First record of a ciliate suctorian (Ciliophora, Suctorea) epibiont on the jellyfish *Pelagia noctiluca* (Scyphozoa, Semaeostomaeida)

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**Abstract**
In the course of a survey of a specimen of the jellyfish *Pelagia noctiluca* (collected at Villefranche-sur-Mer, France) using scanning electron microscopy, the suctorian ciliate *Trichophrya salparum* was found on the jellyfish exumbrella. This ciliate species is reported for the first time on a scyphozoan jellyfish host. A redescription of this suctorian species is presented together with data on its distribution and host prevalence.

**Key words**: suctorian ciliates, jellyfish, epibiont.

**Introduction**
Suctorians (class Suctorea) is a peculiar group of carnivorous or parasitic ciliates. The majority of these ciliates are commensals of various aquatic invertebrates or vertebrates (Dovgal 2002, 2013). A few findings of suctorians on cnidarians have been reported, but never on scyphozoan jellyfishes. For example, some representatives of genus *Ephelota* Wright, 1858 were found on hydroids (Yagi 1980, Tazioli & Di Camillo 2013).

As part of bioluminescence studies conducted by of one of us (PRF) a specimen of *Pelagia noctiluca* Forskål, 1775 was examined in a scanning electron microscope and unexpectedly revealed the presence of some 20 suctorian ciliates identified as *Trichophrya salparum* Entz, 1884.

This is probably the first report of a suctorian ciliate from this host group. Moreover, as *T. salparum* rarely has been collected, we give an updated description of this species based on our finding.

**Material and Methods**
The suctorian specimens used in the present study were accidentally found attached to the exumbrella of a *P. noctiluca* (Scyphozoa, Semaeostomaeida) prepared for scanning electron microscopy. This jellyfish had a dome diameter of ~2cm and was collected at Villefranche-sur-Mer, France, in July 1995. The whole specimen was fixed in 2% glutaraldehyde in 40mM sodium cacodylate (pH = 7.4) and 0.5M sucrose before transport to Bergen, Norway. Upon arrival there, tissue blocks of the exumbrella near the marginal lappets of...
the jellyfish dome were rinsed in isotonic buffer, postosmicated, rinsed, dehydrated in ethanol and critical point dried from liquid CO$_2$. After mounting on a specimen support the tissue was sputter-coated by a thin layer of gold/palladium. About 20 years later (!) the tissue was examined in a Zeiss Supra 55VP field emission scanning electron microscope operated at 5 kV with an “in-lens” secondary electron detector.

All measurements were made by a mm-ruler on paper copies of digital images at 3000 to 10000 times magnification.

Results

Subclass **Endogenia** Collin, 1912  
Order **Trichophryida** Jankowski, 1978  
Family **Trichophryidae** Fraipont, 1878

Genus **Trichophrya** Claparede & Lachmann, 1859

**Trichophrya salparum** Entz, 1884  
(Fig. 1-5).

**Diagnosis.** Unloricate, unstalked suctorian ciliate. The body is somewhat hemispheric or saddle-shaped, with a large, flat base. There are two (rarely one) bundles of capitate tentacles. There are from four to 32 tentacles in each fascicle. Their diameter varied between 0.7 and 1.2 µm dependent on their degree of contraction. Tentacles are capitate with globular knobs covered by several smaller haptocyst dots. The cytoplasm is uncolored, but may contain some bright granules. The macronucleus is granular, and spherical or elongated. There are from one to three contractile vacuoles. Reproduction by multiple internal budding (Fig. 1c).

Measurements (in µm) based on 15 specimens: Body length (parallel to an axis passing through both tentacle fascicles) 20-42 (mean 27.8). Body width 12-32.9 µm (19.6). Length of tentacles from four (contracted) to 42 (extended). After literary data (Sand, 1901) body height 20-50, width 30-90.

**Figure 1.** *Trichophrya salparum* Entz, 1884 in agreement with different authors: a – trophont stage from *Molgula manhattensis* (after Colkins 1902); b - trophont (after Collin 1912); c – multiple internal budding (after Collin 1912); d – individual from *Pyrosoma elegans* named *T. salparum pyrosomae* (after Tregouboff 1916).

**Remarks.** Entz (1886) originally described the species from the Mediterranean Sea near Napoli (type locality) on salp *Thalisa democratica* Forskål, 1775 (type host).

However, the first find of suctorian ciliate on tunicates probably belongs to Lachmann (1859) who mentions the species *Trichophrya ascidiarum* found on sea squirts of the genus *Polycylindrum* Savigny, 1816 in the North Sea. Unfortunately, this species was not described by the author, thus the specific name *Trichophrya ascidiarum* Lachmann, 1859 is a nomen dubium.

Tregouboff (1916) described a subspecies of *T. salparum* named *T. salparum pyrosomae* Tregouboff, 1916 (Fig. 1d). However, *T. salparum* is an extremely variable species thus we believed there is no reason to divide the species into subspecies. Thus, *T. salparum pyrosomae* Tregouboff, 1916 syn. n. is a younger synonym of *T. salparum*. 
Figures 2-5. 2 Scanning electron micrograph of exumbrellar epithelium of *Pelagia noctiluca* with two nematocyst warts (W). Seven suctorian s are indicated by asterisks. 3 Scanning electron micrograph of a *T. salparum* attached to the exumbrellar epithelium of *P. noctiluca*. The knobs are prominent at the ends of the contracted tentacles. Several jellyfish cilia [c] reach above the epibiont. 4 Scanning electron micrograph of *T. salparum* with extended tentacles. 5 Scanning electron micrographic detail of the rim of the suctorion attachment surface towards the jellyfish exumbrellar epithelium (between arrowheads).
Among the 12 species that belong to the genus *Trichophrya* only three, including *T. salparum*, have from one to two tentacle fascicles: The other two are *T. angulata* Dangeard, 1890, and *T. brevis* (Goodrich & Jahn, 1943).

However, according to Dangeard’s (1890) observations *T. angulata* has exogenous budding thus affiliating the species to the *Trichophrya* is uncertain.

As for *T. brevis*, this species is likely to be a specific commensal of freshwater turtles. In addition, the curved or U-shaped (not rounded) macronucleus is characteristic for the latter species (Dovgal 1996, 2013).

The *T. salparum* was specified by Jankowski (1967) as a type species of genus *Actinobranchium* Jankowski, 1967. The lack of tentacle knobs were mentioned as a main characteristic of the genus (Jankowski 1981). However, as was shown of Dovgal (2002) there is a tentacle knob in the type species, and the generic name *Actinobranchium* was therefore synonymized with *Trichophrya*.

**Distribution and host prevalence.** After the first discovery of *T. salparum*, Calkins (1902) reported its presence on the branchial bars of the ascidian *Molgula manhattensis* De Kay, 1843 from the western Atlantic Ocean near Falmouth (Woods Hole) (Fig. 1a). Collin (1912) in the Mediterranean Sea near Sette (France) found later this species on *Thalia democratica* Forskål 1775 and *Salpa fusiformis* Cuvier, 1804 (Fig. 1b, c). Finally, Tregouboff (1916) observed the species on *Pyrosoma elegans* Lesueur, 1813 (Fig. 1d) from Villefranche-sur-Mer (France).

Thus, earlier the species has been found exclusively on tunicates. The lack of finds of *T. salparum* on scyphozoan jellyfishes is probably due to the difficulties in discovering a small epibiont ciliate on such thick and voluminous bodies.

We found 23 specimens of *T. salparum* attached directly to the exumbrellar epithelium of *Pelagia noctiluca* on a single SEM preparation. This covered some 7.5 mm² of the jellyfish dome and consisted of smooth parts separated by several nematocyst warts (Fig. 2), characteristic for this species. The suctorians were exclusively found on the smooth parts where the epithelial surface was covered by densely packed irregular microridges and occasional cilia (Figs. 3 & 4). Tiny microvilli also projected from the attachment surface of the suctoriant body towards the jellyfish tissue (Fig. 5).

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