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Floristic Composition and Structure of Floodplain Vegetation in the Northern Pantanal of Mato Grosso, Brazil

By

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With 18 Figures

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Summary

SCHESSL M. 1999. Floristic composition and structure of floodplain vegetation in the northern Pantanal of Mato Grosso, Brazil. – Phyton (Horn, Austria) 39 (2): 303–336, 18 figures, English with German summary.

The Pantanal depression is located at the Brazil-Bolivia frontier in the upper Paraguay river basin. Its vegetation comprises various types of nonflooded terra firme forest and saisonally to permanently inundated herbaceous vegetation types. A collection of vascular plants in herbaceous vegetation types of the Poconé subunit includes 637 species, at least three of which are new to science. Eight major vegetation types are distinguished on seasonally inundated lowlands, these are hyperseasonal savannas, floating meadows ("batume"), swamps of rhizomatous geophytes, free floating macrophytes, vegetation of termite mounds ("murundus") as well as three communities of monodominant scrub, dominated by *Combretum* spp. ("pombeiro"), *Licania parvifolia* ("pimenteiral") or *Baillonia amabilis* ("sarã") respectively. Little vegetation remains undisturbed due to the influence of extensive cattle breeding.

Zusammenfassung

SCHESSL M. 1999. Floristische Zusammensetzung und Struktur der Vegetation auf Überschwemmungsflächen im nördlichen Pantanal von Mato Grosso, Brasilien. –

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Phyton (Horn, Austria) 39 (2): 303–336, 18 Abbildungen, Englisch mit deutscher Zusammenfassung.

Die Vegetation der am Oberlauf des Rio Paraguay an der Grenze von Bolivien und Brasilien gelegenen Pantanal-Depression setzt sich aus verschiedenen überflutungsfreien Waldgesellschaften und einer Reihe von saisonal bis permanent überschwemmten, krautigen Pflanzengesellschaften zusammen. Durch eine floristische und pflanzensoziologische Bearbeitung der krautigen Vegetationstypen des im nördlichen Teil des Pantanal gelegenen sogenannten Pantanal von Poconé, wurden 637 Arten identifiziert, von denen zumindest drei bislang noch unbeschrieben sind. Die Vegetation der saisonal überfluteten Ebenen läßt sich acht Gruppen zuordnen: Gesellschaften der hypersaisonalen Savanne, Schwimmwiesengesellschaften („Batume"), Rhizomgeophyten-dominierte Sumpfpflanzengesellschaften, frei schwimmende Makrophytengesellschaften, die Gehölzvegetation auf „Murundú"-Hügeln („Murundus") und drei monodominante Gebüschgesellschaften, die jeweils von *Combretum* spp. („pombeiro"), *Licania parvifolia* („pimenteira") oder *Baillonia amabilis* („sarã") aufgebaut werden. Weite Gebiete sind durch die in der Region weit verbreitete extensive Rinderweidewirtschaft beeinflußt.

1. Introduction

The Pantanal of Mato Grosso covers an area of approximately 140.000 km^2 in the upper basin of the Rio Paraguay between 16° and 22° S and 55°–58° W. Situated near the geographical center of South America, the main area of the Pantanal is located in the Brazilian states of Mato Grosso and Mato Grosso do Sul (Fig. 1). It mainly consists of sedimentary deposits in a quarternary erosive depression of the western margin of the Brazilian shield. Various tributaries of the Paraguay river provided the material for alluvial cones (KLAMMER 1982), each forming a flat to slighltly undulating landscape, raising only to about 100–110 m above sea level. Due to differences in the parent alluvial material and different hydrological regimes, the sedimentary depression can be subdivided in various subregions (ADÁMOLI 1982). Runoff of summer precipitation is delayed because of the low inclination of 0,02‰ up to 0,5‰ (POTT 1988), and lowlands become flooded either by stagnant rainwater or by waters of transbording rivers. The monomodal floodpulse causes maximum annual waterlevel fluctuations between 2 and 5 m (JUNK & DA SILVA 1995). However, water level of the floodplains rarely exceeds 1.5 m. Extensive macrophyte stands cover these swamplands during rainy season while being substituted by xerophytic grassy campos during dry season. Nevertheless, nonflooded high ground ("terra firme") is interspersed throughout the region and covered by several forest types.

The tropical Aw climate of the region is strongly seasonal with a short dry season (June–September) and a long wet season (October–April). A mean annual temperature of 22,5° C and a mean annual rainfall of 1739 mm were calculated from data of the weather station set up at Fazenda Ipiranga (16°36'N/56°24'W, altitude: 110 m) in the study area in 1992

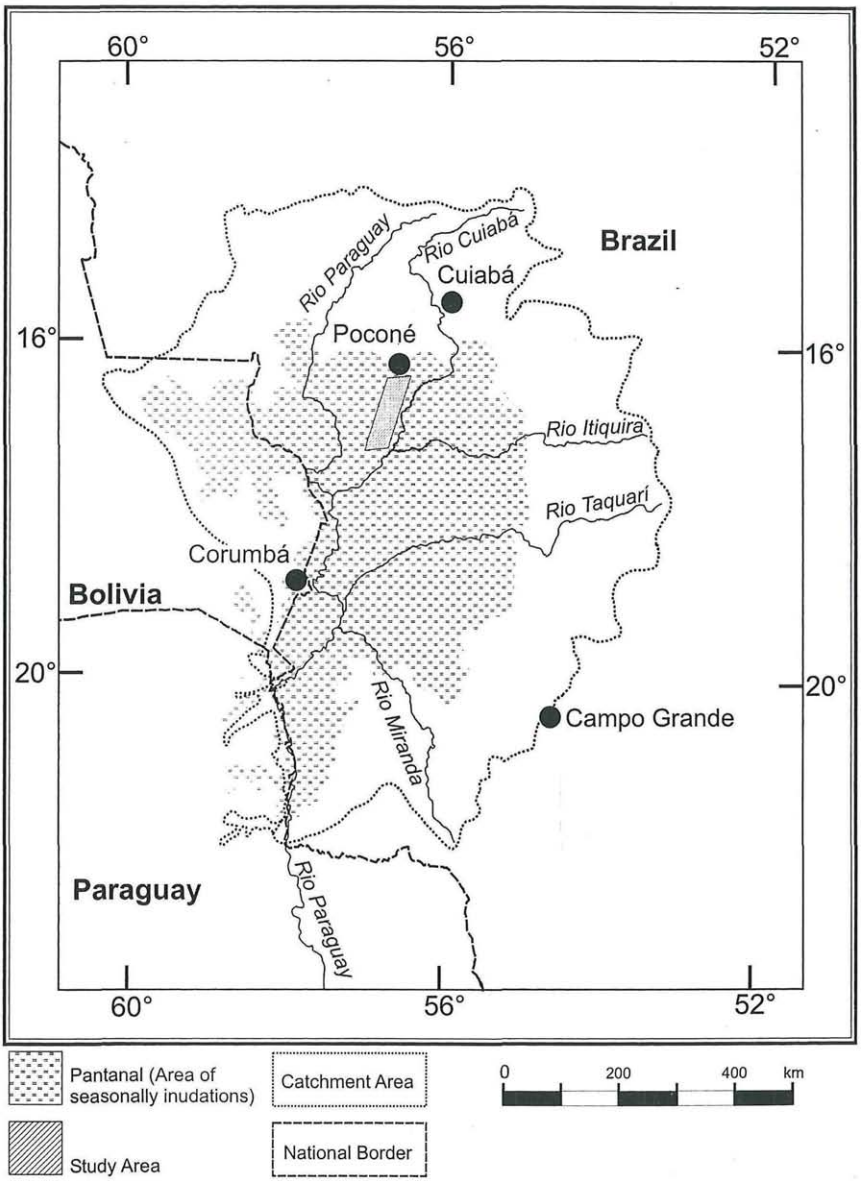


Fig. 1. Map showing the Pantanal of Mato Grosso and its catchment area.

(Fig. 2). The corresponding mean data (1961–1990) for the city of Cuiabá (15°33′S/56°07′W, alt.: 151 m), located about 100 air km northeast of the study area, are 25,8° C and 1315 mm respectively.

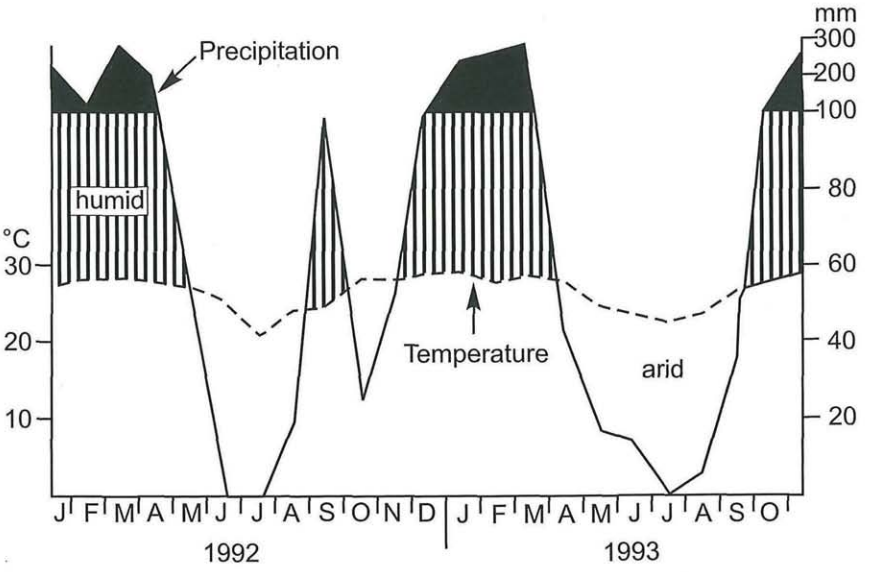


Fig. 2. Climatic diagram for Fazenda Ipiranga (16°36'N/56°24'W, 110 m. a.s.l.), municipality of Poconé, State of Mato Grosso, Brazil.

The soils of the study area are developed from alluvial parent material, and constitute hydromorphic soil types such as Hydromorphic Laterits, Planosols, Solonetz, Vertisols, Podzols, Gleys and recent alluvial soils (Orioli & al. 1982, Oliveira & al. 1982, Macedo 1982). The considerable variation of soil types ranging from pure alluvial sands to very fine textured clays is mainly correlated with the duration of flooding and with differences in the alluvial parent material. Most soil types in the study area have low pH-values of 4 to 5 and low contents of organic matter. Gleyic and stagnic properties (FAO-UNESCO 1988) are common characteristics of the floodplain soils of the region.

Few plant collections were carried out in the Pantanal during the last century (Sampaio 1916), and the Pantanal region still has been considered poorly collected only one decade ago (Prance & Schaller 1986). Since this time, considerable floristic research has been carried out resulting in floristic checklists (e.g. Guarim-Neto 1984, 1991, 1992, Pott & Pott 1986a, 1986b, Pott V.J. & al. 1986, Dubs 1998, Frey 1995), some major floristic surveys (Prance & Schaller 1986, Pott A. & al. 1986) and a first illustrated guide to Pantanal plants (Pott & Pott 1995).

Vegetation studies in the Pantanal are scanty, focussing on woody vegetation types (e.g. Prance & Schaller 1986, Ratter & al. 1988, Prado & al. 1992, Dubs 1992). Apart from a transect study of herbaceous macro-

phytes (POTT & al. 1992, PRADO & al. 1994, FREY 1995), no systematic phytosociological study of herbaceous lowland plant communities has been carried out.

This paper gives an overview of floristic composition of herbaceous lowland vegetation and describes structure and driving ecological factors of major vegetation types distinguished in the study area.

2. Study Area

The study was carried out in the Poconé subregion, an area in the northern part of the Pantanal wetland covering about 18.000 km^2 (ADÁMOLI 1982). Field work was done mainly along the Transpantaneira road and near two base camps at Fazenda Ipiranga (16°36'S/56°24'W, altitude: 110 m) and Fazenda Nova Berlim (16°45'S/56°58'W, alt.: 100 m) (Fig. 3).

The floodplains of the Pantanal are used for extensive cattle breeding for more than 200 years (WILCOX 1992). In the study area, intensified ranching, implying annual burning of the grassy campos during the dry season, deforestation of slightly elevated woodlands, introduction of exotic grass species, and constructions for flood control partly occur (REMPPIS 1995). Nevertheless, extensive landuse systems or even abandoned farmland can frequently be found along the Transpantaneira highway.

3. Methods

Collecting of plant specimens and phytosociological studies were restricted to herbaceous vegetation types and carried out over a two year period from 1991 to 1993. Most of the plant species collected belong to herbaceous communities, but some are found in woody formations as well. More than 400 "relevés" (sample plots) were sampled by means of the Zürich–Montpellier techniques (BRAUN–BLANQUET 1964, MUELLER–DOMBOIS & ELLENBERG 1974). A detailed phytosociological classification of the different plant communities, an evaluation of the 50 soil profiles sampled and data of inundation regime monitored at 31 sample plots will be published elsewhere.

Species are classified according to the life form system of MUELLER–DOMBOIS & ELLENBERG 1974. The following life form groups are distinguished: the phanerophytes including woody plants such as trees and shrubs differ from chamaephytes (dwarf shrubs) forming woody branches only up to 25–50 cm in height. Phanerophytic lianas with woody stems are distinguished from hemicryptophytic lianas, characterized by predominently herbaceous trunks or occasionally with basal lignification. Excluded from the groups of hemicryptophytes, geophytes or therophytes are the free floating hydrophytes and parasitic plants (parasites).

4. Floristic Survey

More than 50% of the 637 collected species in the lowlands studied (Tab. 1), belong to only 10 species-rich families (Fig. 4). Comparison with other floodplain regions in South America reveals relatively little floristic similarity on species level, but considerable similarity on familiy level (Fig. 5).

Tab. 1: Checklist of plants of floodplain vegetation in the study area

Identifications were made or revised by the persons indicated following the family names, otherwise by the author. If only some species belonging to one familiy were identified by a specialist, or more than one specialist identified specimens belonging to the same family, each specimen is marked (with asterics or circle) to indicate individually it's status of identification. Several species of *Poaceae* were identified by J. F. M. VALLS (CEN), V. J. POTT and A. POTT (CPAP) examined several Pantanal specimens, especially *Poaceae* and aquatic macrophytes. The first set of voucher specimens is deposited at UFMT (Cuiabá), duplicates are deposited at ULM. Collection numbers represent plants collected by M. SCHESSL.

Abreviatiations for the major life form-types: (P) = phanerophyte; (C) = chamaephyte; (H) = hemicryptophyte; (G) = geophyte; (T) = therophyte; (LP) = phanerophytic (woody) liana; (LH) = hemicryptophytic (herbaceous) liana; (Hyd) = hydrophyte; (R) = parasite.

Abbreviations for the habitats: (hs) = hyperseasonal savanna grasslands, sometimes divided in: (cdm) = small tussock grassland interspersed by termite mounds, (tg) = tall tussock grassland, (sg) = shortgrass floodplains with (sgi) = sg when inundated, (sgp) sg when paludous, and (sgd) when dried up; (ba) = floating meadows; (a) = aquatic; (p) = paludous; (mu) = termite mounds; (s) = scrub; (dw) terra firme forest; (if) = inundated forest; (cd) = Cerrado; (be) = margin and beaches of rivers and lagoons; (c) = cultivated or planted species; (r) = ruderal.

Taxon	Voucher	life form type	Habitat
I. Phycophyta, Bryophyta,Pteridophyta			
Azollaceae (det. K. MEHLTRETER)			
Azolla filiculoides LAM.	3306	Hyd nat	a,
Characeae (det. B. BORSTELMANN)			
Chara fibrosa AG. ex BRUX. em. R. D. WOOD			
cf. var. *hydropytis* (REICH) R. D. WOOD			
em. R.D. Wood	3364	T hyd	a,
Nitella acuminata A. BR. ex WALLM.			
em. R. D. WOOD	2603	T hyd	a,
Dicranellaceae (det. O. YANO)			
Dicranella hilariana (MART.) MITT.	3551	C herb(pulv)	cdm,
Hemionitidaceae (det. K. MEHLTRETER)			
Pityrogramma calomelanos (L.) LINK	4073	T? scap?	ba,
Lycopodiaceae (det. K. MEHLTRETER)			
Lycopodium cf. *cernuum* L.	2388b	C herb	r,
Marsileaceae (det. K. MEHLTRETER)			
Marsilea polycarpa HOOK & GREV.	2633	H hyd	a, p, sgi,
Ophioglossaceae (det. K. MEHLTRETER)			
Ophioglossum cf. *crotalophoroides* Walt.	3396	G rhiz	sgd,
Parkeriaceae			
Ceratopteris pteridoides (HOOK.) HIERON.	2567	Hyd nat	a,
Ricciaceae			
Ricciocarpus cf. *natans* (L.) CORD.	2085	Hyd nat	a,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Salviniaceae (det. De la Sota)			
Salvinia cf. *auriculata* Aubl.	321/1-2, 3307	Hyd nat	a,
II. *Angiospermae*			
Acanthaceae (* det. D. Wasshausen)			
Justicia anagallis Lindau*	10/3-2	H rept	sgd, sgi,
Justicia laevilinguis (Nees) Lindau*	48/3-16	H rept	sgd, sgi,
Justicia lavandulaefolia (Nees) Pohl ex Nees*	103/1-1	H rept	sgd, sgi,
Lophostachys pubiflora Lindau*	2600 b	H rept	sgd,
Staurogyne diantheroides Lindau*	060891-2-9	H rept	ba,
Alismataceae (* det. R. R. Haynes)			
Echinodorus grandiflorus (Cham. & Schltdl.) Micheli subsp. *grandiflorus**	2783	H ros	sgi, p, sgp,
Echinodorus macrophyllus (Kunth) Micheli subsp. *scaber* (Rataj) Haynes & Holm-Nielsen*	3327 a	H ros	sgi, p, sgp,
Echinodorus paniculatus Micheli in DC.*	3229	H/T ros	sgi, p, sgp,
Echinodorus tenellus (Mart.) Buchenau	2017	T ros	sgp,
Echinodorus teretoscapus Haynes & Holm-Nielsen*	2399	H ros	a, p, sgp?
Sagittaria guyanensis Kunth in H. B. K. subsp. *guyanensis* *	3170	H hyd	sgi,
Sagittaria rhombifolia Cham.*	3088	H hyd	sgi,
Amaranthaceae (* det. T. M. Pedersen)			
Alternanthera kurtzii Schinz ex Pedersen*	221191-4-1	H? rept	s,
Alternanthera paronichyoides A. St. Hil. subsp. *chacoënsis* (Morong) Pedersen ined.	011191-1-2	H rept?	sgd, r,
Alternanthera philoxeroides (Mart.) Griseb.	5167	H rept/hyd	ba, sgi, a,
Amaranthus spinosus L.*	131291-1-2	T scap	r?
Amaranthus viridis L.*	270991-1-1	T scap	r?
Gomphrena celosioides Mart.	3380	H caes	r,
Gomphrena vaga Mart.*	2810c	C? suff	s,
Pfaffia iresinoides (H.B.K.) Spreng.*	030192-2-3	C? suff	s,
Amaryllidaceae			
cf. *Zephyranthes* sp.	3444	G bulb	mu,
Anacardiaceae			
Anacardium humile St. Hil.	3447	N P caes	mu,
Astronium fraxinifolium Schott in Sprengel	3440	Mes P scap	mu,
Annonaceae (det. H. Rainer)			
Annona aurantiaca Barb. Rodr.	051191-1-1	N P caes	mu,
Annona cornifolia A. St. Hil.	3020	N P caes	mu,
Annona dioica A. St. Hil.	3443	N P caes	mu,
Annona phaeoclados Mart.	211091-1-7	N P caes	mu,
Apiaceae (det. L. Constance)			
Eryngium ebracteatum Lam.	193/1-1	H ros	cdm,
Hydrocotyle ranunculoides L.f.	2643, 3252a	H/G hyd/rhiz	ba, a,
Apocynaceae (* det. J. M. Leeuwenberg)			
Catharanthus roseus (L.) G. Don*	2326	H rept	r,
Himatanthus obovatus (Müll. Arg.) Woodson	2970	Mi P caes/scap	r, s,
Mesechites trifida (Jacq.) Müll. Arg.*	159/1-1	LH	hs,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Rauvolfia mollis S. MOORE*	011191-2-5	N P caes	s,
Rhabdadenia pohlii MÜLL. ARG.*	120991-1-3	LH?	hs,
Tabernaemontana siphilitica (L.f.) LEEUWENB.*	221192-1-2	N P caes	s,
Thevetia peruviana (Pers.) K. SCHUM.*	301091-1-6	C suff	hs,
Araceae (det. J. BOGNER)			
Pistia stratiotes L.	3308, 2601	Hyd nat	a,
Taccarum weddellianum Brongn.	5081	G bulb	mu,
Xanthosoma striatipes (KUNTH & BOUCHÉ) MADISON	4991	G bulb	mu,
Arecaceae			
Allagoptera leucocalyx (DRUDE) O. KUNTZE	2802	Mi P ros	mu,
Bactris glaucescens DRUDE	2819	Mi P ros	sgd, sgi,
Copernicia australis BECC.	3448	Mes P ros	mu,
Desmoncus sp.	2299	LP	hs, s,
Aristolochiaceae			
Aristolochia cf. *esperanzae* O. KUNTZE	3290	LP	mu, cd,
Asclepiadaceae (det. S. LIEDE)			
Asclepias mellodora A. ST. HIL.	4828	H scap	hs,
Funastrum clausum (JACQ.) SCHLTR.	3219, 3283, 3660	LH	sgp,
Oxypetalum cf. balansae MALME	4814	LH?	r,
Schubertia grandiflora MART.	2532	LP	s,
Tassadia berterianum (SPRENG.) W. D. STEVENS	4574	LH	r, hs, p,
Asteraceae (* det. G. M. BARROSO)			
Ageratum conyzoides L.	260992-1-12	T scap	sgd, r,
Aspilia latissima MALME*	3361	T scap	be,
Baccharis medullosa DC.*	3404	H scap	p,
Bidens gardneri BAKER	2610c	C(T) frut(scap)	r,
Bidens cf. *pilosa* L.	081192-1-1a	T scap	r,
Conyza bonariensis (L.) CRONQUIST*	311291-1-1	T scap	r,
Eclipta prostrata (L.) L.*	270992-2-1b	H scap	r,
Erechtites hieraciifolia (L.) RAF. ex DC.	311291-1-2	H,(C) ros	mu,
Eupatorium asperulaceum BAKER*	4575	H caes?	sgp, r,
Eupatorium candolleanum HOOK. & ARN.* (= *Barrosoa candolleana* (HOOK. & ARN.) R. M. KING & H. ROB.)	3302, 3250	T scap	ba, p, be,
Eupatorium hecatanthum (DC.) BAKER	131291-1-2	T scap	ba,
Eupatorium macrocephalum Less.* (= *Campuloclinium macrocephalum* (LESS.) DC.)	201091-1-8	H caes	r, (cdm,)
Eupatorium myriocephalum GARDNER* (= *Chromolaena myrocephala* (Gardner) R. M. KING & H. ROB.)	277/1-14	Mi P caes	mu,
Eupatorium odoratum L.* (= *Chromolaena odorata* (GARDNER) R. M. KING & H. ROB.)	4992	N P caes	mu,
Melanthera latifolia (GARDNER) CABRERA*	2860	T scap	hs,
Mikania cf. *micrantha* H. B. K.	3301	LH	mu, ba, hs, s,
Orthopappus angustifolius (SW.) GLEASON	201091-1-10	H ros	mu,
Pacourina edulis AUBL.*	120292-2-2	H? scap	p, ba,
Porophyllum ruderale (JACQ.) CASS.*	48/3-28	T scap	r,
Trichospira menthioides H. B. K.	2777	H caes	hs,
Tridax procumbens L.*	311291-1-3	T rept	r,
Vernonia aff. *cognata* LESS. var. *screptum* (CHODAT) CABR.*	275/1-4	N P caes	mu,
Vernonia brasiliana (L.) DRUCE*	2025	N P caes	mu, r,
Vernonia cf. *rubricaulis* HUMB. & BONPL.	2723	N P caes	mu,
Wedelia brachycarpa BAKER*	131092-6-1	H caes	cdm,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Bignoniaceae (* det. S. BIDGOOD)			
Arrabidaea sp. (#1)	2177	LP	r,
Arrabidaea sp. (#2)	3378	LP	r,
Arrabidaea sp. (#3)	2579	LP	r,
Arrabidaea sp. (#4)	2271	LP	r,
Arrabidaea sp. (#5)	131092-2-3	LP	r,
aff. *Cybistax antisyphilitica* (MART.) MART.	3450, 4944	Mi P scap	mu, r,
Melloa quadrivalvis (JACQ.) A. GENTRY *	3413	Mi P scap	mu, r,
Tabebuia sp. (#3)	3439	Mi P scap	mu, r,
Phryganocydia corymbosa (VEATT.) BUREAU ex K. SCHUM. *	2724a	LP	r,
Macfadyena ungis-cati (L.) A. GENTRY *	2724b	LP	r,
indet. sp. (#2)	2389	Mi P caes?	r,
indet. sp. (#3)	3416a	LP	cd,
indet. sp. (#6)	2265	LP	r,
indet. sp. (#7)	4721	LP	hs,
Bixaceae			
Bixa orellana L.	2556	Mi P caes	r,
Boraginaceae (* det. H. FÖRTHER)			
Cordia cf. *glabrata* (MART.) A. DC.	2179	Mes P scap	r,
Heliotropium filiforme LEHM.*	2319	T scap?	hs,
Heliotropium indicum L.*	2342	T caes	r,
Heliotropium lagoense (WARM.) GÜRKE*	5252, 2831	T rept	hs,
Heliotropium procumbens MILL.*	2187	T rept	hs,
Bromeliaceae			
Ananas ananassoides (BAKER) L. B. SM.	3046	G rhiz	mu, cd,
Bromelia balansae MEZ	3033	G rhiz	mu, cd, df,
Burmanniaceae (det. P. J. M. MAAS)			
Burmannia capitata (WALT. ex J. F. GMEL.) MART.	2631c	T(S) ros	cdm,
Burmannia flava MART.	2631d	T(S) ros	cdm,
Cabombaceae			
Cabomba furcata SCHULT. & SCHULT. f.	2586, 2635	T hyd	a,
Cactaceae (det N. P. TAYLOR)			
Cereus cf. *bicolor* RIZZINI & MATTOS FILHO	3476	Mi P succ.	df,
Cereus kroenleinii (KIESLING) N. P. TAYLOR	3475	C succ	df,
Caesalpiniaceae (* det. R. C. BARNEBY)			
Bauhinia bauhinioides (MART.) J. F. MACBR. *	85/1-2	N P caes	hs,
Bauhinia glabra JACQ.*	3416b	LP	r,
Cassia grandis L.f.	2222	Mes P scap	r,
Chamaecrista desvauxii (COLLAD.) KILLIP var. *brevipes* (BENTH.) H. S. IRWIN & BARNEBY*	110292-2-1	C suff	cdm, r,
Chamaecrista flexuosa (L.) GREENE*	2737a	N P caes	r, cdm,
Chamaecrista kunthiana (SCHLTDL. & CHAM.) H. S. IRWIN & BARNEBY*	3125	C(?) suff	cdm,
Copaifera langsdorffii DESV.*	3071	N P caes	r, cd, mu,
Delonix regia (BOJ. ex HOOK.) RAF.	2340	Mes P scap	c,
Hymenaea cf. *stigonocarpa* MART. ex HAYNE	3521	Mes P scap	mu,
Sclerolobium sp.*	2548	Mi P scap	r,
Senna aculeata (BENTH.) H. S. IRWIN & BARNEBY*	2288	N P caes	r, hs, p,
Senna alata (L.) ROXB.	2617	N P caes	r, hs,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Senna obtusifolia (L.) H. S. IRWIN & BARNEBY*	3194	C suff	hs, r,
Senna occidentalis (L.) Link*	108/1-16	C suff	hs, r,
Senna pendula (WILLD.) H. S. IRWIN & BARNEBY*	2623	Mi P caes	hs, r,
Senna sp.	3299	Mi P caes	r, cd,
Cannaceae (det. P. J. M. MAAS)			
Canna glauca L.	3674, 2339	G rhiz	p,
Capparaceae			
Cleome aculeata L.	2429	T caes	r,
Caryophyllaceae			
indet sp. (3)	2637a	T scap	hs,
indet sp. (4)	2629c	T rept	hs,
Celastraceae			
Maytenus sp.	3429	Mi P caes	s,
Plenckia sp.	3349	Mi P caes	s,
Chrysobalanaceae (det. G. T. PRANCE)			
Couepia uiti (MART. ex ZUCC.) BENTH. ex HOOK.	176/2-1	Mi P scap	if, s,
Licania parvifolia HUBER	2487	Mi P scap	if, s,
Cochlospermaceae (det. H. H. POPPENDIECK)			
Cochlospermum regium (SCHRANK) PILG.	3312	N P caes	r, mu,
Combretaceae (det. C. A. STACE)			
Combretum lanceolatum POHL ex EICHLER	3330	Mi P caes	s, r,
Combretum laxum JACQ.	3386	Mi P caes	s, r,
Commelinaceae (det. R. FADEN)			
Commelina erecta L.	211192-1-6, 3267	G rhiz	r, s,
Murdannia nudiflora (L.) BRENAN	2619c	G rhiz	r,
Murdannia semifoliata (C. B. CLARKE) G. BRÜCKN.	2421a	G rhiz/bulb	hs,
Murdannia sp. nov. ined.	2631g	T rept	hs,
Convolvulaceae (* det. F. AUSTIN)			
Aniseia argentina (BROWN) O'DONELL*	3176	LH	hs,
Evolvulus convolvuloides (WILLD.) STEARN	3352	H scap	r,
Evolvulus filipes MART.*	277/1-11	H caes?	r, hs, p,
Evolvulus nummularius L.*	3535	H rept	r, hs,
Ipomoea alba GARCKE*	071192-1-1	LP	r,
Ipomoea asarifolia (Desv.) ROEM. & SCHULT.*	3278	LH	hs,
Ipomoea carnea JACQ.			
subsp. *fistulosa* (MART. ex CHOISY) D. F. AUSTIN	3331,3012091-1-1	LP?	hs,
Ipomoea rubens CHOISY	304/1-3	LH	hs,
Ipomoea tenera MEISN.	4593,2835	LH	hs, r, s,
Ipomoea sp. (1)	2603c,2348,2634	LH	hs,
Ipomoea sp. (2)	3536a	LP?	hs,
Merremia umbellata (L) HALLIER f.*	3289,2557	LH	hs, r,
Cucurbitaceae (*det. A. KRAPOVICKAS)			
Cayaponia podantha COGN.*	3467	LH	r,
indet. sp. (1)	3244, 4711	LH	r,
Cyperaceae (° det. K. CAMELBEKE, * det. T. M. PEDERSEN)			
Bulbostylis scabra (PRESL) LINDM.			
cf. f. *evolutina* LINDM.	3224	H caes	cdm,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
cf. *Bulbostylis tenella* C. B. CLARKE	3028	H caes	mu,
Cyperus aff. *aggregatus* (WILLD.) ENDL.*	3039	? caes	cdm,
Cyperus albomarginatus MART. & SCHRAD. ex NEES*	160991-4-2	T caes	p, be,
Cyperus diffusus VAHL subsp. *chalaranthus* (C. & J. PRESL) KÜK*.	3054	G rhiz	mu,
Cyperus gardneri NEES	3316	T? caes	hs,
Cyperus giganteus VAHL°	2459, 207/1-1	G rhiz	p,
Cyperus haspan L.°	103/2-3	G rhiz	hs,
Cyperus imbricatus RETZ.°	2458b	T caes	hs,
Cyperus iria L.°	2608	T caes	r,
Cyperus luzulae (L.) RETZ.°	081192-1-1b	G rhiz	p, r,
Cyperus obtusatus (PRESL) MATTF. & KÜK.*	2806	G rhiz	hs,
Cyperus odoratus L. s.l.°	3463	H caes	hs,
Cyperus reflexus VAHL°	177/2-2a	G rhiz	hs,
Cyperus sphacelatus ROTTB.°	139/2-2	H caes	mu, sgp,
Cyperus surinamensis ROTTB.	3024	H caes	hs, r,
Eleocharis acutangula (ROXB.) SCHULT.°	103/2-4	G rhiz	p,
Eleocharis contracta MAURY ex MICHELI*	2500	G rhiz	hs,
Eleocharis elegans (H. B. K.) R. & S.	2151	G rhiz	p, sgp,
Eleocharis filiculmis Kunth*	3094	G rhiz	sgd,
Eleocharis geniculata (L.) ROEM. & SCHULT.°*	3393	G? rhiz?	cdm, p,
Eleocharis interstincta (VAHL) ROEM. & SCHULT.°	3319	H caes	p, sgp,
Eleocharis minima KUNTH*	3185,2827	H/T caes	hs, a,
Eleocharis nodulosa (ROTH) SCHULT. in ROEM. & SCHULT.°*	5/2-2	G rhiz	sgd,
Eleocharis plicarhachis (GRISEB.) SVEN.*	3300	H caes	hs,
Eleocharis viridans KÜK.*	73/1-3	T caes	a, p,
Fimbristylis complanata (RETZ.) LINK°	44/1-1	G rhiz	mu,
Fimbristylis dichotoma (L.) VAHL*	139/2-3	T caes	hs, mu,
Fimbristylis sp. (4)	65/1-	H caes	hs,
Fuirena bulbipes S. F. BLAKE*	315/1-3	H caes	s, p,
Hemicarpha micrantha (VAHL) BRITTON	137/2-11	T caes	hs,
Kyllinga odorata VAHL°	177/2-1b	G rhiz	mu,
Lipocarpha humboldtiana NEES°	150792-1-4	T caes	cdm,
Oxycarium cubense (POEPP. & KÜK.) K. LYE	3323	T caes	ba, p,
Pycreus macrostachyos (LAM.) J. RAYNAL°	149/1-6	H caes	hs,
Rhynchospora armerioides C. & J. PRESL*	3149	G rhiz	cdm,
Rhynchospora cf. *barbata* (VAHL) KUNTH	190592-3-6b	G rhiz	cdm,
Rhynchospora brevirostris GRISEB.*	3100	G rhiz	cdm,
Rhynchospora globosa (KUNTH) ROEM. & SCHULT.	213/1-2	G rhiz	cdm,
Rhynchospora hirta (NEES) BOECK.°	3136	G rhiz	cdm,
Rhynchospora hispidula (VAHL) BOECK.*	263/1-2	G rhiz	sgd, cdm,
Rhynchospora holoschoenoides (L. C. RICH.) HERTER°	145/1-2	G rhiz	hs,
Rhynchospora cf. *nervosa* (VAHL) BOECK.°	44/1-2	G rhiz	cdm,
Rhynchospora setacea (BERG.) BOECK.*	2806	G rhiz	mu,
Rhynchospora tenerrima NEES ex SPRENG. subsp. *tenerrima*°	51/5-3	G/T rhiz	sgd,
Rhynchospora cf. *tenuis* LINK°	3156	G/T rhiz	cdm,
Rhynchospora trispicata (NEES) STEUD.*	149/1-2	G/T rhiz	hs,
Rhynchospora sp.	3358	G rhiz	hs,
Rhynchospora sp. (13)	2367	G rhiz	hs,
Scleria flagellum-nigrorum BERG.°	2407	G rhiz	s,
Scleria leptostachya KUNTH.*	3142	H/T caes	cdm,
Scleria lithosperma (L.) SW.*	3107	T caes	cdm,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Scleria melaleuca REICHENB. ex SCHLTDL. & CHAM.° (= *S. pterota* PRESL)	315/1-3	G rhiz	s,r,
Scleria minima C. B. CLARKE*	129/1-4, 3158	T caes	cdm,
Scleria phylloptera WRIGHT*	3006	G rhiz	cdm,
Scleria reticularis MICHX.° (= *S. setacea* POIR.)	3115	G rhiz?	p, r,
Dilleniaceae			
Curatella americana L.	2308	Mi P scap	mu, cd,
Droseraceae			
Drosera sessilifolia ST. HIL.	2812, 3792	T(?) ros	cdm,
Eriocaulaceae (°det. N. HENSOLD, *det. Th. STÜTZEL)			
Eriocaulon guyanense KÖRN.°	123/1-7	T ros	cdm,
Eriocaulon melanocephalum KUNTH*	3123	T ros	cdm,
Paepalanthus lamarckii KUNTH°	278/1-4	T ros	cdm,
Philodice hoffmannseggii MART.°	2630b	T ros	r,
Syngonanthus chrysanthus (BONG.) RUHL.	2629a	T ros	cdm,
Syngonanthus gracilis (BONG.) RUHL. var. *aureus* RUHL.°	123/1-6	T ros	cdm,
Erythroxylaceae (det. N. HENSOLD)			
Erythroxylum anguifugum MART.	200991-2-2	N P caes	mu,
Erythroxylum cf. *suberosum* ST. HIL.	3069	N P caes	mu,
Euphorbiaceae (° det. W. PUNT, * det. G. L. WEBSTER)			
Alchornea castaneifolia (WILLD.) A. JUSS.*	3466	Mi P caes	hs,
Alchornea schomburgkii KLOTZSCH°	3062	Mi P caesp	be,
Caperonia castaneifolia (L.) ST. HIL.	130392-1-1	T/G rept/rhiz	hs,
Caperonia cf. *palustris* (L.) ST. HIL.°	149/1-5	T scap	p,
Chamaesyce potentilloides (BOISS.) CROIZAT*	132/2-3	T rept	hs,
Chamaesyce thymifolia (L.) MILLSP. *	3417	T rept	hs,
Croton cf. *fuscus* (DIEDR.) MÜLL. ARG.	187/1-1	C frut	hs,
Croton cuyabensis PILG.*	181092-1-1	C suff	hs,
Croton aff. *reitzii* L. B. SMITH & DOWNS°	213/1-7	N P caes	hs,
Croton trinitatis MILLSP.*	260992-1-7	C suff	r,
Dalechampia scandens L.°	2606a	LH	hs, r,
Dalechampia sp.	061192-1-3	LH	hs,
Euphorbia hyssopifolia L. °	2789	T rept	hs, r,
Julocroton aff. *integer* CHOD. & HASSLER*	176/2-3	C suff	hs,
Mabea paniculata BRUCE ex BENTH.*	2274	N P caes	s,
Phyllanthus cf. *stipulatus* (RAF.) WEBSTER*	3099	T scap	hs,
Phyllanthus sp.	102/4-12	T scap	cdm,
Sapium obovatum KLOTZSCH. ex MÜLL. ARG.*	116/1-7	Mi P scap/caes	s,
Sebastiania cf. *bidentata* (MART.) PAX°	3167	C suff	cdm,
Sebastiania glandulosa (MART.) PAX°	2375	C suff	cdm,
Sebastiana hispida (MART) PAX°	277/1-7	C suff	cdm,
Fabaceae (* det. R. C. BARNEBY; ° det. S. BIDGOOD)			
Aeschynomene fluminensis VELL.	3421b	N/Mi P caes	hs,
Aeschynomene histrix POIR. var. *histrix*	142/1-1	N P caes	hs,
Aeschynomene sensitiva SW.*	192/1-1	N P caes	hs,
Andira cuiabensis BENTH.	3353	Mes P scap	mu,
Arachis sp.*	2381	LH	cdm, r,
Calopogonium mucunoides DESV.	190592-1-7	LH	hs,
Centrosema sp.*	190592-2-1	LH	hs,
Clitoria rubiginosa JUSS. ex PERS.	4289	LH	hs,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Cratylia argentea (Desv.) O. Kuntze*	3415, 3379	Mi P caes	r, cd,
Desmodium barbatum (L.) Benth.	44/1-7	H scap	r, hs,
Dioclea cf. *burkartii* R. H. Maxwell	2047	LP	if,
Dioclea sp.*	3368	N P caes	r,
Dipteryx alata Vog.*	269/1-4	Mes P scap	mu,
Discolobium psoraliaefolium Benth.	5256	N P saes	hs,
Discolobium pulchellum Benth.	2240	N P caes	hs, p,
Eriosema longifolium Benth.*	221/1-1	C suff	cdm,
Eriosema simplicifolium (Kunth) G. Don*	2374	C suff	cdm,
Galactia glaucescens Kunth*	2272	C frut	r, hs,
Galactia sp.	3226, 163/1-13	C frut	r,
Indigofera lespedezoides H. B. K.	3131, 190592-1-3	H cae	hs,
Indigofera sabulicola Benth.*	3460	C suff	hs, r,
Machaerium sp.	3416	Mi P scap/caes	df,
Machaerium isadelphum (E. May) Amshoff°	2178	LP	r,
Macroptilium lathyroides (L.) Urb.*	2490c, 2624	LH	hs,
Pterocarpus sp.	3418, 2300	Mes P scap	r,
Sesbania emerus (Aubl.) Urb.*	3399	N P/H caes/	r,
Sesbania virgata (Cav.) Pers.*	3277	N P caes	r,
Teramnus uncinatus (L.) Sw.*	2622, 2492b	LH	hs,
cf. *Vatairea* sp.	190991-2-1	Mi P scap	r,
Vigna sp. (#1)	3768, 190592-2-2	LH	hs,
Vigna sp. (#2)	3770	LH	hs,
Vigna sp.*(#3)	2194	LH	r,
Vigna sp. (#4)	3248	LH	ba,
Gentianaceae (* det. P. J. M. Maas, ° det. A. Jacobs-Brower)			
Coutoubea ramosa Aubl*	5249	T scap	hs,
Curtia tenuifolia (Aubl.) Knobl. subsp. *tenuifolia*	2631b, 2626	T scap	cdm,
Schultesia brachyptera Cham°	3140	T scap	cdm,
Schultesia aff. *pohliana* Progel*	139/1-1,123/1-1	T scap	cdm,
Schultesia pohliana Progel°	125/2-4	T scap	cdm,
Haloragaceae (det. A. E. Orchard)			
Myriophyllum cf. *aquaticum* (Vell.) Verdc.	3084	T hyd	a,
Heliconiaceae			
Heliconia cf. *marginata* (Griggs) Pittier	3435	Mi P herb	p,
Heliconia sp.	120992-1-1	H scap	p,
Hydrocharitaceae			
Egeria najas Planch.	3321	Hyd nat	a,
Limnobium spongia (Bosc.) Steud. subsp. *laevigatum* (Humb. & Bonpl. ex Willd.) Lowden	3253	Hyd nat	a,
Hydrophyllaceae (det. L. Davenport)			
Hydrolea spinosa L. var. *spinosa*	2022	C suff	hs, p,
Iridaceae			
Cipura paludosa Aubl.	2481	G bulb	cdm,
indet. sp. (2)	200991-2-1	G bulb	cdm,
Lamiaceae (* det R. M. Harley)			
Hyptis brevipes Poit*.	270992-2-1	T scap	hs,
Hyptis crenata Pohl ex Benth.	213/1-4	C suff	r, mu,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Hyptis hirsuta KUNTH in H. B. K.*	274/1-2, 3074	H scap	mu, cdm,?
Hyptis hygrobia BRIQ.*	2631h	H scap	cdm,
Hyptis lappacea BENTH.*	221192-2-1	T scap	sgd,
Hyptis lorentziana O. HOFFM.*	2619b	T rept	hs,
Hyptis lutescens POHL ex BENTH.*	280/1-1	C suff	mu,
Hyptis microphylla POHL ex BENTH.*	100/1-20	C suff	mu,
Hyptis mutabilis (RICH.) BRIQ.*	040192-1-2	T scap	r, hs,
Hyptis recurvata POIT.*	2728	H rept	mu,
Hyptis suaveolens (L.) POIT*.	2628	C suff	mu,
Hyptis velutina POHL ex BENTH.*	271/1-7	T scap	mu,
Leonotis nepetifolia (L.) R. BR.*	2630c	T scap	p,
Plectranthus amboinensis (LOUR.) SPRENG.*	2328	Mi P caes	r,
Lauraceae (det. L. J. MUSSELMAN)			
Cassytha filiformis L.	316/1-1	R	s,
Lemnaceae (det. V. J. POTT)			
Lemna aequinoctialis WELW. ex HEGELM.	227/1, 4837	Hyd nat	a,
Lentibulariaceae (* det. P. TAYLOR)			
Utricularia amethystina SALZM. ex A. ST. HIL. & GIR.*	130/1-2	T ros	cdm,
Utricularia breviscapa WRIGHT ex GRISEB.*	3370	Hyd nat	a,
Utricularia cucullata A. ST. HIL. & GIRARD*	2752	Hyd nat	a,
Utricularia foliosa L.	2756	Hyd nat	a,
Utricularia gibba L.*	3411	Hyd nat	a,
Utricularia hydrocarpa VAHL	2763	Hyd nat	a,
Utricularia lloydii MERL ex F. LLOYD*	2750	T ros	cdm,
Utricularia meyeri PILG.*	2754	T ros	cdm,
Utricularia oliveriana STEYERM.*	2757	T ros	cdm,
Utricularia poconensis FROMM-TRINTA*	2761	Hyd nat	a,
Utricularia pusilla VAHL*	2753	T ros	cdm,
Utricularia simulans PILGER*	4590	T ros	cdm,
Utricularia viscosa SPRUCE ex OLIVER*	4430	T ros	cdm,
Limnocharitaceae			
Hydrocleys cf. *parviflora* SEUB.	3286, 3092	T hyd	hs,
Limnocharis flava (L.) BUCHENAU	21565, 2823b	G rhiz	sgp,
Loranthaceae (det. P. KUJIT)			
Psittacanthus cordatus (HOFFMGG. ex SCHULT.) BLUME	2297	R	s,
Psittacanthus corynocephalus EICHLER	3332	R	s,
Lythraceae (* det. A. LOURTEIG; ° det. T. CAVALCANTI)			
Cuphea melvilla LINDL.*	3018	N P caes	r, s,
Cuphea micrantha H. B. K.°	166/2-2	T scap	cdm, r,
Cuphea retrorsicapilla KOEHNE*°	159/1-2, 214/1-5	C suff	cdm,
Rotala mexicana CHAM. & SCHLTDL.	58/3-1	T scap	sgd,
Rotala ramosior (L.) KOEHNE*	56/3-1, 59/2-3	T scap	sgd,
Malpighiaceae (* det. W. R. ANDERSON, ° det. C. ANDERSON)			
Banisteriopsis lutea (GRISEB.) CUATREC.*	3424	LP	r,
Banisteriopsis muricata (CAV.) CUATREC.*	010492-2-1	LP	r, cd,
Banisteriopsis pubipetala (A. JUSS.) CUATREC.*	3424	LP	cd,
Byrsonima cydoniifolia A. JUSS. in A. ST.-HIL.*	279/1-1	Mi P caes	mu, hs,
Heteropterys amplexicaulis MORONG*	3420	LP	r,
Heteropterys marginata W. R. ANDERSON*	2266,2274,190992-1-6	LP	r,cdm

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Mascagnia stannea (Griseb.) Niedenzu*	2226, 2228	LP	r, s,
Peixotoa cordistipula A. Juss.*	3369	LP	r, s,
Stigmaphyllon calcaratum N. E. Brown°	48/3-18	LH	hs,
Malvaceae (* det. A. Krapovickas, ° det. P. Fryxell)			
Gossypium barbadense L.			
var. *braziliense* (Macf.) Mauer*	3388	N P caes	r,
Hibiscus sororius L.*	3481	C suff	ba,
Malachra radiata L.	4286	T scap	r,
Pavonia angustifolia Benth.*°	3016	C suff	hs,
Pavonia cf. *aschersoniana* Gürke°	91/1-3	C suff	hs,
Pavonia garckeana Gürke*	3336	C suff	hs,
Peltaea riedelii (Gürke) Standley*	108/1-12	C suff	hs,
Sida cf. *ciliaris* L.	2716	T scap	hs, r,
Sida aff. *ciliaris* L.°	3104	T scap	hs, r,
Sida linifolia Cav.*	277/1-4	T scap	hs,
Sida santaremensis Monteiro*	108/1-11	C suff	hs,
Sida spinosa L.°	108/1-10	T scap	hs,
Sida cf. *viarum* St. Hil.*	269/1-6	T scap	hs,
Sidastrum paniculatum (L.) Fryxell	3282	T scap	r,
Maranthaceae			
Thalia geniculata L.	3403	G rhiz	p,
Mayacaceae (det. A. Lourteig)			
Mayaca fluviatilis Aubl.	179/1-2	T? caes?	cdm, hs,
Melastomataceae (det. S. S. Renner & J. Wurdack)			
Acisanthera nana Ule	125/2-1	T caes	cdm, mu,
Acisanthera uniflora (Vahl) Gleason	2106		
Clidemia bullosa DC.	3377	Mi P caes	mu,
Miconia albicans (Sw.) Triana	3384	Mi P caes	mu,
Miconia prasina (Sw.) DC.			
var. *attenuata* (DC.) Cogn.	3529	Mi P caes	mu,
Microlicia sp.	3334	N P caes	mu,
Mouriri guianensis Aubl.	2298		if,
Rhynchanthera grandiflora (Aubl.) DC.	3303	C suff	cdm,
Rhynchanthera novemnervia DC.	190592-3-2	C suff	cdm,
Menispermaceae (det. G. L. Webster)			
Cissampelos pareira L.	160991-1-5	LH	r,
Menyanthaceae (det. R. Ornduff)			
Nymphoides grayana (Griseb) Kuntze	76/2-1	G hyd	a, p,
Mimosaceae (° det. R. C. Barneby, * det. T. D. Pennington)			
Inga disticha Benth.*	3406	Mes P scap	hs, tg,
Inga stenopoda Pittier*	2191	Mes P scap	if?
Inga sp.*	3427	Mes P scap	r,
Mimosa debilis Benth.°	211192-1-12	N P caes	hs,
Mimosa pellita Humb. & Bonpl. ex Willd.°	3192	N P caes	hs,
Mimosa setosa Benth.°	3384	N P caes	hs,
Mimosa somnians Humb. & Bonpl. ex Willd.°	190592-1-10	N P caes	hs,
Mimosa xanthocentra Mart.			
var. *mansii* (Mart.) Barneby°	269/1-1	N P caes	hs,
Moraceae			
Cecropia cf. *pachystachya* Trécul	3044	Mi/Mes P ros	r, mu, ba,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Myrtaceae (* det L. R. LANDRUM)			
Eugenia biflora (L.) DC.*	283/1-3	N P caes	mu,
Eugenia cf. *bimarginata* DC.*	118/1-1	N P caes	mu,
Eugenia cf. *punicifolia* (KUNTH) DC.*	2323, 2551b	N P caes	mu,
Najadaceae (det. R. M. LOWDEN)			
Najas conferta (A. BR.) A. BR.	3398	T hyd	a,
Nyctaginaceae (det. A. FURLAN)			
Boerhavia diffusa LAM.	2334	H rept	r,
Neea hermaphrodita S. MOORE	3043	N P caes	mu,
Nymphaeaceae (det. J. H. WIERSEMA)			
Nymphaea amazonum MART. & ZUCC.	3360	G hyd	a,
Nymphaea gardneriana PLANCH.	3081	G hyd	a,
Ochnaceae (det. P. SASTRE)			
Ouratea castaneifolia (DC.) ENGL.	2307	N P caes	s,
Sauvagesia erecta L. subsp. erecta	213/1-6	H caes	cdm,
Sauvagesia tenella LAMARCK	271/1-8	T scap	mu,
Onagraceae (° det. E. ZARDINI)			
Ludwigia affinis (DC.) HARA°	3485	T? scap	ba,
Ludwigia decurrens WALTER	2462	N P scap	ba,
Ludwigia elegans (CAMB.) HARA°	2821	C suff	ba, hs,
Ludwigia grandiflora (MICHX.) GREUTER & BURDET°	185/1-1	T? caes	p, ba,
Ludwigia helminthorrhiza (MART.) HARA °	3305	Hyd nat	a,
Ludwigia hexapetala (H. & A.) ZARD., GU. & RAVEN	270992-3-2	T?	ba,
Ludwigia inclinata (L.f.) GOMEZ	77/4-3	H rept/hyd	a, sgd,
Ludwigia irwinii T. P. RAMAMOORTHY°	2815	Mi C suff	sgd,
Ludwigia lagunae (MORONG) HARA°	3313	H? scap	r,
Ludwigia leptocarpa (NUTT.) HARA°	3465a	T? scap	bs,
Ludwigia longifolia (DC.) HARA	2814	Mes T/H scap	hs, p,
Ludwigia nervosa (POIR.) HARA	3304b	N P caes	ba,
Ludwigia octovalvis (JACQ.) RAVEN	197/1-1	N T scap	sgd, r,
Ludwigia peploides (H. B. K.) RAVEN°	2813	H rept/hyd	a, sgd,
Ludwigia rigida (MIQ.) SANDW°	195/1-2	H? scap	cdm,
Ludwigia sedoides (HUMB. & BONPL.) HARA	3317	H hyd	a,p,
Orchidaceae (det. P. J. CRIPP)			
Galeandra styllomisantha (VELL.) HOEHNE	102/1-11	G bulb	cdm,
Habenaria aricaensis HOEHNE	3005	G bulb	hs, p,
Sarcoglottis hassleri (COGN.) SCHLTR.	132/2-4	G bulb	cdm,
Habenaria sp.	3010	G bulb	hs,
indet. sp. (#5)	141/2-3	G bulb	cdm,
Passifloraceae			
Passiflora cincinnata MAST.	131092-3-1	LH	hs,
Passiflora foetida L.	2203	LH	hs,
Passiflora giberti N. E. BROWN	3216	LH	r,
Passiflora misera KUNTH in H. B. K.	2575	LH	hs,
Piperaceae			
Piper cf. *tuberculatum* Jacq.	2259	Mi P caes	r,

Poaceae (*Paspalum* det. G. H. RUA; *Eragrostis, Aristida* det. S. DE CASTRO-BOECHAT; *Digitaria, Axonopus* det. Z. E. RÚGOLO DE GRASAR; *Luziola* det. M. PIEPENBRINK)

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Acroceras zizanoides (H. B. K.) DANDY	260392-1-10b	H caes	cdm, mu,
Andropogon bicornis L.	3008	H caes	r, hs,
Andropogon gayanus KUNTH	3078	H/C caes	r,
Andropogon hypogynus HACK.	3337	H/C caes	tg, hs,
Andropogon selloanus HACK.	200/1-6	H caes	cdm, tg,
Aristida capillacea LAM.	132/1-1	T caes	mu,
Aristida setifolia H. B. K.	3409, 177/2-2	H caes	mu,
Aristida sp. (#3)	3048	H caes	mu,
Axonopus cf. *complanatus* (NEES ex TRIN.) DEDECCA	138/1-9	T caes	hs, tg,
Axonopus leptostachyus (FLÜGGE) HITCH.	061291-2-11	H/C caes	tg, hs,
Axonopus purpusii (MEZ) CHASE	051191-1-12	H caes	hs, p,
Brachiaria adspersa (TRIN.) PARODI	14/1-3	T rept	hs,
Brachiaria decumbens STAPF	3254, 3310	G rhiz	ba, cd, c,
Brachiaria fasciculata (SW.) PARODI	3223, 3234	T caes	hs, r,
Brachiaria humidicola (RENDLE) SCHWEICKERDT	190592-2-5	H caes	hs, r,
Brachiaria mutica (FORSKAL) STAPF	060892-1-1	G rhiz	p,
Brachiaria plantaginea (LINK) HITCH.	3367	T caes	cdm, c,
Cenchrus echinatus L.	040192-1-1a	T caes	r,
Chloris sp.	2824	T caes	r,
Coelorhachis aurita (STEUD.) CAMUS	3022	H caes	hs,
Cynodon dactylon (L.) PERS.	3461	H rept	r,
Dactyloctenium aegyptiacum (L.) WILLD.	311291-1-5	H caes	r,
Digitaria bicornis (LAM.) R. & S.	020892-1-6	T? caes	be,
Digitaria fuscescens (PRESL.) HENR.	71/1-1	H rept	p, sgd,
Echinochloa colona (L.) LINK	2608c	T caes	r, p,
Echinochloa crus-galli (L.) P. B.	131291-1-7	T caes	r,
Echinolaena gracilis SWALLEN	107/4-2	H? rept	cdm,
Eleusine indica (L.) GAERTN.	2090	T caes	r,
Elionurus muticus (SPRENG.) O. KUNTZE	5255	H caes	hs,
Eragrostis amabilis (L.) WRIGHT & ARNOTT	280991-1-2	T caes	r,
Eragrostis articulata (SCHRANK) NEES	77/2-2	T caes	mu,
Eragrostis bahiensis (SCHRAD.ex SCHULT.) SCHULT.	061291-2-12	H caes	r, cd,
Eragrostis hypnoides (LAM.) BRITTON	160991-4-1	T rept	r, be,
Eragrostis japonica (THUNB.) TRIN.	020892-1-4	T rept/caes	be,
Erianthus cf. *asper* NEES	3390	H caes	cd, p, r,
Eriochloa dystachia H. B. K.	129/1-1	T? caes	cdm,
Gymnopogon fastigiatus NEES	107/4-3	G rhiz	cdm,
Hemarthria altissima (POIR.) STAPF & HUBB.	17/2-2	H? caes	hs, p, r,
Hymenachne amplexicaulis (RUDGE) NEES	3255	H/T hyd,rept	a, p, hs,
Hymenachne donacifolia (RADDI) CHASE	010492-1-4	H hyd	a,
Hyparrhenia rufa (NEES) STAPF	190592-2-6	H caes	r,
Ichnanthus procurrens (NEES ex STAPF) SWALLEN	110292-4-1	H caes	cdm,
Imperata brasiliensis TRIN.	3400	H caes	hs, r,
Imperata tenuis HACKEl	107/4-4	H caes	p, hs,
Lasiacis cf. *sorghoidea* (DESV.) A. HITCH. & CHASE	3410	H caes	df, r,
Leersia hexandra SWARTZ	128/1-5	G rhiz	hs, p, a,
Leptochloa virgata (L.) P. BEAUV.	2609	H rept	hs, p, a,
Leptocoryphium lanatum (H. B. K.) NEES	3001	H caes	cdm,
Loudetia flammida (TRIN.) HUBBARD	3406	T? caes	r,
Luziola fragilis SWALLEN	3284	H hyd	a,
Luziola subintegra SWALLEN	3381	H hyd	a, r,
Mesosetum ansatum (TRIN.) KUHLM	110291-4-2	H caes	cdm,
Mesosetum cayennense STEUD.	3237	H caes	cdm,
Oryza sativa L.	3366	T caes	c,
Oryza cf. *subulata* NEES	3251	H? caes	p,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Otachyrium piligerum SEND. & SOD.	190592-1-4	H? caes	cdm, hs,
Panicum cf. *boliviense* HACKEL	3007	H caes/rept	hs,
Panicum cayennense LAM.	115/1-1	T caes	cdm,
Panicum chloroticum NEES in TRIN.	49/4-3	T rept/hyd	a, hs, p,
Panicum laxum SW.	3003	T caes	hs,
Panicum maximum JACQ.	110292-1-1	H caes	r,
Panicum mertensii ROTH	5023	H (G?)caes	p,
Panicum repens L.	040892-2-2	H rept/hyd	cdm, p,
Panicum rudgei ROEM. & SCHULT.	040892-2-3	H caes	cdm,
Panicum stenodes GRISEB.	107/5-1	H caes	cdm,
Panicum tricholaenoides STEUD.	061291-2-13	H/C caes/herb	hs,
Panicum sp.	3374	H caes	r,
Paratheria prostrata GRISEB.	10/2-1	H rept	hs,
Paspalidium paludivagum (HITCH. & CHASE) PARODI	3220	H rept/caes	hs, p,
Paspalum almum CHASE	3000b	H caes?	hs,
Paspalum conjugatum SWARTZ	2701	H? caes?	hs,
Paspalum coryphaeum TRIN.	110292-1-3	H caes	mu,
Paspalum delicatum SWALLEN	180/1-1, 136/1-1	T rept/hyd	cdm,
Paspalum denticulatum TRIN.	200/1-7	H caes	cdm,
Paspalum eucomum NEES	3096	H caes	cdm,
Paspalum cf. *lenticulare* H. B. K.	3097, 3021	H caes	cdm,
Paspalum lenticulare H. B. K. f. *intumescens* (DOELL) KILLIP	3013	H caes	cdm,
Paspalum limbatum HENR.	3000a	H caes	p, hs,
Paspalum lineare TRIN.	3431	H caes	cdm,
Paspalum morichalense DAVIDSE, ZULOAGA & FILGUEIRAS	030891-1-1	T? rept/hyd	a, cdm,
Paspalum multicaule POIR.	3124	T caes	cdm,
Paspalum notatum FLÜGGE	251291-1-2		
Paspalum pallens SWALLEN	2702a	H? caes	r,
Paspalum paniculatum L.	251191-1-1	H caes	r,
Paspalum pictum EKMAN	166/2-1	T caes?	cdm,
Paspalum repens BERG	3249	H rept/hyd	ba, r,
Paspalum Sect. *Parviflora* sp.	3477	H caes	r,
Paspalum stellatum HUMB. & BONPL. ex FLÜGGE	107/3-1	H caes	cdm,
Paspalum subciliatum CHASE	190592-1-6a	H? caes	cdm,
Paspalum wettsteinii HACKEL	114/1-2, 2694	H caes	r,
Paspalum wrightii HITCH. & CHASE		H caes	r, p,
Pennisetum pedicellatum TRIN. cf. subsp. *unispiculum* BRUNKEN	020592-3-2a	H caes	r,
Pennisetum cf. *polystachion* (L.) SCHULT.	020592-3-2b	H caes	r,
Reimarochloa acuta (FLÜGGE) HITCHC.	10/2-2, 3230	T/H caes	hs,
Rhynchelytrum repens (WILLD.) HUBB.	040192-1-3	H rept	r,
Sacciolepis angustissima (STEUD.) KUHLM.	128/1-6	H caes	cdm,
Sacciolepis myura (LAM.) CHASE	190592-3-4	H caes	cdm,
Schizachyrium microstachyum (DESV.) ROS., ARR. & IZAG.	3751	H caes/rept	r,
Schizachyrium tenerum NEES	040892-2-6	H caes/rept	r, cdm,
Setaria parviflora (POIR.) KERGUÉLEN	60/2-4	T/G rhiz	hs,
Setaria vulpiseta (LAM.) ROEM. & SCHULT.	180892-3-1		
Sorghastrum setosum (GRISEB.) HITCHC.	102/3-7		
Sorghum bicolor (L.) MOENCH subsp. *arundinaeum* (DESV.) STAPF in PRAIN	251291-1-1	H caes	r,
Trachypogon cf. *spicatus* (L.f.) O. KUNTZE	117/1-1, 107/4-6	H caes	cdm,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Polygalaceae (° det. M. d. C. M. MARQUES)			
Polygala cf. *adenophylla* A. W. BENN	2204	T scap	hs,
Polygala celosioides A. W. BENN°	2817	T scap	cdm,
Polygala cf. *filiformis* A. ST. HIL	198/1-2	G bulb	cdm,
Polygala hygrophila H. B. K.°	100/1-17		
Polygala longicaulis H. B. K. var. *maior* CHOD.°	2423	T scap	cdm,
Polygala leptocaulis TORR. & A. GRAY var. *leptocaulis*°	219/1-3, 200/1-15	T scap	hs, cdm,
Polygala timoutoides CHOD. var. *timoutoides*°	131092-5-1	T scap	cdm,
Polygala violacea AUBL.°	050192-1-2	H caes	cdm,
Securidaca rivinaefolia A. ST. HIL.°	2275b	N P caes	cd, r,
Polygonaceae (° det. A. M. CIALDELLA; * J. BRANDBYGE)			
Coccoloba mollis CASAR.	5039, 2810	N P caes	s,
Polygonum ferrugineum WEDD.°	2497b	T/H rept	a, p,
Polygonum hydropiperoides MICHX.°		T/H rept	p,a,
Polygonum punctatum ELLIOT°	2463	T/H rept	p,a,
Triplaris americana L.*	3469	Mi P scap	hs, if,
Triplaris gardneriana L.*	2296	Mi P scap	if,
Triplaris mato-grossensis BRANDBYGE*	3329, 2636	Mes/Mi P scap	if,
Pontederiaceae			
Eichhornia azurea (SCHWARTZ) KUNTH	5307	H hyd	a,
Eichhornia crassipes (MART.) SOLMS	2302	Hyd nat	a,
cf. *Heteranthera reniformis* RUIZ. & PAV.	3326	H hyd	a,
Pontederia cordata L. var. *ovalis* (MART.) SOLMS	2497a	G rhiz	p,
Pontederia cordata L. var. *lancifolia* (MUHL.) TORREY	2282	G rhiz	p,
Pontederia rotundifolia L.f.	2311	G rhiz	a, p,
Pontederia subovata (SEUB.) LOWDEN	3079	G rhiz	a, p,
Portulacaceae			
Portulaca cf. *fluvialis* LEGR.	2470	T scap	sgi,
Portulaca cf. *oleracea* L.	4661	T scap	sgi,
Portulaca sp. (2)	2480	T scap	hs,
Rubiaceae (° det. E. CABRAL;* det J. H. KIRKBRIDE)			
Alibertia edulis (L. C. RICH.) A. C. RICH.*	3041	P caes	mu,
Alibertia myrciifolia SPRUCE ex K. SCHUM.*	3057	P caes	mu,
Borreria capitata (RUIZ. & PAV.) DC.*	2377	T scap	sgd,
Borreria cf. *cupularis* DC.°	115/1-2	T scap	sgd,
Borreria eryngioides CHAM. & SCHLTDL.°	2483b, 2709	T scap	sgd,
Borreria poaya (ST. HIL.) DC.°	214/1-10	T scap	sgd,
Borreria tenella (H. B. K.) CHAM. & SCHLTDL.°	99/3-12, 195/1-8	T scap	sgd,
Borreria tenuis DC.*	169/1-4	T scap	sgd,
cf. *Borreria* sp. (#6)	3151	T rept	sgp,
cf. *Borreria* sp. (#5)	3150b	T caes	sgp,
cf. *Borreria* sp. (#9)	3134	T caes	sgp,
Chomelia cf. *martiana* MÜLL. ARG.°.	211192-1-1	N P caes	hs,
Diodia kuntzei K. SCHUM.*	2773	T rept	sgd,
Diodia wunschmannii K. SCHUM.°	3162	T rept	sgd,
Faramea sessilifolia (H. B. K.) DC.*	3526	P caes	if,
Genipa americana L.	2377b	Mi P scap/caes	s,r,
Limnosipanea schomburgkii HOOK f.	4369	T scap	hs, cdm,
Limnosipanea sp.	4420, 180/1-6	T scap	hs, cdm,
Palicourea crocea (SW.) ROEM. & SCHULT.*	2409,2471	N P caes	s,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Psychotria carthaginensis JACQ.*	210/1-1,319/1-2	N P caes	s,
Richardia grandiflora (CHAM. & SCHLTDL.) SCHULT. & SCHULT.*	2315	T scap	sgd,
Simira rubescens (BENTH.) BREMEK. ex STEYERM.*°	3522	Mi P caes	s,
Sipanea veris S. MOORE*	2524	T? rept	(s), hs,
Spermacoce tenuior L.*	149/1-7	T? scap	sgd,
Spermacoceodes glabrum (MICHX.) O. KUNTZE var. *rectum* BACIG°	2778	T? scap	sgd,
Sphinctanthus microphyllus K. SCHUM.	2224	N P caes	hs,
Tocoyena formosa (CHAM. & SCHLTDL.) K. SCHUM.	3042	Mi/N P caes	r, mu,
indet. sp. (#12)	3526	N P caes	s,
indet. sp. (#1)	2377	H?	cdm,
Rutaceae (det. J. R. PIRANI)			
Zanthoxylum rigidum H. & B. ex WILLD.	3060, 3076	N P caes	mu,
Sapindaceae (det. M. S. FERRUCCI)			
Cardiospermum halicacabum L. var. *halicacabum*	2080	LH/T	sgd,
Magonia cf. *pubescens* ST. HIL.	3385b	P scap	mu,
Paullinia pinnata L.	2286	LH	hs, p, r,
Paullinia spicata BENTH.	5324	LH	r,
Sapindus saponaria L.	2229	Mes P scap	if?
Serjania glutinosa RADLK.	3291	LH	hs,
Serjania adenophylla M. S. FERRUCCI	2829	LH	hs,
Scrophulariaceae			
cf. *Agalanis* sp.	5327	T scap	hs,
Angelonia cf. *angustifolia* BENTH. in DC.	2486	H scap	hs,
Bacopa dubia CHODAT & HASSL.	5331a	T rept	hs,
Bacopa cf. *monnieroides* (CHAM.) ROB.	4791, 5334	T/H? rept	hs,
Bacopa cf. *repens* WETTST.	5331b	T rept	hs, p, a,
Bacopa myriophylloides (BENTH.) WETTST.	3285	T rept	hs, p,
Bacopa sp.(#3)	5140	T hyd?	sgi,
Bacopa sp. (#7)	2019, 10/4-5	T hyd?	sgi,
Bacopa sp. (#11)	3093	T caes	hs,
Buchnera palustris (AUBL.) SPRENG.	3165	H scap	cdm,
Conobea scoparioides (CHAM. & SCHLTDL.) BENTH.	2335, 3177	T scap	sgd,
cf. *Geochorda* sp.	3201	T scap	hs,
cf. *Benjaminia reflexa* (BENTH.) EDWALL (= *Herpestis reflexa* BENTH.)	2822a	T hyd	p, a,
Mecardonia procumbens L.	5330	H? rept	sgd,
Schizosepala matogrossensis G. M. BARROSO	5310	T scap	sgd,
Scoparia dulcis L.	2208	T scap	sgd,
Scoparia montevidensis (SPRENG.) R. E. FRIES	4667	T scap	sgd,
Simaroubaceae			
Simarouba versicolor ST. HIL.	3055	Mes P scap	mu,
Smilacaceae			
Smilax sp.	3026	LP	mu,
Solanaceae			
Cestrum sp.	3019	N P caes	r,
Schwenckia sp.	3133, 3086	T? caes	r,
Solanum aculeatissimum JACQ.	3459	H? scap	r,
Solanum americanum MIL.	2599	C suff	r,
Solanum glaucophyllum DESF.	2781	N P caes	hs,

Tab. 1 (continued)

Taxon	Voucher	life form type	Habitat
Solanum sisymbriifolium LAM.	2176, 3458	N P caes	r,
Solanum sp. (#6)	4008, 2082	H scap	r,
Solanum sp. (#5)	4009, 3459b	C suff	r,
Sterculiaceae (det. C. L. CRISTÓBAL)			
Byttneria genistella TR. & PL.	3371	C suff	hs,
Byttneria rhamnifolia BENTH.	321/1-5	C frut	r, s,
Byttneria scabra L.	3207	C frut	cdm,
Guazuma ulmifolia LAM. var. *ulmifolia*	2396	Mes P scap	r,
Guazuma ulmifolia LAM. var. *tomentella* K. SCHUM.	3430	Mes P scap	r,
Helicteres gardneriana A. ST. HIL. & NAUD.	138/1	N P caes	hs, s, r,
Melochia arenosa BENTH.	3080	C frut	hs,
Melochia parvifolia H. B. K var. *parvifolia*	3198, 2395	C frut	hs,
Melochia pyramidata L. var. *hieronymi* K. SCHUM.	3280	P/C caes/frut	hs,
Melochia simplex A. ST. HIL.	163/1-17, 99/3-13	C frut	hs,
Melochia spicata (L.) FRYXELL	3126, 2492	C frut	hs,
Tiliaceae (det. M.S. FERRUCCI)			
Corchorus argutus Kunth in H. B. K.	166/2-7, 163/1-16	T? scap	hs,
Turneraceae (det. M. M. ARBO)			
Piriqueta cistoides (L.) GRISEB. subsp. *caroliana* (WALT.) ARBO	100/1-16	T/C scap	hs, r,
Piriqueta cf. *corumbensis* MOURA	4182	T/C scap	hs, r,
Typhaceae			
Typha cf. *domingensis* PERS.	2826	G rhiz	p,
Ulmaceae			
Celtis cf. *spinosa* SPRENG.	3288	Mi P scap	r,
Verbenaceae			
Baillonia amabilis BOCQ. ex BAILL.	3433	Mi P caes	hs,
Lantana trifolia L.	211192-1-4	H scap	hs,
Lippia alba (Mill.) N. E. BROWN	2868	C frut	hs,
Stachytarpheta cf. *elatior* SCHRAD. ex SCHULT.	5337	T scap	r,
Vitex cymosa BERT. ex SPRENG.	2501	Mes P scap	hs,
Vitaceae (° det. B. DESCOINGS; * det. S. BIDGOOD)			
Gmelina arborea ROXB. *	2358	Mi P caes	r,
Cissus erosa L. C. RICH°	121/1-3	LP	hs,p,
Cissus verticillata (L.) NICOLSON & JARVIS, subsp. *verticillata* (= *C. sicyoides* L.)	4014, 2820	LP	mu, r, p,
Cissus cf. *spinosa* CAMBESS.	2290, 183/1-5	LP	p,
Cissus sp. (#3)	4354	LP	r, p,
Vitex sp.	2262, 3434	LP	r,
Vochysiaceae			
Vochysia divergens POHL	3309	Mes P caes	hs, if,
Xyridaceae (det. P. J. M. MAAS)			
Xyris cf. *rigida* KUNTH	3144	H? ros	cdm,
Xyris savannensis MIQ.	3193	T ros	cdm,
Zingiberaceae (° det. P. J. M. MAAS)			
Costus arabicus L.°	2533	G rhiz	mu,
cf. *Hedychium coronarium* KÖNIG	3141	G rhiz	r, c?

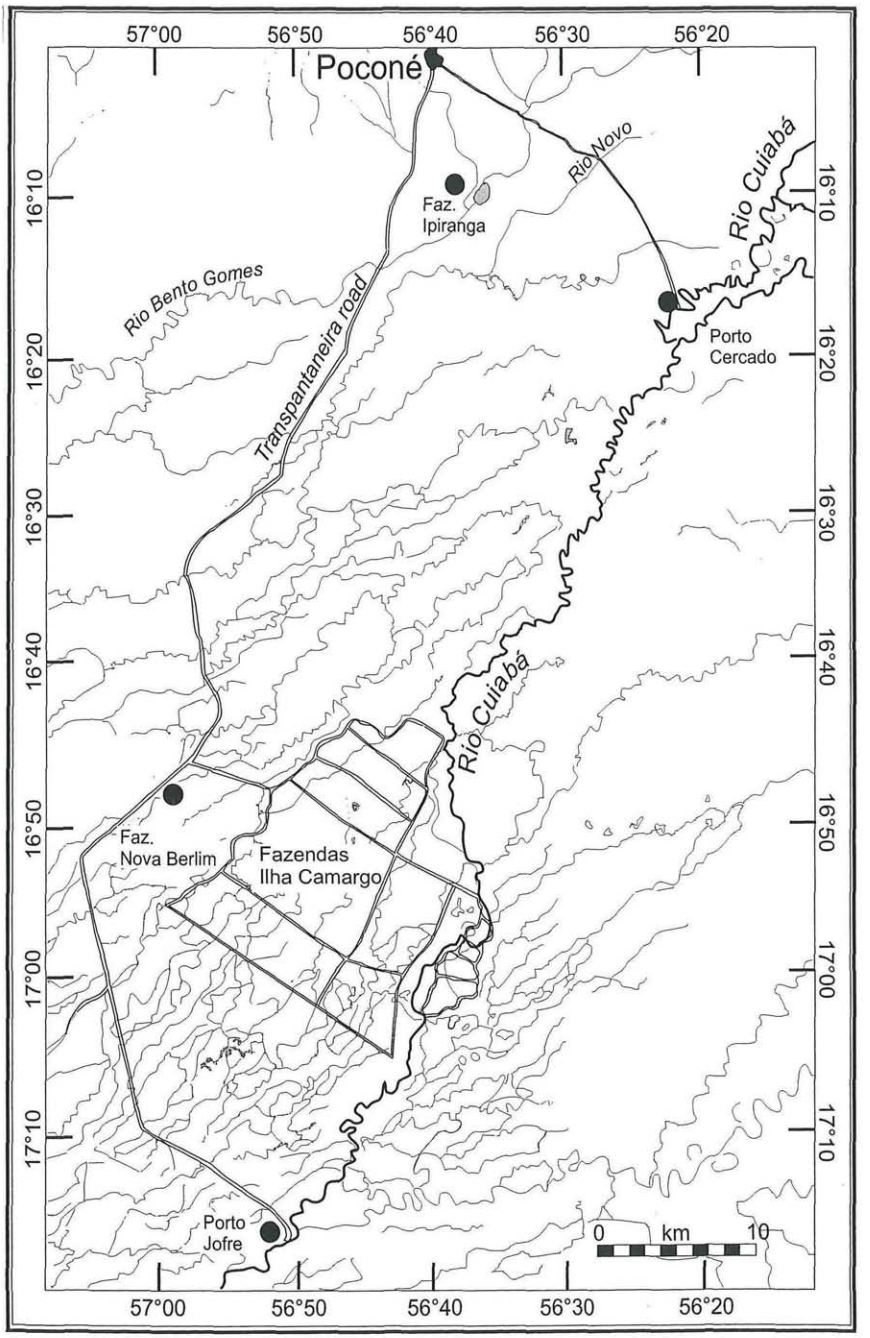


Fig. 3. Map of the study area.

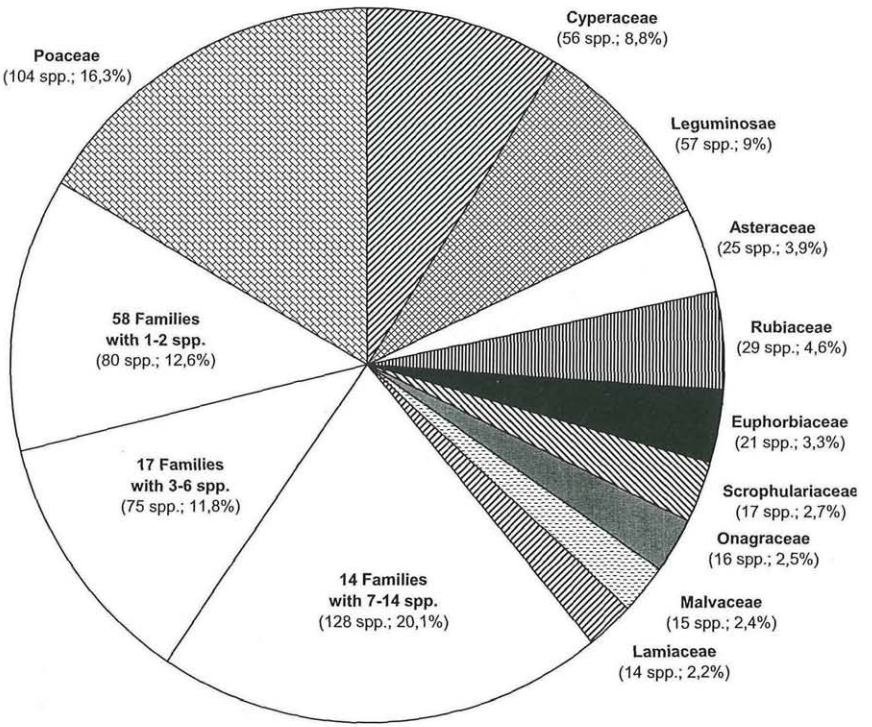


Fig. 4. Diagram of floristic composition with the ten families richest in species separately notated.

5. Major Vegetation Types

Within the lowlands of the study area, differences in elevation do not exceed several meters, but are decisive for duration and heigth of inundation during the wet season. Generally, the level of flooding increases from north to south but a considerable variation within each stand is due to a dentritic system of natural drainage channels forming a slighty undulating landscape. The five major herbaceous vegetation types and three woody vegetation types (Fig. 6) occurring in the lowlands can be arranged according to this gradient of inundation. Vegetation types are named according to local names or by dominant or indicating species if such termes are lacking.

5.1 Herbaceous Vegetation

There are three distinctive types of hyperseasonal savanna the study area, the small tussock grasslands on higher sites in the northern

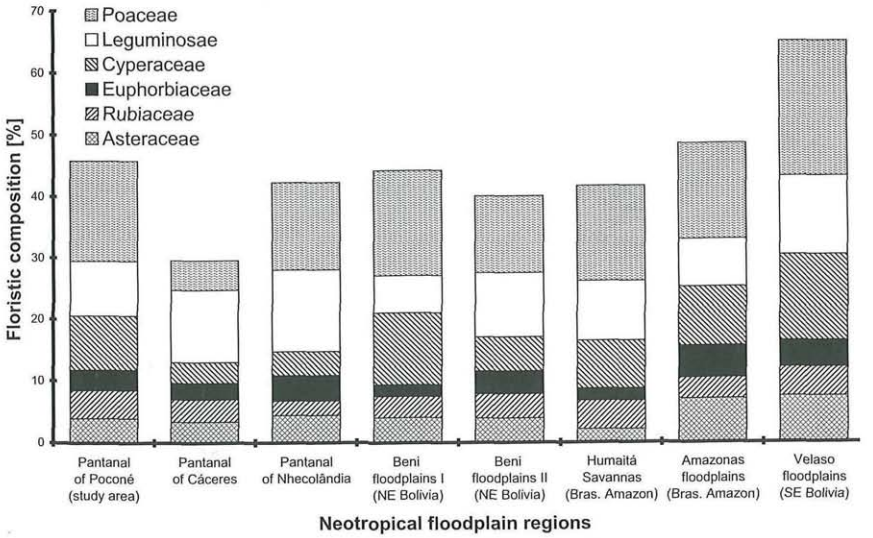


Fig. 5. Diagram of floristic similarity on family level of eight neotropical floodplains. Shown as portion of the six largest families in percentage of total species number respectively.

Data sources: "Pantanal of Cáceres": PRANCE & SCHALLER 1982; "Pantanal of Nhecolândia": POTT V. J. & al. 1986b; "Beni floodplains I": HAASE & BECK 1989; "Beni floodplains II": BECK 1984; "Humaitá savannas: JANSSEN 1986; "Amazon floodplains": JUNK & PIEDADE 1993; "Velaso floodplains": BRUDERRECK 1989.

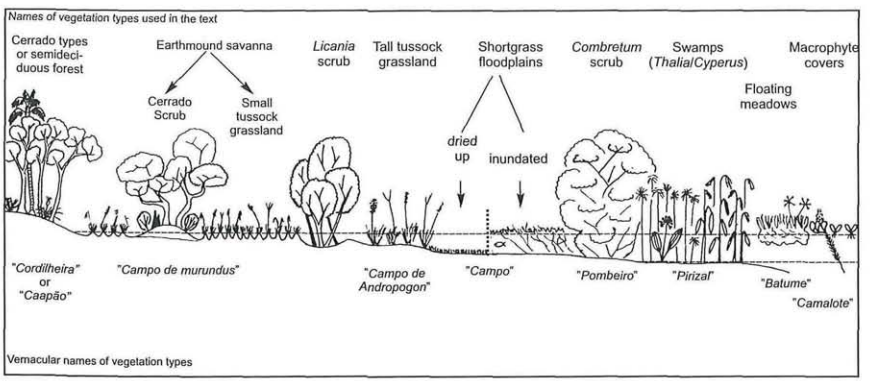


Fig. 6. Sketch profile showing vegetation types of flooded lowlands. Dotted lines represent high water and low water levels respectively.

part, the tall tussock grasslands covering the central part of the study area and shortgrass floodplains on stands underlying pronounced changes during wet and dry phase.

5.1.1 Small Tussock Grasslands – "Campos de murundus". – Extending over large areas in the northern part of the study area, this type is dominated by small bunchgrasses and -sedges. However, elevated earthmounds, regionally called "murundus", are interspersed within these grasslands (Fig. 7–10) forming a distinct and species rich (>250 spp.) type of hyperseasonal savanna. Although plains are flooded by rainwater up to a few decimeters for only 3–12 weeks during the year, the poorly drained soils are saturated with water for almost half a year. These grasslands consist mainly of perennial grasses such as *Panicum stenodes, Axonopus purpusii, Leptocoryphium lanatum, Andropogon selloanus* and *Mesosetum ansatum*. Similar to bunchgrass communities from floodplains in northern Bolivia, described by HAASE & BECK 1989 and BECK 1983, a pronounced microrelief of seasonally inundated depressions or gullies and nonflooded mounds ("micromounds") of a few decimeters in height can be observed. In the study area, termites, ants and earthworms contribute to the raising of these micromounds slightly above highwater level while being held together by the roots of caespitose herbs growing on them. Beside the species of bunchgrasses mentioned above, tussocks of sedges (e.g. *Rhynchospora hirta, R. barbata, R. armerioides*) and forbs such as *Hyptis hygrobia* are quite frequently occuring species on these micromounds. During the few weeks of drying up, shortliving annuals and saprophytes (e.g. *Burmannia* spp., *Utricularia* spp., *Syngonanthus gracilis, Eriocaulon guyanense*) rapidly develop in the gullies between the mounds. The remaining dry season, gullies are almost free from any vegetation.

5.1.2 Tall Tussock Grasslands – "Campo de *Andropogon*". – Another type of hyperseasonal savanna dominated by species of tall bunchgrasses (Fig. 11) such as *Andropogon hypogynus* and *Axonopus leptostachyus* covers to great extent the central part of the study area. The grasslands develop on loamy to clayey soils, which mainly belong to Dystric Planosol and Cambisol soil groups. In contrast to the small tussock grasslands mentioned above, water level during the three months of inundation can be as high as 0.5–1.0 m.

During flooding, dense macrophyte vegetation (e.g. *Leersia hexandra, Sagittaria guyanensis, Hyptis lorentziana*) develops between the grass tussocks, while most of these macrophytes starve away during dry season. Then, groundwater level can be as deep as 2.5 m and frequent burnings occur. Contrary to the small tussock grasslands of the earthmound savanna, no pronounced microrelief could be observed.

On slightly wetter sites, almost monodominant stands of *Paspalum wrightii* substitute the grasslands dominanted by *Andropogon hypogynus* and *Axonopus leptostachyus*.

5.1.3 Shortgrass-Floodplains. – On lowlands underlying a pronounced change between inundation (= aquatic phase) and severe drying

up of the soils during dry season (= dry phase), a seasonal change in vegetation cover occurs (Fig. 12, 13). During a hydrological cycle, floristic composition and vegetation cover changes drastically. However, some small prostrate herbs such as *Diodia kuntzei*, *Hyptis lorentziana, Ludwigia inclinata, Caperonia castaneifolia* or the decumbent dwarf shrub *Hydrolea spinosa* remain growing in both phases. These species show a remarkable dimorphorphism during one hydrologic cycle, surviving as nanous land forms with short leaves and creeping shoots during dry season. During aquatic phase, these species are growing as submerged aquatic macrophytes forming large, flexible leaves and shoots well adapted even to strong water flows; their flowering peak also occurs during the aquatic phase.

During dry season, grassy vegetation can consist up to 50% of small therophytes forming a sparse herblayer up to 15 cm tall. This grassland is heavily grazed and in many places burnt every year. Dominating species are the grasses *Reimarochloa acuta, Panicum laxum, Setaria parviflora* and sedges such as *Cyperus haspan* and *Eleocharis minima,* or a creeping forb (*Murdannia* sp. nov. inedit.). About 11 subtypes of this grassland vegetation can be distinguished according to soil type (sandy vs. clayey texture) and duration of inundation. Quite common species on clayey soils are *Thevetia peruviana, Sphinctanthus microphyllus*, several legume shrubs (e.g. *Mimosa* spp., *Senna* spp.) and *Cardiospermum halicacabum. Chamaesyce thymifolia, Croton trinitatis* and *Richardia grandiflora* are characteristic species of sandy alluvial sediments.

During the early part of the rainy season, usually from october onward, the lowlands begin to inundate. Generally, the low-lying floodplains are covered with blackwater for more than half of the year. Most of the species dominating during dry season decay rapidly and aquatic macrophytes (e.g. *Pontederia* spp., *Nymphoides grayana*) develop. They germinate from seeds stored in the upper soil horizon or regrow from storing organs (e.g. *Eleocharis* spp., *Nymphaea* spp).

Independent of textural differences of the underlying soils, floristic composition of the aquatic macrophyte vegetation is quite similar throughout the study area. Nevertheless, somewhat different vegetation types establish in the different types of natural channels draining the floodplains. Some of them, locally called "vazantes", dry up only for some weeks of the year, others never dry up. The latter, so called "corixos" with stagnant water or "corregos" with flowing water during dry phase are covered by species with emergent floating leaves. Some species such as *Eichhornia azurea*, or *Nymphaea amazonum* form almost pure stands (Fig. 14). Frequently occuring species within these vegetation types are stoloniferous grasses (e.g. *Hymenachne amplexicaulis, Leersia hexandra, Coelorhachis aurita*).

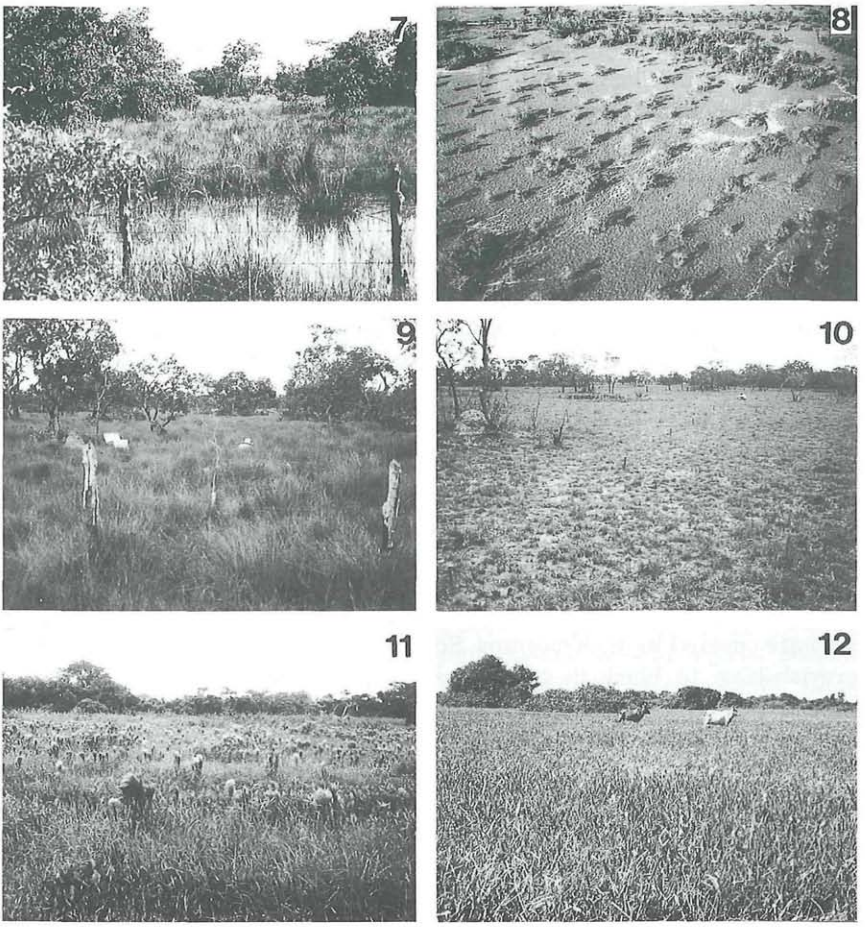
5.1.4 Floating Meadows – "Batume". – In the southern part of the study area, large flood-plains, permanently inundated or drying up for short periods in some years only, are covered by floating meadows. The vegetation of floating meadows consists merely of *Oxycarium cubense*, with a few additional species such as *Pityrogramma calomelanos, Pontederia cordata* var. *ovalis* and *Eupatorium candolleanum* (Fig. 15). Sometimes, meadows compacted by water flow can carry even bushes such as *Alchornea castaneifolia* or *Cecropia* trees. The roots and stolons of *Oxycarium* grow within finely textured detritus and decomposing plant parts, forming a solid detritus layer sometimes as thick as one meter. There is no problem for alligators (Caiman jacare) or rodents such as Capybara (Hydrochoeris hydrochaeris) to walk on these floating meadows and the alligators are known to build their nests on it. Different varieties of floating meadows, built up by *Brachiaria* cf. *decumbens*, *Leersia hexandra* or *Imperata brasiliensis,* can be found within the *Oxycarium* meadows.

5.1.5 Swamps of rhizomatous geophytes – Almost pure stands of the tall papyrus-like sedge *Cyperus giganteus* (Fig. 16) or the marantaceous *Thalia geniculata* (Fig. 17) occur in depressions, that are shallowly inundated for almost the whole year and flooded up to a depth to 1.5 m for three to five months. Large areas of the southern part of the study area are covered by such swamps. Soils of these stands are strongly anoxic greyish-blue to blackish-grey clays. Only a few species can establish themselves in such conditions. Both *Cyperus* and *Thalia* are characterized by thick rhizomes rich in aerenchymatic tissue and growing within the upper 10 cm of the soils. Other frequently occurring species in these swamps are the legume *Discolobium pulchellum,* and the vine *Cissus spinosa*. Less frequent herbs are *Echinodorus teretoscapus, E. paniculatus, Pontederia cordata* var. *ovalis, Nymphaea amazonum* and some winders such as *Tassadia berteriana* and *Ipomoea tenera*.

5.1.6 Free Floating Macrophyte covers. – *Salvinia auriculata* or *Pistia stratiotes* frequently form covers on shallow water bodies in drainage ditches along the Transpantaneira highway (Fig. 18). While dying off during dry season, *Salvinia* and *Pistia* recover rapidly during aquatic phase. Their stands additionally contain a variety of free floating macrophytes such as aquatic *Utricularia* spp., *Limnobium laevigatum, Lemna aequinoctialis, Azolla filiculoides, Egeria najas* or *Ricciocarpus* cf. *natans*. The somewhat more stable permanent water bodies of oxbow lakes are generally overgrown by covers of *Eichhornia crassipes*.

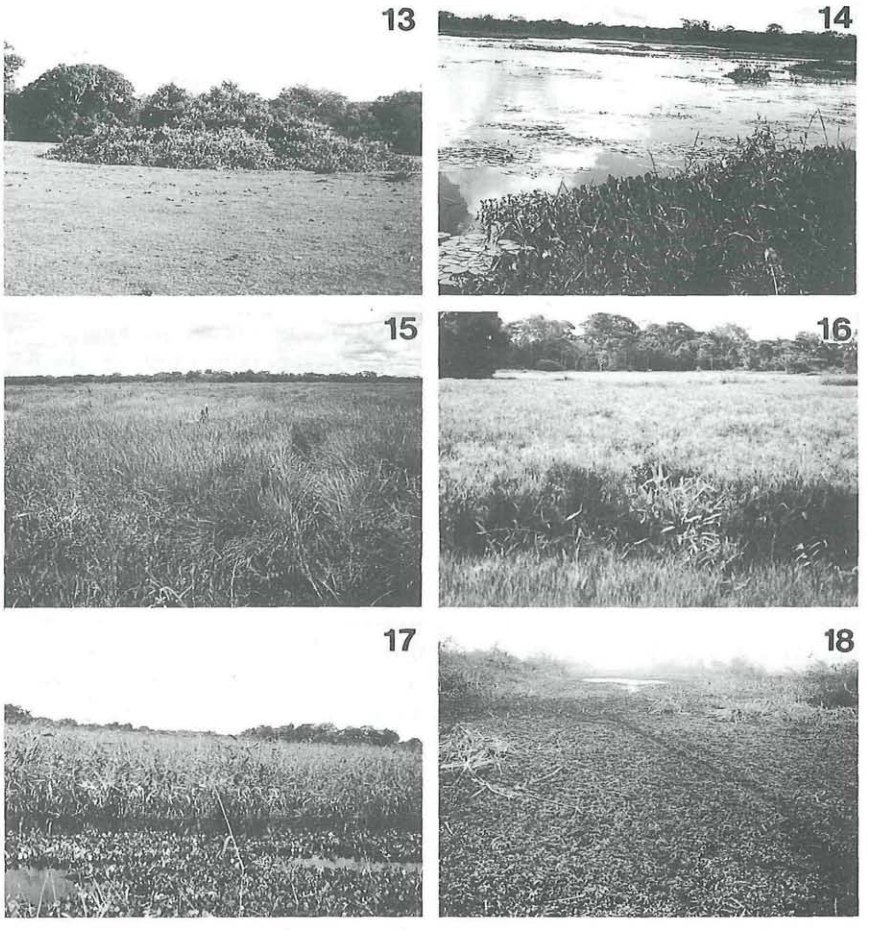
5.2 Woody Vegetation Types

5.2.1 Cerrado scrub on earthmounds – "Murundus". – The most striking type of vegetation in the study area is perhaps the "campo de murundu"-savanna (Fig. 6–10). "Murundus" are approximately circular



Figs. 7–12. Vegetation of the Pantanal region. – Fig. 7. General aspect of an earthmound savanna with small tussock grassland and (relatively grand) elevated earthmounds. – Fig. 8. Aerial view of an earthmound savanna with *Licania*-gallery forest in the background. – Fig. 9. Detailed view of an earthmound savanna: small tussock grassland with interspersed (relativelly little) earthmounds. – Fig. 10. Same site after being burned, showing the gully and micromound structure of the grassland soil and termite mounds on top of the earthmounds. – Fig. 11. Tall tussock grassland *of Andropogon hypogynus* with tussocks of *A. bicornis* interspersed (dense whitish inflorescences). – Fig. 12. Inundated shortgrass floodplain with dominance of *Pontederia cordata* var. *lancifolia*.

earthmounds dotted within the seasonally inundated small tussock grasslands described above. They raise 0.3 up to 1.0 m above the level of the surrounding lowlands. Measurements carried out in the study area using



Figs. 13–18. Vegetation of the Pantanal region. – Fig. 13. Same stand as in Fig. 12, now completely dried up and covered by short grasses (foreground); a scrub of *Combretum lanceolatum* (midground) and interspersed forest island (background). – Fig. 14. Natural drainage channel with running water throughout the year and floating leaves of *Nymphaea amazonum*. – Fig. 15. Floating meadows of *Oxycarium cubense*. – Fig. 16. Swamp of *Cyperus giganteus*. – Fig. 17. A permanently inundated swamp dominated by *Thalia geniculata*. – Fig. 18. Dried up drainage ditch with *Salvinia auriculata*.

point-centered-quarter method (MUELLER–DOMBOIS & ELLENBERG 1974) revealed that dimensions of these earthmounds vary considerably, ranging from 1 to 80 m^2. They occupy approximately 5–6% of total area of the "campo de murundu"-savanna. On top of these earthmounds, termite nests are usually found. Theories recently reviewed by PONCE & CUNHA 1993 at-

tribute the rising of earthmounds above surrounding soil surface to either abiotic factors such as abiotic erosion (ARAUJO NETO & al. 1986), to differential abiotic accumulation or to biotic accumulation due to termite activities (OLIVEIRA FILHO 1986, 1992).

The earthmounds studied feature woody vegetation with *Curatella americana* as the most frequently occurring species. Other common species are trees such as *Andira cuyabensis* and *Astronium fraxinifolium*, reaching more than 6 m in height, and the shrubs *Annona aurantiaca, Byrsonima orbignyana, Alibertia edulis, Eugenia biflora, Erythroxylum anguifugum, Zanthoxylum hasslerianum* and *Annona dioica*, forming a shrub layer of up to 2 m in height. Usually, a third vegetation layer of herbaceous plants such as *Hyptis recurvata, H. crenata, H. microphylla, Cyperus* aff. *aggregatus, Bromelia balansae* and species from the surrounding grassland, is developed. Altogether, floristic composition of 60 "murundus" examined comprises approximately 240 species of vascular plants.

5.2.2 *Combretum* Scrub – "Pombeiro". – Almost monodominant stands of *Combretum lanceolatum* or *C. laxum* or mixed stands of both species are widespread throughout the study area. In the northern part, they appear as scrub of 10–100 meters in diameter interspersed in grassy campos (Fig. 13), whereas large areas extending over several square miles may be covered or at least dominated by "pombeiro" in the southern part of the study area. The *Combretum* shrubs of the study area show a particular growth form. Branches of juveniles grow orthotropically while distal branches of older shrubs hang over as far as to touch the soil. Here, adventitious roots are formed, fixing the vinelike branches, which sprout into the surroundings. The dense scrub, up to 4 m high, establish themselves either on sandy or clayey soils and seem to tolerate both longlasting inundations and desiccation of soils. Therefore, *Combretum* species are regionally known as vigorous invaders of pasture and heavily combatted by local farmers. "Pombeiro" is poor in species and *Combretum* srub generally consists of a few species only. Common species comprise the vines *Cissus* cf. *spinosa* and *Paullinia pinnata*, treelets of *Licania parvifolia, Psychotria* sp., *Coccoloba mollis* or shrubs such as *Cuphea melvilla* and *Erythroxylum* cf. *anguifugum*.

5.2.3 *Baillonia* Scrub – "Sarã". – The *Salix*-like shrub *Baillonia amabilis* forms dense monodominant stands. They occupy up to 100 square meters within seasonally flooded swamps of *Thalia geniculata* or in grassy floodplain vegetation.

5.2.4 *Licania* Scrub. – Natural drainage channels within the "Campos de murundus" in the northern part of the study area are covered by a scrub or low gallery forest up to 6 m in height consisting mainly of *Licania parvifolia*. As the collection of plants from this vegetation type is far from being complete, only some common species can be

mentioned. Beside the dominant *Licania*, the most common species are *Alchornea schomburgkiana*, *Vochysia divergens*, *Triplaris* cf. *americana* and *Faramea sessilifolia*.

6. Conclusions

Distribution pattern of vegetation is primarily caused by small differences in relief not exceding a few centimeters or decimeters and resulting in slightly different water regimes, and secondly in different alluvial soil types.

The combination of these abiotic factors is reflected in by the preferencial occurrence of certain life form groups. Drier sites are occupied by vegetation types dominated by caespitose hemicryptophytes, whereas communities of rhizomateous geophytes dominate on wetter sites. Highest percentages of therophytes are found in communities on sites with pronounced changes of dry phase and aquatic phase.

Some of the vegetation types of the study area, especially those grouped as hyperseasonal savannas, resemble strongly those types described from other savanna regions in the neotropics, e.g. the shortgrass communities of the Beni savannas (BECK 1984, HAASE & BECK 1989, HAASE 1989, 1990), the hyperseasonal savanna types of the Llanos dos Mojos (BRUDERRECK 1989), or the herbaceous savanna types of the Humaitá savannas (JANSSEN 1986).

The study area shares about a hundred plant species with other neotropical floodplains.

At genus or familiy level, floristic similarity is even higher, but seems to decrease with increasing distance to the study area. Even thouth the area is relatively well studied due to ist good accessibility via the Transpantaneira highway, the floristic survey contains a number of species recorded for the first time for Mato Grosso and three new to science (see Tab. 1). Further phytogeographic and comparative taxonomic studies are necessary for a better understanding of floodplain vegetation throughout South America.

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