



# Fisheries Survey Report

## Barefoot Lakes, Firestone, CO

# BAREFOOT LAKES



# SOLITUDE

LAKE MANAGEMENT



## **Introduction**

Barefoot Lakes is a housing development with three separate developers located in Firestone, Colorado and is centered around nature and designed for use by the community. The two lakes at the entrance of the development are a focal point for the community. The West Lake is approximately 30 acres in size while the larger East Lake is roughly 50 acres. Both of the lakes are popularly used for recreation. SOLitude Lake Management's biological report is designed to provide an analysis of the current state of the fishery. The analysis of these characteristics of an aquatic resource help determine the best management and improvements to meet the goals. The findings of the survey and significance are followed by a discussion including management recommendations.

## **Methods**

On June 4<sup>th</sup> and 5<sup>th</sup> 2019, SOLitude biologists completed a fisheries survey. A Smith Root boat-mounted electrofishing unit and gill net technology were used to sample the fish community. Electrofishing applies electricity to the water body and stuns fish that come in contact with the electrical current. Gill nets are a passive sampling method designed to catch fish that are pelagic or actively swimming within the water body. All species of fish observed were collected. Information was gathered on all fish collected over multiple sampling events. Length, weight, and abundance data were recorded and logged into a database. Relative weights (Wr) and Proportional Size Distribution (PSD) were calculated for Largemouth Bass and Bluegill. During sampling, all fish over three inches were collected to determine species relative abundance and size classes were calculated to evaluate the health of the fishery. Any Common Carp captured were removed from 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 above optimal while those with low relative weights are considered below ideal condition. Comparing Wr is a preferred biological method to understand the health and dynamic of a fishery and response to active management practices. Relative weights of bass over 80 is desired for a balanced fishery, 100 and above is desired for an optimal fishery, and 110 and above for trophy fisheries. Proper attention to Wr in relation to the time of year is important when drawing conclusions regarding a fishery due to variability of smaller size classes.

## **Proportional Size Distribution**

The metric of Proportional Size Distribution (PSD) is a measure of size structure within a fishery. PSD is expressed as a percentage of (number of quality-length fish / number of stock-length fish) to represent population size structure. PSD can be very useful for describing predator-prey interactions. For Largemouth Bass, stock and quality lengths are 8 and 12 inches, respectively. A balanced Largemouth Bass fishery should

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have a PSD ranging from 40-60. Additional size classes (preferred, memorable, and trophy) help to further describe the size structure of a population. Calculating PSD allows biologists to fine tune management strategies and help pond owners achieve their goals when managing for a certain size class of fish.

Minimum lengths for calculating PSD, PSD-P (preferred), PSD-M (memorable), and PSD-T (trophy) for Largemouth Bass and Bluegill.

PSD Size Class	Largemouth Bass (inches)	Bluegill (inches)
Stock	8	3
Quality	12	6
Preferred	15	8
Memorable	20	10
Trophy	25	12

### **Fish Populations and Abundance Results**

#### *East Lake*

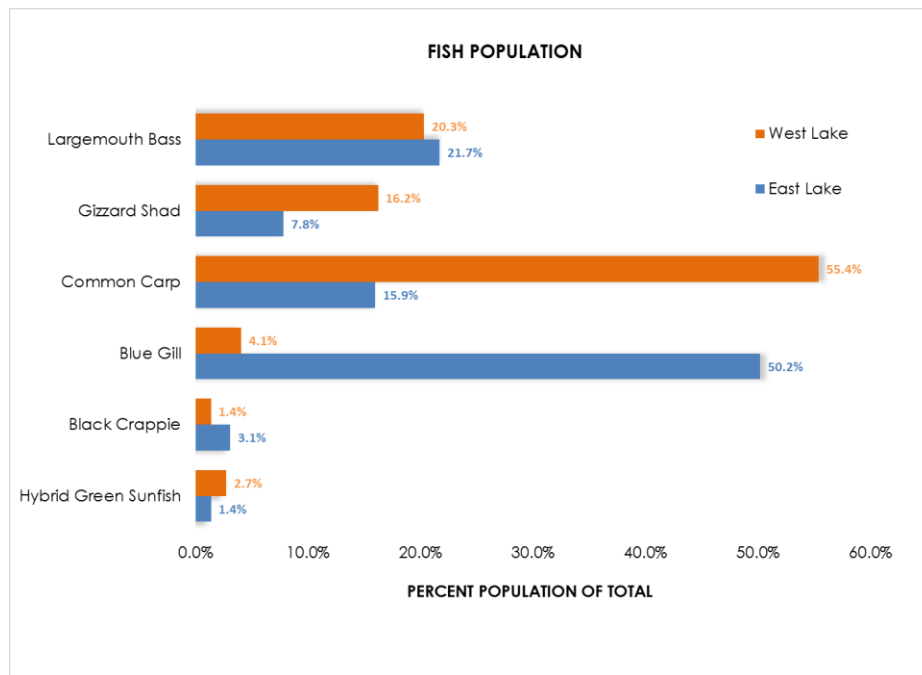
- Nine (9) species of fish were collected and observed: Common Carp (*Cyprinus carpio*) (47), Largemouth Bass (*Micropterus salmoides*) (64), Bluegill (*Lepomis macrochirus*) (148), Gizzard Shad (*Dorosoma cepedianum*) (23), Black Crappie (*Pomoxis nigromaculatus*) (9), Hybrid Green Sunfish (*Lepomis cyanellus* X *Lepomis macrochirus*) (4), White Sucker (*Catostomus commersonii*), Black Bullhead Catfish (*Ameiurus melas*), and Fathead Minnows (observed)
- Forty-seven (47) Common Carp were harvested from the lake.
- Common Carp ranged in size from 12 to 21 inches.
- The sixty-four (64) Largemouth Bass sampled ranged in size from 5.9 to 17.1 inches.
- The fifty-four (54) Largemouth Bass collected were considered catchable size (over 8 inches).
- Average Wr for Largemouth Bass was 108. (see discussion)
- Bluegill collected ranged in size from 3.3 to 5.8 inches.
- No young of the year Bluegill were captured but many were observed during the survey.
- Average Wr for Bluegill was 103.
- The eight (8) Black Crappie captured ranged in size from 7.1 to 11.4 inches.
- The Catch per Unit Effort (CPUE) for Largemouth Bass over 8 inches was 30 fish/ hour, Bluegill (79 fish/hour), Black Crappie (5 fish/hour), Common Carp (27 fish/hour).

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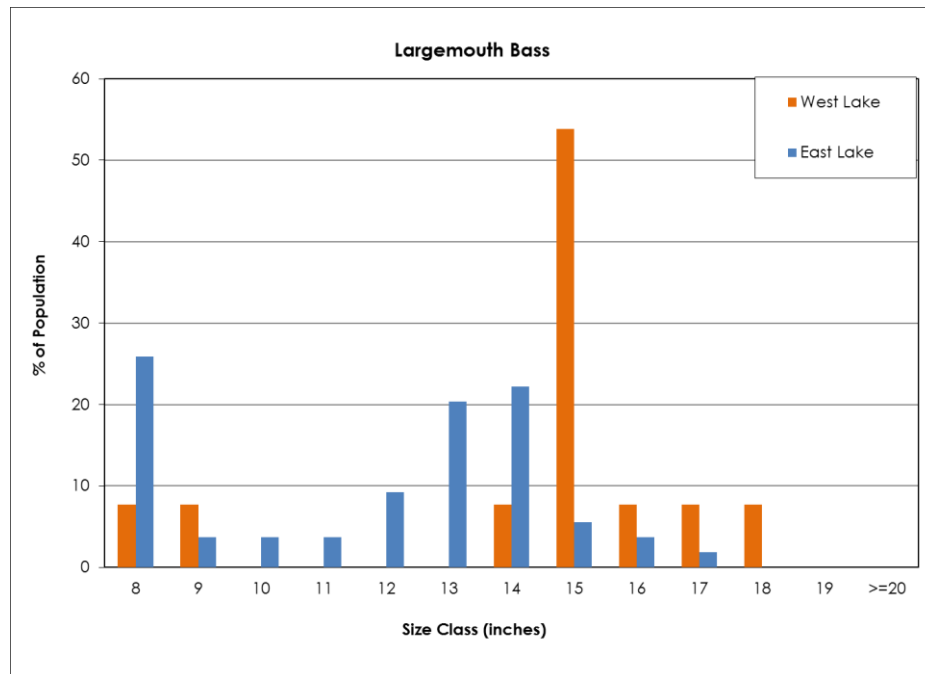
### West Lake

- Eight (8) species of fish were collected and observed: Common Carp (41), Largemouth Bass (15), Smallmouth Bass (1), Bluegill (3), Gizzard Shad (12), Black Crappie (1), Hybrid Green Sunfish (2), and Fathead Minnow (observed).
- A total of 41 Common Carp were harvested from the lake.
- The Common Carp ranged in size for 5.5 to 27.5 inches.
- The fifteen (15) sampled Largemouth Bass ranged in size from 7.0 to 18.5 inches. There were 13 bass collected considered catchable size (over 8 inches).
- Average Wr for Largemouth Bass was 118. (see discussion)
- Two of the three Bluegill were large enough to measure relative weight (Wr) with an average Wr of 133.
- No young of the year Bluegill were captured but were observed.
- The one (1) Black Crappie captured was 5.7 inches.
- The Catch per Unit Effort (CPUE) for Largemouth Bass over 8 inches was 9 fish/ hour, Bluegill (2 fish/hour), Black Crappie (1 fish/hour), and Common Carp (27 fish/hour).

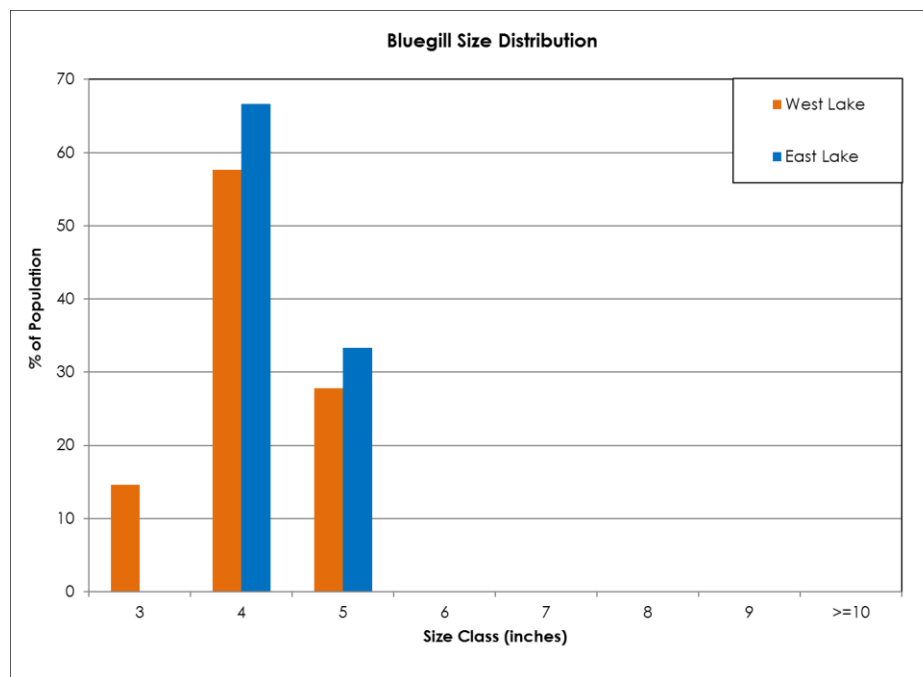


**Figure 1:** 2019 Fish population structure

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**Figure 2.** Largemouth Bass size distribution.



**Figure 3.** Bluegill size distribution.

*Note: This is not representative of the individual counts of fish of each size, but their proportion of the population.*

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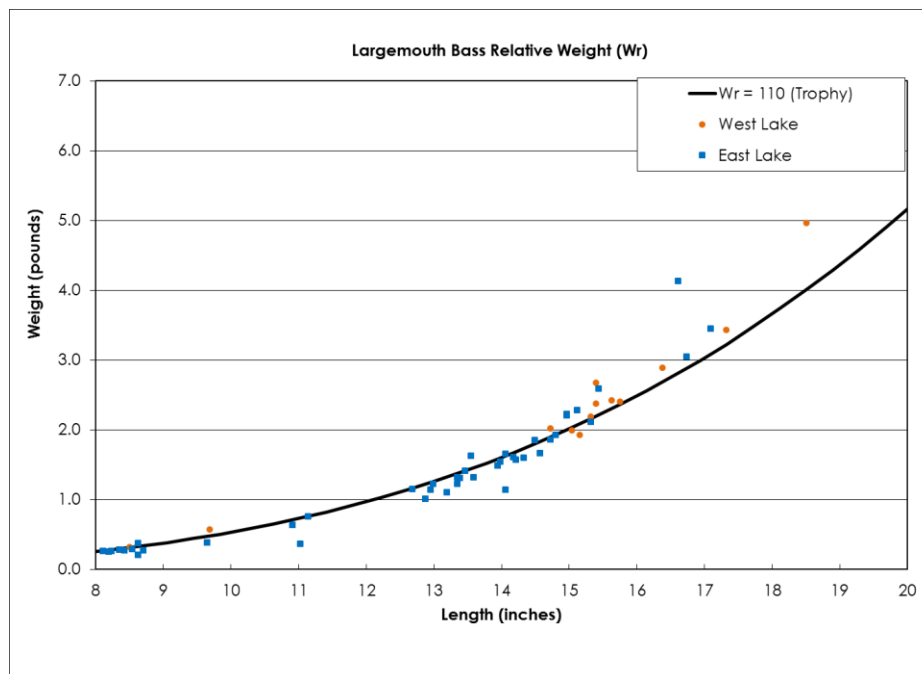
## Discussion/Recommendations

### Fisheries

In the East Lake, 54 of the 64 Largemouth Bass (bass) collected were over 8 inches in length and large enough to determine relative weights. During the previous survey in 2017, relative weights ranged from 97 – 151 and averaged 117 and ranged from 108-162, averaging 108 this year. A slight trend of relative weight increasing as length increased, suggests that suitable forage was present for larger Largemouth Bass at the time of sampling (Figure 4).

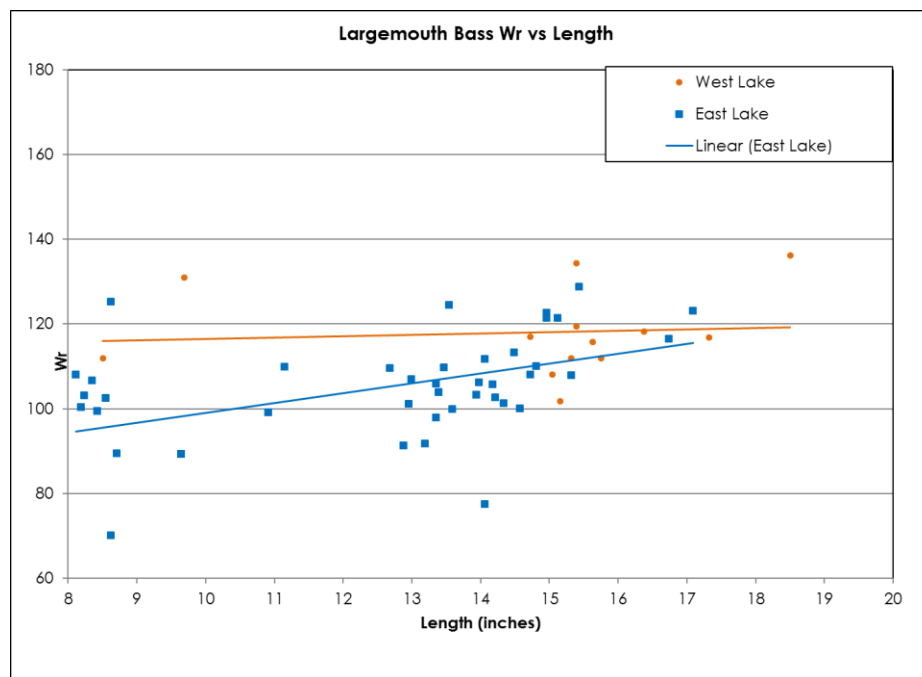
In the West Lake, 13 of the 15 Largemouth Bass collected were over 8 inches. In 2017, the relative weights ranged from 86 – 149 and averaged 136 and ranged from 102-134, averaging 118 this year. The same trend observed as in the East Lake with relative weight increasing as length increased.

Although the Largemouth Bass are currently above the optimal weight in both lakes, it is important to note that this may not be sustainable (Figure 4). As Largemouth Bass reproduce in the lakes, they may become overpopulated and decrease in weight. Selective harvest to maintain a healthy bass population and is still a recommendation to maintain a healthy fishery, if allowed. In both lakes, it would be ideal if Largemouth Bass between 8 and 15 inches are harvested by anglers leaving bass larger than 15 inches for catch and release only.



**Figure 4.** Largemouth Bass relative weight.

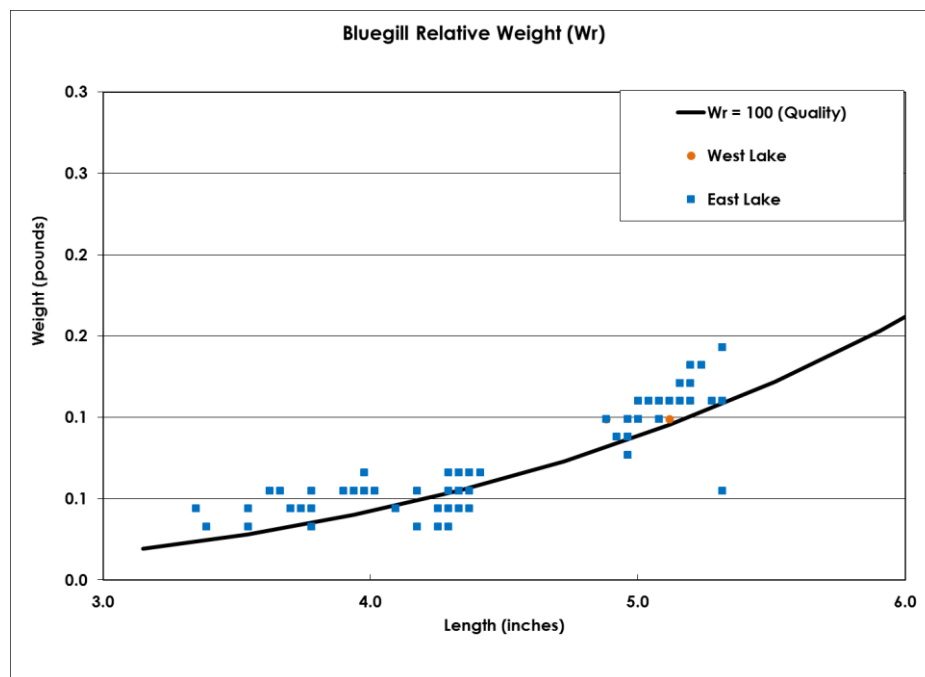
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**Figure 5.** Largemouth Bass relative weight versus length.

In the East Lake, all 148 Bluegill captured all were large enough to determine relative weights (Figure 5). In 2017, the relative weights for the Bluegill ranged between 60 and 184 with an average Wr of 98. In 2019, the relative weights ranged between 45 and 146, averaging 102. This indicates that the relative weight of these fish remains in the same range.

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**Figure 6.** Bluegill relative weights.

In the East Lake, in 2017 the two Black Crappie caught had relative weights 113 and 122 and measured 10.4 and 9.4 inches respectively. In 2019, one Black Crappie was captured measuring 5.7 inches with a relative weight of 100. In 2017, two Black Crappie in the West Lake had Wrs of 114 and 134 and measured 8.9 and 9.3 inches respectively. In 2019, nine Black Crappie captured were large enough to determine relative weights which ranged between 93 and 121, measuring between 5.7 and 11.4 inches. Black Crappie are commonly underrepresented during electrofishing surveys due to their lower susceptibility to the sampling method.

Forage for Largemouth Bass and other sport fish in both lakes consisted of juvenile Common Carp, Fathead Minnows, Bluegill, and Gizzard Shad. Stocking additional forage species regularly is recommended to maintain healthy sport fish development. Each of the lakes had a relative weight above a trophy status. Monitoring fish populations, stocking additional forage species and harvesting fish regularly will help maintain a healthy fishery.

The Common Carp removed had an average length of 16.3 inches and weight of 2.46 pounds. Common Carp should be removed from the lakes when captured to improve water quality and maintain clarity. Manual carp removal techniques during this fishery survey proved to be successful with a total of 88 Common Carp removed from the lakes in 2019 and 1829 Common Carp removed in 2017. In 2017, large quantities of Juvenile Common Carp were captured and removed and in 2019 there were only a few juvenile Common Carp observed. The Common Carp removed this year averaged 16.3 inches and 2.46 pounds. Annual carp removal in the spring is

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recommended. It is important to remove carp as they can minimize vegetation in a resource and create turbid water conditions while stirring up high nutrient sediments.

Another option to help reduce Common Carp populations and increase species diversity is to stock Hybrid Striped Bass (*Marone chrysops X Marone saxatilis*) and/or Tiger Muskie (*Esox masquinongy X Esox lucius*). Hybrid Striped Bass were stocked in 2018 but weren't collected during this survey likely due to smaller size and behavior. This species of fish as they are commonly underestimated or not captured due to preferred deep-water habitat. Monitoring the Hybrid Striped Bass numbers and growth rates will help determine if presence of these predatory fish is likely helping control the rough fish populations or if more should be stocked.

### **Fish Habitat Assessment**

Overall, the lakes have minimal underwater coverage and lake gravel for spawning beds. Proper habitat in the form of dense underwater coverage, gravel beds for spawning, and submerged/emergent plants provide fish shelter from predators. These characteristics also increase spawning potential which helps create a sustainable fishery. Multiple species of aquatic plants were found in both the West and the East Lakes providing underwater coverage. Managing aquatic plants is important to maintain the proper levels and avoid overabundance. Aside from chemically managing aquatic plants, triploid Grass Carp (*Ctenopharyngodon idella*) stocked in the lakes in 2018 appear to be helping to control the vegetation. The habitat is considered to be in 'good' condition. The stacked boulder structures added in East Lake the added additional habitat and many turtles were observed in these areas. Supplementary habitat such as artificial structure or downed timber would improve the underwater environment and provide cover for fish. Additionally, gravel or sand could be added onto shallow sand bars to improve spawning success.

### **Recommendations Summary**

#### **Fisheries**

The fisheries management recommendations are based on our developing and sustain a trophy game fishery. It is understood that adjustments are likely to be made since it is currently a catch and release only fishery.

- Creel limit recommendations:
  - Harvest:
    - Largemouth bass between 8 and 14 inches
    - Black Crappie above 10 inches (unlimited)
    - Green Sunfish (unlimited)
    - Common Carp (unlimited)

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- Regularly stock supplemental forage:
  - Bluegill
  - Fathead Minnows
- Optional fish stocking;
  - Hybrid Striped Bass
  - Tiger Muskie
  - Grass Carp for vegetation control if needed
- Manually remove Common Carp on a regular basis until populations are not negatively impacting water quality
- Conduct surveys every 2-4 years to assess the health and changes in the fishery

#### Habitat/Vegetation

- Add artificial structure or downed timber to improve underwater fish habitat.
- Install substrate such as sand or gravel for spawning in some shoreline area.

#### **Conclusion**

Both of the lakes are currently considered to be exceeding the goals of a healthy fishery and on track to be a trophy fishery. In order to maintain the healthy fishery, harvesting fish is important to maintain populations and predator-to-prey ratios. Currently prey populations are low and additional Bluegill and Fathead Minnows can be stocked. Common Carp should be removed from the resources by manual removal, electrofishing and stocking predatory species.

In addition, Largemouth Bass and Hybrid Stripped Bass are sight feeders, improvements to water quality to reduce nutrients and improve water clarity could increase the forage success on Juvenile Common Carp. Improvements to the water quality would likely help improve the water clarity which would likely improve feeding and growth rates.

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## Appendix A : Fish Pictures and Life History

### 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 pelletized feed, which makes it very straightforward to grow large Bluegill for angling and lots of small fish to feed bass. Bluegill are not only stocked in ponds and lakes as the primary food source for Largemouth Bass, but are also a fun and easy sportfish for kids to catch. In addition to their 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 venter 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 black and sides becoming purple.



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Black Crappie  
*Pomoxis nigromaculatus*

Management Notes: Crappie are a predator species and tend to become over populated, especially in smaller ponds. They compete heavily with largemouth bass for food and can quickly deplete the forage base. If managing for a balanced pond the crappie population should be kept small through regular harvest or removal. If a trophy bass fishery is the goal, as many crappie as possible should be removed or harvested.

Characteristics: The dorsal fin base on black crappie is equal to or slightly longer than the distance from the rear margin of the eye to the origin of the dorsal fin base. The back is usually light gray to light lime green. The sides and venter are lime green with a silvery sheen. Dark mottling is scattered across the body. The dorsal, caudal, and anal fins have several alternating light and dark wavy bands.

Habitat and Biology: Black crappies are less tolerant of silt and turbidity than white crappie and are more apt to be found in clear water where there is abundant vegetation. Spawning season is April to May when the water temperatures are higher than 68°F. Before spawning, black crappie form schools and venture to feed into shallow water where they can be caught in large numbers. Nests are constructed in water 10 inches to 2 feet deep. They are usually built in sandy bottom in weedy areas. Eggs hatch in 3 to 5 days. Young crappie are plankton feeders but older fish feed on insects and fish. Considerable feeding takes place at night. They can live for eight years and grow 12 to 18 inches in length.



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Common Carp  
*Cyprinus carpio*

**Management Notes:** Though native to only Asia, carp are considered a valuable food source in Asia, Europe, and the Middle East. In the U.S. however it is often considered a nuisance. Carp in small waterbodies can greatly reduce water quality by feeding on zooplankton and aquatic vegetation, suspending solids and nutrients into the water column as they feed, increasing algae production and reducing the food available for larval game fish.

**Habitat and Biology:** Common carp are most abundant in large streams and impoundments, especially those made fertile by agricultural and domestic runoff. They can live in waters up to 20 feet deep with cover such as trees or other large structures. They feed mostly in the mud, consuming worms, insect larvae, and plankton. Reproduction occurs from early spring to summer in well-vegetated waters. The adults' vigorous spawning in shallow waters stirs up sediment and causes the water to become turbid. It has been reported that a single female may contain up to 7 million eggs, but the average number of eggs is between 100,000 and 500,000. Because a female releases only about 500 to 1000 eggs at a time, spawning occurs over a long period. Adults become sexually mature in 3 to 5 years. They have a long life span, with one recorded age of 65 years.

**Identification Characteristics:** Unlike the similar goldfish, the common carp has two barbells on each side of the mouth and a long dorsal fin. They have a forked tail-fin often reddish in color and their first dorsal and anal fin spines are serrated. Color ranges from light olive on the back to yellow on the belly. Most heavily scaled fish bronze to golden yellow in color. They typically grow 12 to 26 inches in length and can weigh over 40 lbs.



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Fathead Minnow  
*Pimephales promelas*

**Management Notes:** Fathead minnows (sometimes referred to as toughies) are often the smallest forage fish present in ponds. They bring health and balance to a system by feeding on insect larvae such as mosquitos in small impoundments and drainage ditches. Due to their small size they are easy prey for hungry bigger fish, so if largemouth bass are present, bluegill are a great alternative. They are prolific spawners, with females spawning almost weekly throughout the growing season. They are native to the mid-Atlantic and are less aggressive compared to mosquito fish.

**Habitat and Biology:** The fathead is quite tolerant of turbid, low-oxygenated water, and can be found in muddy ponds and streams that might otherwise be inhospitable to other species of fish. Their diet consists of small invertebrates, detritus, and algae. Spawning occurs in still-water habitats along the shore. In most areas spawning occurs from May through August in calm shallows of streams and along shorelines in ponds. They are nest builders, where the males select and prepare the site defending it from intruders and only allowing persistent females to enter and spawn. Nests are typically located on the undersurface of submerged stones or branches. Females spawn regularly, laying batches of eggs almost weekly.

**Characteristics:** Their natural geographic range extends throughout much of North America. The fathead minnow is generally dull olive-grey, with a dusky stripe extending along the back and side, and a lighter belly. There is a dark blotch midway on the dorsal fin. Breeding males acquire a large, grey fleshy “fat head” during breeding. They average about 3 inches as adults.



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Gizzard Shad  
*Dorosoma cepedianum*

**Management Note:** The gizzard shad is a valuable forage fish in some waters but it can overpopulate and become a nuisance if there are not enough predators to control its population. Gizzard shad compete directly with larval bluegill for zooplankton as food, therefore pelleted feed is recommended to increase the number of bluegill if shad are present.

**Habitat and Biology:** Although individuals occasionally enter large streams, they occur in greatest abundance in open, quiet waters in rivers and reservoirs. Adults are often found near the surface and the young are common around weed beds. They can also endure moderate salinity and high turbidity. Gizzard shad are a preferred food of the largemouth bass and they reproduce rapidly. Mass spawning occurs at night in open waters when the temperature reaches 50° to 70°F, usually in April – June. The tiny adhesive eggs float on the water until they hatch or slowly adhere to the bottom. Depending on year class, the female can lay 60,000 to 300,000 eggs. Newly hatched gizzard shad feed on protozoans and other plankton. After a few weeks, the diet changes to include phytoplankton and algae. They grow faster than bluegill and are easier for bass to swallow, so large bass benefit from shad introduction. The gizzard shad is essentially a filter feeder, but if plankton is unavailable, will switch its diet to bottom feed on detritus (such as leaf litter) and benthic invertebrates.

**Characteristics:** The gizzard shad is the only member of the family with a blunt snout and an inferior mouth. The last dorsal fin ray on both the gizzard and threadfin shad is elongated and whip-like. The ventral edge of the upper jaw is deeply notched. The back is bluish gray. Some individuals may have a greenish or silver tinge overall, as well as several darker, horizontal bars along the sides. The belly is milky white to silver. The color of the vertical fins is variable, from nearly black during spawning season to clear with irregular black blotches in the fall. They typically grow 8 to 14 inches in length.



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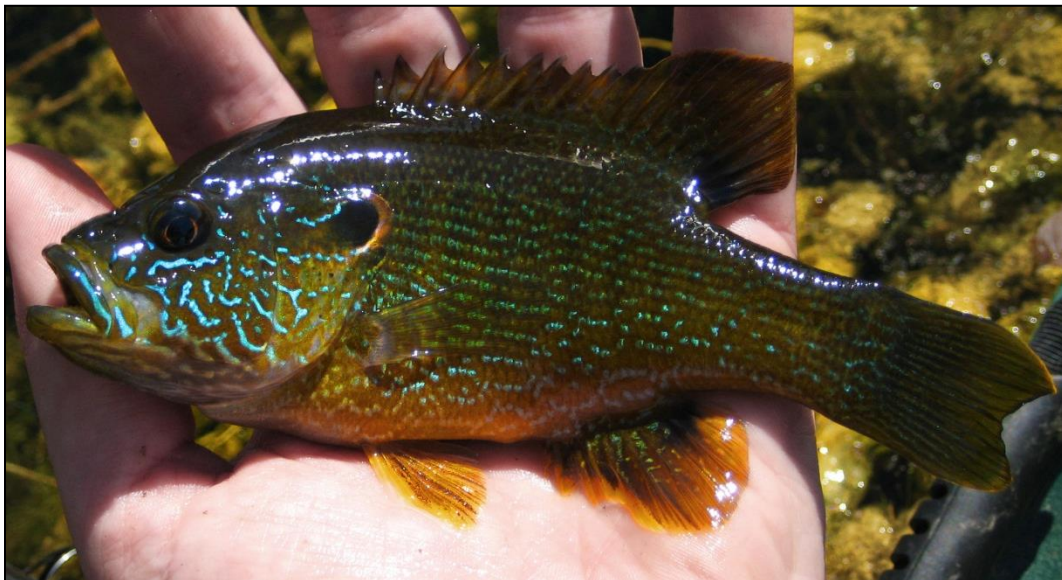


Green Sunfish  
*Lepomis cyanellus*

**Management Notes:** When managing a water body for trophy bass or a balanced fishery, green sunfish are discouraged. Their large mouth allows them to compete with larger fish for prey items, and they feed on the eggs and young of other fishes. If introduced, green sunfish can reduce populations of native species, and alter population structure, relative dominance, and distribution patterns in ponds and lakes. Green sunfish prey heavily on minnows and readily hybridize with other sunfish species.

**Habitat and Ecology:** Green sunfish are native to the Great Lakes, Hudson Bay, and Mississippi River basins of the central US. They are very tolerant to poor water quality and are often the only sunfish found in very muddy waters. The species prefers vegetated areas in sluggish backwaters, lakes, and ponds with gravel, sand, or bedrock bottoms. They feed on aquatic and terrestrial insects and insect larvae, small crayfish and small fish. They do have a strong preference to hide around structure such as rocks, logs, or brush piles. Green sunfish spawn communally, with males constructing nests in shallow water during the spring and summer. Males defend the nest for the three to five days it takes the eggs to hatch and then will try to entice another female to deposit a new batch of eggs in his nest. Males can sometimes be found trapped in their nest if there is a sudden drop in water level because they build their nests so close to shore.

**Characteristics:** They have a moderately compressed body, but are not as deep bodied as bluegill and other sunfish species. They have a large mouth and the upper jaw extends back to the middle of the eye. They also have rows of small iridescent blue speckles on their body.



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Hybrid Striped Bass  
*Morone chrysops x saxatilis*

Management Notes: Hybrid stripers exhibit 'hybrid vigor', meaning they grow faster, are more aggressive, and are more tolerant to environmental extremes than either parent. They are relatively active in cold water, providing an excellent winter fishery when many other warm water fish aren't feeding. In large ponds, they feed in open water on young gizzard shad and can be feed trained to eat pelleted fish food, releasing some pressure off of the forage base.

Habitat and Biology: Hybrid striped bass are not a naturally occurring fish. Individuals are produced by artificially spawning a male white bass with a female striped bass. Hybrid striped bass are commonly released and stocked into rivers, reservoirs, and public lakes. They are considered better suited for culture in ponds than either parent species because they are more resilient to extremes of temperature and to low dissolved oxygen. They feed heavily on shad and grow rapidly, often reaching total lengths of 18 inches or more in two years. Individuals in rivers can migrate great distances in response to changing seasons and flow regimes and they congregate in tail-waters below dams in spring and during high discharge periods. Hybrid striped bass rarely reproduce in nature, but they are known to occasionally back cross with white bass. They can grow 15 to 20 inches in length.

Characteristics: Also called a wiper, hybrids usually exhibit a wide variety of color patterns which can be confusing when trying to separate them from the young of either parent specie. They have a streamlined body with a dark back fading to silver sides and a white belly. As they grow older, hybrid stripers become thicker and deeper-bodied, giving them a distinctive short and stocky appearance. Lateral stripes similar to those of the striped bass are present, but the stripes are generally broken in the area behind the pectoral fin and below the lateral line. Hybrids usually weigh 5 to 10 pounds but can be as large as 20 pounds.



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Largemouth Bass  
*Micropterus salmoides*

**Management Notes:** Largemouth Bass are the most popular warm water sport fish in North America. However, 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 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, although 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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