

The new spider genus *Arctenus*, an afrotropical representative of the Calocteninae (Araneae: Ctenidae)

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Abstract. *Arctenus* gen. nov. is proposed to include the type species *A. taitensis* sp. nov. from the Taita Hills in Kenya. This ctenid species appears to be the first representative of the Calocteninae in the African continent. Results of a parsimony analysis of morphological and behavioral characters indicated that the new species cannot be placed in any known genus and therefore validated the creation of the new genus whose autapomorphies are considered hypotheses for the genus synapomorphies. The phylogenetic relationships of the new genus are discussed and a distribution map of the unique species is presented.

Keywords: Kenya, systematics, Taita Hills, taxonomy, cladistic analysis, phylogenetic analysis

The family Ctenidae Keyserling 1977 is composed of small to large sized spiders (total body length of 4–40 mm), which do not build a snare web to catch prey. They are wandering and active predators, usually found in the litter layer, on tree trunks and in lower vegetation. Most of them are nocturnal, hiding during the day in the litter or in small cracks in the soil or on tree trunks. To date, the family comprises more than 480 described species in 40 genera (Platnick 2014) and are distributed mostly in tropical and temperate forests all over the world. Ctenidae can be diagnosed by the ocular arrangement 2-4-2 (Silva 2003).

The Afrotropical region holds 132 Ctenidae species, distributed in ten genera: *Africactenus* Hyatt 1954, *Anahita* Karsch 1879, *Apolania* Simon 1898, *Ctenus* Walckenaer, 1805, *Petaloctenus* Jocqué & Steyn 1997, *Thoriosa* Simon 1910, *Troglocetus* Lessert 1935, *Viridasius* Simon 1889 and *Vulsor* Simon 1889 (Platnick 2014). *Ctenus* contains the largest number of species (more than 70). The recent redescription of the Neotropical type species, *Ctenus dubius* Walckenaer 1805, by Brescovit & Simó (2007), and results of several cladistic analyses (Silva 2003; Polotow & Brescovit 2009, 2014) indicated that the genus is polyphyletic as currently delimited.

Recent collecting expeditions in the Kenyan Taita Hills, the northernmost part of the Eastern Arc, yielded several specimens identified as Ctenidae. The species was mentioned by Jocqué (2009) as a possible member of the genus *Pseudoctenus* Caporiacco 1949, but that genus proved to belong to the Zoropsidae Bertkau 1882.

The specimens collected in the Taita Hills cannot be assigned to any of the Afrotropical Ctenidae genera. The presence of several elongated spines on tibiae and metatarsi I and II and the absence of a pair of terminal spines on tibiae I and II suggested a relationship of the Taita Hills species with *Africactenus*, *Anahita*, or *Petaloctenus*. However, the diagnostic characters of the male palp and epigynum of these three genera prove otherwise. So far, only five Ctenidae species have been described from Kenya: *Ctenus elgonensis* Benoit 1978 (Benoit 1978: Fig. 2a–c), *C. holmi* Benoit 1978 (Benoit 1978: Fig. 3a–b), *C. kenyamontanus* Benoit 1978 (Benoit 1978: Fig. 1a–c), *C. modestus* Simon 1897 (Benoit 1978: Fig. 3c; Benoit 1979: Fig. 24) and *C. noctuabundus* Arts 1912 (Benoit 1979: Fig. 10). The species collected in the Taita Hills is clearly different from all these type specimens.

Here we describe this species and include it in the most recent cladistic analysis based on morphological characters of Ctenidae (Polotow & Brescovit 2014), to test the relationships with the remaining species of the family. As a result, we propose a new genus, *Arctenus* gen. nov., to accommodate *Arctenus taitensis* sp. nov., and we discuss its phylogenetic placement in Ctenidae.

METHODS

Morphological observations and illustrations were made using Wild M10 and M5 microscopes. Photographs of the habitus were taken with a Leica MZ16 binocular microscope using the LAS automontage software. For SEM, specimens were cleaned ultrasonically, gold coated, and then examined and photographed with a JEOL 6480 LV scanning electron microscope at the Royal Museum for Central Africa, Tervuren, Belgium (MRAC). We detached the epigynum from the abdomen and submerged it in methyl salicylate to clear the internal structures. All measurements are in millimeters. The material examined belongs to the MRAC (curator R. Jocqué).

The morphological matrix comprises 72 species and 89 characters described in detail in Polotow & Brescovit (2014). For the present analysis, we added one terminal taxon: *A. taitensis* sp. nov., male and female from Mbololo Forest, Taita Hills, Kenya, VI.1999, D. Van den Spiegel coll. (MRAC 228739). Mesquite, version 2.75 (Maddison & Maddison 2011) was used to build and edit the character matrix. Non-applicable and unknown states are presented as ‘–’ and ‘?’, respectively. All characters were equally weighted and all multistate characters were coded as non-additive. Character coding for the new species was as follows:

Arctenus taitensis: 0000100110010001110001100000000–0000001211000000000110000011010501100023141000001?1? ??0?

The parsimony analysis was performed with the same methodology described in Polotow & Brescovit (2014). The Diva-GIS version 5.2.0.2 (<http://www.diva-gis.org>) was used to make the maps.

The following abbreviations were used: ALE, anterior lateral eyes; AME, anterior median eyes; C, conductor; CD, copulatory ducts; CO, copulatory opening; Cy, cymbium; E,

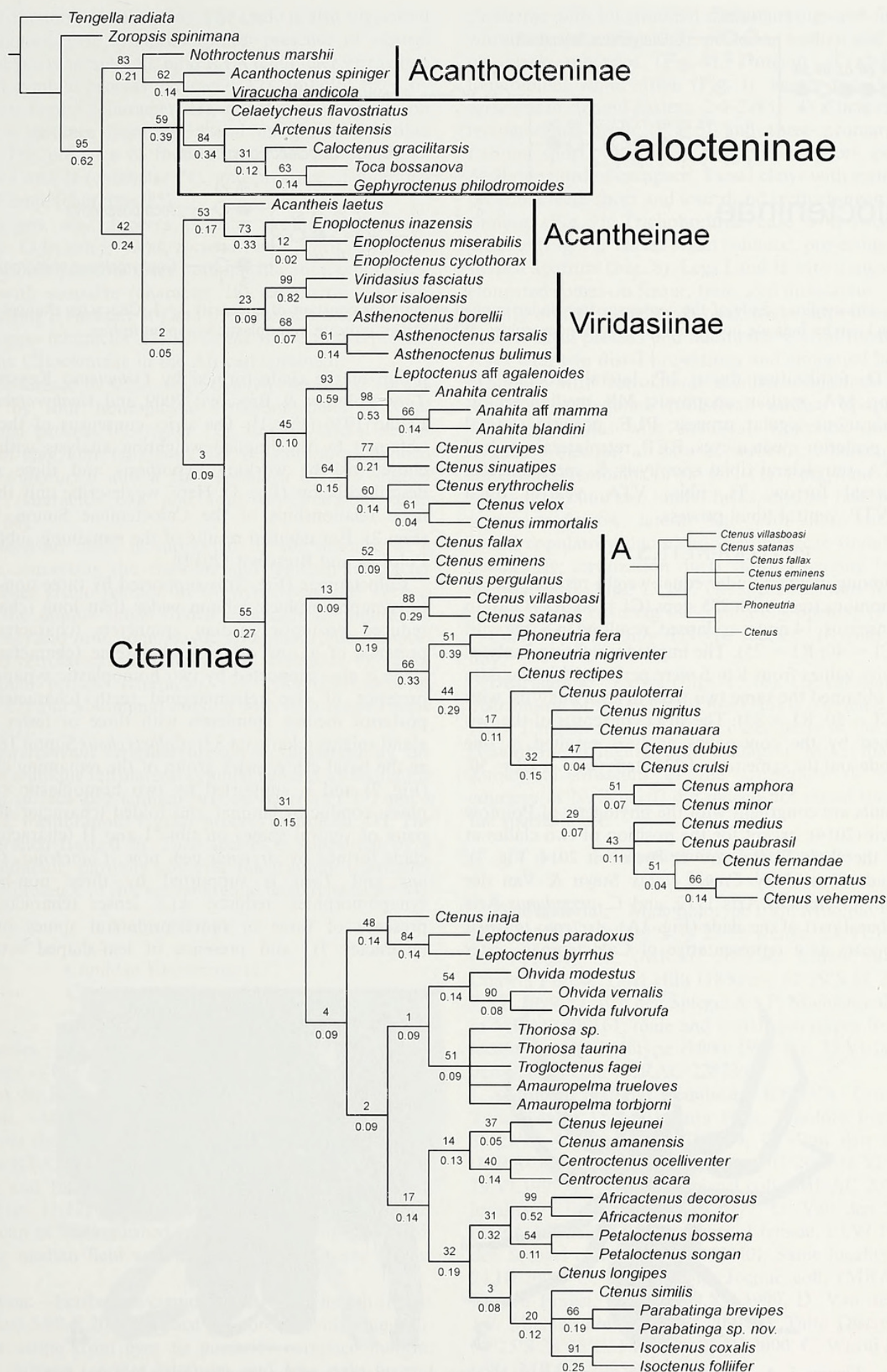


Figure 1.—Consensus tree under implied weights for constant of concavity $k=3$. Rectangle shows Cteninae clade. Support values for groups expressed as GC frequency differences (top) and Bremer support in units of $\text{fit} \times 100$ (bottom).

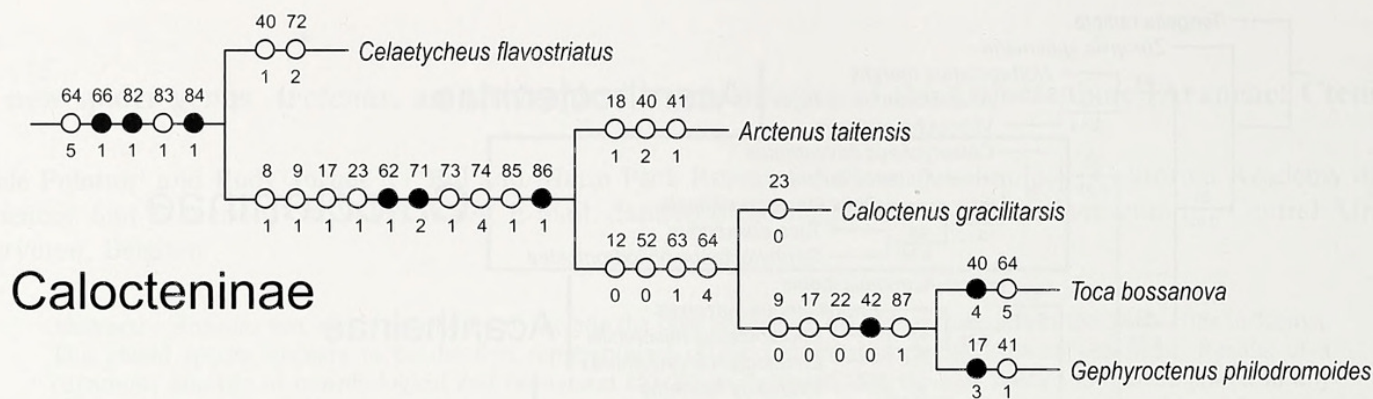


Figure 2.—Calocteninae clade of the consensus tree under implied weights for constant of concavity $k=3$. Character changes mapped on branches. Black circles indicate non-homoplastic synapomorphies. White circles indicate homoplastic synapomorphies.

embolus; FD, fertilization ducts; LP, lateral process; LS, lateral sector; MA, median apophysis; MS, median sector; MTP, membranous tegular process; PLE, posterior lateral eyes; PME, posterior median eyes; RCP, retrolateral cymbial process; RTA, retrolateral tibial apophysis; S, spermathecae; TF, transversal furrow; Ti, tibia; VTA, ventral tibial apophysis; VTP, ventral tibial process.

PHYLOGENETICS

The parsimony analysis under equal weight resulted in 141 most parsimonious trees, with 235 steps (CI = 50; RI = 83). In the strict consensus, 14 nodes collapsed, resulting in a tree with 295 steps (CI = 40; RI = 75). The implied weighting analyses with concavity values from 1 to 6 were performed in the data set, and we obtained the same two trees in each analysis, with 235 steps (CI = 50; RI = 83). The strict consensus of the two trees obtained by the concavities analysis resulted in one collapsed node and the same tree of 236 steps (Fig. 1; CI = 50; RI = 83).

These results are congruent with the phylogeny of Polotow and Brescovit (2014), except for the position of two clades at the base of the clade F (Polotow & Brescovit 2014: Fig. 3), with the clade formed by *Ctenus fallax* Steyn & Van der Donckt 2003, *C. eminens* Arts 1912, and *C. pergulanus* Arts 1912 in the basal part of the clade (Fig. 1A). *Arctenus taitensis* sp. nov. appears as a representative of Calocteninae, sister

group of the clade formed by *Caloctenus* Keyserling 1877, *Toca* Polotow & Brescovit 2009 and *Gephyroctenus* Mello-Leitão 1936 (Fig. 1). The strict consensus of the two trees obtained by the implied weighting analysis with $k=3$ was chosen as the working hypothesis and these results are described below (Fig. 1). Here, we describe only the phylogenetic relationships of the Calocteninae Simon 1897 clade (Fig. 2). For detailed results of the remaining subfamilies see Polotow and Brescovit (2014).

Calocteninae (Fig. 2) is supported by three non-homoplastic synapomorphies: labium wider than long (character 66), reduced posterior median spinnerets (character 82) and presence of a row of thick anal setae (character 84). This clade is also supported by two homoplastic synapomorphies: presence of five retromarginal teeth (character 64) and posterior median spinnerets with three or fewer cylindrical gland spigots (character 83). *Celaetycheus* Simon 1897 appears as the basal clade, sister group of the remaining caloctenines (Fig. 2) and is supported by two homoplastic synapomorphies: conductor laminar and folded (character 40) and five pairs of ventral spines on tibia I and II (character 72). The clade formed by *Arctenus* gen. nov., *Caloctenus*, *Gephyroctenus* and *Toca* is supported by three non-homoplastic synapomorphies: reduced ALE lenses (character 62), the presence of three or more prolateral spines on femur I (character 71) and presence of leaf-shaped setae on the



Figures 3, 4.—*Arctenus taitensis* sp. nov.: 3. Habitus; 4. Frontal view of the carapace. Scale bars = 1 mm.

abdominal dorsum (character 86). The clade is also supported by seven homoplastic synapomorphies: presence of ventral tibial apophysis (character 8), bifid RTA (character 9), median retrolateral cymbial process (character 17), embolus fixed by membranous region (character 23), distal pair of spines on tibia I at a distance from the apical margin of the tibia (character 73), presence of four or more ventral spines on metatarsus I and II (character 74), and presence of modified abdominal setae (character 85).

Arctenus gen. nov. appears as sister group of the clade formed by *Caloctenus*, *Gephyroctenus* and *Toca*. *Arctenus taitensis* sp. nov. presents three homoplastic autapomorphies: cymbium with scopulae (character 18), conductor laminar, wider than long (character 40) and presence of a membranous tegular process (character 41). *Arctenus* is the first representative of the Calocteninae in the African continent.

The clade formed by *Caloctenus*, *Gephyroctenus* and *Toca* is supported by four homoplastic synapomorphies: loss of ventral tibial process (character 12), loss of lateral sector processes of epigynum (character 52), cephalothorax divided into a *pars thoracica* and a *pars cephalica* by a V-shaped depression (character 63), and four retromarginal teeth (character 64).

The *Caloctenus* clade is supported by the absence of a membrane connecting the embolus and tegulum (character 23). The sister group relation of *Gephyroctenus* and *Toca* is based on the unique single folded epigynum configuration (character 42) and four homoplastic synapomorphies: conical or rounded retrolateral tibial apophysis (character 9), retro-basal cymbial process (character 17), cylindrical embolus (character 22) and abdominal dorsum with club-shaped setae (character 87).

The *Gephyroctenus* terminal branch is supported by the presence of a unique retrolateral cymbial process, covering the retrolateral surface as a laminar process (character 17) and a homoplastic membranous tegular process (character 41). The terminal branch formed by *Toca* species is supported by a unique conductor, partially covering the tegulum (character 40) and the presence of five retromarginal teeth (character 64).

TAXONOMY

Ctenidae Keyserling 1877

Calocteninae Simon 1897

Arctenus new genus

Type species.—*Arctenus taitensis* sp. nov.

Etymology.—The generic name is a combination of “arc,” referring to the Eastern Arc Mountains, and “Ctenus.”

Diagnosis.—Males of *Arctenus* gen. nov. can be distinguished from the other Calocteninae by the long hairs on the base of the RTA, the large and thick embolus with a subdistal projection and bifid tip, and presence of a dorsal cymbial scopula (Figs. 11,12) on the male palp. Females of *Arctenus* gen. nov. can be distinguished from the remaining Calocteninae by the median field with an anterior transverse furrow (Fig. 13).

Description.—Ecribellate ctenids. Total body length (males and females) 5.90–7.20. Carapace pale brown with longitudinal lighter stripe from eyes to posterior carapace margin; chelicerae, labium, endites, sternum and legs pale brown;

chelicerae with longitudinal dark markings and femur of legs with dark spots (Figs. 3,4); posterior median and lateral eyes on black tubercles (Fig. 4). Dorsum of abdomen with longitudinal white stripe (Fig. 3), venter pale brown. Eyes arranged in ctenoid pattern, 2-4-2 (Fig. 4). Chelicerae with five retromarginal teeth (Fig. 5) and three promarginal teeth. Labium short, wider than long. Fovea short, positioned in posterior third of carapace. Tarsal claws with eight teeth, four proximal teeth short and four distal teeth elongated and slight sinuous (Fig. 9). Trichobothrial base with two transversal grooves (Fig. 7). Tarsal organ rounded, projecting, with drop-shaped aperture (Fig. 8). Legs I and II with numerous pairs of elongated spines on femur, tibia, and metatarsus. Trochanters slightly notched. Abdomen oval. Male palp: tibia with RTA, ventral tibial process and additional ventral tibial projection; RTA with two distal projections and elongated hairs at base; cymbium with retrolateral median projection and dorsal scopulae; subtegulum prolateral; median apophysis hook-shaped; embolus with subdistal projection and bifid tip; hyaline projection at base of embolus; conductor short, its tip covering embolus (Figs. 6,11,12). Epigynum: divided into median field and two lateral fields; median field with anterior transverse furrow; lateral field with short lateral process; broad copulatory ducts and spermathecae rounded, situated posteriorly; fertilization ducts short, emerging from base of spermathecae (Figs. 13,14). The specimens were found with an epigynal plug covering the copulatory opening (Fig. 10).

Composition.—Only the type species, *Arctenus taitensis* sp. nov.

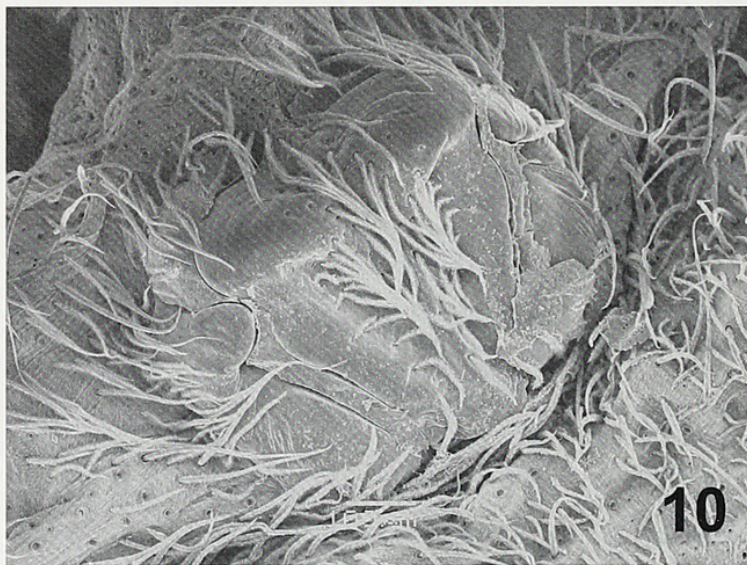
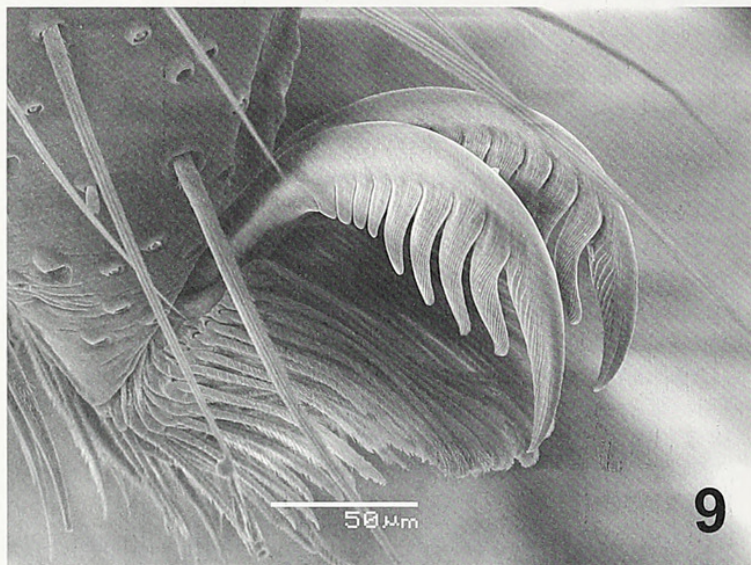
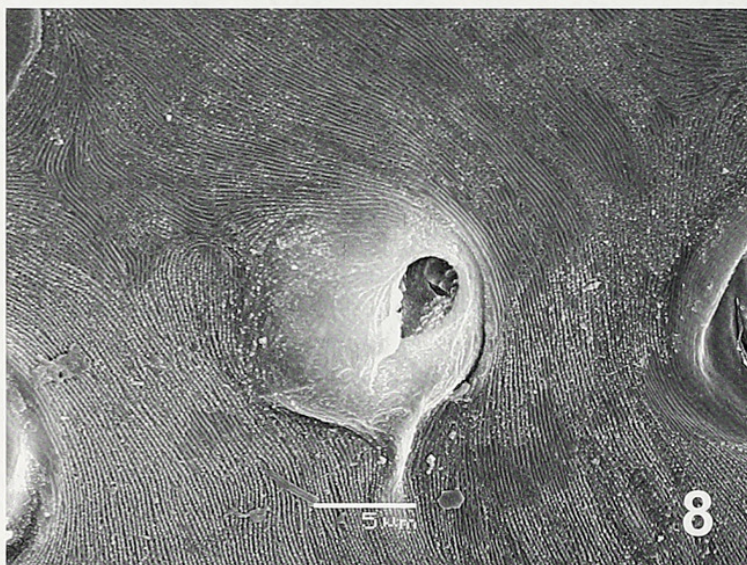
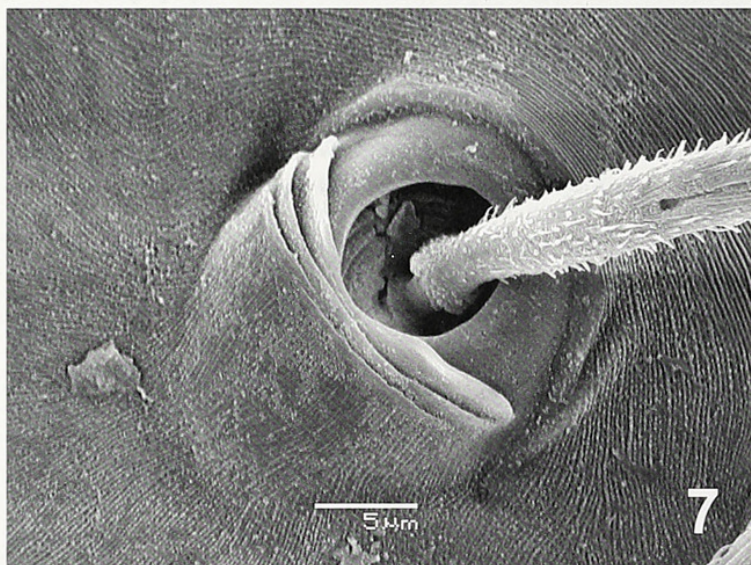
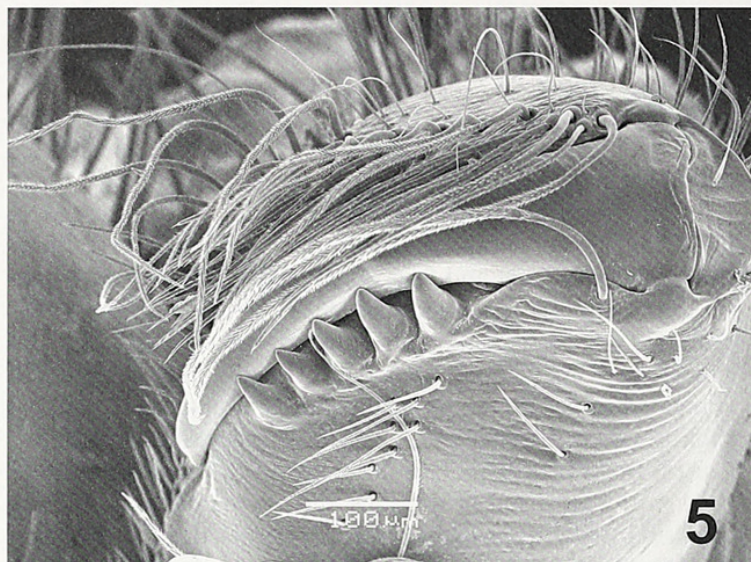
Distribution.—Kenya (Figs. 15,16). The calculated expected distribution of the species (Diva GIS) is restricted to the Taita Hills. Extensive collections in other parts of the Eastern Arc (Usambara, Ulugura and Uzungwa Mts., mainly in the Zoological Museum of the University of Copenhagen, courtesy of N. Scharff) did indeed not reveal the presence of the species there.

Arctenus taitensis new species

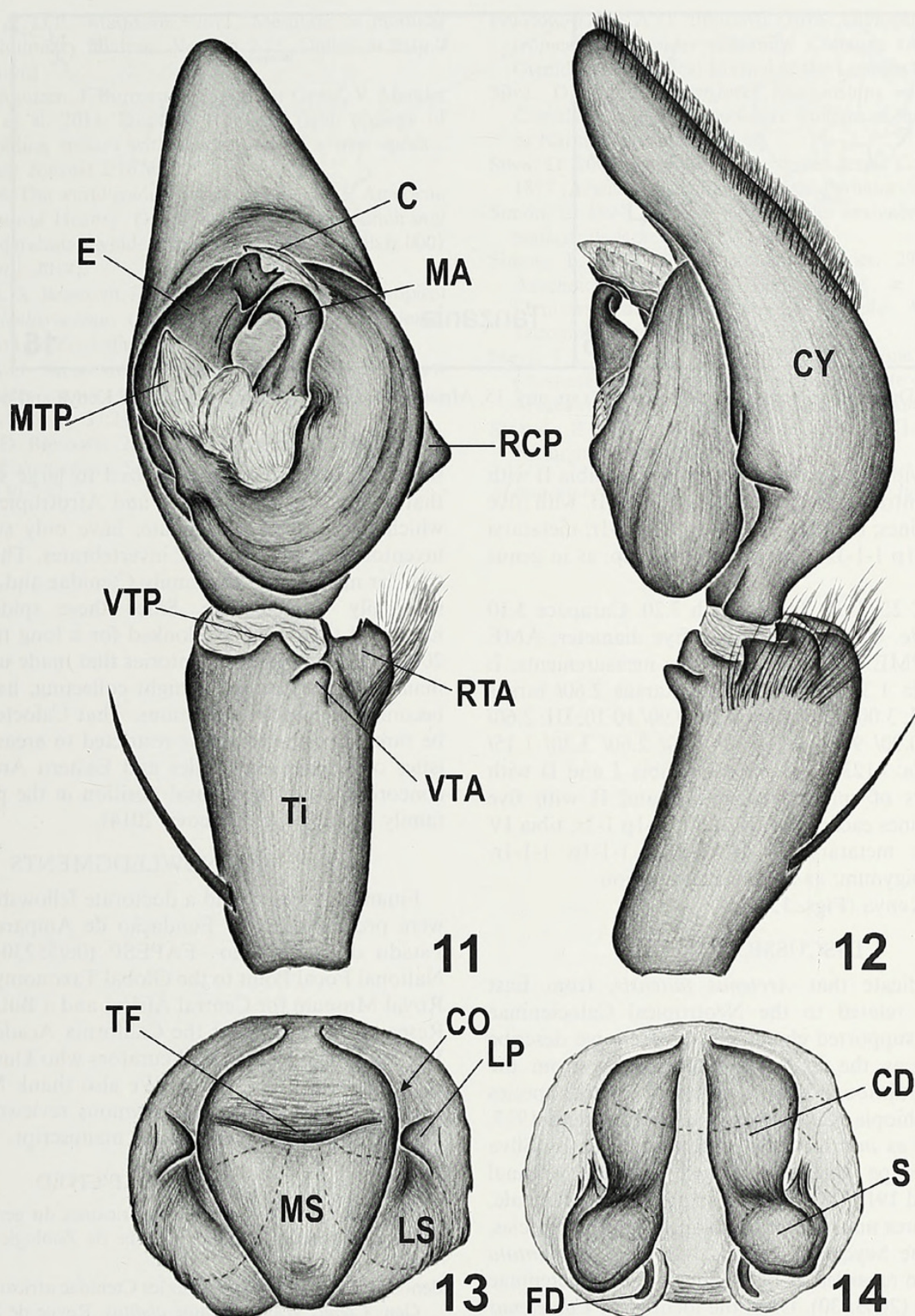
Figs. 3–16

Type material.—Male holotype from Mbololo Forest, Taita Hills (1580 m), 03°19'S 38°27'E, Kenya, 22.VI.1999, D. Van den Spiegel coll., (MRAC 208839); female paratype from Chawia Forest, Taita Hills (1850 m), 02°29'S 38°29'E, Kenya, 7.XII.1999, D. Van den Spiegel & J.P. Michiels coll., deposited in MRAC 209161; male and female paratypes from the same locality as the holotype (1800–1900 m), 23.VI.1999, D. Van den Spiegel coll. (MRAC 228739).

Additional material examined.—KENYA. Coast Province: Taita Taveta District, Taita Hills, Mbololo Forest, 03°19'S 38°27'E, 4 females, 23.VI.1999, D. Van den Spiegel coll. (MRAC 208808); Ngangao Forest, 03°20'S 38°22'E, 1 female, 19.VI.1999, D. Van den Spiegel coll. (MRAC 208813); Same locality, 1 female, 17–18.VI.1999, D. Van den Spiegel coll. (MRAC 208831); Same locality, 1 female, 19.VI.1999, D. Van den Spiegel coll. (MRAC 208840); Same locality, 2 females, 24.III.2000, C. Warui & R. Jocqué coll. (MRAC 209568); Fururu Forest, 1 female, 9.XII.1999, D. Van den Spiegel & J.P. Michiels coll. (MRAC 209160); Taita Discovery Center, 03°25'S 38°46'E, 1 female, 27.III.2000, C. Warui & R. Jocqué coll. (MRAC 209546).



Figures 5–10.—*Arctenus taitensis* sp. nov.: 5. Left chelicera, detail of the five teeth on retromargin; 6. Male right palp; 7. Trichobothrium, female, tarsus I; 8. Tarsal organ, female, tarsus I; 9. Tarsal claws, male, leg II; 10. Epigynum, with epigynal plug.



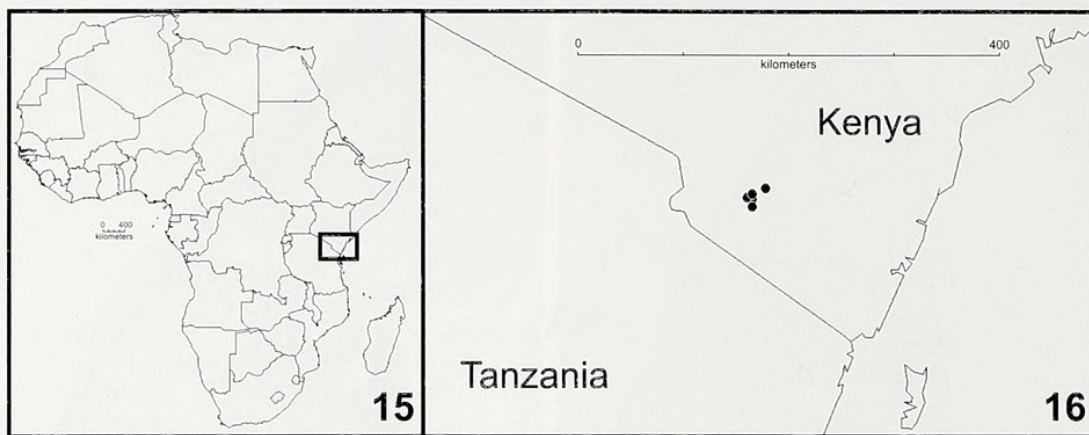
Figures 11–14.—*Arctenus taitensis* sp. nov.: 11–12. Male left palp; 11. Ventral view; 12. Retrolateral view; 13–14. Epigynum; 13. Ventral view; 14. Dorsal view. Abbreviations: C, conductor; CD, copulatory duct; CO, copulatory opening; Cy, cymbium; E, embolus; FD, fertilization ducts; LP, lateral process; LS, lateral sector; MA, median apophysis; MS, median sector; MTP, membranous tegular process; RCP, retrolateral cymbial projection; RTA, retrolateral tibial apophysis; S, spermatheca; TF, transverse furrow; VTA, ventral tibial apophysis; VTP, ventral tibial process.

Etymology.—The species epithet is an adjective derived from the type locality.

Diagnosis.—As for the genus.

Description.—*Male* (MRAC 208839): Total length 5.90. Carapace 2.90 long and 2.50 wide. Clypeus 0.11 high. Eye

diameter: AME 0.15, ALE 0.12, PME 0.20, PLE 0.23. Leg measurements: I: femur 3.70/ patella 1.10/ tibia 3.95/ metatarsus 4.10/ tarsus 2.00/ total 14.85; II: 3.60/ 1.20/ 3.50/ 3.50/ 1.40/ 13.20; III: 3.20/ 1.10/ 2.70/ 2.90/ 1.10/ 11.00; IV: 3.90/ 1.10/ 3.30/ 4.30/ 1.45/ 14.05. Leg formula: 1423. Leg



Figures 15, 16.—Distribution map of *Arctenus taitensis* sp. nov. 15. African continent; 16. Detail of southern Kenya and northeast Tanzania.

spination: tibia I with eight pairs of ventral spines; tibia II with seven pairs of ventral spines; metatarsi I and II with five ventral pairs of spines; tibia III–IV 2-2-2v 1-1p 1-1r; metatarsi III–IV 2-2-2v 1-1-1p 1-1-1r. Coloration and palp: as in genus description.

Female (MRAC 228739): Total length 7.20. Carapace 3.10 long and 2.60 wide. Clypeus 0.14 high. Eye diameter: AME 0.18, ALE 0.12, PME 0.28, PLE 0.28. Leg measurements: I: femur 3.00/ patella 1.30/ tibia 3.00/ metatarsus 2.60/ tarsus 0.95/ total 10.85; II: 3.00/ 1.30/ 2.60/ 2.30/ 0.90/ 10.10; III: 2.60/ 1.10/ 2.10/ 2.30/ 0.90/ 9.00; IV: 3.20/ 1.00/ 2.60/ 3.20/ 1.15/ 11.15. Leg formula: 4123. Leg spination: tibia I and II with eight ventral pairs of spines; metatarsi I and II with five ventral pairs of spines each; tibia III 2-2-2v 1-1p 1-1r; tibia IV 2-1-2v 1-1p 1-1r; metatarsi III–IV 2-2-2v 1-1-1p 1-1-1r. Coloration and epigynum: as in genus description.

Distribution.—Kenya (Figs. 15,16).

DISCUSSION

The results indicate that *Arctenus taitensis*, from East Africa, is closely related to the Neotropical Calocteninae spiders, in a well supported clade (Fig. 1). Here we describe *Arctenus taitensis* as the first true Calocteninae from the African continent, although there is currently another species described from Ethiopia, *Caloctenus abyssinicus* Strand 1917, which was placed as *incertae sedis* within Ctenidae by Silva (2004: 13). The type specimen is lost and the original description (Strand 1917: 41) is based on an immature female, with somatic features unusual for the family. Another species, described from the Seychelles islands, *Apolania segmentata* Simon 1898, is also regarded as belonging to the Calocteninae according to Silva (2003: 30). Until the identity of *Caloctenus abyssinicus* is revealed, *Arctenus taitensis* and *Apolania segmentata* remain the only two Afrotropical Calocteninae species.

The majority, 24 out of the currently 32 species of Calocteninae (in seven genera, *Caloctenus*, *Gephyroctenus*, *Toca*, *Apolania*, *Diallomus* Simon 1897, *Celaetycheus* and *Arctenus*), were described in the last 10 years and most of the specimens were collected recently (Silva 2004; Polotow & Brescovit 2008, 2009, 2013). This is remarkable, as the shelf life between discovery and description of new species is on average 21 years (Fontaine et al. 2012, Miller et al. 2014), and

because it concerns medium sized to large spiders. It shows that at least the Neotropical and Afrotropical regions, from which these animals originate, have only superficially been inventoried even for larger invertebrates. This is particularly true for members of the family Ctenidae and *a fortiori* for the subfamily Calocteninae. Since these spiders are strictly nocturnal they were overlooked for a long time (Steyn et al. 2002). Only in recent inventories that made use of pitfalls but mainly of headlamps for night collecting, have these spiders become common in collections. That Calocteninae appear to be rare and are apparently restricted to areas with characteristics of refuges (Seychelles and Eastern Arc for Africa), is concordant with their basal position in the phylogeny of the family (Polotow & Brescovit 2014).

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