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First Description of the Male of *Aeolocoelotes cornutus* (Nishikawa, 2009) n. comb. (Araneae, Agelenidae) from Japan

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Abstract The male of *Aeolocoelotes cornutus* (Nishikawa, 2009) (Araneae, Agelenidae) n. comb., transferred from *Coelotes* is described for the first time based on the specimen collected from the adjacent area of its type locality in Kochi Prefecture, Japan. The shape of the male palp of this species is extremely unique, and similar to that of *A. mohrii* (Nishikawa, 2009). It became clear that *A. cornutus* is closely related to *A. mohrii* based on the morphological characteristics of both sexes and its genetic data. The differences of the genital organs between these two species are presented. The mitochondrial cytochrome *c* oxidase subunit I (mt-COI) partial sequences of the species have been also documented for future use.
Key words: Coelotine spider, taxonomy, morphology, DNA barcoding, Shikoku district.

Introduction

Spiders of the subfamily Coelotinae F. O. P.-Cambridge, 1893 (Agelenidae C. L. Koch, 1837) are highly diverse in Japan, especially in the area from the central Honshu to the Ryukyu Islands, and 13 genera and 122 species have been identified to date (World Spider Catalog, 2021). However, many species have been described with only one sex. Therefore, the first author has been describing the specimens of missing sex as soon as those were discovered (Okumura, 2010, 2011, 2020a; Okumura *et al.*, 2016, 2018). In some cases, it became clear that the male specimen and the female one described respectively as different species are conspecific, and their phylogenetic situation was revised (Okumura and Ono, 2006; Okumura *et al.*, 2019). *Coelotes cornutus* Nishikawa, 2009 described from southwestern region of Shikoku district has been also known only with the female specimens. Having surveyed spiders in Mt. Ohora-yama, Kochi Prefecture which is near to the type locality of this species, the third author was able to collect a specimen that is considered as its male. *Aeolocoelotes mohrii* (Nishikawa, 2009) inhabits in the western area of Shikoku district has extremely unique shaped male palp (Okumura *et al.*, 2019; Okumura, 2020b; Serita, 2021). The shape of the epigyne of *C. cornutus* resembles that of *A. mohrii* (Nishikawa, 2009; Okumura *et al.*, 2009), and the male palp of the newly collected specimen also resembles that of *A. mohrii*. After careful examinations of these specimens, we judged that this male specimen is conspecific with *C. cornutus*. In addition, it was revealed that the genetic data of this species is the closest to that of *A. mohrii* among Japanese coelotine species known at the moment, likewise its morphological characteristics. Hence, we

made a taxonomic revision of this species with the first description of its male, and transferred *C. cornutus* to the genus *Aeolocoelotes*.

In this paper, we change the classification of *C. cornutus* to the genus *Aeolocoelotes*, and formally describe a male specimen for the first time. We also show the morphological differences between *Aeolocoelotes cornutus*, n. comb., and the closely related species, *A. mohrii*, and the distributional range of these two species in Shikoku district.

Materials and Methods

Sampling and morphological examination. The specimens used in this study were collected by the third author, Nakano, from Mt. Ohora-yama in Otsuki-cho, adjacent to the type locality of *C. cornutus*, Odo-misaki, Otsuki-cho, Hata-gun, Kochi Prefecture. Examination and illustration were performed using an Olympus SZX-7 stereomicroscope. Photographs were taken using an Olympus E-620 digital camera attached to the microscope. Measurements of respective body parts were done using a micrometer mounted on an ocular lens. All measurements are given in millimetres. Leg measurements are given as total length (femur, patella & tibia, metatarsus, tarsus).

Abbreviations: ALE, anterior lateral eye; AME, anterior median eye; MOA, median ocular area; PLE, posterior lateral eye; PME; posterior median eye. The specimens used in this study are deposited in the zoological collection of Kyoto University (KUZ), Japan.

Molecular analysis. A female specimen was used in the molecular analysis. Mitochondrial cytochrome *c* oxidase subunit I (mt-COI) was amplified using the primer combination COIARAF: 5′-ACAAATCATAAAGATATTGC-3′ with COIARAR: 5′-ATAGCATAAATTAT-TCCTAA-3′ (Okumura *et al.*, 2017). For details of DNA extraction, polymerase chain reaction, and sequencing, refer to Okumura *et al.* 2017. As a result, mt-COI partial sequences of 763 bp were obtained. The DNA sequences newly obtained in this study have been deposited in the International Nucleotide Sequence Database Collaboration (INSDC) through the DNA Data Bank of Japan (DDBJ). Accession number is LC632430.

Taxonomy

Family Agelenidae C. L. Koch, 1837
Subfamily Coelotinae F. O. P.-Cambridge, 1893
Genus *Aeolocoelotes* Okumura, 2020
Aeolocoelotes cornutus (Nishikawa, 2009)
n. comb.

[Japanese name: Odo-yachigumo]
(Figs. 1–2, 3A, 3C, 3E)

Coelotes cornutus Nishikawa, 2009, p. 66, fig. 96; Okumura *et al.*, 2009, p. 197, fig. 2-2-33-355. Type locality: Odo-misaki, Otsuki-cho, Hata-gun, Kochi Prefec-

Fig. 1. *Aeolocoelotes cornutus* (Nishikawa, 2009) n. comb. Male, dorsal view. Scale bar: 2.0 mm.

ture, Shikoku, Japan, female holotype not examined.

Material examined. 1 male (*KUZ Z3933*) and 1 female (*KUZ Z3932*), Mt. Ohora-yama, Otsuki-cho, Hata-gun, Kochi Prefecture, N 32°49′14.0″, E132°40′29.6″, 18 November 2010, Takafumi Nakano leg.

Diagnosis. The shape of the male palp of *Aeolocoelotes cornutus* is unique, and resembles that of *Aeolocoelotes mohrii* (Nishikawa, 2009), the only species having this strange structure among the coelotine spiders so far (Figs. 2, 3A–D). The male of *A. cornutus* can be distinguished from that of the latter species by having a developed process situated in the base of embolus and absence of a patellar apophysis. There are also slight differences in curving condition on the lateral portion of the genital bulb and a form of median apophysis. The female of *A. cornutus* can be distinguished from that of the latter species by the length and the position of epigynal teeth, which are long and situated dis-

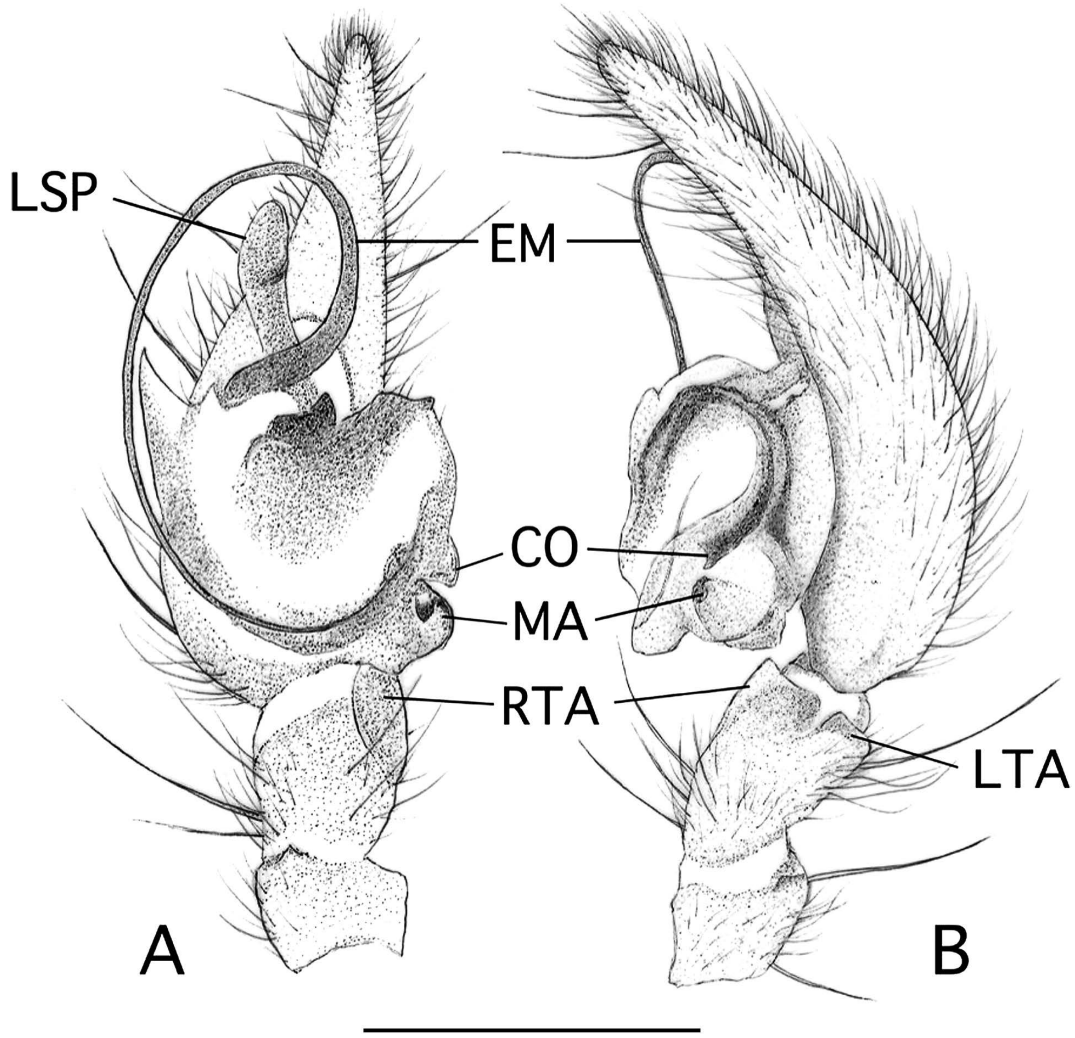

Fig. 2. *Aeolocoelotes cornutus* (Nishikawa, 2009) n. comb. Male palp (left), ventral view (A); same retrolateral view (B). Abbreviations: CO, conductor; EM, embolus; LSP, large spatula-shaped protrusion; MA, median apophysis; RTA, reterolateral tibial apophysis. Scale bar: 1.0 mm.

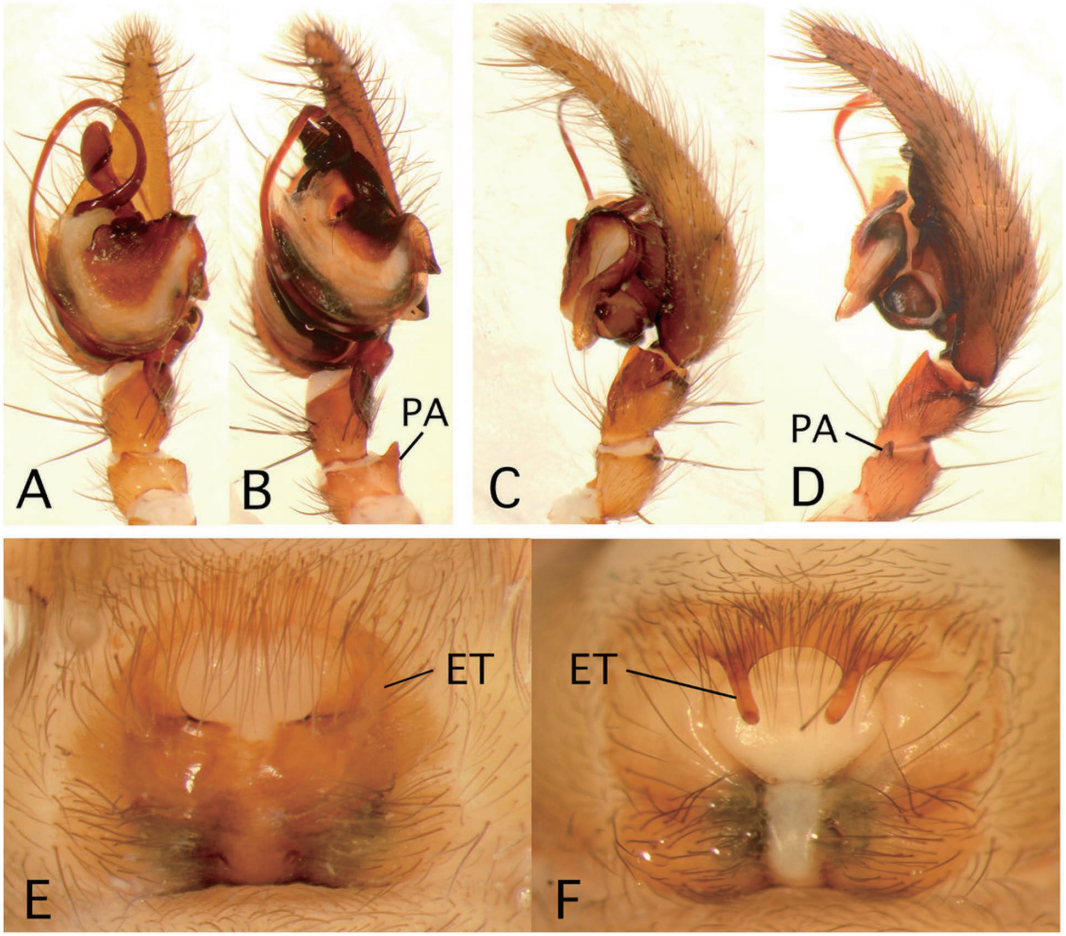

Fig. 3. Comparison of the copulatory organs of *Aeolocoelotes cornutus* (Nishikawa, 2009) n. comb. (A, C, E) and *Aeolocoelotes mohrii* (Nishikawa, 2009) (B, D, F). Male palp (left), ventral view (A–B); same, retrolateral view (C–D); epigyne, ventral view (E–F). Abbreviations: ET, epigynal tooth; PA, patellar apophysis.

tantly from each other (Fig. 3E), while those of *A. mohrii* are short and close to each other (Fig. 3F).

The shape of genital organs of this species is similar to that of *A. mohrii*, although there are some major differences. In addition, it became clear that the obtained genetic data of this species are the closest to that of *A. mohrii* among Japanese coelotine species based on the search results using the DDBJ server. The above facts are the reason for the change of genus.

Description of male (KUZ Z3933). Total length 9.0, carapace 4.6 long, 3.0 wide; abdomen 4.4 long, 2.5 wide; sternum 2.4 long, 1.8 wide. Eye sizes and interdistances AME 0.10, ALE 0.16, PME 0.18, PLE 0.20; AME-AME 0.06, AME-ALE 0.05, PME-PME 0.09, PME-PLE 0.15, AME-PME 0.13, ALE-PLE 0.08. MOA; anterior width 0.26, posterior width 0.45, length 0.41. Leg measurements: I: 15.4 (3.9, 5.1, 4.3, 2.1); II: 13.3 (3.6, 4.4, 3.4, 1.9); III: 11.9 (3.2, 3.7, 3.3, 1.7); IV: 17.0 (4.4, 5.4, 5.1, 2.1).

Palp (Figs. 2, 3A, 3C): patellar apophysis absent, but minute protuberance on the dorsal surface; lateral tibial apophysis short and broad, retrolateral tibial apophysis tabular and broad; cymbium slender, and cymbial furrow indistinct; conductor small located on the lateral side of teg-

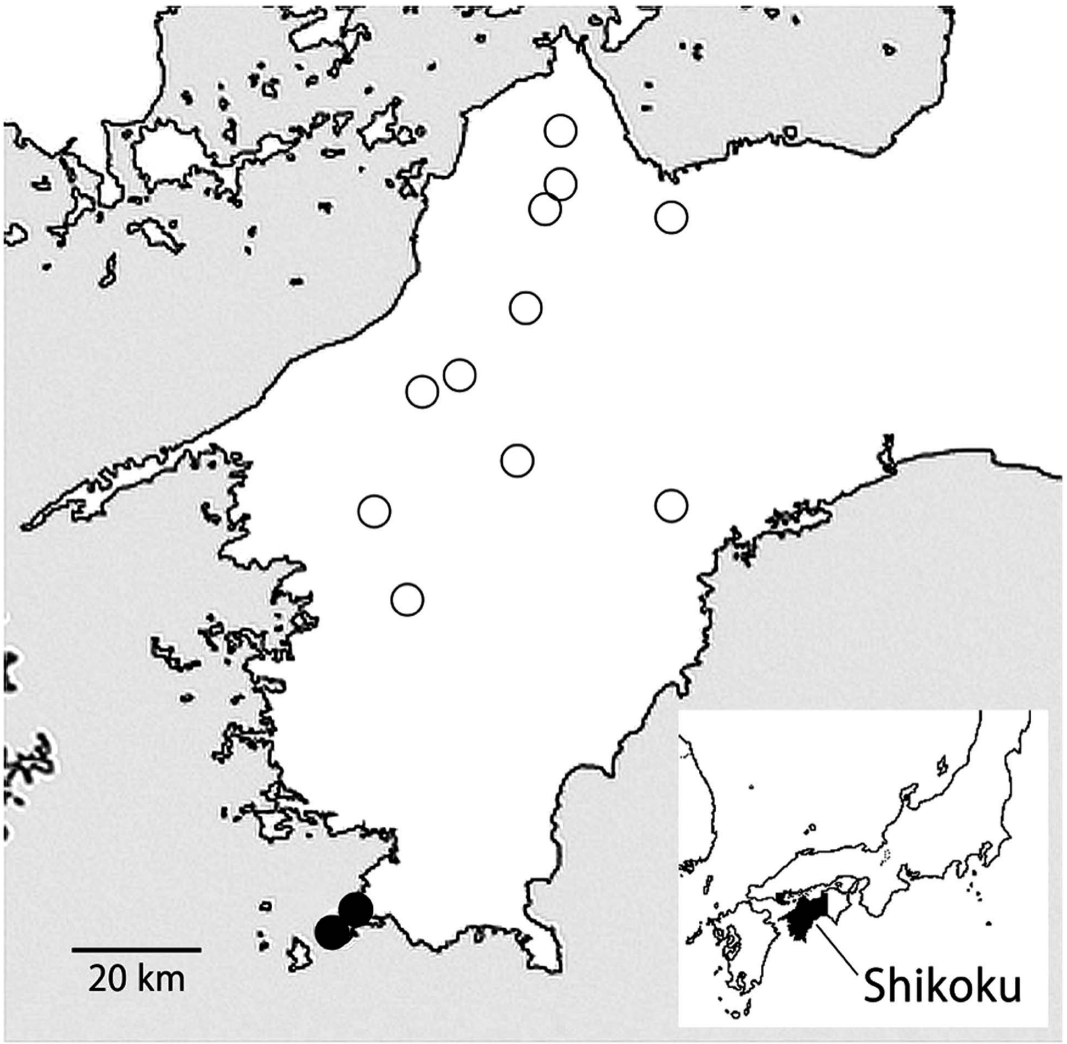

Fig. 4. Distribution of *Aeolocoelotes cornutus* (Nishikawa, 2009) n. comb. and closely related species, *Aeolocoelotes mohrii* (Nishikawa, 2009) in Shikoku district, Japan. Closed circles denote *A. cornutus*; open circles, *A. mohrii*.

ulum, large spatula-shaped protrusion on the dorsal side of the base of embolus, median apophysis small and spoon-shaped situated in the retrolateral portion of genital bulb, embolus flagelliform and extends in a counterclockwise direction (in the left palp) from the anterior portion of the genital bulb.

Chericera: promargin of fang furrow with three teeth and retromargin with two teeth.

Colouration: carapace yellowish brown with indistinct radial flecks, sternum brown, chelicerae and maxillae blackish brown, labium brown, dorsum of abdomen grayish brown with indistinct chevrons, and venter yellowish brown without any flecks, legs yellowish brown with no ring flecks.

Distribution: Otsuki-cho, Hata-gun, Kochi Prefecture, Japan (Fig. 4)

Remark. The habitat of *A. cornutus* currently known is very narrow. This species shows the parapatric distribution with *A. mohrii*. Interestingly, *Aeolocoelotes unicatus* (Yaginuma, 1977)

also related to both species inhabits the blank area between *A. cornutus* and *A. mohrii* (Okumura, 2020b).

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