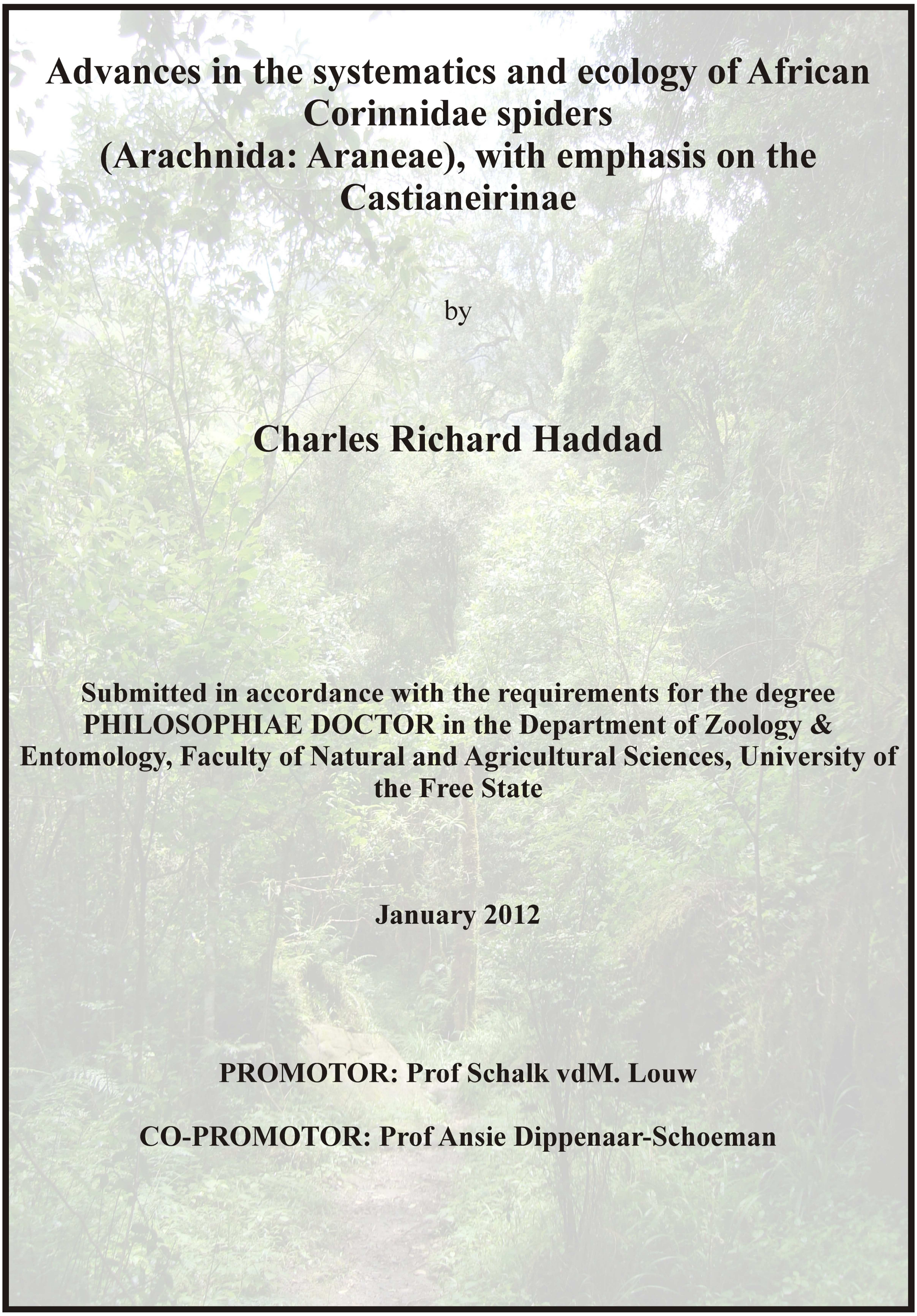


Advances in the systematics and ecology of African Corinnidae spiders (Arachnida: Araneae), with emphasis on the Castianeirinae

by

Charles Richard Haddad

Submitted in accordance with the requirements for the degree PHILOSOPHIAE DOCTOR in the Department of Zoology & Entomology, Faculty of Natural and Agricultural Sciences, University of the Free State

January 2012

PROMOTOR: Prof Schalk vdM. Louw

CO-PROMOTOR: Prof Ansie Dippenaar-Schoeman

I declare that this thesis hereby handed in for the qualification PHILOSOPHIAE DOCTOR at the University of the Free State is my own independent work and that I have not previously submitted the same work for qualification in/at another University/Faculty.

…………………………………………………………

Charles Richard Haddad

CONTENTS

CHAPTER 4: A REVISION OF THE AFROTROPICAL ANT-LIKE SAC SPIDER GENUS *CAMBALIDA* SIMON, 1909 (ARANEAE: CORINNIDAE) 95

CHAPTER 5: TAXONOMIC NOTES ON THE AFROTROPICAL SPECIES OF *CASTIANEIRA* KEYSERLING, 1879 (ARANEAE: CORINNIDAE), WITH REDESCRIPTIONS OF SOME POORLY KNOWN SPECIES 152

CHAPTER 6: A REVISION OF THE CONTINENTAL SPECIES OF *COPA* SIMON, 1885 (ARANEAE: CORINNIDAE) IN THE AFROTROPICAL REGION 177

APPENDIX A – PUBLISHED THESIS CHAPTERS [HARD COPY; ALSO SEE ENCLOSED C.D. FOR PDF FILES]

A1 **HADDAD, C.R.** 2004. A revision of the African spider genus *Graptartia* Simon, 1896 (Araneae: Corinnidae). *African Entomology* **12**: 71–81.

A2 **HADDAD, C.R.** 2006. A new species of *Corinnomma* (Araneae: Corinnidae) from southern and eastern Africa, with taxonomic notes on *C. olivaceum* and *C. semiglabrum*. *African Invertebrates* **47**: 71–83.

APPENDIX B – PUBLISHED NON-THESIS RELATED PAPERS ON AFROTROPICAL CORINNIDAE [SEE ENCLOSED C.D. FOR PDF FILES]

B1 **HADDAD, C.R.** 2005. A redescription of *Corinna natalis* Pocock, 1898 (Araneae, Corinnidae), Africa's largest dark sac spider, with natural history notes. *Journal of Afrotropical Zoology* **2**: 27–32.

B2 **HADDAD, C.R.** 2006. *Spinotrachelas*, a new genus of tracheline sac spiders from South Africa (Araneae: Corinnidae). *African Invertebrates* **47**: 85–93.

B3 **HADDAD, C.R.** 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.

B4 **HADDAD, C.R.** 2007. A revision of the endemic South African dark sac spider genus *Austrophaea* Lawrence, 1952 (Araneae: Corinnidae). *African Invertebrates* **48**: 47–53.

B5 **HADDAD, C.R.** & LYLE, R. 2008. Three new genera of tracheline sac spiders from southern Africa (Araneae: Corinnidae). *African Invertebrates* **49**: 37–76.

B6 **HADDAD, C.R.,** 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.

B7 **HADDAD, C.R.** 2009. *Vendaphaea*, a new dark sac spider genus apparently endemic to the Soutpansberg Mountains, South Africa (Araneae: Corinnidae). *African Invertebrates* **50**: 269–278.

B8 **HADDAD, C.R.** & BOSSELAERS, J. 2010. A revision of the genus *Medmassa* Simon, 1887 (Araneae: Corinnidae) in the Afrotropical Region. *Zootaxa* **2361**: 1–12.

B9 **HADDAD, C.R.** 2010. A new species of *Poachelas* from Maputaland, South Africa (Araneae: Corinnidae), with considerable range extension for *Poachelas striatus*. *African Invertebrates* **51**: 313–319.

B10 **HADDAD, C.R.**, NEETHLING, J.A. & LYLE, R. 2011. *Spinotrachelas montanus* sp. nov., the first Afromontane representative in the genus (Araneae: Corinnidae). *African Invertebrates* **52**: 345–352.

APPENDIX C – CO-AUTHORED PAPERS ON AFROTROPICAL CORINNIDAE [SEE ENCLOSED C.D. FOR PDF FILES]

C1 LYLE, R. & **HADDAD, C.R.** 2006. A revision of the Afrotropical tracheline sac spider genus *Thysanina* Simon, 1910 (Araneae: Corinnidae). *African Invertebrates* **47**: 95–116.

C2 LYLE, R. & **HADDAD, C.R.** 2009. *Planochelas*, a new genus of tracheline sac spiders from West and Central Africa. *Annals of the Transvaal Museum* **46**: 91–100.

C3 LYLE, R. & **HADDAD, C.R.** 2010. A revision of the tracheline sac spider genus *Cetonana* Strand, 1929 in the Afrotropical Region, with descriptions of two new genera (Araneae: Corinnidae). *African Invertebrates* **51**: 321–384.

ABSTRACT

The Corinnidae is one of 76 families of spiders (Arachnida: Araneae) presently recognised in the Afrotropical Region. By the end of the last century their taxonomy and systematics had been very poorly studied and no modern revisions existed on the group. At that time, 110 species in 22 genera were known from the region, making it a family with moderate species richness. The description of the new genus *Hortipes* Bosselaers & Ledoux, 1998 in the family Liocranidae signalled the start of modern systematics studies in that family, and following the transfer of *Hortipes* to the Corinnidae, of that family by default too.

Since that time, 20 taxonomic papers have been published on the Afrotropical Corinnidae and 10 new genera (all endemic to the region) and 164 new species have been described, of which three species form part of the current study (Chapters 7 and 9). Several genera have also been transferred to or from the Corinnidae in those papers. Presently there are 35 genera and more than 270 species known from the region, with the Corinnidae now ranking eighth in species richness in the region. Most of the revisionary work so far has focused on the subfamilies Trachelinae and Phrurolithinae, while the Corinninae *sensu lato* and Castianeirinae have largely remained neglected. The broad aim of the current study was to focus on the systematics of the latter group, treat the taxonomy of each of the currently known genera, at least in part, and provide a basis for future work on the subfamily. As such, many of the smaller genera in the subfamily were revised in the Afrotropical Region and two new genera were described.

The genus *Apochinomma* Pavesi, 1881, the only described genus of accurate ant-mimicking castianeirines from the region, is revised and separated into two species groups based on genitalic and abdominal morphology. The type species, *A. formicaeforme* Pavesi, 1881, is redescribed and three new species are described in the *A. formicaeforme* species group: *A. malkini* **sp. nov.**, *A. parva* **sp. nov.** and *A. tuberculata* **sp. nov.**. Two new species, *A. decepta* **sp. nov.** and *A. elongata* **sp. nov.**, are described in the *A. decepta* species group, although an additional species only known from juveniles can also be placed in the latter group. Members of the *A. formicaeforme* species mimic *Polyrhachis* ants and are mainly arboreal, while members of *A. decepta* species group are ground- or grass-dwelling and probably mimic ponerine ants.

The genus *Cambalida* Simon, 1909 is revised and three species are transferred from *Castianeira* Keyserling, 1879 to *Cambalida*: *C. deminuta* (Simon, 1909) **comb. nov.**, *C.*

fulvipes (Simon, 1896) **comb. nov.** and *C. loricifera* (Simon, 1885) **comb. nov.**. An additional species is transferred from *Brachyphaea* Simon, 1895 to *Cambalida*: *C. fagei* (Caporiacco, 1939) **comb. nov.**. All of these species are redescribed, as is *Cambalida coriacea* Simon, 1909. Two species, *Castianeira depygata* Strand, 1916 **syn. nov.** and *C. mestrali* Lessert, 1921 **syn. nov.**, are considered junior synonyms of *C. fulvipes*. The type material of the type species of the genus, *C. insulana* Simon, 1909 from 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. nov.**, is proposed for *Cambalida fulvipes* Simon, 1909, the latter being a secondary junior homonym of *Cambalida fulvipes* (Simon, 1896) **comb. nov.**. The type material of *C. simoni* is also lost and it too is considered a *nomen dubium*. Five new species are described: *C. compressa* **sp. nov.**, *C. dippenaarae* **sp. nov.**, *C. griswoldi* **sp. nov.**, *C. lineata* **sp. nov.** and *C. unica* s**p. nov.**.

Castianeira Keyserling, 1879 is the largest genus in the Corinnidae with 131 described species, of which 22 are presently known from the Afrotropical Region. There is a very rich undescribed fauna known from the region, and the variable morphology of its component species would suggest it is polyphyletic and should be divided into several genera. For example, six species are misplaced and have been transferred to or synonymised with species in *Cambalida* or the new genus *Copuetta* **gen. nov.**. In the present study, five species are redescribed and illustrated for the first time based on the type material: *C. delicatula* Simon, 1909, *C. formosula* Simon, 1909, *C. majungae* Simon, 1896, *C. phaeochroa* Simon, 1909 and *C. thomensis* Simon, 1909. The female holotype of *C. bicolor* (Simon, 1890) lacks an abdomen and the species is considered a *nomen dubium*. The types of several Afrotropical species could not be traced as yet and the species should be redescribed, if possible, based on recently collected material from near their type localities.

The ground-dwelling genus *Copa* Simon, 1885 is one of four genera in the Afrotropical Region that have cryptic colouration that bears a resemblance to that of wolf spiders (Lycosidae), hereafter referred to as cryptic lycosiform colouration. The type species of the genus, *C. flavoplumosa* Simon, 1885, is redescribed and proposed as a senior synonym of *C. benina* Strand, 1916 **syn. nov.** and *C. benina nigra* Lessert, 1933 **syn. nov.**. This is possibly the most widespread corinnid in the Afrotropical Region albeit that is has not yet been recorded from any of the islands. A new species, *C. kei* **sp. nov.**, is described from South Africa. *Copa agelenina* Simon, 1910, originally described from a subadult female from southern Botswana, is considered a *nomen dubium*. Although the Madagascan fauna was not included in this revision, nearly 30 new species have been distinguished from museum collections, and once that fauna is revised it will provide an exceptional example of island radiation.

In a revision of the Afrotropical species of the ant-mimicking genus *Corinnomma* Karsch, 1880, *Apochinomma semiglabrum* Simon, 1896 is redescribed from both sexes, and based on these descriptions it is transferred to *Corinnomma* as *C. semiglabrum* (Simon, 1896) **comb. nov.**. A new species, *C. lawrencei* **sp. nov.**, is described from Mozambique, Tanzania and South Africa. The taxonomic status of *C. olivaceum* Simon, 1896 is discussed and the first illustrations of the female genitalic structures are presented. Since no fresh material of this species is available and the female holotype is badly faded, it is not thoroughly redescribed. An English translation of Simon's (1896) Latin description of *C. olivaceum* is provided with the intention of more accurately describing the colouration of this species.

The arboreal cryptic lycosiform castianeirine genus *Echinax* Deeleman-Reinhold, 2001, previously known only from South-East Asia, is recorded from the Afrotropical Region for the first time. *Copa longespina* Simon, 1909 is redescribed and the species is transferred to *Echinax* as *E. longespina* (Simon, 1909) **comb. nov.**. Six new species are described from both sexes: *E. clara* **sp. nov.**, *E. hesperis* **sp. nov.**, *E. natalensis* **sp. nov.**, *E. scharffi* **sp. nov.**, *E. similis* **sp. nov.** and *E. spatulata* **sp. nov.**.

The genus *Graptartia* Simon, 1896, presently known only from Africa, is revised. The type species, *G. granulosa* Simon, 1896, is redescribed and the first genitalic sketches of the species are provided. Two new species, *G. mutillica* **sp. nov.** and *G. tropicalis* **sp. nov.**, are described. Unique amongst African castianeirines, all species of *Graptartia* are mimics of wingless female velvet ants (Mutillidae).

Although the genus *Merenius* Simon, 1909 is not revised, a single common species, *Merenius alberti* Lessert, 1923, is redescribed. The species was previously known only from South Africa, and is recorded for the first time from Mozambique, Swaziland and Zimbabwe. While most populations of *M. alberti* comprise the typical black morph of the species, a red morph is described for the first time here. As part of a field study to identify the potential models of the two colour morphs of *M. alberti*, spiders were collected by hand and ants by pitfall trapping in the Ndumo Game Reserve in northern KwaZulu-Natal, South Africa. The ants assemblages sampled at 20 sites in the reserve seem to indicate that the black morph is a generalised mimic of black ground-dwelling ants, most likely *Camponotus cinctellus* (Gerstäcker, 1859), *Streblognathus peetersi* Robertson, 2002 and *Polyrhachis gagates* F. Smith, 1858, while the red morph is a mimic of *Anoplolepis custodiens* (F. Smith, 1858) ants.

Lastly, the genus *Messapus* Simon, 1898, presently placed in the Castianeirinae, is reviewed. The type species, *M. martini* Simon, 1898, clearly represents two different species, one a corinnine (female lectotype) and the other a castianeirine (male paralectotype). The female is redescribed and the true male described for the first time. Based on the redescription, *Messapus* is transferred to the Corinninae. *Corinna natalis* Pocock, 1898 is misplaced and is transferred to *Messapus* as *M. natalis* (Pocock, 1898) **comb. nov.**, while *Messapus secundus* Strand, 1907 is misplaced and transferred to *Merenius* as *M. secundus* (Strand, 1907) **comb. nov.**. A new cryptic lycosiform genus, *Copuetta* **gen. nov.**, with the type species *C. maputa* **sp. nov.**, is established to accommodate the castianeirine male paralectotype of *M. martini*, and its matching female is described for the first time. *Castianeira kibonotensis* Lessert, 1921 **syn. nov.** is considered a junior synonym of *Copa lacustris* Strand, 1916 and the species is redescribed and transferred to *Copuetta* **gen. nov.** as *C. lacustris* (Strand, 1916) **comb. nov.**. An additional eleven new species of *Copuetta* **gen. nov.** are described: *C. comorica* **sp. nov.**, *C. erecta* **sp. nov.**, *C. kakamega* **sp. nov.**, *C. kwamgumi* **sp. nov.**, *C. lesnei* **sp. nov.**, *C. litipo* **sp. nov.**, *C. lotzi* **sp. nov.**, *C. magna* **sp. nov.**, *C. naja* **sp. nov.**, *C. uzungwa* **sp. nov.** and *C. wagneri* **sp. nov.**. A second new cryptic lycosiform genus, *Wasaka* **gen. nov.**, is described for four new species from tropical Africa: *W. imitatrix* **sp. nov.**, *W. montana* **sp. nov.**, *W. occulta* **sp. nov.** (type species) and *W. ventralis* **sp. nov.**.

A phylogenetic analysis of the subfamily Castianeirinae from the Afrotropical Region was carried out. Forty-one ingroup taxa (Castianeirinae) were included, of which 39 were Afrotropical, one Australasian and one Brazilian. Outgroup taxa included three species of Trachelinae, one Phrurolithinae, two Corinninae and two Corinnidae *incertae sedis*, with *Drassodes sesquidentatus* Purcell, 1908 used to root the trees. Only species of Castianeirinae treated in this thesis and known from both sexes were included in the analysis. Analyses performed in Winclada, TNT and PAST all produced similar but very unsatisfactory results, with the outgroups grouping together with part of the Castianeirinae. Consequently, a second analysis was conducted with the exclusion of most of the outgroup taxa (except *D. sesquidentatus* and Corinninae). These results improved the resolution of the results considerably. but still did not resolve the placement of the *Medmassa–Messapus* clade within Castianeirinae; these genera can be considered to belong to Corinninae and should hypothetically have been placed outside the Castianeirinae clade. A single analysis produced in PAST produced the most parsimonious tree, with *Medmassa–Messapus* placed outside the Castianeirinae and each of the Afrotropical castianeirine genera as monophyletic. The results are inadequate to support any systematic changes in the Corinnidae, but future analyses need to include a more diverse range of castianeirine genera from outside the Afrotropical Region to better understand the relationships of the Afrotropical fauna.

In the final chapter, the role of Castianeirinae as components of arthropod mimicry complexes is described for three species of ants, *Anoplolepis custodiens* (F. Smith, 1858), *Polyrhachis gagates* F. Smith, 1858 and *Camponotus fulvopilosus* (De Geer, 1778). There are respectively two out of 10, four out of six, and zero out of five species of Castianeirinae forming part of the arthropod complexes associated with these ants. All of these castianeirines are inaccurate (weak/ generalised) mimics of their models except for *Apochinomma formicaeforme*, which is an accurate (good/specialised) mimic of *P. gagates*. Colour polymorphism is also described for the first time in four species of Afrotropical Castianeirinae, i.e. *Corinnomma semiglabrum*, *Merenius alberti*, *Castianeira* cf. *venustula* (Pavesi, 1895) and *Copa flavoplumosa*. Three of these species are inaccurate mimics of ants, while *C. flavoplumosa* is a species with a widespread variant with cryptic lycosiform colouration and a nigrito form restricted mainly to tropical forests.

High Castianeirinae biodiversity and endemism corresponds to most of the main Biodiversity Hotspots and Centres of Endemism (CE) in the Afrotropical Region: Maputaland-Pondoland-Albany CE (five endemics), Madagascar and Indian Ocean Islands CE (>30 endemics), East African Afromontane Forests CE (four endemics), East African Coastal Forests CE (five endemics), Guinean Forests of West Africa CE (seven endemics) and the Horn of Africa CE (one endemic). No endemic castianeirines have been recorded in the Succulent Karoo and Cape Floristic Region CE’s in southern Africa, although this corinnid fauna of these two CE’s is largely dominated by Trachelinae, most of which are endemics.

UITTREKSEL

Die Corinnidae is een van 76 families spinnekoppe (Arachnida: Araneae) wat in die Afrotropiese streek voorkom. Teen die einde van die laaste eeu was hul taksonomie en sistematiek nog baie swak bestudeer, en geen moderne hersienings op die groep het bestaan nie. Toe was 110 spesies in 22 genera bekend vanaf die streek, wat dit ‘n familie met matige spesie rykheid gemaak het. Die beskrywing van die nuwe genus *Hortipes* Bosselaers & Ledoux, 1998 in die familie Liocranidae was die begin van modern taksonomiese werk op daardie familie, en met die oordrag van *Hortipes* na Corinnidae, van dié familie ook.

Van daardie tyd af is 20 taksonomiese artikels oor die Afrotropiese Corinnidae gepubliseer en 10 nuwe genera (almal endemies tot die streek) en 164 nuwe spesies is al beskryf, waarvan drie spesies deel van die huidige studie uitmaak (Hoofstukke 7 en 9). Verskeie genera is ook vanaf óf na die Corinnidae oorgedra in van dié artikels. Huidig is daar 35 genera en meer as 270 spesies bekend vanaf die streek, met die Corinnidae tans die agtste mees spesie-ryke familie in die streek. Meeste van die onlangse taksonomiese studies het op die subfamilies Trachelinae en Phrurolithinae gefokus, met die Corinninae *sensu lato* en Castianeirinae wat heelwat minder aandag geniet het. Die hoofdoel van die huidige studie was om op die taksonomie en sistematiek van die laasgenoemde groep te fokus, om die taksonomie van elk van die genera ten minste gedeeltelik te hanteer, en om ‘n basis te skep vir toekomstige navorsing op die subfamilie. As sulks, is verskeie van die kleiner genera volledig hersien in die Afrotropiese streek en twee nuwe genera is beskryf.

Die genus *Apochinomma* Pavesi, 1881 is die enigste genus van akkurate miernabootsende Castianeirinae in die streek. Dié genus is hersien en word in twee groepe verdeel op grond van hul genitaliese en abdominale morfologie. Die tipespesie, *A. formicaeforme* Pavesi, 1881, is herbeskryf en drie nuwe spesies is in die *A. formicaeforme* spesiegroep beskryf: *A. malkini* **sp. nov.**, *A. parva* **sp. nov.** en *A. tuberculata* **sp. nov.**. Twee nuwe spesies, *A. decepta* **sp. nov.** en *A. elongata* **sp. nov.**, is in die *A. decepta* spesiegroep beskryf, alhoewel ‘n derde spesie, wat slegs van onvolwassenes bekend is, waarskynlik ook aan hierdie groep hoort. Lede van die *A. formicaeforme* spesiegroep is nabootsers van *Polyrhachis* miere en is hoofsaaklik boomlewend, terwyl dié van die *A. decepta* spesiegroep hoofsaaklik grondlewend is en waarskynlik nabootsers van groot miere in die subfamilie Ponerinae is.

Die genus *Cambalida* Simon, 1909 is hersien en drie spesies word oorgedra vanaf *Castianeira* Keyserling, 1879 na *Cambalida*: *C. deminuta* (Simon, 1909) **comb. nov.**, *C. fulvipes* (Simon, 1896) **comb. nov.** en *C. loricifera* (Simon, 1885) **comb. nov.**. Nog ‘n spesie word oorgedra vanaf *Brachyphaea* Simon, 1895 na *Cambalida*: *C. fagei* (Caporiacco, 1939) **comb. nov.**. Twee spesies, *Castianeira depygata* Strand, 1916 **syn. nov.** en *C. mestrali* Lessert, 1921 **syn. nov.**, word as junior sinonieme van *C. fulvipes* voorgestel. Die tipemateriaal van die tipespesie van die genus, *C. insulana* Simon, 1909 van Annobon eiland, kon nie opgespoor word nie, en slegs onvolwasse eksemplare was tot dusvêr vanaf ‘n nabygeleë eiland versamel. Dié spesie word as ‘n *nomen dubium* beskou totdat nuwe volwasse materiaal versamel kan word. ‘n Vervangingsnaam, *Cambalida simoni* **nom. nov.**, word voorgestel vir *Cambalida fulvipes* Simon, 1909, wat ‘n sekondêre junior homoniem van *Cambalida fulvipes* (Simon, 1896) **comb. nov.** is. Die tipemateriaal van *C. simoni* kon ook nie opgespoor word nie en dié spesie word ook as ‘n *nomen dubium* voorgestel. Vyf nuwe spesies word beskryf: *C. compressa* **sp. nov.**, *C. dippenaarae* **sp. nov.**, *C. griswoldi* **sp. nov.**, *C. lineata* **sp. nov.** en *C. unica* **sp. nov.**.

Castianeira Keyserling, 1879 is die grootste genus in die Corinnidae met 131 beskryfde spesies, waarvan 22 vanaf die Afrotropiese streek afkomstig is. Daar is ‘n baie ryk onbeskryfde fauna vanaf die streek, en die wisselende morfologie van die spesies dui aan dat die genus polifileties is en in ‘n aantal genera verdeel moet word. Byvoorbeeld, ses spesies is al gevind om sinonieme te wees van lede van die genus *Cambalida* of die nuwe genus *Copuetta* **gen. nov.**, of word na daardie genera oorgeplaas. In die huidige studie word vyf spesies herbeskryf en vir die eerste keer geillustreer gebaseer op die tipemateriaal: *C. delicatula* Simon, 1909, *C. formosula* Simon, 1909, *C. majungae* Simon, 1896, *C. phaeochroa* Simon, 1909 en *C. thomensis* Simon, 1909. Die wyfie holotipe van *C. bicolor* (Simon, 1890) het nie ‘n abdomen nie en die spesie word as ‘n *nomen dubium* voorgestel. Die tipemateriaal van verskeie Afrotropiese spesies kon tot dusvêr nie opgespoor word nie, en dié spesies moet in die toekoms herbeskryf word vanaf materiaal wat naby aan die tipelokaliteite versamel is, indien moontlik.

Die grondlewende genus *Copa* Simon, 1885 is een van vier genera in die Afrotropiese streek wat kriptiese kleur het wat baie ooreenstem met dié van wolfspinnekoppe (Lycosidae), wat hierna kriptiese lycosiform kleur genoem word. Die tipespesie van die genus, *C. flavoplumosa* Simon, 1885, word herbeskryf en voorgestel as ‘n senior sinoniem van *C. benina* Strand, 1916 **syn. nov.** en *C. benina nigra* Lessert, 1933 **syn. nov.**. Hierdie is waarskynlik die mees wydverspreide spesie van Afrotropiese Corinnidae, maar is nog nie op enige van die eilande in die streek versamel nie. ‘n Nuwe spesie, *C. kei* **sp. nov.**, word vanaf Suid-Afrika beskryf. *Copa agelenina* Simon, 1910, wat vanaf ‘n onvolwasse wyfie wat in Botswana versamel is, beskryf is, word as ‘n *nomen dubium* voorgestel. Alhoewel die Malagassiese fauna nie in die huidige hersiening ingesluit is nie, is daar al amper 30 nuwe spesies onderskei in museum versamelings. Sodra daardie fauna deeglik hersien word, sal dit as ‘n wonderlike voorbeeld van eiland radiasie dien.

In ‘n hersiening van die onakkurate miernabootsers van die genus *Corinnomma* Karsch, 1880 in die Afrotropiese streek, is *Apochinomma semiglabrum* Simon, 1896 herbeskryf van albei geslagte, en gebaseer op die herbeskrywings word dit oorgedra na *Corinnomma* as *C. semiglabrum* (Simon, 1896) **comb. nov.**. ‘n Nuwe spesie, *C. lawrencei* **sp. nov.**, word vanaf Mosambiek, Tanzanië en Suid-Afrika beskryf. Die taksonomiese status van *C. olivaceum* Simon, 1896 is bespreek, die eerste illustrasies van die wyfie se genitalia word ingesluit. Aangesien geen vars materiaal van dié spesie beskikbaar is nie en die holotype erg verbleik is, word die spesie nie deeglik herbeskryf nie. ‘n Engelse vertaling van Simon (1896) se oorspronklike beskrywing word gegee, aangesien dit meer akkuraat die kleur van die spesie weergee.

Die boomlewende kriptiese lycosiform genus *Echinax* Deeleman-Reinhold, 2001, voorheen slegs bekend van Suid-Oos Asië, word vir die eerste keer in Afrika aangeteken. *Copa longespina* Simon, 1909 word herbeskryf en oorgeplaas na *Echinax* as *E. longespina* (Simon, 1909) **comb. nov.**. Ses nuwe spesies word van albei geslagte beskryf: *E. clara* **sp. nov.**, *E. hesperis* **sp. nov.**, *E. natalensis* **sp. nov.**, *E. scharffi* **sp. nov.**, *E. similis* **sp. nov.** en *E. spatulata* **sp. nov.**.

Die genus *Graptartia* Simon, 1896, slegs vanaf Afrika bekend, word hersien. Die tipespesie, *G. granulosa* Simon, 1896, word herbeskryf en genitaliese sketse van die spesie word vir die eerste keer verskaf. Twee nuwe spesies, *G. mutillica* **sp. nov.** en *G. tropicalis* **sp. nov.**, word beskryf. Uniek onder Afrikaanse Castianeirinae, is dat alle spesies van *Graptartia* nabootsers van vlerklose wyfies van fluweelmiere (Hymenoptera: Mutillidae) is.

Alhoewel die genus *Merenius* Simon, 1909 nie hersien word nie, word ‘n enkele algemene spesie, *Merenius alberti* Lessert, 1923, herbeskryf. Dié spesie was voorheen slegs van Suid-Afrika bekend, en word vir die eerste keer vanaf Mosambiek, Swaziland en Zimbabwe aangeteken. Terwyl meeste bevolkings van *M. alberti* die tipiese swart kleurvorm is, word ‘n tweede kleur variasie (rooi) vir die eerste keer hier aangeteken. As deel van ‘n veldstudie om die potensiële mier nabootsingmodelle van die twee kleurvariasies te identifiseer, is spinnekoppe met handversameling en miere met putvalle in die Ndumo

Wildreservaat in noord KwaZulu-Natal, Suid-Afrika versamel. Die miergemeenskappe wat versamel is dui aan dat die swart variasie ‘n algemene nabootser is van swart grondlewende miere soos *Camponotus cinctellus* (Gerstäcker, 1859), *Streblognathus peetersi* Robertson, 2002 en *Polyrhachis gagates* F. Smith, 1858, terwyl die rooi variasie met *Anoplolepis custodiens* (F. Smith, 1858) miere geassosieer is.

Laastens is die genus *Messapus* Simon, 1898, wat tans in die Castianeirinae geklassifiseer is, hersien. Die tipespesie, *M. martini* Simon, 1898, verteenwoordig duidelik twee verskillende spesies, een wat hoort aan Corinninae (wyfie lektotipe) en die ander ‘n Castianeirinae (mannetjie paralektotipe). Die wyfie word herbeskryf en die ware mannetjie vir die eerste keer beskryf. Gebaseer op die herbeskrywing word *Messapus* na die Corinninae oorgeplaas. *Corinna natalis* Pocock, 1898 is verkeerd is dié genus geplaas en word na *Messapus* as *M. natalis* (Pocock, 1898) **comb. nov.** oorgeplaas, terwyl *Messapus secundus* Strand, 1907 ook verkeerd in dié genus geplaas is en na *Merenius* as *M. secundus* (Strand, 1907) **comb. nov.** oorgedra word. ‘n Nuwe kriptiese lycosiform genus, *Copuetta* **gen. nov.**, met die tipespesie *C. maputa* **sp. nov.**, word vir die mannetjie paralektotipe van *M. martini* beskryf, wat aan die Castianeirinae hoort, en sy ware wyfie word vir die eerste keer beskryf. *Castianeira kibonotensis* Lessert, 1921 **syn. nov.** word as ‘n junior sinoniem van *Copa lacustris* Strand, 1916 voorgestel, en die spesie word herbeskryf en na *Copuetta* **gen. nov.** as *C. lacustris* (Strand, 1916) **comb. nov.** oorgeplaas. Nog elf nuwe spesies van *Copuetta* **gen. nov.** word beskryf: *C. comorica* **sp. nov.**, *C. erecta* **sp. nov.**, *C. kakamega* **sp. nov.**, *C. kwamgumi* **sp. nov.**, *C. lesnei* **sp. nov.**, *C. litipo* **sp. nov.**, *C. lotzi* **sp. nov.**, *C. magna* **sp. nov.**, *C. naja* **sp. nov.**, *C. uzungwa* **sp. nov.** en *C. wagneri* **sp. nov.**. ‘n Tweede nuwe kriptiese lycosiform genus, *Wasaka* **gen. nov.**, word vir vier nuwe spesies vanaf tropiese Afrika beskryf: *W. imitatrix* **sp. nov.**, *W. montana* **sp. nov.**, *W. occulta* **sp. nov.** (tipe spesie) en *W. ventralis* **sp. nov.**.

‘n Kladistiese analiese word op die subfamilie Castianeirinae van die Afrotropiese streek uitgevoer. Een-en-veertig binnegroep spesies (Castianeirinae) was ingesluit, waarvan 39 van die Afrotropiese streek was, en een elk van Australië en Brasilië. Buitegroep spesies het drie lede van Trachelinae, een van Phrurolithinae, twee van Corinninae en twee Corinnidae *incertae sedis* ingesluit. *Drassodes sesquidentatus* Purcell, 1908 is as ankerspesie om die bome te produseer gebruik. Slegs spesies vanuit hierdie tesis wat van albei geslagte (her)beskryf is was in die analiese ingesluit. Die analieses wat in TNT, Winclada en PAST gedoen is het almal soortgelyke resultate geproduseer, wat onaanvaarbaar was, met baie van die buitegroepe wat saam met deel van die Castianeirinae ‘n groep gevorm het. As gevolg daarvan, is ‘n tweede stel analises gedoen met die uitsluiting van meeste van die buitegroep spesies (behalwe *D. sesquidentatus* en Corinninae). Dit het die resolusie van die resultate baie verbeter, maar kon nie die plasing van die *Messapus*-*Medmassa* groep oplos nie. Hierdie genera was hipoteties lede van Corinninae en moes buite die Castianeirinae voorkom. ‘n Enkele analiese in PAST het die mees parsimoniese boom geproduseer, met *Messapus-Medmassa* buite die Castianeirinae en elk van die Castianeirinae genera monofileties. Die resultate van hierdie studie is onvoldoende om enige veranderings in die Corinnidae te ondersteun, maar toekomstige analieses moet ‘n wyer reeks genera van ander streke insluit om die verwantskappe met Afrotropiese spesies beter te verstaan.

In die laaste hoofstuk word die rol van Castianeirinae as deel van mier nabootskomplekse vir drie mierspesies beskryf, *Anoplolepis custodiens* (F. Smith, 1858), *Polyrhachis gagates* F. Smith, 1858 en *Camponotus fulvopilosus* (De Geer, 1778). Daar is onderskeidelik twee uit 10, vier uit ses en nul uit vyf spesies Castianeirinae wat deel uitmaak van die Arthropoda komplekse wat met die drie mierspesies geassosieer is. Al die Castianeirinae kan as onakkurate (swak/algemene) nabootsers beskou word, behalwe vir *Apochinomma formicaeforme,* wat ‘n akkurate (goeie/gespesialiseerde) nabootser van *Polyrhachis* miere is. Kleur polimorfisme word ook vir die eerste keer in vier spesies Afrotropiese Castianeirinae beskryf: *Corinnomma semiglabrum*, *Merenius alberti*, *Castianeira* cf. *venustula* (Pavesi, 1895) en *Copa flavoplumosa*. Drie van hierdie spesies in onakkurate nabootsers van miere, terwyl *C. flavoplumosa* ‘n wydver-spreide kriptiese lycosiform variasie het en ‘n swart variasie wat grootliks tot woude beperk is.

Hoë Castianeirinae biodiversiteit en endemisiteit korrespondeer met meeste van die Biodiversiteits-brandpunte en Sentrums van Endemisme (SE) in die Afrotropiese streek: Maputaland-Pondoland-Albany SE (vyf endemies), Malagassiese en Indiese Oseaan Eilande SE (>30 endemies), Oos-Afrikaanse Afromontaan Woude SE (vier endemies), Oos-Afrikaanse Kuswoude SE (vyf endemies), Guineaanse Woude van Wes-Afrika SE (sewe endemies) and the Horing van Afrika SE (een endemies). Geen endemiese Castianeirinae is in die Sukkulente Karoo of Kaapse Floristiese Streek SE waargeneem nie, maar hier word Castianeirinae hoofsaaklik deur Trachelinae vervang, waarvan meeste spesies endemies is.

ACKNOWLEDGMENTS

I would like the sincerely thank the following persons and organisations:

1. All of the curators of collections from whom material was loaned, without which this study would never have been possible. Your patience with the return of loaned material is especially appreciated!
2. My supervisors, Prof. Schalk vdM. Louw (University of the Free State) and Prof. Ansie Dippenaar-Schoeman (ARC – Plant Protection Research Institute) for their continued patience, support and encouragement, especially during the last six months, and their useful comments and suggestions that helped improve this piece of work.
3. To the two anonymous examiners, for their critique, advice and useful suggestions that improved the final version of this thesis.
4. The many colleagues and collaborators that over the years have contributed to my development as a scientist and especially to my work on Corinnidae: Ansie Dippenaar-Schoeman, Jan Bosselaers, Martin Ramírez, Rudy Jocqué, Alexandre Bonaldo, Robin Lyle, Leon Lotz, Stefan Foord, Robert Raven, Meg Cumming, Johan van Niekerk, Matjaz Kuntner, Wanda Wesołowska, Stano Pekár, Jiri Kral, Mikhail Mostovski, Tony Russell-Smith, Norman Platnick and Charles Griswold. To all of those not included in this list, your contributions are also greatly appreciated.
5. National Research Foundation of South Africa, for their continued financial support through the South African Biosystematics Initiative (SABI) and Thuthuka Programs, without which much of my field work, travel and congress attendance would not have been possible.
6. Rudy Jocqué and colleagues for hosting me during a visit to the Royal Museum for Central Africa in 2008.
7. Martin Ramírez, for advice and assistance with the cladistic analysis.
8. My fellow staff and students in the Department of Zoology & Entomology for their continued support and friendship over the years, and to the head of department Prof. Jo van As for giving me the freedom and support to establish an Arachnology lab in the department and pursue my field of interest.
9. My friends, especially Vaughn Swart, Mark Gradwell, Johann van As, Jonathan Venter, De Villiers Fourie, Candice Jansen van Rensburg and Jason Bithrey, for their encouragement over the years.

10. My parents Cliff and Karin† and brothers Alex and Michael for their love, support and tolerance for my bizarre career path, especially the last few years.
11. My in-laws Glanville and Leonora, and Heleen and Carl, and their children, for their interest and continued friendship.
12. Lastly, and most importantly, my loving wife Samantha and recently arrived daughter Mila, for their understanding, encouragement and endless patience during my studies, and providing me with a lot of joy and stress relief during these testing last six months. I could not have done it without you two!

CHAPTER 1

Austrophaea zebra Lawrence, 1952 (Silaka Nature Reserve, South Africa)

An introduction to the systematics and ecology of Afrotropical Corinnidae

1.1 HISTORY OF TAXONOMIC STUDIES ON AFROTROPICAL CORINNIDAE

Corinnidae is one of 76 spider families presently recognised from the Afrotropical Region. They are commonly referred to as the dark sac spiders or ant-like sac spiders, the latter indicative of ant-mimicking genera placed predominantly in the subfamily Castianeirinae. There are presently 1016 species in 87 genera placed in the family globally (Platnick 2011). All four subfamilies, which display considerable variation in their somatic and genitalic morphology, are presently represented in the Afrotropical Region (Bosselaers & Jocqué 2002): Corinninae is presently the most species-rich (89 spp.), followed by Phrurolithinae (74 spp.), Trachelinae (58 spp.) and Castianeirinae (49 spp.). Our knowledge of their species richness is largely due to an increased interest in the systematics of the family during recent years, which has seen the Afrotropical diversity increase from 110 species in 22 genera before the end of the last century (Dippenaar-Schoeman & Jocqué 1997) to the current 271 species in 35 genera (Platnick 2011).

Until the recent rejuvenated interest in the Corinnidae, the lack of modern revisions had made the identification of material beyond genus level extremely problematic and challenging. Almost all of the Afrotropical species were described prior to 1950 (Fig. 1), while the presently recognised corinnid genera were included in the mega-diverse polyphyletic Clubionidae *sensu lato*. The first Afrotropical species of Corinnidae was described by Karsch (1879), after which the majority of species and endemic Afrotropical genera were described by Karsch (1880), Pavesi (1880, 1881, 1883, 1895), Simon (1885, 1896a,b, 1897a,b,c, 1898, 1903a,b, 1909, 1910) and Strand (1906, 1907a,b, 1916). Unfortunately, almost all of these descriptions lacked figures, and translations of the Latin descriptions were not particularly helpful in recognising species with certainty because of the general nature of many of the descriptive characters.

Fortunately, most of the species described by Lawrence (1937, 1938, 1942, 1952) and Lessert (1915, 1921, 1923, 1929, 1933, 1946) were provided with quite detailed genitalic illustrations (male palpal and female external epigyne structures), facilitating identification of the species that they described. In contrast, the figures provided by Caporiacco (1939, 1947, 1949) are very small and generalised and have little diagnostic value, which has further complicated the taxonomy of some of the species he described, for example *Arushina dentichelis* Caporiacco, 1947 (Bosselaers & Jocqué 2000a). As a result, genitalic structures that could be used as generic synapomorphies have been negated.

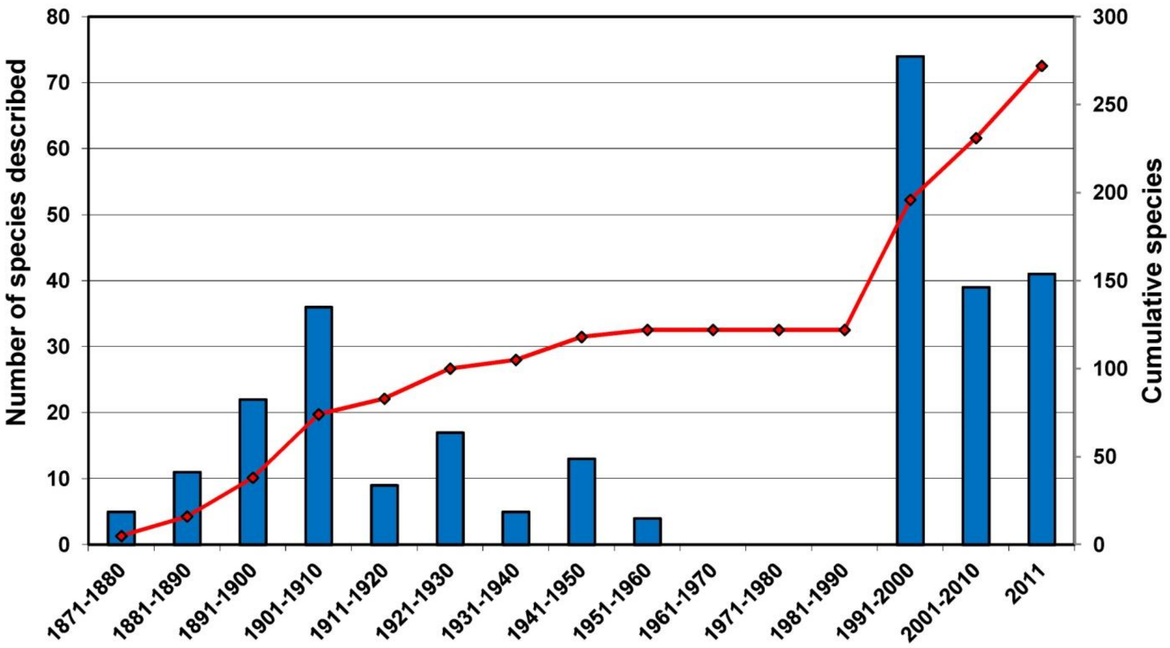


FIGURE 1. Chronological sequence indicating the number of species of Afrotropical Corinnidae described per decade (bars) and cumulative species (line) described since the 1870's.

This situation had two important complications. Firstly, thousands of corinnid specimens were collected post-1950 and deposited in collections without species- or even genus-level identifications. Secondly, many arachnologists nobly attempted to identify corinnids to species level using the limited resources at their disposal, but many of their identifications were incorrect, often even at genus level. This resulted in several significant implications:

- identifications were often unreliable and, consequently, biodiversity data had low resolution
- biogeographical patterns and relationships of the Afrotropical fauna were poorly understood
- areas of high endemism and biodiversity hotspots were unknown
- and consequently, species and areas of potential conservation importance could not be identified.

It is therefore essential that all material of Afrotropical Corinnidae should be re-examined and identified by specialists, preferably as part of or following thorough taxonomic revisions or redescriptions Lehtinen's (1967) landmark paper drastically changed the systematics of spiders and largely resolved many of the historical grey areas in the Araneomorphae, but especially amongst the cribellate families. One of the most important contributions of his paper was to divide the Clubionidae *sensu lato* into a large number of families, which had previously been treated as subfamilies of Clubionidae. Of significance to the current study was the elevation of Liocraninae and Corinninae to family level; these two families are widely regarded as sister taxa to one another, and together form a sister clade to the Gnaphosoidea within the Dionycha (Coddington & Levi 1991; Bosselaers & Jocqué 2002; Jocqué & Dippenaar-Schoeman 2006). Despite Lehtinen (1967) elevating Corinnidae to family rank, several genera were transferred instead to the Liocranidae or retained in the Clubionidae, probably because Lehtinen had not studied their type species, which has since necessitated a re-examination of many of these genera to determine their correct placement (e.g. Bosselaers & Jocqué 2000a). One such case was the retention of the Castianeirinae in Clubionidae by Reiskind (1969) after his reclassification of the Micariinae, rather than placing the subfamily in the Corinnidae. The lack of clarity on the placement of several genera previously listed in Clubionidae: Micariinae requires a re-evaluation of their morphology and relationships. Many of these genera have never been redescribed or properly diagnosed and their relationships remain poorly understood. Currently the Micariinae is placed in Gnaphosidae and is only represented by two genera (Dippenaar-Schoeman & Jocqué 1997; Murphy 2007).

During the modern era of Corinnidae systematics, considerable advances have been made in documenting the Afrotropical fauna. Modern taxonomic studies began at the end of the last century, when Bosselaers & Ledoux (1998) described the new monotypic Afrotropical genus *Hortipes* and placed it in the Liocranidae: Phrurolithinae. Ledoux & Emerit (1998) added a further five new species from tropical Africa. Soon thereafter, Bosselaers & Jocqué (2000b) revised *Hortipes* and 63 new species were described, making it one of the most speciose spider genera in the Afrotropical Region.

Two further papers published early in the 21st century were of great significance. Bosselaers & Jocqué (2000a) redescribed species from four Afrotropical spider genera and proposed their transfer to Corinnidae from Liocranidae or Clubionidae, as well as providing the first redescription of *Lessertina mutica* Lawrence, 1942. None of these species had been previously illustrated except for *L. mutica*, so the detailed redescriptions were of great value in facilitating the identification of these genera and providing the basis for subsequent revisions (e.g. Chapters 4 and 11). Bosselaers & Jocqué (2002) then published the first comprehensive cladistic analysis of the Corinnidae and its sister group Liocranidae, including representatives of 14 and 24 genera, respectively, and transferred the Phrurolithinae from the Liocranidae to Corinnidae. Thus, *Hortipes* became the most speciose Afrotropical corinnid genus. These studies by Jan Bosselaers and colleagues signalled the start of modern systematics studies on the family. Furthermore, Haddad (2005a) redescribed and illustrated *Corinna natalis* Pocock, 1898, which is the largest species of Afrotropical Corinnidae.

To summarise, a total of 20 taxonomic papers have been published on the Afrotropical Corinnidae since 1998, including nine generic revisions, with 164 new species described so far (Table 1). Ten new genera have been described in this period, all of which are endemic to the Afrotropical Region. Four genera have been transferred to the Corinnidae (Bosselaers & Jocqué 2000a) and a single endemic South African genus, *Austrachelas* Lawrence, 1938, has been transferred to the Gallieniellidae (Haddad *et al.* 2009). Also, as part of an unpublished phylogenetic analysis and morphological study of the Dionychan spiders, the endemic South African genus *Lessertina* Lawrence, 1942 will be transferred to the newly established family Eutichuridae, presently a subfamily of Miturgidae, which also includes the sac spider genera *Cheiracanthium* C.L. Koch, 1839 and *Cheiramiona* Lotz & Dippenaar-Schoeman, 1999 from the Afrotropical Region (Martin Ramírez, pers. comm.).

As a consequence of these studies, the true diversity of Corinnidae in the region has already increased substantially, although much work remains to be done, especially on the larger genera (e.g. *Castianeira* Keyserling, 1879, *Trachelas* L. Koch, 1872 and *Merenius* Simon, 1909) and the Madagascan fauna, which remains virtually unknown. Also, many of the corinnine and *incertae sedis* genera still have to be revised (e.g. *Corinna* C.L. Koch, 1841, *Mandaneta* Strand, 1929, *Procopius* Thorell, 1899 and *Pronophaea* Simon, 1897). Apart from the current study, one M.Sc dissertation (Lyle 2008) and one Ph.D thesis (Bosselaers 2001) so far have focused on the systematics of Afrotropical Trachelinae and the genus *Hortipes*, respectively. There is therefore considerable scope for involving post-graduate students in projects to address some of these outstanding taxonomic problems.

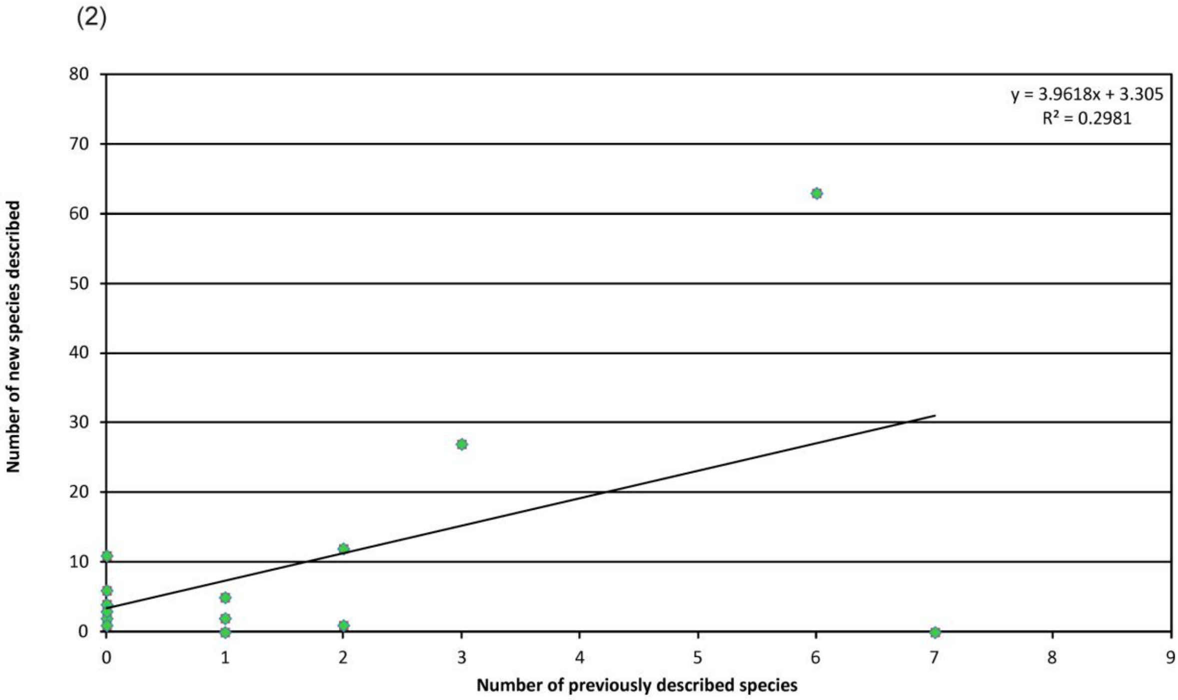
Based on these recent advances the following question can then be raised: How diverse is the Corinnidae in the Afrotropical Region? I conducted two projections using simple linear regression based on: 1) the starting point of 110 species that had been recorded from the Afrotropical Region prior to the modern revisions (Dippenaar-Schoeman & Jocqué 1997); 2) the number of new species that have been described in each of the published revisions and subsequent papers (Table 1); and 3) the published data in combination with unpublished revisions included in the present thesis and other unpublished collaborative projects dealing with Afrotropical genera.

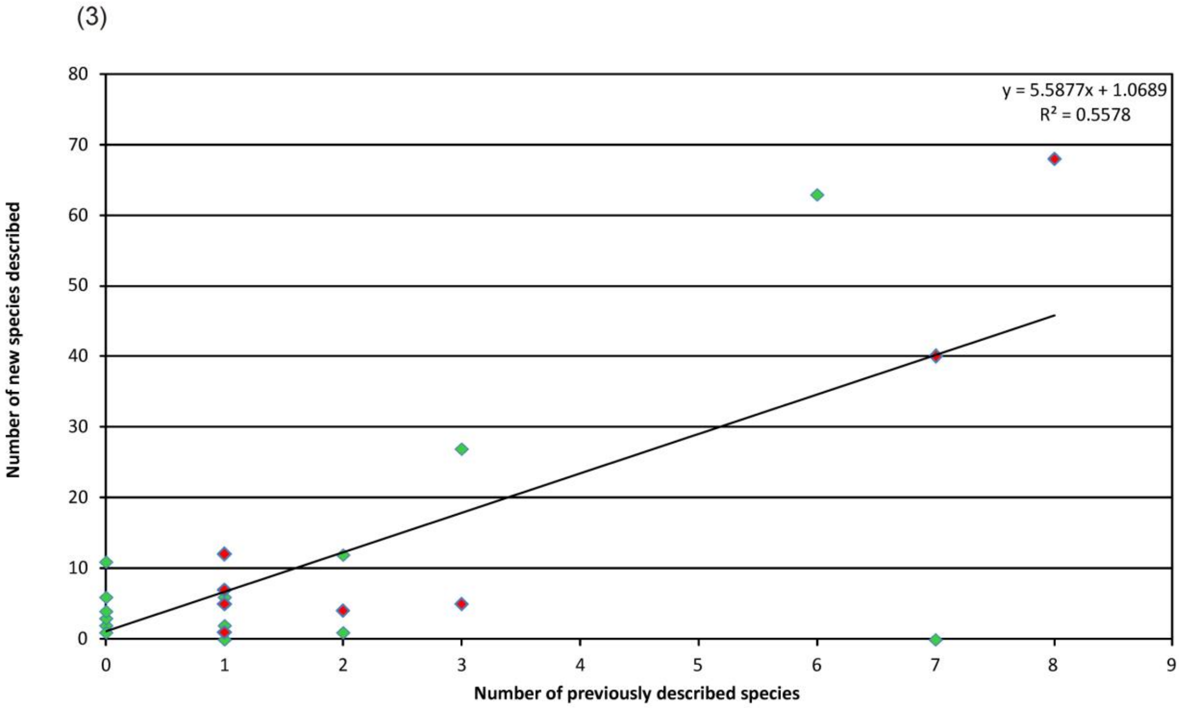
TABLE 1. List of Afrotropical Corinnidae genera revised or described since 1998 (publications listed in chronological order), with the number of new species and total Afrotropical species included in each. Square parentheses for *Hortipes* indicate that all species described in the genus were new, of which 63 were described during the generic revision. *Austrachelas* was transferred to Gallieniellidae following revision.

Genus revised/described	New species	Total species	References
Hortipes Bosselaers & Ledoux, 1998	63[69]	69	Bosselaers & Ledoux (1998), Ledoux & Emerit (1998), Bosselaers & Jocqué (2000b)
Paccius Simon, 1898	5	8	Platnick (2000), Marusik (2009)
Graptartia Simon, 1896	2	3	Haddad (2004)
Corinnomma Karsch, 1880	1	3	Haddad (2006a)
Spinotrachelas Haddad, 2006	5	5	Haddad (2006b), Lyle (2011), Haddad *et al.* (2011)
Thysanina Simon, 1910	5	6	Lyle & Haddad (2006)
Austrophaea Lawrence, 1952	0	1	Haddad (2007)
Fuchiba Haddad & Lyle, 2008	6	6	Haddad & Lyle (2008)
Fuchibotulus Haddad & Lyle, 2008	2	2	Haddad & Lyle (2008)
Poachelas Haddad & Lyle, 2008	4	4	Haddad & Lyle (2008), Haddad (2010)
Austrachelas Lawrence, 1938†	7	9	Haddad *et al.* (2009)
Planochelas Lyle & Haddad, 2009	3	3	Lyle & Haddad (2009)
Vendaphaea Haddad, 2009	1	1	Haddad (2009)
Medmassa Simon, 1887	0	1	Haddad & Bosselaers (2010)
Afroceto Lyle & Haddad, 2010	12	14	Lyle & Haddad (2010)
Patelloceto Lyle & Haddad, 2010	3	3	Lyle & Haddad (2010)
Pseudocorinna Simon, 1910	27	29	Jocqué & Bosselaers (2011)
Crinopseudoa Jocqué & Bosselaers, 2011	11	11	Jocqué & Bosselaers (2011)
TOTAL	**159**	**178**	**–**

Based on the starting point of 110 species, the equations produced by the two analyses would indicate a projected diversity of 439 species based on published revisions only (Fig. 2) and 620 species based on both published and unpublished revisions (Fig. 3). Taking these estimates into consideration, this would indicate at least a four-fold increase in the number of species known from the region compared to before the modern revisions, which could increase to nearly six times greater if unpublished studies are taken into consideration. Together, I would project that these studies should nearly double the presently known species diversity from the region, standing at slightly more than 270 species. It will be interesting to revisit these projections in a few years' time once several more revisions have been published, and again when the Corinnidae has been thoroughly revised in the Afrotropical Region.

In *African Spiders: An Identification Manual*, the landmark publication by Dippenaar-Schoeman & Jocqué (1997) that summarised the knowledge of all of the Afrotropical spider families, 5423 species were recorded from the region, of which Corinnidae represented 110

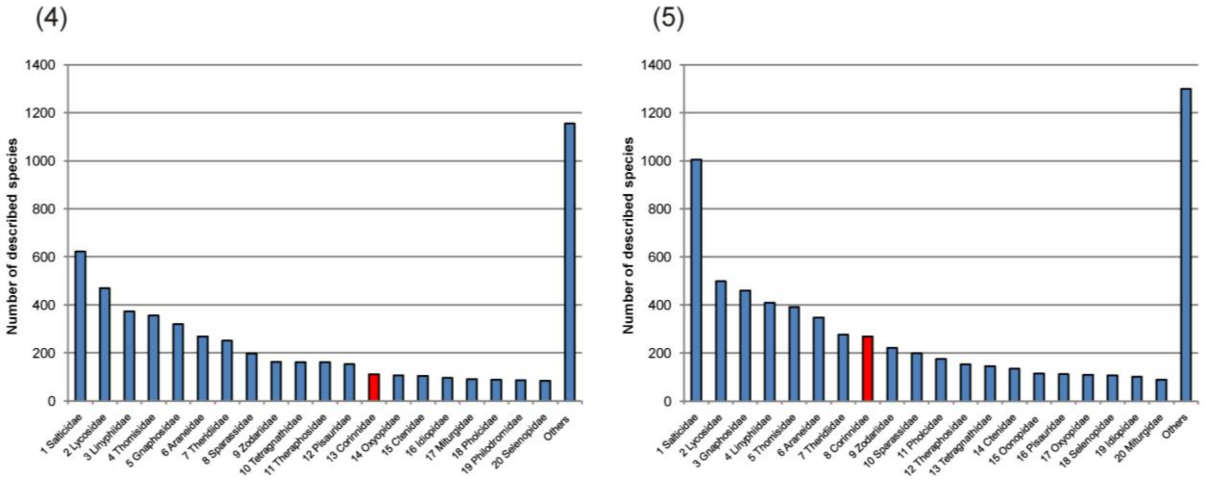




FIGURES 2–3. Projections of Afrotropical Corinnidae species diversity based on linear regression of the number of described vs undescribed species in each genus that has been recently revised or described: 2. published revisions only (see Table 1); 3. published and unpublished revisions (see Table 1, Chapters 3–11 and Lyle 2009). Published studies are indicated in green diamonds and unpublished studies in red diamonds.

species in 22 genera and was ranked the 13th most species rich family in the region (Fig. 4). Based on recently extracted species-level data (2011) from the African Arachnid Database (http://www.arc.agric.za/home.asp?pid=3235, accessed 26 June 2011), 6616 species are now known from the region.

Of the approximately 1200 species described during this period (i.e. 1997–2011), the greatest increase in species can be attributed to the Salticidae, in which nearly 400 species were described. Nearly 160 species of Corinnidae were described in revisions and descriptive studies in this time, which has resulted in it becoming the eighth richest family in the region, with 271 species in 35 described genera (Fig. 5). Considering the number of genera that still need to be revised, and the likelihood that the present species diversity may at least double based on the earlier projections (Figs 2 and 3), this will see a further increase in the ranking of Corinnidae.



FIGURES 4–5. Species diversity of the top 20 most species rich spider families in the Afrotropical Region based on data from (4) Dippenaar-Schoeman & Jocqué (1997), which included 5323 species, and (5) the African Arachnid Database (2011), including 6616 species. Corinnidae is indicated by red bars.

1.2 CORINNIDAE AS COMPONENTS OF SPIDER ASSEMBLAGES IN NATURAL HABITATS AND AGROECOSYSTEMS

Corinnid spiders are widely regarded as hunting spiders that actively search for prey (Dippenaar-Schoeman & Jocqué 1997). Dias *et al.* (2010) evaluated the guilds of Neotropical spiders and divided the Corinnidae into three main groups based on the habitat strata that they occupy: 1) Corinnidae 1, including **arboreal** members of the Castianeirinae, Trachelinae and Corinninae that are usually collected by beating; 2) Corinnidae 2, including **ground- or litter-dwelling** members of Corinninae, Phrurolithinae and Castianeirinae (*Castianeira*), taxa usually collected by nocturnal ground searching, pitfall and Winkler traps; 3) Corinnidae 3, which includes **trunk-drilling ambusher** *Corinna* species. According to Bonaldo (pers. obs. in Dias *et al.* 2010) these species present morphological adaptations to digging in hard surfaces, including strong geniculated chelicerae and a raised cephalic region. Some of these species build a silk retreat structure from which they hunt (Alexandre Bonaldo and Martin Ramírez, pers. comm.), similar to that recently described for the African *Corinna natalis* Pocock, 1898 (Haddad 2005). They further included Corinnidae 1 & 3 in the guild "aerial hunters" and Corinnidae 2 in the guild "ground runners".

Taking these three levels of classification into consideration, the Afrotropical genera can similarly be grouped into these guilds (Table 2). As in the case of the Neotropical fauna (Dias *et al.* 2010), where some genera have species that occupy more than one of these guilds, e.g. *Castianeira* occupying Corinnidae 1 & 2 and *Corinna* occupying Corinnidae 2 & 3, some Afrotropical taxa also have representatives with broad-ranging ecological preferences. For example, species of *Hortipes* are predominantly litter-dwelling, but several species are restricted to tree canopies (Bosselaers & Jocqué 2000b). In the case of *Trachelas* there is a similar proportion of ground- and foliage-dwelling species (Lyle 2008). As such, the representation of the Afrotropical genera below includes an asterisk to indicate the guild occupied by most of the species of a particular genus (Table 2). The guild placement of some taxa is uncertain due to the lack of freshly collected material (e.g. *Arushina*).

An alternate guild classification was proposed by Cardoso *et al.* (2011) using information on foraging strategy (web type or hunting strategy), prey range (euryphagous or stenophagous), vertical stratification (ground- or plant-dwelling) and circadian activity (nocturnal or diurnal) for each spider family.

Based on the above characteristics they classified 108 families of spiders into eight guilds. Corinnidae were considered to be "ground hunters" in their cluster analysis, but this very broad classification is in conflict with that of Dias *et al.* (2010), as a considerable proportion of the Afrotropical genera are plant-dwellers, especially amongst the Trachelinae and Castianeirinae (Table 2). Therefore, classifying Corinnidae as ground hunters may not be entirely accurate, since a considerable proportion of the species are plant-dwellers. However, if there is a possibility for further differentiation, perhaps at subfamily level, it should preferably be used.

TABLE 2. Guild representation of the Afrotropical Corinnidae genera following the classification of Dias *et al.* (2010), listed alphabetically by subfamily. Where a genus has representatives occupying multiple habitat strata or guilds, the guild with the greatest proportion of species is indicated by an asterisk. Question marks indicate genera for which there is uncertainty regarding its guild. A † indicates genera endemic to the Afrotropical Region.

Group		**Corinnidae 1**	**Corinnidae 2**	**Corinnidae 3**
Habitat stratum		**Arboreal**	**Litter/ground**	**Trunk-drilling**
Guild		**Aerial hunter**	**Ground runner**	**Aerial hunter**
SUBFAMILY	**GENUS**			
Castianeirinae	*Apochinomma* Pavesi, 1881	X*	X	
	Cambalida Simon, 1909†		X	
	Castianeira Keyserling, 1879		X	
	Copa Simon, 1885		X	
	Copuetta **gen. nov.**†	X*	X	
	Corinnomma Karsch, 1880	X	X*	
	Echinax Deeleman-Reinhold, 2001	X		
	Graptartia Simon, 1896†		X	
	Medmassa Simon, 1887	X		
	Merenius Simon, 1909†		X	
	Wasaka **gen. nov.**†	X		
Corinninae	*Brachyphaea* Simon, 1895†	X		
	Corinna C. L. Koch, 1841		X	X
	Creugas Thorell, 1878		X	
	Messapus Simon, 1897†	X*		X?
	Oedignatha Thorell, 1881		X	
Phrurolithinae	*Hortipes* Bosselaers & Jocqué, 2000†	X	X*	
	Orthobula Simon, 1897		X	
Trachelinae	*Afroceto* Lyle & Haddad, 2010†	X*	X	
	Fuchiba Haddad & Lyle, 2008†		X	
	Fuchibotulus Haddad & Lyle, 2008†		X	
	Paccius Simon, 1898†		X?	
	Patelloceto Lyle & Haddad, 2010†	X		
	Planochelas Lyle & Haddad, 2009†	X		
	Poachelas Haddad & Lyle, 2008†		X	
	Spinotrachelas Haddad, 2006†		X	
	Thysanina Simon, 1910†	X*	X	
	Trachelas L. Koch, 1872	X*	X	
incertae sedis	*Arushina* Caporiacco, 1947†		X?	
	Austrophaea Lawrence, 1952†		X	
	Crinopseudoa Jocqué & Bosselaers, 2011†		X	
	Lessertina Lawrence, 1938†		X	
	Mandaneta Strand, 1932†	X		
	Procopius Thorell, 1899†	X*	X	
	Pronophaea Simon, 1897†		X	
	Pseudocorinna Simon, 1910†		X	
	Vendaphaea Haddad, 2009†		X	

The general scarcity of studies on spider ecology and biodiversity from the Afrotropical Region (Appendix 1) has contributed to a poor understanding on the importance of each family in shaping spider assemblages, both quantitatively and qualitatively. This situation can be explained partly by the lack of suitably qualified researchers in the majority of African countries with the capacity and resources to execute ecological studies and identify the sampled material correctly. Even in countries where European institutions have sampled extensively (e.g. D.R. Congo, Ivory Coast, Nigeria, Tanzania and Cameroon), most of their collecting was conducted on an *ad hoc* basis, and the ecological factors shaping assemblage structure were not properly investigated.

Where different habitats were sampled for a considerable time, the results have rarely been published. Furthermore, when ecological studies were published they often did not provide species lists or species abundance data despite extensive data sets (Blandin 1971, 1986), and when provided, it was often incomplete and not all families were represented (Blandin & Celerier 1981; Blandin 1983); in the latter cases neither Corinnidae nor Clubionidae were listed and the species represented by these two families are thus unknown. A major factor that may have contributed to this is the taxonomic impediment for many spider families in the Afrotropical Region.

An exception to this pattern is the comparably intense effort made in discovering spider diversity in South Africa during the last three decades (Appendix 1). While many of the earlier surveys were conducted in agroecosystems, the launch of the South African National Survey of Arachnida (SANSA) in 1997 aimed to co-ordinate research efforts on arachnid biodiversity, systematics and biology (Dippenaar-Schoeman & Craemer 2000). Since then, studies have been carried out in various agroecosystems, conserved areas, natural habitats and plantations in the country.

Examination of the data from published surveys from the region indicates that Corinnidae are generally poorly represented both in terms of species richness and abundance, usually ranging between 1–10% of the species and less than 7% of the numbers collected (Appendix 1). Corinnidae only exceeded 10% of the species richness of the spider assemblage on one occasion (Kelly & Samways 2003). They are scarce in agroecosystems and are thus unlikely to play a major role in pest control, in contrast to North America, where *Trachelas* spp. in particular are considered very important predators (e.g. Costello & Daane 1999; Amalin *et al.* 2001). Based on my collecting experience, these lower values could at least be partly attributed to the difficulty in collecting corinnids by conventional methods:

1) Many ground-dwelling Corinnidae species are not easily collected by pitfall trapping. While collecting *Merenius alberti* Lessert, 1923, *Cambalida* spp. and *Corinnomma* spp. from leaf litter at Ndumo Game Reserve in South Africa, these species would often rapidly change direction when they made contact with the edge of a pitfall trap, even when flush with the soil. Such an “escape” reaction would suggest that the spiders are able to recognise different substrate textures through contact with their

tarsal scopulae and change direction in response. Consequently, capture rates of Corinnidae in pitfalls tend to be much lower than those of other spider families occurring in equal densities, i.e. Corinnidae are underrepresented in pitfall surveys.

2) Many grass-dwelling Corinnidae do not wander to the upper foliage levels. In southern Africa there are several species of *Poachelas* Haddad & Lyle, 2008 that have elongate bodies and pale colouration for camouflage in grass (Haddad & Lyle 2008; Haddad 2010). These spiders predominantly reside at the base of grass tussocks and rarely wander up the stems. At the bases of the tussocks they are one of the most common species, especially during summer when the adults are active, but are very rarely collected with sweep-netting. For example, in a study of grass-dwelling spiders in central South Africa only 12 individuals of *P. striatus* Haddad & Lyle, 2008 (as Corinninae sp. imm.) were collected in a sweep-netting survey, representing 0.73% of the total spider fauna (Haddad 2005b). Also, they are rarely collected in pitfalls despite their association with the bases of grasses and their likely frequent contact with the soil surface (Fourie 2010; Neethling & Haddad, unpubl. data). A sweep-netting survey taking diurnal and nocturnal samples could clarify the activity patterns of many apparently underrepresented spider taxa.
3) Many of the foliage-dwelling corinnids have been most often collected by beating. Even then, their abundance is very low compared to other families (e.g. Salticidae, Thomisidae, Theridiidae, Araneidae and Clubionidae/Miturgidae usually dominant) (e.g. Fourie 2010). An obvious contributor to this is the activity patterns of Corinnidae, which are a predominantly nocturnal group, hiding under bark or in silk retreats during the day and emerging in the early evening to forage (pers. obs.). Since most sampling by beating is done during the day when corinnids are usually hidden, they are less likely to be sampled than had collecting been done at night. The more regular use of canopy fogging in recent years has, in part, changed this, as many spiders emerge from under the bark when disturbed by the pesticide and consequently die and fall to the sheets when adequate contact has been made with the pesticide, irrespective of whether they are diurnal or nocturnal. While data from Central and East African forests indicates a species rich corinnid fauna with low abundance (<50 individuals per sample), that from the temperate savannas and Afromontane forests seems to be similarly rich but certainly a lot more abundant (often >100 individuals per sample). Only in a recent survey of bark-dwelling spiders associated with *Acacia xanthophloea* in Ndumo Game Reserve were corinnids very common: *Afroceto plana*

Lyle & Haddad, 2010 represents nearly 20% of the fauna, and nearly 10 further corinnid species were collected, all comparatively rare (Haddad, unpubl. data).

4) Hand collecting has been largely focused at the collecting of larger, more visible taxa (e.g. Araneidae, Nephilidae, Lycosidae and Salticidae diurnally, and Clubionidae, Miturgidae, Ctenidae, Sparassidae and Lycosidae nocturnally). Since corinnids are generally small- to medium-sized spiders it is not surprising that they are often overlooked, especially when the collector is not focusing on this particular group. One of the best methods to collect corinnids is in microhabitats where collectors generally do not search: bases of grass tussocks, dense grasses and leaf litter at the base of trees, and in lichens on bark. Collecting at such sites can be very profitable for locating representatives of all four corinnid subfamilies.

It seems plausible that the above factors may all have contributed to a relative underrepresentation of Corinnidae in arachnological collections. A better understanding of the habits of each genus and an identification of the preferred microhabitats they occupy can only really be achieved through more attentive sampling in the future. As such, collector experience in sampling arachnids in different microhabitats by hand can be invaluable in identifying target taxa during field work. Incorporation of a greater variety of sampling methods during field surveys and projects may also contribute to a better understanding of the contribution of Corinnidae in shaping spider assemblages.

1.3 ANT MIMICRY IN SPIDERS, WITH AN EMPHASIS ON CORINNIDAE

1.3.1 General principles of ant mimicry in spiders

Ants (Hymenoptera: Formicidae) are critical components of the biodiversity of any terrestrial ecosystem due to their varied habits, high diversity and biomass (e.g. Dunn *et al.* 2007; Ward 2007). Their considerable numbers and species richness have inevitably lead to the association of other arthropods with them for the purposes of defence, use of their exploitable resources and formation of symbiotic relationships, especially mutualism (McIver & Stonedahl 1993). Consequently, many ant species have arthropods that are associated with them, of which the myrmecomorphs (mimetic forms that resemble ants morphologically) are the most relevant for this discussion. A second group of arthropods that associate with ants are regarded as myrmecophiles, which usually do not resemble ants morphologically but use chemical and textural mimicry to maintain a close association with ants (McIver & Stonedahl 1993). However, Cushing (1997) proposed that myrmecomorphy and myrmecophily should not be grouped together under ant-mimicry, as the evolutionary forces and selective pressures acting on the two groups are very different. Thirdly, myrmecophagy is the specialised predation on ants (stenophagy) by other organisms. In spiders this phenomenon occurs in several unrelated clades of spiders and has thus evolved independently several times. Also, many myrmecophages are neither myrmecomorphic nor myrmecophilic (Pekár *et al.* in press).

There are four hypotheses that have been proposed to explain the association between ant mimics and their models:

1) Wasmannian mimicry, which involves the evolution of resemblances between a model and mimic that facilitate the mimic living with its host (the model) (Rettenmeyer 1970). In the case of ant associates, these organisms are generally regarded as myrmecophiles (Cushing 1997).
2) Müllerian mimicry, which has been proposed for cases where both the model and mimic are unpalatable (Cushing 1997). This hypothesis is not well supported in the case of spider myrmecomorphs as there is no evidence that spiders are unpalatable, even though their specific models may be (McIver & Stonedahl 1993).
3) Aggressive or Peckhammian mimicry, where the mimic is myrmecomorphic but also preys on its model (Wickler 1968). Such mimics often use their morphological and behavioural adaptations to attract and prey on their models, although only those employing a behavioural strategy to attract their models can truly be considered aggressive mimics (Cushing 1997).
4) Batesian mimicry, where an edible species (the mimic spider in this case) imitates the warning signal of the defended, aposematic species, the model ant in this case (Speed 1999). The mimic imitates the ant model because of an adaptive advantage against visually hunting predators that have an innate or learned aversion towards ants (Cushing in press). This is due to ants being unpalatable, being aggressive and having stings or bites, and having a hard or thorny cuticle that affords them defence against predators (Cushing 1997). The majority of spider myrmecomorphs are generally regarded as Batesian mimics (Oliveira 1988; Cushing in press).

The evolution of ant mimicry in spiders is a fascinating subject that has received a considerable amount of attention for many years, with dedicated papers on the subject going back more than a century (Peckham & Peckham 1892). So far, representatives of 13 families have been implicated as mimics of ants (McIver & Stonedahl 1993; Cushing 1997). In families where a broad spectrum of genera is mimetic, myrmecomorphy has apparently evolved several times independently (Jocqué 1991; Bosselaers & Jocqué 2002; Maddison & Hedin 2003). In contrast to insects that mimic ants, there are several significant morphological problems that spiders face in evolving an ant-like form (McIver & Stonedahl 1993). Ants are usually more slender than spiders, have three rather than two body regions, three rather than four pairs of legs, clubbed and/or elbowed antennae, large compound eyes as opposed to (usually) eight simple eyes, and a shiny as opposed to dull body surface. Spiders have evolved a variety of adaptations to account for these differences, including (but by no means restricted to) a constricted carapace and/or abdomen, raising the forelegs to imitate ant antennae, longitudinal lines on the legs, lateral spots on the cephalic region of the carapace to imitate the compound eyes of ants, and locomotory adaptations to resemble the walking gait of ants (Reiskind 1971a; Cushing in press).

Furthermore, the degree to which the morphology and behaviour of the mimic is adapted to its models has led to the division of spider mimics into two opposing groups, although the choice of terminology varies: weakly versus strongly mimetic (McIver & Stonedahl 1993), good/specific and bad/poor/general/non-specific mimics (Edmunds 2000), or accurate versus inaccurate mimics (Pekár & Jarab 2011; Pekár *et al.* 2011). Weak or inaccurate mimics are considered to be those that only possess similar colouration to their models and not structural similarities or modifications that involve adaptation of the typical body plan of the mimic (Pekár & Jarab 2011).

The visual effectiveness of morphological mimicry can be further enhanced through locomotor and escape mimicry, two important behavioural adaptations. Locomotor mimicry arises when two distantly related species (e.g. model and mimic) appear alike in behaviour, which is supported by a variety of morphological, physiological and biomechanical traits that the two species have in common (Srygley 1999). In the case of adapted spider behaviour, aspects such as vertical movements of the front legs to simulate antennal movements of ants, jerky movements, as well as abdomen bobbing, are widespread amongst myrmecomorphs (Cushing in press). Escape mimicry relates to the ability of a prey species to evade capture by predators. Through frustration learning, predators associate particular colour schemes with low profitability (Srygley 1999). Thus, imitating a model with an effective escape mechanism further lowers predation pressure on the mimic.

Three further phenomena amongst spiders deserve mentioning. Polymorphism is where a spider species mimics multiple ant species in its habitat (Cushing in press). This is made possible through variations in colouration and sometimes body shape to be able to resemble different species of sympatric ants. Polymorphism is usually restricted to two different forms in a particular species, but in the case of the salticid *Myrmarachne bakeri* Banks, 1930, seven different colour variants have been observed, with further variation in degree of shininess or dullness of the integument and the density of setae. Individuals are capable of colour change up to six times during their life (Nelson 2010). In the case of the African salticid *Mexcala elegans* Peckham & Peckham, 1903, its polymorphism is unique in that adults can either mimic ants (such as *Camponotus*) or velvet ants (Mutillidae). Therefore, mimicry in this species spans two families of models (Wesołowska 2009; Wesołowska & Haddad 2009; Pekár & Haddad 2011). Some examples of polymorphism recently discovered in Afrotropical Castianeirinae are discussed in Chapter 12.

Transformational mimicry can be defined as species that mimic different species of ants during their different developmental stages (Cushing in press). Both of the aforementioned salticids show some degree of transformational mimicry, with differently coloured immatures and adults (Nelson 2010; Pekár & Haddad 2011), as does the Neotropical salticid *Zuniga magna* Peckham & Peckham, 1892 and castianeirine corinnid *Myrmecium gounellei* Simon, 1896 (Oliveira 1988). Lastly, sexual dimorphism is where males and females have distinctly contrasting morphological characteristics, which could include colouration. Perhaps the best example of sexual dimorphism amongst myrmecomorphic spiders can be seen in the dramatically elongated chelicerae of male *Myrmarachne* spp., and to a lesser extent, *Belippo* spp., while those of conspecific females are only slightly enlarged (Wanless 1978).

It has been experimentally shown that accurate mimics of ants are subjected to much lower rates of predation by visually astute arachnophagous spiders than inaccurate mimics (Nelson 2012). Thus, the physiological investment in evolving specialised morphology to more accurately mimic a particular model ant has a return in greater rates of survival when confronted with prospective predators.

1.3.2 Spectrum of mimicry in Corinnidae

Corinnid spiders display a wide array of body morphologies, many of which can be considered as generalised, while a smaller proportion of genera have more specialised markings and body morphologies. Ant-mimicry has been recorded from representatives of all four corinnid subfamilies.

In her review of myrmecomorphy and myrmecophily in spiders, Cushing (1997) cited publications reporting myrmecomorphy in 23 species of Castianeirinae, one species of Corinninae and five species of Phrurolithinae (then placed in Liocranidae). While no species of Trachelinae were reported, some African species described subsequently can be considered as mimics of ants: *Spinotrachelas capensis* Haddad, 2006 is a mimic of ground-dwelling *Crematogaster* ants, *S. montanus* Haddad, Neethling and Lyle, 2011 is an inaccurate mimic of ground-dwelling ants, probably ponerines, while several species of *Trachelas* are inaccurate mimics of arboreal *Crematogaster* ants. In all of these cases the males have a smooth glossy dorsal scutum covering the entire dorsum, often with pale transverse bands, and both sexes have a glossy carapace with sparse setae to enforce their resemblance to their models (Haddad 2006b; Lyle 2008; Haddad *et al.* 2011).

Most of the phrurolithine mimics, as well as the aforementioned trachelines, can be considered to be inaccurate mimics of ants (Cushing 1997; Pekár & Jarab 2011; Pekár *et al.* 2011). While there is similarity in the colouration of the spiders relative to their models, morphological adaptations are lacking and these spiders have a similar body form to non-mimetic relatives.

In contrast, the Castianeirinae have a broad range of mimetic genera, representing nearly two-thirds of the representatives of the subfamily, which vary in strategy from the most inaccurate of mimics (immatures but not adults of *Cambalida* Simon, 1909), inaccurate mimics with modified colouration and behaviour, to accurate mimics with modifications in body shape, colouration and behaviour. As the focal group of this thesis, the evolution of mimicry the Castianeirinae will be discussed in more detail in the following section.

1.3.3 Castianeirinae: evolution from primitive cryptic to derived mimetic body forms

When taking a broad look at the morphology of the Castianeirinae, there is a clear sequence of body forms from non-mimetic, lycosiform cryptic, weakly mimetic, to strongly mimetic forms that imitate ants (Hymenoptera: Formicidae) or velvet ants (Hymenoptera: Mutillidae). Taking into account the energetic inputs and natural selection processes involved in evolving a mimetic body form, colouration and behaviour, non-mimetic spiders should be considered as the most primitive within a subfamily/family with mimetic taxa and accurate/strongly mimetic forms as the most advanced (Fig. 6).

The non-mimetic forms include the genus *Medmassa* Simon, 1887, represented in the Afrotropical Region by a single species only (*M. semiaurantiaca* Simon, 1910). I would consider this genus to comprise the most primitive castianeirines on the basis of the heavily spined legs of both sexes, simple spermathecae of the females, the oval male palpal tegulum with a curved rather than coiled distal embolus, and the presence of a palpal tibial apophysis. *Medmassa* species appear to be mainly arboreal and have no adaptations in their morphology or behaviour to indicate any association with ants or other arthropods (Deeleman-Reinhold 2001; Haddad & Bosselaers 2010; pers. obs.).

Crypsis is not considered to be a form of mimicry, as mimicry can be defined as one organism resembling another, while crypsis can be defined as an organism resembling its background (Endler 1981). As such, the colouration of the Afrotropical lycosiform cryptic genera of Castianeirinae (i.e. *Copa* Simon, 1885, *Copuetta* **gen. nov.**, *Echinax* Deeleman-Reinhold, 2001 and *Wasaka* **gen. nov.**) is typically brown and is convergent with that of wolf spiders (Lycosidae), and is intended to resemble the colouration of the soil, leaf litter, bark or leaves that these spiders forage on. *Echinax* also occurs in South-East Asia, while two species of *Copa* have been recorded from Sri Lanka (Deeleman-Reinhold 2001).

The inaccurate mimics are characterised by having a similar body form to non-mimetic species but colouration that resembles that of ants in their environment (Pekár & Jarab 2011). Such spiders are sometimes called generalised mimics of ants, usually at family level (Reiskind 1969), as no particular model can be identified from resident ant assemblages as the definitive model. Such spiders have a general resemblance to black ground-dwelling ants, for example.

Mimics of particular subfamilies or genera of ants are also treated here as inaccurate mimics, as the species-specific characteristics of the specific/accurate models are missing, especially with regard to alterations to the body form. Several Castianeirinae genera are inaccurate mimics, including Afrotropical *Castianeira*, *Merenius* and *Cambalida* and the majority of the North and Central American (Reiskind 1969) and South-East Asian (Deeleman-Reinhold 2001) *Castianeira*.

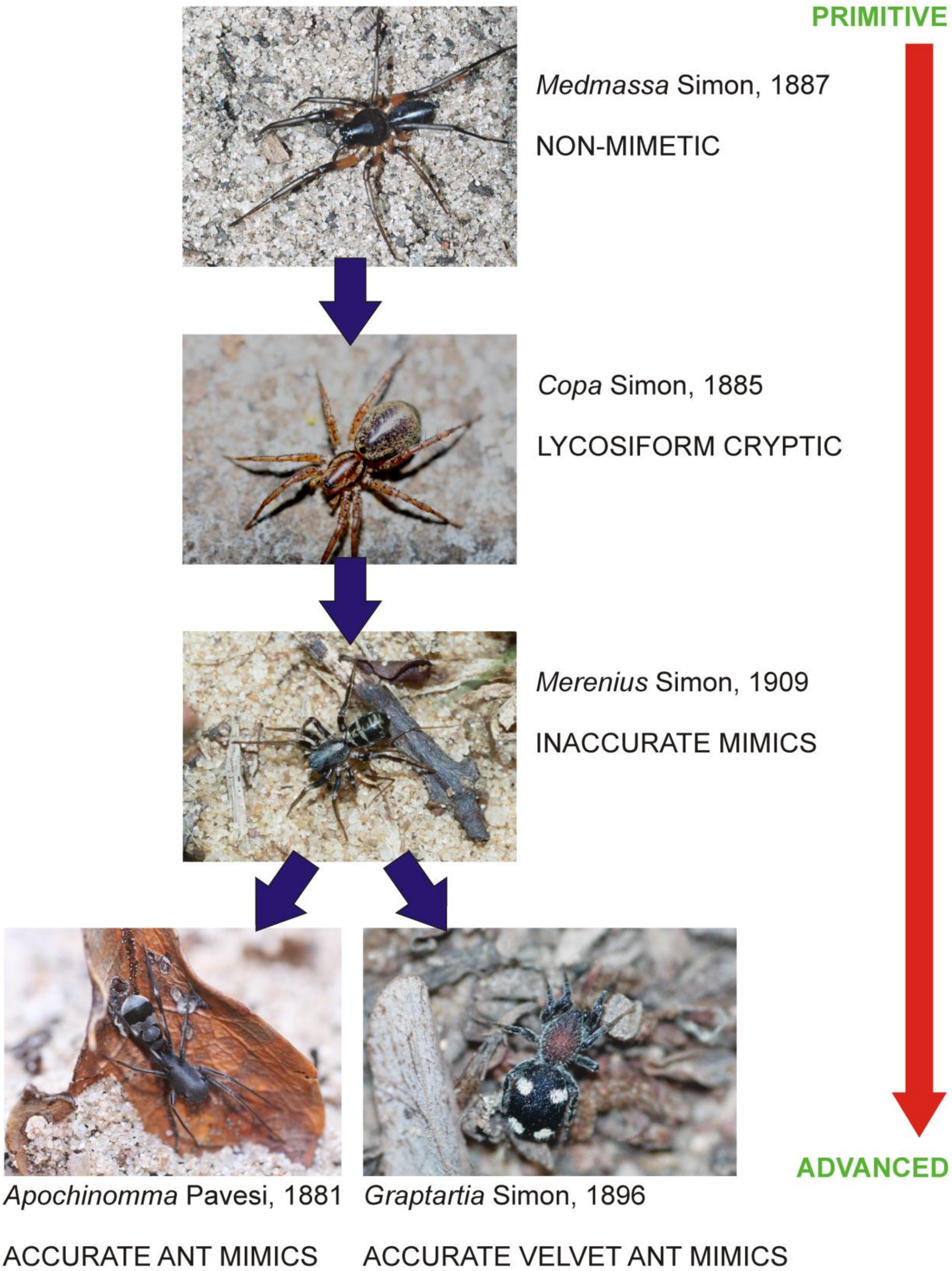


FIGURE 6. Morphological cline of Afrotropical Castianeirinae genera as an indicator of the evolution of the group from primitive non-mimetic forms to advanced mimics of ants (Formicidae) and velvet ants (Mutillidae).

Lastly, the accurate mimics are associated with a single model species. Amongst the rich Afrotropical fauna, only the genus *Apochinomma* Pavesi, 1881 is strongly mimetic, with a very elongate body form and legs. Some species in the genus have a constricted abdomen while others have a very globose abdomen, intended to mimic ponerine and *Polyrhachis* spp. ants, respectively. Afrotropical *Corinnomma* Karsch, 1880 seem to be intermediate between accurate and inaccurate, as its component species are often polymorph (see *C. semiglabrum* [Simon, 1896] in Chapter 12) and each morph varies as to its accuracy in resembling particular ants. For example, two morphs of *C. semiglabrum* resemble *Anoplolepis* and *Polyrhachis* ants but the other forms could be considered generalist mimics of black ground-dwelling ants.

From the New World the genera *Mazax* O.P.-Cambridge, 1898, *Myrmecium* Latreille, 1824, *Myrmecotypus* O.P.-Cambridge, 1894, *Psellocoptus* Simon, 1896 and *Sphecotypus* O.P.-Cambridge, 1895 all have modifications of the body shape and colouration that suggest they are accurate mimics of particular ants (Reiskind 1965, 1969, 1971b, 1977; Oliveira 1988; Rubio & Arbino 2009), although in some cases a particular model ant species cannot be identified (Reiskind 1977). From South-East Asia the genera *Aetius* O.P.-Cambridge, 1896, *Apochinomma*, *Castoponera* Deeleman-Reinhold, 2001, *Corinnomma*, *Pranburia* Deeleman-Reinhold, 1992, *Serendib* Deeleman-Reinhold, 2001 and *Sphecotypus* could all be considered accurate mimics of ants, having modifications of the body form, legs, setae and spines, and colouration to their model ants. The monotypic genus *Coenoptychus* Simon, 1885 from Sri Lanka and India is the only castianeirine from Asia that mimics velvet ants (Deeleman-Reinhold 2001).

Amongst the accurate mimics some bizarre body forms and behaviour have evolved. Most of these genera have species with locomotory adaptations to myrmecomorphy, i.e. using the front legs to imitate antennal movements, abdomen bobbing and a slow or jerky gait similar to that of their models. *Pranburia mahannopi* Deeleman-Reinhold, 2001 has very unique and interesting behaviour not previously described for other castianeirines. When the spiders are disturbed they will raise their legs and press the densely tufted femora together, which creates the illusion of an ant's head. The tibiae, metatarsi and tarsi are held in the air to resemble the antennae of the ants. When the danger has passed the legs are separated and the spider continues walking as usual (Deeleman-Reinhold 1992, 2001).

Beyond what is currently known on myrmecomorphic castianeirines, there is a wealth of knowledge that still needs to be generated for each of these genera with regards to the evolution of myrmecomorphy, effects of predation on mimic detection and distinction from models, possible myrmecophagy by the mimicking spiders, and aspects of the general biology of these spiders (phenology, reproduction etc.). Recent data from karyological studies on Salticidae (Jiri Kral, pers. comm.) suggests that myrmecomorphic spiders have a much lower chromosome number than related non-mimetic genera from the same subfamily (e.g. Heliophaninae), which would indicate that myrmecomorphic specialisation is coupled with a reduction in chromosomes.

It would be interesting to see if a similar pattern emerges in the Corinnidae, and if such a gradient can be used as an indicator of the degree of mimetic accuracy. Since all four corinnid subfamilies have myrmecomorphic species, albeit to different degrees of specialisation in their mimicry, such a study could be applied to all of the groups. The likelihood of discovering such a gradient would be greatest amongst the Castianeirinae, which have the greatest range of morphologies. In contrast, the Corinninae includes two genera of myrmecophiles (Platnick & Baptista 1995; Bonaldo & Brescovit 1998; Erthal & Tonhasca 2001), and the effects of this strategy on their karyology should also be investigated.

1.4 STUDY AIMS

When this study was initiated it was clear that a mammoth task lay ahead if the Afrotropical Castianeirinae were to be thoroughly revised. Certainly from my initial studies of unidentified material, it was clear that a much greater diversity of species occurred in this biogeographical region than in North and Central America, where 59 species in four genera were treated by Reiskind (1969), and in south-east Asia, where Deeleman-Reinhold (2001) treated 27 species in 13 genera.

Two possible approaches were investigated: 1) based on preliminary examinations of material, select and completely revise one of the highly diverse genera in the region (*Castianeira*, *Copa* or *Merenius*), or 2) deal with all of the genera from the region at least in part, revise most of the smaller genera, and describe some of the new genera that may be confused with presently described groups. Both possibilities had their pro’s and con’s, which were weighed up before a decision was made.

Firstly, a complete revision of one of the larger genera would provide taxonomists with the tools to accurately identify all of the members of a particular genus, to resolve the phylogenetic relationships of the component species, and explain the phylogeny within the context of biogeographical patterns. Unfortunately, this approach would leave most of the other castianeirine genera untreated and most of their species difficult or impossible to identify to species level.

Secondly, by treating each of the castianeirine genera, diagnostic characteristics could be proposed for each genus, a detailed key to the genera could be prepared that would facilitate more accurate identification of material in the future, and the species in genera that were revised could be accurately identified to species level. Unfortunately, this approach would leave most of the larger genera incompletely treated, and because of their high species diversity, a considerable proportion of freshly collected material would have to remain unidentified.

After careful consideration I decided to opt for the second possibility, as I felt greater ground could be covered in dealing with many of the major problems in the identification of Afrotropical Castianeirinae, viz. lack of tools for researchers to identify the genera, redescribing poorly known genera and species, revising several genera and describing new species, and providing the desperately needed diagnostic characters to establish generic limits. As such, this study aimed to address the following:

1. Provide a detailed key to the Castianeirinae genera of the Afrotropical Region
2. Revise the genera *Apochinomma*, *Cambalida*, *Corinnomma*, *Echinax* and *Graptartia* in the Afrotropical Region
3. Revise the continental species of *Copa* [Madagascar has a very rich undescribed fauna that will be treated at a later stage]
4. Review the genus *Messapus* Simon, 1898 and describe two new genera of cryptic castianeirines (*Copuetta* **gen. nov.** and *Wasaka* **gen. nov.**)
5. Redescribe some poorly known Afrotropical *Castianeira* species
6. Redescribe the polymorphic castianeirine *Merenius alberti* and conduct a field study to establish the relationship between ant assemblages (i.e. models) and the occurrence of its two colour variations (i.e. mimics) in a savanna reserve
7. Describe for the first time the occurrence of colour polymorphism in Afrotropical Castianeirinae and their role as components of mimicry complexes, and
8. Conduct a preliminary phylogenetic analysis on the Afrotropical members of Castianeirinae to establish generic limits and identify synapomorphies for each genus.

1.5 REFERENCES

AMALIN, D.M., REISKIND, J., PEÑA, J.E. & McSORLEY, R. 2001. Predatory behaviour of three species of sac spiders attacking citrus leafminer. *Journal of Arachnology* **29:** 72–81.

BLANDIN, P. 1971. Recherches écologiques dans la savane de Lamto (Côte d'Ivoire: observation s préliminaires sur le peuplement aranéologique. *La Terre et la Vie* **71:** 218–239.

BLANDIN, P. 1983. La faune aranéologique de la région de Lamto (Côte d'Ivoire). Traits généraux et affinités biogéographiques. *Annales de l'Université d'Abidjan, serie E* **16:** 57–85.

BLANDIN, P. 1986. L'étude de la structure spatio-temporelle des communautés d'Araignées, une contribution à l'écologie évolutive. *Proceedings of the 10th International Congress of Arachnology, Jaca, Spain, 1986*: 143–167.

BLANDIN, P. & CELERIER, M.L. 1981. Les Araignées des savanes de Lamto (Côte d'Ivoire). Organisation des peuplements, bilans énergétiques, place dans l'écosystème. *Publications du Laboratoire Zoologie de l'Ecole normale Supe´rieure* **21:** 1–586.

BONALDO, A.B. & BRESCOVIT, A.D. 1998. On *Ecitocobius*, a new genus from central Amazonia with comments on the tribe Attacobiini (Arachnida, Araneae, Corinnidae, Corinninae). *Spixiana* **21:** 165–172.

BOSSELAERS, J. 2001. *Taxonomic study of the Afrotropical spider genus* Hortipes *and its phylogenetic relationships (Araneae, Clubionidae s.l.).* Unpublished Ph.D Thesis. Katholieke Universiteit, Leuven, 170 pp.

BOSSELAERS, J. & LEDOUX, J.-C. 1998. Description of a new African genus, *Hortipes* (Araneae, Liocranidae). *Revue arachnologique* **12:** 147–152.

BOSSELAERS, J. & JOCQUÉ, R. 2000a. 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. 2000b. *Hortipes,* a huge genus of tiny Afrotropical spiders (Araneae, Liocranidae). *Bulletin of the American Museum of Natural History* **256:** 1–108.

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.

BUTLER, V.P. & HADDAD, C.R. 2011. Spider assemblages associated with leaf litter of three tree species in central South Africa (Arachnida: Araneae). *African Journal of Ecology* **49:** 301–310.

CAPORIACCO, L. DI 1939. Arachnida. In: *Missione biologica nel paese dei Borana. Raccolte zoologiche. Reale Accademia d'Italia, Roma* **3:** 303–385.

CAPORIACCO, L. DI 1947. Arachnida Africae Orientalis, a dominibus Kittenberger, Kovács et Bornemisza lecta, in Museo Nationali Hungarico servata. *Annales Historico-Naturales Musei Nationalis Hungarici* **40:** 97–257.

CAPORIACCO, L. DI 1949. Aracnidi della colonia del Kenya raccolti da Toschi e Meneghetti negli anni 1944-1946. *Commentationes Pontificiae Academia Scientarum* **13:** 309–492.

CARDOSO, P., PEKÁR, S., JOCQUÉ, R. & CODDINGTON, J.A. 2011. Global patterns of guild composition and functional diversity of spiders. *PLoS ONE* **6:** e21710.

CODDINGTON, J.A. & LEVI, H.W. 1991. Systematics and evolution of spiders (Araneae). *Annual Review of Ecology and Systematics* **22:** 565–592.

COSTELLO, M.J. & DAANE, K.M. 1999. Abundance of spiders and insect predators on grapes in central California. *Journal of Arachnology* **27:** 531–538.

CUSHING, P.E. 1997. Myrmecomorphy and myrmecophily in spiders: a review. *Florida Entomologist* **80:** 165–193.

CUSHING, P.E. in press. Spider-ant associations: an updated review of myrmecomorphy, myrmecophily, and myrmecophagy in spiders. *Psyche*.

DEELEMAN-REINHOLD, C.L. 1992. A new spider genus from Thailand with a unique ant-mimicking device, with description of some other castianeirine spiders (Araneae: Corinnidae: Castianeirinae). *Natural History Bulletin of the Siamese Society of Bangkok* **40:** 167–184.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DIAS, S.C., CARVALHO, L.S., BONALDO, A.B. & BRESCOVIT, A.D. 2010. Refining the establishment of guilds in Neotropical spiders (Arachnida: Araneae). *Journal of Natural History* **44:** 219–239.

DIPPENAAR, S.M., DIPPENAAR-SCHOEMAN, A.S. MODIBA, M.A. & KHOZA, T.K. 2008. A checklist of spiders (Arachnida, Araneae) of the Polokwane Nature Reserve, Limpopo Province, South Africa. *Koedoe* **50:** 10–17.

DIPPENAAR-SCHOEMAN, A.S. 1979. Spider communities in strawberry beds: seasonal changes in numbers and species composition. *Phytophylactica* **11:** 1–4.

DIPPENAAR-SCHOEMAN, A.S. 1988. Annotated check list of the spiders (Araneae) of the Mountain Zebra National Park. *Koedoe* **31:** 151–160.

DIPPENAAR-SCHOEMAN, A.S. 2006. New records of 43 spider species from the Mountain Zebra National Park, South Africa (Arachnida: Araneae). *Koedoe* **49:** 23–28.

DIPPENAAR-SCHOEMAN, A.S. & CRAEMER, C. 2000. The South African National Survey of Arachnida. *Plant Protection News* **56:** 11–12.

DIPPENAAR-SCHOEMAN, A.S., HAMER, M. & HADDAD, C.R. 2011. An annotated checklist of the spiders (Arachnida: Araneae) of the Mkambathi Nature Reserve, Eastern Cape, South Africa. *Koedoe* **53(#1058):** 1–10.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual.* Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

DIPPENAAR-SCHOEMAN, A.S. & LEROY, A. 2003. A checklist of the spiders of the Kruger National Park, South Africa (Arachnida: Araneae). *Koedoe* **46:** 91–100.

DIPPENAAR-SCHOEMAN, A.S., LEROY, A., DE JAGER, M. & VAN DEN BERG, A. 1999. A check list of the spider fauna of the Karoo National Park, South Africa (Arachnida: Araneae). *Koedoe* **42:** 31–42.

DIPPENAAR-SCHOEMAN, A.S, VAN DEN BERG, A. & PRENDINI, L. 2009. Spiders and Scorpions (Arachnida; Araneae, Scorpiones) of the Nylsvley Nature Reserve, South Africa. *Koedoe* 51: 1–9.

DIPPENAAR-SCHOEMAN, A.S., VAN DEN BERG, A.M. & VAN DEN BERG, A. 1989. Species composition and relative seasonal abundance of spiders from the field and tree layers of the Roodeplaat Dam Nature Reserve. *Koedoe* **32:** 25–38.

DIPPENAAR-SCHOEMAN, A.S., VAN DEN BERG, A.M., VAN DEN BERG, M.A. & FOORD, S.H. 2005a. Spiders in avocado orchards in the Mpumalanga Lowveld of South Africa: species diversity and abundance (Arachnida: Araneae). *African Plant Protection* **11:** 8–16.

DIPPENAAR-SCHOEMAN, A.S., VAN DEN BERG, M.A., VAN DEN BERG, A.M. & VAN DEN BERG, A. 2001. Spiders in macadamia orchards in the Mpumalanga Lowveld of South Africa: species diversity and abundance (Arachnida: Araneae). *African Plant Protection* **7:** 39–46.

DIPPENAAR-SCHOEMAN, A.S., VAN DER WALT, A.E., DE JAGER, M., LE ROUX, E. & VAN DEN BERG, A. 2005b. The spiders of the Swartberg Nature Reserve in South Africa (Arachnida: Araneae). *Koedoe* **48:** 77–86.

DIPPENAAR-SCHOEMAN, A.S. & WASSENAAR, T.D. 2006. A checklist of spiders from the herbaceous layer of a coastal dune forest ecosystem at Richards Bay, KwaZulu-Natal, South Africa (Arachnida: Araneae). *African Invertebrates* **47:** 63–70.

DUNN, R.R., SANDERS, N.J., FITZPATRICK, M.C., LAURENT, E., LESSARD, J.-P., AGOSTI, D., ANDERSEN, A., BRUHL, C., CERDA, X., ELLISON, A.M., FISHER, B.L., GIBB, H., GOTELLI, N.J., GOVE, A., GUENARD, B., JANDA, M., KASPARI, M., LONGINO, J.T., MAJER, J., McGLYNN, T.P., MENKE, S.B., PARR, C.L., PHILPOTT, S.M., PFEIFFER, M., RETANA, J., SUAREZ, A.V. & VASCONCELOS, H.L. 2007. Global ant (Hymenoptera: Formicidae) biodiversity and biogeography – a new database and its possibilities. *Myrmecological News* **10:** 77–83.

EDMUNDS, M. 2000. Why are there good and poor mimics? *Biological Journal of the Linnean Society* **70:** 459–466.

ENDLER, J.A. 1981. An overview of the relationships between mimicry and crypsis. *Biological Journal of the Linnean Society* **16:** 25–31.

ERTHAL, M. Jr & TONHASCA, A. Jr 2001. *Attacobius attarum* spiders (Corinnidae): myrmecophilous predators of immature forms of the leaf-cutting ant *Atta sexdens* (Formicidae). *Biotropica* **33:** 374–376.

FOORD, S.H., MAFADZA, M., DIPPENAAR-SCHOEMAN, A.S. & VAN RENSBURG, B.J. 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.

FOURIE, R. 2010. *Spider ecology in the Erfenis Dam Nature Reserve, Free State Province (Arachnida: Araneae).* Unpublished M.Sc thesis, University of the Free State, Bloemfontein.

GRIFFIN, E. & DIPPENAAR-SCHOEMAN, A.S. 1991. A checklist of, and references to, the Namibian spider fauna (Arachnida, Araneae). *Cimbebasia* **13:** 155–181.

HADDAD, C.R. 2004. A revision of the African spider genus *Graptartia* Simon, 1896 (Araneae: Corinnidae). *African Entomology* **12:** 71–81.

HADDAD, C.R. 2005a. A redescription of *Corinna natalis* Pocock, 1898 (Araneae, Corinnidae), Africa’s largest dark sac spider, with natural history notes. *Journal of Afrotropical Zoology* **2:** 27–32.

HADDAD, C.R. 2005b. Ecology of spiders (Arachnida: Araneae) inhabiting *Themeda triandra* Forskål grassland in semi-arid South Africa. *Navorsinge van die Nasionale Museum*, Bloemfontein **21:** 25–36.

HADDAD, C.R. 2006a. A new species of *Corinnomma* (Araneae: Corinnidae) from southern and eastern Africa, with taxonomic notes on *C. olivaceum* and *C. semiglabrum*. *African Invertebrates* **47:** 71–83.

HADDAD, C.R. 2006b. *Spinotrachelas,* a new genus of tracheline sac spiders from South Africa (Araneae: Corinnidae). *African Invertebrates* **47:** 85–93.

HADDAD, C.R. 2007. A revision of the endemic South African dark sac spider genus *Austrophaea* Lawrence, 1952 (Araneae: Corinnidae). *African Invertebrates* **48:** 47–53.

HADDAD, C.R. 2009. *Vendaphaea*, a new dark sac spider genus apparently endemic to the Soutpansberg Mountains, South Africa (Araneae: Corinnidae). *African Invertebrates* **50:** 269–278.

HADDAD, C.R. 2010. A new species of *Poachelas* from Maputaland, South Africa (Araneae: Corinnidae), with considerable range extension for *Poachelas striatus*. *African Invertebrates* **51:** 313–319.

HADDAD, C.R. & BOSSELAERS, J. 2010. A revision of the genus *Medmassa* Simon, 1887 (Araneae: Corinnidae) in the Afrotropical Region. *Zootaxa* **2361:** 1–12.

HADDAD, C.R. & DIPPENAAR-SCHOEMAN, A.S. 2002. The influence of mound structure on the diversity of spiders (Araneae) inhabiting the abandoned mounds of the snouted harvester termite *Trinervitermes trinervoides* (Sjöstedt). *Journal of Arachnology* **30:** 403–408.

HADDAD, C.R. & DIPPENAAR-SCHOEMAN, A.S. 2005. Epigeic spiders (Arachnida: Araneae) in Nama Karoo grassland in the Northern Cape Province. *Navorsinge van die Nasionale Museum*, Bloemfontein **21:** 1–10.

HADDAD, C.R. & DIPPENAAR-SCHOEMAN, A.S. 2006a. Epigeic spiders (Araneae) in pistachio orchards in South Africa. *African Plant Protection* **12:** 12–22.

HADDAD, C.R. & DIPPENAAR-SCHOEMAN, A.S. 2006b. Spiders (Arachnida: Araneae) inhabiting abandoned mounds of the snouted harvester termite *Trinervitermes trinervoides* (Sjöstedt) (Isoptera: Termitidae: Nasutitermitinae) in the Free State, with notes on their biology. *Navorsinge van die Nasionale Museum*, Bloemfontein **22:** 1–15.

HADDAD, C.R. & DIPPENAAR-SCHOEMAN, A.S. 2009. A checklist of the non-acarine arachnids (Chelicerata: Arachnida) of the De Hoop Nature Reserve, Western Cape Province, South Africa. *Koedoe* **51(#149):** 1–9.

HADDAD, C.R., DIPPENAAR-SCHOEMAN, A.S. & PEKÁR, S. 2005. Arboreal spiders (Arachnida: Araneae) in pistachio orchards in South Africa. *African Plant Protection* **11:** 32–41.

HADDAD, C.R., DIPPENAAR-SCHOEMAN, A.S. & WESOŁOWSKA, W. 2006. A checklist of the non-acarine arachnids (Chelicerata: Arachnida) of the Ndumo Game Reserve, Maputaland, South Africa. *Koedoe* **49:** 1–22.

HADDAD, C.R., HONIBALL, A.S., DIPPENAAR-SCHOEMAN, A.S., SLOTOW, R. & VAN RENSBURG, B.J. 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.

HADDAD, C.R., LOUW, S.VDM. & DIPPENAAR-SCHOEMAN, A.S. 2004. Spiders (Araneae) in ground covers of pistachio orchards in South Africa. *African Plant Protection* **10:** 97–107.

HADDAD, C.R. & LYLE, R. 2008. Three new genera of tracheline sac spiders from southern Africa (Araneae: Corinnidae). *African Invertebrates* **49:** 37–76.

HADDAD, C.R., 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.

HADDAD, C.R., NEETHLING, J.A. & LYLE, R. 2011. *Spinotrachelas montanus* sp. n., the first Afromontane representative in the genus (Araneae: Corinnidae). *African Inverte-brates* **52:** 345–352.

HADDAD, C.R. & RUSSELL-SMITH, A. 2010. A comparison of spider diversity patterns in the Mkomazi Game Reserve, Tanzania and the Ndumo Game Reserve, South Africa (Arachnida: Araneae). *African Journal of Ecology* **48:** 418–427.

JOCQUÉ, R. 1991. A generic revision of the spider family Zodariidae (Araneae). *Bulletin of the American Museum of Natural History* **201:** 1–160.

JOCQUÉ, R. & BOSSELAERS, J. 2011. Revision of *Pseudocorinna* Simon and a new related genus (Araneae: Corinnidae): two more examples of spider templates with a large range of complexity in the genitalia. *Zoological Journal of the Linnean Society* **162:** 271–350.

JOCQUÉ, R. & DIPPENAAR-SCHOEMAN, A.S. 2006. *Spider Families of the World*. Royal Museum for Central Africa, Tervuren, 336 pp.

KARSCH, F. 1879. West-afrikanische Arachniden, gesammelt von Herrn Stabsarzt Dr. Falkenstein. *Zeitschrift für Naturwissenschaft* **52:** 329–373.

KARSCH, F. 1880. Arachnologische Blätter (Decas I). *Zeitschrift für Naturwissenschaft* **53:** 373–409.

KELLY, J.A. & SAMWAYS, M.J. 2003. Diversity and conservation of forest-floor arthropods on a small Seychelles island. *Biodiversity and Conservation* **12:** 1793–1813.

LAWRENCE, R.F. 1937. A collection of Arachnida from Zululand. *Annals of the Natal Museum* **8:** 211–273.

LAWRENCE, R.F. 1938. A collection of spiders from Natal and Zululand. *Annals of the Natal Museum* **8:** 455–524.

LAWRENCE, R.F. 1942. A contribution to the araneid fauna of Natal and Zululand. *Annals of the Natal Museum* **10:** 141–190.

LAWRENCE, R.F. 1952. New spiders of the eastern half of South Africa. *Annals of the Natal Museum* **12:** 183–226.

LEDOUX, J.-C. & EMERIT, M. 1998. Quelques espèces du genre africain *Hortipes* Bosselaers & Ledoux et leur coupelle métatarsale (Araneae, Liocranidae?). *Revue arachnologique* **12:** 153–168.

LEHTINEN, P.T. 1967. Classification of the cribellate spiders and some allied families, with notes on the evolution of the suborder Araneomorpha. *Annales Zoologici Fennici* **4:** 199–468.

LESSERT, R. DE 1915. Arachnides de l'Ouganda et de l'Afrique orientale allemande (Voyage du Dr J. Carl dans la region des lacs de l'Afrique centrale). *Revue Suisse de Zoologie* **23:** 1–80.

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

LESSERT, R. DE. 1923. Araignées du sud de l'Afrique. *Revue Suisse de Zoologie* **30:** 161–212.

LESSERT, R. DE 1929. Araignées du Congo recueillies au cours de l'expédition organisée par l'American Museum (1909–1915). Troisième partie. *Revue Suisse de Zoologie* **36:** 103–159.

LESSERT, R. DE 1933. Araignées d'Angola. (Resultats de la Mission scientifique suisse en Angola 1928-1929). *Revue Suisse de Zoologie* **40:** 85–159.

LESSERT, R. DE 1946. Araignées du Congo Belge. *Revue Suisse de Zoologie* **58:** 204–225.

LOTZ, L.N., SEAMAN, M.T. & KOK, D.J. 1991. Surface-active spiders (Araneae) of a site in semi-arid South Africa. *Navorsinge van die Nasionale Museum, Bloemfontein* **7:** 529–540.

LYLE, R. 2008. *A review of the Afrotropical trachelinae sac spiders (Araneae: Corinnidae), with revisions of three genera.* Unpublished M.Sc Dissertation. University of the Free State, Bloemfontein, 365pp.

LYLE, R. 2011. The male of *Fuchiba tortilis* Haddad and Lyle, 2008 and three new species of *Spinotrachelas* Haddad, 2006 (Araneae: Corinnidae: Trachelinae) from South Africa. *Annals of the Ditsong National Museum of Natural History* **1:** 123–131.

LYLE, R. & HADDAD, C.R. 2006. A revision of the Afrotropical tracheline sac spider genus *Thysanina* Simon, 1910 (Araneae: Corinnidae). *African Invertebrates* **47:** 95–116.

LYLE, R. & HADDAD, C.R. 2009. *Planochelas*, a new genus of tracheline sac spiders from West and Central Africa. *Annals of the Transvaal Museum* **46:** 91–100.

LYLE, R. & HADDAD, C.R. 2010. A revision of the tracheline sac spider genus *Cetonana* Strand, 1929 in the Afrotropical Region, with descriptions of two new genera (Araneae: Corinnidae). *African Invertebrates* **51:** 321–384.

MADDISON, W.P. & HEDIN, M.C. 2003. Jumping spider phylogeny (Araneae: Salticidae). *Invertebrate Systematics* **17:** 529–549.

MARUSIK, Y.M. 2009. Redescription of *Paccius quadridentatus* Simon, 1898 (Araneae: Corinnidae: Trachelinae) based on the holotype. *Zootaxa* **1990:** 65–68.

McIVER, J.D. & STONEDAHL, G. 1993. Myrmecomorphy: morphological and behavioural mimicry of ants. *Annual Review of Entomology* **38:** 351–379.

MELLET, M.A., SCHOEMAN, A.S. & DIPPENAAR-SCHOEMAN, A.S. 2006. The effect of Bt-cotton cultivation on spider populations in Marble Hall, South Africa. *African Plant Protection* **12:** 40–50.

MGOBOZI, M.P., SOMERS, M.J & DIPPENAAR-SCHOEMAN, A.S. 2008. Spider responses to alien plant invasion: the effect of short- and long-term *Chromolaena odorata* invasion and management. *Journal of Applied Ecology* **45:** 1189–1197.

MIDEGA, C.A.O., KHAN, Z.R., VAN DEN BERG, J., OGOL, C.K.P.O., DIPPENAAR-SCHOEMAN, A.S., PICKETT, J.A. & WADHAMS, L.J. 2008. Response of ground dwelling arthropods to a 'push–pull' system and Bt-maize: Spiders as an indicator group. *Journal of Applied Entomology* **132:** 248–254.

MODIBA, M.A., DIPPENAAR, S.M. & DIPPENAAR-SCHOEMAN, A.S. 2005. A checklist of spiders from Sovenga Hill, an inselberg in the Savanna Biome, Limpopo Province, South Africa (Arachnida: Araneae). *Koedoe* **48:** 109–115.

MUELELWA, M.I., FOORD, S.H., DIPPENAAR-SCHOEMAN, A.S. & STAM, E.M. 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.

MURPHY, J. 2007. *Gnaphosid genera of the world.* Volume 1: text. British Arachnological Society, St Neots, Cambridge, 92 pp.

NELSON, X.J. 2010. Polymorphism in an ant mimicking spider. *Journal of Arachnology* **38:** 139–141.

NELSON, X.J. 2012. A predator's perspective of the accuracy of ant mimicry in spiders. *Psyche* **168549:** 1–5.

OLIVEIRA, P.S. 1988. Ant-mimicry in some Brazilian salticid and clubionid spiders (Araneae: Salticidae, Clubionidae). *Biological Journal of the Linnean Society* **33:** 1–15.

PAVESI, P. 1880. Studi sugli Aracnidi africani. I. Aracnidi di Tunisia. *Annali del Museo Civico di Storia Naturale di Genova* **15:** 283–388.

PAVESI, P. 1881. Studi sugli Aracnidi africani. II. Aracnidi d'Inhambane raccolti da Carlo Fornasini e considerazioni sull'aracnofauna del Mozambico. *Annali del Museo Civico di Storia Naturale di Genova* **16:** 536–560.

PAVESI, P. 1883. Studi sugli aracnidi africani. III. Aracnidi del regno di Scioa e considerazioni sull'aracnofauna d'Abissinia. *Annali del Museo Civico di Storia Naturale di Genova* **20:** 1–105.

PAVESI, P. 1895. Esplorazione del Guiba e dei suoi affluenti compiuta dal Cap. Bottego. XVIII. Aracnidi. *Annali del Museo Civico di Storia Naturale di Genova* **35:** 491–537.

PECKHAM, G.W. & PECKHAM, E.G. 1892. Ant-like spiders of the family Attidae. *Occasional Papers of the Natural History Society of Wisconsin* **2:** 1–83.

PEKÁR, S., CODDINGTON, J.A. & BLACKLEDGE, T.A. in press. Evolution of stenophagy in spiders (Araneae): evidence based on the comparative analysis of spider diets. *Evolution*.

PEKÁR, S. & HADDAD, C.R. 2011. Trophic strategy of ant-eating *Mexcala elegans* (Araneae: Salticidae): looking for evidence of evolution of prey-specialization. *Journal of Arachnology* **39:** 133–138.

PEKÁR, S. & JARAB, M. 2011. Assessment of color and behavioural resemblance to models by inaccurate myrmecomorphic spiders (Araneae). *Invertebrate Biology* **130:** 83–90.

PEKÁR, S., JARAB, M., FROMHAGE, L. & HERBERSTEIN, M.E. 2011. Is the evolution of inaccurate mimicry a result of selection by a suite of predators? A case study using myrmecomorphic spiders. *The American Naturalist* **178:** 124–134.

PLATNICK, N.I. 2000. Chapter 5. The tracheline spider genus *Paccius* (Araneae, Corinnidae) in the Parc National de Marojejy, Madagascar. *Fieldiana Zoology* (n. ser.) **97:** 115–121.

PLATNICK, N.I. 2011. The World Spider Catalog, Version 12.5. American Museum of Natural History, New York. Available at: http://research.amnh.org/entomology/spiders/catalog; accessed 31 December 2011.

PLATNICK, N.I. & BAPTISTA R.L.C. 1995. On the spider genus *Attacobius* (Araneae, Dionycha). *American Museum Novitates* **3120:** 1–9.

REISKIND, J. 1965. The taxonomic problem of sexual dimorphism in spiders and a synonymy in *Myrmecotypus* (Araneae, Clubionidae). *Psyche* **72:** 279–281.

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

REISKIND, J. 1971a. Morphological adaptation for ant-mimicry in spiders. *Proceedings of the 5th International Congress of Arachnology, Brno, Czechoslovakia, 1971*: 221–226.

REISKIND, J. 1971b. The South American Castianeirinae. I. The genus *Psellocoptus* (Araneae: Clubionidae). *Psyche* **78:** 193–202.

REISKIND, J. 1977. Ant-mimicry in Panamanian clubionid and salticid spiders (Araneae: Clubionidae, Salticidae). *Biotropica* **9:** 1–8.

RETTENMEYER, C.W. 1970. Insect mimicry. *Annual Review of Entomology* **10:** 43–74.

ROBERTSON, M.P., HARRIS, K.R., COETZEE, J.A., FOXCROFT, L.C., DIPPENAAR-SCHOEMAN, A.S. & VAN RENSBURG, B.J. 2011. Assessing local scale impacts of *Opuntia stricta* (Cactaceae) invasion on beetle and spider diversity in Kruger National Park, South Africa. *African Zoology* **46:** 205–223.

RUBIO, G.D. & ARBINO, M.O. 2009. The first *Myrmecotypus* O. P.-Cambridge (Araneae: Corinnidae) from Argentina: description of *Myrmecotypus iguazu* new species. *Zootaxa* **2158:** 65–68.

RUSSELL-SMITH, A. 1981. Seasonal activity and diversity of ground-living spiders in two African savanna habitats. *Bulletin of the British Arachnological Society* **5:** 145–154.

RUSSELL-SMITH, A. 2002. A comparison of the diversity and composition of ground-active spiders in Mkomazi Game Reserve, Tanzania and Etosha National Park, Namibia. *Journal of Arachnology* 30: 383–388.

RUSSELL-SMITH, A., RITCHIE, J.M. & COLLINS, N.M. 1987. The surface-active spdier fauna of arid bushland in Kora Reserve, Kenya. *Bulletin of the British Arachnological Society* **7:** 171–174.

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. 1896a. Descriptions d’Arachnides nouveaux de la familie des Clubionidae. *Annales de la Société entomologique de Belgique* **40:** 400–422.

SIMON, E. 1896b. Arachnides recueillis aux environs de Majunga par M. Bastard et envoyés au laboratoire d'entomologie du Muséum. *Bulletin du Museum National d'Histoire Naturelle, Paris* **1896:** 333–335.

SIMON, E. 1897a. *Histoire naturelle des Araignées*. Tomé 1, pp. 1–192. Librairie Encyclopé-dique de Roret, Paris.

SIMON, E. 1897b. Etudes arachnologiques. 27e Mémoire. XLII. Descriptions d'espèces nouvelles de l'ordre des Araneae. *Annales de la Société Entomologique de France* **65:** 465–510.

SIMON, E. 1897c. Description d'arachnides nouveaux. *Annales de la Société entomologique de Belgique* **41:** 8–17.

SIMON, E. 1898. *Histoire naturelle des Araignées*. Tomé 2, pp. 193–380. Librairie Encyclopé-dique de Roret, Paris.

SIMON, E. 1903a. Descriptions d'arachnides nouveaux de Madagascar, faisant partie des collections du Muséum. *Bulletin du Museum National d'Histoire Naturelle, Paris* **9:** 133–140.

SIMON, E. 1903b. Arachnides de la Guinée espagnole. Memorias de la Real Sociedad Espanola de Historia Natural **1:** 65–124.

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.

SIMON, E. 1910. Arachnoidea. Araneae (ii). In, Schultze, L., Zoologische und anthropologische Ergebnisse einer Forschungsreise im Westlichen und zentralen Südafrika. *Denkschriften der Medicinish – Naturwissenschaftlichen Gesellschaft zu Jena* **16:** 175–218.

SØRENSEN, L.L. 2004. Composition and diversity of the spider fauna in the canopy of a montane forest in Tanzania. *Biodiversity and Conservation* **13:** 437–452.

SØRENSEN, L.L., CODDINGTON, J.A. & SCHARFF, N. 2002. Inventorying and estimating subcanopy spider diversity using semiquantitative methods in an Afromontane forest. *Environmental Entomology* **31:** 319–330.

SPEED, M.P. 1999. Batesian, quasi-Batesian or Müllerian mimicry? Theory and data in mimicry research. *Evolutionary Ecology* **13:** 755–776.

STRAND, E. 1906. Diagnosen nordafrikanischer, hauptsächlich von Carlo Freiherr von Erlanger gesammelter Spinnen. *Zoologischer Anzeiger* **30:** 604–637, 655–690.

STRAND, E. 1907a. Vorläufige Diagnosen afrikanischer und südamerikanischer Spinnen. *Zoologischer Anzeiger* **31:** 525–558.

STRAND, E. 1907b. Diagnosen neuer Spinnen aus Madagaskar und Sansibar. *Zoologischer Anzeiger* **31:** 725–748.

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.

SRYGLEY, R.B. 1999. Incorporating motion into investigations of mimicry. *Evolutionary Ecology* **13:** 691–708.

VAN DEN BERG, A. & DIPPENAAR-SCHOEMAN, A.S. 1991. Ground-living spiders from an area where harvest termite *Hodotermes mossambicus* occurs in South Africa. *Phytophylatica* **23**: 247–253.

VAN DEN BERG, A.M. & DIPPENAAR-SCHOEMAN, A.S. 1988. Spider communities in a pine plantation at Sabie, Eastern Transvaal: a preliminary survey. *Phytophylactica* **20:** 293–296.

VAN DEN BERG, A.M., DIPPENAAR-SCHOEMAN, A.S. & SCHOONBEE, H.J. 1990. The effect of two pesticides on spiders in South African cotton fields. *Phytophylactica* **22:** 435–441.

VAN DER MERWE, M., DIPPENAAR-SCHOEMAN, A.S. & SCHOLTZ, C.H. 1996. Diversity of ground-living spiders at Ngome State Forest, KwaZulu-Natal: a comparative survey in indigenous forest and pine plantations. *African Journal of Ecology* **34:** 342–350.

VISSER, D., WRIGHT, M.G., VAN DEN BERG, A. & GILIOMEE, J.H. 1999. Species richness of arachnids associated with *Protea nitida* (Proteaceae) in the Cape Fynbos. *African Journal of Ecology* **37:** 334–343.

WANLESS, F.R. 1978. A revision of the spider genera *Belippo* and *Myrmarachne* (Araneae: Salticidae) in the Ethiopian region. *Bulletin of the British Museum (Natural History)* **33:** 1–139.

WARD, P.S. 2007. Phylogeny, classification, and species-level taxonomy of ants (Hymenopera: Formicidae). *Zootaxa* **1668:** 549–563.

WARUI, C.M., VILLET, M.H. & YOUNG, T.P. 2004. Spiders (Arachnida: Araneae) from black cotton soil habitats of a highland savanna biome in Laikipia, central Kenya. *Journal of Afrotropical Zoology* **1:** 13–24.

WESOŁOWSKA, W. 2009. A revision of the spider genus *Mexcala* Peckham et Peckham, 1902 (Araneae: Salticidae). *Genus* **20:** 149–186.

WESOŁOWSKA, W. & HADDAD, C.R. 2009. Jumping spiders (Araneae: Salticidae) of the Ndumo Game Reserve, Maputaland, South Africa. *African Invertebrates* **50:** 13–103.

WHITMORE, C., CROUCH, T.E., SLOTOW, R. & DIPPENAAR-SCHOEMAN, A.S. 2001. Checklist of spiders (Araneae) from Makalali Private Game Reserve, Northern Province, South Africa: including a new family record. *Durban Museum Novitates* **26:** 10–19.

WHITMORE, C., SLOTOW, R., CROUCH, T.E. & DIPPENAAR-SCHOEMAN, A.S. 2002. Diversity of spiders (Araneae) in a Savanna reserve, Northern Province, South Africa. *Journal of Arachnology* **30:** 344–356.

WICKLER, W. 1968. *Mimicry in plants and animals* [translated from German by R.D. Martin]. Weidenfeld & Nicolson, London, 253 pp.

APPENDIX 1. List of studies on spider diversity and ecology carried out in the Afrotropical Region in agroecosystems, conserved areas and unprotected natural habitats, with an indication of total number of species and abundance, as well as species richness and abundance of Corinnidae (numbers and % of total). Dashes are given where values were not available in the relevant publication or could not be calculated. Symbols: † – cited as Clubionidae but most likely Corinnidae.

Country	Habitat/ Conserved area	Methods	Total species	Corinnidae species	% of total	Total numbers	Corinnidae numbers	% of total	References
AGROECOSYSTEMS									
Kenya	Maize	Pitfalls, soil samples	—	—	—	2175	60	2.76	Midega *et al.* (2008)
South Africa	Avocado	Fogging	90	3	3.33	3715	75	2.02	Dippenaar-Schoeman *et al.* (2005a)
South Africa	Bt cotton	Pittraps	54	2	3.70	3777	50	1.32	Mellet *et al.* (2006)
South Africa	Cotton	Hand collecting, pitfalls, whole-bag	76	0	—	2388	0	—	Van den Berg *et al.* (1990)
South Africa	Macadamia	Fogging	80	2	2.50	2778	27	0.97	Dippenaar-Schoeman *et al.* (2001)
South Africa	Pistachio	Fogging	88	7	7.95	5843	48	0.82	Haddad *et al.* (2005)
South Africa	Pistachio	Hand collecting	63	2	4.08	645	31	4.81	Haddad & Dippenaar-Schoeman (2006a)
South Africa	Pistachio	Pitfalls	49	4	8.16	1692	6	0.35	Haddad & Dippenaar-Schoeman (2006a)
South Africa	Pistachio	Sweeps	55	4	7.27	1760	8	0.45	Haddad *et al.* (2004)
South Africa	Strawberries	Hand	33	0	—	5059	0	—	Dippenaar-Schoeman (1979)
CONSERVED AREAS									
Kenya	Kora Reserve [savanna]	Pitfalls	68	1†	1.54	—	—	—	Russell-Smith *et al.* (1987)
Namibia	Etosha National Park [savanna]	Pitfalls	151	1	—	—	—	—	Russell-Smith (2002)

APPENDIX 1 - continued

Country	Habitat/ Conserved area	Methods	Total species	Corinnidae species	% of total	Total numbers	Corinnidae numbers	% of total	References
South Africa	Blouberg Nature Reserve [savanna]	Hand collecting, sweeps, beats, sifting	186	2	1.08	1328	5	0.38	Muelelwa *et al.* (2010)
South Africa	De Hoop Nature Reserve [fynbos]	Hand collecting, sweeps, beats, sifting	252	15	5.95	—	—	—	Haddad & Dippenaar-Schoeman (2009)
South Africa	Hluhluwe-iMfolozi Park [savanna]	Beating, pitfalls	106	4	3.77	825	16	1.94	Mgobozi *et al.* (2008)
South Africa	Karoo National Park [Nama Karoo]	Hand collecting, sweeps, beats, sifting	116	2	1.72	—	—	—	Dippenaar-Schoeman *et al.* (1999)
South Africa	Kruger National Park [savanna]	Pitfalls	128	5	3.91	1051	12	1.14	Robertson *et al.* (2011)
South Africa	Kruger National Park [savanna]	Hand collecting, sweeps, beats, sifting	152	2	1.32	—	—	—	Dippenaar-Schoeman & Leroy (2003)
South Africa	Lajuma Mountain Retreat [savanna]	Hand collecting, sweeps, beats, pitfalls, sifting	297	21	7.07	9985	311	3.11	Foord *et al.* (2008)
South Africa	Makalali Game Reserve [savanna]	Hand collecting, sweeps, pitfalls, beats	268	6	2.24	4832	14	0.29	Whitmore *et al.* (2001, 2002)
South Africa	Mkambati Nature Reserve [grassland/forest]	Hand collecting, sweeps, beats, sifting	132	2	1.51	1275	70	5.49	Dippenaar-Schoeman *et al.* (2011)
South Africa	Mountain Zebra National Park [Nama Karoo]	Hand collecting	76	0	—	—	—	—	Dippenaar-Schoeman (1988, 2006)
South Africa	Ndumo Game Reserve [savanna]	Hand collecting, sweeps, beats, pitfalls, sifting	431	26	6.03	—	—	—	Haddad *et al.* (2006)
South Africa	Nylsvley Nature Reserve [savanna]	Hand collecting, sweeps, beats	175	10	5.71	—	—	—	Dippenaar-Schoeman *et al.* (2009)
South Africa	Polokwane Nature Reserve [savanna]	Hand collecting, sweeps, beats, pitfalls	275	4	1.45	13821	7	0.05	Dippenaar *et al.* (2008)

APPENDIX 1 - continued

Country	Habitat/ Conserved area	Methods	Total species	Corinnidae species	% of total	Total numbers	Corinnidae numbers	% of total	References
South Africa	Roodeplaat Dam Nature Reserve [savanna]	Hand collecting, sweeps, bears, Berlese	110	1	0.91	10270	—	—	Dippenaar-Schoeman *et al.* (1989)
South Africa	Swartberg Nature Reserve [Nama Karoo]	Hand collecting, sweeps, beats	186	5	2.69	—	—	—	Dippenaar-Schoeman *et al.* (2005)
South Africa	Tembe Elephant Park [savanna/forest]	Hand collecting, sweeps, beats, pitfalls, sifting	251	11	4.38	2808	187	6.66	Haddad *et al.* (2010)
South Africa	Western Soutpansberg [savanna]	Hand collecting, sweeps, beats, sifting	222	6	2.70	909	24	2.64	Muelelwa *et al*. (2010)
Tanzania	Mkomazi Game Reserve [savanna]	Pitfalls	229	10	—	—	—	—	Russell-Smith (2002)
Tanzania	Mkomazi Game Reserve [savanna]	Hand collecting, sweeps, pitfalls, Winkler, Malaise	493	15	3.04	—	—	—	Haddad & Russell-Smith (2010)
Tanzania	Uzungwa Scarp Forest Reserve [forest]	Hand collecting, sweeps, pitfalls	170	7	4.12	9096	54	0.59	Sørensen *et al.* (2002)
Tanzania	Uzungwa Scarp Forest Reserve [forest]	Canopy fogging	149	5	3.36	5233	36	0.69	Sørensen (2004)
NATURAL HABITATS & PLANTATIONS									
Botswana	Savanna	Pitfalls	134	4	2.99	—	—	—	Russell-Smith (1981)
Ivory Coast	Gallery forest	Pitfalls	—	—	4.70†	—	—	—	Blandin (1983)
Ivory Coast	Savanna	Pitfalls	—	—	4.50†	—	—	—	Blandin (1983)
Namibia	Various	Various	578	6	1.04	—	—	—	Griffin & Dippenaar-Schoeman (1991)

APPENDIX 1 - continued

Country	Habitat/ Conserved area	Methods	Total species	Corinnidae species	% of total	Total numbers	Corinnidae numbers	% of total	References
Seychelles	Forest	Tullgren	21	3	14.29	—	—	—	Kelly & Samways (2003)
South Africa	Coastal forest	Sweeps	96	3	3.13	2955	5	0.17	Dippenaar-Schoeman & Wassenaar (2006)
South Africa	Forest/plantation	Pitfalls	136	13	9.55	9360	366	3.91	Van der Merwe *et al.* (1996)
South Africa	Fynbos	Hand collecting, beats	32	0	—	653	0	—	Visser *et al.* (1999)
South Africa	Grassland	Abandoned termitaria	82	4	4.88	771	10	1.30	Haddad & Dippenaar-Schoeman (2002, 2006b)
South Africa	Grassland	Sifting	56	5	8.93	1385	47	3.39	Butler & Haddad (2011)
South Africa	Grassland	Pitfalls	—	—	—	4922	56	1.14	Lotz *et al.* (1991)
South Africa	Grassland	Sweeps	57	2	3.51	1646	14	0.85	Haddad (2005b)
South Africa	Nama Karoo	Pitfalls	56	0	—	1112	0	—	Haddad & Dippenaar-Schoeman (2005)
South Africa	Pine plantations	Pitfalls, paper bark traps	53	4	7.55	1484	—	—	Van den Berg & Dippenaar-Schoeman (1988)
South Africa	Savanna	Hand collecting, sweeps, pitfalls, beats, sifting	76	3	3.95	793	42	5.30	Modiba *et al.* (2005)
South Africa	Savanna	Pitfalls	55	1	1.81	1854	3	0.16	Van den Berg & Dippenaar-Schoeman (1991)
Kenya	Sweeps, pitfalls	Sweeps, pitfalls	132	2	1.52	10487	6	0.06	Warui *et al.* (2004)

CHAPTER 2

Medmassa semiaurantiaca **Simon, 1909 (Lesideng Research Camp, Botswana)**

An illustrated key to the genera of Afrotropical Castianeirinae (Araneae: Corinnidae)

2.1 ABSTRACT

An illustrated identification key to the 11 Afrotropical genera of Castianeirinae is presented. The emphasis in diagnostic characters lies primarily in somatic morphology, especially leg spination and eye arrangements, while genitalic morphology is only particularly diagnostic for *Medmassa* Simon, 1887.

2.2 INTRODUCTION

The Afrotropical dark- and ant-like sac spiders, representatives of the family Corinnidae, were largely neglected in taxonomic studies until the end of the 20th century (Dippenaar-Schoeman & Jocqué 1997). This contrasts dramatically with the Neotropical Region (Platnick & Shadab 1974a,b; Platnick 1975; Bonaldo 1997, 2000; De Souza & Bonaldo 2007), Nearctic Region (Reiskind 1969) and Palaearctic Region (e.g. Grimm 1986; Deeleman-Reinhold 2001; Kim & Lee 2008; Bosselaers *et al.* 2009; Kovblyuk & Nadolny 2009; Zhang *et al.* 2009; Bosselaers & Bosmans 2010), where the faunas have been reasonably well studied. Despite this progress, several of the corinnid subfamilies remain poorly studied in the Neotropical Region (Castianeirinae and Phrurolithinae), Afrotropical Region and Australasia.

During the past decade the Afrotropical genera have been subjected to considerable study through redescriptions, revisions, descriptions of new genera, and cladistic studies (see Chapter 1). These revisions have seen a dramatic increase in the number of genera and species in the region, from 110 species in 22 genera at the end of the last century (Dippenaar-Schoeman & Jocqué 1997) to the current 271 species in 35 genera (Chapter 1). Despite these advances, there are still many species and several new genera that need to be described, notably in the large polyphyletic genera *Trachelas* L. Koch, 1872 and *Castianeira* Keyserling, 1879.

To date, no inclusive keys to the genera of Afrotropical Corinnidae have been attempted, which has contributed significantly to the large proportion of material in collections that has not been identified beyond family level. Recent keys to the subfamilies of the Afrotropical Region (Dippenaar-Schoeman & Jocqué 1997) and South-East Asia (Deeleman-Reinhold 2001) did not include the subfamily Phrurolithinae, which was only transferred to Corinnidae subsequently (Bosselaers & Jocqué 2002), and are thus incomplete. Although Simon (1897) produced keys to the genera of each of his major groups in the Clubionidae *sensu lato*, including groups that would later be elevated to the corinnid subfamilies Corinninae, Trachelinae and Castianeirinae, these can no longer be considered relevant due to the large number of genera described subsequently in each of the subfamilies.

Afrotropical Castianeirine spiders can be easily recognised from the three other Corinnidae subfamilies by the presence of the following genitalic and somatic characters: 1) male palp with pear-shaped tegulum and coiled embolus at distal end, tegulum teardrop-shaped in *Medmassa* Simon, 1887 (Fig. 1; Haddad & Bosselaers 2010); 2) male palp without tibial apophysis, except in *Medmassa* (Fig. 1) and *Graptartia granulosa* Simon, 1896 (Haddad 2004: figs 22, 23); 3) female epigyne with round or oval anterior spermatheca II and usually narrower posterior spermatheca I, usually kidney-shaped, in *Medmassa* with single large spermatheca (Fig. 2); 4) epigyne with median lateral copulatory openings (anterior median in *Medmassa* and one species of *Copuetta* **gen. nov.**); 5) small inframamillary sclerite present in front of spinnerets, covering tracheal opening (Deeleman-Reinhold 2001; Bosselaers & Jocqué 2000, 2002; Haddad 2004).

Another potentially useful character required further clarification. Deeleman-Reinhold (2001) proposed in her Corinnidae subfamily key that Castianeirinae lack claw tufts while Trachelinae and Corinninae have them present. This does not seem to be the case in the Afrotropical fauna, where all of the Castianeirinae have very dense claw tufts, while they may be absent (Haddad 2006: fig. 12; Haddad & Lyle 2008: figs 21) or present (Lyle & Haddad 2006: fig. 4; Haddad & Lyle 2008: fig. 83) in the Trachelinae, and present in the Corinninae *sensu lato* (Haddad 2009; Jocqué & Bosselaers 2011: fig. 6D). Therefore, this character is of no use in the separation of the Afrotropical subfamilies.

As the North American fauna has been quite thoroughly revised, the detailed and beautifully illustrated key to subfamilies and genera of Corinnidae from the Nearctic Region (Ubick & Richman 2005) can be considered as a perfect model for producing keys for the other biogeographical regions. It is likely that when a phylogenetic analysis is conducted that includes all of the genera currently placed in Corinnidae that newly considered characters will emerge that can be proposed as synapomorphies for each of the subfamilies.

Since the focus of this thesis is on the Castianeirinae of the Afrotropical Region, the following key will be restricted to that subfamily only. This key should only be considered as a preliminary attempt to aid identification to genus level. In addition to the two new genera proposed in this thesis (*Copuetta* **gen. nov.** and *Wasaka* **gen. nov.**) that are included in the key, there are at least three new genera from the region that need to be described (two Madagascan and one monotypic continental genus). Also, *Merenius* Simon, 1909 and *Castianeira* Keyserling, 1879 are not subjected to revision here, and many new species are likely to be described in these two genera in the future. *Castianeira* is probably polyphyletic and its component species may be separated into several new genera when it is revised. Consequently, these taxonomic changes will necessitate a review of this key in the future to include those newly proposed taxa and to account for intrageneric variation.

2.3 KEY TO THE GENERA OF AFROTROPICAL CASTIANEIRINAE

1 Posterior eye row procurved...2

– Posterior eye row straight or recurved...9

2 Tibia I with at least six pairs of ventral spines; palpal tegulum teardrop-shaped with curved embolus, and palpal tibia with large retrolateral apophysis (Fig. 1); female epigyne with single large oval spermathecae with anteromedian copulatory openings (Fig. 2); abdomen with two pairs of short stout spines on its anterior margin with several shorter erect setae between them..*Medmassa* Simon, 1887

– Tibia I with no more than three pairs of ventral spines, sometimes with additional pair of ventral terminal spines; palpal tegulum pear-shaped, clearly narrowed distally, with coiled embolus; palpal tibia usually without apophysis, if present very short; female epigyne usually with distinctly separate anterior and posterior spermathecae, copulatory openings usually laterally in epigyne; abdomen without two pairs of short stout spines on its anterior margin but sometimes with several pairs of fine erect setae............................3

3 Carapace colouration similar to that of Lycosidae, i.e. cream, grey or orange-brown with paired black markings laterally of midline (Figs 3, 4)..4

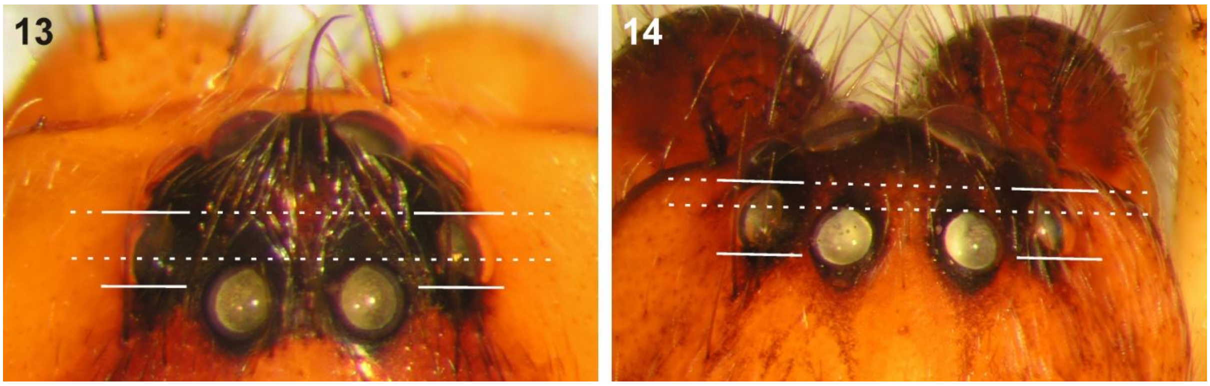
– Carapace usually uniform in colouration, i.e. orange, red, brown or black, occasionally with markings comprising white plumose setae or black striae (Figs 5–7)........................7

4 All patellae with proximal seta and long distal spine, longer than patella (Fig. 8); diameter of anterior median eyes nearly double that of laterals..
....*Echinax* Deeleman-Reinhold, 2001

FIGURES 1–12. Somatic morphology of Afrotropical Castianeirinae: 1. male palp and 2. female epigyne of *Medmassa semiaurantiaca* Simon, 1910; 3–7, 9–12. dorsal habitus of *Copuetta maputa* **sp. nov.** female (3), *Wasaka montana* **sp. nov.** female (4), *Cambalida fulvipes* (Simon, 1896) female (5), *Castianeira* sp. female (6), *Castianeira* sp. male (7), *Apochinomma formicaeforme* Pavesi, 1881 female (9), *A. decepta* **sp. nov.** male (10), *Graptartia tropicalis* Haddad, 2004 male (11) and *Merenius alberti* Lessert, 1923 female (12); 8. patellae and tibiae I and II of *Echinax spatulata* **sp. nov.** male.

– Anterior patellae only with long fine proximal and distal setae, posterior patellae with long fine seta and distal seta or spine, always shorter than patella; diameter of anterior median eyes less than 1.5 times that of laterals..5

5 Posterior eye row strongly procurved, transverse line from anterior margin of median eyes passing through posterior half of lateral eyes (Fig. 13); carapace width more than 3.3 times posterior eye row width...*Copa* Simon, 1885



FIGURES 13–14. Dorsal view of eye region of *Copa flavoplumosa* Simon, 1885 female (13) and *Copuetta lacustris* (Strand, 1916) female (14).

– Posterior eye row slightly procurved, transverse line from anterior margin of median eyes passing through anterior half of lateral eyes (Fig. 14); carapace width usually less than 3 times posterior eye row width...6

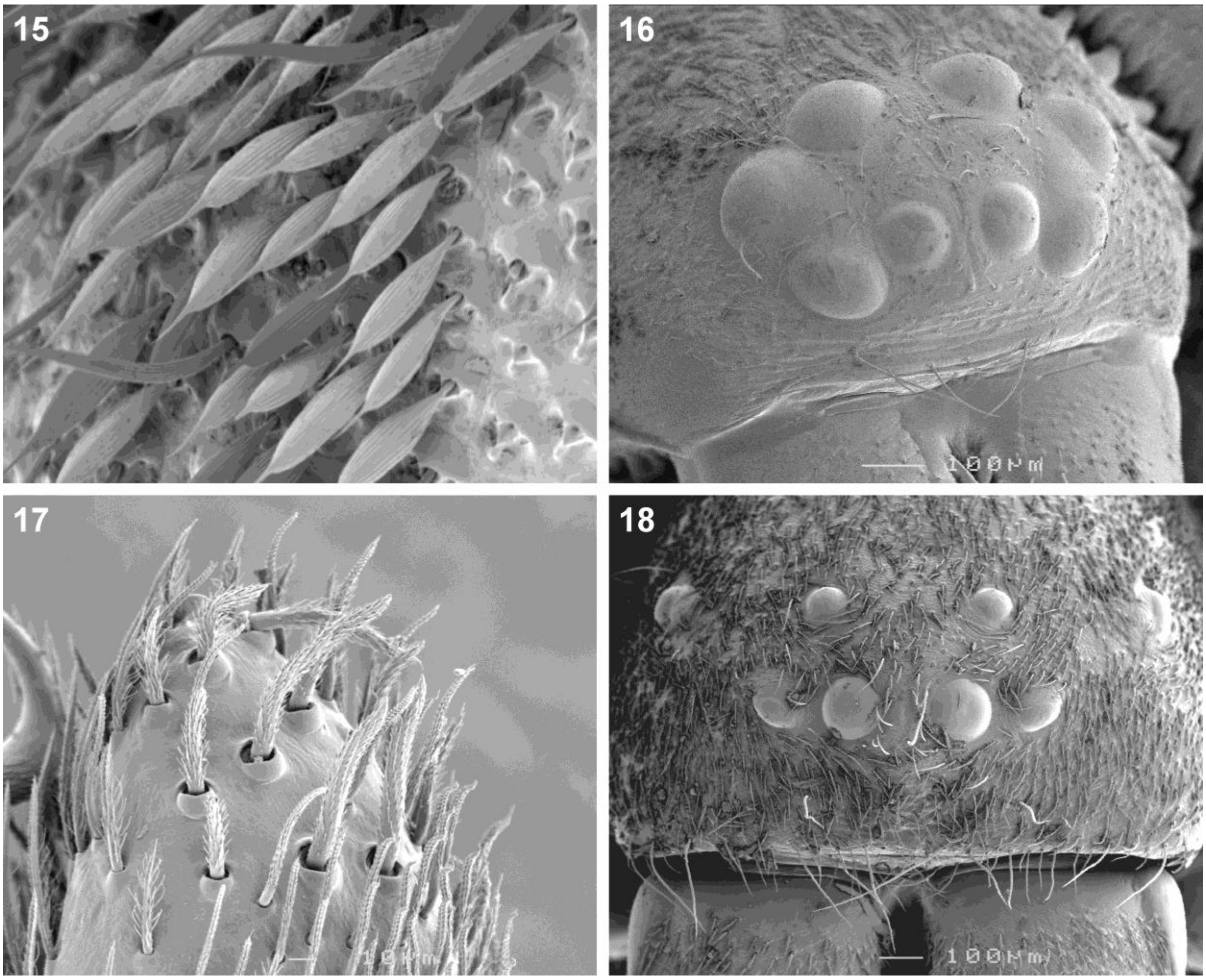
6 Cheliceral promargin with two teeth; anterior tibiae with two pairs of ventral spines...*Copuetta* **gen. nov.**

– Cheliceral promargin with three teeth, distal tooth very small, rarely with two teeth; anterior tibiae with three pairs of ventral spines, sometimes also with a pair of smaller ventral terminal spines...*Wasaka* **gen. nov.**

7 Carapace texture coarsely granulate; cephalic region clearly narrowed anteriorly, posterior eye row very strongly procurved; abdominal surface covered in clavate and straight setae (Fig. 15), black with four large white spots laterally..*Graptartia* Simon, 1896 (in part)

– Carapace texture finely granulate or wrinkled; cephalic region only slightly narrowed anteriorly, posterior eye row slightly procurved; abdominal surface covered in plumose and short straight setae with variable markings..8

8 Anterior eye row with lateral eyes clearly larger than medians (Fig. 16); carapace width less than 2.5 times posterior eye row width; male palpal cymbium with 6–10 large thickened black setae arranged in two or three rows, close to distal end of dorsal surface (Fig. 17); female epigastric scutum weakly sclerotised, epigyne usually with somewhat indistinct weakly sclerotised ridges...*Cambalida* Simon, 1909



FIGURES 15–18. Scanning electron microscope photographs of Castianeirinae morphology: 15. abdominal clavate setae of *Graptartia granulosa* Simon, 1896 female; 16. ocular region of *Cambalida dippenaarae* **sp. nov.** male; 17. thickened long setae at distal end of palpal cymbium of *C. dippenaarae* **sp. nov.** male; 18. ocular region of *Apochinomma formicaeforme* Pavesi, 1881 female.

– Anterior eye row with median eyes usually slightly larger than laterals, rarely smaller than laterals; carapace width usually more than 2.6 times posterior eye row width; male palpal cymbium without long thickened distal setae, sometimes with two or three short thickened or bent setae distally; female epigastric scutum usually strongly sclerotised, epigyne with distinct hardened ridges..................................*Castianeira* Keyserling, 1879

9 Eyes very small, posterior eye row very strongly recurved; posterior eyes separated by more than 1½ times their diameter, medians usually closer to each other than to laterals (Fig. 18); carapace very elongate and narrow, length more than 1.6 times width, usually more than 1.8 times width; mimics of ants with abdomen globose (Fig. 9) or elongate with shallow constriction (Fig. 10)..*Apochinomma* Pavesi, 1881

– Eyes larger, posterior eye row slightly recurved or nearly straight; posterior eyes separated by distance less than 1¼ times their diameter, median eyes closer to lateral eyes than to each other; carapace elongate oval, length less than 1.6 times width; mimics of ants or velvet ants, but abdomen oval, not globose or constricted (Figs 11, 12)..........10

10 Thoracic region of carapace covered in plumose and long erect straight setae; abdomen black, with white or cream median triangular or star-shaped marking and three white spots around spinnerets (Fig. 11).....................................*Graptartia* Simon, 1896 (in part)

– Thoracic region of carapace with plumose and scattered adpressed short straight setae; abdomen with black transverse bands or serrated white marking along dorsal midline...11

11 Abdomen with black transverse bands; femora II with three dorsal spines only; tibiae II with at least one pair of ventral spines......................................*Corinnomma* Karsch, 1880

– Abdomen with symmetrical white marking along dorsal midline (Fig. 12); femora II with one prolateral spine and three dorsal spines; tibiae II with only a single retrolateral ventral spine...*Merenius* Simon, 1909

2.4 REFERENCES

BONALDO, A.B. 1997. On the new Neotropical spider genus *Ianduba* (Araneae, Corinnidae). *Iheringia, Série Zoologia* **83:** 165–180.

BONALDO, A.B. 2000. Taxonomia da subfamília Corinninae (Araneae, Corinnidae) nas Regiões Neotropical e Neártica. *Iheringia, Série Zoologia* **89:** 3–148.

BOSSELAERS, J. & BOSMANS, R. 2010. Studies in Corinnidae (Araneae): a new *Paratrachelas* Kovblyuk & Nadolny from Algeria, as well as the description of a new genus of Old World Trachelinae. *Zootaxa* **2612:** 41–56.

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.

BOSSELAERS, J., URONES, C., BARRIENTOS, J.A. & ALBERDI, J.M. 2009. On the Mediterranean species of Trachelinae (Araneae, Corinnidae), with a revision of

Trachelas L. Koch, 1872 on the Iberian Peninsula. *Journal of Arachnology* **37:** 15–38.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DE SOUZA, D.R.S. & BONALDO, A.B. 2007. Revisão do gênero neotropical *Xeropigo* (Araneae, Corinnidae, Corinninae). *Iheringia, Série Zoologia* **97:** 301–313.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual.* Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

GRIMM, U. 1986. Die Clubionidae Mitteleuropas: Corinninae und Liocraninae (Arachnida, Araneae). *Abhandlungen des Naturwissenschaftlichen Vereins in Hamburg* **27**: 1–91.

HADDAD, C.R. 2004. A revision of the African spider genus *Graptartia* Simon, 1896 (Araneae: Corinnidae). *African Entomology* **12:** 71–81.

HADDAD, C.R. 2006. *Spinotrachelas*, a new genus of tracheline sac spiders from South Africa (Araneae: Corinnidae). *African Invertebrates* **47:** 85–93.

HADDAD, C.R. 2009. *Vendaphaea*, a new dark sac spider genus apparently endemic to the Soutpansberg Mountains, South Africa (Araneae: Corinnidae). *African Invertebrates* **50:** 269–278.

HADDAD, C.R. & BOSSELAERS, J. 2010. A revision of the genus *Medmassa* Simon, 1887 (Araneae: Corinnidae) in the Afrotropical Region. *Zootaxa* **2361:** 1–12.

HADDAD, C.R. & LYLE, R. 2008. Three new genera of tracheline sac spiders from southern Africa (Araneae: Corinnidae). *African Invertebrates* **49:** 37–76.

JOCQUÉ, R. & BOSSELAERS, J. 2011. Revision of *Pseudocorinna* Simon and a new related genus (Araneae: Corinnidae): two more examples of spider templates with a large range of complexity in the genitalia. *Zoological Journal of the Linnean Society* **162:** 271–350.

KIM, B.-W. & LEE, W. 2008. Notes on four corinnid species from Korea, with the description of *Trachelas joopili* new species (Arachnida: Araneae: Corinnidae). *Journal of Natural History* **42:** 1867–1884.

KOVBLYUK, M.M. & NADOLNY, A.A. 2009. The spider genus *Trachelas* L. Koch, 1872 in Crimea and Caucasus with the description of *Paratrachelas* gen.n. (Aranei: Corinnidae). *Arthropoda Selecta* **18:** 35–46.

LYLE, R. & HADDAD, C.R. 2006. A revision of the Afrotropical tracheline sac spider genus *Thysanina* Simon, 1910 (Araneae: Corinnidae). *African Invertebrates* **47**: 95–116.

PLATNICK, N.I. 1975. A revision of the South American spider genus *Trachelopachys* (Araneae, Clubionidae). *American Museum Novitates* **2589:** 1–25.

PLATNICK, N.I. & SHADAB, M.U. 1974a. A revision of the *tranquillus* and *speciosus* groups of the spider genus *Trachelas* (Araneae, Clubionidae) in North and Central America. *American Museum Novitates* **2553:** 1–34.

PLATNICK, N.I. & SHADAB, M.U. 1974b. A revision of the *bispinosus* and *bicolor* groups of the spider genus *Trachelas* (Araneae, Clubionidae) in North and Central America and West Indies. *American Museum Novitates* **2560:** 1–34.

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

SIMON, E. 1897. *Histoire naturelle des araignées.* Tomé 1, pp. 1–192. Librairie Encyclopédique de Roret, Paris.

UBICK, D. & RICHMAN, D.B. 2005. *Chapter 20. Corinnidae.* pp 79–82. *In*: UBICK, D., PAQUIN, P., CUSHING, P.E. & ROTH, V. (eds.). Spiders of North America: An Identification Manual. American Arachnological Society.

ZHANG, F., FU, J.-Y. & ZHU, M.-S. 2009. A review of the genus *Trachelas* (Araneae: Corinnidae) in China. *Zootaxa* **2235:** 40–58.

CHAPTER 3

Apochinomma decepta **sp. nov. (Bartholomew Diaz Point, Mozambique)**

A revision of the ant-like sac spider genus *Apochinomma* Pavesi, 1881 (Araneae: Corinnidae) in the Afrotropical Region

3.1 ABSTRACT

The genus *Apochinomma* Pavesi, 1881 is revised in the Afrotropical Region. The male and female of the type species, *A. formicaeforme* Pavesi, 1881, are redescribed. Five new species are described: *A. malkini* **sp. nov.**, *A. parva* **sp. nov.** and *A. tuberculata* **sp. nov.** in the *A. formicaeforme* species group, and *A. decepta* **sp. nov.** and *A. elongata* **sp. nov.** in the *A. decepta* species group. A further undescribed species, known only from juveniles, is considered to belong to the latter species group. Members of the *A. formicaeforme* species group are mimics of *Polyrhachis* ants and are suspected to be primarily arboreal, while the *A. decepta* species group has ground- or grass-dwelling representatives that mimic large ground-dwelling ponerine ants. The Afrotropical members of the genus display various morphological adaptations to ant mimicry: several species have a median depression on the cephalothorax, an elongate pedicel, and a variable abdominal shape that resembles the abdomen of ants. Plumose setae on the carapace, abdomen and legs, together with banded or striped markings, help enforce their resemblance to their models. Regarding behaviour, *A. formicaeforme* and *A. decepta* **sp. nov.** have been observed to move the forelegs up and down in a manner resembling antennal movements of ants, and their general body movements were also generally ant-like. Tiny pores found on the tarsi and metatarsi need to be further investigated, as they may release pheromone-like chemicals that could help obscure their presence when amongst foraging ants. A single case of *A. formicaeforme* feeding on its model, *Polyrhachis gagates*, has been previously recorded.

3.2 INTRODUCTION

The Castianeirinae are generally regarded as good examples of Batesian mimics of ants (Hymenoptera: Formicidae), although representatives of some genera are cryptic (e.g. *Copa* Simon, 1885 and *Echinax* Deeleman-Reinhold, 2001) or are mimics of velvet ants (Hymenoptera: Mutillidae), e.g. *Graptartia* Simon, 1896 and *Coenoptychus* Simon, 1896. The ant mimicking species can be differentiated into two broad categories, i.e. good or specific mimics, and poor or general mimics (Edmunds 2000). The two groups can also be referred to as accurate or inaccurate mimics, respectively (Pekár & Jarab 2011). Inaccurate mimics only have similar colouration to their models, while accurate mimics also have adaptations to the typical body plan (Pekár & Jarab 2011).

The New World has a rich fauna of specific castianeirine mimics, including the endemic genera *Mazax* O.P.-Cambridge, 1898, *Myrmecium* Latreille, 1824, *Myrmecotypus* O. P.-Cambridge, 1894 and *Psellocoptus* Simon, 1896 (Platnick 2011). The fauna of South-East Asia also includes several endemic specific mimics, namely *Aetius* O. P.-Cambridge, 1896, *Castoponera* Deeleman-Reinhold, 2001, *Pranburia* Deeleman-Reinhold, 1993 and *Serendib* Deeleman-Reinhold, 2001 (Deeleman-Reinhold 2001). In contrast, the Afrotropical Region has no endemic specific castianeirine mimics, with the exception of two undescribed monotypic genera (Haddad, in prep.).

Only three genera of specific mimics have an intercontinental distribution. *Apochinomma* Pavesi, 1881 is recorded from the Afrotropical, Neotropical and Oriental Regions; *Corinnomma* Karsch, 1880 is recorded from the Afrotropical, Palaearctic and Australasian Regions, and *Sphecotypus* O.P.-Cambridge, 1895 is known from the Neotropical and Palaearctic Regions (Platnick 2011).

Apochinomma was described by Pavesi (1881), with the type species, *A. formicaeforme* Pavesi, 1881, from Mozambique. Subsequently, nine species were described from the Neotropical Region and three from the Oriental Region (Platnick 2011), of which two were recently synonymised with *A. nitidum* (Thorell, 1895) by Deeleman-Reinhold (2001). Furthermore, Reiskind (1969) removed *Mazax* from synonymy with *Apochinomma*, including the transfer of three species to *Mazax*, while one Afrotropical species has been transferred to *Corinnomma* Karsch, 1880 (Haddad 2006; Chapter 7).

In this study the Afrotropical species of *Apochinomma* are revised. Apart from *A. semiglabrum* Simon, 1896, which was recently transferred to *Corinnomma* (Haddad 2006), the type species was the only other species known from the region, and five new species are described here. Representatives of the genus are particularly good examples of the morphological adaptations to ant mimicry, including their elongate cephalothoraxes, modified abdomens and long legs to enforce an ant-like appearance (Figs 1–5). Being relatively large spiders, their models are generally larger species of ants, including *Polyrhachis* spp. (Fig. 6), *Streblognatha* and *Pachycondyla* spp. (Fig. 7). In terms of microhabitat selection, Afrotropical *Apochinomma* have been collected from the soil surface or from plants in forest and savanna habitats, in some cases reflecting the stratified vertical distribution of their models.

FIGURES 1–7. General habitus of Afrotropical *Apochinomma* species and two of their ant models: 1. *A. formicaeforme* Pavesi, 1881 male, Ndumo Game Reserve, South Africa; 2. *A. formicaeforme* juvenile, Sodwana Bay, South Africa; 3. *A. decepta* **sp. nov.** female, Bartholomew Diaz Point, Mozambique; 4. *A. decepta* **sp. nov.** subadult male, Bartholomew Diaz Point; 5. Undescribed *Apochinomma* sp. subadult female, De Hoop Nature Reserve, South Africa; 6. *Polyrhachis* sp. from Mombasa, Kenya; 7. *Pachycondyla tarsata* (Fabricius, 1798) from Ndumo Game Reserve.

3.3 MATERIAL & METHODS

The specimens included in this study were observed in 70% ethanol under a Nikon SMZ800 stereomicroscope for all descriptions, digital photographs and measurements. To illustrate the male and female genitalic structures, the male palps and epigynes of each species were dissected, cleaned in 70% ethanol in a Labcon 5019U ultrasonic bath for 30 seconds, and drawn.

Digital photographs were taken of the dorsal habitus, lateral view (except the female of *A. tuberculata* **sp. nov.**) and male emboli of each species using a Nikon Coolpix 8400 mounted on a Nikon SMZ800 stereomicroscope. For each structure, a series of digital photographs were taken and then stacked using Combine ZM software (http://www.hadleyweb.pwp.blueyonder.co.uk) to increase the depth of field.

Male and female specimens of *A. formicaeforme* were prepared for scanning electron microscopy by dehydrating the material, originally preserved in 70% ethanol, overnight in 100% ethanol. The specimens were then critical point dried in an argon chamber and glued to aluminium rivets. The material was then sputter coated with gold three times for 3 minutes and observed in a JEOL 6400 WinSEM. Digital photographs were taken of the structures observed.

All measurements provided in the descriptions are given in millimetres (mm). Body dimensions, eye and leg measurements are given for the holotype and a paratype of the opposite sex, where possible, and total length measurements are provided for the smallest and largest specimens of each to give an indication of size variation in each species. 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; 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); sa – subadult; SL – sternum length; ST – spermatheca; SW – sternum width; TL – total length. Leg spination follows the format of Bosselaers & Jocqué (2000), including the following abbreviations: do – dorsal; pl – prolateral; plv – prolateral ventral; rl – retrolateral; rlv – retrolateral ventral; vt – ventral terminal.

The material examined in this study is deposited in the following institutions (curators given in parenthesis):

BMNH – British Museum of Natural History, London, UK (Janet Baccaloni)
CAS – California Academy of Sciences, San Francisco, USA (Charles Griswold)
MRAC – Royal Museum for Central Africa, Tervuren, Belgium (Rudy Jocqué)
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)

SAM – Iziko South African Museum, Cape Town, South Africa (Margie Cochrane)
ZFMK – Zoologisches Forschungsmuseum Koenig, Bonn, Germany (Bernhard Huber)

Many of the depositories lacked locality co-ordinates on specimen labels and they were also not available in the institutional databases. In such cases they were traced using the Global Gazetteer Version 2.2 (www.fallingrain.com) and are indicated in square brackets.

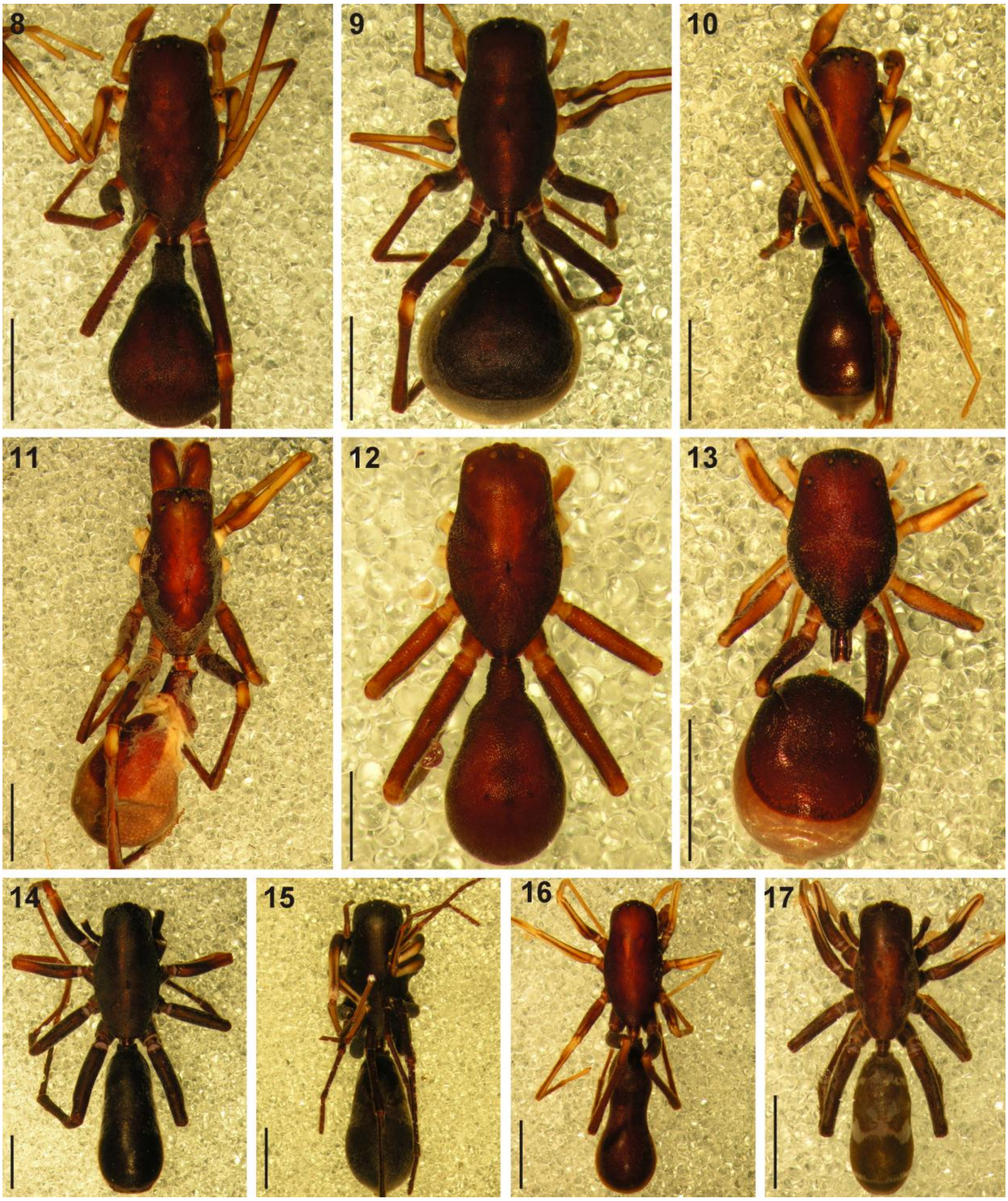
3.4 GENUS *APOCHINOMMA* PAVESI, 1881

Apochinomma Pavesi, 1881: 545; Dippenaar-Schoeman & Jocqué, 1997: 128; Deeleman-Reinhold, 2001: 326.

Type species: *Apochinomma formicaeformis* Pavesi, 1881, by original designation.

Diagnosis: *Apochinomma* species can be recognised by the elongate cephalothorax, which is usually more than twice as long as it is wide, sometimes with a median constriction; the small and widely-spaced posterior eyes in a strongly recurved row, usually separated from each other by 2 times PME diameter or more; and the fusion of the intercoxal sclerites with the pleural bars between coxae II and III, and III and IV, and the absence of such a fusion between coxae I and II. Based on the arrangement of the posterior eyes and the heavy abdominal sclerotisation, *Apochinomma* may be most closely related to *Aetius*, *Serendib* and *Sphecotypus*.

Description: Small to medium sized spiders, 4.95–13.60mm in length; carapace orange-brown to black, with black mottling and striae (Figs 8–26); carapace surface finely to coarsely granulate, covered in short straight and plumose setae, with several long curved setae on clypeus and eye region (Figs 27–31); elongate oval, eye region broad, tapering posteriorly to pedicel, usually broadest at coxa II; fovea distinct, narrow and short, rarely absent. AER procurved or straight, AME approximately 1⅓ times ALE diameter; AME separated by approximately ¾ their diameter, separated from ALE by approximately ½ AME diameter; PER strongly recurved, PME slightly larger or smaller than PLE; PME usually closer to each other than to PLE; MOQ broader posteriorly than anteriorly. Chilum split, triangular, tapering distally, strongly sclerotised; cheliceral promargin with two or three teeth,

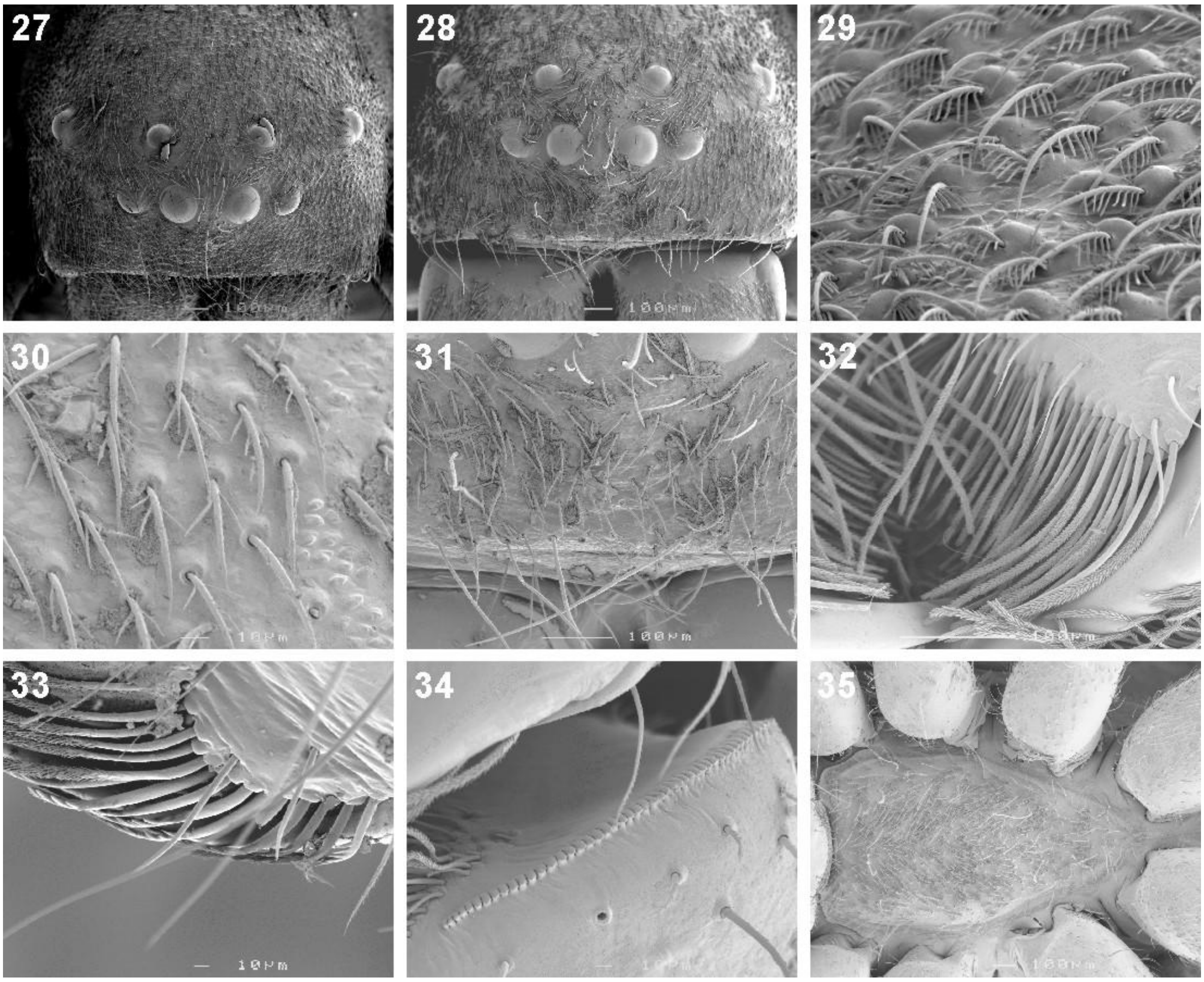


FIGURES 8–17. Digital microscope photographs of the dorsal habitus of species in the *Apochinomma formicaeforme* species group (8–13) and the *A. decepta* species group (14–17): *A. formicaeforme* Pavesi, 1881 (8, 9), *A. malkini* **sp. nov.** (10, 11), *A. parva* **sp. nov.** (12), *A. tuberculata* **sp. nov.** (13), *A. decepta* **sp. nov.** (14, 15), *A. elongata* **sp. nov.** (16) and *Apochinomma* sp. (17). 8, 10, 12, 14, 16. males; 9, 11, 13, 15. females; 17. subadult female. Scale bars: 2.0mm.

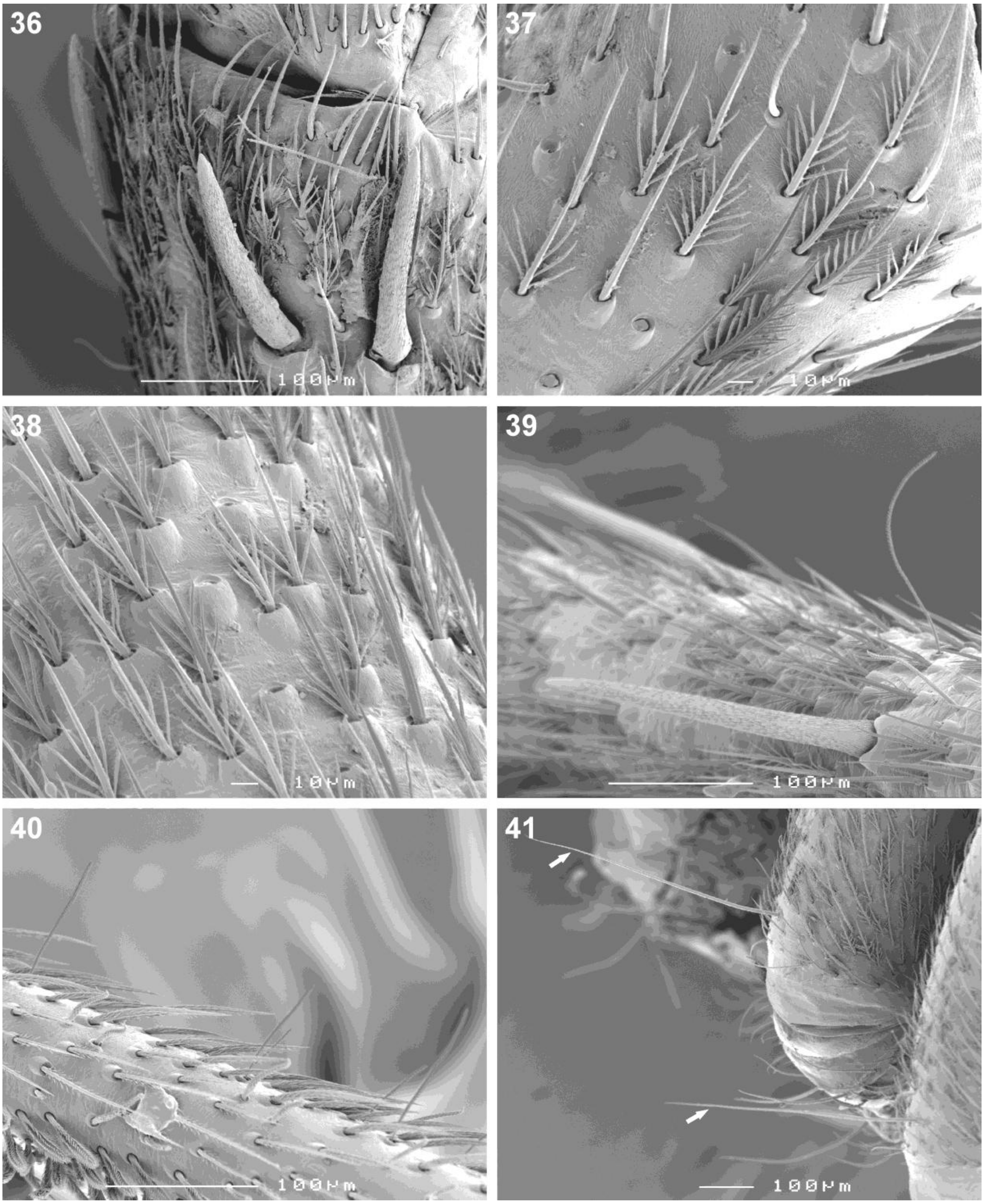
FIGURES 18–26. Digital microscope photographs of the lateral habitus of species in the *Apochinomma formicaeforme* species group (18–22) and the *A. decepta* species group (23–26): *Apochinomma formicaeforme* Pavesi, 1881 (18, 19), *A. malkini* **sp. nov.** (20, 21), *A. parva* **sp. nov.** (22), *A. decepta* **sp. nov.** (23, 24), *A. elongata* **sp. nov.** (25) and *Apochinomma* sp. (26). 18, 20, 22, 23, 25. males; 19, 21, 24. females; 26. subadult female. Scale bars: 2.0mm.

retromargin with two teeth; scrappy seta absent; curved setae on cheliceral promargin finely plumose in males (Fig. 32) and pectinate in female (Fig. 33); endites straight laterally with distinct serrula comprising sharp, ventrally curved denticles (Fig. 34), with dense maxillar hair tuft on mesal margins; labium slightly trapezoid, wider than long. Sternum longer than broad, shield-shaped, slightly narrowed anteriorly (Fig. 35); precoxal triangles present; intercoxal sclerites present between all coxal pairs; pleural bars fused to intercoxal sclerites between coxae II and III, and III and IV, isolated and not fused to intercoxal sclerites between coxae I and II. Leg formula 4123; legs with short spines, all segments except tarsi usually covered in plumose and straight setae (Figs 36–45); retrocoxal window absent on coxa I; femora with several erect ventral setae (Fig. 41); patellar indentation narrow, broad at proximal end (Figs 42, 43); tibiae, metatarsi and tarsi with several erect dorsal and lateral trichobothria with sunken basal plate (Figs 39, 40); all metatarsi and tarsi, including female palpal tarsi, with several tiny pores (Figs 44–46), possibly involved in the release of pheromone-like molecules during contact with model ants; metatarsi scopulate distally (Fig. 45), tarsi weakly scopulate along their entire length (Fig. 47); tarsal organ not examined; paired tarsal claws short, situated laterally, with very dense claw tufts in between (Fig. 47);

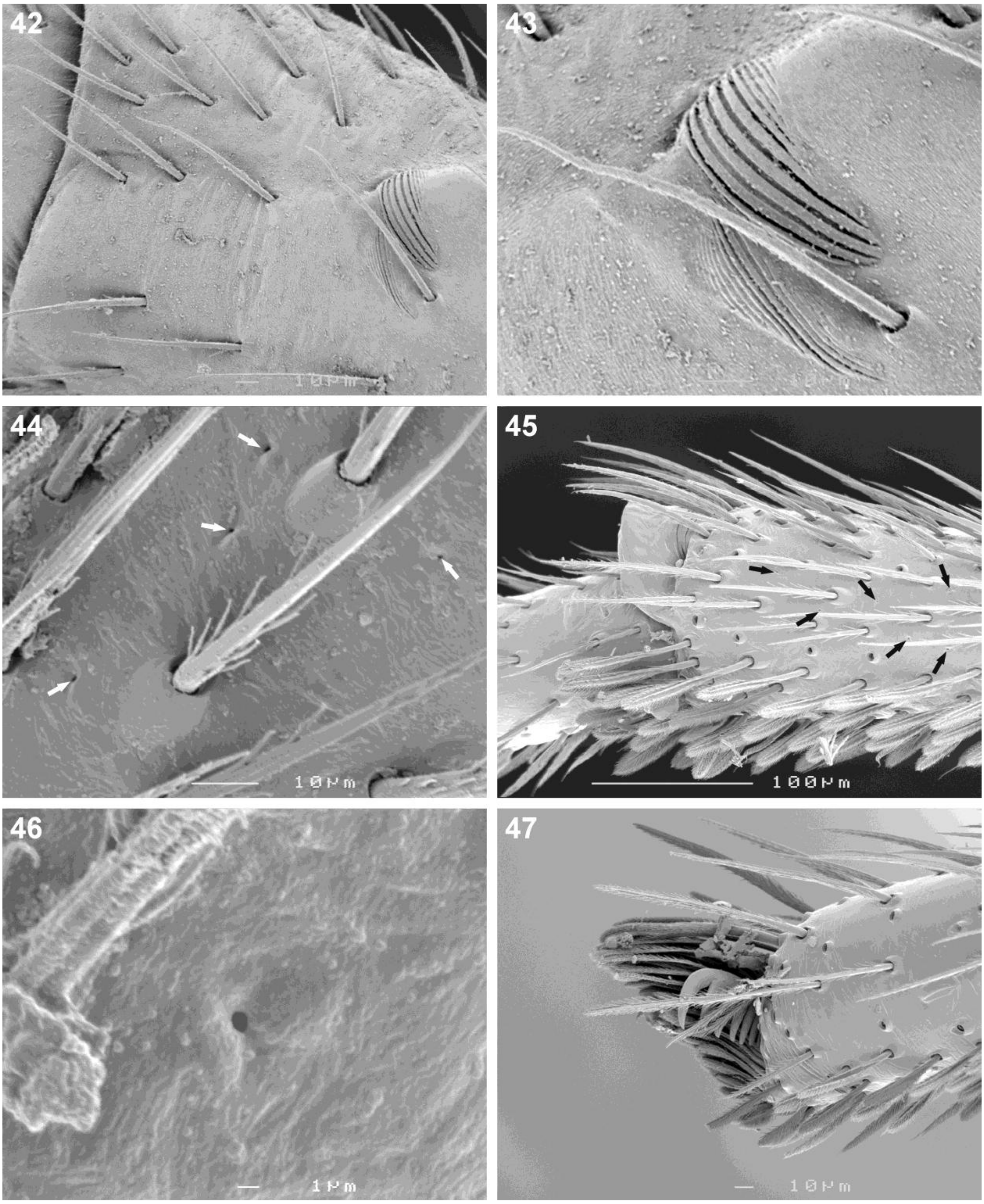
metatarsi III and IV without terminal preening brush or comb. Abdomen pear-shaped, or elongate with a median constriction, anterior with petiolate elongation (Figs 8–26, 48, 49); dorsal scutum strongly sclerotised; in males nearly covering entire dorsum, fused to petiole, epigastric sclerite and post-epigastric sclerites; in females covering ⅓ to ^{7}/8 abdomen length, clearly separate from petiole, epigastric sclerite and post-epigastric sclerites (Figs 18–26); two pairs of weakly sclerotised dorsal sigilla present; epigastric region strongly sclerotised, venter with post-epigastric sclerites; ventral sclerite present in males, absent in all females except for *A. tuberculata* **sp. nov.**; inframamillary sclerite present, distinct, fused to ventral sclerite in *A. tuberculata* **sp. nov.**. Spinnerets (only observed with SEM in *A. formicaeforme* **sp. nov.**): ALS of male (Fig. 54) with one major ampullate gland spigot, one nubbin and many piriform gland spigots; PMS of male (Fig. 55) with one large minor ampullate gland



FIGURES 27–35. Scanning electron microscope photographs of *Apochinomma formicaeforme* Pavesi, 1881 male (27, 29, 32, 34, 35) and female (28, 30, 31, 33): 27, 28. eye region, anterior view; 29, 30. carapace surface, plumose and straight setae; 31. clypeal setae; 32, 33. cheliceral promarginal bent setae, anterior view (32) and dorsal view (33); 34. serrula; 35. sternum.

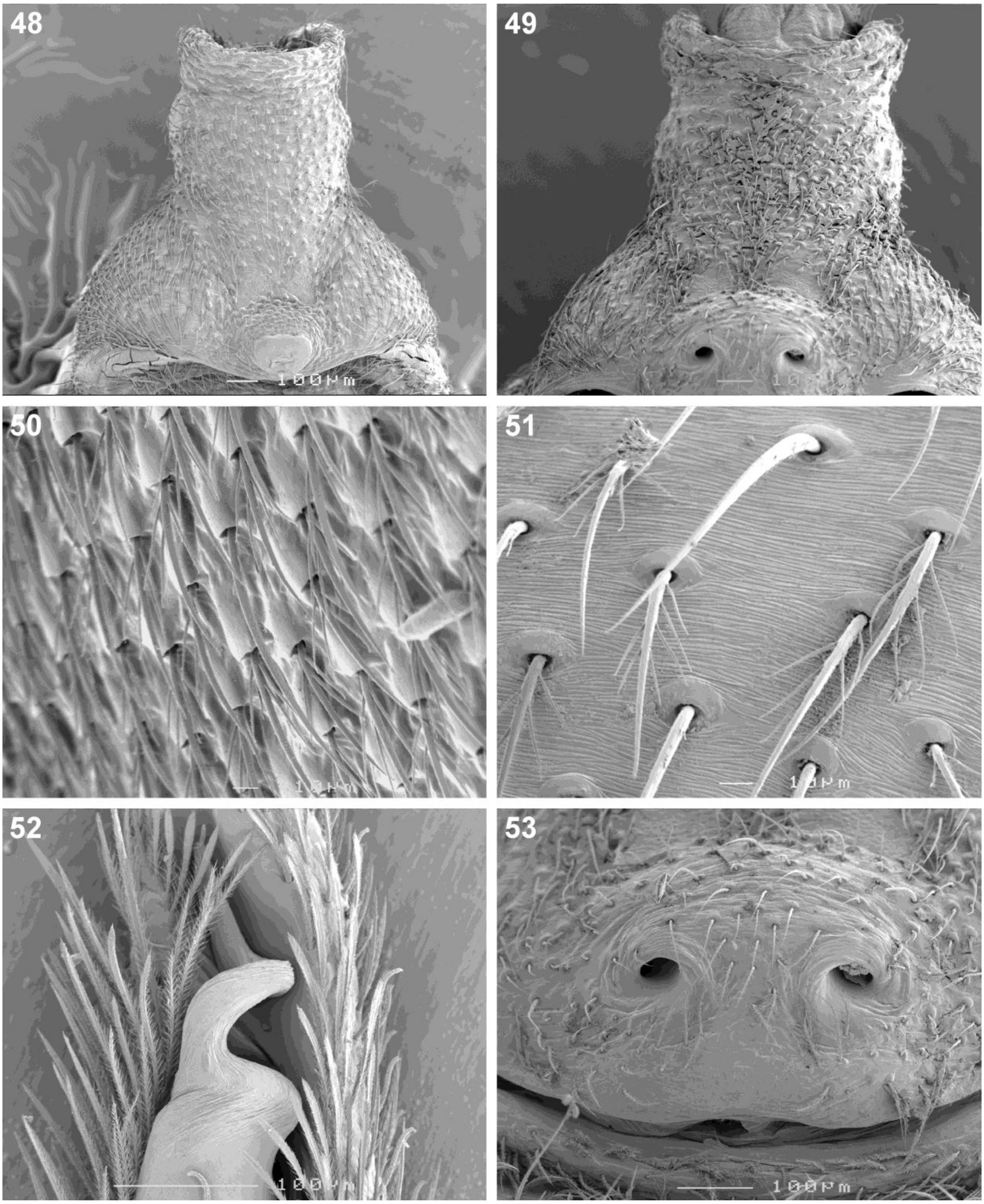


FIGURES 36–41. Scanning electron microscope photographs of *Apochinomma formicaeforme* Pavesi, 1881 female: 36. femur IV, prolateral and prolateral ventral distal spines; 37. patella I, plumose and straight setae; 38. tibia IV, plumose and straight setae; 39. metatarsus IV, dorsal spines and trichobothriae; 40. tarsus I, dorsal trichobothriae; 41. femur I (left) and II (right), arrows indicating erect ventral setae.

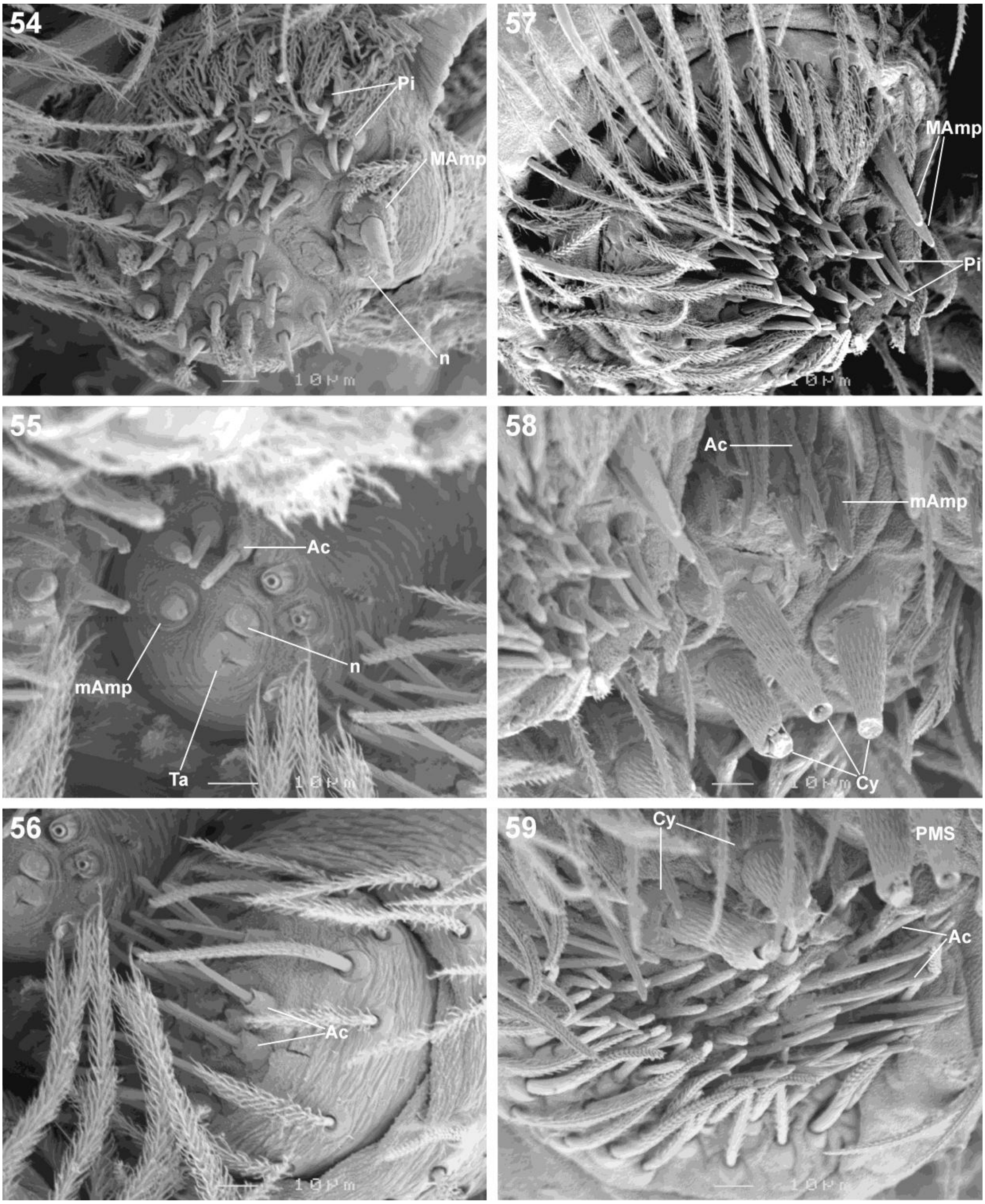


FIGURES 42–47. Scanning electron microscope photographs of *Apochinomma formicaeforme* Pavesi, 1881 male (42, 43) and female (44–47): 42. patella II, patellar indentation (PI); 43. same, detail of proximal end of PI; 44. retrolateral surface of palpal tarsus and 45. distal end of metatarsus I, arrows indicating pores; 46. palpal tarsus, detail of pore; 47. tarsus I, claw tuft.

spigot, one nubbin, one tartipore and several large aciniform gland spigots; PLS of male (Fig. 56) with only aciniform gland spigots distinguishable; ALS of female (Fig. 57) with two major ampullate gland spigots and many piriform gland spigots; PMS of female (Fig. 58) with three large cylindrical gland spigots, one small minor ampullate gland spigot and several aciniform gland spigots; PLS of female (Fig. 58) with two large cylindrical gland spigots and several aciniform gland spigots. Male palpal segments without apophyses; cymbium with



FIGURES 48–53. Scanning electron microscope photos of *Apochinomma formicaeforme* Pavesi, 1881 male (48, 50, 52) and female (49, 51, 53): 48, 49. anterior of abdomen, ventral view; 50. dorsal abdominal setae; 51. ventral abdominal setae; 52. embolus, retrolateral ventral view; 53. female epigyne, ventral view.



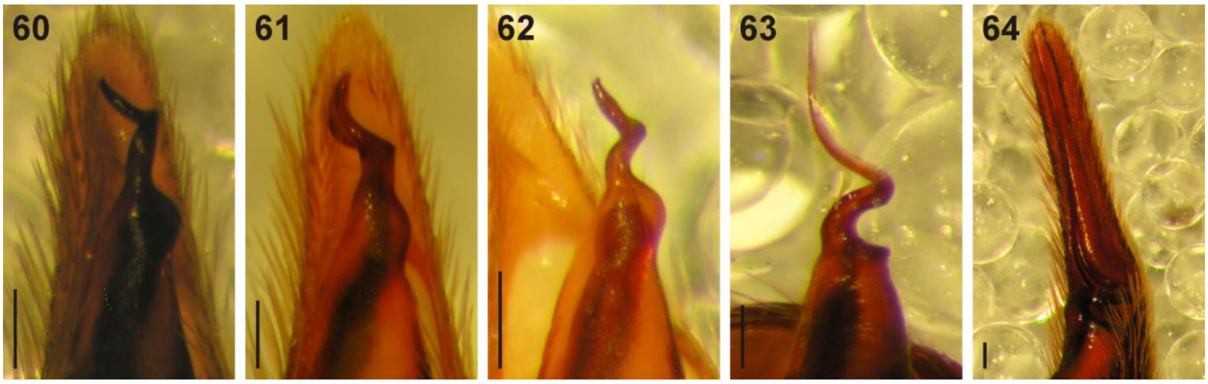
FIGURES 54–59. Scanning electron microscope photographs of *Apochinomma formicaeforme* Pavesi, 1881 male (54–56) and female (57–59) spinneret morphology: 54, 57. anterior lateral spinneret; 55, 58. posterior median spinneret; 56, 59. posterior lateral spinneret. Abbreviations: Ac–aciniform gland spigot(s); Cy–cylindrical gland spigot(s); MAmp–major ampullate gland spigot(s); mAmp–minor ampullate gland spigot(s); n–nubbin; Pi–piriform gland spigot(s); Ta–tartipore.

spines prolaterally and ventrally, without distinct modified dorsal setae; embolus short and slightly thickened in males of the *A. formicaeforme* species group (Figs 52, 60–62), less than

¼ the length of the tegulum; embolus with broad base and long fine distal section in males of the *A. decepta* species group (Figs 63, 64), more than ½ the length of the tegulum; width of base and length and curvature of distal coil variable (Figs 60–64). Female epigyne with oblique or comma-shaped sclerotised epigynal ridges, covering or leading to lateral copulatory openings (Figs 53); copulatory ducts in the *A. formicaeforme* species group directed medially and obliquely before entering ST II (e.g. Fig. 68); copulatory ducts in the *A. decepta* species group (only known for *A. decepta* **sp. nov.**) initially directed anteriorly, with multiple loops medially before entering ST II (Figs 81, 82); ST II usually oval, connected broadly to posterior ST I that are either narrow or broad, longitudinal or diverging.

Key to the Afrotropical species of *Apochinomma*

1 Males (♂ of *A. tuberculata* **sp. nov.** unknown)..2
– Females (♀ of *A. elongata* **sp. nov.** and *A. parva* **sp. nov.** unknown).................................6
2 Carapace in lateral view with slight median depression, abdomen without median constriction (Fig. 18); embolus short, less than ¼ tegulum length (*A. formicaeforme* species group)...3
– Carapace in lateral view without median depression, abdomen with slight (Fig. 23) to strong median constriction (Fig. 25); embolus long, at least ½ tegulum length (*A. decepta* species group)...5
3 Base of embolus broad; distal section of embolus directed retrolaterally (Fig. 61)................ ....*A. malkini* **sp. nov.**
– Base of embolus narrow; distal section of embolus directed prolaterally (Figs 60, 62).......4
4 Basal section of embolus nearly straight in ventral view (Fig. 60); carapace more than two times longer than broad...*A. formicaeforme* Pavesi, 1881
– Basal section of embolus distinctly curved in ventral view (Fig. 62); carapace approximately 1.83 times longer than broad...*A. parva* **sp. nov.**
5 Embolus longer than tegulum (Fig. 84)...*A. elongata* **sp. nov.**
– Embolus approximately half as long as tegulum (Fig. 78)......................*A. decepta* **sp. nov.**
6 Carapace in lateral view without median depression, abdomen with slight median constriction (Fig. 24); entrance ducts of epigyne very long, with several loops before entering anterior spermathecae (Figs 81, 82)...*A. decepta* **sp. nov.**



FIGURES 60–64. Digital microscope photographs of emboli of *Apochinomma* species in ventral view: 60. *A. formicaeforme* Pavesi, 1881; 61. *A. malkini* **sp. nov.**; 62. *A. parva* **sp. nov.**; 63. *A. decepta* **sp. nov.**; 64. *A. elongata* **sp. nov.**. Scale bars = 0.1mm.

– Carapace in lateral view with slight median depression, abdomen without median constriction (Fig. 19); entrance ducts of epigyne short and simple and without loops before entering anterior spermathecae (*A. formicaeforme* species group)......................................7

7 Carapace texture coarsely granulate; fovea absent; abdomen with heart-shaped ventral sclerite..*A. tuberculata* **sp. nov.**

– Carapace texture finely granulate; fovea present, short and narrow; abdomen without ventral sclerite, but two paired rows of tiny sclerites usually present between epigastric furrow and spinnerets..8

8 Epigyne with comma-shaped ridges with lateral copulatory openings (Fig. 72); copulatory ducts short, directed obliquely before entering anterior spermathecae (Fig. 73)................... ....*A. malkini* **sp. nov.**

– Epigyne with oblique ridges covering copulatory openings (Fig. 67); copulatory ducts initially with sharp bend, directed transversely before entering anterior spermathecae (Fig. 68)..*A. formicaeforme* Pavesi, 1881

3.4.1 *Apochinomma formicaeforme* species group

Diagnosis: Carapace in lateral view with slight median depression; abdomen pear-shaped, without median constriction; male embolus short, less than ¼ tegulum length; female epigyne with short entrance ducts directed medially from copulatory openings.

3.4.1.1 *Apochinomma formicaeforme* Pavesi, 1881

Figs 1, 2, 8, 9, 18, 19, 27–60, 65–68

Apochinomma formicaeforme Pavesi, 1881: 546; Simon, 1909: 371; Lessert, 1946: 215, fig. 14 (♀ Holotype: **MOZAMBIQUE:** Inhambane [23°51'S, 35°23'E], leg. Fornasini, 1848, not traced).

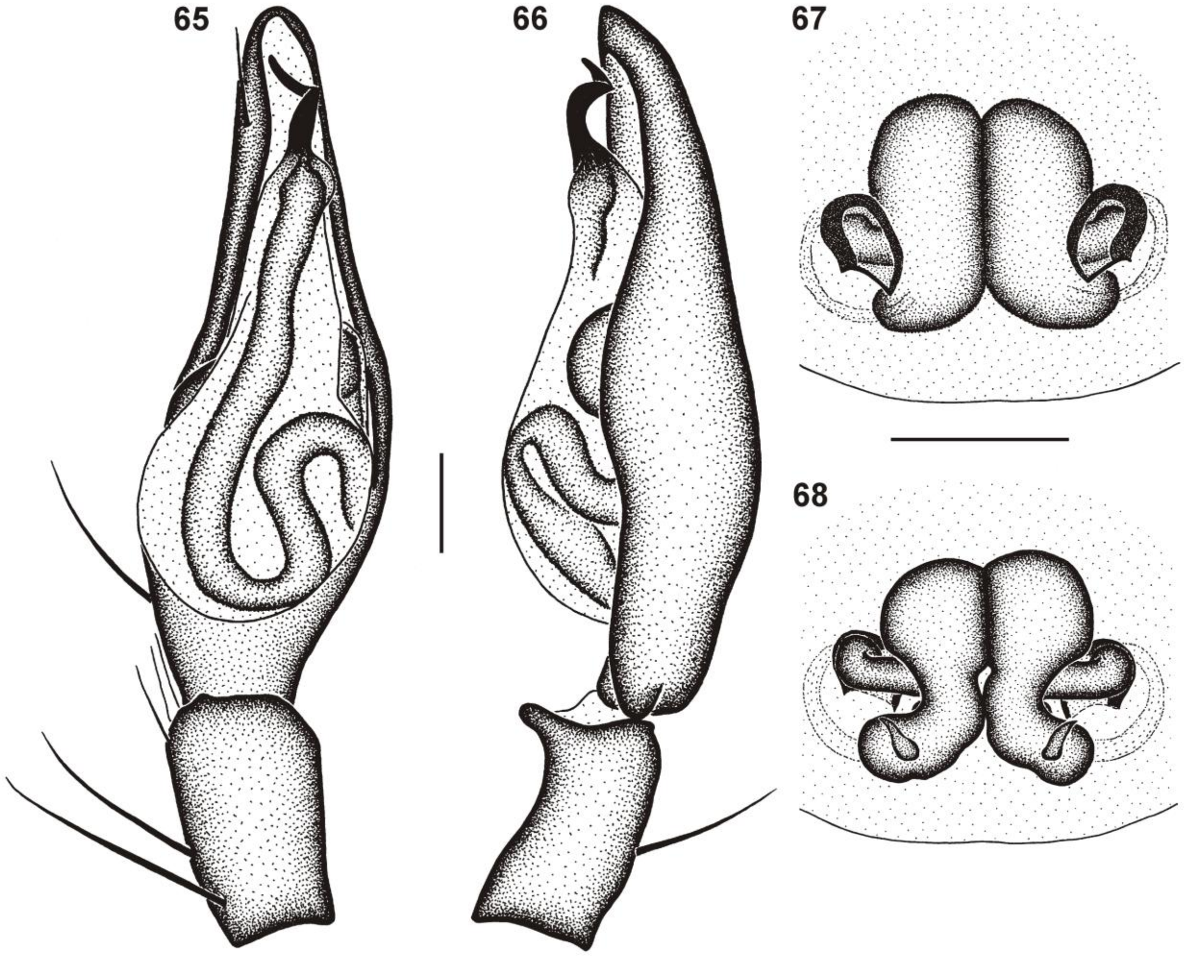
Remarks: The female holotype could not be traced in the Museo Civico di Storia Naturale "Giacomo Doria" in Genova, Italy. It seems likely that the bottle containing the collection from Inhambane was destroyed or lost during floods in 1970 and 1992 that damaged spider specimens that were stored in the basement of the museum (Maria Tavano, pers. comm.). Lessert's (1946) illustration of the dorsal habitus of *A. formicaeforme* is consistent with the specimens here considered to be this species. No adult specimens of *A. formicaeforme* have been collected in Mozambique since its description, although I have collected immatures at several localities in southern Mozambique (Xai-Xai, Marrucuene, Chidenguele and Vilankulos).

In the original description, Pavesi (1881) alludes to the fact that the abdomen of the holotype is somewhat damaged. Although not too detailed regarding abdominal structure, the description indicates two characteristics consistent with the specimens treated here as *A. formicaeforme* that separate it from *A. decepta* **sp. nov.**, which is also recorded from Mozambique: 1) abdomen with long stalk [petiolate pedicel], which is quite short in *A. decepta* **sp. nov.**; 2) abdomen 2.5mm long and wide; in the female redescribed here the abdomen is 1.25 times longer than wide, while in *A. decepta* **sp. nov.** it is nearly twice as long as wide. I have refrained from designating a neotype until adult *Apochinomma* can be collected from Inhambane or nearly localities to confirm the species' identification.

Male (Ophathe, NCA 2008/2874). Measurements: CL 3.45, CW 1.70, AL 3.53, AW 1.88, TL 6.68 (5.60–10.30), FL 0.16, SL 1.40, SW 0.85, AME–AME 0.10, AME–ALE 0.06, ALE–ALE 0.52, PME–PME 0.29, PME–PLE 0.34, PLE–PLE 1.08, PERW 1.22, MOQAW 0.40, MOQPW 0.48, MOQL 0.38.

Length of leg segments: I 1.83 + 0.53 + 1.86 + 1.59 + 1.13 = 6.94; II 1.78 + 0.55 + 1.63 + 1.45 + 1.00 = 6.41; III 1.63 + 0.61 + 1.38 + 1.50 + 0.80 = 5.92; IV 2.25 + 0.63 + 1.87 + 2.30 + 0.97 = 8.02.

General appearance in Figs 1 & 8. Carapace elongate oval, eye region broad, tapering posteriorly to pedicel, broadest at coxa II; raised gently from eye region, with median depression, highest at ⅔ carapace length (Fig. 18); surface finely granulate, covered in white plumose setae, with scattered short straight setae; several long erect setae in eye region and on clypeus; fovea short, narrow, at ⅔ carapace length; three shallow depressions radiating from fovea, first to coxa I, second to between coxae II and III, third between coxae III and IV, resulting in slight concavities in lateral carapace margins; carapace very dark brown, nearly black, with distinct black striae and black mottling. All eyes with black rings; AER slightly procurved, medians larger than laterals; AME separated by distance equal to ⅔ their diameter; AME separated from ALE by distance equal to $^2/5$ AME diameter; clypeus height equal to distance 1⅓ times AME diameter; PER strongly recurved, laterals slightly larger than medians; PME separated by distance equal to $2^5/6$ times their diameter; PME separated from PLE by distance 3⅓ times PME diameter; CW:PERW = 1.42:1. Chelicerae dark red-brown with black mottling, yellow distally prolaterally, covered in short straight setae, with scattered erect straight setae on anterior surface; three teeth on promargin, distal tooth smallest, tiny, median tooth largest; median and distal teeth adjacent, proximal tooth clearly separate from median tooth; retromargin with two slightly separated teeth close to fang base, distal tooth slightly smaller than proximal tooth; endites dark brown, paler prolaterally, cream at maxillar hair tuft; labium brown, cream distally; sternum shield-shaped, elongate, dark brown with black mottling; surface finely granulate, densely covered in short straight and plumose white setae, with scattered long erect straight setae. Legs with surface of all segments except tarsi finely granulate, tarsi finely wrinkled; legs covered in short straight setae, plumose setae dense on dorsal surface of femora, patellae and tibiae, sparse on metatarsi, absent on tarsi; femora I and II yellow, black proximally, with pro- and retrolateral black stripes; femora III and IV black, dark orange-brown dorsally distally; patellae I and II yellow with pro- and retrolateral black stripes, fused distally; patellae III black; patellae IV yellow, with broad proximal and distal black markings, fused dorsally; tibiae I and II yellow, with black pro- and retrolateral stripes; tibiae III and IV black, dark orange-brown dorsally at distal end; metatarsi and tarsi I and II yellow-brown with black mottling; metatarsi III and IV black, dark orange distally; tarsi III and IV yellow-brown with black mottling. Leg spination: femora: I pl 1 do 3, II pl 2 do 3 rl 1-2, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; patellae: all with distal do seta; tibiae: I plv 2 rlv 2, II plv 2 rlv 1, III pl 2 rl 2 plv 1, IV pl 2 rl 2 plv 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: do 1; patellae: pl 1 do 1; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 2. Abdomen pear-shaped, broad and round posteriorly, with long pedicel; dorsal scutum black,



FIGURES 65–68. Genitalic morphology of *Apochinomma formicaeforme* Pavesi, 1881: 65. male palp, ventral view; 66. same, retrolateral view; 67. female epigyne, ventral view; 68. same, dorsal view. Scale bars = 0.25mm.

covering entire dorsum, fused to pedicel anteriorly and epigastric plate and post-epigastric sclerites ventrally; two pairs of sigilla present near midpoint of dorsum; dorsum covered in white plumose setae, with two broad dense transverse bands of white plumose setae at ⅓ and ⅔ abdomen length; venter mottled grey, covered in short straight and plumose black setae, with white plumose setae covering ventral sclerite; venter with deep red-brown rectangular ventral sclerite; inframamillary sclerite red-brown, subtriangular. Male palpal segments yellow-brown with black mottling; tegulum pear-shaped, yellow-brown, with black insemination ducts; embolus short, with narrow, slightly curved base, directed retrolaterally distally; embolus tip slightly broadened and weakly curved, directed prolaterally distally (Figs 60, 65, 66).

Female (Tembe, NCA 2006/1374). Measurements: CL 4.75, CW 2.46, AL 3.95, AW 3.15, TL 8.95 (6.65–10.50), FL 0.23, SL 1.83, SW 1.20, AME–AME 0.13, AME–ALE 0.08, ALE–ALE 0.59, PME–PME 0.32, PME–PLE 0.42, PLE–PLE 1.37, PERW 1.51, MOQAW 0.46, MOQPW 0.54, MOQL 0.49.

Length of leg segments: I 2.60 + 0.80 + 2.64 + 2.28 + 1.53 = 9.85; II 2.40 + 0.80 + 2.30 + 2.03 + 1.30 = 8.83; III 2.13 + 0.85 + 1.89 + 1.90 + 1.03 = 7.80; IV 3.00 + 0.98 + 2.55 + 2.95 + 1.17 = 10.65.

General appearance in Fig. 9, lateral view in Fig. 19. Morphology similar to male except for the following: AER straight, medians larger than laterals; AME separated by distance slightly larger than ¾ their diameter; AME separated from ALE by distance slightly less than ½ AME diameter; clypeus height equal to distance 1¾ times AME diameter; PER strongly recurved, medians very slightly larger than laterals; PME separated by distance slightly larger than 2½ times their diameter; PME separated from PLE by distance equal to $3^2/5$ times PME diameter; CW:PERW = 1.63:1. Leg spination: femora: I pl 1 do 2, II pl 1 do 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; patellae: all with single distal do seta; tibiae: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 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 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora: do 1; patellae: pl 1 do 1; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 rl 1 plv 2 rlv 2. Abdomen teardrop-shaped with long pedicel, with dark red-brown dorsal scutum extending to $^7/8$ abdomen length; posterior tip of dorsum mottled dark grey; two pairs of sigilla present near midpoint of dorsum; dorsum covered in white plumose setae, with broad black bands at ¼ and ⅔ abdomen length, dense band of white plumose setae behind midpoint; venter mottled grey, with dense broad transverse band of white plumose setae behind epigastric furrow, followed by band of black plumose setae, posterior covered in short straight and plumose black setae; two paired rows of tiny sclerites from epigastric furrow to spinnerets; epigastric region strongly sclerotised, post-epigastric sclerites weakly sclerotised; ventral sclerite absent; inframamillary sclerite distinct, orange-brown, subtriangular. Epigyne with oblique lateral copulatory openings at midpoint of epigyne (Fig. 67); copulatory ducts short, initially directed dorsally before bending transversely towards midline, entering oval anterior ST II posterolaterally; ST II broadly connected to diverging posterior ST I (Fig. 68).

Material examined: BOTSWANA: Maun, Maphaneng Pan/Lagoon [19°55'S, 23°26'E], leg. A. Russell-Smith, 30.I.1977 (riverine woodland, spun up in shrubs), 1♀ (BMNH); Same locality, leg. F. Wanless & A. Russell-Smith, 1.IV.1976 (riverine woodland, ground layer), 1sa♀ (BMNH). **CAMEROON:** Ebolowa, Nkoumvom

[02°55'N, 11°09'E], leg. M.C. Day, XII.1980 (pitfall traps), 1♂ (BMNH); Mabete [Mabeta, 04°00'N, 09°17'E], leg. B. Malkin, 24.V–7.VI.1949, 1♀ (CAS, CASENT 9033086); Same data, 1♀ (CAS, CASENT 9033108). **CENTRAL AFRICAN REPUBLIC:** Prefacture Sangha-Mbaéré, Réserve Spéciale de Forêt Dense de Dzanga-Sangha, 12.7km 326° NW Bayanga, 03°00'18"N, 16°11'36"E, 420m a.s.l., leg. B.L. Fisher, 10–17.V.2001 (beating low vegetation, rainforest), 2♂ (CAS, CASENT 9033204, BLF 4087). **D.R. CONGO:** *Bas Congo*: Bas-Fleuve, Boma, 05°51'S, 13°03'E, leg. H. Schouteden, 8.IX.1920, 1♀ (MRAC 12440); Kisantu, 05°08'S, 15°06'E, leg. R.P. Vanderyst, no date, 1♀ (MRAC 15542); Luki [05°39'S, 13°04'E], leg. Pieters, 1924, 1♀ (MRAC 12429); Bas-Congo, Mayombe, Luki Forest Reserve, 05°37'S, 13°05'E, leg. D. de Bakker & J.P. Michiels, 8.XI.2006 (beating along trail near guest house), 1♂ 1♀ (MRAC 219949); Same locality, leg. D. de Bakker & J.P. Michiels, 13.XI.2006 (primary rainforest, fogging 5), 1♀ (MRAC 220932); Same locality, leg. D. de Bakker & J.P. Michiels, 16.XI.2006 (beating, secondary forest), 1♀ (MRAC 219815); Same locality, leg. D. de Bakker & J.P. Michiels, 16.IX.2007 (young secondary rainforest), 1♂ 1♀ (MRAC 222950); Haut Uélé, Moto, 03°15'N, 29°20'E, leg. L. Burgeon, no date, 1♀ (MRAC 15532). **GABON:** Ivindo [Ivoundou, 02°54'S, 11°30'E], leg. A. Pauly, 2.V.1986, 1♀ (MRAC 173071); Woleu-N'Tem, entre Médoneu et Foulebeng [Medouneu, 00°57'N, 10°47'E], leg. A. Pauly, 19.III.1987, 1♀ (MRAC 208490). **GHANA:** Kakum forest, 05°20'N, 01°23'W, leg. R. Jocqué, D. de Bakker & L. Baert, 18.XI.2005 (primary forest, fogging), 1♂ (MRAC 218264); Same data, 25.XI.2005, 1♀ (MRAC 218292); Same locality, leg. R. Jocqué, D. de Bakker & L. Baert, 17.XI.2005 (secondary forest, fogging), 1♂ (MRAC 218257); Same data, 22.XI.2005, 1♂ 1♀ (MRAC 218279); Same data, 24.XI.2005, 1♂ (MRAC 218290). **IVORY COAST:** Appouesso, Bossematié, 06°35'N, 03°28'W, leg. R. Jocqué, 15.XI.1995 (rain forest, station 3), 1♂ (MRAC 202690); Bouaké, F.-Foro, 07°41'N, 05°02'W, leg. G. Couturier, 2–4.XII.1974 (piège coloré), 1♂ (MRAC 216416); Dingouine [07°39'N, 07°37'W], leg. A. Russell-Smith, 25.VII.1995 (lowland rice), 2♀ (BMNH). **KENYA:** Western region, Kakamega Forest, 00°13'N, 34°54'E, leg. D. Shilabira Smith, 31.VIII.2002 (pitfall trap), 1♂ (MRAC 220529); Same locality, 00°22'N, 34°50'E, 1600m a.s.l., leg. W. Freund, I–II.2002 (canopy fogging, *Teclea nobilis*, old secondary forest), 1♂ (ZFMK). **NAMIBIA:** Caprivi Strip, Kwando River [18°S, 23°E], leg. F. Wanless & A. Russell-Smith, 24.III.1976 (*Phragmites* and *Papyrus*), 1♀ (BMNH). **NIGERIA:** Ibadan, IITA, 07°14'N, 03°30'E, leg. A. Russell-Smith, 23.VIII.1980 (beating fallow bush), 1♂ (MRAC 177332); Same locality, leg. A. Russell-Smith, 28.VII.1974 (fallow bush), 1imm. 1♂ 1♀ (BMNH). **SOUTH AFRICA:** *KwaZulu-Natal Province*: Durban, Happy Valley Nature Reserve [29°56'S, 30°59'E], near Bluff, leg. P. Reavell, 7.I.1984 (open grassland, with *Camponotus* and *Polyrhachis gagates* ants), 1imm. 1♂ (NMSA 22000); Empangeni [28°45'S, 31°54'E], leg. P. Reavell, XII.1986 (in garden, with *Polyrhachis gagates* ants), 1♀ (NMSA 22005); Empangeni, Addison Park, 28°45'S, 31°54'E, leg. P. Reavell, 31.II.1984 (dense grass, with *Polyrhachis gagates* ants), 1♀ (NMSA 18270); iSimangaliso Wetlands Park, Hell's Gate block A, 28.00°S, 32.48°E, leg. J. Esterhuizen, 15.XI.2004 (tsetse fly traps), 1♂ (NCA 2010/284); Kosi Bay, Manguzi Forest, 26°58'S, 32°44'E, 80m a.s.l., leg. P. Reavell, 10.I.1985 (grass and shrubs, with *Polyrhachis gagates* ants), 1♂ (NMSA 22003); Same locality, leg. P. Reavell, 9.I.1985 (in crevice of *Ficus vogeli*, near *Polyrhachis gagates* ants), 1♂ 1♀ (NMSA 22004); La Mercy [29°37'S, 31°08'E], leg. C.J. Cilliers, 10.II.1981 (sweeps, grass), 1♀ (NCA 81/251); Mac's Pass, near Ingwavuma, Ingwavuma River [27°04'S, 32°00'E], leg. P. Reavell, 13.I.1980 (herb layer, riverine bush, with *Polyrhachis gagates* ants), 1♀ (NMSA 13173); Natal, G.F. Leigh, 1♀ (BMNH); Ndumo Game Reserve, subtropical bush, 26°53'S, 32°15'E, leg. C. Haddad, 12.VIII.2000 (beats, foliage, with *Polyrhachis gagates* ants), 3imm. 1♂ 1♀

(NCA 2002/368); Ophathe Game Reserve, Overgrazed savanna, 28°22.135'S, 31°23.363'E, 560m a.s.l., leg. C. Haddad, 3.X.2008 (beats, shrubs), 1♂ (NCA 2008/2874); Same locality, Ophathe River bed, 28°23.727'S, 31°23.643'E, 455m a.s.l., leg. C. Haddad, 2.X.2008 (beats, short shrubs), 2imm. 1♂ (NCA 2008/2880); Richards Bay, 28°46'S, 32°06'E, leg. P. Reavell, 4.II.1983, 1♂ (NCA 95/118); Richards Bay nursery, 28°46'S, 32°06'E, leg. P. Reavell, 28.XII.1979 (subcoastal bush, dense herbs and climbers, with *Polyrhachis gagates* ants), 1♂ (NMSA 13133); Sodwana Bay, Camp site [27°33'S, 32°39'E], leg. C. Car, 4.V.1981, 1♀ (SAM C560); St Lucia, 28°05'S, 32°25'E, leg. J.T. Doyen, 23.XI.1985, 1♂ (NMSA 22002); St Lucia, Dukuduku Forest [28°22'S, 32°19'E], leg. M. Filmer, 7.XI.1990 (in leaf litter), 1sa♀ (NCA 91/804); St Lucia, Smith's Farm, 28°20'S, 32°25'E, 40m a.s.l., leg. P. Reavell, 12.I.1986 (grassveld in sandveld bush, with *Polyrhachis gagates* ants), 1♀ (NMSA 22001); Tembe Elephant Park, Open woodland/sand, 27°03'S, 32°25'E, leg. C. Haddad, 10.I.2002 (under log), 1♀ (NCA 2002/371); Same locality, Closed woodland/sand, 27°04'S, 32°27'E, leg. C. Haddad, 13.I.2002 (on ground), 1♂ (NCA 2002/372); Same locality, Sand forest nr viewing tower, 27°01.713'S, 32°24.559'E, leg. C. Haddad, 7.I.2002 (fogging, short shrubs), 1imm. 1♀ (NCA 2006/1374). *Limpopo Province*: Tzaneen, 23°50'S, 30°09'E, leg. D. Swart, 10.VII.1993 (on slides in avocado tree), 1imm. 1sa♂ 3sa♀ (NCA 94/38). *North-West Province*: Rustenburg, 25°39'S, 27°14'E, leg. M. Stiller, 25.IV.1980 (sweeps, grass), 1sa♀ (NCA 94/117). **TANZANIA:** Amani [05°06'S, 38°38'E], 850m a.s.l, leg. E.S. Ross & R.E. Leech, 9.XI.1957, 1♀ (CAS, CASENT 9033095, together with 1♂ *Merenius* sp.). **UGANDA:** Budongo Forest, 01°45'N, 31°25'E, 1200m a.s.l., leg. T. Wagner, 15–25.I.1997 (canopy fogging, *Rinorea beniensis*, secondary forest), 1♂ (ZMFK); Same locality, leg. T. Wagner, 11–20.VII.1995 (canopy fogging, *Teclea nobilis*, swamp forest), 1♂ (ZMFK); Rukungiri district, Buhoma Bwindi Impenetrable National Park, 00°59'S, 29°36'E, 1400m a.s.l., leg. C. Griswold & G. Mayoba, 20–24.IX.1996 (sweeping and beating forest understory), 1♀ (CAS, CASENT 9033283). **ZIMBABWE:** Batoka Gorge, 1726C3, 29–30.vii.1990, F. Nyathi, 2sa♀ (NMZA 8439); Same locality, 30–31.X.1990, V. & B. Roth, 1sa♀ (NMZA 9074); Sohwe River, below escarpment, 1631A3, 6.IV.1991, F. Nyathi, 1sa♀ (NMZA 8869).

Distribution: Widespread throughout the Afrotropical Region (Fig. 69).

Biology: This species was mainly collected from the foliage of trees and shrubs in forest and savanna habitats. Considering its broad distribution range, it is unlikely to be associated with a particular species of *Polyrhachis* ants, which are very diverse in the Afrotropical Region, with 47 species that are largely sympatric with the distribution of *A. formicaeforme* (Bolton 1973). A single case has been observed of an *A. formicaeforme* female preying on a *Polyrhachis* ant (Holm & Dippenaar-Schoeman 2010, fig. 12.378) but this is not adequate evidence to suggest that the species (and indeed, others in the genus) is an aggressive mimic or stenophagous myrmecophage.

FIGURE 69. Distribution of *Apochinomma formicaeforme* Pavesi, 1881 in the Afrotropical Region.

3.4.1.2 *Apochinomma malkini* sp. nov.

Figs 10, 11, 20, 21, 61, 70–73

Etymology: This species is named for Borys Malkin in recognition of his valuable collections of spiders made throughout tropical Africa, including the types of this species.

Diagnosis: The species is easily recognisable by the broadened embolus of the males with the tip directed distally and retrolaterally (Fig. 61), and by the broad coiled comma-shaped ridges surrounding the copulatory openings in the female epigyne (Fig. 72).

Remark: The abdomen of the female paratype is separated from the carapace, and the total length provided here is an approximation based on the sum of the carapace and abdomen lengths, not including possible extension of the pedicel.

Male (holotype, Iseri, CAS). Measurements: CL 3.60, CW 1.80, AL 3.75, AW 1.89, TL 7.35, FL 0.20, SL 1.50, SW 1.03, AME–AME 0.11, AME–ALE 0.05, ALE–ALE 0.52, PME–PME 0.24, PME–PLE 0.21, PLE–PLE 0.92, PERW 1.06, MOQAW 0.43, MOQPW 0.46, MOQL 0.37.

Length of leg segments: I 2.40 + 0.63 + 2.55 + 2.27 + 1.45 = 9.30; II 2.31 + 0.60 + 2.24 + 2.10 + 1.30 = 8.55; III 2.00 + 0.65 + 1.80 + 1.97 + 0.98 = 7.40; IV 2.84 + 0.73 + 2.43 + 2.97 + 1.20 = 10.17.

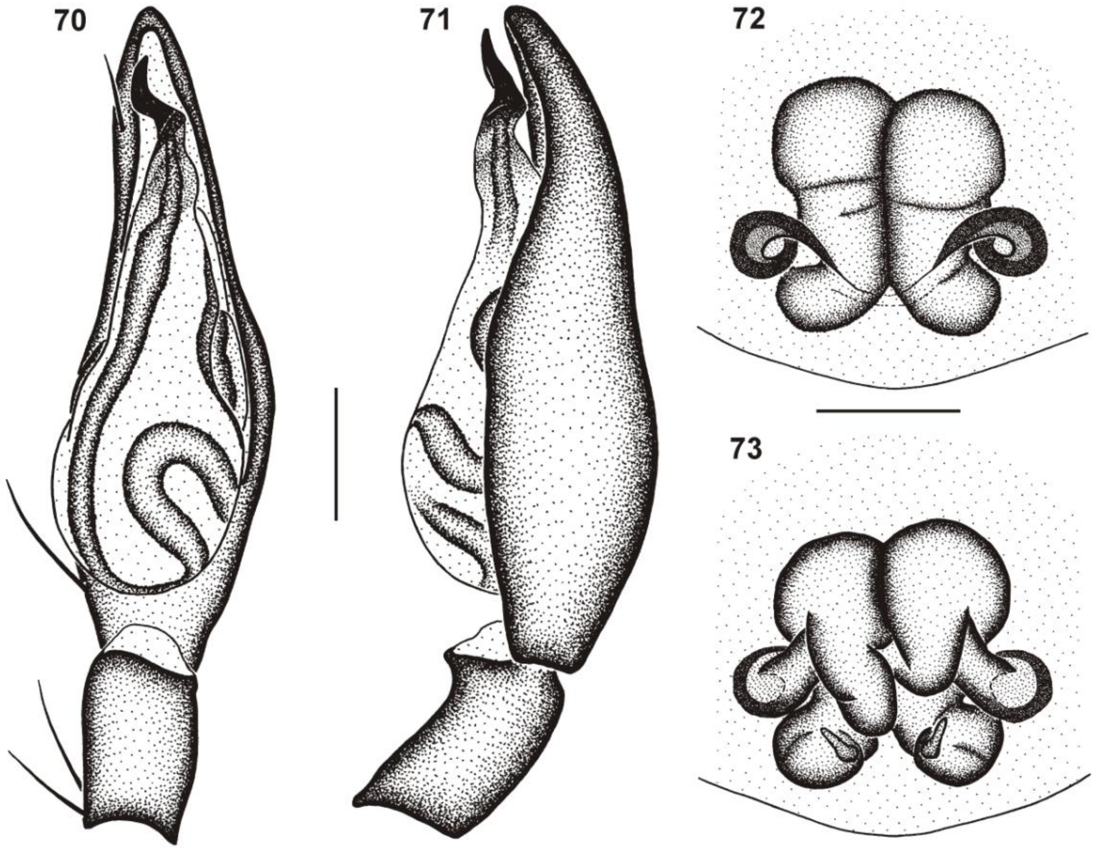
General appearance in Fig. 10. Carapace elongate oval, eye region broad, tapering posteriorly to pedicel, broadest at coxa II; raised gently from eye region, with median depression, highest at ⅔ carapace length (Fig. 20); surface finely granulate, covered in white plumose setae, with scattered short straight setae in eye region and on clypeus; fovea short, narrow, at ⅔ carapace length; carapace deep orange-brown, with distinct black striae and black mottling, eye region slightly darker between anterior eyes. All eyes with black rings; AER straight, medians larger than laterals; AME separated by distance equal to $^{3}/5$ their diameter; AME separated from ALE by distance slightly larger than ½ ALE diameter; clypeus height equal to $1^{1}/6$ times AME diameter; PER strongly recurved, medians very slightly larger than laterals; PME separated by distance equal to 2 times their diameter; PME separated from PLE by distance slightly less than 2 times PME diameter; CW:PERW = 1.70:1. Chelicerae orange-brown, with scattered erect straight setae on anterior surface; three teeth on promargin, distal tooth smallest, tiny, median tooth largest; median and distal teeth closer to each other than to proximal tooth; retromargin with two slightly separated teeth close to fang base, distal tooth slightly smaller than proximal tooth; endites orange-brown, cream at maxillar hair tuft; labium orange-brown, cream distally; sternum shield-shaped, elongate, orange-brown with faint brown mottling; surface finely granulate, densely covered in white short straight setae, with scattered white plumose and long erect straight setae. Legs with surface of all segments except tarsi finely granulate, tarsi finely wrinkled; legs covered in short straight setae, plumose setae dense on dorsal surface of femora, sparse on other segments, absent on tarsi; femora I and II yellow, with pro- and retrolateral black stripes, black proximally; femora III and IV dark brown, with pro- and retrolateral black stripes, yellow at distal end dorsally; patellae I and II yellow with faint pro- and retrolateral black mottling; patellae III and IV yellow, with broad black proximal and distal markings, narrowly linked with pro- and retrolateral black mottling; tibiae, metatarsi and tarsi I and II yellow with black mottling; tibiae III and IV dark brown with black mottling, yellow dorsally at distal end of tibiae IV; metatarsi III yellow with black mottling; metatarsi IV dark brown, yellow dorsally at distal end; tarsi III and IV yellow with faint black mottling. Leg spination: femora: I pl 2 do 3, II pl 2 do 3, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; patellae: all without distal do seta or spine; tibiae: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 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 3 rl 3 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 do 1; tibiae: pl 1 plv 1; tarsi: plv 2. Abdomen pear-shaped, broad and round posteriorly, with long pedicel; dorsal scutum dark red-brown with black mottling, nearly covering entire dorsum, fused to pedicel anteriorly and epigastric plate and post-epigastric sclerites ventrally; sigilla indistinct; narrow mottled dark grey unsclerotised section present behind scutum above spinnerets; dorsum sparsely covered in white plumose setae; venter mottled dark grey, covered in short straight black setae, with scattered white plumose setae behind epigastric furrow, extending halfway to spinnerets; venter with red-brown rectangular ventral sclerite with black mottling, with single paired row of tiny sclerites continuous with lateral margin of ventral sclerite; inframamillary sclerite yellow-brown, subtriangular. Male palpal segments yellow-brown with faint black mottling; tegulum pear-shaped, creamy-yellow, with dark red-brown insemination ducts; embolus short, with single coil, basal section broad and slightly curved; embolus tip broadened, slightly curved, directed retrolaterally and distally (Figs 61, 70, 71).

Female (paratype, Iseri, CAS). Measurements: CL 4.39, CW 2.18, AL 4.60, AW 2.80, TL ~9.00, FL 0.21, SL 1.83, SW 1.15, AME–AME 0.13, AME–ALE 0.06, ALE–ALE 0.59, PME–PME 0.26, PME–PLE 0.29, PLE–PLE 1.06, PERW 1.25, MOQAW 0.49, MOQPW 0.54, MOQL 0.46.

Length of leg segments: I 2.78 + 0.80 + 2.93 + 2.45 + 1.50 = 10.46; II 2.75 + 0.78 + 2.65 + 2.35 + 1.45 = 9.98; III 2.40 + 0.85 + 2.15 + 2.23 + 1.10 = 8.73; IV 3.40 + 0.93 + 2.90 + 3.35 + 1.23 = 11.81.

General appearance in Fig. 11, lateral view in Fig. 21. Morphology as for male except the following: AER straight, medians larger than laterals; AME separated by distance equal to ⅔ their diameter; AME separated from ALE by distance slightly less than ⅓ AME diameter; clypeus height equal to $1^{1}/6$ times AME diameter; PER strongly recurved, medians very slightly larger than laterals; PME separated by distance equal to 1⅔ times their diameter;

PME separated from PLE by distance equal to 2 times PME diameter; CW:PERW = 1.74:1. Leg spination: femora: I pl 2 do 3, II pl 1 do 3, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; patellae: all without distal do seta or spine; tibiae: I plv 2 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 1 vt 2, IV pl 2 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: do 1; patellae: do 1; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 rl 1 plv 2. Abdomen teardrop-shaped with long pedicel, with red-brown dorsal scutum extending slightly passed midpoint; posterior half of dorsum mottled dark grey with small cream spots; sigilla indistinct; dorsum covered with white short straight and plumose setae; venter pale creamy-grey, with two paired rows of tiny sclerites from epigastric furrow to spinnerets; epigastric region strongly sclerotised, post-epigastric sclerites weakly sclerotised; ventral sclerite absent; inframamillary sclerite distinct, red-brown; ventral setae pale, short and straight. Epigyne with broad coiled comma-shaped ridges with lateral copulatory openings at midpoint of epigyne (Fig. 72); copulatory ducts short, oblique, entering round anterior ST II posterolaterally; ST II broadly connected to diverging posterior ST I (Fig. 73).



FIGURES 70–73. Genitalic morphology of *Apochinomma malkini* **sp. nov.**: 70. male palp, ventral view; 71. same, retrolateral view; 72. female epigyne, ventral view; 73. same, dorsal view. Scale bars = 0.25mm.

Type material: Holotype ♂: **NIGERIA:** Lagos State, Iseri [Isheri, 06°38'N, 03°23'E], leg. B. Malkin, 27–30.XII.1948 (CAS, CASENT 9033081).
Paratype: Same data as holotype, 1♀ (CAS, CASENT 9033102).

Additional material examined: none.

Distribution: Known from the type locality (Fig. 86).

Biology: Collected from forests in southern Nigeria.

3.4.1.3 *Apochinomma parva* sp. nov.

Figs 12, 22, 62, 74, 75

Etymology: The specific name is Latin for small, diminutive, referring to the size of the species.

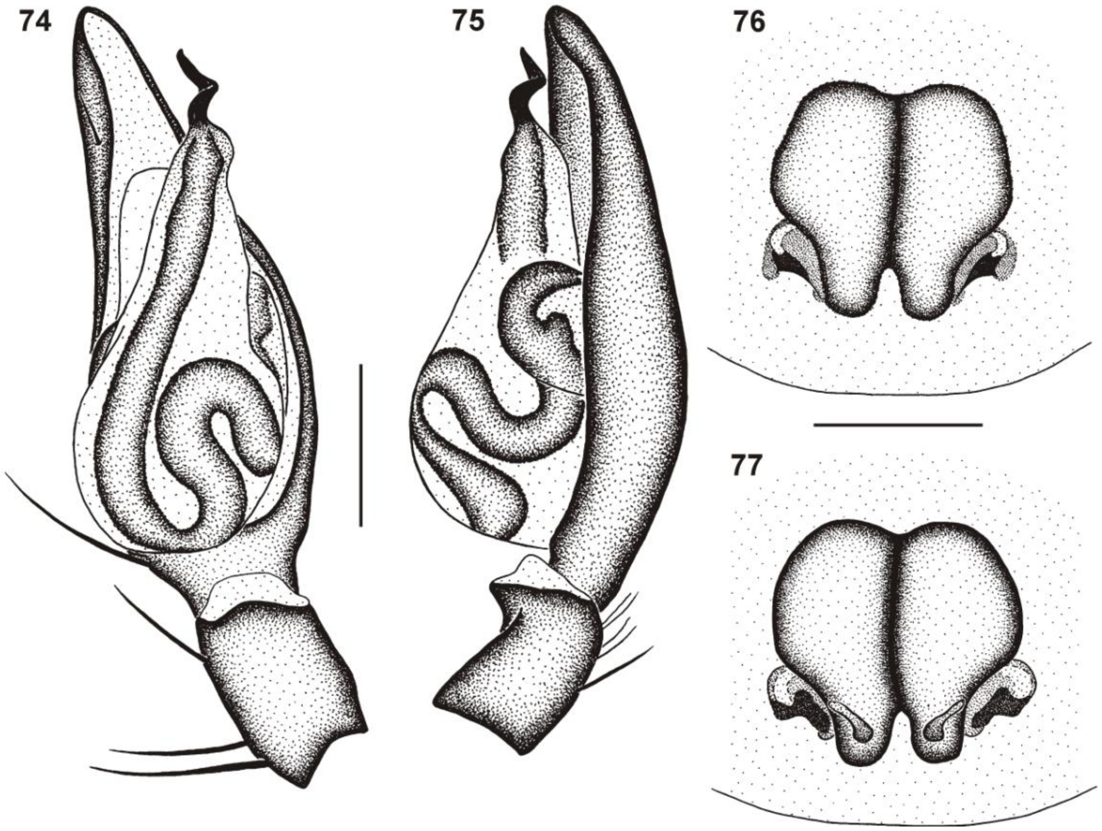
Diagnosis: The species is easily recognisable by strongly curved basal coil of the male embolus (Figs 62, 74).

Male (holotype, F.C. Ziama, MRAC 214921). Measurements: CL 2.55, CW 1.39, AL 2.45, AW 1.48, TL 4.95, FL 0.15, SL 1.00, SW 0.80, AME–AME 0.08, AME–ALE 0.03, ALE–ALE 0.38, PME–PME 0.21, PME–PLE 0.22, PLE–PLE 0.90, PERW 0.92, MOQAW 0.33, MOQPW 0.41, MOQL 0.33.
Length of leg segments: I 2.20 + 0.68 + 1.98 + 1.78 + 1.30 = 7.94; II missing; III 1.93 + 0.73 + 1.70 + 1.75 + 1.03 = 7.14; IV 2.80 + 0.80 + 2.40 + 2.70 + 1.20 = 9.90.
General appearance in Fig. 12. Carapace elongate oval, eye region broad, tapering posteriorly to pedicel, broadest at coxa II; raised gently from eye region, with slight median depression, highest at ⅔ carapace length (Fig. 22); surface finely granulate, covered in white plumose setae, denser on slopes in posterior ⅔ of carapace, with scattered short straight setae in anterior third; several long erect black setae on clypeus and in eye region; fovea short, broad, at ⅔ carapace length; carapace deep red-brown with faint black striae. All eyes with faded black rings; AER very slightly procurved, medians larger than laterals; AME separated by distance equal to $^5/8$ their diameter; AME separated from ALE by ¼ AME diameter; clypeus

height equal to 1½ times AME diameter; PER strongly recurved, laterals slightly larger than medians; PME separated by distance equal to 2¼ times their diameter; PME separated from PLE by distance slightly larger than 2¼ times PME diameter; CW:PERW = 1.51:1. Chelicerae orange-brown, with short straight setae on anterior surface; three teeth on promargin, median tooth largest, distal tooth tiny and indistinct; retromargin with two slightly separated teeth close to fang base, distal tooth slightly larger than proximal tooth; endites orange-brown, cream at maxillar hair tuft; labium orange-brown, cream distally; sternum shield-shaped, longer than broad, deep orange-brown; surface finely granulate, with short straight and scattered white plumose setae. Legs III missing; legs with surface of femora, patellae and tibiae finely granulate, metatarsi and tarsi finely wrinkled, covered in short straight and scattered plumose setae; femora I pale brown, with yellow dorsal and ventral stripes in distal ⅔, remaining segments uniform yellow; femora III and IV deep red-brown, orange-brown distally; patellae III and IV yellow, with broad dorsal yellow-brown stripe; tibiae III yellow-brown and IV orange-brown, yellow distally, each with faint black dorsal stripe metatarsi III faint yellow-brown and IV orange-brown, yellow distally; tarsi III and IV yellow. Leg spination (leg II missing): femora: I do 3, III pl 2 do 3, IV pl 2 do 3 rl 1; patellae I, III and IV with long fine distal do seta; tibiae: I plv 1 rlv 1, III pl 2 rl 2 plv 1, IV pl 2 rl 2 plv 2 vt 2; metatarsi: I plv 1 rlv 2, III pl 1 rl 1 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora: do 1; patellae: pl 1; tibiae: pl 1 plv 1; tarsi: pl 2 plv 2. Abdomen pear-shaped, broad and round posteriorly, with long pedicel; dorsal scutum deep red-brown, with mottled black median stripe up to midpoint, covering entire dorsum, fused to pedicel anteriorly and epigastric plate and post-epigastric sclerites ventrally; two pairs of distinct sigilla present; dorsum uniformly covered in white plumose setae; venter creamy-grey, covered in short straight black setae; venter with orange-brown rectangular ventral sclerite, with two paired rows of tiny sclerites within it; inframamillary sclerite orange-brown, subtriangular. Male palpal segments yellow-brown with faint black mottling; tegulum pear-shaped, orange-brown, with dark red-brown insemination ducts; embolus short, with single coil, basal section strongly curved; embolus tip short, slightly curved, directed prolaterally and distally (Figs 74, 75).

Female: unknown.

Type material: Holotype ♂: **GUINÉE:** F.C. Ziama, 08°24'N, 09°17'W, leg. J.F. van der Donckt, 30.IV.2000 (MRAC 214921).



FIGURES 74–77. Genitalic morphology of *Apochinomma parva* **sp. nov.** (74, 75) and *A. tuberculata* **sp. nov.** (76, 77): 74. male palp, ventral view; 75. same, retrolateral view; 76. female epigyne, ventral view; 77. same, dorsal view. Scale bars = 0.25mm.

Additional material examined: none.

Distribution: Known from the type locality only (Fig. 86).

Biology: Unknown.

3.4.1.4 *Apochinomma tuberculata* sp. nov.

Figs 13, 76, 77

Etymology: The specific name refers to the coarse carapace texture of the species.

Diagnosis: The species can be recognised by its relatively small size, coarsely tuberculate carapace surface, and carapace lacking a fovea (Fig. 13).

Remark: The abdomen is separated from the carapace and the total length provided here is an estimate based on the sum of the carapace and abdomen, excluding the pedicel. The chelicerae were held very firmly together and the dentition was not investigated to avoid further damage to the holotype.

Female (holotype, Appouesso, MRAC 204310). Measurements: CL 2.68, CW 1.65, AL 2.85, AW 2.20, TL ~5.55, FL absent, SL 0.94, SW 0.80, AME–AME 0.13, AME–ALE 0.05, ALE–ALE 0.42, PME–PME 0.27, PME–PLE 0.33, PLE–PLE 0.94, PERW 1.06, MOQAW 0.35, MOQPW 0.44, MOQL 0.35.

Length of leg segments: I 1.22 + 0.52 + 1.02 + 0.92 + 0.73 = 4.41; II 1.22 + 0.49 + 0.98 + 0.89 + 0.70 = 4.28; III 1.21 + 0.52 + 0.95 + 0.87 + 0.52 = 4.07; IV 1.58 + 0.60 + 1.32 + 1.24 + 0.65 = 5.39.

General appearance in Fig. 13. Carapace oval, eye region broad, tapering posteriorly to pedicel, broadest between coxae II and III; raised gently from eye region, with shallow depression at midpoint, highest at ⅔ carapace length; surface coarsely granulate, covered in very short straight setae on tubercles, with scattered white plumose setae and scattered long erect white setae on clypeus, in eye region and at base of pedicel, sparse in midsection of carapace; fovea absent; carapace deep red, black along margins and posteriorly. All eyes with black rings; AER procurved, medians larger than laterals; AME separated by distance slightly larger than $1^{1}/5$ their diameter; AME separated from ALE by distance approximately ½ AME diameter; clypeus height slightly larger than 2 times AME diameter; PER strongly recurved, laterals very slightly larger than medians; PME separated by distance equal to 3 times their diameter; PME separated from PLE by distance slightly equal to $3^{3}/5$ times PME diameter; CW:PERW = 1.56:1. Chelicerae deep orange-brown with faint dark brown mottling, surface granulate, with fine short setae and scattered long erect brown setae on anterior surface; endites orange-brown, cream at maxillar hair tuft; labium orange-brown; sternum shield-shaped, longer than broad, dark orange-brown with brown mottling; surface granulate, covered in erect white curved setae. Legs finely granulate, tubercles most pronounced on femora, covered in short straight setae, with white plumose setae dorsally; femora I and II yellow, with prolateral, retrolateral and retrolateral ventral black stripes and pro- and retrolateral stripes of white plumose setae; femora III orange-brown and IV red-brown, yellow distally, with black mottling and pro- and retrolateral stripes of white plumose setae; patellae I and II yellow and III and IV dark yellow-brown, all with black lateral stripes, fused ventrally distally; tibiae I–III yellow and IV deep orange-brown, all with pro- and retrolateral black stripes; metatarsi I–III yellow, with pro- and retrolateral black stripes; metatarsi IV orange-brown, with faint black mottling; tarsi all yellow. Leg spination: femora: I pl 1 do 1, II do 1, III do 1, IV do 2; patellae with long fine distal do seta; tibiae: I plv 3 rlv 3, II plv 3 rlv 3, III plv 2 rlv 2, IV plv 2; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III plv 1 rlv 1 vt 3, IV plv 1 rlv 1 vt 3. Palpal spination: femora: do 1; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: spineless. Abdomen nearly round, with short pedicel extension; dorsal scutum large, red-brown with black mottling, extending $^5/6$ of dorsum, narrowly separated from pedicel anteriorly and epigastric plate ventrally; two pairs of distinct sigilla present; dorsum covered in short straight white setae, white plumose setae forming anterior spot, median transverse band and lateral patches behind post-epigastric sclerites; venter mottled grey, covered in scattered short straight black setae; venter with deep red-brown epigastric sclerite, post-epigastric sclerites and heart-shaped ventral sclerite situated from half the distance between epigastric groove and spinnerets up to spinnerets, apparently fused to inframamillary sclerite, forming single structure; several small oval sclerites between epigastric groove and ventral sclerite. Epigyne with short curved oblique ridges with lateral copulatory openings (Fig. 76); copulatory ducts short, curving anteriorly and medially, entering large oval anterior ST II posterolaterally; ST II broadly connected to narrow posterior ST I (Fig. 77).

Male: unknown.

Type material: Holotype ♀: **IVORY COAST:** Appouesso, F.C. Bossematie, 06°35'N, 03°28'W, leg. R. Jocqué & Tanoh, 12.III.1995 (forest, pitfall, station 5C) (MRAC 204310).

Additional material examined: none.

Distribution: Known only from the type locality (Fig. 86).

Biology: Apparently a ground-dwelling species collected in forest.

3.4.2 *Apochinomma decepta* species group

Diagnosis: Carapace in lateral view without median depression; abdomen elongate, with a slight to distinct median constriction; male embolus with broad base and long, fine distal section, at least ½ tegulum length; female epigyne with copulatory ducts directed anteriorly initially, with several loops before entering ST II.

3.4.2.1 *Apochinomma decepta* sp. nov.

Figs 3, 4, 14, 15, 23, 24, 63, 78–82

Etymology: The specific name refers to the colouration and morphology of the spider that make it a deceptive mimic of ponerine ants.

Diagnosis: Males of the species share with *A. elongata* **sp. nov.** the short tegulum and long fine embolus, but in *A. decepta* **sp. nov.** the embolus is about half as long as the tegulum (Fig. 78), while in *A. elongata* **sp. nov.** the embolus is clearly longer than the tegulum (Fig. 84). Females can be recognised from congeners by the very long winding entrance ducts of the female epigyne (Figs 81, 82).

Male (holotype, Tembe, NCA 2002/369). Measurements: CL 4.52, CW 2.24, AL 4.85, AW 2.17, TL 9.55, FL 0.30, SL 3.85, SW 2.70, AME–AME 0.10, AME–ALE 0.05, ALE–ALE 0.44, PME–PME 0.21, PME–PLE 0.18, PLE–PLE 0.83, PERW 0.97, MOQAW 0.35, MOQPW 0.44, MOQL 0.48.

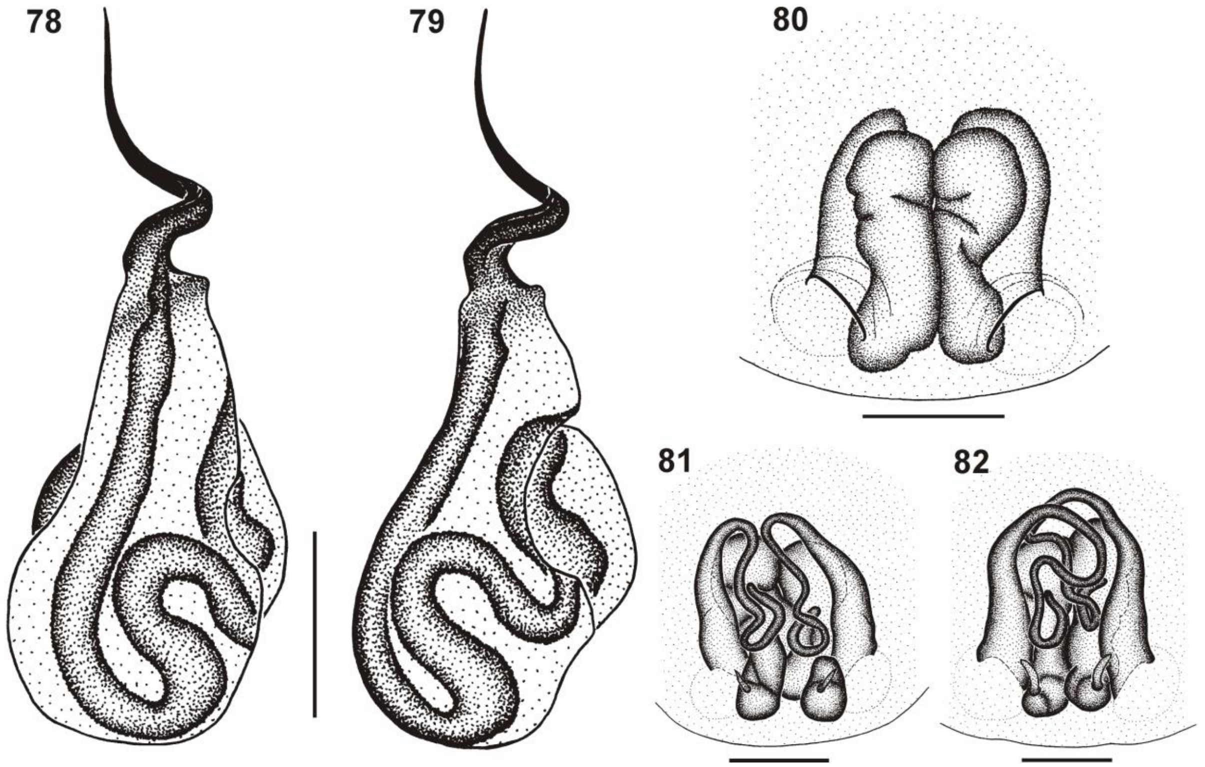
Length of leg segments: I 2.20 + 0.85 + 1.85 + 1.85 + 1.37 = 8.12; II 2.10 + 0.85 + 1.70 + 1.72 + 1.30 = 7.67; III 1.95 + 0.90 + 1.45 + 1.65 + 1.13 = 7.08; IV 2.69 + 1.05 + 2.34 + 2.77 + 1.33 = 10.18.

General appearance in Fig. 14, of subadult male in Fig. 3. Carapace elongate oval, eye region broad, tapering posteriorly to pedicel, broadest at coxa II; raised from eye region, highest at ⅓ carapace length, nearly level in midsection, declining gradually in posterior ⅓ (Fig. 23); surface finely granulate, covered in short straight white setae and sparse white plumose setae; several long erect setae on clypeus, in and behind eye region; fovea short, narrow, between ½ and ⅔ carapace length; carapace dark red-brown with extensive black mottling and distinct striae. All eyes with black rings; AER procurved, medians larger than laterals; AME separated by distance equal to ¾ their diameter; AME separated from ALE by distance slightly larger than ⅓ AME diameter; clypeus height equal to 2¼ times AME diameter; PER strongly recurved, medians very slightly larger than laterals; PME separated by distance slightly less than 2 times their diameter; PME separated from PLE by distance equal to 1⅔ times PME diameter; CW:PERW = 2.31:1. Chelicerae black, orange prolaterally distally, with short straight white setae and scattered long erect setae on anterior surface; three teeth on promargin, distal tooth smallest, median tooth largest; median tooth closer to distal tooth than to proximal tooth; retromargin with two teeth, distal tooth close to fang base, slightly smaller than proximal tooth; endites dark brown, orange prolaterally, cream at maxillar hair tuft; labium dark brown, nearly black, dark yellow-brown distally, broader than long; sternum elongate shield-shaped, dark red-brown; surface finely granulate, with short straight and plumose white setae. Legs with surface finely granulate, except for tarsi, which are finely wrinkled; covered in short, straight, slightly flattened white setae, white plumose setae sparse; femora I and II dark brown proximally, orange in distal ⅓; femora III and IV uniform dark brown; patellae I and II orange with black lateral mottling; patellae III and IV uniform dark brown; tibiae I and II orange with black mottling and faint prolateral and retrolateral stripes; tibiae III and IV uniform dark brown; metatarsi I and II orange-brown with black mottling; metatarsi III and IV dark brown; tarsi I–IV dark orange-brown with black mottling, orange towards tip. 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 I–IV with long erect fine proximal and distal do setae; tibiae: I plv 1 rlv 1, II spineless, 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 1 rlv 1, II plv 1 rlv 1, 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 1 plv 1; tarsi: pl 1 plv 2. Abdomen elongate, broadened posteriorly, with slightly median constriction and long pedicel; dorsal scutum black, covering entire dorsum, fused to pedicel anteriorly and epigastric plate and post-epigastric sclerites ventrally; two pairs of distinct sigilla present within constriction; dorsum with four transverse black bands, at anterior, ⅓, ⅔ and ¾ abdomen length, second band with curved lateral extensions; dorsum densely covered in short, straight, slightly flattened setae and scattered plumose setae, black on markings and white between them, denser along sides, in constriction and posteriorly; venter mottled grey, covered in short straight white setae; venter with dark red-brown elongate rectangular ventral sclerite, anterior margin slightly notched; inframamillary sclerite small, orange-brown. Male palpal segments dark orange-brown with black mottling; tegulum pear-shaped, dark orange, with black insemination ducts; embolus with broad base and single coil, basal section strongly curved, nearly transverse; distal section of embolus long and curved; longitudinal length of embolus more than ½ tegulum length (Figs 78, 79).

Female (paratype, Tembe, NCA 2002/370). Measurements: CL 5.18, CW 2.38, AL 5.35, AW 2.74, TL 11.00 (9.05–11.00), FL 0.37, SL 2.12, SW 1.23, AME–AME 0.14, AME–ALE 0.07, ALE–ALE 0.53, PME–PME 0.32, PME–PLE 0.35, PLE–PLE 1.17, PERW 1.34, MOQAW 0.38, MOQPW 0.52, MOQL 0.51.

Length of leg segments: I 2.85 + 0.89 + 2.57 + 2.25 + 1.50 = 10.06; II 2.70 + 0.89 + 2.28 + 2.05 + 1.45 = 9.37; III 2.30 + 0.95 + 2.00 + 2.08 + 1.20 = 8.53; IV 3.70 + 1.20 + 3.20 + 3.60 + 1.45 = 13.15.

General appearance in Figs 4 & 15, lateral view in Fig. 24. Morphology as for male except the following: AER procurved, medians larger than laterals; AME separated by distance equal to $1^{1}/6$ their diameter; AME separated from ALE by distance equal to ½ AME diameter; clypeus height equal to $2^{4}/5$ times AME diameter; PER strongly recurved, laterals very slightly larger than medians; PME separated by distance slightly less than 3 times their diameter; PME separated from PLE by distance slightly more than 3 times PME diameter;



FIGURES 78–82. Genitalic morphology of *Apochinomma decepta* **sp. nov.**: 78. male palpal tegulum, ventral view; 79. same, retrolateral ventral view; 80. female epigyne, ventral view; 81, 82. same, dorsal view, females from Bartholomew Diaz Point (81) and Tembe Elephant Park (82). Scale bars = 0.25mm.

CW:PERW = 1.78:1. Legs with surface finely granulate, except for tarsi, which are finely wrinkled; covered in short, straight, slightly flattened white setae, with dense white plumose setae on femora, patellae and tibiae, sparse on metatarsi; femora I and II yellow, dark brown in proximal ¼, with prolateral, dorsal and ventral black stripes; femora III and IV uniform dark brown with black mottling; patellae I and II yellow and III and IV dark brown, all with prolateral, dorsal and retrolateral black stripes; tibiae I and II yellow, with dorsal and retrolateral ventral black stripes; tibiae III and IV dark brown, with prolateral ventral, dorsal and retrolateral ventral black stripes; metatarsi I and II yellow with black mottling; metatarsi III and IV dark brown with black mottling; tarsi I and II yellow with black mottling; tarsi III yellow-brown; tarsi IV yellow-brown with black mottling, except distally. Leg spination: femora: I pl 1 do 3, II do 3, III pl 1 do 3, IV pl 1 do 3 rl 1; patellae I–IV with long erect fine proximal and distal do setae; tibiae: I plv 2 rlv 1, II plv 1 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 1 vt 2; metatarsi: I plv 1 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: do 2; patellae: pl 1 do 1; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 rl 1 plv 1 rlv 1. Abdomen elongate, broadened posteriorly, with distinct median constriction and long pedicel, setae as for male; dorsal scutum narrow, black, extending slightly beyond ⅓ abdomen length; dorsum dark mottled grey behind scutum; two pairs of distinct sigilla within constriction, anterior pair on posterior margin of dorsal scutum; dorsum with three transverse black bands, fine band at anterior and ¼ abdomen length, broad band at ⅔ abdomen length, second band with curved lateral extensions; venter mottled grey, with pair of black spots behind post-epigastric sclerites and broad ventral band in front of spinnerets; two paired rows of tiny sclerites from epigastric furrow to spinnerets; epigastric region strongly sclerotised, post-epigastric sclerites weakly sclerotised; ventral sclerite absent; inframamillary sclerite distinct, red-brown; venter covered in white plumose setae, with black plumose setae on markings. Epigyne with oblique lateral ridges in posterior half of epigyne (Fig. 80); copulatory ducts very long and winding, initially broad and lateral, directed anteriorly, bending anteriorly and medially before looping and entering elongate anterior ST II, broadly connected to elongate ST I (Figs 81, 82).

Type material: Holotype ♂: **SOUTH AFRICA:** *KwaZulu-Natal Province*: Tembe Elephant Park, Muzi Swamps, 27°00'S, 32°30'E, leg. C. Haddad, V. Swart, J. van As & J. Venter, 3–23.I.2002 (pitfalls) (NCA 2002/369).

Paratypes: **MOZAMBIQUE:** Bartholomew Diaz Point, BD Lodge, 21°15.585'S, 35°06.851'E, 5m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 10.XII.2007 (leaf litter, mangroves), 6imm. 1♀ (NCA 2008/192); Inhaca, 26°01'S, 32°54'E, leg. T. Steyn, 30.IV–14.V.1994 (pitfalls, wetland), 1♀ (MRAC 224295). **SOUTH AFRICA:**

KwaZulu-Natal Province: Tembe Elephant Park, Sparse woodland, 26°57'S, 32°33'E, leg. C. Haddad, 1.VI.2002 (sweeps, grass), 1♀ (NCA 2002/370).

Additional material examined: none.

Distribution: Only known from the coastal plain of southern and central Mozambique and the northern KwaZulu-Natal Province, South Africa (Fig. 86).

Biology: This ground-living species was collected from coastal woodlands, wetlands and swamps at altitudes lower than 50m a.s.l. with a well-developed grass layer. This species is most likely a mimic of medium sized ponerine ants such as *Streblognatha* and *Pachycondyla*, but further study is needed to assess whether a single species serves as its model.

3.4.2.2 *Apochinomma elongata* sp. nov.

Figs 16, 25, 64, 83–85

Etymology: The specific name refers to the elongate body of the species.

Diagnosis: See under *A. decepta* **sp. nov.** above.

Remark: The male from Zomba Plateau in Malawi, measuring 13.6mm in total length, is the largest known species of Afrotropical Castianeirinae.

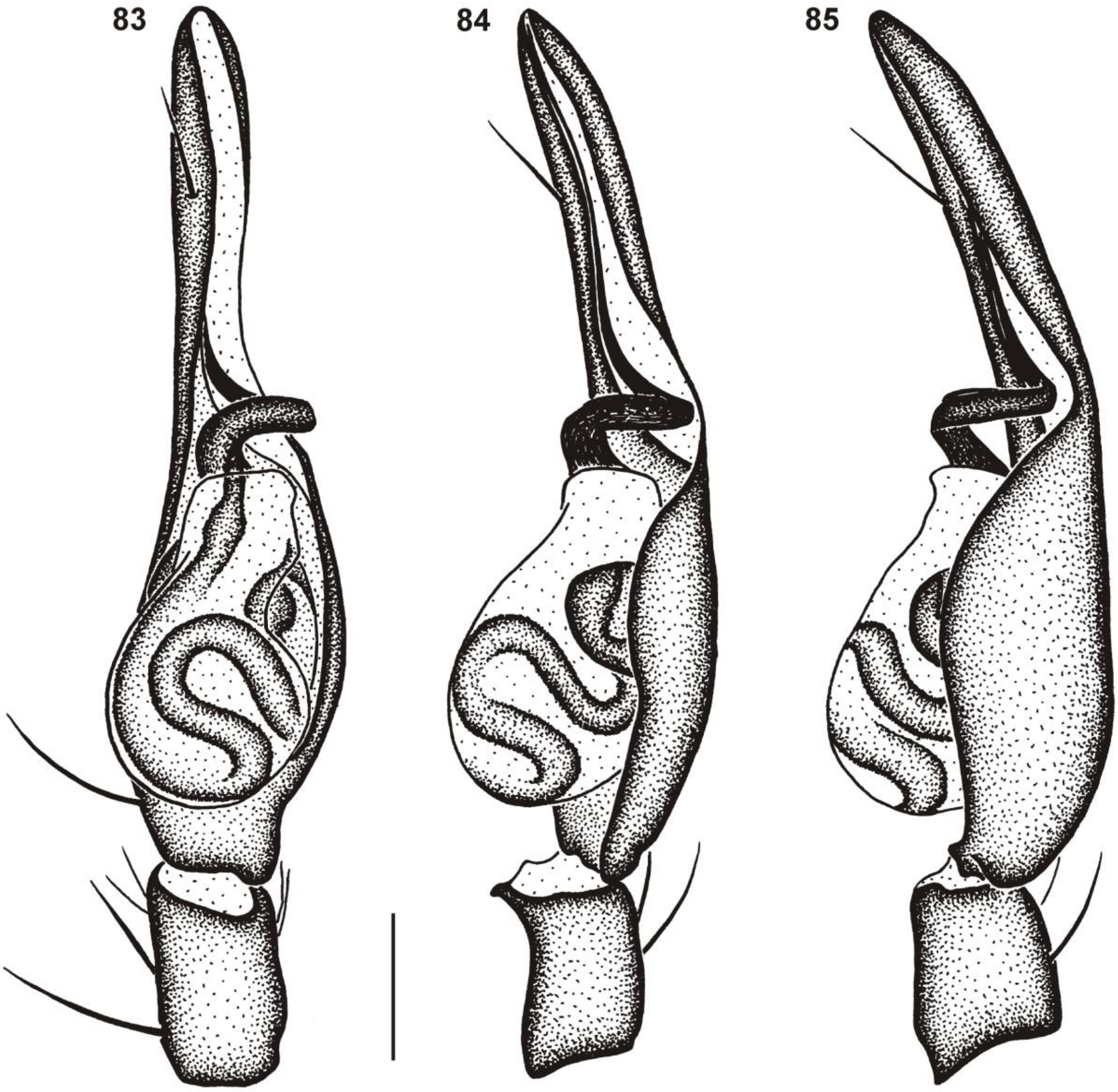
Male (holotype, Nxai Pan, BMNH). Measurements: CL 3.78, CW 1.80, AL 4.69, AW 1.83, TL 8.73 (7.40–13.60), FL 0.20, SL 1.60, SW 1.09, AME–AME 0.08, AME–ALE 0.05, ALE–ALE 0.40, PME–PME 0.21, PME–PLE 0.24, PLE–PLE 0.90, PERW 1.02, MOQAW 0.32, MOQPW 0.42, MOQL 0.40.

Length of leg segments: I 2.10 + 0.73 + 2.06 + 1.95 + 1.35 = 8.19; II 1.96 + 0.70 + 1.85 + 1.73 + 1.20 = 7.44; III 1.91 + 0.75 + 1.63 + 1.65 + 1.00 = 6.94; IV 2.90 + 0.88 + 2.57 + 2.95 + 1.25 = 10.55.

General appearance in Fig. 16. Carapace elongate oval, eye region broad, tapering posteriorly to pedicel, broadest at coxa II; raised from eye region, highest at ⅓ carapace length, nearly level in midsection with very slight median depression, declining gradually in posterior ⅓

(Fig. 25); surface finely granulate, covered in short straight white setae, with sparse white plumose setae; several long erect setae on clypeus and in eye region; fovea short, narrow, at ⅔ carapace length; carapace deep red-brown with faint black striae, black mottling on clypeus, in and behind eye region and along lateral margins of carapace. All eyes with faded black rings; AER procurved, medians larger than laterals; AME separated by distance equal to $^5/8$ their diameter; AME separated from ALE by distance equal to $^3/8$ AME diameter; clypeus height equal to 2 times AME diameter; PER strongly recurved, laterals very slightly larger than medians; PME separated by distance slightly larger than 2 times their diameter; PME separated from PLE by distance slightly less than 2⅓ times PME diameter; CW:PERW = 1.76:1. Chelicerae orange-brown with faint brown mottling, with short straight white setae on anterior surface; three teeth on promargin, distal tooth smallest, median tooth largest; median tooth closer to distal tooth than to proximal tooth; retromargin with two slightly separated subequal teeth, distal tooth close to fang base; endites mottled dark brown, yellow-brown in prolateral ⅓, cream at maxillar hair tuft; labium orange-brown, cream distally; sternum shield-shaped, longer than broad, deep orange with brown mottling laterally, cream distally; surface finely granulate, with short straight white setae. Legs with surface finely granulate, except for tarsi, which are finely wrinkled; covered in short straight setae, white plumose setae dense on femora and do surfaces of patellae and tibiae, sparse elsewhere; femora I and II yellow with broad black proximal marking, with black prolateral, dorsal and retrolateral stripes; femora III yellow-brown with broad dark brown prolateral, dorsal and retrolateral stripes, ventral surface dark brown, distal dorsal ends yellow; femora IV dark brown with black mottling, orange at dorsal distal end; patellae I and II yellow with dorsal and retrolateral ventral black stripes; patellae III yellow with prolateral, dorsal and retrolateral stripes; patellae IV yellow-brown with fine dorsal line, prolateral ventral and retrolateral ventral stripes, ventral surface dark brown; broad dorsal yellow-brown stripe; tibiae III yellow-brown and IV orange-brown, tibiae and metatarsi I and II yellow with dorsal stripe and proximal and distal retrolateral mottled blotches; tibiae III yellow-brown and IV pale brown, with prolateral ventral, dorsal and retrolateral ventral black stripes; metatarsi III and IV mottled brown, proximal and distal ends yellow; tarsi I and II uniform yellow, III yellow with proximal black mottling, IV mottled dark brown, yellow distally. Leg spination: femora: I pl 2 do 3, II pl 1 do 3, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; patellae: all with long fine distal do seta; tibiae: I plv 0-2 rlv 0-1, II plv 1 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 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

1 plv 1; tarsi: pl 1 plv 2. Abdomen elongate, broadened posteriorly, with distinct median constriction and long pedicel; dorsal scutum deep orange-brown with black mottling, covering entire dorsum, fused to pedicel anteriorly and epigastric plate and post-epigastric sclerites ventrally; two pairs of distinct sigilla present within constriction; dorsum densely covered in white plumose setae; venter dark grey, covered in short straight black setae, with scattered white plumose setae; venter with elongate orange-brown rectangular ventral sclerite, anterior and posterior margins notched; inframamillary sclerite orange-brown, subtriangular. Male palpal segments pale orange-brown with black mottling; tegulum short,



FIGURES 83–85. Genitalic morphology of *Apochinomma elongata* **sp. nov.**: 83. male palp, ventral view; 84. same, retrolateral ventral view; 85. same, retrolateral view. Scale bars = 0.25mm.

less than half cymbium length, pear-shaped, pale orange, with dark red-brown insemination ducts; embolus with broad base and single coil, basal section strongly curved, nearly transverse; distal section of embolus very long and fine, similar in length to tegulum, partly hidden in alveolus in ventral and retrolateral views (Figs 64, 83–85).

Female: unknown.

Type material: Holotype ♂: **BOTSWANA:** Nxai Pan National Park, Nxai Pan [19°53'S, 24°45'E], leg. F. Wanless & A. Russell-Smith, 7.III.1976 (amongst grass tufts) (BMNH).
Paratypes: **MALAWI:** Zomba Plateau [15°20'S, 35°18'E], leg. C. Dudley, XI.1980, 1♂ (NCA 2004/829). **TANZANIA:** Mkomazi Game Reserve, Dindira [03°55'S, 37°55'E], leg. A. Russell-Smith, 11.IV.1995 (*Commiphora* woodland), 3imm. 2♂ (MRAC 211320).

Additional material examined: BOTSWANA: Near Maun, Manxunyane Lagoon [19°54'S, 23°22'E], leg. F. Wanless & A. Russell-Smith, 1.IV.1976 (ground layer, grassland), 1sa♀ (BMNH).

Distribution: Known from four scattered localities in southern and eastern Africa (Fig. 86).

Biology: A ground-dwelling species recorded from woodland and wetland habitats. It is most likely a mimic of large epigeic ponerine ants.

3.4.2.3 *Apochinomma* sp.

Figs 5, 17, 26

Remarks: An apparently new species of *Apochinomma* collected only from fynbos habitats in the De Hoop Nature Reserve in southern South Africa was discovered (Fig. 86). This species has very distinctive white abdominal markings, notably a transverse anterior band, a median X-shaped marking and posterior ring (Figs 5, 17, 26). One of the specimens, a subadult female, measures 6.3mm in total length, and it is therefore likely that the adult female will only be marginally larger, probably less than 8.0mm in length. This species will not be formally described until adults have been discovered. Based on the carapace shape and relatively elongate abdomen, this species clearly belongs to the *A. decepta* species group.

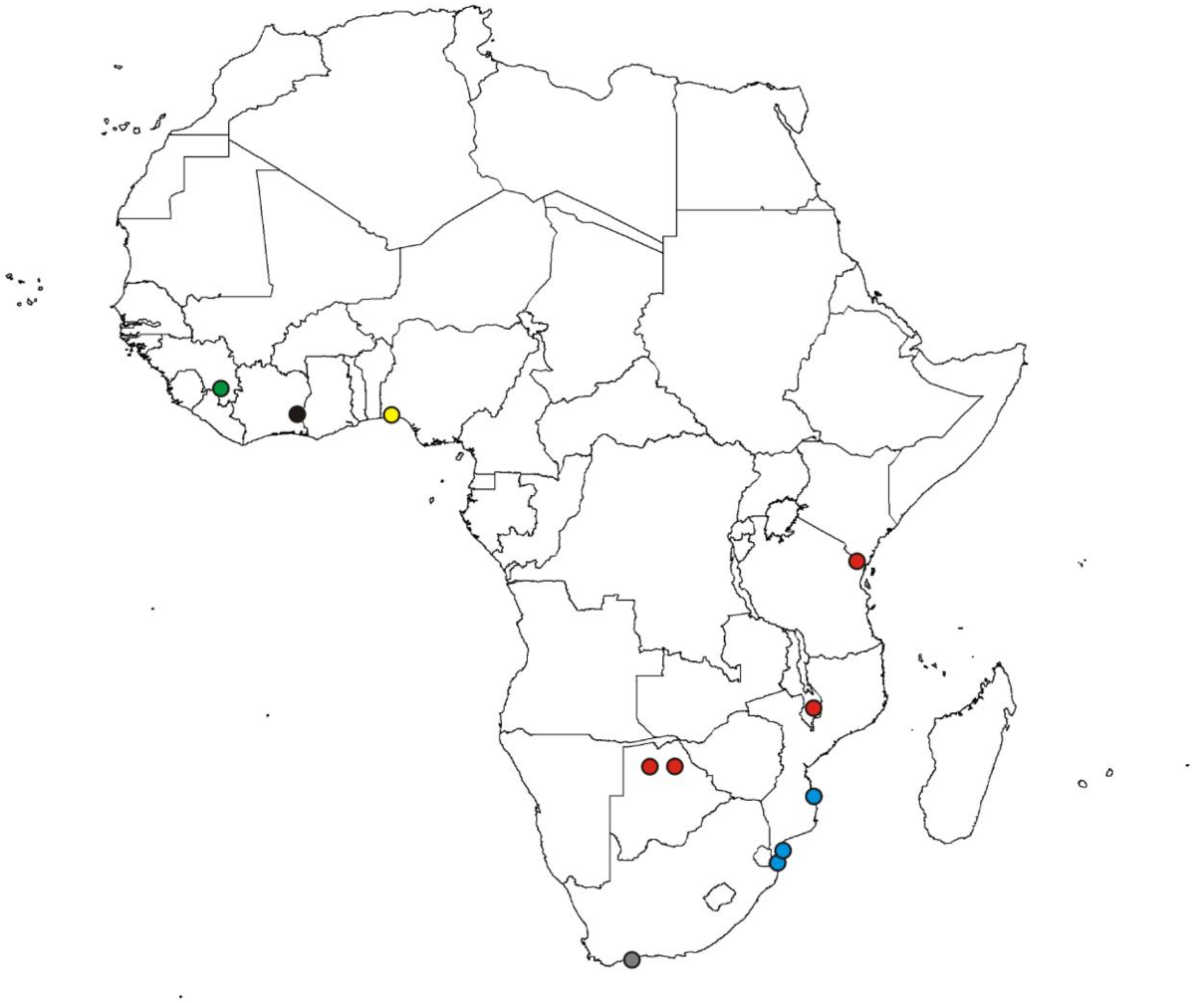


FIGURE 86. Distribution of *Apochinomma decepta* **sp. nov.** (blue circles), *A. elongata* **sp. nov.** (red circles), *A. malkini* **sp. nov.** (yellow circle), *A. parva* **sp. nov.** (green circle), *A. tuberculata* **sp. nov.** (black circle) and an undescribed *Apochinomma* sp. (grey circle) in Africa.

Material examined: SOUTH AFRICA: *Western Cape Province*: De Hoop Nature Reserve, Lekkerwater Road, 34°24.002'S, 20°33.151'E, leg. C. Haddad, 6.IV.2004 (under *Thamnochortis* with *Camponotus* ants), 1imm. 1sa♀ (NCA 2008/1905).

3.5 DISCUSSION

In the present study the genus *Apochinomma* was revised in the Afrotropical Region and five new species were described. All of the species are distinctive mimics of ants, although the Afrotropical species can be separated into two species groups based on their somatic morphology. The *A. formicaeforme* species group can be recognised by the median depression of the carapace and pear-shaped abdomen without a constriction, while the *A.*

decepta species group lacks a carapace depression but has a slightly or distinctly constricted abdomen. Genitalic morphology also differs between the species groups. Despite these differences, members of both species groups share three synapomorphies that unite them as a single genus: 1) posterior eyes separated by approximately twice their diameter or more; 2) carapace twice as long as wide; and 3) intercoxal sclerites between coxae II and III, and III and IV fused to the corresponding pleural bars. The relationships of the Neotropical species cannot be evaluated until that fauna is revised, but the Oriental *A. nitidum* (Thorell, 1895) most likely belongs to the *A. formicaeforme* species group (see Deeleman-Reinhold 2001 for redescription). The Neotropical fauna may comprise species that are not congeneric with *A. formicaeforme*, or that may represent additional species groups not established here.

Together with representatives of *Corinnomma* and two undescribed genera, Afrotropical *Apochinomma* are the only "good" or "specific" ant-mimicking castianeirines from the region. While the Neotropical and Oriental faunas are rich in specialised mimics, the Afrotropical castianeirine fauna seems to be largely dominated by cryptic "lycosiform" spiders and "weak" or "general" ant mimics.

Although widespread throughout the Afrotropical Region, *Apochinomma* species are often only known from isolated localities. This may be indicative of their local rarity within their habitats, even in surveys where a broad suite of sampling methods have been used (Haddad *et al.* 2010) or where samples have been taken for a year or longer (e.g. Dippenaar-Schoeman & Wassenaar 2002). This apparent scarcity may prove a significant hindrance into further studies into the biology of *Apochinomma*, particularly regarding potential myrmecophagy, model specificity and reproductive aspects.

The present evidence on the models of the Afrotropical species also requires further discussion. Members of the *A. formicaeforme* species group are clearly mimics of *Polyrhachis* ants. This ant genus comprises 469 species in 12 subgenera (Dokow 1995), of which only 47 species are Afrotropical (Bolton 1973), representing approximately 10% of the world fauna. The vast bulk of the diversity of the genus lies in the Palaearctic, Oriental and Australasian Regions, but despite this considerable species richness, only a single Oriental *Apochinomma* is presently recognised. If the current six Afrotropical species of *Apochinomma* could have evolved in association 47 potential mimicry models, then one would expect a much richer *Apochinomma* fauna in the aforementioned regions. *Polyrhachis* is absent in the Neotropical Region, but Dokow (1995) commented on the similar morphology of many South American *Camponotus* and *Dolichoderus* with *Polyrhachis*. Therefore, the Neotropical species can clearly not associate with *Polyrhachis* but have morphologically similar models on which the modifications in their body form has been based. It is essential that the Neotropical fauna be thoroughly revised to determine whether they are, in fact, congeneric with *A. formicaeforme*. Also, the Australian castianeirine fauna is presently under revision (Robert Raven, pers. comm.) and it will be interesting to see whether the genus is also represented on that continent, especially considering the rich *Polyrhachis* fauna (Dokow 1995).

Members of the *A. decepta* species group are associated with ground-living ponerine ants. Its three representative species (one undescribed) are only known from nine sample points in the Afrotropical Region, of which the two described species are known from four points each. Consequently, very little can be said regarding the biogeography of these three species, neither can it be accurately assessed which ant species are their specific models. The African ponerine fauna is very rich, with 20 genera presently known from the continent (Taylor 2011), although several genera (e.g. *Hypoponera* Santschi, 1938) are too small to serve as models (see Bolton & Fisher 2011), while others (e.g. *Streblognathus* Mayr, 1862) that may be of suitable size are not sympatric with these *Apochinomma* species and thus could not serve as models. The most likely candidate models for *A. decepta* and *A. elongata* would be representatives of *Pachycondyla* F. Smith, 1858 and *Plectroctena* F. Smith, 1858, whose members are widespread throughout the region (Taylor 2011). At least a few of their species are sympatric with these two *Apochinomma*, and some of these applicable species are similar in size and black colouration to their mimics, and could thus be considered as potential models. Further study is needed to more accurately identify the model species and the interactions between these spiders and their models: is it merely Batesian mimicry or are these spiders aggressive mimics (myrmecophagous myrmecomorphs)?

3.6 REFERENCES

BOLTON, B. 1973. The ant genus *Polyrhachis* F. Smith in the Ethiopian Region (Hymenoptera: Formicidae). *Bulletin of the British Museum of Natural History (Entomology)* **28:** 285–369.

BOLTON, B. 1974. A revision of the ponerine ant genus *Plectroctena* F. Smith (Hymenoptera: Formicidae). *Bulletin of the British Museum of Natural History (Entomology)* **30:** 309–338.

BOLTON, B. & FISHER, B.L. 2011. Taxonomy of Afrotropical and West Palaearctic ants of the ponerine genus *Hypoponera* Santschi (Hymenoptera: Formicidae). *Zootaxa* **2843:** 1–118.

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.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual.* Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

DIPPENAAR-SCHOEMAN, A.S. & WASSENAAR, T.D. 2002. A checklist of the ground-dwelling spiders of coastal dune forests at Richards Bay, South Africa (Arachnida: Araneae). *Bulletin of the British Arachnological Society* **12:** 275–279.

DOKOW, W. 1995. Revision of the ant genus *Polyrhachis* Smith, 1857 (Hymenoptera: Formicidae: Formicinae) on subgenus level with keys, checklist of species and bibliography. *Courier Forschungsinstitut Senckenberg* **185:** 1–113.

EDMUNDS, M. 2000. Why are there good and poor mimics? *Biological Journal of the Linnean Society* **70:** 459–466.

HADDAD, C.R. 2006. A new species of *Corinnomma* (Araneae: Corinnidae) from southern and eastern Africa, with taxonomic notes on *C. olivaceum* and *C. semiglabrum*. *African Invertebrates* **47**: 71–83.

HADDAD, C.R., HONIBALL, A.S., DIPPENAAR-SCHOEMAN, A.S., SLOTOW, R. & VAN RENSBURG, B.J. 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.

HOLM, E. & DIPPENAAR-SCHOEMAN, A.S. 2010. *Goggo Guide: the arthropods of southern Africa.* Lapa Publishers, Pretoria, 304 pp.

LESSERT, R. DE. 1946. Araignées du Congo Belge. *Revue Suisse de Zoologie* **58:** 204–225.

PAVESI, P. 1881. Studi sugli Aracnidi africani. II. Aracnidi d'Inhambane raccolti da Carlo Fornasini e considerazioni sull'aracnofauna del Mozambico. *Annali del Museo Civico di Storia Naturale di Genova* **16:** 536–560.

PEKÁR, S. & JARAB, M. 2011. Assessment of color and behavioral resemblance to models by inaccurate myrmecomorphic spiders (Araneae). *Invertebrate Biology* **130:** 83–90.

PLATNICK, N.I. 2011. The World Spider Catalog, Version 12.0. American Museum of Natural History, New York. Available at: http://research.amnh.org/entomology/spiders/catalog; accessed 30 May 2011.

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

ROBERTSON, H.G. 2002. Revision of the ant genus *Streblognathus* (Hymenoptera: Formicidae: Ponerinae). *Zootaxa* **97:** 1–16.

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.

TAYLOR, B. 2011. The Ants of Africa. American Museum of Natural History, New York. Available at: http://antbase.org/ants/africa/contents.htm; accessed 13 October 2011.

CHAPTER 4

Cambalida dippenaarae **sp. nov. (Wildlives Game Farm, Zambia)**

A revision of the Afrotropical ant-like sac spider genus *Cambalida* Simon, 1909 (Araneae: Corinnidae)

4.1 ABSTRACT

The Afrotropical dark sac spider genus *Cambalida* Simon, 1909 (Araneae: Corinnidae: Castianeirinae) is revised. Three species are transferred from *Castianeira* Keyserling, 1879 to *Cambalida*: *C. deminuta* (Simon, 1909) **comb. nov.**, *C. fulvipes* (Simon, 1896) **comb. nov.** and *C. loricifera* (Simon, 1885) **comb. nov.**. A fourth species, *C. fagei* (Caporiacco, 1939) **comb. nov.**, is transferred from *Brachyphaea* Simon, 1895 to *Cambalida*. Two species, *Castianeira depygata* Strand, 1916 **syn. nov.** and *C. mestrali* Lessert, 1921 **syn. nov.**, 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. nov.** 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. nov.** from West Africa, *C. dippenaarae* **sp. nov.** from southern Africa, *C. griswoldi* **sp. nov.** and *C. lineata* **sp. nov.** from Madagascar, and *C. unica* s**p. nov.** from Cameroon. Notes are provided on the biology of each species and the distribution of the genus in the Afrotropical Region.

4.2 INTRODUCTION

The 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 & Jocqué (1997) already listed *Cambalida* in the Corinnidae: Castianeirinae, but did not formally transfer this genus. Bosselaers & 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 & 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 & 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. nov.**) is proposed for the secondary junior homonym in the current study. Incidentally, the type material of this species is lost and thus *C. simoni* is considered a *nomen dubium*. The present study uncovered a rich diversity of species in the Afrotropical Region, many of which have very similar male embolic structure (Figs 50–56). 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 proposed conservation of the junior name (Haddad 2006).

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 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

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

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.

4.3 MATERIAL & 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. nov.**, 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 & 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)

PCRS – Personal collection of Anthony Russell-Smith, Sittingbourne, UK

SAMC – 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)

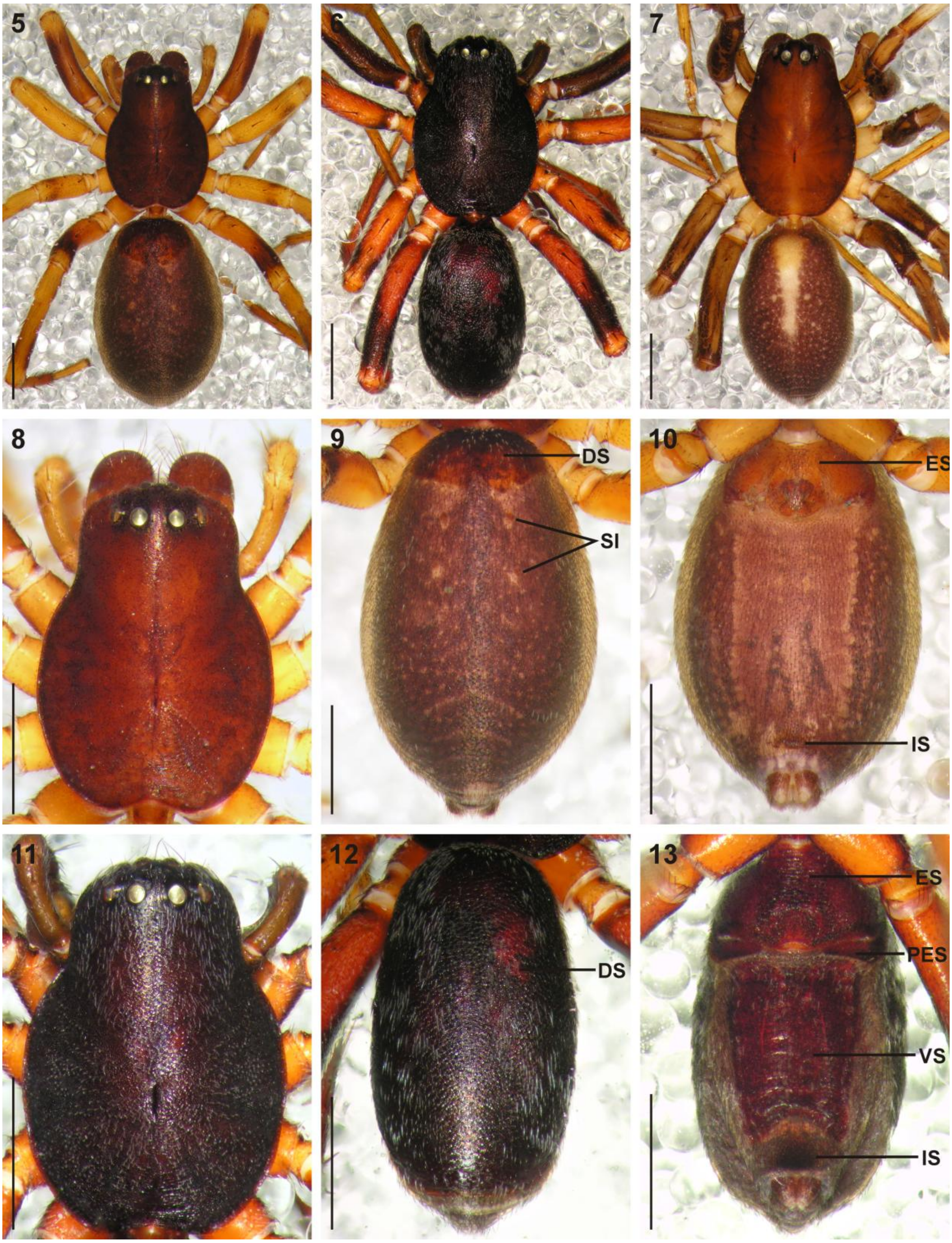
4.4 GENUS *CAMBALIDA* SIMON, 1909

Cambalida Simon, 1909: 369; Reiskind, 1969: 165; Dippenaar-Schoeman & Jocqué, 1997: 128; Bosselaers & Jocqué, 2000: 315.

Type species: *Cambalida insulana* Simon, 1909, by original designation.

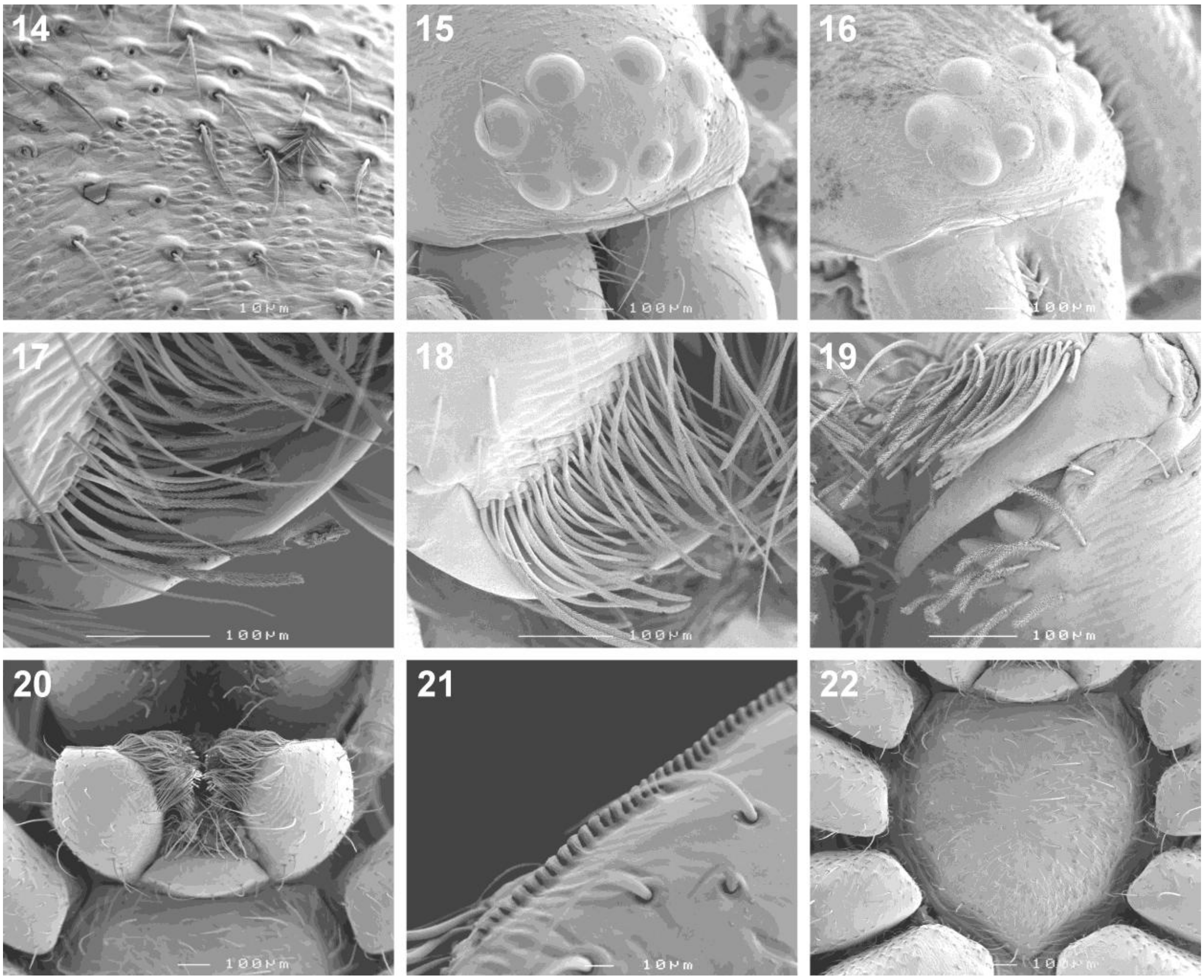
Diagnosis: *Cambalida* is most closely related to *Castianeira* but can be recognised by the relatively broader carapace (width approximately 0.75 carapace length, usually less than 0.70 in *Castianeira*), ALE that are usually considerably larger than the AME, and the posterior eyes that are larger than 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 tegulum (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 tegulum.

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,



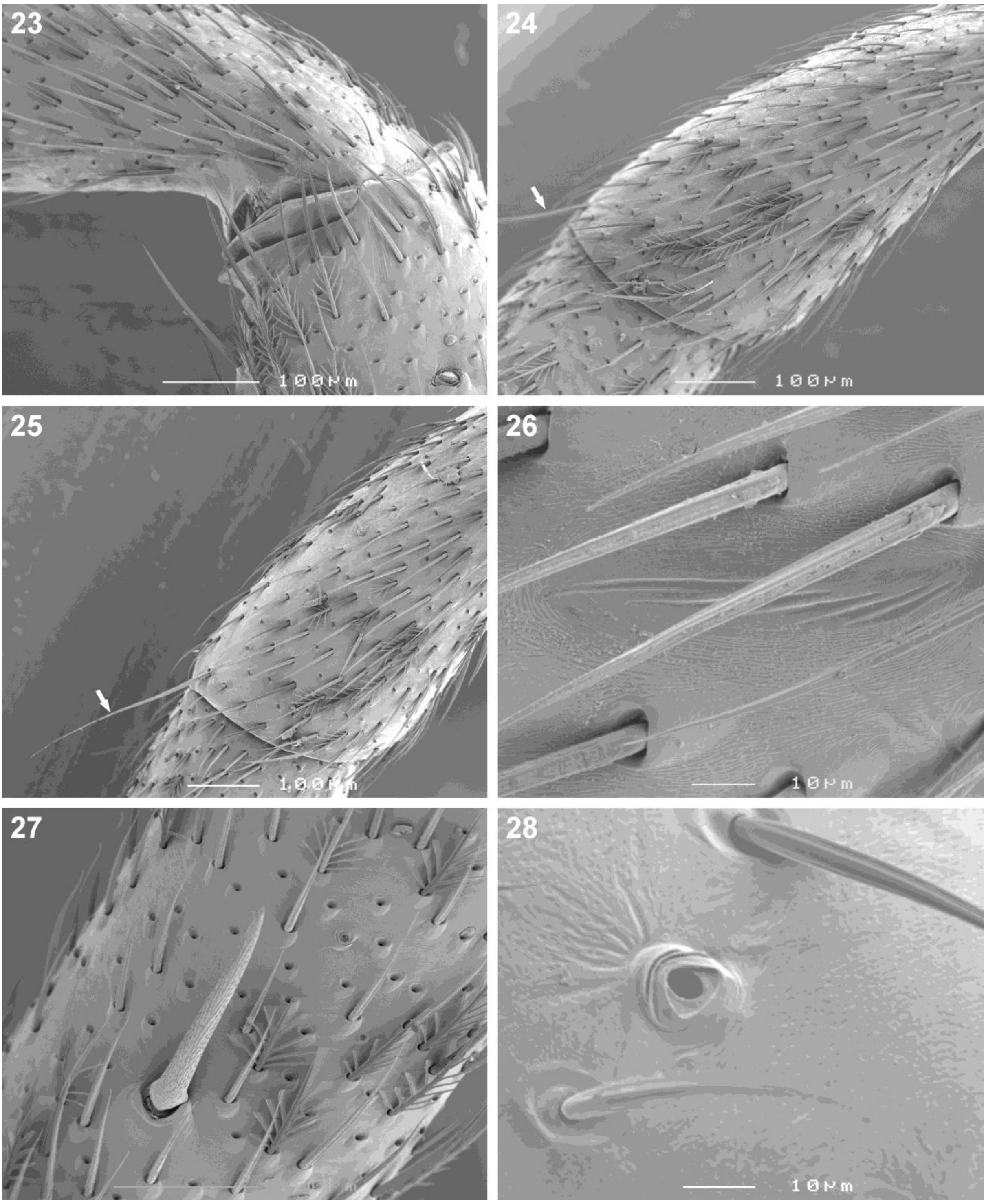
FIGURES 5–13. Digital microscope photographs of *Cambalida fulvipes* (Simon, 1896) from South Africa (5, 6, 8–13) and *C. lineata* sp. nov. from Madagascar (7): 5, 7. female, dorsal habitus; 6. male, dorsal habitus; 8. female carapace, dorsal view; 9. female abdomen, dorsal view; 10. same, ventral view; 11. male carapace, dorsal view; 12. male abdomen, dorsal view; 13. same, ventral view. Scale bars = 1.0mm.

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 surface 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

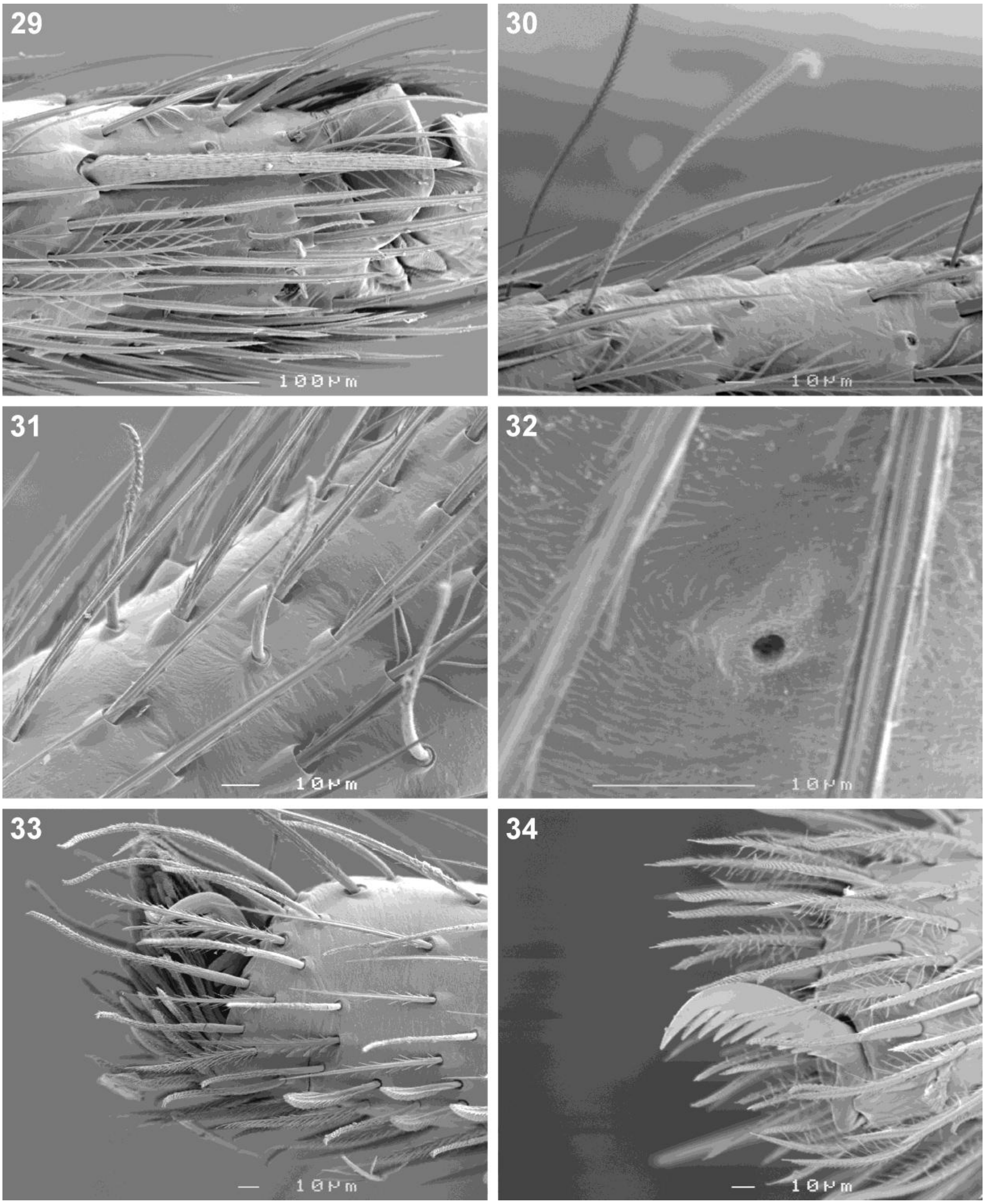


FIGURES 14–22. Scanning electron microscope photographs of *Cambalida dippenaarae* **sp. nov.** female (14, 15, 17, 20–22) and male (16, 18, 19): 14. dorsal carapace setae; 15, 16. eye region and clypeus, anterolateral view; 17, 18. cheliceral promarginal bent setae, anterior view; 19. chelicera, ventral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

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 basal 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

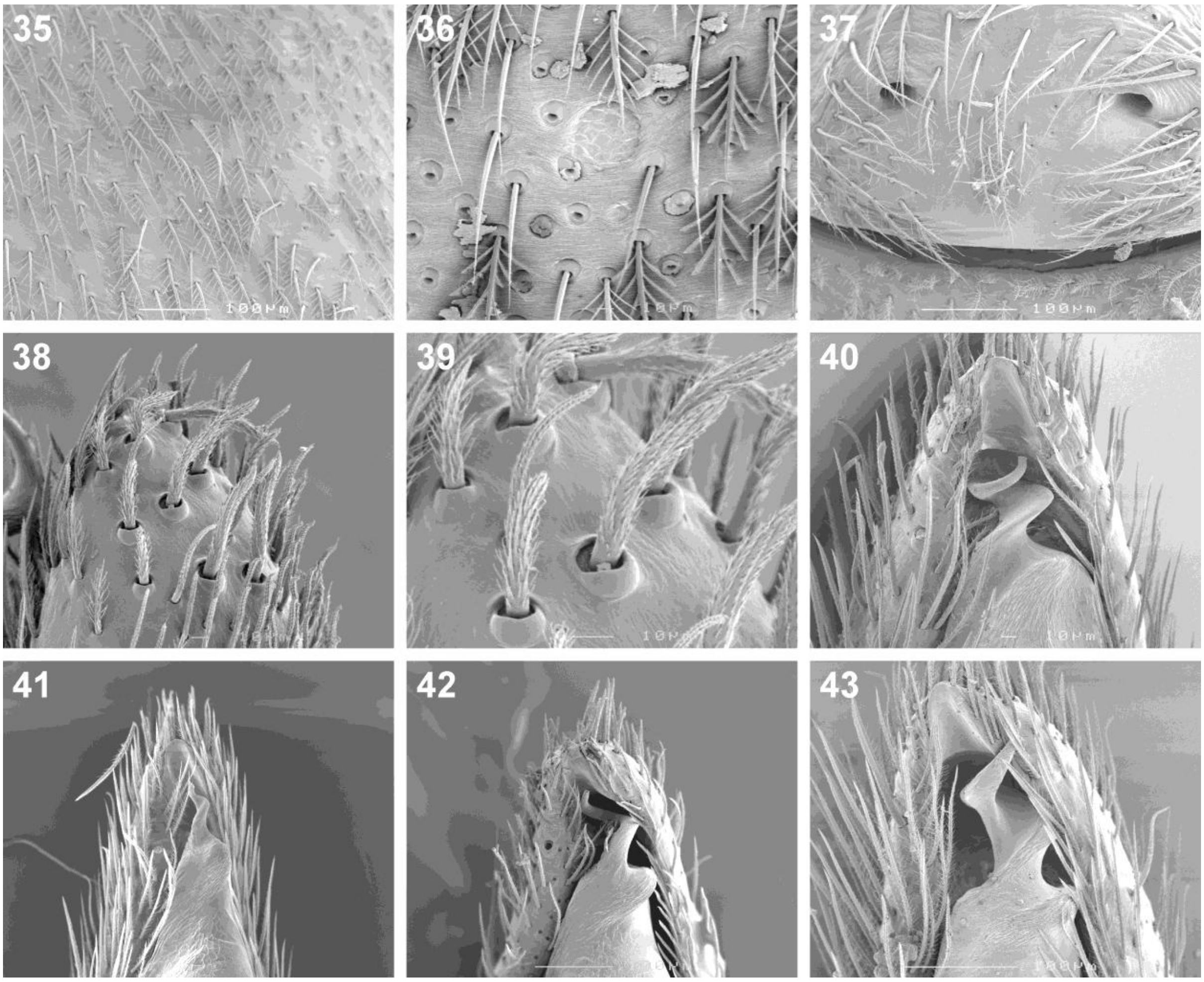


FIGURES 23–28. Scanning electron microscope photographs of *Cambalida dippenaarae* **sp. nov.** female: 23. distal end of femur IV, plumose and short straight setae; 24. patella III and 25. patella IV, arrows indicating long distal setae; 26. leg II, detail of proximal end of patellar indentation; 27.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



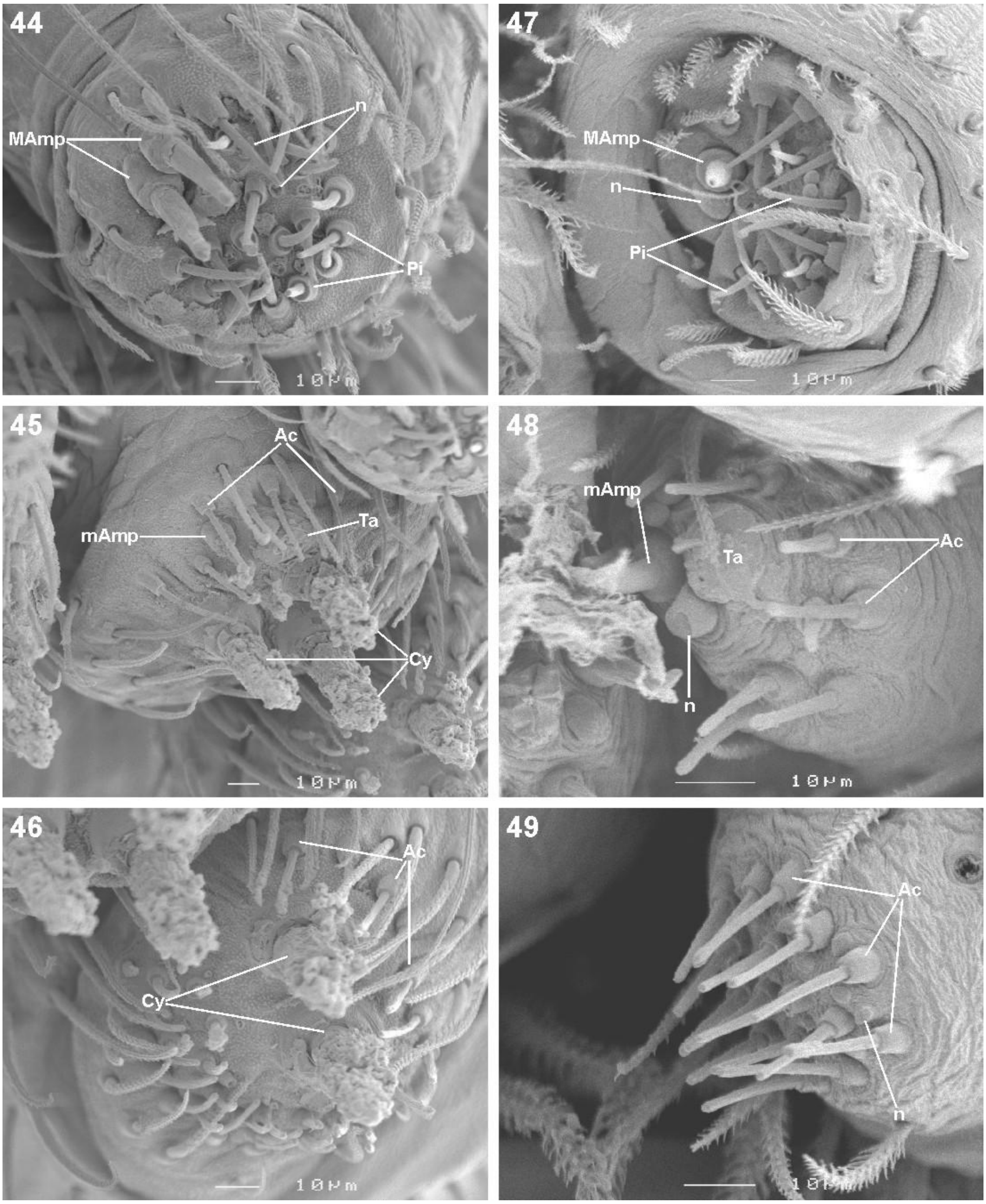
FIGURES 29–34. Scanning electron microscope photographs of *Cambalida dippenaarae* **sp. nov.** female: 29. metatarsus IV, distal prolateral spine; 30. tarsus IV, trichobothria; 31. tarsus II, short erect setae; 32. tarsus I, tarsal organ; 33. same, claw tuft; 34. palpal claw.

rows of tiny sclerites from epigastric furrow to spinnerets, outer row weakly sclerotised and indistinct. Spinnerets (observed here in *C. dippenaarae* **sp. nov.** and by Bosselaers & Jocqué [2002] in *C. coriacea* Simon, 1909): ALS of females with two major ampullate gland spigots, many piriform gland spigots and several small nubbins (Fig. 44; Bosselaers & 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 & Jocqué 2002: fig. 9A); PMS of females with three large cylindrical gland spigots, one small minor ampullate gland spigot and several aciniform gland spigots (Fig. 45; Bosselaers & Jocqué 2002: fig. 9D), female of *C. dippenaarae* **sp. nov.** also with a distinct tartipore; PMS of *C. dippenaarae* **sp. nov.** 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 & Jocqué 2002: fig. 9C); PLS of females with two large cylindrical gland spigots and several aciniform gland spigots (Fig. 46; Bosselaers & Jocqué 2002: fig. 9F); PLS of *C. dippenaarae* **sp. nov.** male with several aciniform gland

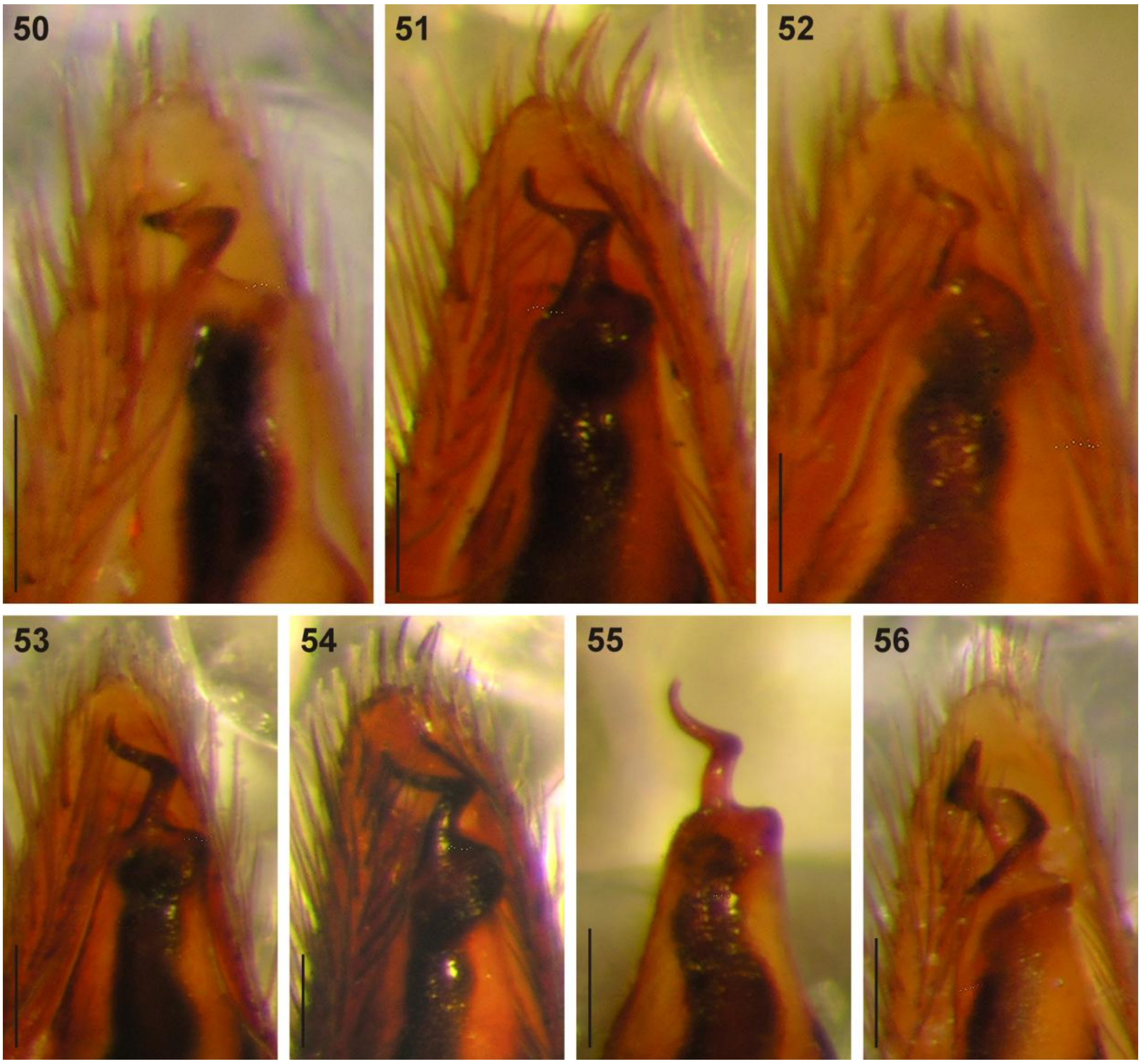


FIGURES 35–43. Scanning electron microscope photographs of *Cambalida dippenaarae* **sp. nov.** (35–39, 42), *C. compressa* **sp. nov.**, *C. deminuta* (Simon, 1909) and *C. loricifera* (Simon, 1885): 35. female, dorsal abdominal surface; 36. dorsal abdominal sigillum and detail of plumose setae; 37.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

spigots and tiny nubbins (Fig. 49), of *C. coriacea* male with only a single aciniform gland spigot (Bosselaers & Jocqué 2002: fig. 9E). Female epigyne weakly sclerotized, with 6-shaped or curved epigynal ridges covering or leading to lateral copulatory openings (Fig. 37);



FIGURES 44–49. Scanning electron microscope photographs of *Cambalida dippenaarae* **sp. nov.** 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.



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

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 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).

4.4.1 *Cambalida compressa* sp. nov.

Figs 40, 50, 57–60

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

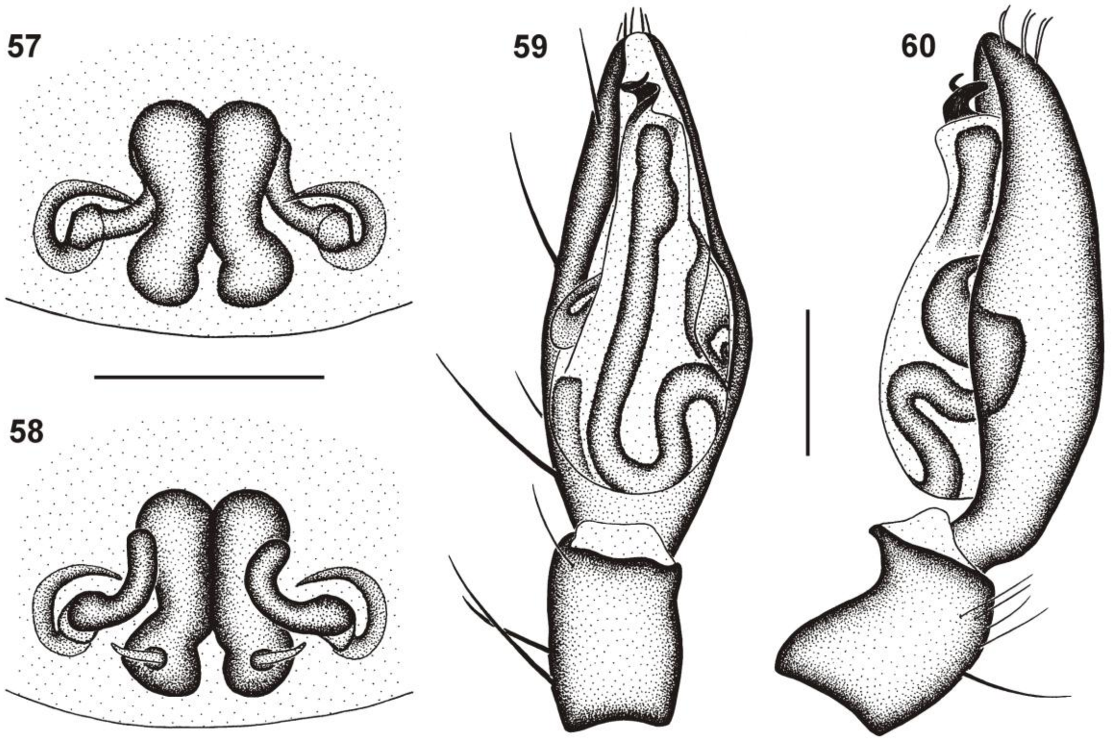
Diagnosis: The females are easily recognised by the very small spermathecae, large 6-shaped epigynal ridges and copulatory ducts that are initially directed medially (Figs 57, 58). Males have an embolus that is distinctly compressed on its longitudinal axis (Figs 40, 50, 59).

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 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 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 ⅕ AME diameter; clypeus height slightly larger than AME diameter; PER procurved, PLE slightly larger than PME; PME separated by distance equal to ⅗ 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 ⅒ 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).



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

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 ⅒ 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).

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

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).

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

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.

4.4.2 *Cambalida coriacea* Simon, 1909

Figs 51, 61–64

Cambalida coriacea Simon 1909: 370; Bosselaers & Jocqué 2000: 315, figs 3D, 4A–H; Bosselaers & Jocqué 2002: 244, figs 9A–F (♀ Holotype: **SIERRA LEONE:** Free Town [08°29'N, 13°14'W], MNHN 24399 – examined).

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).

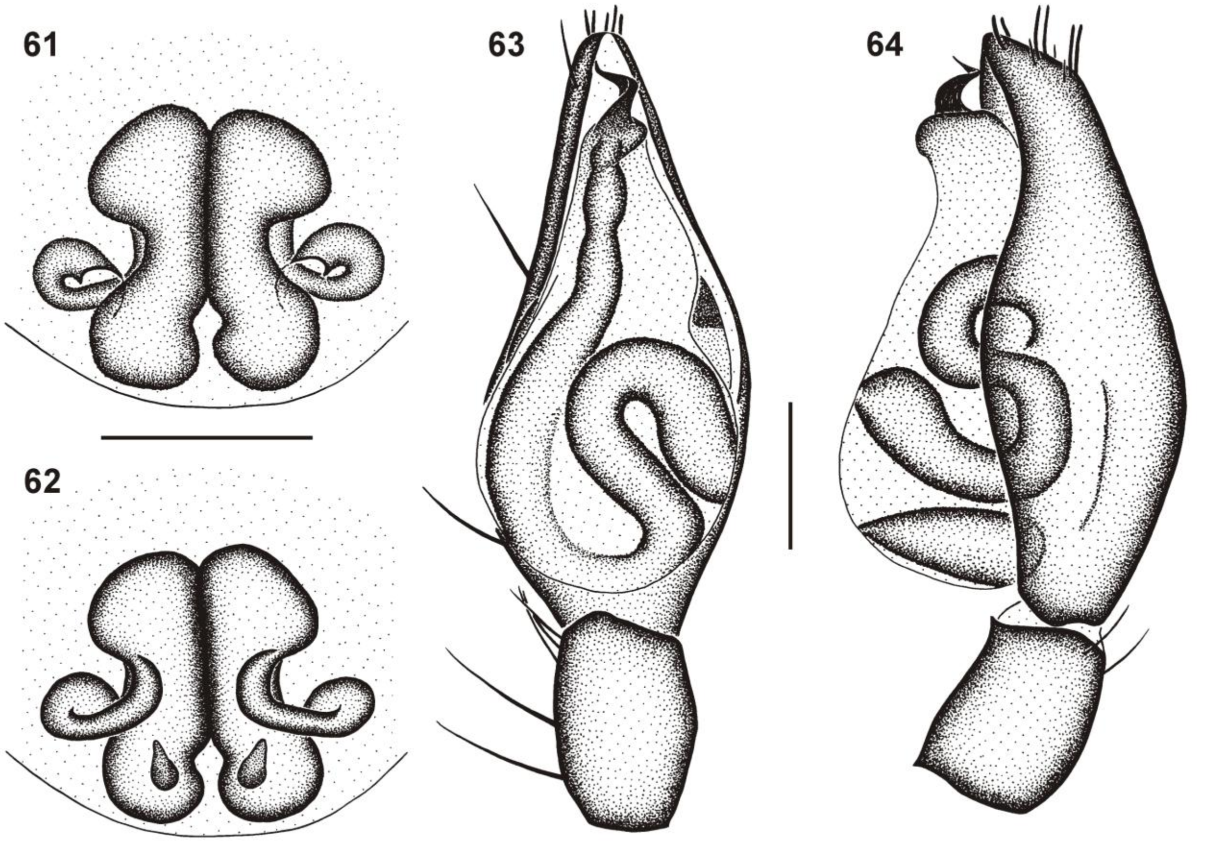
Female (Matute, CASENT 9033096). Measurements: CL 2.04, CW 1.53, AL 2.50, AW 1.80, TL 4.60 (4.50–5.68), FL 0.20, SL 0.94, SW 0.91, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.29, PME–PME 0.10, PME–PLE 0.04, PLE–PLE 0.44, PERW 0.65, MOQAW 0.28, MOQPW 0.39, MOQL 0.38.

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 ⅗ 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, tibia pl 1 do 1 plv 1, tarsus 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.



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.

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 ⅖ their diameter, AME separated from ALE by ⅛ AME diameter; clypeus height equal to 1⅖ AME diameter; PER procurved, PME and PLE equal in diameter; PME separated by distance equal to ⅗ their diameter, PME separated from PLE by distance slightly more than ⅕ 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).

Additional 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 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).

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

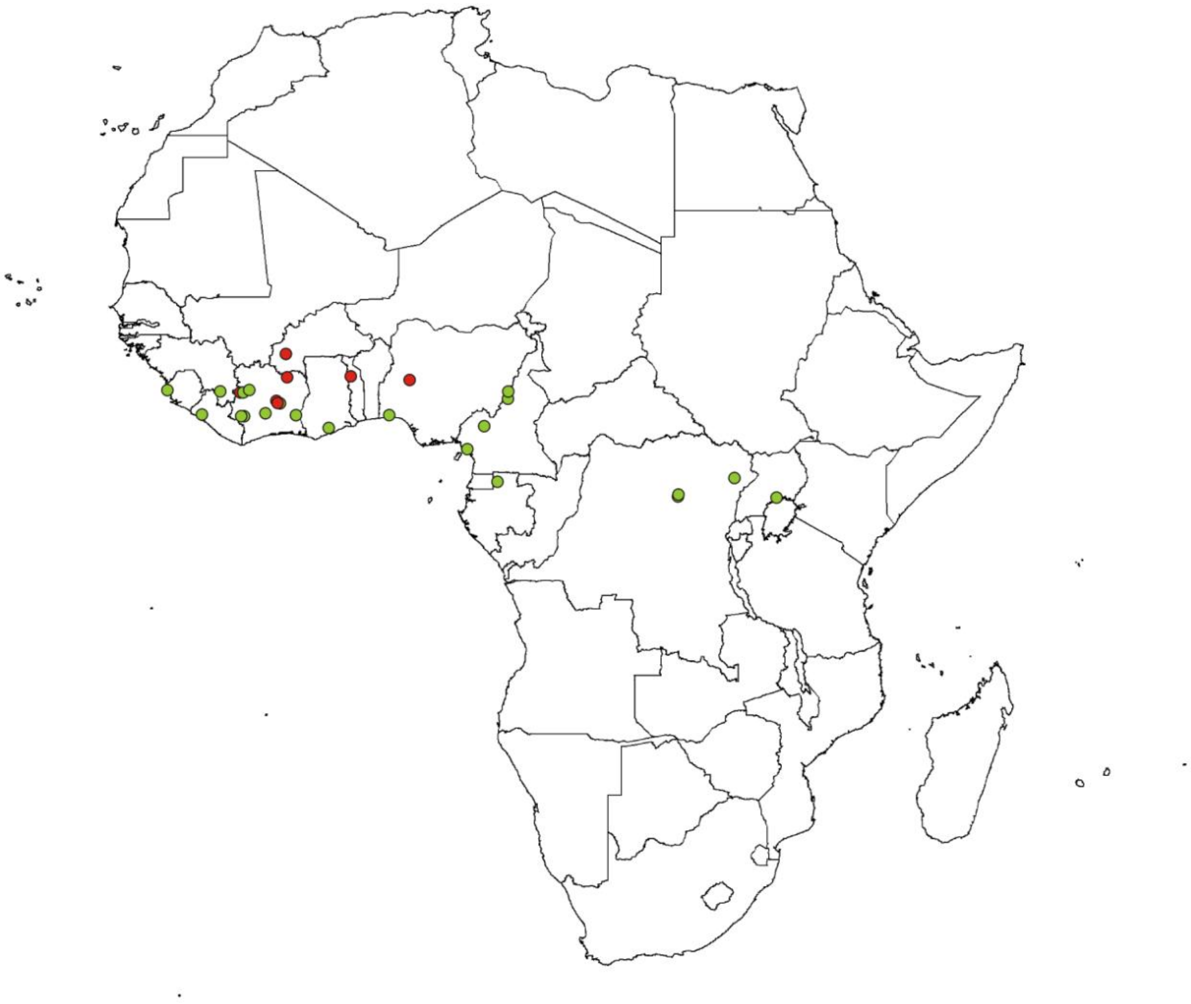


FIGURE 65. Distribution of *Cambalida compressa* **sp. nov.** (red circles) and *C. coriacea* Simon, 1909 (green circles) in the Afrotropical Region.

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

4.4.3 *Cambalida deminuta* (Simon, 1909)

Figs 41, 52, 66–69

Castianeira deminuta Simon, 1909: 367 **comb. nov.** (♂ Lectotype and ♂ paralectotype, here designated, together with 1♂ *Cambalida fulvipes* (Simon, 1896): **D.R. CONGO:** Fernand Vaz, deposited in MNHN 4109 – examined).

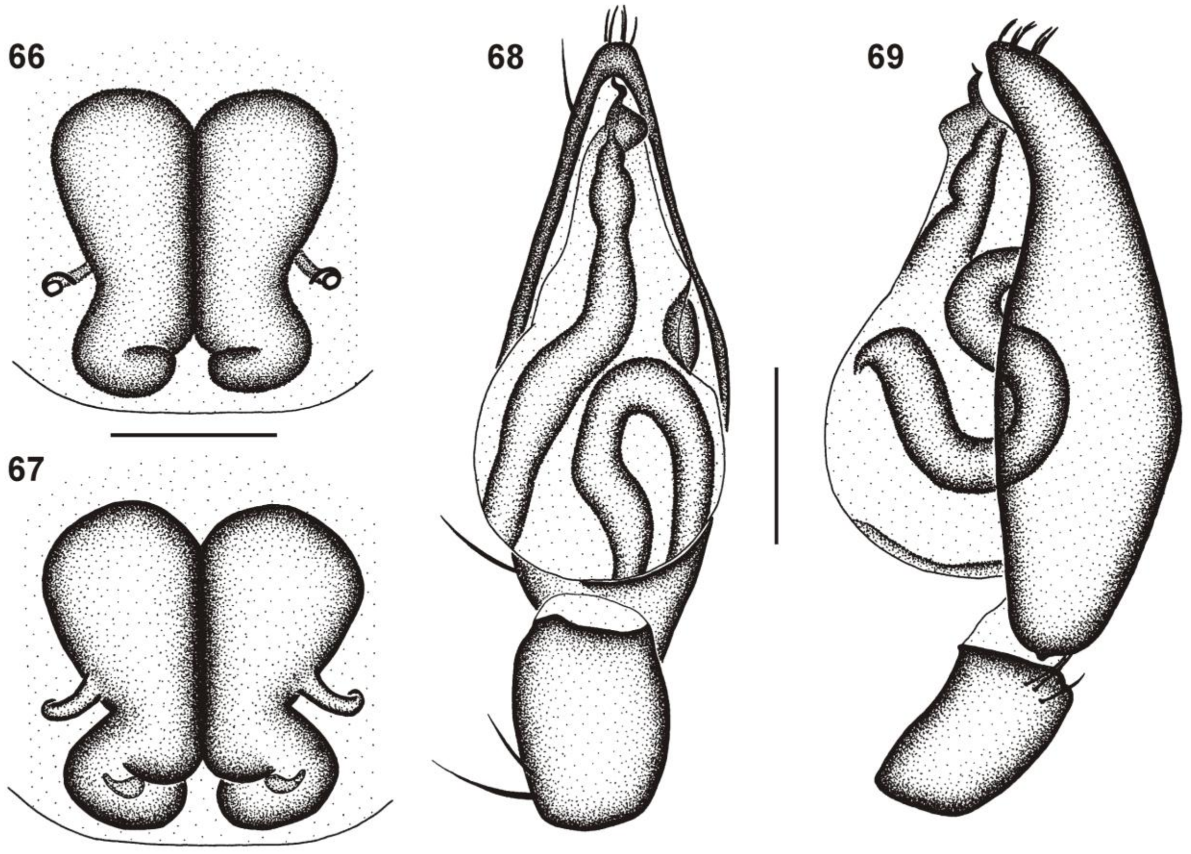
Remarks: The lectotype is the larger of the two *C. deminuta* males in the type series. Fernand Vaz is a river in the D.R. Congo and no specific locality is mentioned in the original description or on the label accompanying the types.

Diagnosis: Females can be recognised by the broad spermathecae and terminal receptacles, 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, tibia pl 1 do 1 plv 1, tarsus 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).



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.

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 ⅕ 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 ⅖ 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).

Additional 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 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., 0°19'27''N, 9°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 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).

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.

4.4.4 *Cambalida dippenaarae* sp. nov.

Figs 1–4, 14–39, 42, 44–49, 53, 70–73

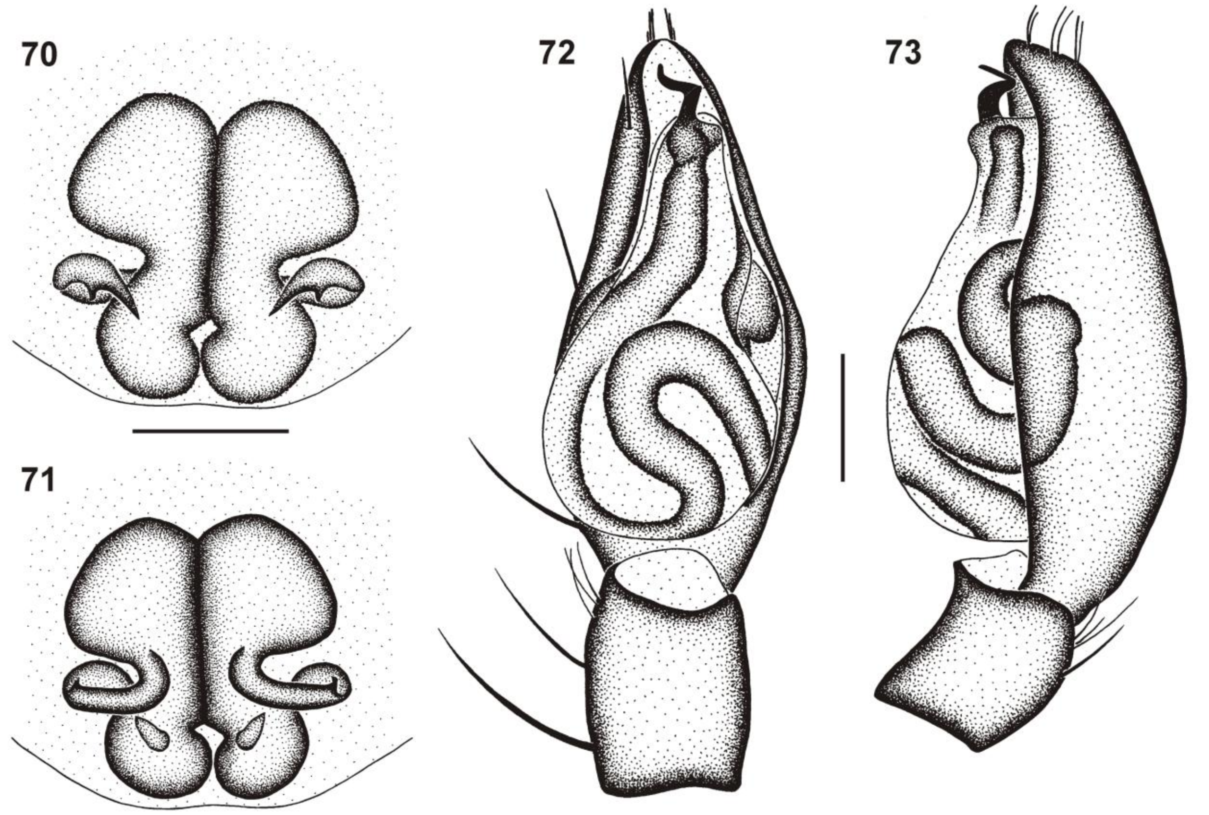
Etymology: The species name is a patronym in honour of Ansie Dippenaar-Schoeman, in recognition of her contributions to the study and promotion of research on African arachnids.

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.

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 ⅙ AME diameter; clypeus height slightly larger than AME diameter; PER procurved, PLE very slightly larger than PME; PME separated by distance slightly less than ⅗ their diameter, PME separated from PLE by distance equal to ⅕ PLE diameter; CW:PERW = 2.23:1. Chelicerae dark orange-brown,



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

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 ⅗ 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, tibia pl 1 plv 1, tarsus 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).

Type material: Holotype ♀, together with one paratype ♂: **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).

Additional 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 Divungu, 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).

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

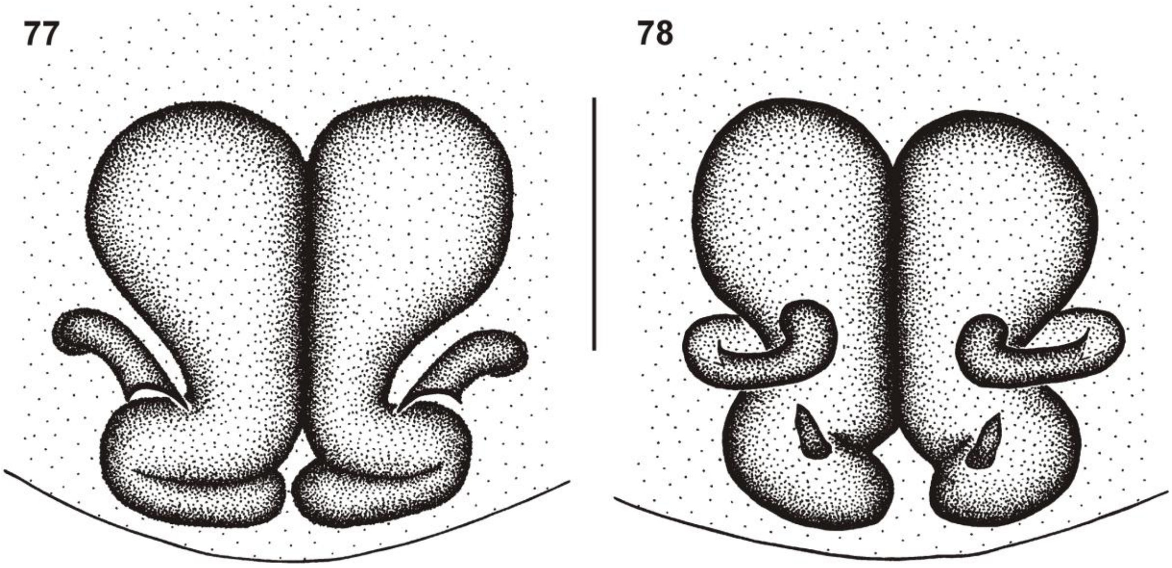
Biology: A fairly common ground-dwelling spider collected mainly by litter sifting and pitfall traps in forest and savanna habitats. Occasionally collected from the Grassland Biome in South Africa.

4.4.5 *Cambalida fagei* (Caporiacco, 1939)

Figs 74–78

Brachyphaea fagei Caporiacco, 1939: 356, fig. 17 (Holotype ♀: **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) **comb. nov.**

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.

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.

4.4.6 *Cambalida fulvipes* (Simon, 1896)

Figs 5, 6, 8–13, 54, 80–83

Castianeira fulvipes Simon, 1896: 406 (♀ Lectotype and ♀ paralectotype, here designated: **SOUTH AFRICA:** Pretoria [25°42'S, 28°13'E], MNHN 18324 – examined) **comb. nov.**

Castianeira depygata Strand, 1916: 91 (♂ Holotype: **D.R. CONGO:** Lake Kivu, Kwidjwi Island [Idjwi Island, 02°10'S, 29°03'E], leg. A.F. Herzog, IX.1907, ZMB 27150 – examined) **syn. nov.**

Castianeira mestrali Lessert, 1921: 424 (♂ Lectotype and ♀ paralectotype, here designated: **TANZANIA:** Kibonoto, IX–X.1905? (zone des cultures), MNHG – examined) **syn. nov.**

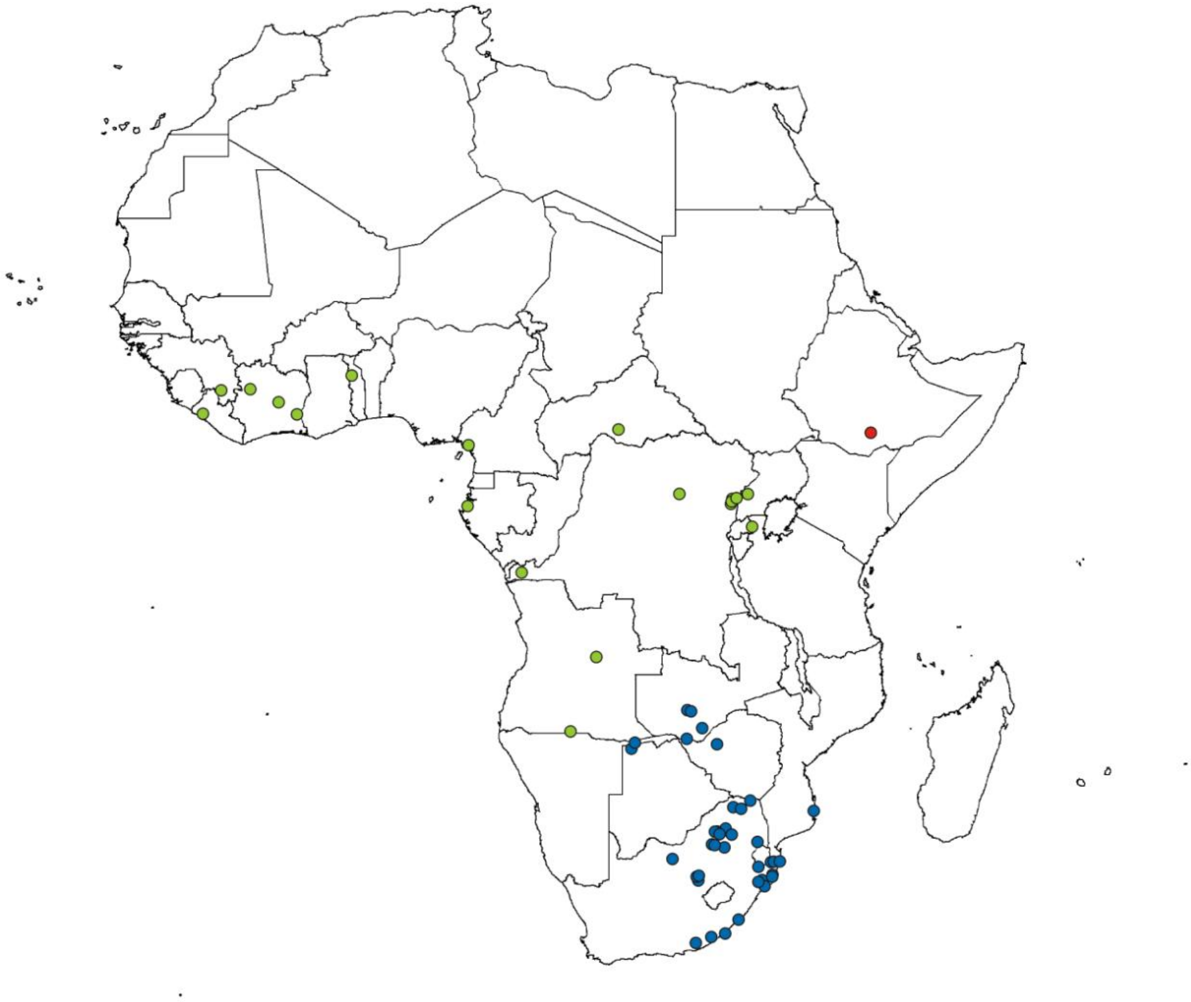


FIGURE 79. Distribution of *Cambalida deminuta* (Simon, 1909) (green circles), *C. dippenaarae* **sp. nov.** (blue circles) and *C. fagei* (Caporiacco, 1939) (red circle) in the Afrotropical Region.

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.

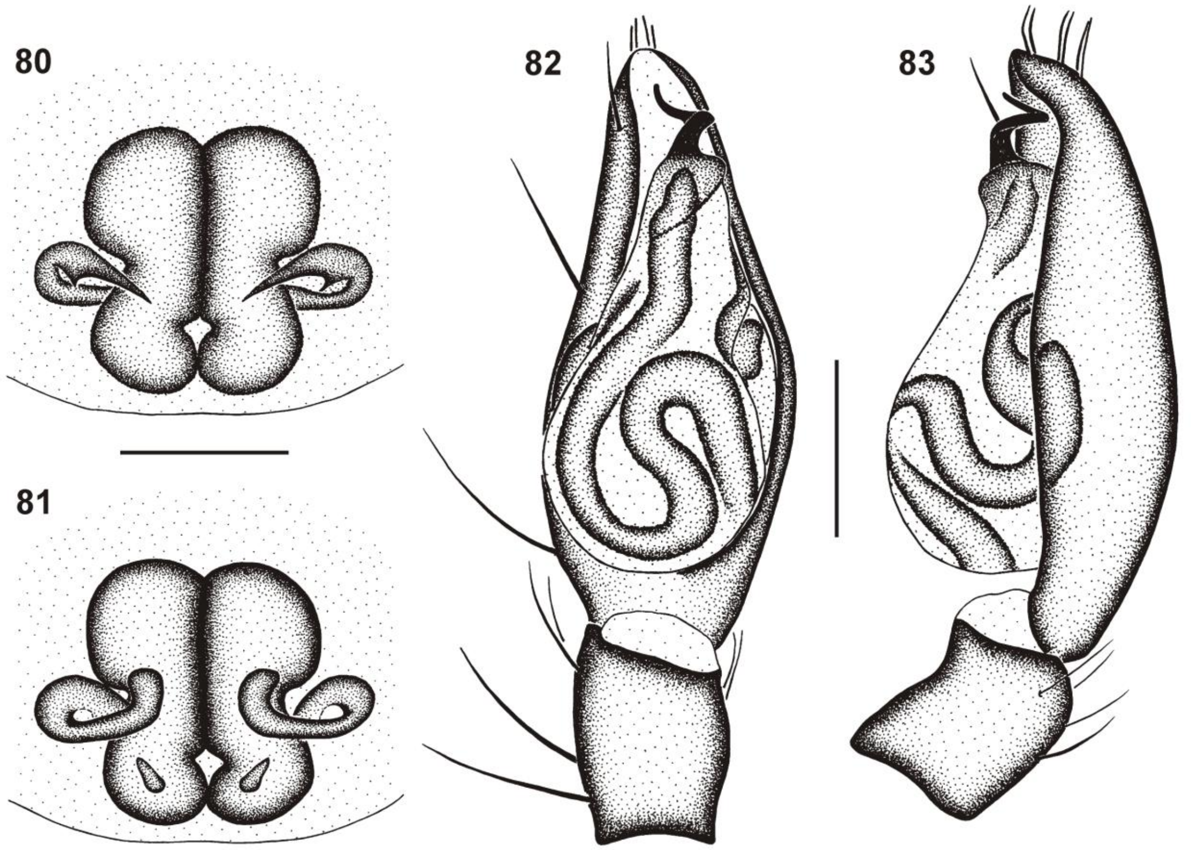
Length of leg segments (sequence from femur to tarsus, and total): I 1.70 + 0.75 + 1.36 + 1.28 + 0.88 = 5.97; II 1.55 + 0.63 + 1.13 + 1.11 + 0.75 = 5.17; III 1.40 + 0.68 + 1.04 + 1.23 + 0.65 = 5.00; IV 2.09 + 0.85 + 1.85 + 2.12 + 0.85 = 7.76.

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 ⅗ their diameter, AME separated from ALE by ⅙ 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 spines 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 ⅕ 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 ⅗ their diameter, AME separated from ALE by distance equal to ¼ AME diameter; clypeus height equal to 1⅘ 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 ⅖ 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.



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.

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 spines 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).

Additional 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 R., 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).

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 & 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.

4.4.7 *Cambalida griswoldi* sp. nov.

Figs 55, 84–86

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.

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).

Remark: The palp of the paratype male is greatly expanded and only the tegulum of 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.

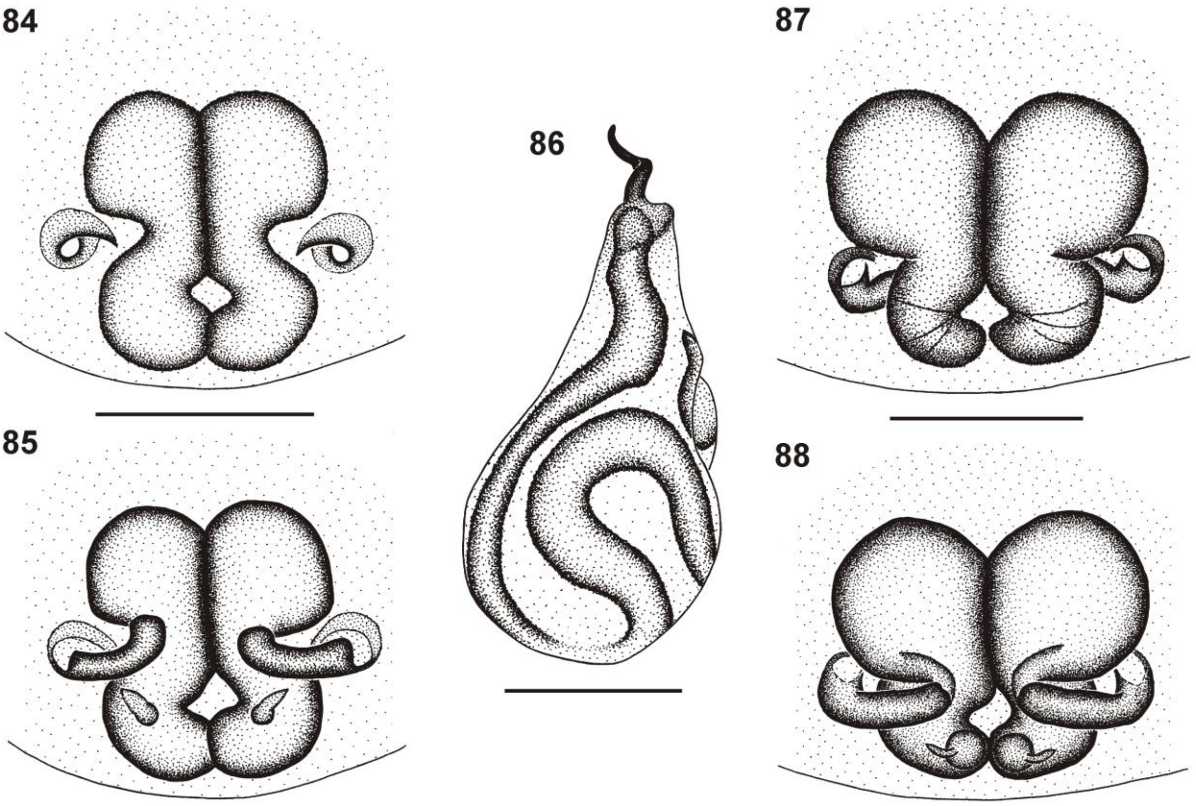
Carapace deep orange-brown, clypeus deep yellow-brown, eye region slightly darker; faint black striae radiating from fovea towards palps and coxae and faint black mottling on slopes; surface finely granulate, sparsely covered in white plumose setae. AER procurved, eyes subequal in diameter; AME separated 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 ⅘ 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 setae 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, tibia pl 1 plv 1, tarsus 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, tibia pl 1 plv 1, tarsus 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).

Type material: Holotype ♀: **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).



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

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).

Additional material examined: none.

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

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

4.4.8 *Cambalida lineata* sp. nov.

Figs 7, 87, 88

Etymology: From the Latin “linea”, referring to the pale dorsal stripe on the abdomen.

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).

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.

Type material: Holotype ♀: **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).

Additional material examined: none.

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

Biology: A ground-dwelling species collected in rainforest.

4.4.9 *Cambalida loricifera* (Simon, 1885)

Figs 43, 56, 89–92

Tylophora loricifera Simon, 1885: 379 (♂ Holotype: **SENEGAL:** Dakar [14°45'N, 17°20'W], MNHN 8062 – examined) **comb. nov.**

Castaneira loricifera Simon, 1897: 167.

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.

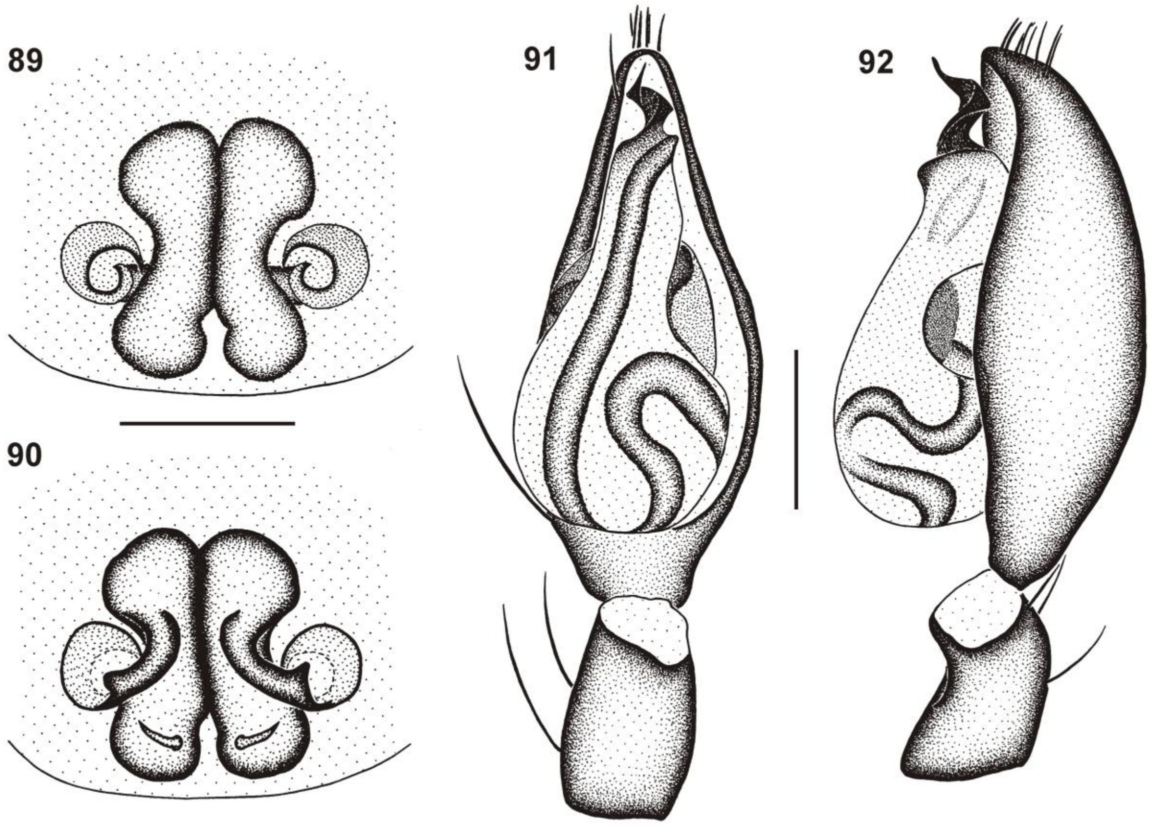
Carapace dark orange-brown, ocular region slightly darker, with dark brown mottling and black striae radiating from fovea towards palps and leg coxae; surface finely granulate, covered in white plumose setae, denser laterally. All eyes with black rings; AER procurved, AME and ALE subequal in size; AME separated by distance slightly less than ½ their diameter, AME separated from ALE by distance equal to ⅕ AME diameter; clypeus height slightly larger than 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 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-



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.

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).

Additional 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).

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

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

4.4.10 *Cambalida unica* sp. nov.

Figs 93, 94

Etymology: The species name is Latin for “unique”.

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

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.

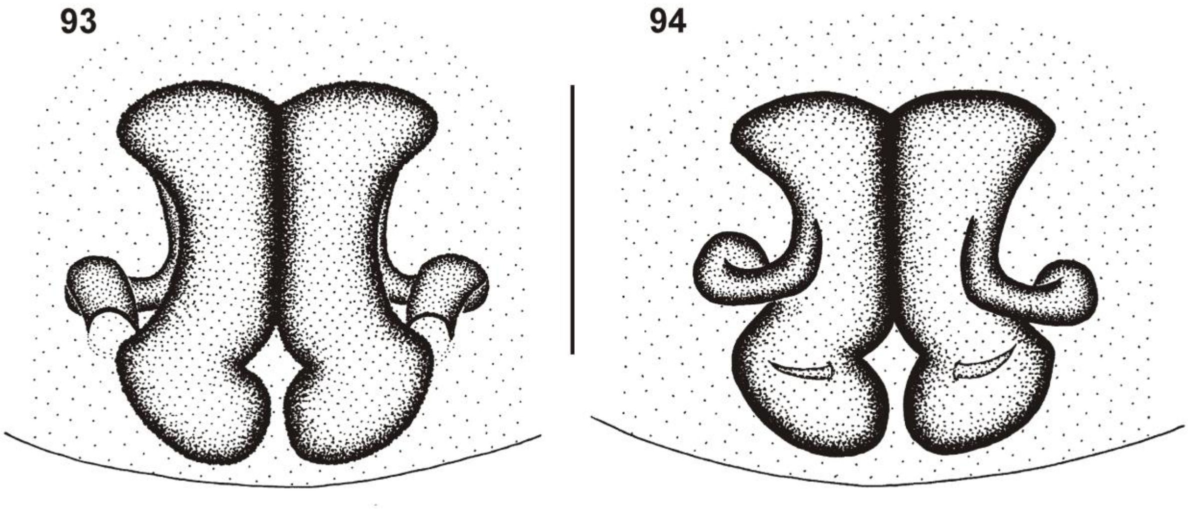
Length of leg segments (sequence from femur to tarsus, and total): I 1.88 + 0.81 + 1.48 + 1.27 + 0.86 = 6.30; II 1.71 + 0.78 + 1.23 + 1.14 + 0.75 = 5.61; III 1.59 + 0.75 + 1.11 + 1.25 + 0.63 = 5.33; IV 2.25 + 0.93 + 1.95 + 2.10 + 0.85 = 8.08.

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 ⅗ their diameter, AME separated from ALE by ⅕ 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, 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, tibia pl 1 do 1 plv 1, tarsus 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. 94); 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. 95).

Male: unknown.

Type material: Holotype ♀, together with 1♀ paratype: **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).

Additional material examined: none.



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

Distribution: Only known from the type locality (Fig. 96).

Biology: Unknown.

4.5 Species *nomina dubia*

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

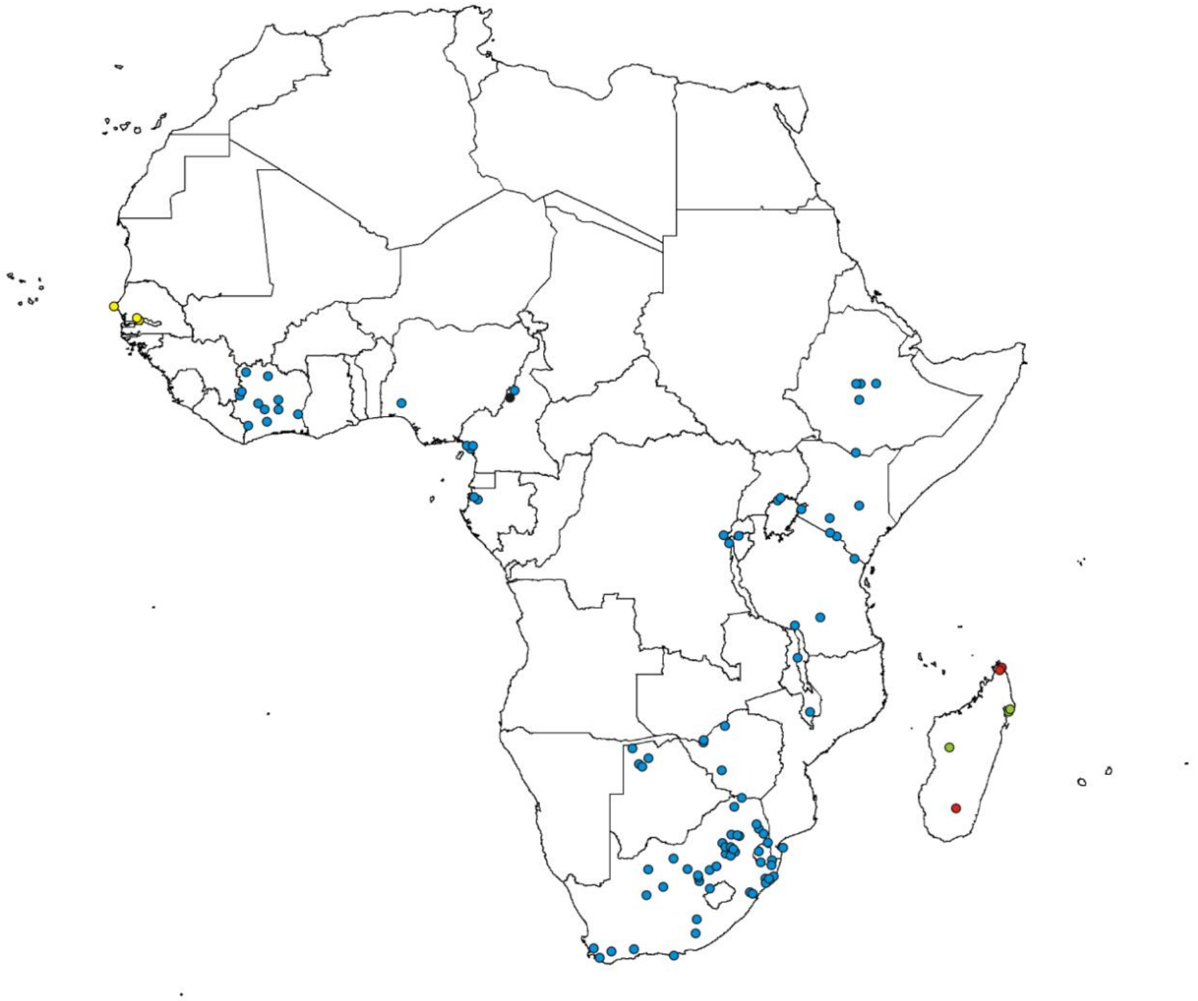


FIGURE 95. Distribution of *Cambalida fulvipes* (Simon, 1896) (blue circles), *C. griswoldi* **sp. nov.** (red circles), *C. lineata* **sp. nov.** (green circles), *C. loricifera* (Simon, 1885) (yellow circles) and *C. unica* **sp. nov.** (black circle) in the Afrotropical Region.

4.5.2 *Cambalida simoni* nom. nov.

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).

4.6 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 (Chapter 3) and *Copa* Simon, 1885 (Chapter 6) each have a single widespread Afrotropical species and *Echinax* Deeleman-Reinhold, 2001 (Chapter 8) has two widespread species, with the others 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*) and two additional species widespread through tropical West and Central Africa (*C. coriacea* and *C. deminuta*) and one 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 (Chapter 6), only two new Madagascan species of *Cambalida* have been described in this study.

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 & Haddad 2011). They are only occasionally collected from agroecosystems in South Africa (Haddad & 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.

4.7 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.

BRIGNOLI, P.M. 1983. *A catalogue of the Araneae described between 1940 and 1981*. Manchester University Press, Manchester, 755 pp.

BUTLER, V.P. & HADDAD, C.R. 2011. Spider assemblages associated with leaf litter of three tree species in central South Africa (Arachnida: Araneae). *African Journal of Ecology* **49:** 301–310.

CAPORIACCO, L. DI 1939. Arachnida. pp. 303–385. In: *Missione biologica nel paese dei Borana, Raccolte zoologiche*. Vol. 3, part 2. Reale Accademia d'Italia, Roma, 463 pp.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual*. Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

FOORD, S.H., MAFADZA, M., DIPPENAAR-SCHOEMAN, A.S. & VAN RENSBURG, B.J. 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.

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

HADDAD, C.R. 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, C.R. & DIPPENAAR-SCHOEMAN, A.S. 2006. Epigeic spiders (Araneae) in pistachio orchards in South Africa. *African Plant Protection* **12:** 12–22.

HADDAD, C.R., HONIBALL, A.S., DIPPENAAR-SCHOEMAN, A.S., SLOTOW, R. & VAN RENSBURG, B.J. 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.

HADDAD, C.R., 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, M.I., FOORD, S.H., DIPPENAAR-SCHOEMAN, A.S. & STAM, E.M. 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.

PLATNICK, N.I. 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.

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. *Paris: Librairie Encyclopédique de Roret*, pp. 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.

CHAPTER 5

***Castianeira* sp. (Bartholomew Diaz Point, Mozambique)**

Taxonomic notes on the Afrotropical species of *Castianeira* Keyserling, 1879 (Araneae: Corinnidae), with redescriptions of some poorly known species

5.1 ABSTRACT

The genus *Castianeira* Keyserling, 1879 is the largest genus in the Corinnidae with 131 described species, of which 22 are presently known from the Afrotropical Region. Six species were misplaced and have been transferred to or synonymised with species of *Cambalida* Simon, 1909 or the new genus *Copuetta* **gen. nov.**. In the present study, five species described by Eugéne Simon are redescribed and illustrated for the first time based on the type material: *C. delicatula* Simon, 1909 (♀), *C. formosula* Simon, 1909 (♂), *C. majungae* Simon, 1896 (♂♀), *C. phaeochroa* Simon, 1909 (♂♀) and *C. thomensis* Simon, 1909 (♂). The male of *C. majungae* is described for the first time. The females of *C. thomensis* described by Simon could not be traced and this sex is not redescribed. The holotype of *C. bicolor* (Simon, 1890) does not have an abdomen and the species is considered a *nomen dubium*.

5.2 INTRODUCTION

The spider genus *Castianeira* Keyserling, 1879 is a well-known and diverse group of ground-dwelling ant-mimicking sac spiders represented by 131 species throughout the tropical and temperate regions of the world except for Australia (Platnick 2011). The fauna of North and Central America and South-East Asia has been thoroughly revised by Reiskind (1969) and Deeleman-Reinhold (2001), respectively, but that of the other biogeographical regions is poorly known. Of interest in the current chapter is the Afrotropical fauna, presently represented by 22 species (Table 1). Only a single species has been described from Madagascar and none are known from Mauritius, the Comoros, Seychelles and the Mascarene islands; all of the remaining species were described from continental Africa with the exception of a single species each from São Tomé and Bioko.

As for most of the larger genera previously placed in the polyphyletic mega-family Clubionidae before its separation into smaller families by Lehtinen (1967), *Castianeira* also seems to have served as a dumping ground for somewhat unspecialised weakly mimetic ground-dwelling castianeirine spiders, and twelve species have so far been transferred to other corinnid genera or to the Gnaphosidae (Platnick 2011). Similarly, several Afrotropical species are presently misplaced and will be transferred to or synonymised with species of other genera (Table 1).

The majority of the Afrotropical species are only known from the original descriptions and have never been illustrated or redescribed previously, making the identification of these species extremely difficult, if not impossible. The aim of the current study was to evaluate the status of the Afrotropical species and provide redescriptions and illustrations of some of the species described by Eugéne Simon whose types could be located and loaned. Remarks are also given on the condition of the types examined. These redescriptions are critical to aid the identification of material, and will serve as a platform for the recognition of both described and undescribed species from the Afrotropical Region amongst the mass of unidentified museum specimens.

TABLE 1: List of Afrotropical species currently placed in *Castianeira* (Platnick 2011), with an indication of their taxonomic status and distribution. Countries of type localities are indicated with an asterisk.

***Castianeira* species**	**Status**	**Reference**	**Distribution**
C. albomaculata Berland, 1922	Types not examined	—	Kenya*
C. antinorii (Pavesi, 1880)	Types not examined	—	Algeria, Tunisia*, Sudan, Egypt
C. bartholini Simon, 1901	Types not examined, possibly lost	—	Ethiopia or Djibouti
C. bicolor (Simon, 1890)	*Nomen dubium* (type damaged)	Present chapter	Tanzania*
C. brunellii Caporiacco, 1940	Types not examined	—	Ethiopia*
C. cecchii (Pavesi, 1883)	Types not examined	—	Ethiopia*
C. delicatula Simon, 1909	Redescribed	Present chapter	Sierra Leone*
C. deminuta Simon, 1909	= *Cambalida deminuta* (Simon, 1909)	Chapter 4	D.R. Congo*, Sierra Leone
C. depygata Strand, 1916	= *Cambalida fulvipes* (Simon, 1896)	Chapter 4	D.R. Congo*
C. formosula Simon, 1909	Redescribed	Present chapter	Bioko*
C. fulvipes Simon, 1896	= *Cambalida fulvipes* (Simon, 1896)	Chapter 4	South Africa*, East, Central and Southern Africa
C. fusconigra Berland, 1922	Types not examined	—	Kenya*
C. insulicola Strand, 1916	Types not examined	—	D.R. Congo*
C. kibonotensis Lessert, 1921	= *Copuetta lacustris* (Strand, 1916)	Chapter 11	Tanzania*, East, Central and Southern Africa
C. loricifera (Simon, 1886)	= *Cambalida loricifera* (Simon, 1886)	Chapter 4	Senegal*
C. majungae Simon, 1896	Redescribed	Present chapter	Madagascar*
C. mestrali Lessert, 1921	= *Cambalida fulvipes* (Simon, 1896)	Chapter 4	Tanzania*
C. micaria (Simon, 1886)	Types not examined, possibly lost	—	Senegal*
C. phaeochroa Simon, 1909	Redescribed	Present chapter	Angola*
C. soyauxi (Karsch, 1879)	Types not examined	—	D.R. Congo*
C. thomensis Simon, 1909	Redescribed	Present chapter	São Tomé*
C. venustula (Pavesi, 1895)	Types not examined	—	Ethiopia*

5.3 MATERIAL & METHODS

All specimens examined during this study were observed in 70% ethanol using a Nikon SMZ800 stereomicroscope for descriptions, digital photographs and measurements. A sequence of digital photographs of the dorsal habitus of each redescribed sex was taken using a Nikon Coolpix 8400 mounted on a Nikon SMZ800 stereomicroscope. The images were subsequently stacked to increase depth of field using the Combine ZM software (http://www.hadleyweb.pwp.blueyonder.co.uk).

The epigynes and male palps of each species were illustrated and measurements taken using a Nikon SMZ800 stereomicroscope with an eyepiece reticule. Where additional female specimens other than the types were available, the epigynes were dissected and cleaned in a Labcon 5019U ultrasonic bath in 70% ethanol for 30 seconds. Scale bars were added to all figures in Corel Draw 14.0.

All measurements are given in millimetres (mm). Total body length measurements are given for the smallest and largest specimens of each sex to give an indication of size variation, and body, eye and leg measurements are given for the specimens indicated in the descriptions. Abbreviations used in the descriptions are as follows: AER – anterior eye row; AL – abdomen length; ALE – anterior lateral eye; AME – anterior median eye; AW – abdomen width; CL – carapace length; CW – carapace width; FL – fovea length; 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; PME – posterior median eye; SL – sternum length; ST – spermatheca; SW – sternum width; TL – total length. Leg spination follows the format of Bosselaers & Jocqué (2000) and includes the following abbreviations: do – dorsal; pl – prolateral; plv – prolateral ventral; rl – retrolateral; rlv – retrolateral ventral; vt – ventral terminal.

The material examined in this study is deposited in the California Academy of Sciences, San Francisco, USA (CAS), Museum National d'Histoire Naturelle, Paris, France (MNHN) and British Museum of Natural History, London, England (BMNH). Locality co-ordinates were not available on any of the labels or in museum databases, and were thus searched for using the Global Gazetteer Version 2.2 (www.fallingrain.com) and are indicated in square brackets, as are original locality names that have changed subsequent to the original description.

5.4 GENUS *CASTIANEIRA* KEYSERLING, 1879

Castianeira Keyserling, 1879: 334; Simon, 1897: 172; Reiskind, 1969: 181; Deeleman-Reinhold, 2001: 304.
Micariaulax Becker, 1879: 82.
Tylophora Pavesi, 1880: 344.
Thargalia Karsch, 1880: 376.
Geotrecha Emerton, 1890: 168.
Pedo O.P.-Cambridge, 1896: 219.

Type species: *Castianeira rubicunda* Keyserling, 1879, by monotypy.

Diagnosis: *Castianeira* species are weakly mimetic ground-living ant-mimicking spiders with a moderately to slightly procurved PER, AME considerably larger than the others, slender legs, a large dorsal scutum covering most of the abdomen in males, small and extending up to a ½ abdomen length in females. Afrotropical species can be separated from *Cambalida* by the relatively smaller and more widely spaced eyes, more slender legs and more elongate carapace, and the absence of two or three rows of thick modified distal dorsal setae on the male palpal cymbium that are diagnostic for *Cambalida*.

5.4.1 *Castianeira delicatula* Simon, 1909

Figs 1, 2, 12

Castaneira delicatula Simon, 1909: 368 (♀ holotype: **SIERRA LEONE:** Free Town [08°29'N, 13°14'W], MNHN 10721 – examined).

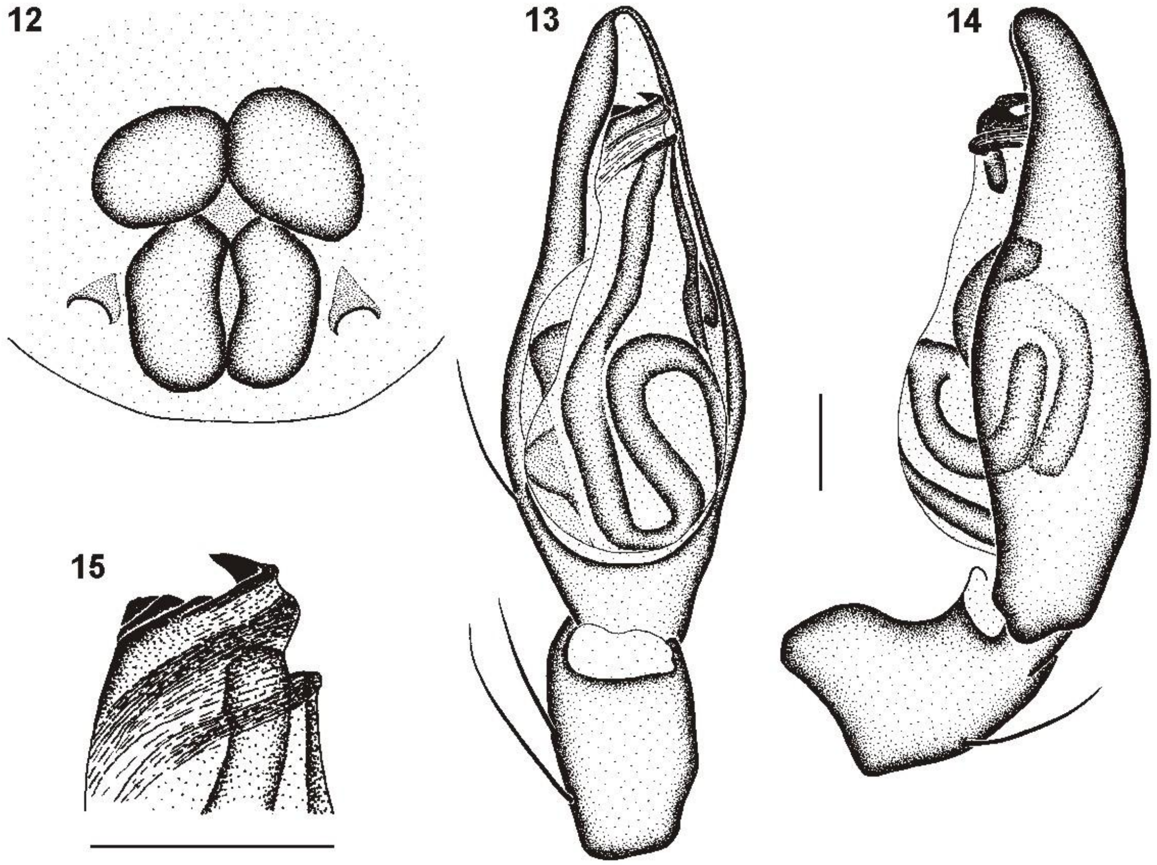
Remarks: The type is in good condition except for the tarsi IV, one of which is detached and the other missing, and the colour that is slightly faded.

Female (holotype, Free Town, MNHN 10721). Measurements: CL 2.63, CW 1.66, AL 3.30, AW 2.04, TL 6.05 (5.30–6.05), FL 0.28, SL 1.26, SW 0.98, AME–AME 0.05, AME–ALE 0.01, ALE–ALE 0.35, PME–PME 0.12, PME–PLE 0.06, PLE–PLE 0.50, PERW 0.70, MOQAW 0.33, MOQPW 0.40, MOQL 0.43.

FIGURES 1–11. Digital microscope photographs of *Castianeira delicatula* (1, 2), *C. formosula* Simon, 1909 (3, 4), *C. majungae* Simon, 1896 (5, 6), *C. phaeochroa* Simon, 1909 (7, 8), *C. thomensis* Simon, 1909 (9, 10) and *C. bicolor* (Simon, 1890) (11): 1, 3, 5–11 dorsal habitus; 2, 4 ventral view of abdomen. Scale bars: 2.0mm.

Length of leg segments: I 1.80 + 0.71 + 1.60 + 1.54 + 1.22 = 6.87; II 1.68 + 0.66 + 1.38 + 1.31 + 1.00 = 6.03; III 1.53 + 0.65 + 1.20 + 1.30 + 0.75 = 5.43; IV 2.18 + 0.78 + 1.93 + 2.30 + 0.95 = 8.14.

General appearance as in Fig. 1. Carapace oval, narrowed in eye region, notched posteriorly; highest at slightly less than ⅔ carapace length, sloping gently posteriorly; carapace slightly depressed anterior to fovea; surface finely wrinkled, nearly asetose, with a few short straight setae; several long erect black setae on clypeus and eye region; fovea short and fine, distinct, at ⅔ carapace length; carapace dark orange-brown, eye region darker, with fine network of dark brown mottling, forming Y-shaped marking in front of fovea and four paired striae radiating from fovea; lateral margins with dark brown mottled markings. All eyes with fine black rings; AER procurved, medians slightly larger than laterals; AME separated by distance slightly less than ⅓ their diameter; AME separated from ALE by $^{1}/_{10}$ AME diameter; clypeus height slightly less than 1¼ times AME diameter; PER strongly procurved, laterals slightly larger than medians; PME separated by distance equal to $^{4}/_{5}$ their diameter; PME separated from PLE by distance approximately equal to $^{2}/_{5}$ PME diameter; CW:PERW = 2.37:1. Chelicerae deep yellow-brown, with scattered long erect setae on anterior surface; three closely spaced teeth on promargin, median tooth largest, distal tooth smallest; median and distal teeth closer to each other than to proximal tooth; retromargin with two teeth, proximal tooth slightly larger than distal tooth; endites orange-brown, cream distally, with distinct serrula and maxillar hair tuft; labium brown, cream distally, broader than long, slightly concave along anterior margin; sternum shield-shaped, yellow-brown with black mottling, with scattered long erect black setae and short straight setae; precoxal triangles present; intercoxal sclerites present between all coxal pairs; pleural bars isolated. Leg formula 4123, all segments covered in short straight setae with scattered plumose setae; coxae pale yellow-brown; femora pale brown, yellow distally, lighter along dorsal midline, all with long proximal ventral seta; femur III paler than others; patellae yellow, III and IV slightly darker, all with retrolateral black mottling surrounding patellar indentation; remaining segments of legs I and II yellow; tibiae, metatarsi and tarsi III pale yellow-brown; tibiae IV yellow-brown with black mottling, yellow proximally and distally; metatarsi IV yellow-brown with black mottling, slightly paler proximally and distally; tarsi IV dark 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: all with one fine do terminal seta; tibiae: I plv 3 rlv 3, II plv 3 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 2-3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora: pl 1 do 2, with rlv 3 erect setae proximally followed by rlv 3 erect spines, in row; patellae: pl 1, with fine distal do seta; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 2. Abdomen oval, clearly narrower in anterior half than posteriorly, with small pale orange-brown dorsal scutum extending ⅓ abdomen length; three pairs of short erect setae above petiole; two pairs of distinct sigilla present, first at ⅓ and second at ½ abdomen length; dorsum mottled grey; dorsum covered in short straight and scattered plumose setae;



FIGURES 12–15. Genitalic morphology of *Castianeira delicatula* Simon, 1909 (12) and *C. formosula* Simon, 1909 (13–15): 12. female epigyne, ventral view; 13. male palp, ventral view; 14. same, retrolateral view; 15. detail of embolus in ventral view. Scale bars = 0.25mm.

venter pale grey, creamy-grey medially, without ventral sclerite; inframamillary sclerite distinct; two paired row of tiny sclerites from epigastric fold to spinnerets medially (Fig. 2); ventral setae pale, short and straight; two pairs of long erect setae ventrally, first at $^{1}/_{5}$ and second at $^{3}/_{5}$ distance between epigastric groove and spinnerets. Epigyne with small lateral hemispherical copulatory openings at ⅔ epigyne length; ST II oval, orientated obliquely; broad ducts connecting ST II to elongate, bean-shaped posterior ST I (Fig. 12).

Male: unknown.

Additional material examined: IVORY COAST: Bouaké [07°41'N, 05°02'W], leg. A. Russell-Smith, 17.VIII.1994 (weed control experiment), 1♀ (BMNH).

Distribution: known only from two localities in West Africa (Fig. 27).

5.4.2 *Castianeira formosula* Simon, 1909

Figs 3, 4, 13–15

Castaneira formosula Simon, 1909: 365 (♂ holotype: **EQUATORIAL GUINEÉ:** Bioko [Fernando Pó]: Basilé [03°35'N, 09°45'E], MNHN 24390 – examined).

Remarks: The holotype is somewhat faded. Left leg III and right tarsus IV are missing and the left palpal tarsus is detached.

Male (holotype, Basilé, MNHN 24390). Measurements: CL 3.45, CW 2.38, AL 3.60, AW 1.80, TL 7.10, FL 0.34, SL 1.56, SW 1.25, AME–AME 0.05, AME–ALE 0.005, ALE–ALE 0.42, PME–PME 0.09, PME–PLE 0.06, PLE–PLE 0.54, PERW 0.81, MOQAW 0.42, MOQPW 0.47, MOQL 0.49.

Length of leg segments: I 2.75 + 1.10 + 2.58 + 2.65 + 1.83 = 10.91; II 2.55 + 1.06 + 2.15 + 2.28 + 1.38 = 9.42; III 2.50 + 1.04 + 1.80 + 2.75 + 1.30 = 9.39; IV 3.37 + 1.18 + 2.85 + 3.89 + 1.70 = 12.99.

General appearance as in Fig. 3. Carapace oval, narrowed in eye region, nearly straight posteriorly; sloping gently from eye region, highest at midpoint of fovea, last $^{1}/_{5}$ sloping steeply; surface finely wrinkled, covered in short pale grey plumose setae; several long erect black setae on clypeus, in eye region, single seta behind each PLE, four setae along midline posterior to PER; fovea long, distinct, at ⅔ carapace length; carapace colour bright yellow-orange; eye region slightly darker; yellow striae radiating from fovea. All eyes with black rings; AER procurved, medians slightly larger than laterals; AME separated by distance equal to ¼ their diameter; AME separated from ALE by $^{1}/_{10}$ AME diameter; clypeus height equal to 1½ times AME diameter; PER strongly procurved, medians very slightly larger than laterals; PME separated by distance approximately ½ their diameter; PME separated from PLE by distance approximately equal to ⅓ PME diameter; CW:PERW = 2.94:1. Chelicerae yellow-orange, with scattered long black straight setae on anterior surface; three closely spaced teeth on promargin, median tooth largest, proximal tooth smallest; retromargin with two teeth, distal tooth slightly smaller than proximal tooth; endites yellow proximally, cream distally, slightly broadened retrolaterally, with distinct serrula and maxillar hair tuft; labium brown proximally, paler distally, broader than long; sternum shield-shaped, longer than broad, yellow with orange margins, with scattered erect black setae; precoxal triangles weakly sclerotised, indistinct; intercoxal sclerites between coxae I and II, II and III, absent between

III and IV; pleural bars isolated. Leg formula 4123; legs covered in black plumose and short straight setae, except tarsi with straight setae only; coxae yellow; femora yellow, paler ventrally, with grey mottling dorsally and laterally, III and IV slightly darker; patellae yellow with grey mottling; tibia I yellow, cream in distal ⅔, with grey mottling laterally; tibiae II and III uniform yellow with grey mottling; tibia IV yellow proximally, cream distally, with broad dark brown band in median ⅓; metatarsi and tarsi I–III yellow, tarsi slightly paler; metatarsus IV dark brown, slightly paler distally; tarsus IV yellow. Leg spination: femora: I pl 2–3 do 3, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; patellae I and II with long erect proximal and distal do setae, patellae III and IV only with single terminal do seta; tibiae: I plv 3 rlv 3 vt 1, II pl 2 plv 3 rlv 3 vt 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; tibiae I and II with long erect do seta at ¾ their length, absent from tibiae III and IV; metatarsi: I plv 2 rlv 2, II pl 1 plv 2 rlv 2, III pl 7 rl 4 plv 3 rlv 1 vt 3, IV pl 3 do 1 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with short erect setae in rlv row; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 1. Abdomen narrow and elongate, with dorsal scutum extending $^4/_5$ abdomen length; sigilla indistinct; dorsum dark grey, extending laterally, with irregular white dorsal median marking to end of scutum; single small white spot above anal tubercle (Fig. 3); dorsum with five pairs of long fine erect setae on anterior margin, covered dorsally in black and white plumose setae corresponding to markings; venter cream; epigastric region sclerotised, yellow, with indistinct, weakly developed post-epigastric sclerites; ventral sclerite hour-glass shaped, extending from behind epigastric fold to ⅔ abdomen length (Fig. 4); inframamillary sclerite weakly developed, covered in short setae; ventral setae pale, short and straight. Male palpal cymbium yellow-brown; tegulum pear-shaped, orange with dark brown looping seminal ducts; embolus broad, compressed, with only 1½ coils, distal margin of embolus with several ridges prolaterally, embolus tip sharp and somewhat flattened (Figs 13–15).

Female: unknown.

Additional material examined: none.

Distribution: known from the type locality only (Fig. 27).

5.4.3 *Castianeira majungae* Simon, 1896

Figs 5, 6, 16–18

Castaneira majungae Simon, 1896: 334 (♀ holotype: **MADAGASCAR:** Mahajanga [Majunga, 15°43'S, 46°19'E], MNHN 18620 – examined).

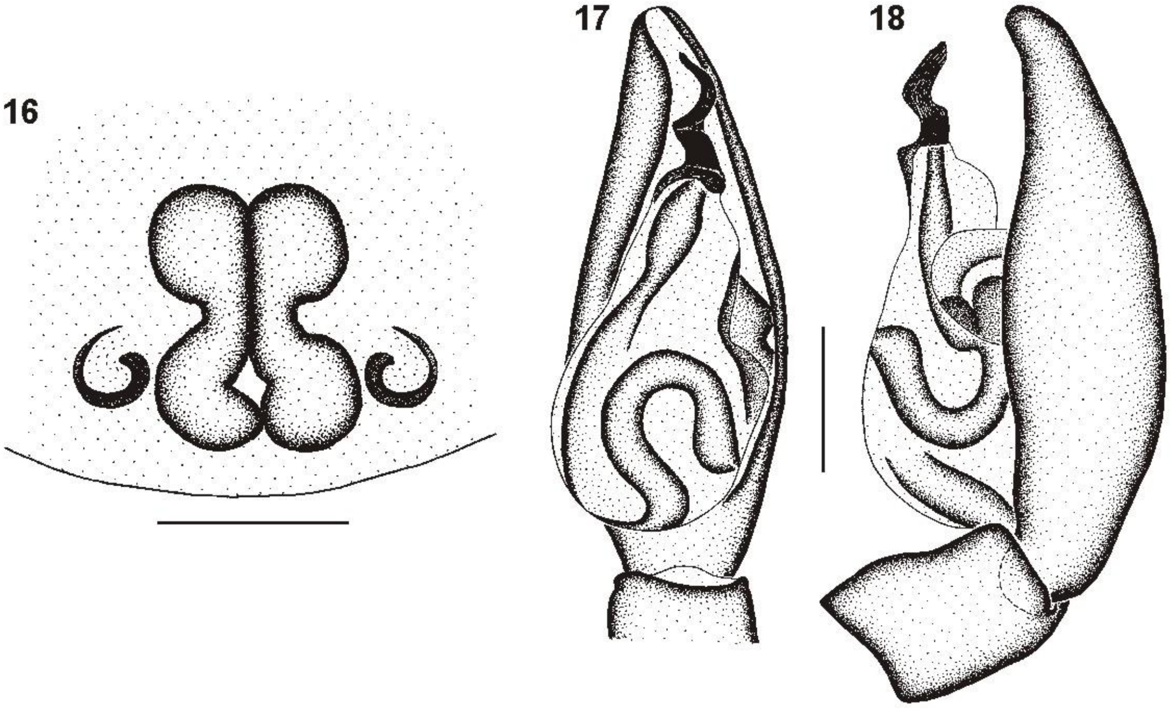
Remarks: Two vials of *C. majungae* were acquired from MNHN on loan. The first contains a single female with a label written by Eugene Simon. The second contains one male, one female and eight immature specimens with three labels with more complete data, including the date collected, collector and the number 122-96, perhaps a reference number for the specimens collected by M. Bastard. The original description does not include a description of the male, and the female is described by Simon as being 8mm in length. The isolated female is 7.4mm in length and the female in the second vial is 7.2mm in length. This evidence would suggest that the isolated female (MNHN 18620) is the holotype and the series of 10 specimens in the second vial are just additional specimens not having type status, as they were not mentioned in the original description.

The specimens in the second vial are quite badly damaged, with many of the legs detached. The single male in the series is described for the first time, but only has one of the legs II and IV still attached to the body. Measurements and leg spination are provided for these legs only.

Female (holotype, Mahajanga, MNHN 18620). Measurements: CL 3.72, CW 2.64, AL 3.93, AW 2.95, TL 7.40 (7.20–7.40), FL 0.23, SL 1.75, SW 1.52, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.43, PME–PME 0.12, PME–PLE 0.02, PLE–PLE 0.59, PERW 0.90, MOQAW 0.40, MOQPW 0.48, MOQL 0.55.

Length of leg segments: I 2.35 + 1.15 + 1.95 + 1.78 + 1.16 = 8.39; II 2.15 + 1.09 + 1.70 + 1.66 + 1.08 = 7.68; III 2.05 + 1.05 + 1.55 + 1.86 + 0.93 = 7.44; IV 2.80 + 1.30 + 2.50 + 3.10 + 1.23 = 10.93.

General appearance as in Fig. 5. Carapace oval, narrowed in eye region, notched posteriorly; highest at ⅓ carapace length, last $^1/_5$ sloping steeply; carapace slightly depressed anterior to fovea and at posterior margin medially; surface finely granulate, covered in short white plumose setae and long erect black setae scattered medially; fovea short, distinct, at ⅔ carapace length; carapace colour deep red-brown, slightly darker laterally; eye region black; black striae radiating from fovea. All eyes with black rings; AER slightly procurved, laterals slightly larger than medians; AME separated by distance equal to ⅓ their diameter; AME separated from ALE by $^{1}/_{10}$ AME diameter; clypeus height equal to 1¼ times AME diameter; PER procurved, laterals slightly larger than medians; PME separated by slightly less than ⅔ their diameter; PME separated from PLE by distance approximately equal to ⅓ PME diameter; CW:PERW = 2.93:1. Chelicerae orange-brown, with scattered short black setae on anterior surface; three closely spaced teeth on promargin, median tooth largest, distal tooth smallest; median and distal teeth closer to each other than to proximal tooth; retromargin with two teeth, distal tooth slightly larger than proximal tooth; teeth separated by distance subequal to that separating proximal and distal promarginal teeth; endites orange, slightly depressed laterally, pale near maxillar hair tuft, with distinct serrula and maxillar hair tuft; labium orange, pale along distal margin, broader than long; sternum shield-shaped, orange, darker laterally, with scattered erect black setae; precoxal triangles present; intercoxal sclerites between coxae I and II, II and III, weakly developed between III and IV; pleural bars isolated. Leg formula 4123; coxae orange; femora I–III orange, femora IV orange-brown with darker band in distal third, distal end yellow; femora covered in white plumose setae; patellae yellow-brown; tibiae I–III yellow-brown, yellow distally; tibiae IV orange-brown, yellow proximally and distally; metatarsi yellow-brown, slightly paler proximally; tarsi yellow-brown, yellow proximally and distally. 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: all with one fine do terminal seta; tibiae: I plv 2 rlv 2, 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 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, with rlv 6 erect setae in row; patellae: pl 1 do 1, with distal do seta; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3. Abdomen with small dorsal scutum extending ¼ abdomen length; two pairs of distinct sigilla present; dorsum dark brown with broad white median marking, forming six white chevrons posteriorly (Fig. 5); dorsum covered with brown and white plumose setae corresponding to markings, with scattered short straight brown setae; venter pale grey, without ventral sclerite; inframamillary sclerite distinct; one paired row of tiny sclerites from epigastric fold to spinnerets medially; ventral setae pale, short and straight; epigyne with lateral circular ridges in posterior half of epigyne, with copulatory openings situated prolaterally in ridges; copulatory ducts curving medially, entering round anterior ST II; narrow ducts connecting ST II to broad kidney-shaped posterior ST I (Fig. 16).



FIGURES 16–18. Genitalic morphology of *Castianeira majungae* Simon, 1896: 16. female epigyne, ventral view; 17. male palp, ventral view; 18. same, retrolateral view. Scale bars = 0.25mm.

Male (Mahajanga, MNHN). Measurements: CL 2.79, CW 2.02, AL 2.90, AW 1.65, TL 5.60, FL 0.22, SL 1.31, SW 1.15, AME–AME 0.05, AME–ALE 0.02, ALE–ALE 0.33, PME–PME 0.10, PME–PLE 0.06, PLE–PLE 0.49, PERW 0.73, MOQAW 0.30, MOQPW 0.40, MOQL 0.41.

Length of leg segments: I missing; II 1.52 + 0.79 + 1.23 + 1.26 + 0.88 = 5.68; III missing; IV 2.20 + 0.90 + 1.86 + 2.35 + 0.98 = 8.29.

General appearance as in Fig. 6. Morphology similar to female except for the following: carapace surface granulate, covered in short white plumose setae, with few scattered long erect black setae in eye region. Clypeus height equal to 1⅓ times AME diameter; PME separated from PLE by distance slightly less than ½ PME diameter; CW:PERW = 2.77:1. Leg formula not determined; coxa II yellow-brown, coxa IV orange-brown; femora II and IV brown, with yellow-brown distal band; patellae II and IV yellow-brown; tibia II yellow brown, yellow distally; tibia IV brown, yellow distally; metatarsus II uniform yellow-brown, metatarsus IV brown, paler proximally and distally; tarsi II and IV uniform yellow. Leg spination: femora: II pl 1 do 3, IV pl 2 do 3 rl 1; patellae II and IV: without do terminal seta; tibiae: II rlv 1, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: II plv 2 rlv 2, IV pl 3 rl 3 plv 2 rlv

2 vt 3. Palpal spination: femora: do 2, with rlv 7 erect setae in row; patellae: do 1; tibiae: pl 1 do 1 rlv 1; tarsi: spineless. Abdomen with scutum covering entire dorsum; two pairs of faint sigilla present; dorsum dark brown with narrow white median marking, forming three faint chevrons posteriorly (Fig. 6); dorsum covered with brown and white plumose setae, with only two pairs of short straight brown setae anteriorly on dorsal scutum; epigastric region strongly sclerotised, fused laterally to post-epigastric sclerites; venter with broad orange ventral sclerite, extending $^4/_5$ distance from epigastric furrow to spinnerets; inframamillary sclerite distinct; ventral setae pale, short and straight. Male palpal cymbium yellow-brown, with three short slightly thicker setae distally on dorsal surface; tegulum pear-shaped, orange-brown; embolus straight, with 1½ slightly flattened coils (Figs 17, 18).

Additional material examined: MADAGASCAR: Mahajanga [Majunga, 15°43'S, 46°19'E], V.1896, M. Bastard, 8 imm. 1♂ 1♀ (MNHN).

Distribution: known only from the type locality (Fig. 27).

5.4.4 *Castianeira phaeochroa* Simon, 1909

Figs 7, 8, 19–23

Castaneira phaeochroa Simon, 1909: 366 (♂ lectotype and 1 subadult ♂ 2♂ 8♀ paralectotypes, here designated: **ANGOLA:** Landana [05°13'S, 12°08'E], MNHN 5826 – examined).

Remark: The label with the type series gives the locality Gabon: Landana. This town is, in fact, within the modern day Angolan enclave of Cabinda, and not Gabon. In the original description of the species, Simon (1909: 366) noted the body length of the male as 5.5mm and that of the female as 6mm. The body lengths of the males in the syntype series are 6.8, 7.3 and 7.5mm, while the females measure 7.0, 7.5, 7.6, 7.9, 8.0, 8.2, 8.3 and 8.9mm, which is inconsistent with the original description of both sexes. A lectotype and paralectotypes are designated here to clarify the concept of the species.

Male (lectotype, Landana, MNHN 5826). Measurements: CL 3.55, CW 2.40, AL 3.65, AW 1.90, TL 7.30 (6.80–7.50), FL 0.29, SL 1.63, SW 1.35, AME–AME 0.04, AME–ALE

0.01, ALE–ALE 0.42, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.60, PERW 0.88, MOQAW 0.41, MOQPW 0.49, MOQL 0.52.

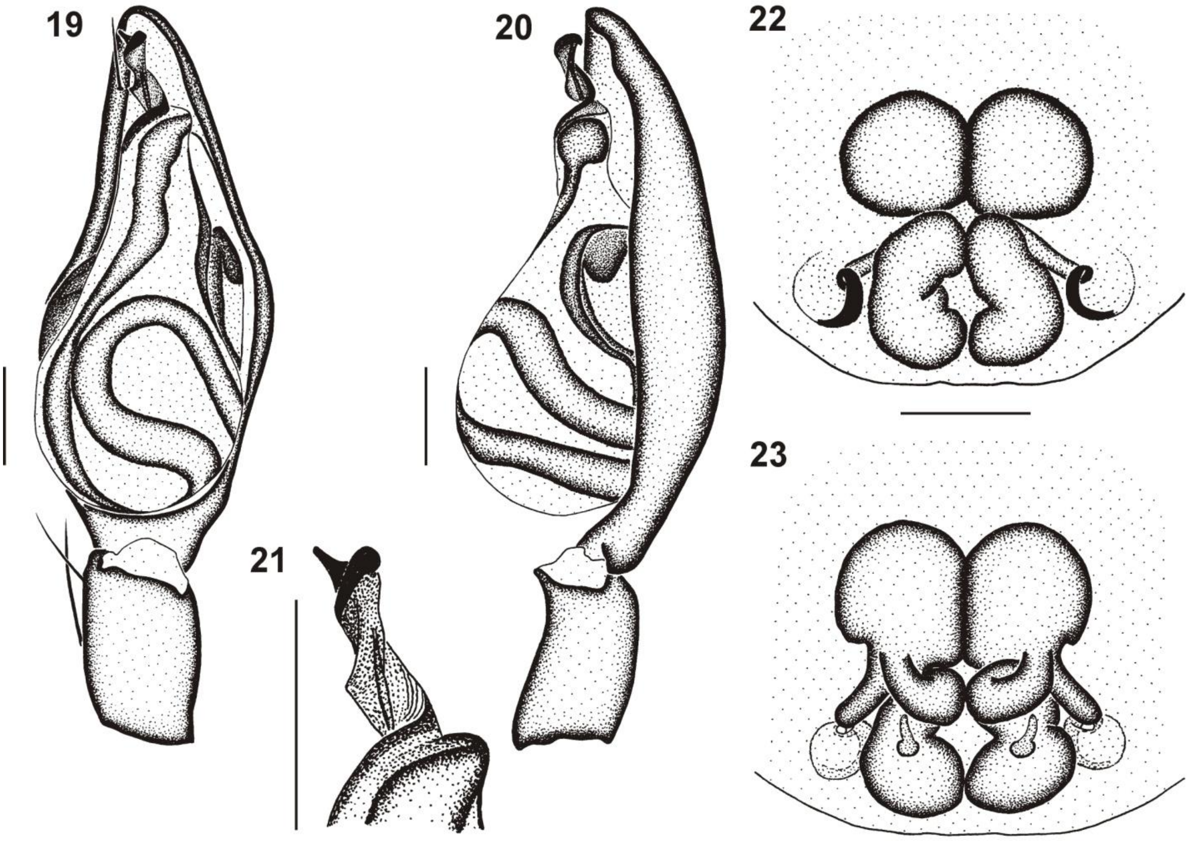
Length of leg segments: I 2.40 + 0.97 + 2.13 + 2.08 + 1.45 = 9.03; II 2.15 + 0.92 + 1.63 + 1.73 + 1.17 = 7.60; III 2.00 + 0.90 + 1.45 + 1.88 + 0.93 = 7.16; IV 2.90 + 1.15 + 2.43 + 3.05 + 1.25 = 10.78.

General appearance as in Fig. 7. Carapace oval, narrowed in eye region, slightly concave posteriorly; sloping gently from eye region, highest at ⅔ carapace length, last ¼ sloping steeply; surface finely granulate, covered in white plumose setae, especially dense laterally and posterior to fovea, with scattered short straight setae; several long erect black setae on clypeus, in eye region, and behind PER; fovea short, distinct, at ⅔ carapace length; carapace dark brown, eye region slightly darker, with faint black striae radiating from fovea. All eyes with black rings; AER slightly procurved, medians slightly larger than laterals; AME separated by distance equal to ¼ their diameter; AME separated from ALE by $^{1}/_{10}$ AME diameter; clypeus height equal to 1¼ times AME diameter; PER procurved, eyes subequal in diameter; PME separated by distance approximately ⅔ their diameter; PME separated from PLE by distance approximately equal to ⅓ PME diameter; CW:PERW = 2.72:1. Chelicerae brown, yellow distally, with many long black straight setae on anterior surface; three teeth on promargin, median tooth largest, distal and proximal teeth smaller, subequal in size; median and distal teeth closer to each other than to proximal tooth; retromargin with two teeth close to fang base, distal tooth slightly larger than proximal tooth; endites brown, cream at maxillar hair tuft, slightly broadened retrolaterally, with distinct serrula and maxillar hair tuft; labium red-brown, paler distally, slightly broader than long; sternum shield-shaped, longer than broad, red-brown with darker margins; surface finely granulate, with many long and short erect straight setae; precoxal triangles present, indistinct at coxa IV; intercoxal sclerites present between all coxal pairs; pleural bars isolated. Leg formula 4123; legs with femora covered in plumose setae with scattered short straight setae, remaining segments with straight setae only; some setae on posterior legs iridescent; coxae orange-brown; femora brown, paler distally, with dense white plumose setae dorsally and ventrally, sparse laterally; patellae I and II yellow, III and IV slightly darker; tibiae I and II yellow, with mottled black band in proximal ⅔; tibiae III yellow-brown and IV orange-brown, yellow distally, each with broad median mottled black band paler distally; metatarsi I yellow, entire segment with black mottling except distally; metatarsi II and III yellow; metatarsi IV orange-brown, yellow proximally and distally, with black mottling; tarsi yellow, III and IV slightly darker. 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 I–IV with long erect fine proximal and distal do setae; 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 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, with erect setae in rlv row; patellae: pl 1 do 1; tibiae: pl 1 plv 1; tarsi: pl 2 plv 1. Abdomen with deep red scutum covering entire dorsum, with two pairs of long straight brown setae anteriorly; dorsum with irregular black mottling, pale chevron markings posteriorly; sigilla indistinct; dorsum covered with plumose and short straight setae, plumose setae especially dense anteriorly and laterally; venter and sides of abdomen dark grey, covered in short straight setae; epigastric region strongly sclerotised, orange-brown with black mottling, fused laterally to strongly sclerotised post-epigastric sclerites; small oval sclerite laterally above epigastric region; venter with broad orange rectangular ventral sclerite, extending close to weakly sclerotised inframamillary sclerite. Male palpal segments yellow-brown with faint black mottling; tegulum pear-shaped, yellow-brown, with dark red-brown insemination ducts; embolus long, stalk-like, directed slightly prolaterally, with 1½ coils; embolus tip small, triangular, directed prolaterally (Figs 19–21).

Female (paralectotype, Landana, MNHN 5826). Measurements: CL 3.44, CW 2.42, AL 4.10, AW 2.40, TL 7.90 (7.00–8.30), FL 0.34, SL 1.70, SW 1.43, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.48, PME–PME 0.13, PME–PLE 0.09, PLE–PLE 0.65, PERW 0.92, MOQAW 0.44, MOQPW 0.50, MOQL 0.56.

Length of leg segments: I 2.65 + 1.10 + 2.13 + 2.05 + 2.90 = 10.93; II 2.33 + 1.08 + 2.06 + 1.85 + 1.25 = 8.57; III 2.15 + 1.04 + 1.63 + 2.00 + 1.00 = 7.82; IV 3.15 + 1.21 + 2.65 + 3.29 + 1.33 = 11.63.

General appearance as in Fig. 8. Morphology similar to male except for the following: carapace light brown; clypeus height slightly larger than AME diameter; PME separated by distance ¾ their diameter; PME separated from PLE by distance equal to ½ PME diameter; CW:PERW = 2.63:1. Chelicerae and labium orange-brown, cream distally; cheliceral promargin with three teeth, median tooth largest, distal tooth smallest; retromargin with two subequal teeth; endites yellow-brown, cream at maxillar hair tuft; sternum orange-brown. Leg colour paler than in male, markings similar. Leg spination: femora: I pl 1 do 3, II do 3, III pl 2-3 do 3 rl 1, IV pl 2 do 3 rl 1; patellae I–IV with long erect fine proximal and distal do setae; 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 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3.



FIGURES 19–23. Genitalic morphology of *Castianeira phaeochroa* Simon, 1909: 19. female epigyne, ventral view; 20. same, dorsal view; 21. male palp, ventral view; 22. male palp, retrolateral view; 23. detail of embolus in ventral view. Scale bars = 0.25mm.

Palpal spination: femora: pl 1 do, with long erect setae in rlv row; patellae: pl 1 do 1; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 2 rlv 2. Abdomen with small anterior orange-brown scutum extending $^{1}/_{5}$ abdomen length; two pairs of small faint sigilla present; dorsum mottled grey, with narrow white median chevron markings in posterior half; dorsum covered with plumose setae, brown medially and white anteriorly, laterally and posteriorly; epigastric region strongly sclerotised, post-epigastric sclerites weakly sclerotised; venter without rectangular sclerite; inframamillary sclerite distinct; ventral setae pale, short and straight. Epigyne with semi-circular ridges with narrow coiled, comma-shaped copulatory opening; copulatory ducts short, oblique, entering round anterior ST II posterolaterally; narrow duct with single spiral connecting ST II to somewhat narrow, kidney-shaped posterior ST I (Figs 22, 23).

Additional material examined: ANGOLA: Porto Amboim [10°43'S, 13°45'E], 4.X.1949, B. Malkin, 1♀ (CAS, CASENT 9033100).

Distribution: known only from Angola (Fig. 27).

5.4.5 *Castianeira thomensis* Simon, 1909

Figs 9, 10, 24–26

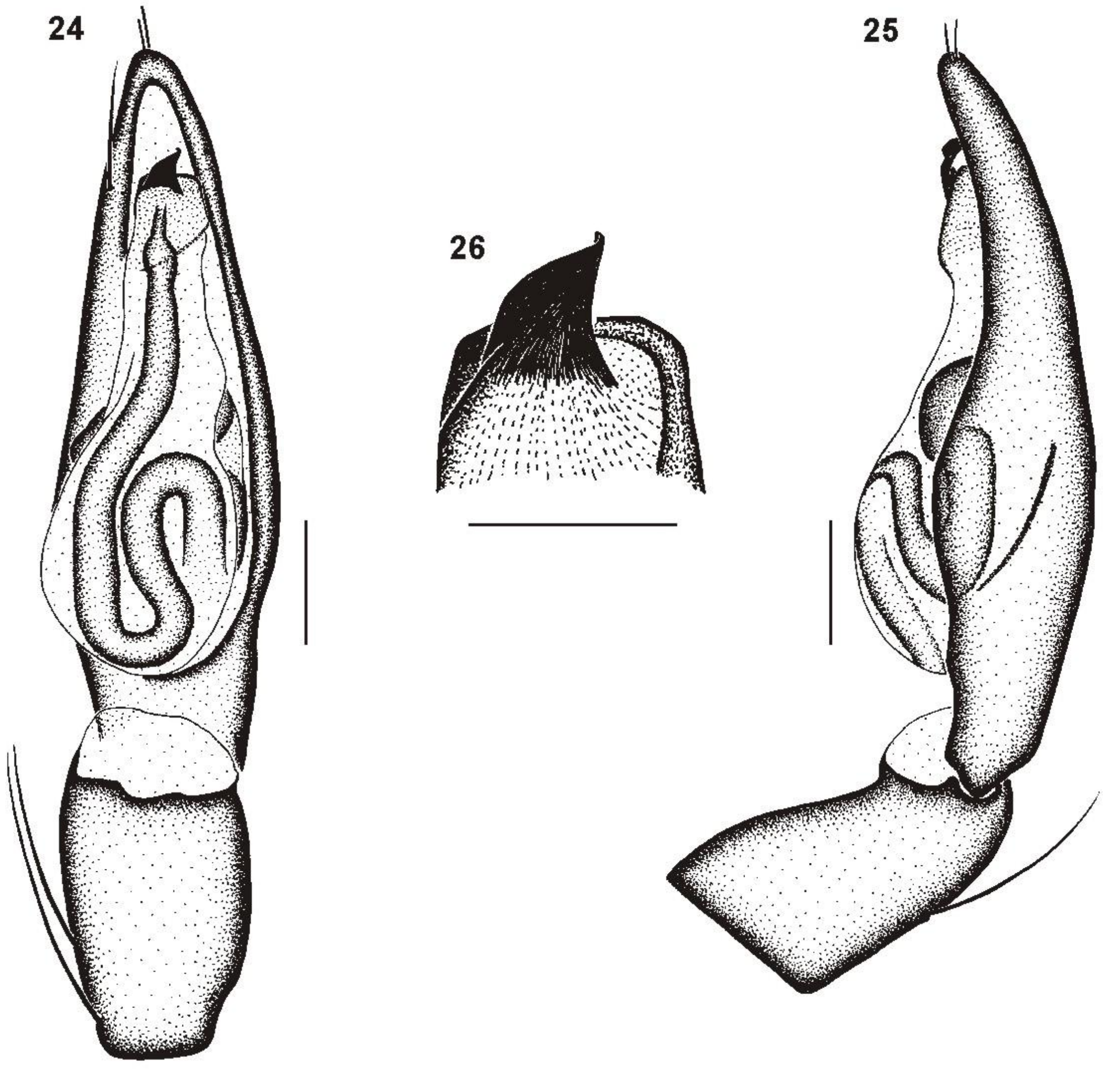
Castaneira thomensis Simon, 1909: 364 (♂ holotype: **SÃO TOMÉ & PRÍNCIPE:** Isla São Tomé, Vista Alegre [00°19'N, 06°41'E], MNHN 24988 – examined).

Remark: Only a single male, presumably the holotype, was received from MNHN, and the whereabouts of the female described by Simon are unknown. In the original description of the species, Simon (1909: 364) indicated the body length of the male as 5–6mm and that of the female as 6mm, while the holotype is 8.85mm in length, which is inconsistent with the original description. The holotype is the largest of the known males of the species. Since no fresh material of females from São Tomé is available this sex cannot be redescribed or illustrated. The holotype is considerably faded (Fig. 9) and the redescription is based on one of the males recently collected at Quisinda (Fig. 10).

Male (Quisinda, CAS). Measurements: CL 3.36, CW 2.44, AL 3.32, AW 2.20, TL 6.75 (6.75–8.85), FL 0.38, SL 1.54, SW 1.34, AME–AME 0.08, AME–ALE 0.01, ALE–ALE 0.43, PME–PME 0.13, PME–PLE 0.09, PLE–PLE 0.56, PERW 0.83, MOQAW 0.41, MOQPW 0.48, MOQL 0.49.

Length of leg segments: I 2.60 + 1.13 + 2.33 + 2.50 + 1.80 = 10.36; II 2.50 + 1.30 + 2.00 + 2.23 + 1.50 = 9.53; III 2.45 + 0.95 + 1.84 + 2.48 + 1.30 = 9.02; IV 3.23 + 1.15 + 2.65 + 3.68 + 1.65 = 12.36.

General appearance as in Fig. 10. Carapace oval, narrowed in eye region, nearly straight posteriorly, with small notch medially; sloping gently from eye region, slightly depressed at front of fovea, highest at posterior of fovea, last ¼ sloping steeply; surface finely wrinkled, covered in black plumose setae, with scattered short straight setae; white plumose setae forming patches behind PME, around and posterior to fovea, and along lateral carapace margins; several long erect black setae on clypeus, in eye region, behind PER, and medially posterior to PER up to fovea; fovea long, distinct, at ⅔ carapace length; carapace deep orange-brown with extensive black mottling; eye region slightly darker; irregular black striae radiating from fovea. All eyes with black rings, extended posteriorly from PME; AER slightly procurved, medians slightly larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by $^{1}/_{10}$ AME diameter; clypeus height equal to 1¼ times AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance approximately ⅔ their diameter; PME separated from PLE by distance approximately equal to ½ PME diameter; CW:PERW = 2.94:1. Chelicerae orange-brown with faint black mottling, with many long black straight setae on anterior surface; three closely spaced teeth on promargin, median tooth largest, distal tooth smallest; median and distal teeth closer to each other than to proximal tooth; retromargin with two teeth, distal tooth slightly smaller than proximal tooth; endites bright yellow-orange proximally, yellow medially, cream prolaterally distally, slightly broadened retrolaterally, with distinct serrula and maxillar hair tuft; labium deep orange-brown proximally, paler distally, cream



FIGURES 24–26. Genitalic morphology of *Castianeira thomensis* Simon, 1909: 24. male palp, ventral view; 25. male palp, retrolateral view; 26. detail of embolus in ventral view. Scale bars: 24, 25 = 0.25mm; 26 = 0.1mm.

along distal margin, slightly broader than long; sternum shield-shaped, longer than broad, deep yellow-brown with faint black mottling, with orange-brown margins; surface smooth, with many long and short erect straight setae; precoxal triangles weakly sclerotised, indistinct; weak intercoxal sclerites between coxae I and II only; pleural bars isolated. Leg formula 4123; legs covered short straight setae and scattered black plumose setae, except tarsi with straight setae only; coxae orange, yellow ventrally; femora deep orange-brown with black mottling, paler in distal ¼, each with pl and rl stripe of white plumose setae running length of femur; patellae yellow with black mottling; tibiae I and II yellow-brown, paler distally, with black mottling; tibiae III and IV deep orange-brown, paler distally, with black mottling; metatarsi yellow-brown, III and IV slightly darker; tarsi yellow. Leg spination: femora: I pl 3 do 3, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; patellae I–IV with long erect fine proximal and distal do setae; tibiae: I plv 3 rlv 3, II pl 1 plv 3 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 rl 1, with short erect setae in rlv row; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 1. Abdomen with deep orange-brown dorsal scutum extending slightly more than ½ abdomen length; sigilla indistinct; dorsum cream, covered with black plumose and short straight setae in irregular patches, with two median patches of white plumose setae in anterior half; venter cream, covered in grey plumose and short straight setae; epigastric region strongly sclerotised, yellow-brown with black mottling; post-epigastric sclerites weakly sclerotised; venter with broad orange ventral sclerite, subrectangular, notched anteriorly, extending from behind epigastric fold to $^{4}/_{5}$ abdomen length; inframamillary sclerite weakly developed, covered in short setae. Male palpal cymbium orange-brown, cream distally, with three rod-like setae distally on dorsal surface; tegulum pear-shaped, orange-brown, with dark brown insemination ducts; embolus broad, compressed, forming only ½ a coil; distal margin of embolus with several ridges dorsally and prolaterally, embolus tip small, subtriangular, sharp and somewhat flattened (Figs 24–26).

Female: described by Simon (1909: 365).

Additional material examined: SAO TOMÉ & PRÍNCIPE: Ihla São Tomé, Palha Plantation, near São Tomé town, Quisinda, 00°24'29.1"N, 06°35'12.3"E, leg. J.M. Ledford, V.2001 (pitfalls), 2♂ (CAS).

Distribution: endemic to the island of São Tomé (Fig. 27).

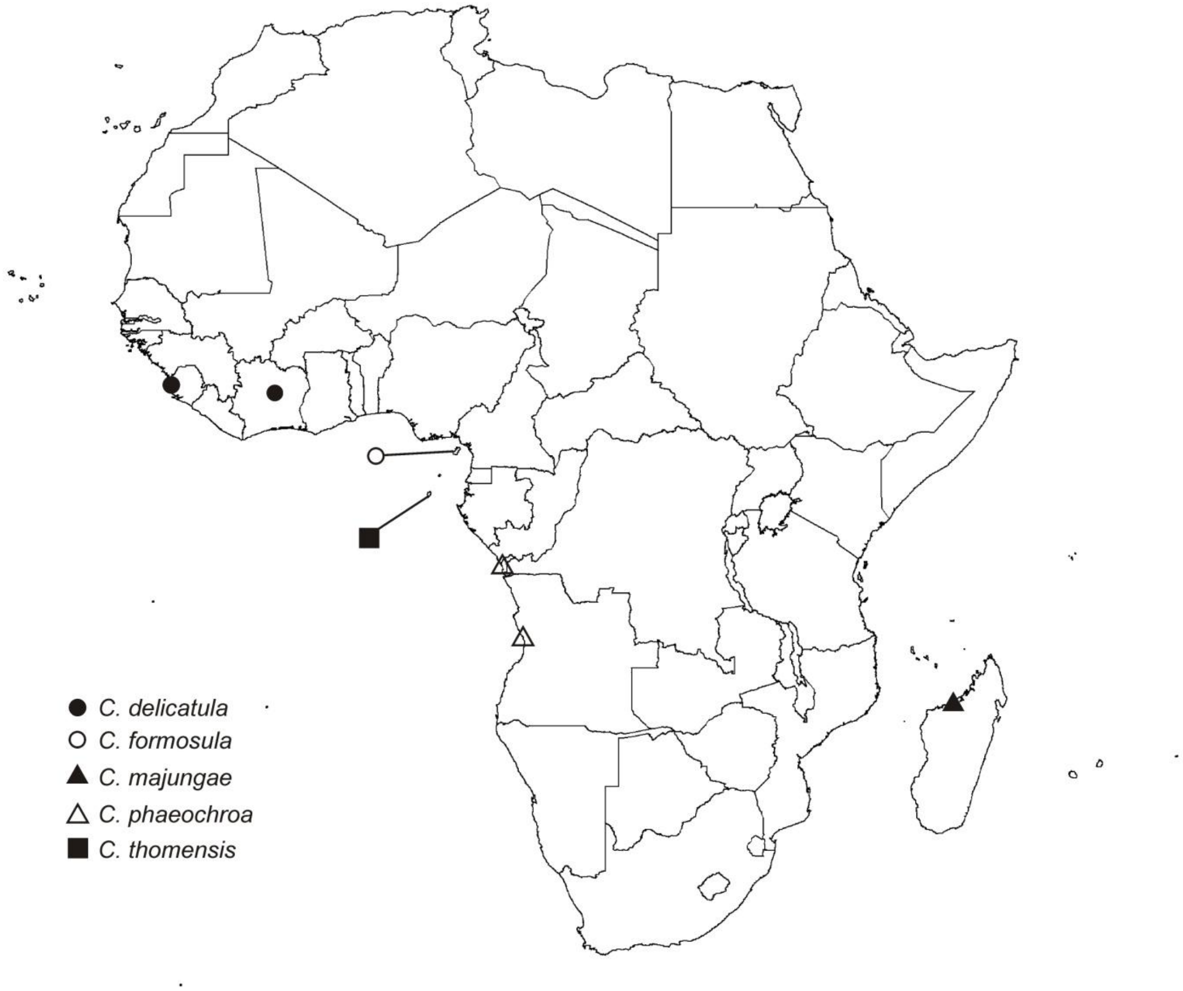


FIGURE 27. Distribution of the five Afrotropical *Castianeira* species redescribed in the current study.

5.5 SPECIES *NOMEN DUBIUM*

5.5.1 *Castianeira bicolor* (Simon, 1890)

Fig. 11

Tylophora bicolor Simon, 1890: 128.
Castaneira bicolor Simon, 1897: 167.

Remarks: The abdomen of the female holotype is missing, a fact alluded to by Simon (1890) in the original description ("*Abdomine carens*"), and consequently the diagnostic genitalic structure and abdominal markings necessary to recognise the species are not available to facilitate identification. I have seen material of several different species of *Castianeira* from Tanzania in the collections of CAS, the Zoological Museum, University of Copenhagen, and the Royal Museum for Central Africa in Tervuren, most of which have a similar carapace structure, eye arrangement and leg markings as the holotype of *C. bicolor* (Fig. 11). Since none of the above specimens are from the type locality of *C. bicolor* (Kilimanjaro) it is impossible to confirm their conspecificity. As such, the species should be considered a *nomen dubium* until material from Kilimanjaro becomes available and the species can be redescribed.

5.6 DISCUSSION

The present chapter aimed to provide redescriptions and the first illustrations of some Afrotropical *Castianeira* species described by Eugéne Simon in order to facilitate the future identification of material. These redescriptions, together with the transfer or synonymy of six other Afrotropical *Castianeira*, means that more than half of the species presently listed in the genus have been subjected to modern revision. Future studies are necessary to resolve the status of the species described by Pavesi, Strand, Karsch, Caporiacco and Berland, and two further species described by Simon, before new species from the region can be described.

In Reiskind's (1969) treatment of the fauna of Northern and Central America, he divided the New World members of the genus into 12 species groups. In his diagnosis of the genus he noted considerable intrageneric variability related to several somatic morphological characters, including the carapace index (i.e. carapace width/length), cephalic width index (i.e. cephalic width/carapace width) and leg spination, as well as in the genitalic morphology of the different species groups. The above redescriptions indicate that similar variability is found in the Afrotropical *Castianeira*, especially with regards to their genitalic morphology. From the specimens I have examined in various collections, it is clear that there is a multitude of undescribed species that should be the focus of a detailed study in the future. For example, the single Madagascan species (*C. majunga*) remains known from the type locality only, and more than 10 new species have to be described from the island. Similarly, the Eastern Arc Mountains of Tanzania harbour a rich *Castianeira* fauna, of which some species may have been described by Berland, Caporiacco and others, but inevitably several new species will need to be described.

The considerable variability in somatic and genitalic morphology in *Castianeira* suggests that the genus is polyphyletic and has served as a dumping ground for weakly mimetic or non-mimetic castianeirines from the region in the past, something supported by the large proportion of misplaced species whose placement has now been resolved (Table 1). As in the case of the South-East Asian castianeirine fauna revised by Deeleman-Reinhold (2001), it is likely that new genera will need to be described for some of the Afrotropical *Castianeira sensu latu* to account for this considerable variability. This could possibly also result in the removal of *Tylophora* Pavesi, 1880 as a synonym of *Castianeira*.

5.7 REFERENCES

BECKER, L. 1879. Diagnoses de nouvelles aranéides américaines. *Annales de la Société Entomologique de Belgique* **22:** 77–86.

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.

CAMBRIDGE, O.P.- 1896. Arachnida. Araneida. *In*: GODMAN, F.D. & SALVIN, O. (eds.) *Biologia Centrali-Americana, Zoology* **1:** 161–224.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

EMERTON, J.H. 1890. New England spiders of the families Drassidae, Agalenidae and Dysderidae. *Transactions of the Connecticut Academy of Arts and Sciences* **8:** 166–206.

KARSCH, F. 1880. Arachnologische Blätter (Decas I). *Zeitschrift fur die gesammten Naturwissenschaften* **53:** 373–409.

KEYSERLING, E. 1879. Neue Spinnen aus Amerika. *Verhandlungen der kaiserlich-koniglichen zoologisch-botanischen Gesellschaft in Wien* **29:** 293–349.

PAVESI, P. 1880. Studi sugli Aracnidi africani. I. Aracnidi di Tunisia. *Annali del Museo Civico di Storia Naturale di Genova* **15:** 283–388.

PLATNICK, N.I. 2011. The World Spider Catalog, Version 12.0. American Museum of Natural History, New York. Available at: http://research.amnh.org/entomology/spiders/catalog; accessed 30 May 2011.

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

SIMON, E. 1890. Etudes arachnologiques. 22e Mémoire. XXXV. Etude sur les arachnides recueillis par M. L. von Höhnel, officier de la marine autrichienne, pendant l'expedition de M. le comte Teleki dans l'Afrique orientale équatoriale en 1887-1888. *Annales de la Société Entomologique de France* (6) **10:** 125–130.

SIMON, E. 1896. Arachnides recueillis aux environs de Majunga par M. Bastard et envoyés au laboratoire d'entomologie du Muséum. *Bulletin du Museum National d'Histoire Naturelle, Paris* **1896:** 333–335.

SIMON, E. 1897. *Histoire naturelle des Araignées*. Tomé 1, pp. 1–192. Librairie Encyclopédique de Roret, Paris.

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.

CHAPTER 6


Copa flavoplumosa **Simon, 1885, female (Lesideng Research Camp, Botswana)**

A revision of the continental species of *Copa* Simon, 1885 (Araneae: Corinnidae) in the Afrotropical Region

6.1 ABSTRACT

The cryptic ground-dwelling castianeirine genus *Copa* Simon, 1885 (Araneae: Corinnidae) is revised in the continental Afrotropical Region. The type species of the genus, *C. flavoplumosa* Simon, 1885, is redescribed and considered a senior synonym of *C. benina* Strand, 1916 **syn. nov.** and *C. benina nigra* Lessert, 1933 **syn. nov.**. It is widespread throughout the Afrotropical Region but has not been introduced to any of the associated regional islands. A new species, *Copa kei* **sp. nov.**, is described from South Africa. *Copa agelenina* Simon, 1910, originally described from a subadult female from southern Botswana, is considered a *nomen dubium*. *Copa flavoplumosa* is a characteristic species of leaf litter spider assemblages and is particularly prevalent in savanna habitats on the continent, but also occurs in various forest types, grasslands, fynbos and semi-arid Nama Karoo habitats. In contrast, *C. kei* **sp. nov.** has only been recorded from Afromontane and coastal forests in south-eastern South Africa.

6.2 INTRODUCTION

The spider genus *Copa* Simon, 1885 (Araneae: Corinnidae) is one of nine genera presently placed in the subfamily Castianeirinae in the Afrotropical Region (Dippenaar-Schoeman & Jocqué 1997; Bosselaers & Jocqué 2000; Haddad & Bosselaers 2010). *Copa* is only known from the Afrotropical and Palearctic Regions, and some of the species from the latter have recently been studied by Deeleman-Reinhold (1995, 2001). Deeleman-Reinhold (2001) described the genus *Echinax* to include three species of *Copa* from South-East Asia that she had earlier described in 1995 and an additional new species. Thus, only two Asian species of *Copa* remain, both described from Sri Lanka (Simon 1896). Prior to this revision, seven species and one subspecies of *Copa* were known from the Afrotropical Region (Dippenaar-Schoeman & Jocqué 1997), of which one described by Simon (1909) has been transferred to *Echinax* (see Chapter 8) and one described by Strand (1916) to the new genus *Copuetta* (see Chapter 11).

Although most genera in this subfamily resemble ants, *Copa* species have cryptic colouration and closely resemble wolf spiders of the family Lycosidae (Figs 1–6), a characteristic shared with *Echinax* and *Copuetta*. *Copa* are very common spiders in the leaf

FIGURES 1–6. General habitus photographs of *Copa flavoplumosa* Simon, 1885 (1–4) and *C. kei* **sp. nov.** (5, 6): 1. female from Lesideng Research Camp, Botswana; 2. female from Livingtone, Zambia; 3. male from Wildlives Game Farm, Zambia; 4. female from Wildlives Game Farm; 5. female from Hogsback, South Africa; 6. male from Cwebe Nature Reserve, South Africa.

litter of various habitats and are predominantly ground-living, occurring widely in savanna woodlands but also occasionally in forests, where they are well camouflaged (Figs 1–6). *Copa flavoplumosa* is also recorded here from drier habitats, including fynbos, grassland and Nama Karoo in South Africa and the arid savannas of north-western South Africa, Botswana and Angola, thereby showing considerable ecological flexibility and adaptability. In contrast, *Echinax* and *Copuetta* species are primarily arboreal are rarely collected in leaf litter.

The current study presents the first revision of the continental Afrotropical species of the genus, and the Madagascan fauna, including two species described by Simon (1903) and Strand (1907) and nearly 30 new species, will be treated at a later stage in a separate paper.

6.3 MATERIAL & METHODS

All specimens examined during this study were observed in 70% ethanol using a Nikon SMZ800 stereomicroscope for descriptions, digital photographs and measurements. A series of digital photographs of the male emboli of each species were taken using a Nikon Coolpix 8400 mounted on a Nikon SMZ800 stereomicroscope. The photographs were then stacked using Combine ZM software (http://www.hadleyweb.pwp.blueyonder.co.uk) to increase depth of field. Photographs of live *C. flavoplumosa* were taken in the field using a Canon EOS 40D digital camera with 50mm or 100mm macro lenses. Material for scanning electron microscopy was dehydrated in a graded ethanol series, critical-point dried in an argon chamber, fixed to aluminium stubs, and sputter-coated with gold three times for three minutes before study in a JEOL 6400 WinSEM.

All measurements are given in millimetres (mm). Total body length measurements are given for the smallest and largest specimens of each sex to give an indication of size variation, and body, eye and leg measurements are given for the specimens indicated in the descriptions. 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 epigynes and male palps of each species were dissected, cleaned in a Labcon 5019U ultrasonic bath in 70% ethanol for 30 seconds, and drawn. Scale bars were added to all microscope photographs and illustrations in Corel Draw 14.0.

Abbreviations used in the descriptions are as follows: 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 & Jocqué (2000) and includes the following abbreviations: do – dorsal; pl – prolateral; plv – prolateral ventral; rl – retrolateral; rlv – retrolateral ventral; vt – ventral terminal.

The material examined in this study is deposited in the following institutions (curators given in parenthesis):

BMNH – British Museum of Natural History, London, UK (Janet Beccaloni)
CAS – California Academy of Sciences, San Francisco, USA (Charles Griswold)
MACN – Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina (Martin Ramírez)
MNHG – Museum of Natural History, Geneva, Switzerland (Peter Schwendinger)
MNHN – Museum National d'Histoire Naturelle, Paris, France (Christine Rollard)
MRAC – Royal Museum for Central Africa, Tervuren, Belgium (Rudy Jocqué)
NCA – National Collection of Arachnida, ARC – Plant Protection Research Institute, Pretoria, South Africa (Ansie Dippenaar-Schoeman)
NMBA – National Museum, Bloemfontein, South Africa (Leon Lotz)
NMSA – Natal Museum, Pietermaritzburg, South Africa (Audrey Ndaba)
NMZA – National Museum of Zimbabwe, Bulawayo, Zimbabwe (Moira FitzPatrick)
PCRS – Personal collection of Tony Russell-Smith, Sittingbourne, UK
SAMC – Iziko South African Museum, Cape Town, South Africa (Margie Cochrane)
TMSA – Ditsong National Museum of Natural History, Pretoria, South Africa (Robin Lyle)
ZFMK – Zoologisches Forschungsmuseum Koenig, Bonn, Germany (Bernhard Huber)
ZMB – Zoologisches Museum, Berlin, Germany (Jason Dunlop)
ZMUC – Zoological Museum, University of Copenhagen, Denmark (Nikolaj Scharff)

Where locality co-ordinates were not provided on specimen labels or 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.

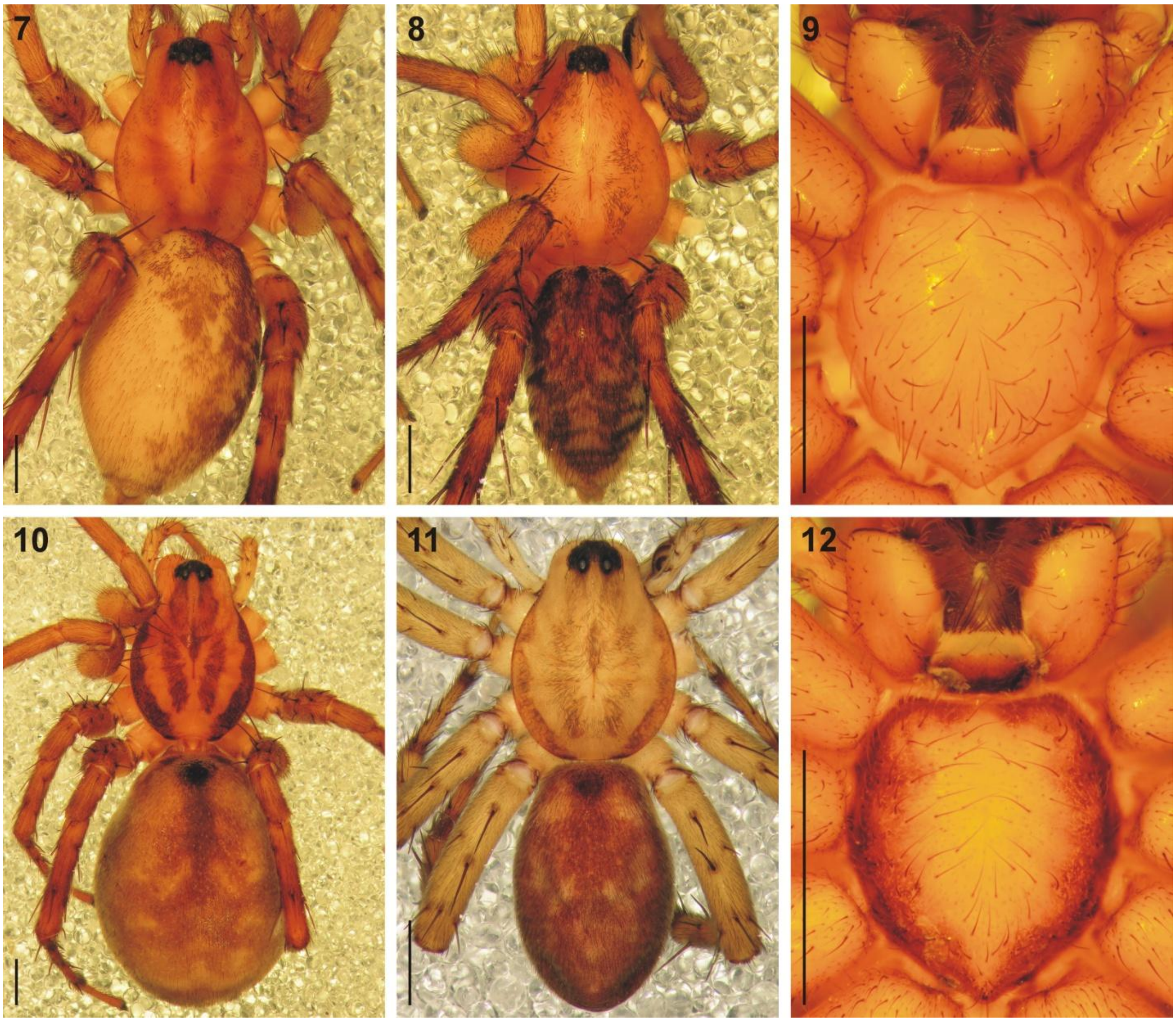
6.4 GENUS *COPA* SIMON, 1885

Copa Simon, 1885: 395; Simon, 1897: 173; Reiskind, 1969: 165; Dippenaar-Schoeman & Jocqué, 1997: 128; Deeleman-Reinhold, 2001: 359.

Type species: *Copa flavoplumosa* Simon, 1885, by monotypy.

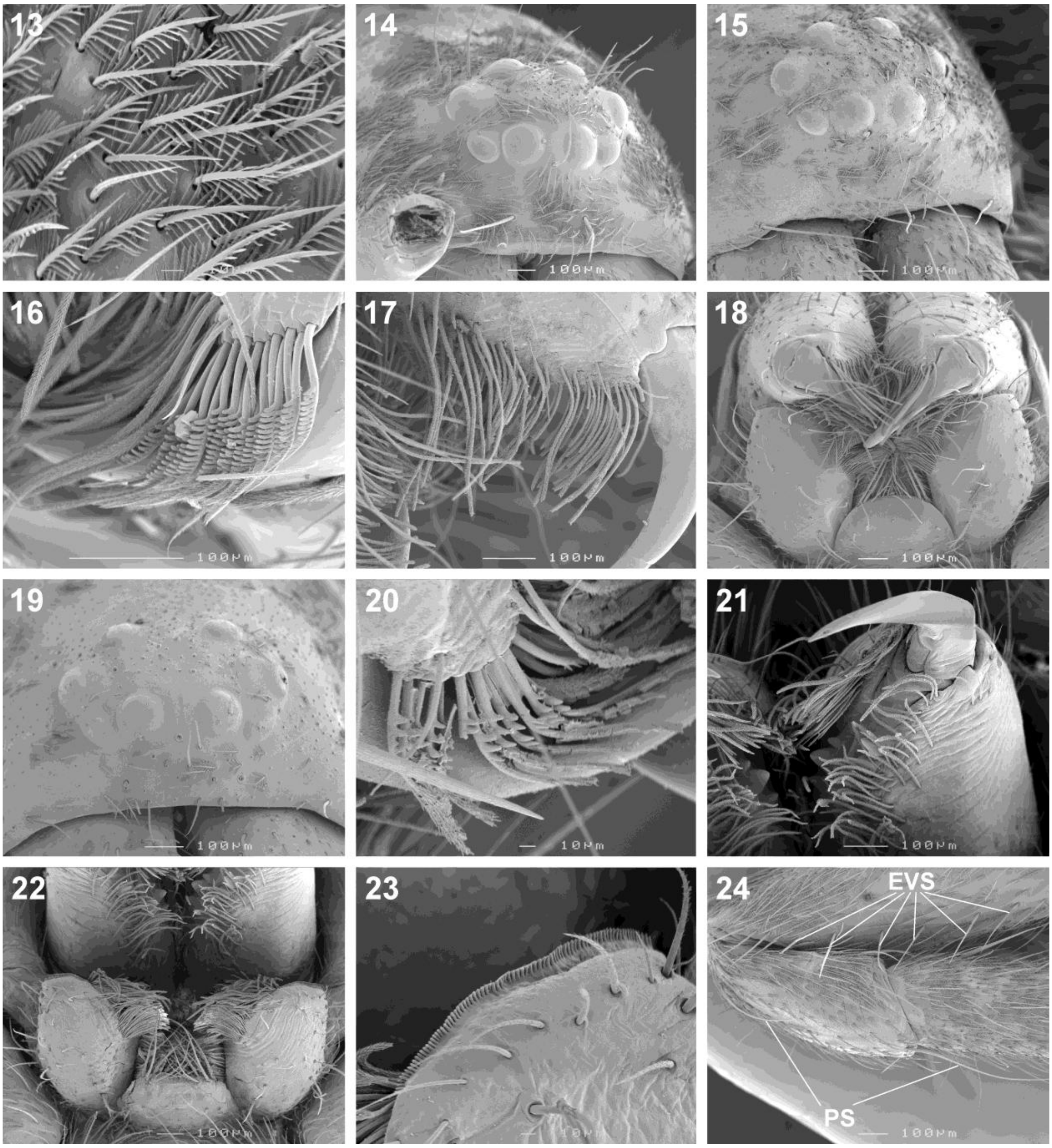
Diagnosis: *Copa* can be recognised from other cryptic Castianeirinae, particularly *Echinax and Copuetta*, by the presence of fine proximal and distal setae on the anterior patellae, and proximal and distal spines on the posterior patellae, that are clearly shorter than the particular leg segment; the AME that are approximately 1.25–1.50 times ALE diameter; and the carapace that is 3.30–3.75 times broader than the PER.

Description: Medium-sized spiders, 5.20–9.80mm in length; carapace usually pale yellow to dark orange-brown with black markings, rarely black with white markings (Figs 1–8, 10, 11); carapace surface smooth, with black plumose setae covering markings (Fig. 13); several long curved setae on clypeus, eye region and posterior to PER up to midpoint (Figs 14, 15, 19);



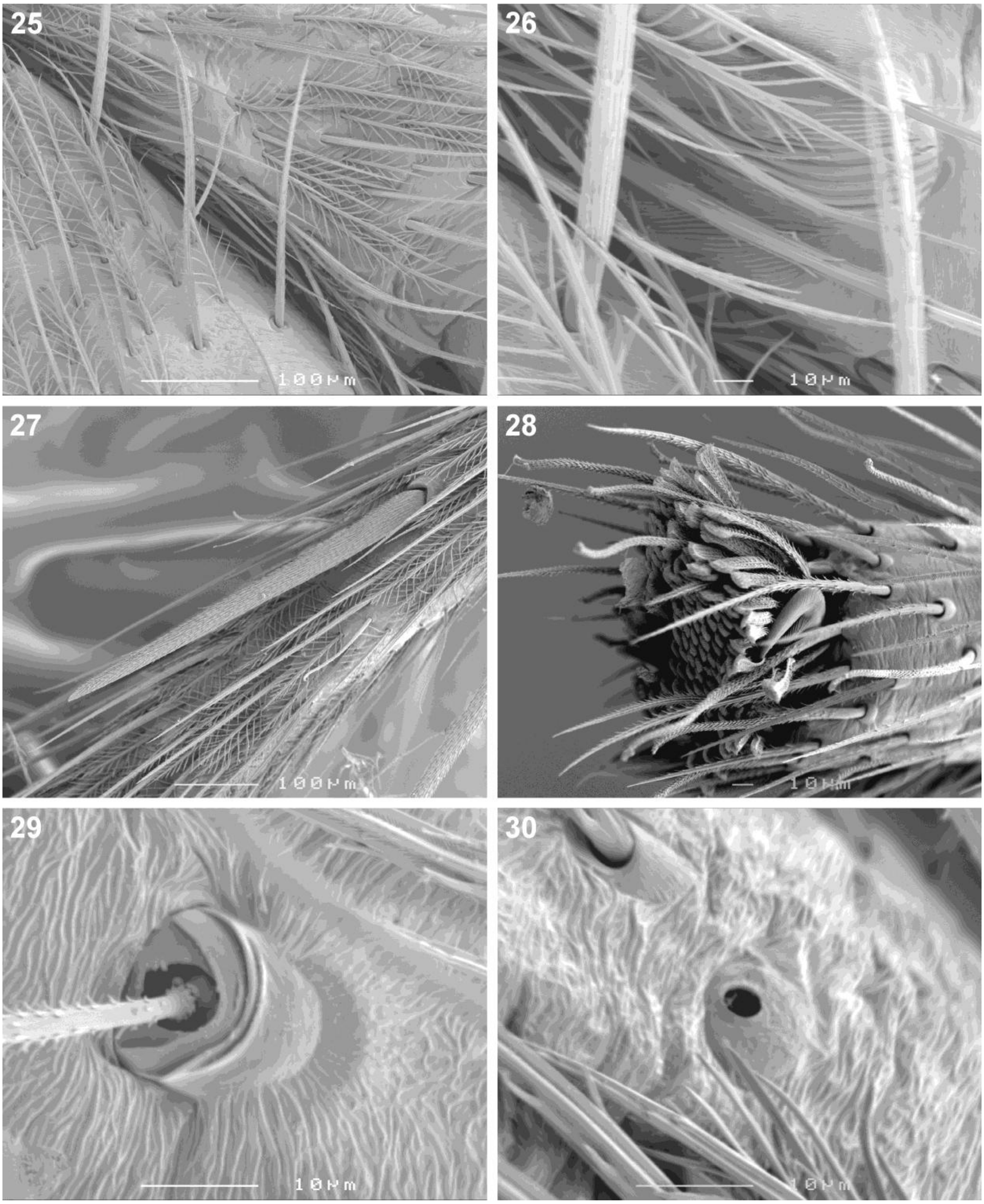
FIGURES 7–12. Digital microscope photographs of *Copa flavoplumosa* Simon, 1885 from D.R. Congo (7–9) and *C. kei* **sp. nov.** from South Africa (10–12): 7, 10. female, dorsal habitus; 8, 11. male, dorsal habitus; 9, 12. sternum of female in ventral view. Scale bars = 1.0mm.

carapace oval, broadest at posterior of coxae II, eye region narrow, fovea distinct; posterior margin very slightly concave or straight (Figs 7, 8, 10, 11). AER procurved, AME approximately 1¼ to 1½ times ALE diameter; AME separated by ½ or less their diameter, nearly touching ALE (Figs 14, 15, 19); PER strongly procurved, PME very slightly larger

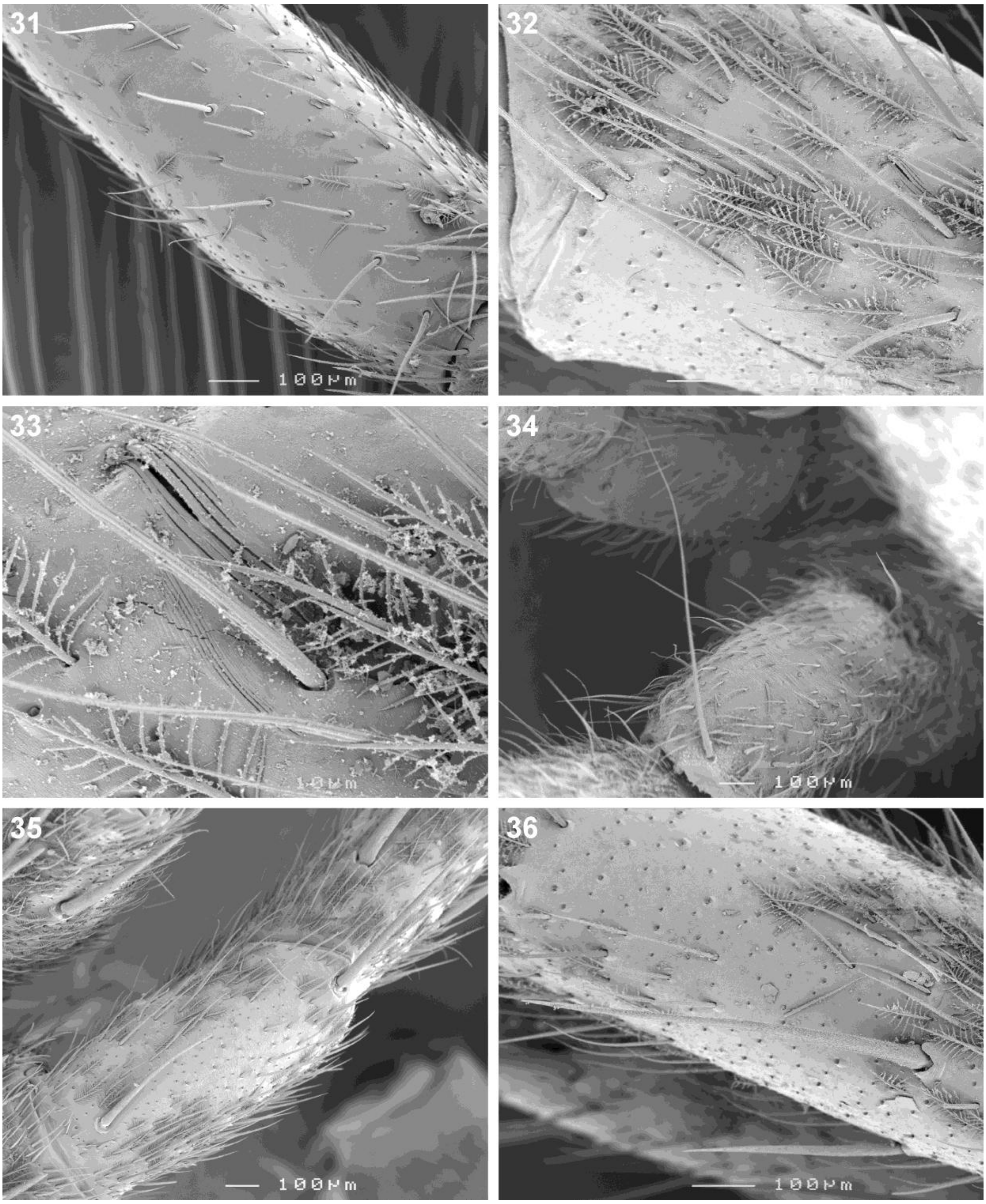


FIGURES 13–24. Scanning electron microscope photographs of *Copa flavoplumosa* Simon, 1885 female (13, 14, 16) and male (15, 17, 18) and *C. kei* **sp. nov.** female (19–24): 13. dorsal carapace setae; 14, 15, 19. eye region and clypeus, anterolateral view (14, 15) and anterior view (19); 16, 17, 20. cheliceral promarginal bent setae, anterior view; 18, 22. mouthparts, ventral view; 21. chelicerae, ventral view; 23. serrula; 24. femur, patella and tibia of leg II, indicating erect ventral setae on femora (EVS) and proximal and distal dorsal patellar setae (PS).

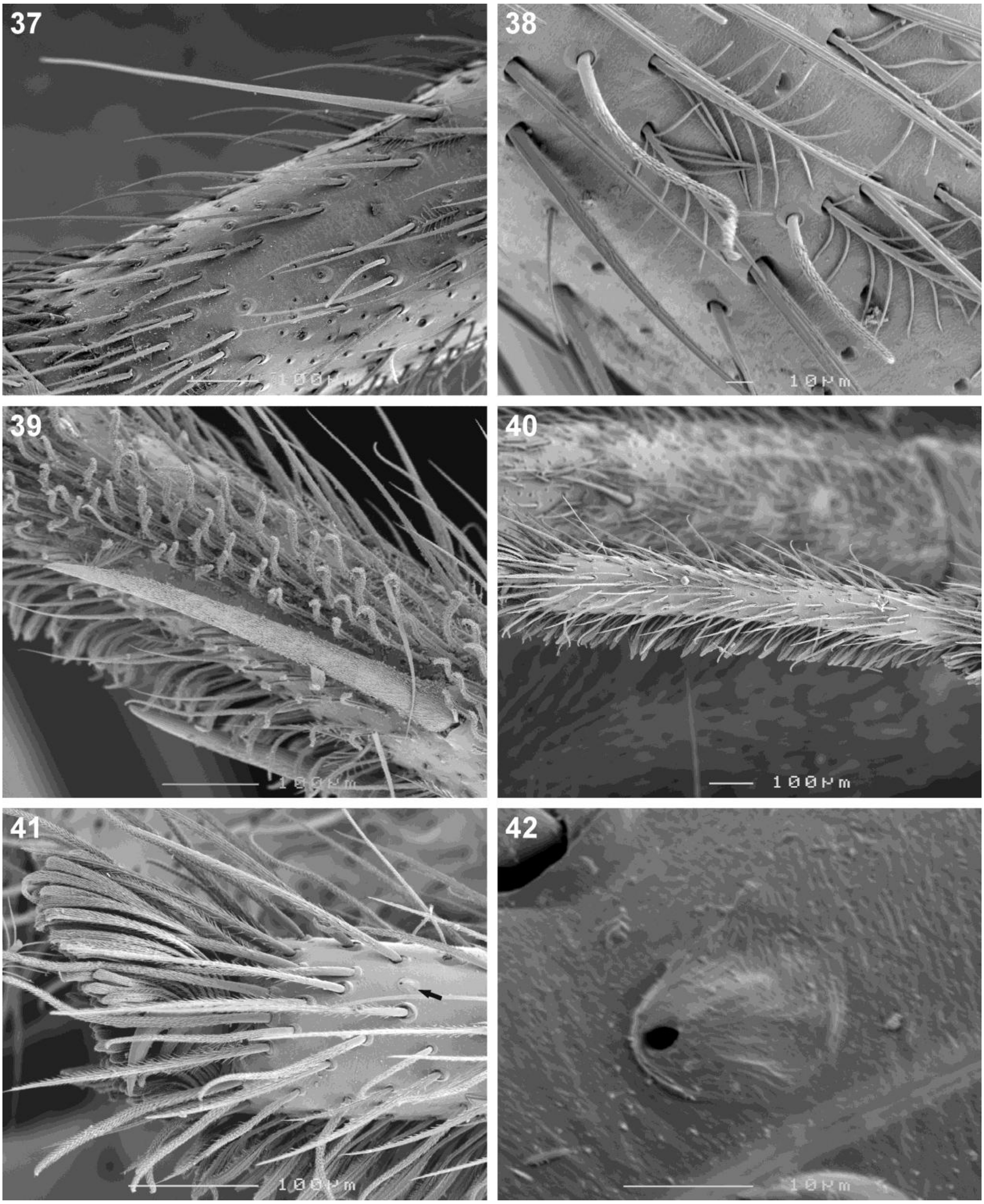
than PLE; PME closer to PLE than to each other; MOQ width equal anteriorly and posteriorly, or very slightly broader posteriorly, longer than wide. Chilum distinct, triangular, bilateral with clear median separation; cheliceral promargin with two or three teeth, retromargin with two teeth; shaggy seta absent; curved setae on cheliceral promargin pectinate in females (Figs 16, 20) and finely plumose in males (Fig. 17); endites straight laterally, with distinct serrula comprising sharp, ventrally curved denticles, with dense maxillar hair tuft on mesal margins (Figs 18, 22, 23); labium hemispherical, wider than long. Pleural bars sclerotised, isolated; sternum slightly longer than broad, shield-shaped, slightly narrowed anteriorly, with or without markings; surface smooth, densely covered in plumose setae, with many long erect straight setae; precoxal triangles present, intercoxal sclerites only present between coxae I and II (Figs 9, 12). Leg formula 4132 in females, 4312 or 4123 in males, legs I and III nearly equal in length; legs strongly spined, femora, patellae, tibiae and metatarsi covered in short straight black setae and black and white plumose setae (Figs 24–27, 31–39), plumose setae sparse on tarsi; retrocoxal window absent on coxa I; femora with several scattered erect ventral setae (Figs 24, 31); anterior patellae with proximal and distal long fine dorsal setae (Figs 24, 34); posterior patellae with fine long proximal dorsal seta and distal spine, clearly shorter than patella (Fig. 35); patellar indentation narrow, broad at proximal end (Figs 25, 26, 32, 33); metatarsi III longer than metatarsi I and II; metatarsi distally scopulate (Fig. 39); tibiae, metatarsi and tarsi with several dorsal and lateral trichobothria with sunken basal plate (Fig. 29), also with several short erect setae (Fig. 38); tarsal organ oval, slightly elevated from integument, surface finely wrinkled, opening oval (Figs 30, 42); paired tarsal claws short, situated laterally, with very dense claw tufts in between (Figs 28, 41); metatarsi III and IV without terminal preening brush or comb. Abdomen oval, either yellow-orange with black markings or black with white markings; three pairs of fine straight setae on anterior margin above pedicel; dorsal scutum small, strongly sclerotized, extending less than ⅛ abdomen length in females and slightly more than ½ abdomen length in males; two pairs of distinct sclerotised dorsal sigilla present in both sexes (Figs 7, 8, 11, 12); epigastric region moderately sclerotised, venter without post-epigastric sclerites and ventral sclerite, inframamillary sclerite present, distinct, densely covered in short setae; two paired rows of tiny sclerites from epigastric furrow to spinnerets, outer row weakly sclerotised and indistinct. Spinnerets: ALS of female (Figs 43, 49) with two major ampullate gland spigots and many piriform gland spigots; females of *C. flavoplumosa* with two distinct types of piriform gland spigots, the more common type with



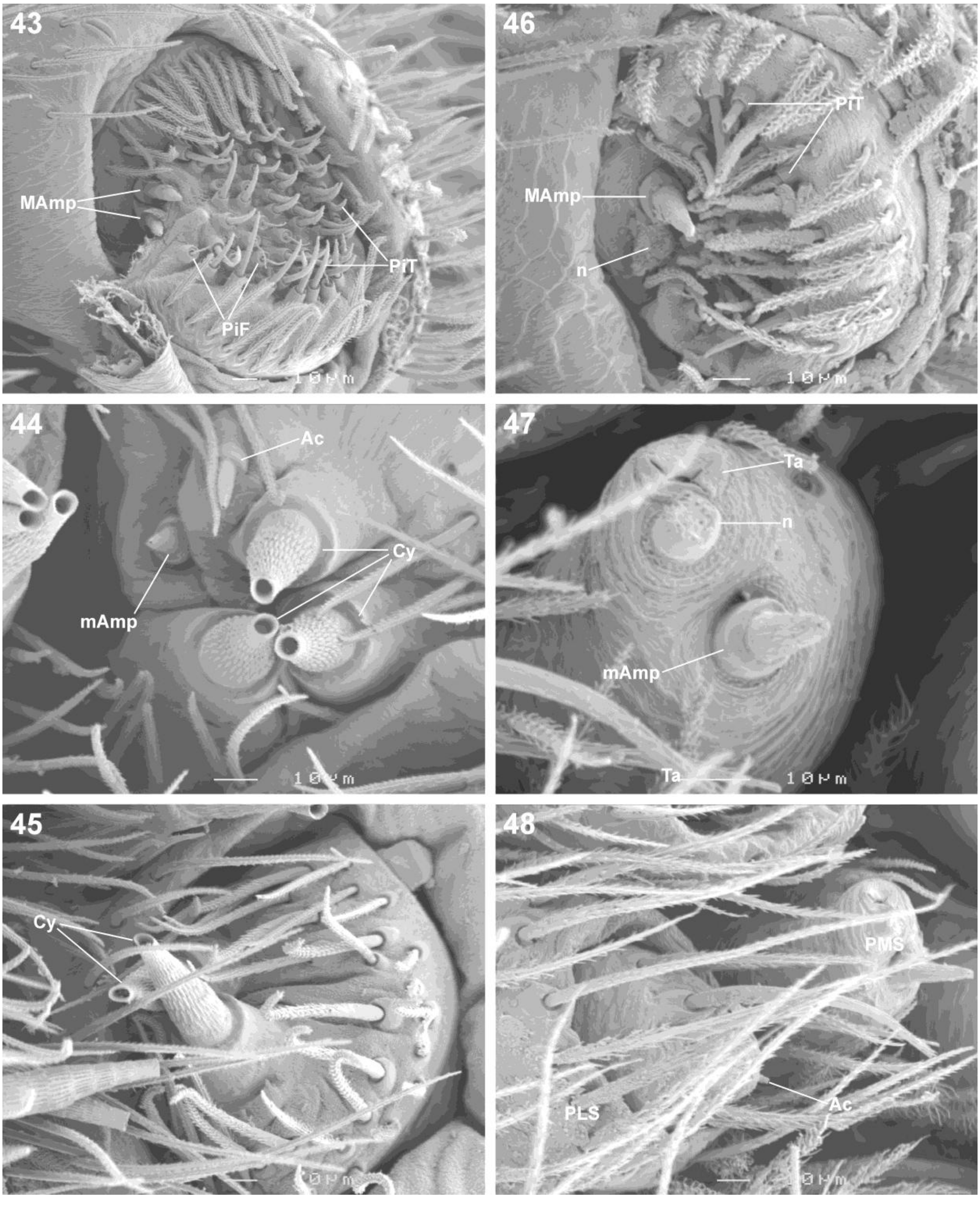
FIGURES 25–30. Scanning electron microscope photographs of *Copa kei* **sp. nov.** female: 25. patella II, indicating patellar indentation (PI); 26. same, detail of proximal end of PI; 27. metatarsus IV, spine and setae; 28. tarsus III, tarsal claw and claw tuft; 29. tarsus IV, trichobothrium base; 30. same, tarsal organ.



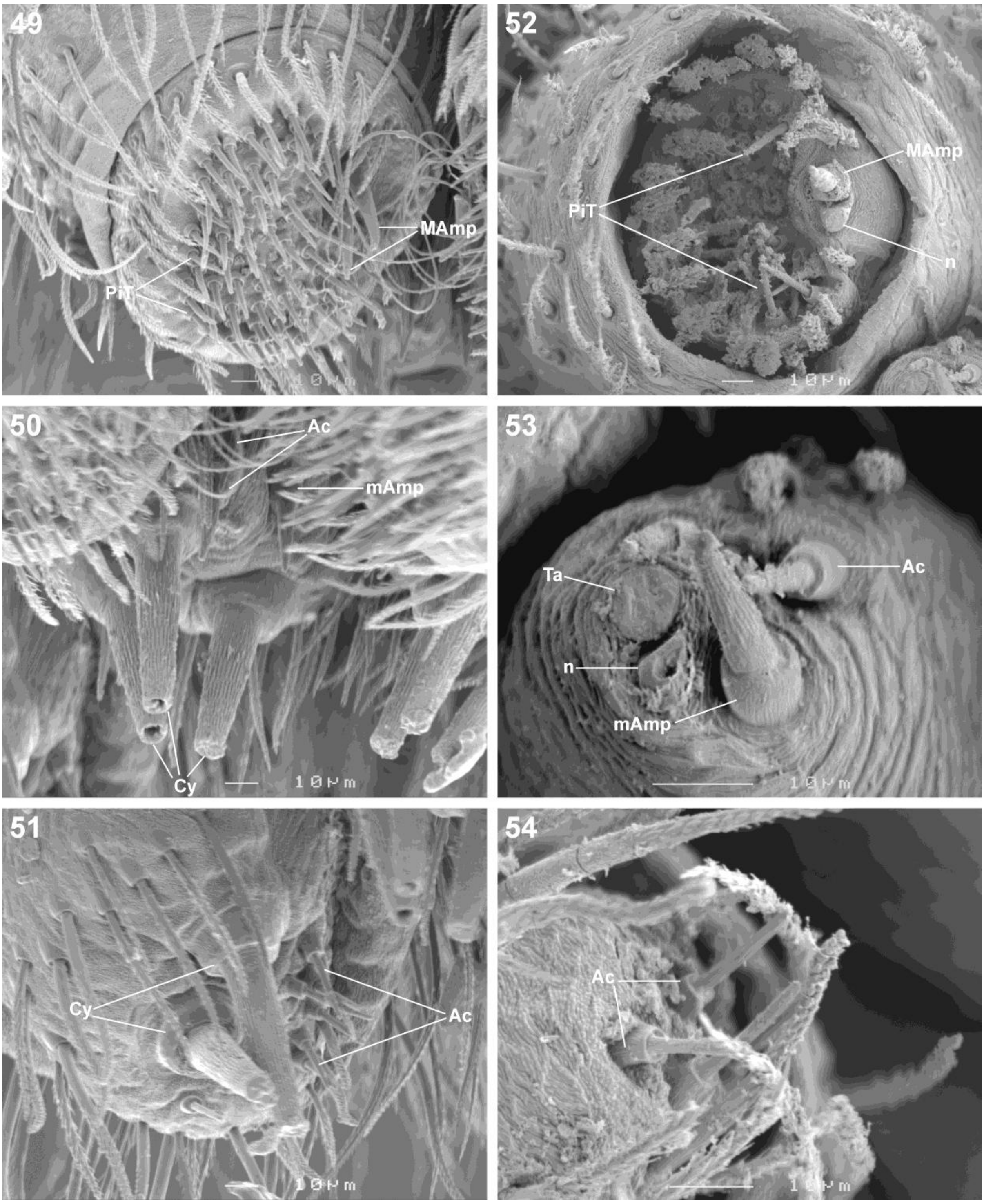
FIGURES 31–36. Scanning electron microscope photographs of *Copa flavoplumosa* Simon, 1885 male (31) and female (32–36): 31. femur I, erect ventral setae; 32. patella II, indicating II patellar indentation (PI); 33. same, detail of proximal end of PI; 34. patella II, arrows indicating proximal and distal dorsal patellar setae (PS); 35. patella III, arrows indicating proximal and distal dorsal patellar spines; 36. tibia II, spines and plumose setae.



FIGURES 37–42. Scanning electron microscope photographs of *Copa flavoplumosa* Simon, 1885 female (37, 39–42) and male (38): 37. tibia I, long dorsal seta; 38. tibia I, arrow indicating short erect setae; 39. metatarsus II, spines and scopula; 40. tarsus III; 41. same, claw tuft and tarsal organ (arrow); 42. same, tarsal organ.

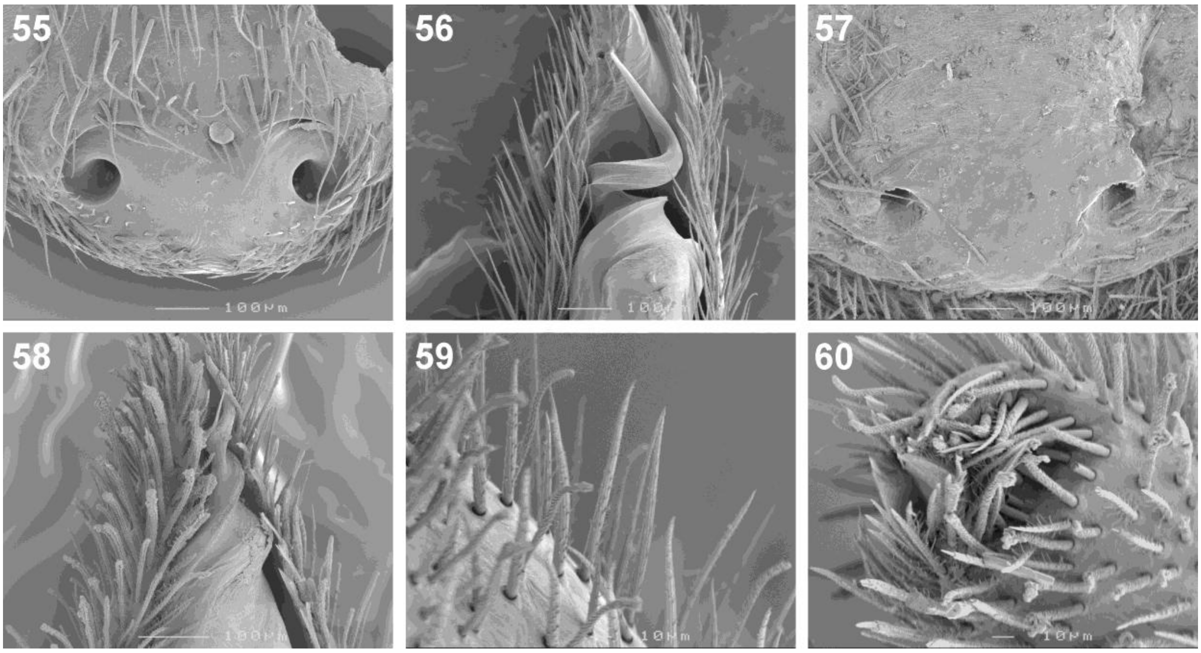


FIGURES 43–48. Scanning electron microscope photographs of *Copa flavoplumosa* Simon, 1885 female (43–45) and male (46–40) spinneret morphology: 43, 46. anterior lateral spinneret; 44, 47. posterior median spinneret; 45, 48. posterior lateral spinneret. Abbreviations: Ac–aciniform gland spigot(s); Cy–cylindrical gland spigot(s); MAmp–major ampullate gland spigot(s); mAmp–minor ampullate gland spigot(s); n–nubbin; PiF–piriform gland spigot(s) with fine shaft; PiT–piriform gland spigot(s) with thick shaft; PLS – posterior lateral spinneret; PMS – posterior median spinneret; ta–tartipore.



FIGURES 49–54. Scanning electron microscope photographs of *Copa kei* **sp. nov.** female (49–51) and male (52–54) spinneret morphology: 49, 52. anterior lateral spinneret; 50, 53. posterior median spinneret; 51, 54. 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; PiT–piriform gland spigot(s) with thick shaft; ta–tartipore.

thicker shafts and several close to posterior margin with very fine shafts (Fig. 43); piriform gland spigots of *C. kei* **sp. nov.** only with thicker shafts (Fig. 49); ALS of male with single major ampullate gland spigot, single large adjacent nubbin and many piriform gland spigots (Figs 44, 50); PMS of female (Figs 45, 51) with three large cylindrical gland spigots, one small minor ampullate gland spigot and one or two aciniform gland spigots; PMS of male (Figs 46, 52) with one large minor ampullate gland spigot, one tartipore and one nubbin, with zero aciniform gland spigots in *C. flavoplumosa* and two in *C. kei* **sp. nov.**; PLS of female (Figs 47, 53) with two large cylindrical gland spigots and zero (in *C. flavoplumosa*) or several (in *C. kei* **sp. nov.**) aciniform gland spigots; PLS of *C. flavoplumosa* male with reduced two aciniform gland spigots and several tiny nubbins present (Fig. 48); PLS of *C. kei* **sp. nov.** with three aciniform gland spigots only (Fig. 54). Female epigyne with 6-shaped or curved sclerotized epigynal ridges leading to lateral copulatory openings (Figs 55, 57); copulatory ducts directed anteriorly or transversely before entering ST II posteriorly; ST II usually oval, sometimes expanded posterolaterally, connected broadly to somewhat elongated posterior ST I. Male palpal segments without apophyses; cymbium with spines prolaterally and ventrally, dorsal surface covered in curved finely plumose setae with round tip and thicker straight setae with sharp tips (Fig. 59); distal end of cymbium in *C. kei* **sp. nov.** with shallow depression,



FIGURES 55–60. Scanning electron microscope photographs of *Copa flavoplumosa* Simon, 1885 (55, 56) and *C. kei* **sp. nov.** (57–60): 55, 57. female epigyne, ventral view; 56, 58. male embolus, ventral view; 59. male palpal cymbial setae; 60. distal end of cymbium, retrolateral distal view.

densely covered in setae (Fig. 60); embolus with variable width and angle of base, and length and curvature of distal coil (Figs 56, 58, 61–66).

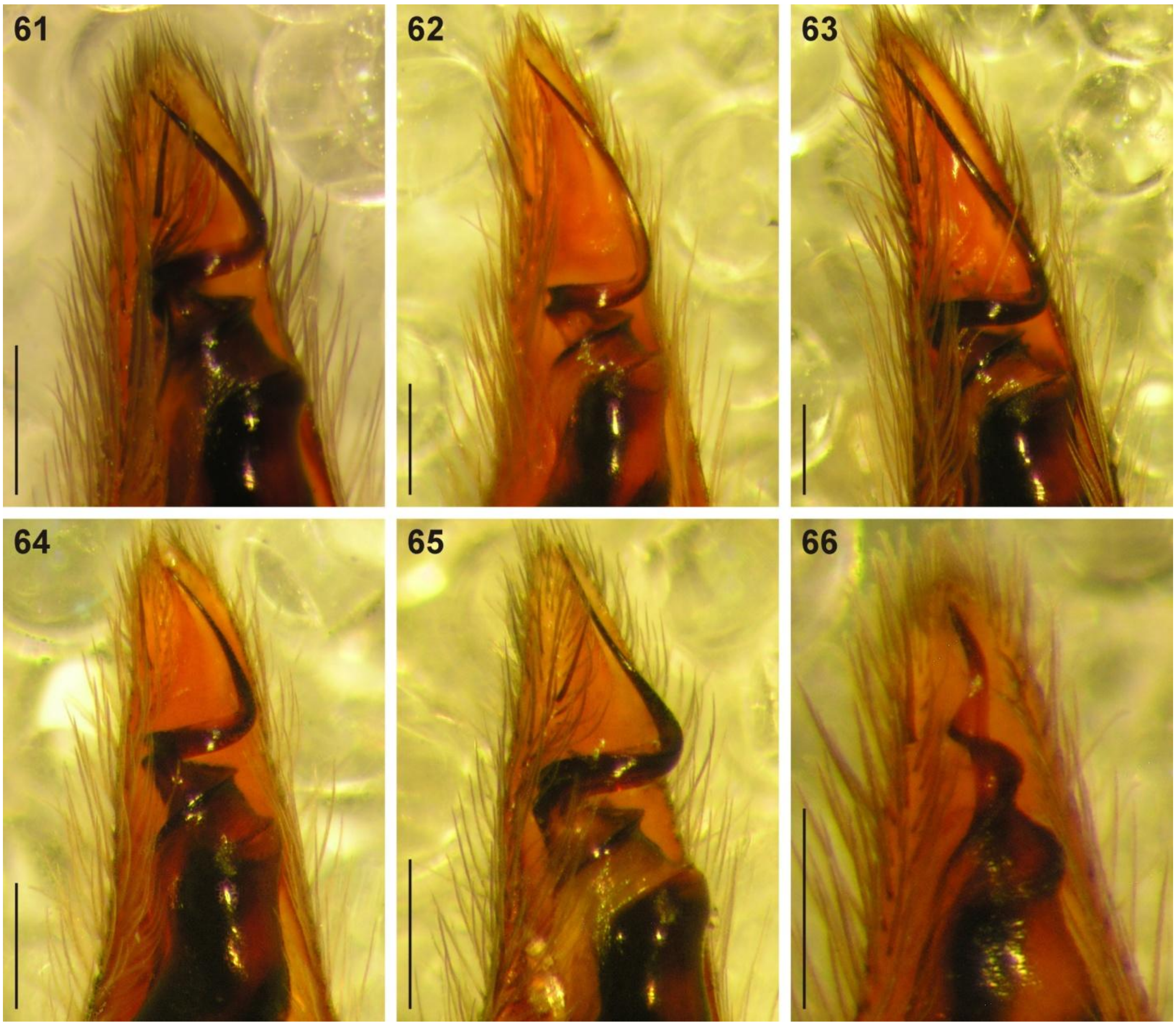
Key to the continental Afrotropical species of *Copa*

1 Males……………………………………………………….………..…………2

– Females……………………………………………………..……..…………3

2 Embolus with broad base and long curved distal section (Fig. 56)……..…………………
..……………………………………………………………*C. flavoplumosa* Simon, 1885

– Embolus with narrow base and narrow coiled distal section (Fig. 58)…….*C. kei* **sp. nov.**



FIGURES 61–66. Digital microscope photographs of emboli of *Copa* species in ventral view: 61–65. *Copa flavoplumosa* Simon, 1885 from D.R. Congo (61), Cameroon (62), Tanzania (63), Botswana (64) and South Africa (65); 66. *C. kei* **sp. nov.** from South Africa. Scale bars = 0.1mm.

3 Epigyne with large 6-shaped epigynal ridges with lateral copulatory openings (Fig. 55); entrance ducts directed anteriorly, with distinct loop before entering ST II (Fig. 68)………………………………………………….…………*C. flavoplumosa* Simon, 1885

– Epigyne with small cup-shaped epigynal ridges covering copulatory openings (Fig. 57); entrance ducts directed transversely and slightly anteriorly before entering ST II (Fig. 74)….……………………………………………………………………*C. kei* **sp. nov.**

6.4.1 *Copa flavoplumosa* Simon, 1885

Figs 1–4, 7–9, 12–18, 31–48, 55, 56, 61–65, 67–70, 105

Copa flavoplumosa Simon, 1885: 396; Simon, 1897: 168, 173, fig. 159 (♀ lectotype and 1♂ 1♀ paralectotypes, here designated: **ANGOLA:** Landana [05°13'S, 12°08'E], MNHN 5338 – examined).

C. flavopilosa Simon, 1897: 160, fig. 159.

Copa benina Strand, 1916: 93; Lessert, 1921: 429, figs 66–69 (♀ holotype: **D.R. CONGO:** Fort Beni [00°29'N, 29°27'E], Ruwenzori, Expedition Adolf Friedrich *Herzog* von *Mecklenburg*, I.1908, ZMB 28199 – examined) **syn. nov.**

Copa benina nigra Lessert, 1933: 129, fig. 48 (**ANGOLA:** 1♂ from Chimporo and 1♀ from Rio Mbale, MNHG – examined) **syn. nov.**

Remarks: The type locality of *C. flavoplumosa* is given by Simon (1885) as Congo: Landana. This locality is within the modern Angolan enclave of Cabinda that is surrounded by the D.R. Congo. Although the syntype series includes a male, this sex was not originally described by Simon (1885). A lectotype and paralectotypes are designated here, of which the larger of the two females in the type series is the lectotype.

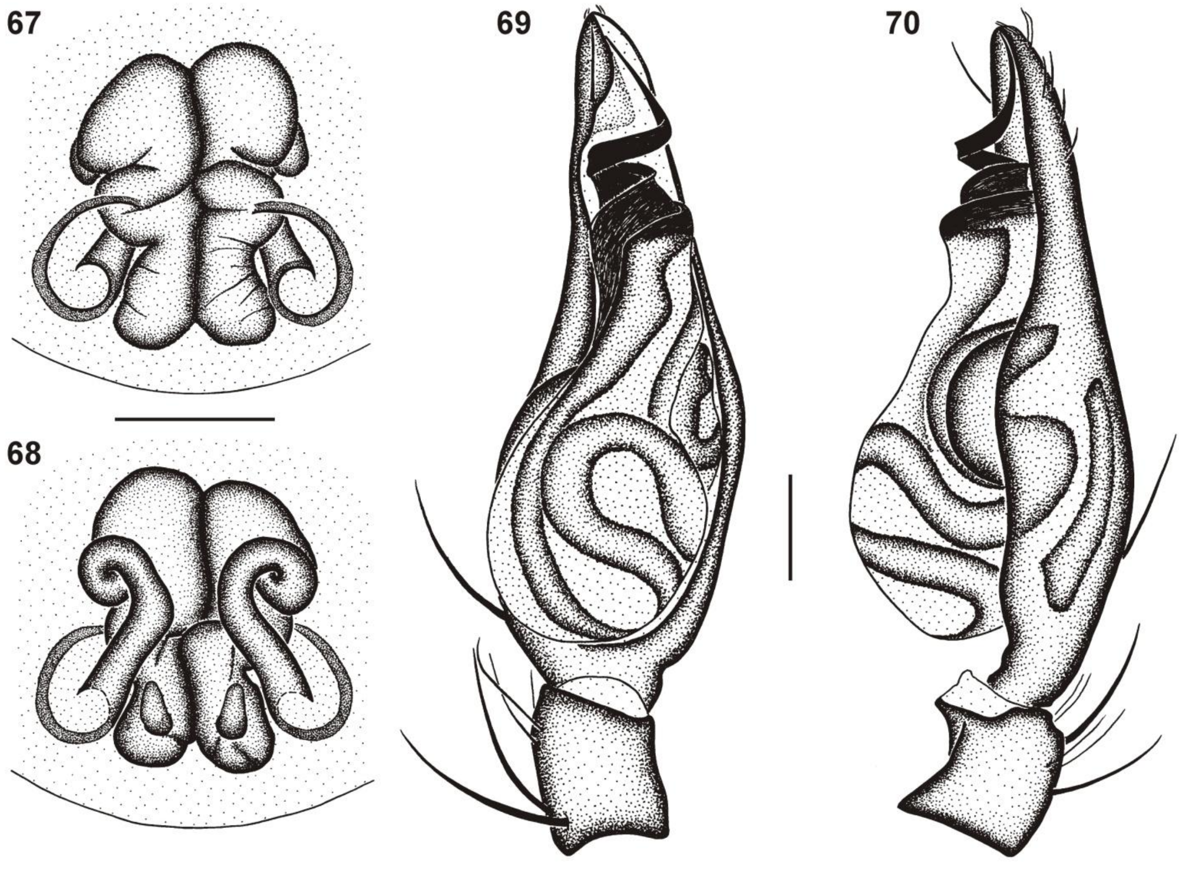
The specimens of *Copa benina nigra* Lessert, 1933 available in the MNHG are not specifically labelled as types and their status is thus uncertain, although the labels indicate localities consistent with that in Lessert's (1933) description, i.e. Chimporo and Rio Mbale. Neither of these localities could be traced on modern maps or electronic resources. Some maps from the early 20th century indicate that the Rio Mbale runs northwards between 16°20'E and 16°40'E with its source at approximately 12°00'S in central Angola. Chimporo has been cited by Mansell (1996) as being located at 17°20'S, 17°17'E in southern Angola. From Lessert's (1933) figure of the male embolus it is clear that *C. b. nigra* is a junior synonym of *C. flavoplumosa*.

Diagnosis: *Copa flavoplumosa* is a distinctive species, easily recognisable from congeners by the large 6-shaped epigynal ridges and long copulatory ducts with an anterior loop in the females, and males by the embolus with a broad base and long, slightly curved distal section.

Female (Parc National Albert, MRAC 234182). Measurements: CL 3.60, CW 2.69, AL 4.85, AW 3.10, TL 8.20 (6.35–9.30), FL 0.40, SL 1.70, SW 1.58, AME–AME 0.10, AME–ALE 0.02, ALE–ALE 0.44, PME–PME 0.12, PME–PLE 0.13, PLE–PLE 0.56, PERW 0.78, MOQAW 0.40, MOQPW 0.43, MOQL 0.57.

Length of leg segments: I 2.60 + 1.23 + 2.04 + 2.05 + 1.20 = 9.12; II 2.58 + 1.20 + 1.93 + 2.03 + 1.18 = 8.85; III 2.55 + 1.16 + 1.89 + 2.25 + 1.25 = 9.10; IV 3.08 + 1.30 + 1.98 + 3.56 + 1.38 = 11.30.

General appearance as in Fig. 7. Carapace bright yellow-orange, eye region black; broad median black line comprising black plumose setae from PER to posterior slope of carapace, broken up by narrow asetose line from between PME to midpoint and Y-shaped asetose area from fovea towards anterior coxae and posterior of carapace; striae absent; lateral margins with narrow fringe of black plumose setae; areas between markings covered in orange plumose setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height slightly less than 1½ AME diameter; PER strongly procurved, eyes subequal in size; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance equal to ⅘ PME diameter; CW:PERW = 3.45:1. Chelicerae yellow-orange, with pectinate curved setae on promargin; promargin with two teeth separated by basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by ½ their basal width, distal tooth slightly larger than proximal tooth, close to fang base. Endites yellow, cream prolaterally and distally, with small black prolateral proximal markings; labium yellow-orange, cream distally, without markings; sternum pale orange, without markings (Fig. 9). Legs yellow-brown, posteriors slightly darker, femora slightly darker dorsally than ventrally; femora with broad dorsal line between proximal and distal spines and incomplete dorsal rings at ⅔ their length and distally, each composed of black plumose setae; patellae with dense black plumose setae laterally; tibiae I & II without markings, with scattered black plumose setae, III & IV with rings proximally and medially corresponding to ventral spines, distal ends with black ring, all covered in black plumose setae with white plumose setae between them; metatarsi I & II without markings, with scattered black and white plumose setae, III & IV with proximal, medial and distal rings corresponding to paired leg spines, covered in black plumose setae with white plumose setae between them; tarsi uniform yellow; palp yellow, spines without spots. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 1-2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal and distal do spines, proximal spine finer and shorter than distal; tibiae: I do 1 pl 2 long fine setae, plv 2 rlv 2 spines, II do 1 long fine seta, pl 2 plv 2 rlv 1 spines, 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 rl 1, with scattered erect ventral setae, mainly retrolaterally; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1-2; tarsi: pl 1 rl 1 plv 2 rlv 1. Abdomen with very small orange-brown anterior dorsal scutum; dorsum cream, densely covered in black straight and plumose setae, interspersed with white plumose setae forming small spots in anterior two-thirds and fine transverse chevrons posteriorly; sides of abdomen cream, densely covered in white plumose setae;



FIGURES 67–70. Genitalic morphology of *Copa flavoplumosa* Simon, 1885: 67. female epigyne, ventral view; 68. same, dorsal view; 69. male palp, ventral view; 70. same, retrolateral view. Scale bars = 0.25mm.

venter cream, covered in short straight black setae, with broad densely setose subrectangular marking medially from epigastric furrow to spinnerets, comprising black and white plumose setae and short straight black setae. Epigyne longer than broad, with large 6-shaped ridges laterally at midpoint of epigyne, separated by approximately 1½ times their width, with copulatory openings distinct (Figs 55, 67); copulatory ducts directed anteriorly, slightly obliquely, with anterior bend and characteristic loop before entering anterior ST II; broad ducts connecting ST II to elongate posterior ST I; ST I clearly narrower than ST II (Fig. 68).

Male (Mikembo, MRAC 234447). Measurements: CL 3.30, CW 2.55, AL 3.55, AW 2.00, TL 6.60 (5.20–8.90), FL 0.37, SL 1.43, SW 1.41, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.38, PME–PME 0.10, PME–PLE 0.11, PLE–PLE 0.49, PERW 0.68, MOQAW 0.37, MOQPW 0.37, MOQL 0.50.

Length of leg segments: I 2.28 + 1.08 + 1.90 + 1.95 + 1.23 = 8.44; II 2.23 + 1.06 + 1.78 + 1.93 + 1.18 = 8.18; III 2.20 + 1.05 + 1.80 + 2.20 + 1.20 = 8.45; IV 2.95 + 1.20 + 2.25 + 3.32 + 1.33 = 11.05.

General appearance as in Fig. 8, male more slender than female. Carapace bright orange, markings and setae as for female. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ⅖ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height slightly larger than double AME diameter; PER strongly procurved, medians very slightly larger than laterals; PME separated by distance slightly less than ⅔ their diameter; PME separated from PLE by distance slightly larger than ⅘ PME diameter; CW:PERW = 3.75:1. Chelicerae orange, with curved setae on promargin not pectinate; dentition as for female. Endites, labium and sternum as for female. Legs yellow-brown, posteriors slightly brighter yellow and darker, markings as for female. Leg spination: femora: I pl 2-3 do 3 rl 1-2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal and distal do spines, proximal spine finer and shorter than distal; tibiae: I pl 1 do 1 rl 1 long fine setae, plv 2 rlv 2 spines, II do 1 rl 1 long fine setae, pl 2 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 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 rl 1, with scattered erect ventral setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 2. Abdomen with orange-brown dorsal scutum extending just past midpoint; dorsum cream, densely covered in black straight and plumose setae with scattered white plumose setae, with patches of white plumose setae forming small spots in anterior two-thirds and fine transverse chevrons posteriorly; sides of abdomen cream, densely covered in white plumose setae with scattered yellow-orange plumose setae; venter cream, covered in short straight black setae, with broad densely setose marking medially from epigastric furrow, converging at spinnerets, comprising black and white plumose setae and short straight black setae. Male palpal cymbium orange-brown, with several thicker bent setae distally (Fig. 70); tegulum pear-shaped, dark red-brown, with nearly black ducts; embolus with broad oblique base directed prolaterally and distally, proximal coil broad and nearly transverse, distal section slightly curved and variable in length (Figs 56, 61–65, 69).

Colour variation: Throughout the geographical range of *C. flavoplumosa* there is considerable variation in the colouration of specimens, particularly with regard to the intensity of yellow/orange and white/cream markings on the body. Three main generalised colour forms can be found. The most widespread variation has a yellow-brown to bright orange carapace and abdomen, with black markings (Fig. 1), and is found throughout the region except in the rainforests of central Africa. This colour form is mainly associated with populations in savanna and grassland habitats.

The second colour form (corresponding to the redescriptions above) has a yellow to orange carapace with black markings and a black abdomen with white markings, similar in pattern and arrangement to the previous form (Figs 2, 3, 7, 8). This form is found in moist savannas and forests across tropical Africa. While most South African populations of this species have colouration corresponding to the first form described here, the populations in the fynbos and grasslands along the southern coast of the country also have a black abdomen with white markings, but the carapace is even darker, nearly dark red-brown in colour.

The third form, corresponding to the description of *C. benina nigra*, is a nigrito form restricted to central and western Africa but only occurring in isolated populations. This form has an entirely black body with white markings corresponding to those described for the other two types above (Fig. 4).

The distribution of the three forms can partly be explained by the habitats they occupy, although some populations (e.g. Faro Game Reserve in Cameroon and Mankono in Ivory Coast) have representatives of all three colour forms but in varying proportions. The colouration of the first form is clearly an adaptation for camouflage in the litter layer of savanna and other habitats that are exposed to sunlight for a considerable portion of the day. The second form apparently occurs in closed canopy forests and dense woodlands that are shaded for most of the day or the entire day. The black abdominal colouration with strongly contrasting markings enables these spiders to blend into dark patches with low light levels in these habitats. The nigrito form can exploit such microhabitats in a similar way, but this does not explain the occurrence of this colour form at some Miombo woodland localities (e.g. Wildlives Game Farm in Zambia). A possible explanation for this case could be the occurrence of natural fires in these habitats. The burned trees, logs and grasses in such disturbed environments may provide sites where these spiders may optimally exploit their colouration for camouflage. Whether individuals have the capability for colour change in response to changing environmental conditions (e.g. following fire) through the use of chromatophores has yet to be determined but seems an unlikely scenario for a representative of Corinnidae.

Additional material examined: BOTSWANA: *Okavango Delta*: Airstrip near Delta Camp, 19°32'S, 23°05'E, leg. K. Wilkins, 13.I.2001 (bush beating), 1♂ (NMZA 14085); Lesideng Research Camp, Near Shakawe, 18°25.822'S, 21°53.771'E, leg. C. Haddad, 25.XI.2006 (leaf litter), 1♀ (NCA 2007/936); Same locality, leg. C. Haddad, 26–29.XI.2006 (under bark), 1♀ (NCA 2007/987); Maun [19°59'S, 23°25'E], leg. A. Russell-Smith, 27.X.1978 (in deep litter, riverine forest), 2♂ (BMNH); Same locality, Government Camp house 36 [19°59'S, 23°25'E], leg. A. Russell-Smith, I–II.1977, 1♀ (BMNH); Botswana, Maun, Maphaneneng Pan [19°55'S, 23°26'E], leg. A. Russell-Smith, 8.II.1976 (riverine woodland, leaf litter), 2♂ (BMNH); Moremi Game Reserve [19°15'S, 23°05'E], leg. W. & I. Barnard, 13–24.I.1991 (mopane woodland), 1♀ (NCA 91/985); Moremi Game Reserve, Maxwee [19°28'S, 23°39'E], leg. A. Russell-Smith, 2.I.1976 (mopane woodland), 1♂ 1♀ (PCRS); Samochima lagoon, Shakawe Fishing Camp, 18°25.749'S, 21°54.035'E, leg. C. Haddad, 10.XII.2006 (leaf litter), 1♂ (NCA 2007/1051); "Woody" Island, NW of Xugana Island, 19°04'S, 23°03'E, leg. B.H. Lamoral, 21–22.XI.1980, 2♂ (NMSA); Xugana Island, 130km NNW of Maun, 19°04'S, 23°03'E, leg. B.H. Lamoral, 18–21.XI.1980, 1♂ (NMSA); Same data (forest floor and logs), 4♂ 2♀ (NMSA); Same locality, leg. B.H. Lamoral, 22–24.XI.1980, 1♀ (NMSA); Same data, 1♀ (NMSA). *North-East Region*: Near Francistown, Selkirk Mine, 21°19.332'S, 27°44.148'E, leg. D.H. Jacobs, 28.III–5.IV.2008, 1♀ (NCA 2008/2905). **CAMEROON:** Bali, Bafuchu Mbu, Shum Laka, 05°51'N, 10°05'E, 1600m a.s.l., leg. H. Doutrelepont, XII.1991–II.1992 (pitfall), 1♂ (MRAC 174794); Chabal Mbabo, South-western slope, 07°25'N, 12°49'E, 1250m a.s.l., leg. Bosmans & Van Stalle, 7–13.IV.1983 (grassland with shrubs, pitfalls), 1♂ (MRAC 162220); Same locality, 1500m a.s.l., leg. Bosmans & Van Stalle, 11.IV.1983 (gallery forest, litter), 1♀ (MRAC 162222); Ebolowa, Nkoumvom [02°55'N, 11°09'E], leg. M.C. Day, 1980 (pitfall traps), 1♂ (BMNH); Faro Game Reserve, 08°24'N, 12°49'W, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 3.V.2007 (river bed, pitfall), 1♀ (MRAC 221128); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 2.V.2007 (gallery forest, pitfall), 2♂ (MRAC 221134); Same data, 4.V.2007, 1♂ 2♀ (MRAC 221169); Same data, 5.V.2007, 3♂ 1♀ (MRAC 221229); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 27.IV.2007 (gallery forest, sieving), 1♀ (MRAC 221434); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 1.V.2007 (mature gallery forest, by hand), 1♀ (MRAC 221359); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 5.V.2007 (mature gallery forest, pitfall), 6♂ 2♀ (MRAC 221211); Same locality, leg.

R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 26.IV.2007 (litter, by hand), 3♀ (MRAC 221280); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 19.IV.2007 (wooded savanna, beating), 1♂ (MRAC 221407); Same locality, leg. R. Jocqué, K. Loosveldt, L. Baert & M. Alderweireldt, 3.V.2007 (litter under tree, by hand), 1♂ 1♀ (MRAC 221432); Mbam mountain area, near Katoupi, Western slope, 05°54'N, 10°44'E, 1550m a.s.l., leg. Bosmans & Van Stalle, 31.III.1983 (gallery forest), 2♀ (MRAC 162244). **CENTRAL AFRICAN REPUBLIC:** Bambari, 04°15'N, 21°54'E, leg. G. Pierrard, II.1969, 1♂ (MRAC 136635). **D.R. CONGO:** Mikembo, 11°28'S, 27°39'E, leg. M. Hasson, 26.XI.2010 (miombo woodland, Uapaca forest, pitfall traps), 1♂ (MRAC 234447), 1♂ 1♀ (MRAC 234384); Same locality, leg. M. Hasson, 26.XI.2010 (gallery forest, alongside river, pitfall traps), 7♂ 4♀ (MRAC 234461); Parc National Albert, Northern Sector, Talya River, area to the right of Lume, near Mutsora [0°19'N, 29°45'E], 1140m a.s.l., leg. P. van Schuytbroeck, 14.II.1955, 1♀ (MRAC 234182); Tshopo, Masako Forest, 15 km N of Kisangani, 00°35'N, 25°11'E, leg. L. de Vos, 19–27.I.1998, 1♂ (MRAC 169357); Same locality, leg. J.-L. Juakaly, 17.XII.2002 (pitfalls, young fallow), 1♀ (MRAC 214341); Same data, 2♂ (MRAC 214334); Same locality, leg. J.-L. Juakaly, 2.VII.2002 (young fallow, pitfall), 1♂ (MRAC 214363). **ETHIOPIA:** Yayu Coffee Forest, 08°23'N, 35°48'E, leg. N. Aklilu, 15.II.2004 (secondary forest, look down), 1♂ 1♀ (MRAC 229596); Same locality, leg. N. Aklilu, 14.XI–12.XII.2003 (pitfall trap), 1imm. 2♂ 4♀ (MRAC 220773); Same locality, leg. N. Aklilu, 2004 (sieving, plantation), 1♂ (MRAC 230893). **GABON:** Estuaire, Ntoum, 00°23'N, 09°47'E, leg. A. Pauly, 5–15.X.1985 (pelouse jardin, pièges moericke), 1♂ (MRAC 172826); Same locality, leg. A. Pauly, X–XI.1985 (piège bac d'eau, forêt), 1♂ (MRAC 172837); Same locality, leg. A. Pauly, 7.XI.1985 (carrier de sable, piège bac d'eau), 1♂ (MRAC 172934). **GUINEÉ:** F.C. de Ziama, 08°24'N, 09°17'W, leg. D. Flomo, 26.XII.1998 (pitfalls, rain forest), 1♂ (MRAC 216225); Same data, 8.I.1999, 1♂ (MRAC 216208); Same data, 21.I.1999, 2♀ (MRAC 216209); Same data, 15.II.1999, 1♀ (MRAC 216226). **IVORY COAST:** Appouesso, F.C. Bossematié, 06°35'N, 03°28'W, leg. R. Jocqué & Tanoh, 23.IV.1995 (pitfalls in forest), 1♂ (MRAC 204369); Same data, 7.V.1995, 1f (MRAC 204366), 1♀ (MRAC 204368); Same data, 20.V.1995, 1♂ (MRAC 204365), 1♂ (MRAC 204370); Same data, 8.X.1995, 1♂ (MRAC 204372); Same data, 22.X.1995, 1♂ (MRAC 204364); Same data, 5.XI.1995, 1♀ (MRAC 204367), 1imm. 1♂ (MRAC 204371); Same locality, leg. R. Jocqué, 1.XII.1995 (modified Malaise trap), 1♂ (MRAC 200963); Bouaflé, 06°59'N, 05°45'W, 12.I.1981, leg. J. Everts (pitfalls), 3♂ 3♀ (MRAC 174002); Same data, 14.I.1981, 2♂ 1♀ (MRAC 173992); Bouaké, F.-Foro, 07°41'N, 05°02'W, leg. G. Couturier, 3–5.VI.1974 (piège coloré), 1♂ (MRAC 216367); Same data, 15–17.VII.1974, 4♂ (MRAC 216400); Same data, 12–14.VIII.1974, 2♂ (MRAC 216484); Same data, 19–21.VIII.1974, 1♀ (MRAC 216414); Same data, 26–28.VIII.1974, 2♂ (MRAC 216456); Same data, 2–4.IX.1974, 1♂ (MRAC 216433), 1♂ 1F (MRAC 216448), 2♂ (MRAC 216420); Bouitha, near Degbézéré, 15km E of Bouflé, 07°22'N, 06°28'W, leg. R. Schouten & J. Buysen, 21.II.1984, 3imm. 1♂ (MRAC 165970); Gagnoa [06°08'N, 05°56'W], leg. A. Russell-Smith, 30.III.1993 (pitfalls, upland rice), 2♂ 1♀ (PCRS); Mankono, Ranch de la Marahoué, 08°27'N, 06°52'W, leg. J. Everts, I.1980 (riverine forest), 102imm. 40♂ 16♀ (MRAC 172282); Same data, II.1980, 19imm. 58♂ 23♀ (MRAC 172281); Same data, III.1980, 61imm. 106♂ 32♀ (MRAC 172284); Same data, IV.1980, 24imm. 39♂ 34♀ (MRAC 172283); Same data, V.1980, 8♂ 20♀ (MRAC 172280); Same data, VI.1980, 4imm. 2♂ (MRAC 172278); Pakodji, near Degbézéré, 15km E of Bouaflé, 06°59'N, 05°38'W, leg. R. Schouten & J. Buysen, 20.II.1984 (pitfall), 22imm. 19♂ 3♀ (MRAC 165977); Titekro, 20km E of Bouaflé, 06°52'N, 06°20'W, leg. R. Schouten & J. Buysen, 15.II.1984 (pitfalls), 8imm. 10♂ 4♀ (MRAC 165965); Touba [08°16'N, 07°41'W], leg. A. Russell-Smith, 19.VI.1995 (pitfalls, upland rice), 1♂ (PCRS); Warda, Bouaké [07°41'N, 05°01'W], leg. A. Russell-Smith, 7.X.1994 (pitfalls, upland rice), 3♂ 2♀ (PCRS). **KENYA:** Kakamega Forest, pitfall near quarry, 00°13'N, 34°54'E, 1626m a.s.l., leg. D. Shilabira Smith, 13.XII.2001, 1♂ (MRAC 212708); Same locality, leg. D. Shilabira Smith, 3.I.2001, 1♀ (MRAC 212715); Same locality, 1654m a.s.l., leg. D. Shilabira Smith, 23.II.2002, 1♂ (MRAC 212656); Mathews Range Forest, Near Kitich camp, 01°13'N, 37°18'E, 1339m a.s.l., leg. D. van den Spiegel, 9.XII.2002, 1♂ (MRAC 212743); Mount Kasigau, Jora Village, 03°50'S, 38°39'E, leg. E. Selempo, 1–3.XII.2001, 1♀ (MRAC 213056); Ngaia Forest, 00°19'N, 38°02'E, leg. Jocqué, Warui & Van den Spiegel, 24.IV.2004 (sieved litter), 1♂ (MRAC 215332); Rift Valley Province, Marich Pass Field Studies Centre, 01°32.2'S, 35°27.4'E, leg. W.J. Pulawski & J.S. Schweikert, 26–29.VII.1999, 1♂ (CAS, CASENT 9033277). **MALAWI:** Chisasira Forest, 25km South of Chintheche, 11°50'S, 33°13'E, leg. R. Jocqué, 1.XII.1977, 1♂ (MRAC 153232); Same data, 20.XII.1977, 3♂ (MRAC 153196); Same data, 3–20.I.1978, 1imm. 1♂ (MRAC 153649); Same locality, leg. R. Jocqué, 3–20.III.1978 (*Brachystegia* woodland), 1♂ 1♀ (MRAC 152985); Nyika plateau, Chelinda [10°35'S, 33°47'E], 2300m a.s.l., leg. R. Jocqué, 7–19.XII.1981 (grassland burned in 1979, pitfalls), 1♂ (MRAC 155686); Same locality, leg. R. Jocqué, 7–19.XII.1981 (grassland burned in 1980, pitfalls), 1♂ (MRAC 155744); Nyika plateau, Chowo rocks [not traced], leg. R. Jocqué, 6–18.XII.1981 (pitfalls in herbaceous vegetation with *Philippia*), 1♂ (MRAC 156302); Same data, 1♀ (MRAC 156384); Nyika plateau, Lake Kaulime [10°34'S, 33°45'E], 2200m a.s.l., leg. R. Jocqué, 6–19.XII.1981 (pitfalls on grassy bank), 2♂ 2♀ (MRAC 155886); Same locality, leg. R. Jocqué, 6–19.XII.1981 (pitfalls on wet bank with *Lobelia*), 1♂ 1♀ (MRAC 156021); Nyika plateau, Manyanjere Forest [not traced], 2100m a.s.l., leg. R. Jocqué, 15.XII.1981 (grassland with stones), 1♀ (MRAC 156722); Nyika plateau, near entrance gate on road Chelinda-Rumphi [not traced], 1700m a.s.l., leg. R. Jocqué, 3–22.XII.1981 (*Brachystegia* woodland, pitfalls), 5♂ 2♀ (MRAC 155822); Same locality, leg. R. Jocqué, 3–22.XII.1981 (secondary *Brachystegia* woodland with *Uapaca*, pitfalls), 1♂ 1♀ (MRAC 155703), 1♂ 1♀ (MRAC 156006), 1♂ 1♀ (MRAC 156062); Same locality, leg. R. Jocqué, 3–22.XII.1981 (pitfalls under large *Brachystegia*), 14♂ 5♀ (MRAC 156289). **MOZAMBIQUE:** Bartholomew Diaz Point, BD Lodge, 21°15.585'S, 35°06.851'E, 5m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 10.XII.2007 (leaf litter, mangroves), 1♂ 3♀ (NCA 2008/194); Bilene, Praia do Bilene, 25°15.649'S, 33°17.659'E, 27m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 20.XII.2007 (leaf litter, coastal forest), 1♂ (NCA 2008/210); Chidenguele, Paraiso de Chidenguele, 24°57.276'S, 34°11.860'E, 38m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 16.XII.2007 (leaf litter, dune forest), 2imm. 1♂ (NCA 2008/205); Inhaca Island, 26°01'S, 32°54'E, leg. T. Steyn, 6–20.VIII.1994 (beach and dunes, by hand), 1♂ (MRAC 215918); Same locality, leg. T. Steyn, 21.VIII–4.IX.1993 (pitfalls, coastal woodland), 1imm. 4♂ (MRAC 209025); Same data, 18.IX–2.X.1993, 2♂ (MRAC 209418); Same data, 2–16.X.1993, 1♀ (MRAC 209037); Same data, 2–16.X.1993, 2♂ 9♀ (MRAC 209044); Same data, 16–30.X.1993, 7♂ 2♀ (MRAC 208995); Same data, 13–23.XI.1993, 5♂ 5♀ (MRAC 209304); Same data, 27.XI–11.XII.1993, 4imm. 9♂ 1♀ (MRAC 209392); Same data, 25.XII.1993–8.I.1994, 13♂ (MRAC 209400); Same data, 8–22.I.1994, 6♂ 1♀ (MRAC 209468); Same data, 19.II–5.III.1994, 3♂ 3♀ (MRAC 209898); Same data, 5–19.III.1994, 1imm. 4♂ (MRAC 209441); Same data, 19.III–2.IV.1994, 1♂ (MRAC 209732); Same data, 13–30.IV.1994, 1♂ (MRAC 209888); Same data, 30.IV–14.V.1994, 3♂ 1♀ (MRAC 209750); Same data, 14–28.V.1994, 2♂ (MRAC 209774); Same data, 19–25.VI.1994, 2♂ (MRAC 209801); Same data, 9–23.VII.1994, 2♀ (MRAC 209699); Same data, 23.VII–6.VIII.1994, 2♂ (MRAC 209880); Same locality, leg. T. Steyn, 18.IX–2.X.1993, (pitfalls, open parkland), 2imm. 1♂ (MRAC 215982);

Same data, 2–16.X.1993, 1♀ (MRAC 209475); Same data, 16–30.X.1993, 5imm. 6♂ 3♀ (MRAC 215999); Same data, 30.X–13.XI.1993, 1♂ (MRAC 209709); Same data, 13–27.XI.1993, 1♀ (MRAC 209414); Same data, 27.XI–11.XI.1993, 2♂ (MRAC 209418); Same data, 11–25.XII.1993, 1♂ (MRAC 209681); Same data, 11–25.XII.1993, 2♂ 2♀ (MRAC 209684); Same data, 25.XII.1993–8.I.1994, 3♂ (MRAC 209693); Same locality, leg. T. Steyn, 15–29.XI.1993 (pitfalls, wetland), 1♀ (MRAC 209325); Same data, 27.XII.1993–10.I.1994, 1♂ (MRAC 209360); Same data, 10–24.I.1994, 1♂ 1♀ (MRAC 209344); Same data, 24.I–7.II.1994, 4♂ (MRAC 208950); Same data, 21.II–5.III.1994, 2♂ (MRAC 209774); Same data, 5–15.III.1994, 2♂ 1♀ (MRAC 209372); Same data, 19.III–2.IV.1994, 4♂ 1♀ (MRAC 209350); Same data, 8–23.IV.1994, 6♂ 2♀ (MRAC 209743); Same data, 23–30.IV.1994, 2♂ 1♀ (MRAC 209786); Same data, 30.IV–14.V.1994, 3♂ 1♀ (MRAC 209903); Same data, 28.V–19.VI.1994, 1♀ (MRAC 209717); Same data, 19–25.VI.1994, 1♂ (MRAC 209796); Same data, 25.VI–9.VII.1994, 1♂ (MRAC 209985); Same data, 20.VIII–3.IX.1994, 1♂ (MRAC 215949); Same data, 3–24.IX.1994, 3♂ 3♀ (MRAC 215922); Same data, 3–24.IX.1994, 3♂ (MRAC 215926); Maxixe [23°52'S, 35°20'E], I.1914, no collector, 1imm. 2♀ (SAM B6589); Morrungulo, Morrungulo Resort, 23°13.983'S, 35°29.587'E, 12m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 6.XII.2007 (leaf litter, dune forest), 1♂ 1♀ (NCA 2008/185); Near Marracuene, Blue Anchor Inn, 25°35.124'S, 32°39.568'E, 50m a.s.l., leg. C. Haddad & R. Fourie, 28.XI.2007 (sifting leaf litter, savanna), 1imm. 2♂ (NCA 2008/165); Near Marracuene, Marracuene Lodge, 25°46.379'S, 32°41.046'E, 12m a.s.l., leg. C. Haddad, 1.XII.2007 (leaf litter, riverine forest), 1imm. 1♀ (NCA 2008/171); Vilankulos, Casa Chibububo, 22°01.231'S, 35°19.237'E, 3m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 12.XII.2007 (leaf litter, coastal bush), 1imm. 2♀ (NCA 2008/199); Xai-Xai, Montego's Camp, 25°03.659'S, 33°40.633'E, 28m a.s.l., leg. C. Haddad, 2.XII.2007 (leaf litter, dune forest), 2♀ (NCA 2008/179). **NAMIBIA:** Caprivi Strip, Popo Falls, 18°07.366'S, 21°34.971'E, leg. R. Lyle, 17.XII.2006 (leaf litter, riverine forest), 1♂ (NCA 2008/4279); Hoarusib River, leg. Museum Expedition, I.1926, 1f (SAM B7110). **NIGERIA:** Borgu Game Reserve [10°19'N, 03°56'E], leg. A. Russell-Smith, 5–6.V.1973 (flood debris by river bank), 1♀ (BMNH); Ibadan, International Institute of Tropical Agriculture [07°29'N, 03°53'E], leg. A. Russell-Smith, 24.V.1973 (bush fallow), 2♂ 5♀ (BMNH); Same data, VII.1973, 4♂ (BMNH); Same data, 25–29.V.1975, 1♂ (PCRS); Same locality, leg. A. Russell-Smith, 22–26.VI.1973 (cultivated plots), 1♂ 2♀ (BMNH); Iseri [06°30'N, 03°16'E], leg. B. Malkin, 26–30.III.1949, 1♀ (CAS, CASENT 9033106). **RWANDA:** P.N. Akagera, 50 km north of la pêcherie Ihema, près du lac Mihindi, 01°32'S, 30°43'E, leg. Jocqué, Nsengimana & Michiels, 23.XI–6.XII.1985 (pièges en forêt sèche), 3♂ 2♀ (MRAC 165007); Same locality, leg. Jocqué, Nsengimana & Michiels, 23.XI–6.XII.1985 (bordure de forêt), 1♂ (MRAC 165020); Same locality, leg. Jocqué, Nsengimana & Michiels, 14.XI–3.XII.1985 (Forêt sêche à *Sansevieria*, pièges), 5♂ 1♀ (MRAC 165416). **SOUTH AFRICA:** *Eastern Cape Province*: Grahamstown [33°18'S, 26°31'E], leg. W.F. Purcell, X.1905, 1♂ (SAM B7539); Great Fish River at Selbourne, 33°28'S, 27°08'E, leg. M. Burger, 5.XII.1993 (pitfall trap), 1♂ (NCA 96/59); Kentani district [32°30'S, 28°18'E], leg. Abernethy, 1903, 1♂ (SAM 1289); Mkambathi Nature Reserve, 31°17.364'S, 30°00.284'E, 52m a.s.l., leg. University of KwaZulu-Natal students, 29.I.2008 (pan traps, grassland), 1♂ (NCA 2008/2906); Same locality, 31°15.816'S, 30°02.098'E, 28m a.s.l., leg. Inland Invertebrate Initiative – University of KwaZulu-Natal, 29.I.2008 (pan traps, grassland), 1♀ (NCA 2010/233), 1♀ (NCA 2010/234); Sterkstroom district, Hazelmere Country Lodge, 31°30.126'S, 26°40.815'E, 1542m a.s.l., leg. R. Lyle & R. Fourie, 3–7.XI.2008 (pitfall traps, poplar trees), 1♂ (NCA 2008/4284); Sundays River Valley, 33°23'S, 25°26'E, leg. H. Potgieter, 23.I.1999 (pitfalls in citrus), 3♂ 5♀ (NCA 2000/237); Same data, 23.XI.1999, 3♂ 1♀ (NCA 2000/238). *Free State Province*: Erfenis Dam Nature Reserve, Site 3, *Acacia karroo* trees, 28°30.272'S, 26°47.527'E, leg. R. Fourie & A. Grobler, 30.IX–28.X.2009 (pitfall traps, woodland), 1♂ (NCA 2009/3590); Kroonstad district, Doornkloof farm, 27°43.376'S, 27°42.042'E, leg. R. Fourie & A. Grobler, 29.X–5.XII.2009 (pitfall traps, grassland), 1♂ (NMSA 22690); Mpetsane Conservation Estate, near Clocolan, 28°48'S, 27°39'E, leg. C. Haddad, 9.III.2007 (*Rhus lancea* leaf litter), 1imm. 1♀ (NCA 2008/558); Sandveld Nature Reserve, 27°40'S, 25°41'E, leg. C. Haddad, 25.X.2003 (leaf litter under *Acacia erioloba*), 1f (NCA 2002/511); Same data, 25.XI.2003, 1♂ (NCA 2005/77); Tussen-die-Riviere Nature Reserve, 30°29'S, 26°11'E, leg. L. Lotz & C. Haddad, 13.X.2008 (active searching, dense *Acacia* woodland), 1♂ (NMBA 12623). *Gauteng Province*: Balmoral, 25°49.013'S, 28°51.970'E, leg. R. Koko, 11.VII.2006 (pitfall traps), 1♀ (NCA 2008/2782); Buffelsdrift, 25°24.251'S, 28°03.581'E, 1700m a.s.l., leg. R. Koko, I.2006 (incidentals), 1♀ (NCA 2008/2780); Pretoria, Weavind Park, 25°43'S, 28°16'E, leg. C. Anderson, 15.III.1997 (in house), 1♂ (NCA 96/455); Pretoria National Botanical Gardens, 25°44'S, 28°16'E, leg. E. Kassimatis, 6.X–24.XI.2007 (pitfall traps), 1♀ (NCA 2008/1966); Suikerbosrand Nature Reserve, Heidelberg, 26°30.102'S, 28°14.165'E, 1830m a.s.l., leg. H. Roux, 13.XI.2001 (pan trap, grassland plateau), 1♂ (NCA 2008/4278). *KwaZulu-Natal Province*: 15km N of Richard's Bay, 28°40'S, 32°13'E, leg. T. Wassenaar, 5.XII.1995 (rehabilitated coastal forest, sweep net), 1f (NCA 96/492); Same locality, leg. T. Wassenaar, 10.XII.1996 (pitfalls, rehabilitated coastal forest), 1♀ (NCA 97/840); Same data, 27.II.1997, 1♂ (NCA 97/842); Botha's Hill [29°43'S, 30°44'E], leg. R.F. Lawrence, XI.1953, 1♀ (NMSA 5951); Cathedral Peak, 28°58.688'S, 29°15.586'E, 1916m a.s.l., leg. Maluti-Drakensburg Transfrontier Park survey, 18.IX.2005 (white pan trap 5, grassland), 1♂ (NCA 2008/1911); Drummond [29°45'S, 30°41'E], leg. R.F. Lawrence, XII.1939, 1♂ (NMSA 2633); Empangeni, 28°45'S, 31°54'E, leg. P. Reavell, 1.X.1983 (in pool), 1♀ (NMSA); Enseleni Game Reserve, 13km N Richard's Bay [28°41'S, 31°59'E], leg. P. Reavell, 10.III.1981, 1♀ (NCA 81/198); Garden Castle, 29°44.700'S, 29°12.663'E, 1842m a.s.l., leg. Maluti-Drakensburg Transfrontier Park staff, 2.XI.2005 (white pan trap 5, grassland), 1♂ (NCA 2008/1913); iSimangaliso Wetlands Park, False Bay Park, 27°55'S, 32°16'E, leg. J. Esterhuizen, 13.X.2003 (tsetse fly traps), 1♀ (NCA 2004/769); Same data, 22.X.2003, 1♂ (NCA 2004/765); Same locality, 27°54.014'S, 32°23.543'E, leg. Earthwatch team 9, 15.I.2005 (yellow pan traps, open savanna), 1imm. 1♀ (NCA 2007/1309); Ithala Game Reserve, Near ruins, Ngubhu loop, 27°30.817'S, 31°14.304'E, leg. C. Haddad, 1.VII.2007 (leaf litter), 11imm. 1♂ 1♀ (NCA 2007/2809); Kosi Bay [26°52'S, 32°52'E], leg. R.F. Lawrence, VII.1936, 1♂ (NMSA 158); Same locality, Banga Nek, near third lake, 27°05.134'S, 32°50.533'E, leg. P. & G. Van Niekerk, X. Combrink & J. Warner, 27.II.2007 (sweeps in grass), 1♀ (NCA 2009/4608); Illovo Beach, Mount Edgecombe [30°07'S, 30°51'E], leg. C. Cilliers, 7.I.1977, 1imm. 1♀ (NCA 2007/1137); Mkuzi Game Reserve, 27°40.356'S, 32°15.065'E, leg. Earthwatch Team 1, 18.III.2005 (yellow pan traps, *Terminalia sericea* woodland), 1♂ (NCA 2007/1297); Same locality, 27°35.768'S, 32°14.365'E, leg. Earthwatch Team 10, 22.I.2005 (blue pan traps, *T. sericea* woodland), 1♂ (NCA 2007/1298); Mtunzini, "Twin Streams" Farm (I.F. Garland), 28°57'S, 31°46'E, leg. T. & C. Griswold, P. Croeser & P. Reavell, 19–20.I.1984 (coastal dune forest), 1♀ (NMSA); Natal, no date, leg. Martin?, 1♂ 1♀ (MNHN 6383); Ndumo Game Reserve, Crocodile farm, 26°53'S, 32°19'E, leg. C. Haddad, 8–23.I.2002 (pitfalls), 1♂ (NCA 2002/391); Same locality, Ezikhebeni, Pongola River, 26°53.380'S, 32°19.098'E, leg. C. Haddad, R. Lyle & V. Butler, 28.VI.2009 (leaf litter, riverine forest), 1♀ (TMSA 23612); Same locality, Pongola River floodplain, near pump, Riverine forest, 26°54.323'S, 32°19.435'E, leg. C. Haddad & F. Jordaan, 27.VI.2006 (sieving leaf litter), 1imm. 3♂ 4♀ (NCA 2006/1201); Same locality, Pongola river floodplain, 26°53.384'S, 32°19.097'E, 16.I.2006, leg. C. Haddad (riverine forest leaf litter), 5♂ 1♀ (NCA 2006/710); Same locality, Viewing tower, 26°54.762'S, 32°16.290'E, leg. C. Haddad, R. Lyle & V. Butler, 30.VI.2009 (leaf litter, broadleaf woodland), 2♂ 2♀ (TMSA 23564); Same locality, Western shore of Shokwe Pan, 26°50'S, 32°12'E, leg. C. Haddad, 3.VII.2002 (leaf litter, *Ficus sycomorus* forest), 1♂ (NCA 2002/392); Same locality, Western shore of Shokwe Pan, 26°52.418'S, 32°12.590'E, leg. C. Haddad, R. Lyle & V. Butler, 8.VII.2009 (leaf litter, *Ficus* forest), 1♀ (TMSA 23548); Near Port Shepstone [30°45'S, 30°26'E], leg. W.F. Purcell, IX.1905, 1♀ (SAM 150751); Ngome State Forest, 27°49'S, 31°26'E, leg. M. van der Merwe, XI.1992 (pitfalls, open forest), 1♀ (NCA 94/396); Same locality, leg. M. van der Merwe, XII.1992 (pitfalls, grass), 1♂ (NCA 94/475); Same data, I.1993, 1♂ (NCA 94/441); Ophathe Game Reserve, Ophathe River bed, 28°22.693'S, 31°24.442'E, leg. C. Haddad & R. Fourie, 5.VII.2007 (leaf litter, river bank), 4imm. 2♂ (NCA 2007/2969); Same locality, Montane grassland, 28°25.344'S, 31°23.957'E, 897m a.s.l., leg. C. Haddad, 4.X.2008 (sifting leaf litter), 1imm. 1♀ (NCA 2008/3910); Same locality, Ophathe River Bed, 28°23.727'S, 31°23.643'E, 455m a.s.l., leg. C. Haddad, 30.IX–4.X.2008 (pitfall traps), 2♂ (NCA 2008/4245); Same locality, leg. C. Haddad, 2.X.2008 (active searching), 1♂ 1♀ (NCA 2008/4222); Same locality, Rocky mountainside, 28°23.202'S, 31°24.077'E, 505m a.s.l., leg. C. Haddad, 1.X.2008 (active searching), 1♀ (NCA 2008/4068); Same locality, leg. C. Haddad, 1.X.2008 (sifting leaf litter), 3imm. 1♂ (NCA 2008/4039); Pietermaritzburg [29°37'S, 30°23'E], leg. P. Croeser, 7.XII.1983 (dense fern in garden), 1♀ (NMSA 18487); Same locality, Town Bush Valley, Southern slopes of Hogsback Mountain, 29°33'S, 30°21'E, 3200–3400ft a.s.l., leg. C. Griswold & T. Meikle-Griswold, 11.XI.1984 (weedy vegetation), 1imm. 1♂ 1♀ (NMSA); Sani Pass, 29°39.022'S, 29°27.047'E, 1500m a.s.l., leg. D. Prentice, IX.2009 (pitfall traps, 6d), 1♂ (NCA 2010/271); Same locality, 29°37.217'S, 29°23.330'E, 1800m a.s.l., leg. D. Prentice, IX.2009 (pitfall traps, 5d), 1♂ (NCA 2010/272); Same locality, 29°36.205'S, 29°18.753'E, 2400m a.s.l., leg. D. Prentice, IX.2009 (pitfall traps, 3c), 1♂ (NCA 2010/221); Scottburgh [30°17'S, 30°45'E], leg. W.G. Rump, II.1943, 1♀ (NMSA 3882); Sodwana Bay, 27°24'S, 32°45'E, R. Harris, XI.1982, 1♀ (NCA 83/247); Tembe Elephant Park, 27°01'S, 32°24'E, leg. C. Haddad, 5.I.2002 (leaf litter, deep sand forest), 1imm. 1♂ (NCA 2002/396); Same locality, 27°01'S, 32°24'E, leg. C. Haddad, 3–23.I.2002 (pitfalls, deep sand forest), 1imm. 7♂ 1♀ (NCA 2002/393); Same locality, 26°57'S, 32°26'E, 3–23.I.2002, leg. C. Haddad (pitfalls, closed woodland/clay), 1♂ (NCA 2002/394); Same locality, Near offices, 27°03'S, 32°25'E, leg. C. Haddad, 3–23.I.2002 (pitfalls, open woodland/sand), 4♂ (NCA 2002/395); Same locality, 27°03'S, 32°25'E, leg. C. Haddad, 8.II.2005 (sifting leaf litter, open woodland/sand), 3♀ (NCA 2007/3606); Vernon Crookes Nature Reserve, camp, 30°16'S, 30°37'E, leg. L. Lotz, 27.IX.1995, 1♂ (NMBA 7719). *Limpopo Province*: Kruger National Park, Maduringwe, 22°35'S, 31°09'E, leg. R.F. Lawrence, 20.XII.1962, 1♂ (NMSA); Lajuma Mountain Retreat, 23°02'S, 29°27'E, leg. N. Schönhofer, 9.X.2002 (hand collecting), 1♂ (NCA 2007/1153); Same locality, Island 3, 23°01.890'S, 29°26.167'E, leg. M. Mafadza, 23.XI.2004 (sifting leaf litter), 1♀ (NCA 2005/1882); Same locality, Short Forest 3, 23°02.165'S, 29°26.985'E, leg. M. Mafadza, 28.XI.2004 (pitfall trap), 1♀ (NCA 2005/2021); Same locality, Tall forest 3a, 23°02.229'S, 29°26.717'E, leg. M. Mafadza, 28.XI.2004 (pitfall trap), 1♂ (NCA 2005/2022); Same locality, Woodland 3, 23°02.532'S, 29°26.897'E, leg. M. Mafadza, 6.XII.2004 (active search), 1♀ (NCA 2005/1881); Same locality, Woodland 5c, 23°02.528'S, 29°26.866'E, leg. M. Mafadza, 28.XI.2004 (pitfall trap), 1♂ 1♀ (NCA 2005/2023); Little Leigh, 22°56.910'S, 29°52.177'E, 1084m a.s.l., leg. F. Mbedzi, 22.XI.2005 (leaf litter, gallery forest), 1♀ (NCA 2008/2764), 1♂ (NCA 2008/2765); Marble Hall, Schoeman Boerdery, 24°57'S, 29°17'E, leg. P. Stephen, 16.XI.1999 (pitfalls in citrus), 1♂ (NCA 2000/204); Nylsvley Nature Reserve, 24°39'S, 28°40'E, leg. C. Schultz, 1.XII.1975, 1♂ (NCA 2007/1154); Springbokvlakte, Settlers (wildskamp), 24°54'S, 28°43'E, leg. M. van Jaarsveld, 9.I.2002 (pitfalls, grassland), 1♀ (NCA 2003/1328). *Mpumulanga Province*: 20km NE of Brondal, 25°21'S, 30°50'E, leg. M. van den Berg, 16.IX.1997 (on Hass avocados), 1imm. 1♂ (NCA 98/196); Same data, 2.XII.1997, 1♂ (NCA 98/197); Same locality, leg. M. van den Berg, 16.IX.1997 (on Fuerte avocados), 1♂ (NCA 98/198); Groblers Farm, 25°29'S, 30°05'E, leg. L. Makaka, 29.XI–2.XII.2008 (pitfall traps, grassland AF2), 1♂ (NCA 2010/265); Same locality, leg. L. Makaka, 26–29.XI.2008 (pitfall traps, grassland AF3), 1♂ (NCA 2010/229); Same data, 29.XI–2.XII.2008, 1♂ (NCA 2010/227), 1♂ (NCA 2010/266); Same locality, 26–29.XI.2008, leg. L. Makaka (pitfall traps, grassland AF4), 2♂ (NCA 2010/228), 1♂ (NCA 2010/267), 1♂ (NCA 2010/268); Hall and Sons, 10km NE of Nelspruit, 25°21'S, 31°46'E, leg. M. van den Berg, 21.VII.1997 (on Hass avocados), 6imm. 2♂ 3♀ (NCA 98/216); Same data, 10.III.1998, 3imm. 1♂ (NCA 98/1065); Same locality, leg. M. van den Berg, 23.X.1997 (on Fuerte avocados), 1imm. 3♀ (NCA 98/217); Same data, 12.XII.1997, 1♂ (NCA 98/776); Hectorspruit, Vergelegen, 25°25'S, 31°40'E, leg. P. Stephen, 12.X.1998 (pitfalls in citrus), 1imm. 1♀ (NCA 99/193); Nelspruit, 25°21'S, 31°46'E, leg. M. van den Berg, 9.XII.1997 (on macadamia nuts), 1♀ (NCA 98/829); Nelspruit, Institute for Tropical and Subtropical Crops, Waaierproef, 25°21'S, 31°46'E, leg. M. van den Berg, 18.XI.1997 (on macadamia tree), 1imm. 1f (NCA 98/174); Same data, 9.XII.1997, 1♀ (NCA 98/829); Same data, 12.II.1998, 1♂ (NCA 98/830); Nelspruit Agricultural College, 25°21'S, 31°46'E, leg. P. Stephen, 12.XI.1999 (pitfalls in citrus), 1♀ (NCA 2000/185); Nelspruit Nature Reserve [25°30'S, 30°58'E], leg. Endrody-Younga, 23.XI.1986, 1♂ (TMSA 19679); Roger Croall, 25°33'S, 30°05'E, leg. L. Makaka, 26–29.XI.2008 (pitfall traps, grassland R1), 1♂ (NCA 2010/269); Same locality, leg. L. Makaka, 26–29.XI.2008 (pitfall traps, grassland R4), 1♂ (NCA 2010/263), 1♂ (NCA 2010/264); Sakhelwe location, 25°24'S, 30°05'E, leg. L. Makaka, 26–29.XI.2008 (pitfall traps, grassland COM3), 1♂ (NCA 2010/224); Veloren Vallei Nature Reserve, Block 3, 25°18.832'S, 30°07.791'E, leg. L. Makaka, 4–7.III.2009 (pitfall traps, grassland V3.4), 1♀ (NCA 2010/225); Witbank Dam Nature Reserve, 25°51'S, 29°18'E, leg. A. Leroy, 9.XI.1991 (grassland), 1♀ (NCA 92/172). *North West Province*: Matshaneng district, Hermitage Farm, 27°04.136'S, 23°40.991'E, leg. C. Haddad, 1.XII.2003–22.I.2004 (pitfalls under trees), 1♀ (NCA 2005/2012); Potchefstroom district, Thabela Thabeng Mountain Retreat, 26°51.825'S, 28°17.819'E, leg. R. Fourie & A. Grobler, 1–29.X.2009 (pitfall traps, woodland grassland), 10♂ (NCA 2009/3553); Same locality, 26°51.828'S, 28°17.805'E, leg. R. Fourie & A. Grobler, 1–29.X.2009 (pitfalls, Vaal River bank), 4♂ 1♀ (NCA 2009/3561). *Northern Cape Province*: Prieska district, Green Valley Nuts, 29°35'S, 22°56'E, leg. C. Haddad, 19.XII.2001 (fogging, pistachio tree canopy), 1♂ (NCA 2002/481); Same locality, 22°56.683'S, 29°35.184'E, leg. C. Haddad, 23.XI–18.XII.2001 (pitfalls, *Eucalyptus* trees), 2♂ 1♀ (NCA 2006/1289); Kuruman district, Sunnyside Farm, 27°43.514'S, 23°36.812'E, leg. C. Haddad, 1.XII.2003–22.I.2004 (pitfalls, gravel bed), 1♀ (NCA 2005/2013). *Western Cape Province*: Brenton-on-Sea, 34°04'S, 23°02'E, leg. H.G. Robertson, 1–7.XII.1996 (pitfall traps, broken fynbos), 1♂ (SAM ENW-C005376); De Hoop Nature Reserve, Bitou number 2, 34°27.194'S, 20°24.250'E, leg. C. Haddad & R. Lyle, 25.IX.2007 (sifting leaf litter), 2♂ 1♀ (NCA 2007/3896); Same locality, Potberg, 34°22.549'S, 20°32.004'E, leg. C. Haddad, 4.IV.2004 (sieving leaf litter), 16♂ 1♀ (NCA 2008/576); Knysna, Uitzicht Annex, 34°00'S, 23°20'E, leg. L. Lotz, 13–19.X.1998 (pitfall trap), 3♂ (NMBA 7420). **TANZANIA:** *Coast Region*: Kisarawe District, Kazimzumbwe Forest Reserve, 06°57'S, 39°03'E, leg. Frontier Tanzania, I–II.1991, 1♂ (ZMUC), 1♂ (ZMUC), 1♂ (ZMUC), 7♂ 5♀ (ZMUC), 2♂ (ZMUC), 5♂ 2♀ (ZMUC); Same locality, leg. Frontier Tanzania, I–II.1992, 1♂ (ZMUC); Rufigi District, Namakutwa Forest Reserve, 08°19'S, 39°00'E, leg. Frontier Tanzania, VIII–IX.1992, 19♂ 5♀ (ZMUC). *Iringa Region*: Uzungwa Mountains, Uzungwa Scarp Forest Reserve, above Chita Village [08°20'S, 35°56'E, 1500m a.s.l., leg. N. Scharff, 2–13.XI.1984 (pitfall traps, montane rain forest), 2♂ (ZMUC); Same locality, leg. N. Scharff, 25–29.X.1984 (pitfall traps, lowland rain forest), 1♀ (ZMUC). *Kilimanjaro Region*: Mkomazi Game Reserve, Ibaya camp, 03°58'S, 37°48'E, leg. A. Russell-Smith, 19–20.XI.1994 (pitfalls, unburnt grassland), 4♂ 6♀ (MRAC 211327). *Lindi Region*: Lindi District, Litipo Forest Reserve, 10°02'S, 39°29'E, leg. Frontier Tanzania, VII–IX.1993, 17♂ 9♀ (ZMUC), 21♂ 10♀ (ZMUC), 20♂ 8♀ (ZMUC). *Mbeya Region*: 8km NE of Kyela, 09°35'S, 33°48'E, leg. R. Jocqué, 10–19.XI.1991 (pitfalls in miombo relict), 4♂ 4♀ (MRAC 173 920); Itungi, 09°36'S, 33°55'E, leg. R. Jocqué, 10.XI–1.XIII.1991 (pitfalls in swamp with floating vegetation, edge high reeds), 1♂ (MRAC 173940), 1♂ (MRAC 173960); Matema, 1km N of Livingstone mountains, 09°30'S, 34°03'E, leg. R. Jocqué, 14–24.XI.1991 (pitfalls, evergreen forest), 2♂ (MRAC 173204). *Morogoro Region*: 62 road km SW of Morogoro, 07°02.5'S, 37°15.3'E, leg. W.J. Pulawski, 2.I.2003, 1♀ (CAS); Morogoro District, Kimboza Forest Reserve, 07°01'S, 37°48'E, leg. Frontier Tanzania, I–III.1994, 9♂ 8♀ (ZMUC); Mwanihana Forest Reserve, 700m a.s.l., leg. N. Scharff, 8–16.IX.1984 (pitfall traps, lowland rain forest), 1♂ (ZMUC), 1♂ (ZMUC), 1♂ (ZMUC). *Pwani Region*: Bagamoyo District, Sadani Zaraninge Forest Reserve, 06°10'S, 38°39'E, leg. Frontier Tanzania, VII–VIII.1991 (pitfalls, dry coastal forest), 1♂ (ZMUC). *Tanga Region*: Mbomole Hill, 05°05.7'S, 38°37'E, 1000m a.s.l., leg. C.E. Griswold, N. Scharff & D. Ubick, 5–8.XI.1995, 1♂ (CAS, CASENT 9033142); Muheza District, Magrotto Hill, 05°07'S, 38°45'E, leg. Frontier Tanzania, VII–IX.1994, 3♂ 1♀ (ZMUC), 2♂ 2♀ (ZMUC); Muheza District, Manga Forest Reserve, 05°02'S, 34°47'E, leg. Frontier Tanzania, VIII.1997, 1♂ (ZMUC); Muheza District, Pangani Falls Forests, 05°20'S, 38°40'E, leg. Frontier Tanzania, I–III.1993 (riverine and dry forest), 8♂ (ZMUC). **TOGO:** Bassari, 09°15'N, 00°47'E, leg. P. Douben, V–VII.1994 (pitfalls), 1♂ 1♀ (MRAC 173991); Bassari, Entre Bassari et Sokode, 09°15'N, 00°47'E, leg. P. Douben, V–VII.1984 (savanna boisée), 4♂ 2♀ (MRAC 166237), 1♀ (MRAC 166176); Dzobégan, 07°14'N, 00°41'E, leg. S. Tchibozo, I.2003 (in house), 1♂ (MRAC 212776). **UGANDA:** Entebbe [00°04'N, 32°27'E], leg. P.L.G. Benoit, 1959, 1♂ (MRAC 131303); Kampala, Namulonge Research Station [00°32'N, 32°35'E], leg. A. Russell-Smith, 22.IV.1994 (in maize field), 1♂ (PCRS); Kanyawara, 00°34'S, 30°21'E, 1600m a.s.l., leg. V. & B. Roth, 30.X.1992, 1♂ (CAS, CASENT 9033135). **ZAMBIA:** Between Namwala and Lake Itezhi-Tezhi, Pontoon road, 15°41.887'S, 26°21.588'E, leg. C. Haddad, 5.XII.2006 (leaf litter), 1imm. 1♀ (NCA 2007/900); 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♂ (NCA 2007/576); Kasanka National Park, Fibwe Camp, 12°33'S, 30°13'E, leg. C. Stuart, 15.II.2001, 1♀ (NCA 2002/540); Same data, 11.XI.2001, 1♀ (NCA 2002/550); Livingstone, Quarry nr Livingstone Airport, 17°47.998'S, 25°46.588'E, leg. C. Haddad & J. Parau, 1.XII.2006 (leaf litter), 3♀ (NCA 2007/624); Near Mpulungu, 08°48'S, 31°05'E, leg. W.J. Pulawski, 20.III.1998, 1♀ (CAS, CASENT 9033105); 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), 1♂ 7♀ (NCA 2007/470); Same locality, Open savanna, 16°58.974'S, 26°38.974'E, leg. C. Haddad, 4.XII.2006 (leaf litter), 1♂ (NCA 2007/553); Same locality, Siatichema River, 16°59.615'S, 26°38.093'E, leg. C. Haddad, 3.XII.2006 (leaf litter), 4♀ (NCA 2007/1128). **ZIMBABWE:** Bulawayo, Hillside, 20°10'S, 28°35'E, leg. M. FitzPatrick, II.1999 (pitfalls), 1♀ (NMZA 13854); Harare, 6km NW of Westwood HQ, Girls College [17°49'S, 30°59'E], leg. Natural History

Museum of Zimbabwe staff, 7.XII.1993 (under logs), 2♂ (NMZA 11157); Victoria Falls, 17°56'S, 25°50'E, leg. W.J. Pulawski, 1–8.II.1995, 1♂ (CAS, CASENT 9033083).

Distribution: Widespread throughout the continental Afrotropical Region (Fig. 71).

Biology: Specimens were mainly collected from the leaf litter layer of all of the main biome types in Africa except for true deserts and karoo habitats, although records from semi-arid temperate grasslands and dry savannas are scarce. The greatest density of records is in moist savannas and closed canopy forests, although the species seems largely absent from rainforests; considering the extensive sampling in the D.R. Congo, especially by the MRAC, only three records from rainforests in this country are reported here. Specimens were most regularly collected by pitfalls traps, litter sifting and by hand from the ground surface.

FIGURE 71. Distribution of *Copa flavoplumosa* Simon, 1885 in the Afrotropical Region.

6.4.2 *Copa kei* sp. nov.

Figs 5, 6, 10–12, 19–30, 49–54, 57–60, 66, 72–75, 106

Etymology: The specific name is a noun in apposition taken from the type locality, the town Kei Mouth, located at the estuary of the Kei River in the Eastern Cape Province.

Diagnosis: The species is easily recognisable by the distinct dorsal black spot on the anterior margin of the abdomen. Males are characterised by the narrow coiled embolus and females by the small copulatory openings and the nearly transverse copulatory ducts.

Female (holotype, Kei Mouth, NCA 2007/3843). Measurements: CL 3.84, CW 2.75, AL 6.00, AW 4.55, TL 9.65 (6.40–9.80), FL 0.40, SL 1.75, SW 1.60, AME–AME 0.10, AME–ALE 0.01, ALE–ALE 0.46, PME–PME 0.20, PME–PLE 0.13, PLE–PLE 0.63, PERW 0.83, MOQAW 0.44, MOQPW 0.51, MOQL 0.54.

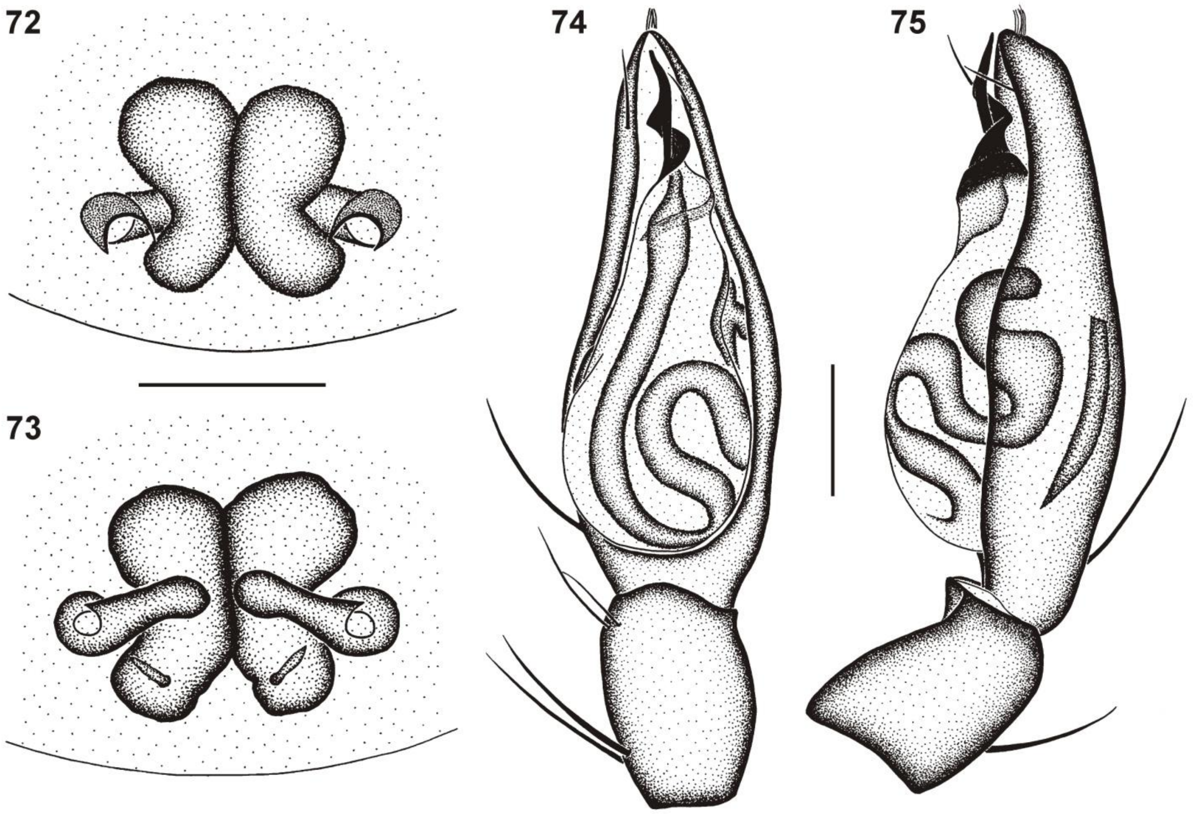
Length of leg segments: I 2.60 + 1.25 + 2.03 + 2.05 + 1.18 = 9.11; II 2.50 + 1.24 + 1.90 + 2.00 + 1.16 = 8.80; III 2.45 + 1.23 + 1.88 + 2.30 + 1.16 = 9.02; IV 3.15 + 1.38 + 2.63 + 3.40 + 1.39 = 11.95.

General appearance as in Fig. 10. Carapace bright yellow-orange, eye region black except between PME; broad median black line covered in black plumose setae from PER to posterior slope of carapace, broken up by asetose line from PME to midpoint and paired oblique asetose line from fovea towards anterior coxae; black striae present, falling within broad median band; lateral margins black from chelicerae to posterior marking, markings expanded from coxae I and from coxae I–IV, densely covered in black plumose setae; areas between markings covered in white plumose setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height approximately 1½ AME diameter; PER strongly procurved, medians very slightly larger than laterals; PME separated by distance equal to 1¼ their diameter; PME separated from PLE by distance equal to ⅘ PME diameter; CW:PERW = 3.31:1. Chelicerae yellow-orange, with pectinate curved setae on promargin; three closely spaced teeth on promargin, distal tooth smallest, median tooth largest; median tooth closer to distal tooth than to proximal tooth; retromargin with two teeth separated by their basal width, distal tooth slightly smaller than proximal tooth, close to fang base. Endites yellow, cream prolaterally; labium yellow-brown, cream distally, with broad transverse black marking along proximal margin;

sternum bright yellow, with broad black marking along margins, expanded at coxae (Fig. 12). Legs yellow-brown, with faint black mottling; spine bases with distinct black spot; trochanters with distal margins black laterally; femora all with black lateral and distal mottling, ventrally with faint distal ring; patellae with fine dorsal proximal line and lateral and distal mottling; tibiae with faint rings proximally and medially corresponding to ventral spines, distal ends with black ring; metatarsi with proximal, medial and distal rings, corresponding to paired leg spines; tarsi yellow; palp yellow, spines with black spots. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal and distal do spines, proximal spine finer and shorter than distal; tibiae: I do 1 long fine seta, plv 2 rlv 2, II do 1 long fine seta, plv 1 rlv 2 spines, III pl 2 do 1 rl 2 plv 2 rlv 1-2 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, with scattered erect ventral setae, mainly retrolaterally; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with very small red-brown anterior dorsal scutum beneath marking; dorsum mottled grey, with large black spot anteriorly, dark grey median stripe from anterior spot to midpoint, and small cream chevrons posteriorly; short straight black setae and white plumose setae on markings dorsally and laterally; sides of abdomen cream; venter cream, covered in short straight black setae, with dark marking medially on epigastric plate covering epigyne, broadened from epigastric furrow, extending to and surrounding spinnerets. Epigyne small, with strongly curved ridges laterally at midpoint of epigyne, separated by approximately three times their width, with copulatory openings distinct (Figs 57, 72); copulatory ducts almost straight, nearly transverse, slightly oblique, entering rounded anterior ST II; broad ducts connecting ST II to subrectangular posterior ST I; ST I slightly narrower than ST II (Fig. 73).

Male (paratype, Kei Mouth, NCA 2002/414). Measurements: CL 3.44, CW 2.54, AL 3.50, AW 2.30, TL 6.98 (5.20–6.98), FL 0.34, SL 1.55, SW 1.48, AME–AME 0.07, AME–ALE 0.01, ALE–ALE 0.40, PME–PME 0.20, PME–PLE 0.11, PLE–PLE 0.55, PERW 0.75, MOQAW 0.42, MOQPW 0.48, MOQL 0.52.

Length of leg segments: I 2.35 + 1.13 + 1.87 + 1.97 + 1.20 = 8.52; II 2.32 + 1.10 + 1.75 + 1.93 + 1.15 = 8.25; III 2.28 + 0.98 + 1.75 + 2.13 + 1.10 = 8.24; IV 2.90 + 1.13 + 2.40 + 3.30 + 1.30 = 11.03.



FIGURES 72–75. Genitalic morphology of *Copa kei* **sp. nov.**: 72. female epigyne, ventral view; 73. same, dorsal view; 74. male palp, ventral view; 75. same, retrolateral view. Scale bars = 0.25mm.

General appearance as in Fig. 11, male more slender than female. Carapace deep orange, markings and setae as for female. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to $^{2}/_{5}$ their diameter; AME separated from ALE by distance approximately $^{1}/_{10}$ AME diameter; clypeus height equal to 1½ AME diameter; PER strongly procurved, medians very slightly larger than laterals; PME separated by distance equal to 1½ their diameter; PME separated from PLE by distance slightly larger than $^{4}/_{5}$ PME diameter; CW:PERW = 3.39:1. Chelicerae yellow-orange, with curved setae on promargin not pectinate; dentition as for female. Endites, labium, sternum and leg colouration and markings as for female. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal and distal do spines, proximal spine finer and shorter than distal; tibiae: I do 1 long fine seta, plv 3 rlv 3 spines, II do 1 long fine seta plv 2 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 1-2 rlv 1-2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora: pl 1 do 2, with scattered erect ventral setae, mainly retrolaterally; patellae:

pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 2 rl 1 plv 2 rlv 1. Abdomen with narrow red-brown dorsal scutum extending just past midpoint; dorsum mottled grey, with large black spot anteriorly, broad dark grey median stripe from anterior spot narrowing towards posterior of scutum, and small cream chevrons in posterior half; short straight black setae and white plumose setae on markings dorsally and laterally; lateral margin of abdomen creamy-grey; venter creamy-grey, covered in short straight black setae, with narrow dark grey marking medially on epigastric plate, broadened from epigastric furrow, extending to and surrounding spinnerets. Male palpal cymbium yellow, with several thicker bent setae distally (Fig. 75); tegulum pear-shaped, orange-brown, with nearly black ducts; embolus with narrow base and 1½ narrow coils around a central prong; distal section slightly curved (Figs 58, 66, 74).

Type material: Holotype ♀: **SOUTH AFRICA:** *Eastern Cape Province*: Kei Mouth, 32°41.206'S, 28°22.497'E, leg. C. Haddad, 25.IX.2004 (grass at tree base) (NCA 2007/3843).

Paratypes: **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), 1♂ (NCA 2008/270); Dwesa Nature Reserve, 32°16.2'S, 26°52.2'E, leg. M. Mgobozi, X.2004 (pitfall traps), 2♂ 2♀ (NCA 2008/1967); East London, Pineapple Research Station, 33°00.6'S, 26°54.0'E, leg. D. Keetch, 15.III.1985 (on soil, coastal dune forest), 1♂ 5♀ (NCA 95/325); Hogsback, Never Daunted Lodge, 32°35.729'S, 26°55.894'E, 1250m a.s.l., leg. C. Haddad, 7.I.2011 (night collecting), 1♀ (NCA 2010/2750); Same locality, Tyume Forest, near Big Tree, 32°36.123'S, 26°56.687'E, 1070m a.s.l., leg. C. Haddad, 28.III.2011 (sifting litter, Afromontane forest), 1♂ (TMSA 24012); Kei Mouth, 32°41.280'S, 28°22.484'E, leg. C. Haddad, 6.XII.2005 (leaf litter, coastal dune forest), 1♀ (NCA 2008/1907); Same locality, 32°41.206'S, 28°22.497'E, leg. C. Haddad, 10.VIII.2002 (leaf litter, coastal dune), 1♂ (NCA 2002/414); Lusikisiki district, Mzimhlava River mouth, 31°20'S, 29°40'E, leg. Baddeley, II.1980 (coastal evergreen forest), 1♀ (MRAC 164163). *KwaZulu-Natal Province*: Howick, Shooter's Hill [29°26'S, 30°19'E, 790m a.s.l.], leg. R.F. Lawrence, X.1937, 1♀ (NMSA 2124); Karkloof Nature Reserve, 29°19.1'S, 30°15.5'E, 1325m a.s.l., leg. M. Mostovski, 28.IX–3.X.2005 (yellow pan trap), 2♂ 2♀ (NMSA 21486); Pietermaritzburg, Town Bush [29°36'S, 30°23'E], leg. R.F. Lawrence, IX–XI.1950, 2♂ (NMSA 5513); Same locality, southern slopes of Hogsback, 29°33'S, 30°21'E, 1000m a.s.l., leg. C.E. Griswold & T. Meikle-Griswold, 20.IX.1984 (Berlese extracted leaf litter, native forest), 1♂ (NMSA 24463).

Additional material examined: none.

Distribution: Known from the south-eastern parts of South Africa, mainly in the Pondoland-Albany Centre of Endemism, but also from the KwaZulu-Natal midlands (Fig. 76).

Biology: Specimens were mainly collected from the leaf litter layer of closed canopy Afromontane and coastal forest habitats.

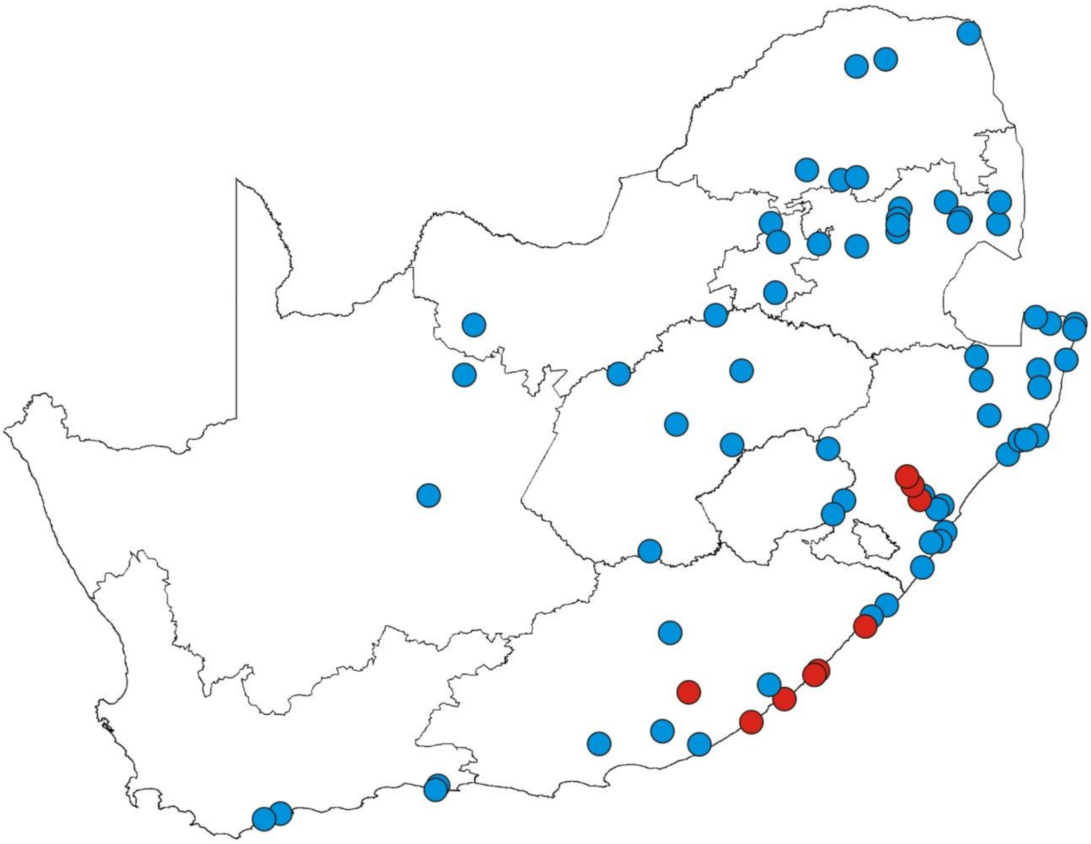


FIGURE 76. Map of South Africa indicating the distribution of *Copa flavoplumosa* Simon, 1885 (blue circles) and *C. kei* **sp. nov.** (red circles).

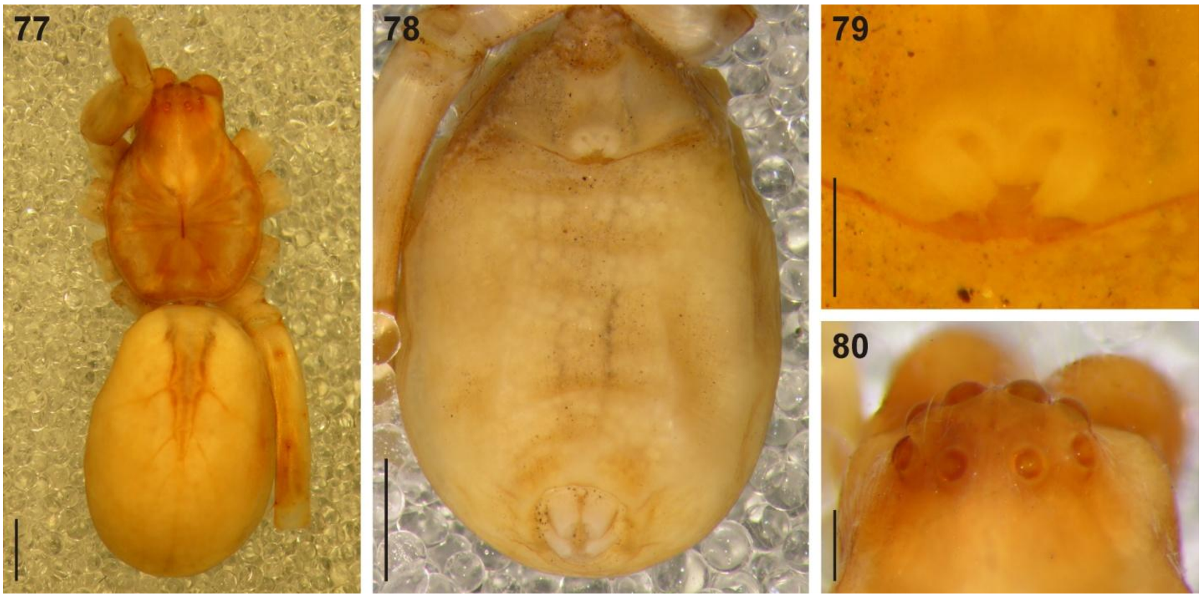
6.5 SPECIES *NOMEN DUBIUM*

6.5.1 *Copa agelenina* Simon, 1910

Figs 77–80

Copa agelenina Simon, 1910: 202 (Subadult ♀ holotype: **BOTSWANA:** Kalahari, Sekcoma [24°24'S, 23°53'E] – Khakea [24°42'S, 23°30'E], leg. L. Prueltje?, XI.1904, ZMB 28198 – examined).

Remarks: The holotype is a subadult female specimen (Figs 77–79), clearly with a pre-epigynum and lack of epigynal sclerotisation typical of adults, and is not an adult female as described by Simon (1910) and listed on Platnick (2011). The species is definitely different to *C. flavoplumosa* specimens collected in north-western South Africa (Sunnyside and Hermitage) and has a clearly broader PER (CW:PERW = 2.84:1 as opposed to 3.45:1 in *C.*



FIGURES 77–80. Digital microscope photographs of the holotype subadult female of *Copa agelenina* Simon, 1910: 77. dorsal habitus; 78. abdomen, ventral view; 79. pre-epigynum; 80. eye region, dorsal view. Scale bars: 77, 78 = 1.0mm; 79, 80 = 0.25mm.

flavoplumosa females) that is less strongly procurved than in *C. flavoplumosa* (compare Figs 7 and 80). Since no adult *Copa* material is available from the arid savanna of southern Botswana, it is impossible to match this specimen to either of the two continental species or to recognise it as a distinct species. I would therefore propose that *C. agelenina* be considered a species *nomen dubium*.

The eye arrangement and measurements suggest that this may be a species of *Copuetta* (see Chapter 11), but adults will have to be collected before the generic placement can be confirmed and the species be revalidated and redescribed.

6.6 DISCUSSION

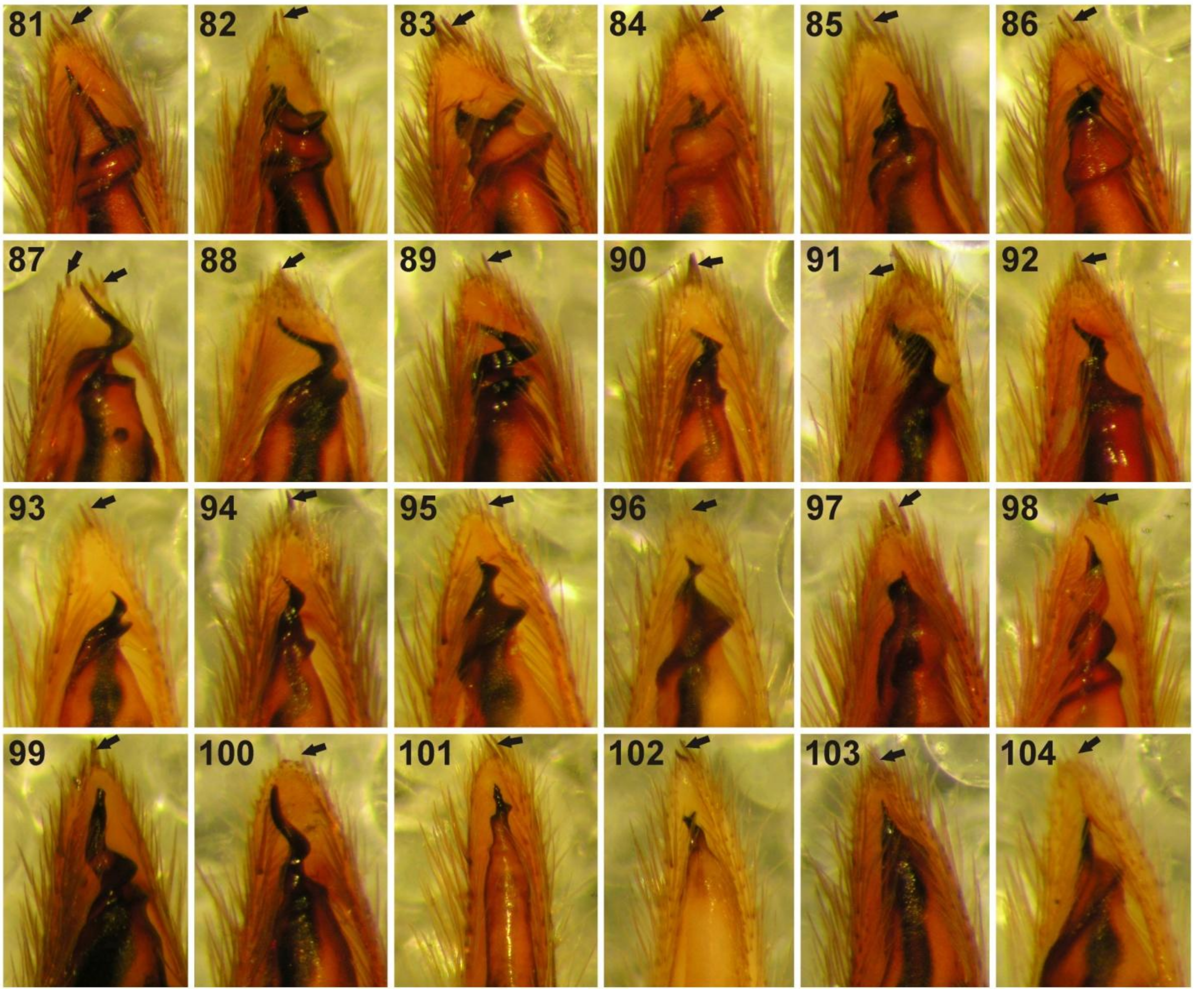
The current study treated the continental species of *Copa* in the Afrotropical Region, reducing the number of species from four to two, of which one species is newly described. The type species of the genus, *C. flavoplumosa*, is widespread throughout the region and includes three synonyms newly proposed here. It is distributed from Guineé in the west to Tanzania in the east, and from Nigeria in the north to South Africa in the south. The new species, *C. kei*, is endemic to south-eastern South Africa. While *C. flavoplumosa* provides a useful example of extreme habitat flexibility, occupying habitats from forests to semi-deserts, *C. kei* is very closely associated with Afromontane and coastal forests in South Africa. The latter species has a distribution falling entirely within the Maputaland-Pondoland-Albany Centre of Endemism in South Africa. Surprisingly, very few *C. flavoplumosa* records exist from the tropical rainforests of the D.R. Congo and Congo Republic, despite the former being one of the best sampled countries on the continent (Fig. 71).

Both species are clearly ground-dwelling leaf litter specialists and were mainly collected by pitfall trapping, litter sifting and hand collecting. *Copa flavoplumosa* may be very abundant in some habitats (e.g. forests in Ivory Coast), but they tend to be considerably less common in savannas and other habitat types (Modiba *et al.* 2005; Dippenaar-Schoeman & Wassenaar 2006; Foord *et al.* 2008; Haddad *et al.* 2010; Muelelwa *et al.* 2010). They have occasionally been collected in agroecosystems, specifically from the canopies of orchard crops in South Africa (avocadoes, macadamias and pistachios), but never exceed 2% of the total spider fauna (Dippenaar-Schoeman *et al.* 2001, 2005; Haddad *et al.* 2005). Their arboreal habits in agroecosystems are in stark contrast to their almost exclusive ground-dwelling in natural habitats, and the reasons for this ecological divergence are unknown.

While the Madagascan species of the genus were not treated in the present study, the rich undescribed fauna on the island prompts a brief discussion. Two described species are currently known from the island but the types of neither species could be traced. Those of *C. auroplumosa* Strand, 1907 (type locality: Nossibé) may possibly have been destroyed during World War II but were not housed in the Königlichen Naturalienkabinetts in Stuttgart, containing 169 of Strand's types that are confirmed to have been destroyed in their entirety (Renner 1988). They are not deposited in the Alexander Koenig Zoological Research Museum, Bonn (Huber & Lankhorst 2010), and could also not be traced in the Museum für Naturkunde, Humboldt University, Berlin or Senckenberg Museum, Frankfurt. The types of *C. lineata* Simon, 1903 (type locality not specified) could not be traced in MNHN, where most of his types were deposited, but amongst the rich diversity of *Copa* from the island only one species has characteristics of *C. lineata*, i.e. dark brown colouration with a cream median line running the length of the body. It might thus be possible to designate neotypes for this species, should the type series remain untraced when the fauna is studied in detail.

In addition to these two species, nearly 30 new species have been discovered on the island, largely due to the intensive sampling conducted there during the last three decades or so by staff of CAS, MRAC, BMNH, American Museum of Natural History in New York, and the Museum of Comparative Zoology, Harvard. Considering that only two species are now known from the African continent, this extreme degree of radiation on Madagascar is quite remarkable. The radiation of the Madagascan fauna has been coupled with considerable diversification in the structure of the male embolus (Figs 81–104), but has also lead to the evolution of two novel structures: 1) two or more distinct thickened setae distally on the male palpal cymbium (Figs 81–104), and 2) the evolution of single or multiple cymbial protuberances and, occasionally, also tibial protuberances (Figs 108, 109), which are absent from the two continental species and a few of the Madagascan species (Figs 105–107). These structures will be studied in more detail when the Madagascan fauna is revised, but they may play an important role as possible structures effecting sexual isolation through chemical transmission or detection (setae) and stridulatory structures (protuberances).

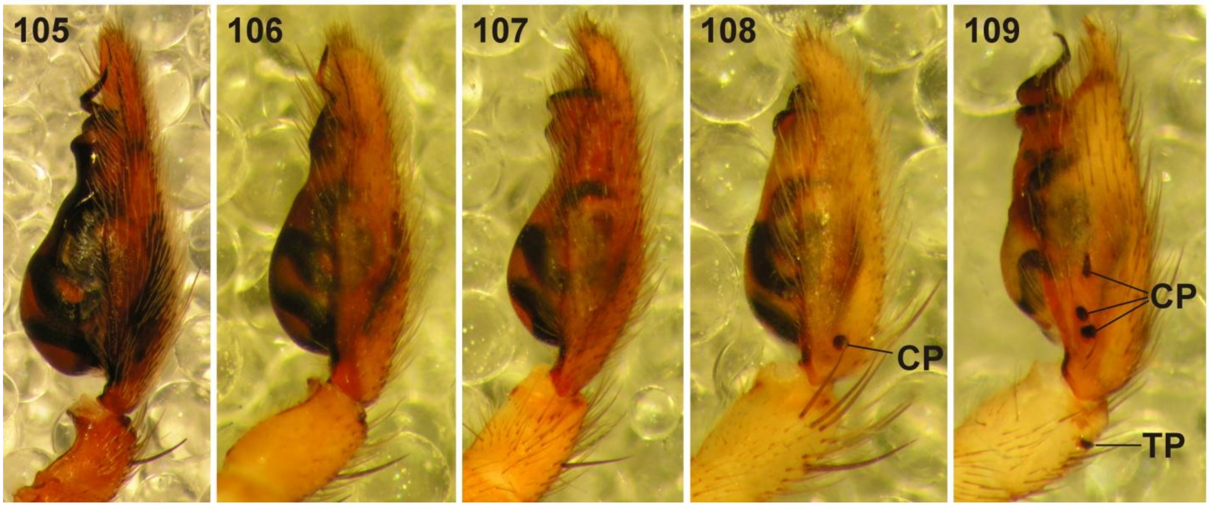
Yoder & Nowak (2006) reviewed a variety of phylogeographic studies to try and explain the high diversity and levels of endemism of Madagascan organisms, concluding that the diversity of a large portion of the taxa investigated can be attributed to Cenozoic dispersal



FIGURES 81–104. Digital microscope photographs of the male emboli of 24 species of *Copa* from Madagascar for which the males are known. Arrows indicate modified distal cymbial setae.

and a smaller portion due to vicariance. Cenozoic dispersal seems a plausible explanation for some web-building spiders such as *Anelosimus* Simon, 1891 (Theridiidae), which have diversified considerably on the island (Agnarsson & Kuntner 2005). In contrast, *Nephilengys* L. Koch, 1872 (Nephilidae) is represented by a single continental species, while the western Indian Ocean island fauna comprises a single endemic species on Madagascar that likely evolved following Cenozoic dispersal, and single endemic species each on Reunion and Mauritius that evolved on these isolated islands following colonisation from Madagascar (Kuntner & Agnarsson 2011*a*). In the case of *Nephila* Leach, 1815 (Nephilidae), Kuntner & Agnarsson (2011*b*) proposed that colonisation of Madagascar and the surrounding islands is also the consequence of Cenozoic dispersal. However, only *Nephila inaurata* (Walckenaer, 1842) has colonised these islands, no endemic species are recorded, and molecular data indicates that considerable gene flow occurs within Madagascar and between this island and the Comoros. This would suggest that *Nephila* is much better disperser than *Nephilengys*.

Taking vicariance theory into consideration, Madagascar was located next to East Africa in the vicinity of Kenya until it rifted off the African continent during the mid-Jurassic (*ca*. 170 Ma), together with India and the Seychelles (Torsvik & Van der Voo 2002). It is thus likely that *C. flavoplumosa*, which is widespread all along the eastern coast of Africa, is the ancestor of the Madagascan *Copa*. A few species from Madagascar have genitalic



FIGURES 105–109. Digital microscope photographs of the retrolateral view of the male palp of *Copa flavoplumosa* Simon, 1885 (105), *C. kei* **sp. nov.** (106) and three new species of *Copa* from Madagascar (107–109) to indicate the absence of palpal apophyses (105–107), presence of a single cymbial protuberance (108), and presence of multiple cymbial protuberances and a single tibial protuberance (109). Abbreviations: CP–cymbial protuberance(s); TP–tibial protuberance.

morphology that is somewhat similar in general plan to *C. flavoplumosa* (Figs 87–89), supporting ancestral links to the continental fauna. Two further species (Figs 99, 100) have genitalic morphology with a similar general plan to *C. kei*, suggesting that this species may have been more widespread during more ancient times and could also potentially be the ancestor to at least some of the Madagascan species.

Separation of Madagascar and India-Seychelles is estimated at 85 Ma (Torsvik & Van der Voo 2002). *Copa* are absent from the Seychelles, but their occurrence on the Indian subcontinent (i.e. Sri Lanka) and Madagascar indicates that a broad area of this ancient landmass was occupied by members of this genus prior to the period of Gondwanan vicariance. Dissanayake & Chandrajith (1999) suggested a strong connection between south-eastern Madagascar and Sri Lanka, rather than southern India, based on their mineral deposits. Such a connection could perhaps explain the presence of the genus on Madagascar and Sri Lanka and its apparent absence in India, but the possibility of undescribed species occurring in the latter cannot be ruled out. Alternately, *Copa* may have occurred on the Seychelles islands following their separation from the Indian subcontinent *ca*. 64 Ma (Royer & Coffin 1992), but have subsequently become extinct on these islands.

Briefly considering the continental fauna, *C. flavoplumosa* is very widespread and has broad ecological requirements, while *C. kei* is range restricted and primarily occupies forests. The two species therefore represent extremes regarding both vagility and ecological flexibility. Colonisation of Madagascar by *Copa* from continental Africa through Cenozoic dispersal seems an unlikely scenario, due to their primarily ground-dwelling habits and apparently very limited use of silk, even for dispersal. All of the species on Madagascar and Sri Lanka are endemic, often with narrow ranges, indicating that speciation is a result of isolation of populations over a very long time, together with low vagility that restricts gene flow, and possibly also very narrow ecological requirements. This situation is similar to that found in the genus *Eriauchenius* O. P.-Cambridge, 1881 (Archaeidae) on the island, which also has many endemics with small distribution ranges (Wood *et al*. 2007; Wood 2008). Therefore, the Madagascan and Sri Lankan endemics probably evolved through allopatric speciation (Vences *et al.* 2009), as could be proposed for *C. kei*. Together with the absence of *C. flavoplumosa* and *C. kei* from the islands, the possible allopatric speciation provides strong evidence against Cenozoic dispersal or more recent colonisation, as in the case of *Nephila* discussed above (Kuntner & Agnarsson 2011*b*). In the case of *Copa*, it seems that Gondwanan vicariance seems the most plausible explanation for the diversification of genus on these two islands.

Once the Madagascan fauna has been revised a cladistic analysis should also be performed to determine whether one or both of the continental species is ancestral to the Madagascan fauna. It would be useful to also include the two described Sri Lankan species (or more, if any new species are discovered there) to assess their origin too. Are they directly derived from a continental African ancestor, as are the Madagascan species, and do they therefore form part of the "Madagascan" radiation following Gondwanan vicariance? Alternately, are they descendants of one of the Madagascan species, i.e. evolved following the separation of Madagascar and India-Seychelles, and thus not direct descendants of *C. flavoplumosa* or *C. kei*? The absence of *Copa* and *Echinax* on the Seychelles, Comoros, Mascarenes and the Aldabra group of islands, the presence of a very diversified *Copa* fauna on Madagascar, and the presence of *Copuetta* on the Comoros only and not on Madagascar, Seychelles, Mascarenes and the Aldabra group of islands (see Chapter 11) indicates very diverse patterns of speciation and/or colonisation of the western Indian Ocean islands in these three cryptic castianeirine genera, and should be the subject of more detailed biogeographical studies in the future.

6.7 REFERENCES

AGNARSSON, I. & KUNTNER, M. 2005. Madagascar: An unexpected hotspot of social Anelosimus spider diversity (Araneae: Theridiidae). Systematic Entomology **30:** 575–592.

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.

DEELEMAN-REINHOLD, C.L. 1995. New or little known non-antmimicking spiders of the subfamily Castianeirinae from southeast Asia (Arachnida: Araneae: Clubionidae). *Beiträge zur Araneologie* **4:** 43–54.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual.* Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

DIPPENAAR-SCHOEMAN, A.S., VAN DEN BERG, A.M., VAN DEN BERG, M.A. & FOORD, S.H. 2005. Spiders in avocado orchards in the Mpumalanga Lowveld of South Africa: species diversity and abundance (Arachnida: Araneae). *African Plant Protection* **11:** 8–16.

DIPPENAAR-SCHOEMAN, A.S., VAN DEN BERG, M.A., VAN DEN BERG, A.M. & VAN DEN BERG, A. 2001. Spiders in macadamia orchards in the Mpumalanga Lowveld of South Africa: species diversity and abundance (Arachnida: Araneae). *African Plant Protection* **7:** 39–46.

DIPPENAAR-SCHOEMAN, A.S. & WASSENAAR, T.D. 2006. A checklist of spiders from the herbaceous layer of a coastal dune forest ecosystem at Richards Bay, KwaZulu-Natal, South Africa (Arachnida: Araneae). *African Invertebrates* **47:** 63–70.

DISSANAYAKE, C.B. & CHANDRAJITH, R. 1999. Sri Lanka–Madagascar Gondwana linkage: evidence for a pan-African mineral belt. *Journal of Geology* **107:** 223–235

FOORD, S.H., MAFADZA, M., DIPPENAAR-SCHOEMAN, A.S. & VAN RENSBURG, B.J. 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.

HADDAD, C.R. & BOSSELAERS, J. 2010. A revision of the genus *Medmassa* Simon, 1887 (Araneae: Corinnidae) in the Afrotropical Region. *Zootaxa* **2361**: 1–12.

HADDAD, C.R., DIPPENAAR-SCHOEMAN, A.S. & PEKÁR, S. 2005. Arboreal spiders (Arachnida: Araneae) in pistachio orchards in South Africa. *African Plant Protection* **11:** 32–41.

HADDAD, C.R., HONIBALL, A.S., DIPPENAAR-SCHOEMAN, A.S., SLOTOW, R. & VAN RENSBURG, B.J. 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.

HUBER, B.A. & LANKHORST, S. 2010. Non-insect arthropod types in the ZFMK collection, Bonn (Acari, Araneae, Scorpiones, Pantopoda, Amphipoda). *Bonn zoological Bulletin* **58:** 217–226.

KUNTNER, M. & AGNARSSON, I. 2011*a*. Biogeography and diversification of hermit spiders on Indian Ocean islands (Nephilidae: Nephilengys). Molecular Phylogenetics and Evolution **59:** 477–488.

KUNTNER, M. & AGNARSSON, I. 2011*b*. Phylogeography of a successful aerial disperser: the golden orb spider Nephila on Indian Ocean islands. BMC Evolutionary Biology 11: 119.

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

LESSERT, R. DE 1933. Araignées d'Angola. (Resultats de la Mission scientifique suisse en Angola 1928-1929). *Revue Suisse de Zoologie* **40:** 85–159.

MANSELL, M.W. 1996. The antlions of southern Africa (Neuroptera: Myrmeliontidae): genus *Palparellus* Navás, including extralimital species. *African Entomology* **4:** 239–267.

MODIBA, M.A., DIPPENAAR, S.M. & DIPPENAAR-SCHOEMAN, A.S. 2005. A checklist of spiders from Sovenga Hill, an inselberg in the Savanna Biome, Limpopo Province, South Africa (Arachnida: Araneae). *Koedoe* **48:** 109–115.

MUELELWA, M.I., FOORD, S.H., DIPPENAAR-SCHOEMAN, A.S. & STAM, E.M. 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.

PLATNICK, N.I. 2011. The World Spider Catalog, Version 12.0. American Museum of Natural History, New York. Available at: http://research.amnh.org/entomology/spiders/catalog; accessed 30 May 2011.

RENNER, F. 1988. Liste der im Krieg vernichteten Typen des Königlichen Naturalienkabinetts in Stuttgart, pp. 319–329. *In*: HAUPT, J. (ed.) Proceedings of the XI European Arachnological Colloquium, Technische Universität Berlin, Germany, 354 pp.

ROYER, J.-Y. & COFFIN, M.F. 1992. Jurassic to Eocene plate tectonic reconstructions in the Kerguelen Plateau region. *Proceedings of the Ocean Drilling Program, Scientific Results* **120:** 917–928.

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*. Tomé 1, pp. 1–192. Librairie Encyclopédique de Roret, Paris.

SIMON, E. 1903. Descriptions d'arachnides nouveaux de Madagascar, faisant partie des collections du Muséum. *Bulletin du Museum National d'Histoire Naturelle, Paris* **9:** 133–140.

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.

SIMON, E. 1910. Arachnoidea. Araneae (ii). In, Schultze, L., Zoologische und anthropologische Ergebnisse einer Forschungsreise im Westlichen und zentralen Südafrika. *Denkschriften der Medicinish – Naturwissenschaftlichen Gesellschaft zu Jena* **16:** 175–218.

STRAND, E. 1907. Diagnosen neuer Spinnen aus Madagaskar und Sansibar. *Zoologischer Anzeiger* **31:** 725–748.

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.

TORSVIK, T.H. & VAN DEN VOO, R. 2002. Refining Gondwana and Pangea palaeogeography: estimates of Phanerozoic non-dipole (octupole) fields. *Geophysical Journal International* **151:** 771–794.

VENCES, M., WOLLENBERG, K.C., VIEITES, D.R. & LEES, D.C. 2009. Madagascar as a model region of species diversification. *Trends in Ecology and Evolution* **24:** 456–465.

WOOD, H.M. 2008. A revision of the assassin spiders of the *Eriauchenius* gracilicollis group, a clade of spiders endemic to Madagascar (Araneae: Archaeidae). *Zoological Journal of the Linnean Society* **152:** 255–296.

WOOD, H.M., GRISWOLD, C.E., SPICER, G.S. 2007. Phylogenetic relationships within an endemic group of Malagasy ‘assassin spiders’ (Araneae, Archaeidae): ancestral character reconstruction, convergent evolution and biogeography. *Molecular Phylogenetics and Evolution* **45:** 612–619.

YODER, A.D. & NOWAK, M.D. 2006. Has vicariance or dispersal been the predominant biogeographic force in Madagascar? Only time will tell. *Annual Review of Ecology, Evolution and Systematics* **37:** 405–31.

CHAPTER 7

Corinnomma semiglabrum **(Simon, 1896), female (Ndumo Game Reserve, South Africa)**

A new species of *Corinnomma* Karsch, 1880 (Araneae: Corinnidae) from southern and eastern Africa, with taxonomic notes on *C. olivaceum* Simon, 1896 and *C. semiglabrum* (Simon, 1896)

[Published – Appendix A2]

7.1 ABSTRACT

The Afrotropical species of the ant-mimicking castianeirine genus *Corinnomma* Karsch (Araneae: Corinnidae) are studied. The female of *Apochinomma semiglabrum* Simon, 1896 is redescribed and the male is described for the first time, and based on these descriptions this species is transferred to *Corinnomma*. A new species, *C. lawrencei* **sp. nov.**, is described from Mozambique, Tanzania and South Africa. The taxonomic status of *C. olivaceum* Simon, 1896 is discussed, including the first illustrations of the female genitalic structures. An English transcription of Simon's (1896) Latin description of *C. olivaceum* is provided. A key to the three known species of *Corinnomma* occurring in the region is given. The biology and ant mimicry of *C. semiglabrum* and *C. lawrencei* **sp. nov.** are briefly discussed. Both species occur on the ground, leaf litter or low foliage, and have colouration and behavioural traits that make them particularly efficient mimics of *Polyrachis gagates* Smith, 1858 ants. Neither species appears to feed on their model.

7.2 INTRODUCTION

The genus *Corinnomma* Karsch, 1880 is one of eight genera included in the subfamily Castianeirinae (Araneae: Corinnidae) occurring in the Afrotropical Region (Dippenaar-Schoeman & Jocqué 1997; Bosselaers & Jocqué 2000). This genus is poorly known in Africa, and only a single species, *C. olivaceum* Simon, 1896 from Ethiopia, has been described to date (Simon 1896). All known species are believed to be ant-mimics (Deeleman-Reinhold 2001), with many species occurring in South-East Asia. These species have been studied recently by Deeleman-Reinhold (1992, 2001).

In this chapter, the species complement of Afrotropical *Corinnomma* is increased to three through the description of a new species and the transfer of *Apochinomma semiglabrum* Simon, 1896 to *Corinnomma*. The genus *Apochinomma* Pavesi, 1881 in the Afrotropical Region is consequently reduced to the type species, *A. formicaeforme* Pavesi, 1881. This is the second paper in a series on the Afrotropical Castianeirinae, and follows the revision of the genus *Graptartia* Simon, 1896 (Haddad 2004).

7.3 MATERIAL & METHODS

All specimens were observed for description under a stereo microscope in 70% ethanol. The epigynes of *C. semiglabrum* and paratypes of *C. lawrencei* **sp. nov.** were dissected, cleared for eight minutes in a Branson 3200 ultrasonic bath in 70% ethanol, and observed in 70% ethanol. No fresh material of *C. olivaceum* was available for study, and the holotype remains undissected. All measurements are provided in millimetres (mm), with a range of extremes given for body measurements of the largest and smallest specimens of each species. Leg lengths and eye interdistances are provided for the largest specimens of each sex. Leg spination in the descriptions of *C. semiglabrum* and *C. lawrencei* **sp. nov.** follows the format of Bosselaers & Jocqué (2000), and genitalic morphology follows Haddad (2004).

The following abbreviations are used in the text: AER – anterior eye row; AL – abdomen length; ALE – anterior lateral eye; AME – anterior median eye; AW – abdomen width; CL – carapace length; CW – carapace width; do – dorsal; dtr – dorsal trichobothriae; FL – fovea length; PER – posterior eye row; pl – prolateral; PLE – posterior lateral eye; plv – prolateral ventral; PME – posterior median eye; rl – retrolateral; rlv – retrolateral ventral; SL – sternum length; ST – spermatheca; SW – sternum width; TL – total length; vt – ventral terminal.

Material for scanning electron microscopy was dehydrated through a graded ethanol series and then critical-point dried in an argon chamber. Specimens were mounted on stubs, sputter-coated three times with gold for 2 minutes, and studied in a JEOL WinSEM at 10 kV. Digitised micrographs were taken of the male emboli.

Holotype and paratype label data are quoted as they appear. A slash (/) indicates the end of a line of print, and two slashes (//) signify data on a further label. Significant supplementary or qualifying information is presented in square parentheses when considered necessary.

Material used in this study is deposited in the following institutions (curators are named in parentheses):

MNHN – Muséum National d'Histoire Naturelle, Paris, France (C. Rollard)
NCA – National Collection of Arachnida, ARC – PPRI, Pretoria, South Africa (A. Dippenaar-Schoeman)
NMZ – National Museum of Zimbabwe, Bulawayo, Zimbabwe (M. FitzPatrick)
SAMC – South African Museum, Cape Town, South Africa (M. Cochrane)

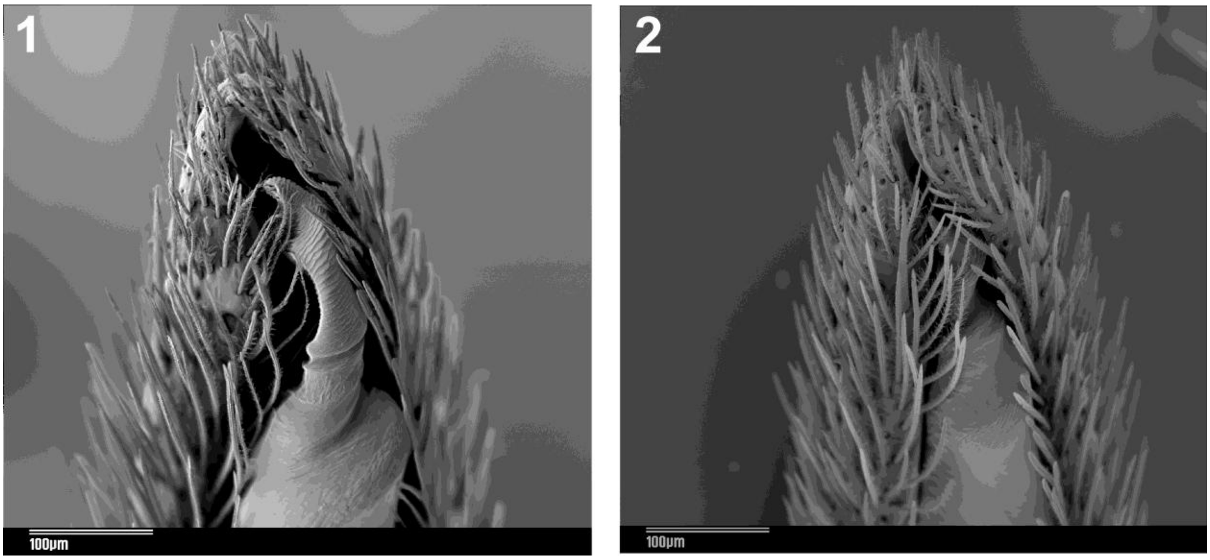
7.4 GENUS *CORINNOMMA* KARSCH, 1880

Corinnomma Karsch, 1880: 374; Deeleman-Reinhold, 2001: 316; Haddad 2006: 72.

Type species: *Corinnomma severum* (Thorell, 1877), by original designation.

Diagnosis: The Afrotropical *Corinnomma* species studied differ from the Asian species, which have a procurved PER, by having a recurved PER. Otherwise, colouration and morphology are similar to the Asian species. The eye characteristics are shared with Afrotropical species of *Apochinomma* and *Merenius* Simon, 1910. The PER of *Apochinomma* differs from Afrotropical *Corinnomma* by being very strongly recurved with the eyes small and separated by approximately four times their diameter, while *Corinnomma* has relatively larger eyes situated more closely together. *Apochinomma* also have a cephalothorax that is twice as long as wide, as well as a globose abdomen, which differs from the more compactly built *Corinnomma*. Afrotropical *Corinnomma* are more similar to *Merenius*, having similar eye arrangements and somatic morphology. *Corinnomma* are different by having a dark silver grey colouration with black transverse bands on the abdomen, while *Merenius* have dark grey to black colouration with a median white or cream marking running the length of the abdomen.

Description: Medium-sized spiders, 5.5–8mm in length; female more robustly built than male. Carapace narrow in ocular region, broadest at midpoint, narrowest posteriorly; AER procurved or straight, medians sometimes slightly larger than laterals; PER slightly recurved, eyes subequal in size; colouration black, covered with silvery-grey plumose setae and black straight setae; surface finely wrinkled. Chelicerae with two promarginal and two retromarginal teeth. Sternum shield-shaped, dark-brown to black. Leg formula 4123; legs with several short stout spines and straight setae; plumose setae scattered on femora and tibiae; scopulae well developed on metatarsi and tarsi; well developed paired tarsal claws with dense claw tufts; proximal leg segments black with yellow bands or stripes, metatarsi brown and tarsi yellow. Abdomen oval, broadest in posterior third; dorsal scutum entire in males, extending to two-thirds abdomen length in females; integument dark brown, densely covered with silver-grey plumose setae, interspersed with short straight black setae; three or four black bands, comprising black plumose setae, in anterior two-thirds of abdomen, simulating abdominal segments of ant models; bands prominent dorsally, extending laterally, fusing ventrally; inframamillary sclerite absent in females, present in males. Spinnerets in close group, anterior lateral spinnerets largest, sub-conical. Female with paired copulatory openings situated laterally in sclerotised epigyne; copulatory openings situated in broad or narrow curved ridge; entrance ducts short, curving towards anterior spermathecae; spermathecae large and oval, terminal receptacles kidney-shaped. Male palp typically castianeirine; cymbium compact and quite broad, covered dorsally with short straight black setae interspersed with thickened setae; bulbus compact and pear-shaped, bulging prolaterally, with internal ducts visible through integument; median apophysis absent; embolus thickened and long, often formed on a stalk, with variable distal structure, either claw-like or with a single compact coil (Figs 1, 2).



FIGURES 1–2. Scanning electron micrographs of male emboli of Afrotropical *Corinnomma* species: 1. *C. semiglabrum* (Simon, 1896); 2. *C. lawrencei* **sp. nov.**

Key to the Afrotropical species of *Corinnomma*

1 Entrance ducts of female epigyne initially directed anteriorly (Fig. 17); PME–PME distance nearly double PME–PLE distance...............................*C. olivaceum* Simon, 1896

– Entrance ducts of female epigyne initially directed medially or posteriorly; PME–PME distance less than 1.5 times PME–PLE distance...2

2 Entrance ducts of female epigyne in a U-shape, initially directed posteriorly, then medially and anteriorly (Figs 5–7); male palpal embolus on an extended stalk, claw-like (Fig. 1); female CL to CW ratio 3:2....................................*C. semiglabrum* (Simon, 1896)

– Entrance ducts of female epigyne initially directed medially (Figs 12, 13); male palpal embolus originating on a short stalk, with a single compact coil (Fig. 2); female CL to CW ratio nearly 5:3...*C. lawrencei* **sp. nov.**

7.4.1 *Corinnomma semiglabrum* (Simon, 1896)

Figs 1, 3–9

Apochinomma semiglabrum Simon 1896: 409 (♀ holotype: two labels accompany the types: '16961 Ap. semiglabrum E.S. / Makapan! // 16961', MNHN 16961 – examined) **comb. nov.**

Diagnosis: This species is recognised by the large, semi-circular depressions in which the copulatory openings are found, and by the U-shaped entrance ducts of the epigyne. The male can be recognised easily by the claw-like palpal embolus, which is distinctively coiled in other species.

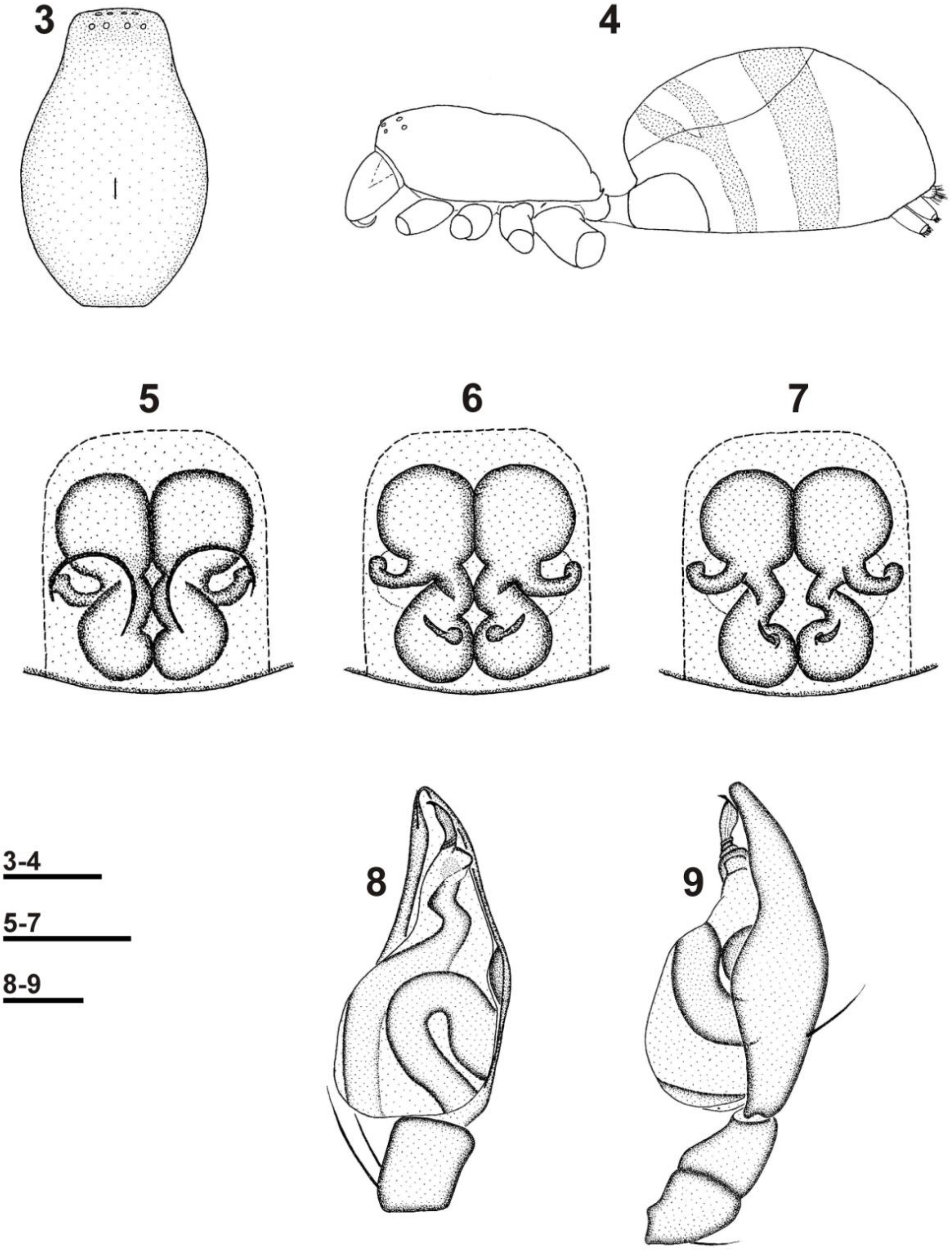
Female. Measurements: CL 2.9–3.5, CW 1.9–2.2, AL 3.6–3.8, AW 2.6–2.8, TL 7.1–7.9, FL 0.18–0.25, SL 1.43–1.65, SW 0.98–1.1. Interdistances between eyes: AME–AME 0.10, AME–ALE 0.07, ALE–ALE 0.44, PME–PME 0.20, PME–PLE 0.16, PLE–PLE 0.74.

Length of leg segments (sequence from femur to tarsus, and total): I 2.30 + 0.90 + 2.25 + 1.93 + 1.30 = 8.68; II 2.05 + 1.00 + 1.75 +1.65 + 1.20 = 8.10; III 1.95 + 0.90 +1.35 + 1.75 + 0.85 = 6.80; IV 2.45 + 0.90 +2.25 + 2.55 + 0.83 = 8.98.

Carapace dark brown to nearly black, finely wrinkled, clothed in very short white setae; elongate, broadest at midpoint (Fig. 3); highest at nearly one-third its length (Fig. 4). Fovea distinct, located slightly posterior to carapace midpoint; striae black, radiating outwards from fovea, fused to black markings laterally on carapace. AER procurved, eyes subequal in size; PER very slightly recurved, laterals very slightly larger than medians; all eyes surrounded by black rings; scattered long white setae on clypeus. Chelicerae dark brown, bulging very slightly beyond anterior margin of carapace (Fig. 4); long white setae on prolateral margin, scattered between short white setae; two teeth on promargin, proximal tooth bifid with single base; two simple teeth on retromargin. Sternum dark brown, nearly black, with faint black mottling; surface slightly granular; densely clothed with short white setae medially, and longer white setae near margins; single long black seta on sternum near each coxal base. Femora I and II dark brown in proximal half, yellow distally; dark brown do stripe extending to end of femora; femur II with second pl stripe extending to three-quarters femur length; femora III and IV dark brown, with yellow marking pl at distal end. Patella I yellow with dark brown rlv stripe; patella II yellow with brown plv and rlv stripes; patellae III and IV dark brown. Tibiae I and II yellow do with brown median stripe, brown vt with yellow median stripe; tibiae III and IV dark brown. All metatarsi brown, with yellow distal tips. All tarsi yellow, brown in do promixal half; black markings on legs comprising plumose setae. Leg spination as follows: femora: I pl 1 do 3, II do 3, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; patellae: all with 1 distal dtr; tibiae: I plv 3 rlv 2, II plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 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 3 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 2; all tibiae and metatarsi with numerous dtr, increasing in size distally. Palp dark brown; palpal spination: femora do 1, patellae pl 1 do 1, tibiae pl 2 do 1, tarsi pl 2 (basal) pl 1 (median) vt 2. Single small terminal pectinate claw. Abdomen oval, slightly globose, integument grey, broadest at two-thirds its length; leathery dorsal scutum present, dark red-brown, quite narrow, extending to two-thirds abdomen length; inframamillary sclerite absent; dorsum densely covered with short white setae; three black bands comprising plumose setae; first at front of abdomen, second at one-quarter abdomen length, third at half abdomen length; first and second bands fusing laterally at second band (Fig. 4). Genitalic area and booklungs dark red-brown to nearly black, strongly sclerotised. Epigyne with copulatory openings situated laterally, anterior to lateral midline of epigyne, situated in semi-circular depression with strong anteromedian ridges (Fig. 5); entrance ducts running in a U-shape, initially directed posteriorly, running medially and anteriorly; spermathecae round, with bean-shaped terminal receptacles that touch or are slightly separated medially (Figs 6, 7).

Male. Measurements: CL 2.65–3.60, CW 1.79–2.35, AL 2.60–3.35, AW 1.40–1.90, TL 5.50–7.45, FL 0.23–0.26, SL 1.28–1.58, SW 0.90–1.05. Interdistances between eyes: AME–AME 0.12, AME–ALE 0.60, ALE–ALE 0.42, PME–PME 0.20, PME–PLE 0.15, PLE–PLE 0.73.

Length of leg segments (sequence from femur to tarsus, and total): I 2.00 + 0.70 + 2.15 + 1.85 + 1.54 = 8.24; II 1.80 + 0.75 + 1.65 + 1.55 + 1.05 = 6.8; III 1.85 + 0.80 + 1.50 + 1.75 + 0.80 = 6.7; IV 2.80 + 0.97 + 2.50 + 3.05 + 1.20 = 10.52.



FIGURES 3–9. *Corinnomma semiglabrum* (Simon, 1896): 3. female cephalothorax, dorsal view; 4. female general habitus, lateral view; 5. female (Tembe), epigyne, ventral view; 6. female (Tembe), vulva, dorsal view; 7. female (Lewombo), variation of vulva, dorsal view; 8. male (Bulawayo), left palp, ventral view; 9. male (Bulawayo), retrolateral view. Scale bars: 3, 4 = 1.0 mm; 5–9 = 0.25 mm.

General habitus similar to female described above; male less robust than female; abdomen more elongate and narrow, broadest at three-quarters its length; dorsal scutum covering entire dorsum; inframamillary sclerite present, rectangular, extending from epigastric furrow to in front of spinnerets. Markings on legs less distinct than for female. Leg spination as follows: femora: I pl 1 do 3, II do 3, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; patellae: all with 1 distal dtr; tibiae: I plv 2 rlv 2, II plv 1 rlv 2, III pl 2 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 1 rlv 2, III pl 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3; all tibiae and metatarsi with numerous dtr, increasing in size distally. Palpal spination: femora pl 1 do 2, patellae pl 1, tibiae pl 2, tarsi do 1 pl 2 plv 1. Male palp lacking retrolateral tibial apophysis; palpal tarsus compact; cymbium uniform red-brown; bulbus red-brown, somewhat square prolaterally; embolus claw-like, curving prolaterally, with a single, indistinct coil (Figs 1, 8, 9).

Additional material examined: SOUTH AFRICA: *Gauteng Province*: Crocodile River, Hartebeespoortdam, leg. A. Leroy, 13.XII.1991 (collected from shrubs and trees), 1♀ (NCA 92/444); Florida, Johannesburg, XII.1918, R. Tucker, 1♀ (SAMC B6518). *KwaZulu-Natal Province*: Greater St Lucia Wetlands Park, Hell's Gate, Block B, leg. J. Esterhuizen, 29.XI.2004 (tsetse fly traps), 1♂ (NCA 2005/2026); Lewombo mission, Zululand, leg. P. Reavell, 15.X.1977 (under bricks), 1♀ (NCA 2000/286); Ndumo Game Reserve, Pongola River floodplain, 26º53'S, 32º18'E, leg. C. Haddad, 12.II.2005 (leaf litter with *Anoplolepis custodiens* and *Polyrachis gagates* ants), 2♂ 1♀ (NCA 2005/48); Tembe Elephant Park, Open woodland-sand, 27º03'S, 32º25'E, leg. C. Haddad, 14.I.2002 (under log with *Polyrhachis gagates* ants), 1♀ (NCA 2004/480); Same locality, leg. C. Haddad, 20.I.2002 (under log with *Polyrhachis gagates* ants), 1♂ (NCA 2004/479). *Limpopo Province*: Gunfontein, 2428A2, leg. Falcon College & C.A. Car, 11.XII.1979, 1♀ (NMZ 1377); Klein Kariba, near Warmbaths, leg. A. Leroy, 27.XI.1996 (running on ground), 1♂ (NCA 2004/831); Settlers, Tuinplaas, Springbokvlake (Lodge), leg. M. van Jaarsveld, 6.II.2002 (pitfall traps, grass), 1♀ (NCA 2003/1331); Same locality, leg. M. van Jaarsveld, 6.II.2002 (pitfall traps, grass), 1♀ (NCA 2003/1335); Wolkberg Nature Reserve, near Haenertsberg, leg. J. Leeming, 21.XII.1994 (leaf litter), 3♂ (NCA 2004/832). **SWAZILAND:** Lugaganeni, leg. A. Monadjem, 29.XII.1998, 1♂ (NCA 2004/828). **ZIMBABWE:** Bulawayo, Hillcrest, 2028B1, leg. L.H.B. Morris, 12.II.1991, 1♂ (NMZ 8746); Bulawayo, Hillside, 20º10'S, 28º55'E, leg. J.L. Minshull, III.1986, 1♀ (NMZ 4341); Same locality, leg. M. FitzPatrick, II.1999 (pitfall traps), 3♀ (NMZ 13838); Same locality, leg. M. FitzPatrick, III.1999 (pitfall traps), 2♀ (NMZ 13863); Same locality, leg. M. FitzPatrick, II.1999 (pitfall traps), 4♂ 3♀ (NMZ 13851); Bulawayo, Natural History Museum, 2028B1, leg. I. Minshull, 13.XI.1985, 1♀ (NMZ 5384); Chiredzi, 2131B1, leg. S. Higgins, 16.XII.1979, 1♂ (NMZ 809); Nungu Farm, Girls College, 20º30'S, 28º29'E, leg. Natural History Museum of Zimbabwe staff, 9–12.II.1999 (sweeping), 1♀ (NMZ 13712).

Distribution: Found in the northern and north-eastern parts of South Africa, Swaziland, and in the southern and south-eastern parts of Zimbabwe (Fig. 18). Specimens have also been collected from Harare, Zimbabwe (M. Cumming, personal collection).

Biology: The bulk of the *C. semiglabrum* material examined was collected in pitfall traps or leaf litter, indicating that this is a primarily epigeic species. Observations of the species were conducted in the Tembe Elephant Park and Ndumo Game Reserve in South Africa, where it was found under logs, in leaf litter and in low foliage with the large silver-grey ant *Polyrhachis gagates* Smith, 1858 (Hymenoptera: Formicidae), which it mimics. At Ndumo, this species was also found near a colony of *Anoplolepis custodiens* (Smith, 1858) ants, with a few *P. gagates* ants in the near vicinity. The ant-mimicking *Apochinomma formicaeforme* was also found in association with this ant. Both species appear silver-grey in appearance, an effect which is achieved by silvery-white setae on the abdomens of these species. In *C. semiglabrum*, the mimicry effect is enhanced by three black transverse bands on the abdomen, which resemble the abdominal segments of their model. In *A. formicaeforme*, the carapace is much more elongate and the abdomen more globose, creating a better illusion than in *C. semiglabrum*. A single egg sac was produced by a captured female. It was round, constructed of tough, papery creamy-yellow silk (typical for Castianeirinae), and was 8.8mm in diameter. This sac contained 16 oval, cream eggs.

7.4.2 *Corinnomma lawrencei* sp. nov.

Figs 2, 10–15

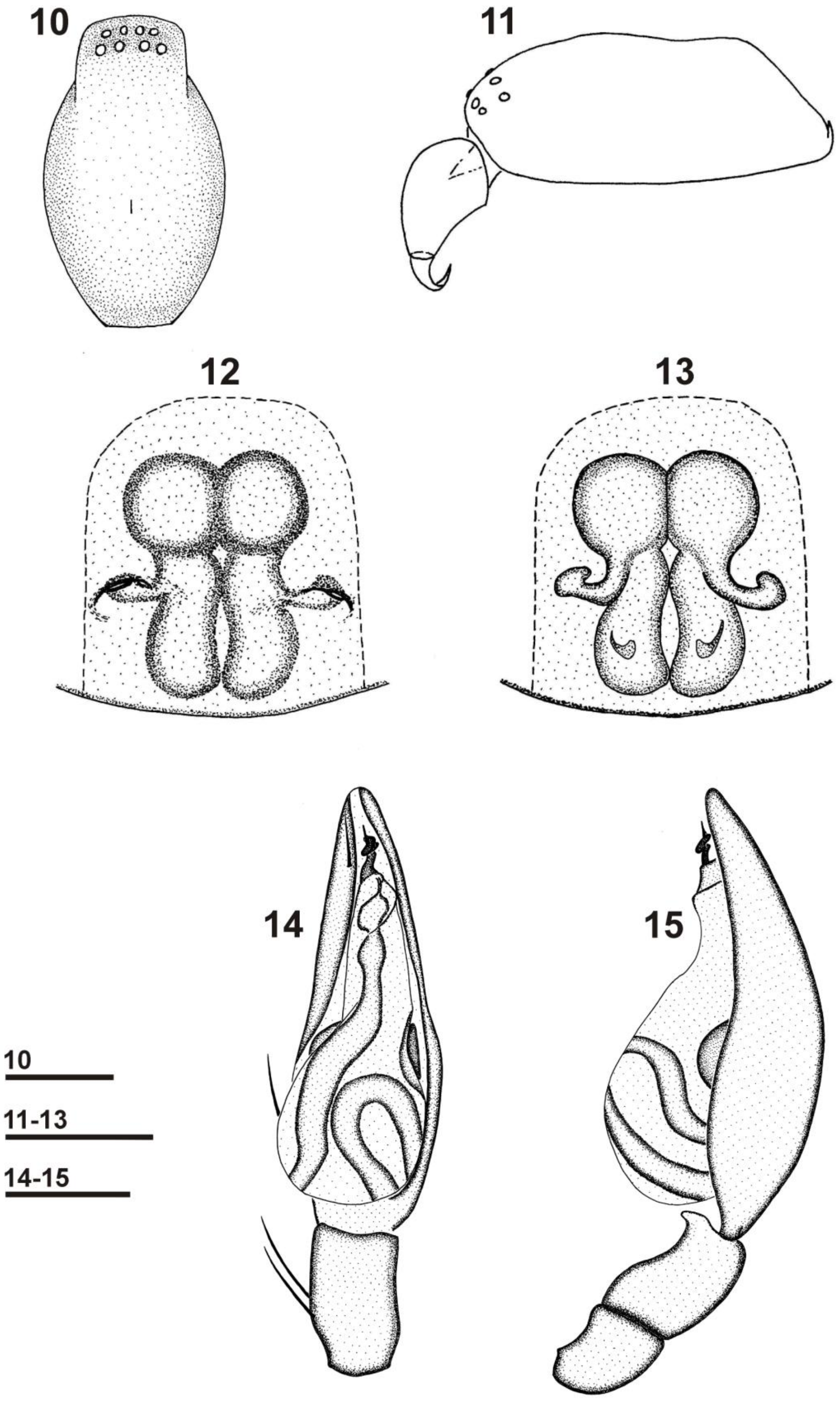
Etymology: This species is named in honour of Dr R.F. Lawrence, prominent arachnologist of the last century and collector of part of the type series.

Diagnosis: This species is distinguished from others in the genus by the small epigyne and the medially directed entrance ducts. Judging from epigyne shape, *C. lawrencei* **sp. nov.** appears most closely related to *C. thorelli* Simon, 1905. It can be distinguished by the distinct separation of the terminal receptacles of the spermathecae, which are directed medially; those of *C. thorelli* lie against each other and are directed laterally (Deeleman-Reinhold 2001).

Description: Female. Measurements: CL 3.40–3.85, CW 2.15–2.30, AL 3.60–4.10, AW 2.40–2.70, TL 7.40–8.10, FL 0.35–0.40, SL 1.60–1.78, SW 1.13–1.20. Interdistances between eyes: AME–AME 0.13, AME–ALE 0.07, ALE–ALE 0.52, PME–PME 0.23, PME–PLE 0.20, PLE–PLE 0.83.

Length of leg segments (sequence from femur to tarsus, and total): I 2.35 + 0.88 + 2.30 + 1.90 + 1.35 = 8.78; II 2.23 + 0.85 + 1.88 + 1.68 + 1.20 = 7.84; III 2.00 + 0.90 + 1.68 + 1.78 + 0.93 = 7.29; III 3.00 + 1.15 + 2.80 + 3.05 + 1.15 = 11.15.

Carapace dark brown to nearly black, finely wrinkled, clothed in very short white setae; elongate, broadest at midpoint (Fig. 10); highest at nearly one-third its length (Fig. 11). Fovea distinct, located slightly posterior to carapace midpoint; striae black, radiating outwards from fovea, fused to black markings laterally on carapace. AER straight, median eyes larger; PER slightly recurved, eyes similar in size; all eyes surrounded by black rings; scattered white plumose setae on clypeus. Chelicerae bulging slightly (Fig. 11), dark brown; long, pale setae on prolateral margin with scattered short white setae between; two teeth on promargin, proximal tooth bifid with single base; two simple teeth on retromargin. Sternum dark brown, nearly black, with faint black mottling; surface slightly granular; densely clothed with short white setae medially, and longer white setae near margins; single long erect black seta on sternum near each coxal base. Femora I dark brown to black in proximal half, yellow distally; dark brown do stripe extending to end of femora; femur II entirely black dorsally, yellow at distal end; femora III and IV dark brown, with yellow marking pl at distal end. Patella I and II yellow with dark brown plv and rlv stripes; patellae III and IV dark brown. Tibiae I and II yellow dorsally with brown median stripe, yellow ventrally with brown plv and rlv stripes; tibiae III and IV dark brown. All metatarsi brown, with yellow distal tips. All tarsi orange-brown, darker in dorsal promixal half; black markings on legs comprising plumose setae. Leg spination as follows: femora: I pl 1 do 3, II do 3, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; patellae: all patellae with distal do tr; tibiae: I plv 3 rlv 1-2, II plv 1-2 rlv 1-2, 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, 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. Palp dark brown, nearly black; palpal spination: femora pl 1 do 2 rlv 4, patellae pl 1 do 1, tibiae pl 2 do 2, tarsi pl 1 do 1 rl 1. Single small terminal pectinate claw. Abdomen oval, slightly globose, integument grey, broadest at two-thirds its length; leathery dorsal scutum present, dark red- brown, narrow, extending to two-thirds abdomen length; inframamillary sclerite absent; dorsum densely covered with short white setae; four black bands comprising plumose setae; first at front of abdomen, extending to epigastric sclerite; second at one-sixth abdomen length and third at one-third abdomen length, both fusing laterally at third band; fourth band broadest, extending from half to two-thirds



FIGURES 10–15. *Corinnomma lawrencei* **sp. nov.**, paratypes: 10. female cephalothorax, dorsal view; 11. female general appearance, lateral view; 12. female (Inhambane), epigyne, ventral view; 13. female (Inhambane), vulva, dorsal view; 14. male (Ndumo), left palp, ventral view; 15. male (Ndumo), retrolateral view. Scale bars: 10, 11 = 1.0 mm; 12–15 = 0.25 mm.

abdomen length (Fig. 11). Genitalic area and booklungs dark red-brown to nearly black, strongly sclerotised. Epigyne with copulatory openings situated laterally (Fig. 12), approximately at midpoint of epigyne; entrance ducts initially directed medially, curving upwards to spermathecae (Fig. 12). Spermathecae round with bean-shaped terminal receptaculae (Fig. 13).

Male. Measurements: CL 2.70–2.90, CW 1.75–1.83, AL 2.90–3.00, AW 1.50–1.60, TL 5.80–5.95, FL 0.25–0.28, SL 1.20–1.23, SW 3.55–3.60. Interdistances between eyes: AME–AME 0.10, AME–ALE 0.05, ALE–ALE 0.39, PME–PME 0.17, PME–PLE 0.14, PLE–PLE 0.64.

Length of leg segments (sequence from femur to tarsus, and total): I 1.83 + 0.63 + 1.78 + 1.70 + 1.33 = 7.27; II 1.60 + 0.70 + 1.43 + 1.45 + 1.05 = 6.23; III 1.48 + 0.68 + 1.28 + 1.55 + 0.80 = 5.79; IV 2.48 + 0.88 + 2.23 + 2.70 + 1.05 = 9.34.

General habitus similar to female described above; male less robust than female; abdomen elongate and narrow, broadest at three-quarters its length; dorsal scutum covering entire dorsum; inframamillary sclerite present, rectangular, extending from epigastric furrow to in front of spinnerets. Markings on legs less distinct than for female. Leg spination as follows: femora: I pl 1 do 3, II do 3, III pl 2 do 3 rl 1-2, IV pl 2 do 3 rl 1; patellae: all with 1 distal dtr; tibiae: I plv 2 rlv 1, II plv 2 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, II plv 2 rlv 2, III pl 3 rl 3 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 2-3 rlv 2 vt 3; all tibiae and metatarsi with numerous dtr, increasing in size distally. Palpal spination: femora pl 1 do 2; patella pl 1, tibiae pl 2, tarsi pl 2 plv 1. Male palp without retrolateral tibial apophysis; palpal tarsus compact; cymbium dark brown, paler distally; bulbus red-brown, rounded prolaterally; embolus prolaterally on bulbus, with short thin stalk and one and a half short compact coils (Figs 2, 14, 15).

Type material: Holotype ♀: ‘Mozambique / Maxixe, Inhambane / 23°52'S 35°23'E / Dec. 1923 / R.F. Lawrence // Clubionidae / South African Museum / Cape Town / B7159 //’ (SAM B7159).

Paratypes: 1♀ Same data and depository as holotype. 2♂ 2♀ ‘R.S.A., Ndumo Game Reserve / Pongola River Floodplain / 26°53'21.7"S 32°18'53.5"E / 09.II.2005 / C. Haddad (Leaf litter) //’ (NCA 2005/45).

Additional material examined: 1 juvenile same data and depository as holotype. **SOUTH AFRICA:** *Limpopo Province*: Lajuma, Short Forest 3, 23º02.165'S, 29º26.985'E, leg. M. Mafadza, 27.XI.2004 (active searching), 2♂ 1♀ (NCA 2005/2018); Same locality, Short Forest 4, 23º02.388'S, 29º26.398'E, leg. M. Mafadza, 27.XI.2004 (active searching), 2♂ (NCA 2005/2017). **TANZANIA:** Udzungwa Mountain National Park, leg. G. Callaham, X.2001 (hand collecting), 1♀ (NCA 2005/2030).

Distribution: Found in the eastern regions of Tanzania, Mozambique and South Africa (Fig. 18).

Biology: This species was found near a nest of *Anoplolepis custodiens* ants in Ndumo Game Reserve, together with *C. semiglabrum*, a *Castianeira* species, *Merenius alberti* Lessert, 1923 and *P. gagates* ants, which it mimics. Initial feeding trials in the laboratory with two male *C. lawrencei* indicate that they do not feed on workers of *A. custodiens* or *P. gagates*, and within the restricted confines of a Petri dish, both spiders were badly injured by the ants, losing several legs. This species is almost identical to *C. semiglabrum* in general appearance, and the two species can only be separated by genitalic and eye characteristics. Adaptations for mimicry of *P. gagates* are similar to those described for *C. semiglabrum* above.

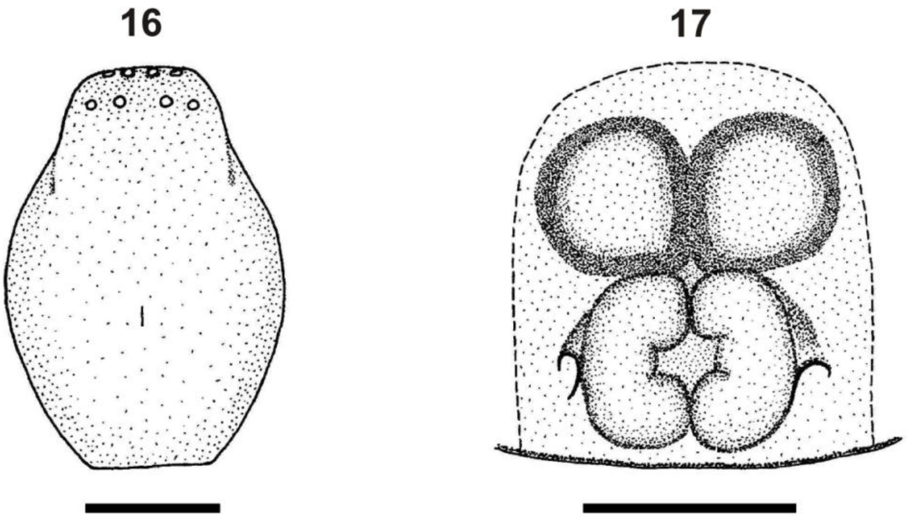
7.4.3 *Corinnomma olivaceum* Simon, 1896

Figs 16, 17

Corinnomma olivaceum Simon, 1896: 403 (♀ holotype: two labels accompany the types: 'Abyssinia, E. Simon, 3405 // C. olivaceum E.S.', MNHN 3405 – examined).

Diagnosis: This species can be recognised by PME–PME eye interdistance, which is greater than in the other two species (Fig. 16), and the entrance ducts, which are directed anteriorly (Fig. 17).

Remarks: On examination of the holotype of *C. olivaceum* and study of Simon's (1896) description of the species, it is clearly evident that the specimen has faded dramatically to an orange colour. Unfortunately, no fresh material of this Ethiopian species was available for examination. Consequently, a translation of the original description is provided, which will describe more accurately specimens found in nature. Where doubts arise as to the meaning of Simon's Latin wording, comments have been included in square brackets. Both second legs of the holotype are missing.



FIGURES 16–17. *Corinnomma olivaceum* Simon, 1896 holotype: 16. cephalothorax, dorsal view; 17. female epigyne, ventral view. Scale bars: 16 = 1.0 mm; 17 = 0.3 mm.

Female. Measurements: CL 3.03, CW 2.03, AL 3.10, AW 1.88, TL 6.50, FL 0.23, SL 1.45, SW 1.13, AME–AME 0.10, AME–ALE 0.05, ALE–ALE 0.40, PME–PME 0.18, PME–PLE 0.10, PLE–PLE 0.65.

Length of leg segments (sequence from femur to tarsus, and total): I 2.10 + 0.85 + 1.93 + 1.62 + 1.15 = 7.65; II both legs missing; III 1.95 + 0.75 + 1.40 + 1.60 + 0.80 = 6.50; IV 2.60 + 0.90 + 2.50 + 2.75 + 1.00 = 9.75.

The following is a translation of Simon's (1896) Latin description: Cephalothorax: Black, finely wrinkled, both sides clothed in downy whitish hairs, shiny golden-yellow medially. Abdomen: Narrow oblong, dark olive green on basal part (in mature specimens), covered with large spot on the back which is enlarged and shortened, with very shiny golden yellow setae, on apical part shiny golden yellow pubescent when mature but narrow and black near spinnerets, and in the middle a distinctive white spot, underneath in front whitish, at the back olive green, smaller when mature and on both sides covered with a pair of oblique whitish spots, in the region of the epigastric furrow leathery, black, near the edge two small indents. Sternum black, finely wrinkled, covered with small and minute white hairs. Claws arched, black, smoothly wrinkled. Tarsi ordinary, slender, front shiny, tibiae, except at apex, black, patellas with black lines on both sides, metatarsi 1 dark towards apex; four tarsi black at the back [referring to scopulae?], metatarsi reddish, tarsi yellowish-brown; tibias 1 with small spines 2–1, tibia 2 with 2 spines, all four metatarsi spined in front 2–2, armoured underneath. Pedipalps black, tarsus slightly brighter apically. – Northern Abyssinia.

Male: Unknown.

Additional material examined: None.

Distribution: Currently known only from the type locality in Ethiopia (Fig. 18).

Biology: Unknown.

FIGURE 18. Distribution of *Corinnomma* in the Afrotropical Region.

7.5 DISCUSSION

The present study increases the number of Afrotropical *Corinnomma* species to three. There are likely however, to be additional as yet undescribed species on the African continent, but the lack of adequate literature to distinguish castianeirine genera and the large number of unidentified specimens may be responsible for the apparently poor representation of this genus in collections. A further factor that may account for poor representation of *Corinnomma* is the fact that most species are vegetation and tree canopy dwellers in forest biomes (Deeleman-Reinhold 2001), and the latter stratum has, in particular, been very poorly sampled in Africa.

It must be noted that this is a preliminary paper on the genus in the region. The Afrotropical *Corinnomma* have similar general morphology and colouration to the Asian species, but differ by the recurved posterior eye row compared to the procurved posterior row of the Asian species. Although such differences have also been reported in the genus *Graptartia* in the Afrotropical region (Haddad 2004), the possibility exists that the Afrotropical *Corinnomma* may represent a distinct species group of the genus *Merenius*, with which they share a similar eye pattern and genitalic morphology. Although the colouration of the two genera differs, *Merenius* being dark brown to black with median white markings down the length of the abdomen compared to *Corinnomma* described above, the male palpal emboli of the two genera are remarkably similar. A particularly good example of this is *C. lawrencei* (Fig. 2), which has a similar embolic structure to *M. alberti* from South Africa and *M. simoni* Lessert, 1921 from East Africa. Further support for additional studies of *Corinnomma* are that the Asian species are primarily canopy dwellers (Deeleman-Reinhold 2001), while the Afrotropical species are primarily leaf litter dwellers, an ecological characteristic shared with *Merenius*. Therefore, the status of the Afrotropical *Corinnomma* is unclear, and could be resolved when *Merenius* is revised and a cladistic analysis performed on that genus, with *Corinnomma* as one of the outgroups.

The presently known distribution of the genus in the Afrotropical Region (Fig. 18) indicates that all species are known only from the eastern parts of the continent. Examination of unidentified material from overseas museums will likely increase the number of species known from Africa and provide a better understanding of the biogeography of the genus.

7.6 REFERENCES

BOSSELAERS, J. & JOCQUÉ, R. 2000. Studies in Corinnidae: transfer of four genera and description of the female of *Lessertina mutica* Lawrence 1942. *Tropical Zoology* **13**: 305–25.

DEELEMAN-REINHOLD, C.L. 1992. A new spider genus from Thailand with a unique ant-mimicking device, with description of some other castianeirine spiders (Araneae: Corinnidae: Castianeirinae). *Natural History Bulletin of the Siam Society* **40**: 167–184.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanteriidae* [sic]*).* Leiden: Brill.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual.* Pretoria: Plant Protection Research Institute Handbook 9, Agricultural Research Council.

HADDAD, C.R. 2004. A revision of the African spider genus *Graptartia* (Araneae: Corinnidae). *African Entomology* **12**: 71–87.

HADDAD, C.R. 2006. A new species of *Corinnomma* (Araneae: Corinnidae) from southern and eastern Africa, with taxonomic notes on *C. olivaceum* and *C. semiglabrum*. *African Invertebrates* **47**: 71–83.

KARSCH, F. 1880. Arachnologische Blatter (Decas I). *Zeitschrift für die gesammten Naturwissenschaften* 53: 373–409.

SIMON, E. 1896. Descriptions d’Arachnides nouveaux de la famille des Clubionidae. *Annales de la Société Entomologique de Belgique* **40**: 400–422.

CHAPTER 8

Echinax **sp., subadult male (Cwebe Nature Reserve, South Africa)**

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

8.1 ABSTRACT

The cryptic arboreal castianeirine genus *Echinax* Deeleman-Reinhold, 2001 (Araneae: Corinnidae), previously known only from South-East Asia, is recorded from the Afrotropical Region for the first time. The female of *Copa longespina* Simon, 1909 is redescribed, the male is described for the first time, and the species is transferred to *Echinax* as *E. longespina* (Simon, 1909) **comb. nov.**. It occurs widely throughout equatorial Africa, from Kenya and Tanzania in the east to Liberia in the west. Six new species are described from both sexes: *E. clara* **sp. nov.** from D.R. Congo and Ghana, *E. hesperis* **sp. nov.** from Ivory Coast, *E. natalensis* **sp. nov.** and *E. similis* **sp. nov.** from South Africa, *E. scharffi* **sp. nov.** from Tanzania, and *E. spatulata* **sp. nov.** that is widespread across tropical Africa. The available ecological data indicates that all seven species are mainly arboreal and represent a prominent component of corinnid assemblage collected by canopy fogging, especially in forests.

8.2 INTRODUCTION

The genus *Echinax* Deeleman-Reinhold, 2001 (Corinnidae: Castianeirinae) presently includes five species of small, foliage-dwelling castianeirine spiders from South-East Asia. Three of these species were initially described in *Copa* Simon, 1885 by Deeleman-Reinhold (1995), but she subsequently established the genus *Echinax* to accommodate them and a fourth, newly described species (Deeleman-Reinhold 2001). Yang *et al.* (2004) later added a fifth species from China.

In the generic description, Deeleman-Reinhold (2001) highlighted several differences between separating *Echinax* from *Copa*: (1) their smaller size; (2) thinner teguments; (3) more strongly procurved posterior eye row; (4) the presence of very long leg spines distally on all patellae and on the anterior metatarsi that are half or longer than the particular leg segment; (5) diameter of anterior median eyes three times that of the laterals, and (6) posterior median eyes usually further apart than in *Copa* and close to the posterior laterals. The two genera are also apparently ecologically separated, *Copa* occurring on the ground and *Echinax* in the foliage of shrubs and trees (Deeleman-Reinhold 2001). Both genera have cryptic colouration: *Copa* are usually brown with black longitudinal carapace markings and black abdominal mottling to blend into leaf litter in their habitats, while live specimens of *Echinax* have a moss-green carapace that matches the colouration of mosses and lichens covering the older leaves and branches of trees they occupy (Deeleman-Reinhold 2001, see also her Plate 4 Fig. 1 for a photo of *Echinax oxyopoides*).

During a present revision of the Afrotropical species of *Copa* by the author, one widespread continental species, *C. longespina* Simon, 1909, was prominent in collections from tropical Africa, particularly in canopy fogging samples. Its pale colouration, small size, very long leg spines and arboreal habits were different from typical ground-dwelling *Copa*, and further examination and comparison with Asian *Echinax* indicated that this species is misplaced and should be placed in the latter genus, thus representing the first records of *Echinax* from the region. Six new congeneric species were also discovered in material from the Afrotropical Region and are described here, the first in a collection of material from tsetse traps in South Africa (*E. natalensis* **sp. nov.**), and five further new species mainly from canopy fogging samples from tropical Africa (*E. spatulata* **sp. nov.** and *E. clara* **sp. nov.**), Ivory Coast (*E. hesperis* **sp. nov.**), South Africa (*E. similis* **sp. nov.**) and Tanzania (*E. scharffi* **sp. nov.)**. This is the fourth paper in a series on the Afrotropical Castianeirinae (Haddad 2004, 2006; Haddad & Bosselaers 2010).

8.3 MATERIAL & METHODS

Material examined during this study was observed in 70% ethanol using a Nikon SMZ800 stereomicroscope for all descriptions, digital photographs and measurements. The epigynes and male palps of each species were dissected, cleaned in a Labcon 5019U ultrasonic bath in 70% ethanol for 30 seconds, and drawn. Digital photographs of the dorsal habitus and male emboli of each species were taken using a Nikon Coolpix 8400 mounted on a Nikon SMZ800 stereomicroscope. The series of digital photographs were stacked using Combine ZM software (http://www.hadleyweb.pwp.blueyonder.co.uk) to increase depth of field. Scale bars were added in Corel Draw 14.0.

Material was prepared for scanning electron microscopy by dehydration through a graded ethanol series, then critical-point dried in an argon chamber. The specimens were glued to aluminium stubs and then sputter-coated with gold three times for three minutes. The material was examined in a JEOL 6400 WinSEM and digital photographs taken.

All measurements are given in millimetres (mm). Body dimensions, eye and leg measurements are given for the holotype and a paratype of the opposite sex, and total length measurements are provided for the smallest and largest specimens of each to give an indication of size range. Abbreviations used in the descriptions are as follows: 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; 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 & Jocqué (2000) and includes the following abbreviations: do – dorsal; pl – prolateral; plv – prolateral ventral; rl – retrolateral; rlv – retrolateral ventral; vt – ventral terminal.

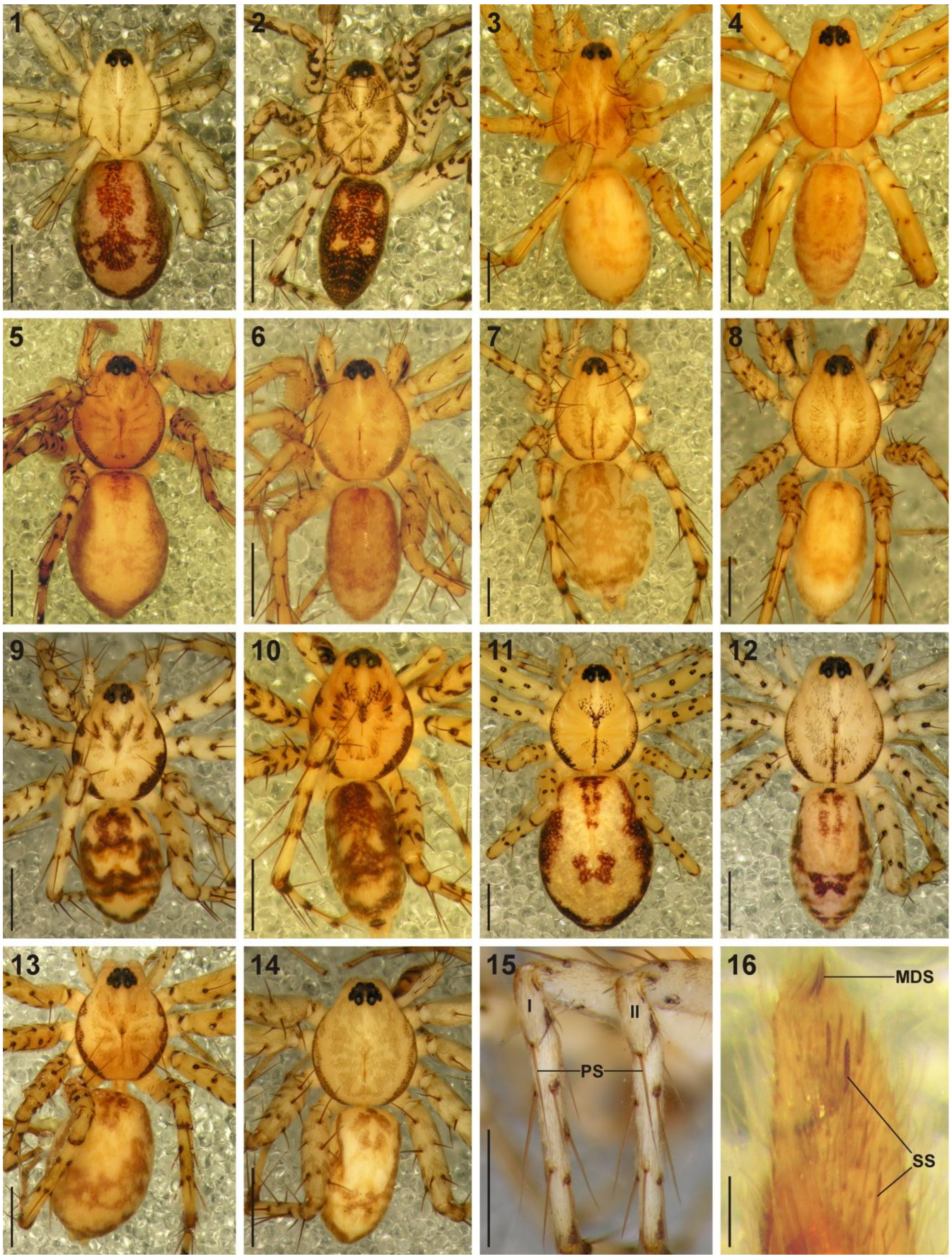
Where locality co-ordinates unavailable they were traced using the Global Gazetteer Version 2.2 (www.fallingrain.com) and are indicated in square brackets. The material examined in this study is deposited in the following institutions (curators given in parenthesis):

CAS – California Academy of Sciences, San Francisco, USA (Charles Griswold)
MACN – Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina (Martin Ramírez)
MNHN – Museum National d'Histoire Naturelle, Paris, France (Christine Rollard)
MRAC – Royal Museum for Central Africa, Tervuren, Belgium (Rudy Jocqué)
NCA – National Collection of Arachnida, ARC – Plant Protection Research Institute, Pretoria, South Africa (Ansie Dippenaar-Schoeman)
NMBA – National Museum, Bloemfontein, South Africa (Leon Lotz)
OUMNH – Oxford University Museum of Natural History, Oxford, UK (Zoe Simmons)
TMSA – Ditsong National Museum of Natural History, Pretoria, South Africa (Robin Lyle)
ZFMK – Zoologisches Forschungsmuseum Koenig, Bonn, Germany (Bernhard Huber)
ZMUC – Zoological Museum, University of Copenhagen, Denmark (Nikolaj Scharff)

8.4 GENUS *ECHINAX* DEELEMAN-REINHOLD, 2001

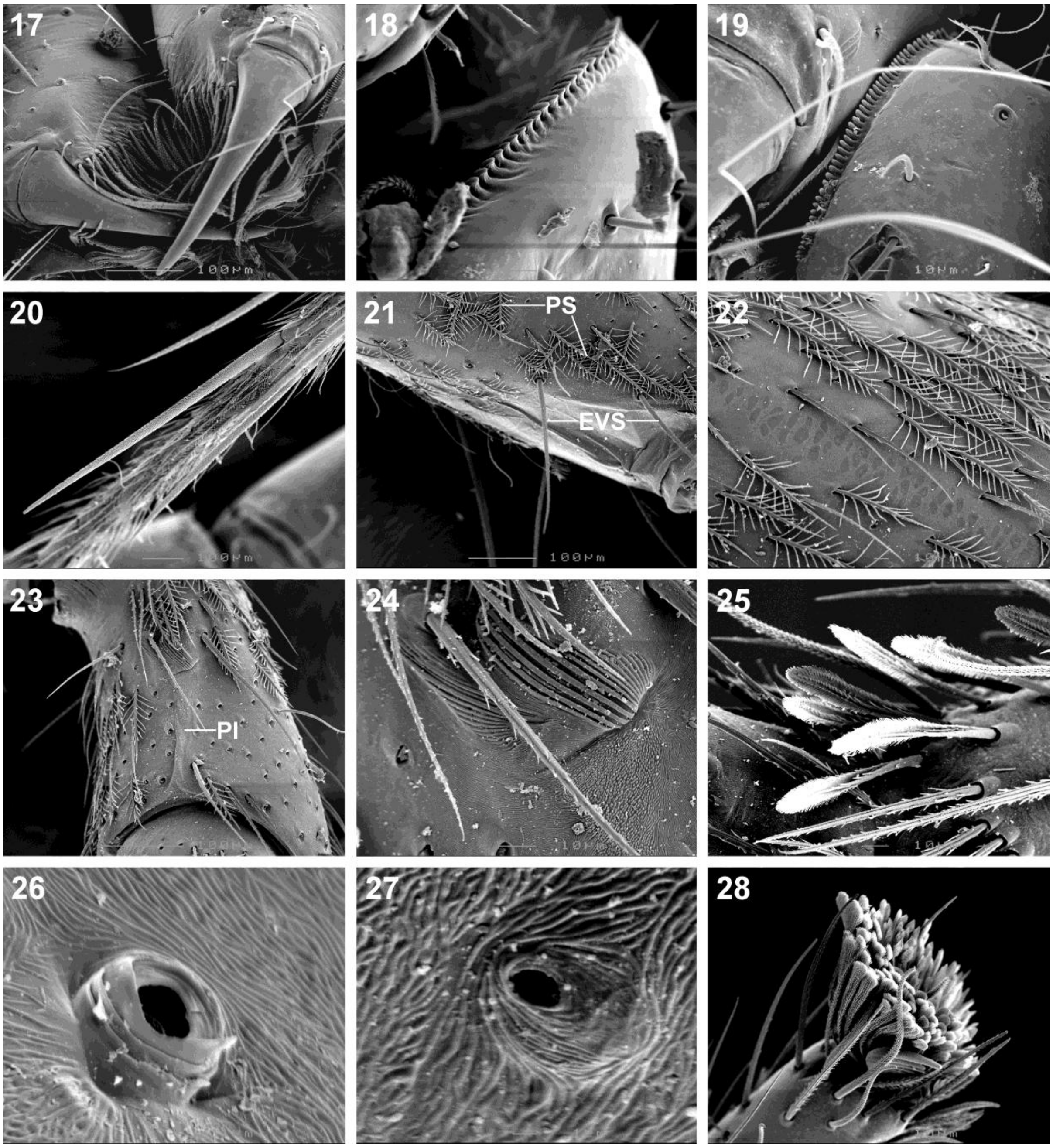
Type species: *Copa oxyopoides* Deeleman-Reinhold, 1995, by original designation.

Diagnosis: *Echinax* can be recognised from other cryptic Castianeirinae, particularly *Copa*, by the presence of very long leg spines distally on all patellae that are longer than the particular leg segment, on the anterior metatarsi that are longer than half of the particular segment; the AME that are 2 to 3 times ALE diameter; and the carapace that is approximately 2.75–3.10 times broader than the posterior eye row.



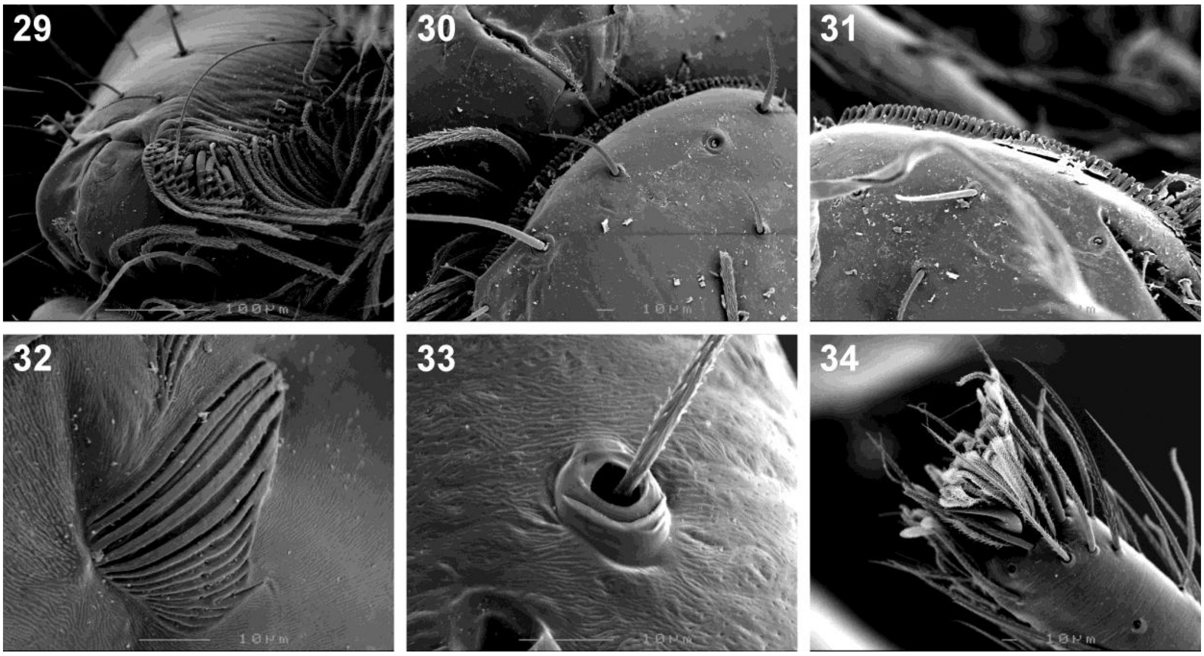
FIGURES 1–16. Digital microscope photographs of *Echinax clara* **sp. nov.** (1, 2), *E. hesperis* **sp. nov.** (3, 4), *E. longespina* (Simon, 1909) (5, 6), *E. natalensis* **sp. nov.** (7, 8), *E. scharffi* **sp. nov.** (9, 10), *E. similis* **sp. nov.** (11, 12) and *E. spatulata* **sp. nov.** (13–16): 1, 3, 5, 7, 9, 11, 13. female habitus, dorsal view; 2, 4, 6, 8, 10, 12, 14. male habitus, dorsal view; 15. male patella and tibia I and II, retrolateral view, indicating distal dorsal patellar spines (PS); 16. male palpal cymbium, dorsal view, indicating modified distal setae (MDS) and spatulate setae (SS). Scale bars: 1–15 = 1.0mm, 16 = 0.1mm.

Description: Small spiders, 2.90–5.80 mm in length; carapace and abdomen cream or pale yellow with black markings; carapace surface smooth, with black plumose setae covering markings; several long curved setae on clypeus and eye region; carapace oval, broadest at coxae II, eye region narrow, fovea distinct (Figs 1–14); posterior margin very slightly concave or straight. AER procurved, AME approximately 2x ALE diameter; AME separated by approximately ½ their diameter, nearly touching ALE; PER strongly procurved, PME slightly larger than PLE; PME closer to PLE than to each other; MOQ width similar anteriorly and posteriorly, longer than wide. Chilum single, triangular, tapering distally, weakly sclerotised, with distal notch; cheliceral promargin and retromargin with two teeth each; scrappy seta absent (Figs 17, 29); curved setae on cheliceral promargin finely plumose (Fig. 17) or pectinate (Fig. 29); endites straight laterally with distinct serrula comprising sharp, ventrally curved denticles (Figs 18, 19, 30, 31), with dense maxillar hair tuft on mesal margins; labium hemispherical, wider than long. Pleural bars isolated, weakly sclerotised; sternum approximately as broad as long, shield-shaped, slightly narrowed anteriorly; surface smooth, with scattered long erect setae; precoxal triangles present, intercoxal sclerites absent. Leg formula 4123; legs strongly spined (Fig. 16), all segments except metatarsi and tarsi with plumose setae (Figs 21–23); retrocoxal window absent on coxa I; femora with two rows of erect ventral setae (Fig. 21); distal patellar spines longer than patella length (Fig. 15); patellar indentation narrow, broad at proximal end (Figs 23, 24, 32); metatarsi III longer than metatarsi I and II; metatarsi distally scopulate (Fig. 25); tibiae, metatarsi and tarsi with several erect dorsal and lateral trichobothria with sunken basal plate (Figs 26, 33); tarsal organ level with integument, surrounded by fine ridges, opening oval (Fig. 27); paired tarsal claws short, situated laterally, with very dense claw tufts in between (Figs 28, 34); metatarsi III and IV without terminal preening brush or comb. Abdomen oval in females, elongate oval in males, with three pairs of fine straight setae on anterior surface above pedicel; dorsal scutum weakly sclerotised, extending ¼ abdomen length in females and ½ to entire abdomen length in males (Figs 1–14); two pairs of weakly sclerotised dorsal sigilla present; epigastric region weakly sclerotised, venter without post-epigastric sclerites and ventral sclerite, inframamillary sclerite present, distinct, densely covered in short setae. Spinnerets (only observed with SEM in *E. natalensis* **sp. nov.**): ALS of female (Fig. 35) with two major ampullate gland spigots, many piriform gland spigots and several small nubbins (not distinguishable in males); ALS of male (Fig. 38) with single major ampullate gland spigot,

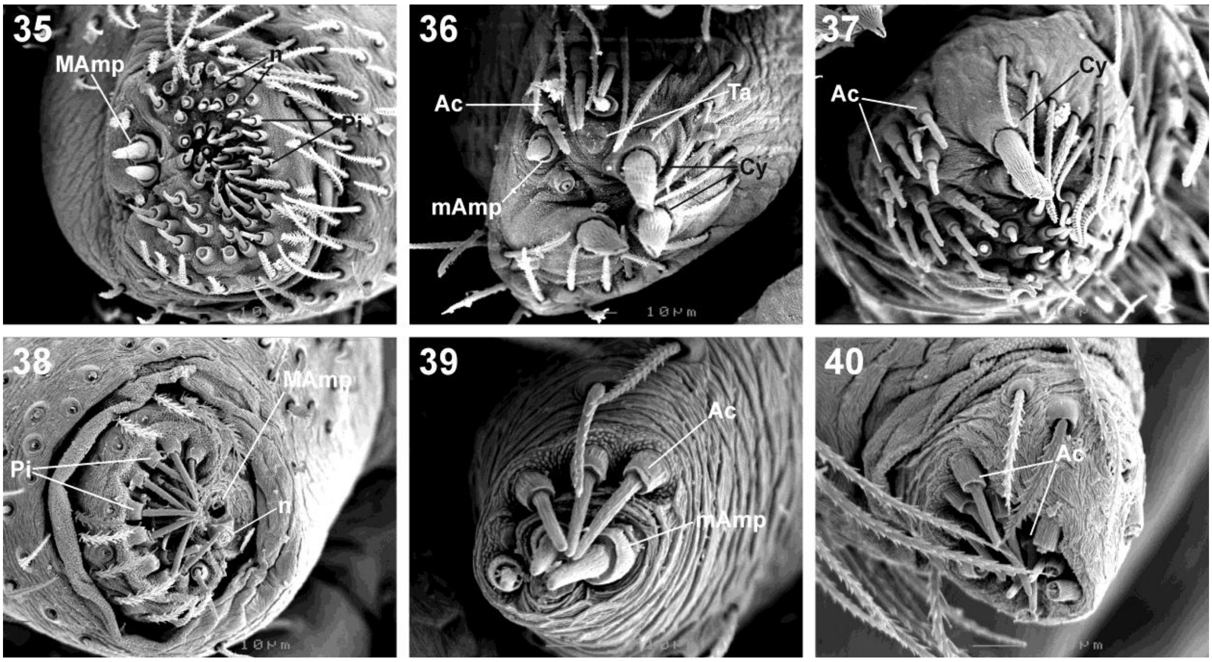


FIGURES 17–28. Scanning electron microscope photographs of *Echinax natalensis* **sp. nov.** male (17, 18) and female (19–28): 17. chelicerae, ventral view; 18, 19. serrula; 20. tibia I, detail of ventral spines; 21. femur I, indicating plumose setae (PS) and erect ventral setae (EVS); 22. same, detail of plumose setae; 23. patella I, indicating patellar indentation (PI); 24. same, detail of proximal end of PI; 25. metatarsus I, detail of ventral distal setae; 26. tarsus I, trichobothrium base; 27. same, tarsal organ; 28. tarsus IV, tarsal claw and claw tuft.

several piriform gland spigots and a single large nubbin; PMS of female (Fig. 36) with three large cylindrical gland spigots, one small minor ampullate gland spigot, several aciniform gland spigots and one distinctive tartipore; PMS of male (Fig. 39) with one large minor ampullate gland spigot and several large aciniform gland spigots; PLS of female (Fig. 37) with two large cylindrical gland spigots and several aciniform gland spigots, of male (Fig.

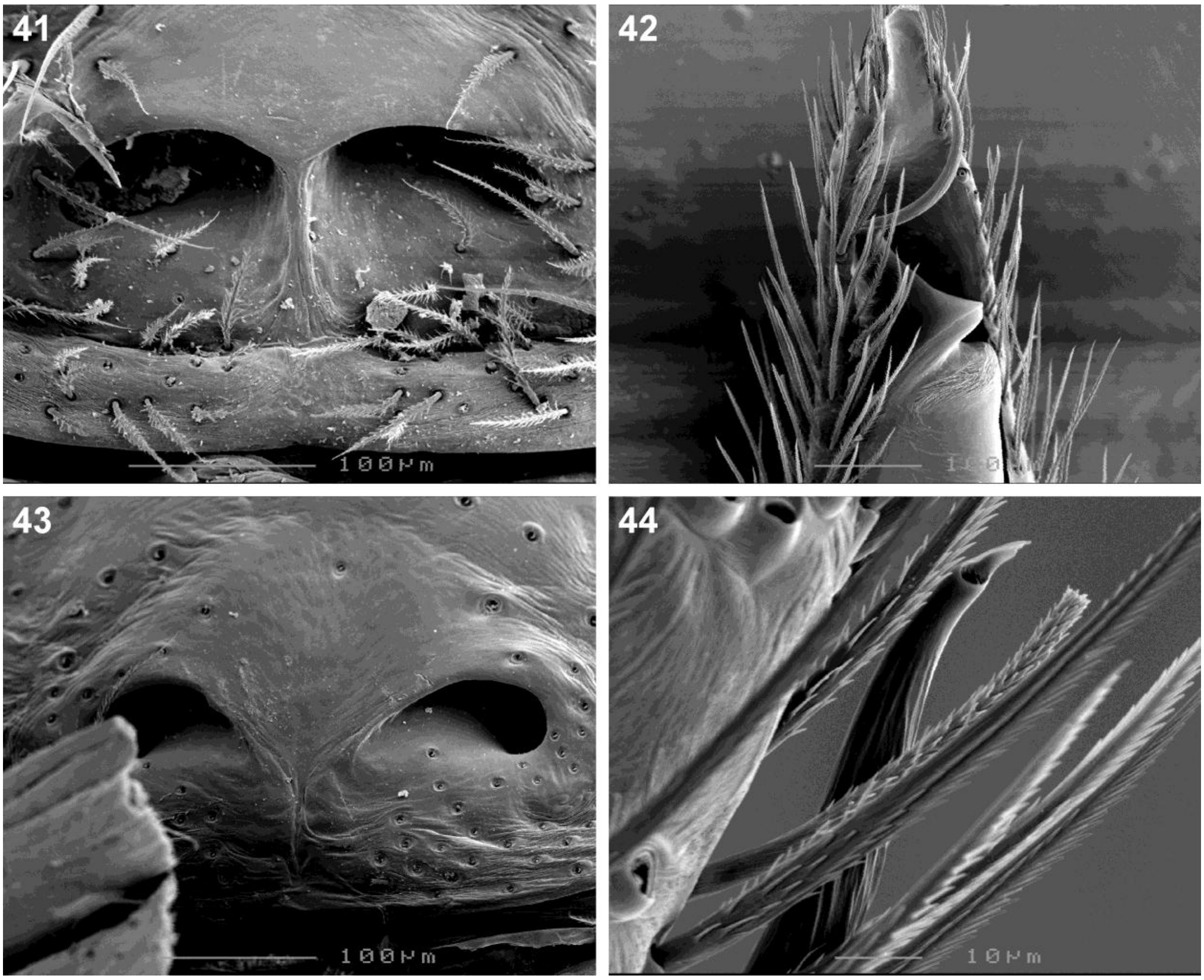


FIGURES 29–34. Scanning electron microscope photographs of *Echinax similis* **sp. nov.** female (29, 30) and male (31–34): 29. chelicerae, anteroventral view; 30, 31. serrula; 32. patella I, proximal end of patellar indentation; 33. tarsus IV, trichobothrium; 34. same, tarsal claw and claw tuft.

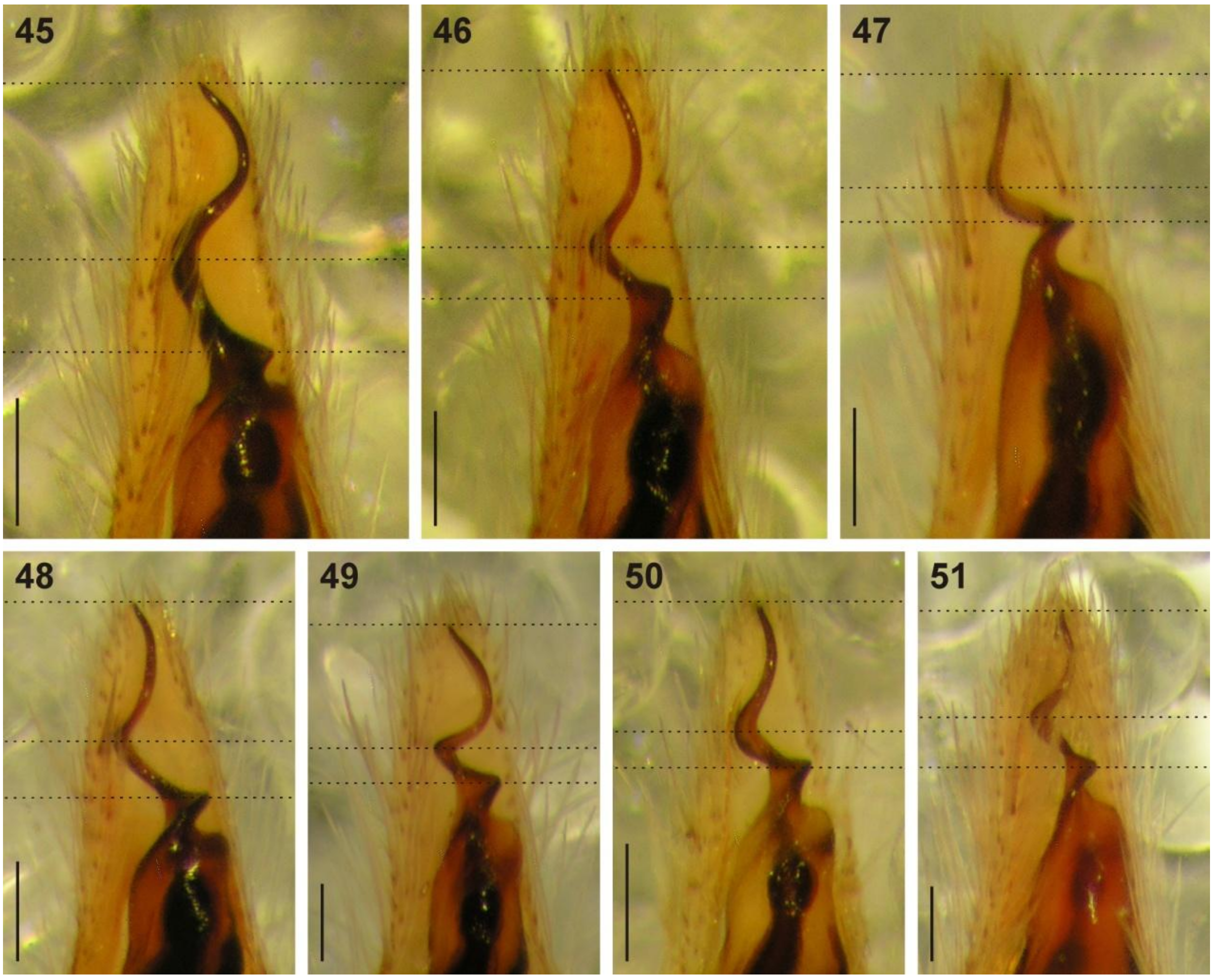


FIGURES 35–40. Scanning electron microscope photographs of *Echinax natalensis* **sp. nov.** female (35–37) and male (38–40) spinneret morphology. 35, 38. anterior lateral spinneret; 36, 39. posterior median spinneret; 37, 40. posterior lateral spinneret. Abbreviations: Ac–aciniform gland spigot(s); Cy–cylindrical gland spigot(s); MAmp–major ampullate gland spigot(s); mAmp–minor ampullate gland spigot(s); nu–nubbin(s); Pi–piriform gland spigot; ta–tartipore.

40) with only aciniform gland spigots distinguishable. Female epigyne with curved sclerotised epigynal hoods leading to lateral copulatory openings (Figs 41, 43), copulatory ducts curving medially and anteriorly before entering ST II posteriorly (e.g. Fig. 53) or anteriorly (Fig. 70); ST II usually oval, sometimes expanded posterolaterally, connected broadly to kidney-shaped posterior ST I. Male palpal segments without apophyses; cymbium with spines prolaterally and ventrally, two thickened bent modified setae dorsally distally (Fig. 16), and several spatulate (Fig. 16) or straight longer black setae on dorsal surface; embolus finely coiled, ending in sharp tip; width and angle of base, and length and curvature of distal coil variable (Figs 45–51).



FIGURES 41–44. Scanning electron microscope photos of *Echinax natalensis* **sp. nov.** (41, 42) and *E. similis* **sp. nov.** (43, 44) genitalia: 41, 43. female epigyne, ventral view; 42. male embolus, ventral view; 44. tip of embolus, prolateral view.



FIGURES 45–51. Digital microscope photographs of emboli of Afrotropical *Echinax* species in ventral view: 45. *Echinax clara* **sp. nov.**; 46. *E. hesperis* **sp. nov.**; 47. *E. longespina* (Simon, 1909); 48. *E. natalensis* **sp. nov.**; 49. *E. scharffi* **sp. nov.**; 50. *E. similis* **sp. nov.**; 51. *E. spatulata* **sp. nov.**. Stipple lines indicate the points of separation between the basal and distal coils of the embolus. Scale bars = 0.1mm.

Key to the Afrotropical species of *Echinax*

1 Females...2

– Males...8

2 Epigyne with large 6-shaped epigynal ridges and large copulatory openings (Fig. 69); copulatory ducts long, entering ST II anteriorly (Fig. 70)......................*E. scharffi* **sp. nov.**

– Epigyne with curved copulatory ridges and small lateral copulatory openings; copulatory openings shorter, entering ST II posteriorly...3

3 Epigynal ridges small, separated by distance greater than their width (Fig. 52); copulatory ducts nearly transverse, with sharp bend medially before entering ST II..*E. clara* **sp. nov.**

– Epigynal ridges broader, separated by distance clearly less than their width; copulatory ducts variable in structure, rarely transverse with sharp bend..4

4 Labium and sternum without black markings.......................................*E. hesperis* **sp. nov.**

– Labium with spots or transverse markings along proximal margin; sternum usually without markings, but sometimes with black spots..5

5 Sternum with distinct small lateral spots at each coxa; epigyne larger than congeners, clearly longer than broad (Fig. 77), with gently curving copulatory ducts (Fig. 78)............ ....*E. spatulata* **sp. nov.**

– Sternum without markings at coxae; epigyne smaller, similar in length and breadth, copulatory ducts with distinct bend along their course..6

6 Epigynal ridges meeting medially in epigyne (Figs 41, 64); copulatory ducts with distinct perpendicular bend medially, anterior and lateral sections of duct similar in length (Fig. 65)...*E. natalensis* **sp. nov.**

– Epigynal ridges clearly separated and not meeting medially (Figs 43, 60, 73); copulatory ducts with bend anteriorly, anterior section of duct much shorter than lateral section (Figs 61, 74)...7

7 Epigynal ridges strongly curved, with large copulatory openings (Figs 43, 73); clypeus height 1⅓ times AME diameter; PME separated by distance slightly larger than their diameter (South Africa)..*E. similis* **sp. nov.**

– Epigynal ridges slightly curved, with small copulatory openings (Fig. 60); clypeus height nearly 2 times AME diameter; PME separated by distance ⅔ their diameter (Tropical Africa)..*E. longespina*

8 Palpal embolus with distal section of coil nearly straight (Fig. 47)................*E. longespina*

– Palpal embolus with distal section of coil slightly to strongly curved (e.g. Figs 48–51)...9

9 Sternum with distinct small lateral spots at each coxa; palpal embolus with very narrow base (Fig. 51); cymbium with several flat thickened spatulate setae in distal third............. ....*E. spatulata* **sp. nov.**

– Sternum without markings at coxae; palpal embolus with moderate to broad base; cymbium only with straight thickened spatulate setae in distal third..............................10

10 Labium without markings; basal coil of embolus very strongly oblique, approximately 75° off transverse palpal axis (Fig. 46)..*E. hesperis* **sp. nov.**

– Labium with proximal transverse marking or lateral spots; basal coil of embolus less oblique, between 45° and 60° off transverse palpal axis...11

11 Distal section of embolus strongly curved, nearly semi-circular (Figs 45, 49)................12

– Distal section of embolus slightly curved (Figs 48, 50)..13

12 Chelicerae with black spots on anterior surface of paturon; embolus with very sharp prolateral bend; longitudinal distance from retrolateral bend to prolateral bend equal to ¼ the distance from prolateral bend to tip (Fig. 49) (Tanzania)..*E. scharffi* **sp. nov.**

– Chelicerae without markings on anterior surface of paturon; embolus with gentle prolateral bend; longitudinal distance from retrolateral bend to prolateral bend approximately ½ the distance from prolateral bend to tip (Fig. 45) (Central and West Africa)..*E. clara* **sp. nov.**

13 Embolus somewhat thickened along its entire length, especially in prolateral bend of coil; longitudinal distance from retrolateral bend to prolateral bend approximately ¼ the distance from prolateral bend to tip (Fig. 50); tibiae III and IV with a single rlv spine..*E. similis* **sp. nov.**

– Embolus fine along its entire length, including prolateral bend of coil (Fig. 48); longitudinal distance from retrolateral bend to prolateral bend approximately ⅖ the distance from prolateral bend to tip (Fig. 48); tibiae III and IV with two rlv spines...*E. natalensis* **sp. nov.**

8.4.1 *Echinax clara* sp. nov.

Figs 1, 2, 45, 52–55

Etymology: The species name is Latin for “clear, distinct”, referring to the distinct shape of the male embolus.

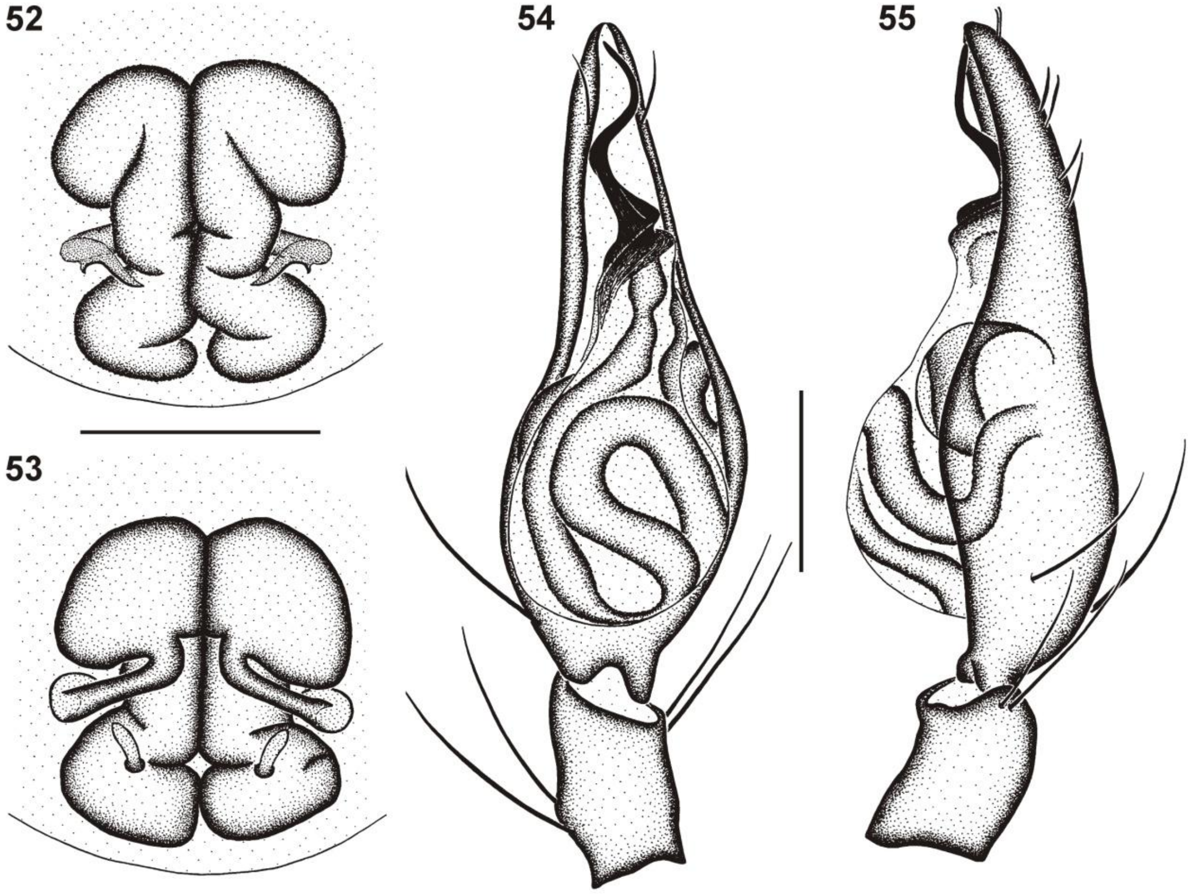
Diagnosis: Females can be easily recognised by the very small epigynal ridges (Fig. 52) and the nearly transverse copulatory ducts bent at a right angle medially (Fig. 53). The male in unique amongst the African species in having a prolateral and retrolateral spine in the proximal third of the cymbium dorsally (Fig. 55), as well as by the relatively short and strongly curved distal section of the embolus (Fig. 54).

Female (holotype, Luki, MRAC 230764). Measurements: CL 1.85, CW 1.53, AL 2.35, AW 1.64, TL 4.18 (3.95–4.60), FL 0.19, SL 0.90, SW 0.90, AME–AME 0.06, AME–ALE

0.02, ALE–ALE 0.32, PME–PME 0.11, PME–PLE 0.07, PLE–PLE 0.39, PERW 0.54, MOQAW 0.30, MOQPW 0.33, MOQL 0.37.

Length of leg segments: I 1.65 + 0.63 + 1.33 + 1.30 + 0.65 = 5.56; II 1.61 + 0.63 + 1.28 + 1.30 + 0.65 = 5.47; III 1.52 + 0.60 + 1.25 + 1.38 + 0.65 = 5.40; IV 1.87 + 0.65 + 1.55 + 2.00 + 0.74 = 6.81.

General appearance as in Fig. 1. Carapace cream, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, with fine black stripe from posterior of fovea to posterior margin of carapace; lateral margins with broad stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height equal to 1½ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to their diameter; PME separated from PLE by distance approximately equal to ⅔ PME diameter; CW:PERW = 2.83:1. Chelicerae cream, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth much larger than proximal; retromargin with two adjacent subequal teeth, distal tooth very slightly larger than proximal tooth, close to fang base. Endites and sternum cream, without markings; labium cream, with black transverse marking along proximal margin. Legs cream, spine bases with faint black spot; femora all with incomplete black ventral ring distally; remaining leg segments uniform in colour. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with plv and rlv rows of erect setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 3 rl 3 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv and rlv erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with small dorsal scutum extending ¼ abdomen length; dorsum pale grey, with narrow black oval marking anteriorly, black X-shaped marking at ⅔ abdomen length, and lateral margins with irregular black marking; black plumose setae on markings, white plumose setae surrounding them; venter creamy-grey, covered in short straight setae with scattered longer setae, with dark grey subrectangular marking medially. Epigyne with short curved lateral ridges at midpoint of epigyne, separated by at least their width, with copulatory openings situated laterally in ridges (Fig. 52);



FIGURES 52–55. Genitalic morphology of *Echinax clara* **sp. nov.**: 52. female epigyne, ventral view; 53. same, dorsal view; 54. male palp, ventral view; 55. same, retrolateral view. Scale bars = 0.25mm.

copulatory ducts initially straight, nearly transverse, curving anteriorly at right angle medially, entering oval anterior ST II; broad ducts connecting ST II to broad, kidney-shaped posterior ST I; ST I nearly as broad as ST II (Fig. 53).

Male (paratype, Luki, MRAC 230767). Measurements: CL 1.80, CW 1.47, AL 2.15, AW 1.10, TL 3.80 (3.80–3.90), FL 0.23, SL 0.77, SW 0.77, AME–AME 0.05, AME–ALE 0.01, ALE–ALE 0.29, PME–PME 0.08, PME–PLE 0.06, PLE–PLE 0.32, PERW 0.48, MOQAW 0.30, MOQPW 0.29, MOQL 0.35.

Length of leg segments: I 1.85 + 0.60 + 1.50 + 1.43 + 0.73 = 6.11; II 1.78 + 0.57 + 1.40 + 1.38 + 0.70 = 5.83; III 1.65 + 0.55 + 1.38 + 1.50 + 0.68 = 5.76; IV 1.93 + 0.58 + 1.60 + 2.03 + 0.75 = 6.89.

General appearance as in Fig. 2, male more slender and smaller than female. Carapace cream, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, broken up by asetose striae directed between coxae, with fine black stripe from posterior of fovea to posterior margin of carapace; lateral margins black, markings expanded medially from coxae, with broad stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than ½ their diameter; AME separated from ALE by distance approximately $^1/_{10}$ AME diameter; clypeus height equal to 1⅔ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance approximately equal to ⅔ PME diameter; CW:PERW = 3.06:1. Chelicerae cream, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth larger than proximal; retromargin with two adjacent teeth, subequal in size, distal tooth close to fang base. Endites and sternum cream, without markings; labium cream, with black transverse marking along proximal margin. Legs cream, spine bases with distinct black spot; femora all with incomplete black markings proximally, at ⅓ and ⅔ femur length and distally, starting mediolaterally and curving laterally; patellae all black distally and laterally; tibiae all with broken black markings laterally; metatarsi with black rings proximally, medially and distally, corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with plv and rlv rows of erect ve setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 2 rl 2 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv and rlv erect ventral setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 rl 1 plv 2 rlv 1. Abdomen with scutum nearly covering entire dorsum; dorsum mottled black with two pairs of cream spots anteriorly and medially, with fine cream chevrons posteriorly; dark brown with narrow white median marking, forming three faint chevrons posteriorly; dorsum covered predominantly with brown plumose setae, with scattered black plumose setae; venter cream, with broad black stripe along midline from pedicel to spinnerets, covered in short straight setae with scattered long straight setae. Male palp cream, cymbium yellow-brown, with a few spatulate setae dorsally in distal ⅓ (Fig. 55); tegulum pear-shaped, yellow-brown with dark brown ducts; embolus with broad base and two ridges, first leading to prolateral and second to retrolateral basal loop of embolus; embolus long, with 1½ coils, distal section strongly curved; longitudinal distance from retrolateral bend to prolateral bend approximately ½ the distance from prolateral bend to embolus tip (Figs 45, 54).

Type material: Holotype ♀: **D.R. CONGO:** Bas-Congo, Mayombe, Luki Forest Reserve, 05°37'S, 13°05'E, 266m a.s.l., leg. D. de Bakker & J.-P. Michiels, 14.IX.2007 (canopy fogging, secondary rainforest) (MRAC 236910).

Paratypes: **D.R. CONGO:** Bas-Congo, Mayombe, Luki Forest Reserve, 05°37'S, 13°05'E, 266m a.s.l., leg. D. de Bakker & J.-P. Michiels, 1.X.2007 (canopy fogging, primary rainforest), 1♂ (MRAC 236903); Same data, 26.IX.2007, 2♀ (MRAC 236901); Same data, 30.IX.2007, 1♀ (MRAC 236913); Same locality, leg. D. de Bakker & J.-P. Michiels, 17.IX.2007 (canopy fogging, secondary rainforest), 1♀ (MRAC 236904); Same data, 28.IX.2007, 2♂ (MRAC 236912); Same data, 20.IX.2007, 2♀ (MRAC 236906); Same data, 24.IX.2007, 3♀ (MRAC 236908). **GHANA:** Kakum forest, 05°20'N, 01°23'W, leg. R. Jocqué, D. de Bakker & L. Baert, 21.XI.2005 (fogging, primary forest), 1♀ (MRAC 236916); Same data, 18.XI.2005, 3♀ (MRAC 236918).

Additional material examined: none.

Distribution: Known only from two localities in Central and West Africa (Fig. 68).

Biology: The species was only collected by canopy fogging in primary and secondary rainforest.

8.4.2 *Echinax hesperis* sp. nov.

Figs 3–4, 46, 56–59

Etymology: The species name is Latin for “western”, referring to its distribution in West Africa.

Diagnosis: Females of the species can be recognised by the narrow copulatory ducts directed at 45° towards ST II from the copulatory openings, with the ST II strongly expanded posterolaterally and nearly touching the copulatory ducts (Fig. 57). Males can be distinguished by the narrow base of the embolus and the distal section that is approximately three times longer than the basal section (Fig. 46).

Female (holotype, Comoe, MRAC 230757). Measurements: CL 2.10, CW 1.67, AL 3.45, AW 2.05, TL 5.35 (4.40–5.35), FL 0.28, SL 1.05, SW 1.05, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.34, PME–PME 0.11, PME–PLE 0.08, PLE–PLE 0.38, PERW 0.56, MOQAW 0.32, MOQPW 0.32, MOQL 0.38.

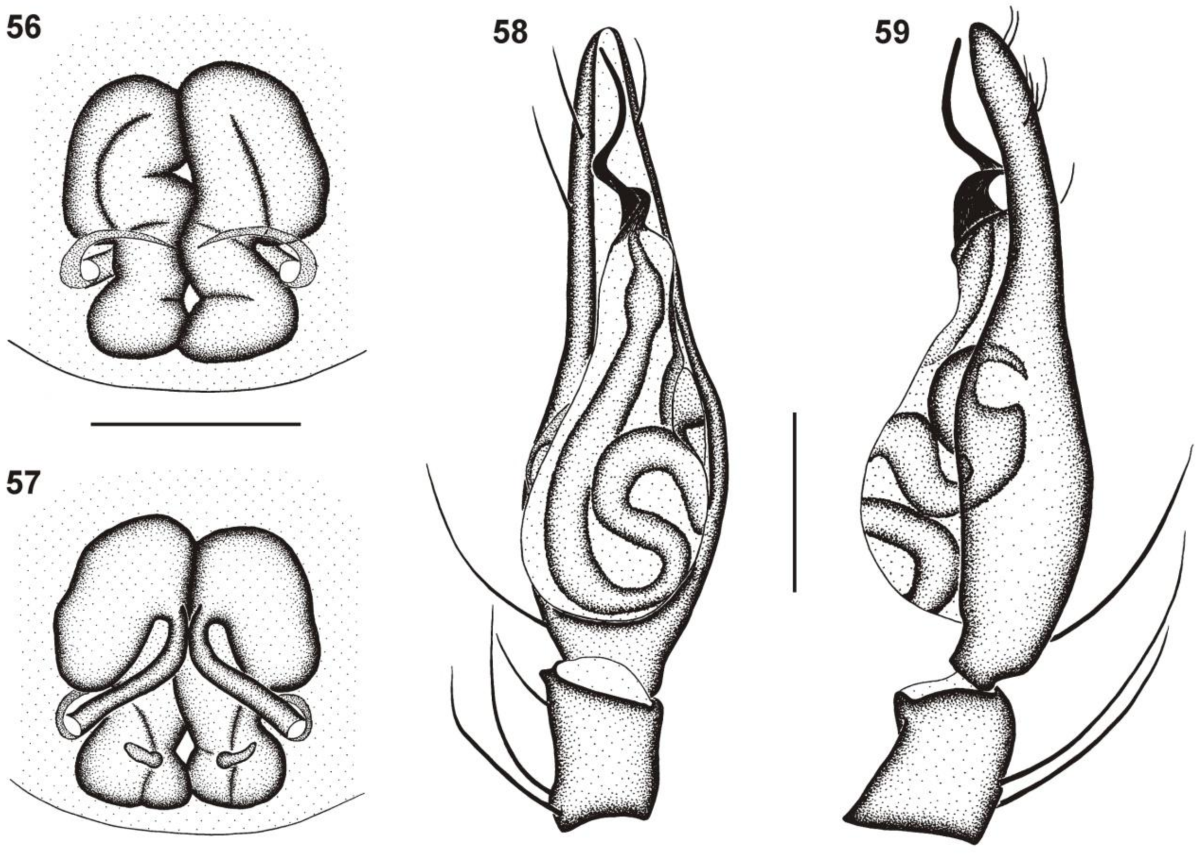
Length of leg segments: I 2.05 + 0.75 + 1.60 + 1.60 + 0.75 = 6.75; II 1.99 + 0.70 + 1.50 + 1.55 + 0.75 = 6.49; III 1.85 + 0.70 + 1.50 + 1.70 + 0.73 = 6.48; IV 2.20 + 0.70 + 1.83 + 2.35 + 0.80 = 7.88.

General appearance as in Fig. 3. Carapace creamy-yellow, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, broken up by asetose lines from PME to midpoint of carapace, to sides of fovea posteriorly, and from fovea directed towards palpal coxa; fine black stripe from posterior of fovea to posterior margin of carapace; lateral margins black, with broader stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height slightly larger than 1½ times AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance approximately equal to their diameter; PME separated from PLE by distance approximately equal to ¾ PME diameter; CW:PERW = 2.98:1. Chelicerae creamy-yellow, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth larger than proximal; retromargin with two adjacent teeth, distal tooth larger than proximal tooth, close to fang base. Endites and sternum cream, labium light brown with cream distal margin, all without markings. Legs cream, spine bases with faint black spot; femora with incomplete black ring ventrally at ¾ their length; patellae black dorsally at distal end, marking surrounding patellar indentation retrolaterally; tibiae and tarsi uniform yellow; metatarsi with black lines between paired spines only. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with plv and rlv rows of erect setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv and rlv erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 3 rl 3 plv 3 rlv 2. Abdomen with small dorsal scutum extending ¼ abdomen length; dorsum creamy-grey, with broad mottled black marking along midline to ¾ abdomen length, lateral margins with irregular black marking; black plumose setae on markings, white plumose setae surrounding them; venter cream, covered in short straight setae, with scattered longer setae posteriorly. Epigyne with narrow, sharply curved ridges at midpoint of epigyne, nearly touching medially, with copulatory openings situated laterally in ridges (Fig. 56); copulatory ducts initially straight, directed at nearly 45 degrees anteromedially, curving anteriorly before entering elongate oval anterior ST II; broad ducts connecting ST II to kidney-shaped posterior ST I; ST I clearly narrower than ST II (Fig. 57).

Male (paratype, Comoe, MRAC 230758). Measurements: CL 1.95, CW 1.53, AL 2.30, AW 1.24, TL 4.40 (3.70–4.40), FL 0.30, SL 0.90, SW 0.90, AME–AME 0.05, AME–ALE 0.01, ALE–ALE 0.30, PME–PME 0.10, PME–PLE 0.06, PLE–PLE 0.38, PERW 0.52, MOQAW 0.30, MOQPW 0.30, MOQL 0.37.

Length of leg segments: I 1.93 + 0.60 + 1.65 + 1.60 + 0.75 = 6.53; II 1.83 + 0.58 + 1.55 + 1.58 + 0.73 = 6.28; III 1.78 + 0.60 + 1.46 + 1.73 + 0.70 = 6.27; IV 2.08 + 0.65 + 1.80 + 2.26 + 0.80 = 7.59.

General appearance as in Fig. 4, male more slender and smaller than female. Carapace creamy-yellow, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, broken up by asetose line medially from PME to midpoint and asetose lines directed between coxae; lateral margins black, markings slightly expanded from coxae, with broad stripe of black plumose setae from palpal coxa to posterior margin.



FIGURES 56–59. Genitalic morphology of *Echinax hesperis* **sp. nov.**: 56. female epigyne, ventral view; 57. same, dorsal view; 58. male palp, ventral view; 59. same, retrolateral view. Scale bars = 0.25mm.

All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance approximately ⅓ their diameter; AME separated from ALE by distance approximately $^1/_{10}$ AME diameter; clypeus height equal to $1^4/_5$ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance slightly less than their diameter; PME separated from PLE by distance slightly larger than ½ PME diameter; CW:PERW = 2.94:1. Chelicerae creamy-yellow, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth much larger than proximal; retromargin with two adjacent teeth, distal tooth slightly larger, close to fang base. Endites and sternum cream, labium yellow-brown with cream distal margin, all without markings. Legs creamy-yellow, spine bases with faint black spot; femora all with incomplete black ring ventrally at ¾ their length; patellae all black dorsally at distal end, marking continuing retrolaterally, surrounding patellar indentation; tibiae all with faint lateral black blotches; metatarsi with faint black rings proximally, medially and distally, corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with plv and rlv rows of erect setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv and rlv erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 2 rlv 1. Abdomen with yellow scutum covering ⅔ of dorsum; dorsum with mottled black marking medially and black chevron markings in posterior half, lateral margins with black mottling; dorsum with black plumose setae corresponding with markings, yellowish plumose setae between them; venter cream, with broad black median stripe from pedicel to epigastric furrow and medially between epigastric furrow and spinnerets; venter covered in short straight setae, with scattered long straight setae posteriorly. Male palp creamy-yellow, cymbium with a few spatulate and straight setae dorsally in distal ⅓ (Fig. 59); tegulum pear-shaped, creamy-yellow with dark red-brown ducts; embolus with narrow base, long, with 1½ coils, distal section curved; longitudinal distance from retrolateral bend to prolateral bend approximately ⅓ the distance from prolateral bend to embolus tip (Figs 46, 58).

Type material: Holotype ♀: **IVORY COAST:** Comoé National Park, 08°44'N, 03°49'E, 220m a.s.l., leg. K. Mody, 13.VII.1997 (canopy fogging, *Anogeissus leiocarpus*, tropical savanna) (MRAC 230757).

Paratypes: **IVORY COAST:** Apouesso, forêt classée de la Bossematie, 06°35'N, 03°28'W, leg. R. Jocqué, 14.XI.1993 (forest edge, on banana leaf), 1♀ (MRAC 177603); Comoé National Park, 08°44'N, 03°49'E, 220m a.s.l., leg. K. Mody, 16.VI.1999 (canopy fogging, *Burkea africana*, tropical savanna), 1♀ (MRAC 230753); Same data, 16.VII.1999, 1♀ (MRAC 230755); Same locality, leg. K. Mody, 23.VII.1997 (canopy fogging, *Combretum fragrans*, tropical savanna), 1♂ 1♀ (MRAC 230759); Same data, 10.VII.1997, 1♂ (MRAC 230760); Same data, 23.VII.1997, 1♀ (MRAC 230752); Same data, 25.VII.1997, 1♂ (MRAC 230758); Same data, 2.VIII.1997, 1♂ (MRAC 230751); Same locality, leg. K. Mody, 24.VIII.1997 (canopy fogging, *Anogeissus leiocarpus*, tropical savanna), 1♂ 1♀ (MRAC 230761); Same data, 19.VIII.1999, 1♂ 1♀ (MRAC 230762); Same data, 28.VI.1999, 2♂ 1♀ (MRAC 230754); Same data, 14.VIII.1999, 1♀ (MRAC 230756); Same data, 1.VII.2000, 1♂ (MRAC 230763).

Additional material examined: none.

Distribution: Known only from the Ivory Coast (Fig. 68).

Biology: In contrast to most of the *Echinax* material from Africa, which was mainly collected in forest habitats, specimens of *E. hesperis* were collected exclusively in tropical savanna. Other records of the genus from this country (*E. longespina*) were collected in forests only.

8.4.3 *Echinax longespina* (Simon, 1909)

Figs 5, 6, 47, 60–63

Copa longespina Simon, 1909: 370 (♀ holotype: **GUINEA-BISSAU:** Bolama [11°34'N, 15°28'W], MNHN – not traced) **comb. nov.**

Remarks: Requests to the MNHN for the type material of *Copa longespina* were not successful and no specimens could be located in the collection or catalogue under this name. Specimens were, however, traced of "*Copa multispinosa*", which is a name not formally used in the description of any *Copa* species by Simon or any other author (Platnick 2011). The locality on the label accompanying these specimens (1 subadult ♂ and two adult ♀) gives the locality as "Gabon", which is different to the type locality (Bolama in Portuguese Guinea = Guinea-Bissau) given by Simon (1909), although he indicates in the following line of the description that *C. longespina* is also found in Sierra-Leone and Gabon. It is therefore possible that the species name written on the label may have been a *lapsus* by Simon and that these are the Gabonese *C. longespina* specimens he referred to in the description, which were not designated as types. The whereabouts of the types from Bolama and the specimens from Sierra-Leone requires further investigation. Specimens consistent with the Gabonese "*C.*

multispinosa” were the only species collected in Senegal and Liberia, countries bordering with Guinee-Bissau. At present it would be advisable to consider specimens conspecific with the “*C. multispinosa*” specimens as *C. longespina*. Neotypes should be designated for this species once fresh material from Guinea-Bissau becomes available.

The species is not congeneric with *Copa flavoplumosa* Simon, 1885, widespread type species of the genus, and should rather be placed in *Echinax,* with which it shares the characters given above in the generic diagnosis. Its transfer to *Echinax* as *E. longespina* (Simon, 1909) **comb. nov.** is proposed here.

Diagnosis: *Echinax longespina* females share with *E. spatulata* **sp. nov.** the shorter copulatory hoods that do not meet medially in the epigyne and the elongate ST II that are longer than wide, but can be separated from the latter species by the copulatory ducts that are distinctly longer and touch medially (shorter and clearly separated in *E. spatulata* **sp. nov.**, compare Figs 61 and 78). Males are distinguished by the narrow embolus base and distal end of the embolus that is nearly straight and not curved as in other Afrotropical species (Fig. 47).

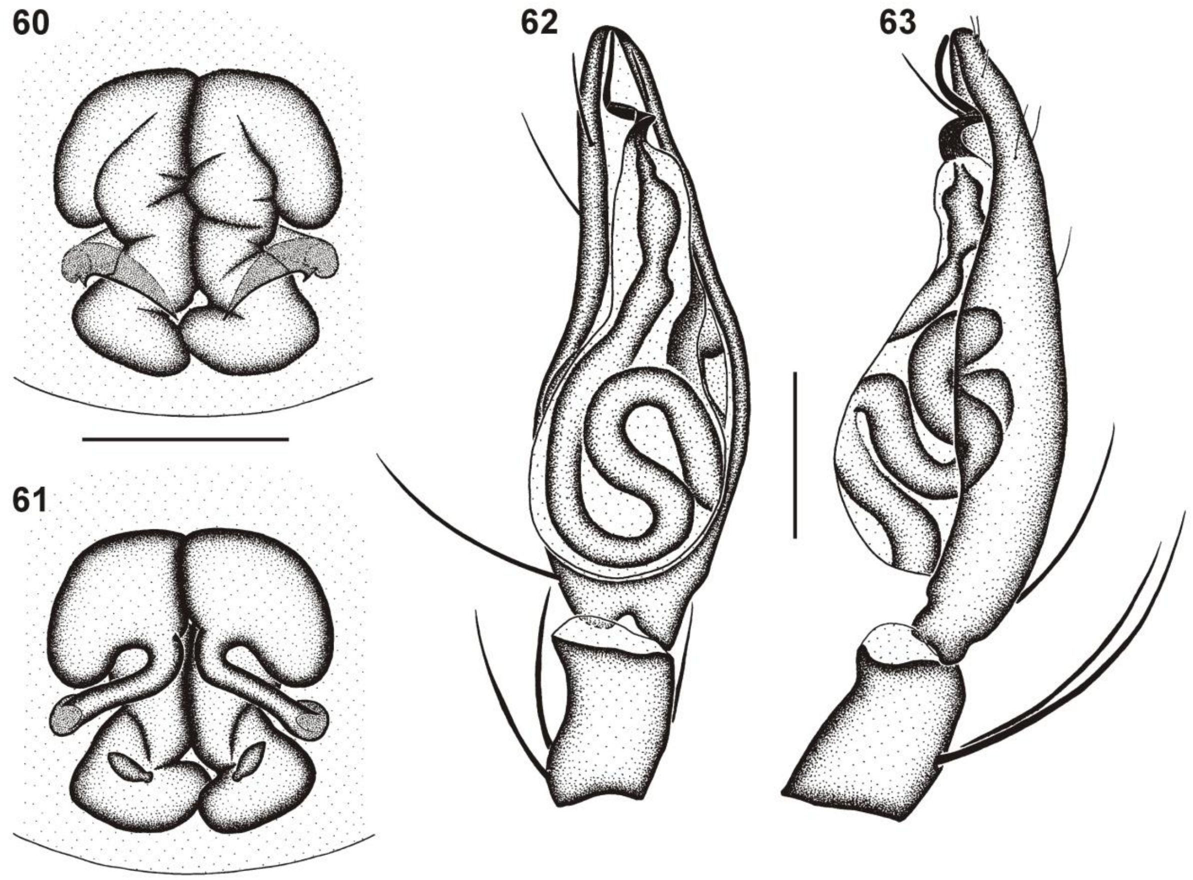
Female (Masako, MRAC 211804). Measurements: CL 2.13, CW 1.65, AL 3.05, AW 2.38, TL 5.28 (4.15–5.70), FL 0.28, SL 1.05, SW 0.98, AME–AME 0.08, AME–ALE 0.02, ALE–ALE 0.36, PME–PME 0.11, PME–PLE 0.09, PLE–PLE 0.44, PERW 0.60, MOQAW 0.33, MOQPW 0.36, MOQL 0.42.

Length of leg segments: I 1.85 + 0.65 + 1.45 + 1.40 + 0.73 = 6.08; II 1.83 + 0.65 + 1.40 + 1.38 + 0.70 = 5.96; III 1.70 + 0.63 + 1.38 + 1.50 + 0.70 = 5.91; IV 2.10 + 0.70 + 1.68 + 2.15 + 0.78 = 7.41.

General appearance as in Fig. 5. Carapace creamy-yellow, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, with fine black T-shaped marking on posterior slope of carapace; lateral margins black, with broad stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ⅔ their diameter; AME separated from ALE by distance approximately $^{1}/_{10}$ AME diameter; clypeus height equal to 1$^{4}/_{5}$ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to ⅔ their diameter; PME separated from PLE by distance equal to ⅔ PME diameter; CW:PERW = 2.75:1. Chelicerae creamy-yellow, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth much larger than proximal; retromargin with two adjacent subequal teeth, distal tooth slightly larger than proximal tooth, close to fang base. Endites and sternum cream, without markings; labium yellow, white distally, with transverse black marking along proximal margin. Legs creamy-yellow, spine bases with distinct black spot; femora with small paired markings dorsally at distal end and incomplete ventral ring distally; patellae with black marking along distal end, marking extending retrolaterally, surrounding patellar indentation; tibiae with black mottled lateral markings proximally, medially and distally, corresponding to paired spines, distal ends black dorsally; metatarsi with incomplete rings proximally, medially and distally, corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with two rows of erect ve setae; patellae: all with one do terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 1 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv 1 and rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with small yellow dorsal scutum extending ¼ abdomen length; dorsum cream, with mottled black markings anteriorly, medially and laterally; black plumose setae on markings, white plumose setae surrounding them; venter creamy, covered in short straight setae with scattered longer setae, especially posteriorly, with grey subrectangular marking medially. Epigyne with curved lateral ridges at midpoint of epigyne, directed obliquely, separated by approximately ⅓ their width, with copulatory openings situated laterally in ridges (Fig. 60); copulatory ducts initially straight, nearly transverse, curving anteriorly at right angle medially, entering oval anterior ST II that are expanded posterolaterally; broad ducts connecting ST II to broad, kidney-shaped posterior ST I; ST I nearly as broad as ST II (Fig. 61).

Male (Nioka, MRAC 174297). Measurements: CL 1.83, CW 1.48, AL 1.90, AW 1.07, TL 3.65 (3.00–3.65), FL 0.20, SL 0.85, SW 0.82, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.29, PME–PME 0.11, PME–PLE 0.06, PLE–PLE 0.35, PERW 0.50, MOQAW 0.28, MOQPW 0.31, MOQL 0.38.

Length of leg segments: I 1.65 + 0.55 + 1.30 + 1.33 + 0.68 = 5.51; II 1.62 + 0.54 + 1.23 + 1.28 + 0.65 = 5.32; III 1.48 + 0.50 + 1.18 + 1.35 + 0.64 = 5.15; IV 1.83 + 0.55 + 1.48 + 1.85 + 0.72 = 6.43.



FIGURES 60–63. Genitalic morphology of *Echinax longespina* (Simon, 1909): 60. female epigyne, ventral view; 61. same, dorsal view; 62. male palp, ventral view; 63. same, retrolateral view. Scale bars = 0.25mm.

General appearance as in Fig. 6, male more slender and smaller than female. Carapace creamy-yellow, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, broken up by asetose line medially from PME to midpoint and asetose lines directed towards coxae II and III; fine black line from posterior of fovea to posterior margin of carapace; lateral margins black, with broad stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance approximately 1⁄10 AME diameter; clypeus height equal to 1¼ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance approximately equal to ⅔ PME diameter; CW:PERW = 2.96:1. Chelicerae cream, with curved setae on promargin not pectinate; two closely spaced teeth on promargin, distal tooth much larger than proximal; retromargin with two adjacent teeth, distal tooth slightly larger, close to fang base. Endites, labium and sternum cream, without markings. Legs cream, spine bases with distinct black spot; femora all with incomplete black ventral ring distally; patellae with black marking distally, marking extending retrolaterally, surrounding patellar indentation; tibiae all with faint black mottling laterally; metatarsi with black rings proximally, medially and distally, corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with two rows of erect ve setae; patellae: all with one do terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 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 2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3-4. Palpal spination: femora: pl 1 do 2 rl 1, with two rows of erect ventral setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with scutum covering ¾ of dorsum; dorsum cream, with broad black median stripe from anterior to ⅓ abdomen length, X-shaped marking at ¾ abdomen length, and black mottling laterally; dorsum covered predominantly with black plumose setae on markings, with yellow plumose setae between them; venter cream, with broad black stripe from pedicel to epigastric groove and rectangular median marking between epigastric groove and spinnerets. Male palp cream, cymbium yellow-brown, with a few thickened straight setae dorsally in distal ⅓ (Fig. 63); tegulum pear-shaped, yellow-brown with dark brown ducts; embolus shorter than congeners, with narrow base and 1½ coils, proximal coil nearly transverse, distal section straight; longitudinal distance from retrolateral bend to prolateral bend less than ⅓ the distance from prolateral bend to embolus tip (Figs 47, 62).

Material examined: D.R. CONGO: *Bas-Congo*: Mayombe, Luki Forest Reserve, 05°37'S, 13°05'E, 266m a.s.l., leg. D. de Bakker & J.-P. Michiels, 12.XI.2006 (primary rainforest, fogging 4), 2♂ (MRAC 220929); Same locality, leg. D. de Bakker & J.-P. Michiels, 16.IX.2007 (young secondary rainforest), 1♀ (MRAC 236902); Same locality, leg. D. de Bakker & J.-P. Michiels, 14.IX.2007 (canopy fogging, secondary rainforest), 1♀ (MRAC 230764); Same data, 19.IX.2007, 1♂ 1♀ (MRAC 230768); Same data, 19.XI.2005, 1♀ (MRAC 236915); Same data, 24.IX.2007, 2♂ (MRAC 230772); Same data, 25.IX.2007, 2♀ (MRAC 236905); Same data, 28.IX.2007, 1♂ 2♀ (MRAC 230767) ; Same locality, leg. D. de Bakker & J.-P. Michiels, 16.IX.2007, 1♂ (MRAC 230765). *Equateur*: Eala, 00°03'N, 18°19'E, leg. J. Ghesquière, I.1936, 1♂ 1♀ (MRAC 22909). *Ituri*: Djugu, 01°56'N, 30°30'E, leg. H.J. Bredo, 1.V.1937, 1♂ 1♀ (MRAC 174298); Nioka, 02°10'N, 30°40'E, leg. J. Leroy, IX.1932, 1♂ (MRAC 174297). *Kivu*: Costermansville, 02°29'S, 28°51'E, leg. H.J. Bredo, 2.III.1937, 1♀ (MRAC 174281); Kasenyi, 01°24'N, 30°26'E, leg. H.J. Bredo, 1.IX.1939, 1imm. 1♂ (MRAC 22939); N'Gesho [01°17'S, 29°07'E], leg. J. Ghesquière, IX.1937, 1♀ (MRAC 22904); Rutshuru, 01°11'S, 29°27'E, leg. J. Ghesquière, V.1937, 3♂ 8♀ (MRAC 174286); Sake, 01°34'S, 29°02'E, leg. J. Ghesquière, V.1937, 2♂ 2♀ (MRAC 174291). *Tshopo*: Masako, 00°35'N, 25°11'E, leg. J. Juakaly, 25.VII.2001 (young fallow), 1♀ (MRAC 211804); Same locality, leg. J. Ghesquière, V.1937, 2♂ 2♀ (MRAC 174307). **GABON:** Mey, 1imm. 2♀

(MNHN 17466). **GHANA:** Kakum forest, 05°20'N, 01°23'W, leg. R. Jocqué, D. de Bakker & L. Baert, 11.XI.2005 (primary forest), 1♀ (MRAC 217305); Same locality, leg. R. Jocqué, D. de Bakker & L. Baert, 14.XI.2005 (fogging, primary forest), 2♀ (MRAC 236919); Same data, 16.XI.2005, 1♂ (MRAC 218255); Same locality, leg. R. Jocqué, D. de Bakker & L. Baert, 19.XI.2005 (fogging, secondary forest), 17.XI.2005, 3♀ (MRAC 218258); Same data, 22.XI.2005, 1♂ 1♀ (MRAC 236921). **IVORY COAST:** Mankono, Ranch de la Marahoué, 08°27'N, 06°52'W, leg. J. Everts, II.1980 (riverine forest), 1♀ (MRAC 172271). **KENYA:** Western region, Kakamega Forest, Lirhanda Hills, 00°13'N, 34°54'E, leg. D. Shilabira Smith, 22.VI.2002 (pitfall trap), 1♀ (MRAC 220191); Same locality, 1625m a.s.l., leg. D. Shilabira Smith, 21.II.2002 (pitfall near quarry), 1♂ (MRAC 212699); Same locality, 00°22'N, 34°50'E, 1600m a.s.l., leg. W. Freund, I–II.2003 (fogging, *Teclea nobilis*), 1♂ (ZFMK Ar1166). **LIBERIA:** Bong Range Forest, 06°49'N, 10°17'W, leg. D. Flomo, 15.I.2006 (pitfalls in rain forest), 1♀ (MRAC 219374). **SENEGAL:** Dakar, Gibraltar [14°41.20'N, 17°26.63'W], leg. W. Settle, 30.IX.1982, 1♀ (CAS, CASENT 9033171). **TANZANIA:** *Iringa Region*: Mufindi District, Uzungwa Scarp Forest Reserve, 08°31.58'S, 35°54.00'E, 750m a.s.l., leg. McKamey *et al.*, 16.III.1996 (canopy fogging sample 39), 1♂ (ZMUC). *Kilimanjaro Region*: Mkomazi Game Reserve, leg. G. McGavin, 12.I.1996 (fogging, *Craibia brownii*, tropical savanna), 1♀ (OUMNH); Same locality, leg. G. McGavin, 12.I.1996 (fogging, *Heywoodia lucens*, tropical savanna), 1♂ (OUMNH); Same locality, leg. G. McGavin, 12.I.1996 (fogging, *Ochna holstii*, tropical savanna), 1♂ 1♀ (OUMNH). *Pwani Region*: Muheza District, Kwamgumi Forest Reserve, 04°57'S, 38°44'E, 170–220m a.s.l., leg. S. McKamey, 22.VII.1995 (canopy fogging sample 9), 1♀ (ZMUC); Same locality, leg. S. McKamey, 26.VII.1995 (canopy fogging sample 12), 2♂ (ZMUC); Same locality, leg. S. McKamey, 31.X.1995 (canopy fogging sample 13), 3♂ (ZMUC); Same locality, leg. S. McKamey, 2.XI.1995 (canopy fogging sample 14), 1♂ (ZMUC); Same locality, leg. S. McKamey, 5.XI.1995 (canopy fogging sample 16), 2♂ (ZMUC). **UGANDA:** Queen Elisabeth National Park, leg. D. Penney, VII.1994, 1♀ (MRAC 219707).

Distribution: Widespread throughout tropical equatorial Africa, from Kenya and Tanzania in the east to Senegal in the west (Fig. 68).

Biology: Much of the material was collected by canopy fogging and beating, with isolated records from pitfall traps. This suggests a primarily arboreal lifestyle. Specimens were collected in tropical forests and savannas from a wide variety of tree species, suggesting a wide habitat and vegetative structure tolerance.

8.4.4 *Echinax natalensis* sp. nov.

Figs 7, 8, 17–28, 35–42, 48, 65–68

Etymology: The species is named for *terra typica*, KwaZulu-Natal Province in South Africa.

Diagnosis: Females can be distinguished by the broad copulatory hoods that meet medially in the epigyne (Figs 41, 65) and the copulatory ducts with a nearly perpendicular bend (Fig. 66). Males can be recognised by the broad, evenly oblique embolus base and the long fine distal coil of the embolus (Figs 48, 67).

Female (holotype, Hell's Gate, NCA 2005/241). Measurements: CL 1.90, CW 1.50, AL 3.15, AW 2.18, TL 4.70 (4.25–4.85), FL 0.24, SL 0.95, SW 0.93, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.30, PME–PME 0.11, PME–PLE 0.06, PLE–PLE 0.37, PERW 0.51, MOQAW 0.29, MOQPW 0.30, MOQL 0.35.

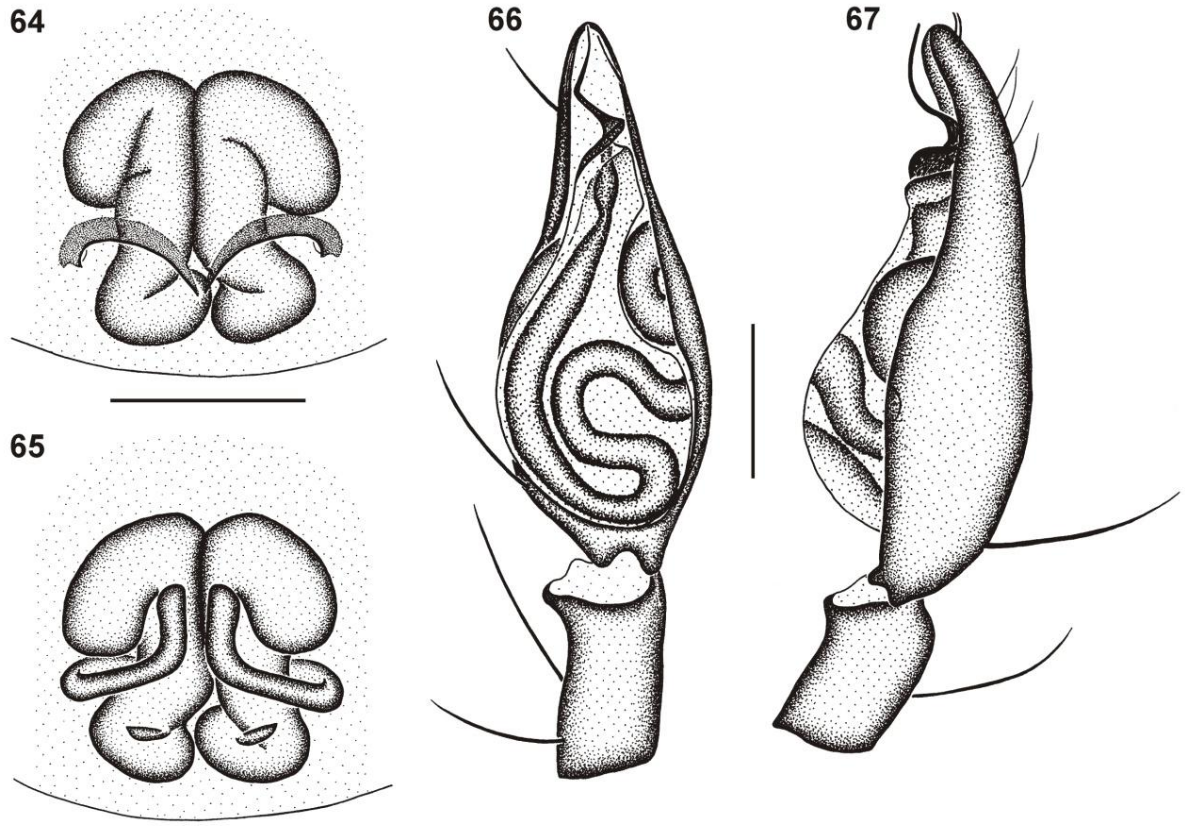
Length of leg segments: I 1.68 + 0.61 + 1.25 + 1.28 + 0.68 = 5.50; II 1.64 + 0.60 + 1.20 + 1.24 + 0.65 = 5.33; III 1.53 + 0.56 + 1.18 + 1.38 + 0.64 = 5.29; IV 1.85 + 0.63 + 1.53 + 1.88 + 0.73 = 6.62.

General appearance as in Fig. 7. Carapace cream, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, broken up by asetose line medially from PME to midpoint and asetose V-shaped marking from fovea; lateral margins black, with broad stripe of black plumose setae from coxa I to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height equal to 1½ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to their diameter; PME separated from PLE by distance approximately equal to ⅔ PME diameter; CW:PERW = 2.94:1. Chelicerae cream, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth much larger than proximal; retromargin with two adjacent teeth, distal tooth slightly larger than proximal tooth, close to fang base. Endites, labium and sternum cream, labium with transverse black marking along proximal margin. Legs cream, spine bases with distinct black spot, less pronounced on femora; femora with black marking dorsally at distal end and black ventral marking distally; patellae with black marking dorsally at distal end, marking extending retrolaterally, surrounding patellar indentation; tibiae with incomplete black ring medially and complete black ring distally; metatarsi with complete black rings proximally and distally, incomplete black ring medially, all corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with two rows of erect ve setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 1 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv 1 and rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with small dorsal scutum extending ¼ abdomen length; dorsum cream, with broad mottled black markings anteriorly, medially and laterally; black plumose setae on markings, white plumose setae surrounding them; venter creamy, covered in short straight setae with scattered longer setae, without markings. Epigyne with long, broad curved ridges at midpoint of epigyne, nearly touching medially, with copulatory openings situated laterally in ridges (Figs 41, 65); copulatory ducts initially straight, nearly transverse, curving medially at nearly a right angle, entering oval anterior ST II that are expanded posterolaterally; broad ducts connecting ST II to broad, kidney-shaped posterior ST I; ST I clearly narrower than ST II (Fig. 66).

Male (paratype, Ndumo, TMSA 23830). Measurements: CL 1.90, CW 1.53, AL 2.18, AW 1.21, TL 4.00 (3.80–4.00), FL 0.24, SL 0.93, SW 0.90, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.31, PME–PME 0.12, PME–PLE 0.06, PLE–PLE 0.34, PERW 0.50, MOQAW 0.29, MOQPW 0.31, MOQL 0.35.

Length of leg segments: I 1.70 + 0.59 + 1.34 + 1.41 + 0.68 = 5.72; II 1.66 + 0.58 + 1.28 + 1.35 + 0.65 = 5.52; III 1.53 + 0.56 + 1.23 + 1.45 + 0.64 = 5.41; IV 1.90 + 0.61 + 1.54 + 2.05 + 0.74 = 6.84.

General appearance as in Fig. 8, male more slender and smaller than female. Carapace cream, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, broken up by asetose line from PME to midpoint and asetose V-shaped marking from fovea; fine black stripe from fovea to posterior margin of carapace; lateral margins black, with broad stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height equal to 1¾ AME diameter; PER strongly procurved, medians very slightly larger than laterals; PME separated by distance equal to 1¼ their diameter; PME separated from PLE by distance approximately equal to ⅔ PME diameter; CW:PERW = 3.06:1. Chelicerae cream, with curved setae on promargin not pectinate; two slightly separated teeth on promargin, distal tooth larger than proximal; retromargin with two closely separated teeth, subequal in size, distal tooth slightly larger, close to fang base.



FIGURES 64–67. Genitalic morphology of *Echinax natalensis* **sp. nov.**: 64. female epigyne, ventral view; 65. same, dorsal view; 66. male palp, ventral view; 67. same, retrolateral view. Scale bars = 0.25mm.

Endites, labium and sternum cream, labium with transverse black marking along proximal margin. Legs cream, spine bases with distinct black spot; femora all with ventral black marking distally; patellae all with black distal marking dorsally, marking extending retrolaterally, surrounding patellar indentation; tibiae all with faint black mottling laterally at midpoint and distally; metatarsi with black rings proximally, medially and distally, corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with two rows of erect ve setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with two rows of erect ventral setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with scutum extending just beyond midpoint of dorsum; dorsum cream, with black inverted V-shaped marking anteriorly, small marking at ¼ abdomen length, X-shaped marking at ¾ abdomen length, and lateral margins mottled black; dorsum with black plumose setae on markings, yellowish plumose setae between them, with scattered straight setae posteriorly and white plumose setae laterally; venter cream, without markings. Male palp cream, cymbium yellow-brown, with a few thickened straight setae dorsally in distal ⅓ (Fig. 68); palpal femora and patellae each with distal retrolateral black spot; tegulum pear-shaped, orange-brown with deep red-brown ducts; embolus long, with broad, straight oblique base and 1½ coils, distal section curved; longitudinal distance from retrolateral bend to prolateral bend slightly more than $^2/_5$ the distance from prolateral bend to embolus tip (Figs 42, 48, 67).

Type material: Holotype ♀: **SOUTH AFRICA:** *KwaZulu-Natal*: iSimangaliso Wetlands Park [Greater St. Lucia Wetlands Park], Hell's Gate, Block A, leg. J. Esterhuizen, 19.IV.2004 (tsetse fly traps) (NCA 2005/241). Paratypes: **SOUTH AFRICA:** *KwaZulu-Natal*: iSimangaliso Wetlands Park, False Bay Park, leg. J. Esterhuizen, 29.IX.2003 (tsetse fly traps), 1imm. 1♂ (NCA 2004/767); Same data, 13.X.2003, 2♂ (NCA 2004/772); Same data, 3.XII.2003, 1imm. 2♀ (NCA 2004/788); Same data, 8.XII.2003, 1♂ (NCA 2004/785); Same data, 15.XII.2003, 1♂ (NCA 2004/792); Same data, 12.I.2004, 1♂ (NCA 2004/773), 1♀ (NCA 2004/784); iSimangaliso Wetlands Park, Hell's Gate, leg. J. Esterhuizen, 19.I.2003 (tsetse fly traps), 3♂ (NCA 2004/815); Same data, 3.V.2004, 1imm. 1♂ 4♀ (NCA 2005/243); Same data, 31.V.2004, 1♂ 2♀ (NCA 2005/244); iSimangaliso Wetlands Park, Hell's Gate, Block B, leg. J. Esterhuizen, 7.VI.2004 (tsetse fly traps), 1 imm. 1♂ 1♀ (NCA 2005/246); Same data, 6.IX.2004, 1♂ (NCA 2005/254); Same data, 4.X.2004, 3♂ (NCA 2005/257); Same data, 15.XI.2004, 1♂ 1♀ (NCA 2005/259); Same data, 6.XII.2004, 1♂ (NCA 2005/261); iSimangaliso Wetlands Park, Hell's Gate, Block C, leg. J. Esterhuizen, 26.IV.2004 (tsetse fly traps), 1♂ (NCA 2005/242); iSimangaliso Wetlands Park, Fanie's Island, leg. M. Filmer, 23.VI.1990 (beating low forest bush), 1♂ (NCA 97/729); Ndumo Game Reserve, Pongola River floodplain, near pump, Riverine forest, 26°54.323'S, 32°19.435'E, leg. C. Haddad, 27.VI.2006 (beating foliage), 1imm. 1♂ (NCA 2006/1222); Same locality, Pongola River, Water pump, Riparian forest, 26°54.309'S, 32°19.444'E, 36m a.s.l., leg. C. Haddad, R. Lyle, V. Butler, 2.VII.2009 (canopy fog 5, *Breonadia salicina*), 1♂ (TMSA 23830).

Additional material examined: none.

Distribution: Presently known only from northern KwaZulu-Natal Province (Maputaland), South Africa (Fig. 68).

Biology: Most of the material initially examined and recognised as a new species of *Echinax* was collected in tsetse fly traps in coastal forest. Recent canopy fogging and beating in the Ndumo Game Reserve yielded specimens from *Breonadia salicina* trees in riparian forest.

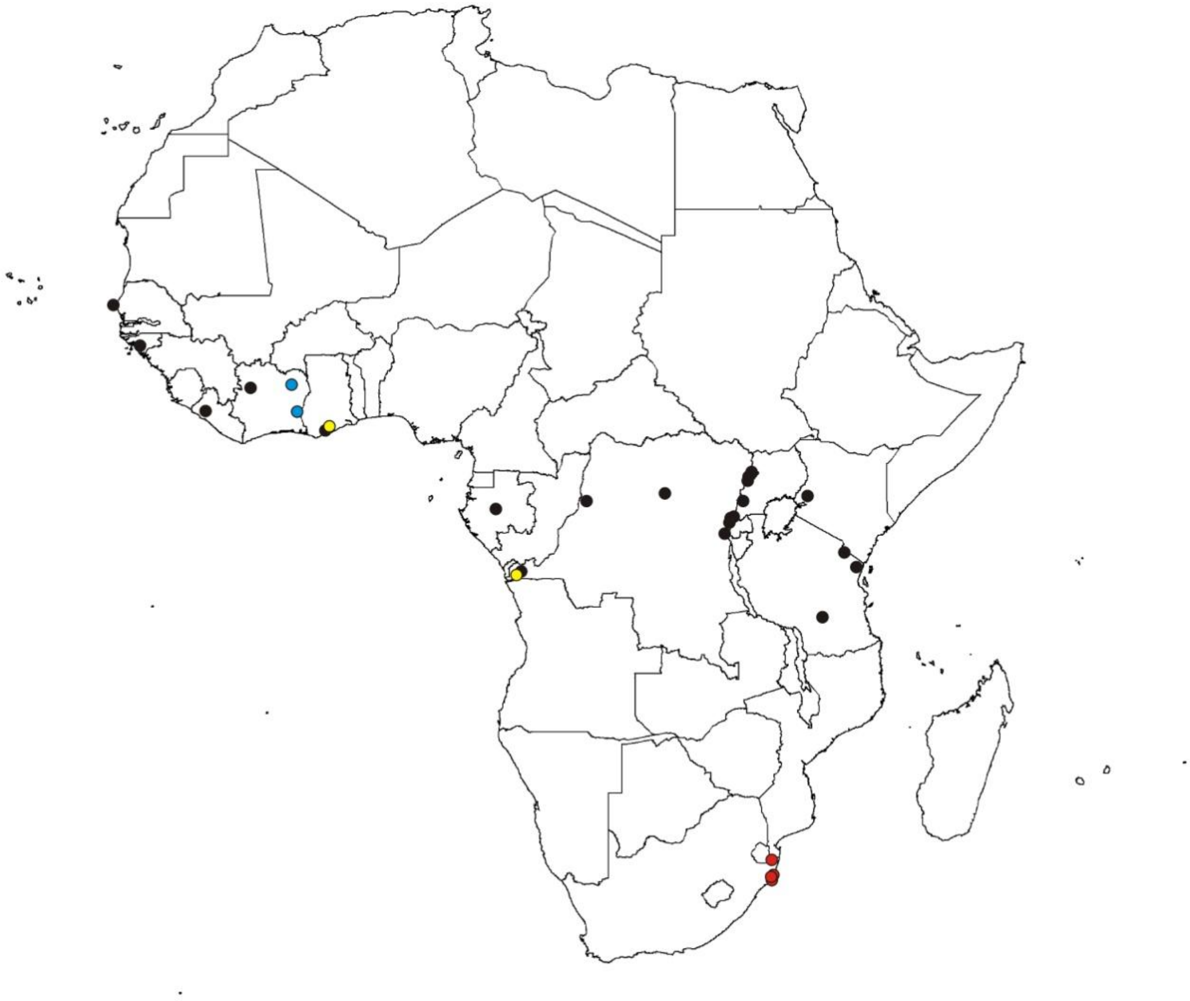


FIGURE 68. Distribution of *Echinax clara* **sp. nov.** (yellow circles), *E. hesperis* **sp. nov.** (blue circles), *E. longespina* (Simon, 1909) (black circles) and *E. natalensis* **sp. nov.** (red circles) in Africa.

8.4.5 *Echinax scharffi* sp. nov.

Figs 9, 10, 49, 69–72

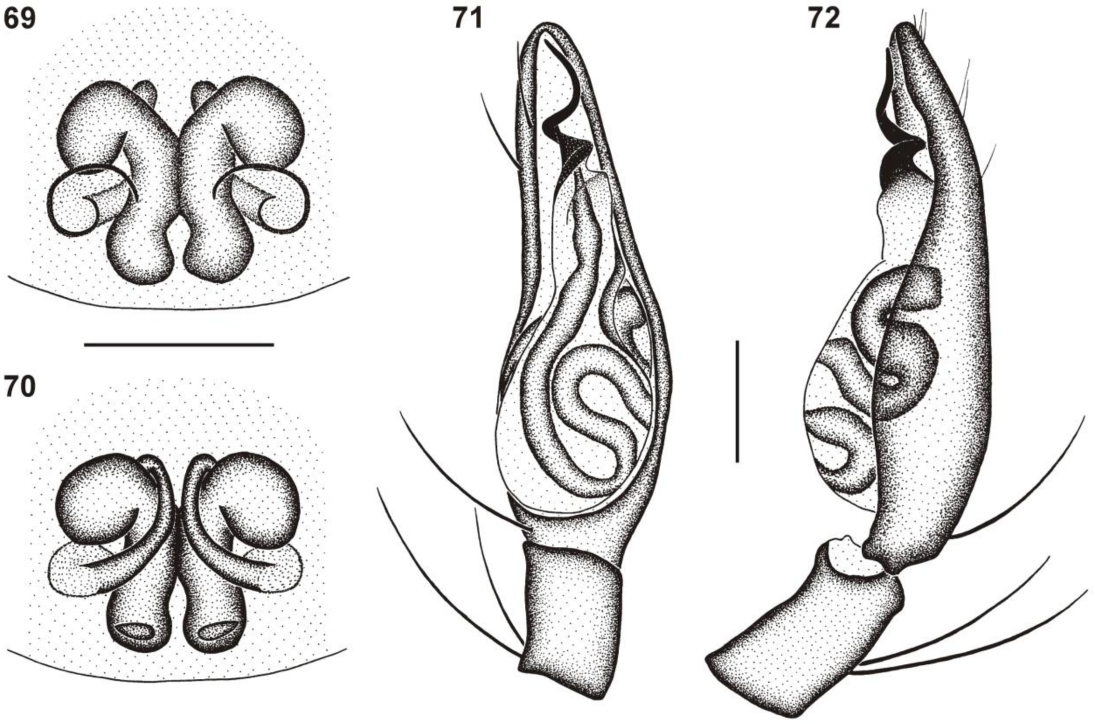
Etymology: The species is named after Nikolaj Scharff in recognition of his contributions to the collection and study of the Tanzanian spider fauna.

Diagnosis: This species is most closely related to the Asian species (see Deeleman-Reinhold 2001), particularly *E. oxyopoides*, in having the copulatory ducts entering ST II anteriorly (Fig. 70), and can be easily separated from the other Afrotropical species, in which the ducts enter ST II medially along their posterior margin. Males can be recognised by the more strongly curved distal section of the embolus than the other Afrotropical species (Figs 49, 71).

Female (holotype, Kwamgumi, ZMUC). Measurements: CL 1.88, CW 1.52, AL 2.50, AW 1.75, TL 4.40 (4.10–5.55), FL 0.23, SL 0.95, SW 0.93, AME–AME 0.07, AME–ALE 0.02, ALE–ALE 0.32, PME–PME 0.14, PME–PLE 0.06, PLE–PLE 0.38, PERW 0.54, MOQAW 0.32, MOQPW 0.33, MOQL 0.35.

Length of leg segments: I 1.85 + 0.64 + 1.40 + 1.38 + 0.70 = 5.97; II 1.80 + 0.60 + 1.35 + 1.38 + 0.63 = 5.76; III 1.63 + 0.59 + 1.31 + 1.45 + 0.63 = 5.61; IV 1.93 + 0.63 + 1.51 + 1.95 + 0.70 = 6.72.

General appearance as in Fig. 9. Carapace cream, eye region black except between PME; distinct Y-shaped marking to the anterior of fovea and black striae radiating from fovea, together forming heart-shaped marking in centre of carapace; lateral margins with broad black marking, narrowed between coxae I and II; all markings covered in black plumose setae, with scattered white setae between them, especially along midline. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly larger than ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height slightly less than 1½ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to 1¼ their diameter; PME separated from PLE by distance slightly less than ⅔ PME diameter; CW:PERW = 2.81:1. Chelicerae cream with black spot laterally on anterior surface, with pectinate curved setae on promargin; two slightly separated teeth on promargin, distal tooth larger than proximal; retromargin with two adjacent teeth, distal tooth slightly larger than proximal tooth, close to fang base. Endites and sternum cream, without markings; labium cream, with black transverse marking along proximal margin. Legs cream, spine bases with large black spot; coxae I–III with small black stripe on prolateral side, coxa IV uniform cream; trochanters with incomplete distal black ring dorsally and laterally; femora with black paired lateral spots proximally, incomplete dorsal ring at first dorsal spine, complete ring at ⅔ femur length and incomplete ventral distal ring; patellae with broad black proximal dorsal ring, distal margin black, markings joined by black retrolateral stripe enveloping patellar indentation; tibiae with lateral spots medially and distally; metatarsi with proximal, median and distal black rings, corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with two rows of erect ve setae; patellae: all with one do terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 2-3 rlv 2, III pl 2 do 1 rl 1 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 1-2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 3 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3-4.



FIGURES 69–72. Genitalic morphology of *Echinax scharffi* **sp. nov.**: 69. female epigyne, ventral view; 70. same, dorsal view; 71. male palp, ventral view; 72. same, retrolateral view. Scale bars = 0.25mm.

Palpal spination: femora: pl 1 do 2 rl 1, with plv 1 and rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3. Abdomen with small dorsal scutum extending ¼ abdomen length; dorsum cream, with broad black rectangular marking extending to middle of abdomen, black star-shaped marking at ⅔ abdomen length, fused laterally to irregular black marking along lateral margins; white plumose setae covering dorsum and lateral margins; venter cream, covered in short straight setae with scattered longer setae posteriorly and white plumose setae to the sides. Epigyne with large 6-shaped lateral ridges at midpoint of epigyne, separated by distance slightly less than their width, with copulatory openings situated prolaterally in ridges (Fig. 69); copulatory ducts long, curving medially and anteriorly, entering oval anterior ST II along their anterior margin; broad ducts connecting ST II to narrow elongate ST I; ST I approximately ½ as broad as ST II (Fig. 70).

Male (paratype, Kwamgumi, ZMUC). Measurements: CL 1.77, CW 1.40, AL 2.05 AW 1.10, TL 3.78 (3.60–4.35), FL 0.21, SL 0.88, SW 0.84, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.31, PME–PME 0.13, PME–PLE 0.05, PLE–PLE 0.36, PERW 0.51, MOQAW 0.30, MOQPW 0.32, MOQL 0.36.

Length of leg segments: I 1.90 + 0.60 + 1.58 + 1.45 + 0.70 = 6.23; II 1.81 + 0.59 + 1.45 + 1.43 + 0.69 = 5.97; III 1.68 + 0.58 + 1.34 + 1.49 + 0.65 = 5.74; IV 1.93 + 0.59 + 1.58 + 1.98 + 0.75 = 6.83.

General appearance as in Fig. 10, male more slender and smaller than female. Carapace cream, eye region black except between PME; distinct Y-shaped marking to the anterior of fovea and black striae radiating from fovea, darker distally, together forming heart-shaped marking in centre of carapace; lateral margins with broad black marking, narrowed between coxae I and II; all markings covered in black plumose setae, with scattered white setae between them. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly more than ⅓ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height equal to 1⅓ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance slightly less than 1½ times their diameter; PME separated from PLE by distance slightly less than ½ PME diameter; CW:PERW = 2.75:1. Chelicerae cream with black spots pro- and retrolaterally proximally on their anterior surface, black line along their interior surface from fang furrow to base of chelicerae, with curved setae on promargin not pectinate; two closely spaced teeth on promargin, distal tooth larger than proximal; retromargin with two adjacent teeth, subequal in size, distal tooth close to fang base. Endites and sternum cream, without markings; labium cream, with broad black transverse marking along proximal margin. Legs cream, spine bases with large black spot; coxae with small black spot on prolateral side; trochanters with incomplete distal black ring dorsally and laterally; femora with paired lateral spots proximally, incomplete dorsal ring at first dorsal spine, complete ring at ⅔ femur length and incomplete ventral distal ring, markings fused retrolaterally; patellae with broad black proximal dorsal ring, small prolateral black blotch, distal margin black, proximal and distal markings joined by black retrolateral stripe enveloping patellar indentation; tibiae with lateral spots medially and distally, more distinct retrolaterally; metatarsi with complete proximal, median and distal black rings. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with two rows of erect ve setae; patellae: all with one do terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 3 rl 3 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with two rows of erect ventral setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with scutum extending ¾ dorsal length; dorsum and sides mottled black with two pairs of cream spots, first anterolaterally, second at a ⅓ abdomen length medially, with broad cream marking medially at ⅔ abdomen length; markings covered with black and white plumose setae, with yellowish plumose setae between them; venter cream, with broad black stripe along midline from epigastric furrow to spinnerets; venter covered in short straight setae with scattered long straight setae. Male palp cream, cymbium yellow-brown, with a few thickened straight setae dorsally in distal ⅓ (Fig. 72); tegulum pear-shaped, yellow-brown with dark brown ducts; embolus long, with broad base and 1½ coils, distal section strongly curved; longitudinal distance from retrolateral bend to prolateral bend only ¼ the distance from prolateral bend to embolus tip (Figs 49, 71).

Type material: Holotype ♀: **TANZANIA:** *Tanga*: Muheza District, Kwamgumi Forest Reserve, 04°57'S, 38°44'E, 170–220m a.s.l., leg. S. McKamey, 18.VII.1995 (canopy fog 7) (ZMUC).
Paratypes: **TANZANIA:** *Tanga*: Lushoto District, Mazumbai Forest Reserve, 04°49'S, 38°29'E, 1650–1730m a.s.l., leg. S. McKamey, 20.XI.1995 (canopy fog 24), 1♀ (ZMUC); Muheza District, Kwamgumi Forest Reserve, 04°57'S, 38°44'E, 170–220m a.s.l., leg. S. McKamey, 26.VII.1995 (canopy fog 12), 3♂ 2♀ (ZMUC); Same locality, leg. S. McKamey, 2.XI.1995 (canopy fog 14), 2♂ (ZMUC); Same locality, 5.XI.1995, leg. S. McKamey (canopy fog 16), 2♂ (ZMUC); Muheza District, Segoma Forest Reserve, 04°59'S, 38°44'E, 210m a.s.l., leg. S. McKamey, 11.XI.1995 (canopy fog 20), 1♂ (ZMUC).

Additional material examined: none.

Distribution: Known only from eastern Tanzania (Fig. 81).

Biology: Collected almost exclusively by canopy fogging in tropical forests with elevations ranging from 170–1730m a.s.l.

8.4.6 *Echinax similis* sp. nov.

Figs 11, 12, 29–34, 43, 44, 50, 73–76

Etymology: Derived from the Latin for similar, referring to the close resemblance of the genitalia to those of *E. spatulata* **sp. nov.**.

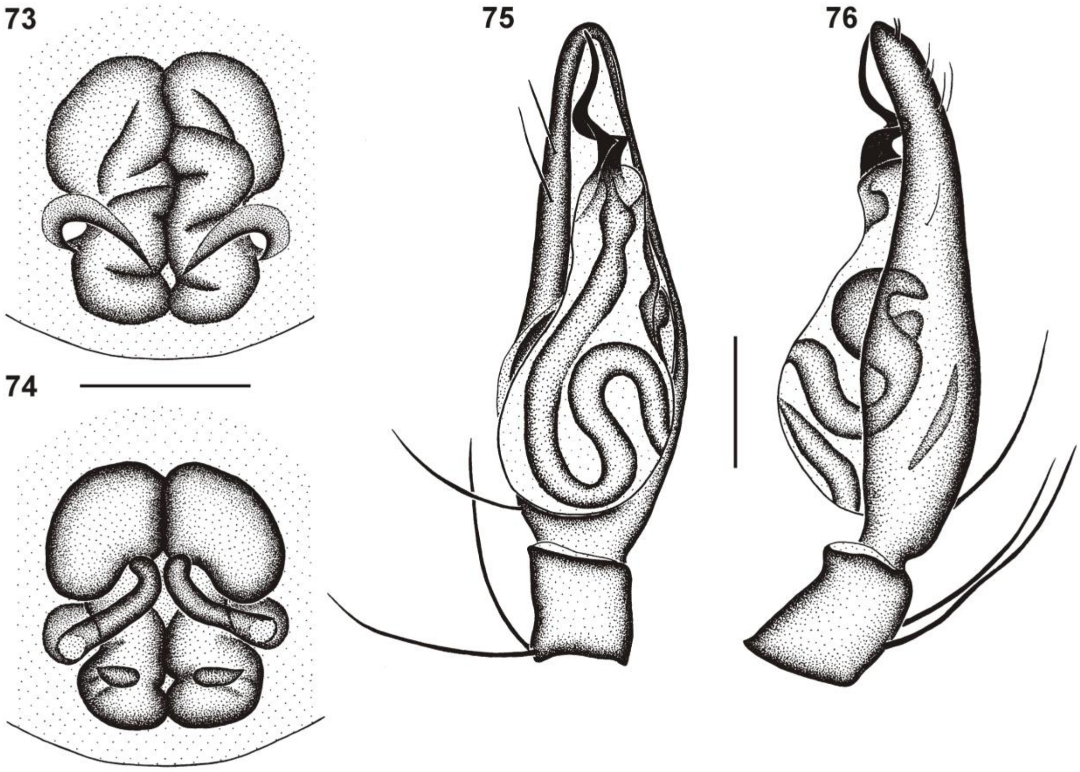
Diagnosis: This species closely resembles *E. spatulata* **sp. nov.** in colour and genitalic morphology. Females can be recognised from the latter species by the shorter ST II, oblique copulatory ducts and more strongly curved epigynal hoods (Figs 43, 73). Males can be recognised by the absence of spatulate setae on the palpal cymbium and the much broader embolus base (compare Figs 50 and 51).

Female (holotype, Ndumo, TMSA 23829). Measurements: CL 2.25, CW 1.73, AL 3.40, AW 2.48, TL 5.60 (3.85–5.60), FL 0.30, SL 1.05, SW 1.03, AME–AME 0.07, AME–ALE 0.02, ALE–ALE 0.37, PME–PME 0.13, PME–PLE 0.07, PLE–PLE 0.42, PERW 0.61, MOQAW 0.36, MOQPW 0.37, MOQL 0.40.

Length of leg segments: I 2.08 + 0.68 + 1.60 + 1.55 + 0.79 = 6.70; II 1.92 + 0.69 + 1.50 + 1.54 + 0.78 = 6.43; III 1.83 + 0.68 + 1.48 + 1.65 + 0.74 = 6.38; IV 2.25 + 0.73 + 1.85 + 2.35 + 0.85 = 8.03.

General appearance as in Fig. 11. Carapace cream, eye region black except between PME; broad median band of black plumose setae from PER to posterior slope, broken up by asetose line from PME to midpoint and asetose Y-shaped marking from fovea; two mottled black Y-shaped markings present, first larger, to anterior of fovea, second smaller, on posterior margin of carapace, markings joined along midline by black line covering fovea; lateral margins black, markings expanded from coxae, with broad stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height equal to 1⅓ AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance slightly larger than their diameter; PME separated from PLE by distance slightly less than ⅔ PME diameter; CW:PERW = 2.83:1. Chelicerae cream, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth larger than proximal; retromargin with two adjacent subequal teeth, distal tooth larger than proximal tooth, close to fang base. Endites, labium and sternum cream, labium with transverse black marking along proximal margin. Legs cream, spine bases with distinct large black spot; femora all with black retrolateral spot at ⅓ their length and black ventral marking distally; patellae black dorsally and laterally at distal end, marking extended retrolaterally, surrounding patellar indentation but broken medially at patellar indentation expansion; tibiae with faint mottling laterally; metatarsi with proximal, medial and distal rings, corresponding to paired leg spines; palp cream, all femoral spines with black spots, only lateral patellar, tibial and tarsal spines with spots. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with two rows of erect ve setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3-4 rlv 1-2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2-3 rlv

2, IV pl 2 do 1 rl 2 plv 2 rlv 1 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv 1 and rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 4 rlv 3. Abdomen with small dorsal scutum extending less than ¼ abdomen length; dorsum cream, with narrow black marking anteriorly, black X-shaped marking just behind midpoint, lateral margins with irregularly black mottling; black plumose setae on markings, white plumose setae surrounding them and along lateral margins of abdomen; venter creamy-grey, covered in short straight setae with scattered longer setae, with black subrectangular marking medially. Epigyne with strongly curved ridges at midpoint of epigyne, separated by approximately ½ their width, with copulatory openings distinct, situated laterally in ridges (Figs 43, 73); copulatory ducts initially straight, oblique, curving sharply medially, entering oval anterior ST II that are projected posteromedially; broad ducts connecting ST II to broad, kidney-shaped posterior ST I; ST I clearly narrower than ST II (Fig. 74).



FIGURES 73–76. Genitalic morphology of *Echinax similis* **sp. nov.**: 73. female epigyne, ventral view; 74. same, dorsal view; 75. male palp, ventral view; 76. same, retrolateral view. Scale bars = 0.25mm.

Male (paratype, Ndumo, TMSA 23827). Measurements: CL 2.16, CW 1.68, AL 2.48 AW 1.46, TL 4.62 (3.40–4.62), FL 0.28, SL 1.05, SW 1.00, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.34, PME–PME 0.11, PME–PLE 0.06, PLE–PLE 0.40, PERW 0.57, MOQAW 0.33, MOQPW 0.34, MOQL 0.38.

Length of leg segments: I 1.98 + 0.65 + 1.58 + 1.63 + 0.75 = 6.59; II 1.93 + 0.63 + 1.53 + 1.58 + 0.73 = 6.40; III 1.78 + 0.65 + 1.45 + 1.69 + 0.73 = 6.30; IV 2.13 + 0.68 + 1.80 + 2.30 + 0.85 = 7.76.

General appearance as in Fig. 12, male more slender and smaller than female. Carapace cream, eye region black except between PME; two mottled black Y-shaped markings present, first slightly larger, to anterior of fovea, second narrower, on posterior margin of carapace, markings joined along midline by black line covering fovea; broad median band of black plumose setae covering markings, extending from PER to posterior slope, broken up by asetose line from PME to front of first marking and asetose V-shaped marking from fovea; lateral margins black, markings expanded medially from coxae, with broad stripe of black plumose setae from palpal coxa to posterior margin. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height slightly less than 2x AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to their diameter; PME separated from PLE by distance slightly larger than ½ PME diameter; CW:PERW = 2.95:1. Chelicerae cream, with curved setae on promargin not pectinate; two closely spaced teeth on promargin, distal tooth larger than proximal; retromargin with two adjacent teeth, distal tooth slightly larger, close to fang base. Endites and sternum cream, without markings; labium yellow, cream distally, with small black spots in lateral corners proximally. Legs with cream femora, remaining distal segments pale yellow, spine bases with distinct black spot; coxae with large black pl spot dorsally, small rl spot retrolaterally; femora all with black incomplete ventral distal ring, extended retrolaterally a short distance to midpoint of femora; patellae all black distally, marking extended retrolaterally, surrounding patellar indentation; tibiae all with faint black lateral markings medially and distally; metatarsi with black rings proximally, medially and distally, corresponding to paired spines. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with two rows of erect ve setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, 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 pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with two rows of erect ventral setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with dorsal scutum extending slightly past midpoint; dorsum cream, with black rectangular marking anteriorly, X-shaped marking at ⅔ abdomen length, with black mottling laterally; dorsal markings covered in black plumose setae, with yellowish plumose setae surrounding them, white plumose setae covering lateral markings; venter cream, with grey rectangular median marking; venter covered in short straight setae, with scattered longer straight setae. Male palp cream, cymbium yellow, with a few thickened straight setae dorsally in distal ⅓ (Fig. 76); tegulum pear-shaped, pale orange with dark red-brown ducts; embolus long and thickened, with broad, oblique base and 1½ coils, distal section curved; longitudinal distance from retrolateral bend to prolateral bend approximately ¼ the distance from prolateral bend to embolus tip (Figs 50, 75).

Type material: Holotype ♀: **SOUTH AFRICA:** *KwaZulu-Natal*: Ndumo Game Reserve, Shokwe Pan, *Ficus* forest, 26°52'S, 32°12'E, 43m a.s.l., leg. C. Haddad, V. Swart & A. Kirk-Spriggs, 2.XII.2009 (canopy fog 33, *Kigelia africana*) (TMSA 23829).

Paratypes: **SOUTH AFRICA:** *KwaZulu-Natal*: Ndumo Game Reserve, Shokwe Pan, *Ficus* forest, 26°52'S, 32°12'E, 43m a.s.l., leg. C. Haddad, R. Lyle, V. Butler, 5.VII.2009 (canopy fog 12, *Kigelia africana*), 1♂ 4♀ (TMSA 23826); Same locality, leg. C. Haddad, V. Swart & A. Kirk-Spriggs, 1.XII.2009 (canopy fog 30, *Trichilia emetica*), 1♂ 2♀ (TMSA 23827); Same locality, leg. C. Haddad, V. Swart & A. Kirk-Spriggs, 4.XII.2009 (canopy fog 39, *Ficus sycomorus*), 2♀ (TMSA 23828).

Additional material examined: SOUTH AFRICA: *KwaZulu-Natal*: Ndumo Game Reserve, Shokwe Pan, *Ficus* forest, 26°52'S, 32°12'E, 43m a.s.l., leg. C. Haddad, R. Lyle & V. Butler, 5.VII.2009 (canopy fog 13, *Kigelia africana*), 3♂ 3♀ (MACN, for molecular analysis).

Distribution: Known only from the type locality (Fig. 81).

Biology: All specimens were collected by canopy fogging from three broad-leaved tree species in seasonally inundated *Ficus sycomorus* forest.

8.4.7 *Echinax spatulata* sp. nov.

Figs 13–16, 51, 77–80

Etymology: The species name is Latin for spatulate, and refers to the modified setae on the male palpal cymbium.

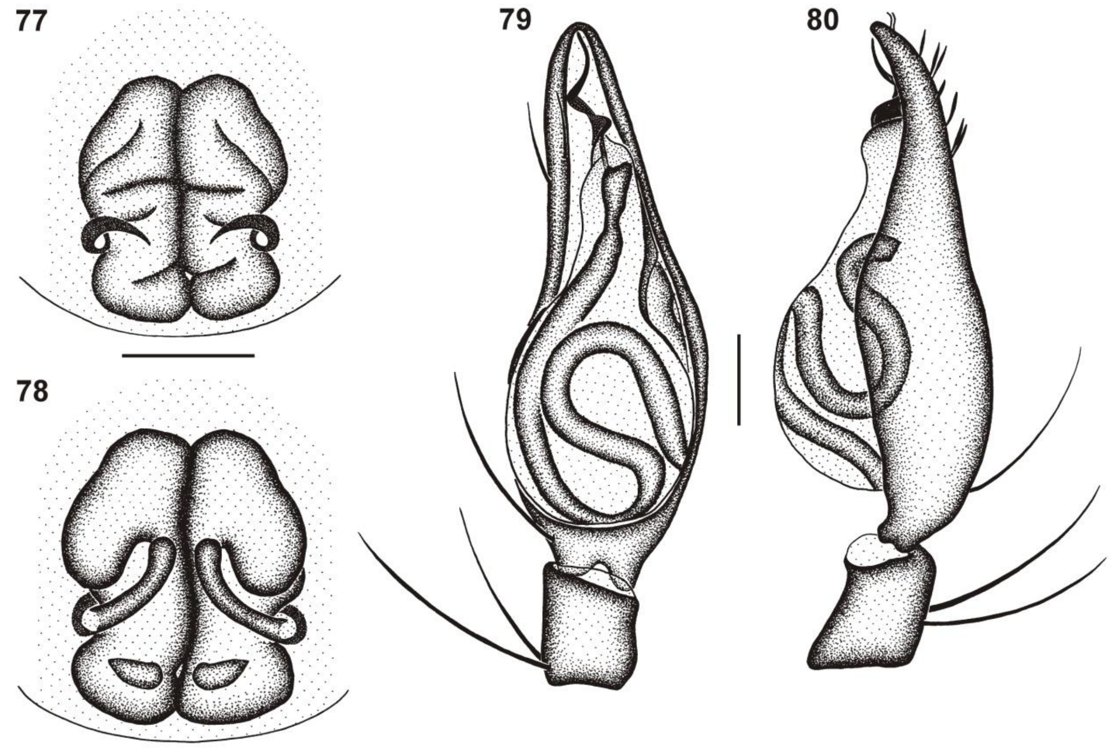
Diagnosis: *Echinax spatulata* **sp. nov.** females are similar to *E. longespina* in genitalic morphology but can be separated by the shorter copulatory ducts that are clearly separated and not touching (Fig. 77). The epigyne of this species is clearly larger than that of African congeners, extending nearly ¾ the distance from the epigastric fold to the pedicel, which in the other species it extends less than ⅔ this distance. Males share with *E. panache* Deeleman-Reinhold, 2001 from South-East Asia the peculiar spatulate setae dorsally on the male palpal cymbium, which are narrower than in the latter species (compare Fig. 16 with fig. 571 in Deeleman-Reinhold 2001 and figs 5 & 6 in Marusik *et al.* 2008). Males can be separated from *E. longespina* by the narrower embolus base and the curved distal end of the embolus (Fig. 51), which is straight in *E. longespina* (Fig. 47).

Female (holotype, Segoma, ZMUC). Measurements: CL 2.20, CW 1.84, AL 2.98, AW 1.83, TL 5.25 (3.70–5.80), FL 0.30, SL 1.09, SW 1.08, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.36, PME–PME 0.12, PME–PLE 0.07, PLE–PLE 0.42, PERW 0.60, MOQAW 0.35, MOQPW 0.37, MOQL 0.43.

Length of leg segments: I 2.18 + 0.75 + 1.75 + 1.68 + 0.80 = 7.16; II 2.13 + 0.73 + 1.68 + 1.65 + 0.77 = 6.96; III 2.00 + 0.70 + 1.65 + 1.80 + 0.73 = 6.88; IV 2.38 + 0.73 + 1.88 + 2.40 + 0.79 = 8.18.

General appearance as in Fig. 13. Carapace cream, eye region black except between PME; distinct Y-shaped marking to the anterior of fovea, broken black striae radiating from fovea and two small spots on posterior slope, all covered in black plumose setae; narrow asetose lines running from PME to Y-shaped marking, and between striae; lateral margins with broad black marking, narrowed between coxae I and II, covered in black plumose setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than ½ their diameter; AME separated from ALE by distance approximately $^1/_{10}$ AME diameter; clypeus height equal to 1⅓ AME diameter; PER strongly procurved, eyes subequal in size; PME separated by distance slightly larger than ¾ their diameter; PME separated from PLE by distance slightly less than ½ PME diameter; CW:PERW = 3.07:1. Chelicerae cream with black line along their interior surface from fang furrow to base of chelicerae, with pectinate curved setae on promargin; two slightly separated teeth on promargin, distal tooth much larger than proximal; retromargin with two adjacent subequal teeth, distal tooth slightly larger than proximal tooth, close to fang base. Endites cream, without markings; labium cream, with broad black marking along proximal margin; sternum cream, with small black spot at prexocal triangles. Legs cream, spine bases with distinct black spot; coxae with black proximal margin ventrally and small black spot prolaterally distally; trochanters with black dorsal distal ring, marking broken medially; femora with proximal retrolateral blotch, pro- and retrolateral blotches at ⅓ femur length, small pro- and retrolateral markings at distal end, retrolateral marking distinctly longer, and incomplete ventral distal ring; patellae with fine prolateral, dorsal and retrolateral stripes proximally, distal margins with complete ring, marking extended retrolaterally, surrounding patellar indentation and fused to proximal retrolateral marking; tibiae with lateral blotches proximally, medially and distally; metatarsi with rings proximally, medially and distally, corresponding to paired spines, incomplete on legs I and II and complete on legs III and IV; palp with black spots at spine bases, femora distal retrolateral blotches, retrolateral proximal blotch on patella. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with two rows of erect ve setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 1-2 vt 2; metatarsi: I pl 1 rl 1 plv 2 rlv 2, II pl 1 rl 1 plv 2 rlv 2, III pl 3 rl 3 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv 1 and rlv 4 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with small dorsal scutum extending ¼ abdomen length; dorsum cream, with broad black marking anteriorly, black star-shaped marking at ⅔ abdomen length, fused laterally to irregular black marking along lateral margins; black and white plumose setae on markings, yellowish plumose setae surrounding them; venter cream, covered in short straight setae with scattered longer setae, with dark grey subrectangular marking medially. Epigyne with short curved lateral ridges at midpoint of epigyne, separated by slightly less than their width, with copulatory openings situated laterally in ridges (Fig. 77); copulatory ducts short, strongly curved, entering oval anterior ST II that are strongly expanded posterolaterally; broad ducts connecting ST II to broad, kidney-shaped posterior ST I; ST I only very slightly broader than ST II (Fig. 78).

Male (paratype, Kwamgumi, ZMUC). Measurements: CL 2.20, CW 1.78, AL 2.25 AW 1.35, TL 4.35 (2.90–5.00), FL 0.28, SL 1.03, SW 1.01, AME–AME 0.05, AME–ALE 0.01, ALE–ALE 0.37, PME–PME 0.12, PME–PLE 0.06, PLE–PLE 0.41, PERW 0.62, MOQAW 0.35, MOQPW 0.37, MOQL 0.44.



FIGURES 77–80. Genitalic morphology of *Echinax spatulata* **sp. nov.**: 77. female epigyne, ventral view; 78. same, dorsal view; 79. male palp, ventral view; 80. same, retrolateral view. Scale bars = 0.25mm.

Length of leg segments: I 2.13 + 0.69 + 1.79 + 1.76 + 0.88 = 7.25; II 2.06 + 0.69 + 1.69 + 1.73 + 0.83 = 7.00; III 1.93 + 0.68 + 1.63 + 1.81 + 0.81 = 5.74; IV 2.28 + 0.70 + 1.88 + 2.46 + 0.90 = 8.22.

General appearance as in Fig. 14, male more slender and smaller than female. Carapace cream, eye region black except between PME; broken mottled Y-shaped marking to the anterior of fovea, with broken black striae radiating from fovea, all covered in black plumose setae; narrow asetose lines running from PME to Y-shaped marking, and between striae; lateral margins with broad black marking, expanded between coxal pairs, covered in black plumose setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than ⅓ their diameter; AME separated from ALE by distance approximately 1⁄10 AME diameter; clypeus height slightly less than double AME diameter; PER strongly procurved, medians slightly larger than laterals; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance slightly less than ½ PME diameter; CW:PERW = 2.87:1. Chelicerae cream, with pectinate curved setae on promargin; two closely spaced teeth on promargin, distal tooth larger than proximal; retromargin with two slightly separated teeth, distal tooth slightly larger, close to fang base.

Endites cream, without markings; labium cream, with black transverse marking along proximal margin; sternum cream, with small black spots at precoxal triangles. Legs cream, spine bases with distinct black spot; coxae uniform cream; trochanters with dorsal prolateral spot; femora with proximal retrolateral blotch, pro- and retrolateral blotches at ⅓ femur length, small pro- and retrolateral markings at distal end, retrolateral marking distinctly longer, and incomplete ventral distal ring; patellae with pro- and retrolateral proximal lines, distal margin black, marking extended laterally, surrounding patellar indentation, fused to proximal retrolateral marking; tibiae all with black lateral mottling medially and distally, darker retrolaterally; metatarsi with black rings proximally, medially and distally, corresponding to paired spines, incomplete on legs I and II and complete on legs III and IV; palpal femora with retrolateral distal blotch, patellae with retrolateral proximal spot. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2-3, IV pl 2 do 3 rl 1-2; all femora with two rows of erect ve setae; patellae: all with do 1 terminal spine; tibiae: I pl 2 do 1 rl 2 plv 3 rlv 2, II pl 2 do 1 rl 2 plv 3 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 1, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 1 rl 1 plv 1 rlv 2, II pl 1 rl 1 plv 1 rlv 2, III pl 2 rl 2 plv 1 rlv 1 vt 3, IV pl 3 rl 3 plv 1 rlv 1 vt 3. Palpal spination: femora: pl 1 do 2 rl 1, with plv 1 and rlv 4 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with dorsal scutum extending slightly more than ½ abdomen length; dorsum with black star-shaped marking covering anterior ⅓ of abdomen, X-shaped marking at ⅔ abdomen length, and lateral margins with mottled black marking; black and yellow plumose setae on markings, yellow plumose setae between them; venter cream, covered in short straight setae and scattered longer straight setae, with narrow black marking medially. Male palp cream, cymbium yellow-brown, with a few thickened spatulate setae dorsally in distal ⅓ (Fig. 80); tegulum pear-shaped, creamy-yellow with dark red-brown ducts; embolus fine, with broad, very narrow base and 1½ coils, distal section curved; longitudinal distance from retrolateral bend to prolateral bend slightly less than ½ the distance from prolateral bend to embolus tip (Figs 51, 79).

Type material: Holotype ♀: **TANZANIA:** *Tanga*: Muheza District, Segoma Forest Reserve, 04°59'S, 38°44'E, 210m a.s.l., leg. S. McKamey, 11.XI.1995 (canopy fog 20) (ZMUC).

Paratypes: **BURUNDI:** Kayanza Province, Parc National de la Kibira, Rwegura Sector, 02°55.320'S, 29°30.067'E, 2237m a.s.l., leg. A.H. Kirk-Spriggs, 21–26.XI.2010 (Malaise traps, indigenous Afromontane forest), 1♀ (NMBA 16167). **D.R. CONGO:** Bas-Congo, Mayombe, Luki Forest Reserve, 05°37'S, 13°05'E, 266m a.s.l., leg. D. de Bakker & J.-P. Michiels, 30.IX.2007 (beating near FS 17, rainforest), 1♂ (MRAC 223644); Same locality, leg. D. de Bakker & J.-P. Michiels, 14.IX.2007 (beating, secondary rainforest, near fogging site 1), 2♂ (MRAC 223417); Same locality, 28.IX.2007, leg. D. de Bakker & J.-P. Michiels (canopy fogging, primary rainforest), 1♂ 2♀ (MRAC 230775); Same data, 4.X.2007, 1♂ 1♀ (MRAC 230779). **KENYA:** Kakamega Forest, 00°22'N, 34°50'E, 1600m a.s.l., leg. W. Freund, IX–X.2001 (fogging, *Teclea nobilis*, middle aged secondary forest), 1♂ (ZFMK Ar1171); Same locality, leg. W. Freund, IX–X.2001 (fogging, *Heinsenia diervilleoides*), 1♀ (ZFMK Ar1172). **TANZANIA:** *Tanga*: Mufindi District, Uzungwa Scarp Forest Reserve, 08°31.58'S, 35°54.00'E, 750m a.s.l., leg. S. McKamey *et al*., 16.III.1996 (canopy fog 39), 1♂ (ZMUC); Muheza District, Kwamgumi Forest Reserve, 04°57'S, 38°44'E, 170–220m a.s.l., leg. S. McKamey, 18.VII.1995 (canopy fog 7), 1♂ (ZMUC); Same data, 2.XI.1995 (canopy fog 14), 1♂ (ZMUC); Same data, 5.XI.1995 (canopy fog 16), 1♂ (ZMUC); Same data, 31.X.1995 (canopy fog 13), 1♂ (ZMUC); Muheza District, Segoma Forest Reserve, 04°59'S, 38°44'E, 210m a.s.l., leg. S. McKamey, 11.XI.1995 (canopy fog 20), 1♀ (ZMUC).

Additional material examined: CAMEROON: Matute [04°06.8'N, 09°25.3'E], Tiko Plantation, leg. B. Malkin, 24.IV–6.V.1949, 1♀ (CAS, CASENT 9033090). **CENTRAL AFRICAN REPUBLIC:** Prefecture Sangha-Mbaéré, Réserve Spéciale de Forêt Dense de Dzanga-Sangha, 12.7km 326˚ NW Bayanga, 420m a.s.l., 03°00'18"N, 16°11'36"E, leg. B.L. Fisher, 10–17.V.2001 (beating low vegetation, rain forest), 2 imm. 1♀ (CAS). **D.R. CONGO:** *Bas-Congo*: Mayombe, Luki Forest Reserve, 05°37'S, 13°05'E, 266m a.s.l., leg. D. de Bakker & J.-P. Michiels, 13–23.IX.2007 (second row of 10 pitfalls, young secondary rainforest), 1♂ (MRAC 222689); Same locality, leg. D. de Bakker & J.-P. Michiels, 15.IX.2007 (beating, near fogging site 2), 1♀ (MRAC 223090); Same locality, leg. D. de Bakker & J.-P. Michiels, 1.X.2007 (canopy fogging, primary rainforest), 1♀ (MRAC 230778); Same data, 26.IX.2007, 2♂ 2♀ (MRAC 230774); Same data, 30.IX.2007, 1♀ (MRAC 230777); Same data, 30.IX.2007, 1♀ (MRAC 230777); Same locality, 21.IX.2007 (canopy fogging, secondary rainforest), 1♀ (MRAC 230771); Same locality, leg. D. de Bakker & J.-P. Michiels, 14.IX.2007 (canopy fogging, secondary rainforest), 3♂ 4♀ (MRAC 236909); Same data 17.IX.2007, 2♂ 1♀ (MRAC 230766); Same data, 19.XI.2005, 2♂ 1♀ (MRAC 218268); Same data, 20.IX.2007, 2♂ 2♀ (MRAC 230769); Same data, 24.IX.2007, 3♀ (MRAC 236907); Same data, 25.IX.2007, 1♂ (MRAC 230773); Same data, 28.IX.2007, 4♂ 3♀ (MRAC 236911); Same locality, leg. D. de Bakker & J.-P. Michiels, 16.IX.2007 (young secondary rainforest), 1♂ 1♀ (MRAC 222946); Same locality, leg. D. de Bakker & J.-P. Michiels, 22.IX.2007 (beating, near FS9, old secondary rainforest), 1♀ (MRAC 223026); Same locality, leg. D. de Bakker & J.-P. Michiels, 3.X.2007 (beating, near FS19), 1♂ (MRAC 230782); Same locality, leg. D. de Bakker & J.-P. Michiels, 4.XI.2006 (canopy fogging 1, primary rainforest), 1♀ (MRAC 220921); Same locality, leg. D. de Bakker & J.-P. Michiels, 13.XI.2006 (fogging 5, primary rainforest), 1♂ 1♀ (MRAC 220930); Same locality, leg. D. de Bakker & J.-P. Michiels, 16.XI.2006 (beating, secondary forest), 1♂ (MRAC 219843); Same locality, leg. D. de Bakker & J.-P. Michiels, 16.IX.2007, 2♀ (MRAC 236914); Same data, 21.IX.2007, 2♀ (MRAC 230770). *Kivu*: Rutshuru, 01°11'S, 29°27'E, leg. J. Ghesquière, V.1937, 2♂ (MRAC 236920). *Lulua*: Kananga [Luluabourg], St. Joseph, 05°54'S, 22°25'E, leg. J. Deheyn, 28.IV.1939, 1♀ (MRAC 3834). **GHANA:** Kakum forest, 05°20'N, 01°23'W, leg. R. Jocqué, D. de Bakker & L. Baert, 14.XI.2005 (fogging, primary forest), 2♂ (MRAC 218250); Same data, 16.XI.2005, 1♂ 1♀ (MRAC 236917); Same data, 18.XI.2005, 3♂ 3♀ (MRAC 218265); Same data, 21.XI.2005, 3♀ (MRAC 218273); Same data, 23.XI.2005, 2♂ 1♀ (MRAC 218284); Same locality, leg. R. Jocqué, D. de Bakker & L. Baert, 15.XI.2005 (fogging, secondary forest), 4♂ 3♀ (MRAC

218251); Same data, 22.XI.2005, 6♂ 4♀ (MRAC 218277). **GUINEÉ:** F.C. de Ziama, 08°24'N, 09°17'W, leg. D. Flomo, 13.IX.1998 (pitfalls, rain forest), 1♂ (MRAC 216215); Same data, 31.III.1999, 1♂ (MRAC 216224); Same data, 31.III.2000, 1♀ (MRAC 216212). **IVORY COAST:** Bouaflé, 06°59'N, 05°45'W, leg. J. Everts, 22.I.1981 (pitfalls), 1♀ (MRAC 173989). **KENYA:** Western region, Kakamega Forest, Lirhanda Hills, 00°13'N, 34°54'E, leg. D. Shilabira Smith, 25.V.2000 (pitfall trap), 1♂ (MRAC 220493); Same locality, leg. D. Shilabira Smith, 10.VIII.2002 (malaise trap), 1♂ (MRAC 220479). **RWANDA:** 50km N of pêcherie Ihema, pres du lac Mihindi, 01°32'S, 30°43'E, leg. Jocqué, Nsemgimana & Michiels, 6.XII.1985, 1♀ (MRAC 165221). **TOGO:** Akloa Falls Forest, 07°30'N, 00°36'E, leg. J. Bosselaers, 1.IV.2005 (hand capture on plants), 1♀ (MRAC 216784).

Distribution: Widespread across tropical Africa (Fig. 81).

FIGURE 81. Distribution of *Echinax scharffi* **sp. nov.** (blue circles), *E. similis* **sp. nov.** (red circle) and *E. spatulata* **sp. nov.** (black circles) in Africa.

Biology: The majority of specimens were collected by canopy fogging. The species was also collected from lower habitat strata (foliage and leaf litter) by beating, hand collecting and pitfall trapping. Most records for which habitat data are available indicate a preference for forests of variable structure, and this species is apparently absent from savannas.

8.5 DISCUSSION

The present revision has expanded the distribution of the genus *Echinax* to the Afrotropical Region, where its representative species are widespread throughout the tropical and subtropical areas from Senegal in the north and west, to Ethiopia in the east and South Africa in the south. Twelve species are now recognised, of which seven are endemic to the region. Only two of the Afrotropical species, *E. longespina* and *E. spatulata*, are widespread, with ranges spanning most of equatorial Africa. The remaining three species all have somewhat restricted distributions in D.R. Congo (*E. clara*), Ivory Coast (*E. hesperis*), South Africa (*E. natalensis* and *E. similis*) and Tanzania (*E. scharffi*).

It is likely that further new species of *Echinax* will be discovered once the geographical coverage of canopy fogging samples becomes more extensive. This sampling method was responsible for the bulk of the specimens examined in this study, and given the localised distribution of some of these species, further sampling in some of the larger gaps on the continent (see Figs 68 and 82) will inevitably lead to further discoveries. For example, immature *Echinax* have been collected by canopy fogging at three additional localities in south-eastern South Africa (Hogsback, Cwebe Nature Reserve and Oribi Gorge Nature Reserve), some 600km or more south of the southernmost records of the genus reported here, and further sampling at these and other localities will indicate whether the species are new or merely range extensions of *E. natalensis* and *E. similis*.

The revised distribution of the genus to include Africa also requires further discussion and investigation. Previously, *Echinax* was only known from five species distributed in South-East Asia, i.e. China, Eastern Java, Borneo, Sumatra and Sulawesi (Deeleman-Reinhold 2001; Yang *et al.* 2004; Marusik *et al.* 2008). In addition, Deeleman-Reinhold (2001) also listed unidentified specimens from Thailand, Bali, Western Sumatra and Borneo. Thus, Thailand represented the most western record of the genus prior to the current study. *Echinax* has to date not yet been recorded from Myanmar, Bangladesh and India to the west or Australia to the south, although it is likely that the forests and woodlands in these countries would provide suitable habitat for these spiders. To the west of India, the dry savannas and deserts of Pakistan and the Arabian Peninsula are probably too arid for *Echinax* and it is unlikely that the genus occurs there. Sampling in these areas and a critical study of their corinnid faunas will be essential in resolving the biogeographical patterns of the genus.

8.6 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.

DEELEMAN-REINHOLD, C.L. 1995. New or little known non-antmimicking spiders of the subfamily Castianeirinae from southeast Asia (Arachnida: Araneae: Clubionidae). *Beiträge zur Araneologie* **4:** 43–54.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

MARUSIK, Y.M., ZHENG, G. & LI, S. 2008. First description of the female of *Echinax panache* Deeleman-Reinhold, 2001 (Aranei: Corinnidae: Castianeirinae). *Arthropoda Selecta* **17:** 165–168.

PLATNICK, N.I. 2011. The World Spider Catalog, Version 12.0. American Museum of Natural History, New York. Available at: http://research.amnh.org/entomology/spiders/catalog; accessed 30 May 2011.

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.

YANG, J.Y., SONG, D.X. & ZHU, M.S. 2004. On the newly recorded genus *Echinax* from China (Araneae: Corinnidae), with description of a new species. *Journal of the Agricultural University of Hubei* **27:** 66–70.

CHAPTER 9

Graptartia granulosa Simon, 1896, female (Livingstone, Zambia)

A revision of the spider genus *Graptartia* Simon, 1896 (Araneae: Corinnidae) in the Afrotropical Region

[Published – Appendix A1]

9.1 ABSTRACT

The genus *Graptartia* Simon, 1896, presently known only from Africa, is revised. The type species, *G. granulosa* Simon, 1896, is redescribed and the first genitalic sketches are provided. Two new species, *G. mutillica* **sp. nov.** and *G. tropicalis* **sp. nov.**, are described in the genus. Notes on the distribution and biology of the species are provided. All species are mimics of wingless female velvet ants (Mutillidae).

9.2 INTRODUCTION

The spiders of the family Corinnidae (Arachnida: Araneae) remain one of numerous taxa of the Afrotropical Region that have yet to be subjected to revisionary work. Only Bosselaers & Jocqué (2000, 2002) have studied this family in recent times. In this study the genus *Graptartia* Simon, 1896 is revised.

Prior to this study, *Graptartia* was composed of two species known only from Africa. The type species *Graptartia granulosa* Simon, 1896 was described from Zambia. Simon (1932) transferred *Micaria scabra* Simon, 1878 (Gnaphosidae) to *Graptartia*, but did nt supply reasons motivating the transfer. However, study of the type material of the latter species showed it to lack many characters vital to its placement in the Corinnidae: Castianeirinae, as defined by Dippenaar-Schoeman & Jocqué (1997) and Bosselaers & Jocqué (2000). These include the bulbus of the male palp of *G. scabra* not being pear shaped, lacking a corkscrew-shaped embolus, and having a median apophysis present. The female epigyne has a U-shaped excavation as opposed to the typical castianeirine paired copulatory openings in a sclerotised epigyne, as found in the other *Graptartia* species. Since this species was described from Algeria, which falls outside the Afrotropical Region, it will not be further referred to further here since it falls outside the scope of this study.

Graptartia species are mimics of the wingless females of velvet ants (Hymenoptera: Mutillidae) (Lawrence 1964), and bear a close resemblance in both colouration and behaviour to their models. Here the genus is revised, the type species *G. granulosa* is redescribed, the male of *G. granulosa* is described for the first time, and two new species, *G. mutillica* and *G. tropicalis*, are described.

9.3 MATERIAL & METHODS

All specimens were observed for identification and description under a light microscope in 70% ethanol. The epigynes of representative specimens were dissected using 0-size insect pins, cleared for 8 min. in a Branson 3200 ultrasonic bath in 70% ethanol, and observed for sketches in 70% ethanol.

All material was dehydrated using a series of increasing ethanol concentrations to 100%, after which it was critical point dried in an argon chamber. Material was pasted on stubs before being coated three times with gold in a sputter coater. Specimens were studied in a JEOL WinSEM at 10kV, and digitized photos taken.

Abbreviations used in the descriptions are as follows: carapace length (CL), carapace width (CW), abdomen length (AL), abdomen width (AW), sternum length (SL), sternum width (SW), posterior median eye (PME), posterior lateral eye (PLE), anterior median eye (AME), anterior lateral eye (ALE), anterior eye row (AER), posterior eye row (PER). All measurements are given in millimeters (mm). A range of body measurements (excluding legs) is provided for each species. Leg measurements are given for a single specimen of each sex.

The material used in this revision has been deposited in the following collections and curators are given in parenthesis (locality co-ordinates of specimens are provided where available):

AMNH – American Museum of Natural History, New York, U.S.A. (Norman Platnick)
CAS – California Academy of Sciences, San Francisco, U.S.A. (Charles Griswold)
MNHN – Museum National D'Histoire Naturelle, Paris, France (Christine Rollard)
MRAC – Musée Royal de l’Afrique Centrale, Tervuren, Belgium (Rudy Jocqué)
NCA – National Collection of Arachnida, Pretoria, South Africa (Ansie Dippenaar-Schoeman)
NMB – National Museum, Bloemfontein, South Africa (Leon Lotz)
PCRS – Personal collection of Anthony Russell-Smith, Sittingbourne, England
PCCH – Personal Collection of Charles Haddad, Bloemfontein, South Africa
SAM – South African Museum, Cape Town, South Africa (Margie Cochrane)

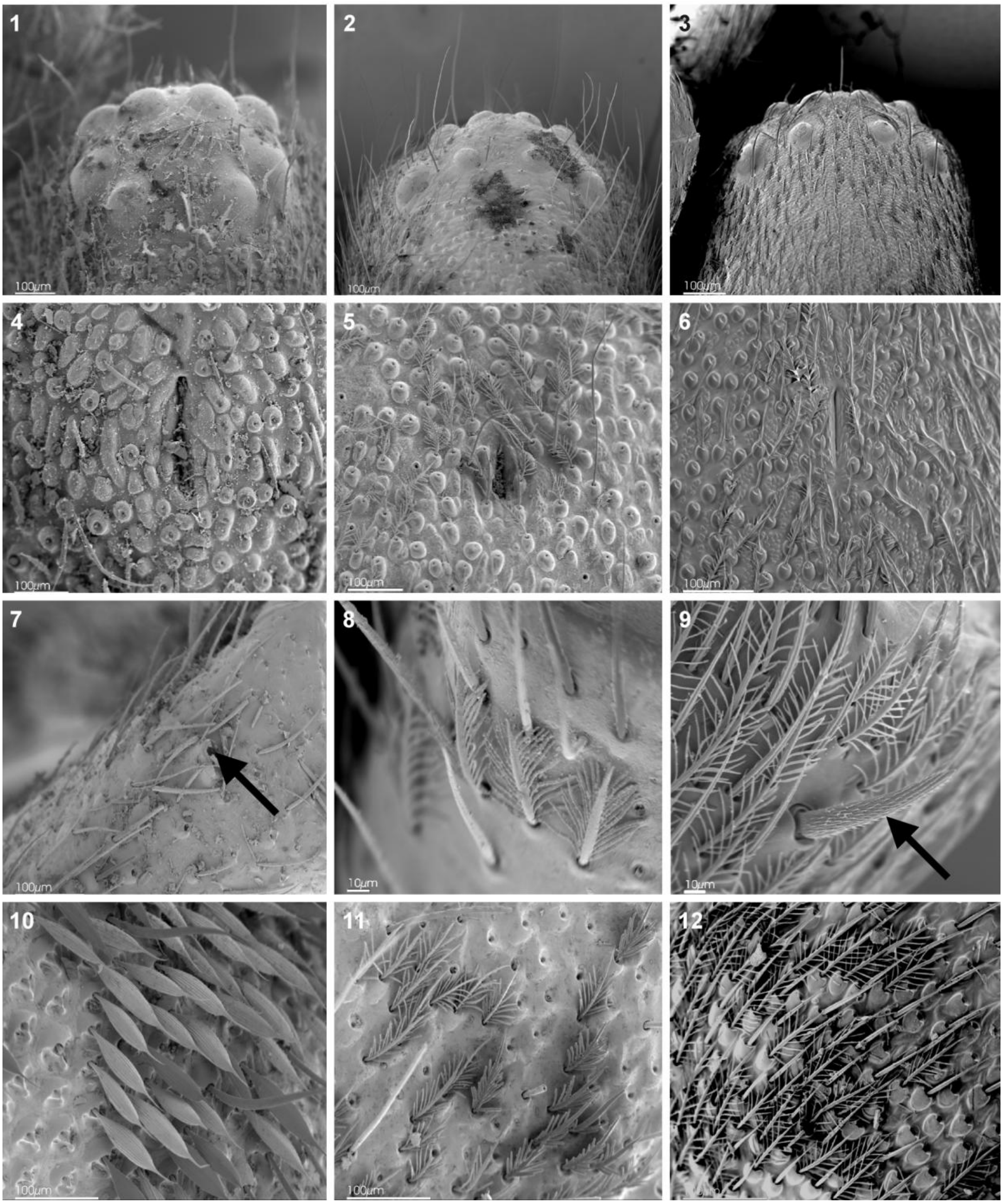
9.4 GENUS *GRAPTARTIA* SIMON, 1896

Graptartia Simon, 1896: 411; Haddad 2004: 72.

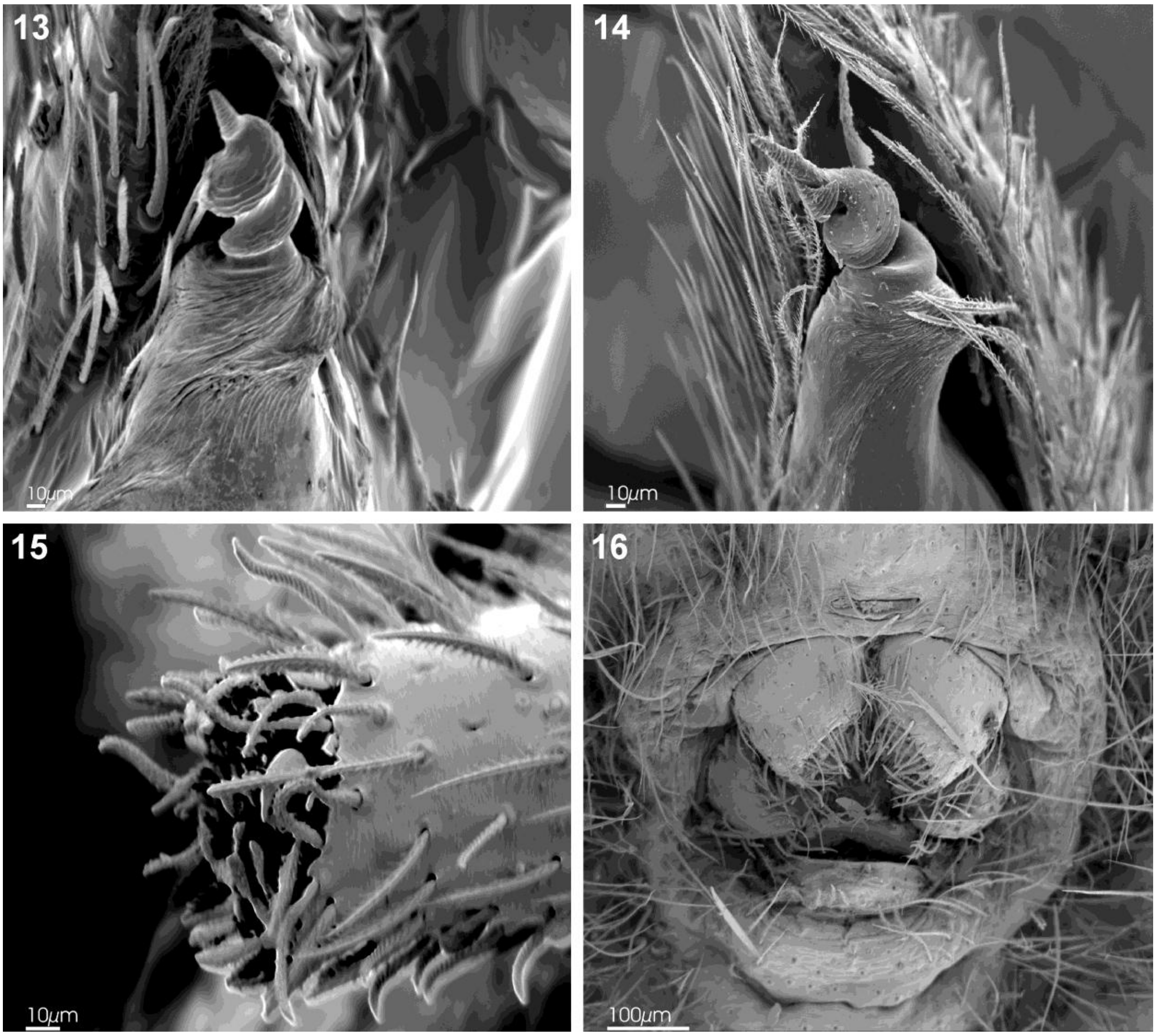
Type species: *Graptartia granulosa* Simon, 1896, by monotypy.

Diagnosis: This genus is separated from other African castianeirines by the distinctive colouration, consisting of a yellow-brown to dark red-brown carapace, and black abdomen with large, white or cream markings. The anterior eye row is strongly procurved, posterior eye row is procurved or recurved, and the eyes are subequal in diameter. The abdomen is characterized by the large dorsal scutum, covered by modified setae (clavate or plumose), which covers the entire dorsum and is present in both sexes. This genus is separated from *Coenoptychus* Simon, 1885 by the posterior eye row, which is procurved or very slightly recurved in *Graptartia*, but very strongly recurved in the *Coenoptychus*. Both of these genera are known to be mimics of wingless female velvet ants (Lawrence 1964; Deeleman-Reinhold 2001).

Description: Small to medium sized spiders, 5–11 mm in length, all species resembling velvet ants (Hymenoptera: Mutillidae); female more robustly built than male. Carapace narrowest in ocular region, broadening medially, and narrowed posteriorly; anterior eye row procurved, posterior eye row procurved (Fig. 1) or recurved (Figs 2–3); colouration yellow-orange to dark red-brown; long and short straight setae, and modified clavate or plumose setae scattered throughout; surface granular (Figs 4–6). Chelicerae with 2-3 teeth on promargin, 2 teeth on retromargin; endites straight to slightly depressed laterally. Sternum longer than wide, with granular or pitted surface; long and short setae scattered across surface. Leg formula 4123; legs with numerous spines and short straight setae on femur, tibia and metatarsus; modified setae absent from legs of *G. granulosa* (Fig. 7), but plumose setae present on femora, patellae and tibiae of *G. mutillica* and *G. tropicalis* (Figs 8–9); scopulae weakly developed, comprising two rows of setae; paired tarsal claws situated between claw tuft of short, barbed setae (Fig. 15); femora I and II uniformly grey, or II with bands; femora III and IV with grey bands on lighter background. Abdomen oval, broadest at ⅔ its length; integument dark red-brown to black, forming background; straight black setae interspersed with straight or modified plumose setae covering surface; predominantly modified white

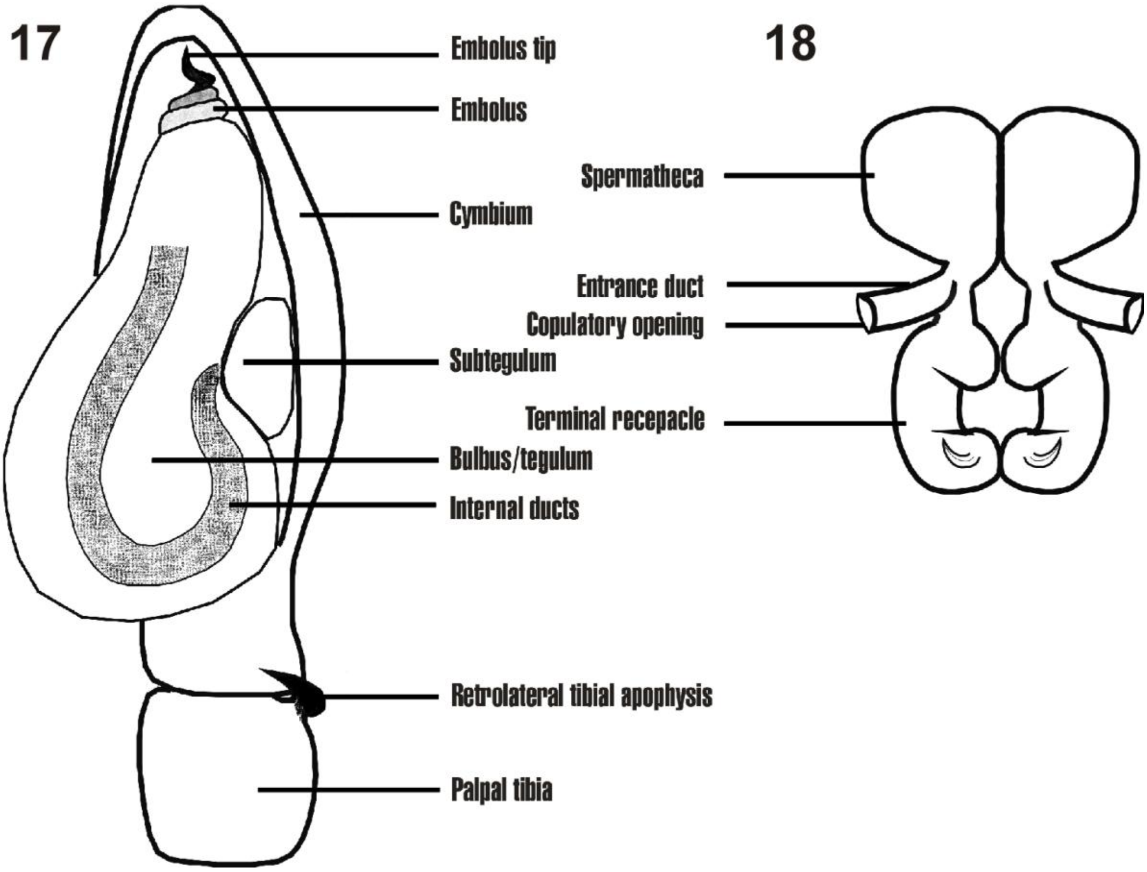


FIGURES 1–12. Scanning Electron Micrographs of *Graptartia granulosa* Simon, 1896 (1, 4, 7, 10), *G. mutillica* **sp. nov.** (2, 5, 8, 11) and *G. tropicalis* **sp. nov.** (3, 6, 9, 12): 1–3. eye pattern of male; 4–6. fovea on carapace of male; 7–9. setae on dorsal surface of femur I; prolateral spine of *G. granulosa* is missing, indicated by an arrow in 7, prolateral spine of *G. tropicalis* indicated by an arrow in 9; 10–12. dorsal abdominal setae: 10. clavate setae; 11, 12. plumose setae.



FIGURES 13–16. Scanning Electron Micrographs of *Graptartia mutillica* **sp. nov.** (13) and *G. tropicalis* **sp. nov.** (14–16): 13, 14. embolus tip; 15. claw tuft of tarsus I; 16. spinnerets.

clavate or plumose setae (Figs 10–12) forming pattern; ventrum black, with straight black setae, interspersed in *G. mutillica* and *G. tropicalis* with black plumose setae; modified setae responsible for velvety appearance. Spinnerets closely grouped together (Fig. 16); anterior spinnerets largest, sub-conical. Female with paired copulatory openings in sclerotised epigynum (Fig. 17); spermathecae round to subtriangular; terminal receptaculae kidney-shaped to narrowly curved. Male palp typically castianeirine (Fig. 17); cymbium moderately broad, with dense mat of setae on dorsal surface; bulbus pear-shaped and smooth, bulging prolaterally, internal structures visible through integument; median apophysis absent; embolus spiraling, with one to two-and-half coils (Figs 13–14).



FIGURES 17–18. Schematic representation of Castianeirinae genitalia: 17. male; 18. female.

9.4.1 *Graptartia granulosa* Simon, 1896

Figs 1, 4, 7, 10, 19–23

Graptartia granulosa Simon, 1896: 411; Berland, 1922: 72, pl. A5, fig. 4; Lawrence, 1928: 252; Lessert, 1936: 276, fig. 73 (♀ holotype: three labels accompany the holotype: “Zambezi / Graptartia granulosa E. S. / 5040”, MNHN 5040 – examined).

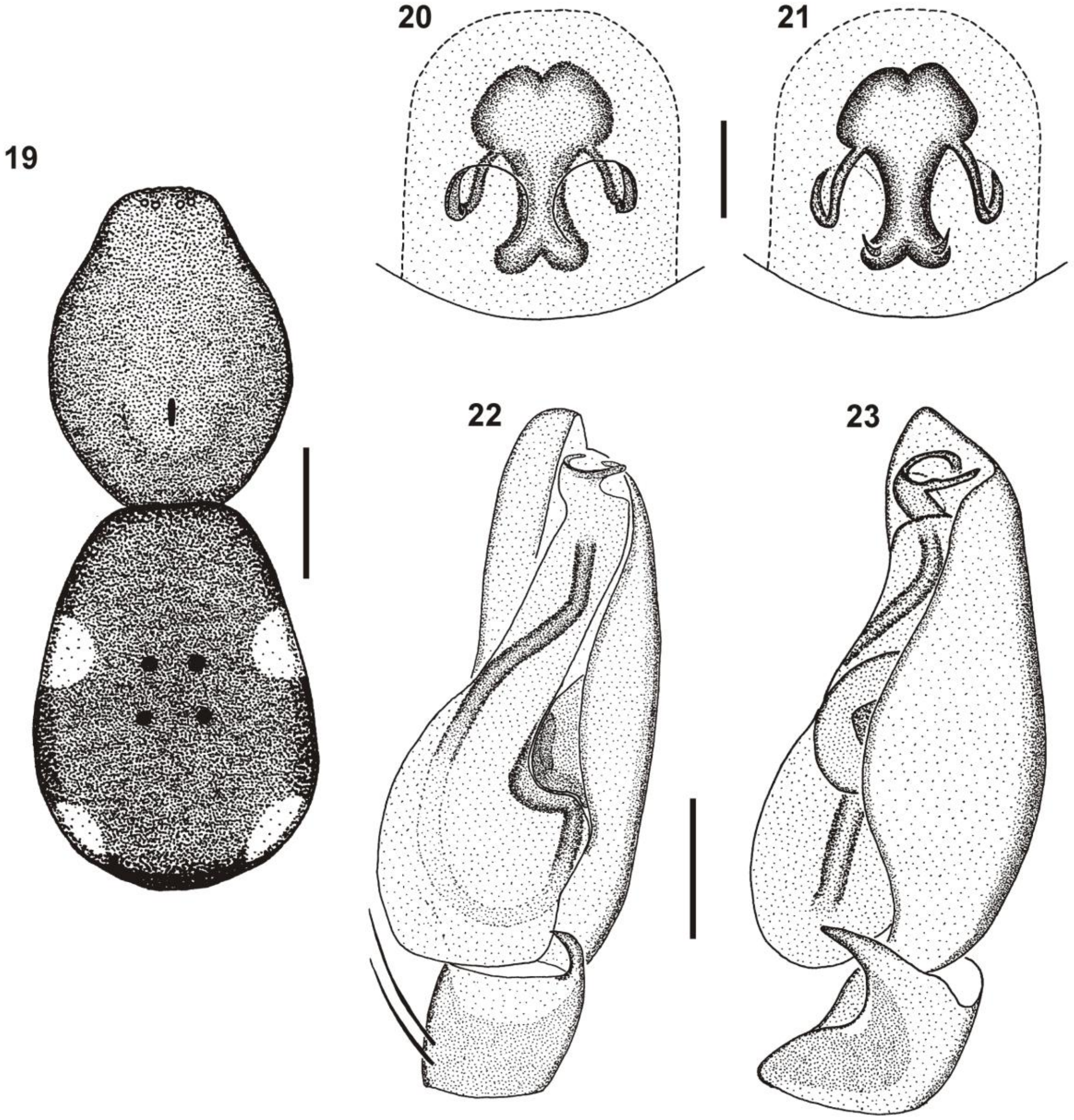
Remarks: The original generic description of *Graptartia* (Simon, 1896), based on *G. granulosa* as the type species, did not include sketches of any genitalic or other characters. Berland (1922), Lessert (1936) and Lawrence (1964) subsequently provided sketches of the dorsum of this species. The first descriptive sketches of the palp and internal epigynal structures of *G. granulosa* are given here.

Female. Measurements: CL 3.30–4.10, CW 2.25–2.75, AL 4.00–4.65, AW 3.00–3.30, SL 1.30–1.60, SW 1.15–1.30, AME–AME 0.08, AME–ALE 0.05, PME–PME 0.23, PME–PLE 0.08, PLE–PLE 0.55.

Length of leg segments (sequence from femur to tarsus, and total): I 1.70+ 0.90 + 1.15 + 1.25 + 0.85 = 5.85; II 1.70 + 0.85 + 1.15 + 1.25 + 0.80 = 5.75; III 1.40 + 0.85 + 0.95 + 1.10 + 0.65 = 4.95; IV 2.00 + 0.80 + 1.50 + 1.80 + 0.95 = 7.05.

General appearance as in Fig. 17. Carapace evenly high, slightly elevated towards rear; highest at two-thirds its length; surface granular, especially at setal bases (Fig. 4); short and long white setae scattered across surface; fovea deep and broad (Fig. 4), at two-thirds carapace length; carapace uniformly yellow to deep orange; ocular region dark grey to black. Eyes in a circular arrangement, AER and PER strongly procurved (Fig. 1); anterior eyes subequal in size; AME pale grey, ALE pearly grey, with dark brown to black rings; AME separated by ⅔ their diameter, AME and ALE separated by ⅓ their diameter; PLE slightly larger than PME; posterior eyes pearly white, with dark brown to black rings; PME separated by 1⅔ their diameter, PME and PLE separated by ⅔ PLE diameter. Chelicerae dark orange; long, grey-black setae on surface; two teeth on cheliceral promargin, two teeth on retromargin, proximal teeth larger. Sternum orange and pitted, darker near border; short and long pale grey setae covering surface. Abdomen oval with large dorsal scutum; dorsum pitted, with black-red undertone; covered with long, straight black setae; two pairs of large, white spots dorsally (Fig. 19), composed of white clavate setae (Fig. 10); first pair at one-third of abdomen length, second pair posterior to two-thirds of abdomen length; extensions of white markings continuing laterally; venter with red-brown undertone; short, straight black setae scattered across surface. Legs I and II with grey femora, yellow distally; femora III and IV with narrow dark grey band proximally, and broader median band; all patellae with pale grey proximal ventral band; all tibiae with proximal and median bands; metatarsi I and II yellow, II and IV with grey proximal band; all tarsi yellow; palp yellow-orange; no modified setae on legs. Genital area sclerotised and red-brown; copulatory openings laterally in centre of epigyne (Fig. 20); spermathecae subtriangular; terminal receptaculae narrow, curving outwards at posterior end (Fig. 21).

Male. Measurements: CL 3.30–4.90, CW 2.25–3.00, AL 3.80–5.70, AW 2.60–3.40, SL 1.30–1.70, SW 1.15–1.40, AME–AME 0.10, AME–ALE 0.05, PME–PME 0.23, PME–PLE 0.08, PLE–PLE 0.60.



FIGURES 19–23. *Graptartia granulosa* Simon, 1896 female (19–21) and male (22, 23): 19. dorsal view of body; 20. epigyne, ventral view; 21. epigyne, dorsal view; 22. left palp, ventral view; 23. left palp, retrolateral view. Scale bars: 19 = 1.0mm; 20–23 = 0.2mm.

Length of leg segments (sequence from femur to tarsus, and total): I 2.40 + 0.90 + 1.50 + 1.60 + 1.10 = 7.50; II 2.20 + 1.10 + 1.50 + 1.50 + 1.10 = 7.40; III 1.90 + 0.90 + 1.30 + 1.70 + 0.90 = 6.70; IV 2.40 + 1.20 + 1.80 + 2.30 + 1.10 = 8.80.

General appearance, setal structure and markings as for female. Eyes in circular arrangement, AER and PER strongly procurved; anterior eyes subequal in size; AME pale grey, ALE pearly white, with dark brown to black rings; AME separated by ⅔ their diameter, AME and ALE separated by ⅓ their diameter; PLE slightly larger than PME; posterior eyes pearly white, with partial or complete brown to black rings; PME separated by 1⅔ their diameter, PME and PLE separated by ½ PME diameter. Cheliceral teeth more strongly developed than in female; two teeth on promargin, two on retromargin. Males similar in size to females, occasionally larger; abdominal scutum slightly smaller than that of female. Palp with small, hook-like retrolateral tibial apophysis; cymbium yellow to dark orange in colour, bulbus paler; embolus short, with a single coil (Figs 22–23).

Additional material examined: **BOTSWANA:** 26 km W of Ghanzi, 1100 m a.s.l., leg. E.S. Ross & A.R. Stephen, 4.XI.1967, 1 juv. ♂ (CAS); Okavango Delta, Maun (in garden), leg. A. Russell-Smith, 16.VI.1976, 1 juv. ♂ (PCRS); Okavango Delta, Maxwee, 19°29'S, 23°45'E, leg. A. Russell-Smith, 26.XII.1976 (Mopane woodland), 1♀ (PCRS). **D.R. CONGO:** Kibali, Niarembe, leg. C. Scops, 1935, 1♂ (MRAC 12424). **KENYA:** 24km SW of Nairobi, 5400ft a.s.l., leg. M.E. Irwin & E.S. Ross, 15.I.1970, 1♀ (CAS). **MALAWI:** Ulongwe Nature Reserve, leg. A. Russell-Smith, 25.V.1991 (on path in *Combretum* woodland), 1♀ (PCRS). **MOZAMBIQUE:** Maxixe, Inhambane, 23°52'S, 35°23'E, leg. R.F. Lawrence, I.1924, 1 juv. (SAM B6594). **NAMIBIA:** Outja, 20°07'S, 16°09'E, leg. South Africa Museum Expedition, I.1924–IV.1926, 1♂ (SAM B7064); 24km NW of Okahandja, 1460m a.s.l., leg. E.S. Ross & R.E. Leech, 9.V.1958, 1 juv. ♀ (CAS). **TANZANIA:** 24km S of Handeni, 630m a.s.l., leg. E.S. Ross & R.E. Leech, 13.XI.1957, 1♀ (CAS); Mbisi Forest, 18km NE of Sumbawanga, 2180m a.s.l., leg. E.S. Ross & R.E. Leech, 14.II.1958, 1 juv. ♀ (CAS); Same locality, leg. E.S. Ross & R.E. Leech, 14.III.1958, 5 juv. ♀ (CAS); Mkomazi Game Reserve, Ibaya Camp, leg. A. Russell-Smith, 7.VI.1995 (unburnt grassland), 1♂ 2♀ (PCRS); Morogoro Region, 62km SW of Morogoro, 07°03'S, 37°15'E, leg. W.J. Pulawski, 6.VII.2001, 1♂ (CAS). **ZIMBABWE:** Umtali, 18°58'S, 32°40'E, leg. A. Bodong, X.1902, 1♂ (SAM 12379); Salisbury (Harare), 17°50'S, 31°04'E, J. A. O'Neil, 1914, 1♀ (SAM B785); Insiza, 19°47'S, 29°12'E, leg. G. French, 1918, 1 juv. ♀ (SAM B3887); Same locality, leg. G. French, 1918, 1 juv. ♀ 1 juv. ♂ (SAM B3897).

Distribution: Distributed in Southern, Central and Eastern Africa. Presently known from Botswana, Democratic Republic of Congo, Kenya, Malawi, Namibia, Tanzania, Zimbabwe.

Natural history: *G. granulosa* has been collected in a variety of habitats, including woodlands, forest and grassland. This species is known to mimic velvet ants (Lawrence 1964), most likely members of larger genera such as *Dolichomutilla*.

9.4.2 *Graptartia mutillica* sp. nov.

Figs 2, 5, 8, 11, 13, 24–28

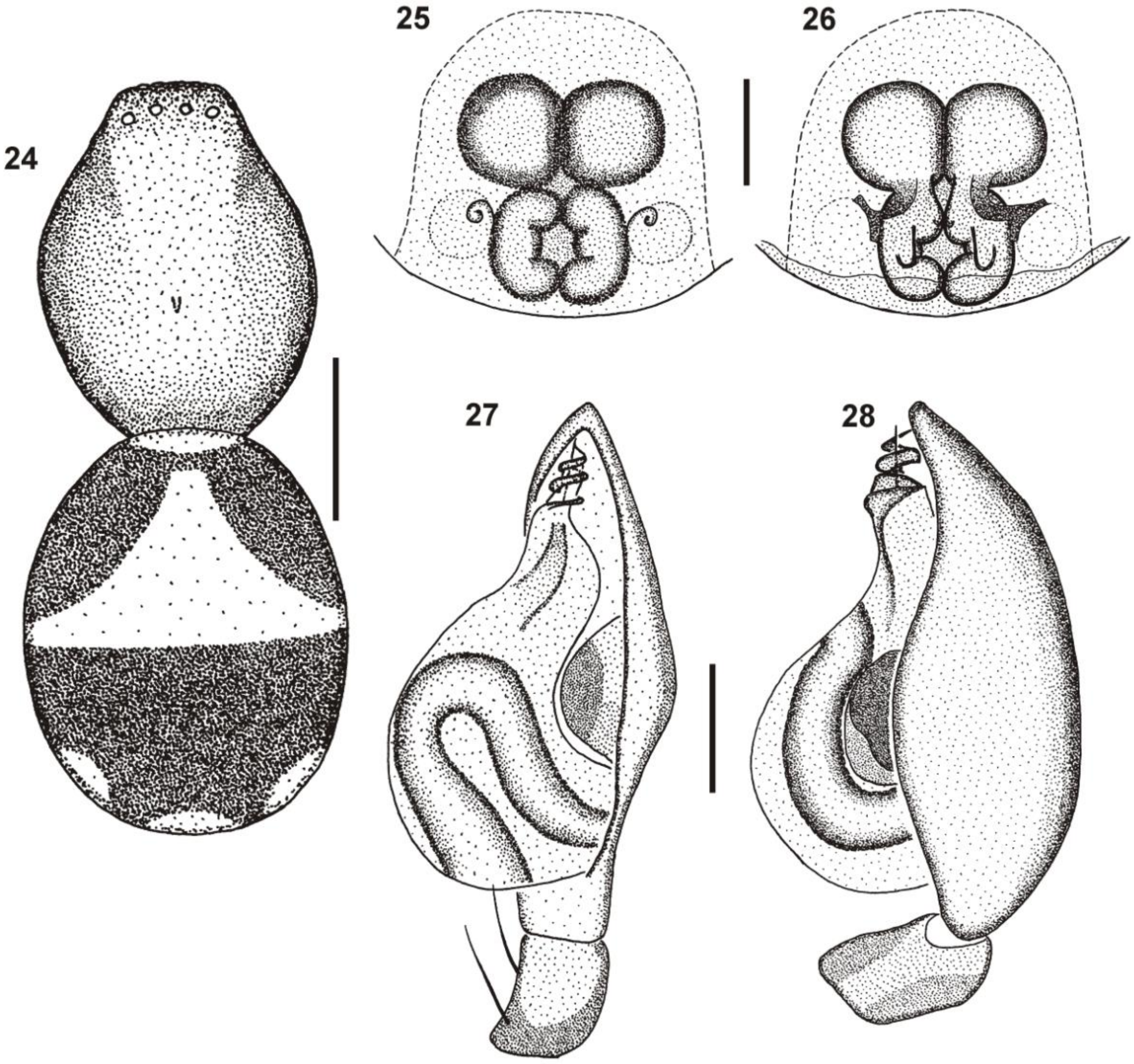
Etymology: The specific name is an acronym of the family name Mutillidae of the velvet ants, of which this species is a mimic.

Diagnosis: This species is much smaller than *G. granulosa*, has a different colour pattern, recurved PER, and plumose rather than clavate setae on the abdomen. The rounded spermathecae of the female and male palpal embolus (Fig. 13), together with the distinctive colour pattern, separates this species from *G. tropicalis*. Additionally, the modified abdominal setae are raised at ~30º to the body surface and are interspersed with long upright straight setae (Fig. 11), while those of *G. tropicalis* lie flat and are interspersed with slightly raised short straight setae (Fig. 12).

Female. Measurements: CL 2.60–2.70, CW 1.80–1.90, AL 2.40–3.40, AW 2.10–2.70, SL 1.00–1.20, SW 0.80–1.00, AME–AME 0.10, AME–ALE 0.05, PME–PME 0.15, PME–PLE 0.10, PLE–PLE 0.60.

Length of leg segments (sequence from femur to tarsus, and total): I 0.90 + 0.50 + 0.80 + 0.80 + 0.70 = 3.70; II 0.90 + 0.50 + 0.80 + 0.80 + 0.60 = 3.60; III 0.90 + 0.50 + 0.80 + 0.80 + 0.50 = 3.50; IV 1.30 + 0.60 + 1.30 + 1.40 + 0.70 = 5.30.

General appearance as in Fig. 24. Carapace gradually raised towards rear; highest at approximately two thirds its length; surface granular (Fig. 5); long and short setae scattered throughout; fovea broad and indistinct (Fig. 5), slightly posterior to midpoint of carapace; carapace deep orange to reddish-brown throughout, but dark grey around borders; ocular region dark grey. AER slightly procurved (Fig. 2); ALE slightly larger than AME; AME blue-grey, ALE pale grey, with brown rings; AME separated by 1½ times their diameter, AME and ALE separated by diameter of AME; posterior eye row slightly recurved (Fig. 2); PLE slightly larger than PME; posterior eyes pale blue-grey, with brown rings; PME separated by 2½ times their diameter, PME and PLE separated by 2 times PME diameter. Chelicerae dark orange, pale near fang bases; black setae on anterior surface; three teeth on promargin, two teeth on retromargin. Sternum orange with pits, darker near border; shorter, pale setae covering surface; long brown setae scattered throughout. Abdomen oval, with large dorsal scutum; dorsum with black undertone, covered with short, black plumose setae; each plumose seta raised at ~30º to surface (Fig. 11); longer, upright regular setae scattered between plumose setae; white plumose setae forming pattern (Fig. 24); white spot on anterior



FIGURES 24–28. *Graptartia mutillica* **sp. nov.** female (24–26) and male (27–28): 24. dorsal view of body; 25. epigyne, ventral view; 26. epigyne, dorsal view; 27. left palp, ventral view; 28. epigyne, retrolateral view. Scale bars: 24 = 1.0mm; 25–28 = 0.2mm.

edge, comprised of scattered setae; medially, a large triangular-shaped marking of dense, white setae; in some specimens fused with anterior spot; one pair of pale spots posterolaterally; a small white spot immediately in front of spinnerets; extensions of dorsal markings continuing laterally; venter of abdomen covered in short, straight black setae, interspersed with black plumose setae. Legs I with uniform dark grey femur, femora II to IV yellow-orange, typically with two dark grey bands, rarely three; remaining leg segments yellow; palp grey with orange tarsus; all 4 pairs of legs with scattered plumose setae. In some faded specimens (e.g. SAM B898) entire body, including legs, pale orange. Genital area sclerotised, dark red-brown; copulatory openings situated laterally, in posterior half of epigyne (Fig. 25); spermathecae large and globose, with kidney-shaped terminal receptaculae situated posteriorly (Fig. 26).

Male. Measurements: CL 2.10–2.20, CW 1.55–1.60, AL 2.30–2.40, AW 1.50–1.65, SL 0.75–0.95, SW 0.60–0.80, AME–AME 0.10, AME–ALE 0.05, PME–PME 0.15, PME–PLE 0.10, PLE–PLE 0.55.

Length of leg segments (sequence from femur to tarsus, and total): I 1.00 + 0.40 + 0.90 + 0.80 + 0.70 = 3.80; II 1.00 + 0.50 + 0.80 + 0.80 + 0.60 = 3.70; III 0.90 + 0.40 + 0.70 + 0.70 + 0.50 = 3.20; IV 1.30 + 0.50 + 1.00 + 1.10 + 0.70 = 4.60.

General habitus similar to female, setal structure same as that of female; male smaller and less robust than female; posterolateral pair of abdominal spots absent, a single white spot in front of spinnerets; abdominal scutum elongate, smaller than in female. AER slightly procurved; ALE slightly larger than AME; AME blue-grey, ALE pale grey, with brown rings; AME separated by 1½ times their diameter, AME and ALE separated by ⅔ AME diameter; PER slightly recurved; PME slightly larger than PLE; posterior eyes pale blue-grey, with brown rings; PME separated by 2 times their diameter, PME and PLE separated by 1½ times PME diameter. Palp lacking retrolateral tibial apophysis; red-brown throughout; bulbus rounded proximally, and wine red; embolus short, robust and directed straight, with two-and-a-half coils (Figs 13, 27, 28).

Type material: ♀ holotype: **SOUTH AFRICA:** *Free State Province*: Deelhoek farm, Bloemfontein district, 28°54'S, 26°07'E, 1250m a.s.l., leg. C.R. Haddad, 12.I.2001 (under old oil drum) (NMBA 9451).

Paratypes: **SOUTH AFRICA:** *Free State Province*: Brandfort district, Florisbad, 28°46'S, 26°05'E, 1250m a.s.l., leg. L.N. Lotz (pitfall traps): 21.XII.1987–5.I.1988, 1♂ (NMBA 3785), 1♀ (NMBA 3803), 2♂ (NMBA 3813), 1♂ 1♀ (NMBA 3839), 1♂ (NMBA 3868); 19.I–1.II.1988, 1♂ (NMBA 4071); 1–15.II.1988, 1♀ (NMBA 4121), 1♂ (NMBA 4161); 15.II–2.III.1988, 1♀ (NMBA 4190), 1♀ (NMBA 4210).

Additional material examined: ETHIOPIA: 19km W of Guder, 2500m a.s.l., leg. A. Russell-Smith, 3.VI.1986, (under stones on hillside), 1 juv. ♂ 1♀ (PCRS). **IVORY COAST:** Kossou, leg. R. Jocqué, 4.VIII.1975 (savanna), 2♂, 14.VIII.1975, 1♀ (MRAC 152416); Mankono, Ranch de la Marahoué, leg. J. Everts, II.1980, 1♂ (MRAC 173982); Same locality, leg. J. Everts, III.1980, 1♂ (MRAC 172265). **SOUTH AFRICA:** *Free State Province*: Smithfield, 30°13'S, 26°32'E, leg. P.R. Kannemeyer, 1909, 1♀ (SAM B898); Bloemfontein district, Deelhoek, 28°54'S, 26°07'E, 1250m a.s.l., leg. C.R. Haddad, 14.VII.2001 (abandoned *Trinervitermes trinervoides* termite mound), 1♂ (PCCH); Bloemfontein district, Hopefield, 28º54'S, 26º14'E, 1260m a.s.l., leg. C.R. Haddad 23.XII.2001 (under dry dung pad), 1♂ (MRAC 211363); Bloemfontein, Valley of Seven Dams Conservancy, 26º04'S, 29º13'E, leg. C.R. Haddad, 18.II.2002 (abandoned *Trinervitermes* *trinervoides* termite mound), 1♀ (AMNH). *KwaZulu-Natal Province*: Lake Midmar, 29°31'S, 30°04'E, leg. V.D. & B. Roth, 6.I.1991, 1♀ (CAS). **TANZANIA:** Mkomazi Game Reserve, 7km SE of Ibaya, leg. M. Ritchie & R. Makusi, 19–20.VIII.1993 (short grass with bushes, burnt, in pitfall traps), 3 juv. 1♂ (PCRS).

Distribution: This species occurs widely, but sporadically throughout western Africa, and along the eastern half of the continent as far south as the Free State, South Africa, and as far north as Ethiopia. This may only be a reflection of poor sampling effort. Country records include Ethiopia, Ivory Coast, South Africa and Tanzania.

Natural history: *Graptartia mutillica* was collected in a variety of habitats, but appears to prefer grassland and savanna. This species was usually collected in pitfall traps, or under prone objects, where it shelters when not active. These include stones, dry cattle dung pads, logs, and in abandoned mounds of the snouted harvester termite *Trinervitermes trinervoides*. According to Lawrence (1964) *Graptartia* may be found in termite nests. The 13 paratype specimens examined from Florisbad formed 23.21% of the corinnid fauna collected in a survey of the surface-active spiders in grassland (Lotz *et al.* 1991), and were mainly collected in grassy habitats with variable soil structure (Leon Lotz, pers. comm.). It is probably an exclusively surface-active species, as it was not collected from grasses or shrubs. This species most likely mimics smaller velvet ants, such as the genus *Mutilla*.

Feeding by *G. mutillica* in captivity follows a similar pattern to other castianeirine corinnids, such as *Copa flavoplumosa* Simon, 1885. Food is captured and held with the front legs while the spider is running or when prey makes contact with a motionless spider, and immediately envenomated. The spider uses rapid movements of the legs to manipulate prey until sedated. Once feeding is complete, only a small ball of prey exoskeleton remains.

9.4.3 *Graptartia tropicalis* sp. nov.

Figs 3, 6, 9, 12, 14–16, 29–33

Etymology: The species name refers to the tropical distribution of this species.

Diagnosis: The male palp of this species has the embolus directed prolaterally compared to that of *G. mutillica*, which is more upright (Figs 13–14). The spermathecae are narrowed laterally compared to the narrow, subtriangular form of *G. granulosa* and the globose form of

G. mutillica. This is the smallest of the *Graptartia* species and has distinctive abdominal colour patterns. The modified plumose setae lie flat against the abdomen.

Female. Measurements: CL 1.90–2.25, CW 1.20–1.45, AL 2.05–3.75, AW 1.50–2.10, SL 0.85–1.00, SW 0.70–0.80, AME–AME 0.10, AME–ALE 0.05, PME–PME 0.15, PME–PLE 0.13, PLE–PLE 0.50.

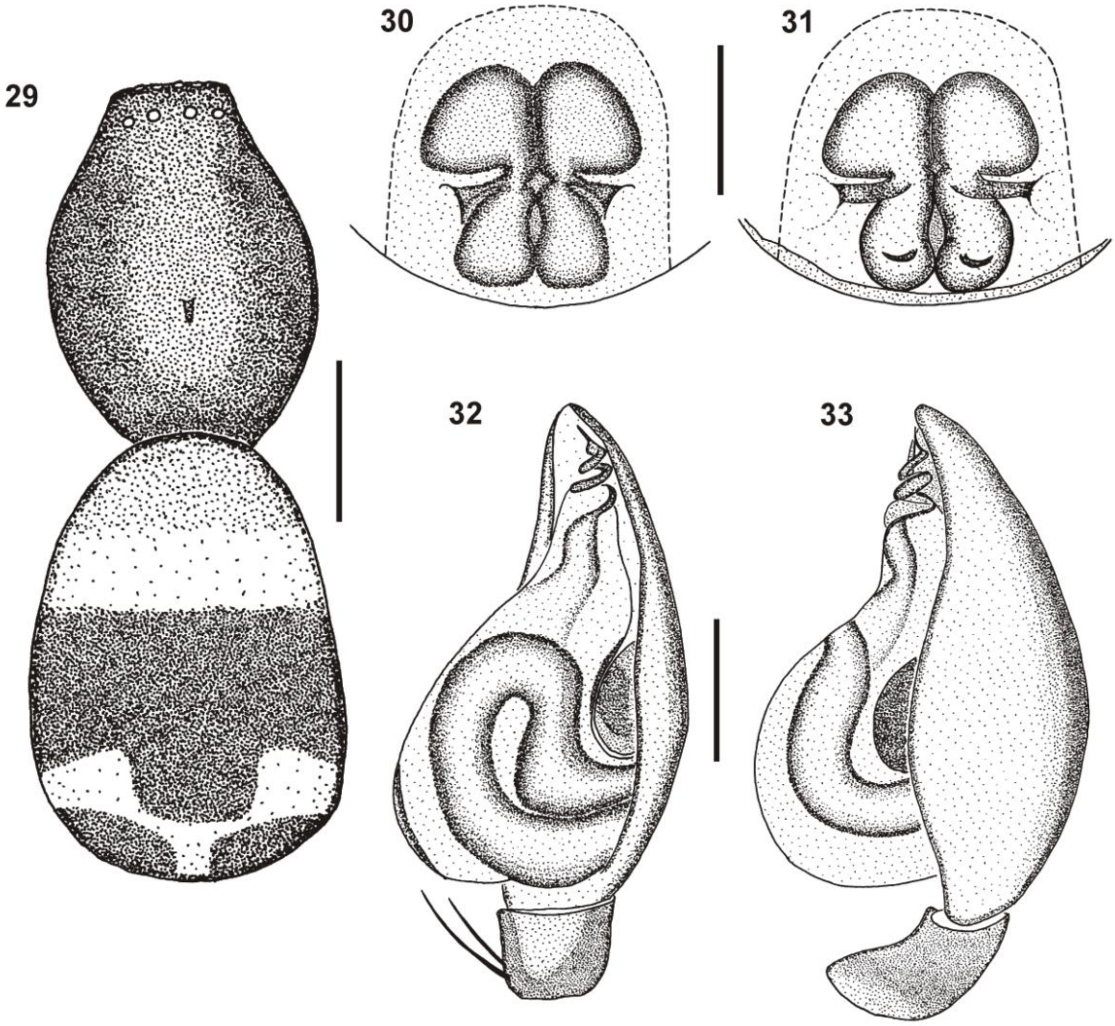
Length of leg segments (sequence from femur to tarsus, and total): I 0.95 + 0.35 + 0.85 + 0.65 + 0.60 = 3.40; II 0.85 + 0.35 + 0.75 + 0.60 + 0.50 = 3.05; III 0.70 + 0.35 + 0.65 + 0.60 + 0.50 = 2.80; IV 1.30 + 0.45 + 1.05 + 1.15 + 0.60 = 4.55.

General appearance as in Fig. 29. Carapace gradually raised towards rear, highest at approximately two-thirds its length; surface slightly granular (Fig. 6); white, plumose setae scattered throughout; fovea shallow and fine (Fig. 6), located slightly posterior to midpoint of carapace; carapace colouration variable, from red to dark wine red; darker around border; ocular region dark grey. AER slightly procurved (Fig. 3); ALE and AME subequal in size; AME dark blue-grey, ALE pale blue-grey, with brown rings; AME separated by 1⅓ their diameter, AME and ALE separated by ½ ALE diameter; PER slightly recurved (Fig. 3); posterior eyes subequal in size, PLE slightly larger than PME; posterior eyes pale blue-grey, with brown rings; PME separated by 2 times their diameter, PME and PLE separated by 1½ times PME diameter. Chelicerae grey-brown, pale near fang bases; black setae on anterior surface; three teeth on promargin, two teeth on retromargin. Sternum red-brown, paler centrally, slightly granular; few black setae and pale plumose setae scattered throughout. Abdomen oval, broadening posteriorly; dorsal scutum large; dorsum with black undertone; covered with short, straight and plumose black setae; plumose setae arranged flat against surface (Fig. 12); white, plumose setae scattered throughout; white plumose setae forming pattern (Fig. 29); broad band at one-third the length of abdomen; posteriorly, two small lateral triangular markings, fused to a median stripe in front of spinnerets; dorsal markings extending ventrally; venter of abdomen pale brown-grey; scattered pale plumose setae between longer, straight black setae. Leg I with grey femur, femora II to IV with three dark bands on orange-grey background; remaining segments yellow to orange-brown, occasionally with dark bands; palp grey-brown. Genital area sclerotised and red-brown; copulatory openings laterally situated, in posterior half of epigyne (Fig. 30); spermathecae roughly subtriangular, narrowed laterally; terminal receptaculae posteriorly situated, somewhat kidney-shaped (Fig. 31).

Male. Measurements: CL 1.80–2.00, CW 1.25–1.30, AL 2.00–2.15, AW 1.20–1.30, SL 0.75–0.80, SW 0.65–0.70, AME–AME 0.10, AME–ALE 0.05, PME–PME 0.15, PME–PLE 0.13, PLE–PLE 0.50.

Length of leg segments (sequence from femur to tarsus, and total): I 0.80 + 0.30 + 0.60 + 0.60 + 0.60 = 2.90; II 0.75 + 0.30 + 0.60 + 0.50 + 0.50 = 2.65; III 0.80 + 0.35 + 0.65 + 0.60 + 0.45 = 2.85; IV 1.15 + 0.40 + 0.95 + 1.10 + 0.55 = 4.15.

General habitus similar to female; male smaller and less robust than female; additional pale setae anterior to dorsal band; abdominal scutum elongate, covering entire dorsum. AER slightly procurved; anterior eyes subequal in size; AME dark blue-grey, ALE pale blue-grey,



FIGURES 29–33. *Graptartia tropicalis* **sp. nov.** female (29–31) and male (32, 33): 29. dorsal view of body; 30. epigyne, ventral view; 31. epigyne, dorsal view; 32. left palp, ventral view; 33. left palp, retrolateral view. Scale bars: 29 = 1.0mm; 30–33 = 0.2mm.

with brown rings; AME separated by 1⅔ AME diameter, AME and ALE separated by AME diameter; PER slightly recurved; posterior eyes subequal in size, PLE slightly larger than PME; posterior eyes pale blue-grey, with partial or complete brown rings; PME separated by 2½ times their diameter, PME and PLE separated by 1⅔ PME diameter. Palp lacking retrolateral tibial apophysis; cymbium uniform red-brown to dark red-brown; bulbus red-brown, somewhat square prolaterally; embolus short, directed prolaterally, with two coils (Figs 14, 32–33).

Type material: ♀ holotype: **TANZANIA:** Kyela (Garden), leg. R. Jocqué, 9.XI.1991 (MRAC 173236).
Paratypes: **D.R. CONGO:** Shaba, Luiswishi, leg. F. Malaisse, XII.1973, 6♀ (MRAC 149002). **SOUTH AFRICA:** *KwaZulu/Natal Province*: Ndumo Game Reserve, W shore of Shokwe Pan, 26º50'S, 32º12'E, leg. C.R. Haddad, 9.I.2002 (leaf litter under logs), 2♂ 1♀ (NCA 2001/487).

Additional material examined: IVORY COAST: Mankono, Ranch de la Marahoué, J. Everts, II.1980, 1♀ (MRAC 173982). **SOUTH AFRICA:** *Eastern Cape Province*: Kei Mouth, 32º41'S, 27º22'E, leg. C.R Haddad, 13.XII.2002 (grass at tree base, coastal forest), 1♀ (NCA 2002/490). *KwaZulu/Natal Province*: Ndumo Game Reserve, W shore of Shokwe Pan, 26º50'S, 32º12'E, leg. C.R. Haddad 3.VII.2002 (leaf litter, *Ficus sycamorus* forest), 1♀ (NCA 2002/397); Same locality, W shore of Nyamiti Pan, leg. C.R. Haddad, 7.VII.2002 (under logs in grass under *Acacia xanthophloea* trees), 1 juv. 1♀ (NCA 2002/398); Same locality, Shabatana Camp, leg. C.R. Haddad, 7.VII.2003 (grass at *A. xanthophloea* tree bases), 4♂ 1♀ (NCA 2002/505); Umgeni Valley Nature Reserve, 29º28, 30º14'E, leg. C.R. Haddad, 11.V.2003 (leaf litter, tree base), 1♂ 1♀ (NCA 2002/506). **TANZANIA:** Matema, Livingstone Mountains, leg. R. Jocqué, 12.XI.1991 (river bank), 1♂ 1♀ (MRAC 173416); Same locality, leg. R. Jocqué, 22.XI.1991, 1♀ (MRAC 173836); Tukuyu, Ushirika area, Kayuki tea estate, 1200m a.s.l., leg. R. Jocqué, 29.XI.1991, 1♂ (MRAC 173439); Masoko Crater Lake, road between Itete and Tukuyu, leg. R. Jocqué, 30.XI.1991 (woodland leaf litter), 1♂ (MRAC 173281); Mkomazi Game Reserve, Kisima, leg. A. Russell-Smith, 25.I.1996 (leaf litter below *Newtonia* tree), 2♂ 2♀ (PCRS).

Distribution: This species is widely distributed, and apparently has a preference for tropical and subtropical climates, being found in western and central Africa, and along the east coast as far south as the Eastern Cape, South Africa.

Natural history: *Graptartia tropicalis* has thus far been collected from woodland and forest habitats, especially in the leaf litter layer. At Ndumo Game Reserve and Kei Mouth it was found to be one of the most common spiders (as were the other corinnids *Medmassa nitida* Lawrence, 1937 and *M. proxima* Lessert, 1923) inhabiting the grass and leaf litter matrix at the base of trees. Likely prey in this niche may include springtails (Collembola), various flies

(Diptera) and possibly ants (Hymenoptera: Formicidae), which are all abundant. Feeding behavior is similar to that described for *G. mutillica*.

Two female *G. tropicalis* laid egg sacs in the laboratory. The egg sacs composed a basal disk on which five bright orange eggs were laid (diameter 0.8 mm), and a cover disk, both constructed of dense, papery silk. The one egg sac was round, with a diameter of 5.3 mm, and the second oval, with a length of 6.1 mm and width of 3.9 mm.

9.5 DISCUSSION

The genus *Graptartia* is widely distributed in the Afrotropical Region, from the Ivory Coast in the northwest, Ethiopia in the northeast, and South Africa in the south (Fig. 34). The sporadic distribution of the various species is probably just an artifact of collecting effort, rather than actual occurrence. The cryptic nature of most species and their resemblance to the wingless females of velvet ants (Hymenoptera: Mutillidae) may contribute to their poor representation in collections.

Graptartia granulosa has a central and southern African distribution, but it has not been collected as far south as South Africa, neither west or north of the Democratic Republic of Congo (Fig. 34). The two smaller species, *G. mutillica* and *G. tropicalis*, have a broadly sympatric distribution, occurring together at Mankono in the Ivory Coast, Mkomazi Game Reserve in Tanzania, and near Howick in South Africa (Fig. 34). However, in South Africa, *G. mutillica* penetrates deeper into the interior, and has been collected frequently in semi-arid grassland, while *G. tropicalis* prefers more moist climates such as grassland in KwaZulu-Natal, and coastal and savanna woodland.

Known species of *Graptartia* bear a close resemblance to velvet ants, which are a type of wasp with an especially painful sting. The movements of *G. mutillica* and *G. tropicalis* were observed to be very rapid, enforcing the resemblance to their models. *Graptartia* is not the only spider genus known to have members that resemble or mimic velvet ants. Another castianeirine genus *Coenoptychus* Simon, 1885 from Sri Lanka and India is also a mimic of velvet ants (Deeleman-Reinhold 2001). This phenomenon has also been observed by Dippenaar-Schoeman (1990) in the males of the buckspoor spider genus *Seothyra* Purcell, 1903 (Eresidae) and in jumping spiders (Salticidae) of the genera *Phidippus* C.L. Koch, 1846, reported by Edwards (1984), and *Mexcala* Peckham & Peckham, 1902. Meg Cumming (pers. comm.) found that the adult female of a *Mexcala* sp. from Zimbabwe has two pairs of white spots on a black background (as in *G. granulosa*) and runs across the ground in the same way as a mutillid female. The males and juveniles mimic and prey on two separate species of ants.

Edwards (1984) observed that numerous other neotropical salticid genera contain members with colour patterns similar to some neotropical mutillids, and that this mimicry may be more widespread than initially suspected. He proposed that the main evolutionary driving force behind mutillid mimicry is predator avoidance. Since the *Phidippus* spp. he studied are primarily arboreal and spend a minimal amount of time on the ground, one would expect the benefits of mutillid mimicry to be greater for the exclusively epigeic *Graptartia* species, since mutillids are also ground-living.

9.6 REFERENCES

BERLAND, L. 1922. Araignées. *In:* Voyage de M. le Baron de Rothschild en Ethiopie et en Afrique orientale anglaise (1904-1905). Résultats scientifiques. *Animaux articulés, 1re Partie, Paris.*

BOSSELAERS, J. & JOCQUÉ, R. 2000. Studies in Corinnidae: transfer of four genera and description 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.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanteriidae [sic])*. Brill, Leiden.

DIPPENAAR-SCHOEMAN, A.S. 1990. A revision of the African spider genus *Seothyra* Purcell (Araneae: Eresidae). *Cimbebasia* **12:** 135–160.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African Spiders— An Identification Manual.* PPRI Handbook No. 9. ARC—Plant Protection Research Institute, Pretoria.

EDWARDS, E.G. 1984. Mimicry of velvet ants (Hymenoptera: Mutillidae) by jumping spiders (Araneae: Salticidae). *Peckhamia* **2:** 46–49.

LAWRENCE, R.F. 1928. Contributions to a knowledge of the fauna of South West Africa. V. Arachnida. *Annals of the South African Museum* **25:** 1–75.

LAWRENCE, R.F. 1964. *A conspectus of South African spiders.* Department of Agricultural Technical Services, South Africa. Science Bulletin 369.

LESSERT, R. DE 1936. Araignées de l'Afrique orientale portugaise recueillies par M. M. P. Lesne et H.-B. Cott. *Revue Suisse de Zoologie* **43:** 207–306.

LOTZ, L.N., SEAMAN, M.T. & KOK, D.J. 1991. Surface active spiders (Araneae) of a site in semi-arid central South Africa. *Navorsinge van die Nationale Museum, Bloemfontein* 7: 529–540.

SIMON, E. 1896. Descriptions d'Arachnides nouveaux de la familie des Clubionidae. *Annales de la Société entomologique de Belgique* **40:** 400–422.

SIMON, E. 1932. Les arachnides de France. Tome VI. Synopsis générale et catalogue des espèces françaises de l'ordre des Araneae; 4e partie. *Paris* **6**: 773–978.

CHAPTER 10

Merenius alberti **Lessert, 1923 (iSimangaliso Wetlands Park, South Africa)**

A redescription of *Merenius alberti* Lessert, 1923 (Araneae: Corinnidae), with remarks on colour polymorphism and its relationship to ant models

10.1 ABSTRACT

The ant-like sac spider *Merenius alberti* Lessert, 1923, previously known only from South Africa, is redescribed. The species is recorded for the first time from Mozambique, Swaziland and Zimbabwe. While most populations of *M. alberti* conform to the typical black morph of the species, a red morph is also reported here, providing the first case of colour polymorphism in an Afrotropical ant-like castianeirine spider. Spiders were collected by hand and ants by pitfall trapping in the Ndumo Game Reserve in northern KwaZulu-Natal, South Africa, to identify the potential models of the two colour morphs of *M. alberti*. The ants collected at 20 sites in the reserve suggest that the black morph is a generalised mimic of black ground-dwelling ants, most likely *Camponotus cinctellus* (Gerstäcker, 1859), *Streblognathus peetersi* Robertson, 2002 and *Polyrhachis gagates* F. Smith, 1858, while the red morph is a mimic of *Anoplolepis custodiens* (F. Smith, 1858) ants.

10.2 INTRODUCTION

Ant mimicry is a widespread occurrence among many unrelated spider families but is usually only encountered in a small proportion of the species diversity of each. The diversity of mimics is greatest in three families of hunting spiders, the Salticidae (jumping spiders), Corinnidae, especially the subfamily Castianeirinae (ant-like sac spiders), and the Zodariidae, particularly Zodariinae (ant-eating spiders). Despite the development of mimicry devices in many genera of these higher taxa, species of Castianeirinae usually employ one of three mimicry strategies (Reiskind 1969): 1) have a broad-based mimicry strategy, resembling, for example, large brown or black ants; 2) subfamilial or generic ant mimics, and; 3) resembling a single species of ant, with which their mimetic modifications are particularly specialised to associate with a particular ant. Little is known of whether castianeirines are aggressive mimics and feed on their models, or whether they are merely Batesian mimics.

During fieldwork in the Ndumo Game Reserve (NGR) in northern KwaZulu-Natal, South Africa, as part of an arachnid biodiversity survey, several species of ant mimicking castianeirine spiders were found (Haddad *et al.* 2006): *Apochinomma formicaeforme* Pavesi, 1881 are distinctive mimics of *Polyrhachis gagates* F. Smith, 1858 ants, while *Corinnomma semiglabrum* (Simon, 1896) and *C. lawrencei* Haddad, 2006 are inaccurate mimics of *P. gagates* and *Camponotus cinctellus* (Gerstäcker, 1859) ants. The two undetermined, possibly new *Castianeira* species recorded from the reserve show contrasting strategies. One species is polymorphic, with a red morph (widespread in southern Africa) that mimics *Anoplolepis custodiens* (F. Smith, 1858) ants and a black morph that mimics *C. cinctellus* ants. The smaller second species apparently mimics *Pheidole* ants. Quite often the distribution of these castianeirine species overlaps as populations of their models overlap.

The sixth ant-mimicking corinnid species, *Merenius alberti* Lessert, 1921, was the most common castianeirine species occurring in leaf litter in most of the habitats in NGR, particularly in woodlands and sand forest, and is an exclusive ground-dwelling spider. During the first three years of the survey (2000–2002), all specimens collected were of the "typical" colouration that is found in eastern southern Africa, being black with cream or blue-grey markings on the body (Figs 1–3, 5). This morph is an inaccurate mimic that resembles several black ground-dwelling ants, including *P. gagates*, *C. cinctellus* and *Streblognathus peetersi* Robertson, 2002. This is the only colour morph observed in museum specimens from more than 50 localities in southern Africa. During 2003 and 2004, two *M. alberti* populations were discovered in NGR (Dipini Hide and Ezikebheni) having a red carapace and grey abdomen with cream markings (Figs 4, 6), which represented the first records of this colour morph. These populations were only found in association with colonies of *A. custodiens* ants. Subsequent sampling in the Kruger National Park forming part of a M.Sc study lead to the discovery of an additional population of the red morph found amongst specimens of the typical black colour morph. The occurrence of two distinctly different colour morphs mimicking different ants in such close proximity to one another is quite remarkable, and warranted further investigation into the role of ant assemblage composition on the occurrence of each morph.

Merenius alberti shows restricted capability to mimicking its models. Adaptations are restricted to the adaptive colouration of their models, as no morphological modifications of the carapace and abdomen are evident, with the exception of gravid females that have a swollen abdomen reminiscent of that of *P. gagates*. The legs of both colour morphs have dark stripes typically found in mimetic castianeirines (Figs 1–6). In contrast, more specialised castianeirine mimics in the genera *Apochinomma* Pavesi, *Mazax* O. P.-Cambridge, *Myrmecium* Latreille, *Myrmecotypus* O.P.-Cambridge, *Pranburia* Deeleman-Reinhold and *Sphecotypus* O. P.-Cambridge (Reiskind 1969; Oliveira 1988; Deeleman-Reinhold 2001) have constricted or elongate carapaces, distinct elongate petioles, and globose or constricted

FIGURES 1–6. General habitus photographs of *Merenius alberti* Lessert, 1923 females from Ndumo Game Reserve, South Africa (1, 4–6), iSimangaliso Wetlands Park, South Africa (2) and Sodwana Bay, South Africa (3): 1–3, 5. common black colour morph; 4, 6. scarce red colour morph.

abdomens, sometimes with modified spines or setae. From a behavioural point of view, *M. alberti* runs in rapid short, darting bursts, and when stationary, moves its front legs up and down to simulate movements of the antennae of ants.

In this paper, *M. alberti* is redescribed and scanning electron microscopy is used to assess whether the genitalic structures of the two colour morphs are the same, to confirm their conspecificity. Quantitative data on the abundance of the two morphs of *M. alberti* and their potential ant models within NGR is presented to explain the occurrence of each morph.

Habitat structure as an influence determining the spatial distribution of ants and their mimics is also considered.

10.3 MATERIAL & METHODS

10.3.1 Taxonomy

All spiders were examined under a Nikon SMZ800 stereomicroscope. Female genitalia were dissected from the abdomen using fine entomological pins, placed in a small vial in 70% ethanol and cleared for 1 minute in a Labcon 5019U ultrasonic bath. Genitalia were observed for illustrations in 70% ethanol. Dissected genitalia were placed in microvials together with the specimens from which they had been removed. A range of total length measurements is provided to indicate size variation, and descriptions of the eye arrangements are given for the anterior view of the AER and dorsal view of the PER. The length of leg segments is given from the femur to tarsus, and total. All measurements are given in millimetres (mm).

The following abbreviations are used in the redescription: 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 & Jocqué (2000) and includes the following abbreviations: do – dorsal; pl – prolateral; plv – prolateral ventral; rl – retrolateral; rlv – retrolateral ventral; vt – ventral terminal.

Material of both sexes of both colour morphs of *M. alberti* was prepared through a graded ethanol series and then critical point dried in an argon chamber. Material was then mounted on stubs and sputter-coated three times for 3 minutes with gold before observation in a JEOL WinSEM 6400 at 10kV. Digitised micrographs were taken. Digital photographs of the general habitus of males and females of both colour morphs were taken using a Nikon Coolpix 8400 camera mounted on a Nikon SMZ800 stereomicroscope.

Material of *M. alberti* from the following collections was examined or was identified as part of general Corinnidae loans (curators in parenthesis):

MNHG – Museum of Natural History, Geneva, Switzerland (Peter Schwendinger)
MRAC – Royal Museum for Central Africa, Tervuren, Belgium (Rudy Jocqué)
NCA – National Collection of Arachnida, ARC – Plant Protection Research Institute, Pretoria, South Africa (Ansie Dippenaar-Schoeman)
NMSA – Natal Museum, Pietermaritzburg, South Africa (Audrey Ndaba)
NMZA – National 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)

10.3.2 Frequency of colour morphs relative to ant assemblages

To assess the relationship between the frequencies of the two colour morphs of *M. alberti* relative to the local abundance of potential ant models, sampling was conducted in the NGR, a small savanna reserve (10112ha or 101km^2 in area) situated on the Maputaland coastal plain in South Africa (Fig. 7). A wide variety of habitats is conserved within the reserve, 16 in total (De Moor *et al.* 1977), including various woodland and savanna types, floodplain habitats and sand forest. The floodplain habitats are of particular importance, and consequently the reserve is considered as a RAMSAR site of international importance (Ramsar 2010). During the arachnid biodiversity survey (Haddad *et al.* 2006), these habitats were grouped into eight broad habitat types, namely: *Acacia tortilis* savanna (AS); *Acacia xanthophloea* forests around pans (AX); Deciduous broadleaf woodland (BW); *Ficus sycomorus* forest (FF); Floodplain vegetation near the Pongola and Usutu rivers (FP); Riparian forests along Pongola and Usutu rivers (RF); Sand forest (SF); and Subtropical bush. For the purposes of the current study, subtropical bush was subdivided into three further habitat types: *Acacia nigrescens* woodland (AW); *Albizia–Euphorbia* thicket (AE); and Mahemane thicket (MT). A base map to indicate the sampling sites was provided by Cathariné Hanekom of Ezemvelo KZN Wildlife.

During June–July (winter) and November–December (summer) 2009, pitfall traps were set out to sample epigeic ants for a period of 10 days at two sites in each of the 10 habitats listed above. The two habitat sampling sites were separated by at least 1km to avoid

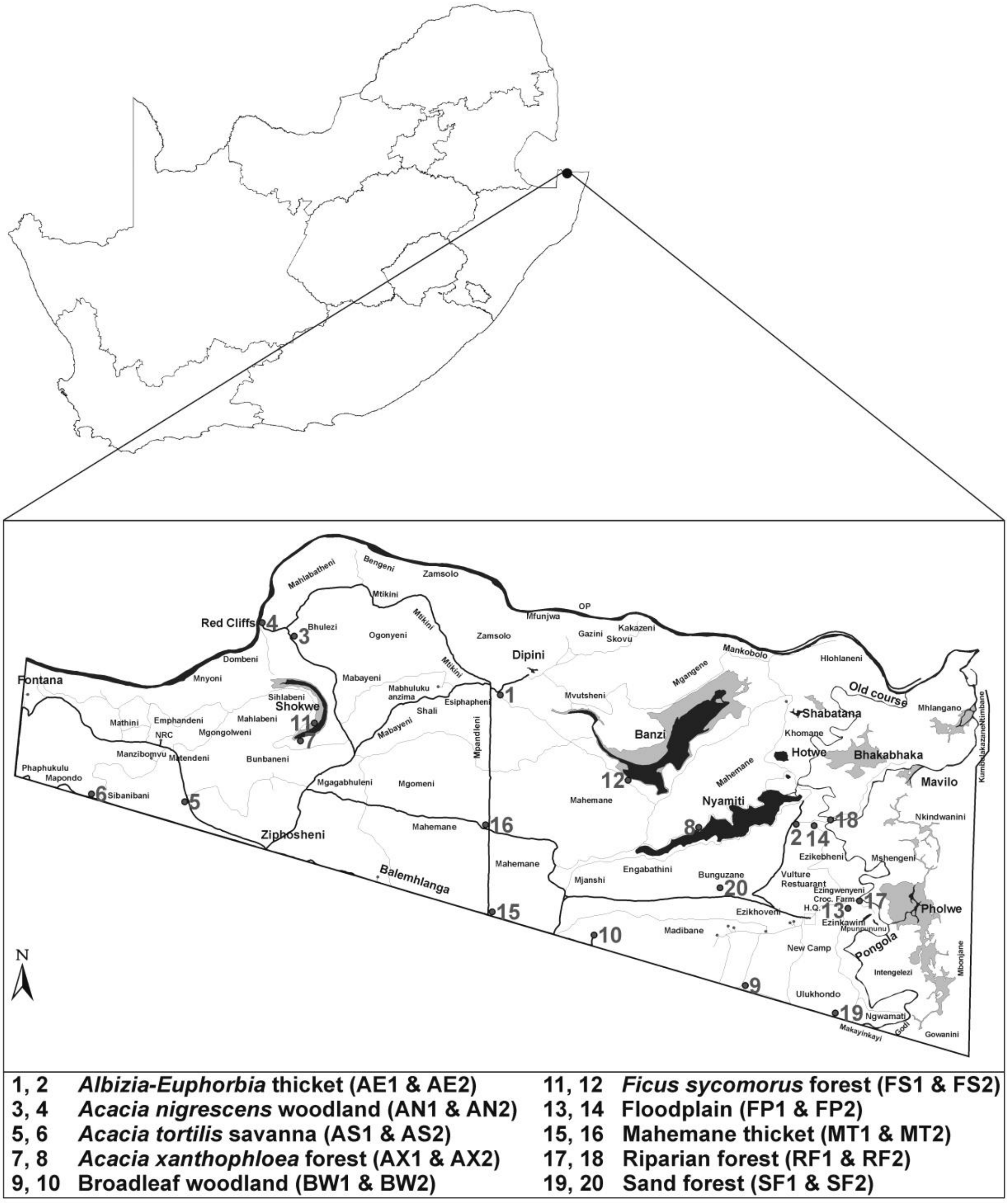


FIGURE 7. Map of South Africa indicating the location of Ndumo Game Reserve, enlarged map indicating the 20 sites sampled for *Merenius alberti* Lessert, 1923 and the resident ant assemblages that may serve as their models.

pseudoreplication (Fig. 7). Five pitfalls (diameter of 10cm) were set out 5m apart in a straight line at each site and filled with 100ml of ethanediol as a preservative. The collected material from each site was pooled together, and the ants were extracted from each sample and preserved in 70% ethanol for later identification in the laboratory. Ants were identified using the online resources The Ants of Africa (Taylor 2011), which has keys to the subfamilies, genera and species of African ants, and AntWeb (Fisher 2002), which provides supplementary figures and original descriptions of ants.

During each of these sampling periods, *M. alberti* were collected at each site by hand in leaf litter, under logs or at the base of grass tussocks. Twenty individuals were collected at each sampling site in the vicinity of the pitfall traps to determine the proportion of red:black variants. Preference was given to adult individuals, but when adults were scarce, subadults or immatures were also collected. If no *M. alberti* were collected during 3 hours of searching, or if sites were inaccessible due to flooding, a site was abandoned. This was the case at two sites during winter (AN1 and AX1, no *M. alberti*) and four during summer (no *M. alberti* at AS2 and AX1, RF1 and RF2 flooded). Collected individuals were pooled for each site, preserved in 70% ethanol, and the proportions of each colour morph were noted in the laboratory. The collected material has been deposited in the collection of TMSA (voucher numbers TMSA 24068–24101).

10.4 RESULTS

10.4.1 Taxonomy

***Merenius alberti* Lessert, 1923**

Figs 1–6, 8–45

Merenius alberti Lessert, 1923: 192, figs 38–41 (1♀ lectotype and 1♂ paralectotype, here designated: **SOUTH AFRICA:** KwaZulu-Natal, Durban, Umbilo, L. Bevis, NMSA 18851 – examined; 1♂ palp 2♀ paralectotypes, here designated, with same collecting data, MNHG – examined).

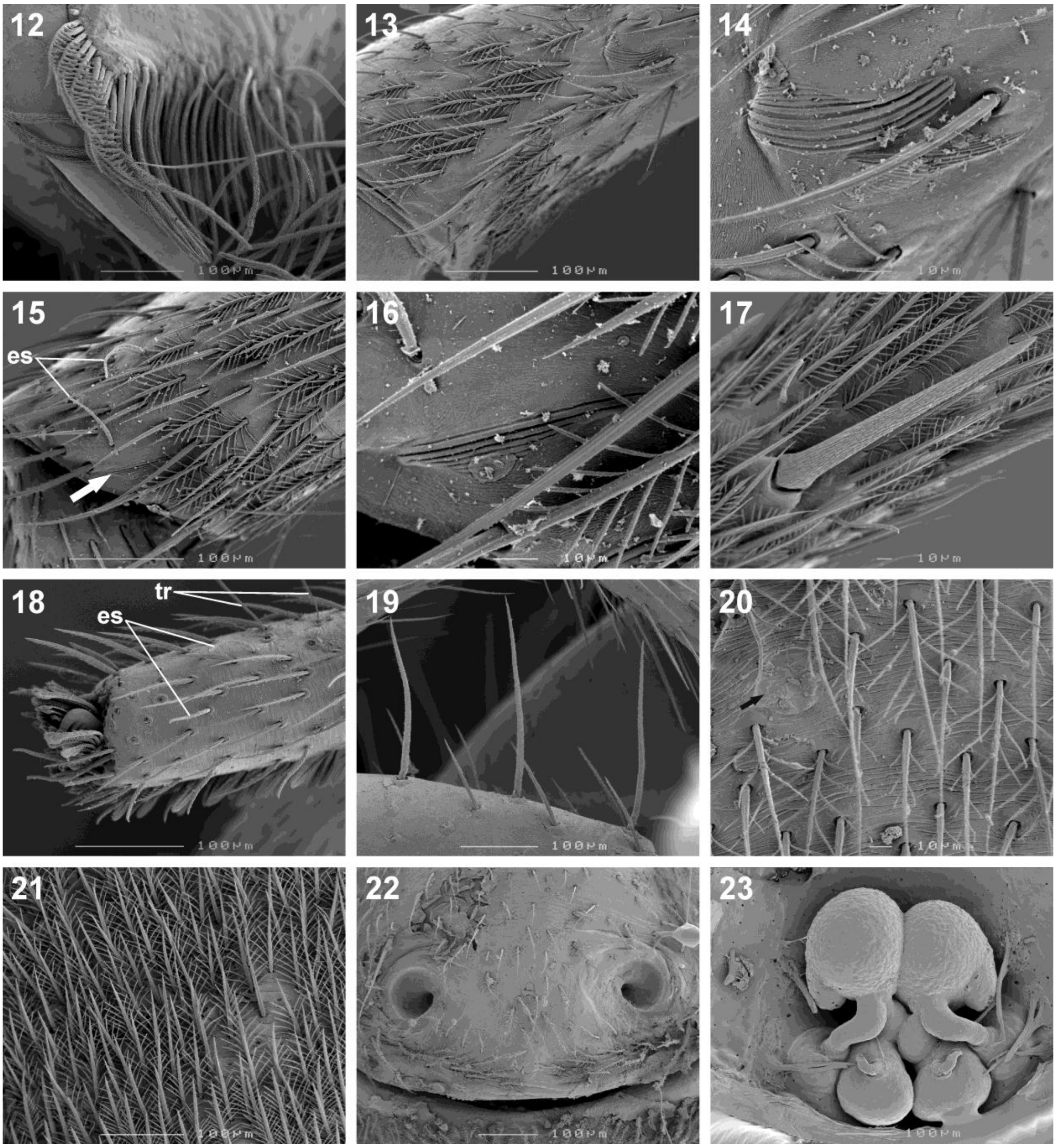
Female (Ndumo, TMSA 24067). Measurements: CL 4.35, CW 2.65, AL 4.10, AW 2.25, TL 8.15 (6.55–10.05), FL 0.36, SL 1.85, SW 1.36, AME–AME 0.10, AME–ALE 0.03, ALE–ALE 0.42, PME–PME 0.16, PME–PLE 0.14, PLE–PLE 0.73, PERW 0.94, MOQAW 0.37, MOQPW 0.44, MOQL 0.45.

Length of leg segments: I 2.60 + 1.10 + 2.25 + 2.18 + 1.55 = 9.68; II 2.33 + 1.08 + 1.88 + 1.96 + 1.37 = 8.62; III 2.30 + 1.04 + 1.67 + 2.10 + 1.03 = 8.14; IV 3.32 + 1.35 + 2.93 + 3.65 + 1.37 = 12.62.

General appearance as in Fig. 8. Carapace dark brown, eye region darker, with black striae radiating from fovea; surface finely granulate, densely setose, white plumose setae forming broad median stripe from cephalic region, narrowed towards posterior margin, black plumose setae forming paired stripes mediolaterally from ⅓ carapace length to posterior, lateral margins with white plumose setae; several long curved setae on clypeus, eye region and along midline posterior to PER; carapace oval-elongate, broadest at posterior of coxae II, highest at ⅔ carapace, eye region slightly narrowed; fovea distinct, short and narrow; posterior margin slightly concave. All eyes with black rings; AER procurved, laterals slightly larger than medians; AME separated by distance approximately ¾ their diameter; AME separated from ALE by distance approximately ¼ AME diameter; clypeus height approximately double AME diameter; chilum single, triangular; PER slightly recurved, nearly straight, medians very slightly larger than laterals; PME separated by distance slightly larger than their diameter; PME separated from PLE by distance equal to PLE diameter; CW:PERW = 2.82:1. Chelicerae dark orange-brown with black mottling, paler proximally retrolaterally, distally prolaterally and on posterior surface of paturon, with long, erect straight setae on anterior surface and pectinate curved setae on fang promargin (Fig. 12); three teeth on promargin, distal tooth smallest, median tooth largest; median and distal teeth

FIGURES 8–11. Digital microscope photographs of *Merenius alberti* Lessert, 1923 from Ndumo Game Reserve, South Africa: 8. female, black morph; 9. male, black morph; 10. female, red morph; 11. male, red morph. Scale bars = 2.0mm.

adjacent; retromargin with two teeth, distal tooth slightly smaller than proximal tooth. Endites dark yellow-brown with black mottling, white at distinct serrula and maxillar hair tuft; labium yellow-brown, white distally, trapezoidal with slightly concave distal margin; sternum shield-shaped, rebordered, orange-brown with black mottling, with scattered long erect and short



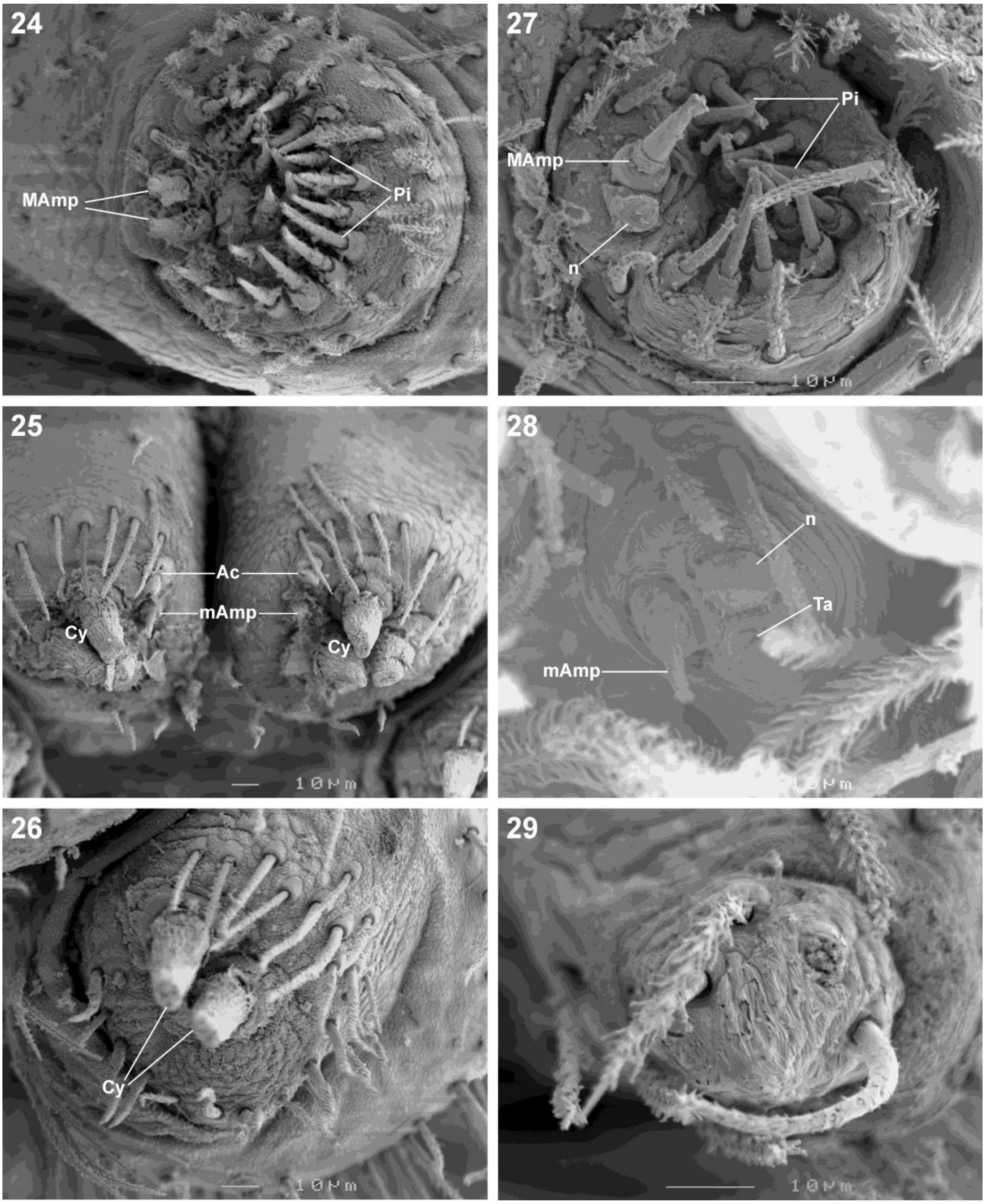
FIGURES 12–23. Scanning electron microscope photographs of *Merenius alberti* Lessert, 1923 female: 12. cheliceral promarginal bent setae, anterior view; 13. leg I, patellar indentation (PI); 14. same, detail of proximal end of PI; 15. tibiae I, retrolateral view, indicating slit sensilla (arrow) and short erect setae (es); 16. same, detail of slit sensilla; 17. metatarsus III, spine and plumose setae; 18. tarsus II, indicating short erect setae (es) and trichobothria (tr); 19. palpal femur, erect ventral setae; 20. dorsal abdominal setae; 21. same, arrow indicating sigillum; 22. epigyne, ventral view; 23. same dorsal, slightly lateral view.

straight setae and white plumose setae; intercoxal sclerites present between all coxal pairs; precoxal triangles present; pleural bars isolated. Leg formula 4123; legs covered in black and white plumose and short straight setae corresponding with markings, with short leg spines on femora, tibiae and metatarsi, and trichobothria and short erect white setae on tibiae, metatarsi and tarsi (Figs 13–17); plumose setae absent on tarsi, claw tufts dense (Fig. 18); coxae finely granulate, yellow-brown with black mottling, coxae I and IV slightly darker; femora black, yellow distally, with prolateral, retrolateral and ventral white stripes, markings fused proximally on ventral side; patellae I and II yellow with black mottling dorsally, proximally and laterally; patellae III and IV yellow-brown with black mottling, III with broken white prolateral stripe and unbroken white retrolateral stripe along length of patella, IV with unbroken white stripes pro- and retrolaterally along length of patella; patellar indentation narrow, broadened proximally (Figs 13, 14); tibiae I and II uniform yellow, with dorsal, prolateral ventral and retrolateral ventral black stripes, fainter on tibia I; tibia III yellow with black mottling, with dorsal, prolateral ventral and retrolateral ventral black stripes; tibia IV yellow-brown, distal end yellow, with prolateral and retrolateral black stripes; tibiae with distal retrolateral slit sensilla (Figs 15, 16); metatarsi I and II uniform yellow; metatarsus III yellow and IV yellow-brown, both with black mottling, with retrolateral black stripe running the length of metatarsi; tarsi all uniform 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: all with single long fine distal seta; tibiae: I plv 2 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; tibiae I and II with single long fine seta near distal end; metatarsi: I plv 2 rlv 2, II plv 2 rlv 2, III pl 3 rl 3 plv 1-2 rlv 2 vt 3, IV pl 3 rl 3 plv 2 rlv 2 vt 3. Palpal spination: femora: pl 1 do 2, with rlv 7 erect ventral spines (Fig. 19); patellae: pl 1; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 2 rlv 1. Abdomen oval, with short sclerotised petiole, three pairs of erect setae on anterior margin and red-brown dorsal scutum extending ⅖ abdomen length; two pairs of distinct sigilla present (Fig. 20), first just behind margin of scutum and second at ⅗ abdomen length; dorsum black, with broad symmetrical irregular cream marking medially, broken at ¾ abdomen length (sometimes not in several specimens), triangular posterior cream marking and white spot of dense setae above spinnerets; sides of abdomen black, with triangular cream marking above epigastric furrow, fused to diamond-shaped median marking; dorsum densely covered in black and cream plumose setae corresponding to markings, with scattered short straight setae; venter pale mottled grey, covered in short straight black setae with sparse plumose setae; ventral sclerite absent, post-epigastric and inframamillary sclerites present, weakly sclerotised; two paired rows of tiny sclerites from epigastric furrow to spinnerets, outer row much smaller and less sclerotised. Spinnerets: ALS with two major ampullate gland spigots and many piriform gland spigots (Fig. 24); PMS with three large cylindrical gland spigots, one small minor ampullate gland spigot and one aciniform gland spigot (Fig. 25); PLS with two large cylindrical gland spigots only (Fig. 26). Epigyne with small circular coiled epigynal ridges with prolateral copulatory openings (Figs 22, 42); copulatory ducts short, sharply bent medially before entering ST II along their posterior margin; anterior ST II round, with posterolateral projection of varying size, broadly connected to smaller kidney-shaped posterior ST I; ST I clearly narrower than ST II (Figs 23, 43).

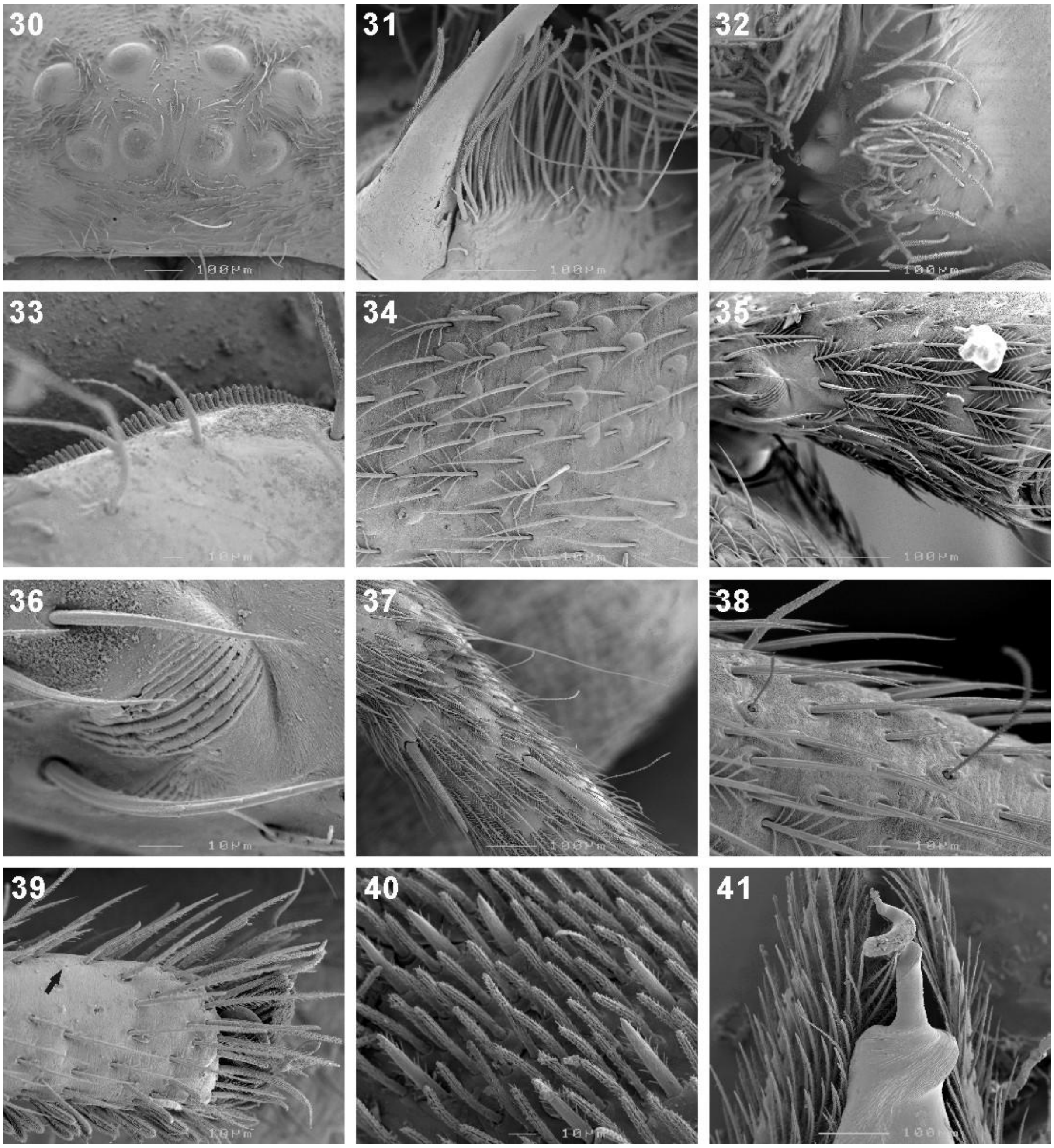
Male (Ndumo, TMSA 24067). Measurements: CL 3.35, CW 2.10, AL 3.50, AW 1.72, TL 6.60 (5.80–9.60), FL 0.23, SL 1.48, SW 1.15, AME–AME 0.07, AME–ALE 0.02, ALE–ALE 0.33, PME–PME 0.13, PME–PLE 0.09, PLE–PLE 0.54, PERW 0.74, MOQAW 0.30, MOQPW 0.38, MOQL 0.39.

Length of leg segments: I 1.88 + 0.76 + 1.68 + 1.66 + 1.31 = 7.29; II 1.73 + 0.73 + 1.38 + 1.41 + 1.06 = 6.31; III 1.70 + 0.75 + 1.25 + 1.56 + 0.84 = 6.10; IV 2.50 + 0.98 + 2.20 + 2.73 + 1.20 = 9.61.

General appearance as in Fig. 9, male more slender than female. Carapace dark brown, nearly black, eye region darker, with black mottling and striae radiating from fovea; markings, setae and carapace proportions as for female. All eyes with black rings; AER procurved, laterals slightly larger than medians; AME separated by distance slightly larger than ½ their diameter; AME separated from ALE by distance approximately ¼ AME diameter; clypeus height slightly more than double AME diameter (Fig. 30); chilum single, triangular; PER slightly recurved, nearly straight, medians very slightly larger than laterals; PME separated by distance slightly less than their diameter; PME separated from PLE by distance equal to $^3/_5$ PME diameter; CW:PERW = 2.84:1. Chelicerae dark red-brown with black mottling, yellow proximally retrolaterally, distally prolaterally and on posterior surface of paturon, with scattered long, erect straight setae on anterior surface and curved setae on fang promargin not pectinate (Fig. 31); cheliceral dentition (Fig. 32) as for female. Endites dark orange-brown with black mottling, yellow at distinct serrula (Fig. 33) and maxillar hair tuft; labium dark brown, cream distally, trapezoidal with slightly concave distal margin; sternum shield-shaped, rebordered, dark red-brown with black mottling, with dense white plumose setae and scattered long erect; intercoxal sclerites present between all coxal pairs; precoxal triangles present; pleural bars isolated. Leg formula 4123; leg setae, spines and claw tuft (Figs 34–39) and markings as for female, except colouration darker and more intense. Leg spination:

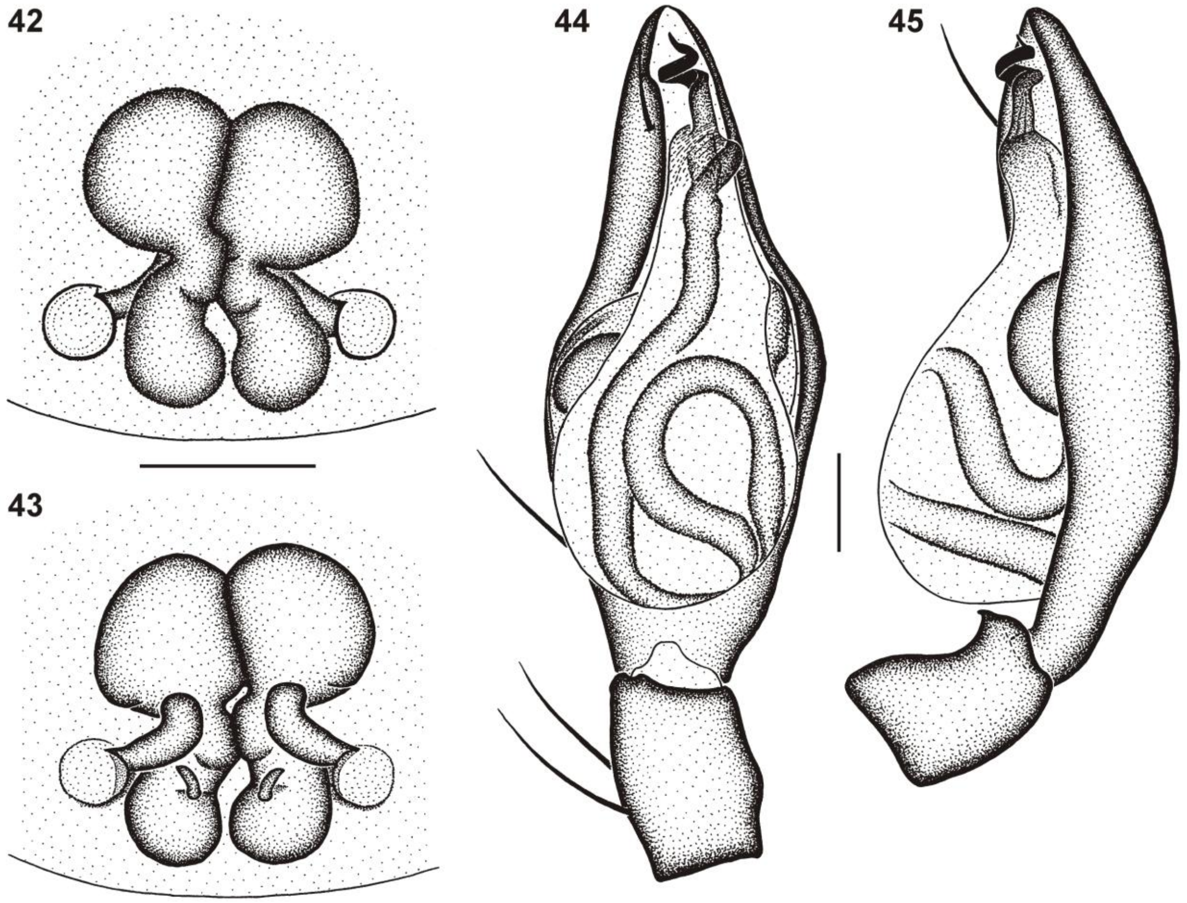


FIGURES 24–29. Scanning electron microscope photographs of *Merenius alberti* Lessert, 1923 female (24–26) and male (27–29) spinneret morphology: 24, 27. anterior lateral spinneret; 25, 28. posterior median spinneret; 26, 29. posterior lateral spinneret. Abbreviations: Ac–aciniform gland spigot(s); Cy–cylindrical gland spigot(s); MAmp–major ampullate gland spigot(s); mAmp–minor ampullate gland spigot(s); n–nubbin; Pi–piriform gland spigot; ta–tartipore.



FIGURES 30–41. Scanning electron microscope photographs of *Merenius alberti* Lessert, 1923 male: 30. eye region, anterior view; 31. chelicera, ventral view; 32. promarginal bent setae, anterolateral view; 33. serrula; 34. femur I, plumose setae; 35. leg II, patellar indentation (PI); 36. same, detail of proximal end of PI; 37. patella and tibia III setae and spines; 38. metatarsus I trichobothria and setae; 39. tarsus II, arrow indicating tarsal organ; 40. distal section of palpal cymbium; 41. embolus.

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: all with single long fine distal seta (Fig. 37); tibiae: I plv 2 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; tibiae I and II with single long fine seta near distal end; 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: plv 2. Abdomen narrow, elongate-oval, with short sclerotised petiole (longer than in female), three pairs of erect setae on anterior margin and deep red-brown scutum covering entire dorsum; two pairs of distinct sigilla present, first at $^{2}/_{5}$ and second at $^{3}/_{5}$ abdomen length; dorsal and lateral setae and markings as for female; venter dark grey, covered in short straight black setae with sparse plumose setae; ventral sclerite present, deep red-brown, subrectangular, nearly extending to spinnerets; post-epigastric and inframamillary sclerites distinct, quite strongly sclerotised. Spinnerets: ALS with single major ampullate gland spigot, single large adjacent nubbin and many piriform gland spigots (Fig. 27); PMS with one minor ampullate gland spigot, one tartipore and one nubbin, without aciniform gland spigots; PLS without functional spigots. Male palpal cymbium dark brown, nearly black, densely setose, with many short thickened black rod-like setae in distal third dorsally (Fig. 40); palpal tegulum dark orange-brown with deep red-brown ducts; embolus with broad base, long stalk-like proximal section and single compressed distal coil (Figs 41, 44, 45).



FIGURES 42–45. Genitalic morphology of *Merenius alberti* Lessert, 1923: 42. female epigyne, ventral view; 43. same, dorsal view; 44. male palp, ventral view; 45. same, retrolateral view. Scale bars = 0.25mm.

Colour variation: The typical colour variant (black morph) of *M. alberti* described above consists of dark brown to black specimens that have cream or blue-grey markings comprising modified plumose setae (Figs 1–3, 5, 8, 9). A second colour variant reported here for the first time has a bright orange to deep red carapace with black integumental markings and cream markings identical to the black morph described above. The abdomen of the red is grey in colour and has cream markings identical to those of the black morph (Figs 4, 6, 10, 11). Juveniles of the black morph have a light to dark brown carapace while those of the red morph have a bright yellow or orange carapace, and thus the two forms can be recognised during all of their life stages.

Additional material examined: MOZAMBIQUE: Bilene, Praia do Bilene, 25°15.649'S, 33°17.659'E, 27m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 20.XII.2007 (leaf litter, coastal forest), 2imm. 1♂ 2♀ (NCA 2008/215); Inhaca Island, 26°01'S, 32°54'E, leg. T. Steyn, 25.XII.1993–8.I.1994 (pitfalls, open parkland), 1♂ (MRAC 209694); Same locality, leg. T. Steyn, 24.I–7.II.1994 (pitfalls, wetland), 1♂ (MRAC 208955); Same data, 13–27.XII.1993, 1♂ (MRAC 208967); Same data, 9–23.VII.1994, 2♀ (MRAC 209210); Same data, 13–29.XI.1993, 1♀ (MRAC 209314); Same data, 27.XII–10.I.1994, 1♀ (MRAC 209361); Same data, 28.V–19.VI.1994, 1♂ (MRAC 209720); Same data, 8–23.IV.1994, 1♂ (MRAC 209744); Same data, 23–30.IV.1994, 2♂ (MRAC 209788); Same data, 19–25.VI.1994, 1♀ (MRAC 209797); Same data, 14–28.V.1994, 1♂ (MRAC 209812); Same data, 30.IV–14.V.1994, 1♂ (MRAC 209904); Same data, 25–30.VIII.1994, 1♀ (MRAC 215901); Same locality, leg. R.F. Lawrence, XII.1954, 1♀ (NMSA 7004); Near Marrucuene, Blue Anchor Inn, 25°35.124'S, 32°39.568'E, 50m a.s.l., leg. C. Haddad & R. Fourie, 28.XI.2007 (sifting leaf litter, savanna), 1♀ (NCA 2008/170); Near Marrucuene, Marrucuene Lodge, 25°46.379'S, 32°41.046'E, 12m a.s.l., leg. C. Haddad, 1.XII.2007 (leaf litter, riverine forest), 2imm. 1♂ 1♀ (NCA 2008/172); Xai-Xai, Montego's Camp, 25°03.659'S, 33°40.633'E, 28m a.s.l., leg. C. Haddad, 2.XII.2007 (leaf litter, dune forest), 1imm. 2♂ 3♀ (NCA 2008/182). **SOUTH AFRICA:** *Eastern Cape Province*: Coffee Bay, 31°59.148'S, 29°09.076'E, 5m a.s.l., leg. C. Haddad, 9.I.2011 (base of grass tussocks), 2♂ (NCA 2010/2745); Cwebe Nature Reserve, The Haven, 32°14.497'S, 28°54.653'E, leg. C. Haddad, 30.X.2006 (grassy litter behind dunes), 3imm. 1♀ (NCA 2007/247); East London, 33°01'S, 27°54'E, leg. D. Keetch, 15.III.1985 (pitfalls), 2♀ (NCA 95/313); Mazeppa Bay, 32°28.476'S, 28°38.873'E, leg. C. Haddad, 28.X.2006 (grassy litter, *Acacia* thicket behind dunes), 1imm. 1♀ (NCA 2007/202); Same locality, leg. C. Haddad, 28.X.2006 (leaf litter, coastal dune forest), 1♀ (NCA 2007/223); Mkhambathi Nature Reserve, 31°17.429'S, 30°00.672'E, 16m a.s.l., leg. Inland Invertebrate Initiative–University of KwaZulu-Natal, 29.I.2008 (pan traps, grassland), 1♀ (NCA 2010/240); Near Mazeppa Bay, 32°26.495'S, 28°36.968'E, leg. C. Haddad, 28.X.2006 (leaf litter, *Eucalyptus* plantation), 1imm. 1♂ 1♀ (NCA 2007/277). *Gauteng Province*: Johannesburg, Florida, 26°30'S, 27°54'E, leg. R. Tucker, XII.1918, 1imm. 1♀ (SAM ENW-C005347). *KwaZulu-Natal Province*: Cathedral Peak, 28°58.054'S, 29°15.832'E, 1910m a.s.l., leg. Maluti-Drakensburg Transfrontier Project staff, 19.XI.2005 (active ground searching), 1♂ (NCA 2008/1912); Charter's Creek, Lake St Lucia, 28°12'S, 32°26'E, leg. J. Doyen & C. & T. Griswold, 19–21.XI.1985 (forest), 1♀ (NMSA 22032); Same data (moulted in captivity), 1♂ (NMSA 22033); Charter's Creek camp, Lake St

Lucia, 2832 Ab, 60m a.s.l., leg. J.G.H. Londt, 3–11.X.1977, 2♀ (NMSA 22029); Dukuduku Forest [28°22'S, 32°19'E], leg. R.F. Lawrence, XI.1957, 1♂ 3♀ (NMSA 6966); Durban, Stella Bush [29°51'S, 31°00'E], leg. W. Bell Marley, I.1915, 1♀ (SAM B891); E side of Lake Sibaya [27°22'S, 32°42'E], leg. B.H. Lamoral, 27.VI.1967 (nest under bark of trees), 1♀ (NMSA 9570); Empangeni, 28°45'S, 31°54'E, leg. P. Reavell, 2.IV.1979, 1♂ (NMSA 12765); Same locality, leg. P. Reavell, 27.III.1983 (pool), 1♀ (NMSA 22026); Same locality, leg. P. Reavell, XII.1986 (in garden), 1♂ (NMSA 22030); Same locality, leg. P. Reavell, 30.IV.1988 (leaf litter in garden), 1♀ (NMSA 22031); Enseleni Nature Reserve, 28°41'S, 32°03'E, leg. C.E. Griswold & T. Meikle-Griswold, 19.I.1986 (*Ficus-Barringtonia* swamp forest), 1♂ 1♀ (NMSA 22028); Gwaliweni, north of Jozini Dam, 27°23'S, 32°03'E, leg. R.F. Lawrence, II.1957, 1♂ 1♀ (NMSA 6887); Hluhluwe [28°02'S, 32°17'E], leg. R.F. Lawrence, X.1953, 2♀ (NMSA 6872); Hluhluwe-Imfolozi Park, Hilltop Research Station, 28°04.680'S, 32°02.472'E, leg. C. Haddad, 20.IV.2006 (leaf litter, Afromontane forest), 3imm. 2♀ (NCA 2006/770); Howick, Shooter's Hill [29°26'S, 30°19'E, 790m a.s.l.], leg. R.F. Lawrence, XII.1937, 1imm. 1♀ (NMSA 2129); Ingwavuma [27°07'S, 31°59'E], leg. R.F. Lawrence, 12.VII.1951, 1♀ (NMSA 5569); iSimangaliso Wetlands Park, Cape Vidal, 28°07'S, 32°33'E, leg. A. Leroy, 18.IV.1992 (sifting leaf litter), 1♀ (NCA 93/317), 1♀ (NCA 93/321); Same locality, leg. A. Leroy, 18.IV.1992 (by hand), 1♀ (NCA 93/355); iSimangaliso Wetlands Park, Fanie's Island, 28°06'S, 32°25'E, leg. M. Filmer, 22.VII.1990 (by hand in rotting log), 1♀ (NCA 91/726); iSimangaliso Wetlands Park, Gwala-Gwala Forest, 28°23.042'S, 32°24.436'E, leg. C. Haddad, 21.IV.2006 (leaf litter, coastal forest), 9imm. 2♂ 3♀ (NCA 2006/723); Same locality, Hell's Gate block A, 28°00'S, 34°28'E, J. Esterhuizen, 15.XI.2004 (tsetse fly traps), 2♀ (NCA 2010/283); Same data, 19.I.2003, 1imm. 2♀ (NCA 2004/820); Same data, 2.II.2004, 1♀ (NCA 2004/822); Same data, 24.XI.2003, 1♀ (NCA 2004/823); Same data, 29.IX.2003, 1♀ (NCA 2004/824); Same data, 2.IX.2003, 3♀ (NCA 2004/825); Same data, 17.XI.2003, 1♀ (NCA 2004/826); Lake Sibaya, 27°20'S, 32°42'E, leg. B. Lamoral, I.1968, 1♂ 1♀ (NMSA 12363); Mapelaan [28°23'S, 32°25'E], leg. P. Reavell, 12.II.1980 (dune forest), 1♂ (NMSA 13197); Mevamhlope area near old Eshowe road [28°43'S, 31°49'E], leg. P. Reavell, 28.IX.1979 (on *Acacia*, *Aloe* and *Euphorbia*), 1♀ (NMSA 12783), 1♂ 1♀ (NMSA 12783); Mfongosi [27°18'S, 32°10'E], leg. W.C. Jones, II.1918, 3♀ (SAM ENW-C005349); Mkhuze Game Reserve, Inhlonhlela Pan road off main reserve road, 27°37.358'S, 32°11.113'E, 95m a.s.l., leg. C. Smith, 6–7.VIII.2007 (pitfall traps), 1♀ (NCA 2008/2908); Mtunzini, "Twin Streams" Farm (I.F. Garland), 28°57'S, 31°46'E, leg. T. & C. Griswold, P. Croeser & P. Reavell, 19–20.I.1984 (coastal dune forest), 1♀ (NMSA 22034); Ndumo Game Reserve, Broadleaf woodland, 26°54.417'S, 32°19.207'E, leg. C. Haddad, 29.XI.2000 (under logs, with ants), 1♂ 1♀ (NCA 2002/399); Same data, 7.VII.2002 (under rocks), 1♂ (NCA 2002/404); Same locality, Broadleaf woodland, 26°55.275'S, 32°17.947'E, leg. C. Haddad, 6.II.2005 (leaf litter), 1♀ (NCA 2005/38); Same locality, Crocodile farm, 26°54.426'S, 32°19.185'E, leg. C. Haddad, 12.I.2007 (under rocks), 4♀ (NCA 2007/3066); Same data, 8–23.I.2002 (pitfalls), 1♂ (NCA 2002/401); Same data, 7.VII.2002 (leaf litter under fig tree), 1♂ 3♀ (NCA 2002/405); Same locality, E shore of Shokwe Pan, 26°52.516'S, 32°12.407'E, leg. C. Haddad, 8–23.I.2002 (pitfalls), 2♂ 1♀ (NCA 2002/400); Same data, 25.I.2006 (leaf litter), 2♀ (NCA 2008/1959); Same locality, E shore of Shokwe Pan, 26°52.516'S, 32°12.407'E, leg. C. Haddad & R. Lyle, 24.I.2006 (grass at tree bases), 2♂ 1♀ (NCA 2006/836); Same locality, Game count transect 4, near Dipini Hide, 26°52.052'S, 32°15.320'E, leg. C. Haddad, 3.VII.2003 (on ground with *Anoplolepis custodiens* ants), 2♂ (TMSA 24102); Same locality, near Fontana Camp, 26°52.072'S, 32°09.545'E, leg. C. Haddad, 2.VII.2002 (under rocks, *Acacia tortilis* woodland), 1♂ (NCA 2002/403); Same locality, Pongola River floodplain, 26°53.362'S, 32°18.892'E, leg. C. Haddad, 9.II.2005 (leaf litter), 8♂ 14♀ (NCA 2005/47); Same locality, Pongola River floodplain, 26°53.384'S, 32°19.097'E, leg. C. Haddad, 16.I.2006 (leaf litter, riverine forest), 3imm. 6♀ (NCA 2006/704); Same locality, Pongola River Floodplain, Ezikebheni, 26°53.389'S, 32°18.878'E, leg. C. Haddad, 9.II.2004 (on ground with *Anoplolepis custodiens* ants), 4♀ (TMSA 24103); Same locality, Pongola River floodplain, near pump, 26°54.323'S, 32°19.435'E, leg. C. Haddad, 9.I.2002 (leaf litter, riparian forest), 1♂ 1♀ (TMSA 24067); Same locality, Southern boundary fence, 26°55.664'S, 32°19.038'E, leg. C. Haddad, 9.II.2005 (leaf litter, sand forest), 2♂ 3♀ (NCA 2005/44); Same locality, W shore of Shokwe Pan, 26°52.013'S, 32°12.982'E, leg. C. Haddad, 19.I.2002 (leaf litter, *Ficus sycomorus* forest), 1♂ (NCA 2002/402); Nfuli River Hillside, leg. P. Reavell, 21.I.1980 (semi-arid *Acacia* veld, under log), 1♀ (NMSA 13002); Ngome State Forest, 27°46'S, 31°27'E, leg. M. van der Merwe, 1.II.1992 (pitfalls, grass-layer), 2♂ (NCA 94/460); Same data, 1.IX.1992, 1♂ (NCA 94/453), 1♂ (NCA 94/455); Same data, 1.X.1992, 2♂ (NCA 94/450); Same data, 1.XI.1992, 1♂ (NCA 94/452), 2♂ (NCA 94/458); Same data, 1.XII.1992, 2♂ 1♀ (NCA 94/457), 1♀ (NCA 94/461); Same data, 1.I.1993, 1♂ (NCA 94/454), 1♂ (NCA 94/456), 3♂ (NCA 94/459); Same locality, leg. M. van der Merwe, 1.X.1992 (beating, grass-layer), 3♂ (NCA 94/451); Ngoye Forest [28°50'S, 31°42'E], leg. R.F. Lawrence, II.1953, 1♂ 2♀ (NMSA 5928); Nkhandla Forest [28°44'S, 31°08'E], leg. R.F. Lawrence, I.1937, 1♀ (NMSA 1397), 1♀ (NMSA 1379), 1♀ (NMSA 1381); Ophathe Game Reserve, 4X4 trail near Imfolozi River, 28°22.555'S, 31°23.993'E, leg. C. Haddad & R. Fourie, 5.VII.2007 (under rocks), 2imm. 1♂ (NCA 2007/2991); Same locality, Game drive trail, rocky outcrop, 28°23.182'S, 31°22.213'E, leg. C. Haddad & R. Fourie, 5.VII.2007 (under rocks), 1imm. 1♂ (NCA 2007/2985); Same locality, Montane grassland, 28°25.344'S, 31°23.957'E, 897m a.s.l., leg. C. Haddad, 4.X.2008 (sifting leaf litter), 12imm. 2♂ (NCA 2008/3911); Same locality, Ophathe River bed, 28°22.693'S, 31°24.442'E, leg. C. Haddad & R. Fourie, 5.VII.2007 (leaf litter, river bank), 1imm. 2♀ (NCA 2007/2970); Same locality, Ophathe River bed, 28°23.727'S, 31°23.643'E, 455m a.s.l., leg. C. Haddad, 2.X.2008 (active searching), 1imm. 1♂ 2♀ (NCA 2008/4221); Same data, 30.IX–4.X.2008 (pitfall traps), 1imm. 2♀ (NCA 2008/4244); Same data, 2.X.2008 (sifting leaf litter), 4imm. 1♀ (NCA 2008/2879); Same locality, Overgrazed savanna, 28°22.135'S, 31°23.363'E, 560m a.s.l., leg. C. Haddad, 1.X.2008 (sifting leaf litter), 2imm. 1♀ (NCA 2008/4074); Same data, 29.IX–3.X.2008 (pitfall traps), 1imm. 1♂ 1♀ (NCA 2008/4098); Same locality, Rocky mountainside, 28°23.202'S, 31°24.077'E, 505m a.s.l., leg. C. Haddad, 29.IX–3.X.2008 (pitfall traps), 3imm. 2♂ 2♀ (NCA 2008/4012); Oribi Gorge Nature Reserve, Open grassland patch, 30°43.079'S, 30°16.381'E, 315m a.s.l., C. Haddad, 13.I.2011 (base of grass tussocks), 1♀ (NCA 2010/2746); Otto's Bluff [29°30'S, 30°21'E], leg. R.F. Lawrence & W.G. Rump, X.1942 (under stones), 1♀ (NMSA 3822); Pietermaritzburg [29°37'S, 30°23'E], leg. C. Akerman, VII.1913, 1♂ (NMSA 2065); Pietermaritzburg, Town Bush [29°36'S, 30°23'E], leg. R.F. Lawrence, X.1936, 1♀ (NMSA 1368); Port Edward [31°03'S, 30°13'E], leg. J. Stannard, I.1986, 1♂ (NMSA 18469), 1♂ (NMSA 18471); Port Edward district, Blencanthra Farm, 5km NW of Port Edward, 31°02'S, 30°10'E, 335m a.s.l., leg. J. Stannard, VIII.1983, 1♀ (NMSA 22027); Port Shepstone [30°45'S, 30°27'E], leg. W.F. Purcell, IX.1905, 2♀ (SAM 150750); Richards Bay, 28°46'S, 32°06'E, leg. R. Oberprieler, 6.XI.1983 (by hand), 10♂ (NCA 95/187); Same locality, leg. R. Oberprieler, 6.IX.1985 (by hand), 1♀ (NCA 91/411); Sani Pass, Site 8c, 30°12'S, 30°24'E, 900m a.s.l., leg. University of Pretoria Students, 1.I.2009 (pitfalls), 1♀ (NCA 2011/778); Sodwana Bay National Park, Hiking trail, 27°32.609'S, 32°39.851'E, leg. C. Haddad, 17.IV.2006 (leaf litter, coastal forest), 2imm. 2♀ (NCA 2006/738); St. Lucia, Fanies Island, 28°32'S, 32°24'E, leg. M. Alderweireldt & R. Jocqué, 22.VII.1990 (by hand), 1♀ (MRAC 172654); Tembe Elephant Park, Deep sand forest, 27°02.030'S, 32°24.784'E, leg. C. Haddad, 6.I.2002 (leaf litter), 2♂ 2♀ (NCA 2002/408); Same data, 10.I.2002, 2♂ (NCA 2002/409); Same data, 3–23.I.2002 (pitfalls), 2♂ (NCA 2002/406); Same locality, 27°02'S, 32°24'E, leg. A. Honiball, 15.III.2003 (leaf litter, sand forest), 1♀ (NCA 2004/265); Same locality, Manungu Picnic spot, Open woodland/sand, 26°58.991'S, 32°28.335'E, leg. C. Haddad & R. Lyle, 9.I.2006 (searching, under logs), 1♀ (NCA 2007/3513); Same locality, Open woodland/sand, near offices, 27°03'S, 32°25'E, leg. C. Haddad, 8.II.2005 (sifting leaf litter), 2imm. 4♂ 5♀ (NCA 2007/3609); Same data, 3–23.I.2002 (pitfalls), 2♂ 1♀ (NCA 2002/407); Same data, 14.I.2002 (leaf litter), 1♂ 3♀ (NCA 2002/410); Same locality, Picnic spot, 26°57.505'S, 32°24.437'E, leg. C. Haddad, 12.IV.2006 (at base of grasses), 1♀ (NCA 2006/872); Same locality, Sand forest near viewing tower, 27°01.713'S, 32°24.559'E, leg. C. Haddad, 10.I.2002 (active searching, leaf litter), 1♂ (NCA 2007/3100); Umhlali [29°28'S, 31°09'E], leg. R.F. Lawrence, II.1940, 1imm. 1♂ 6♀ (NMSA 2938), 1♀ (NMZA 277); Umhlali, Sheffield Beach [29°29'S, 31°16'E], leg. R.F. Lawrence, I.1937, 2imm. 3♂ 2♀ (NMSA 1416); Same data, VII.1937, 3♂ (NMSA 1555); Same data, X.1938, 1♂ 1♀ (NMSA 2435); Umziki Pan Game Reserve, near Hluhluwe [28°02'S, 32°19'E], XII.1999 (sandveld forest), 1♀ (NMSA 22037); Zululand, 28°35'S, 31°13'E, leg. J. Pryke, 12.II.2009, 1♀ (NCA 2011/908). *Limpopo Province*: Klaserie, Bokmakierie Game Farm, tent camp, 24°33'S, 31°02'E, leg. R. Jocqué, 11.IV.2001 (open sandy area, dry river bed, hand collecting), 1♀ (MRAC 210081); Magoebaskloof [23°52'S, 30°00'E], 5000ft a.s.l, leg. R.F. Lawrence, III.1960, 1imm. 3♂ (NMSA 7956); Westphalia, 23°18'S, 29°10'E, leg. R. Harris, 27.V.1983 (by hand), 1♂ (NCA 95/174). *Mpumulanga Province*: Acornhoek [24°36'S, 31°05'E], leg. R. Tucker, II.1918, 1♂ 1♀ (SAM ENW-C005346); Burgershall [25°06'S, 31°05'E], leg. M. van den Berg, 21.I.1989 (beating, citrus orchard), 1♀ (NCA 2008/2774); Crocodile River Gorge, 25°32'S, 31°13'E, leg. J. Leroy, 18.XI.2007 (running in leaf litter), 1♀ (NCA 2008/1988); Komatipoort, 25°31.593'S, 31°49.171'E, leg. J. Horn, 9.II.2005 (in cultivated flower garden near farmhouse), 3♂ 3♀ (NCA 2007/1308); Same locality, leg. R. Tucker, XI.1918, 1♀ (SAM B4342); Kruger National Park, Near Skukuza, 25°00.342'S, 31°35.165'E, leg. K. Harris, 1.V.2006 (pitfall traps, medium *Opuntia* infestation), 1♂ (NCA 2007/3124); Same locality, Near Skukuza, 25°00.352'S, 31°35.106'E, leg. K. Harris, 29.XI.2005 (pitfall traps, heavy *Opuntia* infestation), 1♂ (NCA 2007/3125); Same locality, Near Skukuza, 25°00.286'S, 31°35.186'E, leg. K. Harris, 5.IV.2006 (pitfall traps, no *Opuntia* infestation), 1♀ (NCA 2007/3126); Same locality, Pretoriuskop Camp, 25°10'S, 31°16'E, leg. R.F. Lawrence 2.XII.1963 (in humus), 1♀ (NMSA 22036); Same locality, Skukuza, 25°00'S, 31°36'E, 1200ft a.s.l., leg. C. Griswold, T. Meikle-Griswold, F. & J. Wright, 14–18.XII.1984, 1♂ (NMSA 22035); Same locality, Sabie River, leg. R.F. Lawrence, 16.II.1962, 1♂ (NMSA 18472); Near Graskop, Sabie River, Lisbon Farms, 24°58'S, 31°34'E, leg. A. Dippenaar-Schoeman, 16.XI.1993 (leaf litter), 1♀ (NCA 2007/1139). *North-West Province*: Near Skeerpoort [25°42'S, 27°50'E], leg. P. Reavell, 10.XII.1977 (in *Acacia caffra*, shaded), 1♂ (NMSA 13337). *Western Cape Province*: Terblans trail, Near Grootdraai picnic site [33°56'S, 23°03'E], leg. H.G. Robertson, 14.X.1996 (indigenous evergreen forest), 2imm. 1♂ 1♀ (SAM ENW-C006108). **SWAZILAND:** Mlawula Nature Reserve, 26°13'S, 32°02'E, leg. A. Leroy, 13.V.1988 (by hand, running on hot stones with ants), 1♂ (NCA 91/351). **ZIMBABWE:** Gokwe, 18°14'S, 28°57'E, leg. W. Lawson, VII.1964, 1♀ (NMSA 12267).

Distribution: Widespread throughout the eastern half of southern Africa, extending southwards along the South African coast as far as the vicinity of Knysna in the Western

Cape Province. Most records are of the black morph; the red morph has so far only been recorded from two localities, Ndumo Game Reserve and the Kruger National Park in South Africa (Fig. 46).

Biology: *M. alberti* is an exclusive ground-dwelling spider and has mainly been collected by pitfall traps, litter sifting or by hand from the soil surface, under rocks and logs. Only on very rare occasions have specimens been collected by sweeping or beating. Typical of castianeirines, this species constructs an egg sac with a basal plate and a dome-shaped cover of papery silk, which is usually placed on the underside of dead leaves, rocks and logs on the ground. Egg sacs are 7.4mm to 7.8mm in diameter and contain 17–26 eggs each (n=6).

Prey capture involves a rapid leap when contact is made with a prey arthropod, and the front legs and palps form a basket used to hold the prey securely while being sedated.

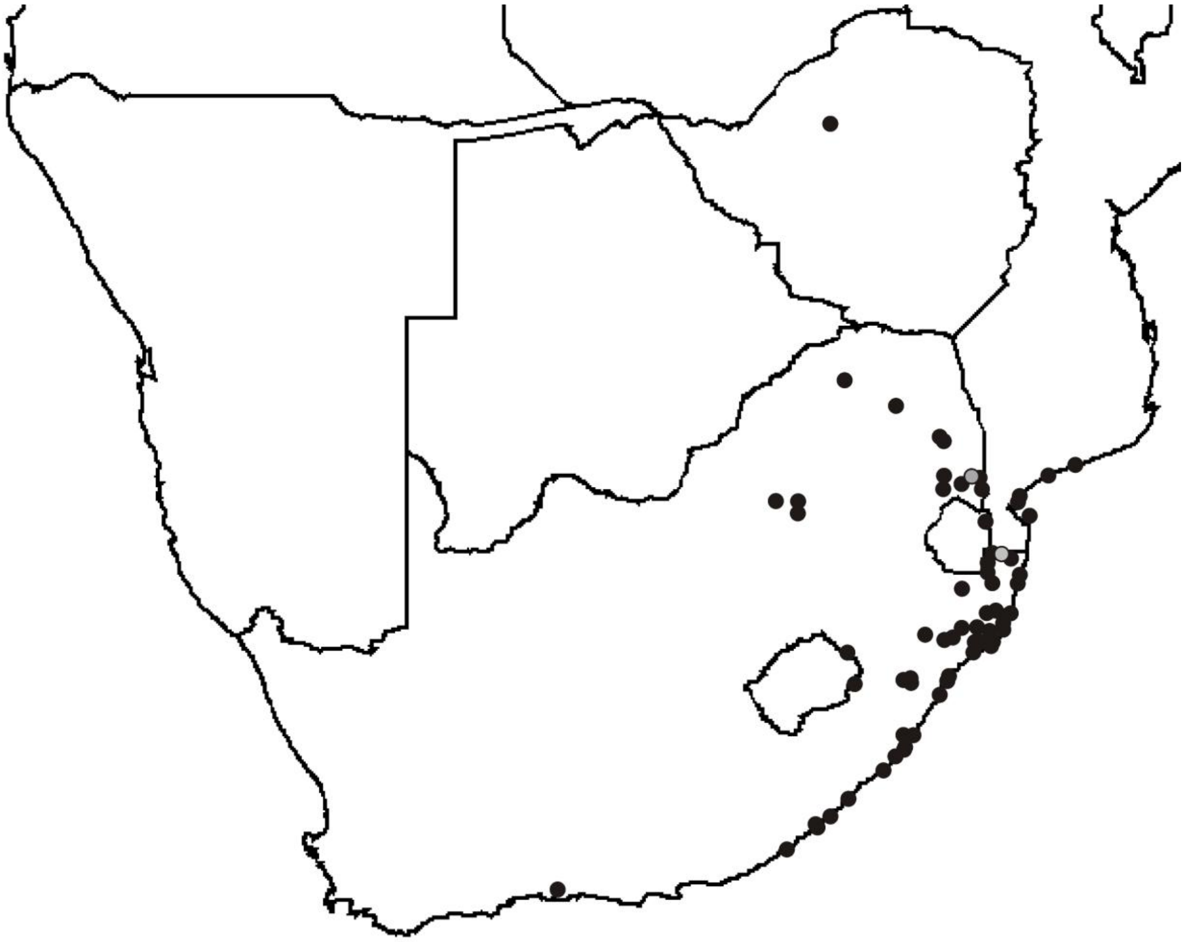


FIGURE 46. Distribution of *Merenius alberti* Lessert, 1923 in southern Africa: black circles – black morph; grey circles – red morph.

Observed prey items in the field include cockroach and cricket nymphs, termites and other spiders (Lycosidae, Salticidae and Theridiidae). This species was not observed feeding on ants in the field, but in the laboratory the black morph would capture *Anoplolepis custodiens* ants, which serve as the model of the red morph. The black morph did not capture its potential models *Camponotus cinctellus* and *Polyrhachis gagates* under laboratory conditions. Further study is necessary to determine whether this species is myrmecophagous, and if so, whether its models or only other non-model species are fed on.

10.4.2 Frequency of colour morphs relative to ant assemblages

During the pitfall trapping survey, 16 species of medium to large ants were collected, representing four subfamilies of Formicidae (Table 1). Of these, nine species were considered not to be potential models for either of the two morphs of *M. alberti* due to their small size, slender bodies and inappropriate colouration. Two species of Formicinae and three of Ponerinae could possibly be models for the black morph, while *A. custodiens* is the model of the red morph. A second species, possibly *Atopomyrmex mocquerysi* André, 1889 (Myrmicinae), could possibly also serve as a model for the red morph in the absence of *A. custodiens*, sharing similar size and colouration, but this is unlikely due to the low activity densities of this species in the pitfall traps.

During winter, an adequate number of *M. alberti* were collected at 18 of the 20 sampling sites, while no *M. alberti* could be found at two sites (AN1 and AX1). Of the 360 *M. alberti* collected, 306 were juveniles (85.0%), 26 were males (7.2%) and 28 were females (7.8%). Of these, only a single adult of the red morph was collected at AE1; all of the remaining individuals were of the black morph (Fig. 47). This individual was collected at the site where *A. custodiens* densities were highest (Fig. 48).

Summer sampling of *M. alberti* could only be conducted at 18 of the 20 sites due to extensive flooding of the two riparian forest sites along the Pongola River, thereby ruling out sampling of ants and spiders at RF1 and RF2. Of these remaining 18 sites, *M. alberti* was only collected at 16 sites; no specimens were collected at AS 1 and AX1 during three hours of searching. Of the 320 *M. alberti* collected, 168 were juveniles (52.5%), 60 were males (18.8%) and 92 were females (28.7%). Thus, the proportion of adults collected was more than three times higher during summer than winter, providing some indication of the phenology of this species.

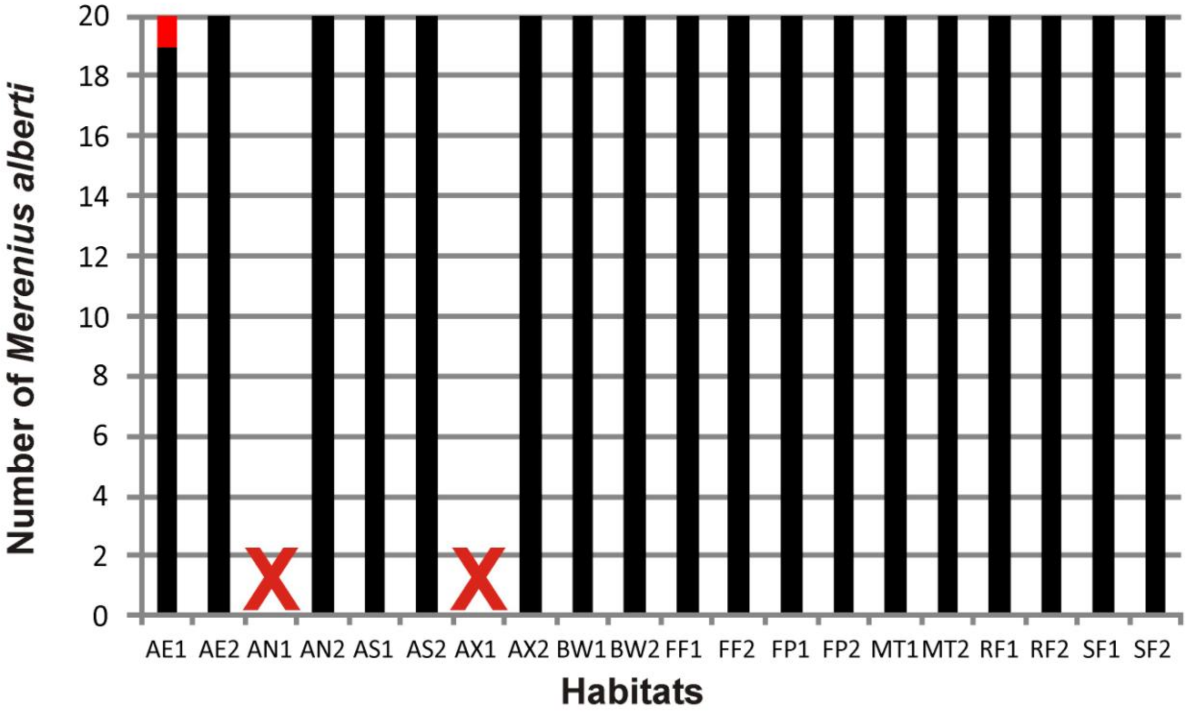
TABLE 1. Checklist of medium to large ants (Hymenoptera: Formicidae) collected by pitfall traps in 10 habitats in the Ndumo Game Reserve in 2009. Species that are potential models for the black morph of *Merenius alberti* Lessert, 1923 are highlighted in yellow, those of the red morph in blue, and species considered not being models in green.

Subfamily/Genus/Species	**Total**	**%**	**Reasons for inclusion/omission as model**
DORYLINAE			
Dorylus helvolus (Linneaus, 1764)?	4	0.24	Too small (<4mm); colouration inconsistent with mimic
FORMICINAE			
Anoplolepis custodiens (F. Smith, 1858)	402	24.33	Colouration and size consistent with mimic
Camponotus cinctellus (Gerstaecker, 1859)	127	7.69	Colouration and size consistent with mimic
Camponotus sp. 1 (*maculatus* group)	38	2.30	Colouration inconsistent with mimic
Polyrhachis gagates F. Smith, 1858	17	1.03	Colouration and size consistent with mimic
MYRMICINAE			
Atopomyrmex mocquerysi André, 1889?	10	0.61	Colouration and size consistent with mimic
Crematogaster sp.	17	1.03	Too small (<4mm); colouration inconsistent with mimic
Myrmicaria natalensis (F. Smith, 1858)	71	4.30	Colouration and ventrally-pointing abdomen inconsistent with mimic
Ocymyrmex fortior Santschi, 1911	48	2.91	Body too slender; colouration inconsistent with mimic
Pheidole sp.	558	33.78	Too small (<4mm); colouration inconsistent with mimic
Tetramorium quadrispinosum Emery, 1886	6	0.36	Too small (<4mm); colouration inconsistent with mimic
PONERINAE			
Leptogenys havilandi Forel, 1901	2	0.12	Body too slender
Odontomachus troglodytes Santschi, 1914	28	1.69	Colouration and size consistent with mimic
Pachycondyla caffraria (F. Smith, 1858)?	40	2.42	Colouration and size consistent with mimic
Pachycondyla tarsata (Fabricius, 1798)	61	3.69	Too large (>16mm)
Streblognathus peetersi Robertson, 2002	223	13.50	Colouration consistent with mimic, size considerably larger

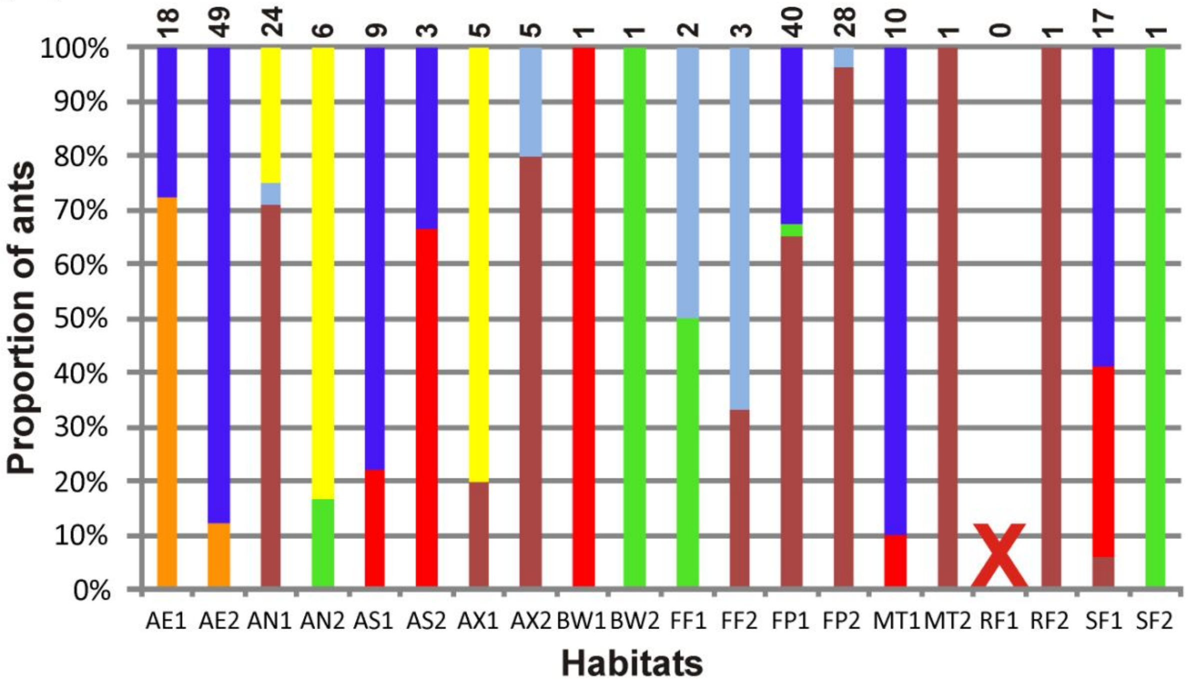
Regarding ant sampling, 223 potential model ants were collected from 19 of the 20 sampled sites during winter; at one site (RF1) no potential models were collected (Fig. 48). Ant densities were generally highest in the AE and FP habitats. During summer, ant activity densities were nearly three times higher than winter (n=623). Almost two-thirds of the ants collected during summer were *A. custodiens* collected at AE1 (n=382). Ant activity densities were second highest at AE2, not due to high *A. custodiens* densities but rather due to dominance of *Streblognathus peetersi* Robertson, 2002 (Fig. 50).

In comparing the proportion of the two *M. alberti* morphs relative to ant assemblages, it is evident that the red morph may be present at sites where its supposed model (*A. custodiens*) may not be active (Fig. 50). However, given the short span of the pitfall trapping (10 days) it is plausible that this ant may be present at these sites but was not actively foraging during the period of sampling. However, when *A. custodiens* densities are very high then the resident *M. alberti* population is strongly dominated by the red morph (Fig. 50).

(47)

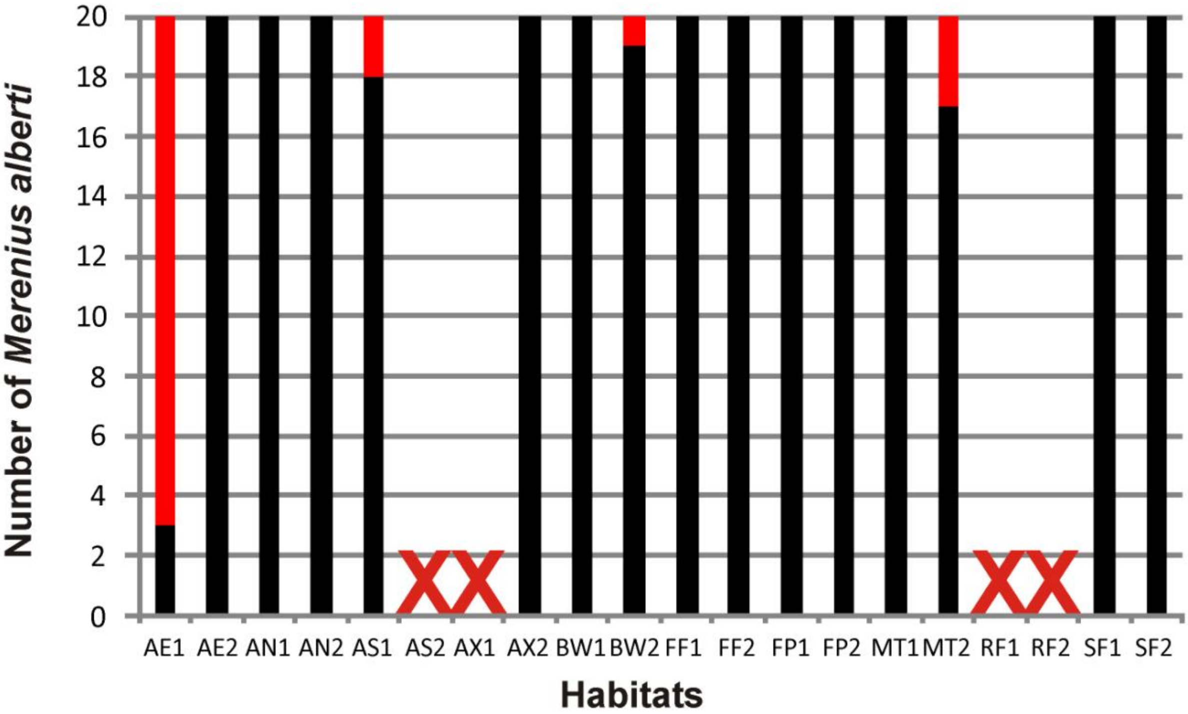


(48)

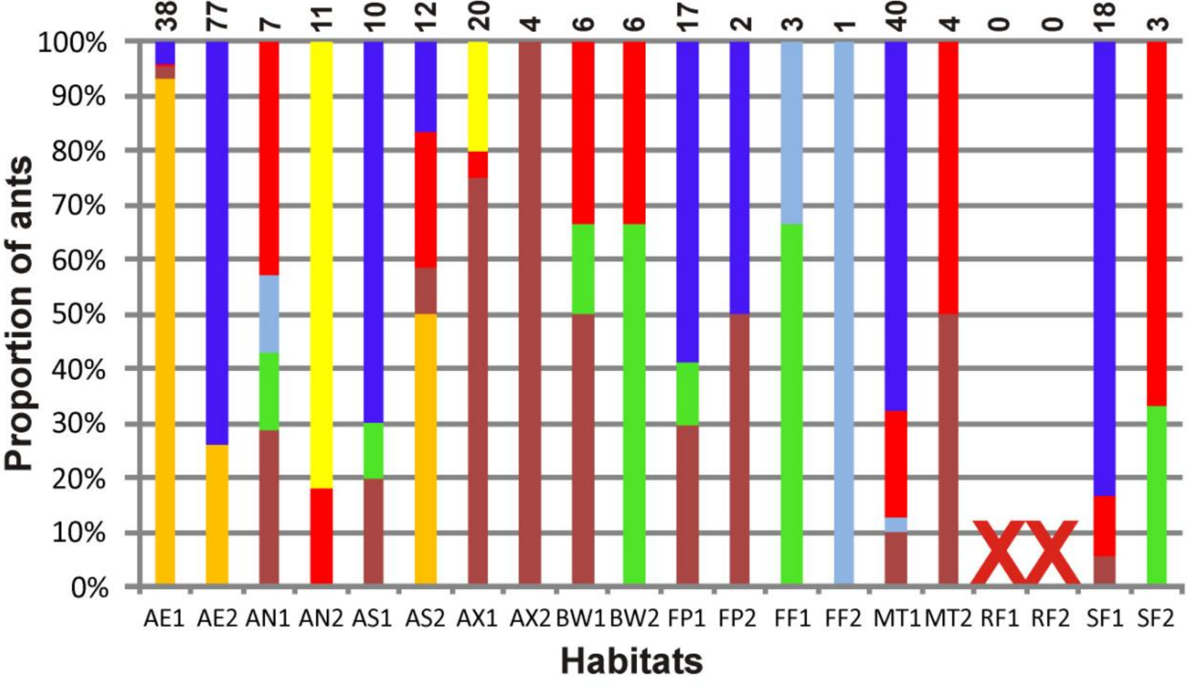


FIGURES 47–48. 47. Number of *Merenius alberti* Lessert, 1923 collected by hand from twenty sites sampled in the Ndumo Game Reserve during June–July 2009. Black bars indicate the typical black morph, red bars the scarce red morph and red crosses sites where no *M. alberti* were collected. 48. Ants collected from the corresponding sites by pitfall trapping over a 10-day period that may be potential models for *M. alberti*. Numbers above each column indicate the total number of potential model ants sampled (see Table 1). Blue bars – *Streblognathus peetersi*; orange bars – *Anoplolepis custodiens*; maroon bars – *Camponotus cinctellus*; turquoise bars – *Atopomyrmex mocquerysi*; yellow bars – *Odontomachus troglodytes*; green bars – *Polyrhachis gagates*; red bars – *Pachycondyla caffraria*.

(49)



(50)



FIGURES 49–50. 49. Number of *Merenius alberti* Lessert, 1923 collected by hand from twenty sites sampled in the Ndumo Game Reserve during November–December 2009. Black bars indicate the typical black morph, red bars the scarce red morph and red crosses sites where no *M. alberti* were collected. 50. Ants collected from the corresponding sites by pitfall trapping over a 10-day period that may be potential models for *M. alberti*. Numbers above each column indicate the total number of potential model ants sampled (see Table 1). Blue bars – *Streblognathus peetersi*; orange bars – *Anoplolepis custodiens*; maroon bars – *Camponotus cinctellus*; turquoise bars – *Atopomyrmex mocquerysi*; yellow bars – *Odontomachus troglodytes*; green bars – *Polyrhachis gagates*; red bars – *Pachycondyla caffraria*.

Conversely, even when *A. custodiens* is present in low densities relative to that of some black models, the red morph may be absent (e.g. AE2 in summer). Since no species of potential black models were found at all of the sites, no species can be identified as the sole model of the black morph. Instead it is likely that the black morph is a generalized mimic of black ground-dwelling ants, while the red morph is specifically associated with *A. custodiens* ants. Based on the abundance of different black potential models, the most likely models for the black morph are *C. cinctellus* and *S. peetersi*.

10.5 DISCUSSION

Polymorphism amongst corinnid spiders, particularly castianeirines, is a relatively scarce and poorly studied phenomenon. In her review of myrmecomorphy and myrmecophagy, Cushing (1997) reported that four of the 23 castianeirine species studied were either polymorphic (different colour morphs) or showed transformational mimicry, i.e. different models during different stages of development. According to the definitions of Edmunds (2000), two of these mimics could be considered good or specific mimics (*Myrmecium* spp.) while the other two are poor or general mimics (*Castianeira* spp.). The current study provides the first report of polymorphism in an African castianeirine, *M. alberti*, which can be considered a general (poor) mimic. Based on the present evidence, the common black morph is a generalised mimic of black ground-dwelling ants while the scarce red morph is specifically associated with *A. custodiens* ants.

This discovery raises many questions regarding the occurrence of the two morphs that require further study, of which three points will be briefly discussed here:

– ***Potential for colour change:*** The red morph was first discovered at site AE1 during 2003 (specimens TMSA 24102), where *A. custodiens* was the dominant actively foraging ant. The specimens collected at this site during 2009 indicate that the colonies of the ant model have remained consistently in this habitat during this period, explaining in part the dominance of the red morph in the summer samples (Fig. 49). However, only a single red morph specimen was collected at the same site during winter, when *A. custodiens* densities were considerably lower. This dramatic change in the proportion of black:red morphs within six months raises the question of whether the colouration of *M. alberti* can be modified based on its perception of the available models in its habitat, i.e. is colour change using chromatophores possible? Is this a rapid process?

Alternately, are these observed changes in the morph ratio the result of differential predation, i.e. when *A. custodiens* activity at these sites is reduced then the red morph stands out from the foraging black ants and is more susceptible to predation, resulting in a relative decrease in the proportion of red morphs occurring at a particular site. The latter scenario seems somewhat unlikely, as a near extermination of the red morphs due to high predation pressure would not be able to result in the considerable dominance of the red form once *A. custodiens* ants become active again and dominate the ant assemblage.

The possibility of chromatophores occurring in *M. alberti* could be tested for using transmission electron microscopy to determine whether cells capable of transferring different ommochrome pigments to the epidermis are present, as is the case in colour-changing crab spiders (e.g. Insausti & Casas 2008, 2009; Théry & Casas 2009; Riou & Christidès 2010). Further, the possibility of colour change can be investigated experimentally by exposing, for example, red morphs to black ants. This will indicate whether the selective pressure exerted by the presence of an alternate model is strong enough to enforce colour change.

– ***Moving with ant assemblages?:*** In the second scenario, the second discovered population of red morphs at Ezikebheni (site FP2) during summer 2004 (specimens TMSA 24103) was around the base of a tree near an *A. custodiens* colony. In subsequent visits to the site following inundation of the Pongola floodplain during 2005, the *A. custodiens* colony was absent (possibly due to flooding of the nest and consequent mortality or dispersal of the ants), the red morphs were also absent and only black morphs could be found. Thus, if the nest were abandoned during the flooding and the ants moved to higher ground, did the red morph spiders follow their models? When the site was dry again, why did only black morphs of *M. alberti* colonise the area? Were only black ants available to serve as models? These questions could only be answered by conducting a long-term survey with a standardised sampling protocol at the sites where (a) the red morph has been sampled or (b) along a transect covering different habitats (including sites where the red morph has been sampled) to investigate temporal changes in ant assemblages and the associated proportion of black : red morphs occurring at each site.

– ***Apparent scarcity of the red morph:*** The incidence of colour polymorphism in *M. alberti* is most likely determined on a microscale by the local abundance of particular ant models. The

A. custodiens ants that serve as a model to the red morph are widely distributed throughout southern and central Africa (Prins 1982), but *M. alberti* is not, being restricted mainly to the eastern half of southern Africa (Fig. 46). Despite their sympatric occurrence throughout most of the range of *M. alberti*, only two populations of the red morph have been recorded so far. Is the red morph just generally scarce despite the wide distribution of its model, or is the apparent scarcity of the red morph an artifact of collecting effort? The latter seems unlikely as considerable sampling has been done through large parts of KwaZulu-Natal, in particular, and additional populations would likely have been sampled had they been present.

The apparent scarcity of the red morph could be tested for by sampling *M. alberti* specifically in the vicinity of foraging *A. custodiens* ants and determining the ratio of black:red morphs. As *A. custodiens* is very widespread and often very abundant (e.g. Parr 2008; Sithole *et al.* 2010) in the savanna habitats dominating the distribution range of *M. alberti*, identifying suitable sites for such sampling should be relatively easy.

Furthermore, the possibility that local microclimatic and environmental variables could be responsible for the occurrence of the red morph needs to be investigated in greater detail, with the possibility of using predictive modeling programs to project the occurrence of additional populations of the red morph.

To summarise, what benefits does polymorphic mimicry strategy hold for *M. alberti*? The main driving force behind mimicry is avoiding predation by being mistaken for an unpalatable model by potential predators (Reiskind 1969). Within a given area, if one species of ant dominates the other, the *M. alberti* phenotypes can change to adapt their mimicry, apparently at a rapid rate of a few generations, according to the dominant ant species present. This was confirmed by the dominance of a particular colour morph in association with particular ant species. When a particular ant successfully colonises an area, the rapid changes in *M. alberti* colour morph within a few generations ensures that it can adapt to the dominant ant species present.

10.6 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.

CUSHING, P.E. 1997. Myrmecomorphy and myrmecophagy in spiders: a review. *Florida Entomologist* **80**: 165–193.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DE MOOR, P.P., POOLEY, E., NEVILLE, G. & BARICHIEVY, J. 1977. The vegetation of Ndumo Game Reserve, Natal: A quantitative physiognomic survey. *Annals of the Natal Museum* **23**: 239–272.

EDMUNDS, M. 2000. Why are there good and poor mimics? *Biological Journal of the Linnean Society* **70**: 459–466.

FISHER, B.L. 2002. Antweb. California Academy of Sciences, San Francisco. Available at: http://www.antweb.org; accessed 13 October 2011.

HADDAD, C.R., DIPPENAAR-SCHOEMAN, A.S. & WESOLOWSKA, W. 2006. A checklist of the non-acarine arachnids (Chelicerata: Arachnida) of the Ndumo Game Reserve, Maputaland, South Africa. *Koedoe* **49**: 1–22.

INSAUSTI, T.C. & CASAS, J. 2008. The functional morphology of color changing in a spider: development of ommochrome pigment granules. *Journal of Experimental Biology* **211**: 780–789.

INSAUSTI, T.C. & CASAS, J. 2009. Turnover of pigment granules: cyclic catabolism and anabolism of ommochromes within epidermal cells. *Tissue Cell* **41**: 421–429.

LESSERT, R. DE. 1923. Araignées du sud de l'Afrique. *Revue Suisse de Zoologie* **30:** 161–212.

OLIVEIRA, P.S. 1988. Ant-mimicry in some Brazilian salticid and clubionid spiders (Araneae: Salticidae, Clubionidae). *Biological Journal of the Linnean Society* **33**: 1–15.

PARR, C.L. 2008. Dominant ants can control assemblage species richness in a South African savanna. *Journal of Animal Ecology* **77**: 1191–1198.

PRINS, A.P. 1982. Review of *Anoplolepis* with reference to male genitalia, and notes on *Acropyga* (Hymenoptera, Formicidae). *Annals of the South African Museum* **89**: 215–247.

RAMSAR 2010. The Annotated Ramsar List of Wetlands of International Importance. Available at: http://www.ramsar.org; accessed 13 October 2011.

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

RIOU, M. & CHRISTIDÈS, J.P. 2010. Cryptic color change in a crab spider (*Misumena vatia*): identification and quantification of precursors and ommochrome pigments by HPLC. *Journal of Chemical Ecology* **36**: 412–423.

SITHOLE, H., SMIT, I.P.J. & PARR, C.L. 2010. Preliminary investigations into a potential ant invader and Kruger National Park, South Africa. *African Journal of Ecology* **48**: 736–743.

TAYLOR, B. 2011. The Ants of Africa. American Museum of Natural History, New York. Available at: http://antbase.org/ants/africa/contents.htm; accessed 13 October 2011.

THÉRY, M. & CASAS, J. 2009. The multiple disguises of spiders: web colour and decorations, body colour and movement. *Philosophical Transactions of the Royal Society B* **364**: 471–480.

CHAPTER 11

Copuetta erecta **sp. nov., female (Chidenguele, Mozambique)**

Taxonomic notes on the Afrotropical genus *Messapus* Simon, 1897, with descriptions of two new genera of Castianeirinae (Araneae: Corinnidae)

11.1 ABSTRACT

The Afrotropical sac spider genus *Messapus* Simon, 1898, presently placed in the Castianeirinae, is reviewed. The type species, *M. martini* Simon, 1898, clearly represents two different species, one a corinnine (female lectotype) and the other a castianeirine (male paralectotype). The female is redescribed and the true male described for the first time. Based on the redescription, *Messapus* is transferred to the Corinninae. *Corinna natalis* Pocock, 1898 is misplaced and is transferred to *Messapus*, while *Messapus secundus* Strand, 1907 is misplaced and transferred to *Merenius*. The new genus *Copuetta* **gen. nov.**, with the type species *C. maputa* **sp. nov.**, is established to accommodate the castianeirine male paralectotype of *M. martini*, and its matching female is described for the first time. *Castianeira kibonotensis* Lessert, 1921 **syn. nov.** is considered a junior synonym of *Copa lacustris* Strand, 1916 and the species is redescribed and transferred to *Copuetta*. A further eleven new species of *Copuetta* are described: *C. comorica* **sp. nov.**, *C. erecta* **sp. nov.**, *C. kakamega* **sp. nov.**, *C. kwamgumi* **sp. nov.**, *C. lesnei* **sp. nov.**, *C. litipo* **sp. nov.**, *C. lotzi* **sp. nov.**, *C. magna* **sp. nov.**, *C. naja* **sp. nov.**, *C. uzungwa* **sp. nov.** and *C. wagneri* **sp. nov.**. Of these species, only *C. lacustris* and *C. magna* **sp. nov.** have large distribution ranges. Seven of the species are only known from the type locality and the remaining four have distributions restricted to one or two countries. A second new genus, *Wasaka* **gen. nov.**, is described for four new species with restricted distributions from East and Central Africa: *W. imitatrix* **sp. nov.**, *W. montana* **sp. nov.**, *W. occulta* **sp. nov.** (type species) and *W. ventralis* **sp. nov.**.

11.2 INTRODUCTION

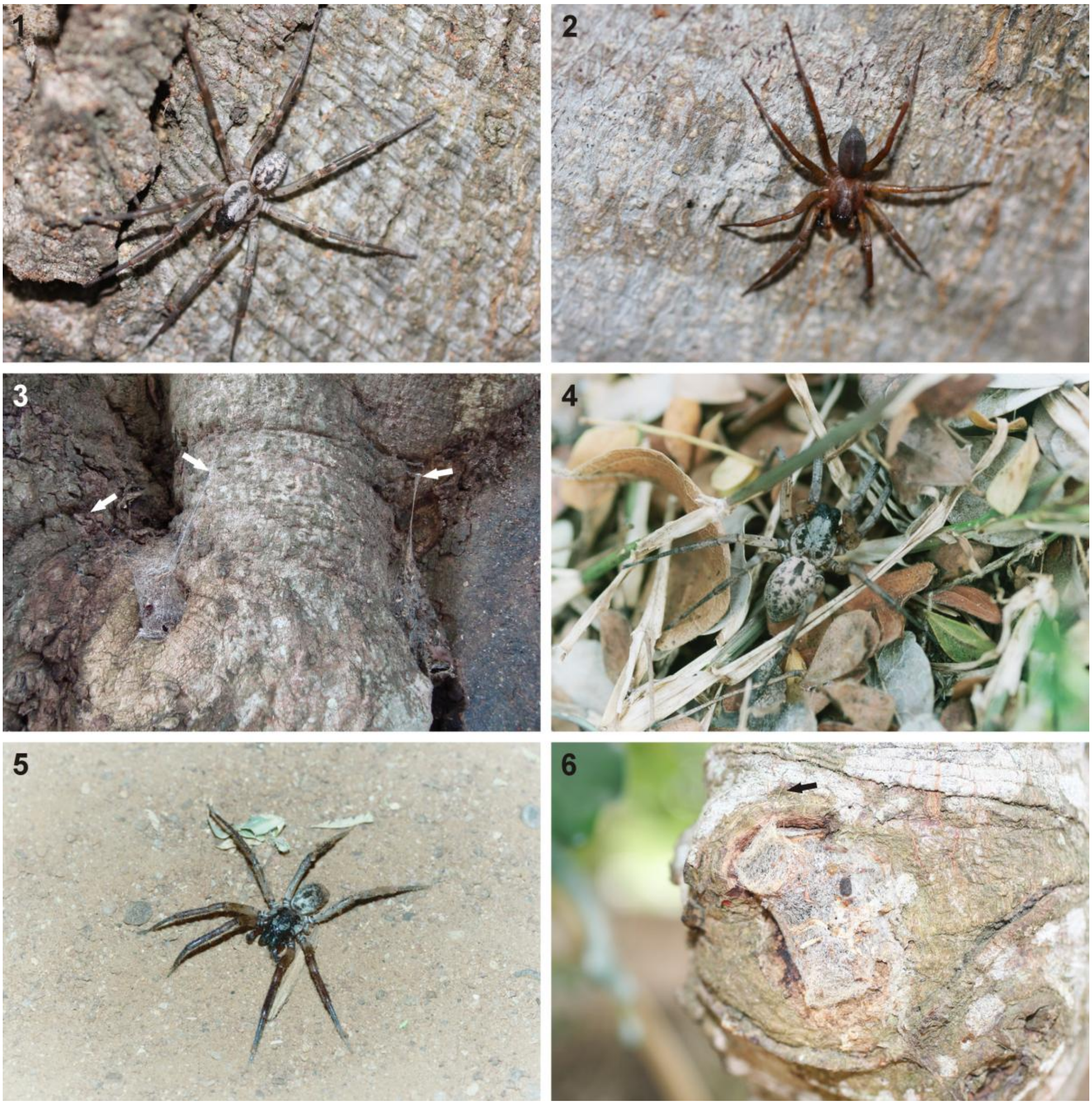
The sac spider subfamily Castianeirinae (Araneae: Corinnidae) generally comprises species of ant-mimicking spiders. Three distinctive exceptions to this general rule from the Afrotropical Region are the genera *Copa* Simon, 1885, *Messapus* Simon, 1898 and *Echinax* Deeleman-Reinhold, 2001. These spiders have pale or brown colouration that makes them cryptic in their environments, which are predominantly leaf litter (*Copa*) and bark and foliage (*Echinax* and *Messapus*), respectively. Although these genera share similar colouration and markings, they can be separated on the basis of genitalic and somatic morphological differences, including eye arrangement and leg structure.

The spider genus *Messapus* was established by Simon (1898) for a single species, *M. martini* Simon, 1898, from KwaZulu-Natal, South Africa. Subsequently, Strand (1907) described a second species (*M. secundus*) in the genus from Tanzania. However, neither author elaborated on the detailed morphology of the species they described, nor did they provide illustrations of the genitalia or habitus. Bosselaers & Jocqué (2000) redescribed *M. martini* and provided the first figures of this species based on the type specimens. These illustrations gave the first indications that the syntype female and male may not be the same species, as the epigyne differed from typical castianeirine genitalia (see Reiskind 1969; Deeleman-Reinhold 2001; Haddad 2004) in having a horse-shoe shaped depression, while the male palp is typically castianeirine.

The taxonomic history of *Messapus* is complex. The genus was originally described in the Clubionidae: Micariinae by Simon (1898), who suggested that the genus may be closely related to *Castianeira* Keyserling, 1879. Lehtinen (1967) later transferred the Micariinae to the Gnaphosidae, where it is still placed today (Dippenaar-Schoeman & Jocqué 1997; Murphy 2007; Platnick 2011). In Reiskind's (1969) revision of the North and Central American Castianeirinae, he considered *Messapus* to be *incertae sedis*. However, most of the genera that were placed in the Micariinae by Lehtinen (1967) were later transferred to the Liocranidae by Platnick (1989), including *Messapus*. Following their recent description of *M. martini*, Bosselaers & Jocqué (2000) transferred *Messapus* to Corinnidae: Castianeirinae, a placement confirmed in a subsequent phylogenetic analysis (Bosselaers & Jocqué 2002). This despite the contrasting genitalic morphology of the male and female types and the likelihood that they are not related.

In this chapter, the type species of *Messapus* is redescribed and a lectotype is designated from the type series. Through examination of more recently collected material, the true male of *M. martini* is identified and described. Based on the female redescription and male description, *Messapus* is transferred to the Corinnidae: Corinninae. The recently redescribed *Corinna natalis* Pocock, 1898, the largest African species of Corinnidae, is transferred to *Messapus*. Both species have mottled markings, are apparently arboreal and construct a retreat of dense silk in fissures of tree trunks (Figs 1–6; Haddad 2005).

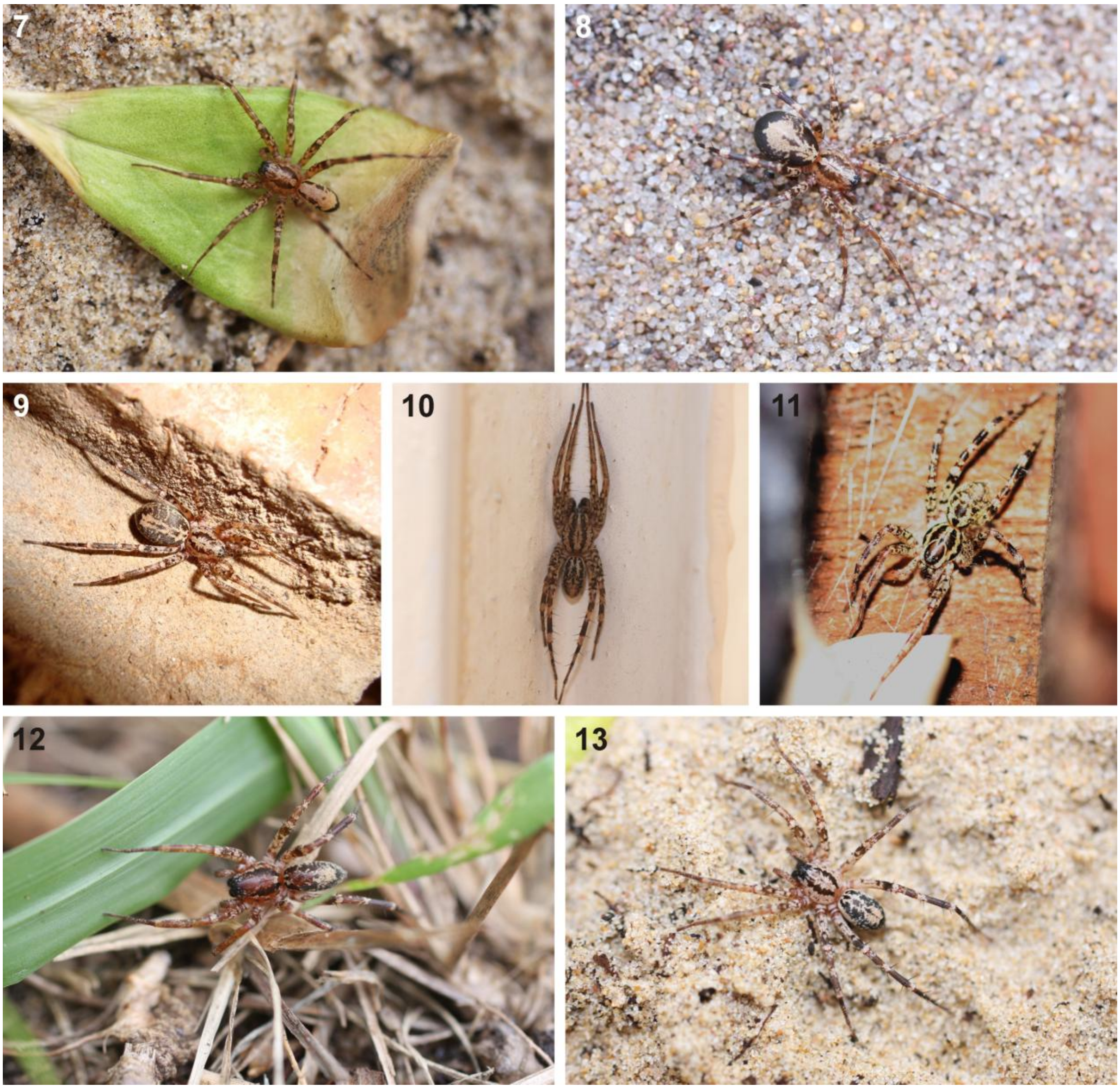
The new castianeirine genus *Copuetta* **gen. nov.** is described to accommodate the syntype male of *M. martini* and a misplaced species of *Copa*, and twelve new species are described. All of the species in the genus have cryptic lycosiform colouration (Figs 7–13) and are primarily arboreal. A second new lycosiform genus, *Wasaka* **gen. nov.**, is described for



FIGURES 1–6. General habitus photographs of *Messapus martini* Simon, 1898 (1–3) and *M. natalis* (Pocock, 1898) (4–6): 1, 4. females, 2, 5. males and 3, 6. retreats from Ndumo Game Reserve, South Africa.

four new species from tropical forests that may be intermediate between *Copuetta* **gen. nov.** and *Echinax*.

Most of the specimens examined in this study were collected in tsetse fly traps and by canopy fogging. Indeed, the vast majority of *Copuetta* **gen. nov.** and *Wasaka* **gen. nov.** species seem to be arboreal forest-dwellers. The rich undescribed diversity sampled using these two sampling methods highlights the importance of canopy fogging in particular as a rich source of undescribed Corinnidae genera and species, as was the case in Afrotropical *Echinax* (Chapter 8) and the subfamily Trachelinae (Lyle & Haddad 2009, 2010).



FIGURES 7–13. General habitus of Afrotropical *Copuetta* **gen. nov.** species: 7. *C. erecta* **sp. nov.** male, Chidenguele, Mozambique; 8. *C. erecta* **sp. nov.** female, Xai-Xai, Mozambique; 9. *C. lacustris* (Strand, 1916) female, Bloemfontein, South Africa; 10. *C. lotzi* **sp. nov.** male, Bloemfontein, South Africa; 11. *C. magna* **sp. nov.** male, Ndumo Game Reserve, South Africa; 12. *C. maputa* **sp. nov.** male, Bilene, Mozambique; 13. *C. maputa* **sp. nov.** female, Chidenguele.

11.3 MATERIAL & METHODS

The material examined during this study was observed in 70% ethanol using a Nikon SMZ800 stereomicroscope for all descriptions, digital photographs and measurements. Digital photographs were taken of the dorsal habitus and male emboli of each species (where available), as well as the cephalic region and female epigyne of *Messapus secundus*, using a Nikon Coolpix 8400 mounted on a Nikon SMZ800 stereomicroscope. The series of images were then stacked using Combine ZM software (http://www.hadleyweb.pwp.-blueyonder.co.uk) to increase depth of field. Photographs of live *Messapus* and *Copuetta* **gen. nov.** species were taken in the field using a Canon EOS 40D digital camera with 50mm or 100mm macro lenses.

Material for scanning electron microscopy (SEM) was dehydrated in a graded ethanol series, critical-point dried in an argon chamber, fixed to aluminium stubs, and sputter-coated with gold three times for three minutes before study in a JEOL 6400 WinSEM. Due to a general scarcity of specimens, no fresh material of *Messapus* or *Wasaka* **gen. nov.** was available to use for SEM. Male and female *Copuetta lacustris* (Strand, 1916), male *C. magna* **sp. nov.** and female *C. maputa* **sp. nov.** were examined for somatic morphology. Male embolus structure was examined in *C. erecta* **sp. nov.**, *C. lacustris*, *C. lotzi* **sp. nov.**, *C. magna* **sp. nov.** and *C. maputa* **sp. nov.**, while the female epigynes of *C. lacustris* and *C. maputa* **sp. nov.** were also studied.

All measurements are given in millimetres (mm). Measurements are given for the particular specimens indicated, on which the descriptions were based, with the exception of total body length measurements, which were taken from the smallest and largest specimens of each sex to give an indication of size variation. 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 epigynes and male palps of each species were dissected and cleaned in a Labcon 5019U ultrasonic bath in 70% ethanol for 30 seconds before being illustrated. Scale bars were added to all digital microscope photographs and illustrations in Corel Draw 14.0.

The abbreviations used in the descriptions are as follows: 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 & Jocqué (2000) and includes the following abbreviations: do – dorsal; pl – prolateral; plv – prolateral ventral; rl – retrolateral; rlv – retrolateral ventral; vt – ventral terminal.

The material examined in this study is deposited in the following institutions and the curators indicated in parenthesis:

BMNH – British Museum of Natural History, London, UK (Janet Beccaloni)
CAS – California Academy of Sciences, San Francisco, USA (Charles Griswold)
MACN – Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina (Martin Ramírez)
MNHG – Museum of Natural History, Geneva, Switzerland (Peter Schwendinger)
MNHN – Museum National d’Histoire Naturelle, Paris, France (Christine Rollard)
MPEG – Museu Paraense Emílio Goeldi, Belem, Brazil (Alexandre Bonaldo)
MRAC – Royal Museum for Central Africa, Tervuren, Belgium (Rudy Jocqué)
NCA – National Collection of Arachnida, ARC – Plant Protection Research Institute, Pretoria, South Africa (Ansie Dippenaar-Schoeman)
NMBA – National Museum, Bloemfontein, South Africa (Leon Lotz)
NMSA – Natal Museum, Pietermaritzburg, South Africa (Audrey Ndaba)
NMZA – National Museum of Zimbabwe, Bulawayo, Zimbabwe (Moira FitzPatrick)
SAMC – Iziko South African Museum, Cape Town, South Africa (Margie Cochrane)
USNM – National Museum of Natural History, Smithsonian Institute, Washington DC, USA (Jonathan Coddington)
ZFMK – Zoologisches Forschungsmuseum Koenig, Bonn, Germany (Bernhard Huber)
ZMB – Zoologisches Museum, Berlin, Germany (Jason Dunlop)
ZMUC – Zoological Museum, University of Copenhagen, Denmark (Nikolaj Scharff)

Where locality co-ordinates were not provided on specimen labels or could not be traced in the institutional databases, they were located using the Global Gazetteer Version 2.2 (http://www.fallingrain.com) or Google Earth Version 6 (http://earth.google.co.uk) and are indicated in square brackets.

11.4 GENUS *MESSAPUS* SIMON, 1898

Messapus Simon, 1898: 214; Reiskind, 1969: 166; Dippenaar-Schoeman & Jocqué, 1997: 196; Bosselaers & Jocqué, 2000: 307.

Type species: *Messapus martini* Simon, 1898, by original designation.

Remarks: *Messapus* presently includes two species, *M. martini* and *M. secundus*. In the current study, *Corinna natalis* Pocock, 1898 is transferred to *Messapus* and *M. secundus* is transferred to *Merenius* Simon, 1909. No fresh material has been collected that will allow a detailed study of some important morphological characters (body setae, leg spines and setae, spinnerets) using scanning electron microscopy. A complete revision of the genus in which a detailed diagnosis can be provided will be delayed until such time. A redescription of the type species is provided here, which should be adequate for the recognition of congenerics.

11.4.1 *Messapus martini* Simon, 1898

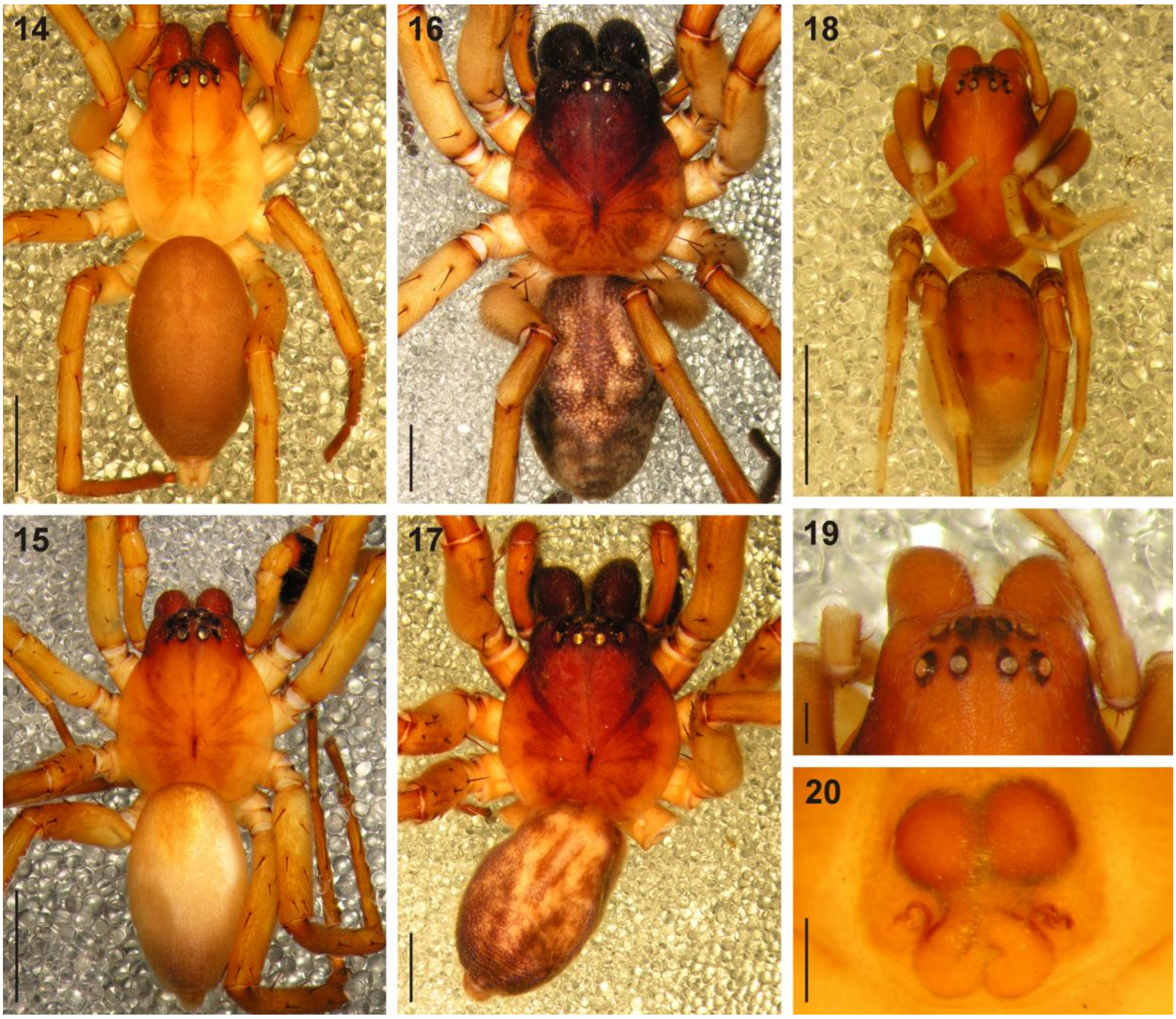
Figs 1, 2, 14, 15, 21–25

Messapus martini Simon, 1898: 214 (♀ lectotype, here designated, together with ♂ paralectotype, here designated, misidentified; male actually belongs to *Copuetta maputa* **sp. nov.**: **SOUTH AFRICA:** Natal, leg. C. Martin, MNHN 19680 – examined); Bosselaers & Jocqué, 2000: 307, figs 1A–H.

Diagnosis: *Messapus martini* can be easily recognised by the females possessing distinct horse-shoe shaped epigynal ridges, with the copulatory openings along their anterior median margins (Fig. 21). Males can be recognised by the structure of the two palpal tibial apophyses and the short curved transverse distal embolus (Figs 23–25).

Remarks: Examination of the female and male syntypes of *M. martini* and comparison of these specimens with more recently collected material indicates that they belong not only to two different species, but should also be placed in different genera and subfamilies. The female has characteristics shared with members of the Corinninae, especially regarding the broad carapace and genitalic morphology, while the male has a palp typical of the Castianeirinae.

In the very brief original description of the genus (Appendix 1), Simon (1898) provides some general characters related to the carapace shape and eye arrangement. He ends the genus description saying “Caetera fere *Castianeira*”, meaning “The rest generally as for *Castianeira*”. In the footnote describing *M. martini* (Appendix 1), Simon indicates a female symbol first, followed by a male symbol. The description then proceeds in two parts, the first giving characteristics of the carapace, abdomen and legs, most notably the presence of three pairs of ventral spines on each of the anterior tibiae and metatarsi. The second part of the description deals with the palpal morphology of the male. Significantly, the leg spination alluded to by Simon is consistent with the female specimen (see redescription below), while the male only has two pairs of ventral spines on these segments. It would thus seem that the focus of the first part of his description is on the morphology of the female. The similar colouration of the female and male described as *M. martini* (compare Figs 14 and 43) lead to the use of more general descriptive characters by Simon (1898), which could be applicable for almost all of the species of cryptic lycosiform Corinnidae. Thus, the more detailed morphological characters needed for a proper generic diagnosis and for recognition which of the syntypes should maintain nomenclatural priority are lacking.



FIGURES 14–20. Digital microscope photographs of *Messapus martini* Simon, 1898 from South Africa (14, 15), *M. natalis* (Pocock, 1898) from South Africa (16, 17) and *Merenius secundus* (Strand, 1907) from Tanzania (18–20): 14, 16. male, dorsal habitus; 15, 17, 18. female, dorsal habitus; 19. cephalic region of female in dorsal view; 20. female epigyne in ventral view. Scale bars: 14–18 = 2.0mm; 19 = 0.1mm; 20 = 0.25mm.

According to the description, the label accompanying the syntypes and the MNHN database, Simon did not specifically designate a holotype and allotype/paratype specimen. This contrasts from Bosselaers & Jocqué (2000), who specified the male as being the holotype and the female as the paratype. Since the female and male belong to unrelated taxa, the female is here designated as a lectotype to clarify the definition of the species, in line with Simon's original description. A new genus of Castianeirinae, *Copuetta* **gen. nov.**, is described below to accommodate the misplaced male paralectotype of *M. martini,* which is described from freshly collected conspecifics as *C. maputa* **sp. nov.**. The true male of *M. martini* is described below for the first time, as is the true female corresponding to *C. maputa* **sp. nov.**.

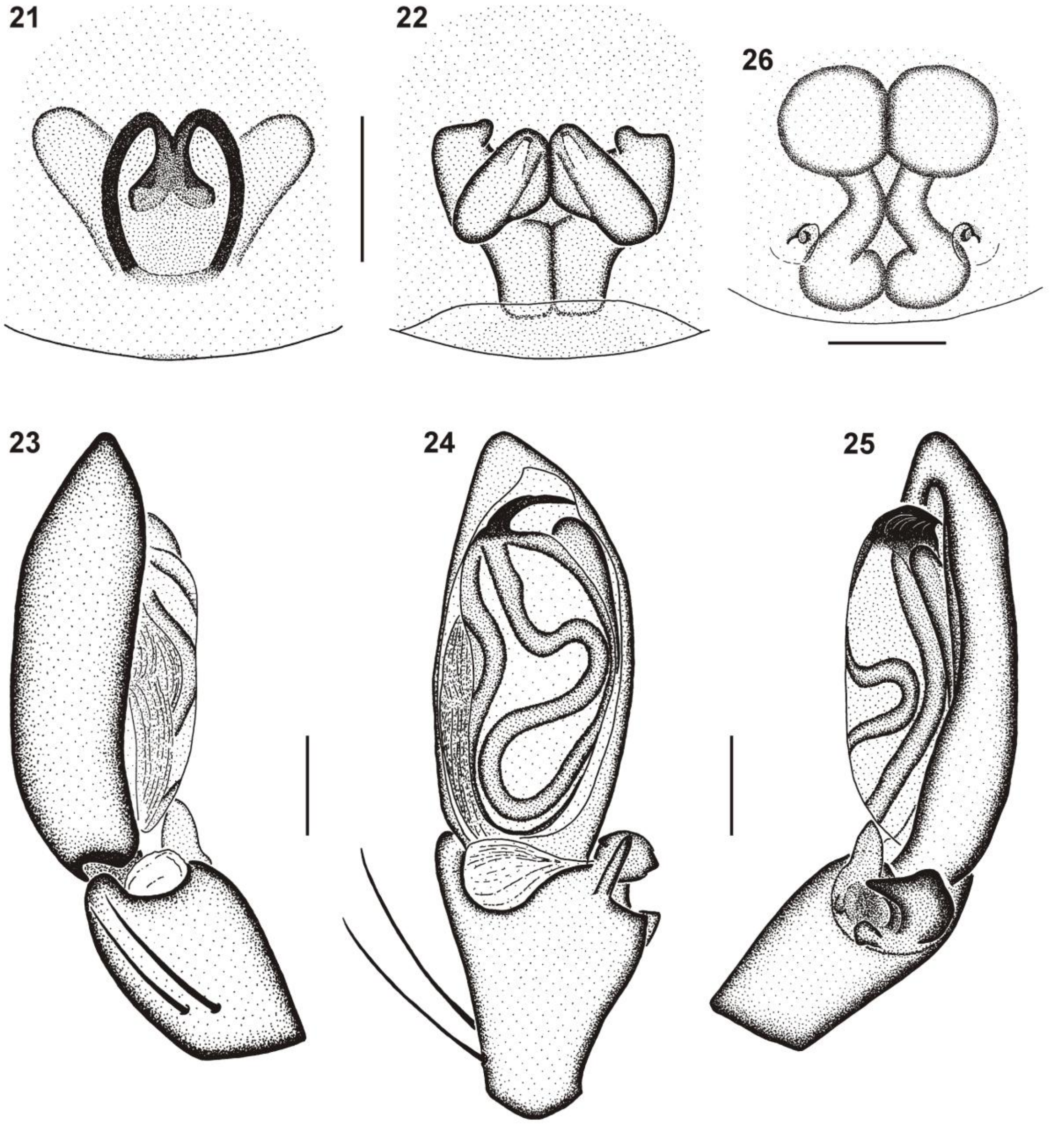
Bosselaers & Jocqué (2000) transferred *Messapus* from the Liocranidae to the Corinnidae: Castianeirinae based on their assumption that the male syntype was the holotype. Based on the redescription of *M. martini* and the designation of the female as the lectotype, the genus is here transferred to the Corinnidae: Corinninae.

Female (Groenkloof, NCA 88/892). Measurements: CL 4.18, CW 3.50, AL 6.40, AW 3.65, TL 10.48, FL 0.65, SL 2.20, SW 2.15, AME–AME 0.10, AME–ALE 0.05, ALE–ALE 0.80, PME–PME 0.22, PME–PLE 0.20, PLE–PLE 1.10, PERW 1.37, MOQAW 0.69, MOQPW 0.70, MOQL 0.81.

Length of leg segments (sequence from femur to tarsus, and total): I 3.70 + 1.75 + 2.90 + 2.80 + 1.70 = 12.85; II 3.58 + 1.72 + 2.70 + 2.78 + 1.60 = 12.38; III 3.60 + 1.70 + 2.80 + 3.60 + 1.55 = 13.25; IV 4.40 + 1.75 + 3.60 + 4.60 + 1.70 = 16.05.

General appearance as in Figs 1 and 14. Carapace broad, yellow-brown in cephalic region, yellow-orange medially, creamy-yellow around margins, eye region grey; faint black line from PER to fovea along midline; faint black mediolateral markings with serrated margins from PER, meeting medially at fovea; striae orange-brown with faint black mottling, radiating from fovea, directed between coxae; lateral margins without markings; markings densely covered with black plumose setae, areas between them covered in white and pale brown plumose setae; several long curved erect setae on clypeus, in eye region and along midline to fovea. All eyes with black rings; AER slightly procurved, medians larger than laterals; AME separated by distance equal to ⅓ their diameter; AME separated from ALE by distance slightly less than ⅕ AME diameter; clypeus height slightly less than AME diameter; PER slightly procurved, laterals very slightly larger than medians; PME separated by distance slightly larger than ⅘ their diameter; PME separated from PLE by distance slightly larger than ¾ PME diameter; CW:PERW = 2.55:1. Chelicerae orange-brown, surface finely granulate, with many long erect setae on anterior surface of paturon and finely plumose curved setae on promargin of fang groove; shaggy seta absent; chilum single; promargin with three teeth, distal tooth smallest, median tooth largest; proximal and median teeth separated by ½ basal width of proximal tooth, median and distal teeth adjacent; retromargin with two teeth separated by basal width of proximal tooth, distal tooth slightly larger, close to fang base. Endites yellow-brown, cream prolaterally distally, with dense maxillar hair tuft and distinct serrula; labium approximately 1½ times broader than long, yellow-brown, cream distally; sternum cream, pale yellow-brown around margins; pleural bars weakly sclerotised, isolated; precoxal triangles and intercoxal sclerites absent. Legs with yellow-orange femora, patellae and tibiae, and orange metatarsi and tarsi; all segments with dense mottling comprising black plumose setae and scattered patches of white plumose setae; femora with asetose retrolateral streaks and ventral median rows of erect setae. Leg spination: femora: I pl 2 do 3-4, II pl 2 do 3, III pl 2-3 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with row of erect setae ventrally, decreasing in length distally and from femora I to IV; patellae: III do 1, IV do 1; tibiae: I pl 2 plv 3 rlv 3, II pl 2 plv 3 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 3, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 3; metatarsi: I plv 2 rlv 2 vt 2, II pl 1 plv 2 rlv 2 vt 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 2 rl 2 plv 2 rlv 2 vt 3; palpal spination: femora: pl 1 do 2, with more than 10 erect ventral setae, longer and thicker on retrolateral side; patellae: pl 1 do 2; tibiae: pl 2 plv 1; tarsi: pl 1 plv 1. Abdomen without dorsal scutum, two pairs of faint sigilla present; dorsum creamy-grey, darker at spinnerets, densely covered in cream and yellow-brown plumose and short straight setae; venter cream, covered in yellow-brown plumose and short straight setae; epigastric scutum and ventral sclerite absent; inframamillary sclerite tiny, cream and indistinct. Female epigyne with strongly sclerotised horse-shoe shaped ridges, with anterior median copulatory openings (Fig. 21); copulatory ducts short and broad, initially directed retrolaterally and posteriorly, with sharp lateral bend before entering anterior ST II; ST II subtriangular with "nipple" on anterior margin, broader laterally than medially, connected broadly to elongate median posterior ST I (Fig. 22).

Male (Pretoria, NCA 97/692). Measurements: CL 4.60, CW 3.80, AL 5.60, AW 3.30, TL 10.08, FL 0.63, SL 2.35, SW 2.20, AME–AME 0.13, AME–ALE 0.05, ALE–ALE 0.73, PME–PME 0.20, PME–PLE 0.17, PLE–PLE 1.05, PERW 1.32, MOQAW 0.68, MOQPW 0.69, MOQL 0.76.



FIGURES 21–26. Genitalic morphology of *Messapus martini* Simon, 1898 (21–25) and *Merenius secundus* (Strand, 1907) (26): 21, 26. female epigyne, ventral view; 22. same, dorsal view; 23. male palp, prolateral view; 24. same, ventral view; 25. same, retrolateral view. Scale bars: 21–25 = 0.50mm; 26 = 0.25mm.

Length of leg segments (sequence from femur to tarsus, and total): I 3.98 + 1.90 + 3.05 + 3.10 + 1.85 = 13.88; II 3.80 + 1.80 + 3.00 + 3.00 + 1.70 = 13.30; III 3.90 + 1.68 + 2.92 + 3.70 + 1.75 = 13.95; IV 4.60 + 1.80 + 3.60 + 4.80 + 1.70 = 16.50.

General appearance as in Figs 2 and 15. Carapace dark orange-brown with faint black mottling in cephalic region, bright orange medially and yellow-orange posteriorly and laterally, eye region dark, nearly black; markings, striae and setae as for female. All eyes with black rings; AER slightly procurved, medians larger than laterals; AME separated by distance slightly larger than ⅖ their diameter; AME separated from ALE by distance slightly less than ⅕ AME diameter; clypeus height slightly less than AME diameter; PER slightly procurved, laterals very slightly larger medians; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance slightly less than ⅔ PME diameter; CW:PERW = 2.88:1. Chelicerae dark orange-brown with black mottling, surface finely granulate, with many long erect setae on anterior surface of paturon and finely plumose curved setae on promargin of fang groove; shaggy seta absent; chilum single; promargin with three teeth, distal tooth smallest, median tooth largest; proximal and median teeth separated by ½ basal width of proximal tooth, median and distal teeth with shared base (bifid); retromargin with two teeth separated by basal width of proximal tooth, distal tooth slightly larger, close to fang base. Endites dark yellow-brown, cream prolaterally distally, with dense maxillar hair tuft and distinct serrula; labium 1½ times broader than long, dark yellow-brown, paler distally; sternum creamy-yellow, yellow-brown around margins; pleural bars weakly sclerotised, isolated; precoxal triangles and intercoxal sclerites absent. Colouration, markings and setae on legs as for female. Leg spination: femora: I pl 2 do 3, II pl 2 do 3, III pl 3 do 3 rl 2-3, IV pl 2 do 3 rl 1; all femora with row of erect setae ventrally, decreasing in length distally and from femora I to IV; patellae: III do 1, IV do 1; tibiae: I pl 1 plv 3 rlv 3, II pl 2 plv 3 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 vt 2, II pl 1 plv 2 rlv 2 vt 2, III pl 2 rl 2 plv 2 rlv 2 vt 3, IV pl 2 rl 2 plv 2 rlv 2 vt 3; palp: femur pl 1 do 2, patella pl 1 do 2, tibia pl 1 plv 1; palpal femur with two rows of erect setae ventrally, rl row longer and thicker. Abdomen with yellow dorsal scutum extending to ½ abdomen length, with two pairs of faint sigilla; dorsum creamy-grey, slightly darker posteriorly, densely covered in cream and yellow-brown plumose and short straight setae; venter cream, covered in yellow-brown plumose and short straight setae; epigastric scutum and ventral sclerite absent, medially with paired row of tiny yellow sclerites; inframamillary sclerite small and yellow. Male palpal femora and patellae bright yellow; tibiae yellow proximally, red medially and black at tibial apophyses; cymbium black, tegulum deep red with dark red-brown ducts; palpal tibiae with large, flat subtriangular retrolateral ventral apophysis and hook-like retrolateral apophysis with lobate proximal projection; tegulum large and oval, subtegulum projecting pro- and retrolaterally, with curved transverse embolus originating prolaterally at distal end of tegulum (Figs 23–25).

Additional material examined: SOUTH AFRICA: *Gauteng Province*: Groenkloof Nature Reserve, leg. M. Filmer, 20.III.1988 (on ground among rocks), 1♀ (NCA 88/892); Pretoria, leg. B. Sunkel, 3.IV.2001 (in house), 1♂ (NCA 2004/422); Pretoria, Agricultural Building, leg. B. Sunkel, 20.I.1997 (in building), 1♂ (NCA 97/692); Pretoria, Wonderboom South, leg. A.S. Dippenaar, 15.IV.1975 (on ground), 1♀ (NCA 76/1180). *KwaZulu-Natal Province*: Charter's Creek, Lake St Lucia, 28°12'S, 32°26'E, leg. J. Doyen & C. & T. Griswold, 19–21.XI.1985 (forest), 2♂ (NMSA 22039); Hluhluwe Game Reserve, Campsite, leg. A. Honiball, 30.IV.2006, 1♂ (NCA 2007/2930); Ingwavuma, leg. R.F. Lawrence, VII.1951, 1♂ (NMSA 5589); iSimangaliso Wetlands Park, Hell's Gate, Block A, 28.00°S, 32.48°E, leg. J. Esterhuizen, 20.X.2004 (tsetse fly traps), 1♂ (NCA 2010/253); Same locality, Block B, leg. J. Esterhuizen, 6.XII.2004 (tsetse fly traps), 1♂ (NCA 2010/274); Ndumo Game Reserve, Southern shore of Hotwe Pan, 26°52.730'S, 32°18.452'E, leg. C. Haddad, 7.II.2005 (*Acacia xanthophloea* bark), 1♀ (NCA 2008/2910); Same locality, Shokwe Pan, 26°52.424'S, 32°12.652'E, 43m a.s.l., leg. C. Haddad, V. Swart & A. Kirk-Spriggs, 2.XII.2009 (canopy fogging, *Kigelia africana*), 1♀ (NCA 2010/2748). *Mpumulanga Province*: Badplaas, 25°57'03"S, 30°34'00"E, 1100m a.s.l., leg. D. & S. Ubick, 26–29.III.2001 (at night, in litter under riparian trees), 1♀ (CAS). **ZAMBIA:** Luangwa Valley, leg. A.S. Dippenaar, 1.VIII.1978 (grass), 1♂ (NCA 2000/375).

Distribution: Gauteng, KwaZulu-Natal and Mpumulanga Provinces in South Africa, and Zambia (Fig. 27).

Biology: This species shows contrasting habits and has been collected from the soil surface, tree bark and tree canopies. The two specimens photographed live (Figs 1, 2) were actively hunting on bark at night. Both sexes were collected from dense silk retreats constructed in the fissures of bark of mature large trees (Fig. 3). There are several attachment lines to the substrate above the retreat as well as slits at the bottom and top ends of the retreat through which the spiders apparently enter and exit.

11.4.2 *Messapus natalis* (Pocock, 1898)

Figs 4, 5, 16, 17

Corinna natalis Pocock, 1898: 221, pl. 8, fig. 14; Haddad, 2005: 28, figs 1–6 **comb. nov.**

See Haddad (2005) for description of both sexes. General appearance of females in Figs 4 and 16 and males in Figs 5 and 17.

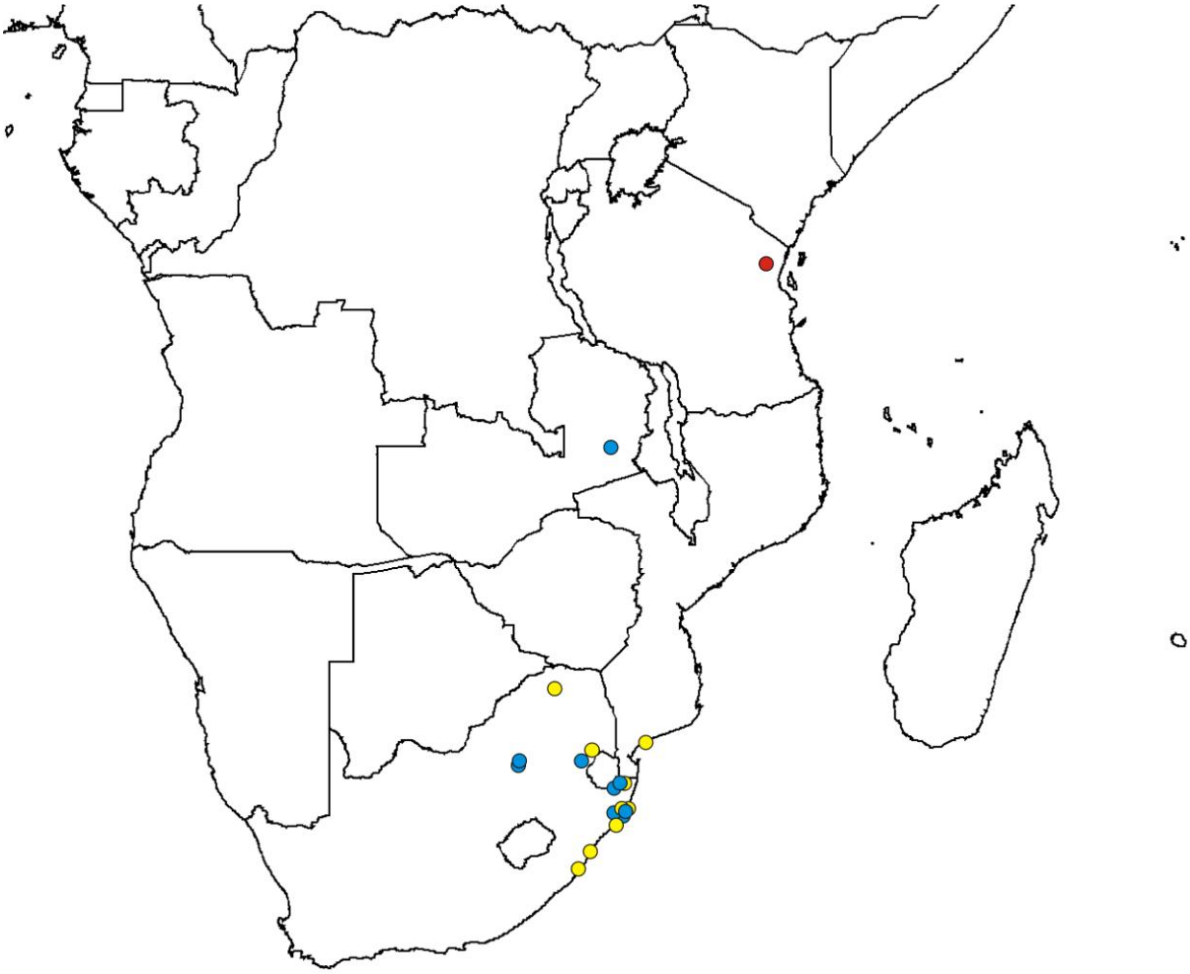


FIGURE 27. Distribution of *Messapus martini* Simon, 1898 (blue circles), *M. natalis* (Pocock, 1898) (yellow circles) and *Merenius secundus* (Strand, 1907) (red circle) in the Afrotropical Region.

Remarks: The recently redescribed and illustrated *Corinna natalis* is a very large corinnine spider (Haddad 2005) that shares a number of characters with *Messapus martini*: 1) eye arrangement with slightly procurved PER and eyes approximately equidistant; 2) broad mottled carapace markings mediolaterally extending from the PER to the posterior margin of the carapace, with eye region darkened; 3) anterior legs with three pairs of ventral spines on the tibiae and two on the metatarsi; 4) chelicerae with three promarginal teeth, and five retromarginal teeth in females and four in males (only two in *M. martini*); 5) abdomen without a dorsal scutum in females and the male of *C. natalis*, but present in male *M. martini*, and ventral sclerite absent in both sexes; 6) female epigyne with strongly sclerotised ridges, anterior copulatory openings, and a broad median tube linking the ST II; 7) male palp with complex RTA comprising several hooked and triangular apophyses, simple tegulum with distal lobe, and short curved embolus originating prolaterally and distally on the tegulum. I feel that this evidence confirms that *C. natalis* is congeneric with *M. martini*, and its transfer to *Messapus* is hereby proposed.

Published records (Haddad 2005): SOUTH AFRICA: *KwaZulu-Natal Province*: Durban (type locality), Dukuduku, Greater St. Lucia Wetlands Park (Hell's Gate), Ifafa, Ndumo Game Reserve (Game count transect 8, Dipini Hide), Richard's Bay.

New records: SOUTH AFRICA: *KwaZulu-Natal Province*: iSimangaliso Wetlands Park, Cape Vidal, 28°10'S, 32°34'E, leg. A. Leroy, J. Leroy & L. Prendini, 18.IV.1992 (thick silk retreats over holes in tree trunks), 2♂ 1♀ (NCA 2007/1141); Ndumo Game Reserve, Main Camp, Broadleaf woodland, 26°54.581'S, 32°18.798'E, leg. C. Haddad, 5.XII.2009 (in silk retreat in *Strynchos spinosa* tree), 1♀ (NCA 2010/2743); Same locality, Shokwe Pan, 26°52.424'S, 32°12.652'E, 43m a.s.l., leg. A. Kirk-Spriggs, 30.XI–4.XII.2009 (Malaise traps), 1♂ (NCA 2010/2749). *Mpumulanga Province*: Nelspruit district, Crocodile River Gorge, 25°32'S, 31°13'E, leg. A. Leroy, 18.XI.2007 (hole in tree with strong papery silk covering hole), 1♀ (NCA 2008/2911). *Limpopo Province*: Soutpansberg Mountains, Vivo district, Lajuma Mountain Retreat, 23°02.454'S, 29°27.205'E, 1200m a.s.l., leg. C. Haddad, 3–11.II.2008 (under bark, Afromontane forest), 1♂ (MPEG 19101). **MOZAMBIQUE:** Bilene, Praia do Bilene, 25°15.649'S, 33°17.659'E, 27m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 20.XII.2007 (leaf litter, coastal forest), 1♀ (NCA 2008/211).

Distribution: Previously known only from the KwaZulu-Natal Province, South Africa (Haddad 2005). Newly recorded from the Mpumulanga and Limpopo Provinces, and from southern Mozambique (Fig. 27).

Biology: The biology of this species was briefly discussed by Haddad (2005). This species constructs a silken retreat in fissures of bark or cerambycid exit holes in the trunks of trees (Fig. 6). The structure of the retreat is similar to that of *M. martini*, described above, comprising a silk mat covering the substrate surface, a mat closing the two opposite walls of the fissure, a folded silk opening on the upper side of the retreat, and an attachment line extending to the substrate above the retreat.

11.5 MISPLACED SPECIES

11.5.1 *Merenius secundus* (Strand, 1907)

Figs 18–20, 26

Messapus secundus Strand, 1907: 543 (♀ Holotype: **TANZANIA:** *Tanga Region*: East Usambara, Amani [05°06'S, 38°38'E], leg. Vosseler, ZMB 28240 – examined) **comb. nov.**

Remarks: This species was the second to be described in the genus *Messapus*. According to Strand's (1907) description, this species is very similar in somatic morphology to *M. martini*. Examination of the holotype female suggests strongly otherwise, and it is possible that Strand never saw the type of *M. martini*. The holotype female of *Messapus secundus* is clearly a castianeirine spider and shares with spiders of the genus *Merenius* (e.g. *M. alberti* Lessert, 1923 – Chapter 10): 1) an elongate body, particularly the carapace and legs (Fig. 18); 2) small eyes, with a very slightly recurved PER (Fig. 19); 3) median eyes of both rows slightly larger than laterals; 4) a dorsal abdominal scutum extending to the middle of the abdomen; 5) distinctive castianeirine genitalia, with quite narrow ST 1 (Figs 20, 26), as for most other *Merenius* species. Based on this evidence and the redescription below I here propose the transfer of the species to *Merenius* as *Merenius secundus* (Strand, 1907) **comb. nov.**.

The holotype is considerably faded and the redescription pertains to the colouration of the specimen in its current form, as no freshly collected specimens were available for study. Live specimens most likely have dark brown to black colouration with cream or white markings on the body, as in other *Merenius* species (Chapter 10).

Female (holotype, Amani, ZMB 28240). Measurements: CL 3.00, CW 1.98, AL 3.05, AW 2.00, TL 5.82, FL 0.23, SL 1.18, SW 1.10, AME–AME 0.10, AME–ALE 0.02, ALE–ALE 0.38, PME–PME 0.16, PME–PLE 0.10, PLE–PLE 0.62, PERW 0.83, MOQAW 0.38, MOQPW 0.41, MOQL 0.41.

Length of leg segments: I 1.83 + 0.70 + 1.65 + 1.48 + 1.08 = 6.74; II 1.73 + 0.69 + 1.40 + 1.34 + 0.96 = 6.12; III 1.60 + 0.70 + 1.25 + 1.40 + 0.80 = 5.75; IV 2.33 + 0.82 + 1.97 + 2.32 + 0.90 = 8.34.

General appearance as in Fig. 18. Carapace orange-brown, MOQ slightly darker, with faint black striae radiating from fovea; surface finely granulate, with short white straight and plumose setae laterally and in eye region, considerably less dense along midline; several long curved setae on clypeus; carapace oval, broadest at coxae II, highest at ⅔ carapace, eye region narrow; fovea distinct, short and narrow; posterior margin very slightly concave. All eyes with black rings (Fig. 19); AER procurved, medians slightly larger than laterals; AME separated by distance approximately ⅔ their diameter; AME separated from ALE by distance approximately ⅛ AME diameter; clypeus height slightly less than 1⅕ AME diameter; PER slightly recurved, medians slightly larger than laterals; PME separated by distance slightly larger than their diameter; PME separated from PLE by distance equal to ⅔ PME diameter; CW:PERW = 2.39:1. Chelicerae orange-brown, with long, erect straight setae on anterior margin of paturon and pectinate curved setae on fang promargin; three teeth on promargin, distal tooth smallest, median tooth largest; median and distal teeth adjacent; retromargin with two teeth, distal tooth slightly smaller than proximal tooth. Endites yellow, cream in distal half, straight laterally, with distinct serrula and maxillar hair tuft; labium yellow, cream distally, trapezoidal with slightly concave distal margin; sternum shield-shaped, rebordered, yellow, with scattered long erect and short straight setae; intercoxal sclerites present between coxae I and II, II and III, absent between III and IV; precoxal triangles present; pleural bars isolated. Leg formula 4123; legs covered in black plumose and short straight setae, plumose setae sparse on metatarsi and tarsi; coxae pale yellow-brown; femora yellow-brown with black mottling, cream distally; patellae I and II cream, III and IV pale yellow-brown, all with black mottling; tibiae, metatarsi and tarsi I and II creamy-yellow with black mottling; tibiae and metatarsi III yellow with black mottling; tibiae and metatarsi IV pale yellow-brown with black mottling, cream distally; tarsi III and IV cream. 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: all with single long fine distal seta; tibiae: I plv 3 rlv 2, II plv 3 rlv 2, III pl 2 do 1 rl 2-3 plv 2 rlv 1-2 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 2; tibiae: pl 1 plv 1; tarsi: pl 1 plv 2 rlv 1. Abdomen oval, with orange-brown dorsal scutum extending ⅗ abdomen length; two pairs of distinct sigilla present, first at ⅓ and second at ½ abdomen length; dorsum pale grey, with two white transverse markings, first anteriorly, extending laterally to behind epigastric furrow, second median marking broader, extending laterally and ventrally to middle of venter; dorsum covered in short straight and plumose setae, white plumose setae predominantly on markings; venter pale grey, cream at markings, covered in short straight setae; post-epigastric and ventral sclerites absent, inframamillary sclerite weakly sclerotised and indistinct. Epigyne large, copulatory openings small, surrounded by somewhat heart-shaped ridges; anterior ST II red-brown, round, narrowly connected to smaller yellow kidney-shaped posterior ST I; ST I clearly narrower than ST II (Figs 20, 26).

Male: unknown.

Distribution: Known only from the type locality (Fig. 27).

Biology: Unknown, but likely a leaf-litter dwelling spider as in the case of other *Merenius*.

11.6 GENUS *COPUETTA* GEN. NOV.

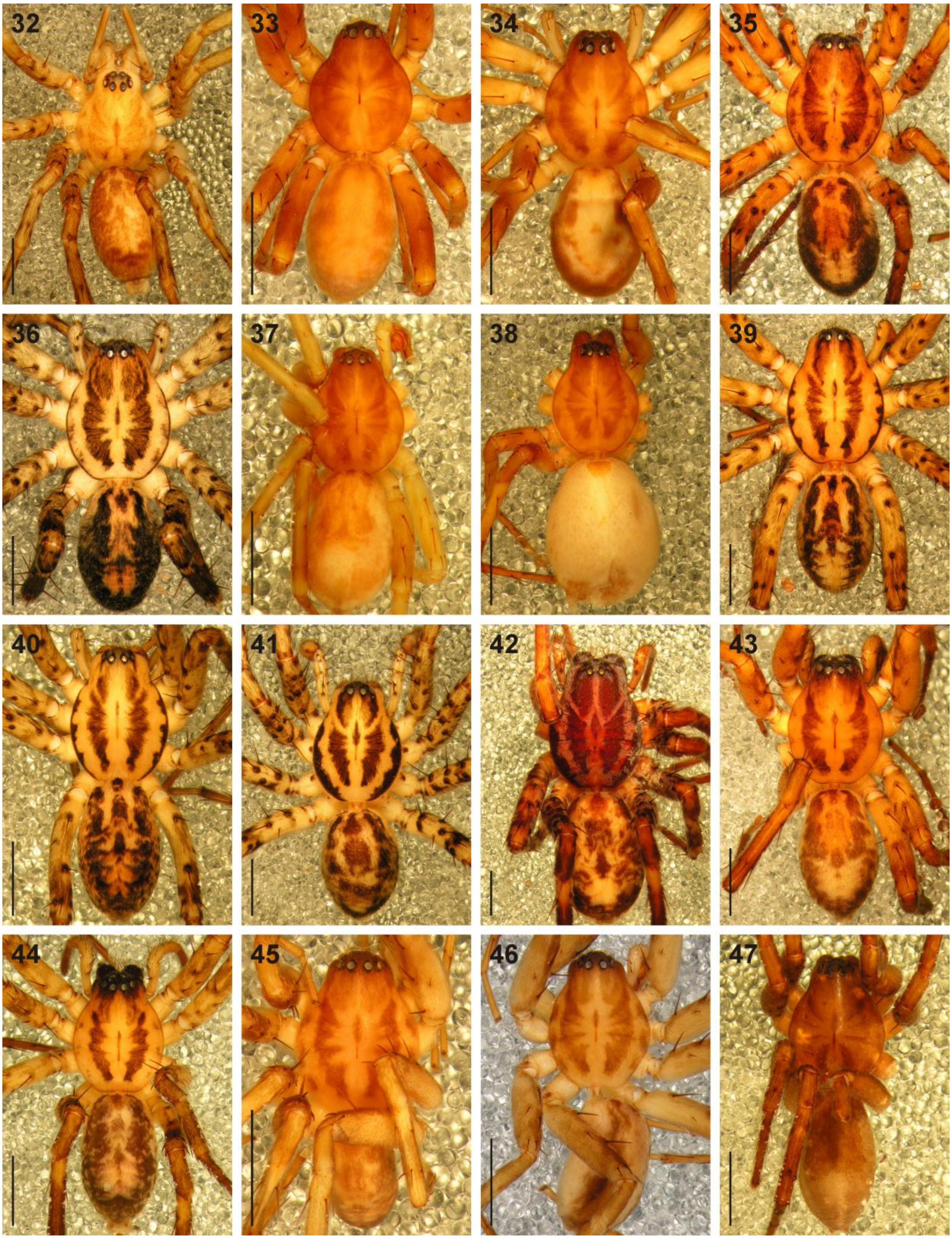
Type species: *C. maputa* **sp. nov.**

Etymology: The genus name is derived from that of *Copa*, with a feminine suffix, and reflects the affinity of this genus to *Copa*.

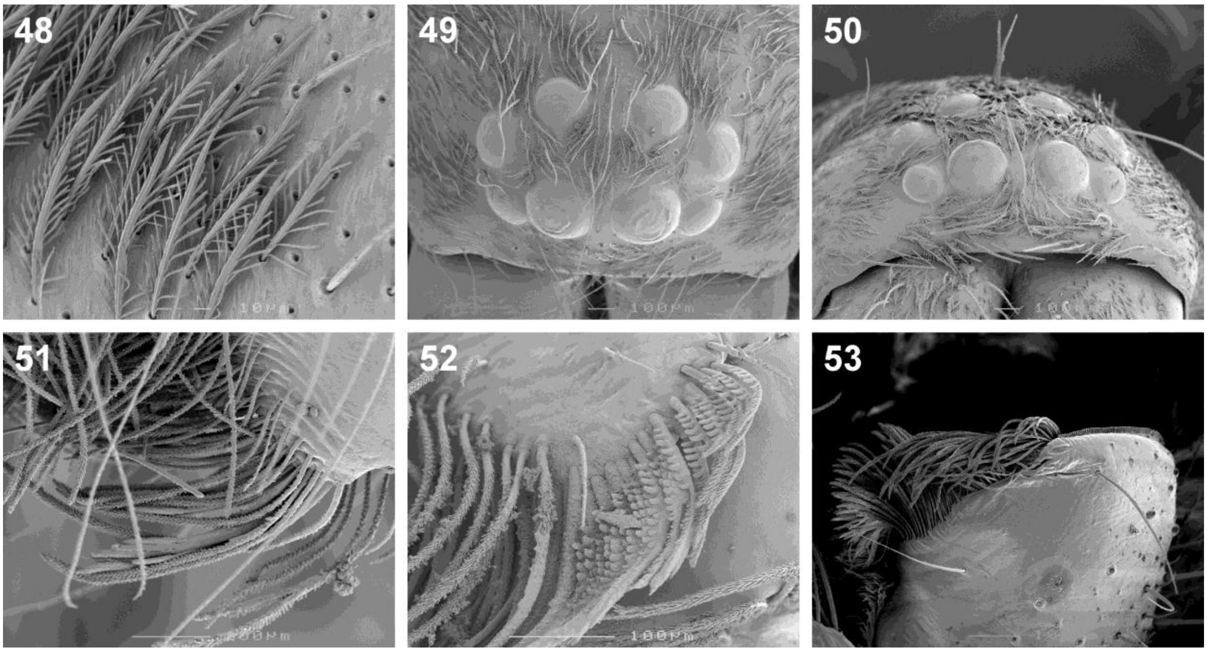
Diagnosis: *Copuetta* **gen. nov.** can be recognised from other Afrotropical cryptic lycosiform Castianeirinae, i.e. *Copa*, *Echinax* and *Wasaka* **gen. nov.**, by the following combination of characters: 1) from *Copa* by the slightly procurved PER and the carapace that is usually less than 3 times broader than the posterior eye row (strongly procurved PER and carapace more than 3.3 times broader than PER in *Copa*); 2) from *Echinax* by the presence of fine setae on anterior patellae (spines in *Echinax*) and the patellar setae and/or spines clearly shorter than the length of the patella (spines longer than patellae in *Echinax*); 3) from *Wasaka* **gen. nov.** by the presence of only two pairs of ventral spines on the anterior tibiae (three pairs in *Wasaka* **gen. nov.**, sometimes also with pair of ventral terminal spines).

FIGURES 28–31. Digital microscope photographs of *Copuetta comorica* **sp. nov.** (28, 29) and *C. erecta* **sp. nov.** (30, 31): 28, 30. male, dorsal habitus; 29, 31. female, dorsal habitus. Scale bars = 2.0mm.

Description: Medium to large spiders, approximately 5.00–12.50mm in length; carapace pale creamy-yellow to dark orange-brown, usually yellow-brown, with black markings (Figs 7–13, 28–47); carapace surface smooth, with black plumose setae covering markings (Fig. 48); several long curved setae on clypeus, eye region and posterior to PER up to midpoint; carapace oval, broadest at posterior of coxae II, eye region narrow, fovea distinct; posterior margin very slightly concave. AER procurved, AME approximately 1¼ ALE diameter; AME separated by ½ or less their diameter, nearly touching ALE (Figs 49, 50); PER procurved, PLE slightly larger than PME; PME closer to PLE than to each other; MOQ width nearly equal anteriorly and posteriorly, slightly longer than wide. Chilum distinct, triangular, usually bilateral with very narrow median separation; cheliceral promargin and retromargin with two teeth; shaggy seta absent; curved setae on cheliceral promargin finely plumose in males (Fig. 51) and pectinate in females (Fig. 52); endites straight laterally, with distinct serrula comprising sharp, ventrally curved denticles, with dense maxillar hair tuft on mesal margins (Fig. 53); labium trapezoidal, slightly wider than long. Pleural bars sclerotised, isolated; sternum very slightly longer than broad, sometimes equal in in length and width, shield-shaped, slightly narrowed anteriorly, with or without markings; surface smooth, covered in short straight setae, with many long erect straight setae; precoxal triangles present, intercoxal sclerites absent. Leg formula 4132; legs strongly spined, femora, patellae, tibiae and metatarsi covered in plumose and short straight setae (Figs 54–60), plumose setae sparse on tarsi (Fig. 61); retrocoxal window absent on coxa I; femora with many erect ventral setae (Fig. 54); anterior patellae with proximal and distal long fine dorsal setae (Fig. 55); posterior patellae with fine long proximal dorsal seta and distal spine or fine seta; distal spine or setae clearly shorter than patella; patellar indentation narrow, broad at proximal end (Figs 56–58); metatarsi III slightly longer than metatarsi I and II, rarely equal to metatarsi I; metatarsi distally with weak scopula, tarsi scopulate; tibiae, metatarsi and tarsi with several dorsal and lateral trichobothria with sunken basal plate (Figs 59, 61, 62), also with several short erect setae (Fig. 61); tarsal organ oval, very slightly elevated from integument, surface finely wrinkled, opening oval (Figs 61, 63); paired tarsal claws short, situated laterally, with very dense claw tufts in between (Fig. 64); metatarsi III and IV without terminal preening brush or comb (Fig. 60). Abdomen oval, black with cream median stripe or chevron markings; three pairs of fine straight setae on anterior margin above pedicel; dorsal scutum strongly sclerotized, usually extending slightly more than ½ abdomen length in males and less than ⅓ abdomen length in females; two pairs of weakly sclerotised dorsal sigilla present in both

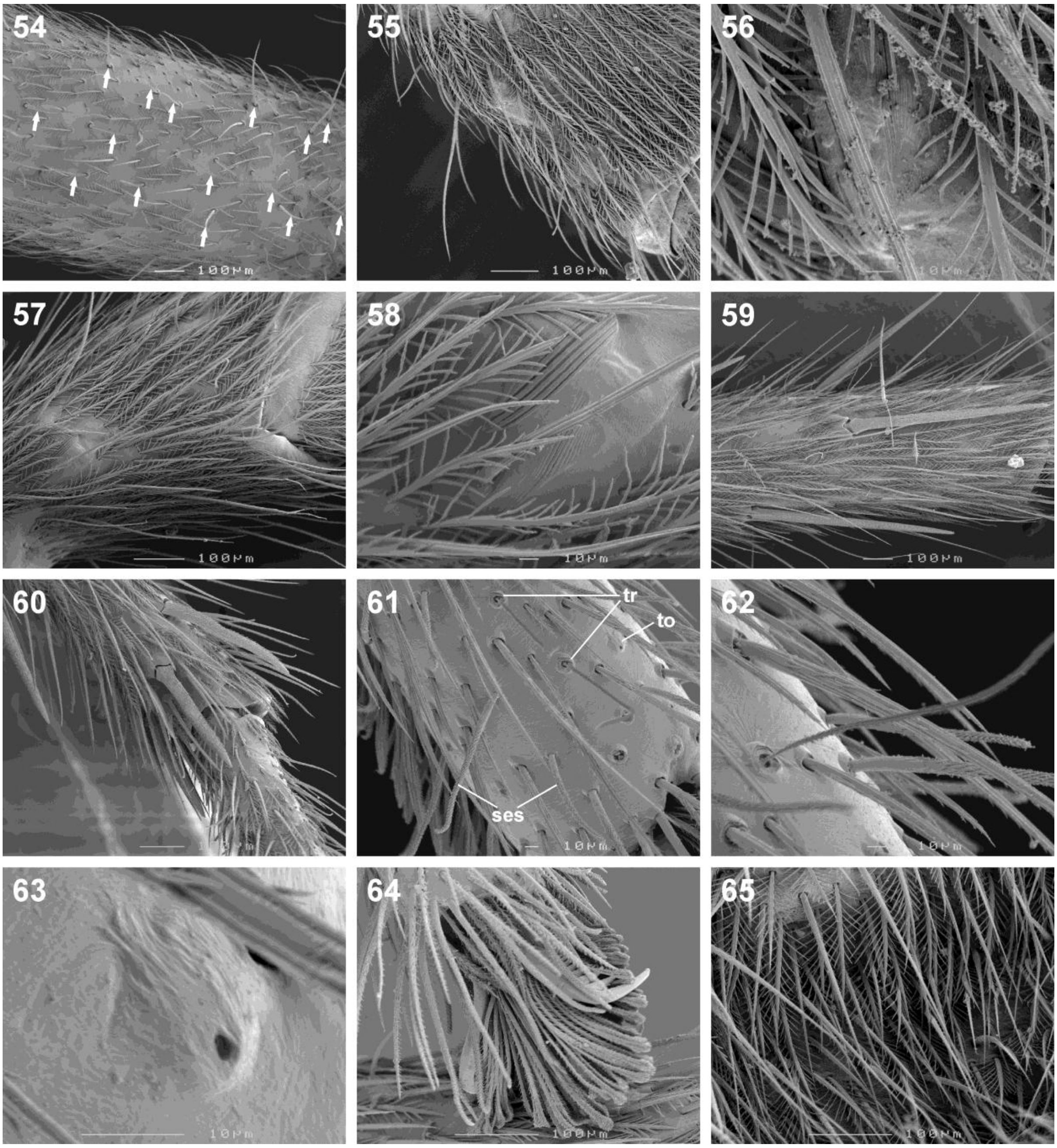


FIGURES 32–47. Digital microscope photographs of *Copuetta kakamega* **sp. nov.** (32), *C. kwamgumi* **sp. nov.** (33, 34), *C. lacustris* (Strand, 1907) (35, 36), *C. lesnei* **sp. nov.** (37), *C. litipo* **sp. nov.** (38), *C. lotzi* **sp. nov.** (39, 40), *C. magna* **sp. nov.** (41, 42), *C. maputa* **sp. nov.** (43, 44), *C. naja* **sp. nov.** (45), *C. uzungwa* **sp. nov.** (46) and *C. wagneri* **sp. nov.** (47): 32, 34, 36, 38, 40, 42, 44. female habitus, dorsal view; 33, 35, 37, 39, 41, 43, 45–47. male habitus, dorsal view. Scale bars: 2.0mm.



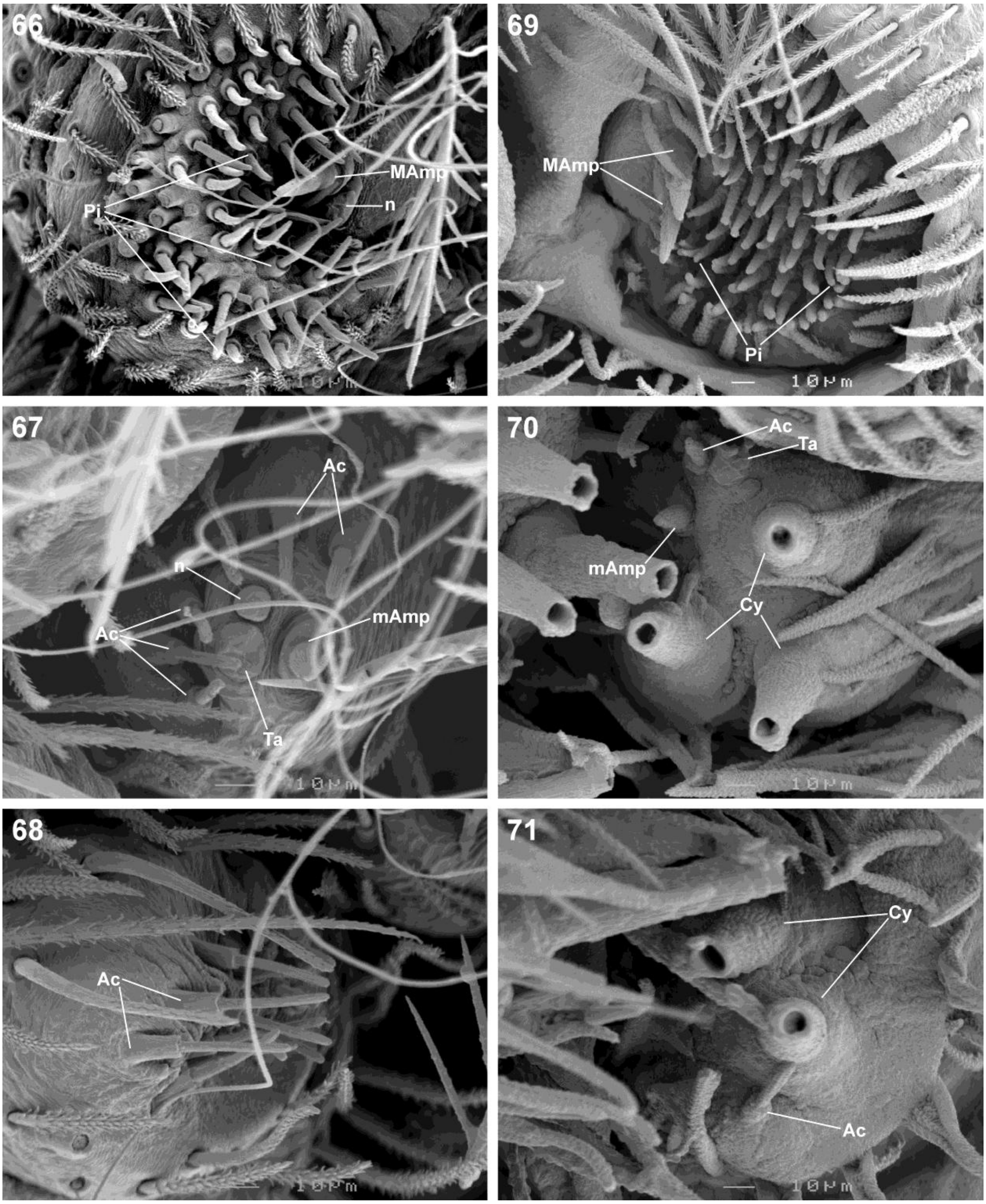
FIGURES 48–53. Scanning electron microscope photographs of *Copuetta lacustris* (Strand, 1916) female (48, 50, 52) and male (49, 51) and *C. maputa* **sp. nov.** female (53): 48. dorsal carapace setae; 49, 50. eye region and clypeus in dorsal (49) and anterior (50) views; 51, 52. cheliceral promarginal bent setae, anterior view; 53. endite, ventral view.

sexes; epigastric region moderately sclerotised, venter without post-epigastric sclerites and usually without ventral sclerite; when absent, two paired rows of tiny sclerites from epigastric furrow to spinnerets, outer row weakly sclerotised and indistinct; inframamillary sclerite present, distinct, densely covered in short setae; venter densely covered in plumose and short straight setae (Fig. 65). Spinnerets (observed in male *C. lacustris* (Strand, 1916) and *C. magna* **sp. nov.**, and female *C. lacustris* and *C. maputa* **sp. nov.**): ALS of male with single major ampullate gland spigot, single large adjacent nubbin and many piriform gland spigots (Figs 66, 72); ALS of female with two major ampullate gland spigots and many piriform gland spigots (Figs 69, 75); PMS of male with one large minor ampullate gland spigot, one tartipore and one nubbin, with six aciniform gland spigots in *C. lacustris* (Fig. 67) and three in *C. magna* **sp. nov.** (Fig. 73); PMS of female with three large cylindrical gland spigots and one small minor ampullate gland spigot, in *C. lacustris* with tartipore and single aciniform gland spigot (Fig. 70), in *C. maputa* **sp. nov.** with tartipore and four aciniform gland spigots (Fig. 76); PLS of male *C. lacustris* with approximately 10 aciniform gland spigots (Fig. 68), of *C. magna* **sp. nov.** with four aciniform gland spigots (Fig. 74); PLS of female with two large cylindrical gland spigots and three (in *C. lacustris*) or more than 10 (in *C. maputa* **sp.**

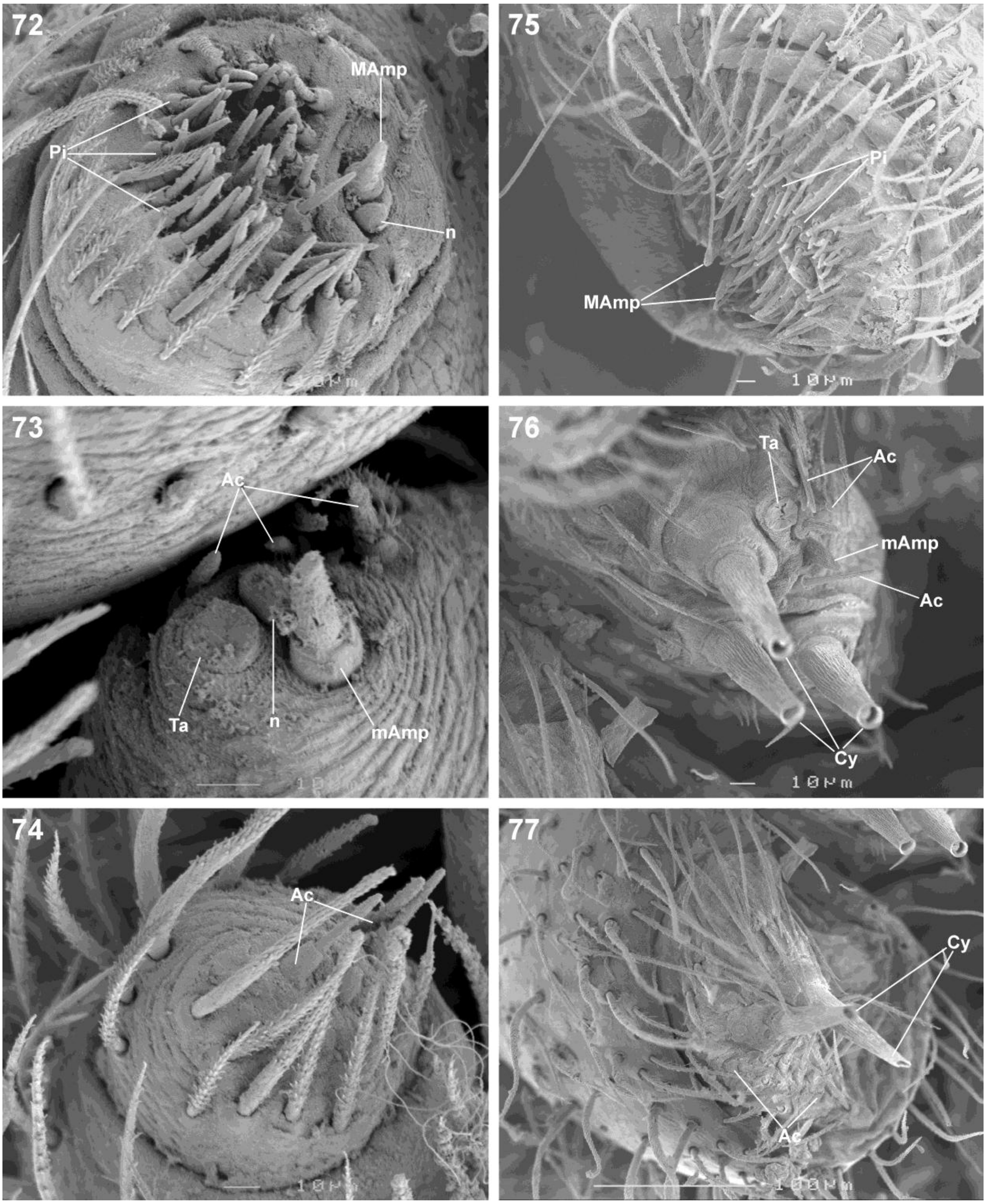


FIGURES 54–65. Scanning electron microscope photographs *Copuetta lacustris* (Strand, 1916) female (54–56, 61–65) and male (57–60): 54. femur II, arrows indicating erect ventral setae; 55. patella II, plumose setae; 56. same, patellar indentation; 57. patella III, patellar indentation; 58. same, detail of proximal end of PI; 59. tibia III, distal spines; 60. metatarsus III, distal spines; 61. tarsus II, indicating tarsal organ (to), trichobothriae (tr) and short erect setae (ses); 62. same, detail of trichobothrium; 63. same, detail of tarsal organ; 64. tarsus II, tarsal claw and claw tuft; 65. ventral abdominal plumose and short straight setae.

nov.) aciniform gland spigots. Male palpal segments without apophyses; cymbium with spines prolaterally and ventrally, dorsal surface covered in curved finely plumose setae, fine setae with bent tips distally and several slightly thickened setae distally; embolus usually



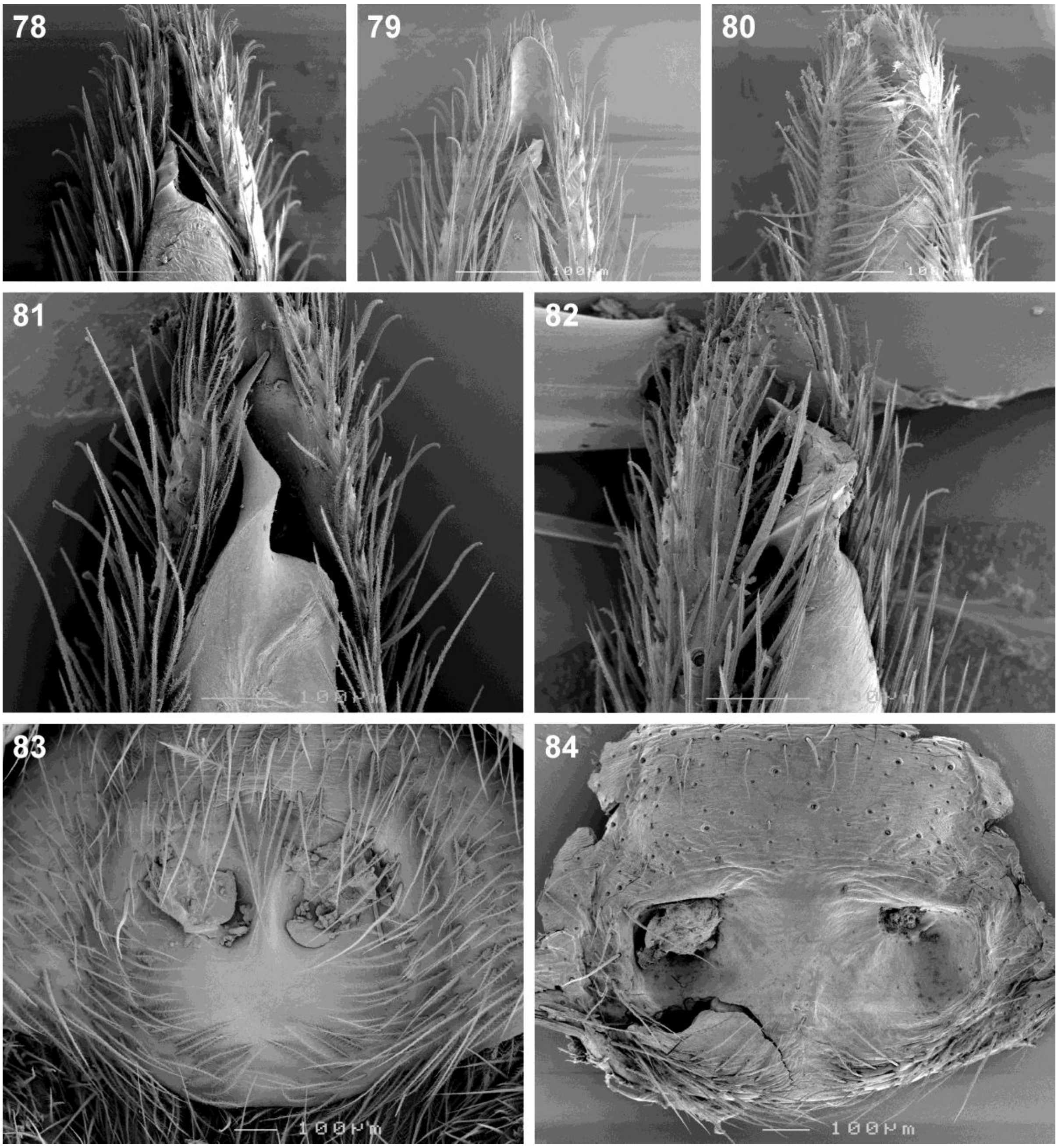
FIGURES 66–71. Scanning electron microscope photographs of *Copuetta lacustris* (Strand, 1916) male (66–68) and female (69–71) spinneret morphology. 66, 69. anterior lateral spinneret; 67, 70. posterior median spinneret; 68, 71. posterior lateral spinneret. Abbreviations: Ac–aciniform gland spigot(s); Cy–cylindrical gland spigot(s); MAmp–major ampullate gland spigot(s); mAmp–minor ampullate gland spigot(s); n–nubbin(s); Pi–piriform gland spigot; ta–tartipore.



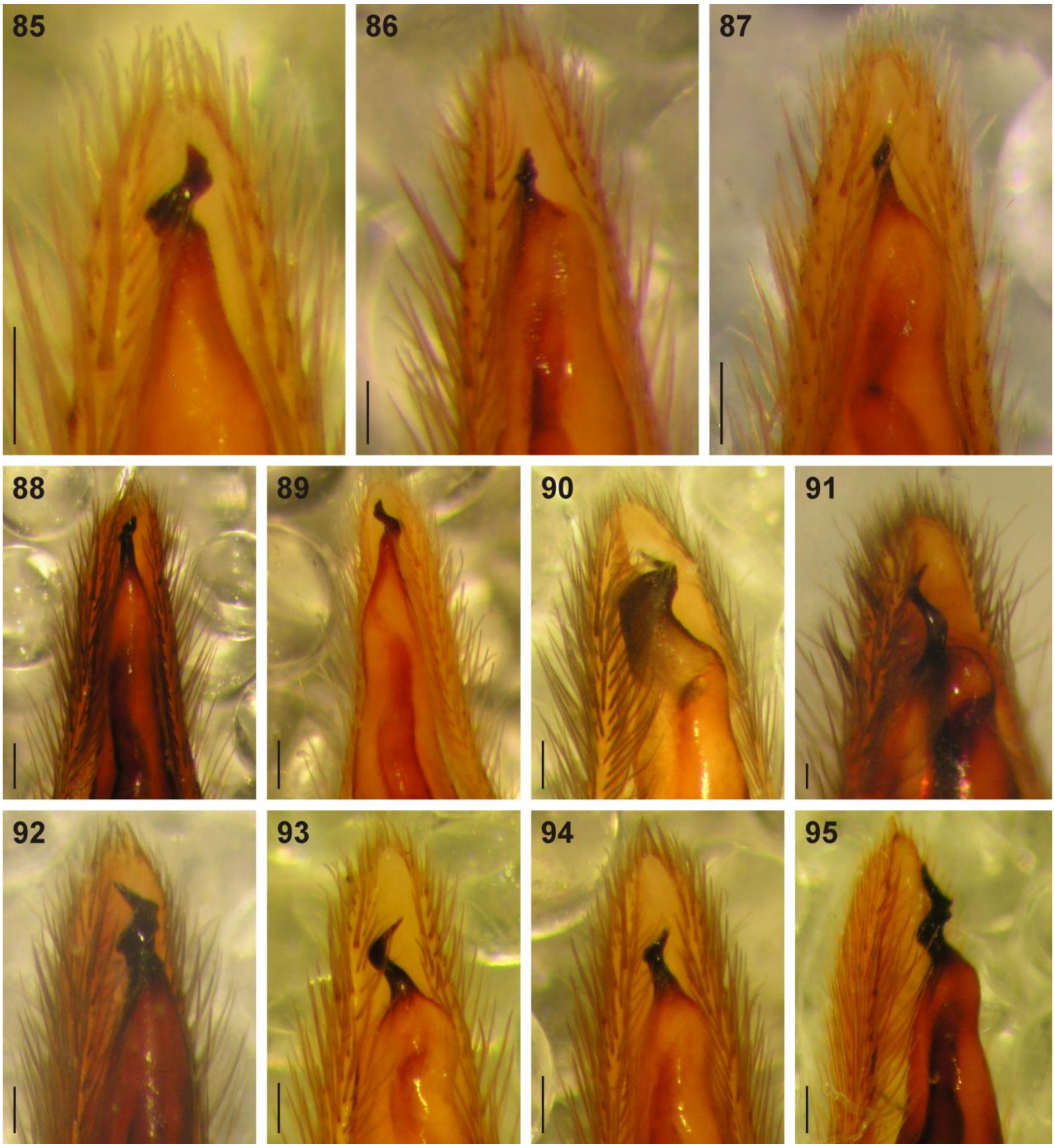
FIGURES 72–77. Scanning electron microscope photographs of *Copuetta magna* **sp. nov.** male (72–74) and *C. maputa* **sp. nov.** female (75–77) spinneret morphology. 72, 75. anterior lateral spinneret; 73, 76. posterior median spinneret; 74, 77. posterior lateral spinneret. Abbreviations: Ac–aciniform 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; ta–tartipore.

small and narrow with compressed coil (Figs 78, 79, 82, 85–89, 92, 94, 95), sometimes with broad base and short curved distal section (Figs 80, 90) or with narrow base and long fine coil

(Figs 81, 91, 93). Female epigyne with strongly sclerotized epigynal ridges, varying in shape, with simple copulatory openings, regularly plugged (Figs 83, 84); copulatory ducts short and broad or absent, copulatory openings entering directly into ST II; ST II usually oval, sometimes with multiple lobes, connected broadly to somewhat elongated posterior ST I; both ST often with multiple folds.



FIGURES 78–84. Scanning electron microscope photographs of *Copuetta* **gen. nov.** genitalia: 78–82. male palpal emboli of *C. erecta* **sp. nov.** (78), *C. lacustris* (Strand, 1916) (79), *C. lotzi* **sp. nov.** (80), *C. magna* **sp. nov.** (81) and *C. maputa* **sp. nov.** (82); 83, 84. female epigynes of *C. lacustris* (83) and *C. maputa* **sp. nov.** (84).



FIGURES 85–95. Digital microscope photographs of male emboli of *Copuetta* **gen. nov.** species in ventral view: 85. *C. comorica* **sp. nov.**; 86. *C. erecta* **sp. nov.**; 87. *C. kwamgumi* **sp. nov.**; 88. *C. lacustris* (Strand, 1916); 89. *C. lesnei* **sp. nov.**; 90. *C. lotzi* **sp. nov.**; 91. *C. magna* **sp. nov.**; 92. *C. maputa* **sp. nov.**; 93. *C. naja* **sp. nov.**; 94. *C. uzungwa* **sp. nov.**; 95. *C. wagneri* **sp. nov.**. Scale bars = 0.1mm.

Key to the species of the genus *Copuetta* gen. nov.

1 Males (♂ of *C. kakamega* **sp. nov.** and *C. litipo* **sp. nov.** unknown)................................2

– Females (♀ of *C. lesnei* **sp. nov.**, *C. naja* **sp. nov.**, *C. uzungwa* **sp. nov.** and *C. wagneri* **sp. nov.** unknown)...12

2 Embolus with very broad base and nearly transverse fine curved distal section, tip slightly curved and directed prolaterally (Fig. 90)....................................*C. lotzi* **sp. nov.**

– Embolus with a narrow base, forming at least one complete coil......................................3

3 Embolus forming a distinctly compressed coil with one or more spirals (e.g. Figs 85–89)...4

– Embolus clearly not forming a spiralling compressed coil, somewhat elongate, with retrolaterally directed tip (Figs 91, 93, 94)..10

4 Embolus short, nearly straight, directed at distal end of cymbium, with three complete coils (Figs 78, 86)..*C. erecta* **sp. nov.**

– Embolus variable in length, with general orientation of coils and embolus tip oblique, with one or two complete coils...5

5 Embolus with length of tip approximately equal to the width of the distal coil (Figs 92, 95)..6

– Embolus with length of tip less than half the width of distal coil......................................7

6 Base of embolus on prolateral side slightly narrowed, continuous with tegulum; embolus tip directed 45° prolaterally (Fig. 92)..*C. maputa* **sp. nov.**

– Base of embolus on prolateral side strongly narrowed, appearing notched; embolus tip directed to distal end of cymbium (Fig. 95)..*C. wagneri* **sp. nov.**

7 Tibiae III with a single ventral terminal spine...8

– Tibiae III without a ventral terminal spine..9

8 Embolus with sharp triangular tip directed at distal end of cymbium (Fig. 89); palpal tegulum with distinct concavity along retrolateral margin, just beyond midpoint between base and tip (Fig. 114); femora IV with single retrolateral spines on dorsal surface..*C. lesnei* **sp. nov.**

– Embolus with blunt tip directed retrolaterally distally (Figs 79, 88); palpal tegulum without distinct concavity, straight along retrolateral margin beyond midpoint (Fig. 110); femora IV with two retrolateral spines on dorsal surface...........*C. lacustris* (Strand, 1916)

9 Palpal tegulum tapering gradually to distal embolus; embolus with short, relatively broad base, two compressed coils and triangular tip directed distally (Fig. 85) (Comoros)..*C. comorica* **sp. nov.**

– Palpal tegulum with slight bump retrolaterally near embolus base; embolus base narrow and stalk-like; embolus tiny, with single compressed coil, tip directed retrolaterally distally (Tanzania) (Fig. 87)...*C. kwamgumi* **sp. nov.**

10 Embolus long, base directed at distal end of cymbium, narrowly coiled around longitudinal axis with gentle prolateral bend (Figs 81, 91); tibiae I without pair of prolateral spines on their dorsal surface..*C. magna* **sp. nov.**

– Embolus short, base directed prolaterally distally, with sharp retrolateral bend (Figs 93, 94); tibiae I with pair of prolateral spines on their dorsal surface....................................11

11 Metatarsi II with single retrolateral spine on their dorsal surface; embolus with narrow base, broadening distally, with very short distally directed retrolateral tip (Figs 94, 133)..*C. uzungwa* **sp. nov.**

– Metatarsi II without retrolateral spine on their dorsal surface; embolus with narrow base, tapering distally, with fine tip directed retrolaterally (Figs 93, 131)..........*C. naja* **sp. nov.**

12 Epigyne with large peripheral subtriangular ridge, small spermathecae and oblique median copulatory openings (Fig. 125)..*C. magna* **sp. nov.**

– Epigyne lacking large peripheral ridge surrounding entire epigyne; spermathecae large; copulatory openings small and round...13

13 Epigyne with distinct large ridges forming depression including copulatory openings...14

– Epigyne without distinct ridges and depression; copulatory openings small, sometimes surrounded by sclerotised rim...18

14 Entire epigynal ridge situated within the margin of the spermathecae (Figs 104, 112)...15

– Part of epigynal ridges extending beyond margins of spermathecae (Figs 98, 129), otherwise epigynal ridges posteriorly situated and not passing over spermathecae (Fig. 102)...16

15 Epigynal ridges large and round; ST II large and round; ST I with many folds (Fig. 104)...*C. kakamega* **sp. nov.**

– Epigynal ridges comma-shaped; ST II oval, obliquely orientated; ST I without folds (Fig. 112)..*C. lacustris* (Strand, 1916)

16 Epigyne with weakly sclerotised semi-circular ridges, curving laterally and posteriorly, not passing over spermathecae; copulatory openings within small coiled ridges (Fig. 102)...*C. erecta* **sp. nov.**

– Epigyne with strongly sclerotised semi-circular ridges, curving over posterior half of ST II; copulatory openings round, just behind anterior margin of epigynal ridges (Figs 98, 129)...17

17 Epigyne with semicircular ridges, meeting medially; ST I and ST II equal in size and width (Fig. 98)...*C. comorica* **sp. nov.**

– Epigyne with oval ridges, lateral and anterior margins at nearly right angle; ST II much larger and broader than ST I (Figs 84, 129)..*C. maputa* **sp. nov.**

18 Epigyne with strongly recurved copulatory openings directed anteriorly; ST II clearly broader than ST I (Fig. 121) (South Africa)..*C. lotzi* **sp. nov.**

– Epigyne with round or oval copulatory openings situated within sclerotised rim; ST I and ST II equal in width (Figs 108, 116) (Tanzania)..19

19 Epigyne with large oval sclerotised rim laterally in posterior half of epigyne, enclosing transverse oval copulatory openings (Fig. 116).......................................*C. litipo* **sp. nov.**

– Epigyne with small comma-shaped sclerotised rim laterally at midpoint of epigyne, enclosing round copulatory openings (Fig. 108)..............................*C. kwamgumi* **sp. nov.**

11.6.1 *Copuetta comorica* sp. nov.

Figs 28, 29, 85, 96–99

Etymology: The species name is taken from the Comoros Islands, to which it is endemic.

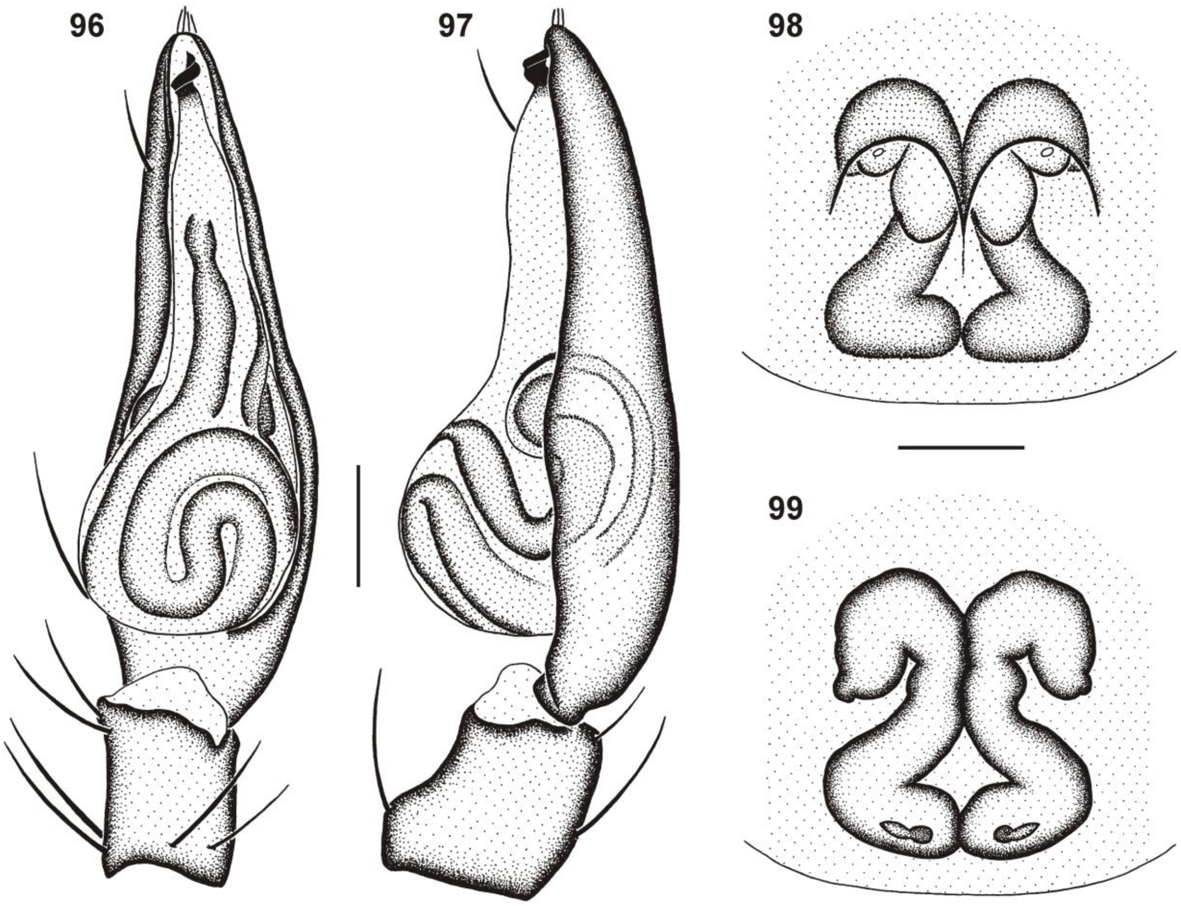
Diagnosis: Males of the species can be recognised from congeners by the relatively large embolus with obliquely oriented coil and the tip directed at the distal end of the cymbium (Fig. 85). Females can be recognised by the semi-circular epigynal ridges (Fig. 98).

Male (holotype, Nioumbadjou, MRAC 158454). Measurements: CL 2.73, CW 2.15, AL 3.00, AW 1.65, TL 5.60 (5.60–5.85), FL 0.30, SL 1.25, SW 1.22, AME–AME 0.05, AME–ALE 0.01, ALE–ALE 0.46, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.52, PERW 0.78, MOQAW 0.48, MOQPW 0.46, MOQL 0.52.

Length of leg segments: I 2.25 + 0.93 + 1.78 + 1.83 + 1.00 = 7.79; II 2.20 + 0.90 + 1.70 + 1.80 + 0.95 = 7.55; III 2.18 + 0.90 + 1.60 + 1.95 + 0.88 = 7.51; IV 2.75 + 1.03 + 2.13 + 2.92 + 1.03 = 9.86.

General appearance as in Fig. 28. Carapace creamy-orange, eye region grey; paired brown mediolateral markings with black mottling from palpal coxae to posterior slope, separated by broad pale median line from PER to posterior of carapace; small mottled black line in front of fovea; pale striae radiating from fovea, directed between coxae; lateral margins with narrow mottled black fringe, expanded between leg coxae; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance slightly larger than $^1/_5$ their diameter; AME separated from ALE by distance less than $^1/_{10}$ AME diameter; clypeus height slightly less than AME diameter; PER procurved, medians very slightly larger than laterals; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.76:1. Chelicerae yellow-brown with faint black mottling, with finely plumose curved setae on promargin; promargin with two teeth separated by basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by slightly less than their basal width, distal tooth slightly larger, close to fang base. Endites pale creamy-yellow, white prolaterally and distally; labium pale orange-brown, cream distally; sternum pale creamy-yellow, darker around margins. Legs cream, posteriors slightly darker, with faint black mottling and black spots at spine bases; surface densely covered in black plumose setae, with yellowish plumose setae between markings and mottling; tibiae I–IV with faint proximal and distal bands; metatarsi III and IV with faint proximal, median and distal bands. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: all with short fine proximal seta and longer thicker distal seta dorsally; tibiae: I plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: plv 2-3 rlv 1. Abdomen with yellowish anterior dorsal scutum extending slightly more than half abdomen length; dorsum cream with mottled black marking around scutum, extending along sides of dorsum to spinnerets; marking covered in brown plumose setae, white and yellow plumose and short straight setae between them; spinnerets surrounded by narrow black ring; venter cream, covered in short straight black setae, with scattered plumose setae; epigastric scutum creamy-yellow; ventral sclerite very weakly sclerotised, pale creamy-yellow; inframamillary sclerite yellow, distinct. Male palp creamy-yellow, cymbium yellow; tegulum pear-shaped, orange, with orange-brown ducts; embolus with narrow base, obliquely oriented coil and tip directed at the distal end of the cymbium (Figs 85, 96, 97).

Female (paratype, Miringoni, MRAC 161162). Measurements: CL 3.55, CW 2.30, AL 3.23, AW 2.35, TL 6.25 (6.25–7.25), FL 0.27, SL 1.38, SW 1.36, AME–AME 0.06, AME–ALE 0.02, ALE–ALE 0.50, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.57, PERW 0.86, MOQAW 0.49, MOQPW 0.48, MOQL 0.56.



FIGURES 96–99. Genitalic morphology of *Copuetta comorica* **sp. nov.**: 96. male palp, ventral view; 97. same, retrolateral view; 98. female epigyne, ventral view; 99. same, dorsal view. Scale bars = 0.25mm.

Length of leg segments: I 2.40 + 1.10 + 1.95 + 1.92 + 1.10 = 8.47; II 2.35 + 1.05 + 1.82 + 1.87 + 0.93 = 8.02; III 2.25 + 1.04 + 1.67 + 2.08 + 0.92 = 7.96; IV 2.66 + 1.14 + 2.25 + 3.00 + 1.05 = 10.10.

General appearance as in Fig. 29, female more robustly built than male. Carapace creamy-yellow, markings and setae as for male. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance equal to ¼ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height equal to $^{4}/_{5}$ AME diameter; PER procurved, medians very slightly smaller than laterals; PME separated by distance slightly less than ⅔ their diameter; PME separated from PLE by distance equal to ⅓ PME diameter; CW:PERW = 2.67:1. Chelicerae yellow-brown with black mottling, with pectinate curved setae on promargin; dentition as for male. Endites pale yellow-brown, cream prolaterally; labium pale yellow-brown, cream distally; sternum creamy-yellow, darker around margins. Legs creamy-yellow, with faint black mottling and black spots at spine bases; surface densely covered in black plumose setae, with yellowish plumose setae between markings and mottling; femora I–IV with distal band of black plumose setae; patellae with proximal and distal black bands; tibiae I–IV with ventral incomplete proximal band and broad median band; metatarsi I and II with faint proximal and distal bands, III and IV with faint proximal, median and distal bands. Leg spination: femora: I pl 2 do 3 rl 2, II pl 2 do 3 rl 2, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: all with do 1 distal seta; tibiae: I plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1 spines, vt 3 setae; tarsi: pl 1 plv 1-3 rlv 1. Abdomen with creamy-yellow dorsal scutum extending slightly more than ⅛ abdomen length; dorsum cream with yellow-brown lateral markings extending to spinnerets, pale along midline except for small brown spot at midpoint; markings covered in dense yellow-brown plumose setae, white and yellow plumose and short straight setae between them; spinnerets surrounded by narrow black ring; venter cream, covered in short straight black setae, with scattered plumose setae; epigastric scutum weakly sclerotised, pale creamy-yellow; inframamillary sclerite tinged with yellow, distinct. Epigyne with semi-circular anterior ridges, meeting medially, with copulatory openings along anterior margin, entering directly into anterior ST II (Fig. 98); ST II oval with lateral “nipple”, with broad duct on their mesal margin connecting ST II to posterior ST I; ST I C-shaped with sharp lateral bent; ST I as broad as ST II (Fig. 99).

Type material: Holotype ♂: **COMOROS:** *Grande Comore*: Nioumbadjou, 11°46'S, 43°18'E, leg. R. Jocqué, 20.VIII.1981 (MRAC 158454).
Paratypes: **COMOROS:** *Moheli*: Miringoni, 12°17'S, 43°39'E, jardin, leg. R. Jocqué, 6–12.XI.1983 (piége Malaisse), 1♀ (MRAC 161162), 2imm. 1♂ 1♀ (MRAC 160957).

Additional material examined: none.

Distribution: Endemic to the Comoros Islands in the Indian Ocean (Fig. 118).

Biology: Unknown.

11.6.2 *Copuetta erecta* sp. nov.

Figs 7, 8, 30, 31, 78, 86, 100–103

Etymology: The specific name is Latin for upright, and refers to the short erect embolus of the male.

Diagnosis: Males of this species can be easily recognised by the short, straight, finely coiled embolus that is directed at the distal end of the cymbium (Fig. 86). Females can be recognised by the small coiled lateral epigynal ridges and copulatory openings at the midpoint of the epigyne (Fig. 102).

Male (holotype, Tembe, NCA 2007/3607). Measurements: CL 2.45, CW 1.90, AL 2.65, AW 1.48, TL 5.25 (5.25–7.40), FL 0.30, SL 1.12, SW 1.12, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.38, PME–PME 0.10, PME–PLE 0.06, PLE–PLE 0.48, PERW 0.70, MOQAW 0.40, MOQPW 0.41, MOQL 0.47.

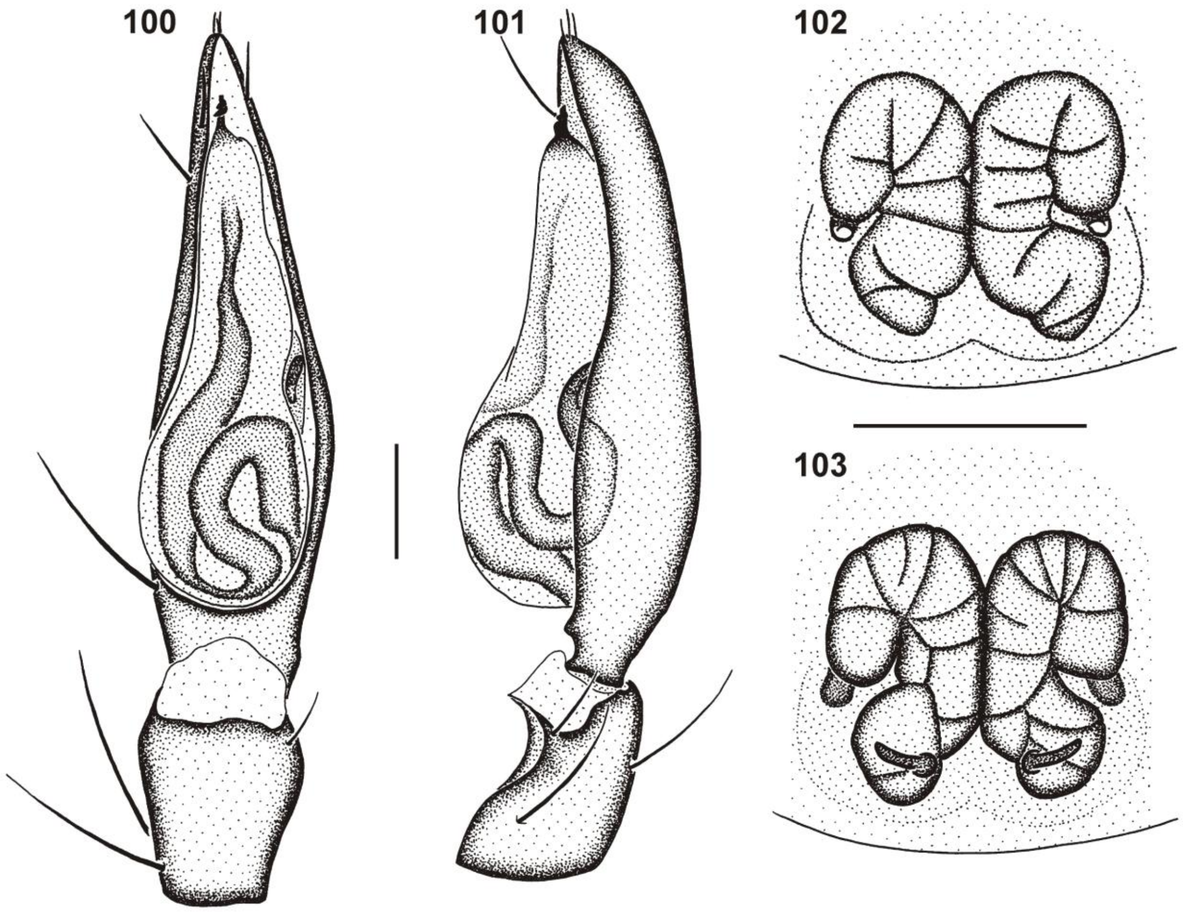
Length of leg segments: I 2.27 + 0.87 + 1.86 + 1.88 + 1.12 = 8.00; II 2.23 + 0.86 + 1.74 + 1.88 + 1.08 = 7.79; III 2.11 + 0.85 + 1.61 + 1.93 + 0.91 = 7.41; IV 2.73 + 0.95 + 2.19 + 2.90 + 1.05 = 9.82.

General appearance as in Figs 7 and 30. Carapace creamy-yellow, eye region grey; paired mediolateral markings with black mottling from palpal coxae to posterior slope, pale along midline from PER to posterior of carapace; faint small mottled black marking in front of fovea; orange striae radiating from fovea, directed between coxae; lateral margins with narrow mottled black fringe, expanded between leg coxae; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance slightly less than ⅓ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height slightly less than $^{5}/_{6}$ AME diameter; PER procurved, laterals very slightly larger than medians; PME separated by distance equal to ⅔ their diameter; PME separated from PLE by distance equal to ⅓ PME diameter; CW:PERW = 2.71:1. Chelicerae yellow, paler prolaterally at distal end, with finely plumose curved setae on promargin; promargin with two teeth separated by basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by slightly less than their basal width, distal tooth slightly smaller, close to fang base. Endites creamy-orange, white prolaterally distally; labium pale orange-brown, paler distally; sternum creamy-yellow, darker around margins. Legs I and II creamy-yellow, III and IV yellow, with faint black spots at spine bases; markings and mottling densely covered in black plumose setae, with yellowish plumose setae between markings and mottling; femora I–IV with faint distal band; patellae I–IV with faint proximal and distal bands; tibiae I–IV with broad median band; metatarsi I and II with faint median and distal bands; metatarsi III and IV with proximal, median and distal bands; tarsi I–IV yellow. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I and II with proximal and distal fine setae dorsally, III and IV with fine proximal seta and distal spine dorsally; tibiae: I pl 2 plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 6 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 2 plv 2 rlv 1. Abdomen with creamy-yellow anterior dorsal scutum extending to ¾ abdomen length, dorsum cream behind scutum; dorsum with broad oval marking around sides of abdomen from posterior margin to spinnerets, brown anteriorly and laterally, black posteriorly, broken up by three narrow white lateral streaks at midpoint; dorsum pale along midline except for small black spot just behind midpoint; markings densely covered in black plumose setae, white plumose setae and brown short straight setae between them; spinnerets surrounded by narrow black ring; venter cream, covered in black plumose setae; epigastric scutum, ventral sclerite and inframamillary sclerite yellow. Male palp creamy-yellow, cymbium yellow; tegulum pear-shaped, yellow-brown, with dark orange-brown ducts; distal end of tegulum broad, embolus with narrow base; embolus short and narrow, straight, finely coiled, directed at the distal end of the cymbium (Figs 78, 86, 100, 101).

Female (paratype, Xai-Xai, NCA 2008/178). Measurements: CL 3.25, CW 2.49, AL 4.13, AW 2.84, TL 7.45 (7.00–7.45), FL 0.27, SL 1.49, SW 1.40, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.48, PME–PME 0.13, PME–PLE 0.07, PLE–PLE 0.59, PERW 0.90, MOQAW 0.50, MOQPW 0.51, MOQL 0.59.

Length of leg segments: I 2.70 + 1.19 + 2.28 + 2.30 + 1.33 = 9.80; II 2.69 + 1.16 + 2.09 + 2.24 + 1.25 = 9.43; III 2.52 + 1.12 + 1.96 + 2.32 + 1.08 = 9.00; IV 3.40 + 1.23 + 2.65 + 3.55 + 1.15 = 11.98.

General appearance as in Figs 8 and 31, female more robustly built than male. Carapace yellow, eye region pale grey, markings and setae as for male, except clypeus black between PLE. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance slightly less than ⅓ their diameter; AME separated from ALE by



FIGURES 100–103. Genitalic morphology of *Copuetta erecta* **sp. nov.**: 100. male palp, ventral view; 101. same, retrolateral view; 102. female epigyne, ventral view; 103. same, dorsal view. Scale bars = 0.25mm.

distance less than $^{1}/_{10}$ AME diameter; clypeus height equal to $^{5}/_{6}$ AME diameter; PER procurved, medians very slightly smaller than laterals; PME separated by distance equal to ⅔ their diameter; PME separated from PLE by distance slightly less than ⅓ PLE diameter; CW:PERW = 2.77:1. Chelicerae orange-brown, yellow prolaterally at distal end, with pair of fine black lines proximally and extensive black mottling on anterior surface of paturon, with pectinate curved setae on promargin; dentition as for male. Endites pale creamy-orange, cream prolaterally distally; labium orange, cream along distal margin; sternum creamy-yellow, yellow-brown around margins. Legs yellow, posteriors slightly darker, markings as for male. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I and II with proximal and distal fine setae dorsally, III and IV with fine proximal seta and distal spine dorsally; tibiae: I pl 2 plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 5-6 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with yellow dorsal scutum extending ⅛ abdomen length; dorsum cream with black oval marking anteriorly, laterally and posteriorly, marking covered in dense black plumose setae; dorsum cream along midline, with white and scattered black plumose setae and scattered black short straight setae; spinnerets surrounded by narrow black ring; venter cream with faint grey median marking between epigastric furrow and spinnerets, covered in black plumose setae; epigastric sclerite pale creamy-orange; inframamillary sclerite orange, distinct. Epigyne with small coiled lateral ridges and copulatory openings at midpoint of epigyne; epigynal ridges weakly sclerotised, large and semi-circular, curving around lateral and posterior margins of epigyne, meeting medially, not passing over spermathecae (Fig. 102); copulatory ducts very short, entering ST II posterolaterally; ST II oval, with broad duct on their mesal margin connecting ST II to posterior ST I; ST I kidney-shaped, somewhat rotated from longitudinal axis; both ST with many folds on their surface (Fig. 103).

Type material: Holotype ♂: **SOUTH AFRICA:** *KwaZulu-Natal Province*: Tembe Elephant Park, Open woodland/sand, near offices, 27°03'S, 32°25'E, leg. C. Haddad, 8.II.2005 (sifting leaf litter) (NCA 2007/3607). Paratypes: **MOZAMBIQUE:** Chidenguele, Paraiso de Chidenguele, 24°57.276'S, 34°11.860'E, 38m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 16.XII.2007 (night collecting, dune forest), 1♂ (NCA 2008/201); Inhaca Island, 26°01'S, 32°54'E, leg. T. Steyn, 27.XI–11.XII.1993 (pitfalls, open parkland), 1♀ (MRAC 215316); Same locality, leg. T. Steyn, 3–24.IX.1994 (pitfalls, wetland), 1♂ (MRAC 215920); Same locality, leg. T. Steyn, 5–19.II.1994 (pitfalls, coastal woodland), 1♂ (MRAC 208944); Xai-Xai, Montego's Camp, 28m a.s.l., 25°03.659'S, 33°40.633'E, leg. C. Haddad, 2.XII.2007 (leaf litter, dune forest), 1♂ 1♀ (NCA 2008/178). **SOUTH AFRICA:** *KwaZulu-Natal Province*: iSimangaliso [Greater St. Lucia] Wetlands Park, Hell’s Gate, 28°00'S, 32°29'E, leg. J. Esterhuizen, 20.X.2003 (tsetse fly trap), 1imm. 1♂ (NCA 2004/816); Same data, 2.XII.2003, 1♂ (NCA 2004/801); Natal, leg. C. Martin, no date given, 2imm. 2♀ (MNHN 19739); Port Shepstone, 30°43'S, 30°27'E, leg. P. Gesse, 1.I.1977 (in garden), 1♂ (NCA 2007/1143); Sodwana Bay, 27°32'S, 32°40'E, leg. P. van Niekerk, VII.1988, 1♂ (NCA 88/844); Ramsgate, Butterfly Sanctuary, 30°53.3'S, 30°20.4'E, leg. M. Mostovski, 1.XI–2.XI.2004 (Malaise trap near stream), 1♂ (NMSA 21455); Umlazi Nature Reserve, 1.5km E of Mtunzini, 28°58'S, 31°48'E, leg. R. Miller, XI.1978 (indigenous forest), 1♂ 1♀ (NMSA 12322).

Additional material examined: SOUTH AFRICA: *KwaZulu-Natal*: iSimangaliso Wetlands Park, False Bay Park, 27°55'S, 32°16'E, leg. J. Esterhuizen, 12.I.2004 (tsetse fly traps), 1♂ (NCA 2004/833); iSimangaliso Wetlands Park, Hell's Gate, Block A, 28°00'S, 32°29'E, leg. J. Esterhuizen, 26.IV.2004 (tsetse fly traps), 1♂ (NCA 2010/252); Same data, 5.III.2004, 2♂ (NCA 2004/834); Same data, 8.IX.2004, 1♂ (NCA 2004/835); Same data, 10.I.2004, 1♂ (NCA 2004/836); Same data, 22.XI.2004, 1♂ (NCA 2004/837); Same locality, Block

B, 29.XI.2004, J. Esterhuizen (tsetse fly traps), 1♂ (NCA 2004/838); Same data, 12.VI.2004, 1♂ 1♀ (NCA 2004/839); Same locality, Block C, 5.III.2004, J. Esterhuizen (tsetse fly traps), 1♂ 1♀ (NCA 2004/840); Same data, 11.I.2004, 1♂ (NCA 2004/841); Ndumo Game Reserve, Pongola River, Water pump, 26°54.309'S, 32°19.444'E, 36m a.s.l., leg. C. Haddad, R. Lyle, V. Butler, 2.VII.2009 (canopy fogging 3, riverine forest, *Breonadia salicina*), 1♂ (MACN); Same data (canopy fogging 5, riverine forest, *Breonadia salicina*), 2♀ (MACN).

Distribution: Found in southern Mozambique, southwards through the KwaZulu-Natal Province of South Africa, to the northern parts of the Eastern Cape Province (Fig. 118).

Biology: This species is largely restricted to closed canopy coastal dune forests and inland riparian forests. Specimens were collected from all habitat strata (tree canopies, shrubs and leaf litter) by a variety of sampling methods.

11.6.3 *Copuetta kakamega* sp. nov.

Figs 32, 104, 105

Etymology: The species name is a noun in apposition of the type locality.

Diagnosis: This species is easily recognised by the large round epigynal ridges with copulatory openings in the anterior half of the depression, entering directly into ST II (Fig. 104).

Female (holotype, Kakamega, MRAC 224266). Measurements: CL 3.78, CW 2.88, AL 4.40, AW 2.60, TL 8.35, FL 0.34, SL 1.63, SW 1.62, AME–AME 0.10, AME–ALE 0.02, ALE–ALE 0.62, PME–PME 0.16, PME–PLE 0.10, PLE–PLE 0.76, PERW 1.07, MOQAW 0.60, MOQPW 0.62, MOQL 0.71.

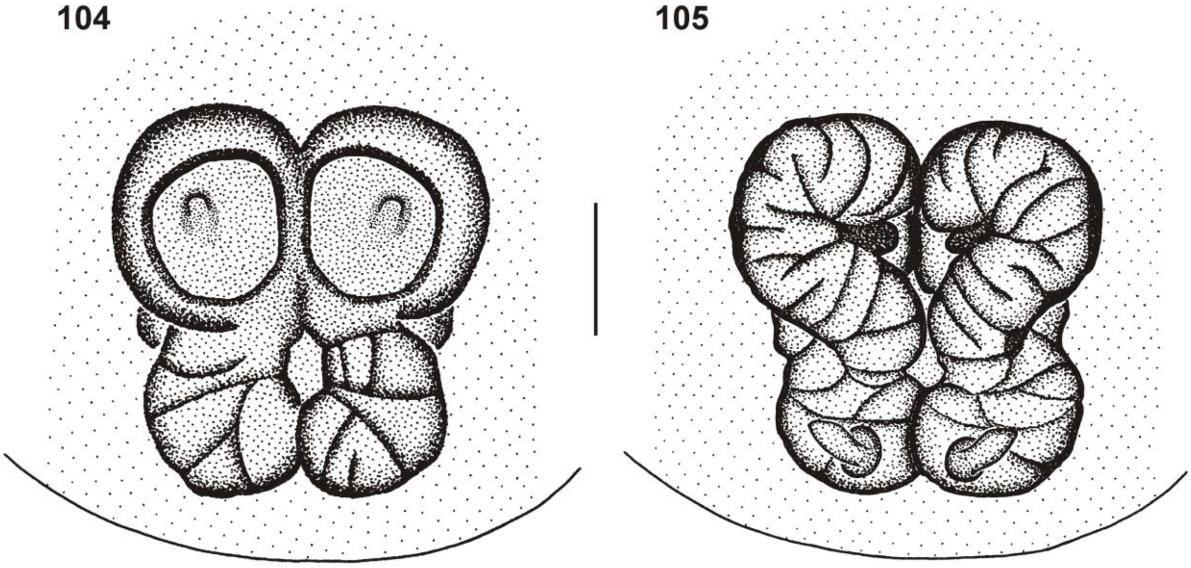
Length of leg segments: I 3.25 + 1.34 + 2.65 + 2.72 + 1.60 = 11.56; II 3.10 + 1.30 + 2.60 + 2.73 + 1.53 = 11.26; III 3.00 + 1.30 + 2.42 + 2.85 + 1.38 = 10.95; IV 3.95 + 1.42 + 3.20 + 4.28 + 1.63 = 14.48.

General appearance as in Fig. 32. Carapace creamy-yellow, eye region pale grey; carapace densely covered in black plumose and short straight setae, forming broad oval marking from PER to posterior slope; pale yellow-brown striae with faint black mottling radiating from fovea, directed between coxae; lateral margins of carapace with three patches of black plumose setae between leg coxae. All eyes with black rings; AER procurved, medians larger than laterals; AME separated by distance slightly less than ⅖ their diameter; AME separated from ALE by distance equal to ⅒ AME diameter; clypeus height slightly less than AME diameter; PER procurved, laterals larger than medians; PME separated by distance equal to ⅔ their diameter; PME separated from PLE by distance slightly larger than ⅖ PME diameter; CW:PERW = 2.69:1. Chelicerae cream, darker laterally, with pectinate curved setae on promargin; promargin with two teeth separated by ½ the basal width of proximal tooth, distal tooth largest; retromargin with two subequal teeth separated by their basal width, distal tooth close to fang base. Endites pale yellow, cream prolaterally distally; labium yellow, cream distally; sternum creamy-yellow, yellow around margins. Legs pale yellow-brown, all femora and patellae and tibiae I–III creamy-white ventrally; all segments except tarsi densely covered in black plumose and short straight setae, faint black mottling laterally and black spots at spine bases; tarsi yellow. Leg spination: femora: I pl 3 do 3 rl 1, II pl 3 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 8; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen creamy-yellow dorsal scutum extending ⅒ abdomen length; dorsum cream, densely covered in black plumose and short straight setae forming mottled pattern, with cream chevrons along midline to ¾ abdomen length; spinnerets surrounded by black ring dorsally and laterally, absent ventrally; venter cream, densely covered in black plumose setae, with many long erect straight setae; epigastric scutum weakly sclerotised, cream; inframamillary sclerite orange. Epigyne with large round ridges in the anterior half, copulatory openings situated in anterior half of depressions, entering directly into ST II (Fig. 104); ST II somewhat comma-shaped, connected broadly to posterior kidney-shaped ST I; ST I slightly narrower than ST II; both ST with many folds on their surface (Fig. 105).

Male: unknown.

Type material: Holotype ♀: **KENYA:** Kakamega Forest, 00°13'N, 34°54'E, leg. D. Shilabira-Smith, 13.IV.2000 (Malaise traps) (MRAC 224226).

Additional material examined: none.



FIGURES 104–105. Genitalic morphology of *Copuetta kakamega* **sp. nov.**: 104. female epigyne, ventral view; 105. same, dorsal view. Scale bars = 0.25mm.

Distribution: Known only from the type locality (Fig. 118).

Biology: Collected in Malaise traps and presumably occupying lower vegetative strata in forest habitats.

11.6.4 *Copuetta kwamgumi* sp. nov.

Figs 33, 34, 87, 106–109

Etymology: The species name is a noun in apposition of the type locality.

Diagnosis: Males can be recognised by the tiny embolus with tip directed distally, which is the smallest in the genus (Fig. 87), and females by the lateral comma-shaped epigynal ridges that surround the copulatory openings (Fig. 108).

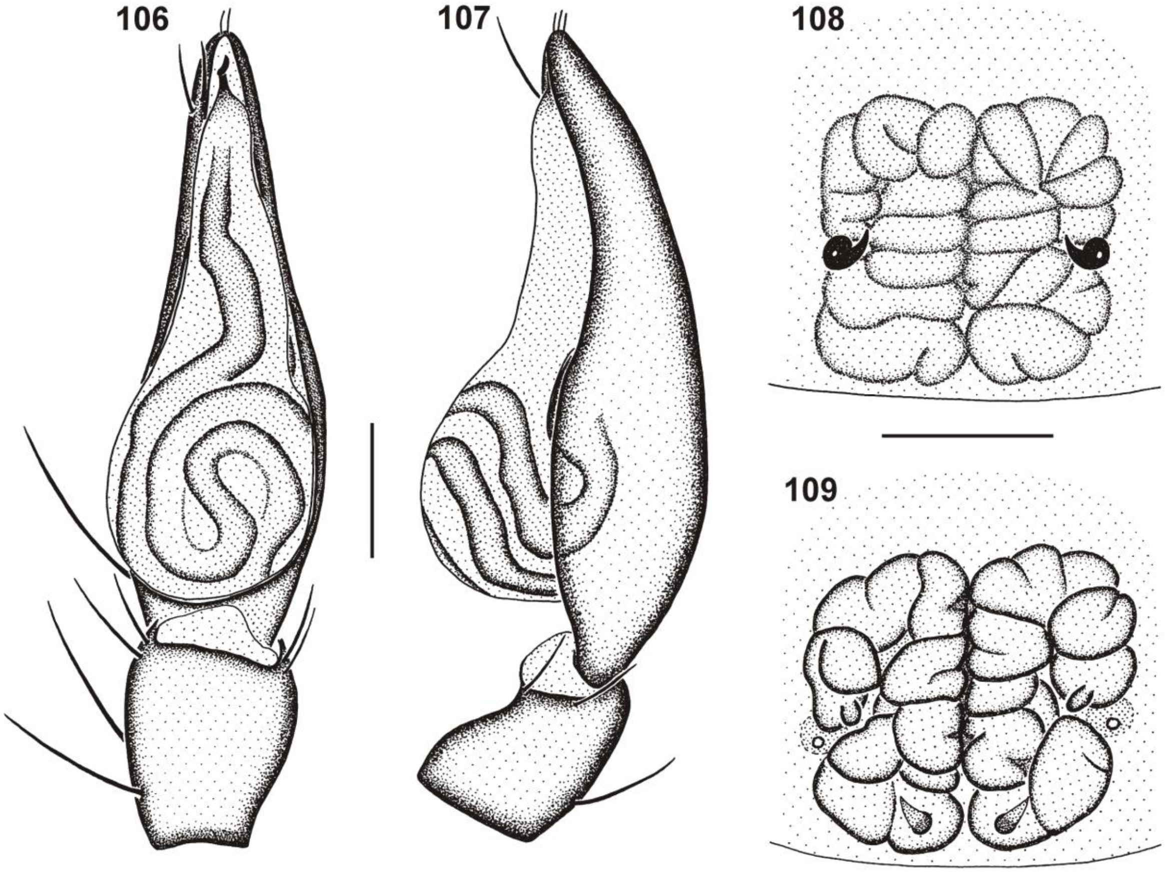
Male (holotype, Kwamgumi, ZMUC). Measurements: CL 2.48, CW 2.00, AL 2.80, AW 1.70, TL 5.32 (5.00–5.65), FL 0.19, SL 1.11, SW 1.16, AME–AME 0.03, AME–ALE 0.01, ALE–ALE 0.44, PME–PME 0.11, PME–PLE 0.05, PLE–PLE 0.51, PERW 0.79, MOQAW 0.44, MOQPW 0.44, MOQL 0.51.

Length of leg segments: I 2.23 + 0.88 + 1.88 + 1.95 + 1.10 = 8.04; II 2.15 + 0.85 + 1.78 + 1.92 + 1.07 = 7.77; III 2.08 + 0.80 + 1.60 + 1.95 + 0.90 = 7.33; IV 2.58 + 0.85 + 2.15 + 2.84 + 1.00 = 9.42.

General appearance as in Fig. 33. Carapace yellow-orange, eye region dark grey; paired mottled black mediolateral markings from palpal coxae to posterior slope, separated by broad pale median line from PER to posterior of carapace; small mottled black marking in front of fovea; orange-brown striae with faint black mottling radiating from fovea, directed between coxae; lateral margins with black fringe, expanded between leg coxae; clypeus mottled black between ALE; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ⅖ their diameter; AME separated from ALE by distance less than ⅕ AME diameter; clypeus height slightly larger than ⅘ AME diameter; PER procurved, laterals larger than medians; PME separated by distance equal to ⅔ their diameter; PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.53:1. Chelicerae yellow-brown with black mottling, yellow distally, with finely plumose curved setae on promargin; promargin with two teeth separated by basal width of proximal tooth, distal tooth largest; retromargin with two subequal teeth separated by ½ their basal width, distal tooth close to fang base. Endites yellow, cream prolaterally distally; labium yellow-brown, cream distally; sternum bright yellow, darker around margins. Legs bright yellow, markings densely covered in black plumose setae, with yellowish plumose setae between them; femora I–IV with broad brown band in distal half; patellae without markings; tibiae and metatarsi I and II without markings, III and IV with faint brown broad median band; tarsi without markings. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 2, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I and II with fine proximal and distal do setae, III and IV with fine proximal seta and distal spine dorsally; tibiae: I pl 2 plv 2-3 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I plv 2 rlv 2, II pl 0-1 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with yellow anterior dorsal scutum extending to ⅘ abdomen length; dorsum with oval marking anteriorly, laterally and posteriorly, comprising black, yellow-brown and white plumose setae, with small faint black spot anteriorly; dorsum pale along midline, covered in white plumose setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream, pale grey between ventral sclerite and spinnerets; epigastric scutum, ventral sclerite and inframamillary sclerite yellow. Male palp yellow, cymbium yellow-brown; tegulum pear-shaped, orange, with orange-brown ducts; embolus tiny, with narrow stalk-like base and single coil, distal end slightly curved, directed at distal end of cymbium (Figs 87, 106, 107).

Female (paratype, Kwamgumi, ZMUC). Measurements: CL 3.27, CW 2.48, AL 3.88, AW 2.59, TL 6.75 (5.70–7.05), FL 0.28, SL 1.39, SW 1.40, AME–AME 0.07, AME–ALE 0.01, ALE–ALE 0.52, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.61, PERW 0.94, MOQAW 0.55, MOQPW 0.54, MOQL 0.60.

Length of leg segments: I 2.78 + 1.13 + 2.35 + 2.45 + 1.40 = 10.11; II 2.62 + 1.10 + 2.20 + 2.40 + 1.33 = 9.65; III 2.53 + 1.05 + 1.98 + 2.40 + 1.08 = 9.04; IV 3.20 + 1.13 + 2.69 + 3.56 + 1.15 = 11.73.



FIGURES 106–109. Genitalic morphology of *Copuetta kwamgumi* **sp. nov.**: 106. male palp, ventral view; 107. same, retrolateral view; 108. female epigyne, ventral view; 109. same, dorsal view. Scale bars = 0.25mm.

General appearance as in Fig. 34, female more robustly built than male. Carapace deep yellow-brown, markings and setae as for male but darker and with more distinct black mottling. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly more than ¼ their diameter; AME separated from ALE by distance less than ⅒ AME diameter; clypeus height slightly more than ⅘ AME diameter; PER procurved, laterals very slightly larger than medians; PME separated by distance slightly less than ⅔ their diameter; PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.64:1. Chelicerae brown with black mottling, yellow prolaterally distally, with pectinate curved setae on promargin; promargin with two teeth separated by ½ the basal width of proximal tooth, distal tooth largest; retromargin with two teeth separated by ½ the basal width of proximal tooth, distal tooth slightly smaller than proximal tooth, close to fang base. Endites yellow-orange, cream distally; labium yellow-brown, cream distally; sternum yellow-brown, orange-brown along margins. Legs densely covered in black plumose setae on markings, with yellowish plumose setae between them; femora I–IV yellow with orange-brown band in distal half, marking covered in faint black mottling; patellae I–IV yellow-brown with faint black mottling laterally and ventrally, with faint median band dorsally; tibiae I–IV yellow with broad median band, absent proximally and distally, faint on tibiae I and II, darker brown on III and IV; metatarsi I–IV yellow-orange, posteriors slightly darker; tarsi I–IV yellow-orange. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I and II with fine proximal and distal do setae, III and IV with fine proximal seta and distal spine dorsally; tibiae: I pl 2 plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with yellow-orange dorsal scutum extending to ⅘ abdomen length; dorsum mottled grey with cream chevrons along midline, sides with three white stripes at midpoint; mottling densely covered in yellow-brown and scattered white plumose setae, chevrons covered in white plumose and short straight setae; venter cream, pale mottled grey in front of spinnerets; spinnerets with narrow black ring dorsally and laterally, absent ventrally; epigastric scutum and inframamillary sclerite yellow. Epigyne with small lateral comma-shaped ridges at midpoint of epigyne with copulatory openings situated in middle of ridges, apparently entering directly into ST II posterolaterally (Fig. 108); ST II n-shaped with anterior bend, connected broadly to posterior kidney-shaped ST I; ST I slightly narrower than ST II; both ST with many folds on their surface (Fig. 109).

Type material: Holotype ♂: **TANZANIA:** Tanga Region: Muheza district, Kwamgumi Forest Reserve, 04°57'S, 38°44'E, leg. S. McKamey *et al.*, 26.VII.1995 (fog 12) (ZMUC).

Paratypes: **TANZANIA:** Tanga Region: Muheza district, Kwamgumi Forest Reserve, 04°57'S, 38°44'E, leg. S. McKamey *et al.*, 20.VII.1995 (fog 8), 2♂ 4♀ (ZMUC); Same data, 22.VII.1995 (fog 9), 1♂ 1♀ (ZMUC); Same data, 25.VII.1995 (fog 11), 1♂ 1♀ (ZMUC); Same data, 26.VII.1995 (fog 12), 1♀ (ZMUC).

Additional material examined: none.

Distribution: Known only from the type locality (Fig. 118).

Biology: All of the specimens were collected by canopy fogging in forest.

11.6.5 *Copuetta lacustris* (Strand, 1916)

Figs 9, 35, 36, 48–52, 54–65, 66–71, 79, 83, 88, 110–113

Copa lacustris Strand, 1916: 94 (♀ Holotype: **D.R. CONGO:** Lake Albert, Kassenge [Kasenye, 01°23'N, 30°26'E], Expedition Adolf Friedrichs, Herzogs & Mecklenberg. III.1908, ZMB 28200 – examined) **comb. nov.**

Castianeira kibonotensis Lessert, 1921: 426, figs 62–65 (♂ Holotype: **TANZANIA:** *Kilimanjaro Region*: Kibonoto [Kibongoto, 03°11'S, 37°06'E], zone cultura, III, left and right palps only, MNHG – examined) **syn. nov.**

Diagnosis: Males can be recognised by the small embolus with two narrow compressed coils and a blunt tip (Figs 79, 83), and females by the large comma-shaped epigynal ridges with the copulatory openings situated laterally in the depression and entering directly into ST II (Fig. 112).

Remarks: The types of *Castianeira kibonotensis* Lessert, 1921 requested from the MNHG comprised only of the two palps of the type specimen, as well as a male specimen from Vila Pery (Mozambique) and a male palp from Faradje (D.R. Congo). The specimen from which the latter palp originates was presumably deposited in the American Museum of Natural History as the label stated “American Museum Congo Expedition” but it could not be traced in that collection. Unfortunately, the female described by Lessert (1921) could not be traced. The male from Vila Pery was misidentified by Lessert (1921) as *C. kibonotensis*, and is a new species, described below as *C. lesnei* **sp. nov.**.

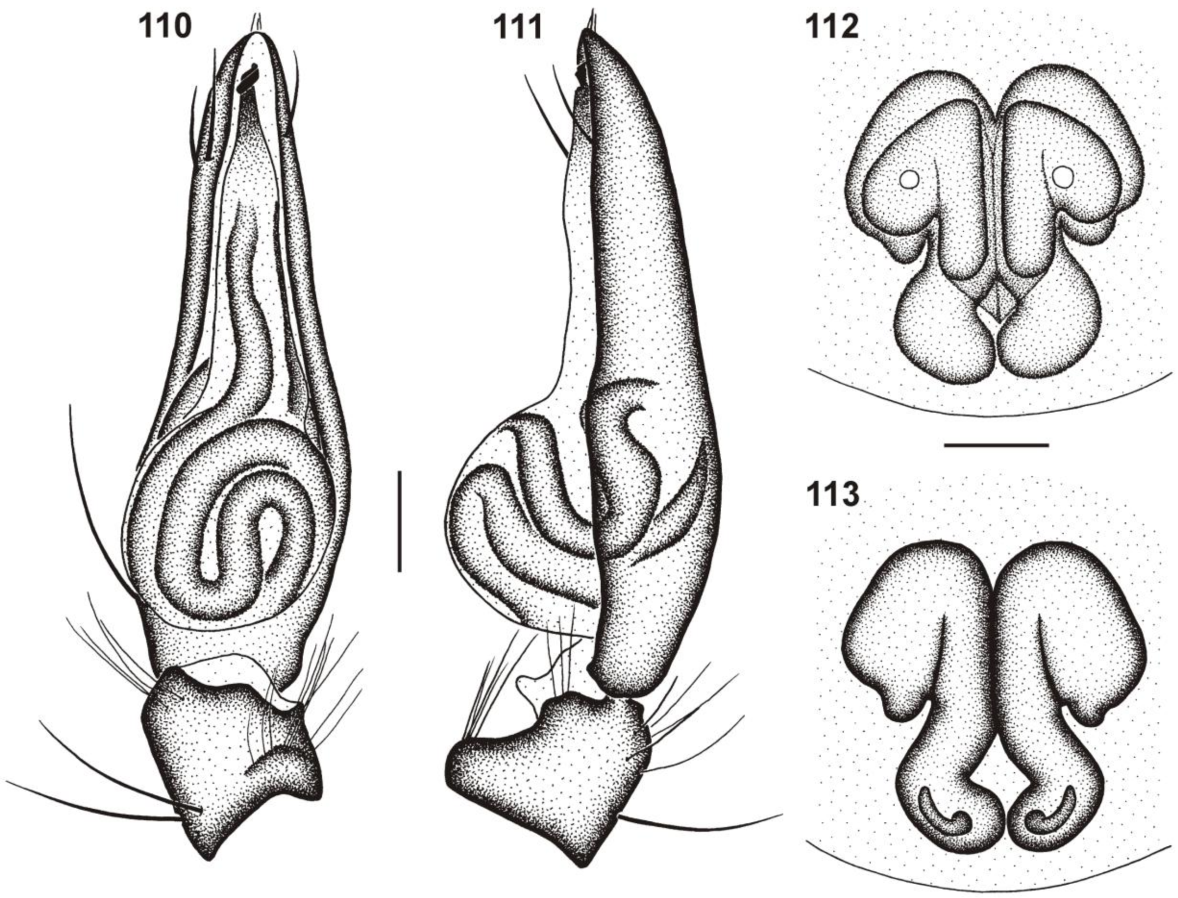
The whereabouts of the male holotype specimen are unknown, but the palps that are available, as well as Lessert's (1921) illustrations of the male and female genitalia, provide adequate detail to indicate that this is the male of the widespread *Copa lacustris* Strand, 1916, which is transferred to *Copuetta* here as *Copuetta lacustris* (Strand, 1916) **comb. nov.**. These two corresponding sexes have been collected together at many localities in southern and eastern Africa. As a result, *Castianeira kibonotensis* **syn. nov.** is proposed as a junior synonym of *Copuetta lacustris*. The male palp from Faradje is confirmed as conspecific to *C. lacustris*.

Male (Hopefield, NCA 2002/493). Measurements: CL 3.98, CW 3.03, AL 4.23, AW 2.60, TL 8.10 (6.10–10.60), FL 0.43, SL 1.72, SW 1.67, AME–AME 0.07, AME–ALE 0.01, ALE–ALE 0.60, PME–PME 0.20, PME–PLE 0.10, PLE–PLE 0.70, PERW 1.03, MOQAW 0.62, MOQPW 0.59, MOQL 0.68.

Length of leg segments: I 3.08 + 1.45 + 2.45 + 2.50 + 1.45 = 10.93; II 3.10 + 1.40 + 2.38 + 2.58+ 1.35 = 10.81; III 3.05 + 1.32 + 2.30 + 2.85 + 1.25 = 10.77; IV 3.55 + 1.43 + 2.90 + 4.00 + 1.40 = 13.28.

General appearance as in Fig. 35. Carapace bright yellow-orange, eye region mottled black; paired mottled black mediolateral markings from palpal coxae to posterior slope; faint black mottling between mediolateral markings from PER to midpoint; pale along midline from midpoint to posterior of carapace, with small mottled black marking in front of fovea; striae distinct, radiating from fovea, directed between coxae, covered in dense black mottling within mediolateral markings; lateral margins with black fringe, forming large black spot between leg coxae; clypeus black between ALE; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance equal to ¼ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height slightly more than $^{4}/_{5}$ AME diameter; PER procurved, laterals slightly larger than medians; PME separated by distance equal to their diameter; PME separated from PLE by distance equal to ½ PME diameter; CW:PERW = 2.94:1. Chelicerae dark orange-brown with black mottling on anterior surface, with pectinate curved setae on promargin; promargin with two teeth separated by ½ the basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by ½ their basal width, distal tooth slightly smaller than proximal tooth, close to fang base. Endites deep yellow-brown with faint black mottling, cream prolaterally distally; labium orange-brown with faint black mottling, creamy-yellow distally; sternum yellow, darker around borders, edge brown. Legs yellow-brown with faint black mottling and black spots at spine bases; markings densely covered in black plumose setae, with yellowish plumose setae between them; femora I–IV with mottled black distal band, ventrally with many small black spots at bases of erect setae; patellae I–IV with black mottling laterally and ventrally, dorsal distal end fringed with black; tibiae I and II with faint mottled black proximal and distal bands, III and IV with broad median orange-brown bands with black mottling; metatarsi I–IV orange-brown, paler at proximal and distal ends, with black mottling dorsally; tarsi yellow. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with bright orange anterior dorsal scutum extending just past ½ abdomen length, cream medially behind scutum; dorsum with oval marking anteriorly, laterally and posteriorly, comprising black plumose and short straight setae; dorsum pale along midline, covered in white plumose setae and scattered short straight setae, with faint mottled black markings; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream, mottled grey in front of spinnerets, densely covered in white plumose setae; epigastric scutum yellow; ventral sclerite absent, paired median row of tiny yellow sclerites between epigastric furrow and spinnerets; inframamillary sclerite yellow-orange. Male palp with yellow femora, yellow-brown patellae and tibiae and orange-brown cymbium; tegulum pear-shaped, dark orange, with dark red-brown ducts; embolus small with narrow base, two narrow compressed coils and a blunt tip (Figs 79, 88, 110, 111).

Female (Erfenis Dam, NCA 2008/553). Measurements: CL 4.30, CW 3.28, AL 5.20, AW 3.65, TL 9.65 (6.95–10.40), FL 0.43, SL 1.97, SW 1.79, AME–AME 0.10, AME–ALE 0.01, ALE–ALE 0.66, PME–PME 0.17, PME–PLE 0.08, PLE–PLE 0.67, PERW 1.07, MOQAW 0.64, MOQPW 0.61, MOQL 0.68.



FIGURES 110–113. Genitalic morphology of *Copuetta lacustris* (Strand, 1916): 110. male palp, ventral view; 111. same, retrolateral view; 112. female epigyne, ventral view; 113. same, dorsal view. Scale bars = 0.25mm.

Length of leg segments: I 3.20 + 1.54 + 2.50 + 2.72 + 1.50 = 11.46; II 3.17 + 1.50 + 2.42 + 2.65 + 1.45 = 11.19; III 2.90 + 1.45 + 2.43 + 2.90 + 1.30 = 10.98; IV 3.58 + 1.60 + 3.17 + 4.15 + 1.50 = 14.00.

General appearance as in Figs 9 and 36, female more robustly built than male. Carapace bright yellow medially, creamy-yellow laterally, markings and setae as for male. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance slightly less than $^{2}/_{5}$ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height slightly larger than $^{4}/_{5}$ AME diameter; PER strongly procurved, laterals very slightly larger than medians; PME separated by distance slightly less than $^{4}/_{5}$ their diameter; PME separated from PLE by distance slightly larger than ⅓ PME diameter; CW:PERW = 3.07:1. Chelicerae brown, yellow prolaterally distally, with pectinate curved setae on promargin; promargin with two teeth separated by the basal width of proximal tooth, distal tooth much larger; retromargin with two subequal teeth separated by ¼ their basal width, distal tooth close to fang base. Endites yellow-brown with faint black mottling, white prolaterally distally; labium yellow-brown with faint black mottling, white distally; sternum creamy-yellow, yellow-brown around borders. Legs with colour, markings and setae as for male. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with creamy-yellow dorsal scutum slightly less than ⅕ abdomen length; markings and setae as for male but mottling less dense; venter cream, densely covered in white plumose setae; epigastric scutum and inframamillary sclerite yellow-orange; ventral sclerite absent, paired row of indistinct sclerites medially between epigastric furrow and spinnerets. Epigyne with large comma-shaped ridges anteriorly, with copulatory openings situated laterally in depressions, entering directly into ST II (Figs 83, 112); ST II large, elongate oval and oblique, with posterior "nipple" and sharp anterior bend, broadly connected to kidney-shaped posterior ST I; ST I much narrower than ST II (Fig. 113).

Additional material examined: BOTSWANA: Okavango Delta, Near Shakawe, Lesideng Research Camp, 18°25.822'S, 21°53.771'E, leg. C. Haddad, 26–29.XI.2006 (night collecting), 1♀ (NCA 2007/976); Okavango Delta, Samochima lagoon, Shakawe Fishing Camp, 18°25.749'S, 21°54.035'E, leg. C. Haddad, 29.XI.2006 (under tree bark), 1♀ (NCA 2007/1022). **D.R. CONGO:** Rwindi, Southern shore of Lake Edward [00°47'S, 29°17'E], leg. E.S. Ross & R.E. Leech, 21.IX.1937, 1♀ (CAS, CASENT 9033111); Faradje [03°44'N, 29°43'E], leg. American Museum Congo Expedition, 1♂ palp (MNHG). **KENYA:** Homa Bay Farmers Training Centre, 00°27'S, 34°24'E, leg. C. Midega, 5.III.2003 (pitfalls, maize), 1♂ (NCA 2005/2014); Kajiado District, Amboseli National Park, Masai Campground [02°44'S, 37°22'E], 14.VII.1982, R.C. Drewes & J.V. Vindum, 1♂ (CAS, CASENT 9033121); Rift Valley Province: Mpala Research Station, 00°17.635'S, 36°53.947'E, 1792m a.s.l., leg. A.H. & M.K. Kirk-Spriggs, 17–18.IV.2011 (Malaise traps, dry *Acacia* savanna), 1♂ (NMBA 16169). **LESOTHO:** Roma Valley [29°27'S, 27°43'E], leg. G. Kopij, date unknown, 1♀ (NCA 2007/3828). **MALAWI:** Chintheche, 11°50'S, 33°13'E, leg. R. Jocqué, 3.XI.1977 (wasp nest), 1imm. 2♀ (MRAC 153558). **MOZAMBIQUE:** Pungwe River, 50 miles E of Umtali (Mutare), leg. D.L. Patrick, 1903, 1♀ (SAM 13638). **RWANDA:** Butare, 02°36'S, 29°44'E, leg. P. Nyalugaka, 10.XI.1970, 1♀ (MRAC 137770); Butare, Nyakizu, 02°36'S, 29°44'E, leg. P. Nyalugaka, 10.VII.1977, 1♀ (MRAC 155482); Nyanga, pos Ashida, 02°21'S, 29°45'E, leg. Leshadi, 1939, 6♀ (MRAC 23099). **SOUTH AFRICA:** *Free State Province*: Bloemfontein, 29°08'S, 26°10'E, leg. D. de Swart, 8.X.1992 (in house), 1♂ (NMBA 5758); Same locality, leg. C. Dreyer, 2.XII.1996 (in house), 2♀ (NMBA 7974); Same data, 22.X.1996, 1♀ (NMBA 8005); Same data, 8.X.1996, 1♂ (NMBA 7939); Same data, 14.XI.1996, 1♂ 1♀ (NMBA 7957); Same locality, leg. J.J.B. Dreyer, 28.VIII.1992 (in house), 1♂ (NMBA 5749); Same locality, leg. L. Lotz, 20.IX.1994 (in house), 1♀ (NMBA 8010); Same data, 16.X.1996, 1♂ (NMBA 7916); Same data, 26.VIII.1994, 1♂ (NMBA 8043); Same data, 11.X.1993, 1♂ (NMBA 7988); Same data, 30.X.1995, 1♂ (NMBA 7938); Same data, X.1994, 1♂ (NMBA 7993); Same data, 17.IX.1993, 1♂ (NMBA 8028); Same data, 4.X.1993, 1♀ (NMBA 8045); Same data, 14.XI.1994, 1♂ (NMBA 8001); Same data, 22.X.1989, 1♀ (NMBA 2961); Same locality, leg. E. Lotz, 6.XI.1989 (in house), 1♂ (NMBA 2963); Same data, 1.X.1990, 1♀ (NMBA 5325); Same data, 11.X.1990, 1♂ (NMBA 5332); Same locality, leg. S. Louw, 4.X.1990 (in house), 1♂ (NMBA 5326); Same data, 13.XII.1990, 1♀ (NMBA 5345); Same data, 1993, 1♂ (NMBA 8025); Same locality, leg. E. Louw, 12.IX.1990 (in house), 1♂ (NMBA 5320); Bloemfontein, Brandwag [29°06'S, 26°11'E], leg. S. van As, 18.III.2002 (in house on wall), 1♂ (NCA 2002/496); Bloemfontein, Fichardt Park [29°08'S, 26°11'E], leg. S. Lotz & L. Lotz, 28.X.2004 (in house, with termite prey), 1♀ (NMBA 9590); Bloemfontein, Hillsborough [29°04'S, 26°12'E], leg. T. Murray, 10.X.2001 (in house on floor), 1♂ (NCA 2002/491); Bloemfontein, Langenhoven Park, 29°05.719'S, 26°09.427'E, leg. C. Haddad, 24.IX.2005 (in house), 1♂ 1♀ (NCA 2005/2031); Same locality, leg. R. Oliver, 23.XII.2002 (in house on curtains), 1♀ (NCA 2002/497); Bloemfontein, National Botanical Gardens, 29°08'S, 26°10'E, leg. L. Lotz, XII.2006–I.2007 (pitfall traps, top of koppie next to stone), 1♀ (NMBA 10850); Same locality, leg. L. Lotz, X.2006 (pitfall traps, next to spruit underneath trees), 1♂ (NMBA 10906); Bloemfontein district, Deelhoek Farm, 28°51'S, 26°07'E, leg. C. Haddad, 1.IX.2001 (under rocks in grassland), 1♂ (NCA 2002/492); Bloemfontein district, 52km W of Bloemfontein, Driekoppies Farm [29°08'S, 25°36'E], leg. C. Haddad, 29.XII.2002 (*Eucalyptus* leaf litter), 2♂ 1♀ (NCA 2002/499); Bloemfontein district, Hopefield Farm 28°54'S, 26°14'E, leg. C. Haddad, 14.X.2001 (bluegum leaf debris), 1♂ (NCA 2002/493); Same locality, leg. C. Haddad, 18.XI.2001 (bluegum leaf debris), 1imm. 1♂ 1♀ (NCA 2002/494); Same locality, leg. C. Haddad, 11.XI.2001 (under *Eucalyptus* bark), 2♂ (NCA 2008/269); Same locality, leg. C. Haddad, 22.XII.2001 (in house on wall), 1♂ (NCA 2002/495); Bloemfontein district, Maselspoort resort, 29°01.683'S, 26°24.317'E, leg. C. Haddad, 26.XII.2002 (under bluegum bark), 1♂ 1♀ (NCA 2002/498); Erfenis Dam Nature Reserve, 28°30.238'S, 26°47.505'E, leg. C. Haddad, 26.X.2006 (*Eucalyptus* leaf litter), 1♂ (NCA 2008/553); Harrismith, 28°17.081'S, 29°06.474'E, leg. C. Haddad, 13.XII.2005 (in house at night), 1♀ (NCA 2008/265); Kroonstad district, Koffielaagte Farm, 27°29'S, 27°28'E, leg. C.R. Haddad, 4.I.2002 (under *Eucalyptus* bark), 1♀ (NCA 2002/504); Sandveld Nature Reserve, 27°41'S, 25°43'E, leg. C. Haddad, 25.X.2003 (in chimney of *Odontotermes* mound), 1♀ (NCA 2002/521); Same locality, leg. C. Haddad, 25.XI.2003 (*Acacia erioloba* litter), 1♀ (NCA 2005/78); Smithfield, 30°12'S, 26°32'E, leg. C. Haddad, 6.VI.2003 (under *Eucalyptus* bark), 1imm. 1♂ (NCA 2008/268); Virginia, 28°07'S, 26°45'E, leg. L.N Lotz, 25.X.1999 (in house), 1♀ (NMBA 9226); Winburg, Allemanskraal Dam, 28°17'S, 27°10'E, leg. L. Lotz, 2.VI.1994 (under stones in grass), 1♂ (NMBA 8094). *Gauteng Province*: Johannesburg, Sandton [26°03'S, 28°03'E], leg. N. Buckley, VIII.1997, 1♀ (NCA 97/1030); Kempton Park, Esther Park, Otter street [26°05'S, 28°12'E], leg. W. Schmidt, 27.XI.2006 (in house), 2♀ (NCA 2008/2778); Pretoria, 25°45'S, 28°12'E, leg. Mrs Thomas, 22.X.1957, 1m (NCA 76/892); Same locality, leg. J. Keytel, 15.XII.1993 (in house), 1♀ (NCA 93/1098); Same locality, C.E. Griswold, 2.XII.1985, 1♀ (NMSA); Pretoria, Monument Park [25°48'S, 28°13'E], leg. Mrs. Bieurenga, 20.II.1993 (in house), 1♀ (NCA 94/7); Pretoria, Roodeplaat Research Station [25°36'S, 28°21'E], leg. A.S. Dippenaar, 8.II.1973 (on strawberries), 1♂ (NCA

2001/172); Pretoria, Winternest [25°39'S, 28°07'E], leg. J. van Niekerk, 1993 (on carpet), 1♀ (NCA 94/19). *KwaZulu-Natal Province*: Empangeni, University of Zululand, 28°45'S, 31°45'E, leg. P. Reavell, 1.X.1981 (on path), 1♂ (NMSA 14035); Same locality, leg. P.E. Reavell, 1.IX.1983 (running on path), 1♂ (NMSA 18486); Illovo Beach, Mount Edgecombe [30°07'S, 30°51'E], leg. C. Cilliers, 7.I.1977, 1♀ (NCA 2007/1136); Pietermaritzburg, Town Bush [29°36'S, 30°23'E], leg. R.F. Lawrence & W.G. Rump, XII.1936, 1♀ (NMSA 1470). *Limpopo Province*: Warmbaths, Klein Kariba, 24°50'S, 28°19'E, leg. R. Jocqué, 27.XI.1996 (bushveld, leaf litter), 1♀ (MRAC 203573); Springbokvlakte, Tuinplaas, 24°54'S, 28°44'E, leg. M. van Jaarsveld, 20.XII.2002 (pitfalls), 1♂ (NCA 2003/1327); Same locality, leg. M. van Jaarsveld, 29.I.2003 (pitfalls, grassland), 1♀ (NCA 2003/1326). *Mpumulanga Province*: Nelspruit, Institute for Tropical and Subtropical Crops, Waaierproef, 25°21'S, 31°46'E, leg. M. van den Berg, 20.I.1998 (fogging, macadamia orchards), 1♀ (NCA 98/531). *Northern Cape Province*: Red Sands Country Lodge, 14km SW Kuruman, 27°30'30"S, 23°17'09"E, leg. M. Burger, F. Endeman & T. Olivier, 26.II–7.III.2006 (pitfall traps, SARCA survey), 1♀ (NCA 2007/1299), 1♀ (NCA 2007/1302), 1♀ (NCA 2007/1311). *North West Province*: Bloemhof, 27°39'S, 25°36'E, leg. C. Haddad, 24.IX.2003 (*Eucalyptus* leaf litter), 1♂ 1♀ (NCA 2003/522); Potchefstroom district, Thabela Thabeng Mountain Retreat, 26°51.828'S, 28°17.805'E, leg. R. Fourie & A. Grobler, 1–29.X.2009 (pitfalls, Vaal River bank), 1♂ (NCA 2009/3562); Same locality, 26°51.825'S, 28°17.819'E, leg. R. Fourie & A. Grobler, 1–29.X.2009 (pitfall traps, woodland grassland), 1♂ (NCA 2009/3551). *Western Cape Province*: Karoo National Park, Beaufort West, leg. M. de Jager, 9.IX.1994, 1♂ (NCA 94/868); Knysna, Uitzicht Annex, 34°00'S, 23°20'E, leg. L.N. Lotz, 4–19.XII.1989 (pres. trap), 1♀ (NMBA 3351); Oudtshoorn, 33.59°S, 22.21°E, leg. Z. van der Walt, 15.XI.2008 (by hand), 1imm. 1♀ (NCA 2010/247); Same locality, at campground, leg. D. Ubick & S. Prinsloo, 5.X.1999, 1♀ (CAS, CASENT 9033168); Worcester, 33.64°S, 19.47°E, leg. H. van der Walt, V.2004 (by hand), 1imm. 1♀ (NCA 2010/248); Same data, 15.XI.2008, 1♀ (NCA 2010/249). **SWAZILAND:** Manzini, Lugaganeni, 24°24'S, 31°34'E, collector unknown, 24.XII.1998, 1♀ (NCA 2005/2028). **TANZANIA:** *Iringa Region*: Mufindi district, Uzungwa Scarp Forest Reserve, 08°31.58'S, 35°54'E, 750m a.s.l., leg. S. McKamey *et al.*, 7.III.1996 (canopy fog 36), 1♂ (ZMUC); W of Matema, 09°30'S, 34°03'E, leg. R. Jocqué, 23.XI.1991 (behind trees on beach of Lake Malawi, webs of *Thelechoris karschi*), 3imm. 1♂ 2♀ (MRAC 173581). **ZAMBIA:** Chingola, 12°32'S, 27°52'E, leg. L. Magic, no date, 1♂ (NMSA 12247). **ZIMBABWE:** Bulawayo, Hillside, 20°10'S, 28°35'E, leg. M. FitzPatrick, III.1999 (pitfall traps), 1♀ (NMZA 13905); Bulawayo, Matsheumhlope [20°12'S, 28°37'E], leg. C.A. Car, 15.IX.1979, 1♂ (NMZA 696).

Distribution: Widespread throughout southern Africa, with isolated records from Central and East Africa (Fig. 118).

Biology: This species was collected using a wide range of sampling methods and evidently occupies all strata of the habitats it occupies from ground to canopy level. A considerable proportion of the records from South Africa, especially deposited in NMBA and NCA, were sampled in and around human habitation, and this species can be considered to be synanthropic. Egg sacs are large (8–10mm in diameter), yellow-brown in colour, have a covering of papery silk, and are constructed on walls, under window sills or in the folds of curtains.

11.6.6 *Copuetta lesnei* sp. nov.

Figs 37, 89, 114, 115

Etymology: The species name is a patronym in honour of Pierre Lesne, collector of the holotype.

Diagnosis: This species can be recognised from congeners, especially *C. lacustris*, by the small embolus with nearly transverse coil and broad sharp tip directed distally (Fig. 89).

Remark: The holotype described below was initially misidentified by Lessert (1921) as *Castianeira kibonotensis*, which is synonymous with *C. lacustris*, but has a distinctly larger embolus than the types of that species. The left palp is missing from a second vial with the label "Vila Pery" received from MNHG, and the right legs I and II are also missing from the holotype. The colouration is somewhat faded and the markings described refer to the current condition of the specimen. Fresh material will likely have black markings on the body.

Male (holotype, Vila Pery, MNHG). Measurements: CL 2.65, CW 2.05, AL 3.10, AW 1.95, TL 5.60, FL 0.24, SL 1.21, SW 1.17, AME–AME 0.03, AME–ALE 0.00, ALE–ALE 0.40, PME–PME 0.12, PME–PLE 0.04, PLE–PLE 0.47, PERW 0.73, MOQAW 0.43, MOQPW 0.44, MOQL 0.49.

Length of leg segments: I 2.23 + 0.93 + 1.82 + 1.90 + 1.05 = 7.93; II 2.15 + 0.89 + 1.68 + 1.83 + 1.02 = 7.57; III 2.05 + 0.85 + 1.60 + 1.95 + 0.95 = 7.40; IV 2.55 + 0.95 + 2.13 + 2.84 + 1.08 = 9.55.

General appearance as in Fig. 37. Carapace creamy-yellow, cephalic region yellow, eye region pale grey; paired mottled yellow-brown mediolateral markings from palpal coxae to posterior slope; faint mottling between mediolateral markings from PER to midpoint; pale along midline from midpoint to posterior of carapace, with small faint grey marking in front of fovea; striae creamy-yellow, radiating from fovea, directed at coxae; lateral margins with pale grey fringe, expanded between leg coxae; markings covered with yellow-brown plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance less than ⅕ their diameter; AME touching ALE; clypeus height equal to ⅘ AME diameter; PER procurved, laterals very slightly larger than medians; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.81:1. Chelicerae bright yellow-orange, yellow retrolaterally at base and prolaterally at distal end, with finely plumose curved setae on promargin; promargin with two teeth separated by the basal width of proximal tooth, distal tooth much larger; retromargin with two subequal teeth separated by slightly more than their basal width, distal tooth close to fang base. Endites yellow, cream prolaterally distally; labium orange, cream distally; sternum creamy-yellow, darker around borders. Legs creamy-yellow, markings faded to pale yellow-brown, with faint lateral mottling and faint spots at spine bases; markings covered in yellow-brown plumose setae, with cream plumose setae between them; femora I–IV with proximal and distal lateral spots and distal bands; patellae I–IV with faint lateral and ventral mottling; tibiae I and II with faint proximal and distal bands, III and IV with broad median bands; metatarsi I and II without markings, III and IV with proximal, median and distal bands; tarsi without markings. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with yellow anterior dorsal scutum extending slightly more than ½ abdomen length, cream medially behind scutum; dorsum with mottled markings anteriorly, laterally and posteriorly, comprising yellow-brown plumose and short straight setae; dorsum pale along midline, with small patches of yellow-brown plumose and short straight setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream, densely covered in white plumose and short straight setae; epigastric scutum and ventral sclerite creamy-yellow; inframamillary sclerite yellow-orange. Male palp pale creamy-yellow; tegulum pear-shaped, yellow, with bright orange ducts; embolus small, with narrow base, single coil that is nearly transverse, and broad sharp tip directed at distal end of cymbium (Figs 89, 114, 115).

Female: unknown.

Type material: Holotype ♂: **MOZAMBIQUE:** Vila Pery [Chimoio, 19°07'S, 33°29'E], leg. P. Lesne (MNHG).

Additional material examined: none.

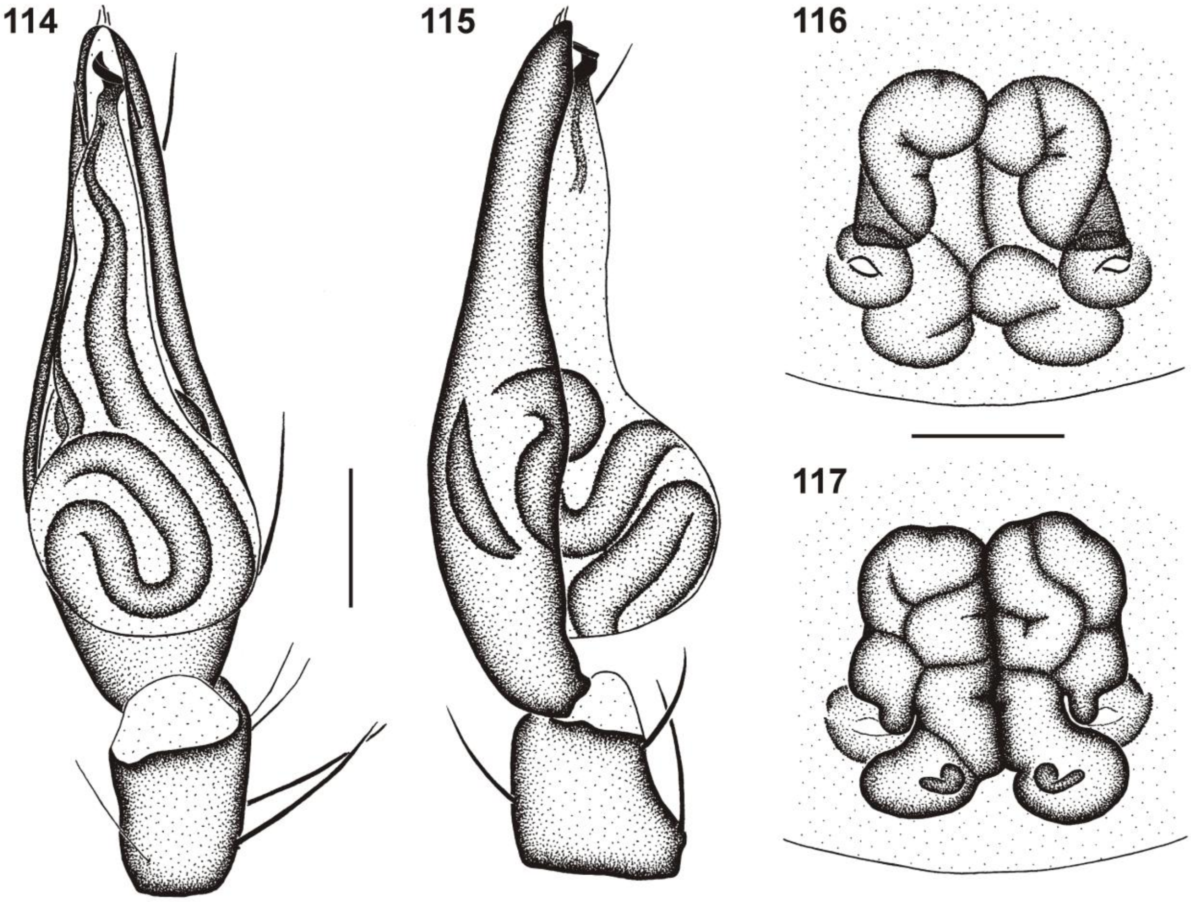
Distribution: Known only from the type locality (Fig. 118).

Biology: Unknown.

11.6.7 *Copuetta litipo* sp. nov.

Figs 38, 116, 117

Etymology: The species name is a noun in apposition of the type locality.



FIGURES 114–117. Genitalic morphology of *Copuetta lesnei* **sp. nov.** (114, 115) and *C. litipo* **sp. nov.** (116, 117): 114. male palp, ventral view; 115. same, retrolateral view. 116. female epigyne, ventral view; 117. same, dorsal view. Scale bars = 0.25mm.

Diagnosis: Females of this species can be recognised by the epigyne with oval thickened structures laterally with the copulatory openings situated within them (Fig. 116).

Remark: The holotype female is in rather poor condition and five of its legs are missing. However, the epigyne structure is very distinctive and warrants description of the species here.

Female (holotype, Litipo, ZMUC). Measurements: CL 2.83, CW 2.26, AL 3.70, AW 3.00, TL 6.80, FL 0.30, SL 1.33, SW 1.30, AME–AME 0.05, AME–ALE 0.01, ALE–ALE 0.45, PME–PME 0.13, PME–PLE 0.05, PLE–PLE 0.56, PERW 0.83, MOQAW 0.46, MOQPW 0.48, MOQL 0.54.

Length of leg segments: I 2.45 + 1.05 + 2.00 + 1.98 + 1.18 = 8.66; II missing; III 2.25 + 0.98 + 1.74 + 2.06 + 1.03 = 8.06; IV 2.90 + 1.05 + 2.30 + 3.10 + 1.10 = 10.45.

General appearance as in Fig. 38. Carapace bright yellow-orange, eye region grey; broad median black line from PER to posterior slope, broken up by paler line from fovea to posterior margin of carapace; pale striae radiating from fovea, directed between coxae; lateral margins with narrow mottled black fringe, expanded between leg coxae; markings covered with black plumose setae, areas between them covered in yellowish plumose and short straight setae. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance equal to ⅕ their diameter; AME separated from ALE by distance less than ⅒ AME diameter; clypeus height slightly less than ⅔ AME diameter; PER procurved, laterals very slightly larger than medians; PME separated by distance equal to ⅔ their diameter; PME separated from PLE by distance equal to ¼ PME diameter; CW:PERW = 2.72:1. Chelicerae yellow-brown with faint black mottling, yellow prolaterally distally, with pectinate curved setae on promargin; promargin with two teeth separated by basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by slightly less than their basal width, distal tooth slightly larger, close to fang base. Endites pale orange, cream prolaterally distally; labium pale orange, cream distally; sternum yellow, darker around margins. Legs (both leg II missing) yellow with faint black mottling, without distinct markings except faint black spots at spine bases and tibiae III and IV with faint proximal and distal black bands. Leg spination (both leg II missing): femora: I pl 3 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I, III and IV with long fine distal seta dorsally; tibiae: I pl 1 plv 2 rlv 2 spines, do 1 long fine seta distally, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 2 rlv 1. Abdomen with yellow-orange anterior dorsal scutum extending to ⅛ abdomen length; dorsum cream, sparsely covered in black plumose and short straight setae, plumose setae yellow-brown posteriorly; spinnerets surrounded by narrow faint black ring; venter cream, covered in black plumose setae; epigastric scutum and inframamillary sclerite yellow. Female epigyne with oval sclerotised rim laterally in posterior half of epigyne, with transverse oval copulatory openings situated within them (Fig. 116); copulatory ducts very short, entering ST II posterolaterally; ST II n-shaped with anterior bend, broadly connected to diverging posterior ST I; ST with several folds on their surface, ST I equal in width to ST II (Fig. 117).

Male: unknown.

Type material: Holotype ♀: **TANZANIA:** Lindi Region, Lindi District, Litipo Forest Reserve, 10°02'S, 39°29'E, leg. Frontier Tanzania, VII–IX.1993 (ZMUC)

Additional material examined: none.

Distribution: Known only from the type locality (Fig. 118).

Biology: Collected in a forest but details of the sampling methodology are unknown.

11.6.8 *Copuetta lotzi* sp. nov.

Figs 10, 39, 40, 80, 90, 119–122

Etymology: This species is named after Leon Lotz, who collected several paratypes, in recognition of his contributions to the taxonomy of Afrotropical spiders.

Diagnosis: Males are easily recognised by the very broad embolus base with a short, curved transverse embolus, the tip of which is directed prolaterally (Fig. 90). Females have characteristic small, sharply procurved lateral epigynal ridges with copulatory openings that enter directly into ST II (Fig. 121).

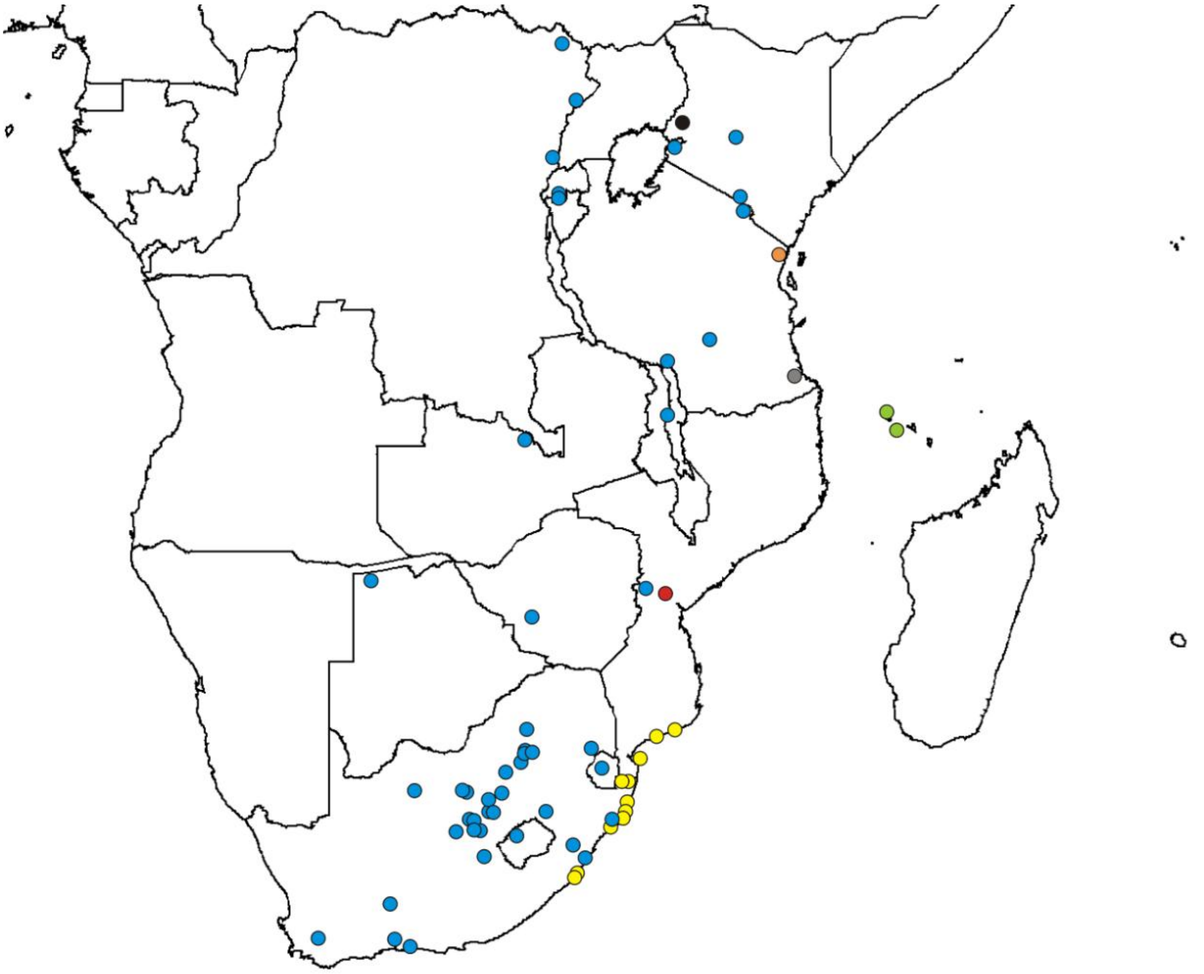


FIGURE 118. Distribution of *Copuetta comorica* **sp. nov.** (green circles), *C. erecta* **sp. nov.** (yellow circles), *C. kakamega* **sp. nov.** (black circle), *C. kwamgumi* **sp. nov.** (orange circle), *C. lacustris* (Strand, 1916) (blue circles), *C. lesnei* **sp. nov.** (red circle) and *C. litipo* **sp. nov.** (grey circle) in the Afrotropical Region.

Male (holotype, Bloemfontein, NCA 2008/267). Measurements: CL 4.42, CW 3.20, AL 4.28, AW 2.60, TL 8.45 (7.40–8.50), FL 0.48, SL 1.89, SW 1.79, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.56, PME–PME 0.17, PME–PLE 0.08, PLE–PLE 0.71, PERW 1.05, MOQAW 0.57, MOQPW 0.62, MOQL 0.68.

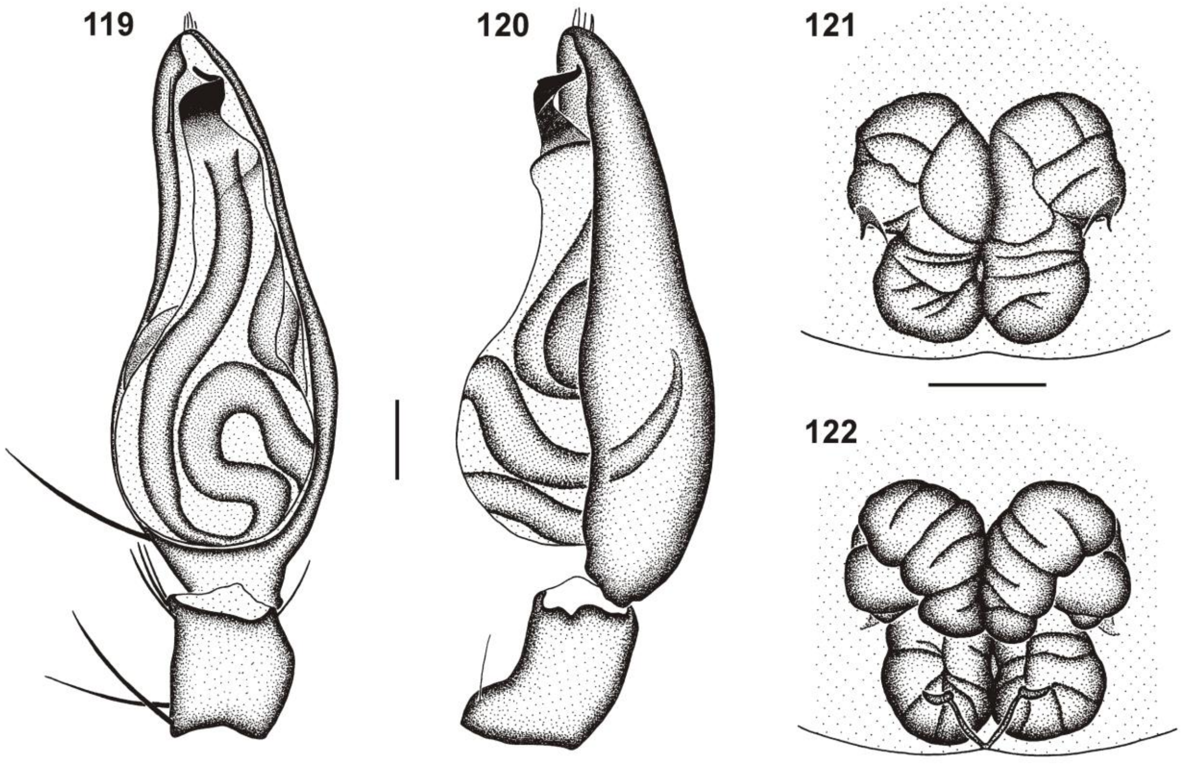
Length of leg segments: I 3.75 + 1.70 + 3.20 + 3.23 + 1.81 = 13.69; II 3.60 + 1.67 + 3.20 + 3.25 + 1.72 = 13.44; III 3.44 + 1.63 + 2.60 + 3.20 + 1.55 = 12.42; IV 4.48 + 1.85 + 3.70 + 4.80 + 1.80 = 16.63.

General appearance as in Fig. 39. Carapace creamy-yellow, cephalic region bright yellow, eye region mottled dark grey; paired mottled black mediolateral markings from between PME and PLE to posterior slope; pale along midline from between PME to posterior of carapace, with narrow mottled black marking in front of fovea; striae orange, radiating from fovea, directed between coxae, covered in dense black mottling within mediolateral markings; lateral margins with narrow black fringe, with triangular expansions at palpal coxae and at anterior and posterior margins of leg coxae I, II and III; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance slightly less than ¼ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height slightly less than 1⅓ AME diameter; PER procurved, laterals slightly larger than medians; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance slightly larger than ⅓ PME diameter; CW:PERW = 3.05:1. Chelicerae dark orange-brown with black mottling on prolateral and retrolateral sides of paturon, with finely plumose curved setae on promargin; promargin with two teeth separated by the basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by slightly less than their basal width, distal tooth slightly smaller than proximal tooth, close to fang base. Endites deep yellow-brown with faint black mottling, cream prolaterally distally; labium orange-brown with faint black mottling, creamy-orange distally; sternum creamy-yellow, darker around borders, edge brown, with mottled black spots at border between palpal coxae and coxae I, and between all coxal pairs. Legs with faint black mottling and black spots at spine bases; markings densely covered in black plumose setae, with yellowish plumose setae between them; femora I–IV cream, proximal and distal ends with prolateral and retrolateral spots dorsally and ventral band distally, ventrally with many small black spots at bases of erect setae; patellae I–IV yellow with black mottling laterally; tibiae I and II yellow-brown with faint black mottling laterally, III yellow-brown and IV orange-brown, both with broad median black bands; metatarsi I and II yellow-brown with black lateral mottling; metatarsi III and IV orange-brown with proximal, median and distal black bands at each dorsal spine pair; tarsi yellow-brown. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I plv 2 rlv 2, II pl 1 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 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, with rlv 5 erect setae; patellae: pl 1 spine, do 2 fine setae; tibiae: pl 1 plv 1; tarsi: pl 1 plv 2. Abdomen with narrow orange anterior dorsal scutum extending just past ½ abdomen length; dorsum with paired black lateral stripes, separated by broad cream median stripe, with narrow black stripe along midline to half abdomen length and six fine black chevrons in posterior half of abdomen; markings covered in black plumose and short straight setae, areas between them with white plumose setae and scattered short straight setae, with several patches of yellow plumose setae in posterior half between chevrons; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; sides of abdomen with black and cream patches of plumose setae; venter cream, densely covered in white plumose setae; epigastric scutum yellow; ventral sclerite absent, with two paired rows of tiny yellow sclerites between epigastric furrow and spinnerets; inframamillary sclerite yellow-orange. Male palp creamy-yellow, cymbium yellow; tegulum pear-shaped, yellow, with yellow-brown ducts; embolus with broad base, transverse and tapering distally; initially directed retrolaterally, curving dorsally and then prolaterally, tip slightly bent (Figs 80, 90, 119, 120).

Female (paratype, Tussen-die-Riviere, NMBA 16179). Measurements: CL 3.52, CW 2.66, AL 3.65, AW 2.28, TL 7.25 (7.25–9.10), FL 0.38, SL 1.63, SW 1.59, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.45, PME–PME 0.14, PME–PLE 0.08, PLE–PLE 0.63, PERW 0.92, MOQAW 0.48, MOQPW 0.53, MOQL 0.60.

Length of leg segments: I 2.90 + 1.45 + 2.60 + 2.55 + 1.55 = 11.05; II 2.85 + 1.40 + 2.35 + 2.50 + 1.42 = 10.52; III 2.65 + 1.30 + 2.17 + 2.62 + 1.28 = 10.02; IV 3.70 + 1.40 + 3.00 + 4.05 + 1.55 = 13.70.

General appearance as in Fig. 40, female more robustly built than male. Carapace pale creamy-yellow, markings and setae as for male. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance slightly larger than ¼ their diameter; AME separated from ALE by distance less than $^1/_{10}$ AME diameter; clypeus height slightly larger than $^4/_5$ AME diameter; PER strongly procurved, laterals very slightly larger than medians; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance slightly larger than $^2/_5$ PME diameter; CW:PERW = 2.89:1. Chelicerae pale yellow-brown with black mottling, with pectinate curved setae on promargin; promargin with two teeth separated by ½ the basal width of proximal tooth, distal tooth much larger; retromargin with two subequal teeth separated by ½ their basal width, distal tooth close to fang base. Endites creamy-yellow, white prolaterally distally; labium yellow, cream distally; sternum cream, with small faint black mottled markings between palpal coxae and leg coxae I, and between coxal pairs. Legs with faint black mottling and black spots at spine bases; markings densely covered in black plumose setae, with yellowish plumose setae between them; femora I–IV cream, proximal and distal ends with prolateral and retrolateral spots



FIGURES 119–122. Genitalic morphology of *Copuetta lotzi* **sp. nov.**: 119. male palp, ventral view; 120. same, retrolateral view; 121. female epigyne, ventral view; 122. same, dorsal view. Scale bars = 0.25mm.

dorsally and ventral band distally, ventrally with many small black spots at bases of erect setae; femora III and IV also with black distal band; patellae creamy-yellow with black mottling laterally, I and II with proximal and distal lateral black spots, III and IV with large proximal lateral spots and complete distal band; tibiae I and II creamy-yellow with faint black mottling laterally, III and IV creamy yellow, both with broad median black bands; metatarsi I and II yellow-brown with black lateral mottling; metatarsi III and IV creamy-yellow with proximal, median and distal black bands at each dorsal spine pair; tarsi cream. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I plv 2 rlv 2, II pl 1 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 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1.

Abdomen with weakly sclerotised cream dorsal scutum extending ⅛ abdomen length, markings and setae as for male; venter cream, densely covered in white plumose setae; epigastric scutum cream; inframamillary sclerite pale creamy-brown; ventral sclerite absent, two paired rows of indistinct sclerites between epigastric furrow and spinnerets. Epigyne with small, strongly recurved lateral epigynal ridges, copulatory openings entering directly into ST II posterolaterally (Fig. 121); ST II large and nearly round, broadly connected to broad kidney-shaped posterior ST I; both ST with many folds on their surface; ST I clearly narrower than ST II (Fig. 122).

Type material: Holotype ♂: **SOUTH AFRICA:** *Free State Province*: Bloemfontein, Langenhoven Park, 29°05.719'S, 26°09.427'E, leg. C. Haddad, 6.I.2008 (under window sill) (NCA 2008/267)

Paratypes: **SOUTH AFRICA:** *Free State Province*: Bloemfontein, Botanical Gardens, 29°08'S, 26°10'E, leg. L. Lotz, X.2006 (pitfall traps, NE slope of koppie), 1♀ (NMBA 10905); Same locality, leg. L. Lotz, XI.2006 (pit-trap 7, against NE slope of koppie), 1♀ (NMBA 10943); Bloemfontein, Naval Hill, Eastern Plateau, 29°06'S, 26°14'E, leg. L. Lotz, XI.1991 (pitfall traps), 1♂ (NMBA 7548); Bloemfontein district, Deelhoek Farm, 28°50'S, 26°06'E, leg. C. Haddad, 17.XI.2001 (under *Eucalyptus* bark), 1imm. 1♂ (NCA 2008/266); Brandfort district, Florisbad Research Station, 28°46'S, 26°05'E, 1250m a.s.l., leg. Museum Staff, XI.1984 (pitfall traps), 1♂ (NMBA 559); Erfenis Dam Nature Reserve, Site 5, 28°29.605'S, 26°47.974'E, leg. R. Fourie & A. Grobler, 30.IX–28.X.2009 (pitfall traps, overgrazed grassland), 1♂ (NCA 2009/3594); Same locality, near koppie, 28°29.888'S, 26°48.488'E, leg. C. Haddad, 28.VIII.2007 (inside abandoned *Trinervitermes trinervoides* termite mound), 1♂ (NCA 2007/3831); Tussen-die-Riviere Nature Reserve, 30°28'S, 26°07'E, leg. C. Haddad & L. Lotz, 14.X.2008 (active searching, grassland), 1♂ 3♀ (NMBA 16179). *Gauteng Province*: Balmoral, 25°49.013'S, 28°51.970'E, leg. R. Koko, 11.VII.2006 (pitfall traps), 1♂ (NCA 2008/2786); Randburg, Glen Austin Pan, Randjesfontein Farm, 25°58.432'S, 28°10.010'E, leg. H. Roux, 25.I.2003 (pitfall traps), 1♂ 1♀ (NCA 2008/2785). *Mpumulanga Province*: Lydenburg [25°05'S, 30°27'E], leg. Colson, XII.1903, 1♀ (SAM 13406). *Western Cape Province*: Anysberg Nature Reserve, Landsekloof, 33°29.493'S, 20°34.078'E, leg. C. Haddad & R. Lyle, 24.IX.2007 (under rocks), 1♀ (NCA 2007/3770).

Additional material examined: none.

Distribution: Endemic to South Africa (Fig. 137), where it occurs sympatrically with *C. lacustris* (Fig. 118).

Biology: Based on collecting data, this species appears to be predominantly ground-dwelling, which contrasts from the others in the genus that are primarily arboreal. Apart from *C. lacustris*, this is the only species occurring in the more arid Grassland and Nama Karoo

Biomes of South Africa. Its absence from the Savanna and Forest Biomes, where most *Copuetta* occur, is also of considerable ecological significance.

11.6.9 *Copuetta magna* sp. nov.

Figs 11, 41, 42, 72–74, 81, 91, 123–126

Etymology: This species takes its name from the Latin meaning large, and relates to the large size of this species.

Diagnosis: Males can be easily recognised by the large, gently curved longitudinal embolus (Figs 81, 91). Females have a large subtriangular ridge surrounding the small epigyne, with oblique copulatory openings along the midline of the epigyne (Fig. 125). This is the largest species in the genus and the second largest Afrotropical castianeirine (with *Apochinomma elongata* **sp. nov.** the largest).

Male (holotype, Ndumo, NCA 2009/3496). Measurements: CL 4.25, CW 3.17, AL 4.10, AW 2.75, TL 8.30 (7.15–12.40), FL 0.38, SL 1.90, SW 1.71, AME–AME 0.10, AME–ALE 0.02, ALE–ALE 0.60, PME–PME 0.20, PME–PLE 0.13, PLE–PLE 0.79, PERW 1.11, MOQAW 0.58, MOQPW 0.63, MOQL 0.75.

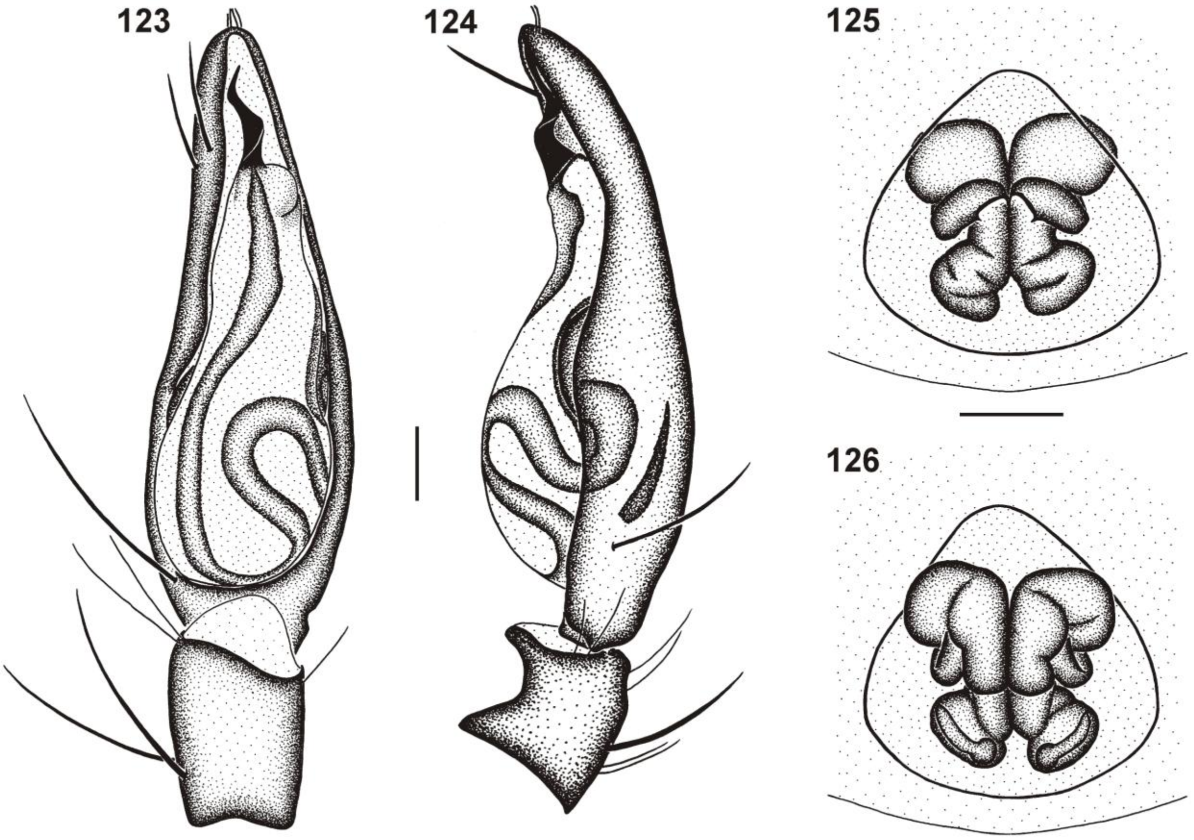
Length of leg segments: I 3.55 + 1.57 + 3.13 + 3.20 + 1.58 = 13.03; II 3.48 + 1.55 + 2.90 + 3.10 + 1.45 = 12.48; III 3.40 + 1.45 + 2.60 + 3.25 + 1.40 = 12.10; IV 3.95 + 1.40 + 3.28 + 4.40 + 1.68 = 14.71.

General appearance as in Figs 11 and 41. Carapace cream, eye region black; paired black mediolateral markings from PER to posterior slope, broken up by oblique pale line from fovea, directed at palpal coxae; pale along midline from between PME to posterior of carapace, with narrow mottled black marking in front of fovea; striae orange, radiating from fovea, directed between coxae, covered in dense black mottling within mediolateral markings; lateral margins with narrow black fringe, expanded palpal and leg coxae; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than $^2/_5$ their diameter; AME separated from ALE by equal to $^1/_{10}$ AME diameter; clypeus height slightly less than 1½ AME diameter; PER procurved, laterals slightly larger than medians; PME separated by distance slightly larger than $^4/_5$ their diameter; PME separated from PLE by distance equal to ½ PLE diameter; CW:PERW = 2.86:1. Chelicerae yellow-brown with black mottling proximally, prolaterally and retrolaterally on paturon, with finely plumose curved setae on promargin; promargin with two teeth separated by the basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by distance equal to their basal width, distal tooth slightly smaller than proximal tooth, close to fang base. Endites pale grey, yellow-brown prolaterally, white prolaterally distally; labium pale grey, yellow-brown in proximal corners, creamy-yellow distally; sternum cream, creamy-yellow around borders. Legs cream with faint black mottling and black spots at spine bases; markings densely covered in black plumose setae, with yellowish plumose setae between them; coxae with dorsal spot, trochanters with spots on prolateral and retrolateral surfaces; femora I–IV with prolateral and retrolateral spots at proximal and distal ends dorsally, oblique prolateral and retrolateral streaks originating from proximal dorsal spine, and distal bands at distal dorsal spine, more distinct on III and IV; ventrally with many small black spots at bases of erect setae; patellae I and II with proximal prolateral and retrolateral spots, lateral mottling and narrow dorsal distal fringe; patellae III and IV with proximal prolateral and retrolateral spots, broad lateral and ventral bands, absent dorsally; tibiae I and II with faint mottled proximal, median and distal bands, III and IV with distinct broad median black band and sparse mottling proximally and distally; metatarsi I–IV with proximal, median and distal black bands, faint on metatarsi I and II and distinct on III and IV; tarsi cream, without mottling. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with narrow cream anterior dorsal scutum extending ¼ abdomen length; dorsum cream with black patches medially and laterally in first three quarters of abdomen, posterior quarter black; markings covered in black plumose and short straight setae, areas between them with white plumose setae and scattered short straight setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream, densely covered in white plumose setae, with faint grey patch in front of inframamillary sclerite and faint fine lateral lines; epigastric scutum weakly sclerotised, cream; ventral sclerite absent; inframamillary sclerite weakly sclerotised, covered in black spot; yellow-orange. Male palp yellow, cymbium dark yellow-brown; tegulum pear-shaped, orange-brown, with black ducts; embolus long, gently curved and longitudinal, with narrow base (Figs 81, 91, 123, 124).

Female (paratype, Morogoro, CASENT 9033126). Measurements: CL 5.70, CW 4.10, AL 6.10, AW 3.80, TL 11.70 (9.70–12.20), FL 0.44, SL 2.46, SW 2.17, AME–AME 0.13, AME–ALE 0.02, ALE–ALE 0.71, PME–PME 0.20, PME–PLE 0.14, PLE–PLE 0.92, PERW 1.32, MOQAW 0.71, MOQPW 0.73, MOQL 0.95.

Length of leg segments: I 4.23 + 2.15 + 3.80 + 3.85 + 1.80 = 15.83; II 4.15 + 2.12 + 3.60 + 3.70 + 1.72 = 15.29; III 4.16 + 1.90 + 3.35 + 3.98 + 1.68 = 15.07; IV 4.70 + 2.10 + 4.25 + 5.90 + 2.95 = 19.90.

General appearance as in Fig. 42, female more robustly built than male. Carapace bright orange, with red markings covered in dense black mottling; markings and setae as for male, except black striae extending to lateral margins, directed at coxae. All eyes with black rings; AER strongly procurved, medians much larger than laterals; AME separated by distance slightly larger than $^{2}/_{5}$ their diameter; AME separated from ALE by distance equal to $^{1}/_{10}$ ALE diameter; clypeus height slightly larger than 1½ AME diameter; PER procurved, medians



FIGURES 123–126. Genitalic morphology of *Copuetta magna* **sp. nov.**: 123. male palp, ventral view; 124. same, retrolateral view; 125. female epigyne, ventral view; 126. same, dorsal view. Scale bars = 0.25mm.

equal to laterals; PME separated by distance slightly less than ¾ their diameter; PME separated from PLE by distance equal to ½ PME diameter; CW:PERW = 3.10:1. Chelicerae deep red-brown with black mottling, bright yellow prolaterally distally; promargin with two teeth separated by distance equal to the basal width of proximal tooth, distal tooth much larger; retromargin with two subequal teeth separated by ½ their basal width, distal tooth close to fang base. Endites deep orange-brown, cream prolaterally distally; labium deep orange-brown, cream distally; sternum bright orange with larger brown spots between coxal pairs. Legs yellow orange, posteriors slightly darker, markings and setae as for male. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I plv 2 rlv 2, II pl 1 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with yellow-brown dorsal scutum, extending slightly less than ⅕ abdomen length; dorsum cream, mottled black laterally with small white patches of plumose setae; broad black marking medially behind scutum, extending to ⅔ abdomen length, posterior end black; setae as for male; venter cream, densely covered in white plumose setae, with fine grey lateral lines; epigastric scutum creamy-yellow; inframamillary sclerite yellow. Epigyne with large subtriangular ridge around margins of spermathecae; copulatory openings oblique, along midline of epigyne (Fig. 125); copulatory ducts initially directed posterolaterally, bending sharply laterally then anteriorly before entering ST II along their posterior margin; ST II oval and transverse, broader than long, with broad ducts connecting ST II to kidney-shaped posterior ST I; both ST with a few folds on their surface; ST I clearly narrower than ST II (Fig. 126).

Type material: Holotype ♂: **SOUTH AFRICA:** *KwaZulu-Natal Province*: Ndumo Game Reserve, Ezulwini Hide, Nyamiti Pan, 26°53.194'S, 32°18.553'E, leg. C. Haddad, 2.VII.2009 (under bark) (NCA 2009/3496).

Paratypes: **MOZAMBIQUE:** Maputo Special Reserve, Xingute, NE edge of lake, leg. R. Boycott, 30.IX.2001 (tsetse fly traps), 1♀ (NCA 2005/764). **SOUTH AFRICA:** *KwaZulu-Natal Province*: iSimangaliso [Greater St Lucia] Wetlands Park, Charter's Creek, 28°12′S, 32°26′E, leg. J. Doyen & C. & T. Griswold, 19–21.XI.1985 (forest), 1♀ (NMSA); iSimangaliso Wetlands Park, False Bay Park, leg. J. Esterhuizen, 15.XII.2003 (tsetse fly traps), 1♂ (NCA 2004/760); Same data, 22.X.2003, 1♂ (NCA 2004/765); Same data, 28.X.2003, 1♂ (NCA 2004/781); Same data, 19.XI.2003, 1♂ (NCA 2004/757); Same data, 19.XI.2003, 1♂ (NCA 2004/777); Same data, 17.XII.2003, 1♀ (NCA 2004/756); Same data, 4.II.2004, 1♂ (NCA 2004/762); Same data, 5.II.2004, 1♂ (NCA 2004/774); iSimangaliso Wetlands Park, Hell's Gate, leg. J. Esterhuizen, 19.I.2003 (tsetse fly traps), 1♂ (NCA 2004/791); Same data, 11.II.2003, 2♂ 1♀ (NCA 2004/811); Same data, 22.IX.2003, 2♂ (NCA 2004/809); Same data, 29.IX.2003, 1imm. 1♂ (NCA 2004/767); Same data, 6.X.2003, 2♂ (NCA 2004/807); Same data, 13.X.2003, 1imm 1♂ (NCA 2004/779); Same data, 13.X.2003, 4♂ 1♀ (NCA 2004/805); Same data, 27.X.2003, 3♂ (NCA 2004/808); Same data, 3.XI.2003, 1♂ (NCA 2004/787); Same data, 10.XI.2003, 3♂ (NCA 2004/800); Same data, 17.XI.2003, 1♂ (NCA 2004/793); Same data, 24.XI.2003, 5♂ (NCA 2004/803); Same data, 1.XII.2003, 1♂ (NCA 2004/801); Same data, 8.XII.2003, 4♂ (NCA 2004/770); Same data, 15.XII.2003, 1♂ (NCA 2004/792); Same data, 22.XII.2003, 1♂ (NCA 2004/763); Same data, 12.I.2004, 1♂ (NCA 2004/773); Same data, 26.I.2004, 5♂ (NCA 2004/810); Same data, 2.II.2004, 2♂ 2♀ (NCA 2004/775); Same data, 9.II.2004, 1imm. 2♂ (NCA 2004/789); Kosi Bay [26°53'S, 32°52'E], leg. J. Esterhuizen, 17.XII.2003 (tsetse fly traps), 2♂ (NCA 2004/780). *Mpumulanga Province*: Hazyview, Brandwag Farm, 25°02.217'S, 31°08.133'E, 950m a.s.l., leg. K. Roos, 26.VIII.2003, 1♂ (NCA 2012/791); Kruger National Park, near Skukuza, 25°00.347'S, 31°35.099'E, leg. K. Harris, 29.XI.2005 (pitfall traps, heavy *Opuntia* infestation), 1♀ (NCA 2007/3123); Same locality, 25°00.235'S, 31°35.049'E, leg. K. Harris, 1.VIII.2005 (pitfall traps, pristine savanna), 1♂ (NCA 2007/1147). **TANZANIA:** 15 miles W of Morogoro, 400m a.s.l., leg. E.S. Ross & R.E. Leech, 13.XI.1957, 1♀ (CAS, CASENT 9033126).

Additional material examined: none.

Distribution: Widespread along the eastern parts of South Africa, Mozambique and Tanzania (Fig. 137).

Biology: Most of the specimens were collected from tsetse fly traps, suggesting a preference for lower-growing vegetation (shrubs and short trees).

11.6.10 *Copuetta maputa* sp. nov.

Figs 12, 13, 43, 44, 53, 75–77, 82, 92, 127–130

Messapus martini Simon, 1898: 214; Bosselaers & Jocqué, 2000: 307, fig. 1A–H (male misidentified, see remarks under *M. martini* above).

Etymology: The species name is derived from the Maputaland ecoregion in southern Mozambique and KwaZulu-Natal Province, South Africa, to which this species is apparently endemic.

Diagnosis: Males can be recognised by the large compressed embolus with two compressed coils, of which the distal coil is much broader than the proximal, with a sharp embolus tip directed prolaterally (Figs 82, 92). Female have an epigyne with opposing semi-circular ridges with copulatory openings anteriorly within the depression (Fig. 129).

Male (holotype, Ndumo, NCA 2006/425). Measurements: CL 3.75, CW 2.80, AL 3.90, AW 2.43, TL 7.75 (6.15–8.90), FL 0.46, SL 1.62, SW 1.57, AME–AME 0.05, AME–ALE 0.00, ALE–ALE 0.53, PME–PME 0.16, PME–PLE 0.08, PLE–PLE 0.63, PERW 0.97, MOQAW 0.59, MOQPW 0.57, MOQL 0.70.

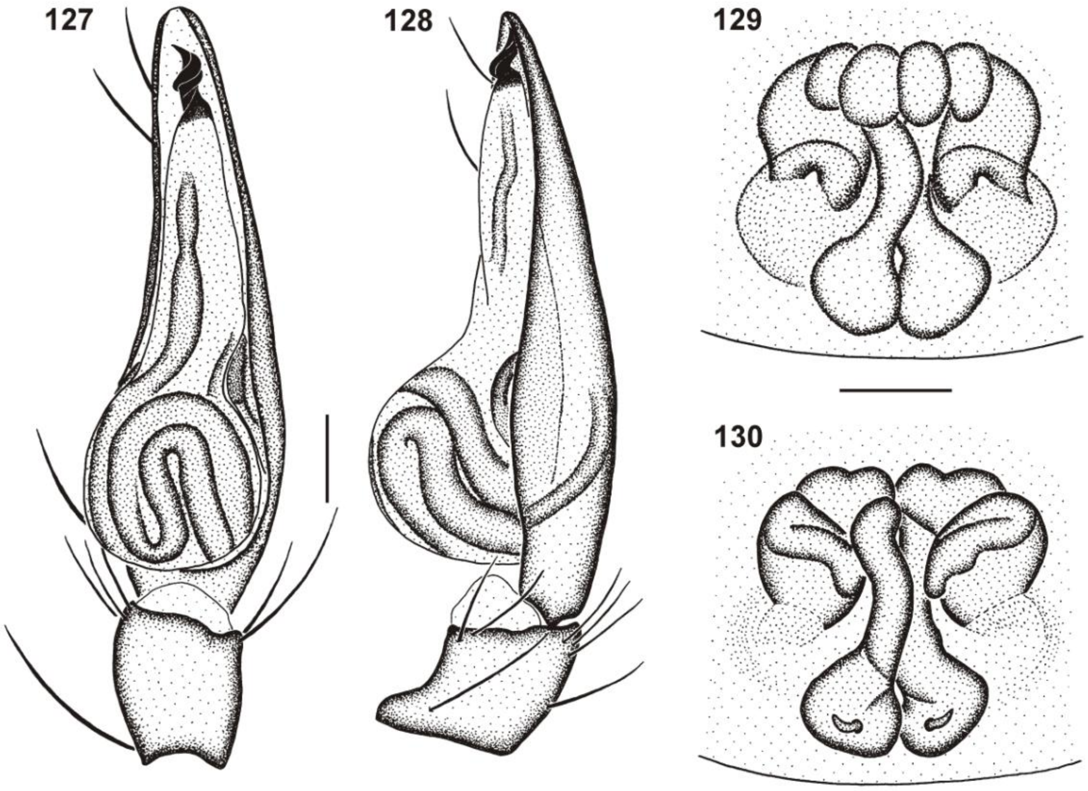
Length of leg segments: I 3.23 + 1.40 + 2.60 + 2.73 + 1.50 = 11.46; II 3.20 + 1.35 + 2.48 + 2.60 + 1.40 = 11.03; III 3.10 + 1.35 + 2.30 + 2.90 + 1.27 = 10.92; IV 3.90 + 1.44 + 3.05 + 4.25 + 1.45 = 14.09.

General appearance as in Figs 12 and 43. Carapace bright yellow, eye region black, entire clypeus mottled black; paired black mediolateral markings from palpal coxae to posterior slope; pale along midline from between PME to posterior of carapace, with faint black mottling between mediolateral markings from PER to midpoint of carapace and with narrow mottled black marking in front of fovea; striae orange, radiating from fovea, directed between coxae, covered in dense black mottling within mediolateral markings; lateral margins with faint black fringe, with indistinct black spots between leg coxae; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than ⅕ their diameter; AME touching ALE; clypeus height equal to AME diameter; PER procurved, medians slightly larger than laterals; PME separated by distance equal to ⅔ their diameter; PME separated from PLE by distance equal to ⅓ PLE diameter; CW:PERW = 2.89:1. Chelicerae dark brown with black mottling, yellow prolaterally distally, with finely plumose curved setae on promargin; promargin with two teeth separated by the basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by ½ their basal width, distal tooth slightly larger than proximal tooth, close to fang base. Endites dark yellow-brown with faint black mottling, white prolaterally distally; labium orange-brown, creamy-orange distally; sternum bright yellow-orange, slightly darker around borders. Legs with faint lateral mottling and faint black spots at spine bases; markings covered in black plumose setae, with yellowish plumose setae between them; femora I–IV yellow, III and IV with faint distal band; patellae I–IV yellow with lateral mottling; tibiae I–III yellow and IV yellow-orange, all with very faint broad median band; metatarsi I–IV pale orange-brown with very faint proximal, median and distal bands; tarsi I–IV yellow-orange. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I pl 2 plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I plv 1-2 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3. Abdomen with yellow anterior dorsal scutum extending to ½ abdomen length; dorsum mottled black anteriorly, laterally and posteriorly, with small white blotches am streaks laterally; dorsum pale along midline, with broadened cream patch behind scutum, with scattered small black blotches; markings covered in black plumose and short straight setae, areas between them with white plumose setae and brown scattered short straight setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream, densely covered in white plumose setae and scattered short straight setae; epigastric scutum weakly sclerotised, creamy-yellow; ventral sclerite absent; inframamillary sclerite yellow-orange. Male palp yellow, cymbium yellow-brown; tegulum pear-shaped, dark orange-brown, with dark red-brown ducts; embolus with narrow base and two compressed coils, of which the distal coil is much broader than the proximal; embolus tip sharp and triangular, directed prolaterally (Figs 82, 92, 127, 128).

Female (paratype, Chidenguele, NCA 2008/200). Measurements: CL 3.35, CW 2.63, AL 3.70, AW 2.20, TL 7.20 (7.20–8.75), FL 0.37, SL 1.59, SW 1.51, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.54, PME–PME 0.12, PME–PLE 0.06, PLE–PLE 0.59, PERW 0.90, MOQAW 0.53, MOQPW 0.52, MOQL 0.62.

Length of leg segments: I 3.00 + 1.35 + 2.40 + 2.55 + 1.40 = 10.70; II 2.95 + 1.34 + 2.30 + 2.43 + 1.35 = 10.37; III 2.87 + 1.30 + 2.11 + 2.65 + 1.23 = 10.16; IV 3.60 + 1.42 + 2.88 + 3.95 + 1.25 = 13.10.

General appearance as in Figs 13 and 44, female more robustly built than male. Carapace creamy-yellow, markings and setae as for male, except with black mottling from PER to mediolateral markings. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly larger than $^1/_5$ their diameter; AME nearly touching ALE, separated by distance less than $^1/_{10}$ ALE diameter; clypeus height slightly larger than $^4/_5$ AME diameter; PER procurved, laterals very slightly larger than medians;



FIGURES 127–130. Genitalic morphology of *Copuetta maputa* **sp. nov.**: 127. male palp, ventral view; 128. same, retrolateral view; 129. female epigyne, ventral view; 130. same, dorsal view. Scale bars = 0.25mm.

PME separated by distance slightly less than $^{3}/_{5}$ their diameter; PME separated from PLE by distance slightly larger than ⅓ PME diameter; CW:PERW = 2.92:1. Chelicerae dark brown with dense black mottling, yellow prolaterally distally; promargin with two teeth separated by distance equal to the basal width of proximal tooth, distal tooth much larger; retromargin with two teeth separated by ½ their basal width, distal tooth slightly smaller than proximal tooth, close to fang base. Endites yellow-brown with faint grey mottling, white prolaterally distally; labium pale orange-brown with grey mottling, cream distally; sternum yellow, yellow-brown around borders. Legs creamy-yellow, metatarsi yellow-brown, markings and setae as for male. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I pl 1 plv 2 rlv 2, II pl 1-2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with pale yellow dorsal scutum, extending to $^{1}/_{5}$ abdomen length;

dorsum with black marking anteriorly, laterally and posteriorly, with several small white blotches; dorsum cream along midline with narrow chevrons, broadened in posterior half, with small black spots along midline; venter cream, densely covered in white plumose setae; epigastric scutum creamy-yellow; inframamillary sclerite orange. Epigyne with opposing semi-circular ridges, with copulatory openings situated anteriorly within depression, entering directly into ST II (Fig. 129); ST II oval with several lobes, connected to kidney-shaped posterior ST I by long narrow ducts; both ST with a few folds on their surface; ST I only half as broad as ST II (Fig. 130).

Type material: Holotype ♂: **SOUTH AFRICA:** *KwaZulu-Natal*: Ndumo Game Reserve, Crocodile Farm, 26°54.426'S, 32°19.185'E, leg. C. Haddad, 17.I.2006 (on wall of house at night) (NCA 2006/425).
Paratypes: **MOZAMBIQUE:** Bilene, Praia do Bilene, 25°15.649'S, 33°17.659'E, 27m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 20.XII.2007 (leaf litter, coastal forest), 1♂ (NCA 2008/209); Chidenguele, Paraiso de Chidenguele, 24°57.276'S, 34°11.860'E, 38m a.s.l., leg. C. Haddad, R. Lyle & R. Fourie, 16.XII.2007 (night collecting, dune forest), 1♀ (NCA 2008/200). **SOUTH AFRICA:** *KwaZulu-Natal*: iSimangaliso [Greater St. Lucia] Wetlands Park, False Bay Park, leg. J. Esterhuizen, 4.II.2004 (tsetse fly traps), 1♂ (NCA 2004/761); iSimangaliso Wetlands Park, Hell's Gate, leg. J. Esterhuizen, 8.XII.2003 (tsetse fly traps), 1♂ (NCA 2004/785); Same data, 14.XII.2003, 1♂ (NCA 2004/799); Same data, 19.I.2004, 3♂ (NCA 2004/812); Same data, 9.II.2004, 1♂ (NCA 2004/804); Lake Sibaya, 27°20'S, 32°42'E, leg. B. Lamoral, I.1968, 1♂ (NMSA 12337); Ndumo Game Reserve, Southern shore of Hotwe Pan, 26°52.730'S, 32°18.452'E, leg. C. Haddad, 7.II.2005 (*Acacia xanthophloea* bark), 1♀ (NCA 2008/2910); Same locality, Crocodile Farm, 26°54.426'S, 32°19.185'E, leg. C. Haddad, 17.I.2006 (on wall of house at night), 1♂ (NCA 2008/271); Sodwana Bay to Lake Sibaya, 27.41563°S, 32.70982°E, leg. P. van Niekerk, G. van Niekerk, X. Combrinck & J. Warner, 28.II.2007 (beats, undergrowth, coastal dune forest), 1♂ (NCA 2007/3829).

Additional material examined: SOUTH AFRICA: *KwaZulu-Natal*: iSimangaliso [Greater St. Lucia] Wetlands Park, False Bay Park, leg. J. Esterhuizen, 1.XII.2004 (tsetse fly traps), 1♂ (NCA 2005/196); iSimangaliso Wetlands Park, Hell's Gate, Block A, leg. J. Esterhuizen, 26.IV.2004 (tsetse fly traps), 1♂ (NCA 2005/192); Same data, 14.VI.2004, 1 imm. 1♀ (NCA 2005/332); Same data, 29.XI.2004, 1♂ (NCA 2005/195); Same data, 6.XII.2004, 1♂ (NCA 2005/197); iSimangaliso Wetlands Park, Hell's Gate, Block B, leg. J. Esterhuizen, 7.VI.2004 (tsetse fly traps), 1 imm. 1♀ (NCA 2005/194); Same data, 16.VIII.2004, 1♀ (NCA 2005/334); Same data, 5.XII.2004, 1♀ (NCA 2005/336); Same data, 6.XII.2004, 1♂ (NCA 2005/198); Natal, leg. C. Martin, misidentified ♂ paralectotype of *Messapus martini* (MNHN 19680).

Distribution: Apparently endemic to the coastal regions and adjacent interior of southern Mozambique and KwaZulu-Natal Province, South Africa (Fig. 137).

Biology: A species primarily collected in the lower strata of forest and woodland habitats (shrubs, tree bark and leaf litter).

11.6.11 *Copuetta naja* sp. nov.

Figs 45, 93, 131, 132

Etymology: The species name is a noun in apposition of the genus name of the cobras, widespread elapid snakes. The shape of the male embolus resembles a cobra in its raised threat posture with expanded hood.

Diagnosis: This species is easily recognised by the embolus with a broad base, tapering distally to a sharp, retrolaterally direct point (Fig. 131).

Male (holotype, Kwamgumi, ZMUC). Measurements: CL 2.80, CW 2.23, AL 2.33, AW 1.40, TL 4.95, FL 0.22, SL 1.24, SW 1.26, AME–AME 0.06, AME–ALE 0.01, ALE–ALE 0.48, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.56, PERW 0.81, MOQAW 0.48, MOQPW 0.45, MOQL 0.51.

Length of leg segments: I 2.40 + 1.00 + 1.93 + 2.00 + 1.07 = 8.40; II 2.35 + 0.92 + 1.83 + 2.02 + 0.98 = 8.10; III 2.32 + 0.95 + 1.70 + 2.10 + 0.98 = 8.05; IV 2.95 + 1.03 + 2.25 + 3.05 + 1.05 = 10.33.

General appearance as in Fig. 45. Carapace cream, eye region dark grey, entire clypeus black; paired mottled yellow-brown mediolateral markings from sides of cephalic region to posterior slope; faint mottling between mediolateral markings from PER to midpoint; pale along midline, with small narrow oval black marking in front of fovea; striae creamy-yellow, radiating from fovea, directed at coxae, densely covered with black mottling within mediolateral markings; lateral margins without markings on fringe, with large black spots between all coxal pairs; markings covered with black plumose and sparse short straight setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly larger than ¼ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height slightly larger than ¾ AME diameter; PER procurved, laterals larger than medians; PME separated by distance slightly less than ¾ their diameter; PME separated from PLE by distance slightly less than ⅓ PLE diameter; CW:PERW = 2.75:1. Chelicerae yellow-brown with black mottling, pale yellow prolaterally at distal end, with finely plumose curved setae on promargin; promargin with two teeth separated by the basal width of proximal tooth, distal tooth much larger; retromargin with two subequal teeth separated by slightly less than their basal width, distal tooth close to fang base. Endites creamy-yellow with faint black mottling, cream prolaterally distally; labium creamy-yellow with faint black mottling, cream distally; sternum cream, creamy-yellow around borders. Legs cream with faint lateral mottling and indistinct markings; markings covered in black plumose setae, with cream plumose setae between them; femora I–IV with narrow distal bands; patellae I–IV with faint lateral mottling; tibiae I–IV with faint broad median bands; metatarsi I–IV with proximal, median and distal bands; tarsi without markings. Leg spination: femora: I pl 2-3 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3-4 rl 1; all femora with scattered erect ventral setae; patellae: all with spines and/or fine setae broken off; tibiae: I pl 2 plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 0-1, 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with cream anterior dorsal scutum, extending only ⅛ abdomen length; dorsum mottled grey with large cream X-shaped markings anteriorly and medially, with several narrow cream chevrons posteriorly; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; dorsum covered in black and yellow-brown plumose and short straight setae on markings; venter cream, densely covered in white short straight setae and sparse white plumose setae; epigastric scutum creamy-yellow; ventral sclerite absent; inframamillary sclerite yellow-orange. Male palp creamy-yellow, cymbium yellow; tegulum pear-shaped, bright yellow, with pale yellow-brown ducts; embolus with broad oblique base that is initially directed prolaterally, with sharp bend, tip directed retrolaterally (Figs 93, 131, 132).

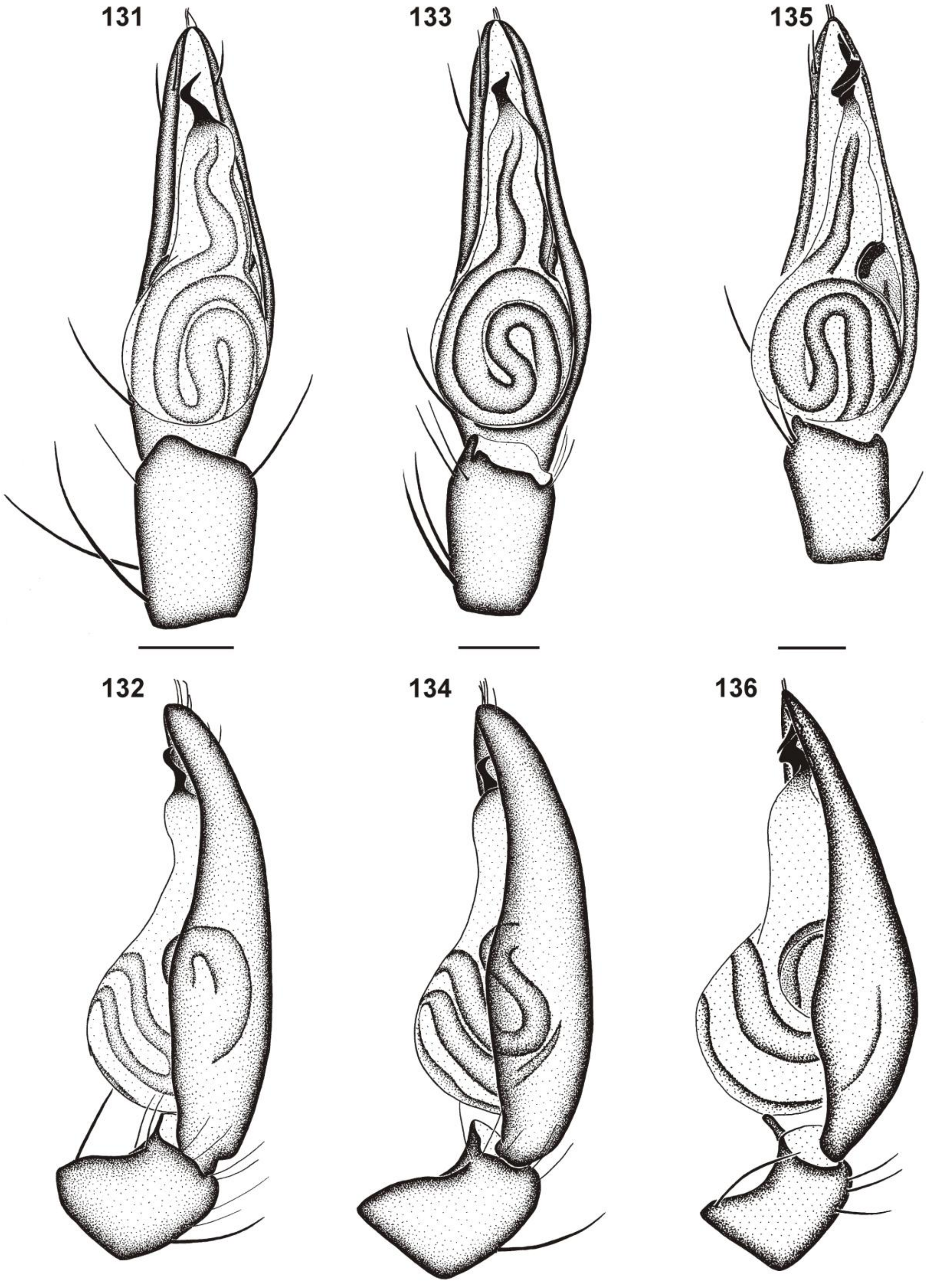
Female: unknown.

Type material: Holotype ♂: **TANZANIA:** *Tanga Region*: Muheza District, Kwamgumi Forest Reserve, 04°57'S, 38°44'E, 170–220m a.s.l., S. McKamey *et al*., 2.XI.1995 (canopy fog 14) (ZMUC).

Additional material examined: none.

Distribution: Known only from the type locality (Fig. 137).

Biology: Collected by canopy fogging in forests.



FIGURES 131–136. Male palpal morphology of *Copuetta naja* **sp. nov.** (131, 132), *C. uzungwa* **sp. nov.** (133, 134) and *C. wagneri* **sp. nov.** (135, 136): 131, 133, 135. male palp, ventral view; 132, 134, 136. same, retrolateral view. Scale bars = 0.25mm.

11.6.12 *Copuetta uzungwa* sp. nov.

Figs 46, 94, 133, 134

Etymology: The species name is a noun in apposition of the type locality.

Diagnosis: Males can be recognised by the embolus with a narrow base, with a much broader distal coil that has a short, distally directed tip (Fig. 94).

Remarks: The carapace of the male holotype is somewhat deformed and is considerably broader on the right side. Consequently, the CW:PERW ratio is much higher in this species than in congeners. The second male that was available for study (collected 12.III.1996 from the type locality) is very badly damaged with all the legs detached from the body and several missing, and the abdomen separated from the cephalothorax. Due to the very poor condition of the specimen it is not designated as a paratype.

Male (holotype, Uzungwa, ZMUC). Measurements: CL 3.23, CW 2.90, AL 3.30, AW 1.35, TL 6.65 (4.90–6.65), FL 0.28, SL 1.37, SW 1.37, AME–AME 0.08, AME–ALE 0.01, ALE–ALE 0.55, PME–PME 0.16, PME–PLE 0.07, PLE–PLE 0.57, PERW 0.86, MOQAW 0.53, MOQPW 0.49, MOQL 0.60.

Length of leg segments: I 2.55 + 1.10 + 2.15 + 2.25 + 1.32 = 9.37; II 2.50 + 1.07 + 2.00 + 2.20 + 1.25 = 9.02; III 2.40 + 1.05 + 1.92 + 2.35 + 1.15 = 8.87; IV 3.18 + 1.15 + 2.50 + 3.50 + 1.10 = 11.43.

General appearance as in Fig. 46. Carapace creamy-yellow, eye region mottled black, entire clypeus black; paired black mediolateral markings from cephalic region to posterior slope; pale along midline, with small narrow oval black marking in front of fovea; striae pale brown with black mottling, radiating from fovea, directed at coxae; lateral margins with narrow black fringe, with large black spots between palpal coxae and leg I coxae, and between all leg coxal pairs; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance equal to ⅓ their diameter; AME separated from ALE by distance less than ⅒ AME diameter; clypeus height slightly larger than ⅘ AME diameter; PER procurved, laterals slightly larger than medians; PME separated by distance slightly larger than ⅘ their diameter; PME separated from PLE by distance slightly less than ⅓ PLE diameter; CW:PERW = 3.37:1. Chelicerae pale orange-brown with black mottling, yellow-brown prolaterally at distal end, with finely plumose curved setae on promargin; promargin with two teeth separated by nearly double the basal width of proximal tooth, proximal tooth very small, distal tooth much larger; retromargin with two teeth separated by approximately ¼ their basal width, distal tooth slightly smaller, close to fang base. Endites creamy-orange, cream prolaterally distally; labium creamy-orange, paler distally; sternum creamy-yellow, yellow around borders. Legs yellow, posteriors slightly darker, with faint black mottling; markings covered in black plumose setae, with white plumose setae between them; femora I–IV with faint lateral mottling; patellae I–IV with faint dorsal and lateral mottling; tibiae I–IV with faint broad median bands, darker on III and IV; metatarsi I and II with proximal and distal bands at paired spines, III and IV with proximal, median and distal bands; tarsi without markings. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I pl 2 plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I plv 2 rlv 2, II rl 1 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with pale creamy-grey anterior dorsal scutum, extending slightly past midpoint; dorsum with lateral black stripes with small white spots, fused posteriorly; cream medially except small black spots anteriorly and behind midpoint of dorsum; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; markings covered in black plumose and short straight setae, with white plumose and brown short straight setae between them; venter cream, densely covered in white short straight and white plumose setae; epigastric scutum creamy-yellow; ventral sclerite absent; inframamillary sclerite orange. Male palp creamy-yellow, cymbium yellow; tegulum pear-shaped, yellow-orange, with orange-brown ducts; embolus with narrow base and single coil, much broader that base, with short, distally directed tip (Figs 94, 133, 134).

Female: unknown.

Type material: Holotype ♂: **TANZANIA:** *Iringa Region*: Mufindi District, Uzungwa Scarp Forest Reserve, 08°31.58'S, 35°54'E, 750m a.s.l., leg. S. McKamey *et al.*, 7.III.1996 (canopy fog 36) (ZMUC).

Additional material examined: TANZANIA: *Iringa Region*: Mufindi District, Uzungwa Scarp Forest Reserve, 08°31.58'S, 35°54'E, 750m a.s.l., leg. S. McKamey *et al.*, 12.III.1996 (canopy fog 38), 1♂ (ZMUC).

Distribution: Known only from the type locality (Fig. 137).

Biology: Collected by canopy fogging in forests.

11.6.13 *Copuetta wagneri* sp. nov.

Figs 47, 95, 135, 136

Etymology: The species is named for German coleopterist Thomas Wagner, in recognition of the many new species of Corinnidae that he has collected by canopy fogging.

Diagnosis: This species has males with a large compressed embolus with two oblique coils and a narrow elongate tip that is directed at the distal end of the cymbium (Fig. 95).

Male (holotype, Budongo, ZMFK). Measurements: CL 3.38, CW 2.62, AL 3.95, AW 2.15, TL 7.35 (6.90–7.35), FL 0.30, SL 1.51, SW 1.46, AME–AME 0.07, AME–ALE 0.01, ALE–ALE 0.51, PME–PME 0.14, PME–PLE 0.06, PLE–PLE 0.71, PERW 0.97, MOQAW 0.54, MOQPW 0.57, MOQL 0.68.

Length of leg segments: I 3.05 + 1.18 + 2.45 + 2.55 + missing = —; II 3.00 + 1.08 + 2.33 + 2.50 + 1.48 = 10.39; III 2.80 + 1.05 + 2.15 + 2.62 + 1.30 = 9.92; IV 3.65 + 1.25 + 2.95 + 3.97 + 1.60 = 13.42.

General appearance as in Fig. 47. Carapace yellow-brown, eye region grey; broad oval pale mottled black marking mediolaterally, separated from lateral fringe by yellow-brown belt, with small narrow oval black marking in front of fovea; striae brown with black mottling, radiating from fovea, directed between coxae; lateral margins with faint narrow black fringe, with large black spots between leg coxae; markings covered with black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians much larger than laterals; AME separated by distance slightly less than ⅓ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height slightly less than AME diameter; PER procurved, laterals slightly larger than medians; PME separated by distance slightly larger than ⅔ their diameter; PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.70:1. Chelicerae yellow-brown, yellow prolaterally at distal end, with finely plumose curved setae on promargin; promargin with two teeth separated by the basal width of proximal tooth, distal tooth much larger; retromargin with two subequal teeth separated by their basal width, distal tooth close to fang base. Endites yellow-brown, cream prolaterally distally; labium brown, cream distally; sternum yellow, brown around borders. Legs yellow-brown, with faint black mottling laterally and black spots at spine bases; markings covered in black plumose setae, with white plumose setae between them; femora I–IV with faint lateral mottling, many small ventral spots and distal ventral band; patellae I–IV with narrow black proximal line and black distal fringe dorsally; tibiae I–III with faint proximal and distal bands at spine pairs, IV with broad median band; metatarsi I–IV with proximal, median and distal bands at paired spines; tarsi without markings. Leg spination: femora: I pl 2 do 3 rl 1, II pl 2 do 3 rl 1, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I & II with fine proximal and distal do setae, III & IV with proximal seta and distal spine dorsally; tibiae: I pl 1 plv 2 rlv 2, II pl 2 plv 2 rlv 2, III pl 2 do 1 rl 2 plv 2 rlv 1, 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, with rlv 4 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 3 rlv 1. Abdomen with yellow-brown anterior dorsal scutum extending to ⅔ abdomen length; dorsum pale grey, covered in yellow-brown and cream plumose and straight setae, with several black chevrons posteriorly; venter pale grey, covered in yellow-brown short straight and plumose setae; epigastric scutum yellow-brown; ventral sclerite absent, single paired row of tiny sclerites laterally; inframamillary sclerite large, subtriangular, dark yellow-brown. Male palp yellow-brown, cymbium brown, with several thicker bent setae distally (Fig. 70); tegulum pear-shaped, dark orange-brown, with dark red-brown ducts; embolus large, compressed, with two oblique coils and narrow elongate tip directed at the distal end of the cymbium (Figs 95, 135, 136).

Female: unknown.

Type material: Holotype ♂: **UGANDA:** Budongo Forest, 01°45'N, 31°25'E, 1200m a.s.l., leg. T. Wagner, 5–15.I.1997 (canopy fogging 44, dry season, secondary forest, *Rinorea beniensis*) (ZMFK).
Paratype: Same data, canopy fogging 55, 1♂ (ZMFK).

Additional material examined: none.

Distribution: Known only from the type locality (Fig. 137).

Biology: Collected by canopy fogging in forests.

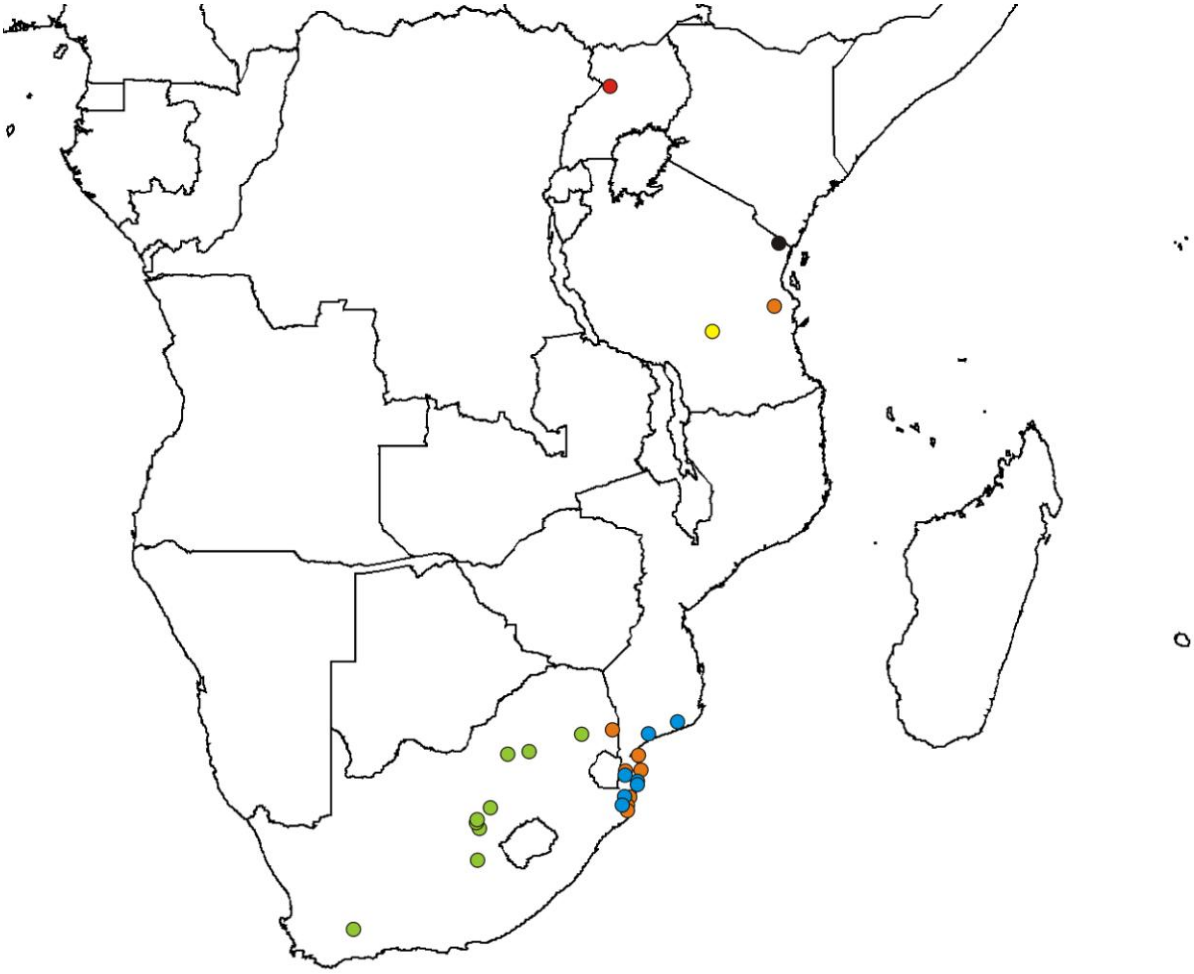


FIGURE 137. Distribution of *Copuetta lotzi* **sp. nov.** (green circles), *C. magna* **sp. nov.** (orange circles), *C. maputa* **sp. nov.** (blue circles), *C. naja* **sp. nov.** (black circle), *C. uzungwa* **sp. nov.** (yellow circle) and *C. wagneri* **sp. nov.** (red circle) in the Afrotropical Region.

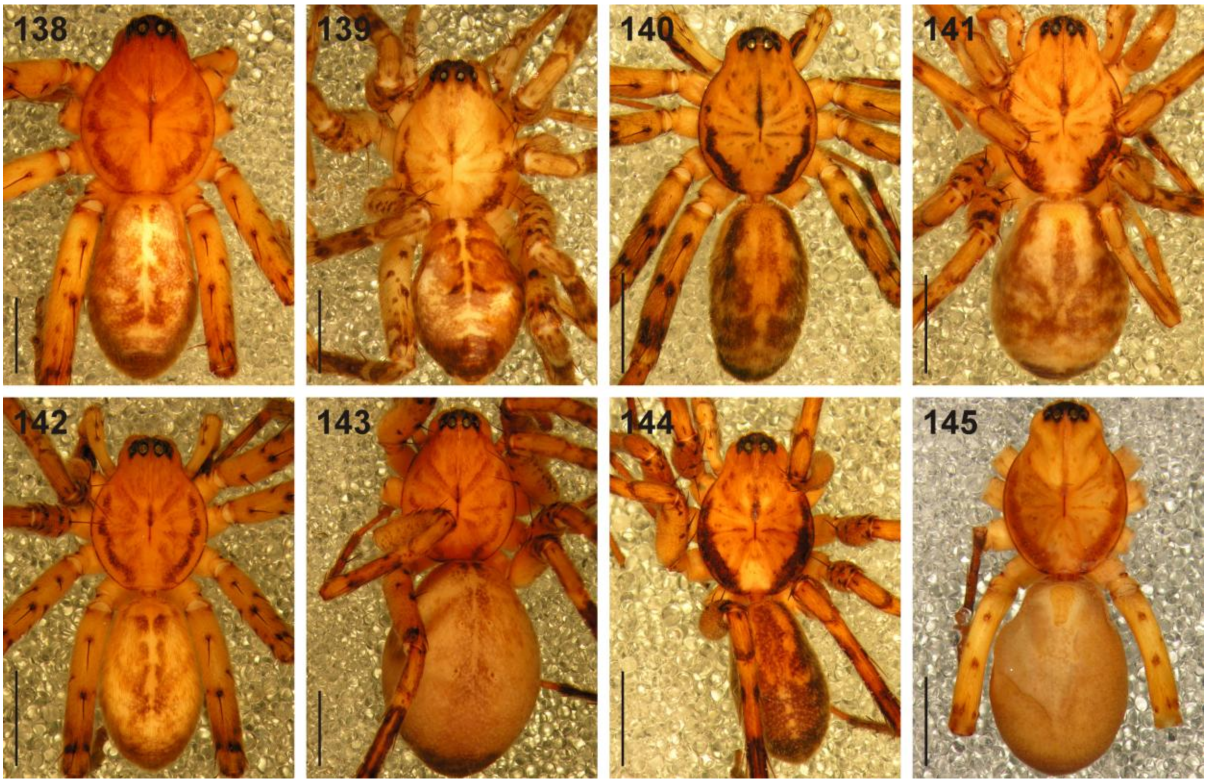
11.7 GENUS *WASAKA* GEN. NOV.

Type species: *W. occulta* **sp. nov.**

Etymology: The genus name is the Swahili word for hunter, referring to the foraging habits of these spiders. Gender feminine.

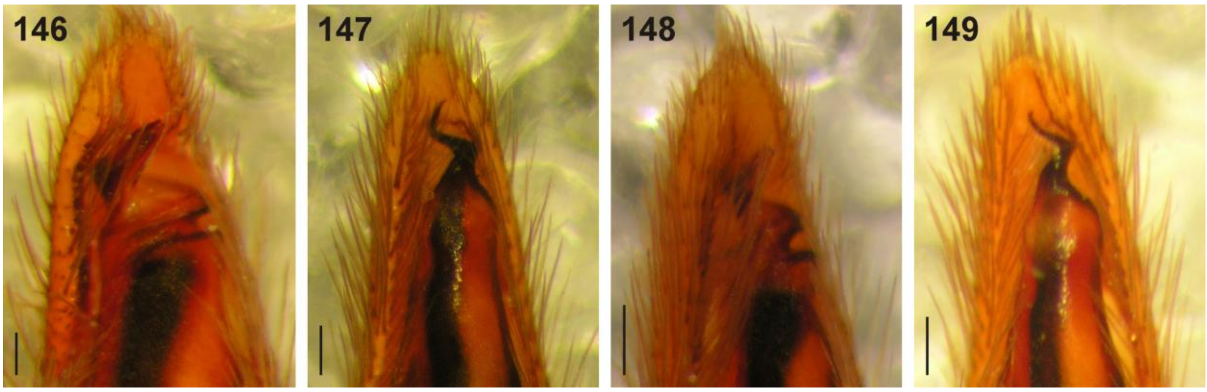
Diagnosis: *Wasaka* **gen. nov.** can be recognised from the other three genera of cryptic lycosiform Castianeirinae from the Afrotropical Region (*Copa*, *Copuetta* **gen. nov.** and *Echinax*) by the presence of three pairs of ventral spines on the anterior tibiae, which are sometimes accompanied by an additional pair of ventral terminal spines, AME only slightly larger than ALE (much larger in the three other genera), the generally flatter carapace, and the metatarsi III that are usually shorter than metatarsi I and II (III longer than I and II in the other three genera).

Description: Medium-sized spiders, 6.55–9.50mm in length; carapace usually pale yellow to yellow-brown with black mottling and lateral markings (Figs 138–145); carapace surface smooth, with black plumose setae covering markings; several long curved setae on clypeus and eye region, isolated posterior to PER as far as midpoint; carapace oval, broadest at coxae II, eye region narrow; fovea distinct, long and narrow; posterior margin very slightly concave. AER procurved, AME slightly larger than ALE; AME separated by ½ or less their diameter, nearly touching ALE; PER slightly procurved, PLE very slightly larger than PME; PME closer to PLE than to each other; MOQ slightly broader posteriorly than anteriorly, length slightly larger than posterior width. Chilum not examined, retracted deep beneath clypeus in all specimens; cheliceral promargin with three teeth, rarely two, retromargin with two teeth; shaggy seta absent; curved setae on cheliceral promargin finely plumose in males and pectinate in females; endites straight laterally, with distinct serrula comprising sharp, ventrally curved denticles, with dense maxillar hair tuft on mesal margins; labium trapezoidal, slightly wider than long. Pleural bars weakly sclerotised, isolated; sternum slightly longer than broad, shield-shaped, slightly narrowed anteriorly, without markings; surface smooth, with many short and long erect straight setae; precoxal triangles present, intercoxal sclerites only reduced to slight expansions of sternal margin, not extending between coxae. Leg formula 4132; legs strongly spined, femora, patellae, tibiae and metatarsi covered in short straight black setae, with black plumose setae on markings and scattered white plumose setae between them, plumose setae sparse on tarsi; retrocoxal window absent on coxa I; femora with many long erect ventral setae; all patellae with proximal and distal long fine dorsal setae; patellar indentation narrow, broad at proximal end; metatarsi III usually shorter and than metatarsi I and II, rarely longer; metatarsi with weak distal scopulae, tarsi with weak scopulae along their entire length; tibiae I and II with long fine dorsal seta at ¾ their length; tibiae, metatarsi and tarsi with several dorsal trichobothria and several short erect setae dorsally and laterally; paired tarsal claws short, situated laterally, with very dense claw tufts between them; metatarsi III and IV without terminal preening brush or comb. Abdomen oval, cream to yellow with mottled black markings (Figs 138–145); three to six pairs of fine straight setae on anterior margin of abdomen above pedicel; dorsal scutum small



FIGURES 138–145. Digital microscope photographs of *Wasaka imitatrix* **sp. nov.** (138, 139), *W. montana* **sp. nov.** (140, 141), *W. occulta* **sp. nov.** (142, 143) and *W. ventralis* **sp. nov.** (144, 145): 138, 140, 142, 144. male habitus, dorsal view; 139, 141, 143, 145. female habitus, dorsal view. Scale bars: 2.0mm.

extending less than ⅔ abdomen length in males, less than ¼ abdomen length in females; two pairs of distinct sclerotised dorsal sigilla present in females, indistinct in males; venter with weakly sclerotised epigastric region, without post-epigastric sclerites and ventral sclerite; inframamillary sclerite distinct, covered in short setae; venter with one or two paired rows of indistinct tiny sclerites from epigastric furrow to spinnerets. Spinnerets (only observed with light microscopy): ALS of male with single major ampullate gland spigot, single large adjacent nubbin and many piriform gland spigots; ALS of female with two major ampullate gland spigots and many piriform gland spigots; PMS of male with one large minor ampullate gland spigot and at least one aciniform gland spigot. PMS of female with three large cylindrical gland spigots, one small prolateral minor ampullate gland spigot and several anterior and prolateral aciniform gland spigots; PLS of male a few aciniform gland spigots; PLS of female with two large cylindrical gland spigots and a few aciniform gland spigots. Male palpal segments without apophyses; cymbium with fine bent setae distally, dorsal surface covered in curved finely plumose setae with; embolus with variable base, degree of compression and length and curvature of distal coil (Figs 146–149). Female epigyne with



FIGURES 146–149. Digital microscope photographs of emboli of *Wasaka* **gen. nov.** species in ventral view: 146. *W. imitatrix* **sp. nov.**; 147. *W. montana* **sp. nov.**; 148. *W. occulta* **sp. nov.**; 149. *W. ventralis* **sp. nov.**. Scale bars = 0.1mm.

strongly sclerotised 6-shaped epigynal ridges or weakly sclerotised round or coiled ridges laterall, enclosing or leading to copulatory openings; copulatory ducts variable, short or long, broad or narrow, directed anteriorly or transversely before entering ST II; ST II usually broad and oval, ST I short and broad.

Key to the species of the genus *Wasaka* gen. nov.

1 Males...2
– Females..5
2 Embolus with broad base, longitudinally compressed, with retrolaterally directed tip (Figs 146, 148)..3
– Embolus with narrow base and fine distal section, tip directed towards distal end of cymbium (Figs 147, 149)..4
3 Base of embolus nearly transverse, distal margin of embolus tip at 30° to longitudinal axis of palp (Fig. 146)...*W. imitatrix* **sp. nov.**
– Base of embolus oblique, distal margin of embolus tip at 45° to longitudinal axis of palp (Fig. 148)...*W. occulta* **sp. nov.**
4 Distal section of embolus coil transverse, with nearly 90° bend; tip long, directed distally and slightly retrolaterally (Fig. 147)..*W. montana* **sp. nov.**
– Distal section of embolus oblique, with slight distal curve; tip short, directed distally and slightly prolaterally (Fig. 149)...*W. ventralis* **sp. nov.**

5 Epigyne with large, strongly sclerotised 6-shaped ridges; copulatory ducts very short, directed anteriorly (Figs 152, 160)..6

– Female with weakly sclerotised coiled or round ridges; copulatory ducts long, directed transversely towards ST II (Figs 156, 164)...7

6 Epigynal ridges nearly meeting medially; copulatory openings slightly curved (Fig. 152)...*W. imitatrix* **sp. nov.**

– Epigynal ridges clearly separated medially; copulatory openings strongly curved (Fig. 160)...*W. occulta* **sp. nov.**

7 Copulatory openings curved towards posterior; copulatory ducts broad, initially directed towards midline of epigyne (Fig. 156)...*W. montana* **sp. nov.**

– Copulatory openings curved towards anterior; copulatory ducts narrow, initially directed laterally and posteriorly before bending towards midline of epigyne (Fig. 164)................... ....*W. ventralis* **sp. nov.**

11.7.1 *Wasaka imitatrix* sp. nov.

Figs 138, 139, 146, 150–153

Etymology: The species name is Latin for “resembling”, referring to the similarity in genitalic morphology of this species and *W. occulta* **sp. nov.**.

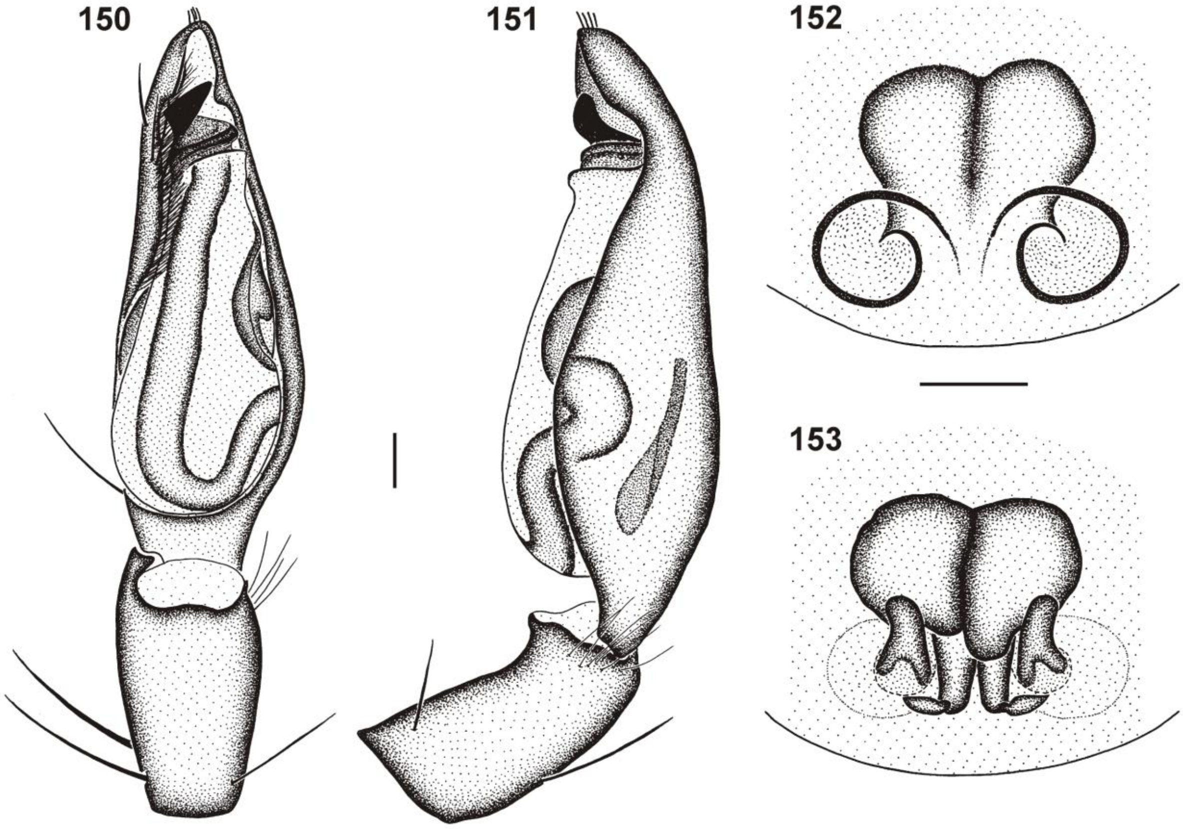
Diagnosis: This species is most closely related to *W. occulta* **sp. nov.**, from which the males can be separated by the more longitudinally compressed coils and more transversely orientated embolus tip (compare Figs 146 and 148). Females can be separated from *W. occulta* **sp. nov.** by the longer coiled epigynal ridges that nearly meet medially (clearly separated in *W. occulta* **sp. nov.**) and the less strongly curved copulatory openings (strongly curved in *W. occulta* **sp. nov.**) (compare Figs 152 and 160). In terms of internal structure of the epigyne, *W. imitatrix* **sp. nov.** females have a distinct separation between ST II and ST I, ST II that are as long as broad, and distinct entrance clearly separated from the ST I and II (Fig. 153), while *W. occulta* **sp. nov.** females have a broad fusion between ST I and II, ST II that are nearly twice as long as broad, and very short entrance ducts that are continuous with ST II and partly hidden beneath ST I (Fig. 161).

Remark: The paratype female is darker than the holotype and has more distinct mottling on the legs and markings on the chelicerae, endites, labium and sternum, similar to those described for the male.

Male (paratype, Uzungwa, USNM). Measurements: CL 4.38, CW 3.34, AL 4.72, AW 2.95, TL 8.90, FL 0.51, SL 1.86, SW 1.78, AME–AME 0.10, AME–ALE 0.02, ALE–ALE 0.63, PME–PME 0.22, PME–PLE 0.16, PLE–PLE 0.98, PERW 1.29, MOQAW 0.60, MOQPW 0.69, MOQL 0.73.

Length of leg segments: I 4.43 + 1.70 + 4.20 + 4.10 + 2.20 = 16.63; II missing; III 4.10 + 1.52 + 3.40 + 3.70 + 1.80 = 14.52; IV 4.85 + 1.60 + 4.15 + 5.20 + 2.08 = 17.88.

General appearance as in Figs 138. Carapace bright yellow-orange, eye region grey; paired mediolateral markings comprising large black blotches corresponding to each coxal pair, fused between coxae III and IV; narrow black mottled marking along midline from PME to fovea; orange-brown striae with faint black mottling radiating from fovea, directed between coxae; lateral margins of carapace with narrow mottled black fringe from cephalic region to posterior margin; cephalic region with small black spot beneath each ALE and lateral of each PLE; markings covered with black plumose setae, areas between them in white plumose and short straight setae. All eyes with black rings; AER procurved, medians very slightly larger than laterals; AME separated by distance equal to $^{2}/_{5}$ their diameter; AME separated from ALE by distance less than $^{1}/_{5}$ AME diameter; clypeus height slightly less than $1^{1}/_{5}$ AME diameter; PER slightly procurved, laterals slightly larger than medians; PME separated by distance equal to ⅞ their diameter; PME separated from PLE by distance equal to ⅝ PME diameter; CW:PERW = 2.59:1. Chelicerae bright orange-brown with black mottling, with finely plumose curved setae on promargin; promargin with three adjacent teeth, distal tooth smallest, median tooth largest; retromargin with two teeth separated by basal width of proximal tooth, distal tooth larger, close to fang base. Endites yellow-brown with black mottling, cream prolaterally distally; labium red-brown proximally with black mottling, fading to orange and cream distally; sternum yellow with black mottling, orange-brown around margins, with large black spots at each coxa. Legs (both leg II missing) with cream femora, remaining segments yellow-brown, with black mottling and markings and black spots at spine bases; markings and mottling densely covered in black plumose setae, with yellowish plumose setae between them; femora I, III and IV with black distal band dorsally; patellae I, III and IV with dorsal line proximally, dark mottling laterally and ventrally; tibiae and metatarsi I and III with broken bands proximally, medially and distally; tibiae and metatarsi IV with proximal and median bands fused, distal end with narrow band; tarsi I, III and IV yellow with black mottling. Leg spination (both leg II missing): femora: I pl 3 do 3 rl 3, III pl 3 do 3 rl 3, IV pl 2-3 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I, III & IV with fine proximal and distal do setae; tibiae: I pl 2 rl 2 plv 3 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, IV pl 2-3 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 2 rl 2 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 2. Abdomen with small anterior dorsal scutum extending only to $^1/_{10}$ abdomen length, dorsum mottled grey behind scutum, with several narrow cream chevrons along midline; markings densely covered in black and yellow-brown plumose setae, with scattered brown short straight setae between them; spinnerets surrounded by narrow black ring; venter mottled grey with cream spots, covered in yellow-brown plumose setae and brown short straight setae; epigastric scutum, ventral sclerite and inframamillary sclerite yellow. Male palp bright yellow with dorsal and



FIGURES 150–153. Genitalic morphology of *Wasaka imitatrix* **sp. nov.**: 150. male palp, ventral view; 151. same, retrolateral view; 152. female epigyne, ventral view; 153. same, dorsal view. Scale bars = 0.25mm.

lateral mottled black spots, cymbium dark yellow-brown; tegulum pear-shaped, orange, with black ducts; embolus with broad, nearly transverse oblique base, proximal coil strongly compressed and narrowly separated from base, embolus tip triangular, nearly transverse, directed retrolaterally (Figs 146, 150, 151).

Female (holotype, Amani, CAS, CASENT 9033285). Measurements: CL 3.38, CW 2.58, AL 3.75, AW 2.25, TL 7.00 (7.00–8.00), FL 0.31, SL 1.49, SW 1.38, AME–AME 0.11, AME–ALE 0.02, ALE–ALE 0.51, PME–PME 0.16, PME–PLE 0.10, PLE–PLE 0.76, PERW 1.00, MOQAW 0.48, MOQPW 0.55, MOQL 0.56.

Length of leg segments: I 3.15 + 1.24 + 2.80 + 2.65 + 1.45 = 11.29; II 3.05 + 1.18 + 2.63 + 2.58 + 1.37 = 10.81; III 3.00 + 1.20 + 2.40 + 2.67 + 1.30 = 10.57; IV 3.73 + 1.30 + 2.95 + 3.90 + 1.25 = 13.13.

General appearance as in Fig. 139, female more robustly built than male. Carapace cream, markings and setae as for male but slightly smaller. All eyes with black rings; AER procurved, medians very slightly larger than laterals; AME separated by distance slightly less than ½ their diameter; AME separated from ALE by distance approximately ⅒ AME diameter; clypeus height slightly less than AME diameter; PER slightly procurved, laterals slightly larger than medians; PME separated by distance equal to ¾ their diameter; PME separated from PLE by distance equal to ½ PME diameter; CW:PERW = 2.58:1. Chelicerae cream, with pectinate curved setae on promargin; dentition as for male. Endites, labium and sternum cream, without markings. Legs cream, with black mottling and markings and black spots at spine bases; markings and mottling covered in black plumose setae, with yellowish plumose setae between them; femora I–IV with faint black mottled band distally; patellae I–IV with black mottling laterally, ventrally and distally; tibiae I–III with black mottling between spine pairs, IV with broad median black band, absent from proximal and distal ends; metatarsi I–IV with faint proximal, median and distal bands; tarsi I–IV cream. Leg spination: femora: I pl 3 do 3 rl 2, II pl 3 do 3 rl 3, III pl 3 do 3 rl 3, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I pl 2 rl 2 plv 3 rlv 3, II pl 2 rl 2 plv 3 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 2 rl 2 plv 2 rlv 2, II pl 2 rl 2 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 2 do 1 rl 1, with rlv 8 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with tiny creamy-yellow dorsal scutum on anterior surface; dorsum cream, densely covered in golden plumose setae with scattered patches of black plumose setae, giving mottled appearance, posterior ⅕ of abdomen covered in black plumose setae with scattered yellowish plumose setae; dorsum cream along midline, with a few short narrow chevrons, paired black spots medially just posterior to midpoint; spinnerets surrounded by black ring dorsally and laterally, absent ventrally; venter cream, covered in white plumose and short straight setae, with many long erect straight setae; epigastric scutum weakly sclerotised, creamy-yellow; inframamillary sclerite yellow-orange. Epigyne with large strongly sclerotised 6-shaped ridges laterally in posterior half of epigyne, nearly meeting along midline, with curved copulatory openings (Fig. 152); copulatory ducts short, slightly longer than broad, directed anteriorly, entering anterior ST II posterolaterally; ST II more than twice as broad as ST I, narrowly joined, clearly separate structures; ST I narrow and elongate, situated posteriorly (Fig. 153).

Type material: Holotype ♀: **TANZANIA:** *Tanga Region*: East Usambara Mountains, Amani, 05°05.7'S, 38°38'E, 950m a.s.l., leg. C.E. Griswold, N. Scharff & D. Ubick, 27.X–9.XI.1995 (forest) (CAS, CASENT 9033285).

Paratypes: **TANZANIA:** Iringa District, Uzungwa Scarp Forest Reserve, 11km SE Masisiwe, Kihanga stream, 08°22'05.7"S, 35°58'41.6"E, 1800m a.s.l., leg. ZMUC & USNM expedition, 17–27.V.1997 (canopy), 1♂ 1♀ (USNM).

Additional material examined: none.

Distribution: Known only from two localities in eastern Tanzania (Fig. 166).

Biology: Collected in forests but details of the sampling methodology are unknown.

11.7.2 *Wasaka montana* sp. nov.

Figs 140, 141, 147, 154–157

Etymology: The species name refers to the high altitude Afromontane habitats in which these spiders occur.

Diagnosis: Males can be easily recognised by the fine embolus with a narrow base, complete coil and tip directed distally and slightly retrolaterally (Fig. 147). Females have an epigyne with copulatory openings that are curved towards the posterior, situated laterally of the lateral margins of the spermathecae, with relatively long, nearly transverse copulatory ducts (Fig. 156).

Male (holotype, Kibira, NMBA 16168). Measurements: CL 3.30, CW 2.45, AL 3.75, AW 2.05, TL 7.20 (6.55–7.65), FL 0.24, SL 1.46, SW 1.32, AME–AME 0.09, AME–ALE 0.02, ALE–ALE 0.45, PME–PME 0.15, PME–PLE 0.07, PLE–PLE 0.65, PERW 0.91, MOQAW 0.46, MOQPW 0.52, MOQL 0.56.

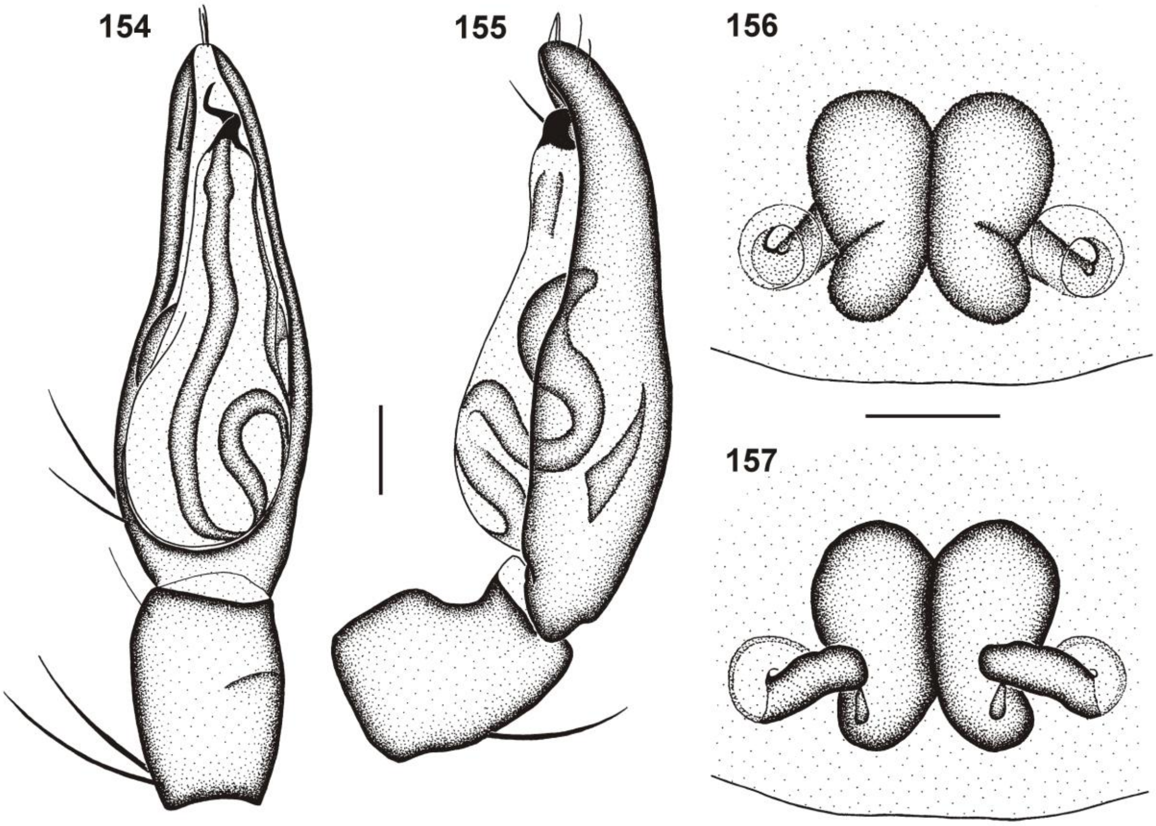
Length of leg segments: I 2.95 + 1.20 + 2.66 + 2.68 + 1.70 = 11.19; II 2.85 + 1.15 + 2.40 + 2.51 + 1.52 = 10.43; III 2.70 + 1.08 + 2.15 + 2.57 + 1.35 = 9.85; IV 3.43 + 1.20 + 2.91 + 3.72 + 1.55 = 12.81.

General appearance as in Fig. 147. Carapace bright yellow with faint black mottling, eye region black; narrow black median line from just behind PME, broadened towards fovea; striae cream, directed at coxae, with small mottled black patches between them; lateral margins with narrow black fringe, with narrow streak at palpal coxae, small spot between coxae I and II and broad black line from middle of coxae III to posterior margin; markings covered in black plumose setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians slightly larger than laterals; AME separated by distance slightly more than ⅖ their diameter; AME separated from ALE by distance less than ⅒ AME diameter; clypeus height equal to distance 1¼ AME diameter; PER slightly procurved, medians and laterals equal in size; PME separated by distance slightly larger than ¾ their diameter; PME separated from PLE by distance equal to ⅜ PLE diameter; CW:PERW = 2.69:1. Chelicerae yellow with faint black mottling prolaterally, creamy-yellow prolaterally at distal end, with finely plumose curved setae on promargin; promargin with three teeth, median tooth largest, distal tooth smallest; proximal and median teeth separated by ½ basal width of proximal tooth, median and distal teeth adjacent; retromargin with subequal two teeth separated by ½ their basal width, distal tooth close to fang base. Endites yellow-brown, cream prolaterally distally; labium pale brown, cream distally; sternum creamy-yellow, darker around borders. Legs with faint black mottling and spots at spine bases; markings covered in black plumose setae, with yellowish plumose setae between them; femora I–IV yellow dorsally, creamy-yellow ventrally, with proximal and distal prolateral and retrolateral spots, I–III with black ventral band distally, IV complete distal band; patellae I–IV yellow-brown with black mottling laterally and ventrally and complete distal band; tibiae I–IV yellow-orange proximally, orange distally, with broad faint black proximal and distal bands; metatarsi I–IV orange-brown, with proximal, median and distal black bands; tarsi I–IV yellow-brown. Leg spination: femora: I pl 3 do 3 rl 2, II pl 3 do 3 rl 2, III pl 2 do 3 rl 3, IV pl 2 do 3 rl 3; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I pl 1 plv 3 rlv 3 vt 2, II pl 2 plv 3 rlv 3 vt 2, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 2, IV pl 2 do 1 rl 2-3 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 rl 1, with rlv 6 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 2. Abdomen with yellow anterior dorsal scutum extending slightly less than ⅔ abdomen length; dorsum with mottled black markings with small white patches laterally; pale along midline with narrow median mottled black marking at ⅓ abdomen length and three posterior chevrons posterior to midpoint; posterior of dorsum with transverse black band above spinnerets; markings covered in black plumose and short straight setae, areas between them with white plumose setae and brown scattered short straight setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream laterally, with broad mottled grey marking from sides of epigastric furrow, tapering posteriorly to spinnerets; venter densely covered in black plumose and short straight setae on marking, white plumose setae laterally; epigastric scutum yellow with black mottling; ventral sclerite absent; inframamillary sclerite orange-brown, covered in small black spot. Male palp cream with lateral and dorsal mottled black spots, cymbium creamy-yellow; tegulum pear-shaped, yellow-orange, with black ducts; embolus with narrow base and fine, complete coil, tip slightly curved, directed distally and slightly retrolaterally (Figs 147, 154, 155).

Female (paratype, Bwindi, CASENT 9033163). Measurements: CL 3.57, CW 2.60, AL 4.00, AW 2.85, TL 7.50, FL 0.30, SL 1.62, SW 1.46, AME–AME 0.10, AME–ALE 0.02, ALE–ALE 0.46, PME–PME 0.13, PME–PLE 0.06, PLE–PLE 0.67, PERW 0.95, MOQAW 0.46, MOQPW 0.53, MOQL 0.56.

Length of leg segments: I 3.00 + 1.20 + 2.55 + 2.41 + 1.55 = 10.71; II 2.85 + 1.15 + 2.30 + 2.33 + 1.45 = 10.08; III 2.65 + 1.15 + 2.10 + 2.40 + 1.25 = 9.55; IV 3.43 + 1.25 + 2.80 + 3.55 + 1.48 = 12.51.

General appearance as in Fig. 141, female more robustly built than male. Carapace creamy, cephalic region yellow, markings and setae as for male, except lateral markings fused. All eyes with black rings; AER procurved, medians slightly larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance less than $^{1}/_{10}$ AME diameter; clypeus height slightly larger than $1^{1}/_{10}$ AME diameter; PER slightly



FIGURES 154–157. Genitalic morphology of *Wasaka montana* **sp. nov.**: 154. male palp, ventral view; 155. same, retrolateral view; 156. female epigyne, ventral view; 157. same, dorsal view. Scale bars = 0.25mm.

procurved, medians and laterals equal in size; PME separated by distance slightly larger than $^{3}/_{5}$ their diameter; PME separated from PLE by distance slightly less than ⅓ PME diameter; CW:PERW = 2.74:1. Chelicerae yellow with two small proximal prolateral blotches, cream prolaterally distally, with pectinate curved setae on promargin; promargin with two teeth separated by distance less than ½ their basal width, proximal tooth slightly larger; retromargin with two teeth separated by ½ their basal width, distal tooth slightly smaller than proximal tooth, close to fang base. Endites pale yellow-brown, cream in distal half; labium pale orange-brown, cream distally; sternum creamy-yellow, darker around borders. Legs creamy-yellow, metatarsi yellow, markings and setae as for male. Leg spination: femora: I pl 3 do 3 rl 1, II pl 2-3 do 3 rl 1, III pl 2 do 3 rl 1, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I plv 3 rlv 3, II plv 3 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, 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, with rlv 5 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1;

tarsi: pl 1 rl 1 plv 3 rlv 1. Abdomen with pale yellow dorsal scutum, extending to ¼ abdomen length; dorsum mottled grey laterally, cream medially, with narrow grey line along midline and three chevrons in posterior half; posterior of dorsum with transverse black band above spinnerets; markings covered in yellow-brown plumose and brown short straight setae, areas between them with cream plumose setae and brown scattered short straight setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream laterally, with broad grey mottled marking from sides of epigastric furrow, tapering to spinnerets; venter densely covered in brown and cream plumose setae and scattered brown short straight setae; epigastric scutum creamy-yellow; inframamillary sclerite orange. Epigyne with indistinct coiled ridges laterally at midpoint of epigyne; copulatory openings small, curved towards posterior (Fig. 156); copulatory ducts nearly transverse, directed medially and slightly anteriorly, entering oval ST II posterolaterally; ST II broadly connected to slightly curved diverging posterior ST I; ST I slightly narrower than ST II (Fig. 157).

Type material: Holotype ♂: **BURUNDI:** *Kayanza Province*: Parc National de la Kibira, Rwegura Sector, 02°55.320'S, 29°30.067'E, 2237m a.s.l., leg. A.H. Kirk-Spriggs, 21–26.XI.2010 (Malaise traps, indigenous Afromontane forest) (NMBA 16168).

Paratypes: **RWANDA:** Nyungwe National Park, 02°30'S, 29°12'E, leg. H. Bosselaers, 11.VIII.2010 (hand catch), 1♂ (MRAC 232768). **UGANDA:** Kabale District, Ruhiza Bwindi Impenetrable National Park, 01°03'S, 29°47'E, 2300m a.s.l., leg. C.E. Griswold, 13–16.IX.1996 (nature trail in forest), 1♂ 1♀ (CAS, CASENT 9033163).

Additional material examined: none.

Distribution: Known only from three localities in central Africa (Fig. 166).

Biology: Collected in Malaise traps and by hand in Afromontane forests above 2200m a.s.l..

11.7.3 *Wasaka occulta* sp. nov.

Figs 142, 143, 148, 158–161

Etymology: The species name is taken from the Latin occultus (hidden, concealed) and refers to the dense fringe of setae along the prolateral edge of the tegular excavation of the cymbium that conceals part of the structure of the male embolus.

Diagnosis: See *C. imitatrix* **sp. nov.** above.

Male (holotype, Mazumbai, CASENT 9033273). Measurements: CL 3.15, CW 2.46, AL 3.60, AW 2.15, TL 6.95 (6.95–8.15), FL 0.30, SL 1.41, SW 1.38, AME–AME 0.07, AME–ALE 0.01, ALE–ALE 0.49, PME–PME 0.13, PME–PLE 0.08, PLE–PLE 0.65, PERW 0.94, MOQAW 0.46, MOQPW 0.51, MOQL 0.54.

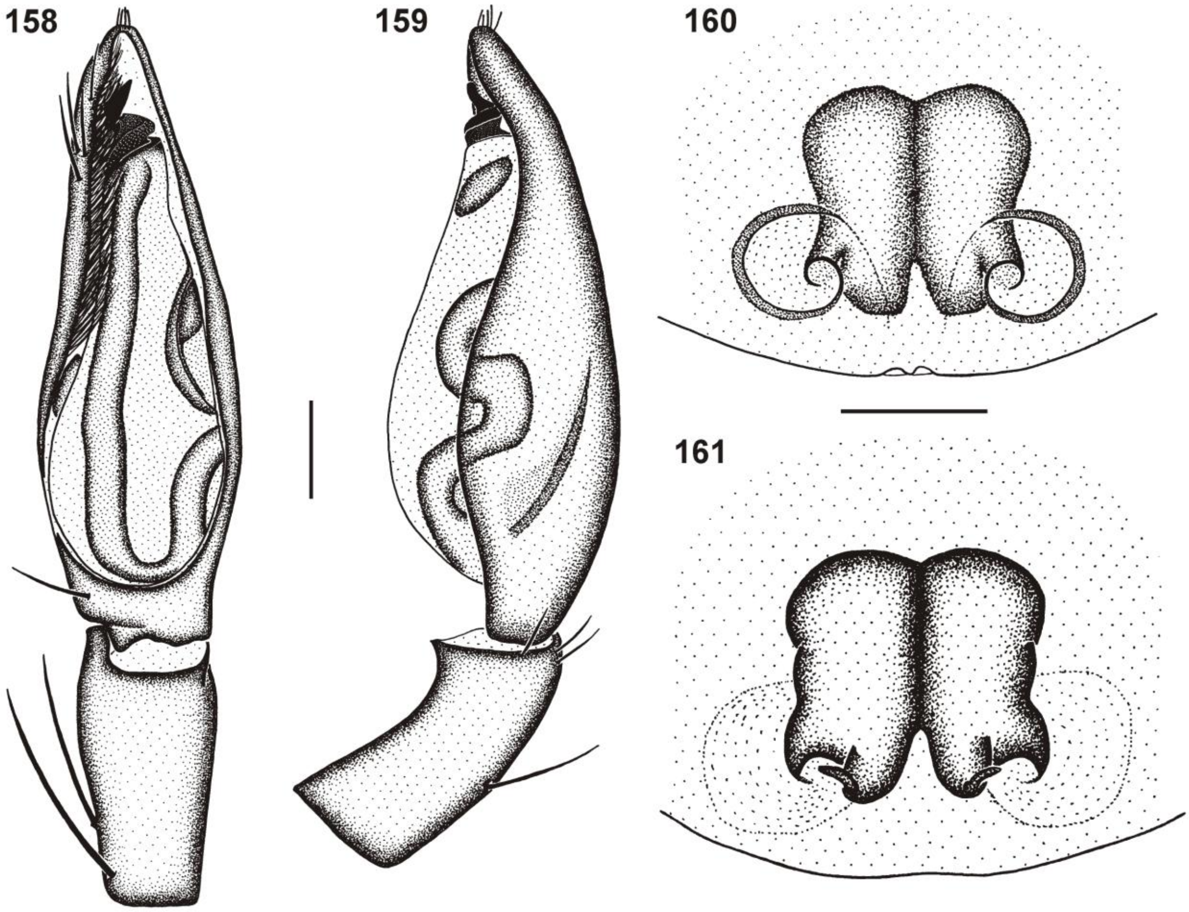
Length of leg segments: I 3.20 + 1.25 + 3.05 + 2.98 + 1.60 = 12.08; II 3.18 + 1.23 + 2.80 + 2.85 + 1.50 = 11.56; III 2.96 + 1.15 + 2.55 + 2.83 + 1.35 = 10.84; IV 3.65 + 1.20 + 3.19 + 4.10 + 1.45 = 13.59.

General appearance as in Fig. 142. Carapace creamy-yellow, cephalic region bright yellow, with faint black mottling, eye region black; two black spots on clypeus at base of curved setae; narrow black median marking in front of fovea; striae yellow, directed between coxae, covered in black mottling; lateral margins with narrow black fringe, with black spots at each coxa between striae, fused between coxae III and IV; markings covered in black plumose and short straight setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians slightly larger than laterals; AME separated by distance slightly less than ⅓ their diameter; AME separated from ALE by distance less than 1⁄10 AME diameter; clypeus height slightly larger than ¾ AME diameter; PER slightly procurved, nearly straight, laterals slightly larger than medians; PME separated by distance slightly less than ⅔ their diameter; PME separated from PLE by distance equal to 2⁄5 PLE diameter; CW:PERW = 2.62:1. Chelicerae yellow proximally, yellow-cream distally, with finely plumose curved setae on promargin; promargin with three teeth, median tooth largest, distal tooth smallest; proximal and median teeth separated by ¼ basal width of proximal tooth, median and distal teeth adjacent; retromargin with subequal two teeth separated by slightly less than their basal width, distal tooth close to fang base. Endites yellow-brown, cream prolaterally distally; labium pale orange-brown, cream distally; sternum creamy-yellow, darker around borders. Legs with faint black mottling and spots at spine bases, posteriors slightly darker than anteriors; markings covered in black plumose setae, with yellowish plumose setae between them; femora I–IV creamy-yellow, with proximal and distal prolateral and retrolateral spots and many small ventral spots, III and IV with faint distal band; patellae I–IV cream, distal end fringed with black, with short proximal narrow stripe dorsally and faint black mottling laterally and ventrally; tibiae I–III with scattered small black patches and faint bands corresponding to paired ventral spines, IV with broad mottled median band; metatarsi I and II with small black spots, III and IV with mottled proximal, median and distal black bands; tarsi I–IV yellow. Leg spination: femora: I pl 3 do 3 rl 3, II pl 3 do 3 rl 3, III pl 2-3 do 3 rl 3, IV pl 2 do 3 rl 2; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I pl 2 rl 2 plv 3 rlv 3, II pl 2 rl 2 plv 3 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 2 rl 2 plv 2 rlv 2, II pl 2 rl 2 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 rl 1, with rlv 6 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 2 plv 1; tarsi: pl 1 plv 4. Abdomen with creamy-yellow anterior dorsal scutum extending slightly more than ½ abdomen length; dorsum cream with black mottling, cream along midline with several short broad chevrons, surrounded by dense black mottling, giving the appearance of black spots; posterior of dorsum dark grey, spinnerets surrounded with black ring; markings densely covered in black straight and plumose setae, interspersed with white plumose setae on chevrons and laterally; venter cream, covered in white short straight setae with scattered plumose setae; epigastric scutum cream; ventral sclerite absent, two paired rows of tiny sclerites present from epigastric furrow to spinnerets; inframamillary sclerite orange with black mottled spot anteriorly. Male palp yellow, cymbium yellow-brown; tegulum pear-shaped, bright orange, with nearly black ducts; embolus with broad oblique base, broad compressed coil and distal section triangular and directed at near 45° retrolaterally and distally (Figs 148, 158, 159).

Female (paratype, Mazumbai, ZMUC). Measurements: CL 3.90, CW 3.05, AL 5.90, AW 4.25, TL 9.50, FL 0.32, SL 1.73, SW 1.70, AME–AME 0.11, AME–ALE 0.01, ALE–ALE 0.59, PME–PME 0.16, PME–PLE 0.06, PLE–PLE 0.73, PERW 1.12, MOQAW 0.56, MOQPW 0.59, MOQL 0.62.

Length of leg segments: I 3.75 + 1.55 + 3.35 + 3.20 + 1.78 = 13.63; II 3.80 + 1.48 + 3.18 + 3.15 + 1.60 = 13.21; III 3.45 + 1.45 + 2.85 + 3.10 + 1.50 = 12.35; IV 4.25 + 1.44 + 3.50 + 4.50 + 1.65 = 15.34.

General appearance as in Fig. 143, female more robustly built than male. Carapace creamy-orange, markings and setae as for male but less distinct. All eyes with black rings; AER procurved, medians slightly larger than laterals; AME separated by distance slightly less than ½ their diameter; AME separated from ALE by distance less than ⅒ AME diameter; clypeus height slightly less than AME diameter; PER slightly procurved, laterals slightly larger than medians; PME separated by distance slightly less than ¾ their diameter; PME separated from



FIGURES 158–161. Genitalic morphology of *Wasaka occulta* **sp. nov.**: 158. male palp, ventral view; 159. same, retrolateral view; 160. female epigyne, ventral view; 161. same, dorsal view. Scale bars = 0.25mm.

PLE by distance slightly larger than ¼ PLE diameter; CW:PERW = 2.72:1. Chelicerae yellow-orange, yellow prolaterally distally, with pectinate curved setae on promargin; promargin with three teeth, median tooth largest, distal tooth smallest; proximal and median teeth separated by ½ basal width of proximal tooth, median and distal teeth by ½ basal width of distal tooth; retromargin with two teeth separated by ½ their basal width, distal tooth slightly smaller than proximal tooth, close to fang base. Endites yellow-brown, cream prolaterally distally; labium orange-brown, cream distally; sternum creamy-yellow, yellow-brown around borders. Legs with faint black mottling and spots at spine bases; markings covered in black plumose setae, with yellowish plumose setae between them; femora I–IV creamy-yellow dorsally, paler ventrally, with proximal and distal prolateral and retrolateral spots, faint distal band and many small ventral spots; patellae I–IV yellow, distal end fringed with black, with short proximal narrow stripe dorsally and faint black mottling laterally and ventrally; tibiae yellow, I and II with small black patches, III and IV with broad median black bands; metatarsi I–III yellow-orange, with faint proximal, median and distal black bands, IV orange-brown, with mottled black band except for at proximal and distal ends; tarsi I–IV orange. Leg spination: femora: I pl 3 do 3 rl 2, II pl 3 do 3 rl 3, III pl 3 do 3 rl 3, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I pl 2 rl 2 plv 3 rlv 3, II pl 2 rl 2 plv 3 rlv 3, III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: I pl 2 rl 2 plv 2 rlv 2, II pl 2 rl 2 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 rl 1, with rlv 4 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 rl 1 plv 2 rlv 1. Abdomen with very small yellow dorsal scutum, restricted to anterior slope of abdomen; dorsum cream, mottled grey medially, with narrow cream line along midline and several fine cream chevrons; posterior of dorsum with transverse black band above spinnerets; markings covered in yellow-brown plumose and brown short straight setae, areas between them with cream plumose setae and brown scattered short straight setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream, densely covered in brown and cream plumose setae and scattered brown short straight setae; epigastric scutum bright yellow; ventral sclerite absent, two paired rows of small sclerites present from epigastric furrow to spinnerets; inframamillary sclerite bright orange. Epigyne with large strongly sclerotised 6-shaped ridges laterally in posterior half of epigyne, clearly separated medially, with strongly curved copulatory openings (Fig. 160); copulatory ducts very short, directed anteriorly, partly hidden beneath ST I, entering anterior ST II posterolaterally; ST II twice as broad as ST I, broadly joined continuous structures; ST I short and narrow, as long as broad, situated posteriorly (Fig. 161).

Type material: Holotype ♂: **TANZANIA:** *Tanga Region*: Lushoto District, Mazumbai Forest Reserve, 04°49'S, 38°31'E, 1400–1800m a.s.l., leg. C.E. Griswold, N. Scharff & D. Ubick, 10–20.XI.1995 (forest, on foliage at night [bit me on hand, sharp pain for few minutes – DU]) (CAS, CASENT 9033273).

Paratypes: **TANZANIA:** *Tanga Region*: Lushoto District, Mazumbai Forest Reserve, 04°49'S, 38°31'E, 1370–1435m a.s.l., leg. S. McKamey *et al.*, 8.XII.1995 (canopy fog 33, *Parinari excelsa*), 1♂ (ZMUC); Same locality, 1370–1435m a.s.l., leg. S. McKamey *et al.*, 4.XII.1995 (canopy fog 31), 1♂ (ZMUC); Same locality, 1650–1730m a.s.l., leg. S. McKamey *et al.*, 11.VII.1995 (canopy fog 6), 1♀ (ZMUC); Same locality, 1370–1435m a.s.l., leg. S. McKamey *et al.*, 4.XII.1995 (canopy fog 31), 1♂ (ZMUC).

Additional material examined: none.

Distribution: Known only from the type locality (Fig. 166).

Biology: Collected by canopy fogging in forests.

11.7.4 *Wasaka ventralis* sp. nov.

Figs 144, 145, 149, 162–165

Etymology: The species name refers to the bold ventral abdominal markings of this species.

Diagnosis: The males of this species can be recognised by the short narrow embolus with narrow base and transverse distal section of the coil with a slightly curved, distally directed tip (Fig. 149). Females have widely separated lateral copulatory openings that are curved towards the anterior (towards posterior in *C. montana* **sp. nov.**) and narrow copulatory ducts with a distinct lateral loop (broad and directly transverse in *C. montana* **sp. nov.**) (Figs 164, 165).

Remarks: The paratype female is in relatively poor condition and all of the legs but one (left leg IV) are broken off and both pairs of anterior legs are missing (Fig. 145). The body of the specimen is, however, good enough for most of the measurements to be provided in the description.

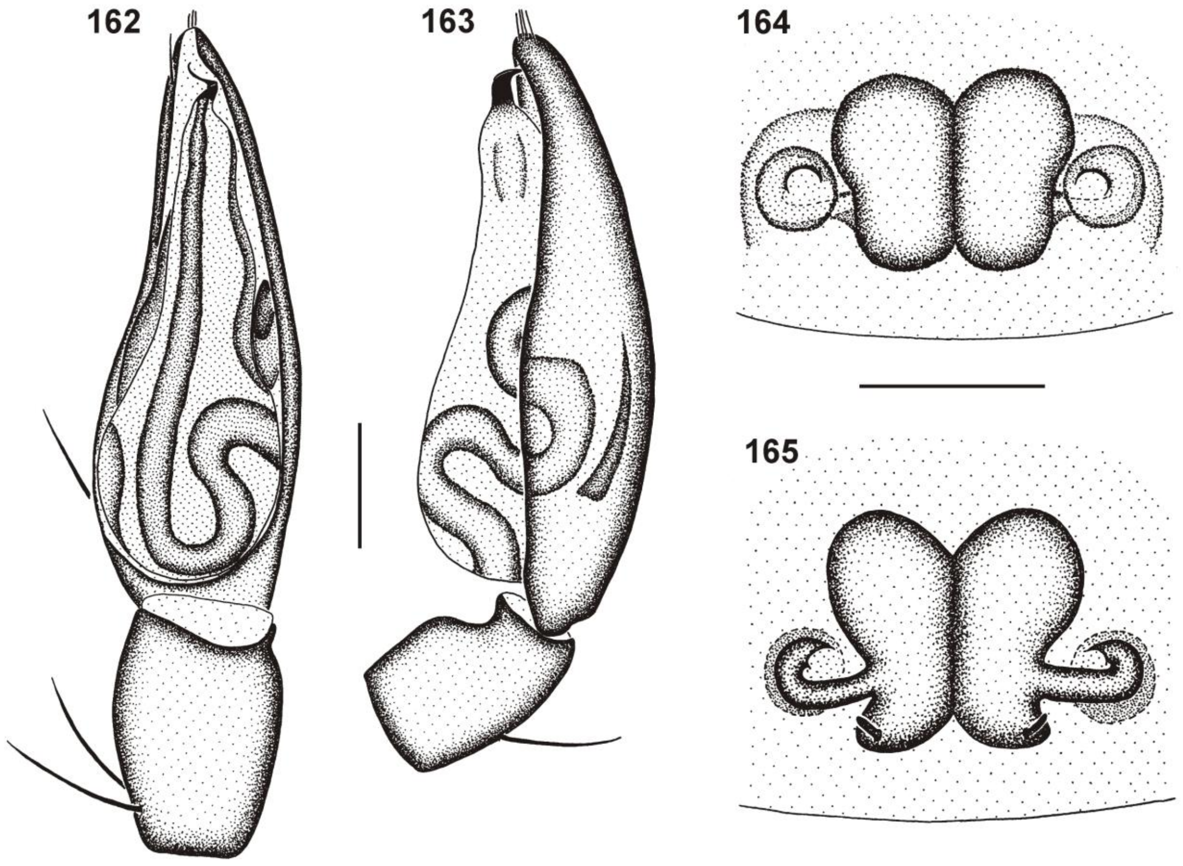
Male (holotype, Lake Oku, CASENT 9033101). Measurements: CL 3.50, CW 2.56, AL 3.60, AW 2.15, TL 7.25 (6.60–7.25), FL 0.35, SL 1.59, SW 1.46, AME–AME 0.10, AME–ALE 0.02, ALE–ALE 0.45, PME–PME 0.17, PME–PLE 0.06, PLE–PLE 0.60, PERW 0.91, MOQAW 0.45, MOQPW 0.51, MOQL 0.54.

Length of leg segments: I 2.96 + 1.14 + 2.66 + 2.68 + 1.70 = 11.14; II 2.80 + 1.13 + 2.40 + 2.55 + 1.55 = 10.43; III 2.75 + 1.10 + 2.15 + 2.52 + 1.25 = 9.77; IV 3.40 + 1.13 + 2.95 + 3.95 + 1.50 = 12.93.

General appearance as in Fig. 144. Carapace creamy-yellow, cephalic region yellow, with faint black mottling, eye region black; faint black mottling medially behind PER, with narrow black median marking in front of fovea; striae yellow-brown, directed between coxae, each with short mottled black line close to fovea and pair of spots mediolaterally; lateral margins with narrow black fringe and broad black line from posterior of coxae I to posterior margin of carapace; markings covered in black plumose and short straight setae, areas between them covered in white plumose and short straight setae. All eyes with black rings; AER procurved, medians slightly larger than laterals; AME separated by distance slightly less than ½ their diameter; AME separated from ALE by distance equal to $^{1}/_{10}$ AME diameter; clypeus height slightly less than 1¼ AME diameter; PER slightly procurved, nearly straight, laterals very slightly larger than medians; PME separated by distance slightly less than their diameter; PME separated from PLE by distance equal to ⅓ PLE diameter; CW:PERW = 2.81:1. Chelicerae yellow with small prolateral proximal stripe and median spot, with finely plumose curved setae on promargin; promargin with three adjacent teeth, median tooth largest, distal tooth smallest; retromargin with two teeth separated by ¼ their basal width, distal tooth slightly larger, close to fang base. Endites creamy-yellow, cream prolaterally distally; labium orange-brown, cream distally; sternum yellow with small faint black dots, yellow-brown around borders. Legs with faint black mottling and spots at spine bases, posteriors slightly darker than anteriors; markings covered in black plumose setae, with yellowish plumose setae between them; femora I–IV yellow, with distal prolateral and retrolateral spots dorsally, ventrally with many small spots and faint mottled black distal band; patellae I–IV yellow, with short proximal narrow stripe dorsally, faint black mottling laterally and ventrally and complete distal band; tibiae I–IV yellow proximally, yellow-brown distally, with proximal and distal lateral mottling, III and IV with broad mottled band in distal half; metatarsi I–IV orange-brown with faint black proximal, median and distal black bands; tarsi I–IV bright yellow. Leg spination: femora: I pl 3 do 3 rl 2, II pl 2 do 3 rl 3, III pl 2 do 3 rl 2, IV pl 2 do 3 rl 2-4; all femora with scattered erect ventral setae; patellae: I–IV with fine proximal and distal do setae; tibiae: I pl 2 plv 3 rlv 3 vt 2, II pl 2 plv 3 rlv 3 vt 2, III pl 2 do 1-2 rl 2 plv 2 rlv 2 vt 2, IV pl 2 do 1 rl 2 plv 2-3 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, with rlv 4 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 plv 2. Abdomen with broad yellow-orange anterior dorsal scutum extending slightly less than ⅔ abdomen length; large omega-shaped marking on scutum, with black mottling inside marking, on sides of abdomen and behind scutum; posterior with four cream spots with fine lateral chevrons; spinnerets surrounded with black ring; black mottling densely covered in black straight and plumose setae, markings and chevrons covered with white plumose setae; venter cream laterally, with broad black median marking from sides of epigastric furrow to spinnerets, marking covered in black short straight and plumose setae; epigastric scutum creamy-yellow, with black fringe at petiole and epigastric furrow and broad black median marking linking them; ventral sclerite absent, two paired rows of tiny sclerites present from epigastric furrow to spinnerets; inframamillary sclerite small, creamy-yellow. Male palps creamy-yellow, cymbium yellow-brown, with several thicker bent setae distally; tegulum pear-shaped, dark orange-brown, with nearly black ducts; embolus with narrow base, distal section of coil fine, transverse, with a slightly curved, distally directed tip (Figs 145, 149, 162, 163).

Female (paratype, Koutoupi, MRAC 162207). Measurements: CL 3.78, CW 2.84, AL 4.60, AW 3.15, TL 8.40, FL 0.33, SL 1.68, SW 1.56, AME–AME 0.11, AME–ALE 0.01, ALE–ALE 0.54, PME–PME 0.17, PME–PLE 0.10, PLE–PLE 0.73, PERW 1.05, MOQAW 0.53, MOQPW 0.57, MOQL 0.60.

Length of leg segments: I and II missing; III 2.85 + 1.15 + 2.25 + 2.50 + 1.28 = 10.03; IV 3.20 + 1.23 + 3.00 + 3.85 + 1.50 = 12.78.



FIGURES 162–165. Genitalic morphology of *Wasaka ventralis* **sp. nov.**: 162. male palp, ventral view; 163. same, retrolateral view; 164. female epigyne, ventral view; 165. same, dorsal view. Scale bars = 0.25mm.

General appearance as in Fig. 145, female more robustly built than male. Carapace creamy-yellow, cephalic region and sides yellow, eye region black; markings as for male but less distinct, setae rubbed off and not discernible. All eyes with black rings; AER procurved, medians larger than laterals; AME separated by distance equal to ½ their diameter; AME separated from ALE by distance less than $^1/_{10}$ AME diameter; clypeus height equal to $1^2/_5$ AME diameter; PER slightly procurved, laterals slightly larger than medians; PME separated by distance slightly larger than $^4/_5$ their diameter; PME separated from PLE by distance equal to ½ PME diameter; CW:PERW = 2.70:1. Chelicerae yellow, without markings, with pectinate curved setae on promargin; dentition as for male. Endites creamy-yellow, cream prolaterally distally; labium yellow-orange, cream distally; sternum yellow, slightly darker around borders. Legs with femora, patellae and tarsi yellow, tibiae and metatarsi yellow-brown; markings and setae as for male. Leg spination (both legs I and II missing): femora: III pl 2 do 3 rl 2, IV pl 2 do 3 rl 1; all femora with scattered erect ventral setae; patellae: III and IV with fine proximal and distal do setae; tibiae: III pl 2 do 1 rl 2 plv 2 rlv 2 vt 1, IV pl 2 do 1 rl 2 plv 2 rlv 2 vt 2; metatarsi: 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 3, with rlv 4 erect setae; patellae: pl 1 do 2; tibiae: pl 1 do 1 plv 1; tarsi: pl 1 rl 1 plv 3 rlv 2. Abdomen with yellow-orange anterior dorsal scutum extending to $^1/_5$ abdomen length; dorsum cream with faint grey mottling, pale medially in anterior quarter; posterior of dorsum mottled grey; dorsum covered in yellow-brown plumose and brown short straight setae; spinnerets surrounded by narrow black ring dorsally and laterally, absent ventrally; venter cream laterally, with broad dark grey mottled marking from sides of epigastric furrow to spinnerets, marking covered in black short straight and plumose setae; epigastric scutum yellow; ventral sclerite absent, two paired rows of indistinct cream sclerites present from epigastric furrow to spinnerets; inframamillary sclerite small, pale creamy-yellow. Epigyne with weakly sclerotised round lateral ridges with copulatory openings that are curved towards anterior (Fig. 164); copulatory ducts narrow, initially directed laterally, looping towards posterior and then transversely, entering ST II posterolaterally; ST II oval, broadly joined to subtriangular divergent posterior ST I; ST I clearly narrower than ST II (Fig. 165).

Type material: Holotype ♂: **CAMEROON:** *North-West Province*: Menchum Division, near Lake Oku, 06°12'N, 10°27'E, ca. 2150m a.s.l., leg. C. Griswold, S. Larcher, N. Scharff & C. Wanzie, 7–13.II.1992 (CAS, CASENT 9033101).

Paratypes: **CAMEROON:** Mbam Mountain area, near Koutoupi, W. Slope, 05°54'N, 10°44'E, 1550m a.s.l., leg. Bosmans & Van Stalle, 30.III–3.IV.1983 (pitfalls, gallery forest), 1♀ (MRAC 162207); Same data as holotype, 1♂ (ZMUC).

Additional material examined: none.

Distribution: Only known from two montane localities in Cameroon (Fig. 166).

Biology: A forest-dwelling species, of which one specimen was collected in pitfall traps.

FIGURE 166. Distribution of *Wasaka imitatrix* **sp. nov.** (green circles), *W. montana* **sp. nov.** (yellow circles), *W. occulta* **sp. nov.** (red circle) and *W. ventralis* **sp. nov.** (blue circles) in the Afrotropical Region.

11.8 DISCUSSION

The two new genera described in the current study, *Copuetta* and *Wasaka*, are cryptically coloured spiders that closely resemble *Copa* and *Echinax* species in general appearance. All four genera have similar colouration to wolf spiders (Lycosidae) in the longitudinal stripes on the carapace and the mottled patterns of the abdomen. *Copa* is the only one of these four genera that is exclusively ground-dwelling, although some species of each of the other the genera have been collected from the soil. The majority of the species of each are arboreal. All species that I have collected by hand (*C. erecta*, *C. lacustris*, *C. lotzi*, *C. magna* and *C. martini*) are nocturnally active.

Two of the *Copuetta* species (*C. erecta* and *C. martini*), and to a lesser extent *C. magna*, dominated the corinnid fauna sampled from blue tsetse fly traps in coastal forest in eastern South Africa (Dippenaar-Schoeman, Esterhuizen & Haddad, unpubl.). The first two mentioned species are endemic to the Maputaland-Pondoland-Albany (MPA) centre of endemism (CE) that extends from the Thicket Biome in the Eastern Cape Province along the east coast to Xai-Xai in southern Mozambique. While most of the records of *C. magna* also fall in MPA, the single record from Tanzania suggests that this species is more widely distributed, also occurring in the adjacent East African Coastal Forests CE.

Two species occurring further inland in southern Africa display wide habitat tolerance: *C. lacustris* occurs in grassland, karoo, savanna and forest habitats, while *C. lotzi* appears to be more specialised, only occurring in more arid grassland and karoo habitats. Specimens of *C. lotzi* were collected from the base of grass tussocks, leaf litter, under rocks and in pitfalls, suggesting that this species is ground-dwelling, which differs from the other species in the genus. In contrast, *C. lacustris* was common in leaf litter and under bark of exotic *Eucalyptus* trees. The majority of *C. lacustris* records originate from human habitation and this species is clearly synanthropic. Several other species (*C. lotzi*, *C. martini* and *C. erecta*) were occasionally collected in human habitation in southern Africa.

Apart from the aforementioned species, most of the remaining *Copuetta* and *Wasaka* species also seem to be distributed in important centres of endemism: *C. comorica* is endemic to the Indian Ocean Islands CE; *W. ventralis* is endemic to the Guinean Forests of West Africa CE; *C. litipo*, *C. kwamgumi*, *C. naja* and *W. occulta* are endemic to the East African Coastal Forests CE; and lastly, *C. kakamega*, *C. uzungwa* and *W. montana* are endemic to the Eastern Afromontane CE.

Given the rather small distribution ranges of most species of *Copuetta* and *Wasaka*, it is likely that additional species await discovery, especially from tropical Central and East Afrrica. Canopy fogging undertaken in isolated, poorly sampled areas is likely to prove very productive, as has been the case in samples taken so far from Tanzania.

11.9 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.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual.* Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

HADDAD, C.R. 2004. A revision of the African spider genus *Graptartia* Simon, 1896 (Araneae: Corinnidae). *African Entomology* **12:** 71–81.

HADDAD, C.R. 2005. A redescription of *Corinna natalis* Pocock, 1898 (Araneae, Corinnidae), Africa's largest dark sac spider, with natural history notes. *Journal of Afrotropical Zoology* **2:** 27–32.

LEHTINEN, P.T. 1967. Classification of cribellate spiders and some allied families, with notes on the evolution of the suborder Araneomorpha. *Annales Zoologici Fennici* **4:** 199–463.

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

LYLE, R. & HADDAD, C.R. 2009. *Planochelas*, a new genus of tracheline sac spiders from West and Central Africa. *Annals of the Transvaal Museum* **46:** 91–100.

LYLE, R. & HADDAD, C.R. 2010. A revision of the tracheline sac spider genus *Cetonana* Strand, 1929 in the Afrotropical Region, with descriptions of two new genera (Araneae: Corinnidae). *African Invertebrates* **51:** 321–384.

MURPHY, J.A. 2007. *Gnaphosid genera of the world*. Volume 1 (text). British Arachnological Society, St. Neots, 92 pp.

PLATNICK, N.I. 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.

PLATNICK, N.I. 2011. The World Spider Catalog, Version 12.0. American Museum of Natural History, New York. Available at: http://research.amnh.org/entomology/spiders/catalog; accessed 30 May 2011.

POCOCK, R.I. 1898. The Arachnida from the province of Natal, South Africa, contained in the collection of the British Museum. *Annals and Magazine of Natural History* **2:** 197–226.

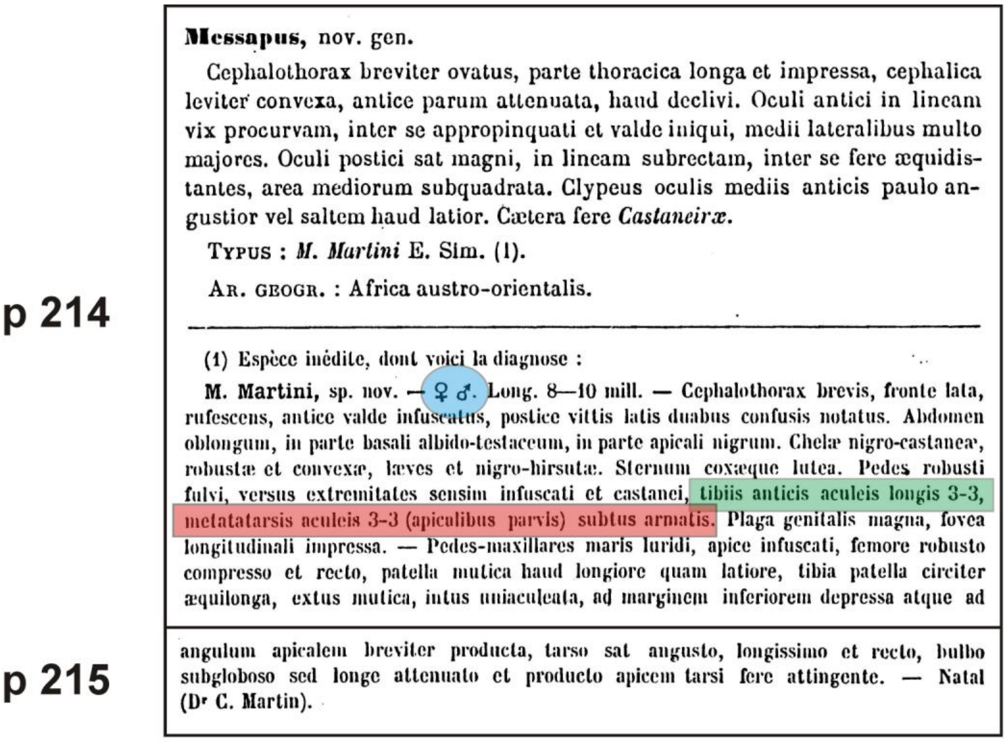
REISKIND, J. 1969. A spider subfamily Castianeirinae of North and Central America (Araneae, Clubionidae). *Bulletin of the Museum of Comparative Zoology* **138:** 163–325.

SIMON, E. 1898. *Histoire naturelle des araignées*. Tomé 2, pp. 193–380. *Librairie Encyclopédique de Roret*, Paris.

STRAND, E. 1907. Vorläufige Diagnosen afrikanischer und südamerikanischer Spinnen. *Zoologischer Anzeiger* **31:** 525–558.

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.

APPENDIX 1: Excerpt from Simon (1898) of the genus description of *Messapus* and the footnote on pages 214 and 215 containing the description of its type species, *M. martini* Simon, 1898. Blue circle indicates the order of the sex symbols, green highlighted text the tibial spination and red highlighted text the metatarsal spination.



Messapus, nov. gen.

Cephalothorax breviter ovatus, parte thoracica longa et impressa, cephalica leviter convexa, antice parum attenuata, haud declivi. Oculi antici in lineam vix procurvam, inter se appropinquati et valde iniqui, medii lateralibus multo majores. Oculi postici sat magni, in lineam subrectam, inter se fere æquidistantes, area mediorum subquadrata. Clypeus oculis mediis anticis paulo angustior vel saltem haud latior. Cætera fere *Castaneiræ.*

TYPUS : *M. Martini* E. Sim. (1).

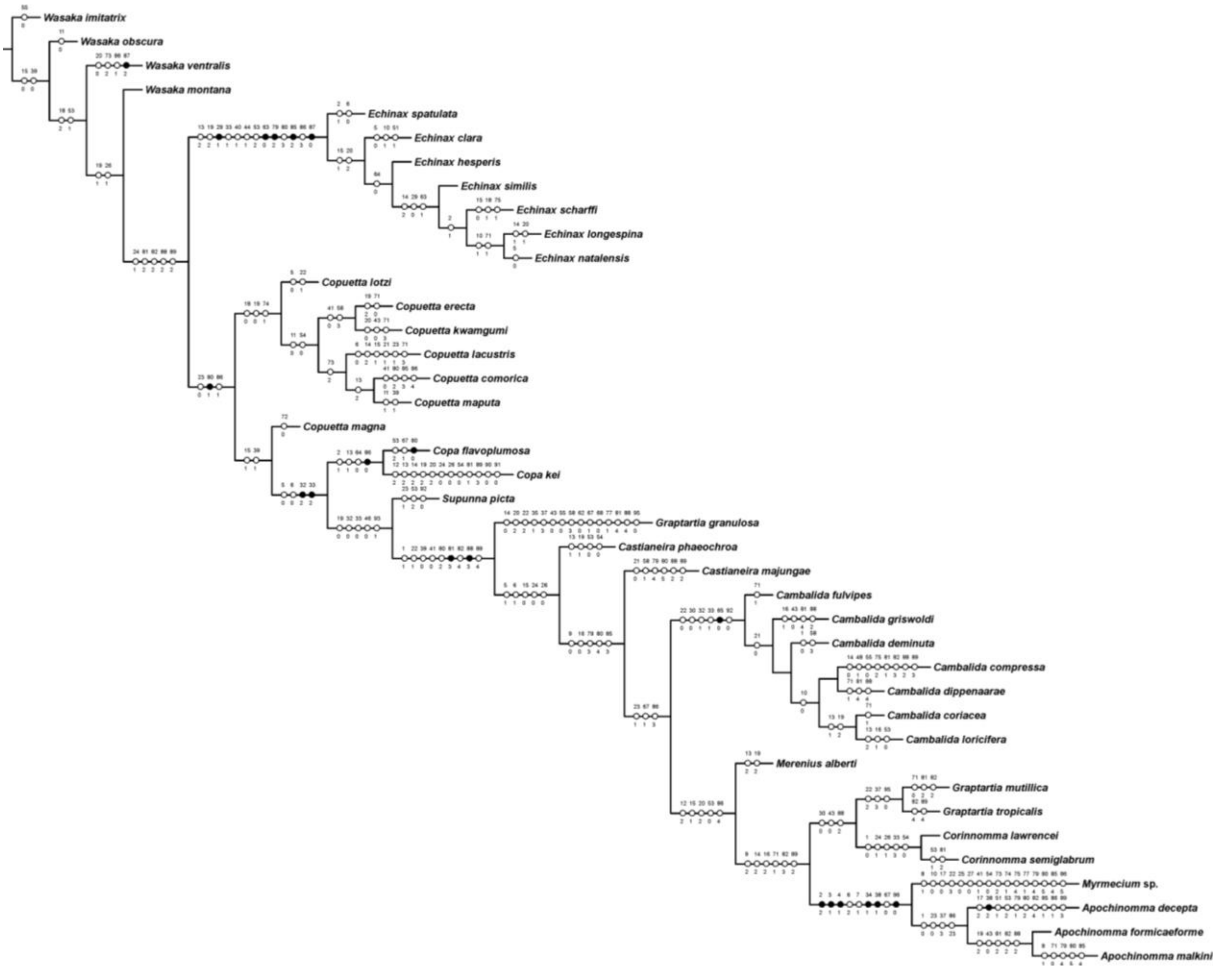
AR. GEOGR. : Africa austro-orientalis.

---

(1) Espèce inédite, dont voici la diagnose :

M. Martini, sp. nov. — ♀ ♂. Long. 8—10 mill. — Cephalothorax brevis, fronte lata, rufescens, antice valde infuscatus, postice vittis latis duabus confusis notatus. Abdomen oblongum, in parte basali albido-testaceum, in parte apicali nigrum. Chelæ nigro-castaneæ, robustæ et convexæ, læves et nigro-hirsutæ. Sternum coxæque lutea. Pedes robusti fulvi, versus extremitates sensim infuscati et castanei, tibiis anticis aculeis longis 3-3, metatatarsis aculeis 3-3 (apiculibus parvis) subtus armatis. Plaga genitalis magna, fovea longitudinali impressa. — Pedes-maxillares maris luridi, apice infuscati, femore robusto compresso et recto, patella mutica haud longiore quam latiore, tibia patella circiter æquilonga, extus mutica, intus uniaculeata, ad marginem inferiorem depressa atque ad angulum apicalem breviter producta, tarso sat angusto, longissimo et recto, bulbo subgloboso sed longe attenuato et producto apicem tarsi fere attingente. — Natal (Dr C. Martin).

CHAPTER 12



A preliminary analysis of the phylogenetic relationships of the Afrotropical Castianeirinae (Araneae: Corinnidae)

12.1 ABSTRACT

The current study provides the first comprehensive phylogenetic analysis of the subfamily Castianeirinae (Araneae: Corinnidae) from any of the biogeographical regions. Forty-one ingroup taxa were included of which 39 were Afrotropical, one Australasian (*Supunna picta* (L. Koch, 1873)) and one Brazilian (*Myrmecium* sp.). Outgroup taxa were included from the Trachelinae (3 spp.), Phrurolithinae (1 sp.), Corinninae (3 spp.) and Corinnidae *incertae sedis* (2 spp.), with *Drassodes sesquidentatus* Purcell, 1908 (Gnaphosidae) used to root the trees. Analyses performed with equal and implied weighting in Winclada and TNT, based on a matrix comprising 96 binary and multistate characters, produced broadly similar results, with the included species of each of the corinnid subfamilies usually grouping together. Within the Castianeirinae, there were differences observed in the placements of different genera under equal and implied weighting, although there was relative consistency in the monophyly of each of the genera, except *Graptartia* Simon, 1896, which appears to be polyphyletic. *Creugas* Thorell, 1878, *Medmassa* Simon, 1887 and *Messapus* Simon, 1898 were consistently placed as sister taxa to the Castianeirinae, supporting the recent transfer of *Messapus* to Corinninae and previous proposals that these two subfamilies are sister taxa. These results would also indicate that *Medmassa* (currently placed in Castianeirinae) should be transferred to Corinninae, although this transfer in not formally proposed here. In future, a more comprehensive analysis of the Castianeirinae will need to be carried out, incorporating a more diverse range of castianeirine taxa from outside the Afrotropical Region, as well as several additional new genera to be described from the region.

12.2 INTRODUCTION

The dark- and ant-like sac spiders (Araneae: Corinnidae) of the Afrotropical Region have in recent years been the subject of a concerted taxonomic effort to revise existing genera and describe new genera and species. Considerable advances have been made in documenting the fauna of the region, but large gaps still exist in each of the four subfamilies (Castianeirinae, Corinninae, Phrurolithinae and Trachelinae) that require attention. Despite this, the number of species from the region has increased from 110 at the end of the last century (Dippenaar-Schoeman & Jocqué 1997) to the current 271 species (Platnick 2011). As part of this effort, ten new genera have already been described (Bosselaers & Ledoux 1998; Haddad 2006a, 2009; Haddad & Lyle 2008; Lyle & Haddad 2009, 2010; Jocqué & Bosselaers 2011), but their relationships have not been properly explored in a comprehensive phylogenetic analysis.

The higher level relationships of the Corinnidae are fairly resolved and most phylogenetic analyses have proposed Corinnidae as the sister group of Liocranidae. Together, these two families form a sister clade to the Gnaphosoidea within the Dionycha (Coddington & Levi 1991), although the relationships of the families within the Dionycha and the larger "RTA clade", of which it forms a part, remain largely unresolved (Coddington 2005; Jocqué & Dippenaar-Schoeman 2006).

Considering the recent advances in the systematics of Afrotropical Corinnidae, a brief overview of the papers in which phylogenetic analyses have been included is justified. Bosselaers & Jocqué (2000) included a phylogeny of 34 species of *Hortipes* Bosselaers & Ledoux, 1998 known from both sexes in their revision, with the liocranid genera *Andromma* Simon, 1893 and *Corysipphus* Simon, 1903 as outgroups. Although *Hortipes* was then placed in Liocranidae, it was later transferred to Corinnidae by Bosselaers & Jocqué (2002), making *Hortipes* the most species-rich genus of Afrotropical Corinnidae.

Bosselaers & Jocqué (2002) published the most comprehensive analysis of the Corinnidae and Liocranidae to date, including 40 species from 14 and 24 genera, respectively. Their results suggested that both families are polyphyletic, but they did not formally divide them into new taxa. They did, however, transfer the Phrurolithinae from Liocranidae to Corinnidae, including 11 genera. The study certainly provided a very useful platform and on which future studies on the group could be based and compared.

Haddad *et al.* (2009) revised the South African genus *Austrachelas* Lawrence, 1938, which was placed in the Corinnidae: Trachelinae (Dippenaar-Schoeman & Jocqué 1997). They performed a cladistic analysis on 51 taxa covering the four corinnid subfamilies, including seven species of *Austrachelas*, as well as representatives of the Gallieniellidae, Lamponidae, Liocranidae and Gnaphosidae, with Zoridae as outgroup. Their analysis supported the transfer of *Austrachelas* to the Gallieniellidae and also indicated possible polyphyly in the castianeirine genus *Copa* Simon, 1885, which lead in part to the revisions of *Copa* (Chapter 6) and *Messapus* Simon, 1898 (Chapter 11) in this thesis.

The cladistic analysis included by Bosselaers & Bosmans (2010), in their assessment of the Old World Trachelinae, was mainly focused on assessing the monophyly of the genera *Trachelas* L. Koch, 1872 and *Paratrachelas* Kovblyuk & Nadolny, 2009. They included four species of Afrotropical trachelines that had recently been redescribed or described in the genera *Thysanina* Simon, 1910, *Fuchiba* Haddad & Lyle, 2008 and *Poachelas* Haddad & Lyle, 2008. Their results suggested that *Thysanina* and *Poachelas* are most closely related to *Cetonana* Strand, 1929, while *Fuchiba* is most closely related to *Metatrachelas* Bosselaers & Bosmans, 2010. Although their analysis did not include all of the currently recognised Trachelinae genera, it did confirm the monophyly of several recently described genera and provided some indication of the generic relationships of trachelines.

In their revision and phylogenetic analysis of the Afrotropical genus *Pseudocorinna* Simon, 1910, Jocqué & Bosselaers (2011) found that it was a sister taxon to the new genus that they described, *Crinopseudoa* Jocqué & Bosselaers, 2011, confirming the monophyly of the two genera. In their analysis they included three genera of Corinnidae *incertae sedis* that were previously placed in Corinninae *sensu lato* by Dippenaar-Schoeman & Jocqué (1997). It is plausible that once a more comprehensive generic level analysis of Corinnidae is undertaken, that all of these genera, which are characterised by the presence of a male palpal median apophysis, will form a monophyletic group at subfamily level within Corinnidae.

In evaluating the above studies, it is clear that considerable strides have been made in resolving the systematics of some groups of Corinnidae in the Afrotropical and Palaearctic Regions, but that considerable work needs to be done to better understand the relationships amongst the current Corinnidae subfamilies, as well as resolving the placement of the large number of *incertae sedis* genera (see Chapter 1, Table 2). In the case of several of the larger genera, particularly *Castianeira* Keyserling, 1879 and *Trachelas* that occur on most of the continents, it is likely that they have served as dumping grounds for generalised representatives of their respective subfamilies, and that both genera are likely to be highly polyphyletic, a fact already alluded to and partly resolved in the case of *Trachelas* by Bosselaers & Bosmans (2010).

In light of the revisions and descriptions of new genera and species that form part of this thesis, the aim of the current study was to provide a preliminary assessment of the relationships of the Afrotropical Corinnidae, with emphasis on the subfamily Castianeirinae. For this reason only selected representatives of each subfamily were included in the analysis, while the castianeirine terminals concentrate on all of the species (re)described from both sexes in this thesis. As some Afrotropical genera (i.e. *Merenius* Simon, 1909, *Castianeira* and most of the Madagascan fauna) still have to be thoroughly revised and at least four additional new genera need to be described, an updated analysis should be conducted once these studies are complete. As such, the results presented here should be considered to be preliminary, but should be able to test the following hypotheses within the context of the analyses:

1) that *Messapus* Simon, 1898 is a corinnine, as proposed in Chapter 11, and would be placed outside the large Castianeirinae clade.
2) that *Medmassa* Simon, 1887 would be placed in the Corinninae on the basis of its heavily spined anterior legs, presence of a male palpal tibial apophysis, and teardrop-shaped tegulum with a curved (not coiled) embolus.
3) that each of the Afrotropical castianeirine genera treated in this thesis would be monophyletic, with the exception of *Merenius* Simon, 1909, for which only a single terminal was included. It was expected that this single terminal, *M. alberti* Lessert, 1923, would emerge as sister taxon to the two species included from the genus *Corinnomma* Karsch, 1880. A possible relationship between the Afrotropical members of these two genera has been previously suggested (Haddad 2006b).
4) that the four castianeirine genera with cryptic lycosiform colouration (*Copa* Simon, 1885, *Copuetta* **gen. nov.**, *Echinax* Deeleman-Reinhold, 2001 and *Wasaka* **gen. nov.**) would form a monophyletic group, and
5) that the inaccurate and accurate ant-mimicking and velvet ant-mimicking genera would form a monophyletic group. Within this group, *Myrmecium* Latreille, 1824 and *Apochinomma* Pavesi, 1881 are expected to group together as the only accurate ant mimicking genera in the analysis.

12.3 MATERIAL & METHODS

12.3.1 General information

All of the specimens included in this study were examined under a Nikon SMZ800 stereomicroscope in 70% ethanol. Where necessary, the male and female genitalic structures were dissected, cleaned in 70% ethanol in a Labcon 5019U ultrasonic bath for 30 seconds, and observed. To illustrate some important diagnostic characteristics, specimens of selected taxa were prepared for scanning electron microscopy through a graded ethanol series from 70% to 100%, then critical point dried in an argon chamber, glued to aluminium stubs and sputter coated with gold prior to observation in a JEOL 6400 WinSEM. Digital photographs were taken of the structures observed.

The following abbreviations are used in the text: AER – anterior eye row; ALE – anterior lateral eye(s); AME – anterior median eye(s); CL – carapace length; CW – carapace width; PER – posterior eye row; PERW – posterior eye row width; PLE – posterior lateral eye(s); PME – posterior median eye(s).

Cladistic analyses were performed using the programs Winclada 1.00.08 (Nixon 2002), Nona 2.0 (Goloboff 1993) and TNT 1.1 (Goloboff *et al.* 2003). Characters were initially scored in a matrix prepared in Microsoft Excel 2007, which was saved as a MS DOS text file and imported into Winclada, Nona and TNT for the analyses. The preferred trees produced by Winclada and TNT were included.

12.3.2 Taxon choice

The selection of taxa for this study was largely concentrated on the Afrotropical Castianeirinae that forms the focus of this thesis. While it would have been ideal to include all of the species treated in the taxonomic Chapters 3–11, I decided to only include species that were known from both sexes. Including species known from one sex only results in a large number of missing entries, which can cause problems when searching for most parsimonious trees (Platnick *et al.* 1991). This can also hinder efficient running of the programs that analyse the matrices (Bosselaers & Jocqué 2000).

A total of 39 Afrotropical Castianeirinae species were included in the analysis, including *Medmassa semiaurantiaca* Simon, 1910 that was not treated in this thesis but redescribed in a recent publication (Haddad & Bosselaers 2010). Two other Castianeirinae species, *Supunna picta* (L. Koch, 1873) from Australia and an undescribed *Myrmecium* sp. from Brazil, were included in the analyses to assess their relationships with the Afrotropical genera. I suspected that *S. picta* would be closely related to *Copa* Simon, 1885, which has been previously suggested by Simon (1898). As one of the most specialised ant-mimicking arthropod genera known, *Myrmecium* Latreille, 1824 is probably the most derived of all castianeirine genera. Considering that *Apochinomma* Pavesi, 1881 is the only specialised (accurate) genus of ant mimics in the Afrotropical Region, I expected that these two latter genera would emerge as sister taxa in the analyses.

Representatives of the other three subfamilies of Corinnidae, as well as two *incertae sedis* species, were included to assess their relationships with one another and the Castianeirinae. For the Corinninae, two species now included in *Messapus* were used as representatives; the taxonomy of this genus was resolved and the genus transferred from Castianeirinae to Corinninae in Chapter 11. Additionally, the cosmotropical species *Creugas gulosus* Thorell, 1878 was included as a typical representative of Corinninae (Bonaldo 2000; Deeleman-Reinhold 2001). As I only had a single male of this species in my possession, I relied on the descriptions provided in the latter two publications to supplement specimen data, particularly for female characteristics.

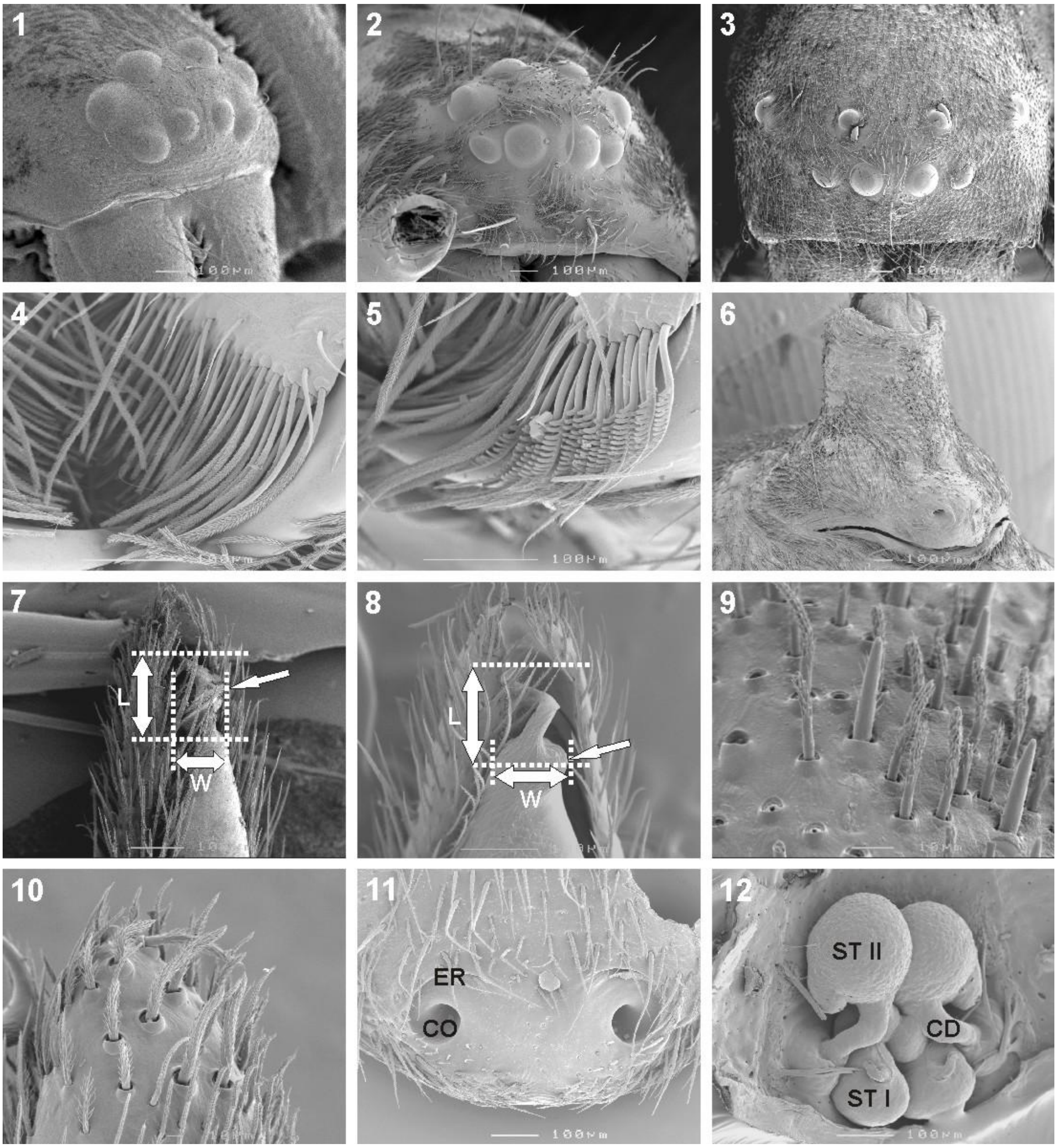
A single species of Phrurolithinae was included, namely *Orthobula radiata* Simon, 1896. Three species of Trachelinae were included: *Afroceto martini* (Simon, 1897), *Spinotrachelas capensis* Haddad, 2006 and *Trachelas schenkeli* Lessert, 1923. Two species of Corinnidae *incertae sedis*, *Pronophaea natalica* Simon, 1897 and *Vendaphaea lajuma* Haddad, 2009, which in the past may have been considered to be corinnines (following the classification of Dippenaar-Schoeman & Jocqué 1997), were included. A single species of Gnaphosidae, *Drassodes sesquidentatus* Purcell, 1908, was used to root the trees.

For the 38 Afrotropical ingroup taxa and two *Messapus* species treated in this thesis and included in the analysis, the list of material examined in the study is taken from the taxonomic chapters dealing with each genus (Chapters 3–11). A complete list of the material examined of the aforementioned terminals is provided in Appendix 1.

12.3.3 Characters

A series of 96 characters (50 binary and 41 multistate) was coded for the 51 taxa chosen (41 ingroup, nine outgroup and single root taxon). The complete matrix, together with consistency index (ci) and retention index (ri) values, is given in Appendix 2. All characters are phylogenetically informative and were scored in an ordered state. Missing entries were scored with a ? in the matrix when characters were not applicable to a particular taxon (Maddison 1993). In assessing the composition of the characters, 35 pertain to structures of the cephalothorax, including 16 eye characters; 10 characters relate to abdominal structure, sclerotisation and spinnerets; 26 characters relate to genitalic morphology, and 15 characters relate to leg structure and spination. The remaining five characters apply to body proportions and morphological specialisation related to mimicry and crypsis. All of the characters used in the analysis are listed below. Unless otherwise indicated, each character applies to both sexes.

1. Carapace texture: 0) smooth or finely wrinkled, 1) finely to coarsely granulate, 2) with deep pits.
2. Carapace posterior margin: 0) concave, 1) straight, 2) convex and subtriangular, tapering to a point.
3. Male CL:CW ratio: 0) CL less than 2 times CW, 1) CL more than 2 times CW.
4. Female CL:CW ratio: 0) CL less than 2 times CW, 1) CL more than 2 times CW.
5. Male CW: 0) more than 3 times PERW, 1) between 2 and 3 times PERW, 2) less than double PERW.
6. Female CW: 0) more than 3 times PERW, 1) between 2 and 3 times PERW, 2) less than double PERW.
7. Carapace with one or two shallow or deep transverse depressions: 0) present, 1) absent.
8. AER viewed from the front: 0) procurved (Figs 1, 2), 1) straight.
9. Male AME: 0) smaller than ALE (Fig. 1), 1) about equal to ALE, 2) larger than ALE (Figs 2, 3).
10. Male AME: 0) separated by half their diameter or less, 1) separated by more than half their diameter.
11. Male clypeus: 0) less than AME diameter, 1) about equal to AME diameter, 2) larger than AME diameter (Figs 1–3).
12. PER viewed dorsally: 0) procurved (Figs 1, 2), 1) straight, 2) recurved (Fig. 3).
13. Male PME: 0) smaller than PLE, 1) about equal to PLE, 2) larger than PLE.
14. Male PME: 0) separated by half their diameter or less, 1) separated by more than half their diameter, 2) separated by distance equal to or larger than their diameter.
15. Male PME: 0) separated from PLE by less than half PME diameter, 1) separated from PLE by distance equal to or larger than ½ PME diameter, 2) separated from PLE by distance equal to or larger than PME diameter.
16. Female AME: 0) smaller than ALE, 1) about equal to ALE, 2) larger than ALE.
17. Female AME: 0) separated by half their diameter or less, 1) separated by more than half their diameter, 2) separated by distance equal to or larger than their diameter.
18. Female clypeus: 0) less than AME diameter, 1) equal to AME diameter, 2) larger than AME diameter.
19. Female PME: 0) smaller than PLE, 1) about equal to PLE, 2) larger than PLE.
20. Female PME: 0) separated by half their diameter or less, 1) separated by more than half their diameter, 2) separated by distance equal to or larger than their diameter.



FIGURES 1–12. Scanning electron microscope photos of *Cambalida dippenaarae* **sp. nov.** (1, 8, 10), *Copa flavoplumosa* Simon, 1885 (2, 5, 11), *Apochinomma formicaeforme* Pavesi, 1881 (3, 4, 6), *Copuetta maputa* **sp. nov.** (7) and *Merenius alberti* Lessert, 1923 (9, 12): 1–3. carapace, anterior view; 4. female, promarginal cheliceral bent setae; 5. male, promarginal cheliceral bent setae; 6. anterior of female abdomen, indicating epigastric sclerite and petiolate pedicel; 7, 8. male emboli, stippled lines indicating width (W) and length (L) of embolus from base to tip, arrow indicating point from which basal width is measured (retrolateral bend of distal end of tegulum); 9. rod-like setae on male palpal cymbium; 10. distal thickened spiniform setae arranged in three rows on male palpal cymbium; 11. female epigyne, ventral view, indicating copulatory opening (CO) and coiled sclerotised epigynal ridge (ER); 12. female epigyne, dorsal view, indicating spermathecae I and II (ST I and ST II, respectively) and copulatory duct (CD).

21. Female PME: 0) separated from PLE by less than half PME diameter, 1) separated from PLE by distance equal to or larger than ½ PME diameter, 2) separated from PLE by distance equal to or larger than PME diameter.

22. Fovea: 0) long and narrow, 1) short and narrow, 2) short and broad, 3) indistinct or absent.
23. Chilum: 0) split, 1) single.
24. Male cheliceral promargin: 0) with three teeth, 1) with two or fewer teeth.
25. Male cheliceral retromargin: 0) with more than three teeth, 1) with three teeth, 2) with two or fewer teeth.
26. Female cheliceral promargin: 0) with three teeth, 1) with two or fewer teeth.
27. Female cheliceral retromargin: 0) with more than three teeth, 1) with three teeth, 2) with two or fewer teeth.
28. Chelicerae with one long thick bent seta (scrappy seta) anterior to fang base: 0) present, 1) absent.
29. Curved setae on male cheliceral promargin: 0) finely plumose, cylindrical with fine barbs (Fig. 4); 1) pectinate, with long fine teeth on one side.
30. Curved setae on female cheliceral promargin: 0) finely plumose; 1) pectinate (Fig. 5).
31. Sternum with precoxal triangles: 0) present, 1) absent.
32. Male sternum with intercoxal sclerites: 0) between coxae I and II, II and III, and III and IV, 1) between coxae I and II, and II and III, 2) I and II only, 3) absent.
33. Female sternum with intercoxal sclerites: 0) between coxae I and II, II and III, and III and IV, 1) between coxae I and II, and II and III, 2) I and II only, 3) absent.
34. Sternum: 0) shield-shaped, less than 1¼ longer than wide, 1) elongate, at least 1½ times longer than wide.
35. Plumose (feathery) setae on body: 0) present, 1) absent.
36. Anterior margin of abdomen with: 0) many curved setae, 1) two pairs of stout spines and several pairs of fine erect setae; 2) several pairs of fine erect setae only, 3) no spines, curved or erect setae.
37. Abdomen shape: 0) oval, at least 1¼ times longer than broad, 1) globose, nearly as broad as long, clearly broader in posterior half, with very shallow constriction, 2) elongate with constriction, clearly broader in posterior half.
38. Dorsal scutum on male abdomen: 0) covering more than ½ of dorsum, 1) covering ½ or less of dorsum, 2) absent.
39. Male abdomen with epigastric sclerite: 0) present, 1) absent.
40. Male abdominal ventral sclerite: 0) present, 1) absent.
41. Male venter with inframamillary sclerite anterior to spinnerets: 0) present, 1) absent.

42. Dorsal scutum on female abdomen: 0) covering more than ½ of dorsum, 1) covering ½ or less of dorsum, 2) absent.
43. Female abdomen with epigastric sclerite: 0) present (Fig. 6), 1) absent.
44. Female venter with inframamillary sclerite anterior to spinnerets: 0) present, 1) absent.
45. Venter with post-epigastric sclerites: 0) present, 1) absent.
46. Male palpal tegulum general shape: 0) oval, 1) smoothly rounded and teardrop-shaped, 2) pear-shaped, narrowed distally towards retrolateral side, with protruding subtegulum.
47. Male embolus originating: 0) prolaterally, 1) distally, 2) retrolaterally.
48. Male embolus: 0) shorter than ½ tegulum length, 1) longer than ½ tegulum length.
49. Male embolus shape in ventral view of palp: 0) broad and flattened, 1) long and thin, encircling tegulum, 2) long and thin, passing beneath tegulum, 3) long, thin and sickle-shaped, 4) short, stout and pointed, 5) corkscrew-shaped.
50. Male corkscrew-shaped embolus distal section of coil: 0) short, stout and subtriangular, less than 10 times longer than basal width, 1) thick and curved, less than 10 times longer than basal width, 2) long and fine, more than 10 times longer than basal width.
51. Male corkscrew-shaped embolus shape: 0) compressed coil with successive spirals apparently fused (Fig. 7); 1) open coil with spirals clearly separated (Fig. 8).
52. Male corkscrew-shaped embolus: 0) broader than long; 1) longer than broad. [This ratio was calculated by determining the basal width as at the retrolateral bend of the basal coil of the embolus, which is represented by the distal end of the tegulum where the coil forms (indicated by arrows in Figs 7, 8). Where the coil of the embolus was broader than the basal width (Fig. 7) then that width was considered in the calculation. The longitudinal length of the embolus was calculated from the basal width to the embolus tip].
53. Male palpal median apophysis: 0) present, 1) absent.
54. Male palpal conductor: 0) present, 1) absent.
55. Male palpal subtegulum in ventral view of palp: 0) hidden, 1) visible prolaterally, 2) visible pro- and retrolaterally, 3) visible retrolaterally, 4) visible proximally.
56. Male palpal cymbium: 0) less than 1½ times longer than broad, 1) more than 1½ times longer than broad.
57. Male palpal cymbium tip: 0) broad and short, 1) distinctly narrowed and pointed.

58. Male palpal cymbium with distal dorsal setal mat (=*cymbial scopula* of Platnick 2002): 0) present, 1) absent.
59. Male palpal cymbium with stout black rod-like setae in distal half: 0) present (Fig. 9), 1) absent.
60. Male palpal cymbium with flattened black spatulate setae in distal half: 0) present, 1) absent.
61. Male palpal cymbium with scattered thickened black setae with bent tip in distal half: 0) present, 1) absent.
62. Male palpal cymbium with thickened large black spiniform setae arranged in two or three rows distally: 0) present (Fig. 10), 1) absent.
63. Male palpal cymbium with thickened club-shaped setae distally: 0) present, 1) absent.
64. Male palpal cymbium with thickened spiniform setae at distal end, sometimes with bent tip, not arranged in rows: 0) present, 1) absent.
65. Male palp with tibial apophysis: 0) present, 1) absent.
66. Female epigyne with median septum: 0) present, 1) absent.
67. Female epigyne a simple unmodified plate with paired copulatory openings within sclerotised epigynal ridges: 0) present (Fig. 11), 1) absent.
68. Shape of sclerotised epigynal ridges, when present: 0) coiled (Fig. 11), 1) weakly or strongly curved, 2) horseshoe-shaped, 3) variable, surrounding copulatory openings but not in direct contact with them.
69. Copulatory openings: 0) situated close to midline of epigyne, 1) situated laterally.
70. Position of copulatory openings: 0) anterior to spermathecae II, 1) in same transverse plane as spermathecae II, 2) posterior to spermathecae II (Fig. 12).
71. Copulatory ducts: 0) present, forming tube linking copulatory opening to spermathecae II (Fig. 12), 1) absent, copulatory opening entering directly into spermathecae II.
72. Copulatory ducts entering spermathecae II: 0) along mesal margin, 1) along anterior margin, 2) along lateral margin, 3) along posterior margin (Fig. 12), 4) not marginally but within borders.
73. Trochanter notch: 0) present, 1) absent.
74. Anterior legs much more robustly built than posteriors: 0) present, 1) absent.
75. Male patellae I and II: 0) with proximal seta and distal spine, 1) with proximal and distal setae, 2) with distal spine only, 3) with distal seta only, 4) without spine or seta.

76. Male patellae III and IV: 0) with proximal and distal spines, 1) with proximal seta and distal spine, 2) with proximal and distal setae, 3) distal spine only, 4) distal seta only, 5) without spine or seta.
77. Male tibiae I ventral leg spine pairs, excluding terminal spines and unpaired spines: 0) four or more pairs, 1) three pairs, 2) two pairs, 3) one pair, 4) no pairs.
78. Male tibiae II ventral leg spine pairs, excluding terminal spines and unpaired spines: 0) four or more pairs, 1) three pairs, 2) two pairs, 3) one pair, 4) no pairs.
79. Male leg I with ventral leg cusps: 0) present, 1) absent.
80. Male leg II with ventral cusps: 0) present, 1) absent.
81. Female patellae I and II: 0) with proximal seta and distal spine, 1) with proximal and distal setae, 2) with distal spine only, 3) with distal seta only, 4) without spine or seta.
82. Female patellae III and IV: 0) with proximal and distal spines, 1) with proximal seta and distal spine, 2) with proximal and distal setae, 3) with distal spine only, 4) with distal seta only, 5) without spine or seta.
83. Length of distal seta or spine on patellae of both sexes, where present: 0) longer than patellae, 1) shorter than patellae.
84. Female tibiae I ventral leg spine pairs, excluding terminal spines and unpaired spines: 0) four or more pairs, 1) three pairs, 2) two pairs, 3) one pair, 4) no pairs.
85. Female tibiae II ventral leg spine pairs, excluding terminal spines and unpaired spines: 0) four or more pairs, 1) three pairs, 2) two pairs, 3) one pair, 4) no pairs.
86. Female leg I with ventral leg cusps: 0) present, 1) absent.
87. Female leg II with ventral leg cusps: 0) present, 1) absent.
88. Morphological specialisation cryptic, with lycosiform colouration: 0) absent, 1) present.
89. Morphological specialisation inaccurate ant mimic: 0) absent, 1) present.
90. Morphological specialisation accurate velvet ant mimic: 0) absent, 1) present.
91. Morphological specialisation accurate ant mimic: 0) absent, 1) present.

12.4 ANALYSIS AND RESULTS

In TNT a traditional search was carried out using the TBR (tree bisection and reconnection swapping) algorithm and 1000 random addition sequences under equal weighting. Branches with a length of zero were collapsed using Settings/Collapsing rules/Min length = 0. This was done to avoid spurious resolution resulting from unsupported branches (Coddington & Scharff 1994) or ambiguously supported branches (Nixon & Carpenter 1996). In total, 22 shortest trees with a length of 655 were found in each of the 1000 random addition sequences, involving 9 538 143 rearrangements. Tree 12 is the preferred result of this analysis and the preferred solution (Fig. 13). In this phylogeny, each of the outgroup taxa formed a monophyletic group. Within the ingroup clade (Castianeirinae, node 59), most of the genera studied in this thesis were monophyletic: *Apochinomma* (node 56), *Corinnomma* (node 81), *Cambalida* (node 64), *Copa* (node 70), *Wasaka* **gen. nov.** (node 100) and *Echinax* (node 84). Two genera may be paraphyletic in this solution (*Copuetta* **gen. nov.** and *Castianeira*), while *Graptartia* is apparently polyphyletic (Fig. 13).

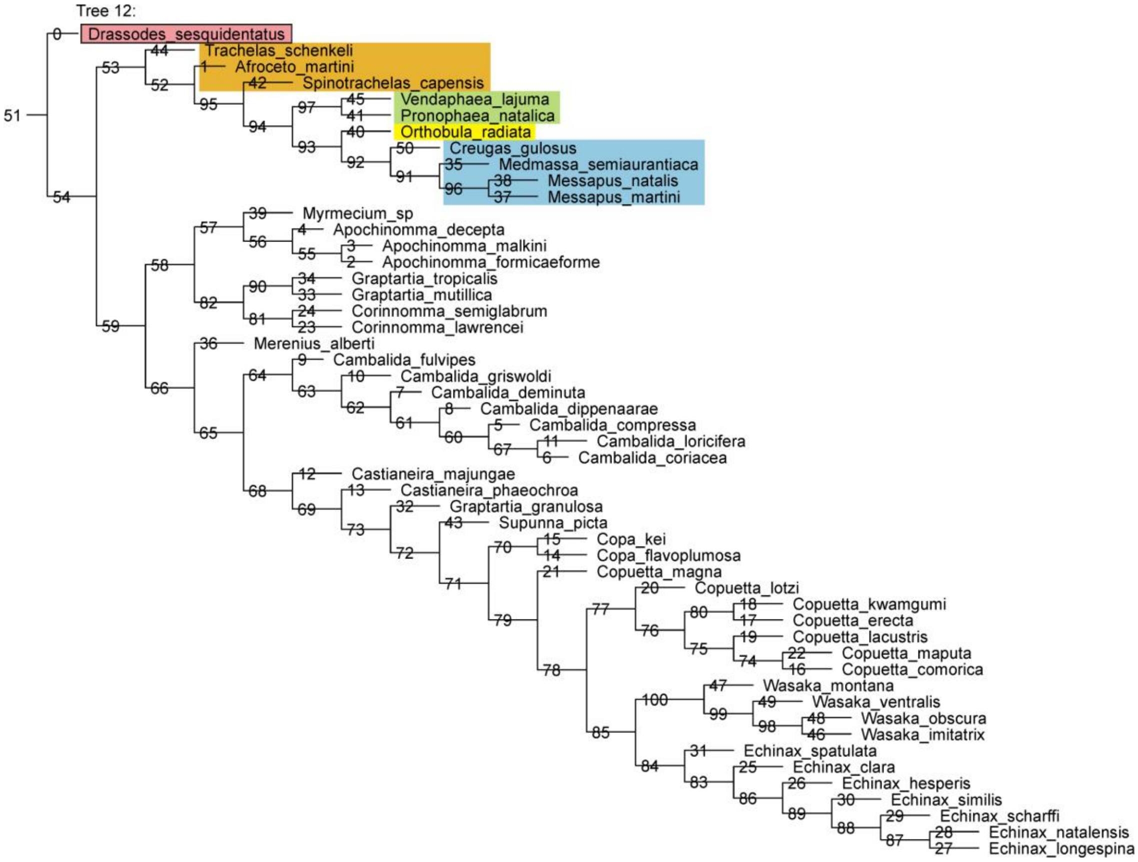


FIGURE 13. Preferred tree obtained under equal weighting in TNT using the traditional search function. Numbers refer to taxa (0–50) and nodes (51–100). Tree rooted with *Drassodes sesquidentatus* Purcell, 1908 (pink highlight), Trachelinae highlighted in orange, Corinnidae *incertae sedis* in green, Phrurolithinae in yellow and Corinninae in blue. Remaining species all belong to Castianeirinae.

A second analysis was performed under equal weighting using a new technology search with the default settings in the dialogue box. Five shortest trees with a length of 656 were found, involving 1 725 741 rearrangements, of which tree 1 provided the best result (Fig. 14). Although consistent in the placement and arrangement of the outgroup taxa, none of the five trees produced with the new technology search were identical to those produced using the traditional search, differing mainly by the inclusion of *Castianeira majungae* Simon, 1896 within the *Cambalida* clade (node 60 in Fig. 14), the arrangement of the genera forming the cryptic lycosiform genera clade (node 75 in Fig. 14), and the inclusion of *Copuetta magna* **sp. nov.** in a clade with the two *Copa* terminals (node 72 in Fig. 14).

FIGURE 14. Preferred tree obtained under equal weighting in TNT using the new technology search function. Numbers refer to taxa (0–50) and nodes (51–100). Tree rooted with *Drassodes sesquidentatus* Purcell, 1908 (pink highlight), Trachelinae highlighted in orange, Corinnidae *incertae sedis* in green, Phrurolithinae in yellow and Corinninae in blue. Remaining species all belong to Castianeirinae.

Analysis of the matrix using NONA, spawned from within Winclada, was done by unconstrained heuristic search under equal weighting with hold = 10000, mult*N = 1000 and hold/ = 1000; Multiple TBR + TBR (mult*max*) as the search strategy; and Wagner optimisation of the trees. Under equal weighting, 28 trees with a branch length of 655 were produced, six more than produced in TNT but with equal tree lengths. None of the trees

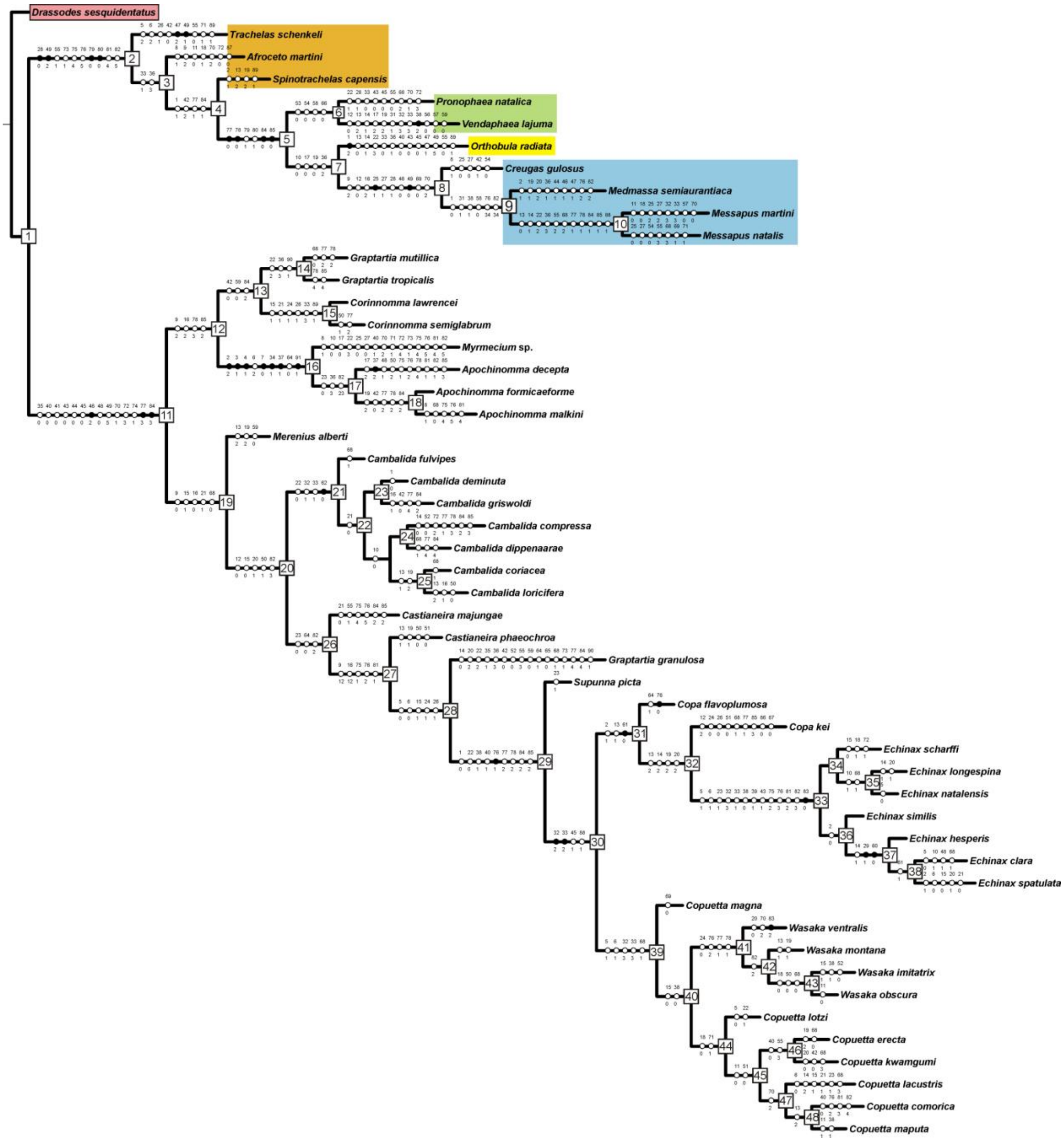


FIGURE 15. Character state changes on the preferred tree obtained under equal weighting in Winclada, optimisation unambiguous. Tree rooted with *Drassodes sesquidentatus* Purcell, 1908 (pink highlight), Trachelinae highlighted in orange, Corinnidae *incertae sedis* in green, Phrurolithinae in yellow and Corinninae in blue. Remaining species all belong to Castianeirinae. Character state changes indicated on branches: characters above and states below. Nonhomoplasious state changes are indicated with black dots and homoplasious state changes with white dots. Nodes numbered in squares.

produced in Winclada were identical to the preferred tree produced in TNT under equal weighting (Fig. 13), nor to the TNT strict consensus tree. Tree 6 agreed most in structure and the arrangement of the taxa with the preferred tree produced in TNT, and is the preferred result (Fig. 15). Notably, in this tree the arrangement of the taxa in node 12 was inverse to that in the otherwise similar TNT trees, and the taxa in node 30 (cryptic lycosiform genera) also contrasted to the arrangements in the TNT trees.

A second search was then performed in TNT using the traditional search function, TBR algorithm and 1000 random addition sequences, using implied weighting (Goloboff 1993) with the weighting function K = 3.0000. Three single fittest trees with fit = 67.83865 were found 10 times, involving 10 468 271 rearrangements. These three trees had a length of 666, slightly greater than those produced under equal weighting. These three trees were virtually identical in structure, differing only in the placement of some of the species within the *Cambalida* clade. Analysis of the matrix using the new technology search under implied weighting was carried out with the same settings as detailed above. Two shortest trees with the same fit value and tree length as in the traditional search were found once only, involving 1 589 986 rearrangements. The strict consensus trees produced under traditional and new technology searches were identical, and the former is presented here (Fig. 16).

The preferred trees obtained under equal weighting (Figs 13–15) and strict consensus tree obtained under implied weighting (Fig. 16) have very different structures, notably regarding the placement of *C. majungae*, *Apochinomma* spp. and the cryptic lycosiform genera (*Copa*, *Copuetta* **gen. nov.**, *Echinax* and *Wasaka* **gen. nov.**). Even though these aforementioned trees represented better solutions than the other trees generated in each analysis, the lack of consensus in the relationships of the castianeirine taxa indicates that further study is necessary to resolve the generic relationships of the subfamily.

Significantly, the outgroup taxa (Trachelinae, Phrurolithinae, Corinnidae *incertae sedis* and Corinninae) consistently clustered together basally in all of the trees attained, and in almost all of the trees produced, each of these higher taxa were monophyletic. These taxa were consistently sister to the ingroup (Castianeirinae). Interestingly, *Medmassa semiaurantiaca* was consistently placed amongst the two other Corinninae genera (*Creugas* and *Messapus*) included in the analysis, which would support the placement of this genus in Corinninae, a possibility previously suggested by Haddad & Bosselaers (2010). Furthermore, the consistent placement of the two *Messapus* terminals as sister taxa in all of the trees confirms the placement of *Corinna natalis* Pocock, 1898 in *Messapus*, and of the genus *Messapus* in Corinninae (see Chapter 11).

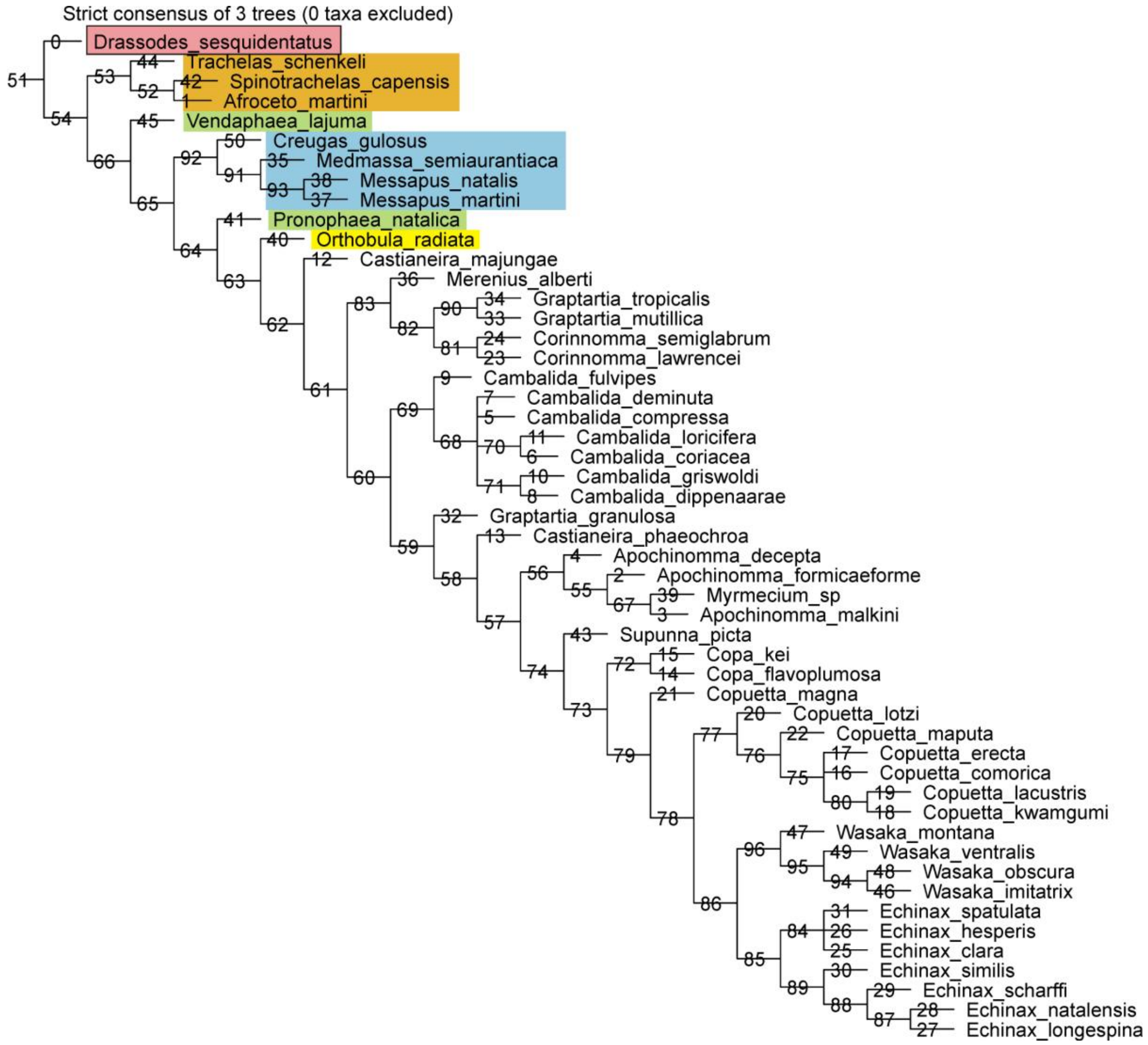


FIGURE 16. Strict consensus tree obtained under implied weighting in TNT using the traditional search function. Tree rooted with *Drassodes sesquidentatus* Purcell, 1908 (pink highlight), Trachelinae highlighted in orange, Corinnidae *incertae sedis* in green, Phrurolithinae in yellow and Corinninae in blue. Remaining species all belong to Castianeirinae.

Amongst the ingroup taxa, the majority of the Castianeirinae genera revised in this thesis were found to be monophyletic, with the following exceptions:

1) *Castianeira*, with the two representative species sometimes emerging as sister taxa (Figs 13 & 15) or being placed in clearly separate clades (e.g. Figs 14 & 16). It is likely that *Castianeira* has been used as a dumping ground for relatively unmodified castianeirines in the past (e.g. see the *Cambalida* revision in Chapter 4), and that a comprehensive analysis forming part of a revision of the genus in the Afrotropical Region, including terminals from other parts of the world, will confirm that the genus is polyphyletic and provide the basis for separating *Castianeira* into several smaller and more clearly defined genera.

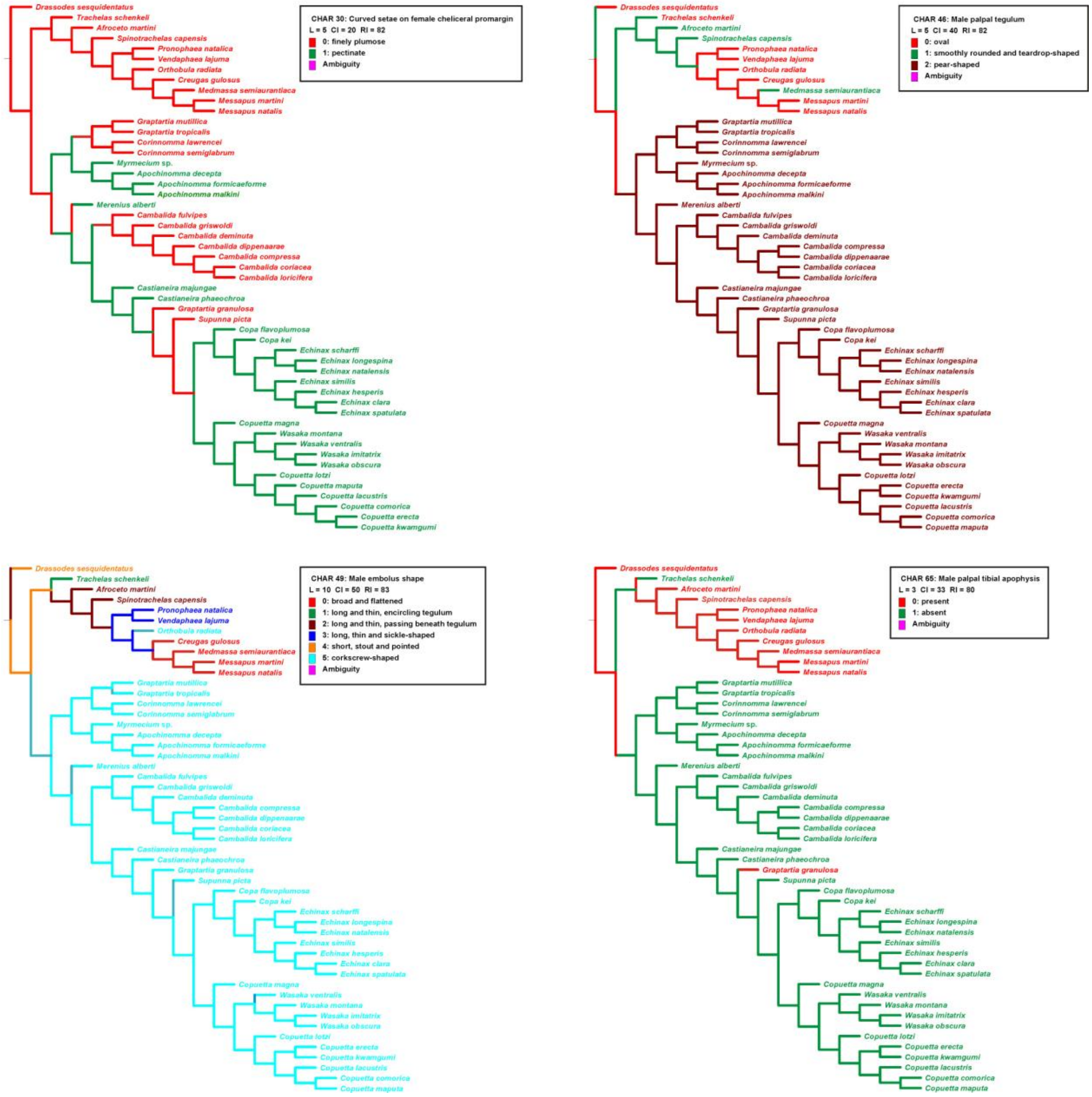
2) *Copuetta* **gen. nov.**, for which a single species (*C. magna* **sp. nov.**) was sister to a clade containing its congeners in some trees (Figs 13 & 16), suggesting paraphyly, but in others as sister taxon to a clade including the two representatives of *Copa* Simon, 1885 (Fig. 14) or to the four *Wasaka* **gen. nov.** species (Fig. 15), indicating that *Copuetta* **gen. nov.** may be polyphyletic. Alternately, these results could be interpreted as *Copa* and *Copuetta* **gen. nov.** being synonymous (Fig. 14) or *Copuetta* **gen. nov.** and *Wasaka* **gen. nov.** being synonymous (Fig. 15). Since each of the cryptic lycosiform genera is resolved in the preferred tree with the exception of a paraphyletic *Copuetta* **gen. nov.** (Fig. 13), it is safest to treat each of the four genera as monophyletic. The relationships of this genus (and indeed, those of the other cryptic lycosiform genera) may be clarified when a greater number of *Copuetta* **gen. nov.** species are known from both sexes, and;
3) *Graptartia* Simon, 1896, in which the type species (*G. granulosa* Simon, 1896) consistently emerged as sister to *Castianeira phaeochroa* Simon, 1909, while the other two species (*G. mutillica* Haddad, 2004 and *G. tropicalis* Haddad, 2004) consistently grouped together with the two *Corinnomma* species (Figs 13–16), suggesting that *Graptartia*, as currently composed, is polyphyletic. This could largely be attributed to differences in the eye arrangements and body setation of the three species (see Chapter 9). As such, an analysis with a more comprehensive terminal set including multiple *Merenius* species may support the transfer of the Afrotropical *Corinnomma* and the latter two *Graptartia* species to *Merenius*. Alternately, *G. mutillica* and *G. tropicalis* may be related to the Asian mutilliform castianeirine genus *Coenoptychus* Simon, 1896 (see Deeleman-Reinhold 2001). Such an outcome would suggest that mutillid mimicry has evolved independently on at least two occasions in the Afrotropical Castianeirinae;

The trees generated under implied weighting were generally similar to the equally weighted trees regarding outgroup placements, but differed considerably in the position of the ingroup taxa (Fig. 16). The strict consensus tree produced under implied weighting also had the majority of castianeirine genera monophyletic (nodes 69, 72, 81, 85, 90 and 96), but the same three problematic genera described in points 1–3 above (*Copuetta* **gen. nov.**, *Graptartia* and *Castianeira*) emerged again, in addition to the inclusion of the *Myrmecium* sp. within a clade including the three *Apochinomma* terminals in node 56 (as opposed to a sister relationship in Figs 13–15).

Regarding morphological specialisation, the species with cryptic lycosiform colouration grouped together in all of the trees (nodes 71, 75, 30 and 73 in Figs 13–16, respectively), with *Supunna picta* consistently as a sister taxon (together forming nodes 72, 76, 29 and 74, respectively). Although *S. picta* is morphologically quite similar to *Copa*, its colouration is black with white markings, dissimilar to that of the typical cryptic lycosiform Castianeirinae but similar to the nigrito morph of *C. flavoplumosa* Simon, 1885 (see Chapters 6 and 13). The accurate ant mimics (*Apochinomma* spp. and *Myrmecium* sp.) consistently formed a monophyletic group in all of the trees (nodes 57, 57, 16 and 56, respectively), while the accurate velvet ant mimics (*Graptartia*) were consistently polyphyletic. The inaccurate ant mimicking species were distributed quite unevenly in different clades, suggesting multiple independent origins of ant mimicry in the Castianeirinae.

In evaluating the range of characters and terminals scored, it is clear that several possible synapomorphies could be considered for the Castianeirinae. These results are based on the optimisation of characters on the preferred tree produced in Winclada using the ACCTRAN algorithm, also regarded as fast or accelerated transformation optimisation. There is much debate regarding the efficacy of the results produced in ACCTRAN versus those produced using DELTRAN (slow or delayed transformation optimisation) (see Agnarsson & Miller 2008, for example), but ACCTRAN was selected as it is the generally more widely used algorithm and provided satisfactory results for assessing the four characters discussed here:

1) Female chelicerae with pectinate curved setae on the cheliceral promargin (30: 1). While this character state was not found in any of the other outgroup taxa included in the analysis, it is reversed five times in Castianeirinae (*Supunna*, *Graptartia*, *Merenius*, *Cambalida* and *Corinnomma*), and is thus of little diagnostic value. It is significant to note that this modification occurs in quite morphologically contrasting clades within Castianeirinae, i.e. all of the cryptic lycosiform genera (*Copa*, *Copuetta* **gen. nov.**, *Echinax* and *Wasaka* **gen. nov.**), one inaccurate ant-mimicking genus (i.e. *Castianeira*), and the accurate ant-mimicking genera *Apochinomma* and *Myrmecium* (Fig. 17), suggesting several independent origins or losses.
2) Male palpal tegulum pear-shaped (48: 2) (Fig. 18).
3) Embolus corkscrew-shaped (52: 5) (Fig. 19), which is also the case for *Orthobula radiata* Simon, 1896 and other members of this genus. In this latter species the embolus is straight with very fine spirals, hence the scoring of this structure as corkscrew-shaped for this species. A similar structural arrangement to *O. radiata* is also seen in several species of *Merenius* from tropical Africa (pers. obs.).



FIGURES 17–20. Character state distribution of four characters representing possible synapomorphies for the Castianeirinae obtained under ACCTRAN on the preferred tree produced in Winclada: 17. structure of curved setae on female cheliceral promargin (character 30); 16. male palpal tegulum shape (character 48); 19. male embolus shape (character 52); 20. male palpal tibial apophysis absence/presence (character 68). Graphics obtained with Winclada 1.00.08.

4) Absence of a male palpal tibial apophysis (68: 1). A tibial apophysis is absent from all Castianeirinae species included in this study except for *G. granulosa*, which has a very small curved apophysis (Haddad 2004) that is not nearly as well developed as that found in most dionychan spiders. This structure was well developed in all of the outgroup taxa from this study except for *Trachelas schenkeli*, which lacks a tibial apophysis but has a patellar apophysis present (Fig. 20). Apophyses can be present on

any of the palpal segments of *Trachelas sensu lato* species, but are notably absent from the tibiae of members of the *T. schenkeli* species group, as well as several other Afrotropical groups (Lyle 2008). As such, this character state, while almost universal in Castianeirinae, also occurs in other taxa of Corinnidae and has limited value as a castianeirine synapomorphy.

The second and third characters states mentioned above are generally accepted synapomorphies for the Castianeirinae (Dippenaar-Schoeman & Jocqué 1997; Deeleman-Reinhold 2001; Ubick & Richman 2005). Unfortunately, no structures found in females emerged from the current analysis that could be proposed as synapomorphies, which requires further study in the future.

12.5 DISCUSSION

The current study provided the first comprehensive analysis of the subfamily Castianeirinae from any of the major biogeographical regions. The ingroup comprised representatives of all of the presently known Afrotropical genera (including two newly described in this thesis) but excluded four additional new genera that require description. In cases where these genera have been completely revised, all of the species that were (re)described from both sexes were included in the analysis. While there were some inconsistencies between the results produced by the two weighting methods and two searching strategies used, notably with regards to the placement of particular clades of Castianeirinae, most of the genera were regularly monophyletic, with the exception of *Graptartia* (consistently polyphyletic), *Castianeira* (often polyphyletic) and *Copuetta* **gen. nov.** (paraphyletic or polyphyletic).

In testing the five proposed hypotheses, *Messapus* and *Medmassa* consistently grouped together with the corinnine *Creugas gulosus*, supporting the placement of the former two genera in Corinninae, as hypothesised (Hyp. 1 and 2). The fact that *Medmassa* and *Messapus* consistently grouped together would support the hypothesis that *Medmassa* is a Corinninae and not a Castianeirinae. A more comprehensive analysis, including some Asian *Medmassa*, undescribed *Messapus* and several other genera of Corinninae *sensu stricto* (e.g. Bonaldo 2000; Deeleman-Reinhold 2001) should provide clarity on the relationships of these two genera within the Corinninae.

Exceptions to the hypothesised monophyly of Afrotropical Castianeirinae (Hyp. 3) were found in the polyphyletic *Graptartia* and *Castianeira*, although the small number of terminals representing these genera may have contributed to this. It appears that two of the *Graptartia* species recently described by Haddad (2004) may be more closely related to *Merenius* or *Corinnomma* than to the type species, *G. granulosa*. Further, the three Afrotropical species of *Corinnomma* (Haddad 2006b) may indeed also belong in *Merenius*. Clarification of the placement of these species should be resolved during a future revision of *Merenius*. The newly described genus *Copuetta* **gen. nov.** was occasionally paraphyletic or polyphyletic, but the inclusion of a more comprehensive terminal set of *Copuetta* **gen. nov.** (species with missing sexes that may be discovered), as well as a number of the multitude of undescribed Madagascan *Copa* species, may resolve the monophyly of the genus.

The cryptic lycosiform genera (*Copa*, *Copuetta* **gen. nov.**, *Echinax* and *Wasaka* **gen. nov.**) consistently formed a monophyletic group, usually including the Australasian *Supunna picta* as a sister species, supporting the proposed hypothesis 4. The occasional paraphyly or polyphyly of *Copuetta* **gen. nov.** was largely due to the unresolved placement of a single species, *Copuetta magna* **gen. nov.**, which sometimes grouped together with the *Copa* terminals or as sister to the *Wasaka* **gen. nov.** clade. In assessing the morphology of this species relative to congeners, there are several intrageneric apomorphic morphological and genitalic characters that may have contributed to this ambiguity: female clypeus larger than AME diameter (18: 2); female PME equal to PLE (19: 1); copulatory openings situated along the midline rather than laterally (69: 0); and copulatory ducts present rather than copulatory openings entering directly into ST II (71: 0). Despite these differences, leg spination and body proportions are similar to those of its congeners and I am fairly convinced of the generic placement of this species.

Lastly, hypothesis 5 can be rejected. The polyphyly of *Graptartia* (accurate velvet ant mimics) and *Castianeira* (inaccurate ant mimics), and the placement of the latter terminals relative to the other inaccurate ant mimicking castianeirines (*Merenius* and *Corinnomma*), suggests that both ant- and velvet ant mimicry have evolved independently multiple times in the Castianeirinae. However, the accurate ant mimics (*Apochinomma* and *Myrmecium*) consistently formed a clade in all of the trees, in part supporting the hypothesis 5 with regards to mimicry specialisation.

A more comprehensive analysis including all of the known genera of Castianeirinae will provide greater clarity on the global distribution and relationships of mimetic genera and species, and provide the basis to explain patterns in the evolution of mimics relative to ant (and velvet ant) biodiversity and biogeography. The current study has, however, provided a basis for an expanded analysis on the subfamily once the Afrotropical, Australasian and Neotropical faunas have been more thoroughly revised.

The inclusion of molecular data in future analyses will be greatly aided by a grant to Dr Martin Ramírez (Museo Argentino de Ciencias Naturales, Buenos Aires) to investigate the molecular phylogeny of Corinnidae on a global scale. More than 40 species of Afrotropical Corinnidae have already been sent for inclusion in that project, and additional species collected during canopy fogging and other projects in South Africa will also be sent once the material is sorted. Other institutions holding material for molecular analysis will be approached in the future for access to their specimens. It is hoped that the sequence data from this large number of terminals will resolve many of the grey areas in Corinnidae phylogeny, especially the fate of the large number of Corinnidae *incertae sedis* genera.

12.6 REFERENCES

AGNARSSON, I. & MILLER, J.A. 2008. Is ACCTRAN better than DELTRAN? *Cladistics* **23:** 1032–1038.

BONALDO, A.B. 2000. Taxonomia da subfamília Corinninae (Araneae, Corinnidae) nas Regiões Neotropical e Neártica. *Iheringia, Série Zoologia* **89:** 3–148.

BOSSELAERS, J. & BOSMANS, R. 2010. Studies in Corinnidae (Araneae): a new *Paratrachelas* Kovblyuk & Nadolny from Algeria, as well as the description of a new genus of Old World Trachelinae. *Zootaxa* **2612:** 41–56.

BOSSELAERS, J. & LEDOUX, J.-C. 1998. Description of a new African genus, *Hortipes* (Araneae, Liocranidae). *Revue arachnologique* **12:** 147–152.

BOSSELAERS, J. & JOCQUÉ, R. 2000. *Hortipes*, a huge genus of tiny Afrotropical spiders (Araneae, Liocranidae). *Bulletin of the American Museum of Natural History* **256:** 1–108.

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.

CODDINGTON, J.A. 2005. *Chapter 2. Phylogeny and classification of spiders.* pp 18–24. *In*: UBICK, D., PAQUIN, P., CUSHING, P.E. & ROTH, V. (eds.). Spiders of North America: An Identification Manual. American Arachnological Society, 377 pp.

CODDINGTON, J.A. & LEVI, H.W. 1991. Systematics and evolution of spiders (Araneae). *Annual Review of Ecology and Systematics* **22:** 565–592.

CODDINGTON, J.A. & SCHARFF, N. 1994. Problems with zero-length branches. *Cladistics* **10:** 415–423.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DIPPENAAR-SCHOEMAN, A.S. & JOCQUÉ, R. 1997. *African spiders: an identification manual.* Plant Protection Research Institute Handbook No. 9. Agricultural Research Council, Pretoria, 392 pp.

GOLOBOFF, P. 1993. *NONA, version 2.0.* Published by the author, Instituto Miguel Lillo, Buenos Aires, Argentina.

GOLOBOFF, P., FARRIS, J. & NIXON, K.C. 2003. *T.N.T.: Tree Analysis Using New Technology.* Program and documentation, available from the authors, and at www.zmuc.dk/public/phylogeny. Accessed 26 September 2011.

HADDAD, C.R. 2004. A revision of the African spider genus *Graptartia* Simon, 1896 (Araneae: Corinnidae). *African Entomology* **12:** 71–81.

HADDAD, C.R. 2006a. *Spinotrachelas*, a new genus of tracheline sac spiders from South Africa (Araneae: Corinnidae). *African Invertebrates* **47:** 85–93.

HADDAD, C.R. 2006b. A new species of *Corinnomma* (Araneae: Corinnidae) from southern and eastern Africa, with taxonomic notes on *C. olivaceum* and *C. semiglabrum*. *African Invertebrates* **47:** 71–83.

HADDAD, C.R. 2009. *Vendaphaea*, a new dark sac spider genus apparently endemic to the Soutpansberg Mountains, South Africa (Araneae: Corinnidae). *African Invertebrates* **50:** 269–278.

HADDAD, C.R. & BOSSELAERS, J. 2010. A revision of the genus *Medmassa* Simon, 1887 (Araneae: Corinnidae) in the Afrotropical Region. *Zootaxa* **2361:** 1–12.

HADDAD, C.R. & LYLE, R. 2008. Three new genera of tracheline sac spiders from southern Africa (Araneae: Corinnidae). *African Invertebrates* **49:** 37–76.

HADDAD, C.R., 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.

JOCQUÉ, R. & BOSSELAERS, J. 2011. Revision of *Pseudocorinna* Simon and a new related genus (Araneae: Corinnidae): two more examples of spider templates with a large range of complexity in the genitalia. *Zoological Journal of the Linnean Society* **162:** 271–350.

JOCQUÉ, R. & DIPPENAAR-SCHOEMAN, A.S. 2006. *Spider Families of the World*. Royal Museum for Central Africa, Tervuren, 336 pp.

LYLE, R. 2008. *A review of the Afrotropical trachelinae sac spiders (Araneae: Corinnidae), with revisions of three genera.* Unpublished M.Sc Dissertation. University of the Free State, Bloemfontein, 365pp.

LYLE, R. & HADDAD, C.R. 2009. *Planochelas*, a new genus of tracheline sac spiders from West and Central Africa. *Annals of the Transvaal Museum* **46:** 91–100.

LYLE, R. & HADDAD, C.R. 2010. A revision of the tracheline sac spider genus *Cetonana* Strand, 1929 in the Afrotropical Region, with descriptions of two new genera (Araneae: Corinnidae). *African Invertebrates* **51:** 321–384.

MADDISON, W.P. 1993. Missing data versus missing characters in phylogenetic analysis. *Systematic Biology* **42:** 576–581.

NIXON, K.C. 2002. *Winclada 1.00.08.* Program and documentation available at www.cladistics.com. Accessed 26 September 2011.

NIXON, K.C. & CARPENTER, J.M. 1996. On consensus, collapsibility, and clade concordance. *Cladistics* **12:** 305–321.

PLATNICK, N.I. 2002. A revision of the Australasian ground spiders of the families Ammoxenidae, Cithaeronidae, Gallieniellidae, and Trochanteriidae (Araneae: Gnaphosoidea). *Bulletin of the American Museum of Natural History* **271:** 1–243.

PLATNICK, N.I. 2011. The World Spider Catalog, Version 12.5. American Museum of Natural History, New York. Available at: http://research.amnh.org/entomology/spiders/catalog; accessed 31 December 2011.

PLATNICK, N.I., GRISWOLD, C.E. & CODDINGTON, J.I. 1991. On missing entries in cladistic analysis. *Cladistics* **7:** 337–343.

SIMON, E. 1898. *Histoire naturelle des Araignées*. Tomé 2, pp. 193–380. Librairie Encyclopé-dique de Roret, Paris.

UBICK, D. & RICHMAN, D.B. 2005. *Chapter 20. Corinnidae.* pp 79–82. *In*: UBICK, D., PAQUIN, P., CUSHING, P.E. & ROTH, V. (eds.). Spiders of North America: An Identification Manual. American Arachnological Society, 377 pp.

APPENDIX 1. List of material examined of outgroups (Trachelinae, Phrurolithinae, Corinnidae *incertae sedis* and Gnaphosidae), *Medmassa semiaurantiaca* Simon, 1910 (Afrotropical Castianeirinae) and non-Afrotropical Castianeirinae included in the phylogenetic analyses. Abbreviations of collections: NCA – National Collection of Arachnida, ARC-Plant Protection Research Institute, Pretoria; PCCH – Personal collection of Charles Haddad; USNM – United States National Museum, Smithsonian Institution, Washington D.C..

CORINNIDAE: CASTIANEIRINAE

***Medmassa semiaurantiaca* Simon, 1910:** BOTSWANA: Okavango Delta, near Shakawe, Lesideng Research Camp, 18°25.822'S, 21°53.771'E, 26-29.XI.2006, C. Haddad (night collecting), 4imm. 3♂ (NCA 2007/995); Okavango Delta, Samochima Lagoon, Shakawe Fishing Camp, 18°25.749'S, 21°54.035'E, 10.XII.2006, C. Haddad (under tree bark), 1♀ (NCA 2007/1023).

***Myrmecium* sp.:** BRAZIL: *Para Brazil*: Melgago, Floresta Nacional de Caxivanã, 1♂ 1♀ (PCCH).

***Supunna picta* (L. Koch, 1873):** AUSTRALIA: *Western Australia*: Jandakot Airport, 32°05'31"S, 115°52'28"E, 1.XI – 4.XI.1994, J.M. Waldock & A.F. Longbottom (wet pitfall traps, site JK 2), 1♂ 1♀ (PCCH).

CORINNIDAE: CORINNINAE

***Creugas gulosus* Thorell, 1878:** LIBERIA: Monrovia, Montserrado Co., 06°19'N, 10°48'W, 1894, O.F. Cook Collection, 1♂ (USNM).

CORINNIDAE: PHRUROLITHINAE

***Orthobula radiata* Simon, 1897:** SOUTH AFRICA: *KwaZulu-Natal Province*: Umgeni Valley Nature Reserve, near Howick, 11.V.2003, C. Haddad (leaf litter, tree base), 2♂ 3♀ (NCA 2008/577).

CORINNIDAE: TRACHELINAE

***Afroceto martini* (Simon, 1897):** SOUTH AFRICA: *KwaZulu-Natal Province*, Greater St. Lucia Wetlands Park, Hell's Gate, 22.XI.2004, J. Esterhuizen (tsetse fly traps), 1♂ 2♀ (NCA 2005/224).

***Spinotrachelas capensis* Haddad, 2006:** SOUTH AFRICA: *Western Cape Province*: De Hoop Nature Reserve, Potberg, 34°22.549'S, 20°32.004'E, 24.III.2005, C. Haddad (under *Eucalyptus* bark), 1♂ (NCA 2005/2011); De Hoop Nature Reserve, Bitou No. 2, 34°27.194'S, 20°24.250'E, 25.IX.2006, C. Haddad (under rocks), 2♀ (NCA 2007/3884).

***Trachelas schenkeli* Lessert, 1923:** SOUTH AFRICA: *Mpumulanga Province*: Kruger National Park, Skukuza, Onder Sabie, 13.VIII.1991, S. Neser (on plant), 1♀ (NCA 2002/480); *KwaZulu-Natal Province*: Ithala Game Reserve, Doornkraal Camp, 27°30.735'S, 31°12.231'E, 29.VI.2007, R. Fourie & C. Haddad (beats, short shrubs), 2imm. 1♂ (NCA 2007/286).

CORINNIDAE *INCERTAE SEDIS*

***Pronophaea natalica* Simon, 1897:** SOUTH AFRICA: *Eastern Cape Province*: Kei Mouth, 12.XII.2002, C. Haddad (leaf litter at tree base), 4♂ 2♀ (NCA 2008/575).

***Vendaphaea lajuma* Haddad, 2009:** SOUTH AFRICA: *Limpopo Province*: Lajuma Mountain Retreat, Island 2, 23°01.921'S, 29°26.193'E, 23.XI.2004, M. Mafadza (active searching), 1♂ 2♀ (NCA 2008/563).

GNAPHOSIDAE

***Drassodes sesquidentatus* Purcell, 1908:** SOUTH AFRICA: *Northern Cape Province*: Prieska District, Green Valley Nuts, 29°35'11"S, 22°56'41"E, 2001–2002, C. Haddad (pitfalls, pistachio orchards), 6imm 2♂ 5♀ (PCCH).

APPENDIX 2. Character-taxon matrix for the 51 species and 91 characters included in the phylogenetic analyses. Root taxon highlighted in yellow.

Character	*Drassodes sesquidentatus*	*Afroceto martini*	*Apochinomma formicaeforme*	*Apochinomma malkini*	*Apochinomma decepta*	*Cambalida compressa*	*Cambalida coriacea*	*Cambalida deminuta*	*Cambalida dippenaarae*	*Cambalida fulvipes*	*Cambalida griswoldi*	*Cambalida loricifera*	*Castianeira majungae*	*Castianeira phaeochroa*	*Copa flavoplumosa*	*Copa kei*	*Copuetta comorica*	*Copuetta erecta*	*Copuetta kwamgumi*	*Copuetta lacustris*	*Copuetta lotzi*	*Copuetta magna*	*Copuetta maputa*	*Corinnomma lawrencei*	*Corinnomma semiglabrum*	*Creugas gulosus*	*Echinax clara*	*Echinax hesperis*	*Echinax longespina*	*Echinax natalensis*	*Echinax scharffi*	*Echinax similis*	*Echinax spatulata*	*Graptartia granulosa*	*Graptartia mutillica*	*Graptartia tropicalis*	*Medmassa semiaurantiaca*	*Merenius alberti*	*Messapus martini*	*Messapus natalis*	*Myrmecium sp.*	*Orthobula radiata*	*Pronophaea natalica*	*Spinotrachelas capensis*	*Supunna picta*	*Trachelas schenkeli*	*Vendaphaea lajuma*	*Wasaka imitor*	*Wasaka montana*	*Wasaka obscura*	*Wasaka ventralis*	Consistency index	Retention index
1	0	0	0	0	0	1	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	1	0	0	1	2	1	1	0	0	1	0	0	0	0	25	64
2	0	0	2	2	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	1	0	0	0	1	0	0	0	2	0	0	1	0	0	0	0	0	0	0	25	62
3	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	100	100
4	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	100	100
5	1	1	2	2	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1	1	1	1	2	1	1	1	0	2	1	1	1	1	1	25	33
6	1	1	2	2	2	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	2	1	1	1	0	2	1	1	1	1	1	33	55
7	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	100	100
8	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	25	0
9	1	2	2	2	2	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	0	2	2	2	0	1	0	2	1	0	2	2	2	2	20	69
10	1	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	1	0	0	0	1	1	1	0	1	0	0	0	0	1	1	1	1	1	0	0	0	0	12	66
11	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	2	2	1	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	0	1	2	2	2	2	2	2	2	2	2	0	2	20	46
12	1	2	2	2	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	2	2	0	2	0	0	2	2	1	2	0	2	0	0	0	0	0	22	75
13	2	1	0	2	2	0	1	0	0	0	0	2	0	1	1	2	2	0	0	0	0	0	2	0	0	1	2	2	2	2	2	2	2	0	0	0	1	2	0	0	0	0	1	2	0	1	2	0	1	0	0	9	50
14	0	2	2	2	2	0	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	1	1	2	2	2	1	1	1	2	2	2	1	0	2	2	2	1	1	1	2	1	2	2	1	2	1	1	1	1	1	16	50
15	2	2	2	2	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	1	1	2	1	1	1	1	0	1	0	1	2	2	1	1	1	1	2	1	2	2	1	2	2	1	0	0	0	18	70
16	1	1	2	2	2	0	0	0	0	0	1	1	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	0	2	2	2	0	1	0	2	1	0	2	2	2	2	18	64
17	2	1	1	1	2	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	1	1	1	0	1	0	0	0	0	1	1	1	1	2	0	1	0	1	14	52
18	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	2	0	2	2	1	2	2	2	2	1	2	2	2	2	2	2	2	0	1	2	2	2	2	2	2	2	0	2	0	2	22	65
19	2	1	2	2	0	0	2	0	0	0	0	2	0	1	1	2	0	2	0	0	0	1	0	0	0	0	2	2	2	2	2	2	2	0	0	0	1	2	0	0	0	0	1	2	0	1	2	0	1	0	0	10	55
20	0	2	2	2	2	1	1	1	1	1	1	1	1	1	1	2	1	1	0	1	1	1	1	2	2	1	2	2	1	2	2	2	1	2	2	2	2	2	1	1	2	1	2	2	1	2	1	1	1	1	0	16	54
21	2	2	2	2	2	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	0	1	0	1	1	2	1	1	1	1	1	1	0	1	2	2	1	1	1	1	2	1	2	2	1	2	2	1	0	0	1	18	65
22	0	0	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	2	2	2	0	1	2	2	3	3	1	0	0	1	0	0	0	0	0	20	50
23	1	1	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	1	1	1	1	1	1	1	?	1	1	1	1	1	1	1	?	0	1	1	1	0	?	?	?	?	14	60
24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	20	78
25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	2	1	2	2	0	0	2	2	2	2	2	2	2	2	2	2	33	20

APPENDIX 2 – cont.

Character	*Drassodes sesquidentatus*	*Afroceto martini*	*Apochinomma formicaeforme*	*Apochinomma malkini*	*Apochinomma decepta*	*Cambalida compressa*	*Cambalida coriacea*	*Cambalida deminuta*	*Cambalida dippenaarae*	*Cambalida fulvipes*	*Cambalida griswoldi*	*Cambalida loricifera*	*Castianeira majungae*	*Castianeira phaeochroa*	*Copa flavoplumosa*	*Copa kei*	*Copuetta comorica*	*Copuetta erecta*	*Copuetta kwamgumi*	*Copuetta lacustris*	*Copuetta lotzi*	*Copuetta magna*	*Copuetta maputa*	*Corinnomma lawrencei*	*Corinnomma semiglabrum*	*Creugas gulosus*	*Echinax clara*	*Echinax hesperis*	*Echinax longespina*	*Echinax natalensis*	*Echinax scharffi*	*Echinax similis*	*Echinax spatulata*	*Graptartia granulosa*	*Graptartia mutillica*	*Graptartia tropicalis*	*Medmassa semiaurantiaca*	*Merenius alberti*	*Messapus martini*	*Messapus natalis*	*Myrmecium sp.*	*Orthobula radiata*	*Pronophaea natalica*	*Spinotrachelas capensis*	*Supunna picta*	*Trachelas schenkeli*	*Vendaphaea lajuma*	*Wasaka imitor*	*Wasaka montana*	*Wasaka obscura*	*Wasaka ventralis*	Consistency index	Retention index
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	20	80
27	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	2	1	2	2	0	0	2	2	2	2	2	2	2	2	2	2	25	14
28	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	1	1	1	33	50
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50
30	0	0	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	1	1	20	82
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0	50	66
32	0	0	0	0	0	1	1	1	1	1	1	1	0	0	2	2	3	3	3	3	3	3	3	0	0	1	3	3	3	3	3	3	3	0	0	0	0	0	3	1	0	0	0	0	0	0	3	3	3	3	3	27	86
33	0	1	0	0	0	1	1	1	1	1	1	1	0	0	2	2	3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1	1	0	0	0	1	0	3	1	0	0	0	1	0	0	3	3	3	3	3	18	70
34	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	100	100
35	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	0	1	1	0	0	0	0	25	62
36	0	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	1	2	3	3	2	1	3	3	2	1	3	2	2	2	2	27	42
37	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	100	100
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	2	1	0	0	0	28	44
39	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	0	0	0	1	0	0	1	0	0	0	0	20	69
40	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	16	76
41	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	33	50
42	2	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0	2	1	2	2	1	2	2	2	1	0	2	1	1	1	1	22	56
43	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	0	0	0	1	0	1	1	0	0	0	0	25	80
44	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	1	0	0	0	0	25	40
45	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	0	0	0	1	0	1	1	1	1	1	1	25	85
46	0	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	2	1	2	0	0	2	0	0	1	2	0	0	2	2	2	2	40	82
47	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	2	0	1	1	1	1	40	57
48	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	25	62
49	0	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	5	5	5	5	5	5	5	5	5	5	4	5	3	3	5	4	3	2	5	1	3	5	5	5	5	50	83
50	?	?	0	0	2	1	1	1	1	1	1	0	1	0	2	1	0	0	1	0	1	1	1	0	1	?	2	2	2	2	2	2	2	1	0	0	?	0	?	?	0	?	?	?	2	?	?	0	1	0	1	15	52

APPENDIX 2 – cont.

Character	*Drassodes sesquidentatus*	*Afroceto martini*	*Apochinomma formicaeforme*	*Apochinomma malkini*	*Apochinomma decepta*	*Cambalida compressa*	*Cambalida coriacea*	*Cambalida deminuta*	*Cambalida dippenaarae*	*Cambalida fulvipes*	*Cambalida griswoldi*	*Cambalida loricifera*	*Castianeira majungae*	*Castianeira phaeochroa*	*Copa flavoplumosa*	*Copa kei*	*Copuetta comorica*	*Copuetta erecta*	*Copuetta kwamgumi*	*Copuetta lacustris*	*Copuetta lotzi*	*Copuetta magna*	*Copuetta maputa*	*Corinnomma lawrencei*	*Corinnomma semiglabrum*	*Creugas gulosus*	*Echinax clara*	*Echinax hesperis*	*Echinax longespina*	*Echinax natalensis*	*Echinax scharffi*	*Echinax similis*	*Echinax spatulata*	*Graptartia granulosa*	*Graptartia mutillica*	*Graptartia tropicalis*	*Medmassa semiaurantiaca*	*Merenius alberti*	*Messapus martini*	*Messapus natalis*	*Myrmecium sp.*	*Orthobula radiata*	*Pronophaea natalica*	*Spinotrachelas capensis*	*Supunna picta*	*Trachelas schenkeli*	*Vendaphaea lajuma*	*Wasaka imitor*	*Wasaka montana*	*Wasaka obscura*	*Wasaka ventralis*	Consistency index	Retention index
51	?	?	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	1	1	0	0	0	?	1	1	1	1	1	1	1	1	1	1	?	1	?	?	0	?	?	?	1	?	?	1	1	1	1	16	50
52	?	?	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	?	1	1	1	1	1	1	1	0	1	1	?	1	?	?	1	?	?	?	1	?	?	0	1	1	1	33	0
53	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	33	33
54	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1	1	25	25
55	4	1	2	2	2	2	2	3	2	2	?	2	1	2	2	2	2	3	3	2	2	2	2	3	2	1	2	2	2	2	2	2	2	3	3	3	1	2	2	3	3	0	0	1	2	0	1	2	2	2	2	26	42
56	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	50	0
57	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	33	0
58	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	0	1	1	1	0	1	1	1	1	33	60
59	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	25	50
60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	50	50
61	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	50	83
62	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	100
63	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1	1	50	50
64	1	1	0	0	0	1	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0	0	0	0	25	87
65	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1	0	0	1	0	0	0	1	1	0	1	1	1	1	33	80
66	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	50	50
67	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	25	40
68	1	1	1	0	1	0	1	0	1	1	0	0	0	0	0	1	1	0	3	3	1	1	1	1	1	1	1	0	1	1	0	0	0	1	0	1	1	0	2	3	1	1	2	1	0	1	1	0	1	0	1	14	21
69	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	33	33
70	0	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	1	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	0	1	1	0	2	0	2	0	0	2	2	2	1	18	30
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	25	62
72	1	0	3	3	3	2	3	3	3	3	3	3	?	3	3	3	?	3	?	?	?	3	?	3	3	0	3	3	3	3	1	3	3	3	3	3	0	3	4	?	4	1	3	1	3	?	1	3	3	3	3	28	44
73	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	?	0	0	0	0	0	0	0	1	0	0	1	0	1	1	1	1	1	1	0	1	1	0	0	0	0	33	80
74	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	1	1	1	1	33	66
75	3	4	3	4	1	3	3	3	3	3	3	3	4	1	1	1	1	1	1	1	1	1	1	3	3	4	2	2	2	2	2	2	2	1	3	3	1	3	4	1	4	4	4	?	1	4	4	1	1	1	1	20	76

APPENDIX 2 – cont.

Character	*Drassodes sesquidentatus*	*Afroceto martini*	*Apochinomma formicaeforme*	*Apochinomma malkini*	*Apochinomma decepta*	*Cambalida compressa*	*Cambalida coriacea*	*Cambalida deminuta*	*Cambalida dippenaarae*	*Cambalida fulvipes*	*Cambalida griswoldi*	*Cambalida loricifera*	*Castianeira majungae*	*Castianeira phaeochroa*	*Copa flavoplumosa*	*Copa kei*	*Copuetta comorica*	*Copuetta erecta*	*Copuetta kwamgumi*	*Copuetta lacustris*	*Copuetta lotzi*	*Copuetta magna*	*Copuetta maputa*	*Corinnomma lawrencei*	*Corinnomma semiglabrum*	*Creugas gulosus*	*Echinax clara*	*Echinax hesperis*	*Echinax longespina*	*Echinax natalensis*	*Echinax scharffi*	*Echinax similis*	*Echinax spatulata*	*Graptartia granulosa*	*Graptartia mutillica*	*Graptartia tropicalis*	*Medmassa semiaurantiaca*	*Merenius alberti*	*Messapus martini*	*Messapus natalis*	*Myrmecium sp.*	*Orthobula radiata*	*Pronophaea natalica*	*Spinotrachelas capensis*	*Supunna picta*	*Trachelas schenkeli*	*Vendaphaea lajuma*	*Wasaka imitor*	*Wasaka montana*	*Wasaka obscura*	*Wasaka ventralis*	Consistency index	Retention index
76	4	5	4	5	2	4	4	4	4	4	4	4	5	2	0	1	2	1	1	1	1	1	1	4	4	5	3	3	3	3	3	3	3	2	4	4	2	4	3	4	5	5	5	5	1	5	5	2	2	2	2	29	79
77	4	4	2	2	3	1	3	3	4	3	4	3	?	3	2	1	2	2	2	2	2	2	2	3	2	0	2	2	2	2	2	2	2	4	2	3	0	3	1	1	3	0	0	1	2	4	0	1	1	1	1	23	64
78	4	4	2	2	4	3	4	4	4	4	4	4	4	4	2	2	2	2	2	2	2	2	2	3	3	0	2	2	2	2	2	2	2	4	2	4	0	4	1	1	3	0	0	4	2	4	0	?	1	1	1	28	78
79	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	50	50
80	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	50	50
81	3	4	3	4	1	3	3	3	3	3	3	3	3	1	1	1	3	1	1	1	1	1	1	3	3	4	2	2	2	2	2	2	2	1	3	3	1	3	4	1	4	4	4	?	1	4	4	1	1	1	?	18	72
82	4	5	2	3	1	3	3	3	3	3	3	3	2	1	0	0	4	1	1	1	1	1	1	4	4	5	3	3	3	3	3	3	3	2	4	4	2	4	3	4	5	5	5	5	1	5	5	2	2	2	1	23	69
83	1	?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	?	0	0	0	0	0	0	0	1	1	1	1	1	1	1	?	?	?	?	1	?	?	1	1	1	2	100	100
84	4	4	2	2	3	2	3	3	4	3	2	3	2	3	2	2	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	4	2	2	0	3	1	1	3	0	0	1	2	4	0	1	1	1	?	26	63
85	4	4	2	2	3	3	4	4	4	4	4	4	2	4	2	3	2	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	4	2	4	0	4	1	1	2	0	0	4	2	4	0	1	1	1	?	23	69
86	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	33	0
87	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	50	0
88	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	1	50	95
89	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	14	14
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	50
91	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	100	100

CHAPTER 13

Apochinomma formicaeforme **Pavesi, 1881 (Ndumo Game Reserve, South Africa)**

Afrotropical Castianeirinae (Araneae: Corinnidae) as components of ant mimicry complexes, with comments on colour polymorphism in the subfamily and its ecological significance

13.1 ABSTRACT

The biology of many Afrotropical spiders has never been studied, and in the case of ant mimics, the interactions between models and their mimics are especially poorly understood. In this chapter the role of Castianeirinae as components of arthropod mimicry complexes is described for three species of ants, *Anoplolepis custodiens* (F. Smith, 1858), *Polyrhachis gagates* F. Smith, 1858 and *Camponotus fulvopilosus* (De Geer, 1778). There are respectively two out of 10, four out of six, and zero out of five species of Castianeirinae forming part of the arthropod complexes associated with the three ant species. All but one species, *Apochinomma formicaeforme* Pavesi, 1881, which is an accurate (good/specialised) mimic of *P. gagates*, are inaccurate (weak/ generalised) mimics of their models. Colour polymorphism is also described for the first time in four species of Afrotropical Castianeirinae, *Corinnomma semiglabrum* (Simon, 1896), *Merenius alberti* Lessert, 1923, *Castianeira* cf. *venustula* (Pavesi, 1895) and *Copa flavoplumosa* Simon, 1885. Three of these species are generalised mimics of ants, while *C. flavoplumosa* is a species with a widespread variant with cryptic lycosiform colouration and a nigrito form restricted mainly to tropical forests.

13.2 INTRODUCTION

Mimicry is a fascinating subject in the field of biology that serves as a classic example of Darwinian selection and evolutionary theory (Joron & Mallet 1998). Mimetic relationships typically involve interactions between three organisms, the first of which is referred to as the signaller, primary signal generator or defended organism (model). This is usually a species that is dangerous or unpalatable to predators. The second organism (mimic) is usually not dangerous or unpalatable but imitates the morphology and/or behaviour of the model and is thus afforded some level of protection from predators. Mimics are often referred to as the secondary signal generators. The predators themselves are regarded as the operators or signal receivers, as they are responsible for interpreting the morphology of potential prey as being suitable for consumption or not (Endler 1981; Speed 1999; Edmunds 2000). Importantly, mimics should ideally maintain reasonably low population densities relative to that of their models, or else predators will learn of their presence and predation pressure on both palatable mimic and unpalatable model may increase (Srygley 1999).

Mimics of ants can generally be divided into two groups: 1) those with morphological, physiological and/or behavioural similarities to ants (myrmecomorphs), and 2) those that either have or lack the aforementioned adaptations but produce or sequester chemical components that facilitate a close association with the model, which are referred to as myrmecophiles (McIver & Stonedahl 1993; Cushing 1997; Elgar & Allan 2004). Ant mimicry is not only restricted to myrmecomorphy and myrmecophily, but also includes the employment of a range of chemical strategies to avoid detection and attacks by ants (e.g. Elgar & Allan 2004; Akino 2008; Pekár & Jiroš in press).

Myrmecomorphy has been reported for more than 300 species of spiders in 13 families (Cushing 1997, in press). Most myrmecomorphic spiders are regarded as Batesian mimics of ants, as their resemblance to unpalatable ants offers them protection from generalist predators (Théry & Casas 2009). Spiders use a variety of morphological and behavioural adaptations to imitate ants. Morphological adaptations include elongated bodies and legs, constrictions of the carapace and abdomen, modifications of the chelicerae and spinnerets, and corresponding colouration to imitate the model. Behavioural adaptations include erratic ant-like movements, vertical movements of a pair of legs to imitate antennal movements of ants, and abdomen bobbing (Reiskind 1971; McIver & Stonedahl 1993; Cushing 1997; Théry & Casas 2009).

The degree to which mimetic spiders are afforded protection from visual predators depends on the strength of the signal produced by the mimic, i.e. the degree to which the body colouration, morphology and behaviour of the spider is adapted to resemble that of the model (Nelson 2012). Furthermore, for the mimicry to be effective, the mimics usually have to live sympatrically and in close association to the ants, which are potentially dangerous to the mimics. The mimics are thus under strong selection pressure to evolve adaptations that improve their survival amongst foraging ants (Pekár & Jiroš in press).

In the current study, two biological factors will be investigated, with specific reference to examples of Castianeirinae spiders from the Afrotropical Region. The first of these, ant mimicry complexes, is where several different arthropod species mimic a particular ant species. The second, colour polymorphism, is a phenomenon that refers to multiple colour phenotypes of a particular species. Both concepts are very poorly researched in spiders, and very few examples have been investigated from the Afrotropical Region in particular (Cushing 1997, in press).

The evolution of mimicry complexes seems to be possible due to the high abundance of ants and the general rarity of their mimics (Hespenheide 1986). The mimicry is not only restricted to spiders, but may also occur in a variety of insect taxa, particularly true bugs (Hemiptera) and beetles (Coleoptera), and has so far been recorded in more than 2000 species of arthropods belonging to 200 genera and 54 families (McIver & Stonedahl 1993). Since multiple species may mimic a particular model, it is inevitable that they will differ in the degrees of morphological and behavioural specialisation, as described for accurate and inaccurate mimics in Chapter 1. Furthermore, some species could be considered to be aggressive mimics, which use their morphological and textual resemblance to ants to deceive their models and prey on them (McIver & Stonedahl 1993). Despite the variety of possible associations with their ant models, little is known of the diversity of taxa forming mimicry complexes, the interactions amongst the mimetic species, and the interactions between the mimics and their models within such complexes.

Prey species with diverse phenotypes, i.e. that are polymorphic in colouration and/or morphology, have historically been considered the evolved reflection of the visual and cognitive characteristics of their predators (Bond 2007). Polymorphic species benefit from this strategy, as it is more difficult for visually dependant predators to simultaneously search for multiple cryptic or mimetic prey species rather than a single one. The most abundant forms of the prey species will most likely be identified and captured, while rarer forms will effectively be overlooked (Bond 2007). As such, the rare morphs in a population are often not recognised as prey items and are thus afforded greater protection than more common morphs (Endler 1981). According to Holen & Johnstone (2004), Batesian mimics that are common and/or mimic weakly defended models are more likely to evolve mimetic polymorphism if they encounter predators regularly and/or are bad at evading predator attacks.

Amongst spiders, polymorphic myrmecomorphic spiders are thought to have different colour morphs that each correspond to a different model ant (Cushing 1997, in press). Where the juveniles and adults mimic different ant species, this is regarded as transformational mimicry. Mimetic polymorphism is generally considered to be rare, as mimics are usually strongly selected towards a single highly abundant and noxious model (Joron & Mallet 1998). By the mere implication that accurate or specific mimics are associated with a single model (Edmunds 2000), polymorphic species should be considered more generalised mimics of ants, i.e. inaccurate or weak mimics, except where the models are also morphologically similar. Polymorphism in spiders is not only restricted to mimics of insects (see Cushing 1997, in press), but has also been reported for several web-builders (Oxford 1976; Wise & Reillo 1985; Reillo & Wise 1987; Gillespie 1989; Gillespie & Tabaschnik 1990; Huber & Hopf 2004), although the selective forces acting on those spiders are largely unexplored.

Polymorphism in myrmecomorphic spiders is taken to extremes in the salticid *Myrmarachne bakeri*, which apart from adult sexual dimorphism also has seven different colour variants, different degrees of shininess or dullness of the integument, and setal densities. This species is also a transformational mimic, with colour changing between and even within instars, even during adulthood (Nelson 2010). In the case of the polymorphic myrmecophagous *Mexcala elegans* Peckham & Peckham, 1903 from southern Africa, adults have mimetic variations that imitate velvet ants (Mutillidae) and silver-grey ground-dwelling ants, while the immatures are bright metallic green and blue and evidently mimic small ground-dwelling ants (Wesołowska & Haddad 2009; Pekár & Haddad 2011). Despite the rich diversity of ant-mimicking corinnids, only three species of Castianeirinae have been reported to be polymorphic (including transformational) so far: *Castianeira rica* Reiskind, 1969 (Reiskind 1969, 1970), *Myrmecium bifasciatum* Taczanowski, 1874 and *M.* cf. *gounellei* Simon, 1896 (Oliveira 1986).

During field work in southern Africa during the last decade, I have often encountered multiple spider and insect species associated with a particular ant model. Time restrictions at a particular locality have usually prevented me from making more detailed studies of these associations, but preliminary observations at least give an indication of the morphological (colouration, body constrictions etc.) and behavioural adaptations to mimicry (abdomen bobbing, use of first pair of legs to simulate antennal movements etc.) of the species comprising these mimicry complexes. Several castianeirine species collected were also found to be polymorphic, even though their conspecificity was not immediately evident in the field. The aim of the present study is to describe the mimicry complexes associated with three common ant species in southern Africa, highlight the contribution of Castianeirinae spiders to these complexes, and further describe colour polymorphism in four species of Afrotropical Castianeirinae, of which one species is generally cryptically coloured and the other three myrmecomorphic.

More detailed studies are needed on most of these mimics to determine whether they are aggressive mimics and feed on their models. This is the case in the salticid *Mexcala elegans*, which feeds exclusively on ants in the field (i.e. stenophagous ant-feeding) but feeds on a variety of prey in the laboratory, suggesting characteristics of euryphagous generalist feeders (Pekár & Haddad 2011). Also, the interactions between the ants and their mimics, and those between the mimics, need to be the focus of more detailed studies in the future.

13.3 CASTIANEIRINAE AS COMPONENTS OF MIMICRY COMPLEXES

13.3.1 Mimics of *Anoplolepis custodiens* (F. Smith, 1858) ants

The first of the mimicry complexes discussed here involves species associated with *Anoplolepis custodiens* ants (Fig. 1). Ten arthropod species from two orders (Araneae and Hemiptera) mimic this ant, of which three species are castianeirines (Table 1, Figs 2–4). Because *A. custodiens* varies considerably in size between minor and major workers (Prins 1982), multiple mimics have evolved, even within a single genus (e.g. *Micaria* Westring, 1851), in which one species is clearly a mimic of the major workers while the two smaller species resemble minor workers. In all areas where mimics of *A. custodiens* were studied, at least the large *Micaria* and one of the smaller species were found. Other widespread mimics include two *Natta* spp. and the polymorphic *Castianeira* cf. *venustula* (Pavesi, 1895) (see section 13.4.3).

TABLE 1. Complex of mimics associated with the ant *Anoplolepis custodiens* (F. Smith, 1858) in South Africa.

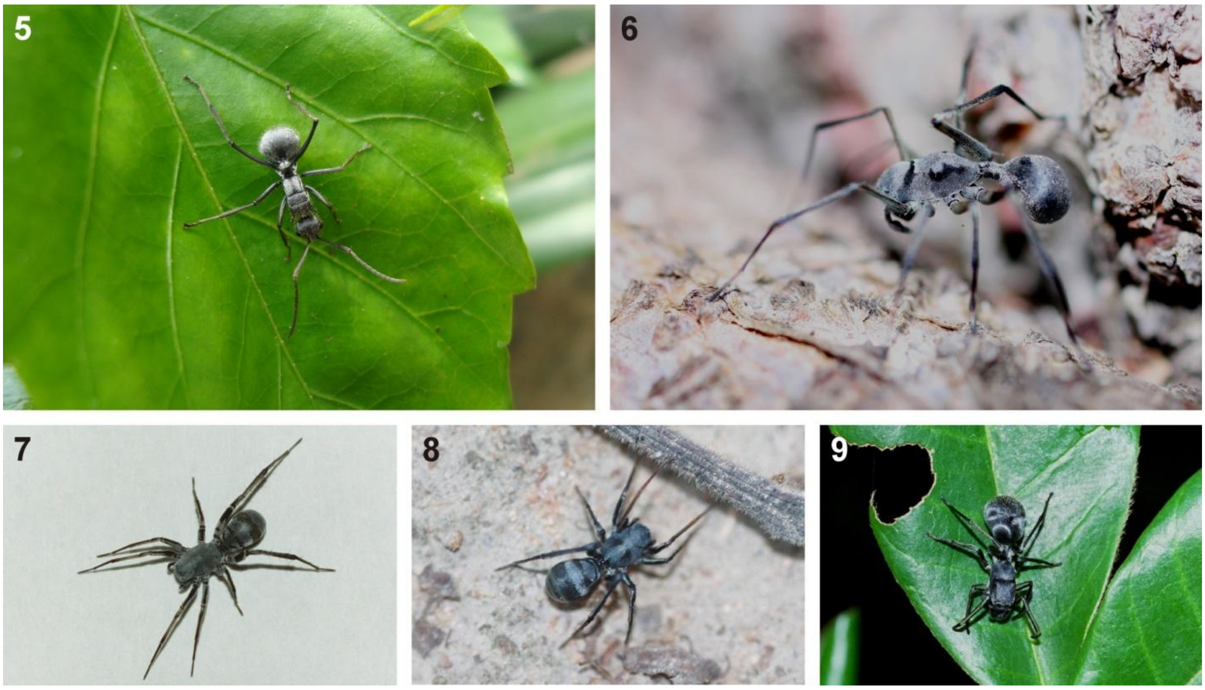
Organism	Family	Strategy	Feeds on model?
Castianeira cf. *venustula* (Pavesi, 1895)	Corinnidae	Colour, behaviour	No
Corinomma semiglabrum (Simon, 1896)	Corinnidae	Colour, behaviour	?
Merenius alberti Lessert, 1923	Corinnidae	Colour, behaviour	Yes
Micaria sp. 1	Gnaphosidae	Colour, behaviour	?
Micaria sp. 2	Gnaphosidae	Colour, behaviour	?
Micaria sp. 3	Gnaphosidae	Colour, behaviour	?
Myrmarachne inflatipalpis Wanless, 1978	Salticidae	Colour, behaviour	?
Natta chionogastra (Simon, 1901)	Salticidae	Colour, behaviour	No
Natta horizontalis Karsch, 1879	Salticidae	Colour, behaviour	No
Ranops sp.	Zodariidae	Colour, behaviour	?
Hemiptera nymph	Lygaeidae	Colour only	?

FIGURES 1–4. The ant *Anoplolepis custodiens* (F. Smith, 1858) (1) and three of its Castianeirinae spider mimics, *Castianeira* sp., female (2), *Corinnomma semiglabrum* (Simon, 1896), female (3) and *Merenius alberti* Lessert, 1923, female (4). Figure 1 photographed by Johan van Zyl, used with permission.

The majority of *A. custodiens* mimics have an orange to red-maroon carapace and a black abdomen with grey markings, similar to that of the model. The carapace is often covered in white straight or plumose setae to resemble the pubescence of the ants, while the abdomen has plumose setae (in castianeirines) or iridescent scales (in *Natta* spp. and *Micaria* spp.) to resemble the abdominal segments of the ants. The legs of most of the mimics are quite finely built and have pale dorsal stripes to enhance the elongation and narrowing effect. Only one species, *Merenius alberti* Lessert, 1923, has been observed feeding on its model in the field, and this was only on one occasion. This spider preys more often on typical leaf litter arthropods, including cockroach and cricket nymphs, springtails and small lycosid and salticid spiders (pers. obs.).

13.3.2 Mimics of *Polyrhachis gagates* F. Smith, 1858 ants

Polyrhachis F. Smith, 1858 is one of the largest ant genera, comprising 469 species in 12 subgenera worldwide (Dokow 1995), of which 47 species have been recorded from the Afrotropical Region (Bolton 1973). Most of these ants have been recorded from tropical and subtropical areas on the continent. *Polyrhachis* generally have a black or silver-grey body, often with dense pubescence, and an abdomen that usually points downwards (Fig. 11), and their slow and steady walking gait makes them easily recognisable in the field. Six arthropod species have been collected in close proximity to *P. gagates* in South Africa, of which four species are castianeirines and one a salticid (Table 2, Figs 6–9). It is likely that all of the *Apochinomma* species in the *A. formicaeforme* Pavesi, 1881 species group (e.g. Fig. 6) are mimics of *Polyrhachis* ants (see Chapter 3).



FIGURES 5–9. The ant *Polyrhachis gagates* F. Smith, 1858 (5) and four of its spider mimics, *Apochinomma formicaeforme* Pavesi, 1881, male (6), *Corinnomma lawrencei* Haddad, 2006, female (7), *C. semiglabrum* (Simon, 1896), female (8) and *Kima variabilis* Peckham & Peckham, 1903, female (9), all from Ndumo Game Reserve, South Africa.

TABLE 2. Complex of mimics associated with the ant *Polyrhachis gagates* F. Smith, 1858 in South Africa.

Organism	Family	Strategy	Feeds on model?
Apochinomma formicaeforme Pavesi, 1881	Corinnidae	Colour, behaviour	Yes
Corinnomma semiglabrum (Simon, 1896)	Corinnidae	Colour, behaviour	?
Corinnomma lawrencei Haddad, 2006	Corinnidae	Colour, behaviour	?
Merenius alberti Lessert, 1923	Corinnidae	Colour only	?
Kima variabilis Peckham & Peckham, 1903	Salticidae	Colour, behaviour	Yes
Hemiptera nymph	Lygaeidae	Colour only	?

The spider mimics of *P. gagates* all have a black body covered densely in silvery-grey to dark grey setae. In the castianeirine mimics these setae are densely plumose. The legs of all of the mimics are fine and have longitudinal dark lines and an abdomen with black transverse bands to simulate the abdominal segments of their model. Only two of the species have modifications of the carapace shape: *A. formicaeforme* and *Kima variabilis* Peckham & Peckham, 1903 have an elongate carapace with a distinct median constriction that effectively creates the illusion that the carapace is divided into two regions. Furthermore, these two species have an elongate, petiolate pedicel and somewhat downwards-pointing abdomen that imitates the petiole and abdomen of the ants (Figs 6 and 9). However, none of the species have the thorny projections at the posterior of the thorax that are found in their models (Fig. 5; Bolton 1973).

In terms of behavioural adaptations, both *A. formicaeforme* and *K. variabilis* have a slow and steady gait, which is similar to their models. This locomotion is atypical for ant-mimics, which generally tend to have very jerky movements while running (Cushing 1997, in press), as is the case with *M. alberti* and the two *Corinnomma* species. All species make use of up-and-down “antennal” movements. The lygaeid nymph has similar locomotion to *A. formicaeforme* and *K. variabilis*, and the abdomen shape is an exceptionally good imitation to that of the model.

13.3.3 Mimics of *Camponotus fulvopilosus* (De Geer, 1778) ants

While the above two examples show that castianeirines may be quite prominent components of mimicry complexes in southern Africa, there are none in the case of *C. fulvopilosus* (Fig. 10). The easy explanation for this is the general scarcity of castianeirines in the arid western parts of South Africa and Namibia where this ant species occurs (Robertson & Zachariades 1997). So far, five arthropods have been found that mimic *C. fulvopilosus* (Table 3), all of which have a black carapace (head and thorax in the Reduviidae nymph) and an abdomen with bright yellow to golden setae. In the case of the two *Mexcala* spp. mimicking this ant species (e.g. Fig. 11), both are suspected of being aggressive mimics that feed on their models (Curtis 1988; Wesołowska 2009), as is the case with *M. elegans*, which feeds exclusively on ants in the field (Pekár & Haddad 2011). Jocqué (2009) also suspected that *Capheris abrupta* Jocqué, 2009 feeds on ants, possibly *C. fulvopilosus*, as one of the specimens was collected together with these ants from underneath a rock.

TABLE 3: Complex of mimics associated with the ant *Camponotus fulvopilosus* (De Geer, 1778) in South Africa (indicated with +) and Namibia (indicated with *).

Organism	Family	Strategy	Feeds on ant?
Capheris abrupta Jocqué, 2009+	Zodariidae	Colour only	Probably
Mexcala namibica Wesołowska, 2009*	Salticidae	Colour, behaviour	Probably
Mexcala rufa Peckham & Peckham, 1902+*	Salticidae	Colour, behaviour	Probably
Kima atra Wesołowska & Russell-Smith, 2000+	Salticidae	Colour, behaviour	?
Hemiptera nymph +	Reduviidae	Colour only	?

FIGURES 10–11. The ant *Camponotus fulvopilosus* (10) and its jumping spider mimic *Mexcala rufa* Peckham & Peckham, 1902 (11). Figure 10 photographed by Johan van Zyl, used with permission.

13.4 POLYMORPHISM IN AFROTROPICAL CASTIANEIRINAE

13.4.1 Polymorphic mimicry in *Corinnomma semiglabrum* (Simon, 1896)

Corinnomma semiglabrum is a common litter-dwelling spider in savanna and forests that is clearly polymorphic. The first variation has a range of body colouration from silver-grey to dark blue-grey, with black markings on the carapace and transverse bands on the abdomen (Figs 12–14). This form is widely distributed in southern Africa and occurs in South Africa, Swaziland, Mozambique, Zimbabwe and Zambia. A second, less common variation occurs in north-western Botswana, the Caprivi strip of Namibia and southern Zambia, and has a deep maroon-red carapace with a creamy-white median stripe and a black abdomen with creamy-white transverse bands (Fig. 15). The transverse bands on the abdomen clearly simulate the abdominal segments of the models (Haddad 2006).

FIGURES 12–15. Four colour variations of *Corinnomma semiglabrum* (Simon, 1896): 12. pale silver-grey variation with black markings from Bilene, Mozambique; 13–14. dark silver-blue variation with black markings from Livingstone, Zambia (13) and Ndumo Game Reserve, South Africa (14); 15. deep red carapace and black abdomen with creamy-white markings from Wildlives Game Farm, Zambia.

In assessing the ants occurring in near proximity to these two forms, it is most likely that the more common blue-grey form is associated with one of two prospective models, *Polyrhachis gagates* or *Camponotus cinctellus* (Gerstäcker, 1859), of which they can be considered inaccurate mimics. Adult females in particular seem to resemble *P. gagates* more closely, especially when the individuals are well-fed or gravid, as the swollen abdomen is similar in general appearance to that of *P. gagates* workers. The more slender male may possibly resemble *P. gagates*, but more likely *C. cinctellus*, which is a more slender ant with similar blue-grey workers.

A second Afrotropical species, *C. lawrencei* Haddad, 2006, only occurs sympatrically with *C. semiglabrum* in South Africa and Mozambique, although the single record of this species from Tanzania suggests it is quite widespread along the east coast of Africa (Haddad 2006). This species has similar colouration and markings to the blue-grey variation of *C. semiglabrum*. While *C. lawrencei* is also most likely an inaccurate mimic of *P. gagates* ants (Haddad 2006), there is no indication that this species is polymorphic.

13.4.2 Polymorphic mimicry in *Merenius alberti* Lessert, 1923

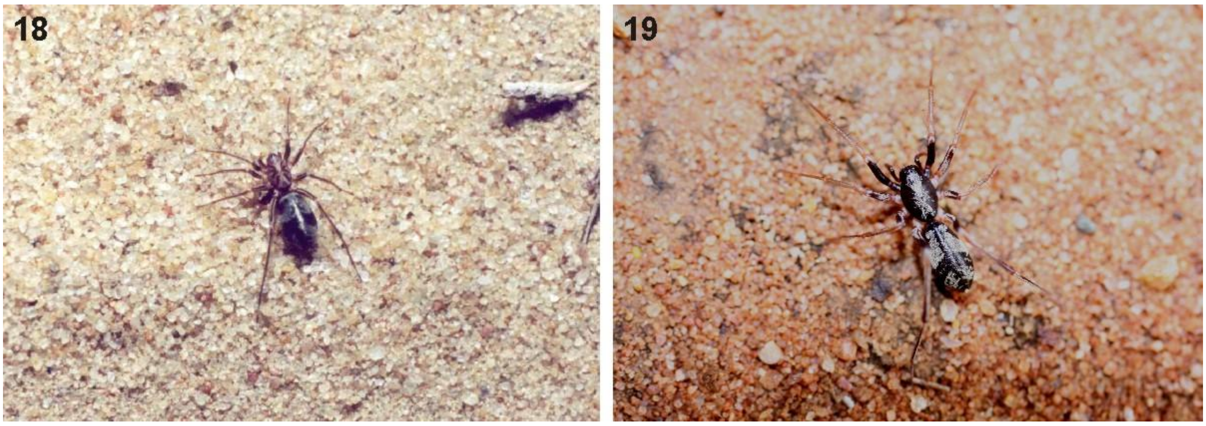
Merenius alberti is a common spider from the eastern half of southern Africa that occurs in leaf litter of savanna and forest habitats. Nearly all records of the species are of the widespread black variation, which has a black body with silver-grey or creamy-white markings (Figs 16–19). This form is suggested to be a general mimic of medium-sized black ground-dwelling ants.

Recently a second colour variation was discovered from two localities in South Africa (Ndumo Game Reserve in KwaZulu-Natal and Kruger National Park in Mpumulanga), in which the carapace is bright orange to red in colour (see Chapter 10). This variant was only found in the vicinity of *Anoplolepis custodiens* ants and the association with this species is quite clear. The broad distribution of *A. custodiens* in southern and central Africa (Prins 1982) suggests that this variant will be collected if sampling focuses on areas close to *A. custodiens* colonies.

FIGURES 16–19. Three colour variations of *Merenius alberti* Lessert, 1923: 16. black integument with silver-grey markings from Ndumo Game Reserve, South Africa; 17–18. black integument with creamy-white markings from Sodwana Bay (17) and iSimangaliso Wetlands Park (18), South Africa; 19. red carapace and black abdomen with cream markings from Ndumo Game Reserve.

13.4.3 Polymorphic mimicry in *Castianeira* cf. *venustula* (Pavesi, 1895)

The last of the polymorphic myrmecomorphic species is an undetermined, possibly new species of *Castianeira* closely related to *C. venustula* (Pavesi, 1895). This species is widely distributed in the Afrotropical Region from Mali in the west to Ethiopia in the east, and southwards to the arid south-western parts of South Africa. In the south of its range it has an orange or red carapace (Fig. 18) and is associated with *Anoplolepis custodiens* ants, while along the eastern and northern parts of Africa it has a black body with white markings and resembles *Camponotus* ants (Fig. 19). Apart from colouration that agrees with the models, this species has a more elongate body and thinner legs than most other Afrotropical *Castianeira* and also moves the front legs in an antenna-like fashion.



FIGURES 18–19. Two colour variations of *Castianeira* cf. *venustula* (Pavesi, 1895) occurring in southern and eastern Africa: 18. orange or red carapace variation from Sandveld Nature Reserve, South Africa; 19. black carapace variation from Ndumo Game Reserve, South Africa.

Anoplolepis ants are generally associated with drier habitats (Prins 1982), so predictably the orange/red carapace variation is found in savanna, grassland and Nama Karoo habitats in southern and eastern Africa. The black variation is more typical of the subtropical and tropical parts of southern and eastern Africa and is typically associated with moist savannas. Both colour morphs may, on occasion, occur sympatrically. At Ndumo Game Reserve in north-eastern South Africa, both variations occur together in broadleaf woodland habitats and dense thicket habitats, while only the red variation in found in various *Acacia*-dominated woodlands.

13.4.4 Polymorphism in *Copa flavoplumosa* Simon, 1885

Copa flavoplumosa is possibly the most widely distributed Afrotropical corinnid species and is found in virtually all biome types in the region except deserts and semi-deserts (see Chapter 6). It can be a prominent component of leaf litter spider assemblages and usually has cryptic lycosiform colouration, an adaptation for camouflage in leaf litter. While examining the massive series of this species for taxonomic study, it was clear that three main colour variations can be found (Figs 22–25). The most common variant is a form with an orange to orange-brown colouration with black markings that is found throughout the region except for tropical rainforests (Fig. 22). The second is found in tropical forests and savannas and has an orange to brown carapace with black markings and a black abdomen with white markings (Figs 23, 24). The third and most scarce form has an entirely black body with white markings (Fig. 25). The black variation of *C. flavoplumosa* was originally described by Lessert (1933) as a subspecies of another species, i.e. *C. benina nigra* Lessert, 1933. Their synonymy in Chapter 6 is supported by the structure of the genitalia of both sexes, and consequently the two species can be considered to be colour variations of a single species.

The widespread orange or brownish form is clearly adapted towards crypsis in leaf litter, but the (at least) black abdomen with white markings of the other two forms might not be as effective in camouflage as that of the widespread form, especially in habitats where sunlight penetration is high. The distribution patterns of the latter two forms would suggest that these darker morphs occur mainly in tropical forests and savannas, where light levels on the ground are darker than more exposed habitats. It seems that these two forms draw benefit from darker areas in the litter layer of these habitats, and that the contrasting carapace and abdominal colouration may make the spider more cryptic than a uniform orange/brown variant in these habitats.

FIGURES 22–25. Three colour variations of *Copa flavoplumosa* Simon, 1885: 22. orange carapace and abdomen with black markings from Ndumo Game Reserve, South Africa; 23–24. orange carapace with black markings and black abdomen with white markings from Livingstone (23) and Wildlives Game Farm (24), Zambia; 25. black integument with white markings from Wildlives Game Farm.

In all cases where I collected this species, it ran extremely rapidly and in an erratic zigzagging fashion when in motion, and almost always ended a run by darting to the underside of a dead leaf. Jackson & Poulsen (1990) described relatively similar locomotion for the Australasian *Supunna picta* (L. Koch, 1873), which has very similar markings to the black variation of *C. flavoplumosa* (compare Fig. 25 to Jackson & Poulsen 1990: figs 1 and 2), and suggested that this rapid locomotion may increase the likelihood of making contact with potential prey, while at the same time making it difficult for predators to capture the spider.

13.5 DISCUSSION

This study provided the first data on mimicry complexes associated with Afrotropical ants, and the first instances on colour polymorphism in Afrotropical Castianeirinae spiders. It is likely that further, more detailed taxonomic studies of the region's fauna, especially in the genera *Castianeira* and *Merenius*, will reveal additional polymorphic species.

There is certainly a lot of scope for future research to be carried out on the four examples given here, especially with regards to identifying the primary models of each of the myrmecomorphic species, detection of the mimics by visually adept predators, and gene flow between and within populations containing more than one colour morph. In the case of *M. alberti*, preliminary studies indicate a reasonably strong association between the red morph of this spider and *Anoplolepis custodiens* ants, while the black variant can be considered a generalised (inaccurate) mimic of black ground-dwelling ants (see Chapter 10). This species has been observed on a single occasion feeding on an *A. custodiens* ant, so there is considerable potential to investigate possible myrmecophagy in this particular species.

Also, the global distribution of myrmecomorphic castianeirines needs to be more completely investigated, especially once the Afrotropical, Neotropical and Australasian faunas have been thoroughly revised. The occurrence of a great diversity of primitive, cryptically coloured species and the presence of only two genera of derived accurate mimics (*Apochinomma* and *Graptartia* Simon, 1896) in the Afrotropical Region might suggest that the Castianeirinae may have evolved in Africa, and that the rich fauna of ant mimics from the Neartic Region (Reiskind 1969) and South-East Asia (Deeleman-Reinhold 2001) may be indicative of the more recent origin of their faunas.

13.6 REFERENCES

AKINO, T. 2008. Chemical strategies to deal with ants: a review of mimicry, camouflage, propaganda and phytomimesis by ants (Hymenoptera: Formicidae) and other arthropods. *Myrmecological News* **11:** 173–181.

BOLTON, B. 1973. The ant genus *Polyrhachis* F. Smith in the Ethiopian Region (Hymenoptera: Formicidae). *Bulletin of the British Museum of Natural History (Entomology)* **28:** 285–369.

BOND, A.B. 2007. The evolution of color polymorphism: cryticity, searching images, and apostatic selection. *Annual Review of Ecology, Evolution, and Systematics* **38:** 489–514.

CURTIS, B.A. 1988. Do ant-mimicking *Cosmophasis* spiders prey on their *Camponotus* models? *Cimbebasia* **10:** 67–70.

CUSHING, P.E. 1997. Myrmecomorphy and myrmecophily in spiders: a review. *Florida Entomologist* **80:** 165–193.

CUSHING, P.E. in press. Spider-ant associations: an updated review of myrmecomorphy, myrmecophily, and myrmecophagy in spiders. *Psyche*.

DEELEMAN-REINHOLD, C.L. 2001. *Forest spiders of South East Asia: with a revision of the sac and ground spiders (Araneae: Clubionidae, Corinnidae, Liocranidae, Gnaphosidae, Prodidomidae and Trochanterriidae* [sic]*).* Brill, Leiden, 591 pp.

DOKOW, W. 1995. Revision of the ant genus *Polyrhachis* Smith, 1857 (Hymenoptera: Formicidae: Formicinae) on subgenus level with keys, checklist of species and bibliography. *Courier Forschungsinstitut Senckenberg* **185:** 1–113.

EDMUNDS, M. 2000. Why are there good and poor mimics? *Biological Journal of the Linnean Society* **70:** 459–466.

ELGAR, M.A. & ALLAN, R.A. 2004. Predatory spider mimics acquire colony-specific cuticular hydrocarbons from their ant model prey. *Naturwissenschaften* **91:** 143–147

ENDLER, J.A. 1981. An overview of the relationships between mimicry and crypsis. *Biological Journal of the Linnean Society* **16:** 25–31.

GILLESPIE, R.G. 1989. Diet-induced color change in the Hawaiian happy-face spider *Theridion grallator* (Araneae, Theridiidae). *Journal of Arachnology* **17:** 171–177.

GILLESPIE, R.G. & TABASHNIK, B.E. 1990. Maintaining a happy face: stable colour polymorphism in the spider *Theridion grallator* (Araneae, Theridiidae). *Heredity* **65:** 67–74.

HADDAD, C.R. 2006. A new species of *Corinnomma* (Araneae: Corinnidae) from southern and eastern Africa, with taxonomic notes on *C. olivaceum* and *C. semiglabrum*. *African Invertebrates* **47:** 71–83.

HESPENHEIDE, H.A. 1986. Mimicry of ants of the Genus *Zacryptocerus* (Hymenoptera: Formicidae). *Journal of the New York Entomological Society* **94:** 394–408.

HOLEN, O.H. & JOHNSTONE, R.A. 2004. The evolution of mimicry under constraints. *The American Naturalist* **164:** 598–613.

HUBER, B.A. & HOPF, S. 2004. Color dimorphism in adults and juveniles of *Buitinga safura* (Araneae, Pholcidae). *Journal of Arachnology* **32:** 336–340.

JACKSON, R.R. & POULSEN, B.A. 1990. Predatory versatility and intraspecific interactions of *Supunna picta* (Araneae: Clubionidae). *New Zealand Journal of Zoology* **17:** 169–184.

JOCQUÉ, R. 2009. Some keep it short: on the radiation in the Afrotropical spider genera *Capheris* and *Systenoplacis* (Araneae, Zodariidae) without male pedipalp complexity increase. *Journal of Afrotropical Zoology* **5:** 77–148.

JORON, M. & MALLET, J.L.B. 1998. Diversity in mimicry: paradox or paradigm? *Trends in Ecology & Evolution* **13:** 461–466.

LESSERT, R. DE 1933. Araignées d'Angola. (Resultats de la Mission scientifique suisse en Angola 1928-1929). *Revue Suisse de Zoologie* **40:** 85–159.

McIVER, J.D. & STONEDAHL, G. 1993. Myrmecomorphy: morphological and behavioural mimicry of ants. *Annual Review of Entomology* **38:** 351–379.

NELSON, X.J. 2010. Polymorphism in an ant mimicking spider. *Journal of Arachnology* **38:** 139–141.

NELSON, X.J. 2012. A predator's perspective of the accuracy of ant mimicry in spiders. *Psyche* **168549:** 1–5.

OLIVEIRA, P.S. 1986. Ant-mimicry in some spiders from Brazil. *Bulletin de la Société Zoologique de France* **111:** 297–311.

OXFORD, G.S. 1976. The colour polymorphism in *Enoplognatha ovatum* (Clerck) (Araneae: Theridiidae) – temporal stability and spatial variability. *Heredity* **36:** 369–381.

PEKÁR, S. & HADDAD, C.R. 2011. Trophic strategy of ant-eating *Mexcala elegans* (Araneae: Salticidae): looking for evidence of evolution of prey-specialization. *Journal of Arachnology* **39:** 133–138.

PEKÁR, S. & JIROŠ, P. in press. Do ant mimics imitate cuticular hydrocarbons of their models? *Animal Behaviour*.

PRINS, A.P. 1982. Review of *Anoplolepis* with reference to male genitalia, and notes on *Acropyga* (Hymenoptera, Formicidae). *Annals of the South African Museum* **89**: 215–247.

REILLO, P.R. & WISE, D.H. 1987. Black-stripe phenotypes in the spider *Enoplognatha ovata* (Araneae, Theridiidae). *Journal of Arachnology* **15:** 419–423.

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

REISKIND, J. 1970. Multiple mimetic forms in an ant-mimicking clubionid spider. *Science* **169:** 587–588.

REISKIND, J. 1971. Morphological adaptation for ant-mimicry in spiders. *Proceedings of the 5th International Congress of Arachnology, Brno, Czechoslovakia, 1971*: 221–226.

ROBERTSON, H. & ZACHARIADES, C. 1997. Revision of the ant genus *Camponotus fulvopilosus* (De Geer) species-group (Hymenoptera: Formicidae). *African Entomology* **5:** 1–18.

SPEED, M.P. 1999. Batesian, quasi-Batesian or Müllerian mimicry? Theory and data in mimicry research. *Evolutionary Ecology* **13:** 755–776.

SRYGLEY, R.B. 1999. Incorporating motion into investigations of mimicry. *Evolutionary Ecology* **13:** 691–708.

THÉRY, M. & CASAS, J. 2009. The multiple disguises of spiders: web colour and decorations, body colour and movement. *Philosophical Transactions of the Royal Society B* **364:** 471–480.

WESOŁOWSKA, W. 2009. A revision of the spider genus *Mexcala* Peckham et Peckham, 1902 (Araneae: Salticidae). *Genus* **20:** 149–186.

WESOŁOWSKA, W. & HADDAD, C.R. 2009. Jumping spiders (Araneae: Salticidae) of the Ndumo Game Reserve, Maputaland, South Africa. *African Invertebrates* **50:** 13–103.

WISE, D.H. & REILLO, P.R. 1985. Frequencies of color morphs in four populations of *Enoplognatha ovata* (Araneae: Theridiidae) in eastern North America. *Psyche* **92:** 135–144.

CHAPTER 14

***Graptartia tropicalis* Haddad, 2004 (Fisherhaven, South Africa)**

Concluding remarks and directions for future research

This thesis focused on the systematics and ecology of Afrotropical Castianeirinae with the main emphasis on revising several of the smaller genera, describing two new genera, and redescribing some poorly known species. An annotated key to the Afrotropical genera is provided and should facilitate the identification of material by researchers. A cladistic analysis performed on the species treated in this thesis that are known from both sexes provided very conflicting results, but the most parsimonious tree generated supported the monophyly of the castianeirine genera and the placement of *Messapus* Simon, 1898 and *Medmassa* Simon, 1887 together in a clade outside the Castianeirinae. A placement in Corinninae would likely be the best solution for those two taxa. Further work is needed before a satisfactory phylogeny for the group can be produced. Furthermore, the role of resident ant assemblages in affecting colour polymorphism in an ant-mimicking species was determined for *Merenius alberti* Lessert, 1923. Colour polymorphism was described from Afrotropical Castianeirinae for the first time, and is now known to occur in at least four widespread species, including *M. alberti*. Lastly, the role of Castianeirinae as components of arthropod complexes of ant mimics was discussed.

In summary, *Medmassa* was not included in this study as it had been revised earlier, but the remaining eight Afrotropical castianeirine genera were at least treated in part and two new genera, *Copuetta* **gen. nov.** (13 species) and *Wasaka* **gen. nov.** (four species), were described. A total of 36 new species were described in this study, nine species were transferred to other genera, and five new synonyms were proposed.

High Castianeirinae biodiversity and endemism corresponds to most of the main Biodiversity Hotspots and Centres of Endemism (CE), of which eight are known in the Afrotropical Region (Fig. 1). Species endemic to the Maputaland-Pondoland-Albany CE in southern Africa are two *Echinax*, one *Copa* and two *Copuetta*. The Madagascar and Indian Ocean Islands CE has nearly 30 *Copa* and two *Cambalida* endemic to Madagascar, and one endemic *Copuetta* from the Comoros, although most of the Castianeirinae from Madagascar were not treated in this study and are likely to be endemic to the island. The East African Afromontane Forests CE has three *Copuetta* and one *Wasaka* species that are endemic. The East African Coastal Forests CE has three *Copuetta*, one *Echinax* and one *Wasaka* species that are endemic. The Guinean Forests of West Africa CE has three endemic *Apochinomma*, one *Cambalida* and at least three *Castianeira*. The Horn of Africa CE has a single poorly known *Cambalida* endemic, although the fauna of that CE is poorly known. Surprisingly, no

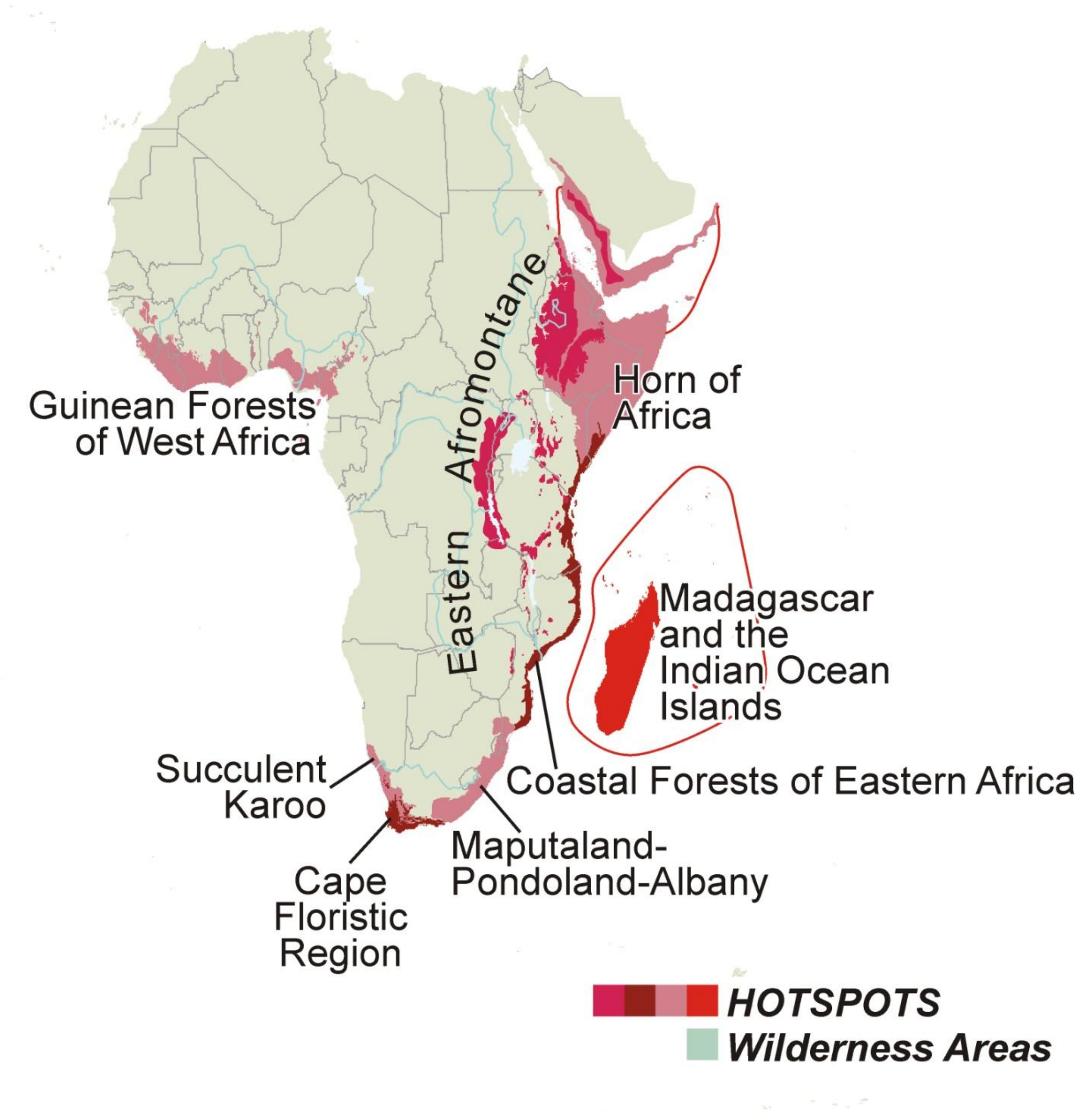


FIGURE 1. Biodiversity hotspots of the Afrotropical Region, modified from Conservation International Global Biodiversity Hotspots (www.conservation.org).

endemic castianeirines have been recorded in the Succulent Karoo and Cape Floristic Region CE's, although this corinnid fauna of these two CE's is largely dominated by Trachelinae, most of which are themselves endemic.

Future work on the Afrotropical Castianeirinae has three main areas of focus: thorough revisions of the genera *Merenius* Simon, 1909 and *Castianeira* Keyserling, 1879, and revisions of the Madagascan fauna. Based on my preliminary examinations of material of these groups, all three are remarkably rich and will need to be a source of a comprehensive study, possibly even at PhD level. Apart from the two new genera described in this study, there are at least four additional new genera that need to be described. Their descriptions were not included here as they may possibly belong to genera occurring outside the Afrotropical Region for which type material has not yet been studied.

Once the above studies have been completed then the Afrotropical castianeirine fauna will have been quite thoroughly treated and the biogeographical patterns of species richness and endemism can be better understood. Data from locality records indicates several areas that need to be sampled critically in order for these patterns to be properly understood: central and northern Mozambique, Namibia, Angola, Gabon, Central African Republic, southern Sudan and Somalia are all comparably poorly sampled relative to other countries and are critical to a better understanding of castianeirine biogeography in the region. Samples from Mauritania and Western Sahara in the west and eastern Sudan, Eritrea and Egypt should be examined to assess whether any of the apparently endemic Afrotropical castianeirine genera (e.g. *Cambalida* and *Merenius*) have distributions extending beyond the borders of the Afrotropical Region.

Finally, apart from the three focus areas amongst castianeirines that still require attention, several genera still need to be revised in other groups. *Orthobula* Simon, 1896 in the Phrurolithinae; *Paccius* Simon, 1898 in the Trachelinae; *Corinna* C.L. Koch, 1841 and *Creugas* Thorell, 1878 in the Corinninae, and several genera presently considered to be Corinnidae *incertae sedis* (*Brachyphaea* Simon, 1895, *Lessertina* Lawrence, 1952, *Mandaneta* Strand, 1932, *Oedignatha* Thorell, 1881, *Procopius* Thorell, 1899 and *Pronophaea* Simon, 1897). Once these studies are complete, the Corinnidae will arguably be one of the most resolved families of spiders in the Afrotropical Region.

SUMMARY

This study focused on resolving the taxonomy of some of the Afrotropical Castianeirinae, exploring their phylogenetic relationships and providing some novel data on their biology. The following were investigated:

- The first annotated key to the Afrotropical genera of Castianeirinae is presented.
- The genus *Apochinomma* Pavesi, 1881 is revised, the type species (*A. formicaeforme* Pavesi, 1881) is redescribed and five new species are described: *A. decepta* **sp. nov.**, *A. elongata* **sp. nov.**, *A. malkini* **sp. nov.**, *A. parva* **sp. nov.** and *A. tuberculata* **sp. nov.**.
- The genus *Cambalida* Simon, 1909 is revised and four species are transferred to *Cambalida*: *C. deminuta* (Simon, 1909) **comb. nov.**, *C. fulvipes* (Simon, 1896) **comb. nov.** and *C. loricifera* (Simon, 1885) **comb. nov.** (all ex *Castianeira* Keyserling, 1879) and *C. fagei* (Caporiacco, 1939) **comb. nov.** (ex *Brachyphaea* Simon, 1895). These four species and *C. coriacea* Simon, 1909 are redescribed. Five new species are described: *C. compressa* **sp. nov.**, *C. dippenaarae* **sp. nov.**, *C. griswoldi* **sp. nov.**, *C. lineata* **sp. nov.** and *C. unica* s**p. nov.**. Two species are proposed as junior synonyms of *C. fulvipes*, namely *Castianeira depygata* Strand, 1916 **syn. nov.** and *C. mestrali* Lessert, 1921 **syn. nov.**. *Cambalida insulana* Simon, 1909 and *Cambalida simoni* **nom. nov.** (replacement name for *Cambalida fulvipes* Simon, 1909, preoccupied) are considered *nomina dubia*.
- Five species of *Castianeira* Keyserling, 1879 are redescribed and illustrated for the first time: *C. delicatula* Simon, 1909, *C. formosula* Simon, 1909, *C. majungae* Simon, 1896, *C. phaeochroa* Simon, 1909 and *C. thomensis* Simon, 1909. *Castianeira bicolor* (Simon, 1890) is considered a *nomen dubium*.
- *Copa flavoplumosa* Simon, 1885, type species of the genus, is redescribed and proposed as a senior synonym of *C. benina* Strand, 1916 **syn. nov.** and *C. benina nigra* Lessert, 1933 **syn. nov.**. A new species, *C. kei* **sp. nov.**, is described.
- The Afrotropical *Corinnomma* Karsch, 1880 are revised, and *Apochinomma semiglabrum* Simon, 1896 is redescribed and transferred to *Corinnomma*. A new species, *C. lawrencei* **sp. nov.**, is described. *Corinnomma olivaceum* Simon, 1896 is redescribed.
- *Echinax* Deeleman-Reinhold, 2001 is recorded from the Afrotropical Region for the first time. *Copa longespina* Simon, 1909 is redescribed and transferred to *Echinax*. Six new species are described: *E. clara* **sp. nov.**, *E. hesperis* **sp. nov.**, *E. natalensis* **sp. nov.**, *E. scharffi* **sp. nov.**, *E. similis* **sp. nov.** and *E. spatulata* **sp. nov.**.

- *Graptartia* Simon, 1896 is revised, *G. granulosa* Simon, 1896 (type species) is redescribed and two new species are described: *G. mutillica* **sp. nov.** and *G. tropicalis* **sp. nov.**.
- *Merenius alberti* Lessert, 1923 is redescribed, polymorphism in the species reported for the first time, and a field study was conducted to assess the effects of ant assemblages on the prevalence of each colour morph and their likely models.
- *Messapus* Simon, 1898 is reviewed and *M. martini* Simon, 1898 is found to represent two different species, one a corinnine (female lectotype designated) and the other a castianeirine (male paralectotype designated). The female is redescribed, its true male described and the genus is transferred to the Corinninae. *Corinna natalis* Pocock, 1898 is transferred to *Messapus* and *Messapus secundus* Strand, 1907 is transferred to *Merenius*. *Copuetta* **gen. nov.** is described with the type species *C. maputa* **sp. nov.**. *Castianeira kibonotensis* Lessert, 1921 **syn. nov.** is considered a junior synonym of *Copuetta lacustris* (Strand, 1916) **comb. nov.**, and another eleven new species are described: *C. comorica* **sp. nov.**, *C. erecta* **sp. nov.**, *C. kakamega* **sp. nov.**, *C. kwamgumi* **sp. nov.**, *C. lesnei* **sp. nov.**, *C. litipo* **sp. nov.**, *C. lotzi* **sp. nov.**, *C. magna* **sp. nov.**, *C. naja* **sp. nov.**, *C. uzungwa* **sp. nov.** and *C. wagneri* **sp. nov.**. A second new genus, *Wasaka* **gen. nov.**, is described for four new species: *W. imitatrix* **sp. nov.**, *W. montana* **sp. nov.**, *W. occulta* **sp. nov.** (type species) and *W. ventralis* **sp. nov.**.
- A preliminary phylogenetic analysis of the subfamily Castianeirinae from the Afrotropical Region was carried out. Most analyses returned the Afrotropical genera as monophyletic (except *Castianeira*, *Copuetta* **gen. nov.** and *Graptartia*) and supported the placement of *Messapus* and *Medmassa* Simon, 1887 in the Corinninae. Further study is needed with a more comprehensive set of castianeirine terminals.
- Castianeirinae as components of arthropod mimicry complexes is described for three species of ants, *Anoplolepis custodiens* (F. Smith, 1858), *Polyrhachis gagates* F. Smith, 1858 and *Camponotus fulvopilosus* (De Geer, 1778). Colour polymorphism is described for the first time for four species of Afrotropical Castianeirinae: *Corinnomma semiglabrum*, *Merenius alberti*, *Castianeira* cf. *venustula* (Pavesi, 1895) and *Copa flavoplumosa*.