

Zootaxa 2017 vol.4341 N4, pages 451-474

A new blind groundwater-dwelling genus of the Cladocera (Crustacea: Branchiopoda) from the Korean Peninsula

Jeong H., Sinev A., Brancelj A., Chang K., Kotov A.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2017 Magnolia Press. Groundwater-dwelling Cladocera are to date known only from the caves and hyporheic zones of the rivers in Europe (Belgium, England, France, Bosnia and Herzegovina, Macedonia, Slovenia, Spain), Turkey (European part) and Arabian Peninsula (Yemen). All these animals belong to the subfamily Aloninae Dybowski & Grochowski of the family Chydoridae Dybowski & Grochowski (Cladocera: Anomopoda). Examination of some samples collected by our colleagues-experts in Copepoda, Bathynellidae and Amphipoda-in South Korea led us to discovery of a new stygobiotic alonine genus, which is also the first record of a groundwater-dwelling cladoceran in Asia. Aims of this paper are: (1) to describe *Korealona* gen. nov., represented by two species, *Korealona karanovici* gen. nov., sp. nov. found in three different localities, and *K. choi* sp. nov., also found in three different localities; and (2) to discuss its differences from other genera of this subfamily and possible phylogenetic position of this genus among the aloninse. Distribution ranges of two species of *Korealona* gen. nov. are not unequivocally associated with present-day main river basins in Korea, but more sampling efforts are needed for final conclusions on their distribution ranges in Korea and closest countries and understanding of the genus evolutionary history.

<http://dx.doi.org/10.11646/zootaxa.4341.4.1>

Keywords

Asia, Cladocera, Groundwater, New genus, Taxonomy

References

- [1] Boonyanusith, C., Brancelj, A. & Sanoamuang, L. (2013) New representatives of the genus *Fierscyclops* Karanovic, 2004 (Copepoda, Cyclopidae) from South East Asia. *Journal of Limnology*, 72 (Supplement 2), 275-289. <https://doi.org/10.4081/jlimnol.2013.s2.e13>
- [2] Brancelj, A. (1990) *Alona hercegovinae* n.sp. (Cladocera, Chydoridae), a blind cave-inhabiting cladoceran from Hercegovina (Yugoslavia). *Hydrobiologia*, 199, 7-16. <https://doi.org/10.1007/BF00007828>
- [3] Brancelj, A. (1992) *Alona sketi* sp.n. (Cladocera: Chydoridae), the second cave-inhabiting Cladoceran from former Yugoslavia. *Hydrobiologia*, 248, 105-114. <https://doi.org/10.1007/BF00006078>
- [4] Brancelj, A. (1997) *Alona stochi* n.sp.-the third cave-dwelling cladoceran (Crustacea: Cladocera) from the Dinaric region. *Hydrobiologia*, 360, 47-54. <https://doi.org/10.1023/A:1003159508735>
- [5] Brancelj, A. (2004) Biological sampling methods for epikarst water. In: Jones, W.K., Culver, D. C. & Hernan J.S. (eds.), *Epikarst: proceedings of the symposium held October 1 through 4, 2003, Shepherdstown, West Virginia, USA*, (Special Publication, 9). Charles Town (West Virginia). Karst Waters Institute, Charles Town, pp. 99-103.

- [6] Brancelj, A. & Dumont, H.J. (2007) A review of the diversity, adaptations and groundwater colonization pathways in Cladocera and Calanoida (Crustacea), two rare and contrasting groups of stygobionts. *Fundamental and Applied Limnology*, 168, 3-17. <https://doi.org/10.1127/1863-9135/2007/0168-0003>
- [7] Brancelj, A., Boonyanusith, C., Watiroyam, S. & Sanoamuang, L. (2013) The groundwater-dwelling fauna of South East Asia. *Journal of Limnology*, 72 (Supplement 2), 327-344. <https://doi.org/10.4081/jlimnol.2013.s2.e16>
- [8] Bronstein, Z.S. (1947) Ostracoda of fresh waters. *Fauna SSSR. Rakoobraznye*, 2 (1), 1-371. [in Russian]
- [9] Boxshall, G.A. & Halsey, S.H. (2004) *An Introduction to Copepod Diversity*. The Ray Society, London, 966 pp.
- [10] Boxshall, G.A. & Jaume, D. (2000) Making waves: the repeated colonization of freshwater by copepod crustaceans. *Advances in Ecological Research*, 31, 61-79. <https://doi.org/10.4081/jlimnol.2013.s2.e16>
- [11] Camacho, A. I. (2004) An overview of Hexabathynella (Crustacea, Syncarida, Parabathynellidae) with the description of a new species. *Journal of Natural History*, 38, 1249-1261. [https://doi.org/10.1016/S0065-2504\(00\)31007-8](https://doi.org/10.1016/S0065-2504(00)31007-8)
- [12] Camacho, A.I. (2006) An annotated checklist of the Syncarida (Crustacea, Malacostraca) of the world. *Zootaxa*, 1374, 1-54.
- [13] Camacho, A.I., Trontelj, P. & Zagmajster, M. (2006) First record of Bathynellacea (Crustacea, Syncarida, Parabathynellidae) in China: a new genus. *Journal of Natural History*, 40, 1747-1760. <https://doi.org/10.1080/00222930600969356>
- [14] Camacho, A.I., Watiroyam, S. & Brancelj, A. (2011) The first record of Bathynellacea from Thailand: a new genus and species of Parabathynellidae (Crustacea: Syncarida). *Journal of Natural History*, 45, 45-56. <https://doi.org/10.1080/00222933.2011.620715>
- [15] Chappuis, P.A. (1955) *Harpacticoides troglobies du Japon*. *Notes Biospéologiques*, 10, 183-190.
- [16] Cho, J.L., Hwang, I.S. & Nam, E.J. (2008) *Nipponbathynella* also in South-Korea (Bathynellacea: Syncarida). *Journal of Crustacean Biology*, 28, 721-726. <https://doi.org/10.1651/08-2979.1>
- [17] Ciroso-Pérez, J. & Elías-Gutiérrez, M. (1997) *Spinalona anophtalma*, n. gen. n. sp. (Anomopoda, Chydoridae) a blind epigeal cladoceran from the Neovolcanic Province of Mexico. *Hydrobiologia*, 353, 19-28. <https://doi.org/10.1023/A:1003053332275>
- [18] Dumont, H.J. (1983) Discovery of groundwater-inhabiting Chydoridae (Crustacea: Cladocera), with the description of two new species. *Hydrobiologia*, 106, 97-106. <https://doi.org/10.1007/BF00006741>
- [19] Dumont, H.J. & Brancelj, A. (1994) *Alona alsafadaii* n.sp. from Yemen, a primitive, groundwater-dwelling member of the *A. karua*-group. *Hydrobiologia*, 281, 57-64. <https://doi.org/10.1007/BF00006556>
- [20] Dumont, H.J. & Silva-Briano, M. (2000) *Karualona* n.gen. (Anomopoda: Chydoridae), with a description of two new species, and a key to all known species. *Hydrobiologia*, 435, 61-82. <https://doi.org/10.1023/A:1004006521874>
- [21] Gibert, J. & Culver, D.C. (2009) Assessing and conserving groundwater biodiversity: an introduction. *Freshwater Biology*, 54, 639-648. <https://doi.org/10.1111/j.1365-2427.2009.02202.x>
- [22] Griebler, C., Stein, H., Kellermann, C., Berkhoff, S., Briemann, H., Schmidt, S., Selesi D., Steube, C., Fuchs A. & Hahn, H.J. (2010) Ecological assessment of groundwater ecosystems-vision or illusion? *Ecological Engineering*, 36, 1174-1190. <https://doi.org/10.1016/j.ecoleng.2010.01.010>
- [23] Frey, D.G. (1967) Phylogenetic relationships in the family Chydoridae (Cladocera). *Proceedings of the Symposium on Crustacea*. Marine Biology Association of India, 12-15, January, 1965, Ernakulam, Part 1, 29-37.
- [24] International Commission on Zoological Nomenclature (ICZN). (2000) *International code of zoological nomenclature*. 4 Edition. The Natural History Museum, London, 306 pp.
- [25] Ito, T. (1957) Groundwater copepods from south-western Japan. *Hydrobiologia*, 11, 1-11. <https://doi.org/10.1007/BF00021005>
- [26] Jeong, H.G., Kotov, A.A., Lee, W., Jeong, R. & Cheon, S. (2015) Diversity of freshwater Cladoceran species (Crustacea: Branchiopoda) in South Korea. *Journal of Ecology and Environment*, 38, 361-366. <https://doi.org/10.5141/ecoenv.2015.037>
- [27] Karanovic, T. (2006) Subterranean copepods (Crustacea, Copepoda) from the Pilbara region in Western Australia. *Records of the Western Australian Museum*, 70 (Supplement), 1-239. <https://doi.org/10.18195/issn.0313-122x.70.2006.001-239>
- [28] Karanovic, T. & Cho, J.L. (2012) Three new ameirid harpacticoids from Korea and first record of *Proameira simplex* (Crustacea: Copepoda: Ameiridae). *Zootaxa*, 3368, 91-127.
- [29] Karanovic, T., Cho, J.L. & Lee, W. (2012) Redefinition of the parastenocaridid genus *Proserpinicaris* (Copepoda: Harpacticoida), with description of three new species from Korea. *Journal of Natural History*, 46, 1573-1613. <https://doi.org/10.1080/00222933.2012.681316>
- [30] Karanovic, T., Grygier, M.J. & Lee, W. (2013) Endemism of subterranean *Diacyclops* in Korea and Japan, with descriptions of seven new species of the languidoides-group and redescriptions of *D. brevifurcus* Ishida, 2006 and *D. suoensis* Ito, 1954 (Crustacea, Copepoda, Cyclopoida). *Zookeys*, 267, 1-76. <https://doi.org/10.3897/zookeys.267.3935>

- [31] Karanovic, T., Kim, K. & Grygier, M.J. (2015) A new species of Schizopera (Copepoda: Harpacticoida) from Japan, its phylogeny based on the mtCOI gene and comments on the genus Schizoperopsis. *Journal of Natural History*, 49, 2493-2526. <https://doi.org/10.1080/00222933.2015.1028112>
- [32] Karanovic, T. & Lee, W. (2012a) A new species of Parastenocaris from Korea, with a redescription of the closely related *P. biwae* from Japan (Copepoda: Harpacticoida: Parastenocarididae). *Journal of Species Discovery*, 1, 4-34. <https://doi.org/10.12651/JSR.2012.1.1.004>
- [33] Karanovic, T. & Lee, W. (2012b) Parastenocaridid Copepods. *Flora and Fauna of Korea, invertebrate Fauna of the World*, 21 (2), 1-232.
- [34] Karanovic, T. & Lee, W. (2012c) Two new candonid species from South Korea (Ostracoda, Podocopida). *Crustaceana*, 85, 1633-1656. <https://doi.org/10.1163/15685403-00003135>
- [35] Kotov, A.A. (2000a) Analysis of *Kozhowia* Vasiljeva & Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda), with a description of *Parakozhowia* n.gen. *Hydrobiologia*, 437, 17-56. <https://doi.org/10.1023/A:1026507529975>
- [36] Kotov, A.A. (2000b) Redescription and assignment of the chydorid *Indialona ganapati* Petkovski, 1966 (Branchiopoda: Anomopoda: Aloninae) to *Indialonini*, new tribus. *Hydrobiologia*, 439, 161-178. <https://doi.org/10.1023/A:1004187007890>
- [37] Kotov, A.A. (2013) Morphology and phylogeny of Anomopoda (Crustacea: Cladocera). KMK, Moscow, 638 pp. [in Russian with English abstract]
- [38] Kotov, A.A. & Elías-Gutiérrez, M. (2002) Analysis of the morphology of *Spinalona anophtalma* Ciro-Pérez & Elías-Gutiérrez, 1997 (Aloninae, Anomopoda, Cladocera). *Hydrobiologia*, 468, 185-192. <https://doi.org/10.1023/A:1015229113634>
- [39] 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, 50-90.
- [40] Kotov, A.A. & Sinev, A.Y. (2011) Cladocera (Crustacea, Branchiopoda) of the Zeya basin (Amurskaya Area, Russian Federation). 2. Descriptions of new taxa. *Zoologicheskij Zhurnal*, 90, 272-284.
- [41] Kotov, A.A., Sinev, A.Y. & Berrios, V.L. (2010) The Cladocera (Crustacea: Branchiopoda) of six high altitude water bodies in the North Chilean Andes, with discussion of Andean endemism. *Zootaxa*, 2430, 1-66.
- [42] Lee, J.M. & Chang, C.Y. (2009) Two groundwater copepods of the genus *Parastenocaris* (Harpacticoida, Parastenocarididae) from South Korea. *Animal Cells and Systems*, 13, 169-178. <https://doi.org/10.1080/19768354.2009.9647209>
- [43] Miura, Y. (1964) Subterranean harpacticoid copepods from a driven well in Japan. *Japanese Journal of Zoology*, 14, 133-141.
- [44] Miura, Y. (1969) Results of the speleological survey of South Korea 1966, XIV. Subterranean harpacticoid copepods of South Korea. *Bulletin of the National Science Museum, Tokyo, Series A, Zoology*, 12, 241-254.
- [45] Morimoto, Y. (1970) Results of the Speleological survey in South Korea 1966. 21. Bathynellid Crustaceans (Syncarida) from South Korea. *Bulletin of the National Science Museum, Tokyo, Series A, Zoology*, 13, 149-184.
- [46] Olesen, J. (1998) A phylogenetic analysis of the Conchostraca and Cladocera (Crustacea, Branchiopoda, Diplostraca). *Zoological Journal of the Linnean Society*, 122, 491-536. <https://doi.org/10.1111/j.1096-3642.1998.tb02161.x>
- [47] Pacioglu, O. (2010). Ecology of the hyporheic zone: a review. *Cave & Karst Science*, 36, 69-76.
- [48] Park, J.G. & Cho, J.L. (2013) New genus and two new species of Parabathynellidae (Malacostraca: Syncarida) from South Korea. *Journal of Crustacean Biology*, 33, 866-881. <https://doi.org/10.1163/1937240X-00002184>
- [49] Park, J.G. & Cho, J.L. (2015) Two new species of *Arisubathynella* Park and Eun, 2012 (Malacostraca: Syncarida: Parabathynellidae) from South Korea. *Journal of Crustacean Biology*, 35, 241-254. <https://doi.org/10.1163/1937240X-00002308>
- [50] Petkovski, T.K. & Flössner, D. (1972) Eine neue Alona-Art (Crustacea: Cladocera) aus dem Ohridsee. *Fragmenta balcanica Musei Macedonici Scientiarum Naturalium*, 9 (10), 97-106.
- [51] Sacherová, V. & Hebert, P.D.N. (2003) The evolutionary history of the Chydoridae (Crustacea: Cladocera). *Biological Journal of the Linnean Society*, 79, 629-643. <https://doi.org/10.1046/j.1095-8312.2003.00216.x>
- [52] Sanmartin, I. & Ronquist, F. (2004) Southern Hemisphere biogeography inferred by event-based models: plant versus animal patterns. *Systematic Biology*, 53, 216-243. <https://doi.org/10.1080/10635150490423430>
- [53] Shen, C.J. & Tai, A.Y. (1973) Preliminary analysis of the characteristics of the harpacticoid Copepoda fauna of China and description of some new species. *Acta Zoologica Sinica*, 19, 365-384.
- [54] Sidorov, D. & Holsinger, J.R. (2007) *Procrangonyx stygoedincus*, a new species of subterranean amphipod (Pseudocrangonyctidae) from the far east of Russia, with remarks on biogeographic relationships. *Crustaceana*, 80, 417-430. <https://doi.org/10.1163/156854007780440984>
- [55] Sidorov, D.A. & Gontcharov, A.A. (2012) Studies on subterranean amphipod crustaceans of Primory, Russia. Part 1. Three new species of the genus *Pseudocrangonyx* from springs and other groundwater habitats in far eastern Russia. *Zootaxa*, 3693 (4), 547-567. <https://doi.org/10.11646/zootaxa.3693.4.8>

- [56] Sidorov, D.A. & Semenchko, K.A. (2012) New records of freshwater ostracods (Crustacea) from the Far East of Russia, with a checklist of recent freshwater ostracods of the region. *Arthropoda Selecta*, 21 (3), 227-234.
- [57] Sinev, A.Y. (2017) Morphology, systematics and zoogeography of the cladocerans of subfamily Aloninae (Cladocera: Anomopoda: Chydoridae). Dr.Sci. Thesis, Biological Faculty of M.V. Lomonosov Moscow State University, Moscow, 428 pp.
- [58] Sinev, A.Y. & Atroshenko, M.M. (2011) Revision of the genus *Alonopsis* Sars, 1862 and its position within Aloninae (Cladocera: Anomopoda: Chydoridae). *Zootaxa*, 2800, 1-17.
- [59] Sinev, A.Y. & Kotov, A.A. (2014) Revision of the Holarctic genus *Rhynchotalona* Norman, 1903 (Cladocera: Chydoridae). *Zootaxa*, 3841 (2), 188-210. <https://doi.org/10.11646/zootaxa.3841.2.2>
- [60] Sinev, A.Y. & Shiel, R.J. (2012) *Extremalona timmsi* gen. nov., sp. nov., a new cladoceran (Cladocera: Anomopoda: Chydoridae) from an acid saline lake in southwest Western Australia. *Journal of Natural History*, 46, 2845-2864. <https://doi.org/10.1080/00222933.2012.727215>
- [61] Smirnov, N.N. (1971) Chydoridae fauny mira. In: *Fauna USSR, Rakoobraznie*, 1 (2), pp. 1-531. [English translation: Chydoridae of the world. Israel Program for Scientific Translations, Jerusalem, 1974]
- [62] Smirnov, N.N. (1998) A revision of the genus *Camptocercus* (Anomopoda, Chydoridae, Aloninae). *Hydrobiologia*, 386, 63-83. <https://doi.org/10.1023/A:1003524414799>
- [63] Smirnov, N.N. (2001) Recent changes and improvements in Aloninae taxonomy (Branchiopoda: Anomopoda: Chydoridae). *Arthropoda Selecta*, 10 (1), 1-4.
- [64] Smirnov, N.N. & Kotov, A.A. (2010) The morphological radiation of setae of the Cladocera (Crustacea) and their potential for morphogenesis. *International Review of Hydrobiology*, 95, 482-519. <https://doi.org/10.1002/iroh.201011244>
- [65] Smith, R.J. (2011) Groundwater, spring and interstitial Ostracoda (Crustacea) from Shiga Prefecture, Japan, including descriptions of three new species and one new genus. *Zootaxa*, 3140, 15-37.
- [66] Sousa, F.D.R., Elmoor-Loureiro, L.M.A. & Santos, S. (2016) New findings of Hexalona-branch representatives in Brazil, with a description of *Prenda* gen. nov. (Crustacea: Anomopoda: Aloninae). *Journal of Natural History*, 50, 2727-2768. <https://doi.org/10.1080/00222933.2016.1208302>
- [67] Sousa, F.D.R., Elmoor-Loureiro, L.M.A. & Santos, S. (2016) Position of the dentifera-group in the Coronatella-branch and its relocation to a new genus: *Magnospina* gen. n. (Crustacea, Chydoridae, Aloninae). *ZooKeys*, 586, 95-119. <https://doi.org/10.3897/zookeys.586.8209>
- [68] Tomikawa, K., Kobayashi, N., Morino, H. & Mawatari, S.F. (2007) New gammaroid family, genera and species from subterranean waters of Japan, and their phylogenetic relationships (Crustacea: Amphipoda). *Zoological Journal of the Linnean Society*, 149, 643-670. <https://doi.org/10.1111/j.1096-3642.2007.00277.x>
- [69] Trojan, P. (1997) The floristic and faunistic Korean refugium during the last glacial period and its significance in postglacial biota formation. *Fragmenta Faunistica*, 40 (17), 215-221. <https://doi.org/10.3161/00159301FF1997.40.17.215>
- [70] Turbanov, I.S., Palatov, D.M. & Golovatch, S.I. (2016) The state of the art of biospeleology in Russia and other countries of the former Soviet Union: a review of the cave (endogean) invertebrate fauna. 1. Introduction-Crustacea. *Entomological Review*, 96, 926-963. <https://doi.org/10.1134/S0013873816070162>
- [71] Uéno, M. (1961) A new Japanese bathynellid. *Crustaceana*, 2, 85-88. <https://doi.org/10.1163/156854061X00266>
- [72] Van Damme, K. (2010) A revision of the genus *Alona* Baird, 1843 (Crustacea: Branchiopoda: Anomopoda). Ph. D. Thesis, The Sate University of Ghent, Ghent, 506 pp.
- [73] Van Damme, K., Brancelj, A. & Dumont, H.J. (2009) Adaptations to the hyporheic in Aloninae (Crustacea: Cladocera): allocation of *Alona protzi* Hartwig, 1900 and related species to *Phreatalona* gen. nov. *Hydrobiologia*, 618, 1-34. <https://doi.org/10.1007/s10750-008-9607-6>
- [74] Van Damme, K., Kotov, A.A. & Dumont, H.J. (2005) Redescription of *Leydigia parva* Daday, 1905 and assignment to *Parvalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). *Journal of Natural History*, 39, 2125-2136. <https://doi.org/10.1080/00222930500060884>
- [75] Van Damme, K., Kotov, A.A. & Dumont, H.J. (2010) A checklist of names in *Alona* Baird 1843 (Crustacea: Cladocera: Chydoridae) and their current status: an analysis of the taxonomy of a lump genus. *Zootaxa*, 2330, 1-63.
- [76] 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. <https://doi.org/10.1111/j.1096-3642.2010.00639.x>
- [77] Van Damme, K., Sinev, A.Y. & Dumont, H.J. (2011) Separation of *Anthalona* gen.n. from *Alona* Baird, 1843 (Branchiopoda: Cladocera: Anomopoda): morphology and evolution of scraping stenothermic alonines. *Zootaxa*, 2875, 1-64.
- [78] Watirogram, S., Brancelj, A., Sanoamuang, L. (2012) A new *Bryocyclops* Kiefer (Crustacea: Copepoda: Cyclopoida) from karstic caves in Thailand. *Raffles Bulletin of Zoology*, 60, 11-21.

- [79] Watiroyam, S., Brancelj, A. & Sanoamuang, L. (2015) Two new stygobiotic species of Elaphoidella (Crustacea: Copepoda: Harpacticoida) with comments on geographical distribution and ecology of harpacticoids from caves in Thailand. *Zootaxa*, 3919 (1), 81-99. <https://doi.org/10.11646/zootaxa.3919.1.4>
- [80] Yu, N., Zhao, Q., Li, E., Chen, S. & Chen, L. (2009) An updated and annotated checklist of recent nonmarine ostracods from China. *Zootaxa*, 2067, 29-50.
- [81] Zigmajster, M., Eme, D., Fišer, C., Galassi, D., Marmonier, P., Stoch, F., Cornu, J.F. & Malard, F. (2014) Geographic variation in range size and beta diversity of groundwater crustaceans: insights from habitats with low thermal seasonality. *Global Ecology and Biogeography*, 23, 1135-1145. <https://doi.org/10.1111/geb.12200>