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# PARASITIC *TRICHODINIDAE* IN SALMONID FISH CULTURED IN POLISH PONDS

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A b s t r a c t. Studies were carried out on qualitative and quantitative composition of ciliates from the family *Trichodinidae*, skin and gill parasites of five salmonid fish species cultured in three different trout hatcheries. Invasion process of *Trichodinidae* was described in the annual cycles. Ten *Trichodinidae* species were found, of which three showed mass development. Mass occurrence of *Trichodinidae* was accompanied by: lowering of fish condition, external changes on the skin, and sometimes also fish kills. Some conclusions have been formulated.

Key words: SALMONID FISH, POND CULTURE, *TRICHODINIDAE*

## INTRODUCTION

The paper is yet another part of the studies on species composition, numbers and ecology of parasitic *Ciliata* in cultured fish. So far these studies have delt with 4 fish species from the family *Cyprinidae* (Migała 1970, 1971, 1978a, Migała and Kazubski 1972), *Coregonus peled* (Migała 1978b), *Anguilla anguilla* (Markiewicz and Migała 1980) and several wild species occurring in the fish ponds and constituting the so-called weed fishes (Migała and Domański 1979). This paper deals with grayling, *Hucho hucho* and the most important *Salmonidae* fish (5 species).

It should be noted that progressing deterioration of water quality in Poland limited range of salmonid fish, thereby increasing their aquaculture. In the case of intensive culture a lot of attention is given to fish health, and especially to the quality of the stocking material. As regards the latter there are only a few data on ciliates, in this on *Trichodinidae*, which may occur in masses in dense fish stocks. There are no quantitative data on the extent in which salmonid cultures might be endangered by *Trichodinidae*.

## DESCRIPTION OF THE STUDY AREA AND METHODS

Studies were carried out in 1969-1971 in three trout hatcheries: in Oliwa (belonging to the Inland Fisheries Institute), Rumia and Łopuszna (belonging to the Polish Anglers Association). The three hatcheries differ as regards character of the catchment area, ecologic conditions and partly also technical conditions. Oliwa and Rumia are located close to Baltic coast and dispone of more polluted water than Łopuszna which

is located in Kotlina Nowotarska and receives water from a clear mountain stream Łopuszanka.

The breeding technology is typical for salmonid fish i.e. the fish are transferred several times from one pond to another, especially in the first year of life. These transfers are more frequent than in the case of cyprinid fry culture. In addition to this the hatcheries used rather intensively various chemicals against fish parasites, maily malachite green, formalin and copper sulfate which were added to water. Oliwa hatchery also used quicklime against algae; it was added to water as well as used to paint the walls of concrete fish tanks. Water surface of these tanks was 20 $m^2$. All these factors might have differentiated the course of ciliate invasion in salmonids compared to that observed in the case of cyprinids.

All cultured fish species were examined in Oliwa and Rumia, while in Łopuszna only these which were cultured on a large scale. The following species were examined: *Salmo gairdneri, Salmo trutta trutta m. fario, Salvelinus fontinalis, Salmo salar* and *Salmo trutta.* Fish samples were collected in consecutive years according to the scheme presented in Tab. 1. Average individual fish weight in the first year was within the range: 0.08-0.14 g for larvae, 0.2 to about 2 g for summer fry (semifingerlings), from a few to several grams for autumn fry (fingerlings). Individual fish weight was very differentiated by the end of the second year, from several to about 200 g. Stock densities in the rearing basins, fish tanks and ponds, were also different. In the majority of cases stocking rate in the concrete tanks a few weeks after fish hatching was from 250 to 950 fish per 1 $m^2$ of water surface. Stocking rates in the ponds with one-year old fish were from 3 to 60 fish per 1 $m^2$.

In the first year of the studies fish samples were collected irregularly and consisted of a few fish only. Since the next year samples were collected regularly in Oliwa and Rumia, at monthly intervals whenever possible. In Łopuszna samples were not collected regularly.

Similarly as in the previous studies the analyses embraced species composition of *Trichodinae* as well as quantitative determinations. Cilliates were collected separately from the fish skin and gills. Particular samples were usually composed of 10 fish of the given species and generation, collected randomly from one tank or pond. In Oliwa a few samples were collected for comparative purposes of *S. gairdneri* and *S.trutta* of the same age but from 2 or 4 ponds. Totally 1052 fish were caught, but in some samples no cilliates were found (totally 25 samples, see Tab. 1). These samples were not taken into consideration. Hence, 802 fish were examined.

The fish were brought alive to the laboratory using pond water. They were killed and slime was collected immediately: in younger fish from the whole body surface,

TABLE 1

List of fish caught for examination of parasitic *Trichodinidae* in salmonid fish

| Sampling date | | Hatchery Oliwa | | | | | | | | Hatchery Rumia | | | | | | Hatchery Łopuszna | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Salmo gairdneri* | | *Salvelinus fontinalis* | | *Salmo salar* | | *Salmo trutta* | | *Salmo gairdneri* | | | *Salmo t.t. m.fario* | Salmo trutta | | *Salmo gairdneri* | | | *Salmo t.t. m.fario* | | *Salmo trutta* |
| | | 0+ | 1+ | 0+–1 | 1+ | 0+ | 1+ | 0+ | 1+ | 0+ | 1+ | 2+ | 0+–1 | 0+–1 | 1+ | 0+ | 1+ | 2+ | 0+ | 2+ | 0+–1 |
| 1969 | 9–11.06 | | 10* | 12 | | 10* | | 10 | | | 10* | | 10* | 10* | | | | | | | |
| | 26–27.08 | | 10* | 10 | | 10* | | 20 | | | 10 | | 10* | 10* | | | | | | | |
| | 14–15.10 | 10 | 10 | 10 | | 10 | | 20 | | | 10 | | 10* | 10 | | | | | | | |
| 1970 | 18.02 | 10* | 20 | 10* | 10* | | | 10* | | | | | | | | | | | | | |
| | 19–20.03 | 10* | 40 | 10* | 10 | | | 10* | | 10* | 10 | | | | 10 | | | | | | |
| | 15–16.05 | 10 | 15 | 10* | 10 | | | 10 | | | 10 | 10 | 10* | | 10 | | | | | | |
| | 17–18.06 | 10 | 20 | 10 | 10 | 10* | 10 | 10 | 10 | | 10 | | | 10 | 10* | | | | | | |
| | 17–18.07 | 10 | 10 | 10 | 10 | 10 | | 10 | | 10 | 10 | | | 10 | 10 | | | | | | |
| | 22.08 | 40 | 10 | 10 | | | | | | | | | | | | | | | | | |
| | 24–25.09 | 10 | 10 | 10* | | | 10 | 10 | | 10 | 10 | | | 10 | 10 | | | | | | |
| | 10–11.11 | 10 | 10 | | | | 10 | | 10 | 10 | 10 | | 10 | | | | | | | | |
| 1971 | 8.06 | | | | | | | | | | | | | | | 10* | 10 | | | | |
| | 9.07 | | | | | | | | | | | | | | | 10* | | | 10 | 8 | 10 |
| | 12.08 | | | | | | | | | | | | | | | | | | 10 | | 10 |
| | 14.09 | | | | | | | | | | | | | | | | | 10 | | 7 | 10 |
| Total number of examined fish | | 120 | 165 | 102 | 50 | 50 | 30 | 110 | 20 | 40 | 90 | 10 | 50 | 60 | 50 | 20 | 10 | 10 | 20 | 15 | 30 |

*Numbers in the table represent all fish caught in the given hatchery.*

* *- samples in which no ciliates were found on fish skin or gills*

TABLE 2

Results of the studies

| Parasites | *Salmo gairdneri* | | | | | *Salmo trutta* | | | | | *Salvelinus fontinalis* | | | | | *Salmo salar* | | | | | *Salmo trutta trutta m. fario* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number of fish examined* | | | | | | | | | | | | | | | | | | | | | | | | |
| | 385 | | | | | 220 | | | | | 102 | | | | | 50 | | | | | 45 | | | | |
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| *Trichodina acuta* | 143 | 37.1 | 23449 | 1–2429 | 60.90 | 18 | 8.2 | 172 | 1–135 | 0.78 | 15 | 14.7 | 660 | 1–205 | 6.47 | 37 | 74.0 | 5678 | 1–1116 | 113.56 | | | | | |
| *Trichodina nigra* | 167 | 43.4 | 6981 | 1–1240 | 18.10 | 29 | 13.2 | 778 | 1–239 | 3.54 | 41 | 40.2 | 939 | 1–178 | 9.21 | 36 | 72.0 | 11594 | 1–2028 | 231.88 | 6 | 13.3 | 94 | 1–49 | 2.09 |
| *Trichodina pediculus* | 25 | 6.5 | 109 | 1–13 | 0.30 | 1 | 0.5 | 7 | 7 | 0.03 | 16 | 15.7 | 11646 | 1–1611 | 114.18 | 11 | 22.0 | 106 | 2–23 | 2.12 | | | | | |
| *Trichodina domerguei s.domerguei* | 2 | 0.5 | 4 | 1–3 | 0.01 | 3 | 1.4 | 20 | 2–12 | 0.09 | 15 | 14.7 | 1711 | 1–407 | 16.77 | 12 | 24.0 | 301 | 2–107 | 6.02 | 1 | 2.2 | 3 | 3 | 0.07 |
| *Trichodina esocis* | | | | | | 54 | 24.5 | 634 | 1–52 | 2.88 | | | | | | 9 | 20.0 | 22 | 1–5 | 0.49 | | | | | |
| *Trichodina mutabilis* | | | | | | | | | | | 6 | 5.9 | 57 | 2–23 | 0.56 | 9 | 18.0 | 96 | 3–18 | 1.92 | | | | | |
| *Trichodinella epizootica* | 63 | 16.4 | 400 | 1–73 | 1.00 | 3 | 1.4 | 42 | 3–23 | 0.19 | 13 | 12.7 | 84 | 1–23 | 0.82 | - | - | - | - | - | - | - | - | - | - |
| *Trichodinella subtilis* | | | | | | 1 | 0.5 | 3 | 3 | 0.01 | 9 | 8.8 | 371 | 1–195 | 3.64 | - | - | - | - | - | - | - | - | - | - |
| *Tripartiella copiosa* | | | | | | 1 | 0.5 | 2 | 2 | 0.01 | - | - | - | - | - | - | - | - | - | - | | | | | |
| *Tripartiella bulbosa* | | | | | | | | | | | 3 | 2.9 | 51 | 1–33 | 0.50 | - | - | - | - | - | - | - | - | - | - |

* - *number of fish examined given in the table refers to all three hatcheries and the whole period 1969–1971*

*1 - Number of infested fish*

*2 - Extensiveness of invasion (in %)*

*3 - Number of Trichodinidae collected in the whole material*

*4 - Extremal infestation values (intensity of invasion)*

*5 - Average number of parasites in 1 microscope slide in relation to the number of examined fish*

*All data given in Table 2 refer to microscope slides of uniform area of 10 $cm^2$.*

in older ones randomly from skin and gills. This was used to prepare smeared slides 10 $cm^2$ in area, which were dried and impregnated with silver according to Klein. The preserved material was used to determine numbers of all trophic stages of ciliates per one slide. Silvering made it possible to determine all *Trichodinidae* species.

## RESULTS

Ten species of *Trichodinidae* were found:

*Trichodina acuta* Lom, 1961

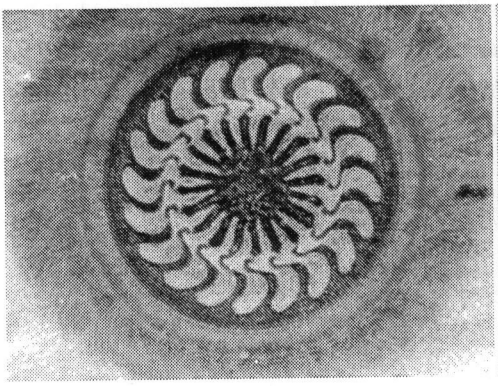
Possessed typical structure and body shape. They were present mainly on skin and very rarely on gills of all examined fish species in Oliwa and in rainbow trout and sea trout in Rumia (Fig. 1). Totally *T.acuta* was found in 26.6% of the fish examined (802 fish) but this species was most numerous in the materials (Tab. 2). Its maximal numbers in one slide amounted to 2429 individuals. This number was recorded in summer (17 July 1970) in *S.gairdneri* fry from a pond in Oliwa. *T.acuta* was also present in masses in two-year old rainbow trout in autumn (14 and 15 Oct. 1969) in a pond in Rumia and in salmon fingerlings in Oliwa. The most infested fish were characterized by lower vitality. In addition to this, infested salmons were dull in colour and were very slimy. These symptoms, however, might have been caused by *Trichodina nigra* which was also doubly numerous in these fish. The degree of infestation was very differentiated within the same fish samples and there was no clear relation between the extensiveness and the intensity of invasion, especially in the case of slides with low numbers of *Trichodinidae*. This might have been caused by the use of chemicals.

It should be underlined that *T.acuta* was present on salmonid fish practically in all periods of the studies. It was present in masses in July (Fig. 2) and October. Hence, seasonality of this species described for carp fry (autumn appearance Migała 1971) was not confirmed. This suggests that water temperature was not the decisive external factor determining increase in *T.acuta* numbers as has been supposed before.

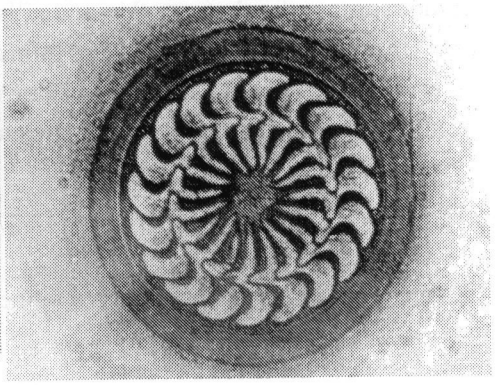
The observations proved that *T.acuta* may be dangerous to fish in certain conditions, when the intensity of invasion is high.

*Trichodina nigra* Lom. 1960

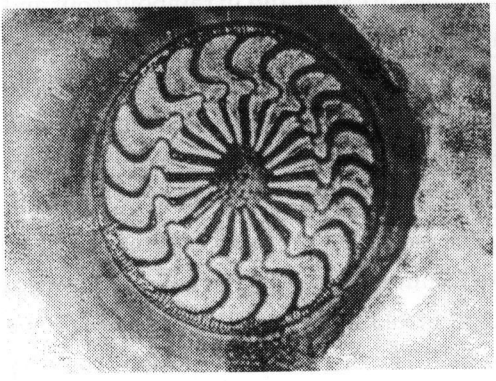
Body size typical. Attachment disc and hooks in *T.nigra* from salmonid fish (Phot. 2-4) a little different than in *T.nigra* from cyprinid fish (Phot. 1). Central field of the disc was usually smaller, hooks in adult specimens more massive (Phot. 4) resembling



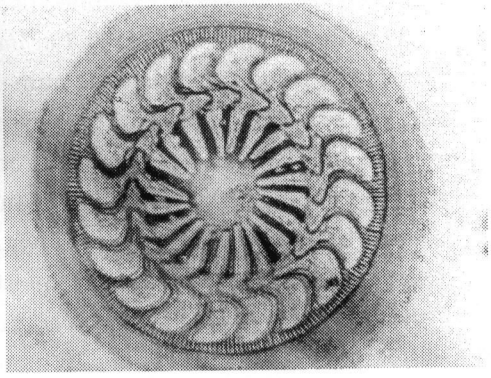
Phot. 1. *Trichodina nigra* from skin of *Cyprinus carpio*, Żabieniec pond farm, 8 July 1964.



Phot. 2. *T.nigra* from skin of *Salmo salar*, Oliwa hatchery, 17 June 1970.



Phot. 3. *T.nigra* from skin of *Salmo trutta*, Oliwa hatchery, 17 June 1970.



Phot. 4. *T.nigra* from skin of *Salmo gairdneri*, Oliwa hatchery, 17 June 1970.

more „broad" hooks described by Kulemina (1968). *T.nigra* found on salmonids were very similar to those found on the fins of *Scardinius erythrophthalmus*, described by Shtein (cit. after Shulman 1984). Specimens of *T.nigra* presented in the photographs were collected in warm period of the year.

*T.nigra* was present mostly on skin, very rarely on gills, in all fish species in Oliwa and in some in Rumia and Łopuszna (Fig. 1), practically in all periods of the studies. Relatively the highest intensity of invasion was noted in salmon fingerlings caught in October 1969 in Oliwa. Maximal number of *T.nigra* found in one slide amounted to 2028. It was a mass invasion. As mentioned before, *T.nigra* occurred in salmon fry together with *T.acuta*. Share of *T.nigra* in this invasion was relatively higher and amounted to 65.4% of all ciliates found in the sample of 10 fish. The invasion took place in a cement rearing tank notwithstanding the use of chemicals. Moreover, salmons most invaded by *Trichodinidae* were less viable and showed skin changes.

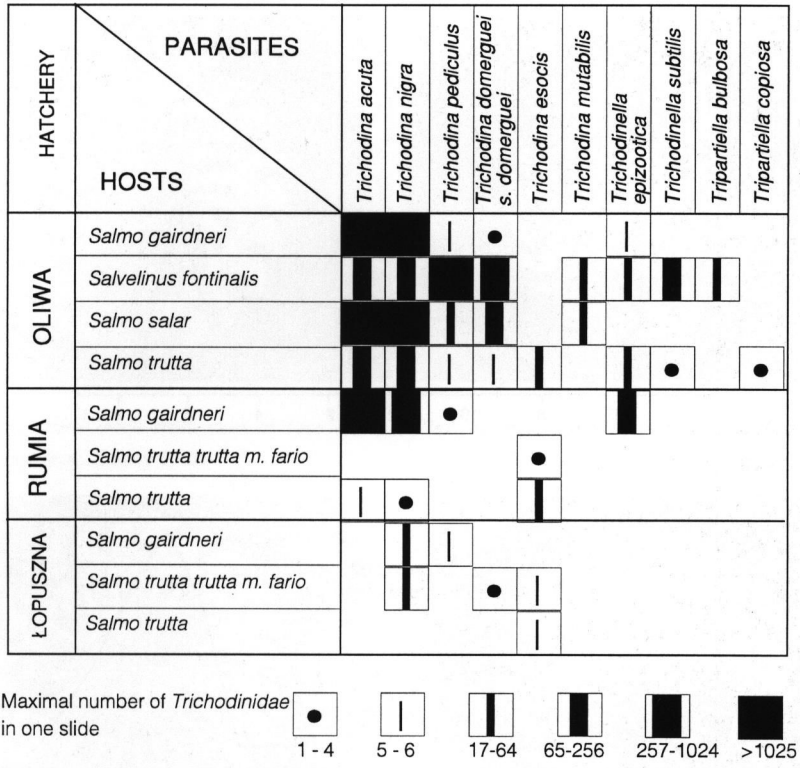



Fig. 1. Parasitic *Trichodinidae* on skin and gills of salmonid fishes in different pond farms.

Another case of high invasion intensity was observed in a single rainbow trout two years of age, on 17 June 1970 in a pond in Oliwa. The latter case suggests that *T. nigra* may appear in fish not only in cool periods. The same was observed in the case of carp in ponds (Migała 1971) also in a warmer period.

The above data suggest that *T.nigra* is very plastic, especially in more variable conditions compared to those noted in carp culture. They also suggest that this parasite occurs relatively independently of the host species, temperature, season and type of water body. In the materials collected *T.nigra* was more frequent than *T. acuta*, altogether in 34.8% of salmonids, but its numbers were 1/3 of those of *T.acuta* (Tab. 2). However, *T.nigra* may also be dangerous for fish if its invasion is a mass one.

*Trichodina pediculus* Ehrenberg, 1838

*T.pediculum* found in the samples conformed to the description of this species. They were present mostly on fish skin, rarely on gills, in all fish species in Oliwa and in *S.gairdneri* in Rumia and Łopuszna (Fig. 1). *T.pediculus* showed a tendency to

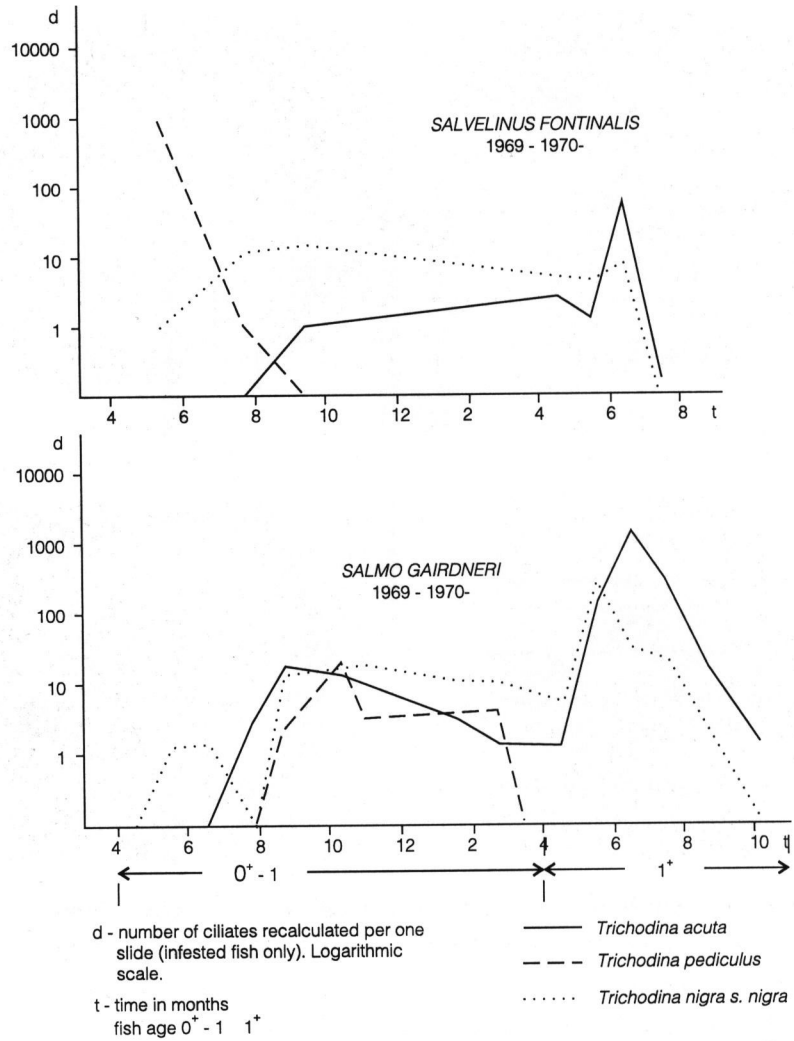
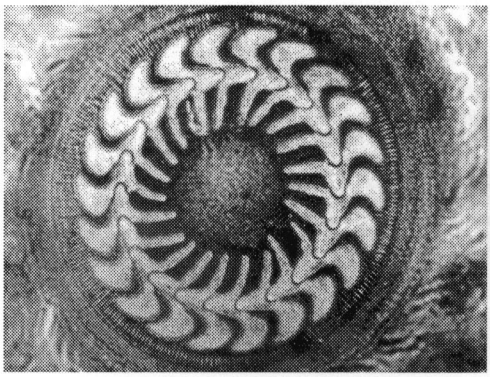
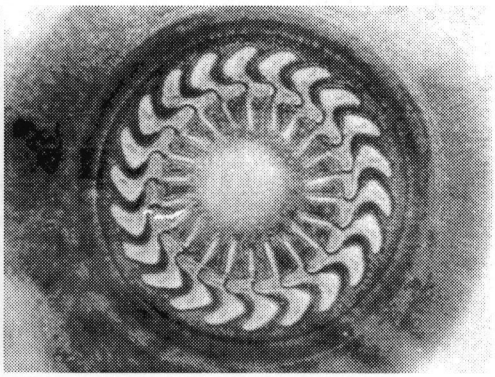



Fig. 2. Changes in the numbers of some *Trichodinidae* species in the annual cycle in rainbow and brook trout in Oliwa hatchery

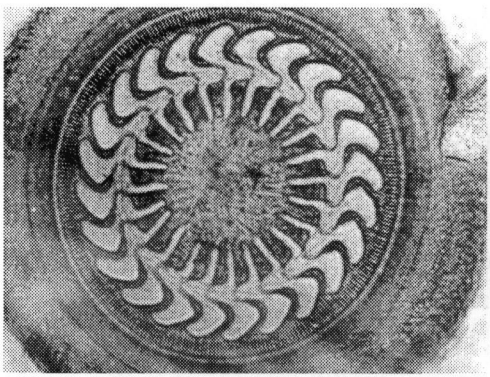
invade semifingerlings of *S.fontinalis* in June 1969 in a cement tank (Fig. 2). In these period out of 12 fish examined 4 had much more than 1000 ciliates in 1 slide, the average number of *T.pediculus* in 1 slide being 970. All fish were infested. In the discussed sample of *S. fontinalis T. pediculus* occurred together with *Trichodina domerguei s. domerguei, Chilodonella piscicola,* and some *Sessilina.* Relative share of these ciliates in total ciliate number was 79.2%, 11.6%, 6.2% and 3.0%. Hence, *T.pediculus* dominated. Most infested fish showed lower vitality: fish kills were observed a few days after sampling. *S.fontinalis* in agonal state had about 2600 ciliates per one fish 0.25 g in weight, in this *T.pediculus* represented 2000, while *T.domerguei s. domerguei* and



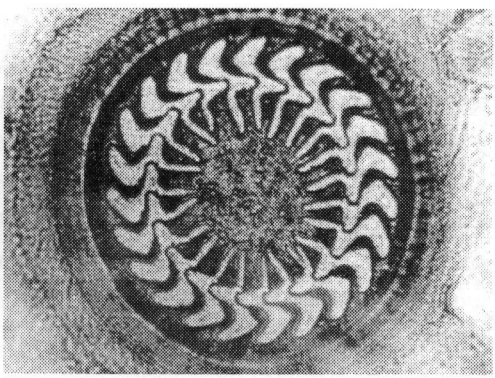
Phot. 5. *Trichodina esocis* from skin of *Esox lucius*, Żabieniec farm, 2 May 1967.



Phot. 6. Various examples of *Trichodina esocis* from skin of *Salmo trutta*, Oliwa hatchery, 26 August



Phot. 7. Various examples of *Trichodina esocis* from skin of *Salmo trutta*, Oliwa hatchery, 26 August



Phot. 8. Various examples of *Trichodina esocis* from skin of *Salmo trutta*, Oliwa hatchery, 26 August

*Ch. piscicola* - totally 600. So intensive invasion of *T.pediculus* in cultured fish has never been observed. *T. pediculus* was very numerous in *Aristichthys nobilis* fry in a pond in spring (Migała 1978a) but the intensity of invasion was lower, amounting to 598 parasites on the average per 1 slide.

In the other salmonids, numbers of *T.pediculus* were low or even very low (Fig. 1) although sometimes they were present in all fish as, for instance, on 14 Oct. 1969 (802 fish). *T.pediculus* was present in only 6.6% of the fish stock but periodically it reached very high densities (Tab. 2).

*T.pediculus* has been defined in some earlier studies as the species specific for hydra (Raabe 1959). In Poland it was found in tadpoles and some wild fish (Kazubski 1965). The latter author underlined the facility with which *T.pediculus* spread in the experimental conditions on *Rutilus rutilus* fry (in small containers). More numerous

appearance of these ciliates in semifingerlings of *S.fontinalis* in a cement rearing tank adds to the knowledge on biology of this species.

No studies were carried out on the presence of hydra in the three hatcheries. It is possible that they were present on the walls of fish tanks.

*T.pediculus* is yet another species dangerous for fish, especially *S.fontinalis* in semifingerling stage. These *Trichodina*, however, appeared in salmonids much less frequently than *T.acuta* and *T.nigra*.

*Trichodina domerguei subsp. domerguei* (Wallengren, 1897)

Structure and body size of *T.domerguei s. domerguei* were typical, conforming to the descriptions of this species (Raabe 1959, Lom a Shtein 1966). They were present mostly on the skin of all fish species in Oliwa and on *S.trutta m. fario* in Łopuszna (Fig. 1). These protozoans were present sporadically in different seasons, usually as single specimens or in very small numbers. Of the total number of 802 fish they were found in 4.1% of the stock. This species was most numerous in *S.fontinalis* semifingerlings, in which intensity of the invasion reached 407 specimens in 1 slide, with all fish in the sample being attacked (Oliwa, 10 June 1969). As mentioned in the description of *T. pediculus*, *T. domerguei s. domerguei* was a subdominant in *S. fontinalis*. These *Trichodina* were also present in *S.salar* but less frequently (Fig. 1).

The analyses showed that this species of *Trichodina*, although it is characteristic for sticklebacks, found favourable conditions to develop only in the case of *S.fontinalis*. In other salmonids its numbers were negligible or very low (single specimens in a slide).

*Trichodina esocis* Lom, 1960 (Phot. 6, 7, 8)

Specimens belonging to these species found in course of the studies were very similar to the description presented by Kulemina (1968) and Ergens and Lom (1970). Frequently, however, the centre of the disc possessed a light spot (Phot. 7, 8) as the one noted by Kulemina. These protozoans were present mostly on fish skin, rarely on gills. They occured as single specimens or in low numbers, mostly in sea trout or *S. fontinalis* in Rumia and Łopuszna (Fig. 1). *T.esocis* was most frequent in semifingerlings of *S.trutta* in Oliwa, in the sample collected on 26 Aug. 1969. Their number reached then up to 52 in one slide. Generally *T. esocis* was present in 7.7% of the fish. Observations suggest that this *Trichodina* was not dangerous for the fish.

*T. esocis* was found in Poland in pike (Migała and Domański 1979).

*Trichodina mutabilis* Kazubski et Migała, 1968

Typical appearance. They were sporadic in summer and autumn on *S.fontinalis* and *S. salar* gills in Oliwa (Fig. 1). Extensiveness and intensity of invasion was very weak. This parasite was found in 1.9% out of 802 fish examined. The highest number of this species in 1 slide was 23 (26 Aug. 1969) in *S. fontinalis* semifingerlings.

The materials collected in Oliwa suggest that *T.mutabilis* may be treated in this case as an accesory species.

*Trichodina epizootica* (Raabe 1950)

Typical structure. These *Trichodina* were present quite frequently but in low numbers, in different seasons, mostly on gills of three host species (Fig. 1). The highest number of 73 specimens in 1 slide was noted only once in Rumia (18 July 1970), in two-year old rainbow trout. Extensiveness of the invasion was of some importance only in the case of *S.fontinalis* (18.6%) and *S.gairdneri* (16.6% of the fish). In the whole material (802 fish) 9.9% of the fish were infested. In the hatcheries under study *T. epizootica* was rare so it had no adverse effect on the fish health.

*Trichodinella subtilis* Lom, 1959

Specimens of *T.subtilis* found on the fish were typical. They were present mostly on the gills of *S.fontinalis*. Intensity of the invasion was a little higher than of *T.epizootica* but only in one fish, a semifingerling (on 17 July 1970), in which 195 specimens were found. Totally *T.subtilis* was found in 9 *S.fontinalis* and 1 sea trout in Oliwa (Fig. 1). They were present in July and August.

Scarcity of the materials related to this species does not allow for its broader discussion.

*Tripartiella bulbosa* (Davis, 1947)

Specimens belonging to this species were found once (on 14 Oct. 1969) on the gills of three *S.fontinalis* (fry) in Oliwa. The intensity of invasion was from 3 to 35 specimens in 1 slide. The parasites were typical, conforming to the existing descriptions (Migała 1976, 1978a, Lom s. Haldar 1977, Shulman 1984). Due to rare occurance these ciliates were treated as accidental and not dangerous for the salmonid fish in Oliwa, Rumia and Łopuszna.

*T.bulbosa* has been brought to Poland with acclimated Chinese carps. They developed rapidly becoming most frequent and most numerous ciliate parasites of *Cteno-*

*pharyngodon idella* and *Hypophthalmichthys molitrix* cultured in ponds, as well as in *Coregonus peled* (Migała 1978a, b). *T.bulbosa* were quite numerous also in *Aristichthys nobilis* (Migała 1978a). According to Shulman (1984) *T.bulbosa* were quite frequent in juvenile salmonids in the Soviet Union.

*Tripartiella copiosa* Lom, 1959

Only two specimens of this species were found. They were on the gills of one sea trout, a semifingerling from Oliwa (on 26 August 1969). Their structure conformed to the existing descriptions (Lom 1959, 1963, Lom s. Haldar 1977, Migała 1978a).

The species was defined as accidental, not dangerous for the cultured fish in the existing ecological conditions.

## DISCUSSION

Studies on *Trichodinidae* occurrence on skin and gills of 5 salmonid fish species from three trout hatcheries revealed 10 species of these ciliates. Five of them were present mostly on the fish skin, the other 5 on gills. Three species of skin parasites (*T.acuta*, *T.nigra* and *T.pediculus*) were characterized by numerous occurrence in some periods. Their invasion weakened vitality of the most infected fish. In one case skin changes were observed in salmon, and in one case there was a fish kill (*S.fontinalis* semifingerlings). In dying *S.fontinalis* total number of ciliates per one fish weighing 0.25 g amounted to 2600, in this 2000 were *T.pediculus*. So intensive invasion of *T.pediculus* has never been noted before.

It is very difficult to state whether weakening of the fish vitality was caused by *Trichodinidae* only, or whether there were also some other factors. However, it may be assumed that such a large number of ciliates on the skin could not have been totally indifferent to the host. Most probably *Trichodinidae* were the final cause of the mentioned skin changes and fish losses. On the other hand, fish gills were hardly attacked. The reason for this phenomenon is not clear.

Attention should be given to relatively lower infestation of salmonids compared to cyprinids (Migała 1971, 1978a). This was probably due to periodical use of chemicals. In the case of cyprinid fish discussed in the cited papers no such measures were taken.

Maximal extensiveness of the invasion (34.8%) as regards the whole material (802 fish) was observed in the case of *T.nigra*, while *T.pediculus* was the only species that caused fish kills although it was present in only 6.6% of the fish. In view of this

*T.pediculus* may be regarded as highhly pathogenic, especially for juvenile *S.fontinalis.*

Analyses of fish infestation with *Trichodinidae* and their results showed that from among 10 species 3 might be considered as pathogenic: *T. pediculus, T. acuta* and *T. nigra. T. domerguei s. domerguei, T. esocis, T. mutabilis, Trichodinella epizootica* and *Trichodinella subtilis* were less dangerous for salmonid fish. The other two species: *Tripartiella bulbosa* and *Tripartiella copiosa* were accidental in the three hatcheries.

Some species, for instance *T. acuta* and *T. nigra,* were very numerous both in cool and warm periods, contrarily to what had been so far observed in cultured carp (Migała 1971). It may be assumed that water temperature did not determined their development, although this was suggested earlier. It was possible that these species are very plastic and adptable to temperature.

Attention ahould also be given to the presence of *Tripartiella bulbosa* on *S. fontinalis* gills. Appearance of these protozoans in *S. fontinalis* gills is an example for the expansion of these parasite.

## CONCLUSIONS

Ten species of *Trichodinidae* were found on skin and gills of salmonid fish bred in Oliwa, Rumia and Łopuszna even though chemicals were periodically used in the three hatcheries. Some of them developed very numerously.

Fish in the first year of life were bred in high densities in concrete tanks so they were more exposed to *Trichodinae* invasion compared to older fish in earthen ponds.

*Trichodina pediculus* proved to be an especially dangerous parasite causing losses of juvenile *Salvelinus fontinalis* reared in a small concrete basin.

Co-existing *Trichodina nigra* and *Trichodina acuta* appeared to be dangerous for autumn fry of *Salmo salar* reared in a similar concrete basin.

Due to possible mass invasion of some *Trichodinidae* species attention should be given to more strict use of prophylactic measures in fish culture.

The results of the studies suggest that biology and ecology of particular *Trichodinidae* species in fish is more complex than it has been thought so far. More extensive knowledge of these problems would be of both theoretical and practical importance.

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## STRESZCZENIE

### PASOŻYTNICZE *TRICHODINIDAE* U RYB ŁOSOSIOWATYCH HODOWANYCH W STAWACH W POLSCE

Zbadano skład jakościowy i ilościowy pasożytniczych *Trichodinidae* ze skóry i skrzeli pięciu gatunków ryb łososiowatych, hodowanych w trzech różnych ośrodkach zarybieniowych typu pstrągowego - Oliwa, Rumia, Łopuszna. Opisano proces inwazji badanych trichodin w terminach rocznych. Stwierdzono obecność 10 gatunków trichodin, w tym 3 gatunki rozwinęły się masowo, pomimo okresowego stosowania środków pasożytobójczych. Masowemu występowaniu trichodin towarzyszyły: osłabienie kondycji ryb, zewnętrzne zmiany na skórze, a nawet śnięcia.

Z 10 stwierdzonych gatunków trichodin 3 z nich (*T. pediculus*, *T. acuta* i *T. nigra*) zaliczyć można do pasożytów chorobotwórczych. Cechy pasożytów mniej niebezpiecznych dla łososiowatych wykazywało 5 gatunków (*T. domerguei s. domerguei*, *T. esocis*, *T. mutabilis*, *Trichodinella epizootica* i *Trichodinella subtilis*). Pozostałe 2 gatunki (*Tripartiella bulbosa* i *Tripartiella copiosa*) były prawdopodobnie pasożytami przypadkowymi u łososiowatych.

Niektóre gatunki np. *T. acuta* i *T. nigra* masowo występowały zarówno w chłodnym, jak i ciepłym okresie roku, a więc odmiennie niż u karpi w stawach. Temperatura wody nie jest więc, jak przypuszczano, głównym czynnikiem środowiska zewnętrznego warunkującym wzrost liczebności osobników tych gatunków. Być może gatunki te posiadają znaczną plastyczność lub duże zdolności adaptacyjne do temperatury.

Ryby w pierwszym roku życia hodowane w dużym zagęszczeniu, w betonowych podchowalniach są bardziej narażone na szkodliwy wpływ inwazji trichodin, w porównaniu z bardziej rozrzedzonymi obsadami ryb starszych w stawach ziemnych.

Ze względu na możliwość masowej inwazji niektórych gatunków trichodin na hodowane ryby, pożądane jest bardziej rygorystyczne stosowanie profilaktyki w walce z orzęskami.

Wyniki przeprowadzonej pracy sugerują, że biologia i ekologia poszczególnych gatunków trichodin występujących u ryb jest bardziej złożona od opisanej dotychczas w literaturze.

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