

Morphological anomaly in *Cornalatus permutatus* (Attems, 1938): first record of a female with gonopods in Chelodesmidae

(Diplopoda: Polydesmida)

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We report the first case of an adult female with fully developed gonopods in the millipede family Chelodesmidae. The specimen of *Cornalatus permutatus* (Attems, 1938), collected in the Parque Nacional da Serra dos Órgãos, Teresópolis, Rio de Janeiro state, exhibits a typical adult female morphology, including larger and more robust body rings than those of adult males along with fully developed vulvae, however, the eighth leg pair is modified into well-developed gonopods. Dissection revealed numerous mature eggs, indicating presence of functional ovaries. This rare morphological condition expands our understanding of intersexuality in millipedes and raises questions regarding developmental pathways and genetic regulation of sexual traits in Polydesmida.

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Introduction

Sexual dimorphism in helminthomorph millipedes is conspicuous, with males bearing a pair of specialized legs on body ring seven (gonopods) which transfer sperm during copulation (Koch 2015). In females, the external genitalia consist of a pair of vulvae situated at the base of the second pair of legs (Koch 2015).

The co-occurrence of sexual characteristics of both sexes in the Diplopoda is rare, however, individuals exhibiting both male and female traits have been found (albeit at low frequencies) in natural populations of other arthropod groups (Narita et

al. 2010, Santos et al. 2019, Zarka et al. 2022). In millipedes, notable cases of co-occurrence of sexual characters has been reported in 1) Polydesmida: *Polydesmus inconstans* Latzel, 1884 (Polydesmidae) with developed vulvae and gonopods (Chalande 1903); *Aphelidesmus hermaphroditus* Brölemann, 1898 (Polydesmida, Aphelidesmidae) with vulvae and a gonopod replacing the left leg eight (Brölemann 1898); and *Coonoorophilus monstruosus* Carl, 1932 (Polydesmida, Fuhrmannodesmidae) with vulvae and a right gonopod paired with a normal left leg (Carl 1932); and 2) Julida: *Tachypodoiulus niger* (Leach, 1814) (Julida, Julidae) with normal ovaries and reduced gonopods (Verhoeff 1910); *Ophiulus*

pilosus (Newport, 1843) (Julida, Julidae) with vulvae and partially developed gonopods (Bigler 1920); and a female *Trichoblaniulus hirsutus* (Brölemann, 1889) (Julida, Trichoblaniulidae) with one of the first pair of legs modified as in males (Verhoeff 1911), see also Minelli (2015).

Results and discussion

Cornalatus permutatus (Attems, 1938) is a chelodesmid species endemic to the Atlantic Forest of Brazil. This species, which has been reported from Minas Gerais, Espírito Santo, and Rio de Janeiro states, is commonly found in forested habitats, sometimes in proximity to urban areas (Bouzan et al. 2026).

Herein, we present an anomalous *C. permutatus* female with fully developed gonopods, vulvae, and functional ovaries, the first report of this condition in the Chelodesmidae.

The aberrant *C. permutatus* female was collected along with 10♂♂ and 3♀♀ at Parque Nacional da Serra dos Órgãos (22°27'18.5"S, 43°00'52.3"W), Teresópolis, Rio de Janeiro state, Brazil, 10–22.xi.2010, R.P. Indicatti, J.P.P. Pena-Barbosa, F.U. Yamamoto coll. The examined material is preserved in 75 % ethanol and deposited in the myriapod collection at the Instituto Butantan (IBSP 3815), São Paulo, Brazil. High-resolution photographs of relevant morphological features were captured with a Leica DFC 500 digital camera mounted on a Leica MZ16A stereomicroscope and extended focal range images were composed with Leica Application Suite version 2.5.0 (Leica Camera, Wetzlar, Germany).

The anomalous specimen possess morphological characteristics consistent with females of *C. permutatus*: total length 33 mm, robust body segments with paranota less slender and ornate than in conspecific males (Fig. 1A). The second pair of legs lack gonapophyses and the male paired genital openings (gonopores) associated with the coxae (Fig. 1D), bearing instead unmodified walking legs accompanied by a pair of fully developed vulvae (Fig. 1E). Surprisingly, the eighth leg pair is modified into fully developed, species-specific gonopods with all branches and processes normally observed in conspecific males (Fig. 1B–C). No additional aberrations were observed. Dissection revealed numerous mature eggs filling the body cavity (Fig. 1F), indicating active and functional ovaries.

This is the first report of a female with fully developed gonopods in Chelodesmidae. While morphological anomalies in millipedes have been occasionally documented, including limb deformities, segmental irregularities, and partial duplication of appendages (see Minelli 2015), the presence of

a fully developed male copulatory apparatus in a female with complete and functional ovaries is noteworthy.

Plausible explanations include developmental anomalies such as intersexuality or localized expression of male-specific developmental pathways. In this case, the absence of male gonopores suggests that gonopod development was decoupled from the formation of the male gonads. This raises intriguing questions about the genetic and hormonal regulation of sexual characteristics in Polydesmida.

From a functional perspective, the presence of fully developed gonopods in this individual likely had no role in reproduction, as the specimen lacks gonapophyses and gonopores. This rare morphological condition expands our understanding of intersexuality in millipedes.

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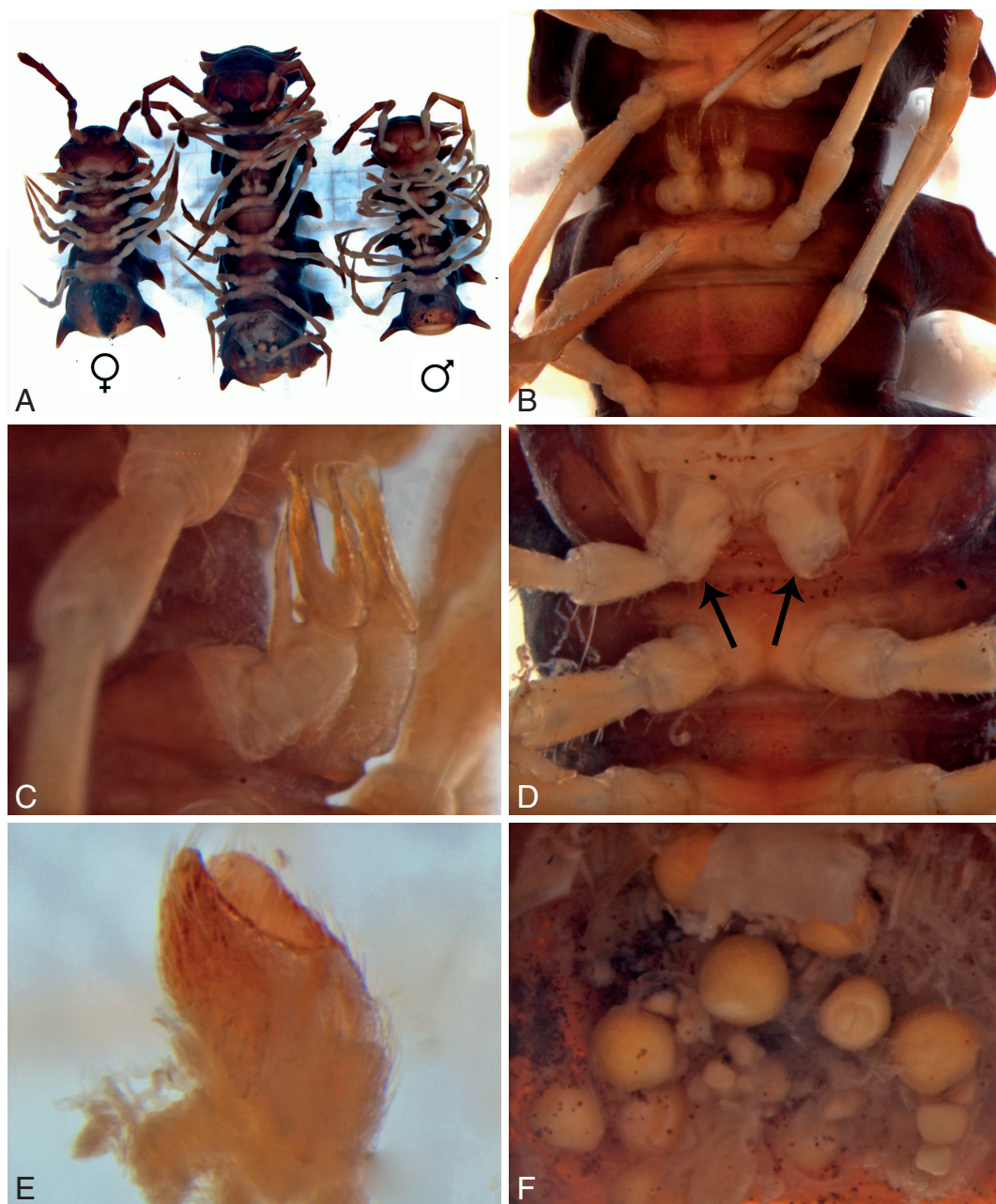


Fig. 1. *Cornalatus permutatus* (Attems, 1938). **A.** Male and female from the same sampling event, with the aberrant specimen shown in the middle; **B.** detail of sternite seven showing fully developed gonopods; **C.** detail of gonopods, lateral view; **D.** detail of sternites 3 and 4, arrows refer to the unmodified coxae of the second pair of legs; **E.** detail of left vulva, ventrolateral view; **F.** detail of mature eggs. Images not to scale.

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