

SHORT COMMUNICATION

A new species of *Tokophrya* (Ciliophora: Suctorea) found on hyporheos harpacticoid copepod of the genus *Forficatocaris* (Crustacea: Copepoda) from Brazil

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Summary

The article describes a new species of the suctorian ciliate *Tokophrya saofranciscoensis* sp. nov. inhabiting the body surface (cuticle) of a hyporheos harpacticoid copepod of the genus *Forficatocaris* from the west São Francisco River (Brazil). The new species differs from other species of the genus by the presence of a short, conical, transversely striated stalk, a body in the form of an elongated cone, and a saddle-shaped apical surface of the body.

Key words: suctorian ciliate, new species, harpacticoid host, Brazil

Introduction

The hyporheic zone is represented by sediments and porous space beneath and alongside a stream bed (Lewandowski et al., 2019). There are numerous invertebrates, which migrate between surface waters and the hyporheic zones, while some species inhabit only the hyporheos (Pacioglu, 2009). The majority of the hyporheic meiofauna is represented by Gastrotricha, Microturbellaria, Rotifera, Nematoda, Oligochaeta, Copepoda, etc. (Pacioglu, 2009).

Although the findings of epibiont ciliates on

crustaceans living interstitially in freshwater sand habitats are known (Delamare Deboutville and Chappuis, 1956, Fernandez-Leborans and Tato-Porto, 2000) the occurrence of epibiotic ciliates attached to hyporheic hosts has not been previously observed.

In samples containing harpacticoid copepods collected in the São Francisco River in the Canastra National Park, Brazil, we found two representatives of the ciliates' genus *Tokophrya* with well-developed hemispherical actinophores. The found ciliate species is recognized as a new species and the present article deals with its description.

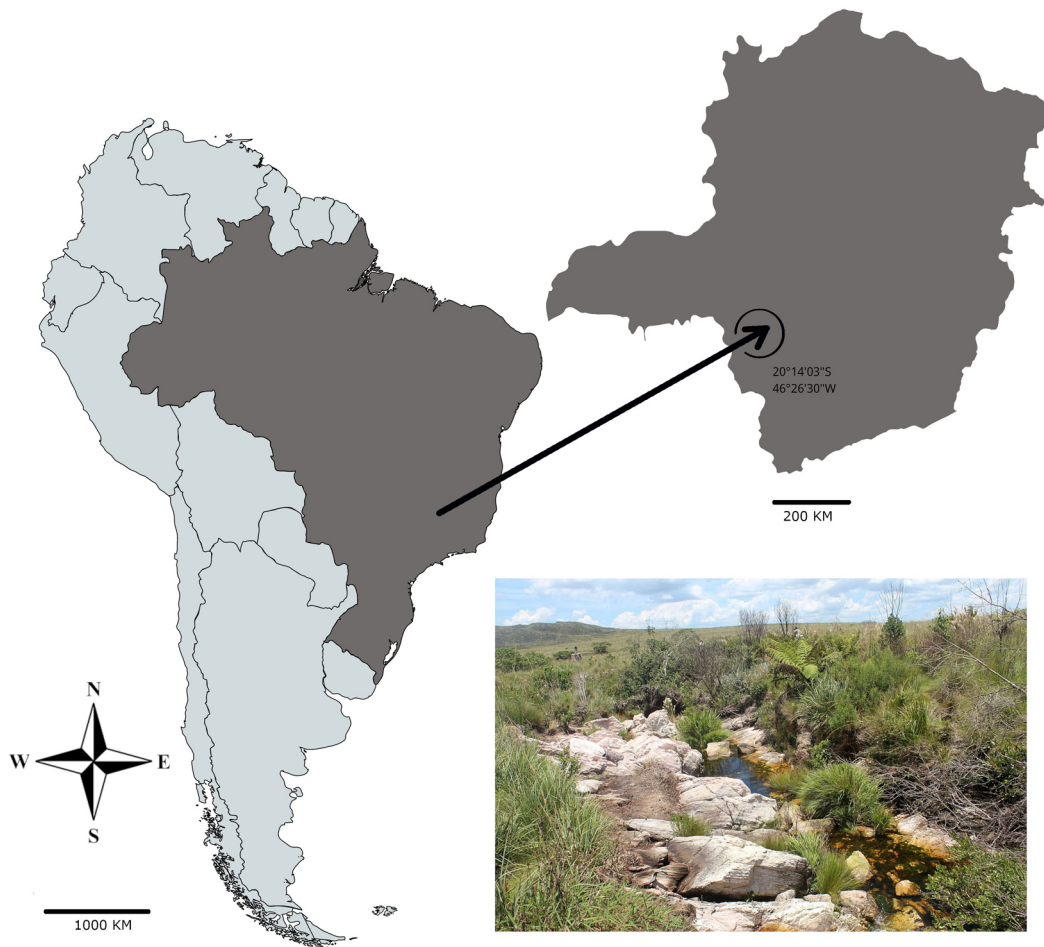


Fig. 1. Map of the South America, with Brazil and the State of Minas Gerais in dark grey. Arrow indicating the type locality at the National Park of Serra da Canastra. Photo: Headwaters of the Sro Francisco River (In: Wikimedia Commons, the free media repository. Florida: Wikimedia Foundation, 2023. [https://commons.wikimedia.org/wiki/File:Nascente_tur%C3%ADstica_do_Rio_S%C3%A3o_Francisco_\(3546\).jpg](https://commons.wikimedia.org/wiki/File:Nascente_tur%C3%ADstica_do_Rio_S%C3%A3o_Francisco_(3546).jpg)).

Material and methods

A female of a harpacticoid copepod *Forficataris* sp. was collected by Paulo Henrique Costa Corgosinho using the method of Karaman-Chappuis (K-Ch) (Chappuis, 1942) in the hyporheic zone of the headwaters of the São Francisco River in the Canastra National Park, Brazil (Fig. 1). This method consists of digging holes of varying depth (10–30 cm) in alluvial deposits next to a stream or river, allowing the water to flow inside, and then sampling the subsurface water seeping into the pits. The sampled water is passed through a sieve of 50 μm , which retains the hyporheic fauna; the latter was transferred to polyethylene vials and fixed with 90% alcohol.

Water is slightly acid (Table 1). Average and SD of some physicochemical properties of water from

the sampling site (CAN) is given in the Table 1.

The infested copepod was mounted on a 50% glycerine slide and sealed with Dibutylphthalate Polystyrene Xylene (DPX). Photomicrographs were obtained by the program Las X for the digital camera DFC700T, mounted on a Leica DM6B microscope. Measurements were carried out on two specimens using the program Toup View 3.7 for digital camera.

The systematic position of suctorian ciliates follows Dovgal (2002, 2013).

Results

Two representatives of the ciliates' genus *Tokophrya* with well-developed hemispherical actinophores in the samples containing harpacticoid copepods collected in the São Francisco River in

Table 1. Physicochemical properties at the sampling site.

Properties	Average ± SD
Altitude (m.a.s.l.)	1.184.57±157.14
Depth (m)	0.58±0.36
Water Temperature (°C)	18.10±2.65
pH	5.84±0.64
Dissolved Oxygen (mgL ⁻¹)	5.68±1.11
Conductivity (µS _{cm} ⁻¹)	2.30±2.65
Total Dissolved Solids (TDS) (mgL ⁻¹)	2.00±3.17
Oxidation-reduction potential (ORP) (mV ⁻¹)	128.08±73.03
Alcalinity (mgL ⁻¹)	3.45±3.55
Hardness (mgL ⁻¹)	6.33±2.86

the Canastra National Park, Brazil was found. The observed species differs from the known members of the genus with actinophores by the presence of a short, conical, transversely striated stalk, a body in the form of an elongated cone, and a saddle-shaped apical surface of the body, which support its description as a new species.

Class Suctorea Claparède et Lachmann, 1859
 Subclass Endogenia Collin, 1912
 Order Acinetida Raabe, 1964
 Family Tokophryidae Jankowski, 1975
 Genus *Tokophrya* Bütschli, 1889

***Tokophrya saofranciscoensis* sp. nov.** (Fig. 2, A–D)

ZooBank number: D4A06A42-230E-4187-AFCA-2B007AF9EA7F

Diagnosis: Unloricate, stalked suctorian ciliate with an elongated, conical, unflattened cell body, apical surface of which is saddle shaped. The two hemispherical actinophores positioned at the bottom of the apical surface of the body and bearing numerous (20–35 per actinophore) thin, flexible, capitate tentacles. Stalk short, conical, flared upward, distinctly transversally striated, attached to the host surface by a well-developed adhesive disc. Macronucleus spherical, positioned in the subapical part of the body. Reproduction not observed.

Dimensions (in µm, based on two individuals): Body length 43–46; maximal body width 24–26; actinophore length 6–8; width 8–14; macronucleus diameter 6–7; stalk length 4–6; stalk diameter 2–3; top of stalk diameter 4–5; adhesive disc diameter 8–10; tentacle length 5–27.

Differential diagnosis: The new species differs from the relative species *T. wenzeli* Matthes et Stiebler, 1970 by the presence of an elongated, not

pyramidal body, conical, and a transversely striated stalk. *T. saofranciscoensis* sp. nov. differs from related species found on amphipods of the lake Baikal i.e., *T. cordiformis* (Swarzewsky, 1929), *T. cornuta* (Swarzewsky, 1929), *T. crypturopi* (Swarzewsky, 1929) and *T. sphaerifera* (Swarzewsky, 1929) (Swarzewsky, 1929) by the presence of a short, conical striated stalk and an elongated body. The presence of a saddle-shaper apical body surface is hitherto known only for *T. saofranciscoensis* sp. nov. (Table 2).

Type materials: Two specimens attached to a harpacticoid copepod host deposited at the Carcinologic collection of the Museum of Zoology of the University of São Paulo; deposition number MZUSP: 43544.

Type locality: Headwaters of the São Francisco River in the Canastra National Park, Minas Gerais, Brazil (20°14'03'S, 46°26'30'W)

Type host: *Forficatocaris* sp.

Etymology: The specific epithet “saofranciscoensis” refers to the type locality in the headwaters of the São Francisco River, Minas Gerais State, Brazil.

Material Examined: Two individuals of an epibiont suctorian ciliate were attached to an undescribed species of a harpacticoid copepod of the genus *Forficatocaris*: one ciliate epibiont is attached to the left lateral margin of the cephalothorax of the host and another to the dorsal margin of the urosome (Fig. 2, A).

Discussion

Tokophrya Bütschli, 1889 is one of the largest genera of Suctorea, including 47 species (Curds, 1985b; Dovgal, 2002; Jankowski, 2007). Representatives of the genus inhabit mainly fresh waters (less in the seas) in the periphyton and as epibionts of various invertebrates, most often crustaceans, or as parasites of sessile ciliates (Curds, 1985a; Matthes et al., 1988; Fernandez-Leborans and Tato-Porto, 2000; Dovgal, 2013). Importantly, the actinophores in *Tokophrya* are usually absent or poorly developed (Dovgal, 2013).

It is Jankowski's (2007) opinion that there are some unresolved problems in the taxonomy and nomenclature of the genus *Tokophrya* Bütschli, 1889. Thus, several species found on amphipods of the lake Baikal were assigned by their author (Swarzewsky, 1929) to the genus *Acineta* Ehrenberg, 1834 (Jankowski, 2007). Gajewskaja (1933) belie-

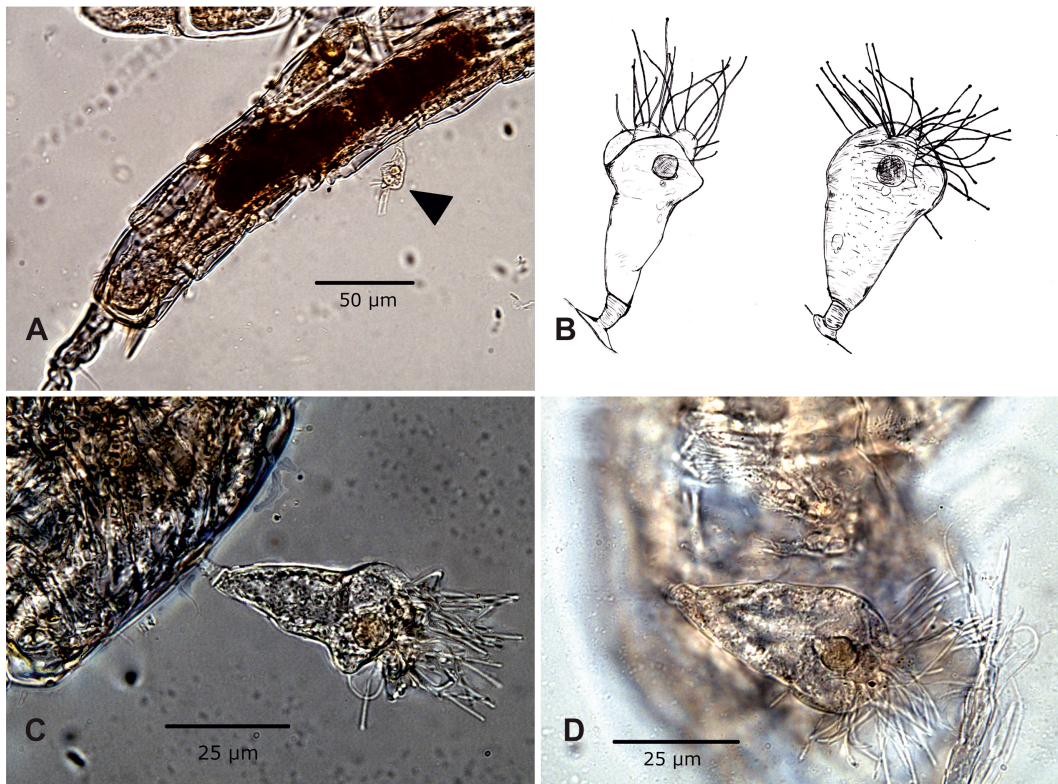


Fig. 2. *Tokophrya saofranciscoensis* sp. nov. A - Attached to the urosome (indicated by arrow); B - schematic drawing (different views); C, D - magnified views.

ved that some species of Swarczewsky, such as *Tokophrya emarginata* Swarczewsky, 1929, *T. cornuta* (Swarzewsky, 1929), *T. sphaerifera* (Swarzewsky, 1929), *T. lobata* (Swarzewsky, 1929), *T. cordiformis* (Swarzewsky, 1929), *T. crypturopi* (Swarzewsky, 1929), *T. biloba* (Swarzewsky, 1929), *T. ovalis* (Swarzewsky, 1929) and *T. pusilla* (Swarzewsky, 1929) are possibly identical to *T. radiata* Gajewskaja, 1933, described by this author (Gajewskaja, 1933) also from Lake Baikal. Curds (1985a) indicated *T. radiata* as a junior synonym of *T. sphaerifera*, which in turn was assigned by this author to the genus *Acineta*. Dovgal (2002) adduced *T. radiata* as a valid name. It should be mentioned that Gajewskaja (1933) did not take into account the high significant characters for suctorian diagnostics such as the presence of actinophores, morphology and development of stalk, as well as the shape of cell body (Dovgal, 2013).

From samples containing harpacticoid copepods collected in the São Francisco River in the Canastra National Park, Brazil, we found two representatives of the genus *Tokophrya* with well-developed hemispherical actinophores. The observed species dif-

fers from the known members of the genus with actinophores by the presence of a short, conical, transversely striated stalk, a body in the form of an elongated cone, and a saddle-shaped apical surface of the body, which support its description as a new species. We believe that the discovery of *T. saofranciscoensis* confirms the necessity of considering actinophores presence and morphology as well as the stalk morphology and development while investigating suctorian ciliates of the family Tokophryidae.

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Table 2. Comparison of morphological characters of the *Tokophrya saofranciscoensis* sp. nov. and some related representatives of the genus *Tokophrya*.

Character	Species					
	<i>Tokophrya cordiformis</i>	<i>Tokophrya cornuta</i>	<i>Tokophrya crypturopi</i>	<i>Tokophrya wenzell</i>	<i>Tokophrya sphaerifera</i>	<i>Tokophrya saofranciscoensis</i> sp. nov.
Actinophore shape	Hemispherical	Not developed	Conical, with rounded apical tops, contractile	Hemispherical, in some cases poorly developed	Almost spherical	Hemispherical
Tentacle number per actinophore	–	–	–	–	Numerous	20–35
Morphology of tentacles	–	–	–	Capitate, contractile, very thin with distinguishable knobs	–	Thin, flexible, capitate
Body shape	Short and broad, flattened, heart shape	Triangular, with flattened, slightly concave in the middle part apical surface	Short, conoidal, apical surface flat, demarcated with a sharp edge	Body in the shape of inverted pyramid, slightly flattened laterally, with flattened apical surface	Body slightly conical to almost cylindrical, expanded in upper part	Elongated, conical, unflattened, with saddle shaped apical surface
Contractile vacuoles' number and position	–	–	–	Single, subapical	–	Not observed
Macronucleus shape and position	Spherical	Spherical	Spherical	Spherical or oviform	Bulbous, positioned in the expanded part of body	Spherical, positioned in the sub-apical part of the body
Stalk shape	Very long, with widened apical part	Very long, with widened apical part, adhesive disk developed	Long, with apical widening	Thick, longitudinally striated, provided with basal plate, adhesive disk developed	Long, thin, with apical widening, adhesive disc developed	Short, conical, flared upward, distinctly transversally striated, basal plate absent, adhesive disk developed
Body length (µm)	120	95	58–60	31–52	115	43–46
Body width (µm)	140	25–30	–	25–41	95	24–26
Body thickness (µm)	50	–	–	–	–	–
Size of Macronucleus (µm)	–	18	–	5–21 × 9–17	20	6–7
Stalk length (µm)	250	200	120–150	6–22	220–230	4–6
Stalk diameter (µm)	9	2–2.5	2–2.5	2–6	2.5–5.5	2–3
Adhesive disk diameter (µm)	–	15	–	–	10–12	8–10
Basal plate diameter	–	–	–	5–11	–	–
Actinophore length (µm)	–	–	–	1–18	–	6–8
Actinophore width (µm)	–	–	–	3–21	–	8–14
Tentacle length (µm)	–	–	–	4–25	–	5–27
Data source	Swarczewsky, 1929	Swarczewsky, 1929	Swarczewsky, 1929	Dovgal et al., 2012	Swarczewsky, 1929	Present study

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