

## Teacher reading

# Bonefish



**Bonefish are predominantly schooling fish that feed in shallow habitats, such as seagrass meadows and sand flats.**

**B**one fish (*Albula spp.*) are one of the world's most exciting and challenging shallow-water recreational fisheries. Anglers stalk various bonefish species in shallow-draft skiffs called flats boats, or wade after them where they feed in water that is sometimes less than shin deep. Anglers must make a delicate, pinpoint presentation with a fly, lure or natural bait, such as a shrimp or crab; otherwise these incredibly wary and speedy fish will flee the flat, leaving a "rooster tail" of wake as they go.

As their common name suggests, bonefish aren't targeted for food except in developing nations. Dead, they are worth little. Alive, each fish is a major economic driver. The passion for bonefishing with fly rods and other light tackle supports a major global travel, boat-building and tackle industry - one that generates well-paying jobs and vital local and regional tourism revenues. Some iconic destinations are: southern Florida; The Bahamas; Turks & Caicos; Cuba; Puerto Rico; the U.S. Virgin Islands, Belize; Mexico; the Seychelles; Hawaii; and Christmas Island. Greater public education and ongoing research are imperative if we are to protect these economically and ecologically vital species.

The name "bonefish" is given to multiple species in the same taxonomic family. Thanks to advances in genetic research, scientists have discovered multiple species with regional distributions around the globe. As many as 11 species and subspecies are now recognized, but there may be more species remaining to be discovered. For example, the roundjaw bonefish (*Albula glossodonta*) and the smallscale bonefish (*Albula oligolepis*) occur in the Indian Ocean and parts of the Pacific. And for most researchers and anglers fishing in the northwestern Atlantic - in the waters in and around The Bahamas, Florida, the Gulf of Mexico, and the Caribbean Sea - *Albula vulpes* (or the "white fox" as it is known) is the species of greatest interest. At least three other species occur in those waters, and one other species, the roundeye bonefish (*Albula gorgonia*), is encountered and targeted specifically in the southern shallows of Florida's Indian River and Lake Worth lagoons. Our lessons will focus on *Albula vulpes*, because it is the most popular, valuable and best understood species in the western North Atlantic.

## Ontogeny

It's often and accurately stated that in nature everything's connected - coastal and marine aquatic habitats included. For example, air and water currents, water chemistry, and geology (to name a few natural forces) create linkages between habitats including seagrass meadows, coral reefs and the blue pelagic ocean. So do animals. It becomes most evident how these different habitats are closely connected when observing the migration routes of a fish throughout its life cycle. As fish grow in size and age, their needs change; this growth over a life cycle is referred to as ontogeny. Small fish are most easily eaten by other fish, and therefore need to live in areas with lots of places to hide and access to small food. Larger fish need less protection, larger food, and access to mating opportunities. Therefore, they move on to new habitats that meet these needs. The ontogeny of bonefish is particularly complex, making them a fascinating model to study.



**A large spawning aggregation heads offshore to reproduce.**

Bonefish, especially *Albula vulpes*, are specifically targeted in clear, shallow waters called "flats" that consist of coral back reef flats, or sandy and/or grassy areas often bordered by mangrove shorelines. Thus, anglers think of the species as solely occupying shallow water. However, *A. vulpes* requires a variety of inshore, nearshore and offshore habitats at various life stages. Like many marine fishes, the bonefish's life cycle or "life history" connects diverse, important habitats.

As with all life, bonefish exist to perpetuate their species. Bonefish reach sexual maturity between ages three and four and can live as long as 23 years in some regions. Individuals spawn many times in the course of their lives.

During spawning season - roughly November through April in the Western North Atlantic - adult bonefish assemble into large groups called "spawning aggregations" before migrating offshore to release their sperm and eggs. There's evidence of "site fidelity" to pre-spawn rendezvous locations called "pre-spawning aggregation sites," meaning that the same fish often return to the same pre-spawn locations year after year. Bonefish schools that typically forage in different areas around the Caribbean all meet in strategic locations, resulting in mixed schools that number in the thousands of fish. The locations are usually next to a channel that offers quick access to the open ocean.

Protecting pre-spawning aggregation sites, and spawning aggregation sites - (the latter are still unknown for bonefish) - is essential if we are to conserve these extremely valuable resources. Efforts are underway to identify pre-spawn and spawning aggregation sites. For example, researchers with Bonefish and Tarpon Trust (BTT) and fishing guides working on Andros Island, The Bahamas, recently identified a new pre-spawning aggregation site - raising the total known number of such vital locations to six in The Bahamas. The fish were gulping air and porpoising, behaviors that signal an imminent departure to offshore spawning grounds, typically around the full and new moons between October and April. There is a video of this behavior included in our online materials.

It is not known where exactly bonefish spawn offshore, or what the cue(s) are for the fish to release eggs and sperm using a strategy known as "broadcast spawning." But early research using ultrasonic tags on bonefish in The Bahamas strongly suggest that spawning takes place offshore - likely in places where and at times when currents are most likely to spread fertilized eggs to ideal settling

locations that enable larval bonefish to survive. Bonefish do not waste any energy building nests or caring for their offspring. They simply gather in large schools and more or less simultaneously release their eggs and sperm together to be fertilized in the currents that will carry those zygotes off - hopefully toward juvenile habitats.

Lunar phases are a key element in spawning success. Bonefish spawn around the new and full moons, when currents are stronger and tides more extreme. Stronger tides can carry the gametes farther. Post-larval bonefish settle in sand- and mud- bottomed bays where they mix with other silver species. It is a safety-in-numbers strategy.

## Bonefish Larvae

Bonefish spend about 40 to 70 days in a leptocephalus larvae stage, an ancient survival strategy employed by tarpon (*Megalops atlanticus*) and myriad eels. In fact, bonefish and tarpon are much older species than most species pursued by modern anglers. Bonefish fossil ancestors date back to the Cretaceous Period, more than 140 million years ago toward the end of the dinosaur era when the oceans were much warmer and more acidic.

Their translucence served them well in those acidic times; it continues to provide them protection in the clear and relatively barren tropical oceans of today. It may serve them well in the future as our

oceans become more acidic again due to oceans' abilities to absorb human-induced carbon dioxide emissions - the same gases causing global climate change. Acidic waters cannot supply sufficient minerals for calcifying animals that rely on plants such as sargassum - an algae that floats in the open ocean which provides cover for a myriad of marine life including many species of fish, shrimp and crabs, all of which have a more difficult time forming their calcareous skeletal structures. So, larval bonefish survive hidden in plain sight by their translucence.



**Bonefish leptocephalus are thin and translucent as a camouflage during their open-ocean**

## Early Juvenile Stage

Bonefish offspring undergo a three-step process of metamorphosis as they settle in bay bottoms. Early in stage one, when the animal is less than 30mm, leptocephali lack dorsal, anal and pectoral fins. Late in stage one, those fins appear as the larval animal reaches its maximum size of about 63mm. During stage two, larvae shrink rapidly to about half their original length. The anal and pectoral fins move forward and the snout projects beyond the mandible. During stage three, scales appear, followed by pigmentation and crossbands. At stage three, bonefish are officially "juveniles."

Early juvenile bonefish are incredibly vulnerable to predation, pollution and sedimentation - the latter creating turbidity and undermining their ability to find food. They also tend to be more dependent on specific types of habitat than at any other life stage. This vulnerability and habitat specificity is not unique to bonefish; newly settled tarpon require small, shallow and relatively low oxygen creeks in marsh/mangrove ecosystems. Such creeks are too shallow for predator fish to access. They're also low in dissolved oxygen, so other species have a difficult time breathing in the low-oxygen environment, while juvenile tarpon have the ability to breathe air. Such creeks are also often covered by vegetation, which blocks the views of birds. And, they are full of the types of food that juvenile tarpon prefer, such as amphipods, copepods and shrimp, as well as mosquito fish that

provide nourishment once the tarpon are able to catch more mobile prey. Researchers have found that early juvenile *A vulpes* settle and grow as juveniles in sandy or muddy bottomed, protected bays of a few feet deep or so - typically close to channels for larval access. Learning more about such habitats are high research and conservation priorities. We cannot protect the species without protecting bonefish nurseries.

## Juvenile Bonefish

Juvenile bonefish prefer mud/sand bottoms in calm bays where they are well-camouflaged and don't have to work too hard to catch the food they need to grow.

## Large Juvenile Bonefish & Sub-Adults

Though researchers aren't quite sure why, large juveniles and sub-adults live mostly on open sandy bottoms in deeper water than where anglers tend to fish for adults. Large juveniles and pre-adults dominate many of the large 'muds' of bonefish. Muds are large areas, often an acre or more, of muddy water that is caused by feeding bonefish as they root into the bottom in search of prey, suspending sediment in the water.



**Silver scale and dark green streaks help the bonefish blend in on the grass flats where they feed.**

## Adult Bonefish

Except in pre-spawn and spawning modes, adult bonefish spend most of their lives in intertidal flats, man- groves, and creeks. Often congregating in schools of 1 00 or more, bonefish generally follow a daily pattern of coming up onto the flats as the tide rises and retreating to deeper water as it falls. Water and air temperatures, as well as the availability of prey, influence their feeding patterns. Larger bonefish tend to travel in twos or threes, and the trophy specimens are solitary. Bonefish feed by digging through the sandy bottom to root up prey, which are crushed in the fish's powerful pharyngeal teeth. They also feed on small fish and epibenthic species.

