

Aquatic Cave Invertebrate Survey
Ozark Plateau National Wildlife Refuge and Associated Areas

submitted to:

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Tulsa, OK

prepared by:

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OBJECTIVES

1. Survey the aquatic invertebrate fauna of caves within and associated with the Ozark Plateau National Wildlife Refuge.
2. As a supplemental objective, the occurrence of non-mammalian vertebrates in the caves was also noted.

INTRODUCTION

The Ozark Plateaus Ecoregion extends through Missouri, Arkansas, Oklahoma and Kansas. The limestone geology of the ecoregion results in abundance of karst caves and underground spaces and passageways. These underground habitats are characterized by a suite of crustacean and salamander inhabitants, which can be observed and sampled in caves, where humans can enter these habitats, and in springs, where underground waters reach the surface.

Subterranean Ozark habitats support a number of endemic aquatic crustaceans and have a diverse salamander fauna. Most of the aquatic crustaceans show the typical troglobitic features: reduced eyes, reduction or loss of pigmentation, attenuation of antennae, legs and sensory hairs (Holsinger and Culver 1988), and well developed tactile and chemical sensory systems (e.g., Brandon 1971). Some epigeal forms can also be found. Troglobitic crayfish, isopods and amphipods in the Ozarks (and in other karst areas) are often known from small geographic areas; often from a single cave or a few clustered caves. Salamanders of the Ozark underground tend to have ranges covering the ecoregion and extending beyond the borders, although there is one endemic, *Typhlotriton spelaeus*.

Potential threats to subterranean karst dwellers include toxic and organic pollutants, hydrologic changes (for example, by changes in land use in the aquifer recharge zone), and direct and indirect disturbance by humans using caves. In the Ozark Plateau area of Oklahoma, the most serious threat is organic pollution that can enter the aquifer from hog and chicken farms in the area. An active program of gating cave entrances, responsible caving groups, and non-commercialization of caves have minimized direct human impacts. Indeed, bat populations have increased in some gated caves (e.g., Twin Caves; Geoff Canty and Steve Hensley, personnel communication).

This survey was conducted to inventory aquatic invertebrates in a set of nine aquatic caves in or associated with the Ozark Plateau National Wildlife Refuge. This survey follows previous surveys in some of the nine sampled caves but may be the first formal survey in several. Previous surveys are reported in Black (1971) and Vaughn and Certain (1992). This study is concurrent with a larger survey of Ozark caves being conducted by Graening and colleagues under the Subterranean Biodiversity Project. The cave surveys reported here are also parts of this larger project; and we have shared data between the two projects.

METHODS

Surveyed caves were AD-08, CZ-??, CZ-18, DL-39, DL-91, DL-119, DL-148, and OT-13. Cave AD-14 was not physically surveyed as part of this project. Instead, specimens from this cave that were collected by Steve Hensley in 2000 and Bill Howard in 1996 were identified as part of the project.

Caves were surveyed by teams of two to four people that included regular survey members and volunteers. Surveys were conducted primarily during the fall and winter (October through March) to minimize disturbance to maternity or roosting colonies of bats, which use some of the caves during the spring, summer and early fall. Two caves that do not have bats were surveyed in August. The survey interval extended from 2000 to 2002, during which most caves were surveyed once, but three caves were surveyed twice.

Because all the surveyed organisms are found in these habitats throughout the year, single-day surveys, if done carefully and thoroughly, should find most of the species within the caves. Repeating surveys may add additional species if there are species that visit the cave intermittently or indicate local subterranean faunal changes over time.

Team members searched among potential habitats for aquatic invertebrates and collected one or a few specimens for later identification. Black aquarium nets, aspirators, and light-weight larval BioQuip forceps were useful in collecting. Specimens were preserved in 70% ethanol. Crayfish from caves with previously identified species were not collected; a few specimens of Form I males were collected from caves with unknown crayfish as part of the Subterranean Biodiversity Project and identifications of these crayfish were provided by Dr. Horton Hobbs III.

Fenolio identified salamanders in the caves. No voucher specimens were collected.

Troglobitic crustaceans are difficult to identify, and all collected amphipods and isopods were sent to experts for identification. After identification, specimens were deposited in the collections of experts (amphipods) or are housed in the Oklahoma Biological Survey cave invertebrate collection (most isopods).

Identification specialists:

Amphipods: Dr. John R. Holsinger
Department of Biological Sciences
Old Dominion University
Norfolk, VA 23529

Isopods: Dr. Julian Lewis
J. Lewis and Associates, Biological Consulting
217 W. Carter Avenue
Clarksville, IN 47129

RESULTS

Overview. A summary of the occurrences of crustaceans and non-mammal vertebrates from this survey is found in Table 1. Total numbers of species, by group were: 3 amphipods, 5 isopods, 3 crayfish, 2 fish, 5 salamanders, and 3 frogs. The *Gammarus*, *Orconectes neglectus*, creek chubs, and frogs are epigeal species that were accidentals or troglophiles in the surveyed caves. In DL-39, *Rana palaustris* apparently overwinters in the cave (Fenolio 2003) and evidence of breeding by *O. neglectus* was found (we found a juvenile in the riffle area far upstream of the entrance).

The diversity of both salamanders and crustaceans was much higher in DL-39 than the other surveyed caves. This cave contains considerable water and has a diversity of habitats; including mud-bottomed pools and runs, stony pool areas and a shallow stony riffle. The other caves were relatively drier.

Site-specific species lists. Cumulative species lists for each survey site are given in Appendix 1. Lists were compiled from this survey, Black (1971), Vaughn and Certain (1992), Fenolio (2003), and Graening et al. (in prep). Graening has additional information on some of these caves (e.g., DL-91).

This survey has updated the caves' species lists as follows (including previously reported troglotic species that we failed to find):

AD-08. New records for *Typhlotriton spelaeus* and *Eurycea longicauda melanopleura*.

We failed to find cave planarians.

AD-14. New record for *Caecidotea stiladactyla*. Failed to find *C. acuticarpa*.

CZ-??. Possibly the first formal survey. Found one species of salamander.

CZ-18. Possibly the first formal survey. Found two species of salamander, including *Typhlotriton spelaeus*.

DL-39. This study plus Fenolio (2003) found two new records of amphipods (*Stygobromus onondagaensis* and the epigeal *Gammarus* sp.) and two additional isopods (*Caecidotea ancyla* and *Caecidotea* sp., which was not identifiable to species).

DL-91. We failed to find the salamander *Eurycea lucifuga*.

DL-119. New records for the cave fish *Amblyopsis rosae*, the crayfish *Cambarus tartarus* and the salamander *Typhlotriton spelaeus*.

DL-148. Added a new *Caecidotea* species, which is an undescribed species. Also found the cave fish *Amblyopsis rosae* and two species of salamander, including *Typhlotriton spelaeus*.

OT-13. Possibly the first formal survey. Found one unidentified species of *Caecidotea* isopod and 2 species of salamander, including *Typhlotriton spelaeus*.

Note: Failure to find a previously reported species does not equate to loss of the species from the site. Species that are present in underground habitats may not be present in caves at all times. Also, troglotic species are generally rare and may be overlooked while searching (e.g., if the species hides under rocks in pools).

Other invertebrates encountered. In addition to aquatic invertebrates and non-mammalian vertebrates, numerous terrestrial invertebrates were found in many of the caves. Records of these occurrences are found in the cave survey reports in Appendix 2. The cave reports also describe survey conditions and miscellaneous observations.

ACKNOWLEDGEMENTS. We especially thank Steve Hensley for his generous help throughout the project, from suggesting caves to leading us to and through many of them. We also thank the other people who helped with fieldwork: Jim Erwin, Shane Feirer, John Malone, Mike Slay, and Mark Walvoord. Caryn Vaughn helped define the original project and was often consulted. Drs Jerry Lewis and John Holsinger kindly identified specimens in a timely manner.

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Table 1. Ozark Plateau National Wildlife Refuge cave inventory summary

Crustacea

AD-08	AD-14	CZ-??	CZ-18	DL-39	DL-91	DL-119	DL-148	OT-13
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Amphipoda

<i>Gammarus</i> sp.					(X) ⁴			
<i>Stygobromus alabamensis</i>		X			X			
<i>Stygobromus onondagaensis</i>					(X) ⁴			
<i>Stygobromus ozarkensis</i>					X			

Isopoda

<i>Caecidotea ancyla</i>					X			
<i>Caecidotea antricola</i>					X			
<i>Caecidotea macropoda</i>	X							
<i>Caecidotea stiladactyla</i>		X						
<i>Caecidotea</i> sp.nov.							X	
<i>Caecidotea</i> unidentified ¹					(X) ⁴			X

Decapoda

<i>Cambarus subterraneus</i>						X		
<i>Cambarus tartarus</i>					X		X ²	X ²
<i>Cambarus</i> unidentified								
<i>Orconectes neglectus</i>					X			

Vertebrates³

Fishes

<i>Amblyopsis rosae</i>						X	X	X
creek chubs								X

Salamanders

<i>Eurycea longicauda melanopleura</i>	X				X			
<i>Eurycea lucifuga</i>	X				X			X
<i>Eurycea multiplicata</i>			X	X				
<i>Plethodon glutinosus</i>					X	X		
<i>Typhlotriton spelaeus</i>	X			X	X	X	X	X

Frogs

<i>Acris crepitans</i>						X		
<i>Rana clamitans</i>							X	X
<i>Rana palustris</i>					X			

¹ immatures, females or poor specimens (species determination not possible)

² *C. tartarus* range extensions; manuscript by Graening et al. (*in prep*)

³ AD-14 was not surveyed for vertebrates (aquatic invertebrates are based on previously collected specimens)

⁴ added by Fenolio (2003); the isopod differs from the other two reported from this cave, but the specimen could not be identified.

Appendix 1. Site-specific species lists based on this survey, Black (1971), Vaughn and Certain (1992), Fenolio (2003), and Graening et al (in prep).

Cave AD-08

This study
2003

Vaughn &
Certain 1992

Black
1971

Planaria

<i>Dendrocoelopsis americana</i>		X	
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Crustacea

Isopoda

<i>Caecidotea macropropoda</i>	X	X ¹	X ²
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Vertebrates

Salamanders

<i>Eurycea longicauda melanopleura</i>	X	
<i>Eurycea lucifera</i>	X	X
<i>Plethodon glutinosus</i>		X
<i>Typhlotriton spelaeus</i>	X	

Frogs

<i>Bufo woodhousi velatus</i>		X ³
<i>Rana pipiens</i>		X

- ¹ identifications of isopods were received after the report was written
- ² listed as *Asellus macropropodus* by Black (1971)
- ³ one 'accidental' individual near the entrance

Cave AD-14¹

Crustacea

This study¹ Vaughn & Black
2003 Certain 1992 1971

Amphipoda

<i>Stygobromus alabamensis</i>	X	X	
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Isopoda

<i>Caecidotea acuticarpa</i>		X ²	
<i>Caecidotea stiladactyla</i>	X ³		

Vertebrates

Salamanders

<i>Eurycea longicauda melanopleura</i>	X
<i>Eurycea lucifuga</i>	X
<i>Plethodon glutinosus</i>	X

¹ AD-14 was not surveyed for vertebrates (aquatic invertebrate records are based on previously collected specimens only)

² identifications of isopods were received after the 1992 report was written; identified by Thomas Bowman (Smithsonian Institution)

³ identified by Julian Lewis (isopod consultant)

CZ-18¹

Vertebrates

Salamanders

<i>Eurycea multiplicata</i>	X
<i>Typhlotriton spelaeus</i>	X

¹ not listed as inventoried by Vaughn and Certain (1992) or in Black (1971)

Cave CZ-??¹

This study
2003

Vertebrates

Salamanders

<i>Eurycea multiplicata</i>	X
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¹ not listed as inventoried by Vaughn and Certain (1992) or in Black (1971)

Cave DL-39

Crustacea

This study 2003 Fenolio 2003 Vaughn & Certain 1992 Black 1971

Amphipoda

<i>Gammarus</i> sp.		X		
<i>Lirceus garmani</i>				X
<i>Stygobromus alabamensis</i>	X	X		
<i>Stygobromus onodagaensis</i>		X		X ³
<i>Stygobromus ozarkensis</i>	X	X	X	

Isopoda

<i>Caecidotea ancyla</i>	X	X		
<i>Caecidotea antricola</i>	X	X	X ^{1,5}	
<i>Caecidotea</i> unidentified ²		X		X

Decapoda

<i>Cambarus tartarus</i>	X	X	X	X ⁴
<i>Orconectes neglectus</i>	X	X		X

Vertebrates

Salamanders

<i>Eurycea longicauda melanopleura</i>	X	X		X
<i>Eurycea lucifuga</i>	X	X		X
<i>Plethodon albagula</i>	X	X		
<i>Plethodon glutinosus</i>				X ⁶
<i>Typhlotriton spelaeus</i>	X	X		X

Frogs

<i>Rana clamitans</i>				X
<i>Rana palaustris</i>	X	X		
<i>Rana pipiens</i>				X

- ¹ identifications of isopods were received after the report was written
- ² Dante's record is a 3rd species; Black's record was not identified beyond genus
- ³ Black (1971) reports *Stygobromus* sp., which "probably represent a new species of the *onodagaensis* group"
- ⁴ Black's record was not identified past genus, but is presumably *C. tartarus*
- ⁵ Noted as a possible new species (slightly different from *C. antricola*)
- ⁶ *Plethodon glutinosus* is a synonym of *Plethodon albagula*

Cave DL-91

Crustacea

This study Vaughn & Black
2003 Certain 1992 1971

Decapoda

<i>Cambarus subterraneus</i>	X	X ¹	
<i>Cambarus</i> unidentified			X ²

Vertebrates

Fishes

<i>Amblyopsis rosae</i>	X		X
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Salamanders

<i>Eurycea lucifuga</i>			X
<i>Plethodon glutinosus</i>	X		X
<i>Typhlotriton spelaeus</i>	X		X

Frogs

<i>Acris crepitans</i>	X		
<i>Rana palustris</i>			X

¹ *C. subterraneus* was described in Hobbs 1993, giving this cave as the type locality. The *C. setosus* from Vaughn and Certain is *C. subterraneus*.

² only identified to genus, but probably *C. subterraneus*

Cave DL-119*

Crustacea

This study
2003 Vaughn &
 Certain 1992

Isopoda

<i>Lirceus sp.</i>		X ¹
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Decapoda

<i>Cambarus tartarus</i>	X ²	
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Vertebrates

Fishes

<i>Amblyopsis rosae</i>	X
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Salamanders

<i>Typhlotriton spelaeus</i>	X
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Frogs

<i>Rana clamitans</i>	X
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* no records are listed under this cave's name in Black 1971

¹ collected at 'spring at DL-119'; possibly a new species

² *C. tartarus* range extension; manuscript by Graening et al. (*in prep*)

Cave DL-148*

Crustacea

This study
2003 Vaughn &
 Certain 1992

Isopoda

<i>Caecidotea</i> sp.nov.	X	
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Decapoda

<i>Cambarus tartarus</i>	X ¹	
<i>Cambarus</i> unidentified		X

Vertebrates

Fishes

<i>Amblyopsis rosae</i>	X
creek chubs ¹	X

Salamanders

<i>Eurycea lucifuga</i>	X
<i>Typhlotriton spelaeus</i>	X

Frogs

<i>Rana clamitans</i>	X
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* no records are listed under this cave's name in Black 1971

¹ *C. tartarus* range extension; manuscript by Graening et al. (*in prep*)

Cave OT-13¹

Crustacea

This study
2003

Isopoda

<i>Caecidotea</i> unidentified ¹	X
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Vertebrates

Salamanders

<i>Eurycea lucifuga</i>	X
<i>Typhlotriton spelaeus</i>	X

¹ not listed as inventoried by Vaughn and Certain (1992) or in Black (1971)

Appendix 2. Cave survey reports, listing species and numbers of individuals found, with notes on habitats and species' observations

Cave Surveyed: AD-08
Date: 1-28-02
State: OK
County: Adair
Surveyors: Danté Fenolio (OU),
Steve Hensley (USFWS)

Organisms Encountered:

Invertebrates:

Aquatic: 50,000+ stygobitic isopods (*Caecidotea macropropoda*) – in main pool below entrance

Terrestrial: 1 cream color spider – possibly troglobitic / on guano pile
10+ heleomyzid flies

Vertebrates:

Aquatic: 50+ larval *Typhlotriton spelaeus* – in main pool
25+ larval *Eurycea longicauda melanopleura* – in main pool

Terrestrial: 1 adult *E. lucifuga* - on cave wall
250+ *Pipistrellus subflavus*

Notes: The isopods made this cave inventory spectacular. Normally, where isopods are present in fair abundance, I will see anywhere from 10 to 50 of them. I am not sure what the congregation signified, I did see several pairs breeding. There were spots along the shore of the main pool where the substrate could not be observed through the dense mat of isopods. The larval salamanders were all so gorged they could barely move...some couldn't reach the ground with their limbs any longer owing to the distortion of their body shape to accommodate such an increase in stomach size. I took quite a number of photographs of the isopods. Additionally, there were individual isopods far larger than any I have observed thus far – several approaching 15mm total length. Several were preserved and Dr. Graening will send them off for identification.

Cave Surveyed: CZ-??
Date: 1-28-02
State: OK
County: Cherokee
Surveyors: Danté Fenolio (OU),
Dr. G.O. Graening (Subterranean Biodiversity Project),
Steve Hensley (USFWS)

Organisms Encountered:

Invertebrates:

Aquatic: None observed
Terrestrial: 2 pseudoscorpions – on raccoon scat
Orange mites – on raccoon scat
Collembola – on raccoon scat
3 Crane flies
50+ mosquitoes
10+ – *Ceuthophilus* sp.

Vertebrates:

Aquatic: 9 larval *Eurycea multiplicata*
Terrestrial: none observed

Notes: This is a small cave just down the hill from CZ-18 opening immediately to the waterway at the base of the hollow. Mr. Hensley indicated that there is usually an Ozark big-ear bat sighted in this cave but we didn't see any today. The many ribbed salamanders were a surprise inside of the cave's waterway – one other was observed in CZ-18 earlier in the day. The waterway in CZ-?? is the same waterway of CZ-18. As the water flows from CZ-18, it flows beneath the ground for several meters, reappearing in CZ-??.

Cave Surveyed: CZ-18
Date: 1/28/02
State: OK
County: Cherokee
Surveyors: Danté Fenolio (OU),
Dr. G.O. Graening (Subterranean Biodiversity Project),
Steve Hensley (USFWS)

Organisms Encountered:

Invertebrates:

Aquatic: None observed

Terrestrial: 2 small white opilionids – near raccoon scat
1 orange opilionid – near raccoon scat
3 small white millipedes – near raccoon scat
2 maroon millipedes – near raccoon scat
100+ coleoptera larvae – on raccoon scat
100+ mosquitoes – many in main entrance room
5+ helemyzid flies
2 *Ceuthophilus* sp.
5+ “wolf spiders”

Vertebrates:

Aquatic:

3 *Typhlotriton spelaeus* larvae - in waterway
2 larval *Eurycea multiplicata* in waterway

Terrestrial:

275+ *Pipistrellus subflavus*
1 *Myotis septentrionalis*
2 *Phoebe* nests – in main entrance room / twilight zone

Notes: We spent a considerable amount of time looking in the waterways of the system for invertebrates without any luck. The larval salamanders in the waterway did not appear to be emaciated – there must be some aquatic invertebrate they are eating that we simply missed. The terrestrial invertebrates were incredible – especially the troglobitic opilionids. Lots of raccoon scat and a wide variety of fungus + coleoptera larvae utilizing it.

Cave Surveyed: DL-39
Date: 5-March-2000
State: OK
County: Delaware
Surveyors: Danté Fenolio (OU), John Malone (OU),
Steve Hensley (USFWS)

Organisms Encountered:

Invertebrates:

Aquatic:

- 1 *Cambarus tartarus* – below the “moonshine room” by ~30m
- 1 *Oronectes neglectus* – near “moonshine room”

Terrestrial:

- 2 cave gnat larvae – near guano piles
- 10+ cave gnats – throughout cave
- 10+ coleoptera - on guano piles
- 10+ *Ceuthophilus* sp. cave crickets – on cave walls

Vertebrates:

Aquatic:

- 18 *Eurycea lucifuga* – aquatic larvae in rimstone pool near moonshine room

Terrestrial:

- 15+ *Pipistrellus subflavus* –throughout cave
- 1 *Myotis grisescens* – near first large guano pile
- 9 *Eurycea lucifuga* – on cave walls
- 1 *Eurycea longicauda melanopleura* – in twilight zone
- 1 *Plethodon glutinosus* – on cave wall
- 1 *Typhlotriton spelaeus* (adult) – on mud bank
- 11 *Rana palaustris* – in shallow water throughout waterway

Notes:

Cave Surveyed: DL-39
Date: 10-09-01
State: OK
County: Delaware
Surveyors: Danté Fenolio (OU),
Dr. L. Bergey (OU),
Steve Hensley (USFWS)

Organisms Encountered:

Invertebrates:

Aquatic:

1 *Cambarus tartarus* – below moonshine room
15 *Oronectes neglectus* – throughout waterway
1 stygobitic amphipod – below moonshine room
10+ stygobitic isopods – below moonshine room
3 Caddis fly larvae

Terrestrial:

Vertebrates:

Aquatic:

2 aquatic *Typhlotriton spelaeus* larvae

Terrestrial:

6 *Eurycea lucifuga*
17 *Rana palaustris*
3 *Myotis grisescens*
2 *Pipistrellus subflavus*

Notes: This was only the second time I have observed *Cambarus tartarus*. They are supposedly more common above the “rasp.”

Cave Surveyed: DL-91
Date: 2-Feb.-2000
State: OK
County: Delaware
Surveyors: Danté Fenolio, John Malone, Jim Erwin

Organisms Encountered:

Invertebrates:

Aquatic:

20 *Cambarus subterraneus*- natural entrance side

Terrestrial:

3 cave gnat larvae- natural entrance side

25+ cave gnats- natural entrance side

5+ coleoptera on guano piles- natural entrance side

Vertebrates:

Aquatic:

1 *Amblyopsis rosae*- natural entrance side

Terrestrial:

10 *Pipistrellus subflavus*- natural entrance side

1 adult *Typhlotriton spelaeus*- natural entrance side

1 *Plethodon glutinosus* – at entrance / natural entrance

1 *Acris crepitans* – at entrance / natural entrance

Notes: Evidence of raccoon, *Procyon lotor*, throughout cave including stream and pool areas where stygobitic crayfish were found. The evidence included scat, claw marks in the mud, and clear raccoon tracks in the mud. Past the stream on the natural entrance side, only a small room with a small pool was accessible after a tight crawl through somewhat of a mud tube. In this pool were *C. subterraneus* and the one *Amblyopsis rosae*.

Cave Surveyed: DL-91
Date: 5-March-2001
State: OK
County: Delaware
Surveyors: Danté Fenolio, Dr. G.O. Graening, Mike Slay, Shane Feirer

Organisms Encountered:

Invertebrates:

Aquatic:

- 16 *Cambarus subterraneus* – natural entrance side
 - 5 adults
 - 11 juveniles all the same size of ~ 2”

Terrestrial:

- 15+ fungus gnats- natural entrance side
- 2 fungus gnat larvae plus webs- natural entrance side
- 5+ other diptera- natural entrance side
- 4 white millipedes (on guano piles) – both sides
- 25+ rust color millipedes (on guano piles) - natural entrance side
- 10 coleoptera (on guano piles) - natural entrance side
- 20+ “earwigs” (on guano piles) - natural entrance side
- 1 sm. White spider (on cave wall) - natural entrance side
- 1 sm. Red spider w/egg sack (on cave wall) - natural entrance side

Vertebrates:

Aquatic:

- 4 Ozark cave fish – *Amblyopsis rosae* – King’s room side / mud-tube waterway

Terrestrial:

- 1 adult *Typhlotriton spelaeus* – grotto salamander – natural entrance side
- 1 *Plethodon glutinosus* – slimy salamander – King’s room side
- 25+ Eastern pipistrelles – *Pipistrellus subflavus* - natural entrance side

Notes: The water level in the creek back from the natural entrance was much higher than when the cave was visited in 2000; the water at that time was at a maximum depth of .5m. The water on this visit occasionally exceeded 1m in depth and had a side channel possibly 3 m in depth. The similarity in size between all of the “juvenile” crayfish would suggest that at least one female had bred in the aquifer system within a window approximately ten months or less prior to this visit (assuming stygobitic crayfish grow at a rate considerably less than aboveground counterparts). One very large adult was observed with a total length between 12 and 15cm. The cave fish were observed in a side passage to the “King’s” room (King’s room entrance) in a pool running through a “mud tube” that extended for ~800m. The rooms on the natural entrance side of the system were different from those reachable in the 2000 visit. Water must have increased in flow and opened up a considerable amount of passage – we were able to push to a very large pond extending back roughly 30m with an average width of 13m – also where 3 stygobitic crayfish were observed including the large adult. Two guano piles were present in a room that was visited in the 2000 visit. Neither of these guano piles had been there the year prior. The bottom to the waterways from both entrances are mainly sediment and no isopods or amphipods were observed. Evidence of raccoon, *Procyon lotor*, throughout cave including stream and pool areas where stygobitic crayfish were found. The evidence included scat, claw marks in the mud and clear raccoon tracks in the mud.

Cave Surveyed: DL-119
Date: 8-31-02
State: OK
County: Delaware
Surveyors: Danté Fenolio (OU),
Mike Slay (UAF),
Dr. G.O. Graening (Subterranean Biodiversity Project)

Organisms Encountered:

Invertebrates:

Aquatic:

1 stygobitic crayfish (*Cambarus* sp.)

Terrestrial:

1 millipede

1 centipede

Vertebrates:

Aquatic:

1 *Amblyopsis rosae*

1 *Typhlotriton spelaeus* larvae

Terrestrial:

1 *Rana clamitans*

Notes: There was evidence of packrats (scat). This cave could probably be pushed farther than we did – there looked to be a high lead up to the right hand corner of the first room.

Cave Surveyed: DL-148
Date: 8-31-01
State: OK
County: Delaware
Surveyors: Danté Fenolio (OU),
Mike Slay (UAF),
Dr. G.O. Graening (Subterranean Biodiversity Project)

Organisms Encountered:

Invertebrates:

Aquatic:

63 stygobitic crayfish *Cambarus* sp.
2 stygobitic isopods
10+ water striders

Terrestrial:

10+ heleomyzid flies
2 unidentified dipterans
4 spiders
1 opilionid

Vertebrates:

Aquatic:

12 *Amblyopsis rosae*
2 "creek chubs"

Terrestrial:

9 *Eurycea lucifuga*
1 *Typhlotriton spelaeus*
5 *Rana clamitans*

Notes: Several of the cave fish observed were juveniles – probably young of the year. The crayfish were observed from very tiny juveniles to what I assume to be adult size. With regard to the identification of the crayfish, Hobbs has indicated that the first form male sent to him from that cave was not *C. subterraneus* and was probably a new species. The waterway is interesting. The cave is shallow at first and tree roots enter the waterway from the walls of the cave. These roots provided hiding places for the juvenile cave fish observed.

Cave Surveyed: OT-13
Date: 1-15-01
State: OK
County: Delaware
Surveyors: Danté Fenolio (OU),
Mark Walvoord (OU),
Steve Hensley (USFWS)

Organisms Encountered:

Invertebrates:

Aquatic:

Terrestrial: 50+ Orange mites - on guano pile
10+ diptera - on guano pile
3 cave gnat larvae

Vertebrates:

Aquatic: 16 larval *Typhlotriton spelaeus* – in cave waterway
3 stygobitic isopods – in chert of the far waterway

Terrestrial: 50+ *Pipistrellus subflavus*
6 *Eurycea lucifuga*

Notes:

Cave Surveyed: OT-13
Date: 10-02-01
State: OK
County:
Surveyors: Danté Fenolio (OU),
Steve Hensley (USFWS)

Organisms Encountered:

Invertebrates:

Aquatic:

2 stygobitic isopods

Terrestrial:

25+ *Ceuthophilus* sp.

Vertebrates:

Aquatic:

9 larval *Typhlotriton spelaeus*

Terrestrial:

15,000+ *Myotis grisescens*
1 adult *Typhlotriton spelaeus*
3 *Eurycea lucifuga*

Notes: We waited until the bats left and entered the cave at roughly 8:15pm.