

Species richness and functional groups of angiosperms from the Paraná River Delta region (Argentina)

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Abstract: We provide a checklist of angiosperms collected in the Paraná River Delta Region during the 1990s and early 2000s. Plants were taxonomically identified and classified according to their origin (native/endemic and exotic) and functional group based on their distribution, biological type, morpho-ecology, photosynthetic type and life cycle. A total of 79 families and 375 species were recorded, of which 87.5% were native (46.93% of subtropical-temperate distribution) and 12.5% were exotic (62.72% of temperate distribution). The herbaceous broadleaf and graminoid vegetation predominated in native (76.65%) and exotic (82.35%) species groups. There were only equisetoid herbaceous plants in native species group. Rooted emergent plants and the C₃ functional group predominated among native (88.69% and 80.62%, respectively) and exotic (100% in both cases) species groups. Most of the native plants (85.23%) were perennials, while annuals and perennials were equally represented among the exotic species.

Key words: biological types, distribution, life cycles, morpho-ecology, native and exotic plant species, photosynthetic types, wetlands

INTRODUCTION

The large wetlands of South America, associated with the floodplains of the large rivers (Orinoco, Amazonas and Paraná), are macrosystems of sub-regional extent in which spatial and temporal fluctuations of the water table constrain biogeochemical cycles and fluxes, promote soils with strong hydromorphic features, and support a very rich and particular biota, well adapted to a wide range of water availability and hydroperiods. The surface area and permanence of

these wetlands depends mainly on superficial water input (by rainfall and river water discharge) as well as the timing of the flooding-non flooding cycle (Neiff and Malvárez 2004).

The Paraná River is unique among the large rivers of the world in that it flows from tropical to temperate latitudes. After its confluence with the Uruguay River, the Paraná River reaches the Río de la Plata estuary, where it forms a large delta (Figure 1). Thus, species of subtropical lineage from the Chaco and the Interior Atlantic Forest penetrate into the delta through both rivers, and coexist with other temperate climate species from the neighboring Pampean Plain. The particular spatial-temporal hydrological dynamics of the delta leads to a highly heterogeneous environment, supporting high levels of plant and animal biodiversity (Malvárez 1999; Kandus et al. 2003). Species typical of these wetlands have different strategies to cope with hydrological changes, including survival during periods of soil anoxia and/or the presence of structures providing buoyancy (Tiner 1999).

The main economic activities in the delta are extensive cattle grazing, hunting, fishing, apiculture, and firewood extraction in the portion corresponding to the Entre Ríos Province, and forestry and tourism in the portion corresponding to the Buenos Aires Province. However, economic activities have generally failed to meet sustainability criteria and/or have been complemented with infrastructure development, which altered the hydrological functioning of the wetlands. This caused considerable changes in the abundance and spatial distribution of many plant and animal native species promoting the invasion of exotic species (Bó and Quintana 1999; Bó et al. 2010).

Although there is available information on the

floristic composition of the different landscape units in the region (Malvárez 1999; Kandus et al. 2003, Quintana et al. 2005), it has never been organized in terms of type of environmental scenario, potential adaptive strategies of plant species to the particular wetland conditions, and their ability to respond to changes driven by anthropic activities.

The objective of this work is to construct a checklist of angiosperm species occurring in the Paraná River Delta region, which were taxonomically identified and grouped according to their origin (as either native, including endemics, or exotic species). Plants within these groups were classified into functional groups based on distribution, biological type, morpho-ecology, photosynthetic type and life cycle.

MATERIALS AND METHODS

Study area

The Paraná river drains an approximate area of 2,310,000 km² and is ranked as the second most important river in South America, after the Amazonas, in terms of length, basin size and water discharge (Neiff and Malvárez 2004).

The Paraná River Delta Region (PRDR) stretches through the final 300 km of the Paraná River basin and covers approximately 17,500 km², including the south of the Entre Ríos Province and the northeast of the Buenos Aires province, close to Buenos Aires city (Figure 1). Due to its particular location, the PRDR receives energy and sediment input from upstream and is under the influence of the Rio de la Plata estuary at its terminal portion.

The climate is predominantly temperate with precipitation throughout the year. Mean annual temperature is 16°C and annual precipitation is 1,000 mm. The combined influence of the Paraná and Uruguay rivers, the Rio de la Plata estuary, and local precipitation leads to a complex hydrological regime.

The seasonal regime of the Paraná River affects almost the entire region, except for the terminal portion of the Buenos Aires province section (“delta front” *sensu* Kandus et al. 2006). The Uruguay River mainly affects the “Lower Delta” located in the Entre Ríos province section, while moon and wind tides of the Río de la Plata estuary increase water levels up to the locality of Zárate and, sporadically, up to the city of Rosario (Kandus et al. 2006; Sepulcri et al. 2012). On some occasions, events associated with El Niño–Southern Oscillation (ENSO) phenomenon, which produces heavy rainfall in southern Brazil, bring about extreme floods all over the Paraná River basin, including the PRDR (Kandus et al. 2006).

The PRDR was first classified within the Mesopotamic Forest in a phytogeographic point of view, (Parodi 1945; Burkart 1947) and later, within the Uruguayense

district of the Pampa province (Cabrera and Willink 1973). Recently, it has been included in the Delta and Islands of the Paraná River ecoregion (Burkart et al. 1999). Because of its particular hydrological and geomorphological features, distinct ecological units of different landscape physiognomy (Malvárez 1999) characterize the PRDR.

Data collection and analysis

We selected some ecological units representing the environmental heterogeneity of the region and for which there is a substantial amount of information from surveys with a similar sampling effort, conducted in the 1990s and early 2000s (Malvárez 1999; Arias et al. 2002; Kandus et al. 2003; Pereira et al. 2003; Quintana et al. 2005). These were Unit A: Forest, prairie and pond in a meandering plain; Unit B: patches of prairies in low ridges; Unit C₁: prairies with ridges and depressions; Unit C₃: forests, prairies and streams in sand ridges and depressions; Unit F: grasslands and savannas of the former littoral plain; and Unit I: marshes and forests of the Lower Delta (*sensu* Malvárez 1999) (Figure 1).

Based on the available information for each unit, a

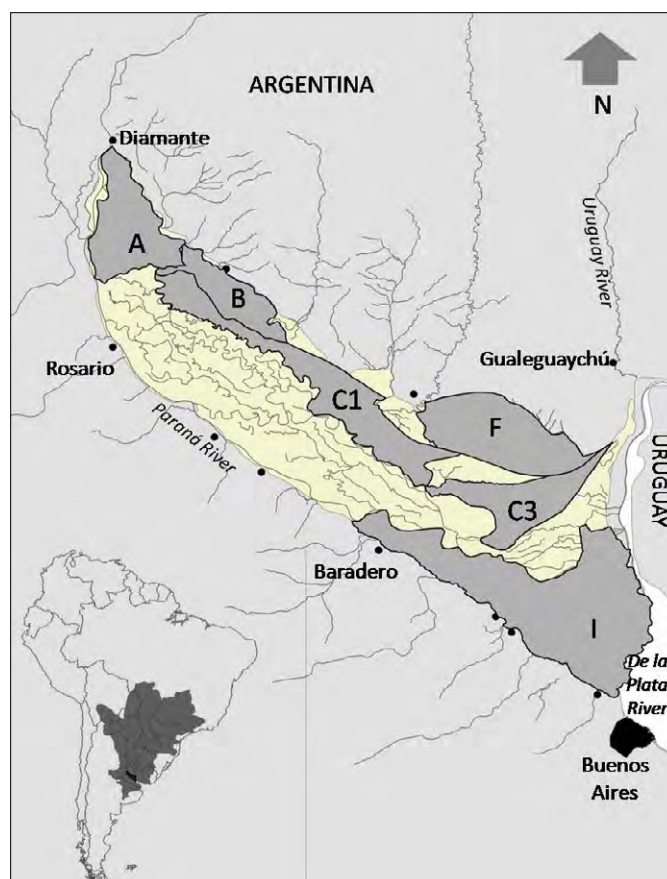


Figure 1. Map of the Delta of the Paraná River Region and the landscape units surveyed. Unit A: Forest, prairie and pond in a meandering plain; Unit B: Patches of prairies in low ridges; Unit C₁: Prairies with ridges and depressions; Unit C₃: Forests, prairies and streams in sand ridges and depressions; Unit F: Grasslands and savannas of the former littoral plain; and Unit I: Marshes and forests of the Lower Delta (*sensu* Malvárez 1999).

checklist of angiosperms was compiled. The species' names and families were updated according to Tropicos (2015). They were classified according to their origin as native (including endemic and cosmopolitan plants) and exotic species (Zuloaga et al. 2008). In turn, native and exotic species were characterized into functional groups (*sensu* Smith et al. 1997) based on distribution, biological type, morpho-ecological characteristics, photosynthetic type and life cycle. According to their distribution, plants were categorized as: temperate, subtropical, tropical, tropical-subtropical, subtropical-temperate, tropical-temperate and tropical-subtropical-temperate (Burkart 1969, 1974; Cabrera and Zardini 1993; Zuloaga et al. 2008). Biological types were classified following Barkman (1988) as tree (T), shrub (S), graminoid herbaceous plant (GH), broadleaf herb (BL), equisetoid herbaceous plant (E) and climber (C). On the basis of morpho-ecological traits, plants were grouped as: free-floating (FF), rooted submerged (RS), rooted emergent (RE) and floating-leaved rooted emergent (FLRE) (Cronk and Fennessy 2001). According to the photosynthetic pathway, species were classified into the types C₃, C₄ and intermediate C₃-C₄ (Black 1971; Smith and Brown 1973; Waller and Lewis 1989; Ueno and Takeda 1992; Sage 2004). Finally, based on life cycle, species were grouped as annual and perennial (Zuloaga et al. 2008).

The species richness was calculated for each category mentioned above, which was expressed as the percentage of all angiosperm species present.

RESULTS

Overall, 375 species in 79 families of angiosperms were recorded in the five ecological units under consideration. Of these species, 87.5% were native (Table 1). The following families showed the highest species richness: Poaceae (19.93%), Asteraceae (13.19%), Cyperaceae (7.68%) and Fabaceae (6.13%). There were only two endemic species: *Panicum sabulorum* var. *polycladum* and *Baccharis phyteuma* Hering. Most of the native species had a subtropical-temperate distribution (46.93%; Table 1 and Figure 2), while species of temperate distribution predominated among the exotic angiosperms (62.72%; Table 2 and Figure 2).

The biological types with the highest species richness were BL and GH, for both native (46.93% and 19.94%, respectively; Table 1 and Figure 3) and exotic species (56% and 26%, respectively; Table 2 and Figure 3). There was a low percentage of E and S, all of which were native species. In analyzing morpho-ecological characteristics, the RE predominated in both native (96%) and exotic species (100%), while all the FLRE, FF and RS belonged to the native flora, with low values of species richness (Figure 4). The most represented photosynthetic group was C₃ for both native (80.62%; Table 1 and Figure 5) and exotic species (86%; Table 2 and Figure 5). Concerning the life cycle, most of the native plants were perennials (85.23%; Table 1 and Figure 6), while annuals and perennials were equally represented among the exotic species (52% and 48%, respectively; Table 2 and Figure 6).

Table 1. List of native species present in the landscape units surveyed in the Delta of the Paraná River Region, arranged by family. BT: biological type; MT: morpho-ecological traits; PT: photosynthetic types; LC: life cycle; Sub-Tem: Subtropical-temperate; Tro-Sub-Tem: Tropical-subtropical-temperate; Tro-Sub: Tropical-subtropical; Tro-tem: Tropical-temperate; BL: broadleaf herb; GH: graminoid herbaceous plant; S: shrub; E: equisetoid herbaceous plant; T: tree; C: climber; RE: rooted emergent; FLRE: floating-leaved rooted emergent; FF: free-floating; RS: rooted submerged; A: annual; P: perennial.

Family	Species	Distribution	BT	MT	PT	LC
Acanthaceae	<i>Ruellia morongii</i> Britton	Sub-Tem	BL	RE	C ₃	P
Acanthaceae	<i>Hygrophila costata</i> Nees & T. Nees	Sub-Tem	BL	SF	C ₃	P
Alismataceae	<i>Echinodorus grandiflorus</i> (Cham. & Schltdl.) Micheli	Tro-Sub-Tem	BL	FLRE	C ₃	P
Alismataceae	<i>Sagittaria montevidensis</i> Cham. & Schltdl.	Tro-Sub	BL	FLRE	C ₃	P
Amaranthaceae	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Sub-Tem	BL	FREL	C ₄	P
Amaranthaceae	<i>Alternanthera kurtzii</i> Schinz ex Pedersen	Sub-Tem	BL	RE	C ₄	P
Amaranthaceae	<i>Gomphrena celosioides</i> Mart.	Sub-Tem	BL	RE	C ₄	P
Amaranthaceae	<i>Gomphrena elegans</i> Mart.	Sub-Tem	BL	RE	C ₃	P
Amaranthaceae	<i>Gomphrena pulchella</i> Mart.	Sub-Tem	BL	RE	C ₄	P
Amaranthaceae	<i>Pfaffia glomerata</i> (Spreng.) Pedersen	Sub-Tem	BL	RE	C ₃	A
Amaranthaceae	<i>Atriplex montevidensis</i> L. Spreng.	Sub-Tem	BL	RE	C ₄	P
Amaranthaceae	<i>Sarcocornia ambigua</i> (Michx.) M. Á. Alonso & M. B. Crespo	Temperate	S	RE	C ₄	P
Amaranthaceae	<i>Pfaffia gnaphaloides</i> (L. f.) Mart.	Sub-Tem	BL	RE	C ₃	P
Amaryllidaceae	<i>Allium ampeloprasum</i> L.	Temperate	BL	RE	C ₃	P
Anacardiaceae	<i>Schinus longifolia</i> (Lindl.) Speg.	Sub-Tem	T	RE	C ₃	P
Apiaceae	<i>Bowlesia incana</i> Ruiz & Pav.	Sub-Tem	BL	RE	C ₃	P
Apiaceae	<i>Cyclosporum leptophyllum</i> (Pers.) Sprague	Sub-Tem	BL	RE	C ₃	A
Apiaceae	<i>Eryngium eburneum</i> Decne.	Sub-Tem	BL	RE	C ₃	P
Apiaceae	<i>Eryngium echinatum</i> Urb.	Sub-Tem	BL	RE	C ₃	P
Apiaceae	<i>Eryngium nudicaule</i> Lam.	Sub-Tem	BL	RE	C ₃	P
Apiaceae	<i>Eryngium pandanifolium</i> Cham. & Schltdl.	Sub-Tem	BL	RE	C ₃	P
Apiaceae	<i>Lilaeopsis carolinensis</i> J. M. Coult. & Rose	Tro-Tem	BL	FLRE	C ₃	P

Continued

Table 1. Continued.

Family	Species	Distribution	BT	MT	PT	LC
Apocynaceae	<i>Orthosia virgata</i> (Poir.) E. Fourn.	Sub-Tem	E	RE	C ₃	P
Araceae	<i>Pistia stratiotes</i> L.	Tro-Sub-Tem	BL	FF	C ₃	P
Araliaceae	<i>Hydrocotyle bonariensis</i> Lam.	Tro-Tem	BL	RE	C ₃	P
Araliaceae	<i>Hydrocotyle modesta</i> Cham. & Schltldl.	Sub-Tem	BL	FF	C ₃	P
Araliaceae	<i>Hydrocotyle pusilla</i> A. Rich.	Sub-Tem	BL	RE	C ₃	P
Araliaceae	<i>Hydrocotyle ranunculoides</i> L. f.	Sub-Tem	BL	FF	C ₃	P
Aristolochiaceae.	<i>Aristolochia fimbriata</i> Cham. & Schltldl.	Subtropical	BL	RE	C ₃	P
Asteraceae	<i>Acmella decumbens</i> (Sm.) R. K. Jansen	Subtropical	BL	RE	C ₃	P
Asteraceae	<i>Alomia spilanthoides</i> D. Don ex Hook. & Arn. .	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Ambrosia scabra</i> Hook. & Arn.	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Ambrosia tenuifolia</i> Spreng.	Temperate	BL	RE	C ₃	P
Asteraceae	<i>Aspilia silphioides</i> Benth. & Hook. f.	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Aster squamatus</i> (Spreng.) Hieron.	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Baccharis articulata</i> (Lam.) Pers.	Sub-Tem	S	RE	C ₃	P
Asteraceae	<i>Baccharis caprariifolia</i> DC.	Sub-Tem	S	RE	C ₃	P
Asteraceae	<i>Baccharis coridifolia</i> DC.	Sub-Tem	S	RE	C ₃	P
Asteraceae	<i>Baccharis penningtonii</i> Heering	Temperate	S	RE	C ₃	P
Asteraceae	<i>Baccharis phyteuma</i> Heering	Temperate	S	RE	C ₄	P
Asteraceae	<i>Baccharis pingraea</i> DC.	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Baccharis salicifolia</i> (Ruiz & Pav.) Pers.	Sub-Tem	S	RE	C ₃	P
Asteraceae	<i>Baccharis spicata</i> (Lam.) Baill.	Temperate	S	RE	C ₃	P
Asteraceae	<i>Bidens laevis</i> (L.) Britton, Stern & Poggenb.	Tro-Sub	BL	RE	C ₃	P
Asteraceae	<i>Calyptocarpus biaristatus</i> (DC.) H. Rob.	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Conyza bonariensis</i> L. Cronquist	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Conyza sumatrensis</i> (Retz.) E. Walker	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Enydra anagallis</i> Gardner	Sub-Tem	BL	FLRE	C ₃	P
Asteraceae	<i>Eupatorium cabreriae</i> B. L. Rob.	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Eupatorium filifolium</i> Hassl.	Sub-Tem	S	RE	C ₃	P
Asteraceae	<i>Eupatorium tremulum</i> Hook. & Arn.	Subtropical	S	RE	C ₃	P
Asteraceae	<i>Gamochaeta coarctata</i> (Willd.) Kerguelén	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Gamochaeta pennsylvanica</i> (Willd.) Cabrera	Subtropical	BL	RE	C ₃	P
Asteraceae	<i>Holocheilus hieracioides</i> (D. Don) Cabrera	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Hypochaeris microcephala</i> (Sch. Bip.) Cabrera	Temperate	BL	RE	C ₃	P
Asteraceae	<i>Melanthera latifolia</i> (Gardner) Cabrera	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Micropsis spathulata</i> (Pers.) Cabrera	Temperate	BL	RE	C ₃	P
Asteraceae	<i>Mikania micrantha</i> Kunth	Tro-Sub	E	RE	C ₃	P
Asteraceae	<i>Mikania periplocifolia</i> Hook. & Arn.	Sub-Tem	BL	FLRE	C ₃	P
Asteraceae	<i>Mikania urticifolia</i> Hook. & Arn.	Subtropical	BL	FLRE	C ₃	P
Asteraceae	<i>Morrenia odorata</i> (Hook. & Arn.) Lindl.	Sub-Tem	E	RE	C ₃	P
Asteraceae	<i>Plagiocheilus tanacetoides</i> Haenke ex DC.	Temperate	HL	RE	C ₃	A
Asteraceae	<i>Pluchea sagittalis</i> (Lam.) Cabrera	Sub-Tem	HL	RE	C ₃	P
Asteraceae	<i>Pterocaulon cordobense</i> Kuntze	Sub-Tem	HL	RE	C ₃	P
Asteraceae	<i>Senecio bonariensis</i> Hook. & Arn.	Temperate	HL	RE	C ₃	P
Asteraceae	<i>Senecio grisebachii</i> Baker	Sub-Tem	HL	RE	C ₃	P
Asteraceae	<i>Senecio montevidensis</i> (Spreng.) Baker	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Soliva anthemifolia</i> (Juss.) R. Br.	Subtropical	BL	RE	C ₃	A
Asteraceae	<i>Soliva sessilis</i> Ruiz & Pav.	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Symphotrichum squamatum</i> (Spreng.) G. L. Nesom	Sub-Tem	BL	RE	C ₃	P
Asteraceae	<i>Tessaria integrifolia</i> Ruiz & Pav.	Sub-Tem	T	RE	C ₃	P
Asteraceae	<i>Xanthium spinosum</i> L.	Temperate	BL	RE	C ₃	A
Begoniaceae	<i>Begonia cucullata</i> Willd.	Tro-Sub	BL	RE	C ₃	P
Brassicaceae	<i>Lepidium bonariense</i> L.	Temperate	BL	RE	C ₃	A
Brassicaceae	<i>Lepidium didymum</i> L.	Temperate	BL	RE	C ₃	A
Brassicaceae	<i>Lepidium spicatum</i> Desv.	Temperate	BL	RE	C ₃	P
Brassicaceae	<i>Rorippa hilariana</i> (Walp.) Cabrera	Tro-Tem	BL	RE	C ₃	A
Bromeliaceae	<i>Tillandsia aëranthos</i> (Loisel.) L. B. Sm.	Tropical	E	RE	C ₃	P
Calyceraceae	<i>Acicarpa tribuloides</i> Juss.	Sub-Tem	BL	RE	C ₃	A
Campanulaceae	<i>Triodanis perfoliata</i> (L.) Nieuwl.	Tro-Tem	BL	RE	C ₃	A
Cannaceae	<i>Canna glauca</i> L.	Tropical	BL	RE	C ₃	P
Caprifoliaceae	<i>Valeriana salicariifolia</i> Vahl	Temperate	BL	RE	C ₃	P
Caryophyllaceae	<i>Cerastium humifusum</i> Cambess ex A. St. -Hil	Sub-Tem	BL	RE	C ₃	A

Continued

Table 1. Continued.

Family	Species	Distribution	BT	MT	PT	LC
Caryophyllaceae	<i>Cerastium rivulariastrum</i> Möschl & Pedersen	Sub-Tem	BL	RE	C ₃	A
Caryophyllaceae	<i>Spergula levis</i> (Cambess.) D. Dietr.	Temperate	BL	RE	C ₃	P
Celastraceae	<i>Maytenus ilicifolia</i> Mart. ex Reissek	Sub-Tem	T	RE	C ₃	P
Celtidaceae	<i>Celtis ehrenbergiana</i> (Klotzsch)Liebm.	Subtropical	T	RE	C ₃	P
Cleomaceae	<i>Cleome trachycarpa</i> Klotzch ex Eichler	Sub-Tem	BL	RE	C ₃	A
Cleomaceae	<i>Tarenaya hassleriana</i> (Chodat) Iltis	Sub-Tem	BL	RE	C ₃	P
Combretaceae	<i>Terminalia australis</i> Cambess.	Sub-Tem	T	RE	C ₃	P
Commelinaceae	<i>Tradescantia fluminensis</i> Vell.	Sub-Tem	BL	RE	C ₃	P
Commelinaceae	<i>Tripogandra diuretica</i> (Mart.) Handlos	Sub-Tem	BL	RE	C ₃	P
Convolvulaceae	<i>Dichondra microcalyx</i> (Hallier f.)Fabris	Temperate	BL	RE	C ₃	P
Convolvulaceae	<i>Dichondra sericea</i> Sw.	Tropical	BL	RE	C ₃	P
Convolvulaceae	<i>Ipomoea alba</i> L.	Sub-Tem	E	RE	C ₃	P
Cucurbitaceae	<i>Cayaponia podantha</i> Cogn.	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Carex brongniartii</i> Kunth	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Carex bonariensis</i> Desf. ex Poir.	Temperate	E	RE	C ₃	P
Cyperaceae	<i>Carex excelsa</i> Poepp. ex Kunth.	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Carex fuscula</i> d'Urv.	Tro-Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Carex longii</i> Mack.	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Carex subdivulsa</i> (Kük.)G. A. Wheeler	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Carex tweediana</i> Nees ex Hooker	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Carex uruguensis</i> Boeckeler	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Cyperus aggregatus</i> (Willd.) Endl.	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Cyperus entrerianus</i> Boeckeler.	Tropical	E	RE	C ₄	P
Cyperaceae	<i>Cyperus eragrostis</i> Lam.	Tro-Sub-Tem	E	RE	C ₄	P
Cyperaceae	<i>Cyperus giganteus</i> Vahl	Tropical	E	RE	C ₄	P
Cyperaceae	<i>Cyperus intricatus</i> Schrad. ex Schult.	Subtropical	E	RE	C ₄	P
Cyperaceae	<i>Cyperus reflexus</i> Vahl	Tropical	E	RE	C ₄	P
Cyperaceae	<i>Cyperus rotundus</i> L.	Tropical	E	RE	C ₄	P
Cyperaceae	<i>Cyperus virens</i> Michx.	Tropical	E	RE	C ₄	P
Cyperaceae	<i>Eleocharis bonariensis</i> Nees	Temperate	E	RE	C ₃ -C ₄	P
Cyperaceae	<i>Eleocharis macrostachya</i> Britton	Tro-Sub-Tem	E	RE	C ₃ -C ₄	P
Cyperaceae	<i>Eleocharis montana</i> (Kunth) Roem. & Schult.	Tropical	E	RE	C ₃ -C ₄	P
Cyperaceae	<i>Kyllinga vaginata</i> Lam.	Tro-Sub	E	RE	C ₄	P
Cyperaceae	<i>Pycnus flavescens</i> (L.) P. Beauv. ex Rchb	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Rhynchospora corymbosa</i> (L.) Britton	Sub-Tem	E	RE	C ₄	P
Cyperaceae	<i>Rhynchospora organensis</i> C. B. Clarke	Subtropical	E	RE	C ₄	P
Cyperaceae	<i>Scirpus giganteus</i> Kunth	Sub-Tem	E	RE	C ₃	P
Cyperaceae	<i>Schoenoplectus californicus</i> (C. A. Mey.) Soják	Sub-Tem	E	RE	C ₃	P
Dioscoreaceae	<i>Dioscorea sinuata</i> Vell.	Tro-Sub	C	RE	C ₃	P
Euphorbiaceae	<i>Croton urucurana</i> Baill.	Sub-Tem	T	RE	C ₃	P
Euphorbiaceae	<i>Euphorbia prostrata</i> Aiton	Tropical	BL	RE	C ₃ -C ₄	A
Euphorbiaceae	<i>Sapium haematospermum</i> Müll. Arg.	Subtropical	T	RE	C ₃	P
Fabaceae	<i>Acacia caven</i> Molina	Sub-Tem	T	RE	C ₃	P
Fabaceae	<i>Aeschynomene montevidensis</i> Vogel	Sub-Tem	S	RE	C ₃	P
Fabaceae	<i>Albizia inundata</i> (Mart.) Barneby & J. W. Grimes	Sub-Tem	T	RE	C ₃	P
Fabaceae	<i>Amorpha fruticosa</i> L.	Temperate	S	RE	C ₃	P
Fabaceae	<i>Enterolobium contortisiliquum</i> (Vell.) Morong	Sub-Tem	T	RE	C ₃	P
Fabaceae	<i>Erythrina crista-galli</i> L.	Sub-Tem	T	RE	C ₃	P
Fabaceae	<i>Inga edulis</i> Mart.	Temperate	T	RE	C ₃	P
Fabaceae	<i>Lathyrus paranensis</i> Burkart	Temperate	BL	RE	C ₃	A
Fabaceae	<i>Lupinus grisebachianus</i> C. P. Sm.	Sub-Tem	BL	RE	C ₄	P
Fabaceae	<i>Mimosa bonplandii</i> (Gillies ex Hook. & Arn.) Benth.	Temperate	S	RE	C ₃	P
Fabaceae	<i>Mimosa pigra</i> L.	Tropical	S	RE	C ₃	P
Fabaceae	<i>Mimosa tweediana</i> Barneby ex Glazier & Mackinder	Sub-Tem	S	RE	C ₃	P
Fabaceae	<i>Prosopis affinis</i> Spreng.	Sub-Tem	T	RE	C ₃	P
Fabaceae	<i>Prosopis nigra</i> (Griseb.) Hieron.	Sub-Tem	T	RE	C ₃	P
Fabaceae	<i>Senna corymbosa</i> (Lam.) H. S. Irwin & Barneby	Sub-Tem	T	RE	C ₃	P
Fabaceae	<i>Senna pendula</i> (Humb. & Bonpl. ex Willd.) H. S. Irwin & Barneby	Sub-Tem	S	RE	C ₃	P
Fabaceae	<i>Sesbania punicea</i> (Cav.) Benth.	Sub-Tem	S	RE	C ₃	P
Fabaceae	<i>Sesbania virgata</i> (Cav.) Pers.	Sub-Tem	S	RE	C ₃	P
Fabaceae	<i>Vicia graminea</i> Sm.	Temperate	BL	RE	C ₃	A

Continued

Table 1. Continued.

Family	Species	Distribution	BT	MT	PT	LC
Fabaceae	<i>Vigna luteola</i> (Jacq.) Benth.	Sub-Tem	E	RE	C ₃	A
Haloragaceae	<i>Myriophyllum aquaticum</i> (Vell.) Verdc.	Sub-Tem	BL	RS	C ₃	P
Hydrocharitaceae	<i>Elodea</i> sp. Michx.	Tro-Sub-Tem	BL	RS	C ₃	P
Hydrocharitaceae	<i>Limnobium laevigatum</i> (Humb. & Bonpl. ex Willd.) Heine	Temperate	BL	FF	C ₃	P
Iridaceae	<i>Cypella herbertii</i> Hook.	Sub-Tem	BL	RE	C ₃	P
Iridaceae	<i>Herbertia lahue</i> (Molina) Goldblatt	Sub-Tem	BL	RE	C ₃	P
Iridaceae	<i>Sisyrinchium minus</i> Engelm. & A. Gray	Temperate	BL	RE	C ₃	A
Iridaceae	<i>Sisyrinchium chilense</i> Hook.	Sub-Tem	BL	RE	C ₃	A
Iridaceae	<i>Sisyrinchium iridifolium</i> Kunth	Tro-Sub-Tem	BL	RE	C ₃	A
Iridaceae	<i>Sisyrinchium pachyrhizum</i> Baker	Sub-Tem	BL	RE	C ₃	P
Juncaceae	<i>Juncus capillaceus</i> Lam.	Sub-Tem	E	RE	C ₃	P
Juncaceae	<i>Juncus dichotomus</i> Elliot	Tro-Sub-Tem	E	RE	C ₃	P
Juncaceae	<i>Juncus imbricatus</i> Laharpe	Tro-Sub-Tem	E	RE	C ₃	P
Juncaceae	<i>Juncus microcephalus</i> Kunth	Tro-Sub-Tem	E	RE	C ₃	P
Lamiaceae	<i>Hyptis fasciculata</i> Benth.	Sub-Tem	BL	RE	C ₃	P
Lamiaceae	<i>Hyptis mutabilis</i> (Rich.) Briq.	Tropical	BL	RE	C ₃	P
Lamiaceae	<i>Salvia pallida</i> Benth.	Sub-Tem	BL	RE	C ₃	P
Lamiaceae	<i>Scutellaria racemosa</i> Pers.	Sub-Tem	BL	RE	C ₃	P
Lamiaceae	<i>Stachys gilliesii</i> Benth.	Tropical	BL	RE	C ₃	P
Lamiaceae	<i>Teucrium vesicarium</i> Mill.	Sub-Tem	BL	RE	C ₃	P
Lauraceae	<i>Nectandra angustifolia</i> (Schrad.) Nees & Hart.	Sub-Tem	T	RE	C ₃	P
Lauraceae	<i>Ocotea acutifolia</i> (Nees) Mez	Sub-Tem	T	RE	C ₃	P
Lentibulariaceae	<i>Utricularia gibba</i> L.	Tro-Tem	BL	RS	C ₃	P
Lentibulariaceae	<i>Utricularia platensis</i> Speg.	Tem	BL	RE	C ₄	P
Limnocaritaceae	<i>Hydrocleys nymphoides</i> (Willd.) Buchenau	Sub-Tem	BL	FLRE	C ₃	P
Lythraceae	<i>Cuphea fruticosa</i> Spreng.	Sub-Tem	BL	RE	C ₃	P
Malvaceae	<i>Hibiscus striatus</i> Cav.	Temperate	S	RE	C ₃	P
Malvaceae	<i>Modiola caroliniana</i> (L.) G. Don	Sub-Tem	BL	RE	C ₃	P
Malvaceae	<i>Modiolastrum lateritium</i> (Hook.) Krapov.	Sub-Tem	BL	RE	C ₃	P
Malvaceae	<i>Modiolastrum malvifolium</i> (Griseb.) K. Schum.	Sub-Tem	BL	RE	C ₃	P
Malvaceae	<i>Monteiroa glomerata</i> (Hook. & Arn.) Krapov.	Temperate	S	RE	C ₃	P
Malvaceae	<i>Sida rhombifolia</i> L.	Sub-Tem	S	RE	C ₃	P
Marantaceae	<i>Thalia multiflora</i> Horkel.	Sub-Tem	BL	RE	C ₃	P
Menyanthaceae	<i>Nymphoides indica</i> (L.) Kuntze	Sub-Tem	BL	BFL	C ₃	P
Myrsinaceae	<i>Myrsine laetevirens</i> (Mez) Arechav.	Tro-Sub	T	RE	C ₃	P
Myrsinaceataceae	<i>Myrsine parvula</i> (Mez) Otegui	Tro-Sub	T	RE	C ₃	P
Myrtaceae	<i>Blepharocalyx tweediei</i> (Hook. & Arn.) O. Berg	Sub-Tem	T	RE	C ₃	P
Myrtaceae	<i>Blepharocalyx salicifolius</i> (Kunth) O. Berg	Sub-Tem	T	RE	C ₃	P
Myrtaceae	<i>Eugenia uruguayensis</i> Cambess.	Sub-Tem	T	RE	C ₃	P
Myrtaceae	<i>Myrceugenia glaucescens</i> (Cambess.) D. Legrand & Kausel	Sub-Tem	T	RE	C ₃	P
Oleaceae	<i>Cabomba australis</i> Speg.	Sub-Tem	BL	RS	C ₃	P
Onagraceae	<i>Ludwigia bonariensis</i> (Micheli) H. Hara	Temperate	BL	RE	C ₄	P
Onagraceae	<i>Ludwigia peploides</i> (Kunth) P. H. Raven	Temperate	BL	FLRE	C ₄	P
Onagraceae	<i>Ludwigia peruviana</i> (L.) H. Hara	Tro-Sub-Tem	BL	RE	C ₄	P
Onagraceae	<i>Ludwigia grandiflora</i> (Michx.) Greuter & Burdet	Tro-Sub-Tem	BL	RE	C ₄	P
Onagraceae	<i>Oenothera longiflora</i> L.	Sub-Tem	BL	RE	C ₃	A
Orobanchaceae	<i>Agalinis communis</i> (Cham. & Schltdl.) D'Arcy	Sub-Tem	S	RE	C ₃	P
Oxalidaceae	<i>Oxalis conorrhiza</i> Jacq.	Sub-Tem	BL	RE	C ₃	P
Passifloraceae	<i>Passiflora caerulea</i> L.	Temperate	E	RE	C ₃	P
Passifloraceae	<i>Passiflora misera</i> Kunth	Tro-Sub-Tem	E	RE	C ₃	P
Phyllanthaceae	<i>Phyllanthus sellowianus</i> (Klotzsch) Müll. Arg.	Tro-Tem	S	RE	C ₃	P
Plantaginaceae	<i>Bacopa monnieri</i> (L.) Wettst.	Tro-Tem	BL	RE	C ₃	P
Plantaginaceae	<i>Plantago myosuroides</i> Lam.	Sub-Tem	BL	RE	C ₃	A
Plantaginaceae	<i>Plantago tomentosa</i> Lam.	Sub-Tem	BL	RE	C ₃	P
Plantaginaceae	<i>Mecardonia procumbens</i> (Mill.) Small var. <i>flagellaris</i> (Cham. & Schltdl.) V. C. Souza	Temperate	BL	RE	C ₃	A
Plantaginaceae	<i>Scoparia montevidensis</i> (Spreng.) R. E. Fr.	Sub-Tem	BL	RE	C ₃	A
Poaceae	<i>Amphibromus scabrivalvis</i> (Trin.) Swallen	Temperate	GH	RE	C ₃	P
Poaceae	<i>Aristida murina</i> Cav.	Temperate	GH	RE	C ₄	P
Poaceae	<i>Axonopus compressus</i> (Sw.) P. Beauv.	Tro-Tem	HG	RE	C ₄	P
Poaceae	<i>Axonopus fissifolius</i> (Raddi) KuhlM.	Tro-Tem	GH	RE	C ₄	P

Continued

Table 1. Continued.

Family	Species	Distribution	BT	MT	PT	LC
Poaceae	<i>Bothriochloa laguroides</i> (DC.) Herter	Sub-Tem	GH	RE	C ₄	P
Poaceae	<i>Bouteloua megapotamica</i> (Spreng.) Kuntze	Sub-Tem	GH	RE	C ₄	P
Poaceae	<i>Briza rufa</i> (J. Presl) Steud.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Briza subaristata</i> Lam.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Bromidium hygrometricum</i> (Nees) Nees & Meyen	Temperate	GH	RE	C ₃	A
Poaceae	<i>Bromus brachyanthera</i> Döll	Tropical	GH	RE	C ₃	P
Poaceae	<i>Bromus catharticus</i> Vahl	Temperate	GH	RE	C ₃	P
Poaceae	<i>Coleataenia prionitis</i> (Nees) Soreng	Tro-Sub	GH	RE	C ₄	P
Poaceae	<i>Cortaderia selloana</i> (Schult.&Schult. f) Asch. & Graebn.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Chloris sesquiflora</i> Burkart	Temperate	GH	RE	C ₄	P
Poaceae	<i>Dichantherium sabulorum</i> var. <i>polycladum</i> (Ekman) Zuloaga	Temperate	GH	RE	C ₄	P
Poaceae	<i>Diplachne uninervia</i> (J. Presl) Parodi	Temperate	GH	RE	C ₄	A
Poaceae	<i>Distichlis spicata</i> (L.) Greene	Tro-Sub-Tem	GH	RE	C ₄	P
Poaceae	<i>Echinochloa helodes</i> (Hack.) Parodi	Tro-Sub	GH	FF	C ₄	P
Poaceae	<i>Echinochloa polystachya</i> (Kunth) Hitchc.	Tro-Sub	GH	FF	C ₄	P
Poaceae	<i>Eleusine tristachya</i> (Lam.) Lam.	Tro-Sub-Tem	GH	RE	C ₄	P
Poaceae	<i>Eragrostis hypnoides</i> (Lam.) Britton, Stern & Poggenb.	Tro-Sub-Tem	GH	RE	C ₄	A
Poaceae	<i>Eragrostis lugens</i> Nees	Tro-Sub-Tem	GH	RE	C ₄	P
Poaceae	<i>Eustachys paspaloides</i> (Vahl) Lanza & Mattei	Subtropical	GH	RE	C ₄	P
Poaceae	<i>Glyceria multiflora</i> Steud.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Hordeum euclaston</i> Steud.	Sub-Tem	GH	RE	C ₃	A
Poaceae	<i>Hordeum stenostachys</i> Godr.	Subtropical	GH	RE	C ₃	P
Poaceae	<i>Hymenachne grumosa</i> (Nees) Zuloaga	Tro-Sub	GH	RE	C ₄	P
Poaceae	<i>Jarava plumosa</i> (Spreng.) S. W. L. Jacobs & J. Everett	Temperate	GH	RE	C ₃	P
Poaceae	<i>Lachnagrostis filiformis</i> (G. Forst.) Trin.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Leersia hexandra</i> Sw.	Sub-Tem	GH	RE	C ₃	P
Poaceae	<i>Luziola peruviana</i> Juss. ex J. F. Gmel.	Tropical	GH	RE	C ₃	P
Poaceae	<i>Melica macra</i> Nees	Temperate	GH	RE	C ₃	P
Poaceae	<i>Melica sarmentosa</i> Nees	Subtropical	GH	RE	C ₃	P
Poaceae	<i>Mnesithea selloana</i> (Hack.) de Koning & Sosef	Tro-Tem	GH	RE	C ₃	P
Poaceae	<i>Nassella hyalina</i> (Nees) Barkworth	Temperate	GH	RE	C ₃	P
Poaceae	<i>Nassella megapotamia</i> (Spreng. ex Trin.) Barkworth	Temperate	GH	RE	C ₃	P
Poaceae	<i>Nassella neesiana</i> (Trin. & Rupr.) Barkworth	Temperate	GH	RE	C ₃	P
Poaceae	<i>Oplismenopsis najada</i> (Hack. & Arech.) Parodi	Tro-Sub	GH	FF	C ₄	P
Poaceae	<i>Panicum bergii</i> Arechav.	Temperate	GH	RE	C ₄	P
Poaceae	<i>Panicum elephantipes</i> Ness ex Trin.	Temperate	GH	FF	C ₄	P
Poaceae	<i>Panicum sabulorum</i> var. <i>polycladum</i> (Ekman) R. A. Palacios	Tro-Sub	GH	RE	C ₄	P
Poaceae	<i>Paspalum alnum</i> Chase	Tro-Sub	GH	RE	C ₄	P
Poaceae	<i>Paspalum denticulatum</i> Trin.	Temperate	GH	RE	C ₄	P
Poaceae	<i>Paspalum dilatatum</i> Poir.	Temperate	GH	RE	C ₄	P
Poaceae	<i>Paspalum distichum</i> L.	Temperate	GH	RE	C ₄	P
Poaceae	<i>Paspalum haumanii</i> Parodi	Sub-Tem	GH	RE	C ₄	P
Poaceae	<i>Paspalum inaequivalve</i> Raddi	Temperate	GH	RE	C ₄	P
Poaceae	<i>Paspalum quadrifarium</i> Lam.	Tropical	GH	RE	C ₄	P
Poaceae	<i>Paspalum repens</i> P. J. Bergius	Temperate	GH	FF	C ₄	P
Poaceae	<i>Phalaris angusta</i> Nees. ex Trin.	Temperate	GH	RE	C ₃	A
Poaceae	<i>Piptochaetium lasianthum</i> Griseb.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Piptochaetium montevidense</i> (Spreng.) Parodi	Sub-Tem	GH	RE	C ₃	P
Poaceae	<i>Piptochaetium stipoides</i> (Trin. & Rupr.) Hack. ex Arechav.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Poa bonariensis</i> (Lam.) Kunth.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Poa lanigera</i> Nees	Temperate	GH	RE	C ₃	P
Poaceae	<i>Polypogon chilensis</i> (Kunth) Pilg.	Temperate	GH	RE	C ₃	A
Poaceae	<i>Setaria fiebrigii</i> R. A. W. Herrm.	Tro-Tem	GH	RE	C ₄	P
Poaceae	<i>Setaria parviflora</i> (Poir.) Kerguelen	Tro-Tem	GH	RE	C ₄	P
Poaceae	<i>Setaria vaginata</i> Spreng.	Tro-Tem	GH	RE	C ₄	P
Poaceae	<i>Sporobolus indicus</i> (L.) R. Br.	Subtropical	GH	RE	C ₄	P
Poaceae	<i>Stachys gilliesii</i> Benth.	Subtropical	GH	RE	C ₃	P
Poaceae	<i>Steinchisma hians</i> (Elliott) Nash	Tro-Sub-Tem	GH	RE	C ₃ -C ₄	P
Poaceae	<i>Stenotaphrum secundatum</i> (Walter) Kuntze	Tro-Sub-Tem	GH	RE	C ₄	P
Poaceae	<i>Vulpia australis</i> (Nees ex Steud.) C. H. Blom	Temperate	GH	RE	C ₃	A
Poaceae	<i>Zizaniopsis bonariensis</i> (Balansa & Poitr.) Speg.	Temperate	GH	RE	C ₃	P

Continued

Table 1. Continued.

Family	Species	Distribution	BT	MT	PT	LC
Polygonaceae	<i>Muehlenbeckia sagittifolia</i> (Ortega) Meisn.	Sub-Tem	S	RE	C ₃	P
Polygonaceae	<i>Polygonum acuminatum</i> Kunth	Tropical	BL	FLRE	C ₃	P
Polygonaceae	<i>Polygonum ferrugineum</i> Wedd.	Tropical	BL	FLRE	C ₃	P
Polygonaceae	<i>Polygonum hydro Piperoides</i> Michx.	Subtropical	BL	FLRE	C ₃	P
Polygonaceae	<i>Polygonum hispidum</i> Kunth	Tropical	BL	FLRE	C ₃	P
Polygonaceae	<i>Polygonum meisnerianum</i> Cham. & Schltldl.	Tro-Sub	BL	FLRE	C ₃	P
Polygonaceae	<i>Polygonum punctatum</i> Elliot	Tropical	BL	FLRE	C ₃	P
Polygonaceae	<i>Polygonum stelligerum</i> Cham.	Sub-Tem	BL	FLRE	C ₃	P
Polygonaceae	<i>Polygonum styticum</i> Cham. & Schltldl.	Sub-Tem	BL	RE	C ₃	A
Polygonaceae	<i>Rumex argentinus</i> Rech. f.	Sub-Tem	BL	RE	C ₃	P
Pontederaceae	<i>Eichhornia azurea</i> (Sw.) Kunth	Tropical	BL	FF	C ₃	P
Pontederaceae	<i>Eichhornia crassipes</i> (Mart.) Solms	Tropical	BL	FLRE	C ₃	P
Pontederaceae	<i>Pontederia cordata</i> L.	Sub-Tem	BL	FLRE	C ₃	P
Pontederaceae	<i>Pontederia rotundifolia</i> L. f.	Sub-Tem	BL	FLRE	C ₃	P
Portulacaceae	<i>Portulaca gilliesii</i> Hook.	Subtropical	BL	RE	C ₄	P
Potamogetonaceae	<i>Potamogeton</i> L.	Sub-Tem	BL	FF	C ₃	P
Ranunculaceae	<i>Clematis bonariensis</i> Juss. ex DC.	Sub-Tem	E	RE	C ₃	P
Ranunculaceae	<i>Ranunculus apiifolius</i> Pers.	Sub-Tem	BL	RE	C ₃	A
Ranunculaceae	<i>Ranunculus bonariensis</i> Poir.	Sub-Tem	BL	RE	C ₃	A
Rhamnaceae	<i>Scutia buxifolia</i> Reissek	Subtropical	T	RE	C ₃	P
Rubiaceae	<i>Borreria dasycephala</i> (Cham. & Schltldl.) Bacigalupo & E. L. Cabral	Temperate	BL	RE	C ₃	A
Rubiaceae	<i>Borreria verticillata</i> (L.) G. Mey.	Tropical	S	RE	C ₃	P
Rubiaceae	<i>Cephalanthus glabratus</i> (Spreng.) K. Schum.	Temperate	S	RE	C ₃	P
Rubiaceae	<i>Galium vile</i> (Cham. & Schltldl.) Dempster.	Sub-Tem	BL	RE	C ₃	A
Rubiaceae	<i>Psychotriacarthagenensis</i> Jacq.	Sub-Tem	S	RE	C ₃	P
Salicaceae	<i>Salix humboldtiana</i> Willd.	Sub-Tem	T	RE	C ₃	P
Santalaceae	<i>Acanthosyris spinescens</i> (Mart. & Eichler) Griseb.	Tropical	T	RE	C ₃	P
Santalaceae	<i>Jodina rhombifolia</i> (Hook. & Arn.) Reissek	Tropical	T	RE	C ₃	P
Samolaceae	<i>Samolus valerandi</i> L.	Sub-Tem	BL	RE	C ₃	P
Sapindaceae	<i>Allophylus edulis</i> (A. St. -Hil., A. Juss. & Cambess.) Hieron. ex Niederl.	Tropical	T	RE	C ₃	P
Sapindaceae	<i>Dodonaea viscosa</i> L. Jacq.	Tropical	S	RE	C ₃	P
Sapotaceae	<i>Pouteria salicifolia</i> (Spreng.) Radlk	Sub-Tem	T	RE	C ₃	P
Scrophulariaceae	<i>Buddleja stachyoides</i> Cham. & Schltldl.	Sub-Tem	S	RE	C ₃	P
Smilacaceae	<i>Smilax campestris</i> Griseb.	Sub-Tem	E	RE	C ₃	P
Solanaceae	<i>Cestrum parqui</i> L' Hér	Sub-Tem	S	RE	C ₃	P
Solanaceae	<i>Jaborosa integrifolia</i> Lam.	Sub-Tem	BL	RE	C ₃	P
Solanaceae	<i>Jaborosa runcinata</i> Lam.	Sub-Tem	BL	RE	C ₃	P
Solanaceae	<i>Nierembergia aristata</i> Sweet	Temperate	BL	RE	C ₃	P
Solanaceae	<i>Nierembergia linariaefolia</i> Graham var. <i>linariaefolia</i>	Temperate	BL	RE	C ₄	P
Solanaceae	<i>Physalis viscosa</i> L.	Tropical	BL	RE	C ₃	P
Solanaceae	<i>Solanum amygdalifolium</i> Steud.	Sub-Tem	S	RE	C ₃	P
Solanaceae	<i>Solanum bonariense</i> L.	Sub-Tem	S	RE	C ₃	P
Solanaceae	<i>Solanum chenopodioides</i> Lam.	Temperate	S	RE	C ₃	P
Solanaceae	<i>Solanum glaucophyllum</i> Desf.	Temperate	S	RE	C ₃	P
Solanaceae	<i>Solanum laxum</i> Spreng	Temperate	BL	RE	C ₃	A
Solanaceae	<i>Solanum nigrescens</i> M. Martens & Galeotti	Sub-Tem	BL	RE	C ₃	P
Solanaceae	<i>Solanum sisymbriifolium</i> Lam.	Sub-Tem	BL	RE	C ₃	A
Typhaceae	<i>Typha latifolia</i> L.	Sub-Tem	GH	RE	C ₃	P
Typhaceae	<i>Typha dominguensis</i> Pers.	Sub-Tem	GH	RE	C ₃	P
Urticaceae	<i>Boehmeria cylindrica</i> (L.) Sw.	Temperate	BL	RE	C ₃	P
Urticaceae	<i>Parietaria debilis</i> G. Forst	Temperate	BL	RE	C ₃	A
Urticaceae	<i>Urtica urens</i> L.	Temperate	BL	RE	C ₃	P
Verbenaceae	<i>Glandularia incisa</i> (Hook.) Tronc.	Sub-Tem	BL	RE	C ₃	A
Verbenaceae	<i>Lantana camara</i> L.	Tro-Sub	S	RE	C ₃	P
Verbenaceae	<i>Lippia alba</i> (Mill.) N. E. Br. ex Britton & P. Wilson	Sub-Tem	S	RE	C ₃	P
Verbenaceae	<i>Phyla canescens</i> (Kunth) Greene	Sub-Tem	BL	RE	C ₃	P
Verbenaceae	<i>Verbena bonariensis</i> L.	Sub-Tem	BL	RE	C ₃	A
Verbenaceae	<i>Verbena gracilescens</i> (Cham) Herter	Temperate	BL	RE	C ₃	P
Vitaceae	<i>Cissus palmata</i> Poir.	Sub-Tem	BL	RE	C ₄	P

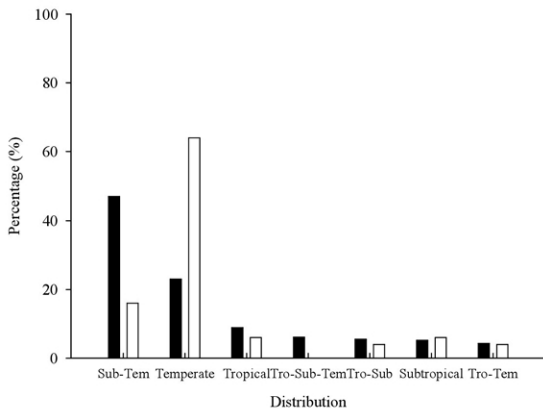


Figure 2. Distribution of the native and exotic species present in the landscape units surveyed in the Delta of the Paraná River Region. Sub-Tem: Subtropical-temperate; Tro-Sub-Tem: Tropical-subtropical-temperate; Tro-Sub: Tropical-subtropical; Tro-Tem: Tropical-temperate. White bars: natives, black bars: exotics.

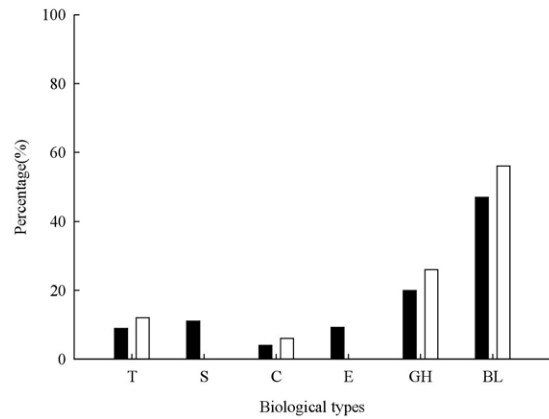


Figure 3. Biological type of the native and exotic species present in the landscape units surveyed in the Delta of the Paraná River Region. BL: broadleaf herb; GH: graminoid herbaceous plant; S: shrub; E: equisetoid herbaceous plant; T: tree; C: climber. White bars: natives, black bars: exotics.

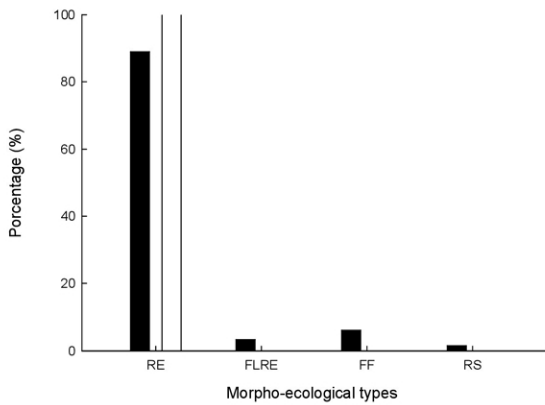


Figure 4. Morpho-ecological traits of the native and exotic species present in the landscape units surveyed in the Delta of the Paraná River Region. RE: rooted emergent; FLRE: floating-leaved rooted emergent; FF: free-floating; RS: rooted submerged. White bars: natives, black bars: exotics.

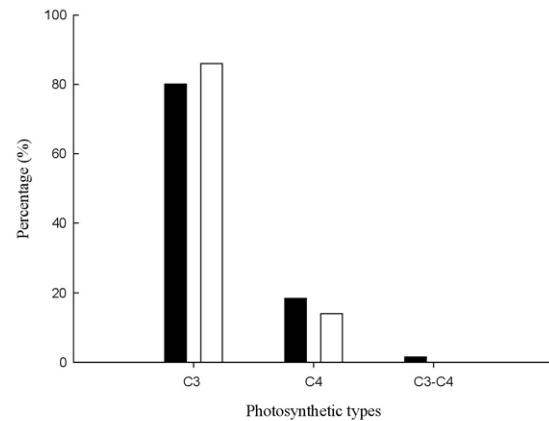


Figure 5. Photosynthetic types of the native and exotic species present in the landscape units surveyed in the Delta of the Paraná River Region. White bars: natives, black bars: exotics.

DISCUSSION

Our analysis of species richness for the angiosperms present in the RDRP provides a first approximation to the understanding of the relative importance of some ecological traits, observed in the functional groups under consideration. Due to this, it may be possible to draw the following conclusions: the high percentage of native species present in the RDRP suggests that the wetland area is well conserved, despite the environmental changes caused by human activity over the last years. The structural and functional diversity of native species reflects the heterogeneity of the wetlands, resulting from the different landscape patterns in the region and their interaction with the hydrological regime (Malvárez 1999). The higher percentage of native subtropical-temperate species would be explained by the particular climate characteristics of the region, such as low seasonal temperature fluctuations and high environmental humidity due to the effect of large amounts of water (Malvárez 1999). These conditions, together with the availability of a variety of habitats and

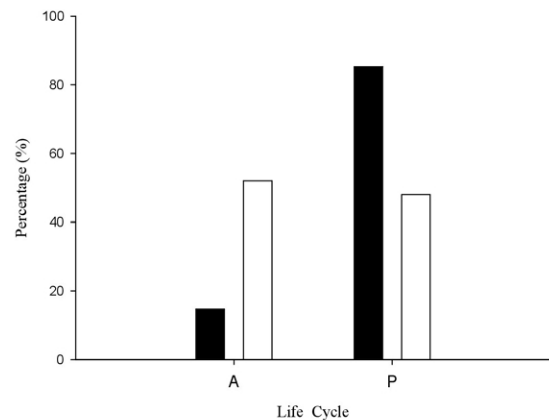


Figure 6. Life cycles of the native and exotic species present in the landscape units surveyed in the Delta of the Paraná River Region. A: annual; P: perennial. White bars: natives, black bars: exotics.

the important role played by the Paraná and Uruguay rivers as biological corridors, may have favored the colonization of subtropical species in a temperate area. In this regard, it is worthwhile to mention that the Paraná River constitutes a major dispersion route for

Table 2. List of exotic species present in the landscape units surveyed in the Delta of the Paraná River Region, arranged by family. BT: biological type; MT: morpho-ecological traits; PT: photosynthetic types; LC: life cycle; Sub-Tem: Subtropical-temperate; Tro-Sub-Tem: Tropical-subtropical-temperate; Tro-Sub: Tropical-subtropical; Tro-tem: Tropical-temperate; BL: broadleaf herb; GH: graminoid herbaceous plant; S: shrub; E: equisetoid herbaceous plant; T: tree; C: climber; RE: rooted emergent; FLRE: floating-leaved rooted emergent; FF: free-floating; RS: rooted submerged; A: annual; P: perennial.

Family	Species	Distribution	BT	MT	PT	LC
Aceraceae	<i>Acer negundo</i> L.	Temperate	T	RE	C ₃	P
Amaranthaceae	<i>Dysphania multifida</i> (L.) Mosyakin & Clemants	Tro-Sub	BL	RE	C ₄	P
Amaranthaceae	<i>Salsola kali</i> L.	Sub-Tem	BL	RE	C ₄	A
Apiaceae	<i>Apium leptophyllum</i> (Pers.) F. Muell. ex Benth.	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Cotula australis</i> (Sieber ex Spreng.) Hook. f.	Subtropical	BL	RE	C ₃	A
Asteraceae	<i>Cotula coronopifolia</i> L.	Subtropical	BL	RE	C ₃	P
Asteraceae	<i>Sonchus asper</i> (L.) Hill	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Tragopogon pratensis</i> L.	Sub-Tem	BL	RE	C ₃	A
Asteraceae	<i>Xanthium cavanillesii</i> Schouw	Sub-Tem	BL	RE	C ₃	A
Brassicaceae	<i>Coronopus didymus</i> (L.) Sm.	Temperate	BL	RE	C ₃	A
Caprifoliaceae	<i>Lonicera japonica</i> Thunb.	Temperate	C	RE	C ₃	P
Caryophyllaceae	<i>Cerastium glomeratum</i> Thuill.	Temperate	BL	RE	C ₃	A
Caryophyllaceae	<i>Silene gallica</i> L.	Temperate	BL	RE	C ₃	A
Caryophyllaceae	<i>Stellaria media</i> (L.) Vill.	Temperate	BL	RE	C ₃	A
Convolvulaceae	<i>Calystegia sepium</i> (L.) R. Br.	Temperate	C	RE	C ₃	P
Euphorbiaceae	<i>Euphorbia peplus</i> L.	Temperate	BL	RE	C ₄	A
Euphorbiaceae	<i>Euphorbia spathulata</i> Lam.	Temperate	BL	RE	C ₄	A
Fabaceae	<i>Gleditsia triacanthos</i> L.	Temperate	T	RE	C ₃	P
Fabaceae	<i>Lathyrus pubescens</i> Hook. & Arn.	Temperate	C	RE	C ₃	P
Fabaceae	<i>Medicago lupulina</i> L.	Temperate	BL	RE	C ₃	A
Fabaceae	<i>Trifolium repens</i> L.	Temperate	BL	RE	C ₃	P
Gentianaceae	<i>Centaurium pulchellum</i> (Sw.) Druce	Temperate	BL	RE	C ₃	A
Geraniaceae	<i>Geranium dissectum</i> L.	Temperate	BL	RE	C ₃	A
Iridaceae	<i>Iris pseudacorus</i> L.	Temperate	GH	RE	C ₃	P
Geraniaceae	<i>Geranium robertianum</i> L.	Temperate	BL	RE	C ₃	A
Nyctaginaceae	<i>Mirabilis jalapa</i> L.	Tropical	BL	RE	C ₃	P
Meliaceae	<i>Melia azedarach</i> L.	Sub-Tem	T	RE	C ₃	P
Oleaceae	<i>Ligustrum lucidum</i> W. T. Aiton	Temperate	T	RE	C ₃	P
Oleaceae	<i>Ligustrum sinense</i> Lour.	Temperate	T	RE	C ₃	P
Poaceae	<i>Briza minor</i> L.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Cynodon dactylon</i> (L.) Pers.	Tro-Tem	GH	RE	C ₄	P
Poaceae	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Tro-Sub	GH	RE	C ₄	A
Poaceae	<i>Hemarthria altissima</i> (Poir.) Stapf & C. E. Hubb	Tropical	GH	RE	C ₃	P
Poaceae	<i>Hordeum flexuosum</i> Nees ex Steud.	Temperate	GH	RE	C ₃	P
Poaceae	<i>Lolium multiflorum</i> Lam.	Temperate	GH	RE	C ₃	A
Poaceae	<i>Paspalum vaginatum</i> Sw.	Temperate	GH	RE	C ₄	P
Poaceae	<i>Phalaris aquatica</i> L.	Tropical	GH	RE	C ₃	P
Poaceae	<i>Poa annua</i> L.	Temperate	GH	RE	C ₃	A
Poaceae	<i>Polypogon monspeliensis</i> (L.) Desf.	Sub-Tem	GH	RE	C ₃	A
Poaceae	<i>Vulpia bromoides</i> (L.) Gray	Temperate	GH	RE	C ₃	A
Poaceae	<i>Vulpia myuros</i> (L.) C. C. Gmel.	Temperate	GH	RE	C ₃	A
Plantaginaceae	<i>Plantago lanceolata</i> L.	Temperate	BL	RE	C ₃	P
Plantaginaceae	<i>Veronica peregrina</i> L.	Tro-Tem	BL	RE	C ₃	P
Polygonaceae	<i>Rumex conglomeratus</i> Murray	Temperate	BL	RE	C ₃	P
Polygonaceae	<i>Rumex crispus</i> L.	Temperate	BL	RE	C ₃	P
Polygonaceae	<i>Rumex pulcher</i> L.	Temperate	BL	RE	C ₃	P
Portulacaceae	<i>Portulaca oleracea</i> L.	Subtropical	BL	RE	C ₄	A
Primulaceae	<i>Centunculus minimus</i> L.	Temperate	BL	RE	C ₃	A
Rosaceae	<i>Duchesnea indica</i> (Andrews) Teschem.	Temperate	BL	RE	C ₃	P
Salicaceae	<i>Populus alba</i> L.	Sub-Tem	T	RE	C ₃	P

species of Chaco-Interior Atlantic Forest lineage and the Uruguay River for species of Interior Atlantic Forest lineage (Burkart 1947).

In contrast, the predominance of exotic temperate species would be related to anthropic activities traditionally developed in the neighboring Pampean

region (temperate climate), which have been continuously undertaken in the delta region and increased at a rapid rate in recent years (Bó et al. 2010). This is evidenced by the fact that many of the exotic species recorded in the RDRP occur in Pampean agroecosystems, such as *Carduus* sp., *Cotula australis*, *Hypochaeris* sp. and *Sonchus*

asper, among others (Requesens and Madanes 1992).

The high species richness of both native and exotic BL and GH reflects the predominant physiognomy of the marsh (“pajonal”) and grasslands in island and coastal areas. The former cover 80% of the surface area of the deltaic islands and include many E, all of which are native. This may be explained by the fact that, except for *Iris pseudocorus*, the native E are better adapted than exotic E to high water level and water permanency, and therefore to anaerobic conditions.

The morpho-ecological characteristics of the angiosperms living in the RDRP are a consequence of the different morphological, anatomical, physiological and metabolic adaptations developed to cope with different water level conditions (Tiner 1999). In this respect, the high species richness of native and exotic RE plants may be due to their presence along an upland-to-lowland landscape gradient (e.g., *Blepharocalyx salicifolius* in temporary flooded areas and *Schoenoplectus californicus* in permanently flooded areas).

All the exotic species were RE, most of which were found in the upper portion of the topographic gradient (e.g., *Lepidium didymum*, *Cerastium glomeratum*, *Silene gallica*, *Spergula levisand* *Stellaria media*) but a few occurred in the lower portion (e.g., *Echinochloa crus-galli*). The absence of exotic FLRE and RS is probably because most of the anthropic activities, closely related to the presence of exotic species, are mainly undertaken in the upper portion of the gradient.

The higher richness of native and exotic C₃ species is likely to be related to the latitude of the study area, as this photosynthetic group is associated with intermediate temperatures in temperate climates (Medina 1977). Additionally, species in the C₃ group may be particularly adapted to flooded lowlands occupying a large surface area of the islands. On the other hand, the considerable presence of the C₄ group, which is typical of subtropical climate, could be partially explained by the peculiar climate conditions of the RDRP but mainly by their location in the uplands. Some exceptions include *Cyperus giganteus* and *Rhynchospora corymbosa*, which tolerate flooding because they can grow under low nutrient conditions (Ueno and Takeda 1992; Sage 2004).

The higher species richness of native perennial species may be related to their adaptation to extreme hydrological conditions through specialized structures (e.g., stolons and rhizomes) providing attachment to the substrate and high vegetative growth. This is the case for many GH and T common in the region, such as *Schoenoplectus californicus*, *Zizaniopsis bonariensis* and *Typha latifolia*, which live in permanently flooded areas and *Salix humboldtiana* (Malvárez 1999) and *Tessaria integrifolia* (Reboratti et al. 1987), which are rapid growing plants. In addition, the latter two species are adapted to highly variable environmental conditions

resulting from two processes characteristic of the fluvial wetlands in the region: erosion and sediment deposition (Kandus et al. 2006).

The equal representation of exotic perennial and annual species would probably be due to a higher proportion of BL, which are r-strategists able to reproduce by vegetative through rhizomes and stolons (perennials) or have a short life-span (annuals).

ACKNOWLEDGEMENTS

We thank Mark Brinson for his encouragement of this work. This study was supported by both the PICT Bicentenario 2227 from the ANPCyT-FONCyT and the PIP 092 from the National Council of Scientific and Technical Researchers (CONICET) grants.

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Author contributions: NM, RDQ and PK collected the data: NM and PK made the analysis. NM, RDQ, PK and RFQ wrote the text.

Received: 30 November 2014

Accepted: 29 September 2015

Academic editor: Juliana de Paula-Souza