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Eufriesea atlantica sp. n. (Hymenoptera: Apidae), a new orchid bee from the Brazilian Atlantic Forest

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Abstract

Specimens recently recorded as belonging to a species widely distributed in the Neotropical Region, *Eufriesea ornata* (Mocsáry, 1896) (Hymenoptera: Apidae), in the Brazilian Atlantic Rain Forest, have been shown to belong to a distinct species, *Eufriesea atlantica* sp. n., described in the present study.

Keywords: Atlantic Rain Forest, Euglossina, northern Brazil, orchid bees, taxonomy.

Introduction

Eufriesea Cockerell (Hymenoptera: Apidae: Apini) is the second largest genus of Euglossina, including more than sixty species (Kimsey, 1982; Roubik & Hanson, 2004). It comprises medium- to large-sized bees (13.0 mm to 26.0 mm long), showing predominantly metallic colors, generally green, red, and blue, but species with dense pilosity are also common. Several new species in this genus were described after the 1970s, when the aromatic compounds that attract male euglossine bees (Dodson *et al*. 1969) became commonly available to researchers. Nevertheless, new species are still being described in this genus (e. g. Moure, 1999; Moure et al., 2001). Members of *Eufriesea* have been considered highly seasonal, usually only active during a few months in the wet season (Kimsey, 1982). As a consequence, *Eufriesea* species are generally rare in entomological collections, contrary to their close allies *Euglossa* and *Eulaema* species, which, as a whole, are active the year round. Nemésio & Silveira (2004) argued that this factor may lead some researchers to a false impression that *Eufriesea* species are rare or their populations are declining.

The Atlantic Rain Forest domain has been sampled for orchid bees in the last decades (works prior to 1999 reviewed by Peruquetti et al., 1999; see also Bezerra & Martins, 2001; Tonhasca Jr. et al., 2002; Nemésio 2003, 2004; Nemésio & Silveira, 2004, 2006) and Atlantic Forest populations of some species previously considered to have wide distribution, such as *El. bombiformis* (Packard) and *El. meriana* (Olivier), have been recently treated as species distinct from their Amazonian and Central American counterparts (see Oliveira, 2000; Moure, 2003; Nemésio, 2005).

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Eufriesea ornata (Mocsáry, 1896) was described from the state of Pará, Brazilian Amazon (see also Moure, 1976). It is one of the largest species in the genus (22.0 mm – 26.0 mm) and has been collected from Central America (Ackerman, 1983) to Rio de Janeiro, southeastern Brazil (Tonhasca Jr. et al., 2002). Dressler (1979) considered this species to be part of a Müllerian mimetic complex, which would also include the large *Eulaema bombiformis* and *El. meriana*.

In this paper the individuals currently regarded as *Ef. ornata* (Mocsáry) from the Atlantic Forest domain are transferred to a new species.

Material and methods

Twenty-nine specimens identified as *Ef. ornata* were studied. Collections from which specimens were loaned or where they were deposited in are listed below, with the acronyms by which they are referred to in the text in parentheses (name of curators responsible for specimen loans are also in parentheses): Entomological Collection of the Universidade Estadual do Norte Fluminense (Magali Hoffmann - UENF); Bee collection of the Universidade Federal da Bahia, Salvador, Brazil (Edinaldo L. Neves - UFBA); Taxonomic Collections of the Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (Fernando A. Silveira - UFMG); Coleção Entomológica "Padre Jesús Santiago Moure" da Universidade Federal do Paraná, Curitiba, Brazil (UFPR); Elen R. Micheletti private bee collection (UFSE); The Natural History Museum of the University of Kansas, Lawrence, USA (UKansas); Museu de Geologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP); Camargo Collection, at the Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Ribeirão Preto, Brazil (USP/RP); and the Zoologische Staatssammlung München, München, Germany (ZSM).

Twelve of the examined specimens were collected in Atlantic Forest areas (in the states of Bahia, Espírito Santo,

Minas Gerais, and Sergipe, eastern Brazil), and 17 came from the Amazon Basin (states of Acre and Amazonas, Brazilian Amazon).

Terga and sterna are referred to as T1, T2, T3, etc, and S1, S2, S3, etc. Three measures were taken to compare size of bees: scutellum width (SCTW), scutellum length (SCTL), and interorbital distance at the base of the scape (IOD). One of the characters used in distinguishing *El. meriana* from *El. flavescens* is the length of the whitish stripes at distal parts of terga. In the present study, the width of the whitish stripes of T1-T3 was also measured. Measurements of the 17 specimens belonging to the Amazonian populations of *Ef. ornata* were also taken for comparison with those of the specimens belonging to the Atlantic Forest populations (list of specimens in Appendix 2).

Bees were separated according to the geographic region they came from: Amazon Basin and the Atlantic Rain Forest. Means (and standard deviations) of all six measured characters were taken. Furthermore, all the bees were grouped and clustered using statistical software SAS (SAS Institute, 1999) according to the measurements of the six characters employed.

After the conclusion of this work, three additional specimens were examined from the state of Rio de Janeiro, at the entomological collection of the Universidade Estadual do Norte Fluminense (UENF). All three specimens were included in the type series but were not included in the statistical analysis described above.

Results

Specimens from the Atlantic Forest revealed to be smaller than those from the Amazonian Forest. Besides, the widths of the light apical bands of T1-T3 were considerably shorter in specimens of the Atlantic Forest than in their Amazonian counterparts (see Appendix 1). The clustering of the bees based on the six characters measured clearly separated the Atlantic Forest and the Amazonian populations (Fig. 1). Moreover, the apical bands of the first three terga of bees belonging to the Atlantic Forest population are more whitish, not yellow as in individuals from the Amazonian Forest (Figs. 2, 3).

Based on this set of distinctive characters and on the fact that no forested connection remains between both forest domains (although some authors suggest that such connections did exist until modern times, see Coimbra-Filho & Câmara, 1996), it is being proposed here that the population of Atlantic Forest is a distinctive undescribed species.

***Eufriesea atlantica* sp. n.**

Diagnosis. This species can be readily distinguished from the very similar *Ef. ornata* by the much narrower apical bands in T1, T2, and T3, which are whitish and not yellow as in *Ef. ornata*.

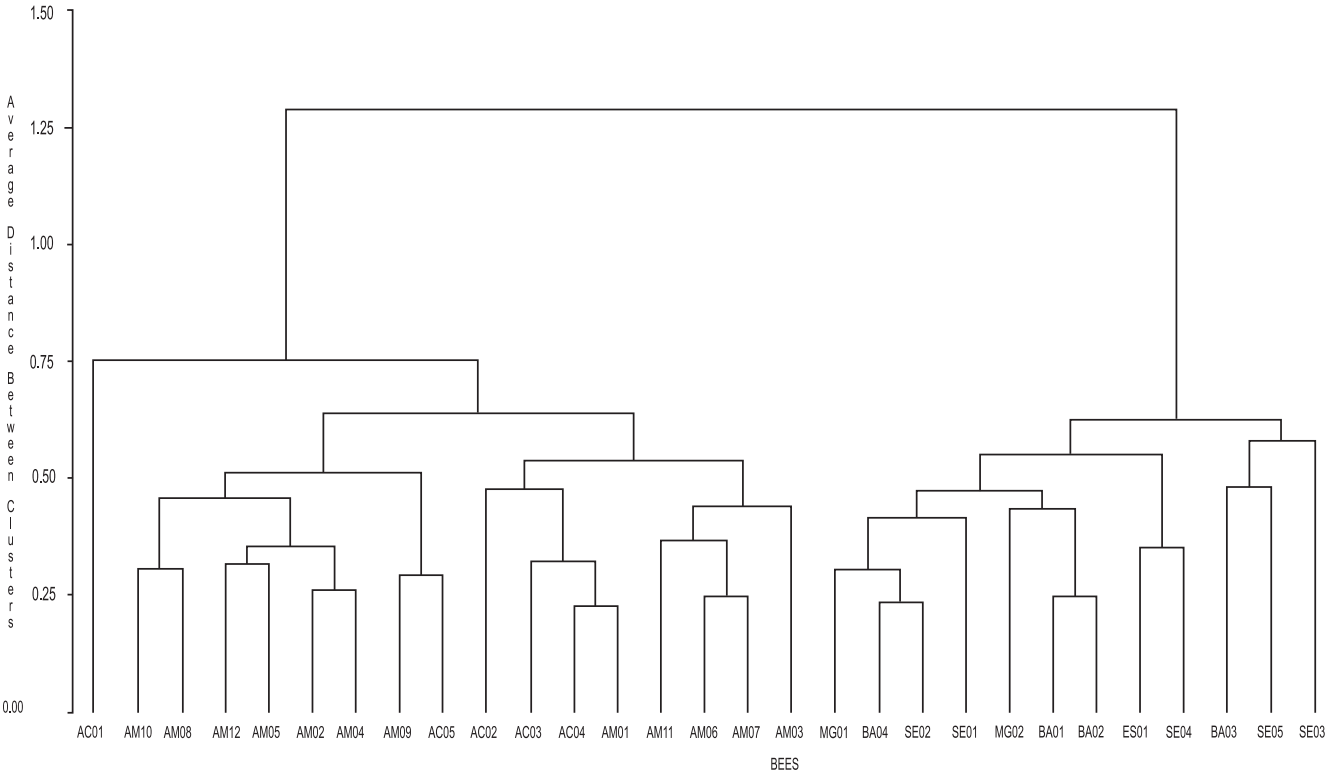

Figure 1 - Cluster of the 29 specimens examined according to the six characters employed. Each specimen is represented by the abbreviation of the Brazilian state where it was collected followed by a number (AC = Acre; AM = Amazonas; BA = Bahia; ES = Espírito Santo; MG = Minas Gerais; SE = Sergipe) (actual data of labels are presented in Appendices 1 and 2 and in the section "Type material" in the text).

Figure 2 - Dorsal view of *Eufriesea atlantica* sp. n., showing the width of tergal stripes.

Figure 3 - Dorsal view of *Eufriesea ornata* (Mocsary), showing the width of tergal stripes.

Male

Color and vestiture: Face black with green hues; mesosoma mostly black, green anteriorly; wings dark brown basally and pale brown distally. Pubescence dense, black on thorax; T1 bronze with whitish hairs; T2-T3 banded (dark green, with black hairs basally and whitish hairs distally). Width of the whitish stripes in T1-T3 about 1.00 mm (see Appendix 1). T4-T7 dark green, completely covered with reddish-orange hairs.

Head: Width 6.95 mm; interorbital distance at base of scape 3.77 mm; maximum interorbital distance 4.34 mm; scape 2.17 mm; eye length 4.65 mm. Clypeus with strong medial ridge, densely punctate; punctures irregular in shape and size (0.04 mm to 0.12 mm).

Body: Body length ca. 22.0 mm; anterior wing ca. 19.8 mm; tongue in repose exceeding S7; scutellum 5.35-mm wide and 2.38-mm long; abdominal width 10.0 mm.

Legs: Foretibia and forebasitarsus dark green fringed with long and dense, black hairs; velvet area occupying the entire outer surface of mid tibia, mid basitarsus completely covered with golden hairs; hind tibia oblong, swollen, ventrally covered with golden hairs and laterally with black hairs, post-glandular area reaching apex.

Abdomen: Punctation on T1-T3 dense, punctures small (0.03 mm) and rounded; on T4-T7 dense, with large (0.05 mm), elongate punctures.

Etymology: The specific epithet refers to the biome where this species is endemic to, the Atlantic Rain Forest of eastern Brazil.

Female: Unknown.

Type locality: Holotype collected at 19º42'31"S - 42º33'50"W, Parque Estadual do Rio Doce, Marliéria municipality, state of Minas Gerais, southeastern Brazil.

Type material. HOLOTYPE: male, with the following data: "PROPERD, 4,000 m [from the forest edge] – área VII, 10896-32242" and "Marliéria – MG, Brasil, 18/12/1999, A. Nemésio" (UFMG). **PARATYPES**: State of Minas Gerais, Brazil: "PROPERD, Borda da mata, 10897-32244" and "Marliéria – MG, Brasil, 19/12/1999, A. G. Damasceno" (UFPR); State of Espírito Santo, Brazil: "Euglossini de Linhares, Paraju 3, 6888-18554" and "Linhares – ES, Brasil, 12/12/1996, M. A. Bonilla" (UFMG); State of Bahia, Brazil: "Eunápolis, Bahia, Brasil (9° 56' 34"S e 38° 59' 17"W), 23.I.2004 (S. Metila), Melo, A.M. Col." and "*Eufriesea ornata* (Mocsary, 1896), E. L. Neves Det. 2005" and "3286" (UFMG); "idem (baunilha)", "idem" and "3287" (ZSM); "idem, 25.I.2004 (baunilha)", "idem" and "3293" (UKansas); "idem, 25.I.2004 (baunilha)", "idem" and "3295" (UFBA); State of Sergipe, Brazil: "PN Serra de Itabaiana – SE – Brasil, XVIII-XII-2004, J.R. Santos leg." and "N° PSI-1221, Ess.: Salicilato, Hor.: 6:00/17:00h, S° 10° 46' 003", HO° 37° 20' 213"" (UFMG); "PN Serra de Itabaiana – SE – Brasil, XX-I-2005, J.R. Santos leg." and "N° PSI-1222, Ess.: Eucaliptol, Hor.: 6:00/17:00h, S° 10° 43' 438", HO° 37° 21' 457"" (USP/RP); "PN Serra de Itabaiana – SE – Brasil, XXI-XII-2005, J.R. Santos leg." and "N° PSI-1223, Ess.: Vanilina, Hor.: 6:00/17:00h, S° 10° 44' 084", HO° 37° 22' 081"" (USP/RP); "idem" and "idem, N° PSI-1224" (USP/RP); "PN Serra de Itabaiana – SE – Brasil, XXXI-III-2005, J.R. Santos leg." and "N° PSI-1225, Ess.: Vanilina, Hor.: 6:00/17:00h, Loc.: Mata do Castro" (MZUSP). State of Rio de Janeiro, Brazil: "Parque do Desengano, Campos, RJ, 6-XII-1997, Col. J. L. Blackmer" and "Local – 1, Fragmento grande, Amostra – 7, Isca – Vanilina" and "*Eufriesea ornata* (Mocsáry, 1896), J.L. Blackmer det. 1998" (UFMG); "idem" and "Local – 1, Fragmento grande, Amostra – 5, Isca – Vanilina" and "idem" (UENF); "Parque do Desengano, Sta. Ma. Madalena, RJ, 07-XI-99, Col. G. S. Albuquerque" (UENF).

Discussion

The relatively small number of specimens examined of *Ef. atlantica* **sp. n.** is a consequence of the uneasy task of collecting *Eufriesea*, which species are highly seasonal (Kimsey, 1982). The holotype, for instance, was the only member of this species among almost 1,200 other orchid-bee males collected in a 10-month study in the type locality (Nemésio & Silveira, 2006). The paratype from the state of Espírito Santo is one of eight specimens among more than 16,000 observed bees (Bonilla-Gómez, 1999).

Species of several taxa in the Atlantic Forest have been reported to have their sister species in the Amazon basin, such as *Mitu mitu* (Linnaeus) (Aves: Cracidae) from the Atlantic Forest of northeastern Brazil and *M. tuberosum* (Spix) from the Amazon Basin (Sick, 1997). Among orchid bees, the recent increases in the number of specimens in entomological collections made it possible to compare large series of bees believed to belong to the same species in both domains. Although no differences in morphology were found for a number of them, other ones were consistent and lead to the separation of the different sets of populations into distinct species. Oliveira (2000) and Moure (2003), for example, treated all the specimens of *El. meriana* found in the Atlantic Forest as *El. flavescens* (Friese) and Moure (2003) has also treated the population of *El. bombiformis* of the Atlantic Forest as a different species, *El. niveofasciata* (Friese), a point of view supported by Nemésio (2005), but not by Oliveira (2007).

It is interesting that the width of the apical bands of the terga in *El. flavescens*, besides the color of the hairs in the last three terga, led Friese (1899: 165) [1899 – "Abdominalsegment 1-3 (auch 4) schmaler"], Moure (2003) and Oliveira (2007) to consider this species distinct from *El. meriana*. This latter species presents wider bands than its Atlantic Forest counterpart. The same phenomenon is here reported between specimens of *Ef. atlantica* sp. n. and *Ef. ornata*. Besides, the whitish bands of *El. niveofasciata* led Moure (2003) to agree with Friese (1899: 165 – "die Haarbinder von Segment 1-3 schneeweiss") and consider this latter species distinct from *El. bombiformis*. Specimens of *Ef. atlantica* sp. n. also present whiter bands then specimens of *Ef. ornata*. Dressler (1979) considers *El. bombiformis*, *El. meriana*, *El. seabrai*, and *Ef. ornata* to be part of a Müllerian mimetic complex. Friese (1899: 167) had already noticed these strong similarities ("*Euglossa ornata* ähnelt der *dimidiata* sehr").

No explanation was presented to date on what selective pressures might have created the mimetic complex envisioned by Dressler (1979), involving tergal-band width and/or color. However, if this complex actually exists as a result of co-evolution among the involved species, then it was broken in the Atlantic Forest, since *El. flavescens* is not very similar to either *El. niveofasciata,* or to *Ef. atlantica* **sp. n.**, and these, in turn, are not as similar to each other as are their Amazonian counterparts, *El. bombiformis* and *Ef. ornata.*

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Appendix 1. Measurements of six characters from 12 specimens of *Eufriesea atlantica* sp. n. and 17 specimens of *Eufriesea ornata.* T1, T2 and T3 = width of the apical bands of the first, second and third terga, respectively; SCTL = length of the scutellum; SCTW = width of the scutellum; IOD = interorbital distance. MG = state of Minas Gerais; ES = state of Espírito Santo; BA = state of Bahia; SE = state of Sergipe; AC = state of Acre; AM = state of Amazonas. Each specimen is represented by the abbreviation of the Brazilian state where it was collected followed by a number as presented in Figure 1. The numbers after the hyphen are numbers present on the labels of the specimens (see "Type material" in the text for *Eufriesea atlantica* sp. n. and Appendix 2 for *Eufriesea ornata*). Std = standard deviation.

Specimen	T1	T2	T3	SCTL	SCTW	IOD
Eufriesea atlantica Nemésio sp. n.						
MG01 – Holotype	1.00	1.00	0.90	2.38	5.35	3.77
MG02 – 10897-32244	0.90	1.00	1.00	2.48	5.05	3.87
ES01 – 6888-18554	1.19	1.39	1.09	2.57	5.25	3.77
BA01 – 3287	1.19	1.00	0.90	2.18	5.05	3.66
BA02 – 3295	1.09	1.00	0.80	2.18	4.85	3.77
BA03 – 3286	0.90	1.09	0.90	1.88	4.95	3.47
BA04 – 3293	1.19	1.19	0.90	2.28	5.44	3.97
SE01 – 1221	1.34	1.09	1.09	2.37	5.13	3.97
SE02 – 1222	1.09	1.00	0.90	2.18	5.35	3.97
SE03 – 1223	1.34	1.19	1.19	2.05	4.85	3.77
SE04 – 1224	1.19	1.34	1.26	2.29	5.44	3.77
SE05 – 1225	0.80	1.26	1.19	2.05	5.13	3.77
Mean	**1.10**	**1.13**	**1.01**	**2.24**	**5.15**	**3.79**
Std	**0.17**	**0.14**	**0.15**	**0.20**	**0.21**	**0.14**
Eufriesea ornata (Mocsáry, 1896)						
AC01 – 1833	1.39	1.59	1.39	2.68	5.94	4.06
AC02 – 61E	1.58	1.78	1.58	2.77	5.15	3.87
AC03 – 12E	1.68	1.78	1.78	2.58	5.35	4.16
AC04 – 29E	1.68	1.68	1.68	2.77	5.54	4.16
AC05 – 43Q	2.21	1.81	1.66	2.77	5.53	4.11
AM01 – 0660	1.78	1.78	1.58	2.67	5.64	4.06
AM02 – 0911	1.98	1.58	1.58	2.28	5.74	4.16
AM03 – 0687	1.78	1.68	1.58	2.28	4.95	3.91
AM04 – 0831	1.78	1.58	1.58	2.28	5.74	3.96
AM05 – 0462	1.98	1.68	1.48	2.57	5.74	4.16
AM06 – 0934	1.98	1.78	1.58	2.48	5.25	3.91
AM07 – 0382	1.78	1.68	1.58	2.38	5.35	3.96
AM08 – 0793	2.08	1.78	1.68	2.67	5.94	4.26
AM09 – 0835	2.21	1.74	1.50	2.69	5.61	4.35
AM10 – 0842	1.88	1.68	1.78	2.77	5.94	4.06
AM11 – 0677	1.78	1.88	1.49	2.18	5.45	4.06
AM12 – 0946	1.98	1.78	1.78	2.48	5.74	4.06
Mean	**1.85**	**1.72**	**1.60**	**2.55**	**5.56**	**4.07**
Std	**0.22**	**0.09**	**0.11**	**0.20**	**0.29**	**0.13**

Appendix 2. Male *Eufriesea ornata* (Mocsary) examined.
State of Acre, Brazil: "1833"; "61E"; 12E; 29E; 43Q (all at UFMG); State of Amazonas, Brazil: "Cineol, N° 835" and "Manaus – AM, Brasil, 5/11/88, E. F. Morato" and "*Euplusia ornata* (Mocs), ♂, Pe. J.S. Moure, 1989" (UFMG); "Cineol, N° 842" and "Manaus – AM, Brasil, 7/11/88, E. F. Morato" (UFMG); "Eugenol, N° 677" and "Manaus – AM, Brasil, 20/11/88, E. F. Morato" (UFMG); "Eugenol, N° 946" and "Manaus – AM, Brasil, 6/11/88" (UFMG); "0382" and "Manaus – AM, PDBFF, 9/10/89, M.L. Oliveira" (UFV); "0462" and "Manaus – AM, PDBFF, 9/10/89, M.L. Oliveira" (UFV); "0660" and "Manaus – AM, PDBFF, 9/11/89, M.L. Oliveira" (UFV); "0687" and "Manaus – AM, PDBFF, 17/11/89, M.L. Oliveira" (UFV); "0793" and "Manaus – AM, PDBFF, 3/11/89, M.L. Oliveira" (UFV); "0911" and "Manaus – AM, PDBFF, 17/11/89, M.L. Oliveira" (UFV); "0831" and "Manaus – AM, PDBFF, 27/11/89, M.L. Oliveira" (UFV); "0934" and "Manaus – AM, PDBFF, 29/11/89, M.L. Oliveira" (UFV).