Little Bass Lake
Otsego County, T29N, R02W, Section 11
North Branch Au Sable River watershed, last surveyed 2023

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Environment

Little Bass Lake is a 17-acre natural lake located about 15 miles southeast of Gaylord in Otsego County (Figure 1). Situated in the headwaters of the North Branch Au Sable River, the lake has a catchment area of 6,463-acre and a maximum depth of 40 feet, classifying it as a small-deep lake (Wehrly et al. 2015) (Figure 2). Its bottom substrate consists primarily of muck and marl, with intermittent inflow from Big Bass Lake to the north. Its outlet, Crapo Creek, flows from the south end.

The lake's watershed is composed of glacial outwash deposits of sand with some gravel, typical of high-infiltration, spring-fed systems in the region. The terrain is primarily flat with minor glacial undulations. Land cover types for the catchment is primarily forested (59.2%), followed by agriculture (17.1%), grassland (10.7%), urban development (6.4%), wetland/water (3.7%), and scrub/shrub (2.9%) (Midwest Glacial Lakes Partnership 2019).

The shoreline, about 0.77 miles around, is almost entirely privately owned. The riparian zone is mostly forested (52.5%) characterized by a mix of hardwoods and conifers, with substantial wetland and water areas (34.0%), and minimal development (13.5%) concentrated to the east side of the lake (Midwest Glacial Lakes Partnership 2019) (Figure 3). Although development density is low, averaging 11.5 dwellings per mile with no shoreline armoring, the lake has a relatively high dock density for the region (10 per mile) (Wehrly et al., 2015). The lake has minimal in-lake large woody debris, with just two submerged logs per mile.

Public access is available through a county easement at the lake's south end, accessible from Old State Road, where there is a gravel boat launch with no amenities and limited parking accommodating only one vehicle with a trailer. However, in recent years, local landowners have contested the public access, asserting that the lake should be designated as private. Despite these challenges, the DNR Law Enforcement Division maintains that an easement deeded to the county in 1938 has legal standing, affirming the public's right to access the lake.

On August 10, 2023, MDNR staff conducted a limnological survey of Little Bass Lake to assess lake stratification by collecting water temperature and dissolved oxygen profiles at the lake's deepest point. Stratification is a natural process that occurs in deeper lakes (typically those over 30 feet deep in Michigan) during the summer months. This process creates three distinct layers:

1. Epilimnion: The uppermost layer, consisting of warm surface water. This layer is well-mixed by wind and wave action, maintaining relatively uniform temperature and dissolved oxygen levels.

2. Thermocline: The middle layer, where water temperature decreases sharply with depth. The thermocline acts as a transitional zone, separating the warmer surface water from the colder bottom water. Dissolved oxygen levels often decline in this layer as mixing with the surface diminishes.

3. Hypolimnion: The bottom layer, composed of cold, dense water. This layer is largely isolated from surface mixing and circulation, often resulting in reduced dissolved oxygen levels due to limited oxygen replenishment and ongoing decomposition of organic material.

Lake stratification is important to fish because these distinct thermal and oxygen layers, allow species to find habitats that suit their temperature and oxygen needs. However, if oxygen levels in the deeper hypolimnion become too low, fish may be forced into less optimal, warmer layers, increasing stress, and affecting survival.

Little Bass Lake shows strong summer thermal stratification, with dissolved oxygen levels declining with depth (Figure 4). Dissolved oxygen followed the temperature gradient, with epilimnetic waters maintaining approximately 8 ppm of oxygen. Below this layer, oxygen levels dropped rapidly through the metalimnion, reaching anoxic conditions in the hypolimnion. Most fish species in Michigan require a minimum of 4.0 ppm of dissolved oxygen to thrive (Wehrly 2015). Consequently, suitable oxygen levels in Little Bass Lake are restricted to the upper 8 feet of the water column. During periods of peak summer stratification.

The combination of thermal stratification and oxygen depletion below the epilimnion creates a relatively narrow band of suitable habitat for fish. This narrow band corresponds to the epilimnion and thermocline, where water temperatures are warm enough to support warmwater species such as Bluegill, Pumpkinseed, Largemouth Bass, and Black Crappie. Below this depth, dissolved oxygen levels decrease rapidly, creating anoxic conditions in the hypolimnion. These conditions limit most fish species to the shallower portions of the lake, effectively reducing the available habitat. This is common to many small, forested lakes in Northern Michigan and is a natural occurrence.

History

There are no records of prior fisheries surveys for Little Bass Lake, nor have any stocking events been documented in the lake. This lack of historical data highlights the importance of this survey in establishing a baseline for future fish community assessments and management decisions.

Current Status

Methods - In the spring of 2023 the Michigan Department of Natural Resources (MDNR) conducted a fish community survey on Little Bass Lake to assess its current population status. The survey followed Status and Trends protocols, which standardize sampling methods based on lake size, ensuring consistent and reliable data collection statewide. A variety of sampling gear and random site selection were used to provide a representative sample of species diversity, size structure, and age composition. This approach enables comprehensive spatial and temporal comparisons of fish populations across the state, supporting broad ecological assessments and informed management strategies.

The 2023 survey occurred in late spring from May 15 - May 18, 2023, using the following sampling effort:

- Two seine hauls.
- Two experimental gill nets were set for two nights, with daily checks, resulting in a total of four net lifts.
- Two small mesh fykes were set for two nights, with daily checks, resulting in a total of four net lifts.
- Three large mesh fykes were set for three nights, with daily checks, resulting in a total of nine net lifts.

All captured fish were identified to species, counted, and measured for total length by inch group. Spine or scale samples were collected from the first 10 individuals of each gamefish species within each inch group for age and growth analysis. The total length for these individuals was recorded to the nearest tenth of an inch. An age-length key was developed using the halk R package (v0.0.5, Frater 2023) to estimate the ages of the remaining fish, based on their length and the aging structures collected from the sampled individuals. Fish weights, in pounds, were estimated using established MDNR length-weight relationships (Schneider et al. 2000).

By examining the distribution of fish sizes and ages, valuable insights can be gained into various aspects of the fish population in the lake. This information is critical for understanding predator-prey relationships, mortality rates, productivity, and growth rates, all of which are essential for assessing the health and sustainability of the fish community. Length distributions provide valuable insights into predator-prey relationships and the size structure of fish populations while age classes analysis provides insights into the population's age structure and growth patterns. Mortality rates are estimated by analyzing the survival of fish across age classes, highlighting the effects of predation and fishing pressure on the population. Productivity is assessed through the abundance of young fish, which indicates successful reproduction and recruitment. Growth rates are evaluated by comparing the sizes of fish at different ages, helping us understand how quickly they grow. Key tools and techniques used to analyze these metrics include the Proportional Size Distribution (PSD) index, catch curves, and the von Bertalanffy growth model. These methods, when combined, offer a better understanding of fish population dynamics, and inform the development of effective management strategies for Little Bass Lake.

The PSD index categorizes fish lengths into five size classes (stock, quality, preferred, memorable, and trophy) based on their proportion of the species' world record length (Gabelhouse, 1984). For Largemouth Bass and Northern Pike, minimum size limits ($\geq$ 14 inches and $\geq$ 24 inches, respectively)

were added to reflect the specific management regulations for this species. The index is determined by dividing the number of angler-desirable size fish of a specific species (e.g., quality-length or legal-length fish) by the total number of individuals of that species that have reached a size or age where they can contribute reproductively to the population (stock-length fish) (Guy et al. 2007). This metric evaluates population balance by comparing the observed size distribution to established benchmarks. A balanced population typically exhibits a diverse range of fish sizes, striking a middle ground between too many small fish and too few larger fish.

Catch curve analysis is a tool used in fisheries management to estimate mortality rates by examining the age structure data of a population. This method that uses linear regression to evaluate how the number of fish caught at each age changes with increasing age. A weighted catch curve was applied to the catch-at-age data using the FSA R package (v0.9.5, Ogle et al. 2023) to estimate annual mortality rates. For accurate results, the analysis assumes the sampled fish represent the overall population, the population is stable with a steady addition of young fish (recruitment) each year, and mortality rates are consistent across age groups. To avoid skewed results, only age groups fully caught by the gear and with at least five fish were included in the analysis (Ricker 1975). Recruitment stability was assessed by examining variability around the catch curve, where less variation suggested a healthy, steady addition of young fish to the population each year (Isermann 2002).

Length-at-age data provides valuable insights into the growth rates of a fish population. By analyzing this data, it is possible to assess species health and sustainability, helping to identify issues such as stunted growth or overfishing that could affect the overall population structure. The von Bertalanffy growth model was used to assess the relationship between growth rates and age and estimate the maximum length a species can reach. This maximum size was calculated for key gamefish species where sufficient data were available, offering valuable information for understanding the growth potential of fish populations. The FSA R package (v0.9.5) was used to fit the von Bertalanffy model to the data (Ogle et al., 2023).

Current Fish Community - The survey collected a total of 869 fish, representing 9 species and one hybrid (Table 1). Centrarchids (the sunfish family) dominated the catch, with Bluegill being the most abundant species, comprising 650 individuals. Other centrarchids included Pumpkinseed (157 individuals), Black Crappie (16), and Largemouth Bass (15). Smaller numbers of Rock Bass (5), hybrid sunfish (3), Yellow Perch (5) Iowa Darter (3), and Central Mudminnow (1) were also present. Although Northern Pike were less numerous, with only 14 individuals, they contributed the most to the total biomass at 44.7 pounds. In contrast, Bluegill, despite their abundance, accounted for a total weight of 38.8 pounds (Table 1).

The Shannon Diversity Index was calculated to assess fish community structure, considering both species richness and evenness. While the community had a relatively high species richness with 9 species, the dominance of Bluegill resulted to a low index of 0.814, indicating a less diverse fish community. This is a common characteristic of small, forested lakes, which tend to have relatively low diversity.

Black Crappie: Black Crappie ranged from 4.9 to 10.7 inches (mean = 8.06), with a unimodal length-frequency distribution peaking around 9 inches. Sixty percent of Black Crappie exceeded the 6-inch "quality" size, while a smaller percentage (20%) reached the "preferred" 8-inch size (Figure 5). These proportions suggest that the Black Crappie tend to be on the larger size of what would be expected from

a balanced population, where the proportion of "quality" fish is between 30% and 60%, and the proportion of "preferred" fish is greater than 10% (Willis 1993). The population consisted of six age classes, with an average age of 4.8 years (Table 2), suggesting a population of mostly mature individuals. The lack of sufficient crappie catches prevented the calculation of mortality rates. Length-at-age and growth rates aligned with statewide averages (Table 2). The von Bertalanffy growth model predicts a maximum length of 11.3 inches for Black Crappie in this population, which is within an inch of the largest observed fish. The close alignment between the predicted maximum length and the observed largest fish suggests that the Black Crappie population in this lake may be approaching its carrying capacity.

Bluegill: The Bluegill population in Little Bass Lake ranged in length from 2.2 to 9.2 inches (mean = 2.93 inches). The length-frequency distribution was bimodal, with peaks at 1 inch and 7 inches (Figure 5). While 22% of Bluegill met the "quality" size criteria (larger than 6 inches), and 4% reached the "preferred" size of 8 inches or more, these proportions suggest the Bluegill populations is on the smaller size of what would be expected from a balanced population (Willis 1993). The population consists of 10 age classes and was relatively young, with an average age of 3.0 years (Table 2). A catch-at-age analysis estimated a low annual mortality rate of 23%, which is notably lower than rates observed in other Michigan lakes (Schneider 1999). The catch curve showed a reasonable coefficient of determination (r^2), with most points falling within the 95% confidence intervals, indicating a generally stable recruitment pattern for Bluegill. However, points outside the shaded area indicate periods of both high and low recruitment.

Bluegill growth rates were below statewide averages (Table 2), falling outside of the acceptable ranges suggested by Schneider et al. (2000). Despite this, the von Bertalanffy growth model predicted a maximum length of about 13.8 inches, which aligns with the current state record of 13.75 inches, suggesting the potential for Little Bass Lake to support the growth of large Bluegill. One Master Angler Bluegill (>10 inches) was reported for the lake, measuring 12.2 inches. Despite slow growth rates, Bluegill in this system appear to experience low predation and fishing pressure, allowing them to achieve good sizes through longevity.

Pumpkinseed: Pumpkinseed ranged in length from 2.1 to 8.9 inches with a mean of 5.04 inches. The length frequency distribution was unimodal, centered around 6 inches (Figure 5), with a majority (52%) exceeding the "quality" size of 6 inches. However, only a small percentage (<1%) reached the "preferred" size of 8 inches, indicating that while many fish are of quality size, relatively few reach the larger size category (Figure 5). Age analysis identified seven-year classes with an average age of 4.6 years (Table 2), which suggests a relatively mature population. The catch-at-age catch curve analysis estimated a low annual mortality rate of 38%. A high coefficient of determination (r^2) value for the catch curve, with all points falling within the 95% confidence intervals, indicates a stable recruitment pattern for this population.

Like Bluegill, growth rates for Pumpkinseed were 0.7 inches lower than statewide averages (Table 2) falling just outside the satisfactory threshold established by Schneider et al. (2000). The von Bertalanffy growth model predicted a maximum length of about 11.3 inches, suggesting potential for further growth. Despite slower growth rates compared to statewide averages, Pumpkinseed in Little Bass Lake appear to experience low predation and fishing pressure, allowing them to achieve good sizes through longevity.

Yellow Perch: The limited Yellow Perch catch consisted of five small individuals, averaging 3.40 inches in length with four age classes present, and an average age of 2.2 years. However, the small sample size limited the ability to conduct further detailed analysis, as five individuals would not accurately represent the entire population.

Largemouth Bass: Largemouth Bass varied in length from 3.2 to 17.7 inches a (mean = 9.80 in). The length-frequency distribution was unimodal, peaking at 12 inches. Of these, 58% were classified as "quality" fish (12 inches or larger), and 8% reached the legal-size limit of 15 inches (Figure 6). These proportions indicate a balanced population, with "quality" fish falling between the expected range of 40% and 70%, and "preferred" fish between 10% and 40% (Willis 1993). This suggests a healthy size structure with a good number of individuals reaching reproductive maturity.

The Largemouth Bass population comprised eight age classes, with an average age of 4.4 years. Due to insufficient catch data, mortality rates could not be calculated. Growth rates for Largemouth Bass aligned with statewide averages (Table 2). The von Bertalanffy growth model predicts a maximum length of 16.6 inches for Largemouth Bass in this population, which is smaller than the maximum observed length. This suggests that there is likely ample forage available to support growth beyond the model's prediction. However, only one individual exceeding the prediction, combined with growth rates that align with statewide averages points more towards individual variation as the primary explanation for the larger size. The von Bertalanffy model provides a useful estimate of growth potential, but individual variation and specific environmental conditions can lead to exceptions.

Northern Pike: The limited Northern Pike catch ranged from 16.6 to 35.0 inches (mean = 22.43 in). The population included seven age classes, with an average age of 5.7 years. Although mortality rates could not be calculated due to insufficient samples, growth rates aligned with statewide averages (Table 2). Interestingly, the observed growth rates for Northern Pike appeared more linear than what the von Bertalanffy growth model predicts. The von Bertalanffy model generally assumes that fish growth slows as they age, but the linear growth observed in this population suggests that Northern Pike are experiencing consistent access to food and thermal refuge, allowing them to grow at a steady rate across all ages.

Forage fish: A limited group of forage species, including Central Mudminnow and Iowa Darters, were caught during the Little Bass Lake survey, comprising <1% of the total catch by number, suggesting limited non-game forage availability in the lake.

Predator-prey interactions: A balanced predator-prey relationship is crucial for maintaining a diverse fish community. The Proportional Size Distribution (PSD) index is a valuable tool for assessing this balance, as it compares the size distribution of prey fish (e.g., panfish) to predator fish. An imbalance in the PSD may indicate issues like over-predation or prey scarcity. A tic-tac-toe plot, commonly used to represent PSD balance, suggests a healthy relationship when data points fall within the central shaded box.

Based on the PSD (Proportional Size Distribution) tic-tac-toe plot (Figure 7), Little Bass Lake exhibits a generally balanced predator-prey relationship. The Black Crappie are positioned high within the central shaded area of the plot, indicating they are achieving desirable size distributions relative to predator levels, suggesting minimal over-predation or excessive abundance. The Bluegill population, positioned

lower within the central shaded area, may indicate some imbalance, possibly due to predation pressure or angling impact. This is reflected in fewer quality-sized individuals, potentially due to a combination of predation, competition, and angling. Pumpkinseed, situated centrally in the shaded area, display a balanced size structure, suggesting stable interactions with predators and suitable angling levels, supporting a healthy range of size classes. This distribution suggests that while Pumpkinseed and Black Crappie populations benefit from stable conditions, Bluegill may be slightly more vulnerable to ecosystem pressures. However, the low sample size for Yellow Perch limits insights into their predator-prey dynamics and population structure.

Analysis and Discussion

Anglers will find a good mix of both panfish and larger game fish in Little Bass Lake. The panfish fishery is dominated by Bluegill, which are abundant and provide accessible fishing opportunities for anglers of all experience levels. While most Bluegill are small to medium-sized, there are occasional chances to catch quality-sized individuals. However, the Bluegill population shows signs of fishing pressure and somewhat slow growth, as larger Bluegill are more frequently harvested, affecting the overall size structure and the balance of the population. Anglers are encouraged to selectively harvest smaller Bluegill while releasing larger individuals to help maintain a healthy and sustainable population. In addition to Bluegill, Pumpkinseed are present in moderate numbers, adding diversity to the panfish community. They tend to average medium sizes, contributing to a varied fishing experience. Black Crappie, though less numerous, are of higher quality, with a good proportion of individuals reaching preferred sizes, making them appealing to anglers targeting larger panfish.

Largemouth Bass offer angler a good fishing opportunity while playing a key role in the overall fishery. Growth rates align with statewide averages, and anglers can expect to catch a range of medium-sized bass, with some reaching quality or preferred sizes. The bass population benefits from the presence of other predator species, like Northern Pike, which help regulate the prey species and maintain a balanced food web.

Northern Pike, while less abundant than other species like Bluegill or Largemouth Bass, still provide valuable opportunity for anglers targeting larger predator fish. Many pike in the lake are at or above the legal-size limit (24 inches), with some exceeding 30 inches, making them an attractive target for anglers. The presence of larger pike adds a challenging and rewarding aspect to the fishery, offering anglers the chance to pursue trophy-sized fish.

The lack of nearshore woody habitat may limit the potential of the fishery. Adding woody debris near the shoreline could greatly benefit all fish species by increasing habitat complexity, offering shelter, and supporting food availability. For panfish species like Bluegill and Pumpkinseed, woody debris provides refuge from predators and creates ideal spawning sites in shallow, vegetated areas. Additionally, the structure attracts small invertebrates, an essential food source for both juvenile and adult fish.

For larger predator species like Northern Pike and Largemouth Bass, nearshore woody debris can create ambush points and provide hiding spots for young fish, increasing their survival rates. It also enhances the availability of forage species, as smaller fish congregate around the shelter offered by submerged logs, branches, and root systems. This in turn promotes a more abundant and diverse forage base, ultimately benefiting all fish populations in the lake.

Moreover, woody debris helps improve water quality by trapping sediment and reducing shoreline erosion, leading to long-term improvements in fish habitat. Overall, increasing nearshore woody debris in Little Bass Lake would foster a more diverse and productive ecosystem, supporting both juvenile and adult fish across species, and enhancing the overall health and sustainability of the fishery.

Management Direction

1. Maintain statewide fishing regulations for this lake to support balanced fish populations and promote sustainable fishing opportunities.

2. Maintain public access through the county easement deeded in 1938, legally described as a 66-foot by 244-foot strip of land located on the south shore of Little Bass Lake, beginning 330.7 feet west of the southeast corner of T29N, R2W, S11 to preserve recreational opportunities for anglers.

3. Encourage anglers to selectively harvest smaller Bluegill while practicing catch-and-release for larger bass and pike. This approach can enhance growth rates and size structure in both predator and prey populations, maintaining balance without requiring additional lake-specific regulations.

4. Encourage property owners to strategically place natural debris along the shoreline in ways that minimize impacts on views and recreational activities. This added woody debris will create essential habitat, especially for Bluegill, Pumpkinseed, and forage fish. It will also support a wider range of size classes and improve food sources by benefiting invertebrate communities. Property owners should be informed that this effort requires permitting through EGLE.

5. Preserve or enhance the existing forested buffer along the shoreline. This natural vegetation supports water filtration, erosion control, and provides essential fish habitat, contributing to the overall health of the lake ecosystem.

6. Encourage anglers to report their catch of all species to the local DNR Fisheries Biologist. These reports are a valuable resource for tracking population trends and supporting informed fishery management decisions for current and future managers.

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Table 1. Catch summary of fish collected during the 2023 survey on Little Bass Lake.

Species	Number	Percent by number	Calculated Weight (lbs.)	Percent by weight	Length range (in.)	Average length (in.)	Percent legal size
Black Crappie	16	1.8	6.1	4.6	4 - 10	8.1	--
Bluegill	650	74.8	38.8	29.7	1 - 9	2.9	--
Hybrid sunfish	3	0.3	0.3	0.2	3 - 6	4.3	--
Iowa Darter	3	0.3	0	0	2 -2	2.5	--
Largemouth Bass	15	1.7	12	9.2	2 - 17	9.8	7
Central Mudminnow	1	0.1	0	0	1 - 1	1.5	--
Northern Pike	14	1.6	44.7	34.2	16 - 35	22.4	36
Pumpkinseed	157	18.1	26.5	20.3	2 - 8	5.0	--
Rock Bass	5	0.6	2.1	1.6	6 - 9	7.6	--
Yellow Perch	5	0.6	0.2	0.1	2 - 6	3.4	--

Table 2. Length-at-age metrics for gamefish collected during the 2023 survey on Little Bass Lake. Mean growth indices were calculated as described by Schneider et al. (2000a)

Species	Age	No. aged	Length Range (in.)	State avg. length (in.)	Weighted mean len. (in.)	Weighted age freq.	Mean growth index
Black Crappie							-0.3
	Age I:	1	4.9-4.9	4.2	4.9	6.25%	
	Age III:	5	6.9-7.4	7.5	7.18	31.25%	
	Age IV:	1	7.9-7.9	8.6	7.9	6.25%	
	Age V:	2	9.4-9.6	9.4	9.5	12.50%	
	Age VI:	3	9.6-10.3	10.2	9.87	18.75%	
	Age VII:	4	9.7-10.7	10.8	10.1	25.00%	
Bluegill							-1.2
	Age I:	4	2.2-2.3	1.8	2.28	7.69%	
	Age II:	8	2.4-2.8	3.8	2.54	15.38%	
	Age III:	5	3.0-3.2	5	3.12	4.49%	
	Age IV:	10	3.2-4.8	5.9	4.16	15.13%	
	Age V:	14	4.8-6.0	6.7	5.21	34.77%	
	Age VI:	10	5.7-6.9	7.3	6.15	11.79%	
	Age VII:	11	6.8-8.0	7.8	7.42	7.26%	
	Age VIII:	9	7.2-8.4	8.2	7.93	2.95%	
	Age IX:	1	8.5-8.5	8.6	8.5	0.28%	
	Age X:	1	9.2-9.2	8.9	9.2	0.26%	
Largemouth Bass							--
	Age I:	2	3.2-4.1	4.2	3.65	14.29%	
	Age II:	1	8.2-8.2	7.1	8.2	7.14%	
	Age III:	3	9.0-9.9	9.4	9.47	14.29%	
	Age IV:	3	10.1-12.4	11.6	11.26	20.00%	
	Age V:	2	12.1-12.2	13.2	12.15	11.43%	
	Age VI:	2	12.5-13.2	14.7	12.89	12.86%	
	Age VII:	2	12.8-13.2	16.3	13.02	12.86%	
	Age X:	1	17.7-17.7	19.3	17.7	7.14%	
Northern Pike							--
	Age III:	4	16.60-19.9	20.8	18.08	30.77%	
	Age IV:	2	18.40-20.2	23.4	19.3	15.38%	
	Age V:	2	20.60-24.3	25.5	22.45	15.38%	
	Age VI:	1	19.50-19.5	27.3	19.5	7.69%	
	Age VIII:	3	25.30-29.3	31.2	27.35	15.38%	
	Age IX:	1	31.20-31.2	--	31.2	7.69%	
	Age XI:	1	35.00-35.0	--	35	7.69%	

Table 3 (continued). Length-at-age metrics for gamefish collected during the 2023 survey on Little Bass Lake. Mean growth indices were calculated as described by Schneider et al. (2000a).

Species	Age	Length Range (in.)	State avg. length (in.)	Weighted mean length (in.)	Weighted age freq.	Mean growth index
Pumpkinseed						-0.7
Age II:	9	2.1-2.6	3.8	2.33	8.03%	
Age III:	10	2.8-3.4	4.9	3.26	10.06%	
Age IV:	18	3.9-5.8	5.6	4.89	27.83%	
Age V:	10	5.9-6.5	6.2	6.13	29.04%	
Age VI:	9	6.7-7.2	6.6	6.91	18.54%	
Age VII:	4	7.2-7.4	7.1	7.28	5.86%	
Age VIII:	1	8.9-8.9	7.5	8.9	0.64%	
Yellow Perch						--
Age I:	2	2.5-2.6	3.3	2.55	40.00%	
Age II:	1	3.9-3.9	5.2	3.9	20.00%	
Age III:	1	4.2-4.2	6.5	4.2	20.00%	
Age IV:	1	6.8-6.8	7.5	6.8	20.00%	

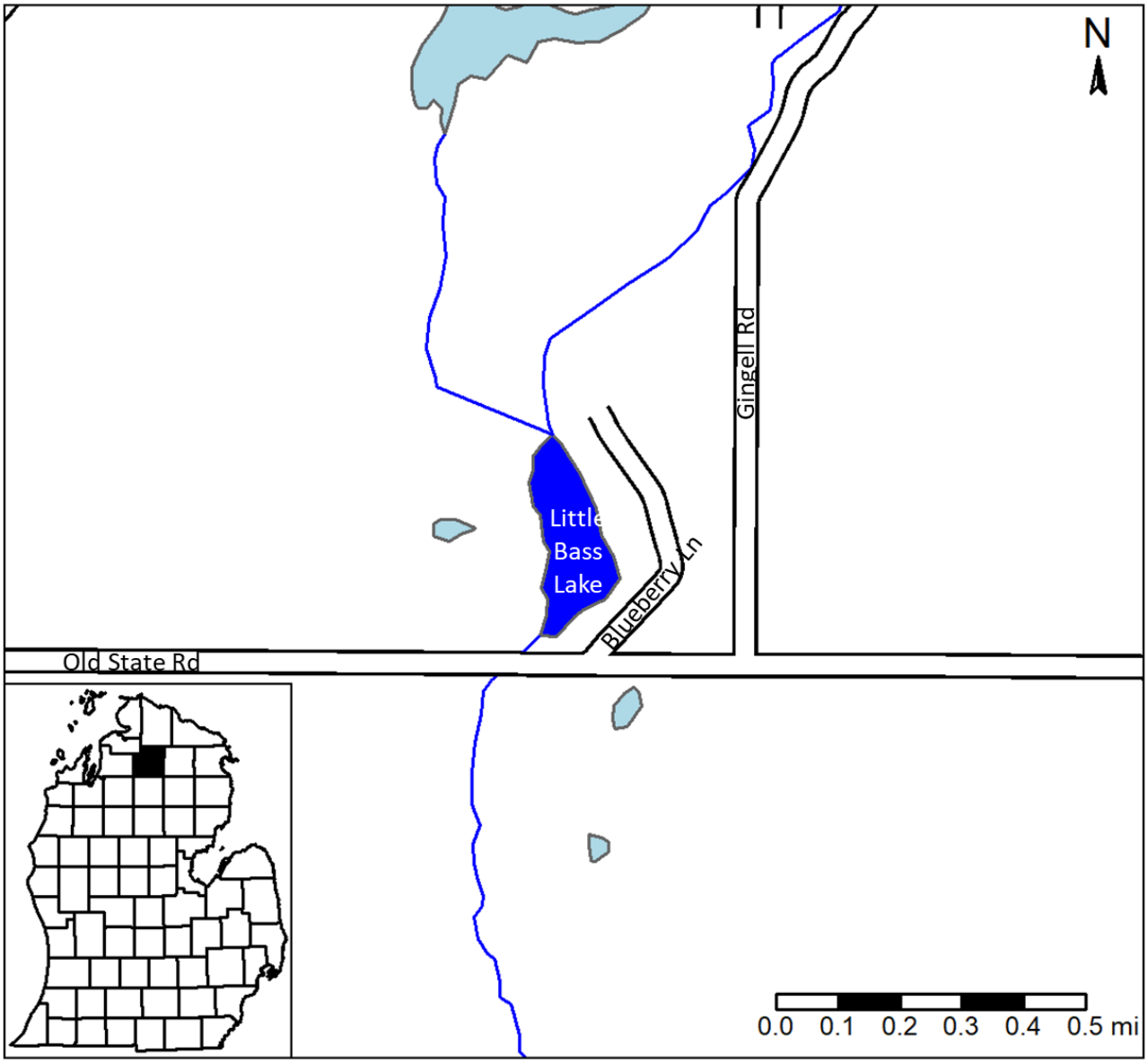

Figure 1. Map of Little Bass Lake, Otsego County, Michigan.

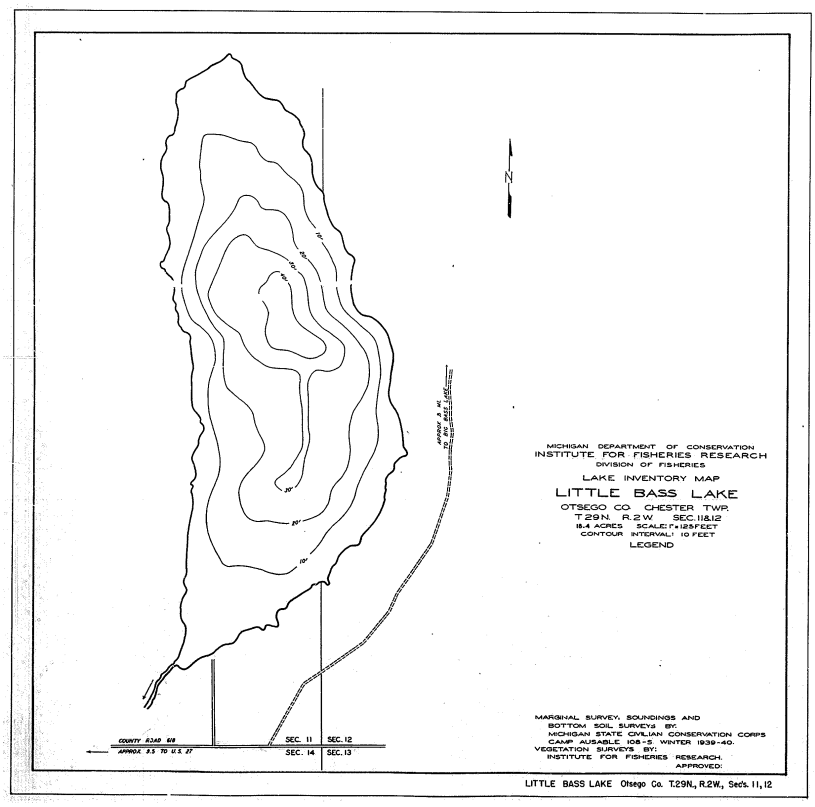

Figure 2. Bathymetric map of Little Bass Lake, Otsego County, Michigan

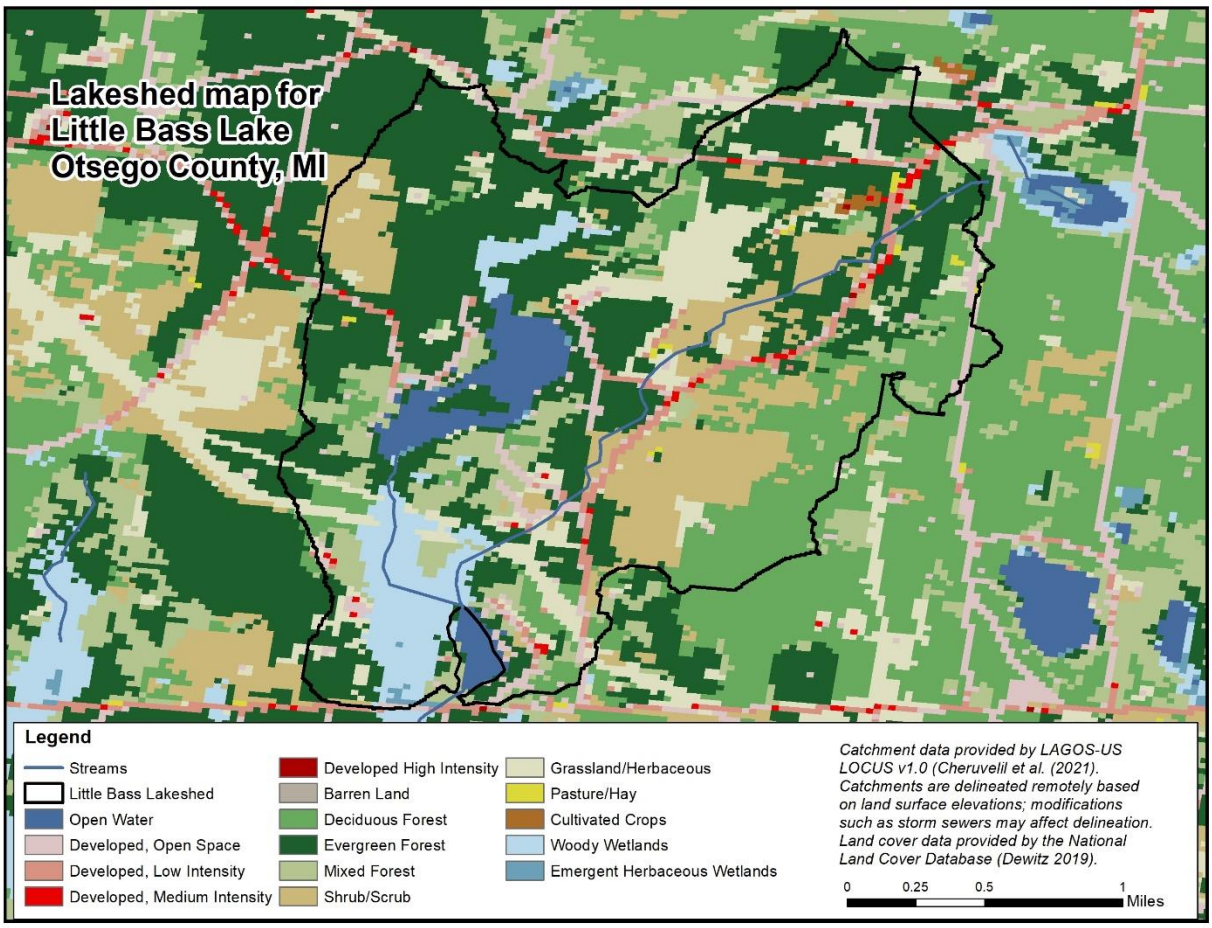

Figure 3. Land cover and catchment area (solid black line) map Little Bass Lake, Otsego County, Michigan *(*Cheruvelil et al. 2021 and Dewitz 2019).

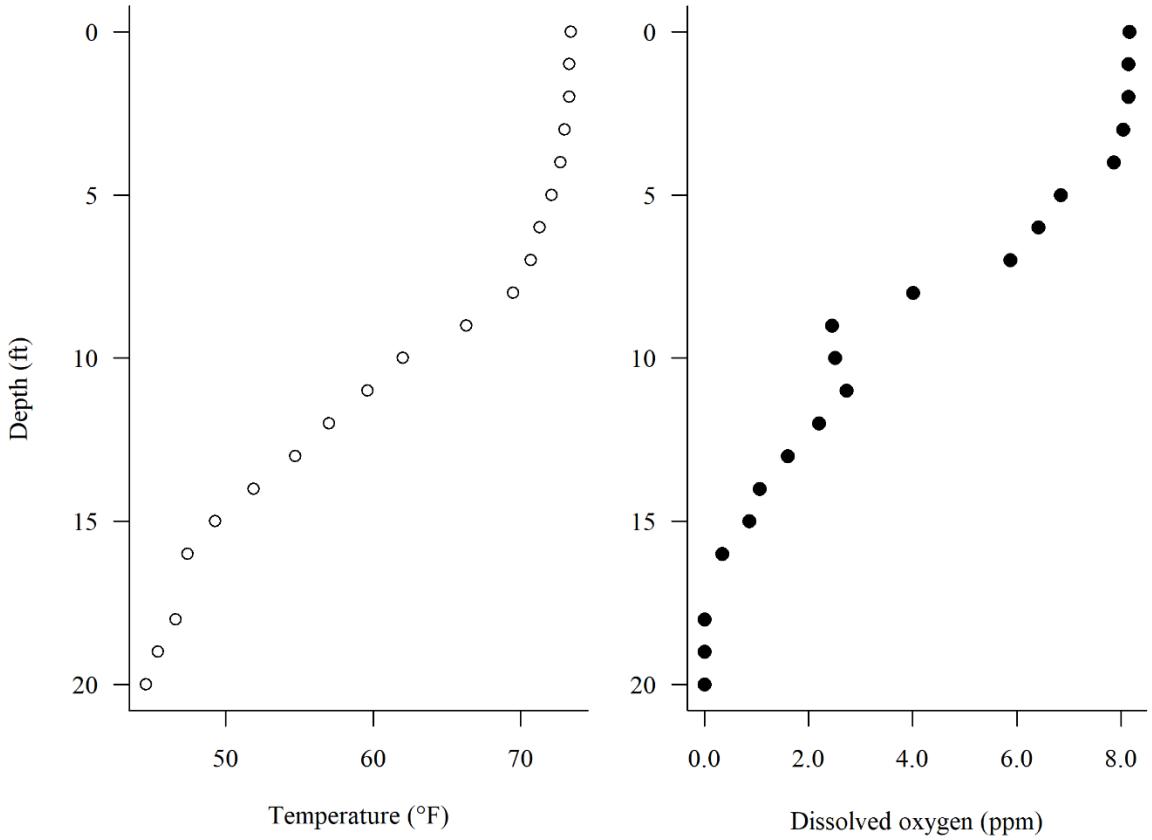

Figure 4. Temperature (open circles) and dissolved oxygen (filled circles) profiles collected August 10, 2023, from the deepest portion of Little Bass Lake.

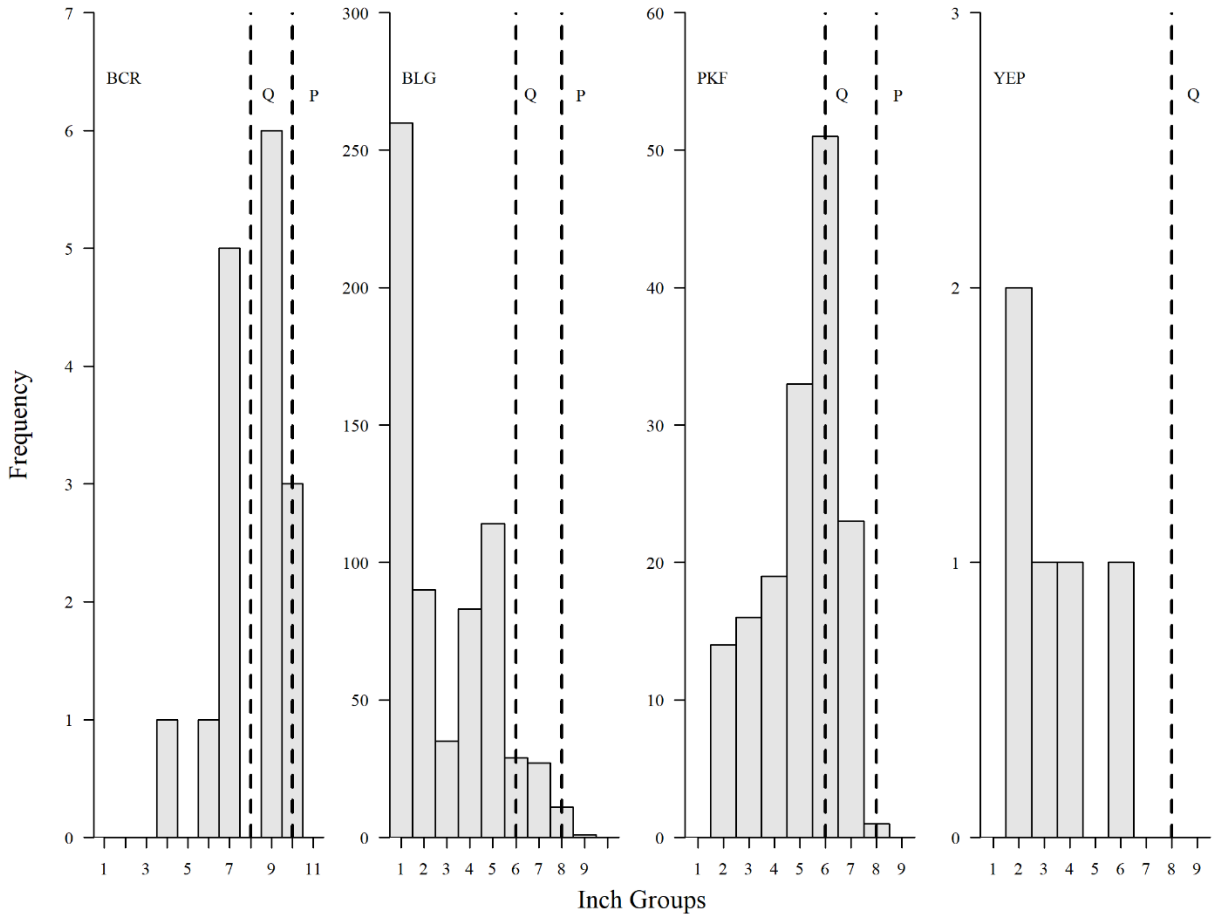

Figure 5. Length frequency distributions and proportional size distributions (PSD; Q – quality, P –preferred) of panfish (BCR -Black Crappie, BLG – Bluegill, PKF – Pumpkinseed, and YEP – Yellow Perch) captured in Little Bass Lake during the 2023 survey.

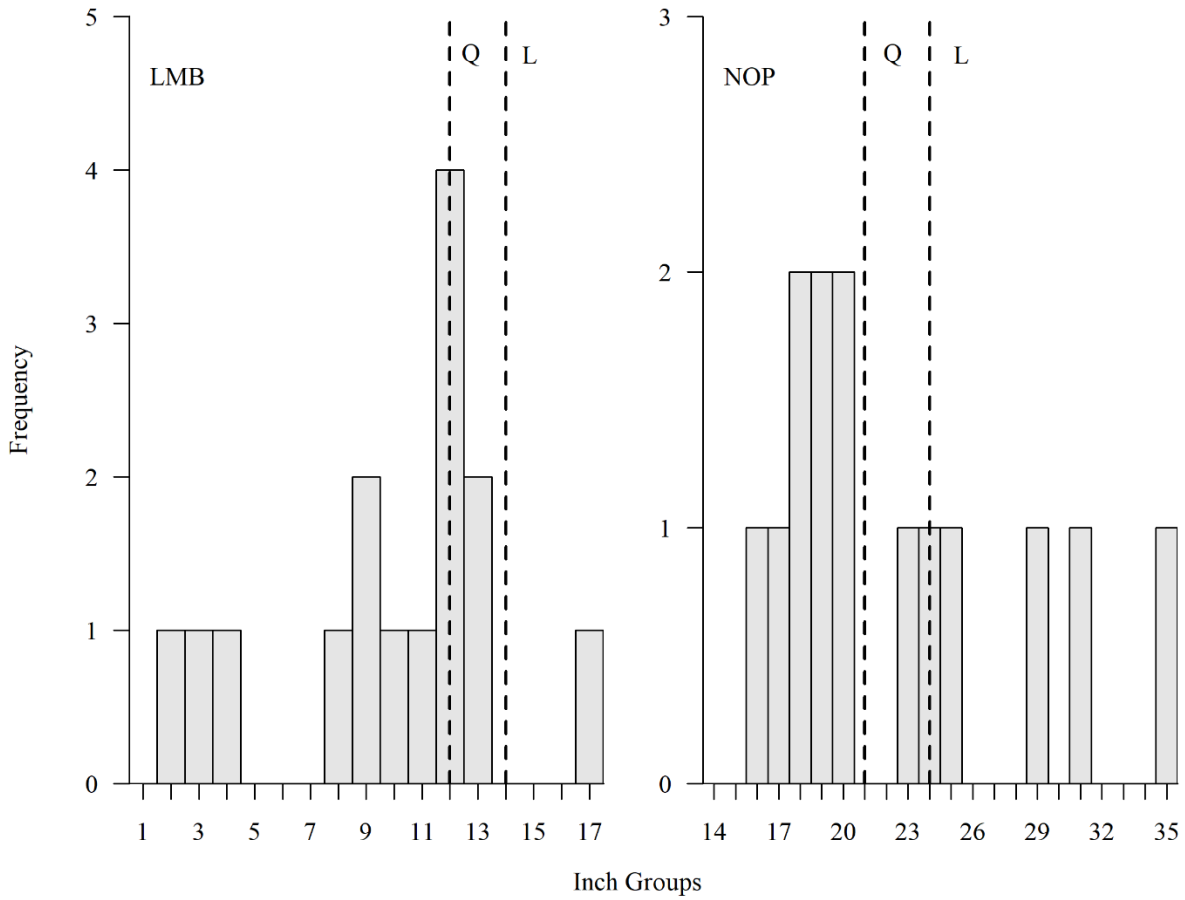

Figure 6. Length frequency distributions and proportional size distributions (PSD; Q – quality and L – minimum legal size) indices of predatory fish (LMB – Largemouth Bass and NOP – Northern Pike) captured in Little Bass Lake during the 2023 survey.

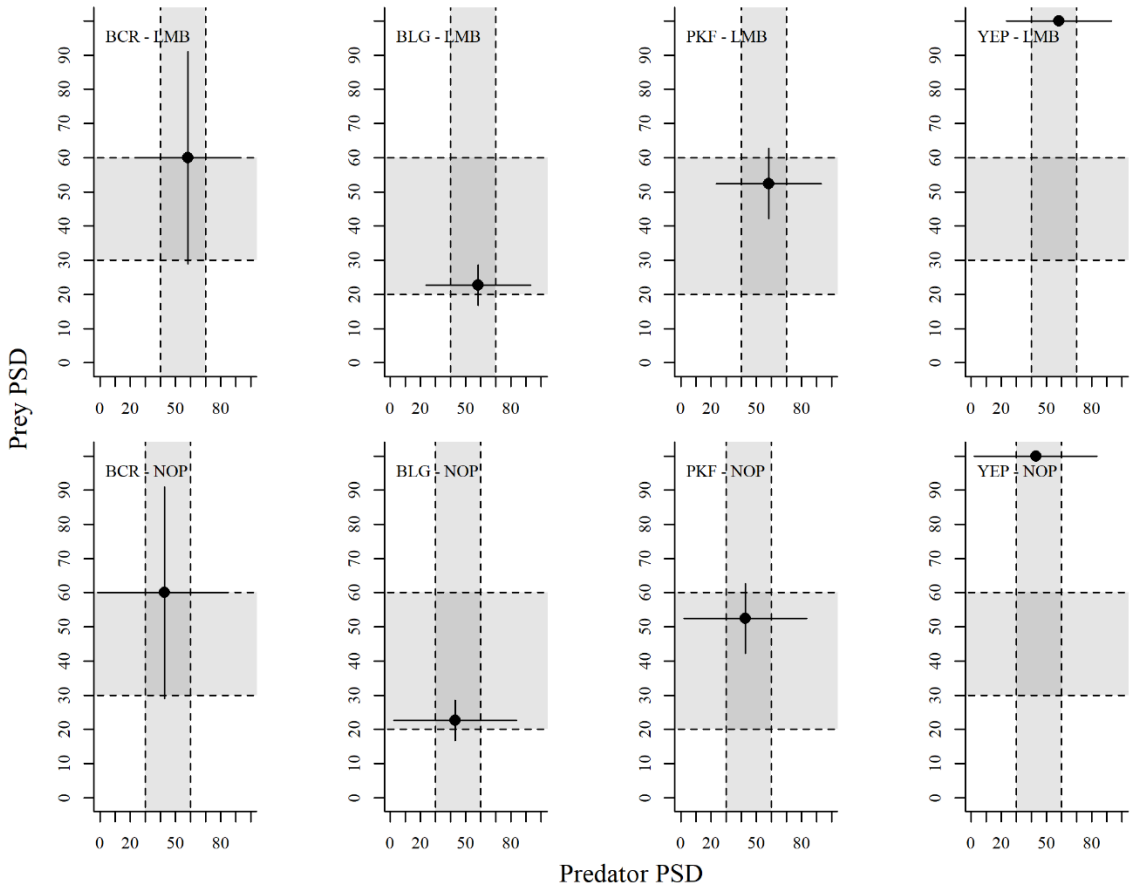

Figure 7. Tic-tac-toe plots of Proportional Size Distribution values for panfish (Black Crappie - BCR, Bluegill - BLG, Pumpkinseed - PKF, Yellow Perch – YEP) and predatory fish (Largemouth Bass - LMB, Northern Pike - NOP)) in Little Bass Lake (2023). The shaded target ranges represent a balanced predator-prey relationship

Received January 3, 2025; Approved March 19, 2025
Tim Cwalinski, Unit Review and Approval
Darren Kramer, External Reviewer
John Bauman, SFR Facilitator
John Bauman, Desktop Publisher and Approval