

<http://www.pjbs.org>

PJBS

ISSN 1028-8880

**Pakistan
Journal of Biological Sciences**

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Four New Species of *Trichodina* Ehrenberg, 1830 (Ciliophora: Trichodinidae) from Bangladeshi Fish

Ghazi S.M. Asmat and Nazma Sultana
Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh

Abstract: During a survey on species diversity of trichodinid ciliates from freshwater and estuarine fishes in the Chittagong district, Bangladesh, four new species of *Trichodina* were recorded. These are: *Trichodina colisae* from *Polyacanthus fasciatus*, *Trichodina cirratusi* from an estuarine fish, *Taenoides cirratus*, *Trichodina glossogobiusi* from another estuarine fish, *Glossogobius giuris* and *Trichodina oreochromisi* sp. n. from *Oreochromis mossambicus*. Taxonomic and morphometric data for these trichodinids based on wet silver nitrate impregnated specimens are presented.

Key words: *Trichodina cirratusi*, *Trichodina colisae*, *Trichodina glossogobiusi*, *Trichodina oreochromisi*, Ciliophora, Trichodinidae, Bangladesh

INTRODUCTION

Trichodinid infection on fish are common in many zoogeographical regions. Among these, the genus *Trichodina*^[1] is the largest of this family. In Bangladesh, very little attention has been paid to the ciliates of this genus. The existing data on this matter can only be found by Asmat *et al.*^[2-7] and Bhouyain *et al.*^[8]. During the present survey on the species diversity of the trichodinid ciliates from some freshwater and estuarine fishes of Chittagong district between January and December, 2001, four new species of *Trichodina*, parasitising the gills of various fish was found and is described here. The existing lists of trichodinid parasites invading commercially important fishes of Bangladesh will certainly be increased if there is a long term research project devoted to the study of these parasites.

MATERIALS AND METHODS

The host fishes were collected by fishing nets from the Karnaphuli River at Sadarghat area and from a pond at Haliashahar of Chittagong between January to December 2001. Gill scrapings were made at the collection site. Air-dried gill scrapings were transported to the laboratory. The slides with trichodinid ciliates were impregnated with Klein's dry silver impregnation technique^[9]. Examinations of prepared slides were made under research microscope at 10x100 magnification. Measurements were done following the recommendations of Lom^[10], Wellborn^[11], Arthur and Lom^[12] and Van As and Basson^[13,14]. For comprehensive morphological details of the ciliates photomicrographs were made. The level of infection was presented as low (1-5 ciliate slide⁻¹), medium (6-10 ciliate slide⁻¹) and high (more than

10 ciliates slide⁻¹). Measurements are given in μm . The results and photographs were compared to results from other studies.

RESULTS AND DISCUSSION

***Trichodina cirratusi* sp. n. (Fig. 1 and 5):** Host. *Taenoides cirratus*^[15]. Locality. Karnaphuli River, Chittagong. Location. Gills. Prevalence. $^{16}/_{165}$ (9.7%); February-March, 2001. Infection. Low.

Description(n = 20): Small-sized trichodinid, 22.4-28.6 (25.8 \pm 1.4) in diameter having cup-shaped adhesive disc 18.4-23.5 (21.3 \pm 1.4) in diameter (Table 1). Central area of adhesive disc contain a circular, bright field of argentophobic area, 3.6-6.6 (4.9 \pm 1.0) in diameter, bordered by a wrinkled or notched outline. Denticulate ring consists of 19-21 (20.1 \pm 0.8) denticle with 3-5 (3.6 \pm 0.7) radial pins per denticle. Adoral zone of cilia spirals about 380°.

Blade broad, falcate shaped, filling most of space between y+1 axis (Fig. 5). Distal margin flat and angular with sharp tangent point, lying slightly below distal margin. Anterior margin smoothly curves towards y+1 axis and forms rounded apex. Apical depression well developed, never impregnates, but border of apex sometimes impregnates, giving sickle shaped appearance of blade. Posterior margin forms shallow, elongated curve with deepest point situated at level lower than apex. Blade connection short and wide. Anterior and posterior blade apophysis absent. Central part stout, wide triangular with sharply rounded point which rarely extends halfway past to y-1 axis and fitted firmly with preceding denticle. No indentation on lower central part. Section above x axis slightly sloped. Ray much shorter (Fig. 5), nearly half of

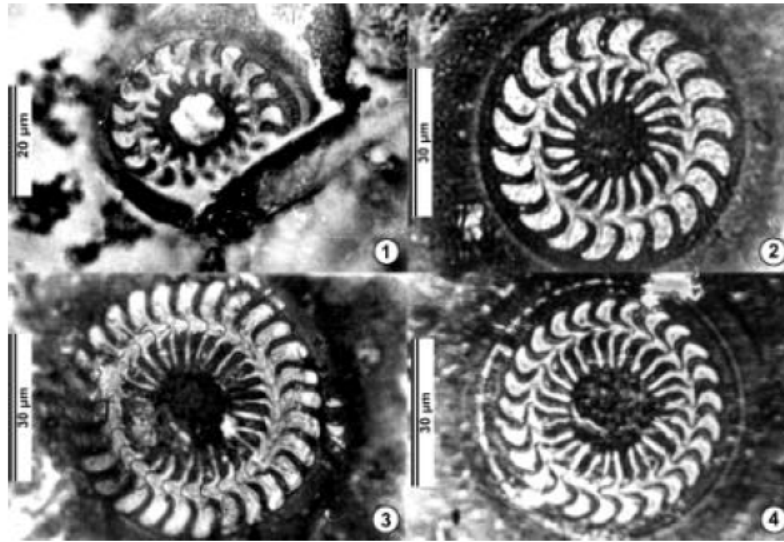


Fig. 1-4: Silver impregnated adhesive discs of trichodinids: 1 *Trochodina cirratusi* sp. n.; 2 *Trichodina colisae* sp. n.; 3 *Trichodina glossogobiusi* sp. n. and 4 *Trichodina oreochromisi* sp. n.

length of blade, of uniform thickness, slanted anteriorly and sometimes slightly curved in posterior direction, but remains almost parallel to y axes. Ray connection short and broad, but ray apophysis not visible. Due to much shortened rays, diameter of central area large, so perimeter of clear area quite often wide.

The described species is one of the smallest species of *Trichodina* and may be characterized by very small body dimensions and by the morphology of denticle components in having falcate blade, relatively stout central part with sloping upper section and very small, half of the blade length, anteriorly slanted ray of uniform thickness along with a relatively small central bright area at the center of the adhesive disc containing black patches (Fig. 1). Based on these characters this trichodinid ciliate can clearly be distinguished from all other existing species of *Trichodina*. However, in comparison with other *Trichodina* sp. from fishes, the denticle shape of the presently described species reminds to a lesser extent *Trichodina ovonucleata*^[6] and *Tripartiella (Paratrachodina) globonuclea*^[7].

Raabe^[6] described *Trichodina ovonucleata* from the gills of a marine fish, *Blennius tentaculatus* from the shores of Split and Rovinj, Poland. The species is characterized by broad, sickle-shaped curved, pointed and loosely articulated blades; relatively weak, slightly curved, pointed rays; and dark centre of the adhesive disc. The number and shape of denticle and body dimensions of the present species fall well within the range of *T. ovonucleata*. But it differs in the centre of the adhesive disc which in *T. ovonucleata* appears dark in silver impregnated preparations, but a white central area with notched or wrinkled perimeter is distinctly visible in

the described species. The dimensions of denticle components and other morphometrics are also differ in the two species.

The denticle shape of the presently described species is allied to that of *P. globonuclea*. Lom^[8] reported *Tripartiella globonuclea* from the skin of marine fish, *Gaidropsis mediterraneus* and the gills of *Ophidium barbatum* in the Rumanian Black Sea coast. Lom^[8], gave a detail description of the species as *Paratrachodina globonuclea* under the genus *Tripartiella*. The species is characterized by having adoral zone makes a turn of about 220°; symbiotic bacteria in the plasm; argentophilic central area at the centre of the adhesive disc; oval macronucleus; and typical *Trichodina*-like denticle. But the presently described species is strikingly different from *P. ovonuclea* in having an argentophobe centre of the adhesive disc; extent of the adoral ciliary spiral that extends about 380° and lacking any kind of symbiotic bacteria in the plasm. The described species can also be clearly distinguished from that of *P. globonuclea* by its body dimensions. The presence of the bright area at the centre of the adhesive disc and the extent of the adoral ciliary spiral that extends about 380° in the described species are sufficient to prove that this is a vague resemblance and the two species are of separate genus.

Type host	<i>Taenoides cirratu</i> ^[9] (Perciformes: Gobiidae)
Type locality	The Karnaphuli River (22°18'N 91°53'E), Chittagong, Bangladesh
Type location	Gills
Type materials	Holotype, slide TC 1 (20/02/2001); paratypes, slide TC 2 (20/02/ 2001) are in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh
Etymology	Named after the species name of the type host

Table 1: Morphometric data of different species of *Trichodina* obtained from the gills of freshwater and estuarine fishes in Chittagong, Bangladesh

Species	<i>Trichodina cirratusi</i> sp. n. (n=20)	<i>Trichodina colisae</i> sp. n. (n = 20)	<i>Trichodina glossogobiusi</i> sp. n. (n=20)	<i>Trichodina oreochromisi</i> sp. n. (n=20)
Host	<i>Taenoides cirratus</i>	<i>Polyacanthus fasciata</i>	<i>Glossogobius giurus</i>	<i>Oreochromis mossambicus</i>
Locality	Karnaphuli River	Peerbari pond	Karnaphuli River	Peerbari pond
Diameter of body	22.4-28.6 (25.8±1.3)	35.8-44.9 (36.9±3.0)	54.1-65.3 (60.7±3.6)	48.0-59.2 (52.1±3.0)
Diameter of adhesive disc	18.4-23.5 (21.3±1.4)	28.8-36.2 (32.2±2.6)	44.9-59.2 (52.3±4.3)	40.8-49.0 (43.4±2.3)
Diameter of denticulate ring	10.2-14.8 (12.5±1.4)	16.3-20.9 (18.3±1.9)	29.6-36.7 (32.5±2.1)	27.0-33.7 (29.8±1.5)
Diameter of central area	4.1-9.2 (7.5±1.2)	7.1-10.2(9.1±1.1)	13.4-15.3 (14.4±0.9)	10.2-18.0 (12.7±2.1)
Diameter of clear area	3.6-6.6 (4.9±1.0)	-	-	-
Width of border membrane	2.0-3.1 (2.3±0.4)	3.1-4.6 (3.7±0.4)	3.6-5.1 (4.2±0.5)	3.1-5.1 (4.3±0.6)
Number of denticles	19.0-21 (20.0±0.8)	20.0-24 (23.1±1.3)	25.0-28 (26.9±1.0)	22.0-24 (23.1±0.7)
No. of radial pins/denticle	3.0-5 (3.6±0.7)	8.0-10 (9.1±0.8)	8.0-10 (8.8 ± 0.8)	9.0-13 (10.9 ± 1.1)
Span of denticle	5.3-7.3 (5.6±0.6)	9.9-11.2 (10.5±0.5)	13.8-20.4 (16.7±2.3)	11.2-14.8 (13.4±0.9)
Length of denticle	2.2-4.1 (3.2±0.4)	4.9-5.6 (5.2±0.2)	6.1-8.2 (7.4±0.8)	6.1-9.2 (7.7±0.7)
Length of ray	1.0-2.0 (1.6±0.4)	3.8-4.6 (4.1±0.2)	5.1-9.2 (6.8±1.4)	3.6-7.1 (5.7±0.8)
Length of blade	2.0-3.6 (3.0±0.4)	3.1-5.1 (4.2±0.6)	5.1-7.9 (6.4±0.7)	4.1-5.1 (4.7±0.3)
Width of central part	1.0-1.7 (1.4±0.3)	1.5-2.1 (2.0±0.1)	2.5-4.1 (3.5±0.4)	2.0-3.6 (2.8±0.4)
°Adoral ciliature	380.0	405.0	390.0	390.0-405

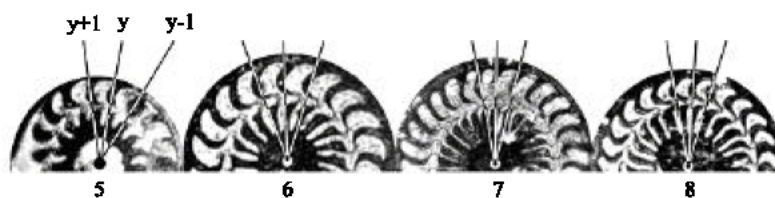


Fig. 5-8: Denticles of trichodinids in relation to various axes: 5 of *T. cirratusi*; 6 of *T. colisae*; 7 of *T. glossogobiusi*; and 8 of *T. oreochromisi*

***Trichodina colisae* sp. n. (Fig. 2 and 6):** Host. *Polyacanthus fasciatus*^[9]. Locality. Peerbari Pond, Chittagong. Location. Gills. Prevalence. ^{22/331} (6.6%); July-September, 2001. Infection. Low.

Description (n = 20): Flattened, saucer-shaped, medium-sized trichodinid, 35.8-44.9 (39.6±3.0) in diameter. Adhesive disc concave, 28.8-36.2 (32.2±2.6) in diameter, surrounded by a distinct finely striated border membrane, 3.1-4.6 (3.7±0.4) wide. Denticulate ring consists of 20-24 (23.1±1.3) denticles. Number of radial pins to one denticle 8-10 (9.1±0.8)(Table 1). Texture of central area granular, stains dark as rest of adhesive disc. Adoral zone of cilia spirals about 405°.

Blade of denticle fills entire space between y axes (Fig. 6). Blade broad, almost with parallel margin, sometimes slightly curved (Fig. 2). Distal margin truncated or flattened, lies away from and parallel to border membrane. Tangent point blunt, situated slightly lower than distal margin. Anterior margin angular or slightly curves down to form a shallow, rounded apex at base of blade. Apical depression prominent, but never impregnates. Posterior margin follows same curve as anterior one forming a shallow crescent with deepest point at same level as apex. Anterior and posterior blade apophysis absent. Blade connection short and thin. Central part moderate, slightly triangular with bluntly

rounded tip which extends slightly more than halfway to y-1 axis and interlocked tightly into preceding denticle. Section of central part above and below x axis similar. Indentation in lower central part absent. Ray connection short having same thickness as ray. Ray apophysis not prominent. Ray with constricted base and blunt rounded point, bears a central groove. Post constricted part of ray broad or inflated. Ray directed in anterior direction, tip of ray touches or crosses y axis.

The general view of the denticle morphology, especially the shape of blade, of silver impregnated adhesive disc of *Trichodina matsu*^[20] and *Trichodina colisae* sp. n. are close to each other. But the detailed study reveals many important differences. In *T. matsu* i) blade sickle-shaped (vs almost with parallel margin, sometimes slightly curved); ii) anterior margin forms smooth, slight curves towards prominent apex (vs angular, sometimes slightly curves down to form a shallow apex); iii) posterior blade margin forms triangular curve (vs shallow crescent); iv) central part wide (vs narrow); v) indentation in lower central part present (vs absent); vi) ray connection short and thicker than ray (vs short and thinner); vii) ray apophysis present (vs not visible); viii) ray thin, of equal thickness throughout with sharp rounded point (vs thick, inflated, with blunt rounded end); and ix) ray directed posteriorly (vs anteriorly).

Type host	<i>Polyacanthus fasciatus</i> ^[19] (Perciformes: Osphronemidae)
Type locality	Peerbari Pond at Haliashahar (22°14'N 91°46'E) in Chittagong, Bangladesh
Location	Gills
Type materials	Holotype, slide PF 1 (09/07/2001); paratypes, slide PF 2 (09/07/2001) are in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh
Etymology	Named after the species name of the type host

***Trichodina glossogobiusi* sp. n. (Fig. 3 and 7):** Host: *Glossogobius giurisi*^[21]. Locality. The Karnaphuli River at Sadarghat area in Chittagong. Location. Gills. Prevalence. $\frac{4}{54}$ (7.4%); July-August, 2001. Infection. Low.

Description (n = 20): Large trichodinid with a saucer shaped body, 54.1-65.3 (60.7±3.6) in diameter. Adhesive disc, 44.9-59.2 (52.3±4.3) in diameter, flat and surrounded by finely striated border membrane, 3.6-5.1 (4.2±0.5) wide. Texture of central area similar as rest of adhesive disc and stained dark. Denticulate ring, 29.6-36.7 (32.5±2.1) in diameter, consists of 25-28 (26.9±1.0) denticles having relatively large interblade space with 8-10 (8.8±0.8) radial pins per denticle. Adoral ciliature, about 390° (Table 1).

Blade elongated, broad and slightly curved with almost parallel margins (Fig. 7). Distal margin somewhat angular, sometimes rounded and close to border membrane. Blade fills almost entire space between y-axis. Tangent blunt, forms small line rather than point and situated lower than distal margin. Anterior margin slopes down angularly or slightly curves to y+1 axis. Apex, though not prominent, situated at base of blade and touches y+1 axis. Anterior blade apophysis well developed. Posterior margin forms shallow, elongated crescent with deepest point at same level as apex. Apical depression well developed and never impregnates. Blade connection narrow, but thicker than ray. Central part robust, extends slightly more than halfway to y-1 axis fitting tightly into preceding denticle. Central conical part strongly developed. Shape of sections above and below x axis almost similar. Indentation in lower central part opposing ray apophysis very small, not visible in most cases. Ray connection short with ray apophysis placed high on ray and directed antero-dorsally. Ray nearly as long as blade, of same thickness with rounded point. Ray thin and straight, runs almost parallel to y-1 axis.

The described species can clearly be distinguished from all other dark centered trichodinids by having a large, saucer shaped body; elongated, broad and slightly curved blade with almost parallel margins, but somewhat angular distal margin and blunt tangent point; well developed anterior blade apophysis; robust central part having no indentation in the proximal section; straight but slightly anteriorly slanted ray

which is nearly as long as the blade, of same thickness with rounded point (Fig. 3) and runs almost parallel to the y-1 axis. However, it shows some resemblance to the denticle shape of *Trichodina ngoma*^[14].

Trichodina ngoma was described from the skin, fins and gills of *Hemigrammocharax multifasciatus* in Lake Lisikili, South Africa. The similarity in the denticle shape of the present species is also shared with *T. ngoma* in having blade with angular or slightly rounded distal margin with rounded tangent point and almost parallel borders; apex at the lowest point; very small indentation in the lower central part and straight rays of equal thickness with rounded point. But the described species differs as follows. In *T. ngoma* 1) the level of deepest point of the semilunar curve formed by the posterior margin is above the apex of blade (vs on the same level as apex); 2) the central part is thin, sloping downwards, so the section above the x axis is also sloped (vs stout with section above and below the x axis similar); 3) the ray of some individuals of *T. ngoma* appears thin with bulging tips (vs absent) and 4) the anterior margin of the blade sometimes impregnates, giving impression of an indentation (vs never impregnates). The morphometrical data also differ in the two species. *T. ngoma* is smaller than the present species.

Type host	<i>Glossogobius giurisi</i> ^[21] (Perciformes: Gobiidae)
Type locality	The Karnaphuli River (22°18'N 91°53'E), Chittagong, Bangladesh
Type location	Gills
Type materials	Holotype, slide GG 1 (27/08/2001); paratypes, slide GG 2 (27/08/2001) are in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh
Etymology	Named after the generic name of the type host

***Trichodina oreochromisi* sp. n. (Fig. 4 and 8):** Host: *Oreochromis mossambicus*^[22]. Locality: Peerbari Pond at Haliashahar in Chittagong. Location: Gills. Prevalence: $\frac{9}{120}$ (7.5); October-November, 2001. Infection: Low.

Description (n = 20): Medium-sized trichodinid with disc-shaped body 48.0-59.2 (52.1±3.0) in diameter. Adhesive disc, 40.8-49.0 (43.4±2.3) in diameter, surrounded by a finely striated border membrane. Central area of same texture as rest of disc, finely granular, stains dark during silver impregnation. Denticulate ring consists of 22-24 (23.1±0.7) denticles with 9-13 (10.9±1.1) radial pins per denticle. Adoral zone of cilia spirals about 390-405° (Table 1).

Blade of denticle broad, but relatively short and sickle-shaped, filling most of space between y and y+1 axes. Distal margin of blade, lying away from border membrane, slightly curved. Tangent point blunt, situated lower than distal margin. Anterior margin curves down

with slightly rounded apex at mid-length of blade, which in some cases extends slightly beyond y+1 axis (Fig. 8). Apex and apical depression never impregnate. Curve of posterior margin forms a shallow crescent with deepest point at same level as apex. Anterior blade apophysis sometimes prominent and blade connection delicate. Interblade space medium. Central part slender, almost tubular, tapering to bluntly rounded point that extends to and sometimes touches y-1 axis and fitted tightly into preceding denticle. Shape of section above and below x axis similar. Posterior blade apophysis and indentation in lower central part indistinct. Ray connection short and of same thickness as blade connection. Ray considerably longer than blade, of same thickness, straight, but slightly curved backward near base and bears central groove. Ray tapers to a rounded end and lies parallel to y axes. Ray apophysis not visible. The adhesive disc morphology in young individuals differs from the adult in having strongly falcate blade with sharp tangent point, conical apex, triangular central part and posteriorly curved rays.

The described species is a medium-sized trichodinid whose adhesive disc is surrounded by a finely striated border membrane and contains a central area of same texture as rest of the disc, which is finely granular and stains dark during silver impregnation (Fig. 4). The only species, which resembles the present one, is *Trichodina siluri*^[23] reported from Nile tilapia, *Oreochromis niloticus* in the Philippines by Bondad-Reantaso and Arthur^[24]. However, in close observation there are marked differences in denticle measurements as well as denticle morphology between the specimens of *T. siluri* as demonstrated by Lom^[23] and Bondad-Reantaso and Arthur^[24] including the body dimensions and measurements of the adhesive disc components.

The present species in having more arched blade with curved distal margin; deeper semilunar curve by the posterior margin whose deepest point lies on the same level as the apex; slender to moderate central part and slightly curved posteriorly directed ray, is distinctly different from the original representation of *T. siluri*^[23]. The same features mentioned above including the position of denticular parts to various axes are also clearly revealed in the specimens of Bondad-Reantaso and Arthur^[24], however, the tip of ray is more broadened than the present materials. Considering the similarities as mentioned we are convinced that the Philippino and Bangladeshi populations of the described trichodinid belong to same species. We propose to establish the present trichodinid as a new species.

Type host	<i>Oreochromis mossambicus</i> ^[22] (Perciformes: Cichlidae)
Type locality	Peerbari Pond at Haliashahar (22°14'N 91°46'E) in Chittagong, Bangladesh
Type location	Gills
Type materials	Holotype, slide OM 1 (14/10/2001); paratypes, slide OM 6 (14/10/2001) are in the collection of the Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh
Etymology	Named after the generic name of the type host

ACKNOWLEDGMENTS

The study was carried out at the Department of Zoology, University of Chittagong. The authors are grateful to Dr. Nurul Anwar, Chairman, Department of Microbiology, University of Chittagong for helping in photomicrography.

REFERENCES

1. Ehrenberg, C.G., 1830. Beitrage zur Kenntniss der Organisation der Infusorien und ihrer geographischen Verbreitung, besonders in Sibirien, I, Beitrag. Physikal. Abhandl. Akad. d.Wissensch., Berlin, Jahrg, pp: 1-88.
2. Asmat, G.S.M., A.M. Bhoyuain and P.S. Siddiqua, 1997. First record of a species of *Paratrachodina* Lom, 1963 (Mobilina: Urceolariidae) from *Mystus vittatus* (Bloch) in Bangladesh. Environ. Ecol., 15: 843-845.
3. Asmat, G.S.M., N. Mohammad and N. Sultana, 2003. *Trichodina anabasi* sp. n. (Ciliophora: Trichodinidae) from climbing perch, *Anabas testudineus* (Bloch, 1795) (Anabantidae) in Chittagong. Pak. J. Biol. Sci., 6: 314-316.
4. Asmat, G.S.M., N. Mohammad, N. Sultana, L. Naher and F. Afroz, 2003. Ectoparasitic species of the genus *Trichodina* (Ciliophora: Trichodinidae) parasitising freshwater and estuarine fish in Chittagong. Abstract No. 25. Zoological Society Bangladesh, Annual General Meeting and Conference, pp: 29.
5. Asmat, G.S.M., N. Mohammad, F. Afroz, L. Naher and N. Sultana, 2003. Trichodinid ectoparasites of the genus *Tripartiella* (Ciliophora: Trichodinidae) from freshwater and estuarine fish in Chittagong. Abstract No. 26. Zoological Society Bangladesh, Annual General Meeting and Conference, pp: 29.
6. Asmat, G.S.M., M. M. Kibria and L. Naher, 2003. *Trichodina gulshae* sp. n. (Ciliophora: Trichodinidae) from the gangetic mystus, *Mystus cavasius* (Hamilton-Buchanan, 1822) (Bagridae) in Chittagong. Pak. J. Biol. Sci., 6: 1608-1611.

7. Asmat, G.S.M., A.K.M. Hafizuddin and M.M.A. Habib, 2003. *Trichodina sylhetensis* sp. n. (Ciliophora: Trichodinidae) from the mud perch, *Nandus nandus* (Hamilton-Buchanan, 1822) (Nandidae) in Sylhet. Pak. J. Biol. Sci., 6: 1774-1777.
8. Bhouyain, A.M., G.S.M. Asmat and P.S. Siddiqua, 1999. Record of *Tripartiella copiosa* Lom, 1959 (Mobilina: Trichodinidae) from the gills of *Mystus vittatus* (Bloch) in Bangladesh. The Chittagong Univ. J. Sci., 23: 67-73.
9. Klein, B.M., 1958. The dry silver method and its proper use. J. Protozool., 5: 99-103.
10. Lom, J., 1958. A contribution to the systematics and morphology of endoparasitic trichodinids from amphibians, with a proposal of uniform specific characteristics. J. Protozool., 5: 215-263.
11. Wellborn, T.L.Jr., 1967. *Trichodina* (Ciliata: Urceolariidae) of freshwater fishes of the Southern United States. J. Protozool., 14: 399-412.
12. Arthur, J.R. and J. Lom., 1984. Trichodinid Protozoa (Ciliophora: Peritrichida) from freshwater fishes of Rybinsk Reservoir, USSR. J. Protozool., 31: 82-91.
13. Van As, J.G. and L. Basson, 1989. A further contribution to the taxonomy of the Trichodinidae (Ciliophora: Peritrichida) and a review of the taxonomic status of some fish ectoparasitic trichodinids. Syst. Parasitol., 14: 157-179.
14. Van As, J.G. and L. Basson, 1992. Trichodinid ectoparasites (Ciliophora: Peritrichida) of freshwater fishes of the Zambesi River system, with a reappraisal of host specificity. Syst. Parasitol., 22: 81-109.
15. Blyth, E., 1860. Report on some fishes received chiefly from the Sitang River and its tributary streams, Tenasserim Provinces. J. Asiatic Soc. Bengal, 138-174.
16. Raabe, Z., 1958. On some species of *Trichodina* (Ciliata - Peritricha) of gills of Adriatic fishes. Acta Parasitol. Pol., 6: 355-362.
17. Lom, J., 1963. The ciliates of the family Urceolariidae inhabiting gills of fishes (the *Trichodinella*-group). Vestn. Cesk. Spol. Zool., 27: 7-19.
18. Lom, J., 1962. Trichodinid ciliates from fishes of the Rumanian Black Sea coast. Parasitology, 52: 49-61.
19. Bloch, M.E. and J.G. Schneider, 1801. M. E. Blochii, Systema Ichthyologiae iconibus ex illustratum. Post obitum auctoris opus inchoatum absolvit, correxit, interpolavit Jo. Gottlob Schneider, Saxo. Berolini. Sumtibus Auctoris Impressum et Bibliopolio Sanderiano Commisum. Systema Ichthyol., pp: 1-584.
20. Basson, L. and J.G. Van As, 1994. Trichodinid ectoparasites (Ciliophora: Peritrichia) of wild and cultured freshwater fishes in Taiwan, with notes on their origin. Syst. Parasitol., 28: 197-222.
21. Hamilton, F. Buchanan, 1822. An account of the fishes found in the river Ganges and its branches. Edinburgh and London. Fishes Ganges, pp: 1-405.
22. Peters, W.C.H., 1852. Diagnosen von neuen Flussfischen aus Mossambique. Monatsb. Akad. Wiss, Berlin, pp: 275-276, 681-685.
23. Lom, J., 1970. Observations on trichodinid ciliates from fresh water fishes. Arch. Protistenkd, 112: 153-177.
24. Bondad-Reantaso, M.G. and J.R. Arthur, 1989. Trichodinids (Protozoa: Ciliophora: Peritrichida) of Nile tilapia (*Oreochromis niloticus*) in the Philippines. Asian Fish. Sci., 3: 27-44.