

Sage Lake

Ogemaw County, T23N R04E Sec. 28
Au Gres Watershed, Last Surveyed 2024

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Environment

Sage Lake is a 785-acre glacial lake that is considered the headwaters for the Au Gres River. It is located approximately 8.5 miles southwest of Hale in eastern Ogemaw County (T23N R04E Sec 27, 28, 29, 33, 34, 35; Figure 1). A stop log dam was constructed on the northwest end of the lake in 1951 with approximately 2 ft of head and is used to maintain a legal lake level of 853.5 ft. Sage Lake is classified as an oligotrophic lake with phosphorus serving as a limiting factor, a category generally characterized by low nutrient levels and high-water clarity, which supports less productive aquatic community. Temperature and dissolved oxygen profiles reveal a strong thermocline around 19 feet deep, with hypoxic conditions (i.e., dissolved oxygen < 3.0 mg/L) beginning abruptly at the same depth (Figure 2). The average depth of Sage Lake is 18 ft with a maximum depth of 79 ft. The bathymetry of Sage Lake shows only a quarter of the lake is less than 15 ft with many steep drop-offs, particularly on the western side of the lake (Figure 3). The lake bottom consists of sand, scattered gravel, and organic material in the shallows, transitioning to pulpy peat and muck in the deeper areas.

In June 2023, Dr. Daniel Hayes's lab at Michigan State University conducted a point-intercept aquatic vegetation survey on Sage Lake. A total of 22 species, including four invasive species, were encountered with 94% of the survey points having at least one species found and the densest point comprised of 10 species (Table 1). The aquatic vegetation community of Sage Lake is dominated by Chara spp. (native) and Starry Stonewort (invasive). Other invasive species included Eurasian Watermilfoil, hybrid Watermilfoil, and Curly-leaf Pondweed, which can form dense mats that outcompete native species. Overall, the survey concluded that while aquatic vegetation is prevalent throughout Sage Lake, it is not overabundant.

Sage Lake has a convoluted shoreline approximately 11.7 miles long, with numerous embayments and three islands. The shoreline development index (DL) measures the shape of a waterbody and estimates the amount of littoral zone present (Cole et al. 2016). Sage Lake has a DL of 2.96, indicating a highly convoluted shoreline compared to a perfectly circular lake (DL=1). This is an appropriate estimate of the littoral zone available. Approximately 46% of the shoreline is armored with seawalls and riprap installed by property owners, which is slightly over the statewide average (Figure 4). Land use in the Au Gres watershed is a mix of agriculture and forested areas with Sage Lake situated in the forested reaches (Figure 5). The surrounding topography varies from flat to gently hilly and features a mix of sandy soils and glacial deposits.

The public can access the lake from the Michigan Department of Natural Resources (MDNR) gravel boat launch in the southeast bay of Sage Lake. This launch has one skid pier and parking to accommodate up to 26 vehicles and trailers.

Fishery Resource

History

Management activities at Sage Lake began in the early 1900s with the stocking of warmwater fish and arbitrary allotments of coldwater fish species (Table 2). Stocking efforts became more consistent in 1933, with nearly annual stocking of Walleye fry and Yellow Perch fingerlings. The first fisheries survey was conducted in August 1949, utilizing gillnets, fyke nets, and seine nets. Bluegill dominated the catch, accompanied by Pumpkinseed, Yellow Perch, Largemouth Bass, Northern Pike, and Rock Bass. One 22.8-inch Walleye was recorded, and an additional six were reported by local Conservation Officers. Native non-game species, particularly Bullheads and Bowfin, were also prevalent. The results of this survey concluded that warmwater species were well established in Sage Lake, leading managers to discontinue stocking warmwater fish. The lack of Walleye recruitment, despite heavy stocking, was attributed to inadequate spawning substrate, resulting in the discontinuation of Walleye stocking as well.

A partial fish inventory conducted in 1955, utilized gillnets and captured just two Bluegill, two Yellow Perch, and six Northern Pike. The small sample size made it difficult to draw conclusions about the panfish community, but the captured Bluegill and Yellow Perch were growing below the statewide average. Conversely, the sampled Northern Pike were growing above the statewide average, with age-1 individuals averaging 18.3 in, age-2 at 20.9 in, and age-3 at 25.2 in. This report marked the first documented concern regarding poor growth rates within the panfish population – the beginning of a recurring issue in Sage Lake management.

In 1958, a seine net survey covering five acres captured 2,662 fish representing 10 species. Bluegill accounted for nearly 70% of the catch, with a mean total length of 5.2 in. The predator-to-prey biomass ratio was calculated at 7:1. Biologists concluded the warmwater fish population was satisfactory, recommending no immediate management actions. However, during the 1950s, local anglers voiced concerns about poor fishing, culminating in requests for spearing and ice fishing closures in 1963. The Michigan Department of Natural Resources (MDNR) dismissed these requests as unwarranted.

A more extensive fisheries survey was completed in 1965, which employed gillnets (experimental and straight mesh), trap nets, and fyke nets. Approximately one-third of the catch consisted of Bluegill, averaging 5.3 inches in length. Growth remained slow across sportfish species, and panfish overpopulation was evident by the abundance of small individuals. The predator ratio could not be calculated because the biomass was not recorded.

In 1979 another fisheries survey was conducted utilizing an electrofishing boat for the first time. While the bass population appeared to be in good condition, this survey highlighted an increasing problem with stunted panfish and Northern Pike along with an abundance of Bullheads, Bowfin, and Common Carp. In response, MDNR initiated a marsh-reared Northern Pike stocking program to reduce the panfish population and improve growth rates.

In 1986, a netting survey evaluated the Northern Pike marsh rearing program and its impact on panfish growth. Secondary, the survey sought to determine survival rates of 1985 stocked Walleye fingerlings. However, the timing of this survey did not lend itself to a successful Walleye fingerling evaluation. The survey utilized two experimental gillnets, two trap-nets, four small-mesh fyke nets, and one large-mesh fyke net over two days. A total of 11 Northern Pike were captured with an average length of 18.6 in and mean growth index of 3.0 in below statewide average. The marsh reared Northern Pike did not

appear to be contributing to the overall pike population, likely due to poor marsh conditions leading to poor fry survival. It was recommended at this time to shift to stocking hatchery reared Northern Pike.

Concurrently, the abundance of native non-game fish, particularly Bullheads and Bowfin, were believed to exacerbate poor growth rates among sportfish. As a result, a netting survey and the manual removal of these species occurred in June 1988. The effort included six large mesh fyke nets that were tended daily for a week resulting in 30 net lifts and 20 net nights. Panfish that measured less than 6 in and all “undesired” species captured were removed with most transferred Tawas State Park or given to anglers waiting at the access site. Overall, 1,636 fish (326.5 lb; five species) were removed with undersized Bluegill comprising approximately 73% of the total number removed. Bullheads and Bowfin comprised roughly 40% of the catch by weight each. Age and growth analysis was completed for sport fish captured and all species were growing below the statewide average.

Attempts to establish a Walleye population resumed with fingerling stockings in 1985 (30 per acre) and 1989 (51 per acre). A follow-up 1993 survey found no Walleye, and the predator-to-prey ratio was 12:1. As a result, both Northern Pike and Walleye stocking programs were discontinued. Another general netting survey in 2001 captured 1,280 fish representing 12 species, with the fish community remaining dominated by Bullheads and Bowfin. The predator-to-prey ratio improved slightly to 11:1, but Bluegill, Largemouth Bass, and Northern Pike still exhibited stunted growth, while Black Crappie growth exceeded the statewide average by +0.8 inches.

In 2002, MDNR established the Inland Lake Status and Trends Program (STP), a statewide initiative with annual obligations for management units. The program's goal is to conduct standardized fisheries surveys on public inland lakes over 10 acres, allowing for statewide comparisons. Surveys are conducted over a one- to two-week period in late spring or early summer, when water temperatures range between 55°F and 80°F. Multiple gear types are used to sample different habitats randomly and gather data on various species and size classes (Wehrly et al. 2015). This protocol is more comprehensive and consistent than previous efforts, and therefore, provides a more holistic view of the fish community. All fish captured were measured (TL to the nearest inch). Fish weights were estimated using length-to-weight regression equations compiled by Schneider et al. (2000). For each sport species, an aging structure (fin ray or scales) was collected for up to 10 individual fish per inch bin, and age was determined. Mean growth indices were calculated from age estimates for species with at least five individuals sampled (Schneider et al., 2000). A mean growth index within ± 1 inch of the statewide average is considered satisfactory for predator sport fish, and ± 0.5 inch is acceptable for panfish.

The first Status and Trends survey for Sage Lake was completed in 2007. A total of 2,355 fish, comprising 25 species, were captured. Sampling efforts included one seine net, four trap nets, two experimental gillnet sets, and two fyke nets. Additionally, three nighttime electrofishing transects, each lasting 600 seconds, were conducted, covering a total of one mile of shoreline. The overall sampling effort consisted of five seine hauls and 20 net-nights. The catch was predominantly stunted Bluegill by number; however, Bullheads and Bowfin dominated catch by weight. Despite multiple efforts to shift the fish community of Sage Lake, all sport fish captured continued to exhibit poor growth. The predator-to-prey ratio remains unbalanced but improved to a 3:1 ratio. The Sage Lake Association stocked fall fingerling Walleye from a private aquaculture in 2005 and 2009 by obtaining a stocking permit from MDNR. No Walleye from the 2005 stocking event were captured in the 2007 survey. No management actions were implemented as a result of the 2007 survey.

Current status of the fish community

Methods

Several surveys were conducted between 2019 and 2024 to describe the fish community in Sage Lake. Status and Trends: The most recent survey as part of the STP was conducted on Sage Lake in June of 2019. Sampling efforts increased compared to 2007 and included one seine net, two trap nets, two experimental gillnet sets, three small- and three large-mesh fyke nets. Additionally, three nighttime electrofishing transects, each lasting 600 seconds, were conducted, covering a total of one mile of shoreline. The overall sampling effort consisted of five seine hauls and 27 net-nights. In addition to evaluating the fish community, STP included the collection of shoreline data. Using methods described by Wehrly et al. (2000), data on the number of dwellings, large (>2 boat slips) and small (1-2 boat slip) docks, submerged and partially submerged logs, and large-diameter tree limbs (≥ 3 inches in diameter, referred to as coarse woody debris) were recorded. The percentage of shoreline armoring was also determined.

Northern Pike Population Estimate: A Northern Pike population estimate was conducted in April 2022. To do this, Northern Pike were captured in two consecutive weeks immediately following spring ice-out with the first week for tagging and the second for recaptures. During week one, five large-mesh fyke nets and four trap nets were set along the littoral zone in potential spawning habitats with a total of 36 net nights. Dorsal fin rays were taken from all Northern Pike for aging and to identify that individual as ‘captured’ during the capture run (week one). During week two, four experimental gillnets were added along with the existing gear for a total of 41 net nights (including the weekend) and 16 gillnet lifts. Experimental gillnets were set at the beginning of each day and lifted at the end of each day. Individuals captured during the recap run (week two) were given a tail fin clip. If the individual captured during week two had a dorsal fin clip it was counted as a “recapture”. The Chapman modification of the Peterson mark and recapture estimate was used to calculate the Northern Pike population estimate in Sage Lake (Figure 7). Captured fish were aged following the STP protocol.

Predator Community: In October 2024, the entire shoreline was surveyed using an electrofishing boat and targeted the sportfish predator species: Largemouth Bass, Smallmouth Bass, Northern Pike, and Walleye. The purpose of this survey was to better understand the predator community of Sage Lake since they are largely under sampled in the STP.

Results

Status and Trends (2019): A total of 1,939 fish, representing 24 species, were captured (Table 3). Similar to 2007, Bluegill dominated the catch by number while Bowfin and Bullhead led by weight. A diverse fish community was caught in Sage Lake, but most sportfish were not captured in high enough numbers to calculate their mean growth index. Those that met the criteria continued to exhibit poor growth with the exception of Pumpkinseed, which was similar to the statewide average. The predator-to-prey biomass ratio had worsened since 2007 at 8:1. Additionally, from 2007 to 2019, there was a 5.24% increase in docks and an 18.91% increase in dwellings, respectively. The average amount of shoreline that has been armored was 46%, this is a slight increase from 2007 (43.2%). Along with this increase in shoreline alteration, there was also a significant decrease in submerged woody debris from 155 logs in 2007 to only 32 logs in 2019 (Figure 9). While there is some anecdotal evidence that fish are attracted to the shade provided by docks, Garrison et al. (2005) found that shading caused by docks reduces vegetation growth and ultimately displaces fish. Submerged trees, however, offer valuable fish habitat due to its more complex structure and support of aquatic invertebrates (Schindler et al. 2000).

Northern Pike Population Estimate: A total of 275 Northern Pike were captured over a two-week span, of which 20 individuals were recaptured (Table 4). Age and growth analysis indicated Northern Pike were growing below the statewide average with a mean growth index of -3.7 in. Multiple year classes (ages 1-13) were found, and the majority of individuals captured were ages 2-5 (Figure 8).

A total of 14 Walleye averaging 22.7 in were collected with 100% of the catch larger than the 15-in minimum size limit (MSL) for inland lakes. Age and growth analysis indicated Walleye were growing above the statewide average with a mean growth index of +2.8 in. Multiple year classes (ages 4-17) were found but only one year (age-17) aligned with stocked years. These data indicate Walleye may be naturally reproducing in Sage Lake, despite the expectation that lake conditions are not suitable to support a self-sustaining Walleye population.

Including Northern Pike and Walleye, a total of 1,759 fish representing 13 species were captured in Sage Lake during week one of sampling (Table 5). Panfish species made up 30.8% by number and 9.5% by weight and included Black Crappie, Bluegill, Pumpkinseed, Rock Bass, and Yellow Perch. The sport predator community included Largemouth Bass, Northern Pike, and Walleye which made up only 17.5% of the total catch by number and 41.1% by weight. It should be noted that Northern Pike were heavily targeted during these efforts and therefore, made up 15.6% by number and 36% by weight of individuals captured. The forage base was not accurately assessed during this survey because the gear set was selective for large individuals. Bullhead and Bowfin comprised the non-sport fish community captured and made up just over half of the catch by number and nearly 50% by weight.

During week two, the recapture run, an additional 117 Northern Pike and 4 Walleye were captured. The population estimate of Northern Pike in Sage Lake is roughly 1 fish per acre. To calculate an accurate population estimate, the marking phase should cease when most individuals are spent (completed spawning, no eggs or sperm) or when the daily recapture rate is greater than 30%. During the recapture phase, it is ideal to continue until 30-50% of the marked fish have been recaptured or the number of experimental gill net lifts has been met. Unfortunately, we did not meet these criteria except for the number of gill net lifts. We were only able to reach a recapture rate of roughly 7% of the marked individuals. This resulted in a coefficient of variation of 25%, which indicated low confidence in the calculated population estimate of 1 fish/ac. While this survey was unsuccessful at confidently calculating the population estimate of Northern Pike in Sage Lake, it was able to verify poor growth rate (-3.7 in) and give a better picture of the population structure.

Predator Community: A total of 68 fish were collected over roughly three hours of electrofishing. Thirty-five Largemouth Bass dominated the catch and ranged from age 0 to 11 with growth rates above the statewide average (+1.5 in). Only six Smallmouth Bass were captured (7-17 in) and therefore the mean growth index could not be calculated. Eleven Walleye were also captured with lengths ranging from 8 to 26 in. Ages 0 to 18 were captured and only the two age-1 individuals aligned with a stocking event providing more evidence of a small naturally reproducing Walleye fishery. Lastly, 16 Northern Pike were captured aging from age 0 to 5. Unlike the other sport predators in Sage Lake, Northern Pike continue to grow below the statewide average (-1.2 in). This is, however, an improvement from the 2022 population estimate. This is likely due to the limited number of age 3 and older individuals captured during this effort compared to the previous 2022 survey because this age range demonstrated slower growth than younger individuals.

Analysis and Discussion

In general, the fish community of Sage Lake can be described as:

- 1.) The fish community is diverse with 24 species present, but abundance is considered low for the number of species caught. There are likely more small, bodied forage species present than represented in the survey.
- 2.) When considering weight, the fish community remains dominated by nongame fish species. These species are also commonly referred to as roughfish.
- 3.) The predator-prey biomass is unbalanced with nongame species serving as the primary predators and Bluegill dominating the panfish community.
- 4.) Northern Pike are the most abundance sportfish predator in Sage Lake followed by Largemouth Bass. The Northern Pike population is growing significantly slower than the statewide average. Secondarily, there is a small Walleye fishery present in Sage Lake.

Northern Pike reach maturity between ages 3 and 5 with males maturing faster than females. While not all individuals captured were ripe, some males and females appeared to be reaching sexual maturity by age 2 and 3. Northern Pike are known to mature early at smaller sizes in lakes that are highly exploited or overpopulated to ensure reproductive success. Angler reports do not support high exploitation, and this survey did not find any evidence of overpopulation. An imbalanced food web can also cause a similar population dynamic of Northern Pike. When Sage Lake was sampled for all species in June 2019, the fish community was dominated by nongame native species (74.6% by weight), which was primarily composed of bullhead and Bowfin. Bullhead and Bowfin are valuable fish species, despite being socially classified as ‘undesirable or roughfish’; however, they are predatory generalist species. It is possible the nongame fish community is outcompeting Northern Pike for suitable prey. Additionally, the feeding and spawning behavior of Bullhead can cause damage to vegetation and reduces cover for panfish to hide in and increase turbidity (Braig and Johnson 2003; Sikora et al. 2021). This makes panfish more vulnerable to predation. This increased predation and lack of suitable habitat could be responsible for the slow growth of Sage Lake panfish making them poor prey items for Northern Pike subsequently leading to poor growth.

To address this recurring issue, management action was taken by MDNR and the Sage Lake Association in 2021. Sage Lake Association hosted their first annual roughfish tournament in 2021. These tournaments primarily targeted Bowfin and Bullhead but Longnose Gar and Common Carp were also taken in smaller numbers. The total weight of rough fish harvested from Sage Lake during these tournaments was 3,564.2 lb (2021-2024; Figure 6). In addition to these events, the Natural Resources Commission implemented a liberalized Northern Pike regulation on Sage Lake beginning March of 2022. This regulation allowed for the harvest of five Northern Pike with no minimum size limit except for the allowance of only one fish over 24 in. The purpose of this change was to encourage the harvest of small, stunted Northern Pike, which in turn would theoretically improve the panfish population.

Sage Lake is classified as a Class 2 Walleye lake with a level 5 natural reproduction rank (Herbst et al., 2021). Class 2 lakes are expected to show resilience to climate change but may have inconsistent natural reproduction, typically relying on stocking to sustain Walleye populations. The level 5 natural

reproduction rank indicates that Sage Lake relies solely on regular stocking. However, previous survey results suggest there may be low levels of natural reproduction in the lake.

Management Direction

- 1.) Hardened shorelines, such as seawalls and riprap, can harm aquatic ecosystems by increasing turbidity, scouring bottomlands, damaging neighboring properties, reducing water quality, and promoting the spread of invasive species. Given the significant shoreline development around Sage Lake, it is essential to consider the impacts on fish habitat. Aquatic vegetation provides critical ecosystem services by stabilizing shorelines with deep roots, filtering nutrient runoff, and offering habitat for prey and nursery areas for fish. Additionally, research shows that coarse woody debris (CWD) supports diverse macroinvertebrate communities, offers refuge for prey, and enhances aquatic food webs. The removal of CWD has been linked to poor fish growth and reduced abundance of forage species, while adding CWD supports panfish growth and increases prey diversity. Property owners should consider natural shoreline improvement projects, especially in areas near or exceeding the recommended 25% alteration threshold.
- 2) Sage Lake was given the liberalized Northern Pike regulation of no minimum size limit ($1 \geq 24"$) and a five fish daily bag limit in 2022. The current Northern Pike population of Sage Lake is exceptionally poor growing, but the special regulation is unlikely to change this problem.
- 3) The Sage Lake Association is encouraged to continue to work closely with Southern Lake Huron Management Unit (SLHMU) in managing and monitoring the nongame fish population through annual roughfish tournaments. It is important to foster this cooperation to ensure these native species are being respectfully managed, not completely eliminated from the fishery.
- 4) The Walleye population in Sage Lake is small but naturally reproducing. There is an opportunity to enhance this fishery by initiating supplemental stocking efforts. MDNR will implement a new spring fingerling Walleye stocking program (50/ac) in 2026 with stocking occurring every even year.
- 5) Anglers are encouraged to report their fishing experience to SLHMU to assist in monitoring population trends over time.
- 6) Michigan law requires boaters to remove boat plugs, drain water, and remove plant/debris prior to leaving the launch. Anglers are encouraged to clean all fishing gear and live wells, as well. Additionally, it is illegal to dump unused bait and aquariums into waterways. These regulations are in place to stop the spread of invasive species and fish diseases.

References

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Tables and Figures

Table 1. 2023 Sage Lake littoral zone (0-25 ft) aquatic macrophyte species checklist from 87 points surveyed by Hartsock and Coskie (2023), and taxa occurrence metrics. (N) = native species; (I) = invasive species.

Common name	N/I	Scientific name	Total sites present	Frequency of occurrence (%) [*]	Relative proportion (%) ⁺
Muskgrass	(N)	<i>Chara sp.</i>	31	36	17
Starry stonewort	(I)	<i>Nitellopsis obtusa</i>	27	31	15
Variable-leaf pondweed	(N)	<i>Potamogeton gramineus</i>	18	21	10
Flat-stem pondweed	(N)	<i>Potamogeton zosteriformis</i>	16	18	9
Aquatic moss	(N)	<i>Bryophyta sp.</i>	15	17	8
Coontail	(N)	<i>Ceratophyllum demersum</i>	11	13	6
Duckweed	(N)	<i>Lemna trisulca</i>	11	13	6
Illinois pondweed	(N)	<i>Potamogeton illinoensis</i>	10	11	5
Fern pondweed	(N)	<i>Potamogeton robbinsii</i>	8	9	4
Small-leaf pondweed	(N)	<i>Potamogeton sp.</i>	8	9	4
Canadian waterweed	(N)	<i>Elodea canadensis</i>	7	8	4
Northern watermilfoil	(N)	<i>Myriophyllum sibiricum</i>	6	7	3
White pond lily	(N)	<i>Nymphaea odorata</i>	4	5	2
Bullhead pond lily	(N)	<i>Nuphar variegata</i>	1	1	1
Large-leaf pondweed	(N)	<i>Potamogeton amplifolius</i>	1	1	1
Water buttercup	(N)	<i>Ranunculus aquatilis</i>	1	1	1
Common bladderwort	(N)	<i>Utricularia macrorhiza</i>	1	1	1
Hybrid watermilfoil	(I)	<i>M. spicatum x sibiricum</i>	V.O.	-	-
Eurasian watermilfoil	(I)	<i>Myriophyllum spicatum</i>	V.O.	-	-
Curly-leaf pondweed	(I)	<i>Potamogeton crispus</i>	V.O.	-	-
Water bulrush	(N)	<i>Schoenoplectus subterminalis</i>	V.O.	-	-

*Frequency of occurrence (%) based on all sampling points (=87) including those lacking vegetation.

⁺Relative proportion of taxa based on summed plant species occurrences (=182).

V.O. = Visual observation

Table 2. Stocking history of Sage Lake, Ogemaw County (1983-present).

Year	Species	Average Length (in)	Number	Operation
1983	Northern Pike	2.49	3,600	State
1985	Walleye	0.98	30,768	State
1986	Northern Pike	2.01	1,000	State
1987	Northern Pike	4.84	14,169	State
1988	Northern Pike	3.31	45,000	State
1989	Walleye	1.73	40,260	State
1990	Northern Pike	3.35	45,000	State
2005	Walleye	10.00	1,000	Private
2009	Walleye	7.07	1,200	Private
2020	Hybrid Sunfish	5.00	2,000	Private
2020	Fathead Minnow	1.50	240,000	Private
2021	Fathead Minnow	1.50	660,000	Private
2023	Walleye	7.00	7,500	Private

Table 3. Fish species captured during the 2019 status and trends survey on Sage Lake. Columns represent number of fish, percent by number, mean total length (TL), and mean growth index (MGI; if calculated) of each species captured.

Species	Number	% by Number	Mean TL (in)	MGI
Black Crappie	10	0.5	10.7	-
Blackchin Shiner	52	2.7	1.9	-
Banded Killifish	251	12.9	2.4	-
Bluegill	428	22.1	3.9	-1.0
Bluntnose Minnow	209	10.8	2.4	-
Blacknose Shiner	60	3.1	1.9	-
Bowfin	31	1.6	19.9	-
Brown Bullhead	163	8.4	10.6	-
Golden Shiner	5	0.3	4.5	-
Grass Pickerel	1	0.1	13.5	-
Green Sunfish	19	1	3.7	-
Iowa Darter	22	1.1	1.6	-
Johnny Darter	2	0.1	1.5	-
Lake Chubsucker	1	0.1	7.5	-
Largemouth Bass	13	0.7	13.2	-
Longnose Gar	29	1.5	25.0	-
Northern Pike	22	1.1	22.9	-3.5
Pumpkinseed	123	6.3	5.0	-0.1
Rock Bass	105	5.4	6.6	-
Smallmouth Bass	5	0.3	7.5	-
Tadpole Madtom	16	0.8	3.3	-
Walleye	1	0.1	21.5	-
Yellow Perch	117	6.0	4.6	-
Yellow Bullhead	254	13.0	10.1	-

[illegible]

Table 4 (Continued). Length frequency of Northern Pike marked and recaptured April 18-29, 2022, on Sage Lake. (M) = Male; (F) = Female; (UNK) = Unknown.

LENGTH INTERVAL (INCHES)	MARKING PERIOD: MARKED			RECAP PERIOD: UNMARKED			RECAP PERIOD: RECAPS		
	M	F	UNK	M	F	UNK	M	F	UNK
30.0 – 30.49	0	0	0	0	0	0	0	0	0
30.5 – 30.99	0	1	0	0	0	0	0	0	0
31.0 – 31.49	0	0	0	0	0	0	0	0	0
31.5 – 31.99	0	1	0	0	0	0	0	0	0
32.0 – 32.49	0	0	0	0	0	0	0	0	0
32.5 – 32.99	0	0	0	0	0	0	0	0	0
33.0 – 33.49	0	0	0	0	0	0	0	1	0
33.5 – 33.99	0	1	0	0	0	0	0	0	0
TOTAL:	99	47	7	32	17	12	7	3	2

Table 5. Fish species captured during the April 2022 spring ice-out survey on Sage Lake. Columns represent number of fish, length range (in), mean length of each species captured, and percent of individuals of harvestable/acceptable size.

Species	Number	Total length Range (in)	Mean total length (in)	Percent acceptable size
Black Crappie	36	5-12	10	81
Bluegill	293	3-10	5.9	52
Bowfin	103	13-24	19	100
Brown Bullhead	197	5-15	11.2	93
Golden Shiner	1	5-5	5.5	100
Lake Chubsucker	4	5-6	6.3	100
Largemouth Bass	17	6-18	13	59
Northern Pike	171	10-33	20	11
Pumpkinseed	158	2-8	5.9	49
Rock Bass	87	2-11	4.6	57
Walleye	10	17-27	22.7	100
Yellow Bullhead	675	4-14	10.2	87
Yellow Perch	7	5-7	6.1	14

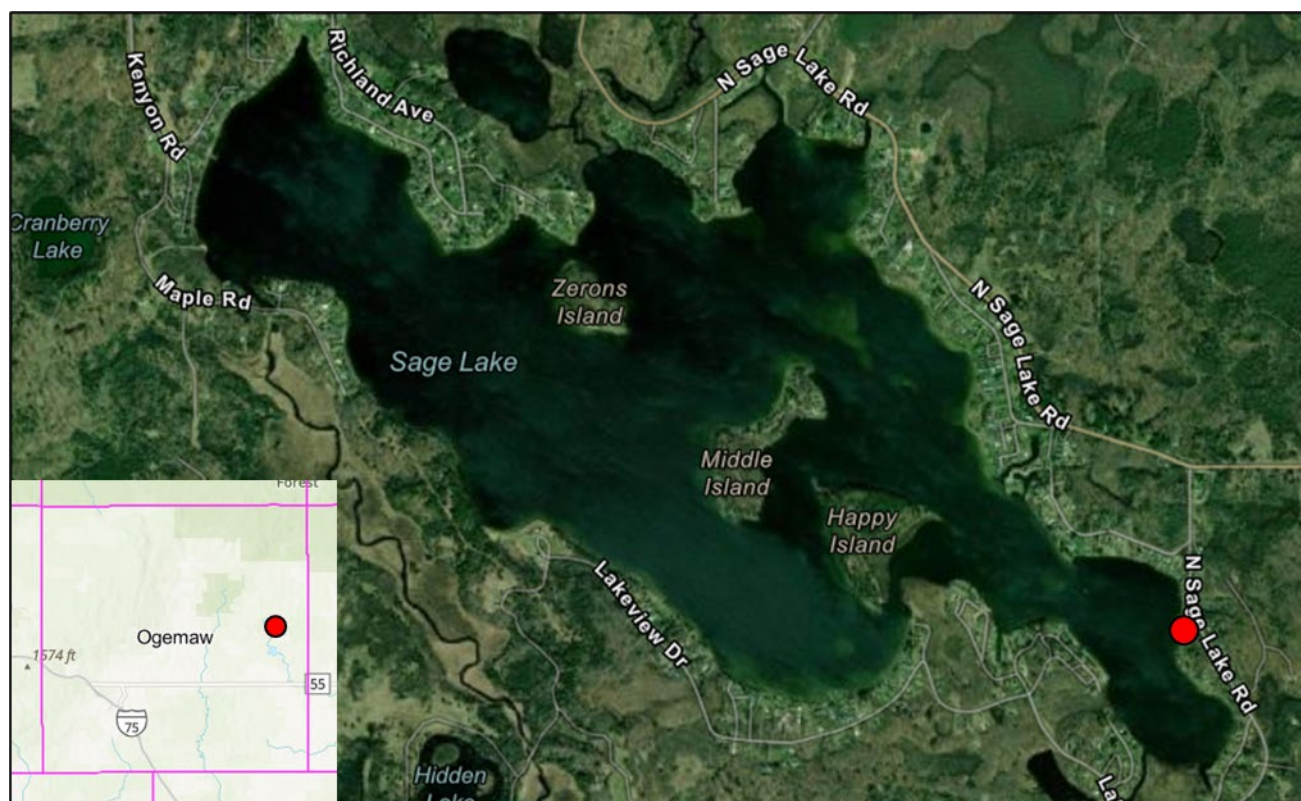


Figure 1. Sage Lake in Ogemaw County, Michigan. The red circle denotes the location of the public boat launch. This image contains a complex map.

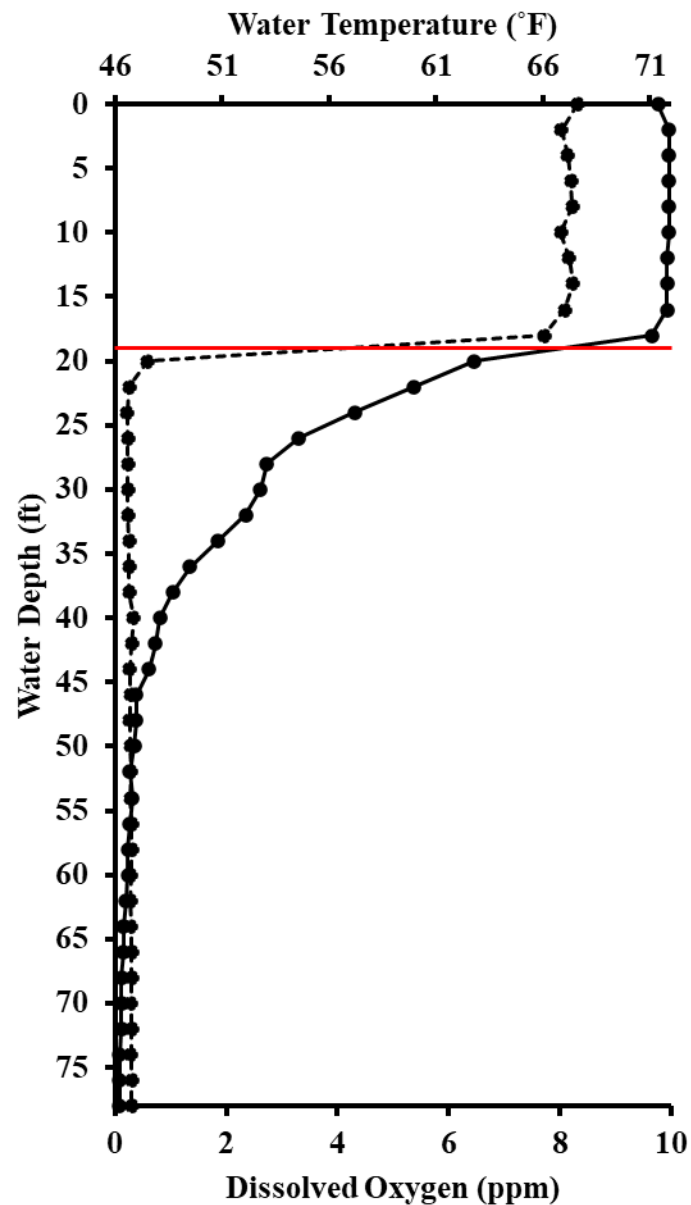


Figure 2. The thermal stratification of Sage Lake, Ogemaw County in August 2019. The solid line represents the temperature, and the dashed line represents the dissolved oxygen levels from the surface. The vertical line at approximately 19 ft represents the thermocline.

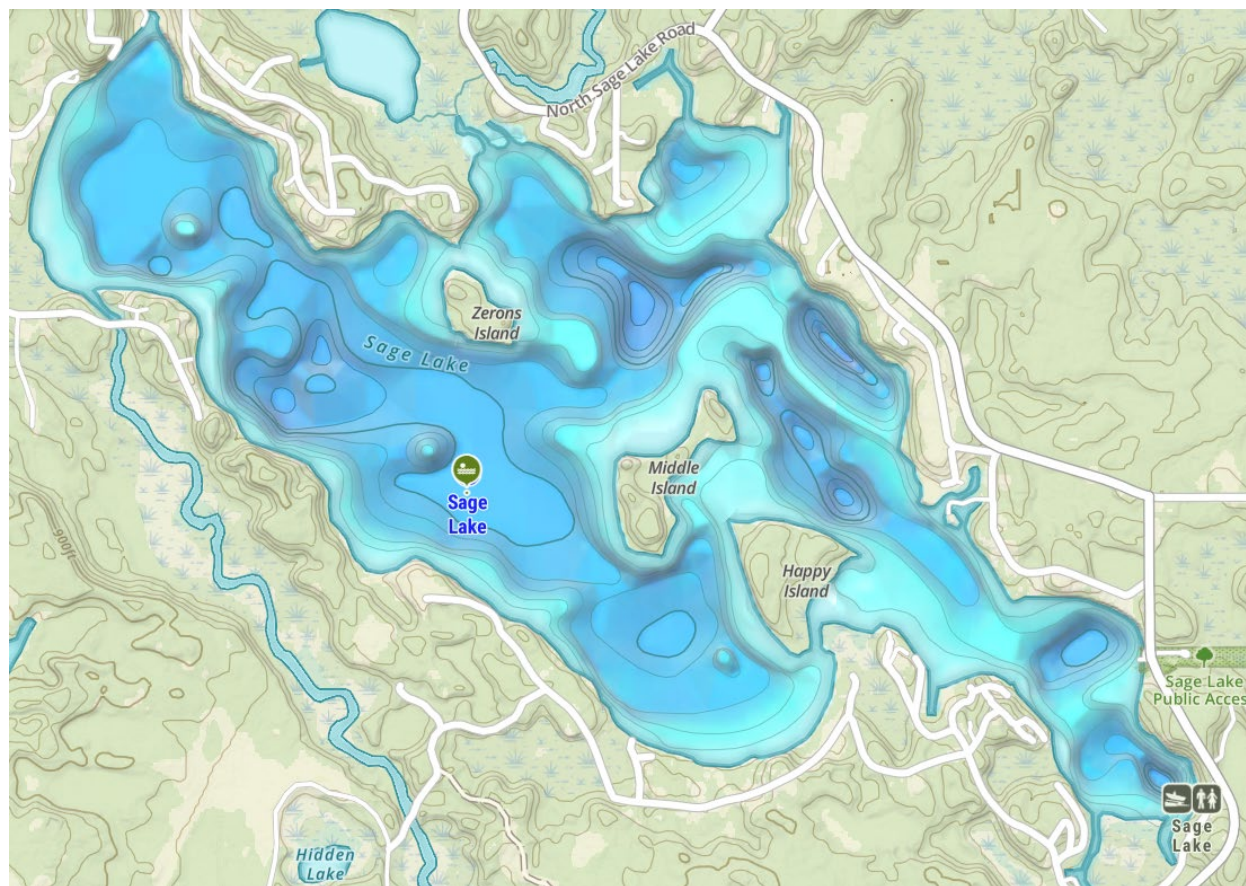


Figure 3. Bathymetry map of Sage Lake (Ogemaw County) created by OnX Fish.

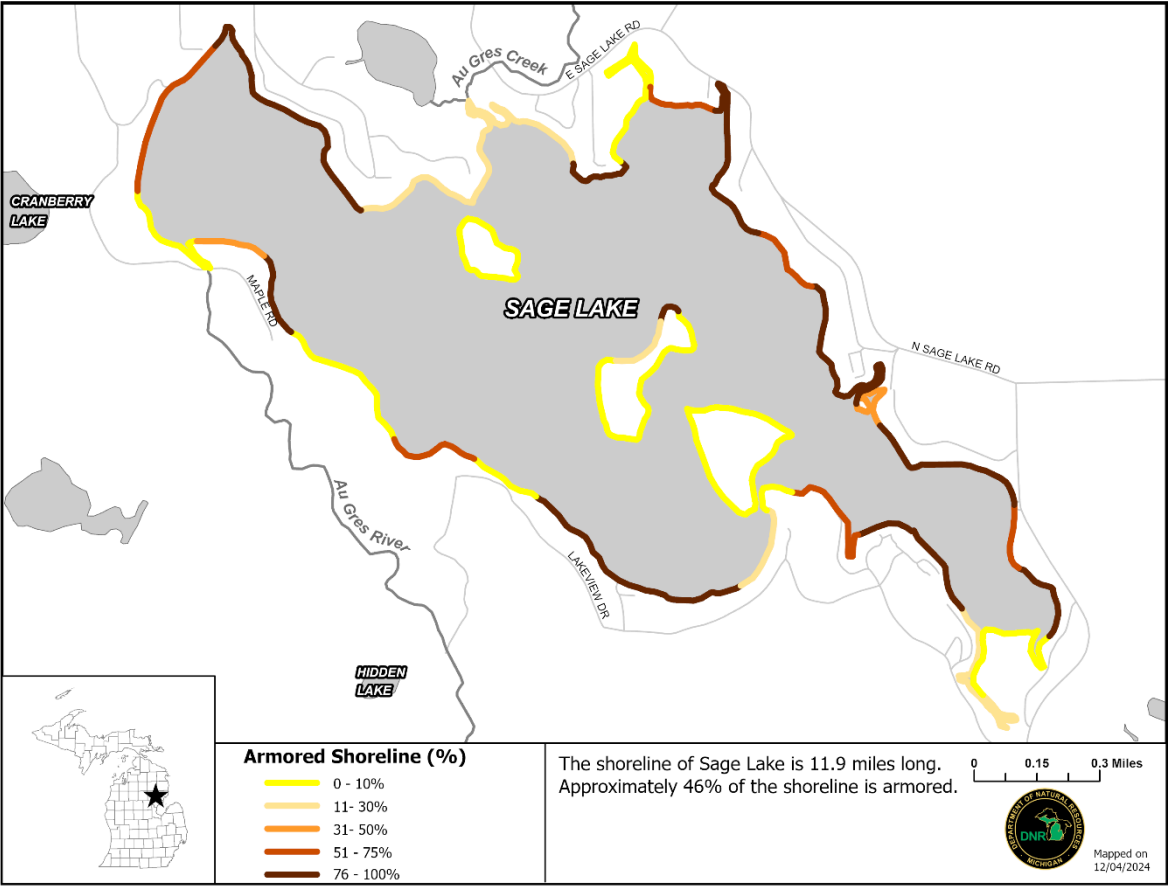


Figure 4. The shoreline of Sage Lake is 11.9 miles long and approximately 46% of the shoreline is armored as of 2019.

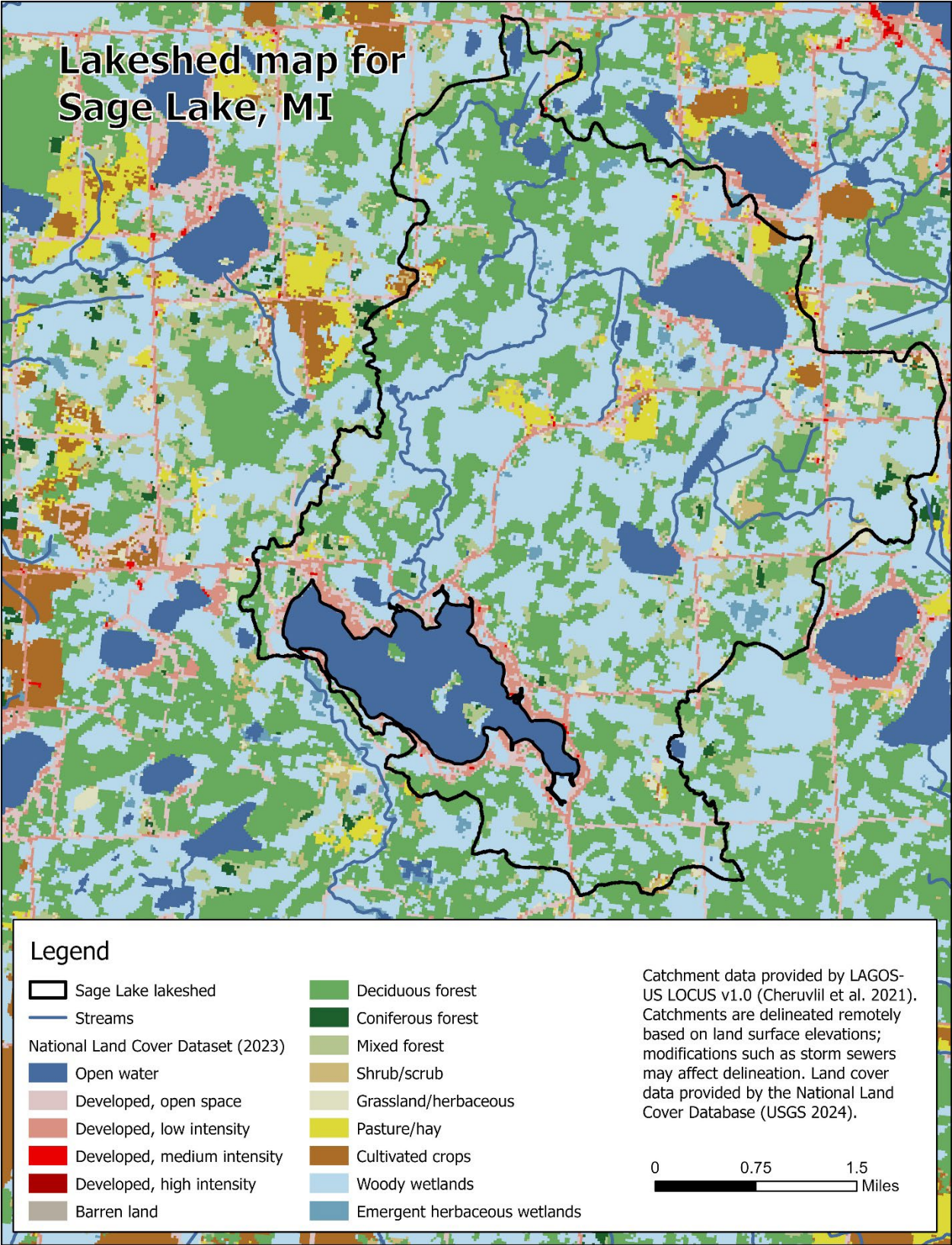


Figure 5. Land use for the Sage Lake (Ogemaw County) lakeshed.

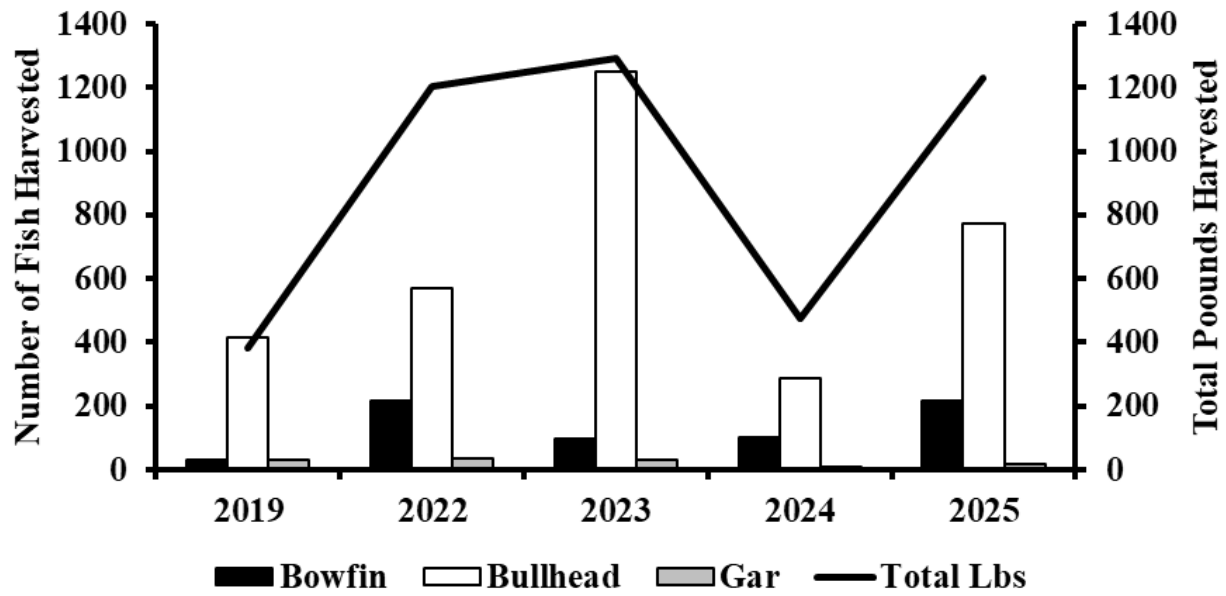


Figure 6. Annual results of the Sage Lake Roughfish tournaments held by the Sage Lake Association.

$$N = \frac{(M + 1)(C + 1)}{R + 1}$$

where:

N = population estimate of adult Northern Pike in each length/sex strata;

M = number of adult Northern Pike caught, marked and released in initial marking phase;

C = total number of adult Northern Pike caught in recapture phase (unmarked + recaptures);

and

R = number of adult Northern Pike recaptured in recapture phase.

Figure 7. Chapman's modification of the Peterson estimator used to calculate the Northern Pike population estimate of Sage Lake.

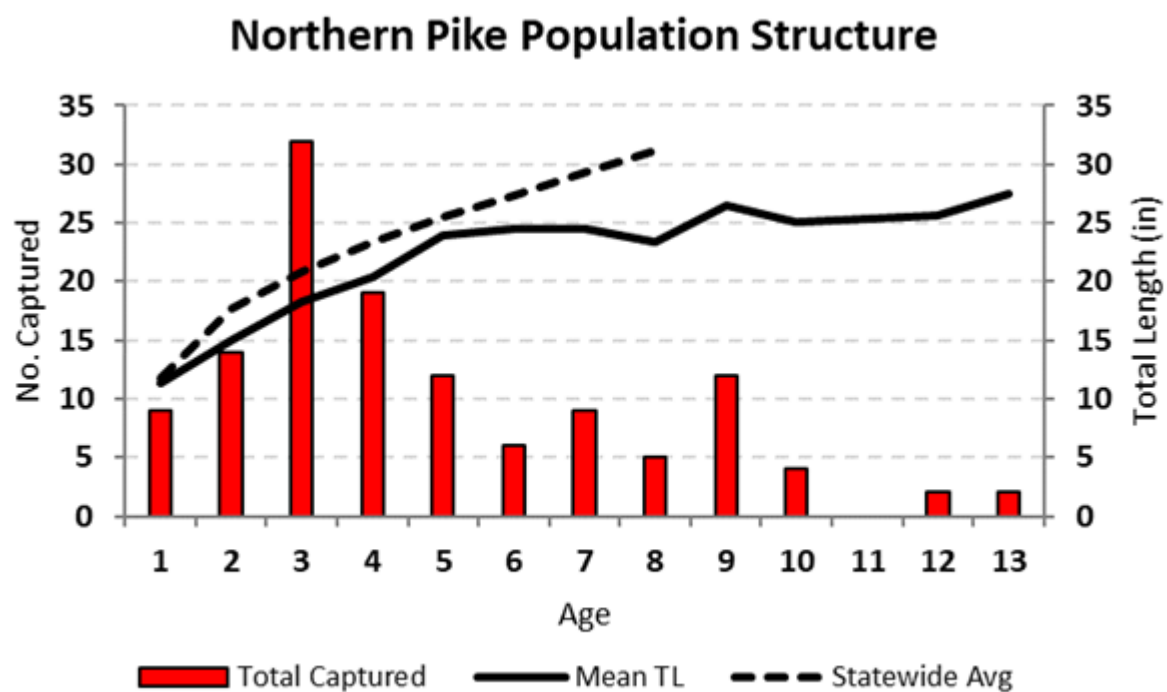


Figure 8. Total number of Northern Pike captured (red bar) in each age class and their mean total length (TL) in Sage Lake (solid line) compared to the statewide average (dashed line).

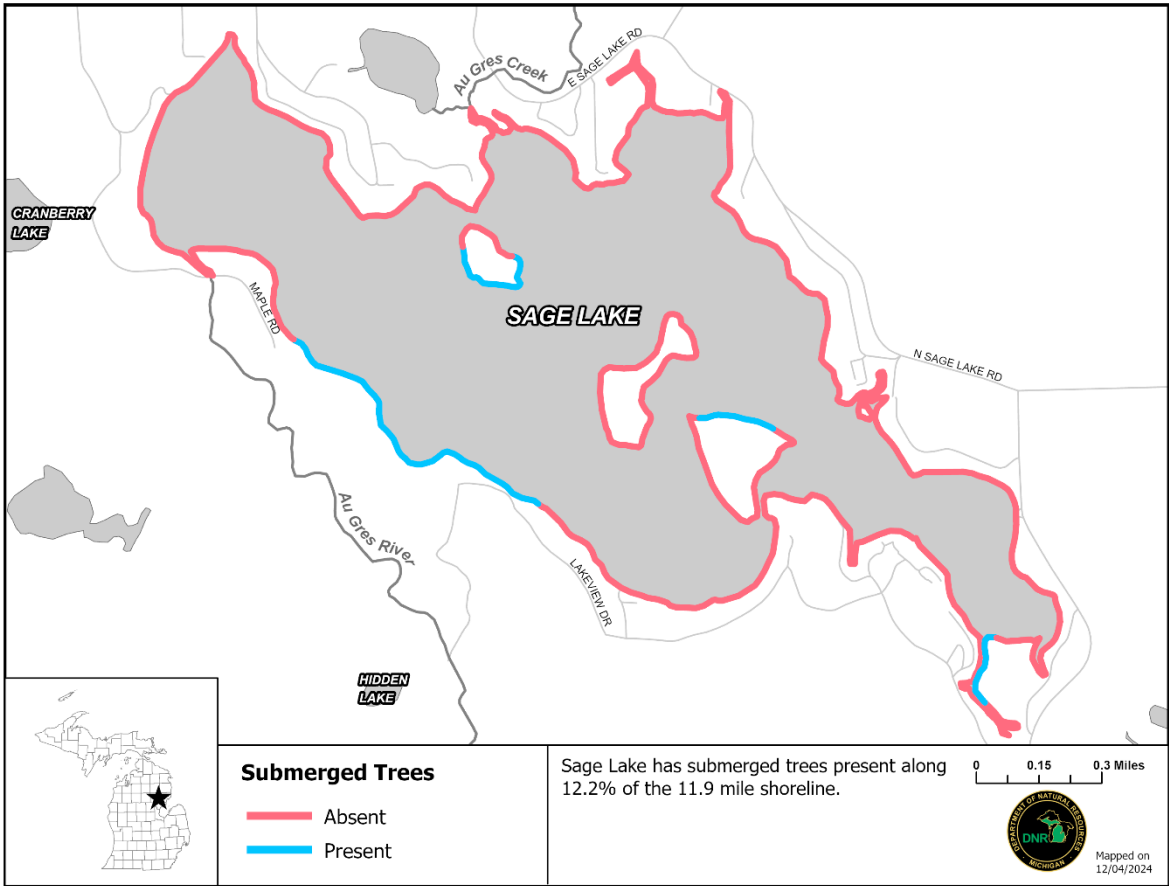


Figure 9. The shoreline of Sage Lake is 11.9 miles long and approximately 12% of the shoreline has submerged trees (coarse woody debris) as of 2019.

Literature Path

Received June 16, 2026; Approved August 28th, 2026

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Scott Heintzelman, External Reviewer

John Bauman, SFR Facilitator

John Bauman, Desktop Publisher and Approval