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The ninth brachypterous *Onthophagus* Latreille (Coleoptera: Scarabaeidae: Scarabaeinae) of the world: a new species from Mexico

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ABSTRACT

A new brachypterous species of *Onthophagus* from Mexico, belonging to the New World *chevrolati* species group, is described and illustrated. Illustrations of the male and female dorsal habitus, and genitalia are provided. The relationships with other brachypterous species that occur in Guerrero (Mexico) are discussed. Placement of the new species in the *chevrolati* group key is provided. Additionally, new locality records for *O. inflaticollis* Bates are provided.

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Introduction

The cosmopolitan genus *Onthophagus* Latreille, with about 2300 species described in the world, is one of the most diverse within Scarabaeinae, mainly in the Afrotropical and Oriental regions (Tarasov and Solodovnikov 2011). Although most species are dung feeders, their evolutionary success is due to specializations such as mycophagy, necrophagy, frugivory, cleptoparasitism, and adaptations to inhabiting small rodent nests or cave habitats (Pulido-Herrera and Zunino 2007; Zunino and Halffter 2007; Ziani and Moradi-Gharakhloo 2011).

The *chevrolati* group, extensively revised by Zunino and Halffter (1988b), is currently comprised of 43 species and subspecies distributed from central USA to Panamá, most of the species being found in Mexico (Arriaga-Jiménez et al. 2016). This group is a supraspecific entity that is distinct both taxonomically, ecologically, and biogeographically. All species are associated with montane environments, and includes most of American *Onthophagus* species associated with caves and burrows. Within the *chevrolati* group, at least three complexes are recognized: *vespertilio*, *hippopotamus* and *chevrolati*, which are defined by morphological characters of the male genitalia and other external characters such as shape of the male frontal carina and the configuration of the pronotal protuberance (Arriaga-Jiménez et al. 2016). At the same time, the *chevrolati* line,

represented by montane species but not associated with burrows or caves, consists of three species complexes: *aureofuscus*, *aztecus* and *undulans* (Zunino and Halffter 1988a).

It should be emphasized that wing reduction in *Onthophagus* is a character that is independent of lineages. Currently, eight brachypterous species are known in the world: *Onthophagus apterus* Matthews from Australia; *O. inflaticollis* Bates and *O. gilli* Delgado and Howden (*chevolati* group), *O. zapotecus* Zunino and Halffter, *O. brachypterus* Zunino and Halffter and *O. pedester* Howden and Genier (*landolti* group) from Mexico; *O. micropterus* Zunino and Halffter (*clypeatus* group, *mirabilis* line), and *O. inediapterus* Kohlmann and Solís (*clypeatus* group, *dicranus* line), both from Costa Rica (Matthews 1972; Zunino and Halffter 1981, 1988a, 1988b; Delgado and Howden 2000; Howden and Genier 2004). In Scarabaeoidea, the evolution of flightlessness is related to arid environments (e.g. deserts) and high altitude environments (e.g. montane forests) (Zunino and Halffter 1988b; Génier 2000). For surviving in arid environments, it is necessary to conserve water, for which the presence of developed wings can represent a negative attribute, while an empty subelytral chamber can retain a significant amount of the water that evaporates through spiracles. In montane forest environments, where American *Onthophagus* species occur, flight is apparently not essential. In the presence of strong winds, it can even represent a negative factor, dragging the flying individuals towards habitats that are unfavourable for their survival (Zunino and Halffter 1981, 1988b).

We describe herein a new brachypterous species of *Onthophagus* from the state of Guerrero in Mexico. The phylogenetic species definition of Wheeler and Platnick (2000) is used in an evidently synchronic sense, which considers the species as the smallest aggregation of populations diagnosable by a unique combination of character states.

Material and methods

Drawings were made with the aid of a Stemi SV6 Zeiss camera lucida stereomicroscope (Oberkochen, Baden-Württemberg, Germany). Photographs were taken using an AutoMontage system by Syncroscopy located at the Florida State Collections of Arthropods (Gainesville, Florida, USA). Measurements were obtained with an ocular micrometer on a Zeiss stereomicroscope. The distribution maps were created using ArcGIS 9.3 (ESRI Inc. 1999–2014).

Results

Onthophagus chilapensis Gasca-Álvarez, Zunino and Deloya, new species (Figures 1, 2)

Type material

Holotype male deposited in Colección Nacional de Insectos, Instituto de Biología, UNAM (Ciudad de México), with the following collection label: 'MÉXICO, Guerrero, Chilapa, "Parque Juan N. Álvarez", en "Ocotal". Bosque de *Quercus*, 31-vi-2012, S. González-Hilario y O. J. García-Días cols.' Paratypes: 10♂♂ and 9♀♀ same data as holotype; 1♂ and 2♀ same data as holotype except 28 April 2012; 6♂ and 1♀ same data as holotype

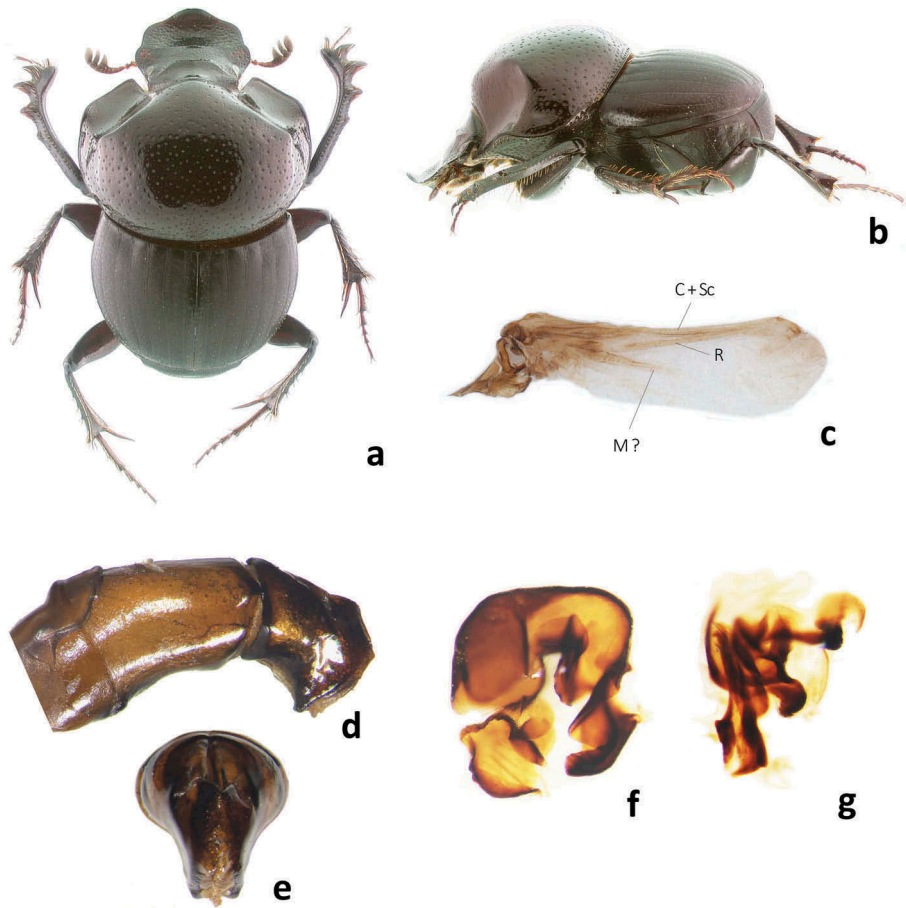


Figure 1. *Onthophagus chilapensis* new species. (a, b) Holotype habitus. (c) Right wing. C + Sc, costa–subcosta complex; R, radial; M?, probable vestigial medial. (d) Parameres lateral view. (e) Parameres caudal view. (f) Lamella copulatrix. (g) Accessory lamellae.

except 31 July 2012; 4♀ same data as holotype except 31 August 2012. Paratypes deposited in following entomology collections: Instituto de Ecología A. C. (Xalapa), Centro de Estudios en Zoología. Universidad de Guadalajara (Guadalajara), Mario Zunino private collection, Asti (Italy), Florida State Collection of Arthropods (Gainesville), Texas A&M University Insect Collection (College Station), Colección de Artrópodos Universidad del Valle de Guatemala (Ciudad de Guatemala), Canadian Museum of Nature (Ottawa) and Instituto de Ciencias Naturales, Universidad Nacional de Colombia (Bogotá).

Description

Holotype male (Figure 1(a–g)). Length 10.2 mm. Maximum width (at the middle of the prothorax) 6.3 mm. **Colour.** Black, pronotum and head distinctly glossy, elytra dull. **Head.** Surface strongly punctate, glabrous, punctures coarse and deep; lateral margin sinuate with small punctures, genal sutures conspicuous. Clypeus strongly concave, pentagonal, rounded shaped in dorsal view, anterior margin strongly reflexed. Clypeal carina transverse,

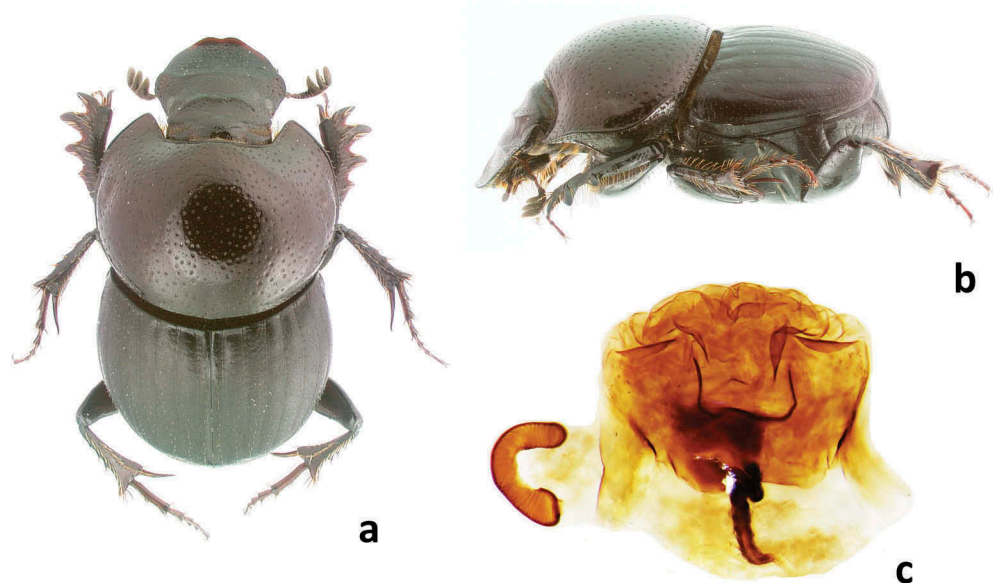


Figure 2. *Onthophagus chilapensis* new species. (a, b) Female habitus. (c) Female genitalia.

prominent and weakly curved medially, frontal carina transverse, strong and slightly sinuated medially. **Pronotum.** Surface glabrous, with strong, deep punctures and smaller fine punctures distributed irregularly. Pronotal prominence triangular and apically obtuse and rounded, intermediate tubercles absent, posterior tubercles strong. Disc with medium-size and shallow punctures. Lateral margins of pronotum almost evenly rounded in dorsal view. **Elytra.** Elytral striae slightly glossy, with circular and very shallow punctures separated by three diameters, elytral interstriae flat and dull, with very small microsculpture. Surface of elytral intervals with very small irregularly distributed setae. Wings reduced (Figure 1(c)), length 2.7 mm. **Pygidium.** Surface with microsculpture similar to elytral intervals, with some strong irregularly distributed punctures. Apical margin surface smooth between fine punctures. **Legs.** Foretibiae long and slender, strongly curved on apical third, and slightly wider, apical tooth triangular and covering the insertion point of the apical spur, spur curved ventrally. **Genitalia.** Parameres short, wide, apex slightly angular, forming a moderate obtuse angle with its longitudinal axis, ventral margin straight. Apex with two ventral projections weakly curved in lateral view (Figure 1(d), 1(e)). Lamella copulatrix developed; left branch concave, right branch longitudinal, apex bent to the left (Figure 1(e)). Accessory lamella as Figure 1(g).

Female (Figure 2(a–c)). Length 9.6 mm. Maximum width (at the middle of the prothorax) 5.7 mm. In addition to secondary sexual characters, as holotype except in the following respects: **Head.** Clypeus curved and clearly sinuated medially, surface with transverse punctures, frontal carina curved on both sides. **Pronotum.** Convex, pronotal prominence absent, with a weak depression laterally. **Legs.** Protibia shorter, entirely curved. **Genitalia.** Structures of female genitalia are shown in Figure 2(c).

Variation

Male paratypes (10). Length 9.1–11.6 mm. Maximum width (at the middle of the prothorax) 5.5–6.1 mm. Two males have an inconspicuous clypeal carina. No minor males were observed. Female paratypes (11). Length 8.6–10.3 mm. Maximum width (at the middle of the prothorax) 4.9–5.7 mm. The other paratypes do not differ significantly from the holotype. Except for the development of the secondary sexual characters and size, other characters show little variation.

Type locality

Parque Natural General Juan N. Álvarez, Chilapa de Álvarez, Guerrero, México (Figure 3).

Etymology

The specific epithet derives from Chilapa de Álvarez, the name of the municipality of Guerrero (Mexico), where the new species was collected.

Diagnosis

Onthophagus chilapensis represents the third brachypterous species found in Guerrero, including *O. inflaticollis* Bates and *O. gilli* Delgado y Howden, all belonging to the *chevrolati* group. The new species differs from *O. inflaticollis* by the form of clypeal apex; while it can be distinguished from *O. gilli* by the presence of the clypeal carina, absent in *O. gilli*. The morphology of the parameres also distinguish these three species (Figure 4). *Onthophagus*

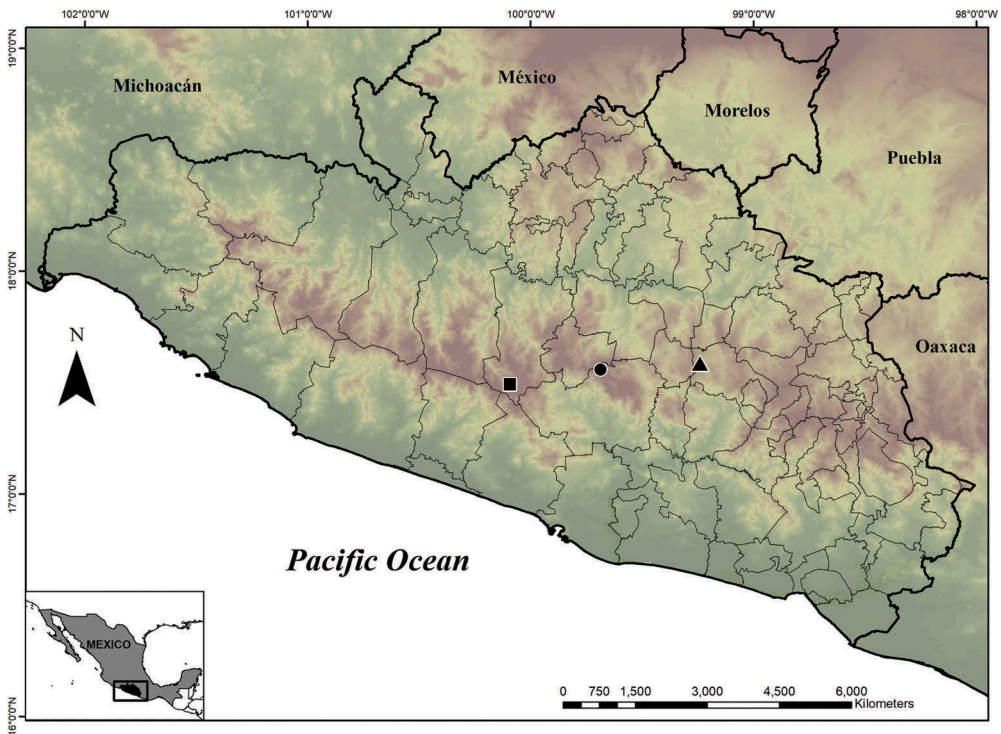


Figure 3. Distribution of brachypterous *Onthophagus* species in Guerrero (Mexico). Square = *O. gilli* Delgado and Howden. Circle = *O. inflaticollis* Bates. Triangle = *O. chilapensis* new species.

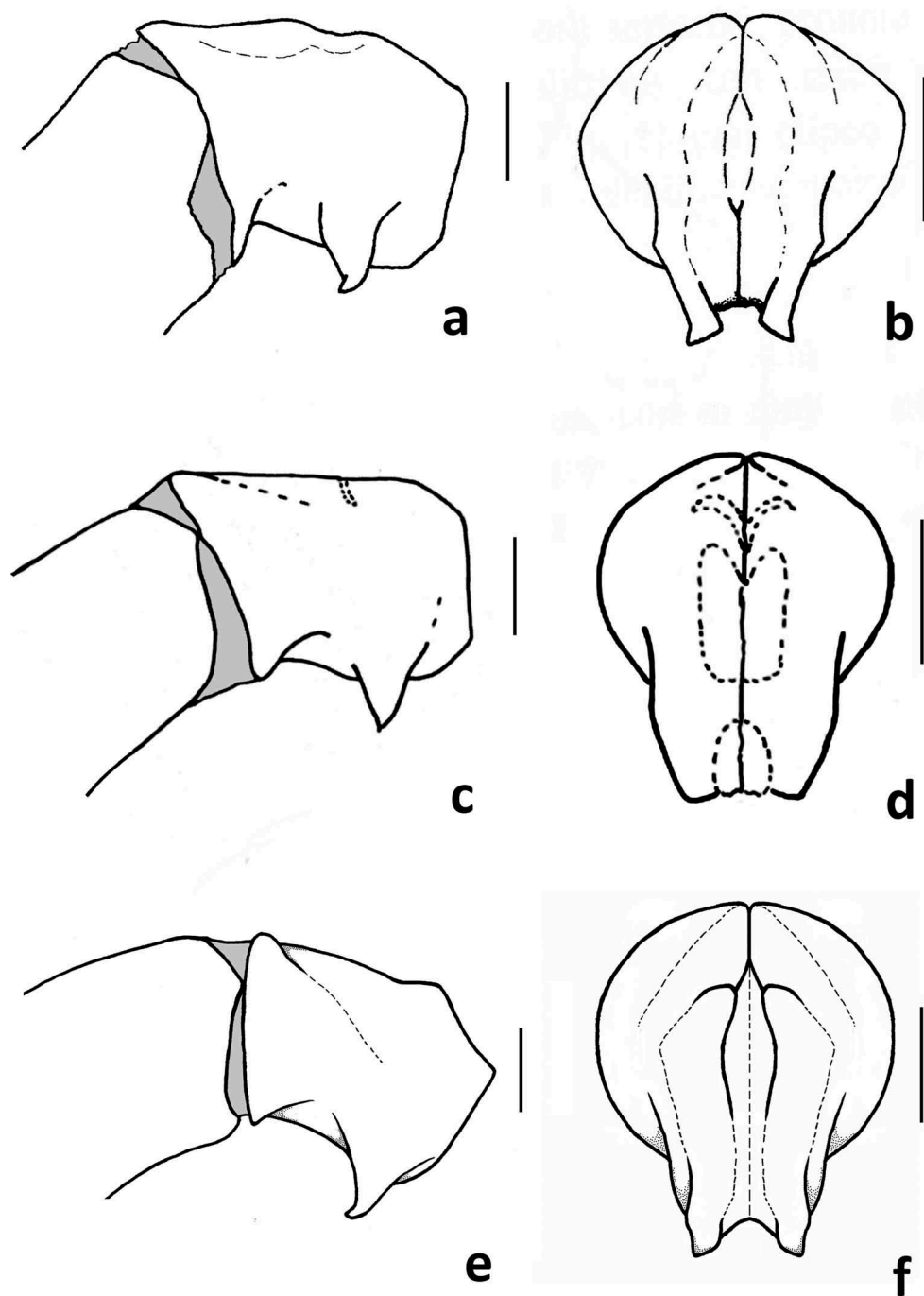


Figure 4. Parameres (lateral and caudal view) of (a, b) *O. gilli* Delgado and Howden (redrawn from Delgado and Howden 2000); (c, d) *O. inflaticollis* Bates (redrawn from Zunino and Haffter 1988a); (e, f) *O. chilapensis* new species. Scale bar = 0.23 mm.

chilapensis is similar to *O. gilli* in terms of the shape of the lateroapical projections of the parameres. Other differential characters are summarized in Table 1.

Natural history

The specimens were captured with a permanently set NTP-80 pitfall trap (Morón and Terrón 1984), baited with decomposing squid (Figure 5). The habitat is a *Pinus–Quercus* forest, dominated mainly by *Pinus lawsonii* Roezl ex Gordon and *Quercus liebmannii* Oersted ex Trel (Figure 6).

New records of *O. inflaticollis* Bates in Guerrero

According to Zunino and Halffter (1988a), *Ontophagus inflaticollis* has not been collected since its description, only specimens from the type series were known from Omiltemi in Guerrero (Mexico). Recent collections carried out for research projects on the scarab beetle fauna of Guerrero, although they do not come from the type locality, confirm the existence of this species in the region after more than 120 years. The 17 collected specimens are deposited in the insect collection of Instituto de Ecología (IEXA), in Xalapa.

MATERIAL EXAMINED: México, Guerrero, Chilpancingo, Xocomanatlán. 2100 m. Bosque de Coníferas-*Quercus*. NTP. 29 May 2014 1 ♀, 27 June 2014 3 ♂, 2 ♀, 10 August 2014 2 ♂, 6 ♀, col: E. López-Huicochea; 1400 m, 16–30 August 2017 1 ♂, 2 ♀, cols: I. G. Gutierrez-Noyola, J. V. Pérez-Quezada.

Discussion

Ontophagus chilapensis represents the ninth brachypterous species described (Table 2), and the seventh endemic species from Guerrero, with *O. inflaticollis* Bates, *O. chevrolati omiltemius* Bates, *O. undulans undulans* Bates, *O. bassariscus* Zunino and Halffter, *O. pseudoundulans pseudoundulans* Zunino and Halffter and *O. gilli* Delgado and Howden (see Deloya et al. 2014). García-Díaz et al. (2014), cited the new species as *Ontophagus* sp. Group '*O. chevrolati*', from the field collection of four specimens, which are part of the type series.

Ontophagus chilapensis sp. nov. inhabits a protected natural area (Parque Natural General Juan N. Álvarez) [17°35'05"–17°36'39" N; 99°04'26"–99°06'13" W], in the region known as Low Mountain (inner slope of Sierra Madre del Sur), where the elevation reaches 2300 m. It is bordered to the N by Rio Balsas basin (550 m), to the W by lowlands of Chilpancingo (1250 m), to the E by lowlands in Chilapa (1400 m) and to the S by Quechultenango (840 m). The habitat is a *Pinus–Quercus* forest. *O. chilapensis* is possibly

Table 1. Differential characters between *O. inflaticollis*, *O. gilli* and *O. chilapensis* new species.

	<i>O. inflaticollis</i>	<i>O. gilli</i>	<i>O. chilapensis</i>
Clypeal apex	Truncate, slightly rounded	Transverse, rounded	Lobiform medially
Clypeal carina	Present	Absent	Present
Frontal punctures	Weakly transverse	Transverse	Circular
Genal sutures	Weakly impressed	Weakly impressed	Strongly impressed
Pronotal disc	With very small setae	With very small setae	Glabrous



Figure 5. NTP-80 trap used during the collections in Parque Natural General Juan N. Álvarez.

a necrophagous species. Local climate is temperate sub-humid [C(w2)(w)big] (García 1988).

Onthophagus gilli is a coprophagous species that is known only from La Guitarra (17°28'36.58" N, 100°51'13.00" W; Heliodoro Castillo, Guerrero, México), and inhabits *Pinus–Abies* forest at 2850 m (Delgado and Howden 2000). As *O. chilapensis*, its distribution area is bordered by lowlands to the E, to the NE by Yextla (1300 m), and to the W by lowlands of Guerrero Natural Park from Carrizal de Bravo (2700 m) to Jaleca de Catalán (750 m). Local climate corresponds to temperate sub-humid.

On the other hand, *O. inflaticollis*, the first species of American *Onthophagus* in which brachypterism was highlighted and discussed (Zunino 1980), is known only from Omiltemi (Guerrero, México), where a mosaic of vegetation is present (Muñoz 1988): *Pinus* forest (2200–2700 m), cloud forest (2000–2600 m), *Pinus–Quercus* forest (1900–2500 m) and *Quercus* forest (2200–2500 m). Feeding habits of this species had been unknown, until recently some adults were captured with pitfall traps baited with squid. Local climate is temperate sub-humid [C(w2)(s)big] (García 1988).

Onthophagus gilli (2850 m) and *O. inflaticollis* (c. 2500 m) are separated by 44 km from each other in the highlands of Sierra Madre del Sur, while *O. chilapensis* (2100 m) is located on the inner slope and is separated by 48 km from *O. inflaticollis*. In general, species of 'chevrolati' group are associated to montane environments (*sensu* Zunino and Halffter 1988a), and in particular with the Sierra



Figure 6. Habitat of *Onthophagus chilapensis* in Parque Natural General Juan N. Álvarez.

Table 2. Brachypterous *Onthophagus* of the world.

	Maximum length	Known specimens		Type locality
		Males	Females	
<i>O. inflaticollis</i> Bates 1886–1890	6 mm	13	14	Omitemi, Guerrero, México
<i>O. apterus</i> Matthews 1972	18 mm	1	Unknown	Queensland, Australia
<i>O. micropterus</i> Zunino and Halffter 1981	6.2 mm	2 males + 237*		San Isidro del General, San José, Costa Rica
<i>O. zapotecus</i> Zunino and Halffter 1988b	5.5 mm	2	2	17–22 km north Oaxaca, México
<i>O. brachypterus</i> Zunino and Halffter 1997	5 mm	1	1	Sierra de Manantlán, Colima, México
<i>O. gilli</i> Delgado and Howden 2000	8.1 mm	31	19	La Guitarra, Heliodoro Castillo, Guerrero, México
<i>O. inediapterus</i> Kohlmann and Solís 2001	5.6 mm		11 *	Estación Pittier, Puntarenas, Costa Rica
<i>O. pedester</i> Howden and Genier 2004	4 mm	1	Unknown	32 km S Juchatengo, Oaxaca, México
<i>O. chilapensis</i> new species	11.6 mm	18	16	Parque Natural General Juan N. Escudero, Chilapa, Guerrero, México

*See Kohlmann and Solis (2001).

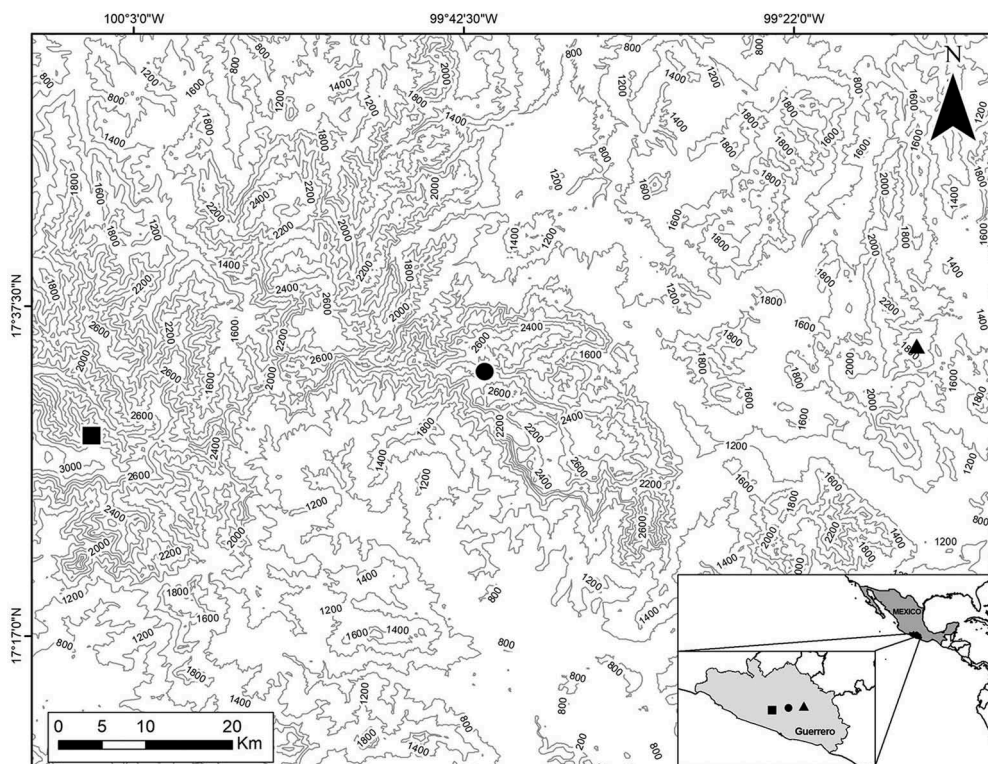


Figure 7. Distribution map of the three brachypterous species showing elevation level curves. Square = *O. gilli* Delgado and Howden. Circle = *O. inflaticollis* Bates. Triangle = *O. chilapensis* new species.

Madre del Sur topography in Guerrero, where each brachypterous species isolated by low elevations in this montane system (Figure 7). In ecological terms, apparently these three species are associated with the same temperate sub-humid climate.

The scarab beetle fauna of Chilapa de Álvarez still needs to be studied. Recently, López-García et al. (2017) described a new species of *Orizabus* collected in the vicinity of the public lights of the municipality at 1400 m.

Key to the *chevrolati* species group proposed by Zunino and Halffter (1988a), and later adapted by Delgado and Howden 2000, modified as follows to include *O. chilapensis*

- 25. Frontal carina distinctly sinuated medially 26
 - Frontal carina like an isosceles regular trapezoid, not sinuated medially..... 29
- 26. Dark blue, almost black. Clypeus sub-trapezoidal and very rounded. Male prothorax normally developed. Female clypeus truncated. Elytra with distinct humeral umbones. Macropterous. Maximum length 7.2 mm. Quiroga, Michoacán, México. ***O. reyesi* Zunino and Halffter**

- Dark brown or black. Male prothorax hypertrophied. Female clypeus emarginated. Elytra with humeral umbones inconspicuous. Brachypterous 27
- 27. Clypeal apex in males truncate to evenly rounded. Disc of pronotum with very small setae, almost imperceptible 28
 - Clypeal apex in males strongly lobate medially (Figure 1). Disc of pronotum glabrous. Maximum length 11.6 mm. Chilapa de Álvarez, Guerrero, Mexico.
..... ***O. chilapensis* n. sp.**
- 28. Punctures of pronotal disc widely spaced and almost as large as half of the dorsal area of the eye. Maximum length 6.0 mm. Omiltemi, Guerrero, México. .
..... ***O. inflaticollis* Bates**
 - Punctures of pronotal disc denser and smaller than one-fourth the dorsal area of the eye. Maximum length 8.1 mm. Heliodoro Castillo, Guerrero, México.....
..... ***O. gilli* Delgado and Howden**

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Disclosure statement

No potential conflict of interest was reported by the authors.

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