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BIOL (MSCI) 537

PRODUCTION METHODS

SPORTFISH CULTURE



Commonly Cultured Sportfish

- ◆ Largemouth bass
- ◆ Smallmouth bass
- ◆ Bluegill
- ◆ Redear sunfish
- ◆ Redbreast sunfish



The Sunfish Family

Centrarchidae family

- ♦ Native to North America
- ♦ Includes the **black bass**, **sunfish** (bream) and **crappies** (30 species total)
- ♦ 50 year history of culture in North America
- ♦ Generally require **natural spawn techniques**

The sunfish family (Centrarchidae) includes 30 species, and is found only in North America. This family includes the black basses (*Micropterus spp.*), crappies (*Pomoxis spp.*), and the bream (*Lepomis spp.*), as well as the genera *Ambloplites*, *Elassoma*, *Enneacanthus*, *Centrarchus*, *Archoplites* and *Acantharcus*. This family is one of the most popular and widely known gamefish groups in North America.

Bass, crappie and bream have been cultured for the past 50 years, primarily to provide fingerlings for stocking recreational ponds and lakes, or for use in research.

Black Bass (*Micropterus* spp.)



Largemouth bass
(*Micropterus salmoides*)



Smallmouth bass
(*Micropterus dolomieu*)

The largemouth bass (*Micropterus salmoides*) and the smallmouth bass (*Micropterus dolomieu*) are members of the sunfish family (Centrarchidae) along with breams (*Lepomis* spp.), crappies (*Pomoxis* spp.) and several other genera. Members of the genus *Micropterus* are known as the black basses.

Sunfish (*Lepomis spp.*)



Redbreast sunfish
(*Lepomis auritus*)



Bluegill
(*Lepomis macrochirus*)



Redear sunfish
(*Lepomis microlophus*)

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Crappie (*Pomoxis spp.*)



Black crappie
(*Pomoxis nigromaculatus*)



White crappie
(*Pomoxis annularis*)

Largemouth Bass Reproduction

Water temp: 65-75 °F
(Warmwater)

The ♂ excavates a nest at 2 to 10 feet water depth.

One or more ♀ then deposit 5,000 to 10,000 eggs over the nest.

Eggs hatch in 3 to 4 days.

The ♂ guards the eggs.



The largemouth bass is the most important freshwater sport fish in South Carolina. More time and money are spent in the pursuit of this fish by anglers than any other species. In addition to being an important sport fish, the largemouth bass is an important part of the ecological balance of fish populations. In farm ponds where they are stocked with bluegill and redear sunfish, the largemouth bass are responsible for controlling the bream population through predation. In large impoundments, they serve a similar but different function in preying on shad populations. The largemouth bass is the dominant predator in many of South Carolina's fish populations.

Smallmouth Bass Reproduction

Water temp: **60°F (April – May)**
(Coolwater)

Nest in **coarse gravel** in shallow, protected areas.

Typically around 2,500 eggs per nest. One or more ♀ may contribute eggs.

Eggs hatch in **2 to 3 days**.

Eggs and fry are guarded by the ♂ **up to 16 days post hatch**.



The smallmouth bass both ambushes and prowls for food. It is common for them to feed on food organisms that are dislodged by suckers or turtles as they disturb the stream bottom rooting for food. On a national basis, the smallmouth bass is judged to be a favorite of anglers for its exceptional sport fishing qualities.

Sunfish Reproduction

Water temp: **68 - 84°F** (Late Spring – Early Summer) (Warmwater)

Nest in **sunny, soft mud or sand**.

Very uniform and compact colonies comprised of **40 – 50 nests**.

Typically around **2,000 – 25,000 eggs per nest**. One or more ♀ may contribute eggs.

Eggs hatch in **1 to 6 days**.

Swim-up times range from 2 – 7 days depending on the species.



The bluegill may be the most well known of all the sunfish, and it is certainly the most popular with anglers and consumers. Originally distributed from the Great Lakes south to the Gulf of Mexico, it has been stocked throughout North America as a gamefish. It is equally at home in lakes or streams, but is most abundant in shallow, eutrophic lakes and ponds. The bluegill is identified by its deep, laterally compressed head and body and small mouth. The opercular flap is black, and individuals longer than 2 inches (51 mm) have a dark blotch at the posterior base of the dorsal fin. The sides usually have eight to ten sets of double vertical bars that are chain-like in appearance. Body colors range from olivaceous to purple, with a white to orange belly.

Nest building

- ◆ Males are first to the spawning sites
- ◆ They build and guard the nests in areas of maximum sunlight and generally in shallow water.
- ◆ 2 – 6" deep depressions in the mud or gravel approximately 12" in diameter (species dependent)

Male sunfish generally appear first at the spawning sites and construct nests along the shoreline in unshaded areas (see below) that have maximum exposure to sunlight (Hunter 1963; Avila 1975). Using his tail, the male sweeps a nest using tail undulations (caudal peduncle), making a shallow circular depression in the soft mud or gravel bottom of quiet shallow water.

Production Steps

- ♦ Collect and **stock brood** into spawning pond
- ♦ Allow for **natural spawning** to take place
- ♦ **Collect** fertilized **eggs or fry** from spawning pond (sometimes)
- ♦ Move fry to **fingerling grow out** ponds (sometimes)
- ♦ After growout, **harvest fingerlings**
- ♦ Sell or restock fingerlings for **phase II growout**
- ♦ After growout, **harvest phase II fish**



Fry



Fingerling



Phase II

Preparing Spawning Ponds

- ♦ Ponds should be **drained and dried** to eliminate predacious insects, fish and disease
- ♦ **Limed, disked and planted** in winter rye (organic fertilizer when flooded).
- ♦ **Fill pond** with well or filtered surface water no more than **14 days** before stocking.
- ♦ **Fertilize** before the first spawn.



Ponds should be rectangular, free of obstructions and no more than 6 feet deep to facilitate harvesting. The ponds should be drained in the fall and completely dried to eliminate predacious insects, fishes, and diseases. The pond should be disked and sown to winter rye, which will furnish a source of organic fertilizer following spring flooding. Apply agricultural lime according to a soil test if the pond bottom soil is acidic. Heavy lime applications, over 4 tons per acre, will also harden soft soils and reduce mud and associated toxins in the harvest seine. Filamentous algae commonly interfere with fry harvesting and must be controlled.

Fill the pond with well water or surface water filtered through 52 mesh/inch saran socks. The pond should be filled only a few days (up to 14) before stocking to reduce the buildup of predacious insects. Spawning ponds should be fertilized when spawning activity is first noticed. The goal is zooplankton production (copepods and cladocerans). Zooplankton is produced from organic materials added to the rearing pond or from feeding on phytoplankton. Inorganic fertilizers are usually added to stimulate phytoplankton growth but are not essential if enough organic fertilizers are applied regularly. Some culturists do not use inorganic fertilizer because it can stimulate filamentous algal growth. Others believe phytoplankton blooms, resulting from added nutrients, enhance fry survival because of reduced visibility.

Spawning Pond Management

Fingerling Harvest Method

- ◆ Brood and fingerlings grow together for ~65 days (or more)
- ◆ Expect lots of cannibalism with some species
- ◆ Fingerlings and brood harvested from *spawning pond*

Fry Harvest and Transfer Method

- ◆ Fry transferred to *rearing ponds* when they reach $\frac{1}{2}$ " to $\frac{3}{4}$ ".
- ◆ Brood harvested from the *spawning pond*
- ◆ Fingerlings harvested from *rearing pond*

Hybridization

- ♦ Extremely important to **correctly ID broodstock**.
- ♦ Extremely important to **exclude all other species from the production pond**.



Largemouth Bass Spawning Pond (Two Methods)



Fingerling Harvest Method

- ♦ Stocking rate: **30 to 50 lbs per acre**
 - ♦ 1:1 ♀ to ♂ ratio (by weight); Usually more males
- ♦ Expected fingerling harvest: **20,000 to 50,000**
- ♦ Expected fingerling size: **1.5" to 2" (marketable)**
- ♦ **Expect heavy cannibalism**

Fry Harvest and Transfer Method (most popular)

- ♦ Stocking rate: **Up to 125 lbs per acre**
- ♦ Fry transferred to rearing ponds when they reach $\frac{1}{2}$ " to $\frac{3}{4}$ ".

Stocking rates depend on whether the fingerlings will be sold directly from the pond, or the fry will be transferred to other ponds for further growth.

Fingerling Harvest

Stocking 30 to 50 pounds (10 to 40 fish) of broodfish/acre to produce 20,000 to 50,000 fingerlings of 1.5- to 2-inch (marketable) size in the same pond is commonly practiced in private fish hatcheries. This method requires fewer resources, and less labor and technical expertise. Approximately equal weights of males and females should be stocked, which usually results in a higher number of males. Fingerlings are harvested by seining small schools with a 1/8 inch- mesh seine or trapping and then subsequently draining the pond.

Broodfish are normally left in these ponds until harvest of the fingerlings. Therefore, the broodfish are expected to be in the ponds for about 65 days before being returned to the broodfish holding ponds. Some predation on the small bass by the adults is expected. In addition, the earliest spawns will normally devour any spawns that hatch later. Unless larger fingerlings are to be produced, do not stock forage fish in the spawning ponds as they interfere with bass reproduction and are difficult to separate from bass fry at harvest.

Fry harvest – Transfer to rearing ponds.

If the maximum numbers of fingerlings are desired, the rearing pond technique is usually used. Up to 125 pounds of broodfish per acre are stocked, and the fry are transferred to separate rearing ponds when they are 1/2 to 3/4 inch in length. Other management techniques are the same. When the number of fry being captured becomes economically unfeasible, the ponds are drained and the broodfish transferred back to the holding ponds. The major advantage of this method is that the culturist can take advantage of multiple spawnings. It is critical that even-aged fry are stocked in the rearing ponds to lessen cannibalism.

Typical Largemouth Bass Production in SC

- ♦ Stock brood in **April**
 - ♦ (65-75 °F)
- ♦ Late April/Early May fry are ready for transfer to *rearing ponds*.
- ♦ **Late May** rearing ponds drained and harvested.
- ♦ Fingerlings are **ready for sale or stocking** for grow-out.



Smallmouth Bass Spawning Pond

Use Fry Harvest and Transfer Method

- ◆ Use gravel spawning boxes



Smallmouth bass Broodfish



Smallmouth bass swim-up fry

Swim-up fry are collected early and transferred to rearing ponds.

SMB fry don't school so get them early.



Smallmouth bass fingerlings

- ♦ Artificial and natural food is required for growth.
- ♦ Smallmouth bass grow to fingerling stage in approximately 35 days.



Sunfish (*Lepomis spp.*) Spawning Ponds



Can be strip spawned if needed for research but...

**For Production Hatcheries Use the
Fingerling Harvest Method**

- ◆ Use **2 year old brood** (0.25 to 0.5 lb fish) for best results.
- ◆ Stocking Rate: **20 to 40 pairs per acre**
- ◆ 1:1 ♀ to ♂ ratio
- ◆ **Supplemental feeding** can improve fecundity
- ◆ Sunfish are **batch spawners** producing up to 80,000 eggs per season.
- ◆ Incubation takes **1 to 6 days** at temps above 70°F

In pond spawning systems, broodstock are allowed to spawn freely. One hundred broodfish can produce up to 375,000 fry, with an average of about 100,000 fry per acre (247,000/ha). With good water quality and optimum temperature, broodfish should produce offspring almost immediately. When fry are observed (which should be soon after hatching), begin a feeding program. A fry powder or a mash should be offered at first. As fry grow, the size of the feed can be matched to the size of the fish. With a feeding program, fry should grow as much as 1 inch per month. Fingerlings should reach stocker size of 2 to 3 inches (51 to 76 mm) in 60 to 100 days.

Pond Spawning Sunfish



- ♦ 100 broodfish can produce 370,000 fry.
- ♦ They begin producing almost immediately once conditions are right.
- ♦ Fry can be provided artificial food.
 - ♦ Fry powder or a mash can be offered
- ♦ Properly fed fish can grow as much as 1" per month.
- ♦ In 60 to 100 days fish will be 2" – 3" (stocker size).
- ♦ Harvest these in the fall.

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Phase II Growout



- ♦ Generally require a combination of hand feeding and fertilization (artificial and natural diet)

Black bass

- ♦ Fingerlings immediately stocked back into Phase II growout pond

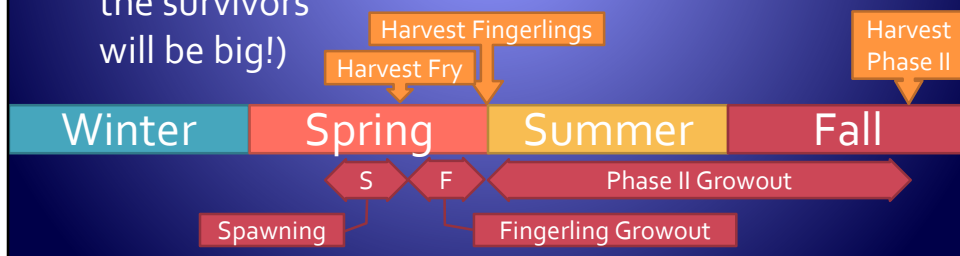
Sunfish

- ♦ Grown from fingerlings held over from the previous year
- ♦ Large enough at harvest to spawn
 - ♦ Typically there are many YOY fingerlings in harvest

Black Bass Phase II Growout



- ♦ Generally require a combination of hand feeding and fertilization (artificial and natural diet)
- ♦ Black bass are piscivores and will eat each other if not well fed (your harvest numbers will drop but the survivors will be big!)



Sunfish Phase II Growout



- ◆ In SC, phase II sunfish are grown from held over fingerlings from the previous year.
- ◆ Generally require a combination of hand feeding and fertilization (artificial and natural diet)
- ◆ Phase II fish are large enough to spawn at harvest.



Age 1+ Phase II and YOY Bluegill



100% return on stocked fingerlings and
14,500 YOY fingerlings at 140/lb

Sunfish Production Notes

YOY Bluegill fingerlings are overwintered in an outdoor raceway

- ♦ Hand feed several times a day based on water temperatures

YOY Redear fingerlings are overwintered in fertilized production ponds.

- ♦ Harvest in the early spring
- ♦ Trained to accept commercial feed (similar to SMB)
- ♦ Very hard to train redear fingerlings to accept feed



Fish Grading

- ◆ Graders sort fish into size groups





Production Steps

- ◆ Natural spawning in a spawning pond
- ◆ Grow out fry in the spawning or separate rearing pond
- ◆ Harvest saleable fingerlings
- ◆ Phase II growout (if needed)
 - ◆ Immediately for black bass
 - ◆ Hold over winter for sunfish
- ◆ Harvest phase II fish

"One gill net produced these really nice smallmouth bass and brown trout today. Many thanks for the great hatchery products!"

- Dan Rankin

