

The subterranean fauna of the Arbuckle Mountains Ecoregion of Oklahoma, USA

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The Arbuckle Mountain Uplift, and the Arbuckle Plains to a lesser extent, hosts an impressive density of caves in karstified limestone formations (e.g., West Spring Creek and Kindblade) of the Ordovician Period. These caves serve as karst windows into the extremely deep and productive Arbuckle-Simpson Aquifer (Graening et al. 2011). The fauna found within subterranean habitats within the Arbuckle Mountains Ecoregion of Oklahoma (Carter, Coal, Johnston, Murray, and Pontotoc counties) were investigated as part of a larger bioinventory program (Graening et al. 2008; Graening et al. 2011). Previous studies of subterranean habitats in or near this ecoregion include Creaser and Ortenberger (1933), Mackin (1935), Mackin and Hubricht (1940), Hall (1956), Chamberlin and Hoffman (1958), Harrel (1960, 1963), Vandel (1965, 1977), Black (1971, 1973, 1974), Holsinger (1971, 1989), Fleming (1972), McKinley et al. (1972), Reisen (1975), Matthews et al. (1983), Vaughn (1996), Gaskin and Bass (2000), Lewis (2002), The Nature Conservancy (2004), Graening et al. (2006, 2007), and Lewis et al. (2006).

Eight obligate subterranean species have been documented from the karst of the Arbuckle Mountains Ecoregion.

- Oklahoma Cave Amphipod *Allocrangonyx pellucidus* (Mackin, 1935) (Allocrangonyctidae) (**Figure 1**): endemic to the Arbuckle Uplift and Plains in four springs in Johnston County, three caves and six springs in Murray County, and

two springs and one cave in Pontotoc County (Graening et al. 2006). We report a new county record for *A. pellucidus*: Carter County, Hard Rock Cave, 31 January 2009, 12 counted by Graening and Harris. Other fauna documented at this cave include the Southern Plains Crayfish *Procambarus simulans*, the stygobiotic isopod *Caecidotea acuticarpa*, and the trogllobiotic pill bug *Miktoniscus oklahomensis* (**Figure 2**) (this study). *Allocrangonyx pellucidus* is designated by the International Union for the Conservation of Nature and Natural Resources (IUCN) as ‘Vulnerable’ to extinction (VU D2) (Inland Water Crustacean Specialist Group 1996) and as ‘Imperiled’ (S2) by the Oklahoma Natural Heritage Inventory (INHI 2015). It is also designated tier I status by the Oklahoma Department of Wildlife Conservation. The full rationale for these conservation status ranking systems is detailed in IUCN (2012) and Faber-Langendoen et al. (2012).

- Arbuckle Mountains Cave Amphipod *Stygobromus* sp. nov. (Crangonyctidae): single-site endemic from one cave in Murray County (Holsinger manuscript in preparation).
- Alabama Groundwater Amphipod *Stygobromus alabamensis* (Stout, 1911) (Crangonyctidae): known from two springs in Murray County and three springs in Pontotoc County (Graening et al. 2006). This stygobiotic amphipod occurs in karst groundwater habitats throughout the southeastern United States but is designated as ‘Vulnerable’ (S3) in Oklahoma (ONHI 2015).
- The stygobiotic isopod *Caecidotea acuticarpa* Mackin & Hubricht, 1940 (Asellidae): endemic to the Arbuckle Uplift and Plains from five springs, one cave, and one well in Johnston County; four springs and four caves in Murray County; and three springs and one cave in Pontotoc County (Graening et al. 2007). Additionally stygobiotic isopods (*Caecidotea* sp.) were reported from an additional five springs in Johnston County and two springs and three caves in Murray County (Graening et al. 2007). *Caecidotea acuticarpa* is designated as ‘Critically Imperiled’ (S1) in Oklahoma (ONHI 2015). It is also designated tier I status by the Oklahoma Department of Wildlife Conservation.
- The trogllobiotic terrestrial isopod *Amerigoniscus centralis* Vandel, 1977 (Trichoniscidae): single-site endemic from one cave in Murray County (Vandel 1977). Subsequent bioinventories have not detected this species (Graening et al. 2007). *Amerigoniscus centralis* is designated as ‘Critically Imperiled’ (S1) in Oklahoma (ONHI 2015).
- The trogllobiotic terrestrial isopod *Miktoniscus oklahomensis* Vandel, 1965 (Trichoniscidae): endemic to the Arbuckle Uplift from one cave in Carter County and four caves in Murray County (Vandel 1965; Graening et al. 2007; this study). *Miktoniscus oklahomensis* is designated as ‘Critically Imperiled’ (S1) in Oklahoma (ONHI 2015).

- The troglobiotic milliped *Chaetaspis* sp. nov. no. 2 (Macrosternodesmidae): single-site endemic from one cave in Murray County (Lewis 2002).
- The troglobiotic harvestman *Crosbyella* sp. (Phalangodidae): endemic to two caves in Murray County (Black 1974; this study).



Figure 1. Oklahoma Cave Amphipod (*Allocrangonyx pellucidus*) from Murray Co., Oklahoma, USA. Photograph by Danté B. Fenolio.



Figure 2. *Miktoniscus oklahomensis*, a troglobiotic terrestrial isopod, from Murray Co., Oklahoma, USA. Photograph by Danté B. Fenolio.

The Arbuckle Mountains Ecoregion is a biodiversity hotspot (Stein et al. 2000) and hosts other endemic species that are dependent upon groundwater resources (but not necessarily caves), including a new species of riffle beetle (Elmidae: *Microcyloepus* sp. nov.) and the Least Darter (Percidae: *Etheostoma microperca*). Terrestrial endemics

include a milliped (Sphaeriodesmidae: *Desmoniella curta*) found only in a single site in the Arbuckle Mountains (Chamberlin and Hoffman 1958). This ecoregion is rich in other crustacean species, including the amphipods *Hyaella azteca sensu lato* (Hyaellidae); *Gammarus lacustris sensu lato* (Gammaridae), and *Crangonyx pseudogracilis* (Crangonyctidae), the aquatic isopod *Lirceus garmani* (Asellidae), and several crayfishes (Cambaridae) (Hubricht and Mackin 1949; Black 1971; Graening et al. 2006, 2007).

Excessive groundwater withdrawal is the single greatest threat to the Arbuckle Mountains Ecoregion (The Nature Conservancy 2004). Approximately 7 million gallons per day are withdrawn from the Arbuckle-Simpson Aquifer (Tortorelli 2009), and such non-sustainable withdrawal of groundwater will eradicate these groundwater-dependent species. We recommend that groundwater withdrawal be monitored and regulated, and that minimum aquifer elevations and discharge rates be established such that subterranean habitats (wells, cave streams, and springs) will sustain their groundwater faunas. The aquatic crustaceans endemic to the Arbuckle Uplift and Plains should be listed as threatened species under the federal Endangered Species Act because of their rarity, isolation, and vulnerability to excessive groundwater withdrawals and habitat destruction (e.g., limestone quarries), especially these three species: *Allocrangonyx pellucidus*, *Stygobromus* sp. nov., and *Caecidotea acuticarpa*.

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