Rec. zool. Surv. India: Vol 119(4)/ 424-437, 2019
DOI: 10.26515/rzsi/v119/i4/2019/141580

ISSN (Online) : 2581-8686
ISSN (Print) : 0375-1511

A checklist of trichodind ciliates (Ciliophora: Peritrichida: Trichodinidae) from India

Sukanya Chanda, Gyan Deb Barman and Probir Kumar Bandyopadhyay*

Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani – 741235, West Bengal, India, prabir0432@hotmail.com

Abstract

A database with all available published accounts on the trichodind species was gathered. They are mainly fish parasites and are also found to infect anuran and molluscs. This information, along with records derived from recently work done in our laboratory that helps to generate a checklist containing all the records, for carrying out the work in this field. This is a must need step to address future questions in the areas of ecology, evolutionary biology and biogeography of these host-parasite interaction. The checklist is a host-parasite based and contains sixty nominal species belonging to five genera of Trichodind family of ciliate parasites.

Keywords: Biogeography, Ciliate Parasites, Host-Parasite Interaction

Introduction

Trichodinids are the most common parasitic ciliates and are widely dispersed in many zoogeographical areas (Lom and Dyakova, 1992). Annandale was the first to report the occurrence of *Trichodina pediculus* Ehrenberg, 1838 from the limnocnid medusa, *Limnocnida indica* in Bombay presidency of British India. They are well classified by mainly two features the morphology of denticles on the adhesive disc and development of adoral ciliary spiral. Species of trichodinds cause a serious disease called trichodiniasis, which is a major concern for aquaculture throughout the world. Corliss (1979) listed seven genera within the trichodinid family. Subsequently later this number increased to nine (Basson and Van As, 1989). Till date than 300 trichodinid species have been reported from skin, fins, gills, urinary bladder of fishes and some other animals from different environment in the world (Tang and Zhao, 2013). Very little and infrequent information on these parasites are available in India out of ten existing genera five namely, *Trichodina* Ehrenberg, 1838; *Paratrichodina* Lom, 1963*; Trichodinella* (Rabbe, 1950) Šramek-Hušek, 1953; *Dipartiella* (Rabbe, 1959) Stein, 1961; *Tripatiella* Lom, 1959 have been established till date(Hagargi and Amoji 1979; Mukherjee and Haldar 1982; Kalavati *et al*., 1991; Mishra and Das 1993; Saha *et al*., 1995; Basu and Haldar 1998; Asmat 2000 a, b; Mitra and Haldar 2004 a, b 2005; Mitra and Bandyopadhyay, 2005, 2006 a, b, 2009; Mitra *et al*., 2012, a, b; Saha and Bandyopadhyay 2016 a, b and 2017 a, b) in India.

The present paper deals with the current knowledge of the taxonomic study and distribution of trichodinid ectoparasites in India. It is obvious that this checklist will enhance future scope of research in this field. The aim of this study is to provide compact and authentic knowledge of trichodinid family with its description. This study has also been compiled all the available published accounts on the trichodinid ciliates in India, incorporating some new records derived from some recent works done in our laboratory in order to prepare a checklist providing host-parasite records.

Systematic Position

Class OLIGOHYMENOPHOREA de Puytorac *et al*., 1974

Subclass PERITRICHIA Stein, 1859

Order MOBILIDA Kahl, 1933

* *Author for correspondence*

Article Received on: 25.01.2019 Accepted on: 23.07.2019

Family TRICHODINIDAE Claus, 1874

Genus *Dipartiella* Stein, 1961

Hemitrichodina Basson and Van As, 1989

Paratrichodina Lom, 1963

Semtrichodina Kazubaski, 1958

Trichodina Ehrenberg, 1830

Trichodinella Sramek-Husek, 1953

Tripartiella Lom, 1959

Trichodoxa Sirgel, 1983

Vauchomia Mueller, 1938

Key to the Genera of Trichodinid Family: (Modified from Xu K. *et al.,* 2000)

1. a) The adoral ciliary spiral makes two and half to three turns(>720°)…….*Vauchomia*
   b) The adoral spiral makes a turn of greater than 360°…….……2
   c) The adoral spiral makes a turn of less than 360°……..……..3
2. a) The denticles have well developed rays and blades…….....*Trichodina*
   b) The blades of denticles are reduced ….....*Hemitrichodina*
3. Haplokinety and polykinety equal length……4.
   a) Haplokinety half the length of polykinety..... .....*Trichodoxa*
4. Adoral rows of cilia turn greater than 180°……5
   a) Adoral rows of cilia turn less than 180° ……...……...……..…….....*Semitrichodina*
5. Rays absent or inconspicuous…….....……..6
   a) Rays are well oped.....……7
6. Rays are very short and curved; blade straight or obl ique.....*Trichodinella*
   a) Rays absent; blades are triangular.….....*Dipartiella*
7. Blades are attached almost perpendicularly to central part; denticles are interlocked only by their central conical parts.....*Paratrichodina*
   a) Blade extends backwards from central part at oblique angle; denticles interlocked by central parts and by anterior projection of blades fitting into corresponding notches in blades of the proceeding denticles.....……..*Tripartiella*

Material and Methods

All the published data of trichodindid parasite from India have been collected in order to make a complete list of all the species of this family. These trichodinid ciliates have been identified following Klein's Silver impregnation technique. Databases such as Zoological records, Biological abstracts and different relevant literature related to trichodind parasites have been consulted. The bibliographic search was undertaken to date. The description of trichodinid parasite host description has been found are incorporated in this communication.

Results

Genus ***Trichodina***

- ***Trichodina acuta*** Lom, 1961

Site of infection: Gills

Host: Mystus gulio Hamilton-Buchanan, 1822; *Carassius auratus auratus* Linnaeus, 1758.

Locality: Ranaghat (23°10'45"N 88°33'42"E), and Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India

Reference material: Lectotype: Slide no. GF- TA-15/2014, deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani, Nadia, West Bengal, India.

Description: Diameter of the body- 42-53(47±4.3)µm. Number of denticles 18-21(19). Radial pins/denticle- 8-9. Adoral ciliary spiral- 380-390°.

- ***Trichodina ahmedi*** Asmat ,2005

Site of infection: Gills.

Host: *Chanda nama* Hamilton, 1822.

Locality: Kalyani (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Holotype, slide CN 1 (06/12/1995); paratype, slide CN 2 (06/12/1995) are in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh.

Description: Diameter of the body- (35-49)µm. Number of denticles 22-30 . Radial pins/denticle-6-7. Adoral ciliary spiral- 400-405°.

- ***Trichodina cancilae*** Asmat, 2001

Site of infection: Gills.

Host: *Xenentodon cancila* Hamilton, 1822.

Locality: Ranaghat (23°10'45"N 88°33'42"E), Nadia, (Latitude: 23°17', Longitude: 88°57'), West Bengal, India

Reference material: Holotype, slide XC-1 prepared on 4.3.1996; paratypes on the above mentioned slide and other slides prepared on different dates in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh.

Description: Diameter of the body- 50.0-74.4(61.9±5.4) µm. Number of denticles 28-32(29.8±1.2) Radial pins/ denticle-28-32.Adoral ciliary spiral- 390-395°.

- ***Trichodina cannigensis*** Asmat, 2001

Site of infection: Gills

Host: *Mystus gulio* Hamilton-Buchanan, 1822.

Locality: Canning (22.31°N, 88.65°E), South 24 Parganas, West Bengal, India

Reference material: Slides MG-5-8 *Mystus gulio*, prepared on 21/12/1999) are in the collection of Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal.

Description: Diameter of the body 47.0-56.1(51.1±2.8). Number of Denticles - 22-29(25.4±2.1); Adoral ciliary spiral could not be detected.

- ***Trichodina centrostrigeata*** Basson, Van As and Paperna, 1983

Site of infection: Gills

Host: Oreochromis mossambicus Peters, 1852.

Locality: River Churni, Ranaghat (23°10'45"N 88°33'42"E), Nadia, West Bengal, India.

Reference Material: OM-2/2002 is in the collection of the authors.

Description: Diameter of the body: 31.8-47.0(41.5±4.9,14) µm. Number of denticles 20-25(25,14). Radial pins/ denticles-5-9(8). Adoral ciliary spiral: 400-410°.

- ***Trichodina chittagongensis*** Asmat, 2005

Site of infection: Gills

Host: *Carassius auratus auratus* Linaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Lectotype, slide OF/KU/ZOOL/2015-111 have been deposited in the parasitology laboratory, Department of Zoology, University of Kalyani.

Description: Diameter of the body -35.5-45.59(40.11±1.79) µm. Number of denticles 22-24(22.9±+0.8). Radial pins/ denticle-5-8. Adoral ciliary spiral – 390-400°.

- ***Trichoina cyanophlicti*** Kalavati, Narasimhamurti and Usharani, 1991

Site of infection: Rectum

Host: Rana cyanophlyctis Hamilton, 1822.

Locality: Eluru (16.7°N,81.1°E) Andhrapradesh, India.

Reference material: Not available.

Descripton: Adhesive disc 28-100 µm in diameter. Number of denticles - 28-42, Velum incipient. Adoral cilary spiral - 360-420°.

- ***Trichodina diaptomi*** (Dogiel,1940) Basson and Van As, 1991

Site of infection: Gills

Host: Tetraodon cutcutia Hamilton1822; *Gagata cenia* Hamilton, 1822.

Locality: River Churni, Ranaghat (23°17'N, 88°57'E), Nadia, West Bengal, India.

Reference material: Slide TC-13 (*Tetradon cutcuta* prepared on 06/09/1996) is in the collection of Protozoology laboratory, University of Kalyani, Kalyani, 741235, West Bengal.

Description: Diameter of the body - 40.8-55.5(50.1±3.8,20) µm. Number of denticles - 15-20(18). Radial pins/denticle -7-11(9). Adoral ciliary spiral - about 390°.

- ***Trichodina domerguei*** Wallengren, 1897

Site of infection: Gills and skin

Host: Mystus gulio Hamilton-Buchanan, 1822; *Carassius auratus* linaeus, 1758.

Locality: North 24 Parganas (22.6168° N, 88.4029° E), West Bengal, India.

Reference material: Lectotype: Slide no. GF-TD-8/2014, has been deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani, Nadia, West Bengal, India.

Description: Diameter of the body- 57.5-74.2(65.85±5.8) µm. Number of denticles 18-22(22.6±1.7). Radial pins/ denticle- 8-10(9±1.4). Adoral ciliary spiral- 375-390°.

- ***Trichodina gangetica*** Jamadar, 1979

Site of infection: Gills, Labial palps

Host: Modiolus striatus Hanley, 1843.

Locality: Triveni, Hoogly (22.9901° N, 88.3943° E), West Bengal, India.

Reference material: Not available.

Description: Diameter of the body - 46.51(40.8-52.7)µm. Number of denticles 22 (21-24). Radial pins/denticle-6-8. Adoral ciliary spiral- greater than 360^0.

- ***Trichodina glossogobae*** Mitra *et al*., 2011

Site of infection: Gills.

Host: Glossogobius giuris Hamiolton, 1822.

Locality: River Churni (23^{0}17'N, 88^{0}57'E), Ranaghat, Nadia, West Bengal, India

Reference material: Holotype: Slide no. GG-3/2011, deposited in the collection of the Department of Zoology, Ranaghat College, P.O. Ranaghat, Dist. Nadia, West Bengal, India.

Description: Diameter of body – 30.6-46.9 (36.2±3.9) µm. Number of denticles -22-24(21.3±4.6) . Radial pins/denticle-6-7. Adoral ciliary spiral-380-390^o.

- ***Trichodina giurusi*** Mitra and Haldar, 2005

Site of infection: Gills

Host: Glossogobis giuris Hamilton, 1822

Locality: Ranaghat, Nadia (23^{0}17'N, 88^{0}57'E), West Bengal, India.

Reference material: Holotype, slide GG-3/2001, and paratype slide GG-2/2002 are in the collection of the Protozoology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India and slide GG-1/2002 bearing some paratype materials in the collection of the Harold W. Manter Laboratory of Parasitology, Lincoln, Nebraska, USA (Accession No. HWML 45700).

Description: Diameter of the body – 24.4- 34.8 (29.7±2.7,20)µm. Number of denticles 20-23 (21). Radial pins/denticle – 5-85 (6). Adoral ciliary spiral 390-400^o.

- ***Trichodina hafizuddini*** Asmat, 2005

Site of infection: Gills.

Host: Amblypharyngodon mola Hamiolton, 1822.

Locality: Hooghly (23^{0}01'20"N– 22^0 39'32"N / 88030'15"E–870 39'32" E), West Bengal, India.

Reference material: Lectotype, slide OF/KU/ZOOL/2015-112 have been deposited in the parasitology laboratory, Department of Zoology, University of Kalyani.

Description: Broad blade, butter-spoon shaped, presence of argentophobic particles between ray bases.

Morphometric data unavailable.

- ***Trichodina haldari*** Mitra and Bandyopadhyay, 2006

Site of infection: Gills

Host: *Glossogobis giuris* Hamilton, 1822.

Locality: Ranaghat (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Reference material: Holotype, slide GG-1/2004, and paratype slides GG-2/2004, GG-4/2004, GG- 5/2004 are deposited in the Museum of the Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India.

Description: Diameter of the body - 40.0-55.0(51.2+5.3,17) µm. Number of denticles 20-22(21,17). Radial pins/denticle (5-7). Adoral ciliary spiral -390-400^0.

- ***Trichodina heterodontata*** Duncan, 1977

Site of infection: Gills

Host: Anabas testudiens Bloch, 1792; *Puntius gelius* Hamiolton, 1822.

Locality: Triveni (22.9901° N, 88.3943° E), Hoogly, West Bengal, India

Reference material: Slides AT 6-9 (*Anabas testudiens,* prepared on 15/10/1996) are in the collection of Protozoology laboratory, University of Kalyani, Kalyani, 741235, WestBengal.

Description: Diameter of the body-46.1-61.2(54.6±3.3,40) µm. Adoral ciliary spiral 395-400^o.

- ***Trichodina heterospina*** Asmat, 2005

Site of infection: Gills

Host: Sardinella fimbriata Valenciennes, 1847.

Locality: Canning (22.31^{0}N, 88.65^{0}E), South 24 Parganas, West Bengal, India.

Reference material: Holotype, slide SF 1 (25/05/1997); paratypes, slide SF 2 (25/05/1997) are in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh

Description: Denticles are broad, rays strong and straight. Morphometric data unavailable.

- ***Trichodina indica*** Tripathi, 1954

Site of infection: Gills and skins

Host: Labeo rohita Hamiolton,1822*; Labeo calbasu* Hamiolton,1822*; Cirrhinnus mrigala* Hamiolton,1822; *C. reba* Hamiolton,1822; *Catla catla* Hamiolton,1822; *Amblypharyn mola* Hamiolton, 1822; *Salmostoma bacaila* Hamiolton,1822; *Labeo rohita* Hamiolton,1822; *Hypothalamichthys molitrix* valenciennes, 1844.

Locality: Midnapore (22.4257° N, 87.3199° E), West Bengal, India.

Reference material: Not available.

Description: Diameter of the body -50-86 µm. Number of denticles- 18-21. Curved denticles with long hooks.

- ***Trichodina indiana*** Saha and Bandyopadhyay, 2017

Site of infection: Gills

Host: Carassius auratus auratus Linnaeus, 1758.

Locality: Diamond Harbour (22.1352N, 88.4016E), West Bengal, India

Reference material: Holotype, slide GF-TD-02/2014, and paratype slides GF-TD-03/2015, GF-TD-08/2015, GF-TD-12/2015, GF-TD-2/2016, GF-TD-4/2016, GFTD-5/2016, GF-TD-6/2016, GF-TD-8/2016 has been deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India. Paratype Slide no. GF-TD-04-15 was deposited in Zoological Survey of India, Kolkata under accession no. Pt. 3703.

Description: Diameter of the body 38.92-44.2(41.1±2.06) µm. Numbers of denticles 24-26(25). Radial pins/ denticles 6-9.

- ***Trichodina japonica*** Imai, 1991

Site of infection: Gills

Host: Lates calcarifer Worthington, 1929.

Locality: Canning (22.31^{0}N,88.65^{0}E), South 24 Parganas, West Bengal, India.

Reference material: Slide PP/85/ZOOL is deposited in the Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India.

Description: Diameter of body-20.9-25.4(22.4±1.2,20) µm, Number of denticles 17-21; 5-7 (6). Adoral ciliary spiral- 360-390°.

- ***Trichodina jadranica*** Raabe, 1958

Site of infection: Gills.

Host: Carassius auratus auratus Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India

Reference material: Slide TJ/ZOOL/KU/34/15 is deposited to Parasitology laboratory, University of Kalyani, Kalyani 741235

Description: Diameter of the body 34-43 µm. Number of denticles -17-22(19.4±1.2)µm. Radial pins/ denticle - 6-7. Adoral ciliary spiral- 360°.

- ***Trichodina jialgensis*** Tang and Zhao, 2013

Site of infection: Gills.

Host: Carassius auratus auratus Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Lectotype, slide OF /KU/ZOOL/2015-114/116/117 have been deposited in the Parasitology laboratory, University of Kalyani, Kalyani 741235.

Description: Diameter of the body- 45.5-52.3(47.44±2.34_) µm; Number of denticles 22-25(23.37±1.30), radial pins/ denticle – 7-8 (7.3+0.48).

- ***Trichodina kapataiensis*** Asmat and Mohammad, 2005

Site of infection: Gills

Host: *Carassius auratus auratus* Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), West Bengal.

Reference material: Lectotype, slide OF/KU/ZOOL/2015-117 have been deposited in the parasitology laboratory, Department of Zoology, University of Kalyani, Kalyani, 741235

Description: Diameter of the body: 45.5-49.5(46.7±1.03) µm. Number of denticles- 20-22(21±1.06).

Radial pins/denticle- 8-10 (8.9 + 0.9).

- ***Trichodina manjuae*** Saha and Bandyopadhyay, 2017

Site of infection: Gills and Skin.

Host: Carassius auratus auratus Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), West Bengal, India.

Reference material: Holotype, slide GF-TM-09/2015, and paratype slides GF-TM-10/2015, GF-TM-11/2015, GF-TM-12/2015, GF-TM-01/2016, GF-TM-12/2016 has been deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India. Paratype Slide no. GF-TB-07-2015 was deposited in Zoological Survey of India, Kolkata under accession no. Pt. 3704.

Description: Diameter of the body-35.1-42.5(37.58±3.14). Number of denticles 29-33(31). Radial pins/denticle-8-10.

- ***Trichodina martinkae*** Basson and Van As, 1991

Site of infection: Gills

Host: Clarias batrachus Linnaeus, 1758.

Locality: Kalyani, (23.3^{0}N, 88.4^{0}E), West Bengal, India

Reference material: Slide TN/KU/26/ZOOL is deposited to Department of Zoology, University of Kalyani, Kalyani, 741235, West Bengal.

Description: Diameter of the body-51.2(36.5-60.5). Number of denticles 25(23-26). Radial pins/Denticle-10(9-12).

- ***Trichodina molae*** Mitra and Haldar, 2005

Site of infection: Gills

Host: Amblypharyngodon mola Hamilton, 1822.

Locality: Ranaghat, (23^{0}17'N, 88^{0}57'E), West Bengal, India.

Reference material: Holotype, slide AM-14/2001, and paratype slide AM-12/2001 in the collection of the Protozoology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India and slide AM-2/2001 bearing some paratype materials in the collection of the Harold W. Manter Laboratory of Parasitology, Lincoln, Nebraska, USA (Accession No. HWML 16742)

Description: Diameter of the body -35.7-42.8(38.2+3.0,20). Number of denticles -18-20. Radial pins/denticle- 6-7. Adoral ciliary spiral - 400-410^o.

- ***Trichodina mossambicusi*** Asmat, 2005

Site of infection: Gills.

Host: Oreochromis mossambicus Peters,1852

Locality: Kalyani, (23.3^{0}N,88.4^{0}E) West Bengal, India.

Refererence material: Holotype, slide OM 1 (14/08/1996); paratypes, slide OM 2 (14/08/1996) in the collection of the Department of Zoology, University of Kalyani, Kalyani 741235, Nadia, West Bengal, India.

Description: Well developed rays. Ray connection well formed and short. Morphometric data is unavailable.

- ***Trichodina mutabilis*** Kazubski and Migala, 1968

Site of infection: Gills

Host: *Puntius sophore* Hamilton, 1822; *Xenentodon cancila* Hamilton, 1822; *Salmostoma bacaila* Hamilton, 1822; *Nandus nandus* Hamilton, 1822.

Locality: Ranaghat, (23^{0}17'N, 88^{0}57'E), West Bengal, India.

Reference material: Lectotype: Slide no. GF-TM-10/2014, deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani, Nadia, West Bengal, India.

Description: Diameter of the body - 40.1-51.0(46.1+3.4) µm, Number of denticles 28(26-30). Radial pins/denticle – 9-13 (11+0.7). Adoral ciliary spiral-400-410^o.

- ***Trichodina mystusi*** Asmat and Haldar, 1998

Site of infection: Gills.

Host: Mystus gulio Hamilton-Buchanan, 1822

Locality: Canning

(22.31^{0}N, 88.65^{0}E), West Bengal, India.

Reference material: Slide no. TM/KU/ZOOL-20, is submitted to Department of Zoology, University of Kalyani, Kalyani, 741235, West Bengal.

Description: Diameter of the body- 27.6-36.8(30.9+ 2.7) µm . Number of denticles 20-24(21.4±1.1). Radial pins/denticle-5-7, Adoral ciliary spiral- 390-400^o

- ***Trichodina nandusi*** Mitra and Bandyopadhyay, 2013

Site of infection: Gills

Host: *Nandus nandus* Hamilton, 1822.

Locality: Banganan (230 01'20"N– 220 39'32"N/880 30'15"E–870 39'32" E), West Bengal, India.

Reference material: Holotype: Slide no; NN-3/2011 deposited in the Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India; Paratype and Other slides NN-14/2011,NN-17/2011,NN-20 deposited to Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West

Bengal, India.

Description: Diameter of the body -42.1-53.0(47.1±3.0) µm; Number of denticles 20-24(22±3.3); radial pins/ denticle – 5-9 (7.0+2.8). Adoral ciliary spiral-370-380°.

- ***Trichodina nigra*** Lom, 1960

Site of infection: Gills

Host: Nandus nandus Hamilton, 1822; *Cirrhinus mrigala* Hamilton, 1822; *Orechromis niloticus* Linnaeus, 1758; *Notpterus notopterus* Pallas, 1769; *Trichogaster fasciatus* Bloch and Schneider, 1801; *Mystus vittatus* Bloch, 1794.

Locality: Ranaghat (23°17'N, 88°57'E), Nadia. West Bengal, India.

Reference material: Slide is deposited to Department of Zoology, University of Kalyani; Slide no.TN/KU/ZOOL/ O5

Description: Diameter of the body- 44.4-74.7(55.2)µm. Number of denticles- 20-28(24). Radial pins/denticle- 5-9 (7.0 ±2.8). Adoral ciliary spiral- 375-390°.

- ***Trichodina ngoma*** Van and Basson, 1992

Site of infection: Gills

Host: Carassius auratus auratus Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Lectotype: Slide no. GF-TN-11/2014, deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani, Nadia, West Bengal, India.

Description: Diameter of the body-52.5-59.6(56.05±5.0,8) µm. Numbers of denticles -25-31(28±4.24). Radial pins/ denticle- 8-10 (9±1.4). Adoral ciliary spiral- 408°.

- ***Trichodina oligocotti*** Lom, 1970

Site of infection: Gills.

Host: *Chanda nama* Hamilton, 1822.

Locality: Triveni, Hooghly, (22.9°N,88.40°E) West Bengal, India.

Reference material: Slide CN-1 (*Chanda nama*, prepared on 12/12/95) in the collection of Protozoology laboratory, University of Kalyani, Kalyani, 741235, West Bengal.

Description: Diameter of the body -48.0-58.1(52.30±3.7) µm, Number of denticles – 22-25 (23.1±1.04). Radial pns/ denticle - 9-12 (11.0±1.00).

- ***Trichodina pangasi*** Mitra and Bandyopadhyay, 2013

Site of infection: Gills

Host: Pangasius pangasius Hamilton, 1822.

Locality: Berhampore, Murshidabad, West Bengal, India.

Reference material: Holotype: One slide no. PP7/2011 obtained from the gills of *Pangasius pangasius* is deposited in the Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India.

Paratype: On the above numbered slide as well as other slides P27/2011, PP4/2011, PP14/2011 are deposited to Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India.

Description: Diameter of the body (38.9-54.1)µm. Number of denticles – 24-26(25.4±1.3). Radial pins/ denticle - 4-8 (5.1±0.6). Adoral ciliary spiral- 390-400°.

- ***Trichodina pediculus*** Ehrenberg, 1838

Site of infection: Gills.

Host: Barbus chola Hamilton, 1822; *Lymncnida indica* Gunther, 1893

Locality: Karnataka (15.3173° N, 75.7139° E), India.

Reference material: Not available.

Description: Morphometric data unavailable.

- ***Trichodina porocephalusi*** Asmat, 2001

Site of infection: Gills

Host: Ophiocara porocephalus Valenciennes, 1837.

Locality: Hooghly River (21°55′N 88°05′E / 21.917°N 88.083°E) of Hooghly District, West Bengal,

India.

Reference material: Holotype, slide OP-1 prepared on 05-10-1996; paratypes, slide OP-2 prepared on 05-10-1996 and slide OP-3 prepared on 15-1-1997 are in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh.

Description: Diameter of the body-32.5-50.5(42.3+ 5.2,20) µm. Number of denticles-20-27(24.3±1.5). Radial pins/ denticle – 6-9 (7.4±1.0). Adoral ciliary spiral -380-390°.

- ***Trichodina pseudominta*** Tang and Zhao, 2013

Site of infection: Gills

Host: *Carassius auratus auratus* Linnaeus, 1758.

Locality: Howrah (22°35'N, 88°19'E), West Bengal, India.

Reference material: Lectotype, slide OF/KU/ZOOL/2015-112 have been deposited in the parasitology laboratory, Department of Zoology, University of Kalyani.

Description: Diameter of the body 45.1-52.5(48.76±2.93) µm. Number of denticles – 20-23(20.71±1.25). Radial pins/denticle -7-8 (7.53±0.51).

- ***Trichodina reticulata*** Hirschman and Partsch, 1935

Site of infection: Gills

Host: Catla catla Hamilton, 1822*; Carassius auratus auratus* Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Lectotype: Slide no. GF-TR-11/2014, deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani.

Description: Diameter of the body 50.0-74.5(62.25±7.32) µm. Number of denticles - 25-31 (28±4.2). Radial pins/ denticle - 8-10 (9±1.4). Adoral ciliary spiral-370-380°.

- ***Trichodina silondiata*** Mitra and Bandyopadhyay, 2013

Site of infection: Gills.

Host: Silonia silondiata Hamilton, 1822.

Locality: River Ganges (24.16912N and 88.32502E), Berhampore, Murshidabad, West Bengal, India.

Reference material: Holotype: One slide no. CP1/2011 obtained from the gills of *Silonia silondia* (Hamilton, 1822) collected at Berhampore of Murshidabad, West Bengal, India is deposited in the Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India; Paratype: On the above numbered slide as well as on other slides (CP4/2011, CP/2011, CP16/2011) are deposited in the Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India.

Description: Diameter of the body - 32.7-60.6(46.4±6.3) µm. Radial pins/ denticles - 6-8 (7.1±0.8). Adoral ciliary spiral-390°.

- ***Trichodina siluri*** **(**Lom, 1970) Arthur, 1989

Site of infection: Gills

Host: *Ctenopharyngodon idella* Valenciennes, 1844.

Locality: Gajodoba (26.6887° N, 88.4118° E), Jalpaiguri, West Bengal, India.

Reference material: Not available.

Description: Diameter of the body - (42.4-58.7)µm . Number of denticles 23-24. Radial pins/denticle-9-10. Adoral ciliary spiral-380°.

- ***Trichodina tenuidons*** Lom and Stein, 1966

Site of infection: Gills.

Host: Liza parsia Hamilton, 1822.

Locality: River Churni, Ranaghat (23°10'45"N 88°33'42"E),

Reference material: Not available.

Descriprtion: Diameter of the body 45-69 µm. Number of denticles 28(25-33). Radial pins/denticle- 8-9.

- ***Trichodina vinodi*** Saha and Bandyopadhyay, 2017

Site of infection: Gills

Host: Carassius auratus auratus Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Holotype, slide GF-TV-01/2016, and paratype slides GF-TV-12/2015, GF-TV-18/2015, GF-TV-19/2015, GF-TV-08/2016, GF-TV-13/2016 has been deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India. Paratype Slide no. GF-TM-7-2016 was deposited in Zoological Survey of India, Kolkata under accession no. Pt. 370.

Description: Diameter of the body – 26.6-40.9(33.75±6.07) µm. Number of denticles 28. Radial pins/denticle 7-9(8).

- ***Trichodina waltairensis*** Kalavati, Narasimhamurti and Usharani, 1991

Site of infection: Urinary bladder

Host: *Rana breviceps* Schneider, 1799 and *Rana cyanopelyctis* Schneider, 1799.

Locality: Eluru (16.7°N,81.1°E) Andhra Pradesh, India.

Reference material: Not available.

Description: Adhesive disc 56-80µm.Number of Denticles -48-52. Adoral ciliary spiral 390-450°. Velum distinct with marginal cilia

Genus ***Tripertiella***

- ***Tripartiella bulbosa*** Davis, 1947

Site of infection: Gills

Host: Labeo bata Hamilton, 1822*; Labeo rohita* Hamilton, 1822; *Catla catla* Hamilton, 1822*; Carassius auratus auratus* Linnaeus, 1758.

Locality: Nambol (24.312°N: 93.669°E), Manipur, Imphal and Haringhata (22°53'N–24°11'N/88°09'E–88°48'E West Bengal, India.

Reference material: Lectotype: Slide No. CC-30 prepared on 14/03/2011 in the collection of the Department of Zoology, Ranaghat College, P.O. Ranaghat, Dist. Nadia, Pin- 741201, West Bengal, India.

Description: Body disc shaped. Diameter of the body- 18.0-23.4(20.8+2.1)µm. Adhesive disc-13.2-18.7(16.7±3.8)µm. Denticles are uniquely shaped. Distal margins almost round. Rays are short and stumpy. Number of denticles 22-24 (22.75±1.4). Radial pins per denticle -5-6(5.6±0.7). Adoral ciliary spiral-180-200º,

- ***Tripartiella bursiformis*** Davis, 1947

Site of infection: Gills

Host: Xenentodon cancila Hamilton, 1822.

Locality: Bethuadahari (23.5989° N, 88.3973° E), Nadia, West Bengal, India.

Reference material: Not available.

Description: Diameter of the body- 38-44µm. Number of denticles- 26-32. Denticles are slender and having long blade. Adoral ciliary spiral – 250-290º.

- ***Tripartiella copiosa*** Lom, 1959

Site of infection: Gills

Host: *Labeo rohita* Hamilton,1822; *Cyprinus carpio* Linnaeus, 1758; *Labio bata* Hamilton,1822; *Labio gonius* Hamilton, 1822; *Catla catla* Hamilton, 1822; *Cirrhinus mrigla* Hamilton, 1822*; Labeo bata* Hamilton, 1822; *Carassius auratus auratus* Linnaeus, 1758.

Locality: Pumlen Pat (24.538°N: 93.960°E), Khoidum pat (24.540°N: 93.886°E), Waithou pat (24.668°N: 93.962°E), Lamphel pat (24.825°N: 93.908°E), Khongham pat (24.895°N: 93.890°E), Kongba (24.797°N: 93.963°E), Nambol (24.312°N: 93.669°E) Manipur, Imphal, India, Ranaghat (23°10'45"N 88°33'42"E), and Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India.

Reference material: Lecotype: One slide no. LB-1 prepared on 19/02/2011 is in the collection of the Department of Zoology, P.O. Ranaghat, Dist. Nadia, Pin- 741201, West Bengal, India.

Description: Body disc shaped, Diameter of the body- 18.4-25.2(21.8±4.8)µm, Denticles are small in size with broad blade. Number of denticles 20-24 (22±2.8), Thin rays are directed posteriorly. There is special hook like structure developed in denticles. Radial pins /denticle-3-4(3.5±0.7). Adoral ciliary spiral -180-240º.

- ***Tripartiella kashkovskyi*** Lom and Haldar, 1974

Site of infection: Gills

Host: Pangasius pangasius Hamilton, 1822.

Locality: Nadia, West Bengal, India.

Reference material: Not available.

Description: Diameter of the body- 24(20-27)µm. Number of denticles 11(8-12). Radial pins /denticle-4-5. Adoral ciliary spiral- 140-180º

- ***Tripartiella leucisci*** Suzuki, 1950

Site of infection: Gills.

Host: *Catla catla* Hamilton, 1822*, Cirrhinus mrigala* Hamilton, 1822.

Locality: West Bengal, India.

Reference material: Not available.

Description: Morphometric data not available

- ***Tripartiella obtusa*** Ergens and Lom, 1970

Site of infection: Gills

Host: Ctenopharyngodon idella Valenciennes, 1844 ; *Gadusia chapra* Hamilton, 1822; *Labeo rohita* Hamilton, 1822*; Catla catla* Hamilton, 1822; *Carassius auratus auratus* Linnaeus, 1758.

Locality: Pumlen Pat (24.538°N: 93.960°E), Khoidum pat (24.540°N: 93.886°E), Waithou pat (24.668°N: 93.962°E), Lamphel pat (24.825°N: 93.908°E), Khongham pat (24.895°N: 93.890°E), Kongba (24.797°N: 93.963°E), Nambol (24.312°N: 93.669°E) Imphal, Manipur; Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), West Bengal, India

Reference material: Slide no TM-45 is deposited 2011 in the collection of the Department of Zoology, University of Kalyani, P.O. Kalyani, Dist. Nadia, Pin- 741235, West Bengal, India.

Description: Very small in size. Diameter of the body- 12.0-24.5(18.25+8.8)µm. Club-shaped blades directed backwardly. Central part appears round. Stout rays directed anteriorly. Radial pins per denticle 3-5(4.0±1.4). Number of denticles- 17-20(18.5±2.1).

Genus ***Trichodinella***

- ***Trichodinella bengalensis*** Saha and Bandyopadhyay, 2017

Site of infection: Gills.

Host: Carassius auratus Linnaeus, 1758.

Locality: Howrah (22.5958N, 88.2636E), West Bengal

Reference material: Holotype, slide GF-TC-02/2015, and paratype slides GF-TC-05/2015, GF-TC-10/2015, GF-TC13/2015, GF-TC-08/2016, GF-TC-19/2016 has been deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani

Description: Diameter of the body- 13.1-19.7(16.4+ 2.7) µm. Number of denticles- 20-21(20.33+ 0.5). Radial pins/ denticle- 4-5.

- ***Trichodinella epizootica*** (Raabe,1950) Šramek-Hušek, 1953

Site of infection: Gills

Host: Puntius gelius Hamilton,1822; *Carassius auratus auratus* Linnaeus, 1758.

Locality: Ranaghat (23°10'45"N 88°33'42"E), Nadia, West Bengal, India.

Reference material: PG/3/11-2001 in the collection of authors.

Description: Diameter of the body- 23.0-50.0µm. Number of denticles 16-28. Adoral ciliary spiral-180º.

- ***Trichodinella rectangulata*** Saha and Bandyopadhyay, 2017

Site of infection: Gills.

Host: Carassius auratus Linnaeus, 1758.

Locality: Diamond Harbour (22.1352N, 88.4016E), South 24 Parganas, West Bengal, India.

Reference material: Holotype, slide GF-TB-09/2014, and paratype slides GF-TB-07/2015, GF-TB-08/2015, GF-TB18/2015, GF-TB-3/2016, GF-TB-4/2016, GF-TB-5/2016, GF-TB-6/2016, GF-TB-8/2016 has been deposited in the collection of the Parasitology.

Description: Diameter of the body- 33.15-58.7(45.92±6.96) µm. Number of denticles 20-24(22±0.7). Radialpins/ denticle-3-4.

- ***Trichodinella sunderbanensis*** Mitra and Bandyopadhyay, 2012

Site of infection: Gills

Host: Mystus gulio Hamilton – Buchanan, 1822.

Locality: Jharkhali (22.0306° N, 88.7013° E) Sunderbans, South 24 Parganas, West Bengal, India

Reference material: Holotype: slide no. MG- 02/2011 is deposited to Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India; Paratype: Other slides MG- 9/2011,MG-12/2011,MG-17/2011 are deposited to Department of Zoology, Ranaghat College, P.O. Ranaghat, Nadia, 741201, West Bengal, India.

Description: Diameter of the body- 15.2-22.4(19.7±1.9) µm. Number of denticles 19-22(21±1.1). Radial pins/ denticle- 3-4. Adoral ciliary spiral-270º.

Genus ***Paratrichodina***

- ***Paratrichodina africana*** Kazubski and El-Tantawy, 1986

Site of Infection: Gills

Host: *Oreochromis mossambicus* Peter,1852

Locality: River Churni, Ranaghat (23°10'45"N 88°33'42"E), Nadia, West Bengal, India.

Reference material: OM-1/2002 in the collection of the authors.

Description: Diameter of the body -15.4-24.8(20.1±1.3, 29)µm. Number of denticles - 17-22(20). Radial pins/ denticle- 3-6(4). Adoral ciliary spiral - 260-270º.

- ***Paratrichodina bassonae*** Mitra and Bandyopadhyay, 2006

Site of infection: Gills

Host: Mystus cavasius Hamilton, 1822.*Locality*: North 24 Parganas (22.1°N, 89.5°E), West Bengal, India.

Reference material: Holotype, slide MC-6/2003, and paratype slide MC-2/2003, MC-5/2003, MC-8/2003 are deposited in the Museum of the Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India

Description: Diameter of the body-14.8-19.3(17.1±1.2,30) µm, Number of denticles 18-21(20), radial pins/

denticle-3-5. Adoral ciliary spiral-170-230^0.

- ***Paratrichodina indica*** Saha and Haldar, 1996

Site of infection: Gills

Host: Heteropnustus fossilis Bloch, 1794; *Liza persia* Hamilton, 1822.

Type locality: Not available.

Reference material: Not available.

Description: Diameter of Body-38-58(43±4.78)µm. Number of denticles - 21-22 (21.9±0.22). Radial pins/ denticle – 6-7 (6.7+0.46). Adoral ciliary spiral-180- 270^o.

- ***Paratrichodina lizae*** Asmat, 2002

Site of infection: Gills

Host: *Liza parsia* Hamilton, 1822. *Locality:* Canning (22.3104° N, 88.6579° E), South 24 Parganas, West Bengal, India.

Reference material: Slide no. PC/ZOOL/12 is in the collection of Protozoology Laboratory, University of Kalyani, 741235, West Bengal.

Description: Diameter of the body-17.2-24.4(22.1±1.7) µm. Number of denticles 18-21, Radial pins/denticle-3-5. Adoral ciliary spiral-240^0

- ***Paratrichodina notopteri*** Saha, Bandyopadhyay and Haldar, 1995

Site of infection: Gills

Host: *Notopterus notopterus* Pallas, 1769

Locality: Not available

Reference material: Not available

Description: Morphometric data not available.

Genus ***Dipertiella***

- ***Dipartiella carassii*** Saha and Bandyopadhyay, 2017

Site of infection: Gills

Host: Carassius auratus Linnaeus, 1758.

Locality: Haringhata (22°53'N–24°11'N/88°09'E–88°48'E), Nadia, West Bengal, India

Reference Material: Holotype, slide no. GF-DSII-1/2015, and -DSII-8/2016, GF-DSII-16/2016 have been deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India

Description: Diameter of the body- 18.4–24.1(20.86±2.1) µm. Number of denticles-20. Radial pins/ denticle -3-5 (4. ±0.9).

- ***Dipartiella indiana*** Saha and Bandyopadhyay, 2017

Site of infection: Gills

Host: *Carassius auratus* Linnaeus, 1758.

Locality: Haringhata, (22°53'N–24°11'N/88°09'E–88°48'E) Nadia, West Bengal, India.

Reference material: Holotype, slide no. GF-DSI-7/ 2015, and paratype slides no. GF-DSI-13/2015, GF-DSI14/2015, GF-DSI-18/2015, GF-DSI-1/2016, GF-DSI-7/ 2016, GF-DSI-9/2016 have been deposited in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India.

Description: Diameter of the body- 30.5-39.1(34.8±3.6) µm. Number of denticles- 20-21. Radial pins/denticle -3-6 (4.5±1.2).

- ***Dipartiella kazubski*** Mitra and Bandyopadhyay, 2009

Site of infection: Gills

Host: *Batasio batasio* Hamilton-Buchanan; *Wallago attu* Bloch and Schneider, 1801

Locality: Gajoldoba, Jalpaiguri (26.6887° N, 88.4118° E) and Ranaghat (23°10'45"N 88°33'42"E). Nadia, West Bengal, India.

Reference material: Holotype, slide BB2, and paratype slides BB1, BB3, BB5, WA1, WA2, WA7, WA10 in the collection of the Parasitology Laboratory, Department of Zoology, University of Kalyani, Kalyani 741235, West Bengal, India

Description: Diameter of the body-15.5-20.7(18.2±1.7,40) µm, Number of denticles 23-33(31), radial pins per denticle-3-5(4). Adoral ciliary spiral-150-170^o.

Discussion

Considering all the data it can be concluded that the present study gives us a clear knowledge on trichodind diversity in India. The taxonomic list includes fourty-two species of *Trichodina,* four species *of Trichodinella* six species of *Tripartiella,* five species of *Paratrichodina* and three species of *Dipartiella* . Many species of these have been newly discovered and few are redescribed by different researchers. This study revealed the knowledge

of new host with some new parasites and locality. Lastly, it can be commented that there are many areas in India where studies on trichodinid ciliates have not been given much importance. So the paper will throw some light on the topic and increase the interest of future researchers who will work on this line in near future.

Acknowledgements

The authors (SC and GB) are thankful to DBT and CSIR, Government of India, New Delhi respectively for providing the research fellowship to continue the research work.

References

Annandale, N. 1912. Preliminary description of a freshwater medusa from the Bombay Presidency. *Rec. Ind. Mus.*, **7**: 235-256. https://doi.org/10.5962/bhl.part.28235

Arthur, J.R. and Lom, J. 1984. Trichodinid Protozoa (Ciliophora: Peritrichida) from freshwater fishes of Rybinsk Reservoir, USSR. *Protozool.*, **31**: 82-91. https://doi.org/10.1111/j.1550-7408.1984.tb04294.x

Asmat, G.S.M. and Haldar, D.P. 1998. *Trichodina mystusi*- a new species of trichodinid ciliophoran from Indian estuarine fish, *Mystus gulio* (Hamilton). *Acta Protozool*, **37**: 173-177.

Asmat, G.S.M. 2001a. *Trichodina cancilae* sp. n. (Mobilina: Trichodinidae) from the gills of a freshwater Gar, *Xenentodon cancila* (Hamilton) (Belonidae). *Acta Protozoool.*, **40**: 141-146.

Asmat, G.S.M. 2001b. *Trichodina canningensis* sp. n. (Ciliophora: Trichodinidae) from an Indian estuarine fish, *Mystus gulio* (Hamilton) (Bagridae). *Acta Protozool.,* **40**: 147-157.

Asmat, G.S.M. 2001c. *Trichodina porocephalusi* sp. n. (Ciliophora: Trichodinidae) from an Indian flathead sleeper, *Ophiocara porocephalus* (Valenciennes) (Eleotrididae). *Acta Protozool.*, **40**: 297-301.

Asmat, G.S.M. 2002a. Trichodinid ciliates (Ciliophora: Trichodinidae) from Indian fishes with description of two new species. *Bangladesh J. Zool.*, **30**: 87-100.

Asmat, G.S.M. 2002b. Two new species of Trichodinid ciliates (Ciliophora: Trichodinidae) from Indian fishes. *J. Zool Rajshahi Univ.*, **21**: 31-34. https://doi.org/10.3329/ujzru.v21i0.59

Asmat, G.S.M. 2004. First record of *Trichodina diaptomi* (Dogiel, 1940) Basson and Van As.,1991, *Trichodina heterodontata* (Duncan, 1977) and *Trichodina oligocotti* (Lom, 1970) (Ciliophora: Trichodinidae) from Indian fishes. *Pakistan J. Bio. Sci.*, **7**(12): 2066-2071. https://doi.org/10.3923/pjbs.2004.2066.2071

Asmat, G.S.M. 2005. Trichodinid ectoparasites (Ciliophora: Trichodinidae) of fishes in India. *Res. J. Agri. Biol. Sci.*, **1**(1):31-37.

Basson, L., Van As, J.G. and Paperna, I. 1983. Trichodinid parasites of cichlids and cyprinid fishes of South Africa and Israel. *Syst. Parasitol.*, **5**: 245- 257. https://doi.org/10.1007/BF00009159

Basson, L. and Van As, J.G. 1989. Differential diagnosis of the genera in the family Trichodinidae (Ciliophora: Peritrichida) with the description of a new genus ectoparasitic on fresh water fish from southern Africa, Syst. *Parasitol.*, **13**: 153- 160. https://doi.org/10.1007/BF00015224

Basson, L. & Van As, J.G. 1994. Trichodinids (Ciliophora: Peritrichia) from a calanoid copepod and catfish from South Africa and notes on host specificity. *Syst. Parasitol.*, **18**: 147-158. https://doi.org/10.1007/BF00017668

Bandyopadhyay, P.K., & Dash, G. 2001. First record of a ciliophphoran *Trichodina domergui* F. Magna Lom, 1960 from freshwater fish *Pseudoapocryptus lanceolatus* (Bloch and Schneider) from India. *J. Bombay nat. Hist. Soc.*, **98**(2): 311-315.

Corliss, J.O. 1979. The ciliated Protozoa: characterization, classification and guide to the literature. Pergammon Press, New York., 455 pp.

Das, M.K. and Haldar, D.P. 1987. Urceolariid ciliates of the genus *Tripartiella* invading gills of freshwater cultured carps in India. *Archiv Protistenk*, **134**: 169-178. https://doi.org/10.1016/S0003-9365(87)80071-4

Das, M.K., Pal, R.N. and Das, P.B. 1987. Preliminary observations on the ecology of animal parasites in estuarine fishes of Deltaic West Bengal,India. *J. Indian Soc. Coastal Agri. Res.*, **5**: 319-323.

Davis,H.S. 1947. Studies of protozoan protozoan parasites of freshwater fishes. *US Depot Interior Fish Bull.,* **51**: 1-29.

Duncan,B. 1977. Urceolariid ciliates, including three new species, fromcultured Philippine fishes. *Trans. Amer. Micros. Soc*. **96**: 76-81. https://doi.org/10.2307/3225966 PMid:403647

Ehrenberg CG. Die Infusionsthierchen als vollkommene Organismen. Ein Blick in das tiefere organische Leben der Natur. *Leipzig: Lepold Voss.*, **547**: 1838. https://doi.org/10.5962/bhl.title.58475

Hagargi, S.S. and Amoji, S.D. 1979. Occurrence of *Trichodina pediculus* Ehrenberg 1838 on freshwater carps, Barbus spp. *Curr. Sci.,* **48**: 789-790.

Imai S., Miyazaki H. and Nomura K. 1991. Trichodinid species from the gills of cultured Japanese eel, *Anguilla japonica*, with the description of a new species based on light and scanning electron microscopy. *Europ. J. Protistol.*, **27**: 79-84. https://doi.org/10.1016/S0932-4739(11)80430-X

Jamadar, Y.A. and Choudhury, A. 1979. Ciliates of some Marine and *Estuarine molluscs* from Indian coastal region. *Rec. zool. Surv.* India. 51-55 pp.

Kalavati,C., Narasimhamurti, C. and Usharani, Y. 1991. Studies on the endocommensal ciliates of Anurans. *Rec. zool. Surv. India., Occ Paper No*., 141: 65pp.

Kazubski S.L., Migala K. 1968. Urceolariidae from breeding carp - *Cyprinus carpio* L. in Zabeniec and remarks on the seasonal variability of trichodinids. *Acta Protozool*., **6**: 137-169

Klein, B.M. 1958. The dry silver method and its proper use. *J Protozool*, **5**: 99-103. https://doi.org/10.1111/j.1550-7408.1958.tb02535.x

Lom, J. 1958. A contribution to the systematics and morphology of endoparasitic trichodinids from amphibians with proposal of uniform specific characteristics. *J. Protozool*., **5**: 251-263. https://doi.org/10.1111/j.1550-7408.1958.tb02563.x

Lom J. 1961. *Ectoparasitic trichodinids* from freshwater fish in Czechoslovakia. *Vestnik Ceskoslovenske Spolecnosti Zoologicke*, **25**: 215-228.

Lom J. 1970 Observations on trichodinid ciliates from freshwater fishes. *Arch. Protistenkd*. **112**: 153-177

Lom, J. and Haldar, D.P. 1977. Ciliates of the genera *Trichodinella, Tripartiella* and *Paratrichodina* (Peritricha, Mobilina) invading fish gills. *Folia Parasitol*., **24**: 193-210.

Lom, J. and Dykova, I. 1992. Protozoan parasites of fishes. Developments in aquaculture and Fisheries Science, Amsterdam: Elsevier, 26: 315 pp.

Mishra, R.K. and Das, M.K. 1993. Urceolariid ciliate, *Trichodina reticulata* infesting gills of Catla catla in India. *J. Inland Fisheries Soc. of Ind*., **25**: 54-56.

Mitra, A.K. and Haldar, D.P. 2004. First Record of *Trichodinella epizootica* (Raabe, 1950) Šramek- Hušek, 1953, with Description of *Trichodina notopteridae* sp. n. (Ciliophora: Peritrichida) from freshwater fishes of India. *Acta Protozool*., **43**: 269-274.

Mitra, A.K., and Haldar, D.P. 2005. Descriptions of two new species of the genus Trichodina Ehrenberg, 1838 (Protozoa: Ciliophora: Peritrichida) from Indian fresh water fishes. *Acta Protozool*., 44: 159-165.

Mitra, A.K. and Bandyopadhyay, P.K. 2009. *Dipartiella kazubski* sp.nov. (Ciliophora: Peritrichida),a new ectoparasitic trichodind species from the gills of fresh water fishes in India. *Protistology*., **6**(1): 33-38.

Mitra, A.K., Bandyopadhyay, P.K., Gong, Y.C., and Bhowmik, B. 2012. Occurrence of trichodinid ciliophoprans (Ciliophora: Peritrichida) in the fresh water fishes of river Churni with description of *Trichodina glossogobae* sp.nov. in West Bengal, India. *J. Parasit. Dis*., **36**: 34-43. https://doi.org/10.1007/s12639-011-0073-0 PMid:23542238 PMCid:PMC3284600

Mitra, A.K. and Bandyopadhyay, P.K. 2005. First records of *Trichodina japonica* Imai, Miyazaki et Nomura 1991 and *Trichodina mutabilis* Kazubski et Migala 1968 (Ciliophora,Trichodinidae) from Indian fishes. *Protistology*., **4**(2): 121-127.

Mitra, A.K. and Bandyopadhyay, P.K. 2006. *Trichodina haldari* n. sp. and *Paratrichodina bassonae* n. sp. (Ciliophora: Peritrichida) from Indian freshwater fishes. *Acta Protozool*., **45**: 289-294.

Mitra, A.K., Bandyopadhyay, P.K., Gong, Y.C., Goswami, M. and Bhowmik, B. 2013. Description of two new species of ectoparsitic *Trichodina* Ehrenberg, 1830 (Ciliophora, Trichodinidae) from freshwater fishes in the river Ganges, India. *J. Parasit. Dis*., **37**(1): 35-41. https://doi.org/10.1007/s12639-012-0126-z

Mitra, A.K., Bandyopadhyay, P.K., and Gong, Y.C. 2013.Studies on trichodinid and Chilodinid Ciliophorans (Protozoza: Cilophora) in the Indian freshwater and esturine fioshes with description of *Trichodinella sunderbanesnsis* sp. nov. and *Trichodina nandusi* sp. nov. *Parasitol. Res*., **112**: 1075-1085. https://doi.org/10.1007/s00436-012-3234-x PMid:23269510

Mohilal, N., and Hemananda, T. 2012. Record of the species of *Tripartiella* (Lom, 1959) from fishes of Manipur. *J. Parasit. Dis*., **36**(1):87-93. https://doi.org/10.1007/s12639-011-0088-6 PMid:23542123 PMCid:PMC3284617

Mukherjee M., and Haldar D.P. 1982. Observations on the urceolariid ciliates of the genera *Trichodina* and *Tripartiella* in freshwater teleosts. *Arch. Protistenk*., **126**: 419-426. https://doi.org/10.1016/S0003-9365(82)80058-4

Raabe Z. 1950. Uwagi o Urceolariidae (Ciliata-Peritricha) skrzelryb. Ann. Univ. M. Curie-Skodowska. Lublin, Sectio DD Medicinaet Veterinaria 5: 292-310 (in Polish, with French and Russian summary)

Saha, B.S., Bandopadhyay P.K., and Haldar D.P. 1995a. Biodiversity of trichodinid ciliates in freshwater fishes of West Bengal, India. *Environ. Ecol.,* **13**: 814-823.

Saha, B.S., Bandopadhyay P.K. and Haldar, D.P. 1995b. First record of *Paratrichodina* sp. (Protozoa: Urceolariidae) from the gills of *Notopterus notopterus* (Pallas) from the Indian subcontinent. *J. Bengal Nat. Hist. Soc. (NS).,* **4**: 35-42.

Saha, B.S. and Haldar, D.P. 1996. First record of *Tripartiella bursiformis* (Davis, 1947) Lom, 1959 (Protozoa: Urceolariidae) from the gills of *Xenentodon cancila* (Hamilton) in the Indian subcontinent. *J. Beng. Nat. Hist. Soc. (NS),* **15**: 11-17.

Saha, B.S. and Haldar, D.P. 1997. Observations on the urceolariid ciliates of the genus *Tripartiella Lom*, 1959 parasitising the gills of three freshwater edible fishes of West Bengal, India, India. *J. Inland Fish Soc. India*, **2**: 28-36.

Saha B.S. and Haldar, D.P. 1997. Observations on the urceolariid ciliates of the genus *Tripartiella Lom*, 1959 parasitising the gills of three freshwater edible fishes of West Bengal, India, India. *J. Inland Fish. Soc. Ind.*, **29**: 28-36.

Saha, M. and Bandyopadhyay, P.K. 2016a. First report of some known *Trichodinella epizootica* Sramek-Husek, 1953 and *Tripartiella Lom*, 1959 from the cultured Oranda Gold Fish *Carassius auratus auratus* in India. *Zootaxa*, **4184**(1): 130-140. https://doi.org/10.11646/zootaxa.4184.1.8

Saha, M. and Bandyopadhyay, P.K. 2016b. Seasonal incidence of protozoan parasitic infestation in ornamental fishes of West Bengal, India, *India. J. Parasit. Dis*., **41**(2): 523-526. https://doi.org/10.1007/s12639-016-0842-x PMid:28615872 PMCid:PMC5447619

Saha, M. and Bandyopadhyay, P.K. 2017a. Occurrence of two new species of the genus *Dipartiella* (Raabe, 1959) Stein 1961 (Ciliophora: Trichodinidae) isolated for the first time from ornamental fish. *J. Parasit. Dis.*, **41**(4): 940-946. https://doi.org/10.1007/s12639-017-0915-5 PMid:29114123

Saha, M. and Bandyopadhyay, P.K. 2017b. Three new species of *Trichodina* (Protozoa: Ciliophora) isolated from ornamental fish *Carassius auratus* from India. *Proc. Zool. Soc*. https://doi.org/10.1007/s12595-017-0228-9. https://doi.org/10.1007/s12595-017-0228-9

Saha, M., Bandyopadhyay, P.K. and Gocmen, B. 2017c. First record of ectoparastic ciliates of genus *Trichodina* (Ciliophora: Trichodinidae) parasitizing cultured Oranda Gold Fish (*Carassius auratus auratus* L.) in India. *Zootaxa*. **4319**(1): 128-142. https://doi.org/10.11646/zootaxa.4319.1.6

Tang, F. and Zhao, Y. 2013. Record of three new *Trichodina* species (Protozoa, Ciliophora) parasitic on gills of freshwater fishes from Chongqing, China, Afr. *J. Microbiol. Res.,* **7**(14): 1226-1232. https://doi.org/10.5897/AJMR12.1163

Tripathi, Y.R. 1954. Studies on parasites of Indian fishes III. Protozoa 2. (Mastigophora and Ciliophora). *Rec. Ind. Mus*., **52**: 221-230.

Van, As J.G. and Basson, L. 1989. A further contribution to the taxonomy of Trichodinidae (Ciliophora: Peritrichida) and a re-view of the taxonomic status of some ectoparasitic trichodinids. *Syst. Parasitol*., **14**: 157-179. https://doi.org/10.1007/BF02187051

Van, As J. G. and Basson, L. 1992. *Trichodinid ectoparasites* (Ciliophora: Peritrichida) of freshwater fishes of the Zambesi River System, with a of host specificity. *Syst. Parasitol*., **2**: 81-109. https://doi.org/10.1007/BF00009603

Xu, K., Lei, Y. and Song, W.,Choi, J.K. and Warren, A. 2000. Diagnosis and probable phylogenetic relationships of the genera in the family Trichodinidae (Ciliophora, Peritrichia). *The Yellow Sea*. 6: 42-49.

Wellborn, T.L. Jr. 1967. *Trichodina* (Ciliata: Urceolariidae) of freshwater fishes of the southeastern United States. *J. Protozool*., **14**: 399-412. https://doi.org/10.1111/j.1550-7408.1967.tb02017.x PMid:4963670