FUNDULUS NOTTII, A STARHEAD TOPMINNOW

Charles Nunziata

Within the subgenus *Zygonectes* of the genus *Fundulus,* there is a super species group known as the "Starhead Topminnows," which includes *Fundulus blairae* (Western Starhead Topminnow); *F. dispar* (Starhead Topminnow); *F. escambiae* (Russetfin Topminnow); *F. lineolatus* (Lined Topminnow); and *F. nottii* (Bayou Topminnow). According to Ghedotti and Grose (1997), this super species group has been confirmed through a molecular biology analysis.

The subgenus *Zygonectes* includes a number of other *Fundulus* species, some similar to the starheads, and some significantly different in color and size. The other members of *Zygonectes* are *F. chrysotus, cingulatus, euryzonus, luciae, notatus, olivaceus,* and *rubrifrons.* Among these, *F. luciae,* a brackish water fish that inhabits an enormous coastal Atlantic range, is the most divergent from the others.

There are a few distinctive markings shared by all the starhead topminnows: a dark blue to black bar under each eye, suggesting a teardrop pattern; a large well-defined gold spot on the top of the head; and a small gold dot at the dorsal fin insert. They are all commonly shaped and sized as well, with similar fin locations and proportions. There are variations by sex and species in the pattern of stripes and rows of dots that appear on the flanks, and these differences are the main identification factors. The body pattern differences are well summarized in Page and Burr (2011).

They are all excellent pond species suitable to the southern regions of the US that do not experience hard freezes or prolonged periods below 40°F. Natural populations tend to be seasonal, breeding outdoors between late spring and late summer. One can expect pond populations to continue over many generations.

Because the starheads are not flashy, they were never popular in the killifish hobby. They have an elegant look

Male *Fundulus nottii* (wild). Autauga Creek, Prattville, AL. (Photo by Mike Jacobs)

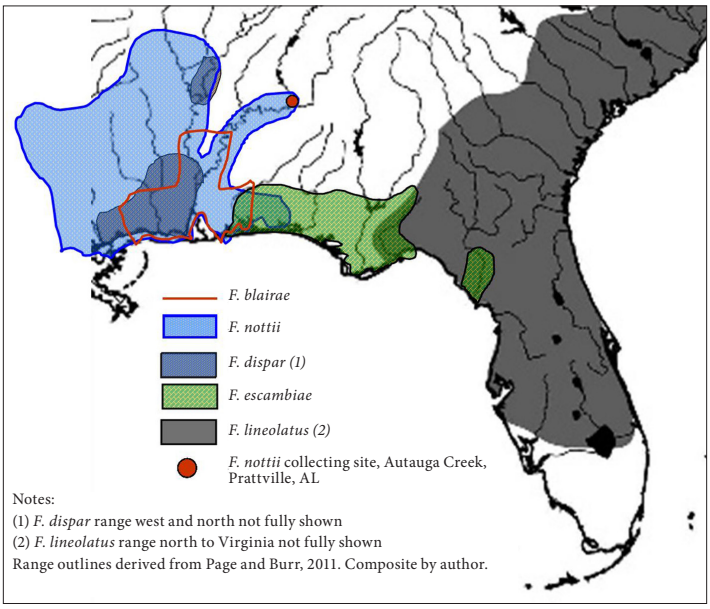

Figure 1. Starhead Topminnow Range Map.

Photos and graphics by the author unless otherwise indicated.

Charlie Nunziata has been an active aquarium hobbyist for more than 55 years, specializing in killifish and North American native fishes. A founding member of the Long Island Killifish Association (NY) and the Suncoast Killifish Society (FL), he is a life member of the American Killifish Association, and has been honored by that organization several times. He is NANFA's Florida representative and chairs the AKA Conservation Committee and the George Maier Fund, a non-profit that issues grants supporting the conservation and study of killifish.

Charlie has published in the *Journal of the American Killifish Association,* several European killifish journals, *American Currents,* and commercial publications. He coauthored the *Florida Collecting Guide,* a valuable resource for anyone collecting Florida's native and exotic fishes.

He has been married for 56 years, has two children, and hangs out with Dude, a very active cat that is always interested in helping out in the fish room.

Western Starhead Topminnow (*Fundulus blairae*). Rolling Fork River, Sevier County, AR. (Photo by Dave Neely)

Starhead Topminnow (*Fundulus dispar*) female (top) and male. Stoddard County, MO. (Photos by Lance Merry)

Russetfin Topminnow (*Fundulus escambiae*). Lake Morality, FL. (Photo by Isaac Szabo)

Lined Topminnow (*Fundulus lineolatus*) female (top) and male. Hopkins Prairie Lake, FL. (Photos by Nate Tessler)

about them, nicely proportioned fins, and in some species, dramatic markings as well. When well maintained, they will exhibit subtle hues of green and blue. All except *F. blairae* take easily to the aquarium, and given a good diet and clean water, will thrive in both species-only and community tanks housing non-aggressive and environmentally similar species. Although I've maintained and bred all but *F. blairae*, this article will focus on a recent collection of *F. nottii*.

F. nottii was discovered in 1854 by a Dr. Nott (for whom the species is named), and the well-known biologist, Louis Agassiz (Agassiz 1854). One sometimes sees the species name "*notti*", with the last letter dropped, especially in older literature, but the correct spelling is *nottii* with the double "ii", conforming to the original spelling in the Agassiz description. It is found from the Mississippi delta (western Lake Pontchartrain) and mouth of Mobile River on the Gulf Coast, and well inland in Louisiana, Alabama, and Mississippi. This range overlaps that of *F. dispar*, *F. lineolatus*, and *F. escambiae* (Figure 1), but sympatry has only been reported with the non-starheads, *F. chrysotus* and *F. olivaceus* (KilliData, 2016).

Once acclimated to their new environment, *F. nottii* makes a good aquarium fish, has no exotic requirements, and is easily maintained. Adult size is 2.75 inches, females slightly smaller. A pair will thrive and breed in a 10-gallon aquarium. It is a known jumper, especially when startled, so a secure cover is a necessity. This species tends to lay just below the upper plant cover, with occasional forays to the bottom in search of food.

Water conditions for adults and fry are not critical. They are found naturally in neutral to alkaline conditions, but appear to tolerate a wide range in captivity. Cleanliness is important for full health and vitality, but well-maintained box or sponge filtration is adequate; more elaborate filtration is not required. *F. nottii* prefers calm water, so set a low to moderate air flow through the filters and avoid roiling the surface. Although this species tolerates low temperatures, a range of 70°F to 80°F is best for indoor maintenance, with breeding activity declining remarkably below that range. Seasonality is less prevalent indoors but activity is slower in the winter months, even in a temperature and illumination controlled fish room.

A dedicated species-only aquarium provided with a thick layer of floating plants is recommended to propagate *F. nottii*. The floating mat will provide a subdued and secure environment that brings out the colors of the fish, promotes a more natural behavior, provides cover for fry, and reduces the tendency to jump. A bottom substrate is not important, but if one is desired, use clean sand or fine gravel.

Plant choices are many. Larger plants such as Water Sprite (*Ceratopteris thalictroides*) left unplanted, will provide both cover, and dense mats of descending roots. For surface plants, the smaller species are preferred; the fern *Azolla*, the always popular and attractive *Riccia flutens,* and any of the duckweeds, especially the mid- and large-sized species that often provide hanging roots. Although duckweed species present a maintenance issue, the plant is a valuable element in *Fundulus* maintenance.

Like most native fishes, *F. nottii* will eat all feed stocks, live, frozen, and dry, with a preference for live swimming foods. When live brine shrimp, daphnia, or copepods are offered, F. *nottii* will chase and strike as soon as the prey item is within range, and not wait for the food to come by as would a dedicated ambush predator. Even foods that quickly sink to the bottom will be eventually consumed.

Healthy, well-fed *F. nottii* are easily bred using either of two generally employed methods. The so-called "natural" method allows the adults to breed in the plants and allow the resulting fry to remain with the adults. This method is a common option for those who don't want to pick or handle eggs or provide separate quarters for fry. It is a virtually work-free approach to breeding killifish, but will not produce quantities of fry, and in the case of *F. nottii*, very few. This is because fry hatch at different times and over the long term, and the adults and a small number of surviving juveniles will consume the vast majority of smaller and newly arriving fry. Although only a few young adult fish will ultimately result, many hobbyists are quite comfortable producing just enough progeny to continue the species.

The more common method involves collecting and incubating eggs outside the breeding aquarium. All the non-floating plants are removed from the aquarium, and one or more artificial spawning mops, constructed of strands of nylon knitting material, are added. The construction of artificial spawning mops is well documented on the internet so they need not be repeated here. The mop should be fitted with a float and made long enough that it spreads a bit across the bottom of the tank. Killifish eggs are easily retrieved for incubation, and if retrieved within days of being spawned, relatively like-sized clutches will result, reducing size disparities, and cannibalism among the fry.

The downside to aquarium husbandry is that the female is always in close proximity to the male, and in these unnatural circumstances, spawning does not necessarily occur at the optimal time, or result in the greatest number of eggs. In the wild, fish breed as nature moves them, an evolved process that likely has the greatest chance of success. Among killifish, females approach a ready male when she has a full complement of eggs, maximizing the probability of producing viable embryos in the shortest and least stressful amount of time. This behavior is not of course exclusive to killifish.

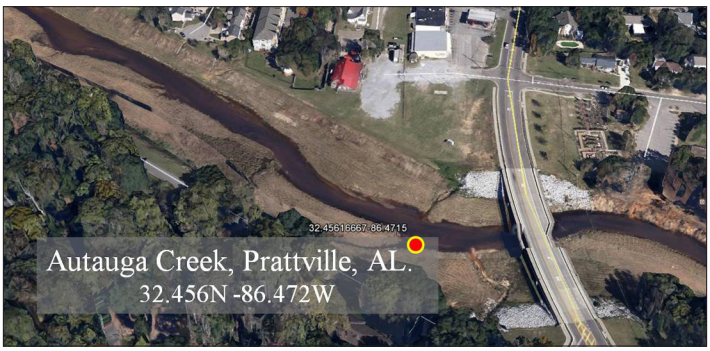

Figure 2. Autauga Creek, Prattville, AL.

Conditioning the breeders prior to spawning is a strategy that can, in part, counter the shortfalls inherent in the closed aquarium environment, and decades of experience propagating captive fish shows that it does. But because this method requires extra effort and physical resources, it is primarily used in the killifish hobby to propagate new or particularly rare species.

Pre-conditioning is straight forward. Prepare a small tank to specifically house the spawning event, and fit it out with a filter, plants, or spawning mops, and water from the breeder's tank. Separate the breeding stock and feed generous portions of live or high-quality foods for a week or more. This will bring the pair into peak readiness, and they will begin to spawn shortly after introduction to the spawning tank. Spawning will be vigorous and relatively continuous until the female is emptied of eggs. Remove the adults when spawning activity slackens or when the female seeks cover from the male. Do not feed at all during the spawning process.

F. NOTTII: A WILD COLLECTION AND SPAWNING ACCOUNT

The subject *F. nottii* were collected during a Central Florida Regional Group trip in the Spring of 2016. It was at a wide area of Autauga Creek, in the city of Prattville, north and west of Montgomery, Alabama (32.456N -86.472W. Figure 2) where group members caught several specimens of *F. nottii.* Other species caught there included the ever-present Eastern Mosquitofish (*Gambusia holbrooki*), and the Banded Pygmy Sunfish (*Elassoma zonatum*). This area is at the most northern and eastern limits of the species' range, representing a rare opportunity for our Florida-based group to obtain this species.

Figure 3. Collecting *F. nottii* at Autauga Creek, Prattville, AL.

The habitat was difficult with deep mud and rancid conditions, presumably due to the slow-moving Autauga at this point and time of year (Figure 3). Several *F. nottii* specimens exhibited fungus-like patches on the body and fins when pulled from the water, a dangerous situation, which required remedial action. All the *F. nottii* were isolated and a few tablets of Furanase® added to their water. Six individuals survived the trip back to my fish room, all thin, with four exhibiting the fungus-like infection. All were treated as noted in the appendix at the end of this article, and all symptoms of the disease were eventually eradicated. Nonetheless, two of the four infected fish died within a few months.

The two that did not show any signs of infection turned out to be a pair; male 2.5 in, female somewhat smaller. They were housed in a standard 10-gallon aquarium, overhead florescent light, sponge filter, a thick layer of large duckweed, patches of Java Moss (*Vesicularia dubyana*), and a typical killifish mop. Water temperatures ranged between 74ºF and 80ºF, pH 7.8 to 8.2, TDS 550 ppm, and 50% water changes were made every two weeks. As expected, the pair preferred the upper reaches of the aquarium, remaining just below the thick plant layer, and only forayed to the lower levels when searching for food.

Their diet was rich in live foods: brine shrimp, newly hatched and adult; chopped blackworms; and white worms. These feedings were occasionally augmented with frozen bloodworm, daphnia, and adult brine shrimp as well as a mix of high-quality flake and freeze-dried foods.

Although eggs were observed in the mop on several occasions during normal maintenance, they were only collected once to study survival and to obtain rearing incubation and rearing information. The eggs were large and firm, typical for the starhead group, about 2+ mm (.085 in) diameter and clear. The mop was examined to assure that no fish were caught up in the strands, then firmly squeezed to remove as much water as possible. There is no need to be delicate; healthy eggs are very difficult to break. It is much more difficult to see eggs in a wet mop than a damp one. The mop was splayed flat on an absorbent material, and illuminated from above; eggs will shine and be easily discovered as the strands are separated.

Fundulus eggs are typically found in the upper third of the mop, jammed in the tight areas around the float and even on the float above the water line. However, of the 11 eggs found, 7 were concentrated in the mid-center of the mop, an area not known to be preferred by the species. Two eggs were found in the upper reaches and two eggs at the ends of strands on the bottom. This atypical placement of eggs implies that many other eggs were likely spawned and subsequently consumed.

Eggs were picked with the fingers and placed in a shallow container with water from the spawning tank (Figure 4). The incubating eggs should be checked daily, infertile ones removed, and all the storage water replaced with fresh water from the spawning tank. These daily water changes will eliminate the need for fungus-suppressing chemicals. Note that because the chorion is clear, one can easily observe the entire embryo development process, itself an interesting and educational process. Fertility rates are high and a high percentage of fertilized eggs will hatch.

Most *F. nottii* eggs will hatch in two weeks or less at temperatures in the mid 70's°F. Prepare an aquarium to receive the fry when the eggs are near hatching. It should be no larger than 2.5 gallons and fitted with a small sponge filter with the air source set to low flow. Add live plants for cover

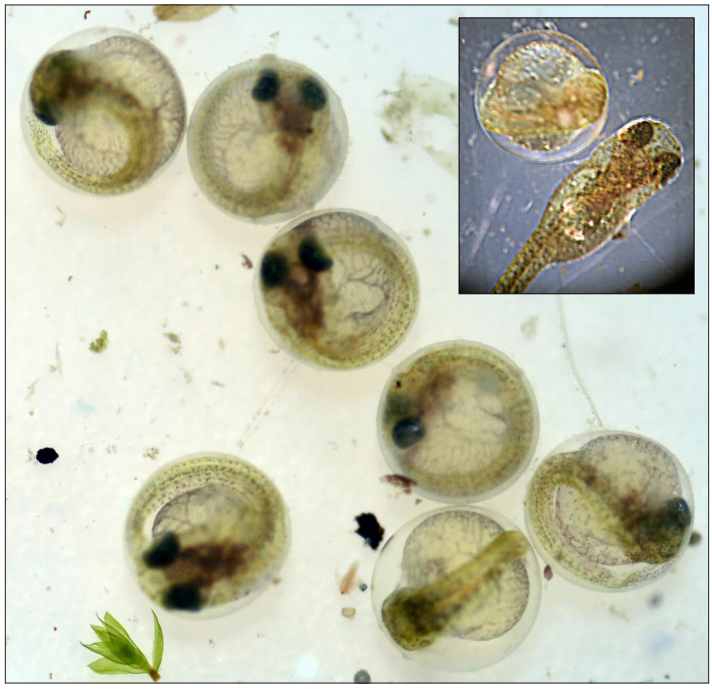

Fig. 4: Incubating *F. nottii* eggs. Inset: Newly hatched fry.

and to keep the water fresh, and add snails to clear away uneaten food. Remove the fry as they hatch with a dropper or pipette, and place them in the prepared aquarium. They are, as expected, quite large, about 0.25 in, silvery and largely transparent, and prefer the upper half of the aquarium. They actively swim about the tank and immediately take all small live foods. Newly hatched brine shrimp is an ideal first food, and for the first few weeks, feed twice a day if possible. Feedings once a day thereafter is adequate. After feeding, the pink stomach filled with shrimp will be noticeable. Finely chopped frozen food can be added to the diet after a month or two. Some breeders introduce a finely crushed high-quality flake at this time, while others rely exclusively on live and frozen foods until the juvenile stage when dry foods are easily taken.

Despite the heavy feeding, growth is relatively slow compared to other killifish, but quite normal for *Fundulus*. As they grow, the fry should be moved into larger and larger quarters to promote a normal growth rate. Raising to adulthood is without challenge, but it will take up to a year for them to reach adult size.

Don't pass up the opportunity to collect *F. nottii*, or one of the other starhead species. They are all elegant, interesting, and although sometimes a challenge to establish, are well worth your effort. Once settled in, you will find them an interesting fish to maintain and propagate. And despite their wide distribution in nature, they may well become the "rarest" fish in your collection.

APPENDIX: COLLECTING-INDUCED INJURIES AND FUNGUS-LIKE INFECTIONS

Virtually all starhead stocks are taken wild, and the collecting process is inherently traumatic, not only because of the enormous change in environment and water quality the fish experience, but also for the physical damage resulting from our handling. One cannot, for example, net a fish without causing at least some minor damage to the mucus layer, fins, or other body parts. Injuries open the fish to disease, and among native fishes, minor wounds, even ones not visible, can blossom with a fungus-like infection within a day or two of capture. These outbreaks are often more prevalent and more severe when specimens are taken from less than pristine conditions, e.g., hypoxic, sediment-filled, low flow, or stagnant sources. In the worst of these environments we sometimes find specimens exhibiting these fungus-like patches when caught.

Some species or groups appear to be more susceptible to these outcomes than others. I've found *Fundulus* species to be among the most sensitive in this regard, with *F. blairae*, in particular, notoriously susceptible to the development of fungus-like infections after capture. The Central Florida group has collected dozens of *F. blairae* on different collecting trips and in nearly every case, most were lost within weeks to an unidentified fungus-looking infection. Typically, a few individuals survive after a month-long application of Furanase®, as directed. Full vitality never seems to be restored however, and damaged fins most often will not regenerate, leaving the fish permanently disfigured.

The infections are referred to as "fungus-like" because our group does not possess the expertise to diagnose it. But whatever its true identity, it is virulent and contagious. I once inadvertently passed it to a lot of the African annual killifish, *Nothobranchius guentheri,* who all succumbed within weeks. I expect it can be passed to domestic stocks of just about any species in your fish room. As a result, even where there is no evidence of infection, consider all collected native stocks suspect; keep them and the utensils and nets used in their maintenance isolated for a few weeks. Some people therapeutically dose collected fish with Furanase® or similar medication prior to exposing them to other stocks. With these cautions, this disease can be managed and prevented from spreading, and need not interfere with the responsible collecting and husbandry of native fishes.

References:

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Killi-Data: www.killi-data.org. Note that this is a subscriber based service.

Google Earth: https://www.google.com/earth/