

6-30-2017

Descriptions of six new species of false click beetles (Coleoptera: Eucnemidae: Macraulacinae), with new identification keys for one tribe and two genera

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INSECTA MUNDI

A Journal of World Insect Systematics

0558

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Date of Issue: June 30, 2017

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Insecta Mundi 0558: 1–19

ZooBank Registered: urn:lsid:zoobank.org:pub:511C0AF6-E9BF-4D75-B9ED-A19FCC30C721

Published in 2017 by

Center for Systematic Entomology, Inc.
P. O. Box 141874
Gainesville, FL 32614-1874 USA
<http://centerforsystematicentomology.org/>

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Electronic copies (Online ISSN 1942-1354, CDROM ISSN 1942-1362) in PDF format:

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Layout Editor for this article: Eugenio H. Nearn

Descriptions of six new species of false click beetles (Coleoptera: Eucnemidae: Macraulacinae), with new identification keys for one tribe and two genera

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Abstract. Six new species of false click beetle (Coleoptera: Eucnemidae) are described. These new species are: *Fornax dixiensis* **sp. nov.** (Florida, USA), *Dromaeolus comayaguiensis* **sp. nov.** (Honduras), *Asiocnemis bicolor* **sp. nov.** (Ecuador), *Miruantennus chinensis* **sp. nov.** (Yunnan prov., China), *Miruantennus cuneiformis* **sp. nov.** (Malaysia) and *Nematodes africanus* **sp. nov.** (Côte d'Ivoire). Identification keys are provided for species of *Fornax* in the Nearctic ecozone and *Miruantennus* in the Palearctic and Indo-Malayan ecozones. A new key to include all the genera within the tribe Nematodini Leiler is also provided.

Key Words. Macraulacini, Nematodini, *Fornax*, *Dromaeolus*, *Asiocnemis*, *Nematodes*, *Miruantennus*, United States, Honduras, Ecuador, Côte d'Ivoire, China, Malaysia

Introduction

Opportunities for new discoveries within the family Eucnemidae have continued to present themselves on several different occasions. One of which is a new species of Eucnemidae described from the African continent, a first since Lucht (1998) described *Nebulatorpidus wagneri* from Uganda. It is also a first for the genus to be recorded on that continent and remained unidentified for many years in the collection of the Global Eucnemid Research Project (GERP) until now.

Recently, while identifying specimens of Eucnemidae from the Florida State Collection of Arthropods (FSCA), Kyle E. Schnepf Collection (KESC) and Robert H. Turnbow Collection (RHTC), four specimens of an unidentified species of *Fornax* Laporte, 1835 were discovered. One of the specimens was retained in the GERP collection for future research. It was determined the eucnemid is undescribed, after comparing the specimen against syntypes of *Fornax truncatus* Horn loaned from the British Museum of Natural History (BMNH) and specimens of *Fornax sericeus* Bonvouloir identified by Fleutiaux loaned from Muséum national d'Histoire naturelle (MNHN) in France.

Numerous eucnemid specimens collected from the Neotropical region have been sent for identification from the Snow Entomology Museum (SEMC). Of those, two species from the region will be initially described as future opportunities to explore other species await further research and eventual publications.

Otto (2013) published a paper describing the male specimen of *Coomanius lugubris* Fleutiaux. However, it was later determined the specimen in question was misidentified and the identity of the species remained a mystery. Otto (2016) published a nearly three year study to elucidate the false click beetle fauna in Laos, accumulated during the major expeditions in the country undertaken by the Naturhistorisches Museum at Basel, Switzerland led by the late Michel Brancucci. That study resulted in the discovery of six new genera and 53 new species, including a description of the genus, *Miruantennus* Otto. Following the conclusion of the study, these unknown specimens, along with an additional specimen from the British Museum of Natural History were examined and later determined to be that of a new species, belonging to that recently described genus. A second undescribed species of *Miruantennus* was immediately discovered amongst the eucnemid specimens loaned from the Naturkundemuseum (NME) in Erfurt Germany.

Materials and Methods

Habitus, antennal and other structural images were taken with a JVC KY-F75U digital camera attached to a Leica® Z16 APO dissecting microscope with apochromatic zoom objective and motor focus drive, using a Synchronscopy Auto-Montage® Pro System and software version 5.01.0005, resulting image stacks were processed using CombineZP®. All images were captured as TIFF files during the imaging process. Habitat images for *M. chinensis* were taken with an EOS® 50D camera by Andreas Weigel and are used by his permission for this study. Each image was modified through Photoshop® Elements 10® software on a Toshiba Satellite® C55 series laptop computer and all were collated into plates through the computer's paint program. Label data for all types are reported verbatim. Observed metadata are placed between parenthesis and brackets for some labels.

Specimens of six newly described species are deposited in the following collections: BMNH — British Museum of Natural History, London, United Kingdom; FSCA — Florida State Collection of Arthropods, Gainesville, FL; GERP — Global Eucnemid Research Project, UW-Madison, Dept. of Entomology, Madison, WI; NME—Naturkundemuseum, Erfurt, Germany and SEMC — Snow Entomology Museum, Lawrence, KS.

Systematics

Subfamily Macraulacinae Fleutiaux, 1922

Tribe Macraulacini Fleutiaux, 1922

Diagnosis. Form oblong, elongate or obtuse; antennomeres usually sexually dimorphic; mandibles either stout with a basal tooth or slender without teeth; simple lateral pronotal ridge present; hypomeron either simple, with basally closed lateral antennal grooves or with basally open lateral antennal grooves; legs slender; prothoracic tibiae with one apical spur; lateral surfaces of mesothoracic and metathoracic tibiae usually with transverse rows of spines; tarsomere IV often bilobed; tarsal claws either simple or basally toothed; prothoracic tarsomere I usually with basal sex combs in males; male aedeagus with dorsally open basal piece; median lobe simple, with solidly fused slender basal struts, fused to lateral lobes; lateral lobes entire, either with notched or apically deeply and narrowly bifurcate; bursa either simple or divided; spermatheca tripartite, sclerotized, divided.

Genus *Fornax* Laporte, 1835

Diversity and Distribution. More than 300 species of *Fornax* are presently assigned to the group. Many species are distributed largely in the tropical and subtropical regions around the globe. The greatest diversity of the group is concentrated in African, Indo-Malaysian, Neotropical and Oceanic regions. Six species are distributed in the Far East region of the Palearctic region, including Japan. Several species are known in the Nearctic region.

Diagnosis. Apical margin of frontoclypeal region evenly rounded and more than twice as wide as the distance between antennal sockets; well-developed basally open lateral antennal grooves present; male prothoracic tarsomere I simple, with basal sex combs; metathoracic coxal plates medially more than 6.0 times wider than laterally; elytral epipleurae basally grooved or evenly punctate; last visible ventrite either strongly produced, rounded or truncated; tarsal claws basally toothed; lateral surfaces of mesothoracic and metathoracic tibiae with setae and transverse rows of spine combs; male aedeagus dorsoventrally compressed, without secondary lateral lobes; median lobe simple, with moderately and narrowly bifurcate apices; lateral lobes simple, entire, flagellum simple.

***Fornax dixiensis* sp. nov.**

Fig. 1–3

Diagnosis. Form of the pronotum, along with produced last abdominal ventrite will distinguish the new species from both *Fornax bicolor* (Melsheimer) and *Fornax knulli* Muona in the United States.

Description. Female holotype: Length 11.0 mm. Width, 3.0 mm. Body subcylindrical, elongate; uniformly brownish-black; scape dark brownish-black, pedicel and antennomeres III–XI dark brown; legs including tarsi dark brown; head, pronotum and elytra clothed with short, recumbent yellowish setae (Fig. 1).

Head: Surface rugose, shiny, subspherical; frons convex, without median carina or fovea above frontoclypeal region; apical margin of frontoclypeal region rounded, about 2 times wider than base; mandibles stout, bidentate, densely punctate.

Antenna: Filiform from antennomeres III–XI, attaining nearly 1/2 the length of the body; antennomere III slightly longer than IV; antennomeres IV–X each sub-equal, longer than wide; antennomere XI slightly longer than X.

Pronotum (Fig. 2): Surface shiny, densely rugose to granulate; slightly longer than wide, with moderate, sharp hind angles; lateral sides widest at the middle, strongly narrowing towards head; disc convex with shallow median groove, without circular fovea; base sinuous, with pair of circular depressions above scutellum.

Scutellum: Elongate, sub-triangular, shallowly punctate and distally rounded.

Elytra: Distinctly striate, deepest at humeral region; interstices slightly elevated; surfaces shiny with dense, crowded punctures.

Legs: First tarsomere as long as the combined lengths of the remaining four on mesothoracic tarsi; tibiae rounded in cross section; metathoracic tarsomeres I–III simple; metathoracic tarsomere IV excavated; mesothoracic tarsomere V elongate with basally toothed claws.

Venter (Fig. 3): Closely punctate, with elongate, recumbent whitish setae; hypomeron with basally open, lateral antennal grooves; metathoracic episterna parallel-sided; elytral epipleura shiny, grooved throughout, without punctures; metathoracic coxal plates medially more than 6.0 times wider than laterally.

Variation. Three female paratypes were examined. Female paratypes measured 11.0–12.0 mm long and 3.0 mm wide. Two of the three paratypes are slightly longer than the holotype. One paratype is as long as the holotype. All paratypes are as wide as the holotype. There are no exoskeletal difference between these paratypes and the holotype.

Type Material. Holotype, ♀: “Florida: Highlands Co., Highlands Hammock, State Park, 16-V-2011, Collector: M.L. Payne, Purple Prism trap, w/ Manuka/phoebe oil” / “*Fornax*, sp., Det. R.L. Otto, 2014” / “**HOLOTYPE:**, *Fornax, dixiensis*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [red printed label]. Holotype deposited in FSCA.

Paratypes. 3 ♀♀: **FLORIDA:** 1♀, “FLORIDA: Highlands Co., Highlands Hammock St. pk., 8-V-2009, D. Harris, lindgren funnel trap” / “**PARATYPE:**, *Fornax, dixiensis*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [yellow printed label]; 2 ♀♀, “Florida: Highlands Co., Highlands Hammock, State Park, 16-V-2011, Collector: M.L. Payne, Purple Prism trap, w/ Manuka/phoebe oil” / “**PARATYPE:**, *Fornax, dixiensis*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [yellow printed label]. Paratypes are deposited in FSCA and GERP.

Distribution. The eucnemid species is known from four specimens taken from a state park in south central Florida.

Biology. Three specimens were taken from a purple prism trap (Synergy Semiochemicals, British Columbia) baited with Manuka oil and Phoebe oil. One specimen was taken from a Lindgren funnel trap. Larvae and pupae are unknown.

Etymology. Specific epithet is derived from a combination of two words, 'dixie', a regional nickname given to the southern United States and '-ensis', a Latin adjectival suffix meaning "pertaining to"; from which the new species has been taken.

Remarks. *Fornax dixiensis* is a highly distinctive species recently discovered in the United States. The new species can be readily separated from both *F. bicolor* and *F. knulli* based on the form of the pronotum and last visible ventrite of the abdomen. Lateral sides of the pronotum is widest at the middle before narrowing anteriorly in the new species, arcuate in the other two species. Secondly, the last visible ventrite is moderately to strongly produced in the new species and obtuse in the other two species. The new species is more closely related to a number of Neotropical species of *Fornax* distributed in Central and South America, which possess a strongly produced last visible ventrite. The new species is very similar in appearance to the Central American *Fornax truncatus* Horn (Fig. 4). The new species differs from *F. truncatus* based on the exoskeletal surfaces of the pronotal disc. The pronotal surface is smooth with widely spaced punctures in *F. truncatus* and rugose with closely spaced punctures in *F. dixiensis*.

Key to the species of *Fornax* in the Nearctic region (modified from Muona (2000))

1. Lateral pronotal sides arcuate; last abdominal ventrite obtusely oval 2
- Lateral pronotal sides widest at the middle; last abdominal ventrite moderately to strongly produced *F. dixiensis* sp. nov.
2. Pronotum wider than long; pronotal surface shiny *F. bicolor* (Melsheimer)
- Pronotum as long as wide; pronotal surface dull *F. knulli* Muona

Genus *Dromaeolus* Kiesenwetter, 1858

Diversity and Distribution. More than 200 species of *Dromaeolus* are presently assigned to the genus. Many species are distributed largely in the tropical and subtropical regions around the globe. The greatest diversity of the group is concentrated in African, Indo-Malaysian and Neotropical regions. Nine species are distributed in the Palearctic region. Nine species are also known in the Nearctic region.

Diagnosis. Macraulacini, with apical margin of frontolclypeal region feebly trilobed and more than twice as wide as the distance between antennal sockets; well-developed basally open or basally closed lateral antennal grooves present; male prothoracic tarsomere I simple with basal sex combs; metathoracic coxal plates medially 1.2–2.5 times wider than laterally; last visible ventrite either rounded or truncated; tarsal claws simple; lateral surfaces of mesothoracic and metathoracic tibiae either with setae and transverse rows of spine combs or setae and irregularly placed spines; male aedeagus dorsoventrally compressed, with laterally attached secondary lateral lobes; median lobe simple, with moderately and narrowly bifurcate apices; lateral lobes simple, entire; flagellum simple.

Dromaeolus comayaguiensis sp. nov.

Fig. 5–6

Diagnosis. Large size, along with body form and metallic reflections on the pronotum will distinguish the new species from any known *Dromaeolus* species in Central America.

Description. Male holotype: Length, 9.0 mm. Width, 2.0 mm. Body cylindrical, elongate and tapering towards the elytral apex; uniformly glossy black, with metallic reflections of orange, blue and violet on the pronotum; antennae black; femur and tibiae dark brown-black; tarsi dark brown-black; head, pronotum and elytra clothed with very short, sparse, white recumbent setae (Fig. 5).

Head: Surface evenly punctate on frons, more concentrated near base of frontoclypeal region, shiny, subspherical; frons convex, with median ridge extending from vertex to above frontolclypeal region;

interantennal carina narrowly interrupted in middle; apical margin of frontolclypeal region evenly rounded, more than 2.0 times wider than base; mandibles stout, bidentate, densely punctate and rugose.

Antenna: Weakly serrate to filiform from antennomeres III–X, reaching just beyond elytral humeri; antennomere III as long as IV and V combined; antennomere IV shorter than II; antennomere V shorter than VI; antennomeres VI–X each sub-equal, longer than wide; antennomere XI slightly longer than X; antennomeres I–VIII with lateral keel.

Pronotum: Surface shiny, very shallowly punctate; punctures widely separated; longer than wide, with moderate hind angles; parallel-sided, sinuous, slightly arcuate anteriorly; disc convex; base sinuous, with deep median groove extending from base to near center of disc.

Scutellum: Sparsely punctate, short, sub-triangular and distally rounded.

Elytra: Without striae, except along elytral suture; interstices flattened; humeri closely punctate, remaining areas with evenly dispersed punctures; elytral suture area densely punctate to rugose.

Legs: First tarsomere as long as the combined lengths of the remaining four on mesothoracic and metathoracic tarsi; tibiae rounded in cross section; metathoracic tarsomeres I–III simple; metathoracic tarsomere IV excavated and slightly emarginated; metathoracic tarsomere V elongate with simple claws.

Venter (Fig. 6): Densely punctate, with white recumbent setae; hypomeron with medially undefined basally open, deep, lateral antennal grooves; antennal grooves without punctures, shiny; metathoracic episterna parallel-sided; metathoracic coxal plates medially 3.0–6.0 times wider than laterally.

Variation. Two male paratypes were examined. Male paratypes measured 9.0–12.0 mm long and 2.0–2.5 mm wide. One male paratype is as long as and as wide as the holotype. The other male paratype is larger and wider than the holotype. Lateral carina on antennomere IX is more pronounced in one of the paratypes, absent in the other paratype. Lateral carina is less defined on antennomeres VI–VIII in the larger paratype. Exoskeletal surfaces are similar in both paratypes compared against the holotype.

Type Material. Holotype, ♂: “HONDURAS: Comayagua: PN Cerro Azul Meambar, 14.86987 -87.89885 ±10m, 1150m, 20–23-V-2010, Malaise, trap, ridgetop cloud forest, LLAMA10 Ma-C-04-2-01” / “*Dromaeolus*, sp. c, Det. R.L. Otto, 2016” / “**HOLOTYPE:**, *Dromaeolus, comayaguiensis*, Otto, det. R.L. Otto, 2016” (♂ handwritten behind species name on label) [red printed label]. Holotype deposited in SEMC.

Paratypes. 2 ♂♂: “HONDURAS: Comayagua: PN Cerro Azul Meambar, 14.86987 -87.89885 ±10m, 1150m, 20–23-V-2010, Malaise, trap, ridgetop cloud forest, LLAMA10 Ma-C-04-2-01” / “**PARATYPE:**, *Dromaeolus, comayaguiensis*, Otto, det. R.L. Otto, 2016” (♂ handwritten behind species name on label) [yellow printed label]. Paratypes are deposited in SEMC and GERP.

Distribution. The eucnemid species is known from the type locality in Honduras.

Biology. Three specimens were taken from a Malaise trap placed on the ridgetop in a cloud forest. Larvae and pupae are unknown.

Etymology. Specific epithet is derived from a combination of two words, ‘Comayagua’, a name of the city in central Honduras and ‘-ensis’, a Latin adjectival suffix meaning “pertaining to”, from which the new species has been taken.

Remarks. *Dromaeolus comayaguiensis* is closely related to two other species in the Neotropical region, *Dromaeolus elongatus* Bonvouloir and *Dromaeolus javeti* Bonvouloir. The new species is distinguished from *D. javeti* by the presence of a median carina on the frons, absent in *D. javeti*. *Dromaeolus comayaguiensis* is further diagnosed from *D. elongatus* by its exoskeletal surface of the pronotum; shiny with evenly dispersed shallow punctures in *D. comayaguiensis*, dull with closely punctate to rugose surfaces in *D. elongatus*. Many similar species closely allied with the new species are present in eastern Nearctic and Indo-Malaysian regions. Metallic reflections of the pronotum will serve as the best diagnostic feature to distinguish the new species from those distributed in other regions around the globe.

Genus *Asiocnemis* Mamaev, 1976

Diversity and Distribution. *Asiocnemis* is a small group comprised of seven species. Six species are primarily distributed along the western side of the North American continent, including a single species in Mexico. One species is distributed in the Far East region of Russia.

Diagnosis. Macraulacini, with apical margin of frontolclypeal region evenly rounded and more than twice as wide as the distance between antennal sockets; antennae serrate, flattened with or without lateral keels; basally opened lateral antennal grooves present; antennal grooves either well defined or medially vaguely defined; male prothoracic tarsomere I simple with basal sex combs; metathoracic coxal plates medially 3.0–6.0 times longer than laterally; last visible ventrite rounded; tarsal claws simple; lateral surfaces of mesothoracic and metathoracic tibiae with setae and transverse rows of spine combs; male aedeagus dorsoventrally compressed, without secondary lateral lobes; median lobe simple, with moderately and narrowly bifurcate apices; median lobe well defined, fused with lateral lobes; flagellum simple.

***Asiocnemis bicolor* sp. nov.**

Fig. 7–8

Diagnosis. Bicolored elytra, along with ornate arrangements of setae on the pronotum will distinguish the new species from any known *Asiocnemis* species.

Description. Female holotype: Length, 7.0 mm. Width, 2.0 mm. Body cylindrical, elongate and tapering towards the elytral apex; head, pronotum, venter, scutellum, elytral suture and lateral sides of elytra black; elytral disc orange; antennae black; femur and tibiae dark brown-black; tarsi dark brown-black; pronotum with wide band of short, white, recumbent setae along each lateral side and a narrowed, medial band of short, white, recumbent setae extending entire length of pronotum; head and elytra completely clothed with very short, sparse, white recumbent setae (Fig. 7).

Head: Surface closely, deeply punctate on frons, shiny, subspherical; frons convex, with median carina extending from frontolclypeal region to middle of frons; interantennal carina complete; apical margin of frontolclypeal region evenly rounded, more than 2.0 times wider than base; frontoclypeal region with carina present along each lateral side from base to apex; mandibles stout, bidentate, densely punctate and rugose.

Antenna: Weakly serrate to filiform from antennomeres III–X, reaching just beyond elytral humeri, flattened; antennomere III shorter than IV and V combined; antennomere IV about as long as II, shorter than V; antennomere V shorter than VI; antennomeres VI–X each sub-equal, longer than wide; antennomere XI slightly longer than X; antennomeres I–XI with lateral keel.

Pronotum: Surface shiny, deeply punctate; punctures closely spaced; longer than wide, with moderate hind angles; slightly arcuate, gradually narrowed anteriorly; disc convex; base sinuous, with short, elevated carina above scutellum.

Scutellum: Closely punctate, short, sub-triangular and distally rounded.

Elytra: Punctate striae present; interstices flattened; humeri closely punctate to transversely rugose, remaining areas with closely spaced, shallow punctures.

Legs: First tarsomere longer than the combined lengths of the remaining four on mesothoracic and metathoracic tarsi; tibiae rounded in cross section; metathoracic tarsomeres I–III simple; metathoracic tarsomere IV excavated and emarginated, wider than tarsomere V; metathoracic tarsomere V short with simple claws.

Venter (Fig. 8): Densely and closely punctate, with white recumbent setae; hypomeron with well-defined basally open, deep, lateral antennal grooves; antennal grooves without punctures, shiny; metathoracic episterna parallel-sided; metathoracic coxal plates medially 3.0–6.0 times wider than laterally.

Variation. One female paratype was examined. Female paratype measured 7.0 mm long and 2.0 mm wide, as long as and as wide as the holotype. Lateral keel on antennomere XI is more pronounced in

the paratype than the holotype. Exoskeletal surfaces and ornate arrangements of setae on pronotum observed for the paratype are similar to the holotype.

Type Material. Holotype, ♀: “ECUADOR: Sucumbios, Sacha Lodge, 0.5°S, 76.5°W, 270m, 10–21-X, 1994, Hibbs, ex: malaise” / “*Dromaeolus*, sp. b, Det. R.L. Otto, 2016” / “**HOLOTYPE**:, *Asiocnemis*, *bicolor*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [red printed label]. Holotype deposited in SEMC.

Paratype. 1 ♀: “ECUADOR: Sucumbios, Sacha Lodge, 0.5°S, 76.5°W, 270m, 10–21-X, 1994, Hibbs, ex: malaise” / “*Dromaeolus*, sp. b, Det. R.L. Otto, 2016” / “**PARATYPE**:, *Asiocnemis*, *bicolor*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [yellow printed label]. Paratype is deposited in GERP.

Distribution. The eucnemid species is known from the type locality in Ecuador.

Biology. Two specimens were taken from a Malaise trap. Larvae and pupae are unknown.

Etymology. Specific epithet is derived from the bicolored elytra present on this species.

Remarks. This is the first record for *Asiocnemis* to be recorded not only in South America, but also in the southern hemisphere. Chassain and Touroult (2011) imaged this species collected in French Guiana. They identified the eucnemid as an unknown species of *Dromaeolus*. The presence of *A. bicolor* in both Ecuador and French Guiana would suggest the species may be more widespread in the Amazonian basin and could be present in Bolivia, Brazil and Peru.

Note. Identity at the generic level was made possible through an on-line key to the world eucnemid genera provided by Muona (2011).

Tribe Nematodini Leiler, 1976

Diagnosis. Mandibles short, with ventral secondary tooth, without expanded lateral surfaces; prothoracic tibiae with one apical spur; male prothoracic tarsomere I with basal sex combs; tarsomere IV usually bilobed; lateral sides of mesothoracic and metathoracic tibiae variable, either with setae and simple spines or with setae and transverse rows of spine combs; hypomeron with antennal grooves or without antennal grooves; prothoracic sternal peg high, either truncated or excavated; median lobe without dorsal basal struts, fused with lateral lobes, distinct, with narrowly and deeply bifurcate apex; bursa divided, simple; spermatheca sclerotized, divided and U-shaped.

Key to the genera of the tribe Nematodini

- | | | |
|----|--|--|
| 1. | Tarsal claws basally toothed | 2 |
| – | Tarsal claws simple | 3 |
| 2. | Habitus bicolored; elytral striae indicated; hypomera with antennal grooves | <i>Microtrigonius</i> Bonvouloir, 1871 |
| – | Habitus unicolored; elytral striae well developed; hypomera without antennal grooves | <i>Coomanius</i> Fleutiaux, 1924 |
| 3. | Hypomera without basally open lateral antennal grooves | 4 |
| – | Hypomera with basally open lateral antennal grooves | <i>Graciliforma</i> Otto, 2016 |
| 4. | Metathoracic episterna parallel-sided | 5 |
| – | Metathoracic episterna apically wide | 6 |

5. Mesothoracic and metathoracic tarsomere IV simple*Neomathion Fleutiaux*, 1930
 – Mesothoracic and metathoracic tarsomere IV excavate*Nematodes Berthold*, 1827
6. Antennomeres IV–V together shorter than III*Trigonopleurus Bonvouloir*, 1871
 – Antennomeres IV–V together as long as or longer than III*Miruantennus Otto*, 2016

Genus *Nematodes* Berthold, 1827

Diversity and Distribution. *Nematodes* is a moderately large group consisting of 39 species primarily distributed in the Neotropical region. Four species are distributed in eastern North America. Twenty-two species are found in the Neotropical region, including the Caribbean Islands. One species occurs in much of Europe and Russia. Two species are distributed along the eastern coastline of the Australian continent. Nine species are represented in Southeast Asia, including Japan. The new species represents the first record for the group on the African continent.

Diagnosis. Frontoclypeal region subtriangular, apically trilobed, apically more than 2.0 times wider than the distance between antennal sockets. Lateral pronotal ridge entire; disc convex with pair of small circular foveae; base sinuous. Elytral disc with indistinct striae, except near suture; humeral region moderately striate; interstices flattened. First prothoracic tarsi with curved basal sex combs in males; lateral side of mesothoracic and metathoracic tibiae with hairs and transverse rows of spines; tarsi with simple claws. Notosternal suture as long as the hypomeral base; hypomeron simple, without lateral antennal grooves; metathoracic episterna parallel-sided; metathoracic coxal plate medially 3.0–6.0 times wider than laterally; last visible ventrite forming a strongly produced beak; male aedeagus dorsoventrally compressed, with laterally attached secondary lateral lobes; median lobe simple, with moderately and narrowly bifurcate apices; lateral lobes simple, entire; flagellum simple.

Nematodes africanus sp. nov.

Fig. 9–14

Description. Male holotype: Length, 5.5 mm. Width, 1.25 mm. Body subcylindrical, elongate, tapering towards elytral apex; uniformly dark brown; antennae reddish-brown; legs reddish-brown; head, pronotum and elytra clothed with short, recumbent yellowish setae (Fig. 9).

Head: Surface with deep, crowded punctures, almost rugose; subspherical; frons convex, with median round fovea above frontoclypeal region; intervals between punctures shiny; apical margin of frontoclypeal region trilobed, more than 2.0 times wider than base; mandibles stout, bidentate, densely punctate.

Antennae (Fig. 10): Serriform from antennomeres III–XI, attaining just beyond pronotal hind angles; antennomere III elongate, nearly as long as combined lengths of antennomeres IV and V; antennomere IV short, longer than wide, as long as V; antennomeres VI–XI each longer than wide, longer than V; antennomere XI longer than X.

Pronotum: Surfaces dullish, rugose; longer than wide, with moderate, sharp hind angles; basal 1/2 parallel-sided, apical 1/2 arcuate; disc convex with shallow median groove extending nearly entire length, with circular fovea on both side of median groove; base sinuous.

Scutellum: Short, sub-triangular, punctate, moderately setose and distally rounded.

Elytra: Striae present, punctate; interstices flattened; surfaces shiny; basal 1/2 transversely rugose, apical 1/2 punctate, almost rugose.

Legs: First tarsomere as long as the combined lengths of the remaining four on mesothoracic and metathoracic tarsi; tibiae rounded in cross section; metathoracic tarsomeres I–III simple; metathoracic tarsomere IV excavated; metathoracic tarsomere V elongate with simple claws.

Venter: Punctate, with elongate, recumbent yellowish setae; hypomeron simple, without lateral antennal grooves; metathoracic episternum parallel-sided; metathoracic coxal plates medially almost 6 times wider than laterally.

Variation. One female paratype was examined. Female paratype (Fig. 11) measured 9.0 mm long and 2.0 mm wide; much larger and wider than the holotype. Female paratype differs from the holotype based on the shorter median groove on the pronotal disc. The median groove extends from just above the base and terminates at the middle. Female antennal structures (Fig. 12) are slightly different than the holotype. For female paratype, antennomere IV is slightly shorter than V; sub-equal in the male holotype. The beak at the terminus of the last visible ventrite is much shorter and almost bifid in the female paratype (Fig. 13), slightly elongate and truncate in the male holotype (Fig. 14).

Type Material. Holotype, ♂: “LAMTO-PACOBO, 27-III-1984” (date, month and year handwritten) / “COTE D’IVOIRE, J.M. LEROUX” (blue label) / “**HOLOTYPE**:, *Nematodes, africanus*, Otto, det. R.L. Otto, 2016” (♂ handwritten behind species name on label) [red printed label]. Holotype is transferred from GERP to BMNH.

Paratype. 1 ♀: [same data as Holotype] / [same data as Holotype] / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE**:, *Nematodes, africanus*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [yellow printed label]. Paratype is retained in GERP.

Distribution. The eucnemid species is known from a type locality in the African nation of Côte d’Ivoire, also known as the Ivory Coast.

Biology. Larvae and pupae are unknown.

Etymology. Specific epithet is derived from the name of the continent, from which the species has been taken.

Remarks. The new African species is closely allied with a number of *Nematodes* species, particularly the Nearctic *Nematodes penetrans* (LeConte) and the Neotropical *Nematodes rugicollis* Chevrolat. All three species have shorter antennomeres IV and V in relation to antennomere VI. *Nematodes africanus* differs by its uniformly dark brown coloration, being uniformly black in the other two species.

Genus *Miruantennus* Otto, 2016

Diversity and Distribution. *Miruantennus* is a very small, recently described group consisting of three species primarily distributed in the Palearctic and Indo-Malaysian regions. *Miruantennus basalis* Otto is a precintive species in southern Laos. The first new species is a precintive species in Yunnan province within the southern region of China. The second new species was taken from two localities within Malaysia.

Diagnosis. Frontoclypeal region subtriangular, apically rounded, apically 2.0 times wider than the distance between antennal sockets. Lateral pronotal ridge entire, slightly sinuate anteriorly; disc convex usually with pair of small circular foveae; base sinuous. Elytral disc with indistinct striae, except near suture; humeral region moderately striate; interstices flattened. First prothoracic tarsi with straight basal sex combs in males; lateral side of mesothoracic and metathoracic tibiae with hairs and transverse rows of spines; tarsi with basally swollen, simple claws. Notosternal suture as long as the hypomerale base; hypomerale simple, without lateral antennal grooves; metathoracic episterna apically wide; metathoracic coxal plate medially 3.0 times wider than laterally; last visible ventrite forming a strongly produced, truncated beak; last abdominal segment exposed, extending beyond elytral apices in males.

Key to the species of *Miruantennus*

1. Habitus bicolored; body elongate, narrow; pronotal hind angles poorly developed **2**
- Habitus unicolored; body strongly cuneiform; pronotal hind angles moderately developed
..... *M. cuneiformis* sp. nov.

2. Elytral humeri region pale orange, remaining areas dark brown-black*M. basalis* Otto
 – Elytra largely orange, except for apical 1/3 and lateral sides dark brown-black
*M. chinensis* sp. nov.

***Miruantennus chinensis* sp. nov.**

Fig. 15–19

Diagnosis. Largely orange colored elytra will distinguish the new species from *M. basalis*. Bicolored, elongate and subcylindrical habitus will also distinguish *M. chinensis* from *M. cuneiformis*.

Description. Male holotype: Length, 6.0 mm. Width, 1.5 mm. Body subcylindrical, elongate; head, pronotum, venter, apical 1/3 of elytra and lateral elytral sides black; elytral humeri and basal 2/3 of elytral disc orange-brown; scape black, antennomeres II–XI brown; legs, including tarsi yellowish-brown; head, pronotum and much of elytra clothed with short, recumbent yellowish setae; elytral humeri with elongate, recumbent yellowish setae (Fig. 15).

Head: Rugose, almost granulose, subspherical; frons convex, without median carina or fovea above frontoclypeal region; surfaces dullish; apical margin of frontoclypeal region rounded, about 2.0 times wider than base; mandibles stout, bidentate.

Antenna (Fig. 16): Capitate from antennomeres VIII–XI, attaining elytral humeri; antennomere III short, as long as II; antennomere IV slightly shorter than III, as long as V; combined lengths of antennomeres IV and V longer than III; antennomeres VI and VII quadrate, both larger than V; antennomere VII larger than VI; antennomeres VIII–XI each much longer than wide, slightly longer than the combined lengths of III–V together.

Pronotum: Surfaces dull, densely rugose to granulose; longer than wide, with short hind angles; basal 1/3 parallel-sided, apical 2/3 wider and arcuate; disc convex with shallow median groove, with pair of circular fovea; base sinuous.

Scutellum: Short, rugose, sub-triangular and distally rounded.

Elytra: Indistinctly striate, except along elytral humeri, sutural areas and near apices; interstices flattened; surfaces shiny with dense punctures.

Legs: Not seen.

Venter: Closely punctate, with elongate, recumbent yellowish setae; hypomeron simple, without lateral antennal grooves; metathoracic episternum apically wide; metathoracic coxal plates medially 3.0 times wider than laterally.

Male aedeagus (Fig. 17): Elongate, dorsally flattened; median lobe free, with fairly deeply notched apex; lateral lobes apically elongate, rounded, shorter than median lobe; lateral lobe each with lateral tooth arising midway; secondary lateral lobe basally attached to lateral lobes, apically rounded and without lateral teeth; basal piece obscured.

Female allotype (Fig. 18): Length 6.5 mm; antennae (Fig. 19) weakly capitate; antennomere III much longer than IV; combined lengths of antennomeres IV and V slightly longer than III; antennomere IV as long as V; antennomere VI longer than V; antennomere VII slightly longer and wider than VI, shorter than VIII; antennomeres VIII–X each wider than VII, longer than wide; antennomere XI slightly longer than X.

Variation. One female paratype was examined. The female paratype measured 5.5 mm long and 1.25 mm wide, slightly shorter and narrower than the holotype. The female paratype differs from the male holotype based on a couple of features. Firstly, fovea on the pronotal disc are more impressed in the male holotype compared with the female paratype. Secondly, the pronotum is slightly more elongate in the male holotype compared with the female paratype. The pronotum in the female paratype is about as long as wide. Elytra in the male holotype is slightly darker than the female paratype. Female paratype is similar in structure and color with the female allotype. First tarsomere of the mesothoracic and metathoracic tarsi in the female paratype is described to be as long as the combined lengths of the remaining four on mesothoracic and metathoracic tarsi; tibiae rounded in cross section; metathoracic tarsomeres I–III simple; metathoracic tarsomere IV excavated.

Type Material. Holotype, ♂: “CHINA: S. YUNNAN, (Xishuangbanna), 28 km, NW Jinghong vic An, MA Xi Zhan (NNNR)” (large space between ‘China’ and ‘S. Yunnan’) / “N22°12, E100°38 EKL, 26.III.2009, Forest, 700m, leg. L. Meng” / “Collection, NATURKUNDE-, MUSEUM ERFURT (yellow printed label) / “**HOLOTYPE**:, *Miruantennus, chinensis*, Otto, det. R.L. Otto, 2016” (♂ handwritten behind species name on label) [red printed label]. **Allotype**, ♀: “CHINA: S-YUNNAN, (Xishuangbanna), 20 km NW Jinghong, Man Dian (NNNR)” (large space between ‘China’ and ‘S. Yunnan’) / “N22°07.80, E100°40.05, 730m, 06.IV.2009, EKL, forest, leg. L. Meng” / “Collection, NATURKUNDE-, MUSEUM ERFURT” (yellow printed label) / “**ALLOTYPE**:, *Miruantennus, chinensis*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [yellow printed label]. Holotype and allotype are deposited in NME.

Paratype. 1 ♀: “CHINA: S. YUNNAN, (Xishuangbanna), 28 km, NW Jinghong, vic., An MA Xi Zhan (NNNR)” (large space between ‘China’ and ‘S. Yunnan’) / “N22°12, E100°38, 700m, 16.III.2009, EKL, leg. L. Meng” / “Collection, NATURKUNDE-, MUSEUM ERFURT” (yellow printed label) / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE**:, *Miruantennus, chinensis*, Otto, det. R.L. Otto, 2016” (♀ handwritten behind species name on label) [yellow printed label]. Paratype was transferred from NME to GERP.

Distribution. The eucnemid species is known from two localities in the Chinese province of Yunnan, near Jinghong.

Biology. According to Andreas Weigel (*pers. comm*), these beetles were taken from the northernmost tropical rainforests (Fig. 20). All specimens were taken from a common cross window trap placed 10 meters above ground in the tree canopies (Fig 21–22). Larvae and pupae are unknown.

Etymology. Specific epithet is derived from the name of the country from which the new species has been taken.

***Miruantennus cuneiformis* sp. nov.**

Fig. 23–27

Diagnosis. Black coloration and strongly cuneiform habitus will distinguish the new species from *M. basalis* and *M. chinensis*.

Description. Male holotype: Length, 7.0 mm. Width, 1.25 mm. Body subcylindrical, elongate, strongly cuneiform toward elytral apex; uniformly black; scape and antennomeres VI–XI black, pedicel and antennomeres III–V dark brown; femur and tibiae dark brown, tarsi dark brown; head, apical 2/3 of pronotum and much of elytra clothed with short, recumbent whitish setae; basal 1/3 of pronotum, elytral humeri and sutural areas with elongate, recumbent whitish setae (Fig. 23–24).

Head: Densely punctate, almost rugose, subspherical; frons convex, without median carina or fovea above frontoclypeal region; surfaces shiny; apical margin of frontoclypeal region rounded, about 2.0 times wider than base; mandibles stout, bidentate, densely punctate.

Antenna (Fig. 25): Capitate from antennomeres VIII–XI, attaining elytral humeri; antennomere III short, as long as II; antennomere IV slightly shorter than III, as long as V; combined lengths of antennomeres IV and V longer than III; antennomeres VI and VII quadrate, both larger than V; antennomeres VIII–XI each much longer than wide, as long as the combined lengths of III–V together.

Pronotum: Surfaces dull, densely rugose to granulose; longer than wide, with moderate, sharp hind angles; lateral sides arcuate, slightly constricted basally above hind angles; disc convex with shallow median groove, without circular fovea; base sinuous, slightly depressed at either side above scutellum.

Scutellum: Short, sub-triangular, medially elevated and distally rounded.

Elytra: Indistinctly striate, except along elytral humeri and sutural areas; interstices flattened; surfaces shiny with dense punctures.

Legs: First tarsomere as long as the combined lengths of the remaining four on mesothoracic and metathoracic tarsi; tibiae rounded in cross section; metathoracic tarsomeres I–III simple; metathoracic tarsomere IV excavated; metathoracic tarsomere V elongate with basally swollen claws.

Venter: Closely punctate, with elongate, recumbent whitish setae; hypomeron simple, without lateral antennal grooves; metathoracic episternum apically wide; metathoracic coxal plates medially 3 times wider than laterally.

Variation. One male and one female paratype were examined. Male paratype measured 6.5 mm long and 1.0 mm wide, slightly shorter and narrower than the holotype. Female paratype (Fig. 26) measured 4.5 mm long and 1.0 mm wide, also shorter and narrower than the holotype. Male paratype differs from the holotype on a number of features. Firstly, arrangement of elongate setae on the basal 1/3 of the pronotum as well as elytral humeri and sutural areas are absent in the male paratype. Secondly, median groove on the pronotal disc is also absent in the paratype. Lastly, pedicel and antennomeres III–V are darker than the holotype. Female paratype differs from the male holotype based on two features. First, the last abdominal segment is hidden beneath the elytra, exposed beyond elytral apices in males. Second, female antennal structures (Fig. 27) are markedly different than the holotype. For female paratype, antennomere III much longer than IV; combined lengths of antennomeres IV and V as long as III; antennomere VI as long as V; antennomere VII slightly longer and wider than VI, shorter than VIII; antennomeres VIII–X each wider than VII, quadrate; antennomere XI slightly longer than X.

Type Material. Holotype, ♂: “Borneo, Sabah, 1240m, Crocker Range, IV.2013, Kota Kinabalu → Tambunan, N5°51’33.7”E116°17’24.1”, General collecting” / “BMNH{E} 2013-58, M.V.L.Barclay, B.H.Garner, H.Mendel and A.Giusti” / “BMNH(E), 1221775” (label upside-down) / “**HOLOTYPE**:, *Miruantennus, cuneiformis*, Otto, det. R.L. Otto, 2015” (♂ handwritten behind species name on label) [red printed label]. Holotype deposited in BMNH.

Paratypes. 1♂, 1♀: **MALAYSIA:** 1♂, “Borneo, 15–27.4.1993, Sabah Crocker Mt., Gunong Emas env., Jenis and Strba leg.” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE**:, *Miruantennus, cuneiformis*, Otto, det. R.L. Otto, 2015” (♂ handwritten behind species name on label) [yellow printed label]; 1♀, “W MALAYSIA – Pahang, Cameron Highlands Mts., Tanah Rata, 1000–1500m, 2–9.iv.1997, P. Čechovský leg.” / “Collection of the Global, Eucnemid Research Project, (Robert L. Otto)” (green framed white label) / “**PARATYPE**:, *Miruantennus, cuneiformis*, Otto, det. R.L. Otto, 2015” (♀ handwritten behind species name on label) [yellow printed label]. Paratypes are retained in GERP.

Distribution. This species is known from two localities; one of which is the mountainous region on Peninsular Malaysia and the second, a mountain range on Bornean Malaysia.

Biology. One specimen was taken in the low to mid-elevation tropical highland forest on the peninsula. Two specimens were taken from a montane forest near Sabah in the northern areas of Borneo. Larvae and pupae are unknown.

Etymology. Specific epithet is derived from the overall general form of the new species, that being strongly cuneiform, compared with two other congeners of the group.

Remarks. Although many groups within the tribe exhibit some form of sexual dimorphism among each species; none is more extreme as *Miruantennus*, with stark differences in antennal structures and last visible ventrite between males and females in the recently described group. Males are highly diagnostic. Females are a bit more difficult to diagnose. Female *Miruantennus* are very similar to *Nematodes* and *Trigonopleurus*. Female *Miruantennus* differs from any *Nematodes* species based on the metathoracic episterna, apically wide in *Miruantennus* and parallel-sided in *Nematodes*. Female *Miruantennus* is further diagnosed from *Trigonopleurus* based on the combined lengths of antennomeres IV and V in relation to antennomere III; IV and V together shorter than III in *Trigonopleurus* versus as long as or longer in *Miruantennus*.

Acknowledgments

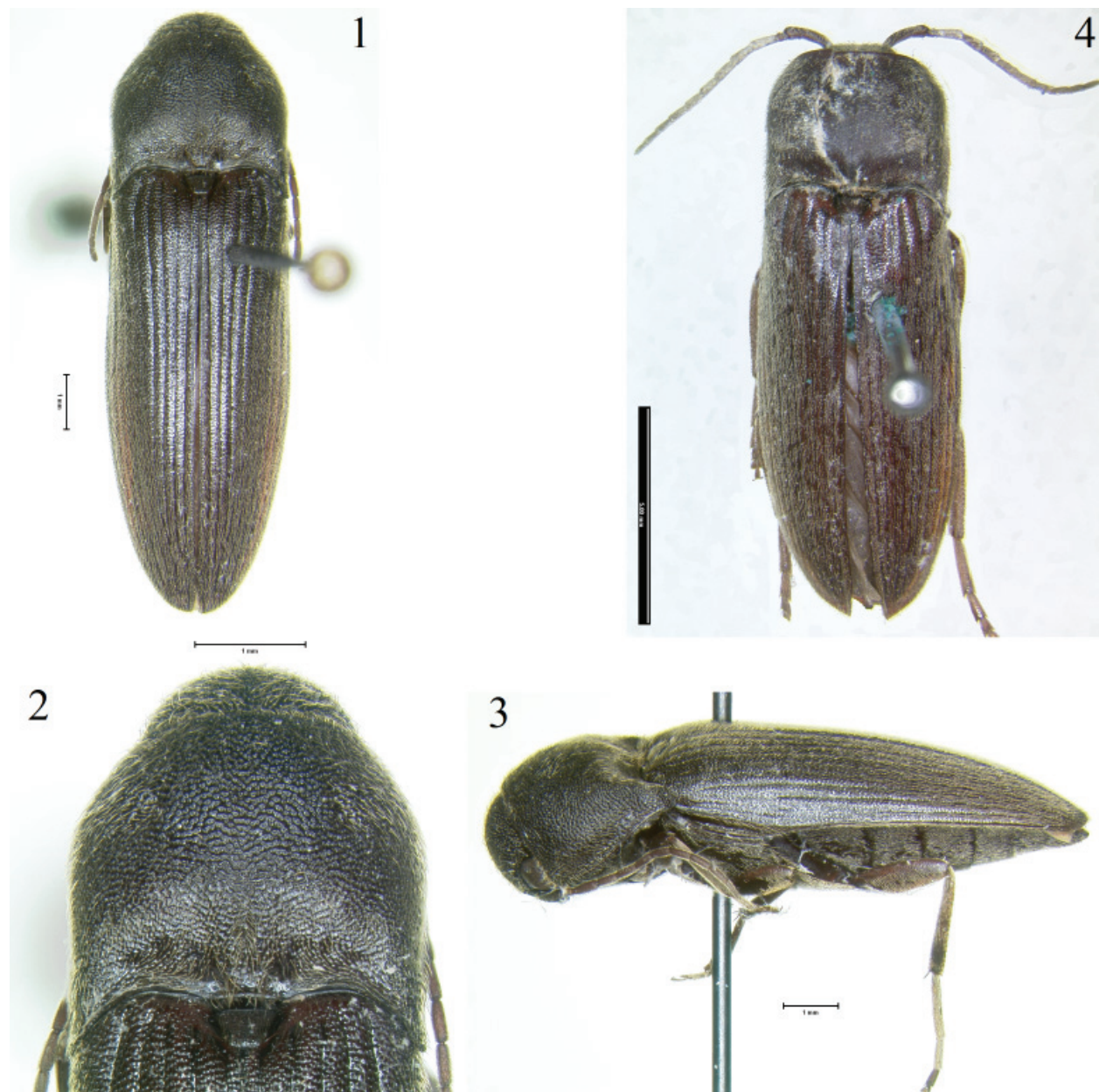
I would like to thank Antoine Mantilleri of Paris, France, Michael Geiser of London, UK, Matthias Hartmann of Erfurt, Germany, Kyle Schnepf and Paul Skelley both of Gainesville, Florida as well as Zach Falin of the Snow Entomology Museum for lending their specimens to my care during the course of my study, Andreas Weigel for providing some collection and site information for *M. chinensis* as well as permitting me to use his photographs in this study, Daniel Young for blocking off time to allow me to operate the Auto-Montage equipment in the laboratory, Jyrki Muona for providing insights and advice on *Coomanius* and *Fornax* and Kyle Schnepf and Alexey Tishechkin for reviewing and offering their input on the manuscript.

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Received April 7, 2017; Accepted May 17, 2017.

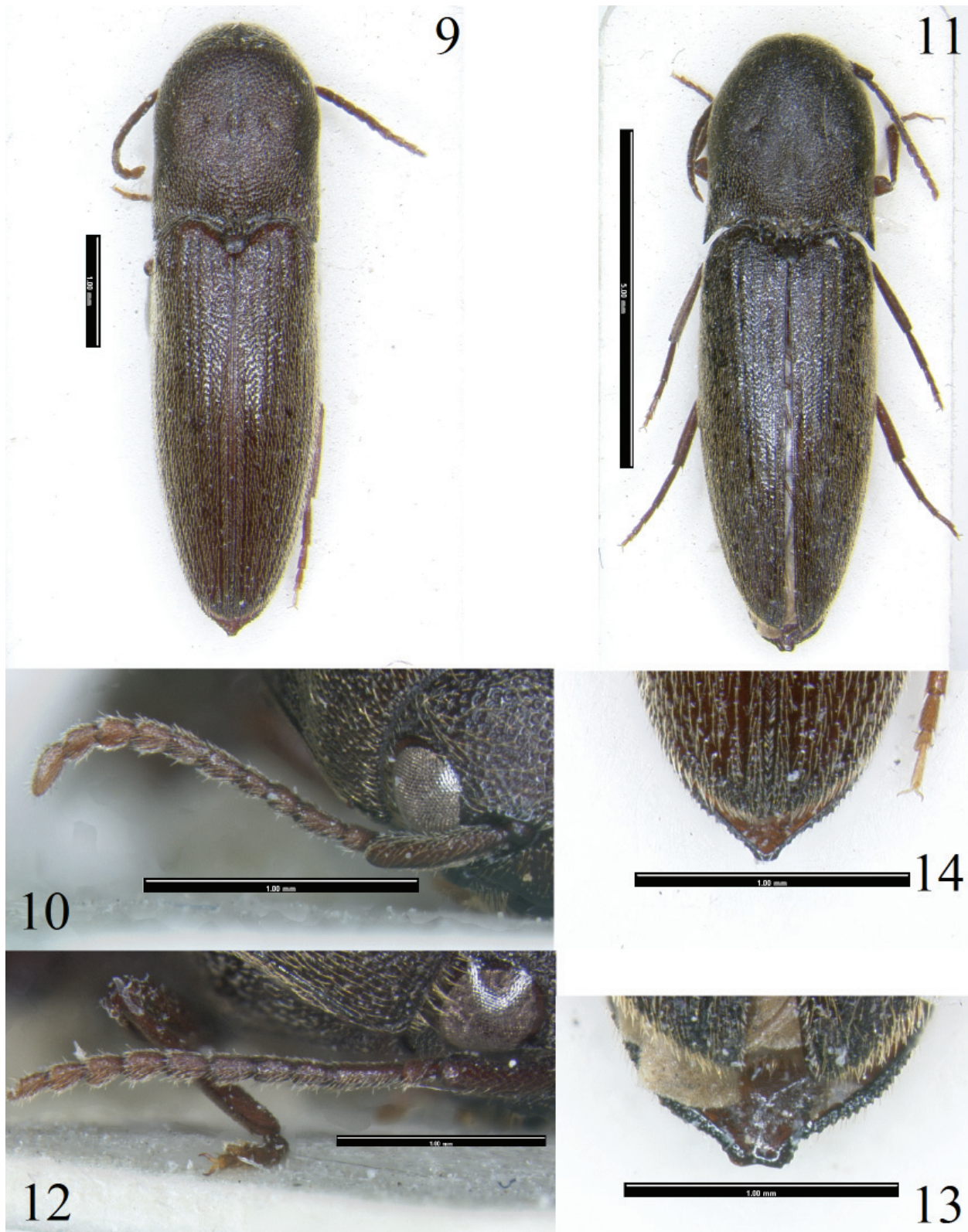
Review Editor Oliver Keller.



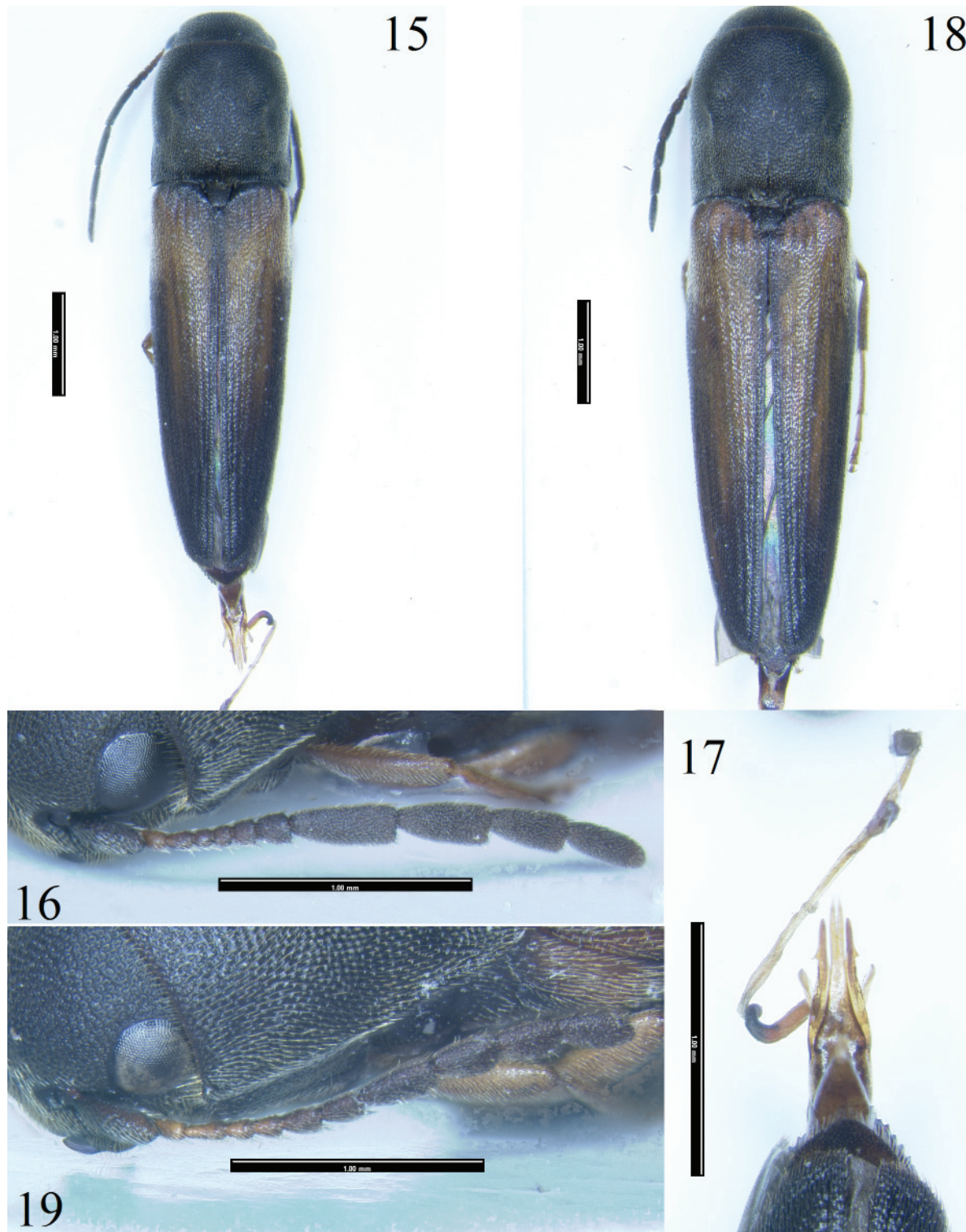
Figures 1–4. *Fornax* species. **1)** *Fornax dixiensis* female holotype (FSCA), dorsal habitus. **2)** *Fornax dixiensis* female holotype (FSCA), head/pronotum, dorsal habitus. **3)** *Fornax dixiensis* female holotype (FSCA), lateral habitus. **4)** *Fornax truncatus* female syntype (BMNH), dorsal habitus. (Scale: 1–3 = 1.0 mm; 4 = 5.0 mm.)



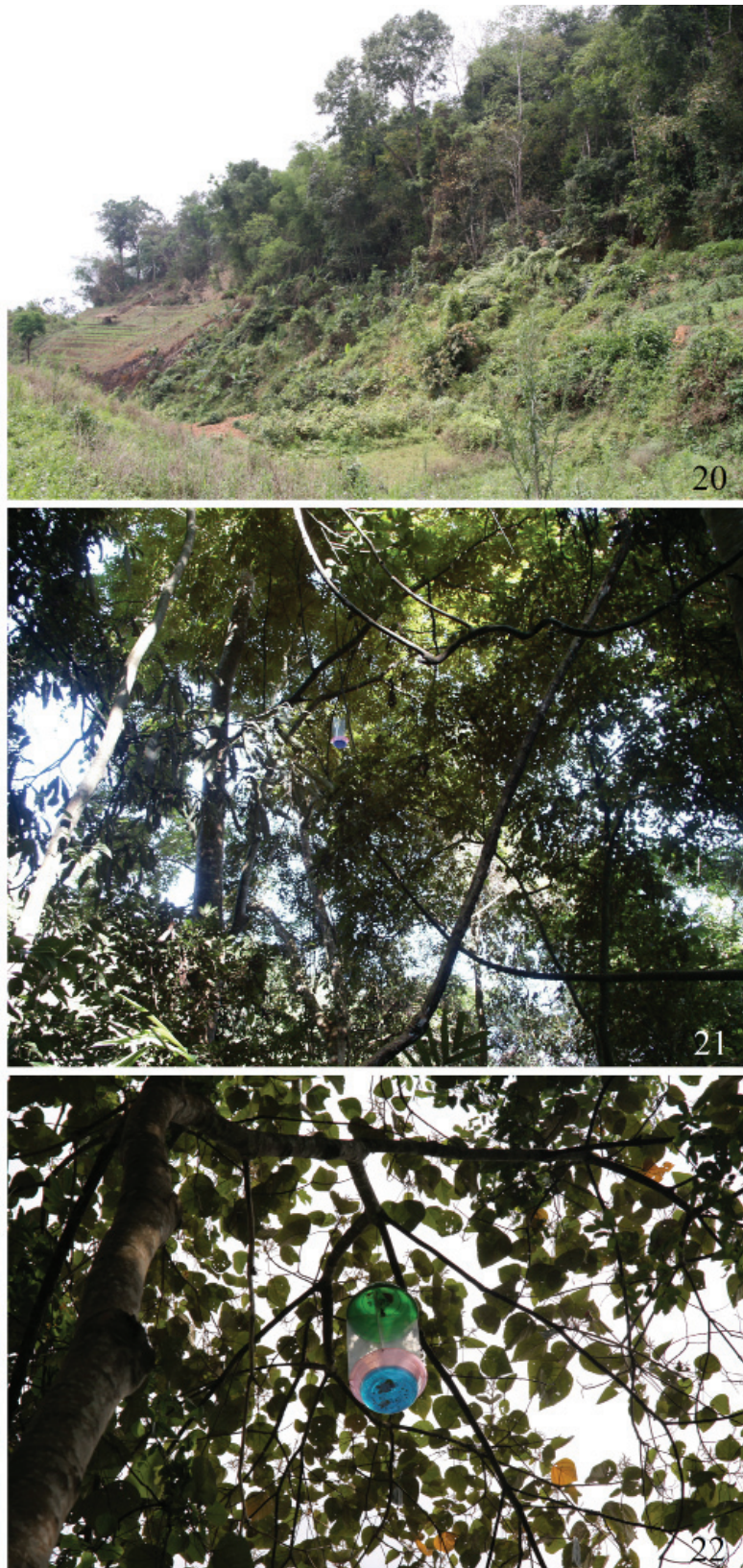
Figures 5–8. Neotropical Eucnemidae. **5)** *Dromaeolus comayaguensis* (SEMC), dorsal habitus. **6)** *Dromaeolus comayaguensis* (SEMC), ventral habitus. **7)** *Asiocnemis bicolor* (SEMC), dorsal view. **8)** *Asiocnemis bicolor* (SEMC), ventral view. (Scale: 6–7 = 5.0 mm; 8–9 = 1.0 mm.)



Figures 9–14. *Nematodes africanus* sp.nov. **9)** Male holotype (BMNH), dorsal habitus. **10)** Male holotype (BMNH), antenna, anterolateral view. **11)** Female paratype (GERP), dorsal habitus. **12)** Female paratype (GERP), antenna, anterolateral view. **13)** Female paratype (GERP), abdominal apices, dorsal view. **14)** Male holotype (BMNH), abdominal apices, dorsal view. (Scale: 11–12, 14–16 = 1.0 mm; 13 = 5.0 mm.)



Figures 15–19. *Miruantennus chinensis* sp.nov. **15** Male holotype (NME), dorsal habitus. **16** Male holotype (NME), antenna, anterolateral view. **17** Male holotype (NME), aedeagus, dorsal view. **18** Female allotype (NME), dorsal habitus. **19** Female allotype (NME), antenna, anterolateral view. Scale line = 1.0 mm.



Figures 20–22. *Miruantennus chinensis* sp.nov. Habitat **20)** An Ma Xi Zhan forest edge, Yunnan Prov., China, 26-VI-2008. **21)** Man Dian forest side with trap, Yunnan Prov., China, 11-XII-2007. **22)** Cross window trap in tree canopy, Yunnan Prov., China, 26-VI-2008. Images provided by Andreas Weigel and used by his permission.



Figures 23–27. *Miruantennus cuneiformis* sp.nov. **23)** Male holotype (BMNH), dorsal habitus. **24)** Male holotype (BMNH), lateral habitus. **25)** Male holotype (BMNH), antenna, dorsal view. **26)** Female paratype (GERP), dorsal habitus. **27)** Female paratype (GERP), antenna, dorsal view. Scale line = 1.0 mm.

