








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

Hermes Machado-Filho^{a*}, Maria Regina de Vasconcellos Barbosa^b, Cleide Regina Major Torres^a, Maria de Fátima de Araújo^c, Luan Pedro-Silva^d, José Iranildo Miranda de Melo^d, Carmen Sílvia Zickel^e

^a Instituto Federal de Educação, Ciência e Tecnologia da Paraíba, João Pessoa, CEP: 58015-435, Paraíba, Brasil.
*hermes@ifpb.edu.br

^b Universidade Federal da Paraíba, João Pessoa, CEP: 58051-900, Paraíba, Brasil.

^c Universidade Federal de Campina Grande, Patos, CEP: 58708-110, Paraíba, Brasil.

^d Universidade Estadual da Paraíba, Campina Grande, CEP: 58429-500, Paraíba, Brasil.

^e Programa de Pós-Graduação Botânica, Universidade Federal Rural de Pernambuco, Recife, CEP: 52171-900, Pernambuco, Brasil.

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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, BHC, CEN, CEPEC, CESJ, EAC, FCAB, FLOR, FUEL, HCDAL, HUCP,

HUEFS, HUNI, HUTO, HVSF, 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 exsiccate, 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).

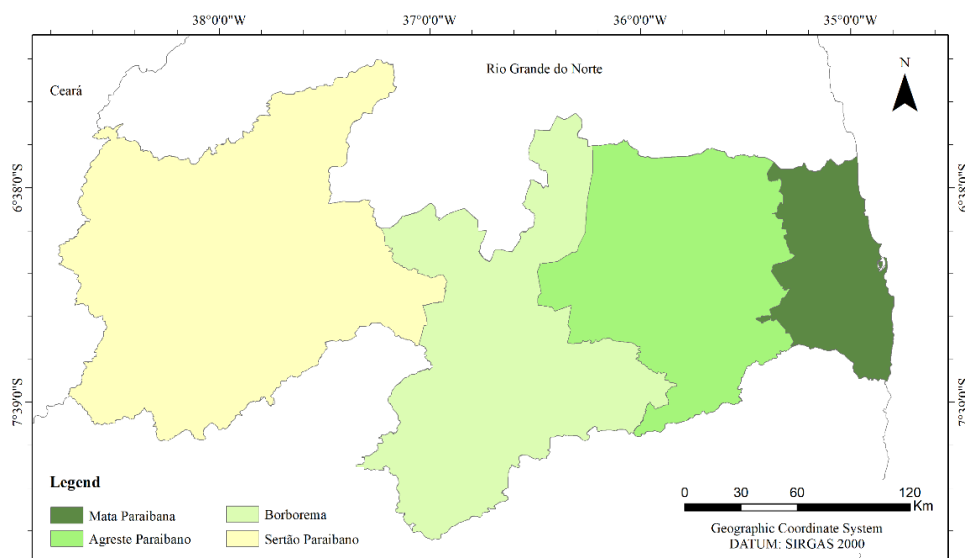


Figure 1. Map highlighting the mesoregions in the state of Paraíba.

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

Table 1. Continuation.

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

Table 1. Continuation.

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

Table 1. Continuation.

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

Table 1. Continuation.

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

Table 1. Continuation.

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