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Plants associated with aquatic and marshy environments in the state of Paraíba, northeastern Brazil

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Abstract

We present a list of aquatic and wetland plant species from the state of Paraíba, Brazil, based on the collections deposited in national and international herbaria. We identified 290 species belonging to 61 families. The checklist includes habit, localities of the collections in the state of Paraíba, and geographic distribution of each species. The amphibious habit was the most prevalent and the Sertão (semiarid inland region) was the region with the greatest collection effort. New occurrences have been registered for the state (14 species). Although our data reveal a high plant richness, we relate this richness to increased field expeditions.

Keywords: Tracheophytes, Aquatic Macrophytes, Conservation, Flora.

Plantas associadas a ambientes aquáticos e pantanosos no estado da Paraíba, Nordeste do Brasil

Resumo

Apresentamos uma lista de espécies de plantas aquáticas e de áreas úmidas do estado da Paraíba, Brasil, com base nas coleções depositadas em herbários nacionais e internacionais. Foram identificadas 290 espécies pertencentes a 61 famílias. A lista anotada inclui hábito, localidades das coleções no estado da Paraíba e distribuição geográfica de cada espécie. O hábito anfíbio foi o mais prevalente e o Sertão (região semi-árida) foi a região com maior esforço de coleta. Foram registradas 14 novas ocorrências para o estado. Embora nossos dados revelem alta riqueza de plantas, relacionamos essa riqueza com o incremento de pesquisas de campo.

Palavras-chave: Traqueófitas, Macrófitas Aquáticas, Conservação, Flora.

Introduction

Aquatic plants comprise lifeforms from macroscopic algae to submerged, floating, emergent or amphibious tracheophytes, the latter capable of surviving in the water, in swampy places or withstand periodic soil soaking (Chambers, Lacoul, Murphy & Thomaz, 2008; Padial, Bini & Thomaz, 2008). With this variety of lifeforms, this group presents several anatomical and functional adaptations, the result of great diversification from a taxonomic point of view (Sculthorpe, 1967; Esteves, 2011), and which draw the attention of researchers to carry out ecological and floristic studies.

The inventories related to aquatic/marshy environments are relatively recent, compared with typically terrestrial ecosystems, besides the majority of these studies are occasional (Machado-Filho, Cabral, Melo, Zickel & Moura, 2014). With the increase in knowledge about these floristic assemblies, in the first two decades of the 21st century, there has been a recognition of the ecological and economic importance of these organisms for water ecosystems (Chambers *et al*., 2008), and these studies are clarifying patterns of structure and composition of these floras.

Faced with scientific advances, Brazil still strives to quantify the floristic richness of its aquatic ecosystems, and there is already, for example, general preliminary list for the Northeast region of Brazil (Moura-Júnior *et al*., 2013). However, scientific publications based on fieldwork,

involving research on aquatic/marshy environments of plants for the state of Paraíba, are still scarce. (Araújo, Sabino, Cotarelli, Silva-Filho & Campelo, 2012; Lima, Machado-Filho & Melo, 2013; Torres, Fernando & Lucena, 2016). In addition, the research that has been published does not even cover the entire territorial dimensions of the state.

In view of these limitations, it is important to explore the collections deposited in herbaria, in order to complement these data and synthesize the regional list of species from aquatic/marshy environments in Paraíba. Such an effort is recommended not only for the purpose of organizing a checklist, based on richness data, but to qualitatively assess the data, for possible recognition of new occurrences or the identification of species with potential lifeforms in water or swampy conditions.

Thus, it is expected that when exploring herbarium collections, it will be possible to ascertain a more accurate number of species of aquatic/marshy environment plants collected for the state. Previous collection expeditions, presumably, lacked any intention of generating information about these floristic assemblies by their collectors, and thus, this information ended up marginalized.

Therefore, this work aims to expand information about plants associated with aquatic and marshy environments in the Northeast region of Brazil. A list of tracheophyte species, occurring in aquatic and swampy environments collected in the state of Paraíba is presented based on the examination of indexed herbarium collections. With this floristic list, data on habit, lifeforms and phytogeography of the registered species are also presented.

Materials and Methods

A preliminary survey was conducted in the collections of the herbaria JPB, EAN, ACAM and CSTR (acronyms according to Thiers, 2017, continuously updated). In addition, the database of the INCT Brazilian Virtual Herbarium of Plants and Fungi – INCT-HVFF (http://inct.splink.org.br) was consulted to find samples of aquatic plants from Paraíba deposited in other herbaria (ALCB, ASE, BHCB, CEN, CEPEC, CESJ, EAC, FCAB, FLOR, FUEL, HCDAL, HUCP, HUEFS, HUNI, HUTO, HVASF, HST, HTSA, HURB, HUFU, ICN, IAN, INPA, IPA, MAC, MBM, MOSS, NYBG, OBIS-BR, PACA, PEUFR, R, RBR, SP, SPF, SPSF, UESC, UFP, US, V and VIC). To save space only one voucher was highlighted in the table.

All specimens whose labels had collection records inside or on the shores of lakes, springs, rivers, streams, estuaries, floodplains, reservoirs and marshy environments were listed and different habits (submerged fixed, submerged free, emergent, floating fixed, floating free or amphibious) were determined according to Veloso *et al*. (1992). However, when the type of habit was not included in the exsiccatae, floristic-taxonomic articles or surveys of aquatic plants were consulted.

The species presented in Table 1 were recorded as identified in the herbarium, excluding those with doubtful identification ("cf." or "aff."). Families that presented a high number of specimens identified only up to genus level were highlighted in the text.

The taxonomic validation of the samples was based on a pre-existing identification on the exsiccate label by an expert in the group. When identification was doubtful, samples were identified based on the specific literature for each botanical group.

The correct spelling of each species name was verified through consultations of the online databases Flora do Brasil 2020 and The Plant List (2019). The delimitation of families followed the Angiosperm Phylogeny Group (APG IV, 2016).

The mesoregions in the territory of Paraíba (Figure 1) were listed according to Brasil (2007), and include the following: Mata (coastal region of hot-humid climate, in the Atlantic Forest domain and over the Barreiras Formation), Agreste (transition zone between the Atlantic Forest and the Caatinga, dominated by a hot-humid climate, preceding the Borborema Plateau), Borborema (region predominantly occupied by the Borborema Plateau) and Sertão (in the Caatinga domain, in a semiarid climate, with crystalline and sedimentary soils of the "Rio do Peixe" basin.

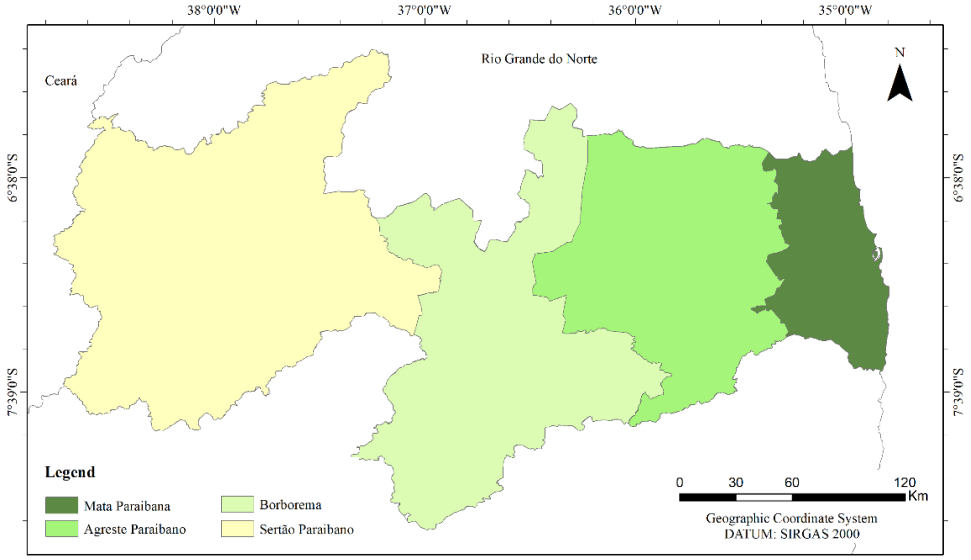

Figure 1. Map highlighting the mesoregions in the state of Paraíba.

To determine the geographic distribution of each species, the following sources were consulted: literature in aquatic plants (Hoehne, 1948; Irgang and Gastal-Jr, 1996; Pott and Pott, 2000; Amaral, Bittrich, Faria, Anderson & Aona, 2008; Lorenzi, 2008), regional Floras and the online databases of the Global Biodiversity Information Facility (2020), Global Invasive Species Data Base (2019), Tropicos (Mobot, 2019) and the Flora do Brasil 2020.

The species were classified into one of the following geographic distribution categories: Endemic (Caatinga, with connections between Cerrado and/or Atlantic Forest), Neotropical (distributed from Mexico to Argentina), American (restricted to the American continent), Gondwanian (encompassing the South American, African and Australian continents), Paleotropical (scattered in the African continent), Pantropical (those of the tropical climatic range), and Palearctic (associated with European continent), cultivated and with uncertain distribution.

Results and Discussion

From the herbaria, 483 exsiccatae that complied with the established criteria were cataloged. Another 91 specimens were recorded in the INCT-HVFF (2017), totaling 574 exsiccatae registered as "aquatic" or "marshy" collected in the state of Paraíba. Of these, 151 exsiccates were identified only to genus, 12 to family, and one remains undetermined.

In relation to the regions of the state of Paraíba, 192 specimens were collected in the Sertão, 98 in the Agreste, 91 in the Borborema and 61 in the Mata. Probably, the greater collection effort in the interior of Paraíba may be associated with the expansion of universities to the interior of Brazil at the beginning of the 20th century (Barros, 2015).

Few aquatic and marshy ecosystems have been the targets of scientific research in Paraíba. The Sertão presents the greatest collection effort due probably to the concern associated with water availability and the quality of its sources. On the other hand, the fact that the Mata region has fewer records could be related to the urbanization process that has intensified in recent years, de-characterizing the landscape and, consequently, causing the loss of habitats and local floristic diversity, including aquatic species.

We recorded 290 tracheophyte species, and 61 families (Table 1) associated with aquatic and marshy environments in Paraíba.

Of the species identified, only three of them are cultivated: *Bryophyllum pinnatum* (weed with potential for invasion of new areas, according to Giulietti *et al*, 2018), *Syzygium cumini* (tree with potential for invasion of new areas, according to Dias, Baptista, Mantoani, Holdefer & Torezan, 2013) and *Ocimum americanum*. Some selected species are shown in Figure 2.

Although the data collection efforts are different, comparing the data obtained here with the results presented by Moura-Júnior *et al*. (2013), who registered 261 species of aquatic plants in the state of Paraíba, this study found 10% more species (another 29 spp.). However, the actual species richness is probably still underestimated due to the low collection effort in the aquatic ecosystems of Paraíba in general.

New occurrences were recorded for the state of Paraíba (14 species), including: *Avicennia schaueriana* (Aviceniaceae), *Cyanthillium cinereum*, *Enydra radicans*, *Pluchea sagittalis* (Asteraceae), *Burmannia capitata* (Burmanniaceae), *Aniseia cernua*, *Ipomoea wrightii* (Convolvulaceae), *Astraea lobata*, *Caperonia palustris* (Euphorbiaceae), *Canavalia dictyota*, *Crotalaria retusa* (Fabaceae), *Syzygium cumini* (Myrtaceae), *Boerhavia diffusa* (Nyctaginaceae) and *Angelonia salicariifolia* (Plantaginaceae). Although several collections are registered in SPlink (2019), the Flora of Brasil (2020) did not include them in their records.

The most species-rich families were the following: Cyperaceae (48 spp.), Poaceae (45 spp.), Fabaceae (26 spp.), Asteraceae (22 spp.), Malvaceae (15 spp.) and Convolvulaceae (12 spp.). The other families contribute with less than 9 species each.

The predominance of Cyperaceae species corroborates the findings of Lima *et al*. (2009), who examined herbarium collections in the state of Pernambuco. In floristic studies, the predominance of this family in aquatic and swampy ecosystems is also confirmed, whether in areas of high altitudes (Díaz *et al*. 2008), subtropical (Rolon, Homem & Maltchik, 2010; Kafer, Colares & Hefler, 2011) or wet-to-dry transition regions (França *et al*., 2003; França *et al*., 2010; Meyer and Franceschinelli, 2011; Lima *et al*., 2013). According to Bove, Gil, Moreira & Anjos (2003), Cyperaceae is a perennial family that develops spatial dominance in environments, especially in dry periods. This fact is related to the cryptophytic biological spectrum of this group, which involves the development of structures that favor vegetative reproduction, such as tubers, rhizomes or stolons (Pott, Bueno, Pereira, Sallis & Vieira, 1989).

Poaceae also presents records of high richness in aquatic and marshy environments, regardless of climate, continentality and/or altitude (Kita and Sousa, 2003; Moreno-Casasola *et al*., 2010). The strategies of predominance of Poaceae resemble those described for Cyperaceae, with the two tending to be hegemonic in aquatic and marshy environments (Neves, Leite, França & Melo, 2006; Kozera, Kuniyoshi, Galvão & Curcio, 2009; Lima *et al*., 2009; França *et al*., 2010; Campelo, Siqueira-Filho & Cotarelli, 2013).

The notable presence of synanthropic species is associated with the fact that many aquatic environments are close to anthropogenic environments, such as cities, areas of animal husbandry, generally linked to pastures, which may have favored a high number of species of Cyperaceae, Poaceae, Asteraceae and Fabaceae (Henry-Silva, Moura & Dantas, 2010; Xavier, Araújo, Nascimento & Pereira, 2012; Pivari, Viana & Leite, 2013; Machado-Filho, Couto, Bezerra & Melo, 2015; Sabino, Araújo, Cotarelli, Siqueira-Filho & Campelo, 2015).

In relation to the lifeform, amphibious species predominated with 69,3% of the species (Figure 5), followed by emergent (12%), fixed submerged (10%), free floating (5,7%) and fixed floating (3%).

Table 1. List of species associated with aquatic and marshy environments in the state of Paraíba. Legend: fixed submerged (Sub. Fixed), free submerged (Sub. Free), floating fixed (Flut. Fixed), floating free (Flut. Free), emerged (Emer.) and amphibian (Amp.); (*) = new occurrences.

Family/Species	Habit	Life form	Phytogeography	*Voucher*
Acanthaceae				
Avicennia schaueriana Stapf & Leechm. ex Moldenke*	Shrub	Amp.	Neotropical	JPB 15949
Dicliptera mucronifolia Nees	Shrub	Amp.	Tropical	IPA 89888
Ruellia paniculata L.	Shrub	Amp.	Tropical	HVASF 17673
Aizoaceae				
Sesuvium portulacastrum (L.) L.	Herb.	Amp.	Pantropical	PEUFR 52348
Amaranthaceae				
Alternanthera brasiliana (L.) Kuntze	Herb.	Amp.	Pantropical	HVASF 20275
Alternanthera tenella Colla	Herb.	Amp.	Tropical	JPB 42622
Amaranthus deflexus L.	Herb.	Amp.	Cosmopolitan	PEUFR 52184
Blutaparon portulacoides (A.St.-Hil.) Mears	Herb.	Amp.	Tropical	IPA 89451
Alismataceae				
Echinodorus glandulosus Rataj.	Herb.	Emer.	Endemic Caa.	ICN 131148
Echinodorus grandiflorus (Cham. & Schltdl.) Micheli	Herb.	Emer.	Neotropical	JPB 19994
Echinodorus lanceolatus Rataj	Herb.	Emer.	Endemic Caa/Cer	EAN 11166
Echinodorus palaefolius (Ness & Mart.) J.F.Marcbr.	Herb.	Emer.	Tropical	HUEFS 221779
Echinodorus subalatus (Mart.) Griseb.	Herb.	Emer.	Tropical	JPB 30450
Helanthium tenellum (Mart. ex Schult.f.) J.G.Sm.	Herb.	Amp.	Tropical	HST 15203
Hydrocleys martii Seub.	Herb.	Flut. Fixed	Endemic Caa/Atl	JPB 26210
Hydrocleys modesta Pedersen	Herb.	Flut. Fixed	Tropical	SP 328556
Hydrocleys nymphoides (Humb. & Bonpl. ex Willd.) Buchenau	Herb.	Flut. Fixed	Tropical	JPB 26323
Hydrocleys parviflora Seub.	Herb.	Amp.	Tropical	UFP 21284
Limnocharis flava (L.) Buchenau	Herb.	Emer.	Tropical	EAN 12148
Limnocharis laforesti Duchass. ex Griseb.	Herb.	Emer.	Tropical	SP 68246
Sagittaria lancifolia L.	Herb.	Emer.	Tropical	NYBG 393818
Apiaceae				
Centella asiatica (L.) Urb.	Herb.	Amp.	Cosmopolitan	JPB 17326
Apocynaceae				
Calotropis procera (Airton) W. T. Airton	Shrub	Amp.	Pantropical	PEUFR 52113
Funastrum clausum (Jacq.) Schltr.	Liana	Amp.	Tropical	HVASF 8429
Araceae				
Lemna aequinoctialis Welw.	Herb.	Flut. Free	Cosmopolitan	EAC 35783
Lemna minor L.	Herb.	Flut. Free	Cosmopolitan	JPB 17448
Lemna valdiviana Phil.	Herb.	Flut. Free	American	EAN 9128
Montrichardia linifera (Arruda) Schott	Herb.	Emer.	Tropical	PEUFR 52221
Pistia stratiotes L.	Herb.	Flut. Free	Cosmopolitan	NYBG 02674654
Wolffia brasiliensis Wedd.	Herb.	Flut. Free	American	JPB 37428
Araliaceae				
Hydrocotyle leucocephala Cham. & Schltdl.	Herb.	Amp.	Tropical	RBR 27506
Hydrocotyle verticillata Thunb.	Herb.	Amp.	Cosmopolitan	JPB 41882
Asteraceae				
Acanthospermum hispidum DC.	Herb.	Amp.	Cosmopolitan	IPA 57026
Acmella ciliata (Kunth) Cass.	Herb.	Amp.	Tropical	IPA 67908
Acmella uliginosa (Sw.) Cass.	Herb.	Amp.	Pantropical	HVASF 5104
Ageratum conyzoides (L.) L.	Herb.	Amp.	Cosmopolitan	PEUFR 52243
Blainvillea acmella (L.) Philipson	Herb.	Amp.	Pantropical	CSTR 5923
Centratherum punctatum Cass.	Herb.	Amp.	Pantropical	PEUFR 52300
Cyanthillium cinereum (L.) H.Rob.*	Herb.	Amp.	Pantropical	IPA 89421
Eclipta prostrata (L.) L.	Herb.	Amp.	Cosmopolitan	CSTR 5792
Egletes viscosa (L.) Less.	Herb.	Amp.	Neotropical	HVASF 16099
Emilia sonchifolia (L.) DC. ex Wight	Herb.	Amp.	Pantropical	PEUFR 53455
Enydra radicans (Willd.) Lack*	Herb.	Emer.	Tropical	HUEFS 221798
Erechtites hieracifolius (L.) Raf. Ex DC	Herb.	Amp.	Tropical	PEUFR 53495
Lagascea mollis Cav.	Herb.	Amp.	Tropical	IPA 57025
Pluchea sagittalis (Lam.) Cabrera*	Herb.	Amp.	Tropical	HVASF 16098
Simsia dombeyana DC.	Herb.	Amp.	Tropical	IPA 57031
Tridax procumbens L.	Herb.	Amp.	Pantropical	PEUFR 52266
Boraginaceae				
Euploca procumbens (Mill.) Diane & Hilger	Herb.	Amp.	Neotropical	IAN 84493
Heliotropium angiospermum Murray	Herb.	Amp.	Tropical	PEUFR 52334
Heliotropium elongatum (Lehm) I.M. Johnst.	Herb.	Amp.	Tropical	CSTR 5702
Burmanniaceae				
Burmannia capitata (Walter ex J.F.Gmel.) Mart.*	Herb.	Amp.	Neotropical	HST 1068

Table 1. C*ontinuation.*

Family/Species	Habit	Life form	Phytogeography	*Voucher*
Cabombaceae				
Cabomba aquatica Aubl.	Herb.	Sub. Fixa	Tropical	IPA 91303
Cleomaceae				
Tarenaya spinosa (Jacq.) Raf.	Shrub	Amp.	Neotropical	PEUFR 52280
Combretaceae				
Laguncularia racemosa (L.) C.F.Gaertn.	Shrub	Amp.	Godwanic	UESC 11089
Commelinaceae				
Callisia filiformis (M. Martens & Galeotti) D.R. Hunt	Herb.	Amp.	Tropical	HVASF 5111
Commelina erecta L.	Herb.	Amp.	Pantropical	PEUFR 52214
Floscopa glabrata (Kunth) Hassk	Herb.	Amp.	Tropical	IPA 47609
Convolvulaceae				
Aniseia cernua Moric.*	Herb.	Amp.	Tropical	JPB 4512
Distimake aegyptius (L.) Simões & Staples	Herb.	Amp.	Pantropical	IPA 89444
Evolvulus filipes Mart.	Herb.	Amp.	Godwanic	IPA 89446
Ipomoea asarifolia (Desr.) Roem. & Schult.	Herb.	Amp.	Pantropical	HVASF 17013
Ipomoea batatas (L.) Lam.	Herb.	Amp.	Cosmopolitan	JPB 63121
Ipomoea carnea Jacq.	Shrub	Amp.	Pantropical	PEUFR 52209
Ipomoea longeramosa Choisy	Herb.	Amp.	Endemic Caa.	JPB 63119
Ipomoea wrightii A. Gray*	Herb.	Amp.	Tropical	PEUFR 53451
Crassulaceae				
Bryophyllum pinnatum (Lam.) Oken	Herb.	Amp.	Pantropical	MOSS 6727
Cymodoceaceae				
Halodule wrightii Asch.	Herb.	Sub. Fixa	Godwanic	ALCB 81353
Cyperaceae				
Cyperus aggregatus (Willd.) Endl.	Herb.	Amp.	Tropical	IAN 81869
Cyperus articulatus L.	Herb.	Amp.	Godwanic	IPA 91339
Cyperus blepharoleptos Steud.	Herb.	Amp.	Godwanic	HUEFS 247970
Cyperus compressus L.	Herb.	Amp.	Pantropical	IAN 84475
Cyperus distans L.	Herb.	Amp.	Pantropical	HVASF 13812
Cyperus giganteus Vahl	Herb.	Amp.	Tropical	PEUFR 52265
Cyperus haspan L.	Herb.	Amp.	Pantropical	IPA 88454
Cyperus hermaphroditus (Jacq.) Standl.	Herb.	Amp.	Tropical	FLOR 48441
Cyperus iria L.	Herb.	Amp.	Pantropical	JPB 63041
Cyperus laxus Lam.	Herb.	Amp.	Pantropical	IAN 81867
Cyperus ligularis L.	Herb.	Amp.	Godwanic	IPA 89492
Cyperus luzulae (L.) Retz.	Herb.	Amp.	Tropical	IPA 88458
Cyperus macrostachyos Lam.	Herb.	Amp.	Pantropical	FLOR 65009
Cyperus meyenianus Kunth	Herb.	Amp.	Tropical	CSTR 5629
Cyperus odoratus L.	Herb.	Amp.	Cosmopolitan	CSTR 5527
Cyperus pohlii (Nees) Steud.	Herb.	Amp.	Tropical	JPB 39245
Cyperus polystachyos Rottb.	Herb.	Amp.	Cosmopolitan	NYBG 622740
Cyperus rotundus L.	Herb.	Amp.	Cosmopolitan	JPB 29175
Cyperus schomburgkianus Nees	Herb.	Amp.	Endemic Caa./Cer.	EAC 36038
Cyperus surinamensis Rottb.	Herb.	Amp.	Tropical	IPA 89954
Cyperus uncinulatus Schrad. ex Nees	Herb.	Amp.	Tropical	NYBG 622718
Diplacrum capitatum (Willd.) Boeckeler	Herb.	Amp.	Godwanic	IPA 88459
Eleocharis acutangula (Roxb.) Schult.	Herb.	Amp.	Pantropical	EAC 35780
Eleocharis atropurpurea (Retz.) J.Presl & C.Presl	Herb.	Amp.	Cosmopolitan	JPB 34522
Eleocharis elegans (Kunth) Roem. & Schult.	Herb.	Amp.	Tropical	NYBG 622779
Eleocharis filiculmis Kunth	Herb.	Amp.	Tropical	JPB 23165
Eleocharis flavescens (Poir.) Urb.	Herb.	Amp.	American	UFP 10072
Eleocharis geniculata (L.) Roem. & Schult.	Herb.	Amp.	Pantropical	JPB 38259
Eleocharis interstincta (Vahl) Roem. & Schult.	Herb.	Amp.	Tropical	JPB 63026
Eleocharis maculosa (Vahl) Roem. & Schult.	Herb.	Amp.	Tropical	UFP 10070
Eleocharis minima Kunth	Herb.	Amp.	Tropical	JPB 37142
Eleocharis montana (Kunth) Roem. & Schult.	Herb.	Amp.	Tropical	EAC 35778
Eleocharis mutata (L.) Roem. & Schult.	Herb.	Amp.	Godwanic	HVASF 14021
Eleocharis nana Kunth	Herb.	Amp.	Tropical	EAN 4969
Eleocharis plicarhachis (Griseb.) Svenson	Herb.	Amp.	Tropical	JPB 15792
Eleocharis sellowiana Kunth	Herb.	Amp.	Tropical	JPB 57074
Fimbristylis cymosa R.Br.	Herb.	Amp.	Pantropical	IPA 89946
Fimbristylis dichotoma (L.) Vahl.	Herb.	Amp.	Cosmopolitan	UFP 43944
Fimbristylis vahlii (Lam.) Link	Herb.	Amp.	American	SPF 111868B
Fuirena umbellata Rottb.	Herb.	Amp.	Pantropical	JPB 17944

Table 1. C*ontinuation.*

Family/Species	Habit	Life form	Phytogeography	*Voucher*
Lagenocarpus guianensis Lindl. ex Nees	Herb.	Amp.	Tropical	HUESB 7187
Lagenocarpus rigidus Nees	Herb.	Amp.	Tropical	US 2545440
Rhynchospora barbata (Vahl) Kunth	Herb.	Amp.	Tropical	UFP 21005
Rhynchospora contracta (Nees) J.Raynal	Herb.	Amp.	Tropical	JPB 39849
Rhynchospora corymbosa (L.) Britton	Herb.	Amp.	Pantropical	JPB 50800
Rhynchospora diodon (Nees) Griseb.	Herb.	Amp.	Endemic Caa.	JPB 15791
Rhynchospora filiformis Vahl	Herb.	Amp.	Tropical	JPB 15384
Rhynchospora gigantea Link	Herb.	Amp.	Tropical	JPB 22042
Rhynchospora globosa (Kunth) Roem. & Schult.	Herb.	Amp.	Tropical	JPB 17115
Rhynchospora holoschoenoides (Rich.) Herter	Herb.	Amp.	Godwanic	UFP 15487
Rhynchospora marisculus Lindl. & Nees	Herb.	Amp.	Tropical	JPB 50802
Rhynchospora nervosa (Vahl) Boeckeler	Herb.	Amp.	Tropical	IPA 89964
Rhynchospora pubera (Vahl) Boeckeler	Herb.	Amp.	Tropical	JPB 15789
Rhynchospora riparia (Nees) Boeckeler	Herb.	Amp.	Tropical	CEPEC 118021
Rhynchospora rugosa (Vahl) Gale	Herb.	Amp.	Pantropical	IPA 88463
Rhynchospora tenerrima Nees ex Spreng.	Herb.	Amp.	Tropical	JPB 43864
Scleria bracteata Cav	Herb.	Emer.	Tropical	IPA 88447
Scleria gaertneri Raddi.	Herb.	Emer.	Godwanic	US 2221689
Scleria interrupta Rich.	Herb.	Emer.	Godwanic	JPB 5722
Scleria microcarpa Nees ex Kunth	Herb.	Emer.	Tropical	JPB 27442
Scleria mitis P.J.Bergius	Herb.	Emer.	Tropical	JPB 64126
Dilleniaceae				
Doliocarpus dentatus (Aubl.) Standl.	Shrub	Amp.	Tropical	NYBG 1758941
Droseraceae				
Drosera sessilifolia A.St.-Hil.	Herb.	Amp.	Tropical	JPB 45205
Eriocaulaceae				
Paepalanthus bifidus (Schrad) Kunth	Herb.	Amp.	Tropical	US 2407871
Paepalanthus myocephalus (Mart.) Körn.	Herb.	Amp.	Endemic Caa./Atl.	JPB 1480
Tonina fluviatilis Aubl.	Herb.	Sub. Fixed	Tropical	EAN 5516
Euphorbiaceae				
Astraea lobata (L.) Klotzsch*	Herb.	Amp.	Godwanic	JPB 5300
Caperonia palustris (L.) A.St.-Hil.*	Herb.	Amp.	Tropical	JPB 34668
Ricinus communis L.	Shrub	Amp.	Cosmopolitan	JPB 24480
Fabaceae				
Aeschynomene rudis Benth.	Herb.	Amp.	Tropical	MOSS 905
Chamaecrista serpens (L.) Greene	Herb.	Amp.	Tropical	HUEFS 252244
Mimosa pigra L.	Shrub	Amp.	Pantropical	PEUFR 52304
Mimosa pudica L.	Shrub	Amp.	Pantropical	PEUFR 52212
Mimosa sensitiva L.	Shrub	Amp.	Tropical	IPA 89658
Mimosa somnians Humb. & Bonpl. ex Willd.	Shrub	Amp.	Tropical	JPB 5762
Neptunia plena (L.) Benth.	Herb.	Amp.	Tropical	HCDAL 5512
Parkinsonia aculeata L.	Shrub	Amp.	Cosmopolitan	UFP 47364
Senna alata (L.) Roxb	Shrub	Amp.	Pantropical	JPB 38608
Senna obtusifolia (L.) H.S.Irwin & Barneby	Shrub	Amp.	Pantropical	UFP 46804
Senna uniflora (Mill.) H.S.Irwin & Barneby	Shrub	Amp.	Tropical	HVASF 17056
Canavalia brasiliensis Mart. ex Benth.	Liana	Amp.	Tropical	JPB 38592
Canavalia brasiliensis Mart. ex Benth.	Liana	Amp.	Tropical	JPB 38592
Canavalia dictyota Piper.*	Liana	Amp.	Tropical	PEUFR 52228
Crotalaria retusa L.*	Herb.	Amp.	Pantropical	IPA 83533
Indigofera microcarpa Desv.	Herb.	Amp.	Godwanic	HVASF 16097
Macroptilium lathyroides (L.) Urb.	Herb.	Amp.	Pantropical	JPB 1589
Sesbania exasperata Kunth	Shrub	Amp.	Tropical	EAN 4259
Tephrosia cinerea (L.) Pers.	Herb.	Amp.	Tropical	JPB 4908
Gentianaceae				
Chelonanthus purpurascens (Aubl.) Struwe *et al*.	Herb.	Amp.	Tropical	HST 995
Heliconiaceae				
Heliconia psittacorum L.f.	Herb.	Amp.	Pantropical	JPB 39612
Hydrocharitaceae				
Apalanthe granatensis (Bonpl.) Planch.	Herb.	Sub. Fixed	Tropical	HUEFS 221806
Egeria densa Planch.	Herb.	Sub. Fixed	Cosmopolitan	HCDAL 3597
Halophila decipiens Ostenf.	Herb.	Sub. Fixed	Pantropical	OBIS-BR 74
Najas arguta Kunth.	Herb.	Sub. Fixed	Tropical	IPA 91234
Najas marina L.	Herb.	Sub. Fixed	Cosmopolitan	IPA 91220
Hydroleaceae				
Hydrolea spinosa L.	Shrub	Amp.	Tropical	HCDAL 5526

Table 1. C*ontinuation.*

Family/Species	Habit	Life form	Phytogeography	*Voucher*
Lamiaceae				
Ocimum americanum L.	Shrub	Amp.	Pantropical	IPA 65192
Vitex gardneriana Schauer	Shrub	Amp.	Endemic Caa.	ASE 36155
Lentibulariaceae				
Genlisea filiformis A.St.-Hil.	Herb.	Emer.	Tropical	US 2547908
Utricularia amethystina Salzm. ex A.St.-Hil & Girard	Herb.	Sub. Fixa	Tropical	JPB 45227
Utricularia foliosa L.	Herb.	Sub. Fixa	Godwanic	R 232511
Utricularia gibba L.	Herb.	Sub. Fixa	Cosmopolitan	JPB 38024
Utricularia hydrocarpa Vahl	Herb.	Sub. Fixa	Tropical	JPB 30673
Utricularia juncea Vahl	Herb.	Sub. Fixa	American	JPB 52721
Utricularia nana A.St.-Hil. & Girard	Herb.	Sub. Fixa	Tropical	JPB 18053
Utricularia pusilla Vahl	Herb.	Sub. Fixa	Tropical	UFP 85501
Utricularia simulans Pilg.	Herb.	Sub. Fixa	Tropical	JPB 8412
Utricularia subulata L.	Herb.	Sub. Fixa	Cosmopolitan	JPB 18049
Utricularia triloba Benj.	Herb.	Sub. Fixa	Tropical	UFP 85483
Linderniaceae				
Lindernia crustacea (L.) F.Muell.	Herb.	Amp.	Cosmopolitan	HST 15011
Loganiaceae				
Spigelia anthelmia L.	Herb.	Amp.	Pantropical	PEUFR 52192
Lythraceae				
Ammannia latifolia L.	Herb.	Amp.	American	HUEFS 182775
Maranthaceae				
Monotagma plurispicatum (Körn.) K.Schum.	Herb.	Amp.	Tropical	NYBG 02098318
Thalia densibracteata Petersen	Herb.	Emer.	Tropical	HTSA 6655
Thalia geniculata L.	Herb.	Emer.	Pantropical	UFP 20305
Maycaceae				
Mayaca fluviatilis Aubl.	Herb.	Amp.	American	NYBG 02636829
Mayaca sellowiana Kunth	Herb.	Amp.	Tropical	FLOR 37817
Menyanthaceae				
Nymphoides humboldtiana (Kunth) Kuntze	Herb.	Flut. Fixed	Tropical	HUNI 6265
Myoporaceae				
Capraria biflora L.	Herb.	Amp.	Tropical	HTSA 6654
Molluginaceae				
Glinus radiatus (Ruiz & Pav) Rohrb.	Herb.	Amp.	Tropical	EAN 3418
Myrtaceae				
Myrcia tomentosa (Aubl.) DC.	Shrub	Amp.	Tropical	JPB 47372
Syzygium cumini (L.) Skeels*	Tree	Amp.	Pantropical	JPB 44157
Nyctaginaceae				
Boerhavia diffusa L.*	Herb.	Amp.	Pantropical	JPB 61183
Nymphaeaceae				
Nymphaea alba L.	Herb.	Flut. Fixed	Cosmopolitan	JPB 4917
Nymphaea amazonum Mart. & Zucc.	Herb.	Flut. Fixed	Tropical	IPA 91230
Nymphaea ampla (Salisb.) DC.	Herb.	Flut. Fixed	Tropical	HUEFS 221805
Nymphaea lasiophylla Mart. & Zucc.	Herb.	Flut. Fixed	Endemic Caa.	IPA 92352
Nymphaea lingulata Wiersema	Herb.	Flut. Fixed	Tropical	JPB 30652
Nymphaea pulchella DC.	Herb.	Flut. Fixed	Tropical	IPA 92347
Nymphaea rudgeana G.Mey.	Herb.	Flut. Fixed	Tropical	JPB 30733
Onagraceae				
Ludwigia erecta (L.) H.Hara	Shrub	Emer.	Godwanic	PEUFR 52141
Ludwigia helminthorrhiza (Mart.) H. Hara	Herb.	Flut. Fixed	Tropical	FUEL 48942
Ludwigia hyssopifolia (G. Don) Exell.	Shrub	Amp.	Pantropical	JPB 17444
Ludwigia leptocarpa (Nutt.) H. Hara	Shrub	Emer.	Godwanic	JPB 39072
Ludwigia nervosa (Poir.) H.Hara	Shrub	Emer.	Tropical	JPB 18634
Ludwigia octovalvis (Jacq.) P.H. Raven	Shrub	Emer.	Pantropical	JPB 40236
Orobanchaceae				
Anisantherina hispidula (Mart.) Pennell	Herb.	Amp.	Tropical	IPA 5474
Plantaginaceae				
Anamaria heterophylla (Giul. & V.C. Souza) V.C.Souza	Herb.	Emer.	Endemic Caa.	JPB 42867
Angelonia biflora Benth	Herb.	Amp.	Tropical	HVASF 16731
Angelonia salicariifolia Bonpl.*	Herb.	Amp.	Tropical	HTSA 7546
Achetaria scutellarioides Wettst (Benth.).	Shrub	Amp.	Tropical	IPA 20076
Bacopa aquatica Aubl	Herb.	Emer.	Tropical	HST 15057

Table 1. C*ontinuation.*

Family/Species	Habit	Life form	Phytogeography	*Voucher*
Scoparia dulcis L.	Herb.	Amp.	Pantropical	JPB 3604
Stemodia durantifolia (L.) Sw.	Herb.	Amp.	Tropical	MAC 1963
Stemodia foliosa Benth.	Herb.	Amp.	Tropical	HUEFS 182654
Stemodia maritima L.	Herb.	Amp.	Tropical	HUEFS 182654
Poaceae				
Aristida adscensionis L.	Herb.	Emer.	Cosmopolitan	IPA 14040
Axonopus centralis Chase	Herb.	Amp.	Tropical	INPA 2406
Bouteloua americana (L.) Scribn.	Herb.	Amp.	Tropical	EAC 37051
Cenchrus brownii Roem. & Schult.	Herb.	Amp.	Pantropical	IPA 15676
Coix lacryma-jobi L.	Herb.	Amp.	Cosmopolitan	INPA 2416
Chloris barbata Sw.	Herb.	Amp.	Pantropical	CSTR 5860
Chloris orthonoton Döll	Herb.	Amp.	Tropical	IPA 49455
Cynodon dactylon (L.) Pers.	Herb.	Amp.	Cosmopolitan	IPA 89453
Dactyloctenium aegyptium (L.) Willd.	Herb.	Amp.	Cosmopolitan	PEUFR 52213
Digitaria sanguinalis (L.) Scop.	Herb.	Amp.	Cosmopolitan	PEUFR 52299
Echinochloa colona (L.) Link	Herb.	Amp.	Cosmopolitan	IPA 15673
Echinochloa crusgalli (L.) P.Beauv.	Herb.	Amp.	Cosmopolitan	IPA 13818
Echinochloa crus-pavonis (Kunth) Schult.	Herb.	Amp.	Cosmopolitan	JPB 32226
Echinochloa polystachya (Kunth) Hitchc.	Herb.	Amp.	Tropical	CSTR 6502
Eleusine indica (L.) Gaertn.	Herb.	Amp.	Cosmopolitan	JPB 31120
Eragrostis pilosa (L.) P.Beauv.	Herb.	Amp.	Cosmopolitan	IPA 49457
Eragrostis tenella (L.) P.Beauv. ex Roem. & Schult.	Herb.	Amp.	Pantropical	HVASF 5022
Eriochloa polystachya Kunth	Herb.	Amp.	Tropical	IPA 89937
Eriochrysis cayennensis P.Beauv.	Herb.	Amp.	Tropical	IPA 1860
Hymenachne amplexicaulis (Rudge) Nees	Herb.	Amp.	Pantropical	HUEFS 221807
Leptochloa virgata (L.) P.Beauv.	Herb.	Amp.	Tropical	IPA 8939
Luziola bahiensis (Steud.) Hitchc.	Herb.	Amp.	Tropical	EAC 62066
Panicum aquaticum Poir.	Herb.	Amp.	Tropical	IPA 2900
Megathyrsus maximus (Jacq.) B.K.Simon & S.W.L.Jacobs	Herb.	Amp.	Pantropical	JPB 38610
Paspalum conjugatum P.J.Bergius	Herb.	Amp.	Pantropical	INPA 2481
Paspalum millegrana Schrad.. ex Schult.	Herb.	Amp.	Tropical	IPA 15675
Paspalum paniculatum L.	Herb.	Amp.	Pantropical	IAN 80748
Paspalum repens P.J.Bergius	Herb.	Amp.	American	IPA 15701
Paspalum scutatum Nees ex Trin.	Herb.	Amp.	Endemic Caa.	IPA 49464
Setaria parviflora (Poir.) Kerguélen	Herb.	Amp.	Cosmopolitan	IPA 8678
Sorghum halepense (L.) Pers.	Herb.	Amp.	Cosmopolitan	IPA 89920
Sporobolus jacquemontii Kunth	Herb.	Amp.	Pantropical	IAN 37488
Streptostachys asperifolia Desv.	Herb.	Amp.	Tropical	IPA 88471
Urochloa fusca (Sw.) B.F.Hansen & Wunderlin	Herb.	Amp.	Tropical	IPA 8677
Urochloa mollis (Sw.) Morrone & Zuloaga	Herb.	Amp.	Tropical	IPA 49473
Urochloa mutica (Forssk.) T.Q.Nguyen	Herb.	Amp.	Pantropical	IPA 65179
Urochloa plantaginea (Link) R.D.Webster	Herb.	Amp.	Tropical	INPA 2410
Polygalaceae				
Polygala galioides Poir.	Herb.	Amp.	Tropical	IPA 76352
Polygonaceae				
Persicaria ferruginea (Wedd.) Soják	Herb.	Amp.	Tropical	PEUFR 52206
Persicaria hispida (Kunth) M. Gómez	Herb.	Emer.	Tropical	PEUFR 52124
Triplaris gardneriana Wedd.	Shrub	Amp.	Tropical	JPB 34268
Pontederiaceae				
Eichhornia azurea (sw) Kunth.	Herb.	Flut. Free	Tropical	HTSA 8055
Eichhornia crassipes (Mart.) Solms	Herb.	Flut. Free	Cosmopolitan	JPB 41885
Eichhornia diversifolia (Vahl) Urb.	Herb.	Flut. Free	Godwanic	IPA 23395
Eichhornia heterosperma Alexander.	Herb.	Flut. Free	Tropical	EAC 42297
Eichhornia paniculata (Spreng.) Solms	Herb.	Flut. Free	Tropical	IPA 58445
Heteranthera limosa (Sw.) Willd.	Herb.	Emer.	American	UFP 42820
Heteranthera oblongifolia Mart. ex Schult. & Schult.f.	Herb.	Emer.	Endemic Caa.	IPA 16806
Heteranthera rotundifolia (Kunth) Griseb.	Herb.	Emer.	American	HVASF 21123
Hydrothrix gardneri Hook.f.	Herb.	Sub. Fixed	Tropical	IPA 47568
Portulacaceae				
Portulaca oleracea L.	Herb.	Amp.	Cosmopolitan	JPB 1059
Pteridaceae				
Doryopteris concolor (Langsd. & Fisch.) Kuhn	Herb.	Amp.	Pantropical	JPB 33069
Rhizophoraceae				
Rhizophora mangle L.	Shrub	Emer.	Pantropical	JPB 54272

Table 1. C*ontinuation.*

Family/Species	Habit	Life form	Phytogeography	*Voucher*
Rubiaceae				
Borreria scabiosoides Cham. & Schltdl.	Herb.	Amp.	Tropical	JPB 3295
Perama hirsuta Aubl.	Herb.	Amp.	Tropical	JPB 52602
Salviniaceae				
Azolla caroliniana Willd.	Herb.	Flut. Free	Cosmopolitan	JPB 17925
Azolla filiculoides Lam.	Herb.	Flut. Free	Cosmopolitan	IPA 91258
Azolla microphylla Kaulf.	Herb.	Flut. Free	American	NYBG 02674812
Salvinia auriculata Aublet	Herb.	Flut. Free	Cosmopolitan	JPB 6696-2
Salvinia minima Baker.	Herb.	Flut. Free	American	IPA 91353
Solanaceae				
Nicotiana glauca Graham	Shrub	Amp.	Cosmopolitan	MBM 148923
Sphenocleaceae				
Sphenoclea zeylanica Gaertn.	Herb.	Amp.	Pantropical	IAN 85596
Talinaceae				
Talinum fruticosum (L.) Juss.	Herb.	Amp.	Pantropical	IPA 69906
Tectariaceae				
Tectaria incisa Cav.	Herb.	Amp.	Tropical	JPB 47387
Thelypteridaceae				
Cyclosorus interruptus (Willd.) H. Ito	Herb.	Amp.	Pantropical	JPB 25992
Typhaceae				
Typha domingensis Pers.	Herb.	Emer.	Cosmopolitan	JPB 30601
Typha latifolia L.	Herb.	Emer.	Cosmopolitan	IPA 91335
Verbenaceae				
Stachytarpheta angustifolia (Mill.) Vahl	Herb.	Amp.	Godwanic	HVASF 5092
Xyridaceae				
Abolboda americana (Aubl.) Lanj.	Herb.	Emer.	Tropical	IPA 16190
Xyris anceps Lam.	Herb.	Amp.	Godwanic	US 2545422
Xiris cipoensis L.B.Sm & Downs	Herb.	Amp.	Tropical	V0047112F
Xyris fallax Malme	Herb.	Amp.	Tropical	JPB 18473-1
Xyris jupicai Rich.	Herb.	Amp.	American	JPB 27440
Xyris macrocephala Vahl.	Herb.	Amp.	Tropical	IPA 47614
Xyris moraesii L.B. Sm. & Downs	Herb.	Amp.	Endemic Atl.	US 2325427
Xyris paraensis Poepp. ex Kunth	Herb.	Amp.	Tropical	JPB 9121
Xyris savanensis Miq.	Herb.	Amp.	Tropical	IPA 13689

In relation to amphibious lifeforms, there is a lack of conclusive studies that point out characteristics common to families, or if there are convergent adaptations. Some researchers have already started investigations in this regard, such as Leite, França & Scatena (2009), who analyzed the anatomy of the amphibious representatives of Cyperaceae and found that the presence of air gaps, buliform cells on the adaxial surface of the leaf epidermis, reduced number of xylem elements and low lignification in the cell walls of the tissues in the different organs studied. For these researchers, these characteristics are important for amphibious plants to adapt to the seasonal variations of transition between the aquatic/marshy environments.

Several studies with aquatic and/or marshy plants have found the predominance of amphibious species (Bove *et al*., 2003; França *et al*., 2003; Kita and Sousa, 2003; Matias, Amado & Nunes. 2003; Roque and Ramirez, 2008; Spellmeier, Périco & Freitas, 2009; França *et al*., 2010; Kafer *et al*., 2011; Meyer and Franceschinelli, 2011; Campelo *et al*., 2013; Moura-Júnior *et al*., 2013; Aona *et al*., 2015; Torres *et al*., 2016; Souza and Moreira, 2017), indicating that this lifeform is present in this type of ecosystem. The floristic assemblies that present the most diversity of amphibious plants are generally associated with the surrounding matrix being more conserved or in a natural state, as seen in the aforementioned studies.

Aquatic plants *sensu stricto* include emergent, floating or submerged lifeforms, and represent 26% of the total species. In this subgroup there is a greater diversity of the botanical families Alismataceae, Lentibulariaceae, Pontederiaceae, Xyridaceae, Nymphaeaceae, Araceae, Onagraceae, Hydrocharitaceae and Salviniaceae. It is noticed that aquatic plants *sensu stricto* increase in terms of phylogenetic diversity towards the center of the aquatic body. Aquatic plants *sensu lato* are restricted to the edge of the reservoir and are more related to the surrounding matrix.

Endemic species accounted for 4% of the total, showing that these species of aquatic/marshy environments plants are more widely distributed than expected. The endemic species recorded were restricted to Caatinga or were related to connections between Caatinga - Cerrado or Caatinga - North Atlantic Forest.

Considering this geographic distribution. a predominance of taxa with a wide geographical range was observed, that is, species occurring within the intratropical region of Americas (48.2%), or occurring in several continents, but within the tropical interval (Pantropical, 19.3%), or reported as occurring worldwide (Cosmopolitan, 15%). The other geographic distributions observed were: Gondwanic (7%), Endemic (4.5%), Americana (4.5%), and Neotropical (0.5%).

Our results corroborate the findings of Schultorpe (1967), who reported that the assemblages of plants associated with

aquatic or malaria environments, in general, are comprised of flora approximately 40% endemic to their own continent, the rest being species of transcontinental, pantropical or cosmopolitan distribution. Regarding this wide distribution, Schultorpe (1967), Hutchinson (1975), Charalambidou and Santamaria (2002) and Les, Crawford, Kimball, Moody & Landolt (2003) highlight that anemochory and zoochory are important to understand this pattern in the composition of species.

These plants also have phenotypic plasticity and wide ecological tolerance, when compared to typically terrestrial plants. Thus, variations in temperature and rainfall in tropical regions, such as the state of Paraíba, do not cause such dramatic effects in this group (Santamaría, 2002).

In addition, Esteves (2011), states that the large-scale occurrence of this group can also be influenced by the anthropization process (homogenization of habitats, water or soil pollution), to which aquatic environments are strongly subject. The biological relationships established among species (competition, allelopathy, herbivory, parasitism) can also affect these groups (Lacoul and Freedman, 2006).

Figure 2. aquatic plant species registered for Paraíba, Brazil. Legend: A: *Sesuvium portulacastrum* (L.) L.; B: *Egeria densa* Planch.; C: *Nicotiana glauca* Graham *Nymphoides indica* (L.) Kuntze; D: *Neptunia plena* (L.) Benth; E: *Nymphoides humboldtiana* (Kunth) Kuntze; F: *Ludwigia leptocarpa* (Nutt.) H. Hara; G: *Vigna peduncularis* (Kunth) Fawc. & Rendle; H: *Tarenaya spinosa* (Jacq.) Raf.; I: *Tridax procumbens* L.; J: *Eichhornia crassipes* (Mart.) Solms ; K: *Borreria scabiosoides* Cham. & Schltdl.; L: *Limnocharis flava* (L.) Buchenau; M: *Stemodia maritima* L.; N: *Erechtites hieracifolius* (L.) Raf. Ex DC; O: *Montrichardia linifera* (Arruda) Schott; P: *Hydrolea spinosa* L; Q: *Ludwigia helminthorrhiza* (Mart.) H. Hara; R: *Nymphaea lasiophylla* Mart. & Zucc.

Most of the water bodies for human supply in the Northeast are eutrophic, due to the conditions of high average temperatures and sunshine throughout the year (Chorus and Bartram, 1999). This characteristic favors the development of aquatic plants, regardless of their way of life. This trophic state is closely related to species composition, in which more generalist species prefer eutrophic ecosystems. This type of situation must also have influenced our data, but in the collections of these plants, it is difficult to find data associated with the trophic state of the water bodies.

Conclusion

There is still a huge gap in Brazil to be filled when it comes to knowledge about the aquatic or swampy floras of its territory. Thus, studies performing a floristic survey of aquatic and swampy environments deposited in botanical collections collaborate to quantify the regional biodiversity in a country.

The State of Paraíba has 290 species of plants registered in aquatic or swampy environments. This data update brought an increase of 11% more species than in previous surveys. In addition, new occurrences were recorded (14 species). This flora comprises mainly herbaceous, amphibious species with wide geographic distributions (the majority occurring in the intratropical zone).

These data need to be updated in the future, with the publication of new field studies, as it was noticed that there are few floristic studies for the state.

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