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# INVERTEBRATE FAUNA OF DEVILS DEN, A SANDSTONE CAVE IN NORTHWESTERN ARKANSAS

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## ABSTRACT

The same invertebrate fauna of 17 species was found in Devils Den Cave, Washington County, Arkansas, in 1969 and 1979. The fauna consists of 1 troglonexine, 14 trogliphiles, and 2 troglobites, a spider, *Porrhomma cavernicolum*, and a collembolan, *Pseudosinella dubia*. Devils Den Cave has a well developed cavernicolous fauna, although it is in sandstone which generally supports a poor cave adapted fauna. The troglobites probably evolved in the vicinity of northwestern Arkansas in limestone caves or in deep forest soils of the Ozark region. They then dispersed overland, perhaps as recently as the late Wisconsinan, to occupy this sandstone cave.

## INTRODUCTION

Surveys of the taxonomic composition of the invertebrate faunas of North American caves have progressed considerably since the checklist by Nicholas (1960) in which few records from Arkansas caves were reported. Considerable survey work has since been conducted in North America (see Peck and Lewis, 1977, for a review), including Arkansas (McDaniel and Smith, 1976; McDaniel et al., 1979; Youngsteadt and Youngsteadt, 1978). These reports concerned faunas of limestone caves, which generally received more attention than sandstone caves in Arkansas and eastern North America. Arkansas has numerous sandstone features approximating caves, such as the sandstone crevice caves of Devils Den State Park, Washington County, in northwestern Arkansas. The report of a troglobitic collembolan from a cave in the park (Christiansen, 1960) suggested to us that these sandstone caves required a survey to assess their cavernicolous faunas.

Devils Den State Park contains six crevice caves in Pennsylvanian sandstone (Harvey et al., 1981). These caves were formed by slippage of sandstone blocks. Widely spaced joints between blocks opened as the blocks slipped on underlying beds of shales, which were probably lubricated by seepage water. The best developed cave is named Devils Den, from which the park receives its name and is a relatively straight fracture-opening penetrating the hillside approximately 180 m and having only a small entrance. We report the results of surveys conducted in 1969 and 1979 to assess the invertebrate fauna of Devils Den Cave.

## METHODS

Surveys were conducted in May of 1969 and 1979, as part of a research program on the evolution and distribution of cave-inhabiting invertebrates. Organisms were obtained by hand collection and at baits of human dung or carrion suspended above pit traps with preservative solutions. A faunal list was prepared and annotated with status, life history, or distributional information. The probable ecological adaptation of each species is given, following the criteria developed by Barr (1963) and used by McDaniel and Smith (1976).

## ANNOTATED FAUNAL LIST

### PHYLUM ARTHROPODA

#### Class Arachnida

##### Order Acarina

##### Family Rhagidiidae

*Rhagida* sp. Troglophile. Species of this and related genera of mites are often found in cool and wet habitats, such as caves. Elliott and Strandtmann (1971) report *R. longisensilla* Shiba from Diamond Cave, Newton Co., AR. Known from Japan and Alaska. Other species undoubtedly occur in Arkansas, since *R. hilli* Strandtmann, *R. weyerensis* (Packard) and *R. whartoni* Strandtmann are found in Missouri caves (J. L. Craig, 1977, and pers. comm.) Zacharda (1980) has revised the nomenclature of this family.

##### Family Eupodidae

*Linopodes* sp. Troglophile. Predatory mites occasionally found in caves.

##### Order Aranea

##### Family Araneidae

*Meta menardi* (Latreille). Troglophile. Widespread in caves and similar habitats throughout much of eastern United States. McDaniel et al. (1979) report this spider from Needles Cave, Izard Co.

##### Family Linyphiidae

*Porrhomma cavernicolum* (Keyserling). Troglobite. A small, pale, eyeless species, widespread in the Appalachian and Interior Low Plateau regions from Virginia to Oklahoma, but known only from caves. This population is well established, since 4 males, 7 females, and 4 immatures were observed. McDaniel et al. (1979) report this species from Davis Pit, Searcy Co.

##### Order Opiliones

##### Family Ischyropsalidae

*Sabacon cavicolens* (Packard). Troglophile. Immatures only. They may not be this species, which is widespread in forest habitats in the eastern U. S. (Shear, 1975). Reported from Roasting Ear Cave, Stone Co. (McDaniel et al., 1979).

##### Family Phalangodidae

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- Crosbyella spinturnix* (Crosby and Bishop). Troglophile. Reported in other Arkansas caves by Goodnight and Goodnight (1942), Youngsteadt and Youngsteadt (1978), and McDaniel et al. (1979).
- Class Diplopoda  
Order Chordeumida  
Family Conotylidae
- Trigenotyia parca* Causey. Troglophile. Phylogenetically close to the cave restricted *Scoterpes* of caves throughout Ozark and Appalachian regions. A monotypic genus restricted to northwestern Arkansas (Shear, 1972).
- Class Collembola  
Order Entomobryomorpha  
Family Entomobryidae
- Pseudosinella dubia* Christiansen. Troglobite. Known only from 4 limestone and sandstone caves in Washington Co. (Christiansen, 1960; Christiansen and Bellinger, 1980). Christiansen (pers. comm.) also records the collembolans *Folsomia candida* Willem., *Tullbergia iowensis* Mills, and *Onychiurus pseudofimetarius* (Absolon) from the cave in the 1950's.
- Class Insecta  
Order Orthoptera  
Family Rhaphidophoridae
- Ceuthophilus* sp. Troglaxene. Immature cave crickets were on the ceiling, just inside the cave entrance.
- Order Coleoptera  
Family Carabidae
- Platynus tenuicollis* LeConte. Troglophile. Widely distributed in caves of the southeastern U. S. and Ozarks.  
Family Leiodidae
- Ptomaphagus shapardi* Sanderson. Troglophile. Found most often in caves, but also occurs in forest litter in Arkansas and Oklahoma. Its small eyes and winglessness suggest adaptation for deep soil habitats (Peck, 1973).  
Family Staphylinidae
- Atheta* sp. Troglophile? Small, poorly known aleocharines. Abundant in caves.  
Order Diptera  
Family Sphaeroceridae
- Leptocera* sp. Troglophile. Common, scavenging flies found in caves of the southeastern U. S.  
Family Mycetophilidae
- Macrocera nobilis* Johnson. Troglophile. Larvae were observed in runway-like webs under rock ledges (Peck and Russell, 1976). Adult fungus gnats were present, but avoided capture.  
Family Tipulidae
- Undetermined genus. Troglaxene. Observed on ceiling, just inside cave entrance.  
Family Sciaridae
- Bradysia* sp. Troglophile. Common, scavenging flies in caves throughout southeastern U. S.  
Family Psychodidae
- Undetermined genus. Troglophile. Scavenging moth flies of caves throughout southeastern U. S.

## DISCUSSION

Seventeen species were found to inhabit Devils Den Cave in 1969 and 1979. Congruence of the faunas over the 10 year period suggests that these organisms are regular inhabitants of the cave and not accidental occupants. The fauna consists of 1 troglaxene, 14 trogliphiles, and 2 troglobites. The troglaxene and trogliphiles are not cave limited, and do not reveal much about the dynamics of faunal dispersal, cave occupation, and evolution. However, the troglobites (obligate cavernicoles) are significant in this respect. Arkansas limestone caves are occupied by an average of 2 troglobitic invertebrates per cave (Barnett, 1970) based mainly on aquatic species. McDaniel and Gardner (1977) suggest that the average number is actually higher, but will require

continued exhaustive surveys of Arkansas caves. The relatively small sandstone cave we surveyed, then, has an average number (Barnett, 1967) in its fauna. Biospeleologists tend to ignore caves similar to Devils Den. Recognition of a significant cavernicolous fauna, including troglobites, from a sandstone cave suggests that additional surveys of similar caves are necessary.

Terrestrial troglobites probably descended from forest litter-dwelling ancestors which became genetically isolated in caves in conjunction with Pleistocene climatic changes (Barr, 1968, 1973). After speciation, various subterranean avenues have been used for dispersion to other caves. However, deep, subterranean terrestrial dispersal from the Mississippian age limestone caves of northwestern Arkansas through insoluble shales and sandstones into the Pennsylvanian age sandstones of the caves at Devils Den State Park is unlikely. A more likely avenue of dispersal to these caves could have been overland within surficial litter, humus, and soil. Some troglobites have been suggested as being capable of using such a dispersal avenue in eastern North America (Peck, 1973, 1978, 1980, 1981; Peck and Lewis, 1977) and in Europe (Juberthie et al., 1980). In the latter case, troglobites were found in deep soils on top of non-calcareous bedrock, precluding a subterranean dispersion. The occurrence of troglobites at Devils Den State Park supports a surficial, overland dispersal avenue, rather than the deep, subterranean dispersal avenue suggested by Barr (1968, 1973).

Time and conditions of overland dispersal to Devils Den State Park cannot be precisely pinpointed, since little is known concerning Ozark forest litter invertebrates and their distributional and habitat requirements. It is reasonable to conclude that species favoring cool, moist habitats would have found such habitats to be more prevalent in Arkansas forests during the full glacial climatic conditions which occurred most recently during the Wisconsin glacial period from 80,000 to 15,000 years before present (Watts, 1980). In the western Ozarks, King (1973) found the dominant vegetation to be boreal spruce forest from at least 20,000 to 13,500 years before present. Such a forest may have provided conditions suitable for overland dispersal by troglobites from Missouri or Arkansas limestone cave areas through moss and deep litter into the vicinity of Devils Den State Park. Subsequent isolation of troglobites at Devils Den State Park represents an example of climatically induced vicariance distributional pattern. Whether dispersal to these caves occurred in earlier glacial epochs or during several epochs can not be assessed. Additional surveys of the litter invertebrates near cave entrances and in forest habitats between caves might clarify components of the overland dispersal hypothesis.

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