

Species of *Euglossa* (*Glossura*) in the Brazilian Atlantic forest, with taxonomic notes on *Euglossa stellfeldi* Moure (Hymenoptera, Apidae, Euglossina)¹

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ABSTRACT. Species of *Euglossa* (*Glossura*) in the Brazilian Atlantic forest, with taxonomic notes on *Euglossa stellfeldi* Moure (Hymenoptera, Apidae, Euglossina). The species of *Euglossa* (*Glossura*) occurring in the Brazilian Atlantic forest were revised and an identification key to males and females is provided. The status of *Euglossa annectans* Dressler and *E. stellfeldi* Moure is reevaluated and the latter species is transferred from *E. (Glossura)* to *E. (Glossurella)*. Here we also synonymize *E. carinilabris* Dressler under *E. stellfeldi*. Taxonomic notes are provided and relevant morphological features are illustrated. Latitudinal color variation along the Brazilian Atlantic forest, found in two of the species studied here, is also presented and discussed.

KEYWORDS. Euglossini; *Glossurella*; Neotropical; orchid bees.

RESUMO. Espécies de *Euglossa* (*Glossura*) da Mata Atlântica, com notas taxonômicas sobre *Euglossa stellfeldi* Moure (Hymenoptera, Apidae, Euglossina). São revistas as espécies de *Euglossa* (*Glossura*) com ocorrência na Floresta Atlântica, incluindo uma chave de identificação para machos e fêmeas. O status de *Euglossa annectans* Dressler e *E. stellfeldi* Moure foi reavaliado, com a transferência de *E. stellfeldi* do subgênero *Glossura* para *Glossurella*. É proposta, também, a sinonímia de *Euglossa carinilabris* Dressler sob *Euglossa stellfeldi* Moure. Notas taxonômicas e ilustrações de características morfológicas relevantes são apresentadas. Discute-se a variação na cor do integumento ao longo da Floresta Atlântica de duas das espécies aqui estudadas.

PALAVRAS-CHAVE. Euglossini; *Glossurella*; Neotropical.

The subgenus *Glossura* was proposed by Cockerell to include the species of *Euglossa* Latreille with extremely elongated mouthparts, extending far beyond the apex of the abdomen, a biconvex scutellum, labrum longer than wide and with a characteristic keel on the inner surface of the male mid basitarsus (Cockerell 1917; Moure 1969; see Dressler 1978).

Three species of *E. (Glossura)* are considered widely distributed in the Neotropical region, including the Brazilian Atlantic forest: *Euglossa chalybeata* Friese, 1925 which occurs in the Amazon Basin and in the Brazilian Atlantic forest (as far south as the Rio de Janeiro state), *E. ignita* Smith, 1874 occurring in Central America, Amazon Basin and the Brazilian Atlantic forest (also as far south as Rio de Janeiro) and *E. imperialis* Cockerell, 1922 which also occurs in Central America, Amazon Basin and the Brazilian Atlantic forest (as far south as Espírito Santo state). In eastern Brazil, the first two species are restricted to coastal lowland areas covered with Atlantic forest, while the last one also occurs inland, in areas with semideciduous forest in São Paulo and Minas Gerais states and cerrado in Minas Gerais (Moure 1969; Dressler 1982a; Janzen et al. 1982; Rebêlo & Garófalo 1997; Bonilla-Gómez 1999; Tonhasca Jr. et al. 2002; Nemésio 2004; Nemésio & Faria Jr. 2004).

Two additional species of the subgenus *Glossura* have

their distribution restricted to the region considered in this work. *Euglossa annectans* Dressler, 1982 ranges from the state of Espírito Santo to Santa Catarina (Brazil), besides Paraguay and Argentina (Misiones). *Euglossa iopoecila* Dressler, 1982 has been considered as restricted to coastal areas in São Paulo and Paraná states (Dressler 1982a; see Peruquetti et al. 1999), although more recently Roubik (2004) proposed that *E. iopoecila* ranges throughout the entire Brazilian Atlantic forest.

Euglossa stellfeldi Moure, as originally proposed, presents the most restricted distribution of the species here considered, occurring only in coastal areas between the states of São Paulo and Santa Catarina (Moure 1947; Dressler 1982a).

It has been hard to provide a safe determination of specimens of these taxa, especially as regards to *E. annectans*, *E. chalybeata*, *E. iopoecila* and *E. stellfeldi*. When studying material of what he considered *E. chalybeata* from the Amazon basin and the Atlantic forest, Dressler (1982a) proposed the name *E. iopoecila*, as a subspecies of *E. chalybeata*, for the blue color morph found at the southern portion of the Atlantic forest. Recently, Roubik (2004) gave species status to *E. iopoecila*, since he found out consistent structural differences between males of *E. chalybeata* proper and *E. iopoecila*. This author also reinterpreted the distribution patterns of these

taxa: *E. chalybeata* is restricted to the Amazon Basin and *E. iopoeicila* to the Atlantic forest.

Distinction between *E. annectans* and *E. stellfeldi*, which have been placed in their own species-group within *Glossura* (sensu Ramírez et al. 2002; Roubik 2004; see Dressler 1978), is more problematic since they occur in sympatry, and their status as separate species have been questioned recently. Nemésio (2004) proposed the synonymy of *E. annectans* under *E. stellfeldi*, a change followed by Nemésio & Faria Jr. (2004). Later, Nemésio & Silveira (2006:320) made the following comment on the status of *E. annectans*: “in this paper, *E. annectans* is reinstated as a valid species by the first author”. In any case, the proper taxonomic treatment of this problem requires the study of the type material of *E. stellfeldi*, which was not done by the authors above.

The development of a sampling methodology focused on males (see Dodson et al. 1969), and the low abundance of euglossine bees in surveys on blooming plants, make it more difficult to determine the identity of the females and associate them correctly with conspecific males. This problem is more relevant here, since the holotype of *E. stellfeldi* is a female and the holotype of *E. annectans*, a male (Moure 1947; Dressler 1982a).

The aim of this work is to contribute to the taxonomy of subgenus *Glossura* occurring in the Brazilian Atlantic forest providing an identification key to the species and reassessing the status of *E. stellfeldi* and *E. annectans*. The limits between the subgenera *Glossura* and *Glossurella* are discussed and *E. stellfeldi* is transferred to *Glossurella*. Also, patterns of latitudinal variation in integument color of these bees along the Brazilian Atlantic forest are presented and discussed.

Morphological terminology adopted here follows Michener (2000) and Roubik (2004). Metasomal terga and sterna are indicated, respectively, as T1 to T7, and S1 to S8. The labels of examined specimens of *E. stellfeldi* were transcribed under the section Material Examined, where one inverted bar symbol (¯) indicates the different lines in the label, two inverted bars (¯¯) indicate information on the back side of the label, and the quotation marks indicate different labels associated with one specimen. In the labels, the signs of male and female were transcribed as M and F, respectively. The density of punctation and intervals between the punctures was based on relative puncture diameter, pd (e.g. <1pd: less than 1x the puncture diameter between the punctures).

Distribution maps for the studied species was generated in ArcView GIS 3.2, based on locality data from examined specimens deposited at DZUP and with records provided by Wittmann et al. (1988), Rebêlo & Moure (1995), Neves and Viana (1997), Rebêlo & Garófalo (1997), Bonilla-Gómez (1999), Peruquetti et al. (1999), Bezerra & Martins (2001), Tonhasca Jr. et al. (2002), Nemésio (2003), Alvarenga (2004), Nemésio (2004), Nemésio & Faria Jr. (2004), Souza et al. (2005), as well as on specimens from other institutions examined by one of the authors. Records outside the study area were not included in the maps for those species (*E. ignita* and *E. imperialis*) with widespread distribution outside eastern Brazil. In the maps,

the Atlantic forest is represented in grey. The Atlantic forest shape files, derived from the ecoregions presented in Olson & Dinerstein (2002), were obtained at <http://worldwildlife.org/science>.

The studied material, including types, belongs to DZUP (Coleção de Entomologia Pe. J. S. Moure, Departamento de Zoologia, Universidade Federal do Paraná), and MHNCI (Museu de História Natural do Capão da Imbuia), both at Curitiba, Brazil.

Comments on the subgenera *Glossura* and *Glossurella*

When Dressler (1978) proposed the current infrageneric classification of *Euglossa*, he placed *E. stellfeldi* in a distinct group (the **stellfeldi** group) apart from other *Glossura*, which posteriorly also included *E. annectans* (see Dressler 1982a). Later, Dressler (1982b:131) wrote “I believe that future work may well treat the **stellfeldi** group and the **intersecta** and **rugilabris** groups (these two perhaps together) as distinct subgenera, leaving *E. (Glossura)* a much more homogeneous and natural group”. Subsequently, Moure (1989) erected a new subgenus, *Glossuropoda*, which included the Dressler’s groups **intersecta** and **rugilabris** and solved this part of the problem within the *E. (Glossura)*. Regarding the **stellfeldi** group, no other proposal concerning its group placement within *E. (Glossura)* has been advanced.

When comparing *E. stellfeldi* to species from other subgenera in *Euglossa*, we found remarkable similarities with *E. laevicineta* Dressler, 1982, a species placed in *E. (Glossurella)*. Unlike species of *E. (Glossura)*, males of several species of *E. (Glossurella)*, including the two species mentioned above and its type-species (*E. bursigera* Moure, 1970), present a conspicuous circular depression on the inner surface of the hind tibia. The hair cover of the depressed area varies among species of *Glossurella* (sensu Ramírez et al. 2002). In *E. laevicineta* and *E. stellfeldi*, the depression has a dense hair pile (Fig. 1), while in *E. bursigera* and related species, the surface is glabrous. In some species of *E. (Euglossa)* of the **analis** group (*E. cognata* Moure, 1970, *E. iopyrrha* Dressler, 1982 and *E. mixta* Friese, 1899), the inner surface of the hind tibia also presents a triangular depression covered with denser pubescence. Details of the inner surface of hind tibia have not been considered in previous taxonomic studies and, as we believe, it can provide important features to distinguish species of *Euglossa*.

Removing *E. stellfeldi* from *E. (Glossura)* makes it a more homogeneous group, although the current subgeneric classification for *Euglossa* remains quite precarious. The limits between the subgenera are not based on phylogenetic analyses and under several aspects are just an arbitrary combination of characters. Only extensive phylogenetic studies could provide robust hypothesis on the position of the species in the different subgenera.

Identification key to species of *Euglossa (Glossura)* in eastern Brazil, including *E. (Glossurella) stellfeldi*

1- Males: Antennae with eleven flagellomeres; metasoma with

- seven visible segments; midtibia with a conspicuous velvety area on its outer surface; posterior tibia inflated, thick and subtriangular, with a slit surrounded by specialized long hair 2
- Females: Antennae with ten flagellomeres; metasoma with six visible segments; midtibia without a conspicuous velvety area on its outer surface; posterior tibia thin and laminar, with its outer surface largely concave and forming a corbicula 6
- 2- Inner surface of the hind tibia with a conspicuous circular depression (Fig. 1); border of hind tibia blade-like along posterior angle; sulcus along the posterior surface of midtibia shallow and weakly indicated on the apical half of the midtibia; epistomal suture forming an obtuse angle in lateral view (Fig. 3) (coastal areas in AL, BA, ES, SP, PR, SC) *E. stellfeldi* Moure
- Inner surface of the hind tibia without a conspicuous circular depression (Fig. 2); border of hind tibia rounded along posterior angle; sulcus along the posterior surface of midtibia deep and strongly indicated on the apical half of midtibia; epistomal suture forming an acute angle in lateral view (Fig. 4), except in *E. annectans* ... 3
- 3- Slits of S2 placed laterally on the sclerite, distance between them more than 3x the width of a single slit (Fig. 14); posterior margin of S2 bisinuated; epistomal suture forming an obtuse angle in lateral view; apical tuft of midtibial velvety area distinctly larger than the basal tuft (Fig. 6) (RJ, SP, MG, PR, SC, RS) *E. annectans* Dressler
- Slits of S2 placed close together on the mid portion of the sclerite (Figs. 15-16); posterior margin of S2 distinctly arched; epistomal suture forming an acute angle in lateral view; basal tuft of midtibial velvety area larger than the apical tuft, tufts subequal in size or forming a single elongated tuft (Figs. 7-9) 4
- 4- S2 slits separated by a distance similar to the width of a slit (Fig. 15); metasoma and hind tibia always coppery green; midtibial tufts subequal in size, the apical tuft only slightly larger than the basal tuft (Fig. 8) (BA, ES, RJ) *E. ignita* Smith
- S2 slits large and convergent at mid line of the sternum, almost contacting each other (Fig. 16); metasoma and hind tibia bright metallic green or blue, without strong golden/brassy reflexes; midtibial basal tuft clearly larger than the apical one or tufts forming a single elongated tuft (Figs. 7, 9) 5
- 5- Larger and more robust bees (ca. 16 mm in body length); basal and apical tufts of midtibial velvety area fused (Fig. 7); long hairs on S7 (BA, ES, MG, SP) *E. imperialis* Cockerell
- Smaller bees (ca. 14 mm in body length); midtibial tufts clearly separated; basal tuft larger than the apical one (Fig. 9); short hairs on S7 (coastal areas in BA, ES, RJ, SP, PR, SC) *E. iopoecila* Dressler
- 6- Expanded posterior lobe of hind tibia narrower than half of tibia maximum width (Fig. 19); setae of galea well developed (thick and hooked); interocellar area with a distinct protuberance in lateral view; epistomal suture forming an obtuse angle in lateral view (Fig. 3); tongue in repose not exceeding, by far, the apex of metasoma 7
- Expanded posterior lobe of hind tibia broader than half of tibia maximum width; setae of galea, when present, sparse and thin; interocellar area without a distinct protuberance in lateral view; epistomal suture forming a distinct acute angle in lateral view (Fig. 4); tongue in repose exceeding, by far, the apex of metasoma 8
- 7- Posterior margin of scutellum, in dorsal view, evenly convex; scutellar tuft occupying about two-thirds of scutellum length; tegulae moderately punctured (~1 pd) (RJ, SP, MG, PR, SC, RS) *E. annectans* Dressler
- Posterior margin of scutellum, in dorsal view, slightly grooved medially; scutellar tuft occupying less than two-thirds of scutellum length; tegulae densely punctured (<0.5 pd) (coastal areas in AL, BA, ES, SP, PR, SC) *E. stellfeldi* Moure
- 8- Larger and more robust bees (ca. 16 mm in body length); surface around scutellar tuft strongly raised, longest setae on posterior border of scutellum about as long as tuft length (BA, ES, MG, SP) *E. imperialis* Cockerell
- Smaller bees (ca. 14 mm in body length); surface around scutellar tuft weakly convex, longest setae on posterior border of scutellum longer than tuft length (coastal areas in ES, RJ, SP, PR, SC) 9
- 9- Terga and sterna with strong golden, brassy or coppery reflexes; margin of corbicula with pale yellow bristles only (BA, ES, RJ) *E. ignita* Smith
- Terga and sterna blue to bluish-violet; margin of corbicula with pale yellow and black bristles *E. iopoecila* Dressler

***Euglossa* (*Glossurella*) *stellfeldi* Moure**

(Figures 1, 3, 5, 14, 17-21, 25)

Euglossa stellfeldi Moure, 1947: 11. Holotype female, Brasil: Paraná, Caiobá (MHNCI; examined).*Euglossa* (*Glossurella*) *carinilabris* Dressler, 1982: 134. Holotype male, Brazil: Bahia, Itabuna (USNM; not examined). **New synonymy.****Comments**

The status of *E. stellfeldi* was reevaluated based on direct study of the female holotype. Although the females of different species of *Euglossa* are harder to distinguish from one another, we could find stable structural differences between females of



Figs. 1–10. 1, Inner surface of hind tibia of male of *E. stelfeldi* (from Cananéia, São Paulo). 2, Same, *E. annectans* (from Florianópolis, Santa Catarina). Left scale bar (= 2.0 mm) applies to Figs. 1 and 2. 3, Head, in lateral view, showing detail of epistomal suture of female of *E. stelfeldi* (from Alexandra, Paraná). 4, Same, *E. imperialis*; arrow pointing to acute angle formed by the epistomal suture (from Conceição da Barra, Espírito Santo). Right scale bar (= 2.0 mm) applies to Figs. 3 and 4. 5–10. Outer surface of male midtibia, showing the hair tufts of the velvety area; scale bar (= 1.5 mm) on Fig. 7 applies to all figures. 5, *E. stelfeldi* (from Cananéia, São Paulo). 6, *E. annectans* (from Florianópolis, Santa Catarina). 7, *E. imperialis* (from Conceição da Barra, Espírito Santo). 8, *E. ignita* (from Conceição da Barra, Espírito Santo). 9, *E. iopocila* (from Alexandra, Paraná). 10, *E. chalybeata* (from Belém, Pará).

E. stellfeldi and other congeneric species. It is superficially similar to females of *E. annectans*, the main differences between them being the punctuation of the tegula, which is very dense (< 0,5 pd) in *E. stellfeldi*, and the shape of scutellum, which is slightly grooved in the latter species. Females of these two species also differ in the contour of the apical border of the hind tibia (with a distinctly deeper emargination in *E. stellfeldi*) and in the clypeal punctures (coarser and sparser in *E. stellfeldi*).

Males of *E. stellfeldi* differ from sympatric males of *E. (Glossura)* in the Atlantic forest by the shape of midtibial tufts and by the presence of a distinct depression, with differentiated hairs, in the inner surface of hind tibia (Fig. 1). This species can be distinguished from males of *Euglossa* s.str. by tongue length and shape of midtibial tufts and from other sympatric *E. (Glossurella)* (*E. augaspis* Dressler, 1982, *E. crassipunctata* Moure, 1968 and *E. sapphirina* Moure, 1968) by the shape of midtibial tufts, larger body size and by the hairy depression on inner surface of hind tibia.

As discussed above, *E. stellfeldi* is transferred to *E. (Glossurella)* considering the several features it shares with other species of this subgenus. Regarding its position within the subgenus, *E. stellfeldi* is very similar to *E. laevicincta* Dressler, both being large *Glossurella* (ca. 12mm), and their males having two tufts in midtibia and bidentate mandibles. Studying additional species of *E. (Glossurella)* we noticed that *E. carinilabris* Dressler is identical to *E. stellfeldi*, except for slight differences in integument color. Therefore, we here synonymize *E. carinilabris* under *E. stellfeldi*. Although not part of the type series, the examined material of *E. carinilabris* has the same label data as part of the type series, including Dressler's manuscript species number associated to the holotype (see below 'Additional Examined Material')

The available locality records indicate that *E. stellfeldi* seems to be restricted to coastal areas in eastern Brazil, including mountain slopes in Espírito Santo (Fig. 25). The records of *E. stellfeldi* presented by Nemésio (2004) and also Nemésio and Faria Jr. (2004) for interior areas represent misidentifications of *E. annectans* (see below), a common species in semideciduous forests (see Rebêlo & Moure 1995; Nemésio & Silveira 2006).

A single nest of *E. stellfeldi*, found within a bamboo cavity, was described by Laroca (1991). Since all previously known nests of *Glossurella* are aerial (Dodson 1966; Young 1985; Eberhard 1988; see Ramírez et al. 2002; Cameron 2004), this is the first cavity-nesting species in *Glossurella*, although other species in this subgenus are likely to nest in cavities as well.

Type Material Examined

Holotype female (MHNCI), "Est. Paraná\ Caiobá\ M. Paranaense\ C. Stellfeld\ 26-VI-1943" "Holótipo" "255" "Euglossa F\ stellfeldi\ P. Moure det.\ 1945"; 1 female (MHNCI), "Est. Paraná\ Matinho\ M. Paranaense\ J. Bigarella\ 28-III-1945" "Paratypus" "254" "Euglossa F\ stellfeldi\ P. Moure det.\ 1946"; 1 female (DZUP), "Est. Paraná\ Matinho\ Hatschbach\ II- 1941" "Paratypus" "Euglossa F\ stellfeldi\ n sp.\ P. Moure det 1946"; 1 male (MHNCI), "Paraná II-1946\ Caiobá\ R. Lange - Leg" "164" "Allotypus" "Euglossa M\ stellfeldi\ n.sp.\ P. Moure det.\ 1946"; 1 male (DZUP), "Est. Paraná\ Matinho\ Hatschbach

II-1941" "Paratypus" "stellfeldi" "Euglossa\ stellfeldi\ m.\ Det. J.S. Moure 1956".

Additional Examined Material (DZUP)

BRAZIL: Alagoas. 1 male, "Maceió- Alagoas- Brasil\ 22-I-2006, Rios, P.A.F. leg." "Serra da Saudinha, Usina Cachoeira, em Canistrum alagoanum, (Flor) Hora: 8:25"; 1 male, same except "...29-I-2006..." and "...Hora: 8:41"; 1 female, same except "...Hora: 8:20"; **Bahia.** 1 female, "Ilhéus - Bahia\ Brasil 16-VII-1965\ S. Laroca, leg"; 1 male, "Brazil: Bahia:\ Itabuna\ 6.XI.1968\ R.L. Dressler 1207" "\ eugenol" "Holotypus M\ Glossurella\ carinilabris\ Pe. J.S. Moure 1968"; 2 males, same except "Paratypus M\ Glossurella\ carinilabris\ Pe. J.S. Moure 1968". **Espírito Santo.** 1 male, "Depto. Zool\ UF - Paraná" "Sta. Tereza - V. Alegre\ ES-BR\ 13-17/III/67\ C. & C.T. Elias leg.". **Paraná.** 4 males, "Depto Zool\ UF - Paraná" "Alexandra - PR\ 25.I.1969\ Pe. J.S. Moure"; 8 males, "Alexandra\ PR - Brasil 01-II-69\ Moure Laroca"; 1 male, "Depto Zool\ UF - Paraná" "Alexandra - PR\ Brasil - 10/10/70\ Moure & Mielke"; 1 female, "Alexandra - PR\ Brasil\ 06.VIII.1983\ S. Laroca & M.C. Almeida" "em flores de\ Jacaranda\ puberula"; 1 male, "Depto Zool\ UF - Paraná" "Antonina - PR\ 30.I.1969\ Moure & Laroca"; 3 males, "eug" "Antonina - PR\ 02.II.1969\ Moure & Laroca"; 1 male, "Antonina\ PR - Brasil\ 30-2-1969\ Pe. J.S. Moure\ cineol" "E. (Glossura) M\ stellfeldi\ Moure\ Pe. J. S. Moure 1969"; 1 male, "Antonina\ PR - 01-II-86\ Pe. J.S. Moure leg." "E. (Glossura) stellfeldi M\ Pe. J.S. Moure 1986"; 1 male, "Antonina - PR\ (Res. Biol. Sapitanduva)\ Brasil 25.III.87\ Exc. PG/ Entom. - DZUP"; 2 males, "Caiobá - Pr\ 1 a 2/II/1964\ R. Lange leg." "E. (Glossura)\ stellfeldi M\ Pe. J.S. Moure 1986"; 1 male, same except "...1 a 8/II/1964..."; 1 male, "Ilha do Mel - PR\ Praia Grande\ 01/01/89\ Renato Dutra col."; 1 female, same except "...03/09/89..."; 1 male, same except "...16/10/88..."; 1 male, "Brasil, Paraná\ 4Km SE de Morretes\ 25°30'33,5"S,\ 48°48'30,5", 64m\ 23.iii.2004, G. Melo"; 1 male "DZUP\ 027138" "Brasil, Paraná\ Morretes, IAPAR\ 25°30'27"S, 48°27'55"W\ Alt. 15m, 08.iv.2006,\ A. Martins, Eugenol."; 1 male, same except "DZUP\ 027141" "...V. Mattozo, L.R.R. Faria Jr. ..."; 1 male, same except "DZUP\ 027142"; 1 male, same except "DZUP\ 027149" "...V. Mattozo..."; 1 male, same except "DZUP\ 027151" "...G. Weiss..."; 9 males, "Atami, Paranaçu, PR\ Pe. J. S. Moure\ Mielke leg. 14.II.94"; 2 males, "Tagaçaba\ PR - Brasil\ 9-III-1969\ J.S. Moure". **Santa Catarina.** 1 female, "Corupá\ S. Catarina Brasil\ Fevereiro 1958\ A. Maller"; 1 female, same except "...Janeiro 1959..."; 1 male, "eug" "Joinville SC\ 9-II-1969\ S. Laroca" "Euglossa M\ stellfeldi\ Moure\ Pe. J.S. Moure 1992"; 1 male, "Depto. Zool.\ UF - Paraná" "Joinville-SC\ 10/VI/1972\ Mers leg.". **São Paulo.** 1 male, "Brasil, São Paulo\ Cananéia. Ilha do\ Cardoso. 02-03.x\ 2004.\ S. Augusto leg."; 1 male, "IBUSP, São Paulo, SP\ Juréia Brasil 15.7.1982\ Col: F.R.N.K.\ P39.-A2-12:56" "luciae\ USP + 2 parat. M\ 6"; 1 male, same except "...22.2.1983...Eug.-A5-9:50" "E. (Glossura)\ luciae M\ n. sp.\ Pe. J.S. Moure det. 1983"; 1 male, same except "...30.8.1983...P34.-A2-11:30" "luciae\ 4"; 1 female, same except "...22.9.1983...P39.-A2-13:40" "E. (Glossura)\ luciae F\ n. sp.\ Pe. J. S. Moure det. 1983"; 1 female, "S. Sebastião - SP\ Brasil 1 1945\ A. Barbiellini" "E. (Glossura)\ annectans\ Pe. J. S. Moure 1964"; 1 female, "Praia do Barro\ São Sebastião\ SP - Brasil\ I-1944 Barbiellini" "\ M 270". **Unknown locality.** 1 female, "E. (Glossura)\ iopocila M\ Dressler, 82\ Det. J.S. Moure 1993".

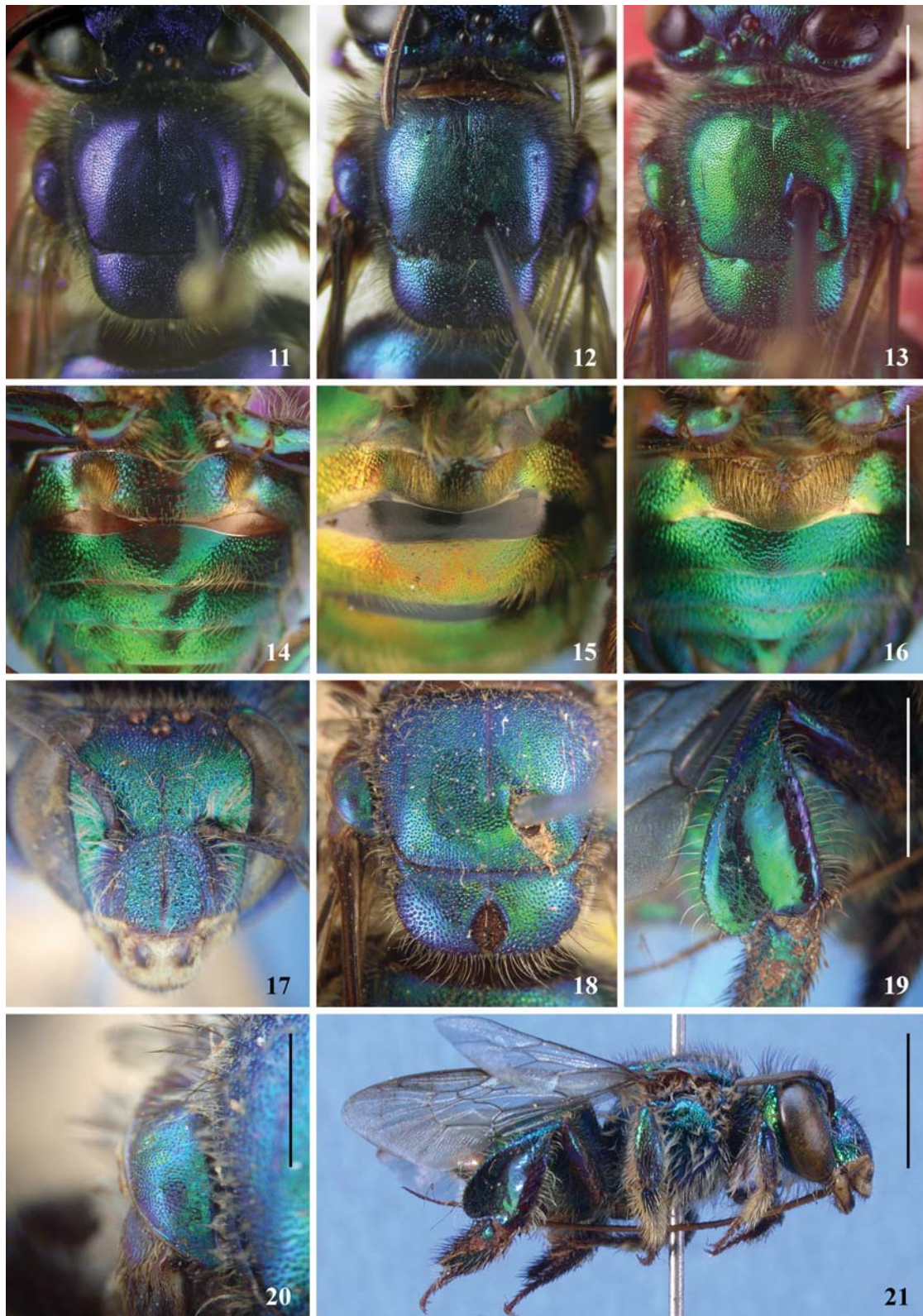
Euglossa (Glossura) annectans Dressler

(Figures 2, 6, 22)

Euglossa annectans Dressler, 1982: 127. Holotype male, Brasil: Guanabara, Floresta da Tijuca (USNM; not examined).

Comments

Nemésio (2004) synonymized *E. annectans* under *E. stellfeldi* without justifying his taxonomic decision, and this synonymy was also followed by Nemésio and Faria Jr. (2004). The study of type material of these two species reveals,



Figs. 11–21. 11–13, Male mesosoma, in dorsal view, illustrating variation in the integument color of *E. iopoecila*; scale bar = 2.5 mm. 11, Specimen from Alexandra, Paraná, southern Brazil. 12, Specimen from Cananéia, São Paulo, southeastern Brazil. 13, Specimen from Conceição da Barra, Espírito Santo, eastern Brazil. 14–16, Male metasoma, in ventral view, showing the S2 hair slits; scale bar = 2 mm. 14, *E. stellfeldi* (from Cananéia, São Paulo). 15, *E. ignita* (from Conceição da Barra, Espírito Santo). 16, *E. iopoecila* (from Cananéia, São Paulo). 17–21, Female holotype of *E. stellfeldi*. 17, Head, in frontal view. 18, Mesosoma, in dorsal view. 19, Hind tibia. 20, Tegula, in dorsal view, showing punctuation. 21, Lateral overview. Upper scale bar (= 4.0 mm) applies to Figs. 17–19. Scale bar (= 1.0 mm) in Fig. 20 applies only to it. Scale bar (= 4.0 mm) in Fig. 21 applies only to it.

however, that they constitute very distinct species. Dressler (1982a) considered that *E. annectans* formed with *E. stellfeldi* a separate group in *Glossura* and this position was followed in subsequent checklists for Euglossina (Ramírez et al. 2002; Roubik & Hanson 2004) and taxonomic works (e.g. Rebêlo & Moure 1995; Roubik 2004).

Transfer of *E. stellfeldi* to *E. (Glossurella)* leaves *E. annectans* in an isolated position in the subgenus *Glossura*. It differs in several features from species of the **piliventris** group: i) angle of epistomal suture, in lateral view, not acute; ii) apical knob, on the inner surface of hind tibia (near spur), small (this knob is large in the **piliventris** group); iii) specialized seta, in the lower border of female hind tibia (between corbicula and basitarsus), well developed (indistinct in females of the **piliventris** group).

Available locality records indicate that *E. annectans* is restricted to the southern portion of the Atlantic forest in Brazil, including the inland forests of the Parana basin, south to Misiones, in Argentina (Fig. 22). Within its geographical range, *E. annectans* can be found in coastal areas (from Rio de Janeiro to Santa Catarina), where it is sympatric with *E. stellfeldi*, and also in inland areas of southeastern Brazil, both in semideciduous forests (Rebêlo & Moure 1995; Rebêlo & Garófalo 1997) and savannas (Nemésio & Faria Jr. 2004).

Type Material Examined

Paratypes deposited at DZUP are not labeled as such, but based on Dressler (1982a), they can be easily recognized: 1 male, "BRAZIL: GB. Flor-\ esta de Tijuca\ 6 I 1966\ R.L.Dressler 444" "*Euglossa M\ annectans\ Dressler\ Pe J.S. Moure 1986*"; 1 male, "BRAZIL: GB. Flor-\ esta de Tijuca\ 9 I 1966\ R.L.Dressler 444" "*Euglossa M\ annectans\ Dressler\ Pe. J.S. Moure 1986*"; 1 female, "BRAZIL: GB. Flor-\ esta de Tijuca\ 8 I 1966\ R.L.Dressler 444" "*Euglossa F\ annectans\ Pe. J.S. Moure 1967*". There are several other specimens labeled as paratypes at DZUP, but these were not indicated in Dressler's paper.

Material Examined from southeastern Brazil and Argentina

ARGENTINA. Misiones. Puerto Iguazú (7 males). **BRAZIL.** Rio de Janeiro. Rio de Janeiro (18 males and 9 females). São Paulo. Brotas (1 male), Campinas (1 male and 1 female), Jundiá (1 male), Luís Antônio (1 male) and Teodoro Sampaio (1 male). Paraná. Alexandra (17 males), Antonina (22 males), Morretes (6 males and 1 female), Tapejara (1 male) and Xambrê (1 female). Santa Catarina. Florianópolis (7 males and 9 females), Joinville (3 males), São Francisco do Sul (2 males) and São Martinho (2 males). Rio Grande do Sul: Tenente Portela (4 males).

Euglossa (Glossura) ignita Smith (Figures 8, 15, 22)

Euglossa ignita Smith, 1874: 444. Holotype male, Jamaica (BMNH; not examined).

Euglossa ignita var. *chlorosoma* Cockerell, 1918: 688. Holotype female, Guyana: Bartica District (AMNH; not examined).

Comments

We compared specimens of *E. ignita* from Espírito Santo and Bahia, in eastern Brazil, with those from Central America and northern South America and did not find any relevant structural differences among them. Roubik (2004) mentions that *E. ignita* ranges from west Amazonia to southern Mexico,

overlooking many reports on the presence of this species in the Brazilian Atlantic forest (Neves & Viana 1997; Bonilla-Gómez 1999; Bezerra & Martins 2001; Tonhasca Jr. et al. 2002) (Fig. 22). Regarding the metasomal color of *E. ignita*, we observed that in specimens from Bahia, the golden reflexes in terga and sterna are distinctly stronger than in specimens from Espírito Santo.

Material Examined from eastern Brazil

Bahia. Cumuruxatiba (1 male) and Prado (10 males). **Espírito Santo.** Conceição da Barra (21 males) and Linhares (3 males and 2 females).

Euglossa (Glossura) imperialis Cockerell (Figures 4, 7, 23)

Euglossa (Glossura) piliventris imperialis Cockerell, 1922: 6. Holotype female, Panamá: Rio Trinidad (USNM; not examined).

Comments

This is the largest species of *Glossura* found in eastern Brazil and presents the largest geographical distribution of all species in the subgenus (Rebêlo & Moure 1995; Ramírez et al. 2002; Roubik 2004). Individuals from Central America, Amazon Basin and Atlantic forest are very similar, indicating that its populations form a continuum. Occurrence of *E. imperialis* in savanna areas of Minas Gerais (Nemésio & Faria Jr. 2004) also suggests connection between Amazonian and Atlantic populations through central Brazil (Fig. 23), as discussed by Rebêlo and Moure (1995).

Integument color variation was also observed in individuals from the Atlantic forest. Specimens from eastern Brazil (Bahia) presented stronger golden and coppery reflexes than those from southern areas of its distribution (Espírito Santo), which are normally entirely bright green.

Material Examined from eastern Brazil

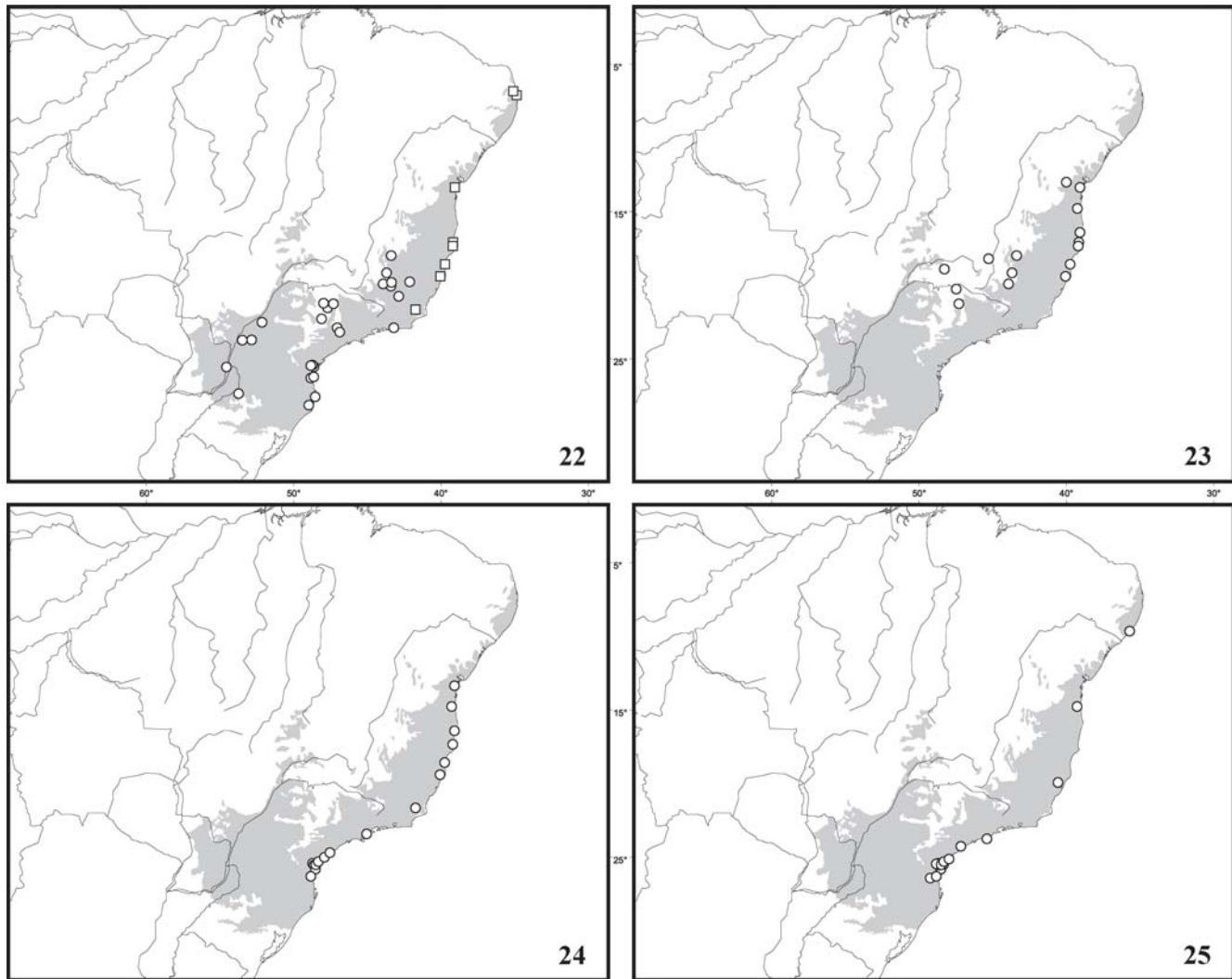
Bahia. Cumuruxatiba (1 male), Itabuna (2 males), Ilhéus (1 female), Prado (48 males) and Porto Seguro (5 males). **Espírito Santo.** Conceição da Barra (199 males and 1 female) and Linhares (2 males). **São Paulo.** Pedregulho (1 male).

Euglossa (Glossura) iopocila Dressler (Figures 9, 11-13, 16, 24)

Euglossa chalybeata iopocila Dressler, 1982: 126. Holotype male, Brasil: Paraná, Alexandra (USNM; not examined).

Comments

When describing *E. iopocila*, Dressler (1982a) gave great importance to differences in integument color. He proposed this name, as a subspecies of *E. chalybeata*, for the blue color morph found at the southern portion of the Atlantic forest, while the green northern population was treated as typical *E. chalybeata*. Comparison of specimens from the type localities of both species (*E. chalybeata*: Belém, Pará, Brazil; *E. iopocila*: Alexandra, Paraná, Brazil) supported the status proposed by Roubik (2004). Besides differences in the shape of the tufts of the midtibial velvety area (Figs. 9–10), additional



Figs. 22–25. Distribution maps. 22, *Euglossa annectans* (circles) and *E. ignita* (squares). 23, *E. imperialis*. 24, *E. iopoecila*. 25, *E. stellfeldi*. Records outside eastern Brazil were not included in the maps for *E. ignita* and *E. imperialis*. The Atlantic forest is represented in grey.

features distinguish these two species: i) *E. iopoecila* presents sparser punctures on the posterior margin of the scutellum (near the scutellar depression); ii) in *E. chalybeata*, punctures on T4 and T5 reaches the posterior margin of these sclerites, while in *E. iopoecila* the posterior margin of T4 and T5 are smooth; iii) *E. iopoecila* presents denser plumose hairs on the mesepisternum than *E. chalybeata*.

The different color morphs found in the Atlantic forest, which varies from completely bluish-violet in southern Brazil (Paraná and Santa Catarina) to mostly green in eastern Brazil (Espírito Santo and Bahia), are here interpreted as the result of a latitudinal gradient of variation (see below). This color variation from dark blue to green seems to be gradual, since we examined specimens from Ubatuba, in São Paulo, and northern Rio de Janeiro, that present an intermediate coloration (Figs. 11-13). It is remarkable that these intermediate colored bees come from areas in the middle of the species range.

Along its range, males of *E. iopoecila* also vary in the

density of punctuation in the disc of T2: individuals from Santa Catarina, Paraná, São Paulo and some of Espírito Santo present a dense punctuation (< 1 pd), while other specimens from Espírito Santo and Bahia present a moderate punctuation (> 1pd). Presence of a white spot on the anterior surface of the scape also varies, completely lacking in some individuals or occupying up to half of the anterior surface of the scape.

Only two females were available for study (DZUP), one labeled “Paranaguá, Paraná\ 16.iv.1995\ Moure\ Olaf H.H. Mielke leg.” “*Euglossa F\ mandibularis\ Friese, 1899\ Det. J.S. Moure 1996*” and the other, part of the type series of *E. stellfeldi*, “Est. Paraná\ Matinho\ J. Bigarella\ 28.III.1945” “Paratypus” “stellfeldi” “*Euglossa\ stellfeldi\ Det. J.S. Moure 1956*”. These two females have a predominantly blue to bluish-violet color, as males from this region. In the northern portion of its distribution, females of *E. iopoecila* will likely have a predominantly green color. These specimens are probably very similar to females of *E. ignita*, perhaps differing only for lacking

strong golden, brassy or coppery reflexes in the metasoma. Besides color, we could not find structural differences to separate *E. ignita* from *E. iopoecila*.

Regarding its distribution pattern, current data indicate that *E. iopoecila*, similarly to *E. stellfeldi*, is restricted to coastal areas in eastern Brazil (from Bahia to Santa Catarina) (Fig. 24).

Type Material Examined

One male at DZUP, although it cannot be considered a paratype according to the original description (Dressler, 1982a), has the same label data as the type series: "Brazil: PR.\ Alexanra\ 8.XII.1968 M\ R.L.Dressler" "Cineol".

Material Examined from eastern Brazil

Bahia. Itabuna (1 male), Prado (4 males) and Porto Seguro (4 males). **Espírito Santo.** Conceição da Barra (79 males) and Linhares (18 males). **São Paulo.** Cananéia (1 male), Iguape (1 male) and Ubatuba (3 males). **Paraná.** Alexandra (40 males), Antonina (26 males), Matinhos (1 female), Paranaguá (1 female) and Tagaçaba (7 males). **Santa Catarina.** Joinville (1 male).

Latitudinal color variation along the Brazilian Atlantic forest

Coloring in nature mostly comes from the inherent colors of materials, but it sometimes has a purely physical origin, such as diffraction or interference of light. The latter, called structural color or iridescence (Kinoshita & Yoshioka 2005), is relatively common among Neotropical bees, including those of the genus *Euglossa*.

In these groups of bees, a diverse range of color hues is exhibited by different species, and these differences are widely used in their taxonomy (e.g. Dressler 1978). In *Euglossa*, intraspecific color variation has not been well documented, although small differences are usually mentioned in the descriptions (e.g. Rebêlo & Moure 1995).

For two of the species studied here, *E. iopoecila* and *E. stellfeldi*, we found a latitudinal gradient of color variation: individuals from the northern portion of the distribution range are green (with golden/ coppery reflexes), while individuals from the southern portion are greenish blue (*E. stellfeldi*) or bluish violet (*E. iopoecila*). In both cases, specimens from the middle portion of the distribution present an intermediate color.

Also, Nemésio (2006) recently described a species, *E. anodorhynchi*, from southern Brazil, which has a conspicuous blue integument. Except for its blue color, this new form is structurally almost identical to *E. townsendi* Cockerell, 1904 a green species occurring further north, from southeastern Brazil to Mexico. Similarly to the two cases studied here, it might be possible that *E. anodorhynchi* represent only a color variation within a more widely distributed taxon.

Except for *E. annectans*, all species of *Euglossa* found in the southern portion of the Atlantic forest (Paraná and Santa Catarina), *E. anodorhynchi*, *E. iopoecila*, *E. mandibularis* Friese, *E. stellfeldi*, and an undescribed form of the **analis** group, have a predominantly blue or greenish blue body color. This apparent tendency to become greenish-blue or dark blue in southeastern Brazil must be taken into consideration in taxonomic works, avoiding misidentifications of species based only in differences of integument color.

Color polymorphisms in adult organisms of many taxa are often adaptive in the context of sexual selection or predation (e.g. Abbott & Svensson 2005) and may be associated to the insect physiology, as in water balance (e.g. Appel & Tanley 1999). The color variation described here in *Euglossa* is an interesting feature to be focused in future behavioral and physiological studies.

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