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SHORTER CONTRIBUTIONS

CAVE SALAMANDER (*EURYCEA LUCIFUGA* RAFINESQUE, 1822) WITH ABERRANT COLORATION

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ABSTRACT

During a bat hibernaculum survey at the Caverns at Natural Bridge (Rockbridge Co., Virginia) on 23 January 2026, we discovered a cave salamander (*Eurycea lucifuga* Rafinesque, 1822) with aberrant coloration. The salamander was lightly pigmented, with varying distribution of pigments along its dorsum. Coloration included hues of light green, light orange, and pink, although the individual maintained the characteristic black spots on the dorsal side and tail. The ventral side was unspotted and pale. Although cave salamanders have been observed in karst habitats of Rockbridge Co., this color morph, described as partial hypo-xanthism, has not been reported previously. Further examination of the literature produced no cave salamanders with this same pattern of aberrant coloration, and we suggest pathways for further study.

Keywords: Color morph, Caverns at Natural Bridge, partial hypo-xanthism.

During a 23 January 2026 effort to survey bats in the Caverns at Natural Bridge in Rockbridge County, Virginia, we discovered an unusual cave salamander (*Eurycea lucifuga* Rafinesque, 1822) near the cave's natural entrance (37.636194 °N, 79.539528 °W). Located in a passage ca. 30m into the cave from the entrance, this salamander existed in complete darkness. Typically bright orange with black spots, we describe this cave salamander as lightly pigmented, lacking the prevalent orange dorsum. Instead, it displayed a varying distribution of muted pigments along its dorsum (Fig. 1A-C): light green, light orange, and pink. The individual exhibited the characteristic black spots on the dorsal side and tail. The tail tip (ca. 20 mm) was olive green and spotted. The ventral side was unspotted and pale, presumably lacking pigmentation.

Because this was an opportunistic find, the salamander was photographed and briefly held to examine the ventral side. In the handling effort, it dropped a portion of its tail, and we collected

that sample (under Powers' Virginia Department of Wildlife Resources Salvage Permit). Although measurements were not taken in hand, we photographed the individual with a ruled notebook for scale (Fig. 1A). From that image, we estimated the salamander was 60 mm SVL, 125 mm TL (prior to tail drop). The salamander was released to its original location.

Figure 1. Images of lightly pigmented *Eurycea lucifuga* (cave salamander, A-C) and a typical individual (D) imaged on 23 January 2026 from Rockbridge Co., Virginia.

Confirmation of identification

DNA was extracted from the tail tip of the salamander using the Qiagen DNeasy blood and tissue kit. We amplified a 713-bp fragment of the mitochondrial cytochrome b (cytb) gene using the primers MVZ 15 and MVZ 16 (Moritz et al. 1992). A 25 uL PCR included 12.5 uL VWR Taq Plus Master Mix, 1 uLof each primer (10uM), 9 uL of water, and 1.5 uL of DNA template. The thermocyling protocol consisted of 2 min at 95 °C followed by 34 cycles of 95 °C for 30 sec, 50 °C for 40 sec, and 72 °C for 30 sec, a final extension at 72 °C for 5 min, then held at 10 °C. A 1% gel electrophoresis was used to confirm amplification and the sample was sent to Genewiz (Azenta Life Sciences, Burlington, MA) for Sanger sequencing. We used the DNA subway (DNA Learning Center, https://dnasubway.cyverse.org) to align forward and reverse sequences and construct a consensus sequence. Ends were trimmed to include clean chromatogram peaks from both directions. This sequence was uploaded to the Barcode of Life database, accession number KJT001-26. We used blastn via NCBI (https://blast.ncbi.nlm.nih.gov/Blast.cgi) to identify the closest sequencing match.

All top hits belong to *E. lucifuga*. The best hit belongs to accession (EF044248.1) with an e-value of 0, percent identity of 100% and query coverage at 99%. This individual is *E. lucifuga* isolate 5 from Harlan & Zigler (2009) and sampled near Sewanee, TN, ca. 500 km south, suggesting this population of *E. lucifuga* contains remnants of Pleistocene range expansions from eastern to central populations or ongoing gene flow (Edgington et al., 2016).

Exploring color morphs

Cave salamanders have been reported in karst habitats in and around today's boundaries of Natural Bridge State Park (e.g., Salotti & Perry, 2019) and typical morphs also were observed in

January 2026 hibernaculum surveys of this cave and others within park boundaries (Fig. 1D). Powers' May 2026 surveys of the same caves and this particular passage in the Caverns at Natural Bridge discovered only typical color morphs of this species.

Based on chromatophore abnormalities described by Gould (2025), this salamander's case best fits the description of partial hypo-xanthism. Here, yellow pigment (produced by xanthophores) appears to be underproduced across much of the dorsum but is not completely absent. Because iris color could not clearly be determined from the images captured, we cannot confirm that it is normal (a feature of partial hypo-xanthism). The presence of the typical back spots suggests that melanophore cells and the melanin pigment they produce appear to be functioning normally – or may be just slightly muted. Given that this individual inhabited a passage that lacked natural illumination, it's unlikely that this coloration benefitted or impaired its livelihood.

To our knowledge, this record is the first report of an adult *Eurycea lucifuga* with this combination or pattern of aberrant coloration throughout its range. Other types of atypical coloration have been reported in cave salamander adults, including piebald or partially amelanistic (Fenolio, 2007; Neff et al., 2015), leucistic (Smith, 1985), and unspotted (Bradley & Eason, 2017). Additional historical reports in the western part of their range include a blotchy marbled pattern (larger or less dispersed melanophores; Eigenmann & Kennedy, 1903; Reese & Smith, 1951) and both blotchy and lacking in orange pigmentation (Mickley, 1959). Our specimen is most like the Mickley (1959) specimen, but ours lacks the connected, consolidated blotches. Reese & Smith (1951) suggest patterns in these western cases are a result of neoteny; in this perceived developmental disorder, the melanophores did not fully disperse and the muted coloration of juveniles was retained. As the cause of our salamander's cutaneous color output cannot be determined with images only, we might consider the influences of dietary issues, genetic abnormalities, developmental disorders, or other environmental stressors (Gould, 2025). We suggest that tissue samples for DNA analyses (e.g., targeting biosynthetic and regulatory genes for melanophores and xanthophores) and improved image quality for future discoveries may further elucidate causation for color patterns.

Finally, nearly all reports of aberrant coloration are from cave salamanders west of the Mississippi River; the exception is Bradley & Easton's (2017) report from Jefferson Co., Kentucky. We, therefore, report the easternmost case of unusual coloration for cave salamanders.

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REFERENCES

Bradley, J. G., & P. K. Eason. 2017. *Eurycea lucifuga* (cave salamander) coloration. Herpetological Review 48(4): 827.

Edgington, H. A., C. M. Ingram, & D. R. Taylor. 2016. Cyto-nuclear discordance suggests complex evolutionary history in the cave-dwelling salamander, *Eurycea lucifuga*. Ecology and Evolution 6(17): 6121–6138.

Eigenmann, C. H., & C. Kennedy. 1903. Variation Notes. Biological Bulletin 4: 227–230.

Fenolio, D. B. 2007. Partially amelanistic *Eurycea lucifuga*. https://calphotos.berkeley.edu/cgi/img_query?seq_num=211535&one=T. (Accessed 20 June 2026).

Gould, J. 2025. Colour confusion: Reviewing ambiguities in the identification and classification of chromatophore deficiencies among amphibians. Ecology and Evolution 15(9): e72149. DOI: 10.1002/ece3.72149

Harlan, A. J., & K. S. Zigler. 2009. The phylogenetic position *of Eurycea lucifiga*, the cave salamander. Journal of the Tennessee Academy of Science 84(4): 77–82.

Mickley, W. L. 1959. An atypical *Eurycea lucifuga* from Kansas. Herpetologica 15: 240.

Moritz, C., C. J. Schneider, & D. B. Wake. 1992. Evolutionary relationships within the *Ensatina eschscholtzii* complex confirm the ring species interpretation. Systematic Biology 41(3): 273–291.

Neff, M., S. Viernum, S. E. Twitchell, & J. C. Mitchell. 2015. Three more unusually-colored salamanders from North America. Herpetology Notes 8: 599–601.

Reese, R. W., & H. M. Smith. 1951. Pattern neoteny in the salamander *Eurycea lucifuga* Rafinesque. Copeia 1951: 243–244.

Salotti, M., & D. A. Perry. 2019. Herpetological survey of Natural Bridge Park, 11 and 12 June, 2016. Catesbeiana 39(1): 15–25.

Smith, D. D. 1985. *Eurycea lucifuga* (cave salamander) coloration. Herpetological Review 16(3): 78.