Spawning the "Green" Banded Darter

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Banded Darter distribution in North America. Map Source: NatureServe. 2013. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. Note: Map error in west-central Minnesota. The species does not occur in Mustinka and Otter Tail River systems.

The color green. Ever common among our terrestrial surroundings within our trees, green hills, and green grasses. Within the world of aquatics there is also an abundance of green shown in aquatic vegetation, algae, and green bottoms. With the affinity for many fish to mimic their surroundings it seems somewhat puzzling why there are so relatively few fish that possess a truly intense green coloration. Certainly some fish exhibit certain amounts of green but very rarely to the degree shown by the subject of this article, the Banded Darter *Etheostoma zonale*. In fact, a fair number of darter species have adopted high intensities of green coloration to blend with their surroundings, and for the age-old process of impressing and courting females.

My introduction to the Banded Darter came under some less than normal circumstances. John Bondhus, the first president of the then newly-founded North American Native Fishes Association, had taken this young man (I was 12) fish collecting on a scenic western Wisconsin river. With a 25-foot seine, we seined through rapids that contained an abundance of aquatic plants. The water flow was so turbulent that at times the seine was pulling us backwards! That's not the way it's supposed to work. Needless to say, collecting was very difficult and exhausting. After some determined perseverance we beached the seine ashore and caught a fair assemblage of the native ichthyofauna, but what really stuck out like a sore thumb (should I say green thumb!) were some vivid green-banded fish. A closer look revealed that they were darters, but what species? John and I were not familiar with the species.

Banded Darter habitat Cannon River Goodhue County, MN - Konrad Schmidt

Eventually, we did identify them as the Banded Darter. Those specimens we collected in mid-May apparently were in premium nuptial coloration as females were quite rotund with eggs, and males exhibiting bright colors. With fish in hand now, how would they adapt to captive maintenance? Would they maintain their bright colors? Could spawning take place in captivity? The latter question would not be answered until 18 years later.

Darters are known to be a bit difficult to keep and the Banded Darter has a reputation of being one of the most difficult to maintain. Bandeds have an affinity for strong currents and, perhaps most important, they require regular feedings of live food. Tubifex and white worms, brine shrimp and daphnia, all make good live foods; frozen brine shrimp, glassworms, and bloodworms make a good intermediate diet. While Banded Darters will readily consume frozen foods, they slowly wither away unless live food is included in their diet. Perhaps captive-bred fish will adjust to a more amenable diet. One way, aside from a rich diet, to coax Banded Darters into optimal color is to supply their aquarium with an abundance of plants, preferably broad-leafed plants positioned near an outward water flow. Aside from the plants being a part of their natural habitat, the Bandeds will attempt to mimic the green of the plants, therefore enhancing the color of the darters.

The Banded Darter has a fairly extensive range, which is apparently expanding due to introductions and possibly water diversion projects. Bandeds range from the Ozarks and Tennessee northward to upper Wisconsin and central Minnesota. From Tennessee the Bandeds range northeasterly through the Ohio River Valley and then through the Susquehanna River Drainage on the Atlantic slope, which is a recent introduction (see map on page 26). A southern population of Banded Darter that formerly had been regarded as the same species, is now known as the Bigeye Darter *E. lynceum*. It ranges within the coastal plain drainages from Terrapin Creek of southern Kentucky to extreme southwestern Alabama. Apparently, this species is absent from the lower western Mississippi coastal drainages. The habitat of these two species varies somewhat with the nominate form living in larger creeks to medium-sized rivers which have gravel, rock, and even boulder bottoms. Generally, there is an abundance of aquatic mosses or algae and/or numerous aquatic plants. The Bigeye Darter, on the other hand, tends to frequent streams where swift runs are created by fallen timber and aquatic plants grow over gravel and sand bars. In Wisconsin, I've caught Bandeds in streams up to three-feet deep in streams void of plants to dense beds in strong currents.

All previous spawning reports of Bandeds state that they deposit their eggs within strands of algae and mosses (Miller and Robison 1973, Pflieger 1975). It would also seem reasonable to speculate that they also utilize aquatic plants as spawning sites. On several occasions I've collected very ripe females and colorful males within shallow riffles of *Potamogeton* with no notable algae or mosses present. The forthcoming captive spawning details also presents this possible alternative spawning site.

In the spring of 1990, I prepared the Banded Darter's spawning tank. The substrate consisted of a black and green colored gravel mixture. *Ambulia* and *Hydrocotyle* comprised the aquatic vegetation and was the most utilized spawning site. Algae covered the rear and sides of the aquarium though it never grew into the filamentous form in which Banded Darters prefer to spawn in nature. As luck would have it, the only two Bandeds I possessed

were, indeed, male and female. Atypical of many darter species, Bandeds display very little sexual dimorphism and therefore, until spawning began, I did not know if all this tank preparation would be in vain. Females often do have larger abdomens and do, more often than not, display subdued coloration. A generous amount of aeration was provided simulating the strong currents of their natural habitat. Food items offered to promote spawning included frozen bloodworms, live brine shrimp, whiteworms, and occasionally mayfly larvae. Prior to the move to their spawning tank, the Bandeds may have been spawning in the community aquarium, because the brightly colored fish frequently visited and lingered in the aquatic plants.

In early May of 1990, the two Bandeds were released into their breeding tank. The newlyweds settled into their new home rather quickly and within days were exhibiting spawning activity. The male exhibited vivid bands of emerald green with his head also embossed in green. The female was not lagging behind in color either and she showed signs of swelling, albeit slightly.

The female initially resisted the male's spawning attempts, but a week later she began accepting the male's advances. The female would frequent areas where egg deposition would take place. As is the case for most darter species, the female chooses the spawning site though males will establish loose, moving territories.

When the female remains within the breeding site, spawning soon commences. Upon seeing the female remaining stationary, the male swims about excitedly and will position himself close to the female. Approaching from behind, the male mounts her from behind and begins rapidly vibrating in order to induce egg laying by the female. Some of the positions were quite acrobatic taking place on the aquarium glass, upside down in the gravel, or in the vegetation on the underside of leaves. During each spawning pass, both parents were in motion swimming and releasing one to three eggs. Because of the generous utilization of spawning sites, an estimate of daily eggs laid could not be assessed. Most of the spawning took place in mid-May at a water temperature of 58°F.

The primary attachment sites for eggs included *Ambulia* leaves and the rooted segments of *Hydrocotyle* plants. As previously indicated, the Bandeds were not too picky in regards to spawning sites. Several eggs laid on the aquarium glass provided an accurate estimate of hatching time, which took 14 days at temperatures ranging from 56°F to 62°F. In early June, the parents were removed from the spawning tank. Within 24 hours post-hatching, the fry appeared to have absorbed their yolk sacs. Immediately after this absorption, the fry can readily consume freshly hatched brine shrimp. Typically, fry of more primitive darter species swim pelagically into the same swift currents the adults inhabit.

For darters, the fry grew rather quickly and the banded pattern became discernible within two months of age. At three months some green was already evident on the fry, particularly around the head and first anterior bands of the larger fry. At six months the fry showed green throughout most of their body, and at one year were showing signs of maturity which coincides with observations of scientists who study southern populations. More northern populations in Wisconsin were noted not to mature until their second year (Lutterbie 1979). At one year the fry have attained a size of one-and-a-half inches, which approximates about half their expected adult size.

Forty-five young were produced in this first batch, but production could have been easily quadrupled since eggs were being produced prior to pre-spawn conditioning and well past the parent's removal. The acceptance of baby brine shrimp immediately after hatching made raising this species relatively easy. Hopefully selective captive breeding will produce even more colorful fish plus yield specimens more adaptable for the average aquarist.

Konrad Schmidt

John Bondhus and Jenny Kruckenberg kicking Banded Darters into a seine held stationary in swift currents of the Cannon River

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Zumbro River (Wabasha County, MN)

Root River (Olmsted County, MN)

North Fork Whitewater River (Douglas County, MO) + ***P_w I_rsj_***