DOI 10.2478/s11687-012-0007-0

HELMINTHOLOGIA, 49, 1: 43 – 48, 2012

# *Catatropis pakistanensis* n. sp. (Trematoda: Notocotylidae) from Northern shovelers, *Anas clypeata* (Anatidae: Aves) from Pakistan with some remarks on the history of *Catatropis* species

R. K. SCHUSTER[1], G. WIBBELT[2]

[1]Central Veterinary Research Laboratory, PO Box 597, Dubai, United Arab Emirates,
E-mail: *rschuster@cvrl.ae*; [2]Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Str. 17,
10315 Berlin, Germany

**Summary**

Five out of 15 free-ranging Northern shovelers (*Anas clypeata* Linneus) caught in Pakistan were infected with notocotylid trematodes. Out of the 31 flukes, 10 specimens were used morphological studies, 4 others were also examined by scanning electron microscopy and one remaining trematode was cut in serial semi-thin sections for histological evaluation in order to describe a new species. Like all species of this genus, *Catatropis pakistanensis* n. sp has a median ridge starting posterior to the basis of the cirrus sac and extends posterior to the ovary. Bilateral to this ridge there are two rows of 9 – 10 ventral papillae each. Metraterm and cirrus sac are equally in length. In contrast to most other *Catatropis* spp. the genital opening in *C. pakistanensis* is situated between the oral sucker and bifurcation of the caeca.

Keywords: *Catatropis pakistanensis*; Trematoda; Notocotylidae; *Anas clypeata*; Pakistan

## Introduction

A trematode with "warts" on the ventral surface was for the first time mentioned by Frölich (1789), who described *Fasciola verrucosa,* a flat worm of 4 mm in length with a median ridge and 2 lateral rows of 12 papillae found in the caeca of wild geese in Germany. Soon after, Zeder (1800) assigned this worm to the genus *Monostomum*. The scientific history of this fluke was described in detail by Kanev *et al*. (1994).

After comparing his own trematode material collected in Sweden with monostomes of the private collection of Arthur Looss from Cairo, Egypt, and flukes from the museal collection in Greifswald, Germany, Odner (1905) established the genus *Catatropis* to delineate monostome digeneans with ventral structures of the 'verrucosa' type from those with 3 rows of evertable ventral spherical papilliform protrusions. These latter remained in the already existing genus *Notocotylus* Diesing, 1839. A few years later, Lühe (1909) formed the family Notocotylidae to unite the monostome genera *Notocotylus, Catatropis* and the newly established *Paramonostomum*, a genus that lacks papillae and ridges altogether. Today, twelve genera are included in the Notocotylidae family (Barton & Blair, 2005).

According to Bayssade-Dufour *et al*. (1996) the genus *Catatropis* included 15 species. At a closer view 2 of them were synonym or invalid species, respectively, and 2 others were added by Flores and Brugni (2003, 2006). The aim of this paper is to describe a new *Catatropis* species found in the caeca of Northern shovelers (*Anas clypeata* Linneus) from Pakistan.

## Materials and methods

Carcasses of 15 wild caught Northern shovelers (*Anas clypeata*) imported from Pakistan in November 2010 underwent a routine necropsy at the Central Veterinary Research Laboratory in November 2010. Apart from hymenolepid cestodes in the small intestines notocotylid trematodes were found in the caeca of 5 birds. Unstained trematodes were examined to describe the pattern and distribution of ventral structures and were later stained in an aquatic solution of carmine, dehydrated in increasing alcohol concentrations and temporarily mounted in glycerin on slides. Measurements were taken from 10 fully developed specimens. Drawings were made from photographs taken with a digital camera (Olympus DP71) connected to microscopes (Olympus BX61 and Olympus SZX12).

After parasitological examination as described above, 4 ethanol-fixed trematodes were critical point dried using CO2, were mounted on a specimen stub and sputter coated with a 10-nm layer of gold-palladium alloy (Polaron Sputter coater SC 7600; Emitech, Montigny-le-Bretonneux, France) before examination with a Supra 40VP scanning

electron microscope (Zeiss, Oberkochen, Germany).
A single ethanol-fixed specimen was embedded in EPON 812 resin and serial semi-thin sections were produced parallel to its longitudinal axis. Sections were stained with toluidin blue and examined by light microscopy (Axioplan, Zeiss, Jena, Germany). Photographs were taken by digital camera (Olympus UC 30, Olympus Soft Imaging Solutions GmbH, Münster, Germany).

Fig. 1. *Catatropis pakistanensis*, bar: 500 µm

**Results**

*Catatropis pakistanensis* n. sp. (Figs. 1 – 8)
*Type specimens*: Holotype (No. 7503) and 5 paratypes (No. 7504) are deposited in the Collection „Vermes“, General Catalogue Entozoa of the Museum für Naturkunde, Berlin, Germany
*Type host*: Northern shoveler, *Anas clypeata*, Linneus 1758 (Aves, Anatidae)
*Site of infection*: caeca
*Type locality*: Pakistan, site of catching unknown
*Prevalence*: 5/15
*Intensity*: 1 – 26
*Etymology*: The specific epiphet is derived from the country of origin of the host, Pakistan.

*Description*
*Catatropis pakistanensis* n. sp. (Fig. 1) reflects the characteristics of the genus *Catatropis* Odner, 1905. Live specimens are pink in colour. Body 2.850 – 3.840 (3,120) mm long and 0.850 – 1.180 (0.990) mm wide, bilaterally flat-

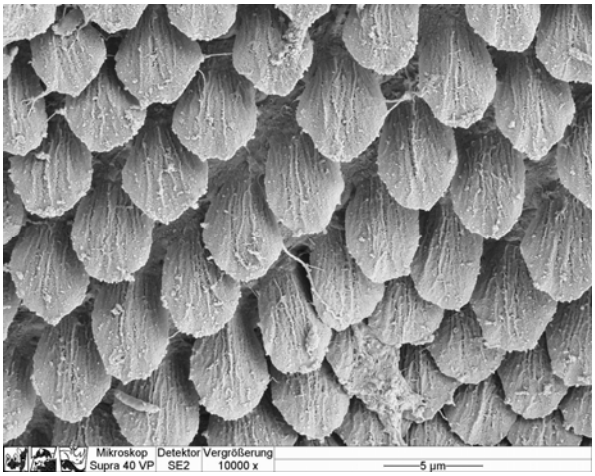


Fig. 2. *C. pakistananensis*, scales in the anterior region, SEM

ted, elongated, with tapered anterior and rounded posterior ends. Ventral surface covered with rhomboid shaped scales (Fig. 2) of up to 5 µm long in the region of the cirrus-sac, posteriorly these scales markedly decrease in size at the level of first uterine coils towards the posterior end of the trematode. Ventral protrusions (Figs. 3, 4) consist of a single continuous median ridge starting posterior to the basis of the cirrus sac and extending posteriorly to the ovary, and 2 lateral rows of 9 – 10 ventral papillae each. First pair of papillae at the level of the anterior border of the vitellaria or slightly in front of it. The rows stretch posterior on the lateral border of the uterine coils and continue on the medial site of testes with the last pair of papillae situated at the posterior level of testes. Histological examination of the papillae (fig. 5, 6) reveals small spines within their outer tegument. Below, a layer of circular and a longitunal muscles is located separating the outer from

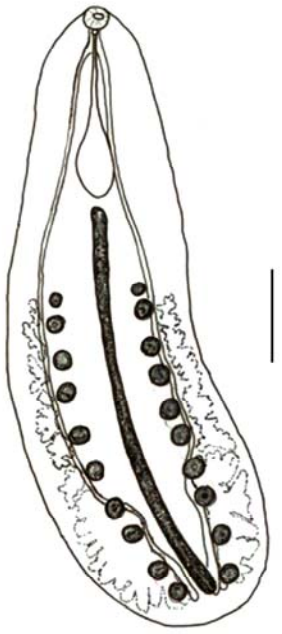

*Fig. 3. C. pakistananensis*, central ventral ridge and lateral ventral papillae, bar: 500 µm

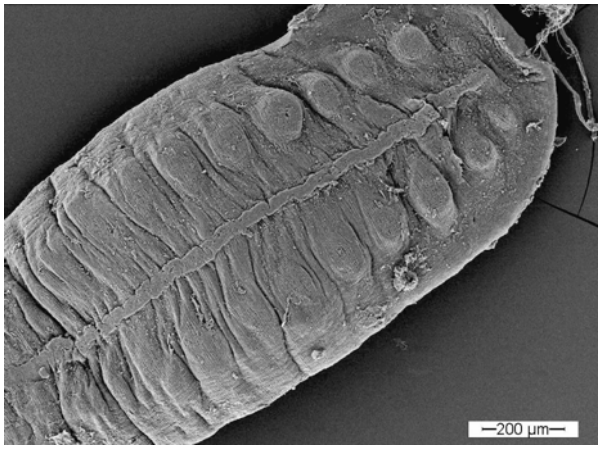


Fig. 4. *C. pakistananensis*, central ventral ridge and lateral ventral papillae, SEM

the inner tegument zone; the latter is comprised of a number of pyriform cells forming the base of the papillae. The diameter of the papillae measure about 40 – 45 µm at the apex and about 145 – 150 µm at the base. The tegument of entire ventral surface as well as the anterior half of the dorsal surface of the trematode are covered with spines, while the posterior half of the dorsal surface is smooth and void of spines and a distinctly thicker outer tegument in comparison to the ventral side. Oral sucker subterminal, wider than long: 100 – 130 x 130 – 170 (120 x 144) µm; esophagus150 – 200 (171) µm long; caeca extend laterally to uterine coils, between ovary and testes and end blindly at posterior end. Testes 600 – 850 x 300 – 380 (740x315) µm at posterior end of the body, symmetrical, extracaecal, deeply lobed on external margin. Cirrus sac 860 (700 – 950) µm elongated with a bulbus 250 – 350 x 110 – 180 (306 x 152) µm containing coiled seminal vesicle; anterior part of cirrus sac narrow and partly overlapped by terminal part of metraterm; basis of cirrus sac at 29.4 – 35.6 (32 %) on the body scale. External seminal vesicle forms 1 – 2 coils. Genital pore median, directly posterior to oral sucker (Fig. 7). Ovary 220 – 400 x 150 – 220 (300x180) µm, intertesticular, consisting of multiple lobes. Mehlis' complex preovarian. Uterus forms 14 – 19 (17) coils of which 3 – 7 previtelline. Metraterm faintly developed having the same length as cirrus-sack. Vitelline glands 750 – 1,060 (900) µm long consisting of irregular follicles, in extracaecal position in the posterior half of the body with an anterior end at 47.1 – 54.7 (48.9) % on the body scale. Eggs 20 x 10 µm with a single filament on each pole: 170 – 200 (Fig. 8).

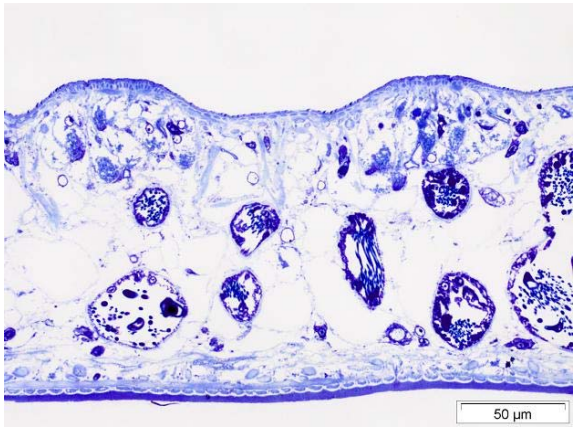


Fig. 5. Histological semi-thin section of *C. pakistananensis* with two adjacent ventral papillae, toluidin blue.

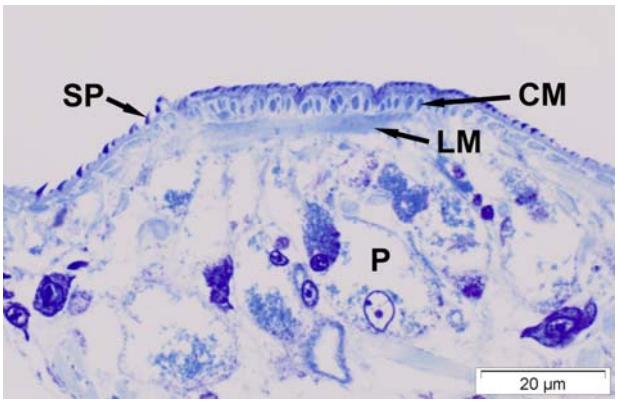


Fig. 6. Histologic semi-thin section, ventral papilla with tegumental spines (SP), circular (C) and longitudinal (L) muscle layers and pyriforme cells (P), toluidin blue

**Remarks**

Including *C. pakistanensis* the genus *Catatropis* comprises 17 valid species: *C. verrucosa* (Frölich, 1789), *C. liara* Kossak, 1911, *C. orientalis* Harshe, 1932, *C. indica* Srivastava, 1935, *C. cygni* Yamaguti, 1939, *C. hisikui* Yamaguti, 1939[1], *C. pricei* Harwood, 1939, *C. harwoodi* Bulock, 1952, *C. rauschi* Sing, 1956, *C. morosovi* Gubanow *et al*., 1966, *C. poecylorhynchai* Gupta & Sing, 1984, *C. chinensis*, Lai *et al*. 1884, *C. misrai* Gupta & Sing, 1984, *C. lagunae,* Bayssade-Dufour *et al*., 1996, *C. chilinae* Flores & Brugni, 2003, *C. hatcheri*, Flores & Brugni, 2006.
*C. chandarii* Skrjabin, 1915 is now considered a synonym of *C. verrucosa* (Filimonova 1985, Kanev *et al*. 1994) and *C. filamentis* Barker, 1915, *C. gallinulae* Johnston, 1928 and *C. pacifera* Noble, 1933 were removed from the genus because of an unproper structure of the median ridge while *C. johnstoni* Martin, 1956 and *C. nicolli Cribb*, 1991 were withdrawn owing their lack of bilateral rows of ventral papillae (Bayssade-Dufour *et al*., 1996).
Gupta and Jahan (1977) described *C. rauschi* from a Spot-billed duck in India not considering that this name was already preoccupied by Singh (1956). Therefore, Gupta and Singh (1984) proposed the name *C. poecylorhynchai* for *C. rauschi*.
The creation of *C. joyeuxi* Dvorjadkin, 1989 was an at-

[1]Bayssade-Dufour *et al*. (1996) excluded this species from genus *Catatropis* due to an apparently unproper structure of the ventral ridge. A redescription of *C. hisikui* by Besprozvannykh (2006) however, showed the presence of a ridge.

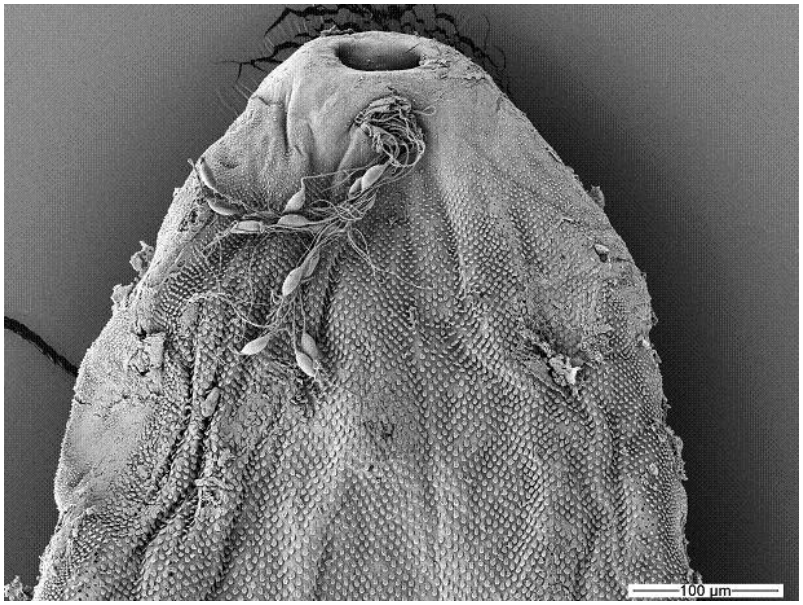


Fig. 7. *C. pakistananensis*, anterior end with oral sucker, genital pore shedded eggs and distinct large tegumental scales, SEM

tempt to include *Paracatatropis joyeuxi* Kanev & Vassilev, 1986 into the genus *Catatropis*. *P. joyeuxi* is morphologically similar to the adult stage of *C. verrucosa* but differs in its larval stage and intermediate host. But as Dvorjadkin (1989) failed to deposit type material it is not recognised as a species. Except for *C. morosovi* with rodents as definitive hosts all *Catatropis* species are parasites of birds.

According to the diagnosis, the genus *Catatropis* unites all monostome digeneans with a continuous ventral ridge bilaterally flanked by a row of discrete papillae and a genital pore that opens median, immediately postbifurcal or prebifurcal (Barton & Blair, 2005). In all examined specimens of *C. pakistanensis* the genital opening was located directly posterior to the oral sucker. This position of the genital pore is also found in *C. indicus, C. pricei, C. harwoodi, C. chinensis, C. misrai, C. poecyclorhynchai* while in all other *Catatropis* species the genial pore opens just posteriorly to the bifurcation of the caeca. Based on the number of ventral papillae in each lateral row *C. pakistanensis* can be delineated from *C. indicus, C. pricei, C. chinensis, C. misrai* that have more than 10 papillae and from *C. poecyclorhynchaj* with only 4 – 6 papillae. *C. harwoodi* with 7 – 9 ventral papillae in each row differs from *C. pakistanensis* by a strikingly longer metraterm compared to the cirrus sac and internally and externally lobed testes. Ventral papillae in the lateral rows in *C. harwoodi*, located anterior to the testes, are very small and difficult to count and their number could only be established in histological serial cross sections.

In the original description of this fluke Bullock (1952) provided only a drawing of a histological section.

Little is known about the structure and function of ventral papillae in Notocotylidae species. Results of histological examination of the ventral surface of *C. pakistanensis* corresponded with findings of MacKinnon (1982a), who described the ventral ridge, papillae, and body margins of *C. verrucosa* to contain numerous pyriform cells packed with mitochondria. Pyriform cells were also present in ventral papillae of *Notocotylus triserialis* and the tegument covering papillae was similar to the non-papillar ventral tegument MacKinnon (1982b).

First data on the life history of *C. verrucosa* lead to great confusion. In a footnote of a paper on trematodes Looss (1893) mentioned a larval stage he detected in the fresh

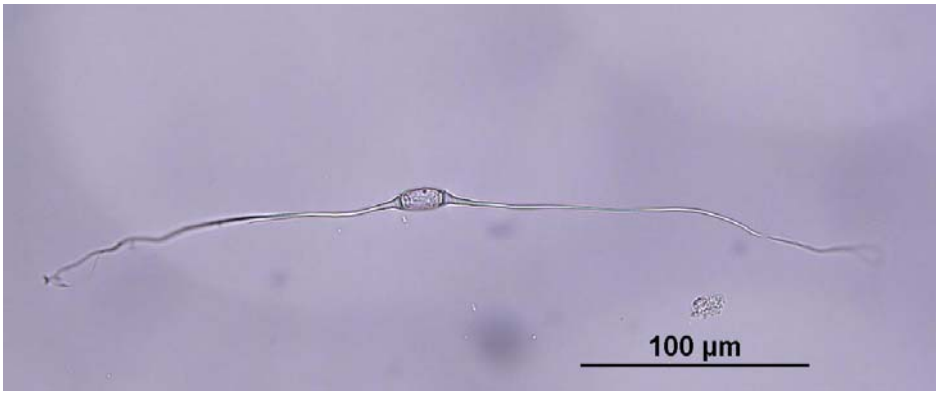


Fig. 8. *C. pakistananensis*, egg

water snail *Paludina impura*[2] collected in Germany and provided the provisional name *Cercaria imbricata*. Few years later Looss (1896) described *C. imbricata* as long tailed tri-occulated monostome cercaria shed by the prosobranch snail *Melanoides tuberculata* and suggested this as the larval stage of *Monostomum verrucosum* that he found in domestic ducks in Egypt. Later, Looss (1899) realised that *M. verrucosum* from ducks in Egypt differed from those found in Germany mainly in the position of the genital pore and Odhner (1905) renamed Looss's Egyptian species to *Notocotyle aegyptica.* Ideally, this fluke would have been named after its larval stage '*imbricata'*.

Lühe (1909) used the description of the Egyptian *Cercaria imbricata* of Looss (1896) to characterise the monostome cercaria shed by *Bithynia tentaculata* in Germany but provided only a poor drawing. He mentioned with regard to eye spots, pigment stripes, intestine and excretory bladder that it is identical with *C. ephemera*. Contrary to *C. imbricata, C. ephemera* in this publication is nicely pictured with excretory vessels united anteriorly to the bifurcation of the caeca. According to this feature both cercariae belong to the 'Monostomi' group[3].

Szidat (1935) worked experimentally with cercariae shed by naturally infected *B. tentaculata* from Eastern Prussia and after raising the marita in ducklings she named the adult form *Notocotylus imbricatus*. Although she did not give an adequate verbal description but pictured the cercariae Rotschild (1940) admitted that this larval form was not identical to *C. imbricata* that Looss (1896) had seen in Egypt because of differences in the excretory system.

Regarding life cycle and intermediate hosts of *C. verrucosa* two opinions prevailed. Erkina in Skrjabin (1953) described 2 monostome cercariae in *B. tentaculata* as larval stages of *N. chionis* and *C. verrucosa*, respectively. Both cercariae posses a long tail and leave the snail host before becoming a metacercariae. The pictured cercariae of *N. chionis* and *C. verrucosa* belong to 'Monostomi' and 'Yenchingensis' groups, respectively.

Little attention was paid to the fact that Joyeux (1922) found small planorbid snails (*Anisus leucostomus*) collected near Paris as the intermediate hosts of a trematode that he wrongly determined as *Notocotylus attenuatus*. When Dubois (1951) reexamined the adult worms raised by Joyeux in a feeding experiment he found most of them identical to *C. verrucosa*. This result was also confirmed by an intense study by Odening (1966). He discovered monostome cercariae with a stumpy tail and without eye spots belonging to the 'Imbricata' group and subsequent metacercariae in small planorbids *Segmentina nitida* and *Gyraulus albus* collected from a pond near Berlin, Germany. In a feeding experiment the resulting adult trematodes apparently corresponded to *C. verrucosa* and confirmed the previous observation that this fluke employs planorbid snails as intermediate hosts. He could raise adult flukes only in ducks while the infection of other hosts failed. However, Odening's *C. verrucosa* possessed only 8 ventral papillae in each ventral lateral row and in terms of the high intermediate host specificy of notocotylids these findings strongly contradicted the results of Erkina.

Experimental infections of 9 bird species (including ducks, geese, chicken, turkey, partridges and quails) with *C. verrucosa* deriving from larval stages shed by naturally infected *B. tentaculata* and *B. leachi* collected along the River Danube in Austria and Bulgaria Kanev *et al*. (1994) supported the opinion of Russian helminthologists. The authors also successfully infected both *Bithynia* species but attempts to infect lymnaeid and planorbid snails failed.

To solve the discrepancy of morphologically identical maritae derived from strikingly different larval stages and using different intermediate hosts Kanev and Vasiliev (1986) had already suggested the name *Pseudocatatropis joyeuxi* for the species developing from eyeless, short tailed cercariae in small planorbids and remained the name *C. verrucosa* for flukes deriving from ocellated cercariae with long tails shed by *Bithynia* spp.

Without mentioning the paper of Kanev and Vasiliev (1986) Dvorjadkin (1989) suggested the name *C. joyeuxi* for the *Catatropis* species with 6 – 9 pair of ventral papillae corresponding to Odening's description. Dvorjadkin (1989) allegedly found the larval stages in the planorbid snail species *Helicorbis sujfunensis* but gave no further details on the morphology of the adult trematodes and failing to deposit type material *C. joyeuxi* is therefore a species inquirenda.

The life cycles of other *Catatropis* species have been studied by several authors, and larval stages were described for *C. indicus* with *Bithynia* sp. (Rhode & Lee, 1967), *C. morosovi* with *B. contortrix* (Dvorjadkin,1987), *C. lagunae* with *Hydrobia ulvae* (Bayssade-Dufour *et al*., 1996), *C. chilinae* with *Chilina dombeiana* (Flores & Brugni, 2003), *C. hatcheri* with *Heleobia hatcheri* (Flores & Brugni, 2006) and *C. hisikui* with *Boreoelona ussuriensis* and *B. contortrix* (Besprozvannykh, 2006) as intermediate hosts. According to the structure of the excretory vessels of their cercaria *C. indica* belongs to the 'Monostomi' group, *C. hatcheri, C. chilinae* and *P. joyeuxi* (= *C. verrucosa* of Odening 1966) to the 'Imbricata' group and *C. morosovi* and *C. verrucosa* to the 'Yenchingensis' group.

[2]current name: *Bithynia tentaculata*

[3]Based on the structure of the excretory system Rotschild (1938) suggested classifying notocotylid cercariae into 'Monostomi', 'Imbricata' and 'Yenchingensis' groups. While *C. imbricata* Looss 1896, nec 1893 belongs to the 'Imbricata' group the cercaria pictured by Szidat (1935) shows characteristics of the 'Monostomi' group. The situation became more complicated after Dönges (1962) described *N. imbricatus* derived from cercariae with features of 'Yenchingensis' group shed by *B. tentaculata*.

**Acknowledgements**

The authors wish to thank Dr. B. Neuhaus, Museum für Naturkunde, Berlin, Dr. H. Sattmann, Naturhistorisches Museum Wien, Dr. V. Besprozvannykh, Russian Academy of Science, Vladivostock, Dr. S. Rehbein, Merial GmbH,

Katharinenhof for the supply with rare literature sources and Mrs. D. Viertel, Leibniz Institute for Zoo and Wildlife Research, Berlin, for her excellent technical assistence in the preparation of SEM and histology samples.

**References**

BARTON, D. P., BLAIR, D. (2005): Family Notocotylidae. In: JONES, A., BRAY, R. A., GIBSON, D. I. (Eds.) Keys to the trematodes Vol. 2. Biddles Ltd., King's Lynn pp. 383 – 399

BAYSSADE-DUFOUR, CH., ALBARET, J.-L., FERMET-QUINET, H., FARHATI, K. (1996): *Catatropis lagunae* n. sp., Trematoda, Notocotylidae, parasite d'oiseau de mer. *Can. Field Naturalist*, 110: 392 – 402

BESPROZVANNYKH, V. V. (2006): The life cycle of the trematode *Catatropis hisikui* (Notocotylidae) in the Primorsk region. (in Russian) *Vestnik Zool.,* 40: 267 – 270

BULLOCK, W. L. (1952): Two new species of monostomes from the Canada goose with a review of *Paramonostomum alveatum* (Mehlis in Ceplin, 1846). *J. Parasitol.,* 38: 371 – 378

DVORJADKIN, V. A. (1987): Morphology and life cycle of *Catatropis morosovi* (Trematoda, Notocotylidae) – a parasite of rodents in Primorja and Priamurja. (In Russian.) In: MAMAEV, Y. L. (Ed.) Gel'minty I vyzvannye imi zabolevanija. Akademia nauk SSSR, Vladivostok. pp. 29 – 33

DVORJADKIN, V. A. (1989): Species and peculiarities of the development of trematodes of the Far East of USSR. (In Russian) In: LEBEDEV B. I. (Ed.) Parazitologiceskie issledovanija. Akademija Nauk SSSR, Vladivostok, pp. 97 – 105

DUBOIS, G. (1951): Etude de trematodes nordamericains de la collection E. L. Schiller et revision du genre *Notocotylus* Diesing, 1839. *Bull. Soc. Neuchatel Sci. Natur.,* 47: 41 – 76

FILIMONOVA, L. V. (1985): Trematodes of the fauna of the USSR. Notocotylidae. (in Russian) Nauka, Moskva. 127 pp

FLORES, V., BRUGNI, N. (2003): *Catatropis chilinae* n. sp. (Digenea: Notocotylidae) from *Chilina dombeiana* (Gastropoda: Pulmonata) and notes on its live-cycle in Patagonia, Argentina. *Syst. Parasitol.,* 54: 89 – 96

FLORES, V., BRUGNI, N. (2006): *Catatropis hatchery* n. sp. (Digenea: Notocotylidae) from *Heleobia hatcheri* (Prosobranchia: Hydrobiidae) and notes on its live-cycle in Patagonia, Argentina. *Syst. Parasitol,* 63: 109 – 116

FRÖLICH, J. A. VON (1789): Beschreibungen einiger neuer Eingeweidewürmer. *Naturforscher,* 24: 101 – 162

GUPTA, V., JAHAN, A. (1977): Some trematodes from avian hosts of India. *Ann. Inst. Biol .Univ. Nat. Mexico*, 48: 13 – 26

GUPTA, P. C., SING, R. B. (1984): On two species of the genus *Catatropis* Odhner, 1905 (Digenea: Notocotylidae) from Asian hosts in India. *Indian J. Helminthology,* 35: 122 – 128

JOYEUX, CH. (1922): Recherches sur les notocotyles. *Bull. Soc. Path. Exot.*, 15: 331 – 343

KANEV I., VASILIEV I. (1986): Identification of *Catatropis verrucosa* (Frölich, 1789) (= pro parte to *Pseudocatatropis joyeuxi* gen. and sp. nov. comb). Proceedings of the 5th International Helminthological Symposium Organised by Helminthological Institute of the Czechoslovak Academy of Sciences in Kosice, 22 – 24. Oct. 1986, High Tatra: 5 – 6

KANEV, I., VASILIEV, I., DIMITROV, V., RADEV, V. (1994): Life-cycle, delimination and redescription of *Catatropis verrucosa* (Frölich, 1789) Odhner, 1905 (Trematoda: Notocotylidae). *Syst. Parasitol.*, 29: 133 – 148

LOOSS, A. 1893: Zur Frage nach der Natur des Körperparenchyma bei den Trematoden nebst Bemerkungen über einige andere zur Zeit noch offene Fragen. *Berichte über die Verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften zu Leipzig*, 45: 10 – 34

LOOSS, A. (1896): Recherches sur la faune parasitaire de l' Egypte. Premiere partie. *Extrait des Memoires de ' Institute Egyptien*, 3: 1 – 252

LOOSS, A. (1899): Weitere Beiträge zur Kenntnis der Trematodenfauna Aegyptens. Zugleich Versuch der natürlichen Gliederung des Genus Distomum Retzius. *Zool. Jahrb.,* 12: 521 – 784

LÜHE, M. 1909: Heft 17: Parasitische Plattwürmer. In: BAUER, A. (Ed.) Die Süsswasserfauna Deutschlands,. Verlag von Gustav Fischer, Jena, 217pp

MACKINNON, B. M. (1982a): The histology, ultrastructure, and histochemistry of the ventral surfaces of *Catatropis verrucosa* (Froelich, 1789) Odhner, 1905 and *Paramonostomum alveatum* (Mehlis in Creplin, 1846) Lühe, 1909 (Digenea: Notocotylidae). *Can. J. Zool.*, 60: 2434 – 2441

MACKINNON, B. M. (1982b): The structure and possible function of the ventral papillae of *Notocotylus triserialis* Diesing, 1839. *Parasitology*, 84: 313 – 332

ODENING, K. (1966): Physidae und Planorbidae als Wirte in den Lebenszyklen einheimischer Notocotylidae (Trematoda: Paramphistomida). *Z. Parasitenk.*, 27: 210 – 239

ODNER, T. (1905): Die Trematoden des arktischen Gebietes. Inaugural-Dissertation, Univers. Upsala, 83 pp

RHODE, K., LEE, F. O. (1967): Life cycle of *Catartropis indica* Srivastava, 1935 (Trematoda: Notocotylidae). *Z. Parasitenk.*, 29: 137 – 148

ROTSCHILD, M. (1938): Notes on the classification of the caercariae of the superfamily Notocotyloidea (Trematoda). With special reference to the excretory system. *Novit. Zool.,* 41: 75 – 83

ROTSCHILD, M. (1940): *Cercaria imbricata* Looss, 1896, nec 1893 - a note on nomenclature. *Novit. Zool*., 42: 215 – 216

SINGH K. S. (1956): *Catatropis rauschi* sp. nov. (Notocotylidae) from the pintail *Dafila acuta* from India. *J. Zool. Soc. India*, 8: 43 – 46

SKRJABIN, K. I. (1953): Trematodes of animals and man. Volume 8. Izd. Akad. Nauk SSSR, Moskva 618 pp (in Russian)

SZIDAT, U. (1935): Weitere Beiträge zur Kenntnis der Monostomidengattung *Notocotylus* Diesing. *Zbl. Bact. Abt. I Orig.*, 133: 265 – 270

ZEDER, J. G. H. (1800): Erster Nachtrag zur Naturgeschichte der Eingeweidewürmer, mit Zufässen und Anmerkungen herausgegeben. Leipzig, 320 pp

RECEIVED SEPTEMBER 7, 2011

ACCEPTED NOVEMBER 30, 2011