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The genus *Myrmarachne* (Araneae, Salticidae) in Flores, Indonesia

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Abstract

Two new species of the genus *Myrmarachne* are described (*M. acutidens* **sp. n.**, *M. epigealis* **sp. n.**), and *M. macrognatha* and *M. melanocephala* are redescribed from Flores specimens. The females of *M. macrognatha* are recorded for the first time.

Keywords

New species, ant-mimicking jumping spiders, Java, Malay Archipelago

Introduction

The genus *Myrmarachne* MacLeay, 1839 is one of the largest groups in the family Salticidae, including around 250 species (Prószyński 2012; Platnick 2012). The members of the genus generally resemble ants morphologically and behaviorally, and the resemblance is considered to be due to Batesian mimicry (Wanless 1978). The area from Southeast Asia to Australia through the Malay Archipelago harbors many *Myrmarachne* species. Wallacea, the non-continental transition zone between the Oriental (Sundan) and Australian (Sahulian) zoogeographical regions, is bounded to the west by

Wallace's line and to the east by Lydekker's line (Hill 2010). The *Myrmarachne* faunas of Wallacean islands have not been studied and revealed sufficiently although Thorell (1877) and Yamasaki (2012) together record ten species from Sulawesi.

Flores forms part of a series of active volcanoes between Java and Timor, and its climate is relatively dry, strongly affected by monsoon and trade winds (Monk et al 1997; van der Geer 2010). Until now, no *Myrmarachne* species have been recorded from the island. In the present study, we describe two new species and redescribe two species known elsewhere, reported from Flores for the first time.

Materials and methods

Collection sites are shown in Figure 1. Morphological observations were made with a Nikon SMZ 1000 stereoscope. Multi-focused montage images were produced using Helicon Focus 4.75 Pro from a series of source images taken by Cannon EOS Kiss x 4 digital camera attached to a Nikon ECLIPSE E600 microscope. Measured parts of the carapace follow Yamasaki (2010). Chelicera length was measured in lateral view, and only for males.

All measurements are given in millimeters. The ranges from the minimum to maximum are shown when more than two specimens were measured. For some species, figures for the holotypes are shown in parentheses. Abbreviations used in the present

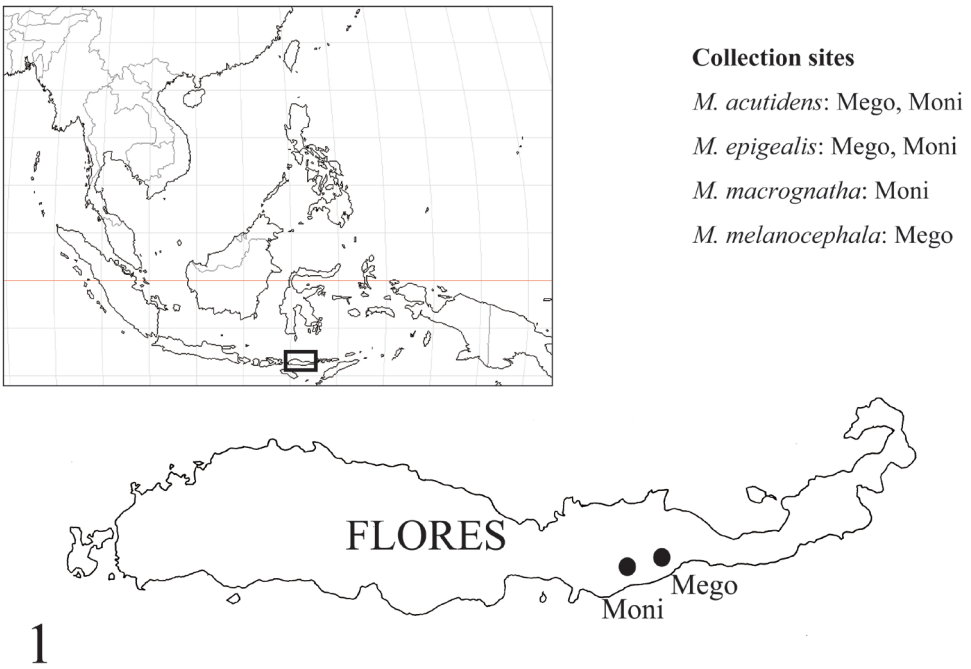


Figure 1. Collection sites. *M. acutidens* and *M. epigealis* were collected from Mego and Moni, *M. macrognatha* from Moni, and *M. melanocephala* from Mego.

paper are as follows: AME, anterior median eye; ALE, anterior lateral eye; PME, posterior median eye; PLE, posterior lateral eye; pd, prodorsal; pv, proventral; rd, retrodorsal; RTA, retrolateral tibial apophysis of palp; rv, retroventral.

The type material examined in the present study was borrowed from Naturhistoriska riksmuseet, Stockholm, Sweden (NRM). The type specimens designated here are deposited at Museum Zoologicum Bogoriense, Research Center for Biology, Indonesian Institute of Science, Cibinong, Indonesia (MZB), and at the Florida State Collection of Arthropods, Gainesville, Florida, USA (FSCA).

Taxonomy

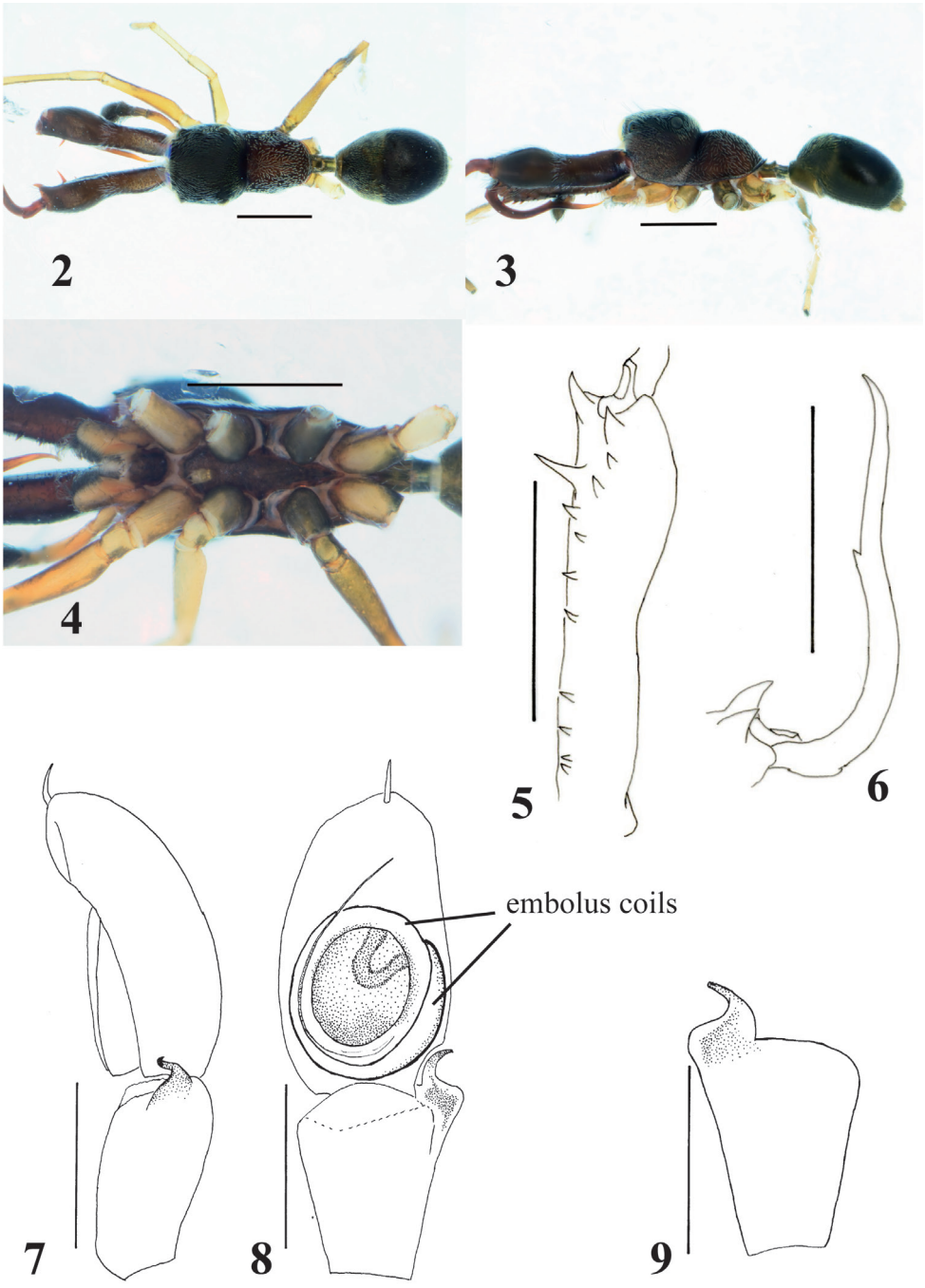
***Myrmarachne acutidens* sp. n.**
urn:lsid:zoobank.org:act:E48ED428-C691-4C0E-B862-A6E9E0D8E9CD
http://species-id.net/wiki/Myrmarachne_acutidens
Figs 2–19

Type material. Holotype male (MZB. Aran. 503), Mego [=8°40'S, 122°2'E], Sikka, Flores, East Nusa Tenggara Prov., INDONESIA, 16.X.2012, T. Yamasaki leg. Paratypes: 1 male and 2 females (1 male and 1 female, FCSA; 1 female, MZB. Aran. 504), same data as holotype; 1 male and 1 female (FSCA), Moni [=8°45'S, 121°51'E], Flores, East Nusa Tenggara Prov., INDONESIA, 17.X.2012, T. Yamasaki leg.

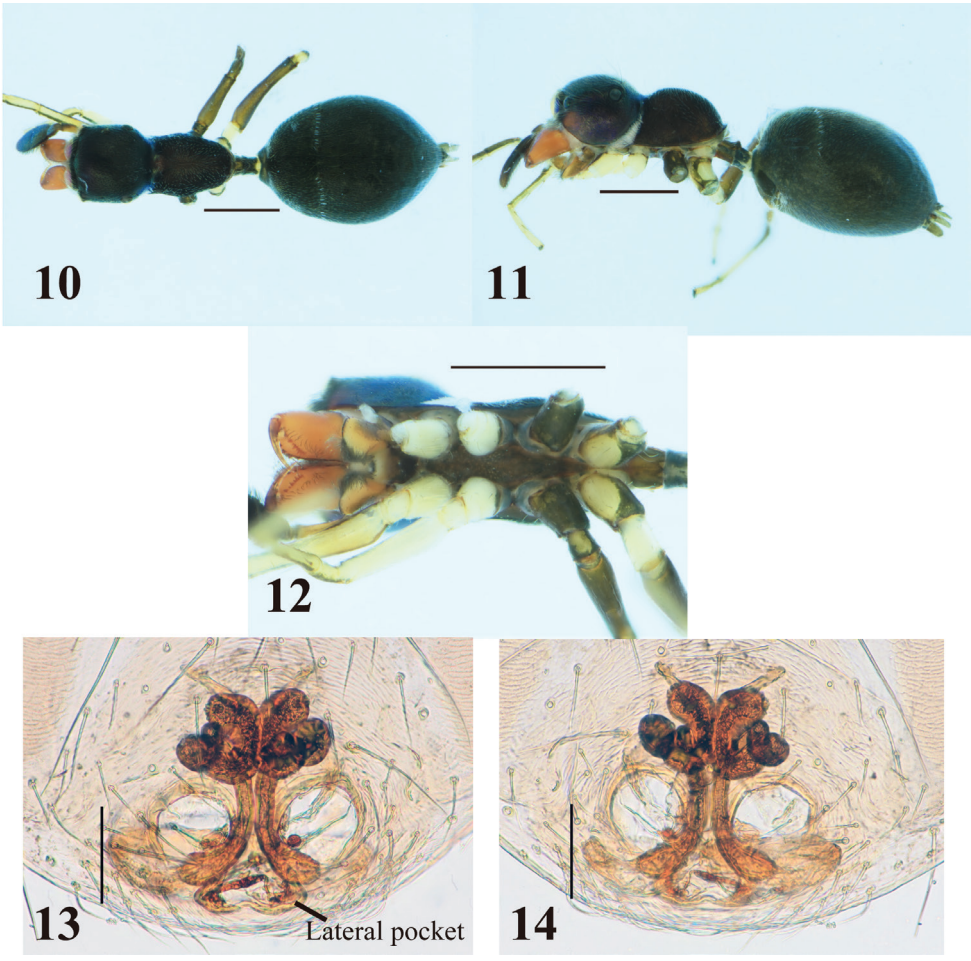
Diagnosis. Blackish species; total length approximately 3.0–4.0 mm in males and 3.5–5.1 mm in females. Males distinguished from other species by structure of chelicera, which is anteriorly swollen and posteriorly narrow (Fig. 2); further distinguished from other species by first and second apical prolateral teeth of chelicera, which are long compared to other teeth (Fig. 5), and fang bearing short tooth-like apophysis submedially on its venter and weak protuberance on dorsum at its base (Fig. 6). Females distinguished from other species except *M. macrognatha* (Thorell, 1894) by shape of dorsum of cephalic and thoracic parts, which are roundly convex (Fig. 11); *M. acutidens* distinguished from *M. macrognatha* by shape of proximal part of sclerotized copulatory ducts of epigyne, which is narrower in *M. acutidens* (Figs 13 vs. 44).

Measurements (male/female). Carapace length 1.50–2.00 (1.90)/1.88–2.20, width 0.83–1.17 (1.10)/0.88–1.07. Chelicera length 1.08–(1.83). ALE–PLE 0.58–0.77 (0.75)/0.65–0.75; ALE–PME 0.26–(0.35)/0.30–0.37. Width of eye row I 0.78–1.05 (1.02)/0.86–1.03; II 0.73–0.98 (0.95)/0.80–0.93; III 0.84–1.13 (1.08)/0.93–1.10. Eye size: AME 0.25–0.37 (0.33)/0.28–0.33; ALE 0.13–0.16 (0.15)/0.13–0.17; PME (0.05)/0.05; PLE 0.14–0.19 (0.16)/0.14–0.16.

Male (Figs 2–9). Cephalic part almost flat dorsally, distinctly higher than thoracic part; lateral surface of carapace strongly incised behind PLE; dorsum of thoracic part weakly convex in middle part, and then sloping downward (Figs 2–3). Chelicera almost as long as carapace, its anterior part weakly swollen dorsally and wider than posterior part; venter of chelicera bearing seven to ten prolateral and two to four retrolat-



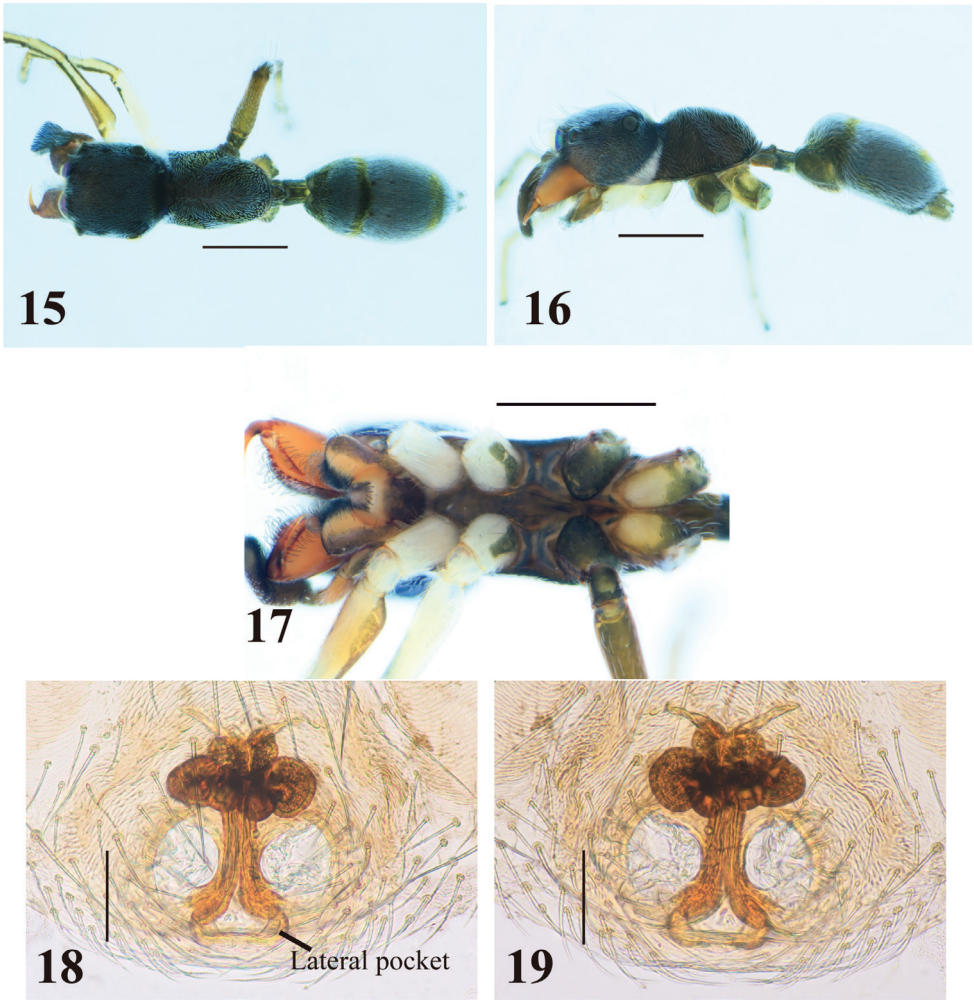
Figures 2–9. *Myrmarachne acutidens*, male. **2** Body in dorsal view **3** body in lateral view **4** endites, labium, coxae and trochanters in ventral view **5** left chelicera in ventral view **6** left fang in retrolateral view **7** left palp in retrolateral view **8** left palp in ventral view **9** left palpal tibia in dorsal view. (Scales. Figs **2–6**: 1 mm; **7–9**: 0.25 mm)



Figures 10–14. *Myrmarachne acutidens*, female. **10** Body in dorsal view **11** body in lateral view **12** endites, labium, coxae and trochanters in ventral view **13** internal structure of epigyne in ventral view **14** internal structure of epigyne in dorsal view. (Scales. Figs **10–12**: 1 mm; **13–14**: 0.1 mm)

eral teeth; apical two prolateral and one retrolateral teeth large, especially second prolateral tooth counted from apex very long (Fig. 5). Fang weakly sinuous, bearing short tooth-like apophysis on venter near its middle, and weak protuberance on dorsum of its base (Fig. 6); proximal part of fang strongly arched. Pedicel short (0.25–0.32 mm). Abdomen oval without distinct constriction, and with two contiguous dorsal scuta; each lateral margin of where scuta are contiguous strongly incised at anterior third.

With palp in dorsal and ventral views, cymbium elongate-oval, with one apical spine (Fig. 8). Tegulum oval, with ejaculatory duct along proximal and prolateral margins, and rounded V-shaped ejaculatory duct at distal retrolateral margin of tegulum (Fig. 8). Embolus forming two oval coils; embolus coils occupying more than half of venter of cymbium, and basal coil as wide as venter of cymbium, while more ventral



Figures 15–19. *Myrmarachne acutidens*, hairy female. **15** Body in dorsal view **16** body in lateral view **17** endites, labium, coxae and trochanters in ventral view **18** internal structure of epigyne in ventral view **19** internal structure of epigyne in dorsal view. (Scales. Figs **15–17**: 1 mm; **18–19**: 0.1 mm)

coil is slightly smaller (Fig. 8). With palp in dorsal and ventral views, RTA curved outward, with well-developed its flange; with palp in retrolateral view, RTA strongly s-curved with tip slightly spiraled (Figs 7, 9).

Number of spines on legs. Femur I pd 0–1, rd 0; tibia I pv 1–3, rv 2–3; metatarsus I pv 2, rv 2; tibia II pv 0, rv 0–2; metatarsus II pv 1, rv 1; femur III pd 1, rd 0; femur IV pd 1, rd 0–1.

Coloration in alcohol and pilosity. Carapace covered with white setae; cephalic part black and thoracic part dark brown; lateral surface of carapace above coxae I and II densely fringed with white setae (Figs 2–3). Chelicera dark brown; boundary between anterior swollen part and posterior narrow part fringed with white setae; anterior swol-

len part covered with long setae. Endite brownish cream. Labium and sternum dark brown (Fig. 4). Coxa and trochanter I dark yellow suffused with gray, coalesced into lateral dark stripe; coxae II and III black, distal prolateral part of coxa II yellowish suffused with gray, trochanter II like trochanter I except lighter yellow, trochanter III with more extensive lateral stripe and yellowish venter suffused with gray; coxa IV dark yellow with gray lateral stripes, trochanter IV white with short lateral gray marks (Fig. 4). Abdomen and its dorsal scuta black, covered with fine setae (Figs 2–3).

Female (Figs 10–19). With carapace in lateral view, cephalic part roundly convex dorsally, slightly higher than thoracic part; dorsal concavity behind PLE distinct; dorsum of thoracic part roundly convex overall (Figs 10–11, 15–16). Chelicera bearing four to six prolateral and seven to eight retrolateral teeth on its venter. Pedicel usually short, but sometimes long (0.23–0.95 mm). Abdomen oval, without distinct constriction (Figs 10–11, 15–16).

Epigyne (Figs 13–14, 18–19). Copulatory atria containing openings round. Median copulatory structure in front of epigastric furrow divided into lateral pockets; each lateral margin anteroposteriorly flattened. Sclerotized copulatory ducts emerging from oval spermathecae with complex twists, then extending between atria to vicinity of lateral pockets.

Number of spines on legs. Tibia I pv 4–5, rv 4; metatarsus I pv 2, rv 2; tibia II pv 0–1, rv2; metatarsus II pv 1–2, rv 2.

Coloration in alcohol and pilosity. Carapace black; cephalic part covered with fine setae; thoracic part sparsely covered with white setae; lateral surface of carapace above coxae I and II densely fringed with white setae (Figs 10–11, 15–16). Chelicera light brown. Endite brownish yellow, tinged with gray (Figs 12, 17). Labium cream, tinged with black (Figs 12, 17). Sternum black (Figs 12, 17). Coxae and trochanters similar to male pattern but lighter in color; coxae and trochanters I and II white, coxa II with variable black retrolateral stripe; coxa and trochanter III black, trochanter lighter ventrally suffused with black; coxa IV yellow with extensive lateral black stripe, trochanter IV white (Figs 12, 17). Abdomen black, covered with fine setae; some white setae roughly forming transverse white band in anterior dorsum of abdomen (Figs 10–11, 15–16).

Etymology. The specific name is derived from the second prolateral tooth counted from the apex in males.

Biology. The species is arboreal, and collected from trees in secondary forests or plantation areas.

Distribution. Flores.

***Myrmarachne epigealis* sp. n.**
urn:lsid:zoobank.org:act:F33ED9E3-EC1F-4211-96FA-86927ADF099E
http://species-id.net/wiki/Myrmarachne_epigealis
Figs 20–32

Type material. Holotype male (MZB. Aran. 505), Moni [=8°45'S, 121°51'E], Flores, East Nusa Tenggara Prov., INDONESIA, 18–19.X.2012, T. Yamasaki leg. Paratypes:

1 male (FSCA), Mego [=8°40'S, 122°2'E], Sikka, Flores, East Nusa Tenggara Prov., INDONESIA, 16.X.2012, T. Yamasaki leg.; 2 females (FSCA), same as holotype; 1 female (MZB. Aran. 506), same loc., 18.X.2012, Rijal Satria leg.

Diagnosis. Black species; total length approximately 5.3–5.8 mm in males, 6.2–7.2 mm in females. Males distinguished from other species by prolateral dorsal margin of chelicera diverted toward retrolateral side in distal half, exposing prolateral surface of chelicera in dorsal view (Fig. 20). Females distinguished from other species except *M. grossa* Edmunds & Prószyński, 2003 by thoracic part, which is longer than cephalic part (Figs 28–29); *M. epigealis* distinguished from *M. grossa* by sclerotized copulatory ducts, which are narrower and longer than those of *M. grossa* (cf. Figs 78–79 in Edmunds and Prószyński 2003).

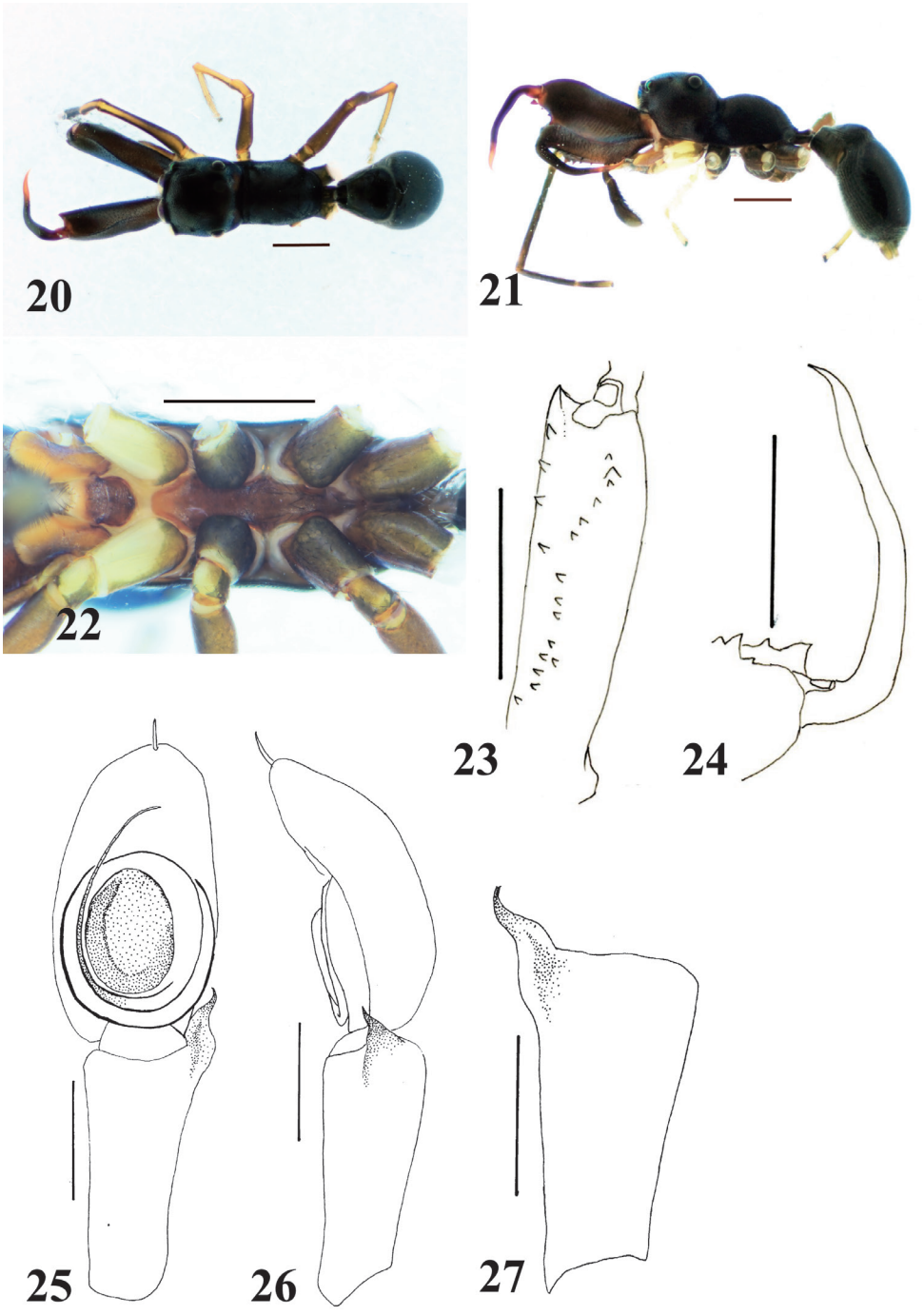
Measurements (male/female). Carapace length 2.63–(2.83)/ 3.20–3.35, width 1.35–(1.40)/1.33–1.48. Chelicera length 1.90–(2.07). ALE–PLE 0.95–(1.00)/1.03–1.13; ALE–PME 0.45–(0.47)/ 0.50–0.55. Width of eye row I 1.28–(1.33)/ 1.38–1.45; II 1.13–(1.18)/1.20–1.28; III 1.33–(1.38)/ 1.43–1.53. Eye size: AME (0.43)/ 0.43–0.45; ALE 0.22–(0.23)/0.22–0.23; PME 0.06–(0.08)/0.08; PLE 0.23–(0.24)/ 0.25–0.26.

Male (Figs 20–27). Cephalic part weakly convex dorsally, distinctly higher than thoracic part; in lateral view, dorsum of carapace sloping downward behind PLE, and concave between cephalic and thoracic parts; lateral surface between cephalic and thoracic parts weakly incised; thoracic part roundly swollen overall (Figs 20–21). Chelicera slightly shorter than carapace; with chelicera in dorsal view, its dorsal prolateral margin diverted toward retrolateral margin in distal half, exposing prolateral surface (Fig. 20); venter of chelicera bearing four to five prolateral and eleven to 14 retrolateral teeth (Fig. 23); apical prolateral corner of venter forming large tooth-like apophysis; with chelicera in ventral view, one retrolateral tooth present next to third retrolateral tooth counted from base, and one prolateral tooth slightly proximal to row of retrolateral teeth. Fang weakly sinuous, without tooth-like apophysis (Fig. 24). Pedicel short (0.30–0.43 mm). Abdomen oval with weak constriction at anterior fourth, and its entire dorsum covered with two contiguous dorsal scuta; lateral margins strongly incised where scuta come together (Figs 20–21).

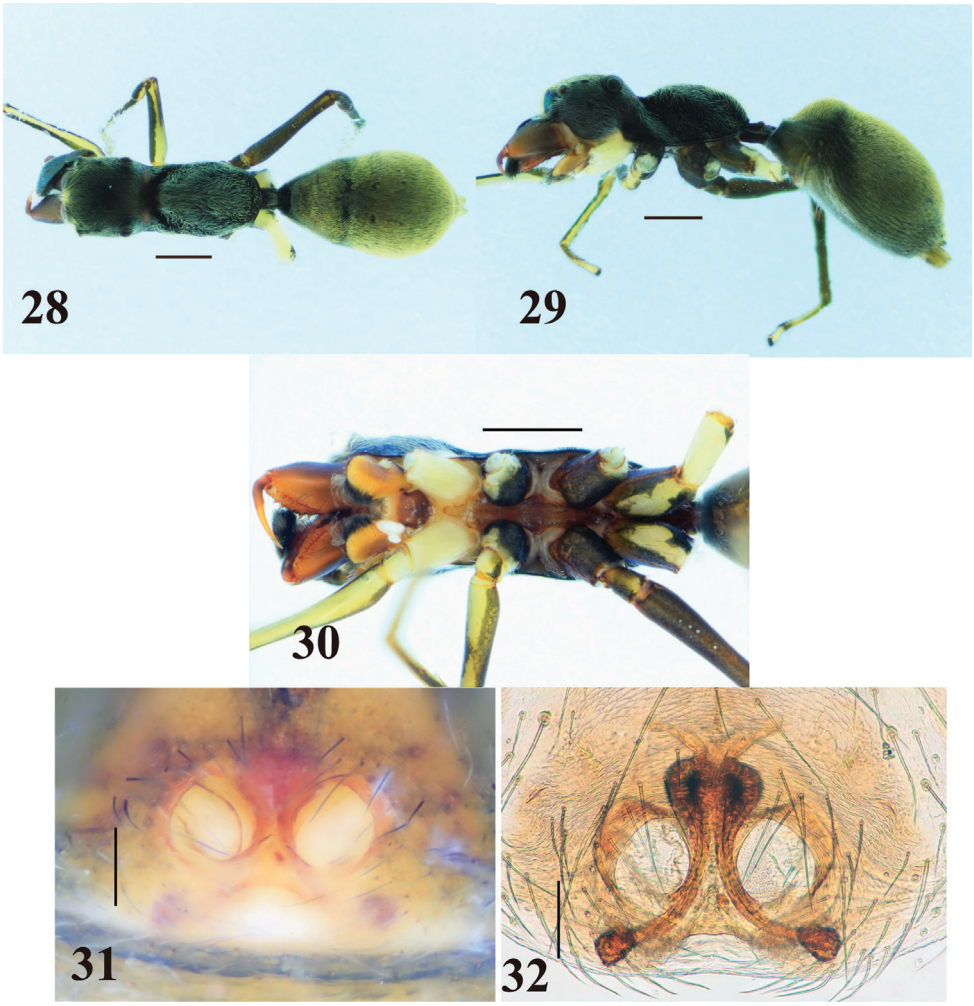
With palp in dorsal and ventral views, cymbium elongate-oval with one apical spine (Fig. 25). Tegulum oval, with long seminal reservoir along margin of tegulum (Fig. 25). Embolus forming two oval coils; more ventral embolus coil as wide as venter of cymbium, slightly narrower than basal coil (Fig. 25). RTA well developed with the tip curved inward, and without a distinct its flange (Figs 26–27).

Number of spines on legs. Patella I pv 0, rv 0–1; tibia I pv 5, rv 5; metatarsus I pv 2, rv 2; tibia II pv 3, rv 3; metatarsus II pv 2, rv 2.

Coloration in alcohol and pilosity. Carapace and chelicera black, covered with very short inconspicuous setae (Figs 20–21). Carapace with pair of light brown spots behind PLE. Endite, labium and sternum light brown, tinged with black (Fig. 22). In ventral view, coxa and trochanter I light yellow, tinged with gray on posterior margin of coxa and laterally on trochanter; coxa II black, trochanter II like trochanter I; coxa and trochanter III black, trochanter yellow ventrally strongly tinged with



Figures 20–27. *Myrmarachne epigealis*, male. **20** Body in dorsal view **21** body in lateral view **22** endites, labium, coxae and trochanters in ventral view **23** left chelicera in ventral view **24** left fang in retrolateral view **25** left palp in ventral view **26** left palp in retrolateral view **27** left palpal tibia in dorsal view. (Scales. Figs **20–24**: 1 mm; **25–27**: 0.25 mm)



Figures 28–32. *Myrmarachne epigealis*, female. **28** Body in dorsal view **29** body in lateral view **30** endites, labium, coxae and trochanters in ventral view **31** epigyne in ventral view **32** internal structure of epigyne in ventral view. (Scales. Figs **28–30**: 1 mm; **31–32**: 0.1 mm)

black; coxa IV blackish with yellow venter strongly tinged with black, trochanter IV light yellow (Fig. 22). Abdomen and its dorsal scuta black, covered with fine setae (Figs 20–21).

Female (Figs 28–32). Cephalic part very weakly convex or almost flat, higher than thoracic part; with carapace in lateral view, dorsal concavity roundly convex behind PLE; thoracic part swollen dorsally overall (Figs 28–29). Chelicera bearing seven prolateral and 13 to 14 retrolateral teeth on its venter. Pedicel short (0.43–0.55 mm). Abdomen oval with weak constriction in anterior third, and without obvious dorsal scuta (may be present under pilosity).

Epigyne (Figs 31–32). Copulatory atria containing openings round. Median pocket present in front of epigastric furrow, weakly sclerotized. Sclerotized copulatory ducts extending from oval spermathecae without twists to posterolateral to atria.

Number of spines on legs. Patella I pv 0, rv 1; tibia I pv 5, rv 5; metatarsus I pv 2, rv 2; tibia II pv 3, rv 3; metatarsus II pv 2, rv 2.

Coloration in alcohol and pilosity. Carapace mainly black, covered with white setae densely; carapace with pair of light brown spots behind PLE; lateral surface of carapace above coxa I white, densely fringed with white setae (Figs 28–29). Chelicera brown. Endite, labium and sternum brownish cream, weakly tinged with black (Fig. 30). Coxae and trochanters in ventral view similar to those of males, except coxa IV with much more yellow ventrally, and trochanter IV yellow with distal retrolateral black spot (Fig. 30). Abdomen covered with golden setae dorsally, and with fine setae ventrally (Fig. 28).

Etymology. The specific name is derived from the ground microhabitat, where the species often occurs.

Biology. The species occurs in lower vegetation and on the ground.

Distribution. Flores.

***Myrmarachne macrognatha* (Thorell, 1894)**
http://species-id.net/wiki/Myrmarachne_macrognatha
Figs 33–45

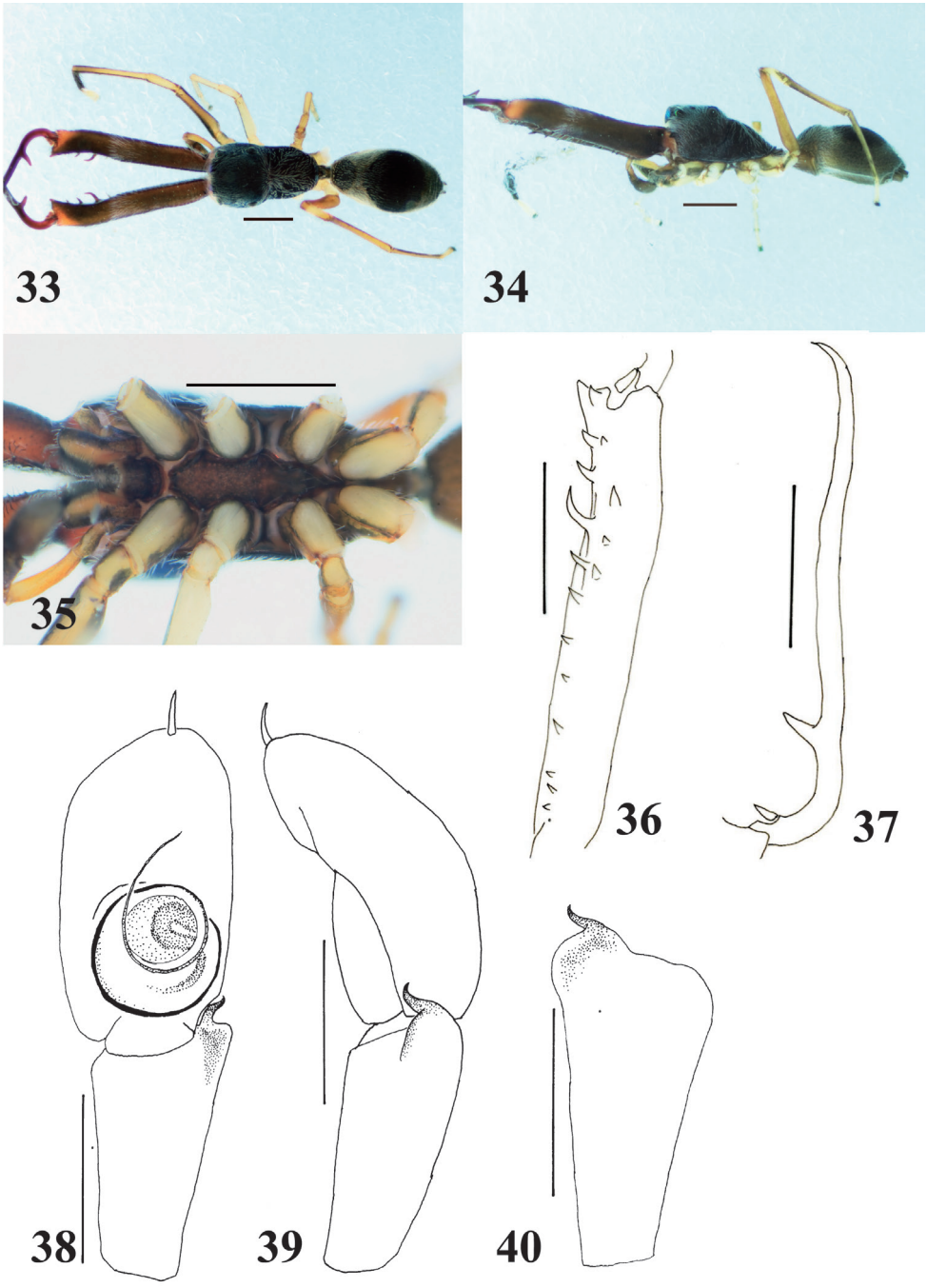
Salticus macrognathus Thorell, 1894: 58.
Myrmarachne macrognatha: Roewer, 1954: 947.

Type material. Holotype male (NRM), Java, [INDONESIA], van Hass. [van Hasselt].

Non-type material examined: 16 males and 11 females, Moni [=8°45'S, 121°51'E], Flores, East Nusa Tenggara Prov., INDONESIA, 17–19.X.2012, T. Yamasaki leg.

Diagnosis. Blackish species; total length approximately 3.2–5.3 mm in males and 4.0–5.2 mm in females. Males distinguished from other species except *M. smaragdina* Ceccarelli, 2010 (cf. Fig. 34 in Ceccarelli 2010) by characteristic dentition of chelicera, of which fourth prolateral tooth counted from apex long (Fig. 36); further distinguished from *M. smaragdina* by shapes of chelicera and carapace (Figs 28–29 in Ceccarelli 2010 vs. Figs 33–34). Females distinguished from other species except *M. melanocephala* MacLeay, 1839 by sclerotized copulatory ducts clearly twisted in "figure 8" (Figs 44–45); *M. macrognatha* distinguished from *M. melanocephala* by absence of distinct markings on abdomen (Figs 41 vs. 54).

Measurements (male/female). Carapace length 1.63–2.50 (2.23)/1.75–2.10, width 0.93–1.57 (1.38)/0.91–1.08. Chelicera length 1.30–3.85 (3.30). ALE–PLE 0.67–1.02 (0.92)/0.68–0.82; ALE–PME 0.30–0.43 (0.42)/0.26–0.35. Width of eye row I 0.87–1.30 (1.17)/0.93–1.05; II 0.80–1.20 (1.10)/0.85–0.95; III 0.95–1.45



Figures 33–40. *Myrmarachne macrognatha*, male. **33** Body in dorsal view **34** body in lateral view **35** endites, labium, coxae and trochanters in ventral view **36** left chelicera in ventral view **37** left fang in retrolateral view **38** left palp in ventral view **39** left palp in retrolateral view **40** left palpal tibia in dorsal view. (Scales. Figs **33–37**: 1 mm; **38–40**: 0.25 mm).

(1.32)/1.02–1.15. Eye size: AME 0.28–0.42 (0.37)/0.31–0.34; ALE 0.15–0.20 (0.18)/0.14–0.16; PME 0.05–(0.08)/0.05–0.06; PLE 0.15–0.23 (0.20)/0.16–0.18.

Male (Figs 33–40). With carapace in lateral view, cephalic part almost flat dorsally, higher than thoracic part; dorsal concavity behind PLE shallow or indistinct; thoracic part sloping downward, not distinctly convex dorsally (Figs 33–34). Chelicera distinctly longer than carapace, each lateral margin almost parallel-sided except for distinctly convex prolateral margin near anterior end of chelicera; venter of chelicera bearing nine to twelve prolateral and three to six retrolateral teeth; fourth prolateral tooth counted from apex long and strongly curved (Fig. 36). Fang almost straight or very weakly sinuous except for curved tip and base, with long tooth-like apophysis on its venter at about 1/4 the length of fang from its base (Fig. 37). Pedicel short (0.18–0.30 mm). Abdomen oval without distinct constriction, with dorsal two scuta that are clearly separated.

With palp in dorsal and ventral views, cymbium elongate-oval, with one apical spine (Fig. 38). Tegulum round and small, with s-curved ejaculation duct in distal retrolateral part of tegulum (Fig. 38). Embolus forming two round coils; embolus coils occupying less than half of venter of cymbium; ventral coil much smaller than basal coil, only about half the diameter (Fig. 38). RTA strongly curved, and in retrolateral view, somewhat spiraled (Fig 38–40). Flange of RTA moderately developed.

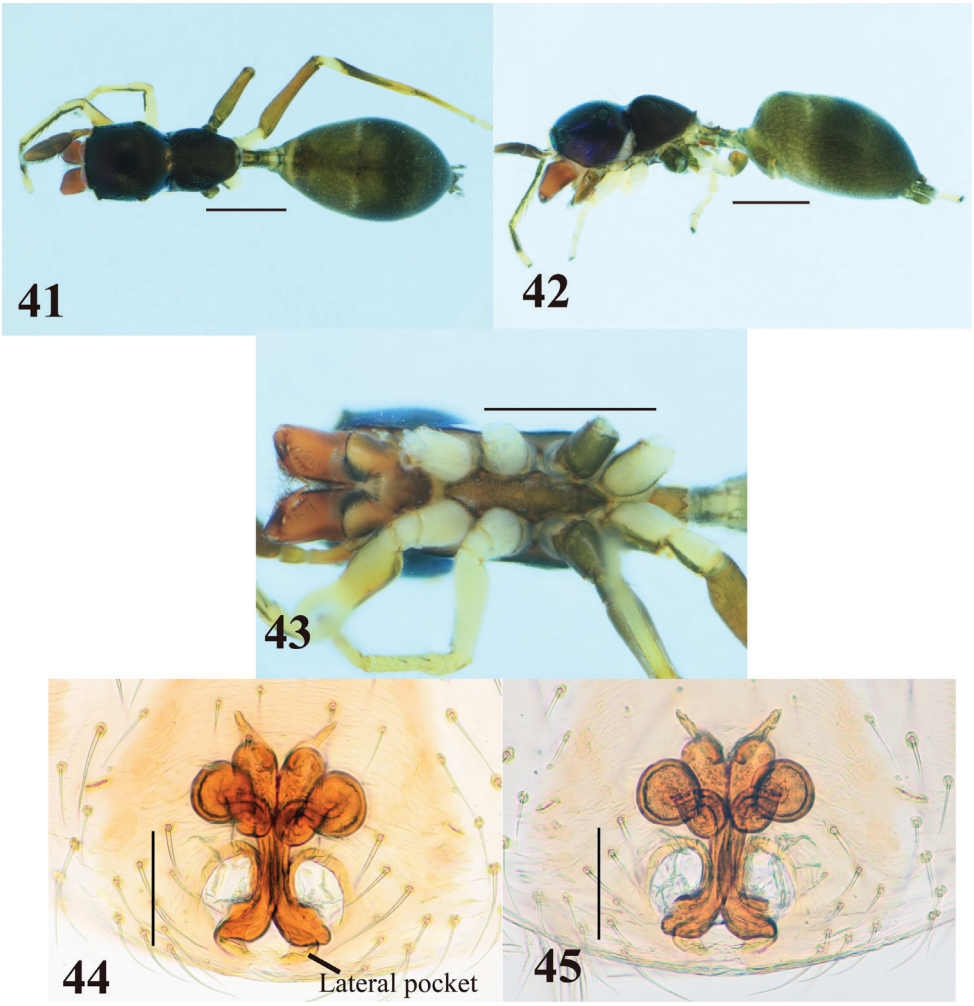
Number of spines on legs. Femur I pd 1, rd 0; tibia I pv 0–3, rv 1–4; metatarsus I pv 2, rv 2; femur II pd 1, rd 0; tibia II pv 0, rv 0–2; metatarsus II pv 0–2, rv 1–2; femur III pd 0–1, rd 0; femur IV pd 1, rd 0.

Coloration in alcohol and pilosity. Carapace black; cephalic part covered with fine white setae, and thoracic part sparsely covered with white setae; lateral carapace not fringed with white setae (Figs 33–34). Chelicera dark brown to black, and long white setae roughly forming transverse band in anterior part of chelicera. Endite and labium brownish orange, tinged with black laterally (Fig. 35). Coxae and trochanters I, III, IV yellow with gray lateral stripes; coxa and trochanter II cream-white, coxa with gray lateral stripes; in large specimens, coxae sometimes strongly tinged with black (Fig. 35). Abdomen and its dorsal scuta black, covered with white long setae and fine setae dorsally (Figs 33–34).

Female (Figs 41–45). With carapace in lateral view, cephalic part weakly convex dorsally, slightly higher than thoracic part; dorsal concavity behind PLE distinct; thoracic part swollen dorsally (Figs 41–42). Chelicera bearing five to six prolateral and six retrolateral teeth on its venter. Pedicel relatively longer than that of males (0.35–0.43 mm). Abdomen oval, without distinct constriction and dorsal scutum.

Epigyne (Figs 44–45). Copulatory atria containing openings oval. Lateral pockets present in front of epigastric furrow, anteroposteriorlly flattened. Sclerotized copulatory ducts clearly twisted in "figure 8" adjacent to cylindal spermathecae, then extending between atria to approximately the area of the lateral pockets.

Number of spines on legs. Tibia I pv 3–4, rv 3–4; metatarsus I pv 2, rv 2; tibia II pv 0, rv 2; metatarsus II pv 0–2, rv 2.



Figures 41–45. *Myrmarachne macrognatha*, female. **41** Body in dorsal view **42** body in lateral view **43** endites, labium, coxae and trochanters in ventral view **44** internal structure of epigyne in ventral view **45** internal structure of epigyne in dorsal view. (Scales. Figs **41–43**: 1 mm; **44–45**: 0.1 mm)

Coloration in alcohol and pilosity. Carapace dark brown to black; cephalic part covered with white and fine setae; thoracic part covered with white setae; lateral surface of carapace above coxae I and II densely fringed with white setae; white setae roughly forming white diagonal band from above coxa IV to upper dorsum (Figs 41–42). Chelicera dark brown. Endite, labium and sternum brownish orange, weakly tinged with black. Coxae and trochanters I and II white; coxa and trochanter III black, trochanter with yellow venter; coxa and trochanter IV pale yellow with lateral gray stripes (Fig. 43). Abdomen gray, covered with fine setae; two spots behind two white partial transverse bands present dorsally in anterior part of abdomen (Figs 41–42).

Remarks. The specimens from Flores are slightly different from the holotype of *M. macrognatha* from Java in the cheliceral teeth. The third prolateral tooth counted from the apex of the Flores specimens is shorter than that of the holotype (which has both the third and fourth teeth elongate). Although the number and size of cheliceral teeth is variable, generally corresponding to body size, the short apical third prolateral tooth seems to be a stable character within our specimens collected from Flores regardless of body size. However, we regard the Flores specimens as *M. macrognatha* on the basis of many other morphological similarities. To understand geographical variation of the species, a phylogenetic study based on molecular analysis is needed in the future.

Biology. *Myrmarachne macrognatha* is an arboreal species, and very common and abundant in eastern Flores.

Distribution. Java, Flores.

Myrmarachne melanocephala **MacLeay, 1839**

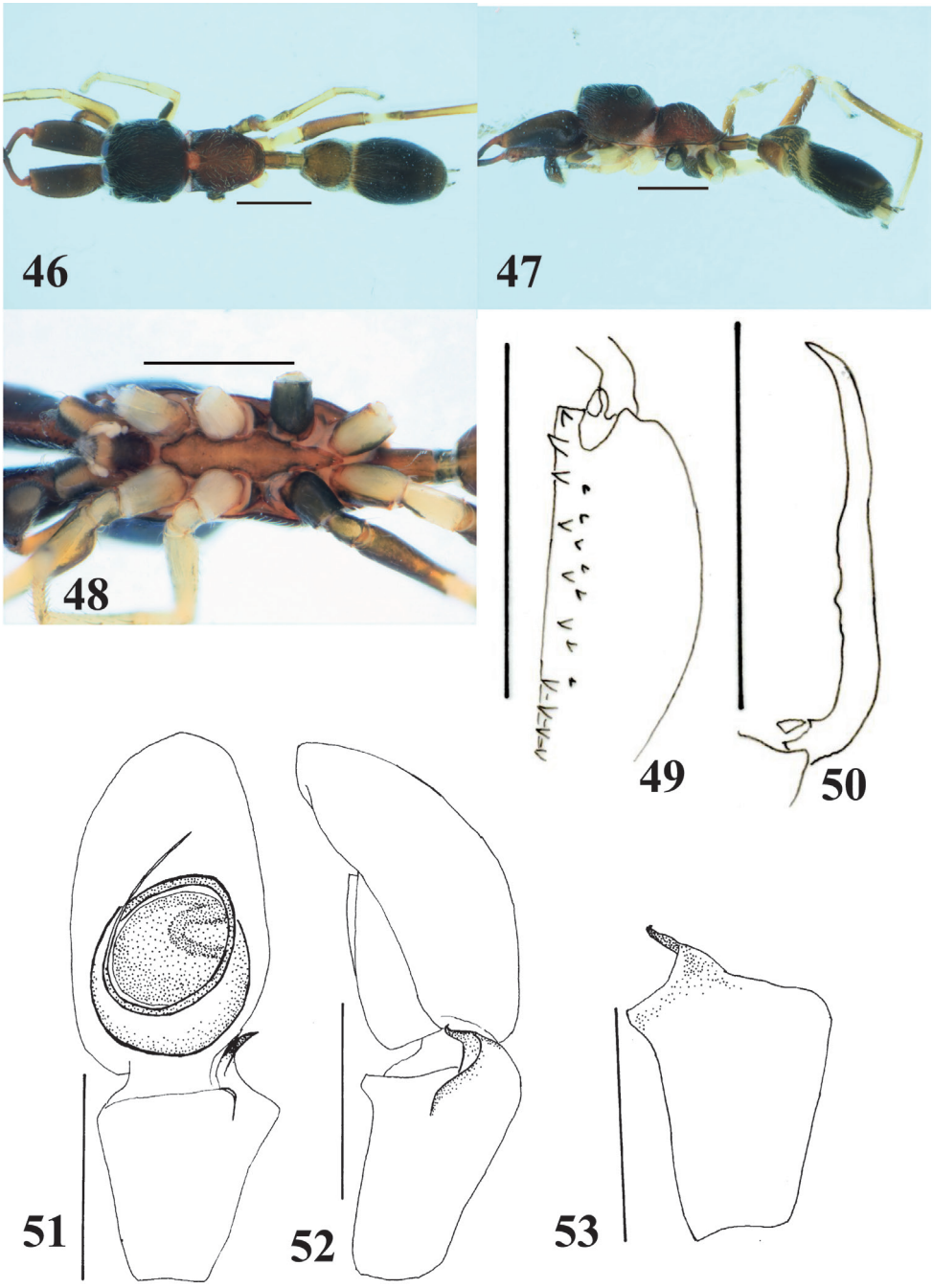
http://species-id.net/wiki/Myrmarachne_melanocephala
Figs 46–58

Myrmarachne melanocephala MacLeay, 1839: 11, pl. 1, fig. 4; Galiano 1969: 146; Edwards and Benjamin 2009: 5, figs. 1A–H, 2A–D, 3A–D, 4A–E, 5A–D.
Mymecia melanocephala Walckenaer, 1841: 462.
Salticus contractus Karsch, 1880: 396.
Salticus providens Peckham & Peckham, 1892: 34.
Myrmarachne providens: Simon 1901: 500.
Myrmarachne ramosa Badcock, 1918: 303, fig. 8; Edmunds and Prószyński 2003: 301, figs. 8–21.
Myrmarachne albicrurata Badcock, 1918: 306, fig. 9a.
Myrmarachne lateralis Badcock, 1918: 310, figs. 9b–c.

Non-type material examined. 1 male and 2 females. Mego [=8°40'S, 122°2'E], Sikka, Flores, East Nusa Tenggara Prov., INDONESIA, 16.X.2012, T. Yamasaki leg.

Diagnosis. Slender, light to dark brown species with relatively long pedicel. Males distinguished from other species by pedicel, which is as long as ALE–PLE (Fig. 46); further distinguished from species having long pedicel such as *M. assimilis* Banks, 1930 (cf. Figs 7, 13 in Banks 1930), *M. cornuta* Badcock, 1918 (cf. Figs 30–35 in Edmunds and Prószyński 2003) and *M. plataleoides* (O. Pickard-Cambridge, 1869) (cf. Figs 1–7 in Edmunds and Prószyński 2003) by shape and dentition of chelicera (Fig. 49). Females distinguished from others species by long pedicel as in males (Fig. 54); further distinguished from species having long pedicel such as *M. assimilis*, *M. cornuta M. glavisi* Prószyński & Deeleman-Reinhold, 2010 and *M. plataleoides* by markings on abdomen (Fig. 54) and structure of epigyne (Figs 57–58).

Measurements (male/female). Carapace length 2.13/2.18–2.37, width 1.15/1.10–1.18. Chelicera length 1.22. ALE–PLE 0.82/0.77–0.83; ALE–PME 0.40/0.36–0.38.



Figures 46–53. *Myrmarachne melanocephala*, male. **46** Body in dorsal view **47** body in lateral view **48** endites, labium, coxae and trochanters in ventral view **49** left chelicera in ventral view **50** left fang in retrolateral view **51** left palp in ventral view **52** left palp in retrolateral view **53** left palpal tibia in dorsal view. (Scales. Figs **46–50**: 1 mm; **51–53**: 0.25 mm).

Width of eye row I 1.03/1.03–1.12; II 0.97/1.00–1.08; III 1.13/1.15–1.20. Eye size: AME 0.33/0.33–0.35; ALE 0.18/0.16–0.17; PME 0.06/0.05; PLE 0.19/0.19.

Male (Figs 46–53). Cephalic part almost flat dorsally, higher than thoracic part; thoracic part swollen dorsally; strongly incised laterally between cephalic and thoracic part (Figs 46–47). Chelicera shorter than carapace, bearing eleven prolateral and seven retrolateral teeth on its venter; fang weakly sinuous, without distinct tooth-like apophysis (Figs 49–50). Pedicel relatively long (0.50 mm). Abdomen elongate-oval; two dorsal scuta strongly incised laterally between them (Figs 46–47).

With palp in dorsal and ventral views, cymbium oval, without distinct spines on its apex (Fig. 51). Tegulum round, with C-shaped ejaculatory duct in its distal retrolateral part (Fig. 51). Embolus forming two round coils; ventral coil much narrower than basal coil, and basal coil slightly narrower than venter of cymbium (Fig. 51). RTA strongly curved and tip spiraled, with well-developed flange (Figs 52–53).

Number of spines on legs. Femur I pd 1, rd 0; tibia I pv 4, rv 4; metatarsus I pv 2, rv 2; tibia II pv 0, rv 2; metatarsus II pv 2, rv 2.

Coloration in alcohol and pilosity. Cephalic part dark brown, covered with white setae; thoracic part light brown, sparsely covered with white setae; lateral surface above coxa II densely fringed with white setae (Figs 46–47). Chelicera dark brown. Endite and labium brownish orange, tinged with black, especially labium (Fig. 48). Sternum brownish orange (Fig. 48). Coxae and trochanters I, II and IV white, IV with lateral black stripes; coxa and trochanter III black except venter of trochanter light brown (Fig. 48). Abdomen covered with fine setae; anterior dorsal scutum grayish pale brown, and posterior dorsal scutum black; white transeverse band between scuta running diagonally from lateral to ventral area (Figs 46–47).

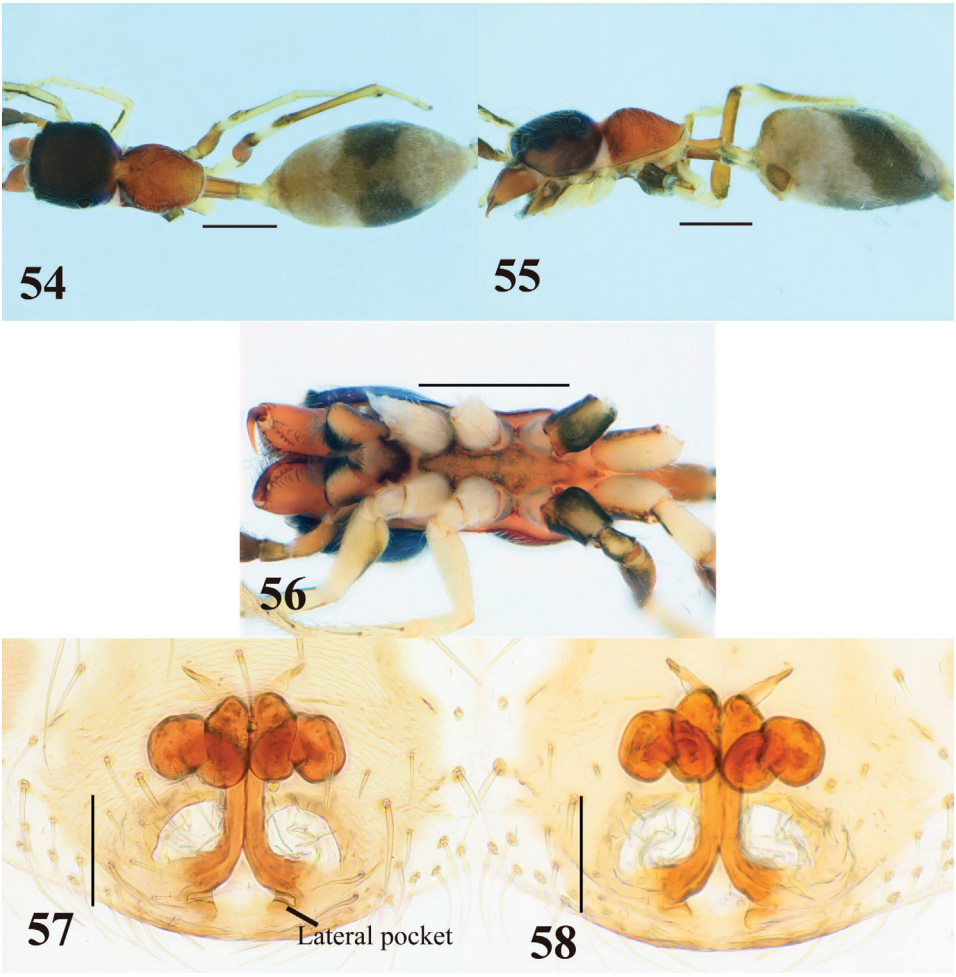
Female (Figs 54–58). Carapace strongly incised laterally behind PLE; cephalic part almost flat dorsally, slightly higher than thoracic part; thoracic part swollen dorsally (Figs 54–55). Chelicera bearing five prolateral and six retrolateral teeth on its venter. Pedicel relatively long (0. 58–0.83 mm). Abdomen elongate-oval, dorsal scuta inconspicuous (Figs 54–55).

Epigyne (Figs 57–58). Copulatory atria laterally-oriented oval. Lateral pockets present in front of epigastric furrow, rather widely separated. Sclerotized copulatory ducts from "figure 8" adjacent to ovoid spermathecae, then extending between atria to approximate vicinity of widely separated lateral pockets.

Number of spines on legs. Tibia I pv 4, rv 4–5; metatarsus I pv 2, rv 2; tibia II pv 1–3, rv 2–3; metatarsus II pv 2, pv 2.

Coloration in alcohol and pilosity. Cephalic part black, covered with sparse white setae dorsally; thoracic part light to dark brown, sparsely covered with white setae; lateral surface of carapace above coxa II white, densely fringed with white setae (Figs 54–55). Chelicera light brown. Endite, labium and sternum brownish orange, weakly tinged with black laterally (Fig. 56). Coxae and trochanters similar to those of males, except venter of coxa III also light brown (Fig. 56). Abdomen covered with white and fine setae (Figs 54–55).

Remarks. *Myrmarachne melanocephala* are very similar to *M. glavisi*, a long-pedicled species, in males (cf. Figs 117, 119–120 in Prószyński and Deeleman-Rein-



Figures 54–58. *Myrmarachne melanocephala*, female. **54** Body in dorsal view **55** body in lateral view **56** endites, labium, coxae and trochanters in ventral view **57** internal structure of epigyne in ventral view **58** internal structure of epigyne in dorsal view. (Scales. Figs **54–56**: 1 mm; **57–58**: 0.1 mm)

hold 2010). However, the females of *M. melanocephala* are distinguishable from the females of *M. glavisi* by the structure of the epigyne (cf. Figs 125–126 in Prószyński and Deeleman-Reinhold 2010). We here consider *M. melanocephala* different from *M. glavisi*. However, the taxonomic status of *M. glavisi* should be reviewed by a detailed comparison between the type materials of *M. glavisi* and *M. melanocephala* in the future.

The male specimen examined in the present study has relatively short chelicera compared with specimens from other areas. The male chelicera varies in the length depending on the body size within a species. The female specimens examined here agree with the description of *M. melanocephala* and specimens from other areas, in particular the gray abdomen with transverse median black band is typical of popula-

tions throughout Southeast Asia, but lighter in color than the mostly black topotypical specimens from India. This seems to be only regional color variation.

Biology. The specimens were collected from plantation areas.

Distribution. Widely distributed in South and Southeast Asia.

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We would like to express our deep gratitude to Prof. Seiki Yamane (Kagoshima University, Japan), Dr. Sadaharu Morinaka (Kawaguchi-shi, Japan), Mr. I Ketut Ginarsa (Bali, Indonesia), Prof. Dahermi (Andalas University, Indonesia), Dr. Henny Herwina (Andalas University, Indonesia) and Mr. Rijal Satria (Kagoshima University, Japan) for arranging the field trip to Flores, and to Ms. Marika Källsen (NRM, Sweden) for offering the type material to us. This work was supported by the JSPS International Training Program, Kagoshima University (Leader: Prof. Eizi Suzuki).

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RESEARCH ARTICLE

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Torrenticolid water mites from Korea and the Russian Far East

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Abstract

New records of water mites of the family Torrenticolidae Piersig, 1902 (Acari: Hydrachnidia) from streams in South Korea and the Russian Far East are presented. Detailed descriptions or redescrptions are provided for eight species of the genera *Torrenticola* Piersig, 1896 and *Monatractides* K.Viets 1926. Two species are described as new to science: *Torrenticola kimichungi* **sp. n.** and *Monatractides abei* **sp. n.** Five species are reported as first records from Korea: *Torrenticola brevirostris* (Halbert, 1911); *T. dentifera* Wiles, 1991; *T. recentis* Tuzovskij, 2003; *T. ussuriensis* (Sokolow, 1934); and *T. turkestanica* (Sokolow, 1926). *Torrenticola nipponica* (Enami, 1940) is reported for the first time from Russia.

Keywords

Acari, Hydrachnidia, new species, new records, running waters

Introduction

Water mites of the family Torrenticolidae are presently known from all continents except Antarctica, with more than 400 species described so far (Zhang et al. 2011, Pešić and Smit 2012a,b, Pešić et al. 2012). However, as the family has its maximum diversity in the still strongly understudied tropical areas, the species number is possibly higher by one order of magnitude (Pešić et al. 2012b). In general, torrenticolid mites are heavily sclerotized, dorso-ventrally flattened, crawling species which colonize running waters with well oxygenated sand and gravel substrates where proto- and tritonymphs can survive the quiescent phase of their life cycle (Di Sabatino et al. 2003).

At present, only one species of the genus *Torrenticola* Piersig, 1896, i.e. *T. nipponica* (Enami, 1940) is known from South Korea (Chung and Kim 1995), while five species, i.e., *T. abbreviata* (Sokolow, 1934), *T. amplexa* (Koenike, 1908), *T. elliptica* Maglio, 1909, *T. recentis* Tuzovskij, 2003 and *T. ussuriensis* (Sokolow, 1934), are known from the Russian Far East (Sokolow 1934, Semenchenko 2010). During a recent survey many specimens of the family Torrenticolidae were collected throughout South Korea and identification of this material was entrusted to the senior author. This research is part of the project aimed at uncovering Korean invertebrate diversity, and led by the National Institute of Biological Resources (NIBR). The identification of the material from the Russian Far East was made by second author. Eight species of the genera *Torrenticola* Piersig, 1896 and *Monatractides* K.Viets, 1926 are identified, two of them are new to science. Descriptions and redescriptions of these species are given in this paper.

Material and methods

Water mites were collected by hand netting, sorted on the spot from the living material, preserved in Koenike's fluid and dissected as described elsewhere (e.g. Gerecke et al. 2007). One sample from the Tigrovaya River (Russian Far East) was obtained via a hand-pump (similar to the Bou-Rouch method) from subterranean waters. A metal tube was hammered into river sediments to a depth of about 30 cm. Pumped samples were filtered through the hand net and fixed in 70 % ethanol for further examination in the laboratory under a stereo microscope. Holotypes and some paratypes are deposited in the National Institute of Biological Resources, Korea (NIBR); other paratypes (material from the Russian Far East) in the research collections of the Institute of Biology and Soil Science, Vladivostok, Russia (IBSS).

In the section 'Material examined' collecting site abbreviations derive from the geographical database Pešić. The composition of the material is given as: males/females/deutonymphs. All measurements are given in μm. The following abbreviations are used: asl = above sea level, Cx-I = first coxae, Cxgl-4 = coxoglandularia of fourth coxae (= E4 in Wiles 1997), dL = dorsal length, L = length, I-Leg-6 = Leg 1, sixth segment (tarsus), mL = medial length, Mt = mountain, n = number of specimens examined, NP = National Park, P-1 = palp, first segment, vL = ventral length, W = width.

Systematics

Family Torrenticolidae Piersig, 1902
Genus *Torrenticola* Persig, 1896
Subgenus *Torrenticola* Persig, 1896

***Torrenticola brevirostris* (Halbert, 1911)**
http://species-id.net/wiki/Torrenticola_brevirostris
Figs 1, 7A

Synonymy: *Atractides brevirostris* Halbert, 1911: 16.

Material examined. SOUTH KOREA: CR9 Ne myeon Mt, Naebyeansan NP, stream near Naebyeansan Info Center, 35°38'25.623"N, 126°34'53.1438"E, 10.x.2012, Pešić & Choi 1/0/0 (mounted, NIBRIV0000268844).

Morphology. Male. *General features*. Idiosoma roundish; Cxgl-4 subapical; posterior suture line of Cx-IV starting at right angle from genital field; excretory pore and Vgl-2 away from the line of primary sclerotization (Fig. 1B); ejaculatory complex conventional in shape (with well developed anterior keel and proximal arms); gnathosomal rostrum shortened, ventrally not evidently set off from gathosomal base (Fig. 1D); P-2 shorter than P-4, P-2 ventral margin slightly convex; P-4 stout, with well developed ventral tubercles (Fig. 1C).

Measurements. Idiosoma (ventral view: Fig. 1B) L 731, W 500; dorsal shield (Fig. 1A, 7A) L 598, W 441, L/W ratio 1.36; dorsal plate L 544; shoulder plate L 175-177, W 78-83, L/W ratio 2.1-2.3; frontal plate L 130-131, W 66-67, L/W ratio 1.9-2.0; shoulder/frontal plate L ratio 1.34-1.36. Gnathosomal bay L 119, Cx-I total L 284, Cx-I mL 164, Cx-II+III mL 93; ratio Cx-I L/Cx-II+III mL 3.05; Cx-I mL/Cx-II+III mL 1.8. Genital field L/W 152/119, ratio 1.28; ejaculatory complex L 222; distance genital field-excretory pore 127, genital field-caudal idiosoma margin 200. Gnathosoma vL 266; chelicera total L 292; palp total L 296, dL: P-1, 26; P-2, 87; P-3, 66; P-4, 89; P-5, 28; P-2/P-4 ratio 0.98.

Remarks. The single male specimen examined from a stream in Naebyeansan National Park fits well the original description of *Torrenticola brevirostris*. The differences are found in a minor idiosoma and gnathosoma dimensions and a more shallow gnathosoma with a relatively less shortened rostrum compared with the populations from the Western Palaearctic (see: Cicolani and Di Sabatino 1990, Pešić et al. 2006, Di Sabatino et al. 2010). In the shape of gnathosoma the specimen from Korea matches the description of *T. brevirostris* from Gifu Prefecture in Japan (Imamura 1953). This may suggest that there is some degree of genetic isolation between the populations from the Far East and populations from the Western Palaearctic. However, understanding of these populations is not possible without additional material and probably will require the application of molecular techniques.

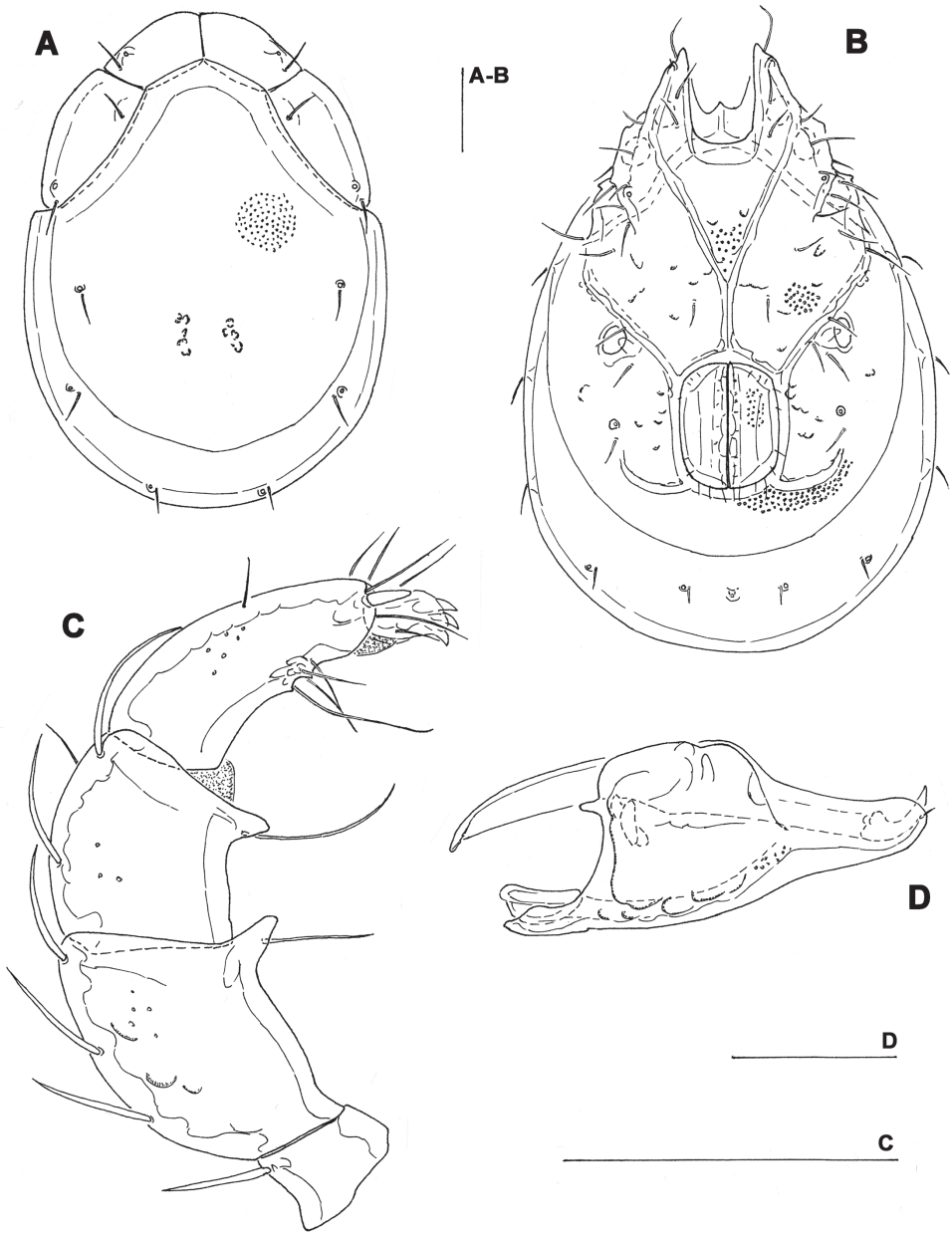

Figure 1. *Torrenticola brevirostris* (Halbert, 1911), male, stream in Naebyeansan NP, Korea: **A** dorsal shield **B** ventral shield **C** palp, medial view **D** gnathosoma. Scale bars = 100 μm.

Habitat. A permanent sandy/bouldary stream, shaded by riparian vegetation (Fig. 14B).

Distribution. Palaearctic. New for the fauna of Korea.

***Torrenticola dentifera* Wiles, 1991**
http://species-id.net/wiki/Torrenticola_dentifera
Figs 2, 7B

Synonymy: *Torrenticola dentifera* Wiles, 1991: 43.

Material examined. SOUTH KOREA: CR9 Ne myeon Mt, Naebyeansan NP, stream near Naebyeansan Info Center, 35°38'25.623"N, 126°34'53.1438"E, 10.x.2012, Pešić & Choi 1/0/0 (mounted, NIBRIV0000268845).

Morphology. Male. *General features*. Idiosoma elongated; frontal platelets anteriorly bulging (Figs 2A,7B); Cxgl-4 subapical; medial suture line of Cx-II+III relatively long; posterior suture line of Cx-IV weakly curved; excretory pore and Vgl-2 on the line of primary sclerotization near posterior idiosoma margin; ejaculatory complex conventional in shape (Fig. 2D); gnathosoma ventral margin only slightly curved, rostrum well developed (Fig. 2E); P-2 shorter than P-4, ventral margin with a fine denticulation also in proximal half of the segment, distally with a laterally compressed, anteriorly directed hyaline extension; P-3 with a subrectangular, apically serrated ventrodistal projection with a fine denticles; P-4 with long and broadly rounded distal seta (Fig. 2C), ventral tubercles well developed and separated.

Measurements. Idiosoma (ventral view: Fig. 2B) L 591, W 341; dorsal shield (Figs 2A, 7B) L 472, W 305, L/W ratio 1.55; dorsal plate L 434; shoulder plate L 141-144, W 37-40, L/W ratio 3.6-3.8; frontal plate L 101-108, W 47-48, L/W ratio 2.2-2.3; shoulder/frontal plate L ratio 1.3-1.4. Gnathosomal bay L 81, Cx-I total L 200, Cx-I mL 117, Cx-II+III mL 113; ratio Cx-I L/Cx-II+III mL 1.8; Cx-I mL/Cx-II+III mL 1.04. Genital field L/W 113/95, ratio 1.19; ejaculatory complex L 166; distance genital field-excretory pore 133, genital field-caudal idiosoma margin 161. Gnathosoma vL 247; palp total L 226, dL: P-1, 22; P-2, 62; P-3, 48; P-4, 77; P-5, 17; P-2/P-4 ratio 0.8.

Remarks. The single male specimen examined fits the original description of *Torrenticola dentifera*, which was based on two male specimens from Selangor, Peninsular Malaysia (Wiles 1991). The only differences are found in larger dimensions of idiosoma and palps of the South Korea specimen.

Habitat. A permanent sandy/bouldary stream, shaded by riparian vegetation (Fig. 14B).

Distribution. Malaysia (Wiles 1991, 1997). New for the fauna of Korea.

***Torrenticola kimichungi* sp. n.**
urn:lsid:zoobank.org:act:B92491ED-F051-4C8B-9381-BFC4668BA2CE
http://species-id.net/wiki/Torrenticola_kimichungi
Figs 3, 4, 7C–F

Type series. Holotype male (NIBRIV0000268846), dissected and slide mounted, SOUTH KOREA: CR4 Seoraksan NP, stream near Temple, 38°10.399'N, 128°29.050'E,

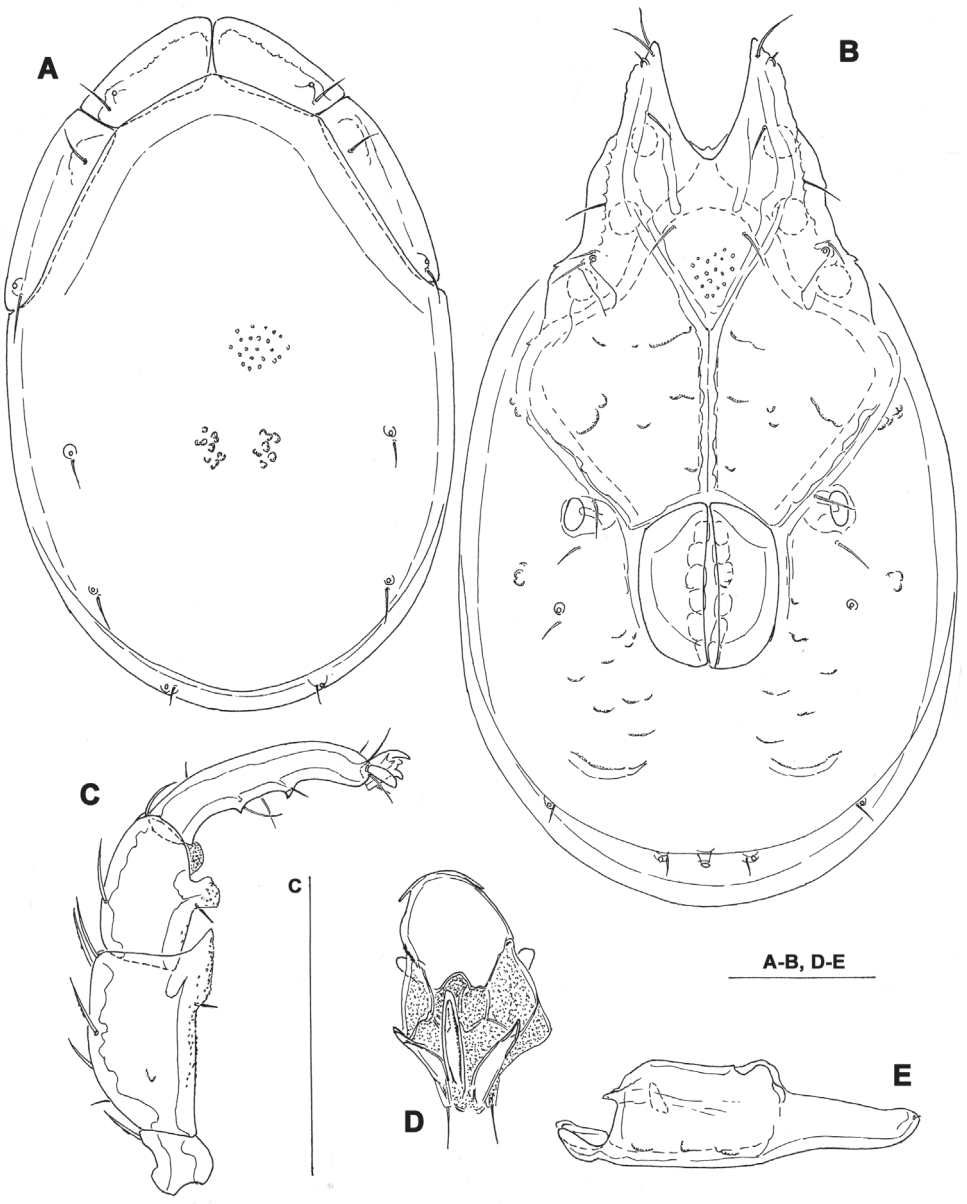

Figure 2. *Torrenticola dentifera* Wiles, 1991, male, stream in Naebyeansan NP, Korea: **A** dorsal shield **B** ventral shield **C** palp, medial view **D** ejaculatory complex **E** gnathosoma. Scale bars = 100 μm.

196 m asl., 8.x.2012 Pešić & Karanović. Paratype: same data as holotype, one male (NIBRIV0000268847); RUSSİA, Primory Territory, Partizansky District, Partizanskay River basin, Tigrovaya River, 43°11.401'N, 133°12.660'E; depth 30 cm below the sediment surface; substrate: cobbles, pebbles, sand; 12.vi.2010, Semenchenko & Sidorov, three males (490-492-kas–IBSS), two females (493-494-kas–IBSS), dissected and slide mounted.

Diagnosis. Idiosoma elongated (dorsal shield L/W ratio 1.5-1.6); medial suture line of Cx-II+III in male short (L 74-85 μm); suture line of Cx-IV extended posterior to the genital field; excretory pore posterior to the line of primary sclerotization, Vgl-2 posterior to excretory pore; male genital field with maximum width at the anterior margin; gnathosoma deep with a short rostrum; P-4 with ventral setae on flat hump.

Description. *General features*. Idiosoma elongated; Cxgl-4 subapical; suture line of Cx-IV evident and curved, starting posterior from genital field, laterally curved anteriorly (Figs 3B,4B); excretory pore posterior to the line of primary sclerotization, Vgl-2 posterior to excretory pore; gnathosoma deep with a short rostrum not evidently set off from gnathosomal base (Fig. 3F); P-2 ventrally slightly convex, ventrodistal projection cone-shaped, pointed towards distal, P-3 with ventrodistal projection slightly larger than projection of P-2, P-4 slightly curved, ventral setae (one long and three short) on flat hump (Figs 3D–E, 4C). Male: Medial suture line of Cx-II+III short; genital field with maximum width at the anterior margin; ejaculatory complex normal in shape (Fig. 3C); P-2 and P-4 almost equal in length.

Measurements. Male (holotype, in parentheses measurements of paratype from South Korea, in square parentheses specimens from Russia, n = 2): Idiosoma (ventral view: Fig. 3B) L 723 (741) [731-748], W 477 (513) [488-578]; dorsal shield (Figs 3A, 7C–E) L 628 (650) [607-663], W 414 (444) [409-425], L/W ratio 1.52 (1.46) [1.47-1.56]; dorsal plate 575 (596) [554-595]; shoulder plate L 166-169 (163-166) [161-167], W 72-75 (73) [72-79], L/W ratio 2.2-2.3 (2.2-2.3) [2.11-2.24]; frontal plate L 131-134 (127-131) [125-126], W 72 (69-73) [62-72], L/W ratio 1.8-1.9 (1.7-1.9) [1.75- 2.0]; shoulder/frontal plate L ratio 1.24-1.29 (1.27-1.28) [1.28-1.33]. Gnathosomal bay L 122 (125) [112-119], Cx-I total L 231 (244) [231-237], Cx-I mL 109 (119) [118-119], Cx-II+III mL 75 (85) [74-79]; ratio Cx-I L/Cx-II+III mL 3.1 (2.9) [2.91-3.2]; Cx-I mL/Cx-II+III mL 1.45 (1.4) [1.5-1.58]. Genital field L/W 138 (148) [145-152]/122 (125) [112-114], L/W ratio 1.12 (1.18) [1.26-1.36]; ejaculatory complex L 183 (184) [180-200]; distance genital field-excretory pore 166 (163) [152-172], genital field-caudal idiosoma margin 266 (263) [251-257]. Gnathosoma vL 191 (198) [194-211]; chelicera total L 234 (231) [231-232]; palp total L 215 (210) [210-216], dL: P-1, 25 (21) [24-27]; P-2, 62 (61) [59-62]; P-3, 43 (42) [43-46]; P-4, 60 (63) [62-63]; P-5, 25 (23) [19-21]; P-2/P-4 ratio 1.03 (0.97) [0.94-1.0].

Female (from Russia, n = 2). Idiosoma (ventral view: Fig. 4B) L 800-816, W 544-580; dorsal shield (Figs 4A, 7F) L 714-731, W 476-493, L/W ratio 1.45-1.54; dorsal plate L 650-663; shoulder plate L 174-185, W 72-74, L/W ratio 2.34-2.57; frontal plate L 132-133, W 71-72, L/W ratio 1.83-1.86; shoulder/frontal plate L ratio 1.32-1.4. Gnathosomal bay L 119-132, Cx-I total L 231-244, Cx-I mL 112-113, Cx-II+III mL 39-46; ratio Cx-I L/Cx-II+III mL 5.02-6.25; Cx-I mL/Cx-II+III mL 2.43-2.9. Genital field L/W 174-178/162-165, L/W ratio 1.05-1.09; distance genital field-excretory pore 160-198, genital field-caudal idiosoma margin 310-330. Gnathosoma vL 218-264; chelicera total L 244; palp total L 220-228, dL: P-1, 24-27; P-2, 66-70; P-3, 46-48; P-4, 64-65; P-5, 18-20; P-2/P-4 ratio 1.01-1.08.

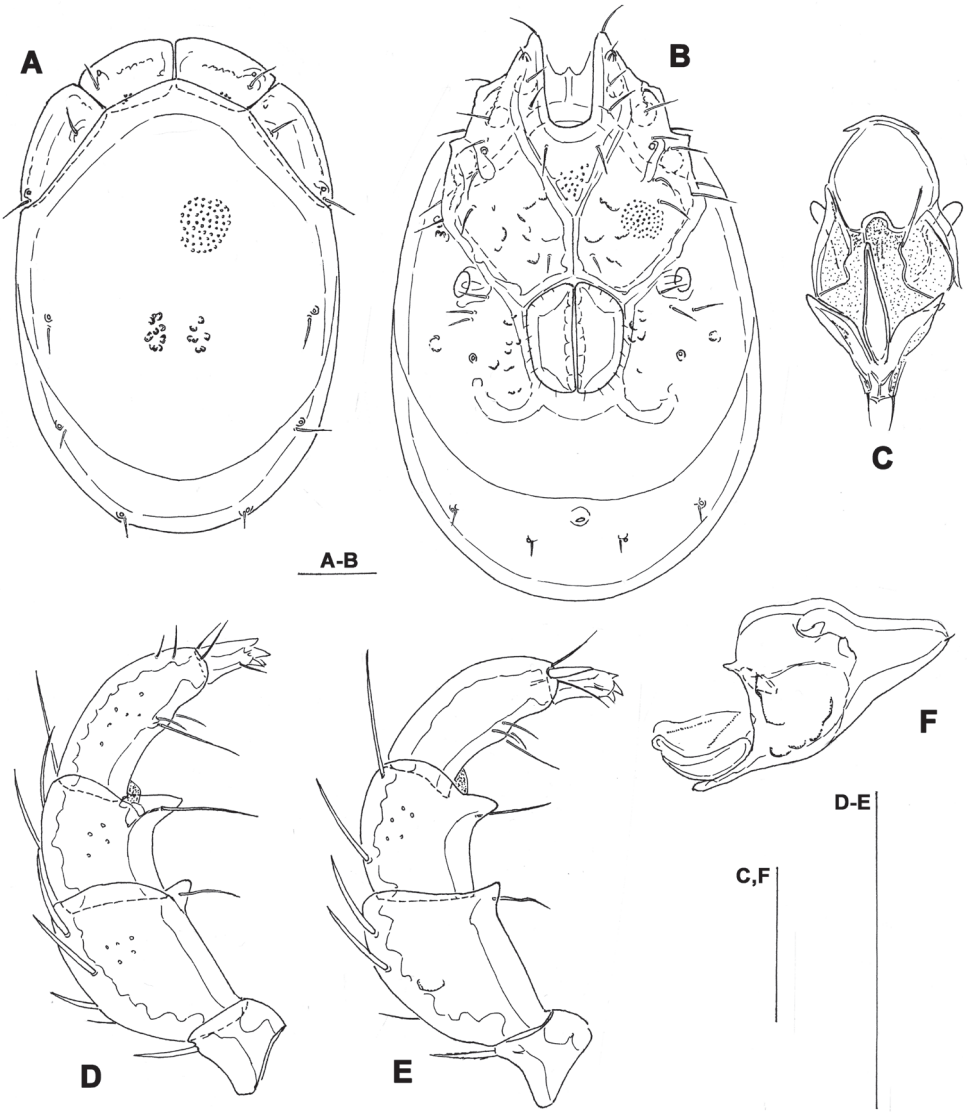

Figure 3. *Torrenticola kimichungi* sp. n., male holotype: **A** dorsal shield **B** ventral shield **C** ejaculatory complex **D** palp, lateral view **E** palp, medial view **F** gnathosoma. Scale bars = 100 μm.

Etymology. The species is named after Drs Il-Hoi Kim and Kyung-Sook Chung in appreciation of their studies of the Korean water mites.

Remarks. The new species belongs to the group of species characterized by having well-developed finger or peg-like ventrodistal tubercles on P-2 and P-3, the deep gnathosoma with a short rostrum, not evidently set off from gnathosomal base and a relatively short medial suture line of Cx-II+III in male. This group includes the following Asian species of *Torrenticola*: *T. brevirostris* (Halbert, 1911) (Palaearctic), *T. nanshihensis* Pešić

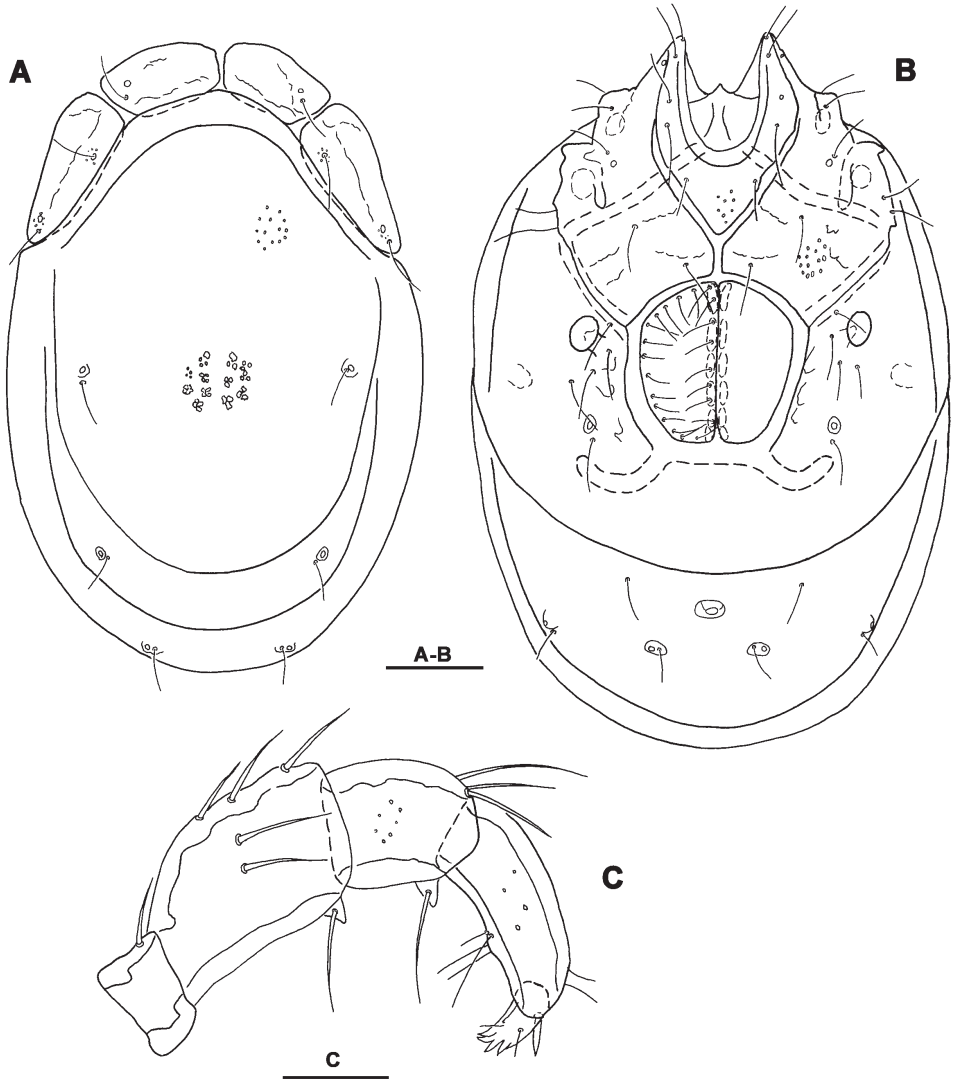

Figure 4. *Torrenticola kimichungi* sp. n., paratype female, Tigrovaya River, Russia: **A** dorsal shield **B** ventral shield **C** palp, lateral view. Scale bars = 100 μm (**A–B**), 25 μm (**C**).

et al., 2011 (Taiwan), *T. projectura* Pešić et al., 2012 (Taiwan), *T. retractipora* Lundblad, 1969 (Burma), *T. siamis* Pešić & Smit, 2009 (Thailand), and *T. subterranea* Imamura, 1957 (Japan). Males of *Torrenticola brevirostris* and *T. nanshihensis* differ in a prominent suture line of Cx-IV starting at a right angle from the genital field, excretory pore on the same level as Vgl-2 and more away from the line of primary sclerotization and P-4 stockier with well developed ventral tubercles (see: Di Sabatino et al. 2010 for *T. brevirostris*, and Pešić et al. 2012 for *T. nanshihensis*). *Torrenticola projectura* clearly separates in having P-3 with a long tapering ventral protrusion which curves distally (Pešić et al.

2012a). Males of *Torrenticola retractipora* can easily be distinguished by larger dimensions of the idiosoma, a differently shaped ejaculatory complex with large proximal chamber (see: Lundblad 1969), and a moderately long median suture line of Cx-II+III (101 μm, data taken from Wiles 1997). *Torrenticola subterranea*, a weakly defined species known from subterranean habitats in Japan (Imamura 1957, 1959) is similar in Cx-IV extended posterior to the genital field, but differs in narrower frontal platelets, excretory pore and Vgl-2 lying on the margin of primary sclerotization, and a less developed distoventral projections on P-2 and P-3 (see: Imamura 1959). *Torrenticola siamis* closely resembles *T. kimichungi* sp. n. in the general shape of idiosoma and palp, but males are distinguishable in having Cx-IV not extended posterior to the genital field and the genital field more elongated (L/W ratio 1.4, data taken from Pešić and Smit 2009) and rectangular in shape.

Habitat. A permanent sandy/bouldery stream with considerably exposure to sunlight (Fig. 14C); the specimens from Russia were collected from interstitial waters.

Distribution. South Korea, Far East of Russia (present study).

***Torrenticola nipponica* (Enami, 1940)**
http://species-id.net/wiki/Torrenticola_nipponica
Figs 5, 6, 7G–I

Synonymy: *Atractides nipponicus* Enami, 1940: 221.

Material examined. SOUTH KOREA: CR1 Seoul, Dobong stream, 37°41.262'N, 127°01.706'E, 19 m asl., 7.x.2012, Pešić & Choi 2/0/0 (mounted, NIBRIV0000268848). RUSSIA: Primory Territory, Partizansky District, Partizanskay River basin, Tigrovaya River, 43°11.401'N, 133°12.660'E; depth 30 cm below the sediment surface; substrate: cobbles, pebbles, sand; 12.vi.2010, Semenchenko & Sidorov 2/2/0 (mounted, IBSS).

Morphology. *General features*. Idiosoma roundish; dorsal shield with colour pattern as illustrated in Figs 7G-I; Cxgl-4 subapical; excretory pore and Vgl-2 slightly away from the line of primary sclerotization; gnathosoma deep, rostrum shorter than depth of gnathosomal base (Fig. 5D); palp robust and compact, P-2 longer than P-4, P-2 and P-3 ventrodistal projection pointed towards distal, P-4 with well developed ventral tubercles bearing one long and three short setae (Figs 5E-F, 6C). Male: Medial suture line of Cx-II+III short; suture line of Cx-IV medially starting from posterior margin of genital field (Fig. 2B); ejaculatory complex normal in shape (Fig. 5C). Female: Suture of Cx-IV curved (Fig. 2C); genital field pentagonal in shape.

Measurements. Male (from South Korea, n = 2; in parentheses specimens from Russia, n = 2) Idiosoma (ventral view: Fig. 5B) L 694-819 (740-755), W 478-534 (508-544); dorsal shield (Figs 5A, 7G-H) L 584-675 (636-670), W 410-469 (422-476), L/W ratio 1.42-1.44 (1.4-1.5); dorsal plate L 556-643 (594-614); shoulder plate L 178-206 (178-188), W 56-61 (59-60), L/W ratio 3.0-3.4 (2.96-3.18); frontal plate L 113-125 (121-125), W 45-50 (46-47), L/W ratio 2.4-2.5 (2.56- 2.72); shoulder/

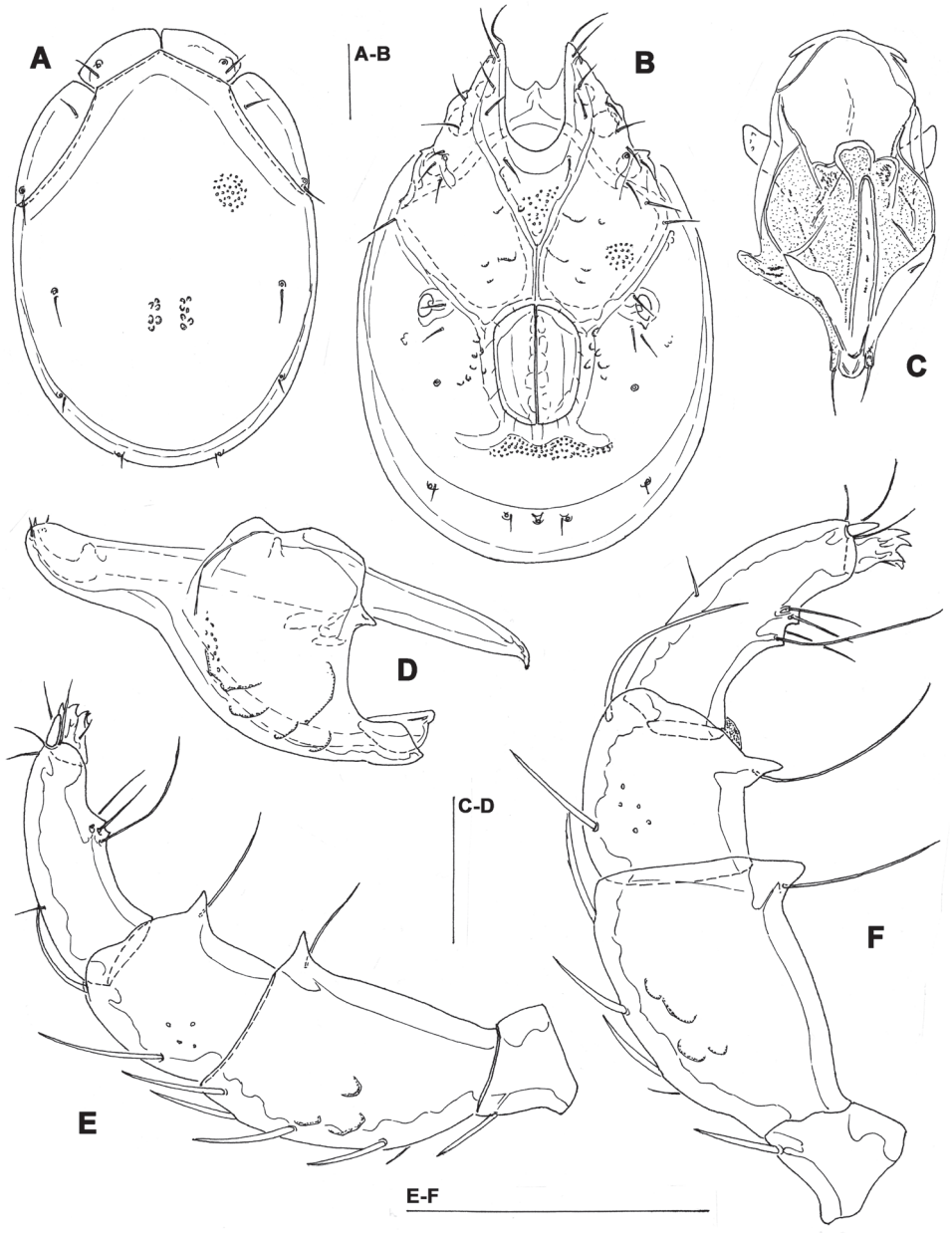

Figure 5. *Torrenticola nipponica* (Enami, 1940), male, Dobong stream, Korea: **A** dorsal shield **B** ventral shield **C** ejaculatory complex **D** gnathosoma **E–F** palp, medial view (E-smaller specimen, F-larger specimen). Scale bars = 100 μm.

frontal plate L ratio 1.56-1.67 (1.46-1.5). Gnathosomal bay L 148-153 (132-141), Cx-I total L 278-294 (284-286), Cx-I mL 129-141 (145-165), Cx-II+III mL 69-91 (79-92); ratio Cx-I L/Cx-II+III mL 3.2-4.0 (3.1-3.6); Cx-I mL/Cx-II+III mL 1.55-

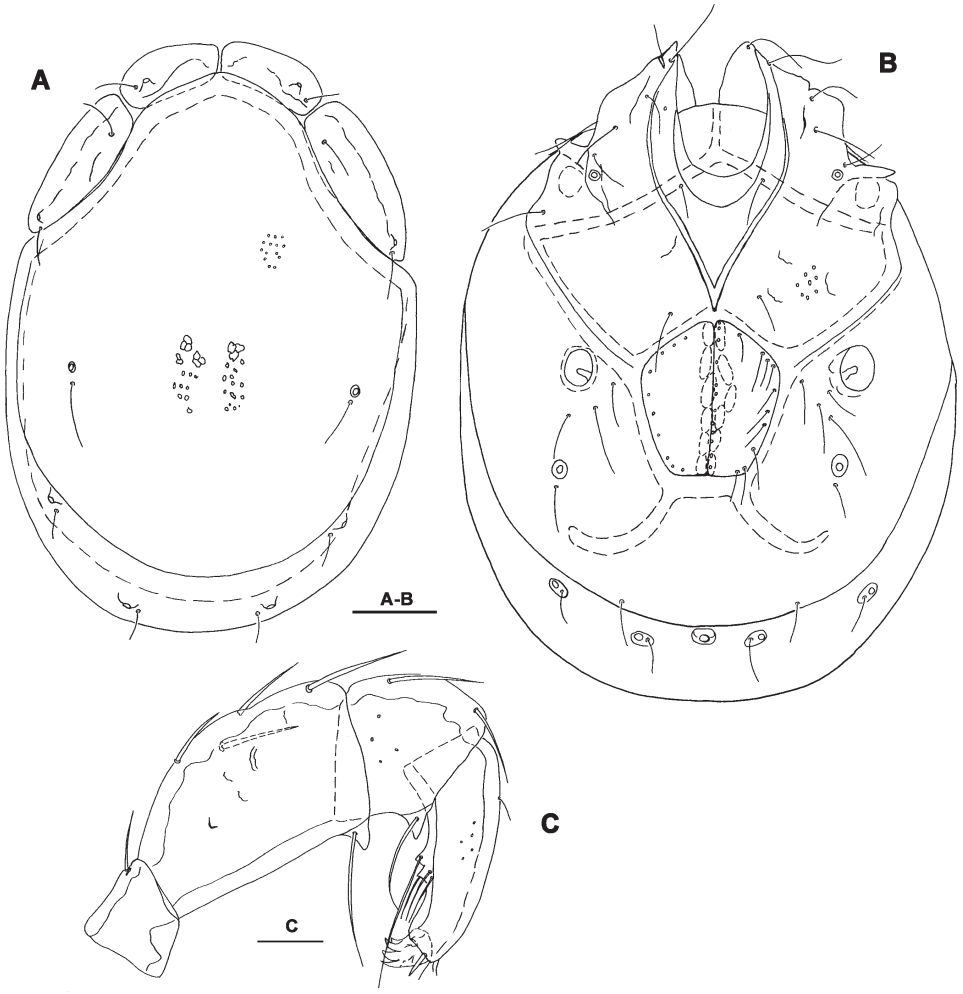

Figure 6. *Torrenticola nipponica* (Enami, 1940), female, Tigrovaya River, Russia: **A** dorsal shield **B** ventral shield **C** palp, lateral view. Scale bars = 100 μm (**A–B**), 25 μm (**C**).

1.87 (1.57-2.08). Genital field L/W 156-181/117-133 (168-172/125-132), L/W ratio 1.33-1.36 (1.26-1.38); ejaculatory complex L 231 (224-251); distance genital field-excretory pore 131-178 (138-145), genital field-caudal idiosoma margin 183-231 (172-205). Gnathosoma vL 273-303 (277-297); chelicera total L 319-347 (323-343); palp total L 279-316 (284-291), dL: P-1, 34-37 (33-36); P-2, 92-101 (92-95); P-3, 52-63 (51-59); P-4, 82-93 (82-92); P-5, 19-22 (17-18); P-2/P-4 ratio 1.09-1.13 (1.03-1.12).

Female (from Russia, n = 2). Idiosoma (ventral view: Fig. 6B) L 860-867, W 629-635; dorsal shield (Figs 6A, 7I) L 723-782, W 502-544, L/W ratio 1.44; dorsal plate L 680-731; shoulder plate L 211-214, W 66-73, L/W ratio 2.92-3.2; frontal plate L 128-139, W 59-64, L/W ratio 2.16- 2.17; shoulder/frontal plate L ratio 1.54-1.65. Gnathosomal bay L 168-178, Cx-I total L 303-310, Cx-I mL 132-145, Cx-II+III mL

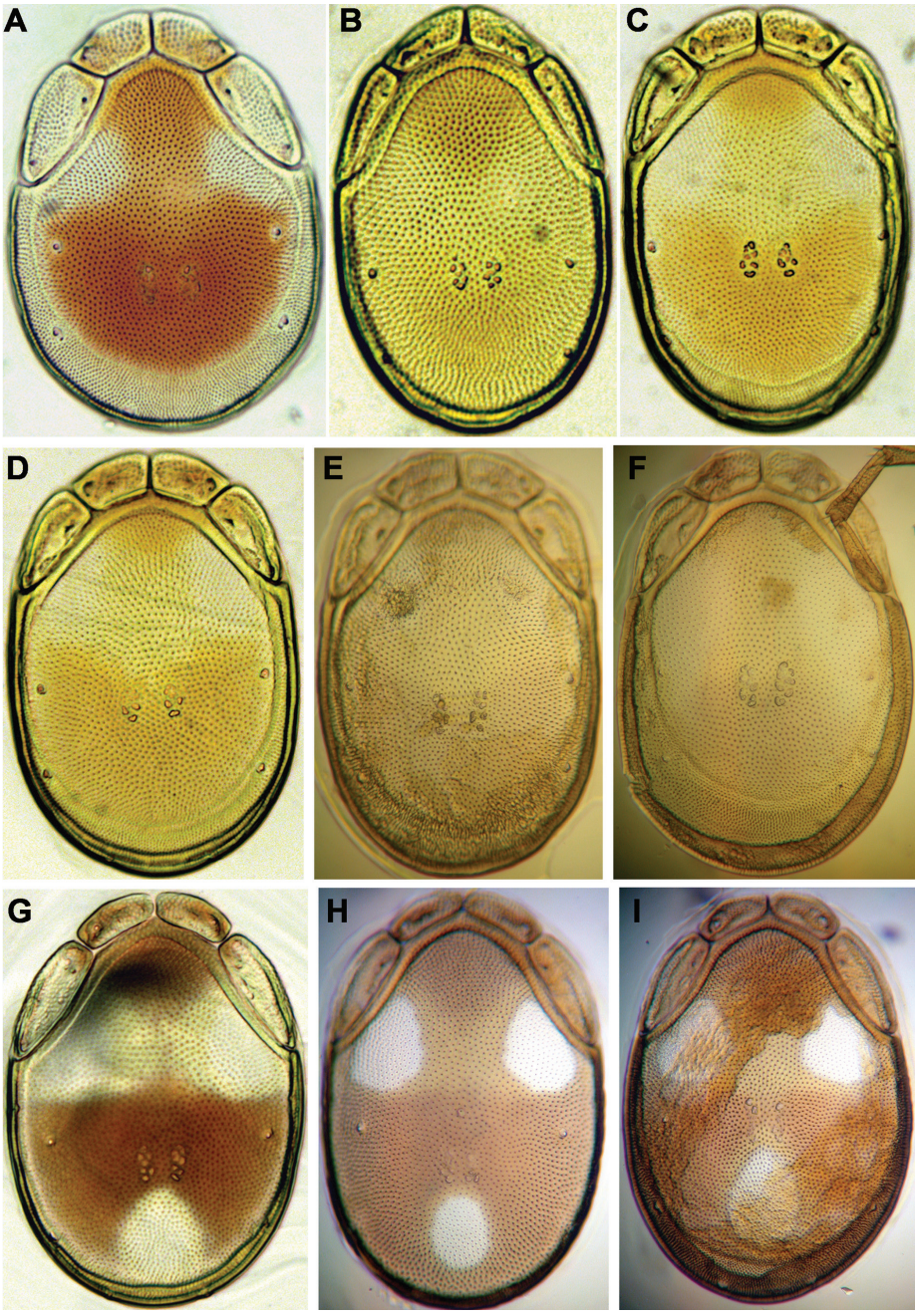

Figure 7. Photographs of dorsal shield: **A** *Torrenticola brevirostris* (Halbert, 1911), female, stream in Naebyeansan NP, Korea **B** *Torrenticola dentifera* Wiles, 1991, male, stream in Naebyeansan NP, Korea: **C–F** *Torrenticola kimichungi* sp. n. (**C–D** specimens from stream in Seoraksan NP, Korea, **E–F** specimens from Tigrovaya River, Russia): **C** male holotype **D–E** male paratypes **F** female paratype **G–I** *Torrenticola nipponica* (Enami, 1940) (**G** specimen from Dobong stream, Korea **H–I** specimens from Tigrovaya River, Russia): **G–H** male **I** female. Photos. V. Pešić (Figs **A–D, G**), K. Semenchenko (Figs **E–F, H–I**).

30-40; ratio Cx-I L/Cx-II+III mL 7.75-10.1; Cx-I mL/Cx-II+III mL 3.63-4.4. Genital field L/W 185-195/172-178, L/W ratio 1.04-1.13; distance genital field-excretory pore 208-210, genital field-caudal idiosoma margin 297-310. Gnathosoma vL 330-336; chelicera total L 420; palp total L 341-345, dL: P-1, 41-43; P-2, 115-116; P-3, 65-67; P-4, 100-102; P-5, 18-19; P-2/P-4 ratio 1.13-1.16.

Remarks. The male specimens from South Korea and Russia fit the description of *Torrenticola nipponica* (Enami, 1940) which was based on one male and seven females from River Inôzava, Uzi region in Japan (Enami 1940). However, as the type material was probably lost (not found in the arachnid collection in the National Museum of Nature and Science, Tokyo, Hirotsugu Ono pers. comm.) additional sampling and selection of a neotype from the locus typicus is necessary to guarantee taxonomic stability of *T. nipponica*. In the original description, Enami (1940) compared *T. nipponica* with *T. brevirostris* (Halbert, 1911), a species which differs in the gnathosomal rostrum not distinctly set off from the gnathosomal base, P-2 shorter than P-4, the suture line of Cx-IV starting at right angle from the genital field, the excretory pore and Vgl-2 more distanced from the line of primary sclerotization and the genital field in male is less elongated.

Habitat. A permanent shaded sandy/bouldary stream at low elevations (Fig. 14A); the specimens from Russia were collected from interstitial waters.

Distribution. Japan (Uzi region- Enami, 1940), South Korea (Chindo Island – Chung & Kim 1995; present study). New for the fauna of Russia.

***Torrenticola recentis* Tuzovskij, 2003**
http://species-id.net/wiki/Torrenticola_recentis
Figs 8, 11A–C

Synonymy: *Torrenticola recentis* Tuzovskij, 2003: 45.

Material examined. SOUTH KOREA: CR1 Seoul, Dobong stream, 37°41.262'N, 127°01.706'E, 19 m asl., 7.x.2012, Pešić & Choi 6/6/0 (1/1/0 mounted, NIBR IV0000268849); CR2 Seoul, Ui-dong stream 37°39.554'N, 127°00.249'E, 114 m asl., 7.x.2012, Pešić & Choi 3[1 juvenile]/0/1; CR4 Seoraksan NP, stream near Temple, 38°10.399'N, 128°29.050'E, 196 m asl., 8.x.2012 Pešić & Karanović 7/2/5; CR7 Odesean NP, stream, 37°49.642'N, 128°42.170'E, 215 m asl., 9.x.2012, Pešić & Karanović 6/6/0 (2/1/0 mounted, NIBRIV0000268850);; CR11 Mudeung Mt., stream, 35°8'50.2584"N 126°59'18.942"E, 11.x.2012, Pešić & Choi 2/2/1; CR12 JiriSan NP, stream near waterfall, 35°22'47''N, 127°29'10''E, 11.x.2012, Pešić & Choi 4/12[1 juvenile]/0 (1/0/0 mounted); CR14 Duckyu San NP, stream, 35°53'50"N, 127°46'35"E, 11.x.2012, Pešić & Choi 0/2/0. RUSSIA, Primory Territory, Khasansky District, "Kedrovaya Pad National Nature Biosphere Reserve", Sea of Japan basin, Kedrovaya River, 43°06.056'N, 131°33.310'E; depth 12–50 cm; substrate: boulders, cobbles, pebbles; 8.xi.1993, Tiunova 2/2/0 (IBSS).

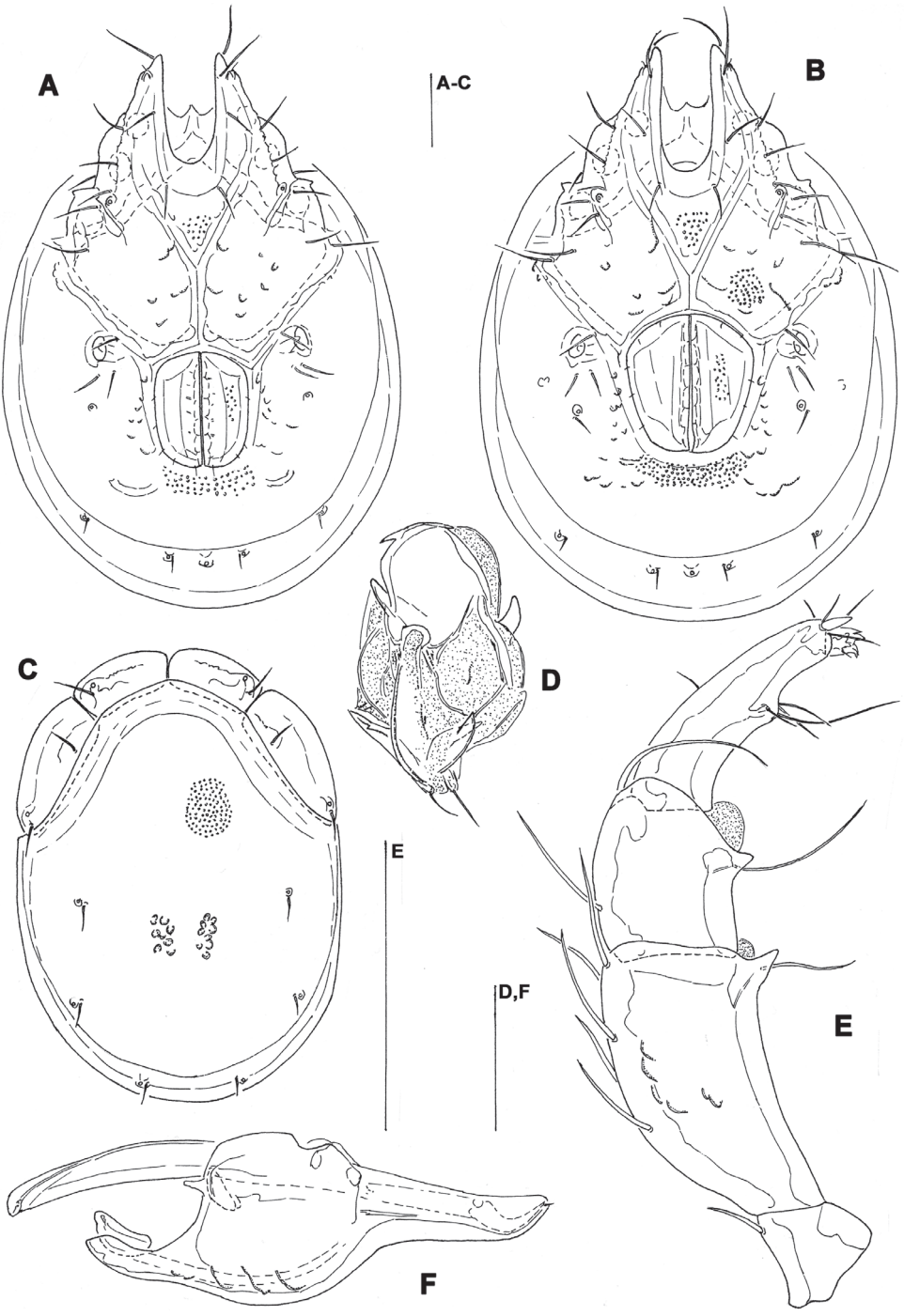

Figure 8. *Torrenticola recentis* Tuzovskij, 2003 (**A, C–F** male **B** female), Dobong stream, Korea: **A–B** ventral shield **C** dorsal shield **D** ejaculatory complex **E** palp, medial view **F** gnathosoma and chelicera. Scale bars = 100 μm.

Morphology. *General features*. Idiosoma roundish; dorsal shield with colour pattern as illustrated in Figs 11A–C; Cxgl-4 subapical; suture line of Cx-IV hardly evident; excretory pore and Vgl-2 only slightly away from the line of primary sclerotization (Fig. 8A); gnathosoma ventral margin strongly curved (Fig. 8F); P-2 longer than P-4, P-2 ventral margin slightly concave, P-4 with well developed ventral protuberance bearing one long and three short setae (Fig. 8E). Male: Medial suture line of Cx-II+III moderately long; genital field subrectangular in shape, ejaculatory complex with small proximal chamber and robust proximal arms (Fig. 8D).

Measurements. Male (from CR1, in parentheses specimen from CR7). Idiosoma (ventral view: Fig. 7A) L 769 (753), W 556 (522); dorsal shield (Figs 7C, 11A-B) L 631 (613), W 450 (446), L/W ratio 1.4 (1.4); dorsal plate L 589 (575); shoulder plate L 195-202 (188-195), W 78 (70-72), L/W ratio 2.5-2.6 (2.6-2.8); frontal plate L 134-138 (136-138), W 58-63 (55-56), L/W ratio 2.1-2.4 (2.4-2.5); shoulder/frontal plate L ratio 1.4-1.5 (1.4). Gnathosomal bay L 152 (159), Cx-I total L 292 (306), Cx-I mL 141 (147), Cx-II+III mL 117 (103); ratio Cx-I L/Cx-II+III mL 2.5 (3.0); Cx-I mL/Cx-II+III mL 1.2 (1.4). Genital field L/W 161 (150)/129 (125), ratio 1.25 (1.2); ejaculatory complex L 189 (193); distance genital field-excretory pore 131 (134), genital field-caudal idiosoma margin 198 (191). Gnathosoma vL 325 (320); chelicera total L 376 (381); palp total L 298 (285), dL: P-1, 34 (34); P-2, 104 (97); P-3, 55 (52); P-4, 91 (88); P-5, 14 (14); P-2/P-4 ratio 1.14 (1.1).

Female (from CR1). Idiosoma (ventral view: Fig. 7B) L 825, W 569; dorsal shield (Fig. 11X) L 672, W 488, L/W ratio 1.38; dorsal plate L 631; shoulder plate L 212-213, W 69, L/W ratio 3.1; frontal plate L 142-144, W 56-59, L/W ratio 2.4-2.5; shoulder/frontal plate L ratio 1.5. Gnathosomal bay L 179, Cx-I total L 320, Cx-I mL 141, Cx-II+III mL 47; ratio Cx-I L/Cx-II+III mL 6.8; Cx-I mL/Cx-II+III mL 3.0. Genital field L/W 191/176, ratio 1.09; egg (n = 1) maximum diameter 222; distance genital field-excretory pore 163, genital field-caudal idiosoma margin 250. Gnathosoma vL 344; chelicera total L 404; palp total L 318-321, dL: P-1, 39; P-2, 110-112; P-3, 56-57; P-4, 97; P-5, 16; P-2/P-4 ratio 1.13-1.16.

Remarks. The specimens from South Korea fit the description of *Torrenticola recentis*, a species described by Tuzovskij (2003) from the Primory Territory in the Russian Far East, and later on reported by Semenchenko (2006) from the River Kedrovaya in the southern part of Primory Territory and from many other southern and northern rivers in the Primory Territory (Semenchenko 2010). The specimens examined from River Kedrovaya agrees well with our specimens due to colour pattern of dorsal shield and length of medial suture line of Cx-II+III, characters not given by Tuzovskij (2003) in the original description of *T. recentis*.

Torrenticola elliptica Maglio, 1909, a species similar in general shape of idiosioma and palps, differs from *T. recentis* in a more slender idiosoma, a more extended postgenital area in the male and the ejaculatory complex with a large proximal chamber (see: Di Sabatino et al. 2010). Possibly *T. recentis* was misidentified as *T. elliptica* in

many old records from the Russian Primory Territory (e.g. Sokolow 1934). Likewise, old records from Japan (Enami 1940) might refer to *T. recentis*.

Habitat. Running waters at low and middle elevations (Figs 14A,D,F).

Distribution. Far East of Russia (Primory Territory – Tuzovskij 2003, Semenchenko 2006, 2010). New for the fauna of Korea.

***Torrenticola ussuriensis* (Sokolow, 1940)**
http://species-id.net/wiki/Torrenticola_ussuriensis
Figs 9, 11D–F

Synonymy: *Atractides ussuriensis* Sokolow, 1940: 347.

Material examined. SOUTH KOREA: CR3 River Inje, 38°03.961'N, 128°10.516'E, 225 m asl., 8.x.2012 Pešić & Karanović 0/1/0 (mounted, NIBRIV0000268851).

Morphology. Female. *General features*. Shoulder platelets fused to the large dorsal plate (Fig. 9B); Cxgl-4 posterior to Cxgl-2 (Fig. 9A), glandular pore Cxgl-4 distanced from Cxgl-2 by 50-55 μm; excretory pore and Vgl-2 clearly posterior to the line of primary sclerotization; suture of Cx-IV curved; P-2 longer than P-4; P-4 with four well developed ventral tubercles (Fig. 9C).

Measurements. Idiosoma (ventral view: Fig. 9A) L 838, W 569; dorsal shield (Fig. 9B, 11D-E) L 694, W 501, L/W ratio 1.39; dorsal plate L 661; frontal plate L 142-147, W 50, L/W ratio 2.8-3.0; gnathosomal bay L 170, Cx-I total L 313, Cx-I medial L 142, Cx-II+III medial 52; ratio Cx-I L/Cx-II+III medial L 6.1; Cx-I medial L/Cx-II+III medial L 2.7; distance between glandular openings of Cxgl-4 and Cxgl-2 51–54. Genital field L/W 171/150, L/W ratio 1.14; distance genital field–excretory pore 181, genital field–caudal idiosoma margin 305. Gnathosoma vL 359; chelicera total L 434; palp total L 358, dL: P-1, 46; P-2, 114; P-3, 69; P-4, 109; P-5, 20; P-2/P-4 ratio 1.05.

Remarks. *Torrenticola ussuriensis* was originally described by Sokolow (1934) from the Primory Territory in the Russian Far East, and later reported from River Inôzava in Japan (Enami 1940). Recently this species was redescribed by Pešić et al. (2011) based on new material from the Russian Far East. A single female specimen examined from River Inje agrees well with the redescription of *T. ussuriensis*. The only difference is found in the excretory pore lying on the same level as Vgl-2 in specimen from Korea while in specimens from Russia and Japan (see: Enami 1940) the excretory pore is shifted slightly posterior to Vgl-2.

Habitat. A permanent sandy/bouldery river with considerably exposure to sunlight (Fig. 14E).

Distribution. Far East of Russia (Primory and Khabarovsk Territory, Jewish Autonomous and Amurskaya Area - "*Atractides semisutus*" Sokolow 1934; Pešić et al. 2011); Japan (Uzi region – "*A. semisutus*" Enami 1940). New for the fauna of Korea.

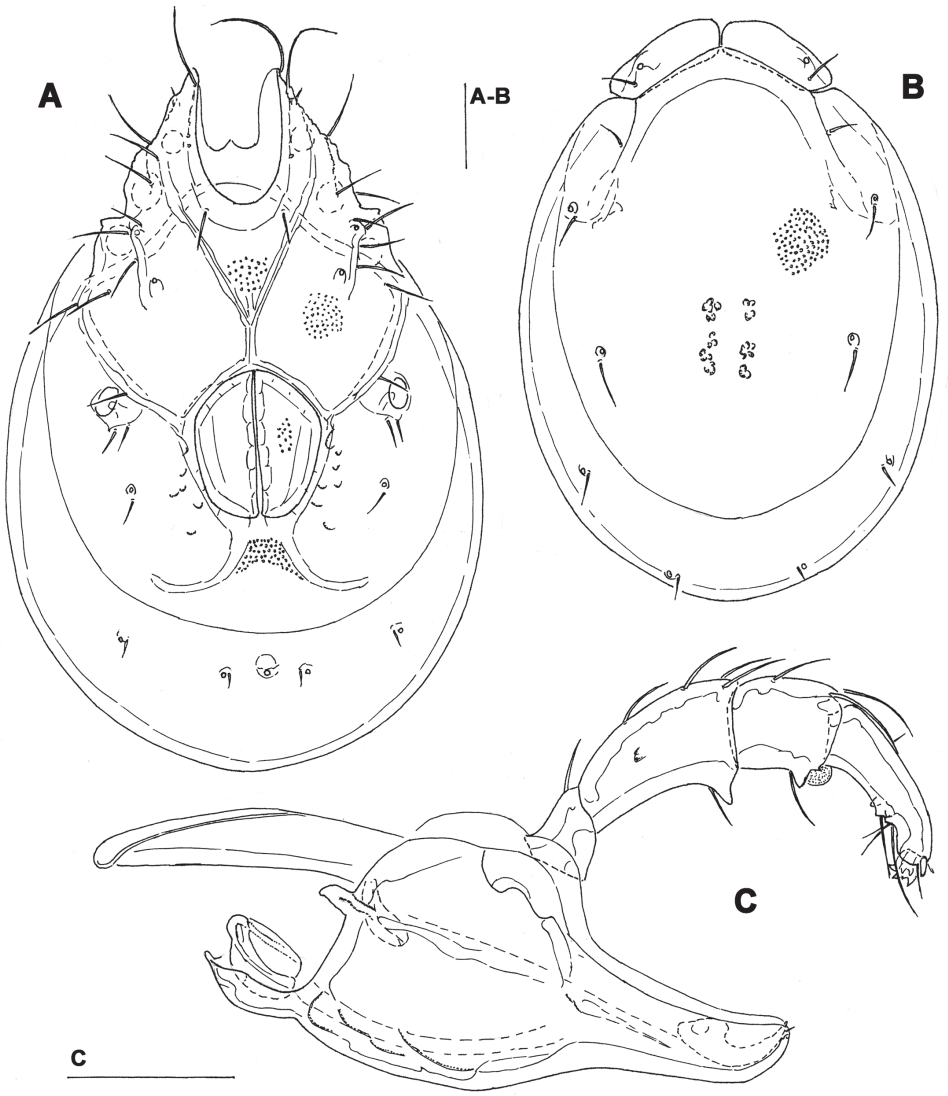

Figure 9. *Torrenticola ussuriensis* (Sokolow, 1940), female, Inje River, Korea: **A** ventral shield **B** dorsal shield **C** gnathosoma and palp, medial view. Scale bars = 100 μm.

***Torrenticola turkestanica* (Sokolow, 1926)**
http://species-id.net/wiki/Torrenticola_turkestanica
Figs 10, 11G–H

Synonymy: *Atractides turkestanicus* Sokolow, 1926: 74.

Material examined. SOUTH KOREA: CR3 River Inje, 38°03.961'N, 128°10.516'E, 225 m asl., 8.x.2012 Pešić & Karanović 1/1/0 (mounted, NIBRIV0000268852).

Morphology. *General features*. Idiosoma elongated (dorsal shield L/W ratio 1.5-1.6); dorsal shield with colour pattern as illustrated in Figs 11G-H; Cxgl-4 subapical; gnathosoma ventral margin strongly curved; P-2 ventral margin convex, P-2 and P-3 with a subrectangular, apically serrated ventrodistal projection, P-4 stocky with well developed ventral protuberance bearing one long and three short setae (Figs 10C-D). Male: Medial suture line of Cx-II+III moderately long; genital field subrectangular in shape, ejaculatory complex normal in shape; excretory pore and Vgl-2 located on the margin of primary sclerotization. Female: Posterior suture line of Cx-IV curved and well evident; genital field excretory pore and Vgl-2 away from the line of primary sclerotization.

Measurements. Male: Idiosoma (ventral view: Fig. 10A) L 700, W 441; dorsal shield (Figs 7B, 11G) L 575, W 375, L/W ratio 1.5; dorsal plate L 541; shoulder plate L 172-174, W 48-56, L/W ratio 3.1-3.6; frontal plate L 106-116, W 44-47, L/W ratio 2.4-2.5; gnathosomal bay L 133, Cx-I total L 270, Cx-I medial L 137, Cx-II+III medial 97; ratio Cx-I L/Cx-II+III medial L 2.8; Cx-I medial L/Cx-II+III medial L 1.4. Genital field L/W 156/122, ratio 1.28; distance genital field–excretory pore 137, genital field–caudal idiosoma margin 169; ejaculatory complex L 212. Gnathosoma vL 283; chelicera total L 323; palp total L 272, dL: P-1, 28; P-2, 88; P-3, 52; P-4, 84; P-5, 20; P-2/P-4 ratio 1.05.

Female. Idiosoma (ventral view: Fig. 10E) L 781, W 494; dorsal shield (Fig. 11H) L 650, W 409, L/W ratio 1.6; dorsal plate L 610; shoulder plate L 178-189, W 56-64, L/W ratio 3.0-3.2; frontal plate L 127-131, W 52-55, L/W ratio 2.3-2.5; gnathosomal bay L 145, Cx-I total L 297, Cx-I medial L 151, Cx-II+III medial 47; ratio Cx-I L/Cx-II+III medial L 6.3; Cx-I medial L/Cx-II+III medial L 3.2. Genital field L/W 169/151, ratio 1.12; distance genital field–excretory pore 188, genital field–caudal idiosoma margin 272. Gnathosoma vL 372; chelicera total L 316; palp total L 301, dL: P-1, 31; P-2, 99; P-3, 59; P-4, 92; P-5, 20; P-2/P-4 ratio 1.08.

Remarks. The specimens examined from River Inje fit the description of *Torrenticola turkestanica*, a species described based on a single female from Tadjikistan (Sokolow 1926). The only difference with the original description is found in a broader genital field in the type specimen. Later on, populations provisionally assigned to *T. turkestanica*, mainly based on the approved non-identity with the alternative species, were reported from Indian Himalayas (Pešić et al. 2007) and Thailand (Pešić and Smit 2006). The populations from Thailand differ from our material and the original description in a less slender idiosoma (dorsal shield L/W ratio 1.3-1.4, data taken from Pešić and Smit 2006), a much shorter ventral seta on P-2 and more slender P-4, and very likely represent an new species. The additional material and finding of a male from the locus typicus is necessary to clarify the taxonomy of *T. turkestanica* (the holotype may be missing, not found in the Zoological Institute of St. Petersburg, Denis Tumanov pers. comm).

Torrenticola japonica Imamura, 1953, a species described based on a single female from a stream in Shinjô-mura in Japan (Imamura 1953), resembles *T. turkestanica* in the characteristic shape of the palp (ventral margin of P-2 convex, P-2 and P-3 with subrec-

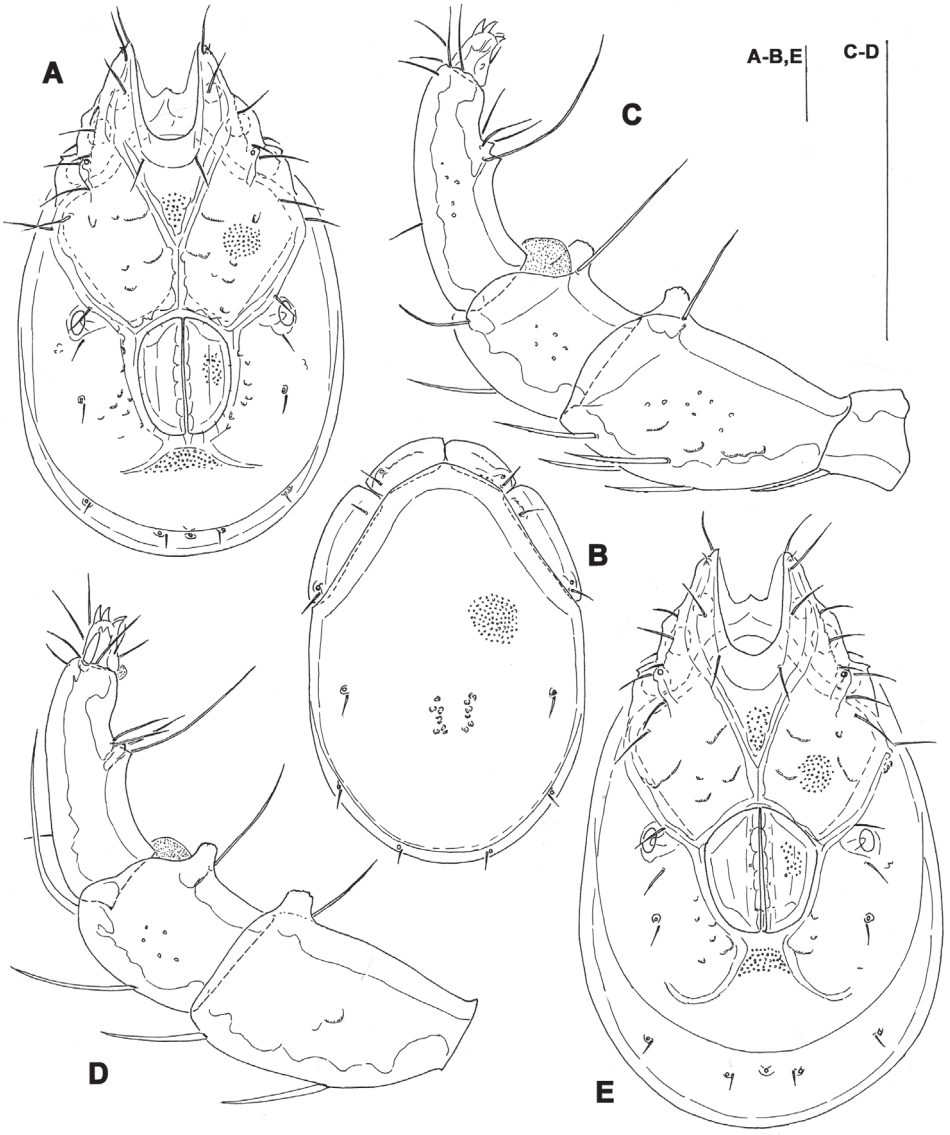

Figure 10. *Torrenticola turkestanica* (Sokolow, 1926) (**A–D** male **E** female), Inje River, Korea: **A, E** ventral shield **B** dorsal shield **C** palp, lateral view **D** palp, medial view (P-1 missing). Scale bars = 100 μm.

tangular ventrodistal projection). From the latter species, *T. japonica* differs in a broader idiosoma, a dorsal shield with broader shoulder platelets and posterior suture line of Cx-IV not extending far beyond genital field (see: Imamura 1953). However as the holotype of *T. japonica* is probably lost (Hiroshi Kajihara, pers. comm), additional material and selection of a neotype from the locus typicus is necessary to clarify its taxonomy.

Imamura (1953) reported a single male of *Torrenticola elliptica* Maglio, 1909, from a stream in Shinjô-mura in Japan. However due to the presence of subrectangular

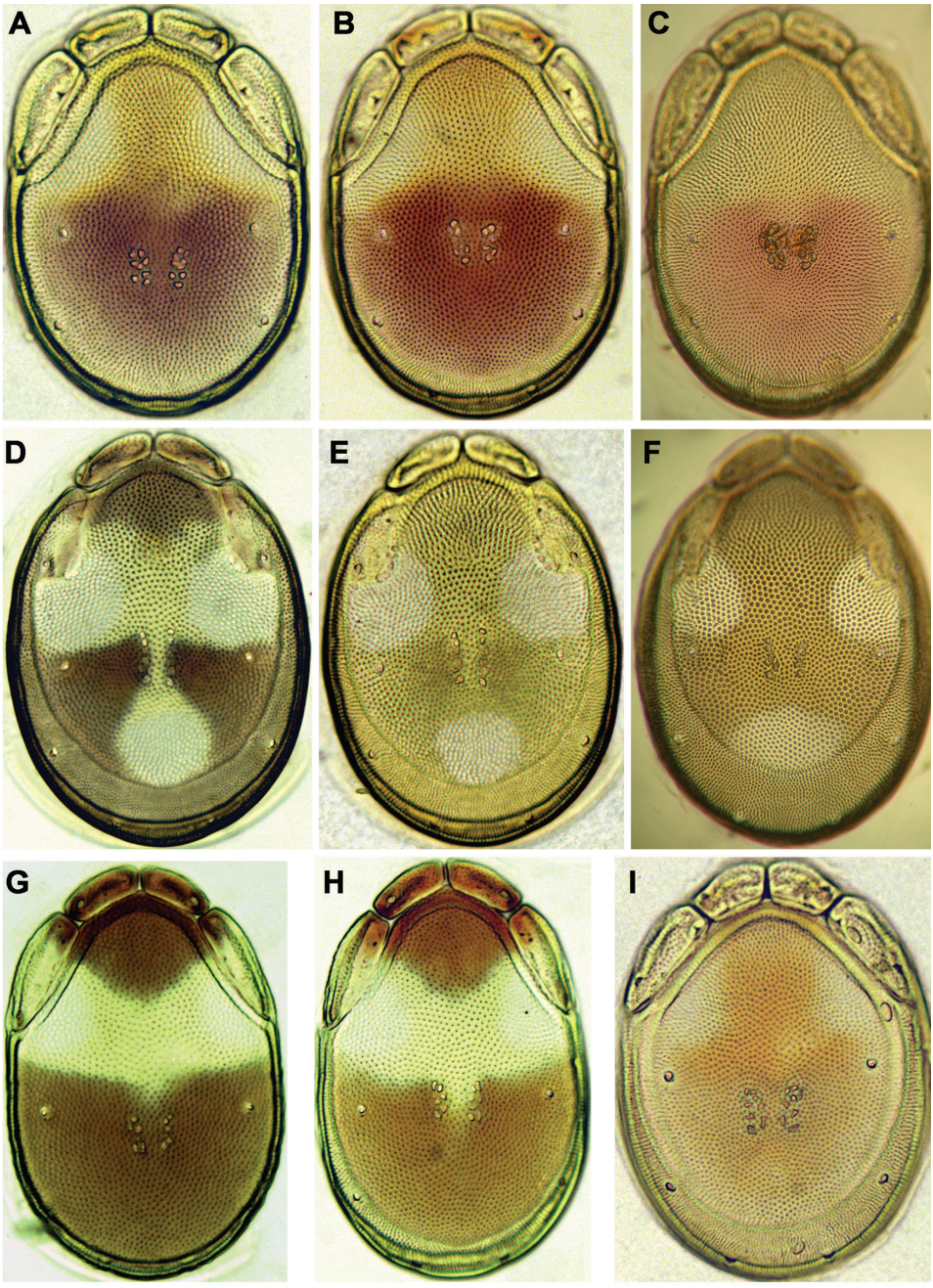

Figure 11. Photographs of dorsal shield: **A–C** *Torrenticola recentis* Tuzovskij, 2003 (**A, B** specimens from Dobong stream, Korea **C** specimen from River Kedrovaya, Russia): **A** male **C–B** female **D–F** *Torrenticola ussuriensis* (Sokolow, 1940), female (**D** specimen photographed immediately after dissection **E–F** specimens mounted in Hoyer's medium): **D–E** specimen from Korea **F** specimen from Russia **G–H** *Torrenticola turkestanica* (Sokolow, 1926), specimens from River Inje, Korea: **G** male **H** female **I** *Monatarctides abei* sp. n., male holotype. Photos. V. Pešić (Figs **A–B, D–E, G–I**), K. Semenchenko (Figs **C, F**).

ventrodistal projections on P-2 and P-3 and a convex ventral margin of P-2, his illustrations show a general conformity with *Torrenticola japonica* and *T. turkestanica*. It is very likely that the specimen attributed by Imamura (1953) to *T. elliptica* is conspecific with *T. japonica*, especially as both species were collected from the same location and on the same day.

Habitat. A permanent sandy/bouldery river with considerable exposure to sunlight (Fig. 14E).

Distribution. Tadjikistan (Sokolow 1926), Indian Himalayas (Pešić et al. 2007), Thailand (Pešić and Smit 2006, but see remarks above). New for the fauna of Korea.

Genus *Monatractides* K.Viets, 1926

Monatractides abei sp. n.

urn:lsid:zoobank.org:act:F9C4384E-4673-4FC9-B098-A002FCDD1CDA
http://species-id.net/wiki/Monatractides_abei
Figs 12, 13, 11I

Type series. Holotype male (NIBRIV0000268853), dissected and slide mounted, SOUTH KOREA, CR2 Seoul, Ui-dong stream, 37°39.554'N, 127°00.249'E, 114 m asl., 7.x.2012, Pešić & Choi. Paratypes: SOUTH KOREA, CR1 Seoul, Dobong stream, 37°41.262'N, 127°01.706'E, 19 m asl., 7.x.2012, Pešić & Choi, one female (NIBRIV0000268854), dissected and slide mounted; RUSSIA, Primory Territory, Partizansky District, Partizanskay River basin, Tigrovaya River, 43°11.401'N, 133°12.660'E; depth 30 cm below the sediment surface; substrate: cobbles, pebbles, sand; 12.vi.2010, Semenchenko & Sidorov, one female (497-kas–IBSS), dissected and slide mounted.

Diagnosis. Lateral margins of dorsal shield nowhere subparallel; distal margins of P-3 with several pointed extensions; genital field in male with slightly protruding anteriolateral angles; medial suture line of Cx-II+III in female relatively long (L 90–105 μm).

Description. *General features*. Lateral margins of dorsal shield nowhere subparallel (Fig. 12A, 11I); three pairs of knob-like protrusions on the lateral margin of gnathosomal bay; suture line of Cx-IV distinct, originating from lateral edge of genital field, laterally curved anteriorly; excretory pore away from the line of primary sclerotization, Vgl-2 posterior to excretory pore; ejaculatory complex (Fig. 12F): proximal chamber large, proximal horns reduced; P-2 equal in length, or only slightly shorter than P-4; distal margins of P-3 with several pointed extensions; ventral seta on P-4 relatively long and away from distal edge (Figs 12C-D). Male. Medial suture line of Cx-II+III moderately long, genital field with slightly protruding anteriolateral angles. Female: Similar to the male; the short postgenital area and caudal position of the excretory pore in the specimen from Korea are due to the obviously juvenile age (indicated by weak sclerotization and absence of eggs); medial suture line of Cx-II+III relatively long.

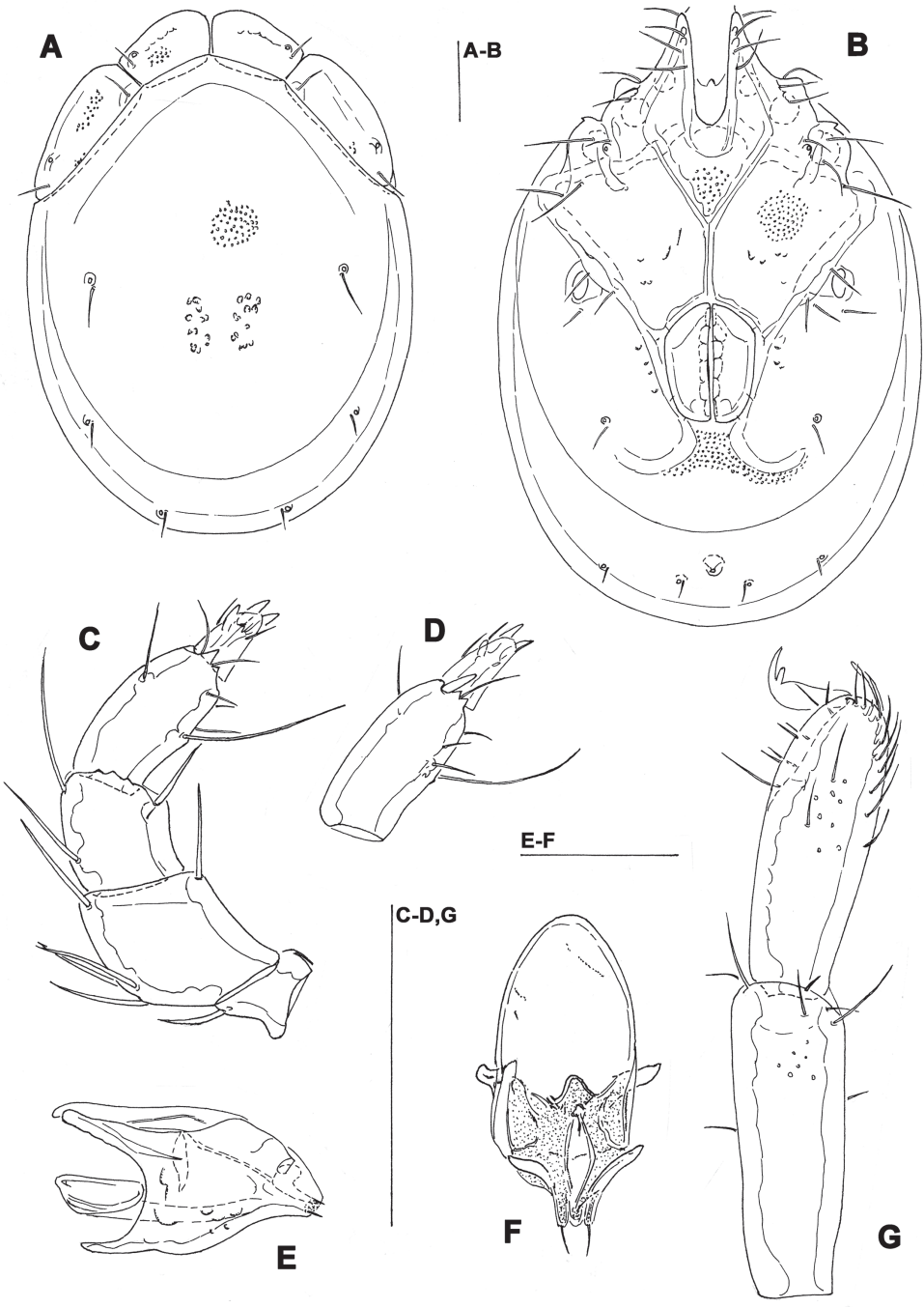

Figure 12. *Monatractides abei* sp. n., male holotype: **A** dorsal shield **B** ventral shield **C** palp, lateral view **D** P-4 and -5, medial view **E** gnathosoma and chelicera **F** ejaculatory complex **G** I–Leg-5 and -6. Scale bars = 100 μm.

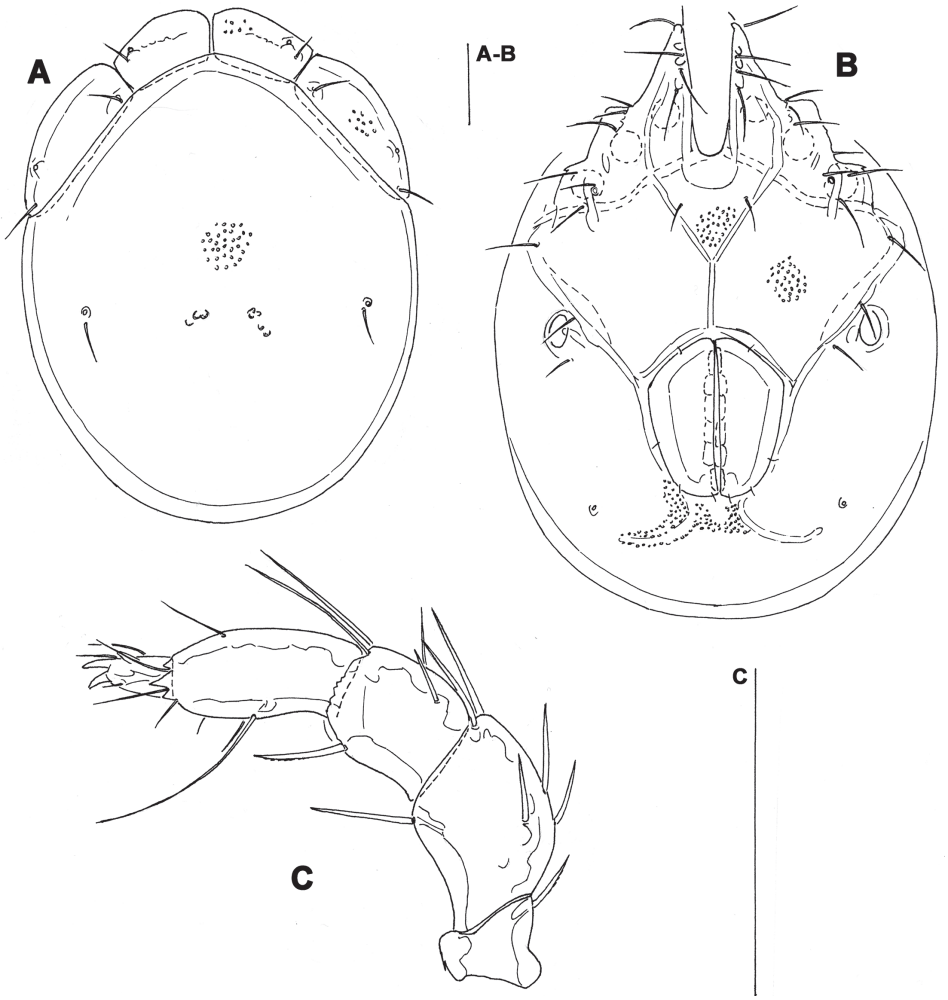

Figure 13. *Monatractides abei* sp. n., paratype female, Dobong stream, Korea: **A** dorsal shield **B** ventral shield **C** palp, lateral view. Scale bars = 100 μm.

Measurements. Male: Idiosoma (ventral view: Fig. 12B) L 775, W 538; dorsal shield (Fig. 12A, 11I) L 663, W 488, ratio 1.36; dorsal plate L 606; shoulder plate L 191-194, W 75, ratio 2.5-2.6; frontal plate L 122-123, W 75, ratio 1.6; shoulder/frontal plate L ratio 1.6. Gnathosomal bay L 143, Cx-I total L 264, Cx-I mL 120, Cx-II+III mL 99; ratio Cx-I L/Cx-II+III mL 2.7; Cx-I mL/Cx-II+III mL 1.2. Genital field L/W 147/115, ratio 1.28; ejaculatory complex L 197; distance genital field-excretory pore 191, genital field-caudal idiosoma margin 264. Gnathosoma vL 152; chelicera total L 181; palp total L 199, dL: P-1, 23; P-2, 54; P-3, 40; P-4, 54; P-5, 28; P-2/P-4 ratio 1.0; dL of I-Leg-5-6 (Fig. 9G): 99, 97.

Female (from CR2, in parentheses specimen from Russia). Idiosoma (ventral view: Fig. 13B) L 725 (800), W 544 (612); dorsal shield (Fig. 13A) L 625 (680), W 488

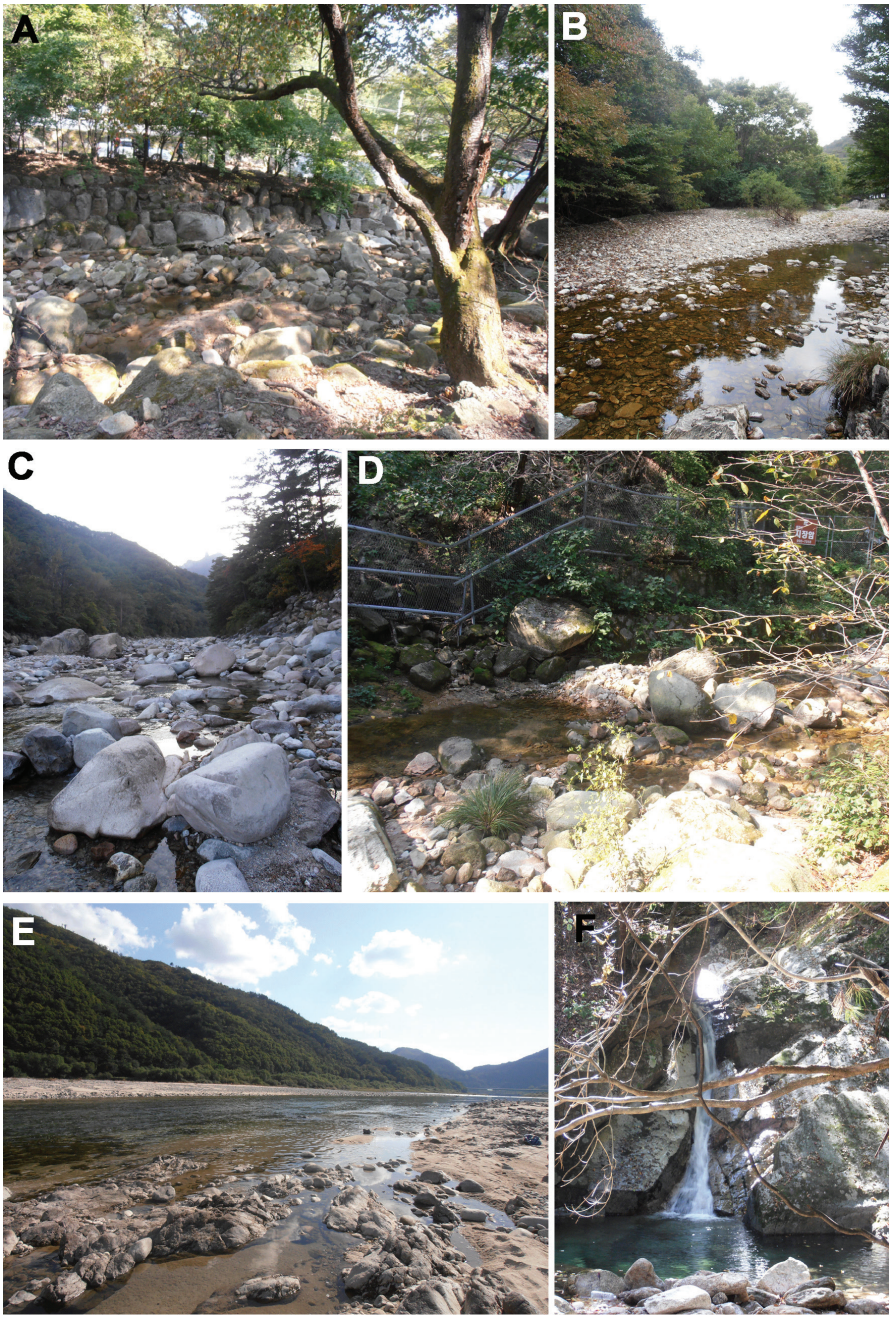

Figure 14. Photographs of selected sampling sites. **A** CR1 (Dobong stream, sampling site of *Torrenticola recentis*, *T. nipponica* and *Monatractides abei* sp. n.) **B** CR9 (stream in Naebyeansan NP, sampling site of *Torrenticola brevirostris* and *T. dentifera*);] **C** CR4 (stream in Seoraksan NP, type locality of *Torrenticola kimichungi* sp. n. and sampling site of *Torrenticola recentis*) **D** CR2 (Ui-dong stream, type locality of *Monatractides abei* sp. n. and sampling site of *Torrenticola recentis*) **E** Inje River (sampling site of *Torrenticola ussuriensisis* and *T. turkestanica*) **F** CR12 (stream in JiriSan NP, sampling site of *Torrenticola recentis*). Photos. V. Pešić.

(476), L/W ratio 1.28 (1.43); dorsal plate L 575 (620); shoulder plate L 203-206 (204), W 70-76 (74), L/W ratio 2.7-2.9 (2.76); frontal plate L 125-127 (114), W 69-70 (79), ratio 1.8 (1.43); shoulder/frontal plate L ratio 1.6 (1.79). Gnathosomal bay L 159 (132), Cx-I total L 283 (257), Cx-I mL 123 (118), Cx-II+III mL 90 (105); ratio Cx-I L/Cx-II+III mL 3.1 (2.45); Cx-I mL/Cx-II+III mL 1.4 (1.1). Genital field L/W 191 (145)/160 (112), ratio 1.19 (1.28); distance genital field-excretory pore (205), genital field-caudal idiosoma margin (277). Gnathosoma vL 162 (198); chelicera total L 202 (200); palp total L 209, dL: P-1, 28; P-2, 56 (54); P-3, 39 (40); P-4, 58 (54); P-5, 28 (19); P-2/P-4 ratio 0.97 (1.0); dL of I-Leg-4-6: 114 (103), 105 (100), 104 (94).

Etymology. The species is named after Dr Hiroshi Abe in appreciation of his studies on water mites.

Remarks. *Monatractides abei* sp. n. is apparently closely related to *M. madritensis* (K. Viets, 1930), known from the Western Palaearctic, due to the presence of an elongated ventral seta on P-4 and the similar shape of the ejaculatory complex. Males of *M. madritensis* differ in a more slender idiosoma with subparallel lateral margins of the dorsal shield, and a slender genital field with more protruding anterior margins of the genital flaps forming a more acute angle (see: Di Sabatino et al. 2010). Furthermore, in *M. abei* nov. sp. the distal margins of P-3 bears several pointed extensions. The female of the new species can be identified on the basis of a relatively long medial suture line of Cx-II+III.

Enami (1940) stated that he identified *Monatractides* population from River Inôzava (Uzi region, Japan) as *Torrenticola stadleri* (syn. to *Monatractides stadleri*), but he noted that his specimens differ from the later species in P-4 bearing an elongated ventral seta. Given the latter character and the shape of genital field in Enami's specimens, with slightly protruding anteriolateral angles in male, resembling the female, suggest that these specimens are probably conspecific with *M. abei* sp. n.

Habitat. The specimens of *Monatractides abei* sp. n. was collected in two sandy/bouldary streams, shaded by riparian vegetation (Fig. 14A, D); the specimens from Russia were collected from interstitial waters.

Distribution. South Korea, Far East of Russia (present study).

Acknowledgements

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RESEARCH ARTICLE

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Six new species of *Cymatodera* from Mexico and Central America and the retention of *Cymatodera obliquefasciata* as a valid name (Cleridae, Tillinae)

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Abstract

Six new *Cymatodera* species from the Mexican states of Jalisco and Chiapas, and the Central American countries of El Salvador, Honduras, Costa Rica and Panamá are described: *C. rosalinae* **sp. n.**, *C. capax* **sp. n.**, *C. sinuosa* **sp. n.**, *C. vittata* **sp. n.**, *C. rubida* **sp. n.** and *C. limatula* **sp. n.** Justification for retaining *C. obliquefasciata* within *Cymatodera* instead of transferring it to *Bogcia* is provided. Male genitalia and other characters of taxonomic value are illustrated.

Resumen

Se describen seis nuevas especies del género *Cymatodera* pertenecientes a los estados Mexicanos de Jalisco y Chiapas, y los países Centroamericanos de El Salvador, Honduras, Costa Rica y Panamá: *C. rosalinae* **sp. n.**, *C. capax* **sp. n.**, *C. sinuosa* **sp. n.**, *C. vittata* **sp. n.**, *C. rubida* **sp. n.** y *C. limatula* **sp. n.** Se proporciona información sobre la retención de *C. obliquefasciata* dentro de *Cymatodera*, invalidando así su transferencia a *Bogcia.* Se presentan ilustraciones de la genitalia masculina así como otros caracteres de valor taxonómico.

Keywords

Coleoptera, *Cymatodera*, *Bogcia*, New World, taxonomy, antennae, genitalia, terminalia

Introduction

The subfamily Tillinae Leach, 1835 has a worldwide distribution with 543 described species classified in 67 genera (Opitz 2010). The fauna is well represented in the North American temperate and subtemperate zones, the Neotropics, and the Paleotropic region of Africa, with an important concentration of genera and species in Madagascar (Opitz 2010). In the New World, the subfamily comprises the following genera: *Araeodontia* Barr, 1952, *Barrotillus* Rifkind, 1996, *Bogcia* Barr, 1978, *Bostrichoclerus* Van Dyke, 1938, *Callotillus* Wolcott, 1911, *Cylidrus* Latreille, 1825, *Cymatodera* Gray, 1832, *Cymatoderella* Barr, 1962, *Lecontella* Wolcott and Chapin, 1918, *Monophylla* Spinola, 1841 and *Onychotillus* Chapin, 1945. The Tillinae is a taxonomically complex group. Polymorphism is frequently encountered, the boundaries between both genera and species are rather difficult to establish, and it is common to observe species that appear to bridge the gap between generic taxa.

Barr (1948, 1952a, 1952b, 1972, 1978) and Rifkind (1993, 1995, 1996) are responsible for most of the recent descriptions and classificatory work treating the Tillinae of Mexico and Central America with a focus mainly on the fauna of northern mainland Mexico and Baja California. Despite some progress, most of the central and southern portion of Mexico has been poorly surveyed. Furthermore, our understanding of the Central American Tillinae fauna is even more limited, and our taxonomic knowledge of this geographical region has been scarcely added to in almost a century.

Cymatodera is the most speciose Tillinae genus in the New World, with a distribution that extends from southern Canada to Colombia and Venezuela (Opitz 2010). The highest diversity of described species is found in the southwest portion of the United States and the north of Mexico (Barr, personal communication). *Cymatodera* is well represented in Mexico (Rifkind 1993). Vaurie (1952) noted the presence of 37 species inhabiting the country, although the records she presented were mostly limited to north-central Mexico. At present, 20 species have been described from Central America (Barr, unpublished checklist).

The genus *Bogcia* was erected by Barr (1978) and is represented by two species, *B. oaxacae* Barr and *B. disjuncta* Barr, both restricted to the western portion of Mexico. Members of this group show strong similarities to *Cymatodera;* however, they can be reliably separated based on the structure of the protarsal unguis. The position of the tarsal claw is in close approximation with the denticle in *Bogcia* (Fig. 22), rather than conspicuously separated as in *Cymatodera* (Fig. 23). Barr (unpublished checklist) included *Cymatodera obliquefasciata* Schaeffer within *Bogcia*. This placement was based on the strongly serrate condition of the antennae (Fig. 16). Nevertheless, I have found that this trait is not reliable for distinguishing *Bogcia* from *Cymatodera*. The antenna of the latter is highly variable, and does not represent a character that marks a clear discontinuity in the group. Consequently, it is possible to encounter antennal forms that range from filiform (Fig. 18), as in *C. longicornis* LeConte, or moderately serrate (Fig. 19), such as *C. antennata* Schaeffer, to strongly serrate (Fig. 15), as observed in

the new species, *C. limatula*, described below. Therefore, *C. obliquefasciata* should be retained as *Cymatodera* based on the ungual structure of the protarsus.

This work is intended to be a small contribution towards a better understanding of the *Cymatodera* fauna of Mexico and Central America, and to shed some light on the complex relationships found in this group.

Methods

The methods used for genitalia extraction and dissection are similar to those described by Ekis (1977). Terminology used partially follows the work of Ekis (1977) and Rifkind (1996). I considered differences in the aedeagi as the primary evidence for determination of biological species (*sensu* Mayr 1963).

Specimens were observed using a Leica MZ APO stereomicroscope. All measurements were made using a stereomicroscope ocular micrometer and the software Leica Application Suite V. 3.4.0. Optic images were taken using a Leica DFC 500 digital camera. Scanning electron photographs were taken using a Hitachi 3500N variable pressure scanning electron microscope.

The following abbreviations are used in the description of the holotypes: **TL**= Total body length, **HW**= Maximum head width, **HL**= Head length, **PW**= Maximum pronotal width, **PL**= Pronotal length, **EW**= Maxium elytral width, **EL**= Elytral length.

Acronyms of collections used here in are:

CNIN Colección Nacional de Insectos, Instituto de Biología, UNAM, México
FSCA Florida State Collection of Arthropods, Gainesville, FL, USA
INBC Instituto Nacional de Biodiversidad, Colección Entomológica, Santo Domingo de Heredia, Costa Rica
JEWC James E. Wappes Collection, San Antonio, TX, USA
JNRC Jacques Rifkind Collection, Valley Village, CA, USA
KSUC Kansas State University Museum of Entomological and Prairie Arthropod Research, Kansas State University, Manhattan, KS, USA
RGCG Roland Gerstmeier Collection, Technische Universitat Munchen, Freising, Germany
RHTC Robert H. Turnbow Jr. Collection, Enterprise, AL, USA
SEMC Snow Entomological Collection, University of Kansas, Lawrence, KS, USA
TAMU Texas A&M Insect Collection, Texas A&M University, College Station, TX, USA
USNM United States National Museum of Natural History, Smithsonian Institution, Washington D.C., USA
WFBM William F. Barr Museum, University of Idaho, Moscow, ID, USA
WOPC Weston Opitz Collection, Salina, KS, USA

Taxonomy

Genus *Cymatodera* Gray, 1832
http://species-id.net/wiki/Cymatodera

See Barr (1952a), Barr (1972) and Vaurie (1952) for references and keys to species.

Type species. *Cymatodera hopei* Gray, 1832: 375.

Diagnosis. Members of the genus *Cymatodera* may be separated from other genera of the New World Tillinae by the following combination of characters (partially adopted from Opitz 2002): 1) frons simple, without prominent horns, 2) elytra with striated punctuations, 3) antenna strongly serrate to filiform, 4) last antennomere circular in cross section, shorter than the length of preceding three antennomeres, 5) tarsal pulvillar formula 4-4-4, 6) tibial spur formula: 2-2-2, 6) basal denticle of tarsal claws trigonal, 7) eyes coarsely faceted, 8) body length 4.0 - 30.0 mm.

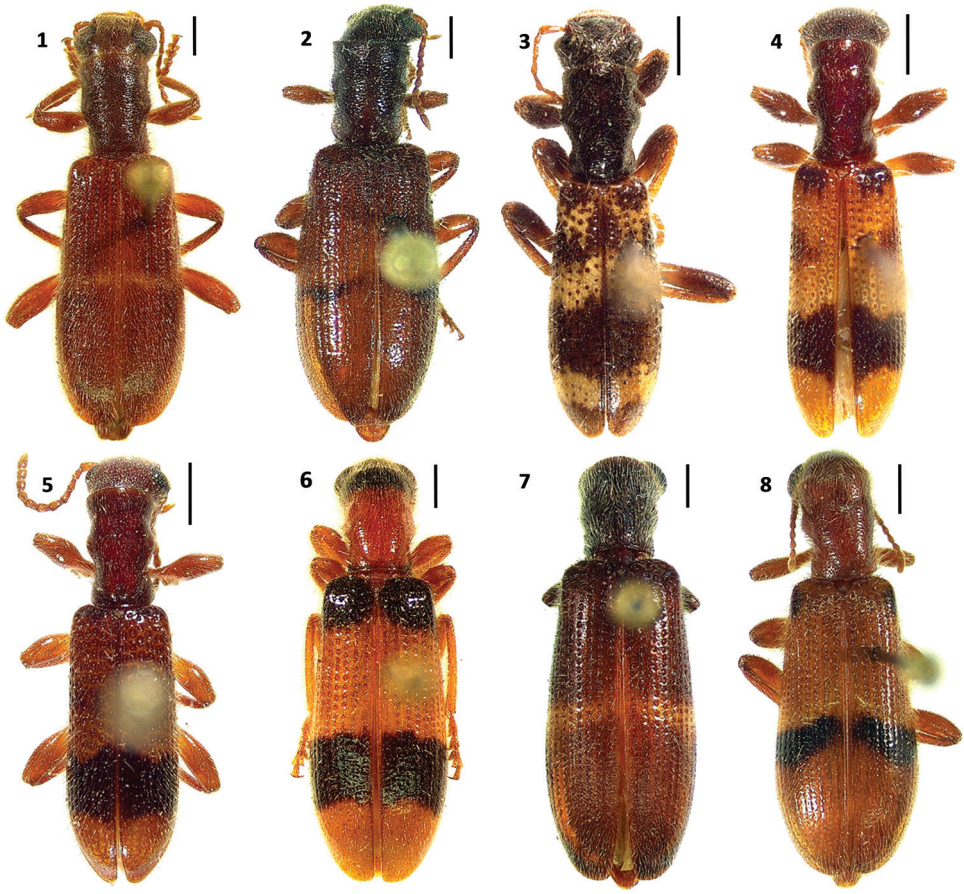
***Cymatodera rosalinae* Burke, sp. n.**
urn:lsid:zoobank.org:act:4F6DAD66-F4F6-4772-A0D5-94AE0492488C
http://species-id.net/wiki/Cymatodera_rosalinae
Figs 1, 9, 10, 20, 24, 31, 38, 45, 52

Type material. Holotype: male, México, Jalisco, Estación Biológica Chamela UNAM, 80 m, 19-VII-1993, J. E. Wappes, red handwritten label, holotype deposited USNM. **Paratypes:** 27 males, 25 females. 11 males and 11 females: same data as holotype (CNIN, 6; JEWC, 6; KSUC, 2; RGCG, 4; TAMU, 4); 1 male and 2 females: México, Jalisco, Costa Careyes, at light, tropical deciduous forest, 7-VII-1991, J. Rifkind and P. Gum (JNRC, 3); 1 female: México, Jalisco, carretera no. 200, Costa Careyes, blacklight, tropical deciduous forest, 6-VII-1993, J. & E. Beierl (TAMU, 1); 6 males and 4 females: México, Jalisco, Estación Biológica Chamela UNAM, 9 to 19-VII-1993, J. Huether (FSCA, 2; CNIN, 2; TAMU, 2; WOPC, 3; JNRC, 1); 8 males and 5 females: México, Jalisco, municipio de La Huerta, Estación Biológica Chamela UNAM, 9 to 19-VII-1993, Morris, Huether and Wappes (RHTC, 4; JNRC, 4; USNM, 4; WOPC, 1); 1 male and 1 female: México, Jalisco, Estación Biológica Chamela, 3 to 4-VIII-1994, R. L. Westcott (WFBC, 2); 1 female: México, Jalisco, Chamela, 7-VII-1990, F. A. Noguera (CNIN, 1).

Description. Size: TL= 12.5 mm, length of males: 8.8 - 13.5 mm, length of females 9.8 - 15.2 mm, n = 53 (Fig. 1).

Color: head and pronotum fuscous-brown; rest of the body uniformly brown. Each elytron with a pair of median, slightly oblique, pale fascia that extends from elytral suture to epipleuron.

Head: HL= 2.1 mm, HW= 1.3 mm; length to width ratio: males average 1.68, females average 1.55; measured across eyes wider than pronotum; finely, rather punc-



Figures 1–8. Habitus of: **1** *Cymatodera rosalinae* sp. n. (holotype male) **2** *Cymatodera capax* sp. n. (holotype female) **3** *Cymatodera sinuosa* sp. n. (holotype female) **4** *Cymatodera vittata* sp. n. (holotype male) **5** *Cymatodera rubida* sp. n. (holotype male) **6** *Cymatodera limatula* sp. n. (holotype male) **7** *Cymatodera obliquefasciata* Schaeffer **8** *Bogcia oaxacae* Barr. Scale bars = 1 mm.

tate; somewhat clothed with short, recumbent setae intermixed with less numerous, erect setae; surface rugose, except frons shiny. Eyes rather big, somewhat rounded, inconspicuously longer than wide, emarginate in front, bulging laterally, separated by approximately 2.5 eye-widths (Fig. 20). Antennae extending to base of elytra; third antennomere 2.0 × longer than preceding antennomere; antennomeres 3-10 subequal in length; antennomeres 2-4 slender; antennomeres 5-10 feebly serrate; last antennomere elongate, subacuminate, 1.5 × longer than preceding antennomere (Fig. 9).

Thorax: PL= 3.2 mm, PW= 1.9 mm; length to width ratio: males average 1.56, females average 1.62; pronotum widest at middle, middle slightly broader than anterior margin; sides constricted subapically, more strongly constricted behind middle; disc flat, indistinctly impressed in front of middle; clothed with short, recumbent setae intermixed with long, erect and suberect setae; surface somewhat rugose; slightly more densely punc-

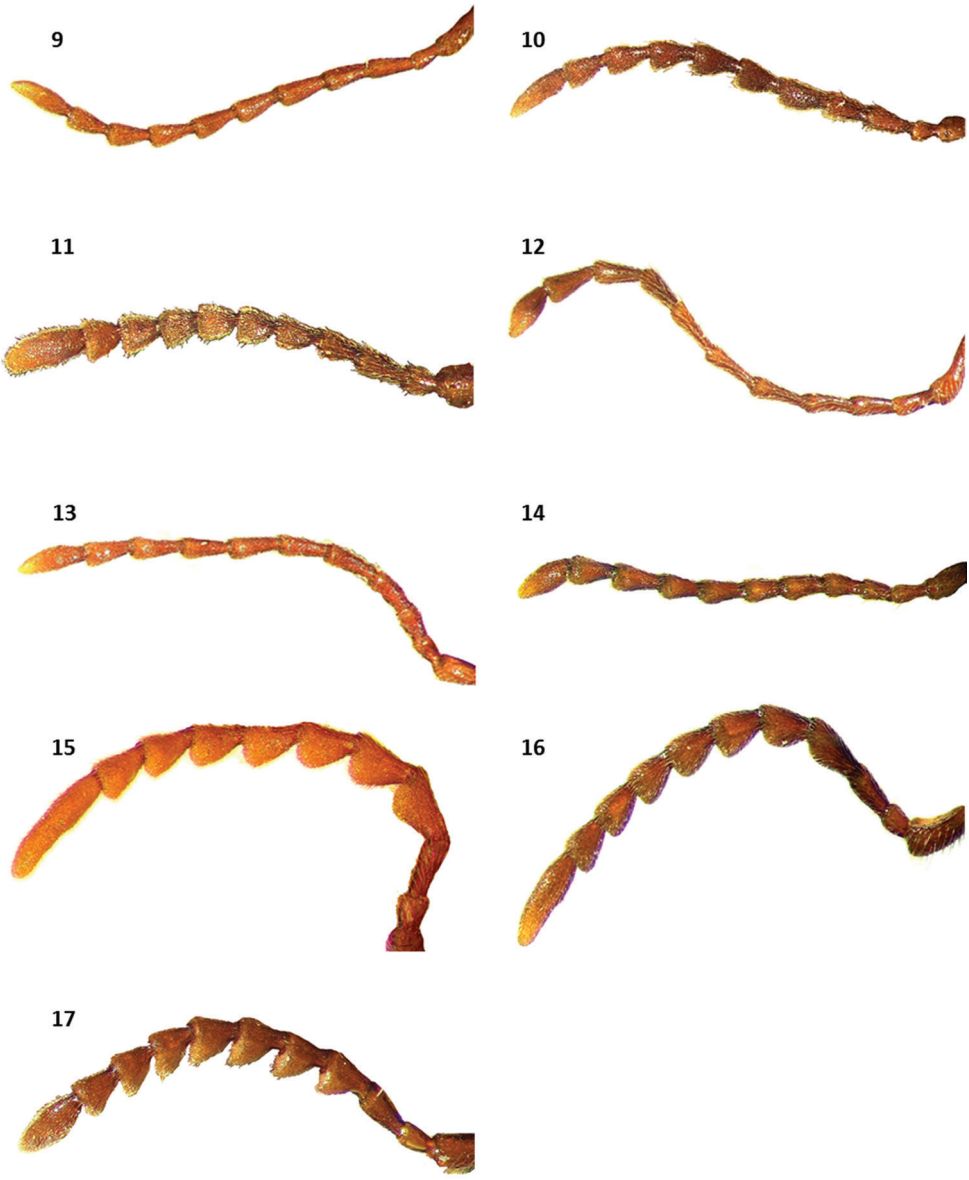
tate than head; subbasal tumescences indistinctly pronounced. Mesosternum scarcely, coarsely punctate. Metasternum convex, puncticulate; covered with fine, recumbent setae. Scutellum subquadrate, notched posteriorly, covered with short, erect setae.

Legs: vested with short, recumbent setae intermixed with long, suberect setae that become more densely arranged on proximal face of tibiae; femora rugulose, moderately, finely punctate; tibiae transversely rugose, moderately, coarsely punctate, vested with short, recumbent setae intermixed with occasional semierect setae.

Elytra: EL= 7.6 mm, EW= 3.4 mm; length to width ratio: males average 2.25, females average 1.78; anterior margin bisinuate; humeri rounded; sides subparallel; base wider than pronotum; widest behind middle; disc flattened apically; apices sinuate, feebly dehiscent; surface feebly rugose; vestiture composed of short, semirecumbent setae intermixed with less numerous, long, erect and semierect setae; sculpturing consisting of small, coarse punctations arranged in striae that gradually reduce in size behind middle; interstices smooth, 4.0 × the width of punctation.

Abdomen: ventrites 1-5 rugulose, vested with short, recumbent setae and some long, semierect setae. First visible ventrite indistinctly, finely punctate; ventrites 2-5 densely, finely punctate. Fifth visible ventrite convex; lateral margins oblique; posterior margin broadly, rather deeply, semicircularly emarginate (Fig. 24). Sixth visible ventrite subquadrate; surface somewhat excavated medially, convex laterally; rather punctate; rugulose; covered with short recumbent setae; lateral margins oblique; posterior margin broadly, moderately deeply, arcuately emarginate; hind angles rounded (Fig. 24). Fifth tergite slightly convex; finely punctate; rugulose; posterior margin broadly, shallowly, arcuately emarginate (Fig. 38). Sixth tergite subrectangular; rugulose; surface convex; broader than long; moderately, finely punctate; inconspicuously covered with short, recumbent setae; lateral margins oblique; posterior margin broadly, shallowly emarginate; hind angles arcuate (Fig. 38). Posterior margin of sixth tergite fully covering sixth visible ventrite. Aedeagus 2.25 mm long, robust, ratio of length of paramere to whole tegmen 0.28: 1; parameres rather prominent, subparallel, pointed distally, phallobase wide; phallus with copulatory piece tapered at apex, phallic plate with a row of large, sclerotized denticles along dorsal margin; phallobasic apodeme and endophallic struts broad, somewhat dilated distally (Fig. 52).

Variation. Female specimens differ from males in the following respects: antennal serration somewhat more evident (Fig. 10); elytral margins less parallel, rendering a somewhat more robust appearance; posterior margin of fifth visible ventrite broadly, shallowly, arcuately emarginate (Fig. 31); sixth visible ventrite subtriangular, lateral margins strongly oblique, almost confluent apically, posterior margin rather acuminate (Fig. 31); posterior margin of fifth tergite narrowly, moderately emarginate (Fig. 45); sixth tergite semicircular, lateral and posterior margins broadly rounded (Fig. 45); sixth tergite fully covering sixth visible ventrite. Pronotum and elytral ground color rather inconsistent in both sexes, ranging from testaceous to fuscous-brown. Midelytral fascia variably marked, almost imperceptible in some specimens. Some individuals possess an irregular, midelytral black band ranging in size from a complete fascia, to a pair of inconspicuous maculae on each side of elytra.



Figures 9–17. Antennae of: **9** *C. rosalinae* (male) **10** *C. rosalinae* (female) **11** *C. capax* (male) **12** *C. sinuosa* (male) **13** *C. vittata* (male) **14** *C. rubida* (male) **15** *C. limatula* (male) **16** *C. obliquefasciata* (male) **17** *B. oaxacae* (male).

Differential diagnosis. Distinguishable from congeners based on its size, antennal shape, midelytral marking, terminal abdominal segments and male genitalia. This species appears most similar to the allopatric species *Cymatodera obliquefasciata.* Color, form, elytral sculpturing, median pale fascia and serrate condition of antennae are characters shared by *C. rosalinae* (Fig. 1) and *C. obliquefasciata* (Fig. 7).

This new species can be separated from the latter based on the following respects: *C. rosalinae* has the antennomeres 2-4 slender, antennomeres 5-10 transversally robust in dorsal view and somewhat serrate (Fig. 9), due to sexual dimorphism, serrate condition of female specimens is somewhat more evident (Fig. 10), last antennomere internally sinuate, and humeral maculae absent. *C. obliquefasciata* has the antennomeres 1-3 slender, antennomeres 4-10 transversally slender in dorsal view and boldly serrate (Fig. 16), and humeral maculae variably marked to absent. In addition, the moderately incised and arcuately emarginate posterior margin of the sixth visible ventrite in male specimens of *C. rosalinae* (Fig. 24) is absent in males of *C. obliquefasciata* (Fig. 30). The female of *C. rosalinae* (Figs 31, 45) can be distinguished from females of *C. obliquefasciata* (Fig. 37, 50) by the distinctive shape of its abdominal terminalia.

Distribution. Known from the vicinity of the Chamela Biological Station, situated in the Chamela-Cuixmala region, on the western portion of Jalisco, Mexico.

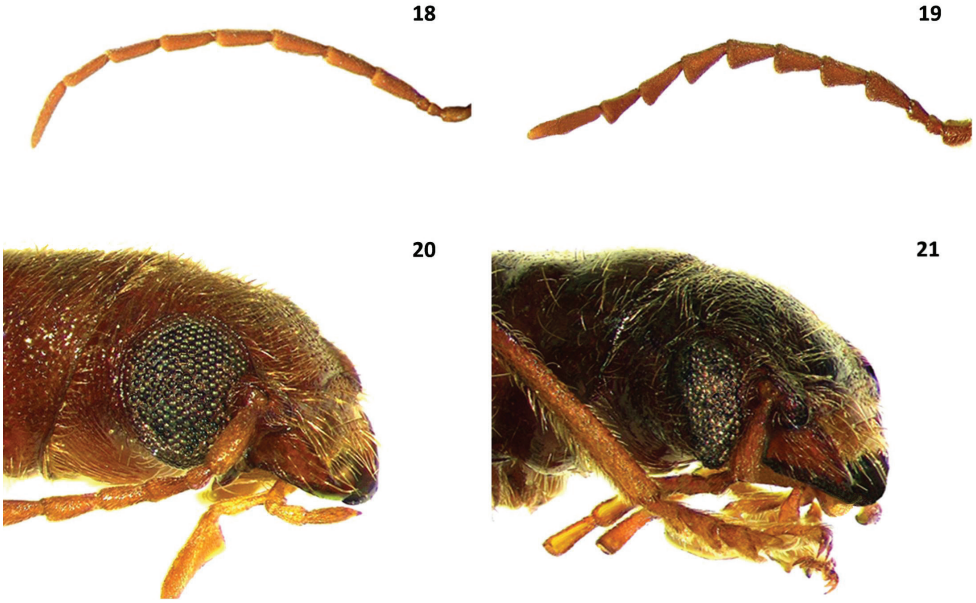
Etymology. I am very pleased to name this new species in honor of my mother, Rosalina Roco, a cornerstone in my life, and a person whose endless efforts have been of inspirational support during my professional career.

***Cymatodera capax* Burke, sp. n.**
urn:lsid:zoobank.org:act:195F1972-989D-4F78-A4FF-5197CBE754B9
http://species-id.net/wiki/Cymatodera_capax
Figs 2, 11, 25, 32, 39, 46, 53

Type material. Holotype: female, Costa Rica, Provincia de Guanacaste, Playa Naranjo, Parque Nacional Santa Rosa, 350 m, (10°50.94'N, 85°36.69'W), XII-1990, E. Alcázar, "INBIO CRI000486511", red handwritten label, holotype deposited in INBC. **Paratypes:** 8 males, 5 females. 4 males and 4 females: same data as holotype, except 1 female collected I-1991 (INBC, 3; RGCG, 1; JNRC, 2; KSUC, 2); 1 male: Costa Rica, Provincia de Guanacaste, Estación Las Pailas, Parque Nacional Rincón de la Vieja, 800 m, 18-XII-1993, F. A. Quesada (WOPC, 1); 1 male: Costa Rica, Provincia de Guanacaste, Estación Las Pailas, Parque Nacional Rincón de la Vieja, 10 to 27-III-1993, K. Taylor (WFBC, 1); 1 male: Costa Rica, Provincia Guanacaste, Sector Las Pailas, 800 m, (10° 47.38' N, 85°18.69' W), 16 to 30-III-1995, K. Taylor (USNM, 1); 1 female: Costa Rica, Provincia de Guanacaste, Estación Las Pailas, Parque Nacional Rincón de la Vieja, 800 m, 1-IV-1991, D. Fernández (CNIN, 1); 1 male: Costa Rica, Provincia Guanacaste, Las Pailas, Parque Nacional Rincón de la Vieja, 10 to 20-IV-1994, D. García (WOPC, 1).

Description. Size: TL= 11.3 mm, length of males 8.5 - 11.25 mm, length of female 10.5 - 11.5 mm, n= 14 (Fig. 2).

Color: head and pronotum dark brown; rest of the body uniformly brown. Each elytron with a post median, irregular, narrow, obliquely directed, black fascia that



Figures 18–21. Antennae and head in lateral view of: **18** *C. longicornis* (male) **19** *C. antennata* (male) **20** *C. rosalinae* **21** *C. sinuosa*.

extends from epipleuron to elytral suture, becoming somewhat paler near suture; this fascia is bordered anteriorly by an inconspicuous pale marking; ventrites 1-5 with a pair of irregular, testaceous maculae near sides.

Head: HL= 2.2 mm, HW 1.95 mm; length to width ratio: males average 1.14, females average 1.22; measured across eyes wider than pronotum; finely punctate; surface rugose; vested with short, recumbent setae intermixed with few long, semirecumbent setae that become more numerous toward epistoma. Eyes medium-sized, rather rounded, inconspicuously longer than wide, emarginate in front, somewhat bulging laterally, separated by approximately 3 eye-widths. Antennae extending to base of elytra; third antennomere 2.0 × the length of second

antennomere; fourth antennomere slightly shorter than third antennomere; antennomeres 4-10 subequal in length; antennomeres 2-4 subcylindrical; antennomere 5-10 gradually becoming serrate toward distal end; last antennomere irregularly elongate, sinuate internally, 1.5 × longer than tenth antennomere (Fig. 11).

Thorax: PL= 2.7 mm, PW= 1.9 mm; length to width ratio: males average 1.36, females average 1.44; anterior and posterior margins of pronotum as wide as middle; sides feebly constricted subapically; slightly more constricted behind middle; disc flat, inconspicuously impressed in front of middle; moderately, coarsely punctate; less densely punctate than head; surface rugose; vested with short, recumbent setae, intermixed with long erect setae; less densely clothed than head; subbasal tumescences moderately projected. Mesosternum clothed with long, recumbent setae; coarsely

punctate. Metasternum smooth, convex; rather puncticulate. Scutellum semicircular, covered with short, recumbent setae, posterior margin slightly notched.

Legs: somewhat covered with short and long semirecumbent setae that become more numerous on second half of tibiae; femora finely punctate, longitudinally rugose; tibiae coarsely punctate, transversely rugose.

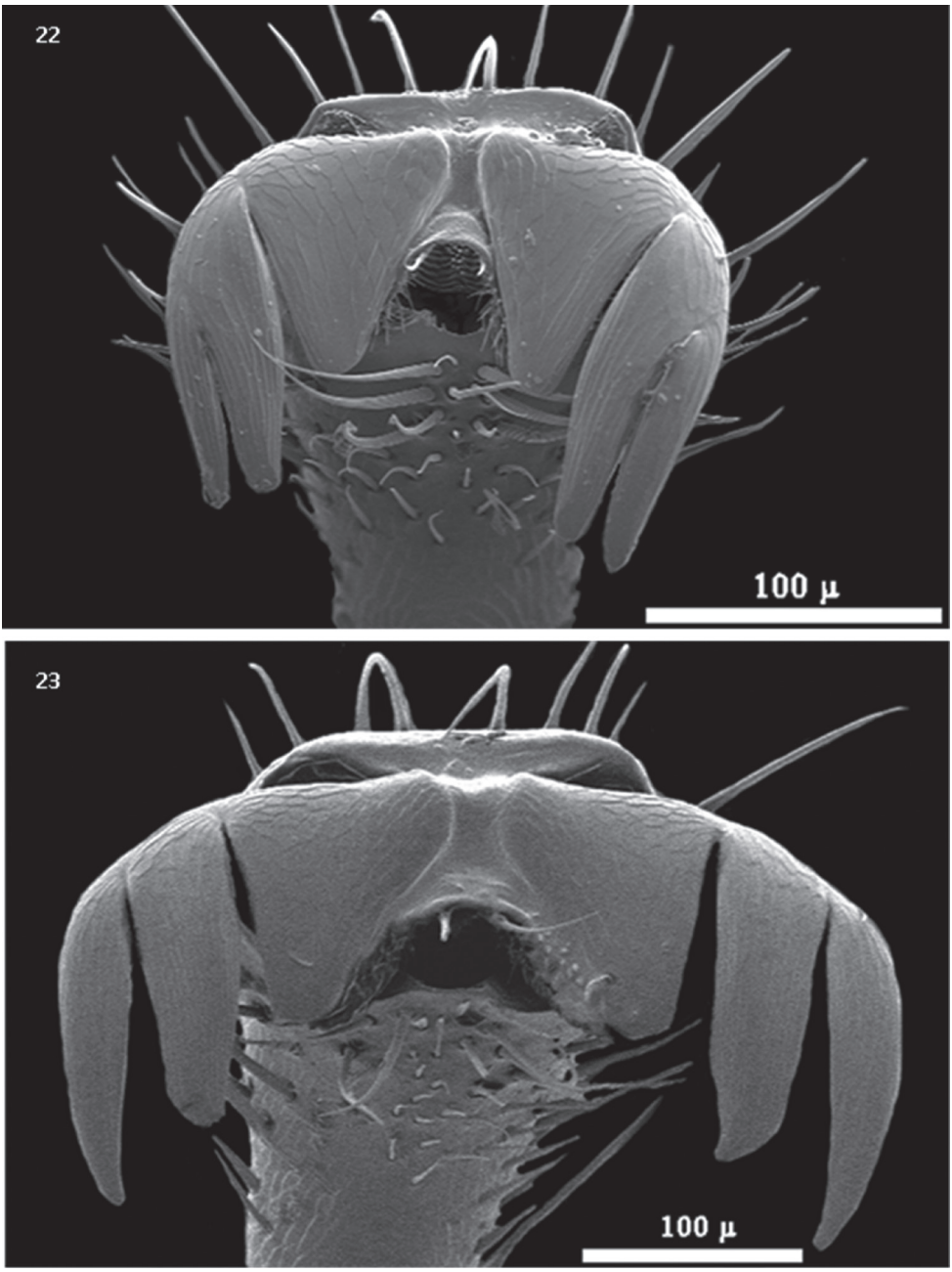
Elytra: EL= 6.2 mm, EW= 3.45 mm; length to width ratio: males average 1.61, females average 1.76; anterior margin bisinuate, broader than pronotum; humeri rounded; sides subparallel; widest behind middle; disc subflattened above; surface rugose; apices rounded, feebly dehiscent; clothed with short, semirecumbent setae intermingled with less densely, longer, erect setae; sculpturing consisting on coarse punctations arranged in striae that gradually reduce in size behind middle; interstices 3.0 × the width of punctation.

Abdomen: ventrites 1-5 rugulose; inconspicuously vested with short, recumbent setae; sparsely, finely punctate. Fifth visible ventrite convex; lateral margins oblique; posterior margin truncate (Fig. 32). Sixth visible ventrite semicircular; rugulose; broader than long; surface feebly convex; moderately, finely punctate; lateral and posterior margins broadly rounded (Fig 32).

Fifth tergite rugulose; surface convex; lateral margins oblique; posterior margin broadly, shallowly, arcuately emarginate; posterior angles rounded (Fig. 46). Sixth tergite subtriangular; broader than long; surface feebly convex; rugulose; moderately, finely punctate; lateral margins oblique; posterior margin broadly, semicircularly rounded (Fig. 46). Posterior margin extending slightly beyond apical projection of sixth visible ventrite. Aedeagus 1.85 mm long; conspicuously robust, ratio of length of parameres to whole tegmen 0.31: 1; parameres prominent, conspicuously pointed at apex, subtriangular; phallobase wide; phallus with copulatory piece tapered distally, phallic plate with a row of long, prominent denticles along dorsal margin; phallobasic apodeme and endophallic struts slender (Fig. 53).

Variation. Male specimens differ from females by having the posterior margin of the fifth visible ventrite broadly, shallowly, arcuately emarginate (Fig. 25); sixth visible ventrite subtriangular, rugulose, surface slightly convex, broader than long, lateral margins rather oblique, posterior margin broadly, shallowly, triangularly emarginated, hind angles arcuate (Fig. 25); posterior margin of fifth tergite broadly, shallowly emarginate (Fig. 39); sixth tergite subtriangular, rugulose, surface convex, as broad as long, lateral margins strongly oblique, posterior margin broadly rounded (Fig. 39); sixth tergite extending slightly beyond apical margin of sixth visible ventrite. Midelytral fascia variably marked in both sexes, ranging from strongly to feebly impressed. Leg color is also rather inconsistent, ranging from uniformly brown to bicolored.

Differential diagnosis. Separable from other *Cymatodera* species based on its shape, elytral marking, unique terminal abdominal segments and male genitalia (Fig. 53). Due to the serrate condition of the antennae (Fig. 11), general size, form, color and midelytral fascia, *Cymatodera capax* (Fig. 2) appears closest to the Mexican *Bogcia oaxacae* (Fig. 8). The new species can be distinguished from the latter based on ungual



Figures 22–23. Ungual structure of the protarsi of: **22** *B. oaxacae* **23** *C. obliquefasciata*.

differences of the protarsus. *C. capax* presents the claw of the protarsus conspicuously separated (Fig. 23) from the denticle, rather than closely approximated, as observed in *B. oaxacae* (Fig. 22).

Distribution. Known from two localities in the Guanacaste Province, Costa Rica: Playa Naranjo, adjacent to Santa Rosa, Guanacaste National Park; and Sector Las Pailas, Rincón de la Vieja National Park.

Etymology. The specific epithet comes from the Latin word capax (= wide), a noun that makes allusion to the overall robust appearance of this new species.

Cymatodera sinuosa **Burke, sp. n.**
urn:lsid:zoobank.org:act:D461C70D-9EA3-49C5-A270-65F53F19749F
http://species-id.net/wiki/Cymatodera_sinuosa
Figs 3, 12, 21, 26, 33, 40, 47, 54

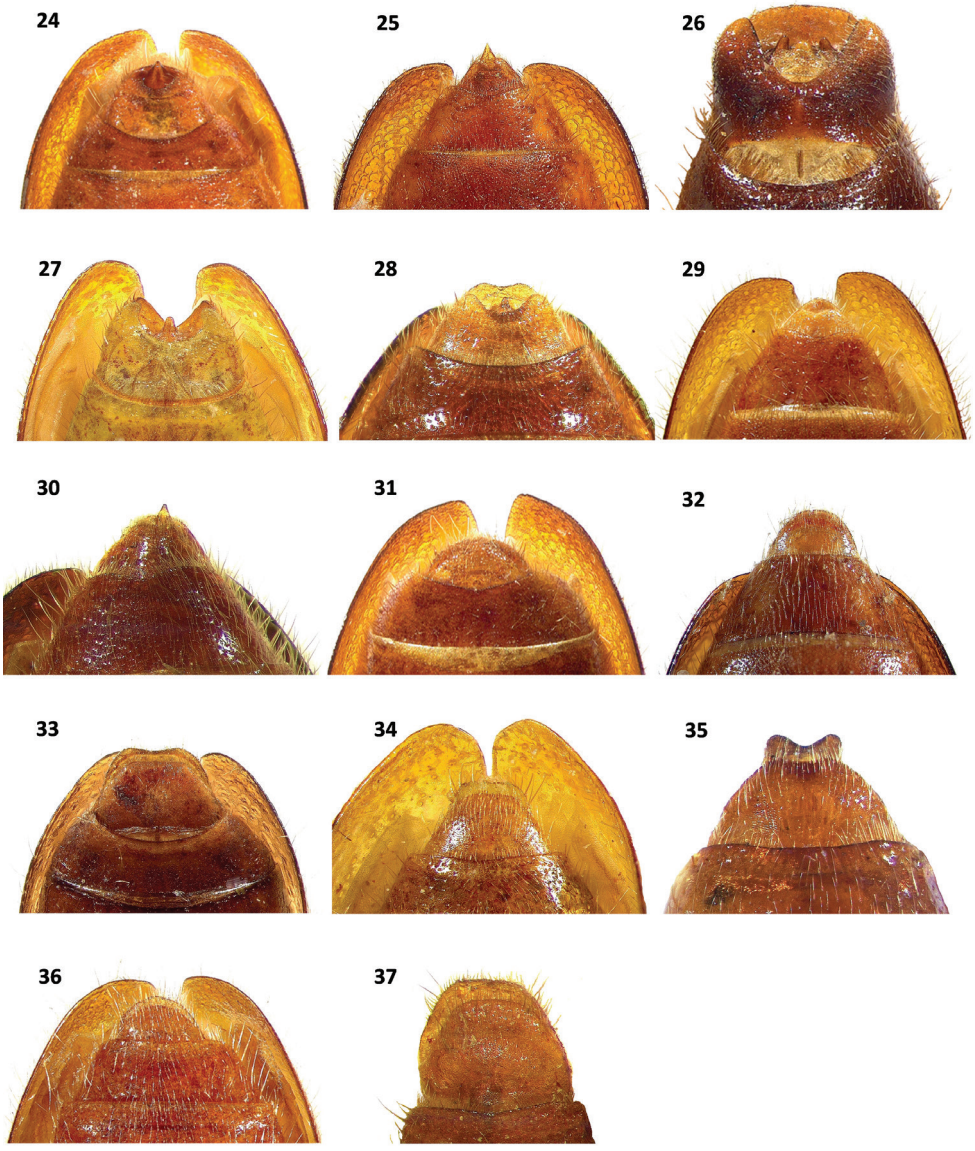
Type material. Holotype: female, Honduras, Olancho, Parque Nacional La Muralla, 1350 m, 1-VI-1995, R. H. Turnbow, red handwritten label, holotype deposited in USNM. **Paratypes:** 2 males, 4 females. 3 females: same data as holotype, except 1 female collected 24 to 27-V-1995 (KSUC, 1; RHTC, 2); 2 males (1 male dissected, body not recovered); 1 female: El Salvador, Departamento de San Salvador, El Boquerón, 22-VI-1959, L. J. Bechyne (INBC, 1; WOPC, 1).

Description. Size: TL= 10.4 mm, length of males 10.8 - 12.2 mm, length of females 7.75 - 10.5 mm, n = 7 (Fig. 3).

Color: head and pronotum fuscous; elytra, scutellum and legs brown, except posterior half of femora dark brown; antennae and mouthparts testaceous; abdomen, meso and metasternum light brown. Each elytron with three irregular, variably sinuate, pale fasciae; first on anterior fourth, slender, extending from elytral suture to epipleuron, surrounding scutellum; next fascia on second fourth, broader than preceding band, extending from elytral suture to epipleuron; third fascia on last fourth, slightly shorter and narrower than preceding fascia, extending from elytral suture to tenth stria, not reaching epipleuron.

Head: HL= 2.2 mm, HW= 1.95 mm; length to width ratio: males average 1.08, females average 1.17; measured across eyes wider than pronotum; densely, coarsely punctate; surface rugose; clothed with short, recumbent setae intermixed with long, erect setae; frons feebly bi-impressed. Eyes somewhat small, subsinuate, longer than wide, moderately emarginated in front, bulging laterally, separated by approximately 4 eye-widths (Fig. 21). Antennae slender; loosely composed; extending to basal sixth of elytra; antennomeres 2-3 subequal in length; fourth antennomere slightly longer than third antennomere; antennomeres 4-10 subequal in length; antennomeres 5-10 weakly serrate; last antennomere flattened apically (Fig. 12).

Thorax: PL= 2.5 mm, PW= 1.75 mm; length to width ratio: males average 1.45, females average 1.39; pronotum widest at middle, middle slightly broader than anterior margin; sides constricted subapically, more strongly constricted behind middle; disc flat, feebly impressed in front of middle; subbasal tumescences pronounced; surface rugose, moderately, finely punctate;



Figures 24–37. Terminalia in ventral view of: **24** *C. rosalinae* (male) **25** *C. capax* (male) **26** *C. sinuosa* (male) **27** *C. vittata* (male) **28** *C. rubida* (male) **29** *C. limatula* (male) **30** *C. obliquefasciata* (male) **31** *C. rosalinae* (female) **32** *C. capax* (female) **33** *C. sinuosa* (female) **34** *C. vittata* (female) **35** *C. rubida* (female) **36** *C. limatula* (female) **37** *C. obliquefasciata* (female).

less densely punctate than head; covered with short, recumbent setae interspaced with less numerous, long, erect and suberect setae. Mesosternum coarsely punctate. Metasternum convex; puncticulate; surface rugulose; median impression strongly indicated. Scutellum semicircular, covered with some short, recumbent setae.

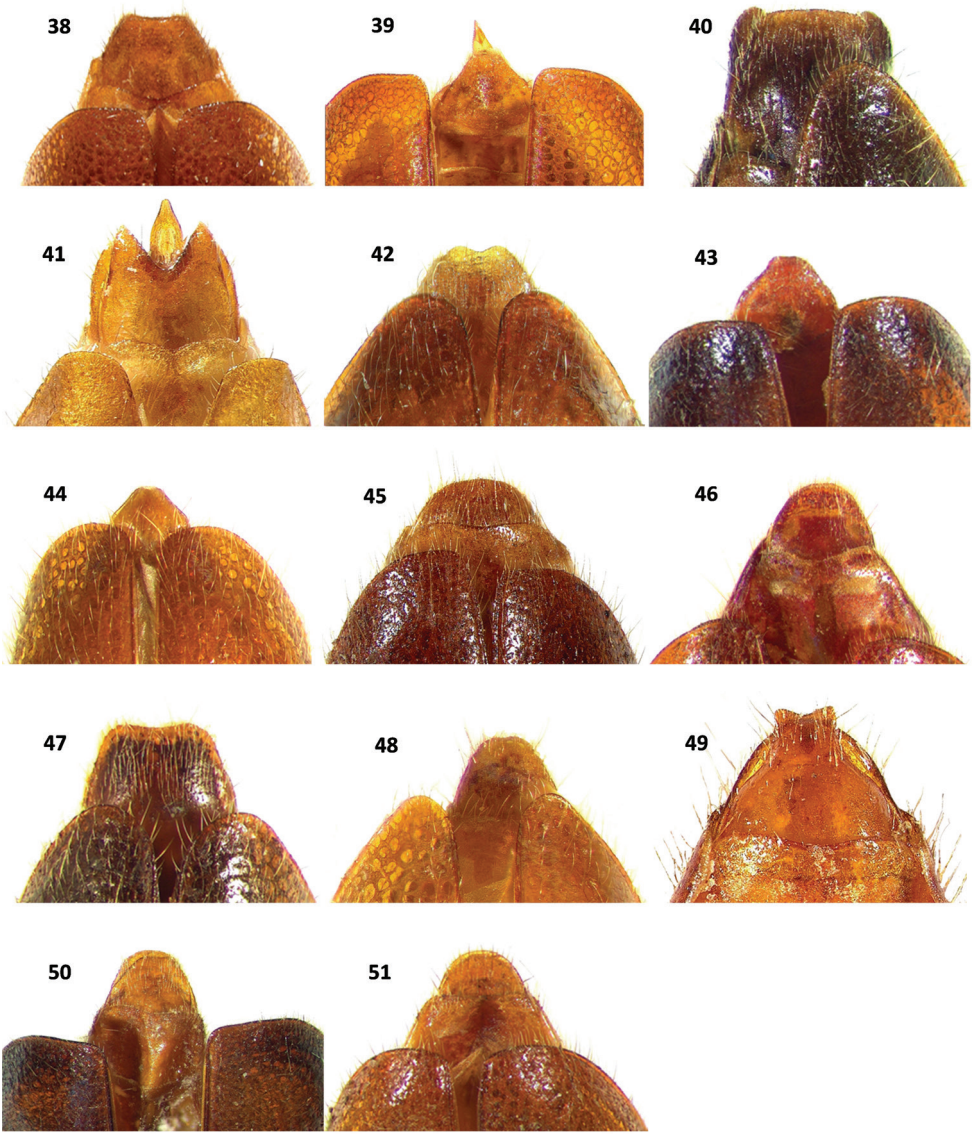
Legs: vested with short, recumbent setae intermixed with occasional long, suberect and erect setae that become more densely arranged on tibiae; femora rugulose; tibiae transversely rugose.

Elytra: EL= 5.5 mm, EW= 2.5 mm; length to width ratio: males average 2.26, females average 2.19; anterior margin arcuately emarginate, as wide as pronotum; humeri feebly indicated; sides subovoid, widest at second third; disc moderately flattened apically; apex broadly, separately rounded, dehiscent, covering sixth tergite; surface smooth, clothed with short, recumbent setae combined with less numerous, long, erect setae; sculpturing consisting on rather numerous, coarse punctations arranged in striae that abruptly reduce in size and become less numerous on last fourth; interstices about 2.0 × the width of punctation.

Abdomen: ventrites 1-5 rugose; each segment with a pair of large, shallow impressions near sides; somewhat clothed with short, fine, pale, recumbent setae; moderately, coarsely punctate. Fifth visible ventrite convex; lateral margins oblique; posterior margin broadly, deeply, arcuately emarginate (Fig. 33). Sixth visible ventrite subquadrate; rugulose; broader than long; surface convex; posterior half depressed at middle; puncticulate; lateral margins oblique; posterior margin truncate; hind angles rounded (Fig. 33). Fifth tergite rather convex; finely rugulose; lateral margins subparallel; posterior margin truncate. Sixth tergite subrectangular, broader than long; surface convex; rugulose; clothed with long, recumbent setae; scarcely, coarsely punctate; lateral margins oblique; posterior margin broadly, shallowly emarginate; hind angles arcuate (Fig. 47). Sixth tergite extending slightly beyond posterior margin of sixth visible ventrite. Aedeagus 2.0 mm long; ratio of length of paramere to whole tegmen 0.29: 1; parameres somewhat slender, elongate, subparallel, obtuse at apex, phallobase moderately broad; phallus with copulatory piece acuminated distally, phallic plate with numerous, long denticles along dorsal margin; phallobasic apodeme rather wide, not dilated distally; endophallic struts slender (Fig. 54).

Variation. Males have the fifth visible ventrite convex, rugose, moderately, coarsely punctate, lateral margins oblique, posterior margin broadly, deeply, arcuately emarginate (Fig. 26); sixth visible ventrite rectangular, surface convex, rugose, moderately, coarsely punctate, with a longitudinal, median depression that extends from middle to posterior margin, lateral margins parallel, becoming somewhat oblique on last third, posterior margin broadly, deeply, arcuately incised, strongly elevated before emargination, forming a conspicuous ridge bordering the area preceding the posterior margin, then abruptly descending toward emargination, hind

angles robust, strongly arcuate at apex (Fig. 26); fifth tergite punctate, rugulose, posterior margin broadly, shallowly, arcuately emarginate; sixth tergite rectangular, longer than broad, rugulose, surface convex, moderately, finely punctate, lateral margins subparallel, posterior margin shallowly emarginate, finely crenulate (Fig. 40). Elytral ground color is slightly variable in both sexes, ranging from brown to fuscous. Leg color ranges from bicolored to uniformly brown. Fasciae color is also rather inconsistent, ranging from stramineous to testaceous. One paratype female displays the posterior margin of fifth tergite broadly, shallowly, arcuately emarginated.



Figures 38–51. Terminalia in dorsal view of: **38** *C. rosalinae* (male) **39** *C. capax* (male) **40** *C. sinuosa* (male) **41** *C. vittata* (male) **42** *C. rubida* (male) **43** *C. obliquefasciata* (male) **44** *B. oaxacae* (male) **45** *C. rosalinae* (female) **46** *C. capax* (female) **47** *C. sinuosa* (female) **48** *C. vittata* (female) **49** *C. rubida* (female) **50** *C. obliquefasciata* (female) **51** *B. oaxacae* (female).

Differential diagnosis. This species recalls various *Cymatodera* members that are similar in color, fasciae pattern, body proportions and antennal *gestalt*. Among these, *Cymatodera sinuosa* is most similar to the Central American *Cymatodera parallela* Gorham, 1882 and the Mexican *Cymatodera grossa* Gorham, 1882. *C. sinuosa* can be separated from the former as follows: anterior margin of elytra as wide as pronotum

(wider in *C. parallela*); elytral margins conspicuously wide behind second half (somewhat subparallel in *C. parallela*); elytral apices (Fig. 3) broadly rounded and dehiscent (moderately rounded and feebly confluent in *C. parallela*); third antennomere (Fig. 12) as long as preceding antennomere (1.5 × the length of preceding antennomere in *C. parallela*). Furthermore, this new species is distinguishable from *C. grossa* based on its unique pronotal and elytral sculpturing. *C. sinuosa* has the pronotum finely, moderately punctate (coarsely, densely punctate, with punctations nearly confluent in *C. grossa*); pronotal disc conspicuously impressed in front of middle (flat in *C. grossa*); antescutelar impression strongly indicated (inconspicuously indicated in *C. grossa*); anterior half of elytral ground moderately punctate (densely punctate in *C. grossa*); interstices 2.0 × the width of punctation (less than the width of punctation in *C. grossa*). Likewise, the male of *C. sinuosa* can be distinguished from males of other species sharing similar fasciae pattern and remaining congeners, by the unique combination of elongated, deeply incised, posteriorly elevated, and abruptly descended emargination on the sixth visible ventrite (Fig. 26).

Distribution. The species is known from two localities: La Muralla National Park, situated in the department of Olancho, Honduras and El Boquerón National Park, in the Department of San Salvador, El Salvador.

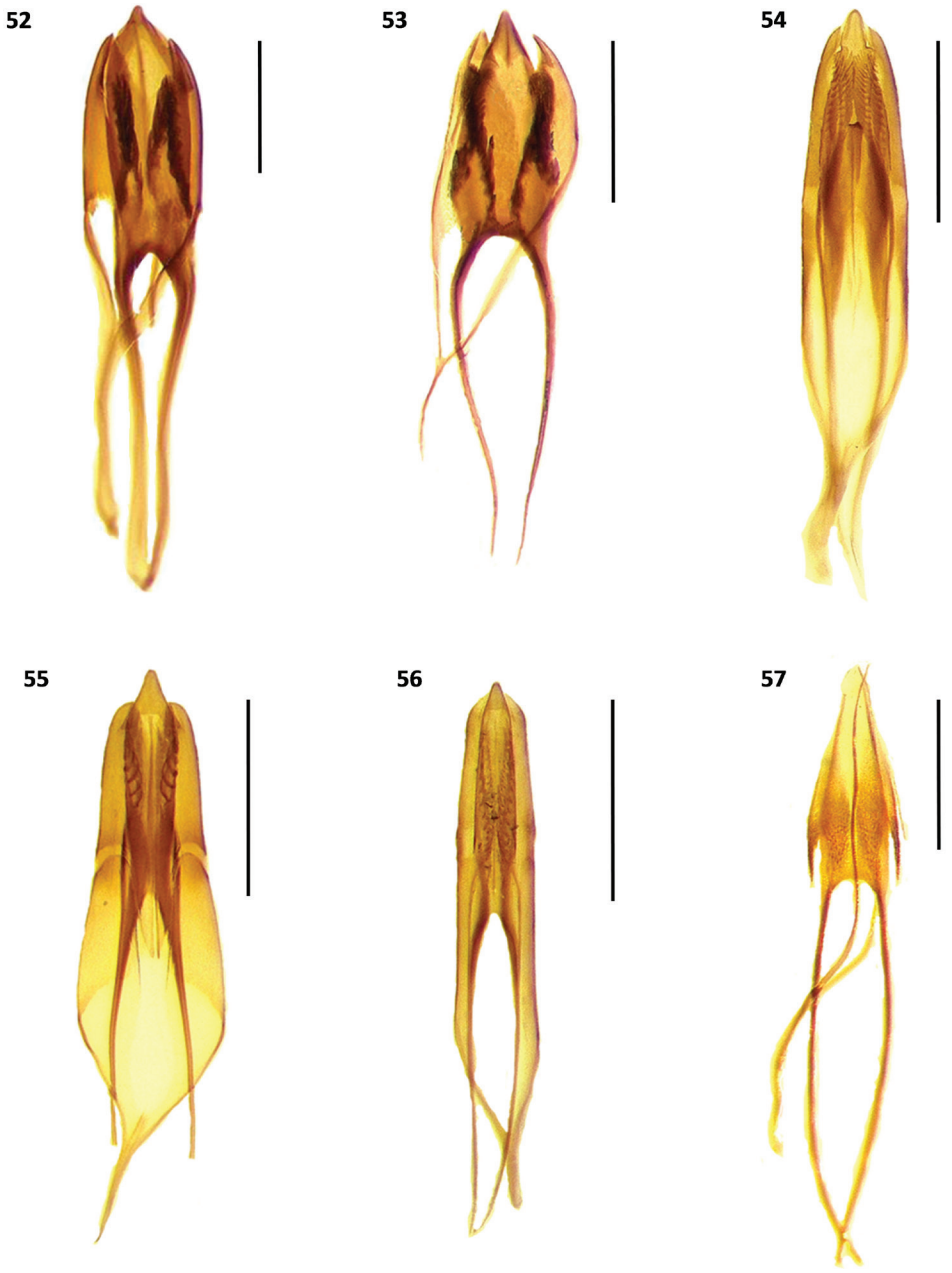
Etymology. The specific name comes from the Latin noun *sinuosa* (=sinuous), and refers to the winding character of the fasciae found on the elytral ground of this species.

***Cymatodera vittata* Burke, sp. n.**
urn:lsid:zoobank.org:act:7BC2D6CE-E909-4FB2-A162-5B7980ECA1F1
http://species-id.net/wiki/Cymatodera_vittata
Figs 4, 13, 27, 34, 41, 48, 55, 58

Type material. Holotype: male, Panamá, Provincia de Panamá, 8-10 km N El Llano, 24-V to 2- VI-1992, E. Giesbert, red handwritten label, holotype deposited in FSCA. **Paratypes:** 2 males, 6 females. 1 male: same data as holotype (USNM, 1); 2 females: Panamá, Provincia de Coclé, 4 km S El Valle, 2-VI-1981, E. Giesbert (KSUC, 1; JNRC, 1); 1 female: Panamá, Provincia de Coclé, 2 km W El Valle, 28-V-1981, E. Giesbert (JEWC, 1); 1 female: Panamá, Provincia de Coclé, Anton-El Valle, 880 m, 27-XII-1993, subtropical moist forest, beating vegetation, J. & E. Beierl (INBC, 1); 1 male: Panamá, Provincia de Panamá, El Llano-Carti, 9-I-1994, J. E. Wappes (JEWC, 1); 1 female: Panamá, Zona del Canal, 8 km NW Gamboa, (9°10.067'N, 79°45.017' W), 100 m, canopy fogging in *Luehea seemanni*, pyrethrin fog, 12-VII-1976, Montgomery and Lubin (WFBC, 1); 1 female: Panamá, Provincia de Panamá, Fuerte Kobbe, 20-I-1996, F. T. Hovore (WOPC, 1).

Description. Size: TL= 7.8 mm, length of males 7.5 to 9.2 mm, length of females 6.5–7.8 mm, n = 9 (Fig. 4).

Color: head fuscous-brown; pronotum, mouthparts, mesosternum, metasternum and abdomen testaceous; elytral ground predominantly testaceous except median re-



Figures 52–57. Male genitalia of: **52** *C. rosalinae* **53** *C. capax* **54** *C. sinuosa* **55** *C. vittata* **56** *C. rubida* **57** *C. limatula.* Scale bars = 500 μ.

gion pale-testaceous; legs mostly testaceous, except posterior half of femora brown. Each elytron with two pairs of black, irregularly marked maculae; the first adjacent to anterior margin, extending from second stria to humeral angle; the second located on

first half of second fourth, more faintly marked than preceding pair, extending from second to eighth stria; a long, irregular, transversally marked, black fascia located on third fourth, in the form of a vitta, extending from suture to epipleuron, covering about one fourth of elytral length.

Head: HL= 1.3 mm, HW= 1.25 mm; length to width ratio: males average 1.06, females average 1.12; measured across eyes wider than pronotum; densely, coarsely punctate; surface rugose; vested with short, semirecumbent setae interspaced with some long, erect setae. Eyes rather small, subsinuate, longer than wide, moderately emarginate in front, somewhat bulging laterally, separated by approximately 3.5 eye-widths. Antennae extending beyond basal sixth of elytra; antennomeres 2-3 subequal in length; fourth antennomere 1.5 × longer than preceding antennomere; antennomeres 4-5 subequal in length; sixth antennomeres slightly shorter than fifth antennomere; antennomeres 6-10 subequal in length; antennomeres 2-5 slender; antennomeres 6-10 weakly serrate; last antennomere 1.5 × longer than tenth antennomere, subsinuate, flattened apically (Fig.13).

Thorax: PL= 1.7 mm, PW= 1.2 mm; length to width ratio: males average 1.38, females average 1.46; pronotum widest at middle; sides constricted subapically, more strongly constricted behind middle; disc flat, rather impressed in front of middle; surface shiny; moderately, finely punctate; less densely punctate than head; somewhat covered with short, semirecumbent setae intermingled with long, erect setae; subbasal tumescences rather pronounced. Mesosternum moderately, coarsely punctate; vested with short, recumbent setae. Metasternum smooth; surface strongly convex, puncticulate laterally; median region with a sensory area consisting of rather dense, short, erect setae set on a rugose ground (Fig. 58). Scutellum semicircular; broader than long; clothed with short, recumbent setae.

Legs: covered with short, semirecumbent setae intermixed with some long, erect and suberect setae, vestiture become more densely arranged on distal half of tibiae; femora rugulose, feebly punctate; tibiae rugose, somewhat punctate.

Elytra: EL= 4.7 mm, EW= 1.85 mm; length to width ratio: males average 2.49, females average 2.38; anterior margin bisinuate, slightly broader than pronotum; sides subparallel; widest behind middle; base slightly wider than pronotum; humeri moderately indicated; disc subflattened above; apices rounded, dehiscent, covering sixth tergite; surface smooth, somewhat covered with short, erect and semierect setae interspaced with long, erect setae; sculpturing consisting of coarse, deep punctations arranged in striae that gradually reduce in size behind middle; interstices 2.0 × the width of punctation.

Abdomen: ventrites 1-5 rugulose; moderately, finely punctate; somewhat covered with short, recumbent setae combined with some long, erect setae. Fifth visible ventrite convex; lateral margins oblique; posterior margin broadly, deeply, arcuately emarginate (Fig. 27). Sixth visible ventrite slightly broader than long; surface concave, excavated, with a median carina initiating medially and reaching posterior margin, a pair of feebly pronounced anterolateral carinae extending from anterior margin to slightly beyond

median region, not reaching posterior margin; lateral margins subparallel on first half, becoming oblique on second half; posterior margin deeply, semicircularly emarginate; hind angles, produced posteriorly, acuminate at apex; (Fig. 27). Fifth tergite shiny; surface somewhat convex; lateral margins feebly oblique; posterior margin narrowly, shallowly, arcuately emarginate; hind angles broadly rounded (Fig. 41). Sixth tergite subrectangular; rugulose; longer than broad; surface convex; posterior half ventrally recurved; lateral margins subparallel, becoming feebly oblique on second half; posterior margin broadly, deeply incised, triangularly emarginate; hind angles produced posteriorly, acuminate, ventrally folded (Fig. 41). Lateral margins of sixth tergite extending beyond sixth visible ventrite. Aedeagus 1.55 mm long, rather robust; ratio of length of paramere to whole tegmen 0.37: 1; parameres well developed, broad, subtriangular; obtuse distally, phallobase conspicuously wide; phallus with copulatory piece acuminated at apex; phallic plate with a reduced number of long denticles along dorsal margin; phallobasic apodeme slender distally; endophallic struts slender (Fig. 55).

Variation. Females differ from male specimens as follows: antennomeres 5-10 weakly serrate, sixth visible ventrite subtriangular, lateral margins oblique, posterior margin broadly, very shallowly emarginate (Fig. 34); sixth tergite subtriangular, lateral margins oblique, posterior margin feebly notched, hind angles broadly rounded (Fig. 48). Additionally, female specimens lack the setiferous area found on the metasternal region of males (Fig. 58). Elytral ground color is rather variable in both sexes, ranging from flavous to ferrugineous. Maculae on anterior half of elytral ground irregularly impressed, ranging from strongly marked to absent. Posterior fascia color ranges from light brown to piceous. Leg color is also rather inconsistent, ranging from uniformly brown to bicolored. One male with anterolateral carinae of sixth visible ventrite more strongly pronounced. One male with surface of sixth ventrite feebly convex. Two females with posterior margin of sixth tergite truncate.

Differential diagnosis. Its distinct elytral ground color, slender form, shape of terminal abdominal segments and male genitalia will readily separate this species from congeners. *Cymatodera vittata* appears especially similar to *C. rubida*, a sympatric species described below. Differences in antennal shape (Figs 13, 14) serve to separate this new species from its closest congener. *C. vittata* has the fourth antennomere conspicuously longer than preceding antennomere (antennomeres 3-4 about the same length in *C. rubida*); antennomeres 5-10 are somewhat longer and extend beyond basal sixth of elytral ground (antennomeres 5-10 are slightly shorter in *C. rubida* and do not extend beyond basal sixth of elytral ground). Additionally, the distinctive metasternal sensory area found in the male of *C. vittata* is poorly developed in males of *C. rubida* (Figs 58, 59). Differences in terminalia (Figs 27, 28, 41, 42) and male genitalia (Figs 55, 56) also distinguish this new species from *C. rubida*.

Distribution. Known from three localities in Panamá: El Llano, Panamá Province; 4 km south of Gamboa, Colón Province; and 4 km south of El Valle, Coclé Province.

Etymology. The specific epithet comes from the Latin noun *vitta* (=band), and refers to the posterior fascia on the elytral ground of this new species.

***Cymatodera rubida* Burke, sp. n.**
urn:lsid:zoobank.org:act:398AFCAB-A1D8-49DD-8809-6B40230CED6F
http://species-id.net/wiki/Cymatodera_rubida
Figs 5, 14, 28, 35, 42, 49, 56, 59

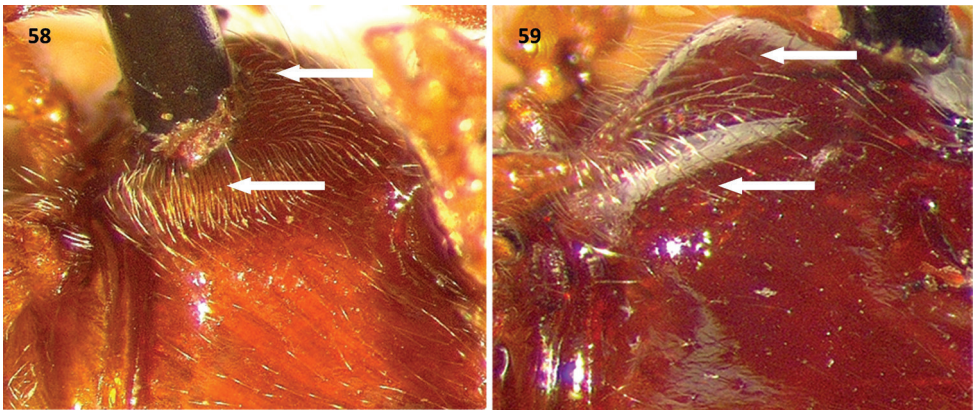
Type material. Holotype: male, Panamá, Zona del Canal, Fuerte Kobbe, 125 m, X-30-1980, H. Stockwell, red handwritten label, holotype deposited in INBC. **Paratypes:** 8 males, 4 females. 1 male and 2 females: Panamá, Provincia de Colón, 4.5 km NE Palenque, 25-II to 4-III-1992, E. Giesbert (USNM, 1; WFBM, 1; KSUC, 1); 1 male: Panamá, Provincia de Panamá, Cerro Azul, 14 to 25-I-1993, F. T. Hovore (KSUC, 1); 1 female: Panamá, Provincia de Panamá, km 8-11 carretera El Llano-Carti, 330 m, 24-V to 2-VI-1992, J. E. Wappes (JEWC, 1); 1 female: Panamá, Provincia de Panamá, 12 km NE El Llano, 23-I-1993, F. T. Hovore (FSCA, 1); 1 male: Panamá, Provincia de Panamá, Cerro Azul/Jefe, 17-I-1996, F. T. Hovore (JNRC, 1); 3 males: Panamá, Provincia de Panamá, NW of Tocumén, Cerro Azul, 12.8 km N C[arretera] Panamericana, 650 m, 18-XII-1993, tropical dry forest, J. & E. Beierl (JNRC, 2; WOPC, 1); 1 male: Panamá, Zona del Canal, 8 km NW Gamboa, (9°10.067'N, 79°45.017'W), 100 m, canopy fogging in *Luehea seemanni*, pyrethrin fog, 12-VII-1976, Montgomery and Lubin (USNM, 1); 1 male: Panamá, Provincia de Panamá, Ancón Hill, 22-II-1983, D. Yanega (SEMC, 1).

Description. Size: TL= 7.7 mm, length of males 7 - 9.2 mm, length of females 6.8 - 9.8 mm, n = 13 (Fig. 5).

Color: head, pronotum, prosternum, mesosternum, metasternum, and abdomen ferrugineous; elytral ground dark-testaceous; legs, antennae and mouthparts testaceous; sixth visible ventrite light brown, slightly lighter than remaining visible ventrites (Fig. 28). Each elytron with two irregular fasciae; first slender, brown, extending from elytral suture to humeral angle, surrounding scutellum; second fascia broad, fuscous, slightly darker than preceding band, in the form of a vitta, located on third fourth, extending from elytral suture to ninth stria, not reaching epipleuron, covering about one fourth of elytral length.

Head: HL= 1.2 mm, HW= 1.4 mm; length to width ratio: males average 0.91, females average 1.02; measured across eyes wider than pronotum; densely, moderately coarsely punctate; surface rugose; covered with short, recumbent setae intermixed with less abundant, long, erect setae that become more densely arranged behind eyes; frons moderately bi-impressed. Eyes rather small, subsinuate, longer than wide, feebly emarginate in front, somewhat bulging laterally, separated by approximately 3.5 eye-widths. Antennae extending to basal sixth of elytra; antennomeres 2-3 subequal in length; fourth antennomere inconspicuously longer than third antennomere; antennomeres 4-10 subequal in length; antennomeres 2-5 slender; antennomeres 6-10 weakly serrate; last antennomere subsinuate, flattened apically, about 1.5 × longer than tenth antennomere (Fig. 14).

Thorax: PL= 1.7 mm, PW= 1.2 mm; length to width ratio: males average 1.39, females average 1.33; pronotum widest at middle; sides constricted subapically, more constricted behind middle; surface somewhat rugose; disc flat, somewhat impressed in



Figures 58–59. Metasterna of: **58** *C. vittata* (male) and **59** *C. rubida* (male). Arrows indicating dense vestiture in *C. vittata*, moderately developed in *C. rubida*.

front of middle; moderately, finely punctate; less densely, deeply punctate than head; clothed with short, semirecumbent setae intermingled with long, erect setae; subbasal tumescences pronounced. Mesosternum rugulose, coarsely punctate. Metasternum rugose, moderately, coarsely punctate; somewhat clothed with short, recumbent setae; absence of sensory area (Fig. 59). Scutellum subquadrate; broader than long; covered with short, recumbent setae.

Legs: vested with short, recumbent setae, intermixed with longer semierect setae, vestiture becomes more abundant on internal face of tibiae; femora rugulose, finely punctate; tibiae rugose, moderately, coarsely punctate.

Elytra: EL= 4.5 mm, EW= 2.0 mm; length to width ratio: males average 2.18, females average 2.12; anterior margin bisinuate, slightly broader than pronotum; sides subparallel, inconspicuously wider behind middle; humeri moderately indicated; apices rounded, dehiscent; covering sixth tergite; surface shiny, vested with short, recumbent setae interspaced with some long, erect setae; sculpturing consisting of coarse, deep punctations arranged in striae that gradually reduce in size behind middle; interstices smooth, 2.0 × the width of punctuation.

Abdomen: ventrites 1-4 moderately, finely punctate; smooth; somewhat vested with fine, short, recumbent setae interspaced with few long, erect setae; hind margins truncate. Fifth visible ventrite smooth; surface convex; lateral margins oblique; posterior margin broadly, deeply, arcuately emarginate (Fig. 28). Sixth visible ventrite subquadrate; broader than long; surface slightly convex; rugose; moderately, finely punctate, less densely punctate than preceding ventrite; lateral margins oblique; posterior margin broadly, deeply, arcuately emarginate; hind angles arcuate (Fig 28). Fifth tergite rugulose; surface convex; puncticulate; lateral margins feebly oblique; posterior margin shallowly, broadly, arcuately emarginate. Sixth tergite subtriangular; surface convex; rugulose; broader than long; lateral margins oblique; posterior margin rounded, with a median, shallow, broad, triangular emargination; hind angles rounded (Fig. 42). Posterior margin of sixth tergite extending slightly beyond apical margin of sixth visible ventrite. Aedeagus 1.4 mm long,

slender; ratio of length of paramere to whole tegmen 0.39: 1; parameres narrow, parallel, obtuse distally; phallus with copulatory piece somewhat tapered at apex; phallic plate with numerous fine, small denticles along dorsal margin; phallobasic apodeme rather broad, not dilated distally; endophallic struts slender (Fig. 56).

Variation. Female specimens have the sixth visible ventrite subquadrate, rugulose, surface strongly convex, lateral margins oblique, posterior margin truncate (Fig. 35); sixth tergite campanulate, rugulose, surface convex, lateral margins oblique, becoming parallel on last third, then abruptly expanding before apex, posterior margin broadly, deeply notched (Fig. 49); posterior margin of sixth tergite extending beyond apical margin of sixth visible ventrite, posterolateral margins of sixth visible ventrite projecting laterally beyond sixth tergite (Figs 35, 49). Elytral marking on anterior half ranges from strongly impressed to absent. Posterior fasciae color is also rather variable, ranging from light brown to piceous. Leg color ranges from uniformly brown to bicolored. One male with posterior margin of sixth ventrite slightly less incised than remaining male specimens in the type series.

Differential diagnosis. *Cymatodera rubida* is separable from congeners based on its size, shape, elytral markings, terminal abdominal segments and male genitalia. Most similar to *C. vittata*, but differs from this by having the fourth antennomere about the same size as third antennomere (Fig. 14), rather than 1.5 × longer (Fig. 13). Unlike *C. vittata*, antennomeres 5-10 of *C. rubida* are rather short; hence, antennae do not extend beyond basal sixth of elytral ground. Furthermore, male specimens of *C. rubida* do not display the moderately dense vestiture found on the metasternal area of males of *C. vittata* (Figs 58–59). Conspicuous differences in terminal abdominal segments (Figs 27, 28, 41, 42) and male genitalia (Fig. 55, 56) also distinguish this new species from *C. vittata*.

Distribution. Known from five localities in Panamá: the Canal Zone, 5 km south of Gamboa; Fuerte Kobbe; the mountainous region of Cerro Azul; the surroundings of Palenque; and El Llano-Carti road, 12 km north of El Llano.

Etymology. The specific epithet comes from the Latin noun *rubida* (=red), this adjective indicates the general reddish color of this new species.

Cymatodera limatula Burke, sp. n.

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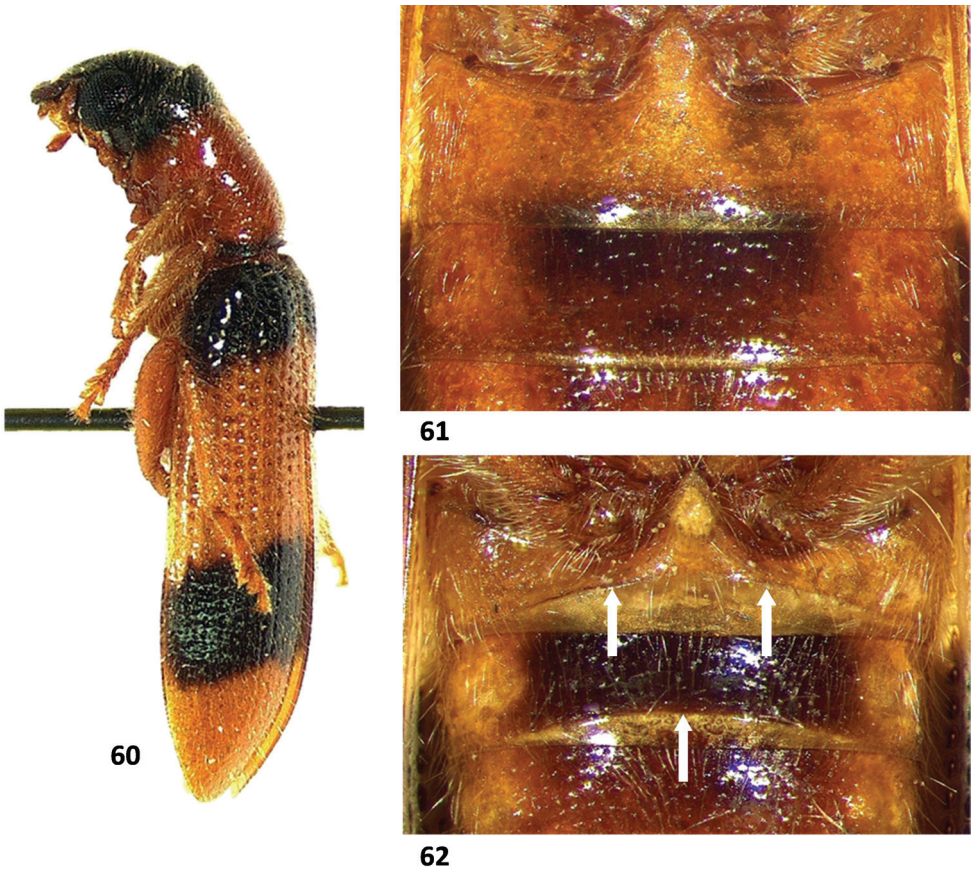
http://species-id.net/wiki/Cymatodera_limatula
Figs 6, 15, 29, 36, 57, 60, 61, 62

Type material. Holotype: male, México, Chiapas, El Aguacero, 680 m, at light, 17-VI-1990, R. A. Cunningham, red handwritten label, holotype deposited in CNIN. **Paratypes:** 2 males, 1 female. 1 male: same data as holotype (JNRC, 1); 1 female: México, Chiapas, El Chorreadero, 10 km W Chiapa de Corzo, 24-VI-1987, E. Giesbert (USNM, 1); 1 male: México, Chiapas, C[arretera] 190, 17 km W Tuxtla Gutierrez, Alt. 1000 m, 21 to 25-VI-1987, E. Giesbert (KSUC, 1).



Figures 60–62. *Cymatodera limatula*: **60** Lateral view **61** First and second visible ventrites of female **62** First and second visible ventrites of male, arrows indicating transverse carinae.

Description. TL= 9.8 mm, length of males 10.2–11 mm, length of female 9.4 mm, n = 4 (Fig. 6).

Color: head predominantly black (Fig. 60), except gula and submentum ferrugineous; pronotum and mesosternum light ferrugineous; elytra, metasternum, legs, mouthparts and antennae testaceous; abdomen testaceous, except sixth visible ventrite pale testaceous (Fig. 29), and median region of ventrites 2-3 irregularly fuscous (Fig. 62); vestiture uniformly pale; a transversally directed, black fascia on anterior margin of pronotum covering about one fifth of pronotal disc, and two irregular, small, black maculae located on lateral area of pronotum adjacent to posterior margin. Each elytron with two broad, somewhat irregular, transversally directed, black fasciae extending from suture to epipleuron; first located on humeral region, covering about one sixth of elytral ground; second behind middle, somewhat longer than preceding band, covering approximately one fifth of elytral ground.

Head: HL= 1.3 mm, HW= 1.5 mm; length to width ratio: males average 0.92, female 0.86; measured across eyes wider than pronotum; surface rugose; frons feebly bi-impressed; moderately, rather coarsely punctate; clothed with short, recumbent setae intermixed with some long, semierect and erect setae. Eyes medium-sized, rather rounded, inconspicuously longer than wide, feebly emarginate in front, somewhat bulging laterally, separated by approximately 3 eye-widths. Antennae reaching humeral angles; antennomeres 2-3 subcylindrical, slender; antennomeres 4-10 strongly serrate, longer than broad; third antennomere somewhat longer than second antennomere; fifth antennomere slightly shorter than fourth antennomere; antennomeres 5-10 subequal in length; last antennomere 2.5 × longer than tenth antennomere (Fig. 15).

Thorax: PL= 2.1 mm, PW= 1.15 mm; length to width ratio: males average 1.85, female 1.75; pronotum rugose; widest at middle; middle slightly wider than front margin; sides constricted subapically, more strongly constricted behind middle; disc flat, feebly impressed in front of middle; subbasal tumescence pronounced; vested with short and long semirecumbent setae interspaced with some erect setae; surface moderately, finely punctate. Mesosternum rugose; moderately, coarsely punctate; somewhat clothed with long, semirecumbent setae.

Metasternum shiny; surface convex, puncticulate; covered with long, semirecumbent setae. Scutellum subquadrate; wider than long; notched medially.

Legs: clothed with long, erect setae and some short, recumbent setae that become more abundant on posterior half of tibiae; femora shiny, finely, indistinctly punctate, transversely rugose; tibiae coarsely, densely punctate, longitudinally rugose.

Elytra: EL= 6.1 mm, EW= 2.8 mm; length to width ratio: males average 2.15, female 2.18; anterior margin bisinuate, wider than pronotum; disc smooth, flattened above; humeri indicated; sides subparallel, widest on third fourth; apices weakly dehiscent, rounded, covering sixth tergite; elytral declivity somewhat procurved, clothed with short, semirecumbent setae intermingled with long, erect, less densely arranged setae; sculpturing consisting of coarse punctations arranged in striae that gradually reduce in size behind middle; interstices smooth, about 1.5 × the width of punctation.

Abdomen: ventrites 1-5 rugose; moderately, coarsely punctate; somewhat clothed with short, recumbent setae interspaced with some long, erect setae. First visible ventrite strongly convex; posterior margin elevated, with a transverse carina that initiates next to hind angles and produces a broad, deep, arcuate emargination (Fig. 62). Second visible ventrite rather convex; posterior margin elevated, moderately, arcuately emarginate (Fig. 62). Ventrites 3-4 feebly convex; hind margins truncate. Fifth visible ventrite somewhat convex; lateral margins oblique; posterior margin broadly, rather deeply, arcuately emarginate; hind angles narrowly rounded (Fig. 29). Sixth visible ventrite subquadrate; rugulose; surface feebly convex; broader than long; puncticulate; second half with a median tumescence; lateral margins oblique; posterior margin broadly, shallowly, triangularly emarginate; hind angles rounded (Fig. 29). Fifth tergite rugulose; surface weakly convex; finely punctate; posterior margin narrowly, shallowly, arcuately emarginate. Sixth tergite subtriangular; rugulose; surface somewhat convex; moderately punctate; lateral margins strongly oblique, narrowing apically, producing a

constricted, rather acuminate posterior margin. Sixth tergite extending slightly beyond the apical margin of sixth visible ventrite. Aedeagus 1.85 mm long, rather slender; ratio of length of paramere to whole tegmen 0.28: 1; parameres feebly developed, pointed at apex, phallobase wide; phallus with copulatory piece acuminated distally, phallic plate without an internal row of denticles at dorsal margin, with fine granular structures on posterior area; phallobasic apodeme and endophallic struts elongate, slender (Fig. 57).

Variation. The only female in the type series differs from the male by having the first visible ventrite moderately longer and the posterior margin of ventrites 1-2 truncate (Fig. 61). Moreover, abdominal differences are as follows: fifth visible ventrite rugose, lateral margins oblique, posterior margin truncate (Fig. 36); sixth visible ventrite rugulose, semicircular, surface feebly convex, broader than long, lateral and posterior margins broadly rounded (Fig. 36); fifth tergite rugulose, lateral margins oblique, posterior margin truncate; sixth tergite rugulose, broader than long, surface inconspicuously convex, lateral and posterior margins strongly oblique, slightly acuminate posteriorly, almost semicircular. Posterior margin of sixth tergite extending slightly beyond sixth visible ventrite. One male paratype does not possess the irregular, small, black maculae located on the posterolateral area of pronotum.

Differential diagnosis. The distinctive coloration and elytral markings of this species will serve to separate it from congeners. No other species in the *Cymatodera* group has the distinctive piceus fasciae on the pronotum and elytral ground, and the predominantly black color on the head (Figs 6, 60). In addition, shape of terminal abdominal segments (Figs 29, 36), strongly serrate condition of antennomeres 4-10, shape of last antennomere (Fig. 17), and male genitalia (Fig. 57) are characters that serve to separate *C. limatula* from remaining *Cymatodera* species.

Distribution. This species is known from three localities in the state of Chiapas, Mexico: El Aguacero, in the periphery of Tuxtla Gutierrez; El Chorreadero, 8 km northeast of Chiapa de Corzo; and on highway 190, 17 km west of Tuxtla Gutierrez.

Etymology. The specific epithet comes from the Latin noun *limatula* (=distinctive), and makes allusion to the characteristic color pattern of this new species.

Cymatodera obliquefasciata Schaeffer 1904

http://species-id.net/wiki/Cymatodera_obliquefasciata
Figs 7, 16, 23, 30, 37, 43, 50

Cymatodera obliquefasciata Schaeffer 1904. 215. TX: Esperanza Ranch, Brownsville [Cameron Co.]; TX. Lectotype designated by Chapin, 1949: 8. (Lecotype deposited in: USNM; sex of lectotype: male).

Material examined. (5 males, 2 females). 2 males: Texas, Hidalgo Co., Bentsen Rio Grande State Park, 16-VI-1974, G. H. Nelsen (FSCA); 3 males and 1 females: USA, Texas, Hidalgo Co., LRGVNWR, MacManus unit, (26°3.228'N, 98°2.9922'W), 5-V-1994, UV light in ebony-guayacan association, J. King and E. Riley (TAMU); 1 fe-

male: USA, Texas, Cameron Co. Sabal Palm Grove Reservation site 1, (25°50.8794'N, 97°25.1286'W), UV light in palm forest, J. King and E. Riley (TAMU).

Diagnosis. *C. obliquefasciata* can be distinguished from *C. rosalinae* based on antennal differences. *C. obliquefasciata* presents the antennomeres 1-3 slender and the antennomeres 4-10 strongly serrate (Fig. 16). Conversely, *C. rosalinae* has the antennomeres 2–5 slender and the anntenomeres 5–10 feebly serrate in males (Fig. 9) and moderately serrate in females (Fig. 10). Differences in male (Figs 24, 30) and female (Figs 31, 37) terminalia also serve to readily separate these species.

Distribution. *C. obliquefasciata* is known from Texas (Opitz, 2010; Wolcott, 1947) and New Mexico (Wolcott, 1947). Barr, in his most recent catalogue (1999, unpublished), points out that the geographical distribution of this species extends southward into north Mexico, yet, no material from Mexico was examined.

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The *Tetramorium tortuosum* species group (Hymenoptera, Formicidae, Myrmicinae) revisited - taxonomic revision of the Afrotropical *T. capillosum* species complex

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Abstract

In this study we revise the taxonomy of the *Tetramorium tortuosum* species group members encountered in the Afrotropical region, which we have placed in its own subgroup: the *T. capillosum* species complex. We re-describe the two previously known species *T. capillosum* Bolton and *T. tabarum* Bolton, and describe the new species *T. hecate* **sp. n.** The geographic distribution of the three species appears to be restricted to the equatorial rainforests of Central Africa. We provide a diagnosis of the *T. capillosum* species complex, an illustrated identification key to species level, and worker-based species descriptions, which include diagnoses, discussions, high-quality montage images, and distribution maps. Furthermore, we discuss biogeography and composition of the globally distributed *T. tortuosum* group.

Keywords

Afrotropical region, Central Africa, equatorial rainforests, taxonomy, Tetramoriini, *Tetramorium*, *T. capillosum* species complex, *T. tortuosum* species group

Introduction

With approximately 500 valid species (Bolton 2012, Hita Garcia and Fisher 2012a, 2012b), the genus *Tetramorium* Mayr represents one of the most species-rich ant genera, a group that is also widely distributed throughout most zoogeographical regions. However, in terms of species and species group numbers, the main diversity of the genus is found in the Afrotropical and Malagasy regions, from where around 220 Afrotropical and 84 Malagasy species are currently known (Bolton 1976, 1979, 1980, 1985, Hita Garcia et al. 2010a, Hita Garcia et al. 2010b, 2010c, Hita Garcia and Fisher 2011, 2012a, 2012b). The majority of the remaining described species diversity (ca. 190 species) is distributed in the Palaearctic, Oriental, and Indo-Australian regions. By contrast, the *Tetramorium* fauna of the New World is rather depauperate with only seven native species (Bolton 1977, Marques et al. 2011, Vásquez-Bolaños 2007, Vásquez-Bolaños et al. 2011).

Despite its large number of species, wide distribution, and relatively high abundance in many regions, the taxonomy of the genus is in a moderately good condition, mainly due to Bolton's (1976, 1977, 1979, 1980, 1985) revisionary studies. Of special importance was his treatment of the tribe Tetramoriini (Bolton 1976), in which he recognised the genera *Atopula* Emery, *Macromischoides* Wheeler, *Tetrogmus* Roger, and *Xiphomyrmex* Forel to be junior synonyms of *Tetramorium*, as well as the later synonymisation of *Triglyphothrix* Forel under *Tetramorium* (Bolton 1985). These studies clearly defined the genus *Tetramorium* and separated it from the other genera in the tribe. Prior to Bolton's work, the definitions of the tribe and its constituent genera were relatively vague and changed regularly depending on whether authorities treated the tribe partly or in its entirety (Bolton 1976). However, most modern ant sampling projects in the Afrotropical region (Belshaw and Bolton 1993, 1994, Braet and Taylor 2008, Deblauwe and Dekoninck 2007, Dejean et al. 2000, Fisher 2004, Hita Garcia et al. 2009, Jackson 1984, Robertson 1999, 2002, Watt et al. 2002, Yanoviak et al. 2007, Yeo et al. 2011) have been carried out in the decades after Bolton's studies. These surveys yielded much new material that resists identification using the keys of Bolton (1976, 1980). Consequently, despite having a good taxonomic foundation, most Afrotropical species groups would benefit from updated taxonomic revisions that incorporate material generated after 1980. Recently, this was done for the relatively species-rich *T. weitzeckeri* species group (Hita Garcia et al. 2010b, 2010c), but all other groups still await taxonomic treatments.

The *T. tortuosum* species group is distributed throughout the Old and New World tropics and subtropics, and with currently 50 species is one of the most species-rich groups within the genus (Bolton 1977, 1979, 1980, Marques et al. 2011, Vásquez-Bolaños 2007, Vásquez-Bolaños et al. 2011). As noted above, the New World has only seven native species all belonging to the *T. tortuosum* group (Bolton 1977, Marques et al. 2011, Vásquez-Bolaños 2007, Vásquez-Bolaños et al. 2011). The group is also well-represented in the Oriental and Indo-Australian regions with eight and ten species respectively (Bolton 1977, Sheela and Narendran 1998). Interestingly, the group attains its highest species richness in the Malagasy region, where 22 species are known

(Hita Garcia and Fisher 2012b). Despite having the highest diversity of species and species groups within the genus *Tetramorium*, the Afrotropical region harbours only three *T. tortuosum* group species, which seems very low compared to the other regions as already noted by Bolton (1980).

The taxonomic foundation for the species group is in relatively good condition. The species from the Oriental and Indo-Australian regions were revised by Bolton (1977) and his keys still work relatively well, although it is not unlikely that they might have to be updated in future revisions of the regions that incorporate material sampled after 1977. The seven New World species can be identified with the latest key from Vásquez-Bolaños et al. (2011), and Hita Garcia and Fisher (2012b) provide identification keys for the species-rich Malagasy fauna in their recent revision. In this study we revise the taxonomy of the *T. tortuosum* group species encountered in the Afrotropical region, which we have placed in its own subgroup: the *T. capillosum* species complex. We describe the two previously known species, *T. capillosum* Bolton and *T. tabarum* Bolton, and describe *T. hecate* sp. n. as new species. All descriptions include high-quality montage images and distribution maps. Furthermore, an illustrated identification key for the Afrotropical region is provided, and the biogeography and composition of the *T. tortuosum* species group is discussed.

Abbreviations of depositories

The collection abbreviations follow Bolton (1980) and Evenhuis (2009). The material upon which this study is based is located and/or was examined at the following institutions:

BMNH The Natural History Museum (British Museum, Natural History), London, U.K.
CASC California Academy of Sciences, San Francisco, California, U.S.A.
MCZ Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A.
MHNG Muséum d'Histoire Naturelle de la Ville de Genève, Geneva, Switzerland
NHMB Naturhistorisches Museum, Basel, Switzerland

Material and methods

The material examined in this study is located in the collections of BMNH, CASC, and MCZ. More than 95% of the specimens examined belong to CASC and were sampled during ant inventories carried out in Central Africa from 1998 to 2001 (Fisher 2004, B.L.F., unpublished data), whereas the type series of *T. capillosum* and *T. tabarum*, together with a small amount of non-type specimens, are found in BMNH and MHNG.

All new type material and all imaged specimens can be uniquely identified with specimen-level codes affixed to each pin (e.g. CASENT0078328). In the presented descriptions we list all of the available specimen-level codes for the whole type series. It should be

noted, however, that the number of stated paratype workers does not necessarily match the number of listed specimen-level codes because pins can sometimes hold more than one specimen. Digital colour images were created using a Leica DFC 425 camera in combination with the Leica Application Suite software (version 3.8). All images presented are available online and can be seen on AntWeb (http://www.antweb.org). The measurements were taken with a Leica MZ 12.5 equipped with an orthogonal pair of micrometers at a magnification of 100×, rarely 80×. Measurements and indices are presented as minimum and maximum values with arithmetic means in parentheses. In addition, all measurements are expressed in mm to two decimal places. The measurements and indices used in this study are the same as in Hita Garcia and Fisher (2011, 2012a, 2012b):

Head length (HL): maximum distance from the mid-point of the anterior clypeal margin to the mid-point of the posterior margin of head, measured in full-face view. Impressions on anterior clypeal margin and posterior head margin reduce head length.

Head width (HW): width of head directly behind the eyes measured in full-face view.

Scape length (SL): maximum scape length excluding basal condyle and neck.

Eye length (EL): maximum diameter of compound eye measured in oblique lateral view.

Pronotal width (PW): maximum width of pronotum measured in dorsal view.

Weber's length (WL): diagonal length of mesosoma in lateral view from the postero-ventral margin of propodeal lobe to the anterior-most point of pronotal slope, excluding the neck.

Propodeal spine length (PSL): the tip of the measured spine, its base, and the centre of the propodeal concavity between the spines must all be in focus. Using a dual-axis micrometer the spine length is measured from the tip of the spine to a virtual point at its base where the spine axis meets orthogonally with a line leading to the median point of the concavity.

Petiolar node height (PTH): maximum height of petiolar node measured in lateral view from the highest (median) point of the node to the ventral outline. The measuring line is placed at an orthogonal angle to the ventral outline of the node.

Petiolar node length (PTL): maximum length of the dorsal face of the petiolar node from the anterodorsal to the posterodorsal angle, measured in dorsal view excluding the peduncle.

Petiolar node width (PTW): maximum width of dorsal face of petiolar node measured in dorsal view.

Postpetiole height (PPH): maximum height of the postpetiole measured in lateral view from the highest (median) point of the node to the ventral outline. The measuring line is placed at an orthogonal angle to the ventral outline of the node.

Postpetiole length (PPL): maximum length of postpetiole measured in dorsal view.

Postpetiole width (PPW): maximum width of postpetiole measured in dorsal view.

Ocular index (OI): EL / HW * 100

Cephalic index (CI): HW / HL * 100

Scape index (SI): SL / HW * 100

Propodeal spine index (PSLI): PSL / HL * 100

Petiolar node index (PeNI): PTW / PW * 100
Lateral petiole index (LPeI): PTL / PTH * 100
Dorsal petiole index (DPeI): PTW / PTL * 100
Postpetiolar node index (PpNI): PPW / PW * 100
Lateral postpetiole index (LPpI): PPL / PPH * 100
Dorsal postpetiole index (DPpI): PPW / PPL * 100
Postpetiole index (PPI): PPW / PTW * 100

Pubescence and pilosity are often of high diagnostic value within the genus *Tetramorium* (Bolton 1976, 1977, 1979, 1980, 1985, Hita Garcia et al. 2010b, Hita Garcia and Fisher 2011, 2012a, 2012b). The varying degree of inclination of pilosity is particularly important for the diagnosis of groups or species. In this context we use the terms "erect", "suberect", "subdecumbent", "decumbent", and "appressed" following Wilson (1955).

Results

Synopsis of Afrotropical *T. tortuosum* species group

Tetramorium capillosum species complex

Tetramorium capillosum Bolton, 1980
Tetramorium hecate Hita Garcia & Fisher **sp. n.**
Tetramorium tabarum Bolton, 1980

Diagnosis of Afrotropical *T. capillosum* species complex

Eleven-segmented antennae; antennal scape short to moderately long (SI 73 - 86); anterior clypeal margin usually entire without median notch; frontal carinae very well developed and usually reaching posterior head margin; antennal scrobe present, weakly to very well developed; propodeal spines medium-sized to long, elongate-triangular to spinose; propodeal lobes short, triangular to elongate-triangular; petiolar node in profile nodiform, in profile as high as long to 1.3 times higher than long (LPeI 78 - 100), in dorsal view always longer than wide (DPeI 80 - 93); postpetiole sub-globular to moderately anteroposteriorly compressed; mandibular sculpture variable; cephalic sculpturation distinct, between frontal carinae longitudinally rugose to reticulate-rugose; mesosoma predominantly longitudinally rugose; petiolar node weakly to distinctly rugose, postpetiole ranging from unsculptured to longitudinally rugose; gaster unsculptured, smooth, and shiny; all dorsal surfaces of body with abundant, long, standing hairs; first gastral tergite without pubescence, and pilosity never short, dense, and appressed; sting appendage spatulate.

Taxonomic notes

In the Afrotropical region, members of the *T. tortuosum* group are unlikely to be misidentified with species from the other three groups having 11-segmented antennae.

The 26 species of the *T. weitzeckeri* group all have a squamiform or high nodiform petiolar node, which is always significantly wider than long. This node shape strongly contrasts with the shape observed in the *T. tortuosum* group since all three members have a nodiform node which is much longer than wide. The second species group, the *T. angulinode* group, is morphologically closer to the *T. tortuosum* group since both groups share a nodiform petiolar node. However, they can be clearly separated by the pilosity/pubescence patterns on the first gastral tergite. In the *T. tortuosum* group pubescence is absent and pilosity is long and mainly erect, whereas in the *T. angulinode* group pubescence and pilosity are usually present, dense, appressed to decumbent, and often pointed towards a longitudinal midline of the tergite. The synonymisation of *Triglyphothrix* under *Tetramorium* (Bolton 1985) added an additional group, the *T. ericae* group, with few species that possess 11-segmented antennae. However, these species are all comparatively small and have branched pilosity on most of the body, thus not easily confused with the much larger *T. tortuosum* group species that all possess simple pilosity.

The taxonomy of the *T. tortuosum* group in the Malagasy region can be challenging, and species delimitations for several group members proved difficult (Hita Garcia and Fisher 2012b). However, this was not the case for the three Afrotropical species. *Tetramorium capillosum*, *T. hecate*, and *T. tabarum* are very easy to distinguish, and the species delimitations presented in this study are straightforward and transparent. This is partly due to the small number of species in Africa. However, the three species are also often found in sympatry, and the fact that they maintain their species-specific characteristics without any intermediate forms provides further evidence for their heterospecificity.

Hita Garcia and Fisher (2012b) introduced four species complexes for the *T. tortuosum* group in the Malagasy region (*T. andrei*, *T. jedi*, *T. noeli*, and *T. smaug* complexes), and it seems appropriate to evaluate whether the Afrotropical species fit into one of these groups or deserve their own species complex. Based on the definitions of the complexes, the Afrotropical species cannot be members of the *T. jedi*, *T. noeli*, or *T. smaug* complexes due to a lack of sculpture on the forecoxae and the first gastral tergite. This would argue for placement in the *T. andrei* complex. Two reasons prevented us from doing so however. First, there is a difference in the development of the anterior clypeal margin, which is strongly medially impressed in the Malagasy *T. andrei* complex while the Afrotropical species treated in this study usually have an entire margin (except for some specimens of *T. hecate* that possess a very small notch that is challenging to see without higher magnifications). The second reason not to place the African species into a Malagasy complex is the current uncertainty about whether the *T. tortuosum* group as a whole is a natural group of closely related species, an issue discussed below. Consequently, we propose to place *T. capillosum*, *T. hecate*, and *T. tabarum* in their own complex, the *T. capillosum* species complex.

Biogeographic notes on the group

The three Afrotropical species of the *T. tortuosum* group have a moderately restricted distribution range since they are only known from Equatorial rainforests in the Central African countries of Gabon, Cameroon, Democratic Republic of Congo,

Central African Republic, and Uganda. Given all of the known African localities, the distribution of *T. capillosum* and *T. tabarum* appears fairly disjunctive. Most localities are located in the west of the distribution range in Gabon, Cameroon, and western parts of the Central African Republic, but few localities are found much further east in the northeastern Democratic Republic of Congo and northwestern Uganda. This represents a great gap between these two groups of localities. However, we think that this lack of occurrence records is very likely due to a sampling artefact since ant sampling has been relatively fragmentary in sub-Saharan Africa. The westernmost known distribution limit is the eastern coast of the Gulf of Guinea and the easternmost known locality appears to be the Budongo Forest in northwestern Uganda. It is unlikely that they occur further east, which is supported by an inventory of the myrmecofauna of the Kakamega Forest in Western Kenya (Hita Garcia et al. 2009). The latter study yielded 40 species of *Tetramorium* in this rainforest locality but no member of the *T. tortuosum* group could be collected, even though the sampling effort was comparatively high. The same is true for West Africa. Several ant sampling projects were carried out northwest of the known distribution range of the group; e.g. in Ghana (Belshaw and Bolton 1993, 1994, Majer 1972, 1976a, 1976b, Room 1971), Nigeria (Taylor 1977, 1978), or Ivory Coast (Kone et al. 2012, Yeo et al. 2011). However, none of these projects collected a single *T. tortuosum* group member. Consequently, it is safe to say that the Afrotropical members of the group are all restricted to the Equatorial rainforests of Central Africa.

As mentioned above, the *T. tortuosum* species group is remarkably species-poor in the Afrotropical region. Bolton (1980) provided two alternative scenarios to explain why the group fauna is so depauperate in Africa. One postulate suggests that the group originated elsewhere outside Africa and colonized the continent relatively late, when it faced strong competition from other *Tetramorium* groups that had already occupied the niches of *T. tortuosum* group members. The second hypothesis presented by Bolton (1980) postulates that the group was once as diverse in the Afrotropical region as elsewhere, but has been displaced by recently developed and possibly better-adapted *Tetramorium* competitors, namely the *T. weitzeckeri* group species. Bolton (1980) preferred the second hypothesis, and even though little more evidence exists today than in 1980, we concur with him. Indeed, several medium-sized to large species of the *T. weitzeckeri* group, such as *T. boltoni* Hita Garcia, Fischer and Peters, *T. guineense* (Bernard), *T. philippwagneri* Hita Garcia, Fischer and Peters, and *T. pinnipilum* Bolton, are fairly successful, common, and relatively abundant species found in many equatorial rainforests. Also, the *T. weitzeckeri* group, with the exception of *T. humbloti* Forel that has invaded the Malagasy region, is restricted in distribution to the Afrotropical region. This fact indicates that it represents a relatively young and successful development within the Afrotropical *Tetramorium* fauna, supporting Bolton's (1980) hypothesis. Furthermore, apart from the strong competition from the *T. weitzeckeri* group, there are many more Afrotropical species groups with 12-segmented antennae that perform well in rainforests, such as the *T. bicarinatum*, *T. camerunense*, and *T. flabellum* groups. This very strong competition in most modern-day rainforests might well explain the depauperate *T. tortuosum* fauna encountered in Africa. The species-rich

Malagasy group fauna does not face the same competition by other genus members within their size and niche ranges, and with 22 species seems to have undergone a fairly successful radiation, mostly in the rainforests of eastern Madagascar (Hita Garcia and Fisher 2012b). However, it remains unclear whether the three Afrotropical *T. tortuosum* group species are a relic of a formerly more successful group fauna or the species group colonised the African continent relatively late.

A different scenario not mentioned by Bolton (1980) offers a third theory. In the recent revision of the Malagasy group fauna Hita Garcia and Fisher (2012b) discuss the possibility that the current *T. tortuosum* group might not be a natural group in a phylogenetic sense. There is a great deal of variation within the group, especially in the Oriental and Indo-Australian regions, and the few key characters that distinguish the group might have evolved several times independently in different zoogeographic regions. If true, then the Afrotropical group fauna would be an isolated Afrotropical development not closely related to the other group members from the New World, the Malagasy, Oriental, and Indo-Australian regions. Hita Garcia and Fisher (2012b) point out that it would be possible to split the *T. tortuosum* group under its current definition into several regional groups, but are reluctant to do so without further evidence from other regions than the Malagasy. Bearing all this in mind, we remain hesitant to split the *T. tortuosum* group into several regional species groups, even though there might be characters to support this action for the species from the New World, the Afrotropical and Malagasy regions (Hita Garcia and Fisher 2012b). The situation for the remainder of the species from the Oriental and Indo-Australian regions is murkier, however. In our opinion it is only possible to assess the validity of the *T. tortuosum* group within the framework of a larger-scale molecular phylogenetic analysis of the genus *Tetramorium* including most species groups and all regions. This might reveal evidence for a reorganisation of the *T. tortuosum* group under its current definition, but until then the species treated in this study must be considered authentic members of the group.

Identification key for Afrotropical *T. capillosum* species complex (workers)

1 Antennal scapes relatively short (SI 73 - 77); petiolar node in profile clearly rectangular nodiform with anterodorsal and posterodorsal margins at about same height (Fig. 1A)..... ***T. hecate***

– Antennal scapes always longer (SI 80 - 86); petiolar node nodiform with less rectangular and more rounded margins, anterodorsal margin situated lower than posterodorsal margin (Figs. 1B, C) **2**

2 Mandibles strongly longitudinally sculptured; eyes moderately large (OI 23 - 25); whole body dark brown to black in colour (Figs. 2A, C)... ***T. capillosum***

– Mandibles unsculptured, smooth and shiny; eyes very large (OI 27 - 31); body bicoloured, head, mesosoma, waist segments yellow to bright orange, gaster very dark brown to black (Figs. 2B, D) ..... ***T. tabarum***

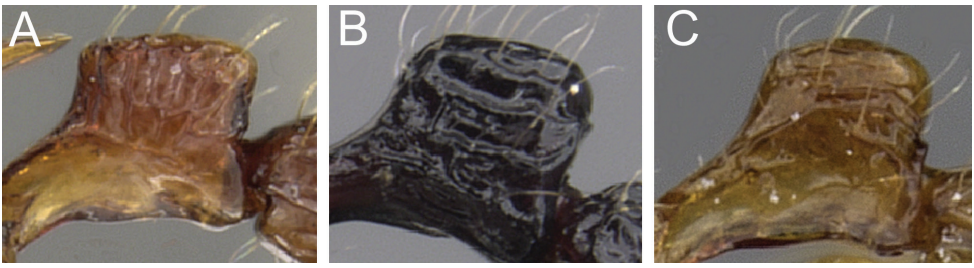

Figure 1. Petiolar node in profile. **A** *Tetramorium hecate* (CASENT0248334) **B** *Tetramorium capillosum* (CASENT0901156) **C** *Tetramorium tabarum* (CASENT0280900).

Figure 2. A, B Head in full-face view. **A** *Tetramorium capillosum* (CASENT0901156) **B** *Tetramorium tabarum* (CASENT0316967) **C, D** Body in profile. **C** *Tetramorium capillosum* (CASENT0316960) **D** *Tetramorium tabarum* (CASENT0316967).

***Tetramorium capillosum* Bolton**
http://species-id.net/wiki/Tetramorium_capillosum
Figures 1B, 2A, 2C, 3A, 3B, 3C, 7

Tetramorium capillosum Bolton, 1980: 236.

Type material. Holotype, pinned worker, GABON, Makokou, 0°34'N, 12°52'E, rainforest, X.1972 (*I. Lieberburg*) [MCZ] [examined]. Paratypes, seven pinned workers with same data as holotype [BMNH; MCZ] [examined].

Non-type material. CAMEROON: Mbalmayo, XI.1993 (*N. Storck*); Ndupe, 20.XII.1989 (*A. Dejean*); Sud, Bondé Forest, N'kolo village, 27.5 km 155° SSE Elogbatindi, 3.2217N, 10.2467E, 40 m, rainforest, 12.IV.2000 (*B.L. Fisher*); Sud, Campo Reserve, 2°36'N, 9°56'E, 40 m, 25.X.1991 (*D.M. Olson*); Sud, P.N. Campo, 43.3 km 108°ESE Campo, 2.2825N, 10.2062E, 290 m, rainforest, 7.IV.2000 (*B.L. Fisher*); Sud, Res. de Faune de Campo, Massif des Mamelles, 15.1 km 84°E Ébodjé, 2.59417N, 9.9595E, 180 m, rainforest, 4.IV.2000 (*B.L. Fisher*); CENTRAL AFRICAN REPUBLIC: Prefecture Sangha-Mbaéré, Réserve Spéciale de Forêt Dense de Dzanga-Sangha, 12.7 km 326°NW Bayanga, 3.005N, 16.1933E, 420 m, rainforest, 10.–17.V.2001 (*B.L. Fisher*); Prefecture Sangha-Mbaéré, Parc National Dzanga-Ndoki, Mabéa Bai, 21.4 km 53°NE Bayanga, 3.0333N, 16.41E, 510 m, rainforest, 1.–7.V.2001 (*B.L. Fisher*); DEMOCRATIC REPUBLIC OF CONGO: Epulu, 1.3833N, 28.5833E, 750 m, rainforest, 1.XI.1995 (*S.D. Torti*); GABON: La Makande, Foret de Abeilles, I.-II.1999 (*S. Lewis*); Makokou, rainforest, X.1972 (*I. Lieberburg*); Ogooue-Maritime, Aire d'Exploit. Rationnelle de Faune des Monts

Doudou, 24.3 km 307°NW Doussala, 2.2264N, 10.4097E, 375 m, rainforest, 6.-9. III.2000 (*B.L. Fisher*); Ogooue-Maritime, Aire d'Exploit. Rationnelle de Faune des Monts Doudou, 25.2 km 304°NW Doussala, 2.2275S, 10.3945E, 640 m, rainforest, 14.III.2000 (*B.L. Fisher*); Ogooue-Maritime, Reserve des Monts Doudou, 25.2 km 304°NW Doussala, 2.2272S, 10.3945E, 630 m, coastal lowland rainforest, 13.-20.III.2000 (*S. van Noort*); Ogooue-Maritime, Reserve de la Moukalaba-Dougoua, 12.2 km 305°NW Doussala, 2.3167S, 10.5333E, 110 m, rainforest, 24.II.2000 (*B.L. Fisher*); Ogooue-Maritime, Reserve de la Moukalaba-Dougoua, 10.8 km 214°SW Doussala, 2.4227S, 10.5453E, 110 m, rainforest, 29.II.2000 (*B.L. Fisher*); Ogooue-Maritime, Reserve de la Moukalaba-Dougoua, 12.2 km 305°NW Doussala, 2.2833S, 10.4972E, 110 m, coastal lowland rainforest, 24.II.–3.III.2000 (*S. van Noort*); Woleu-Ntem, 31.3 km 108°ESE Minvoul, 2.08N, 12.4067E, 600 m, rainforest, 7.II.1998 (*B.L. Fisher*); UGANDA: Bunyoro District, Budongo Forest FS, 1.7264N, 31.5524E, 1081 m, 8.VII.2009 (*W. Freund & T. Klug*).

Diagnosis. The following character combination clearly distinguishes *T. capillosum* from the remainder of the species group: eyes of moderate size (OI 23 - 25); antennal scapes moderately long (SI 80 - 83); petiolar node nodiform with anterodorsal and posterodorsal margins relatively rounded, posterodorsal margin situated higher than anterodorsal margin, dorsum convex; mandibles strongly longitudinally rugose; petiole and postpetiole usually with weak sculpture; whole body uniformly very dark brown to black.

Worker measurements (N=12). HL 0.79 - 0.89 (0.84); HW 0.76 - 0.84 (0.79); SL 0.62 - 0.69 (0.65); EL 0.18 - 0.21 (0.19); PH 0.41 - 0.51 (0.46); PW 0.60 - 0.68 (0.65); WL 1.02 - 1.19 (1.12); PSL 0.26 - 0.38 (0.30); PTL 0.31 - 0.37 (0.34); PTH 0.34 - 0.41 (0.37); PTW 0.28 - 0.33 (0.31); PPL 0.28 - 0.33 (0.30); PPH 0.37 - 0.43 (0.40); PPW 0.37 - 0.44 (0.41); CI 94 - 96 (95); SI 80 - 83 (82); OI 23 - 25 (24); DMI 55 - 62 (58); LMI 39 - 43 (41); PSLI 31 - 43 (35); PeNI 45 - 49 (47); LPeI 89 - 100 (94); DPeI 86 - 94 (89); PpNI 61 - 66 (63); LPpI 70 - 78 (75); DPpI 130 - 139 (135); PPI 127 - 138 (134).

Worker description. Head longer than wide (CI 94 - 96); posterior head margin moderately concave. Anterior clypeal margin entire and convex. Frontal carinae strongly developed, approaching or ending at posterior head margin. Antennal scrobes narrow but very well-developed with clearly defined margins all around. Antennal scapes moderately long, not reaching posterior head margin (SI 80 - 83). Eyes of moderate size (OI 23 - 25). Mesosomal outline in profile weakly convex, moderately marginate from lateral to dorsal mesosoma; promesonotal suture and metanotal groove absent; mesosoma comparatively stout and high (LMI 39 - 43). Propodeal spines relatively long to very long, spinose, and acute (PSLI 31 - 43); propodeal lobes short, triangular to elongate-triangular, and usually acute. Petiolar node in profile rectangular nodiform, approximately as high as long to weakly higher than long (LPeI 89 - 100), anterior and posterior faces approximately parallel, posterodorsal margin situated higher than anterodorsal, anterodorsal and posterodorsal angles relatively rounded, petiolar dorsum convex; node in dorsal view approximately 1.1 times longer than wide

Figure 3. *Tetramorium capillosum* paratype worker (CASENT0901156). **A** Body in profile **B** Body in dorsal view **C** head in full-face view.

(DPeI 86 - 94). Postpetiole in profile relatively high and moderately anteroposteriorly compressed, approximately 1.2 to 1.3 times higher than long (LPpI 70 - 78); in dorsal view around 1.3 to 1.4 times wider than long (DPpI 130 - 139). Postpetiole in profile thinner and higher than petiolar node, in dorsal view approximately 1.3 to 1.4 times wider than petiolar node (PPI 127 - 138). Mandibles strongly longitudinally rugose; clypeus longitudinally rugulose, usually with three to five rugulae, median rugula better developed; cephalic dorsum between frontal carinae irregularly longitudinally rugose to reticulate rugose, posteriorly towards posterior head margin fully reticulate-rugose, anteriorly towards posterior clypeal margin more regularly longitudinally rugose; scrobal area unsculptured, smooth, and shining; lateral and ventral head longitudinally rugose to reticulate-rugose. Mesosoma laterally and dorsally strongly irregularly longitudinally rugose. Forecoxae unsculptured, smooth, and shining. Both waist segments with strong sculpture, mainly longitudinally rugose. Gaster unsculptured, smooth, and shining. Ground sculpture generally faint to absent everywhere on body. Whole body with abundant, very long, and fine standing hairs; first gastral tergite without appressed pubescence. Anterior edges of antennal scapes with suberect to erect hairs. Body of uniform very dark brown to black colour.

Distribution and ecology. Currently, *T. capillosum* is found throughout Gabon, southern Cameroon, eastern Central African Republic, and then much further east in the northeastern Democratic Republic of Congo and northwestern Uganda (Figure 7). As noted above, the disjunctive range is almost certainly due to a sampling artefact, and it is very likely that *T. capillosum* is also encountered in Congo, and in much more of the Democratic Republic of Congo than just the northeastern locality of Epulu. Also, it seems unlikely that the species does not occur in Equatorial Guinea since it is found further north, south, and east, and was likely missed due to a sampling artefact. With the available material in mind, it seems that *T. capillosum* lives in leaf litter and/or on the ground, and is found at elevations from 40 to 1081 m.

Discussion. Within the African *T. tortuosum* group *T. capillosum* is easily recognisable. *Tetramorium capillosum* differs from *T. hecate* and *T. tabarum* in overall body size and colouration. The latter two are smaller species (WL 0.69 - 0.83; PW 42 - 52) either bicoloured or of uniform brown colour, whereas *T. capillosum* is noticeably larger (WL 1.02 - 1.19; PW 60 - 68) and of a very dark brown to black colour. However, both body size and colouration are often variable within the genus *Tetramorium*. *Tetramorium capillosum* also differs from *T. hecate* in antennal scape length, eye size, and petiolar node shape. In *T. capillosum* the antennal scapes are moderately long (SI 80 - 83), eyes are of moderate size (OI 24 - 25), and the petiolar node has anterodorsal and posterodorsal margins that are relatively rounded, with the posterodorsal margin situated higher than the anterodorsal. In contrast, *T. hecate* scapes are relatively short (SI 73 - 77), eyes are relatively large (OI 27 - 31), and the petiolar node is rectangular nodiform with anterodorsal and posterodorsal angles sharply defined and at about the same height. Furthermore, *T. tabarum* significantly varies from *T. capillosum* in eye size, propodeal spine length, and sculpture on mandibles and postpetiole. *Tetramorium tabarum* has much larger eyes (OI 27 - 31), much shorter spines (PSLI 22 - 25),

and the mandibles and the postpetiole are unsculptured, whereas *T. capillosum* has smaller eyes (OI 24 - 25), much longer spines (PSLI 31 - 43), and conspicuously sculptured mandibles and postpetiole.

It should be noted that despite a relatively broad distribution range from the Gulf of Guinea to northwest Uganda, *T. capillosum* remains morphologically remarkably stable without noticeable intraspecific variation.

Tetramorium hecate **Hita Garcia & Fisher sp. n.**
urn:lsid:zoobank.org:act:BEEEF558-1DDA-40AB-8D79-597684B38033
http://species-id.net/wiki/Tetramorium_hecate
Figures 1A, 4A, 4B, 4C, 5A, 5B, 5C, 7

Type material. Holotype, pinned worker, GABON, Province Estuaire, F.C. Mondah, 21 km 331°NNW Libreville, 0°34.6'N, 9°20.1'E, 10 m, littoral rainforest, sifted litter (leaf mold, rotten wood), collection code BLF01742, 24.II.1998 (*B.L. Fisher*) [unique specimen identifier CASENT0248334] [CASC]. **Paratypes**, 16 pinned workers with same data as holotype [BMNH: CASENT0248332; CASC: CASENT0235154; CASENT0248333; CASENT0248335; CASENT0248336; CASENT0248337; CASENT0248338; CASENT0248339; CASENT0248340; CASENT0248341; CASENT0248342; MCZ: CASENT0248343; MHNG: CASENT0248344; NHMB: CASENT0248345].

Non-type material. CAMEROON: Campo Reserve, 2°36'N, 9°56'E, 40 m, 25.X.1991 (*D.M. Olson*); Mbalmayo, XI.1993 (*N. Storck*); Nkoemvon, 16.III.1980 (*D. Jackson*); Sud, P.N. Campo, 43.3 km 108°ESE Campo, 2.2825N, 10.2062E, 290 m, rainforest, 7.IV.2000 (*B.L. Fisher*); Sud, Res. de Faune de Campo, 2.16 km 106°ESE Ébodjé, 2.5678N, 9.8443E, 10 m, littoral rainforest, 9.IV.2000 (*B.L. Fisher*); Sud, Res. de Faune de Campo, Massif des Mamelles, 15.1 km 84°E Ébodjé, 2.5942N, 9.9595E, 180 m, rainforest, 4.IV.2000 (*B.L. Fisher*); Sud-Ouest, Bimbia Forest, 7.4 km 119°ESE Limbe, 3.9818N, 9.2625E, 40 m, rainforest, 14.IV.2000 (*B.L. Fisher*); GABON: Province Estuaire, Mondah Forest, near Libreville, 3.XII.1987 (*J. Noyes*); Province Estuaire, F.C. Mondah, 21 km 331°NNW Libreville, 0°34.6'N, 9°20.1'E, 10 m, littoral rainforest, 24.II.1998 (*B.L. Fisher*).

Diagnosis. *Tetramorium hecate* differs from the other species of the group by the following character combination: antennal scapes relatively short (SI 73 - 77); eyes large (OI 27 - 31); petiolar node rectangular nodiform with anterodorsal and posterodorsal margins strongly angulate and situated at about the same height; mandibles unsculptured, smooth, and shining; petiole and postpetiole usually with weak sculpture; body colouration ranging from uniformly brown to head, mesosoma, waist segments yellowish to bright orange contrasting with very dark brown to black gaster.

Worker measurements (N=12). HL 0.58 - 0.67 (0.63); HW 0.54 - 0.64 (0.60); SL 0.41 - 0.49 (0.45); EL 0.15 - 0.20 (0.17); PH 0.28 - 0.36 (0.33); PW 0.42 - 0.52 (0.47); WL 0.69 - 0.83 (0.77); PSL 0.12 - 0.26 (0.20); PTL 0.20 - 0.26 (0.24); PTH

Figure 4. Variations of *Tetramorium hecate*. **A** bicoloured form with long propodeal spines (CASENT0248334) **B** uniform brown coloured form with long propodeal spines (CASENT0235157) **C** bicoloured form with short propodeal spines (CASENT0235154).

0.22 - 0.27 (0.25); PTW 0.17 - 0.22 (0.20); PPL 0.19 - 0.22 (0.21); PPH 0.22 - 0.28 (0.25); PPW 0.24 - 0.29 (0.27); CI 93 - 96 (94); SI 73 - 77 (76); OI 27 - 31 (28); DMI 58 - 63 (61); LMI 41 - 44 (42); PSLI 21 - 38 (32); PeNI 39 - 46 (43); LPeI 89 - 100 (94); DPeI 81 - 89 (84); PpNI 55 - 62 (57); LPpI 80 - 91 (86); DPpI 120 - 130 (126); PPI 129 - 142 (135).

Worker description. Head longer than wide (CI 93 - 96); posterior head margin weakly concave. Anterior clypeal margin usually entire and convex, sometimes with very small median notch only visible under higher magnifications. Frontal carinae strongly developed, approaching or ending at posterior head margin. Antennal scrobes well developed, moderately shallow, and with clearly defined margins all around. Antennal scapes relatively short, not reaching posterior head margin (SI 73 - 77). Eyes large (OI 27 - 31). Mesosomal outline in profile weakly convex, moderately marginate from lateral to dorsal mesosoma; promesonotal suture and metanotal groove absent; mesosoma comparatively stout and high (LMI 41 - 44). Propodeal spines usually long to very long (PSLI 30 - 38), elongate-triangular to spinose, and acute, rarely spines reduced, short, elongate-triangular, and acute (PSLI 20 - 21); propodeal lobes short, triangular to elongate-triangular, and acute. Petiolar node in profile rectangular nodiform, approximately as high as long to weakly higher than long (LPeI 89 - 100), anterior and posterior faces approximately parallel, anterodorsal and posterodorsal margins situated at about the same height, anterodorsal and posterodorsal angles well-developed and rectangular, petiolar dorsum flat; node in dorsal view around 1.1 to 1.2 times longer than wide (DPeI 81 - 89). Postpetiole in profile globular to subglobular, approximately 1.1 to 1.2 times higher than long (LPpI 80 - 91); in dorsal view around 1.2 to 1.3 times wider than long (DPpI 120 - 130). Postpetiole in profile appearing less voluminous than petiolar node, in dorsal view approximately 1.3 to 1.4 times wider than petiolar node (PPI 129 - 142). Mandibles unsculptured, smooth, and shining; clypeus longitudinally rugulose, usually with three distinct rugulae, median rugula better developed than remainder, rugulae often with cross-meshes; cephalic dorsum between frontal carinae irregularly longitudinally rugose to reticulate rugose, posteriorly towards posterior head margin well reticulate-rugose, anteriorly towards posterior clypeal margin more regularly longitudinally rugose (usually with five to eight longitudinal rugae); scrobal area mostly unsculptured; lateral and ventral head longitudinally rugose to reticulate-rugose. Mesosoma laterally irregularly rugose, dorsally distinctly longitudinally rugose. Forecoxae unsculptured, smooth, and shining. Both

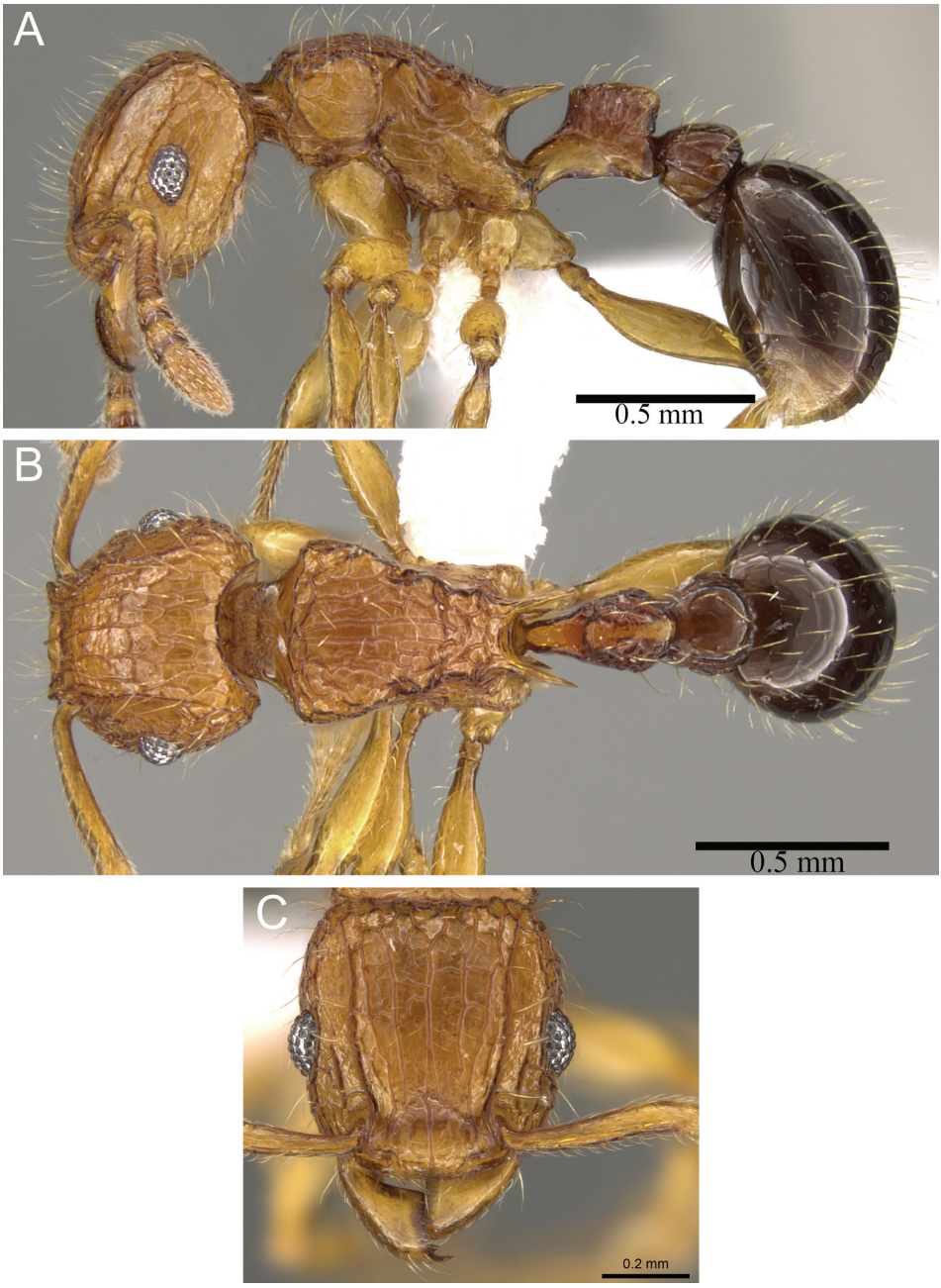

Figure 5. *Tetramorium hecate* holotype worker (CASENT0248334). **A** Body in profile **B** Body in dorsal view **C** head in full-face view.

waist segments laterally weakly, irregularly rugulose/rugose, dorsally mostly unsculptured, smooth, and shining. Postpetiole and gaster unsculptured, smooth, and shining. Ground sculpture generally faint to absent everywhere on body. Whole body with

abundant, long, and fine standing hairs; first gastral tergite without appressed pubescence. Anterior edges of antennal scapes with suberect to erect hairs. Body colouration relatively variable, ranging from bicoloured with head, mesosoma, legs, and waist segments yellowish to bright orange contrasting with very dark brown to black gaster to whole body uniformly brown.

Etymology. The name of the new species is inspired by the ancient Latin and Greek goddess "Hecate" or "Hekate", also known as the "triple Hecate" or "three-faced Hecate", and refers to the morphological variation in colouration and propodeal spine length observed in *T. hecate*. The species epithet is a nominative noun in apposition, and thus invariant.

Distribution and ecology. The new species is currently only known from Cameroon and Gabon (Figure 7). All localities are situated at relatively low elevations ranging from 10 to 300 m, and most are either rainforests or littoral rainforests. Most of the available material was collected through litter sifting, which suggests that the preferred microhabitat of *T. hecate* is forest leaf litter.

Discussion. *Tetramorium hecate* is unlikely to be misidentified with the other two species of the group. The most obvious difference between *T. hecate* and *T. capillosum* and *T. tabarum* is the shape of the petiolar node. In the latter two the node is nodiform with relatively rounded anterodorsal and posterodorsal margins, and, in addition, the posterodorsal margin is situated noticeably higher than the anterodorsal margin. In contrast, the node of *T. hecate* is nodiform, with clearly rectangular anterodorsal and posterodorsal margins, situated at about the same height. The second-most important character is antennal scape length. *Tetramorium hecate* has the shortest scapes of the three species (SI 73 - 77), strongly contrasting with the longer scapes of the other two species (SI 80 - 86). Furthermore, *T. hecate* is also a much smaller species with much larger eyes and very different colouration than *T. capillosum* (see description of the latter for more details). The very well developed antennal scrobes with clearly defined margins all around also separate *T. hecate* from *T. tabarum* since the scrobes of the latter are shallow and without posterior and ventral margins.

The new species shows an intriguing variation in colouration and propodeal spine length. At the initial sorting stage of this revision, we considered the material listed here as *T. hecate* to consist of three potential new species: a strongly bicoloured one with long propodeal spines (Figure 4A), a uniformly brown coloured one with long propodeal spines (Figure 4B), and a bicoloured one with shorter spines (Figure 4C). However, after examination of all the material, it became apparent that they belong to just one species having a moderate variation in colour, which includes a few specimens with exceptionally short propodeal spines. The differences in colouration appear distinct at first when looking at few specimens, but the examination of several hundred specimens showed that there is a gradual variation that ranges from strongly bicoloured to completely uniformly coloured with more than half of the specimens being intermediate. Generally, the spines are long to very long (PSLI 30 - 38) throughout the examined material of several hundred specimens, the exception being three specimens with very short propodeal spines (PSLI 20 -21). Apart from

the spine length, however, no single character would justify a separation of these specimens from the main material. Consequently, we are very confident that all the material examined belongs to just one species.

***Tetramorium tabarum* Bolton**
http://species-id.net/wiki/Tetramorium_tabarum
Figures 1C, 2B, 2D, 6A, 6B, 6C, 7

Tetramorium tabarum Bolton, 1980: 236.

Type material. Holotype, pinned worker, DEMOCRATIC REPUBLIC OF CONGO, Epulu, 4.I.1949 (*J.C. Bradley*) [MCZ] [examined].

Non-type material. CAMEROON: Mvini, 21.XII.1988 (*A. Dejean*); Sud-Ouest, Bimbia Forest, 7.4 km 119°ESE Limbe, 3.9818N, 9.2625E, 40 m, rainforest, 14.IV.2000 (*B.L. Fisher*); CENTRAL AFRICAN REPUBLIC: Prefecture Sangha-Mbaéré, Réserve Spéciale de Forêt Dense de Dzanga-Sangha, 12.7 km 326°NW Bayanga, 3.005N, 16.1933E, 420 m, rainforest, 10.–17.V.2001 (*B.L. Fisher*); Prefecture Sangha-Mbaéré, Parc National Dzanga-Ndoki, 37.9 km 169°S Lidjombo, 2.3707N, 16.1725E, 360 m, rainforest, 20.–28.V.2001 (*B.L. Fisher*); GABON: Woleu-Ntem, 31.3 km 108°ESE Minvoul, 2.08N, 12.4067E, 600 m, rainforest, 17.II.1998 (*B.L. Fisher*).

Diagnosis. *Tetramorium tabarum* is easily recognisable within the Afrotropical *T. tortuosum* group by the following character combination: antennal scape moderately long (SI 84 - 86); eyes large (OI 27 - 31); petiolar node nodiform with anterodorsal and posterodorsal margins relatively rounded, posterodorsal margin situated higher than anterodorsal margin, dorsum convex; mandibles unsculptured, smooth, and shining; petiole with very weak sculpture and postpetiole completely unsculptured; head, mesosoma, waist segments yellowish to bright orange, gaster very dark brown to black.

Worker measurements (N=10). HL 0.61 - 0.66 (0.63); HW 0.55 - 0.60 (0.57); SL 0.47 - 0.52 (0.49); EL 0.16 - 0.18 (0.17); PH 0.30 - 0.34 (0.32); PW 0.43 - 0.46 (0.44); WL 0.75 - 0.82 (0.79); PSL 0.14 - 0.16 (0.15); PTL 0.20 - 0.22 (0.20); PTH 0.24 - 0.27 (0.25); PTW 0.16 - 0.18 (0.17); PPL 0.19 - 0.21 (0.20); PPH 0.23 - 0.27 (0.25); PPW 0.24 - 0.27 (0.26); CI 90 - 92 (91); SI 84 - 86 (85); OI 27 - 31 (29); DMI 55 - 58 (56); LMI 38 - 43 (41); PSLI 22 - 25 (23); PeNI 37 - 39 (38); LPeI 78 - 82 (81); DPeI 80 - 85 (82); PpNI 56 - 59 (58); LPpI 79 - 85 (82); DPpI 124 - 130 (127); PPI 147 - 156 (152).

Worker description. Head significantly longer than wide (CI 90 - 92); posterior head margin moderately concave. Anterior clypeal margin entire and convex. Frontal carinae strongly developed, approaching or ending at posterior head margin. Antennal scrobes developed, but shallow and without clearly defined posterior and ventral margins. Antennal scapes moderately long, not reaching posterior head margin (SI 84 - 86). Eyes large (OI 27 - 31). Mesosomal outline in profile weakly convex, moderately marginate from lateral to dorsal mesosoma; promesonotal suture and metanotal groove

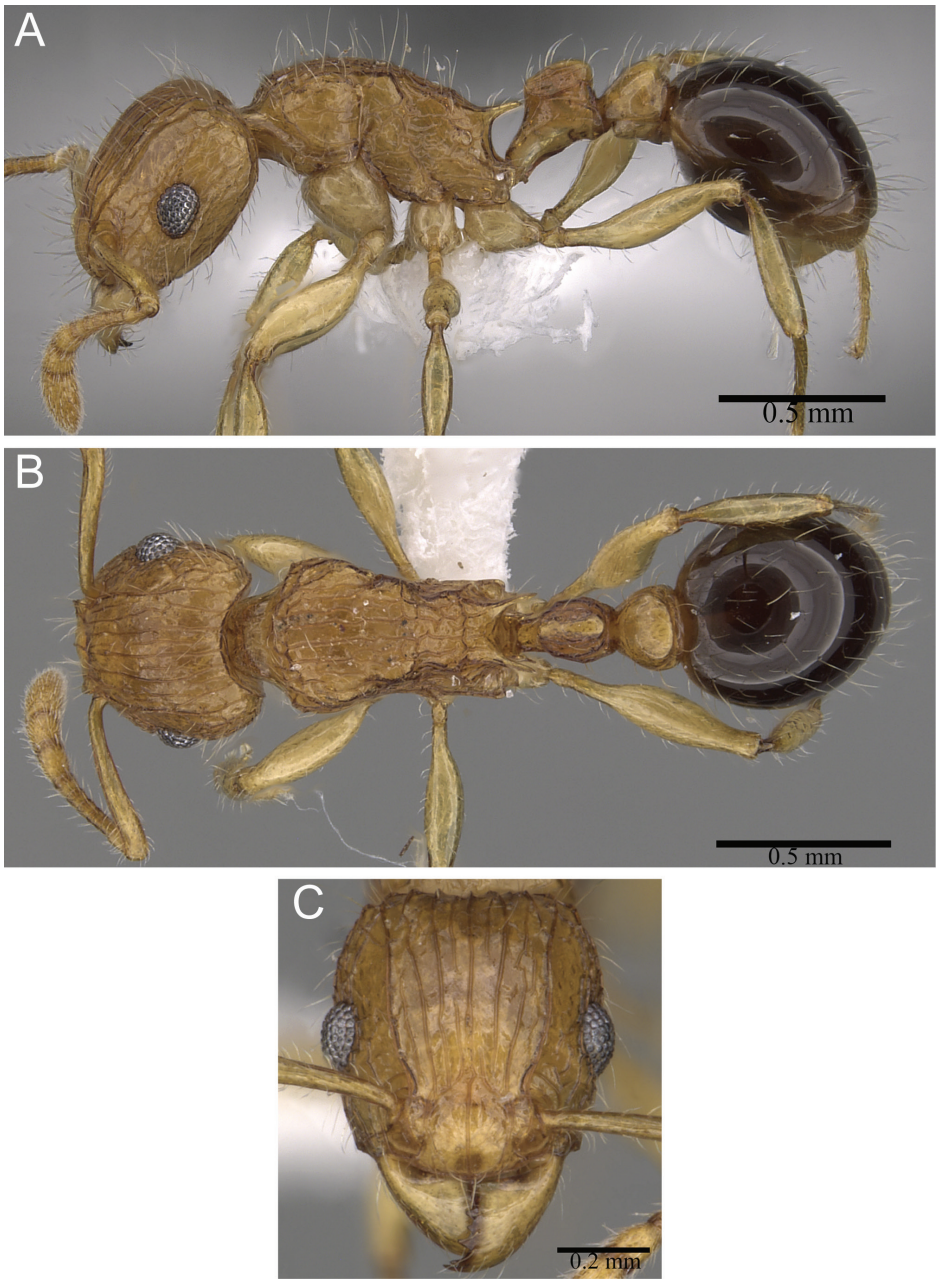

Figure 6. *Tetramorium tabarum* worker (CASENT0316967). **A** Body in profile **B** Body in dorsal view **C** head in full-face view.

absent; mesosoma comparatively stout and high (LMI 38 - 43). Propodeal spines relatively short to medium-sized, elongate-triangular to spinose, and acute (PSLI 22 - 25); propodeal lobes short, triangular to elongate-triangular, and acute. Petiolar node in

Figure 7. Geographic distribution maps for the species treated in this study. Star symbols represent type localities while rectangles represent non-type localities.

profile rectangular nodiform, approximately 1.2 to 1.3 times higher than long (LPeI 78 - 82), anterior and posterior faces approximately parallel, posterodorsal margin situated higher than anterodorsal, anterodorsal and posterodorsal angles relatively rounded, petiolar dorsum convex; node in dorsal view approximately 1.2 times longer than wide (DPeI 80 - 85). Postpetiole in profile subglobular and moderately anteroposteriorly compressed, approximately 1.2 to 1.3 times higher than long (LPpI 79 - 85); in dorsal view around 1.2 to 1.3 times wider than long (DPpI 124 - 130). Postpetiole in profile appearing less voluminous than petiolar node, in dorsal view approximately 1.5 to 1.6 times wider than petiolar node (PPI 147 - 156). Mandibles unsculptured, smooth, and shining; clypeus longitudinally rugulose, usually with three rugulae, median rugula better developed; cephalic dorsum between frontal carinae with five to eight longitudinal rugae, most rugae running unbroken from posterior clypeal margin to posterior head margin, few rugae interrupted, but none with cross-meshes; scrobal area mostly unsculptured; lateral and ventral head longitudinally rugose to reticulate-rugose. Mesosoma laterally irregularly rugose, dorsally distinctly longitudinally rugose. Forecoxae unsculptured, smooth, and shining. Petiolar node laterally weakly to moderately longitudinally rugose. Postpetiole and gaster unsculptured, smooth, and shining. Ground sculpture generally faint to absent everywhere on body. Whole body with abundant, long, and fine standing hairs; first gastral tergite without appressed pubescence. Anterior edges of antennal scapes with suberect to erect hairs. Head, mesosoma, legs, and waist segments yellowish to bright orange, contrasting with very dark brown to black gaster.

Distribution and ecology. *Tetramorium tabarum* is known to occur in northern Gabon, western Cameroon close to the Gulf of Guinea, the southwest of the Central African Republic, and from the type locality in the northeast of the Democratic Republic of Congo (Figure 7). Its distribution seems even more disjunctive than that of *T. capillosum*, but is very likely due to a sampling artefact as already noted above for the latter species. We are very confident that more material of *T. tabarum* will be sampled in the area between the known localities. This species appears to be the rarest in the complex with far less material available than for the other two species. One reason for this scarcity might be its preference for a different microhabitat. The latter two were mainly sampled from the leaf litter/ground, whereas most specimens of *T. tabarum* were collected from vegetation. Additional sampling on low vegetation or canopy might yield more material.

Discussion

As already pointed out in the above descriptions of the other two species, *T. tabarum* is easily recognisable within the complex. It differs significantly from *T. capillosum* in eye size (OI 27 - 31 vs. OI 24 - 25), propodeal spine length (PSLI 22 - 25 vs. PSLI 31 - 43), and sculpture on mandibles and postpetiole, which is present and conspicuous in *T. capillosum* while absent in *T. tabarum*. The latter is also much smaller (WL 0.75 - 0.82) and bicoloured with a dark brown to black gaster contrasting with the remaining yellowish to orange body, which contrasts with the larger size (WL 1.02 - 1.19) and the uniformly very dark brown to black colouration of *T. capillosum*. Despite being often also bicoloured and within the same morphometric range, *T. hecate* is unlikely to be confused with *T. tabarum*. The antennal scapes are significantly longer in *T. tabarum* (SI 84 - 86) than in *T. hecate* (SI 73 - 77). More importantly, the petiolar node of *T. tabarum* has relatively rounded anterodorsal and posterodorsal margins with the posterodorsal margin situated higher than the anterodorsal, and the dorsum is convex, whereas in *T. hecate* the anterodorsal and posterodorsal margins are sharply defined and at about the same height. The varying development of the antennal scrobes is another difference. *Tetramorium hecate* possesses very well-developed scrobes with margins all around while the scrobes of *T. tabarum* are shallow without clear posterior and ventral margins.

The material currently available for *T. tabarum* is relatively limited, but it seems that intraspecific variation is very low.

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