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Fluminagrion gen. nov. for Acanthagrion taxaense Santos, 1965, from Brazil (Odonata: Coenagrionidae)

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***Fluminagrion* gen. nov. for *Acanthagrion taxaense* Santos, 1965, from Brazil (Odonata: Coenagrionidae)**

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A new genus of Coenagrionidae, *Fluminagrion*, from Rio de Janeiro, Brazil is described, diagnosed, and illustrated, based on examination of the type series and additional specimens of *Acanthagrion taxaense* Santos, 1965, deposited in the collection of MNRJ/Brazil. This genus is characterized by: posterior lobe of prothorax trilobate, with medial lobe rounded and projected in both sexes; segment 3 of genital ligula C-shaped in lateral view, bifid in ectal view, ending in lobes directed laterally with apexes pyramidal in cross-section; male cercus entire and decumbent from proximal fourth, with brush-like setae at about half its length; female lacking mesepisternal fossa, S8 with vulvar spine.

Um novo gênero de Coenagrionidae do Rio de Janeiro, Brasil, *Fluminagrion* é descrito, diagnosticado, e ilustrado, com base no exame da série-tipo e espécimes adicionais de *Acanthagrion taxaense* Santos, 1965, depositados na Coleção do MNRJ/Brazil. Este gênero é caracterizado por: lobo posterior do protórax trilobado, com lóbulo mediano arredondado e projetado em ambos os sexos; segmento 3 da lígula genital em forma de 'C' em vista lateral, bifido em vista ectal, terminado em lobos direcionados lateralmente com ápices piramidais na seção transversal; cercos do macho inteiros e descendentes a partir do quarto proximal, com um conjunto de setas em forma de pincel em cerca de metade de seu comprimento; fêmea sem fossa mesepisternal no mesepisterno, S8 com espinho vulvar.

Keywords: Odonata; Zygoptera; Coenagrionidae; damselfly; *Fluminagrion* gen. nov.; Brazil

Introduction

The family Coenagrionidae is the most diverse within Zygoptera, represented by approximately 1130 species, distributed among 100 genera (Garrison, von Ellenrieder, & Louton, 2010). It includes small to large damselflies with delicate bodies, reduced venation, two antenodal crossveins, the wing discoidal cell short and trapezoidal, CuA and MP completely developed, and RP₃ and IR₂ beginning closer to nodus than to arculus (Garrison et al., 2010).

The genus *Acanthagrion* Selys, 1876, is an example of a Neotropical genus whose original generic diagnosis was broad and vague. Selys (1876) erected *Acanthagrion* to include nine species of Neotropical damselflies with the following character combination: origin of CuP & AA', at least in hind wing, as from CuP; 10–14 (occasionally eight) postnodals in forewing; pterostigma similar

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in all the wings of both sexes; postocular spots present; labium split at apical 1/3 with branches acute, distant; posterior margin of prothorax straight medially; abdomen slender and long; legs with spurs of regular length (usually six on hind tibia externally); male coloration bronzy and blue or greenish, with S8 or S9 or S10 blue; posterior margin of S10 more or less prolonged or raised into an emarginated flap; male cercus generally lamellar, slanting from base with an internal basal branch; female vulvar spine generally pointed and coloration nearly similar. No dimorphic orange females.

This generic diagnosis began to be insufficient as new species and genera were described. Kennedy (1920) erected *Cyanallagma* and transferred *A. acutum*, *A. chelififerum*, *A. interruptum* and *A. laterale* to this new genus. Leonard (1977) revised *Acanthagrion*, and provided the following generic diagnosis: male cercus decumbent from the base; inner fold on segment 2 of genital ligula absent; and postocular spots present. His paper, originally written in the 1930s and published posthumously, also transferred *A. nigrinuchale* Selys, 1876, *A. trimaculatum* Selys, 1876, *A. lindneri* Ris, 1928, and *A. ambiguum* Ris, 1904 to *Cyanallagma*.

Von Ellenrieder and Lozano (2008) presented the first phylogenetic analysis of *Acanthagrion* and *Oxyagrion*, diagnosing both genera, with *Acanthagrion* characterized by: wings generally hyaline; CuP of hind wing reaching posterior margin of wing; flexure of genital ligula short; lateral lobes of segment 3, when present, distal to flexure; male cercus slanting from base at an angle of 45° with the posterior margin of S10, with a dorsobasal tubercle, females without a well-defined mesepisternal carina between mesostigmal plates and mediodorsal carina; generally with mesepisternal fossae, and vulvar spine on S8.

Santos (1965a) described and illustrated *Acanthagrion taxaense*. However, his brief original description and schematic drawings have made its generic placement doubtful. Gloyd (1977) wrote an appendix to Leonard's thesis in which she made some remarks and taxonomic changes on the species described between Leonard's work and its publication (e.g. *Acanthagrion apicale descendens* Fraser, 1946; *A. floridense* Fraser, 1946; *A. hildegarda* Gloger, 1967; *A. leonora* Gloger, 1967; *A. luteum* Rácenis, 1958; *A. peruanum* Schmidt, 1942; and *A. taxaense* Santos, 1965). She emphasized the need to review the generic status of *A. taxaense* Santos, 1965. Von Ellenrieder and Lozano (2008) also considered the generic position of *A. taxaense* doubtful and suggested an examination of types to solve this question. Garrison et al. (2010), in their generic characterization of *Acanthagrion*, included some illustrations of *A. taxaense*, and a comparison with *A. fluviatile* (De Marmels, 1984) and also concluded that the position of both species in *Acanthagrion* is doubtful because of the atypical morphology of female pronota and mesostigmal plates and male genital ligulae and cerci.

We examined the types and additional specimens of *A. taxaense* deposited in the Collection of Museu Nacional/Universidade Federal do Rio de Janeiro, Brazil (MNRJ), confirming the existence of morphological differences with the species included in *Acanthagrion* and other known genera of Coenagrionidae. As a result, we describe *Fluminagrion*, a new genus for *A. taxaense*, and provide redescriptions of both sexes, with illustrations, a distributional map and additional information.

Methods

The type series and additional specimens deposited in MNRJ, as well as the original description, revisions and other data available in the literature were analyzed. Dried specimens were examined; the genital ligulae were extruded and prepped in a 10% KOH solution. Wing vein nomenclature follows Riek and Kukalova-Peck (1984), modified by Bechly (1996) and genital ligula terminology is that of Kennedy (1916). All illustrations were made with the aid of a Leica

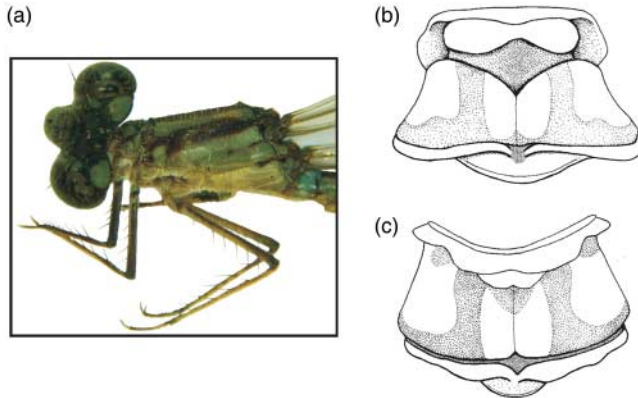


Figure 1. Morphological details of *Fluminagrion taxaense*: (a) head and thorax, general view of male; (b) male prothorax, dorsal view; (c) female prothorax, dorsal view.

MZ6 stereoscopic microscope, coupled with a camera lucida, and are not to scale. The digital photos were taken with a Panasonic Lumix® digital camera with the aid of a Leica EZ4 stereoscopic microscope, and the SEM photographs were taken with Jeol-JSM - 6360 LV scanning electron microscope. Measurements are given in millimeters. Abbreviations for structures used throughout the text are as follows: Ax: antenodal crossvein; Fw: forewing; Hw: hindwing; Px: postnodal crossvein; pt: pterostigma; S1–10: abdominal segments 1 to 10.

Fluminagrion gen. nov. (Figures 1– 5)

Type species

Acanthagrion taxaensis Santos, 1965 by present designation.

Etymology

From: *flumen* (Latin) meaning “river”, in this case referring to an inhabitant or native of Rio de Janeiro state (called “*fluminense*” in Portuguese), and *agrion* (Greek), an adjective meaning “wild” or “rural”, used as a noun for many damselfly generic names belonging to Coenagrionidae (Fliedner, 2006). The name refers to the distribution of the type species, which is apparently endemic to Rio de Janeiro.

Generic characterization

Small coenagrionids, total length 29–32 mm. Predominant colors blue and black. Head with rounded frons; postocular pale spots present; pale occipital bar present (Figure 1a). Posterior lobe of prothorax trilobate, with medial lobe rounded and projected in both sexes, larger in males (Figure 1b, c). Pterothorax with reddish brown to black mid-dorsal and humeral stripes. Metepisternum with dark spot in medial portion. Wings hyaline (Figure 2), petiolated to level of CuP; Fw CuP linking CuA to posterior margin; CuA extending for nine to 11 cells posterior to vein descending from subnodus; vein descending from quadrangle not forming a straight line to wing margin; RP₂ beginning at Px4 or Px5 in Fw and at Px4 or between Px3 and Px4 in Hw; IR₁ beginning at Px9 in Fw and at Px7 or Px8 in Hw; pt dark brown in males and light brown in

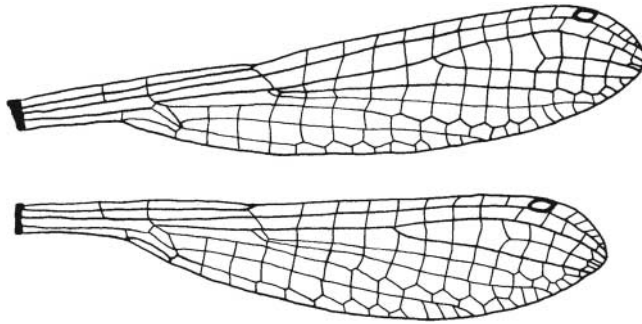


Figure 2. Wings of *Fluminagrion taxaense*.

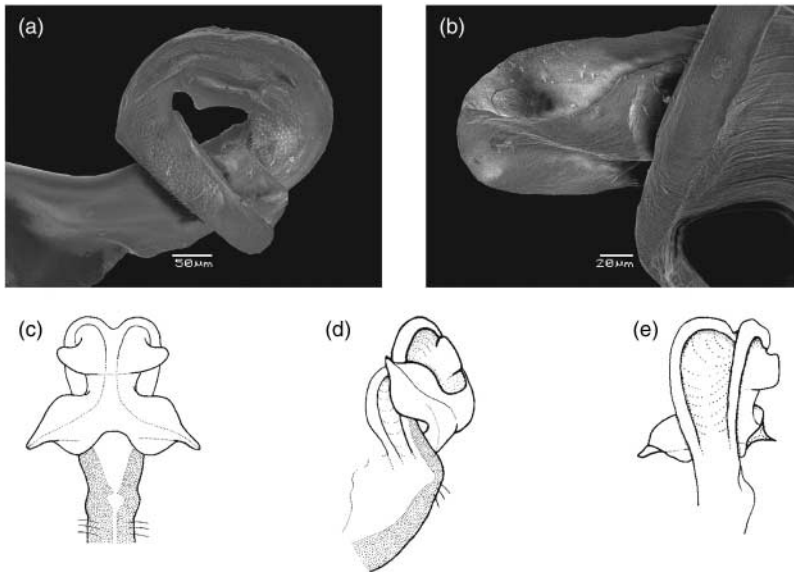


Figure 3. Morphological details of genital ligula of *Fluminagrion taxaense*: (a) right lateral view; (b) tip of distal lateral lobe ental view; (c) ectal view; (d) left lateroposterior view; (e) left lateroposterior view.

females, rhomboidal, slightly smaller or as long as underlying cell. Metatibial spurs subequal to or shorter than intervening spaces; supplementary tooth of pretarsal claw well developed. Genital ligula lacking inner fold proximal to flexure (Figure 3a); with one pair of rounded lateral processes distal to flexure (Figure 3c–e); segment 3 about as long as height of flexure in lateral view and C-shaped (Figure 3a), tip of apical segment bifid, ending in long terminal (or apical) lobes directed laterad (Figure 3c) with apexes pyramidal in cross section (Figure 3b, e); setae on penis shaft absent. Male S10 posterodorsal margin slightly elevated with U-shaped medial cleft in dorsal view (Figure 4b–d). Male cercus entire and decumbent from proximal fourth; broadening distally (Figure 4e); strong, compact, tightly clustered, brush-like setae at about half its length (Figure 4a), and with basal acute apophysis directed anteriorly (Figure 4b, e–f). Male paraproct entire, longer than cercus in lateral view (Figure 4a); tip acute and straight in lateral view (Figure 4a). Female lacking mesepisternal fossae (Figure 5a); mesostigmal lamina (Figure 5a) with diagonal carina; S8 with vulvar spine; ovipositor not surpassing S10 (Figure 5b). Larva unknown.

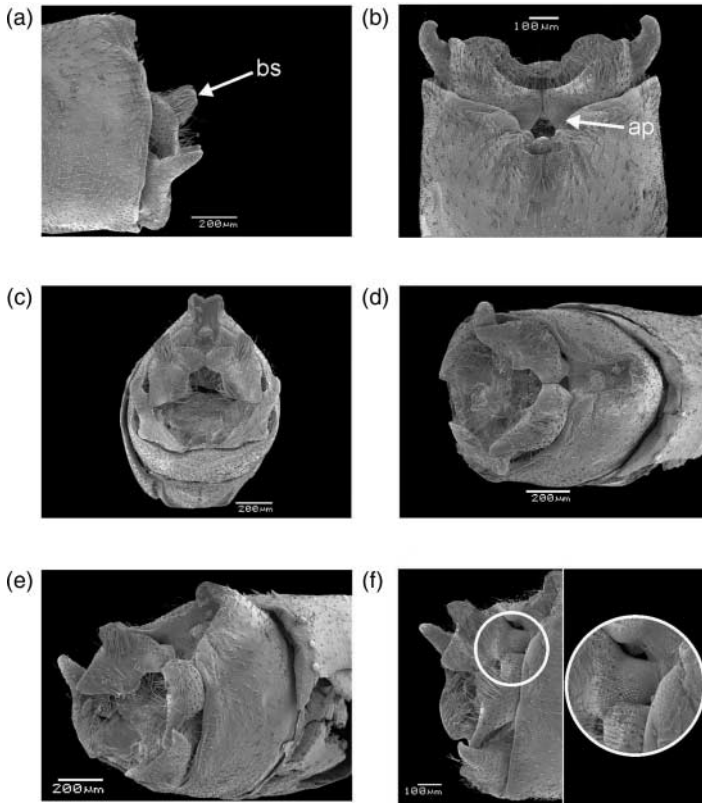


Figure 4. Morphological details of male terminalia of *Fluminagrion taxaense*: (a) left lateral view; (b) dorsal view; (c) posterior view; (d) dorsoposterior view; (e) right dorsolateral view; (f) right dorsolateral view showing apophysis in detail. Abbreviations: ap: apophysis, bs: brush-like setae.

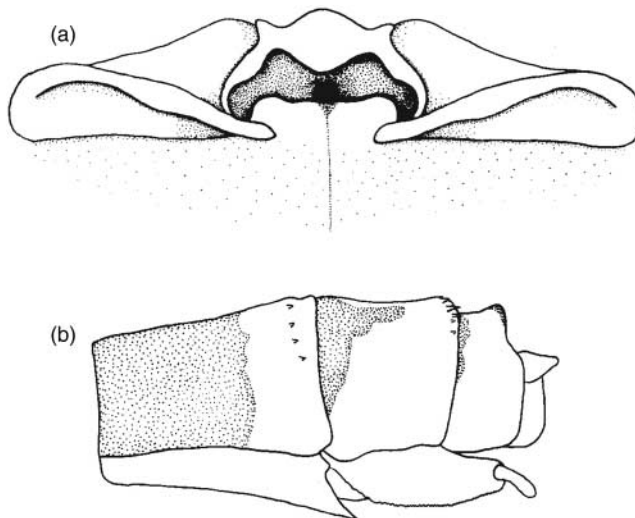


Figure 5. Morphological details of female *Fluminagrion taxaense*: (a) mesostigmal laminae, dorsal view; (b) terminalia, left lateral view.

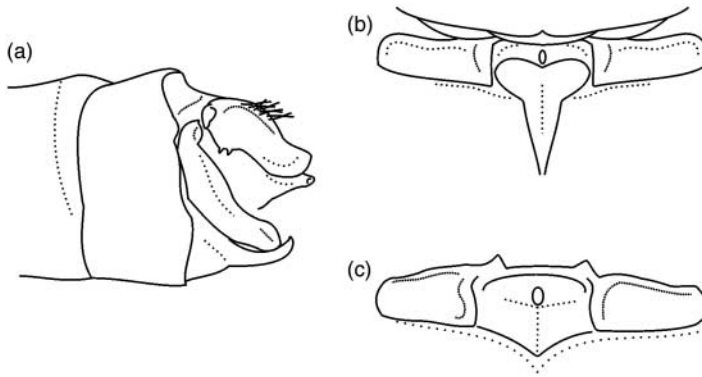


Figure 6. Morphological details of species of *Acanthagrion*: (a) *Acanthagrion fluviatile*, terminalia of male, left dorso-lateral view; (b) *Acanthagrion fluviatile*, mesostigmal laminae of female, dorsal view; (c) *Acanthagrion chararum*, mesostigmal laminae of female, dorsal view.

Diagnosis

Predominant color blue and black; frons rounded; postocular spots present; posterior lobe of prothorax trilobate, with medial lobe rounded and projected in both sexes; in lateral view genital ligula with apical segment C-shaped, tip of apical segment bifid, ending in lobes directed laterally in ectal view, and apexes pyramidal in cross section; male cercus entire and decumbent as from proximal fourth, with strong, compact, tightly clustered, brush-like setae at about half its length, and with basal acute apophysis directed anteriorly; female lacking mesepisternal fossa, S8 with vulvar spine.

Remarks

Fluminagrion can be easily separated from *Acanthagrion* by the morphology of the genital ligula (distal segment as long as flexure height in lateral view in *Fluminagrion* versus distal segment considerably longer than flexure height in lateral view in *Acanthagrion*), cercus (without basal tubercle and not decumbent from its base in *Fluminagrion* versus with basal tubercle and decumbent from its base in *Acanthagrion*), and paraproct (dorsal margin of tip straight in lateral view in *Fluminagrion* versus concave in lateral view in *Acanthagrion*). The presence of compact tightly clustered brush-like setae on male cercus is shared with *A. fluviatile* (Figure 6a); however, these setae are thicker and much denser in *Fluminagrion* than in *A. fluviatile*. Females of *Fluminagrion* lack mesepisternal fossae, a feature shared with *A. chararum* Calvert, 1909 and *A. fluviatile* (Figure 6b, c), from which *Fluminagrion* can be separated by the presence of a diagonal carina on the mesostigmal plates. The C-shaped genital ligula of *Fluminagrion* resembles that found in *Oxyagrion*. However, the latter has lateral lobes on the flexure which are absent on *Fluminagrion*.

Habitat

Fluminagrion taxaense inhabits the margins of small lakes, lagoons, ponds, marshes, and sandbanks. Adults were found in July and August, hovering just above water surface like a *Neoneura* (Protoneuridae) (Santos, 1965a).

Distribution

Fluminagrion taxaense is endemic to the coast of the west side of Rio de Janeiro municipality. It has been found only in three localities: Recreio dos Bandeirantes, Lagoa de Marapendi, and

Pedra de Itaúna. All these areas have suffered constant urbanization since the species was last seen in 1966, and only isolated protected areas (Área de Proteção Ambiental de Marapendi, Parque Natural Municipal de Marapendi, Parque Ecológico Chico Mendes) remain. These sites are located in the Neotropical region, Paranaense subregion, Brazilian Atlantic Forest Province (Morrone, 2001).

***Fluminagrion taxaense* (Santos, 1965) comb. nov.**

Acanthagrion taxaensis Santos, 1965a: 60 (description of male and female; comparison with *C. trimaculatum* (Selys, 1876)); — Santos, 1965b: 104 (recorded as inhabiting restinga and lentic environments); — Gloyd, 1977: 148 (questions placement of species in *Acanthagrion*); — Costa & Mascarenhas, 1998: 5 (type listed in MNRJ collection, comments).

Acanthagrion taxaense: Davies & Tobin, 1984: 63 (synonymic list); — Tsuda, 1986: 12 (distributional list); — Garrison, 1991: 9 (synonymic list); — Bridges, 1994: VII.231 (catalog); — Steinmann, 1997: 236 (catalog); — Machado & Brescovit, 2005: 95 (listed as extinct); — De Marmels, 1984: 25 (male terminalia compared with *Oxyagrion fluviatile*); — Costa, 2000a: 60–62 (distribution, listed as extinct in Rio de Janeiro City); — Costa, 2000b: 61–62 (listed as extinct in Rio de Janeiro State); — Costa, Lourenço, & Vieira, 2001: 436, 439–440, 446 (list of species, comments); — Lencioni, 2006: 69 (information about type, type locality, mentions that the larva is not described, reproduction of original illustrations, distribution); — Heckman, 2008: 304, 514, 517 (species key, illustration, distribution); — von Ellenrieder & Lozano, 2008: 100, 102, 104 (discussion of taxonomic position, synonymic list); — von Ellenrieder, 2009: (listed as Critically Endangered B1ab(iii) in the IUCN Red List of Threatened Species); — Garrison et al., 2010: 181–186 (synonymic list, discussion about taxonomic position, compared with *A. fluviatile*, illustration of male and female).

Types

1♂ holotype, 1♀ allotype and 40♂, 15♀ paratypes cited in original description, but only 25♂, 14♀ paratypes found in MNRJ collection. Most of these specimens are in good condition, packed in cellophane envelopes, with the terminalia separated and packed in small envelopes inside it.

Specimens examined

Holotype ♂, Brazil, Rio de Janeiro State, Rio de Janeiro City, Recreio dos Bandeirantes, Canal das Taxas (23°01'11"–23°01'26" S; 43°26'52"–43°28'07" W), elevation ± 8 m, 26 July 1961, O. Roppa, H.F. Berla, C. Camões leg. Allotype, same as holotype, 10 September 1961, N.D. Santos leg. Paratypes: 4♂, same as holotype, 26 July 1961, O. Roppa, H.F. Berla leg.; 1♂, same as holotype, 10 September 1961, N.D. Santos leg.; 1♂, 2♀, same as holotype, 22 July 1961, N.D. Santos, C. Vianna, H.F. Berla leg.; 1♂, same as holotype, 2 November 1961, N.D. Santos, J.P. Machado, O.A. Roppa leg.; 1♂, same date but N.D. Santos, O. Roppa leg.; 1♂, Brazil, Rio de Janeiro State, Rio de Janeiro City, Lagoa de Marapendi (23°00'–23°01' S; 43°21'–43°27' W), elevation 0–10 m, 21 February 1953, N.D. Santos leg.; 1♂, Brazil, Rio de Janeiro State, Rio de Janeiro City, Pedra de Itaúna (23°00'14' S; 43°25'17" W), elevation c.7–15 m, 16 July 1964, N.D. Santos leg.; 1♀, same, 2 August 1964, N.D. Santos leg.; 6♂, 4♀ same, 9 August 1964, N.D. Santos leg.; 7♂, 5♀ same, 8 August 1964, N.D. Santos leg.; 1♂, same, 15 January 1965, N.D. Santos leg.; 1♂, same, 20 January 1965, N.D. Santos leg. Other specimens not included in the type series: 1♀, Brazil, Rio de Janeiro State, Rio de Janeiro City, Pedra de Itaúna, marsh, 16 January 1965, N.D.

Santos leg.; same, woods, 28 February 1965, N.D. Santos leg.; 1♂, same, woods, 27 November 1966, N.D. Santos, Students of Centro de Ciências da Guanabara (CECIGUA) leg.

Type locality

Brazil – Rio de Janeiro State, Rio de Janeiro City, Recreio dos Bandeirantes (Canal das Taxas).

Redescription of male

Head. Labium pale yellow; labrum pale blue with posteromedian spot and posterolateral margins black; anteclypeus pale blue; postclypeus pale blue with median spot and posterior margin black; antefrons blue with median spot T-shaped; frons rounded. Dorsum of head black, with blue spots between eyes and base of antennae and with small brown spots surrounding median ocellus; scape black, pedicel and flagellum brown; blue postocular spots; occipital bar pale blue; rear of head pale with two black spots surrounding occipital foramen.

Thorax. Prothorax (Figure 1b): Anterior lobe blue, with black line on anterior margin; median lobe predominantly blue with two black spots on each side of median line and black spots on lateral surfaces; posterior lobe blue, trilobate, with median lobe developed, rounded and slightly projected. Pterothorax predominantly blue; mesostigmal plates narrow, blue at distal ends; mid-dorsal stripe dark reddish brown to black, continuous along mediodorsal carina; pale blue antehumeral stripe; humeral stripe dark reddish brown to black and complete; metepisternum with dark spot in median portion; metapleural fossa and interpleural suture with dark spot (Figure 1a). Legs pale blue to yellowish; femora and tibiae black on the extensor margin; tarsi and claws dark brown; metatibial spurs subequal to or shorter than intervening spaces; supplementary tooth of pretarsal claw well developed. Wings hyaline (Figure 2), pt rhomboidal and dark brown, slightly shorter than or as long as underlying cell; wing venation as in generic diagnosis.

Abdomen. S1 blue with anterior half black dorsally; S2 blue with black subquadrangular dorsal spot; S3–7 with dorsal dark spot T-shaped, and pale blue incomplete rings on anterior margin; S8–9 blue; S10 blue with posterodorsal margin black, U-shaped cleft, slightly elevated. Genital ligula (Figure 3a–e) lacking inner fold proximal to flexure (Figure 3a); with one pair of lateral lobe-like processes distal to flexure (Figure 3c–e); segment 3 about as long as the height of the flexure in lateral view and C-shaped (Figure 3a); tip of apical segment bifid, ending in lobes directed laterally in ectal view; apexes of segment 3 pyramidal in cross section (Figure 3b, e). Cercus (Figure 4a–f) shorter than S10, decumbent but not from its base, distal third forming an angle greater than 45° with margin of S10 (Figure 4a, b); without dorsobasal tubercle (Figure 4c, d), with basal, anteriorly projected apophyses on their bases (Figure 4b, f); with strong brush-like setae (Figure 4a). Paraproct entire, longer than cercus in lateral view, with dorsal margin straight (Figure 4a).

Dimensions. Total length 31–32; abdomen length 24–27; Fw 17–18; Hw 16–17.

Redescription of female

Head. As in male but dorsum of head pale blue, with light brown spots surrounding ocellar triangle.

Thorax. As in male but median lobe of pronotum posterior lobe light brown and shorter (Figure 1c); mesostigmal plate completely blue with a diagonal carina extending from anterior margin to inner posterior angle (Figure 5a).

Abdomen. As in male but spot on S1 reddish brown; S2 blue with reddish brown spot T-shaped and incomplete blue ring on distal margin; S8 with distal margin blue and well-developed vulvar spine (Figure 5b); S9 blue with lateral, subtriangular, black spot on each side adjacent to anterior margin; S10 blue with black spot at dorsal distal margin (Figure 5b). Pt light brown; CuA extending for 10 or 11 cells posterior to vein descending from subnodus; RP₂ beginning in Px5 in Fw and in Px4 in Hw; IR₁ beginning in Px9 in Fw and in Px7 in Hw.

Dimensions. Total length 33–34; abdomen length 23–26; Fw 18; Hw 17.

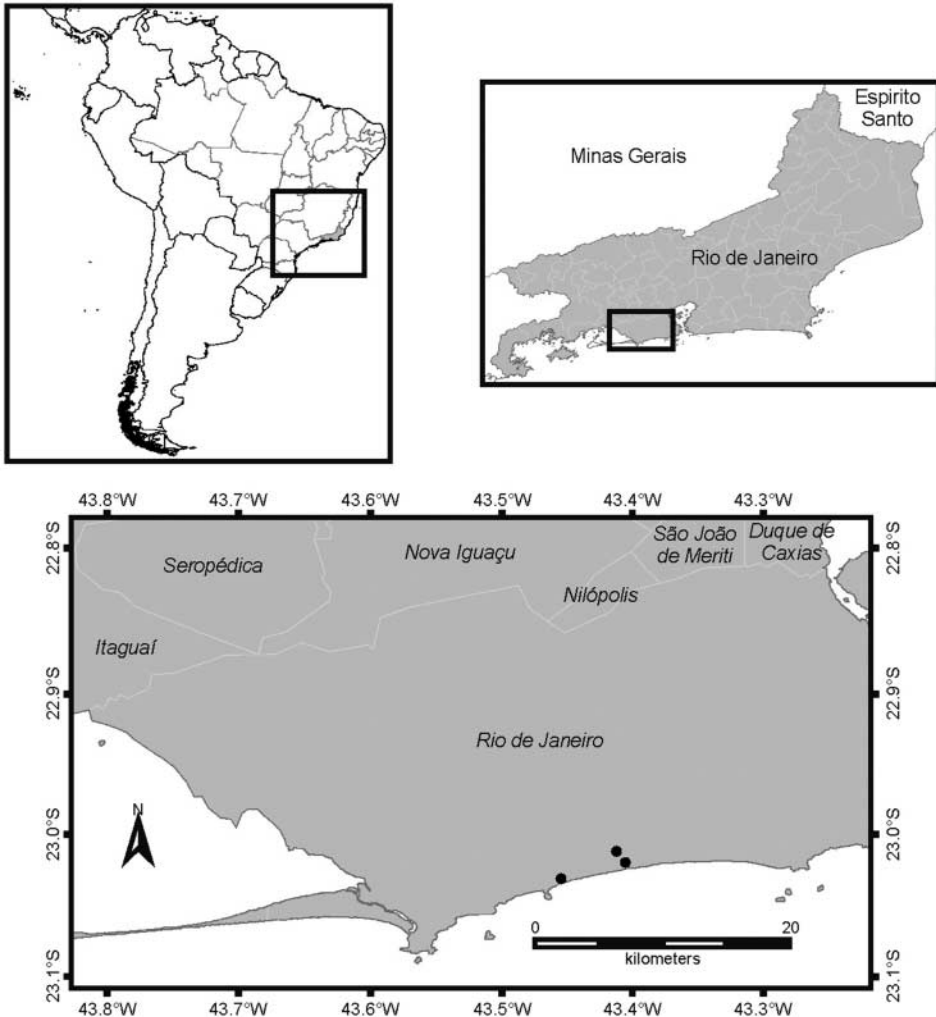


Figure 7. Distribution of *Fluminagrion taxaense*.

Remarks

Paratypes are very similar to holotype and allotype. Differences were found mainly in color pattern as follows: occipital bar pale brown; anterior lobe of prothorax with a brown line on anterior margin. Santos (1965a) mentions having collected several immature specimens, these differences may be attributed to this fact.

Fluminagrion taxaense is known only from the localities of the of the type series (Figure 7). This area has undergone strong urban development as mentioned above. This species has not been seen since 1966 and was considered extinct by Costa (2000a, 2000b) and Machado and Brescovit (2005). Von Ellenrieder (2009) listed this species as Critically Endangered B1ab(iii) on the IUCN Red List of Threatened Species. Since part of the type locality is situated within a protected natural area (Parque Natural Municipal Chico Mendes), surveys are needed in this and other coastal areas of Rio de Janeiro City to determine if populations of this species are still present.

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