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SURVEY OF TERRESTRIAL INVERTEBRATE SPECIES FROM BYERS CAVE; DADE COUNTY, GEORGIA

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ABSTRACT

Byers Cave is one of Georgia's largest cave systems and is inhabited by a wide variety of unique invertebrate organisms that have not been documented or studied. From March 2008 through April 2010, baited ramp pit-fall traps and visual surveys were used to sample and document invertebrate species that live in this cave system. After three trapping periods and four visual surveys, we collected over 4,400 individuals comprising 13 orders, 29 families and 34 species. The majority of these species were troglophiles and trogloxenes; however, there were also numerous troglobitic species present.

Key words: Byers Cave, troglobite, invertebrates, cavernicoles

INTRODUCTION

Caves are nutrient limited ecosystems and the majority of resources available are from allochthonous materials brought in from the surrounding environment. Physical attributes of caves include a relatively constant temperature and also a high relative humidity in combination with a slow rate of evaporation (1). These unique physical attributes of caves have allowed for the adaptation of many organisms to sufficiently utilize such limiting factors, especially troglobitic species.

Cavernicoles, or cave dwelling species can be classified as either troglobitic, troglophilic or as a trogloxene based on their level of dependence on cave ecosystems. Troglobitic species are obligatory individuals that live exclusively within caves, whereas a troglophilic species can live within a cave or in the external environment. A trogloxene is an individual that may utilize caves for resources or protection but live outside of the cave environment and are primarily found near the entrance of a cave (2).

The Georgia Speleological Society has documented 513 caves in Georgia with the majority of these caves located in the Appalachian Plateau and Ridge and Valley physiographic provinces. Despite the existence of numerous caves, invertebrate cave fauna of Georgia has been poorly studied or documented with only a few invertebrate surveys being conducted (3, 4 ,5). Most research

that has been conducted in these caves has primarily focused on vertebrate animals (*e.g.* bats and salamanders) and neglected the macroinvertebrates.

Byers Cave, discovered in 1961 by local cavers, is located on Fox Mountain in Dade County, GA and contains 5.5 miles of passages formed along several different fault lines (6). Although Byers Cave is one of Georgia's largest cave systems, a thorough inventory of terrestrial invertebrates has not been accomplished. Holsinger and Peck (3) surveyed numerous Georgia caves, including Byers Cave, in 1967 for invertebrates. However, their survey of Byers Cave was only based on one trip. Here we present the most thorough survey of terrestrial macroinvertebrates captured with baited ramp-pitfall traps and visual surveys from Byers Cave and compare our survey to Holsinger and Peck (3).

MATERIALS AND METHODS

We used baited ramp-pitfall traps on three occasions (March 2008, June 2009 and December 2009) to collect terrestrial invertebrates from Byers cave. Four traps, baited with chicken liver and banana, were used during each trapping period and were placed at varying distances (5-225 m from the entrance). Baits similar to these were shown to be successful in attracting cave invertebrates (7). Traps were left inside the cave for a period of fourteen days. Trapping periods were chosen to capture seasonally present or rare organisms. Ramp-pitfall traps have been used successfully for trapping cave terrestrial invertebrates (8). Details and measurements of the ramp-pitfall trap can be found in Campbell *et al*. (8).

Four visual surveys were also performed by two or three persons for a duration of two to three hours per trip. Visual surveys began at the entrance and went as deep into the cave as 250 meters. During visual surveys, researchers searched any suitable habitat (*e.g*. under rocks, crevices, organic material) for invertebrates at various distances from the entrance. Invertebrates were captured with aspirators and delivered directly from the aspirator to a vial containing 70% ethanol.

All terrestrial invertebrates were preserved in 70% ethanol and were identified to the lowest possible taxonomic level. Species were also assigned an ecological category (TB= troglobite, TP= troglophile, TX= trogloxene) (Table I) based on previous literature and morphological features (e.g. lack of eyes, reduced pigmentation, *etc*.). Unless otherwise noted, arachnid specimens were deposited at Auburn University (Auburn, Alabama) and all other invertebrates are stored at High Point University (High Point, NC).

Table I. List of terrestrial cave invertebrates captured with baited ramp-pitfall traps or found during visual surveys in comparison with Holsinger and Peck (1971) survey. Ecological categories: TP= troglophile, TX= trogloxene, TB= troglobite.

Class	Order	Family	Genus/species	Ecological Category	Holsinger and Peck (1971)	This study
Gastropoda	Stylommatophora	Polygridae	*Patera perigrapta* PILSBRY	TP/TX		X
Malacostraca	Isopoda	Trichoniscidae	*Caucasonethes* sp.	TB	X	
Arachnida	Acari	Laelapidae		TP/TX		X
		Rhagidiidae	*Rhagidia* sp.	TP/TB	X	
	Pseudoscorpiones	Chthoniidae	*Aphrastochthonius* sp.	TP/TB		X
	Opiliones	Phalangodidae	*Bishopella laciniosa* CROSBY AND BISHOP	TP/TB	X (as *Phalangodes laciniosa*)	X
	Araneae	Amaurobiidae	*Coras* sp.	TP/TX		X
		Clubionidae	*Liocranoides unicolor* KEYSERLING	TP	X	
		Dictynidae	*Cicurina* sp. (undescribed)	TB	X	X
		Hahniidae	*Calymmaria persica* HENTZ	TP/TX		X
			Calymmaria cavicola BANKS	TP/TX	X	
		Hypochilidae	*Hypochilus thorelli* MARX	TP/TX		X
		Leptonetidae	*Neoleptoneta georgia* GERTSCH	TB	X (as *Leptoneta* sp.)	X
		Linyphiidae	*Phanetta subterranea* EMERTON	TB	X	

		Theriidae	*Achaeranea* sp.	TP/TX		X
		Tetragnathidae	*Meta ovalis* GERTSCH	TP/TX		X
Diplopoda	Chordeumida	Cleidognoidae	*Pseudotremia eburnea* LOOMIS	TB	X	
		Lysiopetalidea	*Abacion magnum* LOOMIS	TX	X	
Entognatha	Diplura	Campodeidae		TB		X
	Entomobryomorpha	Entomobryidae	*Pseudosinella* sp.	TB		X
		Tomoceridae	*Tomocerus bidentatus* FOLSOM	TP	X	
	Symphypleona	Sminthuridae		TP		X
Insecta	Orthoptera	Raphidophoridae	*Ceuthophilus ensifer* PACKER	TX	X	
			Ceuthophilus gracilipes HALDEMAN	TX	X	
			Hadenoecus puteanus SCUDDER	TX	X	
			Ceuthophilus sp.	TX		X
	Coleoptera	Carabidae	*Pseudanophthalmus digitus* VALENTINE	TB	X	
			Pseudanophthalmus fulleri VALENTINE	TB	X	
			Rhadine larvalis LACONT	TP		X
		Leiodidae	*Ptomaphagus whiteselli* BARR	TB	X	
			Ptomaphagus sp.	TP/TB		X
		Staphylinidae	*Atheta* sp.	TP	X	
			Atheta klanesi BERNHAUER	TP		X
			Lesteva sp.	TP/TX		X

			Oxypoda sp.	TP/TX		X
			Psedotremia sp.	TP/TX		X
	Diptera	Calliphoridae	*Calliphora vomitoria* L.	TX		X
		Cecidomyiidae		TP/TX		X
		Chironomidae		TP/TX		X
		Heliomyzidae	*Amoebalaria defessa* OSTEN SACKEN	TP/TX		X
		Mycetophylidae	*Leia* sp.	TP/TX		X
		Phoridae	*Megaselia breviterga* LUNDBECK	TP/TX		X
			M. cavernicola BRUES	TP/TX		X
			Megaselia sp.	TP/TX	X	
			M. taylori DISNEY	TP/TX		X
		Psychodidae	*Psychoda* sp.	TP/TX		X
		Sciaridae	*Bradysia* sp.	TP/TX		X
			Sciara sp.	TP/TX	X	
		Sphaeroceridae	*Leptocera* sp.	TP/TX		X
	Hymenoptera	Braconidae	*Aspilota* sp.	TP		X
	Lepidoptera	Tineidae		TX	X	X
Total Species					21	34

RESULTS AND DISCUSSION

We collected 34 terrestrial macroinvertebrate species (Table I). Most were troglophiles or trogloxenes, but seven potential troglobites were captured (Table I). Baited ramp-pitfall traps captured 4,016 individuals comprising 23 species. Visual surveys captured an additional 11 species and were responsible for the capture of all arachnids from class Araneae and Pseudoscorpiones. Entomobryidae was the most prevalent family captured in the baited ramp-pitfall traps comprising 46% of the total captures followed by Phoridae which accounted for another 30% of the specimens. Collembolans (springtails) have been considered to be the most numerous organisms of many cave environments and act as an important part of the underground food chain in many caves (9). The 34 species captured included at least twelve predators, one parasitoid, and 21 opportunistic feeders (mostly detritivores).

Most species were found within or near the twilight zone, which reflects the greater number of troglophiles and trogloxenes. In previous studies, the twilight zone has been shown to contain the highest biodiversity (10). Most species sampled with the ramp-pitfall traps decreased in abundance further in distance from the entrance. However, two species (*Pseudosinella* sp. and *Ptomaphagus* sp.) increased in abundance further into the cave. Both of these species appeared, based on morphology, to be troglobitic. Only a few species were found at all distances sampled (*e.g. Megaselia* spp.), whereas most were exclusive to certain areas of the cave (*e.g. Neoleptoneta georgia* in the dark zone).

Holsinger and Peck (3) potentially found 17 species that our traps and surveys did not document. However, several of these were probably species that we were able to identify further (*e.g. Megaselia* spp.) and vice versa (*Ptmophagus* sp.). The differences between the surveys were most likely due to trapping and searching techniques and our ability to trap and search during various times of the year. Although caves are considered stable environments, invertebrates undoubtedly demonstrate changes in assemblages and life cycles throughout the year.

Our survey, combined with the previous survey by Holsinger and Peck (3), suggests that Byers Cave is a diverse cave ecosystem. Many of the caves on Fox Mountain may be connected as indicated by recent research with *Neoleptoneta georgia*. Previously only known from Byers Cave, this eyeless troglobitic spider has now been found in several nearby caves (11) suggesting connections that enable invertebrate movements between nearby caves. Future research should focus on comparing the Fox Mountain caves and the natural history of the invertebrates. Our survey was not intended to be the final word, but to highlight what is currently known and where gaps in knowledge exist. Due to the uniqueness of many of the organisms found in Byers Cave and the potential connectivity to other caves, management and conservation practices should focus on the whole mountain rather than an individual cave.

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LITERATURE CITED

1. Barr T: Observations on the ecology of caves. Am Nat 101: 475-491, 1967.
2. Sket B: Can we agree on an ecological classification of subterranean animals? J Nat Hist 42: 1549-1563, 2008.
3. Holsinger JR and Peck SB: The invertebrate cave fauna of Georgia. NSS Bull 33: 23-44, 1971.
4. Reeves WK, Jenson JB and Ozier JC: New faunal and fungal records from caves in Georgia, USA. J Cave Karst Stud 62: 169-179, 2000.
5. Buhlmann KA: A biological inventory of eight caves in Northwestern Georgia with conservation implications. J Cave Karst Stud 63: 91-98, 2001.
6. Wilbanks J: Fox mountain history, acquisition, survey and access. NCKMS Symposium 209-211, 1999.
7. Weinstein P and Slaney D: Invertebrate faunal survey of Rope Ladder Cave, Northern Queensland: a comparative study of sampling methods. Aust J Entomol 34: 233-236, 1995.
8. Campbell JW, Woods M, Ball HL, Pirkle RS, Carey V, and Ray CH: Terrestrial macroinvertebrates captured with a baited ramp-pitfall trap from five limestone caves in North Alabama and Georgia (USA) and their association with soil organic matter. J Nat Hist 45: 2645-2659, 2011.
9. Gers, C: Diversity of energy fluxes and interactions between arthropod communities: from soil to cave. Acta Oecol 19: 205-213, 1998.
10. Poulson, TL and White, WB: The Cave Environment. Science 165: 971-981, 1969.
11. Ledford J, Paquin P, Cokendolpher J, Campbell J, and Griswold, C. Systematics of the spider genus *Neoleptoneta* Brignoli, 1972 (Araneae: Leptonetidae) with a discussion of the morphology and relationships for the North American Leptonetidae. Invertebr Syst 25: 334-388, 2011.