



Last instar larva of the critically endangered *Oxyagrion franciscoi* Machado & Bede, 2016 (Odonata: Coenagrionidae) from Serra da Canastra National Park

CAMILA EDUARDA FERNANDES-PIRES¹, FELIPE HENRIQUE DATTO-LIBERATO^{1,2} & RHAINER GUILLERMO-FERREIRA^{1,2*}

¹Lestes Lab, Centre of Entomology and Experimental Biology, Federal University of Triângulo Mineiro (UFTM), Uberaba, MG, Brazil

✉ camilaedufeer@gmail.com; <https://orcid.org/0009-0003-8545-3323>

✉ felipe.datto.liberato@gmail.com; <https://orcid.org/0000-0002-4622-1592>

✉ rhainer.ferreira@uftm.edu.br; <https://orcid.org/0000-0001-7774-5252>

²Graduate Program in Entomology, Department of Biology, University of São Paulo (USP), Ribeirão Preto, Brazil

Mailing address: Av. Tutunas, 490, Universidade Federal do Triângulo Mineiro, 38061-500, Uberaba, MG, Brazil

*Corresponding author: ✉ rhainer.ferreira@uftm.edu.br

Abstract

Oxyagrion franciscoi Machado & Bede, 2016 is a critically endangered damselfly species endemic to the Serra da Canastra National Park, Brazil, a vital environmental reserve within the Cerrado hotspot for biodiversity conservation. Here we reared, illustrated, and described the last instar larva of *O. franciscoi*.

Key words: dragonfly, freshwater, mountains, stream, savannah

Introduction

Oxyagrion Selys, 1876 is a genus comprising 27 species listed in Paulson *et al.* (2023) of which 15 larvae have been described thus far (Costa *et al.* 2000; Von Ellenrieder & Garrison 2006; Dalzochio & Rodrigues 2009). *Oxyagrion franciscoi* Machado & Bedê, 2016 is critically endangered due to its restricted distribution and habitat specificity. It is endemic to the Serra da Canastra National Park (SCNP), only known for the type locality: the springs of the São Francisco River (Machado & Bedê 2016). The SCNP plays a pivotal role in the conservation of the São Francisco River Basin, one of the largest and most important rivers in South America and is acknowledged as a biodiversity hotspot and a sanctuary for odonates, preserving other endemic and threatened species of the Cerrado (Brazilian savannah) (Cezário *et al.* 2019; Machado & Bedê 2016; Vilela *et al.* 2020). Here, we add to the existing knowledge on odonate larvae by describing the last instar larva of *O. franciscoi*.

Material and methods

We collected the last larval instar during an expedition to the SCNP, Minas Gerais state, Southeastern Brazil). The SCNP lies within the Cerrado biome, a Brazilian savannah conservation unit covering an area of 1978 km² and hosting a diverse and unique fauna (Machado & Bedê 2016; Vilela *et al.* 2020). The larva was collected and placed in a plastic vial until its complete emergence. The resulting adult and exuvia were preserved in 80% ethanol and subsequently deposited in the LESTES collection at the Federal University of Triângulo Mineiro, Minas Gerais, Brazil. We examined the cerci and the genital ligula of the emerged male to identify the specimen according to Machado & Bedê (2016). All measurements were recorded in millimeters; total length of abdomen including cerci and excluding caudal gills. The mandibular formula follows classification given in Watson (1956).

We used Adobe illustrator 2020 for illustrations, utilizing photographs captured with a Leica S9l. We used image J 1.53t software to make the measurements (Rueden *et al.* 2017).

Results

Description of the larvae of *Oxyagrion franciscoi* Machado & Bedê, 2016

Material examined. 1 ♂ F0 exuvia (Fig. 1): BRAZIL, Serra da Canastra, Nascente (GPS coordinates: -20.2550528, -46.4466012; plus code: QH43+R9 São Roque de Minas, MG), 11-x-21, Guillermo-Ferreira leg., 1 ♂ F0 (reared).

Exuvia. Light yellow, brownish abdomen; slender, cylindrical body (Figure 1).

Head. Approximately 1.5 times wider than longer, roughly trapezoidal in shape, featuring punctuations on the occipital lobe (Figure 1).

Antennae. Seven segmented, third antennomere being the longest (Figure 2); the proportional lengths of the antennomeres are as follows: 0.4, 0.74, 1, 0.87, 0.65, 0.41, and 0.15.

Prementum. About 0.9 times as wide as long, with two pairs of short setae and two pairs of long setae, lateral margin with six pairs of spiniform setae (Figure 3). Distal margin moderately prominent, serrulate; distal hook of labial palp smaller than the movable hook, outer margin of hook crenulated (Figure 3); six palpal setae extend to the base of the labial palp until the movable hook; mandibles bearing a molar tooth but lack a molar crest, following the formula L 1234 y a / R 1234 0 ab (Figure 4).

Thorax. Pronotum brownish, trapezoidal, adorned with small setae; wing pads dark brown, extending up to S4; legs light brown, distal margin of femora banded (Figure 1).

Abdomen. Covered with brownish spots and medial semicircular spots (Figure 1); cerci (Figure 5) rounded; rounded tip in lateral view, gonapophyses acute and triangular, setae absent; caudal lamellae are laminar, oblong, and narrow at the base, foliaceous posteriomedially (Figure 6); lateral and medial lamellae light-yellow; wider distally.

Measurements (n=1). Total length without appendages: 10.46. Total length of the head: 1.38; width: 2.02. Prementum length: 1.67; width: 1.42. Total length of labial palp: 0.76; width: 0.1. Femur I: 1.17; II: 2.09; III: 2.01. Tibiae I: 1.22; II: 1.39; III: 2.05. Inner wing pads: 3.24, external wing pads: 3.1. Medial caudal lamellae: 3.94; lateral caudal lamellae: 3.88.

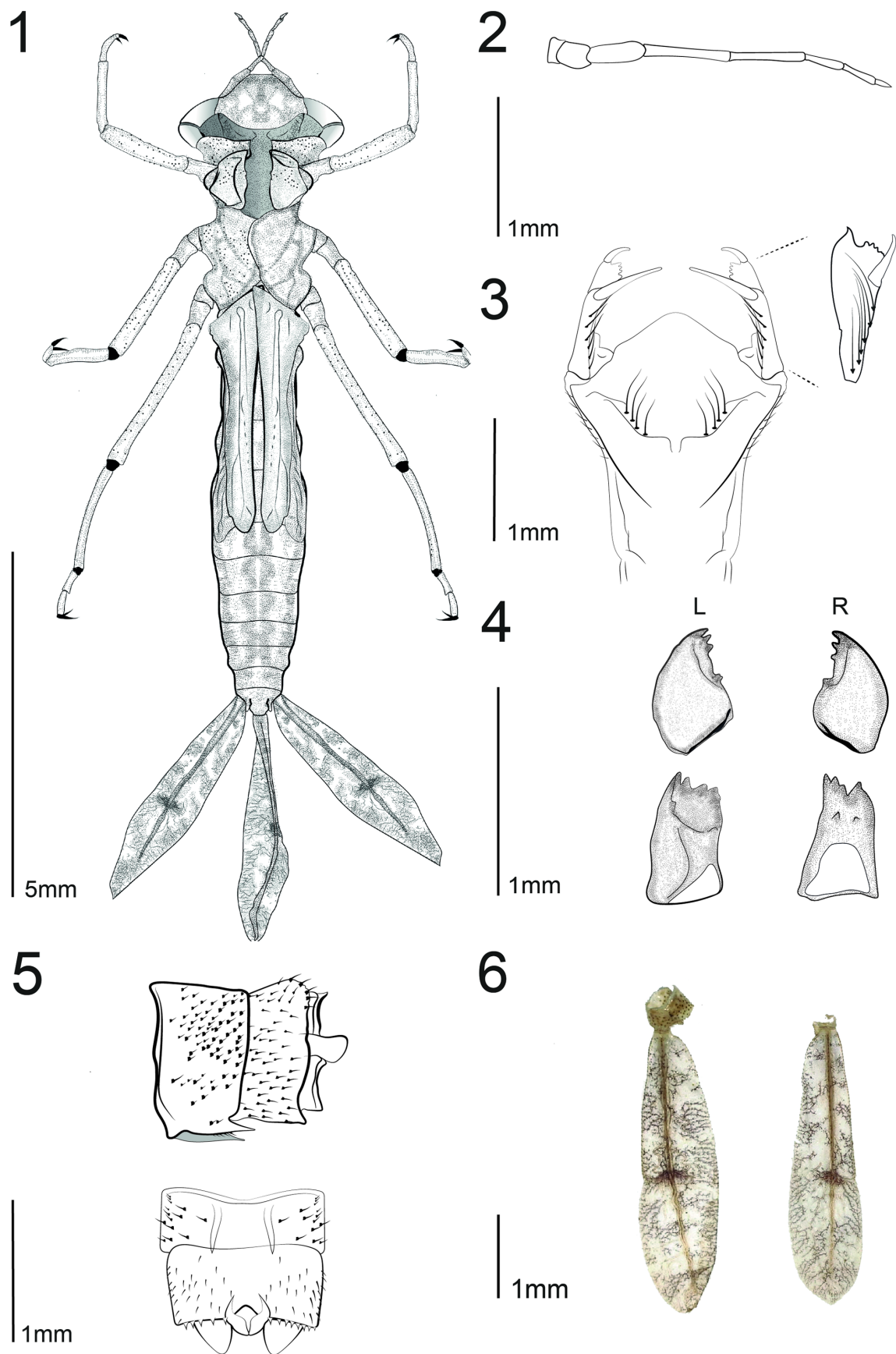
Habitat and ecology

The larva was collected at the historical spring of the São Francisco River, situated within a hydromorphic permanent wetland referred to as a Vereda wetland (Guillermo-Ferreira *et al.* 2016). The habitat comprises a meandering stream that traverses vast floodplains, characterized by a series of elongated and deep pools interspersed with short riffles (Figure 7). Periodic inundation occurs during the rainy months, resulting in the formation of extensive marsh tracts embellished with numerous side pools, all surrounded by dense stands of tall grass tussocks (Machado & Bedê 2016). In four expeditions to the SCNP between 2018 and 2022, no adult of *O. franciscoi* was ever collected and we found only this unique larva described here.

Diagnosis and discussion

Oxyagrion franciscoi exhibits sympatric occurrence alongside *Oxyagrion microstigma* Selys, 1876 and *O. santosi* Martins, 1967. According to the larval stage descriptions provided by Costa *et al.* (2000), we can differentiate *O. franciscoi* from *O. microstigma* based on the presence of lamellae with a transverse suture in the latter. Additionally, the prementum of *O. franciscoi* possesses four primary setae that are not shared with *O. santosi*.

The last instar larva of *O. franciscoi* appears to be similar to *O. simile* Costa, 1978 following the key propose to the genus (Costa *et al.* 2000) presenting the following characteristics: the caudal lamellae without the presence of transverse suture (Figure 6), prementum with 4 primary setae (Figure 3) (Costa *et al.* 2000). The last larval stage of *O. franciscoi* can be distinguished from *O. simile* by the presence of spiniform setae on the lateral margin of the prementum and *O. simile* presents a pair of secondary setae on the prementum absent on the *O. franciscoi* (Figure 3). The lateral lamella (Figure 6) of *O. franciscoi* differ from *O. simile* by the presence of a smooth constriction on the medial portion of lateral lamellae and the different pattern of trachea. The wing pads of *O. franciscoi* extent to the 4th abdominal segment, whereas in *O. simile* it extends to the 3rd segment (Santos 1966).



FIGURES 1–6. Final instar larvae of *Oxyagrion franciscoi* Machado & Bedê, 2016: 1. Dorsal view of habitus; 2. Lateral view of antenna; 3. Dorsal view of prementum, details of labial palps in medio dorsal view; 4. Dorsal and lateral views of mandibles; 5. Lateral view of S10 and cerci, and ventral view of S9–S10 and the cerci; 6. Medial lamella (left) and lateral lamella (right).



FIGURE 7. Habitat of *Oxyagrion franciscoi* Machado & Bedê, 2016, the springs of the São Francisco River.

The Canastra Mountains play a crucial role in biodiversity conservation, particularly concerning odonates, harboring unique and endangered species such as *Franciscagrion franciscoi* Machado & Bedê, 2016, *Franciscagrion longispium* Machado & Bedê, 2016, *Minagrion caldense* Santos, 1965 and *Oxyagrion franciscoi* (IUCN 2023; Vilela *et al.* 2020). The taxonomic data provided herein complement previous conservation efforts aimed at protecting the Odonata fauna of the Cerrado and the Serra da Canastra National Park (Cezário *et al.* 2019; Machado & Bedê 2016).

Acknowledgments

This study was financed by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Finance Code 001, the Ministério Público do Estado de Minas Gerais, and the Mohammed Bin Zayed Conservation Fund. CEFP thanks FAPEMIG for a scholarship grant. RGF thanks Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; Proc. 312847/2022-0) for a productivity grant. We thank to Rodrigo Roucourt Cezário and Vinicius Marques Lopez for valuable contributions. We thank Diogo Silva Vilela for field assistance. We thank Geovana Caneto for lab assistance.

References

- Cezário, R.R., Vilela, D.S. & Guillermo-Ferreira, R. (2019) Final instar larva of *Franciscagrion longispinum* Machado & Bedê, 2015 (Odonata: Coenagrionidae), an endemic species from the springs of the São Francisco river. *Zootaxa*, 4657 (3), 581–586.
<https://doi.org/10.11646/zootaxa.4657.3.10>
- Costa, J.M., Irineu de Souza, L.O. & Santos, T.C. (2000) Two new species of *Oxyagrion* Selys, 1876, with a description of five

- new larvae (Zygoptera: Coenagrionidae). *Odonatologica*, 29, 1–15.
- Costa, J.M. (1978) *Revisão do genero Oxyagrion Selys, 1876 (Odonata, Coenagrionidae)*. Universidade Federal do Rio de Janeiro, Rio de Janeiro, 303 pp.
- Dalzochio, M.S. & Rodrigues, M.É. (2009) Descrição da larva de último estágio de *Oxyagrion sulmatogrossense* Costa, Souza & Santos (Odonata, Coenagrionidae). *EntomoBrasilis*, 2 (3), 73–75.
<https://doi.org/10.12741/ebrasilis.v2i3.63>
- Guillermo-Ferreira, R., Vilela, D., Del-Claro, K. & Bispo, P. (2016) *Erythrodiplax ana* sp. nov. (Odonata: Libellulidae) from Brazilian palm swamps. *Zootaxa*, 4158 (2), 292–300.
<https://doi.org/10.11646/zootaxa.4158.2.10>
- IUCN (2023) The IUCN Red List of Threatened Species. Available from: <https://www.iucnredlist.org> (accessed 20 May 2023)
- Machado, A.B.M. & Bedê, L.C. (2016) Two new genera and nine new species of damselflies from a localized area in Minas Gerais, Brazil (Odonata: Zygoptera). *International Journal of Odonatology*, 18, 269–296.
<https://doi.org/10.1080/13887890.2015.1072113>
- Martins, J.P. (1967) Descrição de *Oxyagrion santosi* sp.n. (Odonata: Coenagriidae). *Atas da Sociedade de Biologia do Rio de Janeiro*, 10, 141–143.
- Paulson, D., Schorr, M., Abbott, J., Bota-Sierra, C., Deliry, C., Dijkstra, K.-D. & Lozano, F. (2023) World Odonata List. Available from: <https://www.odonatacentral.org/app/#/wol/> (accessed 20 May 2023)
- Rueden, C.T., Schindelin, J., Hiner, M.C., DeZonia, B.E., Walter, A.E., Arena, E.T. & Eliceiri, K.W. (2017) ImageJ2: ImageJ for the next generation of scientific image data. *BMC Bioinformatics*, 18, 529.
<https://doi.org/10.1186/s12859-017-1934-z>
- Santos, N.D. (1965) Contribuição ao conhecimento dos “Odonata” da região de Poços de Caldas, MG. *Minagrion* Gen. N., para *Telagrion mecistogastrum* Selys Longchamps, 1865, com a descrição de uma nova espécie (Odonata, Coenagriidae). *Atas da Sociedade de Biologia do Rio de Janeiro*, 9, 8–12.
- Santos, N.D. (1966) Notas sobre ninfa de *Oxyagrion Brevestigma* Selys, 1876 (Odonata Coenagriidae). *Atas da Sociedade Biológica do Rio de Janeiro*, 10, 101–103.
- Selys-Longchamps, E.D. (1876) Synopsis des Agrionines, 5me légion: *Agrion* (suite). Le genre *Agrion*. *Bulletins de l'Académie Royale des sciences, des lettres et des beaux-arts de Belgique*, Series 2, 41, 247–322.
- Vilela, D.S., Koroiva, R., Tosta, T.H.A., Novaes, M.C. & Guillermo-Ferreira, R. (2020) Dragonflies and damselflies from the West of Minas Gerais, Brazil: checklist and new records. *Biota Neotropica*, 20, 1–15.
<https://doi.org/10.1590/1676-0611-bn-2019-0851>
- Von Ellenrieder, N. & Garrison, R.W. (2006) Rediscovery of *Oxyagrion bruchi* Navás, 1924 from Argentina, with a description of its larva (Zygoptera: Coenagrionidae). *The Pan-Pacific Entomologist*, 82 (3/4), 362–374.
- Watson, M.C. (1956) The Utilization of Mandibular Armature in Taxonomic Studies of Anisopteran Nymphs. *American Entomology Society*, 81, 155–202.