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The Cladocera (Crustacea: Branchiopoda) of six high altitude water bodies in the North Chilean Andes, with discussion of Andean endemism

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Table of contents

Abstract	3
Abbreviations	4
Introduction	4
Material and methods	5
Results	6
General	6
Descriptions of and comments on selected taxa	8
<i>Daphnia (Ctenodaphnia) paggii</i> sp. nov.	8
<i>Ilyocryptus</i> cf. <i>nevadensis</i> Cervantes-Martínez, Gutiérrez-Aguirre & Elías-Gutiérrez, 2000.	15
<i>Ilyocryptus denticulatus denticulatus</i> Delachaux, 1919	18
<i>Macrothrix atahualpa</i> Brehm, 1936.	18
<i>Macrothrix</i> cf. <i>oviformis</i> Ekman, 1900	24
<i>Pleuroxus fryeri</i> sp. nov.	24
<i>Pleuroxus hardingi</i> Smirnov, Kotov & Coronel, 2006	32
<i>Pleuroxus varidentatus</i> Frey, 1993.	32
<i>Alona glabra</i> Sars, 1901	33
<i>Alona nigra</i> Smirnov, 1996	33
<i>Alona altiplana</i> sp. nov.	40
<i>Coronatella</i> cf. <i>circumfimbriata</i> (Megard, 1967)	44
<i>Geoffreya</i> gen. nov.	47
<i>Geoffreya fryeri</i> gen. nov., sp. nov.	50
<i>Leydigia (Leydigia) lousi lousi</i> Jenkin, 1934	55
Discussion	56
High endemism of high altitudes	56
Some relicts in the Andes: possible signatures of the Mesozoic Era	57
Andean-Patagonian relationships	58
Conclusions	59
Acknowledgements	60
References	60

Abstract

It was recently demonstrated that mountain areas add to a significant increase of the number of known cladoceran species due to higher chances of endemism. We studied six water bodies in the North Chilean Andes (XV, I and II Regions of Chile), located at more than 4000 m above sea level, and found 19 species of the Cladocera. Several selected taxa are redescribed in detail.

Three new species are described: *Daphnia (Ctenodaphnia) paggii* sp. nov. from Salar de Lagunillas, *Pleuroxus fryeri* sp. nov. from Crater Lake in Licancabur Volcano (type locality) and Laguna Leija, *Alona altiplana* sp. nov. from Crater Lake in Licancabur Volcano (type locality) and three other water bodies. A single female, determined as *Coronatella* cf. *circumfimbriata* (Megard, 1967) from Salar de Lagunillas, probably also belongs to a yet undescribed species.

Geoffreya fryeri gen. nov., sp. nov. is found in a single locality, Salar de Lagunillas. The genus *Geoffreya* gen. nov. (Chydoridae: Aloninae) is different from all other genera of Aloninae in a set of unique and rare characters, such as (1) exopodites III and IV, both having only four setae, all of them terminal, (2) seta 1 of exopodite V longer than setae 2–4, (3) six setae in filter plate II; (4) small size of exopodites III–V in comparison with limb I; (5) two interconnected main head pores of different size; (6) clusters of hard setules on basal and middle segments of antenna II exopodite, (7) very long setules in the lateral fascicles on the postabdomen. The postabdominal claw in *Geoffreya* gen. nov. bears a very short basal spine.

Among 19 species found, four taxa can be regarded as cosmopolitan, ten (more than half among 19!) are Andean endemics (among them six have Patagonian congeners), two are Andean-Patagonian, one circum-Neotropical, one “Gondwanian”, one found in two very distant localities, in the Andes and high mountains of Mexico. Some zoogeographical patterns revealed in this study are discussed. Some species groups, i.e. *Daphnia paggii* sp. nov. and its conge-

ners, *Ilyocryptus nevadensis* and its congeners, are probably differentiated from some pan-continental Mesozoic taxa. We agree with previous authors that the Andean-Patagonian patterns in the cladoceran distribution likely has a Last Glacial Maximum (LGM) signature (Löffler 1984; Adamowicz *et al.* 2002; Mergeay *et al.* 2008).

Based on the marked increase of number of endemic Andean taxa after our investigation of only six water bodies, we assume that the number of Neotropical endemics in the Cladocera could be significantly increased in course of further studies of the Andean high altitude waters.

Key words: Crustacea, Anomopoda, fauna, taxonomy, systematics, new species, new genus, biogeography, South America, Neotropics

Abbreviations

Collections. AAK, personal collection of A. A. Kotov, Moscow, Russia. ALMG, Albany Museum, Grahamstown, U.S.A. AM, Australian Museum, Sydney, Australia. DGF, Collection of D. G. Frey, Support Center of the Smithsonian Institution Museum of Natural History in Suitland, Maryland, U.S.A. ECO-CH-ZOO, Zoological collection of the Chetumal branch of ECOSUR, Chetumal, Q. Roo, Mexico. GOS, Collection of G. O. Sars, Zoological Museum of the Oslo University, Norway. LPM, La Plata Museum, Argentina. MGU, Zoological museum of the Moscow State University, Moscow, Russia. NHM, The Natural History Museum, London, United Kingdom. UNAM, Reference Collection of National Autonomus University of Mexico, Mexico city, Mexico. USNM, The Smithsonian Institution Museum of Natural History, Washington, D.C., U.S.A.

In text and illustrations. IDL, inner distal lobe of limb I. IP, interpore distance. ODL, outer distal lobe of limb I. PP, postpore distance.

Introduction

Problems in cladoceran taxonomy and the poor state of biogeography in the group, are mainly connected with most researchers still ignoring the obvious, so that “acceptable decisions about relationships cannot be made without describing and comparing pertinent populations in detail” (Frey 1993: P. 186). There are about 620 known species of the Cladocera in the world fauna, but their diversity is significantly underestimated, and level of study is very different for different continents (Forró *et al.* 2008). Unfortunately, only a limited portion of non-European territories is studied adequately, according to standards of the 21th century, at least with accurately determined species, such as Thailand (Maiphae *et al.* 2005), Cape Province of South Africa (Smirnov 2008), South Mexico, Belize and Guatemala (Elías-Gutiérrez *et al.* 2006), Central Mexico (Elías-Gutiérrez *et al.* 2008b), Brazilian Pantanal (Hollwedel *et al.* 2003). Species composition of some other regions remains a mystery for the limnologists, or is preliminary information only for some groups, e.g., for *Daphnia*. This situation strongly compromises any attempts for further biogeographical analysis (see discussion in Kotov 2008a). For example, Green (1995) analysed the altitudinal distribution of the cladocerans in Africa and South America (especially in Africa, in attempt to compare distribution with latitude), but some of his “taxa” are complexes of species with different biology and altitudinal-latitude preferences, so, new analysis using updated data could significantly change his conclusions.

For most regions we have information from publications with accurate determinations (e.g. Smirnov & Timms 1983), but these are outdated and need revision due to a rapid progress of systematics in many cladoceran groups, or data from more recent publications based on morphology or genetics with unknown (and frequently quite poor) quality of the species determination. Recently a program of “Barcoding of Life” involved the cladocerans from different regions (Elias-Gutierrez *et al.* 2008a; Quiroz-Vázquez & Elías-Gutiérrez, 2009), but we are still a long way from coordinating such genetical data with an adequate taxonomy, requiring great efforts of both experts in taxonomy and molecular phylogeny, acting according to their own models. It is