A further study of the spider genus Notiocoelotes (Araneae, Agelenidae) from Hainan Island, China

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Abstract
Two new Notiocoelotes species, N. maoganensis sp. n. (♂♀) and N. qiongzhongensis sp. n. (♂♀) are described from Hainan Island, China. In addition, the female of N. membranaceus Liu & Li, 2010 is described for the first time. DNA barcodes of three species treated in this paper were obtained for future use.

Keywords
Taxonomy, Coelotinae, description, diagnosis, Southeast Asia

Introduction
Material and methods

Specimens were examined with a LEICA M205C stereomicroscope. Images were captured with an Olympus C7070 wide zoom digital camera (7.1 megapixels) mounted on an Olympus SZX12 dissecting microscope. Epigynes and male palps were examined after dissection from the spiders’ bodies.

All measurements were obtained using a LEICA M205C stereomicroscope and are given in millimeters. Leg measurements are shown as: Total length (femur, patella + tibia, metatarsus, tarsus). Only structures (palp and legs) of the left body side were described and measured. The terminology used in the text and the figure legends follows Wang (2002). Abbreviations used in this paper and in the figure legends: A = epigynal atrium; ALE = anterior lateral eye; AME = anterior median eye; AME-ALE = distance between AME and ALE; AME-AME = distance between AME and AME; ALE-PLE = distance between ALE and PLE; CD = copulatory duct; CF = cymbial furrow; CL = conductor lamella; CO = conductor; E = embolus; EB = embolic base; ES = epigynal scape; FD = fertilization duct; LTA = lateral tibial apophysis; MA = median apophysis; PLE = posterior lateral eye; PME = posterior median eye; PME-PLE = distance between PME and PLE; PME-PME = distance between PME and PME; R = receptacle; RTA = retroventral tibial apophysis; ST = subtegulum; T = tegulum.

DNA barcodes were obtained for future use. A partial fragment of the mitochondrial gene cytochrome oxidase subunit I (COI) was amplified and sequenced for *N. maoganensis* sp. n., *N. membranaceus* and *N. qiongzhongensis* sp. n. using primers LCO1490-oono (5’-CWACAAAYCATARRGATATTGG-3’) (Folmer et al. 1994; Miller et al. 2010) and HCO2198-zz (5’-TAAACTTCCAGGTGACAACTATCCAGGTGACCAAAAAATCA-3’) (Folmer et al. 1994; Chen et al. 2015). For additional information on extraction, amplification, and sequencing procedures, see Zhao et al. 2013. All sequences were deposited in GenBank and the accession numbers are provided in Table 1.

All specimens (including molecular vouchers) are deposited in the Institute of Zoology, Chinese Academy of Sciences in Beijing (IZCAS).

Table 1. Voucher specimen information.

<table>
<thead>
<tr>
<th>Species</th>
<th>GenBank accession number</th>
<th>Sequence length</th>
<th>Collection localities</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Notiocoelotes maoganensis</em> sp. n.</td>
<td>KU886075</td>
<td>657 bp</td>
<td>Baoting County, Hainan, China</td>
</tr>
<tr>
<td><em>Notiocoelotes membranaceus</em></td>
<td>KU886076</td>
<td>666 bp</td>
<td>Qiongzhong County, Hainan, China</td>
</tr>
<tr>
<td><em>Notiocoelotes qiongzhongensis</em> sp. n.</td>
<td>KU886074</td>
<td>666 bp</td>
<td>Qiongzhong County, Hainan, China</td>
</tr>
</tbody>
</table>
Taxonomy

Family Agelenidae C.L. Koch, 1837
Subfamily Coelotinae F.O.P.-Cambridge, 1893

Genus Notiocoelotes Wang, Xu & Li, 2008


Diagnosis. The chelicerae of all Notiocoelotes have 3 promarginal and 2 retromarginal teeth, while other coelotines usually have 3 or 4 retromarginal teeth. Females of this genus can be separated from other coelotines by the absence of epigynal teeth and the presence of a tongue-shaped epigynal scape (Fig. 2A–B); other coelotines usually have long and broad epigynal teeth. Males can be distinguished from other coelotines by the absence of a patellar apophysis, the presence of a large and strongly bifurcated lateral tibial apophysis and the reduced or invisible median apophysis (Fig. 1); other coelotines usually have a thick patellar apophysis and the special shaped median apophysis.

Composition. Thirteen Notiocoelotes species are currently known: N. laosensis (♀) from Laos; N. parvirtriangulus Liu, Li & Pham, 2010 (♀), N. pseudovietnamensis Liu, Li & Pham, 2010 (♂♀) and N. vietnamensis (♂♀) from Vietnam; N. sparus (♂) from Thailand; N. lingulatus (♀), N. membranaceus (♂), N. orbiculatus Liu & Li, 2010 (♂♀), N. palinitropus (♂♀), N. pseudolingulatus Liu & Li, 2010 (♂♀), and N. spirellus Liu & Li, 2010 (♂♀) from Hainan, China (World Spider Catalog 2016), and two new species described in this paper: N. maoganensis sp. n. (♂♀), N. qiongzhongensis sp. n. (♂♀) from Hainan.

Notiocoelotes maoganensis Zhao & Li, sp. n.
http://zoobank.org/77DC1620-6C90-4167-BA47-CE30A39BF135
Figs 1–2, 7

Paratype: 1 ♀, same data as holotype.

Etymology. The specific name refers to the type locality; adjective.

Diagnosis. The male of N. maoganensis sp. n. can be easily distinguished from all other Notiocoelotes species, except N. palinitropus, by having a semi-circular conductor. From N. palinitropus, the male of the new species can be distinguished by the short cymbial furrow about 1/3 of cymbial length (while N. palinitropus male has a long cymbial furrow, about 0.5 times as long as cymbial length) (cf. Fig. 1A–C; Zhu and Wang 1994: figs 19–21). The female of N. maoganensis sp. n. can be easily distinguished from all the other Notiocoelotes species, except N. palinitropus, by the
Figure 1. Left palp of Notiocoelotes maoganensis sp. n., holotype. A Prolateral view B Ventral view C Retrolateral view. CF = cymbial furrow; CL = conductor lamella; CO = conductor; E = embolus; EB = embolic base; LTA = lateral tibial apophysis; RTA = retroventral tibial apophysis; ST = subtegulum; T = tegulum. Scale bar: Equal for A, B and C.

almost rectangular atrium. From N. palinitropus, the female of the new species can be distinguished by a broad atrium, about two times as long as wide (while N. palinitropus female has a narrow atrium, about three times as long as wide) (cf. Fig. 2A–B; Liu and Li 2010: fig. 9B).

Description. Male (holotype): Total length 8.60. Carapace 4.75 long, 3.50 wide. Abdomen 3.85 long, 2.75 wide. Eye sizes and interdistances: AME 0.20, ALE 0.23, PME 0.25, PLE 0.25; AME-AME 0.08, AME-ALE 0.02, PME-PME 0.08, PME-PLE 0.10. Leg measurements: I: 21.15 (5.75, 6.00, 5.50, 3.90); II: 18.00 (5.50, 5.25, 4.50, 2.75); III: 17.00 (5.00, 5.00, 4.75, 2.25); IV: 22.35 (6.25, 6.70, 6.50, 2.90). Carapace yellowish, the radial grooves indistinct, with the nearly lip-shaped dark pattern, sternum yellowish, about almond-shaped. Abdomen brownish, with yellow and transversal spots, nearly oval-shaped. Legs yellowish, with black annulations. Palp: tibia long,
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Figure 2. Epigyne and habitus of Notiocoelotes maoganensis sp. n. A Epigyne, ventral view B Vulva, dorsal view C Male habitus, dorsal view D Female habitus, dorsal view E Female habitus, ventral view. A = epigynal atrium; CD = copulatory duct; ES = epigynal scape; FD = fertilization duct; R = receptacle. Scale bars: Equal for D and E.
about 1/3 of cymbial length; RTA small, 1/3 of tibial length; LTA divided into two parts, most crescent-shaped and about 1/2 length of RTA; conductor long, with one loop; embolus beginning at 6:30 o’clock position, with the triangular base, about 1/3 width of tibia (Fig. 1A–C).

**Female (paratype):** Total length 8.75. Carapace 4.25 long, 3.50 wide. Abdomen 4.50 long, 3.00 wide. Eye sizes and interdistances: AME 0.20, ALE 0.28, PME 0.25, PLE 0.25; AME-AME 0.05, AME-ALE 0.01, PME-PME 0.08, PME-PLE 0.10. Leg measurements: I: 16.50 (4.75, 5.00, 4.00, 2.75); II: 14.25 (4.25, 4.50, 3.50, 2.00); III: 13.10 (4.00, 4.10, 3.25, 1.75); IV: 17.65 (5.15, 5.75, 4.50, 2.25). Carapace beige, with grey lateral margins; sternum nearly almond-shaped, light brown, with wide yellow median band. Abdomen grey-brown, nearly oval-shaped, with beige herringbone pattern. Legs yellowish, with black annulations. Epigyne: atrium elongated, with distinct septum, about two times as long as wide, posterior broaden; copulatory ducts covering anterior parts of receptacles, about 1.2 times as long as wide; receptacles narrow, about 2.5 times as long as wide; copulatory openings distinct (Fig. 2A–B).

**Distribution.** Known only from the type locality (Fig. 7).

*Notiocoelotes membranaceus* Liu & Li, 2010

Figs 3–4, 7


**Diagnosis.** The female of *N. membranaceus* can be distinguished from all the other *Notiocoelotes*, except *N. orbiculatus*, by the almost oval atrium. From *N. orbiculatus*, the new species can be distinguished by the egg-shaped receptacles (while *N. orbiculatus* has globular and widely separated receptacles) (cf. Fig. 4A–B; Liu and Li 2010: fig. 7B).

**Description.** Male: described in detail by Liu and Li (2010: fig. 2A–C) (Fig. 3A–C).

Female: Total length 4.75. Carapace 2.50 long, 1.75 wide. Abdomen 2.25 long, 1.75 wide. Eye sizes and interdistances: AME 0.08, ALE 0.15, PME 0.15, PLE 0.15; AME-AME 0.03, AME-ALE 0.01, PME-PME 0.05, PME-PLE 0.06. Leg measurements: I: 7.00 (2.05, 2.25, 1.60, 1.10); II: 6.10 (1.85, 1.90, 1.55, 0.80); III: 5.50 (1.70, 1.75, 1.30, 0.75); IV: 7.50 (2.25, 2.30, 2.00, 0.95). Carapace yellowish, with black dark lateral margins; sternum yellow, margins darker than median part. Abdomen yellowish-brown, with black and nearly chevrons-shaped stripes, nearly pineapple-shaped. Legs yellowish, with black annulations. Epigyne: atrium semicircular, about 1.5 times as long as wide, with distinct septum;
epigynal scape wide; copulatory ducts long, about 0.9 times as long as receptacles, well sclerotized; receptacles long, about 1.5 times as long as wide; copulatory openings distinct (Fig. 4A–B).

**Distribution.** China (Hainan) (Fig. 7).

**Remarks.** Female of this species is described for the first time. Although the shape of the palp and epigyne of *N. membranaceus* are a little different from those of the type species of the genus *Notiocoelotes*, the taxonomic placement of this species is supported by the following two features. First, according to the molecular data (our COI sequences, unpublished), *N. membranaceus* is closely related to *N. orbiculatus* and *N. qiongzhongensis* sp. n. Second, the male of *N. membranaceus* has a strongly bifurcated lateral tibial apophysis, characteristic for the males of all *Notiocoelotes* species; the female of *N. membranaceus* has a tongue-shaped epigynal scape, characteristic for the females of all *Notiocoelotes* species.

**Figure 3.** Left palp of *Notiocoelotes membranaceus*, specimen from Hainan. A Prolateral view B Ventral view C Retrolateral view. CF = cymbial furrow; CO = conductor; E = embolus; EB = embolic base; LTA = lateral tibial apophysis; RTA = retroventral tibial apophysis; ST = subtegulum; T = tegulum. Scale bar: Equal for A, B and C.
Figure 4. Epigyne and habitus of *Notiocoelotes membranaceus*, specimens from Hainan. A Epigyne, ventral view  B Vulva, dorsal view  C Male habitus, dorsal view  D Female habitus, dorsal view  E Female habitus, ventral view. A = epigynal atrium; CD = copulatory duct; ES = epigynal scape; FD = fertilization duct; R = receptacle. Scale bars: Equal for D and E.
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Notiocoelotes qiongzhongensis Zhao & Li, sp. n.
http://zoobank.org/1AE669ED-AA8C-4EF0-A883-D0E0984D1F55
Figs 5–6, 7


Etymology. The specific name refers to the type locality; adjective.

Diagnosis. The male of *N. qiongzhongensis*, sp. n. can be distinguished from all of the other Notiocoelotes species, except *N. pseudolingulatus* and *N. sparus*, by having posteriorly extended conductor and cymbial furrow almost half of cymbial length. From the latter two species, it can be distinguished by the semicircular conductor apex (while *N. pseudolingulatus* has a blunt apex, and *N. sparus* has an acute apex) (cf. Fig. 5A–C; Liu and Li 2010: figs 10–11; Dankittipakul et al. 2005: figs 1–3). The female of *N.
Figure 6. Epigyne and habitus of *Notiocoelotes qiongzhongensis* sp. n. A Epigyne, ventral view B Vulva, dorsal view C Male habitus, dorsal view D Female habitus, dorsal view E Female habitus, ventral view. A = epigynal atrium; CD = copulatory duct; ES = epigynal scape; FD = fertilization duct; R = receptacle. Scale bars: Equal for D and E.
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Figure 7. Localities of Notiocoelotes species from Hainan. 1 N. lingulatus 2 N. maoganensis sp. n. 3 N. membranaceus 4 N. orbiculatus 5 N. palinitropus 6 N. pseudolingulatus 7 N. qiongzhongensis sp. n. 8 N. spirellus.

giongzhongensis, sp. n. can be distinguished from all Notiocoelotes, except N. orbiculatus and N. parvitriangularis, by the rounded receptacles. It can be distinguished from N. orbiculatus by the head of receptacles situated on anterior part of receptacles (while the head of receptacles is situated on posterior part of receptacles in N. orbiculatus); and it can be distinguished from N. parvitriangularis by the nearly square-shaped atrium (while N. parvitriangularis has a triangular atrium) (cf. Fig. 6A–B; Liu and Li 2010: fig. 7B; Liu et al. 2010: fig. 78A).

Description. Male (holotype): Total length 4.20. Carapace 2.15 long, 1.60 wide. Abdomen 2.05 long, 1.50 wide. Eye sizes and interdistances: AME 0.05, ALE 0.12, PME 0.15, PLE 0.12; AME-AME 0.04, AME-ALE 0.01, PME-PME 0.04, PME-PLE 0.03. Leg measurements: I: 6.65 (1.95, 2.15, 1.55, 1.00); II: 5.60 (1.75, 1.80, 1.25, 0.80); III: 5.05 (1.50, 1.55, 1.25, 0.75); IV: 7.05 (2.00, 2.25, 1.90, 0.90). Carapace yellowish, with the black and broad radial grooves, with black lateral margins. Abdomen grey, with black spots, nearly eggplant-shaped. Legs yellowish, with black annulations. Palp: tibia short, about 1/4 of cymbial length; RTA about half of tibial length;
LTA divided into two parts, almost hook-shaped and subequal the length of RTA; conductor nearly arc-shaped, about 1.5 times as long as tegulum, with two loops; embolus beginning at 7:00 o’clock position, with a nearly chestnut-shaped base, about 1/2 width of tibia (Fig. 5A–C).

**Female (one of paratypes):** Total length 4.50. Carapace 2.00 long, 1.50 wide. Abdomen 2.50 long, 1.75 wide. Eye sizes and interdistances: AME 0.04, ALE 0.11, PME 0.13, PLE 0.15; AME-AME 0.03, AME-ALE 0.09, PME-PME 0.03, PME-PLE 0.02. Leg measurements: I: 5.15 (1.50, 1.75, 1.15, 0.75); II: 4.50 (1.35, 1.50, 0.95, 0.70); III: 4.05 (1.25, 1.30, 0.90, 0.60); IV: 5.85 (1.75, 1.85, 1.50, 0.75). Carapace yellowish; sternum flavescent. Abdomen beige, with black and wavy stripes, nearly egg-shaped. Legs yellowish, with black annulations. Epigyne: atrium small, almost square-shaped (width=length); receptacles oval, separated by less than 1/2 of their width, about 1.2 times as long as wide; copulatory ducts folded, with two parts, one membranous and another heavily sclerotized cylindrical, almost covered by receptacles; copulatory openings indistinct (Fig. 6A–B).

**Distribution.** Known only from the type localities (Fig. 7).

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**References**

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