AN ANNOTATED CHECKLIST OF THE CLADOCERA OF CUBA

BY

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ABSTRACT

Although Cuba is the most studied Caribbean island with regard to freshwater Cladocera, our knowledge of their species composition and distribution is still limited. In this study, all available published and unpublished, reliable sources were reviewed for all records of this group of crustaceans. Thus, a revised and updated list of 70 species of the orders Ctenopoda and Anomopoda recorded for the island is here presented, including all sources of information. From the total number of records, about 32% are doubtful. Comments on these and on other selected species are included. From a biogeographical point of view, the fauna of Cuba is closely related to that of southern Mexico, and both regions have a close similarity with South America. The actual distribution of the species can be explained on the basis of the origin of the Proto-Antilles-Central America complex, of which the island of Cuba is the most diverse representative among the Recent Caribbean islands.

RESUMEN

Aunque Cuba es la isla caribeña mejor estudiada para los cladóceros de agua dulce, el conocimiento de su composición y distribución es aún limitado. En este trabajo se revisaron todas las fuentes con registros de datos fidedignos publicados y no publicados para este grupo de crustáceos. En este trabajo se presenta una lista revisada y actualizada de 70 especies de los órdenes Ctenopoda y Anomopoda registrados en esta isla, incluyendo las fuentes de información. Del total de registros, aproximadamente el 32% son dudosos. Se incluyen comentarios sobre éstas y otras especies seleccionadas. Desde el punto de vista biogeográfico, la fauna de Cuba se encuentra estrechamente relacionada con el sur de México, y ambas regiones tienen una estrecha similitud con Sudamérica. La distribución actual de estas especies puede ser explicada en base del origen del complejo representado por las Proto-Antillas-Centroamérica. Como resultado Cuba es la isla con mayor diversidad del Caribe.

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INTRODUCTION

Cuba, the largest Caribbean island with a freshwater fauna, seems to be relatively well known. Among the tropical countries, it was extensively studied, mainly by foreign researchers, since the first half of the 20th century. The first mention of cladocerans from its inland waters was by Brehm (1948), who described a new moinid and gave a list of seven species. Straškraba et al. (1969) and Straškraba (1969) listed several species from various reservoirs and discussed their biogeographic affinities. Then, due to the activity of the Cuban-Romanian Biospeleological Expedition, the epigean and hypogean species of cladocerans were recorded in two papers by Orghidan & Negrea (1970, 1973). Biochino (1976) published a list of the Cladocera associated with aquatic plants in various reservoirs. In 1964-1966, the joint Czechoslovakian-Cuban Expedition collected material from many localities of Cuba. Data generated from this expedition were published subsequently by other researchers, as Collado et al. (1984), who presented a list of species recorded at that time. In the same year, Alonso (1984) gave a detailed list of all zooplankters dwelling in the Laguna El Tesoro. Before these two publications, Frey (1982) presented a list including species from previous studies and unpublished records by V. Kořínek and C. H. Fernando. During subsequent years, sporadic studies increased the number of species and new compilations were made (Lalana et al., 2005). Recently, taxonomic changes after careful analyses of many species, discovery of new ones, as well as the dramatic reduction of "true" cosmopolitans, make it necessary to update the list of Cladocera known from this island.

METHODS

To produce this list, an extensive review of published and unpublished, reliable sources was carried out for all records of Cladocera. Each record was updated to the actual valid names. All cases of published names, considered as doubtful to be found in the island of Cuba, were noted and are marked as such in the present paper.

RESULTS AND DISCUSSION

In total, 70 species of Cladocera have been recorded from Cuba to date, but 23 of these records are doubtful (table I). Comments on selected species as well as some biogeographical remarks are provided in the next section.

Sididae. — Since Kořínek (1981) described *Diaphanosoma birgei*, a congener of *D. brachyurum* (Liévin, 1848) from the Old World, it has been accepted that all

TABLE I

Species of Cladocera from Cuba. Sources: 1, Brehm (1948); 2, Straškraba (1969); 3, Orghidan & Negrea (1970); 4, Orghidan & Negrea (1973); 5, Biochino (1976); 6, Frey (1982); 7, Collado et al. (1984); 8, Kořínek (1981); 9, Alonso (1984); 10, Kořínek (1984); 11, Korovchinsky (1992); 12, Kotov et al. (2005); 13, V. Kořínek (in litt.); 14, Lalana et al. (2005). ⋆, Species probably found in Cuba (see text); *, doubtful records; ⋏, includes *L. occidentalis* and *L. fasciculata*; ˣ, cited as *Alona macrocantha*; ◆, marine species; ▲, subgenus sensu Kotov (2009). All names are given according to the actual nomenclature, and because of this reason some names from the original lists have changed (see text)

Taxon	Source
SIDIDAE Baird, 1850	
1. ⋏*Latonopsis australis* G. O. Sars, 1888 group	6, 13
2. **Diaphanosoma brachyurum* (Liévin, 1848)	3, 4, 6, 7, 9
3. *D. brevireme* G. O. Sars, 1901	6, 7, 14
4. *D. spinulosum* Herbst, 1967	6, 7, 14
5. *D. birgei* Kořínek, 1981	6, 8, 13, 14
6. *Sarsilatona serricauda* (G. O. Sars, 1901)	13
7. *Pseudosida bidentata* Herrick, 1884	5, 6
8. *P. ramosa* (Daday, 1904)	6, 13, 11
DAPHNIIDAE Straus, 1820	
9. *Daphnia laevis* Birge, 1878	6, 7, 14
10. *D. pulicaria* Forbes, 1893	6, 7
11. *D. parvula* Fordyce, 1901	6, 7
12. *D. ambigua* Scourfield, 1947	2, 6, 9
13. **Ceriodaphnia* cf. *quadrangula* (O. F. Müller, 1785)	9
14. **C. cornuta* G. O. Sars, 1886	4, 6, 7
15. **C. rigaudi* Richard, 1894	4, 6
16. **C. dubia* Richard, 1895	6, 7
17. **Simocephalus vetulus* (O. F. Müller, 1776)	6, 7
18. *S. serrulatus* (Koch, 1841)	6, 7, 9
19. *Simocephalus* sp. King, 1853	6, 7
20. **S. elizabethae* (King, 1853)	6, 7
21. *S. mixtus* G. O. Sars, 1903	⋆
22. *Moinodaphnia macleayi* (King, 1853)	1, 2, 3, 4, 6, 7
23. **Moina micrura* Kurz, 1874	6, 7
24. *M. affinis* Birge, 1893	4, 2, 6, 7
25. *M. reticulata* (Daday, 1905)	6, 7
26. *M. juanae* Brehm, 1948	1, 6
27. *M. dumonti* Kotov, Elías-Gutierrez & Granados-Ramírez, 2005	12
BOSMINIDAE Baird, 1845	
28. *Bosmina* (*Bosmina*) *longirostris* (O. F. Müller, 1785)	6, 7▲
29. *B.* (*Liederobosmina*) *hagmanni* (Stingelin, 1904) s.l.	13▲
30. *B.* (*Liederobosmina*) *tubicen* Brehm, 1953	6, 7▲
ILYOCRIPTIDAE Smirnov, 1992	
31. *Ilyocryptus spinifer* Herrick, 1884	1, 4, 5, 6, 7, 9, 14

TABLE I
(Continued)

Taxon	Source
MACROTHRICIDAE Norman & Brady, 1867	
32. *Grimaldina brazzai* Richard, 1892	5, 6, 7, 10, 14
33. **Macrothrix rosea* (Liévin, 1848)	6, 7
34. **M. triserialis* Brady, 1886	4, 6, 9, 10
35. *M. goeldi* Richard, 1897	1, 6, 7
36. *M. elegans* G. O. Sars, 1901	1, 6, 7
37. *M. spinosa* King, 1953	10, 14
38. **M. pseudospinosa* Smirnov, 1992	13
CHYDORIDAE Stebbing, 1902	
39. *Chydorus ciliatus* Poggenpol, 1874	9
40. *C. eurynotus* G. O. Sars, 1901	4, 6, 7
41. *C. nitidulus* (G. O. Sars, 1901)	13
42. *C. pubescens* G. O. Sars, 1901	6, 7, 14
43. *Ephemerophorus barroisi* (Richard, 1894)	6, 7
44. *E. hybridus* (Daday, 1905)	1, 6, 7, 9
45. **Alonella excisa* (S. Fischer, 1854)	7
46. *Disparalona dadayi* Birge, 1910	6, 7
47. **Dunhevedia crassa* King, 1853	6, 7
48. *D. setigera* (Birge, 1879)	⋆
49. *D. serrata* Daday, 1898	4, 6, 9
50. *D. odontoplax* G. O. Sars, 1901	3, 4, 6, 9
51. *Pseudochydorus globosus* (Baird, 1850)	6, 7
52. **Alona pulchella* King, 1853	6, 7
53. **A. rustica* Scott, 1895	6, 7
54. *A. monacantha* G. O. Sars, 1901	6, 10, 14[x]
55. *A. verrucosa* G. O. Sars, 1901	6, 7, 9
56. *A. circumfimbriata* Megard, 1967	9
57. *Leberis davidi* (Richard, 1895)	1, 6, 7
58. **Camptocercus rectirostris* Schoedler, 1862	4, 7
59. **C. australis* G. O. Sars, 1896	6, 7
60. **Oxyurella tenuicaudis* (G. O. Sars, 1862)	6, 7
61. **Notoalona globulosa* (Daday, 1898)	6, 10, 14
62. **Euryalona orientalis* (Daday, 1898)	6, 7
63. *E. occidentalis* G. O. Sars, 1901	4, 6, 7
64. *Kurzia polyspina* Hudec, 2000	7
65. **Leydigia acanthocercoides* (Fischer, 1854)	4, 6, 7
66. **L. leydigi* (Schoedler, 1863)	6, 7
67. *L. louisi* Jenkin, 1934	⋆
68. *L.* cf. *striata* Birabén, 1939	⋆
69. *Leydigiopsis ornata* Daday, 1905	6, 7
70. *Pseudevadne tergestina* Claus, 1877	14◆

American representatives of the genus belong to the former species. In the original description of *D. birgei*, 16 localities from Cuba are included, which material was collected between 1964 and 1966. Nevertheless, it should be noted that recently Korovchinsky (2002, 2005), after the description of two related taxa from the United States, concluded that most probably *D. birgei* represents a complex of cryptic species. The forms from Cuba should be re-analysed considering this view. As an example, Elías-Gutiérrez et al. (2008b) found (based on molecular and morphological evidence) that *D. birgei* is restricted to the northern portion of the North American continent.

Latonopsis australis G. O. Sars, 1888 was recognized as a group of species by Korovchinsky (1992). It has been recorded mainly in the tropics, but Birge (1892) described *L. occidentalis* from temperate North America. Actually, the identity of American tropical *Latonopsis* has not been properly defined. In the case of *Latonopsis fasciculata* Daday, 1905, it is considered a junior synonym of *Sarsilatona serricauda* (Sars, 1901) (cf. Korovchinsky, 1992), a rare species found on the Yucatan peninsula as well (Korovchinsky & Elías-Gutiérrez, 2000).

Daphniidae. — The genus *Daphnia* is almost restricted to northern latitudes. In the case of Cuba, four species have been recorded. *D. ambigua*, described from the U.K. by Scourfield (1947), certainly could represent a group of species. Recently, Hebert et al. (2003) found four phylo-groups of *D. ambigua* in North America with a 4% divergence in mitochondrial DNA. Most probably the specimens from Cuba should be considered as related with the East group, defined by Hebert et al. (2003), distributed from New York to Florida.

Another possible complex of species is found in *D. laevis*, distributed over North and South America, as well as in Africa (Benzie, 2005). Taylor et al. (1998) concluded to the existence of five groups in North America of this *Daphnia*, one of these, the "Atlantic", that dwells down to Mexico and which was designated by these authors as *D. laevis gessneri*, and could be the one closer to the Cuban material.

The occurrence of *D. parvula* Fordyce, 1901 and *D. pulicaria* Forbes, 1893 (members of the *D. pulex* Leydig, 1860 group) is not surprising, because these seem to be among the most widespread species in the Americas (Benzie, 2005).

The genus *Ceriodaphnia* is one of the most confusing among Daphniidae. Some species, such as the *C. cornuta* G. O. Sars, 1885 s.l., demonstrate wide morphological diversity and broad distribution. Any effort to clarify this complex will demand molecular and morphological analysis of topotypic material (Elías-Gutiérrez et al., 2008b). In this regard, we note that *C. cornuta*, originally described from Australia (Sars, 1885), has been also recorded from elsewhere, i.e., from the type locality (Australia) to America and Africa (Berner, 1985). A similar case is *C. rigaudi* Richard, 1894 described from Tonkin, Viet Nam (Richard, 1894b),

but recorded from the tropics to temperate regions. The latter represents a species complex in Mexico (Elías-Gutiérrez et al., 2008b).

In accordance with Orlova-Bienkowskaja (2001), *Simocephalus vetulus* (O. F. Müller, 1776) is a species restricted to Europe and North Africa. In the Americas, it has usually been confused with *S. mixtus* G. O. Sars, 1903. The latter species has been recorded from Jamaica by Orlova-Bienkowskaja (2001), so its occurrence in Cuba is expected. A subspecies, *S. vetulus elizabethae* (King, 1853), recorded by Orghidan & Negrea (1970), and actually considered to be distinguished at species level by Orlova-Bienkowskaja (2001), is restricted to Australia and Asia. So, its occurrence in Cuba would be strange, unless an introduction has occurred. The aforementioned taxon could also be confused with *S. mixtus*.

A moinid, *Moina juanae* Brehm, 1948, described from Laguna de Ariguanabo (Brehm, 1948) was synonymized by Goulden (1968) with *Moinodaphnia macleayi* (King, 1853). Recently, the supposedly lost material of Brehm was discovered in Austria, but not all samples have yet been ordered (A. A. Kotov, in litt.). We believe that both species could be found on Cuba. Goulden (1968) synonymized this species based only on some poor quality drawings. We consider that *M. juanae* could be a valid species, but the type locality has been dried up due to agricultural use. From the small pools remaining it has not been possible to find any moinid (C. Varela, pers. obs.).

In addition, all records of *M. micrura* Kurz, 1874 should be carefully analysed. This species was described from Austria (Kurz, 1874) and then recorded from many regions of the world. Elías-Gutiérrez et al. (2008b) found profound divergence in the COI mitochondrial gene among several "micrura"-like populations from Mexico, so this name should be used with care.

Kotov et al. (2005) recently described *Moina dumonti* from the Yucatan Peninsula, and populations from Playa de Guanabo, Cuba seem to be conspecific.

Bosminidae. — Paggi (1979) demonstrated that *Bosmina* (*Eubosmina*) *hagmanni* could easily be confused with *B.* (*E.*) *huaronensis* Delachaux, 1918, a South American species. In fact, Deevey & Deevey (1971) identified specimens from Arizona resembling *B. huaronensis* as *B. hagmanni*. We cannot definitively confirm the identification of the specimens from Cuba, because *B. hagmanni* was originally described from South America as well (Stingelin, 1904), but it has been recorded in the U.S.A. (De Melo & Hebert, 1994; Taylor et al., 2002). V. Kořínek (in litt.) suggested to consider *B. hagmanni* s.l., from the point of view that it would represent a group of sibling species.

Ilyocryptidae. — So far, the only ilyocryptid reported from Cuba is *Ilyocryptus spinifer* Herrick, 1884. In their re-description of this species, Kotov & Williams (2000) examined material from Lake La Luisa, near La Habana. Brehm (1948)

recorded *I. halyi* Brady, 1886, by now considered a junior synonym of *I. spinifer* (cf. Kotov & Štifter, 2006).

Macrothricidae. — "*Macrothrix triserialis*" recorded by Orghidan & Negrea (1973) and Collado et al. (1984) is a complex of cryptic species. Dumont et al. (2002) redescribed *M. triserialis* Brady, 1886, originally described from Sri Lanka (Brady, 1886), and found its distribution restricted to the Old World. American representatives of this group are *Macrothrix agsensis* Dumont, Silva-Briano & Babu, 2002 and *Macrothrix smirnovi* Ciros-Pérez & Elías-Gutiérrez, 1997, both described from central Mexico, and not recorded from the tropical lowlands. Later, Kotov et al. (2004) found that the populations from Cuba, recorded by Orghidan & Negrea (1973) belong to *M. elegans* G. O. Sars, 1901. In their review, Lalana et al. (2005) kept the record by Kořínek (1984) of *M. superaculeata* (Smirnov, 1982), though considered a junior synonym of *M. elegans* G. O. Sars, 1901 by Kotov et al. (2004).

M. spinosa King, 1853 has been recorded from central-southern Mexico and Central America (Van de Velde et al., 1978; Suárez-Morales & Elías-Gutiérrez, 1992; Silva-Briano, 1998; Garfias-Espejo & Elías-Gutiérrez, 2004), but it has been mentioned as a species that needs to be revised, in view of its apparently broad distribution across the world (Garfias-Espejo & Elías-Gutiérrez, 2004). Smirnov (1992) considered that the *M. spinosa* record from the island by Kořínek (1984) could be *M. flabelligera* Smirnov, 1992. We consider this assumption not at fully correct, since the type locality for the latter is Australia (Smirnov, 1992). *M. goeldi* Richard, 1897, recorded by Collado et al. (1984), is a member of the *M. spinosa*-group (A. A. Kotov, pers. comm.). It was originally described from Chile by Richard (1897) and could be valid. *M. pseudospinosa* was described by Smirnov (1992) from Africa, and it was recorded from Cuba by V. Kořínek (in litt.), but its actual presence should be carefully analysed, based in more material.

Chydoridae. — *Ephemeroporus barroisi* (Richard, 1894), regarded as a group of species distributed across the world, was originally described from material collected in Syria (Richard, 1894a). Morphologically similar specimens have been recorded from Central America (Smirnov, 1996) and Mexico (Elías-Gutiérrez et al., 2001). *Chydorus ciliatus* Poggenpol, 1874 was considered incertae sedis by Smirnov (1996), and it is yet to be clarified if it is valid. Frey (1982) and Collado et al. (1984) recorded *Kurzia latissima* (Kurz, 1875) from Cuba, but later Hudec (2000) re-assigned the material to *K. polyspina* Hudec, 2000, described from the Mexican Pacific coast, and apparently found at several Cuban sites.

Pseudochydorus globosus (Baird, 1893) is another species that could represent a complex of congeners. It has been recorded from elsewhere, but there are some subtle differences in the American material with respect to that from the Old World (Elías-Gutiérrez et al., 2008b).

Richard (1895) described *Leberis davidi* from Haiti, a taxon related with *L. diaphanus* (King, 1853) from Australia (King, 1853). Almost certainly, the populations found in Cuba belong to *L. davidi*. The only other American representative of this species is *Leberis chihuahuensis* Elías-Gutiérrez & Valdez-Moreno, 2008 recently described from Mexico by Elías-Gutiérrez & Valdez-Moreno (2008).

The presence of *Alonella excisa* (Fischer, 1854) could also be doubtful. Although it is regarded a possible cosmopolitan (Elías-Gutiérrez et al., 2008a), it has not been recorded from the tropics. The systematics of *Dunhevedia* are not clear. Orghidan & Negrea (1970) recorded *Dunhevedia crassa* King, 1853 but Elías-Gutiérrez et al. (2008a) stated that American records of this Australian species could be related to *D. setigera* (Birge, 1879).

Alona rustica Scott, 1895 is another doubtful record, because it is regarded as an acidic water species, mostly distributed to the Holarctic region, although some Neotropical records exist (Alonso, 1996). The tropical *A. pulchella* King, 1853 has been recorded from the Old World and Australia. This, and the record by Infante (1980) from Venezuela, should be revised, as well as both records of *Camptocercus* Baird, 1843.

Oxyurella tenuicaudis (G. O. Sars, 1862) is a Holarctic taxon. Neotropical species of the genus are *O. longicaudis* (Birge, 1910) and *O. ciliata* Bergamin, 1939, both recently recorded on the continent by Elías-Gutiérrez et al. (2006), so *O. tenuicaudis* from Cuba possibly is a misidentification.

Rajapaksa & Fernando (1987) established the genus *Notoalona* for the *Alona*-like chydorids with headpores represented by two bean-like thickenings. Two species have been recorded near Cuba, *N. freyi* Rajapaksa & Fernando, 1987 described from Florida, and *N.* cf. *globulosa* Daday, 1898, found near the Mexican Gulf coast by Elías-Gutiérrez et al. (2001). The latter authors concluded that *N.* cf. *globulosa* could in reality be related to "*Alonella*" *sculpta* G. O. Sars, 1901 described from Ipiranga (Brazil) by Sars (1901), a taxon not yet clarified and described in detail.

According to Kotov (2003), *Leydigia leydigi* (Schoedler, 1863) is restricted to the Palearctic. Cuban material, if related with *L. leydigi*, could be *L. louisi* Jenkin, 1934 described from Africa and then found in the Americas from Mexico to Argentina. The other *Leydigia*, *L. acanthocercoides* (Fischer, 1854) is restricted to the Old World, but it has been commonly confused with *L.* cf. *striata* Biraben, 1939 found on the Gulf Plateau of Mexico and the Yucatan Peninsula (Kotov et al., 2003). Keeping in mind the close geographical position of these regions to Cuba, and the affinity found in other species from Yucatan (i.e., *Moina dumonti* Kotov, Elías-Gutiérrez & Granados-Ramírez, 2005), it is more possible to find *L.* cf. *ciliata* or *L. striata* than *L. acanthocercoides* on the island.

General remarks

From the total number of species (70), about 32% require confirmation or are doubtful records. Actually, a new survey through the entire island is needed to actualize this list, and most probably many new records could be found. It should be pointed out that cladoceran systematics significantly improved during the last decade, when more than 50 new species have been described. Additionally, two new families, one suborder, and an extinct order have been proposed (Dumont & Silva-Briano, 1998; Santos-Flores & Dodson, 2003; Van Damme et al., 2007; Kotov, 2007).

From a biogeographical point of view, we can say in general terms that the fauna of Cuba is closely related to that of southern Mexico, and both regions have a close similarity to South America. Records such as *Pseudosida ramosa* (Daday, 1904), four species of *Chydorus* Leach, 1816, *Ephemoroporus hybridus* (Daday, 1905), *Euryalona occidentalis* (Daday, 1898), *Dunhevedia odontoplax* G. O. Sars, 1901, *Alona monacantha* G. O. Sars, 1901, *Alona verrucosa* G. O. Sars, 1901, and *Leydigiopsis ornata* Daday, 1905 have a clear South American affinity that extends towards Central America and the southern lowlands of Mexico. In this case, the distribution of these and related species seems to be similar to that of cyclopine copepods discussed by Suárez-Morales et al. (2004). The Proto-Antilles-Central America complex played a key role in the actual distribution of the species found on the continental part and the Greater Antilles, among which Cuba is the most diverse representative (Suárez-Morales et al., 2004).

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