



<http://dx.doi.org/10.11646/zootaxa.3895.2.3>

<http://zoobank.org/urn:lsid:zoobank.org:pub:2D6F1359-28CF-4F84-AC23-61BEB1E1D912>

A comparative morphological analyses of four species of *Camptocercus* Baird, 1843 (Cladocera: Anomopoda: Chydoridae)

ARTEM Y. SINEV^{1,2}

¹Department of Invertebrate Zoology, Biological Faculty, Lomonosov Moscow State University, Leninskie Gory, Moscow 119991, Russia

²A. N. Severtsov Institute of Ecology and Evolution, Leninsky Prospect 33, Moscow 119071, Russia. E-mail: artemsinev@yandex.ru

Abstract

Study of four poorly known cladocera species of the genus *Camptocercus* Baird, 1843 (Anomopoda: Chydoridae): North American *C. oklahomensis* Mackin, 1930, and three Palearctic species, *C. uncinatus* Smirnov, 1971, *C. fennicus* Stenroos, 1898, and *C. lilljeborgi* Schoedler, 1862, revealed strong differences between them in both outer morphology and morphology of appendages. *C. oklahomensis* lacks a head keel, typical for the most species of the genus, and has numerous characters confirming its basal position within the genus, namely less elongated postabdomen with groups of elementary marginal denticles and less specialized morphology of the thoracic limbs. *C. uncinatus* and *C. fennicus* have similar limb morphology, these species form a monophyletic clade with South-East Asian species *C. vietnamensis* Thanh, 1980. *C. lilljeborgi* have a straight ventral margin of valves with specially dense setation, similar to the species of the genus *Graptoleberis* Sars, 1862. *C. lilljeborgi* also has most derived appendages, i.e. exopodites of limbs III–V have seta 4 reduced to a state of a small stub, and seta 3 with extremely wide basal portion. The level of differences in thoracic limb morphology in *Camptocercus* is unusual for the subfamily Aloninae, where in most genera limb morphology is relatively uniform. Morphology and phylogenetic relationships of the studied species are discussed.

Key words: Cladocera, Chydoridae, *Camptocercus*, taxonomy, morphology, thoracic limbs

Introduction

The genus *Camptocercus* Baird, 1843 (Cladocera: Anomopoda: Chydoridae) is among unusual and well-diagnosed genera of the subfamily Aloninae Dybowski & Grochowski. The main features of the genus are: a low, elongated body, extremely elongated postabdomen, and abdomen with an abdominal joint and a saddle-shaped middle segment. Most species of the genus also have a well-developed dorsal keel on both head and valves, but it is absent in two American species: *C. oklahomensis* Mackin, 1930 and *C. aloniceps* Ekman, 1901. Generic status and composition of *Camptocercus* was never questioned. The genus was revised by Smirnov (1998), who listed nine species within the genus. One more species, *C. vietnamensis* Thanh, 1980, was recently redescribed by Sinev (2011), although it was presumed as synonym by Smirnov (1998). According to Sinev & Atroshenko (2011), *Camptocercus* is a most specialized genus within the Arthrocauda-clade of the subfamily, closely related to *Kozhowia* Vasiljeva & Smirnov, 1969 and *Parakozhowia* Kotov, 2000, two endemic genera of Baikal Lake.

Main trend of modern Aloninae systematic is a broad use of limbs morphology for genera and species diagnosis and for the phylogenetic reconstructions (Kotov 2009; Sinev & Atroshenko, 2011; Van Damme *et al.* 2011). But the morphology of appendages were adequately studied only for two species of the genus, *Camptocercus rectirostris* (see Alonso 1996; Hudec 2010) and *C. vietnamensis* (see Sinev 2011). Less detailed description of limbs were available for three more species, *C. uncinatus* Smirnov, 1971, *C. lilljeborgi* Schoedler, 1862 (Smirnov 1971) and *C. streletskae* Smirnov, 1998 (Smirnov 1998). The only feature of limb morphology which was in used in the systematics of the genus is the morphology of setae on inner distal lobe of limb I, which varies greatly among species (see Smirnov 1998). The aim of present study is an investigation of morphology of four species of *Camptocercus*—*C. uncinatus*, *C. oklahomensis*, *C. fennicus* Stenroos, 1898, and *C. lilljeborgi*.

al., 2011; Sinev, 2013). The sole exception is the genus *Leydigia* (see Kotov, 2009), where the diversity of limb morphology reaches same level as in *Camptocercus*.

Leydigia is similar to *Camptocercus*, also being one of the most morphologically divergent genera of Aloninae, and having numerous advanced features in outer morphology namely characteristic body shape, dense seta on the valve ventral margin, broad postabdomen with extremely strong lateral groups of setules, basal claw of postabdomen with reduced or absent basal spine, antenna with clusters of long thick setules, and male postabdomen with a penis-like process. Unlike *Camptocercus*, which is encountered in a variety of environments, *Leydigia* is specially adapted to benthic life at muddy bottom (Kotov 2006). In my opinion, uniform thoracic limb morphology within the most Aloninae genera can be attributed to a high level of competition between genera, where most “optimal” combinations are already attained. *Camptocercus* and *Leydigia* are both extremely specialized and free from competition from other genera, so diversification of thoracic limbs morphology between species became possible.

Acknowledgments

I'm very grateful to Prof. N.N. Smirnov and Dr. A.A. Kotov for the critique and valuable comments. This work is supported by the Russian Science Foundation grant 14-14-00778. The SEM work has been performed at User Facilities Center of M.V. Lomonosov Moscow State University under the financial support of Ministry of Education and Science of Russian Federation.

References

- Alonso, M. (1996) *Fauna Iberica. Crustacea Branchiopoda*. Consejo Superior de Investigaciones Científicas, Madrid, 486 pp.
- Benzie, J.A.H. (2005) *The genus Daphnia (including Daphniopsis) (Anomopoda: Daphniidae). Guides to the identification of the microinvertebrates of the continental waters of the world. Vol. 21*. Kenobi Productions, Ghent & Backhuys Publishers, Leiden, 376 pp.
- Dumont, H.J. & Van De Velde, I. (1977) Report on a collection of Cladocera and Copepoda from Nepal. *Hydrobiologia*, 53, 55–65.
<http://dx.doi.org/10.1007/bf00021232>
- Flössner, D. (1972) *Krebstiere, Crustacea (Kiemen- und Blattfüsser: Branchiopoda, Fischlausse, Branchiura)*. Die Tierwelt Deutschlands. Gustav Fischer Verlag, Jena, 499 pp.
- Flössner, D. (2000) Die Haplopoda und Cladocera (ohne Bosminidae) Mitteleuropas. Backhuys, Leiden, 428 pp.
- Frey, D.G. (1982) Questions concerning cosmopolitanism in Cladocera. *Archiv für Hydrobiologie*, 93, 484–502.
- Fryer, G. (1968) Evolution and adaptive radiation in the Chydoridae (Crustacea: Cladocera): a study of comparative functional morphology and ecology. *Philosophical Transactions of the Royal Society of London, Series B*, 254, 221–385.
<http://dx.doi.org/10.1098/rstb.1968.0017>
- Hudec, I. (2000) Subgeneric differentiation within *Kurzia* (Crustacea: Anomopoda: Chydoridae) and a new species from Central America. *Hydrobiologia*, 421, 165–178.
- Hudec, I. (2010) *Anomopoda, Ctenopoda, Haplopoda, Onychopoda (Crustacea: Branchiopoda)*. *Fauna Slovenska III*. VEDA, Bratislava, 496 pp.
- Kim, I.H. (1988) Key to the Korean freshwater Cladocera. *The Korean Journal of Systematic Zoology*, 2 (Special Issue), 43–65. [in Korean]
- Korovchinsky, N.M. (2013) Cladocera (Crustacea: Branchiopoda) of South East Asia: history of explorations, taxon richness and notes on zoogeography. *Journal of Limnology*, 72 (2), 109–124.
<http://dx.doi.org/10.4081/jlimnol.2013.s2.e7>
- Kotov, A.A. (2000) Analysis of *Kozhowia* Vasiljeva & Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda), with a description of *Parakozhowia* n. gen. *Hydrobiologia*, 437, 17–56.
- Kotov, A.A. (2006) Adaptations of the Anomopoda (Cladocera) for benthic mode of life. *Zoologichesky Zhurnal*, 85, 1043–1059.
- Kotov, A.A. (2009) A revision of *Leydigia* Kurz, 1875 (Anomopoda, Cladocera, Branchiopoda), and subgeneric differentiation within the genus. *Zootaxa*, 2082, 1–68.
- Kotov, A.A. (2013) *Morphology and phylogeny of Anomopoda (Crustacea: Cladocera)*. KMK Scientific Press, Moscow, 638 pp.
- Kotov, A.A., Jeong, H.G. & Lee, W. (2012) Cladocera (Crustacea: Branchiopoda) of the south-east of the Korean Peninsula, with twenty new records for Korea. *Zootaxa*, 3368, 1–304.

- Kotov, A.A., Korovchinsky, N.M, Sinev, A.Y. & Smirnov, N.N. (2011) Cladocera (Crustacea, Branchiopoda) of the Zeya basin (Amurskaya Area, Russian Federation). 3. Systematicfaunistic and zoogeographic analysis. *Zoologicheskyy Zhurnal*, 90, 402–411.
- Kotov, A.A., Van Damme, K., Bekker, E.I., Siboualipha, S., Silva-Briano, M., Ortiz, A.A., de la Rosa, R.G. & Sanoamuang, L. (2013) Cladocera (Crustacea: Branchiopoda) of Vientiane province and municipality, Laos. *Journal of Limnology*, 72 (2), 81–180.
<http://dx.doi.org/10.4081/jlimnol.2013.s2.e6>
- Krasnodebski, F. (1937) *Camptocercus fennicus* Stenroos, eine für Polen neue Cladoceren-Art. *Arhivum Hydrobiologii I Rubatstwa*, X, 4, 426–430.
- Kurz, W. (1875) Dodekas neuer Cladoceren mebst einer kurzen Übersicht der Cladocerenfauna Bohmens. *Sitzungsberichte der Akademie der Wissenschaften in Wien, Abt. I. Mineralogie, Biologie, Erdkunde und verwandte Wissenschaft*, 70, 7–88.
- Lilljeborg, W. (1900) Cladocera Sueciae. *Nova acta regiae societatis scientatis scientiarum upsaleinsis, Seriei Tertiae*, 19, 1–701.
- Mackin, J.G. (1930) Studies on the Crustacea of Oklahoma, I. *Camptocercus oklahomensis* n. sp. *Transactions of American Microscopic Society*, 49, 46–53.
<http://dx.doi.org/10.2307/3222295>
- Margaritora, F.G. (1985) *Cladocera. Fauna d'Italia*. Calderini, Bologna, 339 pp.
- Margaritora, F.G. & Vagaggini, D. (2002) Two Chydoridae species (Crustacea, Cladocera) new to Italy: *Alona rustica* and *Camptocercus uncinatus*. *Italian Journal of Zoology*, 69, 59–63.
<http://dx.doi.org/10.1080/11250000209356439>
- Müller, O.F. (1785) *Entomotraca seu Insecta Testacea, quae in aquis Daniae et Norvegiae reperit, descripsit et iconibus illustravit*. Sumtibus J.G. Mulleriani, Lipsiae et Havniae, 135 pp.
<http://dx.doi.org/10.5962/bhl.title.14414>
- Negrea, S. (1983) *Cladocera*. Fauna Republicii Socialiste Romania, Bucureşti. *Crustacea*, 4, 1–399.
- Rane, P.D. (1985) A new species of the genus *Camptocercus* Baird, 1843 (Cladocera) from Madhya Pradesh, Central India. *Crustaceana*, 48, 113–116.
<http://dx.doi.org/10.1163/156854085x00800>
- Schoedler, J.E. (1862) *Über die Lynceiden und Polyphemiden der Umgebung Berlins*. Jahresbericht über die Dorotheenstaedtische Realschule, Berlin, 1862, 1–26.
- Sinev A.Y. (2009) Discrimination between two sibling species of *Acroperus* (Baird, 1843) from the Palearctic (Cladocera: Anomopoda: Chydoridae). *Zootaxa*, 2176, 1–21.
- Sinev, A.Y. (2011) Redescription of the rheophilous cladocera *Camptocercus vietnamensis* Than, 1980 (Cladocera: Anomopoda: Chydoridae). *Zootaxa*, 2934, 53–60.
- Sinev, A.Y. (2013) Cladocerans of *Alona affinis* group (Cladocera: Anomopoda: Chydoridae) from North America. *Zootaxa*, 3693 (3), 329–343.
<http://dx.doi.org/10.11646/zootaxa.3693.3.3>
- Sinev, A.Y. & Atroschenko, M.M. (2011) Revision of the genus *Alonopsis* Sars, 1862 and its position within Aloninae (Cladocera: Anomopoda: Chydoridae). *Zootaxa*, 2800, 1–17.
- Smirnov, N.N. (1971) *Chydoridae fauny mira*. Fauna USSR. Rakoobraznie, 1. Leningrad, 531 pp. [English translation: Chydoridae of the world. Israel Program for Scientific Translations, Jerusalem, 1974]
- Smirnov, N.N. (1998) A revision of the genus *Camptocercus* (Anomopoda, Chydoridae, Aloninae). *Hydrobiologia*, 386, 63–83.
- Stenroos, K.E. (1898) Das Tierleben in Nurmijaervi-See. *Acta Societatis pro Fauna et Flora Fennica*, 171, 198–202.
- Streletskaia E.A. (2010) Review of the fauna of Rotatoria, Cladocera, and Copepoda of the basin of the Anadyr'River. *Contemporary Problems of Ecology*, 3 (4), 469–480.
<http://dx.doi.org/10.1134/s1995425510040119>
- Van Damme, K. & Dumont H.J. (2008) Further division of *Alona* Baird, 1843: separation and position of *Coronatella* Dybowski & Grochowski and *Ovalona* gen.n. (Crustacea: Cladocera). *Zootaxa*, 1960, 1–44.
- Van Damme, K. & Sinev, A.Y. (2011) A new genus of cave-dwelling microcrustaceans from the Dinaric Region (south-east Europe): adaptations of true stygobitic Cladocera (Crustacea: Branchiopoda). *Zoological Journal of the Linnean Society*, 161, 31–52.
<http://dx.doi.org/10.1111/j.1096-3642.2010.00639.x>
- Van Damme, K., Sinev, A.Y. & Dumont, H.G. (2011) Separation of *Anthalona* gen.n. from *Alona* Baird, 1843 (Branchiopoda: Cladocera: Anomopoda): morphology and evolution of scraping stenothermic alonines. *Zootaxa*, 2875, 1–64.
- Yalim, B. (2001) A new record for the Turkish cladoceran fauna: *Camptocercus uncinatus* Smirnov, 1971. *Turkish Journal of Zoology*, 25, 63–65.