New records of pleasing lacewings (Neuroptera, Dilaridae) from São Paulo state, Brazil

Rogéria I. R. Lara, Nelson W. Perioto

Agência Paulista de Tecnologia dos Agronegócios (APTA), APTA Centro Leste, Av. Bandeirantes 2419, 14030-670, Ribeirão Preto, SP, Brazil.

Corresponding author: Rogéria I. R. Lara, rirlara@yahoo.com.br

Abstract
This note extends the geographic range of Nallachius adamsi Penny, 1981, N. dicolor Adams, 1970 and N. phant­omellus Adams, 1970 to São Paulo state, Brazil, based on the examination of specimens obtained in an area of riparian forest (21°36′47″ S, 047°49′04″ W, ca 532 m above sea level) at the Estação Ecológica de Jataí, in the municipality of Luís Antônio.

Key words
Light trap; Nallachius adamsi; Nallachius dicolor; Nallachius phantomellus; range extensions.

Introduction
The Dilaridae (Neuroptera) comprise 2 extinct and 4 extant genera with near 100 species distributed in 3 subfamilies, Berothellinae, Dilarinae and Nallachinae (Aspöck et al. 2015, Zhang et al. 2016, Liu et al. 2017). Due in part to their rarity, the biology of this family is poorly documented (Penny 1981, Bowles et al. 2015, Liu et al. 2017), but the larvae are known live in decayed wood and under barks of dead trees (MacLeod and Spiegler 1961, Penny 1981, Oswald 1998).

The Dilaridae have a disjunct distribution, with occurrence records in North and South America, Europe, Asia and Africa, but they are absent in the Australian region (Oswald 1998, Liu et al. 2017). Of the Nallachinae, Nallachius Navás, 1909 occurs in the Nearctic and Neotropical regions while Neomallachius Nakahara, 1963 is an African and Asian genus (Liu et al. 2017).


Little is known about their prey, but there are reports of Nallachius larvae feeding upon larvae of Cucujus clavipes Fabricius, 1775 (Coleoptera, Curculionidae), Elaphidion sp. (Coleoptera, Cerambycidae), and Camponotus castaneus (Latreille, 1802) (Hymenoptera, Formicidae) (MacLeod and Spiegler 1961, Kuhar 1995).

Methods
The Nallachius specimens were collected with 2 light traps built according to Szentkirályi (2002). These
traps were operated in an area of riparian vegetation (21°36′47″ S, 047°49′04″ W, ca 532 m above sea level) within the Brazilian Savannah domain at the Estação Ecológica de Jataí, in Luís Antônio municipality, São Paulo state, Brazil (Fig. 1). The light traps were separated from each other by 100 m and fixed in trees inside the forest, ca 2 m from the ground. The traps were equipped with 250 W mercury vapor lamps, and their function was controlled by electronic timer coupled to an electromechanical contactor so that the traps remained active on Mondays, Wednesdays, and Fridays, from dusk to dawn, between November 2007 and November 2009. In the traps, a 5% formalin solution and neutral liquid soap were used as preservative. The captured specimens were sent for identification to the Laboratório de Biocologia e Taxonomia de Parasitoides e Predadores da APTA Ribeirão Preto, in Ribeirão Preto, São Paulo state, Brazil.

Observations were made under magnification using a stereomicroscope (Leica M29.5, Leica Microsystems, Switzerland) and optical microscope (Leica DM500, Leica, China). The color images were obtained with a digital camera (Leica DFC295, Leica, Germany) attached to a stereomicroscope (Leica M205C APO, Leica, Singapore) as well as to a DM500 microscope. Serial images from different layers were combined with Helicon Focus software (v. 5.3) and figures were prepared using Adobe Photoshop software (v. 11.0).

The genitalia were hot-macerated in a 10% KOH solution for about 15 min and subsequently immersed, for 1 h, in a 10% C₂H₄O₂ solution for neutralization. The structures of genitalia were stored in glycerin in glass microvials.

attached in the same pin of the respective specimens.

The voucher specimens, 1 male of *N. adamsi*, 2 males of *N. dicolor*, and 1 male of *N. phantomellus* (LRRP #862-865) examined in this study were deposited in the Entomological Collection of the Laboratório de Sistemática e Bioecologia de Parasitoides e Predadores (LRRP), of the APTA Centro Leste (Ribeirão Preto, SP, Brazil). The collections were done under SISBIO license 16473-1.

The identifications of the *Nallachius* species were made using the keys of Adams (1970) and Machado and Rafael (2010).

**Results**

*Nallachius adamsi* Penny, 1981
Figures 2–4, 11

**Material examined.** 1 male, Brasil, SP, Luís Antônio, Estação Ecológica de Jataí, 21°36’47” S, 047°49’04” W, mata ciliar, light trap, 30/IX/2009, RIR Lara and team, legs., LRRP #862.

The specimen of *N. adamsi* was recognized by the combination of the following morphological characteristics: forewing with RS vein 4 branched, most of costal cross-
Nallachius phantomellus Adams, 1970

Veins unforked and, MP2 and CuA veins fused; ectoproct with dorsal lobes long, narrow, with rounded tip and digitiform process well developed, tapering to acute point; gonocoxites long, stoutly pointed with longitudinal groove and subapical notch; mediuncus lobes basally complexly curved, closely approximated and acutely pointed (Penny 1981, Machado and Rafael 2010).

Nallachius phantomellus was recognized by the pale labrum; forewing with RS vein 5 branched, most of costal crossveins unforked and, MP2 and CuA veins not fused; ectoproct with dorsal lobes approximated on midline, digitiform lobe with stout hook protruding near apex; gonocoxites shorter than in N. dicolor, lateral edge angulate so that shape resembles a scimitar, with tip bent dorsally; mediuncus lobes short, spatulate, hardly bent ventrad, lateral projections rounded and median lobe ends at level of these lateral projections (Adams 1970, Machado and Rafael 2010).

Specimens of N. dicolor were recognized by the pale labrum; forewing with RS vein 4 branched, most of costal crossveins unforked and, MP2 and CuA veins not fused; ectoproct with dorsal lobes approximated on midline, digitiform lobe with stout hook protruding near apex; gonocoxites lancet-shaped, curved outward; mediuncus lobes slender-ligulate apically and, median lobe wide basally, apex simple, only membrane bilobed, projecting beyond lateral processes of mediuncus lobes (Adams 1970, Penny 1981, Machado and Rafael 2010).

Nallachius phantomellus Adams, 1970

Nallachius phantomellus was recognized by the pale labrum; forewing with RS vein 5 branched, most of costal crossveins unforked and, MP2 and CuA veins not fused; ectoproct with dorsal lobes approximated on midline, digitiform process cylindrical, bearing a slender hook on medial surface; gonocoxites shorter than in N. dicolor, lateral edge angulate so that shape resembles a scimitar, with tip bent dorsally; mediuncus lobes short, spatulate, hardly bent ventrad, lateral projections rounded and median lobe ends at level of these lateral projections (Adams 1970, Machado and Rafael 2010).

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Discussion

In this paper, we document a new distributional record, which extends the geographic range of *N. adamsi* to São Paulo state, about 2400 km southeast from the type locality at Manaus, Amazonas state, Brazil (Penny 1981; Table 1).

The geographic range of *N. dicolor* is likewise extended to São Paulo state. From the other previously known occurrences, all in Brazil, the new record is about 800 km northeast from the type locality at Nova Teutônia, Santa Catarina state, about 1800 km southwest from Jatobá, Pernambuco state, about 900 km southwest from Berizal, Minas Gerais state, and about 400 km southeast from Caldas Novas, Goiás state (Adams 1970, Penny 1981, Machado and Rafael 2010, Martins and Araújo 2016; Table 1).

*Nallachius phantomellus* was known only from the type locality at the Rio Caragualá (probably a misinterpretation of Rio Caraguatá, Bataguassu municipality), Mato Grosso do Sul state, and Orelleana province, Ecuador (Adams 1970, Bowles et al. 2015). We extend to São Paulo state the geographical range of this species with our new record, which is about 400 km southeast from the type locality and 4000 km southeast from Orelleana province (Table 1).

The emergence of the Dilaridae seems to be during the summer, and in the southern hemisphere, the all records were made between October and January except for one each in September and March (Adams 1970; Table 1).

During our 2 years of sampling in the study area only 4 specimens of the 3 species were collected with light traps. Although we sampled at the same time with 2 Malaise traps and collected other families of neuropterans, no Dilaridae were collected. This corroborates the statements of Oswald (1998) and Monserrat (2014) that Dilaridae are typically nocturnal, rarely seen in the field, and thus underrepresented in collections.

This note reveals the incipient nature of the knowledge about the Dilaridae and demonstrates the need of further collection effort to get a better representation of this family in Brazil.

Acknowledgements

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Authors’ Contributions

RIRL collected the examined exemplars and identified the specimens. Both NWP and RIRL wrote the text.

References


Table 1. Species of *Nallachius* Navás, 1909 (Neuroptera, Dilaridae) obtained at the Estação Ecológica de Jataí, in Luís Antônio, São Paulo state, Brazil and known geographic distribution in the Americas and months of collection.

<table>
<thead>
<tr>
<th>Nallachius species</th>
<th>Type locality</th>
<th>Distribution</th>
<th>Months of collection</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>N. adamsi</em> Penny, 1981</td>
<td>Brazil, AM, Reserva Duke</td>
<td>Brazil (AM, SP*)</td>
<td>May, July, Sept.*, Dec.</td>
<td>Penny 1981, Machado and Rafael 2010, this study</td>
</tr>
<tr>
<td><em>N. phantomellus</em> Adams, 1970</td>
<td>Brazil, MS, Rio Caraguatá</td>
<td>Ecuador; Brazil (MS, SP*)</td>
<td>March, July, Aug.*</td>
<td>Adams 1970, Bowles et al. 2015, this study</td>
</tr>
</tbody>
</table>

* New records; AM = Amazonas, GO = Goiás, MG = Minas Gerais, MS = Mato Grosso do Sul, PE = Pernambuco; SC = Santa Catarina, SP = São Paulo.