

Research article

[urn:lsid:zoobank.org:pub:089DE7B1-E940-4197-B192-266F786E92D7](https://doi.org/10.5852/ejt.2024.968.2725)

Three new species of the spider genus *Meotipa* Simon, 1895 from Guangxi Zhuang Autonomous Region, China (Araneae: Theridiidae)

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Abstract. Three new species of *Meotipa* Simon, 1895 are described based on specimens collected from Guangxi Zhuang Autonomous Region, China: *Meotipa lingulata* sp. nov. (female), *M. pseudomultuma* sp. nov. (both male and female) and *M. tortuosa* sp. nov. (both male and female). Detailed descriptions, photographs, line drawings, sequences of histone H3, and a distribution map of the three new species are provided.

Keywords. Histone H3, morphology, taxonomy, spiny theridiids.

Liang Y., Yin H. & Xu X. 2024. Three new species of the spider genus *Meotipa* Simon, 1895 from Guangxi Zhuang Autonomous Region, China (Araneae: Theridiidae). *European Journal of Taxonomy* 968: 156–173. <https://doi.org/10.5852/ejt.2024.968.2725>

Introduction

Members of the genus *Meotipa* Simon, 1895, called “spiny theridiids or long-legged spiders”, are generally recognized by having bright spots and stripes, and black flattened spines ornamenting abdomens and/or legs (Deeleman-Reinhold 2009). They prefer to live under leaves of shrubs or trees in both tropics and subtropics. *Meotipa* was established based on the type species, *Meotipa picturata* Simon, 1895, from India. To date, a total of 20 species of *Meotipa* distributed in south-, southeast-, and east Asia have been reported and described (World Spider Catalog 2024).

Historically, *Meotipa* was treated as a junior synonym of *Chryso* O. Pickard-Cambridge, 1882 by Levi & Levi (1962), but the monophyly of the genus is uncertain due to diverse morphology of its current members (Levi & Levi 1962: 47). By comparing specimens (originally belonging to *Meotipa*) collected from Borneo with the type species of *Chryso*, *Chryso albomaculata* O. Pickard-Cambridge, 1882 from North America, Deeleman-Reinhold (2009) discovered that the spiny theridiids from Borneo

share low morphological similarities to *Chryso*. She therefore recovered *Meotipa* as a valid genus based on the following apomorphies: the abdomen extends upwards and backwards beyond spinnerets; flattened spines are present on the abdomen and femora and tibiae of the legs; the conductor extends beyond cymbium edge, and is spoon-shaped and widened distally; and the epigyne has a deep pit-like atrium or large copulatory openings.

China supports a rich diversity of species of *Meotipa* with eleven species reported to date. Yunnan Province and Guangxi Zhuang Autonomous Region are the regions with relatively higher species diversity, including eight and five species of *Meotipa*, respectively (Zhu 1998; Song *et al.* 1999; Li *et al.* 2020; Lin *et al.* 2021; Deng *et al.* 2022). Our recent years of explorations in Guangxi Zhuang Autonomous Region yielded a large number of theridiid specimens, in which we found that three undescribed species could be classified as *Meotipa*, namely *M. lingulata* sp. nov. (♀), *M. pseudomultuma* sp. nov. (♂♀) and *M. tortuosa* sp. nov. (♂♀) by their morphological and molecular analyses provided in this study.

Material and methods

Morphology

All specimens examined in this study are deposited in the College of Life Science, Hunan Normal University (HNU). Specimens were examined using an Olympus SZX16 stereo microscope and an Olympus BX53 compound microscope. Photographs were taken with a Canon PowerShot G12 digital camera mounted on an Olympus BX53 compound microscope. The final multifocal images were produced using Helicon Focus 6.0 (<https://www.heliconsoft.com/>). Both the male palp and female epigyne were examined, photographed, and illustrated after dissection, and the epigyne was digested with pancreatin for approximately four hours before the examination (Álvarez-Padilla & Hormiga 2007). All morphological measurements were calculated using a LEICAM 205C stereo microscope. Eye diameters were taken at the widest point. Leg measurements are given as total length of left leg (femur, patella, tibia, metatarsus, tarsus). Leg segments were measured on their dorsal sides. All measurements are in millimeters (mm).

Abbreviations for morphological terms

Terminology in the present paper follows Agnarsson *et al.* (2007) and Deng *et al.* (2022).

A	= atrium
ALE	= anterior lateral eye
AME	= anterior median eye
C	= conductor
CD	= copulatory duct
CO	= copulatory opening
CT	= connection tissue
E	= embolus
ES	= epigynal septum
FD	= fertilization duct
MA	= median apophysis
PLE	= posterior lateral eye
PME	= posterior median eye
S	= spermatheca
St	= subtegulum
STL	= sternum length
STW	= sternum width
T	= tegulum

Table 1. Collection localities of samples with GenBank accession numbers in this paper.

species	sex	GenBank accession number	collection localities
<i>Meotipa lingulata</i> sp. nov.	♀	PP266433	Fangchenggang City, Guangxi, China
<i>Meotipa pseudomultuma</i> sp. nov.	♀	PP266431	Chongzuo City, Guangxi, China
<i>Meotipa tortuosa</i> sp. nov.	♀	PP266430	Chongzuo City, Guangxi, China
<i>Meotipa tortuosa</i> sp. nov.	♂	PP266432	Chongzuo City, Guangxi, China

Table 2. *P*-distances of the new species.

species	sex	1	2	3	4
1 <i>Meotipa lingulata</i> sp. nov.	♀	–	0.0891	0.0423	0.0423
2 <i>Meotipa pseudomultuma</i> sp. nov.	♀	0.0272	–	0.0151	0.0151
3 <i>Meotipa tortuosa</i> sp. nov.	♀	0.0109	0.0067	–	0.0000
4 <i>Meotipa tortuosa</i> sp. nov.	♂	0.0109	0.0067	0.0000	–

Molecular analysis

To test a conspecific relationship between sexes of individuals collected from different localities (*M. tortuosa* sp. nov.), we ran a genetic distance analysis using MEGA 11 ver. 11.0.13 (Tamura *et al.* 2021) with the following parameters: 1000 bootstrap replications based on *p*-distance method, and other parameters were set the default. For each sample, up to four right legs were used for whole DNA extraction using the Animal Genomic DNA Extraction Kit (TSINGKE Inc., Beijing, China) and the remains of the spider were retained as a voucher. It is necessary to mention that it wasn't in 95% ethanol solution that our specimens in this study were preserved. Because we hadn't successfully amplified the COI sequences for all species, we had to choose the H3 gene which is relatively easy to amplify. The purified genomic DNA was used as a template to amplify H3 sequences (~350 bp) using the primer pair H3aF/H3aR (Colgan *et al.* 1998). PCR reaction protocol and the sequence data inspection followed Wheeler *et al.* (2017). The obtained H3 sequences were verified using BLAST (<https://www.ncbi.nlm.nih.gov>) and deposited in GenBank. The related GenBank accession numbers are listed in Table 1.

Results

The genetic distances between individuals of the new species were calculated using the H3 gene marker in this study. Although two separated localities yielded specimens of solely one sex, the results strongly support they are conspecific as *M. tortuosa* sp. nov. with no sequence differences between them. The genetic distance is reported in Table 2.

Taxonomy

Class Arachnida Cuvier, 1812
 Order Araneae Clerck, 1757
 Family Theridiidae Sundevall, 1833

 Genus *Meotipa* Simon, 1895

Key to the Chinese species of *Meotipa* Simon, 1895

Male

1. Conductor with a deep groove 2
 - Conductor without a distinct groove 4
2. Conductor relative thin, with a sharp top 3
 - Conductor large, with a widened top *M. picturata* Simon, 1895
3. Embolus small and short, dentate-shaped *M. pseudomultuma* sp. nov.
 - Embolus thin and long, filiform *M. zhengguoi* Lin & Li, 2021
4. Embolus mostly covered by conductor 5
 - Embolus uncovered 9
5. Embolus extremely twisted *M. tortuosa* sp. nov.
 - Embolus not twisted 6
6. Conductor relatively thin, end with hook 7
 - Conductor large, widened at end 8
7. Margin of conductor smooth *M. spiniventris* (O. Pickard-Cambridge, 1869)
 - Margin of conductor unsmooth, serrated *M. luoqiae* Lin & Li, 2021
8. Embolus almost as long as conductor *M. menglun* Lin & Li, 2021
 - Embolus about $\frac{1}{3}$ length of conductor *M. capacifaba* Li *et al.*, 2020
9. Conductor large, with a widened end 10
 - Conductor relative thin, maintaining a consistent width *M. argyrodiformi* (Yaginuma, 1952)
10. Embolus large, triangular *M. pulcherrima* (Mello-Leitão, 1917)
 - Embolus thin, ivory-shaped *M. vesiculosa* Simon, 1895

Female

1. Atrium large 2
 - Atrium indistinct or absent 9
2. Atrium divided into two parts by epigynal septum 3
 - Atrium not divided 4
3. Atrium horse hoof-shaped *M. tortuosa* sp. nov.
 - Atrium ring-shaped *M. capacifaba* Li *et al.*, 2020
4. Atrium with a projection 5
 - Atrium without a projection *M. argyrodiformis* (Yaginuma, 1952)
5. Atrium with a rod-shaped projection 6
 - Atrium with an irregular projection 7
6. Copulatory ducts connecting to spermathecae laterally *M. picturata* Simon, 1895
 - Copulatory ducts connecting to spermathecae ventrally
 *M. pseudopicturata* Deng, Agnarsson, Chen & Liu, 2022

7. Copulatory ducts swollen *M. pulcherrima* (Mello-Leitão, 1917)
– Copulatory ducts thin 8
8. Copulatory ducts long, surrounding spermathecae in a loop *M. lingulata* sp. nov.
– Copulatory ducts short, not twisted *M. vesiculosa* Simon, 1895
9. Copulatory ducts long, surrounding spermathecae in semi-loop *M. pseudomultuma* sp. nov.
– Copulatory ducts short, not twisted 10
10. Spermathecae very round *M. spiniventris* (O. Pickard-Cambridge, 1869)
– Spermathecae oval, with a narrow posterior *M. striata* Deng, Agnarsson, Chen & Liu, 2022

Meotipa lingulata sp. nov.

[urn:lsid:zoobank.org:act:7A407F13-8D06-4DB6-BC6C-3C4C161BF86E](https://doi.org/10.21203/rs.3.rs-3811111/v1)

Figs 1–2, 11, Tables 1–3

Diagnosis

This new species is similar to *M. multuma* Murthappa *et al.* 2017 in having a curved CD and spherical S (compare Figs 1F, 2F with Murthappa *et al.* 2017: fig. 3f), but can be distinguished from the latter by an upwardly extended abdomen (triangular in lateral view), indistinct CO hidden by epigynal projection, a slender CD maintaining a consistent width, and V-shaped CT; this is in contrast to the not extended abdomen, clearly visible and large CO, extremely long CD with enlarged starting part but abruptly becoming slender, and the absence of CT in *M. multuma* (compare Figs 1D–F, 2 with Murthappa *et al.* 2017: fig. 3a–f).

Etymology

The specific name is derived from the Latin word ‘*lingulata*’, meaning ‘tongue’, referring to the shape of projection of epigyne, and is an adjective, feminine.

Type material

Holotype

CHINA • ♀; Guangxi Zhuang Autonomous Region, Fangchenggang City, Shangsi County, Shiwandashan Nature Reserve, Songpai Protection Station; 21°59′ N, 108°53′ E; alt. 303 m; 4 May 2021; A. He, J. Liu, Y. Liang, R. Liao, Q. Li and Y. Liu leg.; HNU800.

Paratype

CHINA • 1 ♀; same data as for holotype; HNU801.

Description

Female (holotype HNU800)

Total length 3.1, carapace 1.07 long, 0.88 wide, 0.41 height, abdomen 2.03 long, 1.20 wide, 2.25 height. Carapace yellowish, with dark gray longitudinal band extending to clypeus, and heart-shaped patch in front of fovea. Fovea deep, radial furrow black (Fig. 1A). Eye area slightly elevated. Eye sizes and inter-distances: AME 0.10, ALE 0.07, PME 0.07, PLE 0.07; AME–AME 0.08, AME–ALE 0.03, PME–PME 0.08, PME–PLE 0.05. Clypeus height 0.24. Clypeus bulged outwards. Chelicerae yellow-brown, with three promarginal and one retromarginal teeth. Pedipalp yellowish, tibia and metatarsus with dark brown spots ventrally, patella with one and tibia with two black flattened spines. Endite yellowish, wider than long. Labium nearly rectangle. STL 0.61, STW 0.50. Sternum yellowish, shield-shaped, with brown patches laterally. Legs yellowish, slender, with scattered brown spots ventrally, patellae and tibiae with

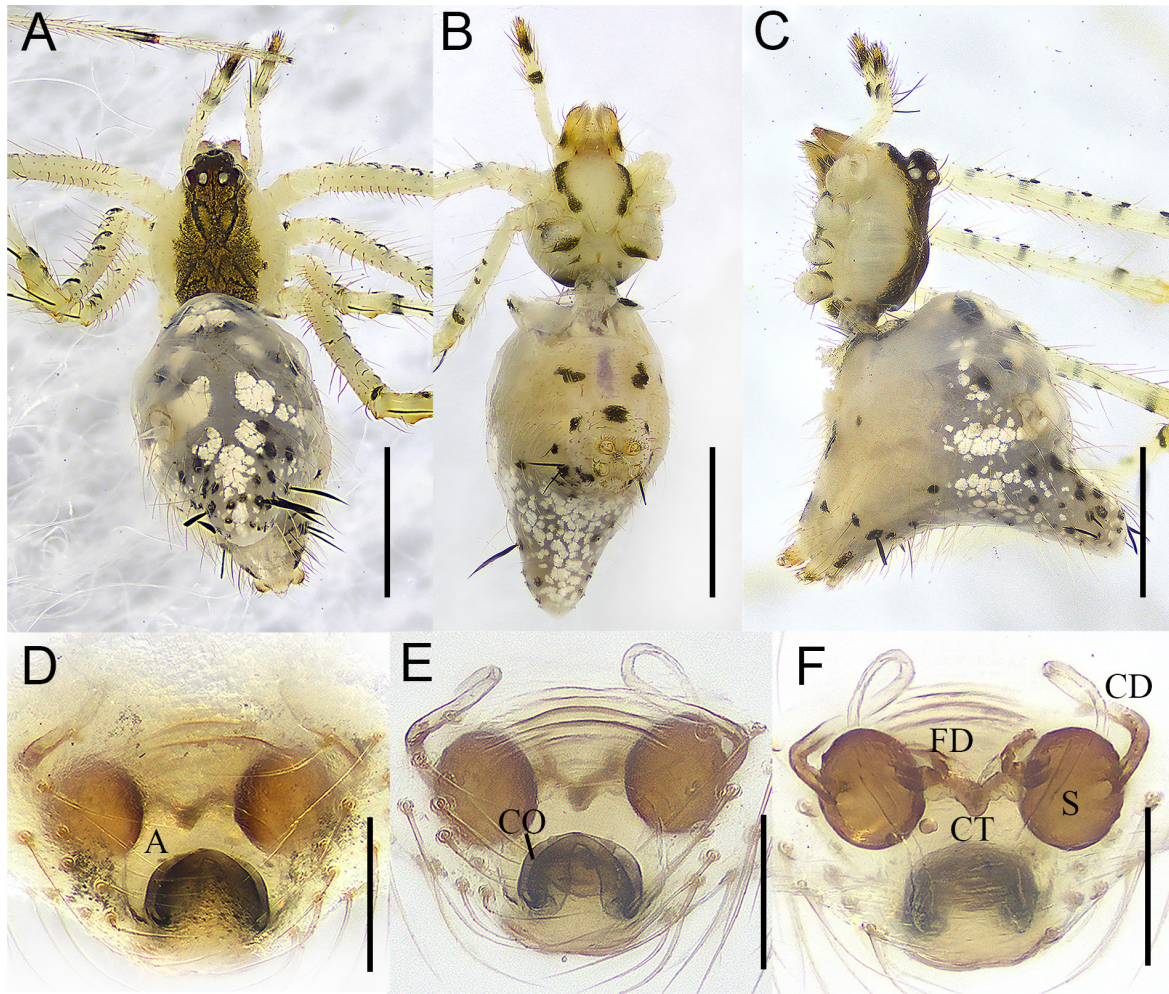


Fig. 1. *Meotipa lingulata* sp. nov., ♀, holotype (HNU800). A–C. Habitus. A. Dorsal view. B. Ventral view. C. Lateral view. D–E. Epigyne, ventral view. F. Vulva, dorsal view (E–F, after digestion with pancreatin). Abbreviations: see Material and methods. Scale bars: A–C = 1 mm; D–F = 0.1 mm.

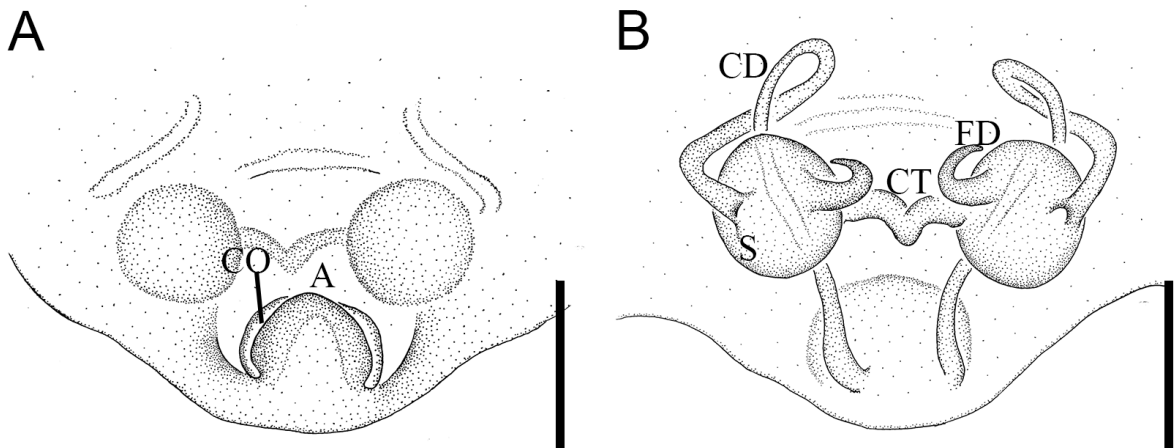


Fig. 2. *Meotipa lingulata* sp. nov., ♀, holotype (HNU800). A. Epigyne, ventral view. B. Vulva, dorsal view. Abbreviations: see Material and methods. Scale bars = 0.1 mm.

Table 3. The distributions of known species of *Meotipa* Simon, 1895 in China.

species	distribution
<i>Meotipa argyrodiformis</i> (Yaginuma, 1952) (♂♀)	China, Japan, Philippines, India
<i>Meotipa capacifaba</i> Li, Liu, Xu & Yin, 2020 (♂♀)	China
<i>Meotipa luoqiae</i> Lin & Li, 2021 (♂)	China
<i>Meotipa lingulata</i> sp. nov. (♀)	China
<i>Meotipa menglun</i> Lin & Li, 2021 (♂)	China
<i>Meotipa picturata</i> Simon, 1895 (♂♀)	China, India, Thailand, Laos, Indonesia
<i>Meotipa pulcherrima</i> (Mello-Leitão, 1917) (♂♀)	tropical Africa, introduced to the Americas, Papua New Guinea, China, Korea, Japan, and Pacific Islands
<i>Meotipa pseudopicturata</i> Deng, Agnarsson, Chen & Liu, 2022 (♀)	China
<i>Meotipa pseudomultuma</i> sp. nov. (♂♀)	China
<i>Meotipa spiniventris</i> (O. Pickard-Cambridge, 1869) (♂♀)	Sri Lanka to China, Japan, introduced to the Netherlands
<i>Meotipa vesiculosa</i> Simon, 1895 (♂♀)	China, Vietnam to Japan, Philippines, Indonesia
<i>Meotipa zhengguoi</i> Lin & Li, 2021 (♂)	China
<i>Meotipa striata</i> Deng, Agnarsson, Chen & Liu, 2022 (♀)	China
<i>Meotipa tortuosa</i> sp. nov. (♂♀)	China

one or two black flattened spines. Leg measurements: I 9.93 (3.13, 0.47, 2.00, 2.80, 0.93); II 5.68 (1.95, 0.27, 1.21, 1.54, 0.71); III 3.55 (1.24, 0.24, 0.58, 0.95, 0.54); IV 6.32 (2.14, 0.48, 1.22, 1.79, 0.69). Leg formula I IV II III. Abdomen gray, with several snowy patches and black spots (Fig. 1A). Caudal region extending upwards beyond spinnerets. Caudal region and region above spinnerets with black flattened spines (Fig. 1C). Venter of abdomen yellowish, with brown spots (Fig. 1B).

EPIGYNE (Figs 1D–F, 2). Atrium deep, with tongue-shaped and double-layered projection. CO indistinct and hidden by depression of epigynal projection. CD slender, surrounding S in loop before connecting to S laterally. S spherical and connected by V-shaped CT. FD relatively long and thick, curved, arising from middle of S.

Male

Unknown.

Distribution

Known only from the type locality, China (Guangxi) (Fig. 11).

Meotipa pseudomultuma sp. nov.

[urn:lsid:zoobank.org:act:B2273F95-07E9-4B3B-88E6-7214FABD5F2F](https://zoobank.org/act:B2273F95-07E9-4B3B-88E6-7214FABD5F2F)

Figs 3–6, 11, Tables 1–3

Diagnosis

The female of this new species is similar to that of *M. spiniventris* (O. Pickard-Cambridge, 1869) in having a large CO and oval S (compare Figs 3D, 4A with Deng *et al.* 2022: fig. 4d–e), but can be distinguished from the latter by the abdomen extending backwards beyond the spinnerets and a slender CD surrounding S in a semi-loop versus oval abdomen without extension as well as short and thick CD not convoluting around S in *M. spiniventris* (compare Figs 3D–F, 4 with Deng *et al.* 2022: fig 4b, d, g). The male of this new species is similar to that of *M. multuma* Murthappa *et al.*, 2017 in having a

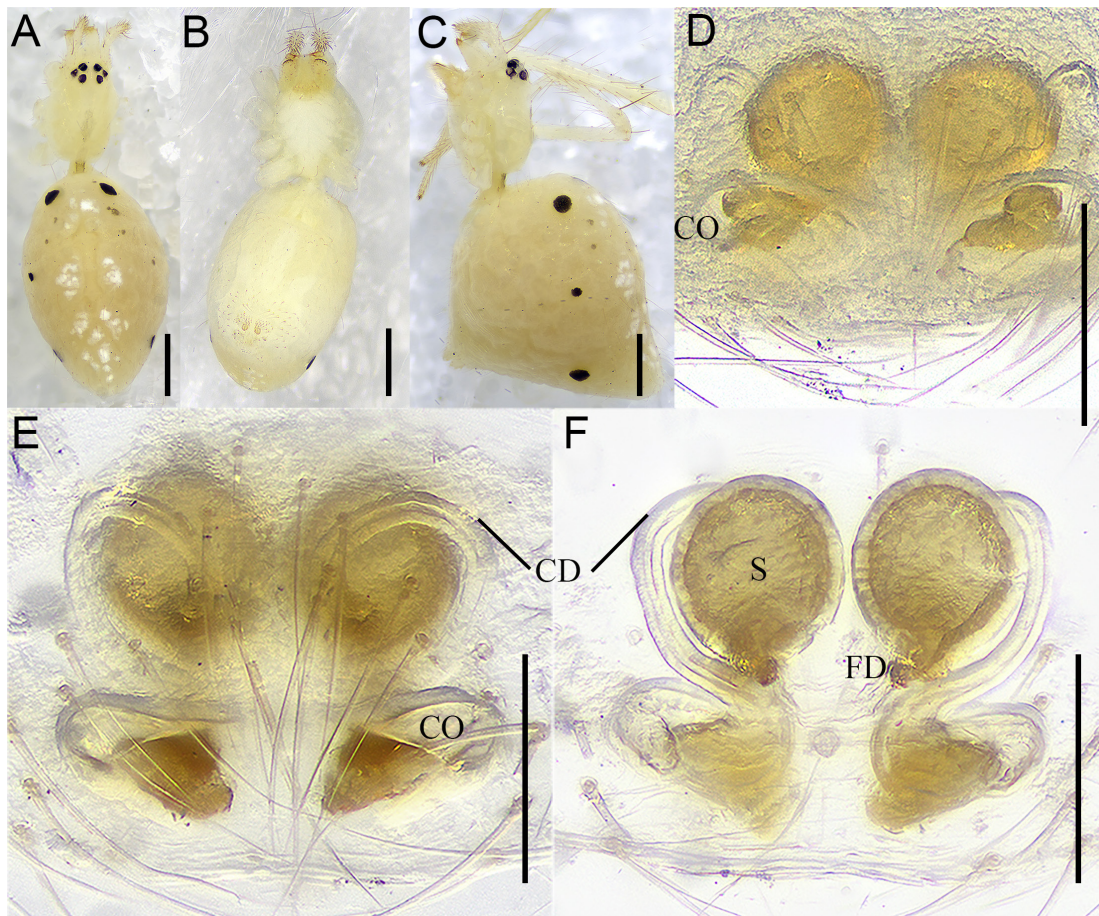


Fig. 3. *Meotipa pseudomultuma* sp. nov., ♀, holotype (HNU802). **A–C.** Habitus. **A.** Dorsal view. **B.** Ventral view. **C.** lateral view. **D–E.** Epigyne, ventral view. **F.** Vulva, dorsal view (E–F, after digestion with pancreatin). Abbreviations: see Material and methods. Scale bars: A–C = 0.5 mm; D–F = 0.1 mm.

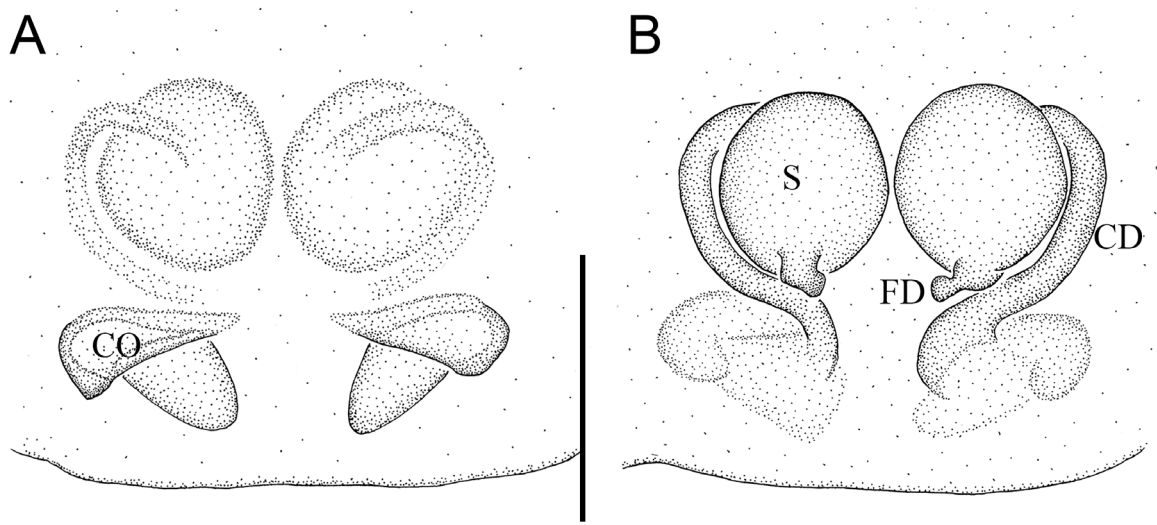


Fig. 4. *Meotipa pseudomultuma* sp. nov., ♀, holotype (HNU802). **A.** Epigyne, ventral view. **B.** Vulva, dorsal view. Abbreviations: see Material and methods. Scale bars = 0.1 mm.

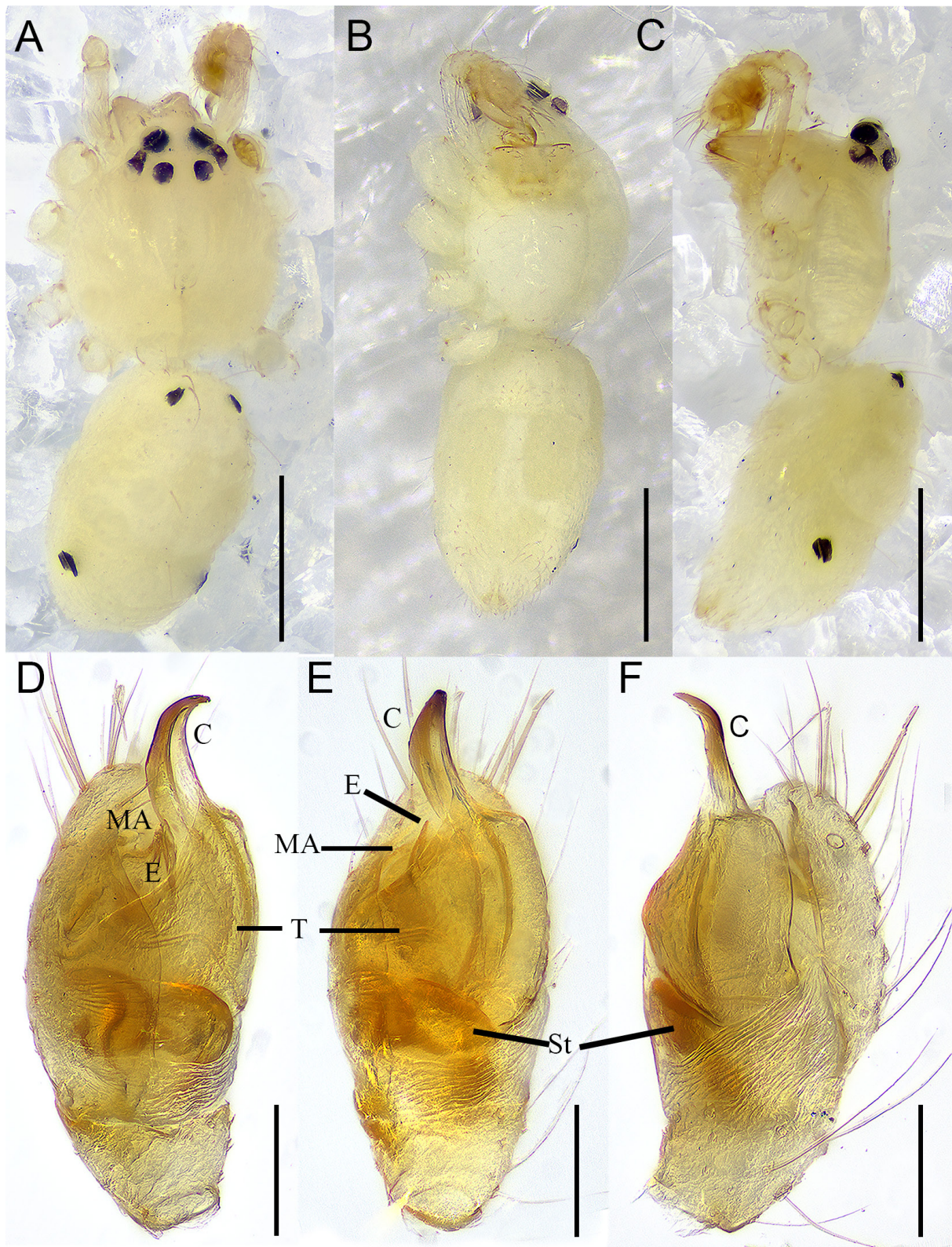


Fig. 5. *Meotipa pseudomultuma* sp. nov., ♂, paratype (HNU803). A–C. Habitus. A. Dorsal view. B. Ventral view. C. Lateral view. D–E. Left palp. D. Prolateral view. E. Ventral view. F. Retrolateral view. Abbreviations: see Material and methods. Scale bars: A–C = 0.5 mm; D–F = 0.1 mm.

protruding C with a deep groove (compare Figs 5D, 6A with Sekhar & Sunil, 2021: fig. 4), but can be distinguished from the latter by a large T joining to C as well as a relatively small, curved C with its basal edge visible through T; whereas relatively small T as well as large, sclerotized, relatively straight, and entirely uncovered C are present in *M. multuma* (compare Figs 5D–F, 6 with Sekhar & Sunil, 2021: fig. 4).

Etymology

The specific name is the combination of the Latin prefix ‘*pseudo-*’ and the species name ‘*multuma*’, meaning that the male of this new species is very similar to that of *M. multuma* in having a protruding conductor with a deep groove, and is an adjective, feminine.

Type material

Holotype

CHINA • ♀; Guangxi Zhuang Autonomous Region, Chongzuo City, Nonggang Nature Reserve, Nonggang Station; 22°28' N, 106°57' E; alt. 184 m; 25 Oct. 2017, A. He, K. Liu, J. Liu, Q. Cai and J. Liu leg; HNU802.

Paratypes

CHINA • 2 ♂♂; same data as for holotype; HNU803 to HNU804 • 8 ♀♀; same data as for holotype; HNU805 to HNU812.

Description

Female (holotype HNU802)

Total length 2.29, carapace 0.84 long, 0.74 wide, 0.45 height, abdomen 1.45 long, 0.94 wide, 1.28 height. Carapace yellowish, fovea round, radial furrow indistinct (Fig. 3A). Eye sizes and inter-distances: AME 0.07, ALE 0.06, PME 0.05, PLE 0.05; AME–AME 0.06, AME–ALE 0.04, PME–PME 0.09, PME–PLE 0.04. Clypeus height 0.17. Clypeus slightly bulged. Chelicerae yellowish, very long, only two promarginal teeth. Pedipalp yellowish, tibia with one black flattened spine. STL 0.52, STW

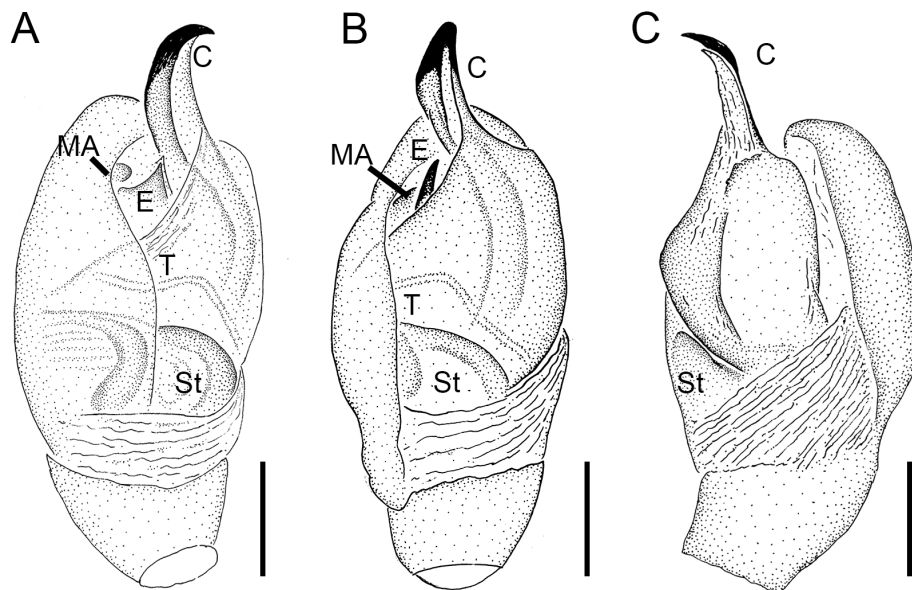


Fig. 6. *Meotipa pseudomultuma* sp. nov., ♂, paratype (HNU803). A–C. Left palp. A. Prolateral view. B. Ventral view. C. Retrolateral view. Abbreviations: see Material and methods. Scale bars = 0.1 mm.

0.43. Sternum yellowish, shield-shaped. Labium nearly rectangle. Legs yellowish, long and slender, patellae and tibiae with one or two black flattened spines. Leg measurements: I 9.57 (2.67, 0.45, 2.51, 3.01, 0.93); II 6.62 (1.75, 0.45, 1.41, 1.78, 0.83); III 3.83 (1.23, 0.25, 0.83, 0.98, 0.54); IV 5.91 (1.92, 0.33, 1.23, 1.65, 0.78). Leg formula I II IV III. Abdomen yellowish, with snowy patches and three pairs of black spots (Fig. 3A). Caudal region extending upwards beyond spinnerets (Fig. 3C). Venter of abdomen yellowish (Fig. 3B).

EPIGYNE (Figs 3D–F, 4). CO large, horn-shaped, with broken embolus as mating plug. CD relatively long, surrounding S in semi-loop, and connecting to center of S ventrally. S oval, adjacent to each other. FD relatively short and curved, arising from lower-middle of S.

Male (paratype HNU803)

Total length 1.62; carapace 0.79 long, 0.70 wide, 0.21 height; abdomen 0.83 long, 0.56 wide, 0.41 height. Eye sizes and inter-distances: AME 0.08, ALE 0.05, PME 0.06, PLE 0.05; AME–AME 0.07, AME–ALE 0.04, PME–PME 0.09, PME–PLE 0.07. CL 0.20. STL 0.49, STW 0.41. Leg measurements: I 8.77 (2.47, 0.37, 2.21, 2.84, 0.88); II 5.52 (1.65, 0.34, 1.25, 1.62, 0.66); III 3.38 (1.13, 0.20, 0.73, 0.88, 0.44); IV 5.32 (1.73, 0.25, 1.15, 1.53, 0.66). Leg formula I II IV III. Abdomen oval, yellowish, dorsum with two pairs of black spots located anteriorly and two posteriorly (Fig. 5A). Caudal region not extending beyond spinnerets (Fig. 5B). Other characteristics similar to those of female.

PEDIPALPUS (Figs 5D–F, 6). Prolateral margin of cymbium strongly extends ventrally. T large, transparent, and joining with C. St small, located on lower of bulb. C transparent, with deep groove in ventral view, resembling curved hook in prolateral view. E short, sharp, partially covered by C. MA small, situated between E and cymbium.

Distribution

Known only from the type locality, China (Guangxi) (Fig. 11).

Meotipa tortuosa sp. nov.

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Figs 7–11, Tables 1–3

Diagnosis

The female of this new species is similar to that of *M. capacifaba* Li *et al.*, 2020 in having a deep, membranous atrium and large, sclerotized S (compare Figs 7D–F, 8 with Li *et al.* 2020: figs 2a, 3a), but can be distinguished from the latter by having an oval abdomen in lateral view, a horse hoof-shaped atrium with equal-width margin, and visible CO; whereas the abdomen is near trapezoidal in lateral view, atrium ring-shaped with widened area that is strongly sclerotized but abruptly becoming slender as well as indistinct CO hidden by anterior margin of atrium in *M. capacifaba* (compare Figs 7D–F, 8 with Li *et al.* 2020: figs 1c, 2a–b). The male of this new species is similar to that of *M. pulcherrima* (Mello-Leitão, 1917) in having a broad, large and sclerotized C (compare Figs 9E, 10E with Yoshida 2003: fig. 213), but can be distinguished from the latter by an extremely twisted E hidden by C in ventral view and C distinctly extending beyond cymbium; whereas E is straight, short, and uncovered in ventral view as well as C slightly extending beyond cymbium in *M. pulcherrima* (compare Figs 9D–F, 10 with Yoshida 2003: fig. 213).

Etymology

The specific name is derived from the Latin word ‘*tortuosa*’, meaning ‘twisted’, referring to the shape of the embolus, and is an adjective, feminine.

Type material

Holotype

CHINA • ♀; Guangxi Zhuang Autonomous Region, Chongzuo City, Jiangzhou District, Zuozhou Town, Guanghe Village; 22°34' N, 107°25' E; alt. 281 m; 6 Sep. 2015; B. Zhou, W. Liu, J. Liu, Q. Cai, X. Huang and D. Li leg.; HNU813.

Paratypes

CHINA • 2 ♂♂; Guangxi Zhuang Autonomous Region, Chongzuo City, Nongang Nature Reserve, Nongang Station; 22° 27' N, 106° 55' E; alt. 188 m; 25 Oct. 2017; A. He, K. Liu, J. Liu, Q. Cai, J. Liu and Z. Huang leg.; HNU814–815.

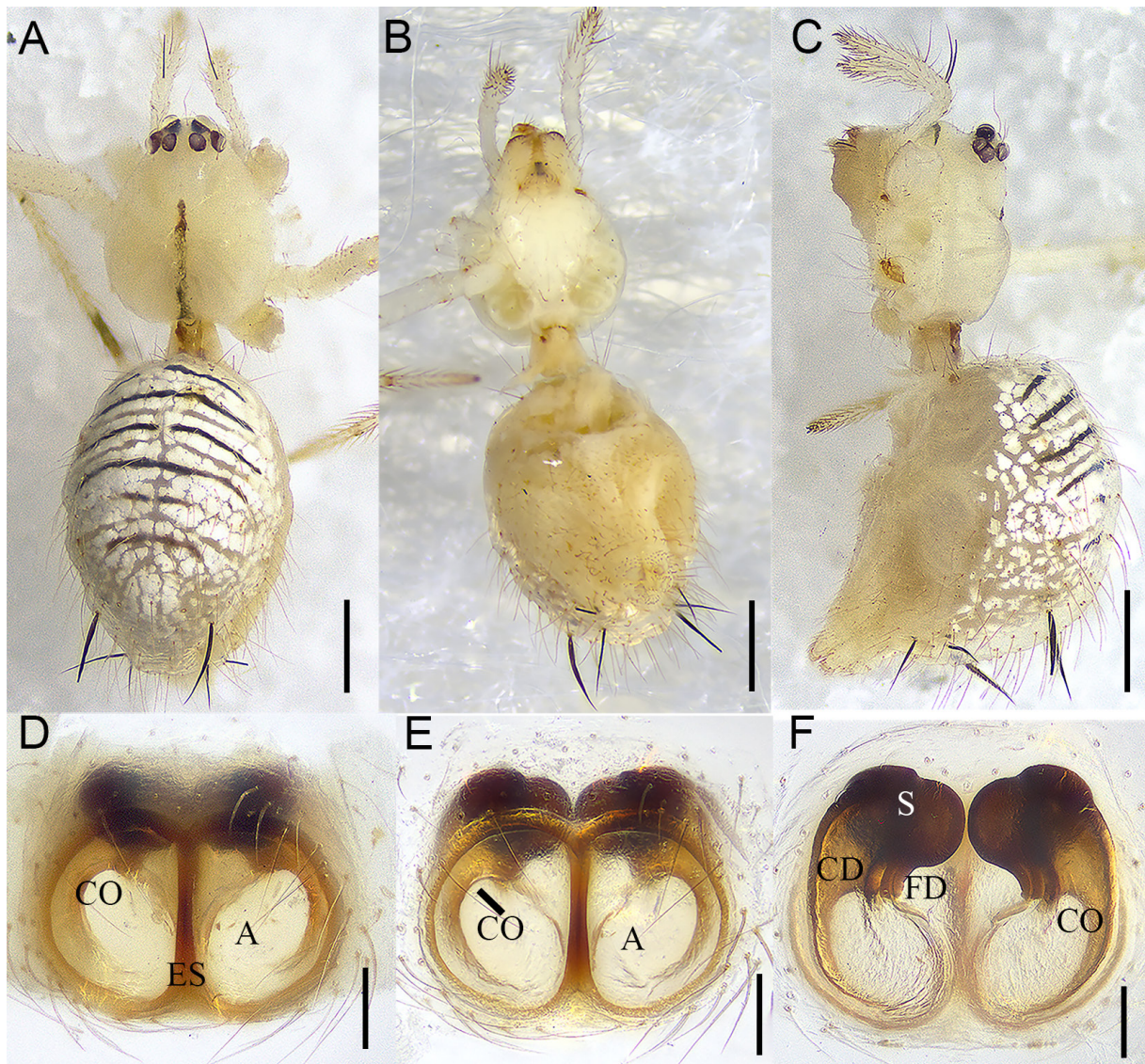


Fig. 7. *Meotipa tortuosa* sp. nov., ♀, holotype (HNU813). **A–C.** Habitus. **A.** Dorsal view. **B.** Ventral view. **C.** Lateral view. **D–E.** Epigyne, ventral view. **F.** Vulva, dorsal view (E–F, after digestion with pancreatin). Abbreviations: see Material and methods. Scale bars: A–C = 0.5 mm; D–F = 0.1 mm.

Description

Female (holotype HNU813)

Total length 2.9, carapace 1.06 long, 0.87 wide, 0.41 height, abdomen 1.84 long, 1.13 wide, 1.29 height. Carapace yellowish, with a pale gray longitudinal stripe, and round fovea, indistinct radial furrow (Fig. 7A). Eye sizes and interdistances: AME 0.10, ALE 0.08, PME 0.09, PLE 0.08; AME–AME 0.06, AME–ALE 0.02, PME–PME 0.07, PME–PLE 0.05. Clypeus height 0.24. Clypeus bulged outwards. Chelicerae yellowish, three promarginal teeth and one retromarginal tooth. Pedipalp yellowish, patellae and tibiae with one black flattened spine each. STL 0.62, STW 0.53. Sternum yellowish, shield-shaped. Labium nearly rectangular. Legs yellowish, long and slender, patellae and tibiae have one or two black flattened spines. Leg measurements: I 10.15 (2.96, 0.69, 2.31, 3.20, 0.99); II 6.18 (2.01, 0.43, 1.27, 1.76, 0.71); III 3.85 (1.27, 0.35, 0.65, 1.03, 0.55); IV 7.2 (2.45, 0.46, 1.57, 2.05, 0.67). Leg formula I IV II III. Abdomen oval, yellowish, with snowy patches and six transverse black stripes. Caudal region and region above spinnerets with black flattened spines (Fig. 7C). Venter of abdomen yellowish (Fig. 7B).

EPIGYNE (Figs 7D–F, 8). Atrium membranous, divided into two parts by ES, each part resembling a horse hoof. Margin of atrium and ES strongly sclerotized. CO distinct. CD sclerotized, width approximately $\frac{1}{2}$ width of S, and terminal portion fused with S. S sclerotized, adjacent to each other, and extending horizontally. FD relatively long, comma-shaped, with sclerotized basal portion and membranous distal portion, arising from posterior margin of S.

Male (paratype HNU814)

Total length 2.33, carapace 1.01 long, 0.93 wide, 0.51 height, abdomen 1.32 long, 0.74 wide, 0.80 height. Eye sizes and inter-distances: AME 0.11, ALE 0.07, PME 0.09, PLE 0.08; AME–AME 0.05, AME–ALE 0.03, PME–PME 0.08, PME–PLE 0.05. Clypeus height 0.29. STL 0.56, STW 0.52. Leg measurements: I 6.75 (1.97, 0.30, 1.41, 1.84, 1.23); II 4.21 (1.50, 0.20, 0.84, 1.24, 0.43); III 2.6 (0.89, 0.16, 0.49, 0.81, 0.25); IV 4.57 (1.54, 0.23, 1.02, 1.34, 0.44). Leg formula I IV II III. Black flattened spines present on dorsum of abdomen, and between caudal region and region above spinnerets. Body size of male much smaller than that of female, and color patterns paler than those of female. Other characteristics similar to those of female.

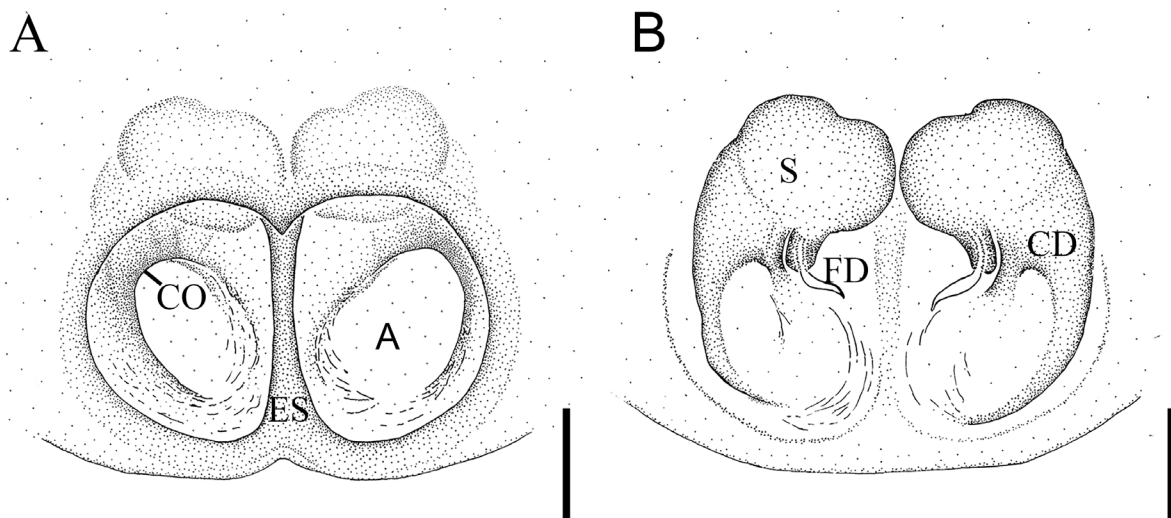


Fig. 8. *Meotipa tortuosa* sp. nov., ♀, holotype (HNU813). **A.** Epigyne, ventral view. **B.** Vulva, dorsal view. Abbreviations: see Material and methods. Scale bars = 0.1 mm.

PEDIPALPUS (Figs 9D–F, 10). Metatarsus with long hairs along distal margin. Cymbium pod-shaped. T broad, sclerotized, joining with C. St relatively large, sclerotized, located on lower of bulb. C robust, well-developed, approximately $\frac{2}{3}$ size of bulb. C mostly sclerotized but basal $\frac{2}{3}$ membranous in retrolateral view. E long, wide, and flat, exhibiting ribbon-like twist, situated between C and E,

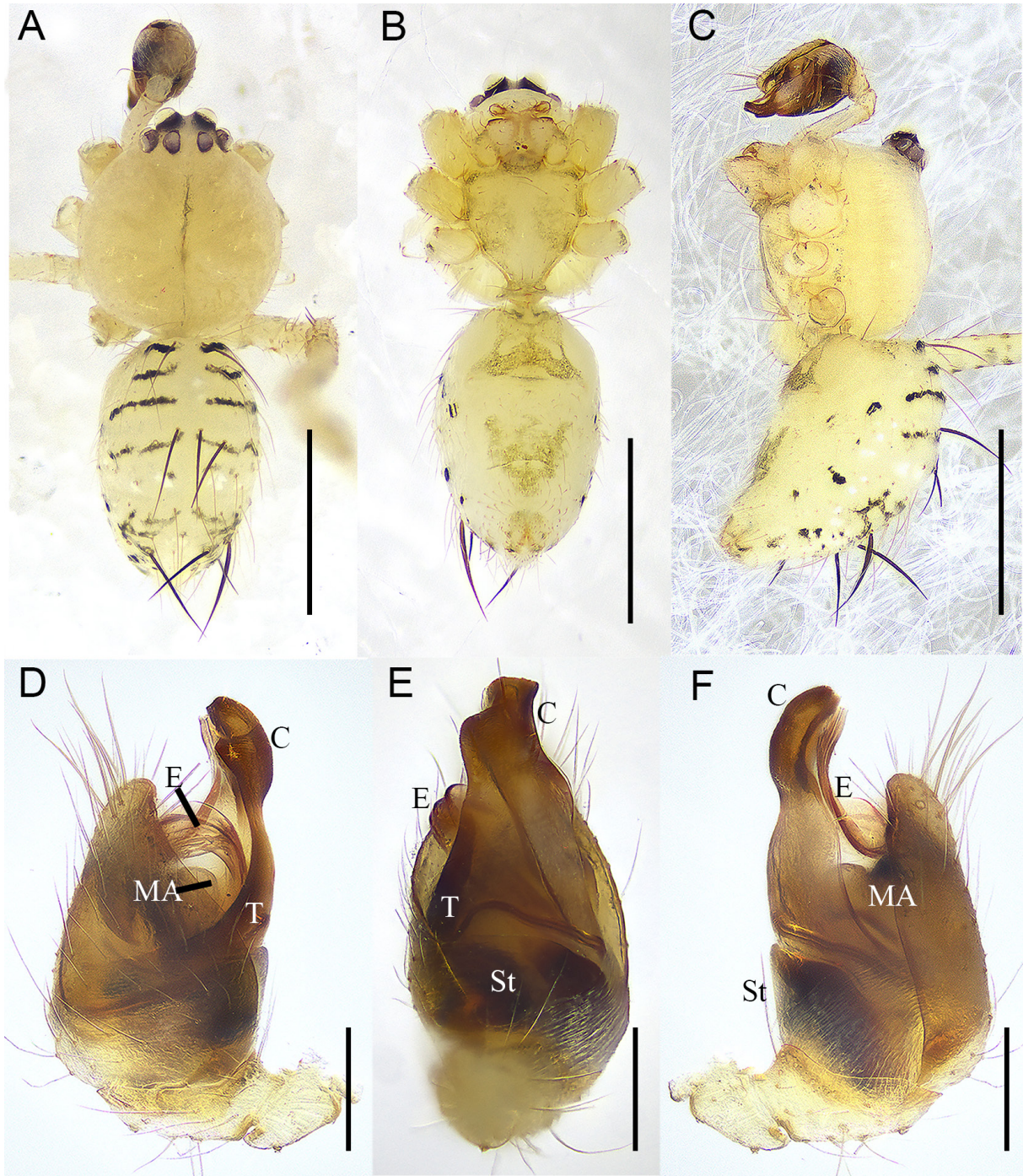


Fig. 9. *Meotipa tortuosa* sp. nov., ♂, paratype (HNU814). **A–C.** Habitus. **A.** Dorsal view. **B.** Ventral view. **C.** Lateral view. **D–E.** Left palp. **D.** Prolateral view. **E.** Ventral view. **F.** Retrolateral view. Abbreviations: see Material and methods. Scale bars: A–C = 1 mm; D–F = 0.1 mm.

originating in position of 6 o'clock and terminating in position of 12 o'clock. MA triangular, situated between C and cymbium.

Remarks

It should be noted that *M. tortuosa* sp. nov. includes one female and two male specimens found in this study, but female and male specimens were not collected in the same locality, nor at the same time. The distance between the two locations is less than 100 kilometers and the time span was nearly two months. In addition, both sexes are similar in appearance. We assumed that the male and female specimens were of the same species, and conducted a molecular analysis using the H3 gene mark to verify our hypothesis. Detailed information about the specimens used for DNA barcoding is shown in Table 1.

Distribution

Known only from the type locality, China (Guangxi) (Fig. 11).

Discussion

Chryso and *Meotipa* share some common characteristics: attractive body color, abdomen with humps and more or less extending upwards and/or backwards (Levi 1957, 1962; Levi & Levi 1962; Deng *et al.* 2022). It is difficult to differentiate the two genera based only on morphology. So far, only one or two members of *Chryso* and *Meotipa* have been involved in resolving the phylogeny of Theridiidae. The lack of a well-sampled phylogenetic analysis on the relationship between *Chryso* and *Meotipa* is the main reason for the continuous controversy about the taxonomic position of species between the two genera (e.g., Kulkarni *et al.* 2017; Murthappa *et al.* 2017; Deng *et al.* 2022).

Historically, *Meotipa* was treated as a junior synonym of *Chryso* (Levi & Levi 1962) but resurrected several decades later by Deeleman-Reinhold (2009). In a recent molecular phylogenetic study by Liu *et al.* (2016), one unnamed species of *Meotipa* was recovered as the sister of two species of *Yunohamella*:

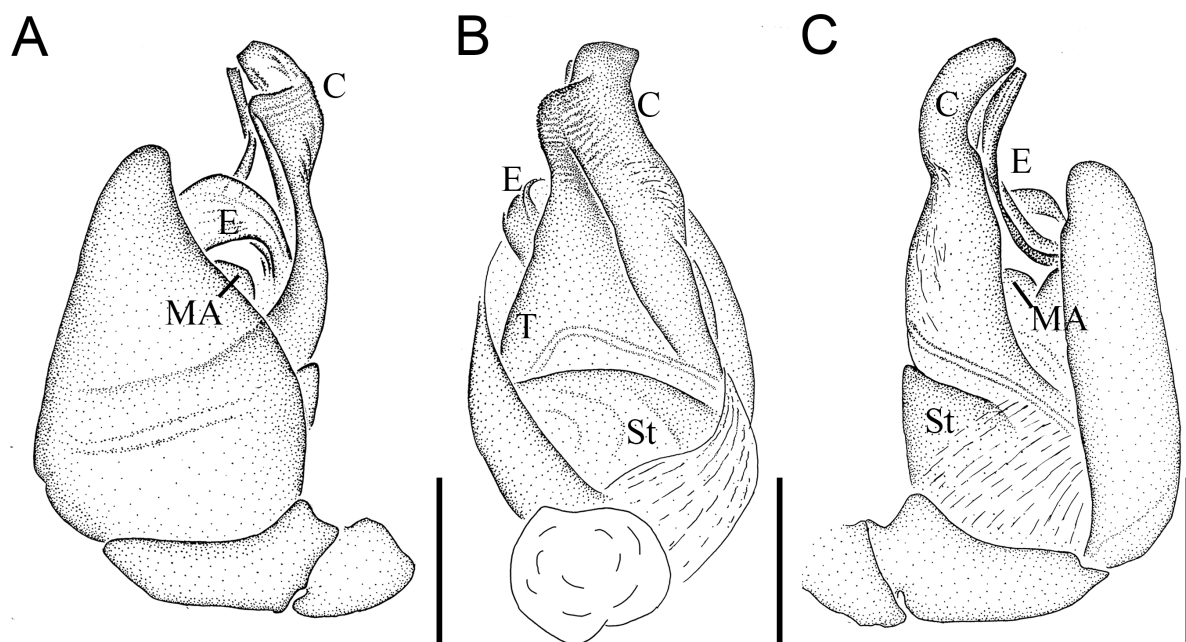


Fig. 10. *Meotipa tortuosa* sp. nov., ♂, paratype (HNU814). A–C. Left palp. A. Prolateral view. B. Ventral view. C. Retrolateral view. Abbreviations: see Material and methods. Scale bars = 0.1 mm.

Y. lyricus (Walckenaer, 1841) and *Y. palmgreni* (Marusik & Tsellarius, 1986). However, another recent cladistic study showed that *Meotipa* was sister to *Chryso* in the subfamily Theridiinae by adding the morphological data of two species of *Meotipa*, *M. picturata* Simon, 1895 and *M. Sahyadri* Kulkarni, 2017, onto Agnarsson's (2004) data matrices including only one species of *Chryso* (Kulkarni 2017). The phylogenetic position of *Meotipa* in the subfamily Theridiinae is strongly supported; however, its phylogenetic relationship with *Chryso* and the division between these two genera remain unknown.

According to Deeleman-Reinhold's (2009) definition, it is reasonable to put the three new species described in this study into the genus *Meotipa* as they all share these characters: abdomen extends upwards and backwards beyond spinnerets; flattened spines present on abdomen and femora and tibiae of legs; spoon-shaped conductor extending beyond cymbium edge, and epigyne bearing deep pit-like atrium or large copulatory openings. Our study increases the total number of known species of *Meotipa* to 23. Future studies on the phylogenetic relationship of *Meotipa* and *Chryso*, as well as establishing diagnostic characteristics and the definition of the two genera are badly needed.

Acknowledgments

We are very grateful to the following graduate students from Hunan Normal University, China for collecting the specimens: Ailan He, Bing Zhou, Wang Liu, Keke Liu, Jihe Liu, Qu Cai, Zongguang Huang, Rongrong Liao, Yang Liu. We also thank Herman Vanuytven and an anonymous referee for their constructive comments, and Nathalie Yonow for correcting the English of the last version of the manuscript. This study was supported by the National Natural Sciences Foundation of China (32070429/31772423/31471963/31372160), Hunan Provincial Natural Science Foundation of China (2023JJ30399), and the Hunan Provincial Innovation Foundation for Postgraduate (CX20230525).

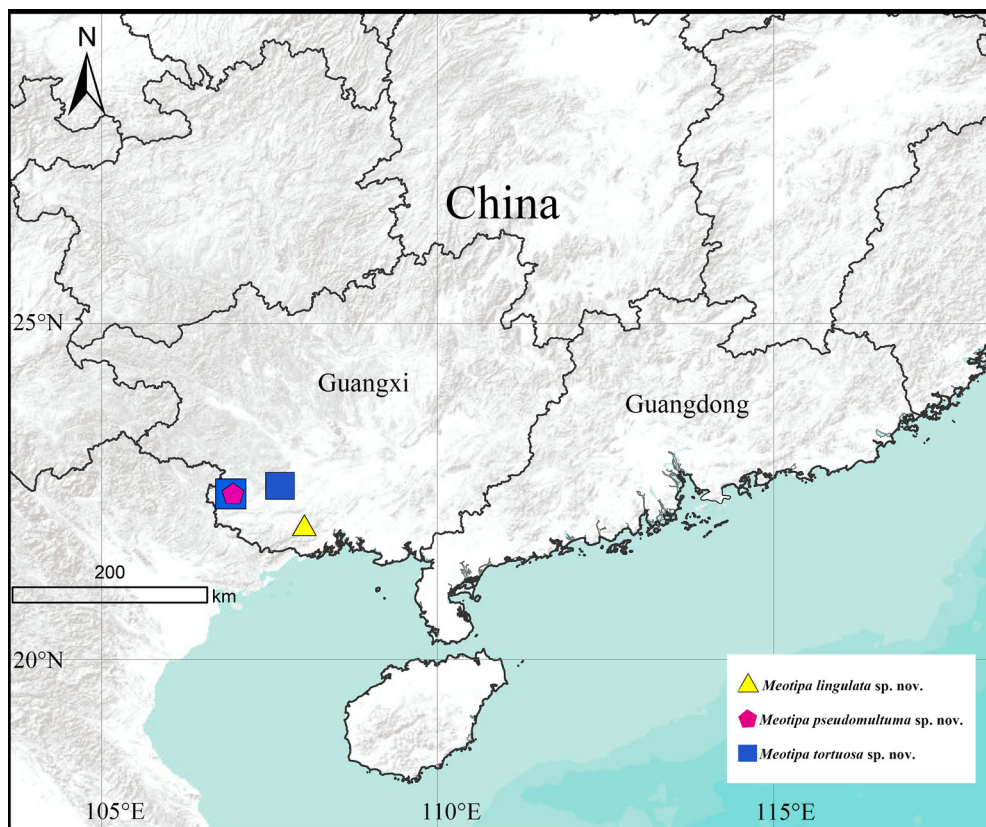


Fig. 11. Collection localities for three new species of *Meotipa* Simon, 1895 in China.

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Manuscript received: 25 February 2024

Manuscript accepted: 15 July 2024

Published on: 5 November 2024

Topic editor: Magalie Castelin

Section editor: Arnaud Henrard

Desk editor: Eva-Maria Levermann

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