

Original papers

The first record of two trichodinid ectoparasites, *Trichodina pseudoheterodontata* Tang et al. 2017 and *Trichodina hafizuddini* Asmat, 2005 (Ciliophora: Peritricha) from the freshwater fishes in the Baikka Beel of Moulvibazar district in Sylhet division, Bangladesh

Md. Amdadul Haque, Mohammad M. Kibria, Ghazi S.M. Asmat

Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh

Corresponding Author: Md. Amdadul Haque; e-mail: amdadcu89@gmail.com

ABSTRACT. A parasitological investigation on trichodinid ciliates from several freshwater fishes in the Baikka Beel of Moulvibazar district of Sylhet was carried out between January and December 2015. During the investigation period, two parasitic trichodinid ciliates (Ciliophora: Peritrichia), *Trichodina pseudoheterodontata* Tang et al. 2017 and *Trichodina hafizuddini* Asmat, 2005 were morphologically studied and described with using the silver nitrate impregnation technique. *Trichodina pseudoheterodontata* was isolated from the gills of *Mystus bleekeri*, while *Trichodina hafizuddini* from the gills of *Amblypharyngodon mola*. This investigation has been revealed that these two *Trichodina* species fall within the range of morphometry and agree closely in the overall appearance of the adhesive disc with the original populations. Geographical variation was also observed by considering the body size and number of the denticles. Depending on country's available taxonomical survey on trichodinid ciliates, this study is the first formal report on these trichodinids from any part of Bangladesh.

Key words: Ciliophora, trichodinid, *Trichodina pseudoheterodontata*, *Trichodina hafizuddini*, freshwater fish, *Mystus bleekeri*, *Amblypharyngodon mola*

Introduction

Trichodinids are peritrichous ciliates found worldwide on a variety of hosts [1,2]. The majority of trichodinids are described for freshwater environments [3–7]. The genus *Trichodina* [8] is the largest within the family Trichodinidae [9]. Representatives of the family parasitize or are symbionts of a broad spectrum of aquatic invertebrate and vertebrate hosts [10]. They infect fish skin, fins and gills [11]. The presence of these organisms often become evident after massive development, causing clinical signs in or leading to mortality of infested hosts [8]. To date, more than 300 nominal trichodinid ciliates have been reported from different environments in the world [12,13]. Despite this the *Trichodina* species found on

freshwater fishes of Bangladesh have been got little attention.

In Bangladesh, Asmat et al. [14] made the first report on trichodinid ciliates. Since then scanty and infrequent information is available on the taxonomy of the particular group. However, most recent attempt brings a great change in trichodinid ciliates investigation by establishing of 36 species of trichodinid ciliates, representing the four genera *Trichodina* [8]; *Paratrachodina* [15]; *Tripartiella* [16]; and *Trichodinella* [17,18] from various species of freshwater and estuarine ichthyofauna [14,19–33].

The aim of the present survey was to examine which trichodinid species occur on collected wild freshwater fishes from the Baikka Beel, Moulvibazar, Sylhet to follow the progress of these infections and to estimate the rate of prevalence, and

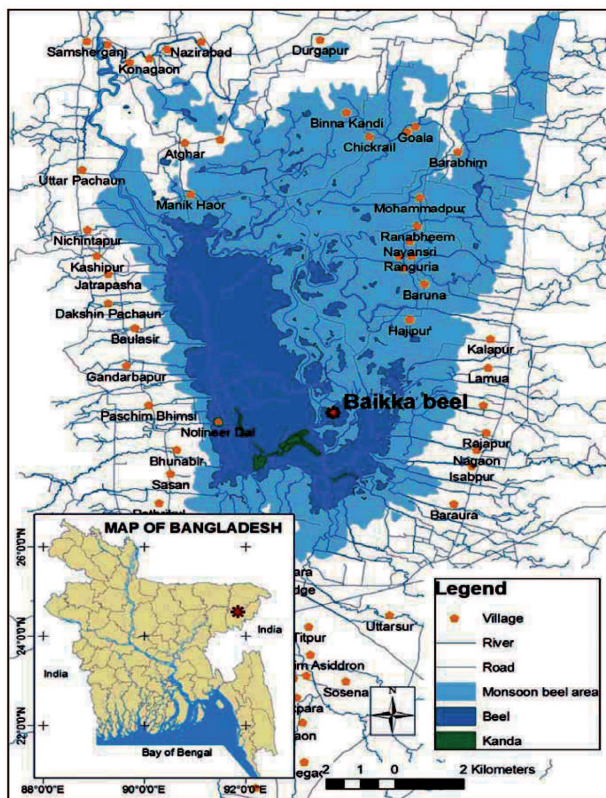


Fig. 1. Map of sampling localities at the Baikka Beel (Source: IPAC [36], www. nishorgo.org)

emphasizing species diversity, morphological variability with reference to existing taxonomic information.

Materials and Methods

Freshwater wild fishes (1.5–7.6 cm and 1.5–30.0 g) were collected from local fish markets and adjacent areas of the Baikka Beel with the help of local people and fishermen during the study period. Gill scrapings were made at the sampling site. Air-dried gill scrapings were transported to the laboratory and observing under a binocular dissecting research microscope for sorting out slides with trichodinid ciliates. Fresh gill smears containing slides infected by trichodinids were impregnated with Klein's [34] silver impregnation technique for observing impregnated adhesive disc of trichodinid ciliates as recommended by Lom [35]. All impregnated trichodinid ciliates were observed with the help of a compound microscope, OSK 9712 T-2 at 1000 \times magnification. Numerous photomicrographs were made using a SONY cyber shot camera in order to have comprehensive morphological data analysis and measurement of these ciliates. All measurements were done with aid

of an ocular micrometer and followed the uniform specific recommendation proposed by Lom [35], Wellborn [7], Arthur and Lom [3] and Van As and Basson [10,37]. In case of morphometric and meristic measurements, maximum and minimum values are given, followed in parentheses by the arithmetic mean and standard deviation. For statistical analysis, morphometric data of 20 specimens for the species were considered. Descriptions and measurements of denticles are following the method proposed by Van As and Basson [10].

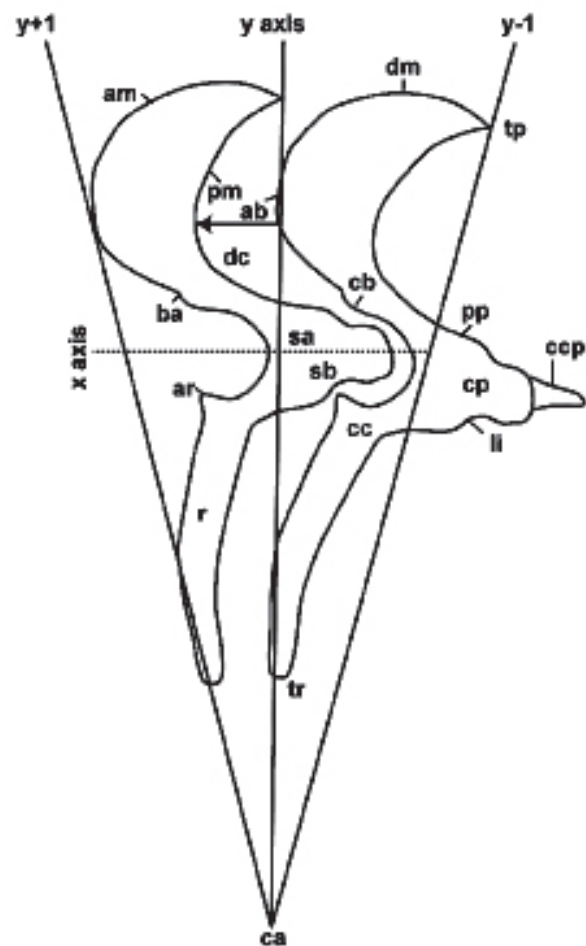


Fig. 2. Denticle structure and construction of X and Y axes as fixed references for description denticles, after Van As and Basson [10]. **Explanations:** AB, apex of blade; AM, anterior margin of blade; AR, apophysis of ray; B, blade; BA, apophysis of blade; CA, central area of adhesive disc; CB, section connecting blade and central art; CC, section connecting part and ray; CCP, central conical part; CP, central part of blade; DC, deepest point of semi-lunar curve relative to apex; DM, distal margin of blade; PM, posterior margin of blade; PP, posterior projection; R, ray; SA, section of central part above x axis; SB, section of central part below X axis; TP, tangent point; TR, tip of ray.

Table 1. Morphometric comparison of *Trichodina pseudoheterodontata* obtained in the present study with that of Tang et al. [39]. Measurement in micrometer (μm).

Species	<i>T. pseudoheterodontata</i> (n=18) [39]	<i>T. pseudoheterodontata</i> (n=20)
Host	<i>Ictalurus punctatus</i>	<i>Mystus bleekeri</i>
Locality	Chongqing, China	Baikka Beel, Moulvibazar, Sylhet
Location	Gills	Gills
Diameter of		
body	73.0-82.5 (76.3 \pm 3.2)	48.0-60.2 (55.8 \pm 3.8)
adhesive disc	61.5-74.0 (67.0 \pm 5.0)	39.9-51.3 (45.4 \pm 4.2)
denticulate ring	39.0-47.5 (42.4 \pm 3.1)	23.8-29.6 (26.5 \pm 1.5)
central area	–	11.2-15.4 (14.1 \pm 1.4)
Width of border membrane	4.0-6.0 (4.9 \pm 0.7)	4.4-5.4 (5.0 \pm 0.2)
Number of		
denticles	23-25	21-25 (23.1 \pm 1.0)
radial pins/denticle	10-12	6-8 (7.1 \pm 0.9)
Span of denticle	19.0-23.0 (21.0 \pm 1.6)	12.1-15.0 (13.8 \pm 0.8)
Length of		
denticle	9.5-11.5 (9.9 \pm 0.7)	3.4-5.6 (4.6 \pm 0.7)
ray	8.5-10.5 (9.4 \pm 0.7)	5.8-8.2 (6.9 \pm 0.7)
blade	5.5-9.0 (7.0 \pm 1.1)	3.7-5.6 (4.6 \pm 0.5)
Width of central part	4.5-5.5 (4.8 \pm 0.4)	2.0-3.3 (2.6 \pm 0.4)
Degree of adoral ciliature	390-410°	400-410°

Results and Discussion

Trichodina pseudoheterodontata Tang et al. 2017 (Figs 3-4, 7; Table 1)

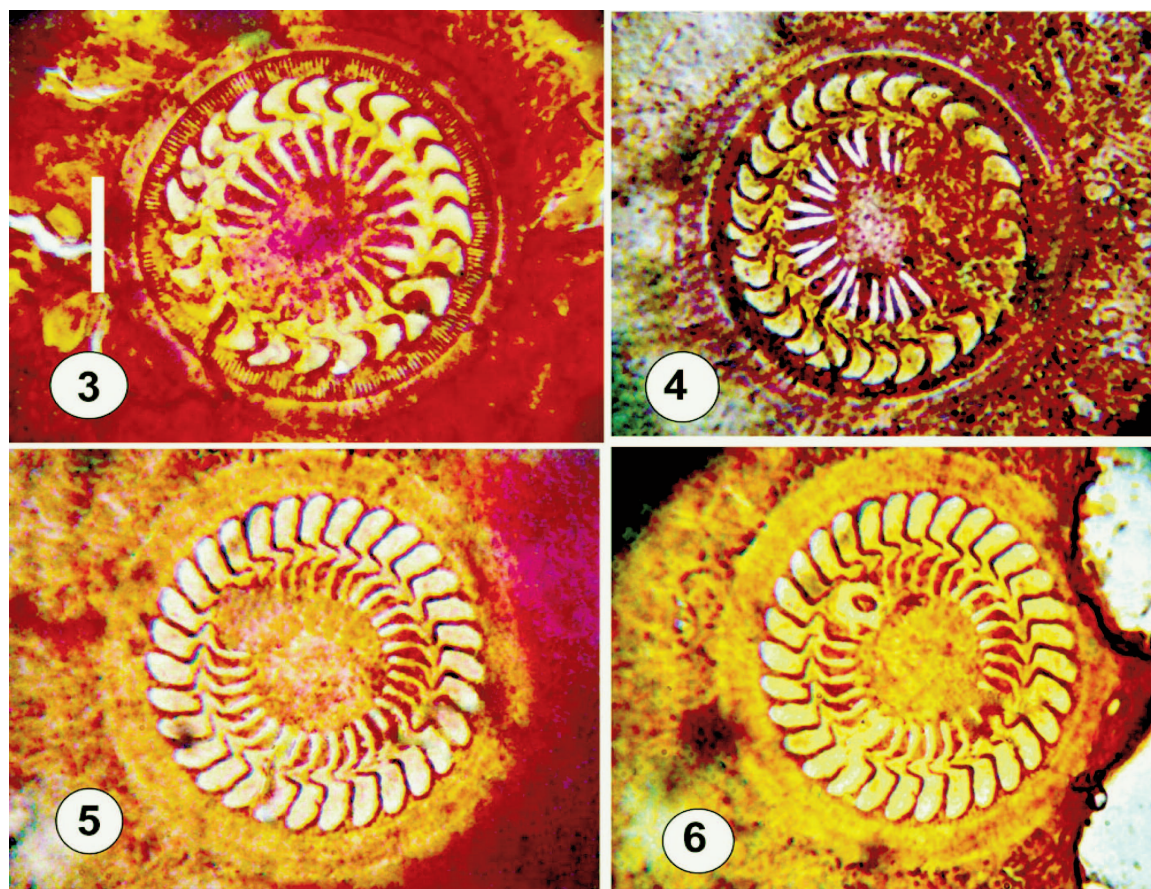
Host: *Mystus bleekeri* [38], **Locality:** The Baikka Beel (24.3514°N, 91.6979°E) of Moulvibazar district in Sylhet division, Bangladesh. **Location on host:** Gills. **Prevalence:** Thirty eight out of fifty specimens examined (76 %). **Intensity of infection:** High. **Voucher specimens:** Two slides (CUZM-MB-1-BB and CUZM-MB-2-BB) with sliver impregnated specimens prepared on 29 April 2015 have been deposited in the Museum of Department of Zoology, University of Chittagong 4331, Bangladesh.

Description (n=20): Large trichodinid ciliate, cup shaped body with 48.0–60.2 (55.8 \pm 3.8) diameter; concave adhesive disc 39.9–51.3 (45.4 \pm 4.2); surrounded by finely striated, wide border membrane 4.4–5.4 (5.0 \pm 0.2); central area large, impregnates slightly less than rest of the disc, diameter 11.2–15.4 (14.1 \pm 1.4), without any silver nitrate impregnated granules; diameter of denticulate ring 23.8–29.6 (26.5 \pm 1.5), consisting of 21–25 (23.1 \pm 1.0) denticles with radial pins per denticle, 6–8 (7.1 \pm 0.9); span and length of denticle 12.1–15.0 (13.8 \pm 0.8) and 3.4–5.6 (4.6 \pm 0.7)

diameter respectively; blade 3.7–5.6 (4.6 \pm 0.5); length of ray 5.8–8.2 (6.9 \pm 0.7) and central part 2.0–3.3 (2.6 \pm 0.4) in width. Adoral ciliary spiral about 400–410°.

Denticle morphology: Blade wide, quadrilateral obliquely and sickle-shaped with sharp tangent point (Fig. 3). Distal margin of blade smooth and little curved not parallel to border membrane, lying somewhat away from border membrane and all but same level of tangent point. Anterior margin angularly curved but not parallel with posterior margin. Anterior margin extending beyond y+1 axis (Fig. 7), prominent anterior blade apophysis always present. Posterior margin of blade distinct to mark semilunar curve with deepest point of curve at below apex. Blade connection thick and posterior blade apophysis present. Central part strong, straight or slightly curved downwards with bluntly rounded, robust point of tip extending just past halfway to y-1 axis and strongly interlinked into preceding denticle. Shape of central part above and below x axis similar. Indentation on lower central part indistinct. Ray connection well developed and markedly distinguishable from entire ray. Ray comparatively stout, long and tip of ray directed parallel with y axis. Ray apophysis not developed.

Trichodina pseudoheterodontata was first



Figs 3-6. Photomicrographs of silver impregnated adhesive discs of *Trichodina pseudoheterodontata* (3-4) and *Trichodina hafizuddini* (5-6). Scale bar 20 μm .

described by Tang et al. [39] from the gills of channel catfish *Ictalurus punctatus* from the Changshou Lake in Chongqing, China. The present study confirms the existence of *T. pseudoheterodontata* for the first time in Bangladesh from freshwater catfish *Mystus bleekeri*. Based on the appearance of adhesive disc *T. pseudoheterodontata* is almost resembles to *Trichodina heterodontata* [40]. Besides morphological features of *T. pseudoheterodontata* reveal that it is freshwater large sized *Trichodina* species, cell diameter 73.0–82.5 μm , possess robust denticles with broad, sickle-shaped blade, width central part, horse-shoe shaped macronucleus and spherical shaped micronucleus situated in +Y position, adoral ciliary spiral turns about 390–410° around peristomal disc.

Presently discussed trichodinid specimens found from the gills of *M. bleekeri* have coincident morphological features of that originally described by Tang et al. [39]. However, morphometric data of presently discussed specimen shows a range of variation. Body dimension of *T. pseudodeterodentata* that described by Tang et al. [39], is larger than

presently described specimens (Table 1). Number of denticles, width of border membrane falls with the range. However, dimension of adhesive disc, denticular ring, number of radial pins per denticles, and measurement of denticle component are comparatively smaller than that of population from Tang et al. [39].

***Trichodina hafizuddini* Asmat, 2005** (Figs 5-6, 9; Table 2)

Host: *Amblypharyngodon mola* [38]. **Locality:** The Baikka Beel (24.3514°N, 91.6979°E) of Moulvibazar district in Sylhet division, Bangladesh.

Location on host: Gills. **Prevalence:** Twenty eight out of seventy specimens examined (40%).

Intensity of infection: Low to medium. **Voucher specimens:** Two slides (CUZM-AM-1-BB and CUZM-AM-2-BB) with silver impregnated specimens prepared on 5th October 2015 have been deposited in the Museum of Department of Zoology, University of Chittagong 4331, Bangladesh.

Description (n=20): Large trichodinid ciliate with hemispherical shaped body, 48.0–52.3 (49.8 \pm 1.3) in diameter. Diameter of adhesive disc

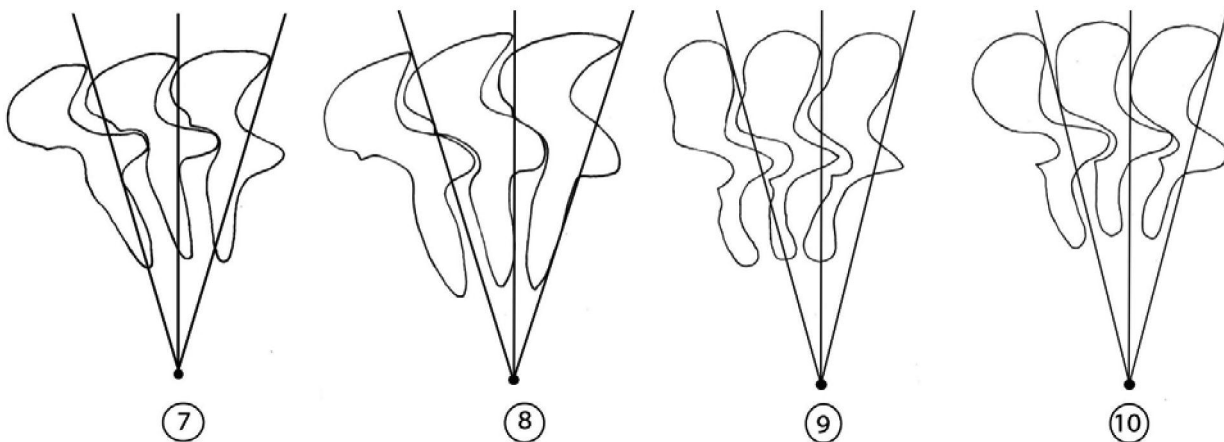
Table 2. Morphometric comparison of *Trichodina hafizuddini* obtained in the present study with that of Asmat [25]. Measurement in micrometer (μm).

Species	<i>T. hafizuddini</i> (n=20) [25]	<i>T. hafizuddini</i> (n=20)
Host	<i>Amblypharyngodon mola</i>	<i>Amblypharyngodon mola</i>
Locality	Hooghly River, India	Baikka Beel, Moulvibazar, Sylhet Bangladesh
Location	Gills	Gills
Diameter of		
body	45.9-62.3 (51.3 \pm 5.2)	48.0-52.3 (49.8 \pm 1.3)
adhesive disc	35.7-54.1 (42.2 \pm 5.1)	39.7-41.7 (40.3 \pm 0.6)
denticulate ring	24.0-38.2 (27.6 \pm 3.5)	24.7-27.9 (26.6 \pm 0.8)
central area	13.7-24.5 (17.6 \pm 2.9)	12.6-16.3 (14.1 \pm 0.8)
Width of border membrane	4.1-5.1 (4.4 \pm 0.4)	4.9-5.8 (5.2 \pm 0.3)
Number of		
denticles	28-31 (29.7 \pm 0.8)	30-33 (31.3 \pm 0.8)
radial pins/denticle	7-11 (8.9 \pm 1.3)	4-6 (5.3 \pm 0.8)
Span of denticle	–	12.5-15.3 (14.0 \pm 0.8)
Length of		
denticle	5.1-8.2 (6.0 \pm 0.9)	3.7-5.6 (4.6 \pm 0.5)
ray	3.1-6.6 (4.5 \pm 1.1)	4.0-6.3 (5.1 \pm 0.5)
blade	4.6-6.6 (5.3 \pm 0.5)	5.3-8.1 (6.6 \pm 0.7)
Width of central part	1.5-2.2 (1.9 \pm 0.2)	1.7-3.0 (2.3 \pm 0.4)
Degree of adoral ciliature	390-405°	380-390°

39.7–41.7 (40.3 \pm 0.6), surrounded by a finely striated border membrane 4.9–5.8 (5.2 \pm 0.3). Centre of disc well impregnated, nearly similar to the rest of adhesive disc without any argentophobic granular processes or patches, 12.6–16.3 (14.1 \pm 0.8) in diameter. Denticulate ring diameter 24.7–27.9 (26.6 \pm 0.8), consists of 30–33 (31.3 \pm 0.8) with radial pins 4–6 (5.3 \pm 0.8) per denticle. Span and length of

denticle 12.5–15.3 (14.0 \pm 0.8) and 3.7–5.6 (4.6 \pm 0.5) respectively. Length of blade 5.3–8.1 (6.6 \pm 0.7), ray 4.0–6.3 (5.1 \pm 0.5), central part 1.7–3.0 (2.3 \pm 0.4) in width. Inter-blade space small to medium.

Denticle morphology: Blade stout, spoon shaped and slightly curved (Fig. 5). Distal margin of blade conically rounded, almost proximate to border membrane. Tangent point smooth, like small line



Figs 7-10. Diagrammatic drawing of the denticles of *Trichodina* species: 7. *Trichodina pseudoheterodontata* from the gills of *Mystus bleekeri* in Bangladesh; 8. from the gills of *Ictalurus punctatus* in China, redrawn from Tang et al. [39]; 9. *Trichodina hafizuddini* from the gills of *Amblypharyngodon mola* in Bangladesh; and 10. from the gills of the *Amblypharyngodon mola* in India, redrawn from Asmat [25].

rather than point and below distal margin. Anterior margin slightly swollen behind slope of distal margin and a shallow concave like depression present above base of apex. Inter-blade space small, having a few number of minute argentophobic glistening particles. Blade connection prominent. Apex extends beyond y+1 axis (Fig. 9). Posterior margin of blade different to mark any shallow semicircular curve remains slightly lower than apex. Posterior projection indistinct. Central part slender, triangular in shaped, directed downwardly, with sharp point of tip, tightly fitting into preceding denticle and extends half way to y axis. Ray shorter than blade, gently slanted in posterior direction, with marked constriction slightly apart to distinct ray apophysis. Post constricted part of ray gradually inflated and ending in bulbous rounded tip. Argentophobic particles present between ray bases. Tip of ray extending almost half way to y-1 axis.

Asmat [25] established *Trichodina hafizuddini* as a new species from the gills of freshwater mud perch *Amblypharyngodon mola* from the Hooghly River of Hooghly in West Bengal, India. In accordance with Asmat [25], *T. hafizuddini* is characterized by moderately spaced, broad, angular, almost sickle-shaped blade, but in many cases appear as spoon – shaped or almost rounded filling most of the inter-blade space. Ray shorter than blade with central groove and sometimes constriction just below ray apophysis. Post constriction part of ray to some extent inflated, ending in rounded tip.

The present paper reports on the occurrence of this species for the first time from the same host *A. mola* in Bangladesh. We found that the trichodinid ciliate obtained from *A. mola* shows some significant variability in comparison to the population reported from the River of Hooghly in West Bengal, India when denticle structure is considered. Asmat [25] observed anterior margin of blade slightly curves down and forms shallow apex at the base of blade. In our study, we observed that anterior margin slightly swollen behind slope of distal margin and a shallow concave depression is visible that situates above the base of apex. Another important difference is the central part. Asmat [25] reported that central part of the *Trichodina hafizuddini* is slender, tubular with bluntly rounded point. Besides present study reveals that central part is triangular in structure with sharp point of tip. These denticle structural variations may be distinguishable as geographical distribution and environmental condition in the locality of the

described trichodinid.

Values for the diameter of body, adhesive disc, deticulate ring and central area are slightly smaller than data given by Asmat [25]. However, width of border membrane, number of denticles, radial pins per denticle, length of denticle, blade and ray length of the present studied specimens fall in the range as reported by Asmat [25] (Table 2).

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References

- [1] Lom J., Hoffman G.L. 1964. Geographic distribution of some species of trichodinids (Ciliata: Peritricha) parasitic on fishes. *Journal of Parasitology* 50: 30-35.
- [2] Uzman J.R., Stickney A.P. 1954. *Trichodina myicola* n. sp. a peritrichous ciliate from the marine bivalve *Mya arenaria* L. *Journal of Protozoology* 1: 149-155.
- [3] Arthur J.R., Lom J. 1984. Some trichodinid ciliates (Protozoa: Peritrichida) from Cuban fishes, with a description of *Trichodina cubanensis* n. sp. from the skin of *Cichlasoma tetracantha*. *Transactions of the American Microscopical Society* 103: 172-184. doi:10.2307/3226240
- [4] Arthur J.R., Lom J. 1984. Trichodinid Protozoa (Ciliophora: Peritrichida) from freshwater fishes of Rybinsk Reservoir, USSR. *Journal of Protozoology* 31: 82-91.
- [5] Lom J. 1970. Observations on trichodinid ciliates from freshwater fishes. *Archive for Protistology* 112: 153-177.
- [6] Urawa S., Awakura T. 1994. Protozoan diseases of freshwater fishes in Hokkaido. *Scientific Reports of the Hokkaido Fish Hatchery* 47: 47-58.
- [7] Wellborn T.L. Jr. 1967. *Trichodina* (Ciliata: Urceolariidae) of freshwater fishes of the southeastern United States. *Journal of Protozoology* 14: 399-412.
- [8] Ehrenberg C.G. 1830. Beitrage zur Kenntniss der Organisation der Infusorien und ihrer geographischen Verbreitung, besonders in Sibirien, [I, Beitrag.] *Abhandlungen der kÖniglichen Akademie der Wissenschaften zu Berlin* 1: 1-88.
- [9] Raabe Z. 1959. Urceolariidae of gills of Gobiidae and Cottidae from Baltic Sea. *Acta Parasitologica Polonica* 6: 441-452.
- [10] Van As J.G., Basson L. 1989. A further contribution to the taxonomy of the Trichodinidae (Ciliophora: Peritrichida) and a review of the taxonomic status of some ectoparasitic trichodinids. *Systematic Parasito-*

- logy 14: 157-179.
- [11] Dickerson H.W. 2006. *Ichthyophthirius multifiliis* and *Cryptocaryon irritans* (Phylum Ciliophora) In: *Fish diseases and disorders. Protozoan and metazoan infections*. (Ed. P.T.K. Woo). 2nd ed. CAB International, Wallingford 1: 116-153.
- [12] Öztürk T., Özer A. 2007. *Trichodina* fauna the toothcarp *Aphanius danfordii* (Boulenger, 1890) (Osteichthyes: Cyprinodontidae), an endemic fish from Sarykum lagoon Lake in Sinop, Turkey. *Acta Protozoologica* 46: 73-80.
- [13] Tang F.H., Zhao Y.J. 2013. Record of three new *Trichodina* species (Protozoa, Ciliophora) Parasitic on gills of freshwater fishes from Chongqing, China. *African Journal of Microbiology Research* 7: 1226-1232. doi:10.5897/AJMR12.1163
- [14] Asmat G.S.M., Bhoyain A.M., Siddiqua P.S. 1997. First record of a species of *Paratrichodina* Lom, 1963 (Mobilina: Urceolariidae) from *Mystus vittatus* (Bloch) in Bangladesh. *Environment and Ecology* 15: 843-845.
- [15] Lom J. 1963. On the buccal apparatus of peritrichous ciliates. In: *Proceedings of 1st International Congress of Protozoology, Prague, August, 1961. Progress in Protozoology* 1: 91-95.
- [16] Lom J. 1959. On the systematics of the genus *Trichodinella* Šrámek-Hušek (= *Brachyspira* Raabe). *Acta Parasitologica Polonica* 7: 573-590.
- [17] Raabe Z. 1950. Uwagi o *Urceolariidae* (Ciliata - Peritricha) skrzyl ryb. *Annales Universitatis Mariae Curie-Skłodowska, Lublin* 5: 292-310 (in Polish).
- [18] Šrámek-Hušek R, 1953. Zur Frage der Taxonomie und der Pathogenität unserer ektoparasitischen Urceolariiden. *Folia Zoologica, Entomology* 2: 167-180.
- [19] Asmat G.S.M., Mohammad N., Sultana N. 2003. *Trichodina anabasi* sp. n. (Ciliophora: Trichodinidae) from climbing perch, *Anabas testudineus* (Bloch, 1795) (Anabantidae) in Chittagong. *Pakistan Journal of Biological Sciences* 6: 269-272. doi:10.3923/pjbs.2003.269.272
- [20] Asmat G.S.M., Kibria M.M., Naher L. 2003. *Trichodina gulshae* sp. n. (Ciliophora: Trichodinidae) from the Gangetic *Mystus*, *Mystus cavasissus* (Hamilton-Buchanan, 1822) (Bagridae) in Chittagong. *Pakistan Journal of Biological Sciences* 6: 1608-1611. doi:10.3923/pjbs.2003.1608.1611
- [21] Asmat G.S.M., Hafizuddin A.K.M., Habib M.M.A. 2003. *Trichodina sylhetensis* sp. n. (Ciliophora: Trichodinidae) from the Mud Perch, *Nandus nandus* (Hamilton-Buchanan, 1822) (Nandidae) in Sylhet. *Pakistan Journal of Biological Sciences* 6: 1774-1777. doi:10.3923/pjbs.2003.1774.1777
- [22] Asmat G.S.M. 2004. First record of *Trichodina diaptomi* (Dogiel, 1940) Basson and Van As, 1991, *Trichodina heterodentata* Duncan, 1977 and *T. oligocotti* (Lom, 1970) (Ciliophora: Trichodinidae) from Indian fishes. *Pakistan Journal of Biological Sciences* 7: 2066-2071. doi:10.3932/pjbs.2004.2066.2071.
- [23] Asmat G.S.M., Sultana N. 2005. Four new species of *Trichodina* Ehrenberg, 1830 (Ciliophora: Trichodinidae) from Bangladeshi fish. *Pakistan Journal of Biological Sciences* 8: 895-900. doi:10.3932/pjbs.2005.895.900
- [24] Asmat G.S.M., Afroz F., Mohammad N. 2005. Four new species of *Trichodina* Ehrenberg, 1830 (Ciliophora: Trichodinidae) from Bangladeshi fishes. *Research Journal of Agriculture and Biological Sciences* 1: 23-29.
- [25] Asmat G.S.M. 2005. Trichodinid Ecotoparasites (Ciliophora: Trichodinidae) of fishes in India. *Research Journal of Agriculture and Biological Sciences* 1: 31-37.
- [26] Asmat G.S.M., Hoque B., Mohammad N. 2006. A new Species of *Trichodina* Ehrenberg, 1830 (Ciliophora: Trichodinidae) from the Long Whiskered Catfish, *Mystus gulio* (Hamilton, 1822) (Siluriformes: Bagridae) in Chittagong, Bangladesh. *Research Journal of Fisheries and Hydrobiology* 1: 28-31.
- [27] Bhoyain A.M., Asmat, G.S.M., Siddiqua P.S. 1999. Record of *Tripartiella copiosa* Lom, 1959 (Mobilina: Trichodinidae) from the gills of *Mystus vittatus* (Bloch) in Bangladesh. *The Chittagong University Journal of Science* 23: 67-73.
- [28] Habib M.M.A., Asmat G.S.M. 2008. Record of *Trichodinella epizootica* (Raabe) Šrámek-Hušek (Ciliophora: Trichodinidae) from a major carp, *Labeo rohita* from Tanguar Haor in Sunamganj. *Journal of Asiatic Society of Bangladesh Science* 34: 89-92.
- [29] Habib M.M.A., Chowdhury A., Asmat G.S.M. 2010. Record of *Trichodina agoma* and *Trichodina ngoma* from freshwater Bagrid host fishes of Tanguar Haor in Sylhet, Bangladesh. *Journal of Asiatic Society of Bangladesh Science* 36: 147-153.
- [30] Kibria M.M., Sultana N., Habib M.M.A., Sharmin N., Asmat G.S.M. 2009. Two trichodinid ciliates (Ciliophora: Trichodinidae) from *Oreochromis mossambicus* (Peters, 1852) in Bangladesh. *Bangladesh Journal of Marine Science and Fisheries* 1: 63-70.
- [31] Kibria M.M., Islam H., Habib M.M.A., Asmat G.S.M. 2010. *Trichodina shitalakshya* sp. n. and *Trichodina acuta* Lom, 1961 (Ciliophora: Trichodinidae) from the freshwater fishes in the Shitalakhya River, Bangladesh. *Wiadomości Parazytologiczne* 56: 153-161.
- [32] Kibria M.M., Asmat G.S.M. 2011. *Trichodina johniusi* sp. n. (Ciliophora: Trichodinidae) from *Johnius coitor* (Hamilton, 1822) in the Shitalakhya River, Bangladesh. *Wiadomości Parazytologiczne* 57: 265-270.
- [33] Kibria M.M., Asmat G.S.M. 2014. *Trichodina* ectoparasites (Ciliophora: Trichodinidae) from the

- historical Bostami Pond of Chittagong, Bangladesh. In: *Modern Parasitology*. (Eds. N. Gupta, D.K. Gupta). Narendra Publishing House, Delhi, India: 39-57.
- [34] Klein B.M. 1958. The dry silver method and its proper use. *Journal of Protozoology* 5: 99-103.
- [35] Lom J. 1958. A contribution to the systematics and morphology of endoparasitic trichodinids from amphibians with a proposal of uniform specific characteristics. *Journal of Protozoology* 5: 251-263.
- [36] IPAC (Integrated Protected Area Co-management). 2013. Fish Catch Monitoring Report, 2013. www.nishorgo.org
- [37] Van As J.G., Basson L. 1992. Trichodinid ectoparasites (Ciliophora: Peritrichida) of freshwater fishes of the Zambesi River System, with a reappraisal of host specificity. *Systematic Parasitology* 22: 81-109.
- [38] Hamilton F. [Buchanan] 1822. An account of the fishes found in the river Ganges and its branches. Archibald Constable and Company, Hidinburg and London, VII. 405.
- [39] Tang F., Zhang Y., Zhao Y. 2017. Morphological and molecular identification of the new species, *Trichodina pseudoheterodontata* sp.n. (Ciliophora, Mobilida, Trichodinidae) from the channel catfish, *Ictalurus punctatus*, in Chongqing China. *Journal of Eukaryotic Microbiology* 64: 45-55. doi;10.1111/jeu.12335
- [40] Duncan B.L. 1977. Urceolariid ciliates, including three new species, from cultured Philippine fishes. *Transactions of the American Microscopical Society* 96: 76-81.

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