

Systematics, Morphology and Biogeography

## A new key for the species of *Ateuchus* Weber (Coleoptera: Scarabaeidae: Scarabaeinae) occurring in Mexico, with a description of the first North American inquiline species from a rodent burrow (Rodentia: Geomyidae) and new distribution records

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### ABSTRACT

The first *Ateuchus* Weber (Scarabaeinae) species, *A. tuza* sp. nov., from a rodent burrow from North America is described. Diagnostic characters are presented; photographs of an adult male and illustrations of male genitalia are included. A key for all known Mexican *Ateuchus* Weber species is provided. *Ateuchus hornai* (Balthasar) is revalidated. New distribution records from Mexico and Central America are reported.

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### Introduction

This work is a continuation of the study of the genus *Ateuchus* Weber for North America, first started in 1981 (Kohlmann, 1981, 1984; Kohlmann and Halffter, 1988), and thereafter extended to Mesoamerica (Kohlmann, 2000) and Costa Rica (Kohlmann, 1996–1997; Kohlmann and Solís, 2009, 2012). It describes the first known *Ateuchus* species from the burrow of a rodent collected in North America. *Ateuchus hornai* (Balthasar) is revalidated. This description and the present revalidation increase the number of previously known species from Mexico to fourteen. As a comparison, twelve species are known from Costa Rica (Kohlmann and Solís, 2012). This study also presents a key for the Mexican *Ateuchus* species. It also reports new *Ateuchus* records from Mexico and Central America.

### Materials and methods

Most specimens studied came from the Entomology Section of the Zoological Collection of the Universidade Federal de Mato

Grosso, Cuiabá, Brazil (CEMT) and the Entomological Collection at the Institute of Ecology (IEXA), Xalapa, Mexico. Other collections are cited only once and so no acronyms are used for them.

The specimens were studied using a Zeiss Stemi 2000-C stereozoom binocular microscope. Measurements were made to the nearest 0.1 mm using an ocular micrometer. Genital dissections and preparations were done following the techniques described by Zunino (1978). Genital structures were stored in microvials with glycerin. The structures of the internal sac were drawn using the freehand technique. Photographs were taken with a Zeiss AxioCam ICc1 camera. Photographs were processed using the Zeiss Axio-Vision 4 image processor. Morphological nomenclature follows Kohlmann (1984, 2000) and Génier (2015).

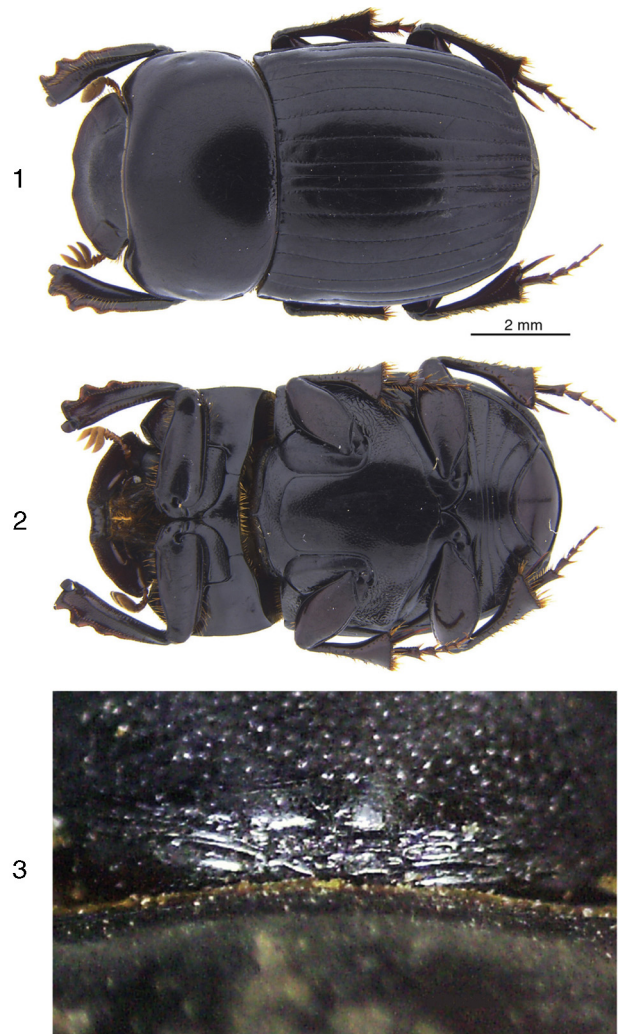
### Results

*Key for the identification of Ateuchus Weber from Mexico (modified from Kohlmann, 1981, 2000)*

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- 1. Eyes viewed from above six times larger than wide ..... 2
  - Eyes viewed from above two or three times larger than wide ..... 4
- 2. Anterior pronotal edge with complete margin; base of the head with a wrinkled area (Fig. 3) in the center; sternellum forming a carina along the middle; inquiline of rodent burrows. Mexico (Veracruz) ..... *A. tuza* Kohlmann and Vaz de Mello, **sp. nov.**
  - Anterior pronotal edge with incomplete margin; base of the head with no wrinkled area; sternellum not forming a carina along the midline; non-inquiline species ..... 3
- 3. Ovoid body; pronotal punctures forming a semi-circle at the middle of the pronotal base; internal sac with a very developed spiny fascia and three copulatory spicules; punctures of the lower surface of the anterior femora fine and uniformly distributed. Mexico to Panama (Sinaloa to Azuero Peninsula) ... *rodriguezii* (Preudhomme de Borre)
  - Long body; pronotal punctures not forming a semi-circle at the middle part of its pronotal base; internal sac with a weakly developed spiny fascia and two copulatory spicules; punctures of the lower surface of the anterior femora moderate in size and uniformly distributed. Mexico (Higher reaches of the Balsas River Valley; Guerrero, Morelos, and Puebla) ..... *halfpteri* Kohlmann
- 4. Apex of the elytral striae weakly impressed ..... 5
  - Apex of the elytral striae strongly impressed ..... 6
- 5. Shagreen elytra; internal sac with a very well developed fascia; pygidium very convex and shagreen in its upper part. Mexico to Colombia (Oaxaca to Chocó) ..... *candezei* Harold
  - Elytra not shagreen; internal sac with a weakly developed fascia; pygidium flat and not shagreen. Mexico and Belize (Atlantic slope; Chiapas, Campeche and Orange Walk) ..... *laetitia* Kohlmann
- 6. Length larger than 8 mm, and ventral surface of anterior femur very finely punctate throughout, lacking any larger or coarser punctures (only one female known, 8.4 mm, Necaxa, Puebla) ..... *hornai* (Balthasar)
  - Either length shorter than 8 mm or ventral surface of anterior femur with areas of larger or coarser punctures ..... 7
- 7. Ventral surface of anterior femur finely punctate throughout, few larger punctures along posterior edge in some Texan individuals; spermatheca tapering from the accessory gland insertion to apex. USA and Mexico (Texas to Veracruz) ..... *texasus* Robinson
  - Ventral surface of anterior femur coarsely punctate throughout or at its posterior edge or apex; spermatheca uniformly thick throughout. Mexico to Honduras ..... 8
- 8. Ventral surface of anterior femur and pygidium with coarse punctures throughout ..... 9
  - Ventral surface of anterior femur with fine punctures throughout or coarse punctures at its apex or at its posterior edge; pygidium finely punctate ... 10
- 9. Spermatheca ring-like at its base; primary copulatory spicule fine. Mexico (Pacific slope of the Transverse Volcanic System and Sierra Madre del Sur; Jalisco to Oaxaca) ..... *carolinae* Kohlmann
  - Spermatheca not ring-like at its base; primary copulatory spicule massive. Mexico (Transverse Volcanic System; Michoacán to Veracruz) ... *klugi* (Harold)
- 10. Anterior pronotal margin almost effaced; pronotal surface moderately to coarsely punctate; pygidium very convex; one of the copulatory hooks of the internal sac is a long and slender filament; one of the apical lamellae of the internal sac has a canoe-like form. Mexico to Nicaragua (Chiapas to Masaya) ..... *guatemalensis* (Bates)
  - Anterior pronotal margin complete; pronotal surface finely punctate, sometimes with some coarse punctures lining the base and margins of the pronotum; pygidium flat to convex; none of the copulatory hooks of the internal sac is filament-like; none of the apical lamellae of the internal sac are canoe-like. Mexico to Honduras ..... 11
- 11. Small species (4.8–5.5 mm); secondary copulatory spicules of the internal sac very small. Mexico (Veracruz to Yucatán) ..... *perezvelai* Kohlmann
  - Big species (6–8.5 mm); size of the secondary copulatory spicules of the internal sac small to big. Mexico to Honduras (Tamaulipas to La Paz) ..... 12
- 12. Copulatory spicules of the internal sac subequal and spine-like; no spiny facies present around the copulatory spicules. Mexico (Chiapas) ... *gershensoni* Kohlmann
  - Secondary copulatory spicules of the internal sac smaller than the primary one; spiny facies present or not around the copulatory spicules ..... 13
- 13. Elongate, convex and broad body (4.0–4.5 mm); eyes dorsally two times longer than wide. Mexico (Tamaulipas to Chiapas) ..... *illaesum* (Harold)
  - Oblong, very convex and broad body (5.0–5.5 mm); eyes seen dorsally three times longer than wide. Mexico to Honduras (Chiapas to La Paz) ..... *chrysopyge* (Bates)



Figures 1–3. *Ateuchus tuza* sp. nov.; 1, dorsal habitus of holotype; 2, ventral habitus of holotype; 3, wrinkled area at the base of the head of a male.

***Ateuchus tuza* Kohlmann and Vaz de Mello, sp. nov.**

(Figs. 1–4)

**Type locality:** MEXICO: VERACRUZ, Dos Amates (Catemaco), elev. 300–600 m (18° 29' 21" N, 95° 03' 35" W)

**Diagnosis.** This species is distinguished from other *Ateuchus* species by the following combination of characters: Long and slender body; dorsum glossy; clypeus bidentate; head simply convex, lacking carina or tubercle; base of the head with a small wrinkled area in the center; anterior border of pronotum continuous, posterior border of pronotum with an area of dense and coarse punctures medially; elytral lateral portion rounded; sternellum forming a carina in the middle; pygidium slightly convex, lightly shagreen, and inconspicuously punctate.

**Description.** Holotype male (Figs. 1–4). **Body.** Elongate (Figs. 1–2), convex dorsally (Fig. 1). **Size.** Total length 10.0 mm. Maximum width 5.5 mm. **Color.** Dark reddish brown to black, lacking metallic sheen. **Head.** Clypeal margin anteriorly broadly V-shaped (Figs. 1–2); anterior margin slightly upturned, gena and frons coarsely wrinkled, vertex coarsely punctate, base of head with a

small wrinkled area in the center (Fig. 3), eyes viewed from above six times longer than wide. **Pronotum.** Transverse, strongly convex, surface glossy; anterior pronotal margin complete; midline weakly impressed at base; pronotal surface punctate throughout, a group of coarse punctures at the center of the pronotal base (Fig. 1); lateral pronotal fossae shallow. **Elytra.** (Fig. 1). Striae fine, shallowly impressed on disk, becoming well defined and deeply impressed on apical declivity; strial punctures elongate-crenulate, slightly wider than stria, separated by 2–3 diameters on disk and apical declivity. Interstriae slightly convex on disk, surface minutely punctate throughout. **Thoracic sterna.** (Fig. 2). Proepisternum excavate anteriorly, surface of excavated portion granulate, with fine and rather long setae, bordered posteriorly by a well-defined keel. Proepimeron finely wrinkled. Sternum glabrous and forming a keel at its center. Mesometasternal suture arched medially, marginal bead fine. Mesosternum coarsely punctured forming rugulae. Mesepisternum flat, surface-forming rugulae. Metasternum evenly convex, disk evidently punctate, surface glossy between punctures, lateral lobes forming rugulae; midline clearly impressed along three fourths of its length. **Legs.** (Figs. 1–2). Foretibia with four teeth on outer margin, the basal one weakly developed; foretibial spur expanded and truncate apically; foretibiae and forefemora long and slender; forefemur smooth, finely punctate throughout. Metatibiae obliquely truncate apically; apical spur spiniform. **Abdomen.** (Fig. 2). Sternites 3–7 crenulately punctate along their anterior borders. Last abdominal segment slender. Pygidium slightly convex and lightly shagreen with indistinct punctuation; basal sulcus fine and deep throughout; marginal bead continuous. **Male genitalia.** Parameres simple, tapering to apex in lateral view, apical portion rounded in dorsal view. The internal sac of the aedeagus with three hooks, two spine-like and one spoon-like (Fig. 4).

**Allotype:** Female. Total length 9.5 mm. Maximum width 5.0 mm. Same as male with the following sexual differences: clypeal margin anteriorly, not so broadly V-shaped; lateral pronotal margin not arched; last abdominal segment broader medially; foretibiae and forefemora shorter and foretibial spurs slender and slightly bent at tip; pygidium not as long.

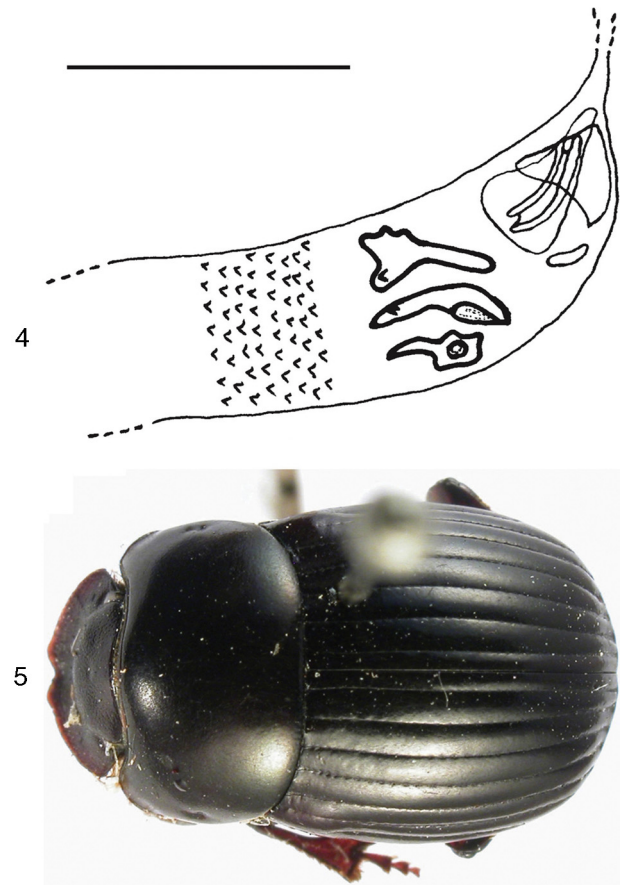
**Variation:** Total length 9.5–10 mm. Maximum width 5.0–5.5 mm. **Material examined** (34 specimens): **Holotype.** Male: México: Veracruz: Dos Amates (Catemaco), 8-V-1968, P. Reyes, M. Cabrera cols. Nido de tuza. Cámara de desechos (CEMT). **Allotype.** Female: *ibidem*, one female. **Paratypes.** *ibidem*, six males, four females (three males and three females at CEMT; one male, Gonzalo Halffter personal collection, Coatepec, Mexico; one male and one female at Bert Kohlmann personal collection, Las Mercedes de Guácimo, Costa Rica; one male to be deposited at Canadian Museum of Nature, Ottawa, Canada); one male, one female, Entomological Collection at the Institute of Ecology, Xalapa, Mexico (IEXA), México: Oaxaca, Sta. María Chimalapas, 12-VI-2015, colecta directa, dentro de madriguera de tuza, J. Luis S. Huerta col.; five males, seven females, *ibidem*, 16-VI-2015; two males, two females, *ibidem*, 18-VI-2015; one male, one female, *ibidem*, 19-VI-2015; two females, *ibidem*, 22-VI-2015.

**Remarks:** This is the first North American inquiline *Ateuchus* species collected from a pocket gopher burrow.

**Etymology:** The name *tuza*, a name in apposition, is the hispanized common name of the indigenous nahuatl word tozan, given to the beaver-looking subterranean rodent, where the new *Ateuchus* species was found.

**Geographical distribution:** The new species is so far only known from the locality of Dos Amates, Catemaco, in the state of Veracruz, and the locality of Santa María Chimalapas, Oaxaca, Mexico.

**Habitat:** The new species was collected in the waste chamber of a pocket gopher (Rodentia: Geomyidae) burrow during the month of May. Although the rodent of the original collection site was not



Figures 4–5. A. *tuza* sp. nov.; 4, drawing of the internal sac, line equals 1 mm; 5, *A. hornai* (Balthasar, 1939), dorsal habitus of the female holotype.

identified at the time, it is most likely that the specimens were found inside the nest of *Orthogeomys hispidus* (Le Conte).

**Chorological affinities:** Interestingly, this new *Ateuchus* species is found under similar ecological conditions, a lowland tropical area, as *Ateuchus kujuchi* Génier, the other known inquiline rodent burrow *Ateuchus* species from Bolivia (Génier, 2015). *A. kujuchi* was collected in a *Ctenomys* burrow, a rodent belonging to a different family, Ctenomyidae, as the one collected in Mexico.

**Taxonomic relationships:** The shape of the body of this species resembles the South American species *apicatum* (Harold, 1867) and is clearly not related to the known body shape of the North or Central American *Ateuchus* species. The new species will key to couplet 23/24 (*apicatum*) in Balthasar's (1939) key. It can be easily separated from *A. apicatum* because of the presence of the small rugose area at the center of the base of the head and the presence of coarse punctures at the middle of the pronotal base. This taxonomic relationship would suggest that *Ateuchus* species derived of South American lines have adapted to and colonized lowland gopher nests in North America; whereas, in the mountainous areas of North America it is species of the genus *Onthophagus*, which has adapted to colonizing gopher nests (Anduaga and Halffter, 1991; Lobo and Halffter, 1994; Zunino and Halffter, 2007).

This new species shows adaptations to living in an environment devoid of light, like the subterranean gopher nest. First, the dorsal eye area is very small. Second, the aforementioned rugose area at the base of the head is a stridulation mechanism, similar to those found at the base of the head of *Uroxys*, as found in *U. microcularis* Howden and Young, *U. micros* Bates and *U. platypyga* Howden and Young (Delgado and Kohlmann, 2007; Solís and Kohlmann, 2013),

and most probably helps in the communication process of this species.

### New distribution records of and notes on *Ateuchus* Weber from Mexico and Central America

#### *Ateuchus guatemalensis* (Bates), 1887

This species has been recorded from Chiapas, Guatemala and Honduras. It is here recorded for the first time from Nicaragua.

Nicaragua: Jinotega: Cerro Kilambe, Camp 5, Las Torres, UTM-16P-1500283-0639500, 1200 m, 23/30-IV-2001, col. J. Sunyer y B. Hernández (5 specimens at CEMT); Masaya: Las Flores, VII-1998, col. J. Téllez (1 specimen at CEMT).

#### *Ateuchus hornai* (Balthasar, 1939), new combination (valid species)

(Fig. 5)

This species was previously considered a synonym of *A. illaesum* based on the original description, since the holotype was not available for study at the time (Kohlmann, 1984). The examination of the female holotype found in the Natural History Museum in Prague, Czech Republic (Bezdek and Hajek, 2011), allowed us to consider it a valid species, distinguishable by the characters in the key presented herein. We suspect the type locality (Necaxa, Puebla, México) to be wrong, and we hope that a male will be collected in order to prepare a more thorough description of this interesting species.

### Conflicts of interest

The authors declare no conflicts of interest.

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### References

- Anduaga, S., Halffter, G., 1991. Escarabajos asociados a madrigueras de roedores (Coleoptera: Scarabaeidae: Scarabaeinae). *Folia Entomol. Mex.* 81, 185–197.
- Balthasar, V., 1939. *Neue Choeridium-Arten* (Ins Col.). *Senckenbergiana* 21, 44–66.
- Bezdek, A., Hajek, J., 2011. Catalogue of type specimens of beetles (Coleoptera) deposited in the National Museum, Prague Czech Republic: Scarabaeidae: Scarabaeinae: Ateuchini and Canthonini. *Acta Ent. Mus. Nat. Prag.* 51, 349–378.
- Delgado, L., Kohlmann, B., 2007. Revisión de las especies del género *Uroxys* Westwood de México y Guatemala (Coleoptera: Scarabaeidae: Scarabaeinae). *Folia Entomol. Mex.* 46, 1–36.
- Génier, F., 2015. *Ateuchus kujuchi* n. sp., a new inquiline species from Scarabaeinae (Coleoptera: Scarabaeidae) from tuco-tuco burrows from Bolivia. *Zootaxa* 3946, 146–148.
- Kohlmann, B., 1981. Nuevas especies de *Ateuchus* (Coleoptera: Scarabaeidae) de México. *Folia Entomol. Mex.* 49, 71–92.
- Kohlmann, B., 1984. Biosistemática de las especies norteamericanas del género *Ateuchus* (Coleoptera: Scarabaeidae: Scarabaeinae). *Folia Entomol. Mex.* 60, 3–81.
- Kohlmann, B., 1996–1997. The Costa Rican species of *Ateuchus* (Coleoptera: Scarabaeidae: Scarabaeinae). *Rev. Biol. Trop.*, 177–192, 44/45.
- Kohlmann, B., 2000. New species and distribution records of Mesoamerican *Ateuchus* (Coleoptera: Scarabaeidae). *Rev. Biol. Trop.* 48, 235–246.
- Kohlmann, B., Halffter, G., 1988. Cladistic and biogeographical analysis of *Ateuchus* (Coleoptera: Scarabaeidae) of Mexico and the United States. *Folia Entomol. Mex.* 74, 109–130.
- Kohlmann, B., Solís, A., 2009. New species of *Ateuchus* and *Canthidium* (Coleoptera: Scarabaeidae: Scarabaeinae) from Costa Rica. *Zootaxa* 2219, 31–37.
- Kohlmann, B., Solís, A., 2012. New species and revalidations of scarab beetles (Coleoptera: Scarabaeidae: Geotrupinae and Scarabaeinae) from Costa Rica and Panama. *Zootaxa* 3193, 28–52.
- Lobo, J.M., Halffter, G., 1994. Relaciones entre escarabajos (Coleoptera: Scarabaeidae) y nidos de tuza (Rodentia: Geomyidae): Implicaciones biológicas y biogeográficas. *Acta Zool. Mex.* 62, 1–9.
- Solís, A., Kohlmann, B., 2013. El género *Uroxys* (Coleoptera: Scarabaeidae) en Costa Rica. *G. It. Ent.* 13, 289–340.
- Zunino, M., 1978. L'armatura genitale negli Onthophagini: Tecniche di preparazione e criteri di studio. L'informatore del Giovane Entomologo (supl.). *Boll. Mus. Zool. Univ. Torino.* 90, 1–5.
- Zunino, M., Halffter, G., 2007. The association of Onthophagus Latreille, 1802 beetles (Coleoptera: Scarabaeinae) with vertebrate burrows and caves. *Elytron* 2, 17–55.