

Presence of the four-spined pygmy devil, *Arulenus validispinus* (Orthoptera: Tetrigidae), confirmed in Bukidnon region on the island of Mindanao, Philippines

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Abstract

The four-spined pygmy devil (*Arulenus validispinus* Stål, 1877) is an endemic species to the Philippines. It was described more than 140 years ago from a single female specimen. Since its description, only a single new record was known, reported by Skejo from the Lanao region in 2017 and based on a specimen from eBay. Here, we record the species from the Bukidnon Mountains. We present measurements of a male and a female we collected, with the description of the species morphology and habitat. This species differs from its congeneric Mia's pygmy devil (*A. miae* Skejo & Caballero, 2016) by the sharp dorsal and lateral spines.

Keywords

Arulenus miae, habitat, morphology, Mt. Pantaron, taxonomy

Introduction

The Philippines is biogeographically one of the most diverse countries due to its high number of islands (Mittermeier et al. 1998). Mindanao, a major island of the Philippines, is located on the southern part of the archipelago. Recently, discoveries of a new species and records of pygmy grasshoppers were made in Mindanao (Skejo and Caballero 2016, Tan et al. 2019, Mohagan et al. 2020). The Bukidnon is located in the central part of Mindanao and contains one of the most extensive mountain massifs of the island—the Mt. Pantaron Range—which is a major part of the central cordillera (Gronemeyer et al. 2014). The mountain region has a high biodiversity value (Coritico et al. 2018). A faunistic inventory was recently conducted in the area, during which an interesting species of pygmy grasshopper was collected, *Arulenus validispinus*, which had not been recorded for more than a century.

The four-spined pygmy devil (*A. validispinus* Stål, 1877) is an obscure species that was, until today, known only from the holotype female collected by Semper in the Philippines without specified locality (Stål 1877, Skejo and Caballero 2016, Skejo 2017)

and a female specimen on eBay from the Lanao region of the island of Mindanao. The other species of the genus, Mia's pygmy devil (*A. miae* Skejo & Caballero, 2016), inhabits the area west of *A. validispinus*' distribution (Skejo 2017).

Our study presents, for the first time, measurements and habitat of a male *A. validispinus*.

Materials and methods

Entry protocol and permits.—Compulsory permits, such as an approved Gratuitous Permit (GP) from the Department of Environment and Natural Resources in compliance with RA 9147 for the collection of the specimens and Institutional Animal Care and Use Committee (IACUC), were obtained.

Field sampling, collection of specimens, photography, and measurements.—The study was conducted in the lower and upper montane forest of Mt. Pantaron, Sitio Miaray, Barangay Mandahican, Cabanglasan (8°27'73.0"N, 125°36'54.6"E; 1004 m.a.s.l.; 03–14 February 2020) (Fig. 1). The combination of standard belt-transect and opportunistic and random sampling was implemented in the study. The collection of specimens was conducted along an established 2-km transect covering 10 m x 5 m on both sides.

Specimens of *Arulenus validispinus* were collected by handpicking when encountered during the diurnal (07:00 h–15:00 h) and nocturnal (17:00 h–22:00 h) period. They were then put in vials filled with 95% ethyl-alcohol for preservation. Specimens were air-dried and mounted. Images of *A. validispinus* were taken using a DSLR Canon EOS 700D camera combined with an AmScope stereomicroscope. Final images of the species were edited using licensed Adobe Photoshop CS software. An ocular micrometer was used to measure the specimens. The standard methodology of Skejo and Bertner (2017), Tumbrinck and Skejo (2017), and Muhammad et al. (2018) were used for gathering measurements.

The following measurements were taken: **Body length** (from fastigium to the end of pronotum), **pronotum length (PL)** (from

the anterior margin to the caudal apex of the pronotum), **pronotum lobe width (PW)** (between the lateral lobes), **pronotum height (PH)** (lateral view from the bottom of the paranota to the tip of the highest spine), **fore femur length (FFL)** (in lateral view, its greatest length from the tip of the dorso-basal lobe to the tip of the knee), **fore femur width (FFW)** (in lateral view, its greatest width), **mid femur length (MFL)** (in lateral view, its greatest length from the tip of the dorso-basal lobe to the tip of the knee), **mid femur width (MFW)** (in lateral view, its greatest width), **hind femur length (HFL)** (in lateral view, its greatest length from the tip of the dorso-basal lobe to the tip of the knee), **hind femur width (HFW)** (in lateral view, its greatest width), **vertex width (VW)** (between the supraocular lobes in dorsal views or between the eyes in frontal view), **compound eye width (CEW)** (dorsal or frontal view), and **antennal length (AL)** (from scapus to the tip of the last segment). The specimens collected and examined in this study were deposited in Central Mindanao University, University Museum, Zoological Section, Tetrigidae collection. All measurements are shown in millimeters.

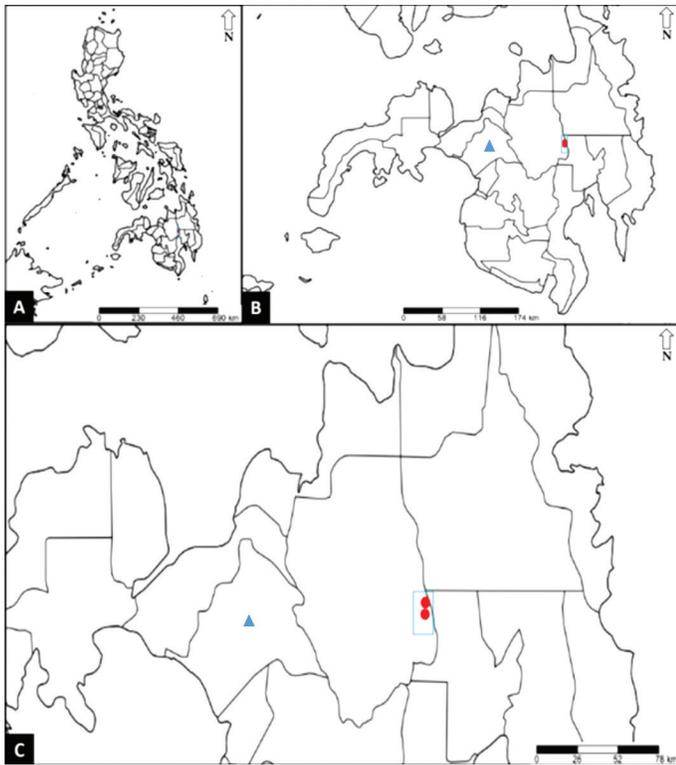


Fig. 1. Map of A. the Philippines and B. Mindanao showing the known distribution of *A. validispinus* in C. Mt. Pantaron, Sitio Miarray, Barangay Mandahican, Cabanglasan where the specimens were collected (red circles) and in Lanao region based on a specimen from eBay (blue triangle).

Results and discussion

Diagnosis of the genus.—The genus can be easily distinguished from similar genera by the following characters: a single paranotal lobe present, tegmina and alae absent, lateral paranotal lobes turned outwards, pronotum surface smooth, slightly wrinkled, and high spines present on pronotal discus. The genus can be separated from *Discotettix* by the shape of paranota, absence of wings, pronotum that is not wrinkled and not tuberculated, and smooth femora surface (Skejo 2017).

Diagnosis of the species.—We collected two specimens, a male and a female, from Bukidnon. Our specimens are very similar to Stål's type specimen, which is from an unknown locality, as well as to the specimens reported by Skejo (2017) in his diploma thesis, which came from Lanao, 105.41 km from Bukidnon. The specimens of four-spined pygmy devils are dark in coloration, and as in *A. miae*, have reddish markings. Dorsum of pronotum bears four long spines: a pair between the shoulders on the bulky elevation of the discus and a pair in the metazona. Our specimens have slightly larger spines and longer ventrolateral projections (Fig. 2) than the holotype (see holotype of *A. validispinus* in Orthoptera Species File, Cigliano et al. 2020). The holotype has a third pair of wart-like spines located at the anterior apex that are not observed in our specimens.

Comparison with congeners.—The genus *Arulenus* is endemic to the Philippines with only two known species, *A. miae* and *A. validispinus*. *A. validispinus* is similar to *A. miae* Skejo & Caballero, 2016, and can be distinguished by the set of the following characters: (i) prozona of pronotum granulated, very wrinkly (slightly granulate, more or less smooth in *A. miae*), (ii) metazona of pronotum from 2.8/10 to 4.5/10 of pronotum length, bearing the first pair of spines higher than the second (more than 2×), from 5.1/10 to 6.5/10 of the length bearing the second pair of spines high, hind femora more robust (length/maximal width ratio 2.4 in male and 2.5 in female), and with dorsal margin undulate and tuberculate, and (iii) notable spiky ventrolateral projections of the lateral lobes (paranota).

Material examined.—PHILIPPINES • (2/2) 1♂1♀. Bukidnon, Cabanglasan, Barangay Mandahican, Sitio Miarray, Mt Pantaron, 8°27'73.0"N, 125°36'54.6"E, 1,004 masl, 03–14 Feb. 2020, AM-011, A.B. Mohagan, R.R. Patano Jr., M.S. Acola, D.O. Amper, F.P. Coritico, and V.B. Amoroso, Central Mindanao University, University Museum, Zoological Section.

Type locality.—The Philippines, no specified locality of the holotype label. Type series: a single female holotype, labeled Ins. Philipp., originates from Semper's collection and is deposited in the entomological collections of the Naturhistoriska Riksmuseet in Stockholm, Sweden.

Distribution.—Inhabiting tropical mountainous rainforests on Mindanao (the Philippines) at 800–1,100 m above sea level: known from Lanao and Bukidnon Region (present study).

Measurements.—Male (N=1). BL 11.1; PL 10.4; PW 6.2; PH 5.0; FFL 4.0; FFW 0.8; MFL 4.5; MFW 0.6; HFL 6.1; HFW 2.5; VW 1.2; CEW 1.0; AL 7.2.

Female (N=1). BL 12.0; PL 10.8; PW (between the tips of the spines) 6.5; PH 5.2; FFL 4.15; FFW 0.14; MFL 4.6; MFW 0.65; HFL 6.52; HFW 2.65; VW 1.24; CEW 1.1; AL 7.6.

Habitat and ecology.—The species is found on tree bark in the montane forest (Fig. 3), similar to the habitat of *A. miae* and *Spartolus pugionatus* Stål, 1877 (Mohagan et al. 2020). The associated vegetation consists of the following species of trees: *Shorea* spp., *Lithocarpus* spp., *Ficus* spp., *Pinanga* spp.; and ferns: *Sphaeropteris elemeri*, *S. polypoda*, *Alsophila fuliginosa*, *Taenitis blechnoides*, *Schizaea dichotoma* and *Selaginella* spp. Besides the Lanao region (Skejo 2017), here we report the species from the Bukidnon region, more specifically Mt. Pantaron, Sitio Miarray, Barangay Mandahican, Cabanglasan. These records finally confirm that *A. validispinus* inhabits Mindanao island in the Philippines—an answer to a 140-year old question of this species' distribution.

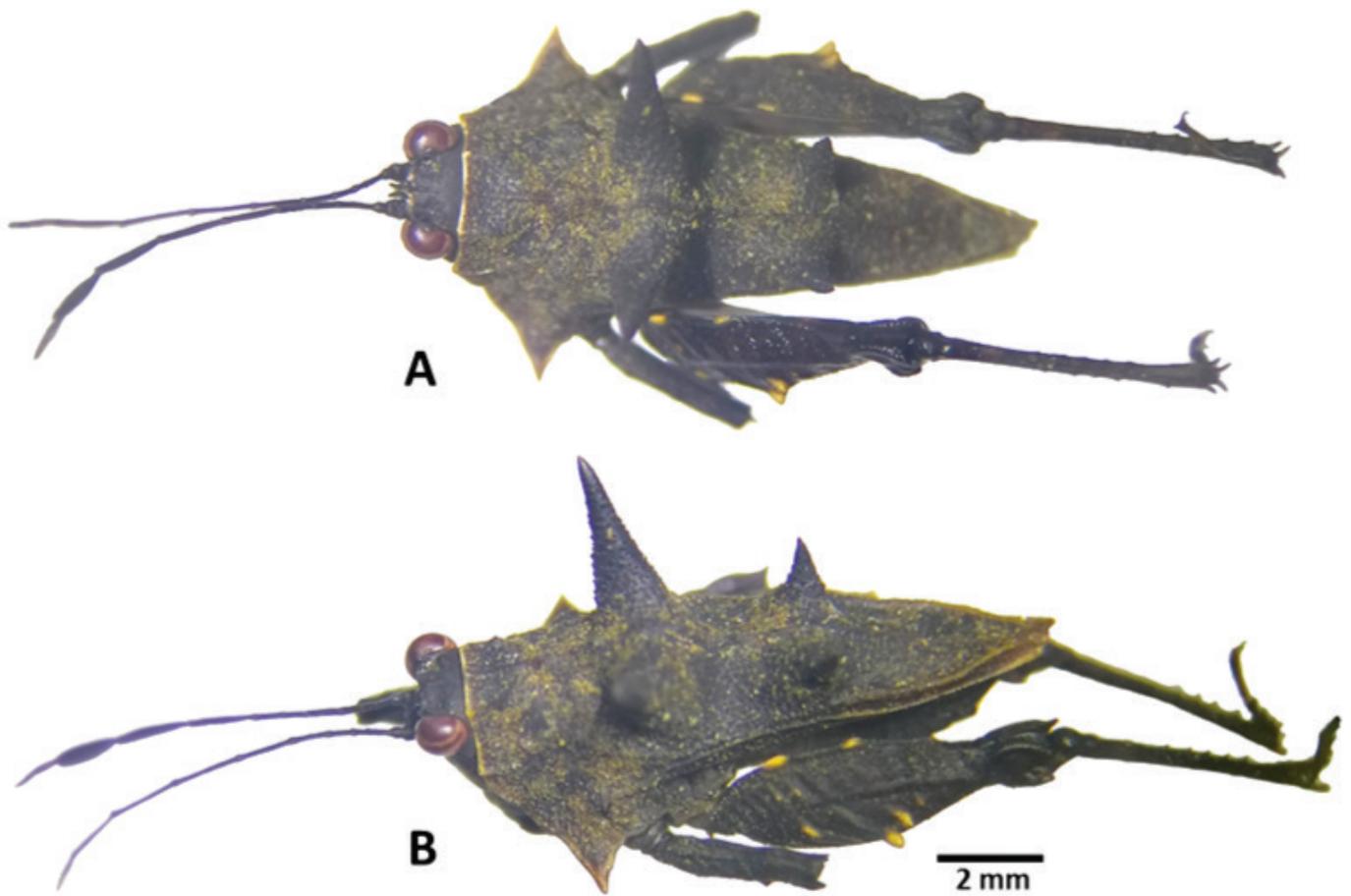


Fig. 2. Habitus of the four-spined pygmy devil, *Arulenus validispinus* Stål, 1877, a male from Bukidnon (Mt. Pantaron) in A. dorsal and B. lateral view.



Fig. 3. Habitat of the four-spined pygmy devil, *Arulenus validispinus* Stål, 1877, in A. lower and B. upper lowland dipterocarp rainforest of Mt. Pantaron (about 1,004 masl).

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Supplementary material 1

Authors: Alma B. Mohagan, Romeo R. Patano Jr., Mescel A. Acola, Daniel O. Amper, Fulgent P. Coritico and Victor B. Amoroso

Data type: Morphometric data

Explanation note: We provide supplementary data on *Arulenus validispinus* morphometric data and comparing to its sibling *Arulenus miae*.

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