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# A revision of the Aphodiini genus *Cnemargulus* Semenov, 1903 (Coleoptera: Scarabaeoidea: Scarabaeidae)

Stefano Ziani

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# INSECTA MUNDI

A Journal of World Insect Systematics

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0689

A revision of the Aphodiini genus *Cnemargulus* Semenov, 1903  
(Coleoptera: Scarabaeoidea: Scarabaeidae)

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Date of issue: February 22, 2019

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Insecta Mundi 0689: 1–10

ZooBank Registered: urn:lsid:zoobank.org:pub:C516A2F6-FF83-4ED4-98D8-2F4DB2C7123

**Published in 2019 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:** Robert G. Forsyth

## A revision of the Aphodiini genus *Cnemargulus* Semenov, 1903 (Coleoptera: Scarabaeoidea: Scarabaeidae)

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**Abstract.** The aphodiine genus *Cnemargulus* Semenov (Coleoptera: Scarabaeoidea: Scarabaeidae) is revised. Two species are recognized as belonging to the genus. A new synonymy (*C. krulikovskyi* Semenov vs *C. pusio* Semenov) is proposed. A new country record for Iran is given. Lastly, a key to species is provided.

**Key words.** Taxonomy, new synonymy, new record, nomenclature, Saudi Arabia, Iran, Central Asia.

### Introduction

The genus *Cnemargulus* was erected by Semenov (1903) for two species: *C. krulikovskyi* Semenov, 1903, type species (designated by Nikolajev (1979)), and *C. pusio* Semenov, 1903, both collected in Central Asia. Later on, Pittino (1984) described *C. alkhubraicus* Pittino, 1984 on one female from Saudi Arabia.

Adults of all *Cnemargulus* species are yellow and more or less brownish, and share the character of four teeth on the clypeal margin (Fig. 3). They all have psammophilous habits, and live in desert environments.

The systematics of the genus have always been poorly known because of the supposed rarity of the species and the unavailability of specimens for study. For these reasons Balthasar (1964) asserted to uncritically follow the paper of Semenov (1903). Also, Pittino (1984) and Dellacasa (1990) confirmed the rarity of the species ascribed to the genus.

Beyond the type series—lectotype and two paralectotypes for *Cnemargulus krulikovskyi*, three syntypes for *C. pusio* and holotype for *C. alkhubraicus*—very few specimens of *Cnemargulus* are recorded in the literature, namely, one for the first species (Dellacasa 1990) and two for the second (Balthasar 1964; Nikolajev 1987). There are no further records for *C. alkhubraicus*.

The finding of six specimens of *Cnemargulus*, in southern Iran, has prompted me to revise the genus.

### Materials and Methods

Species systematics follows Dellacasa et al. (2016) except when explained in remarks. Terminology of the epipharynx follows Dellacasa et al. (2010). Body length is measured from the tip of the clypeal teeth to the extremity of the elytra. Collections abbreviations are as follows:

**NHMB** Naturhistorisches Museum, Basel (Switzerland)

**SACB** Saeed Azadbakhsh private collection, Bandar Abbas (Iran)

**SZCM** Stefano Ziani private collection, Meldola–Forlì (Italy)

**ZIN** Russian Academy of Sciences, Zoological Institute, Saint Petersburg (Russia)

### Systematics

#### *Cnemargulus* Semenov, 1903

*Cnemargulus* Semenov 1903: 354; Jacobson 1906: 315; Schmidt 1910a: 13 (as junior synonym of the genus *Cnemismus*); Schmidt 1910b: 4 (as junior synonym of *Cnemismus*); Schmidt 1922: 344 (as junior synonym of *Cnemismus*); Semenov and Medvedev 1927: 183; Winkler 1929: 1059 (as junior synonym of *Cnemismus*); Balthasar 1964: 471 (as

subgenus of *Cnemisus*); Medvedev and Nikritin 1971: 1881; Nikolajev 1979: 41 (as junior synonym of the *Aphodius* subgenus *Mendidius*); Pittino 1984: 306; Nikolajev 1987: 121 (as junior synonym of the *Aphodius* subgenus *Mendidius*); Dellacasa 1988: 401; Dellacasa 1990: 22; Dellacasa 1994: 39; Dellacasa et al. 2001: 119; Dellacasa and Dellacasa 2006: 140; Krajcik 2012: 75; Dellacasa et al. 2016: 121.

**Type species.** *Cnemargulus krulikovskyi* Semenov, 1903 (subsequent designation by Nikolajev 1979).

**Diagnosis.** Aphodiini species with small to medium adult body size (3.2–7.6 mm), oval-elongate, convex, glossy, glabrous dorsally. Yellow to light brown.

Head with epistome gibbous and granulate, clypeus quadridentate and distinctly bristled, frontal suture trituberculate, not reaching the genal sutures, genae auriculate, elongately ciliate, protruding from eyes.

Pronotum transverse, bordered in all the sides, sometimes the border more or less interrupted anteriorly at middle but therein irregularly crenulated by coarse punctures, rather regularly punctured on disc. Scutellum small, triangular.

Elytra with striae fine, interstriae from nearly flat to slightly convex on disc; humeri not denticulate. Metathoracic wings normally developed in both sexes.

Metasternal plate with complete midline furrow.

Foretibiae with four or more external teeth; apical edge of mesotibiae with spinules more or less equal and a single very long seta near outer angle, almost as long as the first tarsal segment; metatibiae feebly widened apically, with upper apical spur longer than the first tarsal segment.

Pygidium with apical margin very elongately ciliate.

Secondary sexual characters very weak: foretibial and upper metatibial spur very slightly sinuate in males, normally shaped in females. Furthermore, females have elytra slightly widened in apical half.

Aedeagus with paramera elongate and more or less acuminate apically.

Epipharynx round laterally, front edge very slightly sinuate; epitorma globose; corypha with celtes more or less elongate; pedia with few spinules usually uniseriably arranged, pariae with elongate spiculae.

**Distribution.** Only three species hitherto known, from Arabian Peninsula and Central Asia (Dellacasa et al. 2016). The genus is new to Iran.

**Natural history.** Almost nothing is known about the ethology and bionomy of species belonging to the genus, other than that they live in sandy areas. As far as I know, there are no literature references in which specimens have been reported as collected in dung, as happens to the majority of the other Aphodiinae species. All the Iranian specimens referenced in this paper have come to light. This could suggest, as a hypothesis, a saprophilous habit, as for other psammophilous Scarabaeoidea attracted to light, even if the morphology of their epipharynx is clearly adapted to coprophagy (Dellacasa et al. 2001). On the back of the first label of the lectotype of *C. krulikovskyi*, the handwritten note “пески, в корнях” [sands, in roots] could confirm their root-eating habits.

The labels of two specimens of *C. krulikovskyi* (Turkmenistan, “Merv”) have the handwritten note “муравейник” [anthill]. If confirmed, this information would suggest an intriguing relationship of the species with nests of ants, even if it should be explained much more in detail.

**Discussion.** Semenov (1903) described *Cnemargulus* and compared it with the genus *Ahermes* Reitter, 1891, actually considered a junior synonym of *Cnemisus* Motschulsky, 1868. Seven years later, Schmidt (1910a, 1910b) deemed *Cnemargulus* a junior synonym of *Cnemisus*. Synonymy was confirmed by Schmidt (1922) and Winkler (1929). From then on, *Cnemargulus* was considered either a subgenus of *Cnemisus* (Balthasar 1964) or a junior synonym of the subgenus *Mendidius* Harold, 1868 (Nicolajev 1979, 1987). Medvedev and Nikritin (1971) and Pittino (1984), all authors who dealt with the topic, have considered *Cnemargulus* a good and distinct genus. Dellacasa (1994) provided a key to a poorly defined “mendidiform” genus-group taxon, distinguishing *Cnemargulus* from *Cnemisus* by the claws: corneous in the former, hair shaped in the latter. In addition to this character, which is not always significant, the species ascribable to the genus *Cnemisus* are more convex, have the head with a very distinct long frontal suture, almost reaching the eyes at sides, the pronotum not bordered anteriorly, and the femora, particularly the hindfemora, strongly widened apically. Furthermore, the *Cnemisus* are on average larger (7–10 mm), and their mesotibial apical spinules are equal, whereas *Cnemargulus* species have

the mesotibiae with one exceptionally elongate apical seta, beyond the usual ones.

*Cnemargulus* can also be easily distinguished from *Mendidius* by the quadridentate clypeus—bidentate in *Mendidius*—and the more transverse pronotum. Furthermore, males of the two genera can be distinguished by the metatibiae, which are wider apically and clearly longer than the metatarsi, and the paramera, which are obviously wider apically in *Mendidius*.

### ***Cnemargulus alkhubraicus* Pittino, 1984**

(Fig. 1–6)

*Cnemargulus alkhubraicus* Pittino 1984: 306; Dellacasa 1988: 401; Dellacasa and Dellacasa 2006: 140; Krajcik 2012: 75; Dellacasa et al. 2016: 121.

**Type locality.** “Saudi Arabia (Gasim Prov.), Al Khubra” [Saudi Arabia, Al Khubra, al-Qassim prov.].

**Type material.** Holotype ♀, in NHMB (examined).

**Type labelling.** 1<sup>st</sup>, white, printed in black: “Saudi Arabia / W. Büttiker”; 2<sup>nd</sup>, white, printed and handwritten in black: “Al Khubra / 15.X.70”; 3<sup>rd</sup>, red, handwritten and printed in black: “Cnemargulus / alkhubraicus ♀ / HOLOTYPUS n. sp. / Det. Pittino 1983”.

**Diagnostic features.** Length from 5.8 to 7.6 mm. Colour light testaceous, head, pronotum and elytral suture brown; pubescence pale yellow.

Head glossy, convex, epistome granulate, frontal suture strongly tuberculate at middle and with an elongate transverse tubercle at sides, near lateral apex; between frontal suture and anterior clypeal margin, closer to the latter, at middle, with a fourth strong tubercle; vertex coarsely punctate; genae auriculate and elongately ciliate, protruding slightly from eyes; clypeus quadridentate anteriorly, inner teeth clearly longer, narrower, sharper than outer ones, each tooth strongly curved upwards.

Pronotum glossy, transverse, strongly convex, more or less round laterally, closely punctate, punctures separated by one to two diameters on disc in females, wider in male, somewhat sparser along narrow midline area, distinctly completely margined, anterior margin wider than the basal one, lateral margin with sparse long hairs.

Scutellum triangular, distinctly punctate.

Elytra elongate-oval, convex, glossy, moderately dilatate apically in females, more straight in male; striae fine, distinctly impressed, evidently punctate, punctures obviously crenating sides, interstriae nearly flat or only slightly convex on disc, sparsely superficially punctate; sutural interstria strongly narrowed apically; humeral apex of epipleural carina visible from above.

Metasternum almost flat, smooth, shiny, finely sparsely punctate.

Foretibiae with four external teeth, the basal one wide and weak, spur strong, acuminate, downward bent. Meso- and metatibiae barely widened apically, apical setae quite long, almost unequal; mesotibiae with a single extremely long erected seta, about twice as long as other setae; upper spur of metatibiae strong, flattened, slightly curved, reaching half of the second tarsal segment.

Aedeagus (Fig. 4–5) elongate with paramera triangular apically, in dorsal view.

Epipharynx (Fig. 6) transverse, round at sides: epitorma oval; corypha with two stout and protruding apical celtes, and other few very short acropariae.

**Variability.** The most significant and interesting data are related to the length of the examined specimens, ranging from 5.8 to 7.6 mm in females. Clypeal teeth can be more or less sharp and curved upward, and more or less separated from each other.

**Distribution.** Saudi Arabia (Pittino 1984). Herein recorded for the first time from Iran.

**Material examined.** SAUDI ARABIA: al-Qassim prov., Al Khubra, 15.x.1970, W. Büttiker leg. 1 ♀ (holotype, NHMB). IRAN: Hormozgan prov., Bandar Abbas env., 5 km Minab road, 3.iii.2017, S. Azad-bakhsh leg. 1 ♂ and 5 ♀♀ (SACB; SZCM).

**Literature records.** None.

**Discussion.** Although it is not simple to do a comparative study with a species described (and known)



only from a female, I ascribe, even if doubtfully, the six specimens from Iran to *C. alkhubraicus*. The only significant difference between the female from Saudi Arabia and females from Iran is in the pronotal lateral margins, straighter, subparallel in the former, round in the latter. Only the study of other specimens collected in Saudi Arabia will clarify if this morphological difference is within an infraspecific variability or rather has a specific value. Genus and species are new to Iran.

**Remarks.** There are many localities named “Al Khobar”, and localities with related spellings, in Saudi Arabia. As specified in the original description, the type locality of *C. alkhubraicus*, a small historical village, is in al-Qassim province, therefore in the centre of Saudi Arabia.

### *Cnemargulus krulikovskyi* Semenov, 1903

(Fig. 7–13)

*Cnemargulus krulikovskyi* Semenov 1903: 354; Schmidt 1910a: 13 (as *Cnemisus*); Schmidt 1910b: 4 (as *Cnemisus*); Schmidt 1922: 344 (as *Cnemisus krulikovskyi*); Winkler 1929: 1059 (as *Cnemisus*); Balthasar 1964: 474 (as *Cnemisus (Cnemargulus) krulikovskyi*); Medvedev and Nikritin 1971: 1882 (as *Cnemargulus krulikovskyi*); Nikolajev 1979: 40 (as *Aphodius (Mendidius) krulikovskyi*); Pittino 1984: 307 (as *Cnemargulus krulikovskyi*); Nikolajev 1987: 121 (as *Aphodius (Mendidius) krulikovskyi*); Dellacasa 1988: 401; Dellacasa 1990: 22; Dellacasa et al. 2001: 119; Dellacasa and Dellacasa 2006: 140; Krajcik 2012: 75; Dellacasa et al. 2016: 121.

*Cnemargulus pusio* Semenov, 1903: 355 [type locality: “Prov. Transcaspica: Merv [Turkmenistan, Mary region]; type material: 3 syntypes, 2 ♂♂ and 1 ♀, in ZIN (examined)] (**new synonymy**); Schmidt, 1910a: 13 (as *Cnemisus*); Schmidt, 1910b: 4 (as *Cnemisus*); Schmidt 1922: 344 (as *Cnemisus*); Winkler 1929: 1059 (as *Cnemisus*); Balthasar 1964: 474 (as *Cnemisus (Cnemargulus)*); Medvedev and Nikritin 1971: 1882; Pittino 1984: 307; Nikolajev 1987: 121 (as *Aphodius (Mendidius)*); Dellacasa 1988: 401; Dellacasa and Dellacasa 2006: 140; Krajcik 2012: 75; Dellacasa et al. 2016: 121.

**Type locality.** “Prov. Transcaspica: Imam-baba haud procul a Merv” [Turkmenistan, Imam Baba, Mary province].

**Type material.** Lectotype ♂, designated by Dellacasa 1990, and 2 paralectotypes ♀♀, in ZIN (examined).

**Type labelling.** 1<sup>st</sup>, *recto*, white with violet frame, printed in violet: “Transcaspien / C. O. Ahnger.” and handwritten in black: [in Cyrillic, transliterated] “Imam baba. / 3.XI.99.”, *verso*, white, handwritten in black: [in Cyrillic, transliterated] “peski, v kornjach”; 2<sup>nd</sup>, white, handwritten and printed in black: “*Cnemargulus* / *Krulikovskyi* m. / ♂. Typ. X.03 / A. Semenow det.”; 3<sup>rd</sup>, white, printed in black: “Zoological Institute / St. Petersburg / INS\_COL\_0001326”; 4<sup>th</sup>, red, handwritten in black: “*Cnemargulus* / *krulikovskyi* Sem. / Lectotypus ♂ / G. Dellacasa des. 1990”.

**Diagnostic features.** Length from 3.2 to 5.0 mm. Colour light testaceous, head, pronotum and elytral suture pale brown; pubescence pale yellow.

Head shiny, convex, epistome distinctly granulate, frontal suture distinct, with slightly raised coarse tubercle at middle and one elongate transverse tubercle each side, and with a fourth, more or less slightly raised tubercle, at middle between frontal suture and anterior edge of clypeus, sometimes closer to the latter; vertex coarsely punctate; genae strongly auriculate, and elongately ciliate, protruding from eyes; clypeus quadridentate anteriorly, inner teeth longer than outer ones, each tooth strongly curved upward, edge between outer teeth and genae more or less straight, never clearly dentate.

Pronotum glossy, transverse, strongly convex, round laterally, punctate, punctures separated by two to three diameters on disc, completely margined, even if anterior margin sometimes barely perceptible, lateral margin with sparse long hairs.

Scutellum triangular, distinctly punctate.

Elytra elongate-oval, convex, shiny, moderately dilate apically in females, barely more straight in males; striae fine, distinctly impressed, evidently punctate, punctures slightly crenating sides, interstriae nearly flat or only barely convex on disc, sparsely superficially punctate; sutural interstria strongly narrowed apically; humeral apex of epipleural carina visible from above.

Metasternum almost flat, smooth, shiny, finely sparsely punctate.

Foretibiae externally with three strong distal teeth, and with three very small but always distinct

proximal teeth; meso- and metatibiae barely widened apically, apical setae quite long, almost unequal, mesotibiae with a single extremely long erected seta, about twice as long as other setae; upper spur of metatibiae strong, flattened, slightly curved, almost as long as the first two tarsal segments.

Aedeagus (Fig. 10–12) elongate, with paramera round and moderately widened apically and, in lateral view, distinctly acuminate toward apex.

Epipharynx (Fig. 13) transverse, round at sides; epitorma oval; corypha with two stout apical celtes as long as, or little more, acropariae.

**Variability.** Clypeal teeth can be more or less developed and more or less acuminate apically and more or less separated from each other.

**Distribution.** Turkmenistan (Semenov 1903). Kyrgyzstan (Balthasar 1964). Uzbekistan (Nikolajev 1987).

**Material examined.** TURKMENISTAN: “Imam baba” (lectotype, ZIN); “Jolatan” [Ýolöten, Mary province], 24.iv.1899 and 26.iv.1899, C. Ahnger leg. 2 ♀♀ (paralectotypes, ZIN); “Merv” [Mary, Mary province], 18.iii.1900, C. Ahnger leg. 2 ♂♂ and 1 ♀ (syntypes of *C. pusio*, ZIN); “Jolatan” [Ýolöten, Mary province], 15.iii.1927, V. Kiseritzky leg. 2 exx. (ZIN).

**Literature records.** Kyrgyzstan, Sussamyr, 1 ex. (Balthasar 1964). Uzbekistan, Central Kyzylkum, 1 ex. (Nikolajev 1987). Turkmenistan, Jolatan, 1 ex. (Dellacasa 1990).

**Discussion.** *Cnemargulus krulikovskyi* and *C. pusio*, described by Semenov (1903) in the same paper, have as their type localities Imam Baba for the former and Mary for the latter. Imam Baba, if understood as the archaeological site of the Mausoleum of Imam Baba, near Sandykachi, is 78 km south of Ýolöten (the locality of the two paralectotypes of *C. krulikovskyi*), and some 120 km southeast of Mary. Semenov (1903) supplied some characters for distinguishing the two taxa. He wrote that *C. pusio* is smaller than *C. krulikovskyi*, paler, has granules more spaced on the head, clypeal apical teeth more produced and less separated from each other, the distal ones more lateral, the space between the apical tooth and genal suture not crenulate, the frontal carina slightly trituberculate, the pronotum wider, anterior angles broader and elytral interstriae almost convex and shiny. In his dichotomous key, Schmidt (1922) reported only one character to distinguish the two taxa, namely the space between the clypeal apical tooth and the genal suture, which is crenulate in *C. krulikovskyi* and uncrenulate in *C. pusio*. Balthasar (1964) reported this character as well, and also added the distinct frontal carina in *C. krulikovskyi* (weak in *C. pusio*), the less-shiny pronotum, and the elytral interstriae almost flat and impunctate (pronotum shinier and elytral interstriae convex and clearly punctate). In my opinion, these characters fall within infraspecific variability, and can be observed, more or less evident, in all the specimens I have examined. For these reasons, and for paramera that present a remarkable uniformity (Fig. 10–11), I herein propose the synonymy *Cnemargulus krulikovskyi* = *C. pusio*.

**Nomenclatural remarks.** Articles 24.2.1 and 24.2.2 of the International Code of Zoological Nomenclature (ICZN 1999), from now on called the Code, stated that when the precedence between names or nomenclatural acts cannot be objectively determined, the precedence is fixed by the action of the first author – termed “First Reviser” – citing in a published work those names or acts and selecting from them. The “First Reviser” fixes the precedence of a name or an act if those names or acts are published on the same date in the same work. As “First Reviser”, I herein fix the precedence of *Cnemargulus krulikovskyi* Semenov, 1903 upon *Cnemargulus pusio* Semenov, 1903, which is therefore considered its junior synonym.

Semenov (1903) described the species as *Cnemargulus krulikovskii*, and in a footnote declared that it was dedicated to L. C. Krulikovsky [Leonid Konstantinovitsch Krulikowski (1864–1920), a Russian lepidopterologist (Schmitt et al. 1998)]. Therefore, *krulikovskii* is the correct original spelling, and it is not possible to apply article 32.5 of the Code (ICZN 1999). The first author who used *krulikovskyi* was Schmidt (1910a, b), but he did not demonstrate an intentional change in the original spelling of the name. Without an explicit statement of intention, the name should be considered as a subsequent incorrect spelling, and it should not enter into homonymy and cannot be used as a substitute name. Nevertheless, according to article 33.3.1 of the Code (ICZN 1999), if the incorrect subsequent spelling is in prevailing



usage and attributed to the publication of the original spelling, it is preserved and deemed to be the correct original spelling. In the glossary of the Code (ICZN 1999), it is explained that a name is to be considered of prevailing usage when its usage is adopted by at least a substantial majority of the most recent authors concerned with the relevant taxon. In our case, the name *krulikovskyi* Semenov, 1903 has been used nine times (Schmidt 1910a, b; Winkler 1929; Dellacasa 1988, 1990; Dellacasa et al. 2001, 2016; Dellacasa and Dellacasa 2006; Krajcik 2012), the name *krulikovskii* Semenov, 1903 has been used five times (Balthasar 1964; Medvedev and Nikritin 1971; Nikolajev 1979, 1987; Pittino 1984) and the name *krulikovskyii* Semenov, 1903 only once (Schmidt 1922). In addition, the more recent authors that dealt with the subject have used the spelling *krulikovskyi*. For that reasons, under article 33.3.1 of the Code (ICZN 1999), the spelling *krulikovskyi* is deemed to be the correct original spelling and is preserved.

### Key to the genus *Cnemargulus*

1. Adults relatively small, length up to 5.0 mm; foretibiae externally with three strong distal teeth and with three very small but always distinct proximal teeth (Fig. 14); female pronotal punctation wider, punctures separated by two-thirds of the diameter of a puncture on disc; paramera with a small tooth near the apex, visible in lateral view (Fig. 12); Turkmenistan, Uzbekistan, Kyrgyzstan . . . . . ***C. krulikovskyi* Semenov**
- Adults relatively large, length over 5.8 mm; foretibiae externally with four teeth, the basal one wide and weak (Fig. 15); female pronotal punctation closer, punctures separated by one half a diameter on disc; paramera very elongate, slightly sinuate internally, in lateral view (Fig. 5); Saudi Arabia, south Iran . . . . . ***C. alkhubraicus* Pittino**

### Acknowledgments

Many thanks to Maurizio Bollino (Lecce), Giuseppe Carpaneto (Biologia Ambientale, Roma Tre, Roma), Giulio Cuccodoro and Guido Sabatinelli (Muséum d'Histoire Naturelle, Genève), Andrey Frolov (Russian Academy of Sciences, Saint Petersburg), Tigran Ghrejyan (Institute of Zoology, Yerevan), Georgej Nikolajev (Almaty), Eckehard Rössner (Schwerin), Mahmoud Saleh Abdel-Dayem (King Saud University, Riyadh), Eva Sprecher-Uebersax and Isabelle Zürcher (Naturhistorisches Museum, Basel). Special thanks to Saeed Azadbakhsh (Bandar Abbas), who collected the Iranian specimens, Marco Dellacasa (Museo di Storia Naturale, Università di Pisa, Calci, Italy) and Andrey Frolov (Russian Academy of Sciences, Saint Petersburg) for revising the manuscript, Augusto Degiovanni (Bubano) for the photo shoot, Gabriele Fiumi (Forlì) for images settlements and Ivo Gudenzi (Forlì) for the drawings.

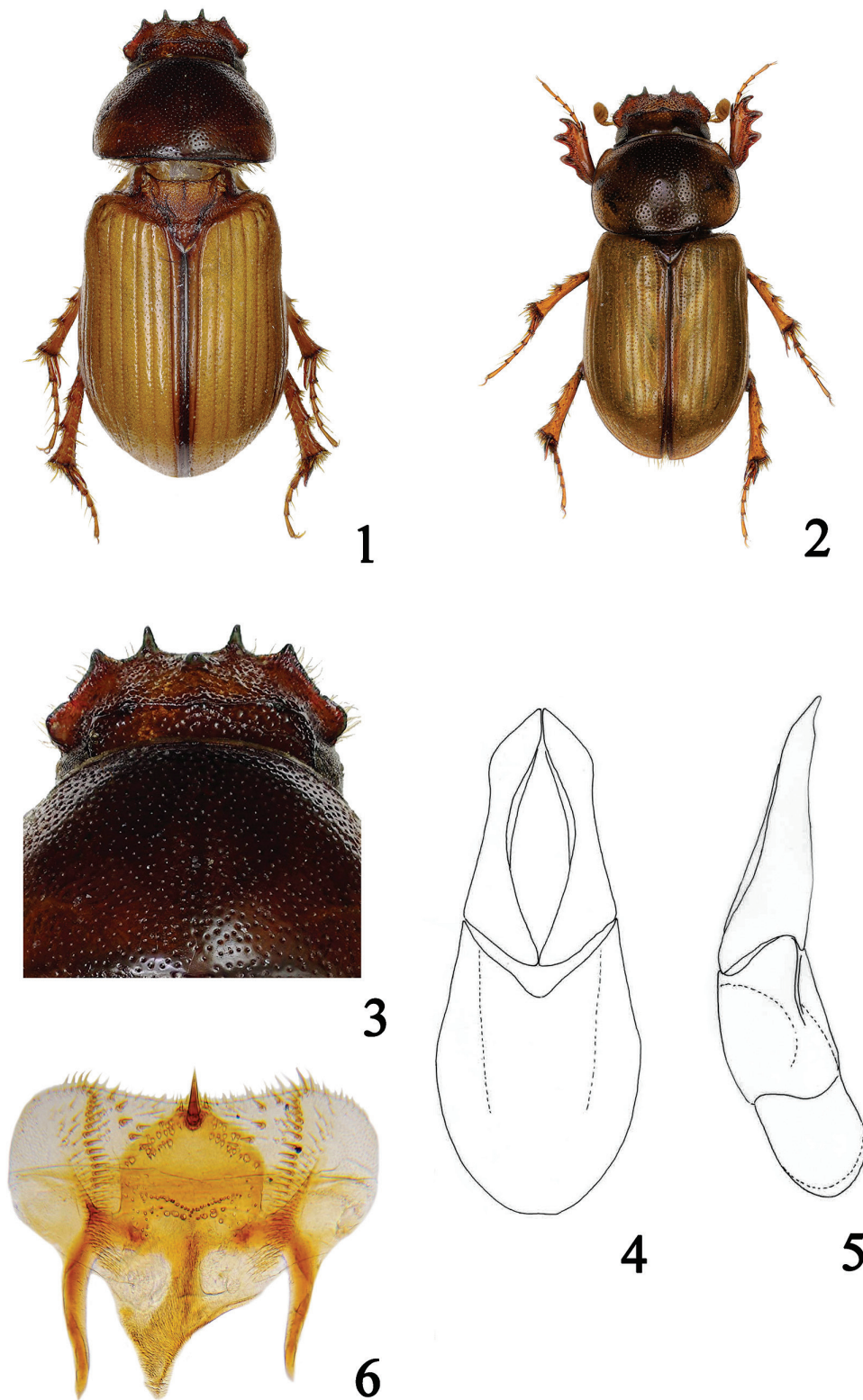
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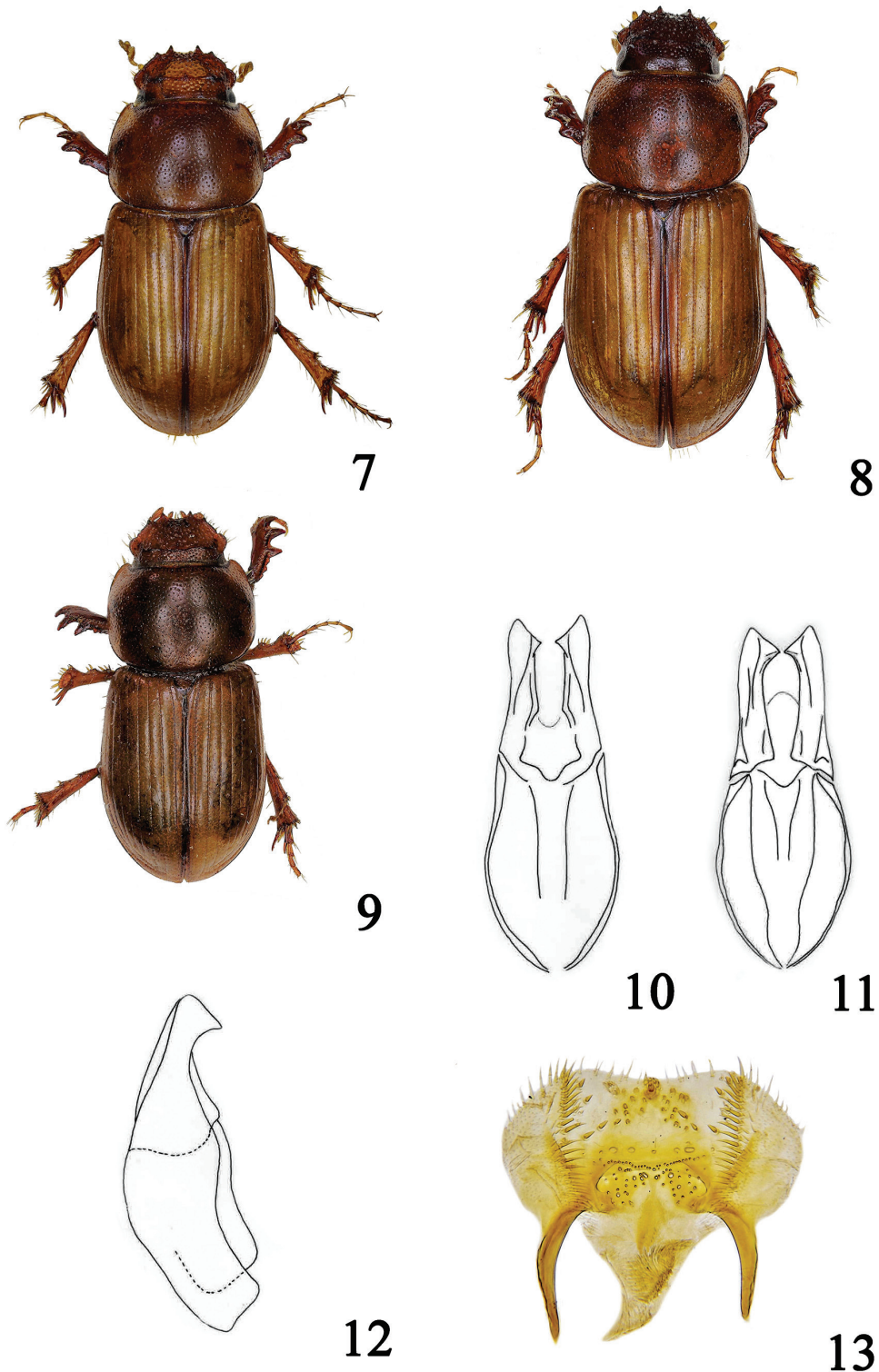
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Received November 16, 2018; accepted January 22, 2019.

Review editor Gareth S. Powell.

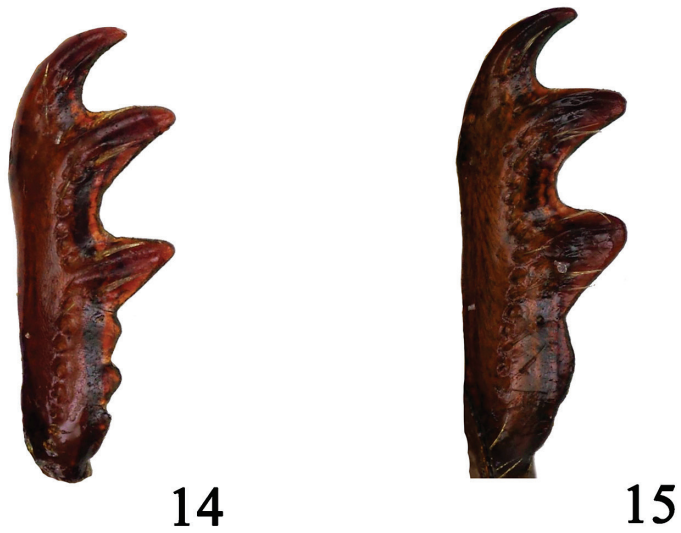


**Figures 1–6.** *Cnemargulus alkhubraicus* Pittino, 1984. **1)** Habitus of female [holotype]. **2)** Habitus of male [Iran, Hormozgan prov., Bandar Abbas]. **3)** Head of holotype. **4)** Aedeagus, dorsal view [Iran, Hormozgan prov., Bandar Abbas]. **5)** Aedeagus, lateral view [Iran, Hormozgan prov., Bandar Abbas]. **6)** Epipharynx [holotype]. Photos by Augusto Degiovanni, drawings by Ivo Gudenzi.



**Figures 7–13.** *Cnemargulus krulikovskyi* Semenov, 1903. **7)** Habitus of male [lectotype]. **8)** Habitus of female [paralectotype, Turkmenistan, Mary prov., Ýolöten]. **9)** Habitus of male [syntype of *C. pusio* Semenov, 1903: Turkmenistan, Mary prov., Ýolöten]. **10)** Aedeagus, dorsal view [lectotype]. **11)** Aedeagus, dorsal view [syntype of *C. pusio* Semenov, 1903: Turkmenistan, Mary prov., Ýolöten]. **12)** Aedeagus, lateral view [syntype of *C. pusio* Semenov, 1903: Turkmenistan, Mary prov., Ýolöten]. **13)** Epipharynx [lectotype]. Photos by Augusto Degiovanni, drawings by Ivo Gudenzi.





Figures 14–15. Foretibiae. 14) *C. krulikovskyi* [syntype of *C. pusio* Semenov, 1903: Turkmenistan, Mary prov., Ýölöten]. 15) *C. alkhubraicus* [Iran, Hormozgan prov., Bandar Abbas]. Photos by Augusto Degiovanni.



Figure 16. Distribution of the genus *Cnemargulus*.