ZooKeys 234: 1–18 (2012)
doi: 10.3897/zookeys.234.3933
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

Redescription of the poorly known planktonic copepod *Pontellopsis lubbockii* (Giesbrecht, 1889) (Pontellidae) from the Eastern Tropical Pacific with a key to species

Eduardo Suárez-Morales[1,†], Eva Kozak[2,‡]

1 *El Colegio de la Frontera Sur (ECOSUR), Av. Centenario Km 5.5, A.P. 424, Chetumal, Quintana Roo 70014, Mexico* **2** *Centro Universitario de la Costa Sur (CUCSUR), Universidad de Guadalajara. San Patricio Melaque, Jalisco, Mexico*

Corresponding author: *Eduardo Suárez-Morales* (esuarez@ecosur.mx)

Academic editor: *D. Defaye* | Received 1 September 2012 | Accepted 18 October 2012 | Published 30 October 2012

Citation: Suárez-Morales E, Kozak E (2012) Redescription of the poorly known planktonic copepod *Pontellopsis lubbockii* (Giesbrecht, 1889) (Pontellidae) from the Eastern Tropical Pacific with a key to species. ZooKeys 234: 1–18. doi: 10.3897/zookeys.234.3933

Abstract

During a survey of the epipelagic zooplankton carried out off the coast of the Mexican states of Jalisco and Colima, in the Eastern Tropical Pacific, female and male specimens of the poorly known calanoid copepod *Pontellopsis lubbockii* (Giesbrecht, 1889) were collected. Because previous descriptions and illustrations are largely incomplete and have caused some taxonomical confusion, this species is fully redescribed from specimens from the Mexican Pacific. The species has some characters that have been overlooked, but those related to the female genital double-somite are the most striking, it has two conical dorsal protuberances and a long ventral spiniform process unique of this species. The mouthparts of this species have not been hitherto described and figured, the flexible terminal setae of legs 3 and 4 is noteworthy. The male general morphology agrees in general with previous data, but new details of the leg 5 and geniculate antennule are added. Its mouthparts, with strong, serrate setae on the maxillae and maxillules, and a strong mandibular edge, suggest that this is a predator form. A dichotomous key for the identification of males and females of the species of *Pontellopsis* known from the Eastern Tropical Pacific is included.

Keywords

Zooplankton, Mexican Pacific, taxonomy of copepods, biodiversity, pelagic crustaceans

Introduction

The genus *Pontellopsis* Brady, 1883 currently contains up to 33 species (Boxshall and Halsey 2004; Razouls et al. 2012; Walter and Boxshall 2012). As other members of the family Pontellidae, species of *Pontellopsis* are usually recorded in surface waters (0–10 m) of tropical and warm temperate latitudes (Othman and Toda 2006). In general, pontellids are regarded as good indicators of water masses (Sherman 1963, 1964; Matsuo and Marumo 1982; Hernández-Trujillo 1989). Because of their morphological complexity and variability (Fleminger 1956, 1967b, 1975; Silas and Pillai 1973), their taxonomy is still in flux, partly caused by incomplete descriptions that have raised taxonomic confusion in different regions (Pillai 1977; Jeong et al. 2009). Therefore, in some instances, it is necessary to revise and redescribe species following upgraded modern standards in order to facilitate the identification of these species and related forms (Mulyadi 2002; El-Sherbiny and Ueda 2008). One of these poorly defined pontellid species is *P. lubbockii* (Giesbrecht, 1889), whose original description and subsequent illustrations by Giesbrecht (1893) Wilson (1950), and Pillai (1977) are limited and lacking in detail. Several important characters of this species have been omitted, not only details of the taxonomically relevant characters, but of the mouthparts and legs 1–4, which still remain undescribed. Besides the occurrence of this species at the type locality off Columbia (Giesbrecht 1889), Wilson (1950) reported this species from the Eastern Pacific; the identity of some of Wilson's specimens were revised by Pillai (1977), who noticed some inconsistencies both in its identification and in the records related to this species. Wilson (1950) identified and labeled female pontellids from the off Sri Lanka, in the South Pacific as *P. lubbockii* but Pillai (1977) noticed that these were in fact specimens of *P. krämeri* (Giesbrecht, 1896); in the same sample he found also copepodites of *Pontella* sp. and of *Labidocera acuta* (Dana, 1849).

Pontellopsis lubbockii has been relatively rarely taken and is known as a neritic equatorial species endemic to the Gulf of California and adjacent areas of the Eastern Tropical Pacific (ETP) (Brinton et al. 1986, Suárez-Morales and Gasca 1998) and extending to Ecuador (Pillai 1977). Overall, the pontellid copepod fauna of the area south of the influence of the California Current and off the Mexican and Central American coasts of the Pacific is still poorly known. Previous regional surveys by Alameda-De la Mora (1980), Álvarez-Cadena (1985), Suárez-Morales and Gasca (1989), Morales-Ramírez (2001), Fernández-Álamo et al. (2000), Álvarez-Silva et al. (2003), and Morales-Ramírez and Suárez-Morales (2009) include only one species of *Pontellopsis* in this area of the ETP and *P. lubbockii* was not recorded. In some instances this could be a result of misidentifications or the rarity of the species. In this work we report and redescribe this poorly known pontellid based on female and male specimens collected during a series of zooplankton surveys carried out off the central Mexican Pacific coast. We also provide comments on the morphology of the mouthparts and a key for the identification of the males and females of the species of *Pontellopsis* recorded in this region.

Material and methods

The zooplankton samples analyzed were obtained at twelve sites sampled during 27 months between December 1995 and December 1998 on board the R/V BIP-V and "León Marino". Samples were collected at night time by oblique, semicircular trawls at different depths (10- 115 m) with a Bongo net (0.5 mm mesh size). The zooplankton samples were fixed and preserved with 4% formaldehyde buffered with sodium borate. Copepods were sorted from the original samples and transferred to 70% ethanol with a drop of glycerine for further analysis. Voucher specimens were deposited in the Zooplankton collection of El Colegio de la Frontera Sur, Chetumal, Mexico (ECO-CHZ).

Systematics

Order Calanoida Sars, 1903
Family Pontellidae Dana, 1853
***Pontellopsis* Brady, 1883**
***Monops* Lubbock, 1853**
***Pseudomonops* Claus, 1892**
***P. lubbockii* (Giesbrecht, 1889)**

***Monops lubbockii* Giesbrecht, 1899**
http://species-id.net/wiki/Monops_lubbockii
Figs 1–5

Type locality. Eastern Tropical Pacific (3–6°N, 80–82° W), about 400 km west of the coasts of Colombia and 320 km south of the Panama coast.

Material examined. Two adult females from the central Pacific of Mexico, 14 December 2010, 19.171 N; 104.912 W, coll. E. Kozak and C. Franco-Gordo, specimens undissected, vial deposited at El Colegio de la Frontera Sur, Chetumal, Mexico (ECO-CHZ-08957). One adult male, same date, site, and collector; specimen dissected, semi-permanent slides sealed with Entellan® (ECO-CHZ-08958). One adult male, 25 October, 2011, same site and collector; specimen dissected in slides sealed with Entellan® (ECO-CHZ-08959). One adult female, 24 October, 2011, 19.171N; 104.912W, coll. C. Franco-Gordo; specimen undissected, ethanol-preserved, vial (ECO-CHZ-08960). One adult male, 25 September, 1997, 19.033 N, 104.674 W, coll. C. Franco-Gordo; specimens undissected, ethanol-preserved, vial deposited in ECOSUR (ECO-CHZ-08961). One adult female from Californian coast, 7 October, 1904, 30.67 N, 119.59 W, Albatross cruise, Eastern Pacific Expedition, ethanol-preserved, identified by A. Fleminger (USNM-109384). One adult female from off Ecuador, South Pacific Ocean, 8 November, 1928, 01.531N, 82.273W, Carnegie Institution of Washington, ethanol-preserved (USNM-80382), previously examined by P. Pillai.

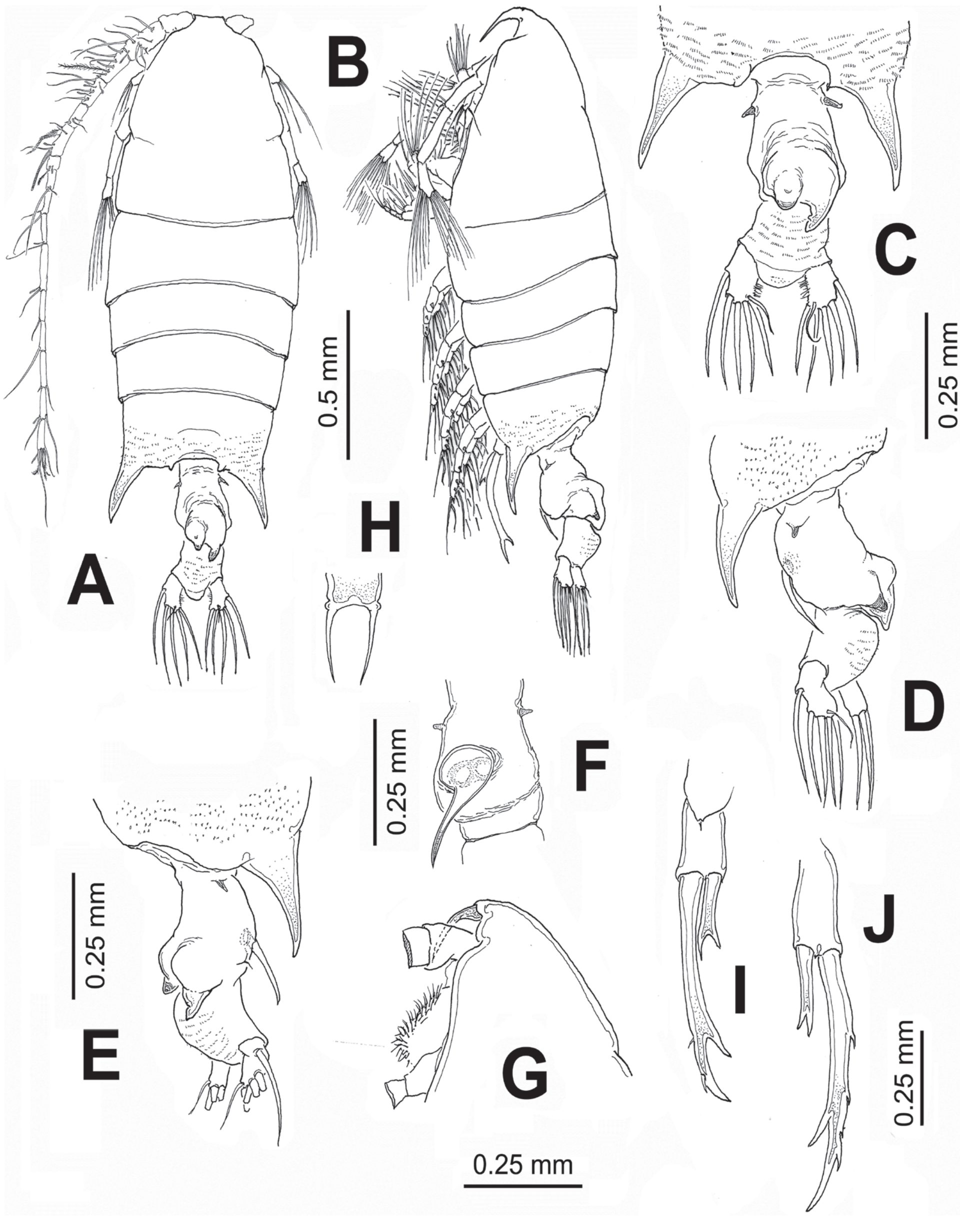


Figure 1. *Pontellopsis lubbockii* (Giesbrecht) from the Mexican Pacific. Adult female **A** habitus, dorsal view **B** same, lateral view **C** urosome showing details of dorsal processes of genital double-somite, ventral view **D** same, left lateral view **E** same, right lateral view **F** genital double-somite, ventral view **G** cephalic section, lateral view **H** rostrum, ventral view **I** right leg 5 **J** left leg 5.

Female. Body length of females range between: 2.09 and 2.17 mm (average 2.13 mm, *n*=5), measured from anterior cephalosome to posterior border of anal somite. Cephalosome robust, widest at level of fully separated first pedigerous somite. Pedigerous somites 4 and 5 fused; posterior corners of fifth pedigerous somite strongly developed, forming large spine-like processes (Fig. 1A, B). Processes straight, posteriorly directed, reaching about halfway along urosome. Cephalosome with rounded forehead, dorsal lenses absent. Rostrum bifid, with long, slender rostral filaments, gap between rostral rami wide (Fig. 1H), in lateral view reaching halfway of second antennular segment (Fig. 1G). Urosome with two segments: genital double somite and anal somite. Genital double-somite representing about 55% of urosome length, excluding caudal rami; somite strongly asymmetrical, with pair of dorsal protuberances arising from distal margin of somite (Fig. 1C, D). In dorsal view, right protuberance subtriangular, curved, posteriorly directed, reaching about half way along anal somite. Left process smaller, also posteriorly directed rounded tapering distally into strongly chitinized bulb-like process (Fig. 1C). Proximal margin of somite bearing lateral spine-like process on each margin, slightly asymmetrical, right one being longer. Ventral surface of genital double somite swollen, with sickle-shaped process arising anterior to genital operculum, posteriorly directed (Fig. 1D, E, F). Anal somite subrectangular, about 1.5 times wider than long, with rounded distomedial process between insertion points of caudal rami. Dorsal surface of anal somite swollen in lateral view, ornamented with rows of minute spinules. Caudal rami weakly asymmetrical, left ramus slightly larger than right, both rami bearing 6 setae: 1 inner, 3 terminal, 1 outer setae plus short, slender dorsal seta.

Antennules (Fig. 2A) symmetrical, 16-segmented. Segments armed as follows (Arabic numbers= setae; Roman numerals= spines, aes=aesthetascs): 1 (I-III) (1), 2 (IV-VII) (9+aes), 3 (VIII-X) (6,I+aes), 4 (XI-XIII) (4,II+3aes), 5 (XIV) (1,I+aes), 6 (XV-XVI) (4,I+ 2aes), 7(XVII) (1+aes), 8(XVIII) (1+aes), 9 (XIX) (1+aes), 10 (XX) (1+aes), 11 (XXI) (1+aes), 12 (XXII) (1), 13 (XXIII) (1), 14 (XXIV) (1,I), 15 (XXV) (2+aes), 16 (XXVI-XXVIII) (4+aes). Larger and longer setae on segments 2, 4, 7, 8, and 13. Modified, wide-based heavily setulated seta proximally inserted on segment 6; same segment with distally blunt, strongly chitinized spine reaching about 2/3 of way along succeeding segment 7 (Fig. 2A).

Antenna (Fig. 2B) biramous: coxa with short plumose distal seta. Basis and first endopodal segment separated, basis bearing 2 setae, one short, one long. First endopodal segment elongate, armed with two small subdistal setae. Second endopodal segment with 9 and 7 setae on proximal and distal lobes, respectively; distal lobe armed with basal outer row of spinules; exopod 6-segmented, setation formula 1, 2, 1, 1, 1,2.

Mandible (Figs 2C–E) with wide, heavily chitinized gnathobase; mandibular palp biramous, basipod robust, subrectangular, armed with inner basipodal seta. Endopod 2-segmented, first segment armed with 3 long and one short setae; second segment with 6 terminal setae. Exopod 5-segmented, setal formula as: 1, 1,1,1,2. Mandibular distal edge bearing 7 teeth: from ventral margin dentition includes one apical (a), one subapical (sa), two compound medial (med), and three basal (bas) (see Fig. 2C); medial teeth with rounded edges. Clusters of long and short spinules on base of medial teeth; dorsal end of gnathobase with tight row of setae.

Maxillule (Fig. 3A) typical of pontellids, praecoxal arthrite with 14 setal elements; coxal endite (cx end) with 3 long, robust spine-like elements on endite and 9 setae on

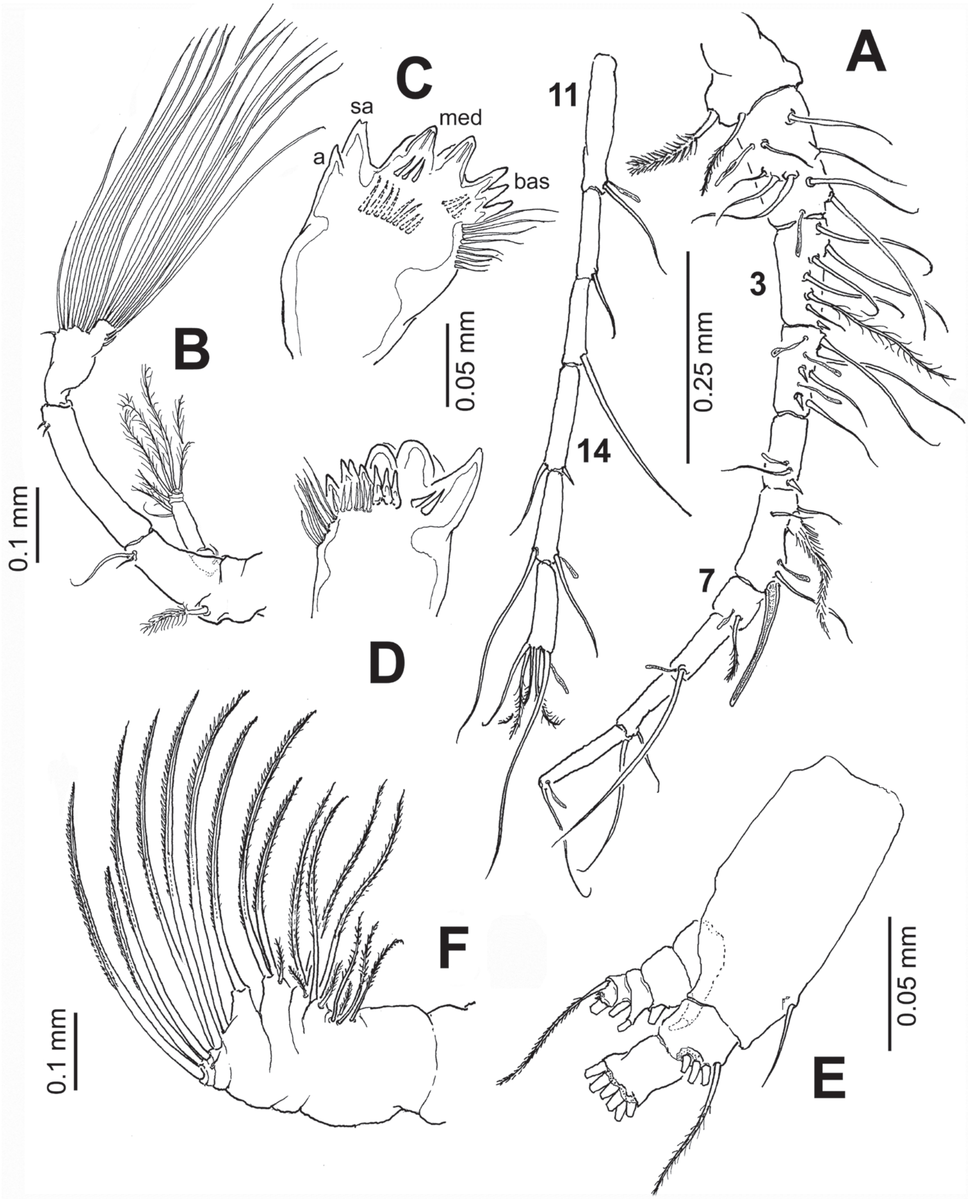


Figure 2. *Pontellopsis lubbockii* (Giesbrecht) from the Mexican Pacific. Adult female **A** antennule (in two sections) **B** antenna **C** mandible edge showing dentition, apical (**a**), subapical (**sa**), medial (**med**), and basal (**bas**) teeth **D** same, another view **E** mandibular palp **F** maxilla.

epipodite (epi); basis with 3 and 1 setae on proximal (bend1) and distal (bend2) endites, respectively; 1st and 2nd endopod segments, each with 2 setae, incorporated into basis, distal endopod segment with 5 apical setae; exopod with 8 setae.

Maxilla (Fig. 2F) uniramous, first praecoxal endite bearing 4 setae, second with 3 setae (one of them shorter and thinner than the others); two coxal endites each bearing

3 setae. Basis with 2 setae; endopod 4-segmented, setal formula of endopod as: 2, 2, 1, 1. Basal and endopodal setae strongly serrate.

Maxilliped (Fig. 3B) uniramous, with praecoxa and coxa fused, three syncoxal endites well developed, with setal formula 2, 2, 3; endites setae strong, serrate. Inner lateral margin of third endite with rows of short setae. Basis fringed with medial row of 5-6 spinules and 2 distal setae. Endopod 4-segmented, setal formula of endopod as: 2, 1, 1, 2.

Leg 1 with 3-segmented endopod; legs 2-4 with 2-segmented endopods and 3-segmented exopods (Figs 3C-F). Coxae with plumose inner seta; basis of leg 4 with slender outer seta, medial patch of spinules on medial anterior margin of legs 3 and 4. First endopodal segment of second leg with inner rounded protuberance (arrowed in Fig. 3D). In one specimen examined, terminal exopodal spine of legs 3 and 4 modified, represented by flexible seta (Italized in setal formula) (Fig. 3G,H). Seta and spine formula (Arabic numbers=setae, Roman numerals=spines) of legs 1-4 as:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-1	0-0	I-1;I-1;II,I,4	0-1;0-2;1,2,3
Leg 2	0-1	0-0	I-1; I-1;III,I,5	0-3; 2,2,4
Leg 3	0-1	0-0	I-1; I-1; III,*1*,5	0-3; 2,2,4
Leg 4	0-1	1-0	I-1; I-1;III,*1*,5	0-3; 2,2,3

Leg 5 (Fig. 1I, J) biramous, slightly asymmetrical; coxa and intercoxal sclerite fused. Basis subrectangular, naked. Endopod distally bifurcate, about 0.3 times as long as exopodal ramus. Exopod of both legs 1-segmented, elongate, right leg with 3 outer spiniform processes and a large distal inner process; left leg smooth except for two subdistal outer spine-like setae.

Male. Body (Fig. 4A) robust, slightly smaller than female (1.85–2.07 mm, average: 1.98 mm, *n*=4). Cephalosome about 3.5 times as long as urosome (caudal rami excluded), dorsal surface of cephalosome pilose, particularly pedigerous somites 1-5. Fifth pedigerous somite with asymmetrical lateral expansions, left process spiniform, reaching posterior margin of first urosomite; right side with long curved, ventromedially directed process with small, distally curved rounded process (Fig. 4B). Urosome (Fig. 4A-C) with 5 somites. Genital double-somite strongly asymmetrical, left side with 2 sensilla on outer distal corner; right side expanded forming rounded process armed with two unequal setae (Fig. 4C). Second urosomite with pair of sensillae on right side; third urosomite as long as succeeding somite, with strong laterally-directed rod-like process on right margin, process armed with anterodistal curved row of teeth-like spinules, a short seta, and terminal rows of spinules (Fig. 4D). Anal somite symmetrical, as long as preceding somite. Caudal rami slightly asymmetrical, approximately twice as long as wide.

Right antennule (Fig. 4E–G) with 12 segments geniculate between segments 10–11, reaching middle of third pedigerous somite. Antennular segments armed as follows (Arabic numbers= setae; Roman numerals= spines, aes=aesthetascs): 1 (I-III)

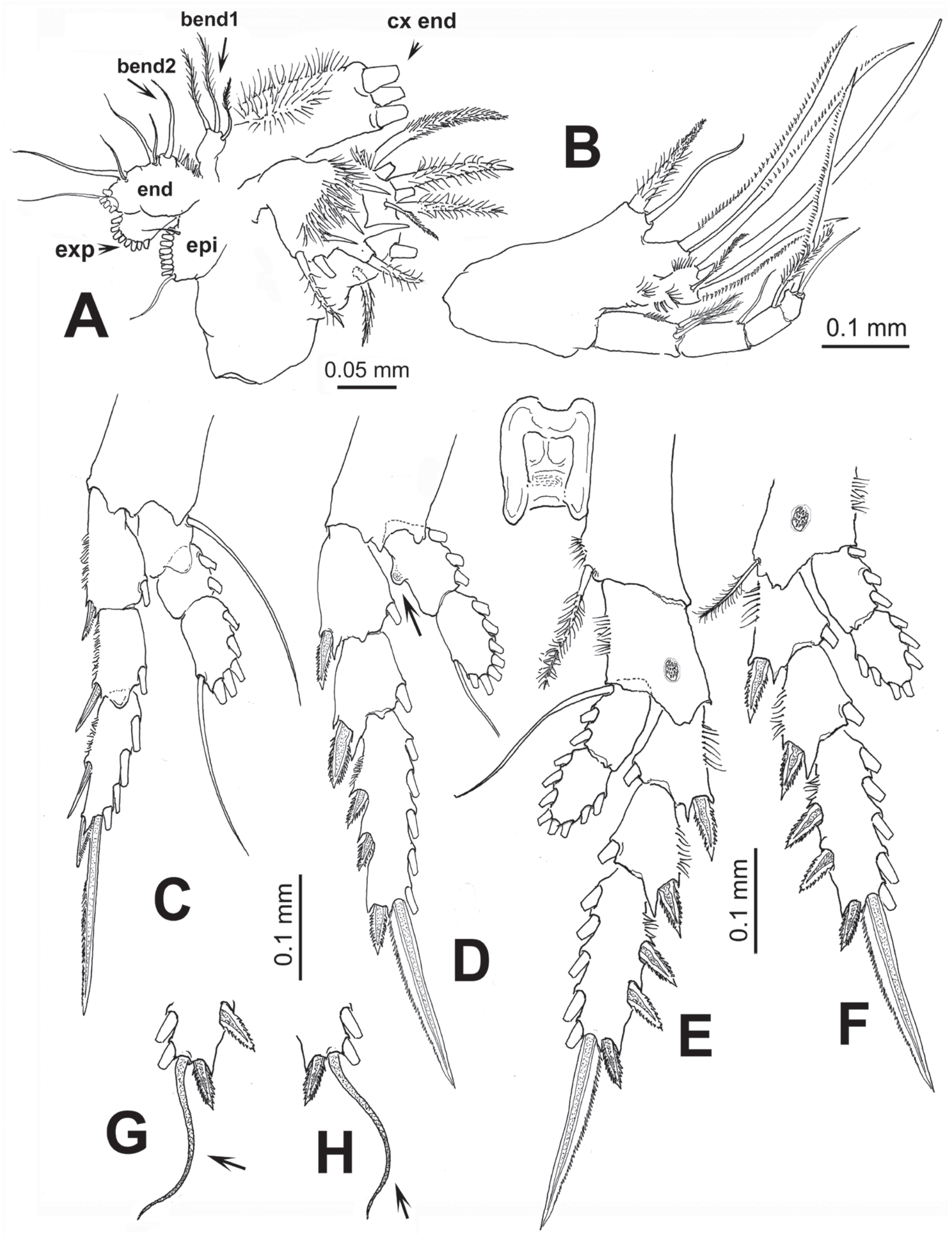


Figure 3. *Pontellopsis lubbockii* (Giesbrecht) from the Mexican Pacific. Adult female **A** maxillule showing armature of coxal endite (**cx end** distal spiniform elements cut short), proximal basal endite (**bend1**), distal basal endite (**bend2**), epipodite (**epi**), exopod (**exp**), and endopod (**end**) **B** maxilliped **C** leg 1 **D** leg 2 **E** eg 3 **F** leg 4 **G** variant form of leg 3 third exopodal segment with flexible terminal setal element (arrowed) **H** same, leg 4.

(1), 2 (IV-VII) (8+2aes), 3 (VIII-X) (2), 4 (?) (2), 5 (?) (2+aes), 6 (X-XIV) (5+ 2aes), 7 (XV-XVI) (4+aes), 8 (XVII) (2,I+aes), 9 (XVIII-XIX) (3+aes), 10 (XX) (1), 11(XXI-XXIII) (1,II), 12 (XXIV-XXVIII) (8+aes). Spine on segment 8 long, slightly curved;

segments 9 and 10 with coarse double row of acuminate sharp teeth (Fig. 4F). Segment 11 with proximal process forming fan-like row of strong spines plus two usual stout spines adjacent to segmental margin (Fig. 4G). Anterior margin of segments 10 and 11 with usual spiniform processes parallel to segmental margin. Left antennule as in female except for shorter spiniform process on segment 6 which is also relatively shorter than in female (Fig. 5A).

Leg 5 (Figs 5B–E) asymmetrical, typical of pontellids. Left leg 5 short; coxa quadrate, basipod (bp) robust, cylindrical, naked. Exopod 3-segmented, segments 2–3 partly fused; first segment cylindrical, with subtriangular process on outer distal margin. Second exopodal segment (Fig. 5E) with medial surface covered by patch of long hair-like setae, segment with inner rounded expansion and subdistal seta on outer lateral margin; third segment with 2 unequal spines plus inner spiniform process. Right leg 5 basis with 2 unequal setae. Exopod with two segments, forming robust, widely open chela; first segment (exp1) forming thumb of chela ending in short, strong process curving inward with inner surface armed with shallow cuticular ridges and small spinules (Fig. 5C). Second exopodal segment forming distal elongate finger, tapering distally, armed with two subequal proximal setae on outer surface plus one proximal and one distal setae inserted on inner surface of segment (Fig. 5D).

Remarks. Our specimens from the Mexican Pacific were identified as *P. lubbockii* by the females having acute, symmetrical posterolateral corners of the fifth pedigerous somite plus an asymmetrical genital double-somite as long as the anal somite and with two dorsal protuberances. Males have a long, curved process on the right side of the fifth pedigerous somite, a laterally directed process on the third urosomite combined with a pair of long stout setae on the right margin of the genital double somite. Females of this species are easily distinguishable from its congeners by the structure and details of the genital double somite. It is unique in having two conical dorsal processes and also a ventral spine arising from the genital field. One of these processes might have been overlooked in previous descriptions (Giesbrecht 1889; Pillai 1977) but its presence was confirmed in museum specimens from California (USNM-109384) and off Ecuador (USNM-80382). There are other species of *Pontellopsis* bearing dorsal processes, like *P. inflatodigitata* Chen & Shen, 1974, *P. laminata* Wilson, 1950, *P. herdmani* Thompson & Scott, 1903, *P. scotti* Sewell, 1932, *P. macronyx* Scott, 1909, and *P. yamadae* Mori, 1937. Only one such dorsal process is illustrated in previous illustrations of *P. lubbockii,* appearing as a single, robust, mammiliform, dorsal process (Giesbrecht 1893; Pillai 1977), but our redescription shows that there are two conspicuous processes; a similar pattern is present in *P. albatrossi* Wilson, 1950. When two dorsal processes are present, they are differently built; in *P. laminata*, the left process is very large, clearly spiniform, laterally projected, whereas the right one is reduced to a low protuberance (see Pillai 1977). In *P. herdmani*, there are two thorn-like projections on the left side (Thompson and Scott 1903); *P. lubbockii* also differs from *P. scotti*, which has a single spiniform dorsolateral process and an enlarged right proximal spine. *Pontellopsis macronyx* has a pair of dorsal spiniform processes, different from the robust, conical processes found in *P. lubbockii* (Scott 1909; Chen and Shen

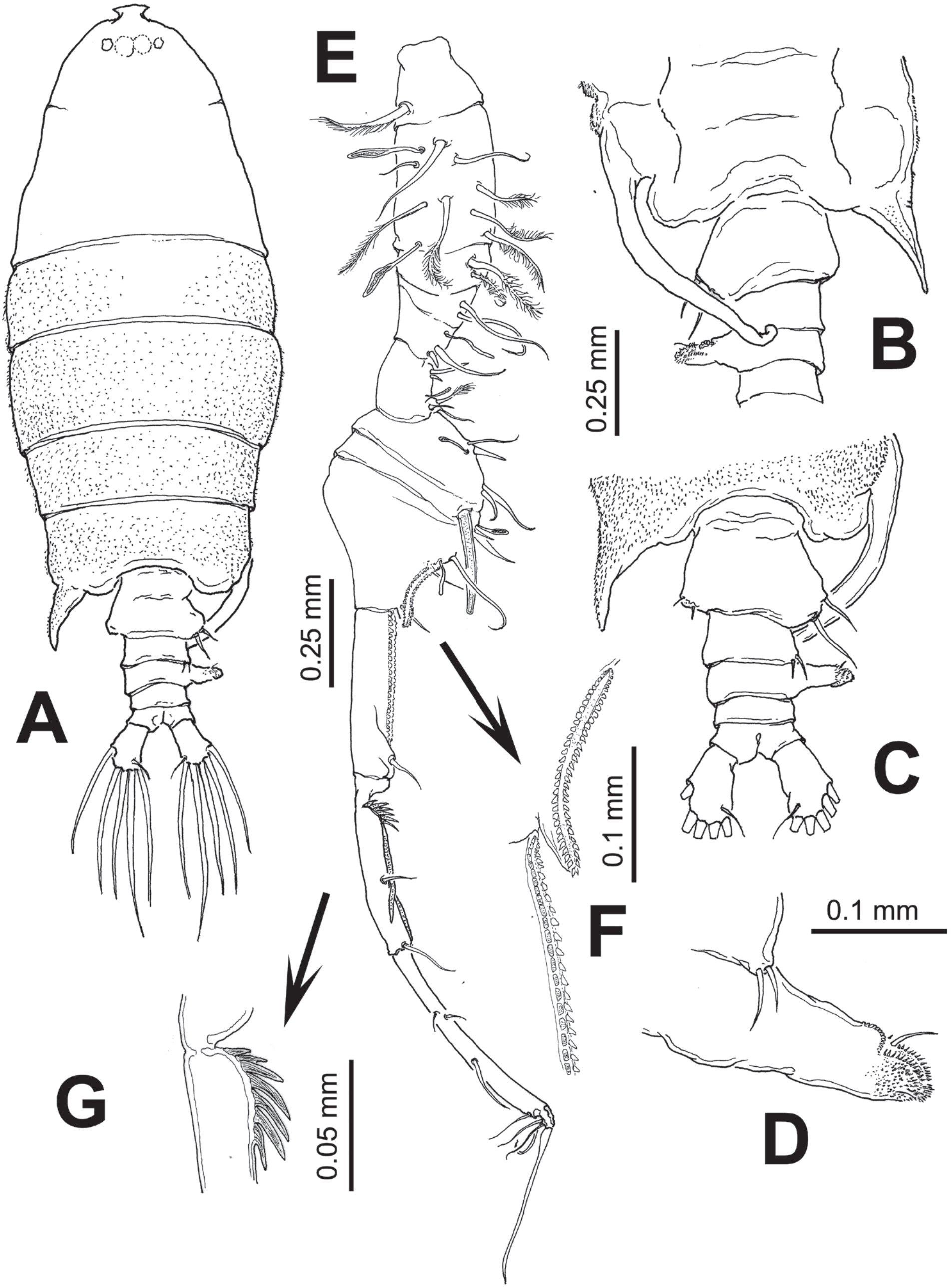


Figure 4. *Pontellopsis lubbockii* (Giesbrecht) from the Mexican Pacific. Adult male **A** habitus, dorsal view **B** urosome, ventral view **C** same, dorsal view **D** detail of process on right margin of third urosomite **E** geniculate antennule **F** detail of ornamentation on antennular segments 9 and 10 (arrowed) **G** detail of ornamentation of proximal part of antennular segment 11 (arrowed).

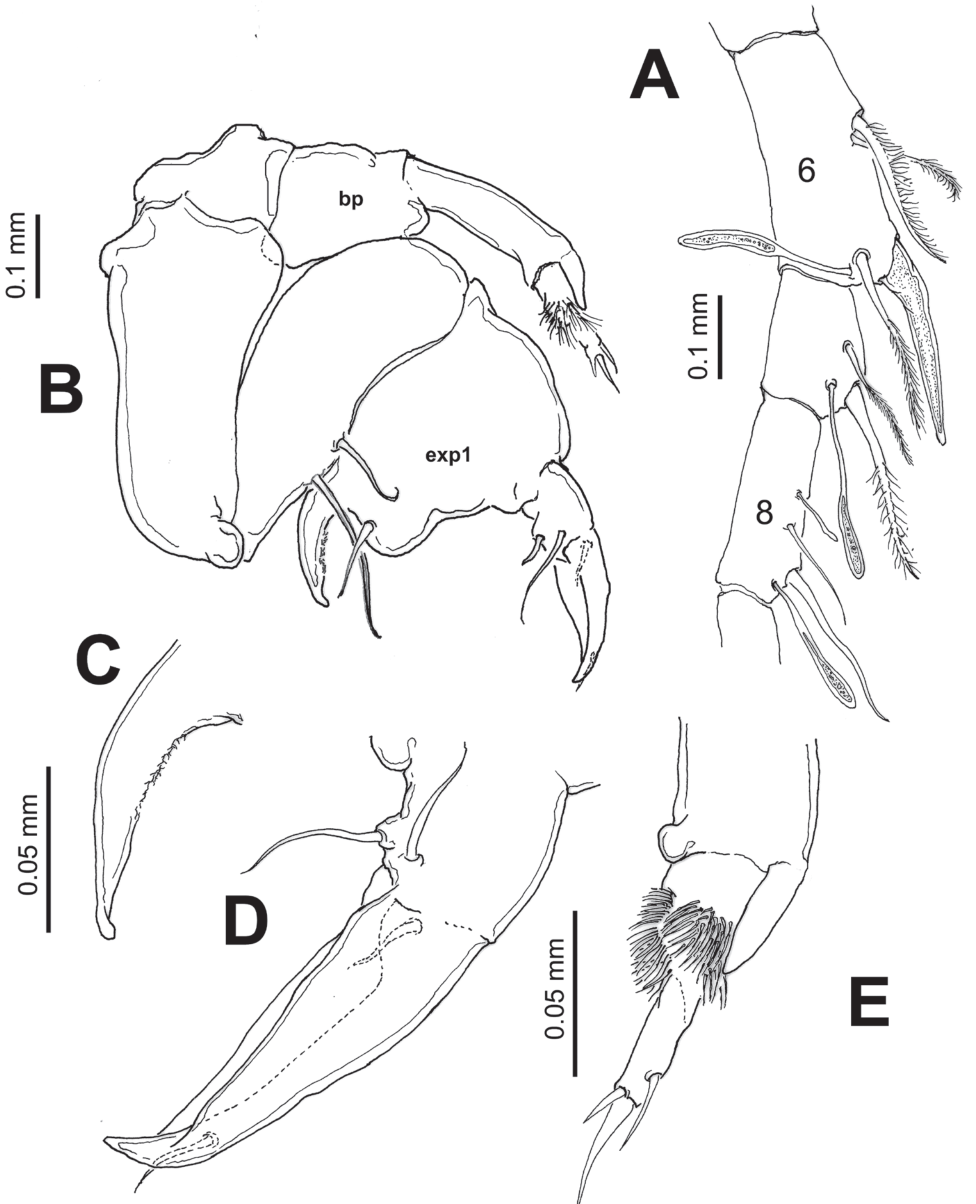


Figure 5. *Pontellopsis lubbockii* (Giesbrecht) from the Mexican Pacific. Adult male **A** left antennule, segments 6–8 showing spiniform process on segment 6 **B**. leg 5 showing basipod (**bp**) of left ramus and first exopodal segment of right ramus (**exp1**) **C** right leg, detail of basal thumb of chela **D** right leg, detail of second exopodal segment or distal finger of chela **E** left leg, distal segments and ornamentation.

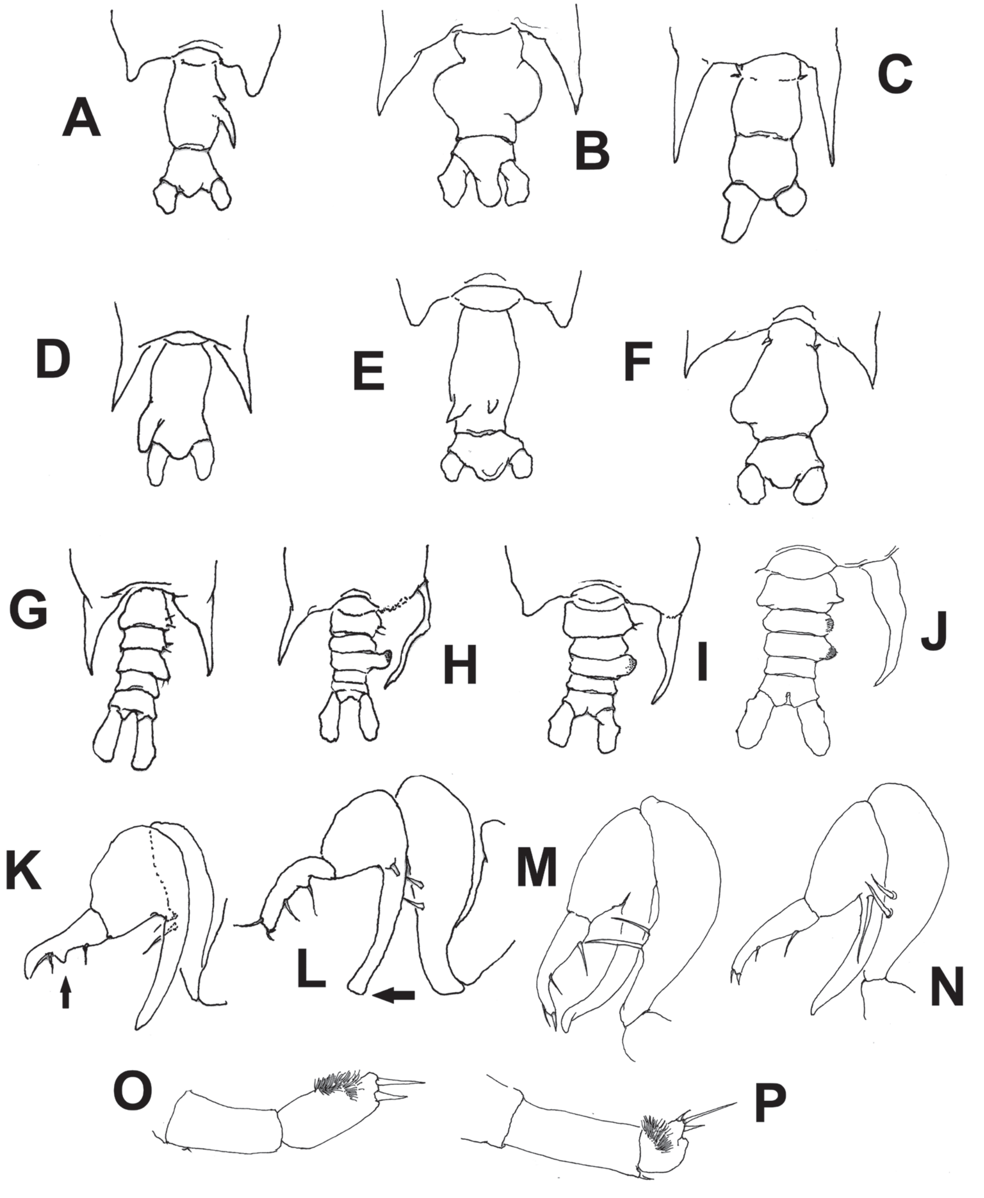


Figure 6. Schematic illustrations of characters used in the identification key to species of *Pontellopsis* from the Eastern Tropical Pacific. Explanation in key couplets. Illustrations modified from Giesbrecht (1893), Mori (1937), Chen & Zheng (1965), Mulyadi (2002), and Palomares-García et al. (1998).

1974). A different pattern, with a single globose lateral process tapering distally into a spine was depicted for the same nominal species by Silas and Pillai (1973), but it also diverges from the pattern observed in *P. lubbockii*. The structure of the female genital double-somite of *P. yamadae* is probably the most similar to that of *P. lubbockii* and in some cases both species may be confused, but the dorsal processes are quite distinct, digitiform, none of them reaching the dorsal margin of the somite (Mori 1937; Jeong et al. 2009). Both species also differ in the structure of the thoracic processes, short, rounded in *P. yamadae* and long, spiniform in *P. lubbockii*. The structure of the female leg 5 is also different in both species, with a much shorter and more robust outer ramus in *P. yamadae* (see Mori 1937).

The extremely long spiniform ventral process present in the genital double-somite of *P. lubbockii*, is a unique character of this species and has not been hitherto described in or illustrated in previous works (Giesbrecht 1893; Pillai 1977). In only a few species of the genus a ventral process related to the genital field has been described: in *P. albatrossi*, *P. armata*, and *P. villosa* (Brady 1883) it is a short, curved spine arising from the genital field (Zheng et al. 1982). Yet another interesting character of *P. lubbockii* is the modification of the distal spines of the third exopodal segment of legs 3 and 4, they are flexible elements, thus contrasting with the usual pattern of stout, spiniform terminal setae. The data available to us from various descriptions suggest that this is a unique character among members of this genus.

The mandibular dentition found in our specimens agrees with the pattern described by Fleminger (1956) for this species and genus; dentition is quite uniform among species of *Pontellopsis* and its taxonomical value is weak. In addition, this species has the main characters described by Ohtsuka and Onbé (1991) as Type II specialized mouthparts for predation, with serrate maxillar setae, a relatively narrow mandibular edge armed with sharp, blade-like teeth, and clusters of setae and spinules near the base of the teeth. Overall, our analysis supports the notion that this species is a predator, as long known for other species of *Pontellopsis* (Lillelund and Lasker 1971).

Distribution of *Pontellopsis* in the Eastern Tropical Pacific

In the Eastern Pacific, particularly in the California Current region, only a few species of *Pontellopsis* have been recorded: *Pontellopsis occidentalis* Esterly, 1906, *P. regalis* (Dana, 1849), and *P. lubbockii*. *Pontellopsis occidentalis* is regarded as endemic of southern California, the Gulf of California, and Baja California area. *Pontellopsis regalis* is frequently found in waters of the ETP (Fleminger 1967a; Brinton et al. 1986; Hernández-Trujillo 1989, 1994). Additional records of the genus are found south of the California Current region, off the southern sector of Baja California and the Mexican Pacific: *P. armata* (Giesbrecht, 1889), *P. tenuicauda* (Giesbrecht, 1889), *P. brevis* (Giesbrecht, 1889), *P. perspicax* (Dana, 1849), and *P. yamadae* Mori, 1937 (Hernández-Trujillo 1989, 1994; Suárez-Morales and Gasca 1998; Palomares-García et al. 1998; Hernández-Trujillo et al. 2004). So far, only 8 out of the 33 known species of the genus have been recorded in the Eastern Tropical Pacific. The genus is clearly more diverse in the Indo-West Pacific, a region harboring many endemic or presumably endemic forms as a result of the geological history and biogeographic processes related to that geologically complex area (Fleminger 1986).

Key to the species of *Pontellopsis* of the Eastern Pacific

Females

1A	Posterolateral corners of fifth pedigerous somite with terminally rounded processes (Figs 6A, E)........ **2**
1B	Posterolateral corners of fifth pedigerous somite forming acute spiniform processes (Fig. 6B,C,D,F) **3**
2A	Genital double-somite elongate, with 2 acute dorsal processes of unequal size on posterior half of somite (Fig. 6E) .... ***P. yamadae***
2B	Genital double-somite with 2 unequal spiniform processes, one small, one long, in right side of posterior half of somite (Fig. 6A)........ ***P. tenuicauda***
3A	Spiniform processes of fifth pedigerous somite reaching the middle length of anal somite or beyond (Fig. 6C, D) **4**
3B	Spiniform processes of fifth pedigerous somite not as long, barely reaching the posterior margin of the genital double-somite or even shorter (Fig. 6 B,F) **5**
4A	Genital double-somite with strong, thumb-like process on left margin. Anal somite half the length of genital double-somite (Fig. 6D) .... ***P. villosa***
4B	Genital double-somite without distinct process. Anal somite as long as genital double-somite (Fig. 6C) .... ***P. armata***
5A	Genital double-somite as long as or slightly longer than anal somite, with processes or expansions on both margins or on dorsal surface **6**
5B	Genital double-somite twice as long as anal somite, with lateral process on right margin only .... ***P. occidentalis***
6A	Genital double- somite with two dorsal conical unequal protuberances .... ***P. lubbockii***
6B	Genital double- somite with no such dorsal processes 7
7A	Both lateral margins of genital double-somite expanded forming nearly symmetrical rounded processes, that on the right side globular; anal somite strongly produced between caudal rami (Fig. 6B) .... ***P. perspicax***
7B	Genital double-somite with asymmetrical, rounded lateral processes, anal somite not strongly produced between caudal rami (Fig. 6F) .... ***P. regalis***

Males

1A	Posterolateral corners of fifth pedigerous somite with symmetrical or nearly symmetrical processes (Fig. 6G) **2**
1B	Posterolateral corners of fifth pedigerous somite with strongly asymmetrical processes, with long, slender, curved process on the right side (Fig. 6H) **3**
2A	Second urosomite with small lateral process on the left margin; second exopodal segment of left leg 5 cylindrical, as long as preceding segment (Fig. 6O),

process on first exopodal segment of right leg 5 very short, distally blunt .... ***P. occidentalis***

2B Second urosomite without such process on left margin; second exopodal segment of left leg 5 globose, half as long as preceding segment (Fig. 6P), process on first exopodal segment of right leg 5 short, distally acute............ ***P. villosa***

3A Left posterolateral corner of fifth pedigerous somite forming short terminally rounded or broadly subtriangular process, not acute (Fig. 6I) **4**

3B Left posterolateral corner of fifth pedigerous somite forming relatively long acute process (Fig. 6H) **5**

4A Second and third urosomites with weak lateral expansions (Fig. 6I), process on first exopodal segment of right leg 5 long, distally truncate (arrow in Fig. 6L)... ***P. tenuicauda***

4B Second and/or third urosomites with lateral expansion on right side, process on first exopodal segment of right leg 5 long, tapering distally (Fig. 6 K, M, N) 7

5A First urosomite symmetrical, armed with small unequal setae inserted on posterolateral margin.. **6**

5B First urosomite clearly asymmetrical, with rounded process on right lateral margin; process armed with two long, stout setae....................... ***P. lubbockii***

6A Right posterolateral corner of fifth pedigerous somite long, acute, tapering distally (Fig. 6I); caudal rami as long as wide, distal segment of chela with protuberance on medial position of inner margin (arrow Fig. 6K)............ ***P. regalis***

6B Right posterolateral corner of fifth pedigerous somite long, slender from insertion, branch-like (Fig. 6H); caudal rami twice as long as wide, distal segment of chela with low proximal expansion on inner margin .... ***P. armata***

7A Second and third urosomites expanded laterally, process on first exopodal segment of right leg 5 shorter than second exopodal segment (Fig. 6N) .... ***P. yamadae***

7B Only third urosomite expanded laterally. Right leg 5 with finger-like process of first exopodal segment longer than second exopodal segment (Fig. 6M)... .... ***P. perspicax***

Acknowledgements

This work is part of the doctoral thesis presented by E.K. in the postgraduate program of the Universidad de Guadalajara. Carmen Franco-Gordo and Enrique González-Domínguez (CUCSUR-Universidad de Guadalajara) kindly granted access to this material. Funding for fieldwork and general logistic support was provided by CUCSUR, Universidad de Guadalajara. We thank the crew of the R/V 'BIP-V' for their help and guidance during these years of sampling. Rosa Ma. Hernández deposited the specimens examined in the collection of Zooplankton at El Colegio de la Frontera Sur (ECOSUR), Chetumal, Mexico. The comments and valuable suggestions of two referees allowed us to improve a previous version of this contribution, particularly in reference to the interpretation and description of morphological details of the mouthparts. The fine editorial work and processing of the manuscript by Danielle Defaye is deeply appreciated.

References

Alameda-De la Mora G (1980) Sistemática y Distribución de los Copépodos (Crustacea) del Golfo de Tehuantepec (México). Tesis de Licenciatura, Fac. de Ciencias, Universidad Nacional Autónoma de México.

Álvarez-Cadena JN (1985) Composición y abundancia de los copépodos planctónicos de la Bahía de Mazatlán. Anales del Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México 12: 1–14.

Álvarez-Silva C, Miranda-Arce MG, De Lara-Isassi G (2003) Familia Pontellidae (Crustacea: Copepoda) en la Bahía La Ventosa, Oaxaca, México: Sistemática y ecología. Revista de Biología Tropical 51: 737–742.

Boxshall GA, Halsey SH (2004) An Introduction to Copepod Diversity. The Ray Society, London, 966 pp.

Brady GS (1883) Report on the Copepoda collected by H.M.S. Challenger during the years 1873–1876. Reports of the Scientific Results of the Voyage of the Challenger Zoology 8: 1–142.

Brinton E, Fleminger A, Siegel-Causey D (1986) The temperate and tropical planktonic biotas of the Gulf of California. CalCOFI Reports 27: 228–266.

Chen QC, Zhang SZ (1965) The planktonic copepods of the Yellow Sea and the East China Sea I. Calanoida. Studia Marina Sinica 7: 20–131.

Chen QC, Shen CJ (1974) The pelagic copepods of the South China Sea. II. Studia Marina Sinica 9: 125–137.

El-Sherbiny M, Ueda H (2008) Redescription of the poorly known calanoid copepod *Pontella karachiensis* Fazal-Ur-Rehman, 1973 from the Red Sea with notes on its feeding habits. Plankton & Benthos Research 3: 19–17.

Fernández-Álamo MA, Sanvicente-Añorve L, Alameda-De la Mora G (2000) Copepod assemblages in the Gulf of Tehuantepec, Mexico. Crustaceana 73: 1139–1153. doi: 10.1163/156854000505137

Fleminger A (1956) Taxonomic and distributional studies on the epiplanktonic calanoid copepods (Crustacea) of the Gulf of Mexico. PhD Thesis, Harvard University Library, Cambridge, 317 pp.

Fleminger A (1967a) Distributional atlas of calanoid copepods in the California Current region, Part II. CalCOFI Atlas 7: 1–213.

Fleminger A (1967b) Taxonomy, distribution and polymorphism in the *Labidocera jollae* group with remarks on evolution within the group (Copepoda: Calanoida). Proceedings of the US National Museum 120: 1–61.

Fleminger A (1975) Geographical distribution and morphological divergence in American coastal-zone planktonic copepods of the genus *Labidocera*. In: Cronin LE (Ed.) Estuarine research: 1: Chemistry, biology and the estuarine system. Academic Press, NY, 392–418.

Fleminger A (1986) The Pleistocene equatorial barrier between the Indian and Pacific Oceans and a likely cause for Wallace's Line. UNESCO Technical Papers on Marine Science 49: 84–97.

Giesbrecht W (1889) Elenco dei Copepodi pelagici raccolti dal tenente di vascello G. Chierchia durante il Viaggio della R. Corvetta: Vettor Pisani" negli anni 1882–1885 e dal tenente di vascello F. Orsini nel Mar Rosso, nel 1884. Atti Accad. naz Liucei. Rd., Ci. Sci. fis. mat. nat. 4: 24–29.

Giesbrecht W (1893) Systematik und Faunistik der pelagischen Copepoden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Fauna Flora Golfes Neapel 19: 1–831.

Hernández-Trujillo S (1989) Copépodos de la familia Pontellidae en Baja California Sur (1982–1984). Investigaciones Marinas CICIMAR 4: 225–232.

Hernández-Trujillo S (1994) Pontellidae copepods in the Pacific off Baja California, México, July 1988. Investigaciones Marinas CICIMAR 9: 55–58.

Hernández-Trujillo S, Palomares-García R, López-Ibarra GA, Esqueda-Escárcega G, Pacheco R (2004) Riqueza específica de copépodos en Bahía Magdalena, Baja California Sur, México. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 75: 253–270.

Jeong HG, Suh HL, Soh HY (2009) *Pontellopsis* species (Copepoda, Pontellidae) in the Korean waters, with notes on the female genital structures and their zoogeography. Animal Cells and Systems 13: 187–203. doi: 10.1080/19768354.2009.9647211

Lillelund K, Lasker R (1971) Laboratory studies of predation by marine copepods on fish larvae. Fishery Bulletin 69: 655–667.

Matsuo Y, Marumo R (1982) Diurnal vertical migration of pontellid copepods in the Kuroshio. Bulletin of the Plankton Society of Japan 29: 89–98.

Mori T (1937) The pelagic Copepoda from the neighboring waters of Japan. Soyo Company, Tokyo, 150 pp.

Morales-Ramírez A (2001) Biodiversidad marina de Costa Rica, los microcrustáceos: Subclase Copepoda (Crustacea: Maxillopoda). Revista de Biología Tropical 49(2): 115–133.

Morales-Ramírez A, Suárez-Morales E (2009) Copepoda. In: Wehrtmann IS, Cortés J (Eds) Marine Biodiversity of Costa Rica. Monographiae Biologicae 86, Springer Science, The Netherlands, 291–305. doi: 10.1007/978-1-4020-8278-8_27

Mulyadi (2002) The calanoid copepods family Pontellidae from Indonesian waters, with notes on its species-groups. Treubia 32: 1–167.

Ohtsuka S, Onbé T (1991) Relationship between mouthpart structures and in situ feeding habits of species of the family Pontellidae (Copepoda: Calanoida). Marine Biology 111: 213–225. doi: 10.1007/BF01319703

Othman BHR, Toda T (2006) Pontellid copepods from Singapore. Coastal Marine Science 30: 305–319.

Palomares-García R, Suárez-Morales E, Hernández-Trujillo S (1998) Catálogo de los copépodos (Crustacea) pelágicos del Pacífico Mexicano. CICIMAR-IPN/ECOSUR, México City, 352 pp.

Pillai PP (1977) On the identity of certain specimens of *Pontellopsis B*rady (Copepoda : Calanoida) of the 'Wilson Collection' deposited in the US National Museum. Journal of the Marine Biology Association of India 19: 58–67.

Razouls C, de Bovée F, Kouwenberg J, Desreumaux N (2012) Diversity and geographic distribution of marine planktonic copepods. Available at http://copepodes.obs-banyuls.fr/en

Scott A (1909) The Copepoda of the Siboga Expedition. 1. Free-swimming, littoral and semi-parasitic Copepoda. Siboga Expedition Monographs 29: 1–323.

Sherman K (1963) Pontellid copepod distribution in relation to surface water types in the central North Pacific. Limnology and Oceanography 8: 214–227. doi: 10.4319/lo.1963.8.2.0214

Sherman K (1964) Pontellid copepod occurrence in the central South Pacific. Limnology and Oceanography 9: 476–484. doi: 10.4319/lo.1964.9.4.0476

Silas EG, Pillai PP (1973) The calanoid copepod family Pontellidae from the Indian Ocean. Journal of the Marine Biology Association of India 15: 771–858.

Suárez-Morales E, Gasca R (1989) Copépodos calanoides epipelágicos del Domo de Costa Rica Junio-Agosto, 1982. Ciencias Marinas 15: 89–102.

Suárez-Morales E, Gasca R (1998) Updated checklist of the marine Copepoda (Crustacea) of Mexico. Anales del Instituto de Biología, Universidad Nacional Autónoma de México, Serie Zoología 69: 105–119.

Thompson IC, Scott A (1903) Report on the Copepoda collected by Prof. Herdman at Ceylon in 1902. Ceylon Pearl Oyster Fisheries 7: 227–307.

Walter TC, Boxshall GA (2012) *Pontellopsis* Brady, 1883. World Copepoda database. Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=104211

Wilson CB (1950) Copepods gathered by the United States Fisheries Steamer "Albatross" from 1887 to 1909, chiefly in the Pacific Ocean. Bulletin of the US National Museum 100: 141–441.

Zheng Z, Li S, Li SJ, Chen B (1982) Marine planktonic copepods in Chinese waters. Shanghai Scientific and Technological Press, Shanghai, 162 pp. [in Chinese]

ZooKeys 234: 19–57 (2012)
doi: 10.3897/zookeys.234.3658
www.zookeys.org

CHECKLIST

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

Hard ticks (Acari, Ixodidae) of Croatia

Stjepan Krčmar[1]

[1] *Department of Biology, J.J. Strossmayer University of Osijek, Cara Hadrijana 8/A, HR-31000 Osijek, Croatia*

Corresponding author: *Stjepan Krčmar* (stjepan@biologija.unios.hr)

Academic editor: *D. Apanaskevich* | Received 9 July 2012 | Accepted 15 October 2012 | Published 30 October 2012

Citation: Krčmar S (2012) Hard ticks (Acari, Ixodidae) of Croatia. ZooKeys 234: 19–57. doi: 10.3897/zookeys.234.3658

Abstract

The present paper is based on original and literature data. In Croatia the first studies on the occurrence of ixodid species were made about 80 years ago. The number of tick species recorded in Croatia considerably increased during the 1950s, 60s, 70s and 80s of the past century. A total of 21 species of hard tick belonging to 5 genera have been recorded in Croatia. *Ixodes* is the best represented genus, with seven species recorded. *Haemaphysalis* is represented by six species, followed by *Rhipicephalus* with four species. *Dermacentor* and *Hyalomma* are represented by two species each. The ticks were collected on 47 different host species. Eleven tick species were collected on *Bos taurus* and *Ovis aries*, followed by *Capra hircus* and *Equus caballus* with 8 species and *Canis lupus familiaris* with 6 species. On the remaining 42 host species one, two or three tick species were collected. The most widespread tick is *Ixodes ricinus* which was found on 25 different host species.

Keywords

Ixodidae, hard ticks, Croatia, Europe

Introduction

Hard ticks (Acari: Ixodidae) are obligate hematophaguos ectoparasites and important vectors of viruses, bacteria and protozoa (Rijpkema et al. 1996, Polić et al. 2002, Duh et al. 2006, 2010, Hornok and Farkas 2009, Hubálek 2010). They are considered second only to mosquitoes as the most medically important group of arthropods (Jaenson and Jensen 2007). Approximately 10% of the currently known 896 tick species are vectors of pathogens from wild animals to humans (Milutinović and Radulović 2002). In Croatia, the first comprehensive studies on the occurrence of ixodid species were made about 80 years ago (Oswald, 1940, 1941a, 1941b). During the 1950s and 1960s, ticks in Croatia were studied from the ecological point of view (Mikačić 1949, 1961, 1963, 1965, 1968, 1969). For that period, the data on tick fauna along the Adriatic Coast are numerous because Prof. Dr. Davor Mikačić, in several of his articles, presented the distribution and dynamics of hard ticks along the Adriatic coast from Pula to Dubrovnik. Furthermore, ecological studies of ticks were carried out on many islands in the Adriatic Sea during the 1970s, and 1980s, with special emphasis on the medical importance of ticks (Tovornik 1976a, 1976b, 1980, 1984, 1987a, 1988b, 1990a, 1991a, 1991b, Tovornik and Černy 1972, Tovornik and Šooš 1976, Tovornik and Brelih 1980, Tovornik and Vesenjak-Hirjan 1988, 1989, Vesenjak-Hirjan 1976, Vesenjak-Hirjan et al. 1977). In Europe, the number of papers on canine tick-borne diseases has progressively increased in the past few years (Földvári 2005). Climate change contributes significantly to the change of habitat conditions which may affect the geographic range expansion of some species of ticks and thus the spread of various pathogens (Lindgren et al. 2000). This indicates the importance of creating a list of the tick fauna in European countries, due to possible changes in the fauna of ticks and tick-borne pathogens. Another reason for creating a list of the Croatian tick fauna is that some tick species have been mistakenly referred to as new for the fauna or were omitted from the list of the Croatian tick fauna on the website of Fauna Europaea, although they had already been identified many years ago. Thus, the principal aim of this study is to summarize all available data on the tick fauna of Croatia. This work is based on literature findings and on the data obtained from faunistic research carried out during 2011 in the continental part of eastern Croatia (Slavonia and Baranja).

Material and methods

The following lists of species include all available literary records and new, still unpublished data. The samplings of ticks in Slavonia and Baranja were carried out during 2011 from the beginning of March to mid-September. Ticks were sampled by the flagging method, and were picked by hand from domestic animals and humans. The flagging method was used for tick sampling in two different vegetation types around the village of Mikleuš (YL 15). A 1 m^2 white flag was dragged over the vegetation for about 50 m at each locality. The first locality was in the mixed forests of durmast oak and hornbeam (as. *Epimedio-Carpinetum betuli* /Horvat 1938/ Borhidi 1963), whereas the second locality was in open biotopes on grassland. In the veterinary clinic in Đakovo (BR 92), ticks were sampled from dogs during vaccination or during normal veterinary examinations, while sampling from cats was performed in the village of Zmajevac (CR 37). Also, some ticks were sampled from humans in the village of Zmajevac. Identification was carried out using standard keys for European ticks (Hillyard 1996, Estrada-Peña et al. 2004). The names of the species were written according to Guglielmone et al. (2010). The nomenclature of hosts follows Fauna Europaea (http://www.faunaeur.org) and ITIS (Integrated Taxonomic Information System), (http://www.itis.usda.gov/index.html) for livestock.

A list of the host species and ticks collected on them

Phylum: Chordata
Subphylum: Vertebrata
Class: Mammalia
Order: Artiodactyla
Family: Bovidae
Genus: *Bos* Linnaeus, 1758

***Bos taurus* Linnaeus, 1758**

Tick species: *Dermacentor marginatus* (Sulzer, 1776), *Dermacentor reticulatus* (Fabricius, 1794), *Haemaphysalis punctata* Canestrini and Fanzago, 1878, *Haemaphysalis inermis* Birula, 1895, *Hyalomma scupense* Schulze, 1919, *Hyalomma marginatum* Koch, 1844, *Rhipicephalus annulatus* (Say, 1821), *Rhipicephalus bursa* Canestrini and Fanzago, 1878, *Rhipicephalus sanguineus* (Latreille, 1806), *Ixodes hexagonus* Leach, 1815, *Ixodes ricinus* (Linnaeus, 1758)

Genus: *Capra* Linnaeus, 1758

***Capra hircus* (Linnaeus, 1758)**

Tick species: *Dermacentor marginatus*, *Haemaphysalis punctata*, *Haemaphysalis sulcata* Canestrini and Fanzago, 1878, *Hyalomma marginatum*, *Rhipicephalus bursa*, *Rhipicephalus sanguineus*, *Rhipicephalus turanicus* Pomerantsev, 1940, *Ixodes ricinus*

Genus: *Ovis* Linnaeus, 1758

***Ovis aries* Linnaeus, 1758**

Tick species: *Dermacentor marginatus*, *Haemaphysalis punctata*, *Haemaphysalis inermis*, *Haemaphysalis sulcata*, *Hyalomma scupense*, *Hyalomma marginatum*, *Rhipicephalus bursa*, *Rhipicephalus sanguineus*, *Rhipicephalus turanicus*, *Ixodes gibbosus* Nuttal, 1916, *Ixodes ricinus*

Family: Cervidae
Genus: *Capreolus* Gray, 1821

***Capreolus capreolus* (Linnaeus, 1758)**

Tick species: *Haemaphysalis concinna* Koch, 1844, *Rhipicephalus turanicus*, *Ixodes ricinus*

Order: Carnivora
Family: Canidae
Genus: *Canis* Linnaeus, 1758

***Canis aureus* (Linnaeus, 1758)**

Tick species: *Rhipicephalus sanguineus*

***Canis lupus familiaris* Linnaeus, 1758**
Tick species: *Dermacentor marginatus*, *Haemaphysalis inermis*, *Rhipicephalus sanguineus*, *Rhipicephalus turanicus*, *Ixodes hexagonus*, *Ixodes ricinus*

Family: Mustelidae
Genus: *Martes* Pinel, 1792

***Martes foina* (Erxleben, 1777)**
Tick species: *Ixodes frontalis* (Panzer, 1798)

***Martes martes* (Linnaeus, 1758)**
Tick species: *Ixodes hexagonus*, *Ixodes ricinus*

Family: Felidae
Genus: *Felis* Linnaeus, 1758

***Felis catus* Linnaeus, 1758**
Tick species: *Dermacentor marginatus*, *Rhipicephalus turanicus*, *Ixodes ricinus*

Order: Chiroptera
Family: Rhinolophidae
Genus: *Rhinolophus* Lacepede, 1799

***Rhinolophus ferrumequinum* (Schreiber, 1774)**
Tick species: *Ixodes vespertilionis* Koch, 1844

***Rhinolophus hipposideros* (Bechstein, 1800)**
Tick species: *Ixodes vespertilionis*

Family: Vespertilionidae
Genus: *Miniopterus* Bonaparte, 1837

***Miniopterus schreibersii* (Kuhl, 1817)**
Tick species: *Ixodes vespertilionis*

Genus: *Myotis* Kaup, 1829

***Myotis myotis* (Borkhausen, 1797)**
Tick species: *Ixodes vespertilionis*

Order: Insectivora
Family: Erinaceidae
Genus: *Erinaceus* Linnaeus, 1758

***Erinaceus concolor* Martin, 1838**
Tick species: *Ixodes hexagonus*

***Erinaceus europaeus* Linnaeus, 1758**
Tick species: *Hyalomma marginatum*

Family: Soricidae
Genus: *Neomys* Kaup, 1829

***Neomys* sp.**
Tick species: *Ixodes trianguliceps* Birula, 1895

Genus: *Sorex* Linnaeus, 1758

***Sorex alpinus* Schinz, 1837**
Tick species: *Ixodes trianguliceps*

***Sorex araneus* Linnaeus, 1758**
Tick species: *Ixodes trianguliceps*

Order: Perissodactyla
Family: Equidae
Genus: *Equus* Linnaeus, 1758

***Equus asinus* Linnaeus, 1758**
Tick species: *Rhipicephalus sanguineus*, *Ixodes ricinus*

***Equus caballus* Linnaeus, 1758**
Tick species: *Dermacentor marginatus*, *Dermacentor reticulatus*, *Haemaphysalis punctata*, *Hyalomma marginatum*, *Rhipicephalus annulatus*, *Rhipicephalus bursa*, *Ixodes hexagonus*, *Ixodes ricinus*

Order: Rodentia
Family: Muridae
Genus: *Apodemus* Kaup, 1829

***Apodemus agrarius* (Pallas, 1771)**
Tick species: *Dermacentor marginatus*, *Ixodes ricinus*, *Ixodes trianguliceps*

***Apodemus flavicollis* (Melchior, 1834)**
Tick species: *Ixodes ricinus*, *Ixodes trianguliceps*

***Apodemus mystacinus* (Danford et Alston, 1877)**
Tick species: *Ixodes ricinus*, *Ixodes trianguliceps*

***Apodemus sylvaticus* (Linnaeus, 1758)**
Tick species: *Dermacentor marginatus*, *Ixodes ricinus*, *Ixodes trianguliceps*

Genus: *Clethrionomys* Tilesius, 1850

***Clethrionomys glareolus* (Schreber, 1780)**
Tick species: *Dermacentor marginatus*, *Ixodes ricinus*, *Ixodes trianguliceps*

Genus: *Microtus*, Schrank, 1798

***Microtus arvalis* (Pallas, 1779)**
Tick species: *Dermacentor marginatus*

Order: Primates
Family: Hominidae
Genus: *Homo* Linnaeus, 1758

***Homo sapiens* Linnaeus, 1758**
Tick species: *Ixodes ricinus*

Class : Aves
Order: Apodiformes
Family: Apodidae
Genus: *Tachymarptis* (Linnaeus, 1758)

***Tachymarptis melba* (Linnaeus, 1758)**
Tick species: *Haemaphysalis erinacei* Pavesi, 1884

Order: Falconiformes
Family: Accipitridae
Genus: *Buteo* Lacepede, 1799

***Buteo buteo* (Linnaeus, 1758)**
Tick species: *Ixodes ricinus*

Order: Passeriformes
Family: Corvidae
Genus: *Pica* Brisson, 1760

***Pica pica* (Linnaeus, 1758)**
Tick species: *Ixodes ricinus*

Family: Bombycillidae
Genus: *Bombycilla* Vieillot, 1808

***Bombycilla garrulus* (Linnaeus, 1758)**
Tick species: *Ixodes frontalis*

Family: Saxicolidae
Genus: *Luscinia* Forster, 1817

***Luscinia megarhynchos* C.L. Brehm 1831**
Tick species: *Ixodes ricinus*

Genus: *Phoenicurus* Forster, 1817

***Phoenicurus ochruros* (S. G. Gmelin, 1774)**
Tick species: *Ixodes frontalis*

Family: Turdidae
Genus: *Turdus* Linnaeus, 1758

***Turdus merula* Linnaeus, 1758**
Tick species: *Ixodes arboricola* Schulze and Schlottke, 1930, *Ixodes ricinus*

***Turdus philomelos* C. L. Brehm, 1831**
Tick species: *Ixodes ricinus*

Family: Motacillidae
Genus: *Anthus* Bechstein, 1805

***Anthus trivialis* (Linnaeus, 1758)**
Tick species: *Ixodes ricinus*

Genus: *Motacilla* Linnaeus, 1758

***Motacilla flava* Linnaeus, 1758**
Tick species: *Haemaphysalis punctata*

Family: Sylviidae
Genus: *Cettia* Bonaparte, 1834

***Cettia cetti* (Temminck, 1820)**
Tick species: *Ixodes ricinus*

Class: Reptilia
Order: Squamata
Family: Lacertidae
Genus: *Lacerta* Linnaeus, 1758

***Lacerta bilineata* Daudin, 1802**
Tick species: *Haemaphysalis concinna*

***Lacerta trilineata* Bedriaga, 1886**
Tick species: *Haemaphysalis sulcata*

***Lacerta viridis* (Laurenti, 1768)**
Tick species: *Haemaphysalis sulcata*

Genus: *Dalmatolacerta* Arnold, Arribas & Carranza, 2007

***Dalmatolacerta oxycephala* (Duméril & Bibron, 1839)**
Tick species: *Haemaphysalis sulcata*

Genus: *Podarcis* Wagler, 1830

***Podarcis melisellensis* (Braun, 1877)**
Tick species: *Haemaphysalis concinna*, *Haemaphysalis sulcata*, *Ixodes ricinus*

***Podarcis muralis* (Laurenti, 1768)**
Tick species: *Haemaphysalis concinna*

***Podarcis sicula* (Rafinesque, 1810)**
Tick species: *Haemaphysalis sulcata*, *Ixodes ricinus*

Genus: *Algyroides* (Bibron & Bory de Saint-Vincent, 1833)

***Algyroides nigropunctatus* (Duméril & Bibron, 1839)**
Tick species: *Haemaphysalis concinna*, *Haemaphysalis sulcata*, *Ixodes ricinus*

Family: Colubridae
Genus: *Elaphe* Fitzinger, 1833

***Elaphe longissima* (Laurenti, 1768)**
Tick species: *Haemaphysalis concinna*

Sampling sites (localities)

Sampling sites are identified by a running number referring to the map in Figure 1 and UTM grid 10×10 km given in the third column of Table 1. The exact geographical coordinates of the sampling sites are given in the second column of Table 1 and were determined by (http://www.google.com/earth/index.html, http://www.worldplaces.net, http://www.plsavez.hr).

Table 1. List of sampling sites

	Locality	Altitude-latitude (degree/min/sec)	UTM
1.	Dubrovnik Močiljska špilja Lokrum Island	42°39'02"N, 18°05'40"E 42°41'17"N, 18°04'24"E 42°37'52"N, 18°07'03"E	BN 62
2.	Kapelački Lug	45°45'37"N, 18°09'53"E	BR 87
3.	Đakovo	45°18'25"N, 18°25'01"E	BR 92
4.	Zmajevac	45°47'59"N, 18°48'23"E	CR 37
5.	Vrtlac reef	43°37'26"N, 15°36'31"E	VJ 88
6.	Baričevac Island Golac Island Mežanj Island Sparušnjak Island	44°09'12"N, 14°51'02"E 44°11'16"N, 14°50'44"E 44°05'39"N, 14°55'07"E 44°08'12"N, 14°57'06"E	VJ 98
7.	Pula	44°51'59"N, 13°50'58"E	VK 16
8.	Unije Island	44°37'29"N, 14°15'34"E	VK 34
9.	Susak Island Vele Srakane Island	44°30'28"N, 14°18'14"E 44°34'51"N, 14°18'41"E	VK 42
10.	Trstenik Island Školjić reef	44°40'06"N, 14°34'46"E 44°38'09"N, 14°13'54"E	VK 54
11.	Cres Island: Belej Hrasta Zeča Island	44°46'41"N, 14°25'46"E 44°48'50"N, 14°25'14"E 44°46'20"N, 14°18'41"E	VK 56
12.	Cres Island: Cres Orlec Vrana	44°57'38"N, 14°24'33"E 44°51'57"N, 14°27'06"E 44°50'40"N, 14°26'32"E	VK 57
13.	Cres Island: Petrićevi- Špilja Čampari Vodice	45°07'06"N, 14°19'51"E 45°00'31"N, 14°23'58"E	VK 58
14.	Kamenjak Island Lutrošnjak Island Premuda Island Južni Greben Island Zapadni Greben Island	44°21'24"N, 14°34'49"E 44°21'51"N, 14°34'26"E 44°20'39"N, 14°35'56"E 44°19'05"N, 14°42'41"E 44°19'46"N, 14°41'42"E	VK 61
15.	Grujica Island Ilovik Island Male Orjule Island Sveti Petar Island	44°24'37"N, 14°34'09"E 44°27'09"N, 14°33'05"E 44°29'20"N, 14°33'53"E 44°27'43"N, 14°33'29"E	VK 62
16.	Lošinj Island: Veli Lošinj, Oruda Island, Palacol Island Ćunski-Like	44°31'09"N, 14°30'09"E 44°33'07"N, 14°34'57"E 44°32'40"N, 14°35'39"E 44°35'21"N, 14°24'35"E	VK 63
17.	Morovnik Island Silba Island Kurjak reef	44°25'55"N, 14°44'03"E 44°24'02"N, 14°41'03"E 44°24'17"N, 14°45'06"E	VK 71
18.	Krk Island: Kozlja	45°00'38"N, 14°45'24"E	VK 79
19.	Dužac Island	44°15'09"N, 14°44'07"E	VK 80
20.	Olib Island Planičić reef Šip reef	44°22'38"N, 14°47'09"E 44°21'45"N, 14°52'31"E 44°25'06"N, 14°45'16"E	VK 81
21.	Mali Dolfin reef Mali Laganj Island	44°41'22"N, 14°41'31"E 44°42'49"N, 14°39'59"E	VK 93
22.	Velebit mountain: Donja Klada Veliki Zavižan	44°48'52"N, 14°53'05"E 44°48'09"N, 14°58'25"E	VK 96

	Locality	Altitude-latitude (degree/min/sec)	UTM
23.	Lukovdol- Lipov Vrh	45°25'33"N, 15°07'37"E	VL 03
24.	Buzet-Rabakova Peć Ročko Polje	45°24'27"N, 13°57'54"E 45°22'11"N, 14°04'44"E	VL 22
25.	Istra: Učka mountain	45°17'01"N, 14°14'58"E	VL 31
26.	Rijeka	45°19'40"N, 14°26'32"E	VL 51
27.	Gorski Kotar: Risnjak mountain	45°25'54"N, 14°37'17"E	VL 63
28.	Sungerski Lug	45°19'22"N, 14°49'12"E	VL 81
29.	Kamik od Tramuntane Palagruža Island	42°23'20"N, 16°16'30"E 42°23'33"N, 16°15'32"E	XG 09
30.	Brač Island: Blato Nadsela Osridke Sveti Toma	43°17'02"N, 16°40'41"E 43°17'16"N, 16°48'49"E 43°16'55"N, 16°49'24"E 43°17'34"N, 16°47'00"E	XH 49
31.	Brusnik Island Pod Mrčaru reef	43°00'29"N, 15°47'55"E 42°46'47"N, 16°46'30"E	XH 43
32.	Brač Island: Zapadna Laščatna Sjeverna Laščatna	 43°19'02"N, 16°53'14"E 43°19'01"N, 16°53'25"E	XH 59
33.	Mljet Island: Soline Veliko Jezero	42°46'04"N, 17°22'55"E 42°46'30"N, 17°21'40"E	XH 93
34.	Baćinska jezera	43°04'39"N, 17°24'54"E	XH 97
35.	Kaštela, Kozjak mountain: Malačka	43°33'51"N, 16°21'29"E 43°34'44"N, 16°21'04"E	XJ 02
36.	Split	43°30'29"N, 16°26'25"E	XJ 11
37.	Kaštela Bay	43°33'09"N, 16°20'36"E	XJ 12
38.	Brač Island: Supetar	43°23'00"N, 16°33'23"E	XJ 20
39.	Brač Island	43°18'17"N, 16°39'09"E	XJ 30
40.	Sinj	43°42'10"N, 16°38'15"E	XJ 34
41.	Srednja Posavina: Stružec	45°31'37"N, 16°32'59"E	XL 24
42.	Repušnica	45°29'44"N, 16°43'50"E	XL 33
43.	Križevci Stara Ves	45°59'04"N, 16°34'29"E 45°58'35"N, 16°29'56"E	XL 39
44.	Nedelišće	46°22'34"N, 16°23'08"E	XM 12
45.	Čakovec	46°23'24"N, 16°26'17"E	XM 13
46.	Dekanovec	46°26'48"N, 16°34'49"E	XM 24
47.	Maslinovac Island	42°55'11"N, 17°29'30"E	WJ 07
48.	Mali Prišnjak Malo Šilo Island Mrtovac Island	43°50'49"N, 15°33'34"E 43°50'44"N, 15°14'10"E 43°49'39"N, 15°13'56"E	WJ 16
49.	Božikovac Island Mala Lavdara Island Mala Skala Island Rončić Island Trimulić Island Trstikovac Island Vela Skala Island	43°55'57"N, 15°15'09"E 43°55'00"N, 15°13'48"E 43°54'33"N, 15°15'54"E 43°54'20"N, 15°16'26"E 43°54'29"N, 15°14'40"E 43°54'31"N, 15°14'56"E 43°54'56"N, 15°15'38"E	WJ 17
50.	Kali Vela Sestrica Zadar	44°03'49"N, 15°12'23"E 44°11'15"N, 14°59'21"E 44°07'11"N, 15°13'59"E	WJ 18
51.	Veseljuh Island	43°45'52"N, 15°21'55"E	WJ 25

	Locality	**Altitude-latitude (degree/min/sec)**	**UTM**
52.	Gušteranski Island Koromašna Island Kosmerka Island Škrovada reef	43°38'43"N, 15°42'48"E 43°39'24"N, 15°41'06"E 43°38'00"N, 15°36'12"E 43°37'36"N, 15°40'47"E	WJ 26
53.	Dugi otok Island Pašman Island	43°57'18"N, 15°05'47"E 43°58'18"N, 15°19'46"E	WJ 27
54.	Bisaga Island Mali Babuljaš Island Veli Babuljaš Island	43°48'29"N, 15°17'00"E 43°48'02"N, 15°17'16"E 43°47'57"N, 15°17'02"E	WJ 35
55.	Biograd-Vrana	43°56'09"N, 15°26'33"E	WJ 36
56.	Babina Guzica Island Jančar Island Kameni Puh Island Mala Prduša Island Purara Island Veli Puh Island Vodeni Puh Island Vodenjak Island	43°42'36"N, 15°29'52"E 43°43'09"N, 15°25'52"E 43°40'38"N, 15°30'42"E 43°42'33"N, 15°27'11"E 43°41'47"N, 15°26'14"E 43°40'31"N, 15°29'45"E 43°40'36"N, 15°31'05"E 43°43'42"N, 15°23'50"E	WJ 43
57.	Rovanjska	44°14'52"N, 15°32'31"E	WJ 49
58.	Čavlin Island Čerigul Island Mali Kamešnjak Island Mali Tetovišnjak Island Mikavica Island Samograd Island Veli Kamešnjak Island Veli Tetovišnjak Island Žirje Island	43°44'03"N, 15°34'54"E 43°43'39"N, 15°36'39"E 43°40'19"N, 15°42'02"E 43°43'07"N, 15°36'08"E 43°40'44"N, 15°36'53"E 43°41'16"N, 15°33'26"E 43°40'21"N, 15°41'29"E 43°43'24"N, 15°35'37"E 43°39'02"N, 15°39'32"E	WJ 53
59.	Velebit mountain: Crni Padež	44°40'18"N, 15°03'06"E	WK 04
60.	Velebit mountain: Baške Oštarije	44°31'51"N, 15°10'51"E	WK 12
61.	Velika Kapela mountain: Razvala	45°04'35"N, 15°12'41"E	WK 29
62.	Lika: Plitvice-Crna rijeka	44°50'41"N, 15°37'45"E	WK 46
63.	Lika: Plitvice-Mukinje	44°52'27"N, 15°37'45"E	WK 56
64.	Velebit mountain: Prezid, Pod ćelavcem	44°15'07"N, 15°50'12"E	WK 60
65.	Zagreb	45°48'47"N, 15°58'40"E	WL 77
66.	Zagreb- vicinity, Medvednica mountain: Sljeme	45°53'58"N, 15°57'09"E	WL 78
67.	Vukomeričke Gorice: Prkovec	45°37'00"N, 15°56'59"E	WL 84
68.	Petrinja	45°25'31"N, 16°14'48"E	WL 93
69.	Peščenica-Vratovo	45°36'08"N, 16°10'05"E	WL 95
70.	Dugo Selo	45°48'21"N, 16°14'16"E	WL 97
71.	Banjol Island Figarola Island Gustinja Island Pisulj Island Pulari Island Revera Island Rovinj Sturag Island Sveti Ivan Island Sveti Ivan np reef Velika Sestrica Island Veliki Piruzi reef Veštar Island	45°04'21"N, 13°36'35"E 45°05'41"N, 13°37'17"E 45°00'59"N, 13°40'53"E 45°01'12"N, 13°41'51"E 45°03'25"N, 13°39'51"E 45°03'02"N, 13°39'34"E 45°04'52"N, 13°38'19"E 45°03'05"N, 13°37'34"E 45°02'49"N, 13°37'17"E 45°02'33"N, 13°36'50"E 45°02'00"N, 13°40'28"E 45°03'32"N, 13°38'22"E 45°02'51"N, 13°40'42"E	UK 99

	Locality	Altitude-latitude (degree/min/sec)	UTM
72.	Umag	45°26'02"N, 13°38'22"E	UL 83
73.	Koversada Lakal Island Lunga Island Tovarjež Island	45°08'03"N, 13°35'51"E 45°09'41"N, 13°35'33"E 45°08'32"N, 13°34'58"E 45°10'07"N, 13°34'55"E	UL 90
74.	Mljet Island: Babino Polje Blato Zadublje	 42°44'08"N, 17°33'03"E 42°45'45"N, 17°28'52"E 42°44'50"N, 17°33'25"E	YH 03
75.	Metković	43°03'12"N, 17°38'57"E	YH 06
76.	Mljet Island	42°44'38"N, 17°32'19"E	YH 13
77.	Metković-Gabela	43°04'01"N, 17°39'08"E	YH 16
78.	Slano	42°47'13"N, 17°53'33"E	YH 33
79.	Mikleuš	45°36'46"N, 17°48'33"E	YL 15

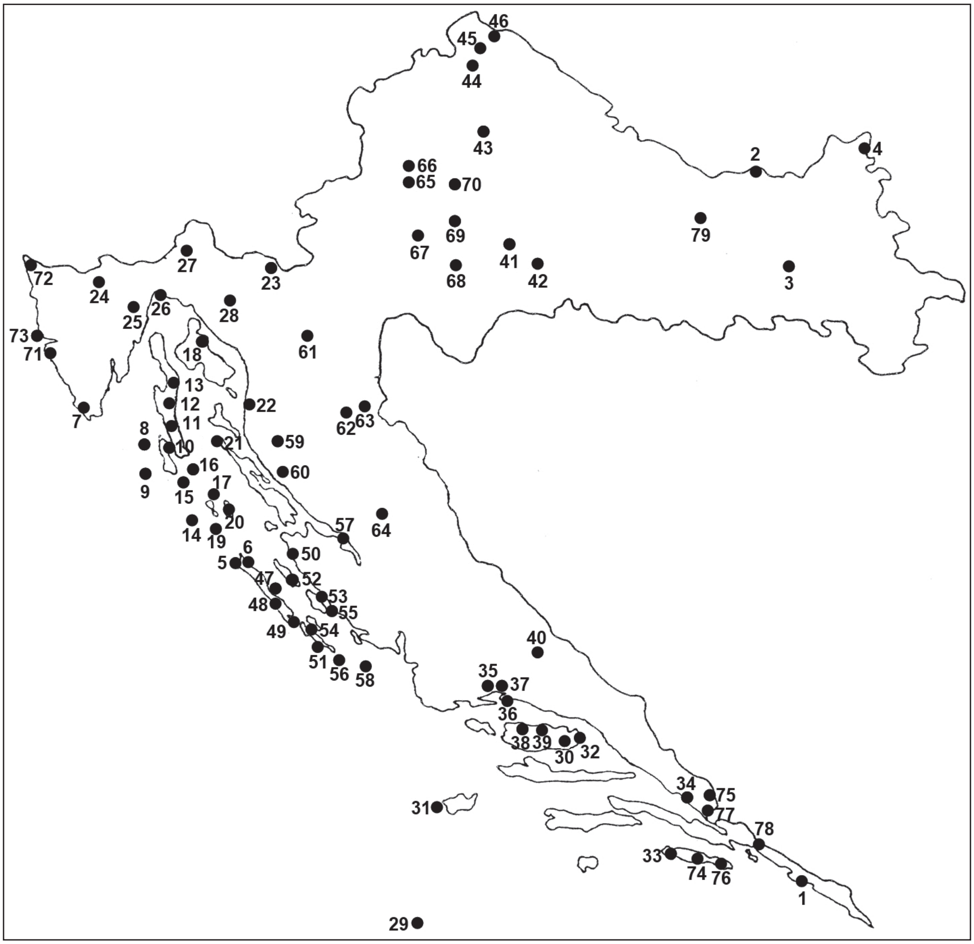


Figure 1. Sampling sites of hard ticks (Ixodidae) in Croatia.

Results

The tick fauna of Croatia is now known to include 21 species. These species are classified into five genera: *Dermacentor* Koch, 1844, *Haemaphysalis* Koch, 1844, *Hyalomma* Koch, 1844, *Rhipicephalus* Koch, 1844, and *Ixodes* Latreille, 1795. The genera *Dermacentor* and *Hyalomma* are represented by a two species, followed by *Rhipicephalus* with four species, *Haemaphysalis* with six species, and *Ixodes* with seven species. While studying the territory of Slavonia and Baranja during 2011, a total of 1425 ticks were collected. All the collected ticks were classified into 5 species. The identified species were classified into the following genera: *Dermacentor*, *Haemaphysalis* and *Ixodes*. *Ixodes ricinus* made up 83.44% of the tick fauna in the researched area, while 16.56% were representatives of other species.

Survey of hard ticks recorded in Croatia

For every species are mentioned, sex, developmental stage (♂ male, ♀ female N = nymph, L = larva), sampling place, month or date, host and data source.

Family IXODIDAE Murray, 1877
Genus *Dermacentor* Koch 1844

1. *Dermacentor marginatus* (Sulzer, 1776)

♂♂,♀ ♀	Cres Island: Hrasta 10.XI.1948, from *Ovis aries* (Mikačić 1949)
♂♂,♀ ♀	ibidem: Vodice 6.–11.IV. 1948, from *Ovis aries* (Mikačić 1965)
♂♂,♀♀	ibidem: Hrasta 29.IX.–1.X.1948, from *Ovis aries* (Mikačić 1965)
♂♂,♀♀	ibidem: Belej 29.IX.–1.X.1948, 4.XI. 1948, from *Ovis aries* (Mikačić 1965)
♂♂, ♀♀	Pula, months: I. II. III. IV.V. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Krk Island, months: I. II. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Cres Island, months: I. II. III. IV. VIII. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, months: I. II. III. IV. VIII. IX. X. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂,♀♀	ibidem: Čunski-Like, month: VIII. 1948, from *Ovis aries* (Mikačić 1965)
♂♂,♀ ♀	Zadar, months: I. II. III. IV.V.VI. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Kaštela, month: VI. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić, 1965)

♂♂, ♀♀	Split, months: I. II. III. IV.V.VI. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Brač Island, months: I. II. III. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Dubrovnik, months: II. III. IV. IX. X. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Srednja Posavina, months: III. IV. V. VI. XI. XII. from *Equus caballus*, *Bos taurus* (Mikačić 1968)
♂♂,♀♀	Brač Island: Sveti Toma 4.–9.XI. 1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂,♀♀	ibidem: Osridke 4.–9.XI.1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂,♀♀	ibidem: Blato 4.–9.XI. 1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂,♀♀	ibidem: months: I. II. X. XI. XII. 1964/1965 collected on vegetation using the cloth dragging method (Tovornik 1976b)
♂♂,♀♀	ibidem: Sveti Toma, months: I. II. XI. XII. 1964/1965 collected on vegetation using the cloth dragging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Zapadna Laščatna, months: I. X. XI. XII.1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Sjeverna Laščatna, months: XI. XII. 1964/1965 collected on vegetation using the cloth dragging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: months: I. II. III. IX. X. XI. XII. 1964/1965 from *Ovis aries* (Tovornik 1976b)
NN	ibidem: month:VII. 1964/1965 from *Ovis aries* (Tovornik 1976b)
♂♂, ♀♀, NN, LL	Srednja Posavina: Stružec from 1970 to 1978 collected on vegetation using the cloth dragging method (Borčić et al. 1978)
NN	Peščenica-Vratovo 17.VII. 1974 from *Microtus arvalis* (Tovornik 1988b)
NN	Velebit mountain: Predzid (pod Ćelavcem) 1.VIII. 1975 from *Apodemus sylvaticus* (Tovornik 1988b)
♂♂,♀♀	Brač Island: Supetar 22.II. 1974 from *Ovis aries* (Tovornik 1991a)
L, NN	Repušnica 5.,6.VIII. 1982 from *Clethrionomys glareolus* (Tovornik and Matjašič 1991)
N	ibidem: 6.,7.VIII. 1982 from *Apodemus agrarius* (Tovornik and Matjašič 1991)
♂♂,♀♀	Čakovec, months: III. IV. V. 2007 collected on vegetation using the cloth-dragging method (Dobec et al. 2009)
♂♂, ♀♀	Kaštela Bay, month: X.2000 from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda -Polić et al. 2002)
♂♂,♀♀	Sinj, month: X. 2000, from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda-Polić et al. 2002)

♂♂,♀♀	Brač Island, Hvar Island (Hubálek 2010)
♂♂, ♀♀	Đakovo 10.III.–30.III. 2011 from *Canis lupus familiaris*
♂♂, ♀♀	ibidem: 7.IV.–25.IV. 2011 from *Canis lupus familiaris*
♂♂, ♀♀	ibidem: 2.V.–25.V.2011 from *Canis lupus familiaris*
♂, ♀	Zmajevac 15.III.- 30.III. 2011 from *Felis catus*
♀♀	ibidem: 10.IV.–24.IV. 2011 from *Felis catus*
♀♀	ibidem: 25.IV.–30.IV. 2011 from *Felis catus*
♀	ibidem: 7.V.–25.V.2011 from *Felis catus*

2. *Dermacentor reticulatus* (Fabricius, 1794)

♂♂, ♀♀	Gornja Posavina,months: III. IV. V. from *Equus caballus*, *Bos taurus* (Mikačić 1968)
♀	Kapelački Lug, month: V. 1967 collected on vegetation using the cloth dragging method (Vesenjak-Hirjan and Šooš 1976)
♂♂, ♀♀, NN, LL	Srednja Posavina: Stružec -, from 1970 to 1978 collected on vegetation using the cloth dragging method (Borčić et al. 1978)
♂♂, ♀♀	Čakovec, months: III. IV. V. 2007 collected on vegetation using the cloth dragging method (Dobec et al. 2009)
♀♀	Mikleuš 27.IV.2011 collected on vegetation using the cloth dragging method
♀♀	ibidem: 14.V.2011 collected on vegetation using the cloth dragging method

Genus *Haemaphysalis* Koch, 1844

3. *Haemaphysalis punctata* Canestrini & Fanzago, 1878

♂♂, ♀♀	Cres Island: Hrasta 6.–11.IV.1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: 29.IX.–1.X. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: 10.XI. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Vrana 6.–11.IV.1948 from *Capra hircus* (Mikačić 1949)
♂♂, ♀♀, N	ibidem: Vodice 6.–11.IV.1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Belej 29.IX.–1.X.1948 from *Ovis aries* (Mikačić 1949)
♂♂,♀♀	ibidem: 4.XI. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	Lošinj Island: Veli Lošinj 29.IX.–1.X. 1948 from *Bos taurus* (Mikačić 1949)
♂♂, ♀♀	ibidem: Čunski-Like 29.IX.–1.X. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀, NN, LL	Pula,months: I. II. , III. , IV. V. VI. , VII. , VIII. IX. , X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Krk Island,months: I. II. IV. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)

♂♂, ♀♀	Cres Island,months: I. II. III. IV.V. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, months: I. II. III. IV. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Zadar,months: I. II. III. IV. V. VI. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂,♀♀, NN, LL	Split,months: I. II. III. IV. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Brač Island, months: II. III. VII. X. XI. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂,♀♀	ibidem: months: I. II.III. IV. V. IX. X. XI. XII 1964/1965 from *Ovis aries* (Tovornik 1976b)
♂♂, ♀♀, NN	Dubrovnik,months: I. II. III. IV.V. IX. X. XI. XII.1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Gornja Posavina,month: V. from *Equus caballus*, *Bos taurus* (Mikačić 1968)
♂♂, ♀♀	Brač Island: Sveti Toma 4–9.XI.1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂, ♀♀	ibidem: Osridke 4.–9.XI. 1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂, ♀♀	ibidem: Blato 4.–9.XI. 1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂, ♀♀	ibidem: months: I. II. IV.V. XII. 1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Sveti Toma, months: I. II. IV.V. IX. X. XI. XII. 1964/1965 from *Ovis aries* (Tovornik 1976b)
♂♂, ♀♀	ibidem: Blato 5.XI.1965 from *Ovis aries* (Tovornik 1987a)
♂♂, ♀♀	ibidem: Zapadna Laščatna, months: I. IV. IX. X. XI. XII. 1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Sjeverna Laščatna, months: I. IV. XI. XII. 1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)
N	Metković 23.IV. 1964 from *Motacilla flava* (Tovornik 1990a)
♂♂, ♀♀	Brač Island: Supetar 22.II. 1974 from *Ovis aries* (Tovornik 1991a)
♂♂, ♀♀	Kaštela Bay, month: X.2000 from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda -Polić et al. 2002)
♂♂, ♀♀	Sinj, month: X. 2000 from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda-Polić et al. 2002)
♂♂, ♀♀	Brač Island, Hvar Island (Hubálek 2010)

4. *Haemaphysalis inermis* Birula, 1895

♂♂, ♀♀	Cres Island, months: I. II.1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, month: IX. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	Zadar, month: V. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	Dubrovnik, month: V. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)

5. *Haemaphysalis concinna* Koch, 1844

♂	Dekanovec 10.VI. 1977 from *Capreolus capreolus* (Tovornik 1988a)
NN	Krk Island: 15.V.2002 from *Podarcis muralis*, *Podarcis melisellensis*,*Lacerta bilineata*, *Algyroides nigropunctatus*, *Elaphe longissima* (Hassl 2003)
♂♂	Mikleuš 14.V.2011 collected on vegetation using the cloth-dragging method
NN	ibidem: 8.VI.2011 collected on vegetation using the cloth-dragging method
♀, NN	ibidem: 9.VI.2011 collected on vegetation using the cloth-dragging method
♂	ibidem: 15.VI.2011 collected on vegetation using the cloth-dragging method
NN, LL	ibidem: 3.VII.2011 collected on vegetation using the cloth-dragging method
♂, NN	ibidem: 4.VII.2011 collected on vegetation using the cloth-dragging method
NN, LL	ibidem: 2.VIII.2011 collected on vegetation using the cloth-dragging method
NN, LL	ibidem: 3.VIII.2011 collected on vegetation using the cloth-dragging method
N	ibidem: 13.IX.2011 collected on vegetation using the cloth-dragging method

6. *Haemaphysalis sulcata* Canestrini & Fanzago, 1878

♂♂, ♀♀	Pula, months: X. XI. 1936–1963 from *Ovis aries* (Mikačić 1965)
♂♂, ♀♀	Krk Island, months: IV. XI. XII. 1936–1963 from *Ovis aries* (Mikačić 1965)
♂♂, ♀♀	Cres Island, months: I. II. III. IV. V. X. XI. XII. 1936–1963 from *Ovis aries* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, months: I. IV. X. 1936–1963 from *Ovis aries* (Mikačić 1965)

♂♂, ♀♀	Zadar, months: I. II. III. IV. XI. XII. 1936–1963 from *Ovis aries* (Mikačić 1965)
♂♂, ♀♀	Split, months: I. II. III. IV. 1936–1963 from *Ovis aries* (Mikačić 1965)
♂♂, ♀♀	Brač Island, months: I. II. III. IV. V. X. XI. XII. 1964/1965 from *Ovis aries* (Tovornik 1976b)
NN	ibidem: months: VII. VIII. 1964/1965 from *Ovis aries* (Tovornik 1976b)
♀	ibidem: Nadsela 1.X.1965 from *Ovis aries* (Tovornik 1987a)
L	Krk Island: 23.VII.1956 from *Algyroides nigropunctatus* (Tovornik and Brelih 1980)
L	ibidem: 23.VII.1956 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
N	Cres Island: Vrana, month: VII.1949 from *Lacerta trilineata* (Tovornik and Brelih 1980)
NN, LL	Trstenik Island: 20.VII.1965 from *Lacerta viridis* (Tovornik and Brelih 1980)
NN	Mali Dolfin reef: 20.IX.1961 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Lutrošnjak Island: 25.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Kamenjak Island: 25.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Premuda Island: 1.VIII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Zapadni Greben Island: 23.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Južni Greben Island: 23.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Silba Island: 13.VIII.1963 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	ibidem: 22.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	ibidem: 2.VIII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Morovnik Island: 24.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Olib Island: 3.VIII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Planičić reef: 3.VIII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Šip reef: 24.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)

L	Vela Sestrica Island: 11.VIII.1963 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Dužac Island: 11.VIII.1963 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Golac Island: 9.VIII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN	Mali Laganj Island: 12.VIII.1963 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Baričevac Island: 6.VIII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Mežanj Island: 8.VIII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Kurjak reef: 24.VII. 1965 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Sparušnjak Island: 7.VIII.1965 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Maslinovac Island: 7.VIII.1963 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Vrtlac Island: 8.VIII.1963 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
LL	Veseljuh Island: 28.VII.1964 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Bisaga Island: 7.VIII.1964 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Mali Tetovišnjak Island: 22.VII.1964 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Čerigul Island: 22.VII.1964 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Mali Kamešnjak Island: 23.VII.1964 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Samograd Island: 6.VIII.1963 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Koromašna Island: 20.VII.1964 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Gušteranski Island: 23.VII.1964 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Palagruža Island: 8.VI.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Kamik od Tramuntane Island: 9.VI.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Brusnik Island: 7.VI.1960 from *Podarcis melisellensis* (Tovornik and Brelih 1980)

NN	Pod Mrčaru reef: 31.VII.1971 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Božikovac Island: 1.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
N, LL	Mala Lavdara Island: 1.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Trimulići Island: 2.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Trstikovac Island: 2.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
LL	Vela Skala Island: 2.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Mala Skala Island: 2.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Rončić Island: 1.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Mali Babuljaš Island: 7.VIII.1963 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Malo Šilo Island: 6.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Mrtovac Island: 6.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Veli Babuljaš Island:7.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Mali Prišnjak Island: 7.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Vodenjak Island: 7.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Jančar Island: 7.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Purara Island: 7.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Mala Prduša Island: 7.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Babina Guzica Island: 8.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
LL	Veli Puh Island: 21.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
LL	Vodeni Puh Island: 21.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Kameni Puh Island: 21.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)

LL	Čavlin Island: 22.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
LL	Veli Tetovišnjak Island: 22.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
LL	Veli Kamešnjak Island: 23.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
N, LL	Žirje Island: 27.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
N, L	Mikavica Island: 4.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
LL	Škrovada reef: 23.VII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Kosmerka Island: 4.VIII.1964 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
L	Pod Mrčaru reef: 31.VII.1971 from *Dalmatolacerta oxycephala* (Tovornik and Brelih 1980)
♂♂, ♀♀	Southern Croatia from *Ovis aries* and *Capra hircus* (Duh et al. 2006, 2010)

7. *Haemaphysalis erinacei* Pavesi, 1884

N	Dubrovnik 10.VIII. 1964 from *Tachymarptis melba* (Tovornik 1990a)

8. *Haemaphysalis parva* (Neumann, 1897)

♂♂, ♀♀	Brač Island: (Tovornik 1980, Hubálek 2010)

Genus *Hyalomma* Koch, 1844

9. *Hyalomma scupense* Schulze, 1919

♂♂, ♀♀	Pula, months: III. IV. IX. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Krk Island, months: II. III. IV. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, month: IV. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Zadar, months: II. III. IV. VI. VIII. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
NN	ibidem: months: IX. XI. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Split, months: I. II. III. IV. VI. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)

NN	ibidem: months: XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Brač Island, months:V.VI. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	ibidem: 1964/1965 from *Ovis aries* (Tovornik 1976b)
♂♂, ♀♀	ibidem: -, (Hubálek 2010)
♂♂, ♀♀, NN	Dubrovnik, month: I. 1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	ibidem: months: II. III. IV.V. IX. XI. XII.1936–1963 from *Ovis aries*, *Bos taurus* (Mikačić 1965)

10. *Hyalomma marginatum* Koch, 1844

♂♂, ♀♀	Pula, months: I. II. III. IV. V. VI. VII. VIII. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Krk Island, months: II. III. IV. V. VI. VII. VIII. IX. X. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Cres Island, months: IV. VI. VII. X. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, months: II. III. IV. V. VI. VII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Zadar, months: II. III. IV. V. VI. VII. VIII. X. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Split, months: II. III. IV. V. VI. VII. VIII. IX. X. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Dubrovnik, months: III. IV. V. VI. VII. VIII. IX. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂, ♀	Petrinja, month: V. from *Equus caballus*, *Bos taurus* (Mikačić 1968)
♂♂, ♀♀	Brač Island, months: I. II. III. IV. V. VI. VII. VIII. IX. X. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	ibidem: months: V. VI. VII. VIII. IX. X. 1964/1965 from *Ovis aries* (Tovornik 1976b)
♂, ♀	ibidem: Blato, month: IV.1964/1965 from *Ovis aries* (Tovornik 1976b)
♂♂, ♀♀	ibidem: Zapadna Laščatna, months: IV. VII.1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: (Hubálek 2010)
NN, LL	ibidem: month: VII. 1967 from *Erinaceus europaeus* (Tovornik 1987b)
♂♂, ♀♀	Kaštela Bay, month: X. 2000 from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda -Polić et al. 2002)
♂♂, ♀♀	Sinj, month: X. 2000 from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda-Polić et al. 2002)

Genus *Rhipicephalus* Koch, 1844

11. *Rhipicephalus annulatus* (Say, 1821)

♂♂, ♀♀	Lošinj Island: Veli Lošinj 29.IX.–1.X.1948 from *Bos taurus* (Mikačić 1949)
♂♂, ♀♀	ibidem: months: IV. V. X. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Zadar, months: III. IV.V. VI. VII. VIII. IX. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)
NN	ibidem: months: IV. VII. VIII. IX. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Split, months: VI. VII. VIII. IX. X. XI. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)
NN	ibidem: months: IX. XI. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	Brač Island: month: VII. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)
♂♂, ♀♀	ibidem: (Hubálek 2010)
♂♂, ♀♀	Dubrovnik, months: III. IV. V. VII. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)
NN	ibidem: months: IV.XI. 1936–1963 from *Equus caballus*, *Bos taurus* (Mikačić 1965)

12. *Rhipicephalus bursa* Canestrini & Fanzago, 1878

♂♂, ♀♀	Lošinj Island: Čunski-Like 6.–11.IV.1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	Cres Island, months:, IV. V. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: month: VIII. 1948 from *Ovis aries* (Mikačić 1949)
LL	ibidem: 29.IX.–1.X.1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀, NN, LL	ibidem: Hrasta 6.–11.IV. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀, NN, LL	ibidem: 29.IX.–1.X.1948 from *Ovis aries* (Mikačić 1949)
NN, L	ibidem: 10.XI.1948 from *Ovis aries* (Mikačić 1949)
NN	ibidem: Vrana 6.–11.IV. 1948 from *Capra hircus* (Mikačić 1949)
♂♂, ♀♀, NN	ibidem: Vodice 6.–11.IV. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Orlec 6.–11.IV. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Belej 29.IX.–1.X.1948 from *Ovis aries* (Mikačić 1949)
NN	ibidem: 4.XI.1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	Pula, months: II. III. IV. V. VI. VIII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months: I. II. III. IV. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
LL	ibidem: months: III. IV. XI. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)

♂♂, ♀♀	Krk Island, months: II. III. IV. V. VI. VII.VIII. X. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months: I. III. IV.VI. X. XI. XII.1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
LL	ibidem: months: III. IV. X. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
♂♂, ♀♀	Cres Island: Cres, months: III. IV. V. VI. VII. IX. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months: I. II. III. IV. V. XI. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
LL	ibidem: months: I. III. XI. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, months: III. IV. V. VI. VII. VIII. IX. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months: II. III. IV.X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
LL	ibidem: months: III. IV. IX. XI. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
♂♂, ♀♀	Zadar, months: III. IV. V. VI.VII. VIII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months: I. II. III. IV. V. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
LL	ibidem: month: I. III. IV. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
♂♂, ♀♀	Split, months: II. III. V. VI. VII. VIII. IX. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months; II. III. X. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
LL	ibidem: month: III. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
♂♂, ♀♀	Brač Island, months: II. III. IV. V.VI. VII.VIII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months: I. II. III. IV. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
♂♂, ♀♀	ibidem: 1964/1965 from *Ovis aries* (Tovornik 1976b)
♂♂, ♀♀	ibidem: (Hubálek 2010)
NN	ibidem: Blato 4.–9.XI. 1965 from *Ovis aries* (Tovornik and Černy 1972)
♂, ♀	ibidem: Blato, month: IX.1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Sveti Toma, months: IX. X. 1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)

♂♂, ♀♀	ibidem: Zapadna Laščatna, months: VII. VIII. 1964/1965 collected on vegetation and/or the ground by flagging/dragging method (Tovornik 1976b)
♂♂, ♀♀	Dubrovnik, months: III. IV.V. VI.VII. VIII. IX. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
NN	ibidem: months: II. IV. V. X. XI. XII. 1936–1963 from *Ovis aries*, *Equus caballus*, *Bos taurus*, *Capra hircus* (Mikačić 1965)
♂♂, ♀♀	Kaštela Bay, month: X. 2000 from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda-Polić et al. 2002)
♂♂, ♀♀	Sinj, month: X. 2000 from *Ovis aries*, *Capra hircus*, *Bos taurus* (Punda-Polić et al. 2002)

13. *Rhipicephalus sanguineus* (Latreille, 1806)

♂♂, ♀♀	Mali Lošinj Island: Čunski-Like 6.–11.IV. 1948 -, V. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	Cres Island: Hrasta 6.–11.IV. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Belej 6.–11.IV. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Vrana 6.–11.IV. 1948 from *Capra hircus* (Mikačić 1949)
♂♂, ♀♀	ibidem: Vodice 6.–11.IV. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Orlec. months: IV. V. 1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	ibidem: Cres, months: IV. V. VII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	Pula, months: V.VI. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂	ibidem: 18.V.1973 from *Canis lupus familiaris* (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀♀	Zadar, months: III. IV. V. VI. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	Split, months: III. IV. V. VI. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	Dubrovnik, months: III. IV. V. VI. VII. VIII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	Brač Island, months: II. III. IV. 1936–1963 from *Ovis aries*, *Bos taurus*, *Canis lupus familiaris* (Mikačić 1965)
♂♂, ♀♀	ibidem: from 1964/1965 from *Ovis aries* (Tovornik 1976b)
♂♂, ♀♀	ibidem: Blato, months; IV. V. VI. 1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Sveti Toma, months: IV. V. VI. VII. 1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Zapadna Laščatna, months: IV. VI. VII.1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b)

♂♂, ♀♀	ibidem: Sjeverna Laščatna, months: IV. VI. 1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: 1.–4.V. 1964 and 28.III.–1.IV.1965 collected on vegetation by dragging method (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀♀	ibidem: 28.III. , 27.IV., 1.VI., 4.VI. 1965 from *Ovis aries*, (Tovornik and Vesenjak -Hirjan 1988)
♂♂, ♀♀	ibidem: (Hubálek 2010)
♂♂, ♀♀	Umag 27.V.1978 from *Canis lupus familiaris* (Tovornik 1987b)
♀	Slano (Dubrovnik) 10.V.1953 from *Canis aureus* (Tovornik and Vesenjak -Hirjan 1988)
♂♂, ♀♀	Ugljan Island: Kali 9.–20.V.1955 from *Ovis aries* (Tovornik and Vesenjak -Hirjan 1988)
♂♂, ♀♀	Rovanjska 23.IV.1958 from *Ovis aries* (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀♀	Zadar 25.IV.1958 from *Ovis aries* (Tovornik and Vesenjak-Hirjan 1988)
♂♂	Pašman Island: 2.V.1985 from *Ovis aries* (Tovornik and Vesenjak-Hirjan 1988)
♂,♀	Dugi otok Island: 29.IV.1986 from *Ovis aries* (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀♀	Mljet Island: Babino polje 8.–9.IV.1981, 16.–17.V. 1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Equus asinus* (Tovornik and Vesenjak -Hirjan 1988)
♂♂, ♀♀	ibidem: Zadublje 8.–9.IV.1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Equus asinus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Veliko jezero 8.–9.IV.1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Equus asinus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Soline 8.–9.IV.1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Equus asinus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Babino polje 16.–17.V. 1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Equus asinus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Blato 16.–17.V. 1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris, Equus asinus* (Tovornik and Vesenjak-Hirjan 1989)

14. *Rhipicephalus turanicus* Pomerantsev, 1940

♂♂, ♀♀	Ugljan Island: Kali 9.–20.V.1955 from *Ovis aries* (Tovornik and Vesenjak -Hirjan 1988)
♂	Zadar 25.IV. 1958 from *Ovis aries* (Tovornik and Vesenjak-Hirjan 1988)

♂	Lokrum Island: 9.IX.1963 from *Capreolus capreolus* (Tovornik and Vesenjak-Hirjan 1988)
♂	ibidem: 4.IX. 1963 from *Capreolus capreolus* (Tovornik 1988a)
♂♂, ♀	Brač Island: 1.–4.V.1964 and 28.III.–1.IV.1965 collected on vegetation by dragging method (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀♀	ibidem: 28.III., 27.IV., 1.VI., 4.VI., 1965 from *Ovis aries* (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀♀	Pašman Island: 2.V.1985 from *Ovis aries* (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀	Dugi otok Island: 29.IV.1986 from *Ovis aries* (Tovornik and Vesenjak -Hirjan 1988)
♂♂, ♀♀	Mljet Island: 8.–9.IV. 1981, 16–17.V. 1981 from *Capra hircus* and other domestic animals (Tovornik and Vesenjak-Hirjan 1988)
♂♂, ♀♀	ibidem: Babino polje 8.–9.IV.1981 from *Capra hircus*, *Ovis aries*, *Felis catus*, *Canis lupus familiaris* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Zadublje 8.–9.IV.1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Felis catus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Veliko jezero 8.–9.IV.1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Felis catus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Soline 8.–9.IV.1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Felis catus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Babino polje 16.–17.V. 1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris*, *Felis catus* (Tovornik and Vesenjak-Hirjan 1989)
♂♂, ♀♀	ibidem: Blato 16.–17.V. 1981 from *Capra hircus*, *Ovis aries*, *Canis lupus familiaris,Felis catus* (Tovornik and Vesenjak-Hirjan 1989)

Genus *Ixodes* Latreille, 1795

15. *Ixodes arboricola* Schulze & Schlottke, 1930

♀♀	Zagreb 29.IX. 1962 from *Turdus merula* (Tovornik 1990a, Tovornik 1991b)

16. *Ixodes frontalis* (Panzer, 1798)

♀	Velebit mountain: Donja Klada, 1975 from *Martes foina* (Tovornik 1987b)
♀	Dubrovnik 22.II.1962 from *Bombycilla garrulus* (Tovornik 1990a, Tovornik 1991b)
♀	ibidem: 1.XII. 1967 from *Phoenicurus ochruros* (Tovornik 1990a, Tovornik 1991b)
♀	Zagreb, vicinity, 20.IV. 1975 from *Martes foina* (Tovornik 1991b)

17. *Ixodes gibbosus* Nuttal, 1916

♂♂, ♀♀	Brač Island: Sveti Toma 4–9. XI. 1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂, ♀♀	ibidem: Osridke 4–9.XI.1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂, ♀♀	ibidem: Blato 4.–9.XI. 1965 from *Ovis aries* (Tovornik and Černy 1972)
♂♂, ♀♀, NN, LL	ibidem: Zapadna Laščatna 24.–25.XI. 1964 collected on the vegetation by dragging method (Tovornik and Černy 1972)
♂♂, ♀♀	ibidem: Blato, months: I. II. IV. V. XII. 1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Sveti Toma, months: I. II. IV. V. XI. XII. 1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Zapadna Laščatna, months: I. IV. XI. XII. 1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b)
♂♂, ♀♀	ibidem: Sjeverna Laščatna, months: I. IV. XI. XII. 1964/1965 collected on vegetation and/or the ground by dragging/flagging method (Tovornik 1976b, Tovornik and Šooš 1976)
♂♂, ♀♀	ibidem: Supetar 22.II. 1974 from *Ovis aries* (Tovornik 1991a)
♂♂, ♀♀	ibidem: (Hubálek 2010)

18. *Ixodes hexagonus* Leach, 1815

♂♂, ♀♀	Gornja Posavina, month: III. from *Equus caballus*, *Bos taurus* (Mikačić 1968)
NN	Velika Kapela mountain: Razvala 16.VIII. 1969 from *Erinaceus concolor* (Tovornik 1987b)
♀	Dugo Selo 5.IV. 1959 from *Martes martes* (Tovornik 1987b)
♀♀	Đakovo 7.IV.–25.IV. 2011 from *Canis lupus familiaris*
♂♂	ibidem: 2.V.–25.V. 2011 from *Canis lupus familiaris*

19. *Ixodes ricinus* (Linnaeus, 1758)

♂♂, ♀♀, NN, LL	Cres Island: Hrasta 6.–11.IV.1948 from *Ovis aries* (Mikačić 1949)
♂, ♀♀	ibidem: 10.XI.1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀, NN	ibidem: Vrana 6.–11.IV.1948 from *Capra hircus* (Mikačić 1949)
♂♂, ♀♀, NN, LL	ibidem: Vodice 6.–11.IV.1948 from *Ovis aries* (Mikačić 1949)
NN	ibidem: Cres 6.–11.IV.1948 from *Capra hircus* (Mikačić 1949)
♂♂, ♀♀, NN	ibidem: Belej 4.XI.1948 from *Ovis aries* (Mikačić 1949)
♂♂, ♀♀	Pula, months: I. II. III. IV. V. VI. VIII. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)

NN	ibidem, months: I. II. III. IV. X. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
LL	ibidem, months: IV. VII. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
♂♂, ♀♀	Krk Island, months: I. II. III. IV. V. IX. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
NN	ibidem, months: I. II. III. IV. IX. X. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
LL	ibidem, months: I. II. III. IV. X. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
♂♂, ♀♀	Cres Island, months: I. II. III. IV.V. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
NN	ibidem, months: I. II. III. IV. IX. XI. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
LL	ibidem, months: II. III. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
♂♂, ♀♀	Lošinj Island: Veli Lošinj, months: I. II. III. IV. V. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
NN	ibidem: months: I. II. III. IV. V. IX. X. XI. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
LL	ibidem: months: II. III. IV. X. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
♂♂, ♀♀	Zadar, months: I. II. III. IV. VI. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
NN	ibidem: months: I. III. IV. IX. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
LL	ibidem: months: I. IV. IX. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
♂♂, ♀♀	Split, months: I. II. III. IV. X. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
NN	ibidem: months: I. II. III.1936–1963 from *Ovis aries*, *Bos taurus*,*Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
LL	ibidem: month: II. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
♂♂, ♀♀	Brač Island, months: I. III. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)

NN	ibidem: months: I. II. III. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
♂♂, ♀♀	Dubrovnik, months: I. II. III. IV.V. IX. X. XI. XII. 1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
NN	ibidem: months: I. II. IV. XI. XII.1936–1963 from *Ovis aries*, *Bos taurus*, *Capra hircus*, *Equus caballus*, *Equus asinus* (Mikačić 1965)
N, L	Rovinj 7.IV.1959 from *Algyroides nigropunctatus* (Tovornik and Brelih 1980)
N, L	ibidem: 7.IV.1959 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
L	ibidem: 10.IV. 1959 from *Podarcis melisellensis* (Tovornik and Brelih 1980)
NN, LL	Tovarjež Island: 7.V.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, L	Lakal Island: 7.V.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Lunga Island: 6.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Koversada Island: 4.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, L	Figarola Island: 9.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, L	Banjol Island: 11.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
N	Veliki Piruzi reef: 4.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Sturag Island: 12.VIII.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Sveti Ivan Island: 12.VIII.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
L	Sveti Ivan na Pučini reef: 4.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Pulari Island: 8.V.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Revera Island: 8.V.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Veštar Island: 8.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Velika Sestrica Island: 8.IV.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Pisulj Island: 8.V.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)

NN, LL	Gustinja Island: 8.V.1959 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Unije Island: 17.VII.1960 from *Podarcis melisellensis*(Tovornik and Brelih 1980)
NN, LL	ibidem: 17.VII. 1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Zeča Island: 18.VIII.1963 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Vele Srakane Island: 19.VII.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Susak Island: 19.VII.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Oruda Island: 19.VII.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Palacol Island: 19.VII.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Male Orjule Island: 19.VII.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
N, LL	Školjić Island: 19.VII.1960 from *Podarcis sicula* (Tovornik and Brelih 1980)
NN, LL	Sveti Petar Island: 29.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Ilovik Island: 29.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
LL	Grujica Island: 28.VII.1965 from *Podarcis sicula* (Tovornik and Brelih 1980)
♂♂, ♀♀, NN, LL	Srednja Posavina: Stružec, 1970–1978 collected on vegetation and/or the ground by dragging/flagging method (Borčić et al. 1978)
♂♂, ♀♀	Gornja Posavina, months: III. IV. V. VI. VII. IX. X. XI. (Mikačić 1968)
NN	ibidem, months: III. IV. V. VI. (Mikačić 1968)
LL	ibidem, months: IV. V. (Mikačić 1968)
♂♂, ♀♀	Stara Ves 22.III.1963 collected in the forest biotopes (Tovornik 1976a, Vesenjak-Hirjan 1976)
♀	Zagreb 5.IV. 1959 from *Martes martes* (Tovornik 1987b)
LL	Velika Kapela mountain: Razvala 16.VIII.1968 from *Clethrionomys glareolus* (Tovornik 1988b)
N, LL	Lika: Plitvice, Crna rijeka 12.VIII. 1968 from *Apodemus sylvaticus* (Tovornik 1988b)
N, LL	ibidem: 12.VIII. 1968 from *Apodemus flavicollis* (Tovornik 1988b)
N	Vukomeričke gorice: Prkovec 19.VII. 1974 from *Apodemus flavicollis* (Tovornik 1988b)

L	Kozjak mountain: Malačka 29.IV. 1974 from *Apodemus mystacinus* (Tovornik 1988b)
♀♀, N	Dugo Selo 9.X.1964 from *Capreolus capreolus* (Tovornik 1988a)
♂, ♀♀, NN	Dekanovec from *Capreolus capreolus* (Tovornik 1988a)
♂♂, ♀♀, NN	Nedelišće 3.V.1978 from *Capreolus capreolus* (Tovornik 1988a)
N	Dubrovnik 12.II. 1966 from *Buteo buteo* (Tovornik 1990a)
♀, NN, LL	Stara Ves 21.IV. 1964 from *Anthus trivialis* (Tovornik 1990a)
NN, LL	ibidem: 10.V. 1964 from *Anthus trivialis* (Tovornik 1990a)
NN, LL	ibidem: 24.VI.1964 from *Pica pica* (Tovornik 1990a)
	ibidem: 15.,16. VII. 1964 from *Pica pica* (Tovornik 1990a)
N	Baćinska jezera 30.IV. 1976 from *Cettia cetti* (Tovornik 1990a)
L	Vrana-Biograd 25.IV. 1974 from *Luscinia megarhynchos* (Tovornik 1990a)
NN	ibidem: 25.IV.1974 from *Turdus merula* (Tovornik 1990a)
NN	Metković-Gabela 14.X. 1964 from *Turdus philomelos* (Tovornik 1990a)
L	Peščenica-Vratovo 26–27.IV.1984 from *Clethrionomys glareolus* (Tovornik and Matjašič 1991)
N	ibidem: month: V. 1984 from *Apodemus flavicollis* (Tovornik and Matjašič 1991)
N, LL	ibidem: 3.VI. 1984 from *Apodemus flavicollis* (Tovornik and Matjašič 1991)
NN	ibidem: 1.VII.1984 from *Apodemus flavicollis* (Tovornik and Matjašič 1991)
LL	ibidem: 2.VII.1984 from *Apodemus flavicollis* (Tovornik and Matjašič 1991)
N	Peščenica-Vratovo 22.–23.III.1984 from *Apodemus agrarius* (Tovornik and Matjašič 1991)
N	ibidem: 2.VII.1984 from *Clethrionomys glareolus* (Tovornik and Matjašič 1991)
♂♂, ♀♀	Northern Croatia (Rijpkema et al. 1996)
♂♂, ♀♀	Lukovdol, Lipov vrh months: V.- VIII. 2008 from *Capreolus capreolus* (Pintur et al. 2012)
♂♂, ♀♀, NN	Zmajevac 5.III.–30.III. 2011 from *Felis catus*
♂♂, ♀♀, NN	ibidem: 10. IV.–24.IV. 2011 from *Felis catus*
♂♂, ♀♀, NN	ibidem: 25.IV.- 30.IV. 2011 from *Felis catus*
♂♂, ♀♀, N	ibidem: 7.V.- 25.V. 2011 from *Felis catus*
LL	ibidem: 31.VII.2011 from *Homo sapiens*
♀	ibidem: 26.X. 2011 from *Felis catus*
♂, ♀♀, NN	Đakovo 10.III.–30.III. 2011 from *Canis lupus familiaris*
♂♂, ♀♀, NN	ibidem: 7.IV.- 25.IV. 2011 from *Canis lupus familiaris*
♀♀	ibidem: 2.V.–25.V. 2011 from *Canis lupus familiaris*
♀, NN	Sungerski Lug 25.VI. 2011 from *Canis lupus familiaris*

♂♂, ♀♀, NN	Mikleuš 27.IV. 2011 collected on vegetation using the cloth-dragging method
♂♂, ♀♀, NN, L	ibidem: 14.V. 2011 collected on vegetation using the cloth-dragging method
♂♂, ♀♀, NN	ibidem: 8.VI. 2011 collected on vegetation using the cloth-dragging method
♂, ♀, NN	ibidem: 9.VI.2011 collected on vegetation using the cloth-dragging method
♂♂, ♀♀, NN	ibidem: 15.VI.2011 collected on vegetation using the cloth-dragging method
♂♂, ♀♀, NN	ibidem: 3.VII.2011 collected on vegetation using the cloth-dragging method
♂♂, ♀♀, NN	ibidem: 4.VII.2011 collected on vegetation using the cloth-dragging method
♂♂, ♀♀, NN, LL	ibidem: 2.VIII.2011 collected on vegetation using the cloth-dragging method
♂, ♀♀, NN, LL	ibidem: 3.VIII.2011 collected on vegetation using the cloth-dragging method
♀♀, N	ibidem: 13.IX.2011 from *Canis lupus familiaris*

20. *Ixodes trianguliceps* Birula, 1895

♂♂, ♀♀	Rijeka (Tovornik 1984)
♂♂, ♀♀	Split (Tovornik 1984)
♂♂, ♀♀	Kozjak mountain: Malačka (Tovornik 1984)
NN, LL	ibidem: 29.IV. 1974 from *Apodemus mystacinus* (Tovornik 1988b)
♂♂, ♀♀	Velebit mountain (Tovornik 1984)
L	ibidem: Veliki Zavižan 28.IX. 1975 from *Sorex araneus* (Tovornik 1988b)
♀	ibidem: Crni padež 1.VIII. 1975 from *Clethrionomys glareolus* (Tovornik 1988b)
L	ibidem: Baške Oštarije 11.VIII. 1968 from *Apodemus sylvaticus* (Tovornik 1988b)
L	ibidem: Predzid (pod Ćelavcem) 1.VIII.1975 from *Apodemus sylvaticus* (Tovornik 1988b)
♂♂, ♀♀	Istra: Učka mountain (Tovornik 1984)
LL	ibidem: 12.VII. 1969 from *Apodemus flavicollis* (Tovornik 1988b)
♂♂, ♀♀	Gorski Kotar: Risnjak mountain (Tovornik 1984)
L	ibidem: 9.VIII. 1967 from *Sorex alpinus* (Tovornik 1988b)
♀, L	ibidem: 1.IX. 1978 from *Clethrionomys glareolus* (Tovornik 1988b)
♀	Velika Kapela mountain: Razvala 16.VIII. 1968 from *Clethrionomys glareolus* (Tovornik 1988b)
LL	Lika: Plitvice, Crna rijeka 12.VIII. 1968 from *Apodemus sylvaticus* (Tovornik 1988b)

LL	ibidem: 12.VIII. 1968 from *Apodemus flavicollis* (Tovornik 1988b)
N	ibidem: Mukinje 29.V. 1977 from *Clethrionomys glareolus* (Tovornik 1988b)
♀	ibidem: 29.V. 1975 from *Sorex araneus* (Tovornik 1988b)
♀, N, L	Medvednica mountain: Sljeme 25.VI. 1975 from *Apodemus flavicollis* (Tovornik 1988b)
N	Vukomeričke gorice: Prkovec 19.VII.1974 from *Apodemus flavicollis* (Tovornik 1988b)
N	ibidem: 19.VII. 1974 from *Apodemus agrarius* (Tovornik 1988b)
♀♀	Peščenica-Vratovo 5.X. 1977 from *Apodemus flavicollis* (Tovornik 1988b)
N, LL	ibidem: 28.X. 1976 from *Sorex araneus* (Tovornik 1988b)
♀	Križevci, Stara Ves 20.IV.1963 from *Apodemus sylvaticus* (Tovornik 1988b)
♀	Peščenica-Vratovo 26.–27.IV. 1984 from *Apodemus flavicollis* (Tovornik and Matjašič 1991)
N	ibidem: 2.VII.1984 from *Apodemus flavicollis* (Tovornik and Matjašič 1991)
NN	ibidem: 3.VI. 1984 from *Apodemus flavicollis* (Tovornik and Matjašič 1991)
N	ibidem: 1.VIII.1984 from *Sorex araneus* (Tovornik and Matjašič 1991)
♀	ibidem: 20.–24.IX. 1983 from *Apodemus agrarius* (Tovornik and Matjašič 1991)
L	Peščenica-Vratovo 29.–30.XI.1983 from *Neomys sp.*, (Tovornik and Matjašič 1991)

21. *Ixodes vespertilionis* Koch, 1844

♀, N	Dubrovnik, Močiljska špilja 31.III.1953 from *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Myotis myotis*, *Miniopterus schreibersii* and from cave habitats (Tovornik 1990b)
♀, L	ibidem: 6.V.1961 from *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Myotis myotis*, *Miniopterus schreibersii* and from cave habitats (Tovornik 1990b)
♂	Krbavsko polje: 17.IX.1963 cave habitats (Tovornik 1990b)
♀	Cres Island: Petrićevi-špilja Čampari 31.III.1975 from *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Myotis myotis*, *Miniopterus schreibersii* and from cave habitats (Tovornik 1990b)
♂	Buzet, Rabakova peć, Ročko polje, month: VII.1961 from *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Myotis myotis*, *Miniopterus schreibersii* and from cave habitats (Tovornik 1990b)
♂♂, ♀♀	Brač Island (Hubálek 2010)

Discussion

Creating a list of ticks present in the Croatian fauna is somewhat complicated because the territory of Croatia was formerly part of the Kingdom of Yugoslavia and later part of the Socialist Federal Republic of Yugoslavia. Before the disintegration of Yugoslavia, nearly all of the records were simply summarized as being from Yugoslavia and the faunas of the new European states were not differentiated. For instance, Oswald (1940, 1941a) mentioned 23 taxa (species, subspecies and variations) of ticks for Yugoslavia without any further data about the localities where the ticks were collected. Only papers published by Mikačić (1949, 1961, 1963, 1965, 1968, 1969) and Tovornik (1976a, 1976b, 1980, 1984, 1987a, 1987b, 1988a, 1988b, 1990a, 1990b, 1991a, 1991b) Tovornik and Šooš (1976), Tovornik and Brelih (1980), Tovornik and Vesenjak-Hirjan (1988) enabled the creation of a list of ticks present in the Croatian fauna. On the basis of current valid species names, 21 species were registered to occur in Croatia. Dobec et al. (2009) recorded *Dermacentor reticulatus* as a new species for Croatian fauna. However, Mikačić (1968) reported that *Dermacentor pictus* (Hermann, 1804) occurred on horses in the greatest number in the territory of northwestern Croatia. He considered that the name *Dermacentor pictus* was a valid name, while the name *Dermacentor reticulatus* was synonymous. Borčić et al. (1978) used the name *Dermacentor reticulatus* correctly, applying the principle of priority which is commonly accepted in zoological nomenclature. Apanaskevich et al. (2010) determined that *Hyalomma (Hyalomma) detritum* Schulze, 1919 is a synonym for the species *Hyalomma* (*Euhyalomma*) *scupense* Schulze, 1919. Because of that, *Hyalomma (Hyalomma) detritum* Schulze 1919 is not included in the list of Croatian tick fauna although it was reported in several papers. Furthermore, seven species *Rhipicephalus annulatus, Dermacentor reticulatus, Haemaphysalis concinna, Haemaphysalis inermis, Haemaphysalis parva, Rhipicephalus sanguineus* and *Ixodes vespertilionis* were not previously included in the previous compilations of ticks for the Croatian fauna on the website of Fauna Europaea. However, some of these species were recorded from several localities in Croatia (Mikačić 1949, 1965, 1968, 1969, Tovornik and Brelih 1980, Tovornik 1976a, 1976b, 1988a, 1988b, 1990a, 1990b, 1991a, 1991b). Most tick species in Croatia were sampled in the Mediterranean part of the country (Mikačić 1949, 1963, 1965, Tovornik and Šooš 1976, Tovornik and Brelih 1980, Tovornik 1976b, 1988b, Tovornik and Vesenjak-Hirjan 1988, Hassl 2003), whereas in the continental part of Croatia only seven species of ticks were sampled (Mikačić 1968, 1969, Tovornik 1976, Borčić et al. 1978), five of which were recorded in a study carried out in 2011 in the territory of Slavonia and Baranja. During our field samplings, *Ixodes ricinus* and *Dermacentor marginatus* were the most common species. According to Hillyard (1996), the frequent occurrence of *Ixodes ricinus* in the field collections throughout Europe seems to be a general trend. The tick fauna of Mikleuš in Slavonia fully corresponds to the tick fauna in Prekmurje and in central Slovenia (Ploj 2007). In most parts of Europe, *Ixodes ricinus* is a common reservoir and the usual vector of *Borelia burgdorferi sensu lato* and a variety of other pathogens infecting humans (Jaenson and Jensen 2007). Finally, new data were obtained on the geographical distribution of *Ixodes ricinus*, *Dermacentor reticulatus*, *Haemaphysalis concinna* and *Ixodes hexagonus* because the specimens of these species had not been found previously in eastern Croatia. Only *Dermacentor marginatus* was noted in 1955 in Baranja, in the territory of eastern Croatia (Mikačić 1968).

Acknowledgments

I would like to thank Dr. Tomi Trilar (Slovenian Museum of Natural History, Ljubljana, Slovenia) for confirming the collected materials and for literature data. Furthermore, I would like to thank Dr. Đurđica Stubičan for assistance in collecting the literature data (Faculty of Veterinary Medicine, University of Zagreb, Croatia) and thank the students Marko Teni for help in field work. Also, I thank Dr. Lawrence J. Hribar of the Florida Keys Mosquito Control District, USA for all improvements in this manuscript.

Refrences

Apanaskevich DA, Filipova NA, Horak IG (2010) The genus *Hyalomma* Koch, 1844. X. redescription of all parasitic stages of *H. (Euhyalomma) scupense* Schulze, 1919 (=*H. detritum* Schulze) (Acari: Ixodidae) and notes on its biology. Folia Parasitologica 57: 69–78.

Borčić B, Aleraj B, Žutić M, Mikačić D (1978) Uloga krpelja (Ixodidae) u podržavanju prirodnog žarišta tularemije u srednjoj Posavini. Veterinarski arhiv 48: 277–283.

Dobec M, Golubić D, Punda-Polić V, Kaeppeli F, Sievers M (2009) *Rickettsia helvetica* in *Dermacentor reticulatus* Ticks. Emerging Infectious Diseases 15: 98–100. doi: 10.3201/eid1501.080815

Duh D, Punda-Polić V, Trilar T, Petrovec M, Bradarić N, Avšič-Županc T (2006) Molecular identification of Rickettsia felis-like bacteria in *Haemaphysalis sulcata* ticks collected from domestic animals in southern Croatia. Annals of the New York Academy of Sciences 1078: 347–351. doi: 10.1196/annals.1374.068

Duh D, Punda-Polić V, Avšić-Županc T, Bouyer D, Walker DH, Popov VL, Jelovšek M, Gracner M, Trilar T, Bradarić N, Kurtti TJ, Strus J (2010) *Rickettsia hoogstraalii* sp. nov., isolated from hard and soft-bodied ticks. International Journal of Systematic and Evolutionary Microbiology 60: 977–984. doi: 10.1099/ijs.0.011049-0

Estrada-Peña A, Bouattour A, Camicas JL, Walzer AR (2004) Ticks of domestic animals in the Mediterranean region. A guide to identification of species. University of Zaragoza, Zaragoza.

Földvári G (2005) Studies of ticks (Acari: Ixodidae) and tick-borne pathogens of dogs in Hungary. PhD dissertation, Budapest, Hungary: Szent István University, Postgraduate School of Veterinary Science.

Guglielmone AA, Robbins RG, Apanaskevich DA, Petney TN, Estrada-Peňa A, Horak IG, Shao R, Barker SC (2010) The Argasidae, Ixodidae and Nuttalliellidae (Acari: Ixodida) of the world: a list of valid species names. Zootaxa 2528: 1–28.

Hassl A (2003) Ectoparasite of lizards and possible vector: the mammal hard tick *Haemaphysalis concinna* Koch, 1844. Herpetozoa 16: 86–88.

Hillyard PD (1996) Ticks of North-West Europe. In: Kermack DM, Barnes RSK, Crothers JH (Eds) Synopses of the British Fauna (New Series). The Linnean Society of London and The Estuarine and Coastal Sciences Association, Shrewsbury, 178 pp.

Hornok S, Farkas R (2009) Influence of biotope on the distribution and peak activity of questing ixodid ticks in Hungary. Medical and Veterinary Entomology 23: 41–46. doi: 10.1111/j.1365-2915.2008.00768.x

Hubálek Z (2010) Biogeography of Tick-Borne Bhanja Virus (Bunyaviridae) in Europe. Interdisciplinary Perspectives on Infectious Diseases. doi: 10.1155/2009/372691

Jaenson TGT, Jensen JK (2007) Records of ticks (Acari, Ixodidae) from the Faroe islands. Norwegian Journal of Entomology 54: 11–15.

Lindgren E, Tällekint L, Polfeldt T (2000) Impact of climatic change on the northern latitude limit and population density of the disease-transmitting European tick *Ixodes ricinus*. Environmental and Health Perspectives 108: 119–123. doi: 10.1289/ehp.00108119

Mikačić D (1949) Ixodidae of the Islands of Cres and Lošinj with a map of distribution of Ticks species in Yugoslavia. Veterinarski arhiv 19: 14–32.

Mikačić D (1961) The ticks of the littoral zone in Yugoslavia. I. The morphology of the species from the genus *Hyalomma*. Veterinarski arhiv 31: 305–310.

Mikačić D (1963) The ticks of the littoral zone of Yugoslavia. II. The genus *Haemaphysalis* with reference to the distinction between *H. punctata* and *H. cholodkovskyi*. Veterinarski arhiv 33: 133–136.

Mikačić D (1965) Ticks in the littoral belt of Yugoslavia III. Distribution and dynamics of Species in the course of the year. Veterinarski arhiv 35: 155–170.

Mikačić D (1968) A contribution to the study of the biocoenology of ticks (Ixodidae) in north -western Croatia. Veterinarski arhiv 38: 23–27.

Mikačić D (1969) Dinamika pojavljivanja krpelja (Ixodidae) u Sjevernoj Hrvatskoj. Veterinarski arhiv 39: 183–186.

Milutinović M, Radulović Ž (2002) Ecological notes on ticks (Acari: Ixodidae) in Serbia (central regions). Acta Veterinaria Beograd 52: 49–58. doi: 10.2298/AVB0201049M

Oswald B (1940) Determination of Yugoslavian (Balkan) Ticks (Ixodoidea). Veterinarski arhiv 10: 297–304.

Oswald B (1941a) On Yugoslavian (Balkan) ticks and their hosts. Veterinarski arhiv 11: 160–165.

Oswald B (1941b) Additional notes on the morphology and classification of ticks of the genera *Dermacentor* and *Haemaphysalis*. Veterinarski arhiv 11: 201–205.

Pintur K, Beck R, Babić I, Popović N, Florijančić T, Krapinec K, Bošković I (2012) Tick Infestation in roe deer from Gorski Kotar area, Croatia. Proceedings.47th Croatian and 7th International Symposium on Agriculture. Opatija. Croatia, 619–623.

Ploj M (2007) Occurence of ticks (Acarina: Ixodidae) and their development in Prekmurje (Lendavsko Dolinsko). Graduation thesis, Ljubljana, Slovenia: University of Ljubljana.

Punda-Polić V, Petrovec M, Trilar T, Duh D, Bradarić N, Klismanic Z, Avšić-Županc T (2002) Detection and identification of spotted fever group Rickettsiae in ticks collected in southern Croatia. Experimental and Applied Acarology 28: 169–176. doi: 10.1023/A:1025334113190

Rijpkema S, Golubc D, Molkenboer M, Verbeek-De Kruif N, Schellekens J (1996) Identification of four genomic groups of *Borrelia burgdorferi* sensu lato in *Ixodes ricinus* ticks collected in a Lyme borreliosis endemic region of northern Croatia. Experimental and Applied Acarology 20: 23–30.

Tovornik D (1976a) Seasonal and diurnal periodicity of the tick *Ixodes ricinus* L. in the Pannonian tick –borne encephalitis focus (Stara Ves). In: Vesenjak-Hirjan J and others (Eds) Tick-borne encephalitis in Croatia (Yugoslavia). Rad JAZU 372, Zagreb, 99–103.

Tovornik D (1976b) Ecological notes on ticks (Ixodidae) on the island of Brač. In: Vesenjak -Hirjan J and others (Eds) Tick-borne encephalitis in Croatia (Yugoslavia). Rad JAZU 372, Zagreb, 105–113.

Tovornik D (1980) Ticks (Ixodidae) of the island of Brač. Zentralblatt für Bakteriologie, Supplement 9: 291–295.

Tovornik D (1984) O distribuciji klopa *Ixodes (Exopalpiger) trianguliceps* (Birula, 1895) (Arachn., Ixodidae) v Jugoslaviji. Acta entomologica Jugoslavica 20: 53–56.

Tovornik D (1987a) Teratological forms of Ixodid ticks. Biološki vestnik 35: 91–100.

Tovornik D (1987b) On the bionomics of the *Ixodes* (*Pholeoixodes*) *hexagonus* Leach, 1815 in Slovenia (Yugoslavia). Biološki vestnik 35: 101–120.

Tovornik D (1988a) The significance of the Roe-Deer (*Capreolus capreolus* Linné, 1758) as the host and disseminator of Ixodid ticks in SR Slovenia (Yugoslavia). Biološki vestnik 36: 85–94.

Tovornik D (1988b) Geographic distribution and other population parameters of *Ixodes (Exopalpiger) trianguliceps* (Birula, 1895) in Yugoslavia. Biološki vestnik 36: 33–54.

Tovornik D (1990a) The significance of the birds (Aves) as the host and disseminators of ixodid ticks (Yugoslavia). Biološki vestnik 38: 77–108.

Tovornik D (1990b) *Ixodes (Eschatocephalus) vespertilionis* Koch, 1844 (Arachn., Ixodidae) regarding its specific hosts and natural habitats (Slovenia, Yugoslavia). Acta entomologica Jugoslavica 23: 1–2.

Tovornik D (1991a) The response of the adult Ixodid ticks to the source of heat in a warm hotel room. Biološki vestnik 39: 71–72.

Tovornik D (1991b) Data on ticks *Ixodes frontalis* (Panzer, 1798) and *Ixodes arboricola* Schulze et Schlottke, 1929, found on birds in Yugoslavia. Biološki vestnik 39: 157–164.

Tovornik D, Černy V (1972) The ecology of the tick *Ixodes gibbosus* Nuttall, 1916 on the island of Brač (Yugoslavia). Biološki vestnik 20: 89–94.

Tovornik D, Šooš E (1976) On the colour of the unfed female of *Ixodes gibbosus* Nuttall, 1916 found in the TBE focus on the island of Brač. In: Vesenjak -Hirjan J and others (Eds) Tick-borne encephalitis in Croatia (Yugoslavia). Rad JAZU 372, Zagreb, 115–116.

Tovornik D, Brelih S (1980) Ixodid ticks, the parasites of Lizards (Lacertidae) in the karst and other districts of Yugoslavia. Scopolia 3: 1–21.

Tovornik D, Vesenjak-Hirjan J (1988) A revision of ticks belonging to the *Rhipicephalus sanguineus* complex (Latreille), collected in the Yugoslav Coastal Region. Biološki vestnik 36: 77–84.

Tovornik D, Vesenjak-Hirjan J (1989) Invasion of Ixodid ticks *Rhipicephalus sanguineus* Complex (Latreille) to domestic animals on the island of Mljet (Yugoslavia). JAZU, Razred za medicinske znanosti, Zagreb, 71–82.

Tovornik D, Matjašič M (1991) Infestacija malih sesalcev z iksodidnimi klopi kot funkcija pokrajinskih razmer. Zdrav Var 30: 199–204.

Vesenjak-Hirjan J (1976) Tick-borne encephalitis in Croatia. In: Vesenjak -Hirjan J and others (Eds) Tick-borne encephalitis in Croatia (Yugoslavia). Rad JAZU 372, Zagreb, 1–8.

Vesenjak-Hirjan J, Šooš E (1976) The role of migrating sheep in dissemination of tick-borne encephalitis virus. Rad JAZU 372, Zagreb, 167–172.

Vesenjak-Hirjan J, Calisher CH, Brudnjak Z, Tovornik D, Škrtić N, Lazuick JS (1977) Isolation of Bhanja virus from ticks in Yugoslavia. American Journal of Tropical Medicine and Hygiene 26: 1003–1008.

Fauna Europaea, URL: http://www.faunaeur.org [accessed 22 September 2012]

Google Earth, URL: http://www.google.com/earth/index.html [accessed 21 September 2012]

ITIS, Integrated Taxonomic Information System, URL: http://www.itis.usda.gov/index.html [accessed 6 July 2012]

Hrvatski planinarski savez, URL: http://www.plsavez.hr [accessed 18 September 2012]

World Places, URL: http://www.worldplaces.net [accessed 17 September 2012]

ZooKeys 234: 59–66 (2012)
doi: 10.3897/zookeys.234.3794
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

A new species of the genus *Himertosoma* from the Ryukyus, Japan, with a key to species from the Palaearctic and Oriental Regions (Hymenoptera, Ichneumonidae, Banchinae)

Kyohei Watanabe[1,†], Kaoru Maeto[2,‡]

1 *Laboratory of Insect Biodiversity and Ecosystem Science, Graduate School of Agricultural Science, Kobe University, Rokkodaicho 1–1, Nada, Kobe, Hyogo 657–8501, Japan*

† *urn:lsid:zoobank.org:author:B66171F7-93BC-44CF-8DFF-EFE241955323*
‡ *urn:lsid:zoobank.org:author:BEBD5A8E-EC49-42CF-8E1E-C375287A0B36*

Corresponding author: *Kyohei Watanabe* (himebati-love@hotmail.co.jp)

Academic editor: *Gavin Broad* | Received 8 August 2012 | Accepted 18 October 2012 | Published 30 Ocotber 2012

urn:lsid:zoobank.org:pub:CF0ADA98-2DC0-4402-8ADA-B192335D2D7E

Citation: Watanabe K, Maeto K (2012) A new species of the genus *Himertosoma* from the Ryukyus, Japan, with a key to species from the Palaearctic and Oriental Regions (Hymenoptera, Ichneumonidae, Banchinae). ZooKeys 234: 59–66. doi: 10.3897/zookeys.234.3794

Abstract

A new species of the genus *Himertosoma* Schmiedeknecht, *H. kuslitzkii* **sp. n.**, was discovered in Amamioshima Island, the Ryukyus. This new species resembles two Oriental species, *H. philippense* Chandra & Gupta and *H. townesi* Chandra & Gupta, in the colour pattern of the head and metasoma, number of flagellomeres, and the relatively slender first metasomal tergite, but can easily be distinguished from them by the nearly evenly punctate propodeum, different length/width ratio of the first metasomal tergite, different length of the ovipositor sheath, tricoloured mesosoma, and the whitish band along the posterior margin of the second and following metasomal tergites. A key to the Palaearctic and Oriental species of *Himertosoma* is also provided.

Keywords

Amamioshima, Atrophini, endemic species, fauna, taxonomy

Introduction

Himertosoma Schmiedeknecht, 1900, is a large genus in the tribe Atrophini of the ichneumonid subfamily Banchinae, containing 58 described species (Yu et al. 2012). The genus is found in the Ethiopian, Palearctic and Oriental Regions, but its species richness is strongly biased to the Ethiopian Region. Only four species have been known from the Palearctic and Oriental Regions; *H. superbum* Schmiedeknecht, 1900 (type species) from Egypt, Israel, Syria and Uzbekistan, *H. uchidai* Kuslitzky, 2007 (= *H. sulcata* Kuslitzky, 1995) from Far East Russia and Japan (Kunashiri Island), and *H. philippense* Chandra & Gupta, 1977 and *H. townesi* Chandra & Gupta, 1977 from the Philippines.

The host records are from three families of Lepidoptera, i.e., Gelechiidae (*Amblypalpis tamaricella* Danilevsky and *Parapodia tamaricicola* Joannis) and Yponomentidae (*Prays oleae* Bernard) for *H. superbum*, and Tortricidae (*Cydia pomonella* (Linnaeus)) for *H. stramineum* (Morley) (Yu et al. 2012). Although details of the biology are unknown for *Himertosoma*, other members of Banchinae are exclusively koinobiont endoparasitoids (Wahl 1993).

In addition to *H. uchidai* from Kunashiri Is. (Kuslitzky 2007), we found a species of *Himertosoma* from Japan, collected on Amamioshima Island, the Ryukyus, which is described here as new to science. A key to all the described species of *Himertosoma* from the Palaearctic and Oriental Regions is also provided.

In this paper, we describe the new species based on only a single specimen, for the three following reasons: 1) the specimen is in good condition, 2) we made intensive collecting efforts in the type locality and checked all major collections of Japanese ichneumonids, but we have not found any more specimens, and 3) we know that the ichneumonid fauna of the Ryukyus contains some biogeographically important species such as relict or endemic species (e.g., Watanabe et al. 2010; Matsumoto and Broad 2011).

Materials and methods

A stereomicroscope (Nikon S800) was used for observation. Digital images were edited using Adobe Photoshop® CS3. Terminology for general morphology follows Gauld (1991) and for surface sculpture follows Eady (1968). The methods used for measuring clypeus, face, malar space (= cheek of Townes) and metasomal tergites follow Townes (1969). The type specimen of the new species will be deposited in the National Institute for Agro–Environmental Sciences, Tsukuba, Ibaraki, Japan. The holotypes of two Oriental species, *H. philippense* (♀) and *H. townesi* (♀), deposited in the American Entomological Institute, were also examined for comparison. The character states of two Palaearctic species, *H. superbum* and *H. uchidai*, are taken from the descriptions by Schmiedeknecht (1907) and Kuslitzky (1995), respectively. Characteristics of *H. superbum* are also available from the excellent figure in Townes (1970).

Taxonomy

Genus *Himertosoma* Schmiedeknecht, 1900
http://species-id.net/wiki/Himertosoma

Yu and Horstmann (1997) for synonymy.

Remarks. According to Townes (1970) and Chandra and Gupta (1977), this genus can be separated from other atrophine genera by the combination of the following character states: occipital carina complete, its lower end joining hypostomal carina; mesoscutum often smooth; areolet always absent; tarsal claws sometimes only partly pectinate; first metasomal tergite covered with longitudinal striation, with more or less distinct median dorsal carina basally, spiracle in front of middle (Figs 7, 8); laterotergite of fifth metasomal tergite not separated by a crease; exposed portion of fifth metasomal tergite of female only about 0.5 times as long as exposed portion of fourth metasomal tergite; and ovipositor distinctly longer than hind tibia (more than 1.4 times as long as hind tibia). However, the classification of *Himertosoma* and its most similar genus, *Lissonota* Gravenhorst, is still in dispute; *Himertosoma* can be separated from *Lissonota* only by a single character, the absence of the crease separating laterotergite of the fifth metasomal tergite. Their generic status should be reconsidered in future study.

The genus *Himertosoma*, hitherto known only from the Philippines in the Oriental Region (Chandra and Gupta 1977), was discovered for the first time on Amamioshima Island, the North Ryukyus, represented by the following new species.

***Himertosoma kuslitzkii* sp. n.**
urn:lsid:zoobank.org:act:DAF3559C-EB4B-4376-8EB5-E0348ED4523E
http://species-id.net/wiki/Himertosoma_kuslitzkii
Figs 1–9

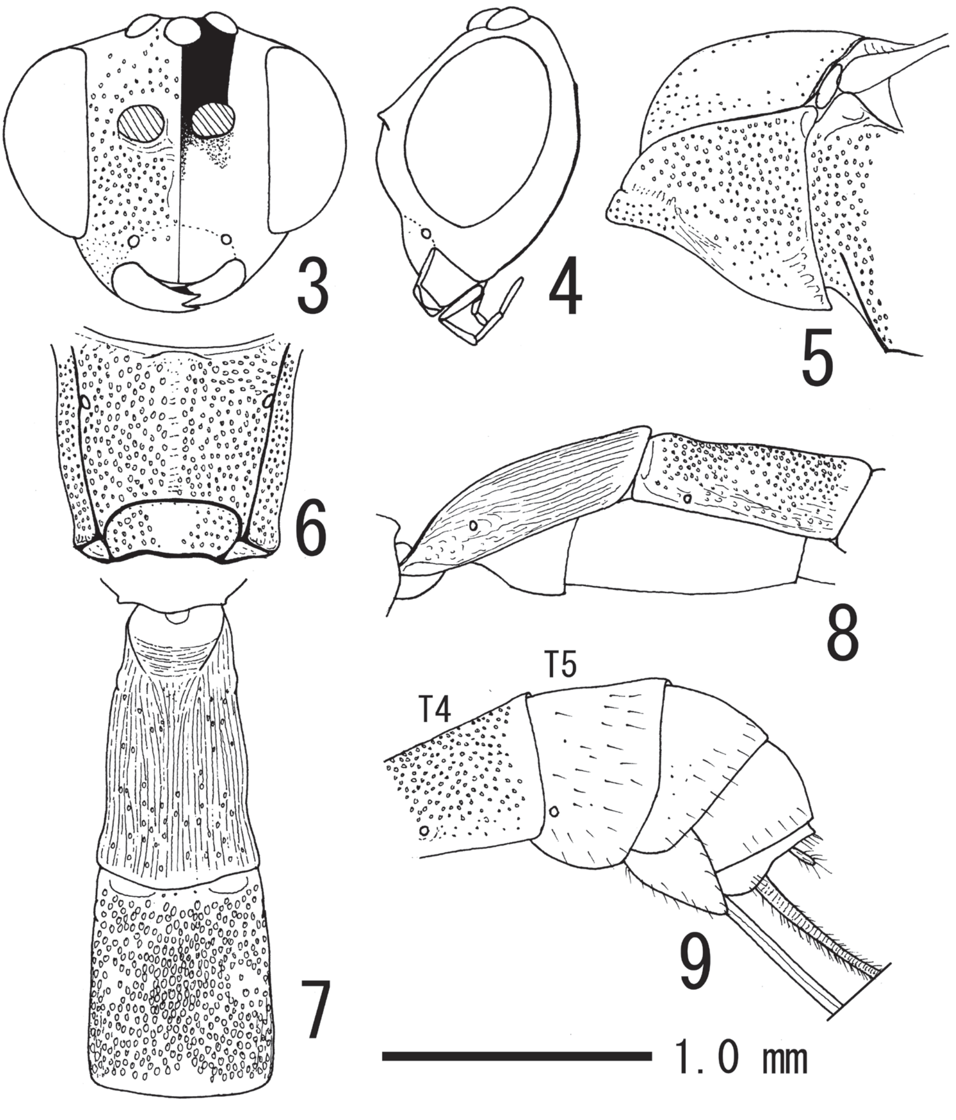
Type specimen. Holotype: ♀, Japan, Kagoshima Pref., Amamioshima Island, Sumiyou Village, near Santaro–toge, 4. June 2007, Kyohei Watanabe leg.

Description. Body length 6.5 mm; length of fore wing 4.5 mm. Head 0.6 times as long as wide in dorsal view; clypeus 0.7 times as long as wide, smooth excluding some punctures along weak supraclypeal suture, its profile gently convex in lateral view (Fig. 4); face 0.6 times as long as wide, median part longitudinally weakly convex, area excluding this convexity and below antennal socket covered with dense punctures (Figs 3, 4); frons sparsely punctate (Fig. 3); malar space 1.0 times as long as basal width of mandible; base of mandible evenly and slightly convex; lower tooth of mandible slightly shorter than upper one; vertex, gena and occiput smooth (but with minute setae and their sockets), excluding oceller area with some punctures and minute rugulae; minimum distance between lateral ocellus and margin of eye (OOL) 1.4 times as long as maximum diameter of lateral ocellus; minimum distance between lateral ocelli

Figures 1–2. *Himertosoma kuslitzkii* sp. n., female (holotype) **1** Body, lateral view **2** head, mesosoma and metasoma, dorsal view.

(POL) 2.0 times as long as maximum diameter of lateral ocellus. Antenna with 31 flagellomeres; first flagellomere 6.7 times as long as apical width and 1.3 times as long as second flagellomere.

Mesosoma 2.9 times as long as minimum distance between tegulae in dorsal view, polished, densely punctate excluding postero–lateral area of pronotum, mesonotum and postscutellum; epomia indistinct, obscurely present on collar (Fig. 5); mesoscutum smooth excluding anterior face, along lateral margin and notauli, and postero–median area sparsely punctate (Fig. 5); scutellum slightly convex, covered with sparse punctures; upper part of epicnemial carina nearly straight, reaching lower 1/4 of pronotum (Fig. 5); episternal scrobe small, narrowly smooth; propodeum with complete posterior transverse carina and pleural carina, with area petiolaris broadly smooth medially (Fig. 6); propodeal spiracle round. Legs: hind femur 6.0 times as long as deep, slightly bulged ventrally near base; hind tibia 9.5 times as long as wide; hind first tarsomere 2.1 times as long as second hind tarsomere and 3.0 times as long as longer hind tibial spur; tarsal claws entirely pectinate. Wings: fore wing with Cu–a distant from vein Rs+M



Figures 3–9. *Himertosoma kuslitzkii* sp. n., female (holotype) **3, 4** head, frontal (**3** right half indicates colour pattern) and lateral (**4** sculpture omitted) views; **5** anterior part of mesothorax, lateral view **6** propodeum, dorsal view **7, 8** first and second metasomal tergites, dorsal (**7**) and lateral (**8** punctation omitted on first metasomal tergite) views; **9** apical part of metasoma, lateral view.

by 0.6 times length of vein Cu–a; areolet absent; hind wing with distal abscissa of vein Cu1 much closer to vein 1A than to vein M, basal abscissa of vein Cu1 5.0 times as long as length of vein cu–a.

Metasoma polished and slender; first tergite 1.7 times as long as maximum width, 1.1 times as long as second tergite, densely longitudinally striate and sparsely punctate (Figs 7, 8); second tergite 1.1 times as long as maximum width; second to fourth tergites covered with dense, large punctures excluding smooth area along each posterior margin (Figs 2, 7, 8); laterotergite of fifth tergite absent (Fig. 9); fifth and following tergites alutaceous with fine, sparse punctures; ovipositor sheath 3.0 times as long as hind tibia and 1.2 times as long as fore wing.

Colouration (Figs 1–3). Head yellow except for: scape and pedicel brown; apex of mandible, antenna excluding scape and pedicel, longitudinal stripes below antennal sockets, frons, vertex and gena excluding orbit, occiput black. Mesosoma black, except for lateral longitudinal spots along upper and lower margins of propleuron, four longitudinal stripes on mesoscutum, two of these stripe in both sides connected anteriorly, scutellum excluding median reddish longitudinal area, tegula, subalar prominence, lower part of mesopleuron, posterior part of metapleuron yellow; median and lateral lobes on mesoscutum excluding yellowish stripe and anterior black area on median lobe of mesoscutum, mesopleuron excluding yellow area, anterior part of metapleuron red. Legs yellow, except for: ventral surface of hind coxa, hind femur, hind tibia, hind tarsus slightly brownish. Wings hyaline. Metasoma black, except for: membranous parts of sternites yellow; posterior margin of second and following tergites, posterior margin of subgenital plate whitish-yellow; subgenital plate excluding white posterior margin, ovipositor brown.

Male. Unknown.

Distribution. Japan (Ryukyus: Amamioshima Island).

Etymology. This species is named after V. S. Kuslitzky, who has contributed to the classification of Banchinae with excellent observations and to the faunal knowledge of ichneumonids in Far East Asia.

Remarks. This species has all the characteristics of *Himertosoma* mentioned above and is distinguished from congeners by the combination of the following character states: flagellum with around 31 segments; propodeum nearly evenly punctate in front of posterior transverse carina (Fig. 6); first metasomal tergite 1.7 times as long as maximum width; ovipositor sheath 3.0 times as long as hind tibia; mesosoma tricoloured (black, yellow and red) (Figs 1, 2); second and following metasomal tergites with whitish bands along posterior margins (Figs 1, 2); ovipositor sheath 3.0 times as long as hind tibia and 1.2 times as long as fore wing; and mesosoma tricoloured.

This species resembles two Oriental species, *H. philippense* and *H. townesi*, in having similar colour patterns on the head and metasoma, the over 30–segmented flagellum and the relatively long first metasomal tergite, but can be easily distinguished from them as shown in the following key.

Key to Palaearctic and Oriental species of *Himertosoma* (♀)

1 First metasomal tergite wide, 1.0–1.4 times as long as maximum (apical) width. Antenna with 26–27 flagellomeres. Inner orbit without yellow marking (face completely black) or metasomal tergites tinged with red. Palaearctic Region **2**

– First metasomal tergite slender, 1.7–2.0 times as long as maximum width. Antenna with 30–32 flagellomeres. Inner orbit with yellow stripe or face completely yellow. Metasomal tergites largely black, without conspicuous reddish areas. Oriental Region **3**

2 First metasomal tergite 1.4 times as long as apical width. Ovipositor sheath longer than fore wing. Metasomal tergites tinged with red. Russian Far East and Japan........ ***H. uchidai* Kuslitzky, 2007 (=*H. sulcata* Kuslitzky, 1995)**

– First metasomal tergite 1.0 times as long as apical width. Ovipositor sheath shorter than fore wing. Metasomal tergites black, without conspicuous reddish areas. Egypt, Israel, Syria and Uzbekistan ....***H. superbum* Schmiedeknecht, 1900**

3 Propodeum covered with transverse striations in front of posterior transverse carina. Malar space 0.7 times as long as basal width of mandible. Ovipositor very long, its sheath 3.6 times as long as hind tibia. The Philippines .... ***H. townesi* Chandra & Gupta, 1977**

– Propodeum nearly entirely covered with punctures before posterior transverse carina (Fig. 6). Malar space and ovipositor sheath not as above **4**

4 Mesosoma bicoloured (black and yellow). Malar space 0.5 times as long as basal width of mandible. Ovipositor sheath 2.0 times as long as hind tibia. The Philippines............................ ***H. philippense* Chandra & Gupta, 1977**

– Mesosoma tricoloured (black, yellow and red) (Figs 1, 2). Malar space 1.0 times as long as basal width of mandible. Ovipositor sheath 3.0 times as long as hind tibia. Japan (the Ryukyus) ....***H. kuslitzkii* sp. n.**

Discussion

While faunal information about ichneumonids in the Ryukyus is poor, several endemic or geographically important species are known from this archipelago (e.g. Momoi 1970). Recently, Matsumoto and Broad (2011) discovered two species of the genus *Rodrigama* Gauld, which occupies a basal branch in the Poemeninae, from Okinawajima Island in the Ryukyus and from Taiwan. In addition, a species of the genus *Tossinola* Viktorov, an atrophine genus with a fragmented Old World distribution, was discovered on the Yakushima, Tokunoshima and Okinawajima Islands in the Ryukyus as well as from Taiwan (Watanabe et al. 2010; Watanabe 2012).

This archipelago is located on the border between the Palaearctic and the Oriental Regions. Some ichneumonids of the Ryukyus, including the above mentioned species, show a tendency towards having the same or closely related species distributed in adjacent areas, viz. Southern China, Taiwan and Southwestern Japan (Momoi 1970; Watanabe et al. 2010; Matsumoto and Broad 2011; Watanabe 2012). The discovery of a new species of *Himertosoma* in the Ryukyus suggests that this or closely related species should also be found in these biogeographically important areas.

Acknowledgements

The authors would like to express their cordial thanks to Dr K. Konishi (National Agricultural Research Center for Hokkaido Region, Sapporo) and Dr K. Takasuka (Kobe University) for their continuous guidance and to Dr Gavin Broad (the Natural History Museum, London) for his critical reading of an early manuscript. KW's cordial thanks also go to Dr David Wahl (American Entomological Institute) for kind support in researching the collection of *Himertosoma* in AEI, to Messrs T. Ban and M. Gunji for their kind assistance in field investigations. This study was partly supported by the Grant-in-Aid for JSPS Fellows to KW.

References

Chandra G, Gupta VK (1977) Ichenumonologia Orientalis, VII. The tribes Lissonontini & Banchini. Oriental Insects Monograph 7: 1–290.

Eady RD (1968) Some illustrations of microsculpture in the Hymenoptera. Proceedings of the Royal Entomological Society of London 43 (4–6): 66–72.

Gauld ID (1991) The Ichneumonidae of Costa Rica, 1. Memoirs of the American Entomological Institute 47: 1–589.

Kuslitzky VS (1995) New genera and species of Ichneumons of the tribe Lissonotini (Hymenoptera, Ichneumonidae) of the Russian Fauna. Entomologicheskoye obozreniye 74(3): 673–676. (In Russian) [English translation in Entomological Review 75(9): 24–28.]

Matsumoto R, Broad GR (2011) Discovery of *Rodrigama* Gauld in the Old World, with description of two new species (Hymenoptera, Ichneumonidae, Poemeniinae). Journal of Hymenoptera Research 20: 65–75. doi: 10.3897/jhr.29.872

Momoi S (1970) Ichneumonidae (Hymenoptera) of the Ryukyu Archipelago. Pacific Insects 12: 327–399.

Townes HK (1969) The genera of Ichneumonidae, part 1. Memoirs of the American Entomological Institute 11: 1–300.

Townes HK (1970) The genera of Ichneumonidae, part 3. Memoirs of the American Entomological Institute 13: 1–307.

Wahl DB (1993) Family Ichneumonidae. In: Goulet H, Huber JT (Eds) Hymenoptera of the World: An identification guide to families, Agriculture Canada Publication, 154–185.

Watanabe K (2012) *Tossinola ryukyuensis* Watanabe et al., 2010 (Hymenoptera, Ichneumonidae, Banchinae) New to Taiwan and Yakushima Island. Japanese Journal of Systematic Entomology 18: 29–30

Watanabe K, Ishikawa T, Konishi K (2010) The first discovery of the genus *Tossinola* from Japan, with description of a new species (Hymenoptera, Ichneumonidae, Banchinae). Japanese Journal of Systematic Entomology 16: 25–31.

Yu DS, van Achterberg K, Horstmann K (2012) World Ichneumonoidea 2011. Taxonomy, biology, morphology and distribution. [Flash driver]. Taxapad®, Vancouver, Canada.

ZooKeys 234: 67–119 (2012)
doi: 10.3897/zookeys.234.3417
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

A revision of the Afrotropical spider genus *Cambalida* Simon, 1909 (Araneae, Corinnidae)

Charles Richard Haddad[1,†]

1 *Department of Zoology & Entomology, University of the Free State, P.O. Box 339, Bloemfontein 9300, South Africa*

† *urn:lsid:zoobank.org:author:417ED537-9B99-48BD-B2AB-CC27E762C850*

Corresponding author: *Charles Richard Haddad* (haddadcr@ufs.ac.za)

Academic editor: *Jeremy Miller* | Received 25 May 2012 | Accepted 16 July 2012 | Published 30 October 2012

urn:lsid:zoobank.org:pub:7FC4DB30-BD40-4AD8-91DC-405458822121

Citation: Haddad CR (2012) A revision of the Afrotropical spider genus *Cambalida* Simon, 1909 (Araneae, Corinnidae). ZooKeys 234: 67–119. doi: 10.3897/zookeys.234.3417

Abstract

The non-mimetic Afrotropical spider genus *Cambalida* Simon, 1909, placed within a subfamily of predominantly ant-mimicking spiders (Araneae: Corinnidae: Castianeirinae), is revised. Three species are transferred from *Castianeira* Keyserling, 1879 to *Cambalida*: *C. deminuta* (Simon, 1909), **comb. n.**, *C. fulvipes* (Simon, 1896), **comb. n.** and *C. loricifera* (Simon, 1885), **comb. n.**. A fourth species, *C. fagei* (Caporiacco, 1939), **comb. n.**, is transferred from *Brachyphaea* Simon, 1895 to *Cambalida*. Two species, *Castianeira depygata* Strand, 1916, **syn. n.** and *C. mestrali* Lessert, 1921, **syn. n.**, are considered junior synonyms of *C. fulvipes*. The males of *C. deminuta* and *C. loricifera* are redescribed and their unknown females are described for the first time. The female and male of *C. fulvipes* and *C. coriacea* Simon, 1909 are also redescribed. The type material of the type species of the genus, *C. insulana* Simon, 1909 from Pagalu (Annobon) Island, is lost, and only immature specimens have been subsequently collected from a nearby island. The species is regarded as a *nomen dubium* until fresh adult material can be collected. A replacement name, *Cambalida simoni* **nom. n.** is proposed for *Cambalida fulvipes* Simon, 1909, the latter being a secondary junior homonym of *Cambalida fulvipes* (Simon, 1896). The type material of this species is also lost and it is too considered *nomen dubium*. The following new species are described: *C. compressa* **sp. n.** from West Africa, *C. dippenaarae* **sp. n.** from southern Africa, *C. griswoldi* **sp. n.** and *C. lineata* **sp. n.** from Madagascar, and *C. unica* **sp. n.** from Cameroon. Notes are provided on the biology of each species and the distribution of the genus in the Afrotropical Region.

Keywords

Castianeirinae, epigaeic, forest, new species, *nomen dubium*, savanna, taxonomy

Introduction

The spider genus *Cambalida* Simon, 1909, endemic to the Afrotropical Region, was initially described in the subfamily Micariinae of the Clubionidae by Simon (1909). Reiskind (1969) also listed this genus in the Clubionidae in his revision of North American Castianeirinae, but was uncertain of its subfamily placement. Brignoli (1983) listed the genus in the Gnaphosidae: Micariinae, while Platnick (1989) subsequently placed *Cambalida* and many of the other micariine genera in the Liocranidae. Dippenaar-Schoeman and Jocqué (1997) already listed *Cambalida* in the Corinnidae: Castianeirinae, but did not formally transfer this genus. Bosselaers and Jocqué (2000) only recently transferred *Cambalida* from the Liocranidae to the Corinnidae based on characters it shares with other members of the Castianeirinae, particularly regarding genitalic structure, a placement confirmed through subsequent phylogenetic analyses (Bosselaers and Jocqué 2002, Haddad et al. 2009).

During this study it became apparent that this small genus posed a large number of taxonomic problems that needed resolution. For example, Simon (1909) described the three species of *Cambalida* from females only, and in the same paper described four species in the genus *Castianeira* Keyserling, 1879 from males only, raising the possibility that some of these sexes could possibly be matched, which turned out not to be the case. Unfortunately, several of these types are lost, including those of the type species of *Cambalida* (*C. insulana* Simon, 1909), raising problems in clarifying the taxonomic status of these species. Bosselaers and Jocqué (2000) recently redescribed *C. coriacea* Simon, 1909, a species that Simon (1909) considered close to the type species but with less sclerotisation, and based on this redescription all castianeirines considered congeneric with *C. coriacea* are considered in this revision to be true *Cambalida*.

The validity of *C. coriacea* was recently put under threat by the discovery that *Castianeira fulvipes* Simon, 1896 may be a senior synonym. This would have resulted in a nomenclatorial change *Cambalida fulvipes* (Simon, 1896), which is a senior homonym of *Cambalida fulvipes* Simon, 1909. I proposed to the International Commission on Zoological Nomenclature that *C. coriacea* have priority over its secondary senior homonym, which has been an unused name since its description (Haddad 2006). However, this proposal was rejected by Kraus (2006), and consequently *Cambalida fulvipes* (Simon, 1896) retains priority (ICZN 2007) and a new name (*C. simoni* nom. n.) is proposed for the secondary junior homonym in the current study. Incidentally, the type material of this species is lost and thus *C. simoni* nom. n. is considered a *nomen dubium*. Detailed examination of the genitalic morphology indicates that *C. coriacea* is, in fact, a good species and that the proposed synonymy with *C. fulvipes* would be incorrect, as was my earlier proposed conservation of the junior name (Haddad 2006). The present study uncovered a rich diversity of species in the Afrotropical Region, many of which have very similar male embolic structures (Figs 50–56).

Cambalida are castianeirines with relatively unspecialised colouration (Figs 1–4), which contrasts with many genera in this subfamily that mimic ants in both colouration and behaviour. It should be noted that *Cambalida* immatures display behaviour similar to mimetic castianeirines, moving the front legs up and down to resemble

Figures 1–4. General habitus of *Cambalida dippenaarae* sp. n., indicating colour variations: **1** and **2** females and **3** male from Wildlives Game Farm, Zambia **4** male from Lesideng Research Camp, Botswana.

antennal movements of ants. This behaviour was only rarely observed in adults. *Cambalida* are entirely ground-dwelling and are mainly associated with savanna and forest habitats on the continent, although two species occurring in southern Africa are also found in drier grassland, Nama Karoo and/or fynbos habitats.

The genus is revised here for the first time and ten species are recognised, of which five are described as new. Based on current data, *Cambalida* is considered endemic to the Afrotropical Region.

Material and methods

Material used in this study was observed in 70% ethanol using a Nikon SMZ800 stereomicroscope for descriptions, digital photographs and measurements. The epigynes and male palps of representative specimens were dissected and cleaned in a Branson 3200 ultrasonic bath for 10 minutes in 70% ethanol, after which they were drawn. Digital photographs of the male emboli of each species, as well as the dorsal habitus of *C. fulvipes* and *C. lineata* sp. n., were taken using a Nikon Coolpix 8400 mounted on a Nikon SMZ800 stereomicroscope. Additional photographs were taken of carapace and abdominal structures of *C. fulvipes* and the holotype female of *C. fagei* (Caporiacco 1939). The photographs were then stacked using Combine ZM software (http://www.hadleyweb.pwp.blueyonder.co.uk) to increase depth of field.

Material for scanning electron microscopy was dehydrated through a graded ethanol series and then critical-point dried in an argon chamber. Specimens were then glued to aluminium stubs and sputter-coated three times with gold for 2 minutes, and subsequently studied in a JEOL WinSEM at 10kV. Digitized micrographs were taken of the morphological structures examined.

All measurements are given in millimetres (mm). Total body length measurements were determined for the smallest and largest specimens of each sex to indicate size variation, and body, eye and leg measurements are given for the specific specimens indicated. Descriptions of the eye arrangements are given for the anterior view of the anterior eye row and dorsal view of the posterior eye row.

The following abbreviations are used in the descriptions: AER – anterior eye row; AL – abdomen length; ALE – anterior lateral eye; ALS – anterior lateral spinneret(s); AME – anterior median eye; AW – abdomen width; CL – carapace length; CW – carapace width; FL – fovea length; MOQ – median ocular quadrangle; MOQAW – median ocular quadrangle anterior width; MOQL – median ocular quadrangle length; MOQPW – median ocular quadrangle posterior width; PER – posterior eye row; PERW – posterior eye row width; PLE – posterior lateral eye; PLS – posterior lateral spinneret(s); PME – posterior median eye; PMS – posterior median spinneret(s); SL – sternum length; ST – spermatheca; SW – sternum width; TL – total length.

Leg spination follows the format of Bosselaers and Jocqué (2000) and includes the following abbreviations: do – dorsal; pl – prolateral; plv – prolateral ventral; rl – retrolateral; rlv – retrolateral ventral; vt – ventral terminal.

Material used in this study is deposited in the following institutions (curators are given in parenthesis):

BMNH	British Museum of Natural History, London, England (Janet Beccaloni)
CAS	California Academy of Sciences, San Francisco, U.S.A. (Charles Griswold)
MNHN	Museum National d'Histoire Naturelle, Paris, France (Christine Rollard)
MHNG	Museum of Natural History, Geneva, Switzerland (Peter Schwendinger)
MRAC	Musée Royal de l'Afrique Centrale, Tervuren, Belgium (Rudy Jocqué)
MZUF	Museo di Storia Naturale, Sezione di Zoologia "La Specola", University of Florence, Italy (Luca Bartolozzi)
NCA	National Collection of Arachnida, ARC–Plant Protection Research Institute, Pretoria, South Africa (Ansie Dippenaar-Schoeman)
NMSA	KwaZulu-Natal Museum, Pietermaritzburg, South Africa (Audrey Ndaba)
NMBA	National Museum, Bloemfontein, South Africa (Leon Lotz)
NMZ	National History Museum of Zimbabwe, Bulawayo, Zimbabwe (Moira FitzPatrick)
SAM	Iziko South African Museum, Cape Town, South Africa (Margie Cochrane)
TMSA	Ditsong National Museum of Natural History, Pretoria, South Africa (Robin Lyle)
ZMB	Zoological Museum, Berlin, Germany (Jason Dunlop)
ZMUC	Zoological Museum, University of Copenhagen, Denmark (Nikolaj Scharff)

Where depositories lacked locality co-ordinates on specimen labels, or where they were not available in the institutional databases, they were traced using the Global Gazetteer Version 2.2 (www.fallingrain.com) and are indicated in square brackets. Distribution maps were produced using the online mapping software SimpleMappr (Shorthouse 2010).

Taxonomy

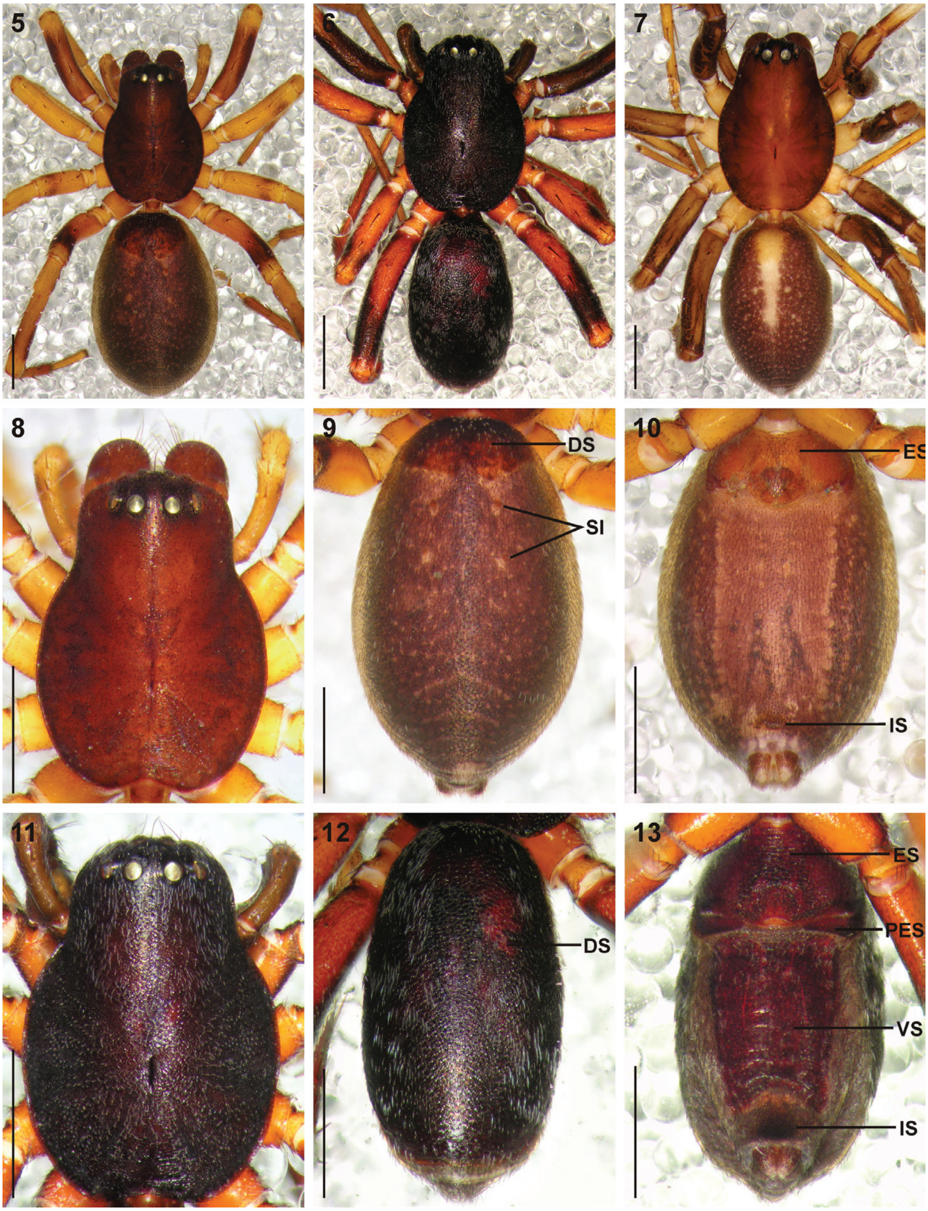
Family Corinnidae Karsch, 1880
Subfamily Castianeirinae Reiskind, 1969

Genus *Cambalida* Simon, 1909
http://species-id.net/wiki/Cambalida

Type species: *Cambalida insulana* Simon, 1909, by original designation. *Cambalida* Simon 1909: 369; Reiskind 1969: 165; Dippenaar-Schoeman and Jocqué 1997: 128; Bosselaers and Jocqué 2000: 315.

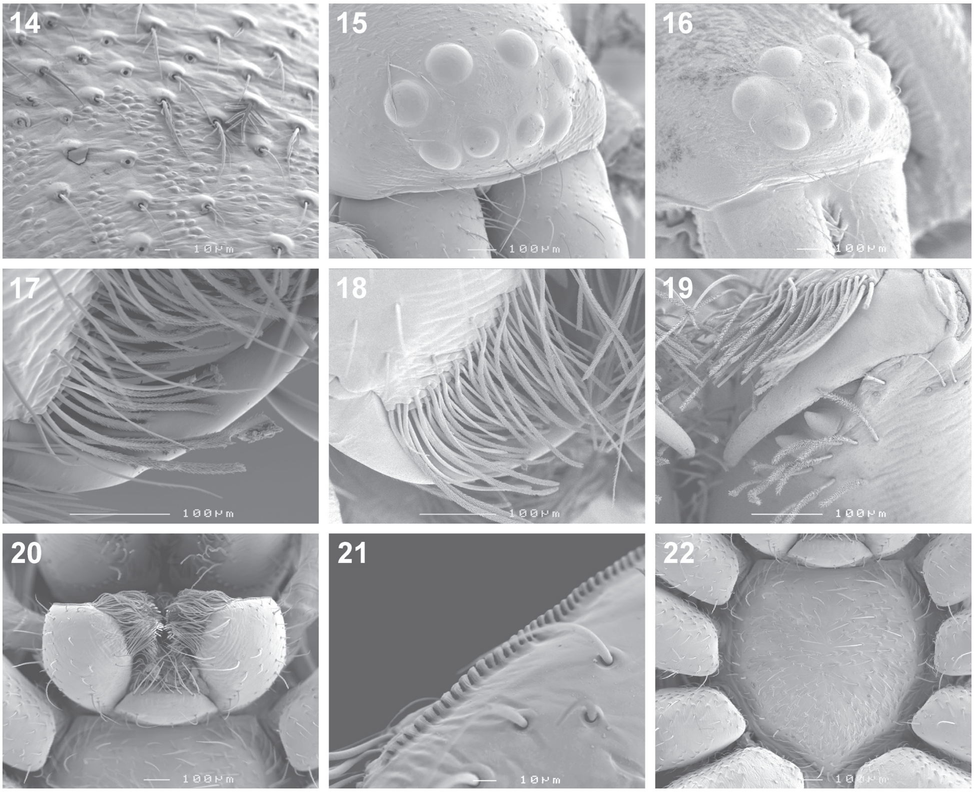
Diagnosis. *Cambalida* is most closely related to *Castianeira* but can be recognised by the relatively broader carapace (width approximately 0.75 carapace length, usually less than 0.70 in *Castianeira*), ALE that are usually considerably larger than the AME, and the posterior eyes that are larger than those of the anterior eye row. Males can further be distinguished from all other castianeirines by the presence of two or three rows of very distinct, longer thickened setae at the distal end of the dorsal surface of the palpal cymbium (Figs 38, 39). These setae usually number between six and 10 and are sometimes accompanied by slightly shorter thickened setae to the sides of these rows. Other genera that possess thickened setae do not show such an arrangement and usually only have two or three thickened setae at the apex of the cymbium.

Description. Small to medium sized spiders, 4.00–7.10mm in length; carapace yellow-brown to dark brown with black markings, sometimes nearly black (Figs 1–8, 11); carapace surface very finely granulate, appearing wrinkled, with scattered plumose and straight setae (Figs 8, 11, 14); several curved setae on clypeus, in eye region and posterior to PER, sometimes also along midline towards fovea (Figs 15, 16); carapace oval, broadest at coxae II, eye region narrowed; carapace slightly elevated posterior to PER, highest at one-quarter its length, depressed slightly at fovea, declining gradually behind fovea; fovea distinct, narrow, quite long; posterior margin strongly concave (Figs 8, 11). AER procurved, AME usually considerably smaller than ALE, rarely subequal in diameter; AME separated by approximately ½ their diameter, close to ALE (Figs 15, 16); PER procurved (Figs 8, 11), PME usually very slightly smaller than PLE, rarely subequal in diameter; PME closer to PLE than to each other; MOQ much wider posteriorly than anteriorly, length approximately equal to posterior width. Chilum single, triangular; anterior surfa-



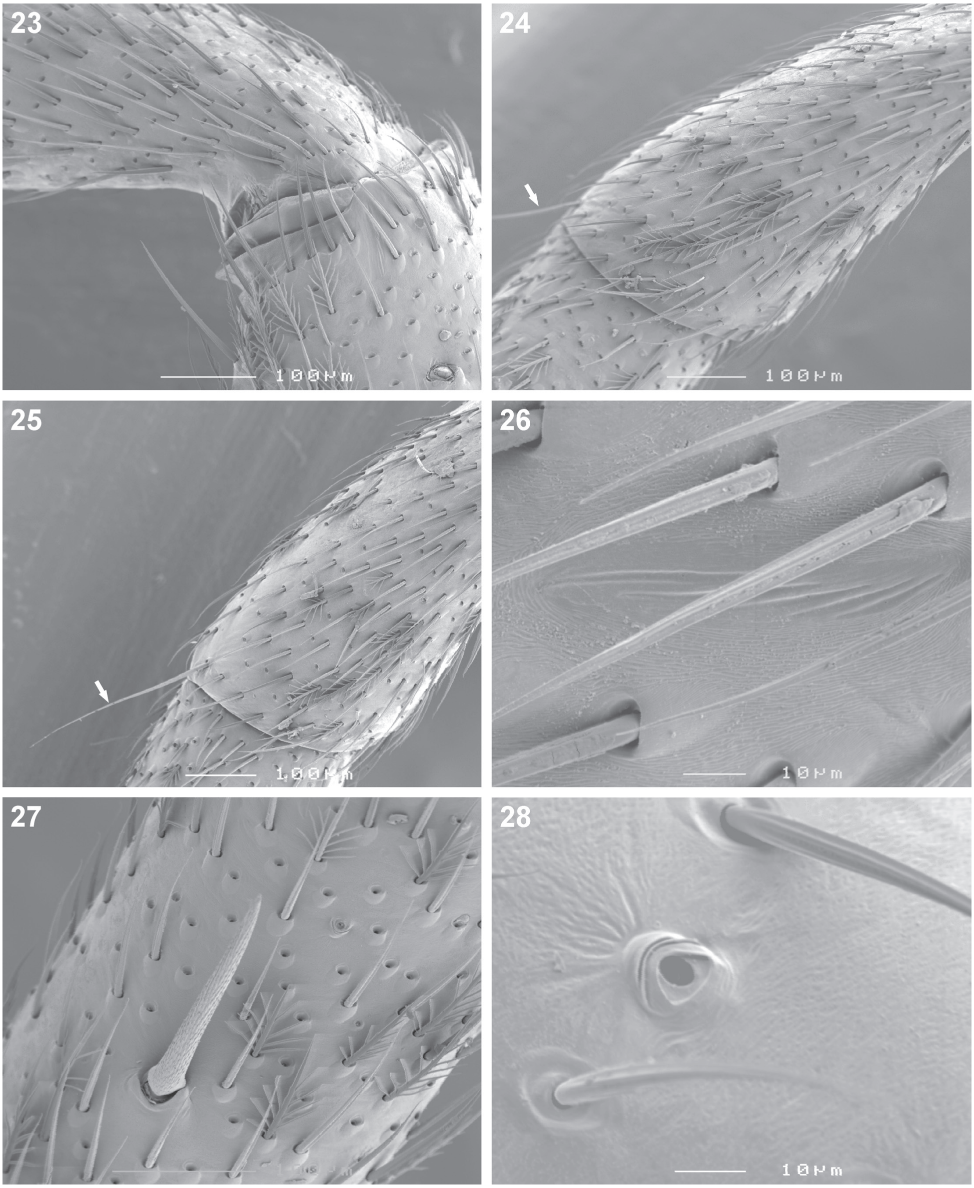
Figures 5–13. Digital microscope photographs of *Cambalida fulvipes* (Simon, 1896) from South Africa (**5, 6, 8–13**) and *C. lineata* sp. n. from Madagascar (**7**): **5, 7** female, dorsal habitus **6** male, dorsal habitus **8** female carapace, dorsal view **9** female abdomen, dorsal view **10** same, ventral view **11** male carapace, dorsal view **12** male abdomen, dorsal view **13** same, ventral view. Scale bars = 1.0mm. Abbreviations: **DS** dorsal scutum **ES** epigastric sclerite **IS** inframamillary sclerite **PES** post-epigastric sclerite **SI** sigilla **VS** ventral sclerite.

ce of chelicerae with scattered long and short erect straight setae; shaggy seta absent; curved setae on cheliceral promargin finely plumose in females (Fig. 17) and males (Figs 18, 19); cheliceral promargin with three teeth, retromargin with two teeth (Fig. 19); endites slightly convex laterally, with distinct serrula comprising short, slightly ventrally curved denticles (Figs 20, 21) and dense maxillar hair tuft on mesal margins (Fig. 20); labium hemispherical, nearly twice as broad as long. Pleural bars weakly sclerotised, isolated; sternum very slightly longer than broad, shield-shaped, slightly narrowed anteriorly; surface finely granulate, covered in short straight setae, with many long erect straight setae (Fig. 22); precoxal triangles and intercoxal sclerites weakly sclerotised, intercoxal sclerites only present between coxae I and II, and II and III. Leg formula 4123 in both sexes; legs finely granulate, with short spines; all segments covered in short straight black setae, with scattered black and white plumose setae (Figs 24–33), usually corresponding to markings; plumose setae sparse on tarsi; retrocoxal window on coxa I small; trochanters notched; femora usually with a single erect ventral seta proximally; patellae each with long fine distal dorsal seta (Figs 24, 25); patellar indentation narrow, slightly broadened at proximal end (Fig. 26); tibiae I and II with long do seta at ¾ tibia length, absent from tibiae III and IV; metatarsi III sometimes longer than metatarsi I and II, otherwise shorter than metatarsus I but longer than II; metatarsi scopulate distally (Fig. 29), tarsi scopulate; tibiae, metatarsi and tarsi with several dorsal and lateral trichobothria with sunken distal plate (Figs 28, 30), patellae, tibiae, metatarsi and tarsi also with several short erect setae dorsally, laterally and ventrally (Fig. 31); tarsal organ 8-shaped, slightly elevated from integument, surface finely wrinkled, opening oval and towards one side (Fig. 32); paired tarsal claws short, situated laterally, with dense claw tufts between them (Fig. 33); metatarsi III and IV without terminal preening brush or comb; palpal claw very elongate, with several ventral teeth increasing in length distally (Fig. 34). Abdomen oval, mottled grey in females, deep red with black markings in males, often with paler grey chevron markings (Fig. 9), rarely with pale median stripe (Fig. 7); three pairs of short fine straight setae on anterior margin above pedicel; dorsal scutum small and extending less than ½ abdomen length in females, covering entire dorsum in males; two pairs of distinct sclerotised dorsal sigilla present in females, absent in males (Figs 9, 12, 35); dorsum covered in short straight black setae, with scattered black and white plumose setae corresponding to chevron markings, in live specimens appearing white, yellow-brown or grey (Figs 1–4, 35); venter densely covered in plumose setae, with scattered short straight setae (Fig. 36); venter of females with moderately sclerotised epigastric region, without post-epigastric sclerites and ventral sclerite, inframamillary sclerite present, distinct, densely covered in short setae (Fig. 10); venter of males with strongly sclerotised epigastric region, post-epigastric sclerites, ventral sclerite and inframamillary sclerite, latter covered in dense short setae (Fig. 13); female with two paired rows of tiny sclerites from epigastric furrow to spinnerets, outer row weakly sclerotised and indistinct. Spinnerets (observed here in *C. dippenaarae* sp. n. and by Bosselaers and Jocqué [2002] in *C. coriacea*): ALS of females with two major ampullate gland spigots, many piriform gland spigots and several small nubbins (Fig. 44; Bosselaers and Jocqué 2002: fig. 9B); ALS of males with single major ampullate gland spigot, single large adjacent nubbin and many piriform gland spigots (Fig. 47; Bosselaers and Jocqué 2002: fig. 9A); PMS of



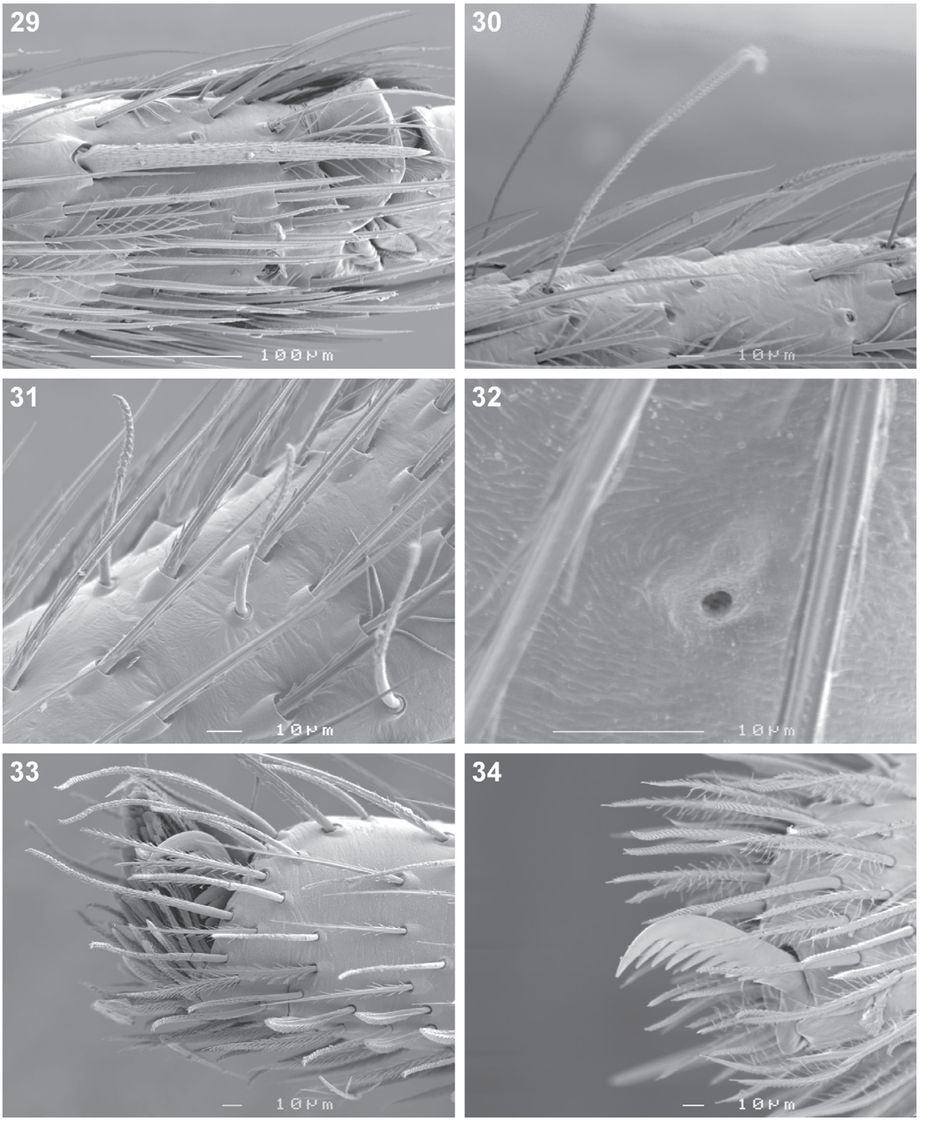
Figures 14–22. Scanning electron microscope photographs of *Cambalida dippenaarae* sp. n. female (**14, 15, 17, 20–22**) and male (**16, 18, 19**): **14** dorsal carapace setae **15, 16** eye region and clypeus, anterolateral view **17, 18** cheliceral promarginal bent setae, anterior view **19** chelicera, ventral view **20** mouthparts, ventral view **21** serrula **22** sternum.

females with three large cylindrical gland spigots, one small minor ampullate gland spigot and several aciniform gland spigots (Fig. 45; Bosselaers and Jocqué 2002: fig. 9D), female of *C. dippenaarae* sp. n. also with a distinct tartipore; PMS of *C. dippenaarae* sp. n. male with one large minor ampullate gland spigot, one tartipore and one nubbin, with several aciniform gland spigots (Fig. 48); PMS of *C. coriacea* male with only a single minor ampullate gland spigot and nubbin (Bosselaers and Jocqué 2002: fig. 9C); PLS of females with two large cylindrical gland spigots and several aciniform gland spigots (Fig. 46; Bosselaers and Jocqué 2002: fig. 9F); PLS of *C. dippenaarae* sp. n. male with several aciniform gland spigots and tiny nubbins (Fig. 49), of *C. coriacea* male with only a single aciniform gland spigot (Bosselaers and Jocqué 2002: fig. 9E). Female epigyne weakly sclerotized, with 6-shaped or curved epigynal ridges covering or leading to lateral copulatory openings (Fig. 37); copulatory ducts directed obliquely or transversely before entering ST II along their lateral or posterior margin; ST II oval, round or subtriangular, usually connected broadly to kidney-shaped posterior ST I. Male palpal segments without apophyses; cymbium short and



Figures 23–28. Scanning electron microscope photographs of *Cambalida dippenaarae* sp. n. female: **23** distal end of femur IV, plumose and short straight setae **24** patella III and **25** patella IV, arrows indicating long distal setae **26** leg II, detail of lyriform organ at proximal end of patellar indentation **27** tibia IV, spine and plumose setae **28** tibia II, trichobothrium base.

broad, with spines prolaterally and ventrally, covered dorsally with short straight and plumose setae; unique thickened setae arranged in two or three rows located distally on dorsal cymbium surface (Figs 38, 39); embolus situated distally, with one complete coil, breadth of base and shape of coil variable (Figs 40–43, 50–56).

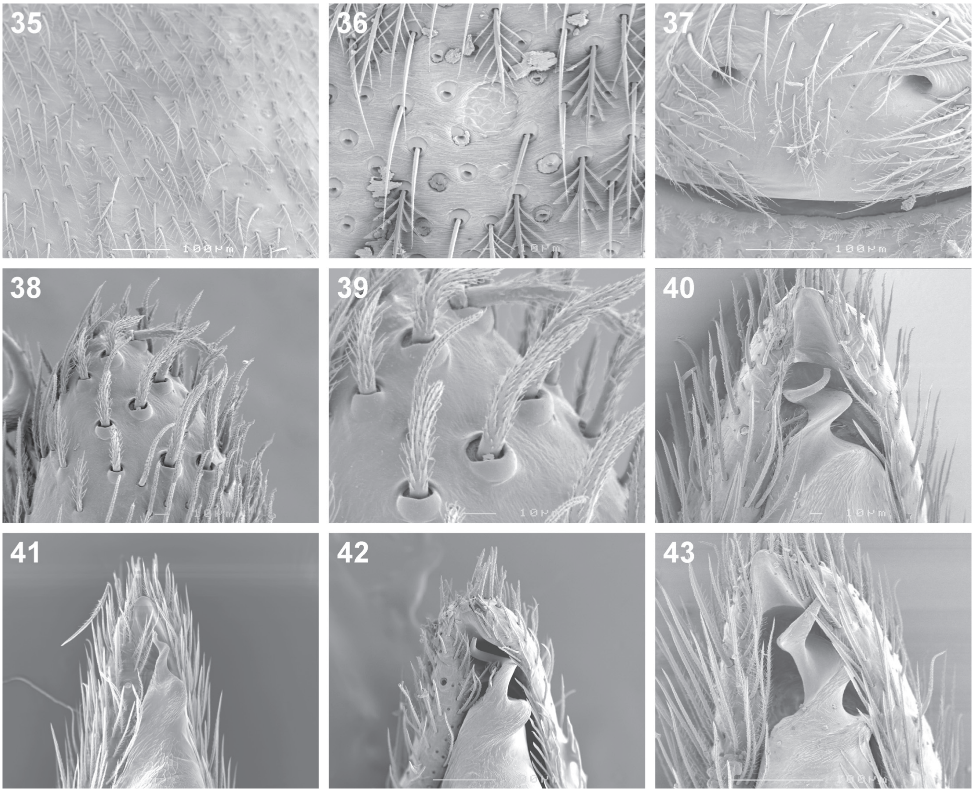


Figures 29–34. Scanning electron microscope photographs of *Cambalida dippenaarae* sp. n. female: **29** metatarsus IV, distal prolateral spine **30** tarsus IV, trichobothria **31** tarsus II, short erect setae **32** tarsus I, tarsal organ **33** same, claw tuft **34** palpal claw.

Cambalida compressa sp. n.

urn:lsid:zoobank.org:act:90AE7140-236F-4F0B-8E4D-FDA6A8653A58
http://species-id.net/wiki/Cambalida_compressa
Figures 40, 50, 57–60

Type material. Holotype female. NIGERIA: Niger State, Mokwa [09°17'N, 05°03'E], leg. A. Russell-Smith, 31.VIII.1974 (14 year savanna regrowth) (BMNH).

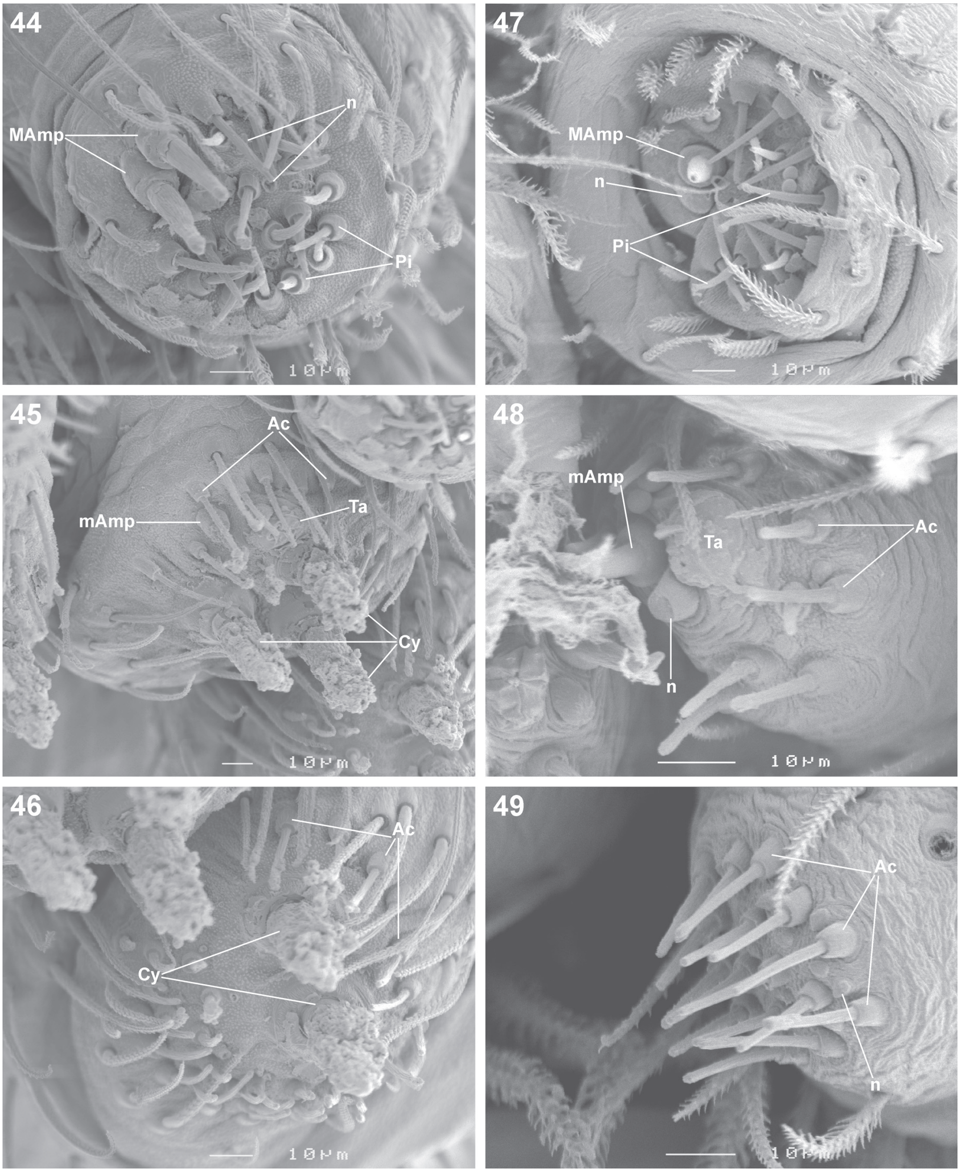


Figures 35–43. Scanning electron microscope photographs of *Cambalida dippenaarae* sp. n. (**35–39, 42**), *C. compressa* sp. n. (**40**), *C. deminuta* (Simon, 1909) (**41**) and *C. loricifera* (Simon, 1885) (**43**): **35** female, dorsal abdominal surface **36** dorsal abdominal sigillum and detail of plumose setae **37** female epigyne **38** thickened setae at dorsal distal end of male palpal cymbium **39** detail of modified setae **40–43** male emboli.

Paratypes. BURKINA FASO: Bobo-Dioulasso, Matourkou, 11°05'N, 04°22'W, leg. J.O. Zongo, VIII–XII.1991 (sorghum field), 1♀ (MRAC 177035). IVORY COAST: Bouaké, F.-Foro, 07°41'N, 05°02'W, leg. G. Couturier, 19–21.VIII.1974 (piège coloré), 1♀ (MRAC 216429); Ferké poste de Comoé, Komoé River, 09°35'N, 04°20'W, leg. J. Everts, 7.III.1980, 1♀ (MRAC 173980); Mbé Research Station, West African Rice Development Association [07°52'N, 05°06'W], near Bouaké, leg. A. Russell-Smith, 17.VIII.1994 (weed control experiment), 12♂ 5♀ (BMNH); Same locality, leg. A. Russell-Smith, 1.IX.1993 (in tall *Andropogon* fallow), 2♂ 1♀ (BMNH); Touba [08°17'N, 07°41'W], leg. A. Russell-Smith, VII–X.1994 (upland rice), 14♂ 3♀ (BMNH).

Other material examined. TOGO: Bassari, 09°15'N, 00°47'W, leg. P. Douben, 6.VII.1984 (pitfalls), 1♂ (MRAC 173987).

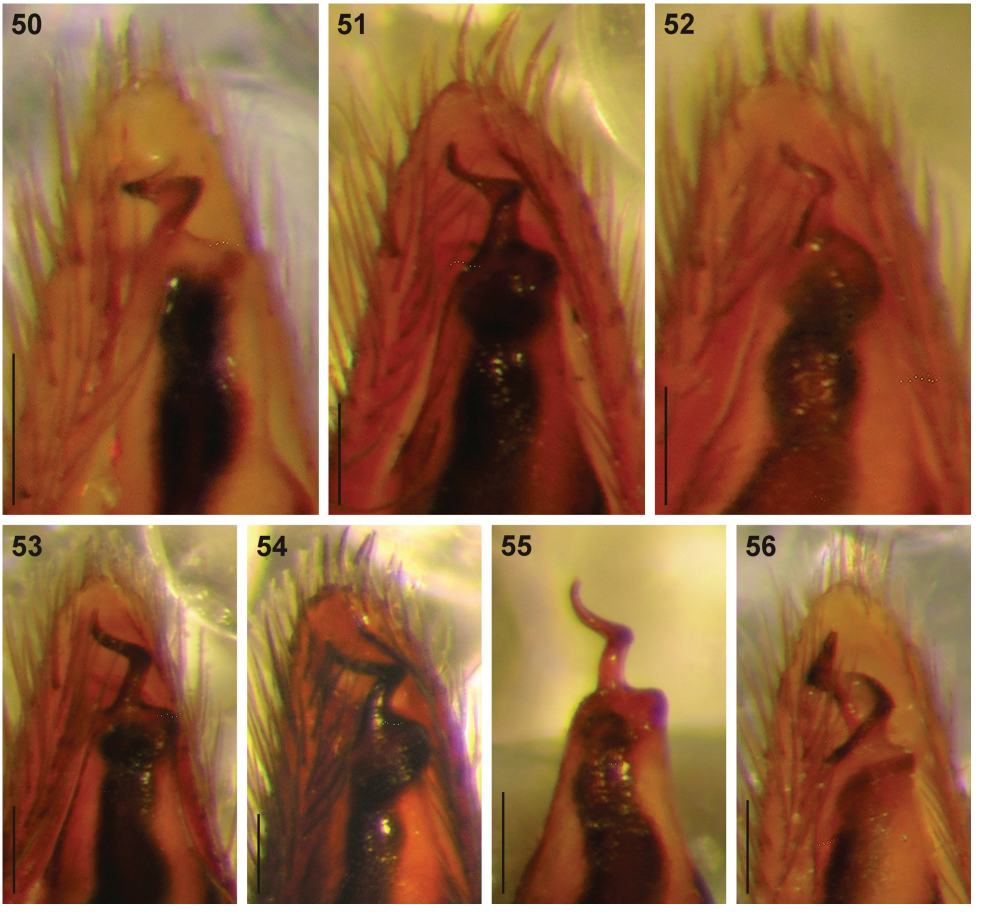
Diagnosis. The females are easily recognised by the very small spermathecae, large 6-shaped epigynal ridges and copulatory ducts that are initially directed medially (Figs 57, 58). Males have an embolus that is distinctly compressed on its longitudinal axis (Figs 40, 50, 59).



Figures 44–49. Scanning electron microscope photographs of *Cambalida dippenaarae* sp. n. female **(44–46)** and male **(47–49)** spinneret morphology: **44, 47** anterior lateral spinneret **45, 48** posterior median spinneret **46, 49** posterior lateral spinneret. Abbreviations: **Ac** aciniform gland spigot(s) **Cy** cylindrical gland spigot(s) **MAmp** major ampullate gland spigot(s) **mAmp** minor ampullate gland spigot(s) **n** nubbin(s) **Pi** piriform gland spigot(s) **ta** tartipore.

Etymology. From the Latin for compact, compressed, referring to the structure of the male embolus.

Remark. The majority of the specimens examined have a much lighter colouration than their congeners, as described below, i.e. a yellow carapace and legs and



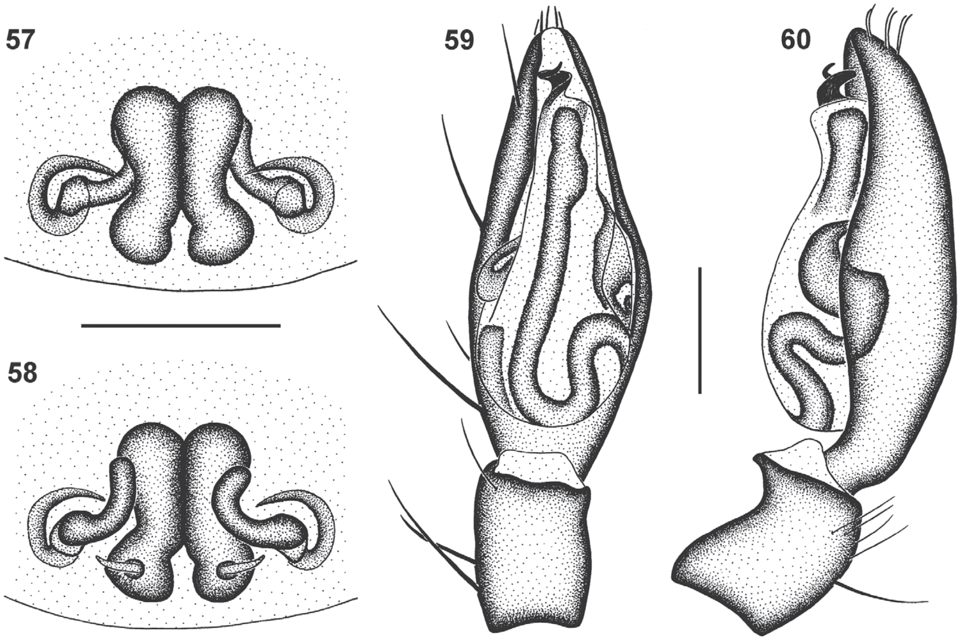
Figures 50–56. Digital microscope photographs of emboli of Afrotropical *Cambalida* species in ventral view: **50** *C. compressa* sp. n. **51** *C. coriacea* Simon, 1909 **52** *C. deminuta* (Simon, 1909) **53** *C. dippenaarae* sp. n. **54** *C. fulvipes* (Simon, 1896) **55** *C. griswoldi* sp. n. **56** *C. loricifera* (Simon, 1885). Scale bars = 0.1mm.

yellow abdomen with black mottling. The remaining specimens had a brown body and legs with similar markings to the majority of congeners. Since the genitalic morphology is very stable in all of the specimens examined it is clear that this species is a case of colour polymorphism.

Female (holotype, Mokwa, BMNH). Measurements: CL 2.69, CW 1.84, AL 3.60, AW 2.10, TL 6.40 (5.80–7.00), FL 0.22, SL 1.19, SW 1.11, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.38, PME–PME 0.11, PME–PLE 0.06, PLE–PLE 0.52, PERW 0.79, MOQAW 0.37, MOQPW 0.48, MOQL 0.49.

Length of leg segments (sequence from femur to tarsus, and total): I 2.10 + 0.85 + 1.78 + 1.66 + 1.20 = 7.59; II 1.95 + 0.78 + 1.45 + 1.54 + 1.07 = 6.79; III 1.80 + 0.75 + 1.38 + 1.68 + 0.95 = 6.56; IV 2.63 + 0.90 + 2.30 + 1.73 + 0.77 = 8.33.

Carapace dark orange-brown with black mottling, clypeus mottled black medially and yellow-brown laterally, eye region black; black striae radiating from fovea towards



Figures 57–60. Genitalic morphology of *Cambalida compressa* sp. n.: **57** female epigyne, ventral view **58** same, dorsal view **59** male palp, ventral view **60** same, retrolateral view. Scale bars = 0.25mm.

palps and leg coxae; surface finely granulate, sparsely covered in white plumose setae. All eyes with black rings; AER procurved, ALE larger than AME; AME separated by distance slightly less than ½ their diameter, AME separated from ALE by distance slightly less than $^1/_5$ AME diameter; clypeus height slightly larger than AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance equal to $^3/_5$ their diameter, PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.33:1. Chelicerae orange-brown with faint black mottling on anterior surface, orange proximally and along prolateral distal margin; three teeth on promargin, median tooth largest, proximal and distal teeth subequal, distal tooth situated closest to median tooth; two slightly separated subequal teeth on retromargin, closer to fang base than promarginal teeth; endites yellow-brown with faint black mottling, cream prolaterally; labium yellow-brown, cream distally; sternum bright yellow with faint black mottling. Legs finely granulate; legs I–III uniform yellow with black mottling laterally, except on tarsi; femora IV yellow with black mottling; patellae IV yellow with black mottling faint proximally, dark in distal half; tibiae IV yellow-brown with black mottling, yellow at distal end; metatarsi IV yellow-brown with black mottling, yellow proximally and distally; tarsi IV yellow. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 2 rlv 2, II plv 1 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination:

femora pl 1 do 2, patellae pl 1 do 1, tibiae pl 1 do 2 plv 1, tarsi pl 1 plv 3 rlv 1. Abdomen lilac-grey, with indistinct white chevrons of plumose setae and two small white patches above spinnerets; dorsal scutum pale brown, extending only $\frac{1}{10}$ abdomen length; venter pale lilac-grey with cream mottling, epigastric sclerite and inframamillary sclerite yellow-brown. Epigyne with large lateral 6-shaped epigynal ridges with prolateral copulatory openings (Fig. 57); copulatory ducts directed medially, curving anteriorly, entering ST II posterolaterally; ST II small and oval, joined broadly to narrow kidney-shaped posterior ST I (Fig. 58).

Male (paratype, Mbé, BMNH). Measurements: CL 2.50, CW 1.75, AL 2.50, AW 1.30, TL 5.00 (4.15–5.75), FL 0.17, SL 1.11, SW 1.02, AME–AME 0.05, AME–ALE 0.01, ALE–ALE 0.33, PME–PME 0.09, PME–PLE 0.04, PLE–PLE 0.48, PERW 0.73, MOQAW 0.35, MOQPW 0.43, MOQL 0.46.

Length of leg segments (sequence from femur to tarsus, and total): I 2.18 + 0.71 + 1.83 + 1.82 + 1.35 = 7.89; II 1.92 + 0.74 + 1.55 + 1.60 + 1.13 = 6.94; III 1.82 + 0.68 + 1.43 + 1.77 + 0.97 = 6.67; IV 2.73 + 0.83 + 2.41 + 2.92 + 1.33 = 10.22.

Carapace bright yellow with faint black mottling, yellow-brown in cephalic region, clypeus mottled black medially, yellow-brown laterally, eye region black; faint black striae radiating from fovea towards palps and leg coxae; surface finely granulate, densely covered in white plumose setae. All eyes with black rings; AER procurved, ALE very slightly larger than AME; AME separated by distance slightly less than ⅓ their diameter, AME separated from ALE by less than $\frac{1}{10}$ AME diameter; clypeus height slightly larger than AME diameter; PER procurved, PME very slightly smaller than PLE; PME separated by distance ½ their diameter, PME separated from PLE by distance slightly less than ¼ PME diameter; CW:PERW = 2.40:1. Chelicerae yellow-brown with black mottling on anterior surface, yellow along prolateral distal margin; three teeth on promargin, median tooth largest, proximal tooth slightly smaller than distal tooth, distal tooth situated closest to median tooth; two slightly separated teeth on retromargin, distal tooth slightly smaller than proximal tooth, closer to fang base than promarginal teeth; endites pale yellow-brown with faint black mottling, cream prolaterally; labium pale orange-brown with faint black mottling, cream distally; sternum yellow with black mottling. Legs finely granulate; legs I–III pale yellow with faint black mottling dorsally and laterally; femora IV pale yellow with faint black mottling; patellae IV yellow with black mottling laterally and ventrally, faint dorsally; tibiae IV yellow with black mottling laterally and ventrally, faint dorsally, distal end pale yellow; metatarsi IV pale yellow with black mottling, faint distally, absent proximally; tarsi IV creamy-yellow. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; patellae with do 1 long distal seta; tibiae: I plv 3 rlv 3, II plv 1 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora pl 1 do 2, patellae pl 1 spine do 2 setae, one proximally and one distally, tibiae pl 1 plv 1, tarsi pl 2 plv 2. Abdomen with pale orange-brown dorsal scutum with faint black mottling, nearly covering entire dorsum, with small white spot of dense plumose setae just above spinnerets; sides of abdomen mottled dark grey; venter creamy grey, epigastric sclerite and post-epigastric sclerites yellow, ventral sclerite creamy-yellow, inframamillary sclerite yellow-brown. Palps yellow with faint black mottling; embolus short and compressed on its longitudinal axis, with one and a quarter coils, tip directed retrolaterally distally (Figs 40, 50, 59, 60).

Distribution. Widespread in West Africa but only known from a few scattered localities (Fig. 65).

Biology. Several records come from agroecosystems (fallow, sorghum and rice); the rest are from riparian forest and savanna habitats.

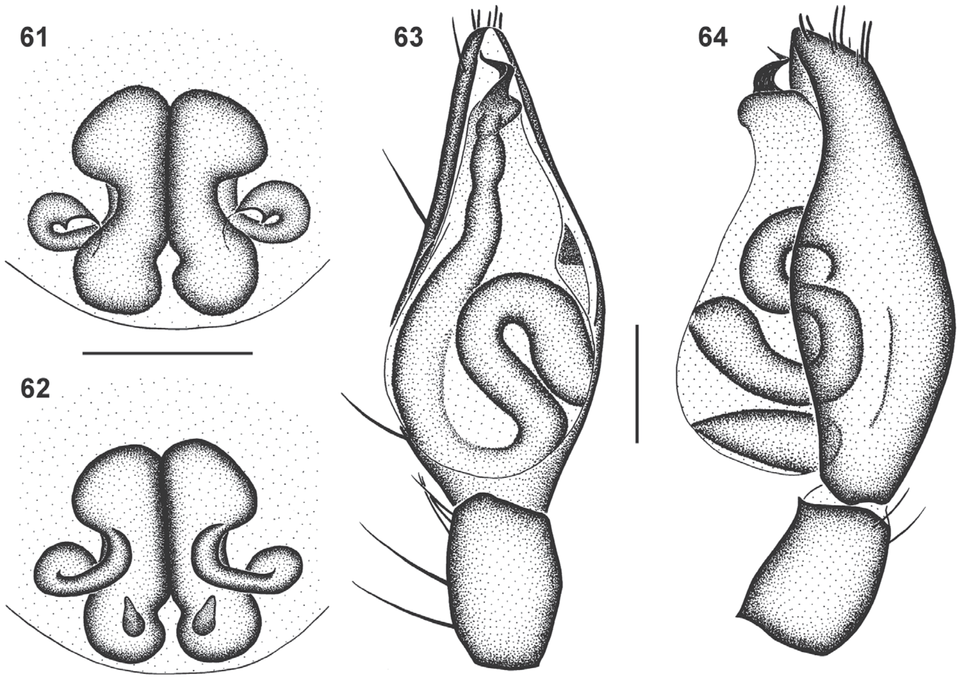
Cambalida coriacea Simon, 1909

http://species-id.net/wiki/Cambalida_coriacea
Figures 51, 61–64

Cambalida coriacea Simon 1909: 370; Bosselaers and Jocqué 2000: 315, figs 3D, 4A–H; Bosselaers and Jocqué 2002: 244, figs 9A–F.

Type material. Holotype female. SIERRA LEONE: Free Town [08°29'N, 13°14'W], MNHN 24399 (examined).

Other material examined. CAMEROON: Chabal Mbabo, SW Slope, 07°25'N, 12°49'E, 1200m a.s.l., leg. Bosmans & Van Stalle, 8.IV.1983 (gallery forest, litter), 1♀ (MRAC 162248); Same locality, 1250m a.s.l., leg. Bosmans & Van Stalle, 7–13.IV.1983 (gallery forest, pitfalls), 3♂ (MRAC 162198); Same locality, 1400m a.s.l., leg. Bosmans & Van Stalle, 11.IV.1983 (gallery forest, litter), 1imm. 2♂ (MRAC 162202); Same locality, 1600m a.s.l., leg. Bosmans & Van Stalle, 10.IV.1983 (transition gallery forest to grassland, sweep-net), 1♂ (MRAC 162204); Same locality, 1600m a.s.l., leg. Bosmans & Van Stalle, 7–13.IV.1983 (gallery forest, pitfalls), 1♂ (MRAC 162213); Faro Game Reserve, 08°24'N, 12°49'E, leg., R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 27.IV.2007 (mature gallery forest, sieving), 1♂ (MRAC 221324); Matute, Tiko Plantation [04°04'N, 09°21'E], leg. B. Malkin, 24.IV–6.V.1949, 1♀ (CAS, CASENT 9033096); Mbam mountain area, near Koutoupi, W slope, 05°54'N, 10°44'E, 1500m a.s.l., leg. Bosmans & Van Stalle, 30.III.1983 (gallery forest), 1♀ (MRAC 162196); Same locality, 1950m a.s.l., leg. Bosmans & Van Stalle, 30.III–3.IV.1983 (grassland), 1imm. 1♀ (MRAC 162197); Same locality, 1580m a.s.l., leg. Bosmans & Van Stalle, 30.III.1983 (transition gallery forest to grassland), 1♀ (MRAC 162242); Same locality, 1580m a.s.l., leg. Bosmans & Van Stalle, 30.III.1983 (transition gallery forest to grassland, pitfalls), 1♂ (MRAC 162201); Same locality, 1100m a.s.l., leg. Bosmans & Van Stalle, 31.III.1983 (forest, litter), 1♂ (MRAC 162209). D.R. CONGO: *North Kivu*: Parc National Albert, sector Tshiaberimu, Riv. Talya Nord afl. Semliki, 01°13'N, 30°32'E, 2340m a.s.l., leg. P. Vanschuytbroeck & H. Synave, 26.III.1954 (Berlese), 1♂ (MRAC 216076), 1♂ (MRAC 216101). *Tshopo*: Kisangani, forêt de Masako, 00°35'N, 25°11'E, leg. J.-L. Juakaly, 17.XII.2002 (young fallow, pitfall), 2♂ (MRAC 214425); Same locality, leg. J.-L. Juakaly, 11.III.2003 (secondary



Figures 61–64. Genitalic morphology of *Cambalida coriacea* Simon, 1909: **61** female epigyne, ventral view **62** same, dorsal view **63** male palp, ventral view **64** same, retrolateral view. Scale bars = 0.25mm.

forest of 40 years old, pitfall), 1♂ (MRAC 214426); Same locality, leg. J.-L. Juakaly, 2.VII.2002 (old fallow, pitfall), 1imm. 2♂ (MRAC 214427); Same locality, leg. J.-L. Juakaly, 24.IX.2002 (young secondary forest, pitfall), 1♂ (MRAC 214580); Kisangani, University campus, 00°31'N, 25°11'E, leg. R. Jocqué, 13.XII.2007 (garden, by hand), 1♂ (MRAC 222506). GABON: Woleu-Ntem, Assok-Ngum, 01°45'N, 11°39'E, leg. A. Pauly, 24.II.1986 (coupe forestière, piège eau), 2♂ (MRAC 172865). GHANA: Kakum Forest, 05°20'N, 01°23'W, 159m a.s.l., leg. R. Jocqué, D. de Bakker & L. Baert, 16.XI.2005 (sieving litter, secondary forest), 1♂ (MRAC 217222). GUINÉE: Forêt classée de Ziama, 08°24'N, 09°17'W, leg. D. Flomo, 21.I.1999 (rain forest, pitfalls), 1♂ (MRAC 218217); Same data, 17.II.2000, 1♂ (MRAC 218219); Same data, 26.IV.1999, 1♀ (MRAC 217955); Same data, 30.VI.1999, 1♂ (MRAC 218220); Same data, 4.II.2000, 1♂ (MRAC 218221); Same data, 15.II.1999, 2♂ (MRAC 218222). IVORY COAST: Abengourou, Forêt classée de Bossematié, 06°37'N, 03°27'W, leg. M. Mühlenberg, 12.III.1993 (rain forest), 1♂ (MRAC 177079); Appouesso, Forêt classée de la Bossematié, 06°35'N, 03°28'W, leg. R. Jocqué & N. Séabé, 30.XI.1994 (rain forest), 1♂ (MRAC 202965); Same locality, leg. R. Jocqué, 1.XII.1994 (modified Malaise trap), 1♂ (MRAC 200938); Same locality, leg. R. Jocqué & Tanoh, 12.III.1995 (forest, pitfall), 1♀ (MRAC 204297); Same data, 26.III.1995, 1♀ (MRAC 204288); Same data, 9.IV.1995, 1♂ (MRAC 204284); Same data, 23.IV.1995, 1♂ (MRAC 204302); Same data, 7.V.1995, 1♂ (MRAC 204283); Same data, 20.V.1995, 1♀ (MRAC 204299), 1♀ (MRAC 204301), 1♂ (MRAC 204303), 1♂ 1♀ (MRAC 204304); Same data, 4.VI.1995, 1♂ (MRAC 204282), 1♀ (MRAC 204300), 1♂ (MRAC 204291); Same data, 18.VI.1995, 1♂ (MRAC 204295), 1♂ (MRAC 204298); Same data, 2.VII.1995, 2♂ 1♀ (MRAC 204285); Same data, 5.XI.1995, 1♂ (MRAC 204296), 1♂ (MRAC 204294); Same data, 19.II.1997, 1♀ (MRAC 205389); Bouaflé, 06°59'N, 05°45'W, leg. J. Everts, 12.I.1981 (pitfalls), 1♂ 5♀ (MRAC 174000); Bouaké, F.-Foro, 07°41'N, 05°02'W, leg. G. Couturier, 5–7. VIII.1974 (piège coloré), 1♀ (MRAC 216372); Guiglo [06°32'N, 07°29'W], leg. Verheyen & Thys van den Audenaerde, 5.VIII.1966, 1♀ (MRAC 131446); Mankono, Ranch de la Marahoué, 08°27'N, 06°52'W, leg. J. Everts, I.1980 (riverine forest), 1♂ (MRAC 172274); Same data, II.1980, 1♂ (MRAC 172249); Same data, III.1980, 8♂ 1♀ (MRAC 172252); Same data, III.1980, 1♂ (MRAC 172261); Touba [08°16'N, 07°41'W], leg. A. Russell-Smith, VII–X.1994, 3♀ (PCRS). LIBERIA: Bong Range Forest, 06°49'N, 10°17'W, leg. D. Flomo, 30.V.2005 (pitfalls in rain forest), 1♀ (MRAC 217132). NIGERIA: Lagos State, Iseri [Isheri, 06°38'N, 03°23'E], leg. B. Malkin, 9–10.IV.1949, 1♀ (CAS, CASENT 9033092). UGANDA: Rubaga, 00°18'N, 32°33'E, leg. D. Penney, VI.1994 (pitfall traps in compound), 1♂ (MRAC 219541).

Diagnosis. Females can be recognised by the relatively long entrance ducts that are initially directed anterolaterally before looping posteriorly, medially and then anteriorly before entering triangular ST II (Figs 61, 62). Males have an embolus with a triangular basal section, and distal section of the coil narrow and tapering to a sharp point (Figs 51, 63, 64).

Female (Matute, CASENT 9033096). Measurements: CL 2.04, CW 1.53, AL 2.50, AW 1.80, TL 4.60 (4.50–5.68), FL 0.20, SL 0.94, SW 0.91, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.29, PME–PME 0.10, PME–PLE 0.04, PLE–PLE 0.44, PERW 0.65, MOQAW 0.28, MOQPW 0.39, MOQL 0.38.

Length of leg segments (sequence from femur to tarsus, and total): I 1.53 + 0.62 + 1.24 + 1.22 + 0.80 = 5.41; II 1.43 + 0.60 + 1.06 + 1.11 + 0.73 = 4.93; III 1.25 + 0.57 + 0.95 + 1.20 + 0.65 = 4.62; IV 1.83 + 0.67 + 1.60 + 1.90 + 0.77 = 6.77.

Carapace deep orange-brown, clypeus yellow, eye region darker; mottled black striae radiating from fovea towards palps and leg coxae; surface finely granulate, sparsely covered in white plumose setae. All eyes with black rings; AER procurved, ALE much larger than AME; AME separated by distance slightly more than ½ their diameter, AME separated from ALE by distance slightly more than ⅛ AME diameter; clypeus height slightly larger than 1¼ AME diameter; PER procurved, PME slightly larger than PLE; PME separated by distance equal to $^{3}/_{5}$ their diameter, PME separated from PLE by distance equal to ¼ PME diameter; CW:PERW = 2.35:1. Chelicerae pale orange-brown, with black mottling on anterior surface; three teeth on promargin, median tooth largest, distal tooth smallest, situated closest to median tooth; two teeth on retromargin, separated by their basal width, distal tooth slightly smaller than proximal tooth, closer to fang base than promarginal teeth; endites yellow with faint black mottling, cream prolaterally; labium yellow-brown, cream distally; sternum pale orange-brown with black mottling. Legs finely granulate; femora I–IV brown, yellow proximally and distally, with paired yellow stripes dorsally in distal half; patellae I–IV yellow, with faint mottled brown prolateral spot, retrolateral end fringed with brown, marking extending around patellar indentation; tibiae, metatarsi and tarsi I and II yellow, with sparse brown mottling; tibiae III yellow with ventral brown band in distal third; tibiae IV yellow with broad brown median band and paired yellow stripes dorsally; metatarsi and tarsi III and IV yellow with faint brown mottling. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 1 rlv 1, II rlv 1, III pl 2 rl 2 plv 1 vt 2, IV pl 2 rl 2 plv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palp with femora and patellae yellow, tibiae and tarsi yellow-orange, all with black mottling. Palpal spination: femora do 2, patellae pl 1 do 2, tibiae pl 1 do 1 plv 1, tarsi pl 1 plv 3 rlv 1. Abdomen mottled dark grey, with darker median stripe and orange dorsal scutum extending ¼ abdomen length; small white spot of dense plumose setae just above spinnerets; venter creamy-grey, darker towards spinnerets, epigastric sclerite and inframamillary sclerite orange-brown. Epigyne with lateral copulatory openings situated narrow curved epigynal ridges (Fig. 61); copulatory ducts initially directed anterolaterally, looping posteriorly and then transversely medially, bending sharply before entering subtriangular ST II posterolaterally; ST II joined broadly to kidney-shaped posterior ST I (Fig. 62).

Male (Ibadan, BMNH). Measurements: CL 2.50, CW 1.84, AL 2.80, AW 1.65, TL 5.15 (4.90–5.40), FL 0.21, SL 1.10, SW 1.03, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.32, PME–PME 0.11, PME–PLE 0.04, PLE–PLE 0.51, PERW 0.75, MOQAW 0.33, MOQPW 0.46, MOQL 0.45.

Length of leg segments (sequence from femur to tarsus, and total): I 2.00 + 0.75 + 1.78 + 1.85 + 1.22 = 7.60; II 1.78 + 0.73 + 1.40 + 1.57 + 1.00 = 6.48; III 1.67 + 0.70 + 1.25 + 1.65 + 0.82 = 6.09; IV 2.38 + 0.80 + 2.12 + 2.70 + 1.05 = 9.05.

Carapace bright orange-brown, clypeus bright yellow with black mottling medially, eye region with dense black mottling; black striae radiating from fovea towards palps and leg coxae; surface finely granulate, sparsely covered in white plumose setae. All eyes with black rings; AER procurved, ALE much larger than AME; AME separated by distance approximately $^2/_5$ their diameter, AME separated from ALE by ⅛ AME diameter; clypeus height equal to 1$^2/_5$ AME diameter; PER procurved, PME and PLE equal in diameter; PME separated by distance equal to $^3/_5$ their diameter, PME separated from PLE by distance slightly more than $^1/_5$ PME diameter; CW:PERW = 2.45:1. Chelicerae bright yellow-orange with black mottling on anterior surface, except distally; three teeth on promargin, median tooth largest, distal tooth slightly smaller than proximal tooth, distal tooth situated closest to median tooth; two slightly separated subequal teeth on retromargin, closer to fang base than promarginal teeth; endites yellow with black mottling, cream prolaterally; labium yellow-orange proximally, cream distally; sternum bright orange with black mottling. Legs finely granulate; legs I–III creamy-yellow, IV bright yellow, femora slightly darker, all with faint black mottling laterally. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 1 rlv 1, II rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 rlv 1 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora pl 1 do 2, patellae pl 1 spine do 2 short setae, tibiae pl 1 plv 1, tarsi pl 2 plv 2. Abdomen with dark orange-brown dorsal scutum with dense black mottling, extending ⅞ abdomen length, with small white spot of dense plumose setae just above spinnerets; posterior end of dorsum and sides of abdomen pale grey; venter pale grey, epigastric sclerite, post-epigastric sclerites and ventral sclerite orange-brown, inframamillary sclerite pale yellow-brown. Palps creamy-yellow, tarsi yellow, with faint black mottling; embolus forming a narrow coil, with a triangular basal section and distal section of the coil tapering to a sharp point (Figs 51, 63, 64).

Distribution. Widespread in central and western Africa (Fig. 65).

Biology. This species has been collected from a variety of tropical forest types, mainly by pitfall trapping, litter sifting and by hand.

***Cambalida deminuta* (Simon, 1909)**
http://species-id.net/wiki/Cambalida_deminuta
Figs 41, 52, 66–69

Castianeira deminuta Simon, 1909: 367 comb. n.

Type material. Male lectotype and male paralectotype, here designated, together with 1 male *Cambalida fulvipes* (Simon, 1896). D.R. CONGO: Fernand Vaz, deposited in MNHN 4109 (examined).

Other material examined. ANGOLA: Chimporo [17°20'S, 17°17'E], 1♂ (MNHG); Vila Luso [Luene, 11°46'S, 19°55'E], leg. B. Malkin, 24–25.XI.1949, 1♂ (CAS, CASENT 9033128). CAMEROON: Muyuka [04°17'N, 09°24'E], leg. B. Malkin, 24–29.VI.1949, 1♀, together with 1♂ *C. fulvipes* (Simon, 1896) (CAS, CASENT 9033116). CENTRAL AFRICAN REPUBLIC: Bambari, 04°15'N, 21°54'E, leg. G. Pierrard, II.1969, 1♂ (MRAC 136621). D.R. CONGO: *Bas-Congo*: Mayombe, Luki Forest Reserve, 05°37'S, 13°05'E, leg. W. Hubau, 18–19.IX.2007 (caught by hand, along trail near guest house), 1♀ (MRAC 222143). *Kivu*: Butembo, 00°07'N, 29°17'E, leg. M. Lejeune, VI.1971, 1♀ (MRAC 140877); Butembo, Vallée Musosa [00°17'N, 29°45'E], 1745m a.s.l., leg. M. Lejeune, IV.1968, 1♀ (MRAC 134048); Lubero, grotte Ribue Lya Mikako [00°09'S, 29°13'E], 1500m a.s.l., leg. J. Celis & M. Lejeune, 27.XII.1966, 1♀ (MRAC 131337). *Tshopo*: Kisangani, Forêt de Masako, 00°35'N, 25°11'E, leg. J. Juakaly, 12.VII.2001 (old Hevea plantation), 1♀ (MRAC 212037); Same data, 18.VII.2001, 1♀ (MRAC 211823); Same data, 20.VII.2001, 1♀ (MRAC 211833); Same locality, leg. J.-L. Juakaly, 6.I.2003 (night catch, young fallow), 1♀ (MRAC 214691), 1♀ (MRAC 214700); Same locality, leg. J.-L. Juakaly, 2.VII.2002 (pitfalls, young fallow), 1♂ (MRAC 214346), 1♂ (MRAC 214421), 2♂ (MRAC 214423); Same data, 17.XII.2002, 1♀ (MRAC 214422), 2♂ (MRAC 214424); Same data, 24.IX.2002, 2♂ (MRAC 214577), 2♂ (MRAC

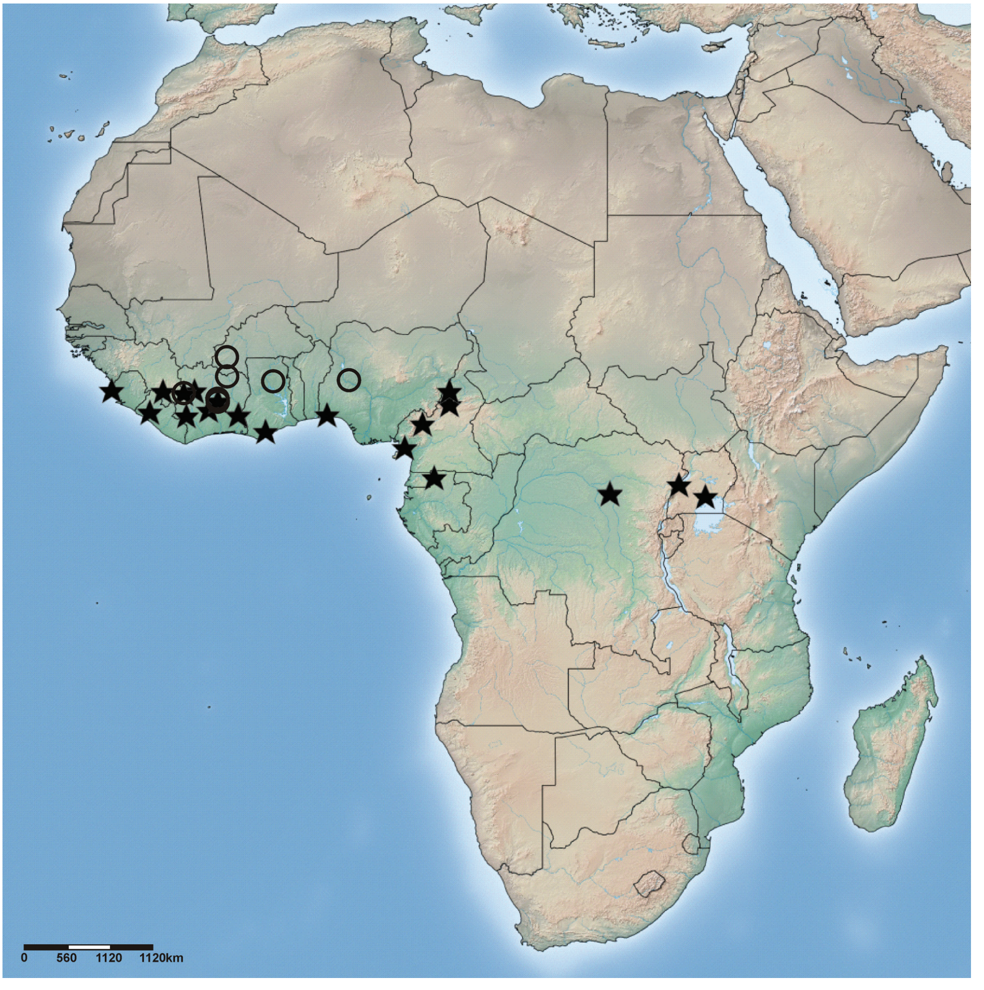
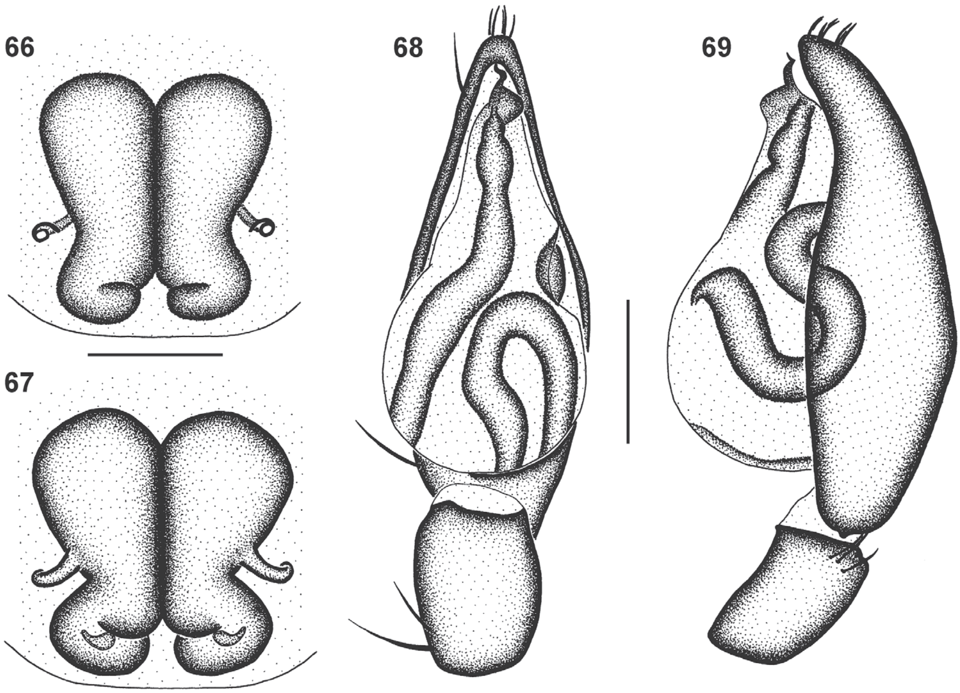


Figure 65. Distribution of *Cambalida compressa* sp. n. (open circles) and *C. coriacea* Simon, 1909 (stars) in the Afrotropical Region.

214578), 1♀ (MRAC 214579); Same locality, leg. J.-L. Juakaly, 11.III.2002 (pitfalls, young secondary forest), 1♂ (MRAC 214428), 1♀ (MRAC 214429); Same data, 5.VII.2001, 1♀ (MRAC 212083); Same locality, leg. J. Juakaly, 4.VII.2001 (young fallow), 1♀ (MRAC 211916); Same data, 11.VII.2001, 1♀ (MRAC 212069), 1♂ (MRAC 212094); Same data, 12.VII.2001, 1♂ 2♀ (MRAC 212053); Same data, 18.VII.2001, 2♀ (MRAC 211850); Same data, 20.VII.2001, 2♀ (MRAC 211826), 1♂ (MRAC 211827); Same data, 25.VII.2001, 1♂ 3♀ (MRAC 211803), 1♀ (MRAC 211815); Same data, 26.VII.2001, 1imm. 4♂ 1♀ (MRAC 211788); Same data, 27.VII.2001, 1♀ (MRAC 211841). GABON: Province Estuaire, Pointe Ngombe, Ekwata, 16km 240° WSW Libreville, 5m a.s.l., 00°19'27''N, 09°18'43''E, leg. B.L. Fisher, 27.III.2000 (littoral rainforest, sifted litter), 1♀ (CAS BLF #2294). GUINÉE: F.C. de Ziama, 08°24'N, 09°17'W, leg. D. Flomo, 18.III.2000 (pitfalls, rain



Figures 66–69. Genitalic morphology of *Cambalida deminuta* (Simon, 1909): **66** female epigyne, ventral view **67** same, dorsal view **68** male palp, ventral view **69** same, retrolateral view. Scale bars = 0.25mm.

forest), 1♀ (MRAC 217954); Same data, 13.IV.1999, 1♀ (MRAC 217953); Same data, 26.IV.1999, 1♀ (MRAC 217956); Same data, 4.VI.1999, 1♀ (MRAC 217957). IVORY COAST: Appouesso, F.C. Bossematié, 06°35'N, 03°28'W, leg. R. Jocqué, 21.XI.1994 (rain forest, grappe 10, near fallen tree), 1♀ (MRAC 201096); Same locality, leg. R. Jocqué & Tanoh, 4.VI.1995 (pitfalls, forest), 1♂ (MRAC 204289); Same data, 18.VI.1995, 1♀ (MRAC 204286); Same data, 2.VII.1995, 1♀ (MRAC 204287); Same data, 30.VII.1995, 1♀ (MRAC 204293); Same locality, Route no. 1, 06°35'N, 03°28'W, leg. R. Jocqué & L. Baert, 19.II.1997 (rain forest, by night, layon 19), 1♀ (MRAC 205436); Bouaké, F.-Foro, 07°41'N, 05°02'W, leg. G. Couturier, 12–14.VIII.1974 (piège coloré), 1♂ (MRAC 216487); Same data, 19–21.VIII.1974, 1♂ (MRAC 216409); Mankono, Ranch de la Marahoué, 08°27'N, 06°52'W, leg. J. Everts, III.1980 (riverine forest), 1♂ (MRAC 172259). LIBERIA: Bong Range Forest, 06°49'N, 10°17'W, leg. D. Flomo, 8.IV.2005 (pitfalls in rain forest), 1♀ (MRAC 216650). RWANDA: Parc National Akagera, Lake Ihema, pêcherie, 01°55'S, 30°45'E, leg. Jocqué, Nsengimana & Michiels, 14.XI–8.XII.1985, 1♀ (MRAC 164699); Same locality, 6km S of Lake Ihema, leg. Jocqué, Nsengimana & Michiels, 30.XI–7.XII.1985 (Berlèse), 1♀ (MRAC 164807). TOGO: Bassari, 09°15'N, 00°47'W, leg. P. Douben, V–VII.1984 (pitfalls), 1♂ (MRAC 173983). UGANDA: Kanyawara, 00°34'N, 30°21'E, 1600m a.s.l., V. & B. Roth, 30.X.1992, 1♂, together with 3 imm. *Castianeira* sp. (CAS, CASENT 9033287).

Remarks. The lectotype is the larger of the two *C. deminuta* males in the type series. Fernand Vaz is a river in the D.R. Congo and no specific locality is mentioned in the original description or on the label accompanying the types.

Diagnosis. Females can be recognised by the broad spermathecae, small coiled lateral copulatory openings, and short entrance ducts of the female epigyne (Fig. 66). Males have a characteristically very short and narrow spiralling embolus (Figs 41, 68).

Female (Mayuka, CASENT 9033116). Measurements: CL 2.05, CW 1.50, AL 2.55, AW 1.71, TL 4.53 (4.25–5.90), FL 0.13, SL 0.96, SW 0.90, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.30, PME–PME 0.11, PME–PLE 0.06, PLE–PLE 0.49, PERW 0.70, MOQAW 0.27, MOQPW 0.40, MOQL 0.38.

Length of leg segments (sequence from femur to tarsus, and total): I 1.52 + 0.63 + 1.30 + 1.25 + 0.90 = 5.60; II 1.40 + 0.60 + 1.09 + 1.13 + 0.78 = 5.00; III 1.28 + 0.57 + 0.95 + 1.19 + 0.61 = 4.60; IV 1.75 + 0.63 + 1.48 + 1.78 + 0.80 = 6.44.

Carapace deep orange-brown, clypeus yellow-brown laterally, eye region slightly darker; black striae radiating from fovea towards palps and leg coxae; surface finely wrinkled, covered in white plumose setae. All eyes with black rings; AER procurved, ALE larger than AME; AME separated by distance slightly larger than ½ their diameter, AME separated from ALE by distance slightly less than ¼ AME diameter; clypeus height slightly less than 1⅓ AME diameter; PER procurved, PME very slightly smaller than PLE; PME separated by distance slightly less than ¾ their diameter, PME separated from PLE by distance slightly larger than ⅓ PME diameter; CW:PERW = 2.14:1. Chelicerae yellow-orange with black mottling on anterior surface, yellow along prolateral distal margin; three teeth on promargin, median tooth largest, proximal tooth smallest, distal tooth closer to median tooth than proximal tooth; two closely separated subequal teeth on retromargin, closer to fang base than promarginal teeth; endites yellow with black mottling, cream prolaterally; labium pale orange-brown with faint black mottling, cream distally; sternum orange with brown mottling, except at setal bases, giving speckled appearance. Legs finely granulate; femora I–IV dark brown, with paler dorsal line and pale retrolateral patch, extending to distal end ventrally; all femora yellow at distal end, also proximally on femora III and IV; patellae I–IV yellow with black mottling laterally; tibiae, metatarsi and tarsi I–III yellow with faint lateral black mottling; tibiae IV brown, yellow proximally and distally, with faint paired dorsal lines; metatarsi IV brown, yellow proximally and distally; tarsi IV yellow. Leg spination: femora: I pl 1 do 3, II do 3, III pl 1 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 1 rlv 1, II rlv 1, III pl 2 rl 2 plv 2 vt 2, IV pl 2 rl 2 plv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3–4 rl 3 plv 2 rlv 1 vt 3. Palpal spination: femora do 2, patellae pl 1 do 1, tibiae pl 1 do 1 plv 1, tarsi pl 1 plv 3 rlv 1. Abdomen mottled dark grey dorsally; dorsal scutum orange-brown with black mottling, extending ¼ abdomen length; venter mottled pale grey, epigastric sclerite orange-brown, inframamillary sclerite yellow-brown. Epigyne with tiny lateral copulatory openings situated within small comma-shaped epigynal ridges (Fig. 66); copulatory ducts short and very narrow, curving obliquely, entering ST II posterolaterally; ST II large and oval, joined broadly to compact, broad, kidney-shaped posterior ST I (Fig. 67).

Male (lectotype, Fernand Vaz, MNHN 4109). Measurements: CL 2.34, CW 1.68, AL 2.55, AW 1.55, TL 4.95 (TL 4.00–5.45), FL 0.23, SL 1.10, SW 1.03, AME–AME 0.09, AME–ALE 0.02, ALE–ALE 0.35, PME–PME 0.14, PME–PLE 0.07, PLE–PLE 0.50, PERW 0.77, MOQAW 0.34, MOQPW 0.47, MOQL 0.46.

Length of leg segments (sequence from femur to tarsus, and total): I 1.80 + 0.70 + 1.65 + 1.60 + 1.05 = 6.80; II 1.60 + 0.63 + 1.36 + 1.35 + 0.85 = 5.79; III 1.35 + 0.70 + 1.02 + 1.00 + 0.73 = 4.80; IV 2.20 + 0.75 + 1.95 + 2.35 + 1.00 = 8.25.

Carapace deep orange-brown with black mottling, clypeus slightly paler, eye region black; black striae radiating from fovea towards palps and leg coxae; surface finely wrinkled, densely covered in white plumose setae. All eyes with black rings; AER procurved, ALE much larger than AME; AME separated by distance slightly less than ⅔ their diameter, AME separated from ALE by distance slightly less than $\frac{1}{5}$ AME diameter; clypeus height slightly less than 1⅓ AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance equal to ¾ their diameter, PME separated from PLE by distance slightly less than $\frac{2}{5}$ PME diameter; CW:PERW = 2.18:1. Chelicerae orange-brown with faint black mottling on anterior surface, yellow-orange along prolateral distal margin; three teeth on promargin, median tooth largest, proximal and distal tooth smaller, subequal in size; distal tooth situated closest to median tooth; two slightly separated subequal teeth on retromargin, closer to fang base than promarginal teeth; endites yellow-brown, cream prolaterally; labium pale orange-brown proximally, cream distally; sternum pale orange-brown with black mottling. Legs finely granulate; femora I brown, yellow at distal end; femora II–IV brown in distal half, yellow-brown proximally and dorsally at distal end; patellae I–IV yellow with black mottling laterally, fused to faint black ring at distal end; tibiae I–III yellow dorsally and ventrally with faint black mottling laterally; tibiae IV brown, yellow at distal end; metatarsi I–IV yellow with faint black mottling in distal half; tarsi I–IV yellow. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 1 rlv 1, II rlv 1, III pl 2 do 1 rl 2 plv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora pl 1 do 2, patellae pl 1, tibiae pl 1 plv 1, tarsi pl 1 plv 2. Abdomen with red-brown dorsal scutum with dense black mottling, nearly covering entire dorsum, with small white spot of dense plumose setae just above spinnerets; sides of abdomen mottled dark grey; venter mottled pale grey, epigastric sclerite, post-epigastric sclerites and ventral sclerite red-brown, inframamillary sclerite yellow-brown. Palps yellow-brown with faint black mottling; embolus very short, with one and a quarter narrow coils, tip directed distally (Figs 52, 68, 69).

Distribution. Widespread in central and western Africa (Fig. 79).

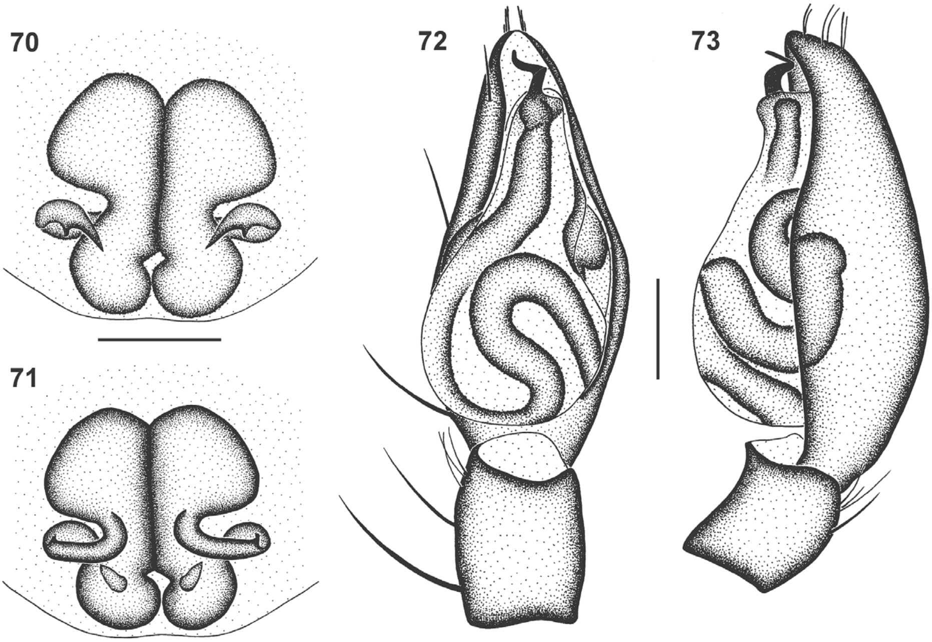
Biology. This species has been collected from a variety of tropical forest types, mainly by pitfall trapping, litter sifting and by hand.

***Cambalida dippenaarae* sp. n.**
urn:lsid:zoobank.org:act:D1093D7A-46A6-403E-ACE4-09E66565DAFD
http://species-id.net/wiki/Cambalida_dippenaarae
Figures 1–4, 14–39, 42, 44–49, 53, 70–73

Type material. Holotype male, together with one paratype male. ZAMBIA: Livingstone, Quarry near Livingstone Airport, 17°47.998'S, 25°46.588'E, leg. C. Haddad & J. Parau, 1.XII.2006 (leaf litter) (NCA 2007/625).

Paratypes. SOUTH AFRICA: *Eastern Cape Province*: Kei Mouth, 32°41.206'S, 28°22.497'E, leg. C. Haddad, 8.XII.2005 (leaf litter, coastal forest), 1♂ 2♀ (NCA 2006/1290). *Free State Province*: Bloemfontein, Free State National Botanical Gardens, 29°03'S, 26°13'E, leg. C. Haddad, 3.I.2011 (sifting leaf litter), 1♀ (NMBA 16157); Same locality, 29°02'S, 26°12'E, leg. V. Butler, 25.XI.2009 (*Cussonia paniculata* leaf litter), 1♂ (NMBA 15727); Same data, 18.IX.2009, 2♀ (NMBA 15666); Same locality, 29°08'S, 26°10'E, leg. L. Lotz, XI.2006 (pitfall traps, next to ridge under tree), 1♂ (NMBA 10941); Brandfort district, Florisbad Research Station, 28°46'S, 26°05'E, 1250m a.s.l., leg. L.N. Lotz, 1–15.II.1988 (pitfall traps), 1♀ (NMBA 3829). *KwaZulu-Natal Province*: Ndumo Game Reserve, Crocodile farm, 26°54.426'S, 32°19.185'E, leg. C. Haddad, 17.I.2006 (on ground surface), 1♂ 2♀ (NCA 2006/423); Same locality, Environmental Centre, 26°54.955'S, 32°18.376'E, leg. C. Haddad & V. Swart, 6.XII.2009 (base of grass tussocks, broadleaf woodland), 1♀ (TMSA 23628); Tembe Elephant Park, Sparse woodland, 26°57'S, 32°23'E, leg. C. Haddad, 6.I.2002 (searching, leaf litter), 1♀ (NCA 2007/3543); Same locality, 27°01'S, 32°24'E, leg. C. Haddad, 5.I.2002 (leaf litter, deep sand forest), 5♀ (NCA 2002/378); Umziki Pan, near Hluhluwe [28°02'S, 32°19'E], leg. P. Reavell, 12.II.1990 (at night on tree trunk), 1♀ (NMSA). *North-West Province*: Marikana, Buffelspoort, 25°45'S, 27°29'E, leg. A.S. Honiball, 30.XI.2006, 1♂ 1♀ (NCA 2007/1155); Vryburg district, Weltevrede Farm, 27°24.976'S, 24°29.906'E, leg. R. Lyle, R. Fourie, D. du Plessis & J. Adendorff, 8–12.I.2008 (garden, active collecting), 1♂ 2♀ (NCA 2009/3676). ZAMBIA: Wildlives Game Farm, near Choma, open savanna, 16°58.974'S, 26°38.974'E, leg. C. Haddad, 4.XII.2006 (leaf litter), 3♂ 7♀ (NCA 2007/552); Same locality, Nabuyani River, 16°59.615'S, 26°38.093'E, leg. C. Haddad, 3.XII.2006 (leaf litter), 7♂ 16♀ (NCA 2007/1126).

Other material examined. BOTSWANA: Okavango Delta, near Shakawe, Lesideng Research Camp, 18°25.822'S, 21°53.771'E, leg. C. Haddad, 25.XI.2006 (leaf litter), 1imm. 5♂ (NCA 2007/937); Same locality, leg. C. Haddad, 26–29.XI.2006 (night collecting), 1♂ 2♀ (NCA 2007/974); Same locality, leg. C. Haddad, 26.XI–11.XII.2006 (pitfalls, riverine forest), 1♀ (NCA 2007/1116); Samochima lagoon, Shakawe Fishing Camp, 18°25.749'S, 21°54.035'E, leg. C. Haddad, 10.XII.2006 (leaf litter), 1imm. 2♀ (NCA 2007/1050). MOZAMBIQUE: Morrungulo Resort, 12m a.s.l., 23°13.983'S, 35°29.587'E, leg. C. Haddad, R. Lyle & R. Fourie, 6.XII.2007 (leaf litter, dune forest), 2imm. 3♂ 1♀ (NCA 2008/188). NAMIBIA: Caprivi strip, 34km E of Divun-



Figures 70–73. Genitalic morphology of *Cambalida dippenaarae* sp. n.: **70** female epigyne, ventral view **71** same, dorsal view **72** male palp, ventral view **73** same, retrolateral view. Scale bars = 0.25mm.

gu, 18°02.944'S, 21°54.611'E, leg. C. Haddad, 30.XI.2006 (under rocks), 2♀ (NCA 2007/907). SOUTH AFRICA: *Eastern Cape Province*: Cwebe Nature Reserve, The Haven, 32°14.497'S, 28°54.653'E, leg. C. Haddad, 30.X.2006 (grassy litter behind dunes), 1imm. 1♂ (NCA 2007/243); Great Fish River Reserve, at Selbourne, 33°08'S, 26°39'E, leg. M. Burger, 5.XII.1993 (pitfall traps), 1♀ (NCA 96/58); Sundays River Valley, 33°23'S, 25°26'E, leg. H. Potgieter, 23.XI.1999 (pitfall traps, citrus orchard), 4♂ (NCA 2000/236). *Gauteng Province*: Kloofendal Nature Reserve, near Roodepoort, 26°08'S, 27°52'E, leg. A. Leroy, 9.I.1988 (pitfall traps), 1♀ (NCA 89/151). *KwaZulu-Natal Province*: 15km N of Richard's Bay, 28°47'S, 32°06'E, leg. T. Wassenaar, 10.XII.1996 (pitfall traps, rehabilitated coastal forest), 1♂ (NCA 97/841); iSimangaliso [Greater St Lucia] Wetlands Park, Eastern Shores Nature Reserve, 29°05.726'S, 26°09.435'E, leg. C. Haddad, 3.VII.2007 (leaf litter), 1imm. 1♀ (NCA 2007/2899); iSimangaliso [Greater St Lucia] Wetlands Park, Hell's Gate, 28°02.3'S, 32°26.0'E, leg. J. Esterhuizen, 19.I.2003 (tsetse fly traps), 1♂ (NCA 2004/795); Ithala Game Reserve, Ngubhu loop, near ruins, 27°30.817'S, 31°14.304'E, leg. C. Haddad, R. Fourie & D. du Plessis, 1.VII.2007 (under rocks), 6imm. 1♂ (NCA 2007/2814); Same locality, Doornkraal Camp, 27°30.735'S, 31°12.231'E, leg. C. Haddad & R. Fourie, 29.VI.2007 (sifting leaf litter), 14imm. 2♀ (NCA 2007/2875); Kosi Bay Nature Reserve, 26°57.767'S, 32°48.981'E, leg. C. Haddad, 15.IV.2006 (leaf litter, coastal forest), 1imm. 1♂ (NCA 2006/757); Ophathe Game Reserve, Montane grassland, 28°25.344'S, 31°23.957'E, 897m a.s.l., leg. C. Haddad, 4.X.2008 (sifting leaf litter), 6imm. 1♂ (NCA 2008/3900); Tembe

Elephant Park, 27°01'S, 32°24'E, leg. C. Haddad, 5.I.2002 (leaf litter, deep sand forest), 2♂ 1♀ (NCA 2002/523). *Limpopo Province*: Klein Kariba, near Warmbaths [Bela-Bela], 24°52'S, 28°20'E, 1140m a.s.l., leg. A. Leroy, 27.XI.1996, 1♀ (NCA 2004/830); Little Leigh, 22°56.910'S, 29°52.177'E, leg. I. Sinthumule, 22.XI.2005 (gallery forest), 1♂ (NCA 2009/2041); Same locality, leg. B. van der Waal, 22.XI.2005 (gallery forest), 2♂ (NCA 2010/3324); Mabula Lodge, near Warmbaths [Bela-Bela], 24°50'S, 27°57'E, leg. J. Loubser, 16.VII.1989 (running with ants in leaf litter), 1♀ (NCA 91/431); Same locality, leg. J. Leroy, 16.XII.1989 (running with ants in leaf litter), 1♀ (NCA 91/434); Nylsvlei Nature Reserve, Naboomspruit, 24°39'S, 28°40'E, leg. G. Ferreira, 27.X.1975 (pitfalls), 1♂ (NCA 87/265); Roedtan, between Settlers and Tuinplaas (Springbokvlake), leg. M. van Jaarsveld, 26.III.2003 (pitfall traps, grass), 1♀ (NCA 2003/1336); Soutpansberg Mountains, Lajuma Mountain Retreat, Island 4, 23°01.894'S, 29°26.123'E, leg. M. Mafadza, 5.XII.2004 (woodland litter sifting), 1♂ 2♀ (NCA 2006/961); Same locality, Island 4, 23°01.894'S 29°26.123'E, leg. M. Mafadza, 28.XI.2004 (sifting leaf litter, sample 2), 1♀ (NCA 2005/1888); Same locality, leg. M. Mafadza, 28.XI.2004 (active searching), 1♂ (NCA 2005/2025); Same locality, leg. C. Haddad, 6.II.2008 (base of grass tussocks), 4♀ (NCA 2008/508); Tshulu, 22°35'S, 30°48'E, leg. S. Foord, 21.II.2008 (pitfall traps), 1♀ (NCA 2008/2876). *Mpumulanga Province*: Nelspruit, Agricultural College, 25°21'S, 31°46'E, leg. P. Stephen, 22.XII.1998 (pitfall traps, grapefruit orchard), 1♀ (NCA 99/133); Same locality, leg. P. Stephen, 12.XI.1999 (pitfall traps, citrus orchard), 2♂ 1♀ (NCA 2000/184). *North West Province*: Magaliesberg, Hartebeespoort, 25°43'S, 27°50'E, leg. A. Honiball, 10.XII.2008, 1♀ (NCA 2011/837). ZAMBIA: Kafue National Park, Near Namwala, Chibila Camp, 15°46.636'S, 26°00.405'E, leg. C. Haddad & J. Parau, 7.XII.2006 (leaf litter), 1♂ 1♀ (NCA 2007/572); Wildlives Game Farm, near Choma, Hunter's Camp, 16°58.957'S, 26°36.973'E, leg. C. Haddad, J. Parau & F. Jordaan, 3.XII.2006 (leaf litter), 1imm. 5♀ (NCA 2007/474); Same locality, Campsite, 17°03'S, 26°30'E, leg. F. Nyathi, 9–14.XII.1994 (drift fence pitfall trap), 1♂ (NMZ 11896). ZIMBABWE: Sengwa Wildlife Research Area, 18°10'S, 28°14'E, leg. M.S. Cumming, 15.I.2007, 1♂ (NCA 2007/1307).

Diagnosis. Females are closely related to *C. fulvipes* but can be recognised by the subtriangular rather than round ST II and the narrower epigynal ridges (compare Fig. 70 with Fig. 80). Males can be recognised by the nearly parallel-sided basal section and the narrowly coiled distal section of the embolus.

Etymology. The species name is a patronym in honour of Ansie Dippenaar-Schoeman, in recognition of her contributions to the study and promotion of research on African arachnids.

Female (holotype, Livingstone, NCA 2007/625). Measurements: CL 2.53, CW 1.85, AL 3.15, AW 2.07, TL 5.75 (4.90–5.95), FL 0.22, SL 1.16, SW 1.11, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.35, PME–PME 0.11, PME–PLE 0.04, PLE–PLE 0.53, PERW 0.83, MOQAW 0.33, MOQPW 0.49, MOQL 0.48.

Length of leg segments (sequence from femur to tarsus, and total): I 1.78 + 0.80 + 1.50 + 1.40 + 0.95 = 6.43; II 1.63 + 0.74 + 1.28 + 1.25 + 0.84 = 5.74; III 1.48 + 0.71 + 1.13 + 1.36 + 0.68 = 5.36; IV 2.18 + 0.88 + 2.03 + 2.28 + 0.92 = 8.29.

Carapace deep red-brown with black mottling, clypeus dark brown medially, yellow-brown laterally, eye region nearly black; faint black striae radiating from fovea towards palps and leg coxae; surface granulate, sparsely covered in white plumose setae. All eyes with black rings; AER procurved, ALE much larger than AME; AME separated by distance slightly less than ½ their diameter, AME separated from ALE by $\frac{1}{6}$ AME diameter; clypeus height slightly larger than AME diameter; PER procurved, PLE very slightly larger than PME; PME separated by distance slightly less than $\frac{3}{5}$ their diameter, PME separated from PLE by distance equal to $\frac{1}{5}$ PLE diameter; CW:PERW = 2.23:1. Chelicerae dark orange-brown, orange proximally and along prolateral distal margin; three teeth on promargin, median tooth largest, distal tooth slightly smaller than proximal tooth, distal tooth situated closest to median tooth; two teeth on retromargin, distal tooth slightly larger than proximal tooth, closer to fang base than promarginal teeth; endites dark brown, fading to yellow and cream prolaterally; labium dark brown, creamy-yellow distally; sternum deep orange-brown with dark brown mottling. Legs finely granulate; femora I–IV dark brown, with slightly paler lines dorsally, bright yellow dorsally at distal end; patellae I–III yellow with faint black mottling ventrally, black around patellar indentation; patellae IV yellow-orange with faint black mottling laterally and ventrally, black around patellar indentation; tibiae, metatarsi and tarsi I–III bright yellow-orange; tibiae IV orange with dense black mottling, except proximally and distally; metatarsi IV orange with faint black mottling; tarsi IV yellow with faint black mottling. Leg spination: femora: I pl 1 do 3, II do 3, III pl 1 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I and II spineless, III pl 2 rl 2 plv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora do 2, patellae pl 1 spine do 2 setae, tibiae pl 1 do 1 plv 1, tarsi pl 1 plv 3 rlv 1. Abdomen dark grey, with dark red-brown dorsal scutum extending slightly more than ¼ abdomen length, with fine cream chevrons posteriorly and small white spot of dense plumose setae just above spinnerets; venter mottled creamy-grey, slightly darker towards spinnerets; epigastric scutum bright yellow-orange with black mottling, inframamillary sclerite yellow-brown. Epigyne with lateral copulatory openings situated within small curved epigynal ridges (Fig. 70); copulatory ducts initially directed anterolaterally, looping posteriorly, then transversely and anteriorly, entering ST II posteromedially; ST II somewhat triangular, with sharply angled lateral margins, joined narrowly to kidney-shaped posterior ST I (Fig. 71).

Male (paratype, Livingstone, NCA 2007/625). Measurements: CL 2.40, CW 1.75, AL 2.90, AW 1.48, TL 5.45 (4.47–5.45), FL 0.19, SL 1.11, SW 0.99, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.31, PME–PME 0.10, PME–PLE 0.06, PLE–PLE 0.51, PERW 0.76, MOQAW 0.30, MOQPW 0.43, MOQL 0.44.

Length of leg segments (sequence from femur to tarsus, and total): I 1.85 + 0.70 + 1.65 + 1.60 + 1.10 = 6.90; II 1.64 + 0.68 + 1.30 + 1.40 + 0.90 = 5.92; III 1.52 + 0.66 + 1.15 + 1.45 + 0.77 = 5.55; IV 2.30 + 0.83 + 2.11 + 2.55 + 1.06 = 8.85.

Carapace dark red-brown with black mottling, clypeus slightly paler laterally, eye region darker; faint black striae radiating from fovea towards palps and leg coxae; surface finely granulate, densely covered in white plumose setae. All eyes with black rings;

AER procurved, ALE much larger than AME; AME separated by distance slightly less than ½ their diameter, AME separated from ALE by distance equal to ⅛ AME diameter; clypeus height slightly larger than 1½ AME diameter; PER procurved, PLE very slightly larger than PME; PME separated by distance slightly more than ³⁄₅ their diameter, PME separated from PLE by distance equal to ⅓ PME diameter; CW:PERW = 2.30:1. Chelicerae brown with black mottling on anterior surface, paler proximally, yellow along prolateral distal margin; three teeth on promargin, median tooth largest, distal tooth smaller than proximal tooth, distal tooth situated closest to median tooth; two slightly separated subequal teeth on retromargin, closer to fang base than promarginal teeth; endites dark yellow-brown with dark brown mottling, fading to yellow and cream prolaterally; labium orange-brown proximally, creamy-yellow distally; sternum deep orange-brown with dense black mottling. Legs finely granulate; femora I and II pale yellow-brown, yellow distally; femora III and IV dark orange-brown, yellow distally; patellae I and II yellow, and III and IV yellow-orange, all with faint black lateral mottling, black around patellar indentation; tibiae, metatarsi and tarsi I and II yellow with faint black mottling laterally; tibiae, metatarsi and tarsi III yellow-orange with faint black mottling laterally; tibiae IV deep orange with black mottling, yellow distally; metatarsi IV yellow-orange with black mottling, absent proximally and distally; tarsi IV yellow. Leg spination: femora: I pl 1 do 3, II do 3, III pl 1 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 0-1, II rlv 0-1, III pl 2 rl 2 plv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora do 2, patellae pl 1 spine do 2 setae, tibiae pl 1 plv 1, tarsi pl 2 plv 2. Abdomen with deep red-brown, nearly black, dorsal scutum covering entire dorsum, with small white spot of dense plumose setae just above spinnerets; sides of abdomen mottled dark grey; venter pale grey, epigastric sclerite, post-epigastric sclerites, ventral sclerite and inframamillary sclerite red-brown with black mottling. Palps yellow-brown with black mottling, cymbium orange-brown; embolus with parallel-sided basal section, distal section of coil transverse, bent at right angle to distally-directed tip (Figs 53, 72); embolic coil relatively narrow (Fig. 73).

Distribution. Widespread throughout southern Africa (Fig. 79); largely sympatric with *C. fulvipes* across its range (Fig. 95).

Biology. A fairly common ground-dwelling spider collected mainly by litter sifting and pitfall traps in forest and savanna habitats. Occasionally collected from the Grassland Biome in South Africa.

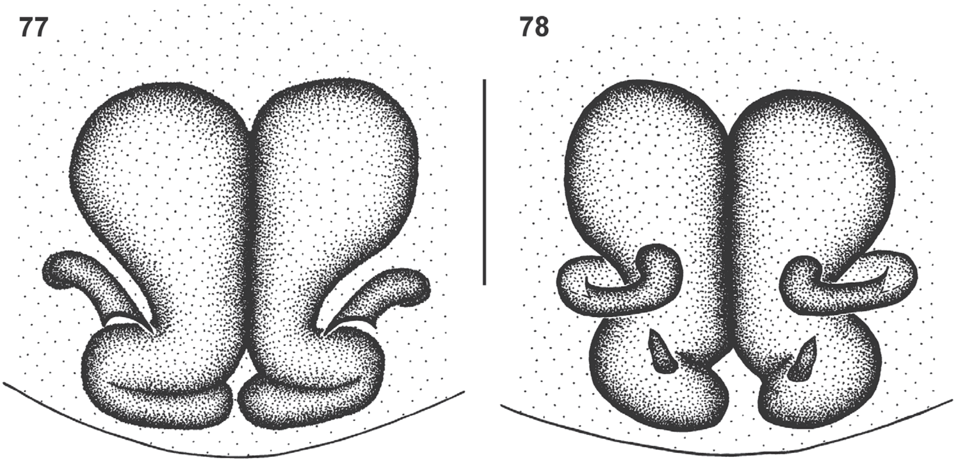
Cambalida fagei (Caporiacco, 1939)

http://species-id.net/wiki/Cambalida_fagei
Figures 74–78

Brachyphaea fagei Caporiacco, 1939: 356, fig. 17 comb. n.

Type material. Holotype female. ETHIOPIA: Neghelli [Negele, 05°19'N, 39°35'E], leg. E. Zavattari, 30.III.1937, deposited in MZUF, type no. 118, mag no. 876 (examined).

Figures 74–76. Digital microscope photographs of the holotype female of *Cambalida fagei* (Caporiacco, 1939): **74** carapace, dorsal view **75** abdomen, dorsal view **76** same, ventral view. Scale bars: 1.0mm.



Figures 77–78. Genitalic morphology of *Cambalida fagei* (Caporiacco, 1939): **77** female epigyne, ventral view **78** same, dorsal view. Scale bar = 0.25mm.

Diagnosis. Females of this species share with *C. deminuta* the very large ST II and compact ST I, but can be distinguished from that species by the much larger copulatory openings (Figs 77, 78).

Remarks. The holotype female is in very poor condition but the eye arrangement (Fig. 74) and abdominal sclerotisation (Figs 75, 76) are consistent with the placement of this species in *Cambalida*. No material other than the holotype could be found and it will not be redescribed here. The epigyne of the species is distinct, notably the very large ST II and compact ST I (Figs 77, 78), and it is clearly different to *C. fulvipes*, which also occurs in Ethiopia.

Distribution. Known from the type locality only (Fig. 79).

Biology. Unknown.

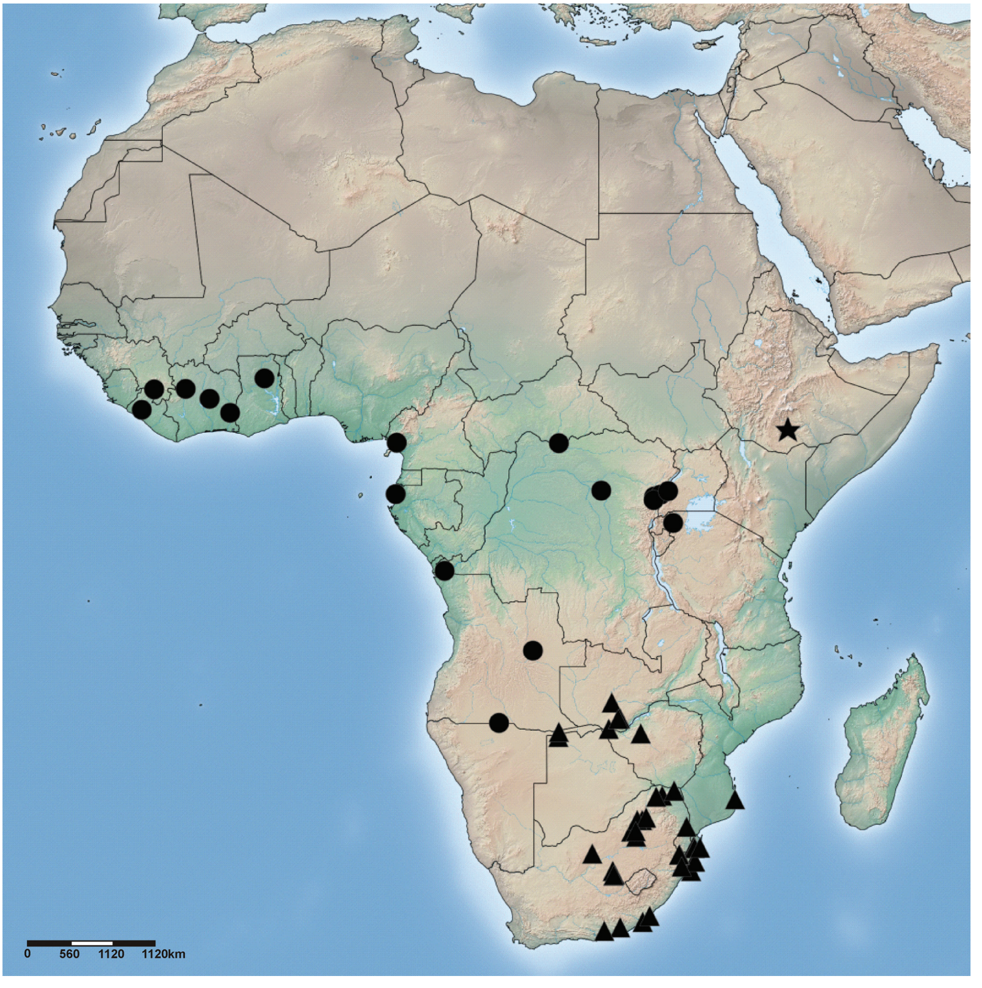


Figure 79. Distribution of *Cambalida deminuta* (Simon, 1909) (circles), *C. dippenaarae* sp. n. (triangles) and *C. fagei* (Caporiacco, 1939) (star) in the Afrotropical Region.

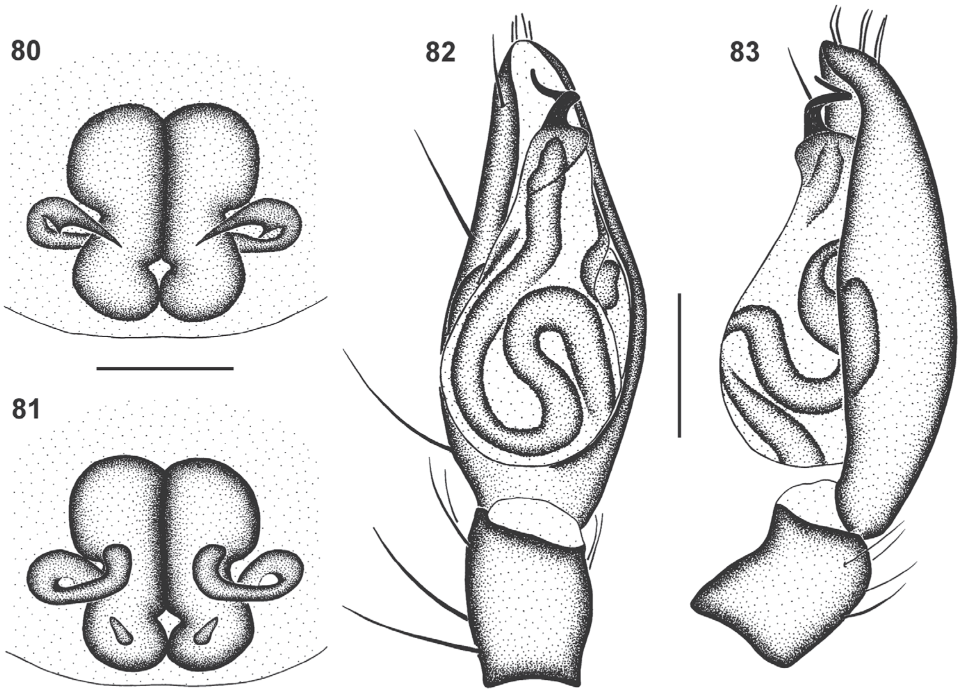
Cambalida fulvipes (Simon, 1896)

http://species-id.net/wiki/Cambalida_fulvipes
Figures 5, 6, 8–13, 54, 80–83

Castianeira fulvipes Simon, 1896: 406 comb. n.
Castianeira depygata Strand, 1916: 91 syn. n.
Castianeira mestrali Lessert, 1921: 424 syn. n.

Type material. Lectotype female and paralectotype female, here designated. SOUTH AFRICA: Pretoria [25°42'S, 28°13'E], MNHN 18324 (examined).

Type material of synonyms. *Castianeira depygata* Strand, 1916. Holotype male. D.R. CONGO: Lake Kivu, Kwidjwi Island [Idjwi Island, 02°10'S, 29°03'E], leg. A.F.



Figures 80–83. Genitalic morphology of *Cambalida fulvipes* (Simon, 1896): **80** female epigyne, ventral view **81** same, dorsal view **82** male palp, ventral view **83** same, retrolateral view. Scale bars = 0.25mm.

Herzog, IX.1907, ZMB 27150 (examined); *Castianeira mestrali* Lessert, 1921. Lectotype male and paralectotype female, here designated. TANZANIA: Kibonoto [Kibongoto, 03°11'S, 37°06'E], IX–X.1905? (zone des cultures), MNHG (examined).

Other material examined. BOTSWANA: Maphaneng Pan, near Maun [19°56'S, 23°25'E], leg. A. Russell-Smith, 13.XI.1976 (mopane woodland), 1♀ (PCRS); Okavango Delta, Pom Pom, 19°35.072'S, 22°50.560'E, leg. E. Kassimatis, 17.VIII.2001 (sweeping, pitfalls), 1imm. 1♂ (NCA 2007/1314); Okavango Delta, Shakawe Fishing Camp, 18°26'05''S, 20°54'23''E, leg. J. van As, 26.IV–7.V.2005 (pitfall traps, forest), 2♀ (NCA 2006/819); Okavango Delta, Xugana island, 130km NNE of Maun, 19°04'S, 23°03'E, leg. B. Lamoral, 18–21.XI.1980, 1♀ (NMSA 20265), 1♂ (NMSA 20266), 1♀ (NMSA 20267), 1♀ (NMSA 20270); Same data, 19–24.XI.1980, 1♀ (NMSA 22011); Same data, 21–22.XI.1980, 1♀ (NMSA 22012). CAMEROON: Faro Game Reserve, 08°24'N, 12°49'E, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 5.V.2007 (gallery forest, pitfall), 1♂ (MRAC 221185); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 5.V.2007 (mature gallery forest, pitfall), 1♂ (MRAC 221214); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 29.IV.2007 (termite mound), 1♂ (MRAC 221372); Mabete [Mabeta, 04°00'N, 09°17'E], leg. B. Malkin, 24.V–7.VI.1949, 3♂ 1♀ (CAS, CASENT 9033127); Mount Cameroun, near Buea, 04°12'N, 09°11'E, 1200m a.s.l., leg. Bosmans & Van Stalle, 12.III.1981 (meadow), 2♂ (MRAC 162109); Muyuka

[04°17'N, 09°24'E], leg. B. Malkin, 24–29.VI.1949, 1♂, together with 1♀ *C. deminuta* (CAS, CASENT 9033116). D.R. CONGO: Fernand Vaz River, 1♂, together with lectotype and paralectotype of *Cambalida deminuta* (MNHN 4109). *Kivu*: Ruindi Plain, leg. M. Lejeune, 10.VII.1972 (battage), 2imm. 1♀ (MRAC 144623); Ruzizi Plain [02°55'S, 29°04'E], Gikanga sector, 890m a.s.l., leg. S. Ndani, V.1966, 2♂ 2♀ (MRAC 130608), 1♂ (MRAC 130609); Same locality, 900m a.s.l., leg. S. Ndani, V.1966 (dans terreau de bamboos), 2♂ 3♀ (MRAC 130586). ETHIOPIA: Abernosa Ranch, Near Adami Tulu, 07°52'N, 38°42'E, 1600m a.s.l., 23.V.1981, leg. A. Russell-Smith (under log, *Acacia tortilis* woodland), 1♂ (PCRS); Addis Ababa, 09°00'N, 38°45'E, 27.IX.1982, leg. A. Russell-Smith (in grazed grassland, course of Bote stream), 1♂ (PCRS); Awash National Park, Compound of Ras Hotel, 09°05'N, 40°00'E, 22.VI.1983, leg. A. Russell-Smith (in heap of cut grass), 1♂ (PCRS); Moyale, 03°33'N, 39°03'E, leg. W.J. Pulawski, 10.VII.1997, 1♀ (CAS, CASENT 9033098); 10 km E of Addis Ababa, Road to Debre Berhan, 09°02'N, 38°14'E, 2400m a.s.l., 15.VI.1987, leg. A. Russell-Smith (litter of semi-deciduous montane scrub), 1♂ 1♀ (PCRS). GABON: *Estuaire*: Ntoum, 00°23'N, 09°47'E, leg. A. Pauly, VII–IX.1985 (milieux divers), 1♂ (MRAC 172996); Same locality, leg. A. Pauly, 7.XI.1985 (carrière de sable, piège bac d'eau), 1♂ (MRAC 172933); Kango, bords du Komo, 00°09'N, 10°08'E, leg. A. Pauly, 17.XI.1985 (piège bac d'eau), 1♀ (MRAC 173037). IVORY COAST: Appouesso, 06°35'N, 03°28'W, leg. R. Jocqué, 20.XI.1994 (cocoa plantation, W of village), 1♂ (MRAC 201033); Same locality, leg. R. Jocqué, 21.XI.1995 (in house), 1♂ (MRAC 202685); Bandama River, N of Korhogo, 09°27'N, 05°38'W, leg. J. Everts, V.1980 (centre riverine forest), 1♂ (MRAC 172291); Same data, VI.1980, 1♂ (MRAC 172288); Bientotkro, near Gagnoa [06°07'N, 05°56'W], leg. A. Russell-Smith, 27.VIII.1992 (in valley rice field), 1♂ 6♀ (PCRS); Bouaké [07°41'N, 05°02'W], leg. A. Russell-Smith, 21.VIII.1994 (under stones, rocky outcrop in degraded savanna), 1♀ (PCRS); Same locality, West African Rice Development Association, leg. A. Russell-Smith, 17.VIII.1994 (weed control experiment), 3♂ 10♀ (PCRS); Dobouo [06°51'N, 06°32'E], leg. A. Russell-Smith, 26.VIII.1992 (in harvested upland rice field), 2♂ 4♀ (PCRS); Gagnoa [06°07'N, 05°56'W], leg. A. Russell-Smith, 14. III.1995 (pitfall, upland rice), 23♂ 14♀ (PCRS); Same locality, leg. A. Russell-Smith, 5.VIII.1995 (in upland rice after harvest), 2♂ 2♀ (PCRS); Ganhoué [08°11'N, 07°51'W], leg. A. Russell-Smith, 27.VIII.1987 (in upland rice field), 1♀ (PCRS); Mankono, Ranch de la Marahoué, 08°27'N, 06°52'W, leg. J. Everts, II.1980 (riverine forest), 1♀ (MRAC 172277); Same data, III.1980, 3♀ (MRAC 172269); Same data, IV.1980, 2♂ (MRAC 172270); Same data, V.1980, 3♀ (MRAC 172266); Odienné, Idessa station [09°30'N, 07°34'W], leg. A. Russell-Smith, 20.VIII.1992 (in upland rice field), 1♀ (PCRS); Serifoula [08°07'N, 07°57'W], leg. A. Russell-Smith, 21. VIII.1993 (in harvested upland rice field), 1♀ (PCRS); Taï Forest, Ecological Research Centre, 05°50'N, 07°21'W, leg. R. Jocqué & D. Van den Spiegel, 22.II.2010 (under planks in base camp, hand catch), 1♀ (MRAC 233650). KENYA: Amboseli National Park [02°40'S, 37°15'E], A. Russell-Smith, 7.I.1985 (in *Acacia* woodland), 3♀ (PCRS); Homa Bay Farmers Training Centre, 00°27'S, 34°24'E, leg. C. Midega, 15.III.2004 (pitfall traps, maize fields), 1♀ (NCA 2004/1340), 1♂ (NCA 2004/1343), 1♂ (NCA 2004/1358), 1♂ 1♀ (NCA 2006/1351), 1♂ (NCA 2004/1348), 1♀ (NCA 2004/2132); Mount Kasigau, Jora village, 03°50'S, 38°39'E, leg. E. Selempo, XII.2001 (pitfall trap), 1♂ (MRAC 213091); Nairobi, Garden at Muthaiga [01°15'S, 36°50'E], leg. A. Russell-Smith, 30.XII.1977 (in short grass and under stones), 2♀ (PCRS); Ngaia Forest, 00°19'N, 38°02'E, leg. R. Jocqué, C. Warui & D. Van den Spiegel, 24. IV.2004 (sieved litter), 1♀ (MRAC 215238); Same locality, 1071m a.s.l., leg. D. Van den Spiegel, 3.XII.2002, 1♀ (MRAC 220167). MALAWI: Chintheche, 11°50'S, 33°13'E, leg. R. Jocqué, II.1977, 1♂ (MRAC 152368); Michiru Wildlife Reserve, near Blantyre, 15°45'S, 34°58'E, leg. A. Russell-Smith, 27.X.1996, 1♀ (PCRS). MOZAMBIQUE: Inhaca Island, 26°01'S, 32°54'E, leg. T. Steyn, 28.V–19.VI.1994 (beach and dunes, by hand), 2♂ (MRAC 215980); Same locality, leg. T. Steyn, 5–19. II.1994 (coastal woodland, pitfalls), 1♂ 1♀ (MRAC 208942); Same data, 2–16.X.1993, 1♀ (MRAC 209033); Same data, 30.X–13.XI.1993, 1♂ (MRAC 209057); Same data, 13–27.XI.1993, 3♂ 1♀ (MRAC 209294); Same data, 5–19.III.1994, 1♀ (MRAC 209437); Same data, 25.VI–9.VII.1994, 1♀ (MRAC 209464); Same data, 19.III–2.IV.1994, 1♂ (MRAC 209731); Same data, 14–28.V.1994, 2♂ (MRAC 209773); Same data, 23.VII–6.VIII.1994, 4♂ 1♀ (MRAC 209878); Same data, 19.II–5.III.1994, 1♀ (MRAC 209893); Same locality, leg. T. Steyn, 11–25.XII.1993 (open parkland, pitfalls), 1♂ (MRAC 209687); Same locality, leg. T. Steyn, 4–18.X.1993 (wetland, pitfalls), 1♂ (MRAC 209068); Same data, 28.V–19.VI.1994, 1♀ (MRAC 209718); Same data, 25.VI–9.VII.1994, 1♂ (MRAC 208987). NIGERIA: *Western State*: Ibadan, I.I.T.A., 07°14'N, 03°30'E, leg. A. Russell-Smith, 7. VI.1981 (short grass beside lake), 1♀ (MRAC 177278). RWANDA: Butare, 02°36'S, 29°44'E, leg. P. Nyalugaka, VI–VII.1971, 1♂ 1♀ (MRAC 140729). SOUTH AFRICA: *Eastern Cape Province*: Mpofu Nature Reserve, 32°36'S, 26°36'E, leg. S. Peinke (in building), 1♀ (NCA 2011/823); St Francis Bay, 34°08'S, 24°50'E, leg. A. Leroy, 18. XII.2006 (in leaf litter, under vegetation, static dunes), 1♂ (NCA 2008/1989); W of Sterkstroom, Bamboesberg, Farm Bamboeshoek, 31°36'S, 26°22'E, leg. M. Burger, M. Fabricius & C. Lakoy, 1♀ (NCA 2008/1895). *Free State Province*: Bloemfontein, 29°08'S, 26°10'E, leg. S. Louw, 8.XII.1988 (in house), 1♀ (NMBA 2800); Bloemfontein, Bain's Vlei, 29°02.764'S, 26°04.780'E, leg. V. Swart, 26.XII.2011 (on floor inside house), 1♂ (TMSA 24131); Bloemfontein, Free State National Botanical Gardens, 29°08'S, 26°10'E, leg. R. Poller & S. Otto, XII.2006 (pitfall traps), 2♂ (NMBA 11165); Same locality, 29°02'S, 26°12'E, leg. V. Butler, 18.IX.2009 (*Searsia lancea* leaf litter), 1♀ (NMBA 15672); Same locality, 29°03'S, 26°13'E, leg. C. Haddad, X.2010 (base of grass tussocks), 1♀ (NMBA 16163); Bloemfontein district, Farm Deelhoek, 28°51'S, 26°07'E, leg. C. Haddad, 17.XI.2001 (*Eucalyptus* leaf litter), 1♂ 2♀ (NCA 2002/500); Bloemfontein district, Hopefield farm, 28°54'S, 26°14'E, leg. C. Haddad, 28.X.2001 (bluegum leaf debris), 1imm. 3♂ 1♀ (MRAC 214919); Same locality, leg. C. Haddad, 18.XI.2001 (*Eucalyptus* leaf litter), 5♀ (NCA 2002/501); Same locality, leg. C. Haddad, 22.XII.2002 (kukuyu grass along reservoir), 1♀ (NCA 2002/502); Brandfort district, Florisbad Research Station, 28°46'S, 26°05'E, 1250m a.s.l., leg.

Museum Staff, III.1983 (pitfall traps), 1♀ (NMBA 351); Same locality, leg. L.N. Lotz, 23.XI–8.XII.1987 (pitfall traps), 1♂ (NMBA 8315), 1♂ (NMBA 8459); Same locality, leg. L.N. Lotz, 8–21.XII.1987 (pitfall traps), 1♂ (NMBA 8464), 1♂ (NMBA 9331); Same locality, leg. L.N. Lotz, 31.X–18.XI.1988 (pitfall traps), 1♂ (NMBA 4814), 1♂ (NMBA 4884), 1♂ (NMBA 4909), 1♂ (NMBA 4919); Erfenis Dam Nature Reserve, 28°30'S, 26°48'E, leg. C. Haddad, S. Otto & R. Poller, 22.X–22.XI.2005 (pitfall traps, unburned site 2), 1♂ (NMBA 13943); Ladybrand district, Farm De Luc, 29°17.524'S, 27°24.267'E, leg. C. Haddad, 5.XII.2008 (base of grass tussocks), 2♀ (NCA 2008/4282); Sandveld Nature Reserve, 27°41'S, 25°43'E, leg. C. Haddad, 22. IX.2003 (*Acacia erioloba* leaf litter), 2♂ (NCA 2002/524); Same locality, leg. C. Haddad, 25.X.2003 (*A. erioloba* leaf litter), 1♂ (NCA 2002/513); Willem Pretorius Nature Reserve, 28°16.660'S, 27°12.207'E, leg. R. Fourie & A. Grobler, 30.IX-–28.X.2009 (pitfall traps, near water level), 1♂ (NCA 2009/3526). *Gauteng Province*: Alice Glockner Nature Reserve, Wonderboom, Farm Rietspruit, 26°44.389'S, 28°22.661'E, leg. R. Koko, 2.VIII.2005 (pitfall traps), 1♀ (NCA 2008/2783); Johannesburg, Florida [26°30'S, 27°54'E], leg. R. Tucker, XII.1918, 1♀ (SAM B4507); Krugersdorp, Farm Hekpoort, 25°56'52.9''S, 27°37'46.0''E, 1447m a.s.l., leg. H. Roux, 2.XII.2003 (baited pitfall, open woodland), 1♀ (NCA 2008/4280); Marievale Bird Sanctuary, 26°20'S, 28°32'E, leg. V.D. & B. Roth, 8.XII.1990, 1♀ (CAS, CASENT 9033179). *KwaZulu-Natal Province*: Empangeni, 28°45'S, 31°54'E, leg. P. Reavell, 21.XI.1978 (on wall of plastic pool), 1♀ (NMSA); Hluhluwe-Imfolozi Park, Hilltop Research Station, 28°04.680'S, 32°02.472'E, leg. C. Haddad, 20.IV.2006 (leaf litter, Afromontane forest), 1imm. 1♂ 1♀ (NCA 2006/808); iSimangaliso [Greater St Lucia] Wetlands Park, Hell's Gate, 28°02.3'S, 32°26.0'E, leg. J. Esterhuizen, 26.I.2004 (tsetse fly traps), 1♂ (NCA 2004/776); Mfongozi, 27°17'S, 32°09'E, leg. W.C. Jones, I.1918, 1♂ (SAM B4140); Ndumo Game Reserve, Dipini Hide, 26°51.678'S, 32°15.514'E, leg. C. Haddad, 6.VII.2002 (on ground), 1♂ (NCA 2002/375); Same locality, E shore of Shokwe Pan, 26°52.516'S, 32°12.407'E, leg. C. Haddad, 22.I.2006 (grass at base of fever trees), 1♂ 2♀ (NCA 2006/721); Pietermaritzburg, 29°37'S, 30°23'E, leg. R.F. Lawrence, XI.1943, 2♀ (NMSA 3921); Same locality, leg. R.F. Lawrence, XII.1936, 1♂ (NMSA 1341); Umgeni River Valley [29°28'S, 30°14'E], leg. R.F. Lawrence, XII.1959, 1♀ (NMSA 7425); Zululand, 28°18'S, 32°21'E, leg. J. Pryke, 1.II.2010 (pitfall traps, indigenous forest), 1♀ (NCA 2011/910). *Limpopo Province*: Acornhoek [24°36'S, 31°05'E], leg. R. Tucker, XI.1918, 2imm. 4♂ 8♀ (SAM B4385); Bekendevlei, between Settlers and Tuinplaas (Springbokvlakte), leg. M. van Jaarsveld, 17.XII.2002 (pitfall traps, grass), 3♂ (NCA 2003/1337); Klein Kariba, near Warmbaths [Bela-Bela], 24°50'S, 28°20'E, 1140m a.s.l., leg. C.E. Griswold, 24–28. XI.1996 (lush bushveld), 1♀ (CAS, CASENT 9033184); Makalali Private Game Reserve, 24°09'S, 30°41'E, leg. C. Whitmore, XI.1999, 1♀ (NCA 2007/1150); Messina [Musina, 22°20'S, 30°02'E], leg. R. Tucker, XI.1918, 1♀ (SAM B4472); Roedtan, between Settlers and Tuinplaas (Springbokvlake), leg. M. van Jaarsveld, 6. II.2002 (pitfall traps, grass), 1♀ (NCA 2003/505); Settlers, 24°59'S, 28°33'E, leg. H. van der Merwe, 5.XII.1979, 1♀ (NCA 2010/246); Soutpansberg Mountains, Lajuma

Mountain Retreat, Woodland 2a, 23°02.534'S, 29°26.848'E, leg. S. Foord, 25.I.2008 (pitfall traps), 1♀ (NCA 2008/1897); Same locality, leg. S. Foord, 3.XI.2004 (sifting litter, woodland), 1♂ (NCA 2010/2626). *Mpumulanga Province*: Bethal, 26°26'S, 29°27'E, leg. Dr. Broodryk, I.1986 (maize field), 1♂ (NCA 86/60); Delmas, Farm Rietvallei, 26.087°S, 28.573°E, leg. M. van Jaarsveld, 23.II.2005 (pitfall traps, unsprayed maize), 1♀ (NCA 2007/1303); Delmas, Farm Welgevonden, 26°14.640'S, 28°42.378'E, leg. D. Jacobs, 9–26.XII.2007, 1♂ (NCA 2008/3900); Komatipoort [25°31'S, 31°49'E], leg. R. Tucker, XI.1918, 1♀ (SAM B4342); Kruger National Park, 6km S of Skukuza, 25°00'S, 31°36'E, 1200ft, leg. C. Griswold, 17.XII.1984 (in shady ravine), 1♀ (NMSA 20278). *Northern Cape Province*: Kathu district, Pniel Farm, 28°35.420'S, 24°31.967'E, leg. R. Lyle, 20.IX–31.X.2005 (pitfall traps, dry savanna), 1imm. 1♂ (NCA 2006/1097); Prieska district, Green Valley Nuts, 29°35'S, 22°56'E, leg. C. Haddad, 18.XII.2002 (under cut ground cover vegetation, pistachio orchards), 1♂ 2♀ (NCA 2002/487); Schmidtsdrift district, Geelkoppies Farm, 28°43'S, 23°52'E, leg. C. Haddad, V.2002 (kukuyu grass along reservoir), 1♂ (NCA 2002/489). *North West Province*: Brits, 25°39'S, 27°45'E, leg. R. Watmough, 1984–1985 (cotton field), 2♀ (NCA 87/8); Vryburg district, Weltevrede Farm, 27°24.976'S, 24°29.906'E, leg. R. Lyle, R. Fourie, D. du Plessis & J. Adendorff, 9–12.I.2008 (leaf litter, Winkler traps), 1♀ (NCA 2009/3675); Same locality, 27°26.258'S, 24°29.873'E, leg. R. Lyle, R. Fourie, D. du Plessis & J. Adendorff, 10.I.2008 (leaf litter, dry river bed), 1♀ (NCA 2009/3677). *Western Cape Province*: Fisherhaven, near Hermanus, 34°21.430'S, 19°07.557'E, leg. C. Haddad, 12.I.2008 (sifting leaf litter), 1♀ (NCA 2008/462); Same locality, leg. C. Haddad, 26.XII.2000 (under rocks along Bot River Lagoon), 1♀ (NCA 2002/503); Malmesbury, Rondeberg, 33°24'S, 18°16'E, leg. G. Visagie, 24.X.1987 (under plants), 1♀ (NMBA 2143); Montagu Baths, 33°47'S, 20°07'E, leg. W.F. Purcell, X.1902, 1♂ 2♀ (SAM 12676); Swartberg Nature Reserve, Gamkaskloof, Die Hel, 33°21'S, 21°41'E, leg. Z. van der Walt, 15.II.2001 (on soil), 1♂ 3♀ (NCA 2002/202); Same data, 1♀ (NCA 2005/2029). SWAZILAND: Hlatikulu [26°57'S, 31°18'E], I.1939, 1♀ (NMSA 2574); Mbabane [26°19'S, 31°08'E], leg. R.F. Lawrence, XI.1964, 1imm. 2♂ 4♀ (NMSA 9441). TANZANIA: Mkomazi Game Reserve, behind Ibaya Camp, 04°00'S, 38°00'E, leg. S. van Noort, 1.XII.1993 (leaf litter near stream), 1♀ (SAM C5360); Same locality, Ibaya Camp, 04°00'S, 38°00'E, leg. S. van Noort, 6.XII.1993 (in *Ficus* litter), 1♂ (SAM C5359); Same locality, leg. A. Russell-Smith, 24.XI.1994 (litter of dry *Spirostachys* forest), 3♂ 8♀ (MRAC 211326); Uzungwa Mountains, Mwanihana Forest, Sanje River [07°50'S, 36°50'E], 300m a.s.l., loc. 14, leg. M. Stoltze & N. Scharff, 25.VIII.1982, 1♀ (ZMUC); 1km N of Matema, forest at foot of Livingstone Mountains, 09°30'S, 34°03'E, leg. R. Jocqué, 24.XI.1991 (sieved litter), 2♀ (MRAC 1735592); Same locality, leg. R. Jocqué, 5.XI.1991 (litter, by hand), 1♀ (MRAC 173449). UGANDA: Entebbe, Entebbe Botanical Gardens [00°03'N, 32°28'E], leg. A. Russell-Smith, 17.V.1991 (in long grass), 1♀ (PCRS); Mpanga Forest Reserve, near Mpigi [00°12'N, 32°17'E], leg. A. Russell-Smith, 28. VI.1998 (in litter), 1♀ (PCRS). ZIMBABWE: 42km S of Karoi, 1729B2, leg. Falcon College and NHMZ staff, 16.XII.1984, 1♀ (NMZ 3977); Bulawayo, Hillside, 20°10'S, 28°33'E, leg. M. FitzPatrick, II.1999, 1♀ (NMZ 15401); Same locality, leg. M. FitzPatrick, III.1999, 1♀ (NMZ 15405); Cheware River, 2km SW of Kasawe spring, 1629B1, leg. Falcon College and NHMZ staff, 8.XII.1984, 1♀ (NMZ 3850); Detema stream, 1km NE of Tobwe School, 1827B1, leg. I.M. Sango, 31.VIII.1985, 1♂ (NMZ 3741); S of Bulawayo, R.E.P. School, Matopos, 2028B3, leg. S. Higgins, 1.XI.1979, 1♀ (NMZ 536); Victoria Falls, 17°56'S, 25°50'E, leg. W.J. Pulawski, 1–8. II.1995, 4♀ (CAS, CASENT 9033117).

Diagnosis. Females of this species can be recognised by the broad curved epigynal ridges and the nearly round ST II of the female epigyne (Fig. 80). Males have a curved basal section of the embolus and a distal section that is gently curved towards the tip of the embolus (Figs 54, 82).

Remarks. The larger of the two females in the type series is designated here as the lectotype.

Female (Hopefield, NCA 2002/502). Measurements: CL 2.45, CW 1.84, AL 3.70, AW 2.30, TL 5.95 (5.95–6.90), FL 0.22, SL 1.16, SW 1.08, AME–AME 0.07, AME–ALE 0.02, ALE–ALE 0.34, PME–PME 0.14, PME–PLE 0.07, PLE–PLE 0.54, PERW 0.77, MOQAW 0.32, MOQPW 0.44, MOQL 0.43.

Length of leg segments (sequence from femur to tarsus, and total): I 1.70 + 0.75 + 1.36 + 1.28 + 0.88 = 5.97; II 1.55 + 0.63 + 1.13 + 1.11 + 0.75 = 5.17; III 1.40 + 0.68 + 1.04 + 1.23 + 0.65 = 5.00; IV 2.09 + 0.85 + 1.85 + 2.12 + 0.85 = 7.76.

Carapace dark orange-brown with black mottling, clypeus slightly paler, eye region darker; black striae radiating from fovea towards palps and leg coxae; surface finely granulate, sparsely covered in white plumose setae. All eyes with black rings; AER procurved, ALE much larger than AME; AME separated by distance approximately $^{3}/_{5}$ their diameter, AME separated from ALE by $^{1}/_{6}$ AME diameter; clypeus height slightly less than 1½ AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance slightly less than their diameter, PME separated from PLE by distance slightly more than ½ PME diameter; CW:PERW = 2.39:1. Chelicerae deep orange-brown with black mottling on anterior surface, pale orange-brown proximally and along prolateral distal margin; three teeth on promargin, median tooth largest, proximal and distal teeth smaller and subequal, distal tooth situated closest to median tooth; two slightly separated subequal teeth on retromargin; endites mottled dark brown, fading to yellow and cream prolaterally; labium mottled dark brown, cream distally; sternum deep orange-brown with dark brown mottling, except at setal bases, giving speckled appearance. Legs finely granulate; femora I brown with black mottling, except along dorsal midline, yellow dorsally at distal end; femora II and III yellow with broad black mottled ring at ¾ their length; femora IV yellow, with dark brown ring with black mottling from ½ their length, yellow at distal end; patellae I–IV yellow with faint black mottling, dark around patellar indentation; tibiae, metatarsi and tarsi I–III yellow with faint lateral mottling; tibiae IV yellow-orange with broad incomplete mottled black ring medially, mottling absent dorsally, proximally and distally; metatarsi IV yellow with faint black lateral mottling; tarsi IV yellow. Leg spination: femora: I pl 1 do 3, II do 3, III pl 2 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta;

tibiae: I plv 1 rlv 1, II rlv 1-2, III pl 2 rl 2 plv 2 vt 2, IV pl 2 rl 2 plv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora do 2, patellae pl 1 spine and do 2 short setae, one proximally and one distally, tibiae pl 1 do 1 plv 1, tarsi pl 1 plv 3 rlv 1. Abdomen mottled dark grey, with cream spots around sigilla, fine cream chevrons in posterior ⅔ of abdomen and small white spot above spinnerets; dorsal scutum mottled dark brown, extending $\frac{1}{5}$ abdomen length; venter mottled pale grey, darker towards spinnerets, epigastric sclerite brown and inframamillary sclerite yellow-brown. Epigyne with broad curved epigynal ridges with lateral copulatory openings (Fig. 80); copulatory ducts initially directed laterally, looping sharply towards posterior then transversely towards midline, bending at nearly a right angle before entering ST II posteromedially; ST II somewhat round, joined broadly to large kidney-shaped posterior ST I (Fig. 81).

Male (Bain's Vlei, TMSA 24131). Measurements: CL 2.50, CW 1.83, AL 2.75, AW 1.55, TL 5.10 (5.07–5.45), FL 0.19, SL 1.10, SW 1.01, AME–AME 0.07, AME–ALE 0.03, ALE–ALE 0.34, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.52, PERW 0.73, MOQAW 0.33, MOQPW 0.42, MOQL 0.41.

Length of leg segments (sequence from femur to tarsus, and total): I 1.73 + 0.73 + 1.48 + 1.43 + 1.03 = 6.40; II 1.62 + 0.63 + 1.23 + 1.26 + 0.91 = 5.65; III 1.49 + 0.65 + 1.10 + 1.35 + 0.73 = 5.32; IV 2.19 + 0.81 + 1.94 + 2.20 + 0.95 = 8.09.

Carapace dark brown, nearly black, clypeus black medially and paler brown laterally, eye region black; black striae radiating from fovea towards palps and leg coxae; surface finely granulate, densely covered in white plumose setae. All eyes with black rings; AER procurved, ALE larger than AME; AME separated by distance slightly more than $\frac{3}{5}$ their diameter, AME separated from ALE by distance equal to ¼ AME diameter; clypeus height equal to $1\frac{4}{5}$ AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance slightly more than ⅞ their diameter, PME separated from PLE by distance slightly more than $\frac{2}{5}$ PME diameter; CW:PERW = 2.51:1. Chelicerae dark brown with black mottling on anterior surface, yellow along prolateral distal margin; three teeth on promargin, median tooth largest, proximal and distal teeth smaller and subequal, distal tooth situated closest to median tooth; two slightly separated subequal teeth on retromargin, closer to fang base than promarginal teeth; endites dark brown, fading to yellow and cream prolaterally; labium dark brown, cream distally; sternum deep red-brown with black mottling, except at setal bases, giving speckled appearance. Legs finely granulate; femora I dark brown, bright yellow-orange dorsally and at distal end laterally; femora II bright orange with proximal and lateral black mottling; femora III orange with black mottling in distal ⅓; femora IV dark orange with black lateral mottling and broad black band in distal ½; patellae I–III bright yellow and IV bright orange, all with black lateral mottling, darker around patellar indentation; tibiae, metatarsi and tarsi I and II yellow and III orange with faint black lateral mottling; tibiae IV reddish-orange with dense black mottling, yellow at distal end; metatarsi IV bright red-orange with black mottling, except at proximal end; tarsi IV yellow-orange. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 1 rlv 1, II rlv 2, III pl 2 rl 2 plv 1-2 rlv 0-1 vt 2, IV pl 2 rl 2 plv 2 rlv 1 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora pl 1 do 2, patellae pl 1 spine and do 2 short setae, one proximally and one distally, tibiae pl 1 plv 1, tarsi pl 2 plv 2. Abdomen with deep wine-red dorsal scutum with dense black mottling, covering entire dorsum; small white spot of dense plumose setae just above spinnerets; venter mottled dark grey, epigastric sclerite, post-epigastric sclerites and ventral sclerite deep red-brown, inframamillary sclerite yellow-brown. Palps dark brown with dense black mottling; embolus short and broad, basal coil slightly curved, distal section nearly transverse in ventral view, curved towards tip (Figs 54, 82, 83).

Distribution. Widely distributed throughout sub-Saharan Africa (Fig. 95).

Biology. This is the *Cambalida* species that occupies the greatest range of habitats, from tropical and temperate forests, to savannas, grasslands, karoo and fynbos. Although generally scarce in agroecosystems, this species has been caught in the ground cover layer of pistachio nuts in the Northern Cape Province of South Africa (Haddad and Dippenaar-Schoeman 2006), maize fields in Kenya and South Africa, and rice paddies in West Africa.

Feeding in *C. fulvipes* follows a similar pattern to that observed for other corinnids such as *Graptartia* (Haddad 2004). Prey is grasped using the first two pairs of legs, which form a basket in which the prey is subdued. Following the bite, prey may die within 1 minute (e.g. vinegar flies *Drosophila melanogaster* Meigen), after which feeding commences. Once complete, only a small ball of macerated prey remains is left.

Cambalida griswoldi sp. n.

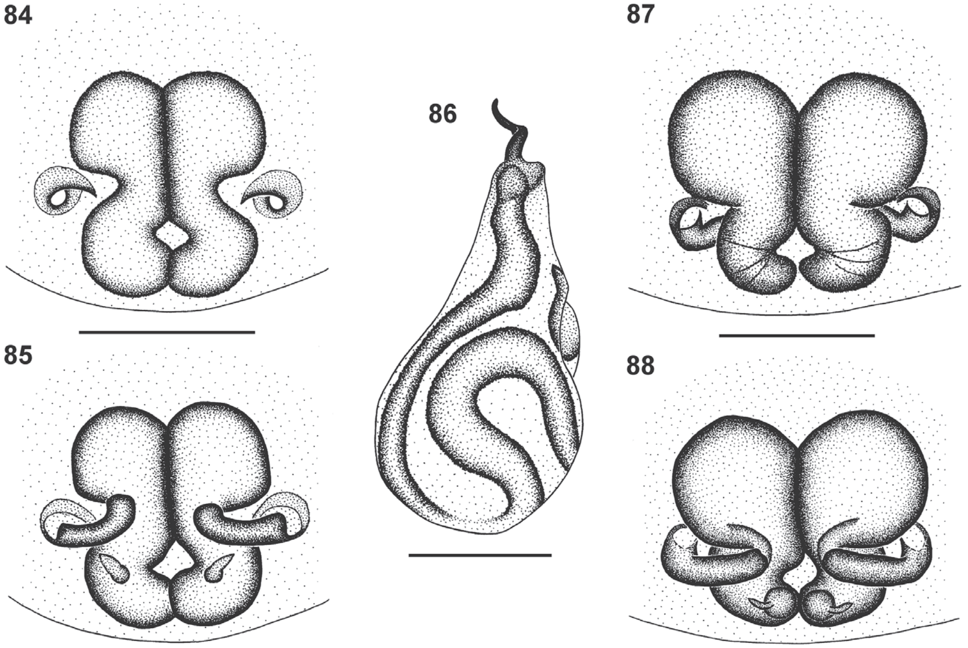
urn:lsid:zoobank.org:act:DC379B57-CF65-4DC1-8D42-901E4A6DD3E5
http://species-id.net/wiki/Cambalida_griswoldi
Figures 55, 84–86

Type material. Holotype female. MADAGASCAR: *Antsiranana*: Réserve Spéciale d'Ambre, 3.5km 235°SW Sakaramy, 12°28'08"S, 49°14'32"E, 325m a.s.l., leg. Fisher-Griswold Arthropod Team, 26–31.I.2001 (sifted litter, tropical dry forest) (CAS, CASENT 9006738).

Paratypes. MADAGASCAR: *Antsiranana*: Forêt d'Orangea, 3.6km 128° SE Remena, 12°15'32"S, 49°22'29"E, 90m a.s.l., leg. Fisher, Griswold *et al.*, 22–28.II.2001 (pitfall trap, littoral rainforest), 2♀ (CAS, CASENT 9007088); Same locality as holotype, leg. L.J. Boutin, 26–31.I.2001, 1♀ (CAS, CASENT 9000791). *Toliara*: 18km NNW Betroka, 23°09'48"S, 45°58'07"E, 825m a.s.l., leg. M. Ivie & A. Pollock, 9–14.XII.1994 (flight intercept traps), 1♂ (CAS, CASENT 9033123).

Other material examined. None.

Diagnosis. Females have similar spermathecal proportions to the continental *C. fulvipes* but can be recognised by the narrower, distinctly coiled epigynal ridges (Fig. 84), which are broad and curved in *C. fulvipes* (Fig. 80). The distal section of the male embolus is short and slightly curved towards the tip (Fig. 86).



Figures 84–88. Genitalic morphology of *Cambalida griswoldi* sp. n. **(84–86)** and *C. lineata* sp. n. **(87, 88)**: **84, 87** female epigyne, ventral view **85, 88** same, dorsal view **86** male palpal tegulum, ventral view. Scale bars = 0.25mm.

Etymology. A patronym in honour of Charles Griswold, one of the collectors of the types, in recognition of his vast and significant collections of spiders on Madagascar.

Remark. The palp of the paratype male is greatly expanded and only the tegulum is illustrated here (Fig. 86). The cymbium has the distal setae characteristic of the genus, confirming the placement of this species and the occurrence of *Cambalida* on Madagascar.

Female (holotype, Réserve Spéciale d'Ambre, CASENT 9006738). Measurements: CL 2.10, CW 1.52, AL 2.53, AW 1.78, TL 4.70 (4.65–4.75), FL 0.13, SL 0.97, SW 0.89, AME–AME 0.05, AME–ALE 0.02, ALE–ALE 0.26, PME–PME 0.11, PME–PLE 0.06, PLE–PLE 0.43, PERW 0.62, MOQAW 0.23, MOQPW 0.37, MOQL 0.36.

Length of leg segments (sequence from femur to tarsus, and total): I 1.28 + 0.57 + 1.03 + 0.98 + 0.64 = 4.50; II 1.17 + 0.55 + 0.84 + 0.88 + 0.56 = 4.00; III 1.05 + 0.54 + 0.70 + 0.95 + 0.44 = 3.68; IV 1.48 + 0.61 + 1.28 + 1.57 + 0.58 = 5.52.

Carapace deep orange-brown, clypeus deep yellow-brown, eye region slightly darker; faint black striae radiating from fovea towards palps and coxae and faint black mottling on slopes; surface finely granulate, sparsely covered in white plumose setae. AER procurved, eyes subequal in diameter; AME separated by distance ½ their diameter, AME separated from ALE by distance equal to ¼ AME diameter; clypeus height equal to 1⅔ AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance slightly more than $^4/_5$ their diameter, PME separated from PLE by distance slightly less than ½ PME diameter; CW:PERW = 2.45:1. Chelicerae deep yellow-brown with black mottling on anterior surface; three teeth on promargin, median tooth largest, proximal and distal teeth small, subequal in size, median and distal teeth adjacent; two teeth on retromargin, distal tooth slightly larger than proximal tooth, closer to fang base than promarginal teeth; endites yellow with black mottling, cream prolaterally; labium orange-brown with faint black mottling, cream distally; sternum orange with dense brown mottling, except at setal bases. Legs finely granulate; femora I–IV yellow-brown with black mottling laterally and ventrally, absent dorsally and at distal end ventrally; patellae I–IV yellow-brown with black mottling laterally and ventrally, absent dorsally, with faint median dorsal black line; tibiae I yellow with black mottling in distal half; tibiae II and III yellow-brown and IV orange-brown, all with black mottling, faint dorsally, with fine median dorsal black line; metatarsi I–III yellow with black mottling, absent proximally; metatarsi IV yellow-brown with black mottling, faint dorsally, absent proximally and distally; tarsi I–IV yellow. Leg spination: femora: I pl 1 do 3, II do 1, III pl 1 do 2 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 3 rlv 2, II rlv 2, III pl 2 rl 2 plv 2 rlv 1, IV pl 2 rl 2 plv 2 rlv 1 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora do 2, patellae pl 1, tibiae pl 1 plv 1, tarsi pl 1 plv 3. Abdomen mottled dark grey dorsally with fine cream chevrons posteriorly; dorsum with red-brown scutum extending ⅔ abdomen length, with black mottling darker around margins of scutum, forming ring-shaped dorsal marking; venter mottled pale grey, darker towards spinnerets, with paired rectangular black markings between paired sclerite rows, midway between epigastric furrow and spinnerets; epigastric sclerite red-brown and inframamillary sclerite yellow-brown. Epigyne with small lateral copulatory openings situated within 6-shaped epigynal ridges (Fig. 84); copulatory ducts initially directed transversely medially, bending at nearly right angle, entering ST II posterolaterally; ST II round, with nearly right-angled posterolateral margin, joined broadly to kidney-shaped posterior ST I (Fig. 85).

Male (paratype, Betroka, CASENT 9033123). Measurements: CL 2.23, CW 1.72, AL 2.70, AW 1.61, TL 4.83, FL 0.15, SL 1.03, SW 0.94, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.30, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.48, PERW 0.71, MOQAW 0.29, MOQPW 0.41, MOQL 0.44.

Length of leg segments (sequence from femur to tarsus, and total): I 1.53 + 0.63 + 1.30 + 1.24 + 0.95 = 5.65; II 1.38 + 0.60 + 1.05 + 1.08 + 0.81 = 4.92; III 1.23 + 0.57 + 0.90 + 1.11 + 0.65 = 4.46; IV 1.89 + 0.74 + 1.69 + 1.90 + 0.83 = 7.05.

Carapace dark brown, eye region darker; faint black striae radiating from fovea towards palps and leg coxae; surface finely granulate, densely covered in white plumose setae. Rings around eyes faded to orange-brown; AER procurved, ALE larger than AME; AME separated by distance equal to ½ their diameter, AME separated from ALE by ⅕ AME diameter; clypeus height slightly less than 1½ AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance slightly less than ¾ their diameter, PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.42:1. Chelicerae brown with faint black mottling on anterior surface, yellow prolaterally in distal half; three teeth on promargin, median tooth largest, distal tooth smallest, median and distal teeth closest; two slightly separated teeth on retromargin, distal tooth slightly smaller than proximal tooth, closer to fang base than promarginal teeth; endites pale brown with dark brown mottling, cream prolaterally; labium pale brown with dark brown mottling, cream distally; sternum red-brown with dark brown mottling. Legs finely granulate; femora I–IV dark brown, slightly paler dorsally, yellow dorsally at distal end; patellae I–IV yellow with black mottling laterally and ventrally distally, darker on posterior legs; tibiae I and II yellow with black mottling; tibiae III and IV orange-brown with dense black mottling, paler along dorsal midline; metatarsi I and II yellow-brown, with sparse dark brown mottling laterally; metatarsi III and IV dark brown, yellow at proximal and distal ends; tarsi I–IV yellow, tarsus IV with black mottling medially. Leg spination: femora: I pl 1 do 3, II do 3, III pl 1 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I and II spineless, III pl 2 rl 2 plv 2, IV pl 2 rl 2 plv 2 vt 2; metatarsi: I plv 2 rlv 1, II plv 1 rlv 1, III pl 2 rl 1 plv 1 vt 3, IV pl 3 rl 3 plv 2 vt 3. Palpal spination: femora pl 1 do 2, patellae pl 1, tibiae pl 1 plv 1, tarsi pl 1 plv 3. Abdomen with dark red-brown, nearly black scutum covering entire dorsum; venter mottled pale grey between sclerites; epigastric sclerite, post-epigastic sclerites and ventral sclerite deep red-brown with black mottling, inframamillary sclerite orange-brown. Palps orange-brown with dense black mottling; embolus short, basal coil slightly curved, distal section gently curved towards tip (Fig. 86).

Distribution. Known from isolated localities in northern and southern Madagascar (Fig. 95).

Biology. A ground-dwelling species collected in contrasting forest types.

Cambalida lineata sp. n.

urn:lsid:zoobank.org:act:59D31562-99C6-4A9A-B5A3-500793263E3A
http://species-id.net/wiki/Cambalida_lineata
Figures 7, 87, 88

Type material. Holotype female. MADAGASCAR: *Toamasina*: Parc National Masoala, Ambohitsitondroina Mountain, Ambanizana, 15°34'09.9"S, 50°00'12.3"E, 600–650m a.s.l., leg. D. Andriamalala, D. Silva *et al.*, 1–2.III.2003 (rainforest, general collecting, night) (CAS, CASENT 6015409).

Paratypes. MADAGASCAR: *Toamasina*: Presqu'ile de Masoala, 5.3km SSE Ambanizana, Andranobe, 15°40'S, 49°58'E, 425m a.s.l., leg. B.L. Fisher, 21.XI.1993 (sifted litter, leaf mould, rotten wood, rainforest), 1♀ (CAS, CASENT 9033140); Same locality as holotype, 750–800m a.s.l., leg. D. Andriamalala, D. Silva *et al.*, 1.III.2003 (rainforest, sweeping), 1♀ (CAS, CASENT 6015423). *Toliara*: Réserve Spéciale d'Ambohijanahary, Forêt d'Ankazotsihitafototra, 35.2km 312° NW Ambaravaranala, 18°16'00"S, 45°24'24"E, 1050m a.s.l., leg. Fisher, Griswold *et al.*, 13–17.I.2003 (general collecting, day spiders), 1♀ (CAS, CASENT 9012850).

Other material examined. None.

Diagnosis. The species is unique amongst *Cambalida* in the cream median stripe on the abdomen, which extends to the carapace in the holotype (Fig. 7) and one of the paratypes, but is very indistinct in two of the paratypes. The ST II are very large and round, and nearly twice as broad as the ST I (Figs 87, 88).

Etymology. From the Latin "linea", referring to the pale dorsal stripe on the abdomen.

Female (holotype, Parc National Masoala, CASENT 6015409). Measurements: CL 2.50, CW 1.74, AL 2.65, AW 1.65, TL 5.20 (5.05–5.60), FL 0.20, SL 1.19, SW 1.06, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.31, PME–PME 0.11, PME–PLE 0.05, PLE–PLE 0.48, PERW 0.71, MOQAW 0.30, MOQPW 0.44, MOQL 0.41.

Length of leg segments (sequence from femur to tarsus, and total): I 1.96 + 0.79 + 1.74 + 1.66 + 1.05 = 7.20; II 1.90 + 0.74 + 1.55 + 1.55 + 0.85 = 6.59; III 1.75 + 0.71 + 1.32 + 1.69 + 0.80 = 6.27; IV 2.33 + 0.83 + 2.09 + 2.56 + 1.00 = 8.81.

Carapace orange-brown, clypeus slightly paler laterally, eye region slightly darker, with slightly paler yellow-orange line from fovea to posterior margin; black striae radiating from fovea towards palps and coxae and faint black mottling on slopes; surface finely wrinkled, sparsely covered in white plumose and short straight setae. All eyes with black rings; AER procurved, laterals larger than medians; AME separated by distance slightly less than ½ their diameter, AME separated from ALE by distance equal to ⅕ AME diameter; clypeus height slightly larger than 1½ times AME diameter; PER procurved, PME and PLE equal in diameter; PME separated by distance slightly less than ⅔ their diameter, PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.45:1. Chelicerae deep orange-brown with black mottling on anterior surface, yellow along prolateral distal margin; bent setae on promargin pectinate; three teeth on promargin, median tooth largest, proximal tooth smallest, median tooth closer to distal tooth than to proximal tooth; two teeth on retromargin, distal tooth slightly larger than proximal tooth, closer to fang base than promarginal teeth; endites pale orange with faint black mottling, cream prolaterally; labium orange, paler distally; sternum bright orange with faint black mottling. Legs finely granulate; femora I–IV mottled brown, with paler dorsal lines proximally and distally and club-shaped retrolateral paler line; patellae I–IV brown, yellow-brown dorsally; tibiae I yellow, mottled proximally and laterally at distal end; tibiae II–IV yellow dorsally and ventrally, mottled brown laterally, tibiae IV yellow at distal end; metatarsi and tarsi I–IV yellow with faint lateral brown mottling proximally. Leg spination: femora: I pl 1 do 2, II do 2, III pl 1 do 3, IV pl 1 do 3-4 rl 1; patellae with do 1 long distal seta; tibiae: I plv 3 rlv 2, II plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 rlv 1 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora pl 1 do 2, patellae pl 1, tibiae pl 1 plv 1, tarsi pl 2 plv 2 rlv 1. Abdomen mottled dark grey dorsally, with narrow triangular median cream line, broadest anteriorly and extending past middle of abdomen, cream spots surrounding sigilla, and small white spot above spinnerets (Fig. 7); dorsum with yellow scutum extending ¼ abdomen length; sides of abdomen mottled dark grey, with cream line extending ⅔ the distance from epigastric furrow to spinnerets; venter mottled pale grey, darker towards spinnerets, epigastric sclerite and inframamillary sclerite yellow.

Epigyne with small lateral copulatory openings situated within hemispherical epigynal ridges (Fig. 87); copulatory ducts initially directed posteriorly, bending at nearly right angle before running transversely towards midline, entering ST II posteromedially; ST II large and round, joined broadly to narrower kidney-shaped posterior ST I (Fig. 88).

Male. Unknown.

Distribution. Known from three isolated localities in northern and central Madagascar (Fig. 95).

Biology. A ground-dwelling species collected in rainforest.

Cambalida loricifera (Simon, 1885)

http://species-id.net/wiki/Cambalida_loricifera
Figures 43, 56, 89–92

Tylophora loricifera Simon, 1885: 379 comb. n.
Castaneira loricifera Simon, 1897: 167.

Type material. Holotype male. SENEGAL: Dakar [14°45'N, 17°20'W], MNHN 8062 (examined).

Other material examined. SENEGAL: Sonkorong [13°46'N, 15°33'W], near Kaymor, leg. A. Russell-Smith, 14.VI.1994 (leaf litter, 20 year old fallow), 4♂ (BMNH); Thyssé Region, Forêt Classé de Ngayene [13°43'N, 15°27'W], leg. A. Russell-Smith, 24.VII.1996 (leaf litter), 1♂ 3♀ (BMNH).

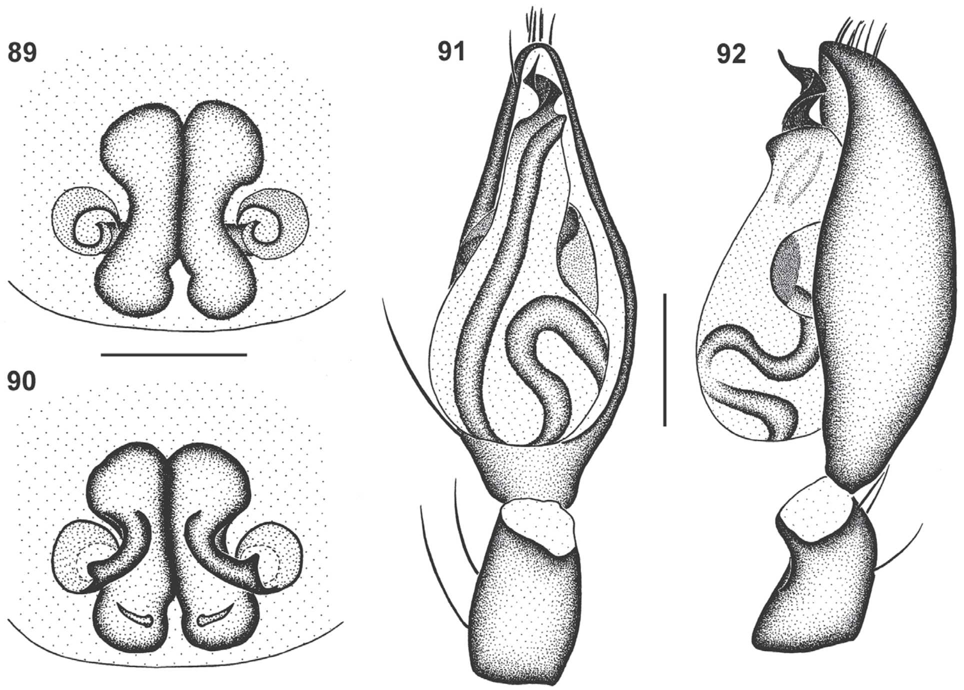
Diagnosis. This species is recognised by the distinctly coiled epigynal ridges and the oblique curved entrance ducts of the females (Figs 89, 90). Males can be recognised by the broad, somewhat flattened embolus (Figs 43, 56).

Remarks. The right leg I and right palp of the male holotype are missing. The redescription of the male is provided for the holotype, although more recently collected specimens are darker brown in colour.

Female (Ngayene, BMNH). Measurements: CL 2.80, CW 2.05, AL 4.55, AW 2.25, SL 1.32, SW 1.21, TL 7.10 (6.45–7.10), AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.40, PME–PME 0.15, PME–PLE 0.06, PLE–PLE 0.61, PERW 0.87, MOQAW 0.39, MOQPW 0.52, MOQL 0.49.

Length of leg segments (sequence from femur to tarsus, and total): I 1.87 + 0.83 + 1.58 + 1.48 + 0.92 = 6.68; II 1.72 + 0.80 + 1.30 + 1.34 + 0.81 = 5.97; III 1.65 + 0.78 + 1.20 + 1.54 + 0.65 = 5.82; IV 2.31 + 0.95 + 2.02 + 2.48 + 0.90 = 8.66.

Carapace dark orange-brown, ocular region slightly darker, with dark brown mottling and black striae radiating from fovea towards palps and leg coxae; surface finely granulate, covered in white plumose setae, denser laterally. All eyes with black rings; AER procurved, AME and ALE subequal in size; AME separated by distance slightly less than ½ their diameter, AME separated from ALE by distance equal to $\frac{1}{5}$ AME diameter; clypeus height slightly larger than AME diameter; PER procurved, PME slightly larger than PLE; PME separated by distance equal to $\frac{4}{5}$ their diameter, PME



Figures 89–92. Genitalic morphology of *Cambalida loricifera* (Simon, 1885): **89** female epigyne, ventral view **90** same, dorsal view **91** male palp, ventral view **92** same, retrolateral view. Scale bars = 0.25mm.

separated from PLE by distance equal to ⅓ PME diameter; CW:PERW = 2.35:1. Chelicerae orange-brown, yellow prolaterally at distal end; three teeth on promargin, median tooth largest, distal tooth smallest, situated closest to median tooth; two teeth on retromargin, subequal in size, closer to fang base than promarginal teeth; endites orange, cream prolaterally; labium orange-brown, cream distally; sternum orange, with pale brown mottling; surface finely granulate, with scattered small, erect black setae; precoxal triangles indistinct, intercoxal sclerites present between coxae I and II, coxae II and III, coxae III and IV. Legs finely granulate; femora I–IV brown, yellow at distal end, with dark brown mottling laterally and darker band at ⅔ femora length; remaining segments of legs I–III yellow with dark brown lateral mottling, leg III slightly darker yellow than anterior legs; patellae IV yellow-brown with dark brown lateral mottling; tibiae IV brown, yellow at proximal and distal ends, with dark brown mottling laterally; metatarsi IV yellow brown dorsally, with brown mottling laterally and ventrally, slightly paler proximally and distally; tarsi IV yellow. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with single long distal do seta; tibiae: I plv 1 rlv 1, II rlv 2, III pl 2 do 1 rl 2 plv 1 rlv 1 vt 2, IV pl 2 do 1 rl 2 plv 2 rlv 1 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3; all tibiae, metatarsi and tarsi with 4–10 do tr. Palpal spination: femora do 2, patellae pl 1 do 2, tibiae pl 2 do 2, tarsi pl 1 rl 1 plv 2 vt 2. Abdomen pale grey with scattered white median markings, with white spot above spinnerets; dorsum with orange dorsal scutum extending ¼ abdomen length; venter mottled pale grey, epigastric sclerite orange and inframamillary sclerite pale yellow-brown. Epigyne with small lateral copulatory openings situated prolaterally within broad comma-shaped epigynal ridges (Fig. 89); copulatory ducts initially directed transversely, curving obliquely towards anterior, entering ST II posterolaterally; ST II small and subtriangular with rounded angles, joined broadly to narrow kidney-shaped posterior ST I (Fig. 90).

Male (holotype, Dakar, MNHN 8062). Measurements: CL 2.51, CW 1.86, AL 2.78, AW 1.50, TL 5.40 (4.60–5.40), FL 0.21, SL 1.16, SW 1.00, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.34, PME–PME 0.14, PME–PLE 0.05, PLE–PLE 0.54, PERW 0.79, MOQAW 0.33, MOQPW 0.47, MOQL 0.44.

Length of leg segments (sequence from femur to tarsus, and total): I 1.64 + 0.68 + 1.34 + 1.25 + 0.85 = 5.70; II 1.46 + 0.62 + 1.10 + 1.11 + 0.70 = 4.99; III 1.40 + 0.68 + 0.96 + 1.26 + 0.61 = 4.91; IV 2.00 + 0.80 + 1.48 + 2.05 + 0.80 = 7.13.

Carapace orange-brown, including ocular region; surface finely granulate, covered in white plumose setae, denser laterally. All eyes with black rings; AER procurved, ALE slightly larger than AME; AME separated by distance slightly less than ½ their diameter, AME separated from ALE by approximately ⅕ AME diameter; clypeus height equal to 1¼ AME diameter; PER procurved, PME slightly larger than PLE; PME separated by distance equal to ⅘ their diameter, PME separated from PLE by distance equal to ⅓ PME diameter; CW:PERW = 2.35:1. Chelicerae orange-brown, yellow prolaterally at distal end; three teeth on promargin, median tooth largest, distal tooth smallest, situated closest to median tooth; two subequal teeth on retromargin, closer to fang base than promarginal teeth; endites orange, cream prolaterally; labium orange-brown, cream distally; sternum orange with pale brown mottling. Legs finely granulate; femora I–IV brown, yellow distally; patellae I–IV yellow, with faint brown mottling laterally; tibiae I and II yellow with brown mottling laterally; tibiae III and IV yellow-brown with brown lateral mottling, yellow distally; metatarsi I and II yellow, III and IV yellow-brown; tarsi I and II yellow, III and IV creamy-yellow. Leg spination: femora: I pl 1 do 3, II pl 1 do 3, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; patellae with single long distal do seta; tibiae: I plv 1 rlv 1, II rlv 1, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2–3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora pl 1 do 2, patellae do 1, tibiae pl 1 plv 1, tarsi plv 2. Abdomen with orange-brown dorsal scutum covering entire dorsum, yellow-brown posteriorly, with faint brown mottling; white spot comprising dense plumose setae above spinnerets; venter cream, epigastric sclerite, post-epigastric sclerites orange-brown, ventral sclerite and inframamillary sclerite orange. Palps yellow with brown mottling; embolus broadly coiled, somewhat flattened, with 1¼ coils (Figs 43, 91, 92).

Distribution. Only known from three localities in Senegal, West Africa (Fig. 95).

Biology. Collected from leaf litter in forests and fallow habitats.

***Cambalida unica* sp. n.**
urn:lsid:zoobank.org:act:2F175096-C8FD-4936-B4FB-639E74C179DB
http://species-id.net/wiki/Cambalida_unica
Figures 93, 94

Type material. Holotype female, together with 1 paratype female. CAMEROON: Chabal Mbabo, SW slope, 07°25'N, 12°49'E, 1250m a.s.l., leg. Bosmans & Van Stalle, 9.IV.1983 (grassland) (MRAC 162219).

Other material examined. None.

Diagnosis. Females of this species can be easily recognised by the sharply bent lateral margins of the ST II (Figs 93, 94).

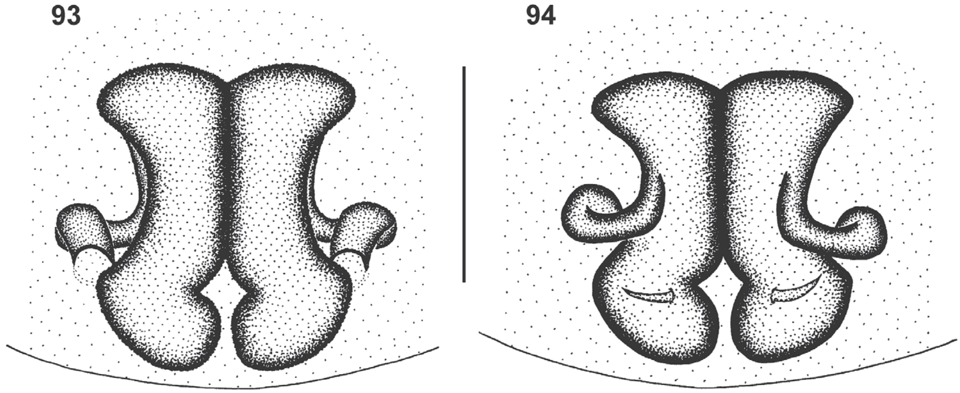
Etymology. The species name is Latin for "unique".

Remark. The holotype is the smaller of the two females in the vial containing the types and has the epigyne dissected.

Female (holotype, Chabal Mbabo, MRAC 162219). Measurements: CL 2.68, CW 1.98, AL 3.50, AW 2.45, TL 5.85 (5.85–6.00), FL 0.21, SL 1.17, SW 1.15, AME–AME 0.08, AME–ALE 0.02, ALE–ALE 0.34, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.55, PERW 0.81, MOQAW 0.33, MOQPW 0.46, MOQL 0.44.

Length of leg segments (sequence from femur to tarsus, and total): I 1.88 + 0.81 + 1.48 + 1.27 + 0.86 = 6.30; II 1.71 + 0.78 + 1.23 + 1.14 + 0.75 = 5.61; III 1.59 + 0.75 + 1.11 + 1.25 + 0.63 = 5.33; IV 2.25 + 0.93 + 1.95 + 2.10 + 0.85 = 8.08.

Carapace deep red-brown, clypeus brown, eye region darker; faint black striae radiating from fovea towards palps and leg coxae; surface finely granulate, densely covered in white plumose setae. AER procurved, ALE much larger than AME; AME separated by distance approximately $^{3}/_{5}$ their diameter, AME separated from ALE by $^{1}/_{5}$ AME diameter; clypeus height equal to 1½ AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance slightly less than ¾ their diameter, PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.44:1. Chelicerae brown with faint black mottling on anterior surface, yellow-orange along prolateral distal margin; three teeth on promargin, median tooth largest, distal tooth smallest, situated closest to median tooth; two teeth on retromargin, distal tooth slightly smaller than proximal tooth, closer to fang base than promarginal teeth; endites yellow-brown, cream prolaterally; labium orange-brown, cream distally; sternum orange with brown mottling. Legs finely granulate; femora I–IV dark brown, yellow dorsally at distal end; patellae I–IV yellow-brown, with dark brown mottling laterally; tibiae I and II yellow-brown, with sparse dark brown mottling laterally; tibiae III and IV dark brown, with paired pale brown stripes dorsally, distal ends bright yellow; metatarsi I and II yellow-brown, with sparse dark brown mottling laterally; metatarsi III and IV dark brown, yellow at proximal and distal ends; tarsi I and II yellow-brown, III and IV yellow. Leg spination: femora: I pl 1 do 3, II do 3, III pl 2 do 3 rl 1, IV pl 1 do 3 rl 1; patellae with do 1 long distal seta; tibiae: I plv 1 rlv 1, II plv 1 rlv 1, III pl 2 do 1 rl 2 plv 2 rlv 1 vt 2, IV pl 2 do 1 rl 2 plv 2 rlv 1 vt 2; metatarsi: I plv 2 rlv 2,



Figures 93–94. Genitalic morphology of *Cambalida unica* sp. n.: **93** female epigyne, ventral view **94** same, dorsal view. Scale bar = 0.25mm.

II plv 2 rlv 2, III pl 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal segments brown, tarsi orange-brown. Palpal spination: femora do 2, patellae pl 1 do 2, tibiae pl 1 do 1 plv 1, tarsi pl 1 plv 3 rlv 1. Abdomen mottled dark grey, with orange-brown dorsal scutum extending ¼ abdomen length; venter mottled pale grey, darker towards spinnerets, epigastric sclerite orange-brown and inframamillary sclerite yellow-brown. Epigyne with lateral copulatory openings situated within small round epigynal ridges (Fig. 93); copulatory ducts initially directed dorsally, looping transversely then anteriorly, entering ST II posterolaterally; ST II somewhat triangular, with sharply angled lateral margins, joined broadly to kidney-shaped posterior ST I (Fig. 94).

Male. Unknown.

Distribution. Only known from the type locality (Fig. 95).

Biology. Unknown.

Species *nomina dubia*

Cambalida insulana Simon, 1909

Cambalida insulana Simon, 1909: 369.

Remarks. The type material could not be traced in MNHN and is probably lost (Christine Rollard, pers. comm.), which was confirmed by Bosselaers and Jocqué (2000), who also could not successfully locate the type. The type locality given by Simon (1909) is "Ile Annobon", also known as Pagalu Island, which is situated 160km south-west of Sao Tomé in the Atlantic Ocean. The only *Cambalida* material available from these islands is a series of immature and subadult specimens from Parc Nacional Ôhó, Sao Tomé, collected in 2001 and deposited in CAS. It is thus likely that *C. insulana* populations may still be viable and not extinct. Additional

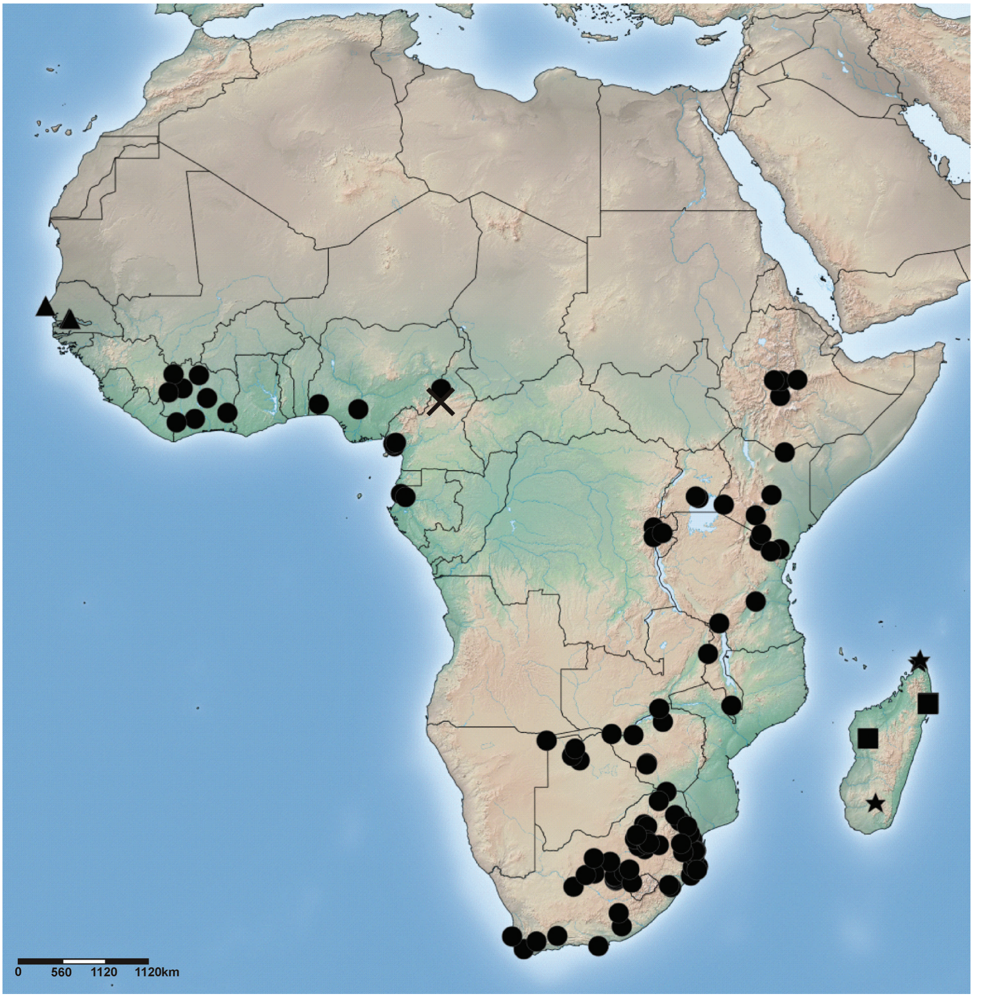


Figure 95. Distribution of *Cambalida fulvipes* (Simon, 1896) (circles), *C. griswoldi* sp. n. (stars), *C. lineata* sp. n. (squares), *C. loricifera* (Simon, 1885) (triangles) and *C. unica* sp. n. (cross) in the Afrotropical Region.

adult material from the type locality is needed before this species can be validated, redescribed and neotypes designated.

Cambalida simoni nom. n.

Cambalida fulvipes Simon, 1909: 369 [preoccupied by senior homonym]

Remarks. A replacement name is here proposed for *Cambalida fulvipes* Simon, 1909, a name occupied by its secondary senior homonym, *C. fulvipes* (Simon, 1896), proposed earlier in this paper. The type material of this species could not be traced in MNHN and is probably lost, and the original description is inadequate for its successful identification. The occurrence of three different species in West Africa, and the lack of any comparable fresh material from Guinee-Bissau, from which this species was described, means that this species should remain *nomen dubium* until fresh material can be collected from the vicinity of the type locality (Bolama, 11°34'N, 15°29'W).

Discussion

The current revision of the Afrotropical genus *Cambalida* increased the species compliment from three to ten species, with a further two species (including the type species of the genus) being considered *nomina dubia*. The biogeographical patterns of *Cambalida* are quite different to most of the other Afrotropical genera. *Apochinomma* Pavesi, 1881 and *Copa* Simon, 1885 (Haddad 2012) each have a single widespread Afrotropical species and *Echinax* Deeleman-Reinhold, 2001 (Haddad in press) has two widespread species, with the other species in each genus generally being restricted to a single biogeographical region (e.g. West Africa) or a single country. In contrast, *Cambalida* has one species widespread throughout the region (*C. fulvipes*), two additional species widespread through tropical West and Central Africa (*C. coriacea* and *C. deminuta*), and one widespread in southern Africa (*C. dippenaarae*). The remaining six species are all comparatively range restricted. While *Copa* has radiated considerably on Madagascar, with more than 30 new species to be described from the island (Haddad 2012), only two new Madagascan species of *Cambalida* have been described in this study. However, there is a large quantity of unidentified material from the island, and it is plausible that several new *Cambalida* have yet to be discovered. Until such time as the fauna has been more thoroughly studied, no discussion or hypotheses of the biogeographical relationships of the Madagascan and continental faunas should be made.

Cambalida appear to be exclusively ground-dwelling leaf litter spiders occurring mainly in savanna and forest habitats. In savannas they are generally uncommon but are similar in abundance to *Copa flavoplumosa* Simon, 1885 and *Merenius* spp. (Foord et al. 2008; Haddad et al. 2010; Muelelwa et al. 2010). In contrast, they contribute a more significant proportion of spider assemblages in the leaf litter of shrubs in the South African Grassland Biome, where they are the most abundant corinnids (Butler and Haddad 2011). They are only occasionally collected from agroecosystems in South Africa (Haddad and Dippenaar-Schoeman 2006), but several species are quite common in rice and fallow habitats in West Africa.

The current study has significantly increased the species compliment of *Cambalida* to ten, and it is likely that further new species will be sampled and need to be described in the future. This is supported by the reasonably small distribution ranges of several species (e.g. *C. griswoldi*, *C. lineata* and *C. loricifera*) and others that are only known from the type locality (*C. fagei* and *C. unica*). It is probable that many historically poorly sampled biodiversity hotspots may yield considerable additions to the fauna, particularly in East and West Africa. The possible occurrence of *Cambalida* on the Indian Ocean islands (other than Madagascar) also requires further investigation.

Acknowledgments

This study was funded through grants from the National Research Foundation of South Africa (NRF) in the South African Biosystematics Initiative programme (grant FA2005040700016) and the Thuthuka programme (TTK2008050500003). Ezemvelo KZN Wildlife (KwaZulu-Natal Province), CapeNature (Western Cape Province) and Eastern Cape Nature Conservation (Eastern Cape Province) in South Africa, and the Department of Agriculture of Mozambique, are thanked for collecting permits that made field work possible in these respective countries. The curators of the collections listed in the Material and methods section are thanked for the loans of material that made this study possible. Schalk Louw, Ansie Dippenaar-Schoeman, Robert Raven and Rudy Jocqué provided suggestions that improved an earlier version of the manuscript. Jan Bosselaers is thanked for discussion on the genus during the early stages of this revision. He, together with Robin Lyle, provided useful comments as the reviewers of this paper.

References

Bosselaers J, Jocqué R (2000) Studies in Corinnidae: transfer of four genera and descriptions of the female of *Lessertina mutica* Lawrence 1942. Tropical Zoology 13: 305–325.

Bosselaers J, Jocqué R (2002) Studies in Corinnidae: cladistic analysis of 38 corinnid and liocranid genera, and transfer of Phrurolithinae. Zoologica Scripta 31: 241–270. doi: 10.1046/j.1463-6409.2002.00080.x

Brignoli PM (1983) A catalogue of the Araneae described between 1940 and 1981. Manchester University Press, Manchester, 755 pp.

Butler VP, Haddad CR (2011) Spider assemblages associated with leaf litter of three tree species in central South Africa (Arachnida: Araneae). African Journal of Ecology 49: 301–310. doi: 10.1111/j.1365-2028.2011.01265.x

Caporiacco L di (1939) Arachnida. In: Missione biologica nel paese dei Borana, Raccolte zoologiche. Vol. 3, part 2. Reale Accademia d'Italia, Roma, 303–385.

Dippenaar-Schoeman AS, Jocqué R (1997) African spiders: an identification manual. Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

Foord SH, Mafadza M, Dippenaar-Schoeman AS, Van Rensburg BJ (2008) Micro-scale heterogeneity of spiders (Arachnida: Araneae) in the Soutpansberg, South Africa: a comparative survey and inventory in representative habitats. African Zoology 43: 156–174. doi: 10.3377/1562-7020-43.2.156

Haddad CR (2004) A revision of the spider genus *Graptartia* Simon, 1896 (Araneae: Corinnidae) in the Afrotropical region. African Entomology 12: 71–81.

Haddad CR (2006) *Cambalida coriacea* Simon, 1909 (Arachnida, Araneae): proposed conservation of usage of the specific name by suppression of *Castianeira fulvipes* Simon, 1896. Bulletin of Zoological Nomenclature 63: 17–19.

Haddad CR (2012) Advances in the systematics and ecology of African Corinnidae spiders (Arachnida: Araneae), with emphasis on the Castianeirinae. Unpublished PhD thesis, Bloemfontein, South Africa: University of the Free State.

Haddad CR (in press) A revision of the spider genus *Echinax* Deeleman-Reinhold, 2001 (Araneae: Corinnidae) in the Afrotropical Region. Zootaxa.

Haddad CR, Dippenaar-Schoeman AS (2006) Epigeic spiders (Araneae) in pistachio orchards in South Africa. African Plant Protection 12: 12–22.

Haddad CR, Honiball AS, Dippenaar-Schoeman AS, Slotow R, Van Rensburg BJ (2010) Spiders (Arachnida: Araneae) as indicators of elephant-induced habitat changes in the Maputaland Centre of Endemism, South Africa. African Journal of Ecology 48: 446–460. doi: 10.1111/j.1365-2028.2009.01133.x

Haddad CR, Lyle R, Bosselaers J, Ramirez M (2009) A revision of the Afrotropical genus *Austrachelas* Lawrence, 1938 (Araneae: Corinnidae), and its transfer to the Gallieniellidae. Zootaxa 2296: 1–38.

ICZN (2007) OPINION 2177 (Case 3331): *Castianeira fulvipes* Simon, 1896 (Arachnida, Araneae): precedence over *Cambalida coriacea* Simon, 1909 maintained. Bulletin of Zoological Nomenclature 64: 196.

Kraus O (2006) Comment on the proposed conservation of the specific name of *Cambalida coriacea* Simon, 1909 (Arachnida, Araneae) by the suppression of *Castianeira fulvipes* Simon, 1896. Bulletin of Zoological Nomenclature 63: 201.

Lessert R de (1921) Araignées du Kilimandjaro et du Merou (suite). 4. Clubionidae. Revue Suisse de Zoologie 28: 381–442.

Muelelwa MI, Foord SH, Dippenaar-Schoeman AS, Stam EM (2010) Towards a standardized and optimized protocol for rapid assessments: spider species richness and assemblage composition in two savanna vegetation types. African Zoology 45: 273–290. doi: 10.3377/004.045.0206

Platnick NI (1989) Advances in Spider Taxonomy 1981–1987: A Supplement to Brignoli's "A Catalogue of the Araneae described between 1940 and 1981". Manchester University Press, Manchester, 673 pp.

Reiskind J (1969) The spider subfamily Castianeirinae of North and Central America (Araneae, Clubionidae). Bulletin of the Museum of Comparative Zoology 138: 163–325.

Shorthouse DP (2010) SimpleMappr, an online tool to produce publication-quality point maps. Available from: http://www.simplemappr.net [accessed 25 May 2012].

Simon E (1885) Etudes arachnologiques. 18e Mémoire. XXVI. Matériaux pour servir à la faune des Arachnides du Sénégal. (Suivi d'une appendice intitulé: Descriptions de plusieurs espèces africaines nouvelles). Annales de la Société Entomologique de France (6) 5: 345–396.

Simon E (1896) Descriptions d'arachnides nouveaux de la famille des Clubionidae. Annales de la Société entomologique de Belgique 40: 400–422.

Simon E (1897) Histoire naturelle des Araignées. Tome second, Premier fascicule. Librairie Encyclopédique de Roret, Paris, 1–192.

Simon E (1909) Arachnides recueillis par L. Fea sur la côte occidentale d'Afrique. 2e partie. Annali del Museo Civico di Storia Naturale di Genova 44: 335–449.

Strand E (1916) Zentralafrikanische Clubioniden. In: Wissenschaftliche Ergebnisse der Deutschen Zentral Afrika Expedition 1907–1908, unter Fuhrung Adolf Friedrichs, Herzogs zu Mecklenberg. Archiv für Naturgeschichte 81(A11): 79–98.