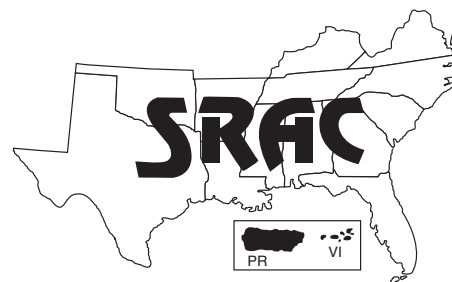


Southern Regional Aquaculture Center



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Forage Fish – Introduction and Species

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Forage fish are stocked in recreational fishing ponds as food for sport fish such as largemouth bass. Early trials found that largemouth bass stocked alone did not grow well, and that an ample supply of small, forage fish was necessary to produce high-quality bass. This publication describes fish species that are particularly suitable for forage.

There are two situations in which stocking forage fish is appropriate. Adding forage fish is a routine, recommended practice when stocking new or renovated ponds (ponds from which the fish population has been eliminated). In the south, bluegill is the best overall forage fish for largemouth bass. Adding some redear sunfish in addition to the bluegill is commonly recommended for snail control, for additional forage, and for additional sport fishing. If ponds are managed properly, sunfish alone will provide enough forage to produce high-quality bass as long as bass are harvested periodically. Bluegill and redear sunfish will grow and reproduce in the pond, creating a long-term food source for predatory fish. In ponds without fish, the typical recommendation is to stock fingerling bluegill in the fall so that they will mature, spawn and provide forage for largemouth bass fingerlings stocked in the spring. Add-

ing fathead minnows at the same time as the bluegill makes food available to bass during the spring before the bluegill start spawning.

Stocking forage fish also may be appropriate when the pond owner wants to provide additional food for predatory fish in a pond with an existing fish population. For example, in a bass-bluegill pond managed for big bass, bass production is often limited by the amount of available prey. Fish such as golden shiners and threadfin shad are added to ponds with existing sunfish populations as additional forage species. Combinations of forage species may also be stocked to increase the total forage base. Fathead minnows and tilapia can be stocked as forage in catfish ponds, but fatheads usually are not recommended for ponds with existing bass populations because they disappear so rapidly. There are trade-offs involved with each of these forage species, so they must be chosen carefully.

Stocking new forage species is not always the solution for underfed bass populations. The problem may be too many bass or competing species such as bullheads or green sunfish. The pond "balance" between the bass and bream populations may need to be adjusted. Or, the pond may need to be managed properly by improving the food supply for fish through liming (if needed) or fertilization.

Unless they are feed-trained when young and maintained on a feed diet, largemouth bass will not consume fish feed directly. However, bass will benefit from the additional production of sunfish and other forage species that readily consume commercial fish feeds.

Determining the need for forage fish, proper forage fish stocking rates, and best management practices is a complex process. Before adding forage fish, obtain farm pond management information from your Cooperative Extension Service and consult with a farm pond professional to seek additional guidance. There are reputable, experienced, private consulting firms that offer complete farm pond evaluation and management services.

Characteristics of a good forage fish

What makes for a good forage fish? It is a species that grows well in ponds, feeds low on the food chain, does not compete with young bass for food, has a small size as an adult, and reproduces prolifically and frequently. It is essential that forage fish be small enough to serve as prey for the desired sport fish. While many forage species will have some overlap in diet with young bass, the key consideration is to avoid competition for food at the same time.

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Another desirable characteristic of a forage fish species is the ability to turn unexploited natural foods in the pond (algae, insects and insect larvae, snails, etc.) into food for desirable predatory fish. The presence of forage fish enhances the growth of bass and can improve their survival through the winter, which is particularly important for young-of-the-year bass. Periodic additions of forage fish such as fathead minnows or golden shiners should increase bass production, but this can be expensive. Laboratory studies have shown that it takes about 4 to 5 pounds of forage fish to produce a pound of large-mouth bass. But in ponds, where forage fish can escape or be lost to other predators, 8 to 10 pounds of forage per pound of bass is more realistic.

Body shape affects the suitability of a fish species as forage, but is less critical than other characteristics. The bluegill is the most important and common forage fish species, but is not necessarily preferred by bass, probably because of its body shape and spines. Bluegill are not highly vulnerable to largemouth bass predation and not easily exterminated from a pond by predators. The fathead minnow has many favorable characteristics as a forage species, but is too vulnerable to predation to serve as a long-term food source. Fatheads are considered a temporary species and their numbers decrease rapidly in ponds with bass populations. Fathead minnows are also too small as adults to be good forage for large bass.

Concerns with forage fish

Adding new fish species to increase the forage base in an established bass-bluegill pond may have unintended consequences. Some fish species compete for the same natural foods as bluegill and can reduce the overall forage base instead of increasing it. For example, threadfin and gizzard shad feed heavily on zooplankton and may reduce food resources for young-of-the-year bluegill. Golden shiners are egg eaters and can reduce bass reproduction. It is also impor-

tant to consider that stocked fish may migrate downstream into other ponds and natural waters.

Forage fish species

The following are common forage fishes in the southern United States. Not all are recommended or permissible in all states. Be sure to check with your state Natural Resources Department for a list of species approved for pond stocking, as regulations and recommendations change over time.

Bluegill

The bluegill sunfish, *Lepomis macrochirus* (also called bream or brim), is the most common forage fish stocked in farm ponds in the south. Adults reach 6 to 10 inches in length. Male bluegill will sweep out a nest in the pond bottom, forming a circular depression. Clusters of these nests are found together in shallow water and are called "beds." Bluegill start spawning in late spring at around 70 °F (21 °C) and spawn periodically until early fall, providing a plentiful supply of small forage. In small, east Texas reservoirs, female bluegill spawned an average of five times over the season. Small bluegill (about 1 inch) do not handle well so it is better to stock larger fingerlings (2+ inches) initially. To reduce predation, additional stockings of bluegill in bass ponds should be limited to fish at least 3 to 6 inches long.

The body is slab-like, deep and flattened, and the mouth is very small. The dorsal (top) fin has a series of 10 (can be 9 to 11) spines in the first half of the fin, followed by a rounded, soft section. The bottom fins (pelvic and anal) also have spines. The pectoral fins are very long and pointed. The short, broad ear flap is a solid dark blue to black, and on fish larger than 2 inches there is a dark splotch at the bottom of the soft dorsal fin.

Coloration is variable, and males and females differ in color, especially in the breeding season. Breeding males become a dark bluish-green with darker, vertical bars; the head has bright blue tones and the breast develops a rusty orange color. Females are lighter in color, with faint vertical bars and a white to grayish-white belly.

Bluegill feed on a wide variety of natural foods, including insect larvae, insects, zooplankton, small fish, fish eggs, snails and crayfish. They also eat some vegetation. Commercial fish feeds can be fed to bluegill. Bluegill are considered to be fine sport fish and table-fare in their own right, and offer additional angling opportunities in farm ponds.

They are native to much of the eastern U.S. (Mississippi River basin, Atlantic and Gulf Slope drainages) and are now common across the continental U.S.

The coppernose bluegill, *L. macrochirus purpureus* (also designated as *L. m. mystacalis*), is a subspecies native to Florida that is raised and sold for pond stocking in much of the southeast. The male coppernose bluegill has a purplish head (jaw and opercles) and a copper-colored band across the head above the eyes that is prominent in the breeding season. Coppernose bluegill have been promoted by fish suppliers as a superior sport fish, and a study found that coppernose bluegill grew larger than east and west Texas bluegill when grown together in ponds. Laboratory tests have shown that the coppernose bluegill has the same cold tolerance as native Texas bluegill.



Bluegill



Redear sunfish

Redear sunfish

The redear sunfish, *Lepomis microlophus*, is often stocked in combination with bluegill. Although it reproduces less prolifically than the bluegill and is not as suitable a forage fish by itself, it eats snails and thus aids in reducing the incidence of snail-borne fish parasites (including yellow, white and black grubs). Common names for the redear sunfish include shell-cracker, stumpknocker and chinquapin. Reported spawning temperatures for redear sunfish vary widely, with several publications indicating that redear start spawning at slightly cooler temperatures than bluegill (68 to 70 °F; 20 to 21 °C), while other literature indicates the opposite. The males generally

construct nests in water deeper than 3 feet and, as with the bluegill, nests are made near each other in colonies.

A redear has a compressed, dark olive body shading to yellow-green or silver on the sides, with dark spots (mottling) and sometimes vertical bars, especially on younger fish. The mouth is small. The short opercular (ear) flap is black with a white border and a red to orange spot on the tip. The pectoral fins are long and pointed; the first dorsal fin has 10 spines and 10 to 12 soft rays.

Redear preferentially feed on snails and small mollusks, but will also consume insect larvae and large zooplankton. Small amounts of vegetation and detritus (decomposing organic matter) are also eaten. Because they feed on the pond bottom, redear sunfish are less likely to consume

commercial fish feeds. Redear sunfish are considered to be an excellent sport fish.

The redear is found throughout the southeastern U.S. (lower Atlantic and Gulf Slope drainages) and west into Texas (Mississippi River basin up to Indiana). It has been intro-

duced into many other states from California to Vermont. It is widely distributed in Oklahoma and Virginia, and there are localized populations in Kentucky and Tennessee.

Fathead minnow

Fathead minnows, *Pimephales promelas*, are also called toughies or flathead minnows. A small, pug-headed fish with a thick, cylindrical body, its normal color is dark olive on top shading to a silvery tan below.



Fathead minnow

A color variant, the "rosy red," was developed by Billy Bland Fisheries of Taylor, Arkansas.

Fatheads usually live less than 3 years and adults are typically less than 3 inches long. In the south, fathead minnows can reach sexual maturity in less than a year and minnows hatched in the spring may spawn in late summer. Males select the undersides of hard surfaces as nests. During spawning, the adhesive eggs are pressed up against the "ceiling" of the nest where they stick and remain to be cared for by the male during incubation. Individual females spawn frequently, about twice a week, during much of April, May and June. Spawning starts when

the water temperature exceeds 64 °F (18 °C), although spawning at 58 °F (14 °C) has been reported. Adding spawning substrate such as wooden pallets or boards to ponds should increase fathead minnow production.

The fathead minnow eats a wide range of plant and animal matter, as well as detritus. Zooplankton and algae are important food items. Fathead minnows will eat commercial fish feeds such as the floating pellets fed to catfish.

Fathead minnows are native to a large portion of North America from Canada south to Alabama, Texas and New Mexico, although the exact native range is unclear. Widely used as a forage and bait species, fatheads are now found in most states in the continental U.S.

Golden shiner

The golden shiner, *Notemigonus crysoleucas*, is the most common bait minnow raised in the U.S. It has a thin, deep body with a triangular head and a deeply forked tail. The back is olive green shading to silver on the sides. Young fish often have a dark stripe down the side. Breeding fish may develop a golden cast to the body; the pelvic fins turn a bright gold (males) or are clear with a gold fringe (females). The maximum size is around 12 inches, but most golden shiners are less than 6 inches long.

Golden shiners scatter adhesive eggs on vegetation or supplied substrates such as hay. No care is given to the young. Spawning starts in the south about mid-April at 68 °F (20 °C) and fish spawn periodically until water temperatures exceed 81 °F (27 °C), typically around the end of June. In one study, a pound of golden shiner brooders was found to produce an



Golden shiner

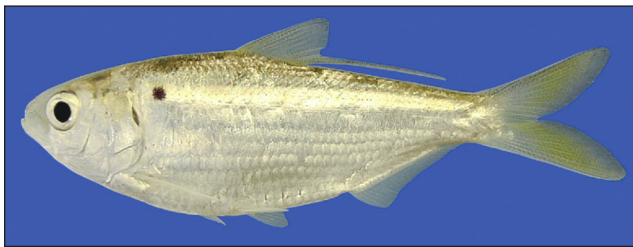
average of almost half a million eggs over the spawning season.

While the principal food of golden shiners is zooplankton (e.g., water fleas and other tiny animals), they will feed on many other food items such as insects, algae, snails and small fish. Golden shiners readily accept commercial fish feeds.

Golden shiners are native to the eastern half of the U.S. and have been widely distributed throughout much of the rest of the country as a forage or bait species. Although they feed primarily by sight, golden shiners tolerate plankton-rich ponds and are found in a wide variety of habitats. Given their small size as adults, their high fecundity, and their omnivorous food habits, golden shiners are considered an excellent forage species despite the fact that they eat fish eggs. In ponds with largemouth bass a golden shiner population usually is not sustainable, so they must be restocked periodically.

Threadfin shad

Threadfin shad, *Dorsoma petenense*, are used as forage fish because they remain relatively small, usually less than 7 inches. Threadfin are a schooling, open-water fish and grow well in productive ponds. Shad are filter-feeders and feed mainly on zooplankton and some larger phytoplankton.



Threadfin shad

Larger threadfin may consume some detritus as well. They eat fish feed only incidentally.

Threadfin do not survive in cold water and usually die in winter outside of the deep South and Florida. High mortalities occur at 45 °F (7 °C), and most fish die at 40 °F (4.4 °C). Abrupt decreases in water tem-

perature are particularly hard on the fish. For this reason, threadfin can overwinter in deeper reservoirs and large rivers in more northerly locations, but are less likely to survive in ponds. The native range of threadfin shad is the southern half of the Mississippi River Basin; portions of Alabama, Mississippi, Tennessee and Texas; and much of Florida. The species has been widely introduced into reservoirs and lakes throughout the Southeast.

Shad are in the herring family; most members of this silvery, slab-sided family live in the ocean. Shad have a sharp, saw-toothed ventral keel (ridge along the belly), shiny scales, and a deeply forked tail. It is important to distinguish between the "look-alike" threadfin shad and the gizzard shad, as normally only the threadfin is suitable for pond stocking. Gizzard shad are considered a problematic species because they grow too large to serve as forage for most predatory fish, and large numbers of big gizzard shad can accumulate in ponds, interfering with the production of other species. Professional pond management services will stock gizzard shad under certain specific conditions to promote trophy bass production, but as a general rule gizzard shad are to be avoided.

Threadfin and gizzard shad both have a thread-like filament at the end of

the dorsal (top) fin, so this thread-like fin does not distinguish the threadfin. The best way to tell the two species apart is that the upper jaw of the gizzard shad extends beyond the lower jaw and has a deep notch in the center. The

upper jaw of the threadfin does not extend beyond the lower jaw and it is not notched. Both species have a dark spot on the shoulder, although it is typically darker on the gizzard shad. Another difference is that the gizzard shad does not have any yellow on the fins, although it may have a distinctive yellow spot in the white

of the eye that is not found in threadfins. The fins of the threadfin usually have a yellowish tint, and the tail fin is often distinctly yellow. The chin and the floor of the mouth of the threadfin have black specks, while there are none on the gizzard shad.

Threadfin shad spawn starting at 67 to 70 °F (19 to 21 °C) and broadcast adhesive eggs over vegetation and woody debris. Prolific spawners, shad mature in less than 1 year and produce large quantities of eggs. The length of the spawning season is variable and spawning can occur over a broad temperature range.

Suppliers of threadfin shad may catch them from the wild, as juvenile threadfin form schools, but threadfin are usually mixed together with gizzard shad. Favorite locations to find abundant shad populations include areas below dams and wastewater treatment facilities. When purchasing threadfin shad, be sure to check the fish carefully to be sure they are all threadfins. Also insist on a fish health inspection, as shad can carry numerous diseases. Shad are delicate and difficult to transport, so some losses are to be expected.

Tilapia

Tilapia is the common name for a number of tropical cichlids. Nile tilapia, *Oreochromis niloticus*, blue tilapia, *Oreochromis aureus*, and Mozambique tilapia, *Oreochromis mossambicus*, are the most common species in the South. These are exotic, non-native fish widely considered to be nuisance species, and many states regulate or prohibit them. It is essential to check with your state Natural Resources Department before obtaining any of these fish. Remember that fish stocked into your pond can and will escape into natural waters.

Tilapias are deep-bodied, spiny fish resembling native sunfish, but they are tropical fish and typically die when the water temperature drops below 50 °F (10 °C) for long periods. However, they thrive in warmer waters in Florida and will overwinter



Blue tilapia

where there are thermal refuges, such as natural springs or heated effluents. Tilapia build circular nests along pond edges and are considered an aggressive species that out-competes native fish species for breeding space.

A major advantage of tilapia is that they spawn frequently throughout the summer and then become easy prey in the fall as water temperatures drop and the tilapia become sluggish. Tilapias are mouth-brooders; the female picks up fertilized eggs and incubates them in her mouth. The number of eggs that can be reared (typically 300 to 1,200 per clutch) is limited by the size of the female's mouth. Thus, although they spawn frequently, relatively few offspring are produced at one time.

Tilapias are very tolerant of low oxygen conditions and will thrive in ponds with heavy plankton blooms. Blue-green algae are common during the summer in nutrient-rich, eutrophic waters with dense algae blooms and surface scums. Though omnivorous, Nile and blue tilapia feed on planktonic algae and, unlike most native fish species, can digest blue-green algae. Thus, these tilapia species can exploit a food source that is unavailable to other fish.

Other species

Other fish species such as silversides (e.g., inland silversides, Mississippi silversides and brook silversides), spot-tail and emerald shiners, rainbow smelt and lake chub have been tested or introduced as forage in certain regions or states. These species are gener-

ally not raised on farms and little is known about their usefulness as forage. Blueback herring and alewife are sometimes listed as forage species, but they are widely considered to be aquatic nuisance species and many states prohibit their possession. Common carp fingerlings, either the wild type or ornamental Koi, are also used as forage, primarily by commercial or government hatcheries. Stocking common carp into farm ponds is not recommended, as carp will muddy the water with their feeding and compete for fish feed. Goldfish are also used as a forage species, but as with common carp, they are prohibited in some states. Goldfish are a disappearing species in farm ponds, as the eggs and fry are consumed by young bluegill. In general, stocking any of these other species for forage is not advisable, and they should never be stocked without the consent of your state Department of Natural Resources.

Summary

Key considerations in selecting and stocking forage fish:

- 1) Obtain knowledgeable advice on appropriate forage fish species for

your pond. Be sure to check with your state Department of Natural Resources to ensure that the fish species you plan to stock are legal in your state.

- 2) Purchase fish from a reputable source and insist that fish have a health inspection. Farm-raised fish are recommended. Fish from the wild can introduce diseases and parasites into your pond and shipments of wild fish often contain other fish species. These "hitchhiker" and "look-alike" species can ruin the fishing in your pond.
- 3) Use care in transport and stocking. Follow recommendations to slowly acclimate fish, giving them time to adjust to the pond water temperature and differences in water chemistry.
- 4) A number of these forage species will not be able to maintain reproducing populations in farm ponds under intensive bass predation and will need to be restocked periodically.

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Photographs

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