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AN ANNOTATED CHECKLIST OF EPIBIONT CILIATE _ *Zoothamnium*

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The sole author designed, analysed, interpreted and prepared the manuscript.

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Review Article

ABSTRACT

A checklist of one of the epibionts ciliates of the genus Zoothamnium with all relevant information has been prepared by consulting the available literatures on Zoothamnium of all continents. This checklist will be helpful for further research in this area. This check list contains 57 species of Zoothamnium.

Keywords: *Zoothamnium*; checklist; epibionts; ciliates.

1. INTRODUCTION

Zoothamnium, a sessile peritrich, was initially a member of family Vorticellidae [1]. Later it was placed under family Zoothamnidae [2]. Finally, this genus is placed under family Vorticellidae again [3]. Zoothamnium was recognized as the only genus within Zoothamnidae by Lynn and Small, 1901. *Zoothamnium* is one of the largest and diverse genera of peritrichs [4-7]. It has a vase shaped body. They may live in freshwater or brackish water or marine water. They are detritus feeder and also consume anaerobic bacteria. They may form symbiotic relationship with different types of arthropods, fishes etc. They may be associated with plants or they may be free living [8,9]. In eutrophic habitat, they may serve the role of dominant periphytons. There are more than 70 species under genus Zoothamnium [10, 5-7, 11-13].

They live by forming branching colonies which varies in size. There is a main stalk from which several branches arise. Zooids are attached to the stalk. Three types of zooids are attached to the stalk. They are macrozooids, microzooids and specialized zooids. Macrozooids are lagre zooids and are capable of transforming into swarmer cells. Microzooids are small cells related to feeding. Specialized zooids are capable of asexual reproduction.

2. SYSTEMATIC POSITION

Phylum: Ciliophora Doflein, 1901[14]

Class: Oligohymenophorea DePuytorac et al., 1974 [15]

Subclass: Peritrichia Stein, 1859 [16]
Order: Peritrichida Stein, 1859 [16]

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Suborder: Sessilina Kahl, 1933 [17]

Family: Vorticellidae Eherenberg, 1838 [18]

3. KEY TO FAMILY VORTICELLIDAE AND GENUS

1. Buccal ciliation runs counterclockwise into the vestibulum or buccal cavity; sessile, stalked, solitary or colonial, mature sessile stages without somatic ciliation; some motile species and migratory larval forms of sessile species equipped posteriorly with a ciliary girdle (subclass Peritrichia, Order Peritrichida) …
2. Sessile, occurring on various living and non-living substrates; solitary or colonial; some forms loricate (Suborder Sessilina) …….
3. Stalk branched and colonial.
4. Myonemes of all stalks of a colony are continuous, therefore the whole colony contracts or expand simultaneously (Genus *Zoothamnium*)……..

4. METHODOLOGY

This article is written with the help of literatures, published papers, books, review articles in different websites.

4.1 Checklist of *Zoothamnium*

- ***Zoothamnium affine*** Stein, 1859

Reference Id: 1620

Type locality: Not known

Host: *Gammarus tigrinus*

Site of Infection: First maxilla

Description: Zooids measure 25 × 60 µm. Colonial organism. Colony consists of 8 - 9 zooids.

- ***Zoothamnium adamsi*** Stokes 1885

Reference Id: 1308, 1620

Type locality: Southeast and southwest coast of India

Host: *Eucalamus sp*

Site of Infection: Postero-dorsal side of cephalo-thorax, Urosomal segment [19].

Description: It is colonial with five to fourteen zooids in a colony. It is 60 µm long and 250 µm height.

- ***Zoothamnium alrasheidi*** Ji et al, 2009

Reference Id: Not known

Type locality: Mangrove forest of Setiu Wetland, Terengganu, Malaysia [20]

Host: Megalopa larva of mud crabs, *Scylla paramamosain*

Site of Infection: Exoskeleton

Description: They are colonial with alternately branched stalk. The colony is giant and leaf shaped. Zooids are bell shaped. Two types of zooids have been observed- mature zooids and immature zooids. Zooids contain C- shaped macronucleus, apical contractile vacuole.

- ***Zoothamnium alterans*** Claparede and Lachmann, 1858

Reference Id: 1620

Type locality: Zoothamnium alternans is cosmopolitan species and widely distributed in coastal areas of Qingdao, China [21], Gulf of Mexico [22]

Host: *Sphaeroma serratum* and the crab *Carinus mediterraneus,*

Site of Infection: Not known

Description: They are colonial with alternatively branched colony. Colony is elongated, slender and with macro & micro zooids. There may be 30 - 50 zooids in a colony. The zooids are subglobular shaped with J- shaped macronucleus, greenish food vacuoles, parallel silver lines, and contractile vacuole.

- ***Zoothamnium arcuatum*** Ji et al., 2015

Reference Id: Not found

Type locality: Estuary of the Taehwagang River, Korea

Host: Green algae

Site of Infection: Not found

Description: Colonial organism. Two types of colonies have been found. Type 1 colony is 1000 µm high with 80 zooids where as type 2 colony is 1200

µm high with more than 120 zooids. Macrozooids are absent. Branching pattern is dichotomous. Mature zooids are sub-conical in shape. Cytoplasm is colourless with yellow to green food vacuoles.

- ***Zoothamnium arbuscula*** Ehrenberg, 1839

Reference Id: 1335, 1620, 1629

Synonym: Zoothamnium geniculatum Ayrton, 1902

Type locality: China

Host: *Penaeus orientalis*

Site of infection: Not known

Description: Not known

- ***Zoothamnium apoarbuscula***

Reference Id: Not known

Type specimen: Holotype specimen regn. No: WT-20190819-01-01
Paratype slide regn. No: NHMUK 2020.4.23.1

Type locality: Quingdao, China

Host: Not known

Site of Infection: Not known

Description: Colonial species with inverted dome like colony with dichotomously branched stalk. Inverted bell shaped microzooids and globular macrozooids are present. Strongly everted, single layered peristomial lip is present. Single apical contractile vacuole is present. Macronucleus is C-shaped.

- ***Zoothamnium apohentscheli***

Reference Id: Not known

Type specimen: Holotype specimen regn. No: WT-20181224-01-01

Paratype slide regn. No: NHMUK 2020.4.23.2

Type locality: Quingdao, China

Host: Not known

Site of Infection: Not known
Description: Zooids are inverted bell shaped. Peristomial lip is single layered. Cytoplasm is colourless with yellow or green food granules. Dorsal wall of infundibulum is with single contractile vacuole. The colony may have upto 50 zooids.

- ***Zoothamnium arbuscula*** Ehrenberg, 1839

Reference Id: 1335, 1620, 1629, 4654

Synonym: *Zoothamnium geniculatum* Ayrton, 1902

Type locality: North Seeland (Europe), South Baltic Sea [23]

Host: Not known

Site of Infection: Not known

Description: They are colonial. The colony measures about 40 – 60 mm. long and 6 mm high.

- ***Zoothamnium asellicola***

Reference Id: 4730

Synonym: *Carchesium pygmeum* D'Udekem, 1864 (Reference Id: 4730)

Type locality: Not known

Host: Not known

Site of Infection: Not known

Description: Not known

- ***Zoothamnium bucciniiformum*** Shen et al, 2017

Reference Id: Not known

Type specimen: The holotype (registration number: SZ-2010-1120-1)
Paratype slide (registration number: SZ-2010-1120-02)

Synonym: It is similar to *Z. duplicatum*, Kahl, 1933.

Type locality: Zhanjiang, southern China

Host: Not known

Site of Infection: Not known

Description: Coniform or horn shaped zooids with slender body are present in the colony. Cytoplasm is with granules and grayish in colour. Contractile vacuole is single and apical. They have peristomial lip

with infolding (circumferential) and dichotomously branched stalk.

- ***Zoothamnium carcini*** Kent 1881

Reference Id: Not known

Type locality: Scotland (Europe)

Host: *Carcinus maenas*

Site of Infection: Not known

Description: Not known

- ***Zoothamnium carinogammari*** Stiller 1950

Reference Id: Not known

Type locality: Holland (Europe)

Host: *Gammarus tigrinus*

Site of Infection: Coxal plates

Description: Zooids measure about 40 x 65 um. The length of the colony may be up to 150 um.

- ***Zoothamnium chlamydis*** Hu & Song, 2001

Reference Id: Not known

Type specimen: Holotype (HD-00042401) and Paratype (HD-00042402)

Type locality: They were first seen from Coast of Qingdao, China.

Host: *Chlamys farreri*

Site of Infection: They are found in mantle cavity as well as shell surface.

Description: They have slender body with one layered, everted peristomial lip. One apical contractile vacuole and band like macronucleus. Many large food vacuoles present.

- ***Zoothamnium commune*** Kahl, 1933

Reference Id: 1620, 4654

Type locality: Gulf of Mexico, Baltic Sea [23]

Host: Free living species. No host is there.
Site of Infection: Not known

Description: Not known

- ***Zoothamnium cupiferum*** Song, 1986

Reference Id: Not known

Type locality: Azerbaijann (Europe)

Host: No host as it is free living [24]

Site of Infection: Not known

Description: Not known

- ***Zoothamnium d'udekemi***

Reference Id: 1620

Synonym: *Zoothamnium parasitica* D'Udekem, 1862 (Reference Id: 1620)

Type locality: Holland (Europe)

Host: *Asellus aquaticus, Gammarus pulex*

Site of Infection: Periopods

Description: Zooids measures about 30 x 60 urn. Many colonies are with 8—30 zooids.

- ***Zoothamnium duplicatum*** Kahl, 1933

Reference Id: 1620, 4654

Synonym: *Zoothamnium kahli* Caspers, 1949 (Reference Id: 4654)

Type locality: Malaysia and Thailand; Baltic Sea [23]
Host: *Limulus polyphemus*. It was found on *Gammarus sp* also [25]. *Gammarus oceanicus*, *Gammarus sp*. & *Gammarus pulex* [26]

Site of Infection: Gnathopods, periopods, epimeres and back

Description: There are 2 to 20 zooids in a colony.

- ***Zoothamnium foissneri*** Ji, Song, Al Rasheid & Sun, 2005

Reference Id: Not known

Type specimen: One holotype slide (No. 0305030201) with protargol-impregnated specimens was deposited in the collection of the Laboratory of Protozoology, OUC, China

Type locality: Qingdao, China

Host: Not known

Site of Infection: Not known

Description: Their zooids are slender, elongate, measuring 70–110 × 32–42 mm in vivo. Peristomial lip is thick, double-layered. Peristomial disc is flat and moderately elevated from oral border. Aboral trochal band is present at lower 1/3 of zooid. Pellicle is smooth at low magnification but striations are visible at 250 magnification. Number of striations from oral area to aboral trochal band is 75. Cytoplasm is colourless with few food vacuoles. Apically positioned single contractile vacuole is present. Macronucleus is C-shaped. Micronucleus has not been observed.

- ***Zoothamnium florens*** Shen et al, 2017

Reference Id: Not known

Type specimen: The holotype (registration number: SZ-2010-1110-02-1)
Paratype slide (registration number: SZ-2010-1110-02-2)

Type locality: It was found in mangrove wetland in Techeng of southern China

Host: Not known

Site of Infection: Not known

Description: They have large inverted conical zooid. Macronucleus is C- shaped. Their peristomial lip is tuberculate. Their colony is asymmetrically and dichotomously branched.

- ***Zoothamnium grossi*** Sun et al, 2009

Reference Id: Not known

Type specimen: Holotype, protargol preparation (NIBRPR0000105278); paratypes are with "dry" silver nitrate preparation (NIBRPR0000105279) and protargol preparation (no. 1311110203)

Type locality: Taehwagang River, Korea.

Host: They were attached to green algae [27].

Site of Infection: Not known

Description: They have double layered peristomial lip. *Z. grossi* has alternately branched stalk, asymmetrically bell shaped zooids with apical, single contractile vacuole. 77 pellicular striations are present between peristomial lip and aboral trochal band.

- ***Zoothamnium hydrobiae*** Hofker, 1930

Reference Id: 1620

Type locality: Baltic Sea [23]

Host: Not known

Site of Infection: Not known

Description: Not known

- ***Zoothamnium hentscheli*** Kahl, 1935

Reference Id: 4610, 7693

Synonym: *Z. kentii* Grenfell, 1884

Type locality: Baltic Sea [23]

Host: Not known

Site of Infection: Not known

Description: Zooid measures about 63 – 84 × 35 – 40 µm with irregular and alternate branching. Colonial organism and the colony may extend upto 1200 µm.

- ***Zoothamnium hiketes*** Precht, 1935

Reference Id: Not known

Type locality: Baltic Sea [23]

Host: *Gammarus sp*., *G. locusta*, *G. oceanicus*, *G. zaddachi* and *G. salinus* [26]

Site of Infection: Last abdominal segments

Description: Elongated, measured about 70×35 µm in vivo with double layered Peristomial lip, C- shaped macronucleus and single, apical contractile vacuole. It is colonial having dichotomously branched stalk.

- ***Zoothamnium horai*** Khajuria & Pillay, 1950

Reference Id: Not known

Type locality: Contai, West Bengal, India, Asia

Host: Grey Mullets, Mugil tade Forsk

Site of Infection: Scales

Description: White coloured colony with dichotomously branched stalk. Zooids are globular with long, horse- shoe shaped nucleus and transverse ridges and furrows.

- ***Zoothamnium hyalinum*** Stiller, 1971

Reference Id: Not known

Type locality: Holland

Host: *Gammarus pulex*

Site of Infection: Pleopods

Description: Zooids measure about 35 x 60 urn. Stalk is 15 x 75 urn. Three colonies are with 3, 4 and 5 zooids.

- ***Zoothamnium ignavum***

Reference Id: Not known

Type specimen: The holotype #5613 and nine paratypes #5614 –#5622 fixed in a modified Trump's fixative (2.5% glutaraldehyde, 2% paraformaldehyde in sodium cacodylate 0.1 mol L^{-1}, 1100 mOsm L^{-1}; pH 7.2) deposited at the Naturhistorisches Museum, Wien (Austria).

Type locality: North Adriatic Sea (Mediterranean Sea)

Host: *Candidatus* Navis *piranensis* [28]

Site of Infection: Have symbiotic relationship with the specified bacteria.

Description: This species contains three types of zooids: microzooids with bulgy oral area, macrozooids and terminal zooids.

- ***Zoothamnium intermedium*** Precht, 1935

Reference Id: Not known

Type locality: Kiel Bay, Germany; Baltic Sea [23]; Chesapeake Bay of USA

Host: It is found as ectosymbiont on calanoid copepod *Acartia tonsa*. It is also found in *Eurytemora affinis*.

Site of Infection: Whole body surface

Description: Colonial organism with dichotomously branched stalk. Zooids are inverted bell shaped. Macronucleus is C shaped. The oral ciliature is with an outer haplokinety as well as an inner polykinety. It performs about 1.5 turns around the peristomial-disk before entering into the infundibulum.

- ***Zoothamnium kahli*** Caspers, 1949

Reference Id: 4654

Synonym: *Z. duplicatum* Kahl, 1933

Type locality: west coast of Scotland [26]

Host: *Gammarus pulex* [26]

Site of Infection: Back

Description: Zooids measure about 50 x 100 urn. Length of the colony may be up to 0.75 mm. Colonies are with 25 zooids.

- ***Zoothamnium laomedeae*** Precht, 1935

Reference Id: Not known

Type locality: Sevastopol bays

Host: *Gammarus insensibilis*

Site of Infection: Legs

Description: They are colonial. The colony is small with 2 zooids.

- ***Zoothamnium minimum*** Stiller 1935

Reference Id: Not known

Type locality: west coast of Scotland [26]

Host: *Gammarus tigrinus* [26]

Site of Infection: Gills

Description: Zooids measure about 25 x 40 um. Stalk is 15x50 µm. Colonies are with 2, 3, 4 and 5 zooids.

- ***Zoothamnium mucedo*** Entz, 1884

Reference Id: 1620

Type locality: west coast of Scotland [26]

Host: *Gammarus tigrinus* [26]

Site of Infection: Mouthparts

Description: Zooids measure about 35 x 85 µm.

- ***Zoothamnium nanum*** Kahl, 1933

Reference Id: 1620, 4654
Type locality: Mostly found on isopods of Sevastopol water. Baltic Sea [23]

Host: *Gammarus sp*., *G. duebenii*, *G. zaddachi*, *G. oceanicus*, *G. salinus* [26]

Site of Infection: Body surface

Description: Not known

- ***Zoothamnium nii*** Ji et al, 2005

Reference Id: Not known

Synonym: *Zoothamnium duplicatum* Kahl, 1933, *Z. kahli*, Caspers, 1949

Type locality: China

Host: Not known

Site of Infection: Not known

Description: Marine and forms colony. Colony has elongated, vase- like, 30 to 50 zooids with alternatively branched stalk. Zooids may be bell shaped. Zooids contain C- shaped macronucleus, colourless cytoplasm, and single contractile vacuole.

- ***Zoothamnium niveum*** Ehrenberg- Kent, 1881

Reference Id: 1620

Synonym: *Zoothamnium spirale* Goose, 1856 (Ref. Id: 1620)

Type locality: They are first described from shallow waters of red sea.

Host: They make symbiotic relationship with 'Candidatus Thiobios zoothamnicoli.

Site of Infection: Not found

Description: They have white and feather shaped colonies may reach a length upto 15 mm. Entire colony can contract into a ball shaped bunch. A contractile vacuole is present just below the peristomial lip. Make symbiotic relationship with 'Candidatus Thiobios zoothamnicoli' and live in aqueous environment rich in sulfur.

- ***Zoothamnium niveum*** Hemprich & Ehrenberg, 1831

Reference Id: 4465

Type locality: Red Sea [29]

Host: Not found

Site of Infection: Not found

Description: They form feather shaped colony with bell shaped zooids. Both macro and microzooids are found in the colony.

- ***Zoothamnium nutans*** Claparede & Lachmann, 1858

Reference Id: 1620

Type locality: Baltic Sea [23]

Host: Not found

Site of Infection: Not found

Description: Not found

- ***Zoothamnium oviforme*** Sommer, 1951

Reference Id: 1248

Type locality: west coast of Scotland [26]; Holland

Host: *Gammarus tigrinus* [26]

Site of Infection: Coxal plate of the first periopod

Description: Zooids measure 30x45µm.

- ***Zoothamnium parahentscheli*** Sun et al, 2009

Reference Id: Not known

Type locality: Taehwagang River, Korea

Host: Found attached to green algae [27]

Site of Infection: Not known

Description: Colonial with alternately branching pattern. The colony may extend up to 2 mm. Colony consists of 1 - 8 zooids. Zooids are sub-conical and elongate. Cytoplasm is transparent and grayish with few gray or yellow food granules. Aboral single contractile vacuole and C- shaped macronucleus present.

- ***Zoothamnium parasiticum*** Stein, 1859

Reference Id: 1620

Type locality: west coast of Scotland [26]

Host: *Cyclops sp*., *Gammarus tigrinus* [26]

Site of Infection: At the junction of gill and gnathopod

Description: Zooids measure about 35 x 50 um

- ***Zoothamnium pelagicum*** Du Plessis, 1891

Reference Id: 1620

Type locality: Mediterranean Sea, Atlantic ocean

Host: It is the only free living species.

Site of Infection: Not known.

Description: Their colony is made up of a radial branch joined at its base with other colony and form pseudo colony.

- ***Zoothamnium penaei*** Couch, 1988

Reference Id: Not known

Type locality: west coast of Scotland [26]

Host*: Penaeus sp, Litopenaeus vannamei*

Site of Infection: Gills

Description: Not known

- ***Zoothamnium perejaslawzeva***, Perejaslawzeva, 1886

Reference Id: 1620

Synonym: *Zoothanium dichotomum* Perejaslawzeva 1885 (Reference Id: 1620)

Type locality: Omega bay

Host: *Sphaeroma serratum*

Site of Infection: Dorsal surface

Description: They are colonial. Colonies are slender having 200 zooids in each colony.

- ***Zoothamnium plumula*** Kahl, 1933

Reference Id: 1620

Synonym: *Z. plumosum* by Perejaslawzewa, 1886 (Reference Id: 1620)

Type locality: They were first seen from black sea but also found in Coast of Quingdao, China; west coast of Scotland [26].

Host: *Chlamys farreri*, *Pagurus bernhardus* [26]

Site of Infection: Not known

Description: They have branched vase shaped colony. Zooids are slender with one layered peristomial collar. Single contractile vacuole is apically present.

- ***Zoothamnium ponticum*** Perejaslawzewa, 1886

Reference Id: 1620

Type locality: Found in Sevastopol bays. This species are described as free living in Black sea.

Host: *Gammarus insensibilis*

Site of Infection: Dorsal side

Description: They are colonial. Colony size is small with 5 to 8 zooids.

- ***Zoothamnium procerius*** Kahl, 1935

Reference Id: 4610, 4654

Type specimen: Not known

Synonym: *Zoothamnium spec. b* Hentschel, 1916 (Reference Id: 1620, 4610. 4654)

Type locality: west coast of Scotland [26]

Host*: Astacus astacus* [26]

Site of Infection: Not known

Description: Not known

- ***Zoothamnium ramosissimum*** Sommer, 1951

Reference Id: 1248

Type locality: Lakes of Germany, Argentina

Host: *Gammarus pulex*, *Enteromorpha intestinalis*, *Cladophora* sp., *Lemna* sp., *A. aquaticus* and insect larvae [30].

Site of Infection: Back and coxal plates in case of *Gammarus pulex.*

Description: Colonial. Length of the colony may be up to 250 µm. Colony may contain 2 – 15 zooids. Zooids are conical or funnel shaped. Cytoplasm is hyaline with numerous digestive vacuoles. Convex and slightly arched peristomial disc has been observed. Macronucleus is C- shaped [30].

- ***Zoothamnium rigidum*** Precht 1935

Reference Id: Not known

Type locality: Baltic Sea [23], west coast of Scotland [26], Holland

Host: *Gammarus sp*., *G. oceanicus*, *Gammarus pulex* [26]

Site of Infection: Periopods

Description: Zooids measure about 40 x 75 um. Colonies may extend up to 1.3 mm, with more than 100 zooids.

- ***Zoothamnium sevastopoli*** Naidenova, 1980

Reference Id: Not known

Type locality: Sevastopol bay

Host: *Gammarus olivii* and *G. insensibilis*

Site of Infection: Anterior periopods

Description: They are colonial. There are 200 zooids in a colony.

- ***Zoothamnium sphaeroma*** Naidenova, 1980

Reference Id: Not known

Type locality: Sevastopol bays

Host: *Sphaeroma serratum*

Site of Infection: Gill

Description: They are colonial. There are 2 to 20 zooids in a colony.

- ***Zoothamnium steueri*** (Kahl 1935)

Reference Id: 1620

Synonym: *Zoothamnium a* Steuer, 1932 (Reference Id: 1620)

Type locality: west coast of Scotland

Host: *Pleuromamma gracilis* [26]

Site of Infection: Not known

Description: Not known

- ***Zoothamnium simplex*** Kent, 1881

Reference Id: 1248, 1620

Type locality: west coast of Scotland, Holland

Host: *Gammarus tigrinus*, *Cambarellus patzcuarensis* [26]

Site of Infection: Mouthparts

Description: Zooids measure about 40 x 85 um. Two colonies are with 6 and 7 zooids.

- ***Zoothamnium thiophiolum*** Stiller 1946

Reference Id: Not known

Type locality: Baltic Sea [23]

Host: Not known

Site of Infection: Not known

Description: Not known

- ***Zoothamnium varians*** Stiller, 1933

Reference Id: 1620

Type locality: west coast of Scotland

Host: Carinogammarus, *Asellus aquaticus*, *Gammarus tigrinus* [26]

Site of Infection: Between spines on the telson

Description: Zooids measure about 40x60 um. Stalk is thin and short. Many colonies are with different numbers of zooids.

- ***Zoothamnium vermicola*** Prechet, 1935

Reference Id: Not known

Type locality: China

Host: Not known

Site of Infection: Not known

Description: Asymmetrical colony with dichotomously branched stalk. Elongate bell shaped zooids measure about 65–95 × 40–50 µm. Zooids also have thick, single-layered peristomial lip. Apically located single contractile vacuole is near dorsal wall of infundibulum. Macronucleus is C-shaped and transversely to obliquely oriented. Pellicle is finely striated. 50–68 pellicular striations present between aboral trochal band and peristomial lip.

- ***Zoothamnium wangi*** (Ji, Song, & Warren, 2005)

Reference Id: Not known

Type locality: China

Host: Not found

Site of Infection: Not found

Description: It has alternately branched colony with campanulate zooids. Colony may contain up to 100 zooids. Zooids may be subconical or campanulate with thick peristomial lip, C- shaped macronucleus. The peristomial lip is without secondary circumferential infolding. Mature colonies of *Zoothamnium wangi* resembles with young colonies of *Zoothamnium plumula* [31].

- ***Zoothamnium zhanjiangense*** (Craspedomyoschiston, Precht, 1935)

Reference Id: Not known

Type specimen: The holotype (registration number: SZ-2010-1110-02-1)

Paratype slide (registration number: SZ-2010-1110-02-2)

Type locality: mangrove wetland of southern China [32]

Host: Not known

Site of Infection: Not known

Description: The colony is alternately branched containing 50 zooids. Cylindrical or campanulate zooids with band like macronucleus. Macronucleus may be C- shaped. Contractile vacuole is single and apical.

5. DISCUSSION

From this study, it is clear that there are 57 species of Zoothamnium distributed throughout the world. Among them, 32 species have been located in Europe, 22 species in Asia, 1 species in North America and 2 species of unknown location. They are freshwater or marine species. Some species are found in mangrove forest of Malaysia (*Zoothamnium alrasheidi*), and mangrove wet land of China (*Zoothamnium florens*). Most of them are parasitic. Variety in host species has also been observed. Different arthropod, mollusks, fish hosts are noticed. Surprisingly green algae host is also found in some species (*Zoothamnium arcuatum*, *Zoothamnium grossi*). Some free living species have also been noted (*Zoothamnium commune*, *Zoothamnium cupiferum*).

6. CONCLUSION

Zoothamnium is a large genus with several species. Complete description of all aspects (species diversity, host diversity, distribution) of Zoothamnium is lacking. So, an attempt is made here to write this review article.

This review depicts current state of *Zoothamnium*. From above, it is clear that Zoothamnium is very large and diverse genus. Diversity occurs in morphology, ecology and distribution. Wide range of geographical distribution is observed. Different types of associations have also been observed like symbiosis, parasitic or free living. Diversity of hosts has been observed starting from crustaceans, molluscs to fish. This paper will help in further research in this field.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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