

Some Trichodinids (Protozoa: Ciliophora: Peritrichida) from Freshwater Fishes Imported into the Philippines

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Abstract

Presented are ten species of Trichodinidae identified from the skin and gills of cyprinid fishes imported into the Philippines for aquaculture purposes and the aquarium trade. These include *Trichodina acuta* Lom, 1970; *T. reticulata* Hirschmann and Partsch, 1955; *T. nobillis* Chen, 1963; *T. nigra* Lom, 1961; *T. kupermani* Arthur and Lom, 1984; *T. heterodontata* Duncan, 1977; *Trichodina* sp.; *Tripartiella tilapiae* (Duncan, 1977); and *Trichodinella epizootica* (Raabe, 1950). An annotated listing of all species of trichodinids reported from freshwater fishes, tadpoles and invertebrates of East and Southeast Asia is included.

Introduction

The trichodinid ciliates of freshwater fishes of East and Southeast Asia have been little studied. The first taxonomic investigations of this group made in East Asia were those of Ariake (1929) and Suzuki (1950) for Japan and Pai (1950) and Chen (1955, 1956a, 1956b) from China. Later publications include those of Hsieh et al. (1959); Chen (1963, 1984a, 1984b); Anon. (1973); Chen and Hsieh (1984) and Feng (1985) for China; Ahmed (1976, 1977) for

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Japan; and Van As and Basson (1986) for Taiwan. Shtein (1984) lists a number of species as occurring in North Korea, China and Japan. For Southeast Asia, the only publications reporting named species of trichodinids are those of Duncan (1977), Natividad et al. (1986), Natividad (1987), and Bondad-Reantaso and Arthur (1989), all from the Philippines; and Shtein (1984), who lists several species from Vietnam. Some 42 species of trichodinids have been reported from freshwater fishes in this geographical area (see Appendix I). However, of these, less than 20 are well established species whose presence in the region is substantiated, the remainder being species whose validity requires confirmation, synonyms of well established species, probable misidentifications, or *nomina dubia*.

This study is part of a larger project of the Government of the Philippines, Bureau of Fisheries and Aquatic Resources (BFAR) to evaluate the need for quarantine and certification regulations for aquatic animals. Presented are some species of trichodinids entering the Philippines with freshwater fishes imported for aquaculture and the aquarium trade. To assist other workers in the region, we include as Appendix I, an annotated list of all species of trichodinids reported from freshwater fishes, tadpoles and invertebrates of East and Southeast Asia to date.

Materials and Methods

Upon arrival by air at Ninoy Aquino International Airport in Manila, samples of fishes were transported live in oxygenated plastic bags to the Fish Health Laboratory of BFAR in Quezon City where they were held in aerated aquaria prior to examination. Trichodinids were identified from the following collections of fishes imported from January 1987 to March 1988:

1. *Cyprinus carpio* juveniles (common carp), imported from Sukabumi, West Java, Indonesia for experimental culture in rice paddies at Central Luzon State University, Freshwater Aquaculture Center, Muñoz, Nueva Ecija Province (n = 11).
2. *Carassius auratus* (goldfish), imported from Hongkong for the ornamental fish trade (n = 15).
3. *Aristichthys nobilis* juveniles (bighead carp), imported from Taiwan for stocking in private aquaculture ponds at San Miguel, Bulacan Province (n = 23).
4. *Ctenopharyngodon idella* juveniles (grass carp), imported from Taiwan for stocking in Caliraya Lake, Laguna Province (n = 15).

Scrapings of skin and gills were examined as wet mounts under a compound microscope at 100x magnification and if trichodinids were present, air dried smears were prepared. Slides were then stained with an aqueous solution of 2% AgNO₃ for 8 minutes followed by 20 minutes exposure to UV light (Klein's dry silver impregnation technique) to demonstrate the morphology of the adhesive disc. Terminology and method of measurement of the components of the adhesive disc follow that given by Lom (1958) and Arthur and Lom (1984b). All measurements are given in micrometers (µm). Representative slides are retained in the collection of the BFAR Fish Health Unit.

Results

Ten species of Trichodinidae were identified from examination of four species of cyprinid fishes originating from four countries. These include eight species of *Trichodina* and one species from each of the genera *Tripartiella* and *Trichodinella*. Their identity, host species, location, localities, and comments on their geographic distribution and taxonomic status follow:

Trichodina acuta Lom, 1970

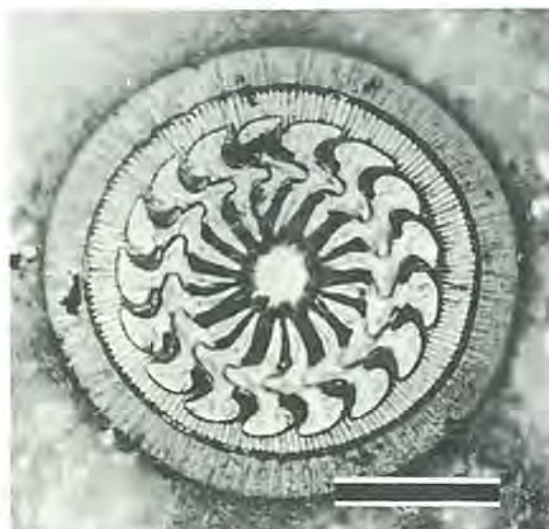


Fig. 1. *Trichodina acuta* from *Cyprinus carpio*. (Scale bar = 20 µm).

Hosts: *Cyprinus carpio* juvenile
Ctenopharyngodon idella juvenile

Location: skin

Comments: A light infection of *T. acuta* was found on juvenile common carp originating from Indonesia, while a single specimen was noted on smears from juvenile grass carp imported from Taiwan.

This species, originally described from several freshwater fishes (among them *C. carpio*) and tadpoles from Czechoslovakia by Lom (1961) has since been reported to have a wide geographical distribution, occurring in the United States, the USSR, Eastern Europe, the Philippines, North Korea, China, South Africa and Israel (see, for example, Lom 1970; Anon. 1973; Duncan 1977; Basson et al. 1983; Shtein 1984; and Bondad-Reantaso and Arthur 1989). Dimensions for our specimens from *C. carpio* (see Table 1) fall well within the range of measurements presented for *T. acuta* by Lom (1961) and Shtein (1984).

Trichodina mutabilis Kazubski and Migala, 1968



Fig. 2. *T. mutabilis* from *C. carpio*. (Scale bar = 20 μ m).

Host: *C. carpio* juvenile

Location: gills

Comments: This species was found on young common carp imported from Indonesia in mixed infection with *T. nobillis* Chen, 1963; *T. nigra* Lom, 1961; and *Trichodinella epizootica* (Raabe, 1950).

Morphometric data and the appearance of the silver impregnated adhesive disc of our specimens of *T. mutabilis* are given in Table 1 and Fig. 2. Our specimens are slightly smaller than those described in the original report of this species by Kazubski and Migala (1968) (e.g., diameter of adhesive disc 41.0-57.1 in our material *vs.* 40.3-68.8

Table 1. Data summary for trichodinid species from fishes imported into the Philippines.¹

	<i>Trichodina acuta</i> (n = 6)	<i>Trichodina mutabilis</i> (n = 12)	<i>Trichodina reticulata</i> (n = 25)	<i>Trichodina nobilis</i> (n = 25)
Diameter of:				
Body	52.0-67.0 (57.6 ± 5.1) ²	53.0-70.0 (63.2 ± 4.6)	57.0-68.5 (60.8 ± 2.8)	70.0-90.0 (78.9 ± 4.3)
Adhesive disc	42.0-57.2 (47.8 ± 5.2)	41.0-57.1 (51.3 ± 4.9)	46.0-57.0 (46.0 ± 2.8)	58.0-77.0 (65.5 ± 4.6)
Denticular ring	28.3-36.0 (30.3 ± 3.0)	28.0-38.5 (34.5 ± 3.5)	31.0-37.0 (34.2 ± 1.7)	38.5-52.5 (44.3 ± 3.0)
Number of:				
Denticles	17-19 (18.5 ± 0.3)	22-27 (24.5 ± 1.4)	22-26 (23.7 ± 1.0)	23-28 (24.8 ± 1.0)
Radial pins/denticle	10-12	11-13	10-12	12-14
Dimension of denticle:				
Length	8.1-9.2 (8.8 ± 0.4)	6.0-9.1 (7.8 ± 0.9)	7.5-8.5 (7.7 ± 0.5)	10.5-12.5 (11.0 ± 0.8)
Blade	5.0-6.0 (5.5 ± 0.4)	5.8-8.1 (6.0 ± 0.4)	6.0-7.5 (7.0 ± 0.4)	7.5-10.5 (9.1 ± 0.7)
Thorn	5.5-7.0 (6.1 ± 0.5)	7.4-10.5 (8.7 ± 0.9)	5.0-7.5 (5.0 ± 0.5)	8.0-13.0 (10.7 ± 1.5)
Center	2.4-3.5 (2.8 ± 0.4)	1.8-2.0 (2.1 ± 0.3)	1.5-2.0 (2.0 ± 0.1)	2.0-3.0 (2.4 ± 0.4)
Span	13.5-15.0 (14.5 ± 0.7)	15.9-19.9 (17.9 ± 1.5)	14.5-16.5 (15.2 ± 0.7)	19.0-26.0 (22.2 ± 1.9)
Width of border membrane	4.9-5.2 (5.0 ± 0.1)	5.0-6.5 (5.0 ± 0.4)	5.0-6.0 (5.7 ± 0.4)	5.5-7.5 (6.8 ± 0.6)
Host	<i>Cyprinus carpio</i>	<i>C. carpio</i>	<i>Carassius auratus</i>	<i>Aristichthys nobilis</i>
Location	skin	gills	skin, gills	skin, gills
Country of origin	Indonesia	Indonesia	Hongkong	Taiwan

¹All measurements in micrometers (μm).

²Range ($\bar{X} \pm S.D.$).

Table 1. Continued.

	<i>Trichodina nigra</i> (n = 25)			<i>Trichodina supermani</i> (n = 21)			<i>Trichodina heterodentata</i> (n = 17)			<i>Trichodina heterodentata</i> (n = 10)		
Diameter of:												
Body	42.8-54.4	(48.8 ± 3.3)	37.5-50.0	(43.9 ± 3.9)	50.0-55.0	(57.9 ± 3.7)	60.0-65.5	(63.7 ± 1.7)				
Adhesive disc	32.9-44.0	(38.7 ± 3.0)	29.5-43.0	(35.4 ± 3.8)	45.0-55.0	(48.7 ± 3.5)	50.0-55.0	(53.3 ± 1.6)				
Denticular ring	22.0-28.7	(25.4 ± 1.8)	18.0-27.0	(22.6 ± 2.8)	28.0-38.0	(32.5 ± 2.5)	37.0-48.5	(37.1 ± 1.9)				
Number of:												
Denticles	19-23	(21.1 ± 1.2)	24-28	(25.6 ± 1.2)	21-25	(23.5 ± 1.7)	22-26	(24.0 ± 1.0)				
Radial pins/denticle	9-12		9-10		12-14		11-12					
Dimension of denticle:												
Length	5.9-8.2	(7.0 ± 0.6)	3.5-6.0	(5.0 ± 0.6)	7.5-9.0	(8.1 ± 0.5)	7.0-11.0	(8.8 ± 1.0)				
Blade	5.0-6.5	(5.7 ± 0.4)	4.0-5.5	(4.7 ± 0.5)	5.0-6.5	(5.6 ± 0.5)	5.0-7.0	(5.9 ± 0.5)				
Thorn	4.5-6.5	(5.2 ± 0.5)	3.0-6.0	(4.6 ± 0.8)	5.5-10.5	(7.7 ± 1.3)	6.0-9.5	(7.3 ± 1.2)				
Center	1.7-3.0	(2.5 ± 0.4)	1.0-1.5	(1.1 ± 0.3)	1.0-2.0	(1.9 ± 0.3)	2.0-3.0	(2.1 ± 0.3)				
Span	11.9-15.3	(13.3 ± 0.8)	9.0-12.0	(10.7 ± 0.9)	13.0-18.0	(15.3 ± 1.3)	14.0-19.0	(16.4 ± 1.5)				
Width of border membrane	4.8-5.5	(5.0 ± 2.2)	4.0-5.0	(4.2 ± 0.3)	4.0-6.0	(4.9 ± 0.4)	5.0-6.0	(5.3 ± 0.4)				
Host		<i>C. corpio</i>		<i>Chenopharyngodon idella</i>		<i>A. nobilis</i>		<i>C. idella</i>				
Location		skin, gills		skin, gills		skin, gills		skin, gills				
Country of origin		Indonesia		Taiwan		Taiwan		Taiwan				

Table 1. Continued.

	<i>Trichodina heterodentata</i> (n = 18)	<i>Trichodina</i> sp. (n = 7)	<i>Tripodiella tilapiae</i> (n = 15)	<i>Trichodinella episcopica</i> (n = 25)
Diameter of:				
Body	53.0-71.5 (67.9 ± 3.7)	55.0-64.5 (59.1 ± 3.8)	21.0-30.0 (23.3 ± 2.6)	19.0-26.0 (22.5 ± 1.8)
Adhesive disc	44.0-61.0 (52.1 ± 5.4)	45.0-52.5 (48.9 ± 2.8)	16.1-25.1 (19.0 ± 2.4)	15.0-21.9 (18.5 ± 1.6)
Denticular ring	24.5-41.2 (35.0 ± 4.2)	31.5-36.5 (34.2 ± 2.0)	8.5-12.5 (9.8 ± 1.1)	9.0-12.5 (11.2 ± 1.1)
Number of:				
Denticles	20-24 (21.8 ± 1.2)	19-23 (21.0 ± 1.4)	21-27 (25.3 ± 1.7)	19-24 (21.2 ± 1.0)
Radial pins/denticle	11-13	10-12	4-7	5-6
Dimension of denticle:				
Length	5.2-10.2 (6.9 ± 1.2)	8.0-9.0 (8.5 ± 0.4)	1.0-2.8 (1.7 ± 0.5)	1.6-2.7 (2.2 ± 0.3)
Blade	5.0-6.5 (5.8 ± 0.5)	6.0-6.5 (6.1 ± 0.9)	2.9-6.0 (3.9 ± 0.8)	2.5-4.0 (3.2 ± 0.4)
Thorn	6.0-9.5 (8.0 ± 1.0)	6.0-9.0 (7.6 ± 1.2)	0.8-1.9 (1.3 ± 0.4)	
Center	2.2-3.5 (3.0 ± 0.4)	2.0 (2.0 ± 0.0)	1.0-2.0 (1.1 ± 0.3)	1.1-2.8 (2.0 ± 0.5)
Span	14.3-18.0 (16.6 ± 1.1)	14.0-17.0 (15.8 ± 1.2)	4.5-9.9 (6.3 ± 1.3)	4.0-6.0 (5.1 ± 0.6)
Width of border membrane	4.0-6.5 (5.3 ± 0.6)	5.0-6.0 (5.4 ± 0.4)	1.8-3.0 (2.3 ± 0.4)	1.8-2.8 (2.1 ± 0.3)
Host	<i>C. carpio</i>	<i>C. auratus</i>	<i>C. idella</i>	<i>C. carpio</i>
Location	skin, gills	skin, gills	gills	gills
Country of origin	Indonesia	Hongkong	Taiwan	Indonesia

in the original report) and have fewer denticles (22-27 *vs.* 22-33) and more radial pins per denticle (11-13 *vs.* 9-10) but fall within the previously reported ranges for *T. mutabilis* given by subsequent authors (see, for example, Basson et al. 1983; Shtein 1984).

Trichodina mutabilis was originally described from the gills of *C. carpio* from aquaculture ponds near Warsaw, Poland (see Kazubski and Migala 1968) and has since been widely reported from this host, and occasionally other cyprinid and non-cyprinid fishes from the USSR, Eastern Europe, North Korea, South Africa and Israel (see Kazubski and Migala 1968; Basson et al. 1983; Shtein 1984). Our finding is the first report of this species for Southeast Asia.

Trichodina reticulata Hirschmann and Partsch, 1955

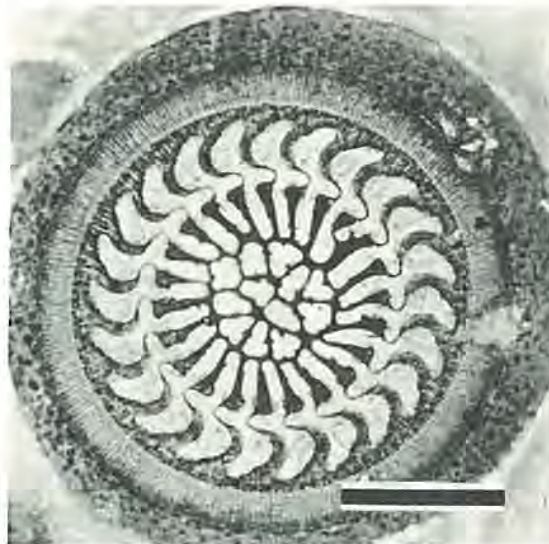


Fig. 3. *T. reticulata* from *Carassius auratus*. (Scale bar = 20 μ m).

Host: *Carassius auratus*

Location: skin and gills

Comments: *Trichodina reticulata* was a common parasite of goldfish imported from Hongkong, occurring in mixed infection with *Trichodina* sp. and *Trichodinella epizootica*. Dimensions and the appearance of the adhesive disc of our specimens (see Table 1 and Fig. 3) agree well with those presented by previous authors (for example, Shtein 1984), only a slight difference in the maximum number of radial pins per denticle being noted (10-12 in our material *vs.* a range of 6-11 for other authors).

Trichodina reticulata is a common parasite of cyprinid and other fishes, having been reported widely from the USSR, Eastern and

Western Europe, Great Britain, Iran, North Korea, Japan, China, the USA and Israel (see, for example, Chen 1963; Ahmed 1976, 1977; Basson et al. 1983; Shtein 1984).

Because of its affinity for cyprinid fishes and particularly for members of the genus *Carassius*, it seems probable that *T. reticulata* is originally an Asian species which has been widely disseminated by the movement of live Chinese carps for aquaculture purposes and other cyprinids, such as *C. auratus* which are popular in the aquarium trade (see Lom and Hoffman 1964). Our report is apparently the first record of this species from Southeast Asia, although it is no doubt widely distributed in this region.

Trichodina nobillis Chen, 1963

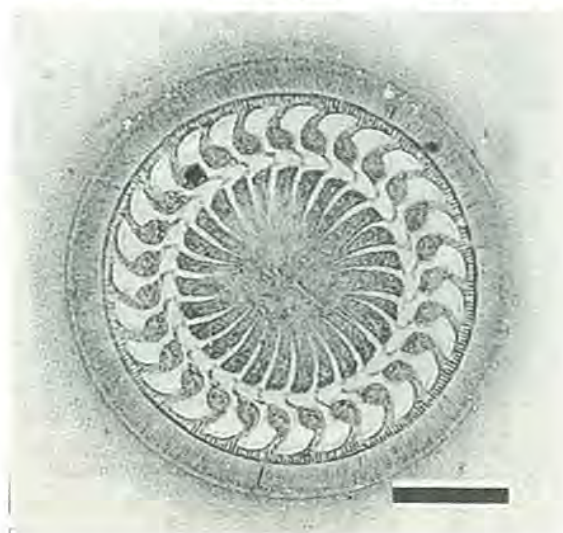


Fig. 4. *T. nobillis* from *Aristichthys nobilis*. (Scale bar = 20 μ m).

Hosts: *Ctenopharyngodon idella* juvenile
Aristichthys nobilis juvenile
Cyprinus carpio juvenile

Location: skin and gills

Comments: *Trichodina nobillis* was the prominent species of trichodinid found on bighead carp and grass carp imported from Taiwan. Two specimens were also noted on slides obtained from common carp imported from Indonesia.

The dimensions of our specimens (see Table 1) and appearance of the adhesive disc (Fig. 4) agree completely with previous descriptions of this well characterized species (see, for example, Chen 1963; Shtein 1984).

Trichodina nobillis, originally described from *C. carpio*, *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix* from China (see Chen 1963), is a widely distributed parasite of cyprinid fishes, having been reported from Vietnam, North Korea, the Soviet Union, and Eastern Europe (see Shtein 1984). This is the first report of *T. nobillis* from Southeast Asian fishes. Most authors, apparently following Shtein (1968), incorrectly list this species as *T. nobilis* Chenn, 1963.

Trichodina nigra Lom, 1961



Fig. 5. *T. nigra* from *C. carpio*. (Scale bar = 20 μ m).

Hosts: *Cyprinus carpio* juvenile
 Ctenopharyngodon idella juvenile
 Aristichthys nobilis juvenile

Location: skin and gills

Comments: *Trichodina nigra* was a common parasite of common carp originating from Indonesia, occurring in mixed infection with *T. mutabilis*, *T. acuta*, *T. heterodontata* Duncan 1977, and *Trichodinella epizootica*. A few specimens were also noted in smears taken from the gills of young bighead carp and grass carp from Taiwan.

Morphometric data and the appearance of the silver impregnated adhesive disc in our specimens of *T. nigra* (see Fig. 5 and Table 1) agree well with the original description of this species presented by Lom (1961) and that given by Shtein (1984).

Trichodina nigra is a well known species of wide distribution, having been reported from the Soviet Union, Eastern Europe, Israel, India, China and the USA from an extremely wide number of host species (see Chen 1963; Basson et al. 1983; Shtein 1984). Our finding is the first observation of this species on fishes of Southeast Asia. Previous reports from common carp include those of Lom (1961), Chen (1963), Kashkovsky (1974), Kazubski and Migala (1968) and Basson et al. (1983), among others.

Trichodina kupermani Arthur and Lom, 1984

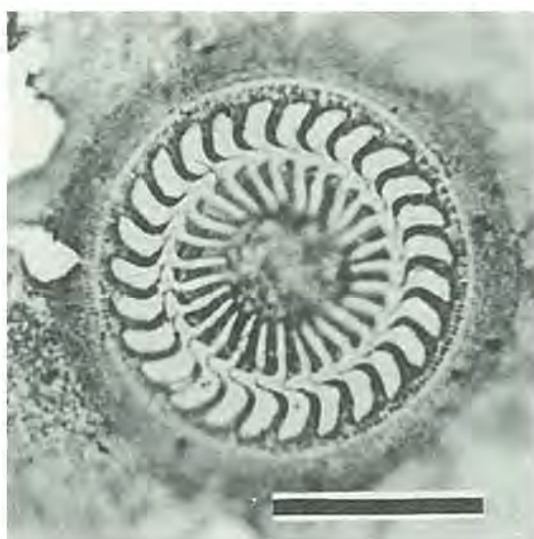


Fig. 6. *T. kupermani* from *Ctenopharyngodon idella*. (Scale bar = 20 μ m).

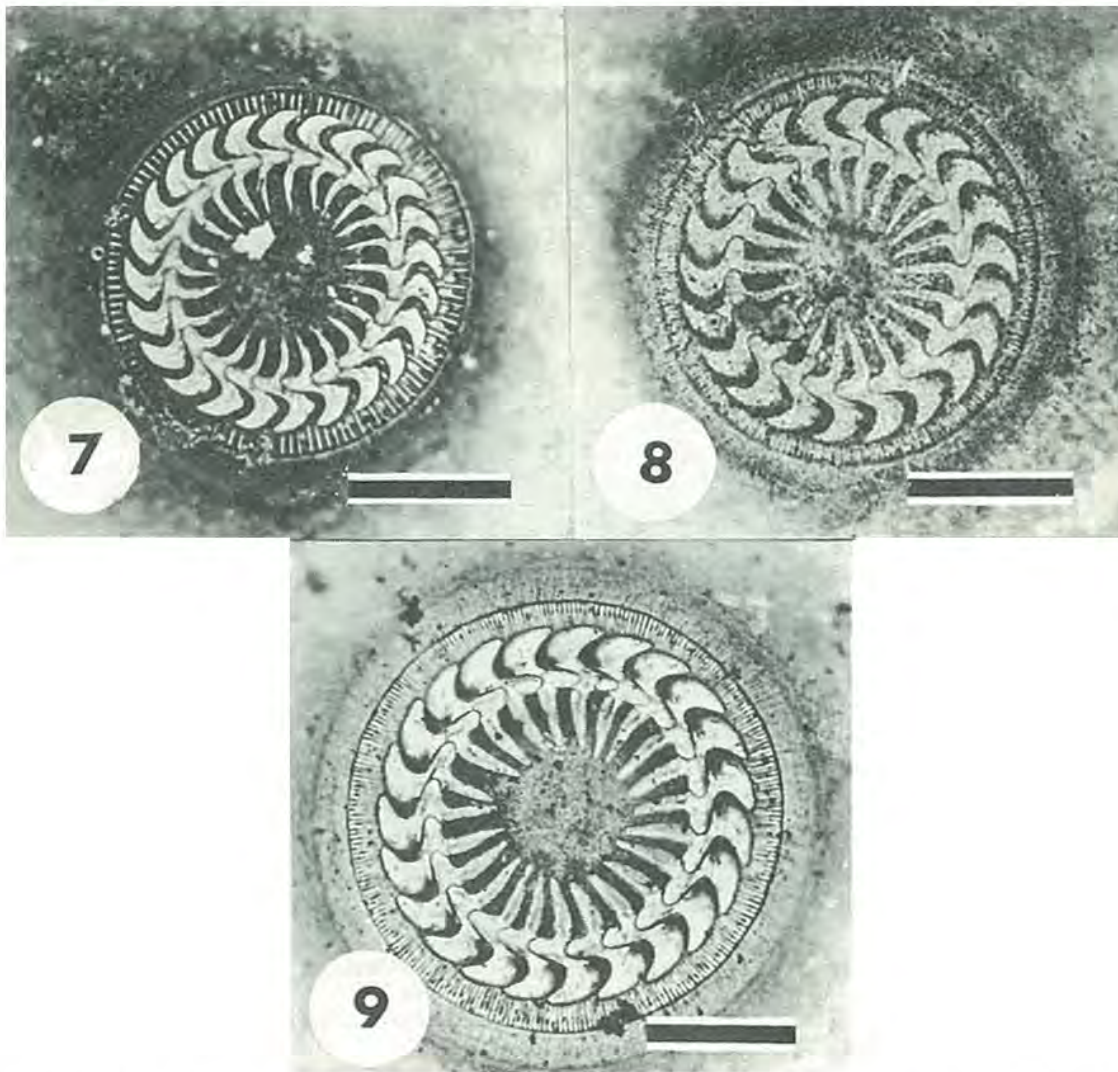
Host: *Ctenopharyngodon idella* juvenile

Location: gills

Comments: *Trichodina kupermani* was a common parasite of juvenile grass carp imported from Taiwan, occurring in mixed infection with *T. nobillis* and *T. heterodentata*.

Our specimens agree well with the original description of this species by Arthur and Lom (1984b), differing only in the length of denticle, which is somewhat shorter in our material (range of 4.5-6.0 vs. 6.1-9.2 in the original description).

Trichodina kupermani was described from the gills of the cyprinid fish *Pelecus cultratus* from the northwestern Soviet Union by Arthur and Lom (1984b). Our finding is only the second report of this species and extends its known distribution some 7,000 km to the southeast.

Trichodina heterodentata Duncan, 1977

Figs. 7-9. *T. heterodentata*; Fig. 7, from *C. idella*; Fig. 8, from *A. nobilis*; Fig. 9, from *Cyprinus carpio*; note variation in denticle shape. (All scale bars = 20 μ m).

Hosts: *Cyprinus carpio* juvenile
 Ctenopharyngodon idella juvenile
 Aristichthys nobilis juvenile

Location: skin and gills

Comments: *Trichodina heterodentata* was found in heavy infection on juvenile common carp and in moderate numbers on young grass carp and bighead carp.

Our measurements and the appearance of the silver impregnated adhesive disc for populations of *T. heterodentata* taken from the three host species (see Table 1 and Figs. 7-9) agree closely with those given in the original description of Duncan (1977) from Philippine freshwater fishes. The considerable variation of the shape

of the denticle of this species has been discussed by Duncan (1977) and Bondad-Reantaso and Arthur (1989).

In addition to reports of *T. heterodentata* from the Philippines (see Duncan 1977; Natividad et al. 1986; and Bondad-Reantaso and Arthur 1989), this species has been recorded from cichlid and cyprinid fishes (among them *C. carpio*) from South Africa and Israel (see Basson et al. 1983), from *Tilapia* sp. from Kenya (under the name *T. equatorialis* Kazubski, 1986) by Kazubski (1986), and from *Oreochromis mossambicus* from Taiwan by Van As and Basson (1986).

Trichodina sp.

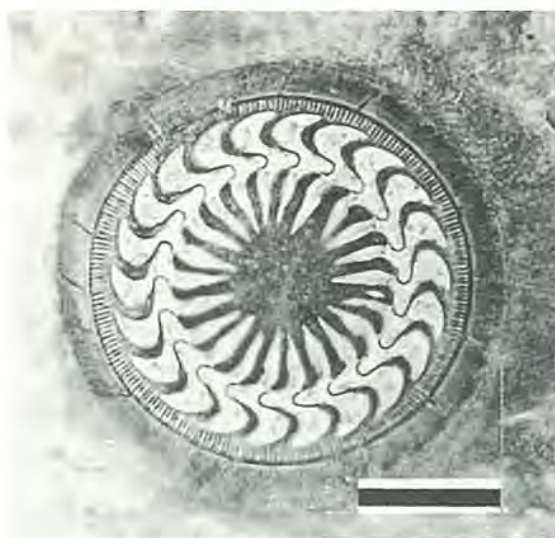


Fig. 10. *Trichodina* sp. from *C. auratus*.
(Scale bar = 20 μ m).

Host: *Carassius auratus*

Location: skin and gills

Comments: A few specimens of this species were found on goldfish imported from Hongkong in mixed infection with *T. reticulata* and *Trichodinella epizootica*.

This species bears close resemblance to *T. heterodentata* (Fig. 6 of Duncan 1977 and our Fig. 10). It differs in that the denticles are somewhat more robust than those of *T. heterodentata* and that the blade of the denticle lacks a notch on the anterior margin. Additionally, our specimens do not display the wide variation in denticle shape common in populations of *T. heterodentata*. *Trichodina* sp. also closely resembles *T. orientalis* Chen and Hsieh in Anon., 1973, a species inadequately described from various cyprinid fishes in

China (see Anon. 1973). Measurements for *Trichodina* sp. agree with those presented by Anon. (1973) for this species, while comparison of our photomicrograph with illustrations of *T. orientalis* (see Figs. 20 and 21 of Anon. 1973) shows only slight differences, the tip of the blade being more pointed and the thorn appearing straighter and more robust in our material. However, the absence of published photomicrographs of the silver impregnated adhesive disc of *T. orientalis* makes it impossible to determine the exact relationship of our material to this species. We do not agree with Shtein (1984) that *T. orientalis* is a synonym of *T. pediculus* (O.F. Müller, 1786). Our specimens appear to be conspecific with *Trichodina* sp. described from the skin of *Lepomis gibbosus* from Cuba by Arthur and Lom (1984a).

Tripartiella tilapiae (Duncan, 1977) Bondad-Reantaso
and Arthur, 1989

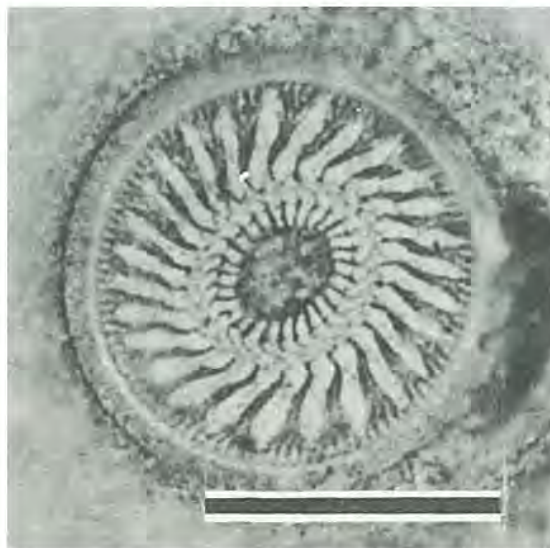


Fig. 11. *Tripartiella tilapiae* from *C. idella*. (Scale bar = 20 μ m).

Hosts: *Ctenopharyngodon idella* juvenile
 Aristichthys nobilis juvenile

Location: gills

Comments: This species was common on young grass carp imported from Taiwan. A single specimen was also observed on a smear taken from a juvenile bighead carp also originating from this locality.

The dimensions of our specimens of *T. tilapiae* (see Table 1) agree well with those presented by Duncan (1977) and by Bondad-Reantaso and Arthur (1989) but show slightly higher maximum

values for body measurements (e.g., diameter of adhesive disc 16.1-25.1 μm in our specimens *vs.* 14-20 in Duncan's material) and number of radial pins per denticle (4-7 in our specimens *vs.* 4-5 in those of Bondad-Reantaso and Arthur 1989). The morphology of the denticle blade in *T. tilapiae* appears to vary slightly between populations. In our specimens from *C. idella*, the blade typically has parallel sides or narrows slightly at its middle before expanding distally, while those described by Bondad-Reantaso and Arthur (1989) have either parallel sides or taper somewhat distally.

The taxonomy of this species has been reviewed by Bondad-Reantaso and Arthur (1989), who reported *T. tilapiae* from Nile tilapia (*Oreochromis niloticus*) cultured in brackishwater ponds in the Philippines. The original report of this species by Duncan (1977) was from *Tilapia zillii* cultured in Muñoz, Nueva Ecija, also in the Philippines. *Tripartiella tilapiae* appears to be a common parasite of many cultured fishes throughout East and Southeast Asia and has been reported under the names *T. bulbosa* and *Trichodina ovaliformis* from China, the USSR, Eastern Europe, and South Africa (see Bondad-Reantaso and Arthur 1989).

Trichodinella epizootica (Raabe, 1950) Srámek-Husek, 1953

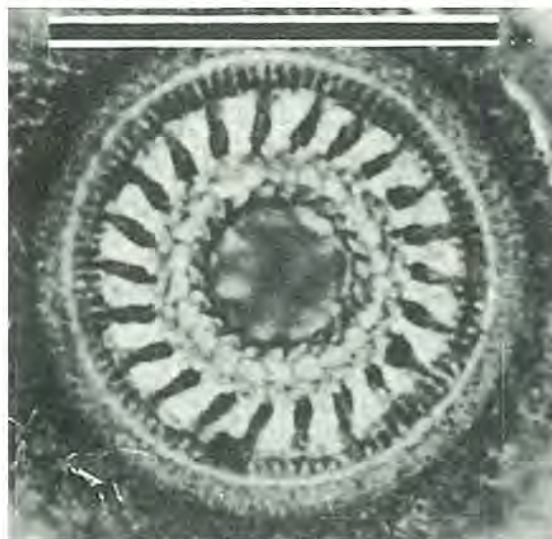


Fig. 12. *Trichodinella epizootica* from *C. carpio*. (Scale bar = 20 μm).

Hosts: *Cyprinus carpio* juvenile
 Ctenopharyngodon idella juvenile
 Aristichthys nobilis juvenile
 Carassius auratus

Location: gills

Comments: *Trichodinella epizootica* was found in heavy infections on juvenile common carp from Indonesia and in moderate numbers on young grass carp and bighead carp from Taiwan. A few specimens were also noted in smears from goldfish imported from Hongkong.

Morphometric data and the appearance of the adhesive disc in our specimens are presented in Table 1 and Fig. 12.

The taxonomic history and wide host and geographical distribution of *T. epizootica* has been extensively reviewed by Lom and Haldar (1977). Soviet workers (see Shtein 1984) continue to separate *T. epizootica* into a number of separate species (*T. percarum* Kostenko, 1969; *T. lotae* Kostenko, 1981 and *T. longispira* Shtein, 1962) based on slight differences in shape of the denticle and the extent of the adoral ciliary spiral. However, we agree with the position of Lom and Haldar (1977) that, with the possible exception of *T. longispira*, these represent only slightly differing populations of a single species.

Discussion

Of the nine trichodinids identified to species level, all but *T. kupermani* have been reported previously as common parasites of cyprinid fishes in the region. Three of these nine species (*T. acuta*, *T. heterodontata* and *Tripartiella tilapiae*) have been reported previously from fishes introduced into the Philippines (see Appendix I).

Most, if not all, of the species identified probably have been introduced previously and become established in the Philippines through the extensive introductions of freshwater fishes for aquaculture purposes (see Natividad 1987). Nonetheless, the fact that imported fishes are commonly infected with these ciliates, as well as with other, possibly more pathogenic parasites and microbes, points to the need for the implementation of programs for the inspection, quarantine and certification of fish stocks within countries in the region to prevent the spread of potentially harmful disease agents.

The results of our study increase to 45 the number of species of trichodinids reported from freshwater fishes, tadpoles and invertebrates of East and Southeast Asia (see Appendix I). Unfortunately, of these, only 18 species have been characterized adequately using silver impregnation to permit their positive reidentification or to confirm the accuracy of their report. An additional five species (*T. hyperparasitis* Chen and Hsieh, 1984; *T. nankingensis* Chen and Hsieh, 1984; *T. orientalis* Chen and Hsieh in

Anon., 1973; *T. parasiluri* Chen and Hsieh in Anon., 1973; and *T. tungtaiensis* Chen and Hsieh, 1984) described by Chinese workers (see Anon. 1973; Chen and Hsieh 1984) have been illustrated from silver impregnated material. However, publication of photomicrographs of their silver impregnated adhesive discs is urgently needed to confirm their distinctness, as the existing descriptions and illustrations of these species lack any readily discernible characteristics to separate them clearly from previously described well established species. Four additional well established species have been reported from fishes of East and Southeast Asia (*T. domerguei* Wallengren, 1897); *T. gobii* Lom, 1970; *T. pediculus* (O.F. Müller, 1786) and *Tripartiella bursiformis* (Davis, 1947). However, as the specimens upon which these reports were based were stained with hematoxylin, their identity is equivocal. Original descriptions for a total of 17 species of trichodinids were made without the use of silver nitrate impregnation. These descriptions lack clearly distinguishable features which would permit subsequent positive species reidentification and, as host and site specificity per se are inadequate to permit establishment of new taxa, we must consider these species names *nomina dubia*. One species name, *T. anguilli* Wu, 1961, is a *nomen nudum*.

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Appendix I

An Annotated List of the Trichodinid Protozoans Reported from Freshwater Fishes, Tadpoles and Invertebrates of East and Southeast Asia

- A. Well established species whose presence on fishes of East and Southeast Asia is confirmed.
1. *Trichodina acuta* Lom, 1970
Syn.: *T. domerguei* f. *latispina* auctorum

References: Chen 1963, 1984a, b (China); Anon. 1973 (China); Duncan 1977 (Philippines); Shtein 1984 (North Korea); Natividad et al. 1986 (Philippines); Bondad-Reantaso and Arthur 1989 (Philippines); Albaladejo and Arthur (this paper) (Indonesia, Taiwan)

Comments: The reports of Chen (1984a, b) were based on hematoxylin stained specimens.

2. *Trichodina centrostrigata* Basson, Van As and Paperna, 1983

References: Van As and Basson 1986 (Taiwan); Natividad et al. 1986 (Philippines); Bondad-Reantaso and Arthur 1989 (Philippines)

3. *Trichodina heterodentata* Duncan, 1977

References: Duncan 1977 (Philippines); Van As and Basson 1986 (Taiwan); Natividad et al. 1986 (Philippines); Bondad-Reantaso and Arthur 1989 (Philippines); Albaladejo and Arthur (this paper) (Indonesia, Taiwan)

4. *Trichodina kuleminae* Lom, 1970

Syn.: *Trichodina rectangli* Chen and Hsieh in Anon., 1973

References: Anon. 1973 (China); Shtein 1984 (China)

Comments: The original description of *T. rectangli* appeared in 1973 (see Anon. 1973) rather than in 1964, as incorrectly indicated in Anon. (1973) (Mrs. Hsieh Shing-ren pers. comm.). This name must be considered a junior synonym of *T. kuleminae*.

5. *Trichodina kupermani* Arthur and Lom, 1984

Reference: Albaladejo and Arthur (this paper) (Taiwan)

6. *Trichodina mutabilis* Kazubski and Migala, 1968

References: Shtein 1984 (North Korea); Albaladejo and Arthur (this paper) (Indonesia)

7. *Trichodina nigra* Lom, 1961

References: Chen 1963, 1984a, b (China); Albaladejo and Arthur (this paper) (Indonesia, Taiwan)

Comments: Kazubski and Migala (1968) considered that the material of Chen (1963) might be a mixture of *T. nigra* and *T. mutabilis*. The reports of Chen (1984a, b) are based on hematoxylin stained specimens.

8. *Trichodina nobillis* Chen, 1963

References: Chen 1963 (China); Anon. 1973 (China); Shtein 1984 (North Korea, Vietnam); Feng 1985 (China); Albaladejo and Arthur (this paper) (Indonesia, Taiwan)

9. *Trichodina perforata* Lom, Golemansky and Grupcheva, 1976

Reference: Shtein 1984 (Japan)

10. ***Trichodina reticulata* Hirschmann and Partsch, 1955**

References: Chen 1963 (China); Ahmed 1976, 1977 (Japan); Shtein 1984 (Japan, North Korea); Albaladejo and Arthur (this paper) (Hongkong)

11. ***Trichodina siluri* Lom, 1970**

Reference: Bondad-Reantaso and Arthur 1989 (Philippines)

Comments: The report of this species by Bondad-Reantaso and Arthur (1989) was noted to be a tentative identification.

12. ***Trichodina velasquezae* Bondad-Reantaso and Arthur, 1989**

Reference: Bondad-Reantaso and Arthur 1989 (Philippines)

Comments: This species has so far only been reported from Nile tilapia cultured in brackishwater.

13. ***Tripartiella clavodonta* Basson and Van As, 1987**

Reference: Bondad-Reantaso and Arthur 1989 (Philippines)

Comments: Bondad-Reantaso and Arthur (1989) noted that this species may be a synonym of *T. spatula*.

14. ***Tripartiella spatula* Van As and Basson, 1986**

Reference: Van As and Basson 1986 (Taiwan)

15. ***Tripartiella tilapiae* (Duncan, 1977) Bondad-Reantaso and Arthur, 1989**

Syn.: *Trichodinella tilapiae* Duncan, 1977
Trichodina oviformis (sic) of Anon., 1973

References: Anon. 1973 (China); Duncan 1977 (Philippines); Bondad-Reantaso and Arthur 1989 (Philippines); Albaladejo and Arthur (this paper) (Taiwan)

16. ***Trichodinella carpi* Duncan, 1977**

References: Duncan 1977 (Philippines); Natividad 1987 (Philippines)

Comments: This species was listed as a possible synonym of *T. epizootica* by Lom and Haldar (1977).

17. ***Trichodinella epizootica* (Raabe, 1950) Srámek-Husek, 1953**

References: Shtein 1984 (North Korea); Albaladejo and Arthur (this paper) (Hongkong, Indonesia, Taiwan)

Comments: Shtein (1984) considered the occurrence of *T. epizootica* in North Korea to be questionable.

18. *Trichodinella subtilis* Lom, 1959

Reference: Shtein 1984 (North Korea)

Comments: Shtein (1984) considered some of the material illustrated under the name *T. myakkae* by Anon. (1973) from China referable to this species.

B. Species whose validity requires confirmation.

Descriptions of the following five species include illustrations made from silver impregnated specimens. However, these alone are inadequate to allow determination of their precise relationships to previously described *Trichodina* species with dark central areas of the adhesive disc and falciform denticle blades. Publication of photomicrographs of their silver impregnated adhesive discs is needed to confirm their validities.

1. *Trichodina hyperparasitis* Chen and Hsieh, 1984

Reference: Chen and Hsieh 1984 (China)

2. *Trichodina nankingensis* Chen and Hsieh, 1984

Reference: Chen and Hsieh 1984 (China)

3. *Trichodina orientalis* Chen and Hsieh in Anon., 1973

Reference: Anon. 1973 (China)

Comments: Shtein (1984) considered this species a synonym of *T. pediculus*. However, we do not concur with this decision.

4. *Trichodina parasiluri* Chen and Hsieh in Anon., 1973

Reference: Anon. 1973 (China)

5. *Trichodina tungtaiensis* Chen and Hsieh, 1984

Reference: Chen and Hsieh 1984 (China)

C. Well established species, reports of whose occurrence in East and Southeast Asia are probably erroneous.

1. *Trichodina domerguei* (Wallengren, 1897)

Reference: Sachlan 1952 (Indonesia)

Comments: Report based on hematoxylin stained material.

2. *Trichodina gobii* Lom, 1970

Syn.: *T. nigra* f. *gobii* of Lom, 1961

References: Chen 1984a, b (China)

Comments: Reports based on hematoxylin stained material.

3. *Trichodina pediculus* (O.F. Müller, 1786) Ehrenberg, 1838

References: Pai 1950 (China); Chen 1955, 1956a, b (China); Hsieh et al. 1959 (China); Shtein 1984 (China, Japan, Vietnam)

Comments: Shtein (1984) considered *T. hydrae* Suzuki, 1950 and *T. orientalis* Chen and Hsieh in Anon., 1973 to be synonyms of *T. pediculus*. The material upon which the identifications of Pai (1950), Chen (1955, 1956a, b) and Hsieh et al. (1959) were based was stained with hematoxylin. The occurrence of this species on fishes of East and Southeast Asia requires confirmation.

4. *Tripartiella bursiformis* (Davis, 1947) Lom, 1959

Syn.: *Trichodina bursiformis* Davis, 1947

References: Chen 1984a, b (China)

Comments: Reports based on hematoxylin stained material.

D. *Nomina Dubia* - Included under this category are species described without the use of silver impregnation to demonstrate the morphology of the adhesive disc. Their positive reidentification is considered impossible and the use of these species names is thus discouraged.

1. *Trichodina annulata* Ariake, 1929

Reference: Ariake 1929 (Japan)

2. *Trichodina ehrenbergi* Ariake, 1929

Reference: Ariake 1929 (Japan)

3. *Trichodina fujitai* (Suzuki, 1950) Lom, 1970

Syn.: *Cyclochaeta fujitai* Suzuki, 1950

Reference: Suzuki 1950 (Japan)

4. *Trichodina gotoi* Ariake, 1929

Reference: Ariake 1929 (Japan)

5. *Trichodina hydrae* (Suzuki, 1950)

Syn.: *Cyclochaeta hydrae* Suzuki, 1950

Reference: Suzuki 1950 (Japan)

Comments: This species was described from material obtained from *Hydra vulgaris attenuata* and tadpoles of *Rana rugosa*.

6. *Trichodina liaohoensis* Chen, 1984

References: Chen 1984a, b (China)

7. *Trichodina lienii* Chen, 1956

References: Chen 1956b, 1984a, b (China); Anon. 1973 (China)

Comments: Illustrations of Anon. (1973) were based on silver impregnated specimens. However, conspecificity with the original material is questionable. Shtein (1984) listed this species as a questionable synonym of *T. mutabilis*.

8. *Trichodina mirabilis* Ariake, 1929

Reference: Ariake 1929 (Japan)

9. *Trichodina multidentata* (Suzuki, 1950) Lom, 1970
Syn.: *Cyclochaeta multidentata* Suzuki, 1950

Reference: Suzuki 1950 (Japan)

Comments: Suzuki (1950) described this species from tadpoles of *Rana rugosa*.

10. *Trichodina nasi* Chen, 1956

Reference: Chen 1956a (China)

11. *Trichodina ovaliformis* Chen, 1955

References: Chen 1955, 1956b, 1984a, b (China)

Comments: The name of this species was given as *T. oviformis* by Chen (1956b) and Anon. (1973).

Lom and Haldar (1977) and Shtein (1984) listed this species as a synonym of *T. bulbosa*.

Silver impregnated specimens reported as *Trichodina oviformis* by Anon. (1973) are referred to *Tripartiella tilapiae*.

12. *Trichodina pulchra* Ariake, 1929

Reference: Ariake 1929 (Japan)

13. *Trichodina taianensis* Chen, 1984

Reference: Chen 1984a, b (China)

14. *Tripartiella bulbosa* (Davis, 1947) Lom, 1959
Syn.: *Trichodina bulbosa* Davis, 1947

References: Pai 1950 (China); Chen 1955, 1956a, b (China); Shtein 1984 (Japan, North Korea, Vietnam)

Comments: Considered a *nomen dubium* by Bondad-Reantaso and Arthur (this vol.). Shtein (1984) considered *Cyclochaeta leucisci* Suzuki, 1950; *T. ovaliformis* Chen, 1955 and *Trichodinella tilapiae* Duncan, 1977 to be synonyms of this species.

Silver impregnated specimens reported under this name by Shtein (1984) are referable to *T. tilapiae*.

15. *Tripartiella leucisci* (Suzuki, 1950) Lom and Haldar, 1977
Syn.: *Cyclochaeta leucisci* Suzuki, 1950

Reference: Suzuki 1950 (Japan)

Comments: Lom and Haldar (1977) listed this species as a questionable synonym of *T. bulbosa* while Shtein (1984) considered it a synonym of this species.

16. *Trichodinella minuta* (Chen, 1956) Kostenko, 1969
Syn.: *Trichodina minuta* Chen, 1956

References: Chen 1956b, 1984a, b (China); Hsieh et al. 1959 (China)

Comments: Probably a synonym of *T. epizootica* according to Lom and Haldar (1977).

17. *Trichodinella myakkae* (Mueller, 1937) Raabe, 1950

References: Anon. 1973 (China); Chen 1984a, b (China)

Comments: Regarded a *nomen dubium* by Lom and Haldar (1977). Some of the illustrations of this species presented by Anon. (1973) were considered identifiable as *T. subtilis* by Shtein (1984).

E. *Nomina Nuda*

1. *Trichodina anguilli* Wu, 1961

References: Chen 1984a, b (China)

Comments: Arthur and Lom (1984b) noted that this species name is a *nomen nudum*. Records of Chen (1984a, b) were based on hematoxylin stained specimens, thus the true identity of his material cannot be determined.

F. Other

1. *Trichodina domerguei* f. *sinensis* of Chen and Hsieh in Anon., 1973

Reference: Anon. 1973

Comments: This form has no taxonomic status. It is clearly not conspecific with *T. domerguei* (Wallengren, 1897).