Description of *Zoothamnium chlamydis* sp. n. (Protozoa: Ciliophora: Peritrichida), an Ectocommensal Peritrichous Ciliate from Cultured Scallop in North China

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**Summary.** The morphology, infraciliature and silverline system of an ectocommensal ciliate, *Zoothamnium chlamydis* sp. n., isolated from mantle cavity and on the shell surface of the cultured scallop, *Chlamys farreri* off the coast of Qingdao, China were studied from living and silver-impregnated specimens. The diagnosis for the new species is: marine *Zoothamnium* with alternatively branched stalk; zooids in vivo 50-90 x 25-60 µm, slender in shape with one layer of peristomial lip moderately everted, and bacteria covering the whole surface of the cell; one contractile vacuole apically positioned; macronucleus normally band-like, longitudinally oriented. Pellicle with conspicuous, widely spaced transverse striae. Number of silverlines from oral area to aboral ciliary wreath about 27-47; from aboral ciliary wreath to the scopula, 19-29. Zooids generally enlarged at both proximal and distal ends of branches.

**Key words:** marine peritrich, morphology, *Zoothamnium chlamydis* sp. n.

**INTRODUCTION**

Ciliated protozoa such as sessile peritrichs play an important role as ectocommensals on the body surface of aquatic organisms from both marine and freshwater habitats (Kahl 1933; Precht 1935; Nenninger 1948; Dietz 1964; Stiller 1971; Green 1974; Bierhof and Roos 1977; Corliss 1979; Valbonesi and Guglielmo 1988; Song 1991a, c, 1992a; Song and Warren 2000). For a long time, much attention has been given to sessile peritrichs of the genus *Zoothamnium*, mainly associated with amphipods, copepods and decapod shrimps. However, as to the author’s knowledge, no records of *Zoothamnium*-species attached to marine scallops, have previously been made (Steuer 1932, Kahl 1935, Precht 1935, Raabe and Raabe 1959, Herman and Mihursky 1964, Fenchel 1965, Foster et al. 1978, Kumari and Nair 1985, Nagasawa 1986, Song 1992b, Xu et al. 1999).

During a survey on parasitic protozoa in molluscs culturing water in the Spring of 2000 off Qingdao, China, an unknown *Zoothamnium* species was found within the mantle cavity as well as on the shell surface of the cultured scallop *Chlamys farreri*. The present paper gives the observations and descriptions on its morphology and silverline system.
MATERIALS AND METHODS

Host scallop Chlamys farreri was collected from the coast of Qingdao (Tsingtao, 36°08’ N; 120°43’ E), China. Ciliates were removed with a pipette and kept in culture at room temperature. Living observations were carried out using both bright field and differential interference contrast microscopy. Protagol staining according to Wilbert (1975) and Chatton-Lwoff silver nitrate method as described by Corliss (1953) were applied to reveal the infraciliature and silverline system respectively. Accounting and measurements on stained specimens were performed at a magnification of x1250. Drawings were made with the help of a camera lucida.

Terminology and systematic arrangement are mainly according to Corliss (1979), Warren (1986) and Foissner et al. (1992).

RESULTS

According to Corliss (1979), the current taxonomic status of this species is given as follows:

Class: Oligohymenophora de Puytorac et al., 1974
Order: Peritrichida Stein, 1859
Suborder: Sessilina Kahl, 1933
Family: Vorticellidae Ehrenberg, 1838
Genus: Zoothamnium Bory de St. Vincent, 1826

Zoothamnium chlamydis sp. n. (Figs. 1-10)

Diagnosis: marine Zoothamnium with alternatively branched stalk; zooids highly variable in size in vivo 50-90 x 25-60 µm, slender body shape with one-layer peristomial lip moderately everted; one contractile vacuole apically positioned; macronucleus normally band-like, longitudinally oriented. Cell surface densely associated with bacteria, and pellicle with conspicuous, widely spaced transverse striations. Number of silverlines from oral area to aboral ciliary wreath (ACW) about 27-47, and from aboral ciliary wreath to scopula, 19-29. Zooids generally enlarged at both proximal and distal ends of branches.

Type specimens: one holotype (HD-00042401) and one paratype (HD-00042402) as protargol-impregnated slides are deposited in the Laboratory of Protozoology, Ocean University of Qingdao, China.

Host and site: Chlamys farreri, off the coast of Qingdao (Tsingtao, 36°08’ N; 120°43’ E), China.

Ecological features: open culturing water, temperature 5-10°C; pH 8.2-8.3, salinity 34-36 ‰.

Morphological description: body constantly slender in shape, widest at peristomial area and narrowed posteriorly with moderately everted, and rigid border (peristomial lip, PL); peristomial disc (PD) small, obliquely elevated when cell is fully extended (Fig. 1). Zooids within same colony conspicuously in two different sizes, mostly (“normal” zooids) in vivo about 50-60 µm long, and ratio of length: width ca 2:1; but zooids at proximal or distal ends of branches often enlarged, ca 70-90 x 50-60 µm (Figs. 2; 11, arrowheads). Formation of telotroch not observed.

Pellicle with conspicuous transverse striations, especially in enlarged zooids even when observed under low magnification; cell surface often covered with densely associated bacteria (Figs. 1, arrow; 14).

Cytoplasm colorless and transparent, containing several large food vacuoles (4-8 µm across). One contractile vacuole (CV), 5-8 µm in diameter (Figs. 4, 5), at level of peristomial lip on dorsal wall of vestibulum, which extends about 1/2 of body length. Macronucleus (Ma) band-like, longitudinally positioned (Figs. 1; 18, arrowhead), which appears twisted or shortened in enlarged zooids (Figs. 4-6).

Stalk with smooth surface and thick spasmoneme (about 3 µm across) (Fig. 3). Continuous spasmoneme extending through entire stalk. Colony comparatively large (up to 0.6 mm), alternately branched, with up to 100 zooids, which are also alternatively located in branches (Figs. 2, 11). When disturbed, colony contracts as one unit.

Infraciliature and silverline system: buccal apparatus typical of genus (Figs. 7-9). Haplokinety (H; Fig. 20, long arrow) and polykinety (P; Figs. 7; 9; 20, short arrow) about 1/4 turn around peristomial disc before entering vestibulum. Polykinety forming three peniculi in lower half of vestibulum. Peniculus 1 (P1) and 2 (P2) about equal length, each comprising 3 rows of kinetosomes, and peniculus 3 (P3) rather short, also composed of 3 rows of kinetosomes (Figs. 7; 19, small arrows); haplokinety passing around vestibulum on opposite wall to peniculi. Germinal kinety (G) comparatively long, located parallel to haplokinety (Figs. 7; 20, small arrow). Epistomial membrane (EM) short, near opening of vestibulum (Figs. 7: 8; 9, arrow; 20, arrowhead). Aboral ciliary wreath (ACW) composed of one row of loosely arranged kinetosomes in normal zooids (Figs. 8; 16, arrowhead), while 2-rowed in enlarged ones (Fig. 8, inset).

Silverline system as shown in Figs. 10, 15, widely striated pattern; i.e., striations widely spaced and conspicuous pellicular pores associated between silverlines. Number of silverlines from oral area to aboral ciliary wreath (ACW; Figs. 8; 13, arrowhead), 27-47 (mean 36.2); from ACW to scopula, 19-29 (mean 24.6) (Table 1).
Figs. 1-10. Morphology of *Zoothamnium chlamydis* sp. n. from life (1-6) and after silver impregnation (7-10). 1 - typical zooid, arrow shows covering of bacteria; 2 - colony, arrowheads show the enlarged zooids; 3 - stalk, note the thick spasmoneme; 4, 5 - contracted and enlarged zooids; 6 - twisted macronucleus in enlarged zooids; 7, 9 - oral apparatus, arrow in 9 indicates epistomial membrane; 8 - general infraciliature, arrow marks epistomial membrane, arrowhead shows macronucleus, inset: aboral ciliary wreath; 10 - silverline system, arrowhead shows aboral ciliary wreath. ACW - aboral ciliary wreath; CV - contractile vacuole; EM - epistomial membrane; G - germinal kinety; H - haplokinety; P - polykinety; P1-3 - peniculus 1-3; Sp - spasmoneme. Scale bar - 30 µm
As commonly accepted, the genus *Zoothamnium* is characterized by a continuous spasmoneme within a branching stalk, thus leading to a contraction of the entire colony and a transverse silverline pattern (vs. *Zoothamnopsis*) (Ehrenberg 1838, Stein 1854, Claparède and Lachmann 1858, Fauré-Fremiet 1930, Kahl 1933, Bauer-Nebelsick *et al.* 1996, Song 1997). For a long time, the species identification and separation in the genus *Zoothamnium* depended on body shape and size, location of contractile vacuole, oral and nuclear
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...apparatus, the habitat, features of the silverline system, and the branching pattern of the colony.


Compared with this new species, *Zoothamnium niveum* can be distinguished by the larger size of its normal zooids (120 µm vs. 50-60 µm in *Z. chlamydis*), clearly lower position of the contractile vacuole (below peristomial lip vs. apically positioned) and presence of typical macrozooids (Ehrenberg 1838, Claparède and Lachmann 1858, Wang and Nie 1932, Kahl 1933, Wailes 1943, Bauer-Nebelsick et al. 1996).

Kahl (1933, 1935) redescribed three different forms of *Zoothamnium alternans*, which could not be confused with this new form regardless of the similarity in several morphological features. Among these, *Z. alternans* sensu Claparède & Lachmann, 1858 and *Z. alternans* sensu Greff, 1870 have conspicuously plumper body shapes, larger macrozooids (up to 120 µm) and cross-striated stalk. The form described by Kent (1881) possesses long cylindrical “Mikrogameten”, and is hence clearly different from *Zoothamnium chlamydis*.

In terms of body shape, size and branching stalk, *Zoothamnium plumula* Kahl, 1933 is most similar to this new species. However, the latter differs distinctly from the former in having fewer silverlines (ca 61 vs. 94-98) and the position of epistomial membrane (near opening of vestibulum vs. at distal end of polykinety) (Perejaslawzewska 1886; Kahl 1933, 1935; Song and AL-Rasheid, unpublished).

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