Ephemera, 2022 (2023), Vol. **24** (1) : 31-38

On the genus *Orthocladius* van der Wulp, 1874 from New Caledonia. I. Description of *O. taonus* sp. n., a rheophilic species occurring in the waterfall of Tao [Diptera, Chironomidae, Orthocladiinae]

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Keywords: Diptera-Chironomidae, *Orthocladius* (*Orthocladius*) *taonus* sp. n., New Caledonia, conservation.

Male adult of *Orthocladius* (*Orthocladius*) *taonus* sp. n. is described based on material collected in the down basin of Tao stream in New Caledonia. The main distinguishing characters are: anal point markedly enlarged at base; phallapodeme butsher's knife shaped; junction of gonocoxites typical Omega shaped; gonostylus with unusual appearance in the genus *Orthocladius*, anterior side covered with orally directed fine setae. Remarks and comments on the ecology of the new species are provided.

Sur le genre *Orthocladius* van der Wulp, 1874 de Nouvelle-Calédonie. I. Description de *O. taonus* sp. n., une nouvelle espèce rhéophile connue de la cascade de Tao [Diptera, Chironomidae, Orthocladiinae]

Mots-Clés: Diptera-Chironomidae, *Orthocladius* (*Orthocladius*) *taonus* sp. n., Nouvelle Calédonie, conservation.

L'adulte mâle d'*Orthocladius* (*Orthocladius*) *taonus* sp. n. est décrit à partir d'un matériel collecté dans le cours inférieur du ruisseau de Tao en Nouvelle-Calédonie. Les principaux caractères distinctifs sont : base de la pointe anale particulièrement élargie; phallapodème en forme de couteau de boucher ; jonction des gonocoxites typiquement en forme d'Oméga ; gonostyle avec une apparence atypique du genre *Orthocladius*, côté antérieur couverte de fines soies dressées. Des données taxonomiques et des commentaires sur l'écologie de la nouvelle espèce sont ajoutés.

1. Introduction

As reported by SÆTHER (2005), the genus *Orthocladius* v. d. Wulp, 1874 is presently divided into five subgenera: *Eudactylocladius* Thienemann, *Euorthocladius* Thienemann, *Pogonocladius* Brundin, *Symposiocladius* Cranston, and *Orthocladius* s. str. Although the genus *Orthocladius* s. l. is more or less commonly recorded in all zoogeographical regions (except Antarctica), little taxonomic knowledges are published from both the Afrotopical and Australasian Regions. On the

other hand, the subgenus *Orthocladius*, in particular, is represented worldwide by about 65 species, which are mostly described and studied from the Palaearctic, Oriental and Nearctic Regions (GOETGHEBUER 1940-1950, THIENEMANN 1944, BRUNDIN 1947, 1956, TOKUNAGA 1964, SÆTHER 1969, 2005, SASA 1979, ROSSARO 1982, CRANSTON et al. 1989, SOPONIS 1990, LANGTON & CRANSTON 1991, SASA & OKAZAWA 1992, LINDEGAARD 1995, CALDWELL 1998, ROSSARO & CASALEGNO 2001, ROSSARO et al. 2003, SPIES & SÆTHER 2004, MAKARCHENKO & MAKARCHENKO 2006, 2008, 2011, LANGTON & PINDER 2007, ASHE & O'CONNOR 2012, SÆTHER & SPIES 2013, MOUBAYED-BREIL & ASHE 2016, MAGOGA et al. 2017, STUR & EKREM 2020, MOUBAYED-BREIL & GARRIGUE 2021, MOUBAYED-BREIL et al. 2021, MOUBAYED et al. 2022, ROSSARO et al. 2022). In New Caledonia, only the generic level *Orthocladius* has been reported (MOUBAYED-BREIL et al. 2021). In this paper, the male adult of *Orthocladius* (*O.*) *taonus* sp. n. is illustrated and described based on material collected in the waterfall of Tao (Tao stream, Mont Panié, northern New Caledonia, alt. 84 m).

2. Material and methods

A large material composed of adults, pupae, pupal exuviae and larvae were collected between 1996 and 2022 in New Caledonia, using Surber, drift and swift nets and Malaise traps. Examination of the captured imagines revealed the presence of one undescribed *Orthocladius* species. After preservation in 80-85% ethanol, the studied male adults were examined and mounted on slides following the procedure outlined by SÆTHER (1969) and MOUBAYED & LANGTON (2019). The morphological nomenclature and measurements of the adults follow those of SÆTHER (1980) and LANGTON & PINDER (2007).

Photo 1. Type-locality of *Orthocladius taonus* sp. n. (Photo N. Mary).

Photo 1. Localité-type d'*Orthocladius taonus* sp. n. (Cliché N. Mary).

3. Results and description

Orthocladius (*Orthocladius*) *taonus* sp. n.

Material examined.

Holotype. New Caledonia, Mont Panié. 1 male adult captured by swift net at the Tao waterfall ((164°48'22.65"E; 20°33'42.32"S); lotic habitat densely covered with carpet of bryophytes and aquatic microalgae (Photo 1); site n° 15 as reported in MOUBAYED-BREIL et al. 2021 (table VI); altitude 84 m, 14.XI.2012 (N. Mary leg.).

Paratype. 1 male adult, same locality and date as for holotype (N. Mary leg.).

Holotype (mounted on one slide) is deposited in the collections of the 'Musée cantonal de Zoologie, Palais de Rumine, 6 place de la Riponne, CH-1014 Lausanne (MZL), Switzerland'. The paratype is deposited in the collection of the senior author.

Etymology: the name *"taonus"* of the new species refers to the well known 'waterfall of Tao', which is located in the down basin of Tao stream (Mont Panié, northern New Caledonia).

Diagnostic characters

The following combination of distinguishing characters will separate the new species from other related congeners. Head. Frontal tubercle triangular, coronals absent; temporals 11-12; antenna 587 µm long, last flagellomere 237 µm long, AR 0.68. Clypeus shiel-like shaped; palpomer 3 with 3 sensilla coeloconica. Thorax. Lobes of antepronotum not gaping; acrostichals 19; dorsocentrals 11; prealars 4; humeral pit indistinct; scutellars 6, median setae longer; wing with 2-3 setae on vein R, squama with 7-8 setae. Legs. Tarsomeres 4 of PII-PIII subequal; sensilla chaetica present on tarsomeres ta_1-ta_s. Hypopygium. Phallapodeme typically characteristic, aedeagal lobe butsher's knife shaped. Anal point triangular, markedly wider at base, apex rounded, bearing about 22 setae including 12 located laterally (6 on each side). Virga absent. Junction of gonocoxites distinctly circular, distal part triangular, typical Omega shaped; superior volsella large lobe-like; inferior volsella long, cylindrical to thumb shaped, setulose with truncate apex. Gonostylus linearly elongate (not *Orthocladius*-type), with unusual appearancer in the subgenus *Orthocladius*; anterior side densely covered with orally directed fine setae; posterior side rounded; crista dorsalis absent; megaseta well-developed, parallel sided, apex rounded, inwardly curved distally.

Male imago

(n = 2 male adults; Figs 1A-L)

Medium sized species. Total length 3.20 mm. Wing length 1.10 mm. TL/WL = 2.91. General colouration brownish with contrasting dark brown to dark brown head, mesonotal strips and scutellum; head brownish with dark brown eyes and pedicels; antenna, legs and anal segment brownish; wing pale brown. Head (Fig. 1A). Eyes bare, hairs absent on inner lateral margin; temporals consist of 11-12 setae including 8-9 inner and 3 outer verticals; postorbital absent. Antenna 13-segmented, 587 µm long, last flagellomere (Fig. 1B) 237 µm long, clubbed apically, with numerous apical sensillae chaetica; segments 2-4, 25 µm long; segments 5-12, subequal, 30 µm long; antennal groove beginning on segment 3; AR 0.68. Clypeus (Fig. 1C) 75 µm long, 80 µm maximum width, typically shield-like shaped, median part smoothly swollen, apex rounded; with 11 setae in 3 rows. Palp unusually 4-segmented, segments 1-2 fused; palpomere 3 (Fig. 1D) with 4 sensilla chaetica and 3 characteristic pin-like pre-apical sensilla coeloconica (Fig. 1E); length (in µm) of segments: 15, 25, 55, 27; segment four much shorter than the third. Thorax. Lobes of

antepronotum (Fig. 1F) not gaping; antepronotals 5; acrostichals 19 uniserial; dorsocentrals consist of 11 decumbent setae in 1 row; prealars 4 uniserial; humeral pit indistinct; scutellum with 6 setae inserted in 1 row (3 on each side of the midline), median setae much longer, about 120-130 µm long; preepisternum bare. Wing. Brachiolum with 1 seta; subcosta extending beyound the fork of the radius; costal expansion about 30 µm long; number and distribution of setae on veins: R, 2-3; remaining veins bare; squama with 7-8 long stout setae in 1 row. Legs. Tarsomeres 4 of PI-PII subequal; tibial spurs present on PI-PIII. Length (in µm) of spurs: 45 (PI); 35, 25 (PII-PIII); sensilla chaetica present only on tarsomeres ta_1-ta_4 of PI-PIII. Length (µm) and proportions of prothoracic (PI), mesothoracic (PII) and metathoracic (PIII) legs as in the following table:

	fe	**ti**	**ta_1**	**ta_2**	**ta_3**	**ta_4**	**ta_5**	**LR**	**BV**	**SV**	**BR**
PI	870	465	265	215	135	75	65	0,57	3,27	5,04	2.20
PII	455	395	225	90	65	45	45	0,57	4,39	3,78	3.10
PIII	450	435	235	135	105	55	50	0,54	3,25	3,77	4.0

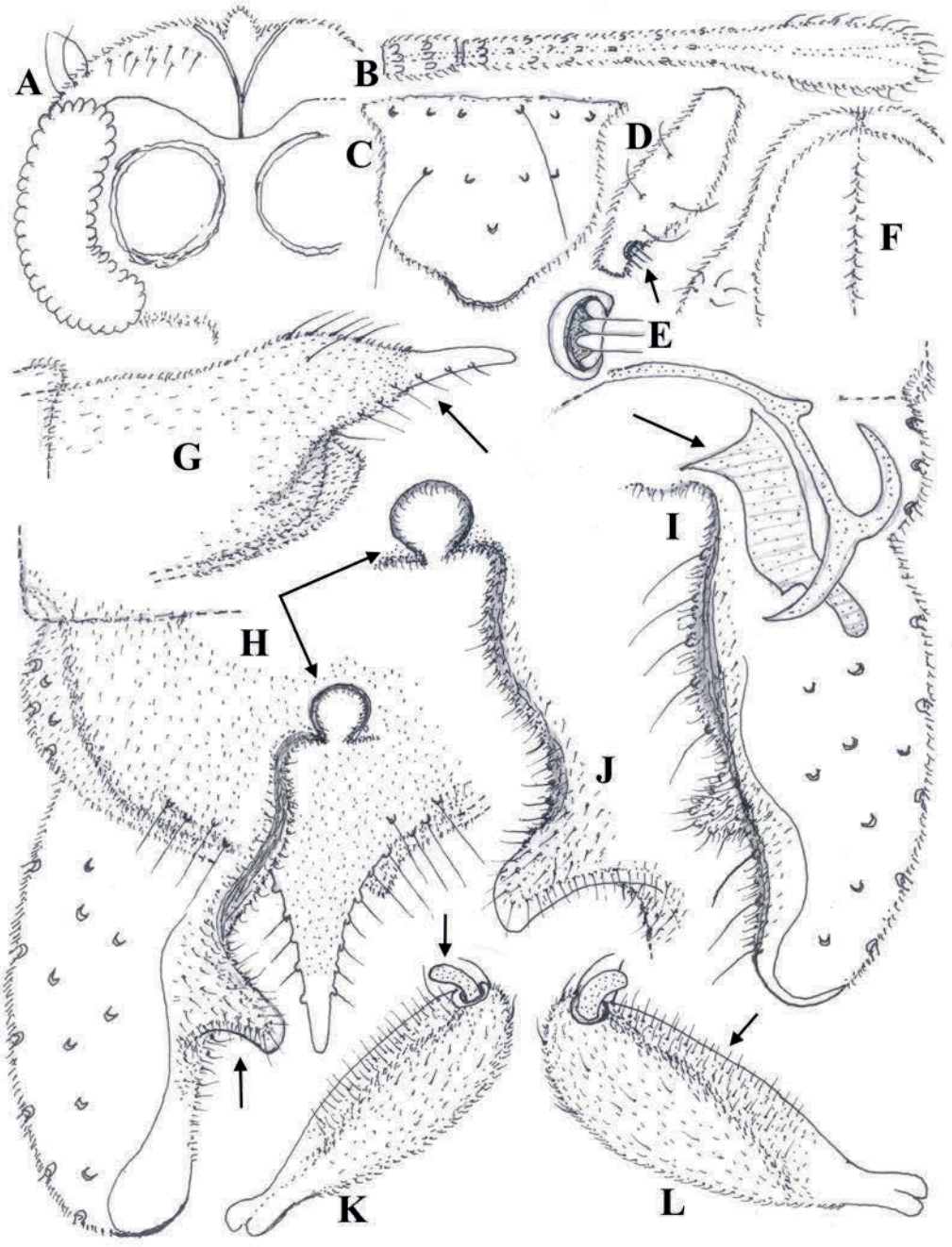
"LR = Length of tarsomere ta_1 divided by length of tibia (ti); BV = Combined length of femur (fe), tibia and ta_1 divided by combined length of tarsomeres ta_2-ta_5; SV = Ratio of femur plus tibia to tarsomere ta_1; BR = Ratio of longest seta of ta_1 divided by minimum width of ta_1, measured one third from apex."

Abdomen. Hypopygium as in Figs 1H (dorsal) and 1I (ventral, with tergite IX and anal point removed). Tergite IX broadly subrectangular with rounded posterior margin; dorsal margin without hump, posterior margin with 4-6 setae located laterally close (2-3 on each side). Laterosternite IX with 10 setae (5 on each side). Anal point (Figs 1H, dorsal; 1G, lateral) about 40 µm long, 65-70 µm maximum width at base, broadly triangular, markedly wider at base; apex rounded, slightly pointed in lateral view; reaching tip of inferior volsella, with 22-23 setae including 12 located laterally (6 on each side); dorsal hump (Fig. 1G) weak, present at base of anal point. Apodemes as in Fig. 1I, transverse sternapodeme rounded; phallapodeme typical butcher's knife to saw-like shaped, aedeagal lobe well-developed. Virga absent. Gonocoxite with rounded apex; dorsal side with sclerotization on proximal half of the inner margin; ventral side with sclerotization covering the entire inner margin, which is bearing 10 stout inner setae; junction of gonocoxites (Figs 1H, J) markedly circular, triangular distally giving appearance of the letter omega; superior volsella low, weakly swollen; inferior volsella long, cylindrical to thumb shaped, setulose with truncate apex. Gonostylus linearly elongate, not *Orthocladius*-type, with unusual appearance in the subgenus *Orthocladius*; anterior side densely covered with orally directed fine setae; posterior side rounded; crista dorsalis absent; megaseta well-developed, parallel sided, distal part inwardly curved, apex rounded. HR (length of gonocoxite divided by length of gonostylus) 2.0; HV (total length divided by length of gonostylus X 10) 2.67.

Female adult, pupal exuviae and larva: unknown.

P. 35. Figure 1. Male imago of *Orthocladius taonus* sp. n. Head (left side, dorsal), frontal area, vertex and temporal setae (A); antenna, two last segments (B); clypeus (C); palpomere 3 (D); sensilla coeloconica on palpomere 3 (E); lobes of antepronotum with acrostichals (F); tergite IX and anal point in lateral view (G); hypopygium in dorsal (H) and ventral view (I); inferior volsella, right side (J); gonostylus at acute (K) and obtuse angle (L). The arrows indicate some distinguishing characters.

P. 35. Figure 1. Imago mâle d'*Orthocladius taonus* sp. n. Tête (côté gauche, vue dorsale), aire frontale, vertex et soies temporales (A) ; antenne, deux derniers segments (B) ; clypéus (C) ; palpomère 3 (D) ; sensilla coeloconica, palpomère 3 (E) ; lobes de l'antépronotum avec soies acrosticales (F) ; tergite IX et pointe anale en vue latérale (G) ;hypopyge en vue dorsale (H) et ventrale (I) ; volselle inférieure, côté droit (J) ; gonostyle, angle aigu (K) et angle obtus (L). Les flèches indiquent quelques caractères distinctifs.


A
B
C
D
E
F
G
H
I
J
K
L

4. Remarks

The following combination of distinguishing morphological characters will easily separate *O. taonus* sp. n. from other related congeners:

- Junction of gonocoxites (Figs 1H, J), circular with a typical Omega appearance, represents a specific relevant character, which is similarly observed in other *Orthocladius* subgenus:

- *O. decoratus* (Holmgren, 1869) as figured in STUR & EKREM 2020 (Figs 49c-d) and ROSSARO et al. 2003 (Fig. 1);

- *O. oblidens* (Walker, 1856) and *O. pedestris* Kieffer, 1909 (ROSSARO et al 2003, Figs 17, 20c);

- Anterior side of gonostylus (Figs 1K-L), finely covered with orally directed setae, represents an unusual character in the subgenus *Orthocladius*.

Based on the above cited atypical characters found in the male adult, the new described species can be considered as a local biogeographic representative of New Caledonia and the Australasian Region.

5. Ecology and geographical distribution

Larvae of the genus *Orthocladius* occur in all types of flowing water, in particular rifles and waterfalls. Representatives are rheophilic in general but can be found in swamps, moist soils, thermal water and hygropetric faces. Type material of the new species was captured in Tao stream, where sandy to gravely substrata and hygropetric faces supplied by fresh water maintain lower annual variation of temperature. Type-locality (Mont Panié, Tao waterfall, alt. 84 m, Photo 1) includes rocks and stones covered by submerged and emerged bryophytes and microalgae, which represent the favourable microhabitats for larval populations.

Environmental data of water recorded along the Tao stream are: water with very low value of conductivity (30 µS/cm); pH 6.8; temperature, minima 16-18, maxima 23-24°C.The biological and ecological quality of many streams over the coastal ecosystem in New Caledonia is now heavily threatened and affected by increasingly greater risk of human activities (pollution, use of pesticides, ecotourism, mine exploration, etc.). The new species belongs to the large community of threatened species, which are believed to be a biological indicator of pristine waterfalls. It may be biogeographic representatives of global warming and local climate change, and therefore deserve greater consideration and conservation measures. *O. taonus* sp. n. appears to belong to a typical Australasian rheophilic element of lower stretches over the New Caledonian streams and rivers. This highlights and indicates that it is likely more widespread in similar lotic habitats located in New Caledonia.

Acknowledgements

This study forms a part of the faunal inventory of 'patrimoine naturel' (*inpn.mnhn.*fr), which is supported in 2022 by the 'UMS PatriNat (OFB-CNRS-MNHN, Paris).

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