# Checklist of the Biota Associated with the Selman Cave System, Woodward County, Oklahoma

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**Over the last 40 years, cave research has been conducted in one of the largest gypsum cave systems in Oklahoma, the Selman Cave System. Enough information has been accumulated to compile an updated checklist of the biota associated with the cave. This checklist of 161 taxa includes 71 vertebrates and invertebrates, as well as 19 bacterial isolates and 20 ectoparasites from the cave myotis (*Myotis velifer*). Also included are 51 plant taxa occurring in the paratroglozone, a new ecological term that describes the area immediately adjacent to cave openings which is directly influenced by the cave microclimate.** 

## INTRODUCTION

Some of the largest gypsum caves in the world occur in western Oklahoma (Klimchouk 2005) but little is known about the biota associated with them. The checklists by Black (1971, 1973, 1974a) are the only inventories of the life forms found in these gypsum caves. A renewal of interest in caves centers on a growing concern about the potential loss of biodiversity due to the fragile nature of cave ecosystems (Elliott 2004). Northwestern Oklahoma has hundreds of gypsum caves; however, because gypsum caves generally lack the natural beauty of limestone caves (Young and Beard 1993), little has been recorded about them other than scattered records of location and geology. To date, research has focused on the biota of eastern Oklahoma caves where endangered species occur (Martin et al. 2000; Hensley 2003). The Selman Cave System (SCS) is the 17th longest gypsum cave on Earth (Klimchouk 2005). Most of what is known about the biota associated with the SCS is based upon reports of cavers (Bozeman 2002a), several theses (Veal 1983; Wakeham-Sohrabi 1986; Zanowiak 1987; Loucks 1996), a dissertation (Kunz 1971) and research projects on bats (Caire et al. 1981a; Caire et al. 1982; Shackelford and Caire 1993; Caire and Loucks 2010) and bat parasites (Caire et al. 1981b; Veal 1983; Caire and Hornuff 1982; 1986; Caire et al. 1985; Wilson et al. 2007). The microbiology of gypsum caves in Oklahoma has not been investigated and the description of isolates from *M. velifer* (Zanowiak et al. 1993) is the only list of bacteria associated with the SCS. Although fungi have been observed on guano under bat roosts in the SCS, these have not been identified. The purpose of this study is to provide an updated list of the biota associated with the SCS with the intent to stimulate a greater interest in the ecology of Oklahoma's gypsum caves.

## METHODS

We searched the literature referencing the SCS to determine which taxa occur and to gather physical descriptions of the cave and

the surrounding environs. An older synonym of this cave complex is J. Selman Cave System. Invertebrate specimens were hand collected during trips to the cave in conjunction with other research projects in 2006 and 2007. Floor debris, rock cracks and a small stream were searched. Specimens were preserved in 70% alcohol. Identifications of cave invertebrates were made by G. O. Graening and G. Walsh. The invertebrates collected are deposited in the University of Arkansas Insect Museum and the Illinois Natural History Museum.

## RESULTS and DISCUSSION

The Selman Cave System, located in Woodward County, Oklahoma, is reportedly the fourth largest cave (4,794 m) in Oklahoma (Gulden 2010). A map of the SCS has been compiled by the Central Oklahoma Grotto (Collins and Bozeman 2002). Along with other gypsum caves and numerous sink holes, the SCS is located in the Cimarron Gypsum Hills karst area of western Oklahoma, which is topographically dominated by rolling hills and plains (Bozeman 2002b). The SCS is a vadose cave formed in the Permian Blaine Formation which is overlain and underlain by shale layers (Bozeman 2002b). The major soil associations on the surface are the St. Paul-Carey-Woodward Association with gently sloping loamy redbeds and the Vernon-Cottonwood Association of dissected gypsum plains (Woodward County Soil Survey 1963). These soils developed under native grasses and in gypsum clay areas. Exposed gypsum rock and an associated microbial crust also occur. A small stream within a portion of the SCS drains to Salt Creek which flows into Trader Creek and then into the Cimarron River. The cave water has high total dissolved solids (1455 ppm $CaCO_3$) due to calcium hardness (Black 1971). No studies have examined the relationship between the SCS cave biota and the hard water. The SCS exists in a semiarid region that characteristically has hot summers and short cold winters. Temperatures average 13.6ºC and the average annual precipitation is 65 cm. (Oklahoma Climatological Survey 2009). The surface vegetation and at the cave entrances is primarily mixed grass prairie vegetation and approximately 230 plant species (including gypsophilous forms) have been identified in the surrounding watershed (Buckallew and Caddell, 2003).

All caves are extremely sensitive and delicate ecosystems (Elliott 2004) and because of expanding anthropogenic stressors on natural ecosystems there is an urgent need for base line descriptions of biodiversity in these gypsum caves. There are few studies which document the biota that occur in association with gypsum caves. Although gypsum caves are typically not as biologically rich as limestone caves, a diverse biota utilize them. Over 35 years ago, Black (1971, 1973, 1974a) compiled the only published checklists of the biota known to occur in gypsum caves and listed 33 taxa in the SCS. Our study expands that list to 161 (including 51 paratroglozone plants).

Table 1 (eubacteria), Table 2 (arthropods), Table 3 (animals other than arthropods), and Table 4 (plants) are updated check lists of all the biota presently known to be associated with the SCS. It includes literature records as well as taxa that have not been previously reported. The taxonomy used by the authors in their original papers is maintained to facilitate referencing those papers. In some cases, only a common or vernacular taxonomic term is used because they do not have positive identifications due to a shortage of specialists and uncertainties about the taxonomy of the groups. Some of these (vernacular identifications) might be new species. Because the cave system receives surface runoff during heavy rains, there are periodic influxes of surface taxa. These flooding events probably preclude knowing all the taxa present in the system. Because gypsum caves are considered to be much younger (only several thousand years old) than limestone caves (Young and Beard 1993) it reduces the probability of many

**Table 1. Checklist of the biota (Kingdom Eubacteria) known to occur in the Selman Cave System on Myotis velifer, Woodward County, Oklahoma. All identifications from Zanowiak et al. (1993).**

| Phylum | Class | Order | Family | Genus/species |
|---|---|---|---|---|
| Actinobacteria | Actinobacteria | Actinomycetales | Corynebacteriaceae | *Corynebacterium aquaticum* |
| | | | | *C. pseudodiphtheriticum* |
| | | | | *C.* (nonfermenting isolates) |
| | | | | *C.* (fermenting isolates) |
| | | | Micrococcaceae | *Micrococcus luteus* |
| | | | | *M. varians* |
| Firmicutes | Bacilli | Bacillales | Bacillaceae | *Bacillus* spp. |
| | | | Staphylococcaceae | *Staphylococcus* spp. |
| | | Lactobacillales | Lactobacillaceae | *Lactobacillus* spp. |
| | Coccus | Lactobacillales | Streptococcaceae | *Streptococcus* spp. |
| Proteobacteria | Gammaproteobacteria | Enterobacteriales | Enterobacteriaceae | *Citrobacter* spp. |
| | | | | *Enterobacter agglomerans* |
| | | | | *E. aerogenes* |
| | | | | *Salmonella* spp. |
| | | | | *Serratia liquifaciens* |
| | | Pseudomonadales | Moraxellaceae | *Acinetobacter calcoaceticus* (var. *anitratus)* |
| | | | | *A. calcoaceticus* (var. *lwoffi)* |
| | | | | *Moraxella/Pseudomonas* spp. |
| | | | Pseudomonadaceae | *P. fluorescens* |

troglobiotic forms from evolving.

The invertebrate collections made in 2006 and 2007 were dominated by cave crickets, rove beetles, and small undetermined spiders, all fairly common invertebrates that may frequent subterranean habitats. The slugs, sow bugs, millipedes, and springtails have not been previously reported for SCS. Currently none of the specimens listed are on any federal or state endangered or threatened species list. However, the owls are protected under the federal Migratory Bird Treaty Act. Of special interest is the troglobiotic spider *Islandiana unicornis*, reported by Black (1971) in SCS, which Ivie (1965) describes as having "degenerate eyes and large, hornlike seta projecting forward from head of male." Gypsum caves generally lack cave-adapted species because the cave systems are thought to be too young and too ephemeral for evolutionary processes to occur (Culver and Pipan 2009), so the occurrence of this spider in SCS is noteworthy, especially when the few other known occurrences are in northern Texas (Ivie 1965).

There is an obvious gap in our knowledge and understanding of the biota associated with gypsum caves in Oklahoma. Most checklists of the biota in caves focus on the macro invertebrates and vertebrates. In order for us to understand biotic interactions and the ecology of gypsum caves, biologists need to begin examining some of the archaebacteria, bacteria, protists and fungi (Barton 2006). We did not sample for

**Table 2. Checklist of the Arthropoda known to occur in the Selman Cave System, Woodward County, Oklahoma. The taxonomic determinations are the same as reported in the original publications to facilitate referencing of the cited literature. Specimens with a date listed have not been published.**

| Class | Order | Family | Genus/species | Reference or Date Collected |
|---|---|---|---|---|
| Arachnida | Acarina-mites | | Unidentified mite | Elliott 1994<br>1 April 2006<br>7 Oct 2006<br>18 Nov 2006<br>28 Oct 2007 |
| | | Argasidae | *Ornithodoros kelleyi* | Veal 1983 |
| | | Chirodiscidae | *Olabidocarpus* spp. | Veal 1983 |
| | | Gastronyssidae | *Rodhainyssus myotis* | Veal 1983 |
| | | Macronyssidae | *Chiroptonyssus robustipes* | Veal 1983 |
| | | | *Cryptonyssus* spp. | Veal 1983 |
| | | | *Macronyssus crosbyi* | Veal 1983 |
| | | | *M. unidens* | Veal 1983 |
| | | | *Steatonyssus occidentalis* | Veal 1983 |
| | | Myobiidae | *Acathophthirius* spp. | Veal 1983 |
| | | | *Pteracarus minutus occidentalis* | Veal 1983 |
| | | Rosensteiniidae | *Chiroptoglyphus americanus* | Veal 1983 |
| | | Sarcoptidae | *Bakeracarus lasionycteris corynorhini* | Veal 1983 |
| | | | *Notoedres myotis* | Veal 1983 |
| | | Spinturnicidae | *Spinturnix americanus* | Veal 1983 |
| | | | *S. globosus* | Veal 1983 |
| | | Trombiculidae | *Euschoengastia pipistrelli* | Veal 1983 |
| | | | *Microtrombicula boneti* | Veal 1983 |
| Arachnida | Araneae-spiders | | Unidentified spider 1 | 11 March 2006<br>15 April 2006<br>18 Nov 2006<br>28 Oct 2007 |
| | | | Unidentified spider 2 | 11 March 2006<br>15 April 2006<br>18 Nov 2006<br>7 April 2007<br>28 Oct 2007 |
| | | | Unidentified spider 3 | 11 March 2006<br>1 April 2006<br>7 Oct 2006 |
| | | | Unidentified spider 4 | 1 April 2006 |
| | | | Unidentified spider 5 | Elliott 1994 |
| | | Agelenidae | *Cicurina varians* | Black 1971 |
| | | Linyphiidae | *Centromerus denticulatus* | Black 1971 |
| | | | *Islandiana unicornis* | Black 1971 |
| | | Nesticidae | *Nesticus (Eidmannella) pallidus* | Black 1971 |
| | | Theridiidae | *Achaearanea porteri* | Black 1971<br>Elliott 1994 |
| Crustacea | Decapoda | Astacidae | *Procambarus simulans simulans* | Black 1971 |
| Diplopoda | | | Unidentified millipede | 1 April 2006 |
| | Polydesmida | Paradoxosomatidae | *Oxidus gracilis* | 11 March 2006 |
| Entognatha | Collembola | | Unidentified springtail | 18 Nov 2006 |
| Insecta | | | Unidentified "chinche" insect | 1 April 2006 |
| | Coleoptera | | Unidentified beetle | 18 Nov 2006 |
| | | | Unidentified beetle 2 | 1 April 2006<br>7 Oct 2006 |
| | | | Unidentified cockroach-like beetle | 7 April 2007 |

| | | | | |
|---|---|---|---|---|
| | | Carabidae | Unidentified ground beetle | 18 Nov 2006 |
| | | | *Agonum (Platynus) tenuicollis* | Black 1971 |
| | | | *A. (Rhadine) rubra* | Black 1971 |
| | | | *Platynus* | 11 March 2006 |
| | | | | 7 April 2007 |
| | | Catopidae | *Ptomaphagus* | Black 1971 |
| | | Leiodidae | Unidentified round fungus beetle | 28 Oct 2007 |
| | | Noteridae | Unidentified burrowing | |
| | | | water beetle | Black 1971 |
| | | Psephenidae | Unidentified water penny beetle | 18 Nov 2006 |
| | | Staphylinidae | *Belonuchus* sp. | Black 1971 |
| | | | *Lithocharis* sp. *(Stilocharis)* | Black 1971 |
| | | | Unidentified rove beetle 1 | 1 April 2006 |
| | | | | 15 April 2006 |
| | | | | 7 Oct 2006 |
| | | | | 18 Nov 2006 |
| | | | | 7 April 2007 |
| | | | | 28 Oct 2007 |
| | | | Unidentified rove beetle 2 | 1 April 2006 |
| | | | | 18 Nov 2006 |
| | | | | 28 Oct 2007 |
| | Diptera | | Unidentified fly 1 | 1 April 2006 |
| | | | | 15 April 2006 |
| | | | | 28 Oct 2007 |
| | | | Unidentified fly 2 | 1 April 2006 |
| | | | | 28 Oct 2007 |
| | | | Unidentified fly 3 | 1 April 2006 |
| | | | Unidentified wasp-like fly 4 | 18 Nov 2006 |
| | | Phoridae | Unidentified humpback fly | Black 1971 |
| | | | | 11 March 2006 |
| | | | | 7 Oct 2006 |
| | | | | 28 Oct 2007 |
| | | Streblidae | *Trichobius major* | |
| | | Tipulidae | Unidentified crane fly | Veal 1983 |
| | | | | Caire et al. 1981b |
| | | | | Caire & Hornuff 1982 |
| | | | | Caire et al. 1985 |
| | | | | Caire & Hornuff 1986 |
| | | | | Wilson et al. 2007 |
| | | | | Elliott 1994 |
| | Hemiptera | Gerridae | Unidentified water strider | Black 1971 |
| Hymenoptera | | Unidentified wasp | 7 April 2007 | |
| | Lepidoptera | Arctiidae | Unidentified moth | |
| | | | Unidentified woolly bear | 15 April 2006 |
| | | | | 20 May 2007 |
| | Orthoptera | Rhaphidophoridae | | |
| | | (Gryllacrididae) | *Ceuthophilus* sp. | Looney 1968 |
| | | | | Black 1971 |
| | | | | Elliott 1994 |
| | | | | 11 March 2006 |
| | | | | 15 April 2006 |
| | | | | 7 Oct 2006 |
| | | | | 18 Nov 2006 |
| | | | | 7 April 2007 |
| | | | | 20 May 2007 |
| | Siphonoptera | Ichnopsyllidae | *Myodopsylla collinsi* | Veal 1983 |
| Malacostraca | Isopoda | | Unidentified terrestrial | 11 March 2006 |
| | | | non-rolling sow bug | 1 April 2006 |
| | | | Unidentified terrestrial | 1 April 2006 |
| | | | "rolly-polly"sow bug | 18 Nov 2006 |

**Table 3. Checklist of animal biota other than Phylum Arthropoda known to occur in the Selman Cave System, Woodward County, Oklahoma. The taxonomic determinations were left the same as reported in the original publications to facilitate referencing of the cited literature. Specimens with a date listed have not been published.**

| Class | Subclass | Order | Family | Genus/species | Reference or Date Collected |
|---|---|---|---|---|---|
| Annelida | | | | Unidentified worm | 1 April 2006 |
| | Oligochaeta | Opisthopora | Lumbricidae | *Allolobophora trapezoides* | Black 1971 |
| Mollusca | Gastropoda | Stylommatophora | Agriolimacidae | *Deroceras laeve* | 11 March 2006 |
| | | | | | 1 April 2006 |
| | | | | | 18 Nov 2006 |
| | | Basommatophora | Physidae | *Physa (Physodon)* | 18 Nov 2006 |
| | | | | | 7 April 2007 |
| | | | Physidae | *Physa (Physella)* | 28 Oct 2007 |
| | | Pulmonata | Physidae | *Physa virgata* | Black 1971 |
| | | Sorbeoconcha | Pleuroceridae | *Elimia* | 7 April 2007 |
| Chordata | Amphibia | Anura | Ranidae | *Rana pipiens* | Black 1971 |
| | | | | | Black 1973 |
| | | Urodela | Ambystomidae | *Ambystoma tigrinum* | Looney 1968 |
| | | | | | Black 1971 |
| | | | | | Black 1973 |
| Chordata | Reptilia | Squamata | Colubridae | *Elaphe guttata* | Black 1974a |
| | | Squamata | Viperidae | *Crotalus sp.* | Black 1971 |
| | | Squamata | Viperidae | *Crotalus atrox* | Black 1974a |
| | Aves | Columbiformes | Columbidae | *Columbia livia* | Black 1971 |
| | | Passeriformes | Tyrannidae | *Sayornis phoebe* | Black 1971 |
| | | Strigiformes | Tytonodae | *Tyto alba* | Black 1971 |
| | | Strigiformes | Strigidae | *Bubo virginianus* | Black 1971 |
| | Mammalia | Didelphimorphia | Didelphidae | *Didelphis virginiana* | Bozeman 2002a |
| | | Carnivora | Procyonidae | *Procyon lotor* | Looney 1968 |
| | | | | | Black 1971 |
| | | | Mephitidae | *Mephitis mephitis* | Black 1971 |
| | | | Canidae | *Canis lupus* | Black 1971 |
| | | | | | Black & Best 1972 |
| | | | Canidae | *Vulpes vulpes* | Black 1971 |
| | | Chiroptera | Molossidae | *Tadarida brasiliensis* | Looney 1968 |
| | | | Vespertilionidae | *Myotis velifer* | Looney 1971 |
| | | | | | Kunz 1971,1973 |
| | | | | | Black 1974b |
| | | | | | Caire et al. 1981a |
| | | | | | Caire et al. 1982 |
| | | | | | Veal 1983 |
| | | | | | Caire & Thies 1988 |
| | | | | | Wakeham et al. 1988 |
| | | | | | Caire et al. 1989 |
| | | | | | Shackelford & Caire 1993 |
| | | | | | Elliott 1994 |
| | | | | | Bozeman 1994 |
| | | | | | Bozeman 2002a |
| | | | | | Mar, Apr, Oct, Nov 2006 |
| | | | | | Oct, Apr 2007 |
| | | | | | Loucks & Caire 2007 |
| | | | Vespertilionidae | *Pipistrellus subflavus* | Looney 1971 |
| | | | | | Elliott 1994 |
| | | | | | Bozeman 2002a |
| | | | | | 18 Nov 2006 |
| | | | | | 28 Oct 2007 |
| | | Vespertilionidae | *Corynorhinus (Plecotus) townsendii* | | Looney 1968 |
| | | | | | Bozeman 2002a |
| | | | Vespertilionidae | *Eptesicus fuscus* | Elliott 1994 |
| | | | | | Bozeman 2002a |
| | | Rodentia | Muridae | *Neotoma micropus* | Black 1971 |

**Table 4. Checklist of the plant biota known to occur in the paratroglozone of the Selman Cave System, Woodward County, Oklahoma. The taxonomic determinations were left the same as reported in the original publications to facilitate referencing of the cited literature. All identifications from Buckallew and Caddell (2003).**

| Taxonomic Group | Family | Genus/species |
|---|---|---|
| Pteridophyta | Pteridaceae | *Cheilanthes feei* |
| | | *Pellaea atropurpurea* |
| Gymnosperms | Cupressaceae | *Juniperus virginiana* |
| Magnoliophyta –Liliopsida | Cyperaceae | |
| | | *Carex aggregata* |
| | | *Carex gravida* |
| | | *Carex muehlenbergii* |
| | Liliaceae | *Allium drummondii* |
| | Poaceae | *Bothriochloa laguroides* |
| | | *Bouteloua curtipendula* |
| | | *Bromus catharticus* |
| | | *Bromus japonicus* |
| | | *Bromus tectorum* |
| | | *Buchloe dactyloides* |
| | | *Elymus canadensis* |
| | | *Hordeum pusillum* |
| | | *Muhlenbergia racemosa* |
| | | *Phalaris caroliniana* |
| | | *Poa arachnifera* |
| | | *Schizachyrium scoparium* |
| | | *Setaria parviflora* |
| | | *Sphenopholis obtusata* |
| | | *Sporobolus texanus* |
| | | *Vulpia octoflora* |
| Magnoliophyta-Magnoliopsida | Anacardiaceae | *Rhus aromatica* |
| | | *Rhus glabra* |
| | | *Toxicodendron radicans* |
| | Asteraceae | *Erigeron strigosus* |
| | | *Gaillardia pulchella* |
| | | *Psilostrophe tagetina* |
| | Boraginaceae | *Lappula occidentalis* |
| | | *Lithospermum incisum* |
| | Brassicaceae | *Descurainia pinnata* |
| | | *Lesquerella gordonii* |
| | Capparaceae | *Polanisia dodecandra* |
| | Cornaceae | *Cornus drummondii* |
| | Euphorbiaceae | *Euphorbia marginata* |
| | | *Euphorbia spathulata* |
| | Fabaceae | *Astragalus missouriensis* |
| | Geraniaceae | *Geranium carolinianum* |
| | Grossulariaceae | *Ribes aureum* |
| | Loasaceae | *Mentzelia oligosperma* |
| | Malvaceae | *Callirhoe involucrata* |
| | Onagraceae | *Calylophus berlandieri* |
| | | *Calylophus serrulatus* |
| | Oxalidaceae | *Oxalis stricta* |
| | Plantaginaceae | *Plantago rhodosperma* |
| | Rubiaceae | *Galium aparine* |
| | Solanaceae | *Physalis* cf *angulata* |
| | Urticaceae | *Parietaria pensylvanica* |
| | Violaceae | *Viola bicolor* |
| | Vitaceae | *Vitis riparia* |

any fungal taxa. We have seen an occasional mushroom in the twilight areas and fungal mycelia on bat guano under some roost sites. Histoplasmosis has been isolated from bats occurring in other gypsum caves in western Oklahoma (Bryles et al. 1969). The fungus *Geomyces destructans* associated with White Nose Syndrome in bats was recently isolated from a single *Myotis velifer* mist netted at an entrance to the cave (personal communication, Richard Stark, US Fish and Wildlife Service, Tulsa Oklahoma Office).

Zanowiak's (1993) study of bacterial isolates from *M. velifer* is the only list of bacteria in western Oklahoma gypsum caves. Examination of bacteria in the air, soil and water as well as those associated with biotic forms will increase our understanding of this ecosystem. Future studies should examine western Oklahoma gypsum caves for archaebacteria, bacteria and clarify which biofilms occur.

To date the only virus identified from caves in western Oklahoma is the rabies virus (Glass 1958). All groups of organisms certainly harbor viruses and their influence should be investigated.

Surveys of other Oklahoma gypsum caves will probably result in a list of taxa similar to those reported for the SCS. However, because no systematic collections (pit falls, drift fences, aquatic drift nets, Berlese funnels, etc.) were made, it is probable that many invertebrates have been overlooked. When such initiatives are undertaken the list of biota might increase significantly. We expect that there will be some variations in the biota of different gypsum caves as well because of variations in physical features and microclimates. Because we lack positive identifications and knowledge of life cycles of many of the taxa listed in Tables 1, 2, and 3, we have not attempted to characterize the organisms listed as troglophiles, trogloxenes, troglobionts, stygophiles, stygoxenes or stygobionts.

Cave entrances are unique environs in mixed grass prairies of arid western Oklahoma. The higher humidity and cooler temperatures provide a refugium for some species. The low light levels of the twilight zones are enough to support algal growth on gypsum surfaces. We have not sampled the algae but they were noted at most entrances. Liverworts that occur at some of the entrances were not sampled.

Herein we define a paratroglozone as the region extending from the entrance of the cave outward to varying distances. This is an extension outside the cave beyond the twilight zone. The distance a paratroglozone extends will vary due to a variety of factors. These include the size and shape of the entrance, the aspect of the entrance relative to the sun, water in the entrance, etc. In essence, the paratroglozone is a microcosm or the region of space (volume) external to the entrance that is influenced by cave effluents (water, air, particulate matter, etc.) as it "breathes" (adiabatic expansion and contraction). This provides a microclimate which might support specific combinations of species. We have included a list of 51 plant species (Table 4) associated with the entrances (paratroglozones) to the SCS. Only 10 of the 51 species are limited to the SCS paratroglozones as the rest can be found away from cave entrances. Although 10 of the species were found only in the paratroglozone in this study of the SCS, these species do occur in habitats other than cave entrances at other locales. These plant communities also support invertebrates, vertebrates and possibly unique combinations of bacteria and viruses. Examination of the taxa in these paratroglozones of gypsum caves is warranted.

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