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Geographic Distribution of Some Species of Trichodinids (Ciliata: Peritricha) Parasitic on Fishes

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ABSTRACT: North American *Trichodina* from *Carassius auratus*, *Lepomis cyanellus*, *L. macrochirus*, *Micropterus salmoides*, and *Rhinichthys atratulus* have been studied by the silver-impregnation method and compared with European species. *T. reticulata* Hirschmann and Partsch, 1955, and *T. (Foliella) subtilis* Lom, 1959, originally described from European goldfish, are herein recorded from North America also. *T. fultoni* Davis, 1947, from *Lepomis cyanellus*, *Micropterus salmoides*, and *Rhinichthys atratulus* is redescribed, and *T. domerguei* f. *magna* Lom, 1961, described from European tench and gudgeon, is considered a synonym. A *Trichodina* sp. from the gills of *Lepomis macrochirus* is described; it is almost identical with *T. nigra* Lom, 1961 from European *Rutilus*, *T. discoidea* from centrarchids, and *T. tumefaciens* from *Cottus* of North America. Other North American trichodinids are reviewed briefly.

Up to the present time, more than 90 species of *Trichodina* have been described from the gills and skin of marine and freshwater fishes. Many of them have been considered as new only because they were found in a different host and remote geographic area. The descriptions in many cases were inadequate since the uniform body structure of these ciliates yields few characters for solid differentiation of species. However, the recently employed Klein's silver-impregnation technique (Lom, 1958; Raabe, 1959) clearly reveals details of the adhesive disc which are important features of urceolariid taxonomy. This, together with careful biometrical and other morphological information, represents a good base for taxonomic studies of this group. It is beyond the scope of this communication to present all the problems of trichodinid taxonomy; they can be found in Uzzmann and Stickney (1954), Raabe (1959), and Lom (1958, 1961, 1962).

Though insufficient description of some species does not permit us to identify them again, reexamination of a number of species which have been accurately characterized by older methods is possible. This is a study on the geographic distribution of some fish trichodinids, based on a comparison of four species

from some North American fishes from Pennsylvania and West Virginia with material from Czechoslovakia.

Trichodina reticulata Hirschmann and Partsch, 1955

Host: *Carassius auratus*, on skin.

Locality: Mt. Parnell Fisheries, Mercersburg, Pennsylvania.

Numerous typical individuals of this parasite were found in March 1962. *T. reticulata* is characterized by the peculiar cell-like structure of the center of the adhesive disc. Its biometrical data agree fully with populations found on the skin of crucian carp, *C. carassius*, in Czechoslovakia and Poland. The goldfish, *C. auratus*,¹ was introduced to North America from East Asia (China and Japan) and has retained the trichodinids from its original country. This finding suggests that *T. reticulata* is typical for crucian carp throughout the area of its present geographic distribution.

Trichodinella (Foliella) subtilis Lom, 1959

Host: *Carassius auratus*, on gills.

Locality: Mt. Parnell Fisheries, Mercersburg, Pennsylvania.

A few individuals were found in smears made from the gills of the host. Its morphology in the impregnated preparations agrees with the description of *T. (F.) subtilis* of gills of crucian carp in Europe.

¹ *C. carassius* and *C. auratus* are considered varieties of the same species (Eddy, personal communication).

TABLE I. *Biometric comparison of Trichodina fultoni of Davis (1947), our findings, and T. domerguei f. magna.*

	<i>Trichodina fultoni</i>	<i>Trichodina fultoni</i>	<i>Trichodina domerguei</i> f. <i>magna</i>
Author of data	Davis, 1947	Our findings	Lom, 1961
Host	<i>Lepomis macrochirus</i> , <i>Micropterus salmoides</i> , <i>M. dolomieu</i> , <i>Ambloplites rupestris</i> , <i>Salmo irideus</i>	<i>Lepomis cyanellus</i> , <i>Rhinichthys atratulus</i> , <i>M. salmoides</i>	<i>Tinca tinca</i> , <i>Nemachilus barbatulus</i>
Locality	Fish and Wildlife Hatchery, Kearneysville, W. Va.	Fish and Wildlife Hatchery, Kearneysville, W. Va.	Bohemia in Czechoslovakia, Europe
Location	Gills and skin	Gills and skin	Skin
Diameter of the body	about 100 μ	101 (91–112) μ	98 (82–111) μ
Diam of the adhesive disc	75–90 μ	78 (71–86) μ	77 (62–82) μ
Diam of the denticulate ring	50–58 μ	52 (47–58) μ	47 (41–55) μ
Number of denticles	27–29 (25–30)	28 (26–31)	27 (25–31)
Number of radial pins per denticle	12–14	12–14	13–14
Dimensions of denticles: length of thorn	— ¹	5.5 μ	6 μ
Length of blade	—	6.5 μ	7.5 μ
Length of denticle	—	12.5 μ	17 μ
Width, central part	—	4 μ	4.5 μ
Width, border membrane	—	5–7 μ	5–7 μ
Diam macronucleus	—	65–74 μ	58–69 μ
Micronucleus	Difficult to find	Could not be detected	1.5 \times 3 μ but difficult to detect

¹ Information not given.

Trichodina fultoni Davis, 1947

Host: *Lepomis cyanellus*, *Micropterus salmoides*, *Rhinichthys atratulus*, on gills and skin.

Locality: Kearneysville, West Virginia.

Specimens were collected from the same locality as Davis' (1947) original North American material from *M. salmoides* and other centrarchids; they were easily recognized as identical with those found in Czechoslovakia on the skin of *Tinca tinca* and *Nemachilus barbatulus*. Lom (1961) identified the same ciliate in Czechoslovakia as *Trichodina domerguei* because of the clear area in the center of the adhesive disc which is a differential feature (Raabe, 1959). However, because his specimens showed certain significant differences from Raabe's form, Lom (op. cit.) designated his ciliate, provisionally, *T. domerguei* f. *magna*; at that time it was impossible to compare it with the North American species described by Mueller (1937), MacLennan (1939), and Davis (1947) because certain details were lacking in the descriptions. Although two species may have almost identical measurements, their morphology may be significantly different.

The biometrical data for the present specimens agree with both *T. fultoni* Davis and *T. domerguei* f. *magna* (Table I). Both are smaller than *T. truttae* Mueller, 1937, but much larger than other North American species. The shape of the den-

ticles in Davis' (1947) illustrations of *T. fultoni*, although stained with usual histological methods, agrees with that found in the trichodinids from *L. cyanellus*, *R. atratulus*, and *M. salmoides* in North America and in *T. domerguei* f. *magna* from Europe. The peculiar grains in the center of the clear area are also discernible in Davis' pictures. Because of priority all these ciliates should be designated *T. fultoni* Davis, 1947.

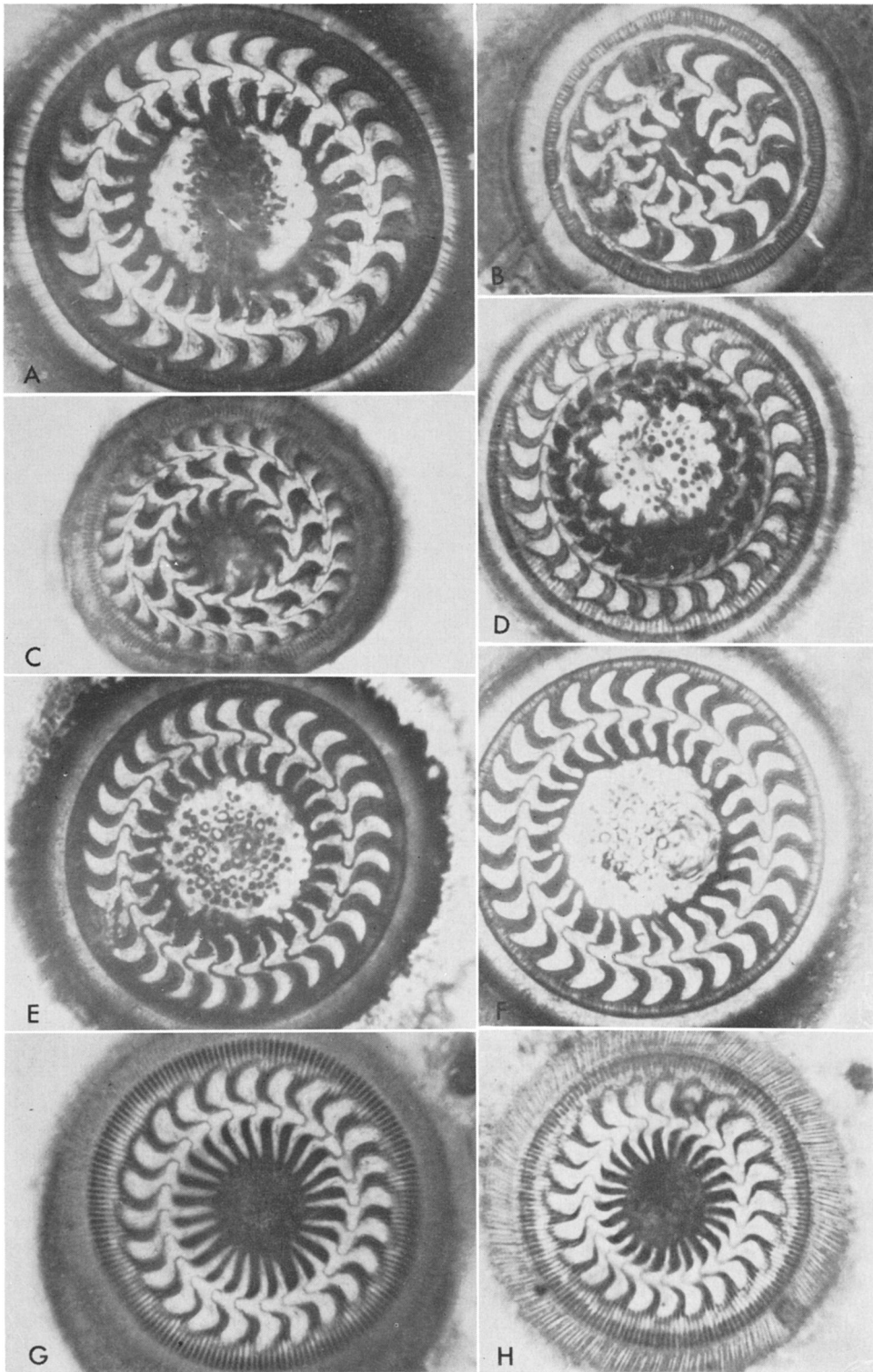
We would like to call attention to the evanescence of the central clear area during division (Figs. A to F). It divides in two, then disappears at the time when the new ciliate, bearing half the adult number of denticles, forms the new denticulate ring. The original clear area then quickly reappears.

Trichodina sp. (? *T. nigra* Lom, 1961)

Host: *Lepomis macrochirus*, *Micropterus salmoides*, on gills.

Locality: Hatchery ponds, Kearneysville, West Virginia.

This species was numerous on 8-month-old *L. macrochirus* in March 1962. The biometrical data are close to those given for *T. nigra* f. *cobitis* Lom, 1961, *T. discoidea* Davis, 1947, and *T. tumefaciens* Davis, 1947, all of which display considerable variability (Table II). It most nearly resembles *T. nigra* f. *cobitis* but the thorns of the denticles



FIGURES A TO H.

TABLE II. *Biometric comparison of Trichodina sp. (? T. nigra), T. discoidea, T. tumefaciens, and T. nigra f. cobitis.*

	<i>Trichodina</i> sp. (? <i>T. nigra</i>)		<i>Trichodina</i> <i>discoidea</i>	<i>Trichodina</i> <i>tumefaciens</i>	<i>Trichodina nigra</i> f. <i>cobitis</i>
Author of description	Our findings		Davis, 1947	Davis, 1947	Lom, 1961
Host	<i>Lepomis macrochirus</i>	<i>Micropterus salmoides</i>	<i>Lepomis macrochirus</i> , <i>Pomoxis sparoides</i> , <i>Ambloplites rupestris</i> , <i>Ictalurus punctatus</i>	<i>Cottus bairdii</i>	<i>Cobitis taenia</i>
Locality	Kearneysville, W. Va.	Kearneysville, W. Va.	Kearneysville, W. Va.	Kearneysville, W. Va.	Bohemia, CSSR
Location	Gills	Gills	Gills	Gills	Gills
Diam of the body	50 (46–55) μ	52–58 μ	—	—	55 (41–58) μ
Diam of the adhesive disc	36 (32–42) μ	40 (35–45) μ	35–50 μ	29–38 μ	35 (32–38) μ
Diam of the denticulate ring	20 (18–23) μ	25 (22–29) μ	19–29 μ	18–23 μ	21 (20–24) μ
Number of denticles	24 (22–25)	23 (20–25)	20–25 (18–30)	21–25 (19–26)	25 (23–30)

of our specimens lack the thicker central axis of the typical *T. nigra* from *Rutilus*. Lacking any striking morphological differences to aid in identification, we have designated this form *T. nigra* (?). The specimens obtained from *L. macrochirus* agree so closely with those from *M. salmoides* that we assume they are identical.

DISCUSSION

It is likely that parasitic protozoa of fish which are not dependent on an intermediate host will be distributed along with their hosts to new geographic areas. There is little doubt that *T. (Foliella) subtilis* and *T. reticulata* have been transferred with the goldfish host from Asia to both Czechoslovakia and North America. One very serious protozoan disease of fish culture, whirling disease of trout, caused by *Myxosoma cerebralis*, has spread all over Europe and Asia (Bauer, 1959) and recently to the United States (Hoffman, Dunbar, and Bradford, 1962). Likewise, *Ichthyophthirius multifiliis* and *Lernaea cyprinacea* have been spread to many parts of the world by transfer

of aquarium, sport, and food fishes. Protozoa which require specific intermediate hosts, such as leeches, will probably not be so easily transferred to new geographic areas and there may be other limiting factors.

On the other hand, morphologically indistinguishable species of *Trichodina*, *T. fultoni* Davis, and *T. sp. (T. nigra ?)* have been found on different hosts in Europe and North America. Assuming that host specificity is involved, proof of physiological identity would have to be established by cross-infection experiments. The occurrence of a trichodinid on a new host in a remote geographic area alone should not support the establishment of a new species. Lom (1962) gave the provisional name *T. domerguei* f. *maris-negri* to a trichodinid from the skin of a marine fish, *Gaidropsis mediterraneus*. Because of its marine occurrence, Lom hesitated at that time to identify it as *T. domerguei* f. *magna*; however, it is quite possible that it will now prove to be *T. fultoni*, found in a different geographic area, different

← Trichodinids from North American fishes. FIGURES A TO F. *Trichodina fultoni*.

A. Specimen just before cell cleavage with the central clear area dividing in two. **B.** Daughter cell with only half of the original number of denticles. The clear area in the center has disappeared; around the denticulate ring a new ring is originating. **C.** Specimen with two rings, the old inner one in resorption, the outer new in formation. **D.** Later stage, the central clear area again formed. **E.** Mature ciliate, the argentophile grains in the clear area, as seen in Figure D, stain in outline only. **F.** Final stage, argentophilic grains reduced to "rings."

FIGURES G AND H. *Trichodina* sp. (? *T. nigra*) from *Lepomis macrochirus*.

host, and even under different conditions of salinity.

The supposed distribution on two continents of the present two trichodinids is supported by other examples—the cosmopolitan distribution of *Trichodina pediculus* on different species of *Hydra*; the myxosporidian *Myxidium lieberkuehni* in *Esox lucius* in Eurasia (Barysheva and Bauer, 1957: 107) and North America (Kudo, 1920: 107); another myxosporidian, *Henneguya salminicola* in salmon of North America and Europe (Shulman, 1958); and an acanthocephalan, *Neoechinorhynchus rutili* in many fish (Van Cleave and Lynch, 1950). As far as we know, the fish hosts of these parasites were not transferred intercontinentally before the parasites were reported from both continents. Since these parasites do not infect birds, they would not have been transferred by this means, as are some fish helminths which live as adults in piscivorous birds.

NORTH AMERICAN TRICHODINIDS

It is not the purpose of this report to review the trichodinids of the world or even North America. The last review of the North American forms was that of Uzman and Stickney (1954). However, we would like to present a brief list of the species found in North America for comparison with those of Europe. Two very distinct species, *Vauchomia renicola* (Mueller, 1932) and *V. nephritica* Mueller, 1938, are found in the urinary systems of *Esox niger* and *E. masquinongy*, respectively (Mueller, 1938); they are further distinguished by more than two turns of their adoral zones. *Trichodina myakkae* Mueller, 1937 is transferred to *Trichodinella* because of its short adoral zone, shape of the denticles, etc. (see Lom, 1963); we suggest that it be reexamined by the silver-impregnation method and *Trichodinella epizootica* (Raabe, 1950) compared with it. *Trichodina truttiae* Mueller, 1937 is the largest species (up to 140 μ in diameter) and clearly differs from our findings; silver-impregnated specimens might be profitably compared with *T. fultoni* Davis, 1947 and *T. janovice* Lom, 1961. In Mueller's (1937) description, *Trichodina pediculus* Ehrbg., 1838 is very similar to the typical form found on *Hydra*, particularly the shape and number of denticles; this form from *Micropterus salmoides*

of the Myakka River and the form from *Hydra* could well be compared after silver impregnation (Klein's method).

MacLennan (1939) redescribed *Trichodina domerguei* from several fishes of the Palouse River; however, it possibly does not possess the clear center of the adhesive disc in impregnated specimens, and also other characteristics of *T. domerguei* as described by Raabe (1959) and Dogiel (1940). Other features of *T. domerguei* noted and illustrated by MacLennan fit the description of several other species as well (number of denticles, diameter of adhesive disc) and cannot be used for differentiation. Reidentification of the Palouse River species will be difficult since MacLennan himself pointed out the lack of host specificity of this species. *Trichodina guberleti* MacLennan, 1939 was described briefly and it may not be possible to compare it with similar species. The distinctive character between these two species, relation of length of the marginal cilia (cirri) to the length of the aboral membranelous wreath, is of little value since there are numerous other species with the same length relation of these ciliary organelles. Thus, both species will unfortunately be designated as nomina nuda.

Though Davis (1947) did not employ impregnation methods, the descriptions of urceolarids in his paper are comprehensive enough to identify many of them in the future.

T. discoidea Davis, 1947 and *T. tumefaciens* Davis, 1947 have already been discussed in this paper. It would be desirable to reexamine these two and also *T. californica* Davis, 1947, *T. vallata* Davis, 1947, and *T. platyformis* Davis, 1947 from the original localities. Perhaps *T. vallata* would be more easily recognized because of the elevated ridge of the adoral ciliary zone.

The remainder of Davis' (1947) species should be removed from *Trichodina*. Due to the degree of development of their buccal structures and denticle shape (cf Lom, 1963) they belong to *Trichodinella* or *Tripartiella*. *T. symmetrica* Davis, 1947 apparently involves two species and from his precise illustrations it is evident that there are also two genera involved—*Trichodinella* (without inner denticle thorns) and *Tripartiella* (with inner denticle thorns). A comparison of *Tripartiella*

bulbosa (Davis, 1947) and *T. bursiformis* (Davis, 1947) with species described from Europe would be useful; such a discussion is beyond the scope of this paper, and to be fruitful, would require new collections.

We hope that this article will lead to future research on trichodinids from North America, to elucidate not only the number of North American species, but also their relations to the European species.

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