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A Dobsonfly, *Corydalus cornutus* (Megaloptera: Corydalidae), from Arkansas with Aberrant Mandibles

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Running title: An Aberrant Dobsonfly

Adult dobsonflies, *Corydalus cornutus* (L.), demonstrate strong sexual dimorphism in mandible configuration and length (Contreras-Ramos 1998; Bowles *et al.* 2007). Males typically have greatly elongated and robust mandibles that are tubular in cross-section and generally lack subapical teeth (Fig. 1A). In contrast, female mandibles are unmodified, much shorter, subequal in length to the head, and dorsoventrally flattened with prominent subapical teeth (Fig. 1B) (Contreras-Ramos 1998; Bowles *et al.* 2007). Contreras-Ramos (1998, 2004, 2011) presented phylogenetic analyses that indicated short mandibles among other *Corydalus* species is the plesiomorphic character state while elongated mandibles represent the apomorphic state. The phenological expression of shortened mandible length thus resides within the genome of the genus. As noted by Contreras-Ramos (1998), long mandibles are most common among male *C. cornutus*, but those of some males are intermediate between those of females and males with long mandibles.

Gynandromorphism and intersexes are conditions where an organism expresses both male and female characteristics simultaneously. Gynandromorphs exhibit both genetically male and genetically female tissues (Narita *et al.* 2010). In other words, they are sexual mosaics where some parts of the specimen are clearly female while other parts are male. Gynandromorphs have been commonly reported among insects (see Narita *et al.* 2010 for review). A similar term, gynomorphism, has been used to describe males that have a morphological resemblance to females (e.g., coloration) but not necessarily having female sexual characters. In contrast to gynandromorphs and gynomorphs, intersexes are genetically uniform but sexually ambiguous (Narita *et al.* 2010). Some intersex individuals may be genetically intermediate between typical male and female genotypes, while others may be genetically purely male or female, but some parts of their bodies show a sexual phenotype that is opposite to their genetic sex (feminization or masculinization of

body parts) (Narita *et al.* 2010).

Bowles *et al.* (2007) reported on two male *C. cornutus* collected from Boone County, Missouri that display shortened mandibles similar to those exhibited by females, although they had genitalia consistent with those of typical males. Those specimens were suggested to be gynandromorphs or possibly gynomorphs (Bowles *et al.* 2007) based solely on their physical appearance, but it is possible they represented intersex specimens. Furthermore, it is unclear if the reduced mandible length in some male *C. cornutus* truly represents a gynandromorphic/intersex condition, an ancestral trait being expressed, or due to environmental factors.

During July 2017, three male and 100 female *Corydalus cornutus* were collected as by-catch in blacklight traps from several locations along the Buffalo River, Arkansas. One of the male specimens collected at the junction of Clabber Creek and Buffalo River (see collection data) was small bodied and had greatly reduced, symmetrical mandibles (Fig. 1C). This specimen is small having a forewing length of only 39.5 mm, each mandible was only 7.2 mm long, and the head capsule was only 5.5 mm wide. The genitalia of this specimen were consistent with that of typical males. The head/mandible length ratio of the aberrant male (0.76) is the same as the ratio of an aberrant male reported by Bowles *et al.* (2007) from Jefferson County, Missouri. The mandibles of the Missouri specimen are flattened with two discreet subapical teeth similar to that of females, while the mandibles of the Arkansas specimen are more tubular-shaped, greatly reduced in length and diameter, and with a single subapical tooth (Fig. 1C). The Arkansas specimen has a mandible configuration somewhat intermediate between those depicted in Bowles *et al.* (2007; figs 4, 5 and 7).

Two additional males collected at Toney Bend on the Buffalo River, only a few kilometers upstream from the previous site, are much larger bodied and the mandibles are typical. One specimen has a forewing length = 56 mm, left mandible length = 29 mm, right mandible length = 30 mm, and head/mandible length

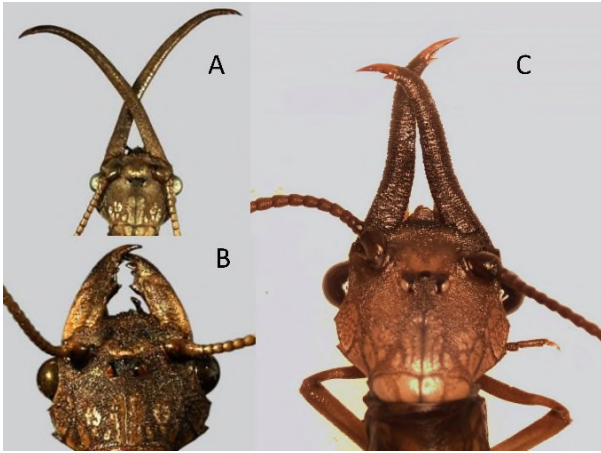


Figure 1. Dobsonfly, *Corydalus cornutus*. A. Typical male, B. Female, C. Aberrant male.

ratio = 0.33. The second specimen has a forewing length = 47 mm, left mandible length = 28.5 mm, right mandible length = 28.5, and head/mandible length ratio = 0.28). Among the females collected, wing length of measured specimens (n=52) ranged from 38 to 54 mm (mean= 47.6 mm), which falls within the previously reported range for this species (Contreras-Ramos 1998, Bowles *et al.* 2007).

The basis for shortened male mandibles in *C. cornutus* remains unclear. The roles of genetics, phylogeny and environmental factors presently cannot be distinguished. It is unknown if the specimen presented here represents a gynandromorph, a gynomorph, an intersex, the expression of an ancestral character (Narita *et al.* 2010) or phenotypic plasticity due to environmental conditions (e.g., temperature, nutrition, pollution) experienced during development. *Corydalus* mandibles are a secondary sexual trait, and as such, their development is modulated by trade-offs and condition dependence (Liu *et al.* 2015). Typically, increased mandible size in adult male megalopterans is a trade-off with reduced wing size and vice versa (Liu *et al.* 2015). That trade-off was not apparent with the aberrant male reported here whose entire body was smaller than that of a typical male. The mandibles of the aberrant specimen resemble the shortened mandibles of a closely related species, *Corydalus texanus* Banks, giving some plausibility to an ancestral expression.

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and policies of the U.S. Department of Interior, National Park Service.

Collection data

All specimens were collected with blacklight traps at Buffalo National River, Arkansas on July 13-14, 2017, collectors D.E. Bowles and C.R. Cheri. Coordinates are UTM eastings, northings (15S).

Marion Co., Buffalo River @ Clabber Creek, UTM 540894, 3998226 , 1 male, 72 females; same, but Buffalo River @ Toney Bend, UTM 540382, 3994907, 2 males, 3 females; same, but Newton Co., Buffalo River @ Carver, UTM 496551, 3982104, 1 female; Buffalo River @ Davis Creek, UTM 504197, 3984942, 15 females; same, but Searcy Co., Buffalo River @ Tyler Bend, UTM 520982, 3982722, 9 females.

Reference specimens are deposited in the collection of the Heartland Inventory and Monitoring Network, National Park Service, Springfield Missouri

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