Protist, Vol. 169, 494–506, xx 2018
http://www.elsevier.de/protis
Published online date 26 May 2018

Protist

ORIGINAL PAPER

The Little-known Freshwater Metopid Ciliate, *Idiometopus turbo* (Dragesco and Dragesco-Kernéis, 1986) nov. gen., nov. comb., Originally Discovered in Africa, Found on the Micronesian Island of Guam

William Bourland[a,1], Johana Rotterová[b], Xiaotian Luo[c], and Ivan Čepička[b]

[a]Department of Biological Sciences, Boise State University, Boise, ID 83725-1515, USA
[b]Department of Zoology, Faculty of Science, Charles University, Prague, Czech Republic
[c]Institute of Evolution and Marine Biodiversity, Ocean University of China, Qingdao, China

Submitted March 1, 2018; Accepted May 18, 2018
Monitoring Editor: Michael Melkonian

Class Armophorea Lynn, 2004 includes two orders of mainly free-living anaerobic ciliates, Armophorida Jankowski, 1980 and Metopida Jankowski, 1980 and, a third, the exclusively endosymbiotic Clevelandellida. Kahl described the majority of free-living metopid species early in the 20th century. Excepting Jankowski in the 1960's, little further interest was shown in this group. *Metopus turbo* Dragesco and Dragesco-Kernéis, 1986, from a West African pond, was more recently described. Although not explicitly described as endemic, Dragesco believed in some degree of endemism of sub-Saharan ciliates. Our discovery of *M. turbo* on Guam, Micronesia was unexpected. *Metopus turbo* was identified by live observation, protargol impregnation, and scanning electron microscopy, providing reasonable evidence of conspecificity when compared with the original description. Outstanding morphologic features include the stout shape and transversely situated bandform macronucleus. The morphology of *Metopus turbo* differs markedly from that of the *Metopus*/*Brachonella* clade and is distant from *Metopus es* in phylogenetic analyses. The 18S rDNA sequence of the Guam *M. turbo* differs from that of *M. es*, type species of *Metopus*, by >8% and shows distinct morphologic differences from the genus *Atopospira* to which it is sister. These facts suggest that transfer to a new genus, *Idiometopus* gen. nov. is indicated.

Key words: Armophorea; anaerobic ciliates; Metopida; phylogeny; protargol; 18S rRNA gene.

Introduction

Class Armophorea Lynn, 2004 comprises three orders inhabiting hypoxic environments, two consisting predominantly of free-living ciliated protists, namely Armophorida Jankowski, 1980 and Metopida Jankowski, 1980, and a third, the endosymbiotic Clevelandellida de Puytorac and Grain, 1976. Kahl described a large majority of known free-living metopids early in the 20th century and, with the exception of Anatole Jankowski in the 1960's, there was little further interest in this group. How-

[1]Corresponding author;
e-mail willbour@me.com (W. Bourland).

https://doi.org/10.1016/j.protis.2018.05.004

ever, a novel metopid, *Metopus turbo* Dragesco and Dragesco-Kernéis, 1986 from a temporary pond in the Republic of Benin (West Africa) was described more recently (Dragesco and Dragesco-Kernéis 1986). *Metopus turbo* was not explicitly described as an endemic species, but Dragesco believed in at least some degree of endemism in the ciliates of sub-Saharan Africa (Dragesco 1973). In their valuable monograph on the free-living ciliates of intertropical Africa he and his co-author state "Endemism, although slight, is nevertheless significant, and thus one may speak of typically African species of ciliates" (Dragesco and Dragesco-Kernéis 1986). Thus, we were surprised to recover a population of ciliates, likely conspecific with one such "African ciliate", *M. turbo*, from Guam, the southernmost of the Marianas islands of Micronesia. The original description of the African population was rather superficial and there are no molecular data from the African population.

In this report, we provide a redescription based on additional modern methods (fluorescence and scanning electron microscopy and 18S rRNA gene analyses) and morphometrics. We assess the phylogenetic position of this interesting species and discuss the biogeographical implications and possible mechanisms of dispersal that might explain how this species came to inhabit the island of Guam.

Results and Discussion

Terminology. Terminology follows Lynn (2008), Foissner and Agatha (1999), and Bourland et al. (2014).

Redescription of *Idiometopus turbo* (Dragesco and Dragesco-Kernéis, 1986**) nov. gen., nov. comb. based on the Guam population (**Table 1, Figs 1–5**).** Size in vivo 69–94 × 64–79 μm, about 80 × 70 μm on average ($n = 16$), protargol impregnated specimens 59–85 × 58–85 μm, about 70 × 70 μm on average ($n = 30$). Cell shape in vivo highly consistent (L:W ratio 1.1 on average, coefficient of variation 4.4%), barrel-shaped to almost spherical; preoral dome broadly convex except for trough-like dorsal depression (Figs 1B; 5A, C) twisted leftward, extends only slightly beyond right and left postoral body margins; posterior end broadly truncate to obconical, inconspicuous cusp on the right posterior margin (Figs 1A–F; 2B). Macronucleus in anterior ½ of cell, usually in preoral dome, long, narrow, sometimes twisted, band form, usually transversely oriented in C-configuration (about 84 × 6 μm on average in protargol-impregnated specimens), numerous 1–3 μm- diameter nucleoli in protargol-impregnated specimens. Micronucleus inconspicuous in vivo, usually adjacent to midportion of macronucleus (Figs 1A, B; 3A–F). Contractile vacuole, terminal, large (Figs 1A; 2B, C). Cytoproct terminal (Figs 2E; 3C). Cortex, inflexible, distinct kinetal furrows (video clip; Figs 1A; 2D; 5A–D). Cytoplasm hyaline, colorless, food vacuoles numerous, up to 15 μm in diameter. Cytoplasmic methanogenic prokaryotes not visible in vivo but clearly present with UV fluorescence examination (Fig. 2F, G). Swims rapidly with frequent, abrupt changes in course, rotation on long axis intermittent, ratchet-like (video clip).

Ordinary somatic cilia about 9 μm long, perizonal stripe cilia about 15 μm long, several elongated posterior cilia up to 20 μm long. Ciliary rows composed of dikinetids, both dikinetids in dome region ciliated, usually only posterior basal body ciliated in the postoral body. Postoral ciliary rows, i.e. those terminating anteriorly near the posterior border of the peristome, only slightly spiraling rightward, preoral dome kineties (4 on average) slightly crowded in right dorsolateral trough-like depression between the proximal and distal ends of the perizonal stripe, sigmoid, i.e. curve strongly rightward onto preoral dome then curve sharply left, broad (about 30 μm wide) glabrous gap between dome kinety 1 and perizonal stripe row 5 (Figs 1B; 5A–D). Dikinetids of widely spaced dome kineties densely spaced; ciliary pattern of the right postoral area highly variable, from short closely spaced organized kineties (Fig. 3E) to disordered dikinetids, or even short zigzag files, bordering a small, barren triangular area (Figs 1C; 3A, C; 5A, C). Perizonal stripe circumferential, composed of completely ciliated dikinetids, slightly spiral with distal end slightly anterior to proximal end (Fig. 5D), almost invariably 5-rowed (one cell observed with 6 rows, Fig. 3C), composed of many (111 on average) small, staggered false kineties, rows 1–3 densely spaced and rows 4, 6 more widely spaced (Figs 1B, C; 3A–C, F).

Adoral zone parallel to, same length as, the perizonal stripe, composed of about 60 small (2.5–7.0 μm at base) membranelles (Figs 1D, 3B; 5D). Paroral membrane stichomonad, i.e. a single file of ciliated basal bodies, on undersurface of preoral dome, does not protrude from buccal cavity (Figs 3B, E; 5D). Pharyngeal fibers inconspicuous in vivo, form prominent tulip or bulb-shaped basket in protargol impregnated specimens (Figs 1C; 3D, E).