

Subterranean reproduction of the Ringed Crayfish, *Orconectes neglectus* Faxon 1885 (Astacoidea: Cambaridae) within an Ozark Highlands cave in Oklahoma, USA

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Several non-troglomorphic species of crayfishes in the family Cambaridae have been reported from subterranean streams, pools, and other hypogean aquatic habitats in the United States. These species are considered stygophiles. Within the Ozark Highlands of North America, the Ringed Crayfish, *Orconectes neglectus* (Faxon, 1885), is a common inhabitant of clear, permanent streams and rivers with rocky substrates (Plieger 1996; Taylor et al. 2004). Facilitating identification, this species has a distinctive black ring at the apex of each chela tipped with red or orange coloration (**Figure 1**). *Orconectes neglectus* also inhabits groundwater springs and subterranean pools and streams, including at least 71 cave occurrences in Arkansas and Oklahoma (Graening et al. 2012).

Despite its prevalence in caves and associated subterranean habitats, evidence that *O. neglectus* can reproduce underground is limited. Bergey et al. (2003) found evidence of successful breeding with the presence of a small juvenile deep within a cave in Delaware Co., Oklahoma (DL-39). To our knowledge, females in berry have never been reported from subterranean habitats. Here we report the first observation of a female *O. neglectus* in berry within the subterranean stream of the January-Stansberry Cave system in Delaware County, Oklahoma, USA, providing additional evidence for reproduction within subterranean habitats.



Figure 1. A Ringed Crayfish (*Orconectes neglectus*) from the stream within Rodman Cave, Delaware Co., Oklahoma, USA. Note the black rings at the tip of each point on the chela tipped with orange/red color. Photograph by Dante B. Fenolio.

On 29 April 2012, the authors entered January-Stansberry Cave in Delaware County, Oklahoma, USA, to perform the annual count of an imperiled aquatic invertebrate, the Oklahoma Cave Crayfish, *Cambarus tartarus* Hobbs & Cooper, 1972, for the U. S. Fish and Wildlife Service. The cave is dominated by a subterranean stream that has dissolved its way through Mississippian-aged Boone Formation limestone and is a phreatic conduit over 2,000 m long with secondary vadose development, concentrating and discharging a subterranean stream of approximately 1 cubic m per minute (Looney et al. 1970). This stream ultimately flows into Spavinaw Creek within the Neosho River watershed approximately 300 m from the mouth of the cave. At ca. 800 m into the cave, the authors encountered an adult female Ringed Crayfish in berry (**Figure 2**). Dozens of previous biological surveys and other research activities have been conducted in this cave system, primarily by one of the authors (DBF), yet no record or

previous sighting of a female surface crayfish in berry had been reported. However, many dozens of *O. neglectus* have been observed within the cave stream and the density of this species decreases with depth into the cave from the spring entrance (DBF, unpublished data). Nonetheless, even in the far reaches of the cave stream (>500 m from the entrance), occasional sightings are made of *O. neglectus* living syntopically with the subterranean obligate *C. tartarus*.

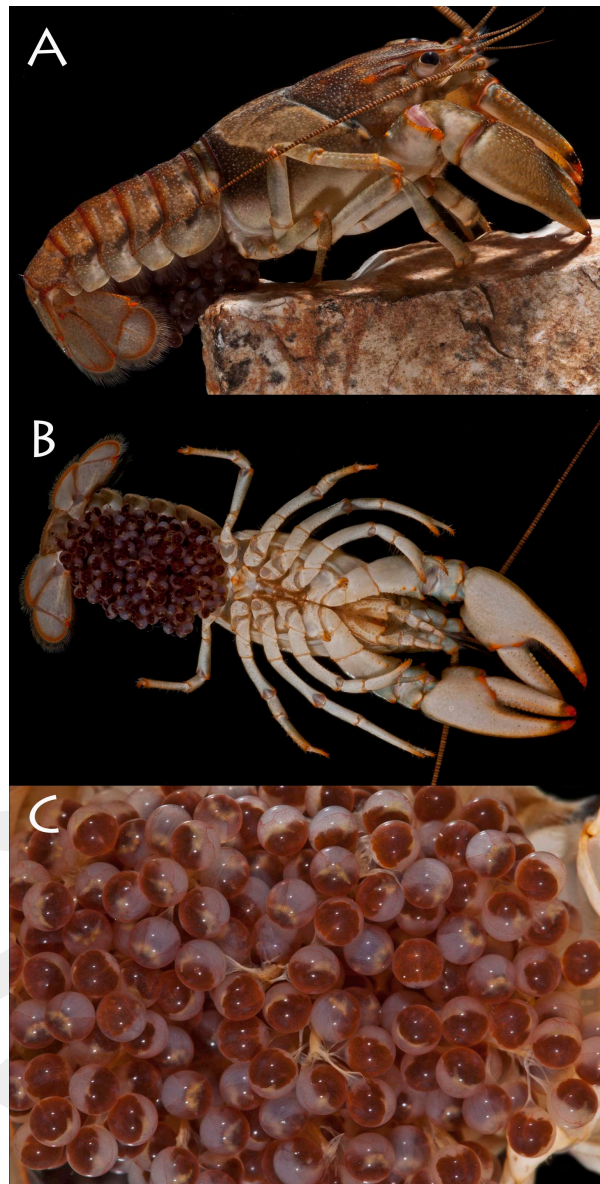


Figure 2. A female Ringed Crayfish (*Orconectes neglectus*) in berry. This individual was observed at over 700 m into the January-Stansberry Cave system in Delaware Co., Oklahoma, USA. A and B depict the adult female with eggs below her tail. C is a close up of the eggs beneath the tail. Photographs by Dante B. Fenolio.

The observation of an ovigerous female within the deep confines of the January-Stansberry cave system strongly suggests that the Ringed Crayfish reproduces within subterranean habitats. However, variation in aspects of reproductive life history between surface and subterranean populations remains to be elucidated. Timing of reproduction appears to be similar to surface populations of *O. neglectus*. Ovigerous females have been reported in March-April from introduced populations in the Spring River drainage of Missouri and Arkansas (Magoulick and DiStefano 2007; Larson and Magoulick 2008). In addition, our observations show that this facultative cavernicolous species can successfully reproduce in subterranean habitats already inhabited by a stygobitic species. *Orconectes neglectus* has been implicated in the decline of other native crayfishes that are habitat specialists (Magoulick and DiStefano 2007). Consequently, this species may pose a threat to stygobitic crayfishes of conservation concern in the Ozark Highlands, such as *Cambarus tartarus*. Further study is warranted to better understand competitive interactions between stygophilic and stygobitic crayfishes in such cave systems.

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