

SHORT NOTE

# Report of epibiont ciliates (Ciliophora) on harpacticoid copepods from Caribbean mesophotic reefs

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**Abstract:** The paper dealt with the description of ciliate epibionts on copepods from mesophotic reefs located in Puerto Rico. The trophonts of the suctorian ciliates *Thecacineta calix* and *Trichophrya odontophora* as well as phoronts of the apostome ciliate *Vampyrophrya* sp. were investigated and described. The two latter species were observed at shallow and mesophotic coral ecosystems and on harpacticoid copepod hosts for the first time.

**Résumé :** Signalement d'épibiontes ciliés (Ciliophora) sur les copépodes harpacticoides des récifs mésophotiques caribéens. L'article traite de la description des épibiontes ciliés sur les Copépodes des récifs mésophotiques situés à Porto Rico. Les trophontes de ciliés suctoriens *Thecacineta calix* et *Trichophrya odontophora* ainsi que les phorontes de l'apostome cilié *Vampyrophrya* sp. ont été étudiés et décrits. Les deux dernières espèces ont été observées pour la première fois dans des écosystèmes coralliens peu profonds et mésophotiques et sur des copépodes harpacticoides.

**Keywords:** Suctorian ciliate • Apostome ciliate • Epibiosis • Meiobenthic host • MCEs

## Introduction

A number of epibiont ciliates have been observed on the cuticle of various species of copepods (e.g., Sewell, 1951; Fernandez-Leborans & Tato-Porto, 2000a & b; Fernandez-Leborans et al., 2012; Chatterjee et al., 2013 & 2014; Clamp et al., 2016). The term "epibiont" includes any organisms that are

attached during the sessile phase of their life cycle, to the surface of a living substratum, while the basibiont lodges and constitutes a support for the epibiont. Most reports of marine ciliate epibionts are coming from coastal, shallow water ecosystems. Under the auspices of Deep Deep-CRES, a NOAA funded project to explore the diversity of mesophotic coral ecosystems (MCEs) of Puerto Rico, we have undertaken a decade long effort to study the meiofauna and macrofauna of these twilight habitats (e.g. Petrescu et al., 2016 and references herein).

Mesophotic coral reef ecosystems are warm water, photosynthesis-dependent reef communities starting at 30-40 m and depending on the water clarity they may extend down to 150 m in some regions. Luscious sponges, macroalgae and corals dominate the mesophotic landscape however, most of the metazoan biodiversity lies on the hidden macrofaunal and meiofauna. Another layer of this hidden biodiversity lays on the ectoparasites/ectocommensals and endoparasites of macrofaunal and meiofaunal organisms.

In this paper we provide a description of ciliate epibionts on harpacticoid copepods from MCEs located in southwest Puerto Rico (Fig. 1, asterisks showing collection locations).

## Material and methods

Technical divers equipped with Tri-Mix Rebreathers collected substrata (loose rubble, corals, sponges, algae) from various depths and placed them in sealed plastic bags. The substrata (samples) were placed on sieves and washed with filtered seawater. The portion of fauna retained on the 0.125 mm sieve was preserved in 95% ethanol. Individual harpacticoid copepods infested with ciliates were individually picked with the aid of an Olympus SZX dissecting scope.

The systematic position of suctorian ciliates follows Dovgal (2002 & 2013), whereas the position of apostome ciliates follows Lynn (2008). Measurements were carried out on four specimens using the program Toup View 3.7 for digital camera. Specimens are kept in the collection of the second author (Igor Dovgal, A. O. Kovalevsky Institute of Biology of the Southern Seas, Sevastopol, Russia).

## Results and Discussion

### Phylum CILIOPHORA Doflein, 1901

Subphylum Intramacronucleata Lynn, 1996  
Class Suctorea Claparède & Lachmann, 1859  
Subclass Exogenia Collin, 1912  
Order Vermigemmidia Jankowski, 1973  
Family Thecacinetidae Matthes, 1956  
Genus *Thecacineta* Collin, 1909

***Thecacineta calix*** (Schröder, 1907)  
(Fig. 2A)

### Material examined

Two epibiont specimens were collected on a harpacticoid copepod from Bajo de Sico

(18°14'41.676"N- 67°24'45.791"W), a mesophotic reef formation located in Mona Passage of Puerto Rico (Fig. 1, collection site 1), 70 m depth, during the 2012 Mesophotic Cruise of the Department of Marine Sciences at the University of Puerto Rico at Mayagüez (DMS-UPRM) (Sherman et al., 2013), date of collection: 27<sup>th</sup> April, 2012, coll. Nikolaos V. Schizas.

### Brief description and morphometric measurements from new find

Marine loricate suctorian. Cell body entirely fills the lorica and attaches to its base. Lorica ribbed with a series of transverse annular ridges that become progressively closer toward the base. Apical part of body protrudes beyond lorica aperture. Up to 30 clavate tentacles arise from apical surface of body. Macronucleus ovoid, located in the basal region of the cell body. Large contractile vacuole located in the basal region of body usually near macronucleus. Lorica length 57-62 µm; Lorica width 31-36 µm; Length of body 32-39 µm; Width of body 18-20 µm.

### Remarks

*Thecacineta calix* was earlier recorded from the US Caribbean: St. John (U.S. Virgin Islands); Caja de Muertos Island, and Buoy (La Parguera), both locations from Puerto Rico. All suctorian ciliates were infecting harpacticoid copepods (Chatterjee et al., 2014).

The present record of *T. calix* from another location of Puerto Rico, Bajo de Sico indicates that this species is a very common epibiont on harpacticoid copepods in Puerto Rico and other near by Caribbean islands. Distribution of *T. calix* and host specificity was given in detail in Chatterjee et al. (2019).

Subclass Endogenia Collin, 1912  
Order Trichophryida Jankowski, 1978  
Family Trichophryidae Fraipont, 1878  
Genus *Trichophrya* Claparède & Lachmann, 1859

***Trichophrya cf. odontophora*** Sand, 1899  
(Fig. 2B & C)

Syn. *Erastophrya odontophora* (Sand, 1899) Curds, 1985

### Material examined

One specimen on a harpacticoid copepod collected from the mesophotic reef El Hoyo (17°52'35.6"N-67°02'26.2"W), La Parguera, Puerto Rico, (November

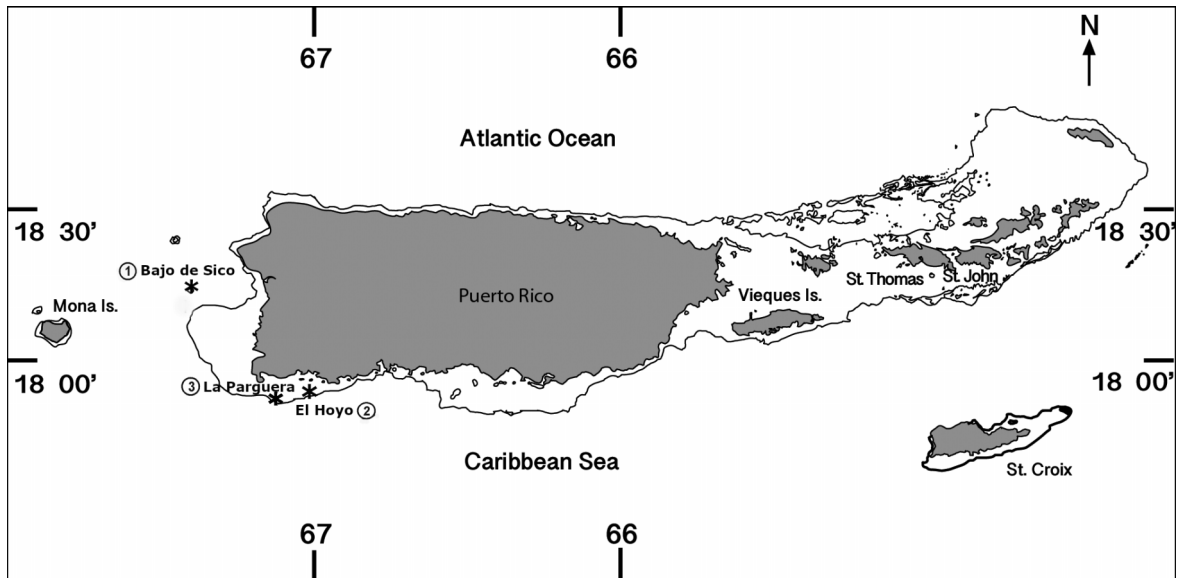


Figure 1. Map of the study area and location of the sampling site (\*).

16, 2007) at 64 m depth (Fig. 1, collection site 2), coll. Nikolaos V. Schizas.

#### sBrief Description

Medium (80-90  $\mu\text{m}$  long), marine suctorian whose shape is irregularly ovoid. Actinophores, lorica and stalk are absent. There are 3 posterior cytoplasmic extensions that may be used as organelles of attachment. The capitulate tentacles are restricted to the anterior half of the body. Macronucleus centrally located. There are 2 contractile vacuoles located in the anterior third of the body.

#### Remarks

The genus *Trichophrya* includes freshwater and marine suctorian species attached to the substrate by the basal surface of the body without a stalk. The body is unramified and unloricate or covered by mucous lorica. Tentacles are capitulate or rod-like, arranged in fascicles or rows rarely on poorly developed actinophores. Several species are commensals or parasites of aquatic invertebrates and vertebrates.

There are 11 species in the genus *Trichophrya*, three of which viz. *T. salparum* Entz, 1884, *T. odontophora* Sand, 1899 and *T. morchellii* Tregouboff, 1916 are marine, all reported from the Mediterranean Sea. *T. salparum* Entz, 1884 was first described as epibiont on salp *Thalia democratica* Forskål, 1775 near Napoli, Italy (Entz, 1884). *T. odontophora* Sand, 1899 was described from Concarneau, France, found

among algae attached to port facilities (Sand, 1901) and *T. morchellii* was reported as epibiont on *Morchellia umargus* (Milne Edwards, 1841) from Villefranche-sur-Mer, France (Tregouboff, 1916). *T. odontophora* and *T. morchellii* have not been reported again since their first description. Flood et al. (2015) reported *T. salparum* on the scyphozoan *Pelagia noctiluca* Forskål, 1775 from Villefranche-sur-Mer, France.

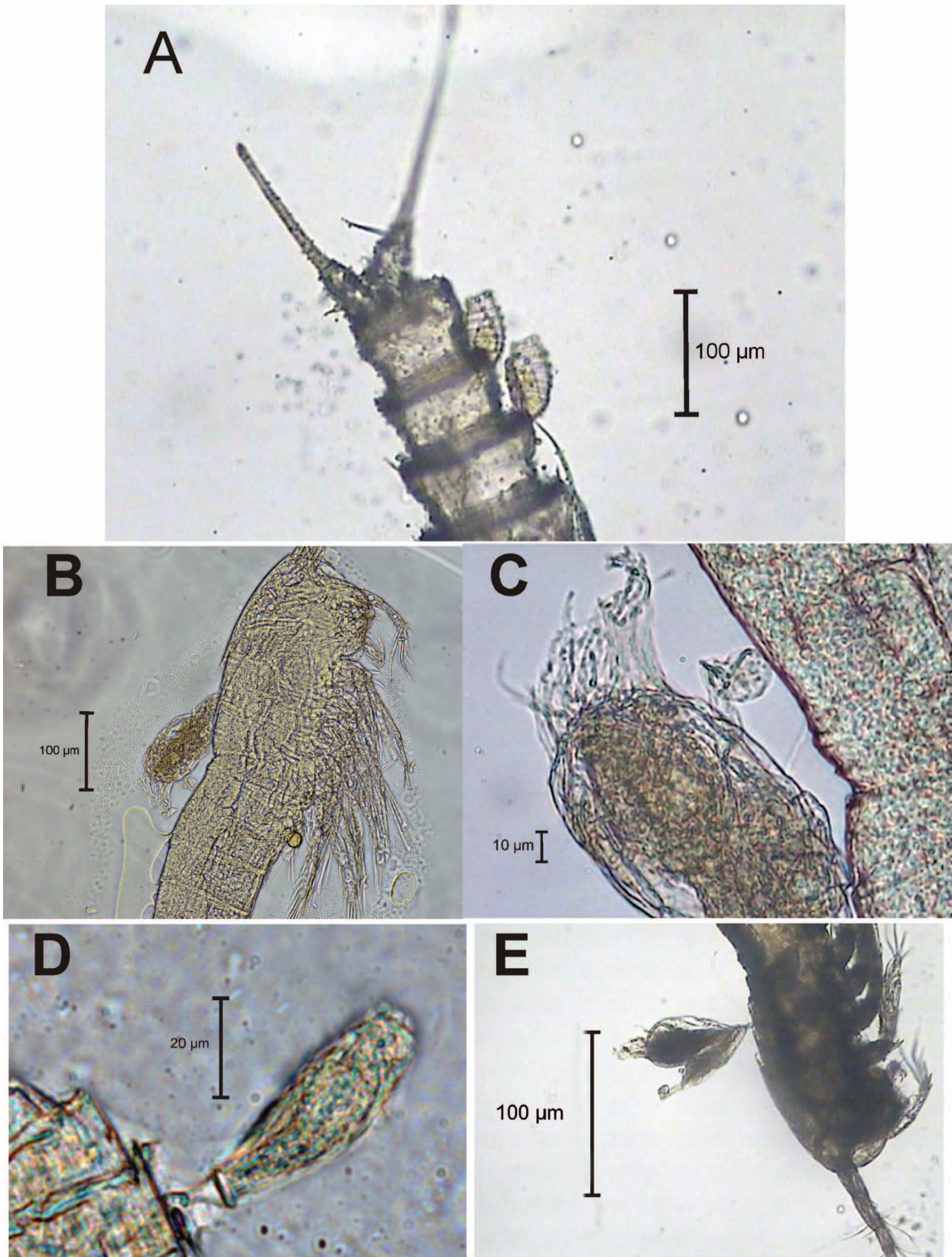
The *Trichophrya* specimen from El Hoyo, Puerto Rico is similar to *Trichophrya odontophora* Sand, 1899 (collected from marine algae) and *T. morchellii* Tregouboff, 1916 (found on tunicates of the genus *Morchellium*). However, the latter species has elongated, band-like macronucleus, whereas in *T. odontophora* the macronucleus is small, compact, and ovoid, similar to the specimens from Puerto Rico. Hence, the ciliate from El Hoyo can be tentatively identified as *Trichophrya odontophora*.

This is the first record of a representative of the genus *Trichophrya* from a copepod host and the first observation from a coral reef ecosystem.

Class Oligohymenophorea de Puytorac et al., 1974  
Subclass Apostomatia Chatton & Lwoff, 1928  
Order Apostomatida Chatton & Lwoff, 1928  
Family Foettingeriidae Chatton, 1911  
Genus *Vampyrophrya* Chatton & Lwoff, 1931

Phoront (cyst) stage of apostome ciliate  
***Vampyrophrya* sp.**  
(Fig. 2D & E)





**Figure 2.** Ciliate species found in Caribbean reefs. **A.** *Thecacineta calix*. **B & C.** *Trichophrya cf. odontophore*. **D & E.** *Vampyrophrya* sp. - Phoront stage.

### Material examined

Two specimens on harpacticoid copepods from south west Puerto Rico (various depths and dates from 2005-2015), La Parguera, 17°52'06.3"N-67°05'31.1"W, (Fig. 1, collection site 3), coll. Nikolaos V. Schizas.

### Description

Phoronts of apostome ciliates with elongate ovoid body, with folded envelop, tapering to the free, distal end, supported by a short, stout stalk. Macronucleus is band-like.

### Measurements (in $\mu\text{m}$ )

Body length 54-57; body width 20-29; length of stalk 6-13.

### Remarks

The species of the genus *Vampyrophrya* at the phoront stage are generally found on the cuticle of calanoid copepods. They transform to the trophont stage, which feeds on crustacean tissues, following eating of copepod hosts by the gelatinous zooplankters such as scyphozoans, siphonophores, or ctenophores (Grimes & Bradbury, 1992; Ohtsuka et al., 2004; Dovgal, 2016).

Phoronts of the genus *Vampyrophrya* are the only apostome phoronts that bear a stalk. Phoronts of apostome ciliates (similar to those observed in Puerto Rico) were found on calanoid copepods and named "short-stalked forms" (Sewell, 1951). Chatton & Lwoff (1935) stated that cysts of this particular type have been found on several species of Copepoda, and should be considered as representatives of the family Foettingeriidae. Representatives of *Vampyrophrya* had been observed only on calanoid copepod hosts (Chatton & Lwoff, 1935), however, Ohtsuka et al. (2004) found *V. pelagica* (Chatton & Lwoff, 1930) on the harpacticoid copepod *Euterpina acutifrons* (Dana, 1847). *Euterpina acutifrons* is a member of estuarine zooplankton, therefore all *Vampyrophrya* specimens had been collected from water column copepods, before the current study. In contrast, the harpacticoid copepods hosts we report here are associated with the benthos, indicating that *Vampyrophrya* specimens can be found readily in both benthic and water column copepod species. Species of other apostome genera have been recorded on harpacticoid copepods e.g., *Calospira minkiewiczzi* Chatton & Lwoff, 1935 on *Harpacticus gracilis* Claus, 1863, *Spirophrya subparasitica* Chatton & Lwoff, 1935 on *Tisbe furcata*

(Baird, 1837), and an unidentified apostome ciliate on *Euterpina acutifrons* (Dana, 1847) (Chatton & Lwoff, 1935).

As a rule, the apostome species are non-identifiable at the phoront stage. However, Chatton & Lwoff (1935) described a *Vampyrophrya* sp. only by specimens at phoront stages (Jankowski, 2007). The additional stages of the *V. pelagica* life cycle were described only recently (Grimes & Bradbury, 1992; Ohtsuka et al., 2004).

The available ciliate material is not sufficient for identification of our specimens to the species level. It is worth noting that phoronts of the current specimens differ from phoronts of *V. pelagica* by a more elongated shape and thin stalk. Thus, we identify the observed cysts as *Vampyrophrya* sp. which represents the first record of the genus *Vampyrophrya* at shallow and mesophotic coral ecosystems.

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