SHORT COMMUNICATION

Register of a gynandromorph of *Euglossa pleosticta* Dressler (Hymenoptera, Apidae)

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ABSTRACT. Register of a gynandromorph of *Euglossa pleosticta* (Hymenoptera, Apidae). Here we provide a description of a gynandromorph of *Euglossa pleosticta* with partial bilateral phenotypic asymmetry. The specimen was collected by cineol bait-trap at *Parque Estadual São Camilo*, a conservation unit in western Paraná. The bee has mostly a female phenotype, except by the right half of its head, including the presence of 11 flagellomeres, ivory markings on scape and parocular area, by the pilosity of the right galea, and by deformed male characteristics on mid and hind tibiae of right legs.

KEYWORDS. Apoidea; deviant phenotypes; Euglossini; Insecta; gynander.

Gynandromorphy is a phenomenon in which an individual becomes phenotypically abnormal, differing in expression of male and female characters (Michez *et al.* 2009; Hinojosa-Díaz *et al.* 2012). This phenomenon occurs in individuals with genetic problems during initial development, probably in the first mitotic divisions, resulting in a combination of morphological features of both sexes (Nesbitt & Gartler 1971). The occurrence of intersexuality, another phenomenon that causes deviant phenotypes, can be confused with cases of gynandromorphy. Intersex individuals are genetically uniform, but gene expression is compromised, since the specimen exhibits phenotypic characteristics of the opposite sex (Ramos & Ruz 2013). Some of the known causes for these deviant genotypes involve hormonal abnormalities, chromosomal aberrations, differences in expression of sex determination genes and parasites such as Strepsiptera (Michez *et al.* 2009; Narita *et al.* 2010). Based solely on morphological analysis, it is difficult to attribute the case of a particular specimen to gynandromorphy or intersexuality, so we prefer to adopt the term gynandromorph in a broader sense herein.

Gynandromorphs (or gynander) are considered rare in nature, however relatively common among bees, especially in *Megachile* (e.g. Engel 2007). Hinojosa-Díaz *et al.* (2012) listed cases from 113 species of 29 genera, but this number is certainly underestimated (see Ramos & Ruz 2013; Silveira *et al.* 2012). According to Michez *et al.* (2009), gynandromorphs are classified into three main categories based on the distribution of male and female features throughout the body: bilateral (characteristics symmetrically distributed along body longitudinal axis), transversal (asymmetric distribution), and mosaic (random distribution of characters along the body). A fourth category also considers the ante-

rior-posterior distribution (Dalla Torre & Friese 1889). Among these categories, bilateral distribution is considered the rarest and mosaic is the commonest (Weislo *et al.* 2004). It is important to note that the classification is observational and arbitrary, and specimens may present a mixture of different patterns described among these categories.

Euglossina comprises five genera, and the majority of species of this subtribe are exclusively found in the Neotropical region, especially forested areas (Roubik & Hanson 2004). These bees are known as orchid bees due to the fact that most males pollinate Orchidaceae after visiting the flowers to collect scents later used during courtship to attract females (e.g. Roubik & Hanson 2004; Eltz *et al.* 2005).

A first record of gynandromorphy in *Euglossa* was recently published by Giangarelli & Sofia (2011) based on a specimen collected in a remnant of Atlantic Forest in southern Brazil, and a second register of a gynander of *Euglossa* was made by Hinojosa-Díaz *et al.* (2012), a specimen from Guatemala. The first record of the phenomenon in *Eulaema* was described by Silveira *et al.* (2012) for a specimen collected in an urban area of northeastern Brazil. As previously mentioned, Euglossina are typical elements in Neotropical forests and commonly sampled by ecological studies, so additional records of gynandromorphs should exist in museum collections but were not studied yet.

This study aims to describe a gynandromorph of *Euglossa pleosticta* Dressler, 1982, contributing to the knowledge of gynandromorphy and providing additional data for further studies on this interesting topic. *Euglossa pleosticta* belongs to the *Euglossa purpurea* group (Dressler 1982), the male being characterized by: swollen hind tibia with intense golden reflexes, clypeus blue-green, whitish metepisternal setae, and

convex scutellum (Rebello & Moure 1996). The female is similar to the male except for its green clypeus and scutellar tuft present on about one third of scutellar length (Dressler 1982). This species occurs in the Atlantic Forests of southeastern Brazil, from coastal forests to inland Seasonal Semideciduous Forests (Rebello & Moure 1996; Sydney *et al.* 2010).

The gynandromorph of *Euglossa pleosticta* was attracted to cineol and collected by a bait trap. The collection site is a conservation unit, the *Parque Estadual de São Camilo*, a Seasonal Semideciduous Forest fragment of about 400 ha situated in the western portion of the Paraná state. The original label data is "HYMPAL 3744" "Brasil, Paraná, Palotina, Parque Estadual São Camilo\08.xii.2012, R_Gonçalves\N_Sydney, M_Trassi\D_Damasceno". The specimen is deposited in the *Laboratório de Hymenoptera, Universidade Federal do Paraná, Setor Palotina*. Additional male specimens and a female (DZUP number 040668), from localities of western Paraná state and deposited in the collection of the *Departamento de Zoologia, Universidade Federal do Paraná*, were studied for comparison with the gynander.

Here we provide a description emphasizing sexually dimorphic characteristics; male features are presented in bold with additional comments on dimorphism for some characteristics presented in parenthesis. Terminology and style follow Rebello & Moure (1996) and Faria & Melo (2012). The specimen was dissected after two days in humid chamber, and the sting apparatus was cleared with a 10% KOH solution during 24 hours. Measurements were taken with micrometrical ocular coupled to a Zeiss Stemi DV4 stereomicroscope. Photographs of the specimen were taken at Taxonline facility, DZUP.

Gynandromorph description (Figs. 1–3). Measurements (in mm): body length, 10.8; head width, 4.8; head length, 3.7; maximum interorbital distance, 3.0; intertegular distance, 3.7. Head. Mandibles tridentate, notch between first and second teeth shallow, ivory markings covering basal two-thirds (in normal males occupying more than four-fifths); right galea without long setae on outer margin, left galea with long setae on outer margin; labrum with symmetric longitudinal blackish oval spots (translucid in males); malar area with ivory spot (transverse marking covering almost all surface in males); clypeus green (blue green in males); right antennae with 11 flagellomeres and scape with ivory stripe, left antennae with 10 flagellomeres and scape without ivory stripe; right parocular area with ivory stripe, left parocular area without ivory stripe. Mesosoma. Scutellum convex with arched posterior border and with small navicular tuft, occupying its posterior one-third; fore leg tarsi without setal brushes; right mid tibia with a small circular black tuft in the region of anterior tuft (anterior tuft in normal males with two lobes which form an approximate right angle), posterior tuft and velvet area absent, left mid tibia female-like; right hind tibia with anterior half dilated but posterior half corbicular, glandular depression deformed, rounded (males possess a slit), left hind tibia female-like. Metasoma. Triangular in shape, apically narrowed and with six exposed terga and sterna; sec-

ond sternum without tufts of setae (small widely separated tufts in males); sting and hemitergites symmetrical.

The observed phenotypic variation could be categorized as mixed (Dalla Torre & Friese 1889; Wcislo *et al.* 2004). The right side of the specimen has male characteristics, while the left side is typically composed by female characteristics. However, it is emphasized that the male characteristics are concentrated in the head and in the mid and hind tibiae (Figs. 1–3), while fore legs, mesosoma and metasoma are fully expressed as in normal females, shown by the presence of the navicular tuft on scutellum, absence of tufts on second sternum and of fore tibial brushes, integumental sculpturing, body coloration and feminine sting apparatus. Additionally, on mid and hind right tibiae, there is a mosaic of phenotypic expression, making these structures deformed, especially the hind tibia (Figs. 2–3).

As regards the behavior of the euglossine gynanders, Giangarelli & Sofia (2011) reported that their scent-sampled gynandromorph of *Euglossa* was behaving as male. While the attraction to scents is very common among euglossine males, bee females are rarely sampled with this method (see Knoll & Santos 2012 for a list non-orchid bee females attracted to scents), and these rare records are usually not published or are restricted to personal observations. The attraction to chemical compounds depends on the responses of olfactory receptors in the antennae and the mediation of nervous centers (Eltz & Lunau 2005), and should be very similar in anatomy and physiology between male and female (Lunau *et al.* 2012). As discussed by Wcislo *et al.* (2004) and Michez *et al.* (2009), the few reports of live gynanders suggest that they behave as females. Curiously in the case reported by Silveira *et al.* (2012), the *Eulaema* specimen there studied stung the collector, clearly a female behavior. So we consider that it is very difficult to predict the behavior of gynander individuals in relation to scent attraction.

Comparing with the gynanders of *E. iopoeila* and *E. tridentata* (Giangarelli & Sofia 2011; Hinojosa-Díaz *et al.* 2012), there is a similarity in the trend to partial bilateralism in the three studied specimens. In the gynander of *E. pleosticta*, however, the right half has male characteristics, differently from the other cases, whose left side is primarily male. The specimen of *E. tridentata* also expresses male characteristics in the right side, seen in the inverted pattern of the labrum, and the mid tibia with rudimentary development of the anterior tuft and velvet area. It also has half of the metasoma with male features, differently from that of *E. iopoeila* that only expresses male characteristics in the left half of the second sternum. In the present case, the gynander of *E. pleosticta* does not exhibit any trace of male characteristics in the metasoma.

The gynandromorph of *Eulaema atleticana* shows a different pattern with some anterior-posterior asymmetry due to the presence of male characteristics in the entire head (Silveira *et al.* 2012). Both specimens of *Eulaema* and *Euglossa pleosticta* show a mosaic of features in the hind tibia with a rudimentary tibial organ, making both cases very similar. According to Hinojosa-Díaz *et al.* (2012), the incipient formation of male characteristics in the right mid tibia of

Figs. 1–3. Gynandromorph of *Euglossa pleosticta*. 1. Head in frontal view. 2. Tibia of right mid leg. 3. Tibia of right hind leg. Figures 2 and 3 at same scale. Scale bars: 1 mm.

E. tridentata shows that the modified surface develops posterad, this phenomenon being also observed in the hind tibia of the specimen of *E. pleosticta* (Fig. 3).

Descriptions of gynandromorphs can provide a solid reference to understand the phenomenon of gynandromorphism, with the update on the current knowledge of deviant phenotypes being relevant data to future studies. While the few known cases of gynandromorphy in orchid bees are similar to other cases reported for bees, the phenomenon in this group can be caused by phenotypic expression of different genetic and/or developmental abnormalities. Therefore, further studies on the causes of these deviant phenotypes are still needed.

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