SOME "COMMANDMENTS" FOR CONSERVATION IN KARST FAUNAL SECTIONS OF ENVIRONMENTAL IMPACT STATEMENTS

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Abstract

Environmental impact statements as mandated by the National Environmental Policy Act (NEPA) have the mantra of "avoid, minimize and mitigate." Four points are made herein concerning these studies in the case of caves and karst: (1) the cave entrance is not the cave; (2) avoiding the cave does not avoid the subterranean fauna; (3) limiting sampling to project areas produces corridor endemics; and (4) nothing should ever be taken for granted when it comes to karst invertebrates.

Key words: NEPA, EIS, environmental impact statements, karst management, cave biology

Introduction

Federal agencies and others receiving federal funding are required by the National Environmental Policy Act (NEPA) to integrate environmental values into their decision-making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. This requirement is met by the preparation of a detailed document known as the Environmental Impact Statement (EIS). The preparatory work for a major EIS may take years of work by dozens of specialists, with the final product being hundreds of pages in length. With all that is entailed the path remains fraught with obstacles, with the treatment of karst and its unique inhabitants being anything but uniform from project to project.

The mantra of NEPA is to avoid, minimize, or as a last alternative, mitigate, the impacts on the environments being affected by construction (which generally entails destruction). That said, experience shows that compliance with avoidance or minimization can be interpreted in many ways, some of which are better than others. The audience that needs to hear this is seemingly absent from the NCKMS, thus we have the familiar feeling of "preaching to the choir." Following this theme, herein we suggest four "commandments!"

Thou Shalt Not Consider the Entrance to be the Cave.

Although this point has been made previously, the problem continues to re-emerge: during planning caves are considered as dots on maps where the entrances occur. Although the entrance is fundamentally important to the access of organisms and nutrients, the entrance is not the cave. From a functional standpoint the "entrance" denotes a portal for humans. With the exception of blind vertical pits, the cave extends from the point on the map denoting the entrance. Thus, avoiding the entrance does not avoid the cave.

Thou Shalt Not Consider Cave Fauna to Live Only in Caves.

This commandment is essentially an extrapolation from the first. Clearly many of the trogloxenes and troglophiles can and do leave the cave. The role of these animals in the nutrient input into caves needs no further elaboration.

Concerning the obligatory cave inhabitants, cave maps show only passages that are traversable by humans. Invertebrates can easily move around in areas that are not enterable by people. For a pselaphine beetle, linyphiid spider, or springtail, a tube the diameter of a pencil would be equivalent to a subway tunnel to a human. For aquatic animals it is becoming increasingly obvious that the saturated interstices of the epikarst are dispersal corridors for aquatic invertebrates. As an example, we shall examine the case of Jordan's groundwater isopod (*Caecidotea jordani*) (fig. 1). Endemic to southern Indiana, this species was discovered in a seep spring under the building housing the Department of Biology on the Indiana University campus at Bloomington. We have subsequently found it in water dripping from the Indiana epikarst at Chase Cave (Lawrence County), a parafluvial gravel deposit on the bank of the Blue River (Crawford County) and a seep spring on our own property in Burns Hollow (Clark County) (Lewis 1998, Lewis, et al. 2004, Lewis and Lewis 2006). This last site is of particular interest. Of the four known populations, all are in Indiana's south-central upland area, but the Burn's Hollow seep occurs in a nonkarst area at the base of the Knobstone Escarpment. Clearly, this eyeless, unpigmented isopod is not restricted to caves, or even karst.

Figure 1 *Jordan's groundwater isopod (Caecidotea jordani).*

Thou Shalt Sample Outside of the Project Area.

One of the major concerns of anyone undertaking a construction project is dealing with the presence of animals or plants listed on the U.S. Fish and Wildlife Service endangered species list. The worst case scenario, the object of nightmares and sleepless nights by project managers, is a listed species that is known solely from within the proposed construction corridor.

The potential for finding extremely rare fauna is great when dealing with caves, where even today many species new to science are constantly being found. Many of these are known from single caves. Thus, little did we know that when we collected a water sample from a pool in Stab Cave (in the Highway 80 band for the proposed I-66 corridor in eastern Kentucky), that we had found a species, new to science, of the copepod *Itocyclops*. Until recently this group of groundwater crustaceans had been reported only from Japan and southeastern Alaska, when Reid and Ishida (2000) discovered it in a seep spring in the Great Smoky Mountains, Tennessee.

After finding the unique new species in Stab Cave we began sampling outside of the proposed highway corridor and found it in two caves outside of the project area. Fortuitously, in time *Itocyclops* undescribed species was also found in a cave in north central Tennessee (Lewis and Lewis, 2007). Although still poorly known, this crustacean is relatively widespread. Had sampling been limited to the I-66 project area it would have remained a problematic "corridor endemic" that would have been an artifact of inadequate collecting rather than a true reflection of the range of the species.

Thou Shalt Take Nothing For Granted.

In March of 2007 we were requested by the Hoosier National Forest to evaluate a site that was to be partially inundated by a project on the adjacent surface channel of the Lost River. The river had been channelized resulting in a drop in the water level of several feet. The proposed project would restore the channel and water to their pre-disturbance levels. The concern by the forest service was that the cave would then be flooded as a result.

The site was Holloway Cave, consisting of an entrance large enough to squeeze through into a hole perhaps 10 feet in length. By the standards of the Indiana Cave Survey it was only considered as a karst feature rather than a cave, a veritable hole in the ground.

During our first visit the sinkhole in which the cave entrance was located was completely under water because of the spring flooding of the Lost River. Looking at the water-filled hole it was easy to be dubious that much was going to be found in such a small, inhospitable place.

On the next visit the river had lowered to a more normal stage and the cave was mostly dry, except for a water-filled fissure in the floor. Using a plankton net, a water sample was taken from this small pool. The result was surprising: Holloway Cave contained the only known Indiana population of Hauer's copepod (*Diacyclops haueri*).

This tiny crustacean usually inhabits floodwater pools. It may be that since the Lost River was channelized the copepod has been using the cave as a refugium and will become more common locally when the habitat is restored (Lewis 2007).

The object lesson from the Holloway Cave project was that even the least suitable looking habitat might have some hidden surprises—one should never make any assumptions.

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