

Vascular plants of oxbow lakes of Turvo River, Upper Paraná River basin, São Paulo State, Brazil

Renato Braz de Araujo^{1*}, Francisco Langeani² and Neusa Taroda Ranga²

¹ Universidade Estadual Paulista, Centro de Aquicultura. CEP 14884-900. Jaboticabal, SP, Brazil.

² Universidade Estadual Paulista, Instituto de Biociências, Letras e Ciências Exatas, Departamento de Zoologia e Botânica, CEP 15054-000, São José do Rio Preto, SP, Brazil.

* Corresponding author: E-mail: renatobrazaraujo@ig.com.br

ABSTRACT: Vascular plants were investigated in oxbow lakes of Turvo River, Upper Paraná River basin, between Icém and Nova Granada municipalities, state of São Paulo, Brazil. In this region, six lagoons were sampled: Ganzella, Mustafá, Braço Morto, 45, Federal, and Parente. The survey showed a total of 54 species, 36 genera and 22 families. The species richest families were Poaceae, Cyperaceae, and Polygonaceae. *Eichhornia crassipes* (Pontederiaceae) was the single species encountered in all the six lakes.

INTRODUCTION

Oxbow lakes are recognized for their importance in the maintenance and integrity of regional biodiversity, as natural nurseries of commercially important species (Agostinho *et al.* 2000), and as a preferential habitat of sedentary and small-sized fish species (Meschiatti *et al.* 2000; Araujo and Langeani 2006). These areas are colonized by aquatic and marginal vegetation that establish strong connection between aquatic and terrestrial ecosystems, play an important role in the primary production, nutrient cycling, and as bioindicators of eutrophication processes (Scheffer 1998). Regarding the aquatic macrophytes from Upper Paraná River basin floodplain, Thomaz *et al.* (2004) registered a total of 60 species in rivers, channels, backwaters, and permanent and temporary lagoons. In this same region, Santos and Thomaz (2007) found 29 species of aquatic plants in seven lagoons. Recently, Amaral *et al.* (2008) listed 400 species of aquatic flora of the state of São Paulo.

Composition of vascular plants of oxbow lakes of Turvo River, Upper Paraná River basin is still unknown. The purpose of this study is to provide a species list of this habitat, the first investigation of the kind in this region.

MATERIALS AND METHODS

The Turvo River basin is part of the large Grande River drainage basin, which belongs to the Upper Paraná River basin. The headwaters of the Turvo River are located in the municipality of Monte Alto and its mouth is located in the city of Cardoso, both in the state of São Paulo. The main tributaries of the Turvo River include Onça, Preto, São Domingos, and Cachoeirinha rivers (Figure 1). Samplings were performed from July 2005 to May 2007 in six oxbow lakes along the Turvo River, 20°21'11" S, 49°16'38" W, near Km 12 of BR-153 highway between Nova Granada and Icém municipalities, state of São Paulo (Figure 1). Material was collected under the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis permits (#03/2005, 12/2006). Vascular plants (aquatic and marginal macrophytes) were manually sampled in the Ganzella (G), Mustafá (M), Braço Morto (BM), 45 (L45), Federal (F), and Parente (P) lakes (Table 1, Figures 2-7). The identification of species was done using specialized literature and by comparison with SJRP herbarium exsiccates previously identified by specialists. The taxonomic classification is according to the Angiosperm Phylogeny Group II (APG II 2003) and Windisch (1992). Voucher specimens of each species are deposited in the Herbário SJRP of the Departamento de Zoologia e Botânica, Instituto de Biociências, Letras e Ciências Exatas, Universidade Estadual Paulista (UNESP).

RESULTS AND DISCUSSION

A total of 54 species distributed in 36 genera and 22 families were collected in the oxbow lakes of Turvo River (Table 2). This number of species represents *ca.* 14 % of the 400 species of aquatic flora listed by Amaral

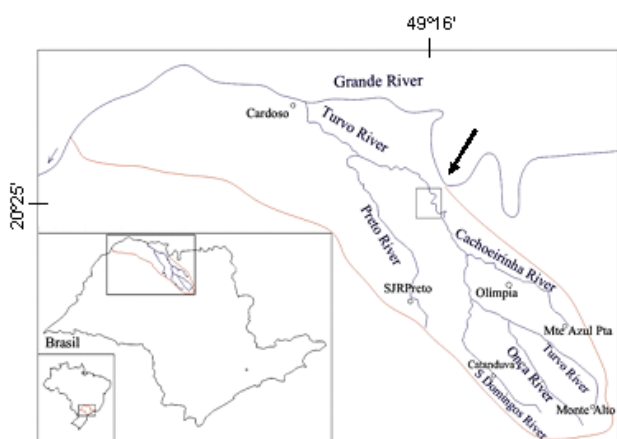


FIGURE 1. Turvo-Grande hydrographic basin showing localization of the study area. The arrow indicates collecting site in the Turvo River, São Paulo, Brazil.

et al. (2008) for the state of São Paulo, suggesting that it is necessary to preserve these environments. Families Poaceae, Cyperaceae, and Polygonaceae were the most representative with eight, six, and five species, respectively, totalizing 34.5 % of the species found. *Eichhornia crassipes* (Pontederiaceae) was the only species found in the six lakes. It is native from the Amazon and Pantanal regions occurring in all regions of Brazil (Amaral *et al.* 2008).

The Parente lake was the species richest (25), followed

by Ganzella (22) and Federal lake (19). Considering the importance of marginal lakes in the maintenance and integrity of regional biodiversity in terms of fishes (Delariva *et al.* 1994; Araujo and Langeani 2006), amphibians, reptiles, birds, and mammals (O.A.B. Azevedo, pers. comm.) the results obtained in oxbow lakes of Turvo River could be useful because can contribute with valuable data for the study of possible interactions with the fauna species.



FIGURE 2. Lake Ganzella, Turvo River, Nova Granada, SP, Brazil (September 16, 2005). Photo: R. B. Araujo



FIGURE 5. Lake 45, Turvo River, Icém, SP, Brazil (September 23, 2005). Photo: R. B. Araujo



FIGURE 3. Lake Mustafá, Turvo River, Nova Granada, SP, Brazil (July 13, 2005). Photo: R. B. Araujo



FIGURE 6. Lake Federal, Turvo River, Nova Granada, SP, Brazil (July 28, 2005). Photo: R. B. Araujo



FIGURE 4. Lake Braço Morto, Turvo River, Nova Granada, SP, Brazil (July 13, 2005). Photo: R. B. Araujo



FIGURE 7. Lake Parente, Turvo River, Icém, SP, Brazil (September 23, 2005). Photo: R. B. Araujo

TABLE 1. Environmental parameters for the six studied oxbow lakes of Turvo River. *M was desiccated.

Lake	Coordinates	Altitude (m)	Area (m ²)	Depth (m)
G	20°25'11.9"S 49°16'00.1"W	459	6,887	0.05-1.7
M	20°24'37.9"S 49°16'05.3"W	454	12,584	* - 1.6
BM	20°21'11.6"S 49°16'39.0"W	432	27,680	0.4-1.8
L45	20°24'56.1"S 49°15'53.7"W	456	22,798	0.6-2.7
F	20°22'45.6"S 49°16'36.1"W	441	48,587	0.65-3.0
P	20°21'30.1"S 49°16'48.6"W	436	124,442	0.1-2.8

TABLE 2. Vascular plants species found in six oxbow lakes of Turvo River, Upper Paraná River basin, from 2005 to 2007. Herbarium SJRP number (SJRP n^o).

FAMILY/SPECIES	LAKE	SJRP NUMBER
AMARANTHACEAE		
<i>Alternanthera pungens</i> Kunth	P,G	28315
<i>Alternanthera brasiliana</i> var. <i>villosa</i> Kuntze (L.)	L45	22936
BORAGINACEAE		
<i>Heliotropium indicum</i> L.	F, P, L45	29846
<i>Heliotropium procumbens</i> Mill.	P, L45	28316
CERATOPHYLLACEAE		
<i>Ceratophyllum</i> sp.	F, P	28847
CONVOLVULACEAE		
<i>Ipomoea</i> sp.	P	28848
CYPERACEAE		
<i>Eleocharis filiculmis</i> Kunth	P	1720
<i>Eleocharis elegans</i> (H. B. K.) Roem. & Schult.	P	28310
<i>Eleocharis</i> sp.	P	29849
<i>Cyperus</i> aff. <i>esculentus</i> L.	G	25265
<i>Cyperus</i> sp.	F, P, L45,G	28312
<i>Oxycaryum cubense</i> (Poepp. & Kunth) Lye	F	28311
EUPHORBIACEAE		
<i>Caperonia castaneifolia</i> (L.) A. St.-Hil.	F, P, G	29850
FABACEAE		
<i>Chamaecrista patellaria</i> (DC).	L45	506
<i>Mimosa</i> aff. <i>setosa</i> Benth.	F, G	12726
<i>Mimosa</i> cf. <i>pigra</i> L.	L45	17473
<i>Mimosa invisa</i>	P, L45, G, M	10698
<i>Mimosa</i> sp.	F, P, G, M, BM	*
<i>Senna obtusifolia</i> (L.) H.S. Irwin & Barneby	G	27912
HALORAGACEAE		
<i>Myriophyllum aquaticum</i> (Vell.) Verdc.	F	396
HYDROCHARITACEAE		
<i>Egeria densa</i> (Planch.) Casp.	F	28326

HYDROLEACEAE (HYDROPHYLLACEAE)

Hydrolea spinosa L. G 23144

LAMIACEAE

Leonotis nepetaefolia (R. Br.) W.T. Aiton G 23147

LENTIBULARIACEAE

Utricularia foliosa L. F 28317

Utricularia warmingii Kamiénski F 29851

Utricularia pusilla Vahl G 8674

LYTHRACEAE

Cuphea sp. G 2518

MALVACEAE

Hibiscus striatus Cav. P 23165

Pavonia sp. G 10854

Waltheria indica L. L45 29471

NYMPHAEACEAE

Nymphaea amazonum Mart. & Zucc. F, P, L45, M 29853

ONAGRACEAE

Ludwigia leptocarpa (Nutt.) H. Hara F 29853

Ludwigia octovalvis (Jacq.) P.H. Raven L45 28318

Ludwigia aff. *elegans* (Cambess.) H. Hara G 29854

POACEAE

Pennisetum americanum (L.) Leeke P *

Brachiaria sp. F 29855

Panicum aff. *dichotomiflorum* Michx. L45 29856

Hymenachne amplexicaulis (Rudge) Nees L45, G 29857

Setaria geniculata P. Beauv. L45 19480

Echinochloa crusgalli (L.) P. Beauv. P 985

Echinochloa polystachya (Kunth) Hitchc. F, G 29858

Paspalum urvillei Steud. P 984

POLYGONACEAE

Polygonum ferrugineum Wedd. F, P, L45, G 234

Polygonum hydropiperoides Michx. P, L45, G, M 28319

Polygonum punctatum Elliot L45 29859

Polygonum lapathifolium L. M 29860

Polygonum sp. P, G 1725

PONTEDERIACEAE

Eichhornia crassipes (Mart.) Solms F, P, L45, G, M, BM 29862

Eichhornia azurea (Sw.) Kunth F, BM 29861

Pontederia sp. P *

SALVINIACEAE

Salvinia sp. F, P, L45, BM 29863

PLANTAGINACEAE (SCROPHULARIACEAE)

Scoparia dulcis L. P 13203

Stemodia trifoliata (Link) Reichb. L45 28320

VERBENACEAE

Lippia alba (Mill.) N.E.Br. P,G 28321

* Material that was damaged.

ACKNOWLEDGMENTS: We are grateful to Oscar A. Shibatta, Lilian Casatti, Antonio F. M. Camargo, and anonymous referees for valuable suggestions; to Fernando R. Carvalho, Fernando L. R. Souza, and Luiz G. G. da Silveira for help in field; to Ademir O. Veschi for technical assistance; to Carlos Daghljan for revision of the English text; to 4^o Batalhão de Polícia Ambiental de São José do Rio Preto for logistical support for collecting. This research was partly supported by a CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) personal grant to the first author (142.180/2005-0) and by FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) (04/00545-8) grant to second author.

LITERATURE CITED

- Agostinho, A.A., S.M. Thomaz, C.V. Minte-Vera and K.O. Winemiller. 2000. Biodiversity in the high Paraná river floodplain; p. 89-118 In: B. Gopal, W.J. Junk, and J.A. Davis (ed.). *Biodiversity in Wetlands: Assessment, Function and Conservation*. Leiden: Backhuys Publishers.
- Amaral, M.C.E., V. Bittrich, A.D. Faria, L.O. Anderson and L.Y.S. Aona. 2008. *Guia de campo para plantas aquáticas e palustres do Estado de São Paulo*. Ribeirão Preto: Holos, Editora. 452 p.
- APG (Angiosperm Phylogeny Group). 2003. An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG II. *Botanical Journal of the Linnean Society* 141: 399-436.
- Araujo, R.B. and F. Langeani. 2006. Lagoas marginais: viveiros naturais de peixes. *O Curumim* 118: 13-16.
- Delariva, R.L., A.A. Agostinho, K. Nakatani and G. Baumgartner. 1994. Ichthyofauna associated to aquatic macrophytes in the Upper Paraná river floodplain. *Revista Unimar* 16: 41-60.
- Meschiatti, A.J., M.S. Arcifa and N. Fenerich-Verani. 2000. Fish communities associated with macrophytes in Brazilian floodplain lakes. *Environmental Biology of Fishes* 58: 133-143.
- Santos, A.M. and S.M. Thomaz. 2007. Aquatic macrophytes diversity in lagoons of a tropical floodplain: the role of connectivity and water level. *Austral Ecology* 32: 177-190.
- Scheffer, M. 1998. *Ecology of shallow lakes*. London: Chapman & Hall. 357 p.
- Thomaz, S.M., T.A. Pagioro, L.M. Bini and D.C. Souza. 2004. Aquatic macrophytes from the upper Paraná river floodplain: species list and patterns of diversity in large scale; p. 221-226 In: A.A. Agostinho, L. Rodrigues, L.C. Gomes, S.M. Thomaz and L.E. Miranda (ed.). *Structure and Functioning of the Paraná River and its Floodplain: LTER-Site 6*. Maringá: EDUEM.
- Windisch, P.G. 1992. *Pteridófitas da região norte-ocidental do estado de São Paulo: guia para estudos e excursões*. São José do Rio Preto: Universidade Estadual Paulista. 110 p.

RECEIVED: July 2009

REVISED: October 2009

ACCEPTED: January 2010

PUBLISHED ONLINE: March 2010

EDITORIAL RESPONSIBILITY: Angelo Gilberto Manzatto