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**REDESCRIPTION OF *ONTHOPHAGUS HALFFTERI* ZUNINO (COLEOPTERA:
SCARABAEIDAE: SCARABAEINAE), WITH ECOLOGICAL
AND DISTRIBUTIONAL NOTES**

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ABSTRACT

Onthophagus halffteri Zunino was originally described based on a single specimen (a hypertelic male), the only one known at that time. The capture of several series with an abundance of individuals allows us to now describe hypertelic (major), eutelic (medium), and hypotelic (minor) males and females. Additionally, the assignment of *O. halffteri* to the *hippopotamus* line within the *chevrolati* group of American species of *Onthophagus* Latreille is confirmed, with *Onthophagus hippopotamus* Harold the species that is most closely related to *O. halffteri*. The association of *O. halffteri* with nests of Geomyidae (Rodentia) is established, and the conditions that separate the distribution of *O. halffteri* from that of *O. hippopotamus* are given. *Onthophagus halffteri* and *O. hippopotamus* are two species that, while practically adjacent, never overlap in a given nest. Biogeographically, *O. halffteri* represents the largest eastward expansion of the *hippopotamus* line, which is distributed along the mountains of Mexico, particularly the Trans-Mexican Volcanic Belt.

RESUMEN

Onthophagus halffteri Zunino se describió en base a un solo ejemplar (un macho hipertélico), único individuo conocido hasta la fecha. La captura de varias series con abundantes individuos nos permite describir tanto a los machos, como a las hembras hipertélicos (mayores), eutélicos (medianos) e hipotélicos (menores). Por otra parte, se confirma la adscripción de *O. halffteri* a la línea *hippopotamus* dentro del grupo *chevrolati* de especies americanas de *Onthophagus* Latreille, siendo la especie más cercana de *O. halffteri*, *O. hippopotamus* Harold. Se establece la asociación de *O. halffteri* con nidos de Geomyidae (Rodentia) y se señalan las condiciones que separan las distribuciones de *O. halffteri* y *O. hippopotamus* que, aunque prácticamente colindantes, no se sobreponen en un mismo nido. Biogeográficamente, *O. halffteri* representa la mayor expansión hacia el oriente de la línea *hippopotamus*, misma que se distribuye siguiendo las montañas de México, especialmente el Sistema Volcánico Transversal.

Key Words: dung beetle, morphology, ecology, Geomyidae nests, Mexico

Onthophagus halffteri was described by Zunino (1981) based on a single specimen, a male found in the Bates collection (ex Musaeo van Lansberge) deposited in the Muséum National d’Histoire Naturelle, Paris. That specimen, designated as the holotype, had been previously identified anonymously as *Onthophagus hippopotamus* Harold and has a label indicating its origin as “Mexico”, with no further details.

Due to its patent affinity with *Onthophagus coproides* Horn, *Onthophagus cuboidalis* Bates, *Onthophagus basariscus* Zunino and Halffter (recte: *bassariscus* Zunino and Halffter, 1988a), and *O. hippopotamus* and in spite of the lack of any capture information, this specimen was thought to associate with burrowing rodents of the family Geomyidae (*tuzas* in Mexican Spanish). This hypothesis was sustained by Zunino and Halffter

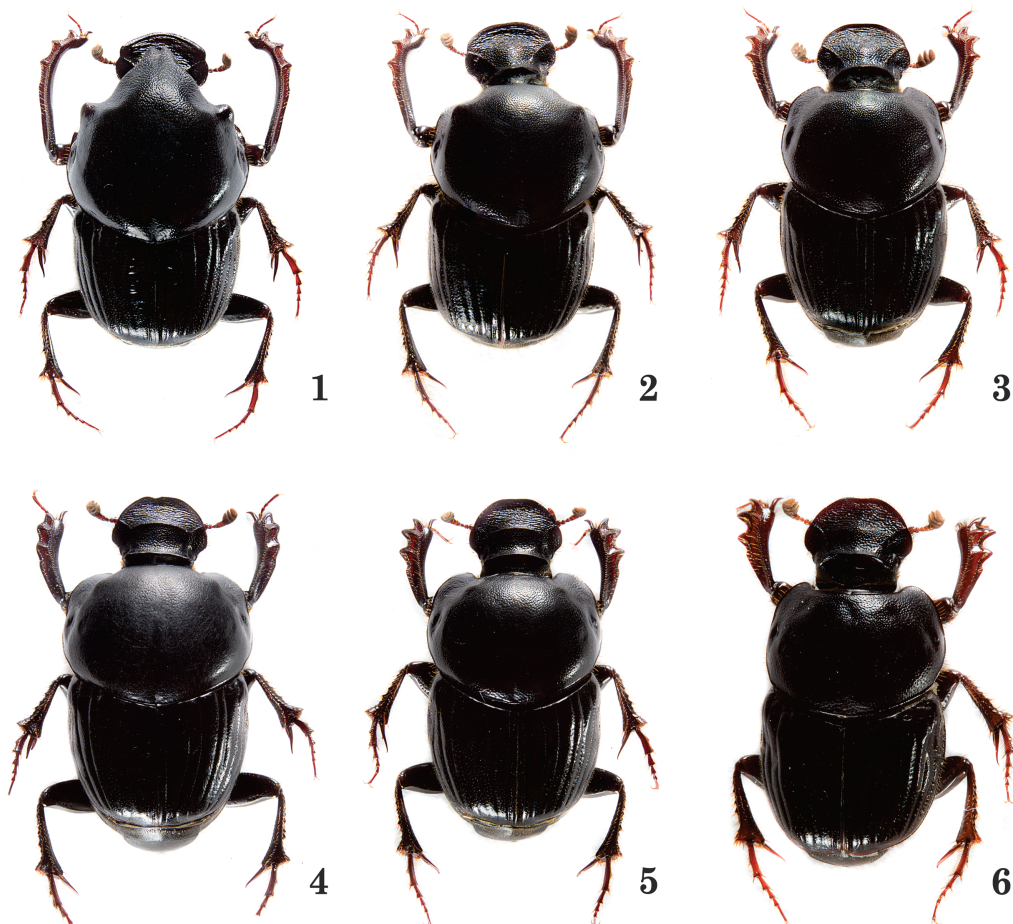
(1988a, 2007) who carried out a detailed review of *Onthophagus* Latreille associated with caves and burrows.

During field research conducted by the first author, 133 individuals of both sexes of *O. halfferi* were found in the towns of Mazatepec and Joya Chica, Municipality of Acajete, Veracruz, Mexico. All of the material was collected from burrows of the hispid pocket gopher, *Orthogeomys hispidus* LeConte. In this paper, we redescribe the adult forms and provide ecological and distributional notes about the species.

***Onthophagus halfferi* Zunino, 1981**
(Figs. 1–8)

Redescription. For the hypertelic (major) male (holotype), we base our redescription on the origi-

nal description by Zunino (1981). Length 14 mm; maximum width close to middle of prothorax. Color black, head and pronotum silky and matte, elytra silky and shiny. Dorsal surface glabrous. Clypeus transverse, concave, trapezoidal, apex subsinuate. Gena subparallel; lateral margin of the head angular but not cut at the clypeus-genal limit. Genal sutures evident. Clypeal carina absent, frontal carina relatively strong, not elevated in the middle, straight. Clypeal sculpture thick, transverse, rough, gradually becoming smooth, though remaining thick and slightly transverse toward the front. Lateral margin of prothorax concave between anterior and intermediate angles; basal margin finely margined. Pronotal prominence lengthened and partially covering head in dorsal view, emarginate at apex, lateral tubercles situated in front of intermediate pronotal angles. Sculpture of pronotal disc



Figs. 1–6. *Onthophagus halfferi*. Males: 1) Hypertelic; 2) Eutelic; 3) Hypotelic. Females: 4) Hypertelic; 5) Eutelic; 6) Hypotelic.

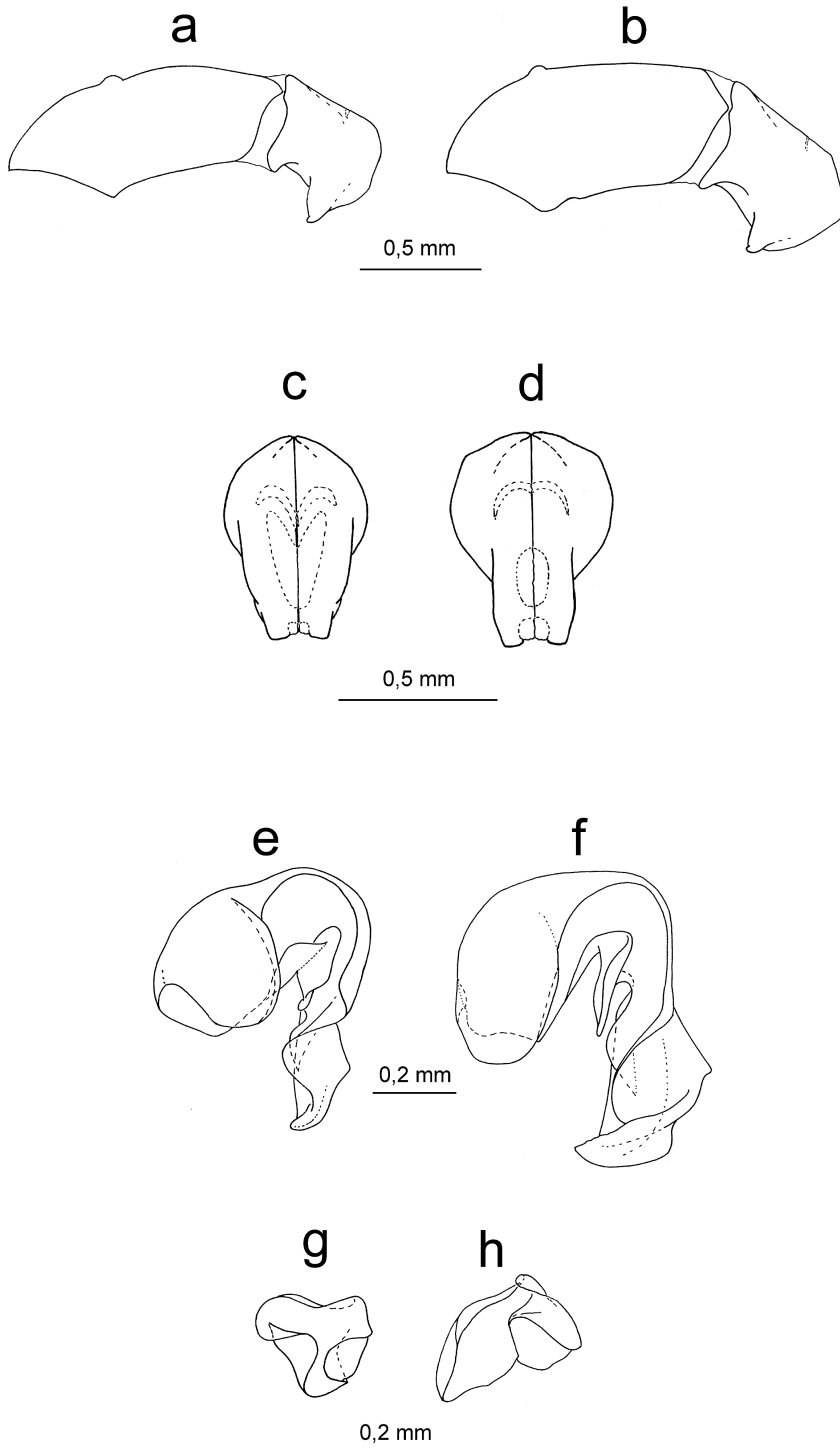


Fig. 7. *Onthophagus* species. Male genitalia aedeagus, lateral view: a) *O. halffteri*, b) *O. hippopotamus*. Aedeagus, frontal view: c) *O. halffteri*, d) *O. hippopotamus*. Copulatory lamellae: e) *O. halffteri*, f) *O. hippopotamus*. Accessory lamellae: g) *O. halffteri*, h) *O. hippopotamus*.

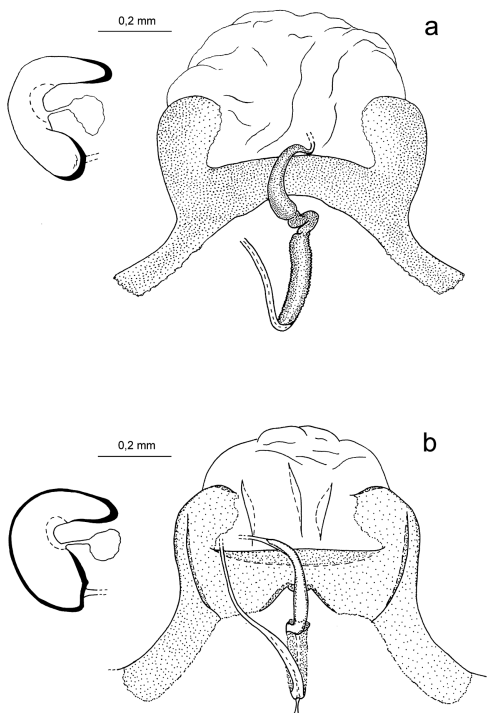


Fig. 8. Female genital structures of a) *Onthophagus halffteri* and b) *Onthophagus hippopotamus*.

formed by small, undefined, shallow, moderately dense punctures irregular in size, gradually scarcer posteriorly. Posterior margin of pronotum with a median, longitudinal, poorly defined groove. Elytral striae with large, dense, well-defined punctures; microsculpture irregularly gridlike, shallow. Anterior tibiae curved and with internal margin expanded to apex; external margin devoid of microteeth. Terminal spur reduced, medially and ventrally curved. Male genitalia as in Fig. 7.

Variation. In the new hypertelic material that we examined, the dorsal surface of the body is always shiny black (Fig. 1). The silky matte or silky appearance reported in the original description was likely due to the age of the first specimen described. Size measurements of the hypertelic males range 11.92–14.19 mm long ($n = 27$, $\bar{x} = 13.01$), as measured from the apex of the clypeus to the apex of the elytra, and 6.40–7.86 mm wide ($n = 27$, $\bar{x} = 7.20$), as measured across the widest part of the pronotum. Eutelic (medium) males (Fig. 2) differ from the hypertelic male in their smaller size (10.96–11.96 mm long, $n = 7$, $\bar{x} = 11.47$; 5.80–6.61 mm wide, $n = 7$, $\bar{x} = 6.20$); the frontal carina is more notable, also in its lateral branches; the pronotal prominence is flattened on its anterior

face, missing the triangular protrusion with a notched apex; and the sculpture of the pronotum is somewhat stronger and denser. Hypotelic (minor) males (Fig. 3) are smaller (9.84–10.88 mm long, $n = 7$, $\bar{x} = 10.37$; 4.96–6.28 mm wide, $n = 7$, $\bar{x} = 5.65$); reduced clypeal carina; intact frontal carina, with almost no relief in the center; pronotal prominence almost unapparent; and the pronotal sculpture is stronger and more dense than in the larger males.

Females. Hypertelic (major) (Fig. 4): Size varies 13.01–14.42 mm long ($n = 27$, $\bar{x} = 13.74$) and 6.01–7.64 mm wide ($n = 27$, $\bar{x} = 7.18$). It differs from the male, in addition to the characters of the anterior tibiae common to the whole group, by the transverse, subtrapezoidal aspect of the clypeus; the notable, regularly elevated clypeal carina slightly curved forward and extending between the clypeal-genal sutures; the straight, regularly elevated frontal carina with blunt lateral apices and lateral margins practically vertical; and the pronotal prominence only slightly sinuous between the posterior and intermediate angles, with a clearly transverse development at its anterior margin. Eutelic (medium) (Fig. 5): Ranges 11.12–12.95 mm long ($n = 9$, $\bar{x} = 12.38$) and 5.77–6.88 mm wide ($n = 9$, $\bar{x} = 6.39$). It differs from the hypertelic female in the lower degree of development of both cephalic carinae. The pronotal prominence is almost non-apparent, and the pronotal sculpture is somewhat more pronounced. Hypotelic (minor) (Fig. 6): Varies 8.88–11.32 mm long ($n = 6$, $\bar{x} = 10.53$) and 4.16–5.74 mm wide ($n = 6$, $\bar{x} = 5.26$). Differs mainly in its almost non-apparent clypeal carina, reduced frontal carina, and stronger and denser pronotal sculpture. The minimum values for both length and width were obtained from an exceptionally small female, even for this category. Genitalia as in Fig. 8.

Given the visual examination of size and degree of expression of secondary sexual traits, the variation in males clearly falls into the three patterns mentioned, while the variation in females is continuous.

Taxonomic Notes. *Onthophagus halffteri* is distinguished from *O. hippopotamus* by elytral interstriae with strong, thick sculpturing almost confluent towards the base of the elytra. The striae are strongly arched toward the outside along almost their entire length (less evident in *O. hippopotamus* and only on the basal third). The interstriae are notably convex starting with the second and with strong punctures more marked toward the base. There are also notable differences in the male genitalia (Fig. 7).

The study of the new material supports previous hypotheses regarding the inclusion of *O. halffteri* in the *hippopotamus* line (Zunino and Halffter 1988a and references cited therein). In this context, all of the characters studied suggest that *O. halffteri* and *O. hippopotamus* are sister species.

Distribution. MEXICO: Mazatepec, Municipality of Acajete, Veracruz. In the foothills of the Cofre de Perote Volcano, 2,040 m elevation.

Ecological and Distributional Notes. The burrows in which *O. halfftteri* were found were located in Mazatepec (19°34'22.51"N, 097°01'5.67"O, 2,040 m elevation) and Joya Chica (19°35'28.31"N, 097°01'23.64"O, 2,152 m elevation) in the Municipality of Acajete, Veracruz. Both sites are located on the eastern slope of the Cofre de Perote Mountain, at the eastern extreme of the Trans-Mexican Volcanic Belt. They are separated by a linear distance of 2.27 km and a difference in elevation of 158 m. Both are located in a region with a cold temperate climate, where the soil characteristics and the precipitation regime allow for the development of elements typical to mountain cloud forest, upland pastures for cattle, and, to a lesser extent, tree species typical to coniferous forest at higher altitudes.

Onthophagus halfftteri is a species that can be considered pholeobic (all stages grow and develop in the nests and burrows of their hosts), strictly associated with gopher burrows (Rodentia: Geomyidae). Inside the burrows, it is strongly associated with the

nesting chamber and to a lesser degree the latrine chamber. As far as we were able to ascertain, the adults feed exclusively on gopher feces, in addition to using it as a resource for pedotrophic nesting. *Onthophagus halfftteri* builds galleries immediately below the nest or the latrine chamber and packs the rodent feces into these galleries.

Inside the examined burrows, a coprophagous species of *Gonaphodioides* Dellacasa, Dellacasa, and Gordon (Scarabaeidae: Aphodiinae) was found in abundance, cohabiting with *O. halfftteri*. This phenomenon of association occurs frequently in systems as specialized as vertebrate burrows and caves (Zunino and Halfftter 1988b; Anduaga and Halfftter 1991; Lobo and Halfftter 1994).

The region where this species was found has been fairly well studied with respect to the coprophagous beetles of the Scarabaeidae (Arellano 2002; Arellano and Halfftter 2003). However, *O. halfftteri* had never been recorded during the systematic sampling conducted previously. We can suppose that its movement between burrows is mostly subterranean, given that flight by individuals to colonize other burrows is not frequent, though like all species belonging to

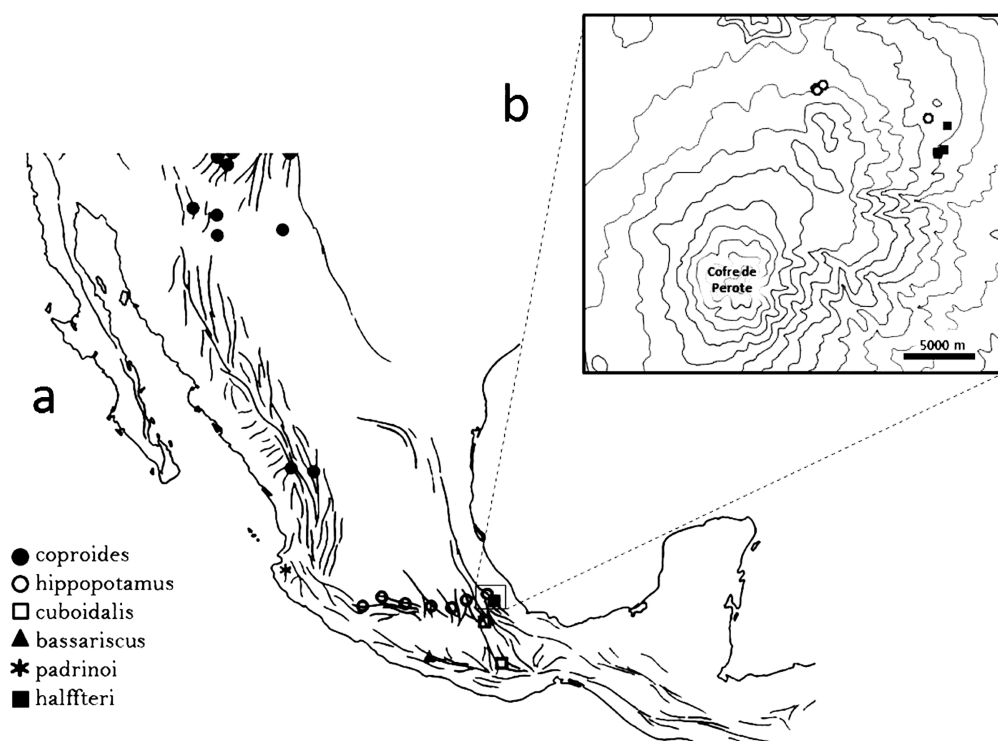


Fig. 9. a) Location of species associated with nests included in the *Onthophagus hippopotamus* line, taking the new records of *Onthophagus halfftteri* into consideration. Map modified from Zunino and Halfftter (1988a). b) Geographic location of *O. halfftteri* and *O. hippopotamus* on the eastern slope of the Cofre de Perote Mountain. Contour lines are 100 m intervals of elevation.

the *hippopotamus* line, it does not have reduced wings. *Onthophagus hippopotamus*, on the other hand, has been recorded on the surface, and even collected from beneath other types of excrement such as bovine dung. This latter species, according to Zunino and Halffter (1988a), has a broader geographic distribution than that presently known for *O. halffteri*. *Onthophagus hippopotamus* is known from sites located at various elevations along the Trans-Mexican Volcanic Belt (Fig. 9 modified from Zunino and Halffter 1988a). For at least the eastern face of the Cofre de Perote Mountain, its elevational distribution spans 930 m (2,170–3,100 m), almost six times greater than that known for *O. halffteri*. Furthermore, it should be noted that during this study *O. hippopotamus* beetles were found in the burrows of the gopher *Cratogeomys perotensis* Merriam, while *O. halffteri* was captured in association with *O. hispidus*.

The known distribution area of *O. halffteri* (Fig. 9) adjoins the eastern end of the area of *O. hippopotamus*. However, as far as we have determined, there is no sympatry between the two species. It is worth emphasizing that no overlap has been detected for any of the other species belonging to the *hippopotamus* line that are associated with rodent nests (Zunino and Halffter 1988a). The distribution of these species extends from the mountains of Arizona, the Sierra Madre Occidental mountain range, the Trans-Mexican Volcanic Belt, and the Sierra Madre del Sur mountain range. We assume that a relatively recent event might have separated a peripheral eastern fraction from the ancestor (*hippopotamus* + *halffteri*). We feel that the separation between the areas of both species could have been precipitated by climate fluctuations related to the glacial-interglacial cycles of the late Quaternary. The fact that the *Gonaphodioides* sp. associated with *O. halffteri* differs from those found in association with *O. hippopotamus* (namely, *Geomyphilus pierai* Deloya and Lobo and, according to Lobo and Halffter (1994), *Neotrichonotulus perotensis* Deloya and Lobo) corroborates our hypothesis.

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