Johnson Lake
Marquette County, T45N/R25W/S27
Escanaba River, Last Surveyed 2023

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Environment

Location
Johnson Lake is a 78-acre, 45-ft deep natural lake located in Forsyth Township in southcentral Marquette County in Michigan's Upper Peninsula (Figure 1). The city of Marquette is located approximately 21 miles north and is the largest city in the Upper Peninsula. Gwinn is an unincorporated community located just a mile and a half northwest of Johnson Lake and is a popular destination for citizens interested in fishing, hunting, and many other recreational outdoor activities.

Geology and Geography
Johnson Lake lies within the Trempealeau bedrock formation (MDNR 2001), a Cambrian era bedrock formation comprised primarily of sedimentary rock including dolomite and limestone. Surface geological landforms surrounding the lake are comprised largely of fluvial outwash materials that eroded as glaciers receded leaving behind a mix of coarse textured (55.9%) and non-textured (44.1%) materials. Coarse textured materials help facilitate the exchange of cool groundwater in deeper regions of the lake where cool- and cold-water fish species reside. The remaining shores of Johnson Lake are comprised largely of non-textured materials such as Rubicon and Au Gres sand as well as Tawas muck (USDA 2019) that have low to moderate groundwater permeability. The lake is highly transparent, with low to moderate groundwater permeability, a characteristic of lakes comprised of fine sands and coarse textured materials. A mixed composition of coarse and non-textured materials may suggest that cold-water aquatic organisms are moderately vulnerable to increases in lake water temperature related to climate change (MGLP 2025).

Watershed Description
Johnson Lake is located within the Escanaba River watershed, however there are no significant tributaries or outflows connecting the lake to the Escanaba River. The landcover of the Johnson Lake watershed is dominated by forest (56.5%), and includes urban (18.2%), grassland (10.8%), wetland (10.6%) and other (3.8%) landforms (Figure 2). Approximately 87 acres of land is currently unprotected and therefore vulnerable to additional residential and commercial development. Additionally, the immediate shoreland area of the lakeshed encompasses a total of 72 acres, of which 100% is currently unprotected and vulnerable to residential and commercial development (MGLP 2025).

Chemical and physical characteristics
Total Alkalinity - Total alkalinity is a measure of buffering capacity and plays an important role in determining a waterbody's acidity (Wetzel 2001, Wehrly et al. 2015). Alkalinity values in Michigan inland lakes can be classified into low (<49.5 mg/L CaCO3), medium (49.5 mg/L CaCO3 to 141.5 mg/L CaCO3) and high (>141.5 mg/L CaCO3) categories. Historically, total alkalinity was measured in Johnson Lake four times (1949, 1952, 1963, and 1968). All historical measurements ranged from 27 to 48 mg/L CaCO3 suggesting a low alkalinity, except those reported in 1968 (51.3 mg/L CaCO3 - medium). Total alkalinity was most recently measured in June of 2008 and was reported to be 33 mg/L CaCO3, again suggesting a `low' alkalinity compared to other Michigan inland lakes. Typically,

isolated lakes without major connecting tributaries or outflows like Johnson Lake have low alkalinity values and support a lower biomass and diversity of aquatic organisms (Wehrly et al. 2015).

Nutrients - Phosphorus and nitrogen are two important nutrients which influence production, biomass, and species composition of aquatic and nearby terrestrial plants in lake ecosystems. Concentrations of these two nutrients vary naturally depending on geology, watershed, and the rate at which water cycles through a lake. Human-derived inputs of nutrients can lead to eutrophication and an increase in the production of phytoplankton and aquatic macrophytes, which can often become noxious or a nuisance. As plants decompose, oxygen in the water is consumed by microorganisms and can be reduced to levels that compromise fish habitat and subsequently fish abundance. Alternatively, inland lakes that are characterized as having `too few' nutrients tend to have lower levels of primary production and thus much lower growth rates and less biomass of fish per acre (e.g., standing crop).

Total phosphorus occurs in relatively low concentrations in the aquatic environment and as a result, tends to be the limiting nutrient for primary producers (phytoplankton, periphyton, and aquatic vegetation) in an aquatic ecosystem. Phosphorus values typically vary quite widely across Michigan inland lakes having low (<0.009 mg/L), medium (0.009 mg/L to 0.020 mg/L), and high (>0.020 mg/L) concentrations. Total phosphorus was most recently measured in Johnson Lake in 2008 and was reported to be 0.120 mg/L. Results from the 2008 total phosphorus sampling suggest that Johnson Lake has a high concentration of this nutrient compared to other inland lakes in Michigan.

In contrast to phosphorus, total nitrogen occurs in relatively higher concentrations in aquatic environments and as a result rarely limits primary production in lakes. Nitrogen values in Michigan inland lakes range from low (<0.403 mg/L), medium (0.403 mg/L to 0.750 mg/L), and high (>0.750 mg/L) concentrations (Wehrly et al. 2015). Total nitrogen was most recently measured in Johnson Lake in 2008 and was reported to be undetectable (low). Results from the 2008 total nitrogen sampling suggest that Johnson Lake has a low concentration of this nutrient compared to other inland lakes in Michigan.

Dissolved Oxygen - Dissolved oxygen (DO) is a critical component for life in aquatic ecosystems. Dissolved oxygen in lakes derives from the atmosphere as well as from aquatic plants during photosynthesis. Concentration of DO in lakes can limit the distribution and growth of fish as well as the size composition and biomass of zooplankton. Concentrations of DO begin to limit cool- and warmwater fish populations at approximately 3.0 mg/L and are often lethal below 0.5 mg/L (Schneider 2002). The areas within a lake that emerge as DO levels decrease are referred to as the hypoxic region, which is characterized by having low levels of DO (e.g., less than 2 mg/L to 4 mg/L), and the anoxic region which contains no DO. Johnson Lake was surveyed routinely during the 1960s and 1970s when low levels of DO were reported to occur at depths ranging from 30 to 35 feet. Dissolved oxygen was measured more recently during the winter and summer of 2023 to document the depths at which hypoxic and anoxic conditions begin to occur. During winter of 2023, hypoxic and anoxic conditions began to occur at a depth of 33- and 39-ft, respectively. During the summer of 2023, hypoxic and anoxic conditions began to occur at a depth of 34- and 36-ft, respectively.

Temperature (stratification) - Thermal stratification occurs in deeper lakes during the summer months and is characterized by three water layers. The uppermost layer (epilimnion) is typically warmer and has adequate levels of sunlight to support photosynthesis. The middle layer (metalimnion) is the region where a more significant change in water temperature occurs. The point at which temperature change is the greatest in this middle layer is called the thermocline. The bottom layer (hypolimnion) lies directly below the thermocline and typically contains less DO compared to other layers. The Johnson Lake water column was surveyed routinely during the 1960s and 1970s when the thermocline

plane was located at a depth ranging from 17 to 30 feet. A water temperature profile was collected more recently during the summer of 2023 when the thermocline plane was located at a depth of 24-ft and the lake was stratified.

Chlorophyll-a - Summer chlorophyll-a concentrations in the upper water column provide a measure of lake primary production by phytoplankton and can be used to evaluate overall lake productivity. Higher chlorophyl-a concentrations suggest high production of phytoplankton, high nutrient inputs, and higher overall lake productivity. Low chlorophyl-a concentrations suggest phytoplankton production is limited by low nutrient availability, or by high rates of grazing by zooplankton. Chlorophyl-a concentrations vary widely across Michigan inland lakes having low (<1.9 ug/L), medium (1.9 ug/L to 4.8 ug/L), and high (>4.8 ug/L) values. Chlorophyl-a was last measured in Johnson Lake in 2008 and was reported to be 6.0 mg/L (or 6,000 ug/L). This last reported measure is high and may be erroneous warranting additional samples be collected.

Based on the chemical and physical characteristics summarized, Johnson Lake is a deep, transparent and dimictic lake with low nutrient productivity (except phosphorus) that contains sufficient dissolved oxygen throughout the water column to support aquatic life during the harsh periods of winter and summer. More recent measures of total phosphorus and chlorophyl-a are high compared to deep highly transparent lakes in the region prompting a request for additional samples to be collected in the future. Johnson Lake has an average reported depth of 19.5 feet.

Development, public ownership, and access
A majority of the Johnson Lake shoreline is held in private ownership, however there is a Michigan Department of Natural Resources (MDNR) public boat launch located (GPS 46.267705 -87.424210) on the northwest shore of the lake (Figure 1). The public launch includes a hard-surfaced ramp with sufficient water depth to accommodate most watercraft. There are a total of six trailer parking spaces and five vehicle-only parking spaces with one vault toilet available. The public access site is managed by MDNR Parks and Recreations Division out of the Escanaba Customer Service Center. Special local watercraft controls exist on Johnson Lake. For example, no operator of any motorboat, during the period from 6:30 PM to 10:00 AM of the following day, shall: (a) Operate such motorboat at high speed, which means a speed at or above which a motorboat reaches a plaining condition, (b) have in tow, or otherwise assist in the propulsion of, a person on water skis, sled, surfboard, or other similar contrivance.

History

From the late 1880s to the early 1920s, management of natural resources was largely market or commercial based. Many inland lakes were stocked with Lake Whitefish during this period to rehabilitate depressed populations or to create new commercial fisheries (Whelan 2004). However, in 1921 the Michigan Legislature created the Department of Conservation (MDOC) to manage the state's natural resources by adopting more science-driven fisheries management actions. The MDOC held public trust authorities and had power to enforce regulations such as closed seasons, size limits, and possession limits (Whelan 2004). Following the establishment of the MDOC, warm- and cool-water fishes were stocked throughout Michigan to replenish diminished stocks or create new recreational fishing opportunities.

Walleye and Bluegill were reportedly stocked into Johnson Lake during the 1920s and 1930s, however, little documentation exists to confirm this. The status of these species was unknown prior to stocking; however, the intent was likely to establish or improve the recreational fishery, as this was now a common practice. In addition to stocking, inland lakes in the region were being surveyed and mapped to provide managers with baseline information needed to guide future management.

Surveys conducted during this period were at times led by university staff or federal work programs but were most often conducted by MDOC staff from the Institute of Fisheries Research. During the 1920s and 1930s, John Nicholas Lowe was a fisheries biologist who taught at the Northern State Teachers College (now Northern Michigan University). J. N. Lowe had assembled fish collections from several inland lakes in Michigan's Upper Peninsula to document fish communities in lakes where information had not existed previously. In 1929, Lowe surveyed the shoreline of Johnson Lake with a seine and documented the occurrence of eight species including Blacknose Shiner, Common White Sucker, Golden Shiner, Iowa Darter, Largemouth Bass, Mimic Shiner, Northern Redbelly Dace, and Yellow Perch. Following the survey completed by Lowe, Johnson Lake was mapped by the Michigan Civilian Conservation Corp (or CCC) during the winter of 1936 and 1937.

By the late 1930s and 1940s, stocking of fish species such as Bluegill, Smallmouth Bass, Largemouth Bass, Yellow Perch, Walleye, and others had ceased or been reduced across Michigan given their ability to reproduce naturally (Cooper 1948). By 1946, the Michigan Fish Commission had a policy to curtail stocking of warmwater species given the "incontestable evidence that the average planting of these-warmwater species has involved an insignificant number of fish as compared to the number already present" (Cooper 1948, pp 8). Following the implementation of this policy, Johnson Lake was stocked with yearling Brook Trout (Table 1) and Lake Trout and thereafter was designated a `trout lake' in January of 1945 signaling a shift in management. This shift in management prompted additional surveys by the MDOC to monitor the Johnson Lake fish community and evaluate the future of trout stocking. For example, Johnson Lake was remapped during the winter of 1948 and 1949, and a comprehensive netting survey was conducted in 1949.

Surveys conducted in 1949 captured Common White Sucker, Lake Trout, Smallmouth Bass, Walleye, and Yellow Perch. In addition to those species captured, area residents of Johnson Lake reported that Black Crappie and Bluegill were also in the lake but not very abundant. Limnology profiles, used to evaluate water temperature and dissolved oxygen within the water column, were collected from Johnson Lake and showed favorable conditions existed for trout. As surveys were being conducted, the MDOC received a letter from lake residents requesting that Johnson Lake be stocked with additional Walleye to support the tourist trade in the Gwinn, Michigan area. At this time, there were approximately 25 cottages around Johnson Lake and many occupants were from out-of-state and utilized these residences seasonally. The MDOC staff responded to residents' request stating that stocking policies for Walleye and other species had recently changed. However, the lake had been recently surveyed and the lake provided suitable conditions for trout management.

During the 1950s, Johnson Lake was stocked with Rainbow Trout, Brook Trout and Lake Trout (Table 1), however, Lake Trout stocking ceased in 1957. There was some hesitation of continuing trout management in Johnson Lake since a public access site had not been established on the lake. The Cleveland Cliff's Iron Company had owned a large portion of the property surrounding Johnson Lake at this time, however they began selling lots in the late 1940s. During the early 1950s, the State of Michigan purchased land on Johnson Lake from a private individual and soon after developed a public access site in 1955. Stocking of Rainbow Trout occurred almost annually through the 1950s and 1960s, with some stocking of Brook Trout and Splake (Table 1). Fishing reports from this period suggested that Rainbow Trout stocking had created one of the best trout lakes in the area and the public access site was receiving considerable use.

As Rainbow Trout management continued into the 1960s, Johnson Lake became the focus of two research projects led by the MDOC Institute for Fisheries Research. One project was designed to document whether there was a pattern of reduction or elimination of zooplankton, following the stocking of Rainbow Trout. Rainbow Trout feed mostly on large zooplankton and can reduce the size

of plankton available when stocked, especially in situations where competing fish species such as Yellow Perch and Bluegill are present (Galbraith 1966).

Johnson Lake was routinely surveyed by the MDOC during this period, and managers noted an increase in the abundance of warm-water fish species that hinder Rainbow Trout management. For example, in 1963, MDOC staff noted that Common White Sucker and Yellow Perch had become increasingly abundant in the lake, requiring a total lake chemical reclamation if trout management were to continue. A public meeting was held in Gwinn where the public was reportedly supportive of the reclamation project. In the late summer of 1963, Johnson Lake was treated with 257 gallons of Rotenone (a fish toxicant) to achieve a 0.5 parts per million treatment concentration.

Following chemical reclamation, MDOC staff recommended that Johnson Lake be stocked with 10,000 sub-legal Rainbow Trout, followed by an additional plant of 1,000 legal-size Rainbow Trout the following spring. Rainbow Trout stocking resumed quickly following chemical reclamation and the fishery in Johnson Lake was reportedly very popular with the public. However, there were concerns shared with MDOC by area residents that night fishing had resulted in littering, light pollution, and loud noise. Despite these concerns, fishing reports remained favorable through the early 1970s. In 1968, the MDOC was renamed the Michigan Department of Natural Resources (MDNR).

Throughout the 1970s, Johnson Lake was stocked almost annually with Rainbow Trout. To evaluate the success of these stocking events the lake was surveyed routinely by MDNR in the spring and fall. Beginning in 1975, the number of Rainbow Trout captured in survey nets began to decline suggesting a decline in the return of stocked individuals. The decline in Rainbow Trout captured was accompanied by an increase in the number of competing species such as Common White Sucker and Yellow Perch. In 1972, there were two Rainbow Smelt captured in Johnson Lake, a species that had not been captured before, suggesting an unintentional introduction. Despite the occurrence of competing species, Johnson Lake still had a reputation of producing an attractive Rainbow Trout fishery with fish that reached remarkable size. However, surveys had shown that the returns were declining prompting an additional chemical reclamation. Area residents were largely in favor of the treatment and in 1976, a total of 332 gallons of Rotenone were used for a total lake treatment at a target concentration of 1.0 parts per million.

During the 1980s, Rainbow Trout were stocked up until 1985 when the species stocked changed to yearling Splake, Brown Trout, and Brook Trout (Table 1). Survey results and angler reports from this period suggested that the return of planted Rainbow Trout was poor and residents were opposed to the night fishing that accompanied Rainbow Trout stocking. Survey reports also showed that competing species were rebounding quickly further hindering trout management. To complicate trout management further, Northern Pike were first reported in Johnson Lake during this period. Since chemical reclamation projects were proving to be costly, MDNR staff began evaluating the success of manual removal surveys. Manual removal surveys consisted of setting several fyke nets within the nearshore areas of the lake to capture and remove undesirable species from the lake. Results from manual removal surveys demonstrated that if done routinely, good numbers of non-target species could be removed, and trout management could continue.

Surveys conducted during the late 1980s showed that a fair number of Splake were represented in the fishery. However, despite routine manual removal surveys conducted during the early 1990s, competing species such as Common White Sucker, Northern Pike, and Yellow Perch remained in high abundance, further hindering trout management. Therefore, Splake stocking ceased in 1994 and MDNR staff met with anglers and lake residents to discuss the future of fisheries management in

Johnson Lake. A public meeting was held in 1994, and a questionnaire was sent to area residents to consider two management options. The management options included for consideration were 1) trout only management (required chemical reclamation), and 2) manage for bass, Northern Pike, and Yellow Perch with periodic stocking of surplus adult broodstock trout. Most respondents preferred that Johnson Lake be managed for warm-water species with periodic stocking of surplus broodstock trout (option 2). From 1994 to 2009, Johnson Lake was stocked routinely with adult Brook Trout and Lake Trout to help maintain trout management.

In May of 2000, a netting survey was conducted by MDNR to learn more about the Johnson Lake fish community and to assess the status of stocked trout. Species captured included Common White Sucker, Largemouth Bass, Northern Pike, Pumpkinseed, Walleye, Yellow Perch, and one Lake Trout. Walleye had not been stocked for over fifty years, suggesting this was an illegal introduction. Northern Pike were reportedly growing well with fish captured ranging in size from 13 to 40-inches. MDNR managers recommended that Bluegill be transferred to Johnson Lake to help diversify the panfish fishery, however, this did not occur right away.

In the early 2000s, the MDNR initiated the Status and Trends Inland Lake survey program (Wehrly et al. 2015), which provided comprehensive information needed to understand and effectively manage Michigan's inland lakes. This survey program marked the first statewide assessment of inland lake resources and is intended for use by scientists, managers, policy makers, and the public. The specific goals of the program are to 1) collect information needed to maintain an inventory of inland habitat and fish community characteristics statewide; 2) develop reference points for local, regional, and statewide management needs; and 3) to assess the status of, and detect changes to, aquatic habitats and fish communities across Michigan. In 2008, Johnson Lake was randomly selected to be surveyed following the newly implemented Status and Trends Inland Lakes Survey Program.

A report from the 2008 Status and Trends survey provided information pertaining to the forage fish, panfish, and predator fish community in Johnson Lake. Additionally, a review of the current state of lake habitat was provided. The forage fish community in Johnson Lake was low in diversity and abundance, similar to the predator community. Predators in Johnson Lake at that time included Northern Pike and Largemouth Bass, which were growing slowly. Panfish in Johnson Lake were reported to be low in diversity and moderate in abundance with acceptable growth and few opportunities for individuals to grow old or very large.

Results from the 2008 nearshore habitat assessment of Johnson Lake showed that the lake was more developed compared to other inland lakes in the region. During the early 1950s, the density of residential dwellings on Johnson Lake was reported to be 19 dwellings per mile of shoreline. However, by 2008 there were approximately 57 residential dwellings per mile of shoreline suggesting heavy development had occurred. The current average density of residential dwellings in the central and eastern Upper Peninsula is 14 dwellings per mile of shoreline. The high level of residential development was accompanied by a low density of nearshore course woody habitat. As a result, managers recommended that programs be designed to compensate for the loss or lack of nearshore woody habitat. Recommendations included the placement of nearshore tree drops around the northern basin of the lake and the placement of sunken brush bundles around the 10- to 20-ft depth contour.

Following MDNR recommendations, a private individual placed approximately 60 brush bundles in Johnson Lake between 2014 and 2019 to improve fish habitat at depths ranging from 10- to 20-ft deep. In addition to the placement of the brush bundles, in May of 2016, MDNR Fisheries Division transferred a total of 810 Bluegill to Johnson Lake from Indian Lake in Iron County. Bluegill transferred ranged in size from 2 to 4 inches and were expected create a self-sustaining population

within the next several years. In 2019, correspondence was received by a Johnson Lake angler stating that the Bluegill were doing very well and were observed using the newly added fish structures. These observations were later validated when MDNR staff used an underwater camera to document multiple year-classes of Bluegill using the fish structures.

During the winter of 2023, a Johnson Lake resident reported a day of poor fishing when a total of 30 tip ups were used by 11 anglers over the period of 10 hours. There were no fish captured during the day and no fish were observed using traditional sonar equipment, prompting concern among anglers. MDNR responded stating that a fish community and habitat survey would be conducted during the next spring to provide a status of the fishery. Prior to the survey, MDNR staff visited Johnson Lake in March of 2023 to document the presence of Bluegill and other fishes near the fish habitat structures. Despite poor reports from anglers, staff observed several Bluegill of various age-classes holding very close to three-dimensional structures at multiple locations in the lake. Largemouth Bass and forage minnows were also observed at that time suggesting that fish were available in proximity to the fish structures.

During the spring of 2023, a comprehensive survey of Johnson Lake was conducted to quantify the abundance of physical habitat in the lake, while gathering more recent fish community information. Additionally, this survey was conducted to assess the status of the Bluegill population following the transfer that occurred in 2016. This most recent survey effort prompted drafting this Status of the Fishery Resource report and will guide fisheries management for Johnson Lake in the future.

Current Status

Methods

Fish Community - The MDNR Fisheries Division conducted a comprehensive survey to assess the status of the Johnson Lake fishery beginning in March of 2023. Survey protocols were consistent with the Status and Trends Inland Lakes survey program (Wehrly et al. 2015); a variety of gear types were used including two small- and three large-mesh fyke nets, four experimental gill nets, one seine, and boat electrofishing. The small- and large-mesh fyke nets were set for two and three nights for a total effort of four and nine net nights, respectively. Four experimental gill nets were set for one night for a total effort of four net nights. Total seine effort was three seine hauls in nearshore areas. Boat electrofishing consisted of three transects totaling 1.16 miles (1,800 seconds) where all fish species were sampled. An additional boat electrofishing transect was conducted totaling 0.36 miles (540 seconds) where only gamefish species were sampled.

To provide general information about the fish community composition in Johnson Lake, species captured were grouped into three categories. Largemouth Bass, Northern Pike, and Walleye were categorized as "piscivores"; Bluegill, Bluntnose Minnow, Creek Chub, Hybrid Sunfish, Northern Redbelly Dace, Pumpkinseed, Rock Bass, and Yellow Perch were categorized as "planktivores-insectivores"; while Common White Sucker and Iowa Darter were categorized as "benthivores".

Gamefish species including Bluegill, Hybrid Sunfish, Largemouth Bass, Northern Pike, Pumpkinseed, Rock Bass, Walleye, and Yellow Perch were measured for total length to the nearest tenth of an inch which was used to compute the average size and range in size for each of these gamefish species, as well as a length-abundance distribution. The relative stock density for each species was assessed using catch per unit effort (CPUE) calculated as the number of fish captured per unit of effort (e.g., net night, seine haul, electrofishing minutes). The CPUE data from this survey were compared to the summary of regional and statewide CPUE data from inland lakes as part of the Status and Trends program (Wehrly et al. 2015).

Age structures (10 per inch group) were collected from each gamefish species for age analysis. Scale samples were collected from Bluegill, and Pumpkinseed (panfish) less than 6.0-inches and Largemouth Bass less than 10.0-inches. Anal fin spines were collected from panfish greater than 6.0-inches, Largemouth Bass greater than 10.0-inches, and all Northern Pike. Dorsal spines were collected from all Walleye captured. Weighted age compositions using length and age references for each gamefish species were calculated as described by Schneider (2000a). A mean growth index for each age class was calculated by subtracting the state average mean length-at-age from that of the 2023 Johnson Lake survey. Growth indices for age classes represented by a minimum of five fish were averaged to provide a mean growth index (Schneider et al. 2000b). Fish growing slower than 1.00-inch below the state average are considered "below average", while fish growing faster than 1.00-inch above the state average are considered "above average". Bluegill are the exception where fish growing slower than 0.50-inches or faster than 0.50-inches compared to the state average are considered below or above the state average, respectively. Bluegill size structure was rated using an index based on the mean growth index and the proportion of fish greater than 6, 7, and 8 inches captured using large-mesh fyke nets and electrofishing (Schneider 2000b; Schneider 1990).

Physical and Oxythermal Habitat - On 16 August 2023, the Johnson Lake littoral zone and lakeshore were visually surveyed to quantify physical habitat parameters including residential development (dwellings per mile), boat dock density (docks per mile), large woody debris (submerged logs per mile) and the average percent shoreline armored. Habitat surveys were conducted by traveling in a boat parallel to shore approximately 100 to 200-ft from the water's edge. Data were recorded in 1,000 ft segments until the entire shoreline of the lake was surveyed. In each 1,000 ft segment, the number of dwellings, large (more than two boat slips) and small (one to two boat slips) docks, submerged and partially submerged logs and large diameter tree limbs (3-inches in diameter or greater), and percent shoreline armored is counted. Only dwellings located immediately along the shoreline were counted. Percent shoreline armoring is a qualitative estimate of the linear amount of each segment comprised of materials intentionally placed to prevent erosion. These materials included sheet piling, concrete, riprap, gabions, boulders, and wood. Percent shoreline armoring was estimated to the nearest 10%. Any submerged trees visible between the boat and shore were enumerated.

To assess the available oxythermal habitat in Johnson Lake, a probe was used to measure temperature and dissolved oxygen at three-foot intervals near the deepest basin of the lake. Winter and summer months were targeted as these periods tend to reflect the most stressful periods of the year when hypoxic or anoxic conditions tend to limit aquatic life. Winter oxythermal profiles were gathered in March of 2023, while a summer profile was collected in August of 2023.

Invasive Species - During the 2023 Status and Trends survey, MDNR staff made note of the presence of any aquatic invasive species observed. Additionally, a desktop review was conducted using the Midwest Invasive Species Information Network (MISIN 2024) to determine the presence or absence of aquatic invasive species.

Results

A total of 2,575 fish weighing 668 pounds and representing 13 species were captured during the 2023 survey (Table 2). Piscivores, such as Largemouth Bass, Northern Pike, and Walleye comprised 3% of the catch by number and 29% of the catch by biomass. Planktivores-Insectivores, such as panfish, Bluntnose Minnow, Creek Chub, Northern Redbelly Dace comprised 92% of the catch by number and 7% of the catch by biomass. Benthivores, such as Common White Sucker and Iowa Darter comprised 5% of the catch by number and 64% of the catch by biomass. The estimated standing crop of Johnson Lake in 2023 was approximately 50 pounds of fish per acre.

Bluegill - A total of 141 Bluegill were caught across all gear types. Bluegill averaged 4.9 inches and comprised 5.5% of the catch by number and 3.1% of the catch by biomass. Bluegill size ranged from 1.0 to 8.0 inches with 36% of the catch meeting or exceeding the preferred size of 6.0 inches (Table 3). A total of 8 age classes, from 3- to 10-years-old, were represented in the catch (Table 4). Bluegill from ages 3- to 5-years-old, as well as those 7- and 8-years-old had a mean growth index of -0.9 inches compared to the state average length at age (Table 4). Based upon an evaluation of length at age information, Bluegill in Johnson Lake reach the preferred size of 6-inches between 5- and 6-years-old. Bluegill CPUE values for each gear type are summarized in Table 5. Large-mesh fyke net CPUE of preferred size Bluegill was 6.1 fish per net night. The average size of Bluegill captured in the large-mesh fyke net was 5.6 inches and 46% of the catch exceeded the preferred size of 6-inches. According to the Bluegill size score index (Schnieder 1990), fish captured in large-mesh fyke nets in 2023 were rated "acceptable". Boomshocking CPUE of preferred size Bluegill was 1.4 fish per minute. The average size of Bluegill captured boomshocking was 5.5 inches and 48% of the catch exceeded the preferred size of 6.0 inches. The Bluegill size score index for fish captured boomshocking in 2023 was considered "good".

Largemouth Bass - A total of 31 Largemouth Bass were caught across all gear types. Largemouth Bass averaged 11.9 inches and comprised 1.2% of the catch by number and 7.6% of the catch by biomass. Largemouth Bass ranged from 2.0 to 17.0 inches with 68% of the catch meeting or exceeding the minimum size limit of 14.0 inches (Table 3). A total of 10 age classes were represented from 1- to 11-years-old (excluding 10-year-old fish) (Table 4). Age 3-, 4-, and 6-year-old Largemouth Bass had a mean growth index of +2.6 inches compared to the state average length at age (Table 4). Based upon an evaluation of length at age information, Largemouth Bass in Johnson Lake reach the legal size of 14.0 inches between 3- and 4-years-old. Largemouth Bass CPUE values for each gear type are summarized in Table 5. The catch rate of Largemouth Bass via boat electrofishing was 0.74 fish per minute (Table 5).

Northern Pike - A total of 53 Northern Pike were caught across all gear types. Northern Pike averaged 21.4 inches and comprised 2.1% of the catch by number and 20.7% of the catch by biomass. Northern Pike size ranged from 1.0 to 34.0 inches with 23% of the catch meeting or exceeding the minimum size limit of 24.0 inches (Table 3). A total of 6 age classes were represented from 2- to 7-years-old (Table 4). Age 3- through 7-year-old Northern Pike had a mean growth index of -2.2 inches compared to the state average length at age (Table 4). Based upon an evaluation of the length at age information, Northern Pike in Johnson Lake reach legal size of 24.0 inches between 6- and 7-years-old. Northern Pike CPUE values for each gear type are summarized in Table 5.

Yellow Perch - A total of 292 Yellow Perch were caught across all gear types. Yellow Perch averaged 4.0 inches and comprised 11.3% of the catch by number and 0.9% of the catch by biomass. Yellow Perch ranged from 1.0 to 10.0 inches with less than 1% of the catch meeting or exceeding the minimum preferred size for harvest (i.e., 7-inches) (Table 3). A total of 5 age classes were represented from 1- to 5-years-old (Table 4). Age 1- to 3-year-old Yellow Perch had a mean growth index of -0.7 inches compared to the state average length at age (Table 4). Based upon an evaluation of the length at age information, Yellow Perch in Johnson Lake reach the preferred size of 7.0 inches between 3- and 4-years-old (Table 4). Yellow Perch CPUE values for each gear type are summarized in Table 5.

Other Gamefish - Hybrid Sunfish, Pumpkinseed, Rock Bass, and Walleye were also represented in the 2023 Johnson Lake netting survey (Table 2). However, catch rates for these species were generally low and insufficient samples were available to make inferences about age and growth. Length and abundance distribution information for these species (except Walleye), has been summarized in Table 3. One Walleye was captured during the 2023 Johnson Lake survey measuring 20.5 inches in length.

Forage Fish - A total of 1,980 forage fish were captured including Bluntnose Minnow, Creek Chub, Common White Sucker, Iowa Darter, and Northern Redbelly Dace. Catch rate values for Bluntnose Minnow and Common White Sucker are summarized in Table 6 by gear type. Catch Rate values for Creek Chub, Iowa Darter, and Northern Redbelly Dace were not calculated given that too few were caught to reliably compare catch rates.

Physical and Oxythermal Habitat - The entire shoreline of Johnson Lake was surveyed totaling 1.52 miles of effort. Physical indicators such as the density of dwellings, boat docks, and shoreline armoring were rated as "high", while the density of submerged trees nearshore was rated as "low" (Table 7).

Johnson Lake was surveyed during the winter (2023) and summer (2023) months to evaluate oxythermal habitat (e.g., temperature and dissolved oxygen). During the winter months hypoxic conditions begin to limit aquatic organisms at a depth of approximately 35-ft (Table 8). During the summer months, the thermocline is located at 24-ft and hypoxic conditions being to limit aquatic organisms at a depth of 36-ft (Table 9).

Invasive Species - During the 2023 MDNR survey, there were no aquatic invasive species observed in Johnson Lake. Additionally, the desktop review of the Midwest Invasive Species Information Network found no documented occurrences of aquatic invasive species in Johnson Lake. However, Invasive Watermilfoil was documented in 2024 in an inland lake (Blue Lake), near Johnson Lake.

Analysis and Discussion

Johnson Lake is a small-sized deep lake with a heavily developed shoreline that contains fish species typical of inland lakes in northern Michigan. Results from the physical habitat suggest that residential development along the shoreline is high and the density of nearshore fish habitat is low. Despite high development and limited physical habitat, Johnson Lake provides anglers with a good mixed-bag fishery comprised of panfish, Largemouth Bass, and Northern Pike with occasional good catches of Hybrid Sunfish, Pumpkinseed, Rock Bass, and Yellow Perch.

Bluegill - In 2016, a total of 810 Bluegill, ranging in size from 2- to 4-inches, were transferred to Johnson Lake. Transferred Bluegill were within the 1- to 3-year-old age category at the time of transfer. By 2023, when the most recent survey was conducted, Bluegill in Johnson Lake would have been 8- to 10-years-old. There were 8- to 10-year-old Bluegill captured during the 2023 survey, however most individuals captured during the survey were born post-transfer confirming that the population is naturally reproducing in Johnson Lake.

Catch rates of Bluegill from electrofishing and fyke nets suggest a moderate density of fish exist in Johnson Lake. Based upon the size index scores, the Bluegill population in Johnson Lake is providing an acceptable to good fishery for anglers. There were no Bluegill captured that exceeded 8-inches in length, suggesting that fishing pressure in Johnson Lake may be high. Anglers are encouraged to selectively harvest smaller Bluegill while releasing larger individuals to help maintain this population. Interestingly, transferred Bluegill have begun to hybridize with the Pumpkinseed in Johnson Lake, providing additional opportunity for interested anglers. Hybridization of these panfish species occurs naturally in the Upper Peninsula and managers do not expect this to negatively impact reproductive success of the population.

The habitat assessment conducted in Johnson Lake reported limited woody habitat within the nearshore areas of the lake. Additional habitat improvement projects are recommended, such as nearshore tree drops, that may provide additional cover for Bluegill allowing them to grow to an older age or larger size that is more attractive to anglers. Tree drops should be located within the lake where

habitat is currently limited in the 1- to 8-ft depth range. As nearshore habitat improves, and the Bluegill population continues to perpetuate itself through natural reproduction, area residents should self-evaluate the level of artificial light pollution in areas adjacent to Johnson Lake. Johnson Lake is heavily developed, and it is likely that the nearshore areas of the lake experience considerable exposure to artificial light at night. Since exposure to intermittent artificial light at night can negatively impact Bluegill feeding behavior (Harrison and Gray 2023), residents are encouraged to consider nighttime light regimes that minimize those impacts to this popular sportfish.

Largemouth Bass - The electrofishing catch rate of Largemouth Bass suggests that a moderate to high density exists in Johnson Lake. Electrofishing catch rate tends to provide a more useful indicator for relative abundance given that Largemouth Bass tend to avoid impoundment nets. A good number of age classes were represented in the catch and growth rates were high compared to the state average suggesting that natural reproduction occurs annually and there is sufficient forage in the lake to support growth. The catch rate, growth, and the high proportion of legal-size fish suggest that Johnson Lake should be providing an attractive recreational fishery for Largemouth Bass.

Northern Pike - Catch rate and growth analyses suggest the population of Northern Pike in Johnson Lake is abundant and slow growing. Surprisingly, the high abundance of Northern Pike has not improved the size structure of Yellow Perch in Johnson Lake. Additionally, the proportion of legal-size Northern Pike was relatively low (23%) suggesting that sorting will be required by anglers seeking harvest opportunities. Within the regulatory framework of the Northern Pike Management Plan (Smith et al. 2016), there are alternative regulatory options for Johnson Lake that aim to improve growth and size structure. However, more species-specific protocols (Bauman and Mylchreest In Press) should be used to validate the status of this population prior to considering any alternative fishing regulations such as the no minimum size limit regulation.

Yellow Perch - The electrofishing catch rate for Yellow Perch was high, however the large-mesh fyke net catch rate was low. Across the state, small-mesh fyke nets and seines typically capture young age classes of Yellow Perch (Wehrly et al. 2015), and this was the case in Johnson Lake where catch rates in these gear types were high. Overall, the catch rate and growth of Yellow Perch suggest that the population in Johnson Lake is moderate to high in abundance but growing slightly below the state average. Growth slows considerably by 3-years-old, however Yellow Perch in Johnson Lake reach the preferred size of 7-inches at about the same age (3- to 4-years-old) as Yellow Perch in other Michigan inland lakes (Wehrly et al. 2015). One fish captured exceeded 10-inches suggesting that a few large fish are available to interested anglers.

Other Gamefish - Four additional gamefish species are present in Johnson Lake, however, catch rates for these species are generally low. Although the catch rate of Pumpkinseed was low, larger fish (greater than 6-inches) are available to anglers. Anglers are encouraged to selectively harvest smaller Pumpkinseed while releasing larger individuals to help maintain or build this population. Occasional catches of these additional gamefish species will help maintain angler interest during periods when angler catch rates for more preferred species slows.

Forage Fish - Diversity and catch rates of forage fish in Johnson Lake is generally low, with Bluntnose Minnow and Common White Sucker being exceptions. Catch rates of Bluntnose Minnow were high in all gears that are expected to capture this smaller forage fish. Catch rates of Common White Sucker were high, but only for those gear that are expected to capture large individuals. Catch rates and the size distribution of Common White Sucker caught during this survey suggest that the population is largely comprised of larger, older individuals. Additional nearshore habitat improvement projects, such as tree-drops, may help to increase the relative abundance of forage fishes in Johnson Lake. A

more diverse and abundant forage base may help to improve the growth rates of gamefish species in Johnson Lake, such as Bluegill, Northern Pike, and Yellow Perch.

Physical and Oxythermal Habitat - Parameters measured indicate that the Johnson Lake shoreline has been altered from its natural state. Shoreline modification projects like installation of seawalls or rip rap can have adverse impacts on populations of fish, reptiles, and amphibians, and the overall ecological integrity of the lake. Therefore, lake shore property owners are encouraged to adopt natural shoreline principles supported by the Michigan Natural Shoreline Partnership (MNSP 2025). As mentioned above, the average density of beneficial woody habitat in Johnson Lake (87 logs per mile) is less than half the average density in the region (201 logs per mile). Natural undeveloped lakes throughout northern Michigan and Wisconsin have large woody debris densities ranging from 470 to 1,545 logs per mile of shoreline (O'Neal and Soulliere 2006). Lake residents have already improved woody habitat in Johnson Lake considerably in deeper regions of the lake. However, additional inputs are needed in shallower areas that are likely to benefit the forage fish community more directly. Protection and rehabilitation strategies that maintain or improve the abundance of woody debris in nearshore areas are well developed (WDNR 2014) and should be adopted in Johnson Lake.

Johnson Lake is unique for the region due to its depth, transparency, and oxythermal habitat available in the water column. Cool water (<68°F) and sufficient dissolved oxygen are available in much of the water column throughout the more stressful periods of the year (e.g., winter and summer). Decades ago, these characteristics helped justify trout management which proved to be successful. However, illegal bucket transfers of Northern Pike and Walleye as well as the high cost of trying to control competing species, Johnson Lake is no longer suitable for trout management.

Invasive Species - Recent surveys conducted in Johnson Lake have not documented any aquatic invasive species residing in the lake. However, the threat of invasive species (namely, Invasive Milfoil and Zebra Mussels) is still a major concern. The introduction of Zebra Mussels could further limit lake productivity resulting in a disruption of the food chain. Invasive Water Milfoil is another aquatic invasive species that exists in an adjacent lake but has not been documented in Johnson Lake. Invasive Water Milfoil can limit fish growth and becomes a nuisance for anglers and residents on the lake. Waterbodies in the Gwinn, Michigan area are largely void of these aquatic invasive species, however these species are expanding towards the central Upper Peninsula which is a concern. Invasive species outreach, education, and prevention measure are needed to ensure species like Invasive Water Milfoil and Zebra Mussels are not introduced or spread to neighboring waterbodies.

Management Direction

Fish Community - The Johnson Lake fish community provides a `mixed-bag' warmwater fishery for Bluegill, Largemouth Bass, Northern Pike, and Yellow Perch with occasional catches of other gamefishes. The current fishing regulations in Johnson Lake are sufficient to maintain this fishery. That said, there may be alternative regulations available in the future that might improve the recreational fishery further. Alternative regulations for Northern Pike may be available but require additional species-specific surveys to ensure relevant information is gathered to justify any regulation changes. Also, panfish regulations may be adjusted to improve the abundance or size structure of some panfish species (e.g., Bluegill, Pumpkinseed). The MDNR Fisheries Division has recently formed a bass and panfish committee that is tasked with drafting guidelines for alternative regulations. Once guidelines are established, MDNR biologists as well as Johnson Lake residents and anglers should be consulted to see if alternative regulation options are worth exploring.

Physical and Oxythermal Habitat - Shoreland and shoreline development can cause poor water quality, erosion, and additional losses to fish habitat. The density of dwellings and the rate of armoring are

high in Johnson Lake. Based on a national lake assessment (USEPA 2024), the loss of natural shorelines is the biggest threat to the overall health of inland lakes in Michigan. Johnson Lake landowners are encouraged to consider adopting natural shoreline principles to help reduce wave energy and stabilize fine sediment that exists in the nearshore areas of Johnson Lake. Rehabilitation projects designed to restore areas of shoreline impacted by alternation could be focused along the areas highlighted in red in Figure 4. For more information about how to identify contractors and incorporate natural shoreline principles, landowners can visit the Michigan Natural Shoreline Partnership website (MNSP 2025).

A preliminary offshore habitat improvement project was completed on Johnson Lake by an area resident. However, the density of nearshore woody habitat is still limited in Johnson Lake. Therefore, the fish community would benefit from additional habitat improvement projects in the form of tree drops. Lake residents, anglers, and local conservation districts are encouraged to work collaboratively with the MDNR Fisheries Division and the Michigan Department of Environment, Great Lakes, and Energy to improve the density of nearshore woody habitat in Johnson Lake. An example of a project that serves to improve the density of nearshore woody habitat includes the "Fish Sticks" program (WDNR 2014). Rehabilitation projects designed to improve the density of nearshore woody habitat could target regions of the lake shoreline where the number of logs per mile is less than 218 submerged logs per mile (Figure 5). Funding for additional monitoring and improvement of nearshore habitat may also be available through the MDNR Fisheries Aquatic Habitat Grant Program (MDNR 2025).

Invasive Species - Fisheries Division recommends that representatives from Johnson Lake, as well as staff from the local conservation district and Cooperative Invasive Species Management Area (or CISMA) work collaboratively to apply for funding to implement programs geared towards outreach and education to prevent future introduction of invasive species in Johnson Lake and the Gwinn, Michigan region. For example, funding for prevention, detection, eradication, and control of aquatic invasive species may be possible through the Michigan Invasive Species Grant Program (MISGP 2025).

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Tables and Figures

Table 1. Decade, species stocked, and the total number of fish stocked in Johnson Lake, Marquette County, Michigan from 1944 to 2016.

Decade	Species	Number Stocked
1940s	Brook Trout	200
1950s	Lake Trout	11,450
1950s	Rainbow Trout	17,700
1960s	Brook Trout	10,000
1960s	Rainbow Trout	78,900
1960s	Splake	2,500
1970s	Rainbow Trout	70,669
1980s	Brook Trout	300
1980s	Brown trout	3,900
1980s	Rainbow Trout	26,300
1980s	Splake	10,550
1990s	Brook Trout	200
1990s	Lake Trout	814
1990s	Splake	18,800
2000s	Brook Trout	2,955
2000s	Lake Trout	141
2010s	Bluegill	810

Table 2. Species, number captured, total weight, average total length, and range in total length of fish captured in Johnson Lake, Marquette County during the 2023 fish community survey.

Species	Number Captured	Total Weight (lbs.)	Average Total Length (in.)	Range in Total Length (in.)
Bluegill	141	21.0	5.5	1.0 to 8.0
Bluntnose Minnow	1,845	5.0	2.1	1.0 to 3.0
Creek Chub	1	0.0	-	-
Common White Sucker	130	426.6	20.1	16.0 to 22.0
Hybrid Sunfish	15	4.5	7.1	4.0 to 8.0
Iowa Darter	2	0.0	2.5	1.0 to 3.0
Largemouth Bass	31	50.7	11.9	2.0 to 17.0
Northern Pike	53	138.5	21.4	1.0 to 34.0
Northern Redbelly Dace	2	0.0	2.5	1.0 to 3.0
Pumpkinseed	12	2.6	5.6	2.0 to 9.0
Rock Bass	50	10.5	5.9	3.0 to 10.0
Walleye	1	2.8	-	-
Yellow Perch	292	6.2	4.0	1.0 to 10.0

Table 3. Species, inch group, and total abundance of fish species captured (all gear types) in Johnson Lake, Marquette County 2023.

Inch Group	Bluegill	Hybrid Sunfish	Largemouth Bass	Northern Pike	Pumpkinseed	Rock Bass	Yellow Perch
1	2			1			1
2	15		1		3		88
3	11					1	139
4	37	1	1		1	11	37
5	25	3			3	10	25
6	15	2			1	17	1
7	22	4			3	6	
8	14	5	1			1	
9					1	3	
10						1	1
11			2				
12			3				
13			2	1			
14			7				
15			5				
16			7				
17			2				
18				2			
19				7			
20				6			
21				7			
22				9			
23				8			
24				6			
25				1			
26				3			
27							
28							
29							
30							
31							
32				1			
33							
34				1			

Table 4. Species, Age (years), number (N) aged, range in total length, State of Michigan average (Avg.) size at age, average total length, growth index per age group, and the average growth index for fish species collected in Johnson Lake, Marquette County 2023.

Species	Age	N Aged	TL Range (in.)	State Avg. TL (in.)	Avg. TL (in.)	Growth Index*	Avg. Growth Index*
Bluegill	3	9	3.3 to 4.7	5.0	3.99	-1.01	-0.9
Bluegill	4	10	4.3 to 6.1	5.9	4.79	-1.11	
Bluegill	5	10	4.4 to 6.1	6.7	5.34	-1.36	
Bluegill	6	4	6.3 to 6.7	7.3	6.57		
Bluegill	7	10	6.1 to 8.3	7.8	7.41	-0.39	
Bluegill	8	12	6.7 to 8.4	8.2	7.65	-0.55	
Bluegill	9	3	7.9 to 8.2	8.6	8.01		
Bluegill	10	2	7.3 to 8.7	8.9	7.84		
Largemouth Bass	1	1	4.9 to 4.9	4.2	4.90		2.6
Largemouth Bass	2	4	8.4 to 12.1	7.1	10.98		
Largemouth Bass	3	5	11.9 to 14.3	9.4	12.96	3.56	
Largemouth Bass	4	6	14.2 to 15.3	11.6	14.7	3.10	
Largemouth Bass	5	2	14.8 to 15.6	13.2	15.2		
Largemouth Bass	6	5	14.8 to 16.9	14.7	15.88	1.18	
Largemouth Bass	7	3	15.7 to 16.2	16.3	15.97		
Largemouth Bass	8	1	17.2 to 17.2	17.4	17.2		
Largemouth Bass	9	2	16.2 to 17.7	18.3	16.95		
Largemouth Bass	11	1	16.7 to 16.7	-	16.70		
Northern Pike	2	4	13.1 to 19.0	17.7	17.48		-2.2
Northern Pike	3	6	19.1 to 22.2	20.8	20.34	-0.46	
Northern Pike	4	12	19.4 to 24.6	23.4	21.36	-2.04	
Northern Pike	5	15	19.6 to 26.6	25.5	23.41	-2.09	
Northern Pike	6	10	20.8 to 32.3	27.3	23.6	-3.70	
Northern Pike	7	5	23.8 to 34.9	29.3	26.78	-2.52	
Yellow Perch	1	14	3.0 to 4.6	3.3	3.38	0.08	-0.7
Yellow Perch	2	12	4.1 to 6.9	5.2	4.82	-0.38	
Yellow Perch	3	5	4.4 to 5.3	6.5	4.84	-1.66	
Yellow Perch	4	3	5.3 to 10.1	7.5	6.25		
Yellow Perch	5	1	5.2 to 5.2	8.5	5.20		

Table 5. Summary of catch CPUE of Bluegill, Largemouth Bass, Northern Pike, and Yellow Perch by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for large-mesh fyke net, gill net, small-mesh fyke net, is the number of fish per net night. Catch per unit effort for seining is the number of fish per haul (Wehrly et al. 2015, Tables 135, 159, 89, and 182, respectively).

Species	Method	25th	Median	75th	Johnson Lake
Bluegill	Electrofishing	1.10	3.50	6.57	1.38
Bluegill	Large-mesh fyke	2.50	8.51	25.86	6.11
Bluegill	Gill net	0.33	1.00	2.50	0.00
Bluegill	Small-mesh fyke	1.50	6.25	19.50	8.00
Bluegill	Seine	7.75	25.96	64.33	0.00
Largemouth Bass	Electrofishing	0.37	0.73	1.57	0.74
Largemouth Bass	Large-mesh fyke	0.44	1.39	2.75	0.11
Largemouth Bass	Gill net	0.50	1.00	1.89	0.00
Largemouth Bass	Small-mesh fyke	0.50	1.00	2.00	0.00
Largemouth Bass	Seine	0.25	0.50	1.00	0.33
Northern Pike	Electrofishing	0.03	0.06	0.10	0.15
Northern Pike	Large-mesh fyke	0.33	0.75	1.55	2.11
Northern Pike	Gill net	1.00	1.89	4.00	6.75
Northern Pike	Small-mesh fyke	0.25	0.50	0.75	0.25
Northern Pike	Seine	0.33	0.50	1.00	0.00
Yellow Perch	Electrofishing	0.27	1.03	2.53	6.82
Yellow Perch	Large-mesh fyke	0.24	0.67	4.00	0.00
Yellow Perch	Gill net	0.75	2.11	4.87	0.50
Yellow Perch	Small-mesh fyke	0.75	2.71	13.00	1.50
Yellow Perch	Seine	0.50	1.75	9.50	6.00

Table 6. Summary of catch CPUE of forage fish by gear, including only sites and gears with catches greater than zero. Catch per unit effort for electrofishing is number of fish per minute. Catch per unit effort for large-mesh fyke net, gill net, small-mesh fyke net, is the number of fish per net night. Catch per unit effort for seining is the number of fish per haul (Wehrly et al. 2015, Tables 46 and 54, respectively).

Species	Method	25th	Median	75th	Johnson Lake
Bluntnose Minnow	Electrofishing	0.10	0.23	0.50	3.21
Bluntnose Minnow	Large-mesh fyke				0.00
Bluntnose Minnow	Gill net				0.00
Bluntnose Minnow	Small-mesh fyke	1.75	10.00	35.50	272.25
Bluntnose Minnow	Seine	3.43	12.30	45.00	210.33
Common White Sucker	Electrofishing	0.07	0.14	0.37	0.03
Common White Sucker	Large-mesh fyke	0.25	0.90	3.00	12.00
Common White Sucker	Gill net	0.50	1.17	2.50	5.25
Common White Sucker	Small-mesh fyke	0.25	0.50	1.50	0.00
Common White Sucker	Seine	0.25	2.83	118.50	0.00

Table 7. Physical indicators including dwelling density (dwellings per mile), boat docks (docks per mile), shoreline armoring (average percent armored), and large woody debris (trees per mile) measured in Johnson Lake, the regional average (Northern Lake Michigan Management Unit, N = 48 surveys), 25th percentile, 75th percentile, and 2023 rating for Johnson Lake.

Regional Statistics	Dwelling Density	Boat Docks	Shoreline Armoring	Submerged Trees
Average	14.0	10.3	10.1	200.6
25th Percentile	1.36	1.44	0.00	22.61
Median	12.22	8.84	4.50	85.08
75th Percentile	22.39	16.82	16.56	217.27
Johnson Lake	43.56	33.66	18.75	87.12
Rating	High	High	High	Low

Table 8. Depth (in feet, ft.), water temperature (°F), and dissolved oxygen concentration (mg/L) measured during winter of 2023 in Johnson Lake, Marquette County. During the winter months, hypoxic conditions begin to limit aquatic organisms at a depth of approximately 35-ft (shaded below).

Depth (ft)	Temp (°F)	Oxygen (mg/L)
0	33	13.10
3	33.4	13.05
6	36.1	12.50
9	37.4	11.50
12	37.6	11.04
15	37.8	10.76
18	38	10.36
21	38.2	10.02
24	38.4	9.72
27	38.8	8.65
30	39.3	7.61
33	39.9	5.13
34	39.9	3.80
35	40.1	2.67
36	40.1	2.06
37	40.1	1.79
38	40.1	1.70
39	40.2	1.09
40	40.3	0.00
41	40.3	0.00
42	40.4	0.00
43	40.7	0.00
44	40.8	0.00

Table 9. Depth (in feet, ft.), water temperature (°F), and dissolved oxygen concentration (mg/L) measured during summer of 2023. During the summer months, the thermocline is located at 24-ft and hypoxic conditions begin to limit aquatic organisms at a depth of 36-ft, (shaded below).

Depth (ft)	Temp (°F)	Oxygen (mg/L)
0	71.2	9.92
2	71.2	10.00
4	71.2	10.01
6	71.1	10.01
8	70.9	10.07
10	70.8	10.13
12	70.6	10.10
14	70.6	10.13
16	70.4	10.21
18	70.3	10.16
20	69	12.04
22	65.8	19.90
24	62.2	19.60
26	57.8	18.35
28	53.9	15.44
30	52.5	13.28
32	51.7	10.86
34	50.5	6.32
36	49.7	2.42
38	49.2	0.49
40	49.1	0.00
42	48.8	0.00
44	48.7	0.00

Figure 1. Map of Johnson Lake located in Marquette County, Michigan.

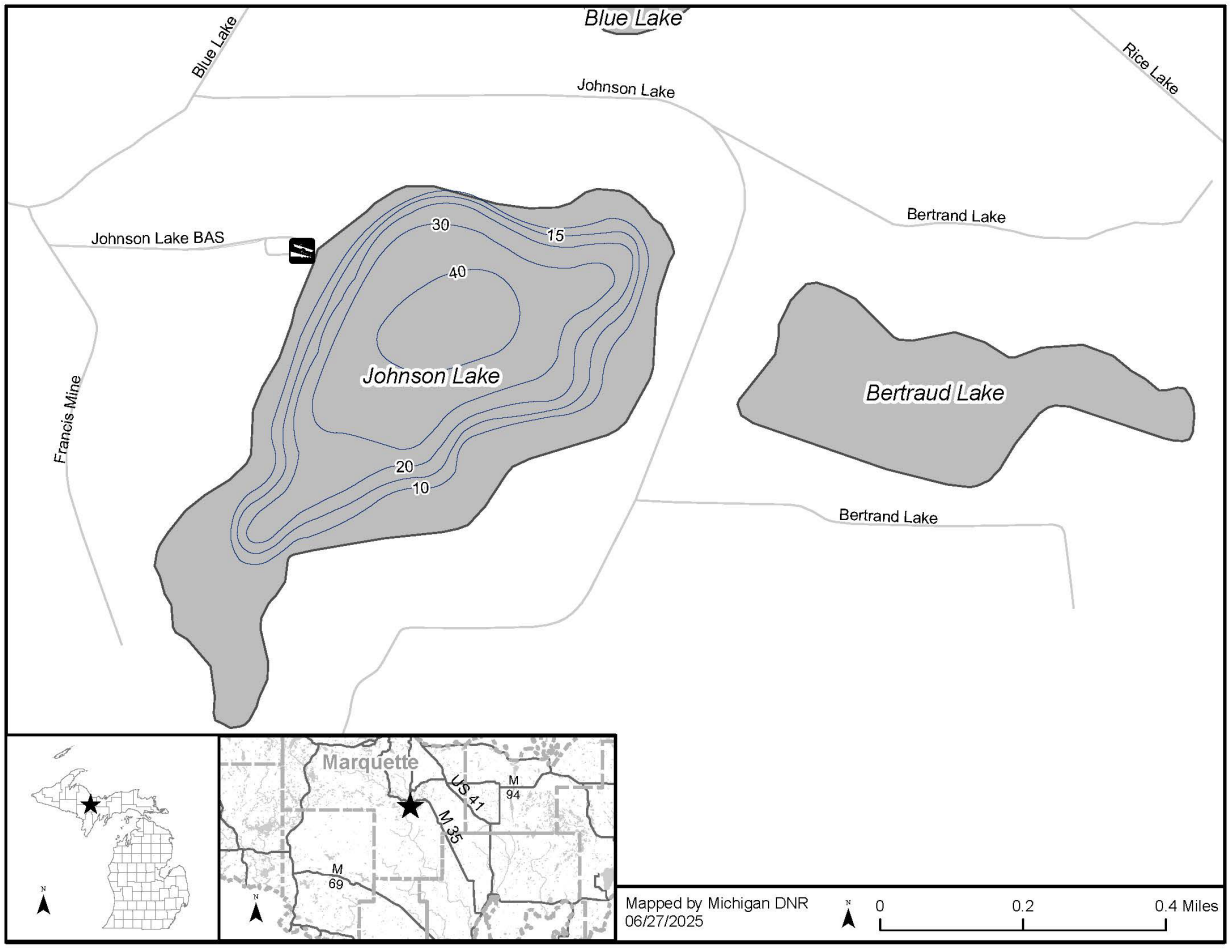


Figure 2. Land use map for Johnson Lake lakeshed located in Marquette County, Michigan.

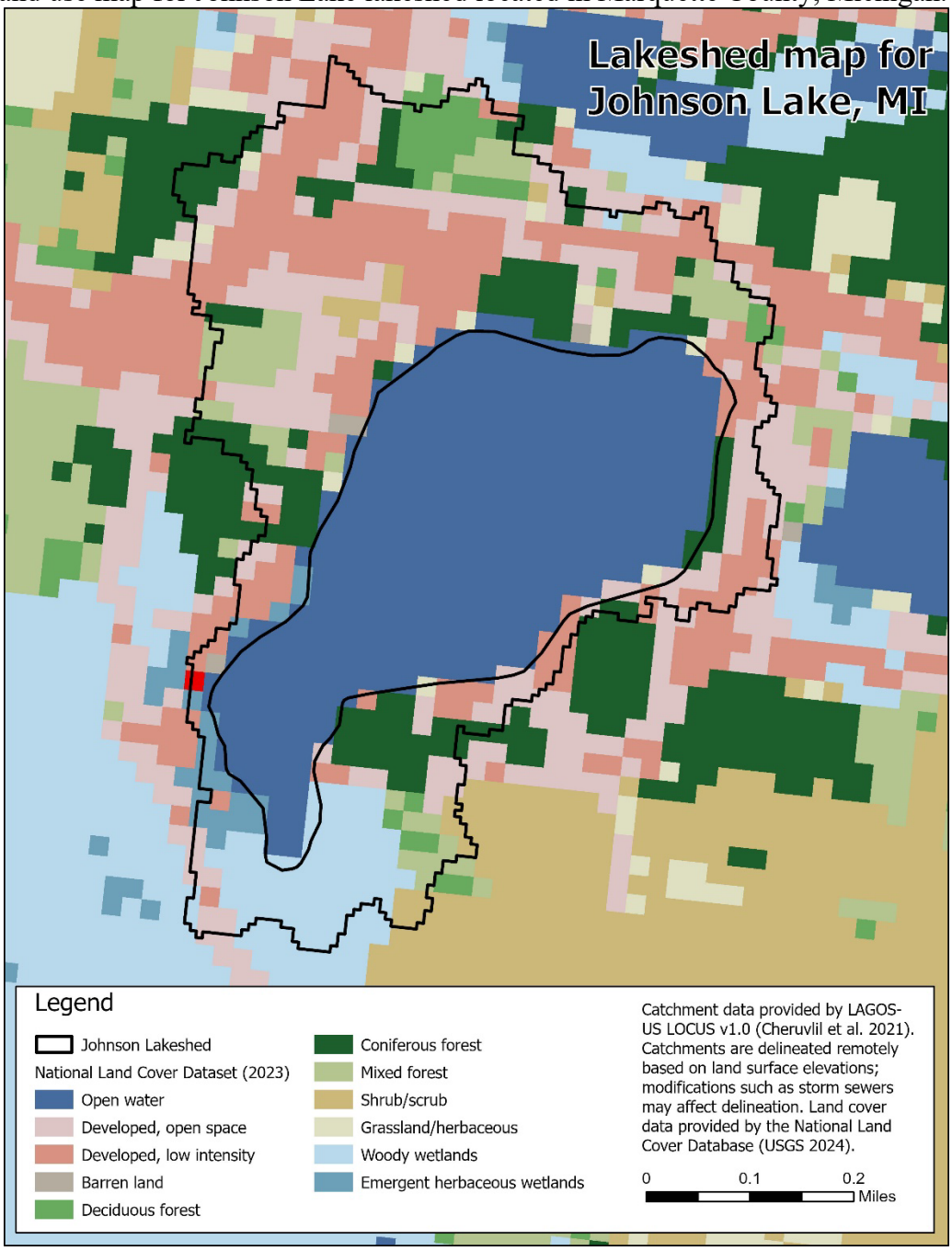


Figure 3. Lakeshed map for Johnson Lake located in Marquette County, Michigan.

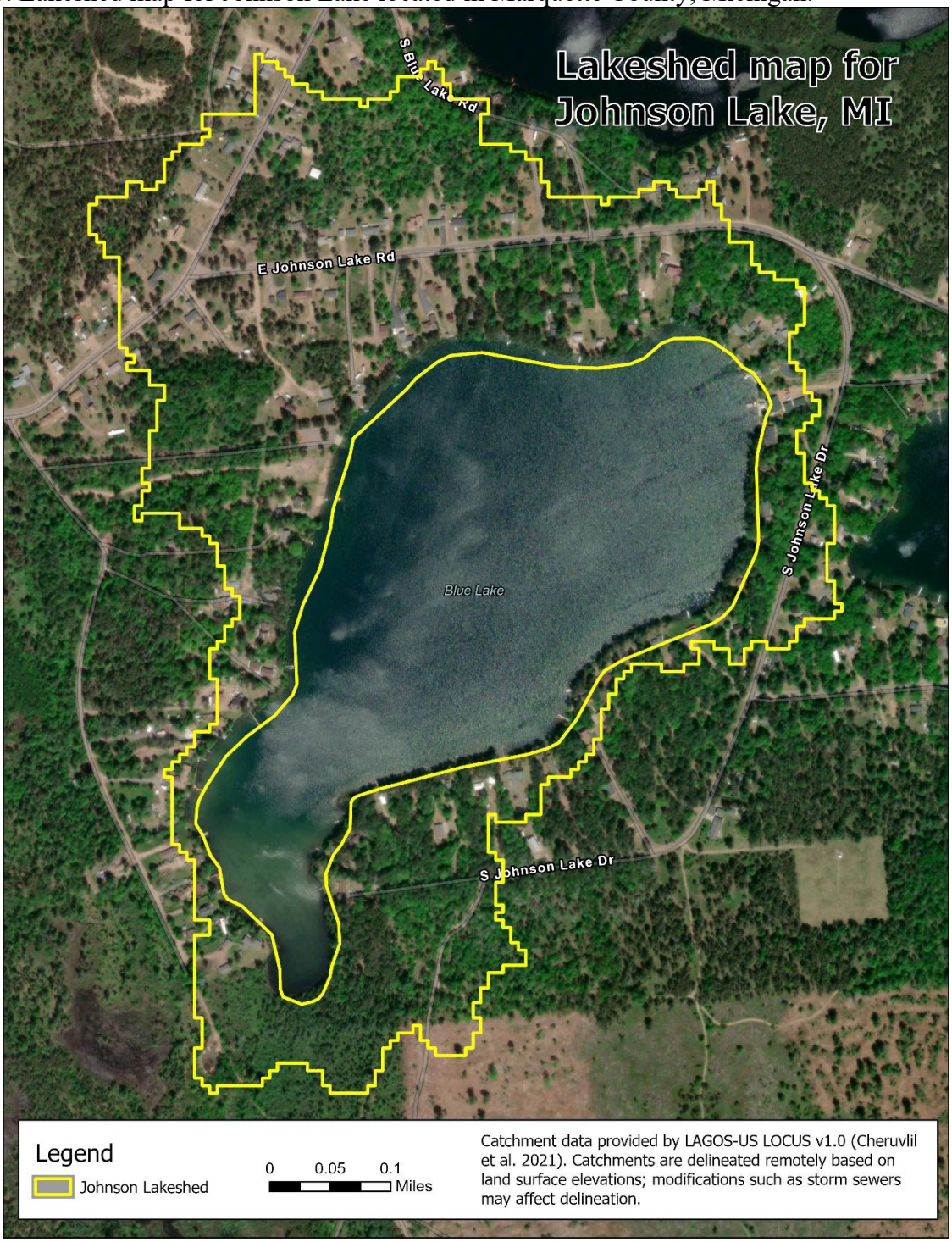


Figure 4. Johnson Lake, Marquette County, shoreline status depicting the percent of shoreline that has been altered from its natural state at each 1,000-ft segment.

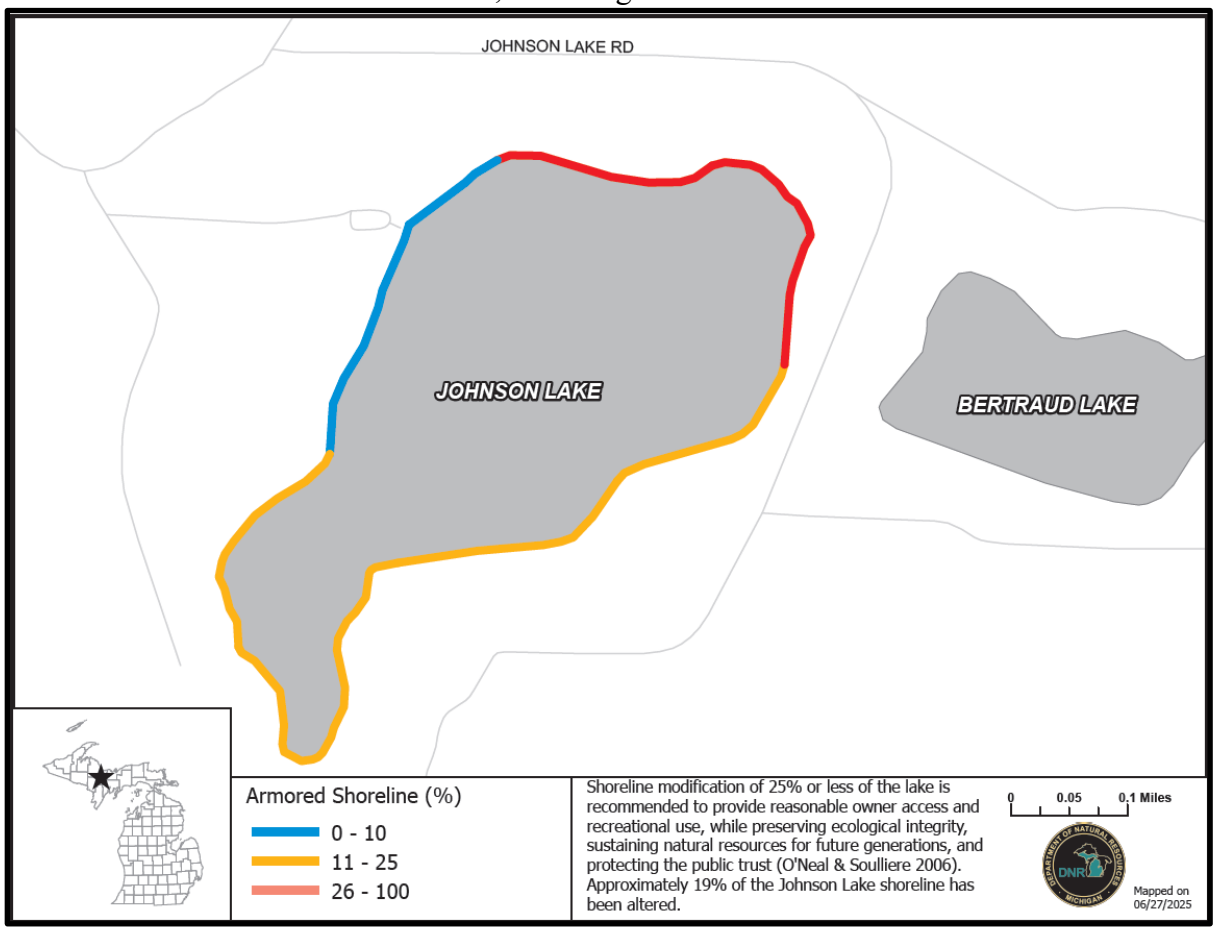
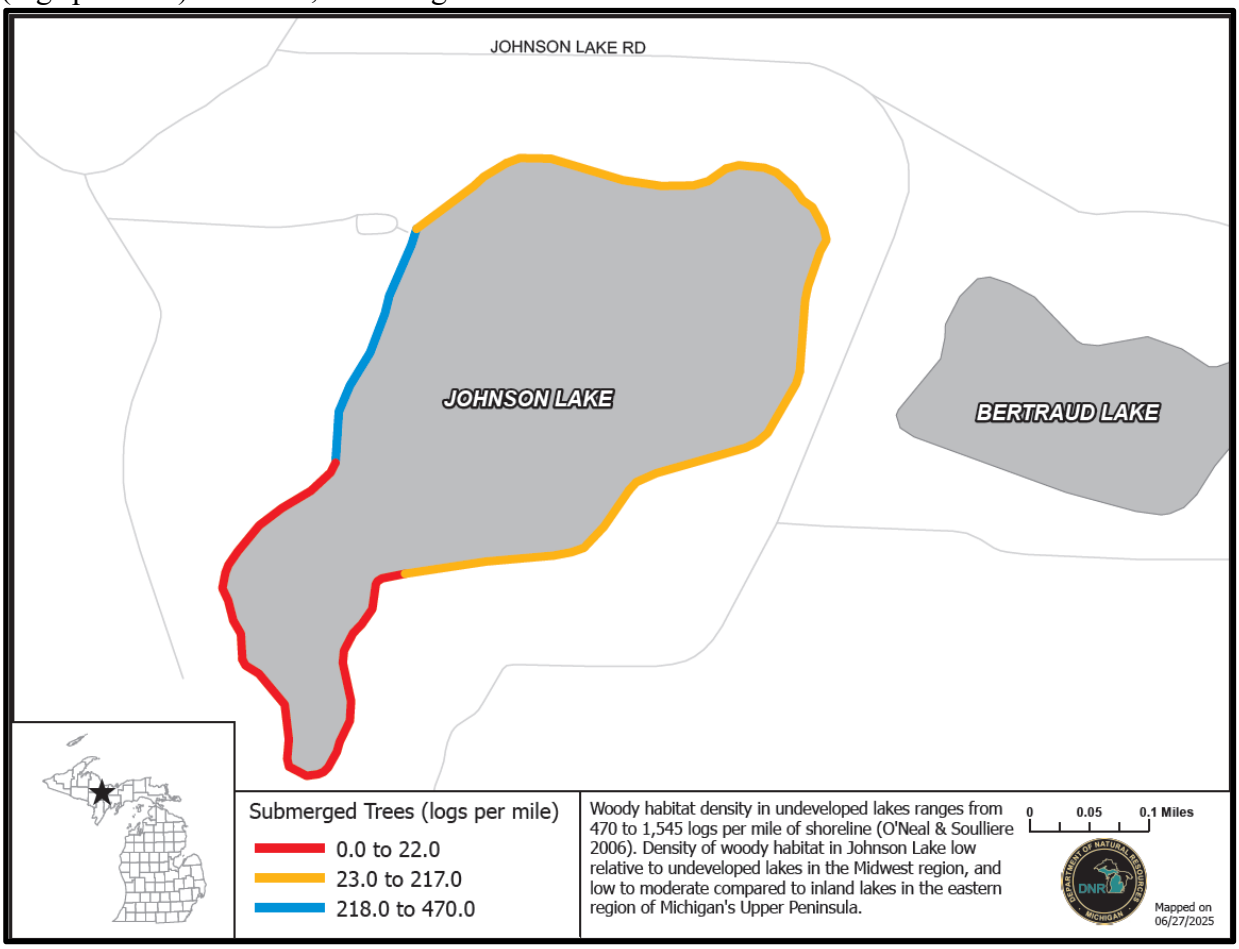


Figure 5. Johnson Lake, Marquette County, shoreline status depicting the density of submerged trees (logs per mile) at each 1,000-ft segment.



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