Occurrence of Macrophytes species in the lower basin of the Xingu River

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(With 1 figure)

The term 'aquatic macrophytes' refers to a diverse group of aquatic photosynthetic organisms, all large enough to see with the naked eye, being represented by seven plant divisions: Cyanobacteria, Chlorophyta, Rhodophyta, Xanthophyta, Bryophyta, Pteridophyta and Spermatophyta, consisting of at least 41 orders and 103 families (Chambers et al., 2008). This group colonizes many different types of aquatic ecosystems and this variety of environments results from a set of adaptive strategies achieved over evolutionary time (Thomaz and Cunha, 2010).

The aquatic macrophyte assemblage is usually composed of species with different life forms and this has been considered very important for maintaining the integrity of aquatic ecosystems (Boschilia et al., 2008). This community is highly productive in floodplains and their structure shows response closely linked to the flood pulse flood disturbance in these environments (Junk and Piedade, 1993).

The process of pulses occurring in Amazonian rivers reaches its greatest amplitude in the floodplain ecosystems (Tundisi, 2007). The variability generated by constant hydrological disturbance promotes new processes of ecological interactions (Junk et al., 1989), generating environmental fluctuations in space and time and providing conditions for the existence of a high diversity of species. These features are observed in the lower stretch of the Xingu River, where large uneven rapids, a series of anastomosing channels, and high amount of tributaries generate specific hydrological conditions and a broad regional limnological heterogeneity. Thus, this scientific note aims to list the species of macrophytes recorded in the Xingu River and tributaries that make up the middle section of the basin of the Xingu River along with 2 full hydrological cycles. This note is related to the large scale limnological survey that is carried out by International Institute of Ecology and Environmental Management in influence area of Belo Monte hydroelectric dam.

Between the years 2012 and 2013, 39 sampling stations were monitored quarterly in different types of environments in the riverine landscape, such as the main course of the Xingu River (XR), different lagoons (La), and affluents (Af) of the Xingu River (Figure 1). In these stations 106 species of aquatic macrophytes were registered, belonging to 33 families and 1 sub-family (Mimosaceae) (Table 1). The families with the highest species (spp.) richness were: Cyperaceae (35 spp.), Poaceae (17 ssp.), Podostemaceae (6 spp.), Pontederiaceae (5 spp.), Fabaceae (4 spp.) and Onagraceae (4spp.). In contrast, 17 families were represented only by one single species (Figure 1 and Table 1).

Five biologic forms of macrophytes were recorded in riverine landscape, and those that had a greater number of species were amphibians (41 species), emergent (37 species) and floating (free: 10; prostrate: 6). Rheophyte and submerged, the others 2 forms registered, had 5 and 6 species, respectively.

In terms of environments analyzed, the Xingu River showed the highest richness in riverine landscape with 67 species identified. In lagoons and affluents 59 and 55 species were recorded, respectively (Table 1). Twenty species had high distribution, being registered in all environments analyzed (*e.g Salviniaauriculata*). On the other hand, 54 taxa occurred only in one type of envirommment (*e.g Thaliageniculata L.*) (Figure 1 and Table 1).

In the sampled stations on the Xingu River was possible to identify two different regions concerning the distribution of macrophytes, one located in the upstream, with rocky stretches and rapids, where predominated the species belonging to the Podostemaceae family, and another located downstream, with milder hydrological conditions and more backwaters, colonized by species such as *Montrichardia linifera* and *Echinochloa polystachya*. Among the species registered in the first region (upstream), it is worth mentioning the occurrence of *Mourera fluviatilis*, which appears in the list of endangered species of flora (Brasil, 2008).

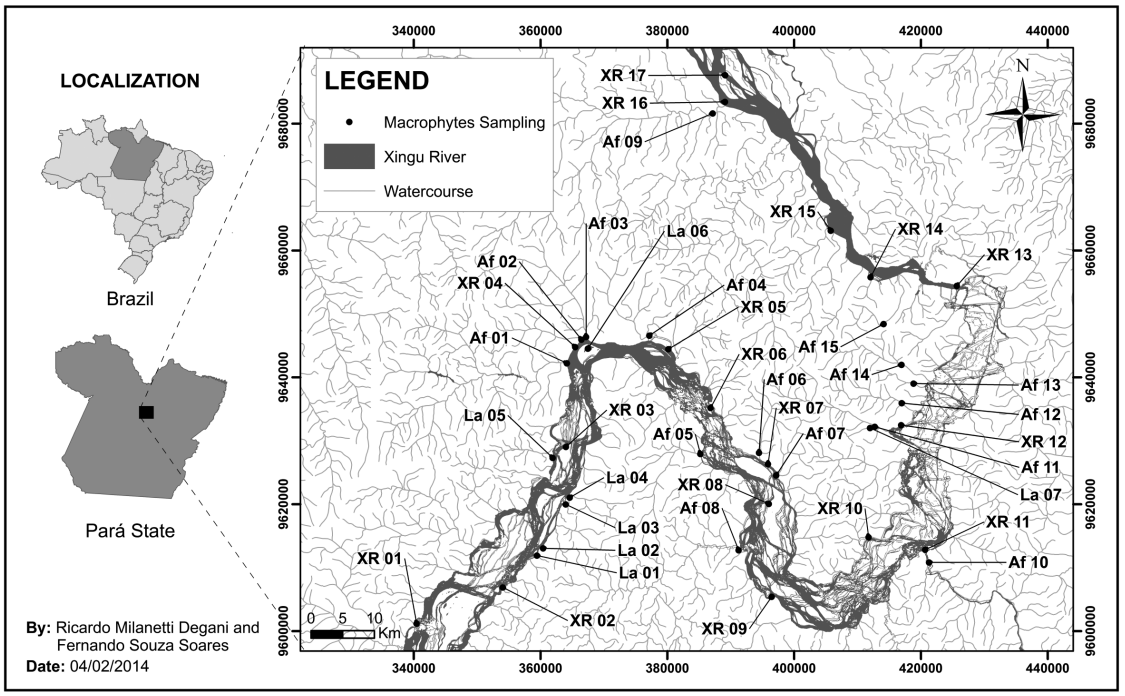

Figure 1. Location of sampling stations of macrophytes in the lower basin of the Xingu River.

Table 1. Taxa and biological forms of macrophytes recorded in riverine landscapes of the Xingu River during two years of sampling.

Taxa	Biological forms	Lagoons	Xingu river	Affluents
BRYOPHYTES				
Ricciaceae				
Ricciocarpus natans (L.) Corda	Floating (free)	X	X	
PTERIDOPHYTE				
Azollaceae				
Azolla filiculoides Lam.	Floating (free)	X	X	X
Salviniaceae				
Salvinia auriculata Aubl.	Floating (free)	X	X	X
Salvinia biloba D. Mitch.	Floating (free)	X		
GYMNOSPERM				
Alismataceae				
Echinodorus sp.	Emergent	X		X
Echinodorus macrophyllus (Kunth) Micheli subsp. Scaber	Emergent	X		
Apiaceae				
Eryngium sp.	Amphibious		X	
Apocynaceae				
Rhabdadenia pohlii Muell. Arg.	Emergent		X	
Araceae				
*Pistia stratiote*s L.	Floating (free)	X		X
Montrichardia linifera (Arruda) Schott	Emergent	X	X	X
Asteraceae				
Eclipta sp1.	Amphibious	X	X	X
Cabombaceae				
Cabomba furcata Schult.&Schult. F.	Submerged (prostrate)	X		

Table 1. Continued...

Taxa	Biological forms	Lagoons	Xingu river	Affluents
Characeae				
Chara sp.	Submerged (prostrate)	X		
Commelinaceae				
Commelinaceae sp.	Emergent	X	X	
Costacea				
Costus sp.	Emergent	X		
Cyperaceae				
Calyptrocarya longifolia (Rudge) Kunth.	Amphibious	X		
Cyperus articulatus L.	Amphibious		X	
Cyperus digitatus Roxb.	Amphibious	X		
Cyperus distans L.	Amphibious	X		
Cyperus esculentus L.	Amphibious		X	X
Cyperus exaltatus Retz.	Amphibious	X		
Cyperus giganteus Vahl	Amphibious	X	X	
Cyperus haspan L.	Amphibious		X	
Cyperus iria L.	Amphibious	X		X
Cyperus lanceolatus Poir.	Amphibious		X	X
Cyperus laxus Lamarck	Amphibious		X	
Cyperus luzulae (L.) Rottb. ex Retz.	Amphibious	X	X	X
*Cyperus mundtii (*Nees) Kunth.	Amphibious		X	
Cyperus odoratus L.	Amphibious	X	X	X
Cyperus cf. prolixus Kunth.	Amphibious			X
Cyperus sphacelatus Rottb.	Amphibious	X	X	X
Cyperus surinamensis Rottb.	Amphibious	X	X	
Cyperus tenuis Sw.	Amphibious		X	
Cyperus sp.	Amphibious	X	X	X
Eleocharis interstincta (Vahl) Roem. & Schult.	Amphibious	X		
Eleocharis montana R.Br.	Amphibious	X		
Eleocharis sp.	Amphibious	X	X	
Fimbristylis miliacea (L.) Vahl.	Amphibious	X	X	X
Fimbristylis dichotoma (L.) Vahl	Amphibious	X	X	
Fimbristylis sp.	Amphibious		X	
Fuirena umbellata Rottb.	Amphibious			X
Oxycarium cubense (Poepp. & Kunth) Lye	Emergent	X	X	X
Oxycarium sp.	Amphibious		X	
Pycreus aff. Polystachyos	Amphibious			X
Scleria gartneri Rad.	Amphibious	X	X	
Scleria mitis P.J. Bergius	Amphibious	X		X
Scleria melaleuca Rchb.	Amphibious	X		
Scleria microcarpa Nees ex Kunth	Amphibious	X		
Scleria secans (L.) Urb.	Amphibious			X
Scleria sp.	Amphibious	X	X	X
Euphorbiaceae				
Caperonia castaneifolia (L.) A. St.-Hill.	Emergent	X	X	X
Hydrocharitaceae				
Hydrilla sp.	Submerged (prostrate)			X
Lamiaceae				
Hyptis lappaceae Benth.	Amphibious	X		
Hyptis sp.	Emergent	X	X	X

Table 1. Continued...

Taxa	Biological forms	Lagoons	Xingu river	Affluents
Fabaceae (Leguminosae)				
Aeschynomene sp.	Emergent	X	X	X
Mimosa sp.	Emergent		X	X
Acosmium nitens (Vogel) Yakovlev	Emergent			X
Mimosa pudica L.	Emergent	X	X	
Mimosaceae				
Neptunia prostrata (Lam.) Baill.	Floating (free)		X	
Lemnaceae				
Lemna sp.	Floating (free)	X	X	X
Spirodela sp.	Floating (free)	X	X	
Lentibulariaceae				
Utricularia sp.	Submerged (free)		X	X
Utricularia foliosa L.	Submerged (free)		X	X
Malvaceae				
Malvaceae sp1	Emergent			X
Marantaceae				
Thalia geniculata L.	Emergent	X		
Melastomataceae				
Melastomataceae sp1	Emergent			X
Menyanthaceae				
Nymphoides sp.	Floating (prostrate)			X
Najadaceae				
Najas guadalupensis (Spreng.) Magnus ssp. guadalupensis	Submerged (prostrate)			X
Nymphaeaceae				
Nymphaea amazonum Mart. & Zucc. ssp *amazonum*	Floating (prostrate)			X
Nymphaea sp.	Floating (prostrate)	X		X
Onagraceae				
Ludwigia leptocarpa (Nutt.) Hara	Emergent	X	X	X
Ludwigia hyssopifolia (G.Don) Excel	Amphibious	X	X	X
Ludwigia sp.	Emergent	X	X	X
Ludwigia helmintorrhiza (Mart.) Hara	Floating (free)		X	
Parkeriaceae				
Ceratopteris sp.	Emergent	X		X
Piperaceae				
Piperaceae sp1	Emergent		X	
Peperomia pellucida L.	Emergent		X	
Poaceae				
Andropogon bicornis L.	Emergent	X		
Echinochloa polystachya (H.B.K) Hitchc.	Amphibious		X	
Echinochloa crusgalii (L.)P.Beauv	Emergent	X	X	
Eragrostis glomerata (Walter) L.H. Dewey	Amphibious		X	
Hymenachne amplexicaulis (Rudge) Nees	Emergent	X	X	X
Luziola subintegra Swallen	Emergent			X
Luziola sp.	Emergent		X	
Oryza glumaepatula Steud.	Emergent	X	X	X
Oryza rufipogon Griff.	Emergent		X	
Panicum elephantipes Nees ex Trin.	Emergent		X	X
Panicum dichotomiflorum Michx.	Emergent		X	

Table 1. Continued...

Taxa	Biological forms	Lagoons	Xingu river	Affluents
Panicum laxum Sw.	Emergent		X	
Panicum mertensii Roth	Emergent	X		X
Panicum sp.	Emergent	X	X	X
Paspalum fasciculatum Wild. Ex. Flueg.	Emergent or Amphibious		X	X
Paspalum repens Berg.	Emergent		X	X
Paspalum sp.	Emergent	X	X	X
Podostemaceae				
Apinagia staheliana (Went) P. Royen	Rheophyte			X
Mourera fluviatilis Aubl.	Rheophyte		X	
Mourera alcicornis (Tul.) P.Royen	Rheophyte		X	
Weddellina squamulosa Tul.	Rheophyte		X	
Castelnavia princeps Tul. & Wedd.	Rheophyte		X	
Polygonaceae				
Poligonum sp.	Emergent	X	X	X
Polygonum hydropiperoides Michx.	Amphibious	X		
Pontederiaceae				
Eichhornia azurea (Sw.) Kunth	Floating (prostrate)	X	X	X
Eichhornia crassipes (Mart.) Solms	Floating (free)	X	X	X
Eichhornia diversiflora (Vahl) Urb.	Floating (prostrate)			X
Pontederia subovata (Seub.) Lowden	Floating (prostrate)			X
Rubiaceae				
Diodia sp.	Emergent		X	

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References

BOSCHILIA, SM., OLIVEIRA, EF. and THOMAZ, SM., 2008. Do aquatic macrophytes co-occur randomly? An analysis of null models in a tropical floodplain. *Oecologia*, vol. 156, no. 1, p. 203-214. http://dx.doi.org/10.1007/s00442-008-0983-4. PMid:18274779.

Brasil. Ministério do Meio Ambiente – MMA, 2008. *Instrução normativa no 06, de 23 de setembro de 2008*. Diário Oficial da República Federativa do Brasil, Brasília. 55 p.

CHAMBERS PA., LACOUL, P., MURPHY, KJ. and THOMAZ, SM., 2008. *Global diversity of aquatic macrophytes in freshwater*. Netherlands: Springer. p. 9-26. Developments in Hydrobiology, vol. 198.

JUNK, WJ. and PIEDADE, MTF., 1993. Biomass and primary production of herbaceous plant communities in the Amazon floodplain. *Hydrobiologia*, vol. 263, no. 3, p. 155-162. http://dx.doi.org/10.1007/BF00006266.

JUNK, WJ., BAYLEY, PB. and SPARKS, RE., 1989. The flood pulse concept in river-floodplain systems. *Canadian Special Publication of Fisheries and Aquatic Sciences*, vol. 106, p. 110-127.

THOMAZ, SM. and CUNHA, ER., 2010. The role of macrophytes in habitat structuring in aquatic ecosystems: methods of measurement, causes and consequences on animal assemblages' composition and biodiversity. *Acta Limnologica Brasiliensia*, vol. 22, no. 2, p. 218-236. http://dx.doi.org/10.4322/actalb.02202011.

TUNDISI, JG. 2007. Exploração do potencial hidrelétrico da Amazônia. *Estudos avançados*, vol. 21, no. 59, p. 109-117.