



Historical analysis of the type species of the genus *Trichobilharzia* Skrjabin et Zakharov, 1920 (Platyhelminthes: Schistosomatidae)

JITKA ALDHOUN¹, PETR KMENT² & PETR HORÁK³

¹*Parasites & Vectors, Department of Life Sciences, Natural History Museum, Cromwell Road, SW7 5BD, London, United Kingdom.*

E-mail: j.aldhoun@gmail.com

²*Department of Entomology, National Museum, Cirkusová 1740, CZ-193 00 Prague 9 – Horní Počernice, Czech Republic.*

E-mail: sigara@post.cz

³*Department of Parasitology, Faculty of Science, Charles University in Prague, Viničná 7, CZ-128 44 Prague 2, Czech Republic.*

E-mail: petrhorak@petrhorak.eu

Trichobilharzia Skrjabin & Zakharov, 1920 is known as the most species-rich genus of the blood fluke family Schistosomatidae. To date, more than 40 species have been described, even though validity of some of them is questionable (Horák *et al.* 2002). Members of the genus use various birds as final hosts, but they attract attention mostly as causative agents of hypersensitive skin reaction (cercarial dermatitis or swimmer's itch) in mammals including humans. As this is one of the re-emerging diseases, the study of *Trichobilharzia* has been intensified in the last few decades (Horák *et al.* 2015).

Systematics of the genus *Trichobilharzia* remains chaotic due to the inadequate species descriptions (including that of the type species) in the first half of the 20th century. The genus was established for the species *T. kossarewi* Skrjabin & Zakharov, 1920 from the liver of *Anas circia* L. (junior synonym of *A. querquedula* L., the garganey) from the Don region of Russia. Later, Brumpt (1931) used cercariae he determined as *Cercaria ocellata* La Valette, 1855 for experimental infections of domestic ducks, and he found the corresponding adults to belong to the genus *Trichobilharzia*, establishing a new combination, *Trichobilharzia ocellata* (La Valette, 1855). Brumpt (1931) believed this species to be identical to *T. kossarewi*, the only known species of the genus at that time, and thus synonymised the two species, with *T. kossarewi* becoming a junior subjective synonym of *T. ocellata*. Since then, *T. ocellata* has been considered the type species of the genus. Unfortunately, the original descriptions (La Valette 1855, Skrjabin & Zakharov 1920) are insufficient, missing any species-specific characters that would allow unambiguous identification of the species, and the identity and validity of *C./T. ocellata* have been questioned by subsequent authors (e.g. Szidat 1942; Odening 1996). Rudolfová *et al.* (2005) discussed the affiliation of *C. ocellata* and considered the synonymy of *T. kossarewi* and *T. ocellata* unsubstantiated, but they stopped short of naming the actual type species of the genus. At present, authors tend to avoid the name *T. ocellata*, repeating the statement that it is a doubtful species. However, we feel that such practice is not acceptable as it does not follow the International Code of Zoological Nomenclature (ICZN 1999).

Therefore, this contribution aims to clarify the situation of the type species of the genus *Trichobilharzia*. Since no voucher specimens for the species in question are available, the only option is to analyse the key works on *T. kossarewi* and *C./T. ocellata* (Skrjabin & Zakharov 1920, La Valette 1855, Brumpt 1931), and confront them with the rules of the International Code of Zoological Nomenclature (ICZN 1999).

Skrjabin & Zakharov (1920) provided a combined description of a new genus and species, '*Trichobilharzia kossarewi* n. g. n. sp.', accompanied by explicit original designation of *T. kossarewi* as the type species of *Trichobilharzia* (Skrjabin & Zakharov 1920: 5). The description of *T. kossarewi* is quite brief and incomplete as it is based on two males only. However, it mentions the following characteristics: body divided into a wider anterior part and filamentous posterior part with a widened portion in between, which obviously refers to gynecophoric canal, even though the term is not used explicitly in the text, oral and ventral sucker present, numerous testes, elongate seminal vesicle located between ventral sucker and gynecophoric canal, and genital pore situated at the anterior end of gynecophoric canal.

Current understanding of the genus is in accordance with this description (see the most recent review of the genus *Trichobilharzia* by Horák *et al.* 2002). There is no reason to question the generic affiliation of the species; however, it is impossible to identify the species described, as the details of digestive system (i.e. position of the caecal reunion) that are

among the most important characters for species identification (Blair & Islam 1983, Horák *et al.* 2002) were not observed.

The description of *Cercaria ocellata* depicts apharyngeate ocellate furcocercariae isolated from *L. stagnalis*. However, while all *Trichobilharzia* species possess five pairs of penetration glands (Blair & Islam 1983, Horák *et al.* 2002) – two pairs of circumacetabular and three pairs of postacetabular penetration glands, the drawing of *C. ocellata* clearly illustrates only three pairs of penetration glands behind the acetabulum, although other tiny organs of the body, e.g., the excretory vesicle or excretory canals, are described. Assuming that the author did not observe the two pairs of circumacetabular glands would be a speculation; therefore, the only conclusion possible is that *C. ocellata* cannot be assigned with certainty to the genus *Trichobilharzia* and even to the family Schistosomatidae. Its taxonomic position is unclear and for this reason it has to be considered a species *incertae sedis*.

The work by Brumpt (1931) is regarded as a description of adult form of *C. ocellata* La Valette, 1855: the author used cercariae from the great pond snail, *Lymnaea stagnalis* (L.) he believed to belong to *C. ocellata* for experimental infections of domestic ducks, and found eggs in the intestinal wall (the distal 3/5 of small intestine and the whole of the large intestine) and fragments of adults in mesenteric vessels and vessels of the inner intestinal wall. However, there is no description of the adults and eggs in the text, and no dimensions are given; fragments of males and females, and eggs are illustrated only in drawings. The worms are filiform with testes situated in one row in males, and a single intrauterine egg in females; eggs are crescentic. The ventral sucker, seminal vesicle, gynecophoric canal and genital pore are not shown, probably because the author got only fragments of adults and did not observe these structures. However, the filiform adults and crescentic eggs suggest that the species does belong to the genus *Trichobilharzia*. Brumpt (1931) states he could identify the worms as *T. kossarewi* but the only reason for such a conclusion seems to be the fact that at that time, *T. kossarewi* was the only known species of the genus. We do not consider these arguments to justify this species identification: the description of *T. kossarewi* lacks any species-specific characters, and the fragments found by Brumpt do not possess any characters allowing identification of the species or even the genus of the worms found.

Moreover, cercariae used for experimental infections are probably not identical with *C. ocellata*. Their morphology is not characterized in the text; the author only mentions the works on *C. ocellata* by Ssinitzin (1910), Mathias (1930), Taylor & Baylis (1930), and Vogel (1930), which indicates that he dealt with similar cercariae. However, cercariae described by these authors had five pairs of penetration glands, except for Ssinitzin (six pairs). Therefore, it seems probable that Brumpt also used cercariae with at least five pairs of penetration glands; this would mean they were not identical with *C. ocellata*. Even if Brumpt did use cercariae with only three pairs of penetration glands as possess cercariae of *C. ocellata* sensu La Valette (1855), it is uncertain that such cercariae would produce adults resembling a *Trichobilharzia* species.

Since we conclude that *C. ocellata* does not belong to *Trichobilharzia*, it follows that the combination *T. ocellata* created by Brumpt (1931) is not valid and no such taxon as *T. ocellata* exists. Species previously identified as *C. ocellata*/*T. ocellata* auct., non La Valette [= sensu authors but not La Valette] were misidentified. As for the identity of the Brumpt's isolate, it is probable he dealt with *T. szidati* Neuhaus, 1952 based on the intermediate host. In general, bird schistosomes have a rather narrow intermediate host specificity (Horák *et al.* 2002), and out of 36 isolates of bird schistosomes from *L. stagnalis* deposited in GenBank, 35 belong to *T. szidati* (two of them are identified as *T. ocellata*, but they are identical to *T. szidati*). These isolates come from different parts of Europe (Germany, Czech Republic, France, Finland, Denmark, Belarus, Russia) and one from the USA, which proves that *T. szidati* is a widespread species. Moreover, the size and shape of eggs (important identification characters of *Trichobilharzia* species as shown by Skirnisson & Kolářová (2008)) in Brumpt's drawings also correspond to *T. szidati*.

As a consequence of the above synonymy of *C. ocellata* and *T. kossarewi*, *Trichobilharzia ocellata* was interpreted by many authors (e.g., Khalil 2002) as the type species of *Trichobilharzia*. However, such interpretation is not in accordance with the provisions of ICZN (1999: Article 67.1.2) saying explicitly that 'the name of a type species remains unchanged even when it is a junior synonym or homonym, or a suppressed name'. Therefore, such a synonymy had/has no effect on the type species of *Trichobilharzia* established by Skrjabin & Zakharov (1920), and *T. kossarewi* is, and always was, the type species of the genus *Trichobilharzia*. To fix the identity of *T. kossarewi*, it is necessary to designate a neotype for the species. As the species description is vague and lacking any species-specific characters, any species of the genus with the same location in the type host, collected in the same or related region and host species could serve as the neotype. At the moment, none of the known species of the genus fully meets the requirements; therefore, we choose to postpone the designation of a neotype for *T. kossarewi* until corresponding material is available.

Based on the above facts, we can conclude:

The type species of the genus *Trichobilharzia* is *T. kossarewi* Skrjabin & Zakharov, 1920, by original designation. The morphology of *Cercaria ocellata* La Valette, 1855 does not correspond to that of any known schistosome genus. For

this reason we exclude this taxon from the genus *Trichobilharzia* and the family Schistosomatidae and consider it a species *incertae sedis*.

There are justified doubts about the correctness of the identification of cercariae and adults in the work by Brumpt (1931). It is probable that he did not deal with *C. ocellata* sensu La Valette (1855); the adults he studied lack characters enabling their identification as *T. kossarewi* Skrjabin & Zakharov, 1920. On this ground we reject synonymisation of *C. ocellata* and *T. kossarewi*. *Trichobilharzia ocellata* is not a valid combination and trematodes identified as such were misidentified.

Trichobilharzia kossarewi Skrjabin & Zakharov, 1920 is a valid species. To fix the identity of *T. kossarewi* designation of a neotype will be necessary in the future pending its rediscovery in the field.

This work was partly financially supported by the Ministry of Culture of the Czech Republic (DKRVO 2016/15, National Museum, 00023272 to P. Kment) and by the Charles University in Prague (research program PRVOUK P41/PrFUK to P. Horák).

References

- Blair, D. & Islam, K.S. (1983) The life cycle and morphology of *Trichobilharzia australis* n. sp. (Digenea: Schistosomatidae) from the nasal blood vessels of the black duck (*Anas superciliosa*) in Australia, with a review of the genus *Trichobilharzia*. *Systematic Parasitology*, 5, 89–117.
<http://dx.doi.org/10.1007/BF00049237>
- Brumpt, E. (1931) *Cercaria ocellata*, déterminant la dermatite des nageurs, provient d'une bilharzie des canards. *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, 192, 612–614.
- Horák, P., Kolářová, L. & Adema, C.M. (2002) Biology of the schistosome genus *Trichobilharzia*. *Advances in Parasitology*, 101, 57–63.
[http://dx.doi.org/10.1016/S0065-308X\(02\)52012-1](http://dx.doi.org/10.1016/S0065-308X(02)52012-1)
- Horák, P., Mikeš, L., Lichtenbergová, L., Skála, V., Soldánová, M. & Brant, S.V. (2015) Avian schistosomes and outbreaks of cercarial dermatitis. *Clinical Microbiology Reviews*, 28, 165–190.
<http://dx.doi.org/10.1128/CMR.00043-14>
- ICZN (1999) *International code of zoological nomenclature*. Fourth edition. International Trust for Zoological Nomenclature, London, 306 pp.
- La Valette de St. George, A. (1855) *Symbolae ad trematodum evolutionis historiam*. Dissertation, Berolius, 42 pp.
- Neuhaus, W. (1952) Biologie und Entwicklung von *Trichobilharzia szidati* n. sp. (Trematoda, Schistosomatidae), einem Erreger von Dermatitis beim Menschen. *Zeitschrift für Parasitenkunde*, 15, 203–266.
<http://dx.doi.org/10.1007/bf00260453>
- Odening, K. (1996) What *Cercaria ocellata* actually is. *Acta Parasitologica Turcica*, 20 [Suppl 1], 387–397.
- Rudolfová, J., Hampl, V., Bayssade-Dufour, C., Lockyer, A.E., Littlewood, D.T.L. & Horák, P. (2005) Validity reassessment of *Trichobilharzia* species using *Limnaea stagnalis* as the intermediate host. *Parasitology Research*, 95, 79–89.
<http://dx.doi.org/10.1007/s00436-004-1262-x>
- Skírnisson, K. & Kolářová, L. (2008) Diversity of bird schistosomes in anseriform birds in Iceland based on egg measurements and egg morphology. *Parasitology Research*, 103, 43–50.
<http://dx.doi.org/10.1007/s00436-008-0925-4>
- Skrjabin, K.I. & Zakharov, N.P. (1920) Zwei neue Trematodengattungen aus den Blutgefäßen der Vögel. (Beitrag zur Kenntnis der Helminthenfauna der Vögel Russlands) [in Russian] *Izvestiya Donskogo Veterinarnogo Instituta*, 2, 1–6.
- Ssinitzin, D.T. (1910) Studien über die Phylogenie der Trematoden. 2. *Bucephalus* v. Baer und *Cercaria ocellata* De la Val. *Zeitschrift für Wissenschaftliche Zoologie*, 94, 299–325, pls. IX–X.
- Szidat, L. (1942) Was ist *Cercaria ocellata* La Valette? Morphologische und entwicklungsgeschichtliche Untersuchungen über den Erreger der europäischen Cercarien-Dermatitis des Menschen. *Deutsche Tropenmedizinische Zeitschrift*, 46, 481–497, 509–524.
- Taylor, E.L. & Baylis, H.A. (1930) Observations and experiments on a dermatitis-producing cercaria, and another cercaria from *Limnaea stagnalis* in Great Britain. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 24, 219–244.
[http://dx.doi.org/10.1016/S0035-9203\(30\)92001-9](http://dx.doi.org/10.1016/S0035-9203(30)92001-9)
- Vogel, H. (1930) Cercarien-Dermatitis in Deutschland. *Klinische Wochenschrift*, 9, 883–886.
<http://dx.doi.org/10.1007/BF01724254>