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**RESEARCH NOTE**

# New Distribution Record for *Paraspartolus curiosus* Gunther, 1939 (Orthoptera: Tetrigidae) with Notes on Taxonomy and Biogeography

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***Paraspartolus* Günther, 1939 is a monotypic genus endemic to the Philippines. Its only species – *P. curiosus* Günther, 1939 – has been known only from Cape Engaño, Santa Ana, Cagayan, Luzon Island. Even though the species was described more than 80 years ago, only three specimens have been known, and nothing about the species' coloration, variability, or ecology was noted. In this study, we provide live photographs of the species for the first time from Negros Island – some 1000 km away from the type locality. We present detailed measurements of the collected male and female specimens and describe the species' color variations and microhabitats, including their bryophyte associates. We provide comments on the distribution of the species and identify problems with the higher classification.**

Keywords: Balinsasayao Twin Lakes Natural Park, biogeography, microhabitat, montane forest, Ophiotettigini, taxonomy

The Philippine archipelago is a known habitat of diverse fauna, including some interesting pygmy grasshoppers of the orthopteran family Tetrigidae. Recent research has been focused on the Mindanao Islands, and discoveries of new species and records of pygmy grasshoppers followed (Skejo and Caballero 2016; Tan *et al*. 2019; Mohagan *et al*. 2020a, b, c; Patano *et al*. 2021a, b). On the other hand, many islands in the Philippines are still underexplored such as the Visayas Islands, which are known habitats of pygmy grasshoppers. This study focuses on the Negros region, home to some island endemic tetrigids (Hebard 1923; Cigliano *et al*. 2017). One of the important protected forest and mountainous areas in Negros Island is the Balinsasayao Twin Lakes Natural Park (BTLNP) – a declared protected area due to its many endemic and threatened species of flora and fauna (Dolino *et al*. 2004; Aureo *et al*. 2019, 2021). BTLNP is one of the Philippines' long-term ecological research sites (LTERs).

*Paraspartolus curiosus* Günther, 1939 is the only known species of its genus, which was only recently assigned to the tribe Ophiotettigini Tumbrinck & Skejo, 2017, subfamily Metrodorinae Bolívar, 1887. The higher taxonomic placement is still unclear, owing to the many problems of Tetrigidae classification (Pavon-Gozalo *et al*. 2012; Tumbrinck and Skejo 2017). *P. curiosus* is a fittingly named curious and rarely observed species. It was originally described over 80 years ago (Günther 1939) from Luzon in the far north of the Philippines. Until now, the holotype female and the two paratypes (male and female) deposited in London, United Kingdom (Cigliano *et al*. 2017) were the only known records

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of this species. The male is in bad condition, lacking legs and a head, whereas the females are, apart from antennae, mostly intact (Natural History Museum 2023). The color has faded in all three specimens. For the first time, our recent faunistic survey in a forested area of Negros Island in BTLNP (an LTER site), Sibulan, Negros Oriental, documented the species in its natural habitat, specifically on its host plant. Moreover, we provide the new distribution record, habitat description, and potential threats of the species in Negros Island, Philippines.

In the present study, we present new records of two more specimens (male and female) more than 1000 kilometers from the type locality and provide live photographs showing the colorations of the species that cannot be easily observed in old museum collections. We assess the differences between the male and female specimens, provide descriptions of microhabitats, and identify potential threats. Lastly, we provide taxonomic and biogeographic comments.

Prior to the fieldwork in BTLNP, Sibulan, Negros Oriental, the research plan was initially presented to the leader and members of the people's organization and the Department of Environment and Natural Resources (DENR). The latter approved and issued the Gratuitous Permit, in compliance with Republic Act No. 9147, to collect the specimens.

The present study was conducted in the locality of Negros Oriental, Sibulan – specifically in the forested areas of BTLNP (09°21.586" N, 123°10.892" E, 905 masl, 28–29 Sep 2023), which is one of the known LTERs of the Philippines (Figure 1). Opportunistic and random sampling methods were implemented in the established 2-ha permanent plot in the area. Specimens were collected along the established transects in the protected area.

Specimens of *P. curiosus* were photographed in their natural habitat and then collected through handpicking during the diurnal period (07:00–15:00 h). Specimens were preserved in vials with absolute ethyl alcohol for future molecular study. Male and female specimens were photographed using the Olympus TG6 digital camera. Images were edited using licensed Adobe Photoshop CS software. A digital caliper was used to measure the specimens employing the standard methodology of Skejo and Bertner (2017), Tumbrinck and Skejo (2017), and Muhammad *et al*. (2018). The specimens were identified by comparison with the type specimens available on the OSF (Cigliano *et al*. 2017) and the specimens from the

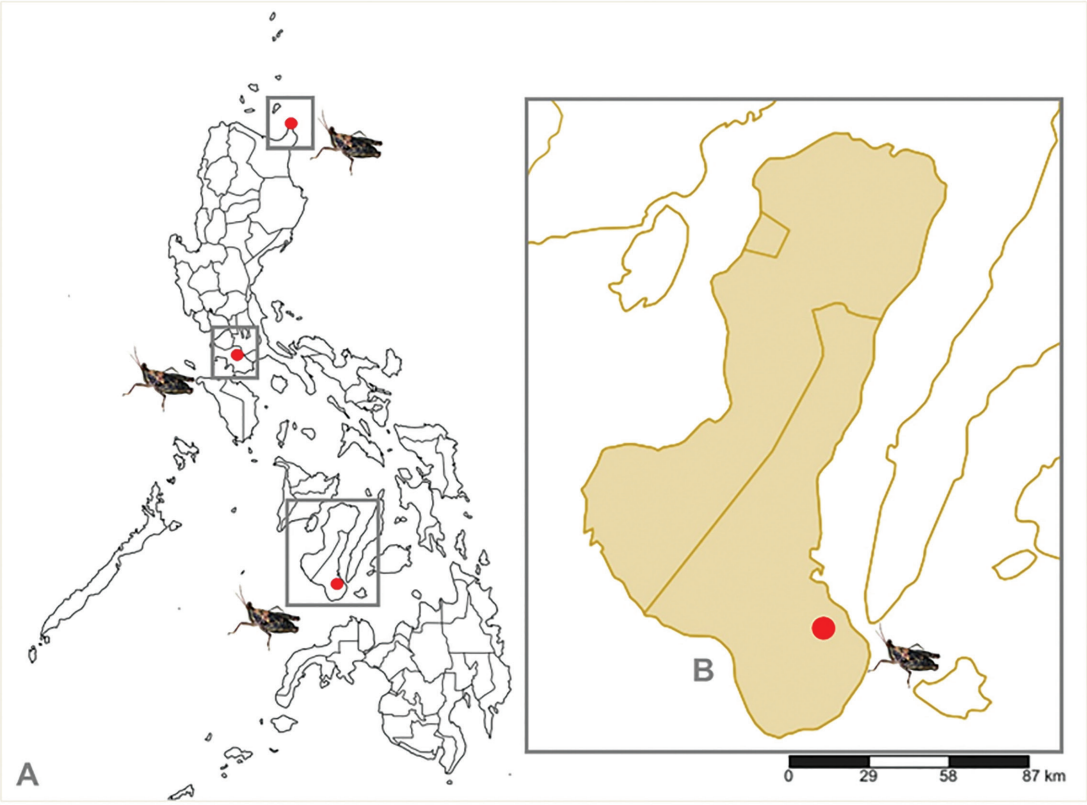


**Figure 1.** Distribution records of *Paraspartolus curiosus* Günther, 1939 in the Philippines in red dots (A) with a new island record in Negros Island (B) specifically in Balinsasayao Twin Lakes Natural Park, Sibulan, Negros Oriental (09°21.586" N, 123°10.892" E; 905 m asl).

National History Museum, London (Natural History Museum 2023) and *Museo Nacional de Ciencias Naturales*, Madrid (MNCN). The original description was verified using the description by Günther (1939).

The measurements that were taken are the following: body length (BL), pronotum length (PL), pronotum lobe width (PLW), pronotum height (PH), fore femur length (FFL), fore femur width (FFW), mid femur length (MFL), mid femur width (MFW), hind femur length (HFL), hind femur width (HFW), vertex width (VW), compound eye width (CEW), and antennal length (AL). The specimens were mounted, deposited, and displayed in the Central Mindanao University, University Museum, Zoological Section, Tetrigidae collection. All measurements are shown in millimeters.

The monotypic genus *Paraspartolus* is most similar to *Spartolus*, with which it shares the moderately elongated head without a noticeable protrusion of the vertex but is clearly separated from it by the following characteristics: [i] short pronotum (apex reaching half of femur length); [ii] lateral lobes contiguous with body, lacking sharp projections; [iii] thicker anterior and middle femora; and [iv] greyish to brownish color with yellow streaks and patches (Figure 2).

The genus *Paraspartolus* belongs to the tribe Ophiotettigini – together with *Ophiotettx* Walker, 1871, *Rhopalotettix* Hancock, 1910, *Spartolus* Stål, 1877, and *Uvarovithyrsus* Storozhenko, 2016. The elongated head shape has been

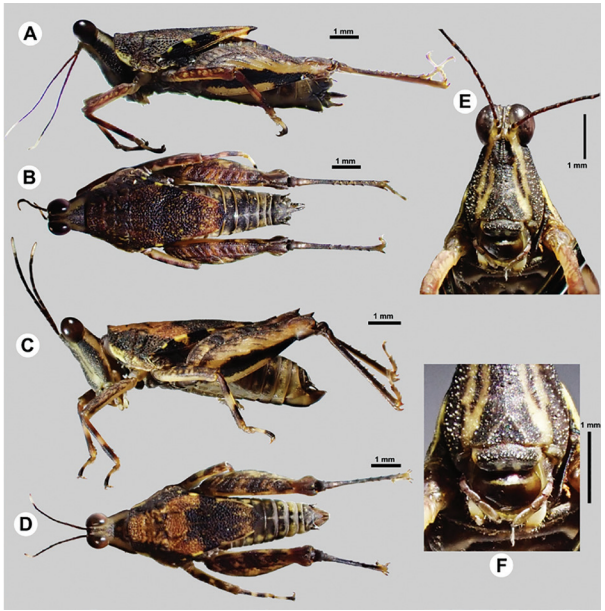


**Figure 2.** Appearance of the *Paraspartolus curiosus* Günther, 1939 showing its color patterns (A–D) and frontal views (E–F). Female (A–B) and male (C–D) specimens from Balinsasayao Twin Lakes Natural Park, Sibulan, Negros Oriental. Lateral (A and C) and dorsal (B and D) view.


**Figure 3.** The female specimen of *Paraspartolus curiosus* from Ignacio Bolívar's collection, reported by Paris (1993) as "Cisthrecus ophthalmicus" (undescribed species). Photo: Josip Skejo and M.N.C.N. Madrid.

suggested as a clear synapomorphy of this supposedly monophyletic (or holophyletic) tribe (Tumbrinck and Skejo 2017), and there is no reason to doubt this at the moment. The morphology of *P. curiosus*, most notably the head morphology, strongly resembles that of many other species attributed to this tribe, making it likely monophyletic. The genus *Rhopalotettix* has been noted to contain some species that strongly differ from the type species (Tumbrinck and Skejo 2017). *Rhopalotettix* is extremely important to consider since it contains species with different combinations of elongation of the head and the elongation of the vertex, which makes them important in elucidating the evolution of these characters, but only after appropriate revisions have been conducted.

Ophiotettigini is a morphologically very distinct tribe, making it difficult to compare in depth to others. However, the tribe Clinophaestini Storozhenko, 2013 shares with Ophiotettigini some potential synapomorphies – namely, the positioning of facial features and the way the vertex forms a rostrum in Clinophaestini and *Uvarovithyrsus*. An in-depth study is necessary to determine whether *Uvarovithyrsus* and potentially *Rhopalotettix* belong to Clinophaestini instead of Ophiotettigini, as indicated by their similarly-shaped rostrums, or whether these tribes are synonymous.

The placement of Ophiotettigini in the subfamily Metrodorinae is a better reflection of its unique morphology in the region than its true place in the Tetrigidae tree of life. A proper definition of core Metrodorinae is still lacking because even the type genus *Metrodora* Bolívar, 1887 includes many different morphologies (Pavon-Gozalo *et al*. 2012; Kasalo *et al*. 2023). A comparison

between Metrodorini and Ophiotettigini is not enough to hypothesize how the two might be related. An extensive review of SE Asian and American Tetrigidae, followed by molecular phylogenies, will be necessary.

PHILIPPINES • (2/2) 1♂1♀. Negros Oriental, Sibulan, BTLNP, 09°21.586" N, 123°10.892" E, 905 masl, 28–29 Sep 2023, R.R. Patano Jr. and V.B. Amoroso, Central Mindanao University, University Museum, Zoological Section.

In a catalog of Ignacio Bolívar's collection of Tetrigidae, a male specimen of "*Cisthrecus ophthalmicus*" from Mt. Makiling, Luzon, collected in 1937 by Baker is mentioned (Paris 1993). This specimen was identified as *Paraspartolus curiosus* by Josip Skejo in 2016. Upon examining this specimen, we found it to be a female of *Paraspartolus curiosus*, as it corresponds exactly to the morphology of the other known specimens of this species. Furthermore, the species "*Cisthrecus ophthalmicus*" was never formally described, as indicated by the label "*especie no publicada*".

Luzon, Cape Engaño, Santa Ana, Cagayan; a female holotype plus two male and female paratypes are deposited in the entomological collections of the British Museum of Natural History, National History Museum. Cape Engaño is known to have forest patches and grasslands over karst substrates, but there is no information on the exact microlocality where the species was collected. It is, thus, impossible to compare the type locality with the new one until more specimens are found in Cape Engaño.

Known from northern Luzon (type locality, Cape Engaño), southwestern Luzon (Mt. Makiling) (Paris 1993), and the newly identified locality: tropical lower mountainous rainforests on Negros, Visayas (the Philippines) at 900–950 m above sea level – known from BTLNP, Sibulan, Negros Oriental.

The three localities on the two islands are far apart from each other, but there are no apparent differences that would suggest that these populations represent separate species. The Philippine archipelago formed during the last 30 My (Mitchell *et al*. 1986), leaving a large window during which the populations might have become separated. Since this species and its close relatives are all flightless, active migration does not seem likely. There may be undiscovered populations between the known three, *i.e. P. curiosus* might be a widely distributed species, which could mean that there is a persistent gene flow between them. Alternatively, it is possible that these populations are separate but morphologically cryptic species, *i.e.* the genus *Paraspartolus* is represented by many microendemic species. It will be necessary to collect specimens from the type locality and conduct molecular analysis to show how different these populations really are.

Female (N = 1). BL 9.2; PL 4.8; PLW 2.8; PH 2.2; FFL 2.3; FFW 0.4; MFL 2.4; MFW 0.6; HFL 5.0; HFW 1.6; VW 0.3; CEW 0.8; AL 3.9. Male (N = 1). BL 9.0; PL 4.5; PLW 2.6; PH 2.1; FFL 2.2; FFW 0.2; MFL 2.4; MFW 0.4; HFL 1.6; HFW 1.6; VW 0.3; CEW 0.7; AL 3.8.

The specimens of the three populations are morphologically quite uniform, with no major differences observed in the commonly used characters. Some sex-specific differences have been observed: [i] the male specimen has more yellowish colorations on its pronotum than the female, and [ii] the pronotal apex of the male forms a more acute angle than the female.

Female and male specimens of *Paraspartolus curiosus* Günther, 1939 were observed in Balinsasayao Twin Lakes, Sibulan, Negros Island perching on rotten logs and tree bark (*Ficus* sp.), which are covered with bryophytes (*Pyrrhobryum spiniforme* (Hedw.) Mitt. and some other species from family Hypnaceae) (Figure 4).

These bryophytes might be a food source for the species. This pristine habitat of *Paraspartolus curiosus* Günther, 1939 is a typical lower montane old-growth forest dominated by some trees (*Ficus* spp., *Antidesma*

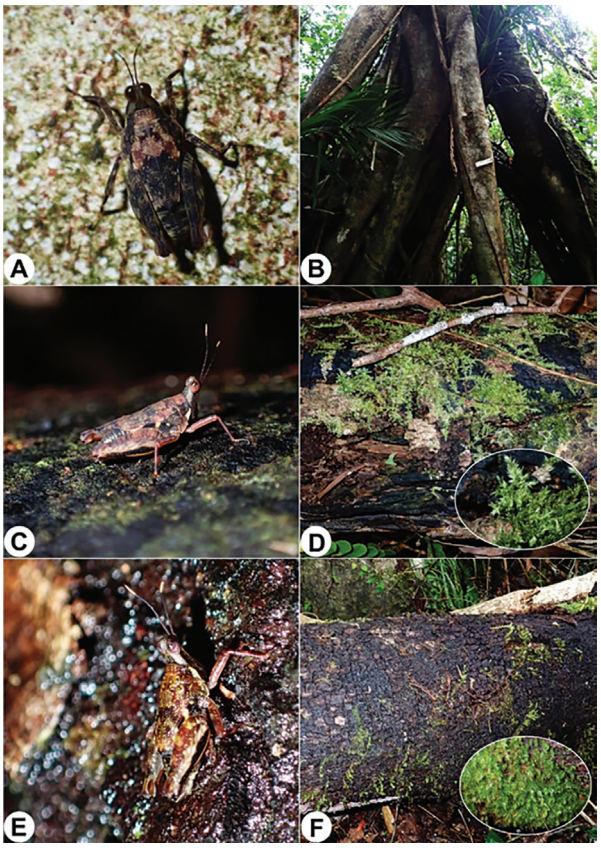


**Figure 4.** Live female and male of *Paraspartolus curiosus* Günther, 1939, in dorsal and lateral views (A, C, and E) with their respective microhabitats (B, D, and F).

spp., and *Euonymus* spp.), some ferns (*Alsophila* spp.), pandans (*Freycinetia* spp.), aroids (*Alocasia* spp.), and pipers (Figure 5). The substrate is mostly covered with big rocks with bryophytes. This locality was a declared protected area in the year 2000 under Senate Bill No. 1067. However, there are isolated cases of hardwood cutting and poaching, which must be eradicated completely. This record confirms that a population of *P. curiosus* inhabits this area, as well as Luzon. The species is still only rarely observed, and there is a possibility that this population represents a separate evolutionary line, making this area an important one for future studies, which is only possible with continued and effective protection.

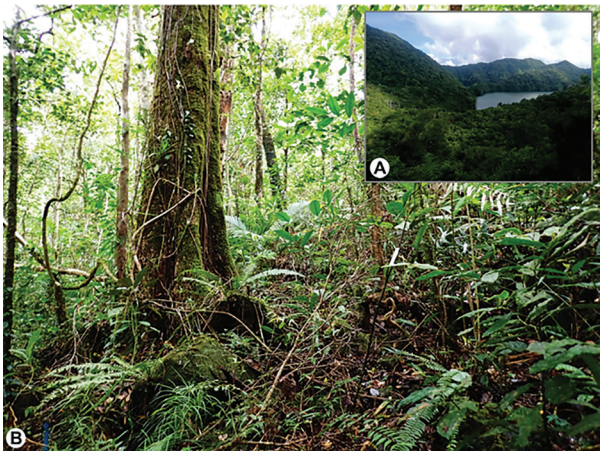


**Figure 5.** Habitat of *Paraspartolus curiosus* Günther, 1939 in the lower montane tropical rainforest (B) of Balinsasayao Twin Lakes Natural Park (A), Sibulan, Negros Island.

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