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The first illustrated *Batocera celebiana metallescens* Pascoe, 1866 (Lamiinae: Batocerini) from Sulawesi (Indonesia) with notes on ecology and habitat

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Abstract

Batocera celebiana metallescens Pascoe, 1866, which is a species endemic to Sulawesi Island, Indonesia. This report presents related male and female morphological and genital characteristics for the first time since it was first described by Pascoe, 1866 and the latest report by T'Joen and Houllier, 2023. In addition, this article also presents useful habitat and host plant data in conservation efforts of Sulawesi endemic species.

Keywords: Cerambycidae, ecology, endemic, longhorn beetle, Sulawesi

Introduction

The genus *Batocera* Dejean, 1835 is a species of beetle with a large size of around 30-55 mm which belongs to the Cerambycidae family, subfamily Lamiinae. This genus is easy to distinguish because it has strong spines on the antennae (Gilmour and Dibb, 1948); antennae that are longer

than the body, the third antennae are longer than the fourth antennomere and the 11th antennomere are longer than the 10th antennomere; (Krische, 1915; Slipinski and Escanola, 2013; Boyane et al. 2021). This genus consists of 55 species that are widely distributed in tropical and sub-tropical climates, including the Afrotropical, Oriental and Australian regions (Slipinski and Escanola, 2013). A total of five nominal taxa were reported from Sulawesi and satellite islands such as *Batocera bryunii* (Lansberge, 1880), *B. celebiana* (Thomson, 1858), *B. grestackerii* (Thomson, 1865), *B. hercules* (Boisduval, 1835) and *B. strandi* (Breuning, 1954). *Batocera celebiana* is the spesies that has the most subspecies among the Batocera species distributed in Sulawesi, namely 10 subspecies (T'Joen and Houllier, 2023). This number is greater than the number of *Batocera* taxa distributed in Australia (Slipinski and Escalona, 2013).

Sulawesi is an island with high endemicity and biodiversity (Myers et al., 2000) due to the history and geological dynamics of this island (Herrera-Alsina et al., 2021). One species that is endemic to Sulawesi Island is *Batocera celebiana metallescens*. *Batocera celebiana metallecens* was described a century ago with limited morphological characters and have a fairly unique historyof description Initial reports regarding by Pascoe (1866) morphological characters of only one specimen with the following characters: general color ocher yellow; abundant pubescence; the body is shiny black where the underside is more faded. The body shape is stronger and more muscular. Two orange-yellow prothorax spots, very large and enlarged, almost meeting at the apex. The tubercles on the anterior part of the elytra are more widely spaced; it has eight spots, two of which are in the anterior third; the other two, very large, are irregular in shape in the middle of their length; and four other points arranged in pairs behind; the last two are the smallest. Later, Krische (1915) considered that this subspecies is a synonym of *Batocera celebiana* because it does not have any striking morphological character differences. Furthermore, Kriesche (1928) mentions that there are differences between the species Batocera celebiana and the subspecies *Batocera celebiana metallescens*. However, he does not give a complete description except the character: the elytra are completely uniformly hairy, only sporadically is there a faint hint of a white central spot (apparently regular in males, whereas complete monochromaticity predominates in females). Subsequently, Breuning (1950) and Rigout (1994) both described two subspecies of *B. celebiana*, *B. celebiana biflavomaculata* and *B. celebiana pierrotae* without looking and comparing them

with *B. celebiana metallescens*. Although there have been recent publications on this species, it is felt that they have not been critical enough regarding the morphological description. To date, there are no recent publications regarding the complete morphological characters of this species. Likewise with the characters that differentiate males and females, although Ehara (1954) has provided a solution related to observing genitalia. We have conducted exploratory studies and ecological understanding that will be useful for future conservation initiatives. For the first time, we present information about the morphological and genital characters of the endemic Sulawesi species *B. celebiana metallescens* as well as ecological data that is useful as part of its conservation efforts.

Methods

Specimens were collected from the Wera Nature Tourism Park, Central Sulawesi Province (fig 1.a), by taking them directly from the tree that hosts *B. celebiana metallescens* (fig 1.b&c) and anesthetized with ethyl acetate in a vial. Apart from collecting directly, we also use specimens that are the result of expeditions that have been carried out in Sulawesi, such as from the wet forests of Lore Lindu National Park, dry forests of Pangi Binangga Nature Reserve (Vitali and Fahri 2019), Bogani Nani Waterbone National Park, Batimurung Bulusaruang National Park, Konawe Islands, and from agroforests around Parigi Moutong Regency (Fahri et al., in review). Specimens from expeditions from several locations were collected using Artocarpus traps (Fahri et al., 2016) and stored at the Laboratory of Animal Biosystematics and Evolution, Department of Biology, Tadulako University, Indonesia and the Museum Zoologicum Bogoriense (MZB) of the National Research and Innovation Agency (BRIN), Indonesia.

Figure 1. Overview of *Batocera celebiana metallescens* beetle collection locations in Central Sulawesi Province: a. The red circle is the sampling location at TWA Wera, Sulawesi. b. *Batocera celebiana metallescens's* habitat is secondary forest. c. Collecting specimens directly from the *Ficus benjamina* host plant.

Morphological and genital characters were observed using a Nikon SMZ745T stereo microscope. Habitus images were taken with a Canon 90D digital camera, and genital images using an S.Eye 2.0 camera connected to a Nikon SMZ745T stereo microscope. All images were edited using Photoshop CS2021 software. The descriptive characters used are based on Slipinski & Escanola (2013) and Boyane et al., (2021). Morphological identification uses guidelines from Thomson (1858) and Pascoe (1886). Making genital preparations and identification refers to Ehara (1954), Slipinski & Escanola (2013); Li & Liang, (2018); Boyane et al., (2021). In this article, illustrations of the dorsal, ventral and lateral female and male genitalia and habitus are shown from specimens whose body parts are still intact.

Results

Famili Cerambycidae Latreille 1802

Subfamily Lamiinae Latreille, 1825

Tribe Batocerini Thomson, 1864

Genus *Batocera* Dejean, 1835

***Batocera celebiana metallescens* Pascoe, 1866**

Specimens examined: 22 males, 13 females**.** 1♀. **Indonesia.** North Sulawesi. Boganinani Watarbone National Park. 14-26 October 1995. A. Salim Leg. (MZB COLE. 178218). 1♂♀. **Indonesia.** West Sulawesi. South Konawe District. South Wawoni sub district. Wongkolo Iwoi Mukulo Village. 28-29 Juny 2006. S:04°. 15' 65.0". E: 123°. 03'. 40.2". Sweeping. Djunijanti Peggie, A. Salim & Sarino Leg. (MZB COLE. 181443 and 181442). 1♀. **Indonesia.** Central Sulawesi. Lore Lindu National Park, Donggala District, Kulawi Subdistrict, Salua village. 12 May 2002. S: 06°. 43' 9,07". E:106°.29'.9,57". Light Trap. Erniwati Leg. (MZB COLE. 181444). 1♂. **Indonesia.** Central Sulawesi. Lore Lindu National Park, Poso District, North Lore subdistrict, Kadua Village. 20 May 2002. S:01°. 26' 38.9". E: 120°. 18'. 45.9". Sweeping. Erniwati Leg. (MZB COLE. 181445). 1♂. **Indonesia.** South Sulawesi. Bantimurung District. 25 Mei 2001. Woro A. N & Pudji A Leg. (MZB COLE. 178219). 2♀. **Indonesia.** Central Sulawesi. Palu-Palolo. Juny 1997. (MZB COLE. 178220 and 178221). 1♂. **Indonesia.** Central Sulawesi. Pangi Binangga Nature Preserve. Agroforest. Handling Collection. 02 November 2017. Sahlan Leg. **(**UNTAD. COLE. 54). 16♂, 8♀. **Indonesia.** Central Sulawesi. Alam Wera Tourism Park. Agroforest. August-December 2022. Novita Hijriah, Arfandi Padju, F. Fahri Leg. (UNTAD. COLE. 55, 56, 57,58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 73, 74, 75,76, 77, 78, 79, 80, 81, 82, 83 and 84). 1♂. **Indonesia.** Central Sulawesi. Sigi District. Mt.Torompupu. 20 November 2017. Evans and F. Fahri Leg. (UNTAD. COLE. 85). 1♂. **Indonesia.** Central Sulawesi. Lore Lindu National Park. August–December 2022. Khofifah I.P. Syahrudin, Aini Anumillah and Dian Husnaya. Leg. (UNTAD. COLE. 111).

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Morphological Characters

Description

In males, the body is flat and elongated from 38.8–58.01 mm; black with fine brownish pubescence all over the body: antennae elongated with sparse black setae; on the lateral side with white pubescence from head to IV ventricle (Fig. 2a).

Head. Hypognathus with trapezoidal front, densely punctate, sparsely pubescent; vertex clearly divides both sides; eyes large, rectangular when viewed from the front and surrounded by brown pubescence; clypeus rectangular with shiny black, setae rarely black, densely puncutate; mandibles strong, curved distally and tapering, black, much puncutate with dense brown pubescence; labrum squeezed as if rising upwards; Labials are shiny brownish on the basal part, covered with fine and dense setae, shiny on the apical part (Fig. 2b & c).

Antennae. Strong, black, tapering at the apical part; scape clearly enlarged apically with scapus-cicatrix, scattered granules, thinly pubescent, scattered and brown; rounded pedicel equipped with spines on the lateral side; Antennomere III-XI are equipped with strong spines on the lateral and apical sides, black setae are rare. In males, the antennae are 88.1 mm or 3.1 times the length of the elytra; reaches elytra apex at basal part of antennomere VII; Antenna formula based on antennomere III; scape: 0.45, pedicel: 0.06, IV: 0.64, V: 0.54, VI: 0.53, VII: 0.56, VIII: 0.54, IX: 0.51, X: 0.48 and XI: 0.64.

Thorax. Pronotum is 0.73 mm wider than long, anterior margin straight, posterior margin sinuous, lateral margin sharply sinuous equipped with strong spines whose tips face dorsally, with granules on the sides, setae black, dense white pubescence. The median is narrowed as if raised upwards, an orange pubescent median oval area dividing the two sides with several ridges on the sides (Fig. 2c). Prosternal area in front of procoxae with fine transverse indentation; prosternal process narrowed between procoxae, margins as if raised. The mesoventrite is broad with the mesoventral prosternum looking like a “tongue” extending between the mesocoxae and covered with dense orange pubescence; short metaventral process not reaching anterior to the mesoventral process and

with a strong median area; the metaventral surface is densely covered with dense white pubescent setae that do not reach the ventrite (Fig. 2g.).

Elytra. Elongate covered with brown pubescence, narrow at the elytra, wide at the humerus and narrow at the apical part, filled with large granules at the humerus, gradually narrowing at the median and not reaching the apex; the median to the apex has a curve; There were 6–8 white tometose patches in males with 2 large, irregularly shaped tometose patches located in the median, arranged neatly and sequentially, but there were several specimens that we examined tometose patches totaling 8–9 irregularly (Fig. 2e). The apical elytra is truncated, there are protruding and blunt spines. The scutellum is shaped like a “tongue”, with white pubescence only found on the underside.

Abdomen. Ventrite elongated, covered with dense brown pubescence. Each segment with a smooth area transverse to each segment. Ventrite I is longer than ventrites II to IV, but longer than ventrite V and narrows at the apex. At the ovipositor the male genitals protrude outward, covered with dense brown pubescence and yellowish black setae.

Legs. Strong legs. In males, the profemur has granules and is prickly at the base, the protibia also have prominent spines; all tarsi with 4 visible segments and separated by 180 degrees; The protarsi have strong, protruding spines and the metatarsi have spines that are reduced and weakened.

Female. Almost similar to males, cylindrical in shape with a body length of 29.3–51.5 mm. Antennas are shorter, smoother, without wrinkles and strong spines; scape: 0.63, pedicel: 0.09, IV: 0.58, V: 0.49, VI: 0.49, VII: 0.43, VIII: 0.48, IX: 0.38, X: 0.34 and XI:0.49 (Fig. 2f.). Elytra with white tometose patches numbering 8-9 with 2 large and neatly arranged, apical elytra without (Fig. 2f.) profemur and protibia do not have granules and spines, pro and metatarsi have no spines. V-VII ventrites are curved downwards, the female genitals are less protruding outward, slightly expanded, covered with dense brown pubescence and black setae.

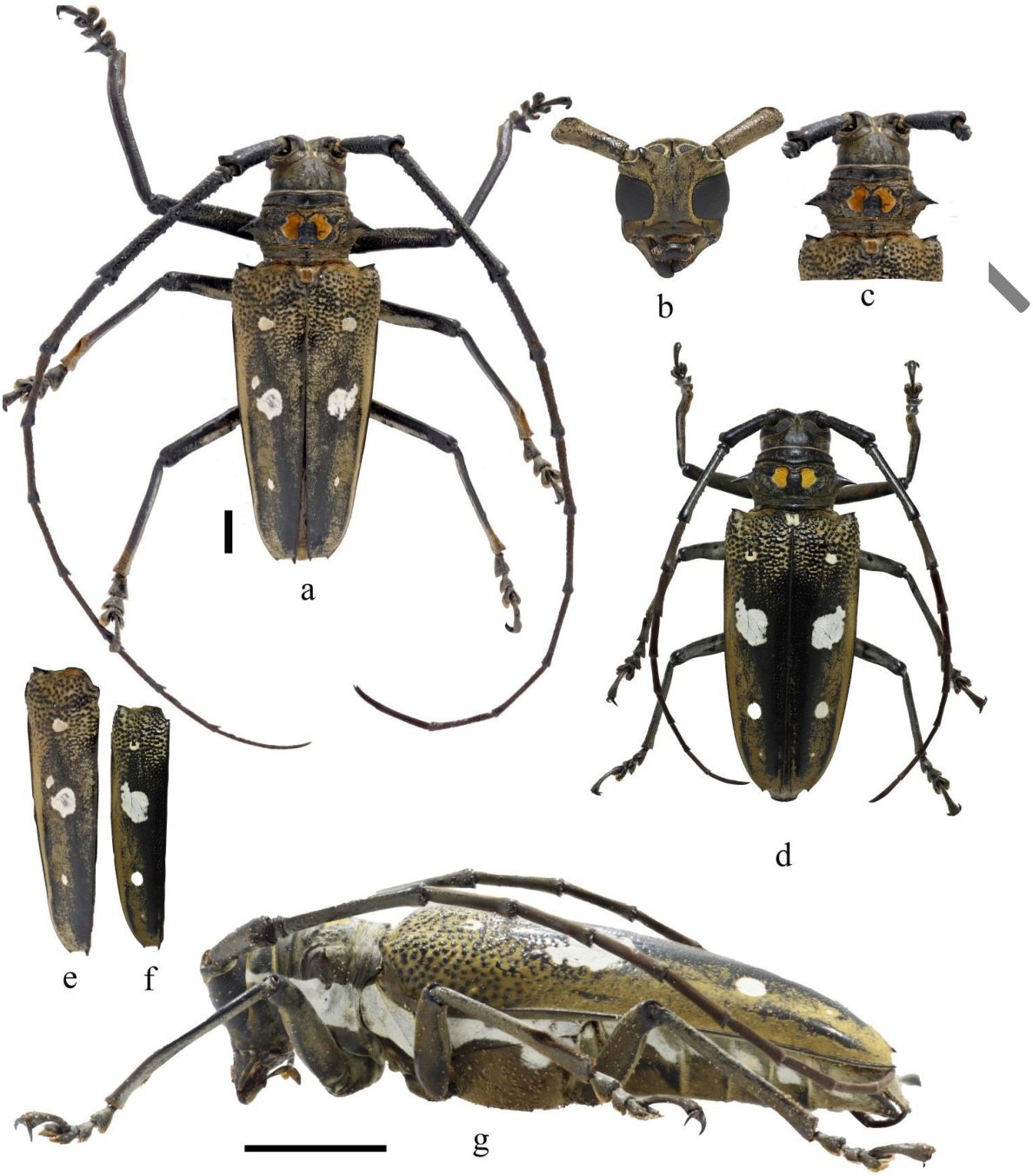

Figure. 2. Habitus *Batocera celebiana metallescens*. a. Dorsal view of male. b. Head in front view. c. Dorsal view of pronotum. d. Dorsal view of female. e. Dorsal view of elytra male. f. Dorsal view

of elytra female. g. Lateral view of female. Scale bar. a-f 5 mm. Scale bar. g. 10 mm. Photos by R. Risaldi.

Genital Characthers

Male. Strong and sturdy, shaped like a bullet; the length of the aedegus is about 5 mm (Fig. 3a.). Median lobe somewhat curved distally; ventral edge of median pit rounded (Fig. 3b.); endophallus without sclerotization of spines; median foramen elongated. Thumb-shaped lateral lobes that appear close together, equipped with dense setae apically; pieces of basalt present curved; ringed part confined, fused, without geniculation at the widest part. Double folded ejaculatory duct (Fig. 3c&d.). The sternite is elongated and has a rounded shape at the apex and is covered with long setae. The spiculum gastrale is elongated with an irregularly rounded base (Fig. 3f).

Female. 7 mm long, cylindrical in shape. Sternite and tergite are the same length, square in shape; in the 8th segment is well sclerotized the apical ring of the 8th sternite which is the tip of the ovopositor is narrowed as if it were not tightly closed, most of the apical sternite-8 has sparse setae; The gastral spiculum is thin and long, almost four times the length of the sternite 8 and also has a rod-like, somewhat thick apex that has an irregular and slightly curved shape (Fig. 3f&g.). The genital sac is stiff and webbed, and has many surfaces. many sclerotized rings. The ovipositor narrows from basal to apical. Apical ovipositor inclined towards the outside, brownish with setae (Fig. 3h.).

Figure. 3. Genital *Batocera celebiana*. a-e. Male genital. a. dorsal view of male aedeagus. b. dorsal view of median lobe. c. dorsal view of tegmen. d. ditto ventral. e. dorsal view of sternite. f-h. Female genital. f. dorsal view of Female genital. g. ditto ventral. h. dorsal view of ovipositor. Scalebar. 0,2 mm. Photos by R. Risaldi.

Geographic Range, Host Plants and Conservation Efforts

Batocera celebiana is distributed only in all areas of Sulawesi Island such as in Dumoga-Bone N.P. or Boganinani Watarbone National Park, Minahasa/Tondano, Manado (part of the North Peninsula), Lore Lindu N.P, Kadua village, Salua, Palolo, Wera TWA (part of Central Sulawesi), Bunta (East Peninsula), Bantimurung (South Peninsula), Kendari (Southeast Peninsula) includes satellite islands such as Wawon Island to Anggai (Obi Island) to Kalidupa Island (Kriesche, 1928). This species is found in the lowlands with an altitude of less than 500-800 meters above sea level

with an average temperature ranging from 28-30℃. This species is often found in secondary forests.

Batocera celebiana metallescens, like most *Batocera* groups, also carries out many activities in the Moracae Family (Fig. 4a). This genus is distributed in mixed forests on all continents except the Antarctic continent (Berg et al. 2006). The typical characteristics of the Moraceae family are white sap, sitting alternate leaves, single, having one supporting leaf on each leaf (Sahromi, 2020) (Fig. 4 b&c). *Ficus celemina* is an example of the Moracae Family. Based on the results of observations made at TWA Wera *B. celebiana metallescens* between 08.00–11.00 WITA and 16.00–18.00 WITA (Fig. 4 f) came to visit the *F. benjamina* plant to carry out feeding activities, rest on branches, leaf stalks and stems, look for mates and laying eggs (Fig. 4 d&e). This reason also causes the use of Artocarpus traps (jackfruit branches) which are also members of the Moraceae Family to collect Cerambycidae beetles (See Fahri et al., 2016).

Similar to *B. celebiana metallescens* in Sulawesi which uses the *F. benjamina* tree as a host plant, *Batocera* species which are distributed in Australia, such as *B. boisduvali*, also use various types of Ficus trees such as *Ficus watkinsiana*, *F. rubiginosa* (also as *F. australis*), *F. microphylla*, *F. variegata* (as *F. ehretioides*) (Froggatt 1923; Duffy 1960, 1963; Hawkeswood & Dauber 1990). However, it is very unfortunate that forest conversion is currently occurring in Sulawesi, which can result in the loss of wild *F. benjamina* trees in the forest which will of course have an impact on the decline in the *B. celebiana metallescens* population in the future (Supriatna et al., 2020) .

Currently, *Batocera celebiana metallescens* with the largest number of individuals ever reported is in the TWA Wera secondary forest area. This area is in a conservation area managed by the government's Natural Resources Conservation Agency (BKSDA). According to reports so far, this species is often found in secondary forest areas which are not far from community activities and are not managed by the government. Community activities include land clearing for plantations, mining and urban development, these activities cause land damage of 7,593ha per year (Djaenudin et al. 2018). These activities cause problems such as changes in environmental quality, loss of natural habitat for flora and fauna, especially insects (Gámez-Virués et al. 2015). Insects of this species are sensitive to environmental changes that occur (Rahayu, 2016). The best way to

conserve this species is to maintain the habitat and host plants, even though the host plants of this species are not endemic species and are widely distributed, however, only old trees are the habitat of this species (personal observation).

Figure. 4. Habitat of *Batocera celebiana metallescens*. Figures a-c. habitus of *F. benjamina*, d-f. Male and female pair of *B. celebiana* in host plant. Photos by R. Risaldi (a-c) and Isaac W. Krone (d-f).

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