

HUTCHISON, VICTOR H. 1966. *Eurycea lucifuga*. Catalogue of American Amphibians and Reptiles, p. 24.

***Eurycea lucifuga* Rafinesque**
Cave salamander

Eurycea lucifuga Rafinesque, 1822:3. Type-locality, "near Lexington," [Fayette County, Kentucky]. Holotype not known to exist. Collector, a "Mr. Crockett."

Spelerpes lucifuga: Rafinesque, 1832:22, 63. Transfer of *Eurycea lucifuga* to *Spelerpes*.

Eurycea longicauda lucifuga: Mittleman, 1942:105. Reduction to subspecific status under *E. longicauda*.

Gyrinophilus maculicaudus Cope, 1890:966. Type-locality, "Brookville, [Franklin County,] Indiana." Holotype not known to exist. Collector, E. R. Quick; date not known. On the grounds that *E. lucifuga* was a synonym of *E. longicauda* and hence not available, Cope erected a new name for the cave salamander.

Spelerpes maculicaudus: Hay, 1891:1135. Transfer of *Gyrinophilus maculicaudus* Cope to *Spelerpes*.

Spelerpes maculicauda: Blatchley, 1897:125. Change in ending to conform with gender of *Spelerpes*.

- CONTENT. No subspecies are recognized.

- DEFINITION. Adult females average about 62 mm and adult males about 60 mm in snout-vent length. Total lengths for adults are about 125 to 181 mm. The tail constitutes about 63 percent of the total length in adults; tails are proportionately shorter in the young. Ground color is usually reddish, varying from yellow (especially in young) to bright orange-red. The venter is yellowish, usually with little pigment, and is unspotted. Black spots scattered irregularly over dorsum and sides of body and tail form no distinct pattern. In the similar species *E. longicauda* the black pigmentation of the tail forms vertical markings. The head is relatively broad and flat and the eyes well-developed.

- DESCRIPTIONS. Eggs laid under natural conditions are up to 5 mm in diameter and are attached singly by a pedicel to the bottom of submerged rocks in cave streams (Myers, 1958a). Each egg consists of a white vitellus 2.4-3.0 mm in diameter that is closely bound by a vitelline membrane and surrounded by two translucent outer envelopes. The outer envelope consists of a peripheral layer of jelly; the inner envelope of a fluid layer. Seven eggs obtained by pituitary implants (Barden & Kezer, 1944) are similar to those found by Myers (1958a), except for a smaller size and lack of attachment. The egg laying period is apparently long, possibly from October to May, but this may vary widely in different populations.

Newly hatched larvae measure approximately 10 mm in total length and are apparently quite helpless, especially in swift water; this might prevent survival in swift streams (Myers, 1958a, 1958b). Young larvae are sparsely pigmented dorsally with gray chromatophores. There are three longitudinal series of small light spots on each side; the upper series is near the middorsal line; the second, dorsolateral; the third, between the insertions of the limbs. A broad tail fin arises near the hind limbs and extends around the tip of the tail to the vent. In older larvae the pigment becomes concentrated into black spots like those of the adults. Maximum total length of larvae is approximately 58 mm.

Adults are slender with a ground color varying from dull yellow through orange to bright orange-red. Numerous round or oval black spots about 1 to 3 mm in diameter are scattered over the dorsal and lateral surfaces of the trunk and tail. These spots may form a dorsolateral series on each side of the trunk and enclose a broad median stripe with a few smaller spots. Young individuals are usually more yellowish. Large adults tend to have darker sides with enlargement and fusion of the lower spots. Ventral surfaces are yellow and unspotted. The tail is subquadrate in cross-section and accounts for 52 to 68 percent of the total length with large individuals having proportionally longer tails. Adults attain a maximum snout-vent length of 69 mm, with males averaging about 60 mm and females, 62 mm. The maximum total length recorded is 181 mm in two specimens (Hutchison, 1956). The head is relatively flat with large eyes. The diameter of the eyes is approximately equal to snout length. The head is widest immediately behind the eyes, the sides converging to a truncated snout.

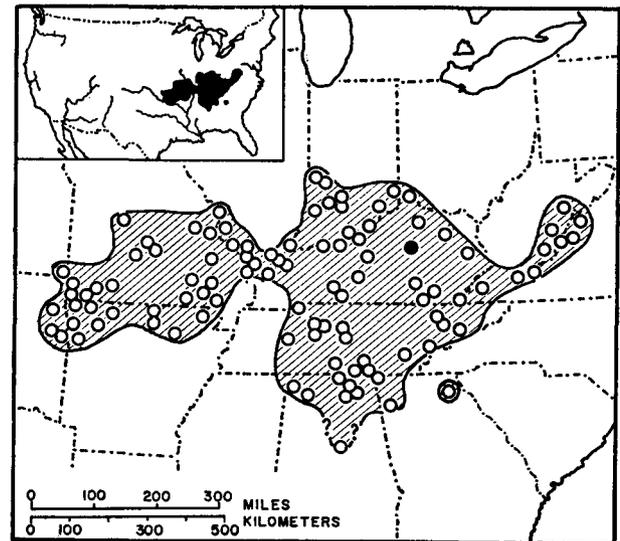
The legs are slender but well developed. Forelimbs have four digits, 1-4-2-3 in order of increasing length. The hindlimbs are stouter than the forelimbs and have five short toes, webbed at the base, 1-5-2-3-4 in order of length from the shortest. Costal grooves number 14-15, counting one each in axilla and groin. Adpressed limbs may overlap slightly or overlap by up to 2 intercostal spaces. Vomerine teeth occur in long angular series of 11-20 that begin posterior to the internal nares, run anteriorly and medially to about the level of the middle of the nares and then make an obtuse angle posteriorly and medially to the level of the orbit where the two series are separated by about the diameter of the orbit. The parasphenoid teeth are in 2 club-shaped patches beginning at the posterior edge of the orbit; the patches are separated by approximately the diameter of a naris. Mature males can be distinguished by the vent, which has raised margins and is lined with numerous small papillae. Males also usually have shorter cirri than females and a rounded mental gland. Populations of melanistic individuals occur in some areas (Grobman, 1943) and occasionally neotenic individuals are found which retain parts of the larval pattern (Eigenmann & Kennedy, 1903; Reese & Smith, 1951; Hutchison, 1956; Minckley, 1959).

- ILLUSTRATIONS. Adults are figured by Eigenmann (1901) and photographs are provided by Banta & McAtee (1906), Bishop (1943), and Mittleman (1950). An illustration in color is offered by Conant (1958). Photographs of larval stages also are offered in Banta & McAtee. Myers (1958a) figures a hatchling. Barden & Kezer (1944) illustrate the egg.

- DISTRIBUTION. The species is essentially limited to limestone areas, especially in and around limestone caves, from southern Indiana and extreme southwestern Ohio southward to central Alabama and Georgia, and from western Virginia westward through northeastern Oklahoma and extreme southeastern Kansas.

Localities from the literature and museum specimens have been summarized by Hutchison (1956). One locality record deserves mention as it is not in a limestone region and is quite isolated. Neill (1957) has shown that a "*Spelerpes longicaudus*" reported from "Augusta, Georgia" (Cope, 1889) was actually a specimen of *E. lucifuga* collected near Demorest, Habersham County, Georgia. The nearest surface limestone to this area is approximately 100 miles away in northwest Georgia. Small caves are present in the crystalline rocks in the Demorest area, however (Neill, 1957). The Demorest record is substantiated by two specimens (U.S. Natl. Mus. 115620-621) collected by J. M. Valentine. B. D. Valentine (1962) reports the southernmost locality, also possibly isolated, as near Pelham, Shelby County, Alabama.

The adults usually live in the twilight zone of caves, rarely in deeper cave recesses. Occasionally they occur in crevices



MAP. The solid symbol marks the type-locality; hollow symbols show other selected localities. Question marks indicate unknown boundaries.

in limestone rock around springs, and under stones, logs, and wood slabs in forest areas—but usually near caves. They are also recorded from swamps (Smith, 1961). Eggs and larvae occur only in water of caves or of springs near caves.

• Fossil Record. None.

• PERTINENT LITERATURE. See Banta & McAtee (1906, life history, development of color patterns, ecology and natural history), Eigenmann (1899, eye structure), Eigenmann & Kennedy (1903, description and figure of melanistic adult), Blatchley (1897, habits and distribution), Hay (1892, habits and distribution), Ives (1951, abundance at different seasons of the year), Sinclair (1950, occurrence of larvae), Reese & Smith (1951, pattern neoteny), Hutchison (1956, distribution, habits and life history, morphological and taxonomic relationships with *Eurycea longicauda*; 1958, distribution and ecology, ecological relationships with *E. longicauda*), and Myers (1958a, description of eggs and hatchlings). See Hutchison (1956, 1958) for additional references and reviews of earlier papers. See Dunn (1926), Bishop (1943), Grobman (1943), Mittleman (1950), Conant (1958), and Smith (1961) for general descriptions, habitat, distribution, and illustrations.

• ETYMOLOGY. The specific name *lucifuga* signifies "fleeing from light"; it is from Latin *lucis*, "light," and *fugi*, "to flee." The name alludes to the usual occurrence of this species in caves.

COMMENT

Mittleman's (1942) suggestion that *E. lucifuga* is a race of *E. longicauda* is based on supposed intergrades from three localities in Tennessee and Kentucky; Neill (1954:80) provides a refutation. See also Hutchison, 1956.

Subspeciation apparently does not exist. This species shows almost no geographic variation in coloration or morphology, but melanistic or partially neotenic individuals occur sporadically.

Further investigations are needed on the ecological and distributional relationships with *E. longicauda*. In Virginia, it appears likely that competition between the two closely related species may govern local distribution (Hutchison, 1958), and in Missouri the two species also appear to occupy different microhabitats (Myers, 1958b).

LITERATURE CITED

- Banta, Arthur M., & Waldo L. McAtee. 1906. The life history of the cave salamander, *Spelerpes maculicaudus* (Cope). Proc. U.S. Natl. Mus., 30:67-83.
- Barden, R. B., & L. J. Kezer. 1944. The eggs of certain plethodontid salamanders obtained by pituitary gland implantation. Copeia, 1944:115-118, pls. 1-2.
- Bishop, Sherman C. 1943. Handbook of salamanders: the salamanders of the United States, of Canada, and of Lower California. Comstock Publ. Co., Ithaca, New York. xiv + 555 pp.
- Blatchley, W. S. 1897. Indiana caves and their fauna. Ann. Rept. Dept. Geol. Nat. Resources, Indiana, for 1896, pp. 121-212.
- Conant, Roger. 1958. A field guide to reptiles and amphibians of the United States and Canada east of the 100th meridian. Houghton Mifflin Co., Boston. xviii + 366 pp., 40 pls.
- Cope, Edward D. 1889. The Batrachia of North America. U.S. Natl. Mus. Bull., (34):1-525, pls. 1-86.
- 1890. On a new species of salamander from Indiana. Amer. Nat., 14:966-967.
- Dunn, Emmett R. 1926. The salamanders of the family Plethodontidae. Smith College 50th Anniversary Publ., Northampton, Massachusetts. viii + 441 pp.
- Eigenmann, C. H. 1899. The eyes of the blind vertebrates of North America, II. The eyes of *Typholmolge rathbuni* Stejneger. Trans. Amer. Microscop. Soc., 21:49-56.
- 1901. Description of a new cave salamander, *Spelerpes stejnegeri* from the caves of southwestern Missouri. *Ibid.*, 22:189-192.
- Eigenmann, C. H., & C. Kennedy. 1903. Variation notes. Biol. Bull., 4:227-229.
- Grobman, A. B. 1943. Notes on salamanders with the description of a new species of *Cryptobranchus*. Occas. Papers Mus. Zool. Univ. Michigan, (470):1-12.
- Hay, O. P. 1891. Note on *Gyrinophilus maculicaudus* Cope. Amer. Nat., 25:1133-1135.
- 1892. The batrachians and reptiles of the state of Indiana. Indiana Dept. Geol. Nat. Resources Ann. Rept., 17:409-602. Also a reprint, 1893, Wm. B. Burford, Indianapolis, Indiana, pp. 1-204.
- Hutchison, Victor H. 1956. Notes on the plethodontid salamanders *Eurycea lucifuga* (Rafinesque) and *Eurycea longicauda longicauda* Green. Natl. Speleol. Soc. Occas. Papers, (3):1-24.
- 1958. The distribution and ecology of the cave salamander, *Eurycea lucifuga*. Ecol. Monogr., 28:1-20.
- Ives, J. D. 1951. Faunal abundance cycles in a small crepuscular cave. Jour. Elisha Mitchell Sci. Soc., 67:259-260.
- Minckley, W. L. 1959. An atypical *Eurycea lucifuga* from Kansas. Herpetologica, 15:240.
- Mittleman, M. B. 1942. A new longtailed *Eurycea* from Indiana, and notes on the *longicauda* complex. Proc. New England Zool. Club, 21:1-2.
- 1950. Cavern-dwelling salamanders of the Ozark Plateau. Bull. Natl. Speleol. Soc., 12:12-15.
- Myers, Charles W. 1958a. Notes on the eggs and larvae of *Eurycea lucifuga* Rafinesque. Quart. Jour. Florida Acad. Sci., 21:125-130.
- 1958b. Amphibia in Missouri caves. Herpetologica, 14:35-36.
- Neill, Wilfred T. 1954. Ranges and taxonomic allocations of amphibians and reptiles in the southeastern United States. Publ. Res. Div., Ross Allen's Reptile Inst., 1 (7):75-96.
- 1957. Distributional notes on Georgia amphibians, and some corrections. Copeia, 1957:43-47.
- Rafinesque, C. S. 1822. On two new salamanders of Kentucky. Kentucky Gazette, Lexington, (new ser.), 1(9):3.
- 1832. Description of the *Spelerpes* or salamander of the caves of Kentucky. Atlantic Jour., 1:22.
- Reese, R. W., & H. M. Smith. 1951. Pattern neoteny in the salamander *Eurycea lucifuga* Rafinesque. Copeia, 1951:243-244.
- Sinclair, Ralph M. 1950. Notes on some salamanders from Tennessee. Herpetologica, 6:49-51.
- Smith, Philip W. 1961. The amphibians and reptiles of Illinois. Illinois Nat. Hist. Surv. Bull., 28(1):1-298.
- Valentine, Barry D. 1962. The range of the cave salamander, *Eurycea lucifuga* Rafinesque, in Alabama. Herpetologica, 18:214.

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