

***MIROMAR LAKES
COMMUNITY DEVELOPMENT DISTRICT***

**Monthly Asset Manager's Report
May 1, 2026**

Prepared For:

James Ward
District Manager

Prepared By:

Richard Freeman



Calvin, Giordano & Associates, Inc.

A SAFEbuilt® COMPANY

CGA Project No. 13-5692

June 1, 2026

**MIROMAR LAKES
COMMUNITY DEVELOPMENT DISTRICT**

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**MIROMAR LAKES
COMMUNITY DEVELOPMENT DISTRICT**

I. PURPOSE

The purpose of this report is to provide the District Manager with an update on recent inspection-related activities. We will continue to provide updated monthly inspection reports on the status of ongoing field activities.

II. CURRENT ASSET UPDATES

1. Lake Maintenance
2. Fishery
3. Cane Toad Program
4. Location Map

1. Lake Maintenance

- Shoreline Wee All CDD lakes and golf course lakes received treatment this month targeting torpedo grass throughout the system.
- Additional shoreline grass and brush treatments were completed on Lakes 5 and 6 behind the clubhouse near the dock areas.
- Submerged aquatic vegetation treatments were completed on Lake 6 along the southeast portion of the property.
- Additional shoreline grass and brush management was also performed on the north end of Lake 6.

Water levels throughout the system remain below normal seasonal elevations; however, water clarity continues to remain favorable, with visibility exceeding approximately five feet in the areas inspected and treated during this reporting period.

Wildlife activity observed during routine inspections included:

- Alligators
- Egrets
- Ducks
- Herons
- Largemouth bass
- The District continues to coordinate with the aquatic maintenance vendor on the Fiscal Year 2026 Lake Bank Restoration Program. Ongoing repairs near the Verna Lago area continue to progress, with riprap stabilization remaining the primary restoration method being utilized in the most erosion-prone sections.
- Following completion of the riprap stabilization work, the district plans to proceed with additional littoral plant installations within select lake and cove areas to assist with shoreline stabilization, water quality enhancement, and long-term habitat restoration.



Rib rap installation in progress, with protective materials placed to safeguard surrounding landscaping



Rib rap installation in progress, with protective materials placed to safeguard surrounding landscaping



Rip rap installation in progress

2. Fishery

- The District recently concluded discussions regarding the status of the fisheries management program following receipt of the latest electrofishing survey report conducted earlier this season. Based on the findings within the report, the District determined that portions of the fisheries program have regressed and are no longer progressing toward the originally intended fishery goals.
- As a result, District staff has transitioned to a new fisheries biologist and vendor team with extensive experience managing similar aquatic systems. The immediate strategy for the remainder of 2026 will focus less on aggressive fisheries stocking efforts and more heavily on restoring overall lake health conditions through vegetation management and nuisance aquatic weed control.
- The District's revised operational approach will prioritize:
 - Management of submerged aquatic vegetation
 - Reduction of nuisance weed growth
 - Stabilization of overall lake conditions during peak summer months
 - Continued electrofishing analysis during cooler months
 - Long-term predator fish balancing and fisheries stabilization
- The goal moving forward is to improve overall water quality, restore ecological balance within the lake systems, and create better long-term conditions before implementing additional fisheries enhancement strategies.
- The electrofishing report has been attached separately for Board review and discussion.

3. Cane Toad Program

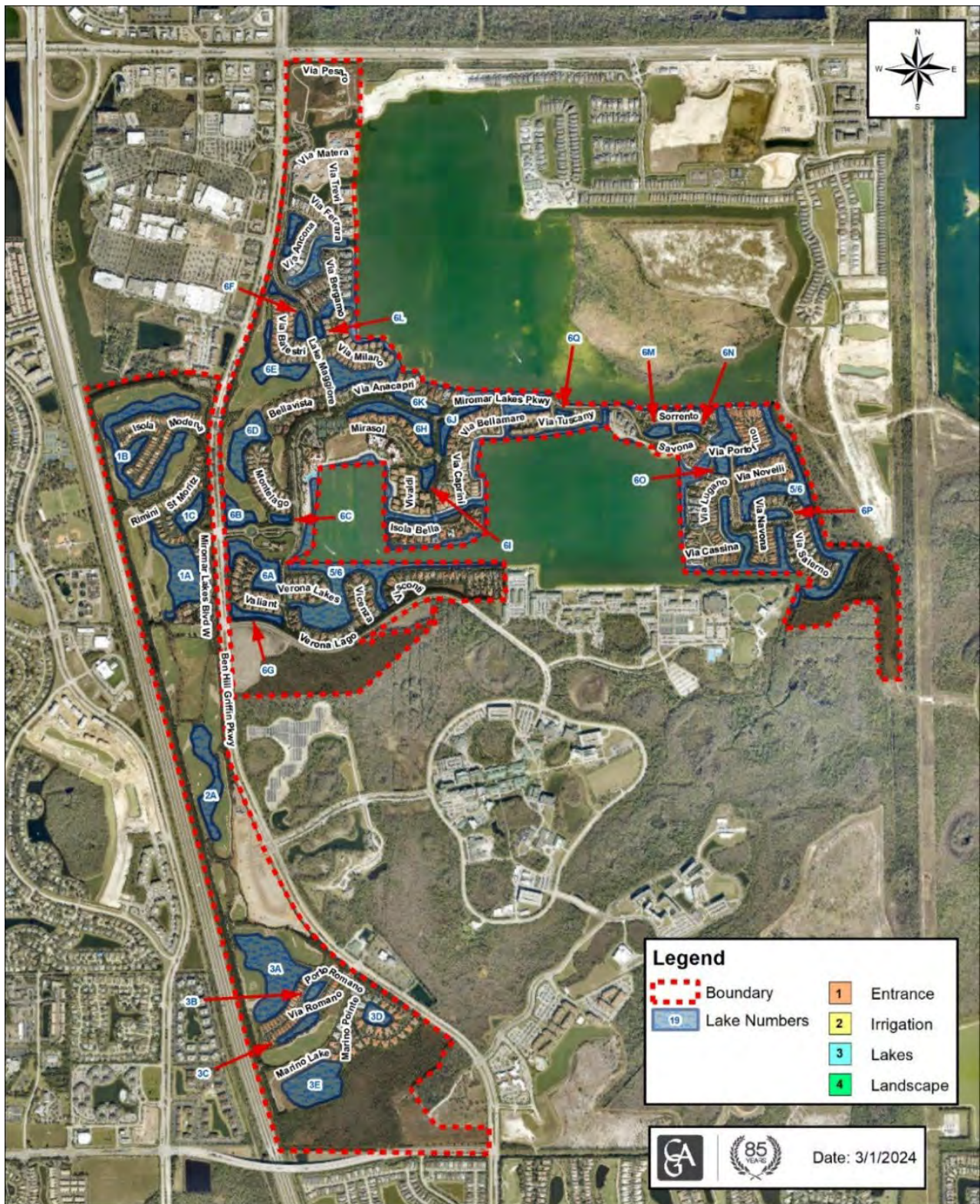
- Cane toad activity remained significantly elevated during May, with ongoing breeding pressure across the community despite continued dry conditions. Tadpole volume remained extremely high, reaching well into the millions across multiple lakes and interconnected shoreline areas.
- Widespread calling from adult males was consistently heard throughout the property, indicating active and sustained breeding activity. Several lakes required multiple return visits due to dense concentrations of larvae and continued development cycles.

- Large clusters of tadpoles were observed shifting away from shoreline areas into deeper water sections, requiring extended management efforts to effectively control concentrations. While ongoing control operations have started reducing peak densities in several locations, overall activity levels remain above seasonal averages.
- Adult cane toad movement also remained steady throughout irrigated turf, landscaped beds, and littoral shelf areas during evening hours.

May Totals

- Larvae Strands Removed: 35
- Tadpoles Removed: ~1,300,000+
- Adult Toads Removed: ~185–205

4. Location Map



Miromar Lakes CDD - Engineer's Report Asset Map



Miromar Lakes CDD Waterway Inspection Report

Reason for Inspection: Routine Scheduled - Qua

Inspection Date: 2026-04-29

Prepared for:

**Miromar Lakes CDD
10160 Miromar Lakes Blvd.
Fort Myers, Florida 33913**

Prepared by:

Mason Maher, Field Operations Manager- Environmental Scientist

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Site: 1A**Comments:**

Site looks good

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific

**Site: 1B****Comments:**

Site looks good

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific

**Site: 1C****Comments:**

Site looks good

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 2A**Comments:**

Site looks good
Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific

**Site: 3A****Comments:**

Normal growth observed
Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Shoreline weeds

**Site: 3B****Comments:**

Site looks good
Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 3C**Comments:**

Site looks good

Shoreline is well maintained.
Algae and submerged vegetation
are at controlled levels. Bank
erosion present along the
shoreline.

Action Required:

Routine maintenance next visit

Target:

Species non-specific

**Site: 6A****Comments:**

Site looks good

Shoreline is well maintained.
Algae and submerged vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific

**Site: 6B****Comments:**

Site looks good

Shoreline is well maintained.
Algae and submerged vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6C

Comments:

Site looks good

Shoreline is well maintained.
Algae and submerged vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6D

Comments:

Normal growth observed

Shoreline is well maintained.
Algae and submerged vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Shoreline weeds



Site: 6E

Comments:

Site looks good

Shoreline is well maintained.
Algae and submerged vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6F

Comments:

Site looks good

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6G

Comments:

Normal growth observed

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Shoreline weeds



Site: 6H

Comments:

Normal growth observed

Shoreline is well maintained.
Minor surface algae present on
western end of lake.

Action Required:

Routine maintenance next visit

Target:

Surface algae



Site: 6I

Comments:

Site looks good

Shoreline is well maintained.
Algae and submerged vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6J

Comments:

Site looks good

Shoreline is well maintained.
Submersed and algae at
controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6K

Comments:

Site looks good

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.
Water levels in this lake are very
low.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6L**Comments:**

Site looks good

Shoreline well maintained. Algae and submerged vegetation are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific

**Site: 6M****Comments:**

Normal growth observed

Some shoreline weed regrowth observed. Algae and submerged vegetation are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Shoreline weeds

**Site: 6N****Comments:**

Site looks good

Shoreline is well maintained. Algae and submerged vegetation are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6O

Comments:

Site looks good

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6P

Comments:

Site looks good

Shoreline is well maintained.
Algae and submersed vegetation
are at controlled levels. Lake was
very turbid during inspection.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 6R

Comments:

Site looks good

Shoreline grasses and weeds are
at controlled levels. Algae and
submersed vegetation are at
controlled levels.

Action Required:

Routine maintenance next visit

Target:

Species non-specific



Site: 5/6-1

Comments:

Treatment in progress

Shoreline is well maintained.
Submerged vegetation recently treated.

Action Required:

Re-inspect next visit

Target:

Submersed vegetation



Site: 5/6-2

Comments:

Treatment in progress

Shoreline is well maintained.
Submerged vegetation in this area has been recently re-treated.

Action Required:

Re-inspect next visit

Target:

Submersed vegetation



Site: 5/6-3

Comments:

Treatment in progress

Shoreline has some areas of torpedo grass regrowth. Algae and submerged vegetation are at controlled levels.

Action Required:

Routine maintenance next visit

Target:

Torpedograss



Site: 5/6-4**Comments:**

Site looks good

Shoreline is well maintained. Algae and submerged vegetation are at controlled levels.

**Action Required:**

Routine maintenance next vis.

Target:

Species non-specific

Management Summary**Observations and Action Items:**

- Overall the the majority of the lakes are in good condition with a few lakes showing minor weed regrowth along the shoreline.
- Water levels are currently low in all lakes due to drought conditions and natural evaporation.
- Next inspection report will be conducted August 2026.

****All observations have been reported to the operations team****

Site	Comments	Target	Action Required
1A	Site looks good	Species non-specific	Routine maintenance next visit
1B	Site looks good	Species non-specific	Routine maintenance next visit
1C	Site looks good	Species non-specific	Routine maintenance next visit
2A	Site looks good	Species non-specific	Routine maintenance next visit
3A	Normal growth observed	Shoreline weeds	Routine maintenance next visit
3B	Site looks good	Species non-specific	Routine maintenance next visit
3C	Site looks good	Species non-specific	Routine maintenance next visit
6A	Site looks good	Species non-specific	Routine maintenance next visit
6B	Site looks good	Species non-specific	Routine maintenance next visit
6C	Site looks good	Species non-specific	Routine maintenance next visit
6D	Normal growth observed	Shoreline weeds	Routine maintenance next visit
6E	Site looks good	Species non-specific	Routine maintenance next visit
6F	Site looks good	Species non-specific	Routine maintenance next visit
6G	Normal growth observed	Shoreline weeds	Routine maintenance next visit
6H	Normal growth observed	Surface algae	Routine maintenance next visit
6I	Site looks good	Species non-specific	Routine maintenance next visit
6J	Site looks good	Species non-specific	Routine maintenance next visit
6K	Site looks good	Species non-specific	Routine maintenance next visit
6L	Site looks good	Species non-specific	Routine maintenance next visit
6M	Normal growth observed	Shoreline weeds	Routine maintenance next visit
6N	Site looks good	Species non-specific	Routine maintenance next visit
6O	Site looks good	Species non-specific	Routine maintenance next visit
6P	Site looks good	Species non-specific	Routine maintenance next visit
6R	Site looks good	Species non-specific	Routine maintenance next visit
5/6-1	Treatment in progress	Submersed vegetation	Re-inspect next visit
5/6-2	Treatment in progress	Submersed vegetation	Re-inspect next visit
5/6-3	Treatment in progress	Torpedograss	Routine maintenance next visit
5/6-4	Site looks good	Species non-specific	Routine maintenance next visit





Electrofishing Study Results & Fishery Analysis

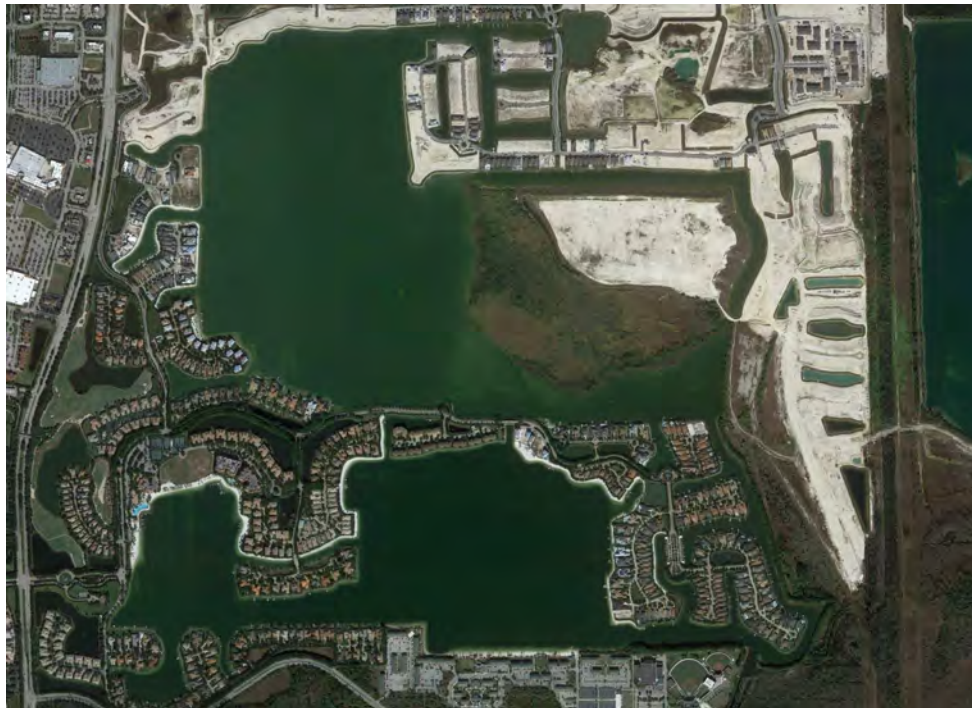
PROPERTY NAME: Miormar Lakes

REPORT DATE: 4/30/2026

SUBMITTED BY: Aaron Cushing & Matthew Drake

SAMPLING DATES: February 13, 2026

SUBMITTED TO: Richard Freeman & Robert Adams



The electrofishing report is designed to provide an in-depth representation and analysis of the current state of the fishery. The results allow our biologists to make educated and precise decisions on any improvements that may be needed to meet your goals. The findings and their significance are followed by a discussion including management recommendations.

Goals

Establish and maintain a healthy fishery with good water clarity as well as minimal midge populations.

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Methods (Approach)

A Midwest Lake Electrofishing System was used to collect all fish that were observed. Information was gathered on all fish collected during standardized sampling event(s). Length, weight, and abundance data were recorded and logged into a database. Relative weights were calculated for Largemouth Bass and Bluegill. Size classes for all species were determined to evaluate the health of the fishery.

Relative Weights

Relative Weight (Wr) is the ratio of the actual weight of a fish to what a healthy fish of the same length should weigh, called standard weight. Fish with high relative weights are fat while those with low relative weights are thin. Comparing Wr is a preferred method of biologists to understand how a fishery is responding to management practices. Proper attention to Wr in relation to the time of year is important when drawing conclusions regarding a fishery. Relative weights of bass below 90 could be an indication of a lack of food resources or difficulty obtaining prey. A relative weight of 100 would indicate a bass of "normal weight" relative to its length and would be desired for a balanced fishery. Those desiring a trophy bass fishery should aim to maintain relative weights of 110 and above.

$$Wr = \frac{\text{Actual Weight of Captured Fish}}{\text{Standard Weight of Fish at Same Length}} \times 100$$

Relative Weight Reference

Wr	Condition of Fish
100	Healthy
110	Trophy

Site Description:

	Spring 2026
Date	2/13/2026
Time of day	4:30pm-11:30pm
Water Temperature (°F)	68

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Results

Fishery at a Glance

- We collected thirteen species of fish in 2026: Bluegill (79), Largemouth Bass (256), Redear Sunfish (50), Blue Tilapia (80), Florida Gar (66), Mayan Cichlid (8), Threadfin Shad (2), Bowfin (1), Pleco (2), Armored Catfish (1), Warmouth (2), and Killifish (47).
- 134 of the 256 bass collected were considered stock size (over 8 inches).
- All but 7 Largemouth Bass were harvested. All Tilapia, Gar, Cichlids, Bowfin, Pleco, Armoured Catfish, and Warmouth were also removed.
- The small/stunted Largemouth Bass population remains extremely high.
- The predator to prey ratio indicates the harvests of predators and stocking of Bluegill are both recommended based on catch-per-unit-effort (CPUE).
- Based on the goals, young-of-the-year Bluegill counts were rare and adult numbers were abundant.

Largemouth Bass:

	Winter 2024	Spring 2025	Spring 2026	Desired Range/Goal
CPUE (All Fish)	155	96	109	60-75 for quality fishery
CPUE (Stock Size $\geq 8''$)	129	57	57	40-60 for quality fishery
Relative Weight (Wr, 8''+)	43 - 135 Average = 80.3	56-108 Average = 85	61-114 Average = 84	100 for healthy
Weight (lbs.)	0.2 - 8.1 Average = 0.64	0.2-5.9 Average = 0.7	0.2-4.7 Average = 0.6	
Length (in.)	8.1 - 24.6 Average = 11.1	8.0-21.5 Average = 11.2	8.0-20.4 Average = 10.8	

- The catch-per-unit-effort (CPUE) for Largemouth Bass is greater than the desired range (60 - 75 fish/hour), and as a result are suppressing the forage population.
- The size distribution of the bass population reflects a classic stunted/overabundant population, with very few fish present over 14 inches (Figure 1).
- The length-weight relationship demonstrates that the Largemouth Bass still remain underweight relative to their length, however a slight upward trend compared to past years is noted (Figure 2).
- A negative trend was observed in relative weight as a function of length, indicating larger bass had poorer condition likely due to less available food (Figure 3).

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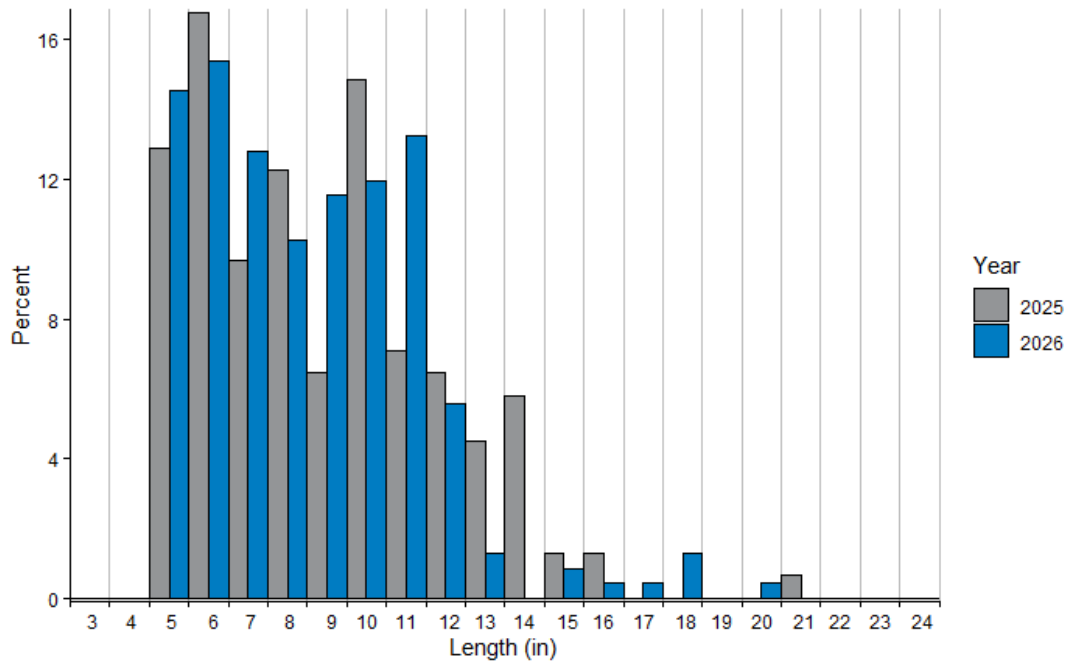


Figure 1 – Largemouth Bass size distribution. Note: This is not representative of the individual counts of fish of each size, but their proportion of the population.

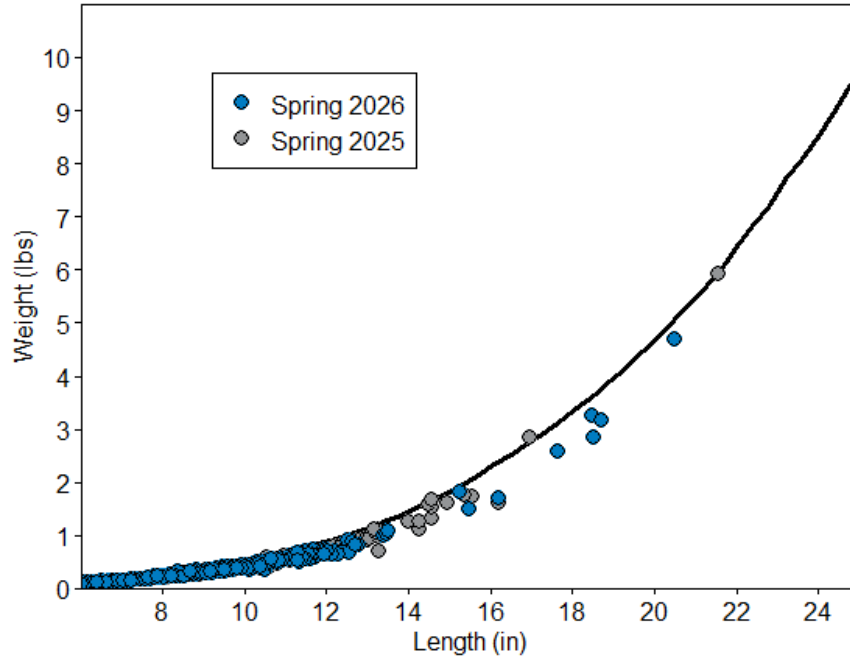


Figure 2 – Largemouth Bass relative weights plotted on a Wr goal line of 100.

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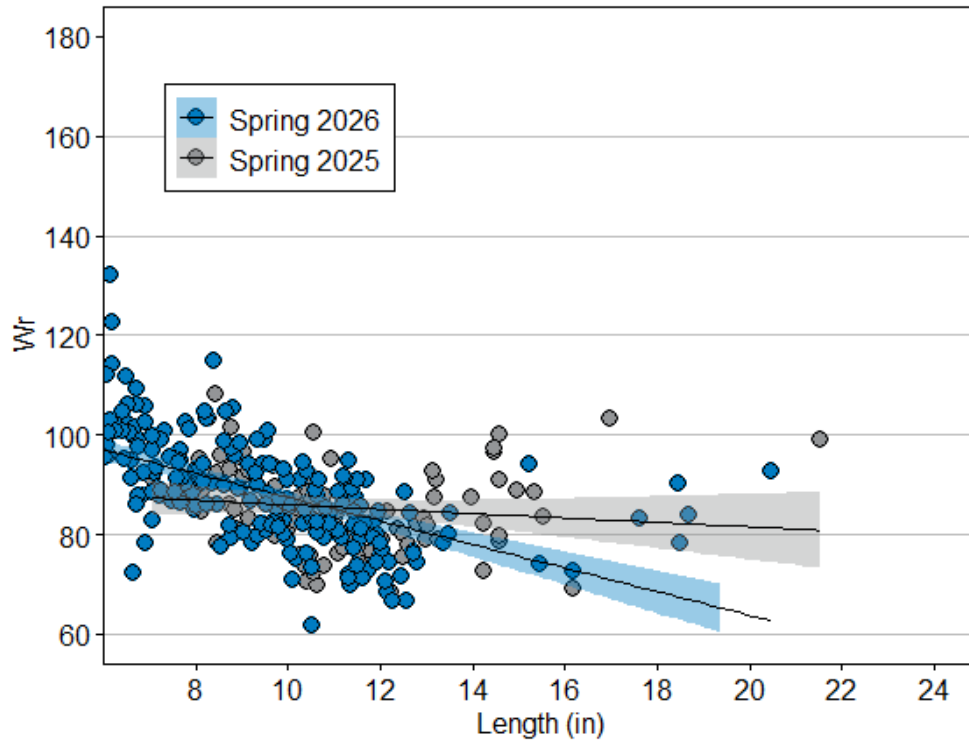


Figure 3 – Largemouth Bass relative weights versus length.

Bluegill:

	Winter 2024	Spring 2025	Spring 2026	Goal
CPUE (All Fish)	10	173*	33	250-350 for Quality Fishery
Relative Weight (Wr)	76 - 100 Average = 86	64-141 Average = 99	56-101 Average = 82	100 for healthy
Weight (lbs.) Stock Only	0.1 - 0.3 Average = 0.15	0.1-0.4 Average = 0.14	.01-.32 Average = 0.10	
Length (in) Stock Size	3.4 - 7.3 Average = 4.9	5.0-8.0 Average = 5.7	4.0-7.70 Average = 5.5	

- The CPUE was much lower than desired for a healthy fishery.
- Stocking 3,750 pounds of 5.5+'' Bluegill (approximately 22,500 fish) greatly influenced the number of fish collected in 2025, with numbers returning to their baseline in 2026.
- The length distribution shows a large proportion of 3'' fish were collected, indicating a high level of recruitment within the population.

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- The health of the adult Bluegill population is relatively poor, with an average W_r of only 82 (Figure 5).
- A negative trend was observed in relative weight as a function of length, indicating as Bluegill get longer their weight declines, indicating larger fish are not finding enough food (Figure 6).

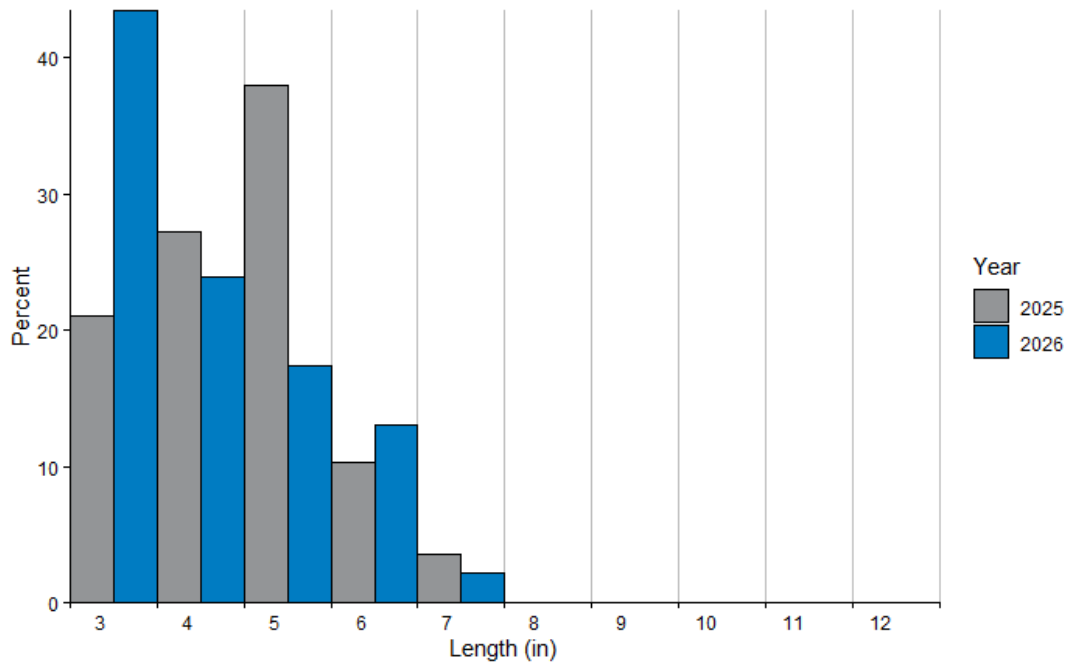


Figure 4 – Bluegill size distribution.

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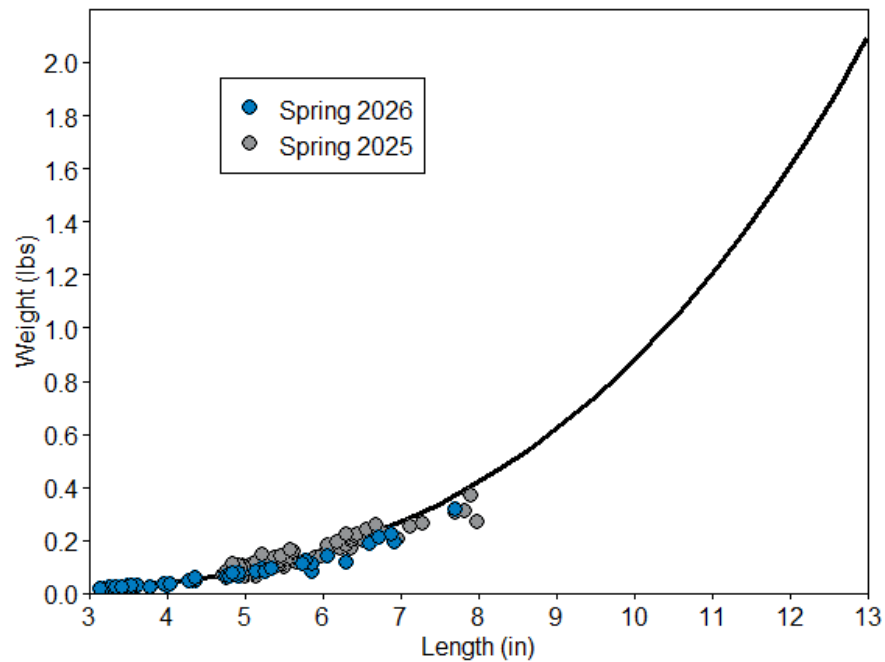


Figure 5 – Bluegill relative weights plotted on a Wr goal line of 100.

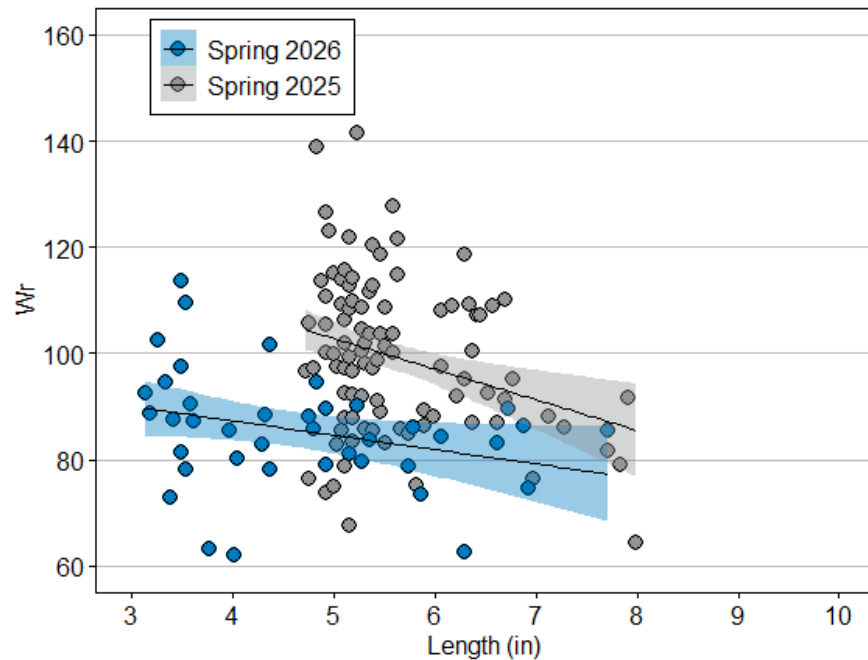


Figure 6 – Bluegill relative weights versus length.

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Redear Sunfish:

	Winter 2024	Spring 2025	Spring 2026	Goal
CPUE (All Fish)	26	38	21	50-100
Wr	64 - 90 Average = 91	64-107 Average = 90	35-125 Average = 89	100
Weight (lbs.) Stock Only	0.10 - 0.67 Average = 0.34	0.34 - 0.67 Average = 0.34	0.1-.60 Average = .22	
Length (in.) Stock Only	6.0 - 9.8 Average = 7.9	6.0-9.8 Average = 7.9	4.0-9.25 Average = 6.6	

- The CPUE was lower than desired for a healthy fishery.
- The size distribution of Redear Sunfish shows a high proportion of smaller fish, indicating successful spawning and survival of small fish.
- The adult Redear Sunfish population is underweight, with an average Wr of 89 (Figure 8).
- The Redear Sunfish of all sizes require increased access to ample forage as indicated by their relative weights (Figure 8).

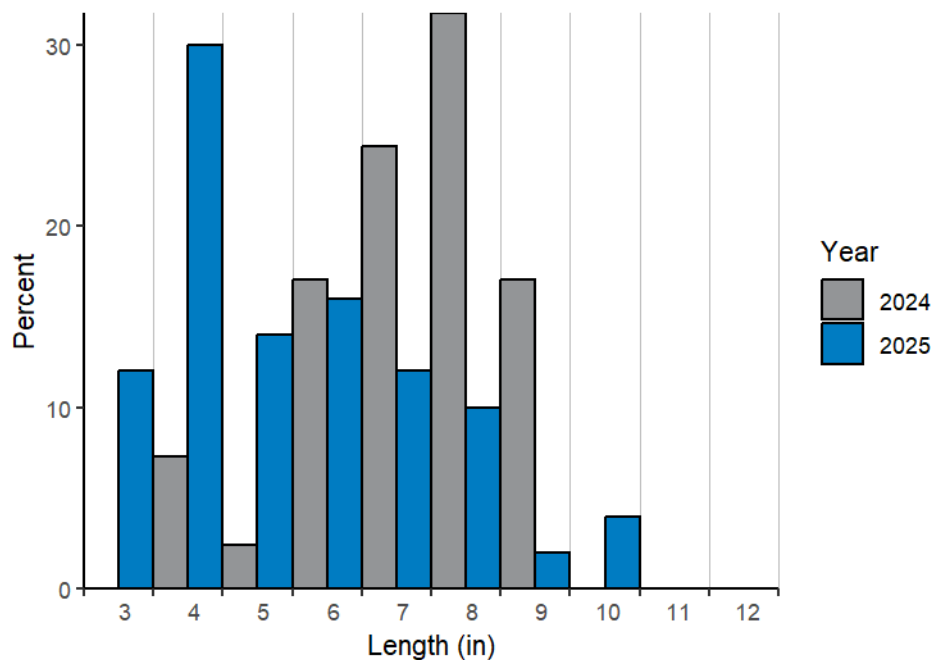


Figure 6 – Redear size distribution.

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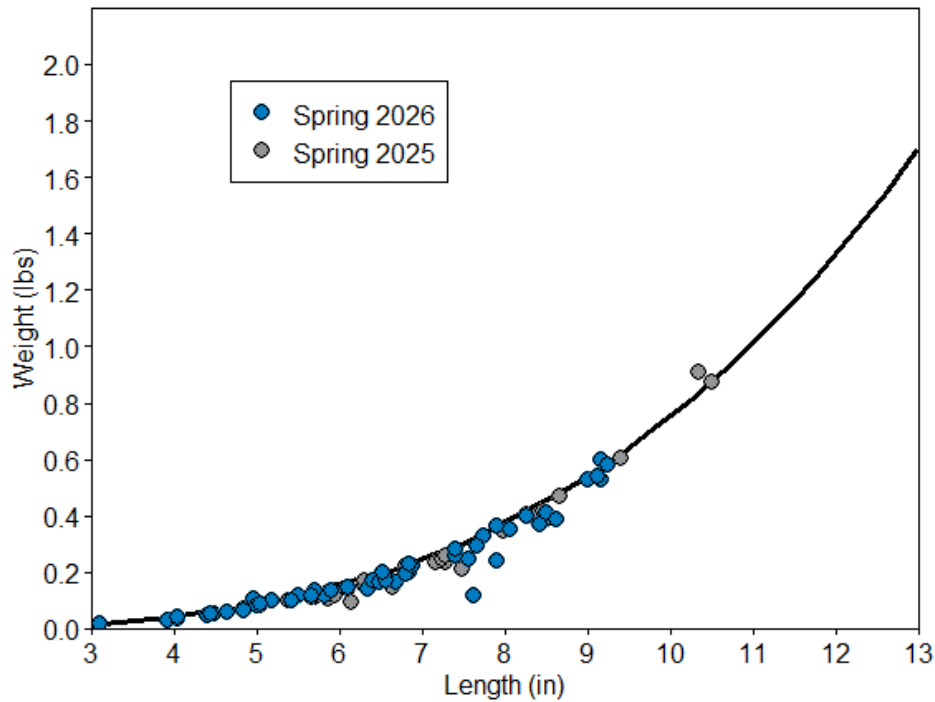


Figure 7 – Redear relative weights versus a W_r line of 100.

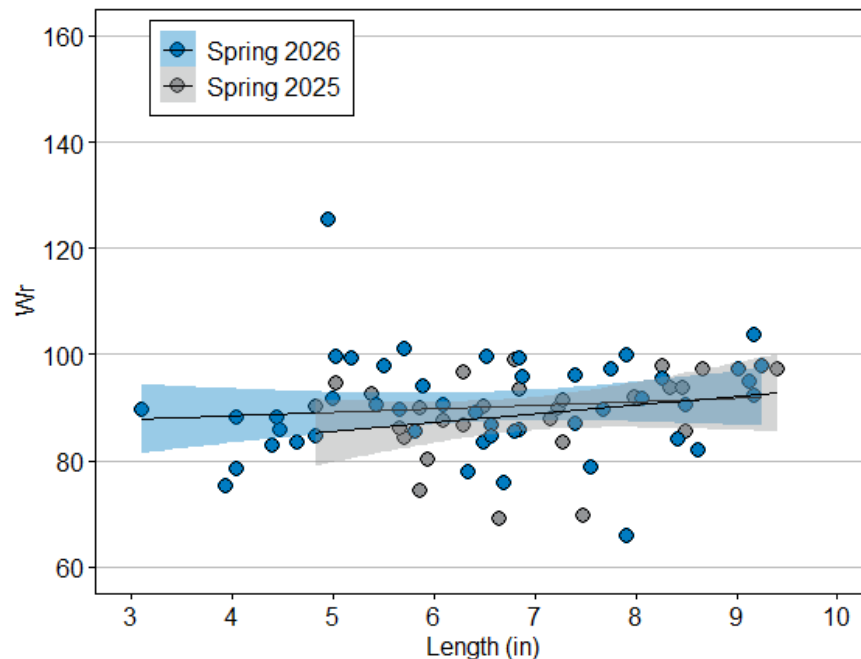


Figure 8 - Redear Sunfish relative weights versus length.

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Fish Habitat

The beneficial aquatic vegetation continues to improve and expand. Vegetation spot treatments designed to reduce plants in undesired areas while letting it grow in others will have a positive impact on the fishery. With the artificial habitat that was installed in various locations throughout the lake in 2024, the overall fish habitat continues to improve.

Fishery Assessment

The population level of forage fish remains too low, and the Largemouth Bass population remains too high. Catch rates of Largemouth Bass were high this year, which is most likely due to the abundant aquatic vegetation (fish cover).

Fisheries managers compute relative weight to assess fish condition. The Largemouth Bass relative weights are below optimal, which is because their population is too high relative to the forage population. This overpopulation of bass results in most of the forage being consumed while small in size, making it difficult for the forage population to increase.

A diverse forage base is key to supporting a healthy Largemouth population. Bluegill and Redear Sunfish are the base of the food chain and their adult populations are very low. It is critical for them to have a well-established population so that their offspring become part of the forage base for the Largemouth.

Conclusions & Recommendations

The lake has made significant progress over the past few years in setting the stage for a more balanced fishery. Future management recommendations must be followed through to keep the momentum going and turn the fishery around. Continuing to combine the bottom-up approaches (improving the cover/habitat and forage stocking) with the top-down strategies (predator harvesting and Largemouth Bass removal), will be the key to sustained success.

The harvesting events are again recommended to further reduce the predator population. While a large number of predators have already been removed, the data supports more harvesting is still needed to reduce their numbers. Advanced size Bluegill should again be stocked to help increase the adult population which will provide forage for the Largemouth Bass to grow.

Mechanical harvesting of nuisance vegetation during low water events is recommended to help maintain a healthy balance of quality habitat and recreational activities. Additional Grass Carp stocking can also be considered.

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Thank you,
SOLitude Lake Management
Aaron Cushing
Fisheries Biologist

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Largemouth Bass ***Micropterus salmoides***

Management Notes: Largemouth Bass are the most popular warm-water sport fish in North America. However, the more fish in a pond does not mean more big bass. They have a tendency to become overpopulated and often require active harvest or removal of intermediate sized fish to prevent size classes from becoming stunted. Under trophy management Largemouth Bass can exceed 12 pounds.

Habitat and Biology: Largemouth Bass occupy almost all aquatic habitats. They thrive in lakes, ponds, and reservoirs where they are more tolerant of turbidity and slack water current and are found in the weedy parts of the body of water. Spawning occurs in spring, when water temperatures reach the mid- 60's and takes place in deeper water than other sunfishes, usually 1 to 4 feet. Males build and defend a nest. After spawning, the female leaves the nest although she, or another female, may return to spawn later. The eggs hatch in 3 to 4 days. Females produce 2000 to 7000 eggs per pound of body weight. Until they are 2 inches long, Largemouth Bass fry feed on plankton, insects and other invertebrates. Adult Largemouth Bass prey upon Bluegill and Redear Sunfish in stocked ponds and upon shad, minnows, smaller sunfishes, crayfishes, and amphibians in natural habitats. Average life span is from 10 to 12 years and growth rates are extremely variable depending on the water body.

Characteristics: The back of the fish is olive green to brown, and the greenish sides are marked with a broad black band composed of somewhat oval blotches connected by shorter blotches. The belly is white, and between it and the lateral stripe are several rows of scales with darkened centers, giving the fish a striped appearance. The dorsal, caudal, and pectoral fins are varying shades of green and the pelvic and anal fins are clear to white. They typically grow 12 to 30 inches in length.



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Bluegill

Lepomis macrochirus

Management Notes: Bluegill are the number one food source for Largemouth Bass. A healthy population with abundant small individuals is critical for ponds being managed as successful Largemouth Bass fisheries. They readily accept pelleted feed, which makes it very straightforward to grow large Bluegill for angling and lots of small fish to feed Largemouth Bass. Bluegill are not only stocked in ponds and lakes as a food source, but they are also a fun and easy sportfish for kids to catch. In addition to their high catchability, they also help bring balance to the ecosystem by feeding on insect larvae, including mosquito larvae.

Habitat and Biology: Bluegill are warm-water species that are well suited for the habitat found in ponds and lakes. Bluegill are colony nesters and begin spawning when the water temperatures reach 60°F. They have a protracted spawning season lasting from April to September. The long spawning season of Bluegill gives them tremendous reproductive potential. Bluegill nest in colonies and prefer sites with firm substrates such as gravel within water 1 to 3 feet deep with little to no vegetation or debris. They typically reach maturity at age 1 or 2. Bluegill feed during the day and most actively in the morning and afternoon. They eat a wide variety of organisms including significant amounts of plant material and insect larvae. Young Bluegill feed on plankton while larger individuals eat insects and other fish. They feed throughout the water column. Bluegill live for 5 to 6 years and grow 6 to 10 inches in length.

Identification Characteristics: The mouth on a Bluegill is small with the upper jaw not extending to the front of the eye. The flexible ear flap is always black and is small in juveniles while longer in adults. Juveniles and non-breeding adults are light olive to gray on the back and sides with several evenly spaced, darker vertical bands. The belly varies from pale yellow to white. All but small individuals have a distinct black spot toward the rear of the soft dorsal fin. Breeding males darken, with the back and sides becoming purple.



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Redear Sunfish (Shellcracker)

Lepomis microlophus

Management Notes: Due to their preferred diet of snails and clams, redear play a vital role in reducing fish parasites such as black and yellow grub in a pond, which require a mollusk host to complete their life cycle. Redear are usually stocked into small ponds and lakes with Bluegill and Largemouth Bass. They grow quite well in these environments, and because of their diet, do not compete with Bluegill. Their reproduction is limited, however, and a supplemental stocking is recommended every few years to support their population.

Habitat and Ecology: This species occurs in moderate to large streams, rivers, reservoirs, lakes, swamps, and other standing-water habitats. Spawning occurs during May, June and July when water temperatures reach 70°F. They prefer water three to four feet deep, and a firm, shelly bottom, often near a dropoff. Nesting sites are often near aquatic vegetation such as water lilies, cattails, lizard's tail, and maidencane. Breeding behavior is similar to other sunfish, with the males doing the nest building and guarding the young. A female may lay between 15,000 to 30,000 eggs during a spawn. Redear sunfish have extensive molar surfaces on the pharyngeal arches and associated musculature that enables the fish to crack mollusk shells, hence the local name of shellcracker. Individuals live for six years and grow 8 - 11 inches in length.

Characteristics: The back on this species is light green to brown with scattered dark spots. The sides are light gray to silver. Lower surfaces of the head and venter are light yellow to white. Sides of the head are mottled with brown to dark orange spots. The dorsal fin is light gray while the anal fin is light yellow to white. The pectoral fin is long and pointed, its end reaching past the nostril when bent forward. The common name of this species is derived from the characteristic red or orange spot at the rear of the opercular flap.



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Threadfin Shad

Dorosoma petenense

Management Notes: The Threadfin Shad is a favorite food for many game fishes including Largemouth Bass, Hybrid Striped Bass, Smallmouth Bass, and catfish. It is a warm water fish that requires annual spring stocking. This fish is widely introduced throughout the U.S. as a forage fish for game fish.

Habitat and Biology: This pelagic, plankton-feeding species occurs in large, often single-size schools and with Gizzard Shad. The greatest numbers occur in rivers, reservoirs, and large streams, where they can be seen rippling the surface at dawn and dusk. Spawning typically occurs from dawn to sunrise, when water temperatures reach 70°F. The eggs adhere to submerged and floating objects. Females lay from 2,000 to 24,000 eggs. The young and adults feed on a variety of planktonic organisms and organic debris. This fish is very sensitive to changes in temperature and dissolved oxygen, and die offs are frequent in fall and late summer especially when water temperature reaches 42 °F. Threadfin Shad sometimes grow larger than their prey when this happens they tend to take up a large number of the biomass and a method of reduction is required. Life expectancy seldom exceeds 2 to 3 years and they grow 5 to 7 inches in length.

Characteristics: Like the Gizzard Shad, the Threadfin Shad has an elongated posterior dorsal ray, but its mouth is terminal and the lower margin of its upper jaw is not notched. The back is bluish gray with a persistent black or purple shoulder spot. The venter is silver to creamy white. The caudal fin is distinctly yellow (hence the local name "yellowtails"). Other fins may be light yellow, dusky, or clear.



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Seminole Killifish
Fundulus seminolis

Management Notes: Seminole Killifish are a prey species for Largemouth Bass and other predatory fish. Since they live in shallow water they are a favorite food for birds such as Kingfishers and Herons. They live in small schools, the size of which increases in the presence of predators to improve their “safety in numbers”.

Habitat and Biology: The Seminole Killifish ranges throughout much of peninsular Florida from the St. Johns and New river drainages south to the Everglades. They typically inhabit shallow, quiet pools of lakes and streams, often near floating and submersed vegetation. They are opportunistic feeders, feeding on small invertebrates, insects, and plant material.

Characteristics: Seminole Killifish are characterised by their metallic green color, often with small black spots on the side of their body. They have a slender body, rounded fins, and an upturned mouth. They are one of the larger Fundulus species, reaching lengths up to 6.5 inches.



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Blue Tilapia *Oreochromis aureus*

Management Notes: Due to their rapid reproduction, Blue Tilapia can be stocked as a supplemental food source in ponds managed for Largemouth Bass. They can also be placed in ponds for algae control where legal. They are a warm water fish and will die each fall when water cools to about 50° F. Whether stocked for algae control or as a food source, it is important to remember they are not native to the United States and should never be moved from pond to pond. Tilapia should only be stocked by a professional biologist who possesses a permit and is certified by each state.

Habitat and Biology: Tilapia are tropical fish species that resemble our native sunfish and can control certain aquatic vegetation. Blue Tilapia commonly stocked in the United States are native to the Middle East and northern Africa. They feed on algae (both planktonic and filamentous) and detritus and do not readily consume submerged vascular plants. Because Blue Tilapia are tropical fish, they cannot survive normal winter water temperatures in most of the U.S. In the mid-Atlantic annual restocking is generally necessary unless a warm water supply (such as thermal spring or power plant cooling reservoir) is available as a refuge where the fish can overwinter. Tilapia are stocked in the spring and reproduce often, providing a steady supply of food for predators. They have demonstrated control of algae in ponds in approximately one month. They are an excellent food fish and can be eaten if caught. The high rate of reproduction, coupled with the high fry survival and fast growth, make Blue Tilapia an excellent supplemental forage for largemouth bass.

Characteristics: Blue Tilapia are large cichlids resembling a two-pound Bluegill with rounded fins when fully grown. They are bluish-gray in color with a white underside. They average about 8 inches but can reach up to 20 inches and 8 pounds.



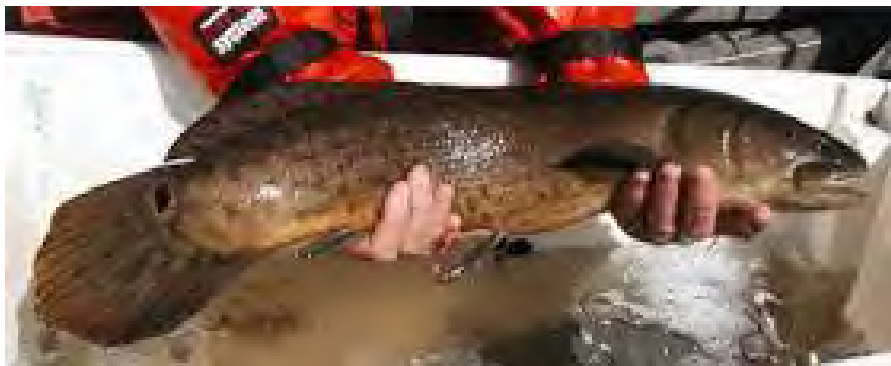
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Bowfin *Amia calva*

Characteristics: The Bowfin has been given other vernacular names as grindle, grinnel, mudfish, and dogfish. The Bowfin is a long, cylindrical fish with a prominent backbone that flexes upward into a rounded tail. Body color is mottled olive green to light brown on the back, grading to light green to cream on the venter. It has a prominent black spot, which is surrounded by a yellow or orange ring and located near the base of the caudal fin on young Bowfins and adult males. The adult Bowfin's large mouth possesses many sharp, canine teeth.

Habitat and Biology: Bowfins prefer quiet, clear, backwater areas, lingering along the margins of aquatic vegetation, in undercut banks, and around branches and other submerged structures. Bowfins are spring spawners, nesting from May to early June when temperatures are 60° to 66°F. The nests are usually in quiet bays or inlets with abundant water plants and have shelter such as stumps or fallen logs. The male Bowfin exhibits extensive parental care. The male clears an area in the mud for the female to lay eggs in, and then fertilizes them. He hovers nearby and aggressively protects the eggs and the fry after they emerge. Hatching typically occurs after 8 to 10 days. Small Bowfin typically form dense schools and remain in or near aquatic vegetation until they reach 4 to 5 inches. Bowfins are able to breathe air, using their swim bladder as a primitive lung and can be seen coming to the surface and gulping air even in well oxygenated water. This air-breathing ability allows them to utilize shoreline habitats that are not accessible to other predator fish. The Bowfin is an indiscriminate predator that readily preys on a broad variety of arthropod and vertebrate prey, from insects and crawfish to other fish and frogs. They can live 30 years or more and reach lengths from 15 to 24 inches.



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Florida Gar *Lepisosteus platyrhincus*

Management Notes: Although native to Florida, these gars may be undesirable in a system being actively managed for Largemouth Bass as they compete for the same forage fish.

Characteristics: Florida Gar have irregular round, black spots on the top of its head and over the entire body including the anal fin. The distance of the eyes is less than two-thirds the length of the snout. Also, it has a shorter, broad snout with a single row of irregularly spaced sharp teeth on the upper and lower jaws. No bony scales are on the throat. Their color is olive-brown on the back and upper sides, with a white to yellow belly. The young may have dark stripes on the back and sides.

Habitat and Biology: The Florida Gar is found throughout peninsular Florida and north into Georgia. It can often be found in medium to large lowland streams such as the Ochlockonee River, lakes and canals with sandy or muddy bottoms and ample vegetation. They inhabit shallow to medium-depth waters and prefer to ambush prey rather than chase them down. Adult gar feed primarily on fish, though they are known to eat crayfish and shrimp as well. They are capable of surviving in poorly oxygenated water due to their ability to gulp air at the surface utilizing their specialized gas bladder. Spawning occurs in late winter and early spring in shallow weedy areas.



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Mayan Cichlid

Cichlasoma urophthalmus

Characteristics: Adult and juvenile Mayan Cichlids have a yellow to olive-brown body, with five to seven distinct vertical bars and a prominent dark spot with a blue ring at the base of the tail fin. Their body color varies greatly in intensity; sometimes with bright red on the chin, throat, and breast and sometimes a dull brown to green.

Habitat and Characteristics: Mayan Cichlids are very adaptable and live well in a wide variety of habitats including canals, rivers, lakes and marshes. They can tolerate a wide range of salinities. They spawn by building a nest in the spring, followed by peak spawn in May and June. Mayan cichlids are biparental substrate spawners, and produce adhesive eggs. When the young hatch, they will immediately swim toward the bottom, where they attach with adhesive head glands. The young begin free-swimming after about five to six days, but continue to be guarded by the parents for days thereafter. They will generally only spawn once per year. Mayan Cichlids are generalist predators, consuming grass shrimp, small fish, snails, and insects along with some incidental detritus and vegetative matter.



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Vermiculated Sailfin Catfish *Pterygoplichthys disjunctivus*

Characteristics: Vermiculated Sailfin Catfish (*Pterygoplichthys disjunctivus*) have worm-like markings all along their body. The sailfin catfish has 9-14 dorsal fin rays. *Pterygoplichthys disjunctivus* is a benthic forager, using its suckorial mouth to attach to surfaces and consuming detritus and algae. They were most likely introduced through fish farm escapes or releases, although aquarium releases cannot be ruled out. Male members of the genus *Pterygoplichthys* dig out banks to create burrows in which an attracted female will lay and guard her eggs. In large numbers, this burrowing behavior by *Pterygoplichthys* contributes to problems with siltation and can potentially destabilize the banks, leading to an increased rate of erosion.

Habitat and Biology: Sailfin catfish live in nearly any type of slow moving streams, canals, ponds, and lakes; and are normally most abundant along the shore and in shallower waters. They are known to create spawning burrows along shorelines, sometimes undermining canal banks and lake shorelines. Little is known about the vermiculated sailfin's specific habitat preferences. Male and females start maturing when they reach 13 and 11 inches long. Females will lay about 2,000 eggs in shoreline burrows, holes, or crevices generally between April and September. The nests are guarded until the eggs hatch. They primarily feed on detritus, algae, sand, small freshwater bivalves, water fleas, and decaying matter. They are most active around dusk, when they root around the bottom sediments looking for worms and insect larvae. They have a sucker-like mouth that is used to scrape algae from stones and other surfaces with their spoon shaped teeth.



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Walking Catfish

Clarias batrachus

Characteristics: Walking catfish have elongated, scaleless bodies that taper to a tail similar to a tadpole. They can grow to be 1.6 ft long and weigh up to 2.6 lb. Walking catfish are usually gray or gray-brown with white spots on their sides, but can also be albino, mottled, or piebald. Walking catfish have long dorsal and anal fins that run along most of their length, and pectoral fins with rigid spines. Walking catfish have broad mouths with fleshy lips, especially the upper lip. Walking catfish have four pairs of sensory barbels. Walking catfish skin is covered in mucus, which protects them when they are out of water.

Habitat and Characteristics:

Walking catfish can live in a variety of habitats, including freshwater, brackish water, and terrestrial environments. They are commonly found in muddy ponds, canals, ditches, swamps, flooded prairies, irrigation channels, lakes, rice fields, wetlands, and Everglades pools. They are known for their ability to thrive in conditions that many other fish cannot, such as warm, stagnant, and often hypoxic waters. They can also survive in water with little to no oxygen because they can breathe air. Walking catfish spend most of their time on or near the bottom of the water, but they will occasionally come to the surface to gulp air. During cold and dry months, they will burrow into the mud to survive. They also have spiny front fins that allow them to waddle from one wetland to another. Walking catfish are omnivorous and eat smaller fish, molluscs, invertebrates, detritus, and aquatic weeds.



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Warmouth *Lepomis gulosus*

Management Notes: Given their large mouth size, Warmouth can consume much larger prey than similar sized sunfish. They compete directly with these fish for available food and can also hybridize with them. If managing for Largemouth Bass, Warmouth populations should be reduced.

Habitat and Biology: Warmouth usually occur around concentrations of aquatic vegetation and submerged roots and brush piles in medium to large streams, rivers, and reservoirs with soft or mucky bottoms. Freshwater shrimp are an important food item for Warmouth but they also feed on small crayfish, aquatic insect larvae, and minnows. Spawning occurs in May and June near stumps or aquatic vegetation, but not over a clean, sandy bottom. Males build nests in water 1 to 4 feet deep and often the nests are close together. Several females may contribute eggs to a single nest. Only a few eggs are laid during each spawning episode. Eggs can hatch as soon as 30 minutes but typically take a day. The nests are guarded by males until the fry hatch. Maturity is reached when the fish are 1 to 2 years old. Males typically grow faster than females. They are not considered a popular panfish because of their small size. They live 6 to 7 years and grow 6 to 8 inches in length.

Identifying Characteristics: The Warmouth, like the Rock Bass, is known locally as goggle-eye. The mouth is large with the upper jaw reaching the middle of the eye or slightly beyond. A small patch of teeth on the tongue can be detected by rubbing its upper surface. One or two anterior and three or four posterior dark streaks radiate out from the eye. The back and sides are yellowish brown with dark blotches and mottling. The belly is light yellow to brown. Young individuals have a light horizontal stripe near the lateral line. Fins are light brown with mottling and banding, particularly near the rear of the soft dorsal and anal fins.



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Brown Hoplo

Hoplosternum littorale

Characteristics: Brown Hoplo are armored catfish known for their bony scales and dark coloration. They possess two pairs of long barbels on their chin, used for sensing food. They are sexually dimorphic, with males displaying larger pectoral fin spines during breeding season which are used for territorial defense. Males will build floating nests in vegetation near shore that consist of bubbles covered with plant material. Eggs are released by the female below the nest. The male then fertilizes them and takes them into his mouth and blows them up into the floating nest. Eggs will typically hatch in about 4 days. Brown Hoplos will typically grow to about 2 inches in 2 months but will rarely exceed 10 inches in length.

Habitat and Characteristics:

Brown hoplos are native to South America. They occur in a variety of freshwater habitats including muddy bottom and slow moving rivers, streams, side channels, ponds, marshes, ditches, and borrow pits. Larva and juveniles inhabit shallow water areas with lots of vegetation, while adults prefer foraging in deeper, open water areas. They can gulp air which allows them to survive in low oxygen as well as high hydrogen sulfide environments. They are bottom dwellers and scavengers, feeding on detritus, invertebrates, and other aquatic matter.



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