

**Report of a mass aggregation of isopods  
in an Ozark cave of Oklahoma  
with considerations of population sizes of stygobionts**

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On 28 January 2002 S. Hensley (United States Fish and Wildlife Service) and DBF entered an Adair County, Oklahoma, cave (code AD-8) to perform a bioinventory. The cave seasonally accommodates a maternity colony of *Myotis grisescens* Howell 1909 and has substantial guano deposits within the main passage. The cave also has a shallow stream running through it which feeds several large pools before exiting the system. The stream meanders directly between guano piles and is in the flight path of bats exiting/entering the cave. The first large pool within the mouth of the cave (roughly 10 m in from the dripline) is just beyond the twilight zone. At the time of the survey, this was a shallow, roughly circular pool, slightly larger than 3 m in diameter. The pool depth was 10 cm or less at its deepest point. The bottom of the pool was covered with fine sediment, a significant portion of which was decaying guano. To the very shoreline of the pool, the bottom was covered by thousands of stygobiotic isopods, *Caecidotea macropropoda* Chase and Blair 1937 which formed a fairly uniform mat, in some places stacked at least 3 individuals deep (Figure 1). In 1981, Lewis<sup>1</sup> had described this aggregation in cave AD-8 as, “a large population of isopods in a guano bog.”

To estimate the number of isopods in the pool, we calculated the surface area of the pool and multiplied by a number of isopods per square cm (derived from visual examination of images taken during the event). We used a radius of 150 cm for the circular pool, a density of 1.5 isopods per cm<sup>2</sup>, and roughly 50% of the pool having isopods stacked 2 or 3 individuals deep; we estimate between 100,000 to 150,000 isopods were in the pool.

The purpose of the aggregation was not inherently obvious in that individuals with eggs were not observed. Further, guano deposits covered the bottom of the aquatic system throughout the waterway and the length of the cave, including the bottoms of large pools farther into the system. While many individual *C. macropropoda* could be found throughout the course of the waterway, the aggregation was only observed in this last large pool, before the cave's stream exited the system. No fewer than 10 larvae of the grotto salamander, *Eurycea spelaea* (Stejneger, 1892), were observed in the pool where the isopods were aggregated. The larval salamanders ranged from 4 to 8 cm in total length. All salamander



**Figure 1.** An aggregation of *Caecidotea macropropoda* in a cave in Adair County, Oklahoma. The black material viewable in the substrate is guano.

larvae had their abdomens so distended from feeding on isopods that they were not resting on their limbs. Instead, their distended abdomens were in direct contact with the substrate. One salamander larva was observed with an isopod in its mouth. This observation confirms a much earlier observation that larval *E. spelaea* feed on *C. macropropoda*<sup>2</sup>.

Subterranean populations are understood to be small because of the scarcity of visible life in caves, the small number of specimens in museum collections, and because of the general paucity of food resources below ground<sup>3</sup>. Yet some biospeleologists believe that population sizes of less than 500 are uncommon for obligate species, in part based upon genetic studies, and that small populations are the exception, not the rule<sup>4,5,6</sup>. As another example of larger population sizes than were assumed, only a handful of Salem cave crayfish, *Cambarus hubrichti* Hobbs 1952 were known from Meramec Cave (Franklin Co., Missouri) until a liquid ammonia spill robbed the cave stream of oxygen and forced the evacuation of thousands of crayfish from the cave<sup>7</sup>. Regardless, most obligate species are known from relatively few individuals<sup>8</sup>; the exception is typically the population explosions that are supported by fresh bat guano inputs. For example, “tens of thousands” of cave flatworms, *Dendrocoelopsis americana* (Hyman, 1939), were reported in this same cave (AD-8) congregating in guano-enriched stream pools<sup>9</sup>.

The debate over true population size of obligate species in caves is important because of the textbook “50-500” rule<sup>10</sup> of the extinction probability of small populations. Franklin<sup>10</sup> calculated that an effective population size of at least 500 individuals are needed to be safe from inbreeding depression, and that an effective size of less than 50 individuals is in danger

of extinction (e.g., from deleterious mutation accumulation). Lynch et al.<sup>11</sup> conclude that populations as large as one thousand are still susceptible to “mutational meltdown.”

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