



SOCIEDADE BRASILEIRA
DE ENTOMOLOGIA
FUNDADA EM 1937

REVISTA BRASILEIRA DE Entomologia

A Journal on Insect Diversity and Evolution

www.rbentomologia.com



Systematics, Morphology and Biogeography

Studies on Brazilian Pseudophasmatidae (Phasmatodea) with the description of a new species of *Agrostia* Redtenbacher and new records for *Metriophasma* Uvarov and *Parastratocles* Redtenbacher



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ARTICLE INFO

Article history:

Received 3 October 2016

Accepted 13 March 2017

Available online 24 March 2017

Associate Editor: Daniela Takiya

Keywords:

Phasmida

Phasmids

Stick insects

Taxonomy

ABSTRACT

Pseudophasmatidae currently includes 65 species recorded from Brazil. In this paper, we increase this number to 68 species by describing *Agrostia flavimaculata* sp. nov., based on male and female specimens from Acre and Amazonas states. Furthermore, *Parastratocles multilineatus* (Rehn) and *Metriophasma* (*Metriophasma*) *diocles* (Westwood) are recorded for the first time from Brazil based on specimens from Rondônia, Acre and Amazonas states. A key to species of *Agrostia* is also given.

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Introduction

Phasmatodea currently includes approximately 3000 described species (Brock *et al.*, 2016), of which 207 occur in Brazil. Among Brazilian species, 65 belong to Pseudophasmatidae. *Agrostia* Redtenbacher, 1906 is one of the Pseudophasmatidae genera recorded from Brazil and currently includes three valid species: *A. amoena* Redtenbacher, 1906 described from Panamá, *A. bipunctata* Redtenbacher, 1906 described from Brazil (Amazonas, Coari) and *A. ega* (Westwood, 1859) described from Brazil (Amazonas, Tefé, formerly known as Ega). Besides *Agrostia*, *Metriophasma* Uvarov, 1940, and *Parastratocles* Redtenbacher, 1906 also occur in Brazil. *Metriophasma* includes 13 valid species, with 4 species recorded from Brazil, while *Parastratocles* has 12 valid species, with only *Parastratocles flavipes* (Redtenbacher, 1904) currently known from Brazil.

In this paper, we contribute to the knowledge of Brazilian Pseudophasmatidae by describing a new species of *Agrostia* and by recording for the first time *Metriophasma* (*Metriophasma*) *diocles* (Westwood, 1859) and *Parastratocles multilineatus* (Rehn, 1904)

from Brazil, as well as providing biological information of these species.

Material and methods

All studied specimens are pinned and deposited at *Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia* (INPA). Identification of specimens was made with the following literature: Redtenbacher (1906), Uvarov (1940), and Zompro (2004). Specimens were compared with pictures of the type material available from the Phasmida species file <http://phasmida.speciesfile.org/> (Brock *et al.*, 2016). Specimens of *Agrostia* were collected at night, on a white sheet illuminated with a 250 W mercury vapor lamp after specimens were attracted to the light. Another female specimen was previously deposited at INPA collection. Specimens of *Metriophasma* and *Parastratocles* were found in the vegetation by actively searching during night time. Specimens were killed with ethyl acetate (EtOAc). Photos of live specimens were taken with a Nikon D3000 digital camera, with an 18–55 mm lens. Photos of pinned specimens were made with a Leica DFC500 digital camera fitted on a Leica MZ205 stereomicroscope connected to a computer with Leica Application Suite software. This software includes an Auto-Montage mode (Syncroscopy software) used to combine multiple layers of photos into a single focused image. Label data

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is given as presented on the labels. Square brackets ([]) indicate complementary data not present on specimens labels.

Taxonomy

Stratocleinae: Stratocleini

Agrostia Redtenbacher, 1906

Comments. The new species is placed in *Agrostia* based on the following diagnostic characters provided by Redtenbacher (1906): metathorax distinctly shorter than mesothorax; tegmina ellipsoid;

fore femur curved at basal third; and fore femur and hind femur dorsally bicarinated. Additionally, *Agrostia* is the only genus in Stratocleini with the following combination of characters: head, pro and mesonotum opaque; mesonotum at least two times longer than pronotum; tegmina elongated, longer than large, dorsally with conspicuous spot of variable coloration; costal area of alae with spots concolor to spots in tegmina; and alae not reaching tergum 8.

Agrostia flavimaculata sp. nov.

(Figs. 1–17)



Figs. 1–9. *Agrostia flavimaculata* sp. nov. holotype ♂. (1) Habitus, dorsal view. (2) Idem, lateral view. (3) Idem, ventral view. (4) Head and prothorax, dorsal view. (5) Head, lateral view. (6) Tegmina, dorsal view. (7) Apex of abdomen, dorsal view. (8) Idem, lateral view. (9) Idem, ventral view.

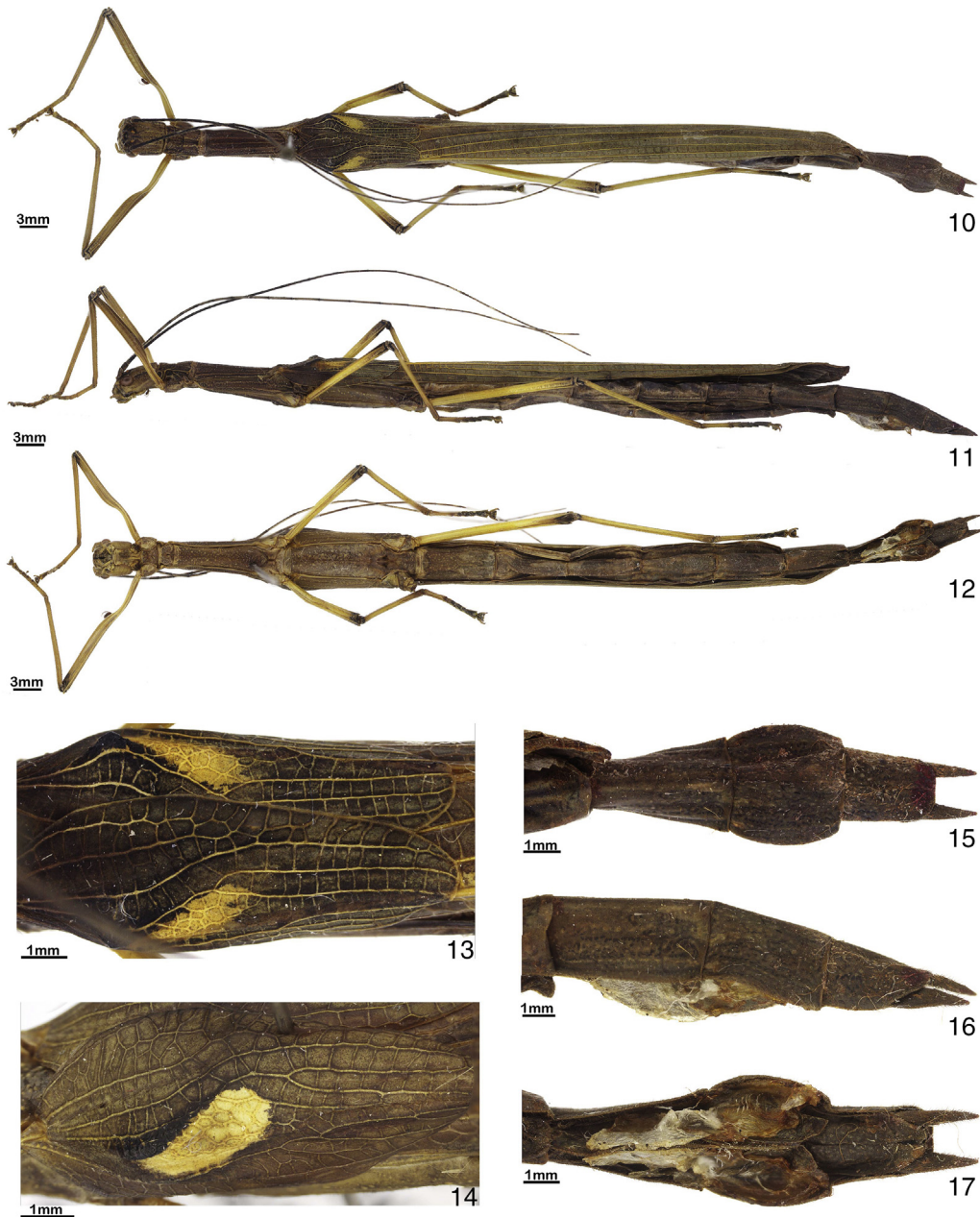
Diagnosis. Ocelli orange (Figs. 1, 4, 10). Tegmina with ellipsoid yellow spot at median region (Figs. 1, 3, 6, 10, 13, 14). Cercus laterally flattened (Figs. 7–9; 15–17). Male subgenital plate longitudinally divided into hemisternites apically (Fig. 9).

Description. Holotype ♂ (Figs. 1–9). *Head.* Dorsally smooth, light brown, with concavity at vertex; coronal suture conspicuous, black (Fig. 4). Frons with black arched spots (Fig. 4). Vertex with two parallel arched pale stripes (Fig. 4). Gena light yellow (Figs. 2, 5). Clypeus trapezoidal. Labrum U-shaped. Ocelli ellipsoid, orange (Figs. 1, 4). Eyes globose, light brown, with longitudinal arched stripe (Fig. 5). Antenna covered by setae, dorsally black, ventrally light brown; first flagellomere 2 times longer than pedicellus (Fig. 4). Maxillary and mandibular palpi yellow, shiny, covered by setae.

Thorax. Pronotum rectangular, 1.5 times longer than wide, with longitudinal black and light yellow stripes; latero-distally

with small light yellow spots (Fig. 4). Mesonotum rectangular, slender, elongated, 6 times longer than wide and 3 times longer than pronotum; with longitudinal parallel stripes, alternating black and light yellow; black stripes with small scattered light yellow spots (Figs. 1 and 2). Metanotum rectangular, 2.5 times shorter than mesonotum, shiny, smooth and light yellow. Prosternum trapezoidal light yellow, with small rounded tubercles. Mesosternum rectangular, slender, elongated, 6 times longer than wide, light brown with several scattered small light yellow tubercles and no visible median longitudinal carina. Metasternum rectangular, elongated, broad, 3 times longer than wide, 1.5 times shorter than mesosternum; with surface rough, light brown (Fig. 3).

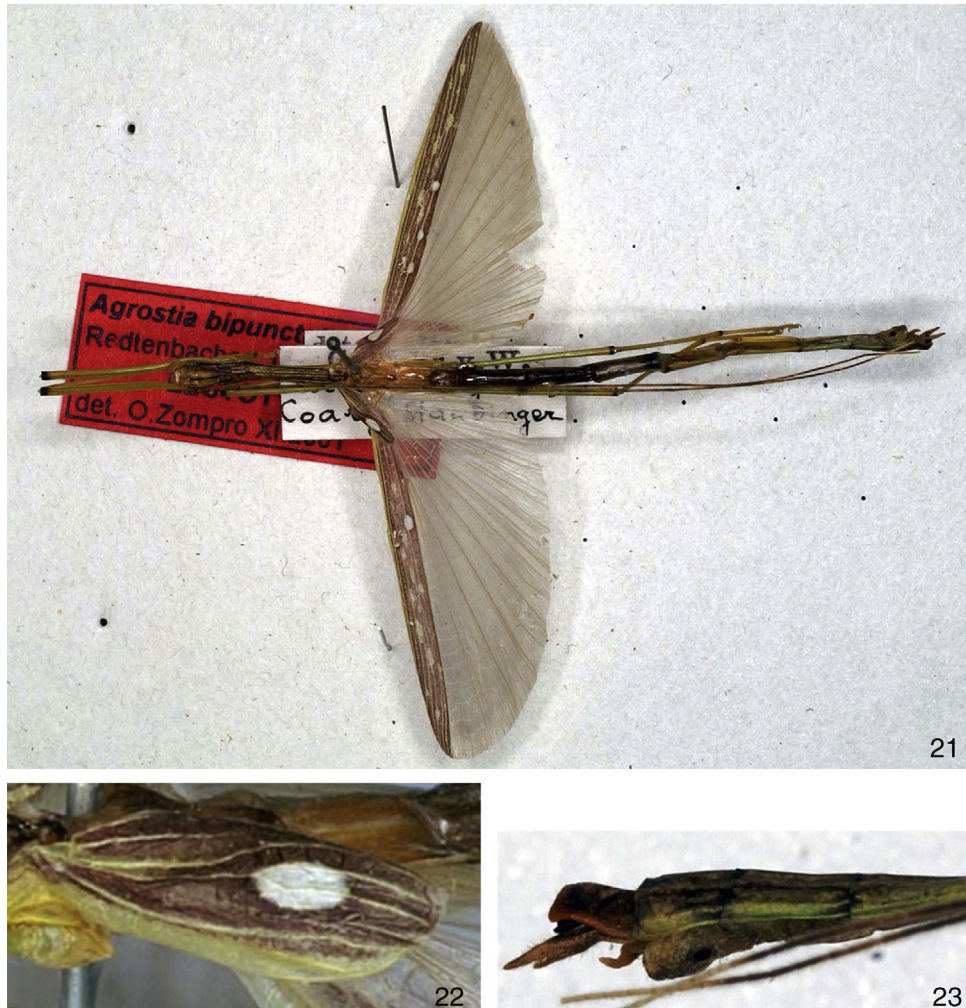
Legs. All legs laterally covered by setae; with femora and tibiae light yellow and with small black spot at apex of femora and base of tibiae; (Figs. 1–3). Mid and hind tarsi with third to fifth



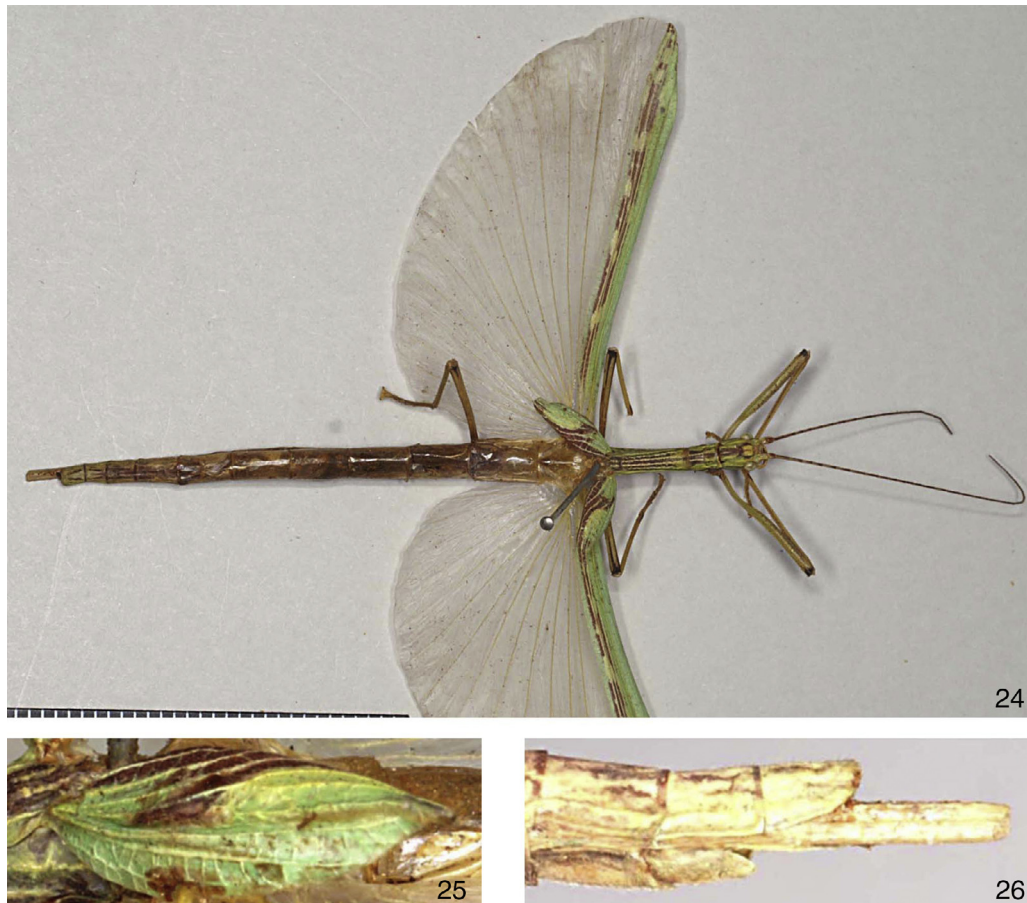
Figs. 10–17. *Agrostia flavimaculata* sp. nov. ♀. (10) Habitus of Acre specimen, dorsal view. (11) Idem, lateral view. (12) Idem, ventral view. (13) Tegmina of specimen from Acre, dorsal view. (14) Tegmina of specimen from Amazonas, idem. (15) Apex of abdomen, dorsal view. (16) Idem, Lateral view. (17) Idem, ventral view.



Figs. 18–20. *Agrostia amoena* syntype ♂. (18) Habitus, dorsal view. (19) Tegmina, lateral view. (20) Apex of abdomen, lateral view. Photos were taken by Paul Brock, copyright Naturhistorisches Museum, Vienna.



Figs. 21–23. *Agrostia bipunctata* lectotype ♂ (21) Habitus, dorsal view. (22) Tegmina, lateral view. (23) Apex of abdomen, lateral view. Photos were taken by Paul Brock, copyright Naturhistorisches Museum, Vienna.



Figs. 24–26. *Agrostia ega* holotype ♀. (24) Habitus, dorsal view. (25) Tegmina, lateral view. (26) Apex of abdomen, lateral view. Photos were taken by Paul Brock, copyright Natural History Museum, London.

tarsomeres gradually turning light brown. Area apicalis in all tibiae conspicuous.

Wings (Fig. 6). Tegmina ellipsoidal, elongated, 3 times longer than wide, brown, with small black spot at shoulder hump; longitudinal and transverse veins yellow; with ellipsoid yellow spot at median region. Alae approximately 5 times longer than tegmina, with costal area dark brown, anal area hyaline; longitudinal veins of costal area light yellow, transversal veins of anal area light brown.

Abdomen. Elongated, slender. Abdominal terga dorsally dark brown from base of tergum 1 to basal third of tergum 6. Terga 1–8 rectangular. Tergum 7 rectangular, in lateral view 4.3 times longer than high; in dorsal view 1.3 times longer than tergum 8, with deep longitudinal median sulcus. Tergum 8 rectangular with deep longitudinal median sulcus, in lateral view 3.4 times longer than high and 1.3 times longer than tergum 9 (Figs. 7 and 8). Tergum 9 rectangular, 1.2 times longer than wide, with deep median longitudinal sulcus; trapezoidal in lateral view, with ventral margin convex, posterior margin emarginated, 2 times longer than tergum 10 (Figs. 7 and 8). Tergum 10 dorsally flattened, anteriorly emarginated; lateral margin sinuous, broadening from base to apex; posterior margin convex; laterally covered by setae (Fig. 7). Abdominal sterna dark brown, with small-scattered yellow spots (Fig. 3) with median longitudinal sulcus from sternum 2 to 8. Sterna 2–7 elongated, longer than wide (Fig. 3). Subgenital plate covered with setae, ellipsoidal, longitudinally divided into hemisternites apically, being 1.5 times longer than tergum 9 (Fig. 9). Paraprocts ellipsoidal, elongated, not covered by subgenital plate. Cercus light brown, covered with setae, moderately incurved, laterally flattened, with pointed apex (Figs. 7–9).

Measurements (mm). Holotype: body length 62.5; antenna >55.0; dorsal head length 3.8 pronotum 2.7; mesonotum 6.4; fore femur 10.5; fore tibia 11.6; mid femur 6.4; mid tibia 5.7; hind femur 10.4; hind tibia 10.5; tegmina length 7.3; alae length 31.9.

Paratype: body length 56.3; dorsal head length 3.1; antenna >55.0; pronotum 2.5; mesonotum 6.1; fore femur 10.4; fore tibia 11.6; mid femur 6.1; mid tibia 5.5; hind femur 10.0; hind tibia 10.1; tegmina length 6.3; alae length 34.4.

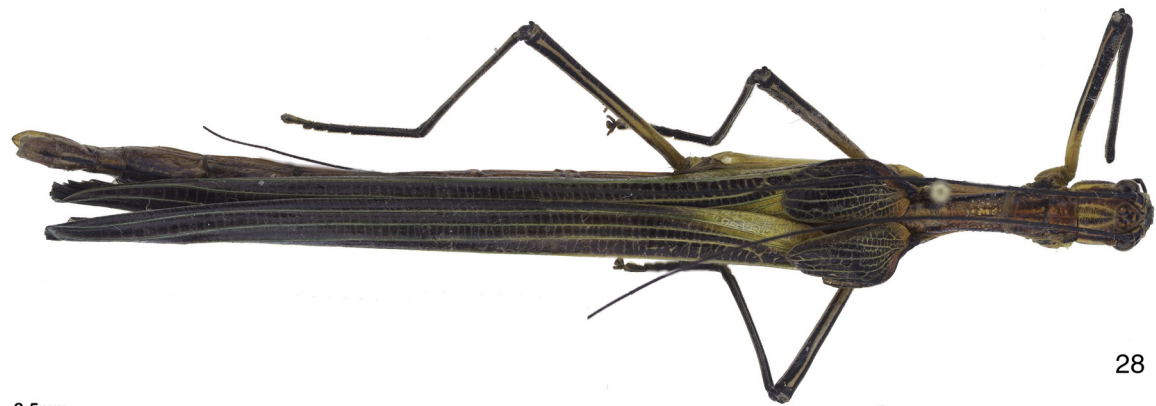
Female (Figs. 10–17). Similar to male, but longer and robust. Following differences listed below.

Head. Slightly quadrate in dorsal view (Fig. 10). Gena dark brown (Fig. 11). Yellow spot at tegmina longer and broader (Figs. 13 and 14).

Abdomen. Tergum 7 in lateral view 2.8 times longer than high (Fig. 16). Tergum 8 in lateral view 1.6 times longer than high (Fig. 16). Tergum 9 trapezoidal (Fig. 15). Tergum 10 covered by setae, in dorsal view oblong, in lateral view with basal and lateral margins straight, posterior margin emarginated (Figs. 15 and 16). Subgenital plate laterally compressed, gradually broadening from anterior margin toward apex, with posterior margin concave, being 1.2 times longer than tergum 9 (Figs. 11, 16, 17). Cercus triangular, nearly straight.

Female measurements (mm). Acre specimen: body length 87.0; dorsal head length 5.2; antenna >40.0; pronotum 4.6; mesonotum 9.0; fore femur 12.0; fore tibia 13.3; mid femur 10.0; mid tibia 9.7; hind femur 15.4; hind tibia 15.2; tegmina length 12.0; alae length 51.6.

Amazonas specimen: body length 75.5; dorsal head length 4.8; antenna >40.0; pronotum 4.4; mesonotum 8.6; fore femur 12.0;



2.5mm



1mm

29



1mm

30



1mm

31

Figs. 27–31. *Parastratocles multilineatus* ♀ from Rondônia. (27) Habitus of live specimen, dorsolateral view. (28) Habitus of dead specimen, dorsal view. (29) Apex of abdomen, dorsal view. (30) Idem, lateral view. (31) Idem, ventral view.

fore tibia 13.2; mid femur 9.7; mid tibia 9.4; hind femur 15.1; hind tibia 15.0; tegmina length 10.3; alae length 49.6.

Variations. Female specimens from Amazonas have a larger yellow spot, with more defined edges in comparison to female specimens from Acre (Figs. 13 and 14).

Etymology. From Latin adjective *flavus* = yellow and noun *macula* = spot, referring to the yellow spot on the tegmina.

Geographical Records. Brazil: Amazonas, Acre.

Type material. Holotype ♂ (INPA). BRASIL, AC [Acre], Bujari, FES [Floresta Extrativista Sustentável] Antimary. 25–27.viii.2016. 09°20'02"S–68°19'15"W, Arm [armadilha] luz, AA Agudelo, FF Xavier, DMM Mendes, JA Rafael [cols.].

Paratypes. Same data as holotype (1♂, ♀ INPA); Brasil, Amazonas, Manaus, Reserva Ducke, 02°55'48"S 59°58'30.6"W. 04.v.2014. Coleta manual. G. Gomes, col. (1♀ INPA).

Parastratocles multilineatus (Rehn, 1904)

(Figs. 27–31)

Comments. This species is recognized by the yellow spot on the anal area of the alae (Figs. 27 and 28). Coloration on living insects can vary significantly from specimens known from Costa Rica. The original coloration is nearly completely lost after drying process, turning it mostly dark yellow and black (Fig. 28). Characters on female terminalia are only available from Rehn (1904) and Redtenbacher (1906), with limited information and without illustrations. Due to this, we characterize the female terminalia based on specimen from Rondônia, Brazil.

Description ♀ terminalia. Terga 8–10 dorsally with median longitudinal black stripe (Figs. 28 and 29). Terga 8–9 rectangular in dorsal view, trapezoidal in lateral view, all margins straight (Figs. 29 and 30). Tergum 10 with anterior margin straight, slightly

Key to species of *Agrostia*

- 1. Tegmina with yellow or white ellipsoidal spot (Figs. 6, 13, 19, 22) 2
- 1'. Tegmina without ellipsoidal spot, instead with green irregular-shaped spot (Figs. 24–26). Brazil (Amazonas) *A. ega* (Westwood, 1859) 3
- 2. Spot on tegmina yellow, starting at median third and touching the antero-lateral tegmina hump (Figs. 6, 13, 19) 3
- 2'. Spot on tegmina white, starting at apical third and not touching the antero-lateral tegmina hump (Figs. 21–23). Brazil (Amazonas) *A. bipunctata* Redtenbacher, 1906
- 3. Spot on tegmina ranging from median third to half length of apical third of the tegmina. Cerci cylindrical ventrally curved (Figs. 18–20). Panamá *A. amoena* Redtenbacher, 1906
- 3'. Spot on tegmina not surpassing the median third of the tegmina. Cerci laterally flattened (Figs. 1–17). Brazil (Acre and Amazonas) *A. flavimaculata* sp. nov.



Figs. 32–33. *Metriophasma (Metriophasma) diocles* ♀ from Amazonas. (32) Habitus in dorsolateral view. (33) Defensive stance.

sinuous laterally and posterior margin emarginated; in lateral view with anterior, dorsal and posterior margins straight, ventral margin sinuous (Figs. 29 and 30). Subgenital plate densely setose, with median longitudinal dark brown carina; sword shaped, narrowing near the posterior margin; apex oblong, being 1.4 times longer than tergum 9 (Fig. 31). Cercus conical, covered by setae, with oblong apex.

Biological information. The specimen was found in an ombrophilous Terra Firme Amazonian Forest, on bushes of approximately 1.6 m high. When stressed, the insect opened its wings, making the aposematic coloration more visible. Furthermore, it also sprayed a strongly stinky (resembling an herbaceous smell) substance.

Geographical records. Costa Rica; Brazil [new record]: Rondônia.

Material examined. BRASIL, RO [Rondônia], Candeias Jamari, UHE Samuel, 17.viii.2016, 8°56'57"S–63°10'60"W, manual [collecting], DMM Mendes, FF Xavier, AA Agudelo, JA Rafael [leg.] (1♀, INPA).

Xerosomatinae: Prexaspini

Metriophasma (Metriophasma) diocles (Westwood, 1859) (Figs. 32–36)

Comments. This species is easily distinguished by having blue spots near base of the alae (Fig. 33). We recorded two coloration patterns for this species: one with body mainly

light yellow (Figs. 32, 33, 36) and another mainly dark brown (Figs. 34 and 35).

Biological records. D. M. M. Mendes took photos from the lighter phenotype (Figs. 32 and 33) in 2013, at an ombrophilous Terra Firme Amazonian Forest in Amazonas State (AM, Brazil), but did not collect the specimen. This year, the same author found different specimens of same species in Acre State (AC, Brazil) with lighter and darker phenotypes (Figs. 34–36) in an ombrophilous Terra Firme Amazonian Forest with bamboos, and collected two females and one male specimen.

Both populations (AC/AM) were found on bushes, approximately between 1.4 and 2.0 m high. When resting, these insects conceal their presence with a camouflage behavior similar to members of Prisopodidae, which consists of joining all legs near to its body to decrease body width (Fig. 36). When stressed, this species performed an agonistic display by opening and closing their wings repeatedly showing the blue and black spots on wings, possibly confusing a potential predator.

Geographical records. Colombia; Costa Rica; Panama; Brazil [new record]: Acre, Amazonas.

Examined material. BRASIL, AM [Amazonas], Manaus, ZF-2, km 34 [Specimen not collected, examined only by photo].

BRASIL, AC [Acre], Bujari, FES [Floresta Extrativista Sustentável] Antimary. 25–27.viii.2016. 09°20'02"S–68°19'15"W, Arm [armadilha] luz, AA Agudelo, FF Xavier, DMM Mendes, JA Rafael [cols.] (2♀, 1♂ INPA).



Figs. 34–36. *Metriophasma (Metriophasma) diocles* from Acre. (34) ♂ Habitus, dorsal view. (35) Live dark brown phenotype female in lateral view. (36) Live light yellow phenotype female in dorsal view, displaying camouflage behavior.

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgments

To Alberto da Silva Neto, Emily Olive, and João Rafael Oliveira for their support in the laboratory. To Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for the research productivity fellowship to J.A.R. (grant 300.305/2007–9) and for financial resources from Chamada MCTI/CNPq/FNDCT Ação Transversal – Redes Regionais de Pesquisa em Biodiversidade e Biotecnologia N° 79/2013 (grant 407.627/2013–8), Fundação de Amparo à Pesquisa do Estado do Amazonas (FAPEAM, grant

016/2006); and Programa de Apoio a núcleos de Excelência (PRONEX, proc. 1437/2007).

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