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Article

Synopsis of the parasitic wasps *Bephrata* (Hymenoptera: Chalcidoidea, Eurytomidae) in Brazil

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ABSTRACT. This study is focused on the parasitic wasps *Bephrata* Cameron, 1884 (Hymenoptera, Eurytomidae), a small and poorly represented genus in entomological collections. Herein we report new geographical records to *Bephrata bahiae* (Ashmead, 1904), *B. bouceki* Gates & Hanson, 2009, *B. cultriformis* (Ashmead, 1894), *B. leptogaster* Gates & Hanson, 2009, *B. lorraineae* Gates & Hanson, 2009, *B. ruficollis* Cameron 1884 and *B. ticos* Gates & Hanson, 2009. Except for *B. bahiae*, *B. chica* Gates & Hanson, 2009 and *B. christeri* Gates & Hanson, 2009, all other studied species were recorded for the first time to Brazil. Additionally, we provide maps with the geographical distribution of the studied species based on the new records and literature data, and an identification key for the species recorded in Brazil. With these new records there are currently nine species of *Bephrata* known in Brazil.

KEYWORDS. Egg parasitoids, extension of geographic range, Eurytominae, Neotropical Region, Tettigoniidae.

RESUMO. Sinopse das vespas parasitoides *Bephrata* (Hymenoptera: Chalcidoidea, Eurytomidae) no Brasil. O presente estudo tem foco nos *Bephrata* Cameron, 1884 (Hymenoptera, Eurytomidae), um pequeno gênero de vespas parasitoides pouco representado em coleções entomológicas. Aqui relatamos novos registros geográficos para *Bephrata bahiae* (Ashmead, 1904), *B. bouceki* Gates & Hanson, 2009, *B. cultriformis* (Ashmead, 1894), *B. leptogaster* Gates & Hanson, 2009, *B. lorraineae* Gates & Hanson, 2009, *B. ruficollis* Cameron 1884 and *B. ticos* Gates & Hanson, 2009. À exceção de *B. bahiae*, *B. chica* Gates & Hanson, 2009 e *B. christeri* Gates & Hanson, 2009, as demais espécies estudadas foram registradas pela primeira vez para o Brasil. Adicionalmente fornecemos mapas com a distribuição geográfica das espécies estudadas baseados em novos registros e dados da literatura e uma chave de identificação para espécies conhecidas para o Brasil. Com esses novos registros há, na atualidade, nove espécies de *Bephrata* conhecidas no Brasil.

PALAVRAS-CHAVE. Parasitoides de ovos, extensão de distribuição geográfica, Eurytominae, Região Neotropical, Tettigoniidae.

Parasitic wasps, an especially diverse and dominant group of insects in the Neotropic, are a fascinating, taxonomically challenging and one of the most abundant groups of terrestrial natural enemies available (Munro *et al.*, 2011; Heraty *et al.*, 2013; Murray & Heraty, 2019).

Among the parasitic wasps, Eurytomidae (Chalcidoidea) includes about 1,400 species and 73 genera (Noyes, 2019), of which 220 species and 34 genera occur in the Neotropical Region (Gates, 2006). In Brazil, are recorded about 80 species belonging to 23 genera and three subfamilies: Eurytominae, Heimbrinae and Rileyinae (Fernandes *et al.*, 2012; Perioto *et al.*, 2020; Perioto, 2022).

Bephrata Cameron, 1884 (Eurytominae) is a predominantly Neotropical chalcid wasp group and currently includes 22 species, of which 19 occur in the Neotropical Region and three have been recorded for Brazil: *B. bahiae* (Ashmead, 1904) in the coastal tablelands of Atlantic Forest from state of Bahia and, *B. chica* Gates & Hanson, 2009 and *B. christeri* Gates & Hanson, 2009, both in the Amazonian basin from state of Amazonas (Gates & Hanson, 2009; Noyes, 2019; Perioto, 2022). Furthermore, an unidentified species of *Bephrata* is mentioned for Pantanal biome in Mato Grosso do Sul state (Shimbori *et al.*, 2017).

The biology of *Bephrata* is poorly known and the available evidence indicates that they act as parasitoids of eggs of *Bucrates* Burmeister, 1838, *Tettigonia* Linnaeus, 1758 and an unidentified Pseudophyllinae (Orthoptera, Tettigoniidae) (Herting, 1973; De Santis, 1989; Gates & Hanson, 2009).

The knowledge about the Brazilian fauna of *Bephrata* and its distribution is still far from complete. Therefore, the new distribution records presented here are important for a better understanding the actual richness and distribution range of this genus of parasitic wasps.

MATERIALS AND METHODS

The studied material was composed of specimens collected in surveys carried out in the Brazilian biomes such as the Amazon forest (Schoeninger *et al.*, 2019), the Atlantic forest (Lara & Perioto, 2014; Azevedo *et al.*, 2015; Perioto *et al.*, 2016), the Caatinga (Fernandes *et al.*, 2014, 2020), the Brazilian savanna (Perioto *et al.*, 2008; Versuti *et al.*, 2014), the Fernando de Noronha oceanic archipelago (Rafael *et al.*, 2020), and collection expeditions carried out by N. W. Perioto and R. I. R. Lara in 2018 and 2019 in areas of Brazilian savanna at Parque Nacional da Chapada dos Veadeiros, in Goiás state and at Parque Nacional Grande Sertões Veredas, in Minas Gerais state, Brazil. The holotypes of *B. chica*, *B. christeri* and *B. lorraineae* Gates & Hanson, 2009 deposited in the Smithsonian National Museum of Natural History (USNM) were studied through photographs available in https://collections.nmnh.si.edu/search/ento/.

The specimens studied were identified using the key provided by Gates & Hanson (2009) and deposited in the collections of the Instituto Biológico - LRRP, Ribeirão Preto, São Paulo, Brazil (N. W. Perioto, curator), Instituto Nacional de Pesquisas da Amazônia - INPA, Manaus, Amazonas, Brazil (J. A. Rafael) and Universidade Federal do Espírito Santo – UFES, Vitória, Espírito Santo, Brazil (M. T. Tavares).

The consistency of anatomical data with the Hymenoptera Anatomy Ontology project (Yoder *et al.*, 2010; Seltmann *et al.*, 2012) was determined using the proofing tool available through the Hymenoptera Glossary (HAO, 2019).

Images were taken using a digital camera attached to a stereomicroscope and specimens illuminated with high diffuse dome illumination. Focus stacking of images was done using the *software* Helicon Focus (version 5.3). The figures were prepared using Adobe Photoshop (version 11.0).

Species distributions were assembled in a dataset and incorporated into distribution maps. Geographic coordinates of the species records, if not present in labels, were taken from Google Earth software (https://www.google.com/earth/), and the maps were generated using the web software SimpleMappr (Shorthouse, 2010).

Abbreviations for Brazilian states are as follows: AC, Acre; AM, Amazonas; BA, Bahia; ES, Espírito Santo; MG, Minas Gerais; PE, Pernambuco; PR, Paraná; RJ, Rio de Janeiro; RN, Rio Grande do Norte; RO, Rondônia; RR, Roraima; and SP, São Paulo.

RESULTS

Bephrata Cameron, 1884

Bephrata Cameron, 1884:109. Type species: *Bephrata ruficollis* Cameron, by monotypy.

Aximogastra Ashmead, 1904:261. Type species: *Aximogastra bahiae* Ashmead, 1904 by monotypy. Synonymy by Lotfalizadeh *et al.*, 2007:508.

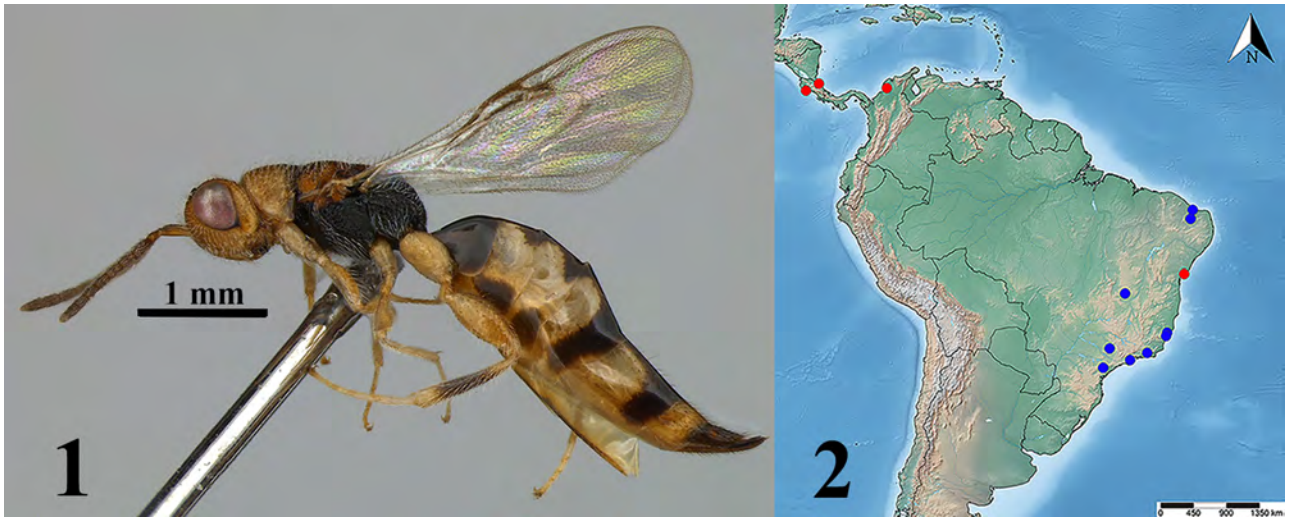
Bephrata bahiae (Ashmead, 1904)

(Figs 1, 2)

Aximogastra bahiae Ashmead, 1904:261.
Bephrata bahiae: Lotfalizadeh *et al.*, 2007:509.

New records. Patú and Mossoró (RN), Chapada Gaúcha (MG), Domingos Martins and Santa Teresa (ES), Descalvado, Ribeirão Grande and São Luis do Paraitinga (SP), and Teresópolis (RJ) (Fig. 2).

Material examined. 30 females. “Brasil, RN, Patú, 06°06’S / 37°37’W, caatinga, arm. Malaise, setembro/2008, D. R. R. Fernandes e eq., cols.”, 4 females (LRRP #18394, 18399, 18404, 18412); same data except outubro/2008, 8 females (LRRP #18395-18397, 18400-18402, 18405,



Figs 1, 2. *Bephrata bahiae* (Ashmead, 1904): 1, lateral habitus, female; 2, distribution map; red circles; previous records, blue circles = new records.

18410); same data except novembro/2008, 1 female (LRRP #18407); "Brasil, RN. Mossoró, Faz. Sta. Julia – caatinga, 05°01'10"S / 37°22'56"O, armadilha Malaise, 14.IV.2008, D. R. R. Fernandes e eq., cols.", 3 females (LRRP #20702-20704); "BRA, MG, Chapada Gaúcha, PARNA Grande Sertão Veredas, 15°10'30.6"S / 45°43'16.6"W, cerrado / arm. Malaise, 11/IX/2018, N. W. Perioto e R. I. R. Lara, cols.", 1 female (LRRP #20711); same data except 6/IX/2018, 1 female (LRRP #20712); same data except 9/IV/2019, 1 female (LRRP #20713); "BRASIL, ES, Domingos Martins, Mata Pico do Eldorado, 20°22'17"S 40°39'29"W, 03-10.xii.2004, Malaise T7, M. T. Tavares and eq. cols.", 1 female (UFES #64931); "Brasil, ES, Santa Teresa, Est. Biol. Sta. Lucia, 19°58'25.2"S 40°31'44.6"W, varredura veg., 11/IV/2001, C. O. Azevedo e eq., cols.", 1 female (LRRP #20706); "BRA, SP, Descalvado, Fazenda Itaúnas, 21°54'05"S / 47°37'26"W, arm. Malaise, cerrado, 21/VI/2006, N. W. Perioto e eq. cols.", 1 female (LRRP #22641); "Brasil, SP, Ribeirão Grande, Parque Estadual Intervales, 24°16'28.0"S / 48°25'14.8"O, arm. Malaise, 22/IV/2010, N. W. Perioto e eq., cols.", 1 female (LRRP #20676); same data except 24°16'27.7"S / 48°25'19.3"O, 22/VII/2010, 1 female (LRRP #20677); "BR, SP, São Luis do Paraitinga, PESM - Núcleo Santa Virgínia, 23°19'24.8"S / 45°05'40.1"O, arm. Malaise, 22/IX/2010, N. W. Perioto e eq., cols.", 1 female (LRRP #20678); same data except 23°19'16.9"S / 45°05'46.6"O, 23/XI/2009, 2 females (LRRP #20679, 20680); same data except 45°05'46.6"O / 23°19'16.9"S, 20/X/2011, 2 females (LRRP #20715, 20716); "BRA, RJ, Teresópolis, PARNA Serra dos Órgãos, 3/IX/2009, V. Flinte, col.", 1 female (LRRP #21451).

Identification. According to Gates & Hanson (2009), *B. bahiae* is recognized for presenting the dorsal-posterior part of head with yellow area between occiput and ocellar area; mesoscutum and mesoscutellum pale yellow or orange yellow; center of pronotum with very narrow, longitudinal black line; procoxa with sinuous groove on anterior surface and metatibia black, at least in part. The specimen collected in Descalvado (SP) has the pronotum completely yellow, without longitudinal black line.

Discussion. *Bephrata bahiae* has been found previously in Costa Rica and Colombia and, in Brazil, has been recorded in state of Bahia (Gates & Hanson, 2009; Noyes, 2019). The new distributional records, in five Brazilian states (RN, MG, ES, RJ and SP) represent a significant increase of the distribution range in Brazil and indicate that this species can develop in different biomes such as Brazilian savannah, Atlantic rainforest and Caatinga.

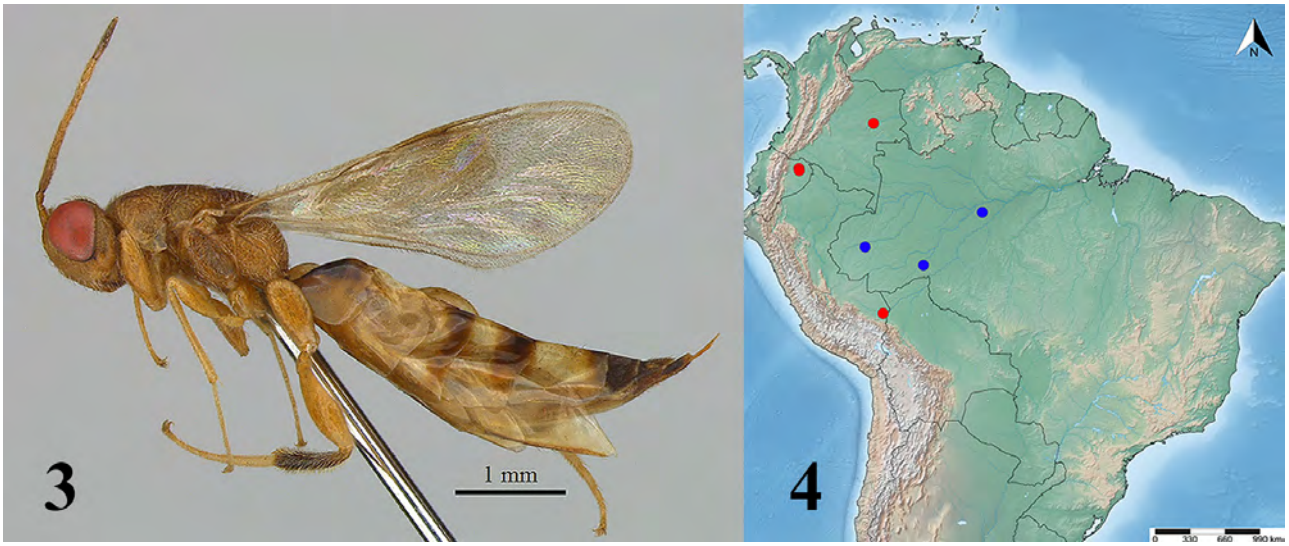
Bephrata bouceki Gates & Hanson, 2009

(Figs 3, 4)

New records. Careiro Castanho and Ipixuna (AM), and Porto Velho (RO) (Fig. 4).

Material examined. 4 females. "BRAZIL, Amazonas, Careiro Castanho, BR 319, Km 181, Sítio São Paulo, 04°12'48"S – 60°49'04"W, 12-27.V.2017, Suspensa 20m, J. A. Rafael & F. F. Xavier. Rede Bia", 1 female (INPA); "BRAZIL, Amazonas, Ipixuna, Rio Gregório, Com. Lago Grande, 07°10'11,7"S – 70°49'10,3"W, 18-23.V.2011, varredura, J. A. Rafael, R. F. Câmara, R. F. Silva, A. Somavilla, R. Ale-Rocha", 2 females (INPA); "BRASIL, RO, Porto Velho, BR 364 km 8,5, armadilha Malaise, 4/I/2006, Mugrabi, P.F., col.", 1 female (LRRP #20675).

Identification. According to Gates & Hanson (2009) *Bephrata bouceki* is recognized for presenting a sinuous groove on anterior surface of procoxa; body nearly entire yellow and metatibia black, at least in part.



Figs 3, 4. *Bephrata bouceki* Gates & Hanson, 2009: 3, lateral habitus; 4, distribution map; red circles = previous records, blue circle = new record.

Discussion. Only seven specimens of *B. bouceki* are known, all of them from the Amazon rainforest. *B. bouceki* has been found previously in Colombia, Equador and Peru (Gates & Hanson, 2009; Noyes, 2019). Now it is reported for the first time for Brazil, in Amazonas and Rondônia states. This new record extends the geographical distribution of *B. bouceki* about 1,800 km to the southeast from the type locality at Sucumbíos, Equador, 1,200 km to the southeast from Amazonas, Colombia and 800 km from Madre de Dios, Peru, the previous records.

Bephrata chica Gates & Hanson, 2009

(Figs 5, 6)

Material examined**.** 1 female. Holotype female (USNM) (images examined, available at http://n2t.net/ark:/65665/397e42c5d-9088-4da3-8cb1-b52a5adf3732): "ECUADOR, Napo, Reserva Etnica Waorani, Transect Ent. 1 km S. Okone Gare Camp, 00°39'10"S 76°26'0"W, 220 m, 8.X.1995, T. Erwin et al., Canopy fogging, t10.5 #1265".

Identification. According to Gates & Hanson (2009) *B. chica* is a small species, with about 4 mm long, with black mesosoma (except yellowish lateral pronotum) and yellowish lower face.

Discussion. Gates & Hanson (2009, p. 40), when describing *Bephrata chica*, stated that this species "can be distinguished by its black hind legs (except for the tarsi)". However, when analyzing the holotype's image, we verified that the hind leg of this specimen has coxa and femur almost entirely colored of yellowish brown, brown tibia, and yellowish tarsi.

Bephrata chica has been found previously in Equador, Peru and Brazil (AM) (Fig 6) (Gates & Hanson, 2009; Noyes, 2019). Only two specimens (paratypes) are known for Brazil, both collected in Amazonas state (Gates & Hanson, 2009; Noyes, 2019).

Bephrata christeri Gates & Hanson, 2009

(Figs 7, 8)

New record. Bujari (AC) (Fig. 8).

Material examined. Holotype female (USNM) ((images examined, available at http://n2t.net/ark:/65665/3d4292b2f-46bf-4fef-91ab-00a78a326866) and 2 females. "ECUADOR, Napo, Reserva Etnica Waorani, Transect Ent. 1 km S. Okone Gare Camp, 00°39'10"S 76°26'0"W, 220 m, 10.II.1995, T. Erwin *et al*., Canopy fogging, Lot #1009, t8, terre firme forest"; "BRASIL, AC, Bujari, FES Antimary, 09°20'01"S – 68°19'17"W, Malaise Pequena, 21.X-04.XI.2016, EF Morato & JA Rafael, Rede Bia", 1 female (INPA); same data except 19.XI-03.XII.2016, 1 female (INPA).

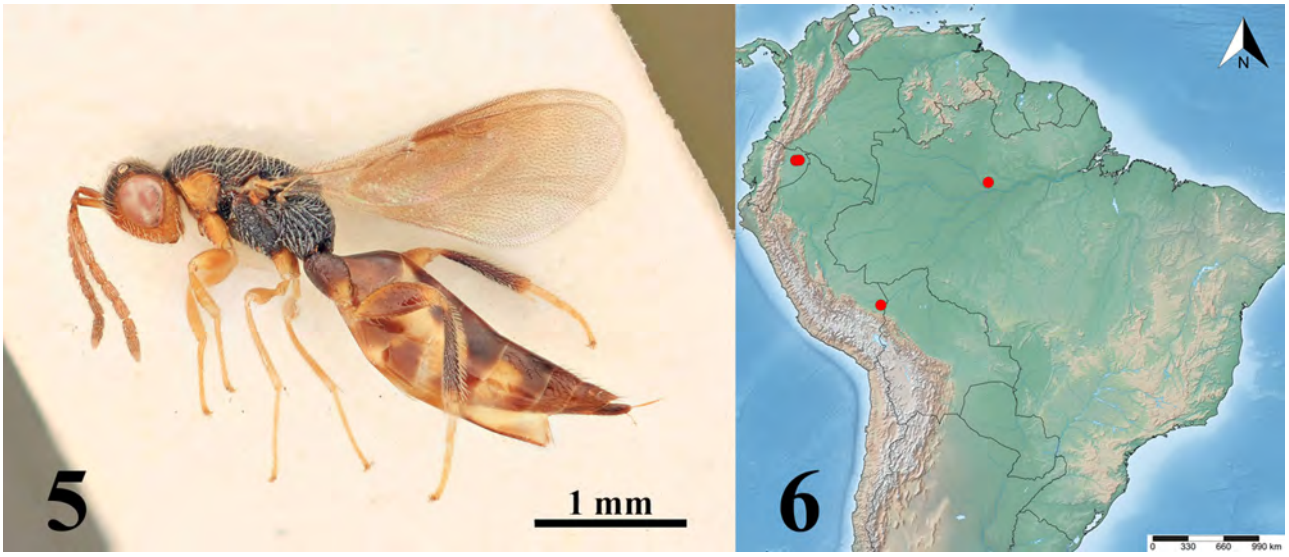
Identification. According to Gates & Hanson (2009) *B. christeri* is quite similar to *B. lorraineae*, but the latter species usually has more extensive black coloration on the pronotum and the female antennal flagellum is uniformly colored (as opposed to bicolored in *B. christeri*).

Discussion. *Bephrata christeri* has been found previously in Equador, Colombia, Peru and Brazil (AM) (Gates & Hanson, 2009; Noyes, 2019) and now the species is reported for the first time in Acre state, Brazil.

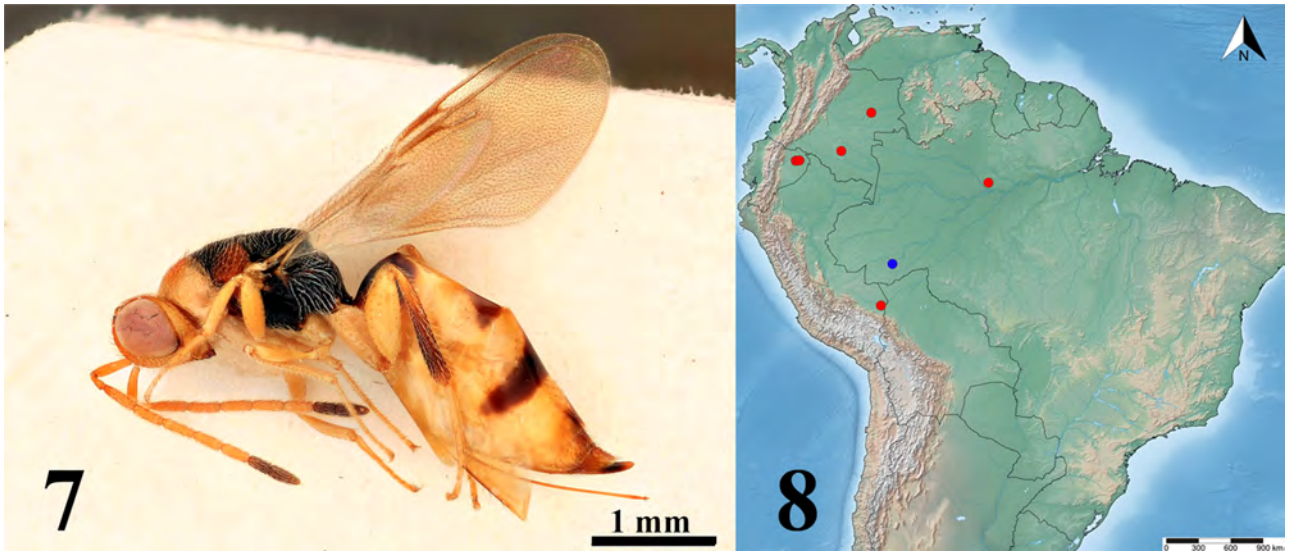
Bephrata cultriformis (Ashmead, 1894)

(Figs 9, 10)

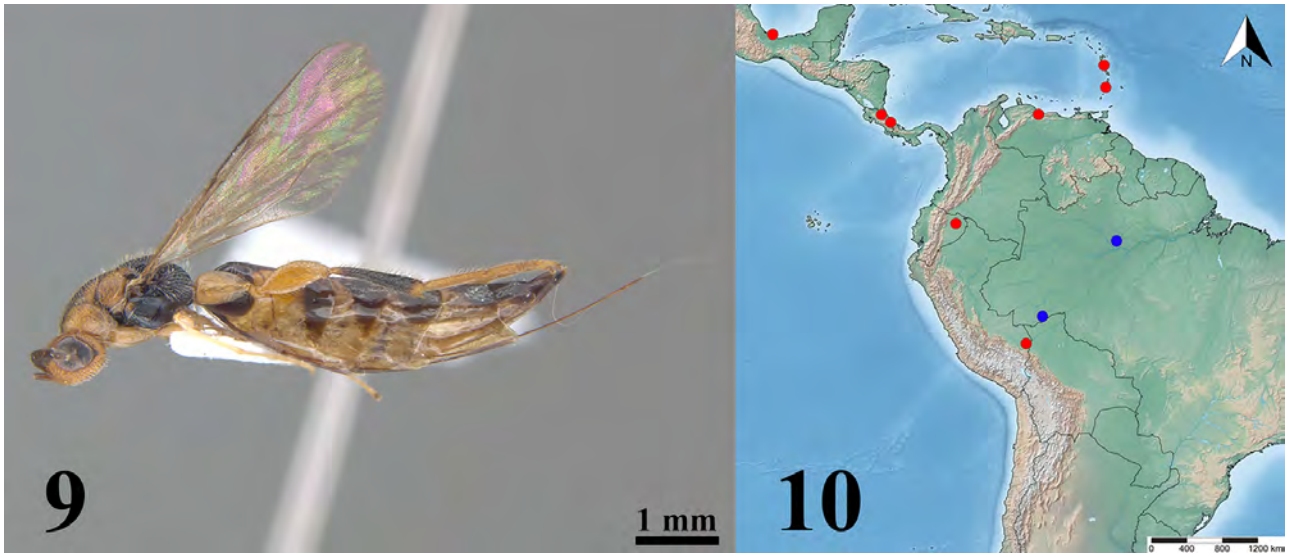
Bephrata cultriformis Ashmead, 1894:146.
Aximogastra cultriformis: Gahan, 1951:173.
Bephrata cultriformis: Lotfalizadeh *et al.*, 2007:508.



Figs 5, 6. *Bephrata chica* Gates & Hanson, 2009: 5, lateral habitus, female, holotype (modified from http://n2t.net/ark:/65665/m30b51a95d-d90f-4fd3-9216-f4711473e5fa); 6, distribution map; red circles = previous records.



Figs 7, 8. *Bephrata christeri* Gates & Hanson, 2009: 7, lateral habitus, female, holotype (modified from http://n2t.net/ark:/65665/m374c43804-1831-4ccc-9bd2-c54f54c050ba); 8, distribution map; red circles = previous records, blue circle = new record.



Figs 9, 10. *Bephrata cultriformis* (Ashmead, 1894): 9, lateral habitus, female; 10; distribution map; red circles = previous records, blue circles = new records.

New records. Senador Guiomard (AC) and Manaus (AM) (Fig. 10).

Material examined. 3 females. "BRASIL, AC, Senador Guiomard, Faz. Exp. Catuaba (UFAC), 10°04'28"S – 67°37'00"W, Malaise, 01-15.IV.2017, EF Morato & JA Rafael, Rede Bia", 1 female (INPA); same data except 14-30.X.2016, 1 female (INPA); "BRASIL, AM, Manaus, Reserva Ducke, 5°12'56.4"S / 61°50'22.6"O (?? certainly wrong coordinates)", 09.iii.2008, Amat E. Leg, Malaise T. firme", 1 female (INPA).

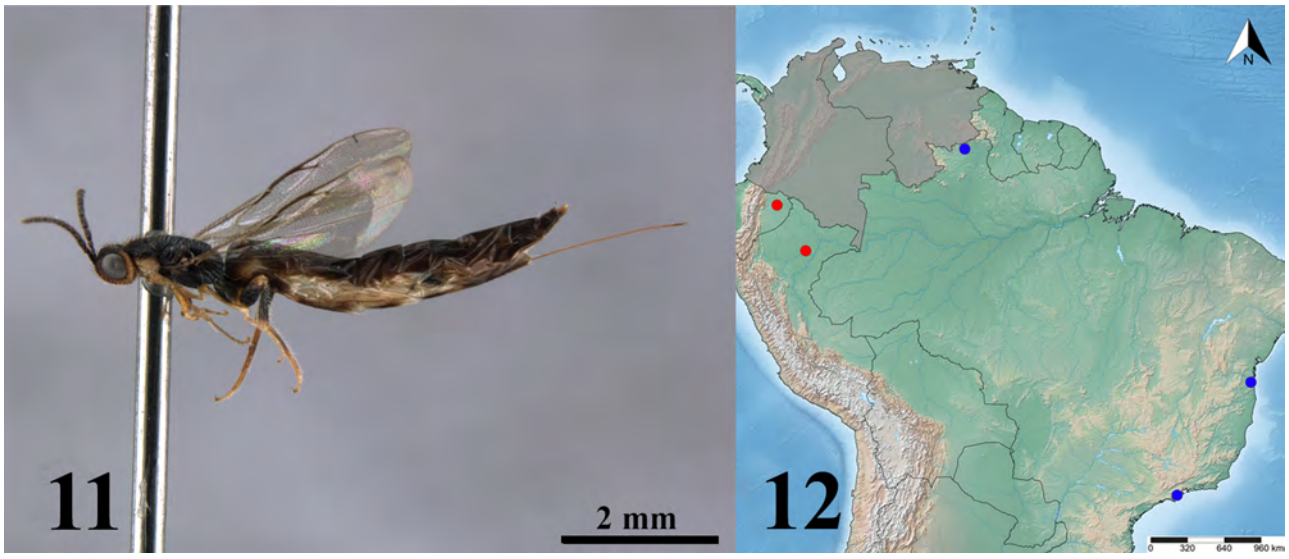
Identification. According to GATES & HANSON (2009) *B. cultriformis* is one of the species in the genus that lack the distinctive groove on the procoxae and could therefore be misidentified as *Isosomodes* Ashmead, 1888 (Eurytomidae: Eurytominae). GATES & HANSON (2009) in Table I provided features that allow safe separation between *Bephrata* and *Isosomodes*.

Discussion. *Bephrata cultriformis* was previously found in Mexico, Costa Rica, Dominica, St Vincent & Grenadines,Venezuela, Ecuador and Peru (GATES & HANSON, 2009; NOYES, 2019). Now it is reported for the first time for Brazil in Amazon rainforest area in the Acre and Amazonas states.

Bephrata leptogaster Gates & Hanson, 2009

(Figs 11, 12)

New records. Amajari (RR), Uruçuca (BA), and Ubatuba (SP) (Fig. 12).



Figs 11, 12. *Bephrata leptogaster* Gates & Hanson, 2009: 11, lateral habitus; 12, distribution map; red circles = previous records, blue circles = new records.

Material examined. 3 females and 1 male. "BRAZIL, Roraima, Amajari, Tepequém, SESC, 03°44'45"N / 61°43'40"W, 1-15.XI.2016, Malaise Pequena, J.A. Rafael, R. Boldrini", 1 female (INPA); same data except 14-29. XII.2015, Malaise, 1 female (INPA); "BRASIL, BA, Uruçuca, Fazenda Bom Jardim, 14°34'94"S 39°17'85"W, 23.xi.2002, Malaise Pt8, J.C. Cardoso e J. Maia cols.", 1 female (UFES #49056); "BRASIL, SP, Ubatuba, 29.xii.1991, Moericke, N.F. Cristo col.", 1 male (UFES #160056).

Identification. According to Gates & Hanson (2009), *B. leptogaster* is recognized by the extremelly elongate gaster (6× as long as high), specially in females. In addition, this species presents the procoxa with a sinuous groove on anterior surface, the lower face yellow (except for small black spot in the middle), the mesosoma with dorsum completely black, the fore wing without dark spot and with veins very thin, and the metatibia mainly black. In males, the mesoscutum and mesoscutellum presents transverse wrinkles and the pronotum is sligthly concave dorsally.

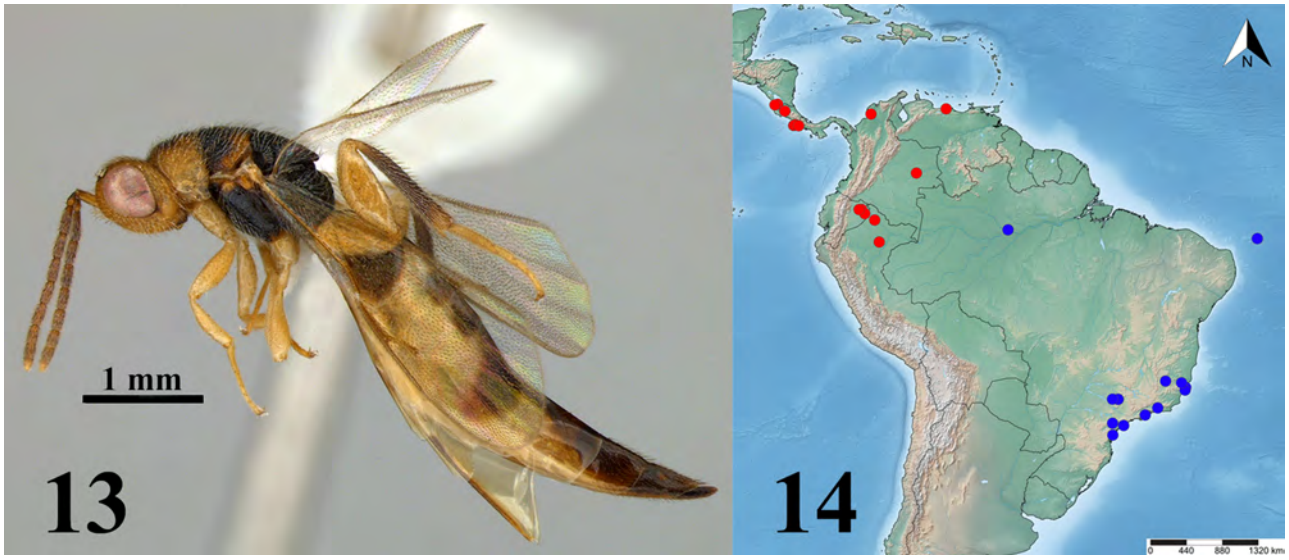
Discussion. *Bephrata leptogaster* was previously found in Venezuela, Colombia, Ecuador and Peru (Gates & Hanson, 2009; Noyes, 2019) and now this species is reported for the first time for Brazil in the Amazon rainforest, in Roraima state, and in the Atlantic rainforest, in Bahia and São Paulo states. The female specimen from Uruçuca (BA) presents the lower face mostly darkened (from brown to black, except by the yellow margins), much larger than the small spot in the middle of lower face pointed by Gates & Hanson (2009). However, the former female agrees with the remaining features of original description of *B. leptogaster* and the male agrees with the whole description.

Bephrata lorraineae Gates & Hanson, 2009

(Figs 13, 14)

New records. Manaus (AM), Fernando de Noronha archipelago (PE), Marliéria (MG), Domingos Martins, Cariacica, Guarapari, Itaguaçú, Laranja da Terra, Santa Maria de Jetibá, Santa Leopoldina, Santa Teresa and Vitória (ES), Nova Iguaçu (RJ), Luiz Antônio, Matão, Ribeirão Grande, Iguape, and Ubatuba (SP), and Morretes (PR) (Fig. 14).

Material examined. Holotype female (USNM) (images examined, available at http://n2t.net/ark:/65665/3c11118c9-34ff-41ae-a7d0-4eabd557fa7e) and 91 females and 25 males. "COSTA RICA, Puntarenas, R.F. Golfo Dulce, 24kmW, Piedras Blancas, 200m, IV-V.1992, col. P. Hanson"; "BRASIL, AM, Manaus, Embrapa-Guar. org., 23.xi.2012, 2°53'29.14"S / 59°58'45.80"O, Borda Malaise Lote: 1909, Karine Schoeninger col.", 1 female (INPA); "BRASIL, PE, Fernando de Noronha, 3°51'17"S / 32°26'26"W, Capim-Açu, 9-24.vi.2019, Malaise G., J.A. Rafael, F. Limeira-de-Oliveira, L.C. Castro col.", 3 males (INPA); same data except 24.vi-8.vii.2019, 1 male (INPA); same data except 23.vii-7.viii.2019, 2 females (INPA); same data except 7-21. viii.2019, 1 female (INPA); same data except 21.viii-8. ix.2019, 3 females and 1 male (INPA); same data except 8-25.ix.2019, 1 female (INPA); same data except 25.ix-8.x.2019, 6 females (INPA); same data except 8-27.x.2019, 23 females and 3 males (INPA); same data except 27.x-11. xi.2019, 7 females (INPA); same data except 27.xi-9.xii.2019, 2 females (INPA); same data except, Sancho, 23.vii-7. viii.2019, Malaise Pq., 1 female (INPA); same data except 3°51'30"S / 32°25'50"W, Sueste mangue, 20-27.ii.2020,



Figs 13, 14. *Bephrata lorraineae* Gates & Hanson, 2009: 13, lateral habitus, female; 14, distribution map; red circles = previous records, blue circles = new records.

Malaise G., 2 females (INPA); same data except 3°51'30"S / 32°25'50"W, Sueste mangue, 1-9.VI.2019, Arm. Luz, J.A. Rafael, F. Limeira-de-Oliveira, D.M.M. Mendes, 4 females (INPA); "BRASIL, MG, Marliéria, P. E. Rio Doce (PELD), área Tereza 3, 19°37'S 42°34'O, 28.x-04.xi.2007, Malaise, J.C.R. Fontenelle, col.", 2 females (UFES #148803, 148804); "BRASIL, ES, Domingos Martins, Mata Pico do Eldorado, 20°22'17"S 40°39'29"W, 03-10.xii.2004, Malaise T7, M.T. Tavares e eq. cols.", 1 female (UFES #64932); "BRASIL, ES, Cariacica, Res. Biol. Duas Bocas, 22.x-05.xii.1996, varredura, N. Freitas, H.S. Santos, C.O. Azevedo cols.", 1 female and 2 males (UFES #111707, 110856, 118852); same data except 16.ix.2006, Malaise, R. Kawada e eq. cols., 1 female (UFES #116601); "BRASIL, ES, Guarapari, Pq. Est. Paulo Cesar Vinha, 20°36'S 40°25'W, 4 masl, 26.x.2006, varredura, M.T. Tavares e eq. cols.", 1 male (UFES #069690); "BRASIL, ES, Itaguaçú, Alto Lajunha, Faz. Binda, 19°48'S 40°48'W, 22-29.ix.2008, Malaise, M.T. Tavares e eq. cols", 1 female (UFES #83323); "BRASIL, ES, Laranja da Terra, Joatuba, Faz. Betzel, 280-430m, 19°50'25"S 40°49'40"W, 05-12.x.2012, Malaise, M.T. Tavares e eq. cols.", 2 females (UFES #135010, 136643); "BRASIL, ES, Santa Maria de Jetibá, Faz. Paulo Seick, 20°02'31,1"S 40°41'51,3"W, 29.xi-06.xii.2002, Malaise T4, M.T. Tavares e eq. cols.", 1 female (UFES #95073); "BRASIL, ES, Santa Leopoldina, Suíça, mata, 361m, 20°04'54,6"S 40°35'38,9"W, 05-12.xi.2007, Malaise, C.O. Azevedo e eq. cols.", 1 female and 1 male (UFES #69825, 69828); "BRASIL, ES, Santa Teresa, Est. Biol. Santa Lúcia, 13-17.x.2008, Malaise, M.T. Tavares e eq. cols.", 1 female (UFES #91937); same data, 29.vi.2001, varredura, R. Kawada & C.O. Azevedo cols, 1 male (UFES #07007); "BRASIL, ES, Vitória, Pq. Est. Fonte Grande, 07.ix.2000, varredura, C.O. Azevedo, R. Kawada, H.S. Santos cols.", 1 male (UFES #07027); same data except 24.xi.2000, R. Kawada e H.S. Santos cols., 2 males (UFES #07028, 07040); same data except 22.II.2001, CO Azevedo & R Kawada cols., 2 males (UFES #06973, 06974); same data except 26.III.2001, 4 males (UFES #906975-06978); same data except 20.IV.2001, 3 males (UFES #09970-09972); "Brasil, RJ, Nova Iguaçu, Res. Biol. Tinguá, 22°34'38"S 43°26'09"O, arm. Malaise, 05-08/III/2002, S.T.P. Amarante e eq., cols.", 1 female (LRRP #20708); "BRASIL, SP, Luiz Antônio, Estação Ecológica de Jataí, 21°37'25.7"S / 47°48'26.1"O, alt. 530 m – Malaise, 30/XI/2006, mata ciliar, N.W. Perioto e eq., cols.", 1 female (LRRP #20714); same data except 21°37'23.7"S / 47°48'27.8"W, 5/XII/2007, 1 female (LRRP #22578); same data except 21°37'23.7"S / 47°48'27.8"W, 29/X/2008, 2 females (LRRP #22592, 22595); same data except 21°37'23.7"S / 47°48'27.8"W, 12/XI/2008, 1 female (LRRP #22600); "BRASIL, SP, Matão, Faz. Cambuí, Mata da Virgínia, 3/IX/2009, A.M.P. Dias e eq., cols.", 1 female (LRRP #21453); "BRASIL, SP, Ribeirão Grande, Parque Estadual Intervales, 24°16'23.6"S / 48°25'21.8"O, arm. Malaise, 22/XII/2009, N.W. Perioto e eq., cols.", 1 female (LRRP #20695); same data except 22/II/2010, 1 female (LRRP #20696); "BRASIL, SP, Iguape, Estação Ecológica Juréia-Itatins, 24°31'12.0"S / 47°12'05.8"O, arm. Malaise, 19/I/2010, N.W. Perioto e eq., cols.", 2 females (LRRP #21612, 21616); same data except 17/I/2011, 2 females (LRRP #22614, 22618); same data except 17 / II / 2011, 1 female (LRRP #22620); same data except 17/III/2011, 1 female (LRRP #22615); "BRASIL, SP, Ubatuba, PESM Núcleo Picinguaba, 23°20'08"S / 44°49'57.2"O, arm. Malaise, 19/XI/2009, N.W. Perioto e eq., cols.", 1 female (LRRP #20681); same data except 23°19'58.8"S / 44°49'56.7"O, 1 female (LRRP #20682); same data except 18/

II/2010, 2 females (LRRP #20683, 20684); same data except 23°19'56.9"S / 44°49'55.2"O, 19/III/2010, 1 female (LRRP #20685); same data except 19/IV/2010, 1 female (LRRP #20686); same data except 23°19'56.9"S / 44°49'55.2"O, 19/IV/2010, 1 female (LRRP #20687); same data except 23°20'02.7"S / 44°49'57.7"W, 19/IV/2010, 1 female (LRRP #20688); same data except 19 / IV / 2010, 2 females (LRRP #20489, 20690); same data except Parque Est. da Serra do Mar, 23°21'43"S / 44°49'22"W, 21-24/I/2002, 1 female (LRRP #20710); "BRASIL, PR – Morretes, Pq. Estadual Pau Oco, 25°34'37.2"S 48°23'53.7"S, arm. Malaise, 10-13/VI/2002, M.T. Tavares e eq., cols.", 1 female (LRRP #20707).

Identification. According GATES & HANSON (2009) *B. lorraineae* is recognized for presenting lower face completely yellow; the procoxa with sinuous groove on anterior surface; lateral area of mesoscutum orange or black; mesoscutellum entirely black; female pronotum with extensive black; fore wing without dark spot; metacoxa completely yellow; metatibia black (dark brown in some specimens here studied), at least in part; female first metasomal segment much wider than long and length of female gaster no more than 5× maximum height and without continuous pale stripe on lateral surface. The specimens collected in Iguape (SP) have the metacoxae black stained.

Discussion. *Bephrata lorraineae* was previously found in Costa Rica, Venezuela, Colombia, Ecuador and Peru (GATES & HANSON, 2009; NOYES, 2019) in Amazon rainforest. Now the species is reported for the first time for Brazil in Fernando de Noronha archipelago (PE), in Atlantic rainforest areas in the Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo, and Paraná states, and in a interface between Amazon rainforest and guarana crop [*Paullinia cupana* Mart. (Sapindaceae)] in Amazonas state. Data based on nine months of samplings in Fernando de Noronha archipelago indicate that for that locality the largest populations of *B. lorraineae* occur in the dry season, with few specimens collected in the rainy season, which may indicate a possible seasonality of this group, or of its possible hosts (Fig. 15).

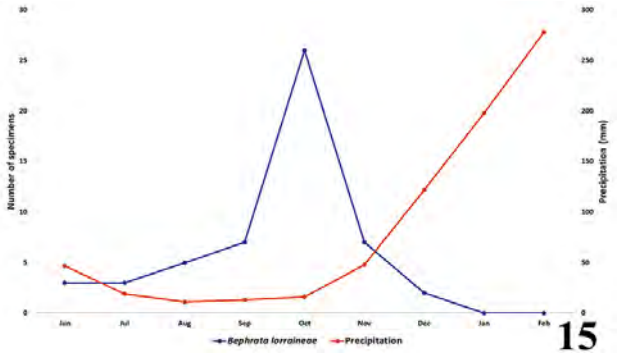


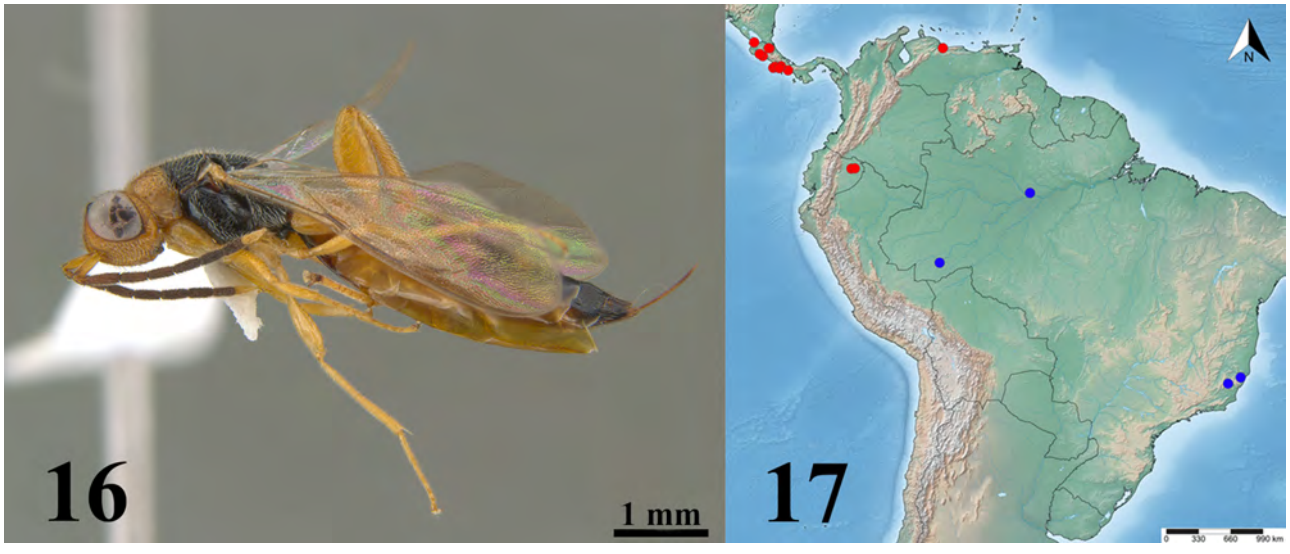
Fig 15. *Bephrata lorraineae* Gates & Hanson, 2009. Seasonality at the Capim-Açu trail, Fernando de Noronha archipelago, Pernambuco, Brazil, 2019-2020.

Bephrata ruficollis Cameron, 1884

(Figs 16, 17)

New records. Bujari (AC), Manaus (AM) and, Santa Teresa and Ibitirama (ES) (Fig. 17)

Material examined. 6 females. "BRASIL, AC, Bujari, FES Antimary, 09°20'01"S – 68°19'17"W, Malaise Grande, 18-31.I.2017, EF Morato & JA Rafael, Rede Bia", 1 female (INPA); "BRASIL, AM, Manaus, Embrapa-Guar. conv., 10.xi.2012, 2°53'42.18"S / 59°59'10.58"O, Mata, Malaise Lote: 1820, Karine Schoeninger col.", 1 female (INPA); "BRASIL, ES, Santa Teresa, Res. Biol. Augusto Ruschi, trilha da Cachoeira, 812m, 19°54'29"S 40°33'19"W,\ 10-17.xii.2012, Malaise 7, C.O. Azevedo e eq. cols.", 1 female (UFES #144434); "BRASIL, ES, Ibitirama, Parque Nacional do Caparaó, Posto Santa Marta, 20°29'S 41°43'W, 10-



Figs 16, 17. *Bephrata ruficollis* Cameron, 1884: 16, lateral habitus; 17, distribution map; red circles = previous records, blue circles = new records.

14.iii.2006, Malaise, R. Kawada col.", 3 females (UFES #65996-65997).

Identification. According to Gates & Hanson (2009), *B. ruficollis* is recognized for presenting the metatibia completely yellow and is the only species in which the clava is white (pale yellow in some specimens here studied), differing from the other brown/black flagellomeres.

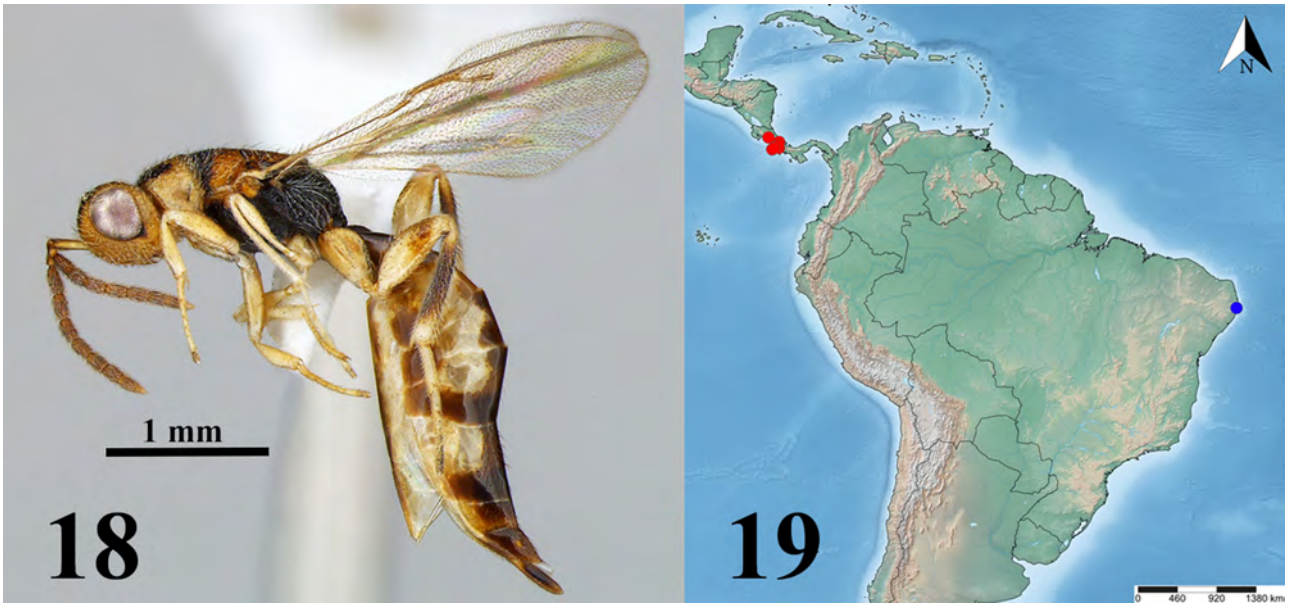
Discussion. *Bephrata ruficollis* was previously found in Costa Rica, Panama, Venezuela, and Ecuador (Gates & Hanson, 2009; Noyes, 2019). Now the species is reported for the first time for Brazil in Amazon rainforest in the state of Acre and Amazonas, and in Atlantic rainforest in the state of Espírito Santo, about 2.600 and 5.300 km southeast, respectively, from the type locality.

Bephrata ticos Gates & Hanson, 2009

(Figs 18, 19)

New record. Recife (PE) (Fig. 19).

Examined material. 1 female. "Brasil, PE, Recife, Pq. dos Dois Irmãos, 08°00'37"S 34°56'31"W, varredura veg., 22/IV/2002, S.T.P. Amarante e eq., cols.", 1 female (LRRP #20709).



Figs 18, 19. *Bephrata ticos* Gates & Hanson, 2009: 18, lateral habitus, female; 19, distribution map; red circles = previous records, blue circle = new record.

Key to species of *Bephrata* occurring in Brazil
(adapted from Gates & Hanson, 2009)

1. Procoxa without sinuous groove on anterior surface (Fig. 20); metatibia with shorter apical spur peglike (Fig. 22); metatarsus with first tarsomere about as long as combined length of remaining tarsomeres ..... ***Bephrata cultriformis***
– Procoxa with sinuous groove on anterior surface (Fig 21); metatibia with shorter apical pointed spur (similar to longer spur) (Fig. 23); metatarsus with first tarsomere usually longer than combined length of remaining tarsomeres 2
2(1). Metatibia completely yellow ..... ***Bephrata ruficollis***
– Metatibia brown or black, at least in part 3
3(2). Scutellum mostly yellow or orange yellow (sometimes with a thin, longitudinal, black line in middle) 4
– Scutellum entirely black 6
4(3). Mesopleuron and propodeum black 5
– Mesopleuron and propodeum orange (often black in median cavity)..... ***Bephrata bouceki***
5(4). Center of pronotum with wide black spot; dorsal-posterior part of head entirely black (Fig. 24) ..... ***Bephrata ticos***
– Center of pronotum with narrow, longitudinal black line; dorsal-posterior part of head with yellow area between occiput and ocellar area (Fig. 25) ..... ***Bephrata bahiae***
6(3). Gaster extremely narrow and elongate, in female length 6× (or more) maximum height (Fig. 26), in male at least 3× height; fore wing veins very thin; mesoscutum and scutellum of male with transverse wrinkles, pronotum slightly concave dorsally [Dorsal surface of mesosoma completely black] ..... ***Bephrata leptogaster***

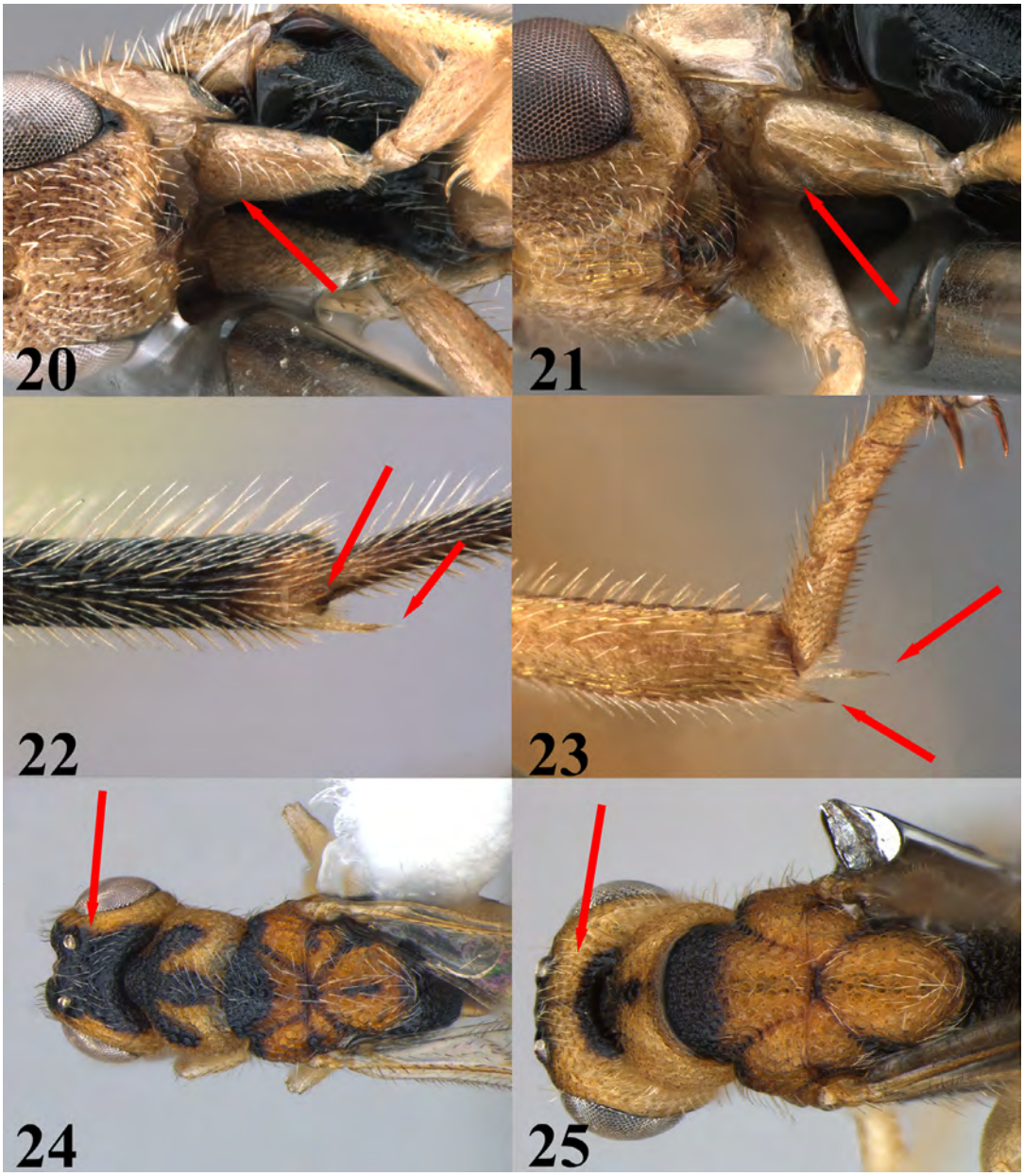
– Gaster less elongate (length no more than 5× maximum height in female) (Fig. 27); veins thicker; male dorsum lacking above characteristics 7

7(6). Metacoxa almost entirely yellowish brown (Fig. 28) [Small, about 4 mm in length; mesosoma, except sides of pronotum, all black; male scape with apical knob opposite insertion of pedicel] ..... ***Bephrata chica***

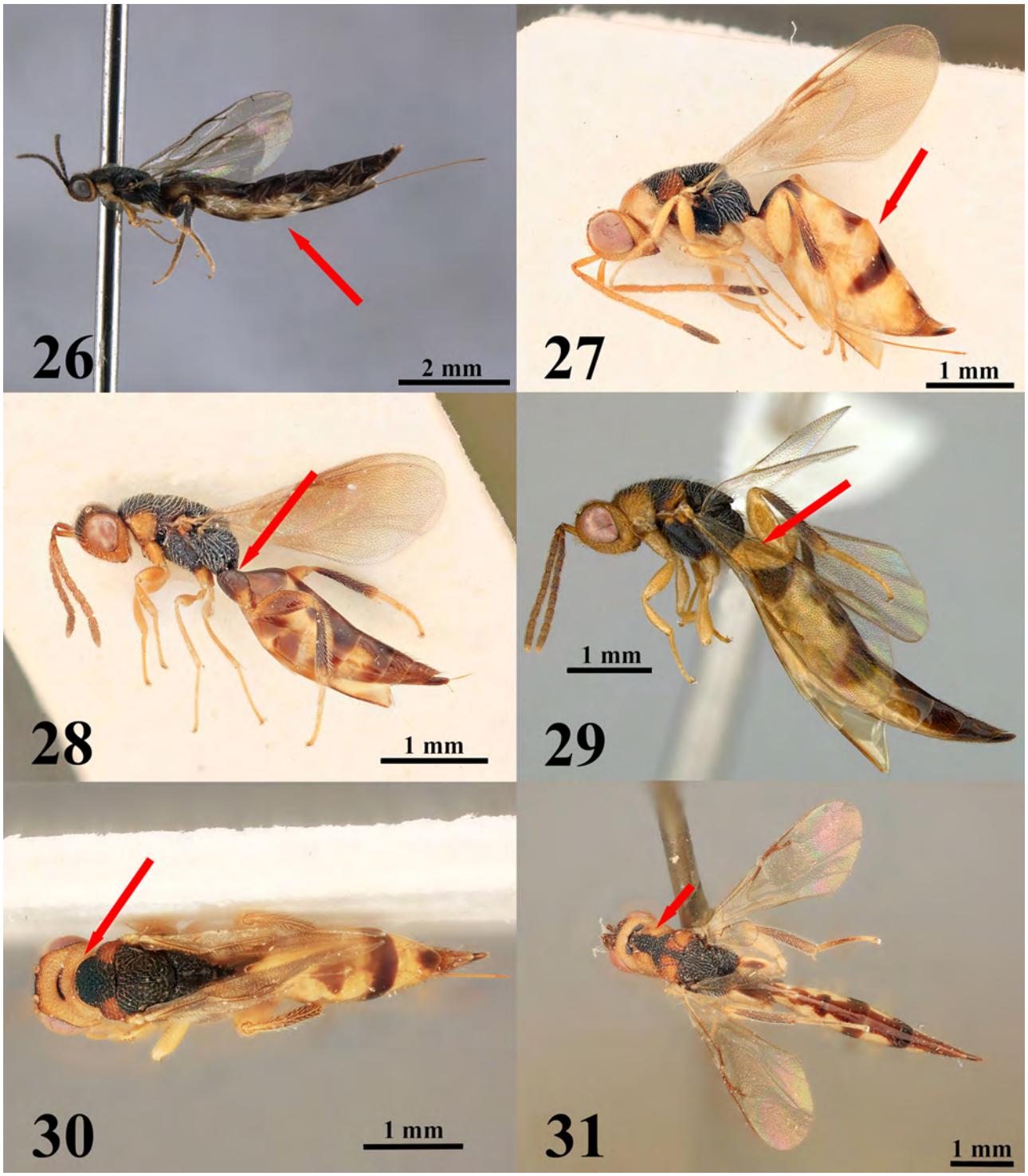
– Metacoxa completely yellow (Fig. 29) 8

8(7). Female with pronotum dorsally usually entirely yellow (Fig 30) (sometimes with some black posteriorly); mesoscutal lobes orange, antenna usually with pale funiculum and darker colored clava; male scape without pronounced apical knob ..... ***Bephrata christeri***

– Female pronotum dorsally with extensive black (Fig 31), mesoscutal lobes orange or black; antennal flagellum uniformly colored; male scape with prominent apical knob opposite insertion of pedicel ..... ***Bephrata lorraineae***



Figs 20-25. 20, *Bephrata cultriformis* (Ashmead, 1894) female, anterior surface of procoxa without sinuous groove, indicated by red arrow; 21, *Bephrata ruficollis* Cameron, 1884, female, anterior surface of procoxa with sinuous groove, indicated by red arrow; 22, *Bephrata cultriformis* (Ashmead, 1894) female, metatibia with shorter apical spur peglike, indicated by red arrow; 23, *Bephrata ruficollis* Cameron, 1884, female, metatibia with shorter apical pointed spur, indicated by red arrow; 24, *Bephrata ticos* Gates & Hanson, 2009, female, dorsal-posterior part of head entirely black, indicated by red arrow; 25, *Bephrata bahiae* (Ashmead, 1904) female, dorsal-posterior part of head with yellow area between occiput and ocellar area, indicated by red arrow.



Figs 26-31. 26, *Bephrata leptogaster* Gates & Hanson, 2009, female, gaster narrow and elongate, length 6× or more maximum height in female, indicated by red arrow; 27, *Bephrata christeri* Gates & Hanson, 2009 (Holotype) (modified from http://n2t.net/ark:/65665/m374c43804-1831-4ccc-9bd2-c54f54c050ba), gaster less elongate, no more than 5× maximum height in female, indicated by red arrow; gaster less elongate, no more than 5× maximum height in female, indicated by red arrow; 28, *Bephrata chica* Gates & Hanson, 2009 (Holotype) (modified from http://n2t.net/ark:/65665/m30b51a95d-d90f-4fd3-9216-f4711473e5fa), female, metacoxa almost entirely yellowish brown colored, indicated by red arrow; metacoxa almost entirely yellowish brown colored, indicated by red arrow; 29, *Bephrata lorraineae* Gates & Hanson, 2009, female, metacoxa completely yellow, indicated by red arrow; 30, *Bephrata christeri* Gates & Hanson, 2009 (Holotype), pronotum dorsally entirely yellow in female, indicated by red arrow; 31, *Bephrata lorraineae* Gates & Hanson, 2009, (modified from http://n2t.net/ark:/65665/m34d2c5ccf-363b-4300-a545-56bbbed8c3ed), pronotum dorsally entirely yellow in female, indicated by red arrow; pronotum dorsally with extensive black in female, indicated by red arrow.

Identification. According Gates & Hanson (2009) *B. ticos* is recognized for presenting the head yellow except black from scrobe to back of head and a small spot below eye; mesoscutum and mesoscutellum mostly yellow or orange yellow (sometimes with a thin, longitudinal, black line in middle); center of pronotum with wide black spot; mesoscutellum orange (reddish) yellow and procoxa with sinuous groove on anterior surface and metatibia black (dark brown in some specimens here studied), at least in part.

Discussion. *Bephrata ticos* was previously found in Costa Rica (Gates & Hanson, 2009; Noyes, 2019). Now the species is reported for the first time for Brazil in Atlantic rainforest area in the state of Pernambuco, about 5.800 km southeast from the type locality.

DISCUSSION

Until now, the knowledge about *Bephrata* in Brazil was restricted to the occurrence of three species: *B. bahiae*, *B. chica* and *B. christeri* (Perioto, 2022). With the addition of *B. bouceki*, *B. cultriformis*, *B. leptogaster*, *B. lorraineae*, *B. ruficollis* and *B. ticos* to the Brazilian fauna, we expanded the knowledge of the group to nine species occurring in the country.

Furthermore, it is important to highlight the record of *B. lorraineae* for Fernando de Noronha archipelago. This archipelago is entirely volcanic in origin and has never been connected to the mainland and the main island area of Fernando de Noronha is 16.9 km^2 (Lopes & Ulbrich, 2015).

Recently, the entomofauna of the Fernando de Noronha archipelago was listed, and currently comprises approximately 460 species distributed in 21 orders of insects; 63 species of Hymenoptera were recognized, among which, unidentified species of Eurytomidae (Rafael *et al.*, 2020; Fernandes *et al.*, 2021a, b; Mahlmann *et al.*, 2022; Martins, 2022; Fernandes *et al.*, 2022). According to Gates & Hanson (2009) the available evidence indicates that *Bephrata* act as parasitoids of eggs of Tettigoniidae (*Bucrates*, *Tettigonia* and an unidentified Pseudophyllinae). Rafael *et al.* (2020) listed only three species of Tettigoniidae occurring in Fernando de Noronha archipelago: *Anaulacomera harpago* Brunner von Wattenwyl, 1878, *Neoconocephalus vernalis* (Kirby, 1890) and *Parapleminia viridinervis* (Kirby, 1890). Some species of *Bephrata* were associated with orchids, and according to Gates & Hanson (2009) specimens of *B. chica*, *B. leptogaster*, *B. lorraineae*, and *B. stichogaster* Gates & Hanson, 2009 were intercepted at ports-of-entry into the United States in association with orchids (*Cattleya* and, *Laelia*), suggesting that they emerged from host eggs (possibly tettigoniid) in these plants.

There is no evidence of the natural occurrence of orchids in the Fernando de Noronha archipelago and certainly the orchids that exist there today were introduced for the purposes of landscaping and decoration of hotels and inns. The archipelago is separated from the mainland by about 550 km. Such facts lead us to believe that *B. lorraineae* was introduced into the archipelago in orchid plants containing parasitized Tettigoniidae eggs. More studies are needed to support the hypothesis raised here.

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