The Tennessee Cave Salamander, *Gyrinophilus palleucus*

Skip Kendrick, 2007

Five hundred million years ago, Tennessee was a warm shallow sea filled with brachiopods, bryozoans, crinoids, trilobites, bivalves, sponges and echinoderms, whose fossilized remains form the limestone of Middle and East Tennessee. In Middle Tennessee sinkholes, springs, siphons, and karst windows are plentiful. The area is called the Central Basin and is composed primarily of limestone (the official state rock of Tennessee) with some dolomite, which readily forms submerged solution and fracture caves. The bedrock was laid down in the Ordovician Period some 450 million years ago and is now known as the Nashville Dome. Middle Tennessee today contains more submerged caves than nearly anywhere else in the world, although not as spectacular as those found in Central Florida in terms of water clarity and size. Middle and East Tennessee are considered a world-wide hotspot of salamanders! The greatest variety of species occurs in the Great Smokey Mountains National Park and the general area of the Tennessee Valley.

Salamanders evolved about 350 million years ago, and are amphibians. They typically are found living under decaying vegetation or rocks in or near streams, springs, grottos, and pools. They have moist porous skin and a lizard-like tail, no claws and cannot survive unless near moisture. Salamanders are nocturnal, hunting at night for worms, insects, and snails. There are more than a hundred species of salamanders in the United States. They can be classified as river-dwelling, creek and stream salamanders, nearly aquatic, predominantly aquatic, and terrestrial with aquatic larvae, rock-face inhabitants, spring inhabitants, swampy inhabitants, wet seepage inhabitants, pond-breeding inhabitants, and cave inhabitants. They range in size from the tiny (1-2 inches, 2.5 – 5cm) to the large (3-4 feet, ~1m). They typically live for 10-15 years, but some, like the Hellbender, may live as long as 25 years. Aquatic and semi-aquatic salamanders deposit eggs in water, typically breeding pools without fish (which eat them and the eggs). Some

leave after breeding, but some build nests and guard the eggs. The young are fully aquatic in a larval stage for a few months to 2-3 years. Several aquatic species exhibit external gills, which is typically indicative of the larval stage when they are fully aquatic. The Tennessee Cave Salamander, *Gyrinophilus palleucus,* is phaedomorphic (remaining in the larval stage all its life).

The Tennessee Cave Salamander is a small long-bodied salamander, 4-8 inches long (10-23cm) with large feathery red gills blooming out from just behind its head. It was designated the Tennessee State Amphibian in 1995. It is listed as "threatened" by the Tennessee Wildlife Resources Agency (TWRA), but has no special status according to the U.S. Fish and Wildlife Service (USFWS). In addition to Tennessee, the salamander can also be found in limestone cave systems with streams in Northern Alabama and Georgia. To date small populations (20-100 individuals) have been verified in 20 cave sites, half of them new sites extending the known populations to Warren County, Marshall County, and Maury County (in Tennessee). Other locations in Tennessee, such as Snail Shell Cave in Rutherford County and Big Mouth Cave in Grundy County, have long been known habitats.

The Tennessee Cave Salamander eats a variety of small invertebrates (e.g., crayfish, isopods) and sometimes other salamanders. Oddly, they do not appear to hide under cover as much as other salamanders, with research showing that about 25-30% of those found were under rocks, the rest were out in the open. It is not known why this is, but I suspect it has to do with the cave system (being in a cave is much like being under a rock already) and reduced predation (less need to hide under rocks - although crayfish are the major predator and are abundant in these caves). The Tennessee Cave Salamander has very small eyes and poor eyesight, typical of cave-adapting animals (eyes tend to disappear over generations due to relaxed evolutionary pressures). Current data suggests that the population of Tennessee Cave Salamanders is increasing in Middle Tennessee. They are apparently doing well despite the increasing population and development.

Habitat degradation is the primary threat to salamanders, which occurs from increasing herbicide and pesticide loads, silt, exhaust run-off from nearby roads, all of which are related to increased development and urbanization. However, there is virtually no data on water quality in submerged caves and cave streams in Tennessee.

Newly discovered cave systems (Three Sisters and Cow Pie Sink) in Rutherford County, Tennessee, has turned up several sightings of larval aquatic salamanders. The red feather gills are a notable feature hard to miss in even the smallest salamander. However, it is not know if these are populations of the Tennessee Cave Salamander, *Gyrinophilus palleucus,* or the more populous Cave Salamander, *Eurycea lucifug,* which is similar in appearance, but more of a darker brown color, than a light orange or red. These two populations have been found 300-1200 feet inside the fully submerged caves, and at depths from 18 feet to 60 feet. If they are the more common *Eurycea lucifug,* then they presumably will not remain in the larval stage, but will metamorphose into adults and leave the submerged cave for the cave pool and stream (at present, only *Gyrinophilus*

palleucus, is known to remain larval even to reproduce, and thus have no need to develop lungs to breath air).

We are hoping to identify the species of salamander in these two systems and through DNA analysis link them to nearby populations (or show them to be distinct populations). Although salamanders are abundant outside of fully submerged caves (cave streams, spring runs, cave pools, etc.), comparisons of behavioral differences between those inhabiting fully submerged caves and those in cave streams and open streams would be interesting, especially in light of the already observed differences in the use of cover by these different groups. Further, salamanders, like frogs, have wet porous skin and are thus early indicators of environmental degradation; especially water quality. Studies correlating water quality to various illnesses and skin diseases of the salamander would provide the basis of monitoring these cute little cave critters as an early warning sign. Indeed, the two species that spend a good deal of their lives in the submerged caves, 100's and 1,000's of feet inside, would make especially good indicators of ground water quality and possibly the type of surface-source contaminants.

Sources for additional reading:

1. Miller, B.T. and Niemiller, M. L. (2007). The Tennessee Cave Salamander: Distribution, Demography, and Phylogenetics. Final Report to the Tennessee Wildlife Resources Agency, Nashville, Tennessee.

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3. No author. (2007). Nearctica: The Natural World of North America. Website located at http://www.nearctica.com. Salamander pages at http://www.nearctica.com/nathist/amphib/newtlist.htm.

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