

How many species of cladocerans (Crustacea, Branchiopoda) are found in Brazilian Federal District?

Quantas espécies de cladóceros (Crustacea, Branchiopoda) são encontradas no Distrito Federal?

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Abstract: Aim: This study aimed provides a checklist of cladocerans and also an evaluation of richness and species composition in the Federal District, Brazil. **Methods:** Checklist of cladocerans was obtained evaluating data from the literature, from taxonomic collection (Elmoor-Loureiro's collection) and from fauna surveys conducted over more than three decades in different types of aquatic environments. **Results:** The 57 water bodies studied showed 56 species, of which 14 are new records. The number of species contained in the list displayed corresponds to 85% of what was expected for richness estimators. The highest number of species was observed in the lentic water bodies (52), which also presented the specific composition of fauna ($R = 0.110$; $p = 0.016$), possibly because there were samples taken among the aquatic vegetation. According to our understanding, some species may be subject to local extinctions because they inhabit water bodies located exclusively in urban areas, which can lead to a decline in richness. **Conclusion:** Thus, the results of this study can assist in monitoring aquatic environments and in selection of new areas for surveys of cladocerans in the Federal District.

Keywords: Chydoridae, lentic, local extinctions, lotic, richness.

Resumo: Objetivo: Este estudo objetivou fornecer uma checklist de cladóceros e também uma avaliação da riqueza e composição de espécies no Distrito Federal, Brasil. **Métodos:** A checklist de cladóceros foi obtida utilizando dados encontrados na literatura, dados de coleção (coleção de Elmoor-Loureiro) e dados de levantamentos faunísticos realizados por mais de três décadas em diferentes tipos de ambientes aquáticos. **Resultados:** Os 57 corpos d'água avaliados apresentaram 56 espécies das quais 14 são novos registros. O número de espécies contido na lista apresentada corresponde a 85% do esperado por estimadores de riqueza. O maior número de espécies foi observado no conjunto de corpos d'água lênticos (52), que também apresentou composição específica de fauna ($R = 0.110$; $p = 0.016$), possivelmente, por amostragens realizadas entre a vegetação aquática. Segundo nosso entendimento, algumas espécies podem estar sujeitas a extinções locais por habitarem corpos d'água localizados exclusivamente em áreas urbanas, o que pode levar ao declínio da riqueza. **Conclusão:** Desta maneira, os resultados deste estudo podem auxiliar no monitoramento de ambientes aquáticos e na seleção de novas áreas para levantamentos da fauna de cladóceros no Distrito Federal.

Palavras-chave: Chydoridae, lêntico, extinções locais, lótico, riqueza.

1. Introduction

Cladocerans are microcrustaceans that inhabit predominantly continental waters. These animals have an important ecological role, functioning as a link between different trophic levels, since they act as scrapers, filterers and collectors of organic matter. According to Forró et al. (2008), there are

approximately 600 species worldwide, of which just over 19% can be found in Brazil.

By the beginning of the last decade, many gaps had been recognized in the diversity and distribution of species of cladocerans in Brazil (Elmoor-Loureiro, 2000). However, in recent years, these gaps have

been reduced by the increasing number of studies that have resulted in a consistent species list, and also studies showing records of species not previously known in the country (*e.g.* Velho et al., 2000; Elmoor-Loureiro, 2002; Elmoor-Loureiro et al., 2004, 2009; Santos-Wisniewski et al., 2001, 2002, 2008; Serafim Junior et al., 2003; Zanata et al., 2003; Guntzel et al., 2004; Sinev et al., 2005; Lopes et al., 2006; Lansac-Tôha et al., 2009; Sousa et al., 2009, 2010; Van Damme and Dumont, 2010; Elmoor-Loureiro and Soares, 2010; Ghidini and Santos-Silva, 2011; Sousa and Elmoor-Loureiro, 2011). The descriptions of new species have also contributed to a better understanding of the biodiversity of these microcrustaceans in Brazilian territory (Sinev and Hollwedel, 2002; Kotov and Elmoor-Loureiro, 2008; Sinev and Elmoor-Loureiro, 2010; Bekker et al. 2010; Van Damme et al., 2011).

The increase in the number of taxa, new records of occurrence and the need to make the information more widely available, since it has so far been restricted to the “gray literature” and in collections, have led to the publication of updated lists of species of cladocerans for some Brazilian states (Soares and Elmoor-Loureiro, 2011; Rocha et al., 2011; Santos-Wisniewski et al., 2011). Lists such as these provide important bases for new investigations, whether in the field of biogeography, ecology or conservation. Other Brazilian regions, including the Federal District, still need an updated list of species of cladocerans.

Currently, knowledge about cladocerans fauna in the Federal District is found in 11 publications, which indicate the occurrence of 39 species (Elmoor-Loureiro, 1988, 1989, 1997, 2000, 2002; Starling, 2002; Elmoor-Loureiro et al., 2004, 2009; Elmoor-Loureiro and Mendonça-Galvão, 2008; Sousa et al., 2010; Sousa and Elmoor-Loureiro, 2011). These studies have gradually been increasing the number of known species, especially due to the large number of environments studied and the greater attention given to the littoral zone. It should be noted that some of these studies have focused predominantly on plankton of lakes and reservoirs.

However, the Federal District has a large network of small and medium lotic systems that conduct these water bodies to the three major Brazilian hydrographic basins (São Francisco, Paraná and Tocantins/Araguaia), besides the occurrence of the many water bodies, shallow, permanent and temporary (Padovesi-Fonseca, 2005). Most of these environments were not sampled, suggesting that the

number of species of cladocerans for the Federal District is underestimated.

Another matter of concern is the reduction of natural areas in the Federal District, resulting in decreased quality of aquatic habitats, with the potential effect of confinement of elements of the biota in areas for conservation. However, according to Agostinho et al. (2005), these are poorly studied from the viewpoint of aquatic biota, which represents a gap in knowledge.

Seeking to fill the gap in the knowledge of aquatic biota in the Federal District, in the last six years, projects have been carried out by the Grupo de Estudos de Ecossistemas Aquáticos (GEEA), from the Catholic University of Brasília, in different kinds of water bodies, including the ones located in areas for conservation. Using the results of these projects, data from published studies and data contained in the Elmoor-Loureiro scientific collection, at the Laboratory of Aquatic Biodiversity of the Catholic University of Brasília, this study aimed to compile the knowledge about the fauna of cladocerans in the Federal District. Another objective was to carry out the assessment of richness and taxonomic composition of this fauna.

2. Methods

Initially, we evaluated 11 publications on the cladocerans of the Federal District (mentioned in the introduction). To the list of species were added data from the analysis of samples collected between 1978 and 2009, from the projects developed by GEEA and several samples deposited in the collection of Elmoor-Loureiro (Aquatic Biodiversity Laboratory, Catholic University of Brasília).

Altogether, data referring to 57 water bodies were considered, including lotic and lentic systems (Table 1). Richness was evaluated using rarefaction and non-parametric estimators of species richness. The estimated values were obtained using the software EstimateS (Colwell, 2009), with the richness estimated by averaging the values for ICE, Chao 2 and Jackknife 1 (formulas in Gotelli and Colwell, 2010).

Water bodies were separated into different categories according to the kind of environment and the occurrence in protected areas. Lotic water bodies were represented by rivers and streams, and lentic water bodies by reservoirs, dams, ponds and shallow lakes. For standardization purposes, protected areas were considered to be water bodies inside or partly inside ecological parks and permanent protected areas (Table 1).

Table 1. List of water bodies sampled in the Federal District, codes and geographical coordinates. EL = Elmoor-Loureiro collection; GEEA = data from research projects conducted by Grupo de Estudos em Ecossistemas Aquáticos.

Code	Sites	Geographic coordinates	Waterbody type	Protected area	Source
1	Garças Pond	15° 50' 47" S, 47° 56' 23" W	Lentic		Present study - EL
2	Temporary Pond	15° 53' 34" S, 47° 54' 55" W	Lentic	APA-Gama-Cabeça-de-Veado	Present study - EL
3	Malacology Tanque	15° 45' 5" S, 47° 52' 9" W	Lentic		Present study - EL
4	Hypopotamos Lagoon	15° 50' 49.1" S, 47° 56' 33.0" W	Lentic		Present study - EL
5	Macacos Lagoon	15° 51' 02.0" S, 47° 56' 11.2" W	Lentic		Present study - EL
6	Telestar Pond	15° 46' 9" S, 47° 51' 17" W	Lentic		Present study - EL
7	Jaburu Pond	15° 47' 49" S, 47° 50' 13" W	Lentic		Present study - EL
8	Águas Claras Dam	15° 50' 07.8" S, 48° 01' 30.6" W	Lentic	Parque Águas Claras	Present study - EL
9	Bananal Pond	15° 42' 32" S, 48° 0' 25" W	Lentic	Parque Nacional de Brasília	Present study - EL
10	Acampamento Dam	15° 44' 53.0" S, 47° 57' 49.1" W	Lentic	Parque Nacional de Brasília	Present study - EL
11	Península Norte Pond	15° 43' 30" S, 47° 51' 48" W	Lentic		Present study - EL
12	Parque da Cidade Pond	15° 48' 3" S, 47° 54' 25" W	Lentic		Present study - EL
13	Funda Pond	15° 38' 19" S, 47° 41' 8" W	Lentic		Present study - EL
14	Torto Dam	15° 41' 44" S, 47° 54' 47.81" W	Lentic		Present study - EL
15	Bonita Pond	15° 35' 22.1" S, 47° 41' 50.1" W	Lentic	Estação Ecológica de Águas Emendadas	Present study - EL
16	Barraginha Pond	15° 58' 12.1" S, 47° 55' 58.3" W	Lentic	APA-Gama-Cabeça-de-Veado	Elmoor-Loureiro and Mendonça-Galvão (2008)
17	Cedro Pond	15° 53' 49.7" S, 47° 56' 36.6" W	Lentic	APA-Gama-Cabeça-de-Veado	Starling (2000)
18	Gansos Pond	15° 40' 33.1" S, 47° 41' 37.4" W	Lentic		Present study - GEEA
19	Taquara Pond	15° 38' 12.4" S, 47° 31' 22.0" W	Lentic		Present study - GEEA
20	Azul Pond	15° 52' 33.02" S, 47° 43' 39.71" W	Lentic		Present study - GEEA
21	Joaquim Medeiros Pond	15° 38' 15.9" S, 47° 41' 29.5" W	Lentic		Present study - GEEA
22	Carás Pond	15° 38' 33.0" S, 47° 41' 0.75" W	Lentic		Present study - GEEA
23	Henrique Pond	15° 41' 18.00" S, 47° 56' 26.10" W	Lentic	Parque Nacional de Brasília	Present study - GEEA
24	Exército Pond	15° 44' 44.30" S, 47° 58' 49.10" W	Lentic	Parque Nacional de Brasília	Sinev and Elmoor-Loureiro (2010)
25	Meandros Pond	15° 43' 29.80" S, 47° 58' 08.90" W	Lentic	Parque Nacional de Brasília	Present study - GEEA
26	Murunduns Pond	15° 46' 48.10" S, 47° 58' 42.20" W	Lentic	Parque Nacional de Brasília	Present study - GEEA
27	Peito de Moça Pond	15° 45' 05.08" S, 48° 01' 33.20" W	Lentic	Parque Nacional de Brasília	Present study - GEEA

Table 1. Continued...

Code	Sites	Geographic coordinates	Waterbody type	Protected area	Source
28	Paranoá Reservoir	15° 43' 47" S, 47° 52' 58" W	Lentic		Present study - EL Elmoor-Loureiro (1988, 1989, 2000, 2002) Elmoor-Loureiro et al. (2004)
29	Estabilização Caesb	15° 50' 15" S, 48° 57' 41.58" W	Lentic		Starling (2000)
30	Descoberto Reservoir	15° 45' 1" S, 48° 11' 11" W	Lentic		Starling (2000) Present study - EL Starling (2000)
31	Santa Maria Reservoir	15° 40' 17" S, 47° 57' 15" W	Lentic	Parque Nacional de Brasília	Starling (2000)
32	Divisor de Águas Pond	15° 34' 32.4" S, 47° 36' 26.1" W	Lentic	Estação Ecológica de Águas Emendadas	Present study - GEEA
33	Gama Dam	15° 57' 26.6" S, 47° 58' 30.2" W	Lentic	APA-Gama-Cabeça-de-Veado	Present study - GEEA
34	Águas Claras Stream	15° 50' 07.8" S, 48° 01' 30.6" W	Lotic	Parque Águas Claras	Present study - EL
35	Riacho Fundo Stream	15° 51' 4.8" S, 47° 55' 55.6" W	Lotic		Present study - EL
36	Bananal Stream	15° 44' 51.24" S, 48° 0' 33.27" W	Lotic	Parque Nacional de Brasília	Present study - EL
37	Capetinga das Águas Stream	15° 55' 21.25" S, 47° 58' 56.43" W	Lotic	APA-Gama-Cabeça-de-Veado	Present study - EL
38	Capetinga Stream	15° 57' 40.6" S, 47° 56' 36.7" W	Lotic	APA-Gama-Cabeça-de-Veado	Present study - GEEA
39	Meio Stream	15° 41' 54.9" S, 47° 42' 48.5" W	Lotic		Present study - GEEA
40	Rêgo Stream	15° 37' 21.8" S, 47° 36' 52.5" W	Lotic		Present study - GEEA
41	Mestre D'armas Stream	15° 35' S-15° 39' S, 47° 38' W-47° 40' W	Lotic	Partly in the Estação Ecológica de Águas Emendadas	Present study - GEEA Sousa and Elmoor-Loureiro (2011)
42	Papuda	15° 53' S-15° 54' S, 47° 44' W	Lotic		Present study - GEEA
43	Quinze Stream	15° 41' 71.7" S, 47° 36' 84.9" W	Lotic	Parque dos Pequizeiros	Present study - GEEA
44	Sarandi Stream	15° 35' 42.3" S, 47° 44' 45.2" W	Lotic		Present study - GEEA
45	Sobradinho Stream	15° 38' S-15° 43' S, 47° 40' W-47° 45' W	Lotic		Present study - GEEA
46	Taboaca Stream	15° 51' S-15° 52' S, 47° 43' W-47° 44' W	Lotic		Present study - GEEA
47	Brejinho Stream	15° 35' 42.3" S, 47° 37' 12.9" W	Lotic		Present study - GEEA
48	Monteiro Stream	15° 34' 38.6" S, 47° 39' 31.7" W	Lotic		Present study - GEEA
49	Olaria Stream	15° 35' 33.8" S, 47° 37' 20.9" W	Lotic		Present study - GEEA
50	Vereda Grande Stream	15° 32' 32.1" S, 47° 34' 40.8" W	Lotic		Present study - GEEA
51	Lagoa Bonita Stream	15° 35' 57.6" S, 47° 41' 46.4" W	Lotic	Estação Ecológica de Águas Emendadas	Present study - GEEA
52	Gama Stream	15° 56' S-15° 57' S, 47° 56' W-47° 58' W	Lotic	APA-Gama-Cabeça-de-Veado	Present study - GEEA
53	Pipiripau Stream	15° 33' S-15° 39' S, 47° 30' W-47° 38' W	Lotic		Present study - GEEA
54	Jacararé Stream	15° 38' 32.3" S, 47° 21' 18.3" W	Lotic		Present study - GEEA
55	Paranoá Stream	15° 47' 17.1" S, 47° 45' 25.0" W	Lotic		Present study - GEEA
56	Preto River	15° 33' S-15° 57' S, 47° 15' W-47° 22' W	Lotic		Present study - GEEA
57	São Bartolomeu River	15° 40' S-15° 56' S, 47° 49' W	Lotic		Present study - GEEA

The categories formed by the kind of environment were compared by rarefaction analysis for the richness data, using EstimateS software (Colwell, 2009). ANOSIM (one-way) was applied to the data to evaluate whether there are significant differences in composition species between the kinds of environment (Clarke, 1993). This analysis was based on Jaccard coefficient, using PAST software (Hammer et al., 2001). NMDS (Non-metric Multidimensional Scaling) was used for ordination of the studied environments.

3. Results

Using data from the literature, from faunal inventories and from collection, the occurrence of 56 species distributed in the families Sididae, Moinidae, Daphniidae, Bosminidae, Ilyocryptidae, Macrothricidae and Chydoridae (Table 2) was recorded. The family Chydoridae presented the highest richness (33 spp), followed by Daphniidae (7 spp), Sididae, Bosminidae and Macrothricidae with four species each, Ilyocryptidae (3 spp) and Moinidae with one species.

The rarefaction analysis for the Federal District indicated that the sampling effort was not enough to stabilize the accumulation curve, and that the richness may be higher than observed (Figure 1). The estimators of species richness used confirmed this trend, showing an average of 65 species expected for the Federal District.

Most species listed in Table 2 had been reported in the literature for the Federal District, but we recorded the occurrence of 14 new taxa. The species

recorded here for the first time showed reduced occurrence in the water bodies investigated, with the exception of *Alona ossiani* (Table 2). The species with the highest occurrence among water bodies evaluated were *Acroperus tupinamba*, *Alona guttata*, *Alona iheringula*, *Alonella clathratula*, *Alonella dadayi* and *Ilyocryptus spinifer*. All were present in approximately in 30% of the water bodies investigated.

Regarding the kind of environment, species richness was significantly higher in lentic (52 spp) compared to lotic water bodies (30 spp), although stabilization of accumulation curves in rarefaction analysis was not observed (Figure 2). This is a result of the large number of unique species occurring in the lentic water bodies, for example, *Diaphanosoma brevireme*, *Ceriodaphnia silvestrii*, *Bosminopsis deitersi*, *Macrothrix paulensis* and *Alona setigera*.

The number of exclusive species in the lentic water bodies, presumably, was responsible for the ordination observed in NMDS (Figure 3) and results of the ANOSIM, which indicated that the composition of fauna was different between the kinds of environment investigated ($R = 0.110$; $p = 0.016$). The fauna found in lotic water bodies is probably a subset of lentic environments.

4. Discussion

According to Figure 1, the sampling effort was not enough to reach the number of species expected for the Federal District. Although results show that the sampling effort was not enough to reach the number of species expected for the Federal

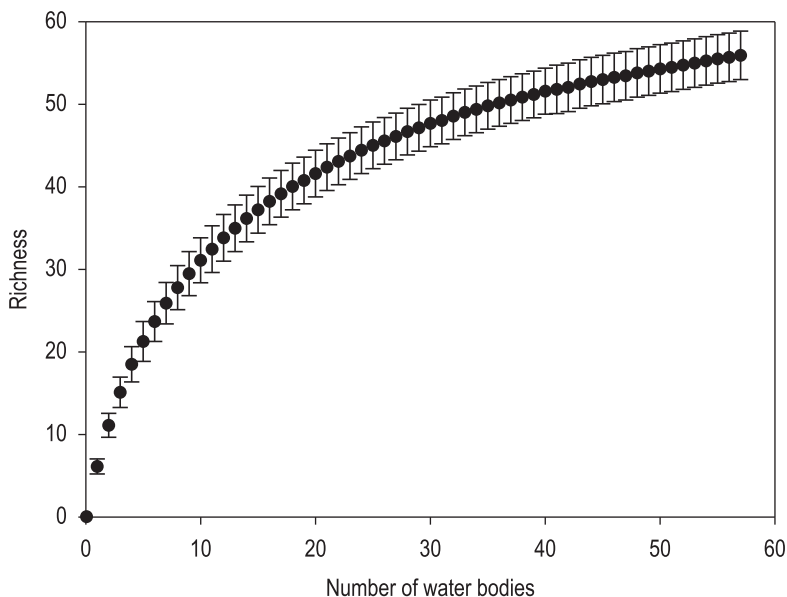


Figure 1. Rarefaction analysis based on the number of water bodies sampled in the Federal District, Brazil.

Table 2. Checklist of the cladocerans species from the Federal District with occurrence of each species in water bodies.

Taxa	Occurrence
Ctenopoda	
Sididae Baird, 1850	
<i>Diaphanosoma birgei</i> Kořínek, 1891	4, 5, 15, 30
<i>Diaphanosoma brevireme</i> Sars, 1901	28
<i>Diaphanosoma spinulosum</i> Herbst, 1967	21, 28, 57
<i>Latonopsis australis</i> -group	15, 21, 22, 23
Anomopoda	
Moinidae Goulden, 1968	
<i>Moina micrura</i> Kurz, 1874	1, 2, 4, 5, 8, 12, 28, 29, 30, 31, 35
Daphniinidae Straus, 1820	
<i>Ceriodaphnia cornuta</i> Sars, 1886	15, 18, 22, 23, 28, 31
* <i>Ceriodaphnia reticulata</i> (Jurine, 1820)	15
<i>Ceriodaphnia silvestrii</i> Daday, 1902	15, 28
<i>Daphnia gessneri</i> Herbst, 1967	28, 30
<i>Simocephalus latirostris</i> Stingelin, 1906	41
<i>Simocephalus semiserratus</i> Sars, 1901	15
<i>Simocephalus serrulatus</i> (Kock, 1841)	15, 21, 28, 41
Bosminidae Sars, 1865	
<i>Bosmina freyi</i> Melo & Hebert, 1994 (<i>Bosmina longirostris</i>)	8, 11, 21, 28, 45
<i>Bosmina hagmanni</i> Stingelin, 1904	7, 12, 30, 31
<i>Bosmina tubicen</i> Brehm, 1953	11, 14, 15, 28, 30, 31
<i>Bosminopsis deitersi</i> Richard, 1895	15, 28
Ilyocryptidae Smirnov, 1992	
<i>Ilyocryptus paranaensis inarmatus</i> Kotov, Eliáz-Gutiérrez & Gutiérrez-Aguirre, 2001	41
<i>Ilyocryptus sarsi</i> Stingelin, 1913 (<i>Ilyocryptus sordius</i>)	17, 25
<i>Ilyocryptus spinifer</i> Herrick, 1882	6, 10, 11, 13, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 27, 28, 31, 33, 34, 37, 41, 42, 43, 44, 45, 46, 53, 56, 57
Macrothricidae Norman & Brady, 1867	
<i>Macrothrix elegans</i> Sars, 1901 (<i>Macrothrix triserialis</i>)	11, 15, 17, 18, 19, 28, 41, 45, 53, 56
<i>Macrothrix paulensis</i> (Sars, 1900)	15, 22, 23, 24
<i>Macrothrix squamosa</i> Sars, 1901 (<i>Macrothrix laticornis/spinosa</i>)	3, 6, 15, 17, 19, 21, 22, 51
<i>Streblocerus pygmaeus</i> Sars, 1901	15, 20, 21, 22, 24, 26
Chydoridae Stebbing, 1902	
<i>Acroperus tupinamba</i> Sinev & Elmoor-Loureiro, 2010 (<i>Acroperus harpae</i>)	10, 11, 14, 15, 17, 18, 19, 27, 31, 33, 37, 38, 39, 41, 44, 45, 47, 49, 53, 57
* <i>Alona dentifera</i> (Sars, 1901)	23, 56
<i>Alona glabra</i> (Sars, 1901) (<i>Alona cambouei</i>)	28
<i>Alona guttata</i> Sars, 1862	14, 15, 18, 19, 33, 34, 38, 39, 40, 41, 44, 45, 46, 47, 49, 51, 53, 57
<i>Alona iheringula</i> Sars, 1901 (<i>Alona rustica</i>)	6, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 43, 47, 49
<i>Alona intermedia</i> Sars, 1862 (<i>Biapertura intermedia</i>)	10, 11, 15, 18, 19, 20, 21, 23, 24, 34, 36, 45, 47, 49, 53
* <i>Alona ossiani</i> Sinev, 1998 (<i>Biapertura affinis</i>)	10, 15, 17, 18, 19, 21, 23, 24, 25, 26, 27, 32, 43
* <i>Alona setigera</i> Brehm, 1931	17, 23, 24, 26, 27
<i>Alona yara</i> Sinev & Elmoor-Loureiro, 2010 (<i>Alona quadrangularis</i>)	9, 33, 39, 41, 44, 45, 49, 50, 51, 53, 57
<i>Alonella clathratula</i> Sars, 1896	13, 14, 15, 16, 19, 21, 23, 24, 25, 26, 32, 38, 41, 44, 47, 53, 57
<i>Alonella dadayi</i> Birge, 1879 (<i>Disparalona dadayi</i>)	15, 16, 17, 18, 19, 23, 24, 25, 26, 31, 37, 38, 39, 40, 44, 45, 47, 49, 51, 53, 57
<i>Anthalona verrucosa</i> (Sars, 1901) (<i>Biapertura verrucosa</i>)	10, 15, 17, 18, 19, 21, 22, 23, 24, 25, 30, 44, 53, 56, 57

*new report for the Federal District. Species names in parentheses correspond to names found in Elmoor-Loureiro (1997).

Table 2. Continued...

Taxa	Occurrence
* <i>Camptocercus australis</i> Sars, 1896 (<i>Camptocercus dadayi</i>)	56
<i>Celsinotum candango</i> Sinev & Elmoor-Loureiro, 2010	23, 24
<i>Chydorus dentifer</i> Daday, 1905	15, 17, 18, 37
<i>Chydorus eurynotus</i> Sars, 1901	15, 18, 19, 20, 21, 23, 24, 53, 56
<i>Chydorus pubescens</i> Sars, 1901	5, 15, 17, 18, 19, 10,21,22, 23, 28,56
* <i>Coronatella poppei</i> Richard, 1897 (<i>Alona poppei</i>)	28, 45,54, 57
* <i>Disparalona leptorhyncha</i> Smirnov, 1996	15, 18, 21
<i>Ephemeroporus barroisi</i> (Richard, 1894)	13, 15, 17, 18, 21, 22, 23, 24, 25, 26, 51
* <i>Ephemeroporus hybridus</i> (Daday, 1905)	17,19, 37
* <i>Ephemeroporus</i> sp.	21, 23, 24
<i>Euryalona orientalis</i> (Daday, 1898)	28
<i>Graptoleberis occidentalis</i> Sars, 1901 (<i>Graptoleberis testudinaria</i>)	10, 15, 23, 24
<i>Karualona muelleri</i> (Richard, 1897) (<i>Biapertura karua</i>)	21, 23, 24, 26
<i>Kurzia polyspina</i> Hudec, 2000	28
* <i>Leydigia striata</i> Baribén, 1939	28
* <i>Leydigiopsis curvirostris</i> Sars, 1901	22, 23, 53
* <i>Leydigiopsis ornata</i> Daday, 1905	53
* <i>Nicsmirnovius</i> sp.	17, 34, 41, 44, 45, 46, 53, 56, 57
* <i>Notoalona sculpta</i> (Sars, 1901)	23
<i>Oxyurella ciliata</i> Bergamin, 1939	15, 53
<i>Parvalona parva</i> (Daday, 1905) (<i>Alona parva</i>)	15, 21

*new report for the Federal District. Species names in parentheses correspond to names found in Elmoor-Loureiro (1997).

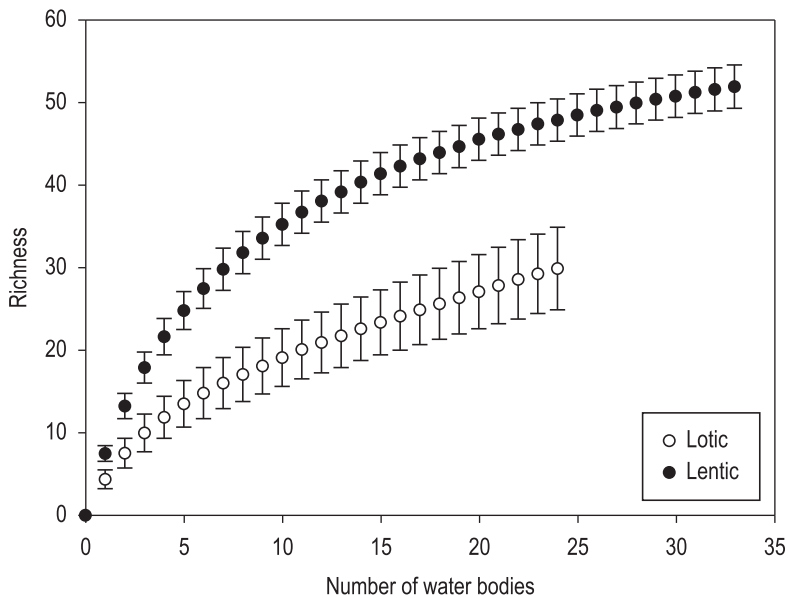


Figure 2. Comparison of the richness of cladocerans between lentic and lotic water bodies using rarefaction analysis.

District, average estimate of richness is very close to that found in this inventory, which, according to Heck et al. (1975), implies a good survey of species once more than 70% of the expected number of species was found. However, it is clear that the number of water bodies studied influenced the number of species, which is the main factor for the

new species included in the inventory and increased occurrence of species of cladocerans already reported in the literature (Table 2).

The relationship described above can be better understood for *Alona dentifera*, *Alona yara* and *Nicsmirnovius* sp. In the case of the first species, the records were obtained by sampling in poorly studied

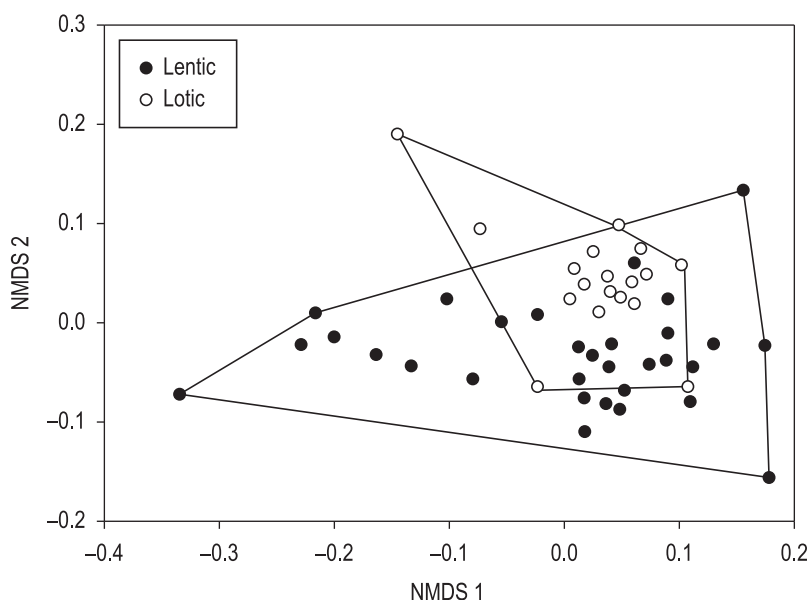


Figure 3. Non-metric multidimensional scaling analysis (NMDS) ordered according to Jaccard index for lentic and lotic water bodies. Stress = 0.3.

environments in the Federal District, which are the lotic systems and wetlands. According to Sinev and Elmoor-Loureiro (2010) *Alona yara* occurs in many kinds of environments, but in the Federal District, its occurrence is related to the number of lotic environments evaluated. The genus *Nicsmirnovius* is recognized as inhabiting the littoral zone of streams and rivers (Van Damme et al., 2003), and its occurrence in the Federal District was only known after systematic sampling in lotic systems. The specimens of *Nicsmirnovius* evaluated did not match any of the species already described, showing that they constitute a new species.

Although there was occurrence of some species exclusive to lotic systems, this kind of environment is considered less favorable to the establishment of cladocerans because of predation by fish and due to high water flow (Viroux, 2002), which suggests that life in lotic environments is related to some specializations and adaptation to turbulence (Dole-Olivier et al., 2000), qualities that are not very evident in the cladocerans.

On the other hand, lentic water bodies provide a better spatial structure, in many cases related to the littoral zone compartments and limnetic regions. In the case of the Federal District, most lotic water bodies found in Table 1 were sampled in the littoral zone and the higher richness in such environments must be a result of the spatial structure generated by aquatic macrophytes. These favor the occurrence of species with hugely variety of habits of life, from scrapers associated with vegetation (Fryer, 1968,

1974), to species that filter sediment organic (Kotov and Štifter, 2006) to species of the limnetic region (Fryer, 1991; Elmoor-Loureiro, 2007). It is likely that the distinctions between fauna in the two kinds of environments studied ($R = 0.110$; $p = 0.016$) was influenced by the characteristics mentioned above.

The current context, which is related to the loss of natural areas to agriculture, and especially to urban sprawl, is identified as a major factor in the process of extinctions of biota (Machado et al., 2006). In this study, some species were found only in water bodies outside protected areas, leading to their reduced occurrence in highly urbanized sites, as seen with *Leydigiopsis ornata* and *Ilyocryptus paranaensis inarmatus*, for example. The conservation status of these populations still requires better understanding, but it is possible that local extinctions may result in a decline in the number of species in the Federal District. The consequences are not yet clear because of the lack of monitoring in these areas. However, it is known that cladocerans act on the energy flow in water environments; namely, the decline in the number of species can lead to an imbalance in ecological processes related to interactions between different trophic levels.

Some species of cladocerans occurring in Brazilian water bodies are being submitted to changes in nomenclature or taxonomic position, and comments on these changes can be found in some already published studies (Sousa and Elmoor-Loureiro, 2008; Elmoor-Loureiro et al.,

2004, 2009; Soares and Elmoor-Loureiro, 2011). Some cases are fairly recent, and represent species recorded for the Federal District: the name *Acroperus harpae* was assigned to the only South American representative of the genus; however, Sinev (2009) revised the morphology of *A. harpae* from the type locality, in the Palearctic region, suggesting a problem of synonymy for other regions of the world. So Sinev and Elmoor-Loureiro (2010) reviewed the Brazilian populations of *A. harpae*, noting differences in size, morphology of the marginal setae and the morphology of the setae of Limb IV, indicative of a new species, which the authors named *Acroperustupinamba*.

Similarly, the redescription of *Alona quadrangularis* for the *terra typica* (Van Damme and Dumont, 2008a) helped in the conclusion that, in the Neotropics, the records of this species could reveal a new species. Brazilian populations named *A. quadrangularis* were reviewed and translocated to a new species, *Alona yara*, based mainly on the number of setules on the ventral surface of Limb I (Sinev and Elmoor-Loureiro, 2010).

The redescription of *Alona quadrangularis* was performed in order to delineate the morphology of the “true-*Alona*,” previously considered a genus of polyphyletic origin (Sacherová and Hebert, 2003). Since then, some complexes of species assigned to the genus *Alona-sensu lato* have been studied and new genera were created, such as *Phreatalona* corresponding to the *protzi*-complex (Van Damme et al., 2009), *Ovalona* and *Coronatella*, corresponding to the *rectangula*-complex (Van Damme and Dumont, 2008b), *Brancelia*, corresponding to the *hercegovinae*-complex (Van Damme and Sinev, 2011), and *Anthalona* that, currently, corresponds to the *verrucosa*-complex (Van Damme et al., 2011). The Brazilian records of *Alona verrucosa* now belong to the genus *Anthalona*.

The species *Simocephalus semiserratus*, was for some time treated as synonymous with *S. serrulatus* (e.g. Elmoor-Loureiro, 1997). However, the review performed by Orlova-Bienkowskaja (2001) raised the status of *Simocephalus semiserratus* to that of a valid species. Thus, the records of this species in the Federal District and in other regions of Brazil have become valid.

The results of this study broaden the number of water bodies studied in the Federal District, including sampling in lotic environments, an environment that showed less richness when compared to lentic water bodies. The species

composition was different in the various kinds of environments, and lentic water bodies possessed a specific composition of fauna, probably due to the influence of aquatic vegetation. Although we observed a high number of species, it is necessary to monitor the areas where species with reduced frequency of occurrence were found, so that there will be no decline in these populations. The information in this study can assist in monitoring and management of water bodies in the Federal District, contribute to knowledge of the richness and species composition of cladocerans and help to select areas for new inventories.

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