Mudfish on the Menu?
Rise of the Much-Maligned Bowfin

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Cajuns call it "choupique" (say "shoe-pick"), from its Choctaw name. Elsewhere, it's the dogfish, blackfish, grindle, cottonfish, or cypress trout. Its official common name is "Bowfin" (*Amia calva*)[1]. But to most anglers, this is the "mudfish," a strange, unusual, and much-maligned fish, most everywhere considered a useless trash fish. One look and the words relict, prehistoric, primitive, and living fossil come to mind. Indeed, the bowfin is the last of its line, the sole-surviving species of a very ancient group of fishes. Its predecessors flourished in the Jurassic and Cretaceous periods during the Mesozoic (= Middle-Animal) Era, a great expanse of geological time. Yes, as commonly noted, the mudfish is a holdover from the age of the dinosaurs, 60-150 million years ago. Other equally ancient holdovers among freshwater fishes are its very distant cousins, the gars, and the sturgeons and Paddlefish, all equally antique, all unique and unusual, all northern hemisphere fishes. All three watched *Tyrannosaurus* come and go. They withstood the tropical Mesozoic, then dramatic global cooling when the Atlantic Ocean began to open 80 million years ago, and again when ice held much of Europe, Asia and North America in the chilling grip of the Pleistocene Ice Age for 2.6 million years. All three antique fishes witnessed the evolution of grasses, flowering plants, and woody trees, as earlier forests of fern trees and giant horsetail rushes disappeared from northern continents. Bowfins, gars, and sturgeons outlasted the sabretooth tiger, the wooly mammoth, Nethanderthal man, and will most likely outlast the human species – if we do not drive them to extinction first (we have already done in or pushed to the brink five of the world's 26 sturgeon species, and one paddlefish[2]). But, back to the dinosaur comparison. In proportion to its size, the mudfish is armed with a wicked set of long, sharp, curved teeth on nearly every bone in its mouth. If scaled up to dino dimensions, its teeth would closely resemble, and rival the size of those of many meat-eaters dinosaurs. And – the mudfish also sports the thickest, densest skull bones of any fish – armored like a dinosaur as well. It is an elegantly designed predator and survivor indeed.

Native to North America, the mudfish ranges from the St. Lawrence River and the Great Lakes to Florida – found just about anywhere in the eastern half of the U.S., Minnesota to southeast Texas. This is a lowland fish, absent from the Appalachian and Ozark mountains. While favoring clear water with dense vegetation, the mudfish can also handle dark swamp waters and muddy rivers. A tough customer, the Bowfin can thrive equally well in frigid waters under Canadian winter ice, or in the mid-summer 90-degree water of steamy southern swamps.

Viewed with disdain by most anglers (but long a favorite in Louisiana), mudfish hauled in while fishing for more noble fare like Largemouth Bass were routinely thrown up on the bank to die. Back in the 1970s, the banks of Tamiami Canal in South Florida were littered with mudfish carcasses, a boon for vultures and other scavengers. Some states even had an official policy of mudfish removal or eradication, even though this is a native species. Lately, however, the mudfish has gained in

esteem as a feisty gamefish, a great fighter worthy of respect. There is even a mudfish anglers association, the "Bowfin Anglers Group"[3], which touts the bowfin as "America's toughest sportfish." The lowly mudfish has also come into favor on the dinner table as well, a tasty menu alternative – not only in Louisiana. And, over the past two decades, it has also become prized for its large black eggs, which make high-quality caviar selling for $10-$15 per ounce.

A voracious predator, the mudfish is the king of its local realm. It gets big – up to nearly three feet long and twenty pounds (world record 21.5 pounds). Don't let that habit of lulling around, or undulating the dorsal fin in slow motion fool you. The mudfish is no slacker. A lion among fishes, this is a fearsome ambush predator, striking with a lightning-fast forward lunge, securing its prey with formidable teeth and powerful jaws. It will eat nearly anything from crayfish to catfish – and will mangle your hand if you let it. But a high-energy strike is not always called for. An opportunist, the mudfish will adjust to the occasion. When "minnows" or tadpoles are schooling along the riverbank or the edge of a pond, a large mudfish can sometimes be seen working the shoreline, swimming forward slowly, capacious mouth yawning periodically to gulp down a whole group of hapless victims. When the mouth is suddenly opened and the gills flared, powerful suction is created – an ancient feeding adaptation in the bowfin, later re-invented and refined in modern fishes like the largemouth bass and groupers. Large eyes suggest that visual feeding is the rule. However, bowfin also feed nocturnally – with prey detection undoubtedly facilitated by a complex system of motion-sensing lateral line organs arrayed in tiny pits over the head. It also has large nasal rosettes.

A special adaptation of the mudfish is its ability to breathe air, a legacy of evolution during the tropical climate of the Mesozoic, and an essential ingredient of its competitive success. Back then, lakes, ponds, and swamps frequently became stagnant or reduced to mudholes. Like most other fishes, the mudfish normally uses its gills to obtain dissolved oxygen from the water. Those gills are unique, specialized to deal with low oxygen. But, the mudfish has another fallback when dissolved oxygen drops near zero. When that happens, the mudfish shifts to breathing air directly, coming to the surface to gulp for a refill periodically. Its gasbladder, used by most modern fishes simply to adjust buoyancy (like a SCUBA diver's buoyancy compensator – or BC), doubles as a lung in the bowfin. A duct connects the foregut to the gasbladder, and the lining of that organ is packed with a myriad of tiny blood vessels that absorb oxygen. As a result, the mudfish thrives in places where few other large fishes can survive, including stagnant backwater channels, swamps, and small ponds. It can even survive brief periods totally encased in damp mud. Much like the lungfish, the mudfish appears able to hibernate for a while, waiting for the water to return. No modern fishes can match that ability.

One more remarkable adaptation completes the unique mudfish package – accounting for the name "Bowfin." Maneuvering in close quarters and in heavy vegetation can be a problem, especially for a large fish. But nature has provided the mudfish with an elegant solution. By undulating its long dor-

Formidable Fang-like Teeth of the Bowfin

sal fin in sinuous waves, the bowfin can swim forward or backward with equal ease and with mesmerizing stealth. It simply reverses the direction of the fin wave to shift from forward to reverse. It can also scull in place with similar wave-like undulation of the caudal fin. This stationary tactic is good for just hanging around without much effort and for hiding in plain sight, looking much like a submerged log. But real power is required for those lunging predatory strikes, mouth open, teeth bared. On such occasions the long, thick body musculature drives the fish forward in a sudden burst. However, the rounded caudal fin reveals that the bowfin is not built for a sustained chase – just for short-range strikes.

Mudfish romance and reproduction is a complicated spring affair. Depending on latitude, and proper water temperature (61-66º F), mudfish spawn from late February through June. Excavated by the male, a circular depression, up to 2-3 feet across is cleared of debris to expose clean, hard substrate. Weed beds and roots are then matted down to complete the nest. To advertise his amorous intentions, the male mudfish sports a brilliant emerald green color, with yellow and orange highlights. If the female is not impressed by either the nest or the resplendent display of color, the male will prod her with chases, nudges, and general rough-housing. Mudfish love is not a gentle affair, nor is it monogamous. Male and female will pair up, lying side by side as the eggs are laid and fertilized. But one and done is not the rule. When the first female departs, the male will approach another lady and repeat the sequence. Eggs are adhesive, sticking to hard substrate. Guarded continuously by the aggressive male, the eggs hatch in about 8-10 days. But the larvae, equipped with an adhesive gland on the forehead, remain glued to the nest for another 8-10 days (an odd adaptation also found in gars). No need to eat just yet – the large football- shaped yolk sac provides nutrition while the mouth and digestive system develop. When finally unglued, hatchling mudfish form schools, still guarded by the vigilant male until they are about 3-4 inches long. Then, the school breaks up and individual fish venture forth to lead solitary lives. Hatchlings feed on tiny planktonic invertebrates such as water fleas and midge larvae, but later switch to a fish and crayfish diet. Feeding voraciously and growing rapidly, mudfish reach a length of about one foot in their first year. They live 10-15 years maximum, but few will survive beyond age five. Sexual maturity comes at age 2-3.

The long undulating dorsal fin of the Bowfin

When landed after a tough fight, a played-out mudfish generally looks a monotone dull gray with indistinct markings, and a whitish belly. But, in life, the mudfish displays a color pattern varying from dramatic dark lines on the head and wavelike markings along the body and through the dorsal and caudal fin, to a mottled or reticulated pattern designed for camouflage over vegetated substrate. Breeding males color up with splashes of yellow and orange on a lateral field of green, and a contrasting belly ranging from bright white to turquoise. Juveniles of both sexes bear a characteristic large black spot on the upper caudal fin base. In adult males, this spot is typically ringed in yellow or orange. But, the spot normally disappears in adult females – or if present, lacks the outer ring. The spot recalls the similar black spot of the redfish (red drum), in roughly the same location. The mudfish "eyespot" probably serves a dual purpose. In small mudfish, it may serve as a predator startle device – fooling a potential predator into thinking it has encountered a big foe. Or

is may serve as a decoy. A predator, thinking it is striking at the "head" may be tricked into attacking the tail – and fooled as the mudfish escapes in the "wrong" direction. The prominent yellow-ringed spot in adult males is probably used for sex recognition during mating.

Want to try angling for mudfish? Cut bait is the ticket for this meat-eater. Want to learn more mudfish angling methods? Check out that " Bowfin Anglers Group" website. A large mudfish will fight fiercely and, when landed, this slippery critter will be hard to hold onto. Watch out for those sharp teeth! In Florida bowfins can be found along vegetated river banks, in quiet areas among the lily pads, in backwaters far upstream, and sometimes in vegetated spring runs. When you reel one in, either keep it alive until ready to cook, or filet the fish and put the filets on ice right away. If you let the flesh sit out and get warm, or just gut the fish and throw it into the frying pan, you'll quickly learn how the "mudfish" got its name. Without proper preparation, the mudfish can indeed taste muddy. Along with sharks, lungfishes, and a few other ancient fishes, the mudfish has evolved a unique way of dealing with toxic metabolic wastes. In the tropical climate of the Mesozoic world, freshwater lakes and ponds often dried up. Converting wastes to urea evolved as a nifty adaptation to detoxify nitrogenous wastes in the blood, also preventing fouling of the local pond with urine. The urea trick has been elaborated most elegantly in lungfishes, which store high concentrations of urea in the blood, enabling them to hibernate for long periods of time. The mudfish does not go quite so far. But, it does neutralize toxic ammonia by converting it to urea before excreting that urea to the environment, just as sharks do. In any event, urea in the blood and muscles makes for a nasty taste in fishes. So, as the first step in getting mudfish on your menu, it is a good idea to bleed the fish just like a shark, soaking the flesh in freshwater thereafter to wash out urea. Fileting to remove the fat-laden backbone, then cutting out the fatty belly meat is also recommended.

OK, so you have caught a nice big Bowfin, fileted it, and iced it down. Now – how to prepare this fish for the table? Fortunately, there are lots of recipes out there already. Start by revisiting that "Bowfin Anglers Group" website again[3]. There you will find recipes for everything from Cajun fried choupique fish cakes, to Bowfin stew, pickled Bowfin, and mudfish tacos. If you land a gravid female laden with black eggs, you can try preparing your own homemade caviar – using essentially the same cleaning and salting process used to prepare sturgeon caviar[4]. Don't want the mess and bother? You can find "Bowfin" caviar online, but do not search using the unsavory name "mudfish". Be prepared to shell out about $50 or more for that 4-ounce tin of Bowfin caviar - plus more for the refrigerated overnight delivery. There is an unfortunate flipside to the recent (late 1980s) discovery that mudfish eggs make fine caviar. Generally considered a "rough" fish, and long unregulated in state commercial and sport fisheries, the lucrative mudfish caviar fishery has rapidly depleted the species in many areas. Harvest for caviar has driven mortality rates in Louisiana and the upper Mississippi River to 35-58%[5], unsustainability high. A few states have now imposed sportfishing harvest regulations or commercial harvest bans to protect the Bowfin from overfishing.

If you find the prehistoric Bowfin to your taste, don't go whole hog. As a top predator, the mudfish naturally accumulates mercury and other heavy metals. A big old mudfish can carry a heavy dose of mercury. The state of North Carolina has warned that children and expectant mothers should never consume Bowfin, and that healthy adults should limit bowfin meals to two per month. Sure, go ahead put the newly appreciated mudfish on your menu – but just not too often!

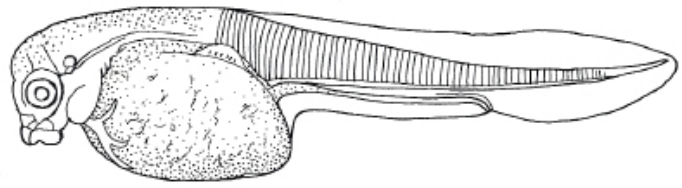
1 Robins, C. R. 2004. **Common and Scientific Names of Fishes from the US and Canada. Sixth Edition.** American Fisheries Society Special Publication No. 29, Bethesda, MD,183 pp.

2 Alabama sturgeon, European sturgeon, Syr-Darya Amu-Darya, and Dwarf sturgeons in eastern Asia, and the Chinese paddlefish.

3 www.bowfinanglers.com

4 http://blog.kitchenmage.com/2005/10/homemade_caviar.html

5 Koch, J. D., M. C. Quist, K. A. Hansen, and G. A. Jones. 2009. Population dynamics and potential management of bowfin (*Amia calva*) in the upper Mississippi River. **Journal of Applied Ichthyology** 25:545-550.



Newly-hatched yolksac larva of the Mudfish