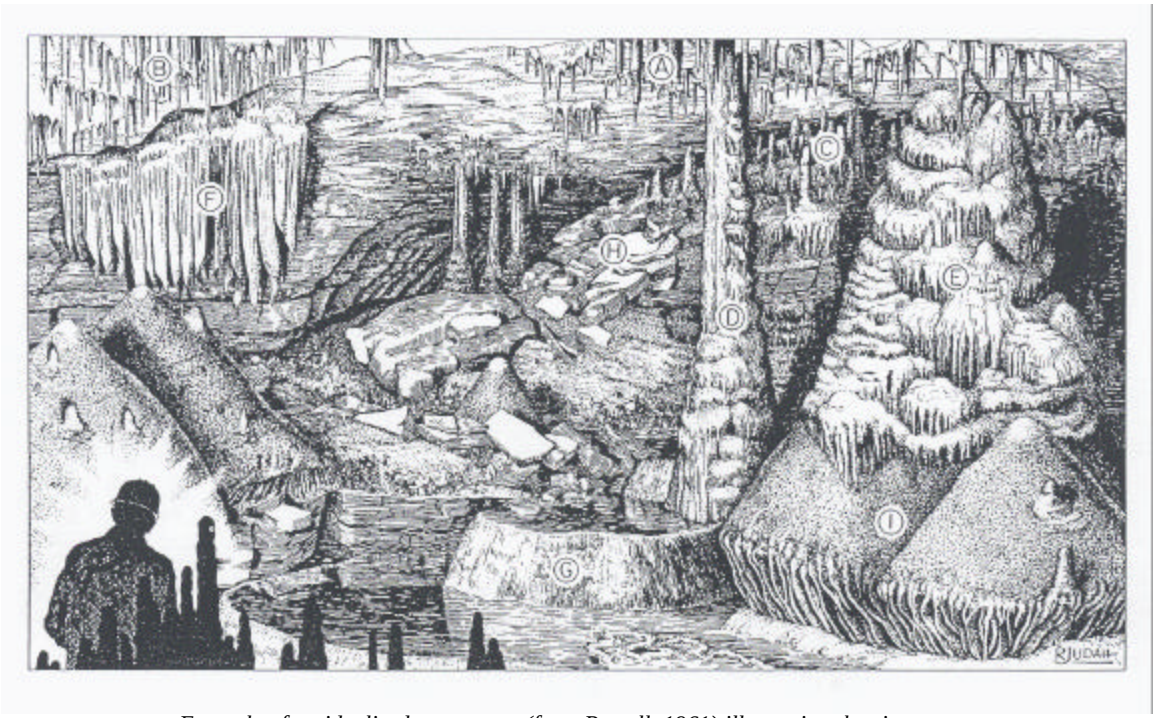
Community Conservation Assessment for Epikarstic Aquifer Habitat (Associated Rare Animal Species)



Example of an idealized cave scene (from Powell, 1961) illustrating the rimstone pools (G) where epikarstic fauna occurs

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HOOSIER NATIONAL FOREST

This Conservation Assessment was prepared to compile the published and unpublished information on the epikarstic aquifer habitat and associated rare animals species in the Hoosier National Forest. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject community and associated taxa, please contact the Eastern Region of the Forest Service Threatened and Endangered Species Program at 310 Wisconsin Avenue, Milwaukee, Wisconsin 53203

Table of Contents

EXECUTIVE SUMMARY

The purpose of this document is to provide the background information necessary to prepare a Conservation Strategy, which will include management actions to conserve the epikarstic aquifer communities. The copepod Megacyclops undescribed species and the amphipod Crangonyx packardi are presently listed as Regional Forester Sensitive Species that occur in epikarstic aquifer communities on the Hoosier National Forest. Rare species to be proposed for listing as Regional Forester Sensitive Species are the flatworm Sphalloplana weingartneri and copepods Diacyclops jeanneli, Rheocyclops indiana.

DESCRIPTION OF HABITAT AND COMMUNITY

The presence of a habitat in an upper zone found above enterable cave passages was first proposed by Meinzer (1923), otherwise referred to as the "zone de percolation temporaire" by Geze (1958) and later as the "zone d'absorption epikarstique" (Mangin, 1975). This epikarstic zone at the interface of the limestone and the overlying strata can contain reservoirs of water and constitutes an epikarstic aquifer (Mangin, 1985).

Viewed in the context of the geology of the Hoosier National Forest, the epikarstic zone probably occurs as a shallow aquifer at the limestone/soil or limestone/sandstone contact. Although the epikarst is the actual habitat, penetration into the epikarst by humans is generally impossible. Thus, the presence of an epikarstic community is detected only through indirect means. Typically, an epikarstic community is suspected when animals are detected in pools high above stream level or in caves where no streams occur.

In Indiana taxa suspected to be present in epikarstic habitats as evidenced by sampling of fauna in pools in underlying caves are the flatworm Sphalloplana weingartneri, copepods Megacyclops undescribed species, Rheocyclops indiana, or Diacyclops jeanneli, amphipod Crangonyx packardi and isopod Caecidotea stygia (Lewis, et al., 2002). The presence of these organisms in caves is believed to be an accidental occurrence, when they are washed or fall from the epikarst.

ENVIRONMENTAL CONDITIONS

In many ways the epikarstic aquifer is similar to that characterized by Camacho (1992) for the phreatic environment:

(1) Sediment grain size – The size of the constituent particles establishes the porosity of the habitat and is the limiting factor as to what kinds of animals can exist in the interstices. At some point there is a minimum threshold below which the pores in the sediment are too small to accommodate animals. Animals that live in epikarstic habitats are usually tiny or vermiform.
(2) Light—According to Pennak (1950) all light disappears with 10 centimeters of the surface. Thus no plant life occurs in the habitat and the animals present in this environment have morphological adaptations similar to animals living in caves.

(3) Water flow rate—Phreatic water flow is not static, there being an interplay between surface and subsurface waters. The current is also dependent upon the size of the sediment grains (determining porosity), the heterogeneity of the sediment, and the degree of compaction. Angelier (1962) stated that flow velocity decreased with increasing depth, as vertical movement decreases and laminar flow increases. Unlike phreatic waters, epikarstic aquifers will eventually flow vertically after traveling some distance along the more or less horizontal epikarst, toward base level in the underlying sedimentary rocks. Where caves exist, this vertical flow can occur rapidly.

(4) Temperature—Surface waters respond to environmental changes on a constant basis. The temperature of the underlying groundwater is a function of the temperature of the surface water supplying it. However, the effect of surface temperature decreases with depth underground and in the deepest groundwater layers the temperature is practically constant and independent of daily or seasonal fluctuations.

(5) Dissolved oxygen—Of the many who have studied the oxygenation of phreatic groundwaters, there is no consensus as to how the constraining factors determining dissolved oxygen levels work. In general dissolved oxygen is a function of temperature. The concentration varies with depth and permeability of the sediment and the rate at which it is being renewed.

(6) Dissolved solids—The level of dissolved solids which determines pH, alkalinity, etc. is determined by the chemical nature of the ground through which the water is flowing, and varies tremendously from site to site.

(7) Organic matter—Organic matter is abundant on the surface and decreases with depth into the ground. The presence of decomposing organic matter determines the level of reduction in the environment, thus affecting dissolved oxygen levels. Evidence indicates that due to the contained nature of the habitat, organics persist in phreatic groundwaters significantly longer than in free flowing waters characteristic of surface streams.

CURRENT COMMUNITY CONDITION, DISTRIBUTION AND ABUNDANCE

In the Hoosier National Forest epikarstic aquifers may occur anywhere that limestone is near the surface. This condition is fairly common in a narrow band of limestone that runs from south to north through the Hoosier National Forest. Although the epikarst is impossible to view, there is reason to think that the condition of the habitat and its community is excellent.

REGIONAL FORESTER SENSITIVE SPECIES

Megacyclops undescribed species and Crangonyx packardi are presently listed as Regional Forester Sensitive Species and occur in upper level drip pools suggestive of overlying epikarstic aquifers on the Hoosier National Forest. Rare species to be proposed for listing as Regional Forester Sensitive Species are the flatworm Sphalloplana weingartneri and copepods Diacyclops jeanneli, Rheocyclops indiana.

POTENTIAL THREATS

Due to the close proximity to the surface epikarstic aquifers are particularly susceptible to contaminants. Potential contaminants include (1) sewage or fecal contamination, including sewage plant effluent, septic field waste, campground outhouses, feedlots, grazing pastures or any other source of human or animal waste (Harvey and Skeleton, 1968; Quinlan and Rowe, 1977, 1978; Lewis, 1993; Panno, et al 1996, 1997, 1998); (2) pesticides or herbicides used for crops, livestock, trails, roads or other applications; fertilizers used for crops or lawns (Keith and Poulson, 1981; Panno, et al. 1998); (3) hazardous material introductions via accidental spills or deliberate dumping, including road salting (Quinlan and Rowe, 1977, 1978; Crawford, 1985; Lewis, 1993, 1996).

SUMMARY OF LAND OWNERSHIP AND EXISTING HABITAT PROTECTION

An undescribed copepod crustacean of the genus Megacyclops is known only from a drip pool receiving water from the overlying sandstone exposed in Campground Cave, Springs Valley Recreation Area (Orange County). The amphipod Crangonyx packardi and isopod Caecidotea stygia also occur in the same pool in Campground Cave.

In Elrod Cave, at Wesley Chapel Gulf Special Area (Orange County), Rheocyclops indiana occurs in upper level pools originating from drip water presumably coming in from a shallow aquifer at the soil/limestone contact. The isopod Caecidotea stygia was also present in these pools.

In Apple Cave, on privately held land adjacent to the Paoli Experimental Forest (Orange County), the copepod Diacyclops jeanneli was taken from an upper level rimstone pool, in the company of the isopod Caecidotea stygia and amphipod Crangonyx packardi.

In Brick Pit, at the Tincher Special Karst Area (Lawrence County) a tiny drip pool in this streamless pit (high above base level) contained the flatworm Sphalloplana weingartneri, amphipod Crangonyx packardi and isopod Caecidotea stygia.

The special areas were designated due to the presence of karst features and have restricted management for protection of the resource (USDA Forest Service, 1991; 2000).

SUMMARY OF MANAGEMENT AND CONSERVATION ACTIVITIES

Cave and karst habitat located on the Hoosier National Forest are subject to standards and guidelines for caves and karst protection and management as outlined in the Hoosier National Forest Land and Resource Management Plan (Forest Plan) (USDA Forest Service, 1991). These standards and guidelines include the following:

*Caves are protected and managed in accordance with the Federal Cave and Karst Resources Protection Act of 1988, Forest Service Manual 2353, Memorandums of Understanding between the forest service and the National Speleological Society, the Indiana Karst Conservancy, Inc., the Forest Cave Management Implementation Plan, and individual specific cave management plans.

*Except where modified by an existing cave management prescription, vegetation within a 150-200 foot radius of cave entrances and infeeder drainages with slopes greater than 30 percent will generally not be cut. No surface disturbing activities will be conducted on any slopes steeper than 30 percent adjacent to cave entrances. Similar protection areas will be maintained around direct drainage inputs such as sinkholes and swallow holes known to open into a cave's drainage system of any streams flowing into a known cave.

*Allow no sediment from erosion of access roads and drilling sites to wash into caves or karst features.

*Seismic surveys requiring explosives shall not be conducted directly over known cave passages or conduits.

*All caves will be managed as significant.

(USDA Forest Service, 1991)

The forest plan includes a cave and karst management implementation plan. This management plan places an emphasis on cave resource protection and mitigation. Understanding of the caves is established through mapping, bioinventory, cataloging of resources (e.g., archaeological, paleontological, speleothems, etc.), and estimating use levels and trends. Protection zones or other mitigation measures recommended by a management prescription will be established around caves entrances, sinkholes and swallowholes. Specific criteria will include consideration for protection of entrance and cave passage microclimate, animals inhabiting the cave, physical and chemical parameters and aesthetic values associated with the cave.

RESEARCH AND MONITORING

A bioinventory of subterranean habitats of the Hoosier National Forest is being conducted in which the epikarstic fauna is being sampled (Lewis, et al., 2002; and in progress).

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