CAVE FAUNAL STUDY FOR THE INTERSTATE 66 E.I.S (SOMERSET TO LONDON, KENTUCKY)

Julian J. Lewis
Salisa L. Lewis
Lewis & Associates LLC
Cave, Karst & Groundwater
Biological Consulting
17903 State Road 60
Borden, IN 47106-8608
lewisbioconsult@aol.com

Abstract

A detailed cave faunal investigation was performed within the scope of a larger karst and geohazards study on the proposed corridor for Interstate 66 in Pulaski and Laurel Counties, Kentucky. The assessment included the five basic steps generally required in National Environmental Policy Act (NEPA) technical studies. A total of 63 caves were visited revealing the presence of 114 taxa. Of the sites sampled, 29 of them were inhabited by globally rare species. The presence of 28 species of troglobites and stygobites was documented in the large cave system associated with Sinking Valley. This is the second largest assemblage of obligate subterranean species known in North America, second only to the Mammoth Cave System. A vulnerability rating using GIS mapping for karst areas within the study bands was developed: (1) low — no known caves or fauna; (2) moderate — cave present; (3) high — cave present with known fauna; (4) very high — cave present with globally rare species. In addition a cave cricket foraging area was buffered around all cave entrances and known or inferred passages.

Introduction

The purpose of the cave faunal inventory was to be encompassed within the inventory of karst features (Figure 1) and geohazards found within the Interstate 66 (Somerset to London, Kentucky) study bands identified by the I-66 Citizens Committee. The firm of Gannett Fleming Engineers and Architects, P.C. was employed to prepare the Karst and Geohazards Study in conjunction with HMB Professional Engineers, Inc. Lewis and Associates LLC were hired as a sub-consultant to Gannett Fleming to prepare the karst faunal investigation.

Gannett Fleming implemented a three-phase approach to provide impact information in the areas of geologic resources and geohazards, hydrogeology, and karst fauna. The assessment included the five basic steps that are generally required in National Environmental Policy Act (NEPA) technical studies for Environmental Impact Statements (EIS): (1) data gathering and literature reviews, (2) field reconnaissance, (3) preparation of a report of existing conditions, (4) development of impact characterization and alternative comparison, and (5) a summary of opportunities for avoidance, minimization and mitigation of potential impacts.

Initially ten alternate bands were designated as possible routes for this interstate. Three preferred alternates were subsequently designated: (1) Kentucky 80 band (Figure 2), following the extant highway; (2) north band (band B), that extends roughly parallel and predominantly north of highway 80, and (3) south band (band D), that runs south of highway 80. The karst feature field inventory was performed prior to the initiation of the karst faunal study, analyzing the three preferred alternates in the western part of the project area where they are largely underlain by carbonate rock strata. A total of 1,129 karst features were identi-

Figure 1. The Short Creek karst window, a major karst feature of the I66 project area, created by collapse of the main stream passage of the Sinking Valley Cave System.

fied within the three bands, with virtually all karst features located in Pulaski County (to the east in Laurel County where the bands extend, non-carbonate strata do not occur at or near the surface). Forty-nine percent of the karst features inventoried were found within the KY-80 band, with 28% and 23% in bands D and B, respectively. Other environmental considerations (for example, coal and industrial mineral resources) were identified in bands crossing Laurel County.

Figure 2. Kentucky Highway 80 crosses over the Sinking Valley Cave System just south of the collapse feature known as Quarry Sink.

Previous bioinventory in caves of the I-66 project area

There has been no previous comprehensive survey of the cave fauna specific to the proposed Interstate 66 project area. Barr (1979) prepared a report for the Kentucky Nature Preserves Commission on the caves and cave fauna of eastern Kentucky. That report included Stab Cave in the project area and Baker Cave, which lies outside of the project area, but is part of the Sinking Valley Cave System that traverses under Kentucky Highway 80. Other caves in the vicinity that were sampled by Barr were Richardson Cave and Richardson Pit (2.5 miles east of Somerset) and Wind Cave (1.1 miles south of Ruth). These caves are far removed from the I-66 project area.

Barr (1979) reported three species from Stab Cave. These were: (1) the cave ground beetle *Darlingtonea kentuckensis*, reported as being a widely distributed species for which 59 caves were listed in seven Kentucky counties; (2) cave sheet-web spider *Porrhomma cavernicolum*, reported from a total of three caves in eastern Kentucky, characterized as having highly disjunct colonies within a wide range; and (3) the cave cricket *Hadenoecus cumberlandicus*, for which over 100 caves were listed from a 13 county area.

Baker Cave is a window into the upstream part of the Sinking Valley Cave System. Barr (1979) reported the following species from this cave: the cave ground beetles *Darlingtonea kentuckensis*, *Ameroduvalius jeanneli*, *Nelsonites jonesi*, cave crayfish *Orconectes australis packardi* (from Hobbs & Barr 1970), cave isopod *Caecidotea* sp., gammarid amphipods, cave cricket *Hadenoecus cumberlandicus* (from Hubbell & Norton 1978), cave salamander *Eurycea* larvae, plecopteran larvae, fish *Notropis* sp., *Schilbeodes* sp., chironomid fly larvae, dipluran *Plusiocampa* sp., springtail *Pseudosinella hirsuta*, millipeds *Pseudotremia* sp. and *Scoterpes* sp., and eastern pipistrelle bat *Pip-*

Figure 3. Sampling the aquatic fauna of rimstone pools in Stab Cave.

istrellus.

Thus, Barr (1979) demonstrated two species of obligate cavernicoles from the project area and eight more that probably occurred there as evidenced by their presence in the Sinking Valley Cave System.

In the broader view, the cave fauna of the project area lies within what has been termed the Rockcastle Fauna, a subset of the assemblage of animals that occur in the karst area associated with the edge of the Cumberland Plateau. Within the Rockcastle Fauna, two areas were delineated with slightly different faunas maintained by extrinsic barriers: (1) northern Rockcastle Fauna, in Rockcastle County and Pulaski County north of the Cumberland River (including the project area), and (2) southern Rockcastle Fauna, in Pulaski and McCreary Counties south of the Cumberland River. The fauna of these areas has been delineated by Barr (1967, 1979) and Lewis (1999).

Results: Cave and groundwater sampling for the I-66 EIS

For the karst faunal section of the Environmental Impact Statement a total of 63 sites, primarily caves (also springs, wells, and other windows into groundwater), were visited for the purpose of sampling the subterranean fauna. Besides hand sampling, pitfall traps baited with limburger cheese were placed in most of the caves visited. Leaf litter was sampled with Berlese extraction. Aquatic sampling (Figure 3) included plankton drift collections, plankton netting of rimstone pools, dipping water from shallow drip pools and running the water through a plankton net, and Karaman-Chappuis extraction of stream gravel habitats.

This bioinventory revealed the presence of 114 taxa. This was a diverse assemblage divided among 4 phyla, 11 classes, 27 orders, 55 families and 90 genera. Of the sites sampled 29 were inhabited by species classified as globally rare by the ranking system typically employed by natural heritage biologists (Table 1). Thirty-seven species were assigned global ranks (Table 1) of significant rarity: G1-13, G2-11, G3-and 13.

Of the fauna found in the project area, the terrestrial snail *Helicodiscus punctatellus* and millipede *Chaetaspis fragilis* were formerly only known associated with the Mammoth Cave System in central Kentucky. One taxon, the stygobitic copepod crustacean *Itocyclops* undescribed species, remains known only from Stab Cave and is thus as presently understood endemic to the I-66 corridor. Another millipede *Pseudotremia* undescribed species is apparently endemic to the Sinking Valley Cave System, but occurs in caves outside of the road bands. The troglobitic carabid beetle *Pseudanophthalmus* undescribed species is also known from a cave west of the study area. Significant vertebrates noted in the caves of the I-66 project area were the federal endangered gray bat *Myotis grisescens* and Rafinesque's big-eared bat *Corynorhinus rafinesquii*.

The presence of 28 species of troglobites and stygobites was documented in the large cave system associated with Sinking Valley (Table 2). This is the second largest assemblage of obligate subterranean species known in North America, second only to the Mammoth Cave System (Mammoth Cave National Park). Of the preferred bands, both the Kentucky 80 and north band alternatives cross this cave system. The southern band avoids Sinking Valley, but has a planned interchange in the sinking stream that flows into Cedar Creek Cave. Fourteen species of obligate subterranean invertebrates were found in this cave. Similarly, 15 obligate subterranean species were found in Stykes Cave that occurs

Table 1. Simplified criteria for global rarity rankings (G-ranks).

Global Rank	Number of global occurrences	Characterization
G1	1-5	critically imperiled
G2	6-20	imperiled
G3	21-99	vulnerable
G4	>100	apparently stable
G5		stable

Table 2. Obligate subterranean species associated with the Sinking Valley Cave System, Pulaski County, Kentucky.

Scientific Name	Common Name
Sphalloplana percoeca	cave flatworm
Carychium stygium	terrestrial snail
Helicodiscus punctatellus	terrestrial snail
Itocyclops undescribed sp.	groundwater copepod
Pseudocandona jeanneli	Jeannel's groundwater ostracod
Pseudocandona undescribed sp.	groundwater ostracod
Caecidotea stygia	cave isopod
Miktoniscus barri	cave terrestrial isopod
Crangonyx castellanum	cave amphipod
Orconectes australis	cave crayfish
Phanetta subterranea	Subterranean sheet-web spider
Porrhomma cavernicola	Cavernicolous sheet-web spider
Anthrobia mammouthia	Mammoth cave sheet-web spider
Hesperochernes mirabilis	cave pseudoscorpion
Pseudotremia undescribed sp.	Sinking Valley cave milliped
Scoterpes copei	Cope's cave milliped
Chaetaspis fragilis	Fragile cave milliped
Pseudosinella christianseni	Christiansen's cave springtail
Pseudosinela hirsuta	Hirsute cave springtail
Sinella barri	Barr's cave springtail
Sinella hoffmani	Hoffman's cave springtail
Sinella krekeleri	Krekeler's cave springtail
Litocampa undescribed sp.	cave dipluran
Ameroduvalius jeanneli	cave beetle
Darlingtonea kentuckensis	cave beetle
Nelsonites jonesi	cave beetle
Pseudanophthalmus undescribed sp.	cave beetle
Spelobia tenebrarum	cave dung fly

in the valley to the south of the southern band.

GIS mapping employed a cave vulnerability rating within the study bands: (1) low — no known caves or subterranean fauna; (2) moderate — cave present; (3) high — cave present with known fauna; (4) very high — cave present with globally rare species. In addition an area was suggested to protect cave cricket foraging grounds in a 500-foot diameter around all cave entrances and known or inferred passages.

Any site with globally rare species (G1, G2, or G3) was of particular significance. An index was developed that places an emphasis on sites where assemblages of two or more rare species occur, which was termed the composite rarity. In this index of composite rarity, a G1 species = 10 points, G2 = 5 points, and G3 = 3 points. To find the composite rarity index for a given site, a formula was employed:

$$A\ (\Sigma G1s) + B\ (\Sigma G2s) + C\ (\Sigma G3s)$$

An example of composite rarities for several caves in the I-66 corridor is presented in Table 3.

Conclusion

All band alternatives potentially affect significant cave faunal assemblages. The Kentucky 80 and northern bands cross the Sinking Valley Cave System. While the southern band avoids this major system and its fauna, it is on or near other smaller caves with significant fauna. The Kentucky 80 band has the merit of utilizing an extant road, whereas the northern and southern bands would entail construction across mostly new terrain. Many things, including the karst and its fauna, must be considered in such an undertaking and the final decision remains to be determined by the Kentucky Transportation Cabinet.

Table 3. Examples of composite rarity ranking of sites in the I-66 project area.

	Composite Rarity	Obligate Subterranean	Band Association
Stab Cave	91	19	Kentucky 80
Stykes Cave	79	15	Southern
Odell's Pit	79	14	Northern
Cedar Creek Cave	57	12	Southern
Cedar Creek Spring Cave	43	10	Southern
Cave #16	42	11	Southern
Blackhawk Cave	37	11	Kentucky 80
Blowing Cave	36	9	Between Ky 80 & Southern
Price Cave	33	8	Kentucky 80

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