Ecologica Montenegrina
ISSN 2336-9744 (online) | ISSN 2337-0173 (print)

Ecologica Montenegrina 103: 80-87 (2026)
This journal is available online at: www.biotaxa.org/em
https://dx.doi.org/10.37828/em.2026.103.6

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https://www.zoobank.org/urn:lsid:zoobank.org:pub:3209B67F-7146-44A1-B9C1-A1C4ABF030A9

Mooreotorix Lukin, 1976, a valid monotypic genus of turtle-associated leech from East Asia (Hirudinida: Glossiphoniidae)

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Received 13 October 2026 | Accepted by *V. Pešić*: 9 November 2026 | Published online 13 November 2026.

Blanchard (1898) briefly described *Torix cotylifer* Blanchard, 1898, a new turtle-associated leech from Shanghai, China. Moore (1930) redescribed this species, presenting its anatomical and morphological features in detail. Lukin (1976) established a new monotypic genus, *Mooreotorix* Lukin, 1976, for this leech, and placed it within the subfamily Toricinae Lukin & Epstein, 1960. According to him, this subfamily included five additional genera, typically possessing (sub)biannulate mid-body somite conditions: *Torix* Blanchard, 1893; *Oligobdella* Moore, 1918; *Oligoclepsis* Oka, 1935; *Paratorix* Lukin & Epstein, 1960; and *Baicaloclepsis* Lukin & Epstein, 1959 (Lukin 1976). Sawyer (1986) revised this group and returned *Mooreotorix cotylifer* to the genus *Torix*, whereas the subfamily Toricinae was considered a synonym of the subfamily Glossiphoniinae. Modern DNA-based studies revealed that *Oligobdella* and *Oligoclepsis* are synonyms of the genera *Placobdella* Blanchard, 1893 and *Torix*, respectively, while *Paratorix* and *Baicaloclepsis* cluster within the *Glossiphonia* clade (Siddall et al. 2005; Bolbat et al. 2022; Bolotov et al. 2023; Kambayashi and Nakano 2023). However, the phylogenetic position of the *Mooreotorix* lineage remains unknown due to the lack of available DNA sequences (Kambayashi and Nakano 2023).

In this correspondence, we present the first DNA sequence data for the genus *Mooreotorix* and discuss its taxonomic status. Three ethanol-preserved specimens of *Torix cotylifer* (Figure 1A-E) were obtained from the collection of the Federal Scientific Center of the East Asia Terrestrial Biodiversity of

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the Far Eastern Branch of the Russian Academy of Sciences, Vladivostok, Russia (sample no. 9155, Bioresource Collection no. 2797657). Label data: "Russia: Primorsky Krai, shore of Malinovka River, 45°54'41.7"N, 133°51'27.3"E, from *Pelodiscus sinensis*, 19.05.2025, leg. Evgeny I. Barabanshchikov". The leeches were located dorsally on the turtle's neck and legs (Figure 1F), as well as ventrally at the base of the tail. The sample was transferred to the RMBH – Russian Museum of Biodiversity Hotspots, N. Laverov Federal Center for Integrated Arctic Research of the Ural Branch of the Russian Academy of Sciences, Arkhangelsk, Russia, and deposited under no. RMBH Hir_1290.

Morphological and anatomical methods, DNA sequencing protocols, and phylogenetic reconstruction approaches used in this research followed those described by Bolotov et al. (2019, 2022). Sequences of the mitochondrial *cytochrome c oxidase subunit I* (*COI*) and the nuclear *small subunit of 18S ribosomal RNA* (*18S rRNA*) gene fragments were generated from one specimen (GenBank acc. numbers QB217650 for *COI* and QB208090 for *18S rRNA*). These sequences were added to a large two-gene alignment of the order Hirudinida compiled by Bolotov et al. (2025).

Our phylogenetic analyses indicate that *Mooreotorix cotylifer* represents a divergent lineage, which clusters together with other vertebrate-associated leech genera such as *Hyperboreomyzon* Bolotov, Eliseeva, Klass & Kondakov, 2022; *Orientobdelloides* Bolotov, Eliseeva & Kondakov, 2022; *Batracobdella* Viguier, 1897; and *Theromyzon* Philippi, 1867, although with moderate support (Figure 2). It is not related to the *Torix* + *Hemiclepsis* clade. Therefore, *Mooreotorix* should be considered a valid monotypic genus within the subfamily Glossiphoniinae. Based on this evidence, we propose *Mooreotorix cotylifer* (Blanchard, 1898) **comb. res.**

Taxonomic account

Class Clitellata Michaelsen, 1919
Subclass Hirudinea Lamarck, 1818
Order Hirudinida Siddall, Apakupakul, Burreson, Coates, Erséus, Gelder, Källersjö & Trapido-Rosenthal, 2001
Suborder Glossiphoniiformes Tessler & de Carle, 2018
Family Glossiphoniidae Vaillant, 1890
Subfamily Glossiphoniinae Vaillant, 1890

Genus *Mooreotorix* Lukin, 1976

Type species: *Torix cotylifer* Blanchard, 1898 (by original designation).

Diagnosis: Medium-sized leeches (length up to 13.3 mm based on our sample and up to 25.5 mm according to Yang 1996); one pair of prominent eyespots on II; mid-body somites ranging from biannulate with a shallow a1/a2 furrow to triannulate; dorsum with numerous round shallow papillae (more prominent in starved specimens); terminal mouth pore (at the rim of the anterior sucker); a pair of compact, massive salivary glands; seven pairs of crop caeca, with the enlarged 1st pair extending antero-laterally; six pairs of testisacs; gonopores separated by two annuli: male gonopore on XI a3 / XII a1, female gonopore on XII a2 / a3; relatively large, circular, and ventrally directed posterior sucker (Figures 1A-E, 3A-B, 4). Phylogenetically, this taxon represents a separate, distant lineage (Figure 2).

Distribution: China: Inner Mongolia, Shaanxi, Shandong, Hebei, Beijing, Jiangsu, Zhejiang, Anhui, Jiangxi, Hubei, and Hunan (Yang 1996); and Russia: Primorsky Krai (Moore 1930; Lukin 1976).

List of species: Currently, this is a monotypic genus incorporating *Mooreotorix cotylifer* (Blanchard, 1898) **comb. res.**

Hosts: It appears to be a host specialist, feeding on the blood of the Chinese softshell turtle *Pelodiscus sinensis* (Wiegmann, 1835) (Moore 1930; Lukin 1976; Yang 1996) (Figure 1F). This leech serves as an

intermediate host and a vector of *Haemogregarina sinensis* Chai & Chen, 1990 (Apicomplexa: Haemogregarinidae), a specialized protozoan blood parasite of *Pelodiscus sinensis* (see Chai and Chen 1990a, 1990b, 1990c; Yang 1996).

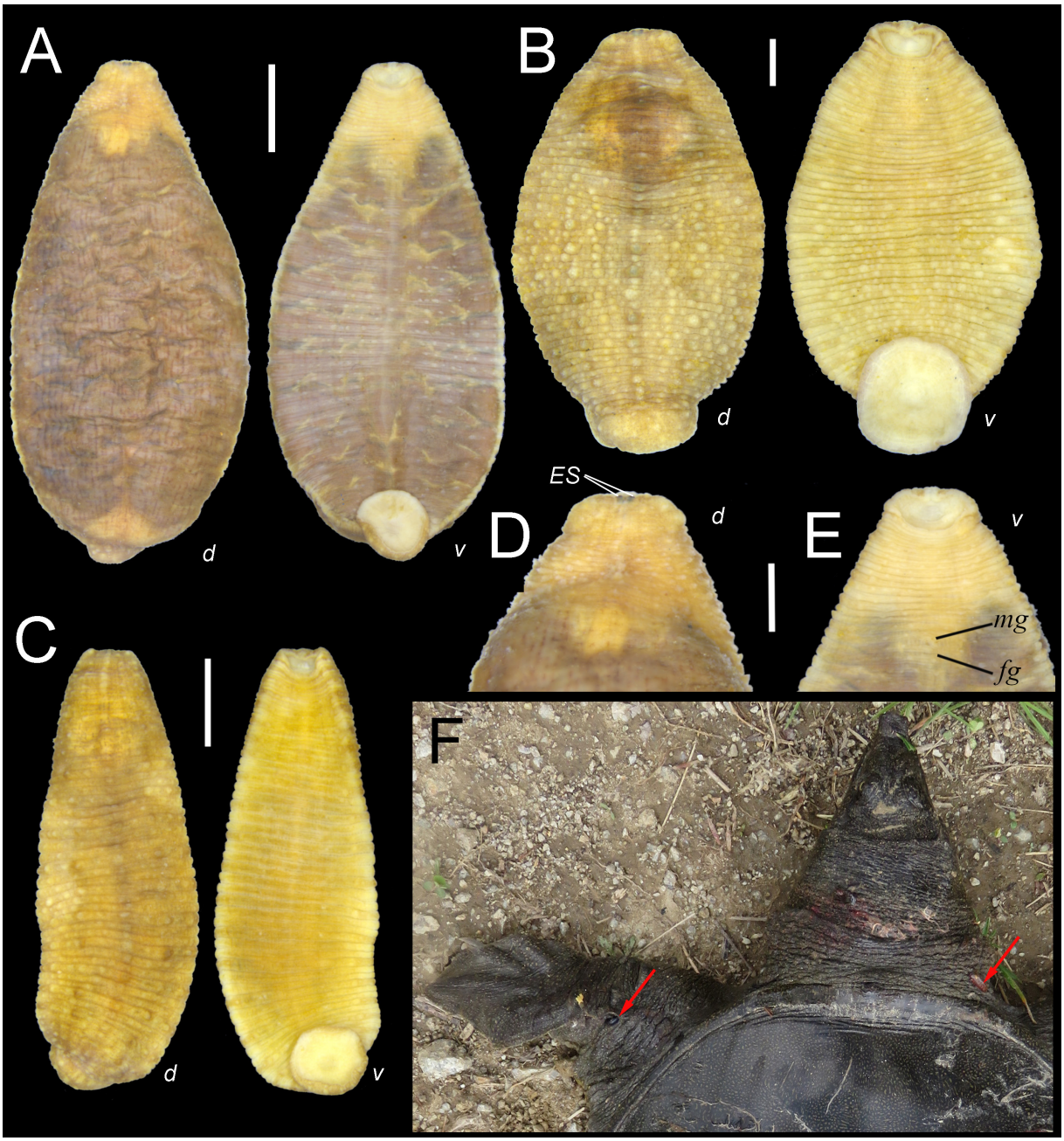


Figure 1. *Mooreotorix cotylifer* collected from the Chinese softshell turtle *Pelodiscus sinensis*, Primorsky Krai, Russia. (**A-C**) Dorsal (*d*) and ventral (*v*) views of specimens RMBH Hir_1290_1 (**A**), RMBH Hir_1290_2 (**B**), and RMBH Hir_1290_3 (**C**). (**D**) Anterior region of specimen RMBH Hir_1290_1 with eyespots (dorsal view). (**E**) Anterior region of specimen RMBH Hir_1290_1 with gonopores (ventral view). (**F**) Location of live leeches (indicated by the red arrows) on the host's neck and left foreleg. Abbreviations: *ES*, eyespots; *mg*, male gonopore; *fg*, female gonopore. Scale bars = 2.5 mm (A, C) and 1 mm (B, D). Photos: Tatyana A. Eliseeva (A-E) and Evgeny I. Barabanshchikov (F).

Comments: Our new data support the conclusion of Sawyer (1986) that the subfamily Toricinae represents a paraphyletic group (see Figure 2). Thus, biannulate mid-body somite condition is not a shared ancestral trait (synapomorphy) and may have arisen convergently in distant clades and lineages

of glossiphoniid leeches (Siddall et al. 2005; Oceguera-Figueroa 2012; Bolbat et al. 2022; Bolotov et al. 2023).

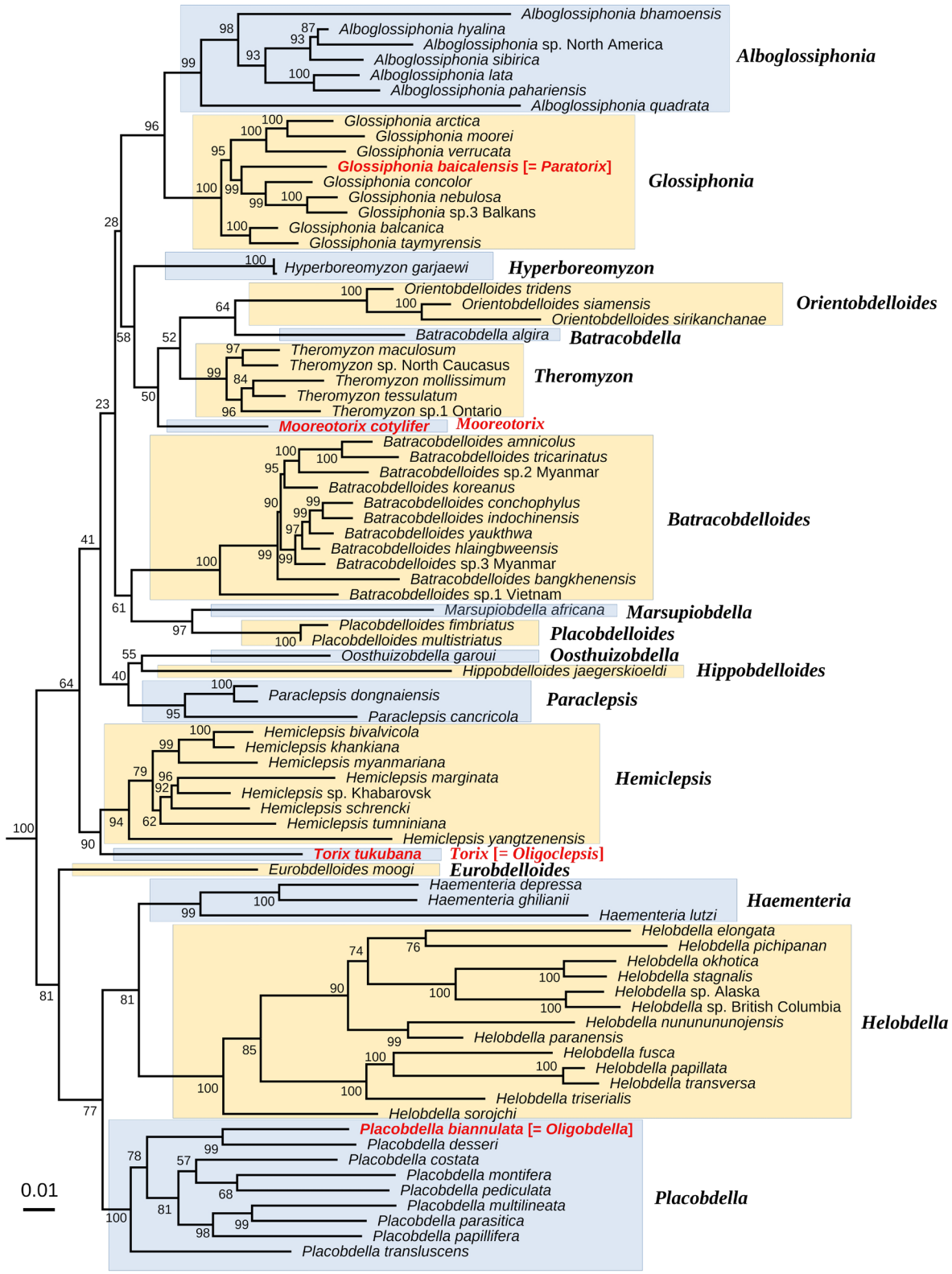


Figure 2. Maximum likelihood phylogeny of the Glossiphoniidae based on the combined *COI* and 18S rRNA gene fragments (see Bolotov et al. 2025 for the complete list of DNA sequences). The black numbers near nodes are bootstrap support values from IQ-TREE v. 3.1.2. The scale bar indicates the branch lengths (substitutions per site). Names of taxa that were formerly placed within the subfamily Toricinae are red. Outgroup taxa are omitted.

In his redescription of *M. cotylifer*, Moore (1930: 172) noted that "*The ovisacs in the one specimen in which they were evident are small ovoidal bodies lying in the ventral sinus on each side of the oesophagus in XII a3 and XIII a1 with short oviducts that pass transversely mediad to unite beneath the nerve cord in a very short common vagina opening by the female gonopore at XII a2 / a3. This form of ovisac is rather unusual in the Glossiphonidae*". Conversely, we observed tubular ovisacs in our dissected specimen (Figures 3A-B, 4). Yang (1996) also described and illustrated ovisacs of *M. cotylifer* as coiled tubular structures. We assume that unusual globular ovisacs in Moore's (1930) specimens may reflect their sub-adult or immature condition, because these leeches were small-sized. Therefore, this trait cannot be used as a diagnostic taxonomic character of *M. cotylifer* (see Kambayashi et al. 2020: 68, tab. 3; Kambayashi and Nakano 2023: 830, tab. 3).

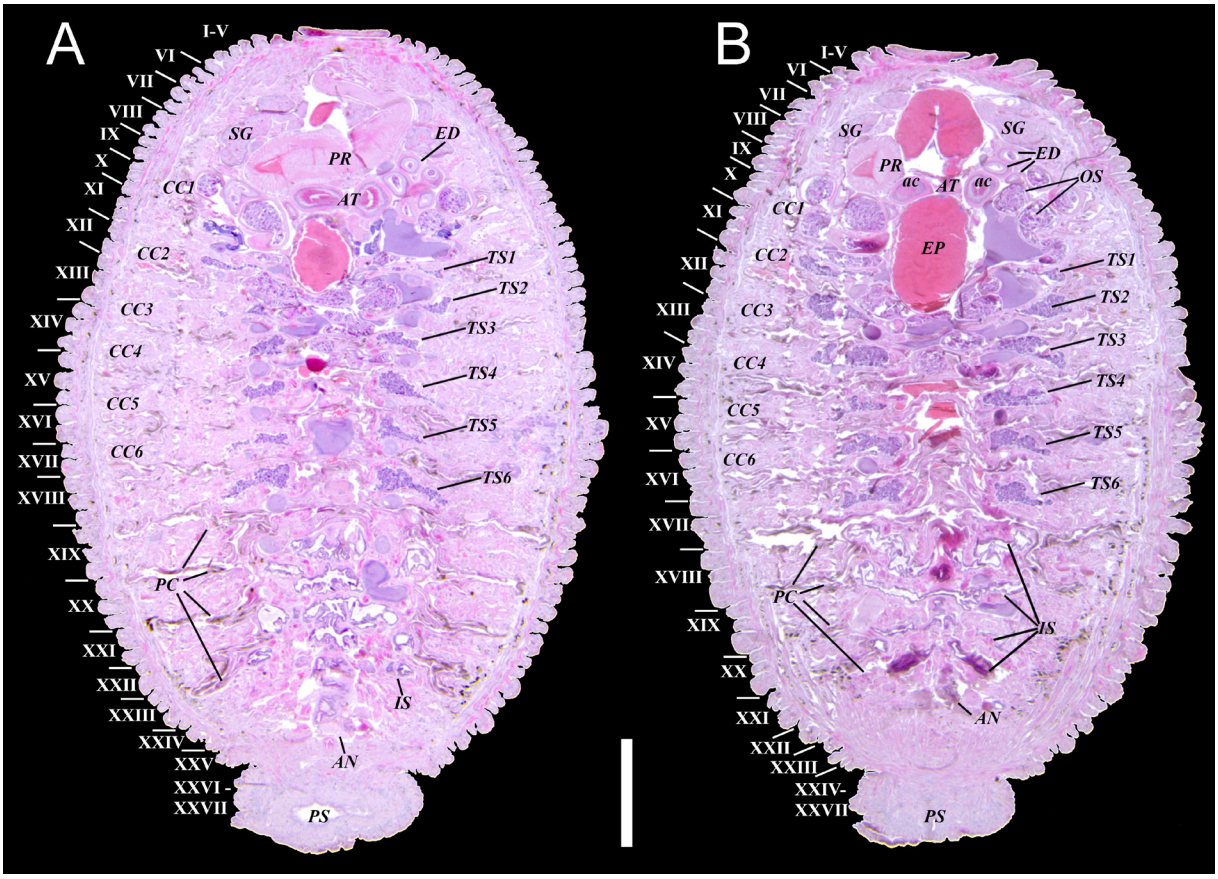


Figure 3. H&E-stained longitudinal sections showing the digestive and generative systems of *Mooreotorix cotylifer* from the Chinese softshell turtle *Pelodiscus sinensis*, Primorsky Krai, Russia (specimen RMBH Hir_1290_2): (**A**) closer to the ventral side (slide no. 1); and (**B**) closer to the dorsal side (slide no. 5). Abbreviations: *PR*, proboscis sheath; *EP*, esophagus; *SG*, salivary glands; *CC*, pairs of crop caeca with their numbers; *PC*, the last pair of crop caeca (posterior caeca); *TS*, testisacs with their numbers; *OS*, ovisacs; *PS*, posterior sucker; *IS*, intestine; *AT*, atrium; *ac*, atrial cornua; *ED*, ejaculatory ducts; *AN*, anus. Body somites are indicated by Roman numerals. Scale bar = 1 mm. Photos: Alexander V. Kropotin; graphics: Tatyana A. Eliseeva.

Furthermore, Moore (1930: 172) stated that "*The caeca of the first pair are more remarkable. They are very long, slender, tapering tubes, which arise from each side of the extreme anterior end of the stomach in XIII and extend obliquely cephalad and laterad and slightly ventrad to open to the exterior by the pores already referred to in the furrow XI / XII at the extreme lateral margins of the body. All of the five specimens, three from Dr. Gee's collection and Blanchard's two cotypes present exactly the same condition*". However, neither Yang's (1996) study nor our examination (Figures 3A-B, 4) could confirm these observations on the lateral openings of the first crop caeca. Yang (1996: 78) wrote that "*The first pair of lateral diverticula is thick and extends in an arc toward the anterior-lateral sides, reaching the lateral margin of the 29th annulus. However, it does not penetrate the body wall on*

both sides of the 25th annulus; Moore's (1930) observation on this point was incorrect" [translated from Chinese].

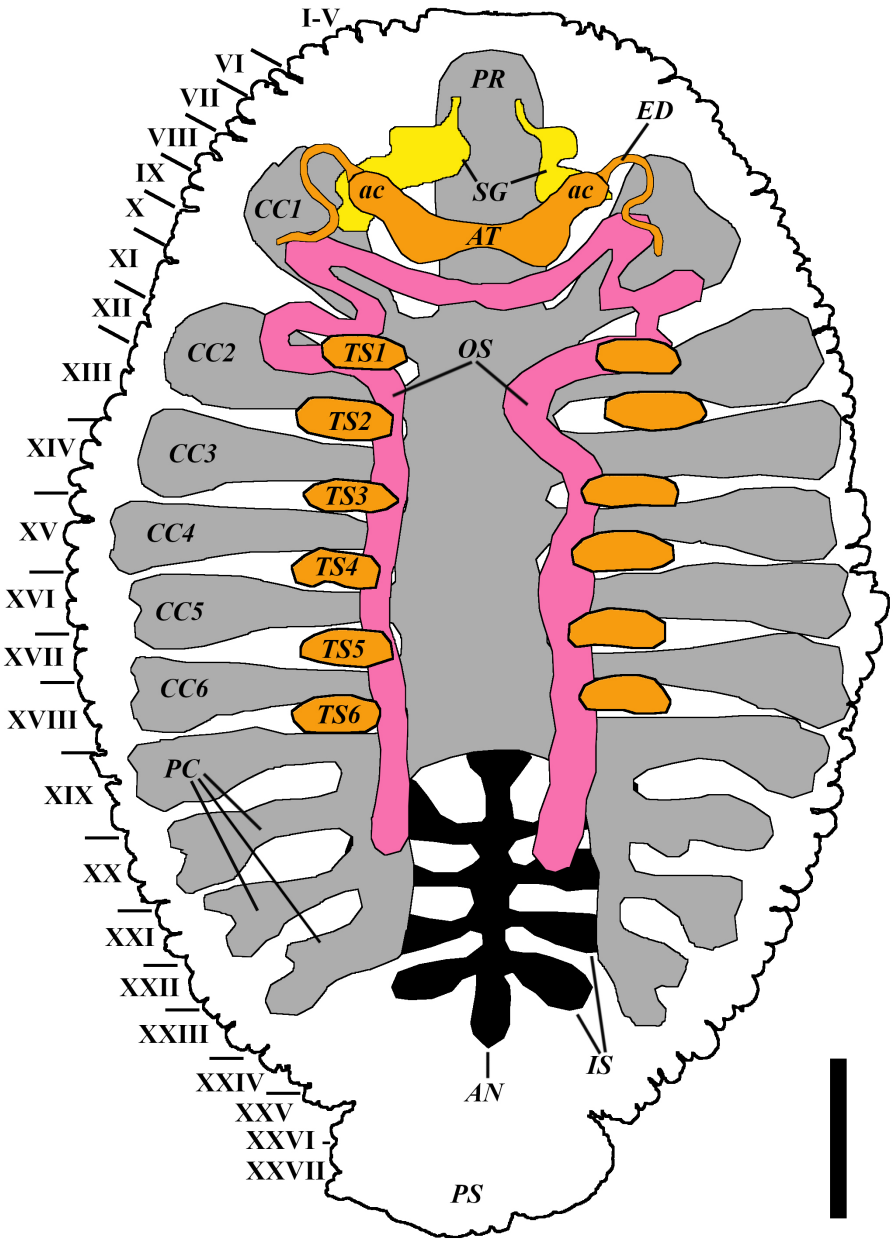


Figure 4. General scheme showing the digestive and generative systems of *Mooreotorix cotylifer*. Abbreviations: *PR*, proboscis sheath; *SG*, salivary glands; *CC*, pairs of crop caeca with their numbers; *PC*, the last pair of crop caeca (posterior caeca); *IS*, intestine; *AN*, anus; *AT*, atrium; *ac*, atrial cornua; *ED*, ejaculatory ducts; *TS*, testisacs with their numbers; *OS*, ovisacs; *PS*, posterior sucker. Body somites are indicated by Roman numerals. Scale bar = 1.0 mm. Graphics: Tatyana A. Eliseeva.

Acknowledgements

We are grateful to Clemens Grosser and an anonymous reviewer for valuable comments on earlier versions of the paper. The Russian Science Foundation (project no. 26-14-00267) supported the molecular-genetic and morphological analyses of specimens, as well as manuscript writing contributions of I.N.B., T.A.E., A.V.K., A.V. Kr., M.Y.G., and Y.V.B. Field sampling of leeches by L.A.P. and V.V.B. was funded by the Ministry of Science and Higher Education of Russia (state assignment theme no. 124012400285-7).

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