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NOTES ON THE VEGETATION OF THE PARQUE NACIONAL DO ARAGUAIA (BRAZIL)

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ABSTRACT. Floristic lists, quantitative analyses and brief descriptions are given of cerrado (tree savanna), forest and campo vegetation in the area close to the headquarters settlement of the Parque Nacional do Araguaia, Goiás, Brazil. A soil reconnaissance of the same area, prepared by the late Professor D. R. Gifford, is appended.

CONTENTS

INTRODUCTION

The following notes are the result of a two-week survey of the vegetation within easy reach of the headquarters of the Parque Nacional do Araguaia, Ilha do Bananal, Goiás, Brazil. The study was carried out in 1980 as the second stage of a reconnaissance made in the previous year by a team which included the late Professor David R. Gifford (University of Brasília, Laboratory of Ecology), Sr Eduardo Kunze Bastos (Instituto Brasileiro de Desenvolvimento Florestal) and Sr Fernando Cardosa da Silva (Botanist, Programa Flora, Conselho Nacional de Desenvolvimento Científico e Tecnológico). The results were first communicated as a ring-bound report (Ratter, 1985), but a number of readers have suggested that they should be made more accessible and therefore they are now being published here.

The Parque Nacional do Araguaia is a 520,000 ha national park run by the Instituto Brasileiro de Desenvolvimento Florestal (IBDF). It consists of the northern end of the Ilha do Bananal, the largest quaternary fluvial island in the world, made up of some 2 million ha of land lying within a bifurcation and later reunion of the course of the great Rio Araguaia (Fig. 1). The area of the park is notably flat and large areas are inundated each year by the seasonal rise of the Rio Araguaia; much of the land around the headquarters, however, is slightly elevated and reaches up to 245 m above sea level (see

Fig. 2). The climate is tropical seasonal with a dry season from April to September of many consecutive rainless weeks, while during the remainder of the year there is a wet season characterized by heavy rainfall and high atmospheric humidity. Data from the closest weather station (Porto Nacional, Goiás, some 200 km east of the HQ of the Parque Nacional and at about the same altitude) show an average annual temperature of 25·6°C, with an absolute maximum of 42·8°C and minimum of 9·5°C, and an average annual precipitation of 1813·1 mm (Nimer, 1977). According to Eidt (1968) the area is exactly on the transition line between Köppen's 'Savanna Subtype' (Aw) and 'Monsoon Subtype' (Am) of the 'Tropical Rain Climate' (A).

As a result of the initial reconnaissance, Professor Gifford prepared vegetation, soil and geological maps and these are reproduced here (Figs 2–5). The text of part of Professor Gifford's report to IBDF is annexed to these notes as an appendix (p. 335) and gives details of the geology and soils of the study area.

VEGETATION TYPES

The park lies at the junction of two great vegetation formations: the cerrado (savanna woodlands) which cover about 2 million km^2 to the south, and the Amazonian forest (Hylaea) occupying some 3·5 million km^2 of Brazilian territory to the north and west. Large areas of the park are also covered in seasonally-flooded campo grassland, usually studded with regularly spaced small islands of higher ground, while seasonally or permanently flooded forest (known in Portuguese as *Várzea* and *Igapó* respectively) occur on the margins of watercourses and lakes. All these vegetation types are represented in the area studied close to the headquarters.

The classification of vegetation in Fig. 2 follows the scheme used for vegetation in the Xavantina-Cachimbo Expedition area (NE Mato Grosso) lying approximately 250 km to the SW (Ratter *et al.*, 1973). The following categories are recognized:

CERRADO/DYSTROPHIC FACIES CERRADÃO* COMPLEX (*Complexo cerrado/cerradão distrófico*). This is more or less typical cerrado thickening into dystrophic facies cerradão, i.e. the type of cerradão found on dystrophic soils (called *Hirtella glandulosa* cerradão in Ratter *et al.*, 1973).

DYSTROPHIC FACIES CERRADÃO/DRY FOREST COMPLEX (*Complexo cerradão distrófico/mata sempreverde estacional*). This represents the transition from dystrophic facies cerradão to 'Dry forest'.

DRY FOREST (*Mata seca sempreverde*). This is an evergreen forest representing the margin of the Hylaea (see Ratter *et al.*, 1973, 1978b, and Pires, 1974). It occurs on well-drained soils, essentially similar to those carrying cerrado. 'Mata seca' is the common vernacular term for this vegetation in NE Mato Grosso.

SEASONALLY FLOODED FOREST (*Mata inundável*). This is a várzea forest on the lower-lying ground. It is flooded for long periods during the rainy season.

*Cerradão is the augmentative of cerrado and means a dense, nearly closed savanna woodland.

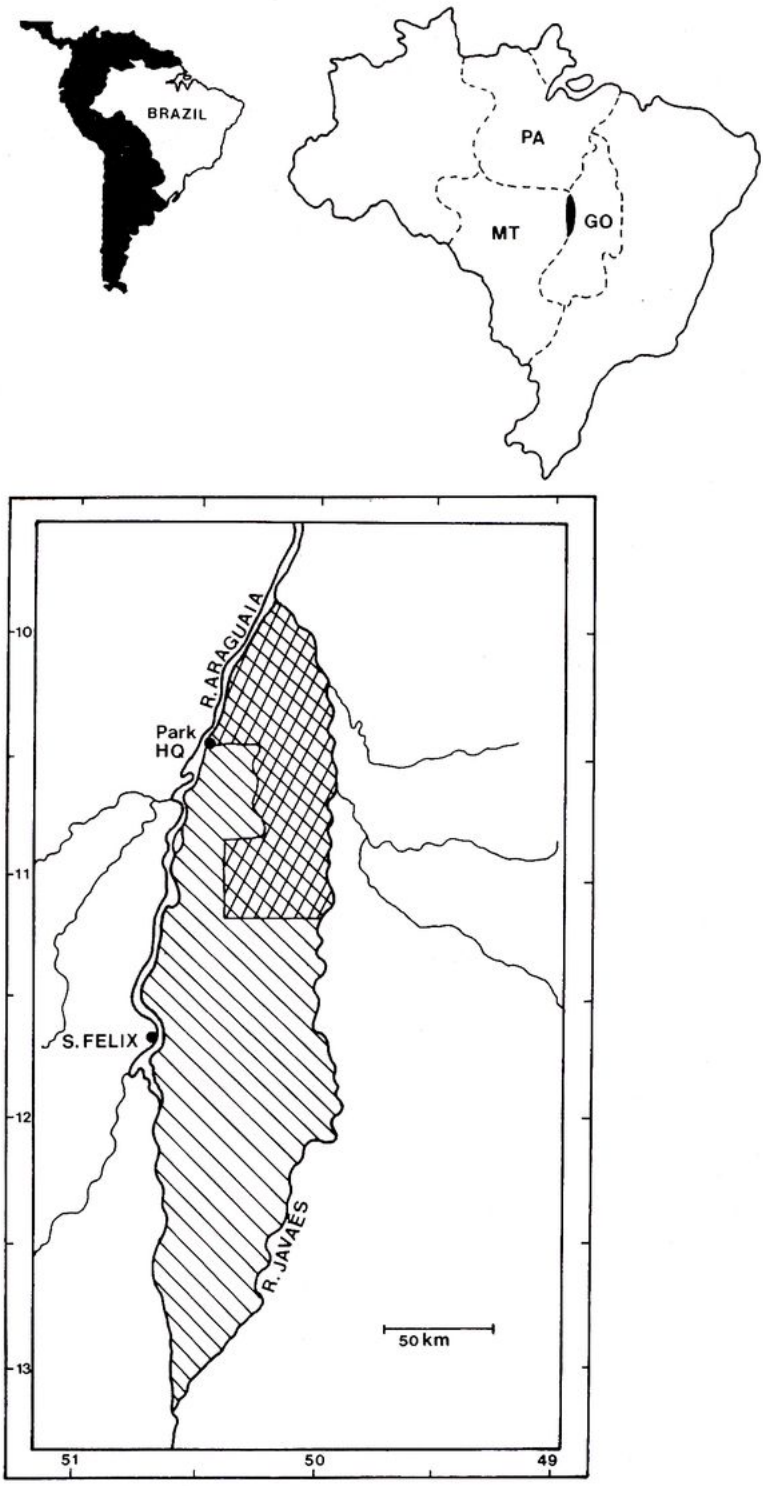

FIG. 1. Ilha do Bananal, black in upper right map, oblique lines in main map with additional cross-hatching for the Parque Nacional do Araguaia.

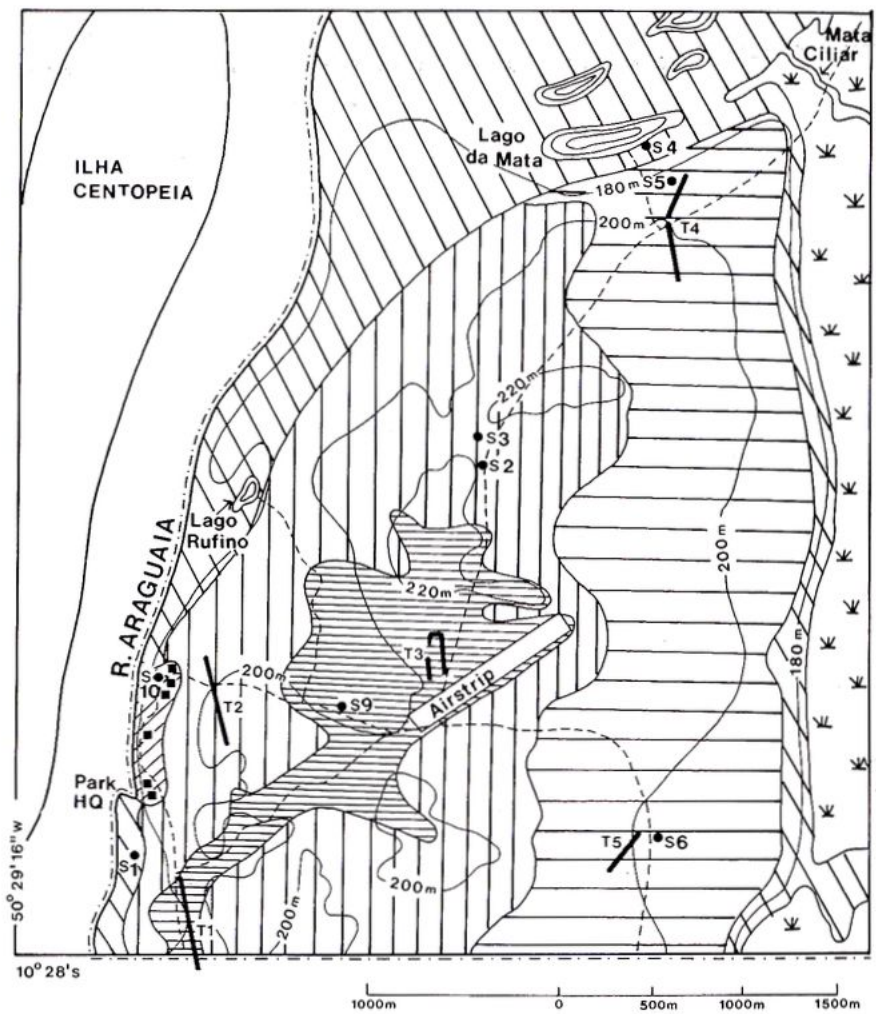

FIG. 2. Vegetation close to the HQ of the Parque Nacional do Araguaia 1:25000 (interpretation of Terrafotó SA aerial photograph (1977) 1:70000, work no. S35 photo 43-44-65-66 – redrawn from Gifford, 1979).

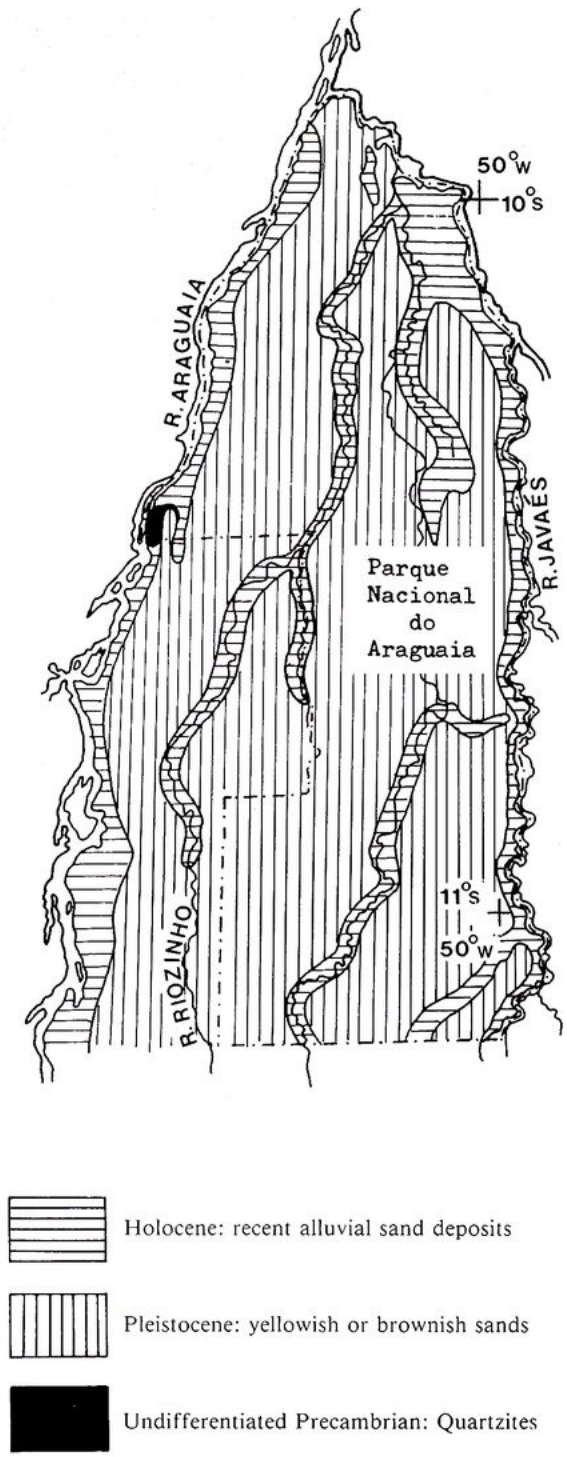

FIG. 3. Geology of the Parque Nacional do Araguaia 1:1000000 (original source MME-DNPM (1975), redrawn from Gifford, 1979).

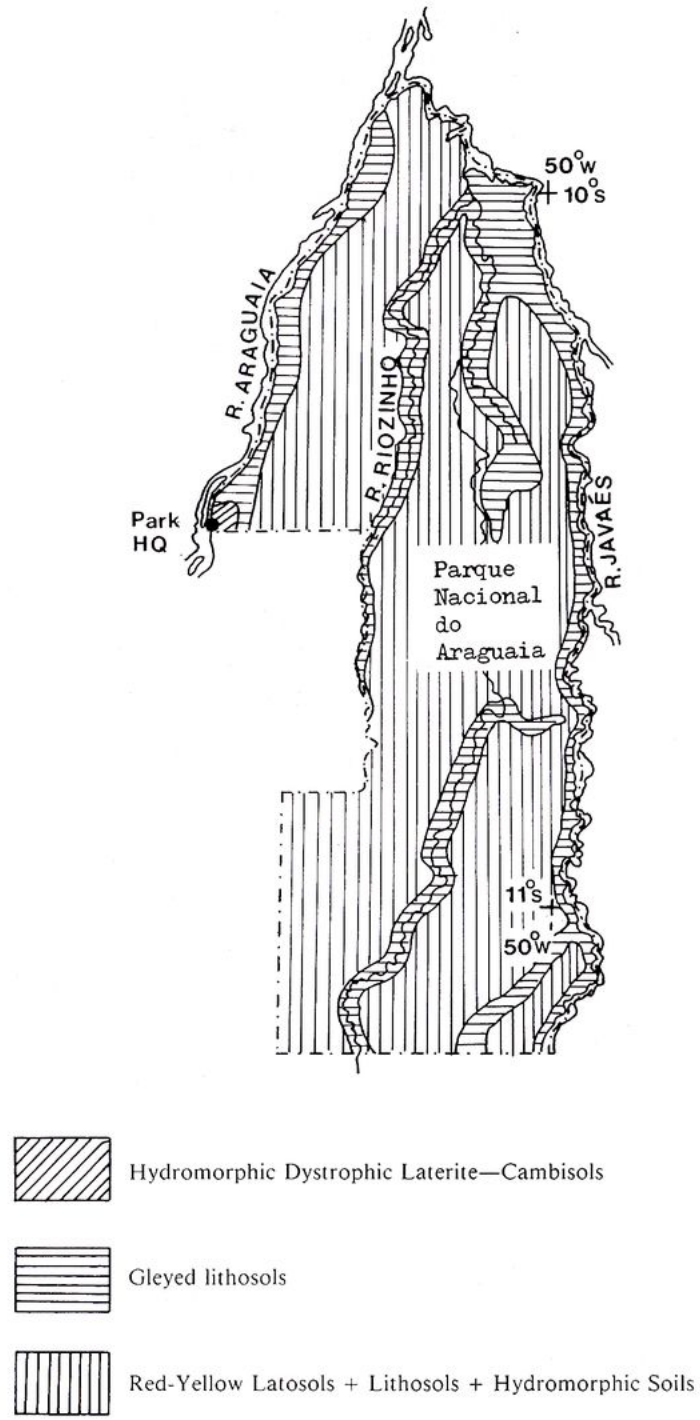

FIG. 4. Soils of the Parque Nacional do Araguaia 1:1000000 (original source MME-DNPM (1975), redrawn from Gifford, 1979).

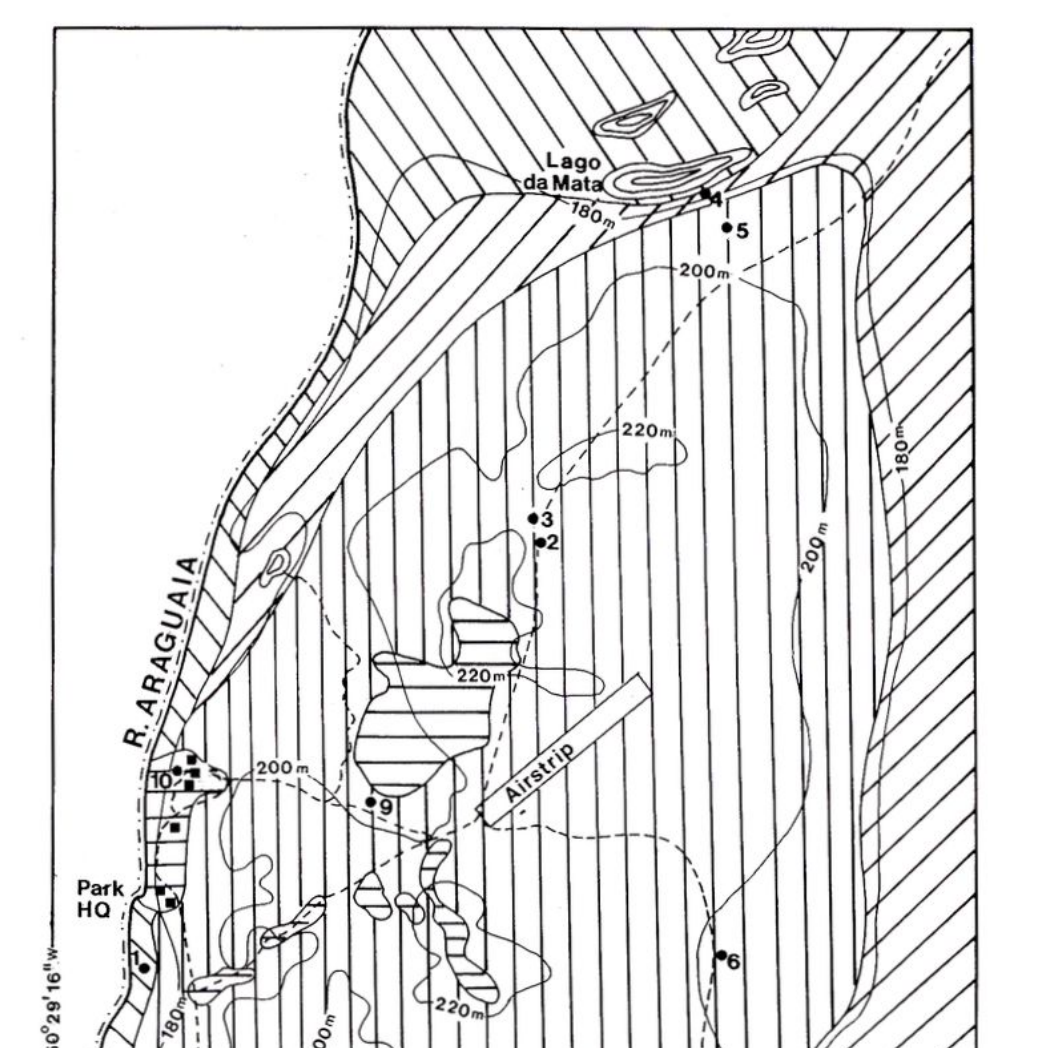

FIG. 5. Soils close to the HQ of the Parque Nacional do Araguaia 1:25000 (redrawn from Gifford, 1979).

SEMIDECIDUOUS FOREST (*Mata semidecídua estacional*). This is the characteristic forest of mesotrophic soils in Central Brazil (Ratter *et al.*, 1973, 1978a). A small area of this vegetation was situated where the park headquarters now stands and there are still remnants around the houses.

CAMPO DE MURUNDU. On the Ilha do Bananal there are vast areas of campo with scattered (or regularly spaced) mounds bearing termitaria, trees and shrubs. Such areas are called 'campo de murundu' in Central Brazil.

METHODS

The vegetation was studied by general observation and collecting*, and by the point-centred method of sampling as described by Mueller-Dombois & Ellenberg (1974). In the latter, transect lines with sampling points at every 10 m were run through vegetation selected to be as homogeneous as possible.

The data obtained from the point-centred quarter surveys allow the following to be calculated:

(1) Mean distance between trees (D) = Total point-tree distance/no. of trees.
(2) Absolute density = Area/D^2 (therefore no. of trees per 100 m^2 = 100/D^2. This can also be calculated for each species using the formula: (No. of trees of sp. in quarters/total no. of trees in quarters) × total number of trees in 100 m^2).
(3) Relative density of a species = (No. of individuals of the species/total no. of individuals) × 100.
(4) Relative frequency of a species = (Frequency of the species/sum frequency of all species) × 100.
(5) Relative dominance of a species = (Total ba of the species/total ba of all species) × 100. ba = basal area.
(6) Importance value of a species (IV) = Relative density + relative frequency + relative dominance.

CERRADO AND DYSTROPHIC FACIES CERRADÃO (*Complexo cerrado/cerradão distrófico*)

Two transects were sited in this vegetation (see Fig. 2), and species lists were made of the trees and shrubs along the road from the airstrip to Park HQ and on the road southwards to Macaúba. The species list is given below and the transect data are presented in Tables 1 and 2.

The vegetation varies from campo sujo through campo cerrado to a dense cerradão† where trees of 7–8 m form a more or less closed canopy. No estimate was made of relative areas covered by these cerrado sub-types but, if memory is accurate, cerradão was commonest.

*A list of all species observed, arranged by families, is given in Appendix 1.

†Cerrado vegetation is classified according to the density of its woody components. Campo sujo (= dirty field) has a sparse scattering of trees and shrubs; campo cerrado (= closed field) has a denser covering of woody plants but still a large area of herbaceous vegetation between them; in cerrado (*sensu stricto*) trees and shrubs are clearly dominant, whilst in cerradão the woody component of the vegetation has nearly or completely closed. It is unfortunate that, as a result of the adoption of the term from common usage, cerrado denotes both Brazilian savanna vegetation in its generic sense and one particular part of the continuum represented by that vegetation.

Transect 3 (Table 1) passes through more or less undifferentiated cerradão in the sense of Ratter (1970) and Ratter *et al.* (1973), i.e. the most important species are to a large extent those typical of more open forms of cerrado. Transect 1 (Table 2) on the other hand is in dystrophic facies cerradão with most of the important trees those characteristic of cerradão and rare in more open forms of cerrado, e.g. *Siparuna guianensis*, *Xylopia sericea*, *Protium heptaphyllum*, *Hirtella glandulosa*, *Vochysia haenkeana*, *Tapirira guianensis*, *Sclerolobium paniculatum*, *Cardiopetalum calophyllum* and *Virola sebifera*. In fact the two transects probably represent stages in the sere from cerrado to Dry forest discussed in Ratter *et al.* (1973 & 1978b).

TREES AND LARGE SHRUBS OF THE CERRADO AND DYSTROPHIC FACIES CERRADÃO

Abuta grandiflora
Acosmium dasycarpum
Agonandra brasiliensis
Alchornea schomburgkii
Alibertia sp.
Anacardium occidentale
Andira cuyabensis
A. paniculata
Annona coriacea
A. crassiflora
Antonia ovata
Aspidosperma multiflorum
A. nobile
A. sp. 'Guatambu'
Astronium fraxinifolium*
Bowdichia virgilioides
Brosimum gaudichaudii
Byrsonima coccolobifolia
B. crassa
B. crassifolia
B. inodora
Bursera leptophleios*
Cardiopetalum calophyllum
Caryocar brasiliense
Casearia commersoniana
C. grandiflora
C. sylvestris
Cecropia sp.
Chaetocarpus echinocarpus
Chomelia ribesioides
Coccoloba cf. mollis
Connarus suberosus var. fulvus
Copaifera langsdorfii
Cordia glabrata
Curatella americana
Davilla elliptica
Didymopanax sp.
Dilodendron bipinnatum*
Dimorphandra mollis
Diospyros hispida
Emmotum nitens
Enterolobium ellipticum
Erythroxylum suberosum
Eugenia dysenterica
E. sp. 'Murtinha'
Ficus sp.
Guatteria sp. 'Embireira'
Guazuma ulmifolia*
Guettarda viburnoides
Hancornia speciosa
Himatanthus obovatus
H. bracteatus
Hirtella glandulosa
Hymenaea courbaril var. stilbocarpa
Kielmeyera coriacea
Lafoensia pacari
Licania gardneri
Luhea paniculata
Mabea fistulifera
Machaerium acutifolium
Magonia pubescens*
Maprounea guianensis
Matayba guianensis
Mouriri elliptica
Myrcia pubipetala
Neea sp. aff. macrophylla
Ouratea hexasperma
O. sp.
Physocallyma scaberrimum
Plathymenia reticulata
Pouteria ramiflora
Protium heptaphyllum
P. brasiliense
Pseudobombax longiflorum
Qualea grandiflora
Q. multiflora
Q. parviflora
Roupala montana
Rudgea amazonica
Salacia sp.
Salvertia convallariodora
Sclerolobium aureum
S. paniculatum
Simarouba versicolor
Siparuna cuyabana
S. guianensis
Spondias mombin*
Stryphnodendron adstringens
Tabebuia caraiba
Tapirira guianensis
Terminalia argentea*
T. brasiliensis?
Tocoyena formosa
Unonopsis lindmannii
Vatairea macrocarpa
Virola sebifera
Vismia amazonica
Vitex cf. polygama*
Vochysia haenkeana
Xylopia aromatica
X. sericea
X. sp.
Myrtaceae sp. 'Araçá boi'
Myrtaceae sp. 'Maria preta'
Myrtaceae sp. 'Murtinha vermelha'

SMALLER SHRUBS

Annona tomentosa
Bauhinia rufa
Cochlospermum regium
Erythroxylum deciduum
Helicteres macropetala*
H. sp.
Jatropha vitifolia
Miconia albicans
M. macrothyrsa
M. stenostachya
Rourea induta

PALMS

Acrocomia sclerocarpa*
Astrocaryum sp.
Orbignya sp.*
Syagrus comosa
S. flexuosa
'Piririma'

*Normally more typical of mesotrophic soils

A number of trees on the transects are more typical of Dry forest than cerradão, e.g. *Chaetocarpus echinocarpus* and *Hymenaea courbaril* var. *stilbocarpa*, while others such as *Magonia pubescens*, *Dilodendron bipinnatum* and *Astronium fraxinifolium* are usually associated with mesotrophic soils—perhaps their presence reflects the presence of pockets of better soil.

The vegetation shows many floristic similarities to that around the Base Camp of the Xavantina-Cachimbo Expedition, NE Mato Grosso (Ratter, 1971; Ratter *et al.*, 1973) but differs conspicuously in the absence of *Pterodon pubescens*, *Aspidosperma macrocarpon*, *A. tomentosum* and *Eriotheca gracilipes*, and in the much sparser occurrence of the three typical cerrado *Qualea* spp., *Q. grandiflora*, *Q. multiflora* and *Q. parviflora*.

The soil is dystrophic (Appendix 2, p. 341, S9 (+S2 & 3)) and therefore most of the characteristic species of cerrados of mesotrophic soils, such as *Callisthene fasciculata* and *Dipteryx alata*, are absent, although, as previously mentioned, a few trees of *Magonia pubescens* and other similar species do occur.

TABLE 1

Point-centred quarter transect in undifferentiated cerradão (Transect 3) with species in order of Importance value (IV).

(Very dense cerradão with taller trees 7–8 m tall forming an almost closed canopy). 50 points, 10 m apart. Qualifying girth 12 cm at breast height.

Mean distance between trees = 2.79 m. Absolute density (trees per 100 m^2) = 12·85; n = no. of individuals; ba = basal area (cm^2).

		n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
1	Pouteria ramiflora	9	4060·1	4·5	16·08	4·41	24·99
2	Matayba guianensis	19	585·0	9·5	2·31	7·73	19·54
3	Syagrus flexuosa	16	847·1	8·0	3·35	7·18	18·53
4	Hancornia speciosa	10	1222·4	5·0	4·84	4·97	14·81
5	Eugenia dysenterica	10	829·5	5·0	3·28	5·52	13·80
6	Qualea grandiflora	7	1664·9	3·5	6·59	3·31	13·40
7	Curatella americana	6	1705·1	3·0	6·76	2·75	12·51
8	Xylopia sericea	10	414·8	5·0	1·64	4·97	11·61
9	Aspidosperma multiflorum	4	1839·2	2·0	7·28	2·20	11·48
10	Palmae sp. 'Piririma'	9	568·1	4·5	2·25	4·41	11·16
11	Lafoensia pacari	7	932·5	3·5	3·86	3·69	11·05
12	Anacardium occidentale	5	1402·1	2·5	5·55	2·75	10·80
13	Diospyros hispida	8	583·9	4·0	2·31	3·86	10·17
14	Byrsonima coccolobifolia	5	872·2	2·5	3·45	2·20	8·15
15	Qualea parviflora	6	514·3	3·0	2·03	2·76	7·79
16	Andira paniculata	3	931·1	1·5	3·68	1·65	6·83
17	Virola sebifera	5	192·5	2·5	0·76	2·76	6·02
18	Xylopia aromatica	4	364·9	2·0	1·44	2·20	5·64
19	Physocallyma scaberrimum	1	1052·4	0·5	4·17	0·55	5·22
20	Annona crassiflora	3	472·2	1·5	1·87	1·65	5·02
21	Mouriri elliptica	3	231·9	1·5	0·91	1·65	4·06
22	Casearia sylvestris	3	185·7	1·5	0·73	1·65	3·88
23	Myrtaceae sp. 'Maria preta'	3	155·5	1·5	0·61	1·65	3·76
24	Vitex cf. polygama	1	644·6	0·5	2·55	0·55	3·60
25	Enterolobium ellipticum	2	336·9	1·0	1·33	1·10	3·43

TABLE 1—*continued*

		n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
26	Siparuna guianensis	3	160·7	1·5	0·63	1·10	3·23
27	Byrsonima inodora	2	112·7	1·0	0·44	1·10	2·54
28	Magonia pubescens	2	95·9	1·0	0·38	1·10	2·48
29	Stryphnodendron adstringens	2	92·3	1·0	0·36	1·10	2·46
30 =	Astronium fraxinifolium	2	81·5	1·0	0·32	1·10	2·42
30 =	Simarouba versicolor	1	346·6	0·5	1·37	0·55	2·42
32	Maprounea guianensis	2	52·2	1·0	0·20	1·10	2·30
33	Didymopanax sp.	2	118·5	1·0	0·46	0·55	2·01
34	Tabebuia caraiba	1	198·9	0·5	0·78	0·55	1·83
35	Andira cuyabensis	1	168·4	0·5	0·66	0·55	1·71
36	Cordia glabrata	1	140·4	0·5	0·55	0·55	1·60
37	Myrtaceae sp. 'Araçá boi'	1	108·9	0·5	0·43	0·55	1·48
38 =	Byrsonima crassifolia	1	97·5	0·5	0·38	0·55	1·43
38 =	Connarus fulvus	1	97·5	0·5	0·38	0·55	1·43
40 =	Myrtaceae sp. 'Murtinha'	1	86·7	0·5	0·34	0·55	1·39
40 =	Pseudobombax longiflorum	1	86·7	0·5	0·34	0·55	1·39
42	Ouratea hexasperma	1	62·4	0·5	0·24	0·55	1·29
43	Salvertia convallariodora	1	58·0	0·5	0·22	0·55	1·27
44	Casearia grandiflora	1	53·8	0·5	0·21	0·55	1·26
45	Siparuna cuyabana	1	49·7	0·5	0·19	0·55	1·24
46 =	Agonandra brasiliensis	1	38·5	0·5	0·15	0·55	1·20
46 =	Alibertia sp.	1	38·5	0·5	0·15	0·55	1·20
46 =	Erythroxylum suberosum	1	38·5	0·5	0·15	0·55	1·20
49	Rudgea amazonica	1	35·1	0·5	0·13	0·55	1·18
50	Hirtella glandulosa	1	31·8	0·5	0·12	0·55	1·17
51	Hymenaea courbaril var. stilbocarpa	1	28·7	0·5	0·11	0·55	1·16
52	Protium heptaphyllum	1	25·8	0·5	0·10	0·55	1·15
53 =	Chomelia ribesioides	1	23·0	0·5	0·09	0·55	1·14
53 =	Himatanthus obovatus	1	23·0	0·5	0·09	0·55	1·14
55	Alchornea schomburgkii	1	20·4	0·5	0·08	0·55	1·13
56 =	Rourea induta	1	17·9	0·5	0·07	0·55	1·12
56 =	Casearia commersoniana	1	17·9	0·5	0·07	0·55	1·12
58	Tocoyena formosa	1	15·6	0·5	0·06	0·55	1·11

TABLE 2

Point-centred quarter transect in very dense dystrophic facies cerradão (Transect 1) with species in order of Importance value (IV).

47 points, 10 m apart. Qualifying girth 12 cm at breast height.

Mean distance between trees = 2·26 m. Absolute density (trees per 100 m^2) = 19·58; n = no. of individuals; ba = basal area (cm^2).

		n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
1	Siparuna guianensis	23	718·74	12·23	4·64	9·09	25·96
2	Xylopia sericea	15	1201·85	7·98	7·75	8·48	24·21
3	Protium heptaphyllum	17	765·59	9·04	4·94	7·27	21·25
4	Hirtella glandulosa	9	1030·91	6·03	6·65	4·85	17·53
5	Curatella americana	3	1488·70	1·59	9·61	1·82	13·02
6	Anacardium occidentale	7	679·93	3·70	4·38	4·24	12·32
7	Xylopia aromatica	7	669·62	3·70	4·32	4·24	12·26
8	Vochysia haenkeana	8	541·50	4·25	3·49	3·63	11·37
9	Tapirira guianensis	8	434·49	4·25	2·80	4·24	11·29
10	Matayba guianensis	8	458·89	4·25	2·96	3·63	10·84
11	Sclerolobium paniculatum	4	560·65	2·13	3·62	1·82	7·57

TABLE 2—*continued*

	n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
12 Cardiopetalum calophyllum	5	266·98	2·66	1·72	3·03	7·41
13 Virola sebifera	4	122·01	2·13	0·79	2·42	5·34
14 Didymopanax sp.	2	474·39	1·06	3·06	1·21	5·33
15 Cordia glabrata	3	278·07	1·59	1·79	1·82	5·20
16 Qualea grandiflora	3	251·19	1·59	1·62	1·82	5·03
17 Roupala montana	3	160·15	1·59	1·03	1·82	4·44
18 Orbignya sp.	1	484·61	0·53	3·13	0·61	4·27
19 Antonia ovata	2	280·45	1·06	1·81	1·21	4·08
20 Alibertia sp.	2	89·20	1·59	0·57	1·82	3·98
21 Plathymenia reticulata	2	260·04	1·06	1·68	1·21	3·95
22 Dimorphandra mollis	1	389·87	0·53	2·51	0·61	3·65
23 Himatanthus bracteatus	2	192·82	1·06	1·24	1·21	3·51
24 = Hancornia speciosa	2	153·36	1·06	0·99	1·21	3·26
24 = Mouriri elliptica	2	154·06	1·06	0·99	1·21	3·26
26 Copaifera langsdorfii	2	143·53	1·06	0·93	1·21	3·20
27 Andira cuyabensis	2	118·36	1·06	0·76	1·21	3·03
28 Coccoloba cf. mollis	2	104·57	1·06	0·67	1·21	2·94
29 Astronium fraxinifolium	2	97·66	1·06	0·63	1·21	2·90
30 Guazuma ulmifolia	1	267·64	0·53	1·73	0·61	2·87
31 = Eugenia sp. 'Murtinha'	2	78·41	1·06	0·50	1·21	2·77
31 = Qualea multiflora	2	78·41	1·06	0·50	1·21	2·77
33 Ouratea hexasperma	2	72·83	1·06	0·47	1·21	2·74
34 Lafoensia pacari	2	62·51	1·06	0·40	1·21	2·67
35 = Myrtaceae sp. 'Murtinha vermelha'	1	223·79	0·53	1·44	0·61	2·58
35 = Vatairea macrocarpa	1	223·79	0·53	1·44	0·61	2·58
37 Xylopia sp.	1	199·06	0·53	1·28	0·61	2·42
38 Pseudobombax longiflorum	1	168·33	0·53	1·09	0·61	2·23
39 Spondias mombin	1	161·05	0·53	1·04	0·61	2·18
40 Salvertia convallariodora	1	140·60	0·53	0·91	0·61	2·05
41 = Vitex cf. polygama	1	127·48	0·53	0·82	0·61	1·96
41 = Tabebuia caraiba	1	127·48	0·53	0·82	0·61	1·96
43 Pouteria ramiflora	1	108·99	0·53	0·70	0·61	1·84
44 Physocallyma scaberrimum	1	103·15	0·53	0·66	0·61	1·80
45 Eugenia dysenterica	1	97·47	0·53	0·63	0·61	1·77
46 Casearia sylvestris	1	91·94	0·53	0·59	0·61	1·73
47 = Cecropia sp.	1	81·39	0·53	0·52	0·61	1·66
47 = Chaetocarpus echinocarpus	1	81·39	0·53	0·52	0·61	1·66
49 Aspidosperma sp. 'Guatambu'	1	67·05	0·53	0·43	0·61	1·57
50 Byrsonima crassifolia	1	49·76	0·53	0·32	0·61	1·46
51 Unonopsis lindmannii	1	45·84	0·53	0·29	0·61	1·43
52 = Terminalia brasiliensis	1	38·48	0·53	0·25	0·61	1·39
52 = Byrsonima crassa	1	38·48	0·53	0·25	0·61	1·39
52 = Hymenaea courbaril var. stilbocarpa	1	38·48	0·53	0·25	0·61	1·39
55 Diospyros hispida	1	31·76	0·53	0·20	0·61	1·34
56 Licania gardneri	1	28·65	0·53	0·18	0·61	1·32
57 Brosimum gaudichaudii	1	25·88	0·53	0·17	0·61	1·31
58 = Bowdichia virgilioides	1	20·43	0·53	0·13	0·61	1·27
58 = Emmotum nitens	1	20·43	0·53	0·13	0·61	1·27
58 = Rudgea amazonica	1	20·43	0·53	0·13	0·61	1·27

DYSTROPHIC FACIES CERRADÃO/DRY FOREST
(*Complexo cerradão distrófico/mata seca sempreverde estacional*)

This category, recognized by Gifford (1979), represents another stage in the continuum from cerrado to Dry forest (Evergreen seasonal forest). It was sampled by general observation and collecting, and by a point-centred quarter transect (Transect 2, Table 3—see Fig. 2 for localization).

The vegetation is dense forest with the taller trees to 20 m or more and floristically is a mixture of Dry forest and cerradão species (two categories which are often difficult to distinguish). Species additional to those noted in the cerrado/dystrophic facies cerradão (p. 319) are given below: in the main they are forest elements. Our notes indicate that *Licania* sp. 'Caripé vermelho', *Ephederanthus parviflorus*, *Aspidosperma nobile*, *Protium heptaphyllum* and *Xylopia aromatica* are particularly common as larger trees, while *Siparuna guianensis* and *Vismia amazonica* are abundant in the understorey. The transect data (Table 3) demonstrate many of the important species but further sampling would be necessary to give a more accurate estimate of the relative importance of species.

TREES OF THE DYSTROPHIC FACIES CERRADÃO/DRY FOREST
(additional to those given on p. 319)

Apuleia molaris
Cedrela fissilis
Connarus perrottetii var. angustifolius
Cordia nodosa
Cupania vernalis
Dulacia sp.
Enterolobium schomburgkii
Ephederanthus parviflorus
Hirtella gracilipes
Inga fagifolia
Lacistema aggregatum
Licania sp. 'Caripé branco'
Mouriri acutiflora
Neea sp. 'Jua mole'
Pithecellobium foliolosum
P. marginatum
Pseudolmedia sp.
Sideroxylon venulosum
Sorocea sp.
Tabebuia sp. 'Taiporca'
T. sp. 'Pau de arco rôxo'
Lauraceae sp. 'Louro rosa'
Lauraceae sp. 1
Lauraceae sp. 2
Rubiaceae 'Bacurí'

PALM
Oenocarpus distichus?

There were cultivated clearings in the area of this vegetation twenty or more years ago and these are now occupied by caapoeira (secondary forest). Since the caapoeira is not always easy to recognize, care should be taken when siting study areas.

TABLE 3

Point-centred quarter transect in dystrophic facies cerradão/Dry forest (Transect 2) with species in order of Importance value (IV).

(Dense forest with trees to about 18 m).
50 points, 10 m apart. Qualifying girth 12 cm at breast height.

Mean distance between trees = 2·54 m. Absolute density (trees per 100 m^2) = 15·50; n = no. of individuals; ba = basal area (cm^2).

		n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
1	Protium heptaphyllum	31	3464·7	15·5	11·69	12·64	39·83
2	Licania sp. 'Caripé vermelho'	16	4066·2	8·0	13·71	6·89	28·60
3	Terminalia brasiliensis	2	3615·1	1·0	12·19	1·14	14·33
4	Sclerolobium paniculatum	5	1775·7	2·5	5·99	2·29	10·78
5	Tapirira guianensis	8	772·5	4·0	2·6	4·02	10·62
6	Diospyros hispida	10	635·5	3·5	2·14	4·02	9·66
7	Ephederanthus parviflorus	9	498·9	4·5	1·67	4·02	10·19

TABLE 3—*continued*

		n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
8	Apuleia molaris	2	2052·2	1·0	6·92	1·14	9·06
9	Hirtella glandulosa	6	755·6	3·0	2·54	3·44	8·98
10	Virola sebifera	7	439·9	3·5	1·48	3·44	8·42
11	Unonopsis lindmannii	3	1418·6	1·5	4·78	1·72	8·00
12 =	Myrtaceae sp. 'Murtinha'	5	397·1	2·5	1·33	2·29	6·12
12 =	Lacistema aggregatum	5	222·8	2·5	0·75	2·87	6·12
14	Casearia sylvestris	4	432·1	2·0	1·45	2·29	5·74
15	Guatteria sp. 'Embireira'	4	390·2	2·0	1·32	2·29	5·61
16	Didymopanax sp.	4	342·5	2·0	1·15	2·29	5·44
17	Connarus perrottetii	4	652·6	2·0	2·20	1·14	5·34
18	Emmotum nitens	2	849·6	1·0	2·86	1·14	5·00
19	Xylopia aromatica	3	430·8	1·5	1·47	1·72	4·69
20	Himatanthus bracteatus	3	430·2	1·5	1·45	1·72	4·67
21	Siparuna guianensis	4	107·8	2·0	0·36	2·29	4·65
22	Vitex cf. polygama	2	686·7	1·0	2·31	1·14	4·45
23	Matayba guianensis	3	296·9	1·5	1·00	1·72	4·22
24	Lauraceae sp. 'Louro preto'	3	220·7	1·5	0·74	1·72	3·96
25	Lauraceae sp. 2	3	143·7	1·5	0·48	1·72	3·70
26	Pseudolmedia sp.	2	436·8	1·0	1·47	1·14	3·61
27	Aspidosperma sp. 'Guatambu'	2	401·8	1·0	1·35	1·14	3·49
28	Oenocarpus distichus?	2	287·5	1·0	0·96	1·14	3·10
29	Spondias mombin	3	133·4	1·5	0·45	1·14	3·09
30	Vochysia haenkeana	2	243·5	1·0	0·82	1·14	2·96
31	Lauraceae sp. 1	2	196·4	1·0	0·66	1·14	2·80
32	Cordia glabrata	2	183·5	1·0	0·61	1·14	2·75
33	Hymenaea courbaril var. stilbocarpa	2	117·9	1·0	0·39	1·14	2·53
34	Chaetocarpus echinocarpus	2	101·9	1·0	0·34	1·14	2·48
35	Astronium fraxinifolium	2	85·6	1·0	0·28	1·14	2·42
36	Copaifera langsdorfii	2	61·4	1·0	0·20	1·14	2·34
37 =	Machaerium acutifolium	1	368·0	0·5	1·24	0·57	2·31
37 =	Orbignya sp.	1	368·0	0·5	1·24	0·57	2·31
39	Dulacia sp.	2	157·0	1·0	0·52	0·57	2·09
40	Cupania vernalis	2	143·9	1·0	0·46	0·57	2·03
41	Rudgea amazonica	2	94·2	1·0	0·31	0·57	1·88
42	Guazuma ulmifolia	1	198·9	0·5	0·67	0·57	1·74
43	Roupala montana	1	191·9	0·5	0·64	0·57	1·71
44	Qualea multiflora	1	86·7	0·5	0·29	0·57	1·36
45	Maprounea guianensis	1	81·5	0·5	0·27	0·57	1·34
46	Antonia ovata	1	71·6	0·5	0·24	0·57	1·31
47	Hirtella gracilipes	1	53·8	0·5	0·18	0·57	1·25
48	Sideroxylon venulosum	1	49·7	0·5	0·16	0·57	1·23
49 =	Coccoloba cf. mollis	1	38·5	0·5	0·12	0·57	1·19
49 =	Neea macrophylla	1	38·5	0·5	0·12	0·57	1·19
49 =	Unknown sp. 2	1	38·5	0·5	0·12	0·57	1·19
52	Ouratea hexasperma	1	35·1	0·5	0·11	0·57	1·18
53 =	Alibertia sp.	1	31·8	0·5	0·10	0·57	1·17
53 =	Salacia sp.	1	31·8	0·5	0·10	0·57	1·17
53 =	Cardiopetalum calophyllum	1	31·8	0·5	0·10	0·57	1·17
56 =	Agonandra brasiliensis	1	25·8	0·5	0·08	0·57	1·15
56 =	Neea sp. 'Jua mole'	1	25·8	0·5	0·08	0·57	1·15
56 =	Siparuna cuyabana	1	25·8	0·5	0·08	0·57	1·15
56 =	Unknown sp. 1	1	25·8	0·5	0·08	0·57	1·15
60	Mouriri acutiflora	1	17·9	0·5	0·06	0·57	1·13
61 =	Physocallyma scaberrimum	1	15·6	0·5	0·05	0·57	1·12
61 =	Rubiaceae 'Bacurí'	1	15·6	0·5	0·05	0·57	1·12
63	Sorocea sp.	1	13·4	0·5	0·04	0·57	1·11
64	Enterolobium schomburgkii	1	11·5	0·5	0·03	0·57	1·10

DRY FOREST (EVERGREEN SEASONAL FOREST) (*Mata seca sempreverde estacional*)

Two transects were sited in tall Dry forest (Transects 4 and 5, Tables 4 and 5) and the species listed below were recorded. The dissimilarity of the two transects demonstrates the heterogeneity of the vegetation—sampling was obviously very inadequate and much more study is required.

TREE SPECIES OF THE DRY FOREST

Agonandra brasiliensis
Amaioua guianensis
Apuleia molaris
Brosimum rubescens
Casearia sylvestris
Cecropia sp.
Chaetocarpus echinocarpus
Connarus perrottetii var. angustifolius
Copaifera langsdorfii
Cordia nodosa
Didymopanax morototoni
Duguetia marcgraviana
Dulacia sp.
Enterolobium schomburgkii
Ephederanthus parviflorus
Guarea sp.
Guatteria sp. 'Embireira'
Hemicrepidospermum rhoifolium
Hirtella glandulosa
H. gracilipes
H. racemosa
Hymenaea courbaril var. stilbocarpa
Jacaranda copaia
Lacistema aggregatum
Licania sp. 'Caripé vermelho'
L. sp. 'Farinha seca'
Miconia chrysophylla
Mouriri acutiflora
Oenocarpus distichus?
Pera sp.
Protium brasiliense
P. heptaphyllum
P. unifoliolatum
Pseudolmedia sp.
Sideroxylon venulosum
Siparuna guianensis
Tapirira guianensis
Tapura amazonica
Unonopsis lindmannii
Virola sebifera
Vitex cf. polygama
Lauraceae sp. 'Louro bosta'
Lauraceae sp. 'Louro branco'
Lauraceae sp. 'Louro ferro'
Lauraceae sp. 'Louro preto'
Lauraceae sp. 'Louro rosa'
Lauraceae sp. 'Louro small leaf'
Meliaceae sp. 'Pororoca'
Unknown 'Chifre de veado'

In the area of Transect 4 (see Fig. 2) the taller trees reach about 30 m and Lauraceae, *Hymenaea courbaril* var. *stilbocarpa*, *Copaifera langsdorfii*, *Enterolobium schomburgkii*, *Vitex* cf. *polygama* and *Licania* spp. are important. The common understorey species are *Mouriri acutiflora*, *Protium unifoliolatum*, *Casearia sylvestris*, *Miconia chrysophylla* and *Siparuna guianensis*: the first three of these, however, sometimes reach the canopy. In the region of Transect 5 the taller trees are about 25 m and there are many 'Bacaba' palms (*Oenocarpus distichus*?) sometimes reaching 20 m, while plants of 'Banana brava' (*Phenakospermum guyanense*) are frequent in the understorey. Lianas are common in the Dry forest and include the bizarrely stemmed 'Escada de jabotim' (*Bauhinia guianensis*). *Olyra latifolia*, *Streptogyne americana* and a *Trichomanes* species were noted as forest floor herbs.

As previously mentioned, the Dry forest is a marginal form of the Hylaea and it is interesting to note that it contains *Phenakospermum guyanense*, one of the two plants considered by Veloso (1966) as reliable markers of the Hylaea—the other being *Hevea*, which is not present.

The soil analyses given in Appendix 2 p. 339–340 for Dry forest and dystrophic facies cerradão/Dry forest (S5, S6, S2, S3) show extreme mineral deficiency and are similar to those recorded for these vegetation types in previous works (Askew *et al.*, 1970a, b, 1971; Ratter *et al.*, 1977, 1978b).

As in the previous vegetation category, there are patches of caapoeira (secondary forest) marking former cultivated areas and care has to be taken to avoid these in siting transects.

TABLE 4

Point-centred quarter transect in Dry forest (Transect 4) with species in order of Importance value (IV).

50 points, 10 m apart. Qualifying girth 12 cm at breast height.

Mean distance between trees = 2·53 m. Absolute density (trees per 100 m^2) = 15·62; n = no. of individuals; ba = basal area (cm^2).

		n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
1	Mouriri acutiflora	41	5683·1	20·8	5·03	15·88	45·39
2	Licania sp. 'Farinha seca'	22	6773·5	11·0	9·57	10·46	31·03
3	Lauraceae sp. 'Louro bosta'	9	13310·0	4·5	18·31	4·85	27·96
4	Siparuna guianensis	27	827·5	13·5	1·17	11·04	25·71
5	Lauraceae sp. 'Louro rosa'	4	9615·7	2·0	13·59	2·32	17·91
6	Hymenaea courbaril var. stilbocarpa	3	10063·7	1·5	14·22	1·74	17·46
7	Protium unifoliolatum	13	596·2	6·5	0·84	7·55	14·89
8	Enterolobium schomburgkii	2	8183·8	1·0	11·57	1·16	13·73
9	Vitex cf. polygama	1	5801·2	0·5	8·20	0·58	9·28
10	Casearia sylvestris	7	1143·0	3·5	1·62	4·06	9·18
11	Miconia chrysophylla	7	395·5	3·5	0·56	4·06	8·12
12	Chaetocarpus echinocarpus	6	1144·5	3·0	1·62	3·48	8·10
13	Hemicrepidospermum rhoifolium	6	545·5	3·0	0·77	3·48	7·25
14	Jacaranda copaia	5	635·8	2·5	0·90	2·90	5·30
15	Protium heptaphyllum	6	230·7	3·0	0·33	2·90	5·23
16	Ephederanthus parviflorus	4	177·9	2·0	0·25	2·32	4·57
17	Hirtella glandulosa	3	579·1	1·5	0·96	1·74	4·20
18	Duguetia marcgraviana	3	265·6	1·5	0·38	1·74	3·62
19	Lauraceae sp. 'Louro ferro'	2	1025·3	1·0	1·45	1·16	3·61
20	Lacistema aggregatum	3	92·4	1·5	0·13	1·74	3·37
21	Copaifera langsdorfii	1	962·9	0·5	1·36	0·58	2·44
22	Dulacia sp.	2	145·2	1·0	0·21	1·16	2·37
23	Unonopsis lindmannii	2	135·3	1·0	0·19	1·16	2·35
24	Licania sp. 'Caripé branco'	2	124·5	1·0	0·18	1·16	2·34
25	Unknown 'Chifre de veado'	2	75·9	1·0	0·11	1·16	2·27
26	Pseudolmedia sp.	2	71·7	1·0	0·10	1·16	2·26
27	Tapirira guianensis	1	616·2	0·5	0·87	0·58	1·95
28	Protium sp. 2	1	574·9	0·5	0·81	0·58	1·89
29	Virola sebifera	2	71·6	1·0	0·10	0·58	1·68
30	Lauraceae sp. 'Louro preto'	1	147·1	0·5	0·21	0·58	1·29
31	Agonandra brasiliensis	1	114·9	0·5	0·16	0·58	1·24
32	Meliaceae sp. 'Pororoca'	1	97·5	0·5	0·14	0·58	1·22
33 =	Connarus perrottetii var. angustifolius	1	81·5	0·5	0·12	0·58	1·20
33 =	Guatteria sp. 'Embireira'	1	81·5	0·5	0·12	0·58	1·20
33 =	Hirtella gracilipes	1	81·5	0·5	0·12	0·58	1·20
36	Pera sp.	1	71.6	0.5	0.10	0.58	1.18
37	Cordia nodosa	1	58·0	0·5	0·08	0·58	1·16
38	Sorocea sp.	1	31·8	0·5	0·04	0·58	1·12
39	Lauraceae sp. 'Small lf'	1	23·0	0·5	0·03	0·58	1·11

TABLE 5

Point-centred quarter transect in Dry forest (Transect 5) with species in order of Importance value (IV).

25 points, 10 m apart. Qualifying girth 12 cm at breast height.

Mean distance between trees = 2·57 m. Absolute density (trees per 100 m^2) = 15·14; n = no. of individuals; ba = basal area (cm^2).

		n	Total ba	Rel. dens.	Rel. dom.	Rel. freq.	IV
1	Licania sp. 'Caripé vermelho'	11	5029·5	11·0	14·70	12·04	37·74
2	Lauraceae sp. 'Louro bosta'	9	6286·5	9·0	18·38	8·43	35·81
3	Lauraceae sp. 'Louro preto'	11	5432·0	11·0	15·88	9·63	36·51
4	Ephederanthus parviflorus	15	1548·1	15·0	4·53	12·04	31·57
5	Apuleia molaris	2	4513·7	2·0	13·49	2·40	17·89
6	Oenocarpus distichus?	6	1361·5	5·0	3·98	6·02	15·00
7	Siparuna guianensis	8	203·8	8·0	0·60	6·02	14·60
8	Enterolobium schomburgkii	2	3340·4	2·0	9·77	2·40	14·17
9	Unonopsis lindmannii	5	830·4	5·0	2·43	4·81	12·24
10	Pseudolmedia sp.	5	42·2	5·0	0·62	6·02	11·64
11	Protium unifoliolatum	4	162·1	4·0	0·47	4·81	9·29
12	Lauraceae sp. 'Louro branco'	2	1035·7	2·0	3·03	2·40	7·43
13	Licania sp. 'Caripé branco'	3	146·7	3·0	0·43	3·61	7·04
14	Cordia nodosa	2	628·0	2·0	1·84	2·40	6·24
15	Lacistema sp.?	1	1263·4	1·0	3·69	1·20	5·89
16	Sideroxylon venulosum	1	1089·3	1·0	3·18	1·20	5·38
17	Hirtella glandulosa	2	281·4	2·0	0·82	2·40	5·22
18	Guatteria sp.	2	39·2	2·0	0·11	2·40	4·51
19	Lauraceae sp. 'Louro ferro'	2	181·8	2·0	0·53	1·20	3·73
20	Cecropia sp.	1	298·1	1·0	0·87	1·20	3·07
21	Amaioua guianensis	1	71·6	1·0	0·21	1·20	2·41
22	Connarus perrottetii var. angustifolius	1	52·4	1·0	0·18	1·20	2·38
23	Didymopanax morototoni	1	28·7	1·0	0·08	1·20	2·28
24 =	Hirtella racemosa	1	23·0	1·0	0·07	1·20	2·27
24 =	Protium heptaphyllum	1	23·0	1·0	0·07	1·20	2·27
26	Guarea sp.	1	15·6	1·0	0·05	1·20	2·25

SEASONALLY FLOODED FOREST
(*Mata inundável*)

Observations on the forest around Lago Rufino (Fig. 2) and another small lake lying nearby were made during a brief visit to the locality. Common tree and shrub species are listed below.

COMMON TREE AND SHRUB SPECIES OF SEASONALLY FLOODED FOREST

Abuta grandifolia
Alchornea schomburgkii
Brosimum latescens
Calophyllum brasiliense
Diospyros poeppigiana
Duguetia marcgraviana
Dulacia egleri
Gustavia augusta
Homalium matogrossense
Mabea inordorum
Mouriri acutiflora
Pera coccinea
Piranhea trifoliolata
Pouteria glabrescens
Psychotria sp. 'Suceninha' R4459
P. sp. R4464
Rheedia brasiliensis
Sclerôlobium froesii
Sloanea sp. aff. monosperma
Ternstroemia candolleana
Unonopsis lindmannii
Vochysia divergens?
Xylopia sp. aff. sericea

On the west side of the lake the trees are slender, well-spaced and mainly about 8 m tall and there is practically no ground vegetation (a characteristic of seasonally flooded forest). Many of the trees are branched into a number of trunks from the base and buttress roots are common. Lianas are very frequent, as are aerial roots hanging from the canopy (e.g. in *Pouteria glabrescens* and *Combretum laxum*). These characteristics combine to give an 'enchanted forest' appearance. The high-water mark on the bark of the trees is about 3 m above ground level.

Sclerolobium froesii 'Taxi preto' is extremely common (in places almost dominant); it often grows to produce a large tree up to over 20 m tall. *Piranhea trifoliolata* also produces groves of big trees which frequently bear the Balanophoraceous root-parasite *Helosis cayennensis*, whose mauve-purple inflorescences were just emerging above ground during our visit in the later part of September. On better drained parts of the bank, *Dulacia egleri*, *Duguetia marcgraviana* and *Homalium matogrossense* were very common.

A remarkable *Scleria* sp., which has two vernacular names—'Navalha de macaco' (= monkey's razor) and 'Tiririca de vampira' (= vampire's razor-grass), climbs in places to the crowns of the lakeside trees and produces a thicket (apparently sometimes impenetrable). So far specialists have been unable to give a specific determination for our collections of this sedge.

A large population of the Gentianaceous annual *Coutabea ramosa* was flowering and fruiting in a sandy seasonally-flooded area by the lake; its annual cycle obviously fits into the period when the soil is exposed.

A very quick glance at an area of várzea forest on the Rio Araguaia close to Park HQ showed a stand of *Piranhea trifoliolata* and *Pouteria glabrescens* with high water mark approximately 4 m up their trunks.

In addition to some of the species recorded above, Gifford (unpubl. notes) mentions *Himatanthus bracteatus*, *Didymopanax morototoni*, *Hirtella gracilipes* and *Cariniana rubra* [or *C. domestica*] as common trees in 'Mata ciliar inundada' at Lago Rico and Lago Mercedes, and *Panopsis rubescens* as a common shrub.

The seasonally-flooded forest at the Ilha do Bananal bears a strong resemblance to that of the flood-plain of the Rio Suiá-Missu (NE Mato Grosso) lying some 250 km to the SW (Ratter *et al.*, 1978b)—at both localities *Sclerolobium froesii**, *Dulacia egleri**, *Ternstroemia candolleana*, *Xylopia* sp. aff. *sericea*, *Abuta grandifolia* and various other species are important constituents of the vegetation.

SEMIDECIDUOUS SEASONAL FOREST
(*Mata semidecídua estacional*)

As previously mentioned, the HQ of the Park is situated in the remnants of Semideciduous seasonal forest. Trees noted are listed on p. 329.

**Sclerolobium* sp. aff. *chrysophyllum* Poepp. and *Liriosma singularis* (Vell.) Mackr. respectively in Ratter *et al.* (1978b).

TREES OF THE SEMIDECIDUOUS FOREST

Apeiba tibourbou
Apuleia molaris
Aspidosperma sp. 'Guatambu'
Astronium fraxinifolium
Bursera leptophleios
Casearia commersoniana
C. grandiflora
Cedrela fissilis
Chorisia sp.
Cordia glabrata
Dilodendron bipinnatum
Dipteryx alata
Duguetia marcgraviana
Fagara sp.
Genipa americana
Guarea trichilioides
Guazuma ulmifolia
Himatanthus bracteatus
Hymenaea courbaril var. stilbocarpa
Luhea paniculata
Machaerium sp.
Maclura tinctoria
Magonia pubescens
Physocallyma scaberrimum
Pithecellobium foliolosum
Platypodium elegans
Qualea multiflora
Spondias mombin
Sterculia striata
Tabebuia sp.
Terminalia sp. aff. amazonica
Vitex cf. polygama

Palms
Astrocaryum sp. 'Tucumá'
Patí
Piririma

Apart from the lack of 'Angicos' (*Anadenanthera* spp.), the forest clearly has much in common with the deciduous seasonal forests of the Xavantina-Cachimbo Expedition area, NE Mato Grosso (Ratter *et al.*, 1973) and with mesotrophic facies cerradão. Patches of similar semideciduous forest were observed within the tall dry Hylaean forest on the road between Cascalheira and Santa Teresinha (i.e. on the Mato Grosso side of the Rio Araguaia at the same latitude as the Ilha do Bananal) and no doubt indicate the presence of islands of richer soils. For more extensive discussion of deciduous forests and mesotrophic facies cerradões see Ratter *et al.* (1977 & 1978a).

The soil analysis (S10, Appendix 2, p. 341) shows the higher levels of Ca + Mg which are characteristically associated with this type of vegetation and Gifford discusses the subject briefly on p. 338.

CAMPO DE MURUNDU

Observations were made on the areas of campo de murundu shown in the NE corner of Fig. 2 and also further to the north near Lago Rico.

They consist of seasonally flooded plains of grasses, sedges, xyrids, etc., with scattered hummocks bearing termitaria and woody vegetation. Trees of species tolerant of seasonal flooding also sometimes occur on the plain itself, or on very small elevations. In the first study area the largest hummock was 28 × 18 m and the highest 6 m at the top of its termitarium, but most were very much smaller—the smallest of 10 examined in detail was 4 × 4 m. The trees and shrubs on the hummocks are usually of typical cerrado species, but forest species also occur. Generally the trees are fairly small but there are exceptions: the largest tree observed was a *Caryocar brasiliense* approximately 17 m tall and 100 cm in diameter at breast height, with a wide, dense crown, 27 m in diameter. The species listed on p. 330 were recorded.

Xylopia aromatica was noted as particularly common on hummocks and *Tabebuia caraiba* as an abundant isolated tree. Other common species are *Andira paniculata*, *Caryocar brasiliense* var. *brasiliense*, *Curatella americana*, *Qualea parviflora* and *Vochysia haenkeana*. *Byrsonima crassifolia*, a species particularly tolerant of flooding, as indicated by the vernacular name 'Murici de vargem' (= *Byrsonima* of the low damp ground), is abundant in many places and the high-water mark can often be seen on its trunk.

The following grasses were recorded on the campo: *Elionurus muticus*, *Leptocoryphium lanatum* and *Paspalum lineare*.

WOODY SPECIES ON HUMMOCKS OR ON THE CAMPO ITSELF

Alchornea schomburgkii
Andira paniculata
Apuleia molaris*
Astronium fraxinifolium
Brosimum gaudichaudii
Byrsonima crassifolia
B. inodora
Calophyllum brasiliense
Caryocar brasiliense subsp. brasiliense
Casearia sylvestris
Cecropia sp.
Combretum laxum†
Copaifera langsdorfii
Cordia glabrata
Couepia grandiflora
Curatella americana
Davilla nitida†
Diospyros hispida
Duguetia marcgraviana
Erythroxylum suberosum
Eugenia dysenterica
E. sp. 'Murtinha'
Euplassa inaequalis*
Ficus sp.
Genipa americana*
Guatteria sp.
Himatanthus bracteatus
Homalium matogrossense
Hymenaea courbaril var. stilbocarpa*
Jacaranda brasiliana*
Lacistema aggregatum
Licania apetala var. apetala
L. gardneri
Mabea inodorum
Maprounea guianensis
Matayba guianensis
Mouriri acutiflora
Moutabea excoriata‡
Neea cf. spruceana
Ouratea hexasperma
Physocallyma scaberrimum
Plathymenia reticulata
Pouteria ramiflora
Protium heptaphyllum
Qualea multiflora*
Q. parviflora
Salacia sp. aff. elliptica†
Senna silvestris var. silvestris
Simaba trichilioides
Simarouba versicolor
Siparuna guianensis
Smilax cf. syringoides†
Tabebuia caraiba
T. sp. 'Pau de arco amarelo'
Terminalia brasiliensis?
Vatairea macrocarpa
Vitex cf. polygama
Vochysia haenkeana
V. rufa*
Xylopia aromatica
Lauraceae sp.
Leguminosae sp. 'Angelim pedra'
Palmae 'Piaçaba'

*Recorded by Gifford (unpubl. notes).
†Climber.
‡Climber or small tree.

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Appendix 1

Species observed in the Parque Nacional do Araguaia

Where collections were made a collecting number is given—specimens are lodged at UB and in most cases at E and K. However, our survey was confined mainly to woody vegetation and time did not allow extensive collecting. Vernacular names (in parentheses) are those in common use in NE Mato Grosso.

C, cerrado; Co, cerradão; D, Dry forest (evergreen seasonal forest); H, herb; L, liana; M, campo de murundu; P, sandy beach; S, semideciduous forest; Sh, shrub; SSh, small shrub (often a hemixyle); T, tree; V, seasonally flooded forest or other wet woodland.

*Recorded only by Gifford (unpublished notes, 1979).

ACANTHACEAE
Ruellia cf. *dissitifolia* (Nees) Hiern; *R*4409; H.C
AMARANTHACEAE
Gomphrena holosericea Moq.; *R*4493; H.P. (Canela de Jacomi)
ANACARDIACEAE
Anacardium humile St. Hil.; SSh.M. (Caju rasteiro)
A. occidentale L.; T.C, Co. (Caju)
Astronium fraxinifolium Schott.; T.C, Co.D. S.M. (Gonçalo Alves)
Spondias mombin L.; *R*4398; T.S. (Cajazeiro)
Tapirira guianensis Aubl.; *R*4415; T.Co, D. (Pau Pombo)
ANNONACEAE
Annona coriacea Mart.; *R*4417; T.C, Co. (Aráticum)
A. crassiflora Mart.; T.C, Co. (Aráticum)
A. tomentosa R.E.Fr.; SSh.C, Co. (Aráticum)
Cardiopetalum calophyllum Schlecht.; *R*4416; T.Co, D. (Embireira preta)
Duguetia marcgraviana Mart.; *R*4438; T.D, M. (Cundurú)
Ephederanthus parviflorus S. Moore; *R*4402; T.D, S. (Mejo de porco.—not 'mijo', meaning unknown)
Guatteria sp.; T, Sh.Co, D, M. (Embireira)
Unonopsis lindmannii R.E.Fr.; *R*4433; T.Co, D, V. (Embireira)
Xylopia aromatica Lam.; T.Co, M. (Pimenta de macaco)
X. sericea St. Hil.; *R*4387; T.Co, D. (Pindaíba preta)
X. sp. aff. *sericea* St. Hil.; *R*4432; T.V. (Pindaíba preta)
APOCYNACEAE
Aspidosperma multiflorum A.DC.; T.C, Co. (Taiporca)
A. nobile M. Arg.; T.C, Co, D.
A. sp.; T.Co, S. (Guatambu)
Hancornia speciosa Gomez.; T, Sh with copious latex. C, Co. (Mangabeira)
Himatanthus bracteatus (A.DC.) Woods.; *R*4436; T with copious latex. Co, D, S, V, M. (Sucuúba, Pau de leite)
H. obovatus (M. Arg.) Woods.; Small T, Sh with copious latex. C, Co. (Sucuubinha, Pau de leite)
Tabernaemontana heterophylla (Vahl) Muell.; V*
T. siphilitica (L.f.) Leeuwenberg; *R*4403; SSh. Margin of D & V. (Rosa cambraia)
ARALIACEAE
Didymopanax morototoni Decne. & Planch.; T.V, D. (Morototó, Mandiocão da mata)
D. sp.; T. C, Co, D. (Mandiocão)
BALANOPHORACEAE
Helosis cayennensis (Sw.) Spreng.; *R*4465; Root parasite of *Piranhea trifoliolata* (Euphorbiaceae) in várzea forest. (Urupé)
BIGNONIACEAE
Jacaranda brasiliana Pers.; T.C, Co. (Tamburí)
J. copaia (Aubl.) D. Don.; T.D. (Pinho)
Pyrostegia dichotoma [Miers ex] K. Schum.; L. Cleared ground at airstrip. (Flôr de São João)
Tabebuia caraiba (Mart.) Bur.; T.C, Co, M. (Caraíba)
T. sp.; T.D, S, M. (Pau de arco amarelo)
T. sp.; T.D, S, V. (Pau de arco rôxo)
T. sp.; White flowers. D.S. (Taiporca)
BOMBACACEAE
Chorisia sp.; T.S. (Barriguda)

Pseudobombax longiflorum (Mart. & Zucc.) A. Robyns.; T.C, Co. (Mamonarana)

BORAGINACEAE

Cordia glabrata (Mart.) A.DC.; *R*4369 [det. N. Taroda]; T.Co, D, S. (Frei Jorge)
C. nodosa Lam.; *R*4497 [det. N. Taroda]; H to T.D, V. (Uruá)
Heliotropium indicum L.; H.M.

BROMELIACEAE

Ananas ananassoides (Bak.) L. Smith; *R*4418; H.C. (Ananas de raposa)
Bromelia sp.; H.C. (Macambira)

BURSERACEAE

Bursera leptophleios Mart.; *R*4466; T, Sh.S, Co. (Imburana)
Hemicrepidospermum rhoifolium (Benth.) Swart; *R*4452; T.D. (Mamoninha da mata)
Protium brasiliense (Spreng.) Engl.; *R*4468; T.Co, D. (Breu branco, Almécega)
P. heptaphyllum March.; T.Co, D. Breu, Almécega)
P. unifoliolatum Engl.; *R*4453; T.D. (Breu, Almécega)

CARYOCARACEAE

Caryocar brasiliense Camb. subsp. *brasiliense*; *R*4376 [det. G.T. Prance]; T.C, Co, M. (Piquí)

CHRYSOBALANCEAE

Couepia grandiflora Benth.; T.C, Co, M. (Oitirana)
Hirtella glandulosa Spreng.; T.Co, D, M. (Bosta de rato)
H. gracilipes (Hook.) Prance; T. Damp Co, M. (Bosta de rato)
H. racemosa Lam.; T.D. (Bosta de rato, Quebra colhão)
Licania apetala (E. Mey.) Fritsch var. *apetala*; *R*4439 [det. G. T. Prance]; T.M. (Caripé)
L. gardneri (Hook. f.) Fritsch; *R*4441 [det G. T. Prance]; T.C, Co, D, M. (Farinha seca)
L. sp.; T.D. (Farinha seca)
L. sp.; T.Co, D. (Caripé branco)
L. sp.; T.D. (Caripé vermelho)

COCHLOSPERMACEAE

Cochlospermum regium (Schrank) Pilger; Hemixyle Sh. C, M. (Algodão do campo)

COMBRETACEAE

Combretum laxum Jacq.; *R*4443; L. V & thicket, M.
Terminalia sp. aff. *amazonica* (J. F. Gmel.) Exell.; *R*4396; T.S. (Miringiba)
T. argentea Mart. & Zucc.; *R*4408; T.C, Co. (Capitão, Garote)
T. brasiliensis Camb.; T.C, Co. (Miringiba)

COMPOSITAE

Vernonia herbacea (Vell.) Rusby; *R*4394; H.C.
Vernonia sp.; *R*4492; H.P.

CONNARACEAE

Connarus perrottetii (DC.) Planch. var. *angustifolius* Radlk.; T.D. (Pajujurana)
C. suberosus Planch. var. *fulvus* (Planch.) Forero; Small T.C, Co. (Coração de negro)
Rourea induta Planch.; Sh. C, M.
R. cf. *gardneriana* Planch.; *R*4496, 4498; SSh, L. Disturbed S

CONVOLVULACEAE

Ipomaea sp.; *R*4375; L. in gallery thicket. (Batata brava)

CYPERACEAE

Rhynchospora cephalotes (L.) Vahl; *R*4420; Co
R. exaltata Kunth; *R*4419; Co. (Tiririca)
Scleria sp.; *R*4427; Climbing to tree tops in lakeside thicket. (Navalha de macaco, Tiririca de vampira)

DICHAPETALACEAE

Tapura amazonica Poepp. & Engl.; *R*4494; T.D. (Grão de galo)

DILLENIACEAE

Curatella americana L.; T, Sh.C, Co, M. (tolerant of wetter places in C). (Lixeira, Sambaíba)
Davilla elliptica St. Hil.; Sh.C, M. (Lixeirinha, Sambaíbinha)
D. nitida (Vahl) Kubitzki; *R*4380; L.C, M. (Cipó de fogo)
Doliocarpus dentatus (Aubl.) Standl.; *R*4487; L.Co. (Cipó de fogo)

EBENACEAE

Diospyros hispida A.DC.; *R*4386, 4413; T.Sh.C, Co. (Olho de boi)
D. poeppigiana A.DC.; *R*4463; Slender T.V. (Olho de boi)

ERYTHROXYLACEAE

Erythroxylum anguifugum Mart.; *R*4476 [det. T. Plowman]; Sh. In forest thicket by lakeside [Lago Rico]
E. deciduum St. Hil.; *R*4411; SSh.C, Co

E. pelleterianum St. Hil.; *R*4414 [det. T. Plowman]; Twiggy SSh.Co, D
E. suberosum St. Hil.; Sh.C.Co.M
E. tortuosum Mart.; Sh. C. (Muchiba comprida)*

EUPHORBIACEAE

Alchornea schomburgkii Klotysch; *R*4371, 4430; Slender T.V, damp places in C, M. (Mamoniha). Fruits are collected for making hair-oil
Chaetocarpus echinocarpus (Baill.) Ducke; T.D, Co. (Cumaté)
Croton cuneatus Klotysch; *R*4470; Slender shrub on low seasonally flooded campo on the margin of lake [Lago Rico]
Jatropha elliptica (Pohl) M. Arg.; *R*4395; H.C. (Batata de teiu, Mamonazinho do cerrado)
J. vitifolia Mill.; SSh.C, Co. (Mulher brava, Cansanção). Stinging hairs
Mabea fistulifera Mart.; T.Co. (Canudeiro preto, Taquarí)
M. inodorum S. Moore; *R*4372; Small T.V, galleries, etc. (Canudeiro)
Maprounea guianensis Aubl.; T.D, Co. (Trapiá)
Pera coccinea (Benth.) M. Arg.; *R*4428; Small T.V. (Tatiuva)
P. sp., 'Feijão de arara'; T.Co, D
Piranhea trifoliolata Baill.; *R*4457; T.V. (Piranheira)

FLACOURTIACEAE

Casearia commersoniana Camb.; *R*4448; T.Co, S. (Mourão)
C. grandiflora Camb.; T.Co, D, S. (Olha de Pomba, Carne de vaca, Sete sangrias)
C. sylvestris Sw.; *R*4374; T, Sh.C, Co, D S. (Vernac. names as previous)
Homalium matogrossense Malme; *R*4442; T, Sh.V, damp thicket. (Catoarí)
Lacistema aggregatum (Berg) Rusby; *R*4382; T, Sh.C, Co, D, S. (Coarí-coarí)
Xylosma ciliatifolium (Clos) Eichler; *R*4447; Multi-stemmed Sh. Thicket at edge of airstrip. (Cascavel)

GENTIANACEAE

Coutoubea ramosa Aubl.; *R*4431; Annual H. Seasonally flooded habitat by lakeside [Lago Rufino]

GRAMINEAE

Elionurus muticus (Spreng.) Kuntze; *R*4479 [det. S. A. Renvoize]; Campo
Leptocaryphium lanatum (H.B.K.) Nees; *R*4478 [det. S. A. Renvoize]; Campo
Olyra latifolia L.; D
Paspalum lineare Trin.; *R*4480 [det. S. A. Renvoize]; Campo
Streptogyne americana C. E. Hubbard; D. (Barba de paca)

GUTTIFERAE

Calophyllum brasiliense Camb.; *R*4379; T.V, M. (Landim)
Kielmeyera coriacea (Spreng.) Mart.; T.C, Co. (Pau santo)
Rheedia brasiliensis (Mart.) Planch. & Triana; *R*4456; T.V. (Azeidinho, Bacurí)
Vismia amazonica Ewan; *R*4389, 4486; Sh.C, Co, D. (Lacro branco)

HIPPOCRATEACEAE

Salacis sp. aff. *elliptica* (Mart.) Peyr.; *R*4384; Gallery forest thicket. (Cipó Bacoparí)

ICACINACEAE

Emmotum nitens (Benth.) Miers.; T.Co, D. (Sobe)

LAURACEAE

Louro bosta; T.D
Louro branco; T.D
Louro ferro; T.D
Louro preto; T.D
Louro rosa; T.D
Lauraceae sp. 1; T.D
Lauraceae sp. 2; T.D
Lauraceae small leaf; T.D

LECYTHIDACEAE

Cariniana rubra [Gardner ex] Miers [or *domestica* (Mart.) Miers]; Tall T.V. (Cachimbeiro)*
Gustavia augusta L.; *R*4450; T.V

LEGUMINOSAE/CAESALPINOIDEAE

Apuleia molaris Spruce; *R*4397; Tall T.D, S, M. (Amarelão, Garapá)
Bauhinia guianensis Aubl.; L.D. (Escada de jabotim)
B. rufa [Bong.] Steud.; SSh.C, Co. (Mororó, Unha de boi)
Cassia velutina Vog.; SSh.C*
Copaifera langsdorfii, Desf.; Tall T to SSh. C, Co, D, S. (Pau de óleo, Copaíba)

Hymenaea courbaril L. var. *stilbocarpa* (Hayne) Lee & Langenheim; Tall T.Co, D, S. (Jatobá)
Sclerolobium aureum (Tul.) Benth.; T.C, Co, M. (Tatarena, Pau bosta—latter name because of the dung-like smell of the wood)
S. froesii Pires; *R*4461, 4471; T.V. (Taxi preto)
S. paniculatum Benth.; T.C, Co, D. (Taxi branco)
Senna silvestris (Vell.) Irwin var. *silvestris*; *R*4437 [det. R. Barneby]; Sh.M

LEGUMINOSAE/MIMOSOIDEAE

Dimorphandra mollis Benth.; T.C, Co. (Faveira, Jacarandá do cerrado)
Enterolobium ellipticum Benth.; *R*4399; T.C, Co. (Vinhático cascudo)
E. schomburgkii Benth.; T.D. (Orelha de macaco)
Inga fagifolia Willd.; *R*4401; T.D. (Ingá branca)
I. sp.; *R*4487; Sh. In seasonally flooded riverine thicket. (Ingá rôxa)
Mimosa sp.; *R*4490; Low SSh.P. (Malice)
Pithecellobium foliolosum Benth.; *R*4455 [det. R. Barneby]; T.D, S. (Pereira)
P. marginatum Benth.; *R*4495 [det. R. Barneby]; Multi-trunked T.Co, D. (Juruparana, Cheri-cheri)
Plathymenia reticulata Benth.; T.Co, D. (Vinhático)
Stryphnodendron adstringens (Mart.) Coville; T.C, Co. (Barbatimão)

LEGUMINOSAE/PAPILIONOIDEAE

Acosmium dasycarpum (Vog.) Yakovl.; T, Sh.C, Co. (Amargosinha)
Andira cuyabensis Benth.; T.C, Co, M. (Angelim branco)
A. paniculata Benth.; T.C, Co. (Angelim)
Bowdichia virgilioides H.B.K.; T.C, Co. (Sicupira preta)
Dipteryx alata Vog.; T.C, S. (Barú, Cumarú)
Desmodium platycarpum Benth.; *R*4390; H.C
Machaerium acutifolium Vog.; T.C, Co. (Cancileiro, Jacarandá muchiba)
M. sp.; T.S
Platypodium elegans Vog.; *R*4454; T.S. (Cancileiro)
Stylosanthes guianensis (Aubl.) Sw.; SSh.C*
Vatairea macrocarpa (Benth.) Ducke.; T.C, Co, M. (Amargosa)
Papilionoideae sp.; T.M. (Angelim pedra)

LILIACEAE

Smilax cf. *syringoides* Griseb.; *R*4383; L.M. (Cipó Japecanga)

LOGANIACEAE

Antonia ovata Pohl.; T.C, Co. (Feijão de arara)
Strychnos pseudoquina St. Hil.; T, Sh.M. (Quina do cerrado)*

LYTHRACEAE

Lafoensia pacari St. Hil.; T, Sh.C, Co. (Mangaba brava)
Physocallyma scaberrimum Pohl.; T.Co, D, S, M. (Cega machado, Carvalho)

MALPIGHIACEAE

Banisteriopsis pubipetala (Adr. Juss.) Cuatr.; *R*4485 [det. B. Gates]; L.Co. (Cipó Crista de galo)
Byrsonima coccolobifolia (Spreng.) Kunth.; T, Sh.C, Co. (Murici vermelho)
B. crassa Nied.; *R*4503 [det. W. R. Anderson]; T, Sh.C, Co. (Murici)
B. crassifolia (L.) Kunk.; *R*4475, 4484 [det. W. R. Anderson]; T, Sh.C, M [damper situations]. (Murici de vargem)
B. inodora Moore; *R*4378 [det. W. R. Anderson]; T.C, Co, M. (Murici de galinha)
Heteropterys campestris Adr. Juss.; SSh.M*
H. eglandulosa Adr. Juss.; *R*4400 [det. W. R. Anderson]; L.D. (Cipó Crista de galo)

MELASTOMATACEAE

Miconia albicans (Sw.) Triana; *R*4407 [det. J. J. Wurdack]; SSh.C, M
M. chrysophylla (L. C. Rich.) Urban; *R*4451 [det. J. J. Wurdack]; T.D
M. macrothyrsa (L. C. Rich.) Urban; *R*4483 [det. J. J. Wurdack]; T.D
M. stenostachya DC.; *R*4482 [det. J. J. Wurdack]; SSh.Co
Mouriri acutiflora Naud.; *R*4381 [det. T. Morley]; T.D, V, M. (Gabiraba)
M. elliptica Mart.; *R*4449, 4481 [det. T. Morley]; T.C, Co. (Pusá)

MELIACEAE

Cedrela fissilis Vell.; T.S, D. (Cedro)
Guarea trichiliodes L.; T.S. (Marinheiro)
G. sp.; T.D. (Marinheiro)
Meliaceae sp., 'Pororoca'; T.D. (Pororoca)

MENISPERMACEAE
Abuta grandifolia (Mart.) Sandw.; *R*4425; Slender T.Co, D, V. (Grão de galo)
Cissampelos pareira L.; C, Co*
MONIMIACEAE
Siparuna cuyabana (Mart.) DC.; Sh.Co, forest margin. (Capitiu, Negramina)
S. guianensis Aubl.; *R*4502; Small T, Sh.Co, D. (As previous)
MORACEAE
Brosimum gaudichaudii Trec.; Sh, T.C, Co. (Inharezinho do cerrado)
B. latescens (S. Moore) C.C. Berg.; *R*4458; T.V. (Ameixa)
B. rubescens Taub.; *R*4501; Tall T.D. (Pau Brasil, Amapá ferro)
Maclura tinctoria (L.) Engl.; *R*4434; T.S. (Moreira)
Pseudolmedia sp.; *R*4404; T.Co, D. (Guiratinga)
Sorocea sp.; Small T.D. (Inharê)
Cecropia sp.; T. Disturbed places Co, D, V, M. (Imbaúba)
Ficus spp.; Co, forest. (Traqueira, Figo)
MUSACEAE
Phenakospermum guyanense Engl.; Giant H.D. (Banana brava)
MYRISTICACEAE
Virola sebifera Aubl.; T.Co, D. (Ucuúba)
MYRTACEAE
Eugenia dysenterica DC.; T.C, Co. (Cagaiteiro)
E. sp.; *R*4410; Low Sh.C. (Cagaiteiro rasteiro)
E. sp. 'Murtinha'; T, Sh.C, Co.
Myrcia pubipetala Miq.; *R*4391; Large Sh. C. (Araçá)
M. rorida Berg.; SSh.M*
Psidium cf. *leptocladum* Berg.; *R*4444; Large Sh. Riverine thicket. (Goiabinha)
P. riparium DC.; *R*4488; Large thicket Sh. Riverine thicket. (Goiabinha da prais)
Myrtaceae sp. 'Araçá boi'; T.C, Co
Myrtaceae sp. 'Maria preta'; T.C, Co
Myrtaceae sp. 'Murtinha vermelha'; T.C, Co
NYCTAGINACEAE
Neea sp. aff. *macrophylla* Poepp. & Engl.; *R*4392; T.C, Co. (Jua mole)
N. cf. *spruceana* Heimsl.; *R*4474; Bushy Sh. Seasonally flooded lakeside vegetation. (Jua mole)
OCHNACEAE
Ouratea hexasperma (St. Hil.) Baill.; *R*4422 [det. K. Yamamoto]; Sh.C, Co. (Cabeça de negro, Inharezinho do cerrado)
O. sp.; *R*4393; Sh.C. (As previous)
OLACACEAE
Dulacia egleri (Rangel) Sleumer; *R*4426, 4429 [det. H. Sleumer]; T.V. (Larangia da vargem)
D. sp.; T.D. (Larangia)
ONAGRACEAE
Ludwigia nervosa (Poir.) Hara; M*
OPILIACEAE
Agonandra brasiliensis Miers.; T.Co, D. (Pau marfim)
PALMAE
Acrocomia sclerocarpa Mart?; Co. (Macaúba)
Astrocaryum sp.; Co, S. (Tucumá)
Oenocarpus distichus Mart.; D. (Bacaba)
Orbignya sp.; Co. (Babaçu)
Syagrus flexuosa (Mart.) Becc.; C, Co. (Piririma, Babão)
S. comosa (Mart.) Mart.; C, Co. (Gariroba)
Palmae sp.; S. (Pati)
Palmae sp.; M. (Piaçaba)
Palmae sp.; C, Co, S. (Piririma)
POLYGALACEAE
Moutabea excoriata Mart.; *R*4373; T. or L. V, M. (Laranjia, Cipó Laranjia, Cipó Boi)
Securidaca bialata Benth.; *R*4472; L in lakeside thicket [Lago Rico]
POLYGONACEAE
Coccoloba cf. *mollis* Casar.; *R*4424; T.Co. (Capeiba)

PROTEACEAE
Euplassa inaequalis (Pohl) Engler; T.M. (Fruta de morcego)
Panopsis rubescens (Pohl) Pittier; Sh, T.V. edge of gallery thicket*
RUBIACEAE
Alibertia sp.; *R*4421; Sh.C, Co. (Marmelada chumbinho)
Amaioua guianensis Aubl.; T.D
Chomelia ribesioides Benth.; Sh.C, Co
Coussarea platyphylla M. Arg.; V*
Genipa americana L.; *R*4445; T.S, M. (Genipapo)
Guettarda viburnoides Cham. & Schlecht.; T, Sh.Co. (Veludo)
Palicourea marcgravii St. Hil.; H.V. (Mato gado)*
Psychotria sp.; *R*4459; Small T.V. (Suceninha)
P. sp.; *R*4464; Sh.V
Rudgea amazonica M. Arg.; T.Sh. (Sucena)
Tocoyena formosa K. Schum.; Sh.C, Co. (Genipapo bravo)
Rubiaceae sp. 'Bacurí'; T.D
RUTACEAE
Fagara sp. Maminha de porca; T.S
SAPINDACEAE
Cupania vernalis Camb.; T.Sh.D. (Olha de cotia)
Dilodendron bipinnatum Radlk.; T.S, Co. (Mulher pobre)
Magonia pubescens St. Hil.; T.S, Co. (Tinguí)
Matayba guianensis Aubl.; T, Sh.C, Co. (Olha de cotia)
M. juglandifolia Radlk.; V, M. (Olho de cotia)*
Serjania sp.; *R*4446; L in riverine thicket. (Cipó Cururú)
SAPOTACEAE
Pouteria glabrescens (Miq.) Bachni.; *R*4460 [det. T. Pennington]; T.V. (Mangue)
P. ramiflora (Mart.) Radlk.; T.C, Co. (Curiola)
Sideroxylon venulosum Mart. & Eichl.; T.D. (Uvinha)
SIMAROUBACEAE
Simaba trichilioides St. Hil.; *R*4370; SSh. Damp C, M
Simarouba versicolor St. Hil.; *R*4435; T.C, Co, D. (Mata cachorro, Marupá)
STERCULIACEAE
Guazuma ulmifolia L.; T.S, C. (Mutamba da mata)
Helicteres macropetala St. Hil. & Naud.; *R*4388; Sh.Co, S. (Sacarolha)
H. sp.; *R*4406; SSh.C, Co. (Sacarolha)
Melochia pyramidata L.; H.M*
Sterculia striata St. Hil. & Naud.; T.S, Co. (Xixá)
TERNSTROEMIACEAE
Ternstroemia candolleana Wawra; *R*4440; T.V. (Mangue)
TILIACEAE
Luhea paniculata Mart.; T.S, Co. (Açoito cavalo)
Sloanea sp. aff. *monosperma* Vell.; *R*4462, T.V. (Urucurana, Pateiro)
Triumfetta semitriloba L.; SSh.M*
VERBENACEAE
Lippia alba (Mill.) N.E. Br.; *R*4489; Prostrate H.P
Vitex cf. *polygama* Cham.; *R*4412; T.S, Co. (Tarumão)
VITACEAE
Cissus erosa L. C. Rich.; L.M*
VOCHYSIACEAE
Qualea grandiflora Mart.; T, Sh.C, Co, M. (Pau terra de folha grande)
Q. multiflora Mart.; T, Sh.C, Co, M. (Pau terra liso)
Q. parviflora Mart.; T, Sh.C, Co, M. (Pau terra rôxo)
Salvertia convallariodora St. Hil.; T.C, Co. (Folha larga)
Vochysia divergens Pohl.; T.S. (Cangerana)
V. haenkeana Mart.; T. Co, D, M. (Escorrega macaco)
V. rufa Mart.; T.C. (Pau doce)
FAMILY UNKNOWN
Chifre de veado; T.D

Appendix 2

The following notes were prepared (originally in Portuguese) by the late Professor D. R. Gifford for a report to IBDF in 1979. They have been slightly edited by Dr Peter Furley, University of Edinburgh, to bring the soil nomenclature into line with the system most commonly used in Brazil. The report deals mainly with soils: the vegetation study was restricted to identification and mapping of plant communities (Fig. 2), collecting, and making some preliminary floristic lists.

Reconnaissance of the soils and vegetation of the Parque Nacional do Araguaia

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According to Freitas & da Silveira (1977), the soils of the Park are classified as 'Dystrophic Hydromorphic Laterites' and as 'Indiscriminate Hydromorphic Soils'. In the international nomenclature (SOIL TAXONOMY, Soil Conservation Service 1975) they are Oxisols (Allic Plinthaquox) with Entisols and Inceptisols (Aquents, Aquepts) in association.

The key factor in the uniformity of the soils is the geology, linked to the flat relief of the greater part of the Ilha do Bananal. According to MME-DNPM (1975) there is a covering of Pleistocene deposits over the whole Park, consisting principally of yellowish or brownish sands with alluvial Holocene sands on the margins of the rivers Araguaia, Javaés and Riozinho and to a lesser extent along the Aroaré and Randi-Toró (see Fig. 3).

In the areas of Quaternary deposits, the soils are those cited by Freitas & da Silveira (1977), principally Dystrophic Hydromorphic Laterite and various Hydromorphic Gleyed soils (see Fig. 4). In the Holocene deposits close to the larger rivers, the soils are sandy Regosols renewed continually by the alluvial deposition each year. Nearly all these soils are flooded for a number of months each year.

Although nearly the whole area of the Park is of these two soil formations there is a region of great topographic interest in the locality of the present headquarters of the Park where the elevation reaches 245 m above s.l., more or less 70 m above the annual flood level. Here there is an area of Precambrian Quartzite of the same type as occurs at Sta. Teresinha (MT) on the other bank of the Rio Araguaia. The greater part of this Quartzite is covered in deposits of Pleistocene or Holocene detritus but there are three central small hills without this covering. Thus the result is a complex mixture of Lithosols, Cambisols, Latosols and various Podzolized soils on the slopes of the elevated area. Lower down, near the Rio Araguaia, are sandy Lithosols (see profile 1, p. 339) carrying seasonally flooded forest with palms. Near the Headquarters buildings there is an area of outcropping quartzite with shallow Lithosols (profile 10) carrying tall Semideciduous Seasonal forest with indicator species of fertile soils, although the Lithosol here is not of high fertility. The explanation probably lies in these young soils showing rapid natural erosion and providing enough bases to support this vegetation, which itself will assist conservation of fertility through the biological cycle. In the central area between the highest of the small hills the Quaternary deposits have given rise to Red-Yellow Latosols, sometimes with deposition of solid Ironstone in the profile (profile 9). Here there are places where because of natural soil erosion layers of gravel or solid Ironstone occur at the surface, allowing only a sparse vegetation principally of grasses to develop; however, on the deeper soils there is a cerrado which is sometimes dense and varies greatly due to the abrupt changes in quality and depth of the soil. There is a tendency for colluvial material to accumulate in the depressions associated with the lines of drainage, producing deeper and probably younger soils which have a covering of dystrophic facies cerradão.

In the eastern part of the elevated area, the Quaternary deposits are much deeper and develop Red-Yellow Latosols without any trace of an Ironstone layer. These soils bear well-developed, tall Dry forest (Evergreen Seasonal forest) with trees reaching more than 30 m (profiles 5 & 6).

Above the area of Quaternary deposition, especially on the slopes of the valleys marking the lines of drainage, there are Red Cambisols, 30 to 50 cm in depth, above the Quartzites. Gravel sometimes appears in these shallow soils at the transition to the areas of Quaternary deposits and also in some places the rocks seem more slaty than quartzitic and give rise to very clayey soils (profiles 2 & 3). On these latter soils the vegetation is either dystrophic facies cerradão or evergreen forest. On the upper slopes of the three hills there are very dystrophic Lithosols, sometimes with mixtures of gravel and sand between the more stony tracts. Here the vegetation is cerrado, cerradão or evergreen forest, the last only in small patches close to the lines of drainage.

At about 180 m.s.l. on the eastern slope of the higher area the most characteristic soils of the Ilha do Bananal appear, i.e. Dystrophic Hydromorphic Laterites (profiles 7 & 8), with the typical vegetation of campo de murundu.

Thus, close to the Headquarters Buildings of the Park, within an area of more or less 16 km^2, are found almost all the types of soil and vegetation of the Park (see Figs 2 & 5).

Soil Profiles Examined During the Reconnaissance

Soils were examined with an auger to a maximum depth of c.1·30 m. The chemical analyses (Table 1, p. 341) were made by the Department of Agronomy, University of Brasília, from a mixture of the top 15 cm of excavation. The locations of all the soil samples with the exceptions of 7 and 8 are given in Figs 2 and 5.

PROFILE No. 1: *Dystrophic Lithosol* (*Soil Taxonomy* 1975: *Entisol*, probably Lithic Oxic Troporthent).

Locality:	500 m S of Park HQ.
Altitude:	c.180 m.
Physiography:	Undulate dune, 5%.
Drainage:	Rapid. Flooded in the wet season.
Parent material:	Alluvial sand.
Vegetation:	Seasonally flooded evergreen forest with palms.
Climate:	Hot, tropical, 1·482 (FAO/UNESCO 1971).
Profile:	0–2 cm decomposing leaves, small stones of concretionary material. 2 cm–1 m, coarse and fine sand, structureless, not plastic, not sticky; pH 4·7; without obvious morphology.

PROFILE No. 2: *Red-Yellow Latosol* (ST. *Oxisol*, Acrorthox).

Locality:	2·5 km NE of Park HQ.
Altitude:	c.215 m.
Physiography:	Undulate, 10%.
Drainage:	Strong.
Parent material:	Quartzite, ancient deposits of gravel.
Vegetation:	Dense cerradão, 15–18 m tall: *Hymenaea* sp., *Couepia* sp., *Copaifera langsdorfii*, *Vochysia haenkeana*, *Mouriri* sp.
Climate:	Hot, tropical 1·482 (FAO/UNESCO 1971).
Profile:	A. 0–15 cm bright brown (7·5 YR5/6), granular, weak; friable, not plastic, not sticky; with 20% of round pebbles and angular fragments of Quartzite; transition gradual; pH 5·1. A_2. 15–50 cm orange (5 YR6/8), granular, weak; friable, non plastic, slightly sticky; gravel content increasing with depth, still with fragments of Quartzite. The auger could not penetrate further.

PROFILE No. 3: *Dystrophic Cambisol* (ST. *Inceptisol*, probably Oxic Distropept).

Locality:	2·5 km NE of Park HQ.
Altitude:	210 m.
Physiography:	Undulate, 20%.
Drainage:	Strong.
Parent material:	Precambrian Quartzite.
Vegetation:	Dense cerradão, 15–18 m tall: *Hymenaea* sp., *Copaifera langsdorfii*, *Vochysia haenkeana*.
Climate:	Hot, tropical, 1·482 (FAO/UNESCO 1971).
Profile:	A. 0–10 cm bright brown (7·5 YR5/6), granular, weak; friable, weakly plastic, slightly sticky; with c.5% of rounded pebbles and angular fragments of Quartzite; transition gradual; pH 4·9. B. 10–35 cm orange (5 YR5/8), granular, weak; friable, plastic, sticky; with 5% of gravel; transition gradual. C. 35–60 cm orange (5 YR5/8), granular, weak; stoniness increasing rapidly with depth, with Quartzite still *in situ* at 60 cm.

PROFILE No. 4: *Dystrophic Hydromorphic Laterite* (ST. *Oxisol* probably Allic Plinthaquox).

Locality:	4 km NE of Park HQ, on the south side of the Lago da Mata.
Altitude:	c.180 m.

Physiography: Flat.
Drainage: Badly drained.
Parent material: Quaternary sand deposits, probably with material of Holocene age on top.
Vegetation: Seasonally flooded forest: *Piranhea trifoliolata*, *Vochysia* sp., *Sclerolobium froesii*, 'Farinha Seca' (Lauraceae), *Mouriri acutiflora*.

Climate: Hot, tropical 1·482 (FAO/UNESCO 1971).
Profile: A. 0–40 cm yellowish brown (2·5 Y5/3), clayey sand; weak, granular; friable, weakly plastic, slightly sticky; transition gradual; pH 4·5.
B. 40–85 cm greyish brown (7·5 YR5/2), sandy clay, with little mottles of red and yellow; friable, plastic, sticky; boundary diffuse.
C. 85–100 cm greyish yellow-brown (10 YR 6/2), clay; wet, structureless; very plastic, very sticky; without mottling.

PROFILE No. 5: *Red-Yellow Latosol* (ST. *Oxisol* Acrorthox).
Locality: 4 km NE of Park HQ.
Altitude: c.190 m.
Physiography: Flat.
Drainage: Good.
Parent material: Quaternary sandy deposits?
Vegetation: High Evergreen Seasonal forest, c.30 m tall: *Vitex* sp., *Hymenaea courbaril* var. *stilbocarpa*, *Jacaranda copaia*, *Enterolobium schomburgkii*.
Climate: Hot tropical 1·482 (FAO/UNESCO 1971).
Profile: A_0. 4–0 cm decaying leaves.
A. 0–20 cm brown (7·5 YR4/6), sandy clay; weak structure, granular; weakly plastic, slightly sticky; transition gradual; pH 4·3.
B. 20 cm–1 m bright reddish brown (5 YR5/6), sandy clay; weak structure, granular; plastic, sticky, without concretionary material and without mottling.

PROFILE No. 6: *Red-Yellow* (ST. *Oxisol*, Acrorthox).
Locality: 2·7 km E of Park HQ.
Altitude: c.195 m.
Physiography: Flat–slightly undulate. Profile with a 2% slope.
Drainage: Good.
Parent material: Quaternary sands?
Vegetation: High Evergreen Seasonal forest, to 30 m tall: 'Louro Preto', *Enterolobium schomburgkii*, *Apuleia molaris*.
Climate: Hot tropical 1·482 (FAO/UNESCO 1971).
Profile: A_0. 2–0 cm decaying leaves.
A. 0–35 cm dull reddish brown (5 YR4/4), sandy clay loam; weak, granular, porous; friable, weakly plastic, slightly sticky; transition gradual; pH 4·6.
B. 35 cm–1 m bright reddish brown (5 YR5/6), sandy clay loam; weak, granular; plastic, slightly sticky; without concretionary material or mottling.

This profile is very similar to the previous but more sandy. The forest is more open and there is greater dominance of 'Louro Preto' and *Enterolobium schomburgkii*, and species typical of general forest habitats such as *Physocallyma scaberrimum* are present. Probably the forest has been disturbed in the past.

PROFILE No. 7: *Dystrophic Hydromorphic Laterite* (ST. *Oxisol* probably Allic Plinthaquox).
Locality: c.7 km NE of Park HQ.
Altitude: c.175 m.
Physiography: Flat with murundus [grassland with hummocks].
Drainage: Impeded, flooded to a depth of 1 m in the wet season.
Parent material: Quaternary sands.
Vegetation: Grasses and sedges.
Climate: Hot tropical 1·482 (FAO/UNESCO 1971).
Profile: 0–45 cm brown (10 YR4/4), sandy clay loam; pH 4·6.
45–80 cm dark greyish yellow (2·5 Y5/2), clay; plastic, sticky, inundated at the depth of 70 cm.
80–100 cm dark greyish yellow (2·5 Y4/2), clay, with reddish mottling.

PROFILE No. 8:
Locality: As No. 7 but on top of a murundu (hummock) 1·4 m high.
Vegetation: *Tabebuia caraiba*, *Curatella americana*, shrubs typical of cerrado.
Profile: 80 cm of a sandy clayey soil above a plastic clay; pH 4·3.

PROFILE No. 9: Red-Yellow Latosol (ST. *Oxisol*, Acrorthox).
Locality: c.1 km E of Park HQ.
Altitude: c.195 m
Physiography: Undulate. Profile on a flat area.
Drainage: Good.
Parent material: Quaternary sands.
Vegetation: Cerrado: *Qualea grandiflora*, *Curatella americana*, *Hirtella glandulosa*, *Himatanthus obovatus*; nearby there are *Qualea parviflora*, *Tabebuia caraiba*, *Antonia ovata* and *Xylopia* sp.
Climate: Hot Tropical 1·482 (FAO/UNESCO 1971).
Profile: 0–50 cm bright reddish brown (5 YR5/6), sandy clay loam, with round pebbles increasing with depth; granular, friable, weakly plastic, slightly sticky. pH 5·0.
Impenetrable by auger more than 50 cm due to the great quantity of gravel.

PROFILE No. 10: Lithosol (ST. *Entisol*, probably Lithic Oxic Troporthent).
Locality: Park HQ.
Altitude: c.185 m.
Physiography: Flat, at the top of the steep bank of the Rio Araguaia.
Drainage: Good.
Parent material: Precambrian Quartzite.
Vegetation: Semideciduous seasonal forest: *Sterculia striata*, *Cedrella fissilis*, *Aspidosperma* sp. 'Guatambu', *Maclura tinctoria*.
Climate: Hot Tropical 1·482 (FAO/UNESCO 1971).
Profile: A. 0–10 cm olive brown (2·5 Y4/4); coarse and fine sand with pieces of Quartzite above broken Quartzite in process of erosion. Blocks of Quartzite at the soil surface. pH 5·0.
Impenetrable by auger more than 10 cm.

TABLE 1

Analyses of a mixture of the top 15 cm of excavation.
RYL = Red-Yellow Latosol

Profile No.	Type of soil	Vegetation	pH	Al Meq/ 100 ml	Ca + Mg Meq/ 100 ml	P p.p.m.	K p.p.m.
1	Regosol	Seasonally flooded forest	4·7	2·8	0·1	3	26
2	RYL	Cerradão	5·1	0·6	0·3	3	58
3	Cambisol	Cerradão	4·9	0·7	0·3	3	58
4	Hydromorphic Laterite	Seasonally flooded forest	4·5	2·3	0·0	3	31
5	RYL	Evergreen forest	4·3	1·3	0·0	4	19
6	RYL	Evergreen forest	4·6	—	—	—	—
7	Hydromorphic Laterite	Seasonally flooded campo	4·6	2·8	0·1	2	19
8	Hydromorphic Laterite	Cerrado on murundu	4·3	3·7	0·0	3	24
9	RYL	Cerrado	5·0	0·5	0·5	2	32
10	Lithosol	Semideciduous forest	5·0	0·6	1·0	6	24

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