

RESEARCH ARTICLE

## In honor of conservation of the Brazilian Atlantic Forest: description of two new damselflies of the genus *Forcepsioneura* discovered in private protected areas (Odonata: Coenagrionidae)

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**ABSTRACT.** Two new Brazilian Protoneurinae damselflies, *Forcepsioneura regua* **sp. nov.** (holotype male deposited in DZRJ: Brazil, Rio de Janeiro State, Cachoeiras de Macacu municipality, RPPN Reserva Ecológica de Guapiaçu) and *Forcepsioneura serrabonita* **sp. nov.** (holotype male deposited in DZRJ: Brazil, Bahia State, Camacan municipality, RPPNs Serra Bonita), are described, illustrated and diagnosed based on males and females. The bluish and smaller *F. regua* **sp. nov.** has been confused with at least three previously described species, being very similar to the type species of *Forcepsioneura*, *F. garrisoni* Lencioni, 1999, but lacking a defined tubercle-like process on the posterolateral margin of the median lobe of the prothorax in both sexes, which allows it to be distinguished from all other known species. The shape of the cercus of the male of *F. serrabonita* **sp. nov.** is similar to that of *F. grossiorum* Machado, 2001 and *F. lucia* Machado, 2000, two species with very short ventrobasal process. However, it differs from them mainly by the mediobasal process of the cercus, which is rounded in dorsal view and almost not visible in lateral view. The taxonomic status of *Forcepsioneura* is discussed and a comparison with the other species of the genus is provided. Based on size, habitat and coloration, *Forcepsioneura* can be informally divided into two groups: (1) large, orange-black and montane species, including *F. grossiorum*, *F. itatiaiae* (Santos, 1970), *F. lucia* and *F. serrabonita* **sp. nov.**; (2) small, bluish and lowland species, including *F. garrisoni*, *F. haerteli* Machado, 2001, *F. regua* **sp. nov.** and *F. sancta* (Hagen *in* Selys, 1860). Our findings highlight the urgency in directing collecting efforts to unexplored areas, as well as the importance of private preserves that harbor the type localities as guardians of the threatened and diverse Atlantic Forest diversity. Together these two localities surveyed account for more than 210 species of odonates, representing almost 24% of the number of Brazilian species. Brazil has the greatest number of known species of odonates in the world. This study shows that further research is required in order to fully understand the diversity of *Forcepsioneura*.

**KEY WORDS.** *Amazonera*, dragonfly, damselfly, Protoneurinae, Southeastern Brazil, taxonomy.

### INTRODUCTION

“...forest cover must be important for adults of the majority of neotropical Odonata. Every effort should be made to preserve forests and forest wetlands in this most biodiverse region of the Earth” (Paulson 2006: 97).

The quotation above illustrates the relevance of forests for the conservation of the insects of the order Odonata, popularly

known as dragonflies and damselflies. Life on Earth is facing the sixth mass extinction in the planet’s geological history (Barnosky et al. 2011). Distinct from the past, when natural processes caused extinctions, for example, the meteorite impact that ended the era of the giant ‘reptiles’ and caused the last big extinction event in the Cretaceous Period (Jablonski 2001, Barnosky et al. 2011), the current high rate of biodiversity loss mostly results from human activities. This has led to this epoch being baptized as the Anthropocene (e.g., Crutzen and Stoermer 2000). As a

consequence of the high demand for energy, crop production, and encroachment on natural habitats by urbanization, ecosystems are under strong pressure, causing what has been coined of Biodiversity Crisis (e.g., Singh 2002).

Amongst the severely threatened areas of the biosphere, the Atlantic Forest (AF) is recognized as an area of immense species diversity and, for some groups of plants, such as Bromeliaceae, the richest one (Martinelli et al. 2008). Originally, the very complex and heterogeneous AF encompassed about 1,500,000 km<sup>2</sup>, mainly along the Brazilian Atlantic Coast (including also small areas in Paraguay and Argentina), and it is estimated that now has been reduced to less than 12% (Ribeiro et al. 2009). The domain, most often referred to as a biome, is composed by herbaceous-arbustive restinga vegetation at sea level, trade off by pluvial forests with tall canopies in the lowland, up to highland fields known as Campos Rupestres of the Southeastern Brazilian Páramos (Safford 1999, Ribeiro et al. 2009). Due to its high levels of biodiversity, endemism, and anthropic pressures, it is considered one of 34 hotspots for conservation (Myers et al. 2000, Mittermeier et al. 2011), even the hottest (Laurance 2009). Its area corresponds to the Parana biogeographical dominion sensu Morrone (2014). As far as Odonates are concerned, the AF holds about 50% of the 878 known Brazilian species (data based on Pinto 2017). However, its original cover corresponds to the most densely populated part of the country, and encompasses, for instance, huge metropolitan areas such as the megacities of São Paulo and Rio de Janeiro, that are among the thirty largest urban centers of the world (UN 2015). The species of *Forcepsioneura* Lencioni, 1999 inhabit this threatened domain. The genus includes small Protoneurinae damselflies that, with the exception of specimens identified as *F. sancta* (Hagen in Selys, 1860) from the Cerrado domain of the Brazilian central plateau (see records in Pessacq et al. 2012), are restricted to the AF.

Protoneuridae s.l., as defined by Tillyard (1917), comprises what Tillyard and Fraser (1938: 164) formerly recognized as two parallel series of damselflies with reduced wing venation: the first series encompassing a small homogenous group of genera from the New World, and a second, clearly heterogeneous series from the Old World. Since Tillyard and Fraser (1938), more genera and species have been added to this unnatural assembly, contributing for its original concept representing a polyphyletic group (see Pessacq 2008, Dijkstra et al. 2014). However, the almost exclusively Neotropical representatives from the New World series (Protoneurinae sensu Bridges 1994: IV.7), containing the type genus *Protoneura* Selys in Sagra, 1857, and fifteen other genera, were recovered as monophyletic, nested within Coenagrionidae in several analyses (Rehn 2003, O'Grady and May 2003, Bybee et al. 2008, Pessacq 2008, Dijkstra et al. 2014). Restraining true protoneurids to its Western Hemisphere members is an old hypothesis (see Watson 1992), but even its monophyly is not free from controversy (see Pimenta et al. 2015). However, considering that the monophyly of the New World protoneurids is

demonstrated as highly supported, its familial status is justified, with other monophyletic groups of genera in Coenagrionidae s.l. each receiving similar level. It is contrary to recent proposals to decrease the rank level of both Pseudostigmatidae (Ingley et al. 2012) and Protoneuridae (Dijkstra et al. 2014) due to these being phylogenetically nested within Coenagrionidae s.l.

South American protoneurids are mostly small sized odonates living near or within forested areas. They are generally weak fliers, frequenting shaded areas near the shoreline of large freshwater bodies and numerous running water environments. Because of very thin general aspect and disruptive colors, protoneurids are difficult to be found in the field, being often overlooked by regular collectors.

Today's Brazilian fauna counts with 70 species of Protoneurinae in 12 genera (Pessacq et al. 2012, Pinto 2017), including the endemic *Forcepsioneura*. This genus was described to include *Phasmoneura ciganae* Santos, 1970 and its type species *Forcepsioneura garrisoni* Lencioni, 1999 (Lencioni 1999). Independently, Angelo B.M. Machado in the same year proposed *P. ciganae* as a junior synonym of *Phasmoneura sancta* Hagen in Selys, 1860 (Machado 1999). Indeed, Machado, in a series of seminal works ("Studies on Neotropical Protoneuridae"), was the first author to suggest that *P. sancta* would need to be transferred to its own genus (see Machado 1985) and he (Machado 2000, 2001, 2005) described half of the six currently valid species of *Forcepsioneura*.

*Forcepsioneura* belongs to a poorly-supported monophyletic group of six genera, along with *Amazonaura* Machado, 2004, *Lamproneura* De Marmels, 2003, *Roppaurea* Santos, 1966, *Phasmoneura* Williamson, 1916, and *Psaironeura* Williamson, 1915 (Pessacq 2008), i.e., the *Roppaurea* clade. All of them have cubitus anterior (CuA) and cubitus posterior plus anal anterior (CuP&AA) veins indistinct (except in *Lamproneura*), antennifer non-carinated dorsally, and male cercus with ventrobasal process and genital ligula with long recurved lateral lobes (Pessacq 2008). The monophyly of this group, as well as that of other formerly erected taxa in Protoneurinae, is uncertain and currently under investigation (Pimenta et al. 2015).

From the six species currently recognized in *Forcepsioneura*, only *F. sancta* was described a long time ago. Most species were discovered recently, thanks to field-works in poor explored areas, and undescribed species are often reported in the literature (e.g., Kompier 2015). At least five undescribed species of *Forcepsioneura*, all from the Brazilian Atlantic Forest, were detected by the first author.

In recognition of conservation efforts to protect AF remnants, we describe here two previously unknown damselflies of "Protoneuridae s.s." (Coenagrionidae: Protoneurinae) recently collected in the states of Bahia and Rio de Janeiro, Brazil. These new damselflies were discovered in protected areas maintained thanks to private associations. The Brazilian AF is one of the most threatened biotic domains of the biosphere, and given its fragmentation and fragility, all conservation actions, including private sector initiatives, must be applauded for their contribution to both the scientific community and society in general.

## MATERIAL AND METHODS

Specimens examined are deposited in the following collections. Acronyms, wherever possible, based on the updated version of Arnett et al. (1993) by Evenhuis (2016): DZRJ – Coleção Entomológica “Prof. José Alfredo Pinheiro Dutra”, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil; DZUP – Coleção Entomológica “Pe. Jesus Santiago Moure”, Departamento de Zoologia, Setor de Ciências Biológicas, Universidade Federal do Paraná, Curitiba, PR, Brazil; MNRJ – Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil; MZSP – Museu de Zoologia, Universidade de São Paulo, SP, Brazil; RWG – Rosser W. Garrison Collection, Sacramento, CA, USA; USNM – National Museum of Natural History, Washington, DC, USA.

General morphology terms follow Pessacq (2008) and Garrison et al. (2010); wing venation is based on the system of Riek and Kukalová-Peck (1984), with additions summarized by Fleck et al. (2003) and Garrison et al. (2010). The terminology proposed by De Marmels (2002) was implemented for the description of the structures of the apical segment of the genital ligula, which we believe corresponds to the second segment following Pfau (1971), while terminology for the ovipositor was based on Matushkina (2004). The genital ligula was extruded using a hook-shaped pin after applying a few drops of 10% ammonia solution on the venter of the second and third abdominal segments (S2–3). In the few instances when genital ligula was fully extracted it was later transferred to a microvial with glycerin and stored with the respective specimen.

All measurements (in mm) and illustrations were made with the aid of a stereomicroscope equipped with a camera lucida. Specimens were photographed with a Leica MZ16 stereomicroscope equipped with a Leica DFC420 camera, and source images combined using Auto-montage software by The Synoptic Group®.

The following abbreviations were used in the text: a.s.l. = above sea level; Ax = antenodal crossveins; Fw = fore wing; GL = genital ligula; Hw = hind wing; MBP = mediobasal process; Px = postnodal crossveins; Pt = pterostigma; S1–10 = abdominal segments; L1–2 = segments of genital ligula; VBP = ventrobasal process.

## TAXONOMY

### *Forcepsioneura regua* sp. nov.

<http://zoobank.org/389F29AC-9E25-4154-80ED-C92FAFE9801C>  
Figs 1–6, 17–20, 24–28, 31–32, 35, 37

*Forcepsioneura garrisoni* nec Lencioni, 1999: — Costa and Oldrini (2005: 200, 208, key, misidentification of specimens from Rio de Janeiro State, Ilha da Marambaia island); — Anjos-Santos and Costa (2006: 41, misidentification based on Costa and Oldrini 2005).  
*Forcepsioneura haerteli* nec Machado, 2001: — Pessacq et al. (2012: 6, misidentification of a male from Rio de Janeiro State, Cachoeiras de Macacu, Japuiba, Santana River).

*Forcepsioneura* sp.: — Garrison et al. (2010: 358–360, 479, figs 2380, 2383, 2386, 2389, illustrations of wings, middle and posterior lobes of prothorax in laterodorsal view, and caudal appendages in lateral and dorsolateral views of a male from Ilha da Marambaia island, Rio de Janeiro State, Brazil); — Kompier (2015: 112–113, photos of male and female habitus on the field from the type locality, characterization, comparison with *Epileoneura venezuelensis*, *F. lucia*, and *F. sancta*, notes on habitat and behavior).

**Diagnosis.** Small, dorsally metallic greenish-blue, lateroventrally light blue and yellowish striped protoneurid; frons angulated; rear of head pale; CuP&AA indistinct; Ax space 1 as long as Ax space 3; GL with long inner fold and distal lateral lobe prolonged into a flagellum; cercus forcipate with mediobasal (MBP) and ventrobasal (VBP) processes, except for ill-defined prothoracic tubercle-like process, all characters agreeing with the definition of *Forcepsioneura* as recently diagnosed (Machado 2009, Garrison et al. 2010).

The comparatively longer VBP, longer than 0.53 of total cercus length (dorsal branch) in lateral view, allows separation of males of *F. regua* sp. nov. from species of the orange-black group (VBP  $\leq$  0.40 of cercus length in *F. grossiorum*, *F. lucia*, and *F. serrabonita* sp. nov.); anteromesal margin of MBP acute in dorsal view (Fig. 25) separates it from *F. sancta* (largely rounded in dorsal view; sensu Machado 2001); apex of VBP acute and MBP not visible in lateral view (Figs 5, 24) from *F. itatiaiae* (apex of VBP truncated and MBP visible in lateral view); VBP shorter, not reaching ventral margin of S10 in lateral view, and apex strongly curved internally (Figs 5, 24–26) from *F. haerteli* (which has a longer VBP at level of S10, and apex slightly curved internally).

Based on its general color and size, *F. regua* sp. nov. is most similar to *F. garrisoni*. Indeed, these two species are remarkably similar due to the blue stripes on thorax (light blue group). The short MP vein, which reaches distally at most 0.5 of the length of cell distal to the vein descending from subnodus, and the fin-shaped plate of MBP with an acute and strongly anteriorly directed apex in laterodorsal view are unique to these two species and separate them from all other known species in the genus. The short VBP, not reaching ventral margin of S10 ventrally, and posterolateral margin of median lobe of prothorax lacking a defined tubercle-like process distinguish *F. regua* sp. nov. from *F. garrisoni* (VBP long, ventrally reaching the ventral margin of S10, and posterolateral margin of median lobe of prothorax with a strongly defined conical tubercle-like projection). The ill-defined process on prothorax is unique for *F. regua* sp. nov. (Figs 1–3, 17, 27–28).

Despite the fact that the blue coloration and the ill-defined process on the prothorax of *F. regua* sp. nov. appear to be unique to females of this species, females of other *Forcepsioneura* are poorly known. Consequently, females should be identified through comparison with descriptions, figures, and their association with males.

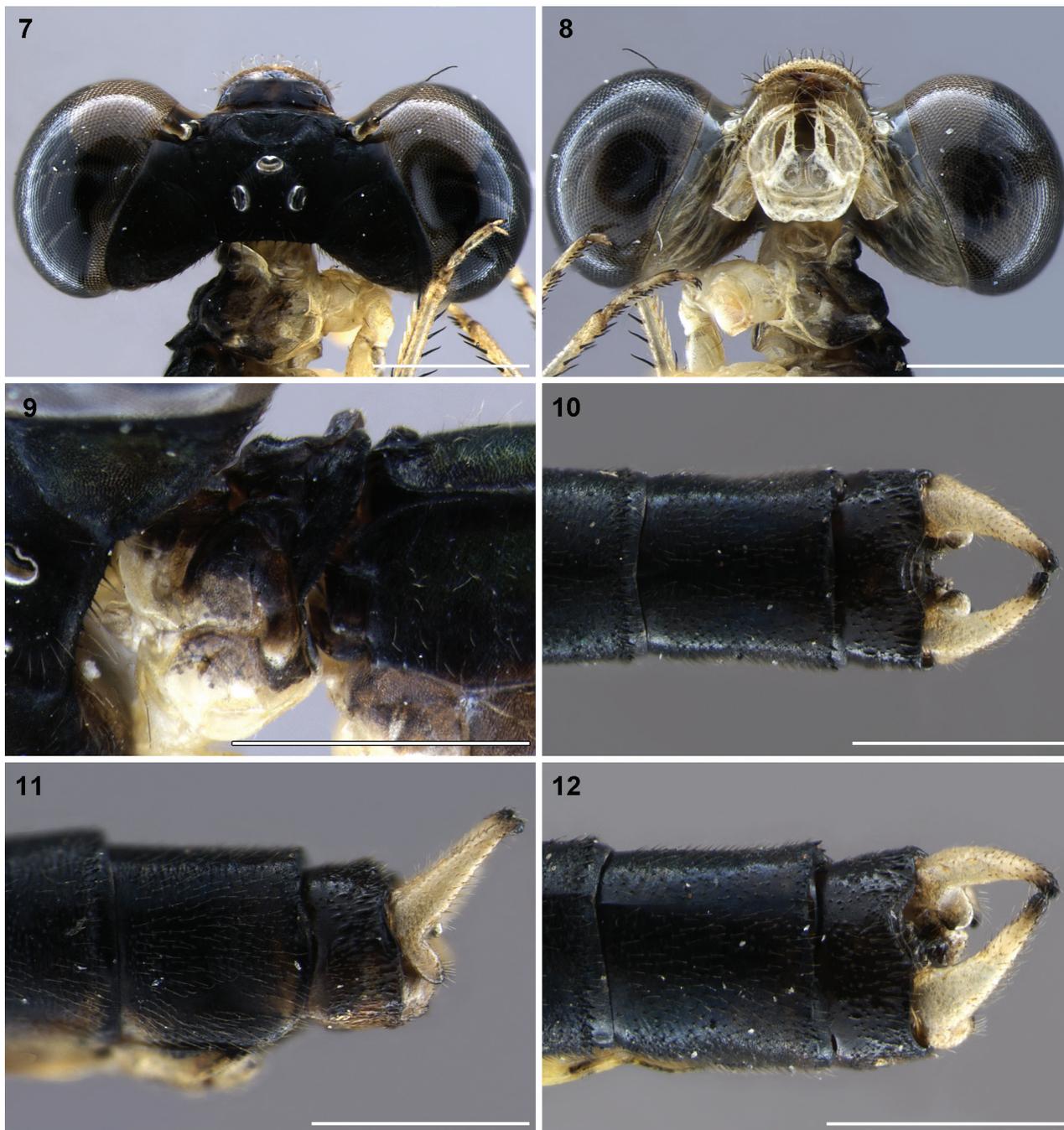
**Description of the male holotype.** Head (Figs 1–2): Labium, visible parts of maxilla and mandibles (except apex)



Figures 1–6. *Forcepsioneura regua* sp. nov., holotype male (Brazil. RJ: Cachoeiras de Macacu, DZRJ 2071): (1–2) head in dorsal (1) and ventral (2) views; (3) prothorax in lateral view; (4–6) caudal appendages in dorsal (4), lateral (5) and dorsolateral (6) views. Scale bars = 1 mm.

ivory yellow. Genae yellowish, darkening gradually posteriorly. Labrum dark brown to black with ventral 0.25 yellowish-orange, extended to 0.50 mesally, areas close to clypeolabral suture paler. Anteclypeus with lateral and mesal membranous ventral part

yellowish, remainder part forming a rectangular black plate, postclypeus shining black. Antefrons, postfrons and remainder of epicranium black with shining bluish metallic reflections after postfrontal suture over postocular area. Antenna, antennifer and



Figures 7–12. *Forcepsioneura serrabonita* sp. nov., holotype male (Brazil. BA: Camacan, DZRJ 0050): (7–8) head in dorsal (7) and ventral (8) views; (9) prothorax in dorsolateral view; (10–12) caudal appendages in dorsal (10), lateral (11) and dorsolateral (12) views. Scale bars = 1 mm.

scape black, posterior surface of pedicel light brown, all parts with laterofrontal surface and distal apex of scape ivory yellow; flagellum lost. Posterior region of the cranium (“postgena” plus “occiput”) ivory yellow, 0.33 dorsal brownish-black.

Thorax (Figs 1–3, 17): Prothorax dorsally black, gradually lightening ventrally to brown laterally, ventral 0.3 of pleural sclerites yellow, notum with a ventrolateral whitish-blue stripe; anterior margin of anterior lobe black mesally, yellow laterally,

posterolateral margin of median lobe with a very weak projection resembling the tubercle-like process observed in other *Forcepsioneura* (Figs 3, 17); posterior lobe asymmetrically convex, narrower than median lobe in dorsal view, right half slightly deformed (Fig. 17); sternellum (furcasternum sensu Asahina 1954) almost entirely black. Synthorax (Fig. 35) dorsally dark, gradually lightening ventrally; mesepisternum from mesostigmal region to antearalar sinus dark brown to black with bluish metallic reflections, with a brown stripe occupying 0.33 of width running longitudinally to mesopleural suture; mesepimeron and metepisternum brown with irregular darker areas and a wide light blue longitudinal stripe running from posterolateral angle of mesinfraepisternum to antearalar processes, occupying at maximum 0.33 of mesepimeron to 0.80 of metepisternum width, a mesal dark dot at level of intersegmental suture; metepimeron ivory yellow with a small brown area close to metapleural suture posteriorly; metapostepimeron ivory yellow with a black spot at lateroventral angle. Legs ivory yellow with irregular dark brown to black areas in the articulations of femur-tibia and tarsal segments, dorsal surface of femora, tibiae and apex of pretarsal claws (pretarsus); spurs black, except scale-like ivory yellow two proximal femoral spurs and tibial comb of prothoracic leg; anteroventral surface of femora armed with long and robust spurs, three in pro-, four in meso- and metathoracic femora, posteroventral surface with shorter and thinner spurs, 5 in pro-, 5–6 in meso- and 6–8 in metathoracic femora; anteroventral surface of tibiae armed with 9–10 spurs in pro- (4–5 of tibial comb), 5–6 in meso-, 6 metathoracic, length similar to intervening spaces; pretarsal claws with distinct acute supplementary inferior tooth at ca 0.50 of their length in all legs.

Wings (Fig. 35): Membrane hyaline; venation dark brown to black; Pt black, quadrangular; MP reaches anal margin at the vein descending from subnodus or very slightly distal, covering 2 cells in all wings; Px in Fw 11; Hw 9; RP2 originating at Px 5 in Fw, at Px 4 in Hw.

Abdomen (Figs 4–6, 18–20, 24–26, 35): S1–10 tergites dark brown to black dorsally, light brown to ivory yellow lateroventrally, darker in S8–10, with a very thin line along dorsal carina on S1–8; sternites similar in color to adjacent areas of tergites, yellow ivory in S1, remainder segments yellow to light brown with irregular dark areas, S9 dark brown; pale longitudinal stripe occupying ventral 0.5 of tergites S1–6 laterally, gradually narrowing to ca 0.2 in S8, a narrow line in S9 and ill-defined areas in S10; S3–7 with a narrow anterior pale ring  $\leq 0.1$  of segment total length, separated dorsally in S3; S1–7 cylindrical, S8–10 distinctly wider than previous segments, S7 width 0.6 of posterior part of S8 width; posterior margin of S10 with a shallow and wide concavity. Secondary genitalia (Figs 18–20) typical of *Coenagrionoidea*, anterior lamina with a deep and acute incision, anterior hamule quadrangular, with anteroventral angle acutely projected, posterior hamule almost entirely internalized with a curved thumb-shape; VS longer than wide, maximum width 0.3 of total length in ventral view. Genital ligula (as in

Figs 18–20; based on paratype) with L1 smooth, without any kind of special setae; L2 with posterolateral portion of flexure projected distally beyond median region, making its margin concave in ectal view; distal margin of L2 (tip of ligula) with a mesal concavity (Fig. 18), lateral margins prolonged into two curved long flagella, in ectal view basally almost perpendicular, afterwards twisted (Figs 18–20); internal fold proximal to flexure, long with ca 0.4 of L2 total length in lateral view; no sclerotized tubercle at flexure. Epiproct reduced to a membranous-like plate. Cercus (Figs 4–6, 24–26) brown to dark brown, apex of cercus, ventrobasal and mediobasal processes black; cercus in lateral view slightly directed obliquely dorsad, gradually tapering distally; ventrobasal process perpendicular to dorsal branch, length ca 0.66 of cercus, apex stoutly rounded, at distal 0.2 distinctly curved posteriorly, distal edge at 0.7 from distance of ventrobasal process base to margin of S10; mediobasal process not visible in lateral view (Figs 5, 24); tip of cercus blunt; in dorsal view forcipate, proximally wide, slender distally; lateral margin almost straight, internal margin very slightly curved, apices converging (Figs 4, 25); mediobasal process as a very acute fin-shaped plate, apex strongly directed anteriorly, positioned at basal 0.2 (Fig. 25); in posterior view directed ventrally obliquely and projected from a dilated area of cercus; apex of ventrobasal process broadly acute and abruptly curved in posterior view (Fig. 26). Paraproct orange-yellow, plate-like.

Measurements (mm). Total length (incl. caudal appendages) 33.5; abdomen length (excluding caudal appendages) 28.8; head maximum width 2.9; Fw length 18.5; Hw length 17.4; Fw maximum width 3.3, Hw maximum width 3.3; Pt length 0.47 in Fw, 0.49 in Hw; length of metathoracic femur 1.6; metathoracic tibia 1.7; length of S9+10 in lateral view 1.1; length of cercus (dorsal branch) in lateral view 0.45; length of ventrobasal process in lateral view 0.29.

Female paratype. Similar to holotype but paler, differences described below.

Head (Fig. 27): Labrum greenish-brown to light brown with ventral 0.25 yellowish, extended mesally to 0.50. Antefrons with mesal pale rounded spot. Posterior region of the cranium (“postgena” plus “occiput”) ivory yellow, dorsal 0.20 brownish-black.

Thorax (Figs 27–28): Mesal projection of posterior lobe of prothorax with a small concavity divided into two lobes (Fig. 28). Anteroventral surface of femora armed with long and robust spurs, 3 in pro-, 4 in meso- and metathoracic femora, right metafemur with 7 supernumerary spurs, posteroventral surface with shorter and thinner spurs, 5 in pro-, 6 in meso- and metathoracic femora; anteroventral surface of tibiae armed with 5 spurs in meso-, 6 in metathoracic tibiae, length similar to intervening spaces (spurs not visible on the single preserved prothoracic leg). Wings: Pt brown, quadrangular but more rounded than in male; MP reaches anal margin at vein descending from subnodus in Fw and very slightly distal in Hw; Px in Fw 9–10; Hw 11.

Abdomen (Figs 31–32): Tergites of S1–10 dark brown to black dorsally, light brown to ivory yellow lateroventrally, distinctly darker in S8–10; tergites with a very thin pale line along the dorsal carina on S1–8; sternites similar in color to adjacent areas of tergites except 0.5 posterior of S8 dark brown with a transverse posterior yellow stripe contiguous to and with similar width of yellow posterior field of tergite. Ovipositor (Fig. 32) distally reaching level of cercus in lateral view, dark brown, lightening distally, dorsal lobe of third valve (gonoploc of S9) yellow, ventral surface smooth; stylus dark brown, tip yellow. Cercus, epiproct and paraproct dark brown to black.

Measurements (mm). Total length (incl. caudal appendages) 35.2; abdomen length (excluding caudal appendages) 30.5; head maximum width 2.9; Fw length 21.2; Hw length 20.2; Fw maximum width 3.7; Hw maximum width 3.8; Pt length 0.53 in Fw; 0.54 in Hw; length of metathoracic femur 2.0; metathoracic tibia 2.2; length of S9+10 in lateral view 1.0; total length of cercus in lateral view 0.28.

Variation in male paratypes. The nine other males are very similar to holotype except for minor differences described below.

Head: Antefrons ivory yellow with a mesal ill-defined brown line; occipital bar with a yellow spot. Flagellum dark brown. Thorax: Prothorax paler with whitish-blue ventrolateral stripe faint; posterior lobe truncated or with small median concavity. Light blue longitudinal stripe on synthorax occupying at maximum 0.5 of mesepimeron width to almost entire metepisternum. Long and robust spurs on anteroventral surface of femora 3–4 in pro-, 4 in meso- and 4–5 in meta-, posteroventral surface with shorter and thinner spurs, 3–5 in pro-, 4–6 in meso- and 5–8 in metathoracic femora; anteroventral surface of tibiae armed with 9–11 spurs in pro- (4–5 of tibial comb), 5–6 in meso-, 5–6 in metathorax.

Abdomen: Paraproct orange-yellow to dark brown.

Measurements (mm, n = 5). Total length (incl. caudal appendages) 31.7–35.9; abdomen length (excluding caudal appendages) 27.0–30.8; head maximum width 2.8–3.0; Fw length 17.3–19.2; Hw length 16.5–18.0; Fw maximum width 3.0–3.5; Hw maximum width 2.9–3.3; Pt length 0.44–0.58 in Fw; 0.46–0.58 in Hw; length of metathoracic femur 1.7–1.9; metathoracic tibia 1.9–2.1; length of S9+10 in lateral view 1.1–1.3; length of cercus (dorsal branch) in lateral view 0.42–0.60; length of ventrobasal process in lateral view 0.30–0.36.

Larva. Unknown.

Material examined (10 males, 2 females). Holotype male and paratype female (in tandem), BRAZIL. Rio de Janeiro State: Cachoeiras de Macacu municipality, Reserva Ecológica de Guapiaçu (REGUA), forest fragment (22°28′08″S, 42°45′39″W, 42 m a.s.l.), 27.VII.2012, T.M.F. Kompier leg. (DZRJ 2071); 1 male paratype, same data but pond with macrophytes (22°27′10″S, 42°46′13″W, 34 m a.s.l.), 03.XII.2009, A.L. Carvalho & Disciplina Técnicas de Coleta PPGZoo/UFRJ leg. (DZRJ 315, DNA voucher ENT3609); 1 male paratype, same data but stream at small wetland (22°25′51″S, 42°45′39″W, 75 m a.s.l.), 02.III.2013, T.M.F. Kompier leg. (DZRJ 326); 2 male paratypes,

same data but 22°28′04″S, 42°45′32″W, 70 m a.s.l., 13.I.2014, (DZRJ 2251, DNA voucher ENT2854; DZRJ 2252, DNA voucher ENT3608); 1 male paratype, same municipality but [District of] Japuiba [22°33′46″S, 42°41′30″W, 26 m a.s.l.], Rio Santana (sic, Rio Macacu?), 08.V.1983, J.M. Costa leg. (MNRJ ODO-0011, DNA voucher ENT2368); 2 male paratypes, Mangaratiba municipality, Ilha de Marambaia, Gruta da Santa (23°03′35″S, 43°57′56″W, 100 m a.s.l.), 02.XII.2000, R.W. Garrison leg. (RWG, DNA voucher ENT3016; DZUP 498845); 1 male and 1 female paratypes, same data but 04.XII.2000 (RWG); 1 male paratype, same data but temporary pool close to areal (MNRJ-ODO 0208, DNA voucher ENT3607). Specimens in DZRJ collected under ICMBIO/SISBIO license numbers 25034-1, 25034-2, and 25034-3.

Biological and ecological data. Males were observed at seeps from peaty substrate at the forest edge and on very shallow, small streams with abundant leaf litter and limited flow. Even though observations were made on sunny days, they seem to avoid direct sunlight, perching suspended from the tips of leaves and grasses, or on the leaf litter. Streams were either partially or fully covered by trees and bushes. Females were observed in the same habitat. Both males and females were seen flying very slowly, and appeared to float in the air. Copulation lasted up to 10 minutes. Females were observed ovipositing unattended on a muddy substrate. Their habitat was shared with *Heteragrion aurantiacum* Selys, 1862, *H. consors* Hagen in Selys, 1862 and *Acanthagrion gracile* Rambur, 1842), species that are tolerant to disturbed habitats in typical southeastern Brazilian Atlantic Forest.

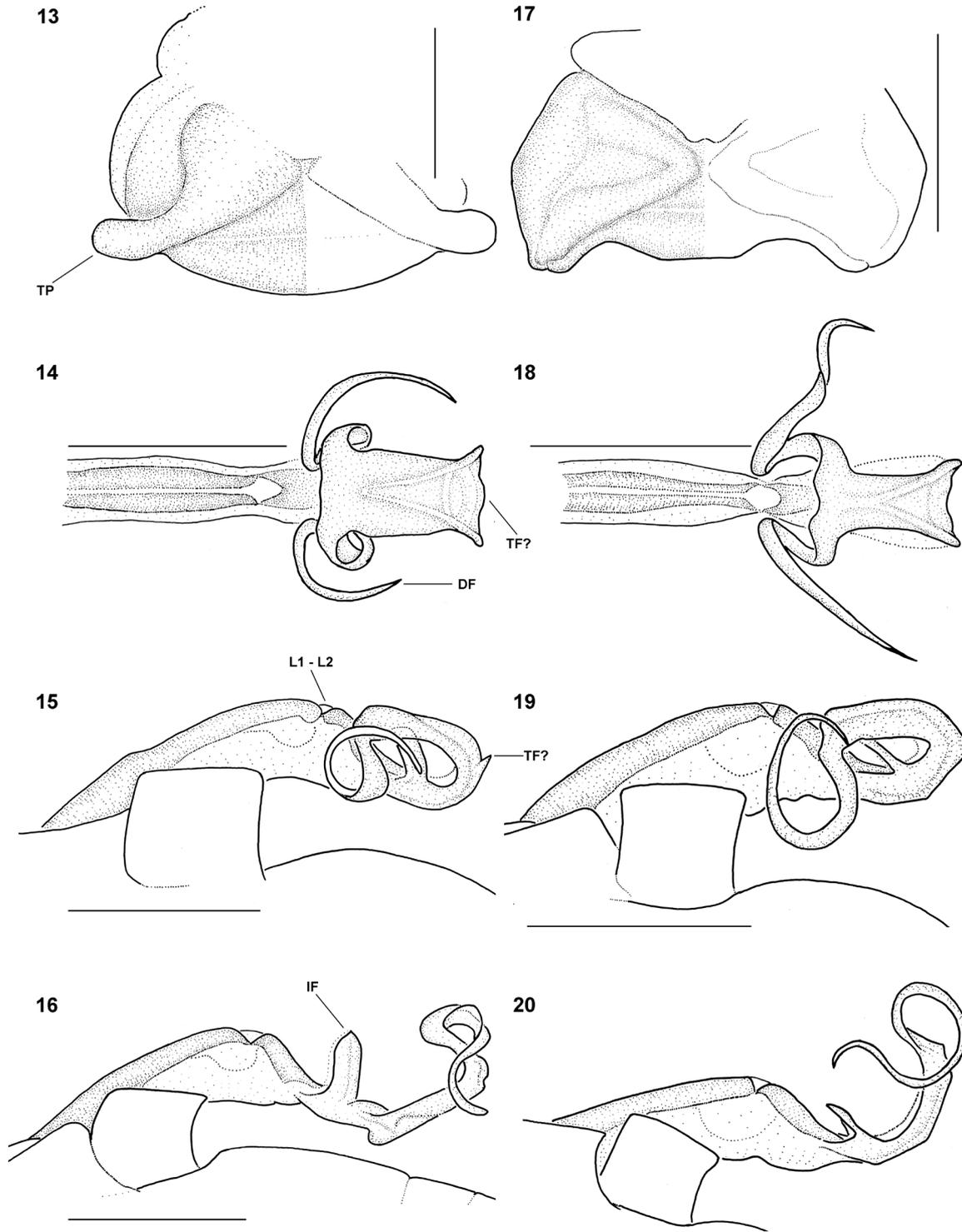
Etymology. Noun in apposition in reference to the acronym of the type locality, Reserva Ecológica de Guapiaçu (REGUA), a private reserve maintained for conservation, scientific research and environmental education.

Remarks. This species has been known to specialists for at least eighteen years (e.g., Garrison 2000). Some specimens of the type series of *F. regua* sp. nov. had been previously determined as *F. garrisoni*, *F. haerteli* or *F. sancta* by distinct specialists. For example, Costa and Oldrini (2005) cited this species as *F. garrisoni* from Ilha da Marambaia island in Rio de Janeiro, and provided an illustration of the cercus in laterointernal view (their fig. 30). Even though that illustration agrees with *F. garrisoni*, we think that it was modified from the original description of that species. We believe this because other illustrations in that paper were clearly extracted from previous works, and reproduced with minor modifications. Individuals of the population from Ilha da Marambaia island are distinctly larger than those from the type locality in REGUA.

### *Forcepioneura serrabonita* sp. nov.

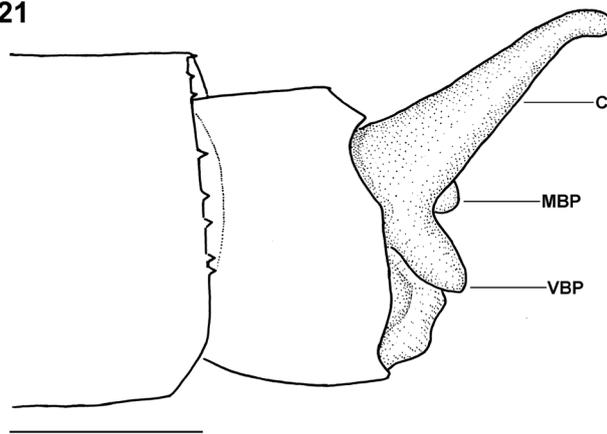
<http://zoobank.org/9D6A447E-4F57-4DF3-AA37-BB59DA7F7829>  
Figs 7–12, 13–16, 21–23, 29–30, 33–34, 36, 38

Diagnosis. A medium, dorsally black and lateroventrally yellowish protonneurid species; frons angulated; rear of head

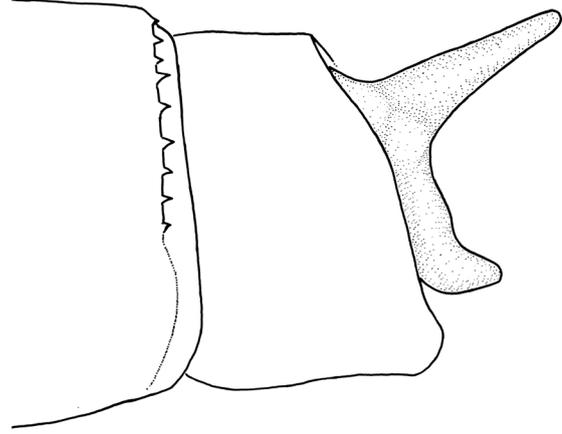


Figures 13–20. Prothorax and genital ligula of males of *Forcepsioneura*: (13–16) *F. serrabonita* sp. nov., holotype (Brazil. BA: Camacan, DZRJ 0050); (17–20) *F. regua* sp. nov., (17) holotype (Brazil. RJ: Cachoeiras de Macacu, DZRJ 2071), remainder from paratype of same locality; (13, 17) prothorax in dorsal view; (14–16, 18–20) genital ligula in ventral (14, 18) and lateral (15–16, 19–20) views. Scale bars = 0.5 mm.

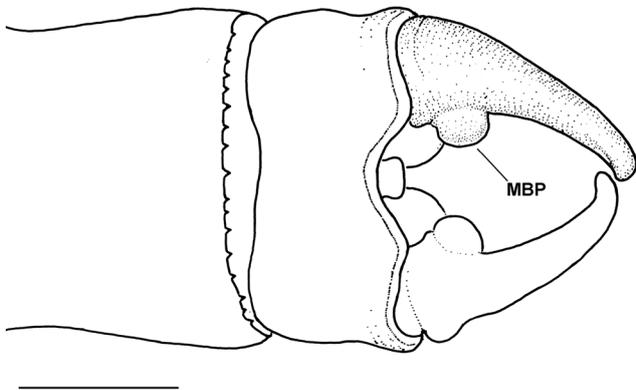
21



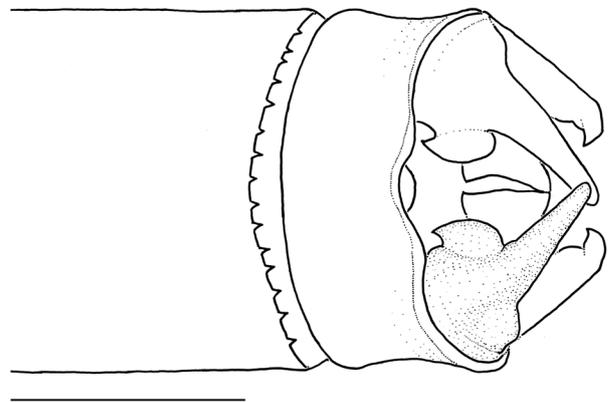
24



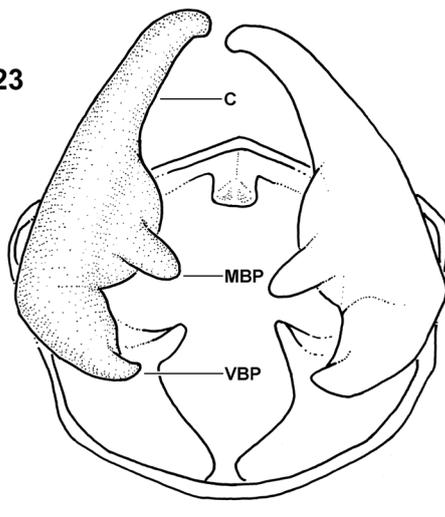
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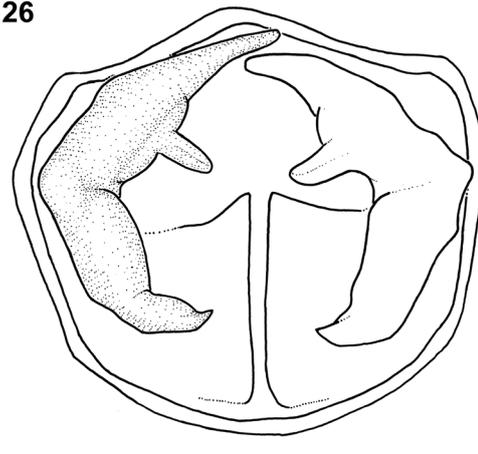
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23



26



Figures 21–26. Caudal appendages of males of *Forcepsioneura*: (21–23) *F. serrabonita* sp. nov., holotype (Brazil. BA: Camacan, DZRJ 0050); (24–26) *F. regua* sp. nov., holotype (Brazil. RJ: Cachoeiras de Macacu, DZRJ 2071); (21, 24) lateral view; (22, 25) dorsal view; (23, 26) posterior view. Scale bars = 1 mm.

pale; posterolateral margin of median lobe of prothorax with well-defined tubercle-like process; CuP&AA indistinct; Ax space 1 as long as Ax space 3; GL with long inner fold and distal lateral lobe prolonged into a flagellum; cercus forcipate with mediobasal (MBP) and ventrobasal process (VBP), all characters agreeing with the definition of *Forcepsioneura* as recently diagnosed (Machado 2009, Garrison et al. 2010).

Based on general color and shape of male cercus, *F. serrabonita* sp. nov. resembles *F. grossiorum* and *F. lucia*. Males of this orange-black group of large species with robust cercus have a short VBP (as long as  $\leq 0.40$  of dorsal branch of cercus in lateral view), while it is longer (as long as  $\geq 0.55$  of dorsal branch) in *F. garrisoni*, *F. haerteli*, *F. itatiaiae*, *F. regua* sp. nov. and *F. sancta*. *Forcepsioneura serrabonita* sp. nov. is distinguished from the first two species by having posterior lobe of prothorax regularly rounded (Figs 9, 13; sinuous in *F. grossiorum*); Pt quadrangular, ratio between costal length and proximal length 0.54 in *F. serrabonita* sp. nov., being similar in size to *F. lucia* (ratio = 0.6), but rectangular and distinctly longer in *F. grossiorum* (ratio = 0.8); cercus slender, with anteromesal margin of MBP process rounded in dorsal view (Figs 10, 22; acute in both *F. grossiorum* and *F. lucia*), MBP almost not visible in lateral view (Figs 11, 21; clearly visible in *F. grossiorum* and *F. lucia*).

In view of the large size of specimens of *F. serrabonita* sp. nov., they can be confused with *F. itatiaiae*, from which, in addition to the shorter VBP mentioned above, it can be separated by the shape of the male cercus with strongly cylindrical VBP (Figs 11, 21; blade-like and truncated apex in *F. itatiaiae*), MBP largely rounded dorsally and almost not visible in lateral view (Figs 10–11, 21–22; angulated plate as an axe with concave blade dorsally, and clearly visible in lateral view in *F. itatiaiae*).

Additionally, the distinctive shape of the GL (Figs 14–16), with a large and upright internal fold (obliquely toward anteriorly in the other species), will separate *F. serrabonita* sp. nov. from all species for which the GL has been described.

Females of several *Forcepsioneura* species are poorly known, which hampers a useful diagnosis. Putative females should be identified by comparison with descriptions, figures and association with males.

Description of male holotype. Head (Figs 7–8): Labium, visible parts of maxillae and mandibles (except apex) ivory yellow (Fig. 8). Genae yellowish, darkening gradually posteriorly. Labrum orange-brown (possibly light orange in life) with two lateral and one mesal rounded dark brown spots from clypeolabral suture to 0.5 ventral, pale areas among them darkened. Anteclypeus with lateral and mesal membranous ventral part yellowish, remainder part forming a semicircular dark brown plate, postclypeus almost entirely shining dark brown with ill-defined orange-brown spots. Antefrons dark brown with ill-defined pale areas, postfrons and remainder of epicranium opaque black with a weak copper luster. Antenna, antennifer and scape black, posterior surface of pedicel light dark brown, all parts with laterofrontal surface and distal apex of antennifer

and scape ivory yellow; flagellum lost. Posterior region of the cranium (“postgena” plus “occiput”) pale brown (Fig. 7), probably light ivory yellow.

Thorax (Figs 9, 36): Prothorax dorsally black, gradually lightening ventrally to yellow at pleural sclerites; anterior margin of anterior lobe ivory yellow; posterolateral margin of median lobe with well-defined tubercle-like process; posterior lobe rounded convex, narrower than median (Figs 9, 13); sternellum (furcasternum sensu Asahina 1954) almost entirely black. Synthorax (Fig. 36) dorsally dark, gradually lightening ventrally; mesepisternum from mesostigmal region to antealar sinus entirely dark brown to black with greenish-copper metallic reflections, except light brown line running longitudinal to mesopleural suture; mesepimeron dorsally light brown, narrowed ventrally by an ivory yellow stripe occupying 0.4 of the lateroventral apex of the sclerite, over mesinfraepisternum it occupies 0.5 ventral; remainder of synthorax ivory yellow, except poorly defined light brown stripe with about 0.3 of width along metapleural suture ending at spiracle level and a small black spot at ventro-distal apex of metapostepimeron. Legs ivory yellow with irregular dark brown to black areas in articulation femur-tibia, dorsal surface of metathoracic femur and apex of pretarsal claws (pretarsus); spurs black except scale-like ivory yellow proximal femoral spurs and tibial comb of prothoracic leg; anteroventral surface of femora armed with long and robust spurs, 5 in pro- and mesothoracic and 6 in metathoracic femora, posteroventral surface with shorter and thinner spurs, 3 in pro- and mesothoracic femora to 6 in metathoracic femur; anteroventral surface of tibiae armed with 9 spurs in pro- (4 of tibial comb), 7 in meso-, 6–7 in metathoracic tibiae, usually longer than intervening spaces; pretarsal claws with distinct acute supplementary inferior tooth at ca 0.50 of their length in all legs.

Wings (Fig. 36): Membrane hyaline; venation dark brown to black; Pt brown, with a narrow internal pale line surrounding the enclosing veins, quadrangular. MP reaches anal margin slightly distal of vein descending from subnodus, covering 2 cells in FW, distal to vein descending from subnodus covering ca 0.5 of a third cell in HW. Px in Fw 12; Hw 11; RP2 originating at or slightly distal to Px 5 in Fw, at or slightly proximal to Px 4 in Hw.

Abdomen (Figs 10–12, 14–16, 21–23, 36): Tergites of S1–10 dark brown to black dorsally, yellow ivory lateroventrally, darker in S8–10; sternites similar in color to adjacent areas of tergite, yellow ivory in S1, remainder segments light yellow to orange-yellow with irregular dark areas; pale longitudinal stripe occupying 0.5 ventral of S1–2 tergites laterally, gradually narrowing to ca 0.3 in S8, S9 with two ill-defined small pale spots, one close to posterior field of S8 and other close to posterior carina, S10 almost entirely black; S3–7 with a narrow anterior pale ring  $\leq 0.1$  of total segment length, dorsally separated by a thin line; S1–7 cylindrical, S8–10 distinctly wider than previous segments, S7–8 slightly smashed preventing an accurate measurement of abdominal width in these segments; posterior margin of S10 with a shallow and wide concavity. Secondary genitalia (Figs 14–16)

typical of Coenagrionoidea, anterior lamina with a deep and acute incision, anterior hamule quadrangular, with anteroventral angle acutely projected, posterior hamule almost entirely internalized with a curved thumb-shape; VS longer than wide, maximum width 0.4 of total length in ventral view. Genital ligula (as in Figs 14–16) rectangular in ectal view; L1 smooth, without any kind of special setae; L2 with posterolateral portion of flexure projected distally beyond median region, mesally slightly projected in ectal view, in lateral view this projection similar to terminal fold (Fig. 15); distal margin of L2 (tip of ligula) almost straight in ectal view; distal lateral lobe prolonged into a gradually thinner, twisted, flagellum; internal fold proximal to flexure, upright, large, ca 0.4 of L2 total length in lateral view (Fig. 16); no sclerotized tubercle at level of flexure. Epiproct reduced to a membranous-like plate. Cercus (Figs 10–12, 21–23) ivory yellow, with apex, ventrobasal (VBP) and mediobasal (MBP) processes dark brown to black; in lateral view strongly directed obliquely dorsad; VBP in opposite direction, short, apex rounded, distal edge at half distance from ventral margin of S10; MBP visible as a rounded tubercle between cercus and VBP; tip of cercus blunt; in dorsal view forcipate, proximally wide, slender distally, lateral margin gently curved, internal margin slightly more curved, apices converging (Figs 10, 22); MBP as a rounded plate, positioned at 0.33 basal; in posterior view obliquely directed ventrally and projected from a dilated area of cercus; apex of VBP process acute and slightly curved in posterior view (Fig. 23). Paraproct orange-yellow, plate-like.

Measurements (mm). Total length (incl. caudal appendages) 38.7; abdomen length (excluding caudal appendages) 33.0; head maximum width 3.4; Fw length 21.8; Hw length 20.3; Fw maximum width 3.8, 3.7 in Hw; Pt length 0.54 in Fw, 0.58 in Hw; length of metathoracic femur 2.0; metathoracic tibia 2.1; length of S9+10 in lateral view 1.46; total length of cercus (dorsal branch) in lateral view 0.88; length of ventrobasal process in lateral view 0.36.

Female paratype. Similar to holotype. The only differences are described below.

Head (Figs 29–30): Labrum light orange with two lateral and a mesal rounded dark brown spots from clypeolabral suture to 0.5 ventral. Anteclypeus yellowish. Antefrons ivory yellow. Scape articulation and posterior surface of pedicel ivory yellow. Posterior region of the cranium (“postgena” plus “occiput”) yellowish, brownish dorsally close to foramen

Thorax (Figs 30, 36): Leg spurs black; anteroventral surface of femora armed with long and robust spurs, 5 in pro-, 4 in meso- and metathoracic femora, posteroventral surface with shorter and thinner spurs, 3 in pro-, 4 in meso- and 6 in metathoracic femora; anteroventral surface of tibiae armed with 10 spurs in pro- (5 of tibial comb), 6 in meso- and metathoracic tibiae, usually longer than intervening spaces.

Wings: MP reaches anal margin slightly distal of the vein descending from subnodus, covering 2 cells and ca 0.25 of a third cell in FW and 0.5 in HW. Px in Fw 13; Hw 11; RP2 originating

at or slightly proximal to Px 6 in Fw, at Px 4 in Hw.

Abdomen (Figs 33–34): Coloration very similar to that of male holotype except for the yellow ivory posterior field of S8 and dorsal longitudinal stripe on S9–10, forming an irregular T-spot dorsally on S9. Sternites light yellow to orange-yellow. Ovipositor (Fig. 34) reaching distally level of cercus in lateral view, yellowish-orange, dorsal lobe of third valve (gonoplac of S9) slightly paler, ventral surface smooth; stylus dark brown, tip yellow. Cercus, epiproct and paraproct dark brown to black (Figs 33–34).

Measurements (mm). Total length (incl. caudal appendages) 37.3; abdomen length (excluding caudal appendages) 31.0; head maximum width 3.1; Fw length 21.2; Hw length 19.8; Fw maximum width 3.8; Hw maximum width 3.9; Pt length in Fw 0.54; Pt length in Hw 0.59; length of metathoracic femur 2.2; metathoracic tibia 2.4; length of S9+10 in lateral view 1.0; total length of cercus (dorsal branch) in lateral view 0.32.

Variation in male paratypes. The four other specimens (excluding the teneral one) are very similar to holotype, minor differences are described below.

Head: Labrum brownish to black. Postclypeus shining dark or with ill-defined mesal orange-brown spot. Frons and remainder of epicranium opaque black with a weak copper luster. Antennal flagellum brown to black. Posterior region of cranium (“postgena” plus “occiput”) ivory yellow.

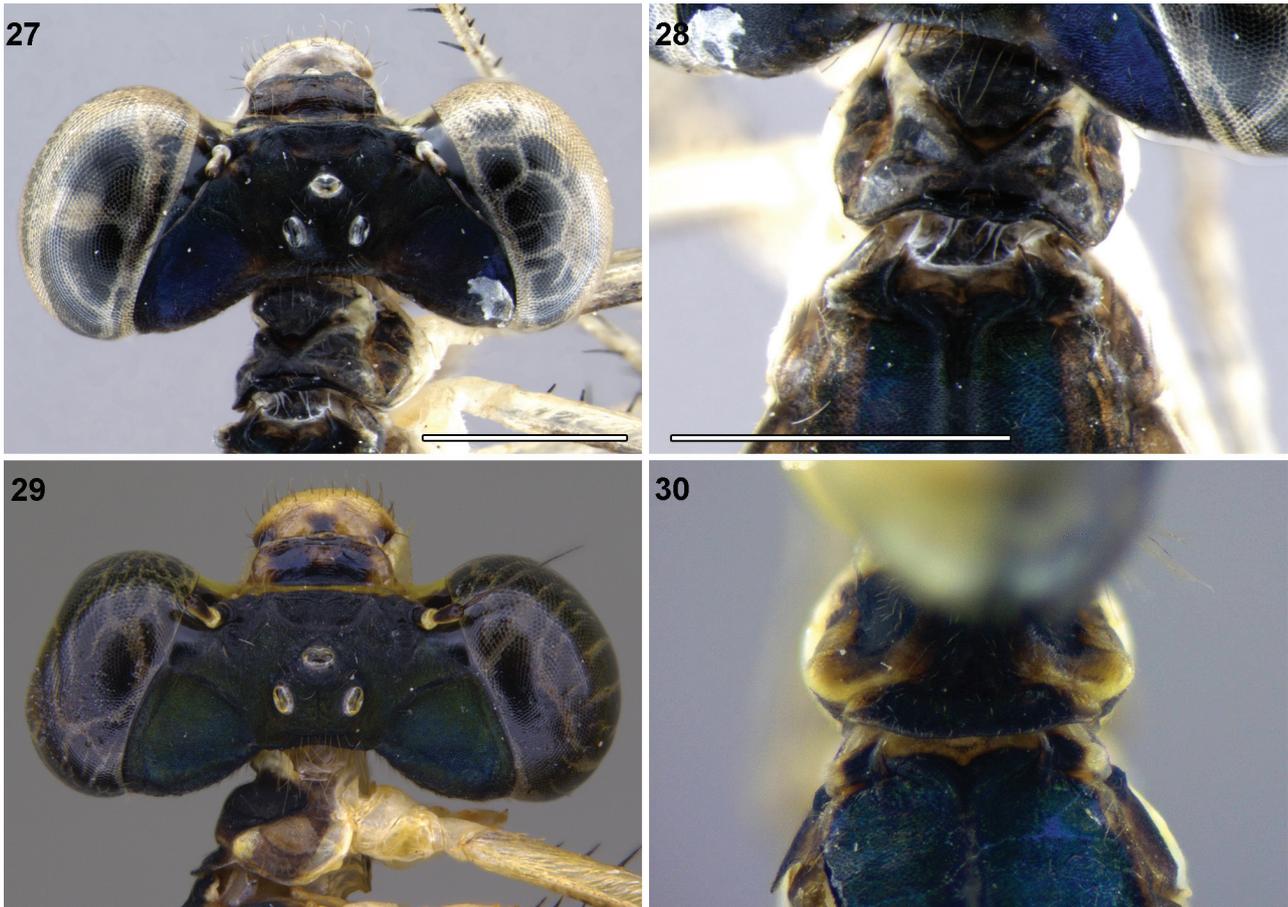
Thorax: Anteroventral surface of femora armed with long and robust spurs, 5 in pro-, 3–4 in meso- and 5 in metathoracic femora, posteroventral surface with shorter and thinner spurs, 3 in pro-, 4–5 in meso-, 5–6 in metathoracic femora; anteroventral surface of tibiae armed with 9–10 spurs in pro- (4–5 of tibial comb), 5–6 in meso-, 5–6 in metathoracic tibiae.

Wings: MP reaches anal margin at or slightly distally to vein descending from subnodus, covering from 0.33 to 0.5 of a third cell in HW. Px in Fw 12–15; Hw 10–13; RP2 originating between Px 5–6 in Fw.

Measurements (mm). Total length (incl. caudal appendages) 37.5–40.5; abdomen length (excluding caudal appendages) 31.7–33.7; head maximum width 2.9–3.3; Fw length 20.3–22.3; Hw length 19.5–21.3; Fw maximum width 3.5–3.8; Hw maximum width 3.7–3.8; Pt length 0.56–0.60 in Fw; 0.58–0.64 in Hw; length of metathoracic femur 1.9–2.1; metathoracic tibia 2.1–2.2; length of S9+10 in lateral view 1.3–1.4; total length of cercus (dorsal branch) in lateral view 0.74–0.86; length of ventrobasal process in lateral view 0.12–0.22.

Larva. Unknown.

Material examined (6 males, 1 female). Holotype male, BRAZIL. Bahia State: Camacan municipality, Reserva Particular do Patrimônio Natural (RPPN) Serra Bonita, collecting point “Alojamento” (BA 2012-001; 15°23'16”S, 39°33'58”W, 810 m a.s.l.), 27–29.II.2012, R.A. Carvalho leg. (DZRJ 0050); 1 male paratype, same data but first trickle on road beyond managers house (15°23'19”S, 39°33'57”W, 710 m a.s.l. [822 m]), 5.I.2013, C.M. Flint & O.S. Flint Jr. leg. (USNM); 2 male paratypes, same



Figures 27–30. Head and prothorax in dorsal view of females of *Forcepsioneura*: (27–28) *F. regua* sp. nov., paratype (Brazil. RJ: Cachoeiras de Macacu, DZRJ 2071); (29–30) *F. serrabonita* sp. nov., paratype (Brazil. BA: Camacan, MNRJ ODO-0001). Scale bars = 1 mm.

data but quarry, 20.II.2015 (USNM; MZSP ODO-492, DNA voucher ENT2857); 1 male paratype, same data but 26.II.2015 (USNM); 1 female paratype, same data but spring near telecommunication towers (15°23'02"S, 39°34'19"W; 850 m a.s.l. [880 m]), 25.XII.2013, T.W. Donnelly leg. (MNRJ ODO-0001; ex-TWD collection). Additional specimen (excluded from type series). 1 male (teneral), same data as holotype but trickles at upper water tank (15°23'03", 39°34'19"W, 890 m a.s.l.), 23.XII.2012, C.M. Flint & O.S. Flint, Jr. leg. (USNM).

**Etymology.** Noun in apposition in reference to the type locality in the complex of RPPNs Serra Bonita, in honor of this protected area and its managers, who have taken positive steps towards the preservation of Atlantic Forest remnants in the southern portion of the biodiversity-rich state of Bahia.

**Biological and ecological data.** Expected to be a submontane forest species, most likely occurring at seepages similar to the mesohabitat occupied by the large montane species from southeastern Brazil (e.g., *F. itatiaiae* and *F. cf. lucia*). The larvae

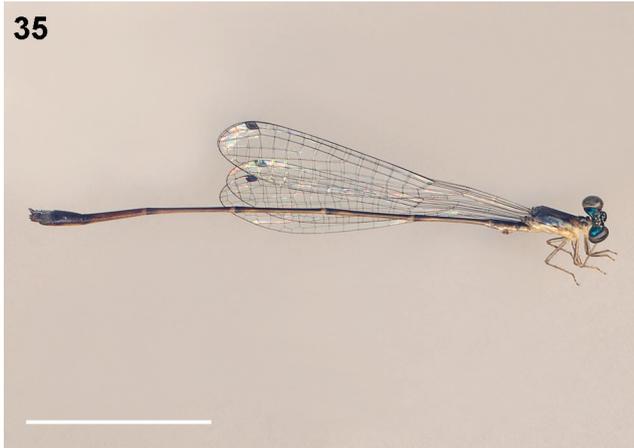
possibly are madicolous and should inhabit shallow streams running over rocky substrates covered by ferns and hornworts/liverworts forming small waterfalls (Fig. 40). Though we have not observed adult behavior in the field it is plausible to assume that *F. serrabonita* sp. nov. is a forest damselfly like most *Forcepsioneura*.

## DISCUSSION

The “Reserva Particular do Patrimônio Natural Serra Bonita” (RPPN, Private Reserve of Natural Heritage) is a complex of protected areas that started from a small fragment bought in the 1990s. Now it covers about 7,500 ha between 300 and 1,080 m above sea level of primary and secondary forests maintained by Instituto Uiraçu (Becker 2017). This complex is located in one of most biodiverse regions of the threatened Atlantic Forest, representing unique fragments with high levels of biodiversity and endemism on montane formations in southern Bahia. Although Serra Bonita remains undersampled, studies have shown



Figures 31–34. Abdominal segments seven to ten (S7–10) of females of *Forcepsioneura*: (31–32) *F. regua* sp. nov., paratype (Brazil. RJ: Cachoeiras de Macacu, DZRJ); (33–34) *F. serrabonita* sp. nov., paratype (Brazil. BA: Camacan, MNRJ ODO-0001). Scale bars for Figs 31–32 = 1 mm.



Figures 35–40. Habitus and habitat of species of *Forcepsioneura*: (35) *F. regua* sp. nov., holotype (Brazil. RJ: Cachoeiras de Macacu, DZRJ 2071); (36) *F. serrabonita* sp. nov., holotype (Brazil. BA: Camacan, DZRJ 0050), (37) *F. regua* sp. nov., live individual at type locality at Reserva Ecológica de Guapiaçu (REGUA); (38) overview of type locality at RPPN Serra Bonita; (39) shallow muddy and slow stream at Itatiaia National Park, typical habitat of small light blue species; (40) seepage covered by hornworts at Três Picos State Park, typical habitat of large orange-black species. Scale bars = 1 mm. Photos: (37) TMFK; (38) RA Carvalho; (39–40) APP.

that it includes at least 810 species of vascular plants, mostly flowering plants (Amorim et al. 2009, Matos et al. 2010), 80 of amphibians (Dias et al. 2014) and a huge number of moths, estimated between five and six thousand species (V. Becker pers. comm.). The species-rich longhorn beetles (Cerambycidae), however, have only been recorded in few numbers, currently only 51 species (Martins and Galileo 2010). In comparison, a preliminary checklist of dragonflies elaborated in collaboration by a few odonatologists already includes almost 90 species.

Like Serra Bonita, also in Southeastern Brazil, the “RPPN Reserva Ecológica de Guapiaçu” originated from private efforts aiming to conserve the AF. This protected area shares a similar history with Serra Bonita, beginning in the 1990s. Originally it was a farm and slowly it became a conservation and restoration portion of the AF. The preserve was founded in the beginning of 2000 and was officially recognized as a RPPN at the state level in 2013, at 302 ha. In 2014 a smaller, 35 ha area was incorporated to it and baptized as REGUA II. Unofficially, the preserve is between 6,500 and 7,500 ha, and 49% to 80% of its area is estimated to be inserted within the Três Picos State Park (Pimentel and Olmos 2011, Soares et al. 2011 for distinct data). The latter is a protected area created by the government of the state of Rio de Janeiro in 2002 and further enlarged in 2009 (INEA 2013, RJ decrees 31,443, 41,990). With elevations from sea level to 2,000 m (Soares et al. 2011), REGUA has a high diversity and is administrated in partnership with the public area of the Três Picos State Park. REGUA also integrates an important watershed for the metropolitan megacity of Rio de Janeiro (Rodríguez Osuna et al. 2014).

Recent studies highlight the relevance of REGUA. For example, 450 species of birds were recorded in REGUA and in neighboring areas (Pimentel and Olmos 2011). As far as we know, 59 species of mosquitoes (Silva et al. 2014) and at least 570 species of butterflies (Soares et al. 2011) have been found there. The most significant aspect of these two protected areas, REGUA and Três Picos State Park, is their status as the richest spots for dragonflies and damselflies in the world, with at least 204 species (see Kompier 2015), surpassing Manu National Park in Madre de Dios province in Peru, the site previously known as the most diverse with 188 species (Paulson 2004; number of species updated by Paulson 2006).

These recent findings, including the two new species described here, bring to attention the urgency in directing collecting efforts at unexplored areas, and also the importance of private preserves that harbor the type localities of described species in the AF. Together, REGUA and Três Picos harbor over 210 species of Odonata, or about 24% of the known Brazilian dragonflies, and represent a major hotspot for the conservation of these insects. As highlighted by Corbet (2006), dragonflies and damselflies depend on forests for survival and these insects are rapidly being deprived of their mesohabitats that allow their existence. Odonatologists should be alert to these processes and focus in knowledge production that promotes mitigation actions

to conserve their populations. Charismatic groups of animals, such as insects of the order Odonata, can be used as flagship species for conservation (see Oertli 2008). The high diversity observed in these areas can be used to foster awareness and empathy for the relevance of the conservation of these fragments of AF. Four species of *Forcepsioneura* (out of the eight described) occur in the state of Rio de Janeiro within the National Park of Itatiaia and REGUA and its neighboring areas represent the hotspot for this genus.

When *Forcepsioneura* was erected, Lencioni (1999) designated *F. garrisoni* as the type species, a poorly known species. *Forcepsioneura garrisoni* was only known from the male holotype, until recently when APP collected males in the states of Rio de Janeiro and Paraná that agree fairly well with the original description, and additional specimens from São Paulo, which are deposited in a private collection (F. Lencioni pers. comm.). Besides the type species, the genus also includes the shady forest species *F. grossiorum*, *F. haerteli*, *F. itatiaiae*, *F. lucia*, *F. sancta* and the two new species described here. Of these, *F. grossiorum* is known from a single male from Serra dos Órgãos and *F. haerteli* from two males collected in state of Santa Catarina, the southernmost known record for the genus. All these aspects help to make the generic limits (especially in relation to *Amazonaura*) uncertain because few are known about the included species (e.g., morphological variation, female morphology).

Erected for Amazonian species (Machado 2004), the poorly known *Amazonaura* can be distinguished from *Forcepsioneura* by eight characters as defined by Machado (2009), even though he recognized they were weak to warrant generic delimitation. However, the rounded frons, dark markings on metepimeron and rear of head in *Amazonaura* and the strongly disjunct geographical distribution from *Forcepsioneura* were considered robust enough to support the separation between these two genera. The generic distinction between *Amazonaura* (Amazonia inhabitants) and *Forcepsioneura* (predominantly Atlantic Forest inhabitants) is still unsatisfactory (Machado 2009, Garrison et al. 2010). The inclusion of more species in *Forcepsioneura* and the discovery of undescribed species defy the original generic definition and make a revision necessary.

The two species described here contribute at different levels to challenge the definition of *Forcepsioneura*. In *F. serrabonita* sp. nov. the posterolateral margin of the median lobe is projected into a well-defined tubercle-like process (Figs 9, 13, 30), but it is only poorly projected in *F. regua* sp. nov. (Figs 3, 17, 28; an exception already cited by Machado 2009). The homology of these processes should be investigated in a phylogenetic context because similar projections are observed in a few other genera of Protoneurinae, including *Psaironeura*, a putative representative of the *Roppaeneura* clade. The short VBP observed in *F. serrabonita* sp. nov. (Figs 11, 21, 23), though not as short as observed in *Amazonaura* or even in *Roppaeneura*, somewhat links species of these genera and probably has a value for generic definition. In addition, *F. lucia* also has very short VBP on the cercus.

The strong separation between AF and Amazonian species, somewhat resembling a vicarious pattern, is questionable. There are records of *F. sancta* (a typical AF species) from the Cerrado domain of the central Brazilian plateau (Pessacq et al. 2012), and an unknown *Forcepsioneura* species was also mentioned from the extreme northern Atlantic Forest of state of Rio Grande do Norte (Irusta and Lencioni 2015). Forested areas in northeastern Brazil have been recently shown to be harbor a mixture between the AF and Amazonian elements (see discussion in Takiya et al. 2016). This puzzle can only be solved, and a more suitable classification proposed, through robust phylogenetic and population level analyses of the genera involved. Indeed, recent investigations using molecular data support the monophyly of *Forcepsioneura* (see Pimenta et al. 2015).

Based on size, general coloration, shape of cercus and habitat, *Forcepsioneura* can be divided into two species groups: (1) includes *F. garrisoni*, *F. haerteli*, *F. regua* sp. nov. and *F. sancta*. Small, lowland species that present pale areas predominantly bluish-green, cercus slender with ventrobasal process comparatively long, and distribution almost restricted to coastal areas of the Atlantic Forest (*F. sancta* is an exception), some species even occupying strictly restinga formations, being associated with small shallow streams and muddy pools with slow running water (Fig. 39); (2) includes *F. grossiorum*, *F. itatiaiae*, *F. lucia*, and *F. serrabonita* sp. nov. Large, submontane to montane species, pale areas predominately greenish-orange, cercus robust with short ventrobasal process, associated with seepages or small streams to rocky shallow waterfalls (Fig. 40). These groups do not necessarily share common evolutionary histories; however provide a useful grouping to be investigated in phylogenetic analyses.

The light blue *Forcepsioneura* form a complex of strongly similar species including *F. garrisoni*, *F. regua* sp. nov. and an undescribed species from southern state of Bahia. Although nothing was mentioned about blue hues in the original description of *F. garrisoni* (see Lencioni 1999), we suspect that is also blue. The males recently collected in Rio de Janeiro and Paraná by APP and which have been associated to this species are bluish. Analogous to other small Protoneurinae, such as species of *Drepanoneura* von Ellenrieder & Garrison, 2008, *Epileoneura* Williamson, 1915, and *Peristicta* Hagen in Selys, 1860 (see von Ellenrieder and Garrison 2008, Anjos-Santos and Pessacq 2013, Pessacq 2014), they are strongly similar, and due to their extreme similarity in external morphology and coloration, species identification is only possible through careful examination of the caudal appendages and genital ligula. Therefore, it is possible that this complex of bluish species is a set of cryptic species (remember that even specialists have failed to identify them as distinct entities). Cryptic species might also be involved in distinct populations of *F. lucia*. This species was originally described from Rola Moça State Park, part of the Serra do Espinhaço mountain range in the state of Minas Gerais. However, other populations have recently been identified in Serra da Mantiqueira and Serra do Mar mountain ranges in state of Rio

de Janeiro (Serra do Mar populations are mentioned in Kompier 2015) and a third one was found in the state of Espírito Santo. These populations might each represent undescribed species. An ongoing integrative taxonomy research on this group of damselflies has revealed a hidden diversity (Pimenta et al. 2015) and possibly will enlighten key aspects for future investigations about species delimitation in *Forcepsioneura*.

Additionally, Anjos-Santos and Pessacq (2013) considered the mysterious *Peristicta lizeria* Navás, 1920 from the province of Buenos Aires, Argentina, as a potential junior synonym of any of the two southern representatives of *Peristicta*, i.e., *P. aeneoviridis* Calvert, 1909 and *P. forceps* Hagen in Selys, 1860. However, there are no characters supporting Navás' (1920) original combination. Generally, Longinos Navás's descriptions of dragonflies are insufficient for identification, and confusing. Most species erected by him still await confirmation, but even considering his inaccuracies the illustration of the caudal appendages is strongly similar to species of the *Roppaneura* clade and not with that observed in *Peristicta*. Based on recent material collected in state of Rio Grande do Sul by APP, that likely represent two unknown species of *Forcepsioneura*, the possibility cannot be dismissed that *P. lizeria* actually belongs to the *Roppaneura* clade, representing a valid species either of *Forcepsioneura*, of *Roppaneura* or even of a new genus.

Finally, this paper is a first step towards an understanding of the diversity and morphology of this remarkable group of damselflies typical of the threatened Atlantic Forest domain. Studies on the morphological and spatial evolution of *Forcepsioneura* are being conducted.

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