A new Guatemalan cloud forest endemic *Onthophagus* Latreille, 1802 (Coleoptera: Scarabaeidae: Scarabaeinae)

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Abstract—A **new species**, *Onthophagus contrapositus* (Coleoptera: Scarabaeidae: Scarabaeinae: Onthophagini), belonging to the New World *O. dicranius* species group is described and illustrated. Photographs of cephalic and pronotal configurations of all known females are presented for the first time to ease identification. A replacement name is proposed, *Onthophagus kohlmanni* **new name**, for the secondary junior homonym *Onthophagus xiphias* Solís and Kohlmann, 2003.

Résumé—On décrit la **nouvelle espèce** *Onthophagus contrapositus* (Coleoptera: Scarabaeidae: Scarabaeinae: Onthophagini) appartenant au groupe *O. dicranius*. Des photographies de la configuration de la tête et du pronotum de toutes les femelles de ce complexe en vue dorsale sont présentées afin de faciliter la détermination de la nouvelle espèce. Un nom de remplacement, *Onthophagus kohlmanni* **nouveau nom de remplacement**, est proposé pour l'homonyme secondaire plus récent *Onthophagus xiphias* Solís and Kohlmann, 2003.

In 2009, my colleague Robert S. Anderson collected a male and a female *Onthophagus* Latreille, 1802 (Coleoptera: Scarabaeidae: Scarabaeinae: Onthophagini) from the cloud forest of Cerro El Pinalón (El Progresso Department, Guatemala). The male specimen was similar to *O. neomirabilis* Howden, 1973, which occurs in southern Mexico and Guatemala, but the configuration of the females pronotum was unlike any of the females currently known belonging to the *O. mirabilis* species complex. At the time, those specimens were put aside in the hope that more material would become available to confirm that the female pronotal configuration was not the result of a deformity. Then in 2015, a specimen lot of Guatemalan scarabaeine was conveyed to the author for identification. Among this material were 16 males and six females matching the two previously known specimens collected at Cerro El Pinalón. Interestingly, the specimens collected in 2015 were from Volcán Atitlán, which belongs to a different Guatemalan mountain range. Species from the *O. mirabilis* species complex are restricted to higher elevations and specifically cloud forest, which form a more-or-less disjunct biome (Zunino and Halffter 1981).

The *O. mirabilis* species complex was revised less than 20 years ago (Génier and Howden 1999), at that time only the female of *O. mirabilis* Bates, 1887 was unknown but it was discovered and described five years later (Génier and Medina 2004). More recently, a new species belonging to the complex was described from Panama (Kohlmann and Solís 2012). The description of *O. turgidus* Kohlmann and Solís, 2012 was based on a single male specimen, and is most similar to *O. solisi* Howden and Gill, 1993. To date, females of this species are still unknown. Because the taxonomy of the entire *O. mirabilis* species complex is resolved, the description of a single species presented here in this context seems warranted.

Received 12 April 2017. Accepted 1 June 2017. First published online 17 August 2017.

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Subject editor: Andrew Smith
doi:10.4039/tce.2017.32
http://zoobank.org/urn:lsid:zoobank.org:pub:AE42B22C-459A-4557-9190-F09098440A03

The cephalic and pronotal configurations of well-developed, known females belonging to this complex are also illustrated by photographs for the first time.

In Génier and Howden (1999), the *O. mirabilis* species complex was considered a species group. Here, a species complex is a group of closely related species that are very similar in appearance to the point that the boundaries between them are often unclear, as seen in the external morphology of the males. A species group has a broader scope and encompass species that possess one or more synapomorphies and may have very distinctive external morphologies. This grouping (Génier and Howden 1999) was essentially based on Howden and Gill (1993) in which two groups were defined, the *O. mirabilis* species group (*O. mirabilis* Bates, 1887, *O. neomirabilis* Howden, 1973, *O. quetzalis* Howden and Gill, 1993, and *O. solisi* Howden and Gill, 1993) and the *O. dicranius* species group (*O. asperodorsatus* Howden and Gill, 1993, *O. dicranius* Bates, 1887, *O. dorsipilulus* Howden and Gill, 1987, and *O. petenensis* Howden and Gill, 1993). Howden and Gill (1993) considered *O. quetzalis* to be in some measure intermediate between their *O. mirabilis* and *O. dicranius* species groups. Zunino and Halffter (1981, 1997) always considered all species belonging to the two groups defined by Howden and Gill (1993) to be part of a larger group encompassing more than 20 species known as the *O. clypeatus* species group. The main character defining the *O. clypeatus* species group as defined by Zunino and Halffter (1981, 1997) is the absence of a secondary lamella associated with the lamella copulatrix, which correspond to the additional medial sclerite of lamella copulatrix in Tarasov and Solodovnikov (2011). The *O. mirabilis* species complex as treated here is considered to be part of the more restricted group defined by Kohlmann and Solís (2001) as the *O. dicranius* species group. The *O. dicranius* species group of Kohlmann and Solís (2001) comprises all species included in the *O. dicranius* and *O. mirabilis* species groups of Howden and Gill (1993). The species group possesses the following combination of characters: males lack carina on vertex, as well as a trace of tubercle or horn adjacent to the eyes; females have a strongly upturned, bidentate anterior clypeal edge and transverse carinae or conical tubercles are located at midpoint or anterior (but not posteriorly) to the eyes (with the exception of *O. barretti* Génier and Howden, 1999, where the cephalic horns are located posterior to the anterior edge of the eyes); both sexes have moderate to large punctures separated by < 1.0–1.5 puncture diameters with the elytral striae and interstriae coarsely punctate; all the species have a rugose punctate pygidium, especially towards apex; colour varies from brown to black, and no species have metallic iridescence, which is present in most species of the *O. clypeatus* species group. The paramere shape is similar for all species in the *O. mirabilis* species complex and has been illustrated by Howden and Gill (1993) for *O. neomirabilis* (Fig. 28), *O. orphnoides* (as *O. mirabilis*) (Fig. 21), and *O. solisi* (Fig. 24).

The specimen preparation, imaging procedures, and format used is the same as Génier and Moretto (2017). The terminology used for the lamella copulatrix follows Tarasov and Solodovnikov (2011). The following collection acronyms are used: CMNC, Canadian Museum of Nature, Ottawa, Ontario, Canada; SEMC, Kansas University Entomology Collection, Lawrence, Kansas, United States of America (Zachary H. Falin); UVGC, Colleción de Artrópodos, Universidad del Valle de Guatemala, Guatemala City, Guatemala (Jack Schuster).

Onthophagus contrapositus Génier, new species

(http://zoobank.org/urn:lsid:zoobank.org:act:C691DA96-4AA1-4DB8-8552-F4DF0559DAAB)

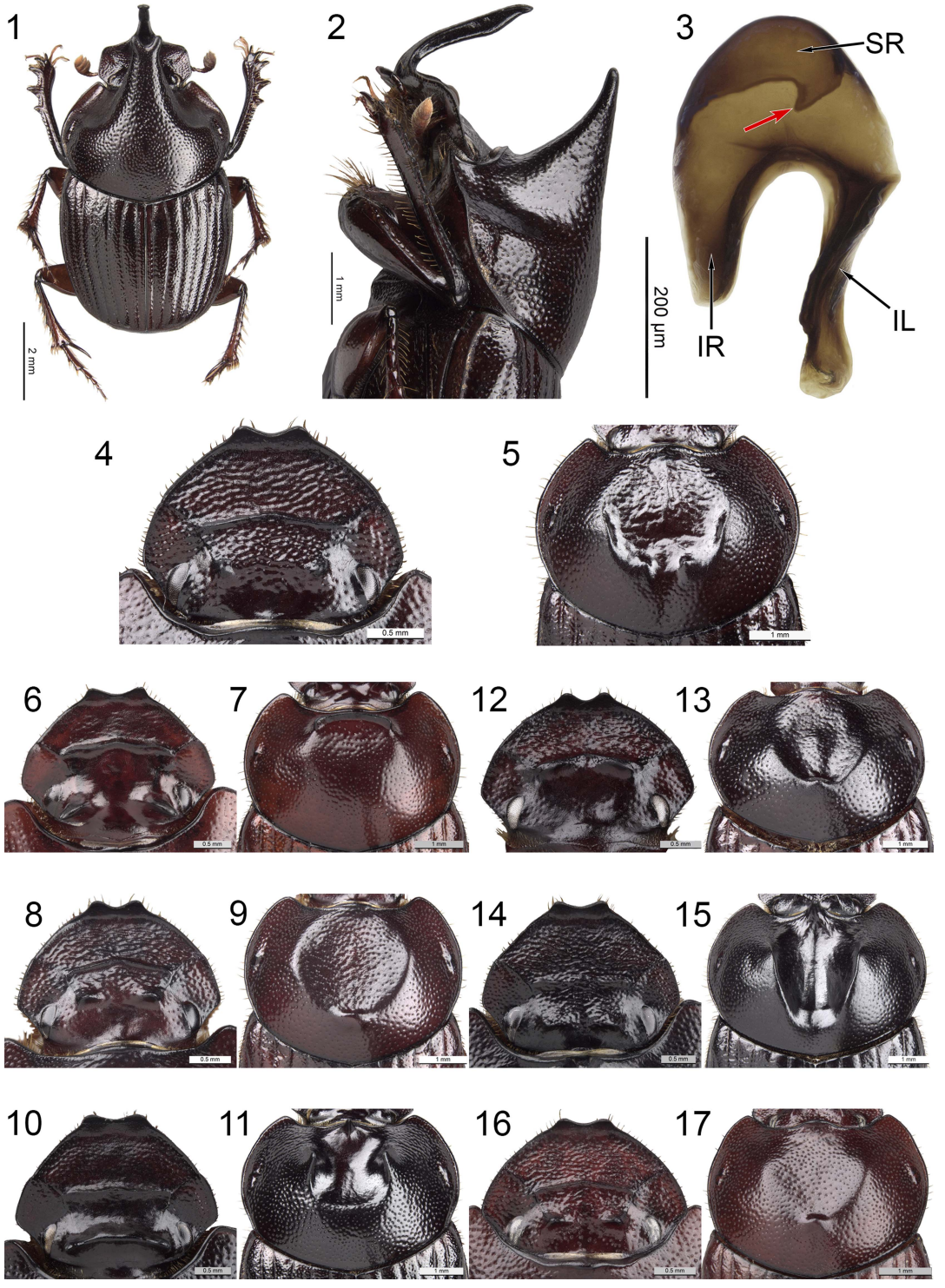
Figures 1–5, 18.

Type locality. Finca Las Nubes (15.08385, –89.94258, 2574 m), Cerro El Pinalón, El Progresso, Guatemala.

Diagnosis. Known from Guatemala and can only be confused with *O. breviconus* Génier and Howden, 1999 from which moderate to largest males can be separated by the deeply concave pronotal surface behind anterior lateral angles (Fig. 1); females of *O. contrapositus* lack the median tubercle bordering the pronotal flat area posteriorly (Fig. 5), surface simply longitudinally concave on midline.

Description. Holotype ♂ (Figs. 1–3). **Measurements**. length 10.0 mm, greatest width 5.5 mm. Dorsum dark brown. **Head**. (Figs. 1–2) Surface dorsally irregularly punctate on posterior two-thirds, with a small transverse impunctate surface between the eyes, surface between punctures shiny

https://doi.org/10.4039/tce.2017.32 Published online by Cambridge University Press



https://doi.org/10.4039/tce.2017.32 Published online by Cambridge University Press

Figs. 1–17. *Onthophagus contrapositus* and other species in the *O. dicranius* species group. **1.** *Onthophagus contrapositus* male holotype, habitus dorsal view. **2.** *Onthophagus contrapositus* male holotype, head and pronotum lateral view. **3.** *Onthophagus contrapositus* male holotype, lamella copulatrix, frontal view. **4.** *Onthophagus contrapositus* female allotype, head, dorsal view. **5.** *Onthophagus contrapositus* female allotype, pronotum, dorsal view. **6.** *Onthophagus barretti*, female, head dorsal view. **7.** *Onthophagus barretti*, female, pronotum dorsal view. **8.** *Onthophagus breviconus*, female, head dorsal view. **9.** *Onthophagus breviconus*, female, pronotum dorsal view. **10.** *Onthophagus mirabilis*, female, head dorsal view. **11.** *Onthophagus mirabilis*, female, pronotum dorsal view. **12.** *Onthophagus neomirabilis*, female, head dorsal view. **13.** *Onthophagus neomirabilis*, female, pronotum dorsal view. **14.** *Onthophagus orphnoides*, female, head dorsal view. **15.** *Onthophagus orphnoides*, female, pronotum dorsal view. **16.** *Onthophagus solisi*, female, head dorsal view. **17.** *Onthophagus solisi*, female, pronotum dorsal view.

throughout, except for a small surface adjacent to the eyes. Clypeus with an upright horn on anterior edge medially, basal portion of horn tapering on basal fourth in frontal view, parallel sided medially and slightly diverging apically, apical edge slightly notched, median portion trapezoidal in transverse section, apical third slightly wider posteriorly and gradually narrowed anteroposteriorly towards apex in lateral view; each side of clypeus with narrow but distinct marginal bead, nearly straight in dorsal view from base of horn to clypeogenal suture; clypeal surface deeply concave posteriorly to base of horn; gena with lateral edge slightly rounded posterior to clypeogenal suture, almost straight medially, lateral edge at clypeogenal junction lacking emargination. Vertex with barely indicated tubercles on each side near anterior edge of each eye. **Pronotum** (Fig. 2). Surface with small irregularly distributed umbilicate punctures on anterior declivous portion, remainder of the surface with moderate coarse umbilicate punctures separated by 1–3 diameters; anterior edge of pronotum slightly upturned medially; with large median conical horn extending over the head, apex of horn flattened dorsoventrally, forming two laterally oriented tubercles, ventral surface of horn lacking longitudinal carina, slightly longitudinally concave; pronotal surface near anterior lateral angles deeply concave; posterior marginal bead only present medially. **Elytra** (Fig. 1). Elytral surface glossy between punctures, puncture of intervals weakly defined and slightly irregular in shape, not umbilicate, lacking setae and separated by 1–3 diameters; Elytral striae deeply impressed, strial punctures separated by 1–2 diameters, encroaching on intervals. **Pygidium**. Surface with confluent coarse umbilicate punctures throughout, surface

Fig. 18. Known distribution of *Onthophagus contrapositus* new species.

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between punctures shiny to feebly alutaceous. **Ventrites**. Median lobe of metasternum with few coarse punctures laterally, impunctate medially, feebly sulcate along midline on most of length. **Legs**. Protibia elongate, apex with internal angle produced into moderately acute tooth, anterior edge with broad tuft of long setae; external apical and penultimate teeth distinctly closer to each other than second to third or third to fourth teeth. All femora with ventral surface finely punctate, punctures evenly distributed, surface between punctures feebly alutaceous on mesofemora and metafemora. **Genitalia**. Lamella copulatrix of internal sac with a projection on the superior right lobe (SR) (Fig. 3, red arrow), inferior right lobe (IR) gradually tapering apically, inferior left lobe (IL) long, gap between inferior right and left lobe wide and parallel sided on most of length Fig. 3).

Allotype ♀. Measurements. length 9.5 mm, greatest width 5.0 mm. **Head** (Fig. 4). Clypeus with anterior margin sharply bidentate, teeth reflexed, median emargination shallow, broadly V-shaped, lateral margins of teeth slightly oblique; lateral clypeal margin slightly arcuate, sharp, lacking marginal bead; clypeus flat, with surface irregularly transversely wrinkled; clypeofrontal suture with wide, moderately sharp and sinuous carina reaching clypeogenal suture laterally; gena with surface flat and shiny, irregularly punctate on most of surface, with lateral edge slightly arcuate anterior to lateral angle, widest portion forming blunt angle. Vertex with surface glossy on posterior third, lacking minute punctures, concave, with two rounded tubercles, tubercle in line with anterior edge of eye and closer to the eye than to each other. **Pronotum** (Fig. 5). Anterior margin upturned medially, disc with a pentagonal and more-or-less flat depression on anterior two-thirds; each side of depression bordered by a subangular protuberance posteriorly, leaving a gap posteromedially; surface of declivity coarsely and irregularly wrinkled; pronotal surface around depression evenly convex, with coarse umbilicate punctures. **Elytra**. Similar to those of male. **Legs**. Protibia robust, lacking median tooth and tuft of setae apically. Femora similar to male. **Ventrites**. Metasternum with median lobe similar to male.

Variation. Size varies from 7.0 to 10.5 mm. All males possess a distinct more-or-less developed conical projection on the pronotum. However the smallest male studied (7.0 mm) has the pronotal surface flat, resembling the female configuration. Such extreme feminisation of the male secondary sexual characters has only been seen in this specimen. The smallest males of all the other species in the complex present at most a simply convex pronotum at equal size or smaller. Except for the development of secondary sexual characters and size other characters show little variation.

Primary type data. Holotype ♂ (CMNC): [**GUATEMALA: El Progreso/**Cerro Pinalón, Finca Las Nubes/2574 m, 15.08385°N 89.94258° W/1-5.V.2009, R. Anderson/cloud forest – various, **2009–016**]; [WORLD/SCARAB./DATABASE/ WSD00033965] barcode label; [HOLOTYPE ♂/*Onthophagus/contrapositus n.sp.*/dés. F. Génier, 2017] red card.

Material examined. Distribution (Fig. 18). **GUATEMALA**: EL PROGRESO, Finca Las Nubes, Cerro Pinalón, 2574 m (15°5'1.86"N, 89°56'33.29"W), 1–5.v.2009, R.S. Anderson (2009–16) – 1 ♀, 1 ♂ (holotype, allotype, CMNC); SUCHITEPÉQUEZ, Refugio del Quetzal, Volcán Atitlán, 1670 m (14°33'2.41"N, 91°11'32.46"W), 3–6.vi.2015, Z.H. Falin and F. Carrillo (GUAT1F15 039) – 3 ♂♂ paratypes (SEMC); Refugio del Quetzal, Volcán Atitlán, 1670 m (14°33'2.41"N, 91°11'32.46"W), 6–10.vi.2015, Z.H. Falin and F. Carrillo (GUAT1F15 095) – 2 ♀♀, 5 ♂♂ paratypes (1 ♀, 1 ♂ CMNC; 1 ♀, 3 ♂♂ SEMC; 1 ♂ UVGC); Refugio del Quetzal, Volcán Atitlán, 1670 m (14°33'2.41"N, 91°11'32.46"W), 10–13.vi.2015, Z.H. Falin and F. Carrillo (GUAT1F15 116.5) – 1 ♀, 1 ♂ paratypes (SEMC); Refugio del Quetzal, Volcán Atitlán, 1670 m (14°33'2.41"N, 91°11'32.46"W), 13–16.vi.2015, Z.H. Falin and F. Carrillo (GUAT1F15 148) – 3 ♂♂ paratypes (2 ♂♂ SEMC; 1 ♂ UVGC); Refugio del Quetzal, Volcán Atitlán, 1670 m (14°33'2.41"N, 91°11'32.46"W), 16–18. vi.2015, Z.H. Falin and F. Carrillo (GUAT1F15 161) – 3 ♀♀, 4 ♂♂ paratypes (1 ♀, 1 ♂ CMNC; 3 ♂♂ SEMC; 2 ♀♀ UVGC).

Etymology. *Contrapositus* (to place in opposition) a Latin adjective pertaining to the configuration of the female pronotum.

Natural history. All specimens were collected in cloud forest between 1670 and 2574 m. All specimens from Volcán Atitlán were taken in flight interception traps. Specimens from Cerro Pinalón were hand collected in cloud forest.

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Identification. Large males (8.5 mm and larger) of *O. contrapositus* will key to *O. mirabilis* in Génier and Howden (1999). They can be separated from *O. mirabilis* externally by the overall more coarsely punctate head dorsal surface and by the deeply concave pronotal surface behind anterior lateral angles (Fig. 1); internally the right superior lobe of the lamella copulatrix bears a denticle (red arrow, Fig. 3).

Females of the *O. mirabilis* species complex can be identified using the following modified key from Génier and Howden (1999), which also includes the female of *O. mirabilis* but lacks the unknown female of *O. turgidus*:

1. Pronotal disc convex with sharp transverse carina anteriorly, carina as wide as distance between eyes (Fig. 7); vertex of moderate to large individuals with two acute horns (Fig. 6), each horn directed laterally and located in line with median portion of the eyes; Panama (Darién) . . . . . *O. barretti* Génier and Howden, 1999
– Pronotal disc flat or concave; vertex of moderate to large individuals with at most two low, conical tubercles, each tubercle located before or in line with anterior portion of the eyes 2

2. Pronotum longitudinally concave anteriorly on midline, concavity deep in moderate and large individuals, anterior marginal bead reflexed and produced into a spine medially 3
– Pronotal disc with a more-or-less rounded, flat surface anteriorly, in larger individuals the area is slightly concave and with a median tubercle on posterior edge of flat area, anterior marginal bead at most lobate medially, lacking spine 4

3. Head with two acute horns connected by a carina (Fig. 10); lateral edges of pronotal concavity angular in lateral view (Fig. 11); Colombia, Ecuador. . . . . *O. mirabilis* Bates, 1887
– Head with two isolated, obtuse denticles (Fig. 14); lateral edges of pronotal concavity broadly arcuate in lateral view (Fig. 15); Costa Rica, Panama . . . . . *O. orphnoides* Bates, 1887

4. Pronotal flat surface pentagonal, lacking median tubercle posteriorly, each side of depression bordered by a subangular protuberance posteriorly (Fig. 5); Guatemala . . . . . *O. contrapositus* Génier, **new species**
– Pronotal flat surface, oval, with a median tubercle posteriorly, each side of depression bluntly rounded (Figs. 9, 13, 17) 5

5. Vertex of moderate to large individuals with tubercles low, transverse and always set closer to the frontoclypeal carina than anterior edge of the eyes (Fig. 12); pronotum as in Figure 13; Mexico (Oaxaca) . . . . . *O. neomirabilis* Howden, 1973
– Vertex of moderate to large individuals with tubercles conical and set more or less in line with anterior edge of the eyes 6

6. Anterior pronotal marginal bead lobate and upturned medially (Fig. 17); flat area of pronotum with anterolateral edges weakly defined, posteromedian tubercle conical, approximately as wide as elytral interval 2 at base in largest individuals; vertex punctate (Fig. 16); Costa Rica (Guanacaste). . . . . *O. solisi* Howden and Gill, 1993
– Anterior pronotal marginal bead unmodified or feebly produced forward medially (Fig. 9); flat area of pronotum with anterolateral edges well defined, posteromedian conical process wide, approximately as wide as elytral interval 2 and 3 at base in largest individuals; vertex impunctate (Fig. 8); Guatemala, Honduras . . . . . *O. breviconus* Génier and Howden, 1999

Nomenclatural notes

While compiling Scarabaeinae bibliographic data from Solís and Kohlmann (2003), the name *Onthophagus xiphias* Solís and Kohlmann, 2003 was found to be a secondary junior homonym. *Scarabaeus xiphias* Fabricius, 1792 was described from "Halae Saxonum" (Halle, Germany) in the first volume of "Entomologia systematica emendata et aucta" (Fabricius 1792). Sturm (1826) transferred this name to the genus *Onthophagus* and placed it in synonymy with *O. nuchicornis* (Linnaeus, 1758) and has been treated as a synonym of this species since. Consequently, the name *Onthophagus*

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xiphias Solís and Kohlmann, 2003 has been a secondary junior homonym since the name was validated. In order to remedy this problem, *Onthophagus kohlmanni* Génier, **new name** (http://zoobank.org/urn:lsid:zoobank.org:act:2C48F18F-C8F6-4A9B-870C-5CA53EDC947C) is here proposed as a replacement name for *Onthophagus xiphias* Solís and Kohlmann, 2003.

Acknowledgements

My colleague and dung beetle specialist, Bert Kohlmann, is thanked for reviewing and commenting on the manuscript, which improved the final version. Michelle Rossini and two anonymous reviewers are also thanked for their valuable remarks and Zachary H. Falin for depositing voucher specimens in the CMNC collection.

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