Journal of the Arkansas Academy of Science

Volume 36 Article 15

1982

Invertebrate Fauna of Devils Den, a Sandstone Cave in Northwestern Arkansas

Stewart B. Peck
Carleton University

James H. Peck
University of Arkansas at Little Rock

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

STEWART B. PECK
Department of Biology
Carleton University
Ottawa, Ontario K1S 5B6, Canada

JAMES H. PECK
Department of Biology
University of Arkansas at Little Rock
Little Rock, Arkansas 72204

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 trogloxene, 14 troglophiles, 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 undoubtably 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

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
Trigenotyla 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. Trogloxene. 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. Trogloxene. 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 trogloxene, 14 troglophiles, and 2 troglobites. The trogloxene and troglophiles 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 insoluable 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 Wisconsinan 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.

ACKNOWLEDGMENTS

Drs. W. J. Gertsch, W. A. Shear, and K. Christiansen are thanked for providing determinations of spiders, millipeds, and collembolans, respectively. Drs. Shear, Christiansen, and V. R. McDaniel are thanked for reviewing the manuscript. Field work was supported by operating grants from Canadian Natural Sciences and Engineering Research Council to S.B.P.

LITERATURE CITED

BARNETT, D. E. 1970. An ecological investigation of cavernicole populations in Mansell cave, Randolph County, Arkansas. M.S. Thesis, Northw. Louisiana St. Univ., Natchitoches, LA 51p.

BARR, T. C. 1963. Ecological classification of cavernicoles. Cave Notes 5(2):9-12.

BARR, T. C., JR. 1968. Cave ecology and the evolution of troglobites. Evol. Biol. 2:35-102.

BARR, T.C., JR. 1973. Refugees of the Ice Age. Nat. Hist. 82:26-35, 72-73.

CHRISTIANSEN, K. 1960. The genus *Pseudosinella* (Collembola, Entomobryidae) in caves of the United States. Psyche 67:1-25.

CHRISTIANSEN, K., and P. BELLINGER. 1980. The Collembola of North America north of the Rio Grande. Part 3, Family Entomobryidae. Grinnell College, Grinnell, Iowa. pp. 785-1042.

CRAIG, J. L. 1977. Invertebrate faunas of caves to be inundated by the Meramec Park Lake in eastern Missouri. Bull. Natl. Speleol. Soc. 39:80-89.

ELLIOTT, W. R., and R. W. STRANDTMANN. 1971. New locality records for *Rhagidia* from Mexican and American caves. J. Kan. Entomol. Soc. 44:468-475.

GOODNIGHT, J., and M. L. GOODNIGHT. 1942. New Phalangodidae (Phalangida) from the United States. Amer. Mus. Novitates No. 1188, 18p.

HARVEY, M. J., J. J. CASSIDY, and G. G. O'HAGAN. 1981. Endangered bats of Arkansas: distribution, status, ecology, and management. Ecological Research Center, Dept. Biology, Memphis St. Univ., Memphis, TN. 137p.

JUBERTHIE, C., B. DELAY, and M. BOUILLON. 1980. Sur l'existence d'un milieu souterrain superficiel en zone non calcaire. C. R. Acad. Sci. Paris 290 (ser. D):49-52.

KING, J. E. 1973. Late Pleistocene palynology and biogeography of the western Missouri Ozarks. Ecol. Mono. 43:539-465.

MCDANIEL, V. R., and K. L. SMITH. 1976. Cave fauna of Arkansas: selected invertebrate taxa. Proc. Ark. Acad. Sci. 30:57-60.

MCDANIEL, V. R., and J. E. GARDNER. 1977. Cave fauna of Arkansas: vertebrate taxa. Proc. Ark. Acad. Sci. 31:68-71.

MCDANIEL, V. R., K. N. PAIGE, and C. R. TUMLISON. 1979. Cave fauna of Arkansas: additional invertebrate and vertebrate records. Proc. Ark. Acad. Sci. 33:83-84.

NICHOLAS, BRO. G. 1960. Checklist of macroscopic troglobitic organisms of the United States. Amer. Midl. Nat. 64:123-160.

PECK, S. B. 1973. A systematic revision and the evolutionary biology of the *Ptomaphagus (Adelops)* beetles of North America (Coleoptera: Leiodidae: Catopinae), with emphasis on cave-inhabiting species. Bull. Mus. Comp. Zool. 145:29-162.

PECK, S. B. 1978. New montane *Ptomaphagus* beetles from New Mexico and zoogeography of southwestern caves (Coleoptera: Leiodidae: Catopinae). Southwestern Natur. 23:227-238.

PECK, S. B. 1980. Climatic change and the evolution of cave invertebrates in the Grand Canyon, Arizona. Natl. Speleol. Soc. Bull. 42:53-60.

PECK, S. B. 1981. The geological, geographical, and environmental setting of cave faunal evolution. pp. 501-52, *in* B. F. Beck, Proc. Eighth Inter. Congr. Speleology, Dept. Geol., Georgia Southw. Coll., Americus, GA.

PECK, S. B., and J. J. LEWIS. 1977. Zoogeography and evolution of the subterranean invertebrate faunas of Illinois and southeastern Missouri. Natl. Speleol. Soc. Bull. 40:39-63.

PECK, S. B., and D. R. RUSSELL. 1976. Life history of the fungus gnat *Macrocera nobilis* in American caves (Diptera: Mycetophilidae). Can. Ent. 108:1235-1241.

SHEAR, W. A. 1972. Studies in the milliped order Chordeumida (Diplopoda): A revision of the family Cleidogonidae and a reclassification of the order Chordeumida in the New World. Bull. Mus. Comp. Zool. 144:151-352.

SHEAR, W. A. 1975. The opilionid genera *Sabacon* and *Tomicomerus* in America (Opiliones, Troguloidae, Ischyropsalidae). J. Arachnol. 3:5-29.

WATTS., W. A. 1980. The late quaternary vegetation history of the southeastern United States. Ann. Rev. Ecol. Systs. 11:387-409.

YOUNGSTEADT, N. W., and J. O. YOUNGSTEADT. 1978. A survey of some cave invertebrates from Northern Arkansas. Assoc. Ark. Cave Studies 1:1-13. (Box 682, Harding College, Searcy, AR 72143).

ZACHARDA, M. 1980. Soil mites of the family Rhagidiidae (Actinedida: Eupodoidea). Morphology, Systematics, Ecology. Acta Universitatis Carolinae (Prague), Biologica 1978 (5-6):489-785.