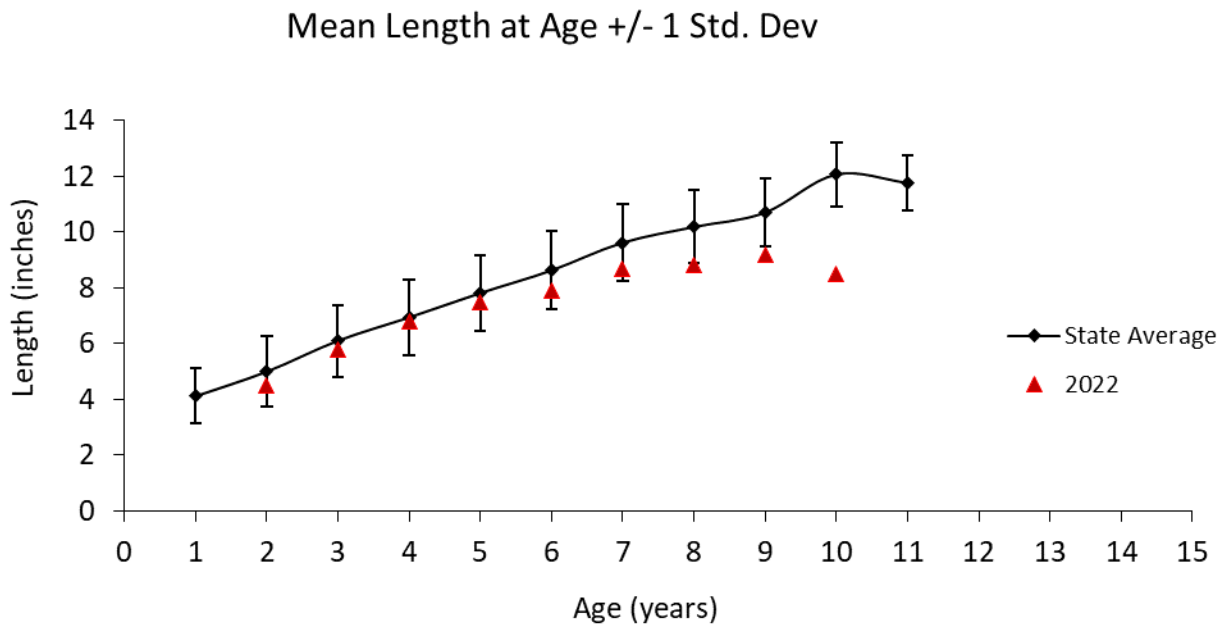


Figure 13. - Mean length at age of yellow perch (structure=otolith) captured in Lake Arrowhead in 2022 compared to the statewide average yellow perch.

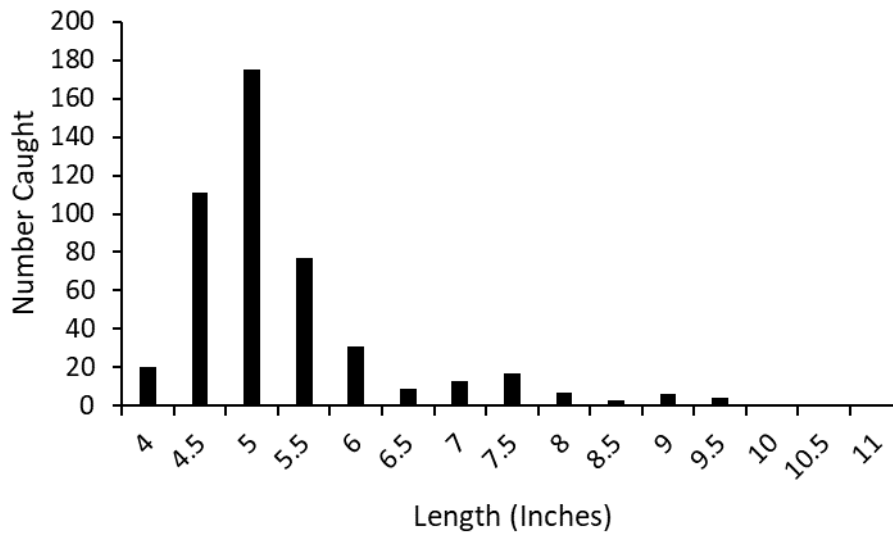


Figure 14. - Length frequency of black crappies captured using fyke nets in Lake Arrowhead in 2022 (n=161).

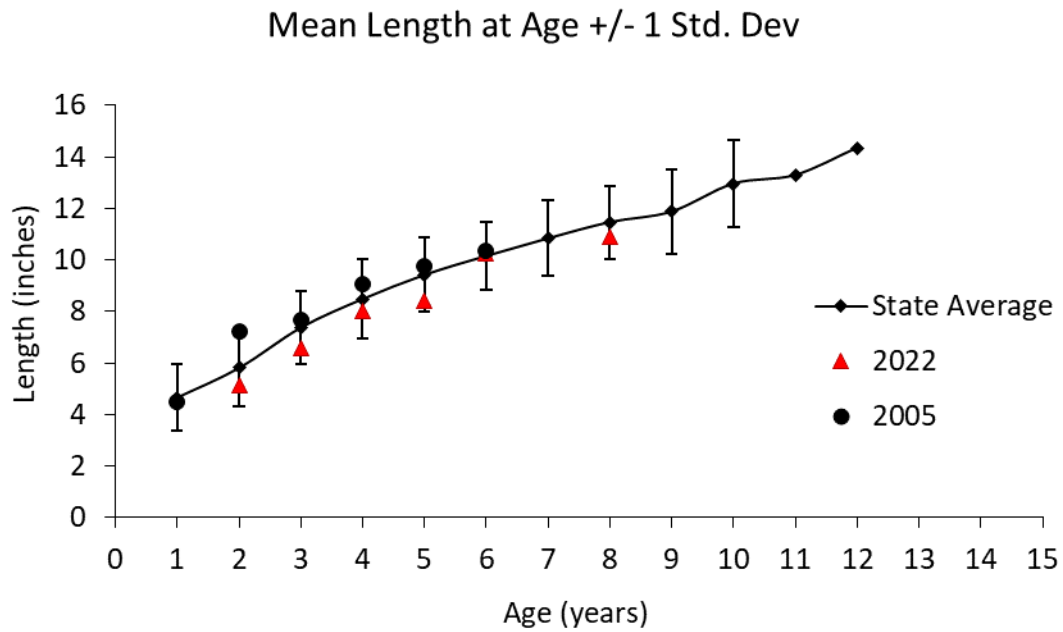


Figure 15. - Mean length at age of black crappies (structure=otolith) captured in Lake Arrowhead in 2005 (structure=scales) and 2022 (structures=otoliths) compared to the statewide average black crappie.

Table 1. – Fish stocking records for Lake Arrowhead, Adams County, Wisconsin.

<b>Year</b>	<b>Species</b>	<b>Number</b>	<b>Length (Inches)</b>	<b>Hatchery</b>
2016	Black crappie	612	5.0	Private
1982	Largemouth bass	30,000	1.0	DNR
1983	Largemouth bass	35,000	1.0	DNR
1984	Largemouth bass	35,000	1.0	DNR
1988	Largemouth bass	5,000	3.0	DNR
1988	Largemouth bass	10,000	1.0	DNR
1994	Largemouth bass	286	6.0	Private
1995	Largemouth bass	1,219	6.0	Private
1996	Largemouth bass	6,000	2.3	DNR
1999	Largemouth bass	35,000	1.3	DNR
1982	Northern pike	250,000	Fry	DNR
1994	Northern pike	400	11.0	Private
1995	Northern pike	435	11.0	Private
2016	Northern pike	100	8.0	Private
1983	Walleye	17,500	3.0	DNR
1984	Walleye	23,520	3.0	DNR
1988	Walleye	18,000	5.0	DNR
1990	Walleye	20,900	1.0	DNR
1992	Walleye	17,520	2.7	DNR
1994	Walleye	17,760	2.1	DNR
1994	Walleye	640	7.0	Private
1995	Walleye	1,194	7.0	Private
1997	Walleye	8,750	2.7	DNR
1999	Walleye	30,000	1.5	DNR
2000	Walleye	8,694	2.0	DNR
2002	Walleye	17,345	2.2	DNR
2003	Walleye	17,455	2.3	DNR
2004	Walleye	17,476	1.2	DNR
2013	Walleye	1,846	6.5	DNR
2014	Walleye	2,951	6.5	DNR
2016	Walleye	2,951	6.4	DNR
2018	Walleye	2,951	6.3	DNR
2020	Walleye	2,951	6.2	DNR
2022	Walleye	2,951	7.0	DNR

Table 2. – Information for fyke-netting surveys conducted on Lake Arrowhead from 1995 until 2022.

Survey Year	Survey Begin Date	Survey End Date	Water Temp (F)	Target Species	Effort (Net-Nights)
1995	06/19	06/22	85	Panfish	12
2005	04/09	04/15	47-56	Walleye	44
2022	04/08	04/21	41.5-46	Walleye Northern pike	72

Table 3. – Information for electrofishing surveys conducted on Lake Arrowhead from 2004 until 2022.

Survey Year	Survey Date	Survey Type	Water Temp (F)	Target Species	Effort (Miles)	Current	Amps	Volt s	DC	PR
2004	10/14	Fall	57	Panfish Gamefish	1.0 4.0	AC	3.5	110	-	-
2010	4/05	Early Spring	51	Walleye	6.0	AC	5.0	100	-	-
2010	5/19	Late Spring	65-67	Panfish Gamefish	1.0 4.0	AC	7.5	110	-	-
2016	9/26	Fall	65.3	Walleye	6.3	DC	10	110	-	-
2018	5/21	Late Spring	65	Walleye	6.4	AC	7	111	-	-
2018	9/11	Fall	71	Walleye	6.4	DCP	14	190	25	50
2019	9/23	Fall	69	Walleye	6.2	DCP	13	172	40	60
2020	9/10	Fall	62.4	Walleye	6.3	DCP	8.6	172	40	60
2021	5/26	Late Spring	69	Panfish Gamefish	1.5 1.5	DCP	17.5	240	25	50
2022	4/21	Early Spring	47	Walleye	8.25	DCP	8	165	25	50
2022	6/01	Late Spring	68.9	Panfish Gamefish	1.5 6.0	DCP	18	215	25	50

Table 4. – Total number and catch per unit of effort (CPE, number per net-night) of fish caught by species in the 1995, 2005 and 2022 fyke-netting surveys for Lake Arrowhead. \*1995 targeted panfish (not walleyes or northern pike) in later spring.

Common name of fish	1995*		2005		2022	
	Number	CPE	Number	CPE	Number	CPE
Black bullhead	5	0.4	0	0	1	0
Black crappie	41	3.4	55	1.3	637	8.8
Bluegill	162	13.5	53	1.2	995	13.8
Golden shiner	0	0	0	0	71	1.0
Largemouth bass	1	0	3	0.1	25	0.3
Northern pike	7	0.6	14	0.3	48	0.7
Pumpkinseed	17	1.4	0	0	69	1.0
Walleye	11	0.9	267	6.1	184	2.6
White bass	0	0	1	0	0	0
White sucker	0	0	564	12.8	10	0.1
Yellow bullhead	17	1.4	48	1.1	17	0.2
Yellow perch	3	0.3	232	5.3	827	11.5

Table 5. – Range of length (inches) of fish caught by species in the 1995, 2005 and 2022 fyke-netting surveys for Lake Arrowhead.

Common name of fish	1995		2005		2022	
	Min	Max	Min	Max	Min	Max
Black crappie	3.5	11.8	4.2	10.8	4.1	11.0
Bluegill	4.2	9.5	3.0	8.7	3.2	9.5
Largemouth bass	6.0	-	12.3	17.5	5.4	14.5
Northern pike	14.0	18.0	23.8	29.7	16.0	34.0
Pumpkinseed	3.9	6.8	-	-	3.5	7.4
Walleye	7.0	16.5	7.0	28.4	8.9	23.7
White bass	-	-	15.4	-	-	-
White sucker	-	-	-	-	10.9	21.3
Yellow perch	9.2	13.8	3.6	6.1	4.1	9.9

Table 6. – Average length (inches) of fish caught by species in the 1995, 2005 and 2022 fyke-netting surveys for Lake Arrowhead. \*Only when at least 50 fish were measured for a given species.

<b>Common name of fish</b>	<b>1995</b>	<b>2005</b>	<b>2022</b>
Black crappie	-	-	5.5
Bluegill	6.7	-	5.4
Largemouth bass	-	-	-
Northern pike	-	-	-
Pumpkinseed	-	-	6.3
Walleye	-	15.1	14.7
White bass	-	-	-
White sucker	-	-	-
Yellow perch	-	-	6.2

Table 7. – Total number of fish caught and catch per unit of effort (CPE; number per mile) by species during the late-spring electrofishing surveys in 2010, 2021 and 2022 in Lake Arrowhead.

<b>Common name of fish</b>	<b>2010</b>		<b>2021</b>		<b>2022</b>	
	<b>Number</b>	<b>CPE</b>	<b>Number</b>	<b>CPE</b>	<b>Number</b>	<b>CPE</b>
Black crappie	3	3	0	0	0	0
Common carp	0	0	0	0	16	4
Northern pike	1	0.3	1	0.7	1	0.2
Pumpkinseed	25	25	78	52	74	49
Walleye	16	4	5	3	5	1
Yellow perch	45	45	57	38	47	31

Table 8. – Relative abundance (CPE; number of fish per mile) of bluegill and largemouth bass for Lake Arrowhead in 2010, 2021 and 2022 late-spring electrofishing surveys.

<b>Common name of fish</b>	<b>2010 CPE</b>	<b>2021 CPE</b>	<b>2022 CPE</b>
Bluegill ≥ 3"	84	76	143
Bluegill ≥ 6"	10	13	39
Largemouth Bass ≥ 8"	29	45	36



Table 9. – Range of length (inches) of fish caught by species in the 2010, 2021 2022 late-spring electrofishing surveys for Lake Arrowhead.

Common name of fish	2010		2021		2022	
	Min	Max	Min	Max	Min	Max
Black crappie	2.5	-	-	-	-	-
Northern pike	13.0	-	24.6	-	22.5	-
Pumpkinseed	3.5	7.5	3.3	7.3	3.7	7.2
Walleye	8.5	19.5	5.7	13.2	10.4	20.8
Yellow perch	2.7	7.6	3.7	9.0	3.4	8.6

Table 10. – Size Structure of bluegill for Lake Arrowhead in 1995, 2004, 2005, 2010, 2021 and 2022 for spring electrofishing (EF) and fyke-netting (FN) surveys. \*2004 survey took place in the fall.

Stock, Quality, Preferred (3.0, 6.0, 8.0 Inches)	Survey Gear	Total	Average Length	Length Range	PSD - Q	PSD- P
1995	FN	162	6.7	4.2-9.5	88	9
2004*	EF	18	-	1.4-6.9	-	-
2005	FN	43	-	3.0-8.7	-	-
2010	EF	89	4.6	1.4-6.9	12	0
2021	EF	116	5.1	2.7-9.0	18	2
2022	EF	215	5.4	3.0-9.1	27	1
2022	FN	291	5.4	3.2-9.5	35	3

Table 11. – Size Structure of largemouth bass for Lake Arrowhead in 2004, 2010, 2021 and 2022 for late-spring electrofishing surveys. \*2004 survey took place in the fall.

Stock, Quality, Preferred, Memorable (8.0, 12.0, 15.0, 20.0 Inches)	Total	Average Length	Length Range	PSD- Q	PSD- P	PSD- M	RSD- 14”
2004*	53	9.4	5.4-14.4	38	0	0	4
2010	123	11.1	6.0-16.0	61	9	0	18
2021	107	9.6	6.2-19.3	30	3	0	6
2022	272	10.8	5.8-17.0	48	5	0	13

Table 12. – Size Structure of walleye for Lake Arrowhead in 2005, 2010 and 2022 for spring fyke-netting and early spring electrofishing surveys.

<b>Stock, Quality, Preferred, Memorable (10.0, 15.0, 20.0, 25.0 Inches)</b>	<b>Gear</b>	<b>Total</b>	<b>Average Length</b>	<b>Length Range</b>	<b>PSD-Q</b>	<b>PSD-P</b>	<b>PSD-M</b>
2005	FN	224	15.1	7.0-28.0	53	9	1
2010	EF	63	12.2	8.5-21.5	33	7	0
2022	FN	179	14.3	8.9-23.7	51	5	0
2022	EF	45	13.2	9.1-17.3	43	0	0