# Beaufort Lake

Baraga County, T48N R21W Secs 21,22,27,28
Last surveyed, 2023

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## Environment

Beaufort Lake is located approximately 40 miles west of Marquette, in Baraga County, within the Michigamme River Watershed. It has a surface area of 468 acres, a maximum depth of 30 feet, and is located just south of US Highway 41 (Figure 1). Homes and cottages are scattered around the perimeter of the lake. Beaufort Lake State Forest Campground is located on the northern shore and has a public boat launch. The lake has multiple seepage areas and inlets in the southern and western portion of the lake. It is connected to George Lake by a short channel. The outlet is the Spurr River located just east of the state campground and flows into Lake Michigamme. East of Beaufort Lake are remnants of a historic mining operation, called the Ohio Mine. Multiple waterbodies are near Beaufort Lake that include Ruth Lake, George Lake, Petticoat Lake, Trout Lake, Middle Lake, and Coon Lake (Figure 2).

The surrounding watershed is a mix of woody wetlands, deciduous forest, mixed forest, and some development (Figure 2). There are no previous surveys that include water chemical parameters, but George Lake has data that classifies it as having good water quality and meso-oligotrophic characteristics (moderate to low productivity).

The surrounding area has bedrock geology that is classified as the Michigamme Formation. The surficial geology type is thin to discontinuous glacial till over bedrock. The larger Michigamme Watershed has been described as having high amounts of exposed bedrock with rocky acidic soils that are nutrient poor, consequently creating low productive waterbodies.

The morphology of the lake comprises an irregular shoreline with five islands in the southern half of the lake. The shoreline is nearly 6 miles in length and the littoral area is relatively sparse in aquatic vegetation. The bottom sediment is a mix of boulders, cobble, gravel, sand, and peat. No aquatic invasive species have been reported in Beaufort Lake. No recent history of fishing tournaments have been registered since mandatory reporting began in 2019.

Beaufort Lake is currently classified as having high vulnerability to climate change impacts with coldwater fish species unlikely to persist through 2050, although there are currently no coldwater fish species in Beaufort Lake. Warm (e.g., Bluegill) and coolwater species (e.g., Northern Pike, Walleye) are projected to be present through 2050 (Midwest Glacial Lakes Conservation Planner).

Beaufort Lake has a fish consumption advisory for Northern Pike (1 serving per month for fish under 30" and 6 servings per year for fish over 30") and Walleye (2 servings per month for fish under 20" and 1 serving per month for fish over 20"). The consumption advisory is due to elevated mercury levels which is similar to other waters in the state and due to atmospheric deposition of mercury.

## History

Stocking

Historical records indicate early fisheries management of Beaufort Lake began in 1905 when Lake Trout and Walleye were stocked (Table 1). Between 1933 and 1944, Beaufort Lake was regularly stocked with a variety of fish species that included: Bluegill, Largemouth Bass, Yellow Perch, Smallmouth Bass, and Walleye. Consistent stocking of Walleye occurred between 1976 and 1993 (Table 1). The last stocking of Walleye occurred in 2003 (Table 1).

Fisheries Management

Beaufort Lake had a bathymetric survey conducted in 1946. The surveyors described Beaufort Lake as having an excellent fishery for Bluegill, Smallmouth Bass, Largemouth Bass, Walleye and to a lesser extent, Yellow Perch. There were a few cottages around the lake, however a majority of the surrounding area was owned by the Ford Motor Company. Fishing effort was concentrated mainly in the summer.

On August 3-4, 1948, a limited fisheries survey was completed by the Michigan Department of Conservation (MIDOC, now Department of Natural Resources). Fish species captured included Northern Pike, Yellow Perch, White Sucker, and Rock Bass. Water temperature was 66°F at the surface to 25ft, suggesting a deep thermocline. Managers also reported an algae outbreak at the time of the survey. Managers determined the water was too warm for trout management and a habitat project utilizing brush bundles should be considered. Anglers reported an overall decrease in successful fishing.

On August 12-25, 1953, a fisheries survey was conducted by the MIDOC. Fish species reported included Walleye, Yellow Perch, Smallmouth Bass, Largemouth Bass, Rock Bass, and Northern Pike. Aquatic vegetation was described as "sparse to common". Anglers reported successful Walleye fishing in the spring and late summer.

On June 10-12, 1975, a fisheries survey was conducted by the MIDOC. Fish species captured and recorded included White Sucker, Northern Pike, Smallmouth Bass, Yellow Perch, Burbot, Walleye, Rock Bass, and Black Bullhead. Managers reported abundant spawning habitat available for Walleye and Smallmouth Bass. Anglers reported Walleye and Yellow Perch fishing were good in previous years but poor that spring.

On August 16-19, 1982, a fisheries survey was conducted by the Michigan Department of Natural Resources (MIDNR). Fish species captured and recorded included Rock Bass (N=315, 3"-10" length range, 6.7" average), Northern Pike (N=10, 14"-26" length range, 18.3" average), Walleye (N=16, 8"-18" length range, 13.8" average), Smallmouth Bass (N=26, 4"-10" length range, 6.5" average), Yellow Perch (N=9, 6"-13" length range, 10.0" average), and White Sucker (N=12, 11"22" length range, 15.5" average). Managers described the fisheries as relatively unchanged since the previous 1975 survey. Rock Bass were dominant in the catch, however Walleye, Northern Pike, Smallmouth Bass, and Yellow Perch all appeared stable but in lower numbers.

On June 11-18, 1987, a fisheries survey was conducted by the MIDNR. A total of 216 fish were captured during the survey efforts. Fish species recorded included Black Bullhead (N=2, 5"-7" length range, 6.5" average), White Sucker (N=3, 14"-22" length range, 17.8" average), Largemouth Bass (N=2, 13"-14"

length range, 13.5" average), Northern Pike (N=22, 15"-24" length range, 19.7" average), Rock Bass (N=107, 5"-10" length range, 7.5" average), Smallmouth Bass (N=25, 6"-14" length range, 9.7" average), Walleye (N=24, 7"-24" length range, 16.0" average), and Yellow Perch (N=31, 9"-13" length range, 11.4" average). Managers again described the fishery as stable and similar to the 1975 and 1982 fisheries survey results.

On June 18-20, 1991, a fisheries survey was conducted by the MIDNR. A total of 188 fish were captured during the survey efforts. Fish species recorded included Black Crappie (N=2, 6"-9" length range, 8.0" average), White Sucker (N=3, 15"-17" length range, 16.5" average), Northern Pike (N=14, 15"-26" length range, 21.2" average), Rock Bass (N=122, 3"-9" length range, 6.5" average), Smallmouth Bass, (N=14, 6"-14" length range, 8.8" average), Walleye (N=16, 9"-24" length range, 17.2" average), and Yellow Perch (N=17, 8"-14" length range, 12.1" average). Managers described the fishery in Beaufort Lake as relatively unchanged compared to the 1975, 1982, and 1987 survey results. However, this was the first survey to document Black Crappie in Beaufort Lake. Walleye stocking efforts that occurred in 1986 and 1989 were considered marginally successful. Managers acknowledged natural reproduction was occurring but couldn't determine how much the stocking efforts contributed to the overall Walleye population. The lack of available forage was likely a key factor in the low Walleye numbers. Anglers reported poor Walleye and Yellow Perch fishing compared to previous years. Managers recommended transferring Yellow Perch from nearby waterbodies into Beaufort Lake to help bolster Walleye and Northern Pike growth . Yellow Perch were subsequently transferred into Beaufort Lake in 1991 and 1993 (Table 1).

On June 10-13, 1997, fisheries surveys were completed by the MIDNR to evaluate the Walleye and Yellow Perch populations in Beaufort Lake. The June survey catch results were dominated by Rock Bass (N=349, 4"-10" length range, 7.2" average), followed by Northern Pike (N=42, 16"-35" length range, 23.3" average), Walleye (N=38, 8"-24" length range, 16.7" average), and Yellow Perch (N=23, 6"-13" length range, 9.0" average). Other species captured but in lower numbers included Black Crappie (N=5), Smallmouth Bass (N=11) and White Sucker (N=19). Walleye ages 2-13 were confirmed as present in the population with a mean growth index of 1.7 inches below state average. Four out of the 12-year classes confirmed in the population coincided with a stocking year. However, natural reproduction was also occurring in Beaufort Lake, therefore it could not be determined how much stocking or natural reproduction were each contributing to the overall Walleye population. The Walleye catch-per-unit-effort (CPUE) increased from 0.7 CPUE in 1991 to 1.9 CPUE in 1997 (Table 2, Wehrly et al. 2015). The Yellow Perch CPUE fluctuated slightly from 1.0 fish per net (1987) to 0.7 fish per net (1991) to 1.2 fish per net (1997) (Table 2, Wehrly et al. 2015). While data is limited, it does not appear stocking Yellow Perch was affective at bolstering numbers within Beaufort Lake to provide more forage for predators.

On September 22-23, 1997, a fall index survey was completed to evaluate the Walleye population. Fish species captured during the September survey effort included Black Crappie (N=2), Burbot (N=7), Northern Pike (N=1), Rock Bass (N=62, 2"-8" length range, 5.1" average), Smallmouth Bass (N=29, 1"-10" length range, 3.6" average), Walleye (N=89, 3"-22" length range, 8.4" average), and Yellow Perch (N=41, 2"-5" length range, 3.2" average). Age and growth samples confirmed Walleye ages 1-3 were present in the population with a mean growth index of 2.9 inches below state average. All three age classes of Walleye were attributed to natural reproduction since stocking did not occur during any of

those years. Age-0 Walleye likely were captured and ranged from 3-5 inches in length. However, age analysis was not performed on these fish to confirm ages.

On April 17-20, 2006, a fisheries survey was conducted by the MIDNR. A total of 194 fish were captured during the survey effort. Fish species recorded included Black Crappie (N=2, 9" and 11" lengths), Northern Pike (N=44, 10"-32" length range, 24.3" average), Rock Bass (N=60, 3"-10" length range, 8.5" average), Smallmouth Bass (N=2, 13" and 14" lengths), Walleye (N=24, 13"-26" length range, 18.3" average), White Sucker (N=61, 16"-24" length range, 19.7" average), and Yellow Perch (N=1, 11"). Age and growth for Northern Pike confirmed 8 age classes present with a mean growth index of 1.5 inches below state average (Table 3). Age and growth for Walleye confirmed 11 age classes present, 8 of which were from natural reproduction (Table 3). Stocking occurred in 3 years of the age classes confirmed, however with natural reproduction also occurring in Beaufort Lake, it cannot be definitively known whether those fish came from stocking or natural reproduction. A mean growth index could not be calculated due to the lack of available fish for analysis.

Between 2016-2023, consistent angling reports described the fishery as reliable for catching Walleye, however many Walleye caught were under the legal size of harvest (≥15").

Beginning in 2021, Lake Beaufort property owners inquired about stocking Walleye into Beaufort Lake with the goal of increasing Walleye numbers. There was a paucity of recent survey data on Beaufort Lake, so a management decision was not made at that time. Rather, a comprehensive analysis of the fish community via multiple surveys was recommended before any management recommendations were put forth.

## Current Status

Multiple fisheries surveys were completed by staff from the Northern Lake Michigan Management Unit (NLMMU) on Beaufort Lake between March 27-October 26, 2023. Each survey's methods and results are described below. Additionally, a temperature logger (Onset Hobo Water Temp Pro V2, Model U22-001) was deployed on May 18, 2023, and retrieved on November 1, 2023. The goal of the temperature logger was to record hourly temperatures for an extended period of time to help inform any management decisions.

### Under-The-Ice Survey

The first survey was from March 27-April 5, 2023, and targeted Northern Pike. Survey methods included deploying gillnets under the ice for a total of 15 net nights (NN). Fish captured included Northern Pike (N=3, 22" average, 17"-28" length range), Walleye (N=3, 13.5" average, 10"-18" length range), White Sucker (N=3, 18" average, 16"-18" length range), and Yellow Perch (N=8, 8" average, 4"-10" length range).

### Northern Pike and Walleye Population Estimates

An additional survey was conducted on April 29-May 18, 2023, with the goal of completing adult population estimates for Northern Pike and Walleye. Surface water temperatures ranged from 36°F-56°F. To calculate the Northern Pike and Walleye population estimates, data was collected by completing three electrofishing transects totaling six (6) hours, deploying 19 large mesh fyke nets for a

total of 86 NN (73 Net Lifts), and nine (9) experimental gillnets were set for 27 NN. The three Northern Pike captured during the under-the-ice survey were included in the calculated population estimate. These survey efforts were targeting Northern Pike and Walleye, therefore data on other fish species is minimal. Fish species captured included Bluegill, Burbot, hybrid sunfish, Pumpkinseed, Rock Bass, White Sucker and Yellow Perch. It should be noted that this was the first survey to document Bluegill and Pumpkinseed in Beaufort Lake.

Northern Pike (N=166) averaged 22.2 inches and ranged from 15-34 inches in length with 22% of the catch meeting or exceeding the legal size for harvest of 24 inches (Table 4, Figure 3). Age analysis indicated ages 2-8, and 10 were present in the population and the mean growth index was 1.8 inches below state average which is considered poor to fair growth for Western Upper Peninsula waterbodies (Table 3). The calculated adult population estimate (Chapman-Petersen) for Northern Pike was 0.6 per acre.

Walleye (N=532) averaged 15.5 inches and ranged from 9-24 inches in length with 60% of the catch meeting or exceeding the legal size for harvest of 15 inches (Table 4, Figure 4). Age analysis indicated ages 1-10 and 12 were present in the population and the mean growth index was 2.5 inches below state average, which is considered poor for Western Upper Peninsula waterbodies (Table 3). However, growth rates for ages 1 and 2 were above state averages and rates for ages 3 and 4 were at state average. Walleye growth slowed substantially below state average between ages 5-10 (Table 3). The calculated adult population estimate (Chapman-Petersen) for Walleye was 1.6 per acre.

Status and Trends Survey

A Status and Trends survey was completed from June 5-21, 2023. Surface water temperatures ranged from 69°F-76°F. Survey methods included the deployment of three (3) small mesh fyke nets (9 NN), five (5) large mesh fyke nets (15 NN), six (6) seine hauls, three 10-minute electrofishing transects (all fish species), and electrofishing for three hours the remaining shoreline (gamefish only). In addition to the collection of biological data, staff surveyed habitat features including the number of dwellings, docks, submerged logs, and distance of armored shoreline (i.e. riprap and seawalls). The habitat survey was completed on August 17, 2023.

A total of 808 fish were captured during the Status and Trends survey efforts. Species captured included: Black Bullhead, Black Crappie, Bluegill, Burbot, Golden Shiner, Iowa Darter, Largemouth Bass, Northern Pike, Pumpkinseed, Rock Bass, Smallmouth Bass, Walleye, White Sucker, and Yellow Perch (Table 5). In terms of the number captured during the survey, Rock Bass were the most abundant (comprising 60% of the total catch), Walleye were second at 9% and Smallmouth Bass and Yellow Perch were tied for third at 8% (Table 5). In terms of biomass captured during the survey, Rock Bass comprised 43% of the survey catch, Northern Pike were second at 21%, and Walleye were third at 17% (Table 5).

Rock Bass (N=483) were the most abundant species captured during the survey. Rock Bass averaged 7.4 inches and ranged from 2-11 inches in length with 78% of the catch meeting or exceeding the acceptable size for harvest of 6 inches (Table 5).

Walleye (N=73) averaged 12.8 inches and ranged from 4-24 inches in length with 36% of the catch meeting or exceeding the legal size for harvest of 15 inches (Table 5). Age analysis indicated ages 1-3,

7-8, and 11 present in the population and the mean growth was considered poor at 2.1 inches below the statewide average (Table 6).

Smallmouth Bass (N=61) averaged 9.6 inches and ranged from 3-17 inches in length with 18% of the catch meeting or exceeding the legal size for harvest of 14 inches (Table 5). Age analysis indicated ages 1-8 present in the population and the mean growth was fair at 1.0 inches below the statewide average (Table 6).

Yellow Perch (N=61) averaged 5.2 inches and ranged from 1-12 inches in length with 23% of the catch meeting or exceeding the recommended size for harvest of 7 inches (Table 5). Age analysis indicated ages 1-5, 7 and 11 present in the population and the mean growth was near average (+0.1) compared to statewide growth rates (Table 6).

Northern Pike (N=26) averaged 23.0 inches and ranged from 14-32 inches in length with 31% of the catch meeting or exceeding the legal size for harvest of 24 inches (Table 5). Age analysis indicated ages 3,5,7 and 8 present in the population (Table 6). An insufficient number of aging samples were collected therefore a mean growth index rate could not be calculated.

The shoreline habitat survey consisted of 28 1,000-foot segments that totaled 5.3 miles sampled. Beaufort Lake was found to have 16 dwellings/mile, 13 docks/mile, 16 submerged logs/mile, and 0% of the shoreline was armored.

Fall Walleye Recruitment Survey

On September 19-20, 2023, a fall Walleye recruitment survey was completed by staff electrofishing the entire shoreline of Beaufort Lake (approximately 6 miles). The water temperature was 62.7°F during the survey effort. Only Walleye were captured and recorded.

Walleye (N=106) averaged 11.9 inches and ranged from 5-19 inches in length with 23% of the catch meeting or exceeding the legal size for harvest of 15 inches (Table 7, Figure 5). Ages 0-2 were confirmed in the population with a mean growth index of 1.7 inches below state average (Table 8). The Young-of-Year (YOY) Walleye (Age-0) and Age-1 were captured at rates of 3.2 per mile and 2.4 per mile, respectively (Table 9).

Fall Northern Pike Gillnetting Survey

On October 23-26, 2023, a gillnet survey targeting Northern Pike was conducted by staff to compare results from the winter gillnetting results. A total of 6 experimental gillnets were set for a total of 15 net nights. Daily surface water temperatures hovered around 48°F. On October 23, 2023, temperature, oxygen, pH, and specific conductance was recorded near the deepest location on Beaufort Lake.

Limnology results indicated that fall turnover had already occurred. All parameters were roughly the same from 0-30 feet of water depth. Water temperatures were 48°F, oxygen levels were 10.4ppm, pH was 7, and specific conductivity was 67µS/cm.

A total of 74 fish were captured during the survey efforts that included Black Crappie, Northern Pike, Rock Bass, Walleye, White Sucker, and Yellow Perch (Table 10). Northern Pike (N=17) averaged 21.1 inches and ranged from 15-26 inches in length with 18% of the catch meeting or exceeding the legal size of harvest (≥24", Table 10). Ages 2-5 and 7 were confirmed in the population with a mean growth index of 2.7 inches below state average (Table 11).

Temperature logger deployment

The minimum, maximum, and average temperatures recorded between May 18-November 1, 2023 were 39°F, 85°F, and 65°F, respectively. Some of these readings are questionable. For example, there was an 80°F water temperature recorded May 29th. The logger was either placed in direct sunlight or was taken out of the water on multiple occasions. Due to these potential erroneous readings, little information can be taken from the temperature logger data.

## Analysis and Discussion

The fish community of Beaufort Lake can be described as follows:

1) A panfish community clearly dominated by Rock Bass with consistent reproduction and recruitment. Black Crappie, Bluegill and Pumpkinseed are present, but at much lower abundances than Rock Bass. Although CPUE is increasing over time for Black Crappie (Table 2, Wehrly et al. 2015).

2) A Walleye population that is successfully naturally reproducing and consistent enough to maintain the population. Walleye CPUE has increased since 1991 (Table 2, Wehrly et al. 2015). However, due to the low productivity of Beaufort Lake, density will likely always be less than 2 adult Walleye per acre.

3) A Northern Pike population of moderate density with older adults struggling to access forage resources.

4) A forage population that is limited in diversity and abundance.

Beaufort Lake did not have any occurrences of an armored shoreline (e.g. seawalls) which is a benefit to both aquatic and terrestrial plants and animals that depend on a connection as part of their life cycle (e.g. reptiles and amphibians). However, compared to other waterbodies in the Northern Lake Michigan Management Unit, Beaufort Lake has a lower-than-average amount of submerged wood along the shoreline and a higher rate of dwellings and docks per mile. With an increase in development (via docks and dwellings), typically the amount of woody debris along the shoreline decreases and that is what is seen on Beaufort Lake. This could be due to riparian owners clearing the littoral zone in front of their properties. Riparian owners should promote healthy environmental stewardship practices and encourage others to retain nearshore woody debris whenever they can. Submerged logs, or coarse woody habitat is a vital component of healthy and diverse habitat in the nearshore areas.

The lack of nearshore woody habitat and aquatic vegetation could be a limiting factor in the overall forage population. Golden Shiners and Iowa Darters were the only two minnow species captured during the Status and Trends survey, and both were low in abundance (Table 5). White Suckers and Yellow

Perch were also low in abundance and showed declines of 93% and 42% from the previous June 1997 survey to the most recent Status and Trends survey, respectively (Table 2). Another limiting factor for forage species is the high abundance of Rock Bass in Beaufort Lake (Table 5). Abundance has steadily increased over time for Rock Bass with the CPUE increasing 51% from the 1997 survey to the 2023 survey (Table 2). Rock Bass eat snails, crayfish, and small fish, which can include Yellow Perch. Rock Bass are dominating by biomass and abundance over all species of fish (Table 5). Rock Bass are often overlooked as a sportfish, so the lack of fishing mortality can also play a role in their high abundance. Black Crappie were first discovered in Beaufort Lake in the 1991 survey. Since that time, numbers captured in surveys have increased. The CPUE of Black Crappie increased 512% from the June 1997 to the Status and Trends survey in 2023 (Table 2). If this increase continues over time, there could be a negative impact to the Walleye population due to egg and larval fish predation. There have been similar Walleye responses in nearby lakes when Black Crappie are introduced (Langford Lake, Gogebic County, Deer Lake and Stager Lake, Iron County). Lastly, the 2023 Status and Trends survey was the first time Bluegill and Pumpkinseed were documented in Beaufort Lake (Table 5). It is unclear at this time how Beaufort Lake will respond to these two new species. If water temperatures increase over time, then there could be a substantial increase in either species. Conducting another Status and Trends survey in about 10-15 years would be advantageous to see how Beaufort Lake responds over time.

Walleye have been a popular fish species for anglers in Beaufort Lake for many decades. Historically, anglers described poor fishing overall in 1948, successful Walleye fishing in 1953 and back to poor fishing in 1975. Previous Michigan DNR Fisheries Biologists have described the overall fisheries in Beaufort Lake as unchanged from 1975-1991. Walleye were stocked during the time period between 1976-1993 (Table 1). The June 1997 survey confirmed natural reproduction of Walleye was occurring, however managers recommended continued stocking until the population could be sustained solely through natural reproduction. Walleye CPUE increased by 171% from the 1991 survey to 1997 survey (Table 2) and 12 age classes were confirmed in the population. In consideration of these factors, the Walleye population was doing well in 1997. In 2006, there were 11 age-classes confirmed in the population which indicates a robust population (Table 3). Of the 11 age-classes, three years coincided with stocking years (1991, 1993 and 2003). Natural reproduction was occurring over this time period and stocked Walleye were not marked; therefore, it is difficult to say those years were solely supported by stocking efforts. For the 2006 survey, an insufficient number of samples were collected to calculate a mean growth index for Walleye, however Walleye that were analyzed were overall growing slower compared to both Walleye statewide and Walleye in the Western Upper Peninsula. Recently there has been some demand by the public to increase numbers of Walleye in Beaufort Lake and was the main reasoning behind the intensive survey efforts conducted by the Michigan DNR in 2023.

Results from the April 2023 survey show there was an increase of 41% in CPUE (1.88 CPUE fyke nets) for Walleye compared to the April 2006 survey (1.33 CPUE fyke nets). Additionally, in the April 2023 survey, there were 11 age-classes of Walleye confirmed in Beaufort Lake that ranged in size of 9-24 inches and 60% of the catch met or exceeded the legal size of harvest (≥15", Table 3, Table 4, Figure 4). Since the last stocking event occurred in 2006 and the oldest fish aged was from the 2008 year-class, all Walleye captured in the 2023 survey can be attributed solely to natural reproduction. The calculated mean growth index was 2.5 inches below state average (Table 3). However, growth was at or above state average in ages 1-4 and slowed down substantially for Walleye aged at 5 years and older. The calculated adult Walleye population estimate was 1.6 fish per acre. There were no previous population estimates to compare to.

Comparing the June 1997 to June 2023 Walleye CPUE rates, there was an increase of 58% in the Walleye catch (Table 2). There were less age classes (N=6) in the June 2023 survey effort compared to the April 2023 survey, but this is expected since Status and Trends survey protocols target all fish species, not solely Walleye. The June Walleye mean growth index was nearly the same as the April survey calculated at 2.1 inches below state average (Table 3 and Table 6). However, the June survey showed all ages below the state average growth rate.

Sizes of Walleye captured in the fall recruitment survey ranged from 5-19 inches in length (Table 7). Additionally, ages 0-2 Walleye were present in the population and had a mean growth index of 1.7 inches below state average (Table 8). The YOY Walleye captured equated to roughly 3.2 fish per mile which can be qualitatively described as "poor" when compared to other lakes (Table 9, Hansen 2012 and Gilbert and Hennessy 2014). However, rates of YOY Walleye are highly variable year to year and from lake to lake. The lack of long-term fall survey data for Beaufort Lake makes evaluating long term YOY trends difficult. There is one year of previous survey data from a fall 1997 survey that had YOY Walleye roughly at 20.5 fish per mile which qualitatively can be describes as "good" (Table 9, Hansen 2012 and Gilbert and Hennessy 2014).

Michigan has a lake classification system that factors in lake habitat characteristics and the fish community (Wehrly et al. 2012). Beaufort Lake is a Class 3 lake because of its low degree days, low mean temperature, larger surface area, and sufficient amounts of deep water. Class 3 lakes are considered to be the most suitable for Walleye and are thought to be able to buffer impacts to climate change (Herbst et al. 2022). This classification system is useful in how it can inform managers of what can be expected in lakes based on set criteria. The shoreline development index (SDI) is another important factor when predicting juvenile Walleye numbers in Michigan lakes (Bopp et al. 2023). The SDI is calculated by using measures of lake perimeter, lake surface area, and lake mean depth. The CPUE for juvenile Walleye is expected to be higher when the SDI is less than 2 (less shoreline irregularity). Essentially, the more circular a lake is, the higher the expected juvenile CPUE. The SDI for Beaufort Lake is 1.93 which indicates higher expected Walleye recruitment.

In consideration of the 2023 surveys conducted and its lake habitat characteristics and shape, the Walleye population in Beaufort Lake can be described as having consistent and reliable natural reproduction with slower than average growth rates in older adults. Due to the low productivity of the surrounding geology, similar to nearby Lake Michigamme, Walleye growth will likely continue to be slower than the State average and have a low density of adult Walleye. Additional stocking of Walleye is not advisable due to the already successfully reproducing population currently in Beaufort Lake. Adding more Walleye will increase competition of an already low forage population and slow growth rates even more than what they currently are now experiencing. Rather than stocking more predators into the system, it would be more beneficial to add additional woody habitat around the perimeter of the lake with the goal of increasing the forage base.

The under-the-ice gillnetting survey only captured three Northern Pike. These three fish were included in the April population estimate survey which was calculated at 0.6 adults per acre. In the April survey, Northern Pike ranged from 15-34 inches in length with 22% of the catch meeting or exceeding the 24-inch minimum size limit (Table 4, Figure 3). Ages 2-8 and 10 were confirmed in the population with a calculated mean growth index of 1.8 inches below state average (Table 3). Growth was good to average

for ages 2-3 but slowed substantially for age 4 and older. Fish growth rates do slow with age, however there is a lack of larger forage fish species that is likely impacting growth of Northern Pike in Beaufort Lake. Northern Pike CPUE increased substantially from the June 1991 survey to the June 1997 by 250% (Table 2). However, there was an 18% decrease in CPUE from the June 1997 survey to the June 2023 survey (Table 2). The fall gillnetting effort was more successful in capturing Northern Pike compared to the under-the-ice gillnetting effort (1.13 CPUE vs. 0.20 CPUE). The Northern Pike population in Beaufort Lake can be described as being of moderate in density and average growth for younger fish that slows with age. Factoring in these population characteristics, the most appropriate regulation for Northern Pike is the current standard 24-inch minimum size limit and 2 daily bag limit.

## Management Direction

Management Direction

1) One of the goals is to maintain the areas of undeveloped shoreline. Natural shorelines often contribute to large woody debris on the water's edge thus providing cover that helps protect fish during critical life stages (i.e. predation while young). Conversely woody debris can provide cover for ambush predators such as Northern Pike. Additionally, any aquatic vegetation should be preserved. Beaufort Lake does not have a high amount of vegetation therefore what little is there should be protected and preserved for fish to spawn on and seek sanctuary. A potential obstacle in obtaining this goal would be lake property owners who wish to have manicured lawns to the water's edge. The riparian owner's education to the benefits of a natural shoreline is critical to reach this goal.

2) There is currently a lack of large woody debris surrounding the shoreline of Beaufort Lake. In conjunction with Management Direction #1, the property owners could implement a habitat enhancement project that would increase nearshore habitat for the benefit a variety of species of fish, amphibians, birds, and reptiles. A potential obstacle in obtaining this goal would be a lack of funds and volunteers to implement the project.

3) Anglers are encouraged to report sport catches of all species to the NLMMU. Reports are useful to track population trends and aid in further management of the fishery for current and future managers.

4) Another Status and Trends survey is recommended in 10-15 years to evaluate any changes in the fish community over time.

## References

Bopp, J., S. Herbst, T. Brenden, K. Wehrly, and J.M. Hessenauer. 2023. Biotic and abiotic factors that influence Walleye recruitment in stocked lakes in Michigan. North American Journal of Fisheries Management. Volume 43, 6: 1673-1686.

Gilbert, S. and J. Hennessy. 2014. Guidelines to evaluate Walleye stocking success in inland lakes. Wisconsin Department of Natural Resources.

Hensen, G., S. Carpenter, J. Gaeta, J. Hennessy, and J. Vander Zanden. 2015. Predicting Walleye recruitment as a tool for prioritizing management actions. Canadian Journal of Fisheries and Aquatic Sciences. 72:661-672.

Herbst. S., D. Hayes, K. Wehrly, C. LeSage, D. Clapp, J. Johnson, P. Hanchin, E. Martin, F. Lupi, and T. Cwalinski. 2022. Management plan for Walleye in Michigan's inland waters. Michigan Department of Natural Resources. https://www.michigan.gov/-/media/Project/Websites/dnr/Documents/Fisheries/NEW/Walleye_Management_Plan_FINAL.pdf?rev=40a59d0915f84c5a9dbe6ce25be41c5c#:~:text=The%20overarching%20goal%20of%20this,healthy%20Walleye%20populations%20and%20fisheries.

Wehrly, K., J. Breck, L. Wang, and L. Szabo-Kraft. 2012. A landscape-based classification of fish assemblages in sampled and unsampled lakes. Transactions of the American Fisheries Society, 141:2. 414-425.

Wehrly, K.E., D.B. Hayes, and T.C. Wills. 2015. Status and trends of Michigan inland lake resources, 2002-2007. Michigan Department of Natural Resources, Fisheries Report 08. Lansing.

## Tables and Figures

Table 1: History of stocking in Beaufort Lake, Baraga County, Michigan from 1905-2003. Numbers stocked are largely based on life stage stocked. Data taken from DNR, Fisheries Division records.

| Year | Species | Number Stocked | Average Size or Life Stage |
|---|---|---|---|
| 1905 | Lake Trout | 15,000 | Fry |
| | Walleye | 90,000 | Fry |
| 1909 | Lake Trout | 30,000 | Fry |
| 1933 | Bluegill | 3,000 | 5 months |
| | Largemouth Bass | 500 | 4 months |
| 1934 | Bluegill | 5,000 | 4 months |
| | Largemouth Bass | 500 | 4 months |
| | Yellow Perch | 2,000 | 7 months |
| 1935 | Bluegill | 7,000 | 3 months |
| | Bluegill | 11,000 | 4 months |
| | Largemouth Bass | 500 | 3 months |
| | Yellow Perch | 2,200 | 7 months |
| 1936 | Bluegill | 10,000 | 4 months |
| | Smallmouth Bass | 500 | 4 months |
| | Yellow Perch | 3,000 | 9 months |
| 1937 | Bluegill | 27,500 | 4 months |
| | Smallmouth Bass | 800 | 4 months |
| | Walleye | 175,000 | Swim-up Fry |
| | Yellow Perch | 3,000 | 7 months |
| 1938 | Bluegill | 25,000 | 4 months |
| | Smallmouth Bass | 400 | 3 months |
| | Walleye | 300,000 | Swim-up Fry |
| 1939 | Bluegill | 8,000 | 3 months |
| | Smallmouth Bass | 2,570 | 3 months |
| | Walleye | 300,000 | Swim-up Fry |
| 1940 | Smallmouth Bass | 2,570 | 3 months |
| | Walleye | 390,000 | Swim-up Fry |
| | Bluegill | 400 | Yearling |
| 1941 | Smallmouth Bass | 1,000 | 3 months |
| | Bluegill | 8,000 | 4 months |
| 1942 | Bluegill | 5,000 | 4 months |
| | Smallmouth Bass | 250 | 4 months |
| | Walleye | 500,000 | Swim-up Fry |
| 1944 | Smallmouth Bass | 500 | 3 months |
| 1976 | Walleye | 1,400,000 | Fingerling |
| 1978 | Walleye | 500,000 | Fingerling |

Table 1 Continued.

| Year | Species | Number Stocked | Average Size of Life Stage |
|---|---|---|---|
| 1979 | Walleye | 59,000 | 0.0 |
| 1980 | Walleye | 300,000 | 0.35 |
| 1983 | Smallmouth Bass | 272 | 9.0 |
| 1986 | Walleye | 15,000 | 1.85 |
| 1989 | Walleye | 10,185 | 1.57 |
| 1991 | Walleye | 13,010 | 1.54 |
| | Yellow Perch | 4,555 | 4.92 |
| 1993 | Walleye | 16,800 | 1.85 |
| | Yellow Perch | 7,500 | 5.0 |
| 2003 | Walleye | 11,500 | 1.63 |

Table 2: Catch-per-unit-effort (CPUE, fyke nets) from 1987-2023 for various fish species collected in June from Beaufort Lake, Baraga County, Michigan. Qualitative ratings are comparing Beaufort Lake CPUE results to statewide averages between 2002-2007 (Wehrly et al. 2015). Data taken from DNR, Fisheries Division Records.

| | 1987 | | 1991 | | 1997 | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Species | CPUE | Qualitative Rating | CPUE | Qualitative Rating | CPUE | Qualitative Rating | CPUE | Qualitative Rating | Change (1997 to 2023) | % Change (1997 to 2023) |
| Walleye | 0.8 | Medium | 0.7 | Medium | 1.9 | Med to High | 3.0 | High | +1.1 | +58 |
| Yellow Perch | 1.0 | Medium | 0.7 | Medium | 1.2 | Medium | 0.7 | Medium | -0.5 | -42 |
| Northern Pike | 0.7 | Medium | 0.6 | Medium | 2.1 | High | 1.7 | High | -.04 | -18 |
| Smallmouth Bass | 0.8 | Medium | 0.6 | Medium | 0.6 | Medium | 0.4 | Low to Med | -0.2 | -27 |
| Rock Bass | 3.6 | Medium | 5.1 | Medium | 17.5 | High | 26.3 | High | +8.8 | +51 |
| White Sucker | 0.1 | Low | 0.1 | Low | 1.0 | Medium | 0.1 | Low | -0.9 | -93 |
| Black Crappie | - | - | 0.08 | Low | 0.25 | Low | 1.53 | Medium | +1.3 | +512 |

Table 3: Weighted mean length (inches) at age and growth relative to the state average for Walleye sampled in April 2006 and 2023 and Northern Pike sampled in April 2023 from Beaufort Lake, Baraga County, Michigan. Number of fish aged is in parenthesis. Data taken from DNR, Fisheries Division records.

| | Age Group | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Mean growth index[1] |
| Northern Pike (2023) | - | - | 19.2 (14) | 20.9 (24) | 22.5 (18) | 21.9 (17) | 22.3 (10) | 26.6 (9) | 25.5 (2) | - | 33.9 (1) | - | - | - | - | - | -1.8 |
| Northern Pike (2006) | - | - | 13.3 (2) | 21.8 (4) | 22.8 (16) | 24.5 (10) | 24.3 (5) | 30.9 (2) | 35.1 (2) | - | 32.8 (1) | - | - | - | - | - | -1.5 |
| Walleye (2023) | | 12.3 (1) | 12.1 (10) | 13.8 (19) | 15.3 (22) | 15.3 (13) | 16.5 (17) | 17.1 (30) | 16.2 (16) | 17.7 (9) | 18.0 (8) | - | 22.8 (2) | - | - | - | -2.5 |
| Walleye (2006) | | - | - | 14.0 (2) | 14.5 (1) | - | 16.3 (4) | 17.5 (4) | 17.4 (3) | 19.4 (3) | 22.3 (2) | 16.8 (1) | 19.3 (1) | 22.0 (1) | - | 26.5 (1) | - |

[1]Mean growth index is the average deviation from the state average length at age.

Table 4: Total catch by length range for Northern Pike and Walleye collected from Beaufort Lake, Baraga County, Michigan in April 2023. Data taken from DNR, Fisheries Division records.

| Inch | NOP | WAE |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 0 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |
| 6 | 0 | 0 |
| 7 | 0 | 0 |
| 8 | 0 | 0 |
| 9 | 0 | 2 |
| 10 | 0 | 0 |
| 11 | 0 | 17 |
| 12 | 0 | 42 |
| 13 | 0 | 55 |
| 14 | 0 | 97 |
| 15 | 2 | 115 |
| 16 | 1 | 93 |
| 17 | 5 | 62 |
| 18 | 8 | 36 |
| 19 | 23 | 1 |
| 20 | 29 | 6 |
| 21 | 30 | 2 |
| 22 | 23 | 1 |
| 23 | 9 | 1 |
| 24 | 8 | 2 |
| 25 | 6 | 0 |
| 26 | 7 | 0 |
| 27 | 5 | 0 |
| 28 | 2 | 0 |
| 29 | 2 | 0 |
| 30 | 1 | 0 |
| 31 | 0 | 0 |
| 32 | 2 | 0 |
| 33 | 2 | 0 |
| 34 | 1 | 0 |
| 35 | 0 | 0 |

Table 5: Number, length, and percentages of fishes collected from Beaufort Lake, Baraga County, Michigan in June 2023. Data taken from DNR, Fisheries Division records.

| Common Name | Scientific Name | Number | Total weight (lbs.) | Average length (in.) | Percent of catch by number | Percent of catch by weight | Percent legal or acceptable size |
|---|---|---|---|---|---|---|---|
| Black Bullhead | Ameiurus melas | 2 | 0.2 | 5.5 | 0.3 | 0.04 | - |
| Black Crappie | Pomoxis nigromaculatus | 23 | 8.4 | 8.4 | 2.9 | 2.1 | 87 (≥7") |
| Bluegill | Lepomis macrochirus | 21 | 6.8 | 7.5 | 2.6 | 1.7 | 95 (≥6") |
| Burbot | Lota lota | 2 | 0.3 | 8.0 | 0.3 | 0.1 | - |
| Golden Shiner | Notemigonus crysoleucas | 1 | 0.04 | 3.5 | 0.1 | 0 | - |
| Iowa Darter | Etheostoma exile | 13 | 0.04 | 2.4 | 1.6 | 0.01 | - |
| Largemouth Bass | Micropterus salmoides | 1 | 0.8 | 11.5 | 0.1 | 0.2 | 0 (≥14") |
| Northern Pike | *Esox lucius* | 26 | 81.2 | 23.0 | 3.2 | 20.8 | 31 (≥24") |
| Pumpkinseed | Lepomis gibbosus | 40 | 7.1 | 5.0 | 4.9 | 1.8 | 48 (≥6") |
| Rock Bass | Ambloplites rupestris | 483 | 169.1 | 7.4 | 59.8 | 43.2 | 78 (≥6") |
| Smallmouth Bass | Micropterus dolomieu | 61 | 41.9 | 9.6 | 7.6 | 10.8 | 18 (≥14") |
| Walleye | *Sander vitreus* | 73 | 68.2 | 12.8 | 9 | 17.4 | 36 (≥15") |
| White Sucker | *Catostomus commersonii* | 1 | 0.5 | 10.5 | 0.1 | 0.1 | - |
| Yellow Perch | *Perca flavescens* | 61 | 6.9 | 5.2 | 7.6 | 1.8 | 23 (≥7") |

Table 6: Weighted mean length (inches) at age and growth relative to the state average for select fishes sampled from Beaufort Lake, Baraga County, Michigan in June 2023. Number of fish aged is in parentheses. Data taken from DNR Fisheries Division records.

| | Age | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | Mean growth index[1] |
| Black Crappie | | 6.6 (7) | 8.3 (11) | 11.3 (1) | 11.3 (2) | 11.3 (2) | | | | | | +0.3 |
| Bluegill | | | 6.7 (13) | 7.2 (6) | 9.6 (1) | 7.4 (1) | | | 10.3 (1) | 10.6 (1) | | +1.2 |
| Largemouth Bass | | | | 11.4 (1) | | | | | | | | - |
| Northern Pike | | | 20.6 (2) | | 25.4 (2) | | 29.5 (2) | 33.6 (2) | | | | - |
| Pumpkinseed | | 3.9 (5) | 6.3 (2) | 6.8 (5) | 6.8 (3) | 7.7 (3) | 8.1 (3) | 8.3 (1) | | | | +0.4 |
| Smallmouth Bass | 5.4 (22) | 7.2 (4) | 10.0 (8) | 11.5 (14) | 15.1 (1) | 14.5 (6) | 15.2 (3) | 17.4 (2) | | | | -1.0 |
| Walleye | 5.5 (11) | 9.9 (16) | 11.8 (1) | | | | 19.5 (2) | 18.9 (1) | | | 23.4 (1) | -2.1 |
| Yellow Perch | 3.4 (9) | 5.6 (3) | 6.6 (5) | 8.9 (9) | 9.3 (1) | | 11.8 (1) | | | | 12.1 (1) | +0.1 |

[1]Mean growth index is the average deviation from the state average length at age.

Table 7: Total catch by length range for Walleye collected from Beaufort Lake, Baraga County, Michigan in September 2023. Data taken from DNR Fisheries Division records.

| Inch | Walleye |
|---|---|
| 0 | 0 |
| 1 | 0 |
| 2 | 0 |
| 3 | 0 |
| 4 | 0 |
| 5 | 10 |
| 6 | 2 |
| 7 | 7 |
| 8 | 12 |
| 9 | 2 |
| 10 | 5 |
| 11 | 10 |
| 12 | 13 |
| 13 | 8 |
| 14 | 13 |
| 15 | 10 |
| 16 | 8 |
| 17 | 2 |
| 18 | 2 |
| 19 | 2 |
| 20 | 0 |

Table 8: Weighted mean length (inches) at age and growth relative to the state average for Walleye sampled from Beaufort Lake, Baraga County, Michigan in September 2023. Number of fish aged is in parentheses. Data taken from DNR, Fisheries Division records.

| | Age Group | | | |
|---|---|---|---|---|
| Species | 0 | 1 | 2 | Mean growth index[1] |
| Walleye | 5.8 (13) | 8.3 (19) | 11.0 (15) | -1.7 |

[1]Mean growth index is the average deviation from the state average length at age.

Table 9: Calculated young-of year (YOY) per mile, and qualitative rating of year class for Beaufort Lake, Baraga County, Michigan from September 1997 and 2023 surveys. YOY qualitative rating based on Hansen 2012 and Gilbert and Hennessy 2014. Data taken from DNR, Fisheries Division records.

| Year | Walleye | Captured | Fish Per Mile | Qualitative Rating |
|---|---|---|---|---|
| 1997 | YOY (3"-5") | 41 | 20.5 | Good |
| | Age-1 (6"-8") | 6 | 3 | - |
| 2023 | YOY (5"-7") | 19 | 3.2 | Poor |
| | Age-1 (8"-9") | 14 | 2.4 | - |

Table 10: Number, length, and percentages of fishes collected from Beaufort Lake, Baraga County, Michigan in October 2023. Data taken from DNR, Fisheries Division records.

| Common Name | Scientific Name | Number | Total weight (lbs.) | Average length (in.) | Percent of catch by number | Percent of catch by weight | Percent legal or acceptable size |
|---|---|---|---|---|---|---|---|
| Black Crappie | *Pomoxis nigromaculatus* | 2 | 0.5 | 7.5 | 2.7 | 0.6 | 100 (≥7") |
| Northern Pike | *Esox lucius* | 17 | 37.3 | 21.1 | 22.9 | 49.1 | 18 (≥24") |
| Rock Bass | *Ambloplites rupestris* | 19 | 5.8 | 7 | 25.7 | 7.6 | 74 (≥6") |
| Walleye | *Sander vitreus* | 20 | 16.5 | 13.2 | 27 | 21.8 | 20 (≥15") |
| White Sucker | *Catostomus commersonii* | 4 | 9.5 | 17.8 | 5.4 | 12.6 | - |
| Yellow Perch | *Perca flavescens* | 12 | 6.4 | 10.4 | 16.2 | 8.4 | 100 (≥7") |

Table 11: Weighted mean length (inches) at age and growth relative to the state average for Northern Pike sampled from Beaufort Lake, Baraga County, Michigan in October 2023. Number of fish aged is in parentheses. Data taken from DNR, Fisheries Division records.

| Species | Age 2 | Age 3 | Age 4 | Age 5 | Age 6 | Age 7 | Mean Growth Index[1] |
|---|---|---|---|---|---|---|---|
| Northern Pike | 18.6 (5) | 20.3 (5) | 22.9 (2) | 23.2 (2) | | 26.2 (1) | -2.7 |

[1]Mean growth index is the average deviation from the state average length at age.

Figure 1: Lake map of Beaufort Lake, Baraga County Michigan.

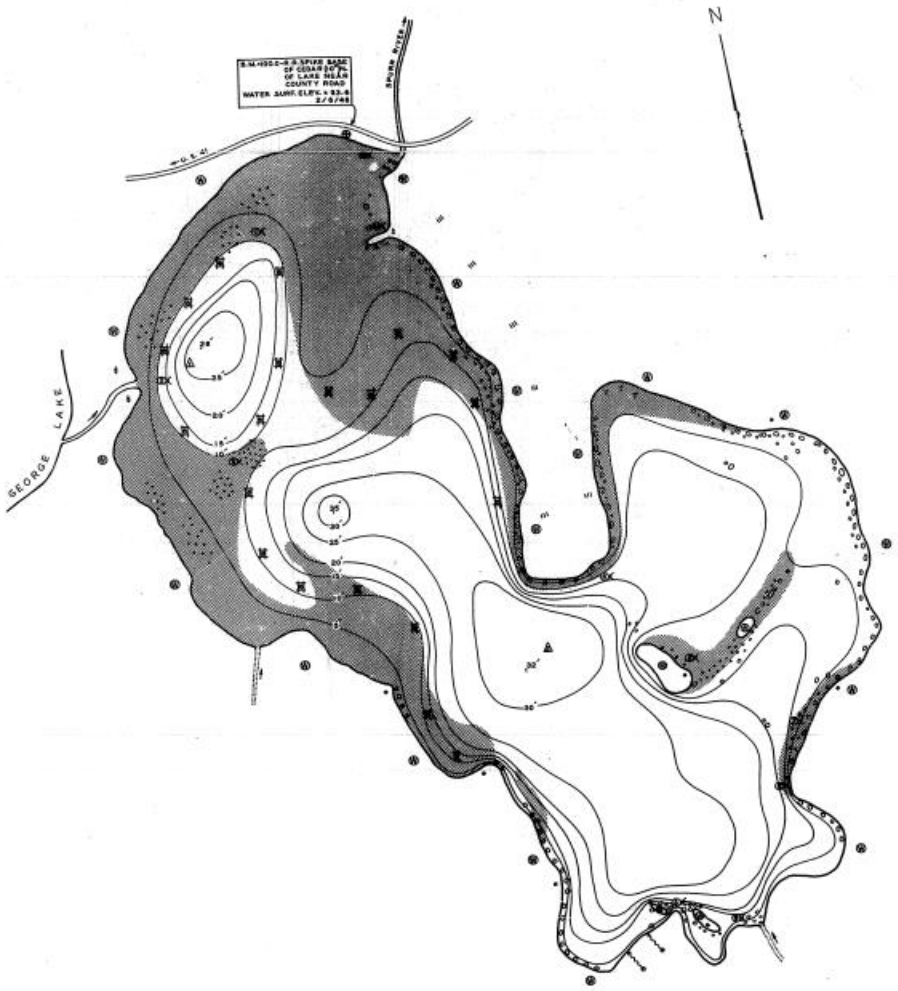


Figure 2: Lakeshed map of Beaufort Lake, Baraga County.

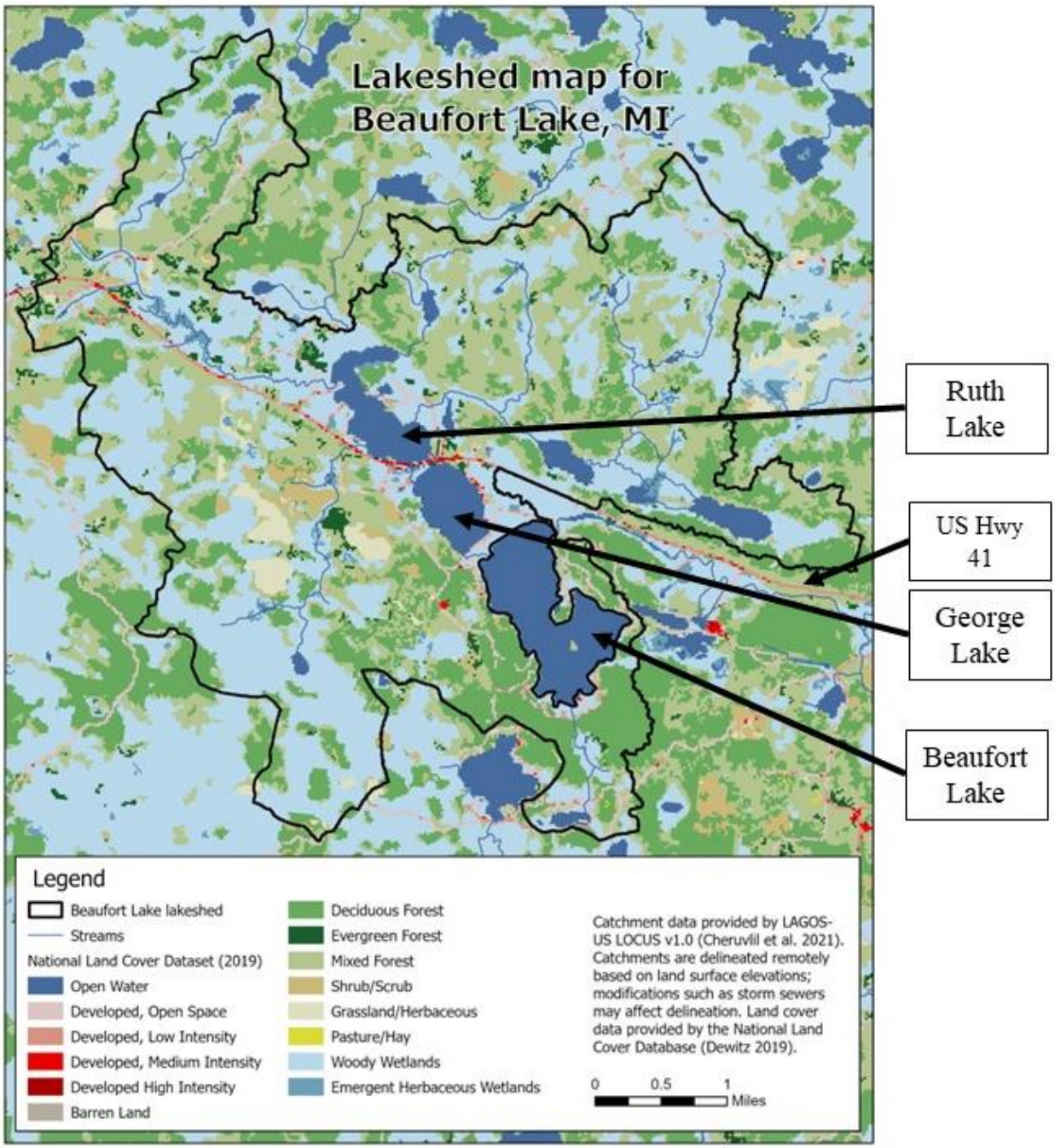


Figure 3: Length frequency data for Northern Pike captured between March 27-May 18, 2023, on Beaufort Lake, Baraga County, Michigan. Data taken from DNR Fisheries Division records.

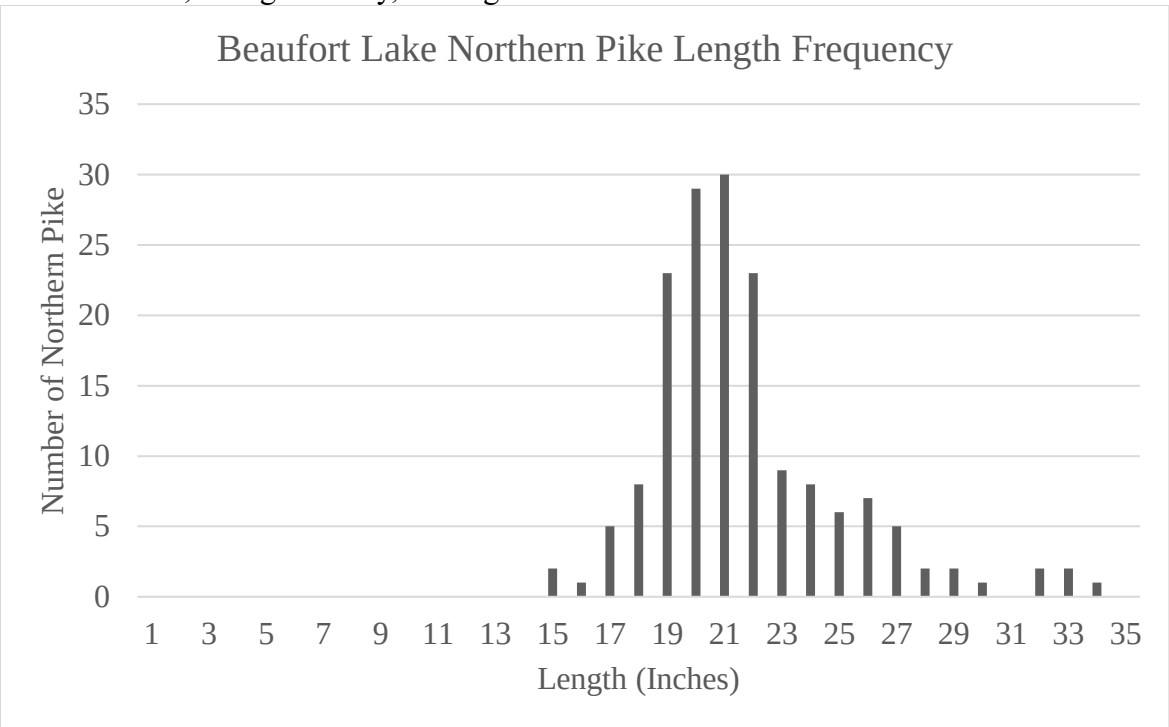


Figure 4:Length frequency data for Walleye captured between April 29-May 18, 2023, on Beaufort Lake, Baraga County, Michigan. Data taken from DNR Fisheries Division records.

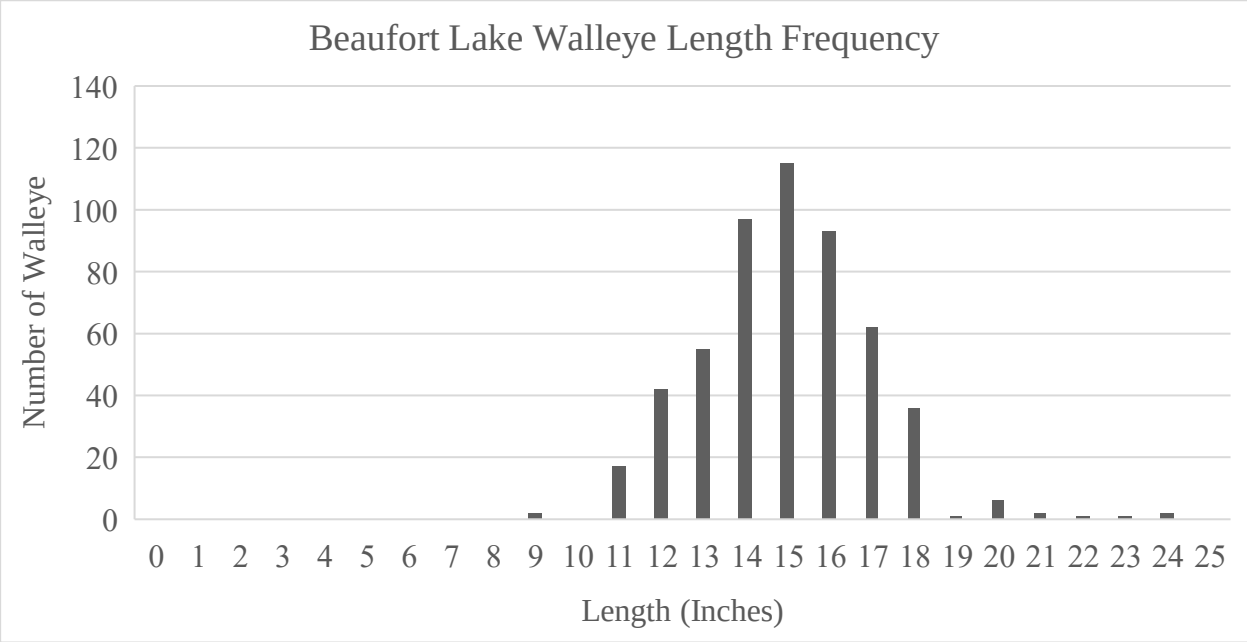
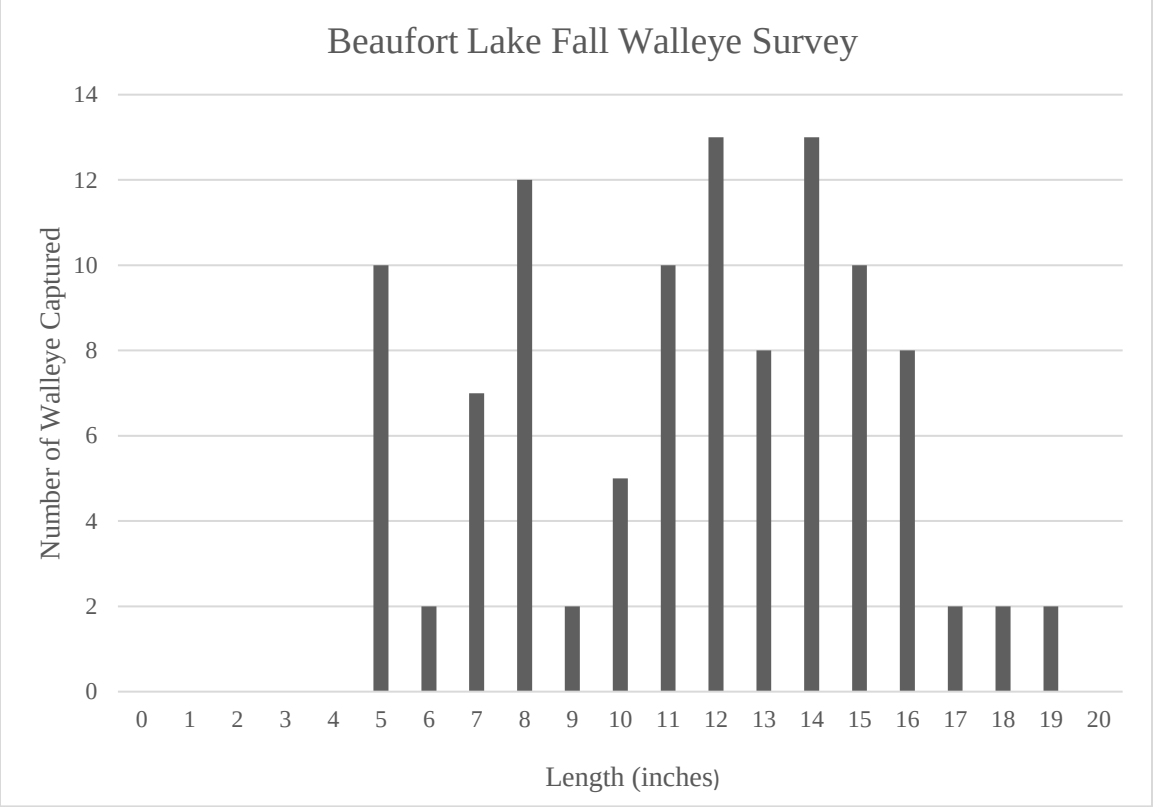


Figure 5: Length frequency data for Walleye captured during the September 2023 survey on Beaufort Lake, Baraga County, Michigan. Data taken from DNR Fisheries Division records.



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