UNIVERSIDADE FEDERAL DE SANTA MARIA
CENTRO DE CIÊNCIAS NATURAIS E EXATAS
PROGRAMA DE PÓS-GRADUAÇÃO EM BIODIVERSIDADE ANIMAL

REVISÃO DE ESPÉCIES NEOTROPICAIS RELACIONADAS AO GÊNERO *Alona* (Crustacea, Chydoridae), COM OCORRÊNCIA NO BRASIL

TESE DE DOUTORADO

FRANCISCO DIOGO ROCHA SOUSA

SANTA MARIA, RS, BRASIL
2016

REVISÃO DE ESPÉCIES NEOTROPICAIS RELACIONADAS AO GÊNERO *Alona* (Crustacea, Chydoridae), COM OCORRÊNCIA NO BRASIL

FRANCISCO DIOGO ROCHA SOUSA

Tese apresentada ao Programa de Pós-Graduação em Biodiversidade Animal – Área de Concentração em Bioecologia, da Universidade Federal de Santa Maria (UFSM, RS), como requisito parcial para obtenção do grau de
Dourtor em Biodiversidade Animal

Orientador: Prof. Dr. Sandro Santos
Co-orientador: Prof. Dra. Lourdes Maria Abdu Elmoor-Loureiro

Santa Maria, RS, Brasil
2016

Ficha catalográfica elaborada através do Programa de Geração Automática
da Biblioteca Central da UFSM, com os dados fornecidos pelo(a) autor(a).

Sousa, Francisco Diogo Rocha
REVISÃO DE ESPÉCIES NEOTROPICAIS RELACIONADAS AO GÊNERO Alona (Crustacea, Chydoridae), COM OCORRÊNCIA NO BRASIL / Francisco Diogo Rocha Sousa.-2016.
179 p.; 30cm

Orientador: Sandro Santos
Coorientadora: Lourdes Maria Abdu Elmoor-Loureiro
Tese (doutorado) - Universidade Federal de Santa Maria, Centro de Ciências Naturais e Exatas, Programa de Pós-Graduação em Biodiversidade Animal, RS, 2016

1. Crustacea 2. Branchiopoda 3. Anomopoda 4. Aloninae 5. Taxonomia I. Santos, Sandro II. Elmoor-Loureiro, Lourdes Maria Abdu III. Título.

Universidade Federal de Santa Maria
Centro de Ciências Naturais e Exatas
Programa de Pós-Graduação em Biodiversidade Animal

A comissão Examinadora, abaixo assinada, aprova a Tese de Doutorado

REVISÃO DE ESPÉCIES NEOTROPICAIS RELACIONADAS AO GÊNERO *Alona* (Crustacea, Chydoridae), COM OCORRÊNCIA NO BRASIL

elaborada por
Francisco Diogo Rocha Sousa

Como requisito parcial para obtenção do grau de
Doutor em Biodiversidade Animal

COMISSÃO EXAMINADORA

Sandro Santos, Dr. (Presidente/Orientador)

Lourdes M. A. Elmoor-Loureiro, Dra. (Co-orientadora)

Miguel Alonso, Dr. (Universitat de Barcelona)

Eliana Aparecida Panarelli, Dra. (UEMG)

Ricardo Lourenço Pinto, Dr. (UnB)

Gilmar Perbiche Neves, Dr. (UFSCar)

Santa Maria, 26 de fevereiro de 2016

"An old slide deposited to a museum collection containing type specimen is more valuable for understanding of a taxon than a thousand of DNA sequences"

Kotov 2015. Zootaxa, 3911(2), 184-200

"Species provide the most pratical metric for distinguishing habitats and tracking progress in exploring Earth's biodiversity. They are as fundamental to biology as elements are to chemistry and particles to physics and are the first step in exploring biology"

Costello et al 2013.Science, v399, n611

Dedico esta tese à minha família, especialmente à minha esposa Elisa, por sempre me apoiar em todas as minhas descisões, por me encorajar nos momentos difícies e por me ensinar o sentido da palavra amor em sua plenitude.

AGRADECIMENTOS

Aos meus orientadores, Sandro Santos e Lourdes Maria Abdu Elmoo-Loureiro. Nada seria possível sem as oportunidades e a confiança que vocês depositaram em mim para que eu pudesse desenvolver esta tese. Vocês são meus exemplos de como a vida acadêmica e a ciência podem ser gratificantes.

Esta tese não poderia ter sido construída sem a contribuição de outros pesquisadores: Dra. Eliana Panarelli (UEMG), Dr. José R. Debastiani Júnior; Dr. Mauro Mello Júnior e Bióloga Leidiane Diniz (UFPE); Dr. André Senna (UERJ); Dr. Riccardo Mugnai (UFRJ); Dra. Adriana Maria Güntzel (UEMS); Dra. Cristina Stenert e Msc. Rachel Fleury (UniSinos); Dra. Maria J. S. Wisniewsiki (UFAL); Dr. Jhonathan O. Silva (UFVS). A vocês, deixo meus sinceros agradecimentos.

Aos integrantes do Grupo de Estudo de Ecossistemas Áquaticos da Universidade Católica de Brasília, em especial Luciana Mendonça Galvão, Bárbara Fonseca, Lourdes Maria Abdu Elmoor-Loureiro e Elisa Alvim. Agradeço por toda estrutura fornecida para o desenvolvimento deste trabalho, pelos momentos vividos em campo e pela amizade.

À Luciana Mendonça Galvão (minha eterna orientadora), pois nos momentos de dificuldade sempre me amparava com palavras de conforto e apoio. Sem sua amizade, eu não teria chegado até aqui.

Aos colegas que passaram pelo laboratório de carcinologia e aos amigos que construi durante esses quatro anos em que estive na UFSM. Meus agradecimentos especiais aos amigos Marcelo M. Dallosto e Alexandre V. Palaoro pela amizade, pela contribuição intelectual ao meu trabalho e por todo suporte durante esses quatros anos de doutorado. Aproveito para agradecer a Bianca Laís Zimmerman por ter tido paciência para me ensinar a lidar com as análises moleculares.

Ao Programa de Pós-graduação em Biodiversidade Animal e a Capes pela bolsa durante o desenvolvimento desta tese. Deixo meus siceros agradecimentos aos pesquisadores que abdicaram de parte do seu tempo para contribuir com a construção desta tese: Dra. Eliana Aparecida Panarelli, Dr. Gilmar Perbiche Neves, Dr. Miguel Alonso e Dr. Ricardo Lourenço Pinto.

À minha família. Esposa (Elisa Alvim), mãe (Maria Helena), tia (Fafá), sogra/amiga (Ana Maria) e primos (Favem, Anne e Faíne). Se eu cheguei até aqui foi por conta do opoio de todos vocês.

LISTA DE ILUSTRAÇÕES

LISTA DE TABELAS

RESUMO

Tese de Doutorado
Programa de Pós-Graduação em Biodiversidade Animal
Universidade Federal de Santa Maria

REVISÃO DE ESPÉCIES NEOTROPICAIS RELACIONADAS AO GÊNERO *Alona* (Crustacea, Chydoridae), COM OCORRÊNCIA NO BRASIL

AUTOR: FRANCISCO DIOGO ROCHA SOUSA
ORIENTADOR: PROF. DR. SANDRO SANTOS
CO-ORIENTADOR: PROF. DRA. LOURDES MARIA ABDU ELMOOR-LOUREIRO

Data e local da defesa: Santa Maria, 26 de fevereiro de 2016

O gênero *Alona* foi, durante muito tempo, considerado o principal agrupamento morfológico dentro da família Chydoridae, apresentando elevada diversidade quando comparado a outros gêneros. A razão por trás desta afirmação emerge da natureza polifilética de *Alona*, que tem sido alvo de intensas modificações taxonômicas com o propósito de estabelecer grupos naturais. Desta maneira, o objetivo desta tese foi revisar espécies Neotropicais relacionadas ao gênero *Alona*, com ocorrência no Brasil. Diferentes populações das duas principais linhagens de *Alona*, os ramos Hexalona e Coronatella, foram analisadas. Três grupos de espécies do ramo Hexalona foram avaliados e os resultados apontaram para a descrição de: *Alona margipluma* Sousa, Elmoor-Loureiro & Santos, 2015 representando o grupo costata; *Alona* cf. *intermedia* e *Alona* sp. nov. 1 representando o grupo *intermedia*; *Alona* cf. *guttata* representando o grupo *guttata*. O gen. nov. 1 e sp. nov. 2 também pertence ao ramo Hexalona, contudo não pôde ser encaixado em nenhum grupo de espécies conhecido por conta do distinto conjunto de características morfológicas observadas nos poros cefálicos principais, pós-abodme, apêndices torácicos I, III e IV. Os resultados relacionados ao ramo Coronatella conduziram à descrição de três novas espécies do gênero *Coronatella*: *C. paulinae* Sousa, Elmoor-Loureiro & Santos, 2015, *C. serratalhadensis* Sousa, Elmoor-Loureiro & Santos, 2015 e *C. undata* Sousa, Elmoor-Loureiro & Santos, 2015. Ao mesmo tempo, a morfologia de *C. poppei* (Richard, 1897) foi inteiramente revisada e a ausência de *C. rectangula* (Sars, 1861) na região tropical foi confirmada. Ainda, o grupo pulchella de *Alona* sensu lato ganhou uma nova espécie com distribuição geográfica na porção meridional da América do Sul: esta

espécie foi nomeada de *Alona kaingang* Sousa, Elmoor-Loureiro & Santos, 2015 (agora considerada pertencente ao gênero *Ovalona*). Além disto, nesta tese é proposto um novo gênero para abrigar *Alona dentifera* e *Alona siamensis*.

Palavras-chave: apêndices torácicos, endemismo, morfologia, pós-abdôme, taxonomia.

ABSTRACT

PhD Thesis
Biodiversity Animal Graduate Program
Universidade Federal de Santa Maria

REVISION OF SPECIES OF THE GENUS *Alona* (Crustacea, Chydoridae) FROM BRASIL

AUTHOR: FRANCISCO DIOGO ROCHA SOUSA
ADIVISOR: PROF. DR. SANDRO SANTOS
CO-ADIVISOR: PROF. DRA. LOURDES MARIA ABDU ELMOOR-LOUREIRO

Date and place of defense: Santa Maria, 26/02/2016

Alona genus was, for a long time, considered the main group of species within the family Chydoridae, presenting high diversity when compared to other genera. The reason behind this statement emerges from the polyphyletic nature of *Alona*, which has been the subject of intensive taxonomic changes in order to establish natural groups. Thus, the aim of this thesis was to review Neotropical species related to the genus *Alona*, occurring in Brazil. Different populations of the two main lineages of *Alona*, the *Hexalona*-branch and *Coronatella*-branch were analyzed. Three species groups of *Hexalona*-branch were evaluated and the results pointed to the description of: *Alona margipluma* Sousa, Elmoor-Loureiro & Santos, 2015 representing the c*ostata*-group; *Alona* cf. *intermedia* and *Alona* sp. nov. 1 representing the *intermedia*-group; *Alona* cf. *guttata* representing the *guttata*-group. The gen. nov. 1 and sp. nov. 2 also belongs to *Hexalona*-branch, but could not be fitted in any group of known species due to the distinct set of morphological characteristics observed in the main head pores, postabodme, limbs I, III and IV. The results related to *Coronatella*-branch led to the description of three new species of the genus *Coronatella*: *C. paulinae* Sousa, Elmoor-Loureiro & Santos, 2015, *C. serratalhadensis* Sousa, Elmoor-Loureiro & Santos, 2015 and *C. undata* Sousa, Elmoor-Loureiro & Santos, 2015. At the same time, the morphology of *C. poppei* (Richard, 1897) has been fully reviewed and the absence of *C. rectangula* (Sars, 1861) in tropical regions was confirmed. Furthermore, the *pulchella*-group of *Alona* sensu lato has a new species with geographical distribution in the southern portion of South America: this species was named *Alona kaingang* Sousa, Elmoor-Loureiro & Santos, 2015 (now considered

to belong to the genus *Ovalona*). In addition, this thesis proposes a new genus, which includes *Alona dentifera* and *Alona siamensis*.

Keywords: endemism, limbs, morphology, postabdomen, taxonomy.

SUMÁRIO

REVISÃO DE ESPÉCIES NEOTROPICAIS RELACIONADAS AO GÊNERO *Alona* (Crustacea, Chydoridae), COM OCORRÊNCIA NO BRASIL

INTRODUÇÃO GERAL

Chydoridae Dybowski & Grochowski, 1894 *emend*. Frey, 1967 é a família mais especiosa pertencente à subordem Cladocera (Crustacea, Branchiopoda). A grande maioria das espécies que a compõem habita a zona litoral de ecossistemas aquáticos, vivendo associadas à vegetação ou sedimentos com granulometria fina (Smirnov, 1974; Kotov, 2006). Entre as duas subfamílias que pertencem a Chydoridae, Aloninae Dybowski & Grochowski, 1894 *emend*. Frey, 1967 tem sido exaustivamente estudada nos últimos anos por duas principais razões: (1) a elevada diversidade de espécies e (2) a existência de elevado número de espécies com descrições superficiais que não permitem uma boa discriminação entre elas. Desde o final do século XX, muitos estudos apresentaram redescrições e descrições de novas espécies a partir de investigações morfológicas criteriosas que utilizam, especialmente, caracteres relacionados aos apêndices torácicos (Smirnov, 1998; Kotov, 2000a; Kotov, 2000b; Sinev & Kotov, 2000; Sinev, 2001; Sinev & Kotov, 2001; Kotov & Eliáz-Gutiérrez, 2002; Kotov, 2003; Van Damme et al., 2003; Kotov & Sanoamuang, 2004; Sinev & Elmoor-Loureiro, 2010; Van Damme et al., 2010; Sinev & Atroschenko, 2011).

Muitas destas recentes investigações morfológicas e redescrições de espécies de Aloninae foram relacionadas ao gênero *Alona* Baird, 1843 e proporcionaram a formação de novos gêneros e/ou translocações de espécies para gêneros correlatos como *Karualona* Dumont & Silva-Briano, 2000 (Dumont & Silva-Briano, 2000; Sinev & Hollwedel, 2005), *Nicsmirnovius* Chiambeng & Dummont, 1999 (Kotov, 2003; Van Damme et al., 2003), *Parvalona* Van Damme, Kotov & Dumont, 2005 (Van Damme et al., 2005), *Armatalona* Sinev, 2004 (Sinev, 2004a), *Matralona* Van Damme & Dumont, 2009 (Van Damme & Dumont, 2009), *Maraura* Sinev & Shiel, 2008 (Sinev & Shiel, 2008), *Miralona* Sinev, 2004 (Sinev, 2004b), *Leberis* Smirnov, 1989 (Sinev et al., 2005) e *Bergamina* (Elmoor-Loureiro et al., 2013). Todos os estudos citados apontam que esta diferenciação em novos taxa é uma tendência gerada pela natureza polifilética de *Alona*, sendo esta afirmação suportada por análises filogenéticas (*e.g* Sacherová & Hebert, 2003; Elmoor-Loureiro, 2004; Eliás-Gutiérrez et al., 2008). Desta maneira, Sinev et al. (2005) sugeriram que a estabilidade filogenética para os Aloninae dependeria da redefinição do gênero *Alona*, estabelecendo suas características próprias e diagnósticas.

Esta tarefa coube a Van Damme & Dumont (2008a), que redescreveram a espécie tipo do gênero *Alona* e da subfamília Aloninae, que é *Alona quadrangularis* (O.F. Muller, 1776), a partir de exemplares da região onde foi originalmente descrita. Embasados na morfologia do pós-abdome, garra e morfologia das cerdas dos apêndices torácicos, definiram caracteres diagnóstico para o gênero *Alona*. Desde então, alguns complexos de espécies, antes atribuídas ao gênero *Alona* no seu *sensu lato*, foram estudados e desmembrados em novos gêneros, como é o caso de *Phreatalona* que corresponde ao complexo-*protzi* (Van Damme et al., 2009), *Coronatella*, correspondentes ao complexo-*rectangula* (Van Damme & Dumont, 2008b), *Anthalona*, que atualmente inclui as espécies do complexo-*verrucosa* (Van Damme et al., 2011), *Ovalona* que corresponde as espécies do grupo *pulchella* (Sinev, 2015) e *Brancelia* Van Damme & Sinev, 2011 que inclui espécies do complexo-*hercegovinae*. Gêneros não iseridos em grandes complexos de espécies, mas também relacionados à *Alona* no *sensu lato* também foram criados recentemente: *Salinalona* Van Damme & Maiphae, 2013 (Van Damme & Dumont, 2013), *Matralona* Van Damme & Dumont, 2009 (Van Damme & Dumont, 2009), *Acanthalona* Sinev & Kobayashi, 2012 (Sinev & Kobayashi, 2012) e *Bergamina* (Elmoor-Loureiro et al., 2013).

Embora tenha havido avanços significativos na taxonomia, Van Damme & Dumont (2008b) e Van Damme et al. (2010) enfatizaram a necessidade de continuação da revisão de complexos de espécies com ampla distribuição no mundo e de espécies neotropicais inseridas no gênero *Alona*, como objetivo de melhorar o entendimento da diversidade e distribuição geográfica dos Aloninae. Neste contexto, se encaixam seis taxa com ocorrência no Brasil: *A. guttata* Sars, 1862, *A. intermedia* Sars, 1862, *Alona broaensis* Matsumura-Tundisi & Smirnov, 1984, *A. dentifera* (Sars, 1901), *Coronatella poppei* (Richard, 1897) e *C. rectangula* (Sars, 1861) (Elmoor-Loureiro, 1997; Elmoor-Loureiro, 2000). Estas espécies representam as duas maiores linhagens da subfamília Aloninae: os ramos Hexalona e Coronatella. O ramo Hexalona é, reconhecidamente, uma linhagem basal dentro de Aloninae porque suas espécies apresentam seis pares de apêndices torácicos, que possuem poucas reduções em número de cerdas e de estruturas especializadas. Por outro lado, o ramo Coronatella é representado por espécies com cinco pares de apêndices torácicos e inúmeras reduções no número de cerdas e estruturas especializadas sobre eles (Van Damme & Dumont 2008b).

Ramo Hexalona

Alona guttata representa um grande complexo de espécies crípticas, com ampla distribuição no mundo (Sinev, 1999a; Van Damme et al., 2010; Sinev & Silva-Briano, 2012).

Os representantes do complexo-*guttata* não são morfologicamente próximos de *Alona* s.str. e, certamente, necessitam de revisão para alocação em um novo gênero. Outra implicação importante para revisão deste táxon é que a localidade tipo de *A. guttata* encontra-se na região Paleártica (Van Damme et al., 2010). Considerando o conceito de não cosmopolistismo de Frey (1982, 1987), é provável que os registros neotropicais de *A. guttata* pertençam a novas espécies com morfologia similar a européia, mas com finas diferenças relacionadas aos apêndices torácicos.

Alona intermedia também forma um complexo de espécies com ampla distribuição no mundo e é um grupo bastante confuso do ponto de vista taxonômico. Smirnov (1974) realocou esta espécie no gênero *Biapertura*, especialmente pela ocorrência de dois poros cefálicos medianos. Contudo, esta característica é compartilhada por outros grupos filogeneticamente distantes (Sinev, 1999b; Sinev & Shiel, 2012: Sinev & Kobayashi, 2012; Sinev & Zawisza, 2013; Van Damme & Dumont, 2009; Van Damme et al., 2011) e não pôde ser considerada determinante, levando ao desuso do gênero e alterando novamente a posição desta espécie para *Alona*. Com todas as mudanças atuais relacionadas ao gênero *Alona*, Van Damme et al. (2010) revelaram que *A. intermedia* não pertence a *Alona* s. str., além de potencialmente ser um complexo de diferentes espécies, sugerindo a revisão deste grupo.

Ramo Coronatella

Alona broaensis foi descrita para o reservatório do Broa no estado de São Paulo com status de espécie, mas com morfologia muito próxima a *Alonella dentifera* (Matsumura-Tundisi & Smirnov, 1984; Elmoor-Loureiro, 1997). A redescrição deste último táxon culminou em sua alocação em *Alona* (Sinev et al., 2004) e o refinamento na descrição de estruturas morfológicas (especialmente ângulo postero-ventral da carapaça e setas sobre o lobo interno distal do primeiro apêndice torácico) evidenciou uma provável sinonímia entre *A. broaensis* e *A. dentifera*. A grande questão é que *A. broaensis* e *A. dentifera* não são espécies próximas a *Alona* s. str. sendo, então, necessária a revisão taxonômica de ambos os taxa e alocação em um novo gênero (Van Damme et al., 2010).

Diferentemente das outras espécies citadas acima, *Coronatella poppei* e *C. rectangula* já tiveram suas definições a nível genérico, sendo transferidas de *Alona* para *Coronatella* (Van Damme et al., 2010). No caso de *C. poppei,* que foi considerada uma espécie válida (Van Damme et al., 2010), a redescrição se torna necessária por que os exemplares originais provenientes do Chile, utilizados em sua descrição foram perdidos (Kotov & Ferrari, 2010). O único estudo que visa delinear a morfologia desta espécie foi realizado por Rey & Vásquez

(1986) a partir de exemplares da Venezuela, e mesmo assim ainda necessita de acréscimos a descrição em relação aos apêndices torácicos. Por outro lado, os registros de *C. rectangula* podem ser considerados duvidosos para a região Neotropical, uma vez que a localidade tipo desta espécie é Paleártica, sendo possível a adição de novas espécies separadas do complexo-*rectangula* como sugerido por Van Damme & Dumont (2008b).

Necessidade de avanços taxonômicos

A revisão de espécies relacionadas à *Alona* tem sido, nos últimos anos, o principal foco dos estudos a respeito da taxonomia de Cladocera, sendo isto fruto de pobres descrições realizadas no passado. Além disto, a localidade tipo de grande parte das espécies que formam complexos dentro do gênero é Paleártica (Van Damme et al., 2010), e, ao longo do tempo, as descrições destas espécies foram utilizadas para identificação, equivocadamente, de populações no Neotrópico. Desta maneira, estudos com caráter taxonômico fora da região Paleártica são de extrema importância para promover uma correta identificação dos taxa citados acima e, conseqüentemente, minimizar os efeitos de subestimativas de biodiversidade.

OBJETIVO GERAL

Revisar espécies neotropicais relacionadas ao gênero *Alona*, com ocorrência no Brasil baseado, principalmente, na morfologia dos apêndices torácicos.

OBJETIVOS ESPECÍFICOS

a) Revisar o status taxonômico de populações brasileiras do complexo-*guttata*.
b) Revisar o status taxonômico de populações brasileiras do complexo-*intermedia*.
c) Revisar o status taxonômico de *Alona broaensis* e *Alona dentifera*.
d) Redescrever *Coronatella poppei* a partir de exemplares da região tipo (Chile) e designar o neótipo.
e) Avaliar populações brasileiras atribuídas a *Coronatella poppei* com base na descrição de exemplares da região tipo.
f) Revisar os registros de *Coronatella rectangula* no Brasil e revisar o seu status taxonômico.

ARTIGO 1

NEW FINDINGS ABOUT SPECIES OF THE Hexalona-branch (CLADOCERA: ANOMOPODA: ALONINAE) FROM BRAZIL WITH A DESCRIPTION OF Gen. nov. 1

Artigo será submetido ao periódico Journal of Natrual History ISSN 1464-5262; Fator de Impacto (JCR 2014) = 0.881; Estrato no Qualis CAPES de Biodiversidade B2. Os novos nomes, genérico e específcos, foram omitidos para que não se tornassem *nomina nuda* (sing. *nomen nudum*).

New findings about species of the Hexalona-branch (Cladocera: Anomopoda: Aloninae) from Brazil with a description of Gen. nov. 1

Francisco Diogo R. Sousa [a,b,*], Lourdes M. A. Elmoor-Loureiro[b] and Sandro Santos[a]

[a]*Núcleo de Estudos em Biodiversidade Aquática, Programa de Pós-graduação em Biodiversidade Animal, Universidade Federal de Santa Maria – UFSM, Av. Roraima 1000, Camobi, CEP 97105-900, Santa Maria, RS, Brazil;* [b]*Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília – UCB, QS7 lote 1, Bloco M, sala 204, CEP 71966-700, Taguatinga, DF, Brazil*

[*]Corresponding author. Email: sousa_bio@yahoo.com.br

Abstract

Altogether, *Coronatella* and Hexalona-branches are considered the main lineages of Aloninae. However, although the taxonomic features of Brazilian members of the Hexalona-branch have been summarized for species from the *costata*-group and *affinis*-group, a revision of other widely distributed species in the world is still lacking in this country. The aim of this paper was to study the morphology of Brazilian populations from the *guttata*-group and *intermedia*-group and to describe a new genus from the Hexalona-branch. The parthenogenetic females of *Alona* cf. *guttata* from Brazil have similar morphology when compared with data from the literature, but the armature of the terminal claw of its males seems different from those of *Alona guttata* sensu strico, *Alona barbulata* and *Alona werestschagini*. The *intermedia*-group is formed by *Alona* cf. *intermedia*, which seems to be endemic from the Cerrado of Brazil Central, and *Alona* sp.nov. 1, which is widely distributed in Brazil; this species has a labral keel armed with 2-4 setules, postabdomen with setules of lateral fascicles longer than the level of marginal denticles, morphological traits that differentiate it from *Alona* cf. *intermedia*. Another endemic species from the Hexalona-branch is Gen. nov. 1 and sp. nov. 2, which has two main head pores, a reduced seta on endite 1 of the first limb and wide lobe as sixth limb. The potential of biodiversity from the Hexalona-branch from Brazil is still underestimated, and a global revision of the *guttata*-group and *intermedia*-group is very important for the progress of Aloninae taxonomy and systematics.

Keywords: endemism, head pores, limbs, morphology, taxonomy.

Introduction

The knowledge about Brazilian Chydoridae Dybowski & Grochowski, 1894 *emend.* Frey, 1967 fauna has been increasing in recent years because numerous works have focused on the littoral zone of inland water, the preferential compartment of these cladocerans that inhabit inland waters (Elmoor-Loureiro et al. 2004; Maia-Barbosa et al. 2014; Rocha et al. 2011; Santos-Wisniewski et al. 2011; Diniz et al. 2013; Soares & Elmoor-Loureiro 2012; Sousa & Elmoor-Loureiro 2012; Sousa et al. 2013, 2014; Van Damme & Dumont 2010). Studies such as these help to improve data on the gaps, regional richness and geographical distribution, and they present new perspectives for taxonomical studies.

From this point of view, a significant advance in the biodiversity of Chydoridae has been established in Brazil. Sinev & Elmoor-Loureiro (2010) described three new species of Aloninae Dybowski & Grochowski, 1894 *emend*. Frey, 1967 belonging to *Alona* Baird, 1843, *Acroperus* Baird, 1843 and *Celsinotum* Frey, 1991. Elmoor-Loureiro et al. (2013) redescribed *Alonella lineolata* Sars, 1901 and created a new genus, named *Bergamina* Elmoor-Loureiro, Santos-Wisniewski and Rocha 2013. The endemic *Ephemeroporus quasimodo* Elmoor-Loureiro 2014 was described for shallow wetlands in the Cerrado biome (Elmoor-Loureiro 2014). More recently, the revision of *Coronatella* Dybowski & Grochowski, 1894 pointed to five species occurring in Brazil (Sousa et al. 2015a) and new species from the *pulchella*-group and *costata*-group were described (Sousa et al. 2015b, c). Previous studies were also important to improve our knowledge about Brazilian Chydoridae (*e. g.* Sinev & Howelldel 2002, 2005; Van Damme et al. 2005).

The literature shows that some species found in Brazil are considered cosmopolitan, which does not agree with the biogeography concept of Frey (1982) of non-cosmopolitanism in cladocerans. Two of these species belong to large lineage of *Alona* sensu lato formed by six-limbed species, the Hexalona-branch. This lineage was proposed based on the some

morphological traits, the most important being the exopodite of the third limb armed with seven setae, the basal portion of the fifth limb armed with a filter comb, in addition to the presence of sixth limb (Van Damme & Dumont 2008b). The Hexalona-branch is composed of species from *Alona costata*-group (Sinev 1999a, 2001, 2008, 2009a; Van Damme & Eggermont 2011), *A. affinis*-group (Sinev 1997, 1998, 2009b, 2013), *A. intermedia*-group (Alonso 1996; Flossner 2000) and *A. guttata*-group (Sinev 1999b).

Here, we pay attention to the two latest species groups. *Alona guttata* Sars, 1862 represents a large cryptic species complex, having wide distribution throughout the world (Sinev 1999b; Van Damme et al. 2010). Only three species from this group are considered valid: besides *A. guttata* sensu lato (Paleartic), the Neartic *Alona barbulata* Megard, 1967 and the Paleartic *Alona werestschagini* Sinev, 1999. Taking into account the concept of non-cosmopolitism of Frey (1982, 1987), it is possible that in the Neotropical region (including Brazil), *A. guttata* sensu lato belongs to a new taxon, distinct from that of the Paleartic and Neartic regions (Van Damme et al. 2010).

Like *A. guttata*, *Alona intermedia* Sars, 1862 is also widely distributed on the global scale (Van Damme et al. 2010). However, this species has a more complicated taxonomic history: Smirnov (1971) reallocated *A. intermedia* in the genus *Biapertura* Smirnov, 1971 based on the presence of two main head pores, which is a morphological trait shared by other phylogenetically distant groups, and this cannot be considered consistent enough for the creation of a new genus (Sinev 1999a; Sinev 2004; Van Damme et al. 2011; Sinev & Kobayashi 2012). At this moment, *Biapertura* has not been validated. On the other hand, it is necessary to know the morphological range of this species to acquire data for wide comparison.

Therefore, the aim of this study was to investigate the morphology of Brazilian populations of *A. guttata* and *A. intermedia*. Additionally, a new genus and species from Hexalona-branch are described.

Material and Methods

Morphological analysis

The selected specimens were transferred to drops of glycerol on slides and dissected under a stereomicroscope. The morphology of the appendages and other structures was studied using phase contrast microscope Olympus BX41. For the enumeration of limb setae, we used the proposal of Kotov (2000a, b), which has been tested in different cladoceran groups and considered a stable method (Kotov et al. 2010). Drawings were prepared using a camera lucida attached to phase contrast microscope Olympus BX41.

Abbreviations in the figures and text

CBS: copulatory brush seta; en: endite; ep: epipodite; ex: exopodite; fc: filtercomb; gfp: gnathobasic filter plate; gn: gnathobase; IDL: inner distal lobe; il: inner lobe; IP: interpore distance (distance between anterior and posterior main head pores); ODL: outer distal lobe; pep: pre-epipodite; s: sensillum; PP: postpore distance (distance between posterior main head pore and posterior border of head shield); P4: fourth limb; P5: fifth limb; P6: sixth limb; ms: male seta; GEEA: Research Group on Aquatic Environments, Universidade Católica de Brasilia, Brazil. ***Collections***. EL: Personal collection of Lourdes Maria Abdu Elmoor-Loureiro; FDRS: Personal collection of Francisco Diogo Rocha Sousa; CLLA: Slides collection of the GEEA, at Universidade Católica de Brasília, Brazil. UFBA: Museu de Zoologia da Universidade Federal da Bahia.

Results

Class **BRANCHIOPODA** Latreille, 1817

Order **ANOMOPODA** Sars, 1865

Family **CHYDORIDAE** Dybowski & Grochowski, 1894 *emend.* Frey, 1967

Subfamily **ALONINAE** Dybowski & Grochowski, 1894 *emend*. Frey, 1967

Genus ***Alona*** Baird, 1843

Alona* cf. *guttata

(Figures 1-3, 11)

Material examined.

Bahia: One adult parthenogenetic female from a pond near Nova Viçosa, Bahia, Brazil (17°57'34.9"S, 39°33'22.1"W), material collected by Lourdes M. A. Elmoor-Loureiro on 22 January 1991 (EL02212). **Distrito Federal:** Ten parthenogenetic females and one juvenile from Capetinga Stream, Distrito Federal, Brazil (15°57'40.6"S, 47°56'36.7"W), material collected by GEEA on 14 August 2008 (FDRS0440; CLLA137-145). Two adult females and one juvenile from Gansos pond, Distrito Federal, Brazil (15°40'33.1"S, 47°41'37.4"W), material collected by GEEA on 02 May 2008 (FDRS0441; CLLA135, 146). One adult parthenogenetic female from Cedro pond, Distrito Federal, Brazil (15°53'49.7"S, 47°56'36.6"W), material collected by GEEA on 19 September 2006 (FDRS0442). Two adult parthenogenetic females and two juveniles from Gama stream, Distrito Federal, Brazil (15°56'39.1"S, 47°56'53.5"W), material collected by GEEA on 19 September 2008 (FDRS444; CLLA134, 140, 144). One adult parthenogenetic female from Mestre D'armas stream, Distrito Federal, Brazil (15°36'23"S, 47°41'28.2"W), material collected by GEEA on 25 April 2008 (FDRS0445). Eight adult parthenogenetic females from Sarandi stream, Distrito Federal, Brazil (15°35'42.3"S, 47°44'45.2"W), material collected by GEEA on 05

September 2009 (FDRS0447). Eighty adult parthenogenetic females from São Bartolomeu River, Distrito Federal, Brazil (15°40'59.6"S, 47°39'44.8"W), material collected by GEEA on 23 May 08 and 26 August 2008 (FDRS0448). One adult parthenogenetic female from Preto River, Distrito Federal, Brazil (15°33'23.1"S 47°17'36.3"), material collected by GEEA on 22 March 2009 (FDRS0449). Five parthenogenetic females from Meio stream, Distrito Federal, Brazil (15°41.931'S, 47°42.834'W), material collected by GEEA on 05 September 2009 (FDRS0451). Two adult parthenogenetic females from Pipiripau stream, Distrito Federal, Brazil (15°33'45.5"S, 47°30'39.7"W), material collected by GEEA on 16 September 2008 and (FDRS0452) and 17 March 2009 (FDRS0455). Three adult parthenogenetic females from Sobradinho stream, Distrito Federal, Brazil (15°38'27"S, 47°46'40"W), material collected by GEEA on 18 September 2009 (FDRS0453). Five adult parthenogenetic females from Bonita Pond, Estação Ecológica de Águas Emendadas, Distrito Federal, Brazil (15°35'22.4"S 47°41'49.0"W), material collected by GEEA on 27 May 2008 (FDRS0454). Five adult parthenogenetic females and one juvenile from Taquara Pond, Distrito Federal, Brazil, (15°38'12.4"S 47°31'22.0"W), material collected by GEEA on 15 August 2006 (FDRS0457), 06 May 2008 (FDRS458) and 17 March 2009 (FDRS459). Four adult parthenogenetic females from Paranoá Lake, Distrito Federal, Brazil (15°43’47”S, 47°52’58”W), material collected in August 2014 by Ciro Joko, Mariana Lessa and Elisângela Rangel (FDRS0401). Two adult parthenogenetic females and two juveniles from Gama stream, Distrito Federal, Brazil (15°56'10.6"S, 47°56'07.7"W), material collected by GEEA on 19 September 2008 (FDRS0357). **Goiás:** One adult parthenogenetic female from Cabocla II pond, Campo de Instrução de Formosa, Goiás, Brazil (15°48’21.00”S, 47°14’09.20”W), material collected by GEEA in December 2009 (CLLA129). **Mato Grosso do Sul:** Two adult parthenogenetic females from Criminosa Lake (21º40’28.8”S, 57º53’28.5”W), Porto Murtinho, Pantanal, Mato Grosso do Sul, Brazil, material collected on 19 January 2010. Leg. Adriana Maria

Güntzel (FDRS0446). Five adult parthenogenetic females from fish pond at Centro Laura Vicuña, Campo Grande, Mato Grosso do Sul, Brazil (20°31'39"S, 54°39'56"W), material collected by Lourdes M. A. Elmoor-Loureiro on 06 August 2000 (EL0669). **Minas Gerais:** One adult parthenogenetic female from dam at the Private Reserve of Caraça, Minas Gerais, Brazil (20°5'42.8"S, 43°29'17.0"W), material collected by Lourdes M. A. Elmoor-Loureiro on 27 December 1992 (FDRS0460). Two adult parthenogenetic females from artificial pond at Alto Caparaó, Minas Gerais, Brazil (20°25'47"S, 41°51'57"W), material collected by Lourdes M. A. Elmoor-Loureiro on 27 January 1991 (EL02258). **Pará**: One juvenile from Curua-Unã River, Amazonas, Brazil (2°59'54.83"S, 54°27'29.99"W), material collected on 05 July 1978 (FDRS0443). Leg Ciro Yoshio Joko. **Rio Grande do Sul:** One adult parthenogenetic female from fish pond at Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brasil (29°43'21.87"S, 53°43'42.86"W), material collected by Francisco Diogo R. Sousa and Marcelo M. Dallosto in July 2014 (FDRS0270). **Rio de Janeiro:** One adult parthenogenetic female from the hyporheic zone of the Tijuca River, Tijuca National Park, Rio de Janeiro, Brazil (22°57'13.08"S, 43°16'55.45"W), material collected by Ricchardo Mugnai and André Senna in November 2012 (FDRS0382). **Santa Catarina:** One adult parthenogenetic female and two juveniles from Mapiju Farm, Santo Amaro da Imperatriz, Santa Catarina, Brazil (27°41'30"S, 48°46'55"W), material collected by Gilberto Pereira Junior on 27 September 2001 (EL02119). **São Paulo:** Forty-two adult parthenogenetic females and five males from Parque Estadual das Fontes do Ipiranga – Hidrofitotério, São Paulo, Brazil (23°38'19.7"S, 46°37'16.5"W), material collected by Lourdes M. A. Elmoor-Loureiro on 08 July 2010 (EL01903).

Diagnosis

Female. Maximum height at middle of body, body height/length ration about 0.67, moderate lateral compression. *Head* with ocellus and eye of different size. Three main pores connected; posterior and anterior pores larger than median pore; PP about 0.3-0.5 IP; lateral head pores tiny. *Labrum* with posterior margin armed with two clusters of setules; portion posterior to keel covered by minute setules. *Carapace* with weak ornamentation, without longitudinal lines; ventral margin almost straight, with 32-35 plumose setae per valve not forming groups, posterior setae relatively long. *Antennule* about 1.7 times longer than wide. *Antenna*: antennal formula: spines 001/101, setae 113/003; seta on first segment of the exopodite thin, not exceeding the length of branches of the antenna. *Postabdomen* short, about 2.4 times as long as wide; pre-anal angle evident, pre-anal margin longer than anal and postanal margin. Anal margin slightly concave, with 3-4 denticle groups. Postanal margin with portion distal acute, truncated, six-seven well-developed marginal denticles, each with several spinules on the anterior margin. *Terminal claw* similar to length of the anal margin, with one group of short spinules on the base; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* short and naked. *Limb* I with ODL seta thin, serrulated in the distal part, accessory seta implanted near the base. IDL with three setae, seta 1 very short, setae 2 and 3 bisegmented and armed with setules; setae (e) and (f) of second endite similar in length; first endite bearing two setae of similar length. *Limb* II with elongated exopodite, one setulated seta present. Scrapers armed with fine spinules; scrapers 6-8 markedly shorter than other scrapers. *Limb* III with seven setae on the exopodite; second seta long, armed with short setules, about 1.6 times longer than the first seta. *Limb* IV with six plumose setae on the exopodite 3-6; second seta armed with spinules implanted unilaterally; first seta naked. *Limb* V with a deep incursion

between lobes of exopodite, armed with four setae; setae 3-4 similar in length; filter plate bearing three setae. *Limb* VI present.

Male. Smaller than female, body height/length ration about 0.62. *Head* with a short rostrum; main head pores connected; posterior and anterior pores larger than median pore; PP about 0.2 IP. *Carapace* armed with 31 plumose setae; posterior setae relatively long. *Antennule* about two times as long as wide, with three rows of short setules on antennular body; aesthetascs short and of different length; male seta about 2.75 times shorter than length of antennular body. *Postabdomen* conical, strongly narrowing distally; nine lateral fascicles present; gonopores opening ventrally, subapically to terminal claw. *Terminal claw* smaller and thicker than in female; one basal spine and a large setule present. *Limb* I with U-shaped copulatory hook; IDL with three setae; male seta similar in length to first seta of IDL.

Ephipial female. Unknown.

Description

Parthenogenetic females. Habitus (Figures 1A-C, 11A). In lateral view the carapace is oval, maximum height at middle of body, body height/length ration about 0.67. Moderate lateral compression. Dorsal margin convex. Dorsal keel absent.

Head (Figure 1F, J). Ocellus and eye of different size. Head shield with maximum width behind the mandibular articulation, line of the posterior margin straight, slightly projected. Rostrum short, rounded, in lateral view projected towards ventral margin of carapace. Three main pores connected; posterior and anterior pores larger than median pore; PP about 0.3-0.5 IP; lateral head pores tiny, located at level between median and anterior pores, distance from midline slightly shorter than IP. *Labrum* (Figures 1K-M, 11B). Of moderate size, anterior margin convex, with or without notch, posterior margin with two clusters of setules; portion

posterior to keel covered by minute setules. In some individuals these setules were not observed.

Carapace (Figures 1A-C; E-F, 11A). Without longitudinal lines; weak hexagons might be observed in some individuals; ventral margin almost straight, with 32-35 plumose setae per valve not forming groups; posterior setae relatively long. Posterior margin armed with internal spinules projected beyond the margin which not arranged in groups at posteroventral corner; distalmost spinules long.

Antennule (Figure 1I). Exceeding the length of rostrum, about 1.7 times longer than wide; three rows of setules on the antennular body. Antennular sensory seta slender, about 1.3 times smaller than antennular body, inserted in two-thirds of the antennule length from its base. Nine aesthetascs of different length, all projecting beyond the tip of rostrum. None the aesthetascs exceeds the length of the antennules.

Antenna (Figure 1J). Two coxal setae of equal length. Basal segment thick, armed with a short spine distally. Antennal formula: spines 001/101, setae 113/003. Seta on first segment of exopodite thin, not exceeding the length of branches of antenna. Seta on second segment of exopodite bisegmented, long. Spine on first segment of endopodite short, sometimes reaching but not exceeding the distal end of second segment. Apical spines of the endopodite and exopodite slightly longer than the apical segments of antenna. Apical setae bisegmented and setulated. All segments have short spinules at the terminal portion.

Abdomen slightly shorter than thorax. Two or three rows of abdominal setae.

Postabdomen (Figures 2A-B, D-J, 11C). Relatively short, about 2.4 times as long as wide, ventral margin straight, with two rows of spinules. Pre-anal angle evident; pre-anal margin longer than anal and postanal margin. Anal margin slightly concave, with 3-4 groups of spinules; distalmost group armed with many spinules. Postanal margin straight, truncated, with a prominent distal angle. Five–six lateral fascicles armed with thin setules; first-second

fascicles exceeding the postabdomen margin. Six-seven well developed merged marginal denticles increasing of length towards the distal portion; each denticle bears spinules on anterior margin. *Postabdominal seta* (Figure1A-B). About two times shorter than postabdomen length. *Terminal claw* (Figure 2C). Implanted at the projected short basis from the postabdomen, similar to length of the anal margin, uniformly curved, with one group of short spinules on base; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* (Figure 2A, C) short, of similar length to the width of base of claw, without spinules or setules.

Mandibles not studied. *Maxilla* (Figure 3A) relatively thin, with two setulated setae.

Six pairs of Limbs.

Limb I (Figure 3B-C). Epipodite oval with a long projection. Accessory seta implanted near base of ODL, which has a thin seta, slightly serrulated at the distal part, shorter than length of IDL setae; IDL (en4) with two groups of spinules on its face and three setae: seta 1 very short, setae 2 and 3 bisegmented and armed with setules. Endite 3 with four setae; posterior setae a-b of similar length to anterior seta 1. Endite 2 with one row of spinules; three posterior setae present (d-f), seta (f) slightly longer than seta (e), both setae have thick spinules on the lateral face; seta (d) setulated and exceeding the midlength of seta (e). First endite with two posterior setae bisegmented and densely setulate in distal part (g-h) of similar length. Ejector hooks of different length and armed with short spinules. Ventral face of the limb with seven groups of setules organized in clusters, decreasing towards the distal portion. Gnathobase elongated, apex armed with short setules.

Limb II (Figure 3D). Exopodite elongated, with a row of setules, one seta setulated at distal portion present. Inner limb portion armed with eight scrapers gradually decreasing in length towards the gnathobase; scrapers armed with fine spinules; scrapers 6-8 markedly shorter than the others. Proximal portion of gnathobase short, apex armed with short setules; distal portion

armed with four elements, first as a short sensillum, second as element with distal portion obtuse or slightly geniculated, third element armed with denticles, fourth element short and obtuse. Filter comb with seven setae; first seta short and densely setulated; other setae long and slightly setulated (setulae not showed).

Limb III (Figure 3E-G). Epipodite with short projection. Exopodite subquadrangular, with five distal and two lateral setae. Seventh seta setulated and longer than sixth seta; sixth seta setulated. Fifth seta long, setulated, about 1.5 times longer than the second seta. Fourth seta relatively long, setulated, about two times longer than third seta. First seta long, armed with short setules, about 1.6 times longer than the second seta. Second seta naked. Distal endite with three setae (1-3), two scraper-like setae of different length (1-2); third seta curved and armed with many setules bilaterally implanted (3); four plumose posterior setae similar in length. Basal endite with four soft anterior setae slightly increasing in length towards the gnathobase. Gnathobase armed with three elements, the first being a cylindrical sensillum, the second a geniculated seta and third element with tip acute, naked. Filter comb with seven setae.

Limb IV (Figure 3H-I). Pre-epipodite round and densely setulated. Epipodite oval with a long projection. Exopodite subquadrangular with six marginal setae and a group of the setules implanted near to base of fourth seta; setae 3-6 plumose; setae 5-6 of similar length; fourth seta longer than all others; third seta short, about two times shorter than second seta; second seta armed with spinules implanted unilaterally; first seta naked, longer than mid-length of second seta. Distal endite with four setae (1-4), one scraper-like (1), three flaming-torch-like (3-4); the first flaming-torch relatively robust, with long setules (2). Basal endite with three soft setae slightly setulated and of similar length. Gnathobase armed with one bottle-shaped sensillum and one setulated seta implanted on a robust base. Filter plate with five setae.

Limb V (Figure 3J). Pre-epipodite oval and densely setulated, epipodite with long projection. Exopodite divided into two lobes, incursion between lobes deep; four plumose setae present; setae 3-4 similar in length, about 1.2 times longer than seta 2; first seta about 1.4 times shorter than seta 2. Internal lobe wide, oval and with long setules; two setulated setae on the inner face of the lobe, first seta of similar length to lobe. Filter plate armed with three setae.

Limb VI (Figure 3K). An elongated lobe, about 1.3 times longer than width of lobe; apical margin of the lobe with long setules.

Male. Habitus (Figure 1N): Smaller than female, body height/length ration about 0.67. Body elongated, moderate lateral compression, body arched as in female.

Head (Figure 1N, H). Rostrum short, ocellus and eye of different size. Three main pores connected; posterior and anterior pores larger than median pore; PP about 0.2 IP; lateral head pores tiny, located at level between median and anterior pores. *Labrum* (Figure 1O). As described for females.

Carapace (Figure 1N). Punctuated ornamentations, without longitudinal lines; ventral margin armed with 31 plumose setae; posterior setae relatively long.

Antennules (Figure 1P). Exceeding tip of rostrum, about two times as long as wide, with three rows of short setules on antennular body. Aesthetascs short and of different length; aesthetascs not exceeding the length of antennules. Sensory seta about 1.8 times shorter than antennular body. Male seta thick, about 2.75 times shorter than length of antennular body, inserted near to apex of antenullar body.

Antenna as described for females.

Postabdomen (Figure 2K-M). Similar in length to female, conical, strongly narrowing distally; anal margin longer than postanal margin, angles not defined; marginal clusters of spinules present; nine lateral fascicles that not exceeding the margin line; anal margin with

spinules differentiated into two-three groups; gonopores opening ventrally, subapically to terminal claw. *Terminal claw* smaller and thicker than in female, tip acute; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. One basal spine and a large setule present.

Limb I (Figure 3L). Of similar size when compared to female, copulatory hook U-shaped, arms of different length; projections on tip present. Copulatory brush present, copulatory brush seta not studied; ODL with a long seta, accessory seta short. IDL (en4) with three setae; male seta similar in length to first seta.

Ephipial female. Unknown.

Size. The length of adult parthenogenetic females was 0.28-0.35 mm. In juvenile females, the length was 0.23-0.26 mm. The length of adult males was 0.25-0.26 mm.

Remarks. We observed high variation in the shape of the labrum (Figure 1K-M, 11A). In this structure, minute setules on posterior portion are present (as in *A. barbulata*, see Megard 1967); however, some individuals had the posterior portion naked. The shape of postabdomen was also variable (Figure 2D-J). To differentiate parthenogenetic females of *Alona* cf. *guttata* from *A. guttata* s.s., *A. werestschangni* and *A. barbulata* is not a simple task because the morphology of the limbs is very similar (see Megard 1967; Alonso 1996; Sinev 1999). However, the morphology of adult males can be used to differentiate them: *Alona* cf. *guttata* is distinguished from other species of the *guttata*-group because it has one basal spine and a long setule on the terminal claw of males (Figure 2K-M). In *A. guttata s.s.*, the males have one very short basal spine (Alonso 1996; Sinev 1999; Floessner 2000). *Alona barbulata* has groups of short spinules instead of basal spine (small patch of cilia in Megard 1967). The

basal spine in males of *A. werestschangni* is absent and the postabdomen is long and very narrow (Sinev 1999).

Geographical distribution. Alona cf. *guttata* seems to have wide distribution in Brazil (see material examined).

Alona* cf. *intermedia

(Figures 4-6, 11)

Material examined.

Thirty-nine adult parthenogenetic females, two ephipial females and eleven males from a rock pool near Rosário Waterfall, Pirenópolis, Goiás (15°42'34"S, 48°59'33"W), material collected by Lourdes M. A. Elmoor-Loureiro on 6 July 2009 (EL02226; FDR0384).

Diagnosis

Female. Maximum height at the middle of the body, body height/length ration about 0.67, moderate lateral compression. *Head* with ocellus and eye of similar size. Two main pores connected; PP about same length as IP; lateral head pores tiny. *Labrum* with 10-11 short spinules of similar size at anterior portion, posterior margin armed with two clusters of setules. *Carapace* armed with longitudinal lines; ventral margin almost straight, with 56 plumose setae forming three groups; inner proximal spinules longer and thicker than others and projected beyond the margin. *Antennule* about 3 times longer than wide. *Antenna*: antennal formula: spines 001/101, setae 113/003; median segment of the exopodite and endopodite long, similar in length to apical segments; seta on first segment of the exopodite thin, not exceeding the length of branches of the antenna. *Postabdomen* relatively long, about

2.7 times as long as wide; distal portion broadly rounded; first spinule of distal-most fascicles thicker than others and exceeding the postabdomen margin but not the length of the marginal denticles; eight-nine marginal denticles, proximal merged and organized in groups. *Terminal claw* about 0.3 of the length of the postabdomen, with one group of short spinules on the base; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* about 1.4-1.6 times longer than the width of base of the claw, armed with spinules. *Limb* I with IDL with three groups of spinules on its face, three setae present; seta 1 relatively short, about half the length of other setae and armed with spinules. *Limb* II with elongated exopodite, one setulated seta present; inner limb portion armed with one element; scraper 4 longer than 5; scrapers 6-8 of different size, decreasing in length towards gnathobase. *Limb* III with seven setae on the exopodite; setae 6-7 of different length. *Limb* IV with six setae on the exopodite, setae 3-6 plumose; second and first seta armed with short setules. *Limb* V with incursion between lobes relatively shallow, armed with four setae; filter plate bearing three setae armed with lateral spinules. *Limb* VI present, 2.6 times longer than width.

Male. Smaller than female, body height/length ration about 0.58. *Head* with short rostrum; main head pores connected; PP about 0.6 IP; lateral head pores tiny, located between main head pores. *Carapace* with longitudinal lines, armed with 36 plumose setae forming three groups. *Antennule* about 2.3 times as long as wide; aesthetascs of different length; male seta about 2.7 times shorter than length of antennular body. *Postabdomen* with dorsal and ventral margin almost parallel; short marginal spinules that occupy whole margin, not arranged in groups; first spinule of distal-most fascicles thicker than others and exceeding the postabdomen margin; gonopores opening ventrally, subapically to terminal claw. *Terminal claw* smaller and thicker than in female. *Basal spine* slightly longer than width of the base of

the terminal claw, naked. *Limb* I with U-shaped copulatory hook, arms of different length; IDL with three setae; slightly shorter in length than other setae on the IDL.

Ephipial female. With ephipium punctate and ornamented with longitudinal lines, brownish.

Description

Parthenogenetic females. Habitus (Figures 4A-C, 11D). In lateral view, the carapace is oval, maximum height at middle of body, body height/length ration about 0.67, moderate lateral compression. Dorsal margin convex. Dorsal keel absent.

Head (Figure 5A-D). Ocellus and eye of similar size. Head shield with maximum width behind the mandibular articulation, line of posterior margin straight and angular. Rostrum short, rounded, in lateral view projected towards ventral margin of carapace. Two connected main pores of similar size, connection relatively wide; PP about same length as IP; lateral head pores tiny, located at level between main head pores, distance from midline slightly shorter than IP. *Labrum* (Figures 5E, 11E). Anterior margin convex armed with 10-11 short spinules of similar size; posterior margin with two clusters of setules; apex rounded.

Carapace (Figures 4A-B, D, 11D). Covered with longitudinal lines; ventral margin almost straight, with 56 plumose setae per valve forming three groups, groups with long setules (anterior and posterior) separated by a group of short setules. Posterior margin straight, armed with long internal spinules: spinules at posteroventral corner longer and thicker than others and projected beyond the margin.

Antennule (Figure 5F). Exceeding the tip of rostrum, length about 3 times width; four rows of short setules on antennular body. Antennular sensory seta slender, about 1.3 times smaller than antennular body, inserted in last third of antennule from its base. Nine aesthetascs

projecting beyond the tip of rostrum, two long aesthetascs present. None of the aesthetascs exceeds the length of the antennules.

Antenna (Figure 5G). Two coxal setae of equal length. Basal segment thick, armed with a short spine and spinules. Antennal formula: spines 001/101, setae 113/003. Median segment of exopodite and endopodite long, similar in length to apical segments. Seta on first segment of exopodite thin, armed with fine setules, not exceeding the length of branches of antenna. Seta on second segment of exopodite bisegmented, similar in length to shorter apical seta. Spine on first segment of endopodite short, exceeding half the length, but not reaching the end of second segment. Apical spines of endopodite and exopodite shorter than apical segments of antenna. Apical setae bisegmented and setulated. All segments have spinules at terminal portion; setules on the second segment of the exopodite long.

Abdomen about 3 times shorter than thorax, armed with two rows of abdominal setae.

Postabdomen (Figures 4F-G, 11F-G). Relatively long, about 2.7 times as long as wide, ventral margin slightly rounded, with two rows of short spinules. Distal portion broadly rounded. Anal margin very long, occupying about 60% of postabdomen length. Nine–ten lateral fascicles armed with thin spinules; first spinule of distal-most fascicles thicker than others and exceeding the postabdomen margin, but not the length of the marginal denticles; Eight-nine marginal denticles increasing in length towards the distal portion; distal-most denticles bear spinules on the anterior margin; proximal-most denticles grouped. *Postabdominal seta* (Figure 4G). About 1.5 times shorter than postabdomen length, bi-segmented; setules on the first segment short when compared to setules of the second segment. *Terminal claw* (Figure 4G-H). About 0.3 of the length of the postabdomen; implanted at the projected short base from the postabdomen, uniformly curved, with one group of short spinules on base itself; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* (Figure 4G-H). About 1.4-

1.6 times longer than length of width of claw at its base; basal spines armed with spinules that reach the distal portion.

Mandibles not studied. *Maxilla* (Figure 6A). Armed with two setulated setae.

Six pairs of Limbs.

Limb I (Figure 6B-C). Epipodite oval with long projection. ODL with thin seta serrulated at distal part, longer than length of IDL (en4) setae; accessory seta not studied. IDL with three groups of spinules on its face, three setae present; seta 1 relatively short, about half the length of other setae and armed with spinules; setae 2 and 3 of different size, bisegmented and armed with thick spinules. Endite 3 with four setae; posterior setae a-b of similar length to anterior seta 1. Endite 2 with two rows of spinules; three posterior setae present (d-f), seta (f) 0.3 times shorter than seta (e), both setae have thick spinules on the lateral face; seta (d) setulated and exceeding half the length of seta (e). Endite 1 with three posterior setae (g-i); setae (g) and (h) bi-segmented and densely setulated in distal part, of similar length; seta (i) relatively short, about 0.2 of setae (g) and (h). Ejector hooks of different length and armed with short denticles. Ventral face of the limb with seven groups of setules organized in clusters, decreasing towards the distal portion. Gnathobase elongated; setules were not observed on the gnathobase.

Limb II (Figure 6D-E). Exopodite elongated, with two rows of setules; one seta present, setulated at distal portion, about two times shorter than exopodite itself. Inner limb portion armed with eight scrapers and a sensilum; scraper 3 shorter than 2 and 4; scraper 4 longer than 5; scrapers 6-8 of different size, decreasing in length towards gnathobase. Scrapers 1-4 armed with fine spinules; scrapers 5-8 armed with fine spines. Proximal portion of the gnathobase short, apex armed with setules; distal portion armed with four elements, first as a robust sensillum, second as element with distal portion acute and slightly geniculated, third element

armed with denticles, fourth element long. Filter comb with seven setae; first and second setae short; other setae long and slightly setulated (setulae not showed).

Limb III (Figure 6F-H). Epipodite not studied. Exopodite subquadrangular, with five distal and two lateral setae. Seventh seta setulated and about 1.6 times longer than sixth seta; sixth seta setulated. Fifth seta long, armed with short setules, about 1.7 times longer than second seta. Fourth and third seta setulated and similar in length. Second seta about 2.8 times longer than first seta; armed with long setules from median portion. First seta naked. Distal endite armed with a sensillum and three setae (1-3), two scraper-like of different length (1-2); third seta curved and armed with many setules bilaterally implanted (3); four plumose posterior setae similar in length (a-c). Basal endite with four soft anterior setae increasing in length towards the gnathobase. Gnathobase armed with four elements, the first being a cylindrical sensillum, the second a geniculated seta and third and fourth elements with tip acute, naked. Filter comb with seven setae (setulae on the setae not showed).

Limb IV (Figure 6I-K). Pre-epipodite rectangular and densely setulated. Epipodite oval with a long projection. Exopodite subquadrangular with six marginal setae; setae 3-6 plumose; seta 6 slightly longer than setae 4-5; setae 4-5 similar in length; third seta short, about three times shorter than second seta; second seta about 1.2 times longer than first seta; second and first seta armed with short setules. Distal endite with a sensillum and four setae (1-4), one scraper-like (1), three flaming-torch-like (3-4); the first flaming-torch relatively robust, with long setules (2). Basal endite with three soft setae slightly setulated increasing in length proximally (a-c). Gnathobase armed with one globular sensillum and one setulated seta implanted on a robust base. Filter plate with five setae (setulae on the setae not showed).

Limb V (Figure 6L). Pre-epipodite oval and densely setulated, epipodite with long projection. Exopodite divided into two lobes, incursion between lobes relatively shallow; four plumose setae present; setae 3-4 similar in length, about 1.4 times longer than seta 2; first seta about

three times shorter than seta 2. Internal lobe wide, oval and with long setules; two setulated setae on the inner face of the lobe, first seta longer than length of the lobe. Filter plate armed with three setae that bear spinules; an element present.

Limb VI (Figure 6M). An elongated lobe, about 2.6 times longer than width of lobe; apical margin of the lobe with long setules; lateral margin not totally setulated.

Male. Habitus (Figures 4I, 11H): Smaller than female, body about 1.5 times as long as high, elongated, lateral compression absent; less arched than female.

Head (Figures 4I, 11H). Rostrum short, ocellus and eye of similar size. Two main pores connected of similar size; PP about 0.6 IP; lateral head pores tiny, located between main head pores. *Labrum* (Figure 11I) as described for females.

Carapace (Figures 4I, 11H). With evident longitudinal lines; with 36 plumose setae per valve forming three groups, groups with long setules (anterior and posterior) separated by a group of short setules.

Antennule (Figure 5I). Exceeding tip of rostrum, about 2.3 as long as wide. Aesthetascs of different length and not exceeding the length of antennule. Sensory seta about 1.7 times shorter than antennular body. Male seta thick, about 2.7 times shorter than length of antennular body, inserted near to apex of antenullar body.

Antenna as described for females. In one individual, the exopodite of left antenna had the second and third segments modified in more slender structures; the apical segment was sharp and densely setulated; no apical setae were observed (Figure 5J).

Postabdomen (Figures 4J-K, 11J). Smaller in length than female, dorsal and ventral margin almost parallel; anal margin long as in female; short marginal spinules that occupy whole margin, not arranged in groups; ten lateral fascicles armed with thin spinules; first spinule of distal-most fascicles thicker than others and exceeding the postabdomen margin; gonopores

opening ventrally, subapically to terminal claw. *Postabdominal seta* as in females. *Terminal claw* smaller and thicker than in female, tip acute, armed with a group of short spinules on the base. *Basal spine* slightly longer than claw at its base, naked.

Limb I (Figure 5K-L). Smaller when compared to female, copulatory hook U-shaped, arms of different length; projections on tip present. Copulatory brush armed with many setules, copulatory brush seta longer than seta (g) on endite 1; ODL with a long seta, accessory seta not studied. IDL with three setae; male seta robust and slightly shorter in length than other setae on IDL.

Ephipial female (Figure 4E). With body about 0.69 longer than high. Ephipium punctate and ornamented with longitudinal lines, brownish, almost translucent.

Size. The length of the adult parthenogenetic females was 0.35-0.39 mm. In juveniles the length was 0.29-0.36 mm. The length of adult males was 0.26-0.29 mm. In juvenile male, the length was up to 0.24 mm. The length of the ephipial female was 0.39mm.

Remarks. The absence of a detailed description of *A. intermedia* based on the specimens from the type locality prevents the formal inclusion of populations here studied in a new taxon. *Alona* cf. *intermedia* differs from *Alona* sp. nov. 1 in the proportion of length/height of body; one group of proximal spinules on the posterior margin of carapace; morphology of labral keel that bears 10-11 spinules on the anterior margin; PP about same length as IP; setules of distal-most lateral fascicles not exceeding the level marginal denticles on postabdomen; first seta on IDL that bears denticles; setae on filter comb of fifth limb armed with visible lateral spinules. There are two descriptions of *A. intermedia* from specimens of Paleartic zone (Alonso 1996; Floessner 2000) and drawings of Neartic individuals (Chengalath 1987) that

suggest some differences and similarities when compared to *Alona* cf. *intermedia*: the labral keel and the first seta of IDL present in Floessner (2000) are naked; the description of Alonso (1996) resembles Brazilian *Alona* cf. *intermedia* in many morphological traits, including the armature of labral keel, postabdomen, first and fourth limbs. However, in this description there is no mention of spines on the first seta of IDL or spinules on the filter comb setae of fifth limb; besides, setae 6-7 of the third limb have a similar length. Regarding the adult male, the postabdomen shape of *Alona* cf. *intermedia* is more rectangular, with parallel margin ventral and dorsal, while in Floessner (2000) and drawings of Chengalath (1987) it is more conical.

Geographical distribution. So far, *Alona* cf. *intermedia* has just been observed in the locality here studied (15°42'34"S, 48°59'33"W). This population was observed in a lateral pool formed from a waterfall.

***Alona* sp. nov. 1**

Alona intermedia Sars, 1862 in Sousa and Elmoor-Loureiro (2006, 2012, 2013).

(Figures 7-8, 11)

Type locality.

Bonita Pond, Estação Ecológica de Águas Emendadas, Distrito Federal, Brazil (15°35'22.4"S 47°41'49.0"W).

Type material

Holotype: undissected, adult parthenogenetic female in a tube with 92% ethanol deposited at the Museum of Zoology of the State University of Bahia under accession number UFBA2167.

The label of the holotype is: "*Alona* sp. nov. 1, 1 parth. ♀ from Bonita Pond, Estação Ecológica de Águas Emendadas, Distrito Federal, Brazil. Holotype".

Material examined.

Paratypes: **Distrito Federal:** Twenty-four adult parthenogenetic females from Bonita Pond, Estação Ecológica de Águas emendadas, Distrito Federal, Brazil (15°35'22.4"S 47°41'49.0"W), material collected by Lourdes M. A. Elmoor-Loureiro on 03 May 2005 (EL00750-751), Maria do Socorro Ibañez on 05 July 2001(EL00681) and GEEA on 10 March 2009 (FDRS0080); 27 May 2008 (FDRS081); 12 September 2009 (FDR082). Three adult parthenogenetic females from Henrique pond, Brasilia National Park, Distrito Federal, Brazil (15°41'18.00"S , 47°56'26.10"W), material collected by GEEA in August 2009 (FDRS071-72). One adult parthenogenetic female from Exercito pond, Brasilia National Park, Distrito Federal, Brazil (15°44'44.30"S, 47°58'49.10"W), material collected by GEEA on August 20109 (FDRS073). Four adult parthenogenetic females from Bananal stream, Brasilia National Park, Distrito Federal, Brazil (15°44'51.2"S, 48°0'33.3"W), material collected by Lourdes M. A. Elmoor-Loureiro on 13 March 2012 (EL02144) and GEEA on 28 February 2013 (EL02497). One adult parthenogenetic female from Cedro pond (15°53'49.7"S, 47°56'36.6"W), material collected by GEEA on 19 September 2009 (FDRS079). Nineteen adult parthenogenetic females from Taquara Pond, Distrito Federal, Brazil (15°38'12.4"S 47°31'22.0"W), material collected by GEEA on 15 August 2006 (FDRS083) and 28 August 2008 (FDRS084). One adult parthenogenetic female from Joaquim Medeiros pond, Distrito Federal, Brazil (15°38'15.9"S, 47°41'29.5"W), material collected by GEEA on 02 September 2008 (FDRS085). Two adult parthenogenetic females from Brejinho stream, Estação Ecológica de Águas Emendadas, Distrito Federal, Brazil (15°35'42.3"S, 47°37'12.9"W), material collected by GEEA on 19 September 2008 (FDRS087). One adult parthenogenetic

female from Sobradinho Stream, Distrito Federal, Brazil (15°38'15.9"S, 47°41'29.5"W), material collected by GEEA on 18 August 2009 (FDRS088). Two adult parthenogenetic females from Gansos Pond, Distrito Federal, Brazil (15°40'33.1"S, 47°41'37.4"W), material collected by GEEA on 08 August 2006 (FDRS0437). Three adult parthenogenetic females from Pipiripau stream, Distrito Federal, Brazil (15°39'53.2"S, 47°38'44.0"W), material collected by GEEA on 17 March 2009 (FDRS0438). **Goiás:** Six adult parthenogenetic females from Grande Pond, Campo de Instrução de Formosa, Formosa, Distrito Federal, Brazil (15°49’35.70”S, 47°13’49.40”W), material collected by GEEA on December and 07 August 2009 (FDRS074-75; EL01749). Two adult parthenogenetic females from Cabocla II Pond, Campo de Instrução de Formosa, Formosa, Distrito Federal, Brazil (15°48’21.00”S, 47°14’09.20”W), material collected by GEEA on December/2009 (FDRS076-77). Six adult parthenogenetic females from wetland from Emas National Park, Mineiros, Goiás, Brazil (18°16'10.9"S, 52° 45'17.9"W), material collected by Valeria Barros on 21 April 2000 (EL00683-684). Three adult parthenogenetic females from Rio Formosa, Emas National Park, Mineiros, Goiás, Brazil (18°15'34.0"S, 52°53'18.7"W), material collected by Valeria Barros on 01 July 2001 (EL00686-688). One adult parthenogenetic female from a small dam, Cocalzinho, Goiás, Brazil (15°45'12.2"S, 48°40'07.5"W), material collected by Lourdes M. A. Elmoor-Loureiro on 30 September 2000 (EL0250). Ten parthenogenetic females from Estiva stream, Chapada dos Veadeiros National Park, Goiás, Brazil (14°06'40.3"S, 47°44'02.2"W), material collected by GEEA on 13 March 2013 (EL02372). One juvenile from Stream 1, Chapada dos Veadeiros National Park, Goiás, Brazil (14°06'13.5"S, 47°42'19.5"W), material collected by GEEA on 13 March 2013 (EL02388). One adult parthenogenetic female from Sete Lagoas, Chapada dos Veadeiros National Park, Goiás, Brazil (14°04'26.5"S, 47°39'40.7"W), material collected by GEEA on 14 March 2013 (EL02369). **Minas Gerais:** Six parthenogenetic females from Preto River, Sempre Vivas National Park, Minas Gerais,

Brazil (17°55'28.6"S, 43°48'32.4"W), material collected by Adriana Marinho Fernandes in May 2010 (EL01861 EL0161). Twenty-five adult parthenogenetic females from Jequitaí River, Sempre Vivas National Park, Minas Gerais, Brazil (17°53'35.9"S, 43°47'38.7"W), material collected by Adriana Marinho Fernandes on 03 May 2010 (EL01936). One adult parthenogenetic female from Inhacica River, Sempre Vivas National Park, Minas Gerais, Brazil (17°50'11.4"S, 43°45'58.6"W), material collected by Adriana Marinho Fernandes on 04 May 2010 (EL01866). **Rio Grande do Sul**: Six adult parthenogenetic females from pond at Lagoa do Peixe National Park, Rio Grande do Sul, Brazil (31º02'S, 50º77'W), material leg. Dr. Cristina Sternet (FDRS0439).

Diagnosis

Female. Carapace oval, with posterior margin slightly elongated; maximum height at middle of body, body height/length ration about 0.60, not laterally compressed. *Head* with ocellus and eye of similar size. Two main pores connected; PP about 0.5-0.6 IP; lateral head pores tiny. *Labrum* with 2-4 short and fine spinules of similar size; clearly separated; posterior margin with two clusters of setules. *Carapace* armed with longitudinal lines; ventral margin concave near half-length of body, with 42-45 plumose setae forming three groups; inner proximal spinules longer and thicker than others and projected beyond the margin, arranged in 2-3 groups. *Antennule* about 2.6 times longer than wide, armed with nine aesthetascs, two long aesthetascs similar in length to antennular body. *Antenna*: antennal formula: spines 001/101, setae 113/003; median segment of exopodite and endopodite long, similar in length to apical segments; seta on first segment of exopodite thin, not exceeding the length of branches of the antenna. *Postabdomen* relatively long, about 2.6 times as long as wide; distal portion broadly rounded; first spinule of distal-most fascicles thicker than others and exceeding the postabdomen margin and length of the marginal denticles; eight marginal

denticles, proximal merged and organized in groups. *Terminal claw* about 0.3 of the length of the postabdomen, with one group of short spinules on base; pecten armed with a row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* about 1.7 times longer than width of claw base; basal spines armed with spinules. *Limb* I with IDL with three groups of spinules on its face, three setae present; seta 1 relatively short, about half length of seta 2, naked; second endite armed with anterior two elements. *Limb* II with elongated exopodite, one setulated seta present; inner portion of limb armed with two elements; scraper 4-5 and 6-7 of similar length. *Limb* III with seven setae on the exopodite; setae 6-7 of different length. *Limb* IV with six setae on the exopodite, 3-6 plumose; second and first seta armed with short setules. *Limb* V with incursion between lobes relatively deep, armed with four setae; filter plate bearing three naked setae. *Limb* VI present, 1.7 times longer than width.

*Male.*Unknown.

Ephipial female. Unknown. Ephipium covered by dense longitudinal lines, pale brownish.

Description

Parthenogenetic females. Habitus (Figures 7A-C, 11K). In a lateral view, the carapace is oval with posterior margin slightly elongated, maximum height at middle of body, body height/length ration about 0.60, not laterally compressed. Dorsal margin curved. Dorsal keel absent.

Head (Figures 7A-B). Ocellus and eye of similar size. Head shield with maximum width behind the mandibular articulation, line of the posterior margin straight and angular. Rostrum short, rounded, in lateral view projected towards ventral margin of carapace. Two connected main pores, of similar size, connection relatively narrow; PP about 0.5-0.6 IP; lateral head

pores tiny, located at level between main head pores, distance from midline about two times shorter than IP. *Labrum* (Figures 7K-N, 11L). Anterior margin convex, armed with 2-4 short and fine spinules of similar size, clearly separated; posterior margin with two clusters of setules; apex rounded.

Carapace (Figure 7A-E). Covered with longitudinal lines; ventral margin concave near half length, with 42-45 plumose setae per valve forming three groups, groups with long setules (anterior and posterior) separated by a group of short setules. Posterior margin straight, armed with long and rosbust internal spinules: spinules at posteroventral corner longer and thicker than others and projected beyond the margin, arranged in 2-3 groups.

Antennule (Figure 7I). Exceeding the length of rostrum, about 2.6 times longer than wide; four rows of short setules on antennular body. Antennular sensory seta slender, about 1.7 times smaller than antennular body, inserted in last third of antennule length at its base. Nine aesthetascs projecting beyond the tip of rostrum, two long aesthetascs similar in length to antennular body present.

Antenna (Figure 7J). Coxal setae not studied. Basal segment thickly armed, with a short spine and spinules. Antennal formula: spines 001/101, setae 113/003. Median segment of the exopodite and endopodite longer than apical segments. Seta on first segment of exopodite thin, armed with fine setules, not exceeding the length of branches of antenna. Seta on second segment of exopodite bi-segmented, about 1.5 times longer than shorter apical seta. Spine on first segment of endopodite short, exceeding half of the length, but not reaching the end of the second segment. Apical spines of the endopodite and exopodite similar in length to apical segments of antenna. Apical setae bi-segmented and setulated. All segments have spinules at the terminal portion; setules on the second segment of the exopodite long.

Abdomen about two times shorter than thorax. Two rows of abdominal setae.

Postabdomen (Figures 7O, 11M-N). Relatively long, about 2.6 times as long as wide, ventral margin slightly rounded, with two rows of short spinules. Distal portion broadly rounded. Anal margin very long, occupying about 60% of the postabdomen length. Nine lateral fascicles armed with thin and long spinules; first spinule of fascicles thicker than others, exceeding the postabdomen margin and length of the marginal denticles; eight marginal denticles increasing in length towards distal portion; denticles bear spinules on the anterior margin; the proximal-most denticles grouped. *Postabdominal seta* (Figure 7A-B). About two times shorter than postabdomen length, bi-segmented; setules on first segment short when compared to setules of second segment. *Terminal claw* (Figure 7O, 11M). About 0.3 of length of postabdomen; implanted at projected short basis from the postabdomen, uniformly curved, with one group of short spinules on base itself; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* (Figure 7O, 11M). About 1.7 times longer than width of claw at its base; basal spines armed with spinules that reach the distal portion.

Mandibles not studied. *Maxilla* (Figure 8A). Armed with two setulated setae.

Six pairs of limbs.

Limb I (Figure 8B-D). Epipodite oval with long projection. Accessory seta short, similar in length to base of ODL, which has a seta armed with long setules in the distal part, shorter than length of seta 3 of the IDL. IDL (en4) with three groups of spinules on its face, three setae present; seta 1 relatively short, about half length seta 2, naked; setae 2 and 3 of different length, bisegmented and armed with thick spinules. Endite 3 with four setae; posterior setae a-b longer than posterior seta 1 on the endite. Endite 2 with two rows of spinules; three posterior setae present (d-f), seta (f) 0.7 times shorter than seta (e), both setae have thick spinules on the lateral face; endite armed with two minute elements inserted near to base of seta (d); seta (d) setulated and exceeding half the length of seta (e). Endite 1 with three

posterior setae (g-i); setae (g) and (h) bi-segmented and densely setulated in distal part, of similar length; seta (i) relatively short, about 0.2 of setae (g) and (h). Ejector hooks of similar length and armed with short denticles. Ventral face of the limb with eight groups of setules organized in clusters, decreasing towards the distal portion. Gnathobase elongated; setules were not observed on the gnathobase.

Limb II (Figure 8E-F). Exopodite elongated, with two rows of setules, distal row longer than proximal; one seta setulated at distal portion present, about 1.8 times shorter than its own exopodite. Inner limb portion armed with eight scrapers and two elements; scraper 3 shorter than 2 and similar in length to scrapers 4 and 5; scrapers 6-7 of similar length. Scrapers 1-4 armed with fine spinules; scrapers 5-8 armed with fine spines. Proximal portion of the gnathobase short, apex armed with setules; distal portion armed with four elements, first as a robust sensillum, second as element with distal portion acute and slightly geniculated, third element armed with denticles, fourth element short and obtuse. Filter comb with seven setae; first and second setae short; other setae long and slightly setulated (setulae on the setae not showed).

Limb III (Figure 8G-I). Epipodite oval, with short projection. Exopodite subquadrangular, with five distal and two lateral setae. Seventh seta setulated and about 1.8 times longer than sixth seta; sixth seta setulated. Fifth seta long, armed with proximal short setules, distal setules relatively long, about 1.6 times longer than second seta. Fourth and third setae setulated and similar in length. Second seta about 2.7 times longer than first seta; armed with long setules from median portion. First seta slightly setulated. Distal endite armed with one sensillum and three setae (1-3), two scraper-like of different length (1-2); third seta curved and armed with many setules bilaterally implanted (3); four plumose posterior setae similar in length (a-c). Basal endite with four soft anterior setae increasing in length towards the gnathobase. Gnathobase armed with four elements, the first being a cylindrical sensillum, the

second a geniculated seta and third and fourth elements with tip acute, naked. Filter comb with seven setae (setulae on the setae not showed).

Limb IV (Figure 8J-L). Pre-epipodite rounded and densely setulated. Epipodite oval with a long projection. Exopodite subquadrangular with six marginal setae; setae 3-6 plumose; setae 4-6 similar in length; third seta short, about 3.5 times shorter than second seta; setae 1-2 of similar length, armed with short setules. Distal endite with a sensillum and four setae (1-4), one scraper-like (1), three flaming-torch-like (3-4); the first flaming-torch relatively robust, with long setules (2). Basal endite with three soft setae slightly setulated, increasing in length towards gnathobase. Gnathobase armed with one globular sensillum and a setulated seta implanted on a robust base. Filter plate with five setae (setulae on the setae not showed).

Limb V (Figure 8M-N). Pre-epipodite rectangular and densely setulated, epipodite oval with long projection. Exopodite divided into two lobes, incursion between lobes relatively deep; four plumose setae present; setae 3-4 similar in length, about 1.3 times longer than seta 3; first seta about 2.7 times shorter than seta 2. Internal lobe wide, oval and with long setules; two setulated setae on inner face of lobe, first seta longer than length of lobe. Gnathobase armed with an inflated element; Filter plate armed with three naked setae.

Limb VI (Figure 8O-P). An elongated lobe, relatively rounded, about 1.7 times longer than width of lobe; apical margin of lobe with long setules; only one lateral margin totally setulated, with short or long setulae.

Male. Unknown.

Ephipial female. Unknown. Ephipium (Figure 7P-Q) covered by dense longitudinal lines, pale brownish; weak lateral compression.

Size. The length of the adult parthenogenetic females were 0.30-0.34 mm. In juvenile females, the length was 0.28-0.29 mm.

Remarks. Alona sp. nov. 1 clearly resembles *A. intermedia* (Alonso 1996; Floessner 2000) and *Alona* cf. *intermedia*. However, it has a unique armature of labral keel and setules of lateral fascicles on the postabdomen. Specifically, *Alona* sp. nov. 1 differs from *Alona* cf. *intermedia* because it has naked first seta of the IDL and setae of the filter comb of the fifth limb. The postabdomen of *Alona* sp. nov. 1 bears spinules of lateral fascicles longer than level of marginal denticles, internal setules are armed in 2-3 groups on the posterior margin of carapace and antennule with two long aesthetascs. The limbs of *Alona* sp. nov. 1 are less robust when compared to *Alona* cf. *intermedia* and the main differences were observed on the first, second and fifth limbs. On the first limb, *Alona* sp. nov. 1 has two elements, not observed in *Alona* cf. *intermedia*.

Geographical distribution. Alona sp. nov. 1 has a wide distribution in Brazilian territory, occurring in Brazil Central, Sourthern and South regions. This species may be found in shallow lakes, ponds and lotic ecosystems.

Gen. nov. 1

(Figures 9-10, 11)

Diagnosis

Female. Carapace oval, with posterior margin slightly elongated; maximum height at middle of body, body height/length ration about 0.63; not laterally compressed. *Head* with ocellus and eye of different size; two main pores connected; connection relatively wide; PP about 0.5

IP; lateral head pores tiny. *Labrum* presenting anterior margin armed with large notch, posterior margin with two clusters of setules. *Carapace* armed with longitudinal fine lines; ventral margin almost straight, with 36 plumose setae per valve, posterior setae long; inner proximal spinules not arranged in groups, projected beyond the margin. *Antennule* about two times longer than wide; antennular sensory seta short, about three times smaller than the antennular body; nine aesthetascs shorter than length of the antennular body. *Antenna*: antennal formula: spines 001/101, setae 113/003; median segment of exopodite and endopodite shorter than apical segments; seta on first segment of exopodite thin, not exceeding the length of branches of antenna. *Postabdomen* about 2.8 times as long as wide; postanal margin slightly concave, truncated; pre-anal and postanal angles evident; seven robust merged marginal denticles increasing in length towards the distal portion; eight–10 lateral fascicles armed with thin setules. *Terminal claw* armed with 3-4 short spinules on the base; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* similar length to the width of claw at its base, naked. *Limb* I with IDL with two groups of spinules on its face, three setae present; seta 1 about 3.5 times shorter than setae 2-3, naked; setae 2-3 armed with short and slight setules. Seta (1) of third endite slender, setae (a-b) longer than seta 1. Setae (e-f) similar in length, one element present on the endite; endite 1 armed with one reduced seta (i). *Limb* II with elongated exopodite, one setulated seta present; setae 1-2 on the inner portion long, of similar length; filter comb armed with seven setae, first seta shorter than others. *Limb* III with seven setae on the exopodite; setae 6-7 of different length; setae 3-4 similar in length; first seta naked, shorter than midlength of second seta. Gnathobase armed with four elements, one not acute. *Limb* IV with six setae on the exopodite, of which 3-6 plumose; seta 4 slightly longer than setae 5-6; third seta long, similar in length to second seta; first seta naked. *Limb* V with relatively shallow incursion between lobes, armed with four

setae; filter plate bearing three naked setae and one element. *Limb* VI present, 1.3 times longer than width; only one lateral margin is totally setulated.

Male.Unknown.

Ephipial female. Unknown.

Differential diagnosis

Gen. nov. 1 and sp. nov. 2 belong to the Hexalona-branch, but has exclusive morphological traits that differentiate it from other species groups that compose the aforementioned lineage: from *Alona affinis*-group it differs in its short size and lower number of marginal denticles on the postabdomen. From *A. costata*-group it differs in the absence of pockets in large lateral head pores. From *Alona guttata*-group, Gen. nov. 1 and sp. nov. 2 is distinguished by presenting two main head pores, distal marginal denticles on postabdomen about 1.4-1.6 longer than width at base (in *A. guttata* this is 2.5-3), long seta 1 on the IDL, a rudimentary seta on endite 1, long third seta on the exopodite of the fourth limb and wide lobe of the sixth limb. From *A. intermedia*-group, Gen. nov. 1 and sp. nov. 2 is differentiated by short length of the second segment of the branches of antenna, postabdomen shape, labral keel and organization of setae on the valves. In the limbs of Gen. nov. 1 and sp. nov. 2, the main differences when compared to *A. intermedia*-group are related to a rudimentary seta on the first endite of the first limb, second seta on the exopodite of the third limb not plumose and long third seta on the exopodite of the fourth limb. In the near future the members of *A. guttata*-group, *A. intermedia*-group, *A. costata*-group and *A. affinis*-group will be transferred to another genera, different from *Alona*.

Gen. nov. 1 and sp. nov. 2

(Figures 9-10, 11)

Type locality. A temporary pond located in high-altitude field (aproximadately 1200 m), Bom Jesus, Rio Grande do Sul, Brazil (28º36’57”S , 50º22'11"W).

Material type

Holotype: Dissected parthenogenetic female on the slide deposited at the Museum of Zoology of the State University of Bahia under accession number UFBA2168. The label of the holotype is: “Gen. 1 nov. and sp. nov. 2, 1 parth. ♀ from a temporary pond, Bom Jesus, Rio Grande do Sul, Brazil. Holotype”.

Paratypes: Four parthenogenetic females from temporary pond located in high-altitude field, Bom Jesus, Rio Grande do Sul, Brazil (28º36’57”S , 50º22'11"W). Material collected by MSc. Raquel Freiry and Dr. Leonardo Maltchik on 17 June 2014 and leg by Dr. Cristina Sternet. Slides containing dissected specimens deposited at Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília (CLLA216-219).

Diagnosis

As for genus.

Description

Parthenogenetic females. Habitus (Figure 9A). In a lateral view, the carapace is oval, maximum height at middle of body, body height/length ration about 0.63, not laterally compressed. Dorsal margin convex. Dorsal keel absent.

Head (Figure 9A, D-E). Ocellus and eye of different size. Head shield not studied. Rostrum short, in lateral view projected towards the ventral margin of carapace. Two connected main pores of similar size, connection relatively wide; PP about 0.5 IP; lateral head pores tiny, located at level between main head IP. *Labrum* (Figures 9F, 11O). Anterior margin armed with large notch; posterior margin with two clusters of setules; apex rounded.

Carapace (Figure 9A-C). Covered with fine longitudinal lines; ventral margin almost straight, with 36 plumose setae per valve, posterior setae long. Posterior margin straight, armed with internal spinules not arranged in groups, projected beyond the margin; distal-most spinules short.

Antennule (Figure 9G). Exceeding the length of rostrum, about two times longer than wide; three rows of short setules on the antennular body. Antennular sensory seta slender, about three times smaller than the antennular body, inserted in two-thirds of antennule length counting from the base. Nine aesthetascs of different length projecting beyond the tip of rostrum; aesthetascs shorter than length of the antennular body.

Antenna (Figure 9H). Coxal setae not studied. Basal segment thick, armed with a short spine and spinules. Antennal formula: spines 001/101, setae 113/003. Median segment of exopodite and endopodite shorter than apical segments. Seta on first segment of exopodite thin, not exceeding the length of branches of the antenna. Seta on second segment of exopodite bi-segmented, similar in length to shorter apical seta. Spine on first segment of endopodite short, exceeding half the length, but not reaching the end of second segment. Apical spines of the endopodite and exopodite slightly longer than length of apical segments of antenna. Apical seta bi-segmented and setulated. All segments bear spinules at terminal portion; setules on second segment of exopodite long.

Abdomen about 1.7 times shorter than thorax, armed with three rows of abdominal setae.

Postabdomen (Figures 9I-J, 11P). Relatively short, about 2.8 times as long as wide, ventral slightly rounded, with two rows of spinules. Pre-anal and postanal angles evident; pre-anal margin longer than anal and postanal margin. Anal margin strongly concave, with 3-4 groups of denticles. Postanal margin slightly concave, truncated, with prominent distal angle. Eight–ten lateral fascicles armed with thin setules. Seven robust merged marginal denticles increasing in length towards distal portion, distal-most denticles bear spinules on the anterior margin. *Postabdominal seta* (Figures). Not studied. *Terminal claw* (Figure 9I-K). Implanted at the projected short basis from the postabdomen, similar to length of anal margin, uniformly curved, with 3-4 short spinules on the base; pecten armed with one row of inner and outer spinules; outer row with spinules of similar length; distal spinules on inner row longer than others. *Basal spine* (Figure 9I-K) short, of similar length to claw at its base, without spinules or setules.

Mandibles not studied. *Maxilla* (Figure 10A). Armed with two setulated setae.

Six pairs of Limbs.

Limb I (Figures 10B-D, 11Q). Epipodite oval with long projection. ODL with a seta armed with slight and short setules from distal part, shorter than length of IDL setae; accessory seta not studied. IDL (en4) with two groups of spinules on its face, three setae present; seta 1 short, about 3.5 times shorter than setae 2-3, naked; setae 2 and 3 similar in length, bi-segmented and armed with short and slight setules. Endite 3 with four setae; posterior setae a-b longer than anterior seta 1, which is slender. Endite 2 with two rows of spinules; three posterior setae present (d-f), setae (e-f) similar in length, both setae have thick spinules on the lateral face; endite armed with a minute element inserted near to base of the seta (d); seta (d) setulated and exceeding half the length of setae (e-f). Endite 1 with three posterior setae (g-i); seta (g) and (h) bi-segmented and densely setulated in distal part, of similar length; seta (i) not developed. Ejector hooks of different length and armed with short denticles. Ventral face of

the limb with nine groups of setules organized in clusters, decreasing towards the distal portion. Gnathobase elongated; setules were not observed on the gnathobase.

Limb II (Figure 10E-F). Exopodite elongated, with one row of setules; one seta setulated at distal portion present, about two times shorter than its own exopodite. Inner limb portion armed with eight scrapers decreasing in length towards the gnathobase; scraper 5-4 of similar length 5; scrapers 1-5 armed with fine spinules; scrapers 6-8 armed with fine spines. Proximal portion of the gnathobase short, apex armed with setules; distal portion armed with four elements, first as a short sensillum, second as element with distal portion acute and slightly geniculated, third element armed with denticles, fourth element short and obtuse. Filter comb with seven setae; first seta short and densely setulated; other setae long and slightly setulated (setulae on the setae not showed).

Limb III (Figures 10G-I, 11R). Epipodite not studied. Exopodite subquadrangular, with five distal and two lateral setae. Seventh seta setulated and about 1.5 times longer than sixth seta; sixth seta setulated. Fifth seta long, armed with short setules, about 1.5 times longer than second seta. Third and fourth setae setulated and similar in length. Second seta about 1.6 times longer than first seta, armed unilaterally with short spinules. First seta naked, shorter than midlength of second seta. Distal endite armed with three setae (1-3), two scraper-like of similar length (1-2); third seta curved and armed with many setules bilaterally implanted (3); four plumose posterior setae similar in length (a-d). Basal endite with four soft anterior setae increasing in length towards the gnathobase and one sensillum. Gnathobase armed with four elements, the first being a cylindrical sensillum, the second a short geniculated seta, the third elongated and not acute, the fourth element with tip acute, naked. Filter comb with seven setae (setulae on the setae not showed).

Limb IV (Figures 10J-L, 11R). Pre-epipodite rounded and densely setulated. Epipodite oval with a long projection. Exopodite subquadrangular with six setae; setae 3-6 plumose; seta 4

slightly longer than setae 5-6; third seta long, similar in length to second seta; first seta slightly shorter than second seta, naked. Distal endite with four setae (1-4), one scraper-like (1), three flaming-torch-like (3-4); the first flaming-torch relatively robust, with long setules (2). Basal endite with three soft setae of similar length. Gnathobase armed with one globular sensillum and one setulated seta implanted on a robust base. Filter plate with five setae.

Limb V (Figures 10M-N, 11R). Pre-epipodite rounded and densely setulated, epipodite oval with long projection. Exopodite divided into two lobes, incursion between lobes relatively shallow; four plumose setae present; setae 2-4 similar in length; first seta about two times shorter than other setae. Internal lobe wide, oval and with long setules; two setulated setae on the inner face of the lobe, first seta longer than length of the lobe; Filter plate armed with three naked setae and one element (setulae on the setae not showed).

Limb VI (Figures 10O, 11R). A short lobe, relatively rounded, about 1.3 times longer than width of lobe; apical margin of the lobe with long setules; only one lateral margin totally setulated.

Male. Unknown.

Ephipial female. Unknown.

Size. Up 0.37 mm.

Geographical distribution. Gen. nov. 1 and sp. nov. 2 seems to have a reduced geographic distribution, restricted to altitude fields. So far, this species was observed in the type locality. This is a rare species and we believe it to be endemic. Gen. nov. 1 and sp. nov. 2 inhabits a temporary pond with higher cover of S*phagnum*. The water conditions point to an acid environment (pH below 5).

Discussion

The Hexalona-branch is formed by some morphologically well-defined groups of species. Although the morphology of main head pores is variable, morphological traits related to limbs support *A. costata*-group in a general context (Sinev 1999a, 2008; Van Damme & Dumont 2008a). In that group, however, distinct arrangements may be observed related to the morphology of the postabdomen (e.g. *rustica*-group) (Hudec 1998; Sinev 2001; Van Damme & Erggemont 2011), which might represent subgeneric differentiation. In the *A. affinis*-group, external morphological traits such as limbs support the group (Sinev 1997, 2009b, 2013; Van Damme & Dumont 2008b). The aforementioned groups of species have well delineated species from different regions of world, which is fundamental to find natural groups in a phylogenetic and biogeographical context. It is possible that in the near future the members of *A. costata*-group and *A. affinis*-group will be transferred to another genera, different from *Alona*.

Although many names related to *A. guttata*-group are observed in the literature, only three species are considered valid so far: *A. guttata* sensu stricto (Sars, 1862) and *A. werestschagini* (Sinev 1999b) distributed in the Paleartic and *A. barbulata* from Neartic (Megard 1967). The current knowledge about this group of species shows that parthenogenetic females are differentiated by slight features. For instance, differences in the limbs between *A. werestschagini* and *A.* cf. *guttata* from Mexico (Sinev & Silva-Briano 2012) are related to the proportion of setae at limbs III and IV and absence or presence of short seta on the IDL. The specimens from Brazil studied here have similar morphology of limbs when compared to the Mexican population (Sinev & Silva-Briano 2012). However, Brazilian specimens have the posterior portion of the labral keel covered by minute setules (Figures 1K-M, 11B) and higher variability in the shape of the postabdomen (Figure 2D-J). From *A. werestschagini,* the Brazilian populations of *A.* cf. *guttata* also differ in the proportions of

setae 3-4 of the third limb, seta 3 on the fourth limb and presence of the three setae on the IDL. There is no description of limbs of *A. barbulata*, but this species has triangular posterior margin of head shield, while *A.* cf. *guttata* from Brazil has a more rounded margin (Figure 1G).

Sinev & Silva-Briano (2012) suggested that gamogenetic specimens of *A. guttata* may be essential to help resolve taxonomic problems. Indeed, Sinev (1999b) previously showed important differences in the morphology of males of three species of *A. guttata*-group. Both the first limb, postabdomen and terminal claw have differences: *Alona barbulata* has a postabdomen narrowing distally and a "small patch of cilia" instead of basal spine on the terminal claw (Megard 1967). The basal spine in males of *A. werestschangni* is absent and the postabdomen is long and strongly narrow (Sinev 1999b). In *A. guttata* sensu lato, the males have one very short basal spine (Alonso 1996; Sinev 1999b; Floessner 2000). The males of *A.* cf. *guttata* from Brazil (São Paulo state) have a postabdomen narrowing distally, but the terminal claw is armed with basal spine and a large setule (Figure 2K-M). New evidences for the non-cosmopolitanism of *A. guttata* was raised in this study; however, it is necessary to carry out an investigation worldwide to delimit species, if possible, including the redescription of *Alona guttata* sensu lato from the type locality (Norway) and molecular tools.

Likewise, *Alona intermedia* is taken as a complex with many cryptic species (Van Damme & Dumont 2008b; Van Damme et al. 2010), and a worldwide revision is also required. In this study, we observed that *A.* cf. *intermedia* from the Brazilian population is very similar to the description of Alonso (1996), with few differences: in Alonso (1996), the first seta of IDL does not bear spines, spinules on the filter comb setae of fifth limb are absent and setae 6-7 of the third limb have a similar length. Floessner (2000) also presented a partial description and figures of other European population of *A. intermedia*, and the main difference when compared to *A.* cf. *intermedia* from Brazil was observed at the labral keel,

which is naked. We described the male from *A.* cf. *intermedia*, and the shape of the postabdomen is distinct from males previously described: Chengalath (1987) presented two forms of postabdomen for *A. intermedia* from Canada, with one being similar to that of males from Floessner (2000). However, the postabomen of males of *A.* cf. *intermedia* from Brazil is quite different, with the dorsal and ventral margins being almost parallel (Figures 4K, 11J). We could not place *A.* cf. *intermedia* in a new taxon, because there is no material for comparisons, such as full descriptions of *A. intermedia* from the type locality (Norway). Nevertheless, the findings about the morphology of the Brazilian population may help in comparison with specimens from other continents and in South America.

In Brazil, however, there is a new species from *A. intermedia*-group, *Alona* sp. nov. 1. Although the description of *A. intermedia* sensu stricto is still required, *Alona* sp. nov. 1 has consistent differences when compared with data for the Paleartic zone (Alonso 1996; Floessner 2000) and *A.* cf. *intermedia* from Brazil. *Alona* sp. nov. 1 has a unique armature of its labral keel with 2-4 short spinules on the anterior margin (Figures 7K-N, 11L), spinules of lateral fascicles on the postabdomen longer than the level of marginal denticles (Figures 7D, 11N) and internal setules of posterior margin of carapace armed in 2-3 groups. When compared to *A.* cf. *intermedia*, *Alona* sp. nov. 1 also presented differences in the limb morphology, such as (1) two elements on the second endite on the first limb, (2) seta 1 of IDL naked, (3) scrapers 4-5 of similar length on the second limb and (4) setae of filter comb on the fifth limb naked. Although *Alona* sp. nov. 1 and *A.* cf. *intermedia* have many differences, both share morphological traits from *intermedia*-group (see Van Damme & Dumont 2008). Likewise, *A. costata*-group and *A. affinis*-group from Hexalona-branch, the species that compose *A. intermedia*-group, may be transferred to a new genus in the future (Van Damme et al. 2010; Sinev & Zawisza 2013).

The members of the core group of the Hexalona-branch share some morphological traits, such as seven setae on the exopodite of the third limb, well developed seta 1 of the IDL, exopodite of fifth limb bilobed with filter comb armed with three setae, sixth limb present and marginal denticles on the postabdomen merged (Van Damme & Dumont 2008b; Sinev & Zawisza 2013). These features are also shared by Gen. nov. 1 and sp. nov. 2, but its position is unclear. This species surely does not belong to *A. affinis*-group and *A. costata*-group because of the morphology of the postabdomen and armature of limb I and IV. This species also does not fit in *A. intermedia*-group because it has a reduced seta on the first endite of limb I, seta 2 on the exopodite of limb III not plumose, the gnathobase of limb III is armed with two cylindrical elements, the postabdomen with distal portion not rounded and the second segment of the antenna branches is shorter than first segment. Regarding *A. guttata*-group the differences are observed in many morphological traits: (1) reduced seta on the first endite of limb I, (2) well-developed seta 1 of the IDL, (3) gnathobase of limb III armed with two cylindrical elements, (4) long seta 3 on the exopodite of limb IV and (5) robust distal marginal denticles of postabdomen.

The Gen. nov. 1 and sp. nov. 2 also does not fit in marginal groups of the Hexalona-branch. From *quadrangularis*-group and *pulchella*-group, now, belong to *Ovalona* genus (Van Damme & Dumont 2008a, b; Sinev 2012; Sinev 2015), it is differentiated by the morphology of the labral keel, postabodomen, main head pores, and limbs (especially the sixth limb absent in these groups). From *Matralona* Van Damme & Dumont 2009, a genus closer to the Hexalona-branch, Gen. nov. 1 and sp. nov. 2 differs in the number of setae on the IDL, number of seate on the exopodite of limb III, morphology of flaming torch setae of limb IV, shape and armature of postabdomen and labral keel armature (Van Damme & Dumont 2009b).

Recently, Sinev & Zawisza (2013) described a species from Mexico that superficially resembles *A. intermedia*, and they named it *Alona manueli* Sinev & Zawisza 2013. This species also does not fit any core group or marginal group of the Hexalona-branch. At the same time, *Alona manueli* seems not to be close to Gen. nov. 1 and sp. nov. 2 because it has no filter comb on limb V and limb VI is absent. The postabdomen, labral keel and fine structures of limbs are also different (Sinev & Zawisza 2013). These species have in common the association with a specific habitat, evidencing the strong endemism in regions of altitude and shallow ponds in species of *Alona* sensu lato or related genera (Kotov et al. 2010; Sinev & Kobayashi 2012; Sinev & Shiel 2012).

Acknowledgements

We are deeply grateful to Dr. Cristina Sternet, MSc. Raquel Freiry, and Dr. Leonardo Maltchik for donation of the material from Rio Grande do Sul state. We also thank members of GEEA for collecting samples used in this manuscript. We also thank Ms. Susan Casement for revising the English version of this manuscript. The first author of this paper received a scholarship from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

References

Alonso M. 1996. Crustacea, Branchiopoda. Serie Fauna Ibérica, Vol. 7. Madrid CSIC.

Chengalath R. 1987. The distribution of Chydoridae in Canada. Hydrobiologia 145: 151-157.

Diniz, LP, Elmoor-Loureiro LMA, Almeida VLS, Melo-Junior M. 2013. Cladocera (Crustacea, Branchiopoda) of a temporary shallow pond in the Caatinga of Pernambuco, Brazil. Nauplius 21: 65–78.

Elmoor-Loureiro LMA, Mendonça-Galvão L, Padovesi-Fonseca C. 2004. New cladoceran record from Paranoa Lake, Central Brazil. Brazilian Journal of Biology 64 (3A): 415-422.

Elmoor-Loureiro LMA. 2007. Phytophilous cladocerans (Crustacea, Anomopoda and Ctenopoda) from Paranã River Valley, Goiás, Brazil. Zoologia 24 (2): 344-352.

Elmoor-Loureiro LMA. 2014. *Ephemeroporus quasimodo* sp. nov. (Crustacea: Cladocera: Chydoridae), a new species from the Brazilian Cerrado. Zootaxa 3821: 88–100.

Elmoor-Loureiro LMA, Santos-Wisniewski MJ, Rocha O. 2013. Redescription of *Alonella lineolata* Sars, 1901 (Crustacea, Cladocera, Chydoridae) and its translocation to the subfamily Aloninae and to the new genus *Bergamina* gen. nov.. Zootaxa 3630 (1): 571–581.

Flössner, D. (2000) Die Haplopoda und Cladocera (ohne Bosminidae) Mitteleuropas. Backhuys Publishers, Leiden, Netherlands.

Frey DG. 1982. Questions concerning cosmopolitanism in Cladocera. Archiv für Hydrobiologie 93 (4): 484–502.

Frey DG. 1987. The taxonomy and biogeography of the Cladocera. Hydrobiologia 145: 5–17.

Hudec I. 1998. Anomopoda (Crustacea: Branchiopoda) from some Venezuelan tepuis. Hydrobiologia 377: 205–211.

Kotov AA. 2000a. Analysis of *Kozhowia* Vasiljeva & Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda), and a description of *Parakozhowia* gen. n.. Hydrobiologia 437: 17–56.

Kotov AA. 2000b. Redescription and assignment of the chydorid *Indialona ganapati* Petkovski, 1966 (Branchiopoda: Anomopoda: Aloninae) to Indialonini, new tribus. Hydrobiologia 439: 161–178.

Kotov AA, Sinev, AY, Berrios VL. 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.

Maia-Barbosa PM, Menendez RM, Pujoni D, Brito SL, AOKI A, Barbosa FAR. 2014. Zooplankton (Copepoda, Rotifera, Cladocera and Protozoa: Amoeba Testacea) from natural lakes of the middle Rio Doce basin, Minas Gerais, Brazil. Biota Neotropica 14: 1-20, 2014.

Megard RO. 1967. Three new species of *Alona* (Cladocera, Chydoridae) from the United States. Internationale Revue der gesamten Hydrobiologie 52, 37–50.

Rocha O, Santos-Wisniewski MJ, Matsumura-Tundisi T. 2011. Checklist de Cladocera de água doce do Estado de São Paulo. Biota Neotropica 11: 1-21.

Santos-Wisniewski MJ, Matsumura-Tundisi T, Negreiros NF, Silva LCS, Santos RM, Rocha O. 2011. O estado atual do conhecimento da diversidade de Cladocera (Crustacea, Branchiopoda) nas águas doces do estado de Minas Gerais. Biota Neotropica 11: 287-301.

Sars GO. 1862. Hr. studios. Medic. G.O. Sars fortsatte sit Foredrag over de af ham i Omegnen af Christiania iagttagne Crustacea cladocera. (Mr. Medical student G.O. Sars continued his presentation about the Crustacea cladocera he collected in the vicinity of Christiania; see Frey, 1988). Forhandlinger i Videnskabs–Selskabet I Christiania 1861: 250–302.

Sinev AY. 1997. Review of the *affinis*-group of *Alona* Baird, 1843, with the description of a new species from Australia (Anomopoda Chydoridae). Arthropoda Selecta 6: 47–58.

Sinev AY. 1998. *Alona ossiani* sp. n., a new species of the *Alona affinis* complex from Brazil, deriving from the collection of G. O. Sars (Anomopoda Chydoridae). Arthropoda Selecta 7: 103–110.

Sinev AY. 1999a. *Alona costata* Sars, 1862 versus related palaeotropical species: the first example of close relations between species with a different number of main head pores among Chydoridae (Crustacea: Anomopoda). Arthropoda Selecta 8: 131–148.

Sinev AY. 1999b. *Alona werestschagini* sp. n., new species of genus *Alona* Baird, 1843, related to *A. guttata* Sars, 1862 (Anomopoda, Chydoridae). Arthropoda Selecta 8; 23–30.

Sinev AY. 2001. Redescription of *Alona iheringi* Sars, 1901 (Chydoridae, Anomopoda, Branchiopoda), a South American species related to *A. rustica* Scott, 1895. Hydrobiologia 464: 113–119.

Sinev AY. 2004. *Armatalona* gen. n. – a new genus of subfamily Aloninae (Anomopoda, Chydoridae), separated from genus *Alona* Baird, 1840. Hydrobiologia 420: 29–47.

Sinev AY. 2008. A new species related to *Alona costata* Sars, 1862 (Cladocera: Anomopoda: Chydoridae) from South Africa. Zootaxa 1707: 23–36.

Sinev AY. 2009a. Notes on morphology and taxonomic status of some North American species of the genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae). Fundamental and Applied Limnology 175: 59–77.

Sinev AY. 2009b. Cladocerans of the *Alona affinis* (Leydig, 1860) group from South Africa. Zootaxa 1990: 41–54.

Sinev AY. 2012. *Alona kotovi* sp. nov., a new species of Aloninae (Cladocera: Anomopoda: Chydoridae) from South Vietnam. Zootaxa 3475: 45–54.

Sinev AY. 2013. Cladocerans of *Alona affinis* group (Cladocera: Anomopoda: Chydoridae) from North America**.** Zootaxa 3693 (3): 329–343.

Sinev AY. 2015. Revision of *pulchella*-group of *Alona* s. lato leads to its translocation to *Ovalona* Van Damme et Dumont, 2008 (Branchiopoda: Anomopoda: Chydoridae). Zootaxa 4044 (4): 451-492.

Sinev AY, Elmoor-Loureiro LMA. 2010. Three new species of Chydoridae cladocerans of subfamily Aloninae (Branchiopoda: Anomopoda: Chydoridae) from Brazil. Zootaxa 2390: 1–25.

Sinev AY, Hollwedel W. 2002. *Alona brandorffi* sp.n. (Crustacea: Anomopoda: Chydoridae) – a new species from Brazil, related to *A. verrucosa* Sars, 1901. Hydrobiologia: 472, 131–140.

Sinev AY, Hollwedel W. 2005. Translocation of *Alona muelleri* Richard, 1897 into the genus *Karualona* Dumont & Silva-Briano, 2000 (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Selecta 14: 93–101.

Sinev AY, Kobayashi T. 2012. Redescription of the endemic Australian cladoceran *Alona willisi* (Smirnov, 1989) and its assignment to *Acanthalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). Zootaxa 3390: 43–45.

Sinev AY, Shiel R. 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.

Sinev AY, Silva-Briano M. 2012. Cladocerans of genus *Alona* Baird, 1843 (Cladocera, Anomopoda, Chydoridae) and related genera from Aguas Calientes State, Mexico. Zootaxa 3569: 1-24.

Sinev AY, Zawisza E. 2013. Comments on cladocerans of crater lakes of the Nevado de Toluca Volcano (Central Mexico), with the description of a new species, *Alona manueli* sp. nov.. Zootaxa 3647 (2): 390–400.

Smirnov, N.N. (1971) Chydoridae fauny mira. Fauna USSR. Rakoobraznie, 1 (2), Leningrad, 531 pp. [English translation: Chydoridae of the world. Israel Program for Scientific Translations, Jerusalem, 1974]

Soares, CEA, Elmoor-Loureiro LMA. 2011. Uma atualização da lista de Cladocera Cladocera (Crustacea, Branchiopoda) do Estado de Pernambuco, Brasil. Biota Neotropica 11: 1-6.

Sousa FDR, Elmoor-Loureiro LMA. 2012. How many species of cladocerans (Crustacea; Branchiopoda) are found in Brazilian Federal District? Acta Limnolgica Brasiliensia 24: 351–362.

Sousa FDR, Elmoor-Loureiro LMA. 2012. Cladocerans (Crustacea: Anomopoda and Ctenopoda) of the Sempre Vivas National Park, Espinhaço Range, Minas Gerais, Brazil. Checklist 9 (1): 004-008.

Sousa FDR, Elmoor-Loureiro LMA, Santos S. 2015a. Redescription of the *Coronatella poppei* (Richard, 1897) (Crustacea, Branchiopoda, Chydoridae) and a revision of the genus in Brazil, with descriptions of new taxa. Zootaxa 3955: 211–244.

Sousa FDR, Elmoor-Loureiro LMA, Santos S. 2015b. *Alona kaingang* (Crustacea, Cladocera, Aloninae): a new species of the *pulchella*-group, with identification key to Neotropical species. Zoological Studies 54: 1-12.

Sousa FDR, Santos S, Guntzel AM, Diniz LP, Melo-Júnior M, Elmoor-Loureiro LMA. 2015c. Description of a new species of the *costata*-group (Cladocera, Chydoridae, Aloninae) from Brazil. Zootaxa 4040 (4): 445-447.

Sousa FDR, Elmoor-Loureiro LMA, Quadra A, Senna A.R. 2014. First record of Cladocera (Crustacea: Chydoridae) from Parque Nacional do Itatiaia, Southeastern Brazil. Check List 10: 665-668.

Sousa FDR, Elmoor-Loureiro LMA, Mendonça-Galvão L, Pujol-Luz JR 2014. Evaluation of a new sampling method for assessing Cladocera richness (Crustacea, Branchiopoda) in macrophyte-rich wetlands. Annales de Limnologie 50: 143-153.

Van Damme K, Dumont HJ. 2008a. The 'true' genus *Alona* Baird, 1843 (Crustacea: Cladocera: Anomopoda): characters of the *A. quadrangularis*-group and description of a new species from Democratic Republic Congo. Zootaxa 1945: 1–25.

Van Damme K, Dumont HJ. 2008b. 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, Dumont HJ 2010. Cladocera of the Lençóis Maranhenses (NE-Brazil): faunal composition and a reappraisal of Sar's Method. Brazilian Journal of Biology 70(3): 755-779.

Van Damme K, Eggermont H. 2011. The Afromontane Cladocera (Crustacea: Branchiopoda) of the Rwenzori (Uganda–D. R. Congo): taxonomy, ecology and biogeography. Hydrobiologia 675: 57-100.

Van Damme K, Kotov AA, Dumont HJ. 2005. Redescription of *Leydigia parva* Daday, 1905 and assignment to *Parvalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). Journal of Natural History 39: 2125–2136.

Van Damme K, Kotov AA, Dumont HJ. 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.

Van Damme K, Sinev AY, Dumont HJ. 2011. Separation of *Anthalona* gen.n. from *Alona* Baird, 1843 (Branchiopoda: Cladocera: Anomopoda): morphology and evolution of scraping stenothermic alonine. Zootaxa, 2875, 1–64.

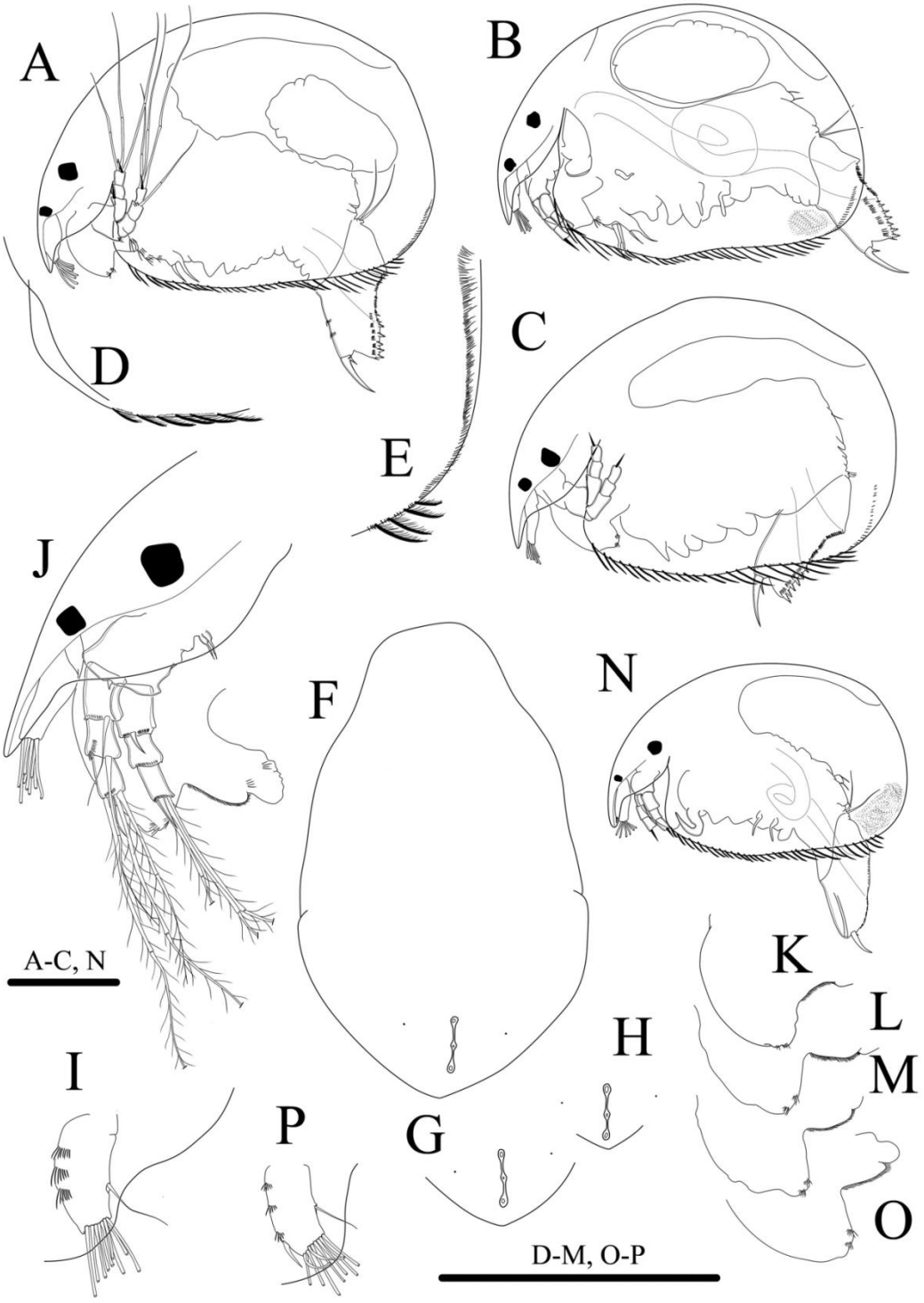


Figure 1. *Alona* cf. *guttata*. (A) *Habitus* from parthenogenetic female, São Paulo; (B) *idem*, Rio de Janeiro; (C) *idem*, Rio Grande do Sul; (D) Anteroventral corner of carapace; (E) Posteroventral corner of carapace; (F) Head shield; (G) Head pores; (I) Antennule; (J) Antenna; (K-M) Labral keel; (H, N-P) Male from São Paulo. (H) Head pores; (N) *Habitus*; (O) Labral keel; (P) Antennule. Scale bars = 50µm.

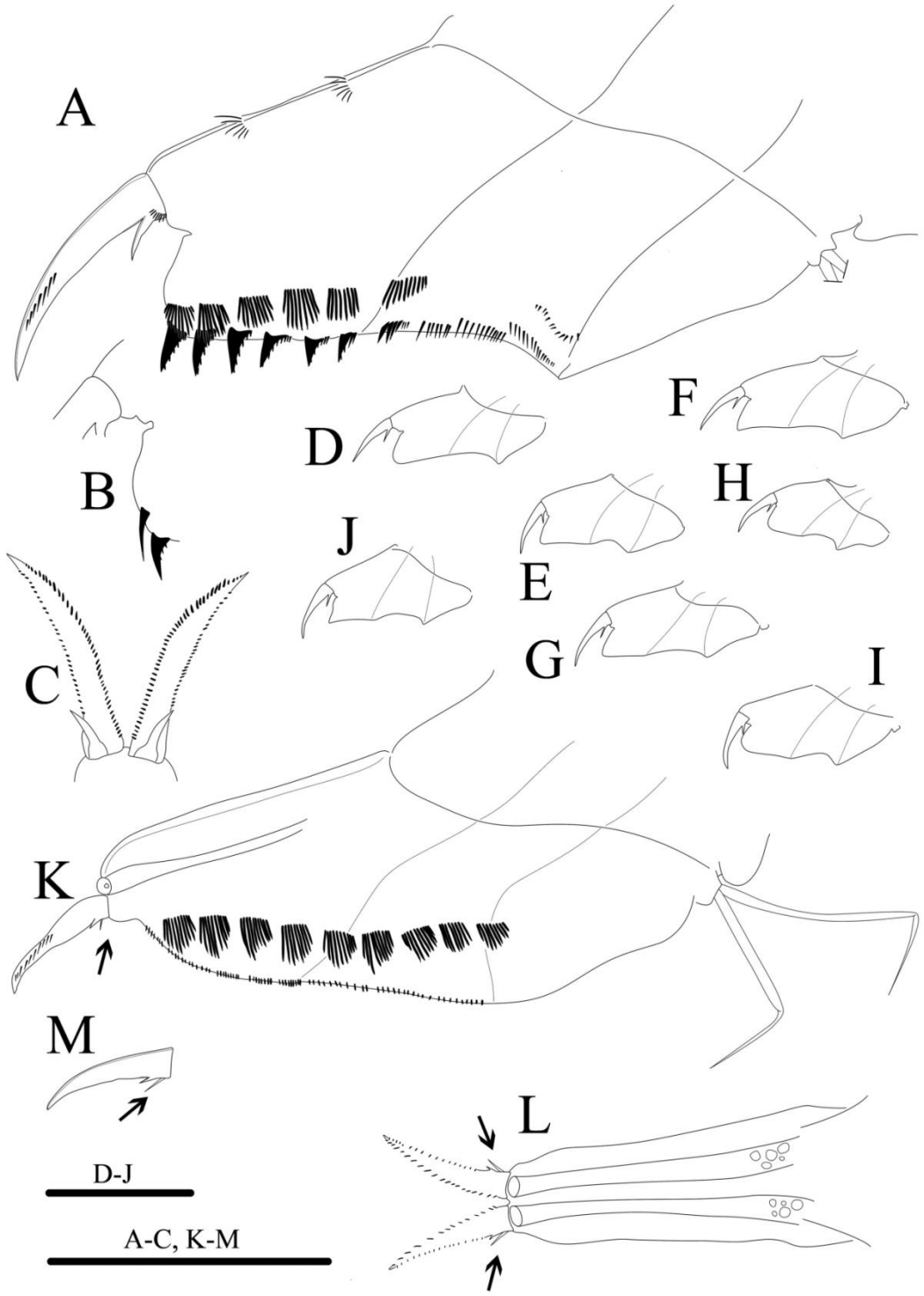


Figure 2. *Alona* cf. *guttata*. (A) Postabdomen from parthenogenetic female; (B) *idem*, incision on the distal line margin; (C) Ventral view from terminal claw and basal spines; (D-J) Variability of postabdomen shape; (K-M) Male from São Paulo. (K) Postabdomen, arrow showing the setule; (L) *idem*, dorsal view, arrows showing setules. (M) Terminal claw, arrow showing setule. Scale bars: A-C, K-M = 50µm; D-J = 100µm.

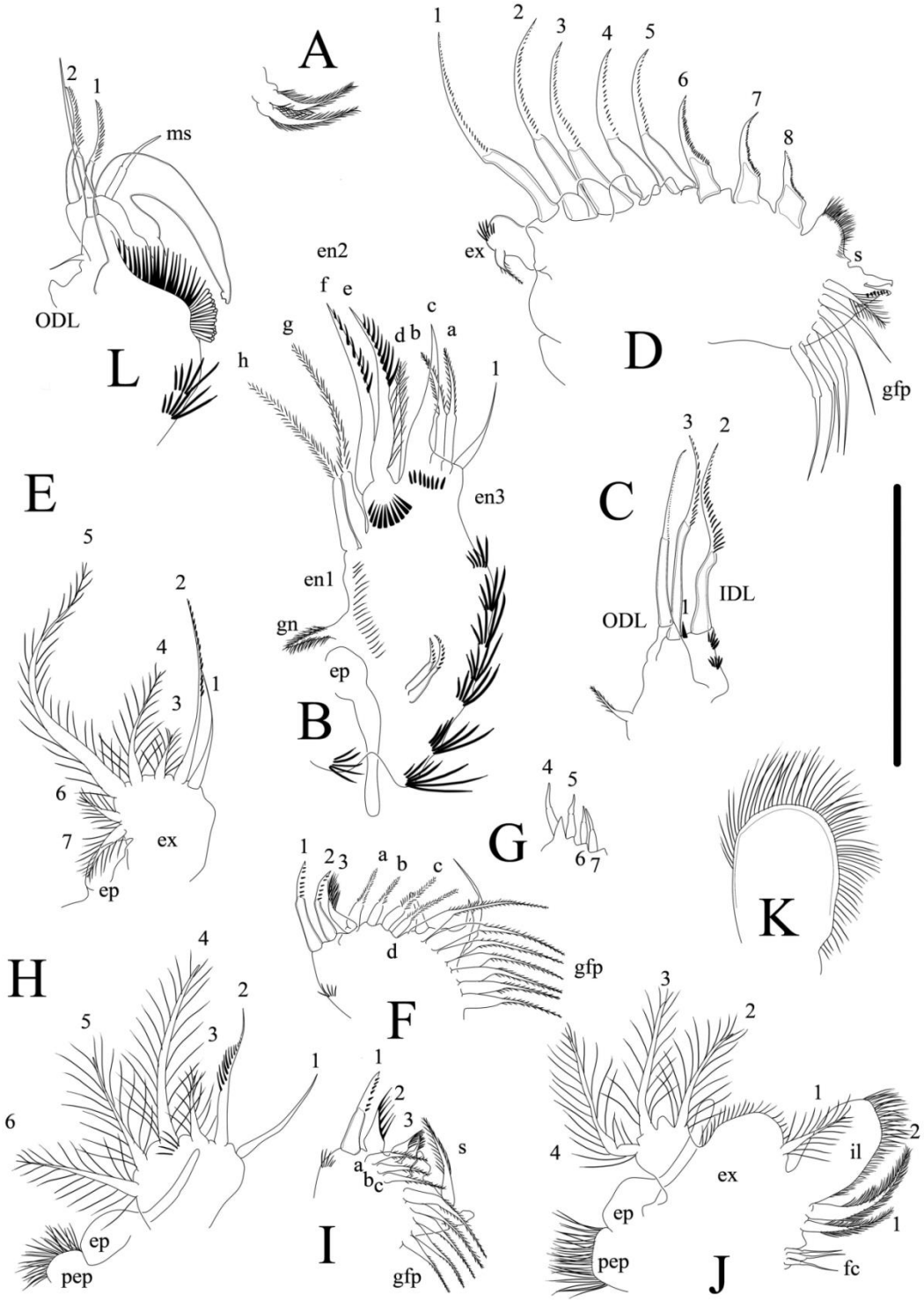


Figure 3. *Alona* cf. *guttata* from São Paulo. (A) Maxilla; (B) Limb I; (C) *idem* – ODL and IDL; (D) Limb II; (E) Limb III, exopodite; (F-G) *idem*, endites; (F) distal endite (G) basal endite; (H) Limb IV, exopodite; (I) *idem*, endites; (J) Limb V; (K) Limb VI; (L) Male, Limb I. For abbreviations, see Material and Methods. Scale bar = 50µm.

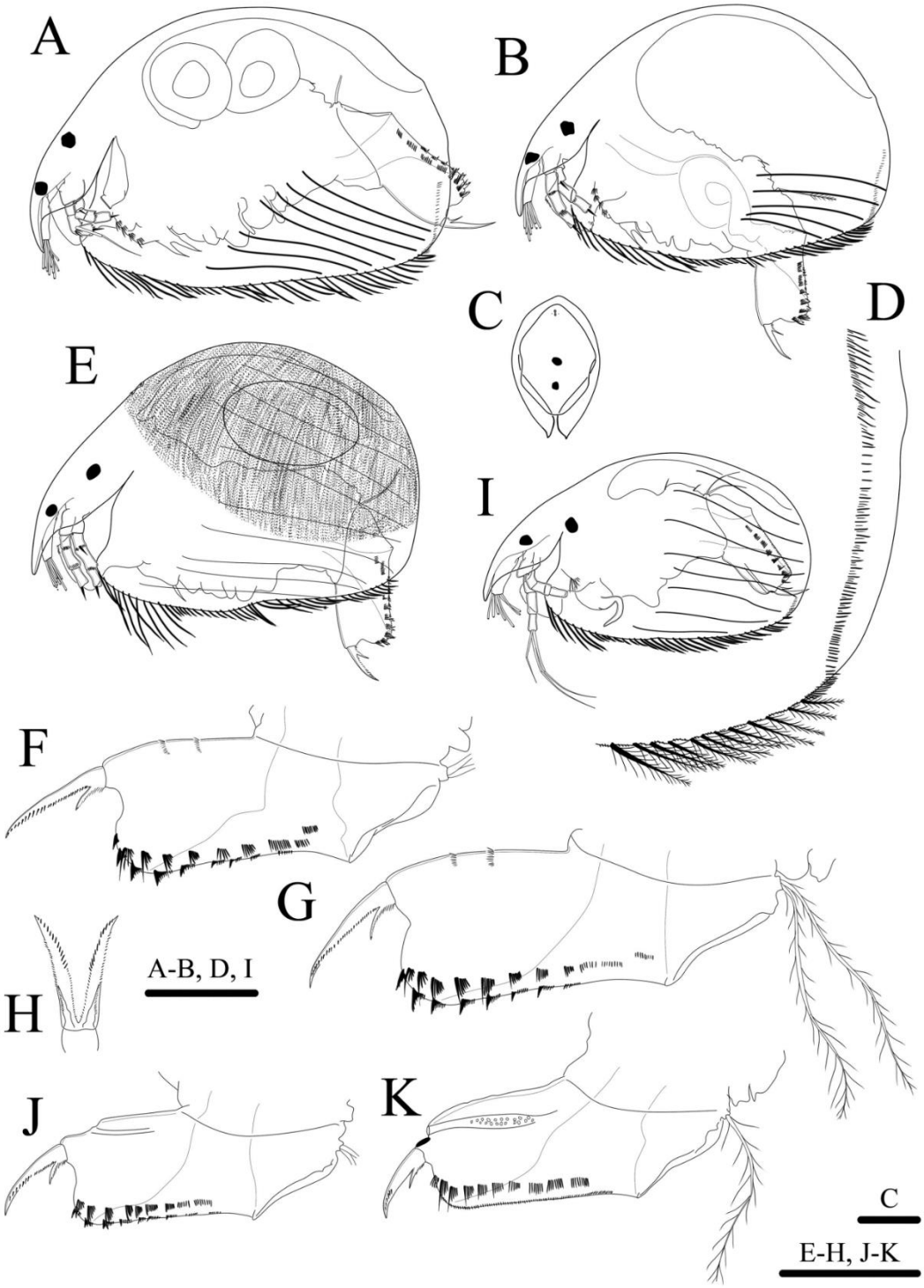


Figure 4**.** *Alona* cf. *intermedia* from a rock pool near Rosário Waterfall, Pirenópolis Goiás. (A-B) *Habitus* from parthenogenetic female; (C) Frontal view; (D) Posteroventral corner of carapace; (E) Ephipial female; (F-G) Postabdomen; (H) Ventral view from terminal claw and basal spines; (I-K) Male. (I) *Habitus* from adult; (J) Postabdomen, juvenile; (K) *idem*, adult. Scale bars = 50µm.

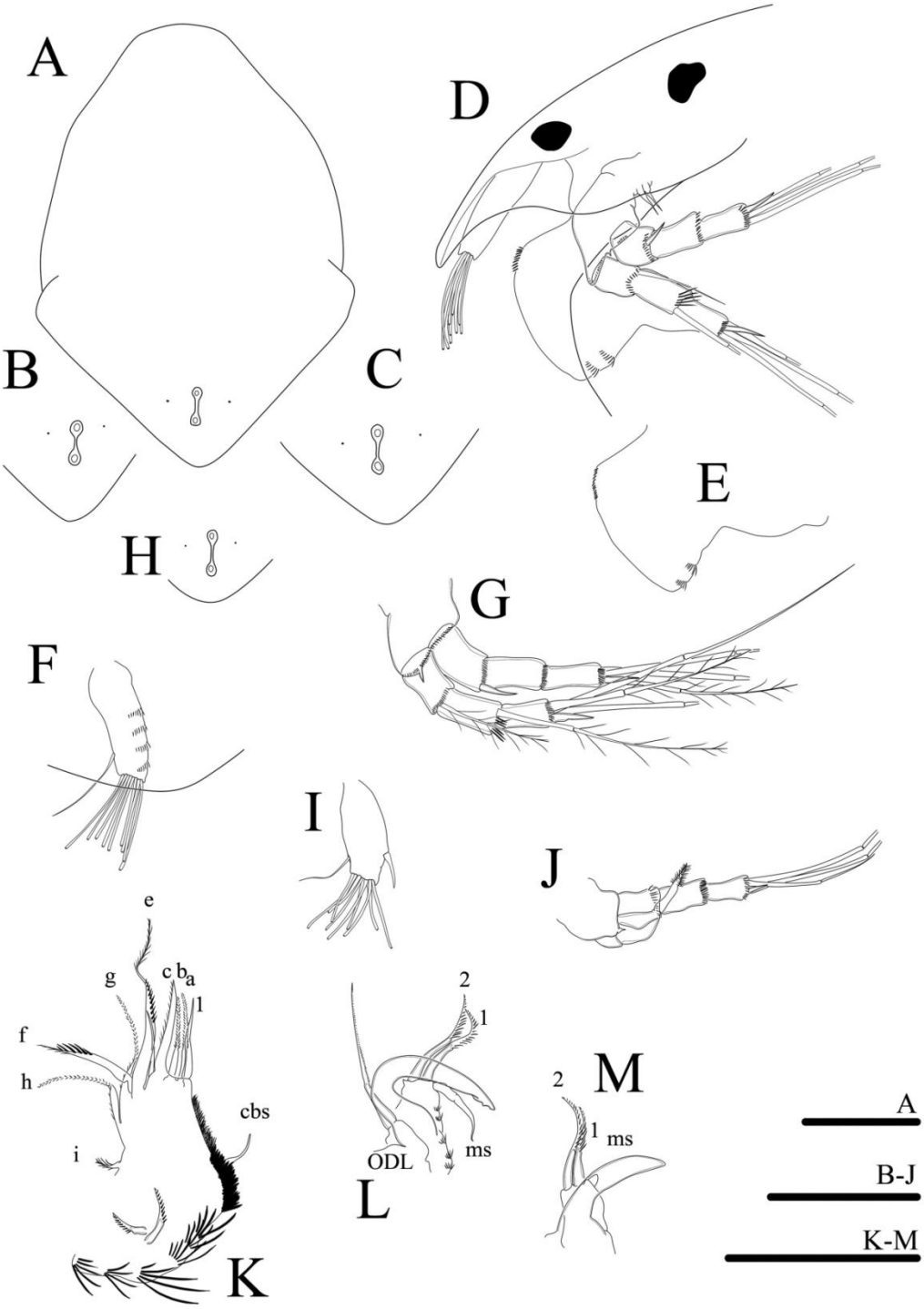


Figure 5. *Alona* cf. *intermedia* from a rock pool near Rosário Waterfall, Pirenópolis Goiás. (A-F) Parthenogenetic females. (A) Head shield; (B-C) Head pores; (D) Head; (E) Labral keel; (F) Antennule; (G) Antenna; (H-M) Male. (H) Head pores; (I) Antennule; (J) Abnormal antenna; (K-L) Limb I, adult; (M) *idem*, juvenile. For abbreviations, see Material and methods. Scale bar = 50µm.

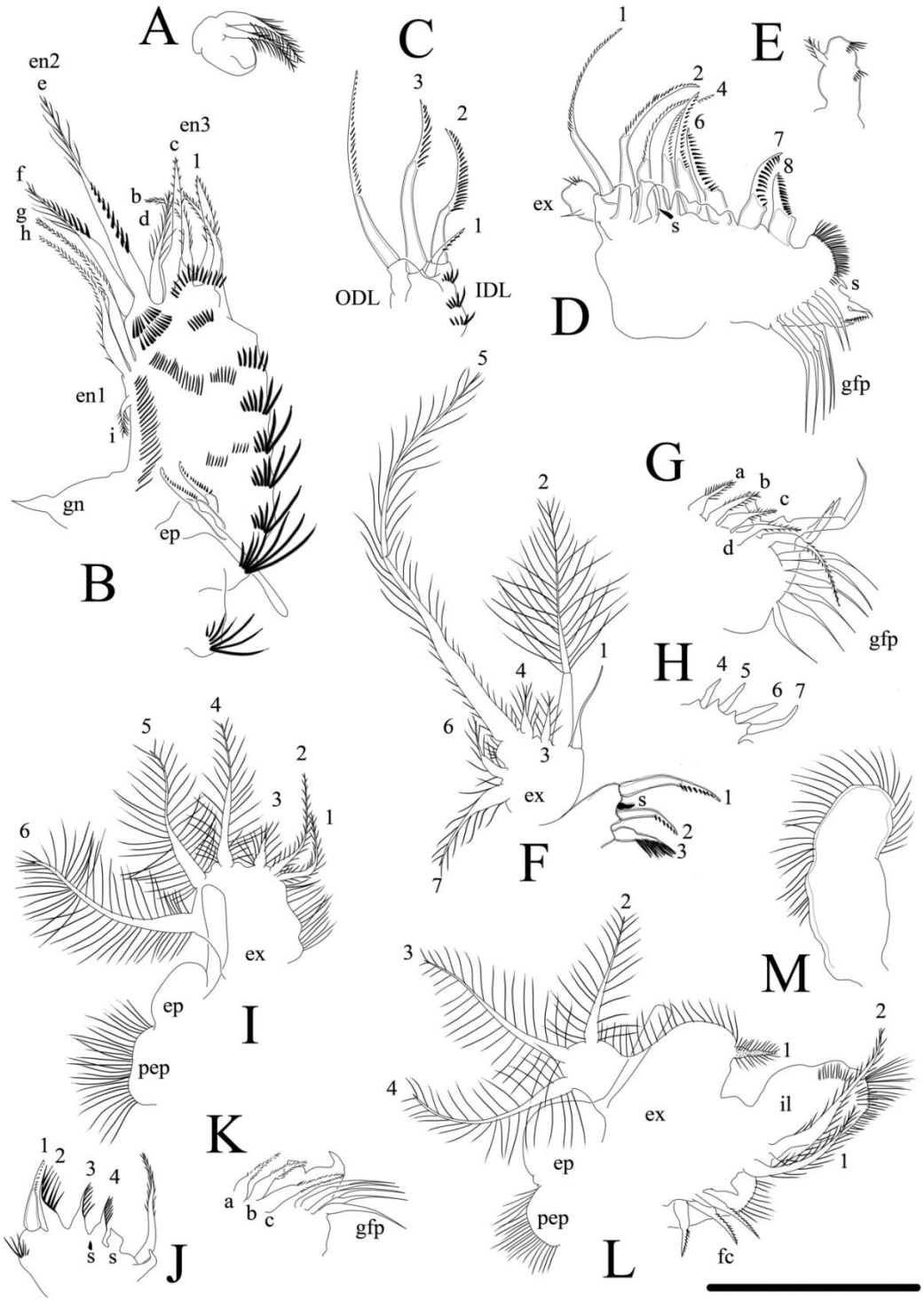


Figure 6. *Alona* cf. *intermedia* from a rock pool near Rosário Waterfall, Pirinópolis Goiás. (A) Maxilla; (B) Limb I; (C) *idem* – ODL and IDL; (D) Limb II; (E) *idem*, exopodite; (F) Limb III, exopodite; (G-H) *idem*, endites; (G) distal endite; (H) basal endite; (I) Limb IV, exopodite; (J-K) *idem*, endites; (J) distal endite; (K) basal endite; (L) Limb V; (M) Limb VI. For abbreviations, see Material and methods. Scale bar = 50µm.

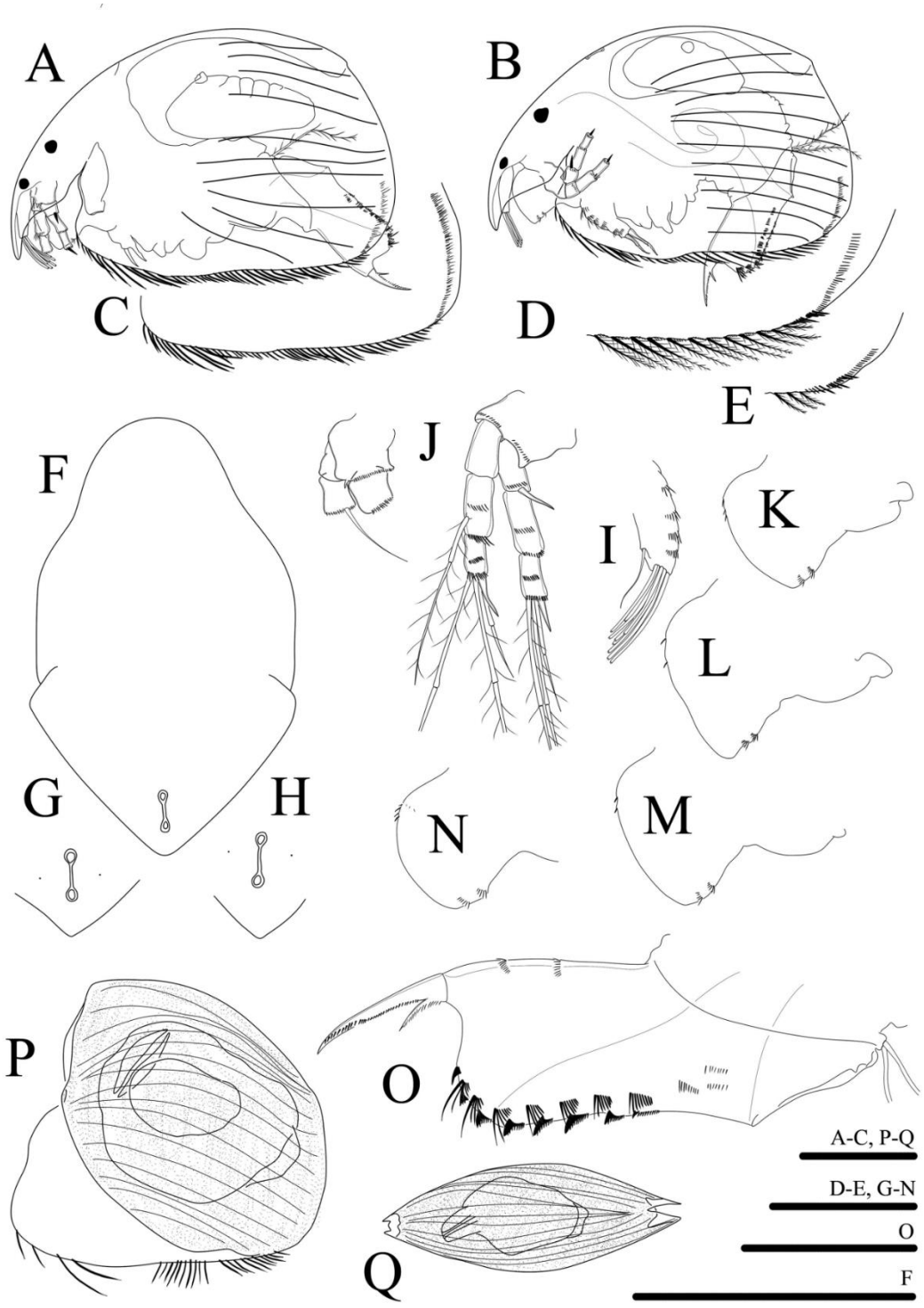


Figure 7**.** *Alona* sp. nov. 1 (A) *Habitus* from parthenogenetic female, Distrito Federal; (B) *idem*, Minas Gerais; (C) Marginal setae of carapace; (D-E) Posteroventral corner of carapace; (F) Head shield; (G-H) Head pores; (I) Antennule; (J) Antenna; (K-N) Labral keel; (O) Postabdomen; (P) Ephipium, lateral view; (Q) *idem*, dorsal view. Scale bars = 50µm.

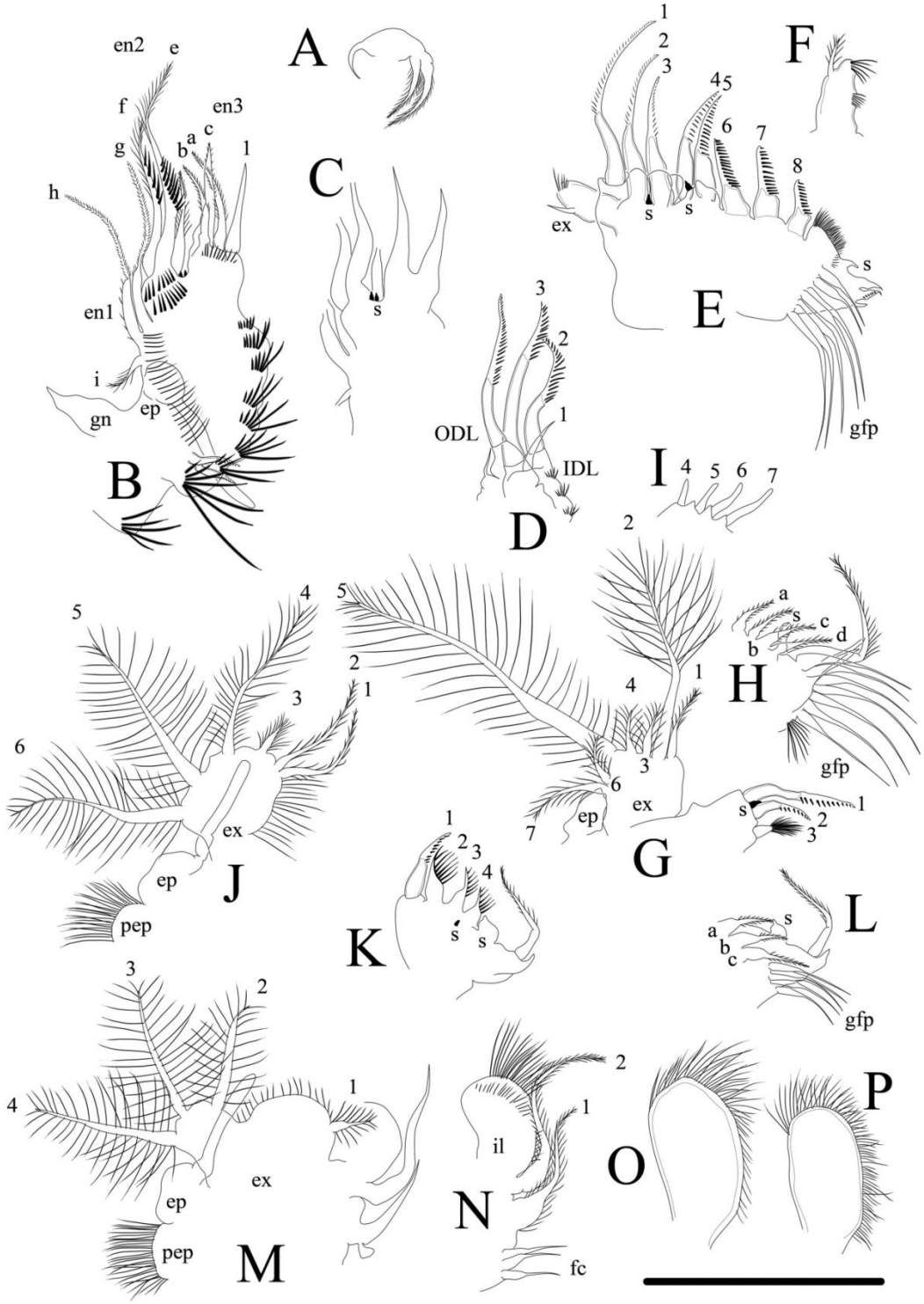


Figure 8. *Alona* sp. nov. 1 from Bonita pond, Distrito Federal. (A) Maxilla; (B) Limb I; (C) *idem*; (D) *idem* – ODL and IDL; (E) Limb II; (F) *idem*, exopodite; (G) Limb III, exopodite and distal endite; (H-I) *idem*, endites; (H) distal endite; (I) basal endite; (J) Limb IV, exopodite; (K-L) *idem*, endites; (K) distal endite; (L) basal endite; (M) Limb V; (N) *idem*, iternal lobe; (O-P) Limb VI. For abbreviations, see Material and methods. Scale bar = 50µm.

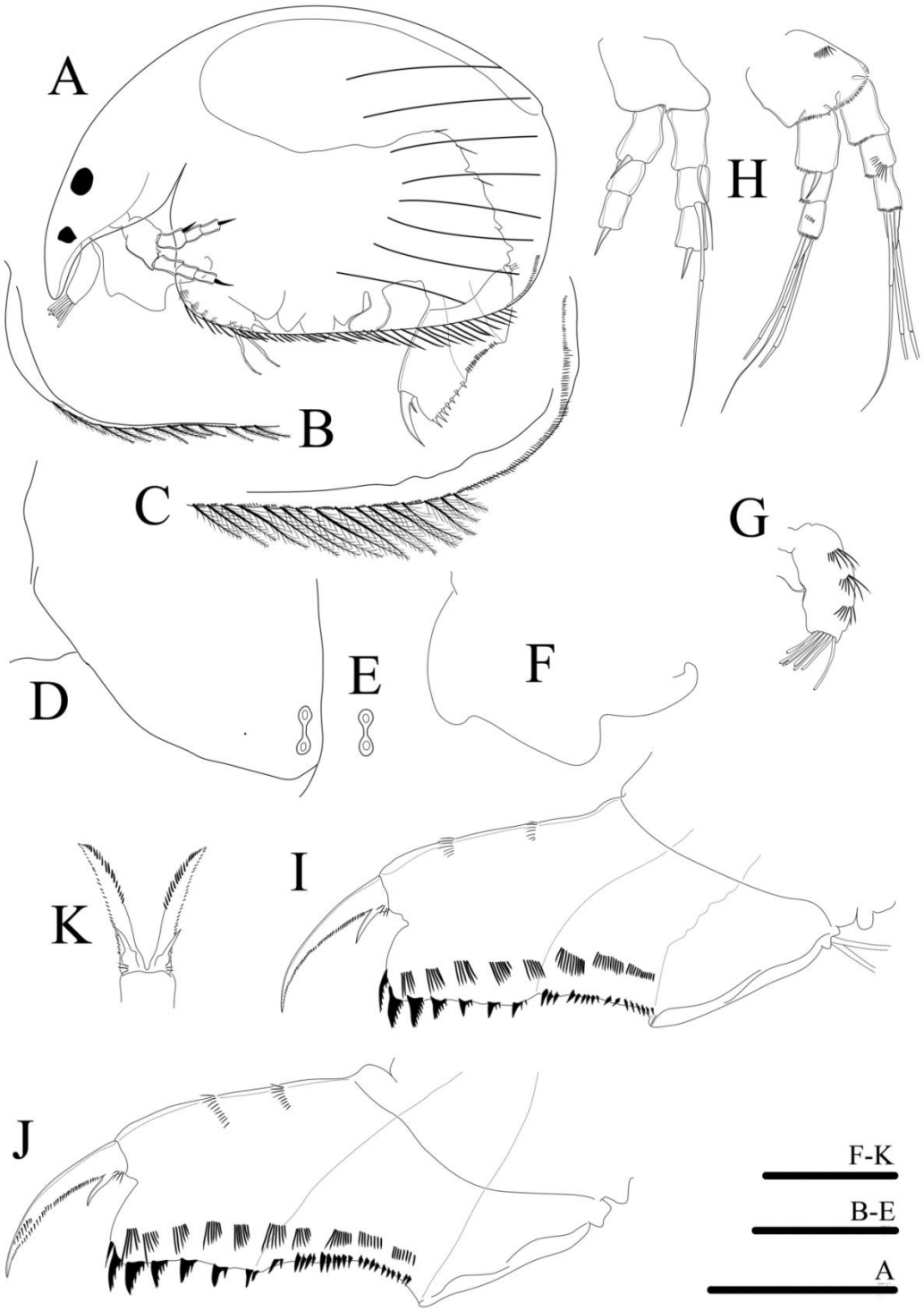


Figure 9**.** Gen. nov. 1 and sp. nov. 2 from type locality. (A) *Habitus*; (B) Anteroventral corner of carapace; (C) Posteroventral corner of carapace; (D-E) Head pores; (F) Labral keel; (G) Antennule; (H) Antenna; (I-J) Postabdomen; (K) Ventral view from terminal claw and basal spines. Scale bars = 50µm.

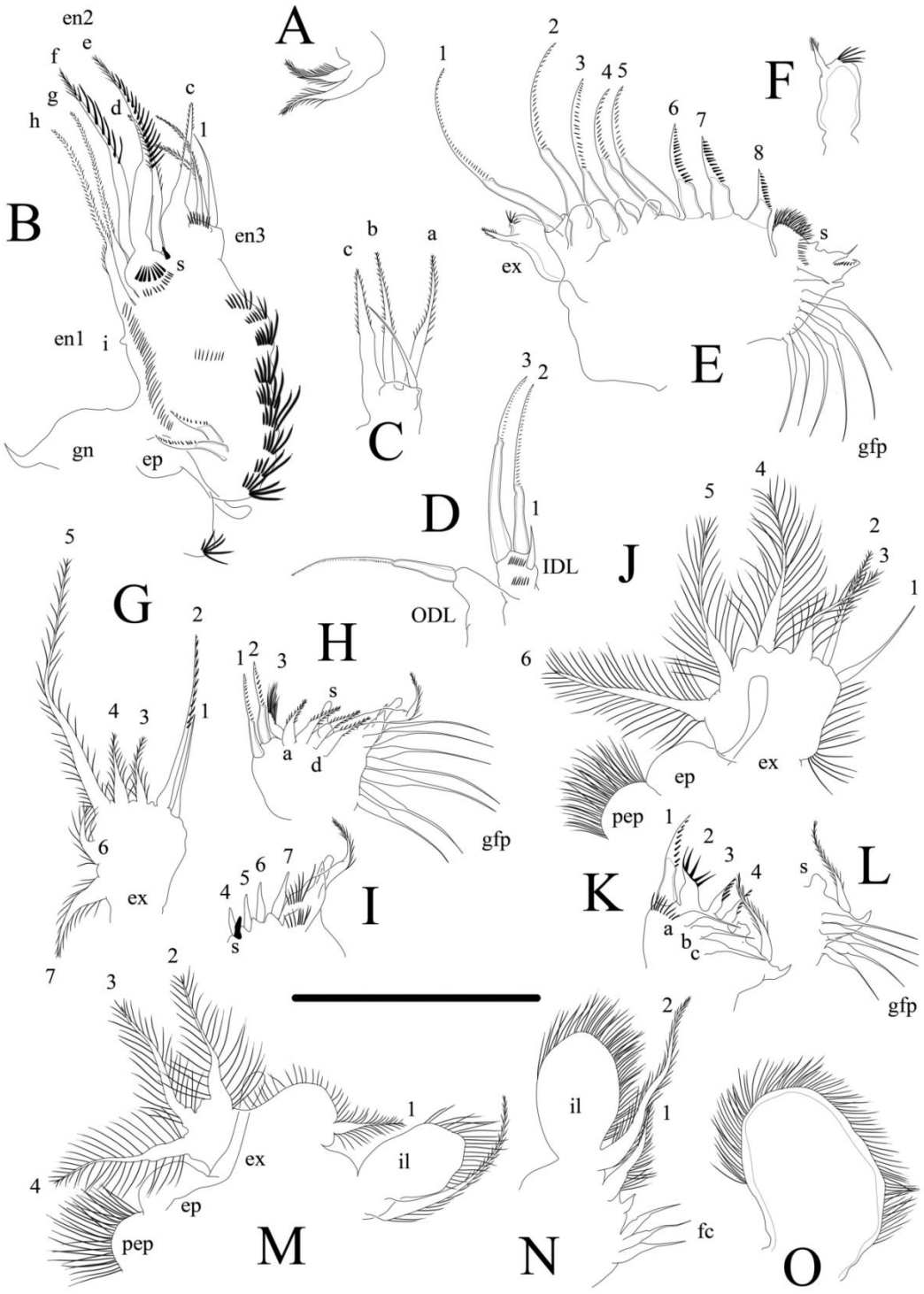


Figure 10. Gen. nov. 1 and sp. 2 nov from type locality. (A) Maxilla; (B) Limb I; (C) *idem*, third endite; (D) *idem* – ODL and IDL; (E) Limb II; (F) *idem*, exopodite; (G) Limb III, exopodite; (H-I) *idem*, endites; (H) distal endite; (I) basal endite; (J) Limb IV, exopodite; (K-L) *idem*, endites; (L) filtercomb; (M) Limb V; (N) *idem*, iternal lobe; (O) Limb VI. For abbreviations, see Material and methods. Scale bar = 50µm.

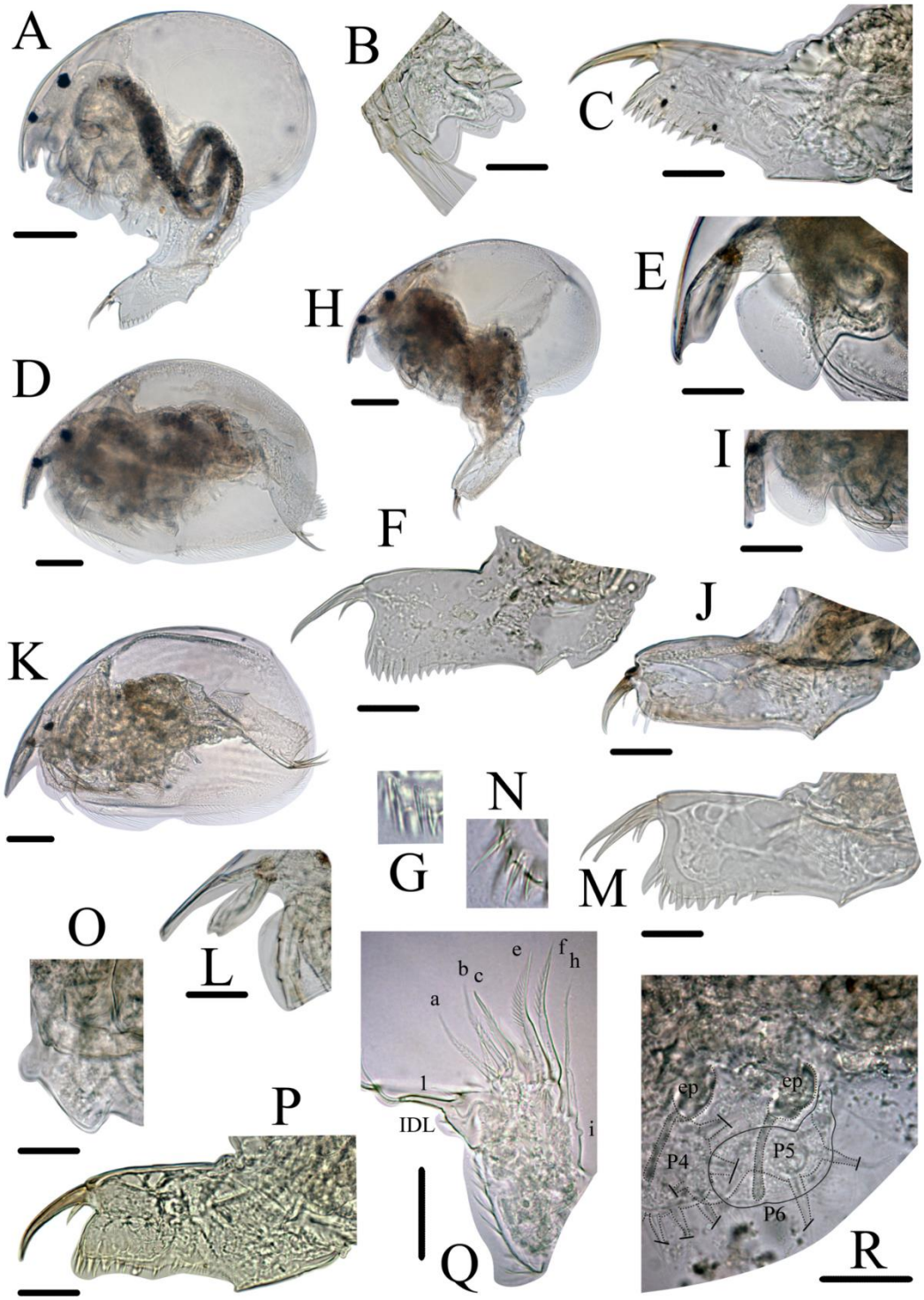


Figure 11. *Alona* cf. *guttata* (A-C). (A) *Habitus* from parthenogenetic female; (B) Labral keel; (C) Postabdomen. *Alona* cf. *intemedia* (D-J). (D) *Habitus* from parthenogenetic female; (E) Labral keel; (F) Postabdomen; (G) *idem*, lateral fascicles; (H) *Habitus* from male; (I) Male, labral keel and hook; (J) Male, postabdomen. *Alona* sp. nov. 1, holotype (K-N). (K) *Habitus* from parthenogenetic female; (L) Labral keel; (M) Postabdomen; (N) *idem*, lateral fascicles;

Gen. nov. 1 and sp. nov. 2, holotype (O-R). (O) Labra keel; (P) Postabdomen; (Q) Limb I; (R) Limb IV, V and VI. For abbreviations, see Material and methods. Scale bars: B, C, E, F, I, J, M, O-R = 25µm; A, D, H, K = 50µm.

ARTIGO 2

DESCRIPTION OF A NEW SPECIES OF THE *costata*-group (CLADOCERA, CHYDORIDAE, ALONINAE) FROM BRAZIL

Artigo publicado no periódico Zootaxa ISSN 1175-5334; Fator de Impacto (JCR 2014) = 0.906; Estrato no Qualis CAPES de Biodiversidade B1.

Zootaxa 4040 (4): 445–457
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.4040.4.4
http://zoobank.org/urn:lsid:zoobank.org:pub:E338036A-B542-46EB-9F49-B2DB183CCF46

Description of a new species of the *costata*-group (Cladocera, Chydoridae, Aloninae) from Brazil

FRANCISCO DIOGO R. SOUSA[1,2,5], SANDRO SANTOS[1], ADRIANA MARIA GÜNTZEL[3], LEIDIANE PEREIRA DINIZ[4], MAURO DE MELO JÚNIOR[4] & LOURDES M. A. ELMOOR-LOUREIRO[2]

[1]*Núcleo de Estudos em Biodiversidade Aquática, Programa de Pós-graduação em Biodiversidade Animal, Universidade Federal de Santa Maria – UFSM, Av. Roraima 1000, Camobi, CEP 97105-900, Santa Maria, RS, Brazil*
[2]*Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília – UCB, QS7 lote 1, Bloco M, sala 204, CEP 71966-700, Taguatinga, DF, Brazil*
[3]*Unidade Universitária de Coxim, Universidade Estadual de Mato Grosso do Sul - UEMS, Rua General Mendes de Moraes, 370, Jardim Aeroporto, CEP 79400-000, Coxim, MS, Brazil*
[4]*Laboratório de Ecologia do Plâncton, Unidade Acadêmica de Serra Talhada, Universidade Federal Rural de Pernambuco (UAST/UFRPE), Fazenda Saco, s/n, Zona Rural, CEP 56903-070, Serra Talhada, PE, Brazil*
[5]*Corresponding author. E-mail: sousa_bio@yahoo.com.br*

Abstract

The aim of this study is to describe a new species of the *costata*-group from Brazil. *Alona margipluma* **sp. nov.** shares morphological traits with *A. costata* Sars, 1862, *A. natalensis* Sinev, 2008, and *A. cheni* Sinev, 1999, but differs from them in: (i) thin setulae between the marginal setae on the valves, (ii) setae 4–5 on the exopodite of limb III long and different in length, (iii) bottle-shaped sensillum on the basal endite of limb IV. For identification of *Alona margipluma* **sp. nov.** it is necessary to check carefully the main head pores and postabdomen characters since the former superficially resemble *A. iheringula*, *A. setigera* and *Alona guttata*.

Key words: *Alona costata-group*, head pores, morphology, taxonomy, Neotropics, South America

Introduction

The *costata*-group is a well-defined species complex of the subfamily Aloninae Dybowski & Grochowski, 1894 emend. Frey, 1967 belonging to the Hexalona-branch (Van Damme *et al.* 2010). Its representatives have a number of conservative morphological features, such as transverse lateral head pores, each with a pocket-like cavity, inner distal lobe of limb I with three setae, limb I with one flat plumose seta on endite 1, exopodite of limb III with seven setae, presence of filter comb on limb V, and limb VI. However, structures such as the postabdomen, main head pores and labral keel show important differences among different species (Sinev 1999; Sinev 2001; Sinev 2008; Sinev 2009a; Van Damme & Eggermont 2011; Van Damme *et al.* 2011). The *costata*-group is expected to be transferred to a new genus because it differs from the "true *Alona"* core group, which includes species with morphology similar to *Alona quadrangularis* (O.F. Müller, 1776) (Van Damme & Dumont 2008a; 2008b).

Until now, the Brazilian fauna of the *costata*-group has been represented by two species, *A. iheringula* Sars, 1901 and *A.* cf. *setigera* Brehm, 1931. *Alona iheringula* was, for a long time, considered a junior synonym of *A. rustica* Scott, 1895 (cf. Smirnov 1971). Sinev (2001) revalidated the species status of *A. iheringi* after its redescription based on Sars' material. Kotov & Sinev (2004) created a *nomem novum*, *Alona iheringula*. *Alona setigera* was initially described from New Zealand as a variation of *A. guttata* Sars, 1862 and later transferred to the genus *Biapertura* Smirnov, 1971 because it has two main head pores (Smirnov & Timms 1983). Sinev (1999) observed that the morphology of its limbs was related to the *Alona costata*-group, and it was considered as a valid species (Van Damme *et al.* 2010). In Brazil, this species was reported for the first time in São Paulo state (Santos-Wisniewski *et al.* 2001) and new records have been added for other states (Elmoor-Loureiro 2010).

Accepted by M. Alonso: 22 Oct. 2015; published: 12 Nov. 2015

In samples from different localities in Brazil, a new species of the *costata*-group was found occurring together with *A. iheringula*, *A.* cf. *setigera,* and *A.* cf. *guttata*. The aim of this study is to describe this species.

Material and methods

Morphological analyses. The selected specimens were transferred to drops of glycerol on slides and dissected under a stereomicroscope. The morphology of the appendages and other structures was studied using a phase contrast microscopy. Enumeration of limbs setae and other structures proceeds from the epipodite to the gnathobase, without relation to homology, according to recent literature (Van Damme & Dumont 2007; Sinev & Kobayashi 2012) and to facilitate comparisons with the description of *Alona natalensis* (Sinev 2008). Drawings were prepared using a camera lucida. Two animals were dehydrated in a graded alcohol series (50%, 70%, 90%, 95% and 100%) and dried using HMDS (Hexamethyldisilazane), mounted on aluminum stubs, coated with platinum and examined under a JEOL-JSM 7001F scanning electron microscope.

Abbreviations in figures and tables. as: accessory seta; en: endite; ep: epipodite; ex: exopodite; fc: filter comb; gfp: gnathobasic filter plate; IP: interpore distance (distance between anterior and posterior major head pores); IDL: inner distal lobe; il; inner lobe; ODL: outer distal lobe; pep: pre-epipodite; s: sensillum; PA: postabdomen; PP: postpore distance (distance between the posterior major head pore and the posterior border of the head shield); P2: limb II; P3: limb III; P4: limb IV; P5: limb V; P6: limb VI; GEEA: Research Group on Aquatic Environments, Universidade Católica de Brasilia, Brazil.

Abbreviations of the collections. FDRS: Personal collection of Francisco Diogo Rocha Sousa. CLLA: Slides collection of the GEEA, at Universidade Católica de Brasília, Brazil. MZUSP: Museu de Zoologia da Universidade de São Paulo, Brazil.

Results

Taxonomy

Class Branchiopoda Letreille, 1817

Order Anomopoda Sars, 1865

Family Chydoridae Dybowski & Grochowski, 1894 emend. Frey, 1967

Subfamily Aloninae Dybowski & Grochowski, 1894 emend. Frey, 1967

Genus *Alona* Baird, 1843

***Alona margipluma* sp. nov.**
(Figs. 1–4)

Etymology. the name "*margipluma*" comes from two Latin words, *margo* (= margin) and *pluma*, which refers to thin setules between ventral setae of the carapace.

Type locality. Criminosa Lake (21°40'28.8"S, 57°53'28.5"W), Porto Murtinho, Pantanal, Mato Grosso do Sul, Brazil.

Type material. Holotype: undissected, adult parthenogenetic female in a tube with 92% ethanol deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 33196. The label of the holotype is: "*Alona margipluma* sp. n., 1 parth. ♀ from to Criminosa Lake, Porto Murtinho, Pantanal, Mato Grosso do Sul, Brazil. Holotype".

Material Studied. Paratypes. Eight adult parthenogenetic females and two juveniles from Criminosa Lake (21°40'28.8"S, 57°53'28.5"W), Porto Murtinho, Pantanal, Mato Grosso do Sul, Brazil. Material collected on 10.i.2010 and 19.i.2010, leg. Adriana Maria Güntzel (FDRS0275). Two adult parthenogenetic females from the

Amonguijá River (21°41'11.3" S, 57°52'54.8" W), Porto Murtinho, Pantanal, Mato Grosso do Sul, Brazil. Material collected on 18.xi.2009, leg. Adriana Maria Güntzel (FDRS0274). Four adult parthenogenetic females and one juvenile from Baía da Célia, Fazenda Nhumirim (18°59'27.5"S, 56°39'41.0"W), Pantanal, Mato Grosso do Sul, Brazil. Material collected on 07.ix.2000 by Valéria Barros (FDRS0276). Two adult parthenogenetic females from the Cachoeira II reservoir (07°58.338'S, 38°19.628'W), Serra Talhada, Caatinga, Pernambuco, Brazil. Material collected on 18.vi.2011, leg. Leidiane Pereira Diniz (FDRS0378). One adult parthenogenetic female from Capetinga Stream (15°57'40.6" S, 47°56'36.7"W), Água Limpa Farm, Cerrado, Distrito Federal, Brazil. Material collected on 01.ix.2006 by GEEA. Two adult parthenogenetic females from Cabocla I pond (15°48'16.6"S, 47°14'58.8'W"), Campo de Instrução de Formosa, Cerrado, Distrito Federal, Brazil. Material collected on 07.viii.2009 by GEEA (FDRS0273). Six parthenogenetic females from Paranoá Lake (15°43'47" S, 47°52'58"W), Cerrado, Distrito Federal. Material collected on viii.2014 by Ciro Joko, Mariana Lessa and Elisângela Rangel (FDRS0383). Slides containing dissected individuals deposited at the Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília (CLLA001 to CLLA018).

Diagnosis. *Female.* Maximum height at middle of body, body about 1.5 times as long as high, weakly compressed laterally. Head with ocellus and eye of different size. Three main pores connected; anterior pore larger than others; a wide connection between the posterior and middle pores, connection between the middle pore and anterior pore wide or relatively narrow; transverse lateral head pores about 0.7 – 0.85 IP; deep and rounded pockets, about 1.5 times longer than lateral head pores. Carapace covered by dense longitudinal lines; ventral margin almost straight, with 45–49 plumose setae per valve; thin setulae between marginal setae. Labral keel without a notch. Antennule about two times longer than wide. Antenna, antennal formula: spines 001/101, setae 113/003. Apical spine of endopodite and exopodite long, of similar size, with visible denticles. Apical setae bisegmented and setulated. Postabdomen slightly narrowing distally, about three times as long as wide. Pre-anal margin of similar size to anal margin, and shorter than postanal margin. Anal margin slightly concave, with 3–4 denticle groups. Postanal portion of postabdomen with acute distal portion. Ten-twelve well developed marginal denticles, each with several spinules on its anterior margin. Terminal claw longer than anal margin, with one group of short spinules on its base; pecten armed with a row of outer spinulae decreasing in size towards distal portion. Basal spine relatively short, shorter than width of claw base, without spinulae or setulae. Limb I with ejector hooks different in size, accessory seta implanted near the base; ODL with a thin seta, serrulated in the distal part; IDL with three setae; seta 1 small and thin; setae 2 and 3 bisegmented and armed with setulae, similar in size to ODL setae. Limb II with elongated exopodite bearing a non-setulated seta; scrapers 3 and 7 armed with robust denticles as compared to other scrapers. Limb III, fourth and fifth setae of exopodite relatively long. Limb IV, exopodite subquadrangular with setae 1–4 plumose; gnathobase armed with a bottle-shaped sensillum. Limb V, exopodite with four setae, divided into two lobes; gnathobase as a rounded lobe; filter comb with three long setae. Limb VI present. *Male* and *ephipial female* unknown.

Description. Parthenogenetic female. *Habitus* (Figs. 1A–B; 4A). Animal of a relatively large size 0.32–0.43 mm; in a lateral view, carapace oval, maximum height at middle of body, which is about 1.5 times as long as high. Dorsal margin convex. From a ventral view, body weakly compressed laterally. Dorsal keel absent.

Head (Figs. 1A; 2A–D; 4A, C). Ocellus and eye of different size. Headshield with maximum width behind the mandibular articulation, posterior margin wavy. Rostrum short, rounded, projected towards ventral margin of carapace. Three main pores connected; anterior pore larger than others; a wide connection between posterior and middle pore, connection between middle and anterior pore wide or relatively narrow. PP about 0.7–0.95 IP. Transverse lateral head pores about 0.7 – 0.85 IP, located at the level of middle main head pores. Deep and rounded pockets, about 1.5 times longer than lateral head pores.

Labrum (Fig. 2E) of moderate size. Labral keel without a notch; anterior margin convex, posterior margin with two clusters of setules.

Carapace (Fig. 1C–D; 4B) covered by longitudinal lines. Ventral margin almost straight, with 45–49 plumose setae per valve; thin setulae between marginal setae; middle group consists of short marginal setae; posterior group of long setae decreasing in size towards the posteroventral corner. Posterior margin armed with spinulae not arranged in groups and not projected beyond the margin.

Mandibles large relatively to body size.

First maxilla (Fig. 2H) well developed, with two long setulated setae.

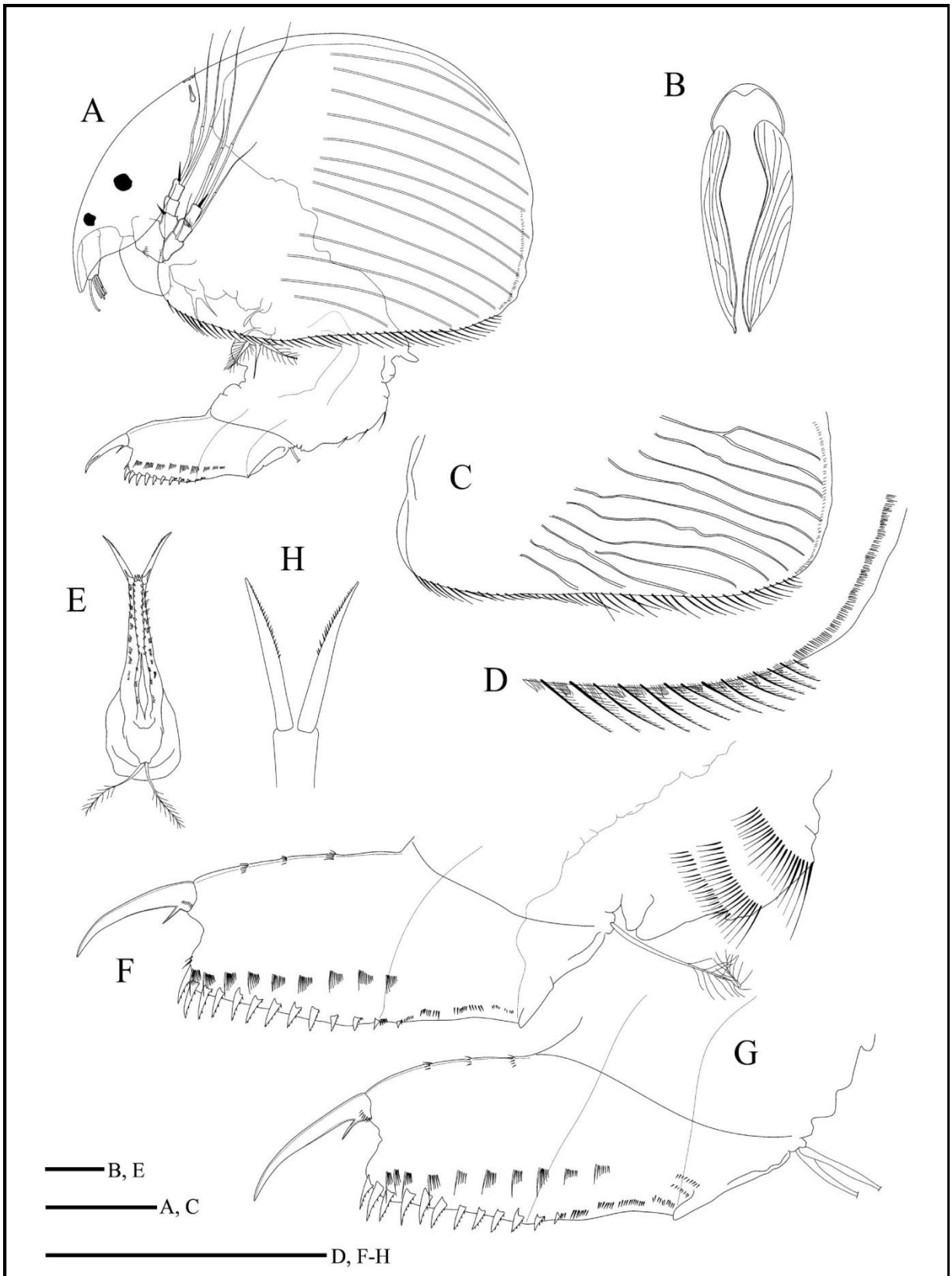


FIGURE 1. *Alona margipluma* **sp. nov.**, parthenogenetic females. A, habitus, lateral view. B, habitus, ventral view. C, carapace. D, posteroventral corner of the valves. E, postabdomen, ventral view, F-G, postabdomen, lateral view (Pernambuco state). Scale bars = 100μm.

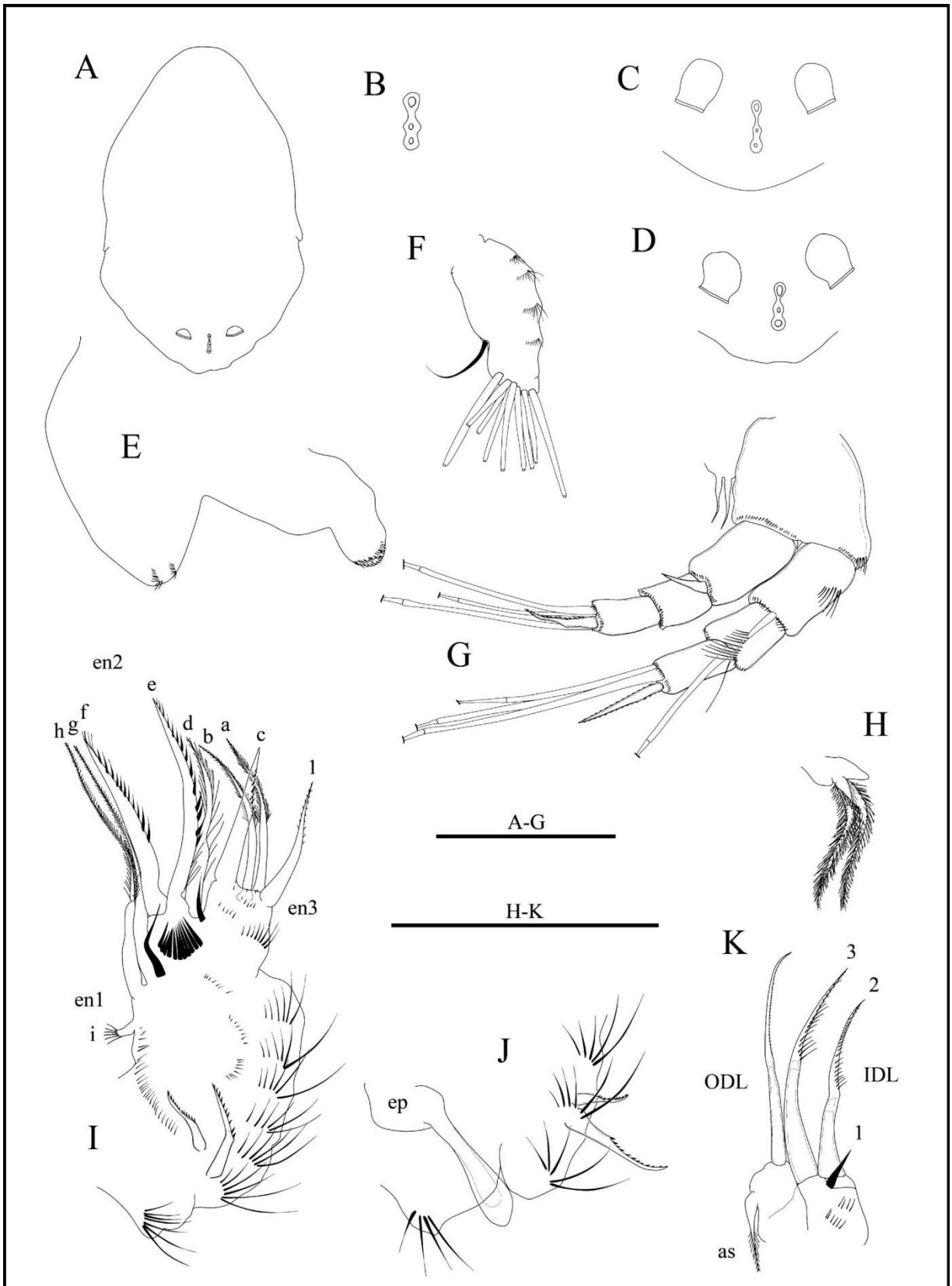


FIGURE 2. *Alona margipluma* **sp. nov.**, parthenogenetic females. A, headshield. B–D, head pores. E, labral keel. F, antenule. G, antenna. H, maxila. I, limb I. J, limb I, ejector hooks and epipodite. K, limb I, IDL and ODL. Scale bars = 50μm.

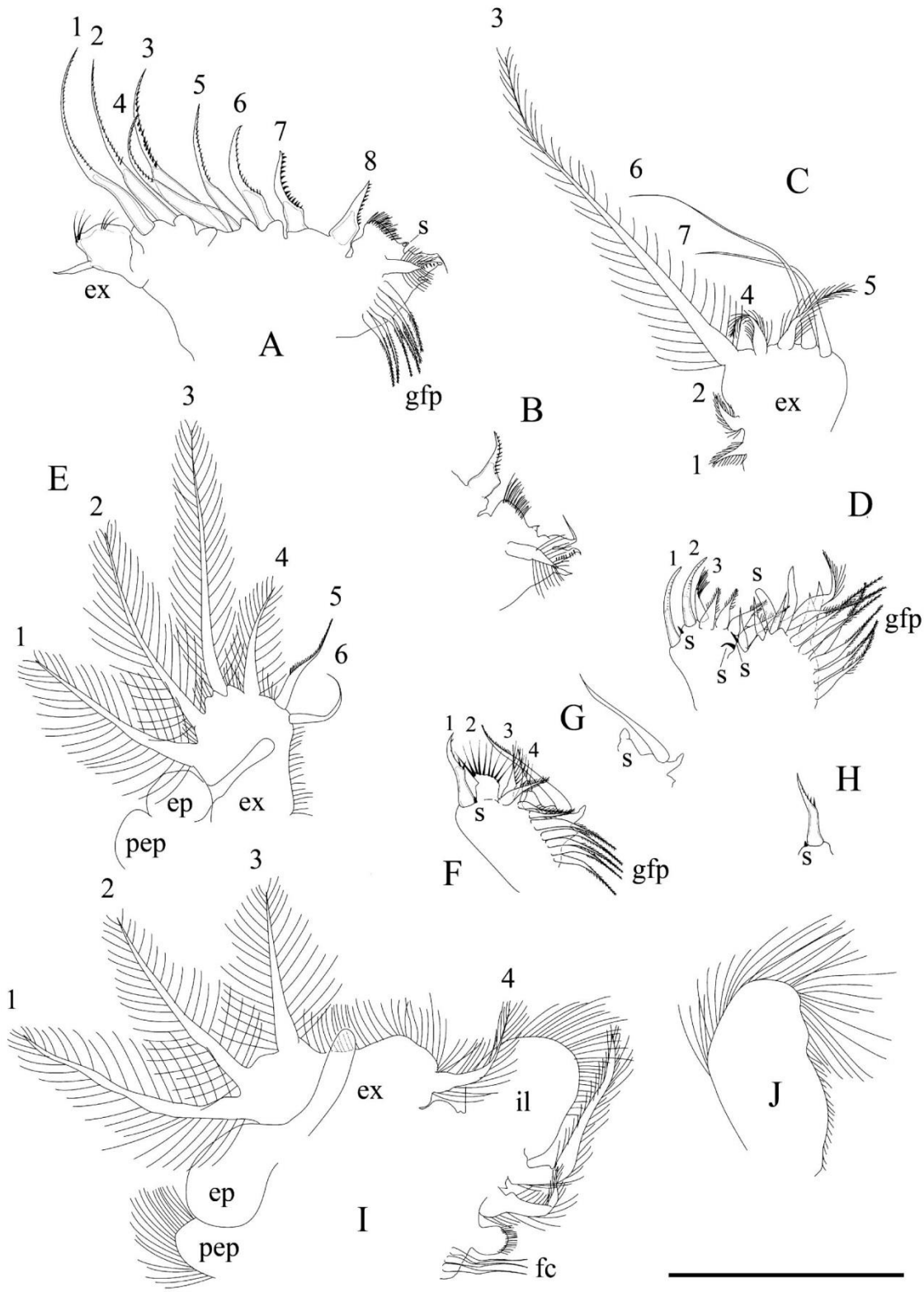


FIGURE 3. *Alona margipluma* **sp. nov.**, parthenogenetic female. A, limb II. B, limb II, gnathobase. C, limb III, exopodite. D, limb III, endites. E, limb IV, exopodite. F, limb IV, endites. G, limb IV, sensillum. H, limb IV, distal endite seta. I, limb V. J, limb VI. Scale bar = 50µm.

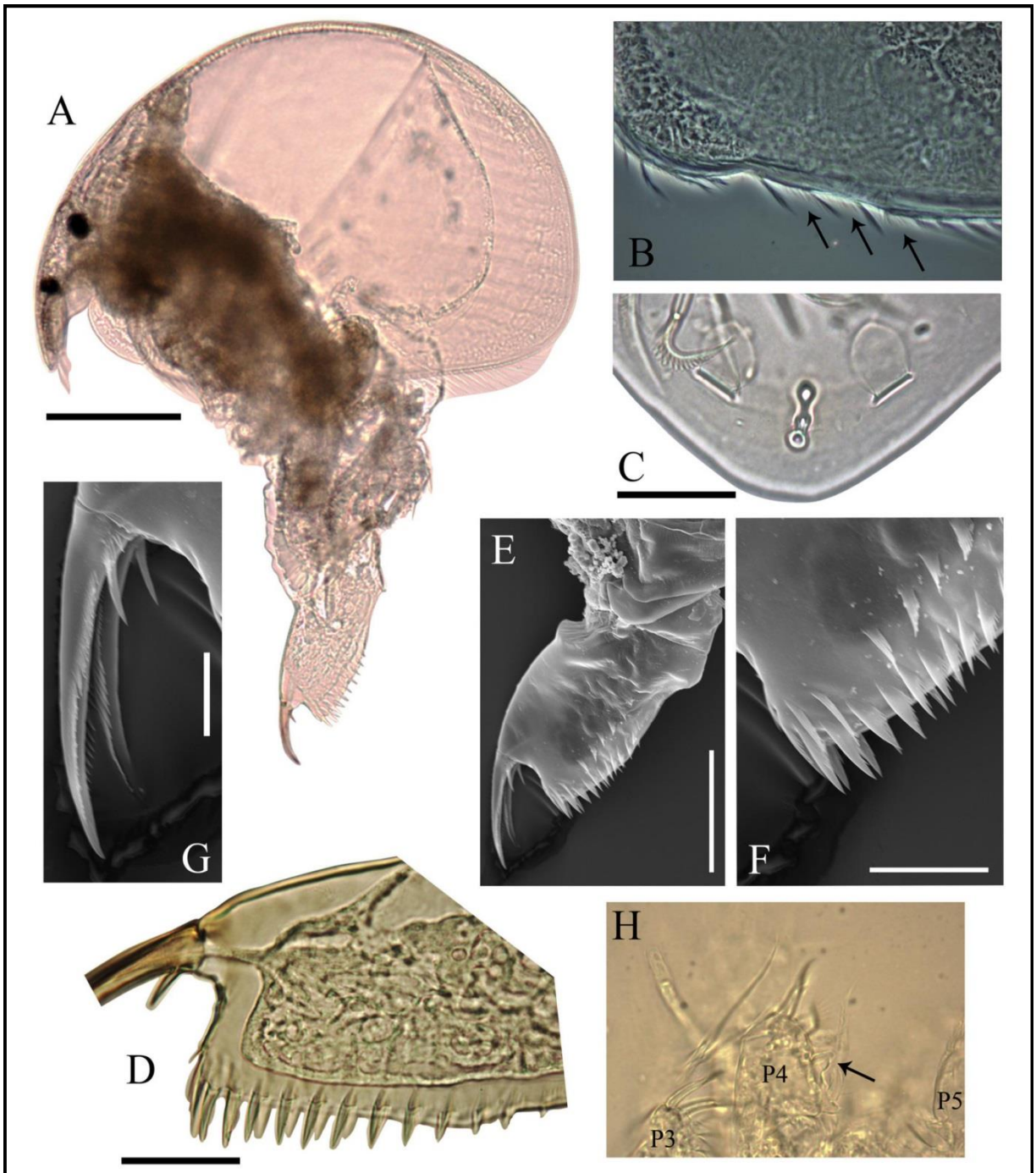


FIGURE 4. *Alona margipluma* **sp. nov.**, parthenogenetic female. A, habitus. B, ventral margin, arrows showing the setulae between setae of valves. C, main and lateral head pores. D-F, postabdomen. G, terminal claw of postabdomen. H, limb IV endite, arrow showing the bottle-shaped sensillum. Scale bars: A, E = 100μm; C, D, F = 50μm; G = 10μm.

Antennule (Fig. 2F) with length two times the width; four rows of setules on antennular body. Antennular sensory seta slender and short, about 2–2.5 times smaller than antennular body, inserted at two-thirds of antennule length from its base. Nine aesthetascs of different length, all projecting beyond the tip of rostrum. None of them exceeds the length of the antennules.

Antenna (Fig. 2G). Two coxal setae of equal length. Basal segment thick, with many spinulae and a short spine distally. First segment of exopodite with long and slender spinulae near its base and short spinulae at its terminal

portion. Second segment with long and slender setulae located at median portion and short spinulae in its terminal portion. Endopodite segments with short spinulae at its terminal portion. Antennal formula: spines 001/101; setae 113/003. Setae on first segment of exopodite thin, not reaching mid length of terminal setae. Seta on second segment of exopodite bisegmented. Spine on first segment of endopodite short, not exceeding distal end of second segment. Apical spines of similar length, longer than apical segments and with visible denticles. Apical setae bisegmented and setulated.

Abdomen about two times shorter than thorax, armed with three rows of long abdominal setae.

Postabdomen (Figs. 1E–G; 4D–G). Slightly narrowing distally, about three times as long as wide, ventral margin slightly convex with at least three rows of spinulae. Pre-anal margin of similar size to anal margin and shorter than postanal margin. Anal margin slightly concave, with 3–4 groups of spinulae. Postanal margin almost straight, distal angle acute, slightly projected. Lateral fascicles arranged in 8–9 groups; first spinule of each fascicle longer and thicker than others; first three fascicles exceeding postabdomen margin. Ten-twelve well developed marginal denticles, each one with several spinulae on its anterior margin; most proximal denticles grouped. Postabdominal seta (Fig. 1E). About two times shorter than postabdomen; proximal portion naked; long setules armed bilaterally towards its distal portion. Terminal claw (Figs. 1E–H; 4G). Implanted in a projected basis of postabdomen, slightly longer than anal margin, uniformly curved, with a group of short spinules at its base; external pecten armed with a row of outer spinules. Basal spine relatively small, shorter than width of claw at its base, without spinulae or setulae.

Six pair of limbs.

Limb I (Fig. 2J–K). Epipodite oval with a long projection. Accessory seta implanted near base of ODL, which has a thin seta, serrulated in its distal part, with length about the same as the longest IDL seta; IDL (en 4) with three groups of spinules on its face and three setae: seta 1 about three times shorter than setae 2; setae 2 and 3 bisegmented and armed with setulae, seta 3 slightly longer than seta 2. Endite III with four setae; posterior setae (a–b) setulated, longer than the other two setae (posterior seta c and anterior seta 1). Endite II with one row of spinules; three posterior setae present (d–f), setae (f) and (e) similar in length and with thick spinules on the lateral face; setae (d) exceeding the midlength of seta (e); endite armed a single anterior stiff seta. Endite I with three posterior setae (g–i), two being bisegmented and setulated in distal part (g–h) and a short flat plumose seta (i), and a thin anterior stiff seta. Ejector hooks of different length. Ventral face of the limb with six groups of setulae organized in clusters, decreasing in size towards the distal portion. Gnathobase not studied.

Limb II (Fig. 3A–B). Exopodite elongated, with two rows of setulae and a naked seta. Inner limb portion armed with eight scrapers gradually decreasing in length towards gnathobase. Scrapers 3 and 7 armed with robust denticulation. Distal armature of gnathobase armed with four elements: first a sensillum, second an element with distal portion geniculated, third element armed with denticles, fourth element relatively short, not sharp. Filter comb with seven setae; first seta short, robust, with dense and long setulae; other setae long and with short setulae.

Limb III (Fig. 3C–D). Epipodite not studied. Exopodite relatively large, subquadrangular, with five distal and two lateral setae. Setae 1–2 setulated, similar in length. Third seta long, setulated, about 1.5 times longer than the sixth seta. Fourth and fifth setae shorter than setae 6–7, but longer than setae 1–2. Sixth seta about 1.3 times longer than the seventh seta, both naked. Distal endite with one sensillum and three setae (1–3), two scraper-like and similar in length (1–2), and third seta slightly curved and armed with many setules bilaterally implanted (3); four plumose posterior setae similar in length. Basal endite with four soft anterior setae, distalmost seta very long and robust; two sensillum near to first soft seta present. Gnathobase armed with four elements, the first being a cylindrical sensillum, the second a strong geniculated seta, third and fourth elements with tip acute, naked. Filter comb with seven setae.

Limb IV (Fig. 3E–H; 4H). Pre-epipodite round. Epipodite rounded, with a long projection. Exopodite subquadrangular with six marginal setae: setae 1–4 plumose; seta 1 slightly shorter than seta 2; third seta longer than all others; fourth seta subequal in length to the fifth seta; fifth seta slightly setulated unilaterally; sixth seta naked. Distal endite with four setae (1–4), one scraper-like and armed with one sensillum at the base (1), three flaming-torch-like (3–4); the first flaming-torch robust, with long setules (2) and three soft setae increasing in size proximally. Gnathobase armed with one bottle-shaped sensillum and one setulated seta implanted on a robust base. Filter plate with five slender setae.

Limb V (Fig. 3I). Pre-epipodite oval and densely setulated; epipodite with long projection. Exopodite unclearly divided into two lobes, with four plumose setae decreasing in size towards the internal lobe; setae 1–2 similar in

length; fourth seta about 1.3–1.5 times shorter than the third seta. Internal lobe very wide, oval and with long setulae; two setulated setae on the inner face of the lobe, first seta about two times longer than the other. Gnathobase as a rounded lobe; filter comb with three long setae.

Limb VI (Fig. 3J). An elongated lobe, about two times longer than wide; apical margin of the lobe with long setulae; proximal margin armed with short setules.

Ephippial female. Unknown.

Male. Unknown.

Differential diagnosis. *Alona margipluma* **sp. nov.** clearly differs from species of the *rustica*-branch (see Hudec 1998; Sinev 1999; Sinev 2009a; Van Damme & Eggermont 2011), such as from Neotropical *A. iheringula,* in the morphology of the postabdomen, and main and lateral head pores. Differences in aforementioned structures are also observed as compared with *A. weltneri* Keilhack, 1905 (see Van Damme *et al.* 2011). Specifically, *Alona margipluma* **sp. nov.** differs from *A. setigera* because it has three main head pores. Because its large lateral head pores and distal postabdominal angle acute, *Alona margipluma* **sp. nov.** resembles *A. costata*, *A. cheni* and *A. natalensis*, but the former has different morphology of the exopodite of the limb V and the lateral head pores. Such as, in *A. cheni* and *A. natalensis* the pockets are shallow, about 2 and 3 times smaller than length of lateral head pores, respectively. In *A. costata* the pockets are deep, about two times longer than lateral head pores, and the basal spine on the postabdomen is longer than the width of terminal claw base. *Alona margipluma* **sp. nov.** has deep pockets, about 1.5 times longer lateral head pores, and basal spine is shorter than the width of terminal claw base. Furthermore, *Alona margipluma* **sp. nov.** can be recognized by the presence of thin setulae between setae on the valves, absent in another species (see Sinev 1999, 2008); long setae 4–5 on exopodite of the limb III; and bottle-shaped sensillum on the basal endite of the limb IV. Other differences among *A. costata*, *A. setigera*, *A. cheni*, and *A. natalensis* are summarized in Table 1.

Distribution and ecology. So far, *Alona margipluma* **sp. nov.** has been found only in Brazil, in five localities. However, as the records of *A. margipluma* **sp. nov.** observed in this study are very distant from each other, it is possible that distribution of this species covers a considerable portion of the country. *Alona margipluma* **sp. nov.** is a species with preference for lentic waters; however, it was also found in lotic environments, associated with leaves in backwater zones (Capetinga Stream and Amonguijá River). Water bodies inhabited by *A. margipluma* **sp. nov.** (except Baía da Célia and Paranoá Lake) have temperatures ranging between 19.7 and 33.5 ºC, electric conductivity < 300 µS/cm, pH 4.63–7.3, turbidity 31.3–100 NTU, total dissolved solids 0.071–0.187 g/L and dissolved oxygen 4.11–7.3 mg/L. In some localities, *Alona margipluma* **sp. nov.** was found together with *A.* cf. *setigera*, *A. ossiani*, *A. iheringula,* and *A. guttata*. *Alona margipluma* **sp. nov.** was collected associated exclusively with the spongy air-filled roots of *Ludwigia helminthorrhiza* Mart. in the Cachoeira II reservoir (Caatinga) or with a multispecific bank of macrophytes in the Cabocla I pond (Cerrado).

Key to the identification of American species of the *costata*-group

1	Distal angle of postabdomen projected and acute, slightly narrowed distally. Lateral head pores long, over 1/2 IP	2 (*costata*-branch)
-	Distal angle of postabdomen rounded and projected, strongly narrowed distally. Lateral head pores short, about 1/3 IP	3 (*rustica*-branch)
2	Three main head pores	*Alona margipluma* **sp. nov.**
-	Two main head pores	*Alona* cf. *setigera* Brehm, 1931
3	Rostrum elongated, labral keel with projections on its upper half	*Alona bicolor* (Frey, 1965)
-	Rostrum not elongated, labral keel without projections	4
4	Middle main head pore at similar distance of anterior and posterior head pore	*Alona rustica* Scott, 1895
-	Middle main head pore near to posterior head pore	5
5	Second seta on the exopodite of limb V slightly longer than first seta	*Alona iheringula* Kotov & Sinev, 2004
-	Second seta on the exopodite of limb V about two times shorter than first seta	*Alona hudeci* Sinev, 1999

Discussion

Fauna of the Chydoridae in Brazil are represented by about 65 valid species. Recently, a widening of the studied area and the revision of some species contributed to demonstrating the peculiar composition of the fauna, with few

species that are endemic to habitats or specific regions (see Sinev & Elmoor-Loureiro 2010; Elmoor-Loureiro *et al.* 2013; Elmoor-Loureiro 2014). However, the country has a large number of species with wide distribution, as this is the case of *A. iheringula*, *Alona* cf. *setigera* and *A. margipluma* **sp. nov.**. These three species can coexist, but are different morphologically in the features of the head pores, postabdomen and limbs. For instance, the following morphological traits are present in *A. iheringula,* but absent in *A. margipluma* **sp. nov.**: main head pores with narrow connection and short transverse lateral head pores; postabdomen narrowing distally and with distal projection slightly rounded; setae 4–5 on the exopodite of limb III of similar length; seta 4 on the exopodite of limb IV shorter than seta 5; and exopodite of the limb V clearly bilobed (see Sinev 2001).

The main difference between *A. setigera* and *A. margipluma* **sp. nov.** is that the first species has two main head pores. However, consistent differences are also observed in the limbs; *A. setigera* has seta (f) on limb I markedly longer than seta (e); setae 4–5 on the exopodite of limb III short and of similar length; exopodite of limb V clearly bilobed; and limb VI armed with setulae on the distal part (see Sinev 1999). These morphological traits are not found in *A. margipluma* **sp. nov.**

According to Sinev (2008), *Alona cheni*, *A. natalensis, A. setigera* and *A. costata* form a special lineage (*costata*-branch) within the *costata*-group because they share large lateral pores and an acute distal angle of the postabomen (for differences and similarities between these species, see Table 1). These characteristics are found also in *A. margipluma* **sp. nov.** and make it a new member of this subgroup. *Alona margipluma* **sp. nov.** seems to be closer to *A. natalensis* because of the affinities in the morphology of the main and lateral head pores, unclear division of the exopodite of limb V, and morphology of labral keel (Table 1). However, *A. margipluma* **sp. nov.** has some exclusive characteristics, such as setae 4–5 on the exopodite of limb III different in length, a bottle-shape sensillum on the distal endite of limb IV and thin setules between the valves of the marginal setae. This latter characteristic is uncommon for species of Aloninae, which generally present short spinules.

Biogeographic analyses and descriptions of species distributed in different continents have repeatedly displayed affinities among fauna from areas that were connected before continental drift. This includes some species of *Nicsmirnovius* Chiambeng & Dumont, 1999 (Van Damme *et al*. 2003), the *Alona affinis*-group (Sinev 1997; 2009b), *Ovalona* Van Damme & Dumont, 2008 (Sinev 2006; Van Damme & Dumont 2008a), *Ilyocryptus* Smirnov, 1992 (Kotov & Elias-Gutierrez 2009), *Leydigia* Kurz, 1875 (Kotov 2009; Kotov & Fuentes-Reines 2014), and *Macrothrix* Norman & Brady, 1867 (Kotov 2007). This is also evident for the *costata*-branch, as shown by the affinities between the African *A. natalensis* and South American *A. margipluma* **sp. nov.**. *Alona margipluma* **sp. nov.** and *A. natalensis* also have many morphological affinities with *A. cheni,* but the phylogenetic and biogeographic significance of these affinities needs to be further investigated. It is clear that the *costata*-branch represents a good example of the continental endemism in Chydoridae; however, analyses of molecular data may be helpful to reconstruct the evolutionary history of this linage from *costata*-group.

On the other hand, the deep pockets of lateral head pores observed in *A. margipluma* **sp. nov.** resemble those found in *A. costata*, but many differences are observed between these species. For instance, *A. costata* has a short lateral head pore when compared with its pockets, and it has a narrow connection between middle and posterior main head pores. Besides that, other differences are observed in features from limbs (see Table 1). *Alona costata* has been reported in North America in some studies (Frey 1965, 1986; Flössner & Frey 1970), but, the morphology of the limbs in these populations has not yet been completely studied. According to Frey (1965, 1986) and Sinev (1999), the status of *A. costata* in North America is unclear and it may represent a cryptic species, not allowing more comparisons with *A. margipluma* **sp. nov.**. More consistent studies on the North America populations of *A. costata* are needed.

Recently, Silva *et al.* (2014) presented good photographs of an individual cultured from material collected at Furnas Reservoir, Minas Gerais state, which they labeled as *A. iherinhula* and indicated the COI sequence. However, the photographs show main head pores with wide connection, lateral head pores large and with deep pockets, longitudinal lines on the carapace and distal region of the postanal margin of the postabdomen clearly acute, which are not morphological traits observed in the typical *A. iheringula*, but belong to *A. margipluma* **sp. nov**. Therefore, we are convinced that the specimen photographed belongs to the new species instead of to *A. iheringula.* Likewise, the COI sequence deposited at GenBank (access number KF383284) should be considered as belonging to *A. margipluma* **sp. nov.**. and the considerations based on the genetic divergence performed by Silva *et al.* (2104) might not be considered valid, so far. Keeping in mind that the specimens that led to the culture were collected from a location within the range of the new species, this idea is reinforced.

TABLE 1. Main morphological differences between species from *costata*-branch: *Alona costata* (Sinev 1999), *Alona setigera* (Sinev 1999), *Alona cheni* (Sinev 1999) and *Alona natalensis* (Sinev 2008) and *Alona margipluma* **sp. nov.**. * Morphological trait absent.

	Alona costata	*Alona setigera*	*Alona cheni*	*Alona natalensis*	*Alona margipluma* **sp. nov.**
Size (mm)	0.38–0.42	0.38–0.42	0.47	0.54	0.32–0.43
Number of main head pores	3	2	3	3	3
Connection between middle and posterior main head pores	narrow	*	wide	wide	wide
Connection between middle and anterior main head pores	narrow/wide	*	narrow	narrow	narrow/wide
Main head pores PP/IP	0.5–0.8	1.1–1.3	0.7–0.9	1–1.2	0.7–0.95
Length of lateral main head pore	about 0.75 IP	about 0.9–1 IP	about 0.9–1 IP	about 1–1.2 IP	about 0.7–0.85 IP
Depth of pockets/ length lateral head pores and shape of pockets	about 2, rounded	about 1.5, rounded	about 2, semicircular	about 3 shallow	about 1.5, rounded
P3 setae 3–4	short, different length	short, subequal length	short, subequal length	short, subequal length	long, different length
P4 endite distal sensillum	reduced	reduced	reduced	rounded	bottle-shaped
P5 exopodite, lobe division	pronounced	pronounced	pronounced	unclear	unclear
P6 setules position	distal	distal	distal and lateral	distal	distal and lateral

In conclusion, the Brazilian fauna of the *costata*-group is now composed of three species: the previously reported *A. iheringula* and *A. setigera,* and the new species, *Alona margipluma* **sp. nov.**. We found *A. margipluma* **sp. nov.** in samples containing *A. guttata*, *A.* cf. *setigera* and *A. iheringula*, and it is very difficult to distinguish among these species at a low magnification or under the stereomicroscope. Because of their co-occurrence and high similarity in general view, we suggested careful observation of the main and lateral head pores and postabdomen in order to reduce the likelihood of mistakes in identifying these species.

Acknowledgements

The sampling campaigns in Cachoeira II reservoir were partially financed by the Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco – Facepe (APQ #0664-2.05/10). The sampling campaigns in Capetinga Stream and Cabocla I Pond were financed by the FNMA (Fundo Nacional do Meio Ambiente) and FAP-DF (Fundo de Amparo à Pesquisa do Distrito Federal), respectively. The sampling campaigns in Criminosa Lake and Amonguijá River were supported by FUNDEC/MS. We thank Marcelo Marchet Dalosto MSc. and Susan Casement for help in the English revision. We also thank Dr. Sônia N. Báo and Ingrid C. M. da Silva (Electron Microscopy Laboratory of the University of Brasília), who made the SEM micrographs possible. We are deeply grateful to Prof. Dr. Artem Yu. Sinev for initial suggestions about the morphology of the head pores. We are deeply grateful to Dr. Alexey A. Kotov and an anonymous reviewer for their valuable criticism, comments and suggestions, which improved this manuscript.

References

Elmoor-Loureiro, L.M.A. (2010) Cladóceros do Brasil: Famílias Chydoridae e Eurycercidae. Available from: http://cladocera.wordpress.com/ (accessed 15 April 2015)

Elmoor-Loureiro, L.M.A. (2014) *Ephemeroporus quasimodo* sp. nov. (Crustacea: Cladocera: Chydoridae) a new species from the Brazilian Cerrado. *Zootaxa*, 3281 (1), 88–100. http://dx.doi.org/10.11646/zootaxa.3821.1.6

Elmoor-Loureiro, L.M.A., Santos-Wisniewski, M.J. & Rocha, O. (2013) Redescription of *Alonella lineolata* Sars, 1901 (Crustacea, Cladocera, Chydoridae) and its translocation to the subfamily Aloninae and to the new genus *Bergamina* gen. nov.. *Zootaxa*, 3630 (1), 571–581. http://dx.doi.org/10.11646/zootaxa.3630.3.11

Flössner, D. & Frey, D.G. (1970) A morphological comparison of European and North American populations of *Alona rustica* Sars and *Alona costata* Scott (Cladocera, Chydoridae). *Limnologica (Berlin)*, 7, 325–337.

Frey, D.G. (1965) Differentiation of *Alona costata* Sars from two related species (Cladocera, Chydoridae). *Crustaceana,* 8, 159–173. http://dx.doi.org/10.1163/156854065X00695

Frey, D.G. (1986) The non-cosmopolitanism of chydorid Cladocera: Implication for Biogeography and evolution. *In*: Gore, R.H.K., Heck, K.I. & Balkema, A.A. (Eds.), *Crustacean Biogeopraphy.* Rotterdam, pp. 237–256.

Kotov, A.A. (2007) Revision of the *hirsuticornis*-like species of *Macrothrix* Baird, 1843 (Cladocera: Anomopoda: Macrothricidae) from Subantarctic and temperate regions of the southern hemisphere. *Journal of Natural History,* 41, 2569–2620. http://dx.doi.org/10.1080/00222930701689937

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. & Sinev, A.Y. (2004) Notes on Aloninae Dybowski & Grochowski, 1894 *emend.* Frey, 1967 (Cladocera: Anomopoda: Chydoridae): 3. *Alona iheringula* nom. nov. instead of *A. iheringi* Sars, 1901, with comments on this taxon. *Arthropoda Selecta*, 13, 95–98.

Kotov, A.A. & Elias-Gutierrez, M. (2009) A phylogenetic analysis of *Ilyocryptus* Sars, 1862 (Cladocera: Ilyocryptidae). *International review of Hydrobiology,* 94, 208–225. http://dx.doi.org/10.1002/iroh.200811102

Kotov, A.A. & Fuentes-Reines, J.M. (2014) A new species of *Leydigia* Kurz, 1875 (Cladocera: Chydoridae) from Colombia. *Zootaxa,* 3814 (3), 399–408. http://dx.doi.org/10.11646/zootaxa.3814.3.7

Santos-Wisniewski, M.J., Rocha, O. & Matsumura-Tundisi, T. (2001) First record of *Alona setigera* Brehm (Cladocera: Chydoridae) in the neotropical region. *Brazilian Journal of Biology,* 61, 701–702.

http://dx.doi.org/10.1590/S1519-69842001000400022
Silva, E.S., Abreu, C.B., Orlando, T.C., Wisniewski, C. & Santos-Wisniewski, M.J. (2014) *Alona iheringula* Sinev & Kotov, 2004 (Crustacea, Anomopoda, Chydoridae, Aloninae): Life Cycle and DNA Barcode with Implications for the Taxonomy of the Aloninae Subfamily. *Plos One*, 9, e97050.
http://dx.doi.org/10.1371/journal.pone.0097050
Sinev, A.Y. (1997) Review of the *affinis*-group of *Alona* Baird, 1843, with the description of a new species from Australia (Anomopoda Chydoridae). *Arthropoda Selecta*, 6, 47–58.
Sinev, A.Y. (1999) *Alona costata* Sars, 1862 versus related palaeotropical species: the first example of close relations between species with a different number of main head pores among Chydoridae (Crustacea: Anomopoda). *Arthropoda Selecta,* 8, 131–148.
Sinev, A.Y. (2001) Redescription of *Alona iheringi* Sars, 1901 (Chydoridae, Anomopoda, Branchiopoda), a South American species related to *A. rustica* Scott, 1895. *Hydrobiologia,* 464, 113–119.
http://dx.doi.org/10.1127/1863-9135/2009/0175-0059
Sinev, A.Y. (2006) *Alona meridionalis* sp.n.-A new species of Chydoridae (Branchiopoda: Cladocera: Anompoda) from South Africa, with transverse lateral head pores. *Arthropoda Selecta,* 15, 193–202.
Sinev, A.Y. (2008) A new species related to *Alona costata* Sars, 1862 (Cladocera: Anomopoda: Chydoridae) from South Africa. *Zootaxa*, 1707, 23–36.
Sinev, A.Y. (2009a) Notes on morphology and taxonomic status of some North American species of the genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae). *Fundamental and Applied Limnology – Archiv für Hydrobiologie*, 175, 59–77.
http://dx.doi.org/10.1127/1863-9135/2009/0175-0059
Sinev, A.Y. (2009b) Cladocerans of the *Alona affinis* (Leydig, 1860) group from South Africa. *Zootaxa*, 1990, 41–54.
http://dx.doi.org/10.11646/zootaxa.3693.3.3
Sinev, A.Y. & Elmoor-Loureiro, L.M.A. (2010) Three new species of Chydoridae cladocerans of subfamily Aloninae (Branchiopoda: Anomopoda: Chydoridae) from Brazil. *Zootaxa*, 2390, 1–25.
Sinev, A.Y. & Kobayashi, T. (2012) Redescription of the endemic Australian cladoceran *Alona willisi* (Smirnov, 1989) and its assignment to *Acanthalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). *Zootaxa,* 3390, 43–45.
Smirnov, N.N. (1971) Chydoridae fauny mira. *Fauna USSR. Rakoobraznie*, 1 (2), Leningrad, 531 pp. [English translation: *Chydoridae of the world*. Israel Program for Scientific Translations, Jerusalem, 1974]
Smirnov, N.N. & Timms, B. (1983) A revision of the Australian Cladocera. *Records of the Australian Museum,* 1 (Supplement), 1–132.
http://dx.doi.org/10.3853/j.0812-7387.1.1983.103
Van Damme, K., Chiambeng, G., Maiphae, S. & Dumont, H.J. (2003) New species in the rheophilous genus *Nicsmirnovius* Chiambeng & Dumont, 1999 (Branchiopoda: Anomopoda: Chydoridae) and reassignment of *Alona eximia* Kiser, 1948 and *Alonella fitzpatricki* Chien, 1970. *Hydrobiologia*, 499, 25–49.
http://dx.doi.org/10.1023/A:1026391501312
Van Damme, K. & Dumont, H.J. (2007) Limb morphology of the carnivorous anomopods *Anchistropus emarginatus* Sars, 1862 and *Pseudochydorus globosus* (Baird, 1843) (Crustacea: Branchiopoda: Anomopoda). *Annales de Limnologie-International Journal of Limnology*, 43, 271–284.
http://dx.doi.org/10.1051/limn:2007005
Van Damme, K. & Dumont, H.J. (2008a) 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. & Dumont, H.J. (2008b) The 'true' genus *Alona* Baird, 1843 (Crustacea: Cladocera: Anomopoda): characters of the *A. quadrangularis*-group and description of a new species from Democratic Republic Congo. *Zootaxa,* 1945, 1–25.
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.
Van Damme, K. & Eggermont, H. (2011) The Afromontane Cladocera (Crustacea: Branchiopoda) of the Rwenzori (Uganda–D. R. Congo): taxonomy, ecology and biogeography. *Hydrobiologia*, 675, 57–100.
http://dx.doi.org/10.1007/s10750-011-0892-0
Van Damme, K., Eliáz-Gutiérrez, M. & Dumont, H.J. (2011) Three rare European "*Alona*" taxa (Branchiopoda: Cladocera: Chydoridae), with notes on distribution and taxonomy. *Annales de Limnologie*, 47, 45–63.
http://dx.doi.org/10.1051/limn/2010034

ARTIGO 3

POSITION OF THE *dentifera*-group (CRUSTACEA, CHYDORIDAE, ALONINAE) IN THE *Coronatella*-branch AND ITS TRANSLOCATION TO A NEW GENUS

Artigo será submetido ao periódico ZooKeys ISSN 1313-2970; Fator de Impacto (JCR 2014) = 0.933; Estrato no Qualis CAPES de Biodiversidade B2. O novo nome genérico foi omitido para que não se tornasse *nomen nudum*.

POSITION OF THE *dentifera*-group (CRUSTACEA, CHYDORIDAE, ALONINAE) IN THE *Coronatella*-branch AND ITS TRANSLOCATION TO A NEW GENUS

Franscisco Diogo R. Sousa[1,2*], Lourdes Maria Abdu Elmoor-Loureiro[2] and Sandro Santos[1]

[1]Núcleo de Estudos em Biodiversidade Aquática, Programa de Pós-graduação em Biodiversidade Animal, Universidade Federal de Santa Maria – UFSM, Av. Roraima 1000, Camobi, CEP 97105-900, Santa Maria, RS, Brazil

[2]Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília – UCB, QS7 lote 1, Bloco M, sala 204, CEP 71966-700, Taguatinga, DF, Brazil

*corresponding author. Email: sousa_bio@yahoo.com.br

ABSTRACT

The Gen. nov. 2 was created to translocate species of the *dentifera*-group from *Alona* sensu lato and include Gen. nov. 2. *dentifera* **comb. nov.** and Gen. nov. 2 *siamensis* **comb. nov.**. The synapomorphies of the Gen. nov. 2 are setae on the valves inserted internally and basal spines larger than 2/3 of terminal claw. Morphological traits, such as habitus, rostrum and postabdomen shape, presence of the denticles on the posteroventral corner of valves and armature of IDL setae are also important in the distinction between Gen. nov. 2 and other genera from the *Coronatella*-branch. The morphology of Gen. nov. 2 *dentifera* **comb. nov.** male confirms the closer relationship with *Leberis*, but the morphology of the terminal claw, basal spine and setae 2-3 of IDL support their separation. Now, this lineage of Aloninae is composed of the genera *Coronatella*, *Anthalona*, *Karualona*, *Bergamina*, *Extremalona*, *Ovalona*, *Celsinotum*, *Leberis* and Gen. nov. 2.

Keywords *Alona broaensis*, *Alona dentifera*, *Alona siamensis*, *Celsinotum*, *Leberis*, male, morphology, *Ovalona*

INTRODUCTION

The taxonomic status of *Alona dentifera* (Sars, 1901) was discussed by Sinev et al. (2004). In this study, the authors translocate *Alonella dentifera* to genus *Alona* Baird, 1843 based on the argument of the absence of typical morphological traits of Chydorinae Dybowsky & Grochowski, 1894 *emend.* Frey, 1967 and presence of some morphological traits of Aloninae Dybowsky & Grochowski, 1894 *emend.* Frey, 1967. Because of the polyphyletic nature of *Alona* (Sacherová and Hebert 2003; Elmoor-Loureiro 2004; Eliáz-Gutiérrez et al. 2008), translocations of species groups to different genera were made: *Phreatalona*, which corresponds to the *protzi*-complex (Van Damme et al. 2009); *Coronatella*, which corresponds to the *rectangula*-complex (Van Damme and Dumont 2008a); *Brancelia* (Van Damme and Sinev 2011), which corresponds to the *hercegovinae*-complex; and *Anthalona* Van Damme, Sinev & Dumont, 2011, which includes species of the *verrucosa*-complex (Van Damme et al. 2011a). Most recently, Sinev (2015a) included the *pulchella*-group in *Ovalona* Van Damme & Dumont, 2008.

Likewise, the position of *A. dentifera* is doubtful because its morphology is very different from that of the "true *Alona*", which is represented by the *quadrangularis*-group (Van Damme and Dumont 2008b; Van Damme et al. 2010). Van Damme and Dumont (2008a) suggested that *A. dentifera* belongs to a large lineage of *Alona* sensu lato, named the *Coronatella*-branch, and that it may be close to *Leberis*, as evidenced by molecular tools (Elias-Gutiérrez et al. 2008) or to the *Coronatella* genus. Although Chatterjee et al. (2013) consider *A. dentifera* as a member of the *Coronatella* genus, this species seems to be part of a group with separate evolution, together with *Alona siamensis* Sinev & Sanoamuang, 2007. *Alona dentifera* and *A. siamensis* share synapomorphies, as showed by Sinev and Sanoamuang (2007). Besides, the male morphology of *A. dentifera* is quite different from *Coronatella* and *Leberis* (see description below).

Thus, our aim is to evaluate the morphological traits of *Alona dentifera*, based on material from Brazil and Argentina, and to describe the adult male, for the first time. Additionally, we translocate *A. dentifera* to a new genus, which also includes *A. siamensis*.

MATERIAL AND METHODS

The description of the new genus was based on material collected in different localities in Brazil and Argentina (see material examined) and data from the literature (Sinev et al. 2004). The selected animals were transferred to drops of glycerol on slides and dissected under a stereomicroscope. The morphology of appendages and other structures was studied using a phase contrast microscope Olympus BX41. To enumerate the setae of limbs, we used the proposal of homology from Kotov (2000a, b), which presented stability when tested in different cladoceran groups (Kotov et al. 2010). Drawings were prepared using a camera lucida attached to a phase contrast microscope Olympus BX41.

The following abbreviations were used in the text, table and figures – A1: antennule; as: accessory seta; CBS: copulatory brush seta; en: endite; ep: epipodite; ex: exopodite; fc: filter comb; gfp: gnathobasic filter plate; gn: gnathobase; IDL: inner distal lobe; il; inner lobe; ms: male seta; ODL: outer distal lobe; P1: limb I; PA: postabdomen; pep: pre-epipodite; s: sensillum.

RESULTS

Taxonomy

Class Branchiopoda Latreille, 1817

Order Anomopoda Sars, 1865

Family Chydoridae Dybowsky & Grochowski, 1894 *emend.* Frey, 1967

Subfamily Aloninae Dybowsky & Grochowski, 1894 *emend.* Frey, 1967

Gen. nov. 2

Figures 1-33

Material examined. Nine parthenogenetic females and one adult male from Henrique pond, Brasília National Park, Distrito Federal, Brazil (15º 41’ 18”S; 47º 56’ 26.10”W), material collected by Grupo de Estudos de Ecossistemas Aquáticos (GEEA) in ix.2009. One parthenogenetic female from Henrique pond, Brasília National Park, Distrito Federal, Brazil (15° 41’ 16.5”S; 47° 56’ 22.2”W), material collected by Lourdes M. A. Elmoor-Loureiro on 27.v.2002. One parthenogenetic female from Cabocla II pond, Campo de Instrução de Formosa, Goiás, Brazil (15º 48’ 21”S; 47º 17’ 09.20”W), material collected by Grupo de Estudos de Ecossistemas Aquáticos (GEEA) on viii.2009. Six adult parthenogenetic females and one juvenile from Baía da Célia, Fazenda Nhumirim (18° 59' 27.5"S, 56° 39' 41.0"W), Pantanal, Mato Grosso do Sul, Brazil, material collected on 07.ix.2000 by Valéria Barros. Four parthenogenetic females from Criminosa Pond (21º40’28.8”S, 57º53’28.5”W) identified as *Alona broaensis*, Porto Murtinho, Pantanal, Mato Grosso do Sul, Brazil, material collected on 19.i.2010, leg Adriana Maria Güntzel. Two parthenogenetic females from Coqueiral Pond, Paranapanema River, Angatuba, São Paulo, Brazil (23° 29’ 22.64”S; 48° 37’ 6.65”W). Material collected by Lourdes M. A. Elmoor-Loureiro on 30.v.2001. Two parthenogenetic females from Esquina, Middle Paraná River, Argentina (30º 00.54’ 59”S; 59º 32’ 51.93”W), material collected by José Roberto Debastiani Júnior on 12.vi.2010. Six parthenogenetic females from San Pedro, Lower Paraná River, Argentina (30º 40’ 49”S; 59º 18’ 48.80”W), material collected by José Roberto Debastiani Júnior on 14.vi.2010. Three parthenogenetic females from Pimenteira pond, Mata da Pimenteira State Park, Serra Talhada, Pernambuco, Brazil (7°53’48.96”S, 38°18’14.30”W), material collected by Leidiane Pereira Diniz on 13.iv.2014.

Type species of the genus. Gen. nov. 2 *dentifera* **comb. nov.** = *Alona dentifera* (Sars, 1901). We recognize two valid species, Gen. nov. 2 *dentifera* **comb. nov.** and Gen. nov. 2 *siamensis* **comb. nov.**.

Diagnosis of the genus. ***Parthenogenetic female***

Habitus - Body ovoid, without dorsal keel; *Head* – Rostrum wide, not pointed; head shield wide with distance between mandibular articulations longer than posterior portion, main head pores absent in adults of *A. dentifera* **comb. nov.** or three in *A. siamensis* **comb. nov.** (Figures 8-9); lateral head pores absent (*A. detifera* **comb. nov.**) or present (*A. siamensis* **comb. nov.***)*. ***Carapace*** - ornamentation punctated or with longitudinal lines; valves armed with 40-53 setae internally inserted in the valves (Figures 1-6); posteroventral corner armed with 1-4 denticles (Figure 7); ***Labral keel*** - wide and naked, apex not elongated (Figure 10). ***Antennule*** - exceeding the tip of the rostrum, nine aesthetascs of different length present (Figure 11). ***Antenna*** **-** with formula antennal : setae 003/113, spines 101/001; first segment of endopodite and exopodite elongated; weak setules or spicules on the segments (Figure 12). ***Postabdomen*** - narrowing distally, preanal angle prominent; postanal margin armed 10-13 groups of unmerged denticles; eight-10 lateral fascicles of which the most distal beyond postanal margin (Figures 13-14); terminal claw inserted on the projection of postabdomen, longer than anal margin; spinules on the ventral margin may be present; pecten armed on the internal and external face of the claw, base of claw armed with 1-5 long and strong spinules (Figures 14-15); ***basal spine*** - remarkably long, longer than 2/3 of terminal claw length, with spinules on the dorsal margin (Figures 14-15) (absent in *A. siamensis*). ***Limb I*** **(Figures 16-19) –** endite 1 with three setae (g-i); IDL (en 4) with two long setae (2-3), seta 1 reduced (*A. dentifera* **comb. nov.**) or even absent (*A. siamensis* **comb. nov.**); IDL setae 2-3 armed with

proximal denticles. ***Limb II*** **(Figure 20) –** anterior setae soft absent; short seta on the exopodite present; scrapers not specialized, but presenting denticles, especially on scrapers 6-8; gnathobase armed with four elements, filter comb armed with seven setae, of which two are shorter. ***Limb III*** **(Figures 21-22) –** six setae on the exopodite, third and fourth setae long; distal endite armed with three setae and one sensillum; gnathobase with three elements, filtercomb with seven setae. ***Limb IV*** **(Figures 23-26) –** relatively short, six setae on the exopodite; flaming-torch setae on the distal endite not modified; gnathobase armed with a long setulated setae, filter comb armed with five setae. ***Limb V*** **(Figures 25-26) –** relatively short, setae 3-4 of exopodite similar in length; filter comb reduced, with one short seta in *A. dentifera* **comb. nov.** and none in *A. siamensis* **comb. nov.**. ***Limb VI*** **–** absent.

Ephipial female unstudied.

Adult male only known for *A. dentifera* **comb. nov.**; it is smaller than female, (Figure 27), ***postabdomen*** strongly narrowing distally, ***terminal claw*** short and robust (Figures 30-31), ***basal spine*** about half-length of terminal claw, with tip forked (Figure 31); ***copulatory hook*** with one projection on the tip (Figures 32-33).

Description of the genus. As for *Alona dentifera* = Gen. nov. 2 *dentifera* **comb. nov.** (see Sinev et al. 2004). We observed variations in relation to description of *A. dentifera* **comb. nov.**: number of denticles on the posteroventral corner of carapace (Figure 7) and presence of three main head pores in single juvenile individual from Argentina (Figure 9).

Description of adult male Gen. nov. 2 *dentifera* comb. nov.

Habitus **(Figure 27) -** ovoid, smaller than female, length 0.35 mm, high in the middle of the body. ***Head*** **(Figure 27) -** Eye and ocellus not observed, rostrum elongated not blunt, main

head pores absent. ***Carapace*** without ornamentations; ventral margin armed with 37 setae, posteroventral corner with two denticles without setulae between them. ***Antennules*** **(Figures 27-28) -** Exceeding the tip of rostrum, about 2.5 times as long as wide, with three rows of short setules on antennular body; eleven aesthetascs, two lateral and nine apical. Sensory seta and male seta not studied. ***Antenna*** **(Figure 29) -** As described for females, however, apical spines relatively longer. ***Postabdomen*** **(Figure 30).** Long as in female, strongly narrowing distally. Anal margin shorter than postanal margin; twelve rows of thin setules on the anal and postanal margin; eight lateral fascicles which do not exceed the marginal line. ***Terminal claw*** **(Figures 30-31)** - smaller and more robust than in female, base armed with one long and strong spinule, pecten armed with strong spines along terminal claw. ***Basal spine*** **(Figure 31) -** Long, about half-length of terminal claw, forked tip, ventral margin armed with spinules. ***Limb I*** **(Figures 32-33) -** Copulatory hook curved, U-shaped, projection on the tip present, copulatory brush seta shorter than mid-length of male seta on IDL, which is armed with three setae; male setae thick with tip slightly curved; setae 2-3 armed with proximal denticles (as observed in female). ODL seta longer than IDL setae.

Differential diagnosis. The synapomorphies of Gen. nov. 2 are (1) basal spines longer than 2/3 of terminal claw, (2) setae on the valves inserted internally. The Gen. nov. 2 can also be differentiated from *Coronatella* genus by body ovoid, rostrum wide, postabdomen narrowing distally; the males of *Coronatella* do not bear two lateral aesthetascs. Specifically from *Anthalona*, the Gen. nov. 2 differs in the morphology of IDL, which is armed with denticles not specialized, shape of the postabdomen and armature of limb I; the males of *Anthalona* do not bear lateral aesthetascs. From *Karualona*, the new genus differs in the morphology of IDL setae, shape of the postabdomen and seta on the exopodite of limb II (present in Gen. nov. 2 and absent in *Karualona*). The Gen. nov. 2 is closer to *Leberis* according to Eliáz-Gutiérrez et

al. (2008); however, it is distinguished in the morphology of setae 2-3 of the IDL (Figures 18-19), presence of seta on exopodite of limb II, absence of the dorsal keel (Figures 1-5), and presence of long basal spine on the terminal claw of the postabdomen (Figures 13-16); the males of *Leberis* do not bear denticles on the postero-ventral corner of valves. The Gen. nov. 2 differs from *Celsinotum* Frey, 1991 in the absence of dorsal keel, absence of spine-like setae on the posterior portion of valves, long basal spine, absence of a rudimentary seta on endite 1 of limb I. The new genus differs clearly from *Bergamina* Elmoor-Loureiro, Santos-Wisniewski & Rocha, 2013 in morphology of postabdomen, presence of denticles on the posteroventral margin of valves and absence of anterior naked seta between endites 1-2 (see Elmoor-Loureiro et al. 2013). The Gen. nov. 2 differs from *Extremalona* Sinev & Shiel, 2012 in general morphology, presence of denticles on the posteroventral margin of valves, postabdomen morphology and armature of setae 2-3 of IDL; the male of *Extremalona* bears six lateral aesthetascs. Table 1 shows the main differences and similarities between genera related to the *Coronatella*-branch.

DISCUSSION

Morphological analyses

In the redescription of *Alona dentifera*, Sinev et al. (2004) suggested that morphological traits observed in this species were not enough to create a new genus, however, the description of *A. siamensis* (Sinev and Sanoamuang 2007) showed a new perspective about *dentifera*-group. Thus, Gen. nov. 2, created to allocate the *dentifera*-group, is mainly supported by setae on the valves inserted internally, basal spine longer than 2/3 of terminal claw. Other morphological traits also are observed in Gen. nov. 2: naked denticles on the posteroventral corner of valves, prominent preanal angle at postabdomen, setae 2-3 of IDL armed with proximal denticles, six setae on limb III and limb IV absent. The presence of six setae on exopodite of limb III and

absence of limb VI are considered important to clade Gen. nov. 2 *dentifera*/ Gen. nov. 2 *siamensis*, since they may have arisen in the ancestral of the *Coronatella*-branch.

The morphology of head shield, main head pores and of some structures of the limbs are different between Gen. nov. 2 *dentifera* **comb. nov.** and Gen. nov. 2 *siamensis* **comb. nov.**; however, variation in these structures was already observed in *Euryalona* (Rajapaksa and Fernando 1987). Species-groups of *Alona* sensu lato, such as the *costata*-group (Sinev 1999b, 2001a, 2008; Van Damme & Eggermont 2011; Van Damme et al. 2011b), *verrucosa*-group (Van Damme et al. 2011a; Sinev and Kotov 2012), *rectangula*-group (Van Damme and Dumont 2008b; Sousa et al. 2015a), and *pulchella*-group (Sinev 2001 b, c; Sinev 2009; Sinev and Silva-Briano 2012; Van Damme et al. 2013; Sousa et al. 2015b) also have differences in structures on head, postabdomen, and limbs.

Recently, Sinev (2014, 2015b) reviewed the morphology of *Camptocercus* Baird, 1843 species and showed significant differences in structures on the limbs. In the same way, *Celsinotum* also has many differences in the morphology of head shield, postabdomen and limbs (Frey 1991; Sinev and Elmoor-Loureiro 2010; Sinev and Kotov 2012). This endorses our position that the differences between Gen. nov. 2 *dentifera* **comb. nov.** and Gen. nov. 2 *siamensis* **comb. nov.** should be considered at a specific level in the *dentifera*-group (also suggested by Sinev and Sanoamuang 2007). For Van Damme and Sinev (2013), this small lineage may represent an ancient vicariant divergence, presenting currently an Amphi-Pacific distribution. The differences in the morphology between Gen. nov. 2 *dentifera* **comb. nov.** and Gen. nov. 2 *siamensis* **comb. nov.** may be the result of adaptations to different environmental pressure on a micro-scale.

The trend in morphological radiation in the clade Gen. nov. 2 appears to be related to external morphology and not to features of trunk limbs (such as in the *pulchella*-group). It has been observed that a wide rostrum and the maintenance of primitive ovoid body shape, shared

with other species-groups, possibly result from convergence or parallelism (Sinev et al. 2005; Van Damme and Dumont 2008b; Sinev et al. 2009; Van Damme and Sinev 2011).

The morphology of the postabdomen is the most evident trait of Gen. nov. 2 in contrast to *Leberis*, *Coronatella*, *Anthalona*, *Karualona*, *Extremalona*, *Bergamina*, *Celsinotum* or *Alona* senso stricto; however, this morphological feature does not show a clear relationship with habitat or evolutionary history. Generally, specialized species have their morphology linked to habitat conditions (Van Damme et al. 2003; Kotov 2000a, b; Kotov 2006; Van Damme et al. 2009; Kotov et al. 2010; Van Damme and Sinev 2011; Van Damme et al. 2011a; Sinev 2014), but, apparently, this is not case of the two species from the *dentifera*-group, because they may occur in different kinds of habitats (Sinev and Sanoamuang 2007; Güntzel et al. 2010; Sousa et al. 2012; Kotov et al. 2013; Van Damme and Sinev 2013).

Some studies observed that the male's morphology is very important in making any inference about the relationship between closer species or between species groups in Aloninae (Sinev 1999a; 2013). Indeed, the morphology of the Gen. nov. 2 *dentifera* **comb. nov.** male indicates more affinities with *Leberis* than with any genus from the *Coronatella*-branch. For instance, the general shape of postabdomen and antennules is similar to that described for adult females of *L. davidi* (Richard, 1895) (Sinev et al. 2005) and *L. colombiensis* Kotov & Fuentes-Reines 2015 (Kotov and Fuentes-Reines 2015). However, there are clear differences between *Leberis* and Gen. nov. 2: the presence of denticles on posteroventral corner of valves, shape of terminal claw, length of the basal spine, and armature of IDL setae (for Gen. nov. 2 *dentifera* **comb. nov.**, Figures 30-32).

Differently from Gen. nov. 2, males of the *Coronatella* genus have dorsal and ventral margins of the postabomen almost straight and lateral aesthetascs on antennules absent (Van Damme and Dumont 2008a; Sousa et al. 2015a). *Anthalona* males have short basal spine and

long distalmost lateral fascicles on the postabdomen and lateral aesthetascs on antennules absent (Van Damme et al. 2011a; Sinev and Kotov 2012). The males from *K. muelleri* (Richard, 1897) has reduced basal spine and all lateral fascicles long on postabdomen, exceeding the marginal line, and lateral aesthetascs on antennules absent (Panarelli, unpublished data from Minas Gerais state, Brazil).

According to Sinev (2015b), *Celsinotum* is closer to *Leberis* and *Ovalona*, and thus, its close relationship with Gen. nov. 2 could be inferred. *Celsinotum* females differ quantitatively from Gen. nov. 2 in external and limb structures (see Frey 1991; Sinev and Elmoor-Loureiro 2010; Sinev and Kotov 2012). The males of *Celsinotum* differ from Gen. nov. 2 in the shape of postabdomen, length of basal spines, presence of six lateral aesthetascs on antennules and setae 2-3 of IDL armed with setules (see Frey 1991; Sinev and Kotov 2012).

Besides short postabdomen, the male of *Extremalona* has six lateral aesthetascs on antennules and well developed seta 1 of IDL and setae 2-3 armed with setules (Sinev and Shiel 2012). The male of *Ovalona* genus also has two lateral aesthetascs on the antennules, but differs from Gen. nov. 2 because it has straight dorsal and ventral postabdominal margins, gonopores opening above projection to insertion of terminal claw, and setae 2-3 of IDL armed with setules. Differences between Gen. nov. 2 male and *Bergamina* cannot be stated because the male is not known, so far.

Note on *Alona broaensis* Matsumura-Tundisi & Smirnov, 1984

Alona broaensis species was described from Broa Reservoir, São Paulo, Brazil (Matsumura-Tundisi and Smirnov 1984) and it has not often been found in fauna studies conducted in many regions (including type region). The absence of some information on the morphology, including details from trunk limbs, led Van Damme et al. (2010) to list this species as a junior synonym of *A. dentifera*. Indeed, the morphological variation observed between Gen. nov. 2

dentifera **comb. nov.** populations studied here and by Rey and Vasquez (1986) for number of denticles on the posteroventral corner of carapace (Figure 8), morphology of the terminal claw, basal spine, and rostrum, include the features signed as diagnostic for *A. broaensis* (see Matsumura-Tundisi and Smirnov 1984). They are like those observed in description of *A. broaensis* (see Matsumura-Tundisi and Smirnov 1984). We analyzed one population identified as *Alona broaensis* from the Pantanal, Brazil, and morphological traits distinct from Gen. nov. 2 *dentifera* **comb. nov.** were not observed (Güntzel et al. 2010). In the other words, there are not morphological traits that support the validity of *Alona broaensis*. We agree with the suggestion of Van Damme et al. (2010), and *Alona broaensis* is here considered as a junior synonym of Gen. nov. 2 *dentifera* **comb. nov.**.

Conclusion

The Gen. nov. 2 is one more genus derived from *Alona* sensu lato and belongs to the *Coronatella*-branch, being close to *Leberis*, as suggested by phylogenetic analysis based on molecular data (Eliáz-Gutiérrez et al. 2008). The synapomorphies of the Gen. nov. 2 are setae on the valves inserted internally and long basal spines. The Gen. nov. 2 also has a wide rostrum, naked denticles on the posteroventral corner of valves, prominent preanal angle at postabdomen, setae 2-3 of IDL armed with proximal denticles, six setae on limb III and limb IV absent. In addition to the female morphology presenting consistent differences when compared to other genera from the *Coronatella*-branch, the male features also support the creation of this new genus that includes Gen. nov. 2 *dentifera* **comb. nov.** and Gen. nov. 2 *siamensis* **comb. nov.**.

Acknowledgements

We thank Prof. Dr. Adriana M. Güntzel (FUNDECT/MS), Dr. Jose Roberto Debastiani Junior and Biologist Lediane Pereira Diniz for providing the material of *Alona broaensis* from Pantanal and of *Alona dentifera* from Argentina and Pernambuco, respectively. The first author of this paper was awarded a grant from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

References

Chatterjee T, Kotov AA, Van Damme K, Chandrasekhar SVA, Padhye S (2013) An annotated checklist of the Cladocera (Crustacea: Branchiopoda) from India. Zootaxa 3667(1): 1-89.

Güntzel AM, Panarelli EA, Silva WM, Rochhe KF (2010) Influence of connectivity on Cladocera diversity in oxbow lakes in the Taquari River floodplain (MS, Brazil). Acta Limnolgica Brasiliensia 22(1): 93-101.

Elías-Guttiérez M, Martínez-Jerónimo F, Ivanova NV, Valdez-Moreno M, Hebert PDN (2008) DNA barcodes for Cladocera and Copepoda from Mexico and Guatemala, highlights and new discoveries. Zootaxa 1839: 1–42.

Elmoor-Loureiro LMA (2004) Phylogenetic relationships among families of the order Anomopoda (Crustacea, Branchiopoda, Cladocera). Zootaxa 760: 1-26.

Elmoor-Loureiro LMA, Santos-Wisniewski MJ, Rocha O (2013) Redescription of *Alonella lineolata* Sars, 1901 (Crustacea, Cladocera, Chydoridae) and its translocation to the subfamily Aloninae and to the new genus *Bergamina* gen. nov. Zootaxa 3630(3): 571-581.

Frey, G (1991) A new genus of alanine chydorid cladocerans from athalassic saline waters of New South Wales, Australia. Hydrobiologia 224: 11-48.

Kotov, AA (2000a) Analysis of *Kozhowia* Vasiljeva & Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda), and a description of *Parakozhowia* n. gen. *Hydrobiologia*, 437: 17–56.

Kotov AA (2000b) Redescription and assignment of the chydorid *Indialona ganapati* Petkovski, 1966 (Branchiopoda: Anomopoda: Aloninae) to Indialonini, new tribus. Hydrobiologia 439: 161–178.

Kotov AA (2006) Adaptations of Anomopoda Crustaceans (Cladocera) to the Benthic Mode of Life. Entomological Review 86: 210–225.

Kotov AA, Fuentes-Reines, JM (2015) A new species of Leberis Smirnov, 1989 (Cladocera: Chydoridae) from Colombia. Zootaxa 3957(5): 553-566.

Kotov AA, Sinev AY, Berrios VL (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.

Kotov AA, Van Damme K, Bekker EI, Siboualipha S, Silva-Briano M, Ortiz AA, De la Rosa RG, Sanoamuang L (2013) Cladocera (Crustacea: Branchiopoda) of Vientiane province and municipality, Laos. Journal of Limnology 72(s2): 81-108.

Matsumura-Tundisi T, Smirnov NN (1984) Description of Alona broaensis sp.nov. (Crustacea: Cladocera). Hydrobiologia 113: 327–329.

Rajapksa R, Fernando CH (1987) A redescription of *Euryalona orientalis* (Daday, 1898), with a consideration of the other species in the genus *Euryalona* (Cladocera: Chydoridae). Hydrobiologia 150: 75-90.

Rey J, Vasquez E (1986) Cladocères de quelques corps d'eaux du basin moyen de l'Orénoque (Vénézuéla).Annales de Limnologie – International Journal of Limnology 22(2): 137-168.

Sacherová V, Hebert PDN (2003) The evolutionary history of the Chydoridae (Crustacea: Cladocera). Biological Journal of the Linnean Society 79: 629-643.

Sinev AY (1999a) *Alona werestchangini* sp.n., a new spcies of the genus *Alona* Baird, 1843 related to *A. guttata* Sars, 1862 (Anomopoda: Chydoridae). Arthropoda Selecta 8: 23-30.

Sinev AY (1999b) *Alona costata* Sars, 1862 versus related palaeotropical species: the first example of close relations between species with a different number of main head pores among Chydoridae (Crustacea: Anomopoda). Arthropoda Selecta 8: 131–148.

Sinev AY (2001a) Redescription of *Alona iheringi* Sars, 1901 (Chydoridae, Anomopoda, Branchiopoda), a South American species related to *A. rustica* Scott, 1895. Hydrobiologia 464: 113–119.

Sinev AY (2001b) Redescription of *Alona glabra* Sars, 1901, a South American species of the *pulchella*-group (Chydoridae, Anomopoda, Branchiopoda). Arthropoda Selecta 10: 273–280.

Sinev AY (2001c) Separation of *Alona cambouei* Guerne & Richard, 1893 from *Alona pulchella* King, 1853 (Branchiopoda, Anomopoda, Chydoridae). Arthropoda Selecta 10: 5–18.

Sinev AY (2008) A new species related to *Alona costata* Sars, 1862 (Cladocera: Anomopoda: Chydoridae) from South Africa. Zootaxa 1707: 23–36.

Sinev AY (2009) Notes on morphology and taxonomic status of some North American species of the genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae). Fundamental Applied Limnology 175: 59–77.

Sinev AY (2012) *Alona kotovi* sp. nov., a new species of Aloninae (Cladocera: Anomopoda: Chydoridae) from South Vietnam. Zootaxa 3475: 45-54.

Sinev AY (2013) Cladocerans of *Alona affinis* group (Cladocera: Anomopoda: Chydoridae) from North America. Zootaxa 3693: 329-343.

Sinev AY (2014) A comparative morphological analyses of four species of *Camptocercus* Baird, 1843 (Cladocera: Anomopoda: Chydoridae). Zootaxa 3895: 183-207.

Sinev AY (2015a) Revision of the *puchella*-group of Alona s. lato leads to its translocation to *Ovalona* Van Damme et Dumont, 2008 (Branchiopoda: Anomopoda: Chydoridae). Zootaxa 4044: 451-492.

Sinev AY (2015b) Morphology and phylogenetic position of three species of genus Camptocercus Baird, 1843 (Cladocera: Anomopoda: Chydoridae). Zootaxa 4040: 169-186.

Sinev AY, Elmoor-Loureiro LMA (2010) Three new species of chydrorid cladocerans of subfamily Aloninae (Brachiopoda: Anomopoda: Chydoridae) from Brazil. Zootaxa 2390: 1–25.

Sinev AY, Kotov AA (2012) New and rare Aloninae (Cladocera: Anomopoda: Chydoridae) from Indochina. Zootaxa 3334: 1-28.

Sinev AY, Sanoamuang L (2007) *Alona siamensis* sp. n., a new species of Cladocera from South-East Asia, related to *Alona dentifera* (Sars, 1901) (Anomopoda: Chydoridae). Arthropoda Selecta 16: 143–150.

Sinev AY, Shiel RJ (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: 45-46.

Sinev AY, Silva-Briano M (2012) Cladocerans of genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae) and related genera from Aguascalientes State, Mexico. Zootaxa 3569: 1–24.

Sinev AY, Alonso M, Sheveleva LG (2009) New species of *Alona* from South-East Russia and Mongolia related to *Alona salina* Alonso, 1996 (Cladocera: Anomopoda: Chydoridae). Zootaxa 2326: 1-23.

Sinev AY, Kotov AA, Van Damme K (2004) Morphology of a Neotropical cladoceran *Alona dentifera* (Sars, 1901), and its position within the Chydoridae Stebbing, 1902 (Branchiopoda: Anomoda). Arthropoda Selecta 13: 99–107.

Sinev AY, Van Damme K, Kotov AA (2005) Redescription of tropical-temperate cladocerans *Alona diaphana* King, 1853 and *Alona davidi* Richard, 1895 and their translocation to Leberis Smirnov, 1989 (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Selecta 14(3): 183–205.

Sousa FDR, Elmoor-Loureiro LMA (2012) How many species of cladocerans (Crustacea, Branchiopoda) are found in Brazilian Federal District? Acta Limnologica Brasiliensia 24(4): 351-362.

Sousa FDR, Elmor-Loureiro LMA, Santos S (2015a) Redescription of *Coronatella poppei* (Richard, 1897) (Crustacea, Branchiopoda, Chydoridae) and a revision of the genus in Brasil, with description of new taxa. Zootaxa 3955(2): 211-244.

Sousa FDR, Elmor-Loureiro LMA, Santos S (2015b) *Alona kaingang* sp. nov (Crustacea, Cladocera, Chydoridae): a new species of the pulchella-group, with identification key to Neotropical species. Zoological Studies 54(48): 1-12.

Van Damme K, Dumont HJ (2008a) 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, Dumont HJ (2008b) The ‘true’ genus *Alona* Baird, 1843 (Crustacea: Cladocera: Anomopoda): characters of the *A. quadrangularis*-group and description of a new species from Democratic Republic Congo. Zootaxa 1945: 1–25.

Van Damme K, Eggermont H (2011) The Afromontane Cladocera (Crustacea: Branchiopoda) of the Rwenzori (Uganda–D. R. Congo): taxonomy, ecology and biogeography. Hydrobiologia 675: 57-100.

Van Damme K, Sinev AY (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 Linnenan Society 161: 31-52.

Van Damme K, Sinev AY (2013) Tropical Amphi-Pacific disjunctions in Cladocera (Cruscatacea: Branchiopoda). Journal of Limnology 72(s2): 209-244.

Van Damme K, Bekker E, Kotov AA (2013) Endemism in the Cladocera (Crustacea: Branchiopoda) of Southern Africa. Journal of Limnology 72: 440-463.

Van Damme K, Brancelj A, Dumont HJ (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.

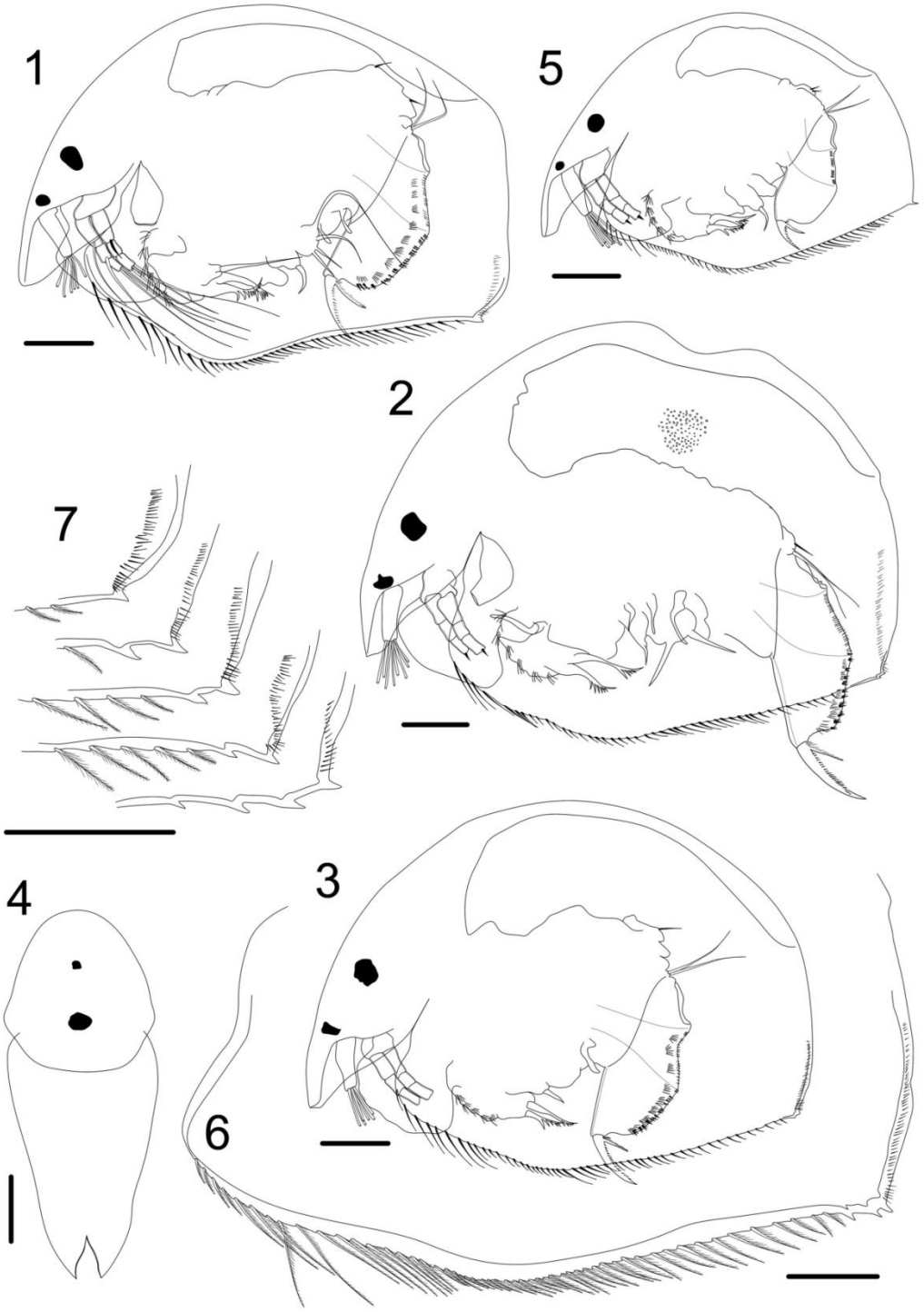
Van Damme K, Elías-Gutiérrez M, Dumont HJ (2011b) Three rare European "*Alona*" taxa (Branchiopoda: Cladocera: Chydoridae), with notes on distribution and taxonomy. Annales de Limnologie – International Journal of Limnology 47: 45-63.

Van Damme K, Kotov AA, Dumont HJ (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.

Van Damme K, Sinev AY, Dumont HJ (2011a) Separation of *Anthalona* gen.n. from *Alona* Baird, 1843 (Branchiopoda: Cladocera: Anomopoda): morphology and evolution of scraping stenothermic Alonine. Zootaxa 2875: 1-64.

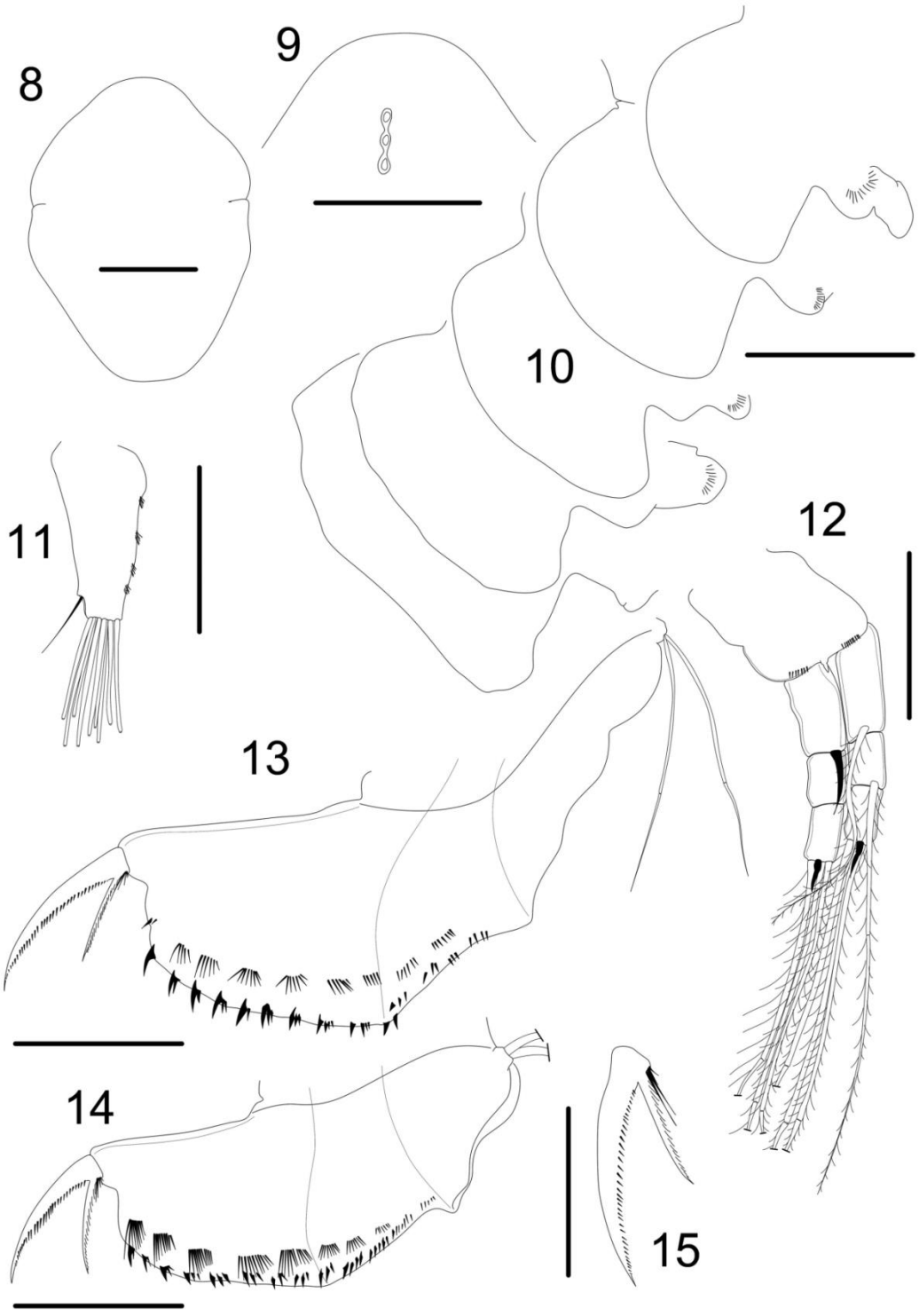
Van Damme K, Chiambeng G, Maiphae S, Dumont HJ (2003) New species in the rheophilous genus *Nicsmirnovius* Chiambeng&Dumont, 1999 (Branchiopoda: Anomopoda:

Chydoridae) and reassignment of *Alona eximia* Kiser, 1948 and *Alonella fitzpatricki* Chien, 1970. Hydrobiologia 499: 25–49.

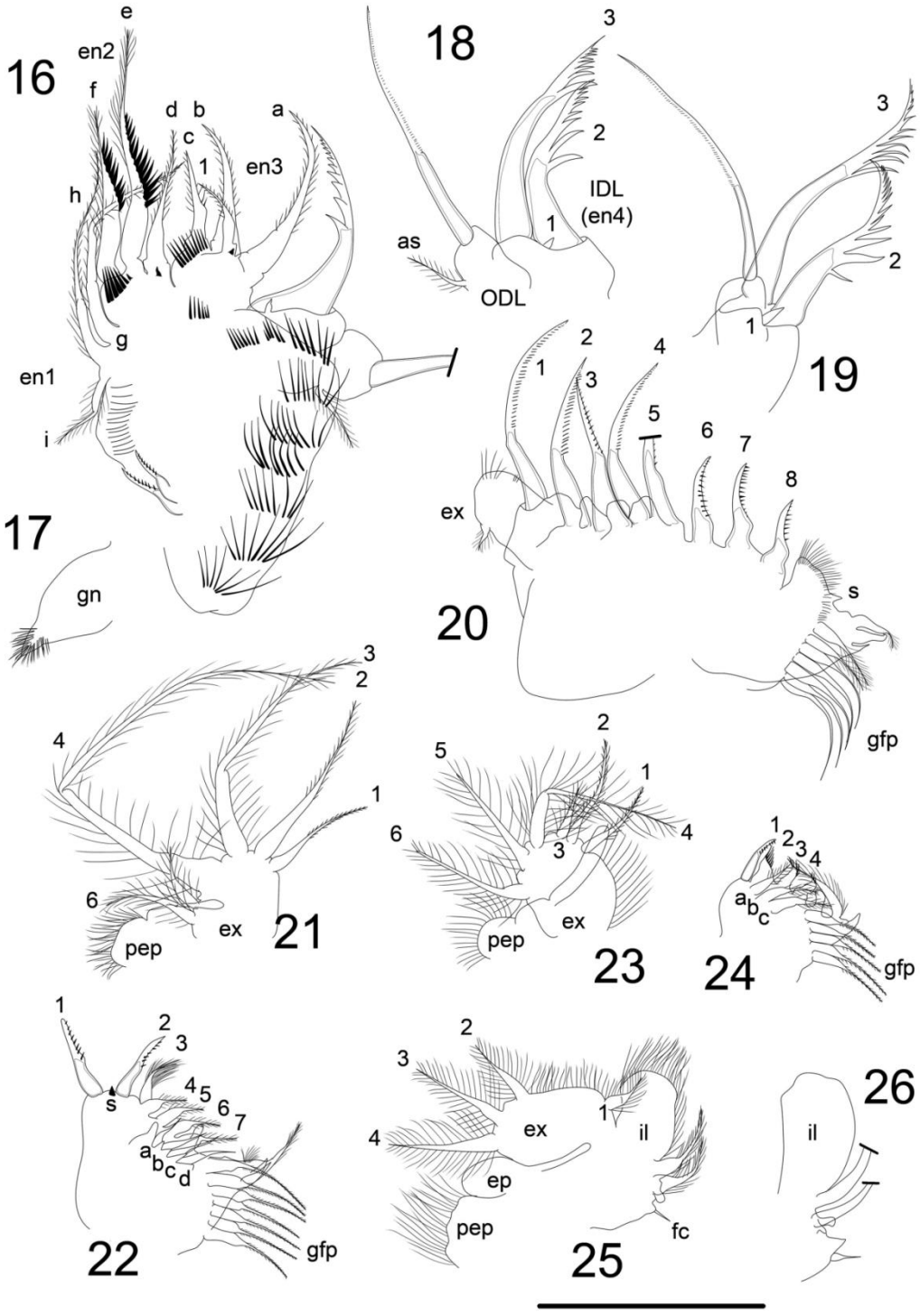


Figures 1-7. Gen. nov. 2 *dentifera* **comb. nov.**, parthenogenetic female. **1** *habitus* from Pantanal, Mato Grosso do Sul, Brazil. **2** *habitus* from São Paulo, Brazil. Specimen damaged. **3-4** *habitus* from San Pedro, Argentina parthenogenetic female adult from. **5** *habitus*, parthenogenetic female juvenile from San Pedro, Argentina. **6** ventral margin of carapace

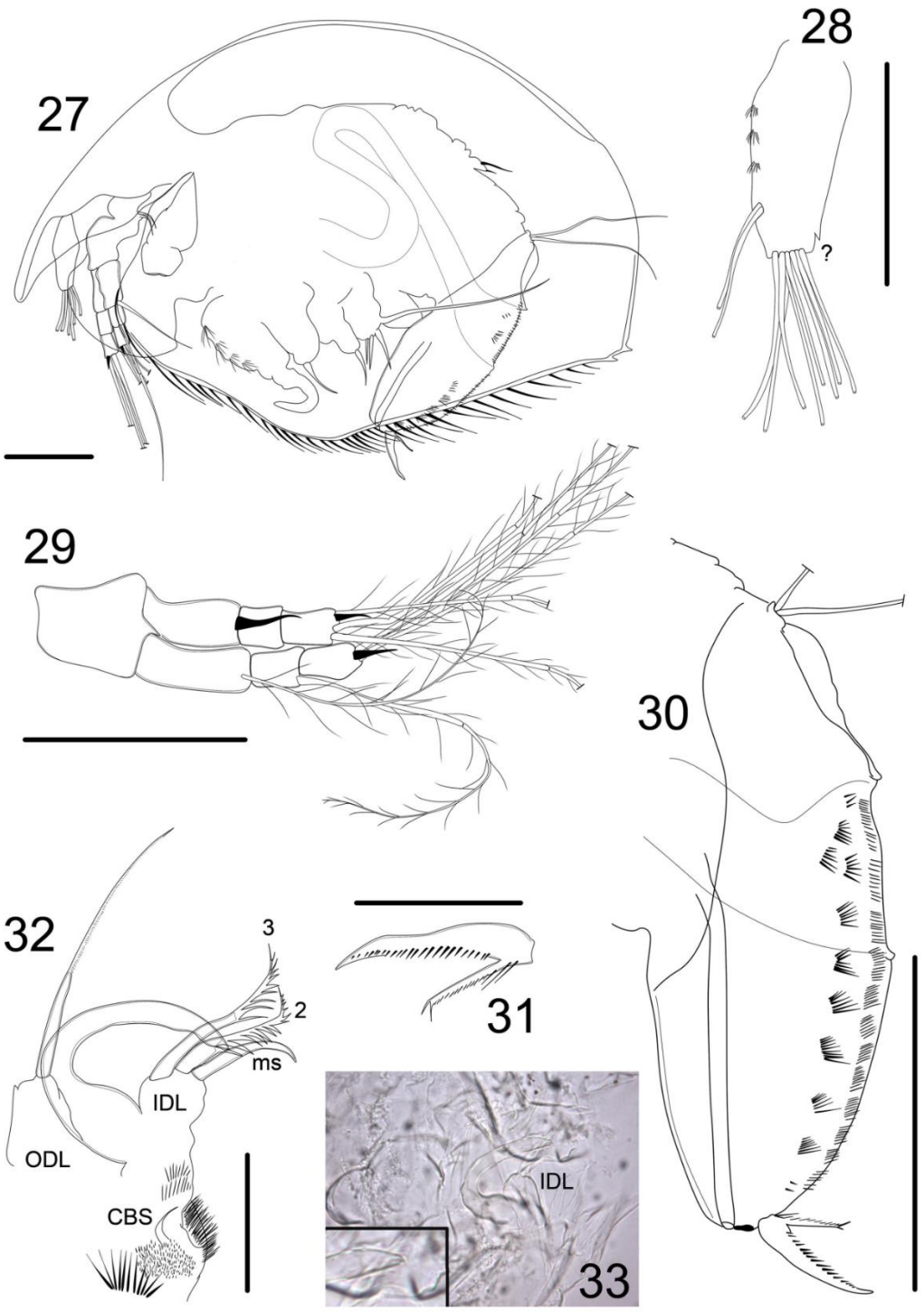
from Distrito Federal, Brazil. **7** denticles on the posteroventral margin of carapace. Scale bars = 50µm.



Figures 8-15. Gen. nov. 2 *dentifera* **comb. nov.**, parthenogenetic females. **8** head shield. **9** main head pores, female juvenile. **10** labral kell. **11** antennule. **12** antenna. **13 -14** postabdomen. **15** terminal claw. Scale bars = 50µm.



Figures 16-26. Gen. nov. 2 *dentifera* **comb. nov.**, adult parthenogenetic females. **16** limb I. **17** limb I, gnathobase. **18-19** limb I, IDL and ODL. **20** limb II. **21** limb III, exopodite. **22** limb III, endites. **23** limb IV, exopodite. **24** limb IV, endites. **25** limb V. **26** limb V, internal lobe. Scale bars = 50µm.



Figures 27-33. Gen. nov. 2 *dentifera* **comb. nov.**, adult male from Henrique Pond, Brasília National Park, Distrito Federal, Brazil. **27** *habitus*. **28** antennule. **29** antenna. **30** postabdomen. **31** terminal claw. **32** limb I, IDL and ODL. **33** limb I, copulatory hook. Scale bars: 50µm for to figures 27-30; 25µm for to figures 31-33.

Table 1. Main differences and similarities between genera related to *Coronatella*-branch, based on male morphology. So far, there is not description of males of *Karualona* and *Bergamina*. From Gen. nov. 2, only male of Gen. nov. 2 *dentifera* **comb. nov.** is known.

	Coronatella	*Ovalona*	*Leberis*	*Anthalona*	*Extremalona*	*Celsinotum*	Gen. nov. 2
Head pores in adults	presente	present	present	present	present	present	absent
Valves – denticles on the posteroventral corner	absent	absent	absent	absent	Absent	absent	present
A1 – nº of lateral aesthetascs	absent	two	two	absent	Six	six	two
PA – shape of the distal portion	margins almost parallel	straight or narrowing	narrowing	margins almost parallel	margins almost parallel	narrowing	narrowing
PA – length of basal spine/ length of terminal claw	0.2 and 0.5	reduced - 0.5	0.2-0.5	0.1-0.3	up 0.4	0.1-0.3	up 0.5
PA – gonopores located above terminal claw base	-	-	+	-	-	-	+
P1 – IDL nº of setae	two	two	two-three	two	Three	two	two
P1 – IDL, armature of setae 2-3	denticles	hard setulae	hard setulae	denticles or setulae	Setulae	setulae	denticles

ARTIGO 4

REDESCRIPTION OF *Coronatella poppei* (Richard, 1897) (CRUSTACEA, BRANCHIOPODA, CHYDORIDAE) AND A REVISION OF THE GENUS IN BRAZIL, WITH DESCRIPTIONS OF NEW TAXA

Artigo publicado no periódico Zootaxa ISSN 1175-5334; Fator de Impacto (JCR 2014) = 0.906; Estrato no Qualis CAPES de Biodiversidade B1.

Zootaxa 3955 (2): 211–244
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3955.2.3
http://zoobank.org/urn:lsid:zoobank.org:pub:B5C8F107-FA98-4158-BC80-B238F1395F38

Redescription of *Coronatella poppei* (Richard, 1897) (Crustacea, Branchiopoda, Chydoridae) and a revision of the genus in Brazil, with descriptions of new taxa

FRANCISCO DIOGO ROCHA SOUSA[1,2,3], LOURDES MARIA ABDU ELMOOR-LOUREIRO[2] & SANDRO SANTOS[1]

[1]*Núcleo de Estudos em Biodiversidade Aquática, Programa de Pós-graduação em Biodiversidade Animal, Universidade Federal de Santa Maria—UFSM, Av. Roraima 1000, Camobi, CEP 97105-900, Santa Maria, RS, Brazil*
[2]*Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília—UCB, QS7 lote 1, Bloco M, sala 204, CEP 71966-700, Taguatinga, DF, Brazil*
[3]*Corresponding author. E-mail: sousa_bio@yahoo.com.br*

Abstract

The description of the genus *Coronatella* Dybowski & Grochowski, 1894 (Cladocera: Chydoridae: Aloninae) pointed towards the need for a revision of species on a worldwide scale. For the Neotropical region, the main challenge noted was the redescription of *Coronatella poppei* (Richard, 1897). We redescribed this species and revised populations from Brazil that had previously been assumed to be *Alona poppei* (= *C. poppei*). Our results indicate that *C. poppei* is distributed in the southern part of South America. In Brazil, two other taxa are recognized, *Coronatella paulinae* **sp.nov.** and *Coronatella serratalhadensis* **sp.nov.**, which are morphologically distinguished both from each other and from *C. poppei*. These species also have different geographic distributions. The Brazilian *Coronatella* fauna also comprises *Coronatella monacantha* (Sars, 1901) and a related species, *Coronatella undata* **sp.nov.** Our results point towards a previously unknown high diversity of *Coronatella* in the Neotropical region with several implications for to biogeography of the genus.

Key words: Aloninae, Amphi-Pacific, Chydoridae, *Coronatella circumfimbriata*, *Coronatella* cf. *trachistriata*, morphometry, taxonomy

Introduction

Since the redescription of the genus *Alona* Baird, 1843 based on the *quadrangularis*-group (Van Damme & Dumont 2008a), the focus of studies concerning the taxonomy of Chydoridae shifted to the allocation of species of *Alona* s.l. into several natural groups (Van Damme *et al.* 2010). Recent studies resulted in the separation of species complexes and in the description of new genera, based mostly on morphological traits (Van Damme *et al.* 2005; Van Damme & Dumont 2008b; Van Damme *et al.* 2009; Van Damme *et al.* 2011; Sinev & Kobayashi, 2012; Elmoor-Loureiro *et al.* 2013). Furthermore, the inclusion of information regarding biogeographic patterns and ecological specializations has also supported the creation of new natural groups (Kotov *et al.* 2010; Van Damme & Sinev 2011; Sinev & Shiel 2012).

Approximately 17 genera were created from *Alona* s.l. (Van Damme *et al.* 2010). The genus *Coronatella* Dybowski & Grochowski, 1894, re-established by Van Damme & Dumont (2008b), is the most diverse so far, with species registered in Africa, Asia, South America, Central America, North America, and parts of Europe (Van Damme & Dumont 2008b; Van Damme *et al.* 2010). Recently, Van Damme & Dumont (2008b) listed some species that could potentially be placed in *Coronatella*, and highlighted the need for a revision of the records of *Coronatella rectangula* (Sars, 1861) outside of the Afrotropical-Palearctic region. Several undescribed taxa of *Coronatella* are known from different continents (Van Damme *et al.* 2010; Kotov *et al.* 2013).

Indeed, what was formerly known as *C. rectangula* in the Neotropical region can be attributed to a species of the *pulchella*-group (Sousa *et al.* in preparation). Besides, there are also records of populations of *C. monacantha* with pronounced morphological variations (e.g., absence of a denticle on the labral keel and on the posteroventral

Accepted by M. Alonso: 1 Apr. 2015; published: 4 May 2015

corner of the carapace), which further highlights the need for a taxonomic revision of more populations (Sinev 2004).

Originally described from Chilean material (Richard 1897), *C. poppei* (Richard, 1987) has been widely reported in South America, then being found in Peru (Valdívia-Villar 1988), Venezuela (Rey & Vasquez 1986) and Brazil (Brehm 1937; Schubart 1942; Eskinazi-Sant'Anna *et al.* 2005; Soares & Elmoor-Loureiro 2011; Sousa & Elmoor-Loureiro 2012; Diniz *et al.* 2013). The redescription of this species based on Chilean material, as suggested by Van Damme *et al.* (2010), will allow for the evaluation of populations located outside the type-region, and thus lead to a better understanding of its distribution.

Alona dentifera (Sars, 1901) is other Neotropical species candidate to translocation to the *Coronatella* genus. According to Van Damme & Dumont (2008b), the morphology of the limbs suggests that *A. dentifera* (named as *Coronatella dentifera* by Chatterjee *et al.* (2013)) is very close to *Coronatella*, however, molecular data indicate a proximity with the genus *Leberis* Smirnov, 1989 (Eliás-Gutiérrez *et al.* 2008). Besides, the external morphology indicates that *A. dentifera* is part of a species group with separated evolution, along with Asian species *Alona siamensis* Sinev, 2007 (Sinev *et al.* 2004; Sinev 2007). Thus, the position of *A. dentifera* is still doubtful and this issue needs to be further investigated.

This study aims to redescribe *Coronatella poppei* based on specimens from the region of its type locality and to evaluate its occurrence in Brazil, including the description of two new taxa. We also include new remarks on the morphology of *Coronatella monacantha* and the description of a new species related to it.

Material and methods

Morphological analyses. Richard (1897) indicated the locality of Lunache (Chile) as the origin of the specimens used in the description of *C. poppei*. However, this locality was not found on any map or online database, which suggests a typing mistake. Thus, we think that the type-locality is actually Limache, a small village close to Valparaiso, Chile. This opinion is shared by Dr. Patrício De los Ríos, from the Universidad Católica de Temuco, Chile (pers. comm.). The morphological analyses also include specimens identified as *C. poppei* and *C. monacantha* from the personal collection of Lourdes M. A. Elmoor-Loureiro.

The specimens selected for morphological analyses were transferred to slides containing glycerin and dissected under a stereomicroscope. Appendage morphology and other structures were analyzed using phase contrast microscopy. All drawings were made with the aid of a camera lucida. Some animals were dehydrated by using increasing concentrations of acetone (50%, 70%, 90% and 100%), mounted on aluminum stubs, covered with gold and examined under scanning electron microscopy (JEOL-JSM 7001F scanning electron microscope). The enumeration of the setae and other limb structures was carried out from the epipodite towards the gnathobase, without relation to homology, following recent literature on the topic (Van Damme & Dumont 2007; Sinev & Kobayashi 2012).

Morphometric analyses. A total of six morphometric measurements are taken from the five studied taxa (Fig. 1). These are: (1) carapace length; (2) anal margin length; (3) postanal margin length; (4) postanal margin, width (5) terminal claw length, and (6) basal spine length. We did not include values of carapace height to avoid using data considering that it is highly correlated with the length of the carapace (*C. poppei*: $r = 0.90$, $p < 0.001$; *C. paulinae* **sp.nov.**: $r = 0.72$, $p < 0.001$; *C. serratalhadensis* **sp.nov.**: $r = 0.97$, $p < 0.001$; *C. undata* **sp.nov.**: $r = 0.66$, $p < 0.001$; *C. monacantha*: $r = 0.63$, $p < 0.001$). To obtain the aforementioned measurements, 89 individuals (adult parthenogenetic females) were drawn with a camera lucida, and the measurements were taken manually. After that, the values for the six morphometric measurements taken were converted according to the scale adopted.

In order to meet the premises of homocedasticity and normality, data were log10 transformed, and then submitted to a multivariate canonical variable analysis (MANOVA/CV) to verify if the selected morphometric measurements are reliable to discriminate the investigated species. Furthermore, morphometric data were also separately submitted to an analysis of variance (one-way ANOVA) to test the variation of these measurements and a Tukey *post hoc* test was used to search for morphometric differences in the investigated taxa. All analyses were performed using the PAST software (Hammer *et al.* 2001).

Abbreviations. Figures and tables. A2: Antenna; as: accessory seta; CBS: copulatory brush seta; en: endite; ep: epipodite; ex: exopodite; fc: filtercomb; gfp: gnathobasic filter plate; gn: gnathobase; IDL: inner distal lobe; il;

inner lobe; IP: interpore distance (distance between anterior and posterior main head pore); ODL: outer distal lobe; pep: pre-epipodite; s: sensillum; PA: postabdomen; PP: postpore distance (distance between posterior main head pore and posterior border of head shield); P1: Limb I; P2: Limb II; P3: Limb III; P4: Limb IV; P5: Limb V; CL: carapace length; AML: anal margin length; PAML: postanal margin length; PAMW: postanal margin width; TCL: terminal claw length; BSL: basal spine length; ms: male seta; GEEA: Research Group on Aquatic Environments, Universidade Católica de Brasilia, Brazil

Collections. EL: Elmoor-Loureiro collection, at Universidade Católica de Brasília, Brazil. CLLA: Slides collection of the GEEA, at Universidade Católica de Brasília, Brazil. MZUSP: Museu de Zoologia da Universidade de São Paulo, Brazil.

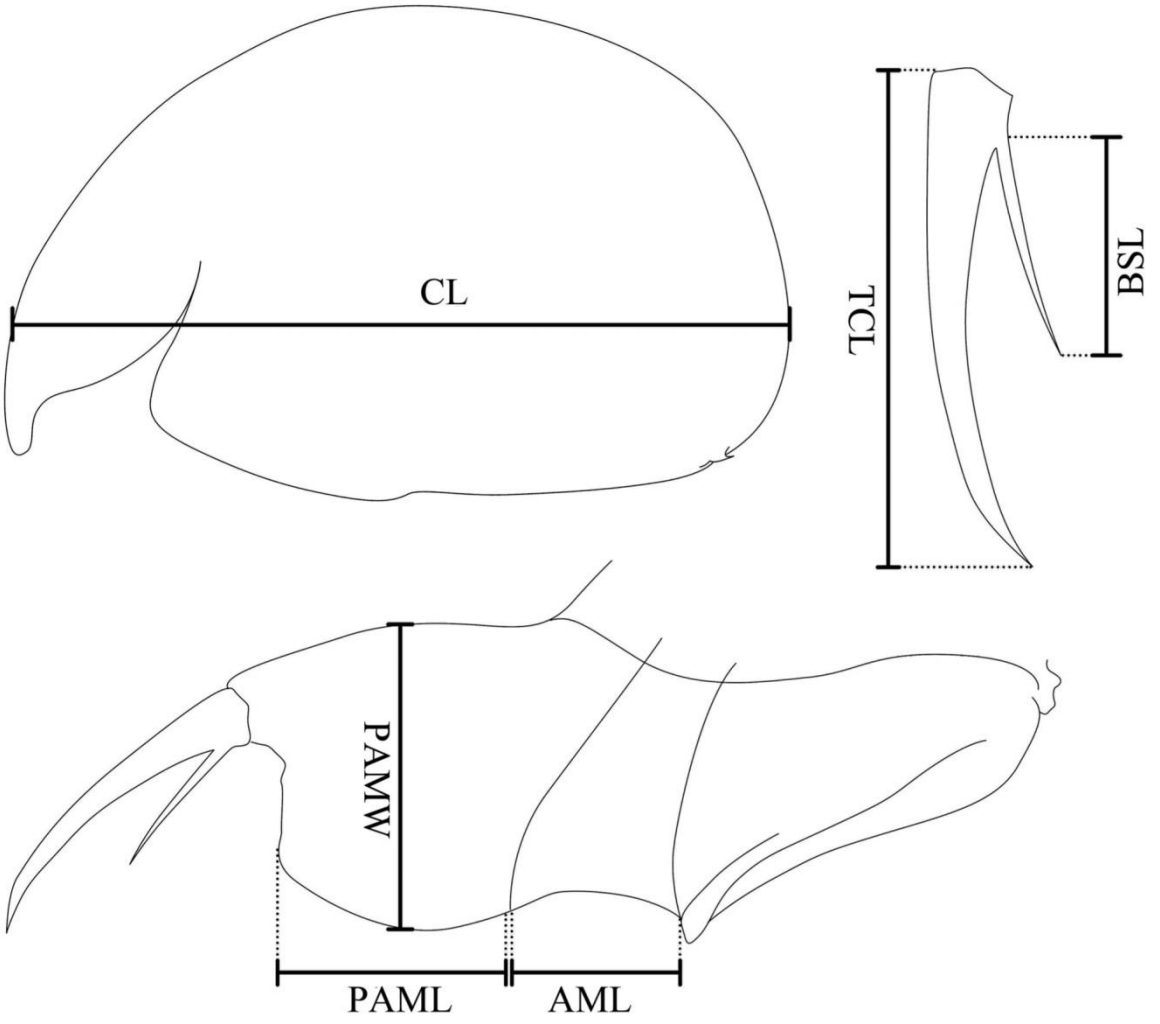


FIGURE 1. Scheme of the measurements used for morphometric analyses of *Coronatella* species occurring in Brazil. CL = carapace length; TCL = terminal claw length; BSL = basal spine length; PAML = postanal margin length; ALM = anal margin length; PAMW = postanal margin width.

Results

Our results indicate that five *Coronatella* taxa occur in the Neotropical region. The redescription of *C. poppei* based on the type-region (Limache—Chile) demonstrated that this name has possibly been attributed to different taxa in Brazil. These taxa are described below.

Additionally, we also described one new species of this genus, which is related to *C. monacantha*, but differs from it in some morphometric variables from the postabdomen (Table 2) and in the structure of the thoracic appendages. Following suggestions from Sinev (2004), we also studied several populations of *C. monacantha* in order to better define the morphological variability of this species.

Taxonomy

Class Branchiopoda Letreille, 1817

Order Anomopoda Sars, 1865

Family Chydoridae Dybowsky & Grochowski, 1894 *emend.* Frey, 1967

Subfamily Aloninae Dybowsky & Grochowski, 1894 *emend.* Frey, 1967

Genus *Coronatella* Dybowsky & Grochowski, 1894

Coronatella poppei (Richard, 1897)

(Figs. 2–3; 12)

Alona Poppei Richard 1897, p. 290–292, figs. 37–38; Smirnov (1971), p. 346, fig. 389; Rey & Vasquez 1986, p. 155, figs. 1–12.

? *Alona poppei* Richard in Delachaux 1919, p. 29, Pl. 2: figs. 4–5. *Coronatella poppei* (Richard) in Van Damme & Dumont (2008b), p. 33. (see Kotov & Ferrari 2010)

Material examined. Thirty adult parthenogentic females, three juvenile females and two males from the Tranque Recreo, Limache, Chile (33° 05' 10.1"S, 71° 22' 37.6"W), material collected by Lourdes M. A. Elmoor-Loureiro on 12/10/2012. One adult parthenogenetic female from the Lagoa dos Patos (30° 08' 32.8"S, 51° 13' 36.4"W), Porto Alegre, Rio Grande do Sul, Brazil, material collected by Lourdes M. A. Elmoor-Loureiro on 27/12/2001 (EL00716).

Type material. Neotype. undissected, adult parthenogenetic female in a tube with 90% ethanol deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 32925. The label of the neotype is: "*Coronatella poppei*, 1 parth. ♀ from to Tranque Recreo, Limache, Chile. Neotype". Richard's original material is lost (Kotov & Ferrari 2010).

Other material from the neotype locality. About 20 females and two males deposited at Elmoor-Loureiro's collection (EL02334). Many slides containing dissected individuals deposited at the Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília (CLLA035 to CLLA041).

Diagnosis. *Female.* Animal medium-sized, length 0.30–0.44 mm. Head with short rostrum, blunt, not projected; ocellus as large as eye; lateral head pores tiny. Antennules with sensory seta about two times smaller than antennular body. Antenna with segments of endopodite presenting spinules inserted near to terminal portion, antennal formula: setae 013/003, spines 001/101, apical spines of different length, seta on the first exopodite segment not observed. Postabdomen long, distal portion presenting incision, lateral fascicles arranged in seven groups, 8–9 clusters of marginal denticles. Terminal claw about 1.5 times longer than anal margin. Basal spine about 1.2 times as long as width of terminal claw at its base and with long setules on the dorsal margin. Limb I: with ODL seta about same length as the longest IDL seta, IDL with two setae armed with strong proximal spines. Limb II: with seta on exopodite, accessory seta present on endite, scrapers 6–8 of similar length, filter comb with seven setae. Limb III: exopodite with six setae, seta 3 about 3.2 times longer than fifth seta, seta 6 about two times shorter than fifth seta, distal endite with sensillum. Limb IV: exopodite with six setae, fourth seta about 3.3 times shorter than fifth seta, third seta about 1.9 times shorter than fifth seta. Limb V: with exopodite without depression on marginal line, setae of the inner lobe of similar size, one long and inflated element inserted behind the inner setae present, filter comb absent.

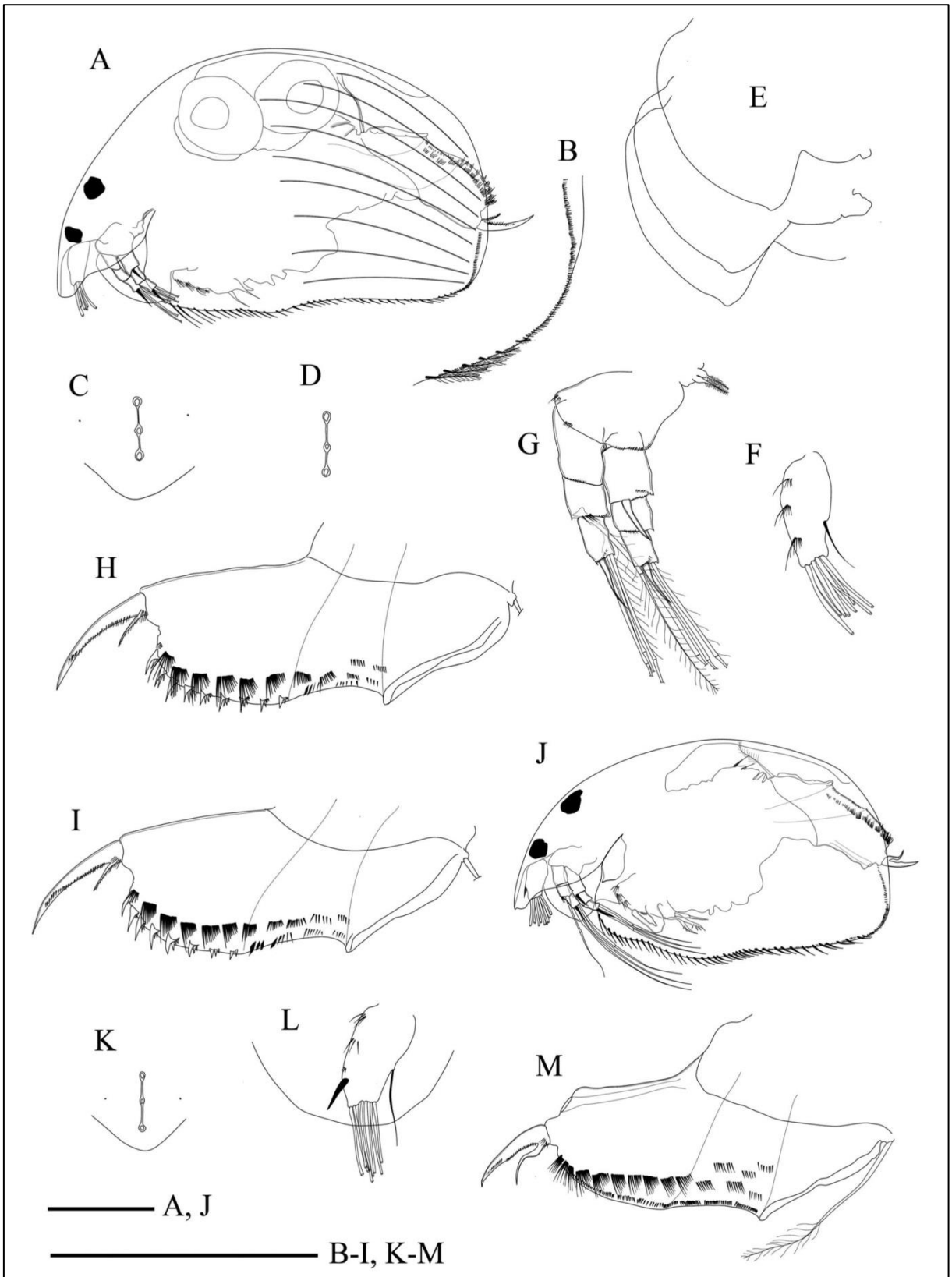


FIGURE 2. *Coronatella poppei* (Richard, 1897) from Limache, Chile. A–I parthenogenetic female. A, *habitus*, lateral view. B, posteroventral corner of carapace. C–D, head pores. E, labral keel. F, antennule. G, antenna. H–I, postabdomen. J–M Male. J, *habitus.* K, head pores. L, antennule. M, postabdomen. scale bars = 100μm.

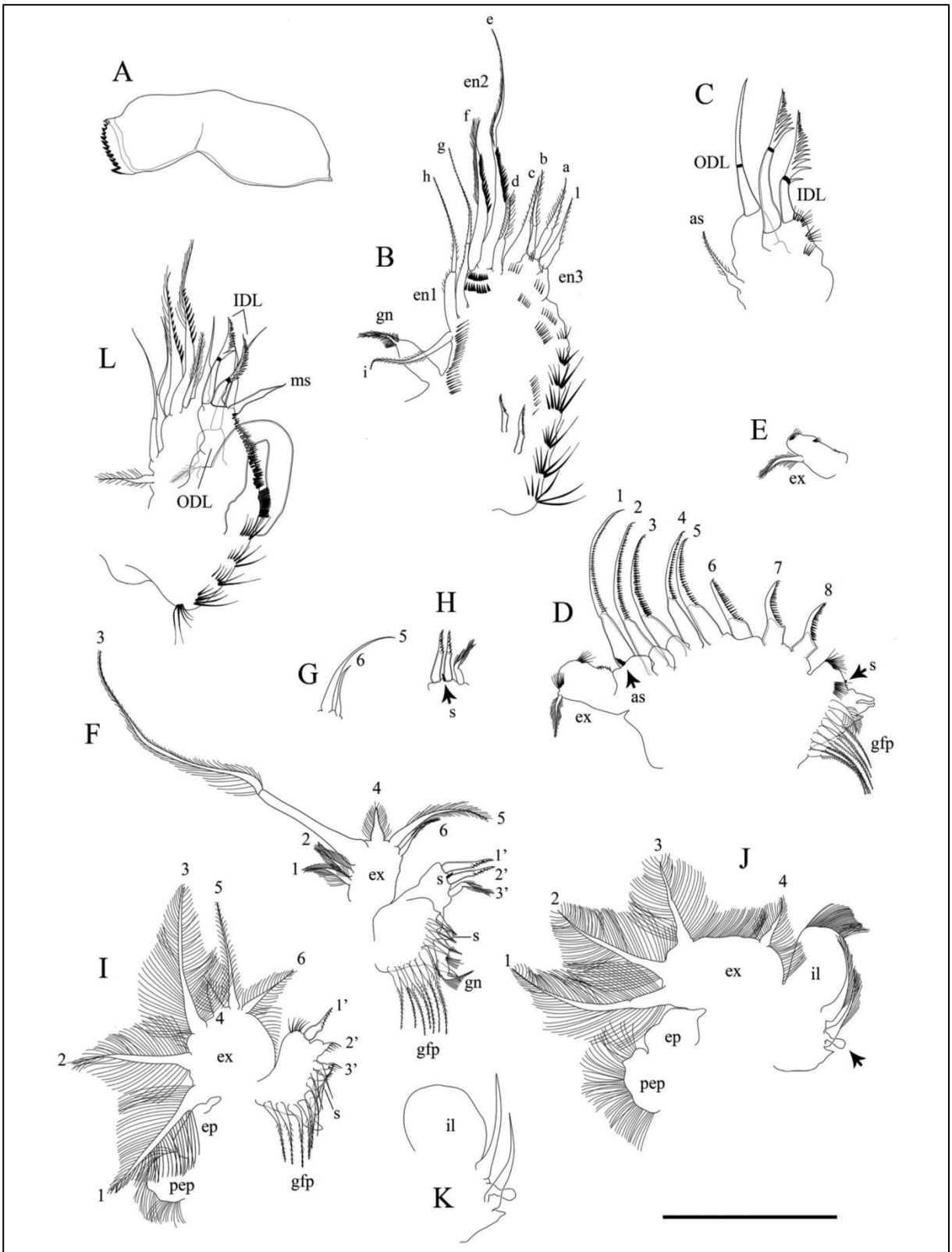


FIGURE 3. *Coronatella poppei* (Richard, 1897) from Limache, Chile. A, mandibles, B, limb I. C, *idem*—ODL and IDL. D, limb II. E, *idem*—exopodite. F, limb III. G, *idem*—setae 5 and 6 of the exopodite. H, *idem*—endite, arrow showing the sensillum. I, limb IV. J, limb V, arrow showing the element. K, *idem*—internal lobe. L, limb I of the male. For abbreviations, see Material and methods. Scale bars = 50µm.

Male. Postabdomen smaller than in female, postanal margin armed with many clusters of spinules, 7–8 lateral fascicles. Terminal claw short and robust. Basal spine long and sinuous. Antennules with sensory seta about 1.3 times shorter than length of antennular body; male seta about 3.7 times shorter than length of the antennules. Limb I with ODL seta about 1.5 times longer than small seta of the IDL, male seta of similar length to smaller seta of IDL.

Redescription. Adult parthenogenetic female. *Habitus* (Figs. 2A, 12A). Animal medium-sized, length 0.30–0.44 mm, about 1.6 times as long as high.

Head (Fig. 2A). Ocellus as large as eye. Rostrum short, blunt, not projected. Three main head pores of similar size connected by narrow connection, IP about 1.4 times longer than PP (Fig. 2C–D). Lateral head pores tiny, not inserted near to main head pores, located between anterior and median pores (Fig. 2C). Head shield not studied.

Labrum (Fig. 2E). Labral keel wide in lateral view, moderately convex, naked. Apex slightly projected towards anterior (in some individuals the apex is not projected).

Carapace (Fig. 2A–B). Rectangular in lateral view presenting lateral compression, colorless and transparent. Carapace striate with many longitudinal lines. Ventral margin concave near to median portion, with 34–40 setae, proximal group longer than other setae, short spines present between ventral setae (Fig. 2B). Ventral setae followed by spinules not arranged in groups, proximalmost spinules relatively thick, projecting beyond margin (Fig. 2B). Posterior ventral corner without denticles. Posterior lines of valve are weakly wavy.

Antennules (Fig. 2F). Exceeding tip of rostrum, about two times longer than wide, three rows of setules on antennular body, distalmost row longer than others. Antennular sensory seta slender, about two times smaller than antennular body, inserted at two-thirds of the antennular length. Nine terminal aesthetascs of different sizes that do not exceed the length of the antennular body.

Antenna (Fig. 2G). Coxal setae of similar length, slightly setulated. Basipodite thick, with many spinules and a single spine. First exopodite segment with one row of conspicuous spinules on the terminal portion. Second exopodite segment presenting two rows of spinules, one these rows presenting long spinules (3–4). All segments of endopodite have short spinules inserted near to terminal portion. Antennal formula: spines 001/101, setae 013/003. Spine on the first segment of the endopodite naked, thick, long, exceeding the length of the second segment. Apical spines of different length, naked. Apical setae bi-segmented and densely setulated.

Thorax about two times longer than *abdomen* (Fig. 2A). Abdominal setae not studied.

Postabdomen (Figs. 2H–I; 12B). Long, relatively wide, about 2.6 times as long as wide, ventral margin relatively straight, ventral margin without rows of spinules. Pre-anal margin longer than anal margin and similar in length to postanal margin. Anal margin with concave portion near to pre-anal corner, armed with at least three groups of spinules. Postanal margin rounded and robust, distal portion presenting incision variable in size (intrapopulation variation), inserted near to terminal claw base. Lateral fascicles arranged in seven groups with up 15 long setules; at least four fascicles exceeding the margin of the postabdomen. Eight-nine clusters of marginal denticles presenting 2–3 denticles, proximalmost denticles may be not arranged in groups. *Terminal claw* (Fig. 2H–I). Implanted at projected basis from the postabdomen, about 1.5 times longer than anal margin, slender, uniformly curved, with one row of spinules on base. Two armed pectens; inner spinules long, laterally inserted; outer spinules decreasing in length towards distal portion. *Basal spine* short in relation to terminal claw, about 1.2 times as long as width of terminal claw at its base, armed with long setules on the dorsal margin.

Mandibles (Fig. 3A). Well developed in relation to body size. First maxilla not studied, most probably absent.

Five pairs of limbs. *Limb I* (Fig. 3B–C). Epipodite not studied. Accessory seta relatively long, plumose. ODL with thin seta, serrulated from to median portion, about same length as the longest IDL seta. IDL with three groups of spinules on its face, two setae of similar size present; setae armed with strong proximal spines, the distalmost ones as thin denticles. Third endite with four setae relatively robust; inner setae setulated (a–b), slightly longer than the other two. Second endite with two rows of strong spinules; three setae of different length (d–f), seta 5 (e) about 1.5 times longer than seta 4 (f) and about 3.2 times longer than seta 6 (d); setae 4–5 (e–f) with thick spinules on lateral face; seta 5 with spinules inserted on median portion (e); seta 6 (d) about two times shorter than seta 4. First endite with three marginal setae (g–i), setae 2–3 (h–i) bi-segmented and of similar length. No specialized elements on the endites. Ejector hooks of different length. Ventral face of the limb with seven rows of setules organized in clusters, decreasing in length towards the distal portion. Gnathobase thick, with a single densely setulated seta on its tip.

Limb II (Fig. 3D–E). Exopodite elongated, with tiny proximal spinules, distally setulated. Seta on exopodite

present, about 1.5 times smaller than the exopodite itself. Endite armed with eight scrapers uniformly denticulated, accessory setae near to scraper 1. Scraper 3 shorter than 4; scraper 6–8 of similar length. Proximal portion of gnathobase short, wide and densely setulated; distal portion armed with three elements and one sensillum, first element with apex blunt. Filter comb armed with seven setae setulated from median portion; seta 1 setulated and remarkably shorter than other setae.

Limb III (Fig. 3F–H). Pre-epipodite and epipodite not studied. Exopodite quadrangular with six marginal setae arranged in 2+4; setae 1–2 of similar length; seta 3 bi-segmented, distal segment setulated, about 3.2 times longer than fifth seta; fourth seta short and thick; sixth seta setulated, about two times shorter than fifth seta; all setae are plumose. Distal endite with three setae (1'–3'), two scraper-like of similar length (1'–2'), sensillum present between them; third seta geniculated and bilaterally armed with many setules (3'). Basal endite armed with four plumose setae increasing in length towards gnathobase. Gnathobase armed with four elements, first a robust and cylindrical sensillum, second a geniculated seta setulated on the base and distally, third and fourth elements naked, with acute tip. Filter comb armed with seven long setae.

Limb IV (Fig. 3I). Pre-epipodite rounded and setulated, epipodite oval with short projection. Exopodite with six plumose marginal setae; setae 1–3 of similar length. Fourth seta about 3.3 times shorter than fifth seta, reaching the midle length of the sixth seta. Distal endite with four setae (1'–4'), one scraper-like (1'), three flaming-torch-like decreasing in length towards the base (2'–4'). Basal endite armed with three soft setae increasing in length towards the base. Gnathobase armed with a long and cylindrical sensillum; long seta present, inserted on a robust base. Filter comb armed with five setulated setae.

Limb V (Fig. 3J–K). Pre-epipodite subquadrangular and densely setulated, epipodite oval with short projection. Exopodite oval, not divided in lobes, about two times as long as wide, marginal line between setae 3–4 densely setulated; four plumose marginal setae decreasing in length. Third seta about 1.9 times shorter than first seta; fourth seta about 1.6 times shorter than third seta. Internal lobe wide, oval and with long terminal setulae; two setulated setae of similar size on inner face of the lobe; one long and inflated element inserted behind the inner setae. Gnathobase reduced, with a short element. Filter comb absent.

Male. *Habitus* (Fig. 2J). Length 0.29–0.33 mm, about 1.6 times as long as high.

Head (Fig. 2J). Rostrum short, blunt, not projected; ocellus and eye of similar size; main head pores of similar size, nearly connected; lateral head pores tiny, inserted on same plane as the median main pore (Fig. 2K). Labral keel wide, naked, with apex projected. Carapace relatively elongated, ornamentation as obscure longitudinal lines; ventral margin armed with 37 slightly plumose setae not differentiated in groups, followed by fine spinules, the most proximal are robust and exceeding the line of the posterior margin; fine spinules between ventral setae present. Posterior-ventral corner without denticles. Thorax two times longer than abdomen; two rows of abdominal setae present.

Antennules (Fig. 2L). Exceeding the tip of rostrum, about 1.8 times as long as wide; three rows of setules decreasing in length toward distal portion of antennular body. Nine aesthetascs of different length, shorter than length of antennular body; lateral aesthetascs not observed. Sensory seta long, about 1.3 times shorter than length of antennular body. Male seta short and robust, about 3.7 times shorter than length of the antennules, inserted at distal three-thirds.

Antenna as described for females.

Postabdomen (Figs. 2M, 12C). Moderately rectangular, smaller than in female, narrowing distally; anal margin shorter than postanal margin; anal angles well defined; postanal margin armed with many clusters of spinules; seven-eight lateral fascicles, distalmost ones exceeding the margin line; anal margin with spinules differentiated in three groups; gonopores opening ventrally, subapically to terminal claw. Terminal claw smaller and more robust than in female, tip acute; pecten formed by thick spinules. Basal spines long, robust and sinuous, exceeding the middle length of terminal claw; one row of fine spinules inserted on its base.

Limb I (Fig. 3L). Smaller than in female, copulatory hook U-shaped. Copulatory brush present; seta of the copulatory brush not studied. Seta of the ODL long, slightly serrulated, about 1.5 times longer than the smallest IDL seta. IDL with two setae of different length with strong proximal spines; male seta relatively long, similar in length to the smallest IDL seta.

Ephippial female. Unknown.

Differential diagnosis. *Coronatella poppei* was entirely revised and can now be differentiated from other species of the genus because it has long and robust postabdomen with 8–9 clusters of marginal denticles, seta on

ODL relatively short in the females and the limb II with accessory seta near first scraper. The male of *C. poppei* has a long and sinuous basal spine in postabdominal claw similar to the one observed in *C. circumfimbriata* male (Sinev 2009), but it presents more evident sinuosity. The main differences between *C. poppei*, *C. rectangula* and the species here described from Brazil are summarized in Table 1.

Distribution and biology. *Coronatella poppei* was found in two locations in South America, Limache, Chile (type location) and Lagoa dos Patos, Rio Grande do Sul state, Brazil. Initially, our data indicate that this species occurs in the Neotropical region (as discussed in Van Damme & Dumont 2008b), possibly restricted to the southern portion of South America, including high altitude regions (Fig. 13). The biology of this species is not known and more studies concerning its ecology are necessary.

***Coronatella paulinae* sp. nov.**
(Figs. 4–6; 12)

Coronatella poppei in Sousa & Elmoor-Loureiro (2012), p. 357.

Etymology. The name "*paulinae*" refers to the renowned Brazilian limnologist, Paulina Maria Maia Barbosa, who provided the specimens selected as type series in this taxonomic revision.

Type Locality. Gambazinho Pond, Rio Doce State Park, Minas Gerais, Brazil (19°47'10.6"S, 42° 34' 48.3"W).

Type Material. Holotype. Undissected, adult parthenogenetic female in tube with 90% ethanol deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 32923. The label of the holotype is: "*Coronatella paulinae* sp. n., 1 parth. ♀ from to Gambazinho pond, Rio Doce State Park, Minas Gerais, Brazil. Holotype".

Paratypes. One undissected adult parthenogenetic female deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 32924. Several females and eight males deposited at Lourdes M.A. Elmoor-Loureiro's collection (EL02330). Sixteen females and eight slides containing dissected specimens deposited at Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília (CLLA042 to CLLA049).

Material Examined. Twelve adult parthenogenetic females from Gambazinho pond, Rio Doce State Park, Minas Gerais, Brazil (19°47'10.6"S, 42° 34' 48.3"W), collected by Paulina M. Maia-Barbosa on 18.vi.2011. One adult parthenogenetic female from the Paranoá Lake, Distrito Federal, Brazil (15° 45' 18"S, 47° 49' 12"W), collected by Lourdes M. A. Elmoor-Loureiro on 17.ix.1983. Two adult parthenogenetic females from the São Bartolomeu River, Distrito Federal, Brazil (15° 41' 01.2"S, 47° 39' 43.9"W), collected by GEEA on 11.viii.2006 and 29.viii.2006.

Diagnosis. *Female*. Animal small-sized, length 0.29–0.33 mm. Head with rostrum relatively long, blunt, projected downward, ocellus as large as eye, lateral head pores tiny. Carapace with dorsal keel, presenting lateral compression, with at least 13 longitudinal lines, 28–33 ventral setae not reaching the end of the carapace, posterior ventral corner without denticles. Antennules with sensory seta about 1.8 times smaller than antennular body. Antenna with first exopodite segment presenting one row of long setules on the base, antennal formula: spines 001/101, setae 113/003, apical spines of different lengths. Postabdomen long, narrowing distally, anal margin very concave, lateral fascicles arranged in 5–6 groups, 5–6 clusters of marginal denticles. Terminal claw about 1.6 times longer than anal margin. Basal spine about two times as long as terminal claw width at its base and with long setules on the dorsal margin. Limb I with ODL seta about same length as the longest IDL seta; accessory seta relatively short; IDL with two setae armed with short proximal spines. Limb II without seta on exopodite; scrapers 6–8 of similar length and armed with strong denticles; filter comb with six setae. Limb III: exopodite with six setae; seta 3 about 2.9 times longer than fifth seta; seta 6 about 1.6 times shorter than fifth seta. Limb IV: exopodite with six setae; fourth seta about 2.7 times shorter than fifth seta; third seta about 1.9 times shorter than fifth seta. Limb V with exopodite with depression on marginal line; first seta of exopodite long; setae of inner lobe of different size; one long and inflated element inserted behind the inner setae present; filter comb present. *Male*. Unknown.

Description. Parthenogenetic female. *Habitus* (Figs. 4A, C; 5A; 12D). Animal small-sized, length 0.29–0.33 mm, about 1.5 times as long as high.

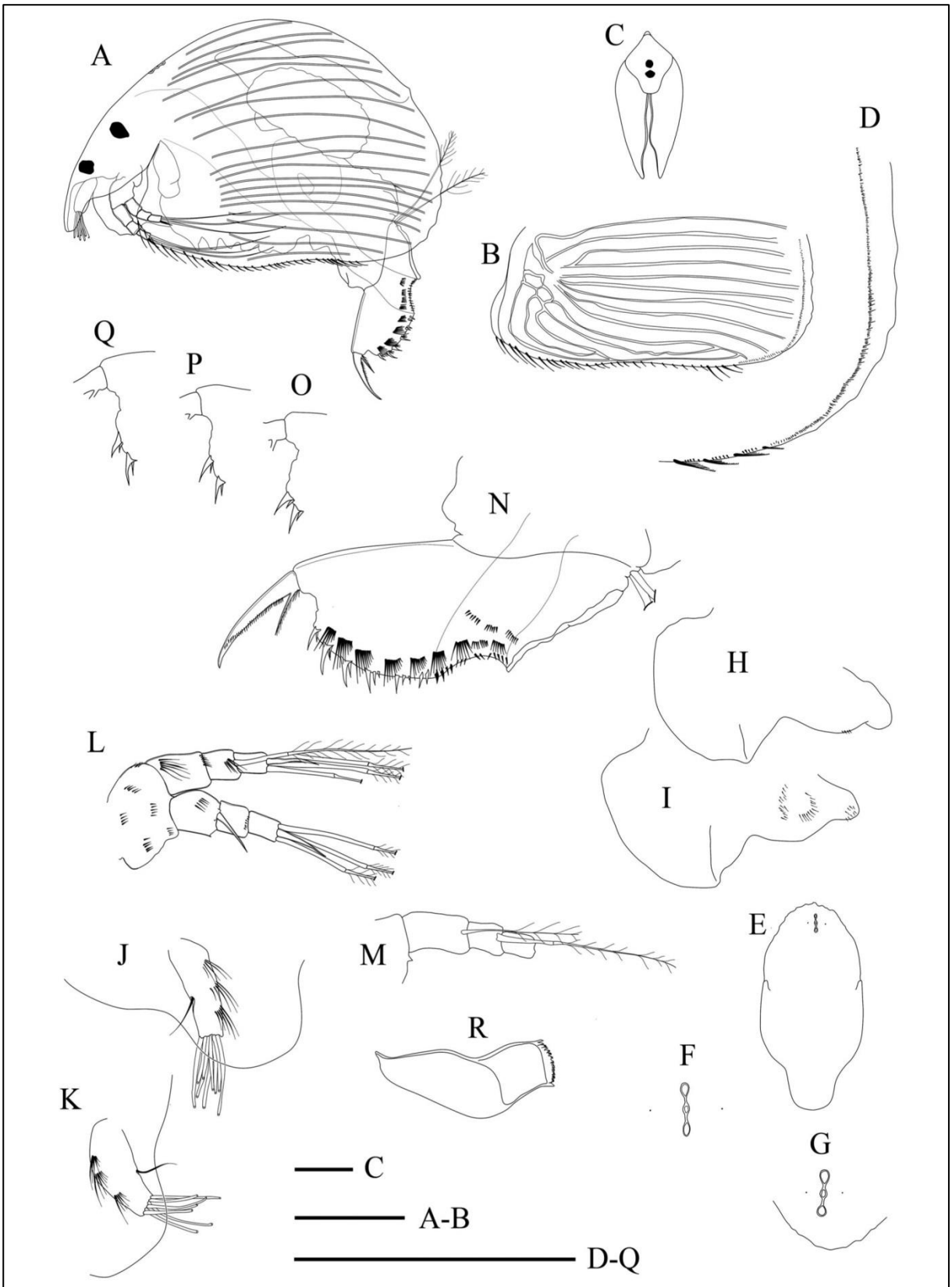


FIGURE 4. *Coronatella paulinae* **sp. nov.**. A, *habitus*, lateral view. B, carapace. C, *Habitus,* frontal view. D, posteroventral corner of carapace. E, head Shield. F, head pores. G. *idem*. H, labral keel. I, *idem.* J, antennule. K, *idem*. L, antenna. M, *idem*. N, postabdomen. O–Q, *idem*—distalmost portion. Scale bars = 100µm.

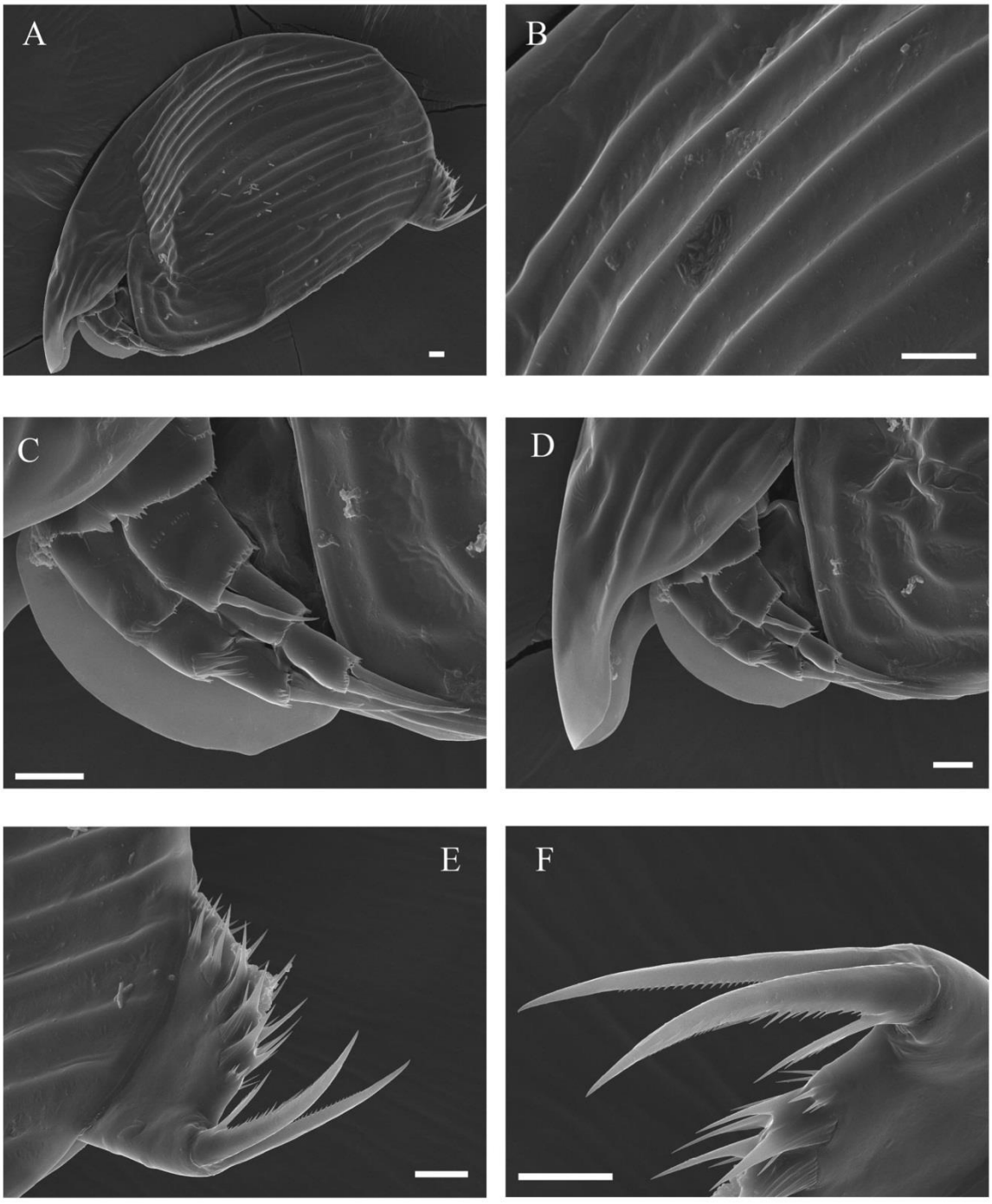


FIGURE 5. *Coronatella paulinae* **sp.nov.**. Scanning Electronic Microscopy. A, *habitus.* B, longitudinal lines on the carapace. C, antenna and labral keel. D, rostrum. E, postabdomen—distalmost portion. F, terminal Claw. Scale bars = 10μm.

Head (Fig. 4A). Ocellus as large as eye. Head shield about 1.9 times as long as wide, posterior margin line irregular (Fig. 4E). Rostrum relatively long, blunt, projected downward (Fig. 4E–5D). Three main head pores connected by narrow connection, median pore smaller than proximal and distal pores ones (Fig. 4E–G), IP about 2.2 times longer than PP (Fig. 4E–G). Lateral head pores tiny, inserted at same level as the median pores, distance to main head pores about 2.5 times shorter than the distance to line of the head shield.

Labrum (Fig. 4H–I; 5C). Labral keel wide in lateral view, relatively short, naked; anterior portion convex, apex

slightly projected. Base presenting fine spinules.

Carapace (Figs. 4A–B; 5A–B). Oval and narrowing in lateral view presenting lateral compression, colorless and transparent. Carapace striated with at least 13 longitudinal lines. Dorsal keel present (Fig. 4C). Ventral margin slightly concave near to last third of carapace length, with 28–33 setae, proximal and distal groups longer than median group (Fig. 4B), short spines present between ventral setae; ventral setae not reaching the end of the carapace, followed by spinules not arranged in groups and not exceeding the margin (Fig. 4D). Posterior ventral corner without denticles. Posterior lines of valve with distinct waves.

Antennules (Fig. 4J–K). Exceeding tip of rostrum, about 2.7 times longer than wide, three rows of setulae of similar length on antennular body. Antennular sensory seta slender, about 1.8 times smaller than antennular body, inserted at two-thirds of antennular length. Nine terminal aesthetascs of different sizes not exceeding the length of the antennular body.

Antenna (Fig. 4L–M; 5C). Coxal setae not studied. Basipodite thick, with many spinules and one long spine. First exopodite segment robust, with one row of long setulae on the base; apical spinules short. Second exopodite segment presenting one row of setulae near terminal portion. First endopodite segment with one row of setulae relatively long. Second endopodite segment presenting one row of fine and short spinules on terminal portion. Third segment of the exo and endopodite naked. Antennal formula: spines 001/101, setae 113/003. Seta on the first exopodite segment relatively long, about 0.75 the length of the second segment seta; setae on second segment bi-segmented, distal segment plumose. Spine on the first endopodite segment thin, long, exceeding the length of the second segment. Apical spines of different length, naked. Apical setae bi-segmented and plumose on distal segment.

Postabdomen (Figs. 2H–I; 12B). Long, about 1.6 times as long as wide, ventral margin relatively curved. Rows of the spinules were not observed on the ventral margin. Pre-anal margin longer than anal margin and similar in length to postanal margin. Anal margin clearly concave, armed with at least three groups of spinules; angles evident; 2–4 fascicles present. Postanal margin slightly rounded, narrowing distally; distalmost margin with variable shape; lateral fascicles arranged in 5–6 groups with 9–12 long setulae exceeding the margin of the postabdomen; 5–6 groups of marginal denticles, proximalmost denticles not clustered, the distalmost clustered.

Terminal claw (Fig. 5F). About 1.6 times longer than anal margin, slender, with four-5 spinules on the base, and implanted at a projected basis from the postabdomen. Two pecten present; inner spinules long, laterally inserted; outer spinules of similar length. Basal spine projected on the terminal claw, relatively long and slender, about two times as long as width of terminal claw at its base, armed with long setules on the dorsal margin.

Mandibles (Fig. 4R). Well developed in relation to body size.

First maxilla (Fig. 6A). Well developed, with two setulated setae.

Five pairs of limbs.

Limb I (Fig. 6B–D). Epipodite with long projection. ODL with thin seta, serrulated from to median portion of seta, about the same length as the longest IDL seta; accessory seta relatively short, plumose. IDL with two groups of spinules on its face, two setae of different size present; longest seta armed with strong and relatively short proximal spines, grouped at distal third of the seta; distalmost spines as thin denticles; shortest seta armed with strong and relatively short proximal spines. Third endite with four setae; inner setae setulate (a–b), shorter than the other two. Second endite with two rows of strong spinules; three setae of different length (d–f), seta 5 (e) about 1.2 times longer than seta 4 (f) and about 2.6 times longer than seta 6 (d); setae 4–5 (e–f) with thick spinules on lateral face; seta 5 (e) with spinules inserted on median portion; seta 6 (d) about 2.1 times shorter than seta 4 (f). First endite with three marginal setae (g–i), two bi-segmented (g–h); setae 1–3 (g–i) of similar length. No specialized elements on endites. Ejector hooks of different length. Ventral face of limb with seven rows of setules organized in clusters, decreasing in length toward distal portion. Gnathobase thick, with distal portion densely setulated.

Limb II (Fig. 3D–E). Exopodite elongated, with long distal spinules and short spinules on basal region; seta on exopodite absent. Endite armed with eight scrapers; accessory seta absent. Scraper 1–2 of similar length, longer than scraper 3; scraper 4 of similar length to scraper 3 and longer than scraper 5; scrapers 6–8 short, of similar length; scrapers with strong denticulation, except scrapers 1 and 2, which are finely denticulated; denticulation on scrapers 5–8 stronger than on scrapers 3–4. Proximal portion of gnathobase wide and densely setulated; distal portion armed with three elements and one sensillum, first element as a short seta. Filter comb armed with six setae setulated from median portion; seta 1 remarkably shorter than the others, densely setulated.

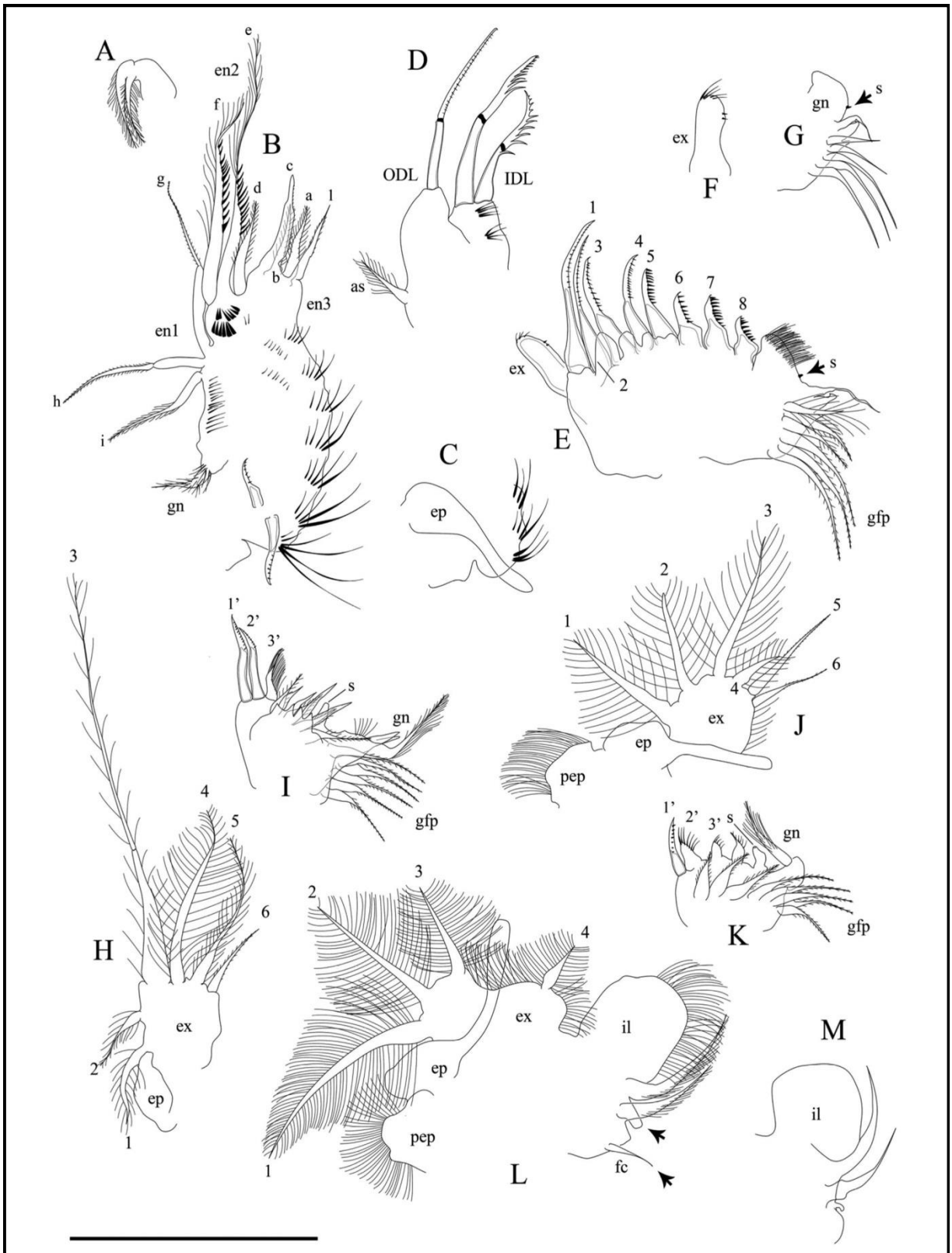


FIGURE 6. *Coronatella paulinae* **sp.nov.**. A, maxillule. B, limb I. C, *idem*—epipodite. D, *idem*—ODL and IDL. E, limb II. F, *idem*—exopodite. G, *idem*—gnathobase. H, limb III, exopodite. I, *idem* - endite. J, limb IV, exopodite. K, *idem*—endite. L, limb V, arrow showing one element and filter comb seta. M, *idem*—internal lobe. For abbreviations, see Material and methods. Scale bars = 50µm.

Limb III (Fig. 6H–I). Pre-epipodite not studied. Epipodite oval with short projection. Exopodite subquadrangular with six marginal setae arranged in 2+4; setae 1–2 of similar length; seta 3 bi-segmented, armed with short setules, about 2.9 times longer than fifth seta; fourth seta long and plumose, about 2.4 times shorter than third seta and 1.2 times longer than fifth seta; sixth seta slightly setulated, about 1.6 times shorter than fifth seta. Distal endite with three setae (1'–3'), two scraper-like of similar length (1'–2'), without element between them; third seta slightly geniculated and bilaterally armed with many setules (3'). Basal endite armed with four setulated setae increasing in length towards the gnathobase; four soft setae increasing in length toward base. Gnathobase armed with four elements, first a robust and bottle-shaped sensillum, second a geniculated seta with a group of setules on its base and distally setulated, third and fourth elements naked, with acute tip. Filter comb armed with seven long setae slightly setulated from median portion.

Limb IV (Fig. 6J–K). Pre-epipodite subquadrangular and densely setulated. Epipodite subquadrangular with long projection. Exopodite rounded with six marginal setae: setae 1–4 plumose; setae 1–2 of similar length; third seta about 1.3 times shorter than setae 1–2; fourth seta short, about 2.7 times shorter than third seta and about 1.9 times shorter than fifth seta; fifth seta slightly setulated; sixth seta slightly setulated, about 1.2 times shorter than fifth seta. Distal endite with four setae (1'–4'), one scraper-like (1'), three flaming-torch-like decreasing in length towards the base (2'–4'). Basal endite armed with three soft setae increasing in length towards the base. Gnathobase armed with one long sensillum, of similar length to median flaming torch; long seta inserted on robust base. Filter comb armed with five setae setulated from median portion.

Limb V (Fig. 6L–M). Pre-epipodite subquadrangular and densely setulated, epipodite oval with long projection. Exopodite wide, not divided in lobes, about twice as long as wide, marginal line between setae 3–4 presenting a slight and densely setulated depression. Four plumose marginal setae decreasing in length: first seta long, about 1.5 times longer than second seta; second seta about 1.5 times longer than third seta; fourth seta short, about two times shorter than third seta. Internal lobe wide, oval and with long terminal setules: two setulated setae of different size on its inner face; one long and inflated element inserted behind of the inner setae. Gnathobase reduced. Filter comb with one seta.

Adult Male. Unknown.

Ephippial female. Unknown.

Differential diagnosis. *Coronatella paulinae* **sp.nov.** is distinguished from other species of the genus because of its well-developed dorsal keel. Regarding Brazilian *Coronatella* species, *C. paulinae* **sp.nov.** differs from other species possessing a postabdomen that narrows towards the distal portion and anal margin very concave, row of ventral setae not reaching the end of the carapace, absence of setae on the exopodite of Limb II and presence of a seta on the filter comb of Limb V. *Coronatella paulinae* **sp.nov.** resembles the Palearctic *C.* cf. *trachistriata* Chen, Zhang & Liu, 1994 in external morphology, presence of the denticles on the IDL setae, shape of postabdomen and rostrum (see Kotov *et al.* 2011). However, *C. paulinae* **sp.nov.** differs from *C.* cf. *trachistriata* in the presence of a dorsal keel, smaller number of marginal denticles on postabdomen, seta on the first exopodite antennal segment and filter comb on Limb V. The main differences between *C. paulinae* **sp.nov**, *C. rectangula* and other Brazilian species of the genus may be observed in Table 1.

Distribution and biology. *Coronatella paulinae* **sp.nov.** was found in two different hydrographic regions of Brazil (Paraná and São Francisco basins), in both lentic and lotic systems, always associated with some kind of substrate. We believe that after *C. monacantha*, *C. paulinae* **sp.nov.** is the *Coronatella* species with the broadest distribution in Brazil (Fig. 13).

***Coronatella serratalhadensis* sp.nov.**
(Figs. 7–8; 12)

Coronatella poppei in Soares & Elmoor-Loureiro (2011), p. 4; Diniz *et al.* (2013), p. 70.

Etymology. The name "*serratalhadensis*" refers to the type-locality of this species.

Type locality. A pond in Mata da Pimenteira State Park, Serra Talhada, Pernambuco, Brazil (7°53'48.96"S, 38°18'14.30"W).

Type material. Holotype. Undissected, adult parthenogenetic female from a pond in Mata da Pimenteira State Park, Serra Talhada, Pernambuco, Brazil (7°53'48.96"S, 38°18'14.30"W), in tube with 90% ethanol deposited at

the Museum of Zoology of the University of São Paulo under access number MZUSP 32926. The label of the holotype is: "*Coronatella serratalhadensis* sp. n., 1 parth. ♀ from to Pond in Mata da Pimenteira State Park, Serra Talhada, Pernambuco, Brazil. Holotype".

Paratypes. Eight slides containing dissected individuals deposited at Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília (CLLA050 to CLLA057). This material was collected by Leidiane Diniz on 21.x.2011.

Other Material Examined. Four adult parthenogenetic females from the Saco I reservoir, Serra Talhada, Pernambuco, Brazil (7°24'43"S, 35°10'74"W), material collected by Marcos Felipe Menezes Magalhães on 11.xi.2011. Two adult parthenogenetic females and two juveniles from the pool in Casa Forte Square, Recife, Pernambuco, Brazil (15° 46' 59"S, 47° 50' 53"W), material collected by Lourdes M. A. Elmoor-Loureiro on 04.iii.1981 (EL02018).

Diagnosis. *Female*. Animal small-sized, length 0.27–0.36 mm. Head with rostrum short, blunt, projected downward, ocellus as large as eye, lateral head pores tiny. Carapace without dorsal keel, presenting lateral compression with 8–13 longitudinal lines, 28–38 ventral setae, posterior ventral corner without denticles and armed with spinules arranged in three groups presenting 8–10 spinules. Antennules with sensory seta about 1.7 times smaller than antennular body. Antenna with second exopodite segment presenting one row of long setules, atennal formula: spines 001/101, setae 113/003, apical spines of different length. Postabdomen relatively long, lateral fascicles arranged in 5–6 groups, 5–6 clusters of marginal denticles. Terminal claw about 1.5 times longer than anal margin and with one row of short spinules on base. Basal spine about 2.6 times as long as width of terminal claw at its base and with setules on the dorsal margin. Limb I: with ODL seta about same length as the longest IDL seta, accessory seta relatively short, IDL armed with setae 2+1, longest setae with strong proximal spines, third endite with inner setae longer than the other two setae. Limb II: with seta on exopodite, scrapers 6–8 of similar length and armed with strong denticles, filter comb with seven setae. Limb III: exopodite with six setae, seta 3 about 2.6 times longer than fifth seta, seta 6 naked and about 2.6 times shorter than fifth seta, distal endite presenting one sensillum. Limb IV: exopodite with six setae, fourth seta about 2.3 times shorter than fifth seta. Limb V: with exopodite without depression on marginal line, setae of inner lobe of different size, one long and inflated element inserted behind the inner setae present. Gnathobase with one short element, filter comb absent. *Male.* Unknown.

Description. Parthenogenetic female. *Habitus* (Fig. 7A–C; 12F). Animal small-sized, length 0.27–0.36 mm, about 1.5 times as long as high.

Head (Fig. 7A–C). Ocellus as large as eye. Rostrum short, blunt, projected downward. Three main head pores of similar size connected by narrow connection, IP about 1.6 times longer than PP. Lateral head pores tiny, at level of median pore or inserted between proximal and median pores. Head shield (Fig. 7G–I). With anterior margin rounded, mandibular articulation inserted at median portion.

Labrum (Fig. 2E). Labral keel wide in lateral view, moderately convex, naked; apex with variable morphology, rounded or presenting projecting towards anterior.

Carapace (Fig. 7D–F; 12G). Presenting lateral compression, colorless and transparent; dorsal keel absent; carapace striated with eight-13 longitudinal lines; ventral margin slightly concave near to median portion, with 28–38 setae, proximal and distal group longer than median group; short spinules present between ventral setae; ventral setae followed by spinules arranged in at least three groups, each presenting 8–10 spinules projected beyond margin; last spinules of the each group thick. Posterior ventral corner without denticles. Posterior lines of valve may present weak waviness.

Antennules (Fig. 7M). Exceeding tip of rostrum, about two times longer than wide, three rows of setulae of similar length on antennular body. Antennular sensory seta slender, about 1.7 times smaller than antennular body, inserted at two-thirds of antennular length. Nine terminal aesthetascs of different size not exceeding the length of the antennular body.

Antenna (Fig. 7N–O). Coxal setae of similar length, slightly setulated. Basipodite thick, with one row of setulae and one spine. First exopodite segment naked. Second exopodite segment presenting a group of three relatively long setulae and inserted on terminal portion of segment. Segments of endopodite naked. Antennal formula: spines 001/101; setae 113/003. Seta on the first exopodite segment short, slightly exceeding the length of the last segment; seta on the second segment bi-segmented and densely setulated. Spine on the first segment of the endopodite naked, thick, long, exceeding the length of the second segment, reaching the mid-length of third segment. Apical spines of different length, naked. Apical setae bi-segmented and densely setulated.

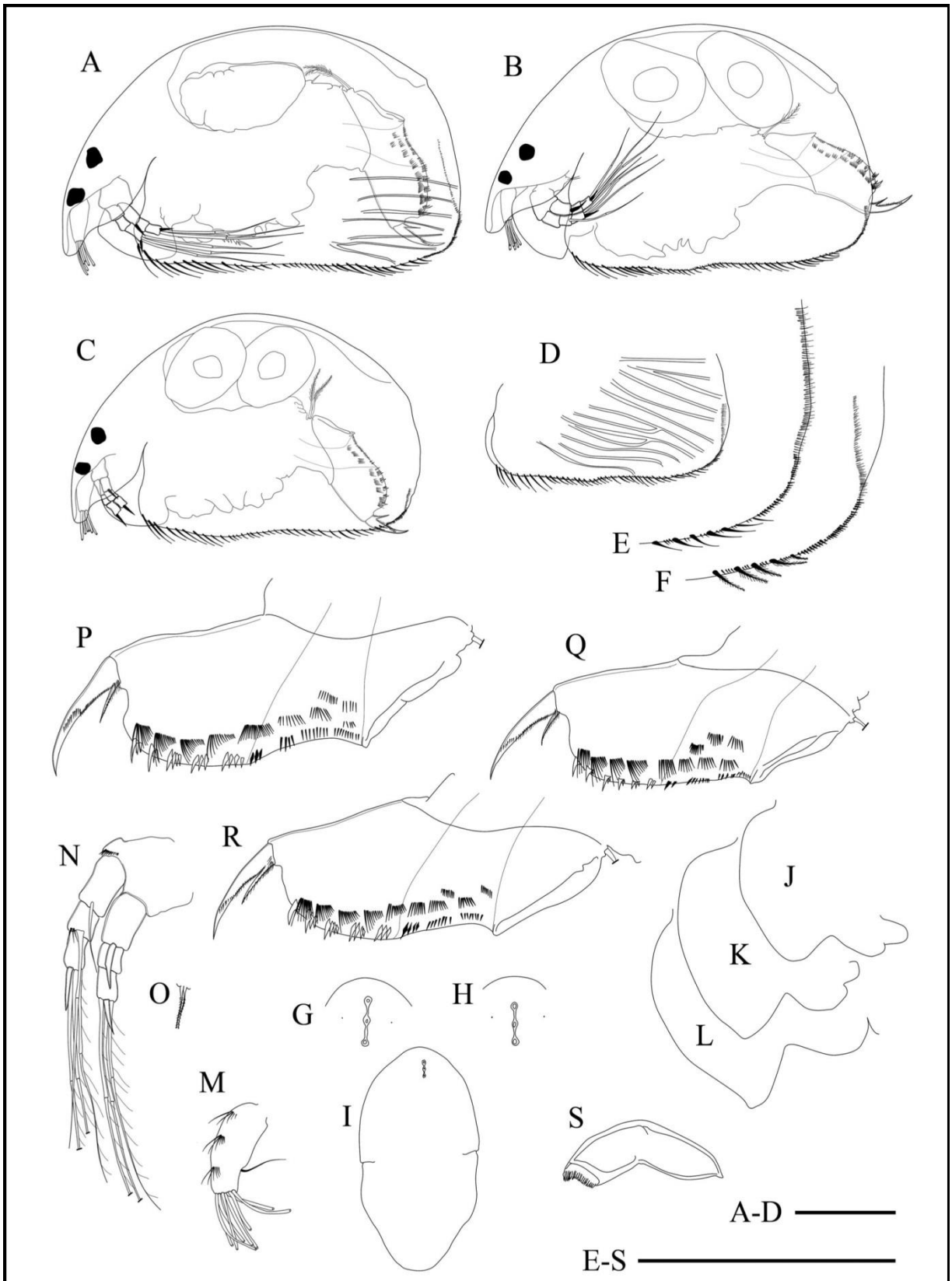


FIGURE 7. *Coronatella serratalhadensis* **sp.nov.**. A–C, *habitus*, lateral view. D, carapace. E, posteroventral corner of carapace. F, *idem.* G, head pores. H, *idem*. I, head shield. J–L, labral keel. M, antennule. N, antenna. O, *idem*—coaxal setae. P–R, postabdomen. Scale bars = 100µm.

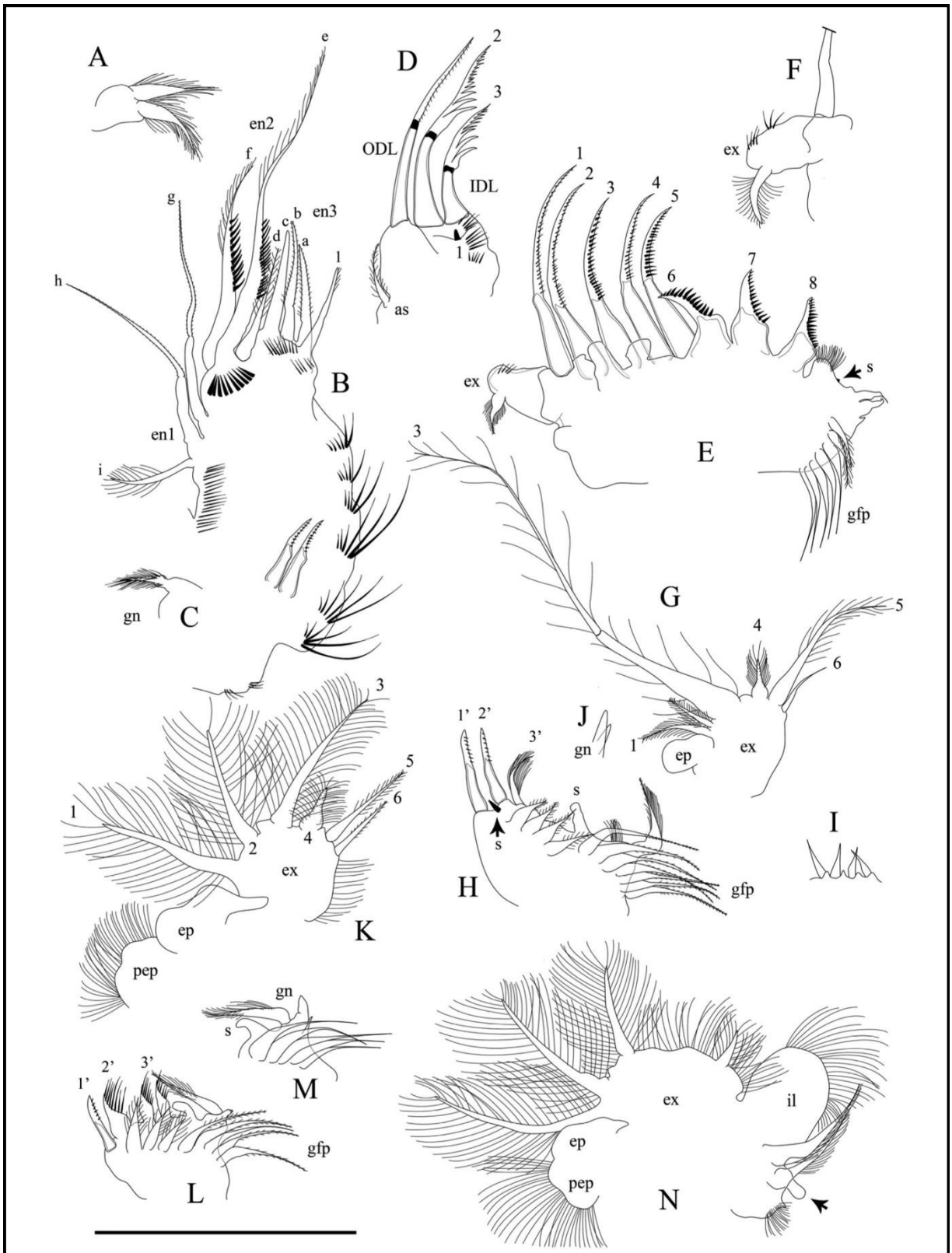


FIGURE 8. *Coronatella serratalhadensis* **sp.nov.**. A, maxillule. B, limb I. C, *idem*—gnathobase. D, *idem*—ODL and IDL. E, limb II. F, *idem*—exopodite. G, limb III, exopodite. H, *idem*—endite. I, *idem*—endite, internal setae. J, *idem*—elements of gnathobase. K, limb IV, exopodite. L, *idem*—endite. M, *idem*—gnathobase. N, limb V, arrow showing one element on the gnathobase. For abbreviations, see Material and methods. Scale bars = 50µm.

Thorax about 2.5 times longer than abdomen (Fig. 7A–C). Abdomen presenting 1–2 rows of setae.

Postabdomen (Fig. 7P–R; 12H) relatively wide, about 1.6 times as long as wide; ventral margin relatively straight. Rows of spinules on the ventral margin were not observed. Pre-anal margin longer than anal and postanal margin. Anal margin ranging from slightly concave to straight, armed with at least three groups of spinules and four lateral fascicles; anal and postanal corners not well marked. Postanal margin rounded and massive, lateral fascicles arranged in 5–6 groups with up to 18 long setules; at least three fascicles exceeding the margin of the postabdomen; 5–6 clusters of 2–4 marginal denticles, proximalmost one presenting more denticles than the others. Terminal claw (Fig. 7P–R; 12I) implanted at short projected basis from the postabdomen, about 1.5 times longer than anal margin, thick, uniformly curved, with a row of short spinules on base. Two pecten present. Basal spine short in comparison to terminal claw, about 2.6 times as long as width of terminal claw at its base, armed with setules on the dorsal margin.

Mandibles (Fig. 7S). Well developed in relation to body size.

First maxilla (Fig. 8A). Armed with two setae densely setulated.

Five pairs of limbs.

Limb I (Fig. 8B–D). Epipodite not studied. ODL with thin seta, serrulated from to median portion, about same length as the longest IDL seta; accessory seta relatively short, plumose. IDL with three groups of spinules on its face, setae armed in 2+1, two longest setae of similar size; setae armed with strong proximal spines; distalmost spines as thin denticles. Third endite with four setae relatively robust; inner setae setulated (a–b), longer than the two others. Second endite with one row of strong spinules: three setae of different length (d–f); seta 5 (e) about 1.2 times longer than seta 4 (f) and about 3.2 times longer than seta 6 (d); setae 4–5 (e–f) with thick spinules on lateral face; seta 5 (e) with spinules inserted on median portion; seta 6 (d) about two times shorter than seta 4 (f). First endite with three marginal setae (g–i), setae 2–3 (g–h) bi-segmented and of similar length. No specialized elements on endites. Ejector hooks of similar length. Ventral face of limb with six rows of setulae organized in clusters, decreasing in length toward distal portion. Gnathobase thin, with distal portion densely setulated.

Limb II (Fig. 8E–F). Exopodite elongated and distally setulated. Seta on exopodite present, plumose, about 1.6 times smaller than the exopodite itself. Endite armed with eight scrapers, scraper 6 markedly denticulated, without accessory seta near scraper 1; scraper 1 slightly longer than scraper 2; scraper 3–5 of similar length, armed with thick denticles; scraper 7–8 short, armed with thick denticles. Proximal portion of gnathobase short, wide and densely setulated; distal portion armed with three elements and one sensillum; first element with sharp apex. Filter comb armed with seven setae setulated from median portion; setae 1–2 remarkably shorter than other setae.

Limb III (Fig. 8G–J). Pre-epipodite not studied. Epipodite oval without projection. Exopodite subquadrangular with six marginal setae arranged in 2+4: setae 1–2 of different length; seta 3 bi-segmented, setulated, about 2.6 times longer than fifth seta; fourth seta short and thick; sixth seta naked, about 2.6 times shorter than fifth seta. Distal endite with three setae (1'–3'): two scraper-like of similar length (1'–2'), sensillum present between them; third seta slightly geniculated, densely and bilaterally armed with setules (3'). Basal endite armed with four plumose setae increasing in length towards the gnathobase; four soft setae of similar length present. Gnathobase with four elements: first as a robust and cylindrical sensillum; second a geniculated seta with a group of setulae on its base and distally setulated; third and fourth elements naked, with acute tip. Filter comb armed with seven long setae.

Limb IV (Fig. 8K–M). Pre-epipodite subquadrangular and setulated, epipodite rectangular with short projection. Exopodite rounded with six plumose marginal setae: setae 1–2 of similar length; fourth seta about 2.3 times shorter than fifth seta and 1.6 times shorter than sixth seta. Distal endite with four setae (1'–4'), one scraper-like (1'), three flaming-torch-like decreasing in length towards the base (2'–4'); first flaming-torch thick, similar in length to scraper-like seta. Basal endite armed with three soft setae increasing in length towards the base. Gnathobase armed with one long and cylindrical sensillium and a long seta inserted on robust and naked base. Filter comb armed with five setulated setae.

Limb V (Fig. 8N). Pre-epipodite subquadrangular and densely setulated, epipodite rectangular with short projection. Exopodite oval, not divided in lobes, about twice as long as wide; marginal line between setae 3–4 densely setulated; four plumose marginal setae decreasing in length; third seta about 1.8 times shorter than first seta; fourth seta about 2.7 times shorter than third seta. Internal lobe wide, oval and with long terminal setules; two setulated setae of different size on inner face of the lobe; one long and inflated element inserted behind of the inner setae. Gnathobase reduced, with a short element. Filter comb absent.

Male. Unknown.

Ephippial female. Unknown.

Differential diagnosis. *Coronatella serratalhadensis* **sp.nov.** is distinguished from other species of the genus because of its spinules on the posteroventral carapace margin, organized into groups. In general features, *C. serratalhadensis* **sp.nov.** resembles *C. circumfimbriata* Megard, 1967, which can be differentiated in number of denticles of postabdomen (5–6 in *C. serratalhadensis* **sp.nov.** and 6–8 in *C. circumfimbriata*) and fine morphological traits from the thoracic limbs: *C. serratalhadensis* **sp.nov.** has long setae on the third endite of Limb I, IDL setae armed in 2+1, sensillum on gnathobase of Limb II, Limb III with four elements on the gnathobase and inner setae without sensillum, Limb IV with first flaming-torch of similar size to scraper-like seta, inner portion of Limb V armed with two elements. Recently, Kotov *et al.* (2010) discovered a similar species from the Chilean Andes (not yet described) to *C. circumfimbriata*, but it presents long and thin setules on the base of the terminal claw of the postabdomen. This morphological trait is not observed in *C. circumfimbriata* and *C. serratalhadensis* **sp.nov.** The main differences between *C. serratalhadensis* **sp.nov.** and other Brazilian species of *Coronatella* may be observed in Table 1.

Distribution and biology. So far, *C. serratalhadensis* **sp.nov.** possesses a very narrow distribution, being found only in the state of Pernambuco, northeastern Brazil (Fig. 13). This species seems to be associated with small and shallow water bodies, including artificial environments.

***Coronatella undata* sp.nov.**
(Figs. 9–10, 12)

Alona sp. in Sousa *et al.* (2009), p. 103.

Etymology. The name "*undata*" (from the latin "*unda*") refers to the marked waves observed on the posterior marginal line of the carapace.

Type locality. Swamp on Ypioca farm, São Gonçalo do Amarante, Ceará, Brazil (3°34'39"S, 38°52'31"W).

Type material. Holotype. Undissected, adult parthenogenetic female in a tube with 90% ethanol deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 32974. The label of the holotype is: "*Coronatella undata* sp. n., 1 parth. ♀ from to Swamp of the Fazenda Ypioca, São Gonçalo do Amarante, Ceará, Brazil. Holotype".

Paratype. One undissected adult parthenogenetic female deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 32975. Paratypes. Eleven females and three slides containing dissected individuals deposited at Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília (CLLA042 to CLLA049). Material collected by Maria Beatriz Gomez e Souza on 19.xii.2007.

Other Material Examined. One adult parthenogenetic female from the Esperança pond, Lençóis Maranhenses National Park Maranhão, Brazil (2°40' 51"S, 43°1'55"W), material collected on 01.vii.2000, leg. Maria José Saraiva Lopes (EL02125).

Diagnosis. *Female.* Animal small-sized, length 0.24–0.36 mm. Head with rostrum short, blunt, projected downward, ocellus as shorter as eye, lateral head pores tiny. Labral keel short, naked, marginal line wavy. Carapace with dorsal keel, presenting weak lateral compression, arched anteriorly, with ten-12 longitudinal lines, 34–38 ventral setae of similar length, posterior ventral corner with two denticles, posterior margin of valves strongly wavy. Antennules with sensory seta about 2.8 times smaller than antennular body. Antenna with second exopodite segment presenting one row of long setules, antennal formula: spines 001/101, setae 113/003, apical spines of similar length. Postabdomen relatively short, lateral fascicles arranged in four groups exceeding the marginal line, five-6 clusters of marginal denticles, projection for insertion of terminal claw presenting one small incision. Terminal claw about 1.5 times longer than anal margin and with one row of short spinules on base. Basal spine about 2.5 times as long as width of terminal claw at its base and with setulae on the dorsal margin. Limb I with ODL seta shorter than longest IDL seta; IDL with two setae armed with long and strong proximal spines, first endite with first seta short. Limb II with rudimentary seta on exopodite, scraper 8 remarkably short, filter comb with six setae. Limb III: exopodite with six setae; seta 3 about 4.2 times longer than fifth seta; seta 6 naked and longer than midlength of the fifth seta. Limb IV: exopodite with six setae; fourth seta about 1.8 times shorter than

fifth seta; sixth seta naked and about 1.3 times shorter than fifth seta; distal endite with thick first flaming-torch. Limb V with exopodite with depression on marginal line, setae of inner lobe of similar size, gnathobase setulated and armed with one short element, filter comb absent. *Male*. Unknown.

Description. Parthenogenetic female. *Habitus* (Fig. 9A; 12J). Animal small-sized, length 0.24–0.36 mm, about 1.5 time as long as hihgh.

Head (Fig. 9A). Ocellus shorter than eye. Rostrum short, blunt, projected downward. Three main head pores connected by narrow connection, IP about 1.4 times longer than PP; median pore smaller than posterior and anterior pores (Fig. 9D–F); lateral head pores tiny, inserted nearer main head pores than marginal line of head shield (Fig. 9D–F). Head shield (Fig. 9F). With anterior margin rounded, mandibular articulation inserted at posterior portion.

Labrum (Fig. 9G–H; 12K). Labral keel relatively short, naked; with a wavy marginal line. Apex rounded, not projected.

Carapace (Fig. 9A–C; 12L) presenting weak lateral compression, arched anteriorly, colorless and transparent; dorsal keel absent; carapace striated with 10–12 longitudinal lines; ventral margin slightly concave near to posterior portion, with 34–38 setae not differentiated in groups; short spinules present between ventral setae; ventral setae followed by spinules not arranged in groups, proximalmost projected beyond carapace margin. Posterior ventral corner with two denticles. Posterior margin of the valve strongly wavy (Fig. 9B–C).

Antennules (Fig. 9I) long, exceeding the tip of rostrum, about 2.5 times longer than wide; three rows of setulae of similar length on antennular body. Antennular sensory seta short, about 2.8 times smaller than antennular body, inserted at two-thirds of antennular length. Nine terminal aesthetascs of different size that do not exceed the length of the antennular body.

Antenna (Fig. 9J). Coxal setae of similar length. Basipodite thick, with one spine. First exopodite segment with short setulae near to base. Second exopodite segment presenting a group of three relatively long setulae and inserted on terminal portion of segment. Antennal formula: spine 001/101; setae 113/003. Seta on the first exopodite segment short, remarkably exceeding the length of the last segment; seta on the second segment bi-segmented and densely setulated. Spine on the first segment of the endopodite thick, long, exceeding the length of the second segment but not reaching the midlength of the third segment. Apical spines of similar size. Apical setae bi-segmented.

Thorax about two times longer than *abdomen* (Fig. 9A). Abdominal setae not studied.

Postabdomen (Fig. 9K–M) short, about 2.8 times as long as wide; ventral margin relatively straight. Rows of the spinules were not observed on the ventral margin. Preanal margin longer than anal and postanal margin. Anal margin concave near to preanal corner, armed with at least three groups of spinules; short lateral fascicles; postanal corner not evident. Postanal margin rounded and robust; projection for insertion of terminal claw presenting one small incision (Fig. 9M); lateral fascicles arranged in four groups with variable number of setules; all fascicles exceeding the margin of the postabdomen; five-six clusters of marginal denticles, distal denticles may be not clustered. Postabdominal seta (Fig. 9K) about midlength of postabdomen, distal portion setulated. Terminal claw (Fig. 9K–L) about 1.5 times longer than anal margin, thick, uniformly curved, with one row of short spinules on base, implanted at a projected basis from the postabdomen. Pecten armed with two groups of spinules; inner spinules long and laterally inserted to terminal claw. Basal spine long in comparison to terminal claw, inserted in its base, about 2.5 times as long as width of terminal claw at its base, armed with setules on the dorsal margin.

Mandibles (Fig. 9N). Well developed in relation to body size, molar surface with robust denticles.

First maxilla not found.

Five pairs of limbs.

Limb I (Fig. 10A–C). Epipodite not studied. ODL with thin seta, serrulated from the median portion, remarkably shorter than longest IDL seta; accessory seta not studied. IDL with two groups of spinules on its face, two setae of different size present; setae armed with long and strong proximal spines, distalmost spines as thin denticles. Third endite with four setae relatively robust; inner setae setulated (a–b), similar in length to the other two setae. Second endite with two rows of strong spinules; three setae of different length (d–f); seta 4 (f) long, about the same length as seta 5 (e); setae 4–5 (e–f) with thick spinules on lateral face; seta 6 (d) about two times shorter than seta 4 (f). First endite with three marginal setae (g–i), setae 2–3 (g–h) bi-segmented and of similar length, first seta (i) short. No specialized elements on endites. Ejector hooks of similar size. Ventral face of limb with six rows of setules, decreasing in length towards the distal portion. Gnathobase not studied.

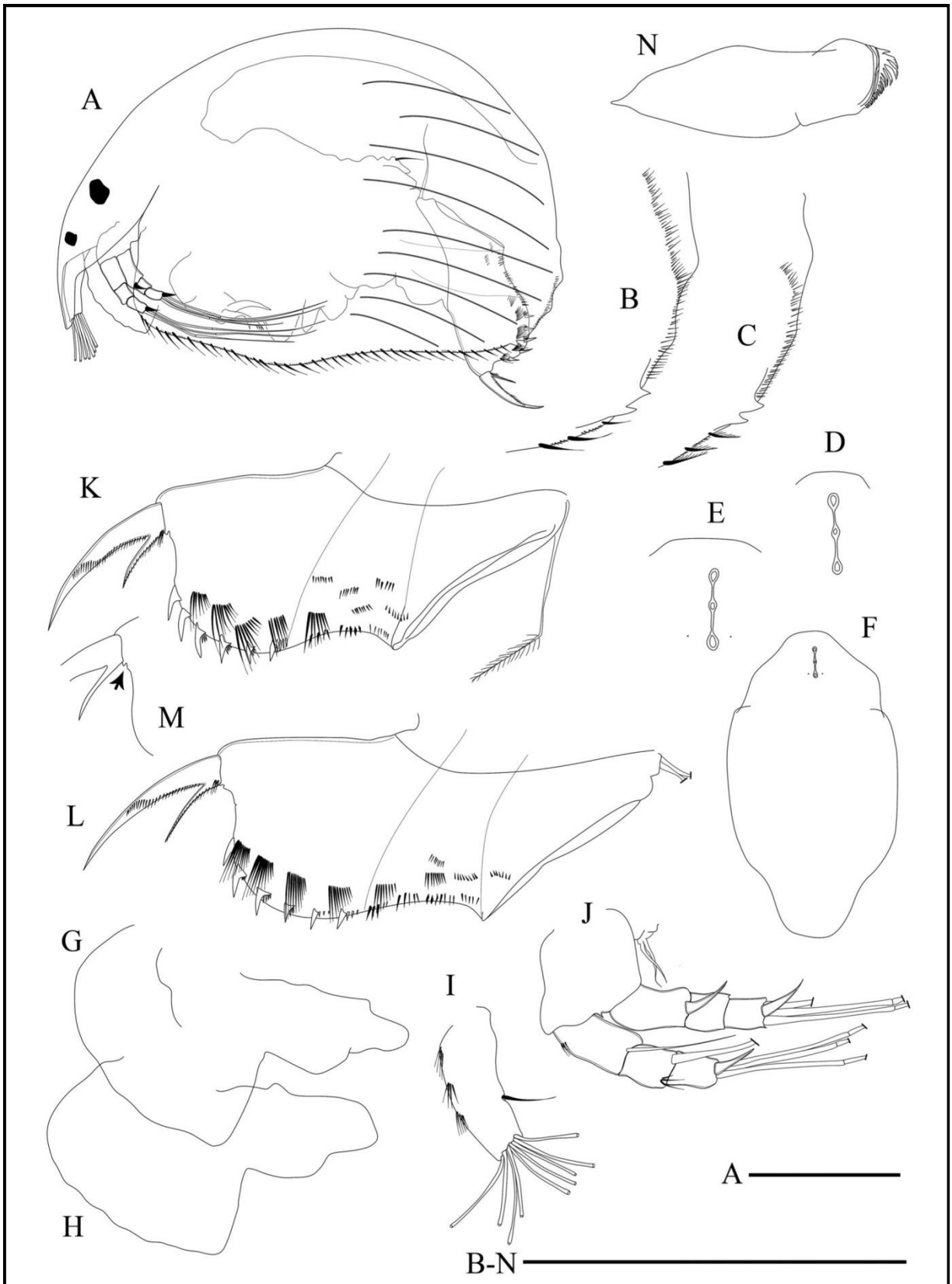


FIGURE 9. *Coronatella undata* **sp.nov.**. A, *habitus.* B, posteroventral corner of carapace. C, *idem.* D, head pores. E, *idem*. F, head shield. G–H, labral keel. I, antennule. J, antenna. K, postabdomen. L, *idem*. M, *idem*—arrow showing incision on the projection for the inserting of claw. N, mandibles. Scale bars = 100µm.

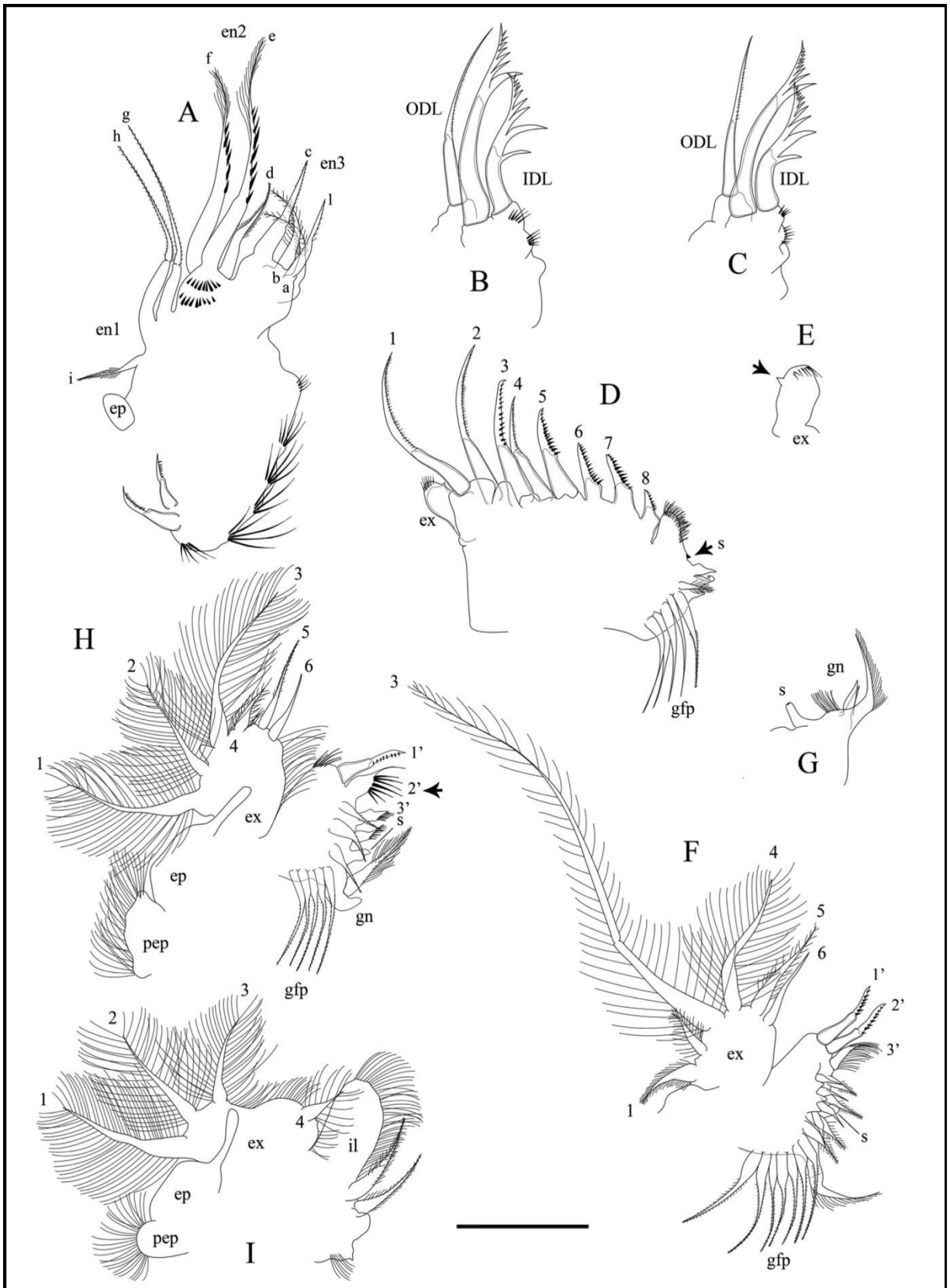


FIGURE 10. *Coronatella undata* **sp.nov.**. A, limb I. B–C, *idem*—ODL and IDL. D, limb II. E, idem—arrow showing the rudimentary seta on the exopodite. F, limb III. G, idem—gnathobase. H, limb IV, arrow showing the most robust flaming-torch satae. I, limb V. For abbreviations, see Material and methods. Scale bars = 50μm.

Limb II (Fig. 10D–E). Exopodite elongated, distally setulated. Seta on exopodite rudimentary. Endite armed with eight scrapers decreasing in length towards gnathobase, without accessory seta near scraper 1; scraper 3 shorter than scrapers 1–2 and longer than scraper 4; scraper 5 shorter than scraper 4; scraper 8 remarkably shorter than scrapers 6–7; scrapers 3, 5–7 armed with thick denticles. Proximal portion of the gnathobase long and densely setulated; distal portion armed with three elements and one sensillum; first element with blunt apex. Filter comb armed with six setae setulated from median portion; seta 1 remarkably shorter than other setae.

Limb III (Fig. 10F–G). Pre-epipodite and epipodite not studied. Exopodite subquadrangular with six marginal setae arranged in 2+4; setae 1–2 of different length; seta 3 long, bi-segmented, setulated, about 4.2 times longer than fifth seta; fourth setae about 3.1 times shorter than third seta and 1.3 times shorter than fifth seta; sixth seta naked, longer than midlength of the fifth seta. Distal endite with three setae (1'–3'), two scraper-like of similar length (1'–2'); third seta slightly geniculated and armed bilaterally with many setules (3'). Basal endite armed with four plumose setae slightly increasing in length towards the gnathobase; four soft setae increasing in length towards the gnathobase. Gnathobase armed with four elements, first a robust and cylindrical sensillum, second a geniculated seta with a group of setulae on its base and distally setulated, third and fourth elements naked, with acute tips. Filter comb armed with seven long setae.

Limb IV (Fig. 10H). Pre-epipodite rectangular and densely setulated, epipodite oval with long projection. Exopodite rounded with marginal setae: setae 1 about 1.2 times longer than seta 2; seta 3 about 1.2 times longer than seta 1 and 1.5 times longer than seta 2; fourth seta about 1.8 times shorter than fifth seta and reaching midlength of the sixth seta; sixth seta naked, 1.3 times shorter than fifth seta. Distal endite with four setae (1'–4'): one scraper-like (1') and three flaming-torch-like decreasing in length towards the base (2'–4'); first flaming-torch thick, similar in length to scraper-like seta; endite armed with one row of setulae near scraper-like seta. Basal endite armed with three soft setae increasing in length towards the base. Gnathobase armed with one long, thin and cylindrical sensillum, and a long seta inserted on a robust and naked base. Filter comb armed with five setulated setae.

Limb V (Fig. 10I). Pre-epipodite oval and densely setulated, epipodite oval with long projection. Exopodite oval, not divided in lobes, about twice as long as wide; marginal line between setae 3–4 with a densely setulated depression; four plumose marginal setae decreasing in length; third seta about 1.5 times shorter than first seta; fourth seta about 1.8 times shorter than third seta. Internal lobe wide, oval and with long terminal setules; two setulated setae of similar size on the inner face of the lobe, without any element between them. Gnathobase reduced, with one short element, setules present. Filter comb absent.

Adult male. Unknown.

Ephippial female. Unknown.

Differential diagnosis. *Coronatella undata* **sp. nov.** is differentiated from the other species of the genus by a combination of following morphological traits: (1) denticles on the labral keel absent, (2) presence of two denticles on the posteroventral corner of the carapace, (3) ventral setae of the carapace not arranged in groups and (4) marked waves on the posterior marginal line of carapace. *Coronatella undata* **sp. nov.** resembles *C. monacantha* but differs regarding the fine features of the thoracic limbs, such as rudimentary seta on the exopodite of Limb II. More differences between these species are presented in Table 1.

Distribution and biology. *Coronatella undata* **sp.nov.** is known for only two localities, the Ypioca farm swamp, in São Gonçalo do Amarante, Ceará state and the Esperança pond at the Lençóis Maranhenses National Park, Maranhão state, Brazil (Fig. 13). We believe that this species is distributed in coastal habitats.

***Coronatella monacantha* (Sars, 1901)**
(Fig. 11)

= *Alona monacantha* in Sinev (2004), pg. 9–10, figs. 1–22.

Type locality. Ipiringa, São Paulo state, Brazil. No further comments were made by Sars (1901).

Lectotype. Females, Zoological Museum of Oslo University, sample F12332a.

Other material examined. Six adult parthenogenetic females from the Jurumirim Reservoir, São Paulo, Brazil (23° 16' 35.67"S, 49° 5' 10.94"W), material collected by José Roberto Debastiani-Júnior. Five adult

parthenogenetic females from Nhumirim Embrapa Farm, Baía-49, Mato Grosso do Sul, Brazil (19º 00' 14.9"S, 56º 38' 06.9"W), material collected by Valéria Barros on 07.ix.2000 (EL02243). Two adult parthenogenetic females from pond located in Paranã River floodplain, Goiás, Brazil (15º 09' 15.8"S, 47º 28' 04.7"W), material collected by Ciro Joko on 20.viii.2003 (EL00717). Seven adult parthenogenetic females from a pond in vicinity of São José do Mipibú, Rio Grande do Norte, Brazil (06º 04' 45"S, 35º 14' 17"W), material collected by Lourdes M. A. Elmoor-Loureiro on 20.vii.1985 (EL02122). Eight adult parthenogenetic females from the Swamp at the Ypioca Farm, São Gonçalo do Amarante, Ceará, Brazil (3º 34' 39"S, 8º 52' 31"W), material collected by Maria Beatriz Gomes e Souza on 19.xii.2007.

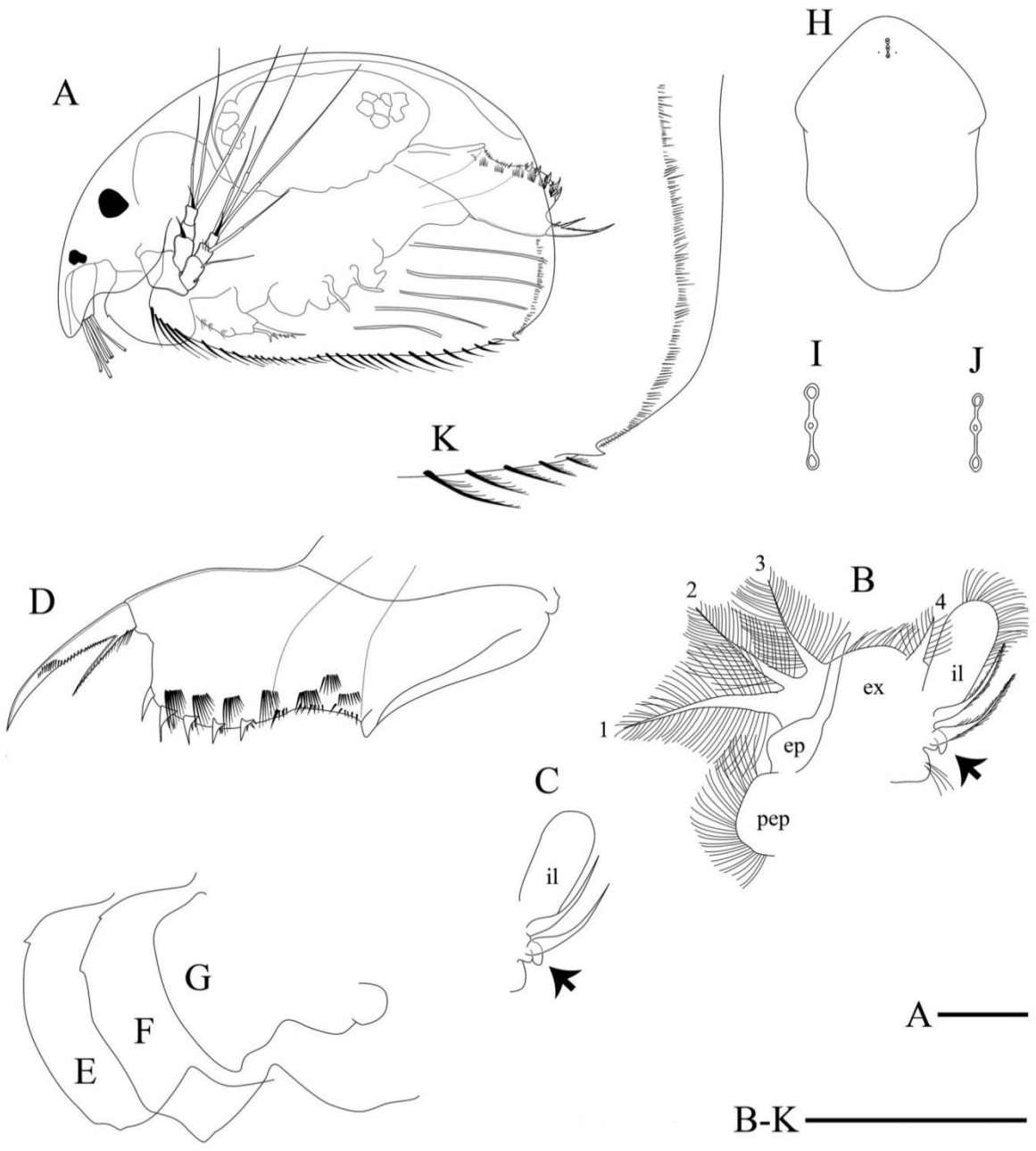


FIGURE 11. *Coronatella monacantha* (Sars, 1901). A, *habitus*, lateral view. B, limb V—arrow showing one element on the gnathobase (São Paulo). C, *idem*. D, postabdomen. E, labral keel. F, *idem*. G, *idem*. H, head shield. I, head pores, J, *idem*. K, posteroventral corner of carapace. For abbreviations, see Material and methods. Scale bars = 50 µm. Figures A–F and H–I from São Paulo; figures G and J from Ceará, Brazil.

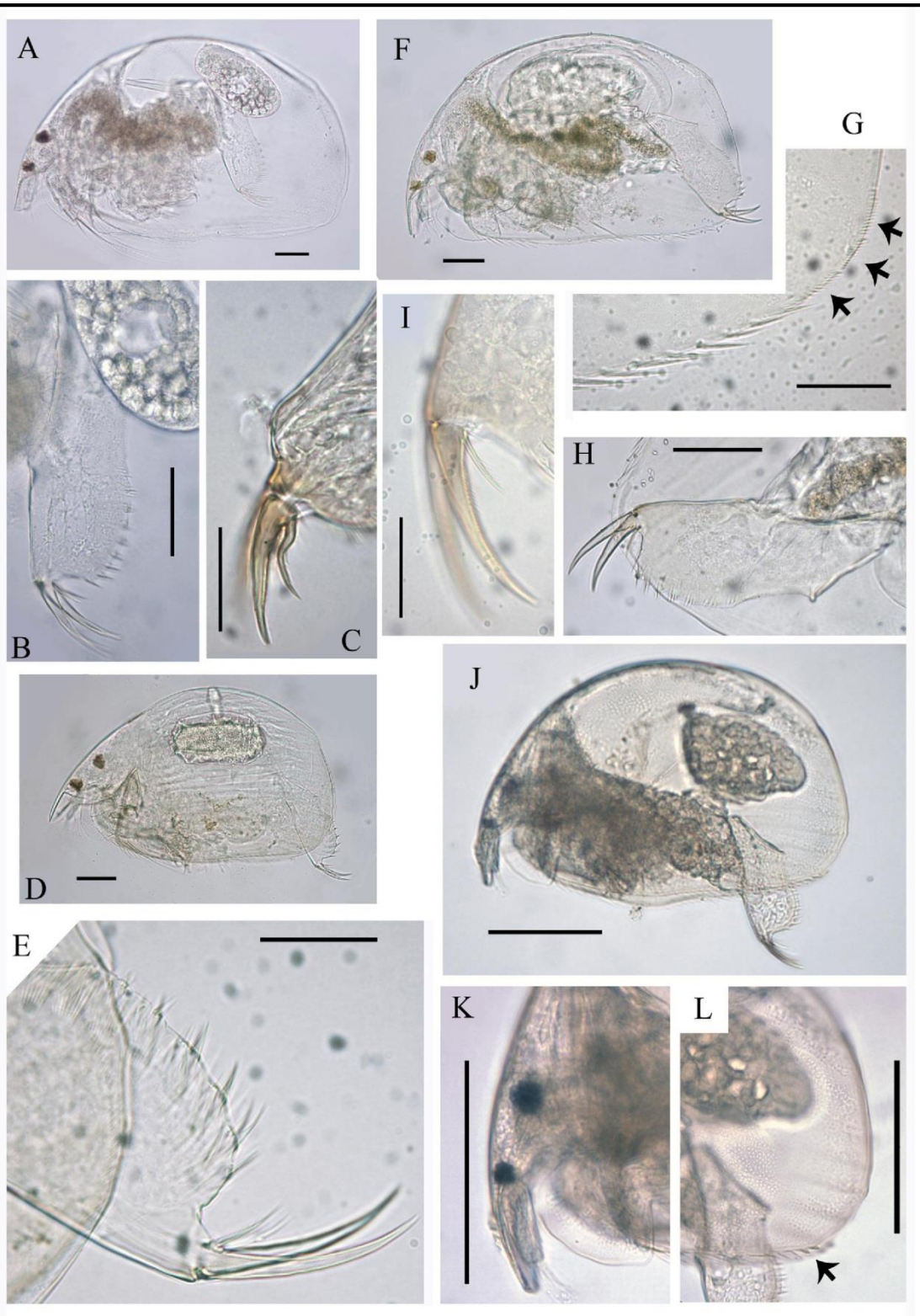


FIGURE 12. *Coronatella* species with occurrence in Brazil. A, *Coronatella poppei*. B, *idem*—postabdomen. C, *idem*—terminal claw of male. D, *Coronatella paulinae* **sp.nov.**. E, *idem*—postabdomen. F, *Coronatella serratalhadensis* **sp.nov.**. G, *idem*—posteroventral corner of carapace, arrows showing the internal group of spinules. H, *idem*—postabdomen. I, *idem*—terminal claw. J, *Coronatella undata* **sp.nov.**. K, *idem*—rostrum and labral keel. L, *idem*—posteroventral corner of carapace, arrow showing the denticles. Scale bars: 50µm = B, C, G, I, E; 100 µm = A, D, F, H, J, K, L.

Comments. The morphology of the studied populations almost completely agrees with the recent redescription of this species (Sinev 2004), with only one exception observed in the inner portion of Limb V. In this appendage, we can observe an inflated element, variable in size, inserted behind the inner setae (Fig. 11B–C). In the post-abdomen, we can observe spinules along the whole dorsal margin of the basal spine (Fig. 11D). Agreeing with Sinev (2004), we found intrapopulational and interpopulational variations in the denticle on the posteroventral corner of carapace and labral keel (Fig. 11E–G). The position of the lateral head pores exhibited variation in comparison to data from Sinev (2004) (Fig. 11K).

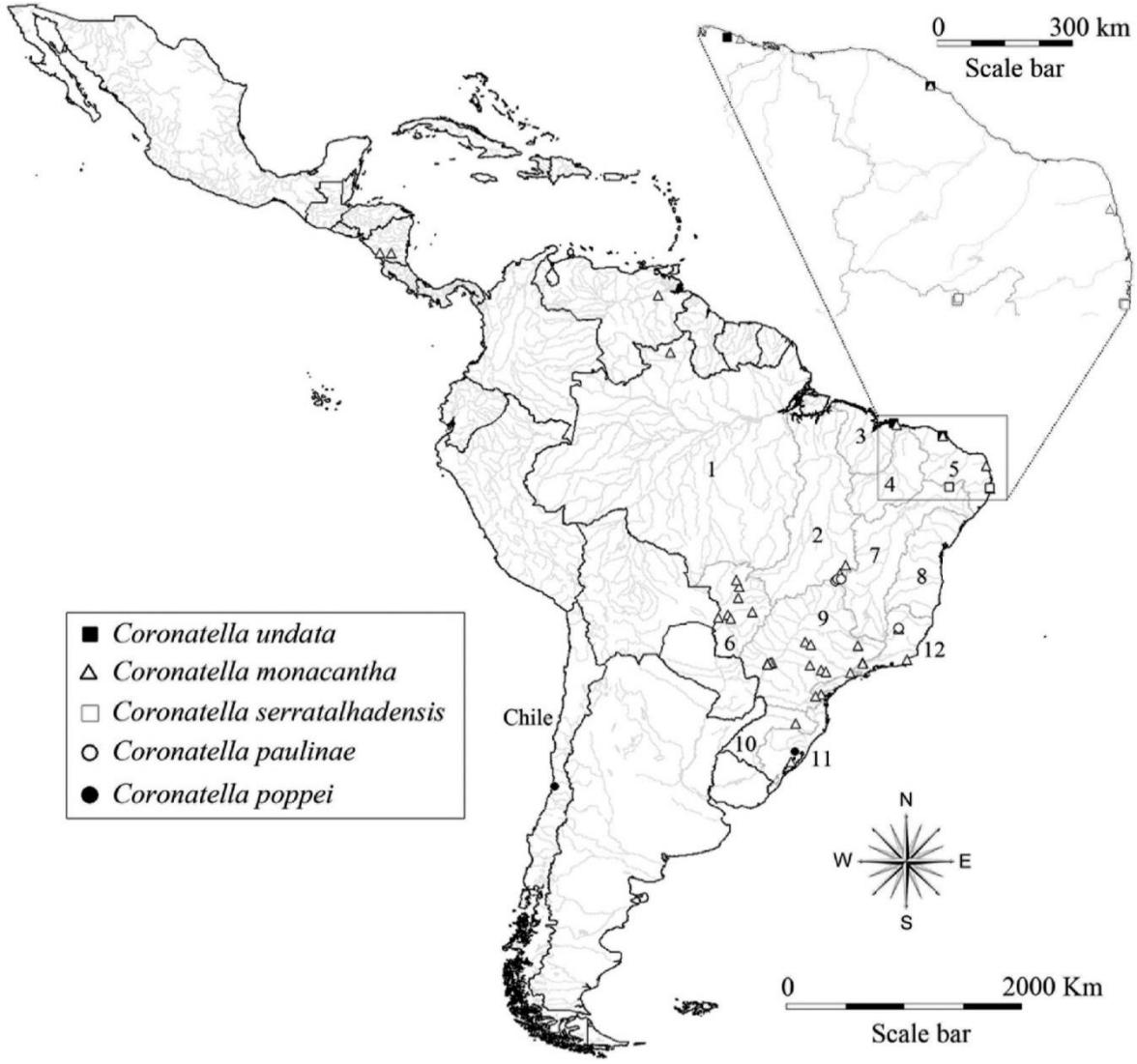


FIGURE 13. Geographical distribution of *Coronatella* species in the Neotropics. Specifically for Brazil, the map presents the delimitation of hydrographic Regions according to Resoltution 32 from Conselho Nacional de Recursos Hídricos. 1 Amazônica; 2 Tocantins/Araguaia; 3 Atlântico Nordeste Ocidental; 4 Parnaíba; 5 Nordeste oriental; 6 Paraguai; 7 São Francisco; 8 Atlântico leste; 9 Paraná; 10 Uruguai; 11 Atlântico sul; 12 Atlântico sudeste. *Coronatella monacantha* is widely distributed in the Neotropics. *Coronatella poppei* seems to be restricted to the meridional part of South America. *Coronatella paulinae* **sp.nov.**, until this moment, shows distribution in the central part of Brazil. *Coronatella serratalhadensis* **sp.nov.** and *C. undata* **sp.nov.** occur in the Brazilian Northeast; however, *C. undata* **sp.nov.** seems to be restricted to environments closer to the coast.

TABLE 1. Morphological differences in Brazilian *Coronatella* species and *Coronatella rectangula* (data from Van Damme & Dumont, 2008b). A1 = first Antenna; end = endopodite; ex = exopodite; PA =postabdomen; ODL = outer distal lobe; IDL = inner distal lobe; P1 = limb I; P2 = limb II; P3 = limb III; P4 = limb IV; P5 = limb V; Pvc = posteroventral corner of the carapace; fc = filter comb; IP: interpore distance (distance between anterior and posterior main head pore); PP: postpore distance (distance between posterior main head pore and posterior border of head shield). * Missing data.

	C. rectangula	***C. poppei***	***C. paulinae* sp.nov.**	***C. serratalhadensis* sp.nov.**	***C. undata* sp.nov.**	***C. monacantha***
Size	0.25-0.40	0.30-0.44	0.29-0.33	0.27-0.36	0.24-0.36	0.19-0.30
IP > PP	*	1.4 times	2.2 times	1.6 times	1.4 times	2.0 times
Labral keel, denticles	-	-	-	-	-	+
Ventral setae, groups	+	+	+	+	-	+
Nº of ventral setae	30-40	34-40	28-33	28-38	34-38	35
Pvc - denticles	-	-	-	-	two	one
Pvc – groups of spinules	-	-	-	three groups	-	-
A1 antennular body/ antennular seta – length	2.3	2	1.8	1.7	2.8	2.9
PA Nº marginal denticles	6-7	8-9	5-6	5-6	5-6	5-6
PA Nº lateral fascicles	5	7	5-6	5-6	4-5	6-7
PA length of basal spine/base of the terminal claw	2	1.2	1.2	2.6	2.5	2.5
P1 Nº of rows of setules on the limb	7	7	7	6	6	5
P1 ODL seta vs. longest seta of the IDL	ODL ≅ IDL	ODL ≅ IDL	ODL ≅ IDL	ODL ≅ IDL	ODL < IDL	ODL ≅ IDL
P1 IDL reduced seta	+	-	-	+	-	-
P2 exopodite seta	long	long	absent	long	rudimentary	reduced
P2 Nº of setae on the fc	7	7	6	7	6	7
P3 fourth setae of the ex	short	short	long	short	long	long
P3 length of seta 3/length of seta 5	2.3	3.2	2.9	2.6	4.2	2.4
P4 length of seta 4/length of seta 5	2.0	3.3	1.9	2.3	1.8	2.3
P5 ex depression between setae 3-4	-	-	+	-	+	-
P5 fc	-	-	+	-	-	-

Distribution and biology. *Coronatella monacantha* is the most well-known Neotropical species of the genus and occurs in many types of aquatic environments, including artificial ones (Fig. 13). Regarding natural water bodies, this species may be found in permanent and temporary ponds, swamps, lakes, rivers, streams and floodplains (Howelldel *et al.* 2003; Sousa *et al.* 2009; Van Damme & Dumont 2010). Populations of *C. monacantha* in Brazil have been associated with large macrophyte beds, especially *Eichornia azurea* (Serafim-Junior *et al.* 2003), and also with slightly acid waters (pH between 4–6). According to Sousa *et al.* (2011), *C. monacantha* is very sensitive to environmental conditions, and reductions in water quality can result in morphological abnormalities.

Identification key for American species of *Coronatella*

1. IDL setae with thick proximal denticles, row of setae on the carapace reaches the end of the carapace 2
- IDL setae with short and thin proximal denticles, row of setae on the carapace not reaching the ends of the carapace . . . . . *C. paulinae* **sp.nov.**—Brazil
2. Posteroventral corner of carapace with denticles 3
- Posteroventral corner of carapace without denticles 4
3. One denticle on the posteroventral corner of carapace, one denticle on the labral keel, seta on the exopodite of the Limb II reduced . . . . . *C. monacantha*—Neotropics
- Two denticles on the posteroventral corner of carapace, labral keel naked, seta on the exopodite of the Limb II rudimentary . . . . . *C. undata* **sp.nov.** —Brazil, Northeast
4. Inner spinules on the posterior margin of carapace arranged in group 5
- Inner spinules on the posterior margin of carapace not arranged in group . . . . . *C. poppei*—Southern of South America
5. Terminal claw of postabdomen with long and thin setules on the base . . . . . *C.* cf. *circumfimbriata*—Chile, Andes
- Terminal claw of postabdomen with short spinules on the base 6
6. Postanal margin of postabdomen armed with 6–8 clusters of denticles . . . . . *C. circumfimbriata* —From Northern Canada to Northern Mexico
- Postanal margin of postabdomen armed with 5–6 clusters of denticles . . . . . *Coronatella serratalhadensis* **sp.nov.**—Brazil, Northeast

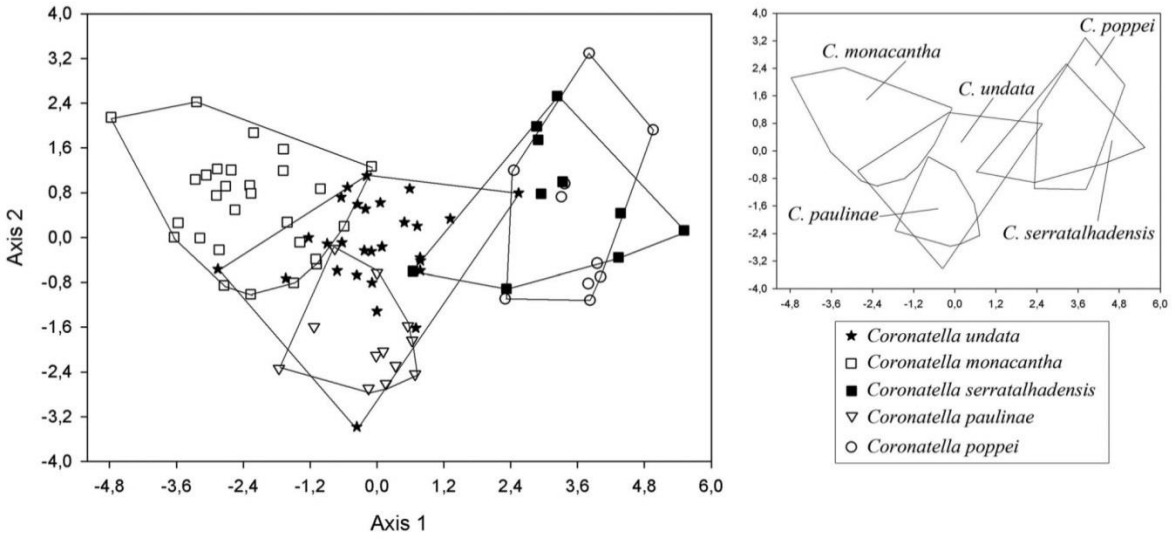


FIGURE 14. Clustering for six morphometric variables from MANOVA/CVA presenting the separation of species of *Coronatella*. (Wilk's $\lambda = 0.06373$; $F = 13.68$; $p = <0.001$).

Morphometric analyses

The null hypothesis regarding the measurements of the six morphometric variables for *Coronatella* taxa was

rejected, indicating morphometric differences between the species (Wilk's λ = 0.06373; F = 13.68; p = <0,001). Therefore, the morphometric variables adopted here could contribute to the separation of the studied taxa (Table 2). The analysis of canonical variables supported these results, showing a separation between some of the studied taxa (Fig. 14).

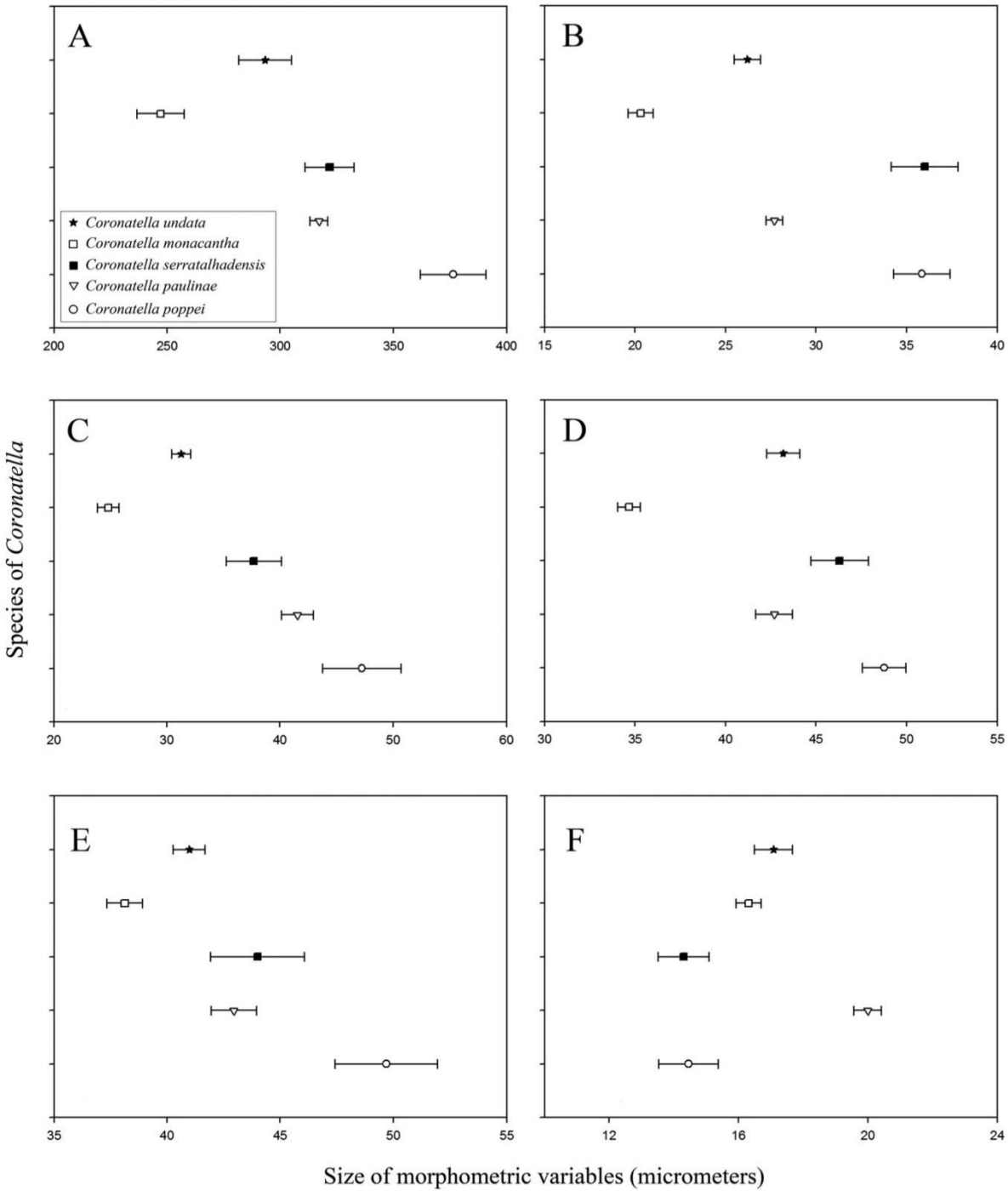


FIGURE 15. Analyses of variance (One-Way ANOVA) for six morphometric variables taken for species of *Coronatella*. A, carapace length. B, anal margin length, C, postanal margin length. D, postanal margin width. E, terminal claw length. F, basal spine length.

Carapace length was significantly different among the studied taxa (F_{89-1} = 29.54, $p < 0.001$). On average, it was larger in *Coronatella poppei*, when compared to the other taxa. *C. monacantha* showed the smallest average values of carapace length. *C. serratalhadensis* **sp.nov**. and *C. paulinae* **sp.nov.** did not differ regarding mean carapace lengths (Fig. 15A).

The results of the ANOVA show that the species also differ in the length of the anal margin (F_{89-1} = 31.72, $p < 0.001$). *Coronatella monacantha* presented the smallest average values among all taxa, regarding this morphological measure. *Coronatella poppei* and *C. serratalhadensis* **sp.nov.** presented the highest mean values of the length of the anal margin, but these did not differ statistically (Fig. 15B).

The length of the post anal margin differed among the studied taxa (F_{89-1} = 33.33, $p < 0.001$). *Coronatella poppei* showed higher average values when compared to the other taxa, being statistically different from *C. undata* **sp.nov.**, *C. monacantha* and *C. serratalhadensis* **sp.nov.**. The smallest average values for the postanal margin were observed in *C. monacantha* (Fig. 15C).

The width of the postanal margin of the postabdomen also differed among the studied taxa (F_{89-1} = 31.72, $p < 0.001$). *Coronatella poppei* showed higher average values in relation to the other taxa being statistically different from all species except, *C. serratalhadensis* **sp.nov.** *Coronatella monacantha* presented average values smaller than all other taxa (Fig. 15D).

The morphometric results for the claw length demonstrated statistical differences in the mean values among the species (F_{89-1} = 11.57, $p < 0.001$), with a longer claw in *Coronatella poppei*. *Coronatella serratalhadensis* **sp.nov**. and *C. paulinae* **sp.nov**. did not exhibit differences in the mean length of the claw. Once again, *C. monacantha* presented the smallest mean values in relation to the other studied taxa, and this difference is statistically significant (Fig. 15E).

The length of the basal spine did not present the same pattern as the claw, even though there were also statistical differences for this variable (F_{89-1} = 9.85, $p < 0.001$), with *C. poppei* and *C. serratalhadensis* **sp.nov.** showing the smallest values of all taxa, with no significant differences between these two species. *Coronatella monacantha* and *C. undata* **sp.nov.** did not exhibit significant differences in the mean length of the basal spine. Among all taxa, *C. paulinae* **sp.nov.** possesses the largest average length values for the basal spine (Fig. 15F).

TABLE 2. Mean and standard errors for the six morphometric variables obtained from Brazilian *Coronatella* species. Values are shown in micrometers.

	C. poppei n = 10	***C. paulinae* sp.nov.** n = 13	***C. serratalhadensis* sp.nov.** n = 10
Carapace length	376.64 (13.80)	317.17 (3.44)	321.81 (10.19)
Anal margin length	35.84 (1.47)	27.69 (1.47)	36 (1.74)
Postanal margin length	47.23 (3.28)	41.53 (1.24)	37.69 (2.31)
Postanal margin width	48.76 (1.15)	42.69 (0.90)	46.30 (1.51)
Terminal claw length	49.69 (2.14)	42.94 (0.89)	44 (1.97)
Basal spine length	14.46 (0.87)	20 (0.37)	14.30 (0.75)

continued.

	***C. undata* sp.nov.** n = 28	***C. monacantha*** n = 28	Anova Parameters
Carapace length	303.67 (5.27)	255.88 (5.78)	$F = 29.54$, $p < 0.001$
Anal margin length	26.20 (0,71)	20.32 (0.68)	$F = 31.72$, $p < 0.001$
Postanal margin length	31.26 (0.83)	24.83 (0.93)	$F = 33.33$, $p < 0.001$
Postanal margin width	43.18 (0.89)	34.67 (0.61)	$F = 31.72$, $p < 0.001$
Terminal claw length	40.98 (0.69)	38.13 (0.77)	$F = 11.57$, $p < 0.001$
Basal spine length	17.08 (0.57)	16.31 (0.38)	$F = 9.85$, $p < 0.001$

Discussion

Following recommendations from Van Damme & Dumont (2008a) and Van Damme *et al.* (2010), we redescribed *C. poppei* using material from the type locality. We believe that our morphological redescription will help in comparisons with populations identified as "*C. poppei*" from other continents, which comprise potentially separate taxa following Frey's (1982) concept of cladoceran non-cosmopolitanism. *Coronatella poppei* sensu stricto is an exclusively Neotropical species, with probable distribution in southern South America. It is definitely distinct from any other species of *Coronatella* described so far, including those requiring further revisions (Van Damme *et al.*, 2008b). In the females, the long postanal margin of the postabdomen with up to nine denticles and the accessory seta near to first scraper of Limb II are exclusive morphological traits; in the males, the sinuous basal spine only superficially resembles that of *C. circumfimbriata* (Sinev 2009). Furthermore, *C. poppei* also possesses morphometric differences in comparison to the other species investigated here (Fig. 15; Table 2).

Rey & Vasquez (1986) provided a good diagnosis and good drawings of *C. poppei* for Venezuela, presenting: (1) a specific morphology of the main pores; (2) a specific morphology of the labral keel (even though this aspect is variable); (3) a specific shape of the postabdomen and (4) a long basal spine on the terminal claw. However, the morphology of the postabdomen of the population described by Rey & Vasquez (1986), including the number of marginal denticles and shape, is very similar to *C. paulinae* **sp.nov.**. The only incongruence is that it lacks the well-defined pre-anal angle observed in *C. paulinae* **sp.nov.**. Besides, the morphology of the main head pores with large median pore inserted near anterior or posterior is different from that of *C. paulinae* **sp.nov.** We believe that the population described by Rey & Vasquez (1986) might be a subspecies or even a new species of *Coronatella* related to *C. paulinae* **sp.nov.**, and not to *C. poppei*. Thus, more studies on these Venezuelan populations are needed. Previously it was demonstrated for other cladoceran groups that even in different parts of South America, taxa from a species group could be different (Frey 1993; Kotov *et al.* 2010). Some species described from Brazil seem to be endemics of some regions of this country (Rey & Vásquez 1989; Elmoor-Loureiro *et al.* 2013; Elmoor-Loureiro 2014).

The name *C. poppei* (=*Alona poppei*) was frequently cited in publications concerning different regions of Brazil (Brehm 1937; Schubart 1942; Eskinazi-Sant'Anna *et al.* 2005; Soares & Elmoor-Loureiro 2011; Diniz *et al.* 2013). Our results showed that *C. poppei* occurs only in the southern portion of the South American continent. Up to now, only one formal record for *C. poppei* in Brazilian territory has been confirmed, in the southernmost state of Rio Grande do Sul (Fig. 13).

Two different species might have been so far identified as *C. poppei*: *C. serratalhadensis* **sp.nov.** and *C. paulinae* **sp.nov.** Nevertheless, they are different in many aspects, including the *habitus* and limb characteristics. *Coronatella paulinae* **sp.nov.** possesses more affinities with African species, such as *C. holdeni* Van Damme & Dumont 2008 and *C. anemae* Van Damme & Dumont 2008, than with *C. poppei*. An example would be the similarities among these species regarding the shape of the post-abdomen and the long seta 4 on the exopodite of Limb IV (See Van Damme & Dumont 2008a). These characters are absent in *C. poppei*. Affinities with *C. bukobensis* Weltner 1897 are also likely, but these will only be properly evaluated after the redescription of this taxon.

The similarities in morphological traits between *C. paulinae* **sp.nov.** and the Asian species *Coronatella* cf. *trachistriata* (see Kotov *et al.* 2011) are remarkable, being this another example of the Amphi-Pacific disjunction in Cladocera. Inferences about Amphi-Pacific distribution are generally limited by the absence of molecular data and absence of records for particular groups on the large fragments of the Gondwana, as observed by Van Damme & Sinev (2013) to *Leydigiopsis* Sars, 1901 and by Padhye & Dumont (2014) to *Moina hemanti* Padhye & Dumont, 2014 and *Moina dumonti* Kotov, Eliás-Gutiérrez & Granado-Ramírez, 2005. However, species of *Coronatella* are distributed on the main fragments of Gondwana (Van Damme & Dumont 2008b) being the Amphi-Pacific disjunction a likely hypothesis in explaining the divergence between *C. paulinae* **sp.nov.** and *Coronatella* cf. *trachistriata*. Molecular tools may be useful to confirm or reject hypothesis.

Besides the morphological aspects (see Table 1), *C. serratalhadensis* **sp.nov.** exhibits a geographic distribution clearly distinguished from that of *C. poppei*, occurring in the Brazilian Northeast. Kotov *et al.* (2010) indicated for the first time, the occurrence of a taxon related to *C. circumfimbriata* outside the Nearctic region, in a high altitude location from Chile, and observed a large number of differences in relation to *C. circumfimbriata*. The population studied by Kotov *et al.* (2010) is distinguished from *C. serratalhadensis* **sp.n.**, since the species described here

possesses eye and ocellus of similar sizes, a smaller number of setae upon the valves (28–38), a smaller number of spinules per group on the posterior margin of the valves (8–10), short setulae on the base of the claw and a long basal spine. These evidences allow us to conclude that in the Neotropical region there are actually two *Coronatella* species related to the Nearctic *C. circumfimbriata*.

One of the *Coronatella* species most commonly found in Brazil is *C. monacantha*. Van Damme *et al.* (2010) suggested that *C. monacantha* is actually a species complex with circumtropical distribution, and highlighted the need for a revision of populations from outside the type region, including taxonomic divisions below the species level (*e.g.* Dumont *et al.* 1981; Chiambeng and Dumont 2005; Maiphae *et al.* 2005; Chatterjee *et al*. 2013; Van Damme *et al.* 2013). The review of these populations requires well-defined morphological criteria, since *C. monacantha* sensu stricto presents a high morphological variability in some structures, such as the labral keel and the valves (Sinev, 2004), and also in the limbs, as shown here (Fig. 11). Furthermore, the description of *C. undata* **sp.nov.** shows that cryptic species can be found within the *monacantha*-complex. *Coronatella undata* **sp.nov.** is very similar to *C. monacantha*, but it is distinguishable through the absence of denticles in the labral keel and the presence of two denticles in the posteroventral angle of the valves. There are clear additional differences between *C. monacantha* and *C. undata* **sp.nov.**, which include their size, length of the setae of the valves and a strong reduction of the seta of the exopodite of Limb II. Such differences might not be merely morphological, but actually could indicate a niche divergence between these two species. Since their geographic distributions overlap, a hypothesis of sympatric speciation between these species might be considered.

Conclusions. In Brazil, the name *Coronatella poppei* has been used to refer to more than one species. This species is distributed in southern South America and, except for the type-location, its occurrence has been confirmed only in Rio Grande do Sul state, southern Brazil. Other records of *C. poppei* in Brazil are likely to belong to *C. paulinae* **sp.nov.**, which occurs in central-southern Brazil, or *C. serratalhadensis* **sp.nov.**, which occurs in northeastern Brazil. The Brazilian *Coronatella* fauna also includes *C. monacantha* and *C. undata* **sp.nov.**, which are closely related species. Sinev & Elmoor-Loureiro (2010) indicated that the Brazilian Aloninae fauna is far from being completely known. Indeed, the richness of *Coronatella* species has clearly been underestimated, since the number of species known in Brazil has now more than doubled.

Acknowledgments

We thank Biologist Leidiane Pereira Diniz and Prof. Dr. Mauro de Melo Júnior, Dr. José Roberto Debastiani Júnior, Prof. Dr. Paulina Maia Barbosa (Peld Project—site 4) and Prof. Dr. Maria José Saraiva Lopes for donation of the material from Pernambuco, São Paulo, Minas Gerais and Maranhão, respectively. We also thank Dr. Sônia N. Bao, Ingrid C. M. da Silva and Márcia C. O. da Rocha (Electronic Microscopy laboratory of the University of Brasília), who made the SEM micrographs possible. We also thank MSc. Marcelo M. Dalosto and Ms. Susan Casement for revising the English version of this manuscript. We are deeply grateful to Dr. Artem Yu. Sinev and Dr. Alexey A. Kotov for the valuable criticisms, comments and suggestions that greatly improved this manuscript. The first author of this paper received a scholarship from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

References

Brehm, V. (1937) Brasilianische Cladoceren gesammelt von Dr. O. Schubart. Zweiter Bericht. *Internationale Revue der gesamten Hydrobiologie und Hydrographie*, 35, 497–512.
http://dx.doi.org/10.1002/iroh.19370350127

Chatterjee, T., Kotov, A.A., Van Damme, K., Chandrasekhar, S.V.A & Padhye, S. (2013) An annotated checklist of the Cladocera (Crustacea: Branchiopoda) from India. *Zootaxa*, 3667 (1), 1–89.
http://dx.doi.org/10.11646/zootaxa.3667.1.1

Chiambeng, G.Y. & Dumont, H.J. (2005) The Branchiopoda (Crustacea: Anomopoda, Ctenopoda and Cyclestherida) of the rain forests of Cameroon, West Africa: low abundatances, few endemics and a boreal–tropical disjunction. *Journal of Biogeography*, 32, 1611–1620.
http://dx.doi.org/10.1111/j.1365-2699.2005.01280.x

Diniz, L.P., Elmoor-Loureiro, L.M.A., Almeida, V.L.S. & Melo-Junior, M. (2013) Cladocera (Crustacea, Branchiopoda) of a

temporary shallow pond in the Caatinga of Pernambuco, Brazil. *Nauplius*, 21, 65–78.
http://dx.doi.org/10.1590/S0104-64972013000100008

Dumont, H.J. Pensaert, J. & de Velde, V. (1981) The crustacean zooplankton of Mali. *Hydrobiologia*, 80, 161–187.
http://dx.doi.org/10.1007/BF00008434

Elías-Guttiérez, M, Martínez-Jerónimo, F., Ivanova, N.V., Valdez-Moreno, M. & Hebert, P.D.N. (2008) DNA barcodes for Cladocera and Copepoda from Mexico and Guatemala, highlights and new discoveries. *Zootaxa*, 1839, 1–42.

Elmoor-Loureiro, L.M.A. (2014) *Ephemeroporus quasimodo* sp. nov. (Crustacea: Cladocera: Chydoridae), a new species from the Brazilian Cerrado. *Zootaxa*, 3821, 88–100.
http://dx.doi.org/10.11646/zootaxa.3821.1.6

Elmoor-Loureiro, L.M.A., Santos-Wisniewski, M.J. & Rocha, O. (2013) Redescription of *Alonella lineolata* Sars, 1901 (Crustacea, Cladocera, Chydoridae) and its translocation to the subfamily Aloninae and to the new genus *Bergamina* gen. nov.. *Zootaxa*, 3630 (1), 571–581.
http://dx.doi.org/10.11646/zootaxa.3630.3.11

Eskinazi-Sant'Anna, E.M., Barbosa, P.M.M. & Rietzler, A.C. (2005) Zooplankton Biodiversity of Minas Gerais State: a Preliminary Synthesis of Present Knowledge. *Acta Limnologica Brasiliensia*, 17, 199–218.

Frey, D.G. (1982) Questions concerning cosmopolitanism in Cladocera. *Archiv für Hydrobiologie,* 93 (4), 484–502.

Frey, D.G. (1993) Species of *Pleuroxus* (Anomopoda, Chydoridae) from the subantarctic islands and southernmost South America: a partial unravelling of the *Pleuroxus aduncus* problem. *Hydrobiologia,* 262 (3), 145–188.
http://dx.doi.org/10.1007/BF00010882

Hammer, Ø., Harper, D.A.T. & Ryan, P.D. (2001) PAST: paleontological statistics software package for education and data analysis. *Palaeontologia Electronica*, 4, 1–9.

Hollwedel, W., Kotov, A.A. & Brandorff, G.O. (2003) Cladocera (Crustacea: Branchiopoda) from the Pantanal (Brazil). *Arthropoda Selecta*, 12, 67–93.

Kotov, A.A. & Ferrari, F.D. (2010) The taxonomic research of Jules Richard on Cladocera (Crustacea: Branchiopoda) and his collection at the National Museum of Natural History, U.S.A. *Zootaxa*, 2551, 37–64.

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.

Kotov, A.A., Sinev, A.Y., Korovchinsky, N.M., Smirnov, N.N., Bekker, E.I. & Sheveleva, G.N. (2011) Cladocera (Crustacea, Branchiopoda) from the Zeya river basin (Amur region, Russia). 1. new taxa for the fauna of Russia. *Zoologicheskii Zhurnal*, 2, 131–142.

Kotov, A.A., Van Damme, K., Bekker, E.I., Siboualipha, S., Silva-Briano, M., Adabache Ortiz, A., Galván de la Rosa, R. & Sanoamuang, L. (2013) Cladocera (Crustacea: Branchiopoda) of Vientiane province and municipality, Laos. *Journal of Limnology* 72 (S2), 81–108.
http://dx.doi.org/10.4081/jlimnol.2013.s2.e6

Maiphae, S., Pholpunthin, P. & Dumont, H.J. (2005) Species richness of the Cladocera (Branchiopoda: Anomopoda and Ctenopoda) in southern Thailand, and its complementarity with neighboring regions. *Hydrobiologia*, 537, 147–156.
http://dx.doi.org/10.1007/s10750-004-2791-0

Padhye, S. & Dumont, H.J. (2014) Moina hemanti sp. nov., a new species of the genus Moina s.l. (Branchiopoda: Anomopoda) from Pune, India. *Zootaxa*, 3860 (6), 561–570.
http://dx.doi.org/10.11646/zootaxa.3860.6.4

Rey, J. & Vasquez, E. (1986) Cladocères de quelques corps d'eaux du bassin moyen de l'Orénoque (Vénézuéla). *Annales de Limnologie*, 22, 137–168.
http://dx.doi.org/10.1051/limn/1986013

Rey, J. & Vásquez, E. (1989) *Bosminopsis brandorffi* n. sp. (Crustacea, Cladocera) une nouvelle espece de Bosminidae des systémes Amazone et Orénoque. *Annales de Limnologie*, 25, 215–218.
http://dx.doi.org/10.1051/limn/1989022

Richard, J. (1897) Entomostracés de l'Amerique du Sud, recueillis par MM U. Deiters, H. von Ihering, G.W. Müller et C.O. Poppe. *Mémoires de la Société Zoologique de France*, 10, 263–301.

Sars G.O. (1901) Contributions to the knowledge of the fresh-water Entomostraca of South America, as shown by artificial hatching from dried material. 1. Cladocera. *Archiv for Mathematik og Naturvidenskab*, 23 (3), 1–102.

Schubart, O. (1942) Fauna do Estado de Pernambuco e estados limítrofes: segundata lista. *Boletim do Museu Nacional do Rio de Janeiro,* Zoology, 14/17, 21–64.

Serafim-Júnior, M., Lansac-Tôha, F.A., Paggi, J.C., Velho, L.F.M. & Robertson, B. (2003) Cladocera fauna composition in a river-lagoon system of the upper Paraná River floodplain, with a new record for Brazil. *Brazilian Journal of Biology*, 63, 349–356.
http://dx.doi.org/10.1590/S1519-69842003000200020

Sinev, A.Y. (2004) Redescription of a South American cladocera, *Alona monacantha* Sars, 1901 (Branchiopoda: Anomopoda: Chydoridae). *Arthropoda Selecta*, 13, 7–12.

Sinev, A.Y. (2009) Notes on morphology and taxonomic status of some North American species of the genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae). *Fundamental and Applied Limnology—Archiv für Hydrobiologie*, 175, 59–77.
http://dx.doi.org/10.1127/1863-9135/2009/0175-0059

Sinev, A.Y. & Sanoamuang, L. (2007) *Alona siamensis* sp. n., a new species of Cladocera from South-East Asia, related to *Alona dentifera* (Sars, 1901) (Anomopoda: Chydoridae). *Arthropoda Selecta*, 16, 143–150.

Sinev, A.Y. & Kobayashi, T. (2012) Redescription of the endemic Australian cladoceran *Alona willisi* (Smirnov, 1989) and its assignment to *Acanthalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). *Zootaxa,* 3390, 43–45.

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, 45–46. http://dx.doi.org/10.1080/00222933.2012.727215

Sinev, A.Y., Kotov, A.A. & Van Damme, K. (2004) Morphology of a Neotropical cladoceran *Alona dentifera* (Sars, 1901), and its position within the Chydoridae Stebbing, 1902 (Branchiopoda: Anomoda). *Arthropoda Selecta,* 13, 99–107.

Soares, C.E.A. & Elmoor-Loureiro, L.M.A. (2011) An updated checklist of Cladocera (Crustacea: Branchiopoda) from Pernambuco State, Brazil. *Biota Neotropica*, 11, 409–414. http://dx.doi.org/10.1590/S1676-06032011000200038

Sousa, F.D.R. & Elmoor-Loureiro, L.M.A. (2009) A contribution to the fauna of Cladocera (Branchiopoda) from Ceará state, Brazil. *Nauplius*, 17, 101–105.

Sousa, F.D.R. & Elmoor-Loureiro, L.M.A. (2012) How many species of cladocerans (Crustacea; Branchiopoda) are found in Brazilian Federal District? *Acta Limnolgica Brasiliensia*, 24, 351–362. http://dx.doi.org/10.1590/S2179-975X2013005000008

Sousa, F.D.R., Elmoor-Loureiro, L.M.A. & Souza, M.B.G. (2011) Occurrence of abnormalities on labral keel of *Coronatella monacantha* (Cladocera, Anomopoda, Chydoridae) in a population from Ceará, Brazil. *Brazilian Journal of Biology*, 71, 797–798. http://dx.doi.org/10.1590/S1519-69842011000400027

Valdívia-Vilar, R.S. (1988) Lista de Cladóceros dulceacuícolas del Perú. *Amazoniana*, 10, 283–297.

Van Damme, K. & Dumont, H.J. (2007) Limb morphology of the carnivorous anomopods *Anchistropus emarginatus* Sars, 1862 and *Pseudochydorus globosus* (Baird, 1843) (Crustacea: Branchiopoda: Anomopoda). *Annales de Limnologie-International Journal of Limnology*, 43, 271–284. http://dx.doi.org/10.1051/limn:2007005

Van Damme, K. & Dumont, H.J. (2008a) The 'true' genus *Alona* Baird, 1843 (Crustacea: Cladocera: Anomopoda): characters of the *A. quadrangularis*-group and description of a new species from Democratic Republic Congo. *Zootaxa*, 1943, 1–25.

Van Damme, K. & Dumont, H.J. (2008b) 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. & Dumont, H.J. (2010) Cladocerans of the Lençóis Maranheses (NE- Brazil): faunal composition and a reappraisal of Sars' Method. *Brazilian Journal of Biology*, 70, 755–779. http://dx.doi.org/10.1590/S1519-69842010000400008

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 Linnenan Society*, 161, 31–52. http://dx.doi.org/10.1111/j.1096-3642.2010.00639.x

Van Damme, K. & Sinev, A.Y. (2013) Tropical Amphi-Pacific disjunctions in Cladocera (Crustacea: Branchiopoda). *Journal of Limnology*, 72 (S2), 209–244. http://dx.doi.org/10.4081/jlimnol.2013.s2.e11

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. http://dx.doi.org/10.1007/s10750-008-9607-6

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. http://dx.doi.org/10.1080/00222930500060884

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.

Van Damme, K., Maiphae, S. & Sa-Ardrit, P. (2013) Inland swamps in South East Asia harbour hidden cladoceran diversities: species richness and the description of new paludal Chydoridae (Crustacea: Branchiopoda: Cladocera) from Southern Thailand. *Journal of Limnology*, 72 (S2), 174–208. http://dx.doi.org/10.4081/jlimnol.2013.s2.e10

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 alonine. *Zootaxa,* 2875, 1–64.

ARTIGO 5

Alona kaingang (CRUSTACE, CLADOCERA, ALONINAE): A NEW SPECIES OF THE *pulchella*-group, WITH IDENTIFICATION KEY TO NEOTROPICAL SPECIES

Artigo publicado no periódico Zoological Studies ISSN 1810-522X; Fator de Impacto (JCR 2014) = 0.78; Estrato no Qualis CAPES de Biodiversidade B1.

Sousa *et al. Zoological Studies* (2015) 54:48
DOI 10.1186/s40555-015-0128-5

Zoological Studies
a SpringerOpen Journal

RESEARCH Open Access

Alona kaingang (Crustacea, Cladocera, Aloninae): a new species of the *pulchella*-group, with identification key to Neotropical species

Francisco Diogo Rocha Sousa[1,2*], Lourdes Maria Abdu Elmoor-Loureiro[2] and Sandro Santos[1]

Abstract

Background: The subfamily Aloninae has been the focus of extensive studies on the Chydoridae because it has a higher diversity of species and due to the necessity of a detailed redescription of many taxa, especially using characters related to thoracic appendages. The polyphyletic genus *Alona* was redefined recently, and many species complexes were translocated to natural groups. The *pulchella*-group is a candidate for removal from *Alona* because it forms a well-defined complex of species, besides possessing higher species diversity. At present, 50 % of the known species occur in the Neotropics.

Results: In this study, we described *Alona kaingang*, a new species of *pulchella*-group distributed in southern South America. The new species shares with other species similarities in general features of limbs but, for instance, differs from South American *Alona glabra* because it has a short postabdomen. *Alona kaingang* sp. nov. differs from Andean *Alona altiplana* because it has thick denticles on the postabdomen and longitudinal lines on the carapace are absent. Differences in the limbs were also observed.

Conclusions: *Alona kaingang* sp. nov. is part of the group that contains species with complete connection between the main head pores. Like other species of the *pulchella*-group, *A. kaingang* sp. nov. also has similarities with the genus *Ovalona*. The relationship between these two species groups still needs to be tested.

Keywords: Chydoridae; *Alona anamariae*; *Ovalona*; Head pores; Limb; Postabdomen

Background

Chydoridae Dybowski & Grochowski, 1894 *emend*. Frey, 1967 is the most speciose family of the superorder Cladocera (Crustacea: Branchiopoda). The majority of its species inhabit the littoral zones of inland waters, usually associated with aquatic vegetation or fine sediments (Smirnov 1971; Kotov 2006). The subfamily Aloninae Dybowski & Grochowski, 1894 *emend*. Frey, 1967 has been extensively studied for two main reasons: (1) the high diversity of species and (2) the need for detailed redescriptions of taxa, especially using characters related to thoracic appendages (Smirnov 1998; Kotov 2000a, b; Sinev and Kotov 2000; Sinev 2001a; Sinev and Kotov 2001; Kotov and Elías-Gutiérrez 2002; Kotov 2003; Van Damme et al. 2003; Kotov and Sanoamuang 2004; Sinev and Elmoor-Loureiro 2010; Van Damme et al. 2010; Sinev and Atroschenko 2011).

Many of the recent morphological investigations and redescriptions of species within this subfamily were related to the genus *Alona* Baird, 1843 and resulted in the description of new genera or species translocations to correlated groups, such as *Karualona* Dumont & Silva-Briano, 2000 (Dumont and Silva-Briano 2000; Sinev and Hollwedel 2005), *Nicsmirnovius* Chiambeng & Dumont, 1999 (Kotov 2003; Van Damme et al. 2003), *Parvalona* Van Damme, Kotov & Dumont, 2005 (Van Damme et al. 2005), *Armatalona* Sinev, 2004 (Sinev 2004a), *Matralona*

* Correspondence: sousa_bio@yahoo.com.br
[1]Núcleo de Estudos em Biodiversidade Aquática, Programa de Pós-graduação em Biodiversidade Animal, Universidade Federal de Santa Maria—UFSM, Av. Roraima 1000, Camobi, Santa Maria CEP 97105-900, RS, Brazil
[2]Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília—UCB, QS7 lote 1, Bloco M, sala 204, Taguatinga CEP 71966-700, DF, Brazil

Van Damme & Dumont, 2009 (Van Damme and Dumont 2009), *Maraura* Sinev & Shiel, 2008 (Sinev and Shiel 2008), *Miralona* Sinev, 2004 (Sinev 2004b), and *Leberis* Smirnov, 1989 (Sinev et al. 2005). Together, these studies highlighted the polyphyletic nature of *Alona*, which has been supported by phylogenetic analysis (e.g., Elmoor-Loureiro 2004; Sacherová and Hebert 2003).

Recently, Van Damme and Dumont (2008a) redescribed *Alona quadrangularis* (O.F. Müller 1776) using specimens from the Palearctic region, where it was originally described. Based on the morphology of the postabdomen, terminal claws, and limb setae, these authors defined consistent diagnostic characters for the genus *Alona*. Subsequently, some species complexes that had previously been attributed to *Alona* sensu lato were studied and allocated to new genera, such as *Phreatalona*, which corresponds to the *protzi*-complex (Van Damme et al. 2009); *Coronatella*, which corresponds to the *rectangula*-complex (Van Damme and Dumont 2008b); *Brancelia* (Van Damme and Sinev, 2011) which corresponds to the *hercegovinae*-complex; and *Anthalona* Van Damme, Sinev & Dumont, 2011, which includes species of the *verrucosa*-complex (Van Damme et al. 2011). However, several groups still require removal from *Alona* sensu lato, such as the *pulchella*-group (Van Damme et al. 2010).

The *pulchella*-group is a well-defined complex of species of *Alona* sensu lato characterized by postabdomen with marginal denticles merged and moderately developed and inner distal lobe (IDL) with three setae, seven setae on the exopodite of the third limb, reduced filter comb on the fifth limb, and two lateral aesthetascs on male antennules (for more details, see Sinev et al. 2012). The *pulchella*-group has at least 16 valid species and six species waiting for revision, which have been reported for all continents, except Antarctica (Sinev 2001b, c; Sinev 2002a; Sinev 2009; Kotov et al. 2010; Van Damme et al. 2010; Sinev et al. 2012; Sinev and Silva-Briano 2012).

In the Neotropics, the *pulchella*-group is highly diverse presenting species with the entire morphological range known for the group, including the specialized species *Alona bromelicola* Smirnov, 1988 (Sinev 2002a). Specifically for South America, there are reports of three species (Sinev 2001b; Kotov et al. 2010); however, the knowledge of the *pulchella*-group remains incipient. This manuscript is part of an extensive review concerning populations of *Alona* sensu lato in Brazil, aims to evaluate the morphology, and describes a new species of the *pulchella*-group.

Methods

Selected specimens were transferred to slides containing glycerin and dissected under a stereomicroscope. The morphology of appendages and other structures was studied using a phase-contrast microscope. Some animals were dehydrated in an acetone series (50, 70, 90 and 100 %) and critical point-dried or air-dried, mounted on aluminum stubs, coated with gold, and examined under a JEOL-JSM 7001F scanning electron microscope. Enumeration of limb setae and other structures proceeded from the epipodite to the gnathobase, without relation to homology, according to the recent literature (Van Damme and Dumont 2007; Sinev and Kobayashi 2012). Drawings were prepared using a camera lucida.

Results

Systematics

Class Branchiopoda Latreille, 1817

Order Anomopoda Sars, 1865

Family Chydoridae Dybowski & Grochowski, 1894 *emend*. Frey, 1967

Subfamily Aloninae Dybowski & Grochowski, 1894 *emend*. Frey, 1967

Genus *Alona* Baird, 1843

Alona kaingang Sousa, Elmoor-Loureiro & Santos (Figs. 1, 2, 3, and 4)

Type material

Holotype. Undissected, adult parthenogenetic female in a tube with 90 % ethanol deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 29593. The label of the holotype is "*Alona kaingang* n. sp., 1 parth. ♀ from Mostardas—Lagoa de São Simão, RS, Brazil, Holotype."

Paratypes. Two undissected adult parthenogenetic females in tubes with 90 % ethanol, deposited at the Museum of Zoology of the University of São Paulo under access number MZUSP 29594. One adult parthenogenetic female and one adult male, undissected in tubes with 90 % ethanol, deposited at the National Museum of Rio de Janeiro under access numbers MNRJ 23739 and MNRJ 23740. Eight specimens selected as paratypes (access number EL02477), and several unstudied individuals (access numbers EL02165 and EL02166) are deposited at the Laboratório de Biodiversidade Aquática, Universidade Católica de Brasília.

Type locality

Pond in São Simão, Mostardas, Rio Grande do Sul state, Brazil (30° 57′ 06″ S, 50° 42′ 29″ W).

Etymology

The name *kaingang* refers to indigenous people who inhabited the southern portion of South America before the European colonization. The *kaingang* people were distributed in Southeastern and Southern Brazil, where the new species occurs.

Material examined

Twenty-three adult parthenogenetic females and five males from the pond in São Simão, Mostardas, Rio Grande do Sul state, Brazil (30° 57′ 06″ S, 50° 42′ 29″ W). Material collected by Lourdes M. A. Elmoor-Loureiro on 01.i.2002. Four adult parthenogenetic females from the Limnology

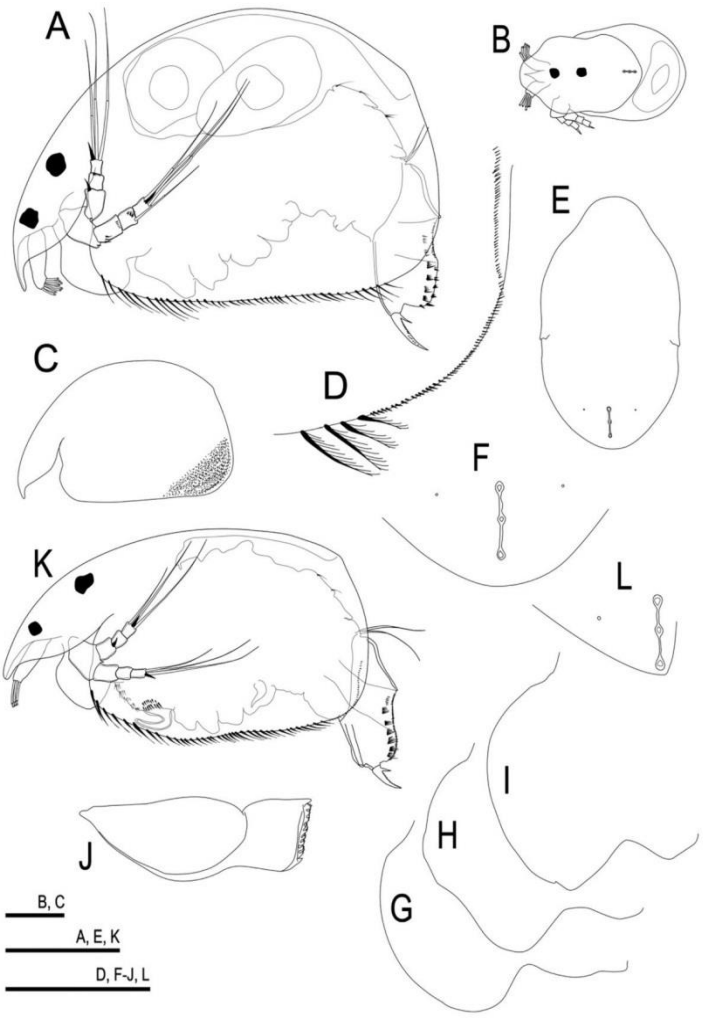


Fig. 1 *Alona kaingang* sp. nov., (***a–j***) adult parthenogenetic females from São Simão pond, Mostardas, Rio Grande do Sul, Brazil. (***a***) Habitus, lateral view; (***b***) dorsal view; (***c***) ornamentation on the carapace; (***d***) posteroventral valve corner; (***e***) head shield; (***f***) head pores; (***g–i***) labral keel; (***j***) mandible; (***k–l***) adult male from São Simão pond, Mostardas, Rio Grande do Sul, Brazil; (***k***) habitus, lateral view; (***l***) head pores. *Scale bar* = 50 μm

Laboratory cultivation facility, Instituto de Ciências da Natureza, Universidade Federal de Alfenas; specimens collected at Furnas Reservoir, Minas Gerais state, Brazil (21° 03′ 24″ S, 46° 00′ 18″ W), leg. M. J. Santos-Wisniewski (EL02167). Four adult parthenogenetic females from a marginal pond in São Simão Reservoir, Minas Gerais state, Brazil (18° 48′ 50″ S, 50° 22′ 58″ W); material collected by José Roberto Debastiani-Júnior (EL02173).

Diagnosis

Female. Of small size, length 0.33–0.40 mm. Body ovoid with dorsal margin strongly arched. In dorsal view, it shows weak lateral compression, dorsal keel absent. *Head*. Head shield with posterior margin rounded, rostrum short, three main head pores subequal in size, narrowly connected, postpore distance (PP) less than 0.2 interpore distance (IP). Lateral pores tiny, inserted midway between the main pores and the head shield margin. Labral keel wide, apex obtuse, without setae or denticles. *Carapace*. No striations or longitudinal lines. Ventral margin with 40–50 setae arranged in three groups. Posteroventral corner without denticles, with numerous spinules. *Antennules*. About 2–2.5 times as long as wide, four rows of setules on antennular body, distalmost row shorter than the others. Antennular sensory seta slender and long, about 1.5 times smaller than antennular body. Nine terminal aesthetascs of different sizes. *Antenna*. Antennal formula: spines 001/101, setae 113/003. Spine on first endopodite segment not exceeding the length of the second segment. Apical setae of endopodite and exopodite with lateral spinules. *Postabdomen*. Of moderate

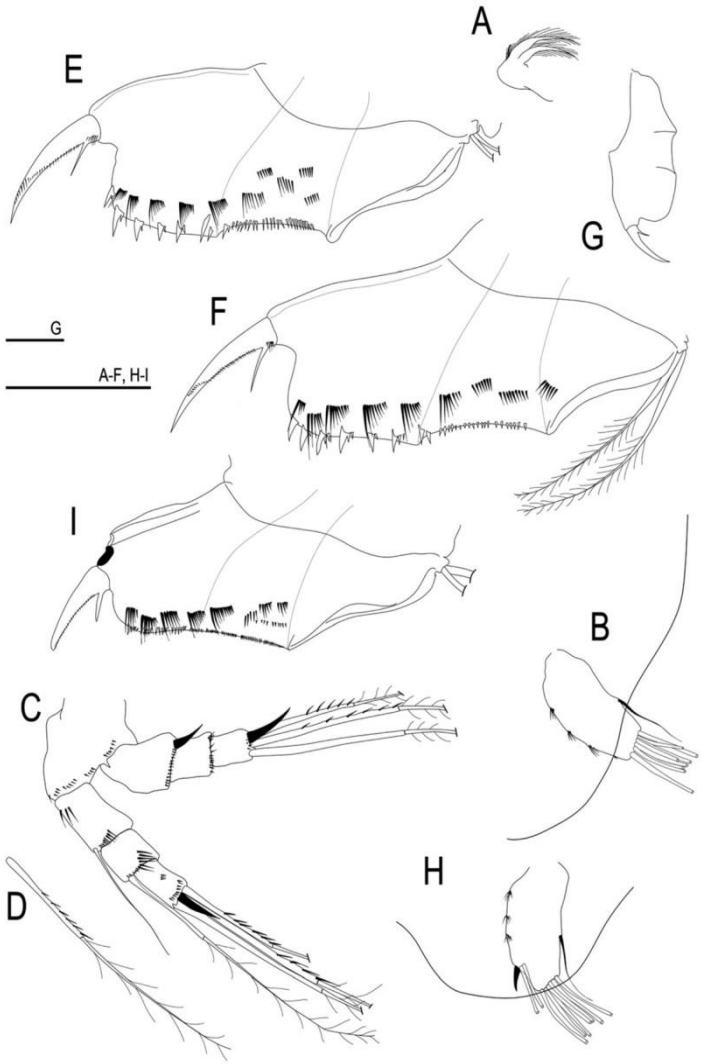


Fig. 2 *Alona kaingang* sp. nov., (***a–g***) adult parthenogenetic female. (***a***) first maxilla; (***b***) antennule; (***c***) antenna; (***d***) antenna terminal setae; (***e***) postabdomen (Lagoa de São Simão, Mostardas, Rio Grande do Sul); (***f***) postabdomen (São Simão Reservoir, Minas Gerais, Brazil); (***g***) idem; (***h–i***) adult male from São Simão pond, Mostardas, Rio Grande do Sul, Brazil; (***h***) antennule; (***i***) postabdomen. *Scale bar* = 50 μm

size (about 2–2.4 times as long as wide). Pre-anal margin longer than anal margin and shorter than postanal margin. Anal margin inserted in a depression, with distinct angles. Lateral fascicles arranged in five to seven groups, first spines of each group thick and exceeding margin of postabdomen. Six to seven clusters of marginal denticles. Postabdominal setae with proximal portion naked, distal portion with short setules armed bilaterally. *Terminal claw*. Longer than anal margin, with one row of spinules on its base. *Basal spine*. Long, without spinules or setules. *Limb I*. First endite with two marginal setae, IDL with three setae; setae 2–3 bisegmented, long and with strong proximal spines. *Limb II*. Exopodite elongated, with setae present; scrapers 3, 5, 6, 7, and 8 with robust denticulation. *Limb III*. Exopodite with seven marginal setae; first seta longer than the second, fifth, and seventh setae less than half length of sixth seta, fourth setae geniculated. *Limb IV*. Exopodite with six marginal plumose setae; fourth seta thick and more than half length of fifth seta; sixth seta half as long as fifth seta. *Limb V*. Exopodite with slight depression in middle portion, with four plumose setae; seta 3 smaller than setae 1 and 2; Gnathobase without elements or setae. *Male*. Body elongated, smaller than female (length 0.27–0.30 mm). Ventral margin armed with 40 setae followed by fine spinules. Posteroventral corner without denticles. Head with short rostrum. Main pores nearly connected. Lateral pore inserted between distal and median pores. *Antennules*. With three rows of short setules on the antennular body. Nine (juvenile) to 11 (adult) aesthetascs present: seven to nine terminal and

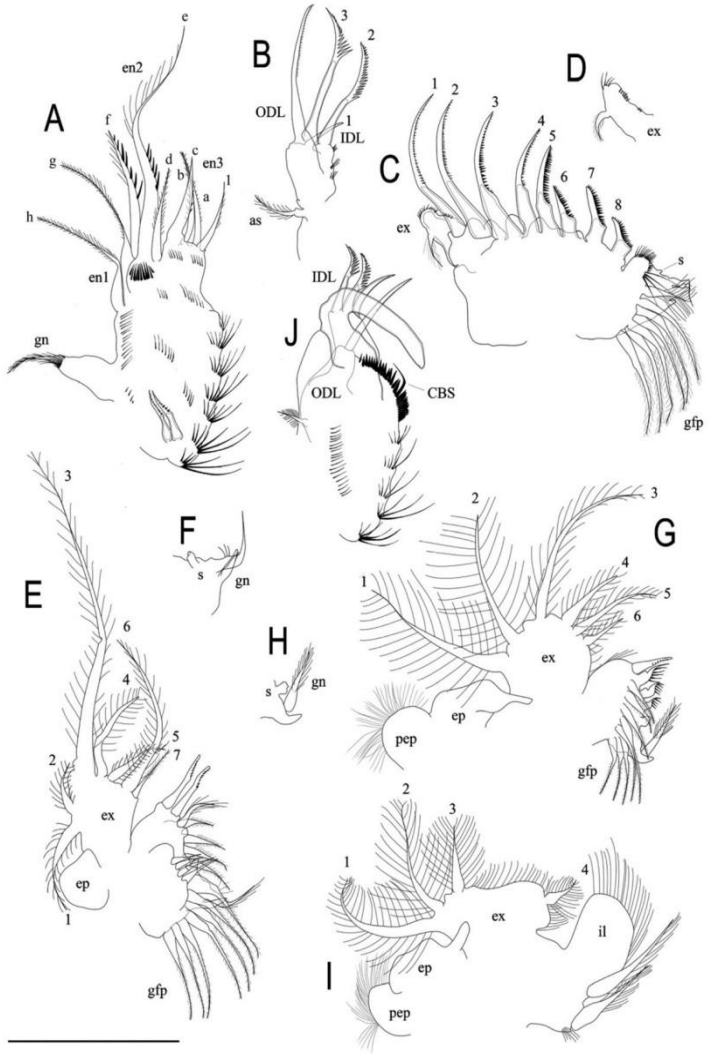


Fig. 3 *Alona kaingang* sp. nov., adult parthenogenetic females from São Simão pond, Mostardas, Rio Grande do Sul, Brazil. (***a***) limb I; (***b***) idem; (***c***) limb II; (***d***) idem; (***e***) limb III; (***f***) idem, sensillum and gnathobasic elements; (***g***) limb IV; (***h***) idem, gnathobase; (***i***) limb V; (***j***) limb I (male). *Scale bar* = 50 μm

two lateral. Male seta short, thick, about 4.6 times shorter than length of antennular body. *Postabdomen*. Narrowing toward distal portion, anal angle not defined. Marginal clusters of spinules present, at least five postanal fascicles. Gonopores opening ventrally, subapically to terminal claw. *Terminal claw*. Smaller than that of female, tip blunt, with slender spinules implanted at base. Basal spine about one-third length of terminal claw. *Limb I*. With copulatory hook U-shaped; copulatory brush seta slender; IDL with three setae. Seta 1 long, thick, subequal in size to setae 2 and 3.

Description of adult parthenogenetic female

Habitus (Fig. 1(a–c)). Compared to other species of the genus, it is a small-sized animal (0.33–0.40 mm), colorless, and transparent. Carapace ovoid in lateral view, about 1.5 times as long as high, dorsal margin strongly arched. In dorsal view, it shows weak lateral compression. Dorsal keel absent.

Head (Fig. 1(a, e, f)). Ocellus as large as eye. Head shield about 1.7 times as long as wide, with posterior margin rounded. Rostrum short, blunt, projected toward ventral margin. Three main head pores of subequal size, narrowly connected (Fig. 4(a)), PP less than 0.2 IP. Lateral pores tiny, inserted midway between main pores and head shield margin. *Labrum* (Fig. 1(g–i)). Labral keel wide in lateral view, anterior margin slightly convex, apex obtuse, lateral projections not observed, without setae or denticles. In some specimens, the margin is subquadrangular (Fig. 1(h)) or with a small depression near

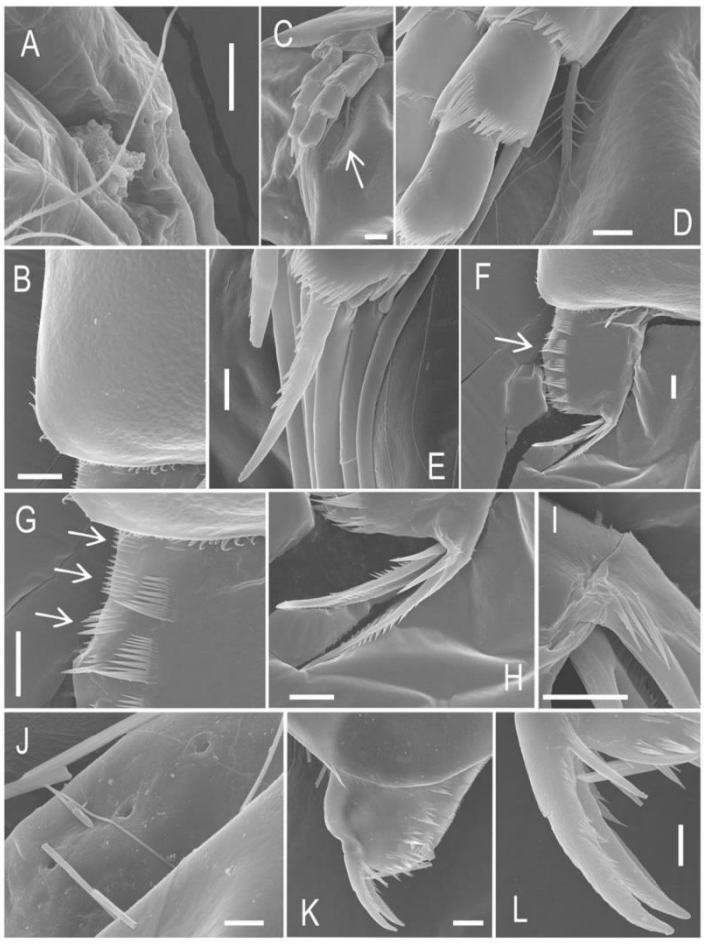


Fig. 4 *Alona kaingang* sp. nov., (***a–i***) adult parthenogenetic females from São Simão pond, Mostardas, Rio Grande do Sul, Brazil. (***a***) main head pores; (***b***) valves. (***c***) antenna—*arrow* showing seta on the first exopod segment; (***d***) idem. (***e***) antenna—apical spine on the first endopod segment; (***f***) postabdomen—*arrow* showing spinules on the anal margin; (***h***) terminal claw; (***i***) idem—base with spinules; (***j-l***) adult male from Lagoa de São Simão, Mostardas, Rio Grande do Sul, Brazil. (***j***) main head pores. (***k***) valves and postabdomen; (***l***) terminal claw. *Scale bar* indicates 5 μm to figures (***d***), (***e***), (***i***), (***j***), (***l***); 10 μm to figures (***a***), (***b***), (***c***), (***f***), (***g***), (***h***), (***k***)

the apex (Fig. 1(i)). *Mandible* (Fig. 1(j)). Well developed in relation to body size (Fig. 1(a)). *First maxilla* (Fig. 2(a)). Relatively well developed, with two long setulose setae.

Carapace (Figs. 1(c, d) and 4(b)). No striations or longitudinal lines (Fig. 4(b)), punctuated ornamentation observed in optical microscopy. Ventral margin straight, with 40–50 setae arranged in three groups, proximal group long, middle group short, posterior group increasing in size toward posteroventral corner. These setae are followed by spinules not arranged in groups, proximalmost spinule projecting beyond margin.

Antennules (Fig. 2(b)). Reaching the tip of the rostrum, setae sometimes exceeding it, about 2–2.5 times longer than wide, four rows of setules on antennular body, distalmost row shorter than the others. Antennular sensory seta slender and long, about 1.5 times smaller than antennular body, inserted at two thirds of antennule length, counting from the base. Nine terminal aesthetascs of different sizes. None of these aesthetascs exceed the length of the antennules.

Antenna (Figs. 2(c, d) and 4(e)). Coxal setae not studied. Basipodite thick, with many spinules and one long spine. First exopodite segment with long thick spinules near the base (3–4) and terminal portion. Second exopodite segment with long thick spinules on the terminal portion. Endopodite segments with short spinules. Antennal formula: spines 001/101, setae 113/003. Seta on first exopodite segment thick and plumose (Fig. 4(c, d)), not reaching mid length of terminal setae. Seta on second exopodite bisegmented, long, with many setules. Spine on first endopodite segment without denticles, reaching but not exceeding distal end of second segment. Apical spines of endopodite and exopodite of different sizes, with denticles (Fig. 4(e)). Two apical setae

of endopodite and exopodite with spinules, which are larger on the first segment.

Abdomen. About two times shorter than thorax. Two or three abdominal setae (Fig. 1(a)).

Postabdomen (Fig. 2(e–g)). Moderate size, relatively wide, about 2–2.4 times as long as wide, ventral margin slightly rounded, with at least three rows of spinules. Preanal margin longer than anal margin and shorter than postanal margin. Anal margin concave, clearly inserted in a depression and with two distinct angles (Fig. 4(f–g)), with many spinules forming groups (Fig. 4(g)). Postanal margin rounded, not projected. Lateral fascicles arranged in five to seven groups, first spines of each group thick and exceeding margin of postabdomen. Six to seven clusters of marginal denticles, distal ones with two to three marginal denticles (apparently fused when observed in optical microscopy but superimposed in layers when observed in SEM (Fig. 4(f)); proximal denticles may be separated; length of the marginal denticles on the postanal margin of the postabdomen about two times longer than the width of the base of the denticles. *Postabdominal seta* (Fig. 2(e)). Approximately half as long as postabdomen, proximal portion naked. Short setules armed bilaterally, inserted toward distal portion. *Terminal claw* (Fig. 2(e–g)). Implanted at projected basis from the postabdomen, longer than anal margin, uniformly curved, with one row of spinules on the base (Fig. 4(i)); pecten armed with rows of internal and external spinules; inner row composed of robust spinules; outer row with spinules increasing in size toward distal region (Fig. 4(h)). Basal spine long, about two times as long as width of claw at its base, without spinules or setules.

Five pairs of limbs

Limb I (Fig. 3(a, b)). Epipodite not studied. Outer distal lobe (ODL) with thin seta, serrulate in distal part, about same size as the longest IDL seta. Accessory seta relatively small, setulated, and implanted near base of ODL. IDL with three groups of spinules on its face, three setae present; seta 3 smaller than the others, naked. Setae 2–3 bisegmented, long, and with strong proximal spines and narrow distal portion with short denticles. Third endite with four setae, one of them thinner than the others (1); inner seta densely setulated, longer than the other two (a, b). Second endite with one row of spinules; three setae of different sizes, seta 4 (e) about 2.7 times longer than seta 3 (f) and about 4.3 times longer than seta 5 (d); setae 3–4 (d–f) with thick spinules on the lateral face, seta 4 (e) with spinules not exceeding median portion; seta 5 (d) about half length of seta 3 (f). First endite with two marginal setae (g, h), bisegmented, similar in size and slightly setulated. No specialized elements on endites. Ejector hooks similar in size. Ventral face of limb with seven rows of setules organized in clusters, decreasing toward distal portion. Gnathobase thick, corresponding to a densely setulated seta.

Limb II (Fig. 3(c, d)). Exopodite elongated, with tiny proximal spinules, and distally setulated. Seta on exopodite present, setulated, about two to three times smaller than the exopodite itself. Endite armed with eight scrapers gradually decreasing in size toward the gnathobase, sixth and eighth scrapers smaller than seventh. Scrapers 1, 2, and 4 armed with fine denticulation, other scrapers with robust denticulation. Proximal portion of gnathobase wide, apex armed with fine spinules followed by long setules (in the populations from Minas Gerais state, these appear shorter, thinner, and more numerous), distal portion armed with sensillum and three elements, first element geniculated and setulated. Filter comb with seven setae, first seta short and densely setulated; other setae long, with setules and implanted from median portion.

Limb III (Fig. 3(e, f)). Epipodite round, without evident projections (in the populations from Minas Gerais state, long projections were observed). Exopodite subquadrangular, with seven marginal setae arranged in 2 + 5. First seta longer than second; third seta about 1.8 times longer than sixth seta; fourth seta geniculated; fifth and seventh setae less than half length of sixth seta; all setae are plumose, except the seventh. Distal endite with three setae, two scraper-like of different sizes, third seta geniculated and armed with many setules implanted bilaterally; four plumose setae, increasing in size towards the gnathobase. Basal endite with four soft setae, increasing in size towards the base. Gnathobase armed with four elements, first a cylindrical sensillum, second a strong geniculated seta, setulated on the base, third and fourth elements with acute tip and without setules. Filter comb with seven long setae.

Limb IV (Fig. 3(g, h)). Pre-epipodite round, densely setulated, epipodite oval with short projections. Exopodite round with six marginal plumose setae; setae 1 and 2 subequal in size, third seta longer than all others, fourth seta thick exceeding the half length of fifth seta; sixth seta half as long as fifth seta. Distal endite with four setae, one scraper-like and three flaming-torch-like, decreasing in size toward the base. Basal endite with three soft setae, increasing in size toward the base. Gnathobase armed with one globular sensillum and a setulated seta implanted on robust base. Filter plate with five slender setae.

Limb V (Fig. 3(i)). Pre-epipodite round and densely setulated, epipodite with short projections. Exopodite rectangular, not divided in lobes, about twice as long as wide, slight depression in the middle portion; four plumose setae, decreasing in size toward internal lobe; setae 1 and 2 subequal in size, seta 3 markedly smaller than setae 1 and 2; seta 4 about half length of seta 3. Internal lobe wide, oval and with long setules; two setulated setae

of similar size on the inner face of the lobe, no elements between these setae. Gnathobase reduced, without elements or setae.

Ephippial female: Unknown.

Description of male

Habitus (Fig. 1(k)). Smaller than female, length 0.27–0.30 mm, about 1.6 times as long as high. Body elongated, weak lateral compression, body less arched than in female. *Head* with short rostrum, ocellus smaller than eye. Main pores close to each other, nearly connected, lateral pores tiny and arranged in different positions than in females (between distal and median pores; Fig. 1(l)). *Carapace* without punctuated ornamentations or longitudinal lines (Fig. 4(k)), ventral margin armed with 40 setae followed by fine spinules, the most proximal exceeding the line of posterior margin.

Antennules (Fig. 2(h)). Slightly exceeding the tip of the rostrum, about two times as long as wide, with three rows of short setules on antennular body; seven (juvenile) to nine (adult) aesthetascs of different sizes (none of these aesthetascs exceeds the length of antennules). Two lateral aesthetascs of different sizes, about half as long as antennular body; sensory seta long, about 1.4 times shorter than antennular body. Male seta short, thick, about 4.6 times shorter than length of antennular body, inserted at three thirds of antennular length, counting from base.

Antenna as described for females.

Postabdomen (Fig. 2(i)). Smaller than in female, narrowing distally; anal margin longer than postanal margin, angles not defined; marginal clusters of spinules present (Fig. 4(k)); at least five postanal fascicles, distalmost fascicle exceeding the margin line; anal margin with spinules differentiated in three groups; gonopores opening ventrally, subapically to terminal claw. *Terminal claw* smaller and thicker than in female, tip not acute (Fig. 4(l)). Slender spinules implanted at the base of terminal claw (as in the female). Basal spine about one-third length of terminal claw.

Limb I (Fig. 3(j)). Smaller than in female, copulatory hook U-shaped. Copulatory brush present, copulatory brush seta slender; IDL with three setae, smaller than corresponding setae of female, seta 1 long, thick, subequal in size to the other two setae, setae 2 and 3 bisegmented and with strong proximal spines (as in female).

Differential diagnosis

Alona kaingang sp. nov. is a member of the *pulchella*-group because its posteroventral corner of the carapace is armed with many short and thin spinules not arranged in groups, three main head pores, marginal denticles of postabdomen merged and developed, lateral fascicles developed, IDL with three setae, seven setae on the exopodite of limb III, fourth setae of limb III well-developed, gnathobase of limb V reduced, and limb VI absent. *Alona kaingang* sp. nov. also has the fourth seta on the exopodite of limb III geniculated, like many species of the *pulchella*-group (except in *Alona archeri*). As an alternative to identification, the *pulchella*-group may be separated into two groups based on the morphology of the main head pores: one group contains species with interrupted connection (including those species with main head pore isolated) and the other contains species with complete connection. Thus, *A. kaingang* sp. nov., having a complete connection between the main head pores, could be differentiated from species belonging to do the first group: *Alona capensis* (Rüher, 1914), *Alona setulosa* (Megard, 1967), *Alona cambouei* (Guerne & Richard, 1893), *Alona aguascalientensis* Sinev & Silva-Briano, 2013, *Alona nigra* Smirnov, 1996, *Alona setuloides* Smirnov & Timms, 1983, *Alona azorica* Frenzel & Alonso 1989, *Alona anastasia* Sinev Alonso, Miracle & Suhaquillo, 2012, and *Alona nuragica* Margaritora, 1971. Regarding species with complete connection between main head pores, *A. kaingang* sp. nov. is distinguished by the presence of spinules on apical setae of antenna and proximal spines on IDL setae. Besides, *A. kaingang* sp. nov. has single morphological traits such as the slight depression in the middle portion of the exopodite of the limb V.

Ecology and distribution

Alona kaingang sp. nov. has populations occurring in water bodies of the subtropical region of South America. Until now, *A. kaingang* sp. nov. has been found only in Minas Gerais state (São Simão and Furnas Reservoirs) and Rio Grande do Sul state (São Simão pond), Brazil. However, we expect that its geographical distribution is broader in the subtropical zone, because *A. kaingang* sp. nov. might be confused with *Coronatella rectangula* (Sars, 1861). This latter species likely does not occur in the Neotropics (Van Damme and Dumont 2008b), but there are many records in different Brazilian hydrographic regions (see Green 1972; Smirnov and Santos-Silva 1995; Eskinazi-Sant'Anna et al. 2005; Sterza and Fernandes 2006; Rocha et al. 2011), including the Furnas Reservoir (Santos et al. 1994; Viti et al. 2013). The review of *Coronatella* in Brazil confirmed that *C. rectangula* does not occur in Brazil, and probably not in the Neotropics (Sousa et al. 2015).

São Simão pond is located on the coastal plain of Rio Grande do Sul state and is part of the coastal wetland complex between the Atlantic Ocean and Patos Lagoon. São Simão pond does not connect with the ocean. The abiotic parameters of the pond water were as follows: pH 6.8–7.1, electrical conductivity 97.3–110 $\mu S.cm^{-1}$, total phosphorus 0.104–0.139 $mg.L^{-1}$, ammoniacal nitrogen 0.051–0.11 $mg.L^{-1}$, dissolved oxygen 7.2–9.1 $mg.L^{-1}$,

and temperature 17–17.5 °C (data available from State Foundation of Environmental Protection Henrique Luiz Roessler—FEPAM, referring to the year when the type material was collected).

Furnas Reservoir, located in Minas Gerais state, is the largest reservoir in southeastern Brazil, with a total area of approximately 1440 km^2. Recent data indicate that water temperature ranges between 24 and 28 °C, pH is approximately 7, electrical conductivity 19–22 $\mu S.cm^{-1}$, total nitrogen 210–318 $\mu g.L^{-1}$, total phosphorus 13–29 $\mu g.L^{-1}$, and dissolved oxygen 8–9 $mg.L^{-1}$ (Santos et al. 2010).

São Simão Reservoir is located on the boundary between Goiás and Minas Gerais states. Currently, it is being impacted by the uncontrolled increase in urban areas and farmland in its surroundings. This has led to eutrophication of the reservoir (Fonseca 2010).

The biology of *A. kaingang* sp. nov. is not well known. It inhabits the littoral zones of water bodies, probably among aquatic vegetation. Based on the present records, it should be found in different kinds of ecosystems: reservoirs, wetlands, and coastal lagoons. We believe that this species may occur in habitats with varying degrees of salinity. *Alona kaingang* sp. nov. is presumed to be an active scraper of substrates, based on the strong scrapers found in the limbs I and II (Fryer 1968; Van Damme et al. 2011).

Identification key for species from the *pulchella*-group with occurrence in the Neotropics (adult parthenogenetic females)

1. Basal spines very short, less 0.1 of the length claw, aesthetascs length about 2.6 times shorter than antennular body……..*A. bromelicola*-Central America (Sinev 2002b)

– Basal spine longer than 0.1 of the length of the claw, aesthetascs length about 1.6–2 times shorter than antennular body…….. 2

2. Labral keel with two rows of short setules……..3

– Labral keel naked…… 4

3. Postabdomen narrowing distally, basal segment of the apical setae of antenna without spines, one seta markedly longer than the others on the anterior group on the ventral margin of the carapace,……*Alona anamariae*—Endemic from the Central Plateau of Mexico (Sinev and Silva-Briano 2012)

– Postabdomen wide and truncated, basal segment of the apical setae of antenna with spines, setae of the anterior group on the ventral margin of the carapace not differentiated in length……*A. setulosa*—From North Canada to North Mexico (Sinev, 2009; Sinev and Silva-Briano 2012)

4. Abdomen armed with two to three rows of setules……5

– Abdomen armed with five to six rows of long setules……*A. nigra*—Bolivia and North Chile on the Andes (Kotov et al. 2010)

5. Main head pores connected……6

– Main head pores disconnected…….. *A. aguascalientensis*—Endemic of the Central Plateau of Mexico (Sinev and Silva-Briano 2012)

6. Antenna, spine on the first segment of the endopodite shorter than second segment…….7

– Antenna, spine on the first segment of the endopodite of the same length of the second segment……*A. kaingang* sp. nov—Southern South America

7. Carapace ornamented with longitudinal lines, length of the postabdomen about 2.5 height, postanal margin armed with 5–6 denticles……*Alona altiplana*—Endemic from Andes (Kotov et al. 2010)

– Carapace without longitudinal lines, length of the postabdomen about 2.8–3 height, postanal margin armed with seven to eight denticles…… *Alona glabra*—Common in the Neotropics (Sinev 2001b; Sinev and Silva-Briano 2012)

Discussion

The presence of main head pores with complete connection may be taken as the main morphological trait uniting *A. kaingang* sp. nov. with valid species *Alona pulchella* (Herrick, 1884), *A. archeri* (Sars, 1888), *A. altiplana* Kotov, Sinev & Berrios, 2010, *A. glabra* (Sars, 1901), *A. bromelicola* (Smirnov, 1988), *A. karelica* Stenroos, 1897, and *A. anamariae* Sinev & Silva-Briano, 2012. Among these species, the postabdomen of *A. kaingang* sp. nov. is quite similar to other species that present short postabdomen: the Chilean *A. altiplana* and the Mexican *A. anamariae*. All other species aforementioned have an elongated postabdomen (Sinev and Silva-Briano 2012).

Alona kaingang sp. nov. (length 0.33–0.40 mm) is smaller than *A. altiplana* (0.35–0.50 mm). Besides, *A. kaingang* sp. nov. differs from *A. altiplana* because its carapace does not have longitudinal lines (Fig. 4(b)). In

A. kaingang sp. nov., the length of the marginal denticles on the postanal margin of the postabdomen is about two times longer than the width of the base of the denticles (Fig. 2(e–f)) while in *A. altiplana*, this proportion is about 2.5–3 times longer (Kotov et al. 2010). The following morphological traits of the limbs are observed in *A. kaingang* sp. nov. but not in *A. altiplana*: (1) seta e on the endite 2 of the limb I about two times longer than seta f, (2) setae 2–3 of the IDL markedly different in length, (3) setae 2–3 of the IDL armed with proximal spines, (4) scrapers 5–8 armed with strong denticles, (5) absence of specialized structure on the endite of the limb III, (6) seta 5 on the exopodite of the limb IV longer than setae 5–6, and (7) seta 3 on the exopodite of the limb V shorter than setae 1–2.

Regarding the size, *A. kaingang* sp. nov. (length 0.33–0.40 mm) is longer than *A. anamariae* (0.28–0.30 mm) (Sinev and Silva-Briano 2012). In *A. anamariae*, the labral keel has two rows of setules, while in *A. kaingang* sp. nov., the labral keel is naked (Fig. 1(g–i)). In *A. kaingang* sp. nov., PP is less than 0.2 IP while in *A. anamariae*, PP is about 0.2–0.3 IP. Another important morphological trait observed in *A. anamariae* and that is absent in *A. kaingang* sp. nov. is the longest setae on the anterior group of margin of the carapace (Sinev and Silva-Briano 2012). The postabdomen of *A. anamariae* does not have postanal angle as evident as in *A. kaingang* sp. nov (Fig. 2(e–f)). On the limbs, *A. kaingang* sp. nov. differs from *A. anamariae* because it has (1) setae 2–3 of the IDL markedly of different length, (2) setae 2–3 of the IDL armed with proximal spines, (3) scrapers 5–8 armed with strong denticles, (4) absence of a specialized structure on the endite of the limb III, (5) first flaming torch relatively robust, and (6) seta 5 on the exopodite of the limb III shorter than seta 7.

Recently, Sinev et al. (2012) described the Mediterranean *A. anastasia*, which has a distinct short postabdomen; however, this species may be easily separated from *A. kaingang* sp. nov. by the interrupted connection of the main head pores and absence of seta on the exopodite of the limb II. *Alona setulosa* is another species of the *pulchella*-group with a short postabdomen (Sinev 2009), and the shape of this structure is quite similar to that observed in *A. kaingang* sp. nov. Besides that, *A. setulosa* and *A. kaingang* sp. nov. share similar armature of the apical setae of the antenna and denticulation of scrapers 6–8. The armature of the apical setae of the antenna observed in *A. setulosa* and *A. kaingang* sp. nov. was also found in phylogenetically distant groups such as *Armatalona* (Sinev 2004a) and *Acanthalona* (Sinev and Kobayashi, 2012), which suggests that this morphological similarity may be the result of convergence. *Alona setulosa* differs from *A. kaingang* sp. nov. because it has a labral keel with two rows of setules and incomplete connection between main head pores. They differ also in fine features of the limbs (see Sinev 2009).

The differences between the other species that possess main head pores with complete connection and *A. kaingang* sp. nov. go beyond the shape of the postabdomen. The South American *A. glabra* has the third seta on the exopodite of the limb V longer than the second seta, and the first flaming torch on the limb IV is relatively thinner (Sinev 2001b). Besides that, the geographical distribution of *A. glabra* extends from Argentina to the extreme North of the Neotropics, while *A. kaingang* sp. nov. is restricted to the southern regions. *Alona archeri* has a PP less than 0.5 IP, well-developed distal denticles on the postabdomen transformed in setules toward the anal margin and seta 4 on exopodite of the limb III relatively straight and markedly long (Sinev 2002b). The paleotropical *A. pulchella* has thin setules on the scrapers of the limb II and relatively long second setae on the exopodite of the limb III (Sinev 2001c). The specialized *A. bromelicola* has a markedly short seta on the exopodite of the limb II, setae 6–4 on the exopodite of the limb IV of similar length, seta 3 is of similar length to setae 1–2 and seta 5 is markedly long, and the basal spine is very short (Sinev 2002a). Some other species that are presumed to be members of the *pulchella*-group still await revision (Van Damme et al. 2010), and their affinities and differences with *A. kaingang* sp. nov. cannot be addressed yet.

Although there are several morphological differences between species in the *pulchella*-group and those related to species groups, Van Damme et al. (2013) indicated the possibility of identification mistakes. For example, some species of the *pulchella*-group has a postabdomen of a similar shape to the one observed in the *Alona gutatta*-group (e.g., *A. archeri*, *A. glabra*, and *A. bromelicola*). However, the *Alona gutatta*-group is a member of the *Hexalona*-branch, and the observation of the limbs is necessary (or at least the use of high magnification) for correct identification. Under low magnification, the postabdomen of *A. kaingang* sp. nov. resembles *C. rectangula* (= *Alona rectangula*), and many records of this species in Brazil (see Green 1972; Santos et al. 1994; Smirnov and Santos-Silva 1995; Eskinazi-Sant'Anna et al. 2005; Sterza and Fernandes 2006; Rocha et al. 2011; Viti et al. 2013) perhaps may be attributed to new species of the *pulchella*-group described here; this, however, needs to be checked.

From the evolutionary point of view, the *pulchella*-group presents an interesting duality because its species do not have many specializations on the limbs (their morphology is almost constant) but differ in habitus and, mainly, in the morphology of the postabdomen. An extreme case was observed in *A. capensis*, which is similar in its limb morphology to other species of the group, but has an elongated body, a bulge on the rostrum, and

a very peculiar postabdomen (Van Damme et al. 2013). Besides, the variability of shapes of the postabdomen in other species of *pulchella*-group (elongated, short and narrowing, short and massive, short and rounded; marginal denticles thick or thin; lateral fascicles short or long) suggests speciation mediated by evolutionary pressure on the movement, once postabdomen is the main morphological trait involved in such purpose, being also related to food collecting and shelter searching. The phylogenetic interpretation of the diversity of shapes of postabdomen in the *pulchella*-group still remains unclear, but elongated and short forms in different species may be arisen from adaptive convergence associated to similar environmental pressure.

As in other species group (e.g., *Anthalona*, *Nicsmirnovius*, *Euryalona*, *Monospilus*), the morphology of head pores may be important phylogenetically for the *pulchella*-group because of the absence of reductions or specializations in the limbs, that make difficult to do suggestions of affinities between species. However, in species with both morphologies of main head pores, a considerable level of affinities related to general shape of the postabdomen and fine structure on the limbs are observed: *A. cambouei*, a species with broken connection, has armatures of postabdomen and seta 5 of the limb III similar to species with complete connection, such as, *A. pulchella* and *A. glabra* (Sinev 2001b, c). When compared with the broken connection species *A. nigra*, *A. aguascalientensis*, and *A. setulosa*, *A. cambouei* presents differences in the armature of antenna, postabdomen, and proportions of setae on limbs I and III (Sinev 2001c, 2009; Sinev and Silva-Briano 2012). Therefore, morphology of main head pores could also be the result of convergence and to test relationship in *pulchella*-group may be useful to elucidate these issues.

The morphological boundaries of the *pulchella*-group indicate that it does not belong to the *Alona* sensu stricto (Van Damme and Dumont 2008a). It is probable that in the future, a new genus will be created and that will include *A. kaingang* sp. nov. (Van Damme et al. 2010). Moreover, the *pulchella*-group has many affinities with *Ovalona* Van Damme & Dumont, 2008, a group recently removed from *Alona*. These two groups present affinities in habitus and limbs (mainly with *Ovalona weinecki*), and the only feature that is truly different is the presence of the merged (*pulchella*-group) and not-merged (*Ovalona*) denticles on the postanal margin of the postabdomen (Van Damme and Dumont 2008b). The use of molecular tools can be valuable to define the relationship between the *pulchella*-group and *Ovalona*.

Conclusions

The *pulchella*-group is now composed of at least 15 valid species. The Neotropical fauna of the *pulchella*-group is extremely diverse and contains 50 % of the known species. *Alona kaingang* sp. nov. has connection between main head pores complete; therefore, it is separated from *A. setulosa*, *A. cambouei*, *A. aguascalientensis*, *A. nigra*, *A. setuloides*, *A. azorica*, *A. nuragica*, *A. capensis*, and *A. anastasia*. *Alona kaingang* sp. nov. resembles *A. altiplana* but differs from it mainly in the morphology of the marginal denticles of the postabdomen and fine features on the limbs. The relationship between *pulchella*-group and *Ovalana* needs to be better studied.

Abbreviations

As: accessory seta; CBS: copulatory brush seta; EL: Elmoor-Loureiro collection, at Universidade Católica de Brasília, Brazil; en: endite; ep: epipodite; ex: exopodite; fc: filtercomb; gfp: gnathobasic filter plate; gn: gnathobase; IDL: inner distal lobe; il: inner lobe; IP: interpore distance (distance between anterior and posterior major head pores); MNRJ: National Museum of Rio de Janeiro, Brazil; MZUSP: Museum of Zoology of the University of São Paulo, Brazil; ODL: outer distal lobe; pep: pre-epipodite; PP: postpore distance (distance between posterior major head pore and posterior border of head shield); s: sensillum; SEM: scanning electron microscopy.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

FDRS, LMAEL, and SS wrote the manuscript. FDRS and LMAEL produced the drawings, photographs on the SEM, and taxonomic discussion. SS discussed the taxonomic parts, made the intellectual contributions, and reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgements

We thank Prof. Dr. Maria José dos Santos Wisniewski and Dr. José Roberto Debastiani Júnior for providing the material from Furnas and São Simão reservoirs, respectively. Thanks to Prof. Dr. Ciro Joko for the suggestion about the digital scientific illustrations. We also thank Dr. Sônia N. Bao, Ingrid C. M. da Silva, and Márcia C. O. da Rocha (Electron Microscopy Laboratory of the University of Brasília), who made the SEM micrographs possible. We also thank MSc. Diego M. Magalhães and Ms. Susan Casement for revising the English version of this manuscript. We are grateful to Dr. Gilmar Perbiche Neves, Dr. Ricardo Lourenço Pinto, Carla Bender Kotizian, and Dr. Alexey Kotov for the suggestions on the initial draft of this manuscript. We are grateful to the anonymous reviewers for their valuable comments and suggestions on the manuscript. FDRS was awarded a grant from the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES). We are also grateful to the CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for the productivity grant to SS (308598/2011-3).

Received: 27 January 2015 Accepted: 8 June 2015
Published online: 19 June 2015

References

Dumont JH, Silva-Briano M (2000) *Karualona* n. gen. (Anomopoda: Chydoridae), with a description of two new species, and a key to all known species. Hydrobiologia 435:61–78

Elmoor-Loureiro LMA (2004) Phylogenetic relationships among families of the order Anomopoda (Crustacea, Branchiopoda, Cladocera). Zootaxa 760:1–26

Eskinazi-Sant'Anna EM, Barbosa PMM, Rietzler AC (2005) Zooplankton biodiversity of Minas Gerais State: a preliminary synthesis of present knowledge. Acta Limnol Bras 17:199–218

Fonseca GAB (2010) Contribuição antrópica na poluição de reservatórios hidrelétricos: o caso da usina hidrelétrica de São Simão – GO/MG. Universidade Federal do Rio de Janeiro, Dissertation

Fryer G (1968) Evolution and adaptive radiation in the Chydoridae (Crustacea: Cladocera): a study in comparative functional morphology and ecology. Philos Trans R Soc Lond B Biol Sci 254:221–384

Green J (1972) Freshwater ecology in the Mato Grosso, Central Brazil. II. Associations of Cladocera in meander lakes of the Rio Suiá Missú. J Nat Hist 6:215–227
Kotov AA (2000a) Redescription and assignment of the chydorid *Indialona ganapati* Petkovski, 1966 (Branchiopoda: Anomopoda: Aloninae) to Indialonini, new tribus. Hydrobiologia 439:161–178
Kotov AA (2000b) Analysis of *Kozhowia* Vasiljeva & Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda), with a description of *Parakozhowia* n. gen. Hydrobiologia 437:17–56
Kotov AA (2003) Notes on Aloninae & Grochowski, 1894 *emend.* Frey, 1967 (Cladocera: Anomopoda: Chydoridae): 1. Translocation of *Alona incredibilis* Smirnov 1984 to the genus *Nicsmirnovius* Chiambeng & Dumont, 1999. Arthropoda Sel 12:167–170
Kotov AA (2006) Adaptations of Anomopoda crustaceans (Cladocera) to the benthic mode of life. Entomol Rev 8:210–225
Kotov AA, Elíaz-Gutiérrez M (2002) Analysis of the morphology of Spinalona anophtalma Ciros-Pérez & Elíaz-Gutiérrez, 1997 (Aloninae, Anomopoda, Cladocera). Hydrobiologia 486:185–192
Kotov AA, Sanoamuang L (2004) Comments on the morphology of *Nicsmirnovius eximius* (Kiser, 1948) (Aloninae, Anomopoda, Cladocera) in Thailand, with description of its male. Hydrobiologia 519:117–125
Kotov AA, Sinev AY, Berrios VL (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
Rocha O, Santos-Wisniewski MJ, Matsumura-Tundisi T (2011) Checklist de Cladocera de água doce do estado de São Paulo. Biota Neotrop 11:571–592
Sacherová V, Hebert PDN (2003) The evolutionary history of the Chydoridae (Crustacea: Cladocera). Biol J Linn Soc 79:629–643
Santos GB, Maia-Barbosa PM, Vieira F, López CM (1994) Fish and zooplankton community structure in reservoirs of southeastern Brazil: effects of the introduction of exotic predatory fish. In: Pinto-Coelho RM, Giani A, Sperling EV (eds) Ecology and human impact on lakes and reservoirs in Minas Geraia. SEGRAC Press, Belo Horizonte, pp 115–130
Santos RM, Negreiro NF, Silva LC, Rocha O, Santos-Wisniewski MJ (2010) Biomass and production of Cladocera in Furnas Reservoir, Minas Gerais, Brazil. Braz J Biol 70:879–887
Sinev AY (2001a) Redescription of *Alona iheringi* Sars, 1901 (Chydoridae, Anomopoda, Branchiopoda), a South American species related to *A. rustica* Scott, 1895. Hydrobiologia 464:113–119
Sinev AY (2001b) Redescription of *Alona glabra* Sars, 1901, a South American species of the *pulchella*-group (Chydoridae, Anomopoda, Branchiopoda). Arthropoda Sel 10:273–280
Sinev AY (2001c) Separation of *Alona cambouei* Guerne & Richard, 1893 from *Alona pulchella* King, 1853 (Branchiopoda, Anomopoda, Chydoridae). Arthropoda Sel 10:5–18
Sinev AY (2002a) Place of a Central American bromeliad-inhabiting cladoceran *Alona bromelicola* Smirnov, 1988 within the genus (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Sel 11:109–116
Sinev AY (2002b) Redescription of Australian cladocera *Alona archeri* Sars, 1888 (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Sel 11:247–254
Sinev AY (2004a) *Armatalona* gen. n.—a new genus of subfamily Aloninae (Anomopoda, Chydoridae), separated from genus *Alona* Baird, 1840. Hydrobiologia 520:29–47
Sinev AY (2004b) *Miralona* gen. n.—a new genus of the subfamily Aloninae (Anomopoda, Chydoridae) from Australia. Hydrobiologia 526:3–14
Sinev AY (2009) Notes on morphology and taxonomic status of some North American species of the genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae). Fundam Appl Limnol 175:59–77
Sinev AY, Atroschenko MM (2011) Revision of the genus *Alonopsis* Sars, 1862 and its position within Aloninae (Cladocera: Anomopoda: Chydoridae). Zootaxa 2800:1–17
Sinev AY, Elmoor-Loureiro LMA (2010) Three new species of chydorid cladocerans of subfamily Aloninae (Branchiopoda: Anomopoda: Chydoridae) from Brazil. Zootaxa 2390:1–25
Sinev AY, Hollwedel W (2005) Translocation of *Alona muelleri* Richard, 1897 into the genus *Karualona* Dumont & Silva-Briano, 2000 (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Sel 14:93–101
Sinev AY, Kobayashi T (2012) Redescription of the endemic Australian cladoceran *Alona willisi* (Smirnov, 1989) and its assignment to *Acanthalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). Zootaxa 3390:43–45
Sinev AY, Kotov AA (2000) Redescription of *Alona labrosa* Vasiljeva& Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda). Hydrobiologia 439:125–139
Sinev AY, Kotov AA (2001) Redescription of *Alona setosocaudata* Vasiljeva & Smirnov, 1969 (Anomopoda, Branchiopoda). Hydrobiologia 452:47–58
Sinev AY, Shiel RJ (2008) Redescription of *Alona macracantha* Smirnov and Timms, 1983 and its assignment to *Maraura* gen. nov. (Cladocera: Anomopoda: Chydoridae). J Nat Hist 42:2809–2824
Sinev AY, Silva-Briano M (2012) Cladocerans of genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae) and related genera from Aguascalientes State, Mexico. Zootaxa 3569:1–24
Sinev AY, Van Damme K, Kotov AA (2005) Redescription of tropical-temperate cladocerans *Alona diaphana* King, 1853 and *Alona davidi* Richard, 1895 and their translocation to *Leberis* Smirnov, 1989 (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Sel 14:183–205
Sinev AY, Alonso M, Miracle MR, Sahuquillo M (2012) The West Mediterranean *Alona azorica* Frenzel & Alonso, 1988 (Cladocera: Anomopoda: Chydoridae) is composed of two species. Zootaxa 3276:51–68
Smirnov NN (1971) *Chydoridae fauny mira. Fauna USSR.* Rakoobraznie, Leningrad. (English translation: Chydoridae of the world. Israel Program for Scientific Translations, Jerusalem, 1974
Smirnov NN, Santos-Silva EN (1995) Some littoral anomopods (Crustacea) from Central Amazonia. Hydrobiologia 315:227–230
Smirnov NN (1998) A revision of the genus Camptocercus (Anomopoda, Chydoridae, Aloninae). Hydrobiologia 386:63–83
Sousa FDR, Elmoor-Loureiro LMA, Santos S (2015) Redescription of the *Coronatella poppei* (Richard, 1897) (Crustacea, Branchiopoda, Chydoridae) and a revision of the genus in Brazil, with descriptions of new taxa. Zootaxa 3955:211–244
Sterza JM, Fernandes LL (2006) Distribution and abundance of Cladocera (Branchiopoda) in the Paraíba do Sul River estuary, Rio de Janeiro, Brazil. Braz J Oceanogr 54:193–204
Van Damme K, Dumont HJ (2007) Limb morphology of the carnivorous anomopods *Anchistropus emarginatus* Sars, 1862 and *Pseudochydorus globosus* (Baird, 1843) (Crustacea: Branchiopoda: Anomopoda). Ann Limnol – Int J Limnol 43:271–284
Van Damme K, Dumont JH (2008a) The 'True' genus *Alona* Baird, 1843 (Crustacea: Cladocera: Anomopoda): position of the *A. qudrangularis*-group and description of a new species from Democratic Republic of Congo. Zootaxa 1943:1–25
Van Damme K, Dumont JH (2008b) 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, Dumont JH (2009) Notes on chydorid endemism in continental Africa: *Matralona* gen. n., a monotypic Alonine from the Fouta Djalon Plateau (Guinea, West Africa) (Crustacea: Cladocera: Anomopoda). Zootaxa 2051:26–40
Van Damme K, Sinev AY (2011) A new genus of cave-dwelling microcrustaceans from the Dinaric Region (south-east Europe): adaptations of true stygobitic Cladocera (Crustacea: Branchiopoda). Zool J Linn Soc 161:31–52
Van Damme K, Brancej A, Dumont HJ (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
Van Damme K, Chiambeng G, Maiphe S, Dumont JH (2003) New species in the rheophilous genus *Nicsmirnovius* Chiambeng & Dumont, 1999 (Branchiopoda: Anomopoda: Chydoridae) and reassignment of *Alona eximia* Kiser, 1948 and *Alonella fitzpatricki* Chien, 1970. Hydrobiologia 499:25–49
Van Damme K, Kotov AA, Dumont HJ (2005) Redescription of *Leydigia parva* Daday, 1905 and assignment to *Parvalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). J Nat Hist 39:2125–2136
Van Damme K, Kotov AA, Dumont HJ (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
Van Damme K, Sinev AY, Dumont HJ (2011) Separation of *Anthalona* gen.n. from *Alona* Baird, 1843 (Branchiopoda: Cladocera: Anomopoda): morphology and evolution of scraping stenothermic Alonine. Zootaxa 2875:1–64
Damme V, Bekker E, Kotov AA (2013) Endemism in the Cladocera (Crustacea: Branchiopoda) of Southern Africa. J Limnol 72:440–463
Viti T, Wisniewski C, Orlando TC, Santos-Wisniewski MJ (2013) Life history, biomass and production of *Coronatella rectangula* (Branchiopoda, Anomopoda, Chydoridae) from Minas Gerais. Iheringia, Sér Zool 103:110–117

CONCLUSÕES GERAIS

Os resultados apresentados neste estudo sugerem que a diversidade de espécies relacionadas ao gênero *Alona* foi bastante subestimada no Brasil, especialmente, por conta da utilização de descrições de espécies da região Paleártica. Isto também é fruto de antigas e inadequadas descrições, para os padrões atuais, que induzem ao erro durante a identificação. Podemos também citar a não utilização de literatura e de aspectos morfológicos adequados no momento do difícil e lento processo de identificação.

Para o ramo Hexalona, foram descritas três novas espécies e um gênero. *Alona margipluma* parece ser um típico caso de confusão quando avaliamos apenas aspectos superficiais da morfologia externa, uma vez que esta espécie foi encontrada em amostras identificadas como *Alona guttata* e *Alona iheringula.* A endêmica Gen. nov. 1 e sp. nov. 2 foi coletada em campos de altitude associada à *Sphagum*.

No caso do *Coronatella*-branch, três resultados são relevantes: o primeiro é a confirmação de que *Alona broaensis* é sinônimo de *Alona dentifera,* como previamente sugerido (Van Damme et al., 2010); o segundo é que as características morfológicas apresentadas por *Alona dentifera* permitiram a sua inclusão em um novo gênero; e o terceiro foi que *Coronatella rectangula* não ocorre no Brasil, e provavelmente, no Neotrópico. Existe uma chance bastante concreta desta espécie ser confundida com outras espécies do gênero descritas nesta tese, ou com uma nova espécie do grupo pulchella nomeada de *Alona kaingang* (agora considerada membro de *Ovalona* por Sinev, 2015). A literatura estava correta quanto à subestimativa de espécies do gênero *Coronatella* para o Neotrópico, sendo que o número de espécies, agora, mais que dobrou.

O número de espécie descritas nesta tese é apenas uma parte do potencial de biodiversidade de espécies de Aloninae no Brasil. Exemplos disto são as populações de *Alona* cf. *guttata* e *Alona* cf. *intermedia* aqui estudadas e que só poderão ser atribuídas a novos taxa após a redescrição de seus tipos (Noruega) ou a realização de análise de dados moleculares. Habitats específicos como ambientes de altitude, intermitentes, ácidos e semiterrestres podem ser a chave para decobertas de novas espécies.

REFERÊNCIAS BIBLIOGRÁFICAS

Dumont, J.H. & Silva-Briano, M. (2000) *Karualona* n.gen. (Anomopoda: Chydoridae), with a description of two new species, and a key to all known species. Hydrobiologia, v435, p61-78.

Elías-Guttiérez, M., Martínez-Jerónimo. F., Ivanova, N.V., Valdez-Moreno, M. & Hebert P.D.N. (2008) DNA barcodes for Cladocera and Copepoda from Mexico and Guatemala, highlights and new discoveries. Zootaxa, 1839: 1–42.

Elmoor-Loureiro, L.M.A. (1997) Manual de identificação de cladóceros límnicos do Brasil. Universa, Brasília, 155p.

Elmoor-Loureiro, L.M.A. (2000) Brazilian cladoceran studies: where do we stand? Nauplius, v8, p117-131.

Elmoor-Loureiro, L.M.A. (2004) Phylogenetic relationships among families of the order Anomopoda (Crustacea, Branchiopoda, Cladocera). Zootaxa, v760, p1-26.

Elmoor-Loureiro, L.M.A. (2010) Cladóceros do Brasil: Famílias Chydoridae e Eurycercidae. Publicado em: http://cladocera.wordpress.com

Elmoor-Loureiro, L.M.A, Santos-Wisniewski, M.J. & Rocha O. (2013) Redescription of *Alonella lineolata* Sars, 1901 (Crustacea, Cladocera, Chydoridae) and its translocation to the subfamily Aloninae and to the new genus *Bergamina* gen. nov.. Zootaxa 3630 (1): 571–581.

Frey, D.G. (1982) Relocation of *Chydorus barroisi* and related species (Cladocera, Chydoridae) to a new genus and description of two new species. Hydrobiologia, v86, p231-269.

Frey, D.G. (1987) The North American *Chydorus faviformis* (Cladocera, Chyodridae) and the honeycombed taxa of other continents. Philosophical Transactions of the Royal Society of London, v315, n1175, p353-402.

Hijmans, R.J. et al.,(2005) Very high resolution interpolated climate surfaces for global lands areas. International Journal of Climatology, v74, p65-81.

Kotov, A.A. (2000a) Redescription and assignment of the chydorid *Indialona ganapati* Petkovski, 1966 (Branchiopoda: Anomopoda: Aloninae) to Indialonini, new tribus. Hydrobiologia, v439, p161-178.

Kotov, A.A. (2000b) Analysis of *Kozhowia* Vasiljeva& Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda), with a description of *Parakozhowia* n. gen. Hydrobiologia, v437, p17-56.

Kotov, A.A. & Eliáz-Gutiérrez, M. (2002) Analysis of the morphology of *Spinalona anophtalma* Ciros-Pérez & Eliáz-Gutiérrez, 1997 (Aloninae, Anomopoda, Cladocera). Hydrobiologia, v468, p185-192.

Kotov, A.A. (2003) Notes on Aloninae & Grochowski, 1894 *emend*. Frey, 1967 (Cladocera: Anomopoda: Chydoridae): 1 Translocation of *Alona incredibilis* Smirnov 1984 to the genus *Nicsmirnovius* Chiambeng & Dumont, 1999. *Arthropoda Selecta,* v12, n3-4, p167-170.

Kotov, A.A. & Sanoamuang, L. (2004) Comments on the morphology of *Nicsmirnovius eximius* (Kiser, 1948) (Aloninae, Anomopoda, Cladocera) in Thailand, with description of its male. Hydrobiologia, v519, p117-125.

Kotov, A.A. (2006) Adaptations of Anomopoda Crustaceans (Cladocera) to the Benthic Mode of Life. Entomological Review, v8, n9, p210-225.

Kotov, A.A. & Ferrari, F.D. (2010) The taxonomic research of Jules Richard on Cladocera (Crustacea: Branchiopoda) and his collection at the National Museum of Natural History, U.S.A. Zootaxa, v2551, p37-64.

Matsumura-Tundisi, T. & Smirnov, N.N. (1984) Description of *Alona broaensis* sp. nov. (Crustacea: Cladocera). Hydrobiologia, v113, p327-329.

Rey, J. & Vasquéz, E. (1986) Cladocères de quelques corps d'eaux du bassin moyen de l'Orénoque (Venezuela). Annales de Limnologie, v22, p137–168.

Sacherová, V. & Hebert, P.D.N. (2003) The evolutionary history of the Chydoridae (Crustacea: Cladocera). Biological Journal of the Linnean Society, v79, p629-643.

Scachetti-Pereira, R. (2002) DesktopGarp. The University Kansas Biodiversity Research Center.

Sinev, A.Y. (1999a) *Alona werestschagini* sp.n., a new species of the genus *Alona* Baird, 1843 related to *A. guttata* Sars, 1862 (Anomopoda: Chydoridae). Arthropoda Selecta, v8, n1, p23-30.

Sinev, A.Y. (1999b) *Alona costata* Sars, 1862 versus related palaeotropical species: the first example of close relations between species with a different number of main head pores among Chydoridae (Crustacea: Anomopoda). Arthropoda Selecta, v8, n3, p131-148.

Sinev, A.Y. & Kotov, A.A. (2000) Redescription of *Alona labrosa* Vasiljeva& Smirnov, 1969 (Chydoridae, Anomopoda, Branchiopoda). Hydrobiologia, v439, p125-139.

Sinev, A.Y. (2001) Redescription of *Alona iheringi* Sars, 1901 (Chydoridae, Anomopoda, Branchiopoda), a South American species related to *A. rustica* Scott, 1895. Hydrobiologia, v464, p113-119.

Sinev, A.Y. & Kotov, A.A. (2001) Redescription of *Alona setosocaudata* Vasiljeva & Smirnov, 1969 (Anomopoda, Branchiopoda). Hydrobiologia, v452, p47-58.

Sinev, A.Y. (2004a) *Armatalona* gen. n. – a new genus of subfamily Aloninae (Anomopoda, Chydoridae), separated from genus *Alona* Baird, 1840. Hydrobiologia, v520, p29-47.

Sinev, A.Y. (2004b) *Miralona* gen. n. – a new genus of the subfamily Aloninae (Anomopoda, Chydoridae) from Australia. Hydrobiologia, v526, p3-14.

Sinev, A.Y. et al., (2004) Morphology of a Neotropical cladoceran *Alona dentifera* (Sars, 1901), and its position within the Chydoridae Stebbing, 1902 (Branchiopoda: Anomopoda). Arthropoda Selecta, v13, n3, p99-107.

Sinev, A.Y. & Hollwedel, W. (2005) Translocation of *Alona muelleri* Richard, 1897 into the genus *Karualona* Dumont & Silva-Briano, 2000 (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Selecta, v14, n2, p93-101.

Sinev, A.Y. et al., (2005) Redescription of tropical-temperate cladocerans *Alona diaphana* King, 1853 and *Alona davidi* Richard, 1895 and their translocation to *Leberis* Smirnov, 1989 (Branchiopoda: Anomopoda: Chydoridae). Arthropoda Selecta, v14, n3, p183-205.

Sinev, A.Y. & Shiel, R.J. (2008) Redescription of *Alona macracantha* Smirnov and Timms, 1983 and its assignment to *Maraura* gen. nov. (Cladocera: Anomopoda: Chydoridae). Journal of Natural History, v42, n45-46, p2809-2824.

Sinev, A.Y. & Elmoor-Loureiro, L.M.A. (2010) Three new species of chydorid cladocerans of subfamily Aloninae (Branchipoda: Anomopoda: Chydoridae) from Brazil. Zootaxa, v2390, p1-25.

Sinev, A.Y. & Atroschenko, M.M. (2011) Revision of the genus *Alonopsis* Sars, 1862 and its position within Aloninae (Cladocera: Anomopoda: Chydoridae). Zootaxa, v2800, p1-17.

Sinev, A.Y. & Kobayashi, T. (2012) Redescription of the endemic Australian cladoceran *Alona willisi* (Smirnov, 1989) and its assignment to *Acanthalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). Zootaxa, 3390: 43–45.

Sinev, A.Y. & Silva-Briano, M. (2012) Cladocerans of genus *Alona* Baird, 1843 (Cladocera: Anomopoda: Chydoridae) and related genera from Aguascalientes State, Mexico. Zootaxa, 3569: 1–24.

Sinev, A.Y. & Zawisza, E. (2013) Comments on cladocerans of crater lakes of the Nevado de Toluca Volcano (Central Mexico), with the description of a new species, *Alona manueli* sp. nov.. Zootaxa, 3647 (2): 390–400.

Sinev, A.Y. (2015) Revision of the *pulchella*-group of *Alona* s. lato leads to its translocation to *Ovalona* Van Damme et Dummont, 2008 (Branchiopoda: Anomopoda: Chydoridae). Zootaxa, 4044 (4): 451-492.

Smirnov, N.N. (1974) 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, v386, p63-83.

Van Damme, K. et al., (2003) New species in the rheophilous genus *Nicsmirnovius* Chiambeng & Dumont, 1999 (Branchiopoda: Anomopoda: Chydoridae) and reassignment of *Alona eximia* Kiser, 1948 and *Alonella fitzpatricki* Chien, 1970. Hydrobiologia, v499, p25-49.

Van Damme, K. et al., (2005) Redescription of *Leydigia parva* Daday, 1905 and assignment to *Parvalona* gen. nov. (Cladocera: Anomopoda: Chydoridae). Journal of Natural History, v39, n23, p2125-2136.

Van Damme, K. & Dumont, J.H. (2008a) The 'True' genus *Alona* Baird, 1843 (Crustacea: Cladocera: Anomopoda): position of the *A. qudrangularis*-group and description of a new species from Democratic Republic of Congo. Zootaxa, v1943, p1-25.

Van Damme, K. & Dumont, J.H. (2008b) Further division of *Alona* Baird, 1843: separation and position of *Coronatella* Dybowski & Grochowski and *Ovalona* gen.n. (Crustacea: Cladocera). Zootaxa, v1960, p1-44.

Van Damme, K. & Dumont, H.J. (2009) Notes on chydorid endemism in continental Africa: *Matralona* gen. n., a monotypic Alonine from the Fouta Djalon Plateau (Guinea, West Africa) (Crustacea: Cladocera: Anomopoda). Zootaxa, v2051, p26–40.

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, p31-52.

Van Damme, K. & Maiphe, S. (2013) Salinalona gen. nov., an euryhaline lineage (Crustacea: Branchiopoda: Cladocera: Anomopoda) from the Oriental region. Journal of Limnology, v72(s2), p142-173.

Van Damme, K. et al., (2009) Adaptations to the hyporheic in Aloninae (Crustacea: Cladocera): allocation of *Alona protzi* Hartwig, 1900 and related species to *Phreatalona* gen. nov. Hydrobiologia, v618, p1-34.

Van Damme, K. et al., (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, v2330, p1-63.

Van Damme, K. et al., (2011) Separation of *Anthalona* gen.n. from *Alona* Baird, 1843 (Branchiopoda: Cladocera: Anomopoda): morphology and evolution of scraping stenothermic alonine. Zootaxa, v2875, p1-64.