Introduction

Despite the level and complexity of research in a handful of well-studied caves, there remain major knowledge gaps in the overall biodiversity of karst regions and individual karst systems. Even in Mammoth Cave, Kentucky, the best-studied cave system in North America, there is reason to believe that species are yet to be discovered and described (Culver & Pipan 2009). In an effort to quantify and better understand the fauna of a Pennington Formation cave on the Domain of the University of the South in Sewanee, Tennessee, we systematically surveyed four selected cave passages in February and April for two consecutive years (2014-2015) and produced a map showing the cave’s morphology, including hydrologic sources, springs, and areas of biologic interest.

Caves present a challenge for researchers interested in quantifying biodiversity. Cave fauna are mostly small and inconspicuous, occupying habitats that are difficult and sometimes impossible for humans to access. Additionally, the sensitivity of cave obligate organisms to disturbance of physical habitat, for example, increased sediment content in streams due to foot traffic, raises concern for the conservation of cave fauna during sampling attempts. Repeated visitation to Coon’s Labyrinth Cave and the slow pace of travel through the cave during the 2015 tape-and-compas survey ensured that all the accessible passage in the cave (~370 meters) was observed with care. This resulted in a number of exciting biological observations that would have otherwise been missed by multiple timed surveys of short (10 meters) sections of passage. We determined a high potential for future study in this cave, with special regard to: a) recurrence interval and community consequences of mammalian guano subsidies, b) population dynamics and ecology of the beetle genus Ptomaphagus (Order Coleoptera), and c) assessment of nutrient and sediment cycling dynamics in a sandstone-capped, Pennington Formation cave.

Methods

Coon’s Labyrinth Cave was chosen for this study because of its unique geologic position, in the ecotone between upland and cave habitats, and because of the lack of biological data for caves on the University Domain, especially in this geologic unit. The cave entrance is around 1800’ elevation, in the Upper Pennington Formation where Mississippian-aged limestone directly overlies Pennsylvanian-aged Warren Point sandstone (the Raccoon Mountain Formation is absent in this location). The cave was visited a total of eleven times, twice in spring of 2014 and nine times in spring of 2015. Biological surveying transects were established in February 2014 in four 10-meter stretches of cave passage, designated as “entrance terrestrial,” “entrance stream,” “deeper terrestrial,” and “deeper stream.” All surveyed passages were in the dark zone of the cave and ranged from 1 to 2 meters high and from 1 to 2.5 meters wide.

Biological surveys occurred on the following dates: 3/19/14, 4/9/14, 2/9/15, and 4/13/15. Two to five researchers (depending on year/availability) conducted visual surveys ten to twelve minutes in length, working together to find and identify fauna (see “Special Thanks”). In each passage, all accessible rock, sediment, and organic debris on the cave floor, walls, and ceiling was searched and fauna were reported as a tally. Species were identified using Niemiller et al. ‘s Cave Life of TAG (2013) and the World Wide Web. Very few specimens were removed from the cave for the purpose of identification.

The 2015 general cave survey was conducted with a one hundred meter tape, compass, inclinometer, prismatic, pencil, and paper (see “Special Thanks”). Nancy Lilly (C’2015) drew the map and cross-sectional views for 2415 feet (736 m) of passage.

Special Thanks to Nancy Lilly, Kelly Smallwood, Jason Hardy, Kristine Medlen, Anne Grindle, Lorna Harkey, and Peter Davis

Results & Observations

In total, thirty species were observed within Coon’s Labyrinth Cave (Table 1). Ten species were considered to be troglobionts (cave-obligate residents), while the remaining twenty were considered troglophiles or trogloxenes (facultative or accidental cave residents). Tree roots penetrating the cave ceiling could not be identified, but were noted for their use as molting sites by cave crickets (observed 2/20/15 and 4/13/15). On average, the greatest transect species diversity over both months was found in the terrestrial transect nearest the cave entrance (Figure 2). The entrance terrestrial transect had an even 13 to 14 species throughout February and April, while the deeper terrestrial transect underwent a shift in the 10-15 species on average in February to 8.5 in April. More data is needed to determine whether this reflects seasonal movement of fauna throughout the cave.

Biological surveys occurred on the following dates: 2/19/14, 2/25/15, 4/13/15.

Biological surveys occurred on the following dates: 2/19/14, 2/25/15, 4/13/15.

Biological surveys occurred on the following dates: 2/19/14, 2/25/15, 4/13/15.

Biological surveys occurred on the following dates: 2/19/14, 2/25/15, 4/13/15.

Biological surveys occurred on the following dates: 2/19/14, 2/25/15, 4/13/15.

Biological surveys occurred on the following dates: 2/19/14, 2/25/15, 4/13/15.

For those concerned with the conservation of subterranean life, the establishment of routine biological surveys in representative caves should be a major priority. Ten thousand or more caves have been documented in the state of Tennessee, yet only a small fraction of these have been sampled biologically. Cave fauna are threatened by direct human impacts such as introduction to or removal of species from the cave, as well as indirect impacts from surficial activities like mining, pollution, and habitat fragmentation. In order for land managers and policy-makers to protect sensitive cave ecosystems, we must have a complete picture of which species occupy caves, when, and in what ways scarce resources are utilized by cave inhabitants. The results of this survey suggest that multiple cave visits are necessary to acquire a complete list of fauna for one cave, meaning there is much work to be done if a representative number of Tennessee caves are to be thoroughly surveyed. Additionally, researchers must give equal attention to facultative and obligate/endemic cave fauna, since sources of energy necessary for the latter are derived from the surface and are transported by troglophiles or trogloxenes. In Coon’s Labyrinth Cave, mammalian guano serves as the primary energy source for a diverse community of decomposers, several of which never leave the cave.

Discussion

For those concerned with the conservation of subterranean life, the establishment of routine biological surveys in representative caves should be a major priority. Ten thousand or more caves have been documented in the state of Tennessee, yet only a small fraction of these have been sampled biologically. Cave fauna are threatened by direct human impacts such as introduction to or removal of species from the cave, as well as indirect impacts from surficial activities like mining, pollution, and habitat fragmentation. In order for land managers and policy-makers to protect sensitive cave ecosystems, we must have a complete picture of which species occupy caves, when, and in what ways scarce resources are utilized by cave inhabitants. The results of this survey suggest that multiple cave visits are necessary to acquire a complete list of fauna for one cave, meaning there is much work to be done if a representative number of Tennessee caves are to be thoroughly surveyed. Additionally, researchers must give equal attention to facultative and obligate/endemic cave fauna, since sources of energy necessary for the latter are derived from the surface and are transported by troglophiles or trogloxenes. In Coon’s Labyrinth Cave, mammalian guano serves as the primary energy source for a diverse community of decomposers, several of which never leave the cave.

Literature Cited
