

A new subspecies of *Adelpha messana* (C. Felder & R. Felder) from the Brazilian Atlantic forest (Nymphalidae: Limenitidinae)

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Date of issue online: 17 May 2019

Zoobank Registered: urn:lsid:zoobank.org:pub:959B694C-E8E8-455F-AD40-AB4E4DC3448C

Electronic copies (ISSN 2575-9256) in PDF format at: <http://journals.fcla.edu/troplep>; <https://zenodo.org>; archived by the Institutional Repository at the University of Florida (IR@UF), <http://ufdc.ufl.edu/ufir>; DOI: 10.5281/zenodo.2685490

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Abstract: *Adelpha messana* (C. Felder & R. Felder, 1867) is an uncommon forest species hitherto known from Central America to the Amazon basin. Here we report the species for the first time from the Atlantic Forest region of southeastern Brazil, where it occurs as a distinct subspecies which we describe and name as *Adelpha messana seminivea* Freitas, Willmott and Woodbury, n. ssp. The subspecies is known from only two localities in Espírito Santo, from where another new *Adelpha* taxon was recently described and named, highlighting the need for further field work to better document the biodiversity of the remaining natural habitats in this region.

Key words: Atlantic forest; biodiversity; butterflies; conservation; Lepidoptera; natural history collections; new taxon; taxonomy.

INTRODUCTION

With approximately 90 described species, *Adelpha* Hübner, [1819] is one of the largest genera of Neotropical Nymphalidae (Willmott, 2003a; Lamas, 2004; Willmott & Hall, 2013). The genus is well-known for having many species whose adults are extremely similar in dorsal wing pattern but not closely related, as evidenced by ventral wing pattern, genitalia, immature stages, host plants and molecular data (Moss, 1933; Aiello, 1984; Willmott, 2003b; Mullen *et al.*, 2010; Ebel *et al.*, 2015; Rush & Hill, 2017). As a consequence of this strong similarity in wing pattern, discoveries continue to be made of rare, undescribed species and subspecies of *Adelpha* that have remained unnoticed in museum collections, mixed with other more common widespread species (e.g. *Adelpha atlantica* Willmott, 2003 and *Adelpha herbita perdita* Willmott & Freitas, 2016).

The vanishing tableland forests in the Brazilian states of Espírito Santo and Bahia are important not only for their relatively high species richness, but also for harboring significant populations of several threatened species (MMA, 2000; Brown & Freitas, 2000; Peixoto *et al.*, 2008). For butterflies in particular, the occurrence of numerous otherwise typically Amazonian species in the lowland forests of the region is remarkable, in addition to the presence of several endemic species (Brown & Freitas, 2000; Freitas *et al.*, 2016), some of which have only recently been described (Willmott *et al.*, 2016; Nakahara *et al.*, 2017).

Recently, ongoing curation of the *Adelpha* collection at the McGuire Center for Lepidoptera and Biodiversity, Florida

Museum of Natural History, revealed a female specimen of *Adelpha messana* (C. Felder & R. Felder, 1867) from northern Espírito Santo, representing the first record of this species from Atlantic Brazil. Moreover, the reduced orange on the forewing of that specimen, similar to many *Adelpha* taxa from that region, suggested that it might represent a distinct subspecies (Fig. 1). Additional searching in the collection of the Zoology Museum of Campinas State University (the former collection of Keith S. Brown) revealed seven additional specimens from the same region, previously identified as *Adelpha erotia* (Hewitson, 1847) (Freitas *et al.*, 2016). These specimens confirmed that the characters observed in the specimen initially found at the McGuire Center for Lepidoptera and Biodiversity were consistent, and we therefore here describe the southeast Brazilian taxon as a new subspecies of *Adelpha messana*.

MATERIALS AND METHODS

Adelpha specimens were examined in major public and private collections in Europe, North and South America, as listed in Willmott (2003a), to record distributional data, study morphological variation, assess taxonomic diversity and locate type specimens. Acronyms used here include: **FLMNH**: McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, Gainesville, FL, USA; **NHMUK**: The Natural History Museum, London, United Kingdom; **ZUEC**: Museu de Zoologia da Universidade Estadual de Campinas, Unicamp, Campinas, São Paulo, Brazil. Morphology was studied using standard techniques, with adult abdomens being soaked in hot 10% KOH for 10–15 minutes,

dissected and subsequently stored in glycerin. Body morphology and dissections were studied and photographs of male genitalia made using a Zeiss Discovery V20 Stereomicroscope at 50× magnification. Male genitalia terminology is indicated in Fig. 2, and the terminology for morphology and wing pattern follows Willmott (2003a). We use the abbreviations DFW, VFW, DHW and VHW for dorsal and ventral forewing and hindwing.

RESULTS

Adelpha messana seminivea Freitas, Willmott and Woodbury, n. ssp.

Figs. 1, 2, 3

Adelpha erotia erotia Freitas et al. (2016: 322).

Description and diagnosis: This subspecies is most similar to *A. messana delphicola* Fruhstorfer, 1910, which is also the neighboring subspecies found in Amazonian Brazil (Fig. 1C). It is distinguished from *A. m. delphicola* by having a white DFW postdiscal band in cells 2A-Cu₂ and Cu₂-Cu₁ that fuses with the orange postdiscal band in the latter cell, rather than a completely orange postdiscal band and inner postdiscal series. It is distinguished from typical *A. messana* (Fig. 1D) by the fusion of the white postdiscal band in cell Cu₂-Cu₁ and orange

margins anterior of vein Cu₁ (but see Taxonomy and variation below).

Types: HOLOTYPE. Male (Fig. 1A) with the following labels (four labels separated by transverse bars): / HOLOTYPE / BRAZIL, Espírito Santo, Linhares, Floresta Nacional de Goytacazes, 19°26'11.47"S 40°45'2.79"W, 31.VIII.1973, 20-30 m, K. S. Brown & C. Elias leg. / DNA voucher - BLU 1057 / ZUEC LEP 10637 / *Adelpha messana seminivea* Freitas, Willmott and Woodbury, det. 2018 /. Deposited in the ZUEC.

ALLOTYPE. Female (Fig. 1B) with the following labels (four labels separated by transverse bars): / ALLOTYPUS / BRAZIL, Espírito Santo, Linhares, Floresta Nacional de Goytacazes, 19°26'11.47"S 40°45'2.79"W, 31.VIII.1973, 20-30 m, K. S. Brown & C. Elias leg. / DNA voucher - BLU 1055 / ZUEC LEP 10635 / / *Adelpha messana seminivea* Freitas, Willmott and Woodbury, det. 2018 /. Deposited in the ZUEC.

PARATYPES (1 ♂, 5 ♀): **Brazil:** *Espirito Santo:* Linhares, Floresta Nacional de Goytacazes, 25-35 m, 19°26'11.47"S, 40°45'2.79"W, 31.VIII.1973, K. S. Brown & C. Elias leg., 1 ♂, (DNA voucher 1056; ZUEC-LEP-10636; dissected) (ZUEC); Linhares, Reserva Natural da Vale do Rio Doce, 19°9'10"S, 40°1'8"W, 6.IX.1987, K. S. Brown leg., 1 ♀, (DNA voucher BLU-1051; ZUEC-LEP-10613) (ZUEC); Linhares, south of city [Floresta Nacional de Goytacazes], 19°26'11.47"S, 40°45'2.79"W, 17.X.1987, K. S. Brown leg., 2 ♀, (DNA voucher BLU-1050, BLU-1053; ZUEC-LEP-10616, ZUEC-LEP-10617) (ZUEC); Linhares, VIII.1973, 1 ♀, (DNA voucher 1058; ZUEC-LEP-10638) (ZUEC); Linhares, August 1973, 1 ♀, P. C. Elias, (FLMNH-MGCL-204328) (FLMNH).

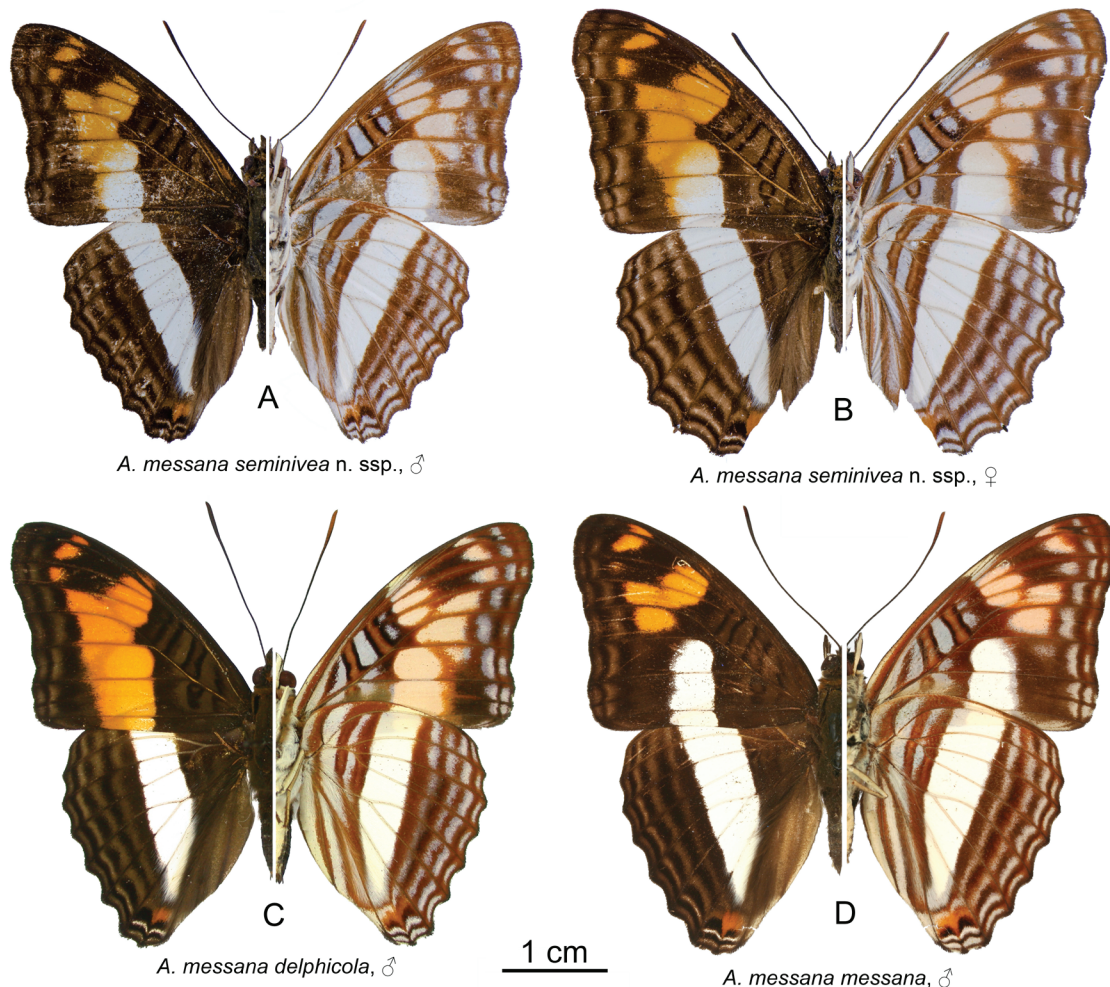


Fig. 1. A,B. *Adelpha messana seminivea* n. ssp., holotype male on left, allotype female on right (dorsal left, ventral right) (ZUEC). C. *Adelpha messana delphicola*, male, Ecuador, Orellana, Río Tiputini (FLMNH). D. *Adelpha messana*, male, Colombia, ‘Bogotá’ (NHMUK, © Trustees of the Natural History Museum).

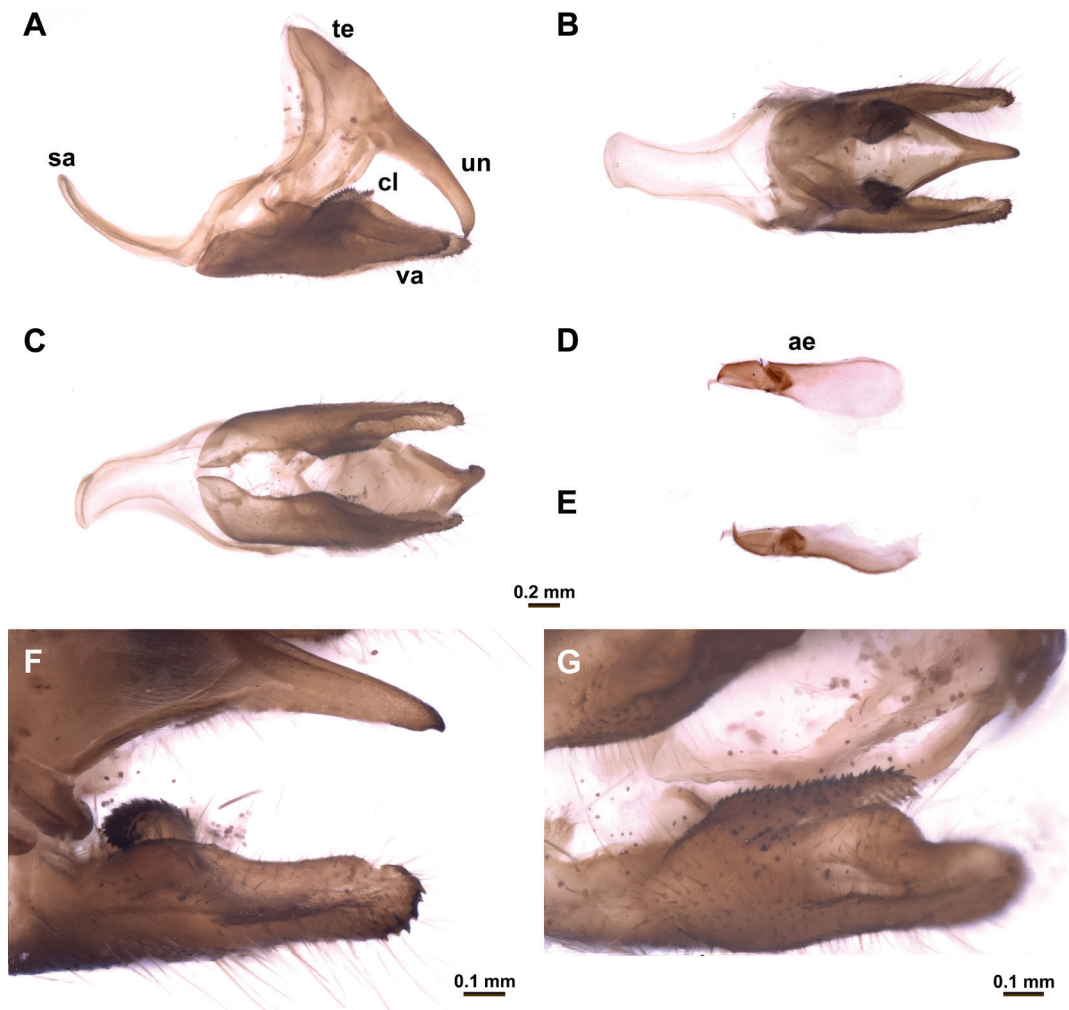


Fig. 2. Male genitalia of *Adelpha messana seminivea* n. ssp. (paratype in ZUEC). **A.** lateral view; **B.** dorsal view; **C.** ventral view; **D, E.** aedeagus, dorsal and lateral views, respectively; **F.** dorsal view of valva; **G.** ventral view of valva. Abbreviations: ae = aedeagus, cl = clanicula, sa = saccus, te = tegumen, un = uncus, va = valva.

Etymology: The name is derived from the Latin prefix ‘semi-’, meaning half, and the adjective ‘nivea’, meaning snow-white, in reference to the coloring of the FW band. It is treated as a feminine adjective.

Taxonomy and variation: Wing pattern and genitalic characters place this taxon within the *Adelpha phylaca* group (Willmott, 2003a). These characters include: densely packed, pale whitish scales along the base of vein Rs on the DHW (a synapomorphy for the *Adelpha phylaca* group (Willmott, 2003a)); the postdiscal series fused in cell Cu_2-Cu_1 on the VFW and fused to the postdiscal band in cell Cu_1-M_3 (a characteristic of the *A. phylaca* group also found in some other *Adelpha*); and in the male genitalia, a broad-based clanicula and ‘teeth’ extending from the posterior tip of the valva along its ventral edge (Fig. 2). Within the *A. phylaca* group, this taxon shares a number of wing pattern characters with *A. messana delphicola* and *A. messana messana*, which suggest that those taxa are its closest relatives. These characters include: a prominent, often ‘v’-shaped silver spot representing the inner submarginal series in cell Cu_1-M_3 on the VFW (absent or indistinct in *A. thesprotia*, a straight line in *A. phylaca*), reddish brown ground color

immediately distal of the white VHW postdiscal band (dark blackish brown in *A. thesprotia*), and the postdiscal series on the VHW present as even silvery dashes that broaden in cells M_1-Rs and $Rs-Sc+R_1$ (in *A. erotia*, the inner postdiscal series is broadest in cell M_1-Rs while the outer postdiscal series is more or less even throughout the wing except for being reduced in cell $Rs-Sc+R_1$). Genitalic characters are not apparently useful in distinguishing species within the *A. phylaca* group (Willmott, 2003a), and unfortunately, despite attempts to sequence the COI ‘barcode’ region, we have so far been unable to obtain any DNA sequence data for the new taxon.

We treat the new taxon as a subspecies of *A. messana* since it does not show any differences in ventral wing pattern or genitalia in comparison with other subspecies of that species, with which it is also allopatric. The principal difference between this subspecies and *A. messana delphicola* is in the extent of orange on the forewing, a character that varies intraspecifically in numerous other *Adelpha* species (Willmott, 2003a), as well as within *A. messana* west of the Andes (see below). Slight variation was observed in the extent of the orange shading over the white DFW postdiscal band, which in some individuals reached the anterior edge of cell $2A-Cu_2$, but nevertheless all



Fig. 3. Known distribution of *Adelpha messana*. Specimens in collections labeled “Guatemala” and “Costa Rica” (see Willmott, 2003) suggest that *A. m. messana* occurs at least as far west as the former country, although the locality information is too imprecise to show on the map.

individuals presented an entirely white postdiscal band posterior of vein 2A and in most or all of cell 2A-Cu₂, in contrast to all examined *A. messana delphicola*.

The new subspecies is similar in dorsal wing pattern to some individuals, currently treated as *A. messana*, occurring from Guatemala to the Chocó region of western Ecuador. In these individuals the orange apical marking on the DFW is similarly fused, or touches, the white postdiscal band, and such a specimen was figured by Willmott (2003a: fig. 89c,d) as ‘*A. messana* ssp. nov.’. However, Willmott (2003a) noted that there was significant variation in specimens from this geographic region in the extent of orange on the DFW, and a lack of reliably, precisely labeled specimens from central Colombia. Given that there is no obvious geographic barrier separating populations from the Colombian Magdalena valley (the probable type locality for the nominate subspecies) from those further west in Colombia, the possibility of clinal variation argues against recognizing Chocó and central American specimens as a distinct subspecies at present. Such is not the case with *A. messana seminivea* n. ssp., which shows a distinctive wing pattern consistent with other sympatric and presumably co-mimetic *Adelpha*, and which is also presumably strongly isolated from Amazonian *A. m. delphicola* by the Brazilian *cerrado*.

Distribution: This subspecies is known from only two forest remnants close to the town of Linhares, in Espírito Santo, Brazil (Fig. 3).

Habitat and adult ecology: The two areas where this new subspecies has been collected are covered by tableland forest (known locally as “tabuleiro” forest), a formation associated

with oligotrophic soils on flat land (20-60 m above sea level), with a high floristic diversity (Peixoto *et al.*, 1995, 2008). These forest formations, also known as “Hiléia Bahiana” (Andrade-Lima, 1966), extend from Espírito Santo north of the mouth of Rio Doce river, to south Bahia, with warm annual temperatures with little fluctuation and deciduousness in some tree species (Peixoto *et al.*, 2008).

The dorsal wing pattern of *A. messana seminivea* n. ssp. is very similar to those of several sympatric *Adelpha*, namely *Adelpha thesprotia* (C. Felder & R. Felder, 1867) (the most similar species), *Adelpha capucinus velia* (C. Felder & R. Felder, 1867), *Adelpha plesaire plesaire* Hübner, 1823 and *Adelpha malea goyama* Schaus, 1902, suggesting that mimicry may be involved. All the above species of similar *Adelpha* are widespread from Santa Catarina to Espírito Santo (Willmott, 2003a), but so far *A. messana seminivea* n. ssp. is known only from the two localities mentioned above.

DISCUSSION

The discovery of *A. messana seminivea* n. ssp. is notable since it represents the first record of *A. messana* in the Brazilian Atlantic forest, one of the four main biogeographic regions in the Neotropics (Brown, 1982), and a range extension of c. 1800 km. It is also remarkable that all specimens of the type series were collected at the same two sites where the recently described *A. herbata perdita* also occurs (Willmott *et al.*, 2016).

As previously discussed for the sympatric *A. herbata perdita*, the conservation status of *A. messana seminivea* also needs attention. This subspecies is known from only two large forest remnants in central Espírito Santo, and even though both localities are now conservation units, there are few additional forest remnants in the tableland forests of north Espírito Santo and south Bahia where the species could occur (MMA, 2000). Accordingly, as for *A. herbata perdita*, areas to be searched for *A. messana seminivea* include the Sooretama Biological Reserve and the Floresta Nacional do Rio Preto, both in Espírito Santo, and the Una Biological Reserve, the Monte Pascoal Historic National Park and the Descobrimento National Park, all in Bahia. However, considering the rarity and difficulty in finding some species of *Adelpha* in nature, intensive field work is needed in each of the above-mentioned sites before it can be assumed that *A. messana seminivea* is absent in a given locality. In Ecuador, both *A. messana delphicola* and *A. messana messana* are uncommon inhabitants of relatively undisturbed forest, and virtually all the records from that country represent males attracted to rotting fish bait, usually in canopy bait traps on ridge tops (Willmott, 2003a).

Although nothing is known about the immature stage biology of this taxon, it is likely that caterpillars will be found feeding on one of the host plants already known for *A. messana messana* and other members of the *A. phylaca* species group (Aiello, 2006). These plants include *Luehea* (Malvaceae) for *A. m. messana*, and several genera of Urticaceae for remaining species (*Cecropia*, *Coussapoa*, *Pourouma*). Aside from improving our understanding of the biology of this taxon, immature stage information could also help better decide on its taxonomic status, given the demonstrated value of *Adelpha*

immature stages in illuminating relationships among *Adelpha* (Moss, 1933; Aiello, 1984, 2006; Willmott, 2003a).

Finally, this new finding calls attention to the still poorly studied biodiversity of the tableland forests of Bahia and Espírito Santo, suggesting that additional new taxa await discovery in the last remaining forests of the region.

ACKNOWLEDGMENTS

The authors are indebted to the tireless fieldwork of the two collectors of the seven known specimens of *A. messana seminivea* n. ssp., Keith S. Brown Jr. and P. C. Elias. KRW acknowledges support from NSF (DEB-1342705) and the McGuire Center for Lepidoptera and Biodiversity. AVLF acknowledges support from FAPESP (BIOTA-FAPESP grants 2011/50225-3 and 2013/50297-0), from the Brazilian Research Council – CNPq (303834/2015-3, 421248/2017-3) and from the National Science Foundation (DEB-1256742). EPB thanks FAPESP for a Post-Doc fellowship (2016/15873-8). KRW thanks the Trustees of the Natural History Museum, London, UK, and Blanca Huertas for assistance and permission to figure a specimen from the NHMUK, and Jane Blanchard for her tireless work in curating the FLMNH *Adelpha* collection. Augusto H. B. Rosa helped in find additional specimens of the type series from the former K. S. Brown collection, Tamara M. C. Aguiar spread the type series deposited in Campinas and André Cesar photographed the types. This publication is part of the RedeLep “Rede Nacional de Pesquisa e Conservação de Lepidópteros” SISBIOTA-Brasil/CNPq (563332/2010-7). The present study is registered in the SISGEN (ADC0BD6). Finally, we thank two reviewers for their helpful comments which improved this paper.

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