Rezente Pollenspektren der Planalto-Region der Serra Geral, Rio Grande do Sul/ Brasilien: Rekonstruktion der rezenten Vegetation – Eine Fallstudie

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Recent palynological spectra from the Planalto region of the Serra Geral, Rio Grande do Sul/ Brazil: Reconstruction of contemporary vegetation – a case study

Thesis for obtaining the doctorial degree in natural sciences

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Eidesstattliche Erklärung

Hiermit erkäre ich, **Kerstin Kriegel**, geboren am 12.01.1977, daß ich die vorliegende Arbeit ohne unerlaubte Hilfe und nur mit den in der Arbeit angegebenen Hilfsmitteln angefertigt habe.
Deweiteren bestätige ich, daß bisher von mir noch kein Promotionsversuch an einer anderen Universität unternommen wurde.

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Abstract

The relationships between vegetation and recent palynomorphs are examined along a areal of 8000 km² in the state of Rio Grande do Sul, South Brazil. This areal is located between Caxias do Sul (NW) and Cambará do Sul (NE), and Canela/Gramado (SW) and the CPCN Pró-Mata (Centro de Pesquisas e Conservação da Natureza Pró-Mata, SE). Local plant communities of semi-deciduous and deciduous forests, *Araucaria* forests, Capões, gallery forests, Capoeiras, grasslands (Campos) and anthropogenic affected areas were sampled for palynological analysis and plant identification. The distribution of these communities can be related to the equivalent specific regional environmental parameters such as topography, temperature and moisture. The palynomorphs of eighty-five surface-soil samples were classified using TILIA and raster interpolation method ArcGIS 8/ArcMap for visualisation of counted pollen and spore data, cluster analysis and were ordinated using Principal Component Analysis (PCA). Results indicate that the plant communities sampled have distinct pollen and spore assemblages: *Araucaria* forests are characterised by *Dicksonia sellowiana*; semi-deciduous and deciduous forests are characterised by Cyatheaceae; Capões are characterised by *Podocarpus sp.*, Poaceae, Euphorbiaceae, *Ilex sp.* and *Drymis brasiliensis*, gallery forests are also characterised by *Podocarpus sp.*, Poaceae, Euphorbiaceae and *Ilex sp.* but in lower amounts, and grasslands are characterised by Poaceae, Anthocerotaceae, Cyperaceae and Asteraceae. While Capoeiras are characterised by pollen and spores of the previous (original) plant communities, anthropogenic affected areas are characterised by pollen and spores of actual plant communities. The raster interpolation method shows that two spore types (*Dicksonia sellowiana* and Cyatheaceae) are sufficient to distinguish *Araucaria* forests, semi-deciduous and deciduous forests. Cluster analysis and PCA revealed that palynological spectra permit to interpret the distribution of vegetation. Applied on fossil assemblages, they allow an interpretation of the vegetation history.

Zusammenfassung

In der vorliegenden Arbeit waren die Beziehungen zwischen Vegetation und der rezenten Palynomorphae in Oberflächenbodenproben Gegenstand der Untersuchungen. Als Untersuchungsgebiet wurde ein 8000 km² großes Areal im Bundesstaat Rio Grande do Sul, Brasilien ausgewählt, das sich zwischen den Ortschaften Caxias do Sul (NW) und Cambará do Sul (NO) sowie Canela/Gramado (SW) und dem Pró-Mata – Schutzareal (CPCN, Centro de Pesquisas e Conservação da Natureza Pró-Mata, SO) erstreckte. In dieser Region lassen sich 7 pflanzensoziologische Einheiten unterscheiden – subtropisch Halbimmergrüne Feuchtwälder und Laubabwerfende Trockenwälder, *Araukarien*-Wälder, inselartige *Araukarien*wälder (Capões), Galleriewälder, verbuschte Grasländer (Capoeiras), offene Grasländer (Campos) und stark anthropogen überprägte Flächen. Aus den Oberböden der in dem Untersuchungsgebiet anzutreffenden Vegetationstypen wurden die Pollen- und Sporengesellschaften isoliert und sowohl qualitativ als auch quantitativ analysisert. Außerdem wurde für jede Fläche eine bodengestützte Vegetationskartierung nach der Methode von BRAUN-BLANQUET durchgeführt. Die Verteilung dieser pflanzensoziologischen Einheiten ist stark an die abiotischen Parameter der Region, wie Topographie, Temperatur und Feuchtigkeit, gekoppelt. Insgesamt wurden 85 Oberflächenbodenproben quantitativ und qualitativ palynologisch ausgewertet. Die Ergebnisse wurden mit Hilfe der TILIA-Software und der Raster-Interpolations-Methode von ArcGIS 8/ArcMap visualisiert. Außerdem wurden die Ergebnisse aus der palynologischen Untersuchung einer multivariaten statistischen Auswertung – Clusteranalyse, Hauptkomponentenanalyse (**P**rincipal **C**omponent **A**nalysis, PCA) - unterzogen. Die Ergebnisse zeigen, daß jede der unterschiedenen pflanzensoziologischen Einheiten ein spezifisches palynologisches Spektrum aufweist: *Araukarien*wälder können mit Hilfe der Sporen des Baumfarnes *Dicksonia sellowiana* charakterisiert werden; in den halbimmergrünen und laubabwerfenden Wäldern sind Sporen einer zweiten Baumfarn-Familie, die der Cyatheaceae, dominant; *Podocarpus sp.*, Poaceae, Euphorbiaceae, *Ilex sp.* und *Drymis brasiliensis* sind typisch für Capões; Galleriewälder werden ebenfalls von den Pollen von *Podocarpus sp.*, Poaceae, Euphorbiaceae und *Ilex sp.* dominiert jedoch zu einem

deutlich geringeren Anteil als in Capões; und für Grasländer sind die Pollen der Poaceae, Anthocerotaceae, Cyperaceae und Asteraceae charakteristisch. Während in den Oberflächenbodenproben der Capoeira-Flächen vor allem Palynomorphae der vormals anzutreffenden Vegetation nachweisbar sind, werden die stark anthropogen überprägten Flächen durch Pollen und Sporen der aktuellen Vegetation charakterisiert. Die angewendete Raster-Interpolations-Methode hat deutlich gezeigt, daß zwei Sporen-Typen (*Dicksonia sellowiana* und Cyatheaceae) ausreichend sind, um *Araukarien*wälder, halbimmergrüne und laubabwerfende Wälder palynologisch voneinander zu unterscheiden. Die Clusteranalyse und die PCA haben verdeutlicht, daß palynologische Spektren eine Interpretation der Vegetationsverteilung gestatten. Wird diese Methode auf fossile Proben angewendet, erlaubt sie eine Interpretation der Vegetation in Raum und Zeit.

Resumo

No presente trabalho, foram analisadas as relações entre vegetação recente e palinomorfos de solo, em uma área de 8.000 Km^2 no Estado do Rio Grande do Sul, Região Sul do Brasil, localizada entre Caxias do Sul (limite Noroeste – NO), Cambará do Sul (limite Nordeste – NE), Canela/Gramado (limite Sudoeste – SO) e o Centro de Pesquisas e Conservação da Natureza Pró-Mata (CPCN Pró-Mata, limite Sudeste – SE). Para o desenvolvimento do estudo foram coletadas amostras de solo para análise palinomórfica e identificadas as plantas ocorrentes em cada ponto. Na área de estudo ocorrem as seguintes Comunidades Vegetais, cuja distribuição pode ser relacionada com fatores ambientais como topografia, temperatura e umidade: Floresta Estacional Semidecidual; Floresta Estacional Decidual, Mata de Araucária (Floresta Ombrófila Mista); Capões; Mata de Galeria; Capoeira; Campo e Áreas de Cultivo. Os palinomorfos de 85 amostras de solo foram classificados com a utilização do Programa TILIA e o *Método de interpolação* matricial (*Raster Interpolation Method, ArcGIS 8/ArcMap*), possibilitando a visualização dos dados palinomórficos, os quais posteriormente, foram analisados por *Cluster* e ordenados por *Principal Component Analysis (PCA)*. Os resultados indicam que as diferentes Comunidades Vegetais amostradas possuem associações distintas de polens e esporos. A Mata de Araucária é caracterizada pelo domínio de esporos de *Dicksonia sellowiana*; as Florestas Estacional Semidecidual e Estacional Decidual pelo de esporos de Cyatheaceae; Capões pelo de polens de *Podocarpus* sp., Poaceae, Euphorbiaceae, *Ilex* sp. e *Drymis brasiliensis*; Mata de Galeria pelo de polens de *Podocarpus* sp., Poaceae, Euphorbiaceae e *Ilex* sp., todavia em quantidades consideravelmente menores que a anterior; e Campos pelo de esporos de Anthocerotaceae e polens de Poaceae, Cyperaceae e Asteraceae. De forma bastante diferenciada, as Capoeiras são caracterizadas por palinomorfos das Comunidades Vegetais que se desenvolviam nesses locais anteriormente. As Áreas de Cultivo são caracterizadas por palinomorfos das Comunidades Vegetais circundantes atuais. O *Método de interpolação* mostra que dois tipos de esporos (*Dicksonia sellowiana* e Cyatheaceae) são suficientes para distinguir Mata de Araucária, Floresta Estacional Semidecidual e Floresta Estacional Decidual. *Cluster Analysis* e *PCA* revelam que os espectros polínicos permitem inferir as Comunidades

Vegetais. Esses métodos também, quando aplicados em associações palinomórficas fósseis, permitem estabelecer a composição da vegetação em tempos remotos.

1. Introduction

Brazil offers an interesting investigation area with respect to its bountiful and impressive flora and fauna. Since the beginnings of the 19th century, many expeditions were undertaken to research Brazil. The scientifically interested Earl KLEMENS WENZEL LOTHAR NEPOMUK VON METTERNICH (1773–1859), foreign secretary of Austria around 1800, organised an expedition to Brazil from 1817 to 1821. Noteworthy scientists like the botanist HEINRICH WILHELM SCHOTT (1794-1865), the botanist and mineralogist JOHANN BAPTIST EMANUEL POHL (1782-1834) and the zoologist JOHANN NATTERER (1787-1834) accompanied him. Since the 19th century the vegetation of South Brazil has been meticulously explored. The first scientist who studied the vegetation of Rio Grande do Sul was AUGUSTE DE SAINT-HILAIRE (1779-1853). Numerous scientists followed. LINDMAN (1906), KLEIN (1960, 1961, 1964, 1984), RAMBO (1945, 1956) and VELOSO & KLEIN (1957, 1959, 1961, 1968) are being mentioned exemplary.

During the 20th century the original forest vegetation of Rio Grande do Sul has been nearly completely cleared. Thus, the knowledge about the original vegetation is fragmentary and a reconstruction is difficult (LEITE 2002, OVINGTON 1983). Today, the vegetation of Rio Grande do Sul is strongly affected by agro-forestal use. Therefore, the environmental agency of Brazil (IBAMA) placed the forests of Rio Grande do Sul in large part under protection by the Brazilian legislation since 1998.

The identification of vegetation proves itself as being complicated as a result of the density of vegetation and the tree size. The height of trees renders the collection of leave and blossom material impossible for plant identification. Mapping of vegetation according to BRAUN-BLANQUET (1964), as applied in Europe, is hence difficult to realize. Therefore, recently the plant covering is identified by remote sensing. But this method holds errors regard to the resolution, therefore mapping of vegetation in the field is indispensable.

Since the 20th century the correlation between contemporary vegetation and palynological spectra and the history of vegetation of South America, especially of Brazil, has received growing attention. GRAF (1992) undertook the effort to reconstruct the palaeoenvironment of the Andes based on palynological analysis. BEHLING (e.g. BEHLING 1993, 2001, 2002, 2003, BEHLING & NEGRELLE 2001, BEHLING et al. 2000, 2001, 2004) analysed meticulously the palaeoenvironment of Brazil. He extracted and analysed palynomorphs from cores of peat, lakes and other organic deposits. Determined pollen and spores of the deposits were used to provide better insight into previous vegetation. Grassland ecosystems (their composition, biodiversity and distribution) and advices of human impacts on the vegetation received special attention because different opinions exist. LINDMANN (1906) has already noticed that the forest-grassland-pattern of Rio Grande do Sul does not present the climax. According to his opinion the climate would generate a more widespread forest. Some ecologists (e.g. DE QUADROS & PILLAR 2002,) explain the grassland-forest-mosaic of South Brazil as a result of human impacts. Unlike this position, others explain this phenomenon as a result of climatic changes especially during Late Quaternary times (BEHLING 1995, 2001, LORSCHEITTER 1988). Knowledge of palaeograssland distribution and composition may help to improve models of past vegetation and climate in these tropical and subtropical regions.

The present thesis may represent a possibility to simplify the reconstruction method. This work is attached to the thesis of EBNER (2005), who developed and tested the method in the biological reserve “Pró-Mata” (near São Francisco de Paula/ RS, Brazil). The method is based on a palynological analysis of topsoil (analysis of “recent” pollen and spores) in relationship with the contemporary vegetation. Local plant communities of *Araucaria* forests, semi-deciduous and deciduous forests, islands of *Araucaria* forest (Capões), gallery forests, scrubland (Capoeiras), grassland (Campo) and anthropogenic affected area were sampled for pollen analysis and the contemporary vegetation was identified according to a simplified BRAUN-BLANQUET-technique. A special pollen spectrum for each explored vegetation type was aimed to be detected. These spectra may eventually be utilised by future scientists in order to reconstruct palaeoenvironment. In this work emphases were laid on the following 5 questions.

Objectives

1. Are the different vegetation types of the plateau of Rio Grande do Sul (Planalto) and the slopes of the Serra Geral distinguishable from each other by pollen spectra extracted from topsoil and if so, to what extent?

2. If the first objective can be answered with YES, are discriminatory pollen/ spore type detected characterising a certain vegetation type?

3. Is EBNER`s (2005) proposition, as postulated on the basis of his research in the Pró-Mata area, applicable to a larger area in the region of the Planalto and Serra Geral?

4. How detailed does a topsoil pollen spectrum represent the contemporary plant covering?

5. To what extent is a reconstruction of the original plant formations and their distribution in former time (under application of the drilling method) feasible?

2. Material and methods

2.1. Study area

2.1.1 Geographical position

The present study was carried out in the state of Rio Grande do Sul, South Brazil. The study site was defined between the longitudinal values of 50°50'33.60" and 51°09'53.94" and latitudinal values 29°18'59.40" and 29°31'10.70", including the municipalities Cambará do Sul, Canela, Caxias do Sul, Gramado, Jaquirana, Linha Nova, Nova Petropolis and São Francisco de Paula (Fig. 1). The limits of the study site corresponded to Caxias do Sul at northwest, Cambará do Sul at northeast, Canela/Gramado at southwest and the biological reserve "Pró-Mata" (Centro de Pesquisas e Conservação da Natureza Pró-Mata) at southeast. To consider the regional variability of the different vegetation types, the observed area was divided from East to West in three sub-areas (Fig. 1, red lines).

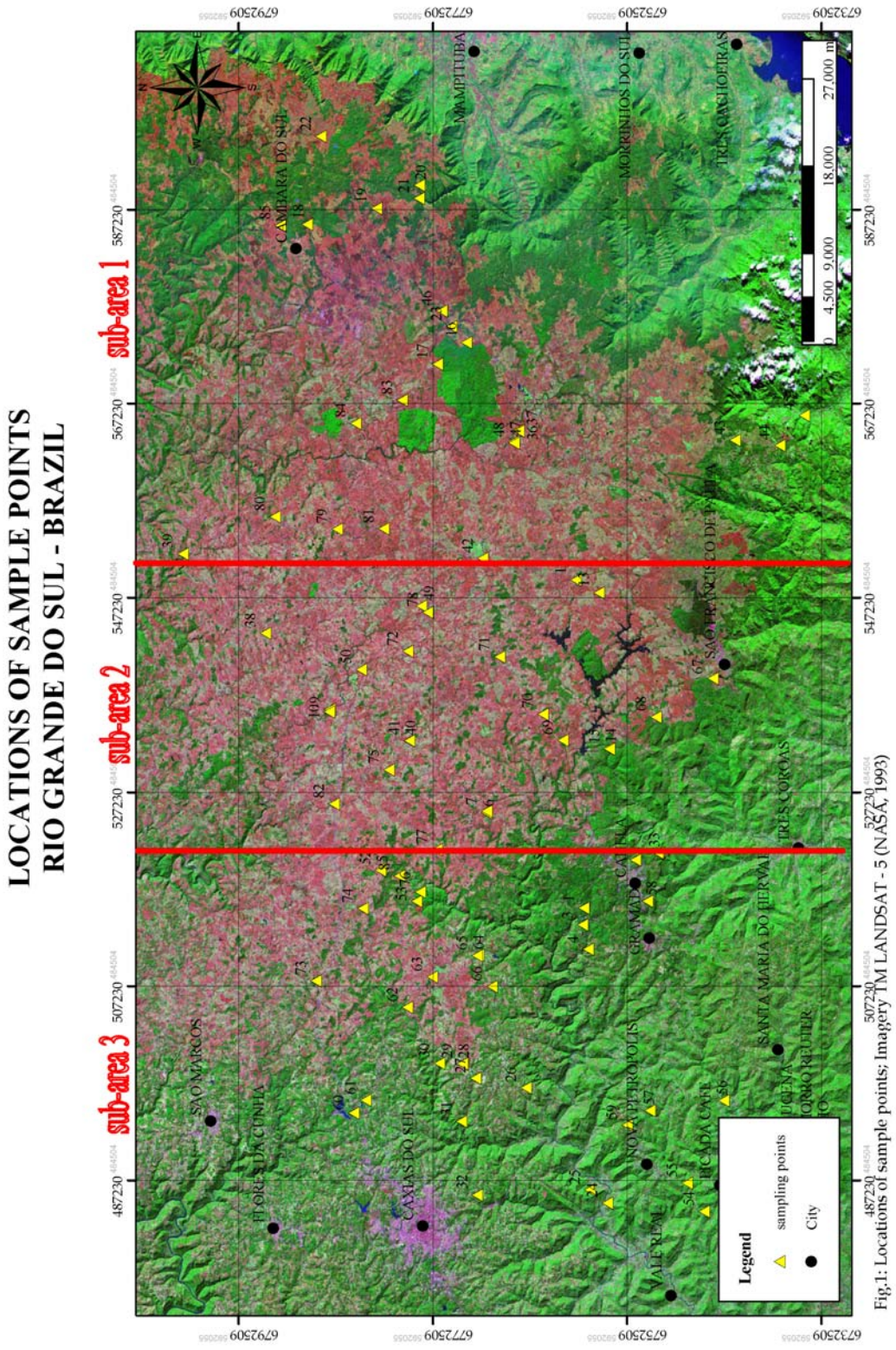


Fig. 1: Locations of sample points; Imagery TM LANDSAT – 5 (NASA, 1993)

2.1.2 Landscape, geomorphology and soil

The study area was located at the top of the South Brazilian plateau, *Planalto* (HUECK 1966) and its slopes. The cleft and steep rugged slopes of the Planalto (Fig. 2) form a distinct geomorphological unit, the so-called **Serra Geral**. The Planalto is formed by ancient sedimentary rocks mainly ***sandstone*** from the Botucatu–formation (Jurassic/Cretaceous) and is covered by ***trap basalt*** (IBGE 1986, LEINZ 1949, ROISEMBERG 1990).

Fig. 2: Cleft slopes of Serra Geral; transition from Araucaria forest (top) to Mata Atlântica, photo: M. EBNER

The ground is subject to profound weathering. These activities result in elevated acidification, a slow base saturation and cation exchange capacity. Laterites and limonitic surface crusting are common phenomena not only in grassland but also in humid forests (SCHULTZ 2000). The pedogenesis is mainly influenced by the humid subtropical climate with high precipitation rates.

According to SCHULTZ (2000), the soils in the studied region belong to the Acrisol-zone. According to Brazilian Soil Classification (SIBCS, EMBRAPA 1999) and STRECK et al. (2002) five soil types are found in the area (Fig. 3):

1) ***Argisol*** occurs predominantly in Rio Grande do Sul and corresponds to Podsol in the Russian Systematics or to Ultisol in US Soil Taxonomy (1975). Argisols are moderately profound, well drained soils. Their main characteristic is the presence of a textural B-horizon. The B-horizon is always more clayish than the horizons above and below it. A-Bt-C is a typical horizon sequence, where Bt represents the textural B-horizon.

2) ***Alisol*** originates from rhyolite, occurs in the region Caxias do Sul and shows an elevated content of aluminium. Usually, Alisol is moderately profound.

3) ***Cambisol*** occurs in areas with high rates of rainfall and low temperatures. Cambisols are shallow and well drained soils still including fragments of the parent material in their upper horizons. Cambisol is typical for the regions of the Planalto and Caxias do Sul. Their horizon sequence is A-Bi-C, where Bi represents the B incipient horizon. These soils are similar to Tropepts in Soil Taxonomy (1975).

4) ***Chernossol*** is a shallow or profound and less coloured soil. It contains at least 18% iron, as well as high concentrations of calcium and magnesium.

5) ***Neosol*** **(Litholic Neosol)** is a “young” soil that contains many primary minerals and high amounts of silt, also in the surface horizon. It is present on accentuated relief in the regions of Caxias do Sul and the Planalto. Litholic Neosol was previously classified as Litholic Soil. Like Cambisol, Litholic is widely distributed in Brazil and is shallow and sometimes stony.

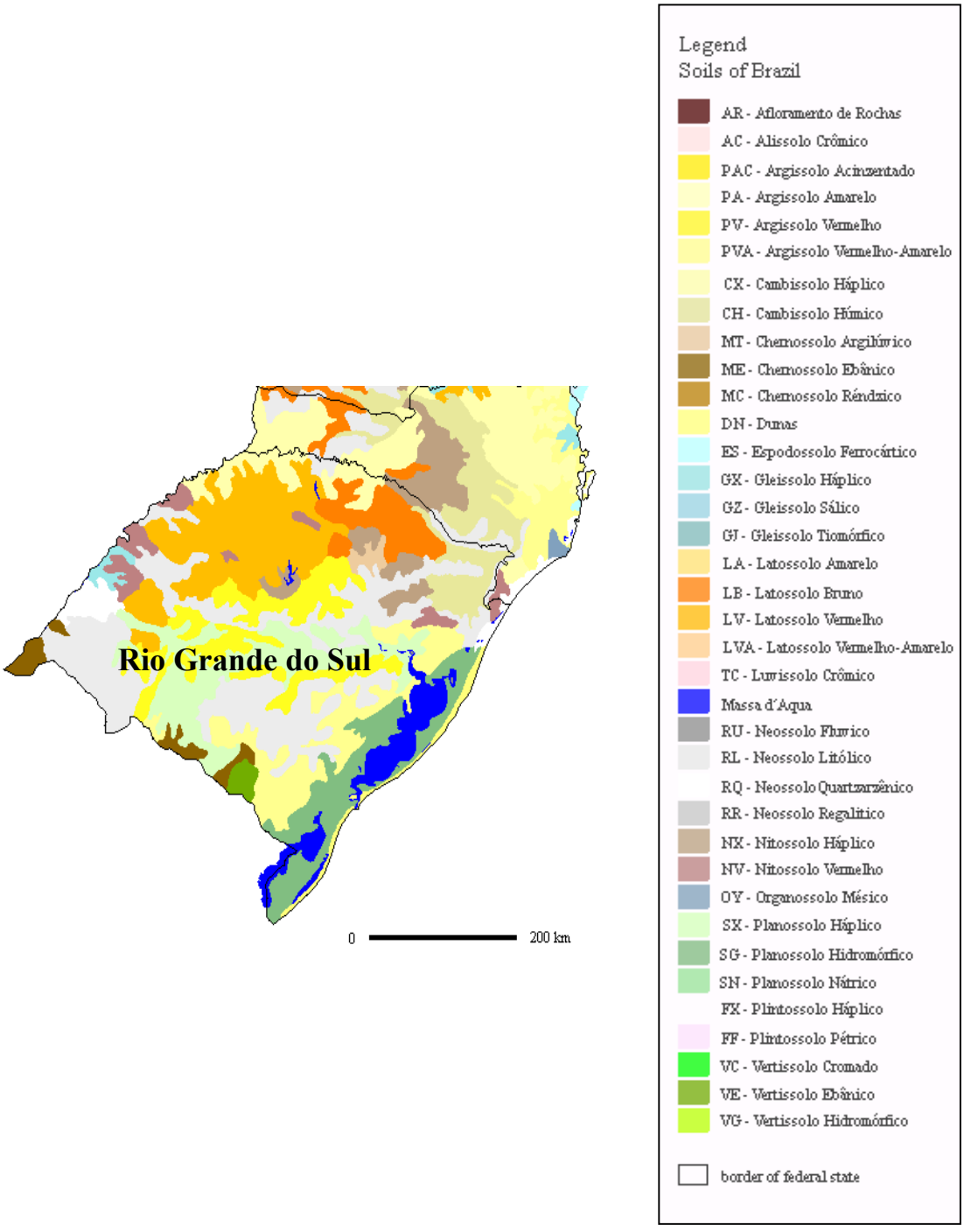


Fig. 3: Soils of Rio Grande do Sul according to the Brazilian Soil Classification (EMBRAPA 1999, IBGE 2005)

2.1.3 Climate

The humid subtropical climate predominates in South Brazil (SCHULTZ 2000). It varies from humid to moderate climate and lacks dry periods (FÄHSER 1985). Precipitation is influenced by tropical cyclones, zenith rainfall and maritime trade winds on the one hand and sea current (Brasil stream) on the other hand. These factors interact upon the climate of South Brazil (IBGE 1986, GOLTE 1993). The study area was located on the eastern side of the South American continent therefore the permanent high pressure determines the climate with maximum rainfall in summer (LAUER & RAFIQPOOR 2002). The climate causes a longitudinal humidity-vegetation-gradient from the East to the West, with decreasing precipitation from the coast westward. While the climate, at lower regions of Rio Grande do Sul and the slopes of Serra Geral, corresponds to type Cfa in the classification of KÖPPEN (1923), the Planalto is characterised by the temperate climate type Cfb1 (MORENO 1961, NIMER 1989) and Bslphγ (LAUER & RAFIQPOOR 2002). Reference values from São Francisco de Paula can be applied to describe the climate of the explored area. In São Francisco de Paula the average annual temperature is 14.5°C, July being the coldest month (10.3°C); January the warmest (18.8°C). São Francisco de Paula features an average precipitation of 2252mm annually. The precipitations are dispersed evenly over the year (Fig. 4). Polar air masses are responsible for pleasant temperatures all over the year. Frost and snow are rare climatic phenomena (GOLTE 1993, HUECK 1966, MORENO 1961). Due to the subtropical climate, various vegetation types are able to grow within a small regional scale. Rainforests occur beside semi-deciduous and deciduous forests as well as savanna and grassland.

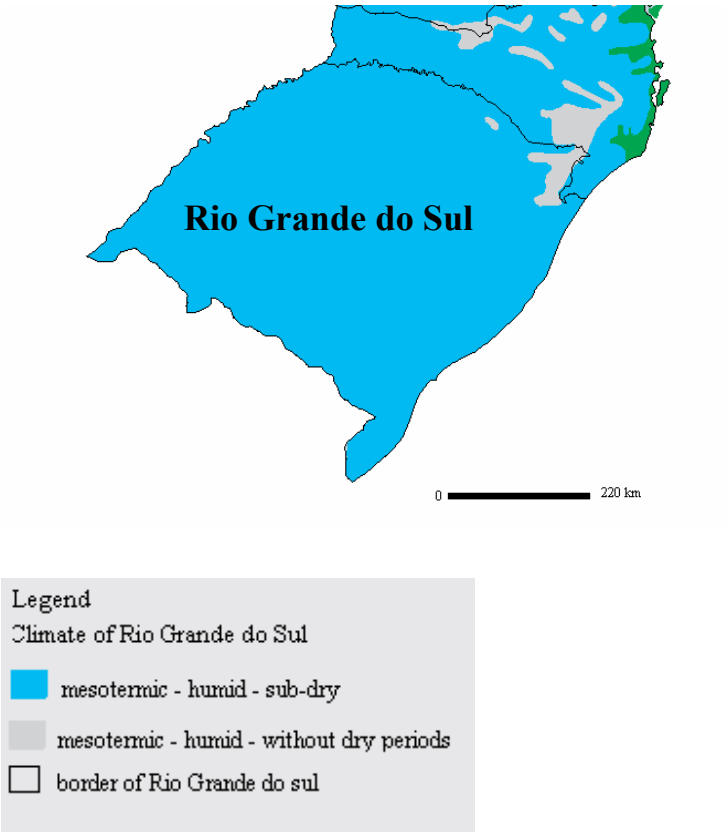


Fig. 4: Climate of Rio Grande do Sul according to IBGE (2005)

2.1.4 Vegetation in the study region

Rio Grande do Sul belongs to the ecozone of the Evergreen Subtropics (SCHULTZ 2000). The Evergreen Subtropics are located between the latitudes 25° and 35°, and are solely located on the east side of continents.

Rio Grande do Sul is characterised by an interesting mosaic of grassland and forest vegetation. A transition of *Araucaria* forest, broad-leaved evergreen forest (in the Anglophone literature also named warm-temperate, e.g. OVINGTON 1983) and semi-deciduous forest predominates the northern territory of the state. The southern territory is dominated by grassland (HUECK & SEIBERT, 1972, KLEIN, 1975 and TEIXEIRA et al., 1986).

The total territory of the state of Rio Grande do Sul includes 132.103 km² (46.73%) of grassland and 49.557 km² (17.53%) of forest (SEMA 2001). The forest ecosystems have been strongly cleared during the last century. Today, the vegetation of Rio Grande do Sul is strongly affected by agro-forestal use. Thus, the knowledge about the original vegetation is only fragmentary and a reconstruction is difficult (HUECK 1956, 1966, OVINGTON 1983).

The modern potential natural vegetation cover of the study site is composed of voluptuous broad-leaved evergreen forest which is located on the coastal eastern slopes of the Serra Geral. These slopes are characterised by high amounts of precipitation during all season. As a result of lower amounts of precipitation westwards, this forest type turn into a semi-deciduous forest and then into a deciduous forest. The Planalto is predominantly covered by subtropical grassland, which in Brazil is called ´campos`. Patches of these species-rich grasslands form a mosaic with *Araucaria* forests (Fig. 5).

Fig. 5: Mosaic of grassland (Campo) and islands of Araucaria forest (Capões)

Different methods were applied to classify the vegetation of the Neotropics, especially of South Brazil (DRUDE 1890, RAMBO 1956, LINDMANN 1906, HUECK and SEIBERT 1972). Recent publications refer to a nomenclature proposed by VELOSO & GÓES-FILHO (1982) which was further modified and applied by JOLY et al. (1999), IBGE (1986) and others. In this system the vegetation of South Brazil is divided into phyto-ecological regions. A phyto-ecological region is characterised by an original, well-defined floristic composition, by uniform climate and similar geomorphology, whereas the geology may be different (IBGE 1986).

In the present study, seven different vegetation types were considered as follow (Fig. 6, 7):

1. **Semi-deciduous forest (Floresta Estacional Semidecidual)**
2. **Deciduous forest (Floresta Estacional Decidual)**
3. ***Araucaria* forest (Floresta Ombrófila Mista, Mata de Araucária)**
4. **Islands of *Araucaria* forest (Capões, Matas insulares)**
5. **Gallery forest (Mata de Galeria)**.
6. **Grassland (Campo** and **Capoeira)**
7. **Anthropogenic disturbed area**

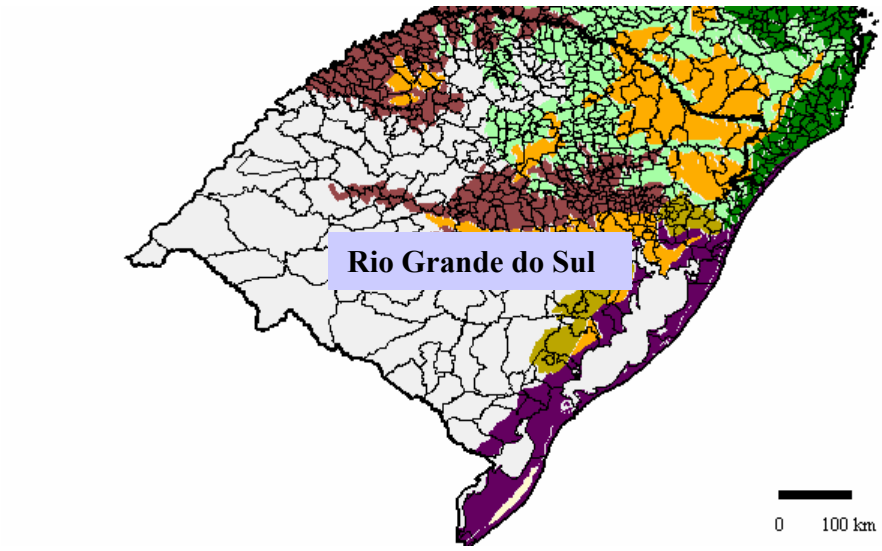
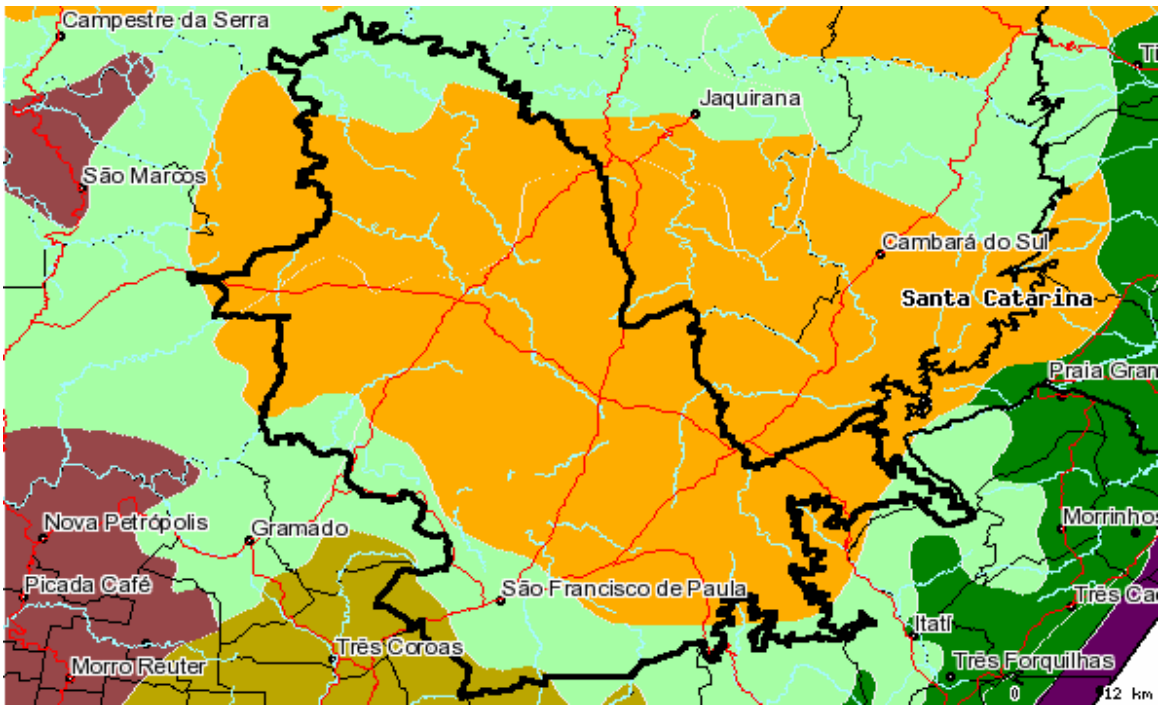


Fig. 6: Vegetation of Rio Grande do Sul (SOS Mata Atlântica, 2003, slightly modified, legend: below Fig. 7)



- Territorial border
- Road
- Principal drainage
- Municipal border
- Pioneer vegetation
- *Araucaria* forest
- Subtropical broad-leaved evergreen forest
- Semi-deciduous forest
- Deciduous forest
- Grassland alternating with gallery forests and Capões

Fig. 7: Overview of the vegetation of the study area (SOS Mata Atlântica, 2003, slightly modified)

1. Semi-deciduous forest (Floresta Estacional Semidecidual)

This forest type is found exclusively on the Serra Geral slopes at low altitudes. Southward it is limited by pasture and to the north by *Araucaria* forest and the grassland of the Planalto. Within this geographical range the semi-deciduous forest may vary considerably. While the forest in the valley of the river Maquiné assumes a more subtropical character

like the Atlantic rainforest, the forests of the Canela region and parts of the river Caí valley present a blend between a semi-deciduous forest and a deciduous forest.

Fig. 8: Subtropical forest in the valley of the river Caí

This forest type resembles tropical forest regarding the floristic composition and the occurrence of lianas. A feature of the semi-deciduous forest is a clear understorey structure. The upper tree storey contains strong trees forming dense canopy. This storey is mainly composed by species of the genera of Lauraceae *Ocotea* and *Nectandra*, *Cabralea canjerana* (Meliaceae), *Cedrela fissilis* (Meliaceae) and *Luehea divaricata* (*Tiliaceae*). The medium storey generally contains *Actinostemon concolor* (Euphorbiaceae), *Sorocea bonplandii* (Moraceae) as well as *Euterpe edulis* (Palmito, Arecaceae) whose "hearts" are an appreciated delicacy. The subjacent shrub storey contains high shrubs and small trees. *Trichilia elegans* (Meliaceae), *Mollinedia* (Monimiaceae), *Rudgea* (Rubiaceae), *Psychotria*

(Rubiaceae), *Piper* (Piperaceae) and *Celtis* (Ulmaceae) are the dominant species. Lianas render the forest its typical subtropical character. Species of *Mikania* (Asteraceae), *Aristolochia* (Aristolochiaceae, Fig. 9), *Smilax* (Smilacaceae) and several species of the families Bignoniaceae and Leguminosae appear frequently. Another species is the "*stairs of monkey"* (*Bauhinia langsdorffiana*) named after its zigzag growth, belonging to the Caesalpinoidae.

This high plant diversity was already referred by KLEIN (1964, 1984) and VELOSO & KLEIN (1957, 1959). They described meticulously the composition of several formations of this forest type and underlined this aspect with numerous species.

Fig. 9: Aristolochia sp. (Aristolochiaceae)

Tree ferns like *Alsophila spp.* and *Nephelea spp.* (Cyatheaceae) appear on humid ground (Fig. 10 and 11).

Fig. 10: Forest with tree ferns

Fig. 11: Stem of a tree fern

Epiphytes are significant components of semi-deciduous forests. Most of the epiphytes belong to the orchids, e.g. species of the genera *Cattleya* and *Oncidium*. Further on, various cactus species, e.g. of *Rhipsalis* and bromelies like *Tillandsia* and *Vriesea* are abundant. The prevalence of bryophytes and lichens is obvious.

2. Deciduous forest (Floresta Estacional Decidual)

Upcountry semi-deciduous forest merges into deciduous forest. The River Caí valley in the regions of Nova Petropolis, Picada Café and Morro Reuter is interesting because it is characterised by a mélange of semi-deciduous and deciduous forests (Fig. 7). Controversial studies exist about the distinct `limits` between these forest types.

The floristic inventories of semi-deciduous and deciduous forests are similar to subtropical broad-leaved forests but they also include deciduous floristic elements (IBGE 1986). While 20-50% of the plants are deciduous in semi-deciduous forests, deciduous forests include more than 50% deciduous plants.

3. Araucaria forest (Floresta Ombrófila Mista, Mata de Araucária)

The *Araucaria* forest (Fig. 12) is formed by the *Araucaria angustifolia* (pinheiro–do–paraná), which due to its habit is the main characteristic tree of the Planalto. According to HUECK (1952) and REITZ & KLEIN (1966) the *Araucaria* forest is the predominant forest formation on the Planalto of Rio Grande do Sul state. The *Araucaria* forest occupies regions at an altitude between 500m in the West and 1000m in the East. The *Araucaria* forests are interlocked by grassland and the landscape therefore presents the typical mosaic pattern.

Fig. 12: Araucaria forest

The composition of the storey in *Araucaria* forest shows a specific pattern. The upper storey consists of *Araucaria angustifolia* in association with some species of Lauraceae as *Cryptocarya aschersoniana*, *Ocotea pulchella* and *Ocotea puberula* (LÖTSCHERT 1981, IBGE 1986). The lower tree storey is dominated by trees of *Drymis brasiliensis* (Winteraceae), *Schinus polygamus* (Anacardiaceae), *Cupania vernalis* (Sapindaceae), *Lamanonia speciosa* (Cunnoniaceae), *Berberis laurina* (Berberidaceae) and *Podocarpus lambertii* (Podocarpaceae) (HUECK 1956, RAMBO 1956). Myrtaceae occur in an extremely high diversity of species, some of which differ slightly from each other and are therefore difficult to distinguish. Typical genera of the lower tree storey and the shrub storey are *Myrceugenia*, *Myrcia*, *Eugenia* and *Calyptranthes*. Epiphytes, like *Tillandsia usneoides* (Bromeliaceae), play an important role because they provide the unique character of a virgin forest. Some of the understorey plants belong to the ***andin–subantarctic*** elements (RAMBO 1951) (Fig. 13, 14).

Fig. 13: Drymis brasiliensis (Winteraceae)

Fig. 14: Fuchsia regia (Onagraceae)

Fig. 15: Sophronites coccinea (Orchideacea)

The huge, conspicuous tree fern *Dicksonia sellowiana* (Dicksoniaceae) occurs occasionally on humid ground.

The *Araucaria* forests of the Planalto in the region between the River Taquari and the spring of the river Sinos are different. They are higher and more sumptuous than the *Araucaria* forest on the border of "Aparados da Serra" and contain more elements of the broad-leaved evergreen forest (RAMBO 1956). *Ilex paraquariensis* (Aquifoliaceae), *Drymis brasiliensis* (Winteraceae), *Lithraea brasiliensis* (Tiliaceae), *Sebastiana commersoniana* (Euphorbiaceae), *Zanthoxylum rhoifolium* (Rutaceae), *Prunus sellowii* (Rosaceae), different species of *Roupala* (Proteaceae), *Matayba elaeagnoides* (Sapindaceae), *Campomanesia xanthocarpa* (Myrtaceae), *Eugenia uniflora* (Myrtaceae) and different species of the genera *Nectandra* and *Ocotea* (both Lauraceae) could be listed as examples for the high diversity in these *Araucaria* forests.

4. Islands of *Araucaria* forest (Capões, Matas insulares)

Capões (Fig. 16 and 17) are small forest islands, not larger than four to five hectares and are characterised by common elements of subtropical broad-leaved evergreen forest but in a lower amount and volume. They are also part of the Planalto. In the majority of cases they are located where water reaches the surface.

Fig. 16: Capão, completely surrounded by grassland

Fig. 17: *Interior view of a Capão; trees are trapped by Tillandsia usneoides (Bromeliaceae), lower surface of the leaves of Drymis brasiliensis (Winteraceae, white arrow)*

5. Gallery forest (Mata de Galeria)

Gallery forests (Fig. 18) resemble Capões but unlike them they join rivers and accompany them downstream. The vegetation is relatively open and poor in species.

Lithraea brasiliensis (Anacardiaceae), *Matayba elaeagnoides* (Sapindaceae), *Calyptranthes* concinna and *Siphoneugenia reitzii* (both Myrtaceae), *Casearia decandra* (Flacourtiaceae), *Daphnopsis racemosa* (Thymeleaceae), *Actinostemon concolor* (Euphorbiaceae), *Sorocea bonplandii* (Moraceae) and *Zanthoxyllum* (Rutaceae) are typical species of Capões and gallery forests.

Fig. 18: Gallery forest following a river (arrow)

6. Grassland (Campo)

Campo alternates with *Araucaria* forests and Capões in the territory of the Planalto. The grasslands are often riddled with *Sphagnum* moss patches (Fig. 19) particularly in contact with Capões. Prior to post-Columbian settlement more than half of the territory (60% = 161.460 km²) of Rio Grande do Sul was covered by grasslands (FELDENS 1989). Today, the modern grasslands and also the forest biomes are strongly influenced by human activities. The origin of these grasslands could still not be explained sufficiently (HUECK 1952, LÖTSCHERT 1981, RÖNICK 1981, IBGE 1986, GOLTE 1993, MAIER 1998, BEHLING 2002). It has been proved that the grassland vegetation does not correspond to the actual humid and moderate warm climate, which normally would favour more bountiful forests (HUECK 1966, KLEIN 1975, LÖTSCHERT 1981, RÖNICK 1981). Several scientists, e.g. HUECK 1952, RAMBO 1956, LINDMAN 1906, LEITE & KLEIN 1990, suppose that grasslands are relicts from a former drier climate which are joined in by *Araucaria* forest. However, a reconstruction

of the former vegetation is difficult due to serious anthropogenic influences (BEHLING 2002, BEHLING et al. 2001, HUECK 1966, OVINGTON 1983).

Fig. 19: Swamped Campo

Campo is differentiated in two expressions:

6.1 "Clean" grassland (Campo limpo, Campinas, Fig. 20)

The vegetation of the "campo limpo" is highly diverse and is characterized by hemi-cryptophytes and geophytes. Different species of Poaceae, especially the genera of *Andropogon*, *Agrostis, Axonopus, Eragrostis* and *Paspalum*, Asteraceae (*Achyrochline*, *Baccharis, Eupatorium, Senecio*), Cyperaceae (*Rhynchospora*), *Desmodium* (Leguminosae), *Relbunium* (Rubiaceae) are dominant (LEITE & KLEIN 1990, RAMBO 1956). Further species of this vegetation type are *Tibouchina gracilis* (Melastomataceae), *Eryngium spp.* (Apiaceae) and *Pteridium aquilinum* (Dennstaedtiaceae) (KLEIN 1978, RAMBO 1956, RÖNICK 1981). The occurrence of this vegetational pattern is associated with shallow soil and with cold winds during winter.

Fig. 20: Campo with Tibouchina gracilis (Melastomataceae, magenta blossoms)

6.2 "Dirty" grassland (Campo sujo, Capoeira, Fig. 21)

In contrast with the "campo limpo", the "campo sujo", in addition to grasses and sedges, contains irregular dense and high shrubs, as well as small wooden plants. It is characterised by the impressive "*Pampass grass" Cortaderia selloana* (Poaceae), *Blechnum imperiale* (Blechnaceae), *Eryngium sp.* (Apiaceae), *Baccharis uncinella* and *Baccharis trimera* (both Asteraceae). Originally, forests grew on this ground, but were completely cleared in the course of settlement. Capoeiras represent the first stage of succession to the point of the forest stage.

Fig. 21: Capoeira with Baccharis uncinella (Asteraceae)

Both types of grasslands include a high number of different herb species.

7. Anthropogenic affected area

Beside a classification in vegetation types, it is necessary to distinguish forest types, depending on the kind and intensity of exogenous factors. They are divided in **primary forests**, **secondary forests** and **exploited forests**. **Primary forests** (**Mata primária**) are primeval forests or forests subjected to a lower extent of anthropogenic influence. **Secondary forests** (**Mata secundária**, Fig. 22) include all stages of succession. *Dasiphyllum spinescens, Dasiphyllum tomentosum, Vernonia sp.* (Asteraceae) and *Mimosa spp.* (Leguminosae) are indicator plants pertaining to this forest type. Exploited forests are characterised by a selective exploitation of valuable timbers (LAMBRECHT, 1986). Generally, a vast area was transformed to cropland (**Áreas de cultivo**). Beside the cultivation of several economic plants, e.g. *Zea mays* (maize) and *Saccharum officinarum* (sugar cane), large areas of the region are covered by plantations of exotic species, such as

Pinus elliotii, *Pinus taeda* and *Eucalyptus*. However, most parts of the area are used extensively as pasture land.

Fig. 22: Typical secondary forest on the slopes of the Serra Geral

2.2 Characterisation of vegetation by palynological analysis

For the characterisation of vegetation, 85 localities were selected at random in the 3 sub-areas of the study region (Fig. 23). At each locality the geographical position (GPS) and the altitude (altimeter) were recorded (App. IV). The vegetation around each sample point was described and a surface-soil sample was collected for the palynological analysis.

Vegetation types	**Sub-area**		
	1	**2**	**3**
Semi-deciduous forest	1	1	5
Deciduous forest	0	0	2
Araucaria forest	3	8	12
Gallery forest	1	2	1
Capão	9	6	4
Capoeira	1	2	2
Grassland	5	9	3
Anthropogenic affected area	1	1	6

Tab. 1: Overview of sample point distribution in the different sub-areas and vegetation types

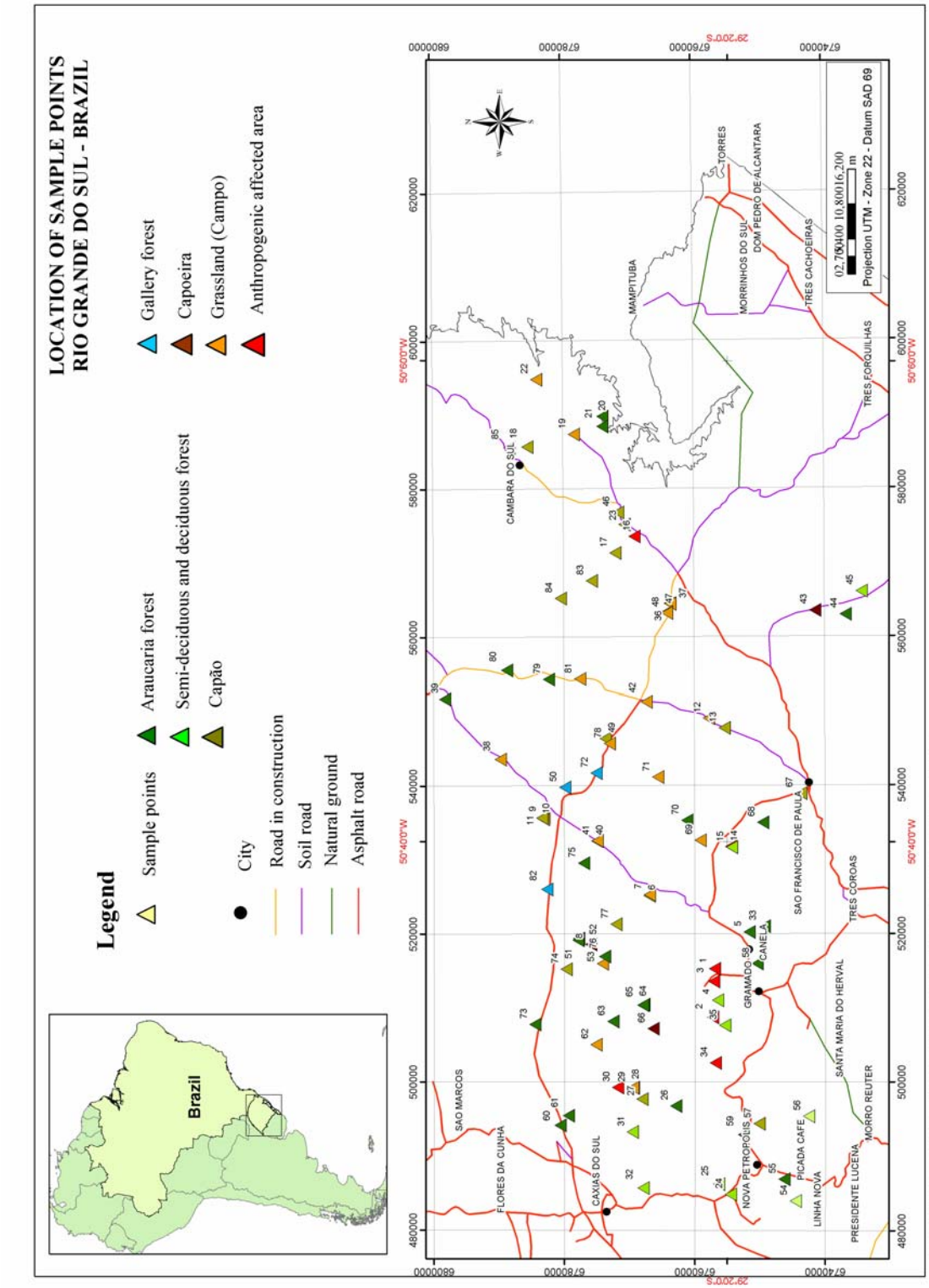


Fig. 23: Locations of sample points - Rio Grande do Sul - Brazil

Fig. 23: Locations of sample points – Rio Grande do Sul - Brazil

2.2.1 Sampling of surface-soil samples

The surface-soil samples were collected to extract and analyse the palynomorphs from these soils. Metal samplers measuring 7/ 5.5/ 3.6 cm (≅139 cm³) (Fig. 24) were used for sampling the surface soil. Before the sampler was driven into the soil with a sledge, the surface of the ground was softly cleaned from leafage, grass-tufts etc. The samples were transported in tagged plastic bags, sealed and kept in a freezer until preparation.

Fig. 24: Soil sampler

2.2.2 Preparation of surface-soil samples

Before the soil samples were prepared by the modified method of KAISER & ASHRAF (1974) and EBNER (2005) they were dried at 40 – 45°C in a drying kiln overnight.
The samples underwent the following steps:

1) Crushing of the sample with mortar and pestle.
2) **10g** of the dried soil and **2 Lycopodium tablets** were mixed with **100 ml distilled water** in a glass beaker and heated at once.

3) **5g KOH lumps** were added to deflocculate and remove humic colloides.
4) The reaction was allowed to proceed under heating and stirring for 5 min.
5) Stopping of reaction by addition of **40 ml** of **36% HCl**.
6) Filtration of the solution over a **125 µm sieve** (Fig. 25) with great quantities of water.
7) Filtration over a **6 µm filter** (Fig. 26) with great quantities of water.
8) Placing of the filter on paper towel for drying.
9) Rinsing the dried filter with saturated **$ZnCl_2$-solution** and transfer of the soil precipitate in a glass beaker.
10) The soil solution and the saturated $ZnCl_2$ were transferred into centrifuge tubes and allowed to spin at **3000 rpm** for 5 **min** (heavy liquid separation) without using brakes as to avoid turbulences. The heavy liquid separation is based on a separation of organic material from inorganic material. The saturated solution which has a specific weight higher than that of the palynomorphs but lower than that of the inorganic material. Whereas the specific weight of the palynomorphs is between 1.4 g/cm³ (RT) and 2.1 g/cm³ in RT (depending on the density of the exine) the specific weight of most inorganic materials is over 2.64 g/cm³ in RT (cp. JUVIGNÉ 1973). Saturated $ZnCl_2$-solution has a specific weight ranging between 1.96 g/cm³ in RT (cp. with FUNKHOUSER & EVITT, 1959) and 2.1 g/cm³ in RT.
11) Decantation of the supernatant from the tube over a **6 µm filter** (Fig. 27) and washing with great quantities of water.
12) Transfer of the filter in **99.7% CH_3COOH.**
13) Transfer of the filter in **Acetolytical solution** (**H_2SO_4 :$(CH_3CO)_2O$ = 1:10**) and boiling in a water bath for **20 min**.
14) Washing of the filter with great quantities of water.
15) Preparation of microscopic slides with glycerine gelatine.
16) Sealing the slides with nail polish the next day.

Fig. 25: soil sieve, mesh size 125µm

Fig. 26: Filtration over 6µm filter

Fig. 27: Decantation after centrifugation

Used materials and chemicals:

MATERIALS/CHEMICALS	COMPANY
Lycopodium spore tablets (marker)	Quaternary Sciences University Lund/ Sweden
KAISER´s glycerine gelatine	MERCK
KOH (potassium hydroxide)	SYNTH, DINÂMICA
HCl (hydrochloric acid)	VETEC, NUCLEAR
$ZnCl_2$ (zinc chloride)	NUCLEAR
CH_3COOH (acetic acid)	SYNTH
$(CH_3CO)_2O$ (acetic anhydrite)	MERCK, NUCLEAR
H_2SO_4 (sulphuric acid)	DINÂMICA
Centrifuge T23	JANETZKI

2.2.3 Palynological analysis

The palynological analysis was carried out with a ZEISS-Standard-LAB-light microscope with a magnification of 400x. As supposed by FIRBAS (1952) 200 palynomorphs were counted, including pollen, spores, fungi and *Lycopodium*-marker. Their morphological identification was based on reference atlases from the states of Amazonas, Rio de Janeiro and Rio Grande do Sul, from Argentina, Barro Colorado Islands as well as from other publications (Para. 5.2). Based on morphological similarity of pollen/ spores, the taxonomic relationship or the similarity of the habitat, 116 pollen/ spore types were distinguished and, assigned in 62 groups (App. II). This assignment facilitates a more concise treatment of the data with the following different analysis methods. The palynomorphs were catalogued by photographs (App. I) for further comparisons.

2.2.4 Data analysis

For comparative analyses of pollen and spore data and of recent vegetation and pollen and spore data, the results of the palynological analysis were evaluated. Before analysing pollen and spore data with the different methods, their composition was scrutinised and some groups were excluded. For a more concise treatment of the data it was agreed upon the following definition: A group of palynomorphs has to exhibit more than 5% of the total amount of playnomorphs per sample. Only these were taken into consideration. As a result 25 groups of palynomorphs (taxa) were considered. Indicator-palynomorphs characterising the different vegetation types were at the focus of attention.

EXCEL was used for the calculation of the percentages of counted palynomorphs for adjacent TILIA-analyses as well as for data plotting in PCA charts.

The software programs TILIA, TILIAGRAPH, TILIAVIEW were used for data plotting in pollen diagrams.

The distribution of the indicator-spores of *Cyatheaceae* and *Dicksonia sellowiana* was investigated with the *raster interpolation method* ArcGIS 8/ArcMap (1999-2002).

CANOCO (Version 4, 1988-98) and PAST (2002) were used for *multivariate statistical analysis*.

Principal components analysis (*PCA*) was one of the applied *multivariate statistic methods*. It is an ordination method that produces hypothetical variables (components), accounting for as much of the variation in the data as possible. These new variables (components) are linear combinations of the original variables. PCA is a descriptive method (HAMMER 2002). In this thesis the abundance of 25 taxa of pollen and spores in 81 samples was determined. PCA resulted in 25 components from these variables. The program also presents ´loadings´

of the components, illustrating to what extent each original variable contributes to the components.

Cluster analysis is the second utilised method of multivariate analysis. It aims to find groups of samples (or taxa) based on an appropriate distance measure. Hierarchical cluster analysis produces a ´dendrogram´ where similar samples are grouped together. Cluster analysis of samples (`Q`mode) is used for detecting associations. Cluster analysis of taxa (`R` mode) is used for detecting of associations of taxa. Several algorithms are available for hierarchical clustering. Generally they cluster the most similar items first, and then proceed by grouping the next most similar cluster until a single is left. Cluster analysis was executed on the sample level to emphasise the results of PCA. In this study the mean linkage algorithm, also known as *Unweighted Pair-Group Moving Average (UPGMA)*, was used for hierarchical clustering. This algorithm was combined with *MORISITA´s similarity index* (KREBS 1989). 80 samples of a total of 85 were clustered. In four samples the palynomorphs were under-represented and one sample (sample No. 55) yielded a misinterpretation. They were therefore not considered in the data analysis. For obtaining more detailed information, a cluster analysis was executed separately for the forest samples, the grassland samples and samples with intense interaction with grassland (samples of Capões, Capoeira, gallery forests).

2.3 Mapping of the vegetation

For comparison of the relationship between the pollen/ spore data and the vegetation, the recent vegetation around each sample point was identified and recorded. Therefore, the vegetation around the points was identified in a 10m x 10m square by a simplified BRAUN – BLANQUET-technique. The application of this method to forests in subtropical and tropical regions is intricate because the identification of high trees is difficult to ascertain.

Therefore, it is emphasised that this work does not claim completeness of the vegetation record. The mapping of vegetation was merely done to get a first impression about the local vegetation.

For the mapping of vegetation the following keys for dominance and species abundance were used:

Dominance:

scale	covering in %
5	>75 - 100
4	50 - 75
3	25 - 50
2	5 - 25
1	< 5

Species abundances:

r (raro) sporadic, mostly one specimen only
p (paululum) few specimens
a (amplius) numerous specimens
m (multum) multiple specimens

The vegetation was identified on site and specimens of unknown plants were collected for their further identification in the laboratory. The collected plant specimens were identified in the herbaria of LPB/PUCRS and UFRGS, generously supported by Professors J. A. JARENKOW (UFRGS), M. SOBRAL (UFMG) and N. I. MATZENBACHER (PUCRS). In addition, several references were used for the identification (Para. 5.3)

For concise comparison between the different vegetation types and the sample sites, the most frequent taxa were further analysed. Therefore the BRAUN-BLANQUET-abundance values were substituted by numbers as follows: r = 1,1; p = 1,2; a = 1,3; m = 1,4. For each selected taxa (Para. 3.5, Tab. 4) the mean value of dominance and abundance were selected independent from the different tree or shrub layers. Then, by multiplying of these

abundance values with the dominance values, a new factor (AD-value = abundance-dominance-value) was calculated. One example should explain the procedure: The family of Myrtaceae occurs in sample No. 5 (*Araucaria* forest) in the first tree layer with the BRAUN-BLANQUET-value of 2p in the second tree layer of 2a. For further calculations the value 2a was used and converted in 2,6. Finally, the average of the AD-values of the selected taxa (Tab. 4) for the different vegetation types in the different sub-areas was calculated.

3. Results

3.1 Pollen diagrams - distribution of pollen and spores in the different vegetation types

The pollen diagrams represent the relative percentage variation of pollen and spore types found in the according vegetation type. Each of the presented pollen/ spore type has at least relative percentages of 5% in one sample. Top down it moves from taxa frequency in sub-area 1 to those in sub-area 2 and 3.

3.1.1 Distribution of pollen and spores in semi-deciduous forests

In semi-deciduous forests (samples No. 4,15, 24, 25, 31, 32 and 45) the phylum of pteridophytes was the most frequent group (60%, Fig. 28). Within the pteridophyts the *Blechnum* group, the *Microgramma* group, the *Asplenium* group and the *Cyatheaceae* group were predominant. It has to be emphasised that the same spores of the *Blechnum* and *Microgramma* group appeared both, in the forests on the south-eastern slopes of the Serra Geral (sample No. 45) and in the valley of the river Caí (samples No. 24, 25). The striking presence of the *Asplenium* group, mainly in the semi-deciduous forests in the valley of the river Caí (sample No. 24, about 3% and sample No. 25, about 10%) and on the Western slopes of Serra Geral (sample No. 31, more than 20%); is worth a careful observation. The *Asplenium* group was scarce in the sites on the southern (samples No. 4, 15) and south-eastern slopes of the Serra Geral (sample No. 45). In addition, sample No. 31 aroused attention by the occurrence of spores of the *Dennstaedtia/ Pteridium*-group and the *Anogramma/ Pteris*-group. The spores of *Dennstaedtia/ Pteridium*-group amount to more than 10% of all counted palynomorphs. The Cyatheaceae group was most abundant in the total amount of Pteridophyta spores. In sample No. 15 it reached over 40% of the total amount of pollen and spores.

The spores of Cyatheaceae and conditionally of *Asplenium* are characteristic marker of semi-deciduous forest. Pollen grains of gymnosperms and angiosperms were generally

under-represented in semi-deciduous forests with exception of *Ilex* pollen (more than 10%). *Ilex* pollen was found to occur solely in sample No. 15 and 45.

3.1.2 Distribution of pollen and spores in deciduous forests

The semi-deciduous forests and deciduous forests were intricate to distinguish by palynological analysis. The combined illustration (Fig. 28) ought to emphasise this complexity of separation of these two forest types.

As shown for semi-deciduous forests, the phylum of pteridophytes was the most frequent group in deciduous forests. However, fern spores did not appear in the same quantity in deciduous forests as they did in semi-deciduous forests. The spores of the members of the *Microgramma* group, and even *Microgramma* itself (Tab. 2), were rare. In sample No. 56 they even lacked. In contrast to the semi-deciduous forests, the *Asplenium* group appeared to be rare in deciduous forests in this investigation.

Pollen grains of gymnosperms and angiosperms were also under-represented in deciduous forests with exception of Euphorbiaceae pollen (Fig. 28). Pollen grains of Euphorbiaceae appeared in samples No. 54 and 56 and were more frequent in sample No. 54 with almost 7%.

Sub-area	**Sample ponits**	***Blechnum* group**	***Microgramma* group**	***Asplenium* group**			***Dennstaedtia/ Pteridium* group**	**Cyatheaceae group**				**Euphorbiacea group**	
		Blechnum	*Microgramma*	*Asplenium 1*	*Asplenium 2*	*Dryopteris*	*Dennstaedtia*	*Alsophila*	*Cyathea schaschin*	*Cyathea spp.*	*Nephelea*	*Alchornea triplinerva*	*Sebastiana commersoniana*
1	**45**	0.2	1.7	1.2	0.2	0.5	0.2	0.0	0.2	0.0	0.0	0.0	0.0
2	**15**	8.4	9.3	0.0	0.0	0.0	0.0	15.2	12.7	2.1	10.5	0.0	0.0
3	**4**	1.7	0.4	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	**24**	0.7	2.0	0.0	0.0	3.2	0.0	0.5	0.5	0.0	0.0	0.0	0.0
3	**25**	0.5	1.4	0.0	0.0	10.3	0.0	2.6	0.0	0.0	0.0	0.0	0.0
3	**31**	1.8	0.4	3.5	12.7	9.9	14.1	0.4	0.0	1.4	0.0	0.4	0.0
3	**32**	10.0	6.1	0.0	0.0	0.0	0.0	14.3	8.2	8.2	5.4	0.0	0.0
3	**54**	3.8	3.1	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	2.3	4.6
3	**56**	0.4	0.0	0.0	0.0	1.8	0.0	0.4	0.0	0.0	0.0	0.0	0.0

Tab. 2: Relative percentage of important pollen and spore types within selected groups in semi-deciduous and deciduous forests (conspicuous values are accented)

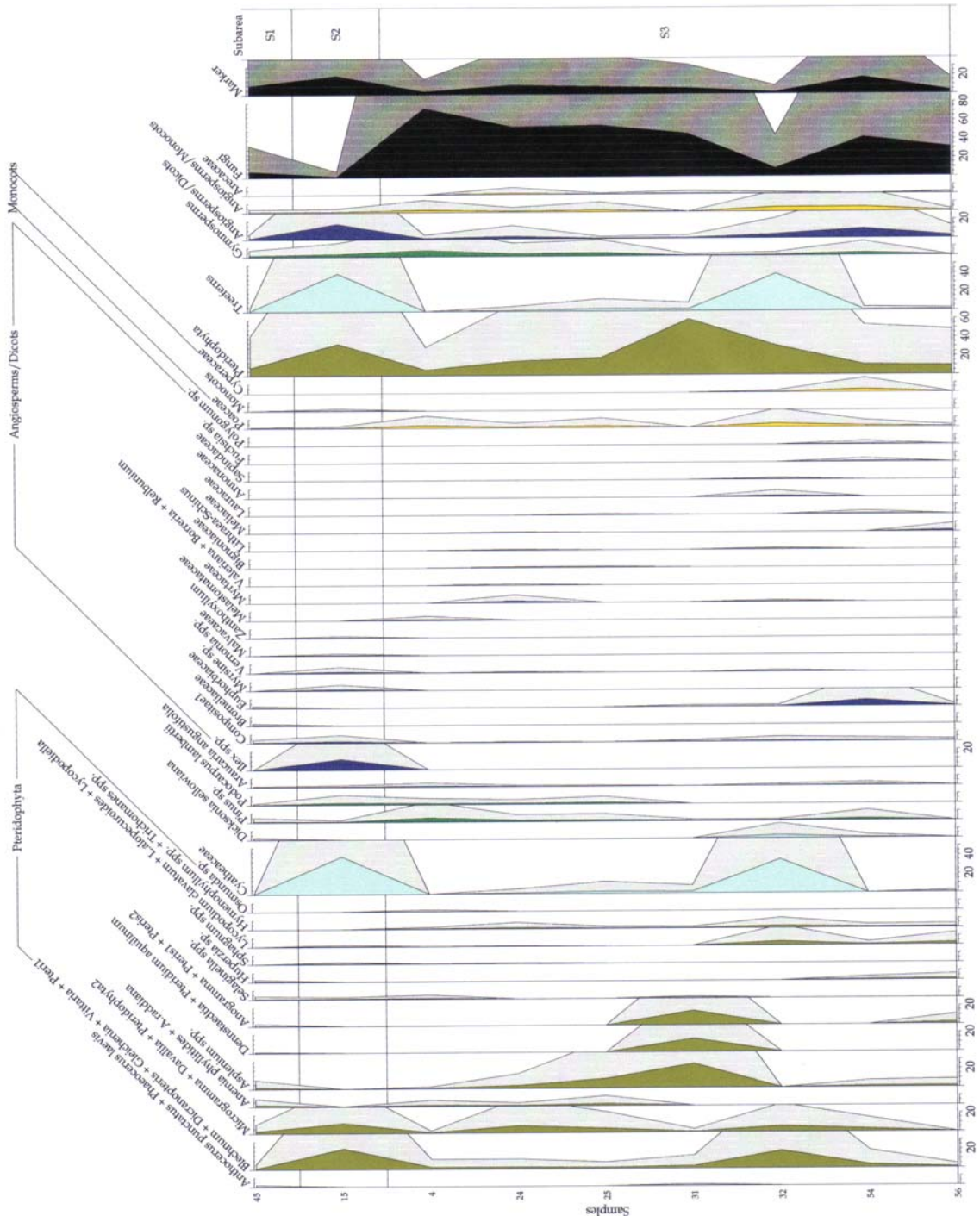


Fig. 28: Distribution of pollen and spores in semi-deciduous and deciduous forests (%)

3.1.3 Distribution of pollen and spores in *Araucaria* forests

In *Araucaria* forests, like in semi-deciduous and deciduous forests, pteridophytes were among the most frequent group. The palynomorphs in *Araucaria* forests were characterised by the *Blechnum* (almost 30%) and the *Microgramma* group (almost 40%) (Fig. 29). Interestingly enough, it is observed that *Vittaria* occured mainly in *Araucaria* forests situated on the slopes of Serra Geral (sample No. 44, almost 2%) or on slopes alongside rivers (samples Nos. 5, 33, maximum about 3 %) (Tab. 3). The increased amount of *Hymenophyllum* (more than 3% in sample No. 79) and *Trichomanes* spores in *Araucaria* forests was remarkable compared to the semi-deciduous and deciduous forests. The high percentage of tree fern spores is worth being paid attention to. *Dicksonia sellowiana* reached an amount of almost 44% (sample No. 44). Depending on the location, the tree ferns of Cyatheaceae unfold a peculiar significance (Para. 3.2).

Pollen grains of *Araucaria angustifolia* and *Podocarpus lambertii* occured but rather occasionally (Fig. 29). They were clearly evident in samples located in the transition zone of *Araucaria* forest with the broad-leaved evergreen forest (about 8%) and on the Planalto (over 6% in sample Nos. 64 and 79 or rather more than 18% in sample No. 61).

Pollen of angiosperms, in particular Poaceae (almost 30% in sample Nos. 73 and 79), Asteraceae (over 10% in sample Nos. 73 and 76), Euphorbiaceae, Myrtaceae, Meliaceae and Sapindaceae, as well as the genus *Ilex* occured more often than in semi-deciduous and deciduous forests. However, they do not exclusively represent the *Araucaria* forests which are located on the Planalto as they appeared also in *Araucaria* forests which are conspicuously influenced by subtropical elements. Sample No. 55 is eminently mentioned because in this sample Myrtaceae pollen grains were represented with almost 25%, Meliaceae pollen with about 17% and Sapindaceae pollen were detected with a percentage of about 15%. The pollen assemblages Nos. 65, 68, 70, 73, 75 and 76 generated an unusual low amount of pollen grains and were represented rather exclusively by Asteraceae, therefore they did not represent a typical pollen spectrum of *Araucaria* forest.

Sub-area	Sample ponits	***Blechnum* group**					***Microgramma* group**			**Euphorbiaceae group**		
		Blechnum	*Dicranopteris*	*Gleichenia*	*Pteridophyta 1*	*Vittaria*	*Microgramma*	*Davallia*	*Pteridophyta 2*	*Actinostemon concolor*	*Alchornea triplinerva*	*Sebastiana commersoniana*
1	**20**	1.1	0.0	0.0	3.5	0.0	0.9	0.0	0.2	0.2	0.9	0.7
1	**21**	9.1	3.8	3.2	1.6	0.0	8.6	3.2	0.0	0.0	0.0	1.1
1	**44**	5.7	2.3	3.1	10.0	1.9	7.3	3.8	0.0	0.0	0.4	1.5
2	**5**	2.4	0.0	0.0	13.3	2.4	0.3	0.0	0.0	0.0	0.3	1.0
2	**33**	8.4	1.3	0.9	0.0	2.7	24.8	4.4	0.0	0.0	0.0	1.3
2	**39**	4.9	4.9	7.7	8.1	0.4	10.2	2.4	0.0	0.0	0.0	1.2
2	**68**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	**70**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	**75**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	**79**	0.5	0.0	0.8	0.5	0.0	1.8	0.5	0.0	0.0	0.5	0.0
2	**80**	1.2	0.0	1.2	2.8	0.0	4.8	0.8	0.0	0.0	1.6	1.6
3	**26**	0.6	0.0	1.9	1.2	0.0	9.0	0.9	0.0	0.0	0.0	0.0
3	**52**	5.0	7.0	4.0	5.4	0.0	10.7	2.3	0.3	0.3	0.0	1.7
3	**55**	0.9	0.0	0.4	0.0	0.4	2.2	0.0	0.0	0.0	0.0	0.4
3	**58**	0.5	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
3	**59**	7.5	2.9	2.2	11.0	0.4	24.1	3.5	0.0	0.0	0.4	3.1
3	**60**	0.9	2.7	1.7	3.0	0.4	11.6	2.6	0.0	0.0	0.0	0.0
3	**61**	1.6	2.1	0.5	1.6	0.0	18.1	0.0	1.6	1.6	0.0	0.0
3	**63**	5.6	0.0	0.0	3.1	0.0	1.5	0.0	3.1	3.1	21.9	4.8
3	**64**	2.2	2.2	1.3	1.3	0.0	8.7	1.3	0.0	0.0	0.9	1.3
3	**65**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	**73**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	**76**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Tab. 3: Relative percentage of important pollen and spore types within selected groups in Araucaria forests (conspicuous values are accented)

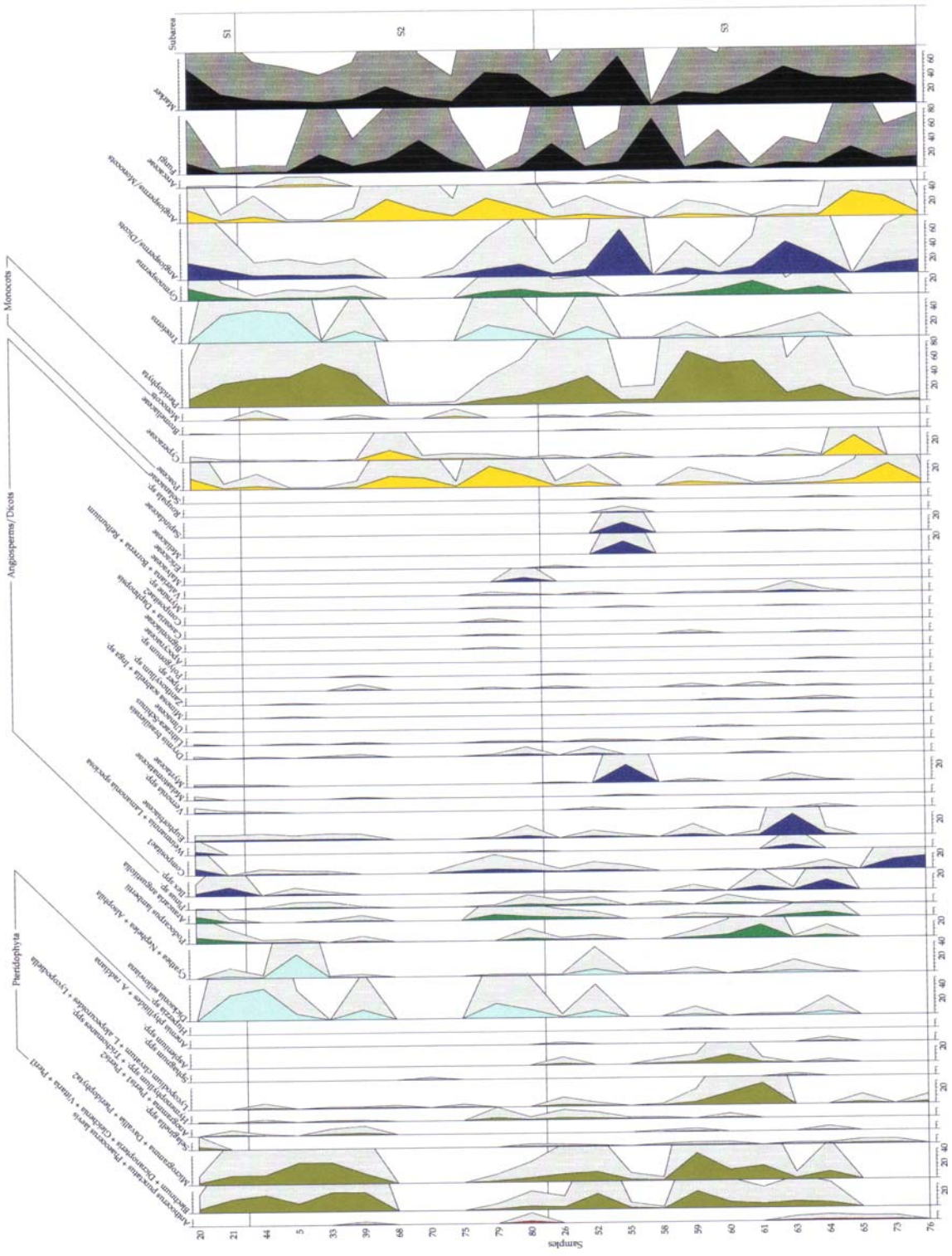


Fig. 29: Distribution of pollen and spores in Araucaria forests (%)

3.1.4 Distribution of pollen and spores in Capões

Capões are comparable to *Araucaria* forests with respect to the *Blechnum* and *Microgramma* group which occured most frequently. Tree ferns were less abundant in Capões (about 8%) than in *Araucaria* forests (Fig. 30). The percentage of *Dicksonia sellowiana* spores was slightly higher (7.6%) than Cyatheaceae spores (6.6%).

Pollen grains of the gymnosperms *Araucaria angustifolia* and *Podocarpus lambertii* occured more constantly in Capões than in *Araucaria* forest, with *Podocarpus lambertii* reaching a high pollen prevalence of almost 75% (sample No. 13, Fig. 30) or almost 30% (sample No. 36). However, *Podocarpus lambertii* was almost inexistent in Capões situated on flat declivities of the Western Serra Geral (samples No. 27, 28 and 57).

In Capões, dicotyledons were found to be less abundant than in *Araucaria* forests but the monocotyledons, particularly Poaceae (over 40%) and Cyperaceae (almost 15%), were more abundant in Capões compared to *Araucaria* forests. *Ilex* pollen (11%), pollen of Asteraceae (about 8%) and Euphorbiaceae (up to 8%), and *Drymis brasiliensis* pollen (nearly 5%) featured a distinct abundance (Fig. 30). While *Drymis brasiliensis* pollen grains appeared sporadically in *Araucaria* forests, they appeared more frequently in Capões. Their rare appearance in Capões situated on flat declivities of the Western Serra Geral (samples No. 27, 28, 57) is worth being mentioned.

In general terms, Capões are characterised by pollen of *Podocarpus lambertii*, Poaceae, *Ilex sp.,* Euphorbiaceae and *Drymis brasiliensis*.

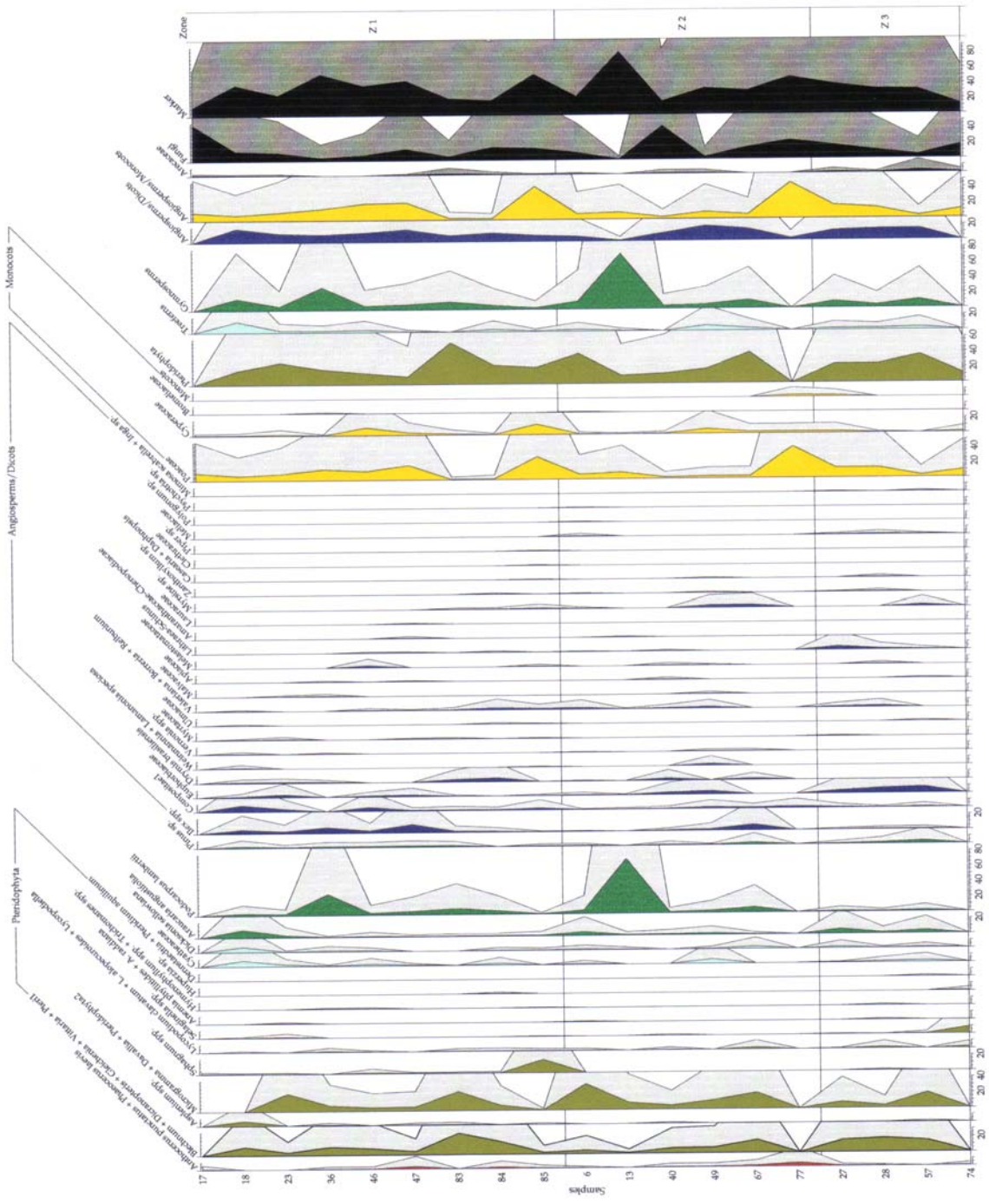


Fig. 30: Distribution of pollen and spores in Capões (%)

3.1.5 Distribution of pollen and spores in gallery forests

With regard to the composition of pollen and spores, gallery forests did not provide the clear pattern of an *Araucaria* forest or Capão (Fig. 31). The *Microgramma* group was specifying the pollen spectrum with a total amount of almost 21% (sample No. 82). Other spores were rarely present.

Pollen of gymnosperms and angiosperms were also rare. Only *Podocarpus lambertii*, *Ilex* and Asteraceae, Euphorbiaceae and Poaceae occasionally presented notable pollen abundance (3-8%).

With regard to gallery forests, bryophytes obtained a higher quantity (about 5%) than in the semi-deciduous and deciduous forests and *Araucaria* forests (Fig. 31).

The characterisation of gallery forests by palynological spectra is less distinct. They are also characterised by *Podocarpus sp.*, Poaceae, Euphorbiaceae and *Ilex sp.* but in lower amounts than Capões.

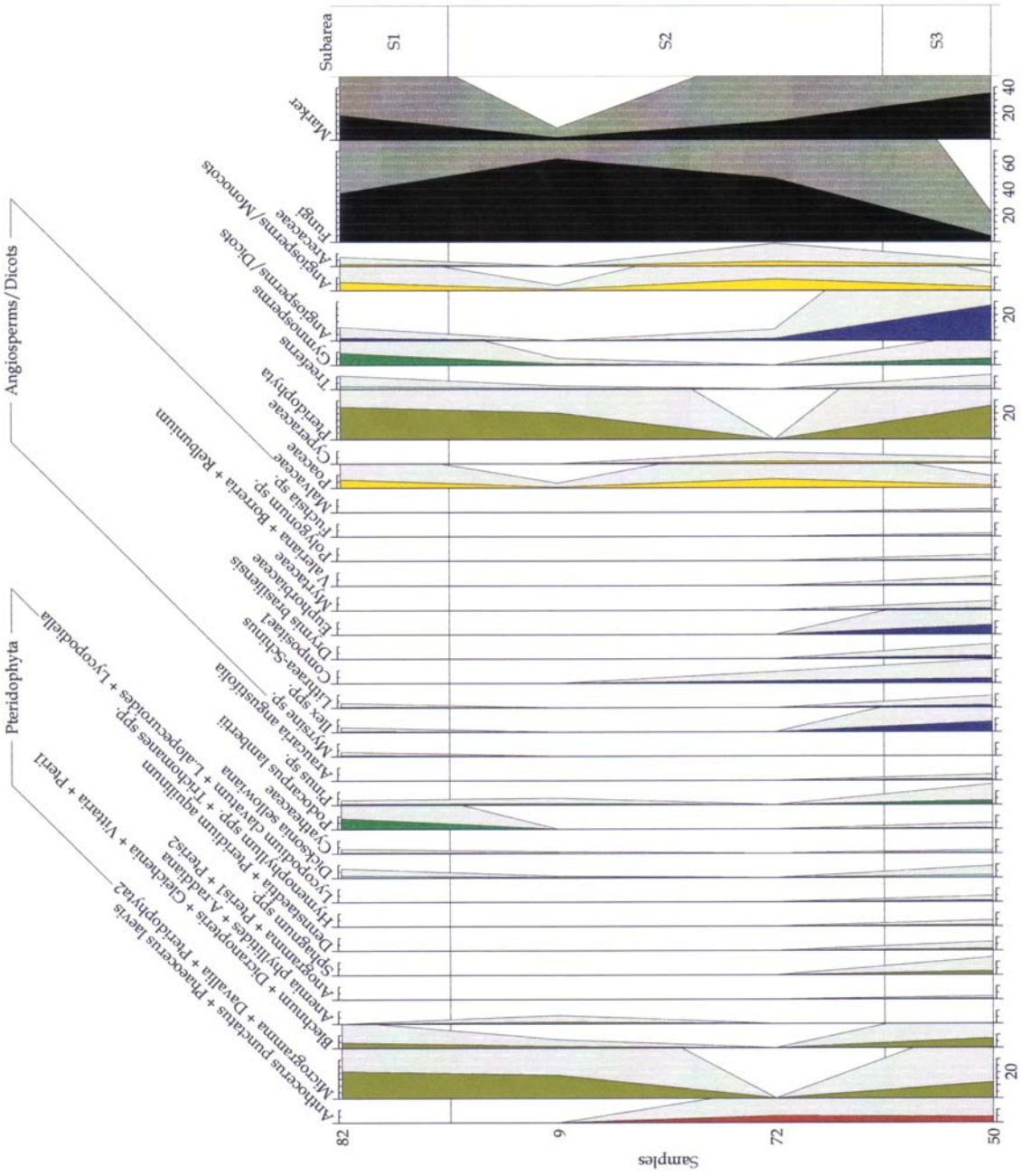


Fig. 31: Distribution of pollen and spores in gallery forests (%)

3.1.6 Distribution of pollen and spores in Capoeira vegetation

Like in forests, pteridophytes were also abundant in Capoeiras, but the importance is no longer related to the *Microgramma* and *Blechnum* groups (Fig. 32). Spores of *Hymenophyllum*, *Trichomanes*, *Lycopodium* and *Lycopodiella* become more important. The tree ferns (mainly Cyatheaceae) are notably present. In sample No. 43 spores of Cyatheaceae are notable present (37%).

Records of Capoeiras mainly contained pollen of Poaceae (more than 18% in sample No.51) and of the *Compositae1* group (over 21% in sample No. 8) including pollen of Asteraceae such as *Achyrochline, Artemisia, Baccharis, Calea, Eupatorium, Senecio* and *Trixis* which mainly grow on grassland.

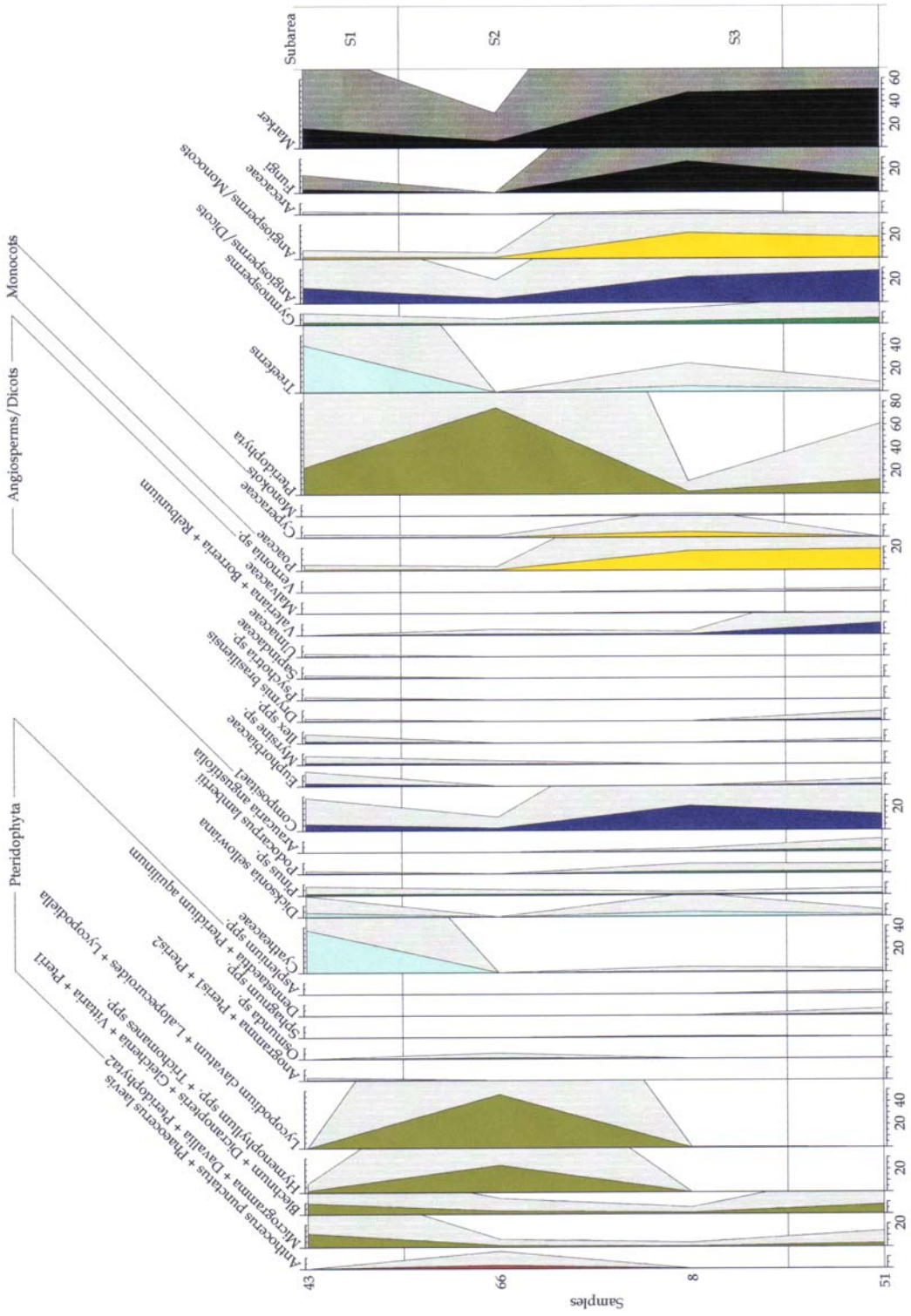


Fig. 32: Distribution of pollen and spores in Capoeira vegetation (%)

3.1.7 Distribution of pollen and spores in Campo vegetation

The pollen of Poaceae and Cyperaceae dominated in grassland samples, with about 50% and 30% respectively, of the total sum of palynomorphs (Fig. 33).

The bryophytes *Anthoceros punctatus* and *Phaeoceros laevis* (about 50% in sample No. 71 and over 25% in sample No. 42) and the peat moss *Sphagnum* (over 2%) reached a conspicuous relevance.

Pollen grains of angiosperms were rare. The group of *Compositae 1* amounted to more than 9% (sample No. 22). However, this was lower than in Capoeira vegetation. Pollen and spores from the surrounding vegetation, such as *Dicksonia sellowiana, Araucaria angustifolia* or *Podocarpus lambertii* occured scarcely (about 1-4%).

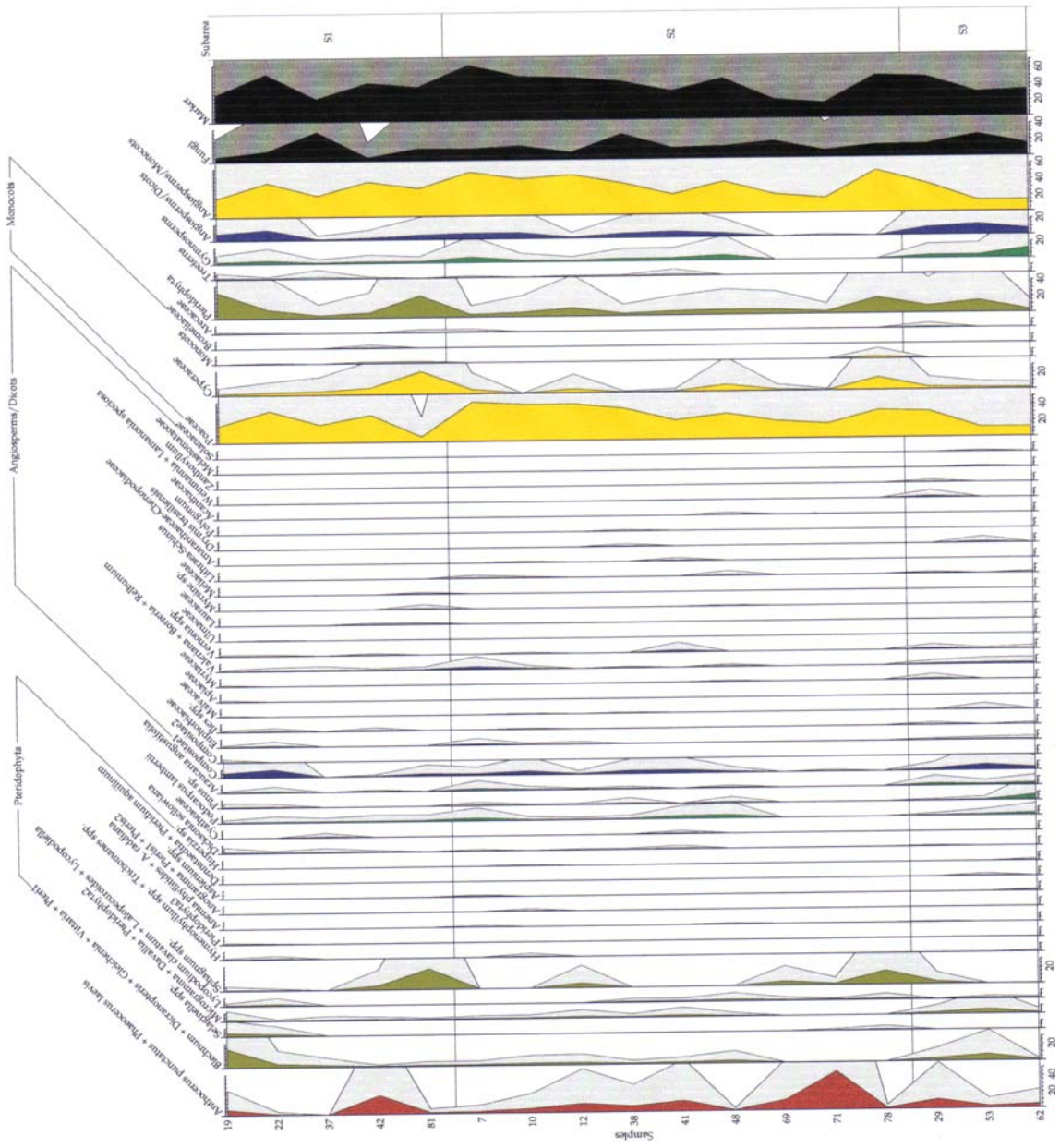


Fig. 33: Distribution of pollen and spores in Campo vegetation (%)

3.1.8 Distribution of pollen and spores in anthropogenic affected area

There were noticeable amounts of pollen of *Araucaria angustifolia* (maximum 6.5% in sample No. 14, Fig. 34), *Podocarpus lambertii* (maximum 16% in sample No. 1) and of Myrtaceae (almost 9% in sample No. 1) and spores of *Dicksonia sellowiana* (about 7% in sample No. 14). The pollen diagram illustrates palynomorphs, e.g. spores of the *Microgramma* (about 13% in sample No. 30) and *Blechnum* group (about 14% in sample No. 30) as well as *Vernonia* (about 2% in sample No. 14) and *Ilex* pollen (about 1% in sample No. 14), which are representative for forest vegetation (Fig. 34). In addition, typical grassland indicator pollen and spores also occured. They were represented by pollen of the Compositae1 group, spores of *Anthoceros punctatus* and *Phaeoceros laevis* (1 – 4%).

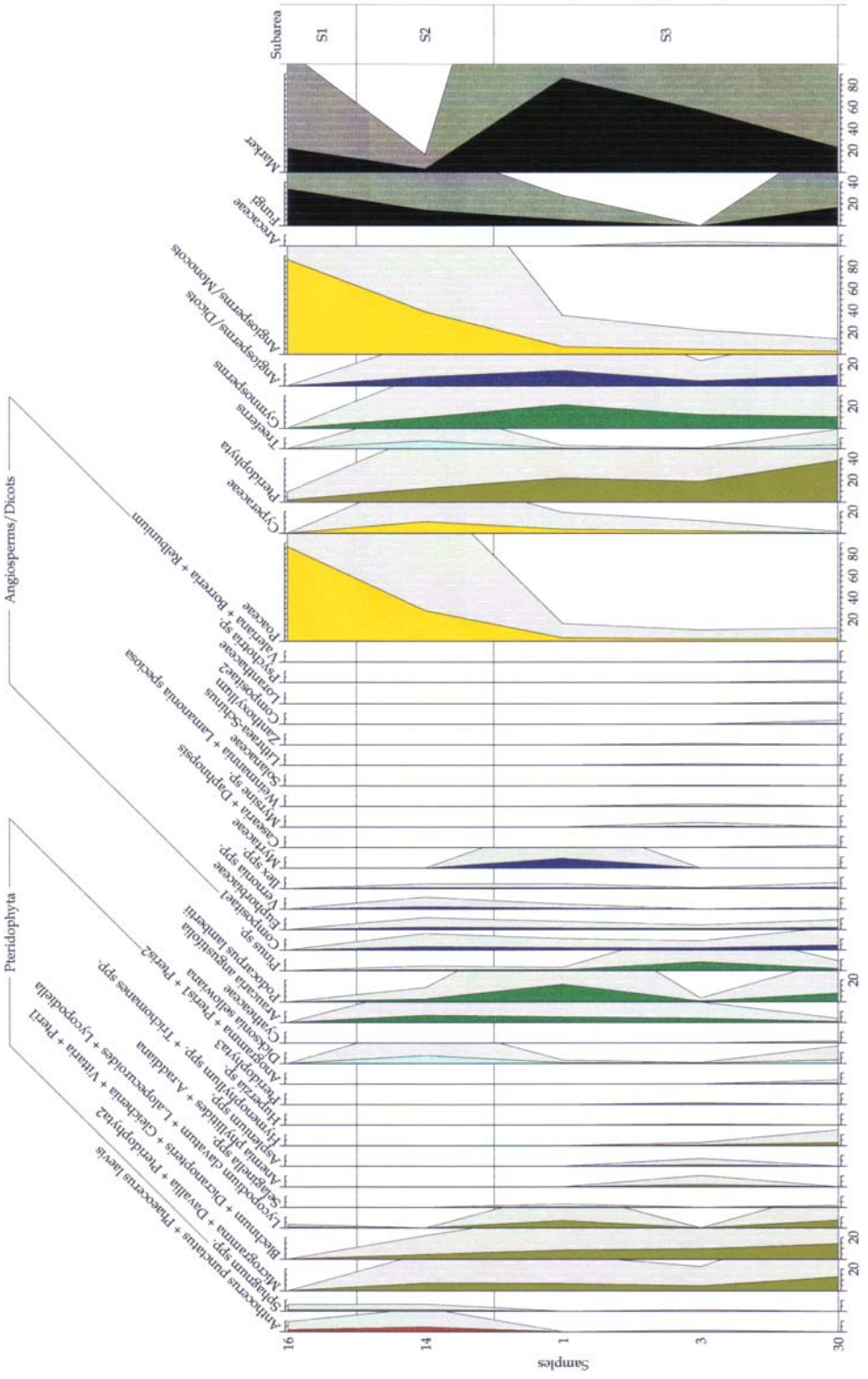


Fig. 34: Distribution of pollen and spores in anthropogenic affected area (%)

3.2 Distribution of spores of *Cyatheaceae* and *Dicksonia sellowiana* in the study area (ArcGIS analysis)

For the distribution of spores of *Cyatheaceae* and *Dicksonia sellowiana*, the following tendency was observed: spores of *Dicksonia sellowiana* mainly occured on the Planalto (Fig. 35). As represented in samples No. 5, 20, 21, 39, 49 and 79, the spores occured exclusively in *Araucaria* forests, Capões and in grasslands located close to *Araucaria* forests or Capões (samples No. 19, 22 and 78). These spores occurred even in secondary forest (sample No. 14). Occasionally spores of *Dicksonia sellowiana* appeared also in semi-deciduous forests (samples Nos. 15, 33). The amount of spores of *Dicksonia sellowiana* decreased from the east westwards concerning the *Araucaria* forest, Capões and in grassland (Fig. 35). Whereas in the eastern part of the study region the amount of spores of *Dicksonia sellowiana* reached amounts of 34.9% (sample No.21) and 43.3% (sample No.44), they lacked in the western part of the study region.

In contrast to *Dicksonia sellowiana*, spores of *Cyatheaceae* occured rarely on the Planalto. They were primarily found in forests on the Western and Southern slopes of the Serra Geral (samples No. 15, 32 and 43) and in river valleys (sample No. 5) (Fig. 36). They prevail in high percentages in these forests (40.5% in sample No.15, 36.2% in sample No.32 and 32% in sample No.5). In addition, these spores also occured on the Eastern margin of the Planalto (sample No.19, 7.6%). They appeared most remarkably in soils of semi-deciduous and deciduous forests and of *Araucaria* forests situated on rivers.

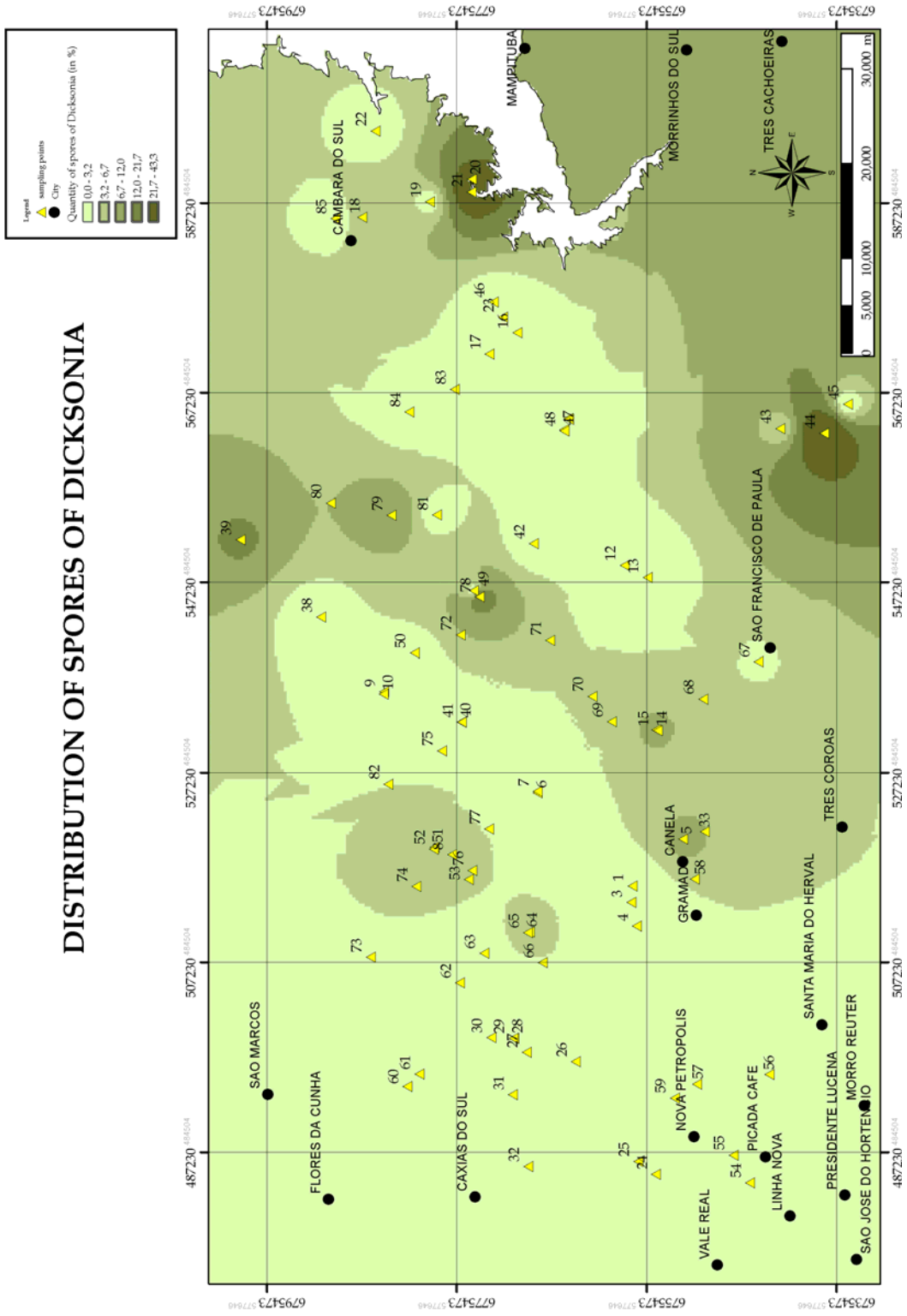


Fig. 35: Distribution of spores of Dicksonia sellowiana

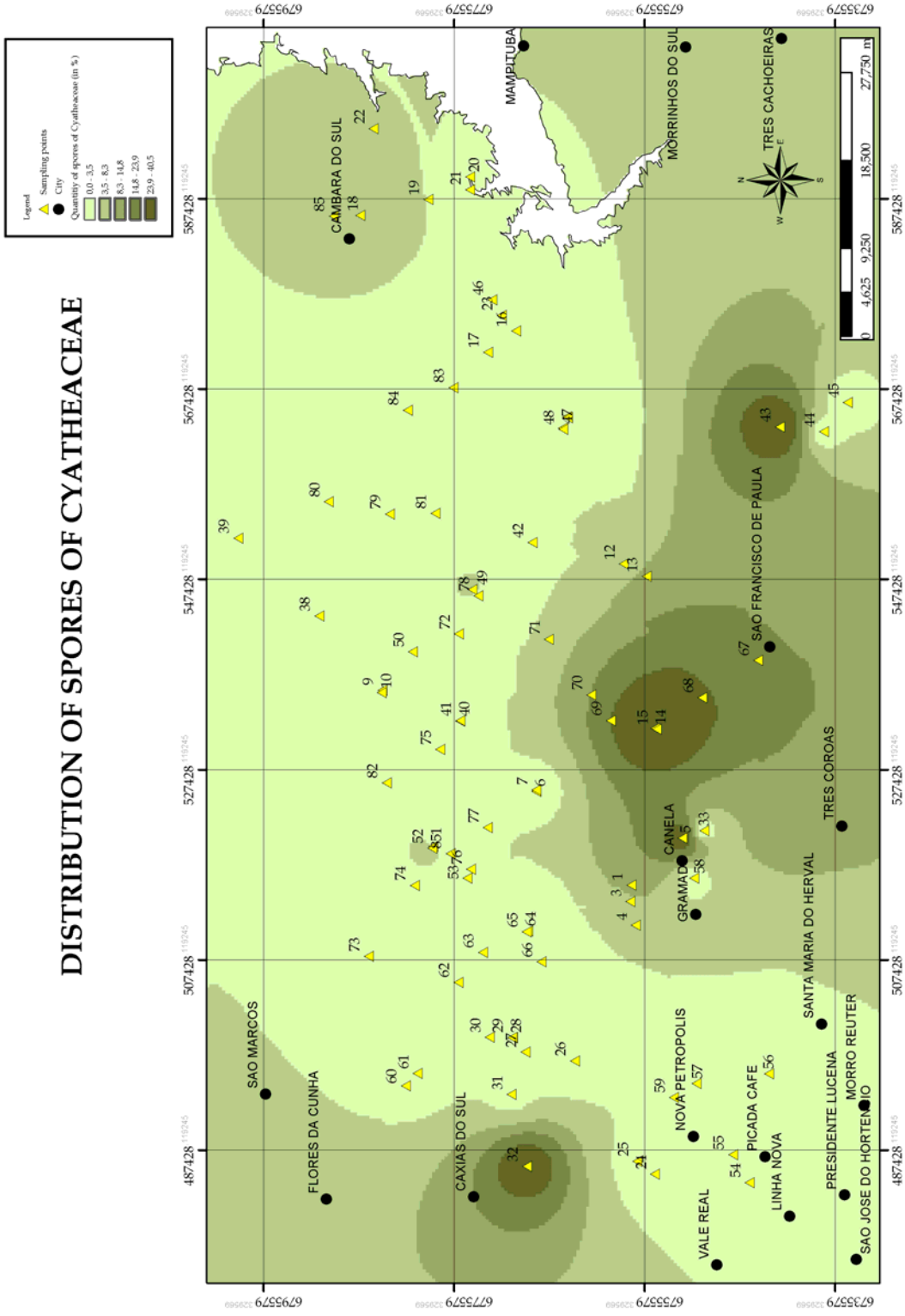


Fig. 36: Distribution of spores of Cyatheaceae

3.3 Principal components analysis (PCA)

3.3.1 Dispersion of samples

PCA demonstrates that a separation of different vegetation types by dint of the palynological analysis is feasible. It results in a distinct separation of grassland vegetation and forest vegetation. Based on 25 variables (pollen and spore types), the PCA analysis produced 25 components (axes). Four of these components were responsible for the variation in the samples of the different vegetation types. The results of PCA the first component explains 40.2% of the data variation, the second explains 12.9 %, the third 9.7%, while the fourth explains 7.7%. Whereas the positive end of the first axis groups primarily grassland vegetation, the negative end of the first axis represents primarily forest vegetation. The results of the PCA can be interpreted in terms of environmental variables. The first axis represents the humidity gradient. Humidity increases from the positive to the negative end of the first axis, and separates clearly the grassland from the forests. The samples corresponding to transitional vegetation (Capoeira, Capões and gallery forests) are in the middle of the scatter indicating that they cannot be distinguished distinctly as separate groups. The second axis is interpreted possibly as the elevation gradient corresponding to the different forest types and Capoeira vegetation. From bottom to top, the second axis represents vegetation types from the slopes of the Serra Geral to the Planalto. Capões represent a binding tie between grassland vegetation and forest vegetation with higher tendency to forest vegetation. The assemblages of Capoeira vegetation displayed a diffuse distribution pattern. They were located along the axis of grassland vegetation as well as at the axis of forest vegetation. Assemblages of the anthropogenic influenced area showed the same distribution pattern.

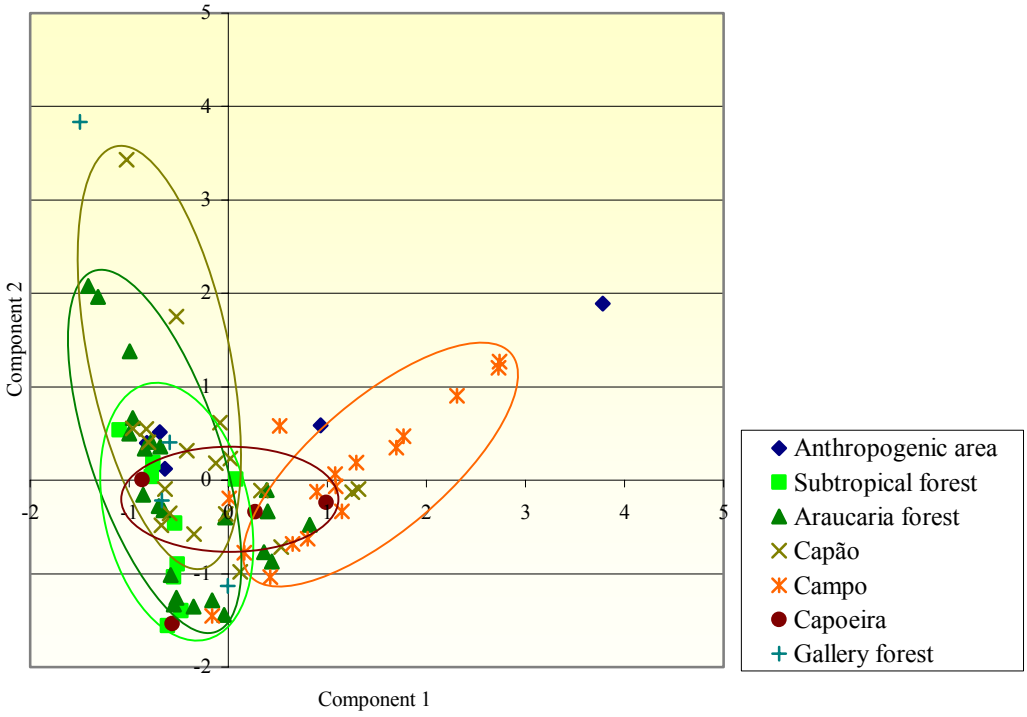


Fig. 37: *Scatter diagram of principal component analysis carried out on 81 samples*

3.3.2 Dispersion of taxa

The arrangement of components on the level of pollen and spores types demonstrates principally the same pattern as shown above on the sample level. Taxa, such as Poaceae, Cyperaceae, herbaceous members of Asteraceae and Rubiaceae, which are characteristic for grassland vegetation, are arranged along the first axis (Fig. 38, brown ellipse). Taxa which belong to the forest vegetation, e.g. *Araucaria*, *Podocarpus*, *Ilex*, *Dicksonia*, *Microgramma* and *Blechnum*, were mainly clustered on the second axis (Fig. 38, dark green ellipse).

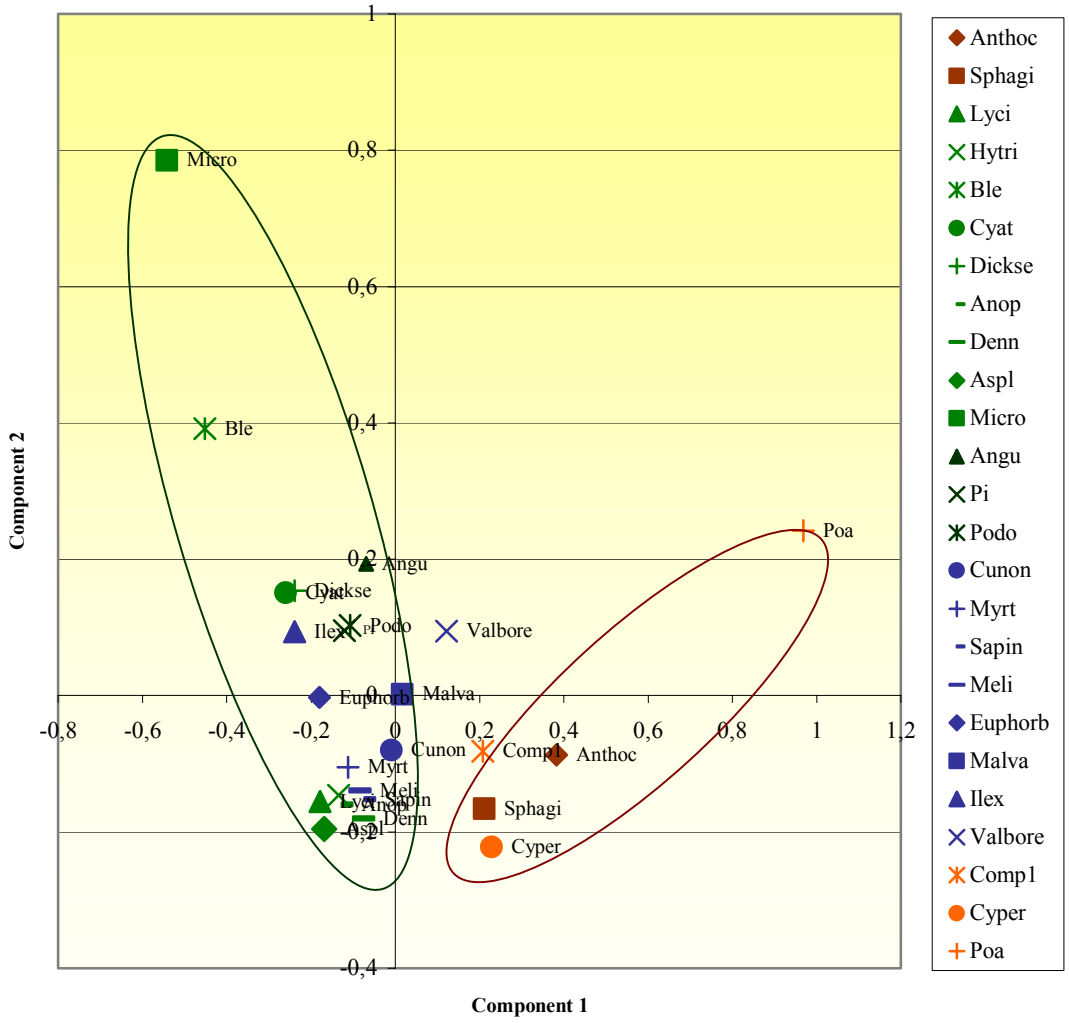


Fig. 38: Scatter diagram of principal component analysis carried out on 62 pollen/ spore types

3.3.3 Loadings of the components

The first component (axis) is defined by taxa of grassland vegetation because they show a positive value (Fig. 39). Poaceae, which contribute with 97%, is the determining group whereas other taxa contribute 38% (e.g. Anthocerataceae) to the first component. Further taxa contributing grassland vegetation are Cyperaceae, Asteraceae (Comp1) and the Sphagnum group. Taxa of the pteridophytes, such as *Microgramma* (76%) and *Blechnum* (39%) define the second component (Fig. 40). The measured contribution of Poaceae (24%) is not to be scoffed.

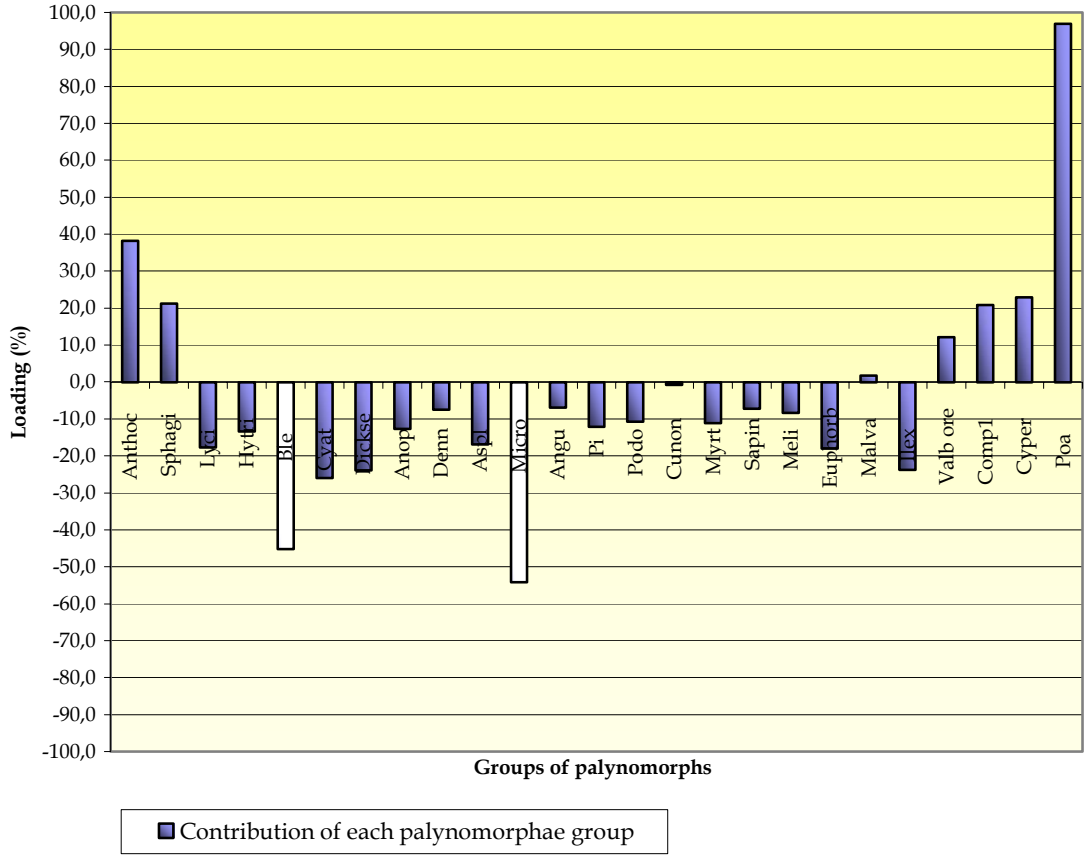


Fig. 39: Palynomorphs contributing to the first axis

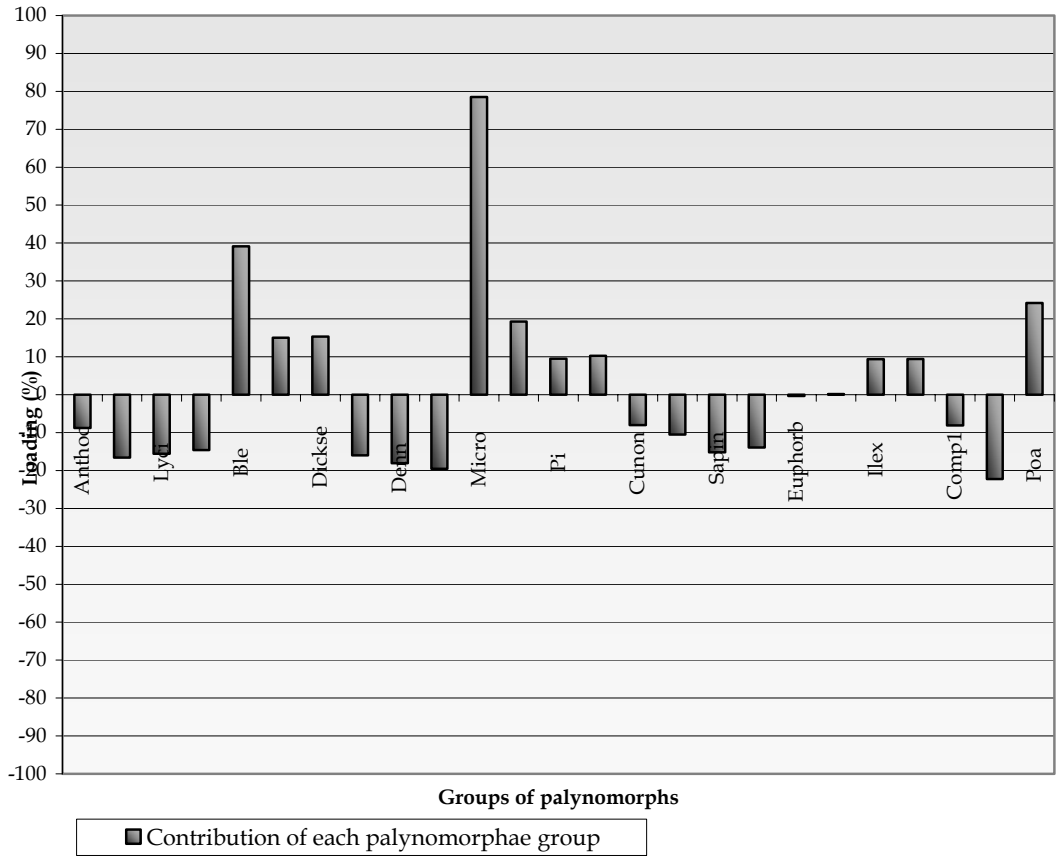


Fig. 40: Palynomorphs contributing to the second axis

3.4 Cluster analysis

3.4.1 Cluster analysis for all samples

Two main clusters are distinguished: The separation is located between sample No. 21 and 31 (Fig. 41, red arrow). The first cluster is characterised by the different forest types (*Araucaria* forest (dark green numbers), semi-deciduous and deciduous forest (mangenta numbers), gallery forest (blue numbers) and Capão(dark yellow numbers) as well as by some assemblages from Capoeira vegetation (brown numbers) and assemblages from anthropogenic affected areas (red numbers). The second cluster implies all grassland samples (light blue numbers) and isolated samples of the different forest types, Capoeira and anthropogenic affected areas. In the first cluster the different forest types intermix. A clear separation between the different forest types is not possible. The second cluster shows, in matters of separation, a similar pattern. It presents the grassland cluster spotted by forest vegetation. While the second cluster (`grassland cluster`) includes also forest samples, the first cluster (`forest cluster`) includes exclusively samples of forest vegetation and transitional vegetation.

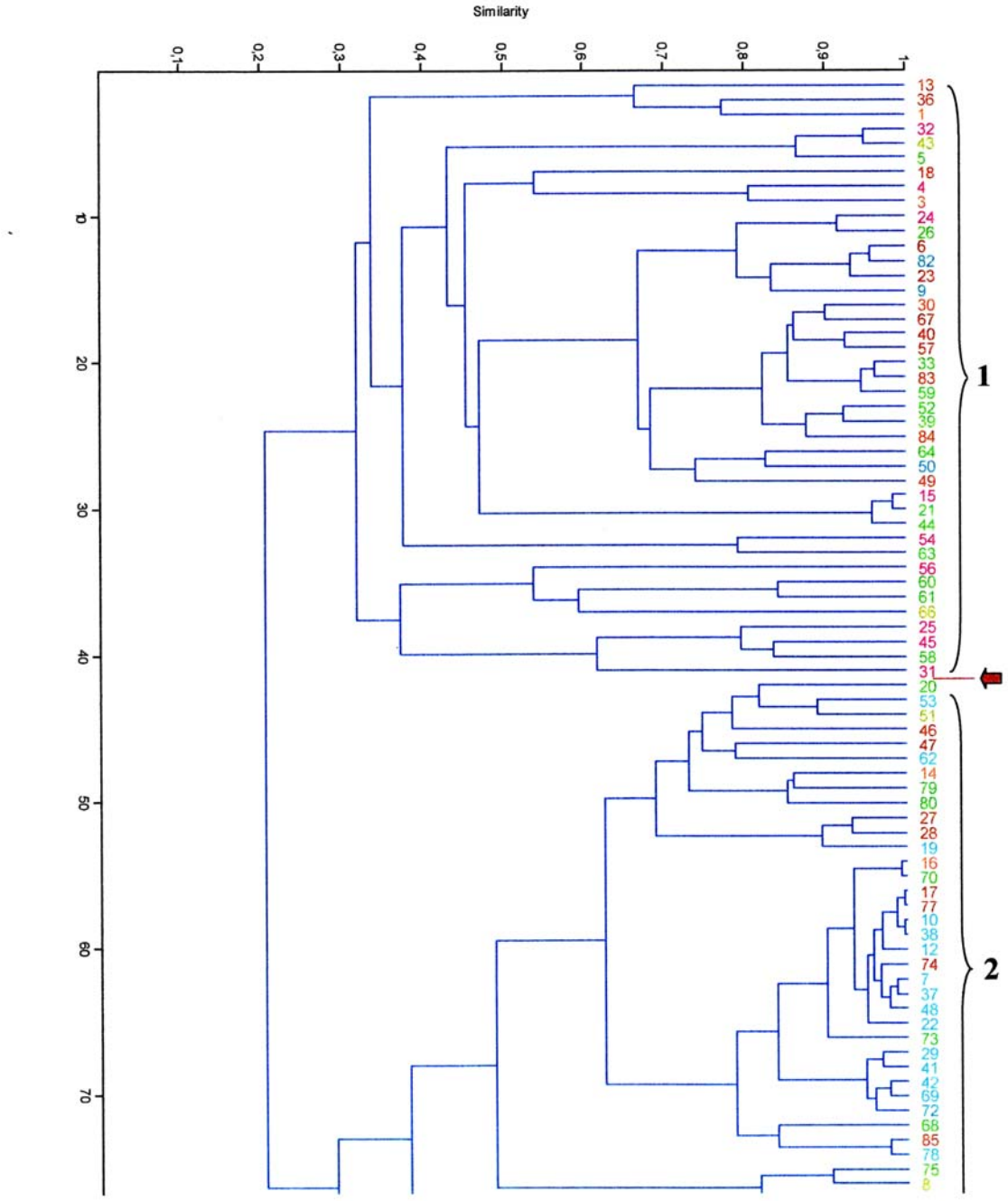


Fig. 41: Cluster analysis – clustering of all samples, using the algorithm of UPGMA and MORISITA´s index

3.4.2 Cluster analysis for samples of forest vegetation

The dendrogram illustrates a splitting up of samples in two main branches (branch 1 and branch 2) but within these branches there is no order identifiable (Fig. 42). The branch 2 aggregates mainly samples of Capões collected in sub-area 1, whereas the first branch aggregates samples of Capões of all sub-areas. The other forest types point out similar results: Samples of semi-deciduous and deciduous forest sites showed a diffuse pattern.

3.4.3 Cluster analysis for samples of Campo vegetation and samples with intense interaction with Campo vegetation

The dendrogram of this cluster analysis presented a splitting up of the samples in two main branches (Fig. 43). In contrast to the previous dendrogram, the first main branch clusters all samples of Campos. Samples of Capão-, Capoeira and gallery forest vegetation appear in branch 1 and branch 2 independent of the origin of the sample. A clear order is not identifiable.

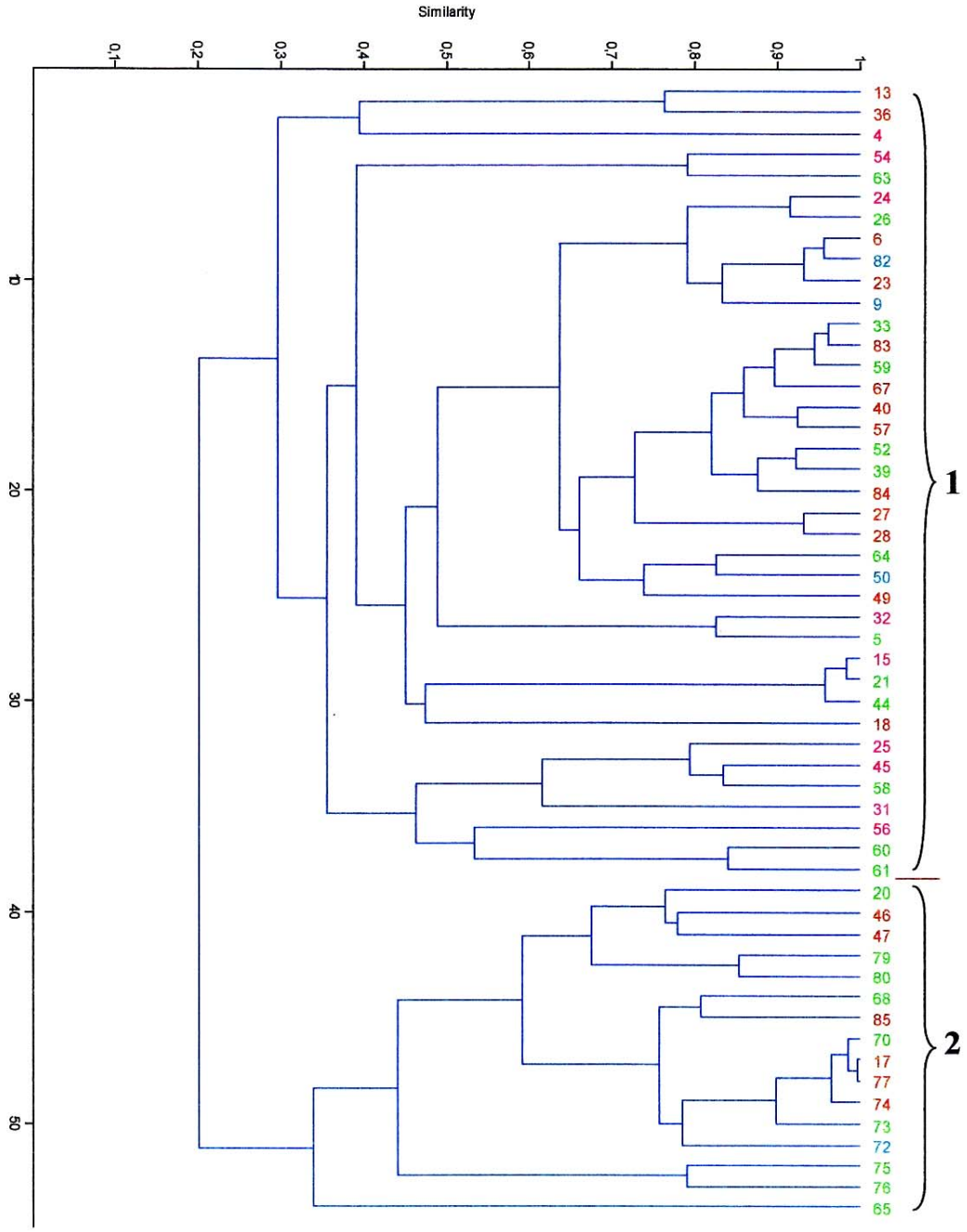


Fig. 42: Cluster analysis – clustering of samples of forest vegetation, using the algorithm of UPGMA and MORISITA´s index

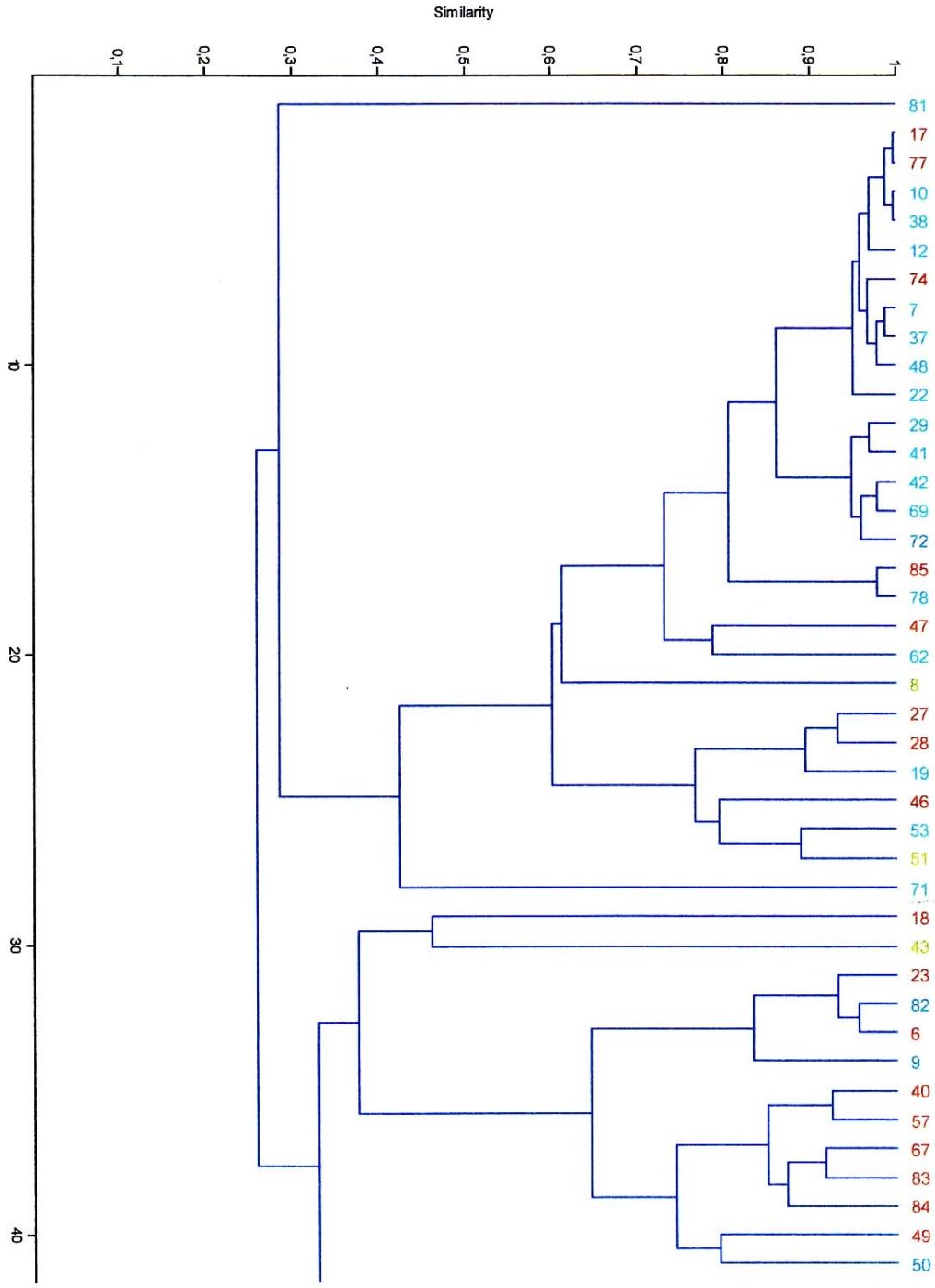


Fig. 43: *Cluster analysis – clustering of samples of grassland, Capões, Capoeira and gallery forest vegetation, using the algorithm of UPGMA and MORISITA´s index*

3.5. Comparison of vegetation mapping with the palynological analysis

Five categories of relationships between plants and the appearance of their pollen grains or spores in the soil were detected (Tab. 4):

The first category (Tab. 4, yellow accented taxa) includes plants which occur frequently with a high dominance and abundance (high AD-value). Asteraceae (mainly herbaceous forms, but also shrubs) and Poaceae are examples for this category. Poaceae occur not only in grassland and Capoeira vegetation but also in forest vegetation where it even exhibits a high dominance and abundance. The palynological analysis presents a similar pattern. Pollen grains of Poaceae occur of course in Campo and Capoeira vegetation (there with a conspicuously higher amount) as well as in forest vegetation (Figs. 32 and 33). While herbaceous Asteraceae grow mainly in grassland and Capoeira vegetation, shrubby Asteraceae occur mainly in the skirts of forests. The palynological spectra of the respective vegetation types reflect this aspect (Figs. 28 to 34).

The second category (Tab. 4, red accented taxa) encloses taxa which are characteristic for a certain vegetation type. *Araucaria angustifolia* – the eponymous element of *Araucaria* forest - *Dicksonia sellowiana*, *Drymis brasiliensis* and *Vernonia spp.* (mainly *Vernonia discolor*) are mentioned exemplarily for taxa belonging to this group (Tab. 4, red accented taxa). Whereas *Araucaria angustifolia* is a typical element of *Araucaria* forests, Capões and gallery forests, *Dicksonia sellowiana* is almost exclusively related to *Araucaria* forests. *Drymis brasiliensis* is prevalent in Capões and partially in gallery forests. It is an element of the skirts of Capões. *Vernonia* also prefers the skirts of the wood but is less frequent than *Drymis brasiliensis*. Respectively, the palynomorphs of these taxa determine the palynological spectra of the accordant forest type.

The third category (Tab. 4, green accented taxa) encloses taxa which are characteristic for a certain vegetation type but their palynomorphs did not occur frequently in the palynological

spectra of the accordant vegetation type. Leguminosae (with dendriform habit) and Piperaceae should be mentioned exemplarily for typical taxa of broad-leaved evergreen forests, semideciduous and deciduous forests. They are characteristic taxa of these forest types. They even distinguish the character of these forest types. However, in the palynological spectra of the correspondent forest type they appear sporadically and they were not considered in further analyses. In the cases of *Casearia spp.* (Flacourtiaceae), Melastomataceae, Myrtaceae and *Daphnopsis spp.* (Thymeleaceae), it is similar (Tab. 4). The Melastomataceae-species *Miconia hiemalis* and *Miconia cinerascensas* as well as the Flacourtiaceae-species *Casearia decandra* and *Casearia sylvestris* and the Thymeleaceae-species *Daphnopsis fasciculate* and *Daphnopsis racemosa* are typical elements of *Araucaria* forests, Capões and gallery forests but their pollen are rare in the palynological spectra of these forest types. Myrtaceae, which occur in an extremely high diversity of species in all forest types, appear rare in the palynological spectra.

The fourth category (Tab. 4, blue accented taxa) includes taxa which emerge in forests but with a high variability of abundance and dominance. The palynological spectra of these forests demonstrate this variability related to the palynomorphs. *Podocarpus lambertii* represents one example of this relationship between vegetation and pollen presence. *Podocarpus lambertii* occurs in forests but with a different abundance and dominance of specimens. *Podocarpus lambertii*-pollen grains showed the same variability.

Finally, the fifth category (Tab. 4, brown accented taxa) includes epiphytes like Bromeliaceae and Orchidaceae. They mainly emerged in *Araucaria* forests, Capões and gallery forests but in the palynological spectra they rarely appeared (Bromeliaceae) or are absent (Orchidaceae).

The other taxa (non-accented taxa) do not show a clear relationship between the taxon and a certain vegetation type. They cannot be used as indicator-taxa.

	semi-deciduous and deciduous forest			Campo			Capoeira		
subareas	1	2	3	1	2	3	1	2	3
Lithraea+Schinus (Anacardiaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,2
Ilex spp.(Aquifoliaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Vernonia spp. (Asteraceae)	0,0	0,0	0,0	0,0	0,1	0,8	0,0	0,0	0,0
Asteraceae (general)	0,0	0,0	0,0	0,5	2,1	2,5	5,2	4,7	3,9
Sloanea + Weinmannia	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sebastiana commersoniana (Euphorbiaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Actinostemon concolor (Euphorbiaceae)	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0
Alchornea triplinervia (Euphorbiaceae)	0,0	0,0	0,5	0,0	0,0	0,0	0,0	0,0	0,0
Euphorbiaceae (general)	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0
Casearia spp.(Flacourtiaceae)	0,0	0,0	0,0	0,0	0,0	0,8	0,0	0,0	0,0
Lauraceae	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0
Leguminosae	2,4	1,2	1,4	0,2	0,3	0,0	0,0	0,0	0,0
Melastomataceae	0,0	0,6	0,0	0,2	0,5	0,4	0,0	0,6	0,0
Cabralea canjerana (Meliaceae)	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0
Trichilia spp.(Meliaceae)	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0
Meliaceae (general)	0,0	0,0	0,7	0,0	0,0	0,0	0,0	0,0	0,0
Myrsine spp.(Myrsinaceae)	0,0	0,0	0,9	0,0	0,0	0,0	0,0	0,0	0,0
Myrtaceae (general)	0,0	2,0	1,7	0,0	0,0	0,4	2,4	0,0	0,0
Piperaceae	2,4	0,0	2,1	0,0	0,0	0,0	0,0	0,0	0,0
Matayba elaegnoides (Sapindaceae)	0,0	0,0	0,4	0,0	0,0	0,0	0,0	0,0	0,0
Cupania spp. (Sapindaceae)	0,0	0,0	1,6	0,0	0,0	0,0	0,0	0,0	0,0
Allophyllus spp. (Sapindaceae)	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0

Tab. 4: *Average dominance and abundance (AD-values) of selected plant taxa in the different vegetation types and the different sub-areas*

	semi-deciduous and deciduous forest			Campo			Capoeira		
subareas	1	2	3	1	2	3	1	2	3
Solanaceae (general)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Solanum spp. (Solanaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Daphnopsis spp.(Thymeleaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	2,4
Drymis brasiliensis (Winteraceae)	0,0	0,0	0,0	0,0	0,0	0,8	0,0	0,0	0,0
Bromeliaceae	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cyperaceae	0,0	0,0	0,0	0,0	0,7	0,0	0,0	1,2	0,0
Orchidiaceae	0,0	0,6	0,5	0,0	0,0	0,0	0,0	0,0	0,0
Poaceae	2,4	0,0	0,6	6,4	6,4	2,3	7,0	6,3	7,0
Araucaria angustifolia (Araucariaceae)	0,0	2,3	0,0	0,0	0,0	0,0	0,0	1,1	0,0
Podocarpus lambertii (Podocarpaceae).	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Lycopodium sp. (Lycopodiaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,0
Sphagnum sp. (Sphagnaceae)	0,0	0,0	0,0	0,5	0,4	0,0	0,0	0,0	0,0
Asplenium spp. (Aspleniaceae)	1,1	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Blechnum imperiale (Blechnaceae)	0,0	0,0	0,6	0,0	0,3	0,0	0,0	0,0	0,0
Alsophila sp.(Cyatheaceae)	0,0	0,0	0,3	0,0	0,0	0,0	0,0	0,0	0,0
Dennstaedtiaceae	0,0	3,5	1,6	0,0	0,7	1,6	0,0	0,0	1,2
Dicksonia sellowiana (Dicksoniaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Gleichenia sp.(Gleicheniaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Pteridophyta (general)	0,0	0,6	0,0	0,0	0,0	0,0	0,0	1,3	0,0

Tab. 4: Average dominance and abundance (AD-values) of selected plant taxa in the different vegetation types and the different sub-areas

subareas	gallery forest 1	gallery forest 2	gallery forest 3	Capão 1	Capão 2	Capão 3	*Araucaria* forest 1	*Araucaria* forest 2	*Araucaria* forest 3
Lithraea+Schinus (Anacardiaceae)	0,0	0,0	0,0	0,0	1,0	0,0	0,0	0,3	0,2
Ilex spp.(Aquifoliaceae)	0,0	0,0	2,4	0,2	0,0	1,0	0,0	0,3	1,6
Vernonia spp. (Asteraceae)	0,0	0,0	0,0	0,3	0,4	0,0	0,0	0,0	0,2
Asteraceae (general)	0,0	2,8	0,0	0,3	0,0	0,6	0,0	0,6	0,0
Sloanea + Weinmannia	0,0	0,0	0,0	0,0	0,0	0,0	0,6	0,3	0,2
Sebastiana commersoniana (Euphorbiaceae)	0,0	0,0	2,4	0,0	0,0	0,0	0,0	0,0	0,2
Actinostemon concolor (Euphorbiaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
Alchornea triplinervia (Euphorbiaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Euphorbiaceae (general)	0,0	0,0	0,0	0,0	0,0	0,6	0,0	0,5	0,3
Casearia spp.(Flacourtiaceae)	0,0	0,0	0,0	0,0	0,8	0,6	0,0	0,7	1,1
Lauraceae	0,0	1,8	0,0	0,4	0,0	0,0	0,6	0,8	1,1
Leguminosae	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0	0,4
Melastomataceae	3,9	0,6	2,4	1,5	2,5	0,7	1,2	1,4	1,9
Cabralea canjerana (Meliaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,4
Trichilia spp.(Meliaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,2
Meliaceae (general)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Myrsine spp.(Myrsinaceae)	0,0	0,0	0,0	0,5	0,2	0,0	0,6	0,3	1,0
Myrtaceae (general)	3,6	2,0	3,6	3,4	3,0	3,2	3,2	2,0	2,4
Piperaceae	0,0	0,0	0,0	0,0	0,0	0,7	0,0	0,0	0,5
Matayba elaegnoides (Sapindaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,6
Cupania spp. (Sapindaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,9
Allophyllus spp. (Sapindaceae)	0,0	0,6	0,0	0,3	0,0	0,0	0,0	0,0	0,1

Tab. 4: Average dominance and abundance (AD-values) of selected plant taxa in the different vegetation types and the different sub-areas

	gallery forest			Capão			*Araucaria* forest		
subareas	1	2	3	1	2	3	1	2	3
Solanaceae (general)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,2
Solanum spp. (Solanaceae)	0,0	0,0	2,4	0,0	0,2	0,6	0,0	0,0	0,1
Daphnopsis spp.(Thymeleaceae)	2,4	0,0	0,0	1,4	2,4	1,3	0,0	1,0	0,8
Drymis brasiliensis (Winteraceae)	0,0	0,0	2,4	1,2	0,8	0,0	0,0	0,4	0,3
Bromeliaceae	1,4	0,7	1,3	0,9	1,3	0,3	1,3	0,8	0,4
Cyperaceae	0,0	0,0	1,1	0,0	0,0	0,0	2,6	0,0	0,6
Orchidiaceae	0,0	0,0	0,0	0,3	0,2	0,3	0,0	0,4	0,2
Poaceae	2,4	0,0	2,6	2,2	2,1	4,4	0,0	2,4	1,4
Araucaria angustifolia (Araucariaceae)	2,4	2,6	0,0	2,7	3,3	3,4	3,0	3,0	4,0
Podocarpus lambertii (Podocarpaceae)	2,4	0,0	0,0	0,7	0,4	0,0	0,0	0,5	0,7
Lycopodium sp. (Lycopodiaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Sphagnum sp. (Sphagnaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Asplenium spp. (Aspleniaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Blechnum (Blechnaceae)	0,0	0,0	0,0	0,3	0,4	0,6	0,0	0,1	0,0
Alsophila sp.(Cyatheaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Dennstaedtiaceae	0,0	0,6	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Dicksonia sellowiana (Dicksoniaceae)	0,0	0,0	0,0	0,0	0,0	0,9	1,2	1,1	0,4
Gleichenia sp.(Gleicheniaceae)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,1
Pteridophyta (general)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,3	0,0

Tab. 4: Average dominance and abundance (AD-values) of selected plant taxa in the different vegetation types and the different sub-areas

4. Discussion and conclusion

4.1 Discussion

The intense correlation between vegetation and palynological spectra had already been demonstrated by different authors. While e.g. BIRKS (1981), FIRBAS (1949), SALGADO-LABOURIAU (1997) and STRAKA (1957) attempted to reconstruct the palaeovegetation based on palynological analysis, other authors accomplished a direct comparison of palynological spectra and the contemporary vegetation. DAVIES & FALL (2001) studied the modern pollen precipitation from an elevational transect in central Jordan and layed open its relationship to vegetation. CONNOR et al. (2004) conducted a similar study in southern Georgia, Caucasus region. ELENGA et al. 2000, EL GHAZALI & MOORE 1998, GAJEWSKI 2002 executed similar studies in Africa.

This work has shown that recent pollen data from the Planalto region of Rio Grande do Sul show differences between various vegetation types. The different vegetation types can be separated by the relative proportion of different taxa as shown in the palynological spectra, by the occurrences of pollen/ spore markers sorted by interpolated raster data, by principal component analysis and cluster analysis.

4.1.1 Interpretation of palynological spectra from TILIA-analyses and interpolated raster data (ArcGIS)

Palynological analyses of the present study, performed with TILIA and also interpolated raster data from ArcGIS, demonstrate that a separation between the different vegetation types is feasible. Like MARCHANT et al. (2001) who reconstructed different biomes derived from modern pollen data along an altitudinal gradient in Colombia, this study aimed to reconstruct different vegetation types along a regional gradient in the Planalto region of Rio Grande do Sul. The presence and abundance of pollen and spores are controlled by the

chemism of the pollen-exine and the sporoderm, by the dispersion mechanism of pollen and spores. DENG et al. (2004) refer emphatically that the quantitative relationship between source taxon vegetation frequency and its pollen presentation varies between species due to differential pollen production and dispersal. VINCENS et al. (2000) disclose this as a general feature in many tropical regions. Processes of degradation, which are controlled by climatic factors, also affect on the presence and abundance of the palynomorphs. The climatic factors include intense rain, subtropical temperatures, etc. interacting with the soil texture and stratigraphic conditions (EBNER 2005). This point of view has always to be taken into consideration. For example, soils situated on slopes, subjected to erosion and rearrangement including their palynomorphs which, themselves, modify the palynological spectrum. Taking into account all these factors, local vegetation influences the palynological spectra and consequently, the different vegetation types will still be distinguished on the basis of palynological spectra.

The fundamental question which was posed was confirmed in this work with regard to:

1. grassland/forest-level
2. different grassland types and
3. different forest types

1. grassland/forest-level

The present study confirms that grassland is determined primarily by pollen grains of Poaceae (almost 50%) while the soil samples of forests contained pollen grains of Poaceae from 20 to 30%. The conspicuous amount of Cyperaceae pollen is worth being mentioned in soil samples of grassland. Accessory pollen of *Araucaria angustifolia*, *Podocarpus lambertii* and taxa of Asteraceae are worth being listed as well. REESE & LIU (2005) described the dominance of grass (Poaceae) in combination with moderate frequencies of Asteraceae pollen, which tend to increase slightly towards the southern (drier) locations as a characteristic of the Altiplano of the central Andes region of South America.

The pteridophytes group is the predominant one in soil samples of forests, where up to almost 60% of the total amount of palynomorphs were found in *Araucaria* forests, up to almost 50% in semi-deciduous and deciduous forests and of 40-50% in Capões. Furthermore, pollen of shrub and tree species, e.g. *Araucaria angustifolia*, *Podocarpus lambertii*, *Ilex sp*., Euphorbiaceae and Myrtaceae, emerge stronger in soil samples of forest vegetation than in soil samples of grassland vegetation. In contrast to forests, the amount of pteridophytes reaches a maximum of 20% in soil samples of grassland. In general, the proportion of fern spores, arboreal pollen (e.g. of *Araucaria angustifolia*, *Podocarpus lambertii*, *Ilex sp*., Euphorbiaceae and Myrtaceae) and non-arboreal pollen, especially Poaceae pollen, reflect the physiognomy of the forests and grasslands. EBNER (2005) described similar results for the Pró-Mata area. Gallery forests reveal an intermediate situation with maximum 25% spores of pteridophytes and a scarce pollen amount of tree species. This reflects the situation of the recent vegetation where gallery forests represent open vegetation alongside rivers interacting intensely with grasslands. BROWN (1987) constituted gallery forests as paths for exchange of floristic elements of different forest biomes like Mata Atlântica and Amazonia. Gallery forests present a transitional vegetation which is not clearly separable from other forest types.

2. different grassland types

On the basis of palynological analysis two types of grassland are distinguished. While spores of the bryophytes *Anthoceros punctatus* and *Phaeoceros laevis* were found in soil samples of dry grassland, spores of *Sphagnum* occured exclusively in wet grassland. Consequently, *Sphagnum* represents an indicator for wet subsurface and swamp. Swamped grassland interferes frequently in recent vegetation with dry grassland, especially with neighbouring Capões. PAEZ et al. (1998) separated three different steppe types by multivariate analysis of pollen samples.

3. different forest types

A determination of the three forest types – *Araucaria* forest, semi-deciduous and deciduous forest – is feasible by means of availability and frequency of tree fern spores. Investigations of the vegetation carried out by KLEIN (1984) confirmed that genera of Cyatheaceae occur on slopes of the Serra Geral especially in subtropical broad-leaved evergreen forests while species of *Dicksonia* prefer the Planalto. In this investigation, spores of Cyatheaceae appear mainly on slopes of the Serra Geral, the thick-walled spores of *Dicksonia sellowiana* emerge exclusively on the Planalto. This aspect correlates with the forests types because the eastern and south-eastern slopes of Serra Geral are covered with semi-deciduous forests influenced by coastal, subtropical broad-leaved evergreen forests while the Planalto is exclusively covered by *Araucaria* forests and Capões. This aspect corroborates the hypothesis that it is feasible to determine the two types of forests - *Araucaria* forest and semi-deciduous forest. In relation to deciduous forests, this hypothesis is invalid. In fact, deciduous forests are located on the slopes of the Serra Geral but tree fern spores are less relevant. The drier climate upcountry (SCHULTZE 2000) that requires an equivalent forest – a deciduous forest – is probably the reason why the amount of tree ferns and consequently tree fern spores decline. Furthermore, the influence of elements of the broad-leaved evergreen forest of the coastal slopes of the Serra Geral, which passed the "Gate of Torres" (RAMBO 1951), diminishes from the East westward. That means that a determination of the three mentioned forest types is practicable by tree fern spores of palynological spectra. This result corresponds with EBNER´s result (2005) who detected the frequency of the two spore types of tree ferns depending on the location/ forest type within the Pró-Mata area. Apart from the above mentioned, spores of *Asplenium sp.*, pollen of *Araucaria angustifolia*, *Podocarpus lambertii* and accessory palynomorphs are relevant for a determination of the forest types. With exception of two soil samples (samples No.15 and 32), *Asplenium* spores were found regularly in semi-deciduous and deciduous forests, but in a low amount. In contrast, *Asplenium sp*. is irrelevant in *Araucaria* forests. *Asplenium sp*. could represent a discriminatory species which is decisive for a vegetation type (DIERSCHKE 1994) – in this

case for semi-deciduous and deciduous forests. All these facts prove the *Araucaria* forests can be distinguished from the deciduous forests. But in contrast to the proposition of BONNEFILLE et al. (1999), detecting deciduous forests are characterised by abundant Melastomataceae pollen, this study does not confirm this statement. In the present study Melastomataceae pollen are rare or absent in *Araucaria* forests, Capões, gallery forests as well as in deciduous forests, although the source plants are well-presented in the contemporary vegetation. Pollen of *Araucaria angustifolia* and *Podocarpus lambertii* indicate *Araucaria* forests and Capões, while they fail to appear in semi-deciduous and deciduous woods. DENG et al. (2004) described similar effects for modern pollen-vegetation relationships along transects on the Whangapoua Estuary. They emphasise the presence of discriminatory species, even in small pollen amounts, will allow correct identification of the local vegetation represented in sedimentary palynological sequences. In the course of the present work it was also ascertained that the number of pollen/ spore taxa identified in each sample of the semi-deciduous and deciduous forests is notably less than that obtained in each sample of the other vegetation types. BONNEFILLE et al. (1999) also mentioned this observation in the deciduous forests of South India. This result would agree with a lower plant diversity estimated for deciduous forests (GHATE et al. 1998)

Similar to the intermediate position of gallery forest implied by pteridophytes spores, gallery forests are exceptions in relation to tree fern spores and pollen of *Araucaria angustifolia* and *Podocarpus lambertii* because they were rare.

The position of Capões is in so far interesting as the latter are less characterised by pollen of *Araucaria angustifolia* rather than *Podocarpus lambertii*, *Ilex sp.* and *Drymis brasiliensis* which are well-represented. *Podocarpus lambertii*, *Ilex sp.* and *Drymis brasiliensis* are classified as settlement pioneers of vegetation and prefer rather open vegetation (EBNER 2005). These conditions match those of Capões which have an open mantle of vegetation interacting with surrounding grassland vegetation. Their margin is favoured by species of *Podocarpus lambertii*, *Ilex sp.* and *Drymis brasiliensis*. The increased value of Poaceae pollen (up to 40%) in Capões can be attributed to aeolian input

from nearby grasslands. This reflects the mosaic pattern of Capões and grasslands. BONNEFILLE et al. (1999) ascertained similar effects for the mosaic pattern of shoals and grasslands in South India.

4.1.2 Interpretation of the PCA results

Results deriving from two different methodologies were compared in juxta position: Palynomorphs, extracted from soil and counted thereafter, were analysed with multivariate statistical methods to verify values resulting from assessing palynological spectra. PCA was one of the applied multivariate statistical methods. The palynological spectra arrange in distinct cluster groups subjected to the main vegetation types. These results correspond to EBNER (2005) who introduced the term ´fingerprint´ for palynological spectra of upper floor samples for identification of ecological units. ANUPAMA et al. (2000) distinguished between deciduous and evergreen forest of the southern Eastern Ghats of India. But in contrast to his work, in the present study the separation of semi-deciduous and deciduous forests is less distinct. This reflects the secret transition from semideciduous to deciduous forest. PCA resulted in a separation of palynological spectra of forest vegetation and grassland vegetation along the first axis (component). The separation of *Araucaria* forest and semi-deciduous/ deciduous forest takes place along the negative end of the first axis (component). The smooth transition, from semi-deciduous/ deciduous forest on the slopes of the Serra Geral to *Araucaria* forest on the border of the Planalto, is reflected in the PCA-charts.

Capões represent ties between forests on the one hand and grassland on the other hand accordingly they arrange in the PCA between the forest clusters and the grassland cluster.

Pollen assemblages of Capoeira vegetation cluster in a large diffuse cloud. Their palynological spectra seem to represent pollen and spores of the previous vegetation (vegetation before deforestation) because the palynological spectra vary intensively from the source vegetation. If semi-deciduous forest presented the previous vegetation, the

palynological spectra of Capoeira is analogue to the palynological spectra of semi-deciduous forest.

Capões, gallery forests and Capoeira are transitional vegetation types and their palynological spectra are not clearly separable from those of the other vegetation types. BONNEFILLE et al. (1999) described a similar behaviour of transitional forests in South India.

The loadings of taxa corroborate the mentioned characteristics. This signifies that the vegetation types are characterised by a special composition of palynomorphs. Poaceae, Cyperaceae and Anthocerotaceae cluster on the grassland side while typical forest taxa like spores of *Blechnum*, *Microgramma*, *Dicksonia sellowiana* and Cyatheaceae cluster on the forest side. LIU et al. (1999) noted characteristic combinations of pollen types for each analysed vegetation zone in south-eastern Inner Mongolia. The quintessence of EBNER´s thesis (2005) expresses the same idea. However, the separation of the different types of vegetations is less distinct than shown in EBNER (2005). He described the separation of the vegetation types as a result evoked by a moisture gradient. This aspect can also be seen in the study area because the mean annual rainfall, which presents an east-to west gradient caused by orography, induces the release of rains on the eastern slopes of the Serra Geral and the eastern edge of the Planalto and blocks the inland progression (MORENO 1961). The decreasing east to west rainfall gradient limits both the expansion of subtropical broad-leaved evergreen forest on the slopes of the Serra Geral and of widespread *Araucaria* forest on the Planalto. SCHNECK (2005) described PCA as an excellent method for separation of vegetation types. This study is in accordance with his results and results of other groups: VINCENS et al. (2000) confirm that pollen data from soil samples reflect well the recent transgression of forest versus savanna vegetation in Cameroon. STUTZ et al. (2003) adduce the relationship of modern pollen and vegetation on the basis of a study along a coast to inland gradient (coastal lagoon area and Pampa grassland) in Mar Chiquita (Argentina).

4.1.3 Interpretation of the cluster analysis results

The second applied multivariate statistic method – the cluster analysis –confirms the results of the previous methods shown above. By applying cluster analysis, the soil samples cluster on the basis of palynological spectra in two cardinal groups – the ´grassland group´ and the ´forest group´. Further divisions within these cardinal groups are not feasible. This is also reflected by two distinct paths in the recent vegetation. One path describes semi-deciduous and deciduous forests on the slopes of Serra Geral which pass into *Araucaria* forest on the border of the Planalto. The second path describes *Araucaria* forest, Capões and gallery forest interacting intensively with grasslands (Campos). The palynological spectra of soil samples of Capoeira and anthropogenic areas represent, beside the pollen and spores of the recent vegetation, also the palynomorphs of the previous vegetation. Therefore, they scatter within the cardinal clusters. The cluster analysis of EBNER (2005) demonstrates a similar disperse distribution of the vegetation types. The present study confirms the proposition of SCHNECK (2005) referring to an indistinct separation of different vegetation types. In contrast to the present work, COURT-PICON et al. (2005) observed a good agreement between classifications and ordinations of the data-sets and the palynological separation of different vegetation types.

4.1.4 Interpretation of the palynological analysis and the mapping of vegetation

The palynological spectrum of soil depends not only on the abundance of the taxa or their pollen production but also depends on:

1. the dispersion mechanism of plants
2. the texture of pollen/ spores and
3. soil processes

1. Dispersion mechanism of plants

Some plants, e.g. ferns, gymnosperms (*e.g. Ilex, Pinus*) and Poaceae do not dispose on a special dispersion mechanism or are anemophilous plants, respectively. Considering this aspect, these plants produce numerous pollen/ spores which are typically well-represented in the palynological spectra of soil. Their presence ought to be interpreted carefully. In contrast, pollen of zoophilous plants, as Bignoniaceae, Malpighiaceae, Orchidaceae and Piperaceae, are rare or lack in the palynological spectra. Orchidaceae belong to zoophilous plants and the pollen grains are clustered to a polinarium. Orchids are well-represented in forests but their pollen lack in palynological spectra.

2. Texture of pollen/ spores

The rare presence or absence of *Araucaria angustifolia* pollen and Lauraceae pollen, respectively, are the consequence of their delicate pollen structure (ROJ & VAN DER WERFF 1988). Therefore, they are expeditiously damageable. The spores of *Dicksonia* are thick-walled and therefore they are well-presented in palynological spectra.

3. Soil processes

The palynomorphs in the soil are exposed to processes of pedogenesis and degradation. As a result, delicate pollen/ spores are corroded strongly and lack in palynological spectra. The adjacent soil preparation for extraction of the palynomorphs enforces this effect.

4.2 Conclusion

Although pollen/ spore diversity does not exactly reproduce the plant diversity, this study concludes that the main features of the vegetation composition are preserved in the pollen assemblages. The separation of different vegetation types has been proved by the relative proportion of different taxa as shown in the palynological spectra (TILIA analyses), by the occurrences of pollen/ spore markers sorted by interpolated raster data (ArcGIS), by principal component analysis and cluster analysis. Therefore, this study leads to the conclusion that the biomization procedure might be applicable to this region and that propositions, which are valid in a defined area, have validity in a widespread area of the Planalto and the Serra Geral as well.

Such concepts are advantageous for reconstructions of biomes from pollen/ spore data and modelling past vegetation in Rio Grande do Sul and entire Brazil. BEHLING et al. (2004, 2005) have already a share in this field of study. STUTZ & PRIETO (2003) revealed by dentrended corresponded analysis that fossil pollen assemblages have modern counterparts, permitting to interpret the vegetation history of an area in greater detail than previously possible. The method of BARTH & PINTO DA LUZ (2003), executed a palynological analysis of geopropolis sediments, would be an auxiliary method added to the methodology of the present study. They demonstrated that pollen spectra of geopropolis sediments reflected a vegetation characteristic of the southeast region of Brazil.

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Appendix I

Plates with figures of an extract of identified palynomorphs

The palynomorphs were observed under 400-times magnified. The LM-micrographs were also taken with the same magnification.

Plate 1, p.III:

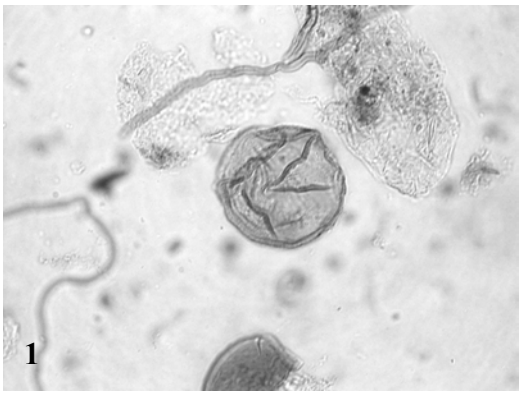
Gymnosperms

Fig.1: *Araucaria angustifolia* (Araucariaceae): inaperturate, scbrate, spheroidal, diameter of 65-80 µm

Fig.2: *Pinus sp.* (Pinaceae): vesiculate, bisaccate, diameter 80 -110 µm

Fig.3: *Podocarpus sp.*(Podocarpaceae): vesiculate, bisaccate, diameter 49 -80 µm

Gymnosperms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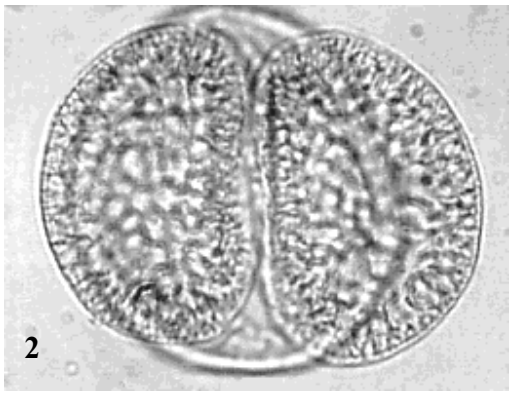
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Plate 2, p.V

Angiosperms – Dicots

Fig.4: *Sebastiana cf. commersoniana* (Euphorbiaceae): tricolporate, microreticulate, spheroidal to prolate, colpi with smooth margin, pori conspicuously to observe

Fig.5: *Actinostemon concolor* (Euphorbiaceae): tricolporate, scabrate, prolate to subprolate, colpi with smooth margin, pori sometimes inconspicuous

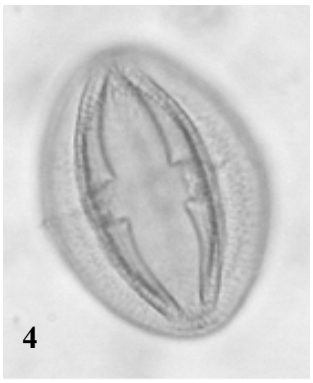
Fig.6: *Alchornea triplinerva* (Euphorbiaceae): tricolporate, psilate to scabrate, suboblate

Fig.7: Melastomataceae: heterocolporate (tricolporate with 3 pseudocolpi), psilate, prolate

Fig.8: *Ilex* (Aquifoliaceae): tricolporoidate, clavate, subprolate to prolate, colpi and margin inconspicuous

Fig.9: *Cabralea canjerana* (Meliaceae): tricolporate, psilate to slightly scabrate, spheroidal

Angiosperms - dicots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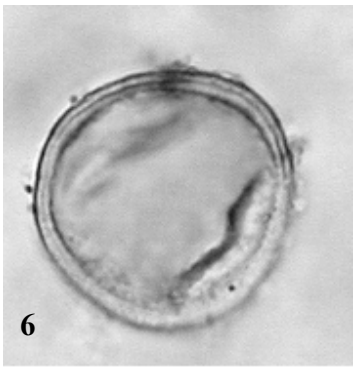
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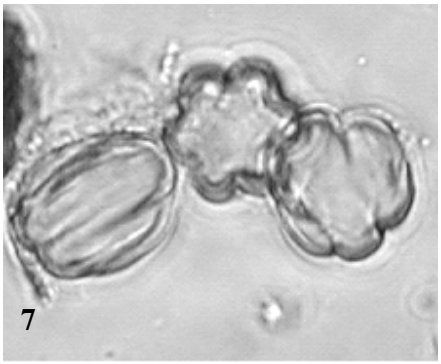
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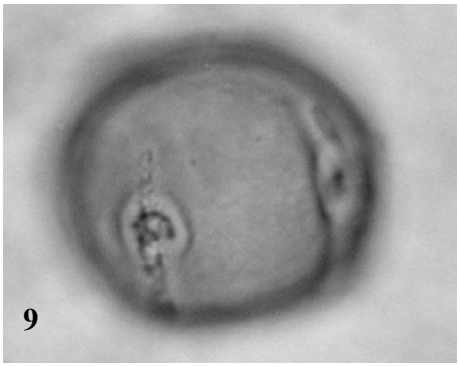
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Plate 3, p. VII

Angiosperms

Fig.10: *Daphnopsis* (Thymeleaceae): periporate, baculate, spheroidal

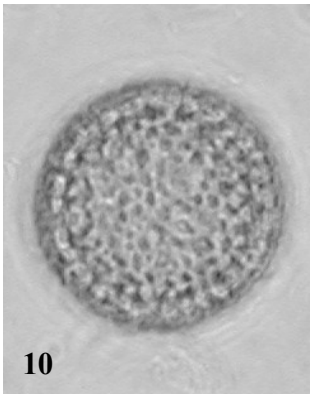
Fig.11: *Lithraea*-*Schinus*-type (Anacardiaceae): tricolpate, striate, subprolate

Fig.12: *Celtis* (Ulmaceae): triporate, psilate to scabrate, spheroidal

Fig.13: *Weinmannia*-type (Cunoniaceae; including *Sloanea*/ Elaeocarapaceae): tricolporoidate, microreticulate to psilate, prolate; fossil *Weinmannia* pollen are much alike *Sloanea* pollen therefore these two types were integrated in one type to avoid misidentifications (personal information of BEHLING 2003)

Fig.14: *Drymis brasiliensis* (Winteraceae): tetrads, single pollen grain inconspicuous zonasulcate, irregularly reticulate

Fig.15: *Myrsine* (Myrsinaceae): stephanocolpate (4 colpi), psilate to scabrate, spheroidal to subprolate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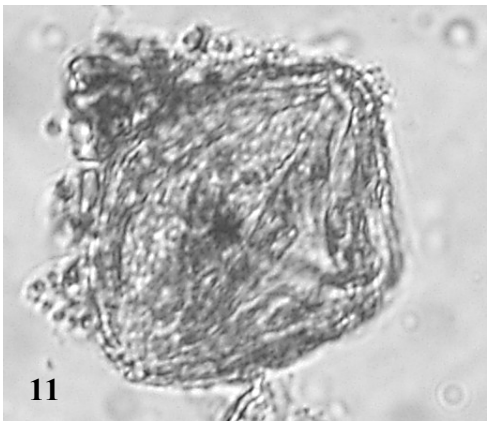
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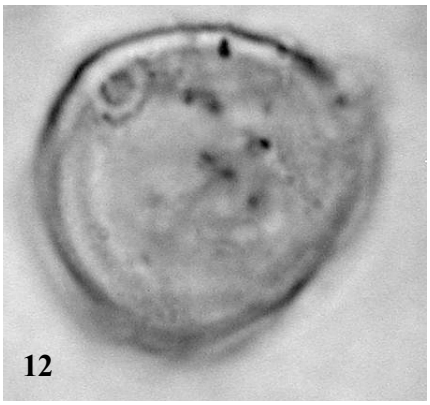
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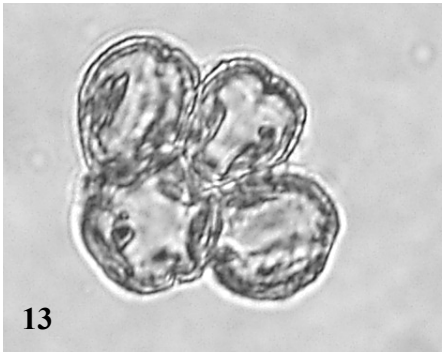
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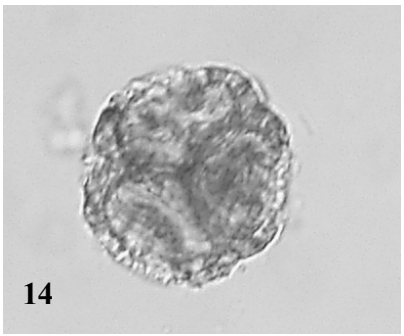
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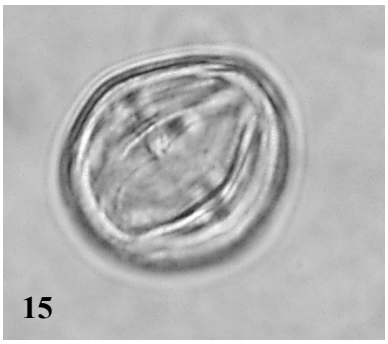
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Plate 4, p. IX

Angiosperms - dicots

Fig.16: *Zanthoxyllum* (Rutaceae): tricolporate, striate, subprolate to prolate

Fig.17: Myrtaceae: tricolporate, psilate to scabrate, peroblate

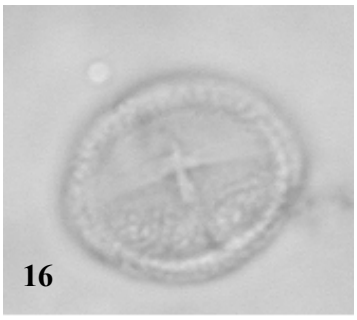
Fig.18: Solanaceae: tricolporate, psilate, subprolate to prolate

Fig.19: Loranthaceae: syncolpate, psilate to scabrate, peroblate, contour in polar view triangular with intense concave sides

Fig.20: *Cupania* (Sapindaceae): tricolporate, microreticulate, oblate, contour in polar view triangular with weakly sides

Fig.21: *Inga*-type (Mimosaceae): polyades, single pollen grains periporate, verrucate

Angiosperms - dicots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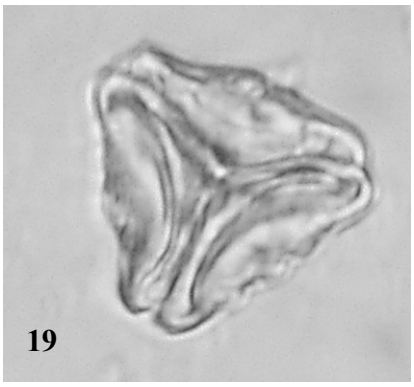
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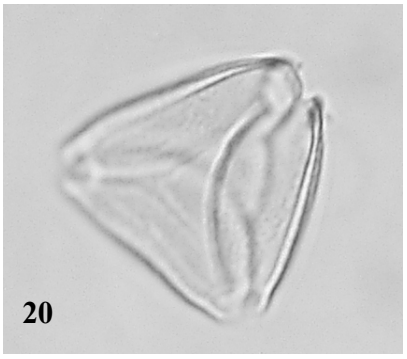
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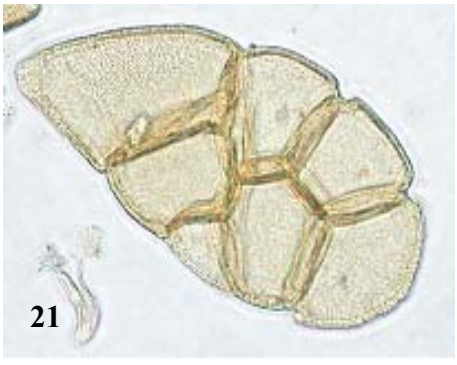
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plate 5, p. XI

Angiosperms - dicots

Fig.22: *Vernonia*-type (Asteraceae): triporate, echinate, reticulate (fenestrate), spheroidal

Fig.23: Malvaceae: pantoporate, echinate, spheroidal, tectate

Fig.24: *Trixis* (Asteraceae): tricolporate, psilate to scabrate, prolate, exine thicker on the poles

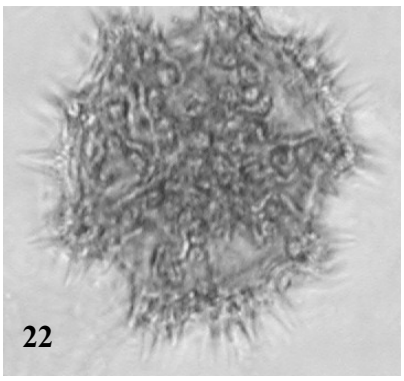
Fig.25: *Polygonum* (Polygonaceae): pantoporate, reticulate, spheroidal

Fig.26: *Eryngium* (Apiaceae): tricolporate, psilate to scabrate, perprolate

Fig.27: *Borreria* (Rubiaceae): stephanocolporate, reticulate, suboblate to spheroidal

Fig.28: Amaranthaceae-Chenopodiaceae-type: periporate, reticulate, spheroidal

Angiosperms – dicots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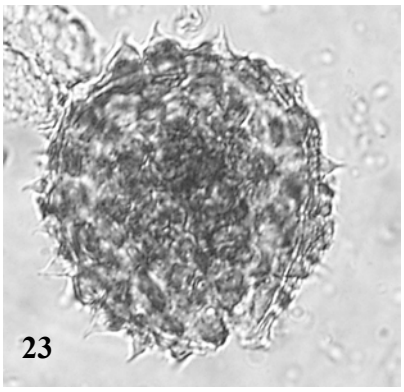
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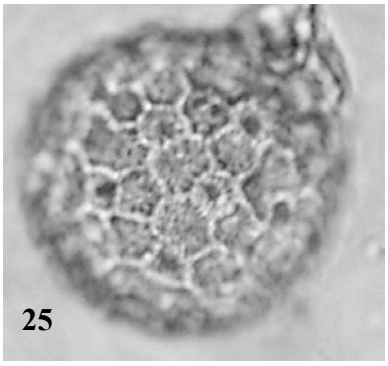
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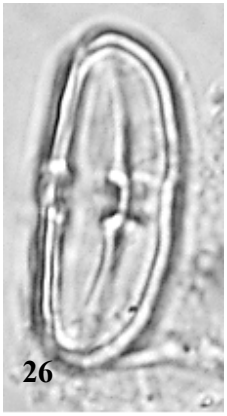
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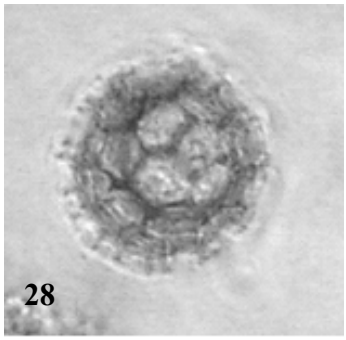
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Plate 6, p. XIII

Angiosperms – dicots

Fig.29: *Baccharis*-type (Asteraceae): tricolporate, echinate, prolate spheroidal

Fig.30: *Senecio*-type (Asteraceae): tricolporate, echinate, spheroidal to subprolate

Angiosperms – monocots

Fig.31: Poaceae**:** monoporate, psilate to scabrate, spheroidal

Fig.32: cf. *Xyris* (Xyridaceae): dicolpate, reticulate, contour in equatorial view biconvex

Angiosperms - dicots

Angiosperms – monocots

Plate 7, p. XV

Bryophytes

Fig.33: *Anthoceros punctatus* (Anthocerotaceae): trilete, echinate, trisymmetric

Fig.34: *Sphagnum* (Sphagnaceae): trilete, psilate to verrucate, trisymmetric

Pteridophyts – trilete spores

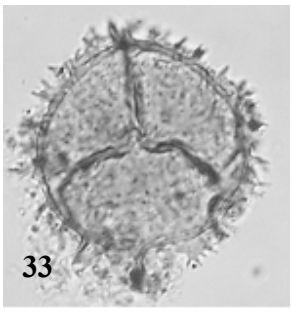
Fig.35: *Lycopodium* (Lycopodiaceae): trilete, reticulate, subtriangular-convex

Fig.36: *Selaginella* (Selaginellaceae): trilete, baculate to clavate, subtriangular-convex

Fig.37: *Huperzia* (Lycopodiaceae): trilete, foveolate, subtriangular-convex

Fig.38: *Trichomanes* (Hymenophyllaceae): trilete, echinate-papilate, subtriangular-convex

Bryophytes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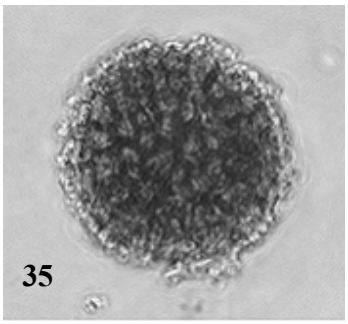
Pteridophytes – trilete spores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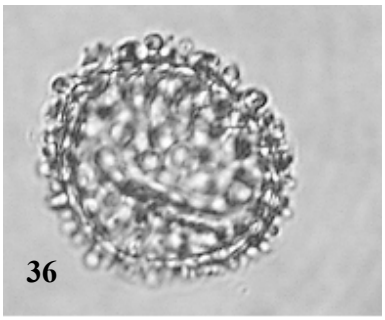
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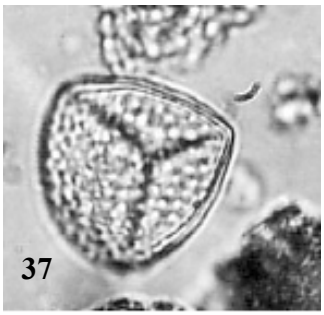
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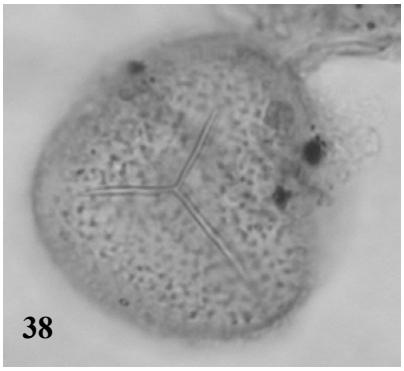
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Plates 8, p. XVI

Pteridophyts – trilete spores

Fig.39: *Anemia raddiana* (Schizaceae): trilete, cicatricose (coarse, compact and parallel exospore ridges), triangulares

Fig.40: *Anemia phyllitides* (Schizaceae): trilete, cicatricose-baculate, triangulares

Fig.41: *Alsophila* (Cyatheaceae): trilete, laevigate, straight sides, rounded angles, triangulares

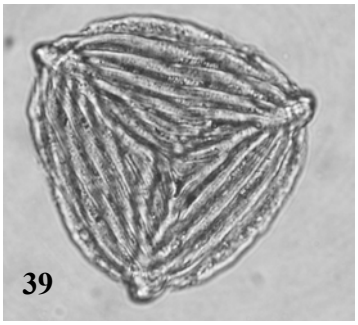
Fig.42: *Lophosoria quadripinnata* (Lophosoriaceae): trilete, tuberculate to perforate, rounded angles, triangulares

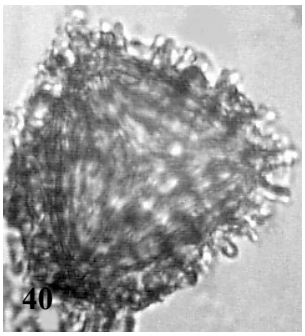
Fig.43: *Dicksonia sellowiana* (Dicksoniaceae): trilete, laevigate, straight to lightly convex sides, rounded angles, sporoderm thicker at the angles, triangulares

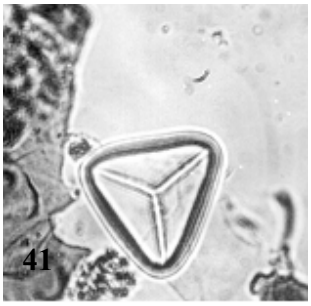
Fig.44: *Dennstaedtia* (Dennstaedtiaceae): trilete, eroded perispore, laevigate exospore, triangulares

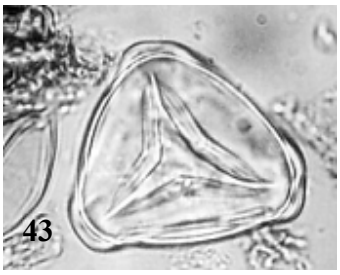
Fig.45: *Dennstaedtia* (Dennstaedtiaceae): trilete, preserved perispore, verrucate, triangulares

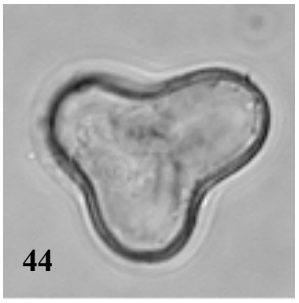
Pteridophytes – trilete spores











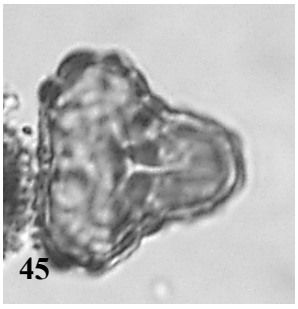


Plate 9, p. XIV

Pteridophytes – monolete spores

Fig.46: *Asplenium* (Aspleniaceae; including *Dryopteris*/ Dryopteridaceae): monolete, irregularly undulated, bilateral; fossil *Asplenium* spores are much alike *Dryopteris* spores therefore these two types were integrated in one type to avoid misidentifications

Fig.47: *Blechnum*-type (Blechnaceae): monolete, psilate, bilateral

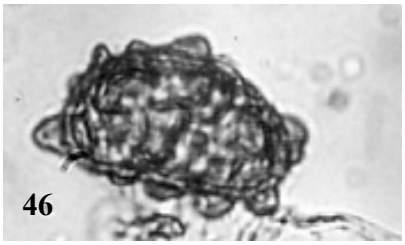
Fig.48: *Microgramma*-type (Polypodiaceae): monolete, verrucate, bilateral

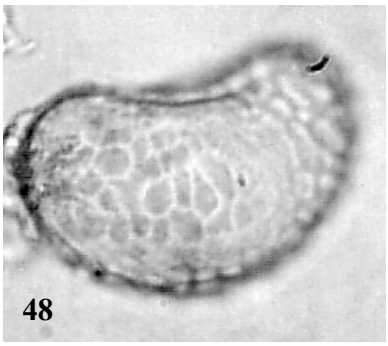
Fungi

Fig.49: cf. *Helmintosporium*

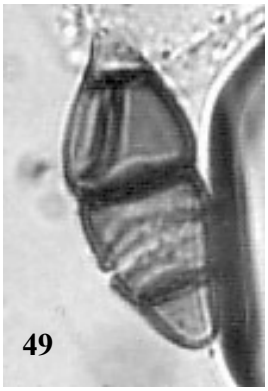
Fig.50: Fungi

Pteridophytes – monolete spores





Fungi



Appendix II

1. List of identified palynomorphs

The undermentioned list numerates the indicated pollen and spores. The order follows the hierarchical system of the plant systematic (FROHNE & JENSEN, 1998). On a detailed description of pollen and spore taxa were renounced. Meticulous description about pteridophyte spores, appropriate plant, habitat and geographical distribution in Brazil are prevailed in LORSCHEITTER (1988, 1989) and in LORSCHEITTER et al. (1998, 1999, 2001 and 2002). Pollen and also spores are detailed described amongst others in BEHLING (1993), ROUBIK et al. (1991) and COLVINVAUX et al. (1999). The aforementioned references were very beneficial for pollen and spore identification on the genus level and the family level and sometimes also on the specie level.

1. *Anthoceros punctatus* (Anthocerotaceae)
2. *Phaeoceros laevis* (Anthocerotaceae)
3. *Sphagnum spp.* (Sphagnaceae)
4. *Lycopodiella* (Lycopodiaceae)
5. *Lycopodium alopecuroides* (Lycopodiaceae)
6. *Lycopodium clavatum* (Lycopodiaceae)
7. *Huperzia* (Lycopodiaceae)
8. *Selaginella* (Selaginellaceae)
9. *Hymenophyllum* (Hymenophyllaceae)
10. *Trichomanes* (Hymenophyllaceae)
11. *Osmunda* (Osmundaceae)
12. *Dicranopteris* (Gleicheniaceae)
13. *Gleichenia* (Gleicheniaceae)
14. *Anemia phyllitides* (Schizaceae)
15. *Anemia raddiana* (Schizaceae)
16. *Alsophila* (Cyatheaceae)

17. *Cyathea schaschin* (Cyatheaceae)
18. Cyathea (Cyatheaceae)
19. *Nephelea* (Cyatheaceae)
20. *Lophosoria quadripinnata* (Lophosoriaceae)
21. *Dicksonia sellowiana* (Dicksoniaceae)
22. *Doryopteris* (Hemionitidiaceae)
23. *Anogramma* (Gymnogrammaceae)
24. *Pteris sp.1* (Pteridaceae)
25. *Pteris sp.2* (Pteridaceae)
26. *Vittaria elongata* (Vittariaceae)
27. *Dennstaedtia* (Dennstaedtiaceae)
28. *Pteridium aquilinum* (Dennstaedtiaceae)
29. *Asplenium sp.1* (Aspleniaceae)
30. *Asplenium sp.2* (Aspleniaceae)
31. *Blechnum imperiale* (Blechnaceae)
32. *Dryopteris* (Dryopteridaceae)
33. *Davallia* (Davalliaceae)
34. *Microgramma* (Polypodiaceae)
35. *Pteridophyta 1*
36. *Pteridophyta 2*
36. *Pteridophyta 3*
38. *Araucaria angustifolia* (Araucariaceae)
39. *Pinus* (Pinaceae)
40. *Podocarpus* (Podocarpaceae)
41. *Drymis brasiliensis* (Winteraceae)
42. Annonaceae
43. Lauraceae
44. *Piper* (Piperaceae)
45. Amaranthaceae-Chenopodiaceae-type
46. *Polygonum* (Polygonaceae)

47. Ulmaceae
48. *Lamanonia speciosa* (Cunoniaceae)
49. *Weinmannia* (Cunoniaceae)
50. *Mimosa scabrella* (Leguminosae-Mimosoideae)
51. *Inga* (Leguminosae-Mimosoideae)
52. *Roupala* (Proteaceae)
53. Myrtaceae
54. Melastomataceae
55. *Fuchsia* (Onagraceae)
56. *Zanthoxyllum* (Rutaceae)
57. *Lithraea-Schinus*-type
58. *Cupania* (Sapindaceae)
59. *Matayba* (Sapindaceae)
60. Erythroxyllaceae
61. *Cabralea canjerana* (Meliaceae)
62. *Trichilia* (Meliaceae)
63. Meliaceae
64. *Polygala* (Polygalaceae)
65. *Actinostemon concolor* (Euphorbiaceae)
66. *Alchornea triplinerva* (Euphorbiaceae)
67. *Bernhardia pulchella* (Euphorbiaceae)
68. *Sebastiana commersoniana* (Euphorbiaceae)
69. Euphorbiaceae
70. *Casearia* (Flacourtiaceae)
71. *Daphnopsis* (Thymeleaceae)
72. Loranthaceae
73. *Eryngium* (Apiaceae)
74. Apiaceae
75. Malvaceae
76. Sterculiaceae

77. *Myrsine* (Myrsinaceae)
78. *Ilex divaricata* (Aquifoliaceae)
79. *Ilex 2* (Aquifoliaceae)
80. Ericaceae
81. *Clethra* (Clethraceae)
82. *Valeriana* (Valerianaceae)
83. *Borreria* (Rubiaceae)
84. *Psychotria* (Rubiaceae)
85. *Relbunium* (Rubiaceae)
86. Apocynaceae
87. Bignoniaceae
88. Acanthaceae
89. *Brunfelsia* (Solanaceae)
90. *Petunia* (Solanaceae)
91. *Solanum* (Solanaceae)
92. Solanaceae
93. Boranginaceae
94. *Achyrocline*-type (Asteraceae)
95. *Artemisia*-type (Asteraceae)
96. *Baccharis*-type (Asteraceae)
97. *Calea*-type (Asteraceae)
98. *Eupatorium* (Asteraceae)
99. *Mikania* (Asteraceae)
100. *Senecio*-type (Asteraceae)
101. Trixis (Asteraceae)
102. *Vernonia 1* (Asteraceae)
103. *Vernonia 2* (Asteraceae)
104. Asteraceae
105. Bromeliaceae
106. Cyperaceae

107. Poaceae
108. *Desmoncus*-type (Arecaceae)
109. *Palmae 1* (Arecaceae)
110. *Palmae 2* (Arecaceae)
111. *Palmae 3* (Arecaceae)
112. Iridaceae
113. Liliaceae
114. Xyridaceae
115. Amaryllidaceae
116. Monokotyle

2. List of pollen and spore groups

The pollen and spores were arranged in groups for the further work with different analysis methods (TILIA, CANOCO etc.). This arrangement facilitates a more concisely treatment of the data. The arrangement results from considering of morphological similarity of pollen or spores, taxonomic relationship or the similarity of the habitat respectively. The first column illustrates the groups (abbreviations were used) and the second column the taxa (reference number considering of the list above) which were incorporated in the appropriate group.

Pollen or spore group	***Incorporated taxa***
Anthoc	1, 2
Sphagi	3
Lyci	4, 5, 6
Hupe	7
Sela	8
Hytr	9, 10
Osmu	11
Ble	12, 13, 26, 31, 35
Anem	14, 15
Cyat	16, 17, 18, 19
Dickse	20, 21, 22
Anop	23, 24, 25
Micro	33, 34, 36
Denn	27, 28
Aspl	29, 30, 32
Pteri3	36
Angu	38

Pi	39
Podo	40
Drybra	41
Anno	42
Laura	43
Piper	44
AmaCh	45
Polygo	46
Ulma	47
Cunon	48, 49
Mimo	50, 51
Roup	52
Myrt	53
Melast	54
Fuchs	55
Zantho	56
Lithra	57
Sapin	58, 59
Ery	60
Meli	61, 62, 63
Polyga	64
Euphorb	65, 66, 67, 68, 69
Cada	70, 71
Lora	72
Apia	73, 74
Malva	75
Stercu	76
Myrs	77
Ilex	78, 79

Eric	80
Clethra	81
Valbore	82, 83, 85
Psycho	84
Apocy	86
Bigno	87
Acan	88
Solan	89, 90, 91, 92
Borangi	93
Comp 1	94, 95, 96, 97, 98, 100, 101, 104
Comp 2	99
Ver	102, 103
Brome	105
Cyper	106
Poa	107
Palm	108, 109, 110, 111
Mono	112, 113, 114, 115, 116

Appendix III

Tables of mapping of vegetation according to BRAUN-BLANQUET

	Zone 3						
Specimen number	**4**	**24**	**25**	**31**	**32**	**54**	**56**
Date of record	5.5.02	18.7.02	18.7.02	21.7.02	21.7.02	23.1.04	23.1.04
1. Tree section							
Altitude (in m)	10	10	9	11	12	12	11
Angiosperms - Dicotyledons							
Bignoniaceae							
Jacaranda cf. micrantha Cham.							3p
Euphorbiaceae							
Alchornea triplinervia (Spreng.) Muell. Arg.						3p	
Myrtaceae							
Eugenia neomyrtifolia Sobral		2p					
Myrtaceae							
Meliaceae							
Cedrela fissilis Vell.				2p			
Mimosaceae	1p						
Moraceae							
Ficus sp.		2r					
Sapindaceae							
Matayba elaegnoides Radlk.						2a	
Gymnosperms							
Araucariaceae							
Araucaria angustifolia (Bertol.) Kuntze	2r						
2. Tree section							
Altitude (in m)	7	7	6	9	8	10	9
Angiosperms - Dicotyledons							
Araliaceae						1p	
Bombacaceae					2r		

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Bignoniaceae							
Jacaranda cf. micrantha Cham.							2p
Euphorbiaceae							
Gymnanthes concolor Spreng.		2p					
Lauraceae							
Nectandra megapotamica (Sprengel) Mez			2p				
Leguminosae - Mimosoidae							
Inga marginata Willd.			2p				
Leguminosae (general)				3p			
Meliaceae							
Cabralea canjerana Sald.		2p					
Trichilia claussenii C. DC.		2p					
Moraceae							
Sorocea bonplandii (Baill.) Burger		2p	2p				
Myrsinaceae							
Myrsine sp.					2p		
Myrtaceae							
Calyptranthes grandifolia Berg.					2p		
Rubiaceae							
Psychotria leiocarpa Cham. et Schlecht.		2p					
Sapindaceae							
Cupania vernalis Camb.		2p	3a			3a	
Tiliaceae							
Luehea divaricata Mart.		2p					
Angiosperms - Monocotyledons							
Palmae (Arecaceae)							
Euterpe edulis Mart.	1r						
3. Tree section							
Altitude (in m)	4	5	4	7	6	6	5
Angiosperms - Dicotyledons							
Annonaceae							
Rollinia rugulosa Schltdl.	2p						

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Bignoniaceae							
Tabebuia sp.	2p						
Euphorbiaceae							
Gymnanthes concolor Spreng.		2p				2p	
Flacourtiaceae							
Banara tomentosa Clos.							2r
Lauraceae							
Ocotea pulchella Mart.						2p	
Leguminosae - Faboideae							
Leguminosae (general)			2p				
Myrocarpus frondosus Fr. Allem.						2p	
Meliaceae							
Cabralea canjerana Sald.		2p					3a
Guarea macrophylla Vahl.		2p					
Trichilia claussenii C. DC.							1r
Monimiaceae							
Mollinedia cf. schottiana (Spr.) Perk.						2p	
Myrsinaceae							
Myrsine sp.			3a		2p		
Myrtaceae							
Calyptranthes concinna DC.					2p		
Campomanesia xanthocarpa O.Berg			2p			2p	
Eugenia schuechiana O. Berg							
Myrcia oligantha O. Berg							
Myrcianthes pungens (Berg.) Legrand							2p
Rubiaceae							
Rudgea parquioides (Cham.) Müll. Arg.		2p					
Rutaceae							
Zanthoxylum cf. hyemale A. St.-Hil.		2p					
Sapindaceae							
Allophyllus edulis (St. Hil.) Radlk.		2p					
Cupania vernalis Camb.			3a			2p	

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Tiliaceae							
Luehea divaricata Mart.		2p					
Gymnosperms							
Araucariaceae							
Araucaria angustifolia (Bertol.) Kuntze	1r						
Lianes							
Aristolochia sp.							r
Smilax sp.		p					
Dioscorea multiflora Mart.	p						
Shrub section							
Altitude (in m)	2	3	2	3		2	2
Acanthaceae							
Ruellia angustifolia Sw.		3m				2p	
Euphorbiaceae							
Pachystroma longifolium (Ness) IM Johnst.						1r	1r
Endlicheria paniculata (Spr.) Macbr.						2p	
Nectandra megapotamica (Sprengel) Mez						2p	
Leguminsae - Faboideae							
Myrocarpus frondosus Fr. Allem.						2p	
Leguminosae - Mimosoidae							
Inga marginata Willd.			2p			1p	1r
Malvaceae							
Byttneria australis St. - Hil. (Malvaceae sens. lat.)						2a	
Melastomataceae							
Miconia cinerascens Miq.							
Miconia hiemalis St. Hil.							
Meliaceae							
Cabralea canjerana Sald.		1p					
Guarea macrophylla Vahl.		2p					
Trichilia claussenii C. DC.		2p					

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Myrtaceae							
Calyptranthes grandifolia Berg							
Campomanesia xanthocarpa (Mart.) O.Berg			2p				
Myrcianthes pungens (Berg.) Legrand							2p
Siphoneugenia reitzii Legr.							
Piperaceae							
Piper gaudichaudianum (Kunth) Kunth ex C. DC.		3m	3a	3a		2a	
Piper cf. mikanianum (Kunth) Steud.							
Rubiaceae							
Coutarea hexandra (Jacq.) K. Schum.	3p	2p					
Psychotria kleinii Smith & Down					2p		
Rudgea parquioides (Cham.) Müll. Arg.		2p					
Sapindaceae							
Allophyllus edulis (St. Hil.) Radlk.			2p				
Cupania vernalis Camb.			1r			2p	2a
Angiosperms - Monocotyledons							
Poaceae							
Bambus sp.					3a		
Herb section							
Angiosperms - Dicotyledons							
Acanthaceae							
Ruellia angustifolia Sw.		4m				1r	
Leguminosae - Mimosoidae							
Inga marginata Willd.							1p
Inga cf. marginata Willd.			1p				
Melastomataceae							
Leandra sp.	1p						
Meliaceae							
Trichilia claussenii C. DC.		1r				1r	
Monimiaceae							
Mollinedia elegans Tul.						1r	1p

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Oxalidaceae							
Oxalis sp.				1p			
Passifloraceae							
Passiflora sp.			1r				
Piperaceae							
Piper sp.							
Proteaceae							
Roupala sp.							
Sapindaceae							
Cupania vernalis Camb.						1r	1p
Urticaceae							
Urera baccifera (L.) Gaud.						1p	
Pteridophyta							
Aspleniaceae							
Asplenium raddianum Gaud.	1p						
Asplenium sp.L.							
Blechnaceae							
Blechnum imperiale (Fée et Glaz.) C. Chr.					3a		
Dennstaedtiaceae							
Lastreopsis amplissima (Presl) Tindale				3a	5m		
Pteridaceae			1p				
Pteridophyta	1p						
Epiphytes							
Angiosperms - Dicotyledons							
Cactaceae							
Rhipsalis sp.		p	p				
Angiosperms - Monokotyledons							
Orchidiaceae							
Oncidium hookeri Rolfe.							
Oncidium sp.					p		
Orchidaceae		p	p				
Pleurothallis hygrophila Barb.Rodr.							

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Pteridophyta							
Antigramma brasiliensis (Sw.) Moore	p						
Microgramma sp.							
Bryopsida							
moss							

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

	Zone 2	Zone1
Specimen number	**15**	**45**
Date of record	25.6.02	25.8.02
1. Tree section		
Altitude (in m)	10	9
Angiosperms - Dicotyledons		
Bignoniaceae		
Jacaranda cf. micrantha Cham.		
Euphorbiaceae		
Alchornea triplinervia (Spreng.) Muell. Arg.		
Myrtaceae		
Eugenia neomyrtifolia Sobral		
Myrtaceae	3a	
Meliaceae		
Cedrela fissilis Vell.		
Mimosaceae		
Moraceae		
Ficus sp.		
Sapindaceae		
Matayba elaegnoides Radlk.		
Gymnosperms		
Araucariaceae		
Araucaria angustifolia (Bertol.) Kuntze	2p	
2. Tree section		
Altitude (in m)	8	6
Angiosperms - Dicotyledons		
Araliaceae		
Bombacaceae		

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Bignoniaceae		
Jacaranda cf. micrantha Cham.		
Euphorbiaceae		
Gymnanthes concolor Spreng.		
Lauraceae		
Nectandra megapotamica (Sprengel) Mez		
Leguminosae - Mimosoidae		
Inga marginata Willd.		2p
Leguminosae (general)		
Meliaceae		
Cabralea canjerana Sald.		
Trichilia claussenii C. DC.		
Moraceae		
Sorocea bonplandii (Baill.) Burger		
Myrsinaceae		
Myrsine sp.		
Myrtaceae		
Calyptranthes grandifolia Berg.	2p	
Rubiaceae		
Psychotria leiocarpa Cham. et Schlecht.		
Sapindaceae		
Cupania vernalis Camb.		
Tiliaceae		
Luehea divaricata Mart.		
Angiosperms - Monocotyledons		
Palmae (Arecaceae)		
Euterpe edulis Mart.		
3. Tree section		
Altitude (in m)	6	
Angiosperms - Dicotyledons		
Annonaceae		
Rollinia rugulosa Schltdl.		

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Bignoniaceae		
Tabebuia sp.		
Euphorbiaceae		
Gymnanthes concolor Spreng.		
Flacourtiaceae		
Banara tomentosa Clos.		
Lauraceae		
Ocotea pulchella Mart.		
Leguminosae - Faboideae		
Leguminosae (general)		
Myrocarpus frondosus Fr. Allem.		
Meliaceae		
Cabralea canjerana Sald.		
Guarea macrophylla Vahl.		
Trichilia claussenii C. DC.		
Monimiaceae		
Mollinedia cf. schottiana (Spr.) Perk.		
Myrsinaceae		
Myrsine sp.		
Myrtaceae		
Calyptranthes concinna DC.		
Campomanesia xanthocarpa O.Berg		
Eugenia schuechiana O. Berg	2p	
Myrcia oligantha O. Berg	2p	
Myrcianthes pungens (Berg.) Legrand		
Rubiaceae		
Rudgea parquioides (Cham.) Müll. Arg.		
Rutaceae		
Zanthoxylum cf. hyemale A. St.-Hil.		
Sapindaceae		
Allophyllus edulis (St. Hil.) Radlk.		
Cupania vernalis Camb.		

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Tiliaceae		
Luehea divaricata Mart.		
Gymnosperms		
Araucariaceae		
Araucaria angustifolia (Bertol.) Kuntze	2p	
Lianes		
Arictolochia sp.		
Smilax sp.		
Dioscorea multiflora Mart.		
Shrub section		
Altitude (in m)	3	3
Acanthaceae		
Ruellia angustifolia Sw.		2p
Euphorbiaceae		
Pachystroma longifolium (Ness) IM Johnst.		
Endlicheria paniculata (Spr.) Macbr.		
Nectandra megapotamica (Sprengel) Mez		
Leguminsae - Faboideae		
Myrocarpus frondosus Fr. Allem.		
Leguminosae - Mimosoidae		
Inga marginata Willd.	2p	2p
Malvaceae		
Byttneria australis St. - Hil. (Malvaceae sens. lat.)		
Melastomataceae		
Miconia cinerascens Miq.	1r	
Miconia hiemalis St. Hil.	1r	
Meliaceae		
Cabralea canjerana Sald.		
Guarea macrophylla Vahl.		
Trichilia claussenii C. DC.		

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Myrtaceae		
Calyptranthes grandifolia Berg	2p	
Campomanesia xanthocarpa (Mart.) O.Berg		
Myrcianthes pungens (Berg.) Legrand		
Siphoneugenia reitzii Legr.	2p	
Piperaceae		
Piper gaudichaudianum (Kunth) Kunth ex C. DC.		
Piper cf. mikanianum (Kunth) Steud.		2p
Rubiaceae		
Coutarea hexandra (Jacq.) K. Schum.		
Psychotria kleinii Smith & Down		
Rudgea parquioides (Cham.) Müll. Arg.		
Sapindaceae		
Allophyllus edulis (St. Hil.) Radlk.		
Cupania vernalis Camb.		
Angiosperms - Monocotyledons		
Poaceae		
Bambus sp.		2p
Herb section		
Angiosperms - Dicotyledons		
Acanthaceae		
Ruellia angustifolia Sw.		
Leguminosae - Mimosoidae		
Inga marginata Willd.		
Inga cf. marginata Willd.	1p	
Melastomataceae		
Leandra sp.		
Meliaceae		
Trichilia claussenii C. DC.		
Monimiaceae		
Mollinedia elegans Tul.		

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Oxalidaceae		
Oxalis sp.		1r
Passifloraceae		
Passiflora sp.		
Piperaceae		
Piper sp.		
Proteaceae		
Roupala sp.	1p	
Sapindaceae		
Cupania vernalis Camb.		
Urticaceae		
Urera baccifera (L.) Gaud.		
Pteridophyta		
Aspleniaceae		
Asplenium raddianum Gaud.		
Asplenium sp.L.		1r
Blechnaceae		
Blechnum imperiale (Fée et Glaz.) C. Chr.		
Dennstaedtiaceae		
Lastreopsis amplissima (Presl) Tindale	5m	
Pteridaceae		
Pteridophyta		
Epiphytes		
Angiosperms - Dicotyledons		
Cactaceae		
Rhipsalis sp.		
Angiosperms - Monokotyledons		
Orchidiaceae		
Oncidium hookeri Rolfe.	p	
Oncidium sp.		
Orchidaceae		
Pleurothallis hygrophila Barb.Rodr.	p	

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

Pteridophyta		
Antigramma brasiliensis (Sw.) Moore		
Microgramma sp.	m	
Bryopsida		
moss	a	

Table III.1: Alphabetic order of identified plants in semi-deciduous and deciduous forests (vegetation record according to Braun-Blanquet)

	Zone 3							
Specimen number	**26**	**52**	**55**	**58**	**59**	**60**	**61**	**63**
Date of record	18.7.02	21.12.02	23.1.04	23.1.04	24.1.04	24.1.04	25.1.04	25.1.04
1. Tree section								
Altitude (in m)	13	10	15		8	12	11	16
Angiosperms - Dicotyledons								
Asteraceae								
Vernonia discolor (Spreng.) Less					2p			
Myrtaceae								
Eugenia multicostata Legr.	2p							
Myrcia arborescens Berg								
Myrtaceae								
Solanaceae								
Solanaceae (general)								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze	3p	2p	3p	3p	3a	3p	3p	4m
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.					2p			
2. Tree section								
Altitude (in m)	6	7	11			10	9	10
Angiosperms - Dicotyledons								
Anacardiaceae								
Lithraea brasiliensis (L.) March.								
Aquifoliaceae								
Ilex brevicuspis Reissek. Sin.						2p		
Ilex cf.microdonta Reissek								
Ilex paraguariensis St. Hil.					2p			
Bombacaceae								
Bombacaceae (geral)								

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Lauraceae								
Nectandra megapotamica (Sprengel) Mez				2p				
Ocotea pulchella Mart.		2p	3p					
Leguminosae - Mimosoidae								
Leguminosae (general)				2r				
Moraceae								
Ficus organensis (Miq.) Miq.			3r					
Sorocea bonplandii (Baill.) Burger	2p							
Myrsinaceae								
Myrsine sp.								
Myrtaceae								
Calyptranthes grandifolia Berg.	2p							
Siphoneugenia reitzii Legr.								
Myrtaceae (general)								
Sapindaceae								
Cupania oblongifolia Cambess.	2p							
Cupania vernalis Camb.	2p		3a					
Matayba elaegnoides Radlk.							3p	
Styracaceae								
Styrax cf. acuminatus Pohl								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.						2p		
3. Tree section								
Altitude (in m)	4	5	5		5	8	7	6
Angiosperms - Dicotyledons								
Annonaceae								
Rollinia cf. sylvatica (A. St.-Hil.) Mart.								2p
Rollinia sp.							2p	

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Aqufoliaceae								
Ilex brevicuspis Reissek. Sin.						2p	2p	
Ilex paraguariensis St. Hil.	2p				3a			
Asteraceae								
Dasiphyllum spinescens (Less.) Cabr.								
Berberidacae								
Berberis laurina Billb.								
Bombacaceae		1r						
Cunoniaceae								
Weinmannia paulliniifolia Pohl ex Ser.								
Elaeocarpaceae								
Sloanea monosperma Vell.							2p	
Euphorbiaceae								
Gymnanthes concolor Spreng.			2p					
Sapium glandulatum (Vell.) Pax								
Sebastiana commersoniana (Ball.) Smith & Downs					2p			
Stillingia oppositifolia Baill.								
Flacourtiaceae								
Banara tomentosa Clos.								
Casearia sylvestris Sw.					2p		2p	
Lauraceae								
Nectandra megapotamica (Sprengel) Mez				3p				
Nectandra sp.								
Melastomataceae								
Miconia hiemalis St. Hil.								
Meliaceae								
Trichilia catigua A.Juss.				2p				
Monimiaceae								
Mollinedia elegans Tul.	2r							
Moraceae								
Sorocea bonplandii (Baill.) Burger								

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Myrsinaceae								
Myrsine sp.					2a		2p	
Myrtaceae								
Acca sellowiana (O. Berg) Burret								
Calyptranthes concinna DC.		2p						3a
Eugenia uniflora L.					2p			
Myrtaceae (general)								
Siphoneugenia reitzii Legr.		2p					2p	
Phytolaccaceae								
Sequieria aculeata L.				2p				
Rubiaceae								
Sapindaceae								
Cupania vernalis Camb.				2p				
Matayba elaegnoides Radlk.								
Symplocaceae								
Symplocos uniflora (Pohl) Benth.								
Thymeleaceae								
Daphnopsis fasciculata (Meissner) Nevl.					2p			
Daphnopsis racemosa Gris.								
Winteraceae								
Drymis brasiliensis Miers.	1r	2p						
Angiosperms - Monocotyledons								
Bambus sp.								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.						2p		
Shrub section								
Altitude (in m)	3	3	2		2	4	3	2
Acanthaceae			3a					
Ruellia angustifolia Sw.			2p	1r				

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Anacardiaceae								
Schinus cf. lentiscifolius L.								
Annonaceae								
Rollinia sp.							2p	
Aquifoliaceae								
Ilex brevicuspis Reissek. Sin.						2p	1p	
Ilex paraguariensis St. Hil.	1r				2p		1p	
Asteraceae								
Dasyphyllum spinescens (Less.) Cabr.								
Bombacaceae								
Bombacaceae (geral)	1r							
Celastraceae								
Maytenus ilicifolia Mart. Reiss								
Cunoniaceae								
Weinmannia paulliniifolia Pohl ex Ser.								
Elaeocarpaceae								
Sloanea monosperma Vell.							2p	
Euphorbiaceae								
Sapium glandulatum (Vell.) Pax								1p
Sebastiana commersoniana (Ball.) Smith & Downs					2p			
Flacourtiaceae								
Casearia decandra Jacq.							2p	
Casearia sylvestris Sw.							2p	
Icacinaceae								
Citronella gongonha (Mart.) Howard								
Lauraceae								
Nectandra megaphylla Hassl.								
Nectandra megapotamica (Sprengel) Mez				2p				
Nectrandra sp.								
Leguminosae - Caesalpinoideae								
Bauhinia sp.				1r				

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Leguminosae - Mimosoidae								
Mimosa scabrella Benth.								
Leguminosae (general)				1r				
Melastomataceae								
Leandra cf regnellii Cogn.								
Leandra sp.								
Miconia cinerascens Miq.		2p				3p	2a	2p
Miconia hiemalis St. Hil.		2p					2a	
Meliaceae								
Cabralea canjerana Sald.				2p	2p			
Monimiaceae								
Mollinedia elegans Tul.				2p				
Myrsinaceae								
Myrsine sp.				1r	2a	2a	2p	
Myrtaceae								
Acca sellowiana (O. Berg) Burret								
Eugenia pyriformis Cambess.								
Eugenia ramboi D. Legrand				2p				
Eugenia uniflora L.							2p	
Calyptranthes concinna DC.		2p				2p		3a
Campomanesia xanthocarpa (Mart.) O.Berg								
Eugenia psidiifolia								
Eugenia multicostata D. Legrand	1r							
Myrceugenia glaucescens Cam.) D.Legrand et Kausel								2p
Myrceugenia miersiana (Gardner) D. Legrand et Kausel								
Myrceugenia mesomischa (Burret) D.Legrand et Kausel				3m				
Myrceugenia myrcioides (Cambess.) Berg.								
Myrceugenia oxysepala (Burret) D. Legrand et Kausel							2p	
Myrcia guianensis (Aubl.)DC. = M.obtecta (Berg) Kiaerskov						2p		
Myrcianthes pungens (Berg.) Legrand								

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Myrciaria delicatula (DC.) O.Berg							2p	
Psidium cattleianum Sabine						2p		
Siphoneugenia reitzii Legr.						2p		
Onagraceae								
Fuchsia regia (Vell.) Munz								
Piperaceae								
Piper gaudichaudianum (Kunth) Kunth ex C. DC.	3a		2p					
Proteaceae								
Roupala brasiliensis Klotzsch								
Rosaceae								
Prunus sellowii Koehne	1r							
Rubiaceae								
Coutarea hexandra (Jacq.) K. Schum.			3a	1p				
Psychotria kleinii Smith & Down								
Psychotria sp.								
Rudgea parquioides (Cham.) Müll. Arg.								
Rutaceae								
Citrus reticulata (L.) Osbeck								
Zanthoxyllum rhoifolium Lam.				2p				2p
Zanthoxyllum sp.				1r				
Salicaceae								
Xylosma sp.1				1p				
Xylosma sp.2								
Sapindaceae								
Allophyllus edulis (St. Hil.) Radlk.			2p	2p				
Cupania oblongifolia Camb.	1r							
Cupania vernalis Camb.	1r		2p	2p				
Solanaceae								
Brunfelsia sp.							2p	

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Thymeleaceae								
Daphnopsis fasciculata (Meissner) Nevl.					2p			
Daphnopsis racemosa Gris.								3m
Winteraceae								
Drymis brasiliensis Miers		2p						
Angiosperms - Monocotyledons								
Bambus sp.								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze					2p			2p
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.						2p		
Pteridophyta								
Dicksoniaceae								
Dicksonia sellowiana (Presl.) Hook.		2p						
Alsophila sp.								
Herb section								
Angiosperms - Dicotyledons								
Acanthaceae								
Ruellia angustifolia Sw.			1p					
Aquifoliaceae								
Ilex cf. brevicuspis Reissek. Sin.								
Asteraceae								
Baccharis uncinella DC.								
Dasiphyllum sp.								
Euphorbiaceae								
Sapium glandulatum (Vell.) Pax					1r			
Leguminosae - Ca esalpinoideae								
Bauhinia sp.				1r				
Leguminosae - Mimosoidae								
Inga marginata Willd.			1p					

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Melastomataceae								
Leandra sp.					2a		1p	
Miconia cinerascens Miq.					2p	1a	1p	
Miconia hiemalis St. Hil.					2a		1p	
Monimiaceae								
Mollinedia elegans Tul.			1p	1p				
Myrsinaceae								
Myrsine sp.					1r	1p	1p	
Myrtaceae								
Myrciaria delicatula (DC.) O.Berg							1p	
Passifloraceae								
Passiflora sp.	1r							
Phytolaccaceae								
Seguieria aculeata L.				2p				
Plantagaceae								
Plantago sp.								
Polygonaceae								
Polygonum sp.								2a
Piperaceae								
Piper sp.				2p				
Rubiaceae								
Coutarea hexandra (Jacq.) K. Schum.			2p					
Sapindaceae								
Allophyllus edulis (St. Hil.) Radlk.								
Cupania vernalis Camb.								
Matayba elaegnoides Radlk.					1r		2p	
Solanaceae								
Brunfelsia sp.							1p	
Solanum montegazzianum Somm.et Lev.								1r
Thymeleaceae								
Daphnopsis racemosa Gris.								1p
Winteraceae								
Drymis brasiliensis Miers.				1r				

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Angiosperms - Monokotyledons								
Poaceae								
Agrostis sp.								
Poaceae (general)							2a	5m
Cyperaceae								
Cyperus sp.								3a
Rhynchospora sp.								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze					1a			
Pinaceae								
Pinus sp.L.								
Pteridophyta								
Blechnaceae								
Blechnum imperiale (Fée et Glaz.) C. Chr.								
Gleicheniaceae								
Gleichenia sp.							1p	
Pteridophyta								
Epiphytes								
Angiosperms - Dicotyledons								
Cactaceae								
Rhipsalis sp.					r			
Loranthaceae - parasite						a		
Angiosperms - Monokotyledons								
Bromeliaceae								
Bromelia sp.								
Tillandsia usneoides (L.) L.							p	p
Tillandsia with red blossom					p			
Vriesea platynema Gaud.								

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Orchidiaceae								
Maxillaria picta Hooker								
Oncidium concolor Hooker					p			
Oncidium hookeri Rolfe.		p						
Oncidium sp.		p						
Pleurothallis grobyi Bateman ex Lindl.								
Pleurothallis hygrophila Barb.Rodr.								
Pleurothallis cf.linearifolia Cogn.								
Pleurothallis triado								
Pteridophyta								
Microgramma sp.								
Bryopsida								
moss		a						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

	Zone 3				Zone 2				
Specimen number	**64**	**65**	**73**	**76**	**5**	**33**	**39**	**68**	**70**
Date of record	25.1.04	25.1.04	1.2.04	1.2.04	22.6.02	22.7.02	11.8.02	31.1.04	31.1.04
1. Tree section									
Altitude (in m)	16	16	10	9	12	12	11	12	12
Angiosperms - Dicotyledons									
Asteraceae									
Vernonia discolor (Spreng.) Less									
Myrtaceae									
Eugenia multicostata Legr.									
Myrcia arborescens Berg						3r			
Myrtaceae					2p				
Solanaceae									
Solanaceae (general)								2p	
Gymnosperms									
Araucariaceae									
Araucaria angustifolia (Bertol.) Kuntze	4a	3a	4a	3a			3p	4m	3p
Podocarpaceae									
Podocarpus lambertii Klotzsch ex Endl.				3a					
2. Tree section									
Altitude (in m)	12	12	8		8	10	9	10	10
Angiosperms - Dicotyledons									
Anacardiaceae									
Lithraea brasiliensis (L.) March.									
Aquifoliaceae									
Ilex brevicuspis Reissek. Sin.			3p						
Ilex cf.microdonta Reissek								2p	
Ilex paraguariensis St. Hil.									
Bombacaceae									
Bombacaceae (geral)							2p		

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Lauraceae									
Nectandra megapotamica (Sprengel) Mez									
Ocotea pulchella Mart.									
Leguminosae - Mimosoidae									
Leguminosae (general)									
Moraceae									
Ficus organensis (Miq.) Miq.									
Sorocea bonplandii (Baill.) Burger									
Myrsinaceae									
Myrsine sp.									
Myrtaceae									
Calyptranthes grandifolia Berg.									
Siphoneugenia reitzii Legr.									
Myrtaceae (general)					2p				
Sapindaceae									
Cupania oblongifolia Cambess.									
Cupania vernalis Camb.									
Matayba elaegnoides Radlk.									
Styracaceae									
Styrax cf. acuminatus Pohl	3p	3p							
Gymnosperms									
Araucariaceae									
Araucaria angustifolia (Bertol.) Kuntze									
Podocarpaceae									
Podocarpus lambertii Klotzsch ex Endl.									
3. Tree section									
Altitude (in m)	8	8	6	5	5	7	7	7	7
Angiosperms - Dicotyledons									
Annonaceae									
Rollinia cf. sylvatica (A. St.-Hil.) Mart.									
Rollinia sp.									2p

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Aqufoliaceae									
Ilex brevicuspis Reissek. Sin.	2p								
Ilex paraguariensis St. Hil.									
Asteraceae									
Dasiphyllum spinescens (Less.) Cabr.						2p			
Berberidacae									
Berberis laurina Billb.									
Bombacaceae									
Cunoniaceae									
Weinmannia paulliniifolia Pohl ex Ser.									
Elaeocarpaceae									
Sloanea monosperma Vell.									
Euphorbiaceae									
Gymnanthes concolor Spreng.									
Sapium glandulatum (Vell.) Pax									
Sebastiana commersoniana (Ball.) Smith & Downs									
Stillingia oppositifolia Baill.							2p		
Flacourtiaceae									
Banara tomentosa Clos.	2p								
Casearia sylvestris Sw.									
Lauraceae									
Nectandra megapotamica (Sprengel) Mez									
Nectandra sp.	2p								
Melastomataceae									
Miconia hiemalis St. Hil.	2p								
Meliaceae									
Trichilia catigua A.Juss.									
Monimiaceae									
Mollinedia elegans Tul.									
Moraceae									
Sorocea bonplandii (Baill.) Burger						2p			

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Myrsinaceae									
Myrsine sp.				3p					
Myrtaceae									
Acca sellowiana (O. Berg) Burret									
Calyptranthes concinna DC.			2p						
Eugenia uniflora L.									
Myrtaceae (general)									
Siphoneugenia reitzii Legr.			3p						
Phytolaccaceae									
Sequieria aculeata L.									
Rubiaceae									
Sapindaceae									
Cupania vernalis Camb.									
Matayba elaegnoides Radlk.				2p					
Symplocaceae									
Symplocos uniflora (Pohl) Benth.			2p						
Thymeleaceae									
Daphnopsis fasciculata (Meissner) Nevl.									
Daphnopsis racemosa Gris.							2p		
Winteraceae									
Drymis brasiliensis Miers.									
Angiosperms - Monocotyledons									
Bambus sp.					2a				
Gymnosperms									
Araucariaceae									
Araucaria angustifolia (Bertol.) Kuntze								2p	
Podocarpaceae									
Podocarpus lambertii Klotzsch ex Endl.							2p	2p	
Shrub section									
Altitude (in m)	3		2	2	3		4		
Acanthaceae									
Ruellia angustifolia Sw.									

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Anacardiaceae									
Schinus cf. lentiscifolius L.		2p							
Annonaceae									
Rollinia sp.									2p
Aquifoliaceae									
Ilex brevicuspis Reissek. Sin.									
Ilex paraguariensis St. Hil.	2p	2p							
Asteraceae									
Dasyphyllum spinescens (Less.) Cabr.					1r				
Bombacaceae									
Bombacaceae									
Celastraceae									
Maytenus ilicifolia Mart. Reiss									
Cunoniaceae									
Weinmannia paulliniifolia Pohl ex Ser.							2p		
Elaeocarpaceae									
Sloanea monosperma Vell.									
Euphorbiaceae									
Sapium glandulatum (Vell.) Pax									
Sebastiana commersoniana (Ball.) Smith & Downs									
Flacourtiaceae									
Casearia decandra Jacq.	2p	2p		3a					
Casearia sylvestris Sw.									2p
Icacinaceae									
Citronella gongonha (Mart.) Howard									
Lauraceae									
Nectandra megaphylla Hassl.	2p	2p							
Nectandra megapotamica (Sprengel) Mez									
Nectrandra sp.									
Leguminosae - Caesalpinoideae									
Bauhinia sp.	1p								

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Leguminosae - Mimosoidae									
Mimosa scabrella Benth.									
Leguminosae (general)									
Melastomataceae									
Leandra cf regnellii Cogn.			2p						
Leandra sp.				2p					
Miconia cinerascens Miq.				2a					1p
Miconia hiemalis St. Hil.			2a					1p	1p
Meliaceae									
Cabralea canjerana Sald.									
Monimiaceae									
Mollinedia elegans Tul.									
Myrsinaceae									
Myrsine sp.				2p					
Myrtaceae									
Acca sellowiana (O. Berg) Burret									1p
Eugenia pyriformis Cambess.	2p								
Eugenia ramboi D. Legrand									
Eugenia uniflora L.									
Calyptranthes concinna DC.			2p					2p	
Campomanesia xanthocarpa (Mart.) O.Berg				2p					
Eugenia psidiifolia					2r				
Eugenia multicostata D. Legrand									
Myrceugenia glaucescens Cam.) D.Legrand et Kausel									
Myrceugenia miersiana (Gardner) D. Legrand et Kausel									2a
Myrceugenia mesomischa (Burret) D.Legrand et Kausel									
Myrceugenia myrcioides (Cambess.) Berg.									
Myrceugenia oxysepala (Burret) D. Legrand et Kausel									
Myrcia guianensis (Aubl.)DC. = M.obtecta (Berg) Kiaerskov									
Myrcianthes pungens (Berg.) Legrand									

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Myrciaria delicatula (DC.) O.Berg									
Psidium cattleianum Sabine							2p		
Siphoneugenia reitzii Legr.			2p				2p		2p
Onagraceae									
Fuchsia regia (Vell.) Munz									
Piperaceae									
Piper gaudichaudianum (Kunth) Kunth ex C. DC.									
Proteaceae									
Roupala brasiliensis Klotzsch					1r				
Rosaceae									
Prunus sellowii Koehne									
Rubiaceae									
Coutarea hexandra (Jacq.) K. Schum.	2p								
Psychotria kleinii Smith & Down						2p			
Psychotria sp.			2p				2p		
Rudgea parquioides (Cham.) Müll. Arg.			3a						
Rutaceae									
Citrus reticulata (L.) Osbeck	1r								
Zanthoxyllum rhoifolium Lam.									
Zanthoxyllum sp.									
Salicaceae									
Xylosma sp.1									
Xylosma sp.2									1p
Sapindaceae									
Allophyllus edulis (St. Hil.) Radlk.				2p					
Cupania oblongifolia Camb.									
Cupania vernalis Camb.									
Solanaceae									
Brunfelsia sp.									

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Thymeleaceae									
Daphnopsis fasciculata (Meissner) Nevl.									
Daphnopsis racemosa Gris.				2p					
Winteraceae									
Drymis brasiliensis Miers									
Angiosperms - Monocotyledons									
Bambus sp.							3a		
Gymnosperms									
Araucariaceae									
Araucaria angustifolia (Bertol.) Kuntze				2p					1p
Podocarpaceae									
Podocarpus lambertii Klotzsch ex Endl.									
Pteridophyta									
Dicksoniaceae									
Dicksonia sellowiana (Presl.) Hook.		2p			2p	2p	2p		
Alsophila sp.									
Herb section									
Angiosperms - Dicotyledons									
Acanthaceae									
Ruellia angustifolia Sw.									
Aquifoliaceae									
Ilex cf. brevicuspis Reissek. Sin.	1p	1p							
Asteraceae									
Baccharis uncinella DC.									
Dasiphyllum sp.									
Euphorbiaceae									
Sapium glandulatum (Vell.) Pax									
Leguminosae - Ca esalpinoideae									
Bauhinia sp.									
Leguminosae - Mimosoidae									
Inga marginata Willd.									

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Melastomataceae									
Leandra sp.	1p	1p							
Miconia cinerascens Miq.	1p	1p							1p
Miconia hiemalis St. Hil.									
Monimiaceae									
Mollinedia elegans Tul.									
Myrsinaceae									
Myrsine sp.									
Myrtaceae									
Myrciaria delicatula (DC.) O.Berg									
Passifloraceae									
Passiflora sp.									
Phytolaccaceae									
Seguieria aculeata L.									
Plantagaceae									
Plantago sp.									
Polygonaceae									
Polygonum sp.									
Piperaceae									
Piper sp.	2p	2p							
Rubiaceae									
Coutarea hexandra (Jacq.) K. Schum.									
Sapindaceae									
Allophyllus edulis (St. Hil.) Radlk.	1p								
Cupania vernalis Camb.	1p	1p							
Matayba elaegnoides Radlk.									
Solanaceae									
Brunfelsia sp.									
Solanum montegazzianum Somm.et Lev.									
Thymeleaceae									
Daphnopsis racemosa Gris.									2a
Winteraceae									
Drymis brasiliensis Miers.									

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Angiosperms - Monokotyledons									
Poaceae									
Agrostis sp.									
Poaceae (general)			5m						
Cyperaceae									
Cyperus sp.									
Rhynchospora sp.	1p	2p							
Gymnosperme									
Araucariaceae									
Araucaria angustifolia (Bertol.) Kuntze									
Pinaceae									
Pinus sp.L.									
Pteridophyta									
Blechnaceae									
Blechnum imperiale (Fée et Glaz.) C. Chr.									1p
Gleicheniaceae									
Gleichenia sp.									
Pteridophyta					2a				
Epiphytes									
Angiosperms - Dicotyledons									
Cactaceae									
Rhipsalis sp.									
Loranthaceae - parasite									
Angiosperms - Monokotyledons									
Bromeliaceae									
Bromelia sp.					a	a	a		
Tillandsia usneoides (L.) L.				p					a
Tillandsia with red blossom									
Vriesea platynema Gaud.				a					

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Orchidiaceae									
Maxillaria picta Hooker						p			
Oncidium concolor Hooker									
Oncidium hookeri Rolfe.									
Oncidium sp.									
Pleurothallis grobyi Bateman ex Lindl.						p	p		
Pleurothallis hygrophila Barb.Rodr.							p		
Pleurothallis cf.linearifolia Cogn.						p			
Pleurothallis triado							p		
Pteridophyta									
Microgramma sp.									
Bryopsida									
moss									

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

	Zone 2			Zone1		
Specimen number	**75**	**79**	**80**	**20**	**21**	**44**
Date of record	1.2.04	2.2.04	2.2.04	6.7.02	6.7.02	25.8.02
1. Tree section						
Altitude (in m)	10	12	10	10	11	8
Angiosperms - Dicotyledons						
Asteraceae						
Vernonia discolor (Spreng.) Less						
Myrtaceae						
Eugenia multicostata Legr.						
Myrcia arborescens Berg						
Myrtaceae						
Solanaceae						
Solanaceae (general)						
Gymnosperms						
Araucariaceae						
Araucaria angustifolia (Bertol.) Kuntze	2p	4m	3a	2p	3p	2p
Podocarpaceae						
Podocarpus lambertii Klotzsch ex Endl.						
2. Tree section						
Altitude (in m)	8	6	8	7	9	5
Angiosperms - Dicotyledons						
Anacardiaceae						
Lithraea brasiliensis (L.) March.			2p			
Aquifoliaceae						
Ilex brevicuspis Reissek. Sin.						
Ilex cf.microdonta Reissek						
Ilex paraguariensis St. Hil.						
Bombacaceae						
Bombacaceae (geral)						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Lauraceae						
Nectandra megapotamica (Sprengel) Mez						
Ocotea pulchella Mart.			3p			
Leguminosae - Mimosoidae						
Leguminosae (general)						
Moraceae						
Ficus organensis (Miq.) Miq.						
Sorocea bonplandii (Baill.) Burger						
Myrsinaceae						
Myrsine sp.						2p
Myrtaceae						
Calyptranthes grandifolia Berg.						
Siphoneugenia reitzii Legr.					2p	
Myrtaceae (general)						2p
Sapindaceae						
Cupania oblongifolia Cambess.						
Cupania vernalis Camb.						
Matayba elaegnoides Radlk.						
Styracaceae						
Styrax cf. acuminatus Pohl						
Gymnosperms						
Araucariaceae						
Araucaria angustifolia (Bertol.) Kuntze			2a			2p
Podocarpaceae						
Podocarpus lambertii Klotzsch ex Endl.				2p	2p	
3. Tree section						
Altitude (in m)	6	4		6	5	
Angiosperms - Dicotyledons						
Annonaceae						
Rollinia cf. sylvatica (A. St.-Hil.) Mart.						
Rollinia sp.	2p					

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Aqufoliaceae						
Ilex brevicuspis Reissek. Sin.						
Ilex paraguariensis St. Hil.						
Asteraceae						
Dasiphyllum spinescens (Less.) Cabr.						
Berberidacae						
Berberis laurina Billb.		2p				
Bombacaceae						
Cunoniaceae						
Weinmannia paulliniifolia Pohl ex Ser.					1r	
Elaeocarpaceae						
Sloanea monosperma Vell.						
Euphorbiaceae						
Gymnanthes concolor Spreng.						
Sapium glandulatum (Vell.) Pax		2p				
Sebastiana commersoniana (Ball.) Smith & Downs						
Stillingia oppositifolia Baill.						
Flacourtiaceae						
Banara tomentosa Clos.						
Casearia sylvestris Sw.						
Lauraceae						
Nectandra megapotamica (Sprengel) Mez						
Nectandra sp.						
Melastomataceae						
Miconia hiemalis St. Hil.						
Meliaceae						
Trichilia catigua A.Juss.						
Monimiaceae						
Mollinedia elegans Tul.						
Moraceae						
Sorocea bonplandii (Baill.) Burger						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Myrsinaceae						
Myrsine sp.						
Myrtaceae						
Acca sellowiana (O. Berg) Burret			2p			
Calyptranthes concinna DC.						
Eugenia uniflora L.						
Myrtaceae (general)				3a		
Siphoneugenia reitzii Legr.						
Phytolaccaceae						
Sequieria aculeata L.						
Rubiaceae						
Sapindaceae						
Cupania vernalis Camb.						
Matayba elaegnoides Radlk.						
Symplocaceae						
Symplocos uniflora (Pohl) Benth.						
Thymeleaceae						
Daphnopsis fasciculata (Meissner) Nevl.						
Daphnopsis racemosa Gris.						
Winteraceae						
Drymis brasiliensis Miers.	2p					
Angiosperms - Monocotyledons						
Bambus sp.						
Gymnosperms						
Araucariaceae						
Araucaria angustifolia (Bertol.) Kuntze						
Podocarpaceae						
Podocarpus lambertii Klotzsch ex Endl.						
Shrub section						
Altitude (in m)	2	2,5				3
Acanthaceae						
Ruellia angustifolia Sw.						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Anacardiaceae						
Schinus cf. lentiscifolius L.						
Annonaceae						
Rollinia sp.						
Aquifoliaceae						
Ilex brevicuspis Reissek. Sin.						
Ilex paraguariensis St. Hil.						
Asteraceae						
Dasyphyllum spinescens (Less.) Cabr.						
Bombacaceae						
Bombacaceae						
Celastraceae						
Maytenus ilicifolia Mart. Reiss			1r			
Cunoniaceae						
Weinmannia paulliniifolia Pohl ex Ser.						
Elaeocarpaceae						
Sloanea monosperma Vell.						
Euphorbiaceae						
Sapium glandulatum (Vell.) Pax		2p				
Sebastiana commersoniana (Ball.) Smith & Downs						
Flacourtiaceae						
Casearia decandra Jacq.	3a					
Casearia sylvestris Sw.						
Icacinaceae						
Citronella gongonha (Mart.) Howard	2p					
Lauraceae						
Nectandra megaphylla Hassl.						
Nectandra megapotamica (Sprengel) Mez						
Nectrandra sp.					1p	
Leguminosae - Caesalpinoideae						
Bauhinia sp.						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Leguminosae - Mimosoidae						
Mimosa scabrella Benth.						
Leguminosae (general)						
Melastomataceae						
Leandra cf regnellii Cogn.						
Leandra sp.	2p			1p	1p	
Miconia cinerascens Miq.	2p		2p			2p
Miconia hiemalis St. Hil.	2p	2m	2p			2p
Meliaceae						
Cabralea canjerana Sald.						
Monimiaceae						
Mollinedia elegans Tul.						
Myrsinaceae						
Myrsine sp.						
Myrtaceae						
Acca sellowiana (O. Berg) Burret						
Eugenia pyriformis Cambess.						
Eugenia ramboi D. Legrand						
Eugenia uniflora L.						
Calyptranthes concinna DC.						
Campomanesia xanthocarpa (Mart.) O.Berg						
Eugenia psidiifolia						
Eugenia multicostata D. Legrand						
Myrceugenia glaucescens Cam.) D.Legrand et Kausel						
Myrceugenia miersiana (Gardner) D. Legrand et Kausel						
Myrceugenia mesomischa (Burret) D.Legrand et Kausel						
Myrceugenia myrcioides (Cambess.) Berg.						
Myrceugenia oxysepala (Burret) D. Legrand et Kausel						
Myrcia guianensis (Aubl.)DC. = M.obtecta (Berg) Kiaerskov						
Myrcianthes pungens (Berg.) Legrand						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Myrciaria delicatula (DC.) O.Berg						
Psidium cattleianum Sabine						
Siphoneugenia reitzii Legr.						
Onagraceae						
Fuchsia regia (Vell.) Munz		2p				
Piperaceae						
Piper gaudichaudianum (Kunth) Kunth ex C. DC.						
Proteaceae						
Roupala brasiliensis Klotzsch						
Rosaceae						
Prunus sellowii Koehne						
Rubiaceae						
Coutarea hexandra (Jacq.) K. Schum.						
Psychotria kleinii Smith & Down						
Psychotria sp.						
Rudgea parquioides (Cham.) Müll. Arg.						
Rutaceae						
Citrus reticulata (L.) Osbeck						
Zanthoxyllum rhoifolium Lam.						
Zanthoxyllum sp.	1r					
Salicaceae						
Xylosma sp.1			1r			
Xylosma sp.2						
Sapindaceae						
Allophyllus edulis (St. Hil.) Radlk.						
Cupania oblongifolia Camb.						
Cupania vernalis Camb.						
Solanaceae						
Brunfelsia sp.						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Thymeleaceae						
Daphnopsis fasciculata (Meissner) Nevl.		2p				
Daphnopsis racemosa Gris.		2m	3a			
Winteraceae						
Drymis brasiliensis Miers	2p	3p				
Angiosperms - Monocotyledons						
Bambus sp.						
Gymnosperms						
Araucariaceae						
Araucaria angustifolia (Bertol.) Kuntze						
Podocarpaceae						
Podocarpus lambertii Klotzsch ex Endl.						
Pteridophyta						
Dicksoniaceae						
Dicksonia sellowiana (Presl.) Hook.	2p				1p	
Alsophila sp.						
Herb section						
Angiosperms - Dicotyledons						
Acanthaceae						
Ruellia angustifolia Sw.						
Aquifoliaceae						
Ilex cf. brevicuspis Reissek. Sin.						
Asteraceae						
Baccharis uncinella DC.						1p
Dasiphyllum sp.	1r					
Euphorbiaceae						
Sapium glandulatum (Vell.) Pax		1p				
Leguminosae - Ca esalpinoideae						
Bauhinia sp.						
Leguminosae - Mimosoidae						
Inga marginata Willd.						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Melastomataceae						
Leandra sp.						
Miconia cinerascens Miq.						2p
Miconia hiemalis St. Hil.						2p
Monimiaceae						
Mollinedia elegans Tul.						
Myrsinaceae						
Myrsine sp.				1p		
Myrtaceae						
Myrciaria delicatula (DC.) O.Berg						
Passifloraceae						
Passiflora sp.						
Phytolaccaceae						
Seguieria aculeata L.						
Plantagaceae						
Plantago sp.		2m				
Polygonaceae						
Polygonum sp.						
Piperaceae						
Piper sp.						
Rubiaceae						
Coutarea hexandra (Jacq.) K. Schum.						
Sapindaceae						
Allophyllus edulis (St. Hil.) Radlk.						
Cupania vernalis Camb.						
Matayba elaegnoides Radlk.						
Solanaceae						
Brunfelsia sp.						
Solanum montegazzianum Somm.et Lev.						
Thymeleaceae						
Daphnopsis racemosa Gris.						
Winteraceae						
Drymis brasiliensis Miers.	1p					

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Angiosperms - Monokotyledons						
Poaceae						
Agrostis sp.		3m				
Poaceae (general)	3m		5m			
Cyperaceae						
Cyperus sp.						
Rhynchospora sp.				4a		
Gymnosperme						
Araucariaceae						
Araucaria angustifolia (Bertol.) Kuntze						
Pinaceae						
Pinus sp.L.		2a				
Pteridophyta						
Blechnaceae						
Blechnum imperiale (Fée et Glaz.) C. Chr.						
Gleicheniaceae						
Gleichenia sp.						
Pteridophyta						
Epiphytes						
Angiosperms - Dicotyledons						
Cactaceae						
Rhipsalis sp.						
Loranthaceae - parasite						
Angiosperms - Monokotyledons						
Bromeliaceae						
Bromelia sp.				a	p	
Tillandsia usneoides (L.) L.		p	p			
Tillandsia with red blossom		p				
Vriesea platynema Gaud.						

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

Orchidiaceae						
Maxillaria picta Hooker						
Oncidium concolor Hooker						p
Oncidium hookeri Rolfe.						
Oncidium sp.						
Pleurothallis grobyi Bateman ex Lindl.						
Pleurothallis hygrophila Barb.Rodr.						
Pleurothallis cf.linearifolia Cogn.						
Pleurothallis triado						
Pteridophyta						
Microgramma sp.					a	
Bryopsida						
moss				a		

Table III.2: Alphabetic order of identified plants in Araucaria forests (vegetation record according to Braun-Blanquet)

	Zone 3				Zone 2			
Specimen number	**27**	**28**	**57**	**74**	**6**	**13**	**40**	**49**
Date of record	18.7.02	20.7.02	23.1.04	1.2.04	22.6.02	23.6.02	11.8.02	21.12.02
1. Tree section								
Altitude (in m)	10	12	12	9	13	12	10	10
Angiosperms - Dicotyledons								
Asteraceae								
Vernonia discolor (Spreng.) Less								
Myrtaceae								
Myrtaceae	3a				2a			
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze	2p	3p	3p	3a	3p	3a	2p	2p
2. Tree section								
Altitude (in m)	6	9	9	7	10	8	8	7
Angiosperms - Dicotyledons								
Anacardiaceae								
Lithraea brasiliensis (L.) March.								
Aquifoliaceae								
Ilex brevicuspis Reissek. Sin.								
Asteraceae								
Dasyphyllum spinescens (Less.) Cabr.								
Dasyphyllum tomentosum (Spreng.) Cabr.	1r							
Vernonia discolor (Spreng.) Less								
Bombacaceae								
Euphorbiaceae								
Sebastiana commersoniana (Ball.) Smith & Downs								2p
Lauraceae								
Ocotea pulchella Mart.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Myrsinaceae								
Myrsine umbellata Mart.								
Myrtaceae								
Acca sellowiana (O. Berg) Burret								
Campomanesia aurea O. Berg.								
Campomanesia xanthocarpa O.Berg								
Calyptranthes concinna DC.								2r
Eugenia multicostata D. Legrand								
Myrceugenia oxysepala (Burret) D. Legrand et Kausel								
Myrcia arborescens Berg								
Siphoneugenia reitzii Legr.								
Myrtaceae (general)			3a		2a	3a		
Rhamnaceae								
Rhamnus sphaerosperma Sw.								
Thymeleaceae								
Daphnopsis racemosa Gris.		2p					3a	
Winteraceae								
Drymis brasiliensis Miers.								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								2r
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.					2p	2p		
3. Tree section								
Altitude (in m)	4	7	5	5	6		5	4
Angiosperms - Dicotyledons								
Annonaceae								
Rollinia rugulosa Schltdl.		2p						
Rollinia cf. rugulosa Schltdl.			2p					
Aqufoliaceae								
Ilex paraguariensis St. Hil.	2p							

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Asteraceae								
Dasyphyllum tomentosum (Spreng.) Cabr.	2p							
Bombacaceae								
Bombacaceae (general)								
Euphorbiaceae								
Stillingia oppositifolia Baill.			2p					
Flacourtiaceae								
Casearia decandra Jacq.			2p					
Melastomataceae								
Miconia cinerascens Miq.	2p							
Miconia hiemalis St. Hil.	2p							
Myrtaceae								
Acca sellowiana (O. Berg) Burret								
Calyptranthes concinna DC.		2p						
Campomanesia xanthocarpa O.Berg				2p				
Eugenia neomyrtifolia Sobral							2a	
Hexachlamys etatiaiensis Mattos			2p					
Myrceugenia alpigena (DC.) Landrum								
Myrrhinium atropurpureum Schott							2p	
Myrtaceae (general)								
Siphoneugenia reitzii Legr.								2p
Rubiaceae								
Rudgea parquioides (Cham.) Müll. Arg.		2p						
Rutaceae								
Zanthoxyllum sp.								
Sapindaceae								
Allophyllus edulis (St. Hil.) Radlk.								
Solanaceae								
Solanum namulosum Sendtner			2p					
Thymeleaceae								
Daphnopsis racemosa Gris.					2a			2p
Winteraceae								
Drymis brasiliensis Miers.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								2p
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.					2p			
Shrub section								
Altitude (in m)	3	4	3	2	3			3
Anacardiaceae								
Lithraea brasiliensis (L.) March.						2p		
Annonaceae								
Rollinia cf. rugulosa Schltdl.			2p					
Rollinia sp.								
Aquifoliaceae								
Ilex brevicuspis Reissek. Sin.								
Ilex paraguariensis St. Hil.	3a							
Asteraceae								
Dasyphyllum spinescens (Less.) Cabr.								
Berberidaceae								
Berberis laurina Billb.								1p
Celastraceae								
Maytenus ilicifolia Mart. Reiss								
Euphorbiaceae								
Sapium glandulatum (Vell.) Pax			1p					
Stillingia oppositifolia			2p					
Flacourtiaceae								
Casearia decandra Jacq.			2p					
Casearia sylvestris Sw.					2a			
Icacinaceae								
Citronella gongonha (Mart.) Howard								
Lauraceae								
Nectrandra sp.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Leguminosae - Mimosoidae								
Mimosa scabrella Benth.								
Melastomataceae								
Leandra cf regnellii								
Leandra sublanata Cogn.	2p							
Leandra sp.						2p		
Miconia cinerascens Miq.	2p				2a	2p	2p	2p
Miconia hiemalis St. Hil.					2p		2p	2p
Myrsinaceae								
Myrsine coriacea (Sw.) R. Br.								
Myrsine lorenzianum								
Myrtaceae								
Acca sellowiana (O. Berg) Burret								
Calyptranthes concinna DC.		2p						2p
Eugenia pyriformis Cambess.		2p						
Eugenia cf. oeidocarpa O.Berg								
Eugenia uruguayensis Cambess.								
Hexachlamys etatiaiensis Mattos			2p					
Myrceugenia alpigena DC.) Landrum								
Myrceugenia mesomischa (Burret) D.Legrand et Kausel				2p				
Myrceugenia miersiana (Gardner) D. Legrand et Kausel								
Myrceugenia myrcioides (Cambess.) Berg.	2p							
Myrceugenia ovata (Hook. & Arn.) O. Berg								
Myrtaceae (general)						3a		
Siphoneugenia reitzii Legr.								
Onagraceae								
Fuchsia regia (Vell.) Munz								
Piperaceae								
Piper gaudichaudianum (Kunth) Kunth ex C. DC.	2a							
Rhamnaceae								
Rhamnus sphaerosperma Sw.				2p				

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Rubiaceae								
Rudgea parquioides (Cham.) Müll. Arg.		2p						
Symplocaceae								
Symplocos uniflora (Pohl) Benth.		2p						
Thymeleaceae								
Daphnopsis racemosa Gris.				2a	3a		3a	2p
Winteraceae								
Drymis brasiliensis Miers								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								1r
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.					2p			
Pteridophyta								
Dicksoniaceae								
Dicksonia sellowiana (Presl.) Hook.	3p							
Herb section								
Angiosperms - Dicotyledons								
Annonaceae								
Rollinia cf. rugulosa Schltdl.			1p					
Apiaceae								
Eryngium horridum Malme								
Asteraceae								
Conyza notobellidiastrum Griseb.								
Melastomataceae								
Leandra sp.						1p		
Miconia cinerascens Miq.	2a					1p		
Miconia hiemalis St. Hil.	2a							
Solanaceae								
Solanum variabile Mart.			1p					
Solanum montegazzianum Somm.et Lev.			1r					
Solanum namulosum Sendtner			1r					
Solanum sp.						1p		

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Thymeleaceae								
Daphnopsis racemosa Gris.								
Urticaceae								
Urera baccifera (L.) Gaud.								
Commelinaceae								
Commelina sp.					4m			
Poaceae								
Poaceae (general)	4m	2p	2a	5m	4m	5m		
Gymnosperme								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								
Pinaceae								
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.								
Pteridophyta								
Blechnaceae								
Blechnum imperiale (Fée et Glaz.) C. Chr.	2p							
Epiphytes								
Angiosperms - Dicotyledons								
Cactaceae								
Rhipsalis sp.					p		r	r
Angiosperms - Monokotyledons								
Bromeliaceae								
Bromelia sp.					a		a	
Tillandsia usneoides (L.) L.	p				a	m	p	a
Tillandsia with red blossom								
Vriesea platynema Gaud.								
Orchidiaceae								
Bulbophyllum cf. glutinosum (Barb. Rodr.)Cogn.								r
Maxillaria picta Hooker								
Octomelia sp.								
Oncidium concolor Hooker		r						
Pleurothallis hygrophila Barb.Rodr.		p						
Pleurothallis sonderana Reichenbach		p						

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Pteridophyta								
*Microgramm*a sp.						m		
Bryopsida								
moss								
lichens						a		

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

	Zone 2		Zone 1					
Specimen number	**67**	**77**	**17**	**18**	**23**	**36**	**46**	**47**
Date of record	31.1.04	1.2.04	25.6.02	6.7.02	7.7.02	10.8.02	25.8.02	21.12.02
1. Tree section								
Altitude (in m)	10	12	11	10	8	12	10	9
Angiosperms - Dicotyledons								
Asteraceae								
Vernonia discolor (Spreng.) Less	2p							
Myrtaceae								
Myrtaceae				3a				
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze	3p	3p	2p	2p	2p	2p	2p	2p
2. Tree section								
Altitude (in m)	8	8	7	7	6	8	8	6
Angiosperms - Dicotyledons								
Anacardiaceae								
Lithraea brasiliensis (L.) March.		3p						
Aquifoliaceae								
Ilex brevicuspis Reissek. Sin.								
Asteraceae								
Dasyphyllum spinescens (Less.) Cabr.			2p					
Dasyphyllum tomentosum (Spreng.) Cabr.								
Vernonia discolor (Spreng.) Less				2p				
Bombacaceae							2p	
Euphorbiaceae								
Sebastiana commersoniana (Ball.) Smith & Downs								
Lauraceae								
Ocotea pulchella Mart.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Myrsinaceae								
Myrsine umbellata Mart.			2p		2p			
Myrtaceae								
Acca sellowiana (O. Berg) Burret						2p		
Campomanesia aurea O. Berg.								2p
Campomanesia xanthocarpa O.Berg								
Calyptranthes concinna DC.								
Eugenia multicostata D. Legrand								
Myrceugenia oxysepala (Burret) D. Legrand et Kausel								2p
Myrcia arborescens Berg								
Siphoneugenia reitzii Legr.								2p
Myrtaceae (general)			3a		3a		2p	
Rhamnaceae								
Rhamnus sphaerosperma Sw.								2p
Thymeleaceae								
Daphnopsis racemosa Gris.								
Winteraceae								
Drymis brasiliensis Miers.								2p
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze						2p	2p	
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.	3a				2p	3a		
3. Tree section								
Altitude (in m)		5	6			6	6	4
Angiosperms - Dicotyledons								
Annonaceae								
Rollinia rugulosa Schltdl.								
Rollinia cf. rugulosa Schltdl.								
Aqufoliaceae								
Ilex paraguariensis St. Hil.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Asteraceae								
Dasyphyllum tomentosum (Spreng.) Cabr.								
Bombacaceae								
Bombacaceae (general)			1r					
Euphorbiaceae								
Stillingia oppositifolia Baill.								
Flacourtiaceae								
Casearia decandra Jacq.								
Melastomataceae								
Miconia cinerascens Miq.								
Miconia hiemalis St. Hil.								
Myrtaceae								
Acca sellowiana (O. Berg) Burret								
Calyptranthes concinna DC.								
Campomanesia xanthocarpa O.Berg								
Eugenia neomyrtifolia Sobral								
Hexachlamys etatiaiensis Mattos								
Myrceugenia alpigena (DC.) Landrum	2p							
Myrrhinium atropurpureum Schott								
Myrtaceae (general)						3p	2p	
Siphoneugenia reitzii Legr.		2p			2p			
Rubiaceae								
Rudgea parquioides (Cham.) Müll. Arg.								
Rutaceae								
Zanthoxyllum sp.								
Sapindaceae								
Allophyllus edulis (St. Hil.) Radlk.								
Solanaceae								
Solanum namulosum Sendtner								
Thymeleaceae								
Daphnopsis racemosa Gris.			2p					2p
Winteraceae								
Drymis brasiliensis Miers.		2r				2p		

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze		2p						
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.						2p		
Shrub section								
Altitude (in m)	3		3,5		3	4	3	3
Anacardiaceae								
Lithraea brasiliensis (L.) March.								
Annonaceae								
Rollinia cf. rugulosa Schltdl.								
Rollinia sp.		2p						
Aquifoliaceae								
Ilex brevicuspis Reissek. Sin.								
Ilex paraguariensis St. Hil.								
Asteraceae								
Dasyphyllum spinescens (Less.) Cabr.			2p					
Berberidaceae								
Berberis laurina Billb.								
Celastraceae								
Maytenus ilicifolia Mart. Reiss								
Euphorbiaceae								
Sapium glandulatum (Vell.) Pax								
Stillingia oppositifolia								
Flacourtiaceae								
Casearia decandra Jacq.		2p						
Casearia sylvestris Sw.								
Icacinaceae								
Citronella gongonha (Mart.) Howard								
Lauraceae								
Nectrandra sp.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Leguminosae - Mimosoidae								
Mimosa scabrella Benth.				1p				
Melastomataceae								
Leandra cf regnellii	2p							
Leandra sublanata Cogn.					2p			
Leandra sp.				2p				
Miconia cinerascens Miq.	3a			2p	2p		2p	
Miconia hiemalis St. Hil.	3a	1p						2p
Myrsinaceae								
Myrsine coriacea (Sw.) R. Br.	1p							
Myrsine lorenzianum					1p			
Myrtaceae								
Acca sellowiana (O. Berg) Burret						2p		
Calyptranthes concinna DC.	2p							
Eugenia pyriformis Cambess.								
Eugenia cf. oeidocarpa O.Berg	2p							
Eugenia uruguayensis Cambess.			1p					
Hexachlamys etatiaiensis Mattos								
Myrceugenia alpigena DC.) Landrum	2p							
Myrceugenia mesomischa (Burret) D.Legrand et Kausel								
Myrceugenia miersiana (Gardner) D. Legrand et Kausel	2p							
Myrceugenia myrcioides (Cambess.) Berg.								
Myrceugenia ovata (Hook. & Arn.) O. Berg	2p					2p		
Myrtaceae (general)		3a	3a					3a
Siphoneugenia reitzii Legr.	2p	3p	2p			2p		
Onagraceae								
Fuchsia regia (Vell.) Munz								
Piperaceae								
Piper gaudichaudianum (Kunth) Kunth ex C. DC.								
Rhamnaceae								
Rhamnus sphaerosperma Sw.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Rubiaceae								
Rudgea parquioides (Cham.) Müll. Arg.								
Symplocaceae								
Symplocos uniflora (Pohl) Benth.								
Thymeleaceae								
Daphnopsis racemosa Gris.		3a	2p					3a
Winteraceae								
Drymis brasiliensis Miers	2p	2p	1r		2p	2p		2p
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze	2p		2p					
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.	2p					2p		
Pteridophyta								
Dicksoniaceae								
Dicksonia sellowiana (Presl.) Hook.								
Herb section								
Angiosperms - Dicotyledons								
Annonaceae								
Rollinia cf. rugulosa Schltdl.								
Apiaceae								
Eryngium horridum Malme				1p				
Asteraceae								
Conyza notobellidiastrum Griseb.			1r					
Melastomataceae								
Leandra sp.	1p							
Miconia cinerascens Miq.	2a							
Miconia hiemalis St. Hil.	2p							
Solanaceae								
Solanum variabile Mart.								
Solanum montegazzianum Somm.et Lev.								
Solanum namulosum Sendtner								
Solanum sp.								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Thymeleaceae								
Daphnopsis racemosa Gris.								
Urticaceae								
Urera baccifera (L.) Gaud.								
Commelinaceae								
Commelina sp.			4m			4m		
Poaceae								
Poaceae (general)						4a		
Gymnosperme								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze	2p							
Pinaceae								
Podocarpaceae								
Podocarpus lambertii Klotzsch ex Endl.	2p							
Pteridophyta								
Blechnaceae								
Blechnum imperiale (Fée et Glaz.) C. Chr.	2a							
Epiphytes								
Angiosperms - Dicotyledons								
Cactaceae								
Rhipsalis sp.								
Angiosperms - Monokotyledons								
Bromeliaceae								
Bromelia sp.			p					p
Tillandsia usneoides (L.) L.	p	m	p			a		a
Tillandsia with red blossom	p							
Vriesea platynema Gaud.								
Orchidiaceae								
Bulbophyllum cf. glutinosum (Barb. Rodr.)Cogn.								
Maxillaria picta Hooker							p	
Octomelia sp.							r	
Oncidium concolor Hooker							r	
Pleurothallis hygrophila Barb.Rodr.								p
Pleurothallis sonderana Reichenbach								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Pteridophyta								
*Microgramm*a sp.			m					
Bryopsida								
moss								
lichens								

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Specimen number	**83**	**84**	**85**
Date of record	28.2.04	28.2.04	29.2.04
1. Tree section			
Altitude (in m)	12	10	14
Angiosperms - Dicotyledons			
Asteraceae			
Vernonia discolor (Spreng.) Less			
Myrtaceae			
Myrtaceae			
Gymnosperms			
Araucariaceae			
Araucaria angustifolia (Bertol.) Kuntze	3p	2p	3a
2. Tree section			
Altitude (in m)	9	7	8
Angiosperms - Dicotyledons			
Anacardiaceae			
Lithraea brasiliensis (L.) March.			
Aquifoliaceae			
Ilex brevicuspis Reissek. Sin.		2r	
Asteraceae			
Dasyphyllum spinescens (Less.) Cabr.			
Dasyphyllum tomentosum (Spreng.) Cabr.			
Vernonia discolor (Spreng.) Less			
Bombacaceae			
Euphorbiaceae			
Sebastiana commersoniana (Ball.) Smith & Downs			
Lauraceae			
Ocotea pulchella Mart.			3p

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Myrsinaceae			
Myrsine umbellata Mart.			
Myrtaceae			
Acca sellowiana (O. Berg) Burret			
Campomanesia aurea O. Berg.			
Campomanesia xanthocarpa O.Berg			3a
Calyptranthes concinna DC.			
Eugenia multicostata D. Legrand	2p		
Myrceugenia oxysepala (Burret) D. Legrand et Kausel			
Myrcia arborescens Berg	3r		
Siphoneugenia reitzii Legr.			
Myrtaceae (general)			3a
Rhamnaceae			
Rhamnus sphaerosperma Sw.			
Thymeleaceae			
Daphnopsis racemosa Gris.			
Winteraceae			
Drymis brasiliensis Miers.			
Gymnosperms			
Araucariaceae			
Araucaria angustifolia (Bertol.) Kuntze		2p	
Podocarpaceae			
Podocarpus lambertii Klotzsch ex Endl.		2p	
3. Tree section			
Altitude (in m)	4	5	6
Angiosperms - Dicotyledons			
Annonaceae			
Rollinia rugulosa Schltdl.			
Rollinia cf. rugulosa Schltdl.			
Aqufoliaceae			
Ilex paraguariensis St. Hil.			

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Asteraceae			
Dasyphyllum tomentosum (Spreng.) Cabr.			
Bombacaceae			
Bombacaceae (general)			
Euphorbiaceae			
Stillingia oppositifolia Baill.			
Flacourtiaceae			
Casearia decandra Jacq.			
Melastomataceae			
Miconia cinerascens Miq.			
Miconia hiemalis St. Hil.			
Myrtaceae			
Acca sellowiana (O. Berg) Burret			2p
Calyptranthes concinna DC.			
Campomanesia xanthocarpa O.Berg			
Eugenia neomyrtifolia Sobral			
Hexachlamys etatiaiensis Mattos			
Myrceugenia alpigena (DC.) Landrum			
Myrrhinium atropurpureum Schott			
Myrtaceae (general)	2a		
Siphoneugenia reitzii Legr.			
Rubiaceae			
Rudgea parquioides (Cham.) Müll. Arg.			
Rutaceae			
Zanthoxyllum sp.		1p	
Sapindaceae			
Allophyllus edulis (St. Hil.) Radlk.		2p	
Solanaceae			
Solanum namulosum Sendtner			
Thymeleaceae			
Daphnopsis racemosa Gris.			
Winteraceae			
Drymis brasiliensis Miers.		2a	

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Gymnosperms			
Araucariaceae			
Araucaria angustifolia (Bertol.) Kuntze	1p	2p	
Podocarpaceae			
Podocarpus lambertii Klotzsch ex Endl.		2p	
Shrub section			
Altitude (in m)			
Anacardiaceae			
Lithraea brasiliensis (L.) March.			
Annonaceae			
Rollinia cf. rugulosa Schltdl.			
Rollinia sp.			
Aquifoliaceae			
Ilex brevicuspis Reissek. Sin.			
Ilex paraguariensis St. Hil.			
Asteraceae			
Dasyphyllum spinescens (Less.) Cabr.			
Berberidaceae			
Berberis laurina Billb.			2p
Celastraceae			
Maytenus ilicifolia Mart. Reiss		1r	
Euphorbiaceae			
Sapium glandulatum (Vell.) Pax			
Stillingia oppositifolia			
Flacourtiaceae			
Casearia decandra Jacq.			
Casearia sylvestris Sw.			
Icacinaceae			
Citronella gongonha (Mart.) Howard		1r	
Lauraceae			
Nectrandra sp.			1p

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Leguminosae - Mimosoidae			
Mimosa scabrella Benth.			
Melastomataceae			
Leandra cf regnellii			
Leandra sublanata Cogn.			
Leandra sp.			
Miconia cinerascens Miq.		1p	
Miconia hiemalis St. Hil.	2p	1p	
Myrsinaceae			
Myrsine coriacea (Sw.) R. Br.			
Myrsine lorenzianum			
Myrtaceae			
Acca sellowiana (O. Berg) Burret		1r	
Calyptranthes concinna DC.			
Eugenia pyriformis Cambess.			
Eugenia cf. oeidocarpa O.Berg			
Eugenia uruguayensis Cambess.			
Hexachlamys etatiaiensis Mattos			
Myrceugenia alpigena DC.) Landrum			
Myrceugenia mesomischa (Burret) D.Legrand et Kausel			
Myrceugenia miersiana (Gardner) D. Legrand et Kausel			
Myrceugenia myrcioides (Cambess.) Berg.			
Myrceugenia ovata (Hook. & Arn.) O. Berg			
Myrtaceae (general)			
Siphoneugenia reitzii Legr.			
Onagraceae			
Fuchsia regia (Vell.) Munz		1p	
Piperaceae			
Piper gaudichaudianum (Kunth) Kunth ex C. DC.			
Rhamnaceae			
Rhamnus sphaerosperma Sw.			

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Rubiaceae			
Rudgea parquioides (Cham.) Müll. Arg.			
Symplocaceae			
Symplocos uniflora (Pohl) Benth.			
Thymeleaceae			
Daphnopsis racemosa Gris.	3a	2p	
Winteraceae			
Drymis brasiliensis Miers		2p	
Gymnosperms			
Araucariaceae			
Araucaria angustifolia (Bertol.) Kuntze	1p	2p	1p
Podocarpaceae			
Podocarpus lambertii Klotzsch ex Endl.		3a	
Pteridophyta			
Dicksoniaceae			
Dicksonia sellowiana (Presl.) Hook.			
Herb section			
Angiosperms - Dicotyledons			
Annonaceae			
Rollinia cf. rugulosa Schltdl.			
Apiaceae			
Eryngium horridum Malme			
Asteraceae			
Conyza notobellidiastrum Griseb.			
Melastomataceae			
Leandra sp.			
Miconia cinerascens Miq.		1p	
Miconia hiemalis St. Hil.		1p	
Solanaceae			
Solanum variabile Mart.			
Solanum montegazzianum Somm.et Lev.			
Solanum namulosum Sendtner			
Solanum sp.			

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Thymeleaceae			
Daphnopsis racemosa Gris.		1a	
Urticaceae			
Urera baccifera (L.) Gaud.			
Commelinaceae			
Commelina sp.			
Poaceae			
Poaceae (general)	5m	5m	
Gymnosperme			
Araucariaceae			
Araucaria angustifolia (Bertol.) Kuntze			
Pinaceae			
Podocarpaceae			
Podocarpus lambertii Klotzsch ex Endl.			
Pteridophyta			
Blechnaceae			
Blechnum imperiale (Fée et Glaz.) C. Chr.		2a	
Epiphytes			
Angiosperms - Dicotyledons			
Cactaceae			
Rhipsalis sp.		p	
Angiosperms - Monokotyledons			
Bromeliaceae			
Bromelia sp.			
Tillandsia usneoides (L.) L.	m	m	p
Tillandsia with red blossom			
Vriesea platynema Gaud.			a
Orchidiaceae			
Bulbophyllum cf. glutinosum (Barb. Rodr.)Cogn.			
Maxillaria picta Hooker			
Octomelia sp.			
Oncidium concolor Hooker			
Pleurothallis hygrophila Barb.Rodr.			
Pleurothallis sonderana Reichenbach			

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

Pteridophyta			
*Microgramm*a sp.			
Bryopsida			
moss		a	
lichens			

Table III.3: Alphabetic order of identified plants in Capões (vegetation record according to Braun-Blanquet)

	Zone 3	Zone 2		Zone 1
Specimen number	**50**	**9**	**72**	**82**
Date of record	21.12.02	23.6.02	31.1.04	1.2.04
1. Tree section				
Altitude (in m)	8	11		15
Angiosperms - Dicotyledons				
Euphorbiaceae				
Sebastiana commersoniana (Ball.) Smith & Downs	2p			
Myrtaceae				
Calyptranthes concinna DC.	2p			
Myrtaceae	3p	3a		
Gymnosperms				
Araucariaceae				
Araucaria angustifolia (Bertol.) Kuntze		4a		2p
2. Tree section				
Altitude (in m)	6	7		
Angiosperms - Dicotyledons				
Lauraceae				
Ocotea pulchella Mart.			3p	
Myrtaceae				
Calyptranthes concinna DC.	2p			
Siphoneugenia reitzii Legr.		2p		
3. Tree section				
Altitude (in m)	5			8
Angiosperms - Dicotyledons				
Myrtaceae				
Myrcia lajeana D. Legrand	2p			

Table III.4: Alphabetic order of identified plants in gallery forest (vegetation record according to Braun-Blanquet)

Gymnosperms				
Podocarpaceae				
Podocarpus lambertii Klotzsch ex Endl.				2p
Shrub section				
Altitude (in m)	2	2	2,5	2,5
Aquifoliaceae				
Ilex sp.	2p			
Asteraceae				
Eupatorium serratum			4m	
Euphorbiaceae				
Sebastiana cf. brasiliensis Spreng.			2p	
Melastomataceae				
Leandra sp.		1p		
Miconia cinerascens Miq.	2p	1p		3a
Miconia hiemalis St. Hil.				3a
Myrtaceae				
Eugenia schuechiana O. Berg		2p		
Eugenia sp.		2p		
Myrcia richardiana (O. Berg) Kiaersk.		2p		
Siphoneugenia reitzii Legr.		2p		2a
Sapindaceae				
Allophyllus guaraniticus (St. Hil.) Radlk.			2a	
Thymeleaceae				
Daphnopsis racemosa Gris.				2p
Winteraceae				
Drymis brasiliensis Miers	2p			
Gymnosperms				
Podocarpaceae				
Podocarpus lambertii Klotzsch ex Endl.				1p
Herb section				
Angiosperms - Dicotyledons				
Amaranthaceae				
Iresine diffusa Humb. & Bonpl. ex Willd.	1p			

Table III.4: Alphabetic order of identified plants in gallery forest (vegetation record according to Braun-Blanquet)

Apiaceae				
Eryngium horridum Malme			3m	
Malvaceae				
Sida rhombifolia L.	1r			
Sida spinosa L.	1p			
Melastomataceae				
Miconia hiemalis St. Hil.				2a
Polygonaceae				
Polygonum hydropiper L.	2p			
Rubiaceae				
Relbunium cf.gracilum		1r		
Sapindaceae				
Allophyllus guaraniticus (St. Hil.) Radlk.			1p	
Solanum sp.	2p			
Verbenaceae				
Verbena cf. littoralis Kunth.	1r			
Angiosperms - Monokotyledons				
Poaceae				
Paspalum pumilum Nees	2a			
Poaceae (general)				2p
Cyperaceae				
Cyperus sp.	1r			
Gymnosperme				
Araucariaceae				
Araucaria angustifolia (Bertol.) Kuntze		1p		
Podocarpaceae				
Podocarpus lambertii Klotzsch ex Endl.				1p
Pteridophyta				
Dennstaedtiaceae				
Pteridium aquilinum (L.) Kuhn.		1p		

Table III.4: Alphabetic order of identified plants in gallery forest (vegetation record according to Braun-Blanquet)

Epiphytes				
Angiosperms - Dicotyledons				
Cactaceae				
Rhipsalis sp.	p			
Angiosperms - Monokotyledons				
Bromeliaceae				
Tillandsia usneoides (L.) L.	a	m		m
Pteridophyta				
Microgramma sp.		m		
Bryopsida				
moss				m

Table III.4: Alphabetic order of identified plants in gallery forest (vegetation record according to Braun-Blanquet)

	Zone 3	Zone 2		Zone 1
Specimen number	**51**	**8**	**66**	**43**
Date of record	21.12.02	22.6.02	25.1.04	25.8.02
3. Tree section				
Altitude (in m)		4		
Angiosperms - Dicotyledons				
Gymnosperms				
Araucariaceae				
Araucaria angustifolia (Bertol.) Kuntze		2r		
Shrub section				
Altitude (in m)	2,5	2	1,5	2,5
Anacardiaceae				
Schinus polygamus (Cav.) Cabrera.	2r			
Asteraceae				
Baccharis uncinella DC.	3a	4a	3m	4a
Eupatorium serratum			3m	
Berberidaceae				
Berberis laurina Billb.	2p	1p		
Erythroxylaceae				
Erythroxylum sp.			2p	
Melastomataceae				
Miconia cinerascens Miq.		1p		
Myrtaceae				
Psidium cattleianum Sabine				2p
Rubiaceae				
Psychotria sp.				2p
Thymeleaceae				
Daphnopsis racemosa Gris.	2p			

Table III.5: Alphabetic order of identified plants in Capoeira vegetation (vegetation record according to Braun-Blanquet)

Gymnosperms				
Araucariaceae				
Araucaria angustifolia (Bertol.) Kuntze	1r	1r		
Herb section				
Angiosperms - Dicotyledons				
Apiaceae				
Eryngium horridum Malme				2a
Asteraceae				
Baccharis articulata (Lam.) Pers.	2a			
Senecio brasiliensis Less.		1p		
Trichocline catharinensis Cabr.		1p		
Erythroxyllaceae				
Erythroxyllum sp.			2r	
Angiosperms - Monokotyledons				
Poaceae				
Andropogon lateralis Ness				5m
Cortaderia selloana (Schultes)Ascherson et Graebner			4m	
Holcus lanatus L.			1p	
Poa cf. anua L.	5m			
Poaceae (general)		5m		
Cyperaceae				
Rhynchospora sp.		1p		
Pteridophyta				
Dennstaedtiaceae				
Pteridium aquilinum (L.) Kuhn.	1p			
Pteridophyta		2a		
Lycopsida - Lycopodiaceae				
Lycopodium sp.			1p	

Table III.5: Alphabetic order of identified plants in Capoeira vegetation (vegetation record according to Braun-Blanquet)

	Zone 3			Zone 2			
Specimen number	**29**	**53**	**62**	**7**	**10**	**12**	**38**
Date of record	20.7.02	22.12.02	25.1.04	22.6.02	23.6.02	23.6.02	11.8.02
3. Tree section							
Altitude (in m)							
Gymnosperms							
Araucariaceae							
Araucaria angustifolia (Bertol.) Kuntze							
Shrub section							
Altitude (in m)	4						
Asteraceae							
Baccharis uncinella DC.							
Berberidaceae							
Berberis laurina Billb.							
Flacourtiaceae							
Casearia decandra Jacq.	2p						
Loganiaceae							
Buddleja reitzii EM Norman et LB Sm.	1p						
Melastomataceae							
Miconia cinerascens Miq.							
Myrtaceae							
Acca sellowiana (O. Berg) Burret							
Calyptranthes concinna DC.	1p						
Winteraceae							
Drymis brasiliensis Miers	2p						
Gymnosperms							
Araucariaceae							
Araucaria angustifolia (Bertol.) Kuntze							

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Herb section							
Angiosperms - Dicotyledons							
Amaranthaceae							
Pfaffia cf. gnaphaloides (Lf) Mart.			1p				
Apiaceae							
Eryngium cf. ebracteatum Lam.							
Eryngium horridum Malme							
Eryngium pandanifolium Cham. et Schltdl.							
Aquifoliaceae							
Asteraceae							
Achyrocline satureoides (Lam.) DC					5p		
Aspilia montevidensis (Spreng.) Kuntze							
Baccharis articulata (Lam.) Pers.		3a	2p		2a		
Baccharis axillaris DC.			1p				
Baccharis cultrata Baker			1p		2a		
Baccharis microcephala Baker			1p				
Baccharis cf. milleflora (Less.)		2p					
Baccharis pseudovillosa Teodoro							
Baccharis spicata (Lam.) Baill.							
Baccharis tridentata Vahl.							
Baccharis uncinella DC.							
Conyza chilensis Spreng.							
Erigeron catharinensis Cabr.			1p				
Erigeron tweediei Hook et Arn.							
Eupatorium betoniciforme (DC.) Bak. var. hastatum							
Eupatorium bupleurifolium DC.		1p					
Eupatorium catharinensis							
Senecio brasiliensis Less.		2p					
Senecio conizifolius Bak.	1p				1p		1p
Stevia lundiana DC.							
Trichocline catharinensis Cabr.							
Vernonia brasiliensis Less.	1a						
Vernonia flexuosa Sims			1p				

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Lamiaceae							
Hyptis muelleri Briquet							
Leguminosae - Faboidae							
Aeschynomene cf. microphylla Chodat et Hassl.							
Agmella grissi							
Leguminosae - Mimosoidae							
Mimosa scabrella Benth.							
Lentibulariaceae							
Utricularia sp. L.							
Lythraceae							
Heimia myrtifolia Cham.et Schlecht.							
Melastomataceae							
Tibouchina gracilis (Kunth) Cogn.			1p	1p			
Meliaceae							
Trichilia claussenii C. DC.							
Oxalidaceae							
Oxalis sp.	1p		1p				
Polygalaceae							
Polygala campestris Gardn.			1p	1r		1p	
Polygonaceae							
Polygonum sp.							
Rubiaceae							
Borreria fastigata (Griseb.) K. Schum.			1p				
Borreria verticillata var.sulcata Bacig.			1p				
Verbenaceae							
Verbena bonariensis L.							
Verbena sp.1							
Verbena sp.2							
Angiosperms - Monokotyledons							
Iridaceae							
Sisyrinchium foliosum IM Johnst.							
Sisyrinchium laxum Sims							
Sisyrinchium vaginatum Spreng.							

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Poaceae							
Andropogon lateralis Ness			5m		3m		5m
Calamagrostis viridiflavescens (Poir.) Steud.							
Eriochrysis cayanensis P. Beavrois							
Paspalum pumilum Nees							
Poa cf. anua L.							
Poaceae (general)			5m	5m		5m	
Sacciolepis campestris (Nees)L.R.Parodi							
Cyperaceae							
Cyperus cf. eragrostis Lam.							
Cyperus sp.							
Pycreus uniloides (R.BR.) Urban							
Rhynchospora cf. corymbosa (L.) Britton							
Rhynchospora marisculus Nees ex Lindl.							
Rhynchospora sp.							
Pteridophyta							
Blechnaceae							
Blechnum imperiale (Fée et Glaz.) C. Chr.							
Dennstaedtiaceae							
Pteridium aquilinum (L.) Kuhn.		2p	2p	1p	2a		
Pteridophyta							
Bryopsida - Sphagnopsida							
Sphagnum sp.							

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

	Zone2					Zone 1		
Specimen number	**41**	**48**	**69**	**71**	**78**	**19**	**22**	**37**
Date of record	11.8.02	21.12.02	31.1.04	31.1.04	2.2.04	6.7.02	7.7.02	10.8.02
3. Tree section								
Altitude (in m)								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								
Shrub section								
Altitude (in m)								
Asteraceae								
Baccharis uncinella DC.								
Berberidaceae								
Berberis laurina Billb.								
Flacourtiaceae								
Casearia decandra Jacq.								
Loganiaceae								
Buddleja reitzii EM Norman et LB Sm.								
Melastomataceae								
Miconia cinerascens Miq.								
Myrtaceae								
Acca sellowiana (O. Berg) Burret								
Calyptranthes concinna DC.								
Winteraceae								
Drymis brasiliensis Miers								
Gymnosperms								
Araucariaceae								
Araucaria angustifolia (Bertol.) Kuntze								

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Herb section								
Angiosperms - Dicotyledons								
Amaranthaceae								
Pfaffia cf. gnaphaloides (Lf) Mart.					1p			
Apiaceae								
Eryngium cf. ebracteatum Lam.			2p		2p			
Eryngium horridum Malme		2a				2p	1p	3a
Eryngium pandanifolium Cham. et Schltdl.					3m			
Aquifoliaceae								
Asteraceae								
Achyrocline satureoides (Lam.) DC			1r	1p				
Aspilia montevidensis (Spreng.) Kuntze					1p			
Baccharis articulata (Lam.) Pers.					1p			
Baccharis axillaris DC.	1p				1p			
Baccharis cultrata Baker	2p			1p	1p			
Baccharis microcephala Baker			1p					
Baccharis cf. milleflora (Less.)								
Baccharis pseudovillosa Teodoro		2a		1p				
Baccharis spicata (Lam.) Baill.		2a						
Baccharis tridentata Vahl.			1p					
Baccharis uncinella DC.								1p
Conyza chilensis Spreng.		1p						
Erigeron catharinensis Cabr.								
Erigeron tweediei Hook et Arn.					2p			
Eupatorium betoniciforme (DC.) Bak. var. hastatum					1p			
Eupatorium bupleurifolium DC.				2p				
Eupatorium catharinensis		1a						
Senecio brasiliensis Less.								
Senecio conizifolius Bak.								
Stevia lundiana DC.		1p						
Trichocline catharinensis Cabr.				1p				
Vernonia brasiliensis Less.								
Vernonia flexuosa Sims		1a						

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Lamiaceae								
Hyptis muelleri Briquet			1p		1p			
Leguminosae - Faboidae								
Aeschynomene cf. microphylla Chodat et Hassl.		1r						
Agmella grissi	1p							
Leguminosae - Mimosoidae								
Mimosa scabrella Benth.								
Lentibulariaceae								
Utricularia sp. L.			1p		1p			
Lythraceae								
Heimia myrtifolia Cham.et Schlecht.					2p			
Melastomataceae								
Tibouchina gracilis (Kunth) Cogn.		1p	1p	1p	1p			
Meliaceae								
Trichilia claussenii C. DC.								
Oxalidaceae								
Oxalis sp.	1p							
Polygalaceae								
Polygala campestris Gardn.								1p
Polygonaceae								
Polygonum sp.						1p		
Rubiaceae								
Borreria fastigata (Griseb.) K. Schum.				1p				
Borreria verticillata var.sulcata Bacig.								
Verbenaceae								
Verbena bonariensis L.		1r						
Verbena sp.1	1p							
Verbena sp.2	1r							
Angiosperms - Monokotyledons								
Iridaceae								
Sisyrinchium foliosum IM Johnst.	1r							
Sisyrinchium laxum Sims	1r							
Sisyrinchium vaginatum Spreng.			1r					

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Poaceae								
Andropogon lateralis Ness	5a	4a	5m				3a	5m
Calamagrostis viridiflavescens (Poir.) Steud.					3a			
Eriochrysis cayanensis P. Beavrois			2p					
Paspalum pumilum Nees		2a		2p			3a	3a
Poa cf. anua L.								
Poaceae (general)			5m	5m	5m	5m		
Sacciolepis campestris (Nees)L.R.Parodi					2a			
Cyperaceae								
Cyperus cf. eragrostis Lam.					1p			
Cyperus sp.				1p				
Pycreus uniloides (R.BR.) Urban			1p		1p			
Rhynchospora cf. corymbosa (L.) Britton				2p				
Rhynchospora marisculus Nees ex Lindl.			2p					
Rhynchospora sp.								
Pteridophyta								
Blechnaceae								
Blechnum imperiale (Fée et Glaz.) C. Chr.			1p		1r			
Dennstaedtiaceae								
Pteridium aquilinum (L.) Kuhn.			1p	1p				
Pteridophyta								
Bryopsida - Sphagnopsida								
Sphagnum sp.					3a			

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

	Zone 1	
Specimen number	**42**	**81**
Date of record	12.8.02	2.2.04
3. Tree section		
Altitude (in m)		
Gymnosperms		
Araucariaceae		
Araucaria angustifolia (Bertol.) Kuntze		
Shrub section		
Altitude (in m)		
Asteraceae		
Baccharis uncinella DC.		
Berberidaceae		
Berberis laurina Billb.		
Flacourtiaceae		
Casearia decandra Jacq.		
Loganiaceae		
Buddleja reitzii EM Norman et LB Sm.		
Melastomataceae		
Miconia cinerascens Miq.		
Myrtaceae		
Acca sellowiana (O. Berg) Burret		
Calyptranthes concinna DC.		
Winteraceae		
Drymis brasiliensis Miers		
Gymnosperms		
Araucariaceae		
Araucaria angustifolia (Bertol.) Kuntze		

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Herb section		
Angiosperms - Dicotyledons		
Amaranthaceae		
Pfaffia cf. gnaphaloides (Lf) Mart.		
Apiaceae		
Eryngium cf. ebracteatum Lam.		
Eryngium horridum Malme		
Eryngium pandanifolium Cham. et Schltdl.		4m
Aquifoliaceae		
Asteraceae		
Achyrocline satureoides (Lam.) DC		
Aspilia montevidensis (Spreng.) Kuntze		
Baccharis articulata (Lam.) Pers.		1p
Baccharis axillaris DC.		1p
Baccharis cultrata Baker		1p
Baccharis microcephala Baker		
Baccharis cf. milleflora (Less.)		
Baccharis pseudovillosa Teodoro		
Baccharis spicata (Lam.) Baill.		
Baccharis tridentata Vahl.		
Baccharis uncinella DC.		
Conyza chilensis Spreng.		
Erigeron catharinensis Cabr.		
Erigeron tweediei Hook et Arn.		
Eupatorium betoniciforme (DC.) Bak. var. hastatum		
Eupatorium bupleurifolium DC.		
Eupatorium catharinensis		
Senecio brasiliensis Less.		
Senecio conizifolius Bak.		
Stevia lundiana DC.		
Trichocline catharinensis Cabr.		
Vernonia brasiliensis Less.		
Vernonia flexuosa Sims		

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Lamiaceae		
Hyptis muelleri Briquet		
Leguminosae - Faboidae		
Aeschynomene cf. microphylla Chodat et Hassl.		
Agmella grissi		
Leguminosae - Mimosoidae		
Mimosa scabrella Benth.	1r	
Lentibulariaceae		
Utricularia sp. L.		
Lythraceae		
Heimia myrtifolia Cham.et Schlecht.		2p
Melastomataceae		
Tibouchina gracilis (Kunth) Cogn.		1p
Meliaceae		
Trichilia claussenii C. DC.		
Oxalidaceae		
Oxalis sp.		
Polygalaceae		
Polygala campestris Gardn.		1p
Polygonaceae		
Polygonum sp.		
Rubiaceae		
Borreria fastigata (Griseb.) K. Schum.		
Borreria verticillata var.sulcata Bacig.		
Verbenaceae		
Verbena bonariensis L.		
Verbena sp.1		
Verbena sp.2		
Angiosperms - Monokotyledons		
Iridaceae		
Sisyrinchium foliosum IM Johnst.		
Sisyrinchium laxum Sims		
Sisyrinchium vaginatum Spreng.		

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

Poaceae		
Andropogon lateralis Ness	5a	
Calamagrostis viridiflavescens (Poir.) Steud.		
Eriochrysis cayanensis P. Beavrois		
Paspalum pumilum Nees	4m	
Poa cf. anua L.		
Poaceae (general)		5m
Sacciolepis campestris (Nees)L.R.Parodi		
Cyperaceae		
Cyperus cf. eragrostis Lam.		
Cyperus sp.		
Pycreus uniloides (R.BR.) Urban		
Rhynchospora cf. corymbosa (L.) Britton		
Rhynchospora marisculus Nees ex Lindl.		
Rhynchospora sp.		
Pteridophyta		
Blechnaceae		
Blechnum imperiale (Fée et Glaz.) C. Chr.		
Dennstaedtiaceae		
Pteridium aquilinum (L.) Kuhn.		
Pteridophyta		
Bryopsida - Sphagnopsida		
Sphagnum sp.		2a

Table III.6:Alphabetic order of identified plants in campo vegetation (vegetation record according to Braun-Blanquet)

	Zone 3			Zone 2	Zone 1
Specimen number	**1**	**3**	**30**	**14**	**16**
Date of record	4.5.02	5.5.02	21.7.02	25.6.02	25.6.02
Vegetation type	E	Secyf	Secf	AM	P
1. Tree section					
Altitude (in m)	15		11	12	8
Angiosperms - Dicotyledons					
Asteraceae					
Vernonia discolor (Spreng.) Less					
Vernonia sp.			2p		
Myrtaceae					
Eucalyptus sp.	3a				
Gymnosperms					
Araucariaceae					
Araucaria angustifolia (Bertol.) Kuntze			2p	3p	
Pinaceae					
Pinus taeda L.					4m
Podocarpaceae					
Podocarpus lambertii Klotzsch ex Endl.					
2. Tree section					
Altitude (in m)	9		8		
Angiosperms - Dicotyledons					
Leguminosae (general)			2p		
Myrtaceae					
Eucalyptus sp.	2a				
Gymnosperms					
Araucariaceae					
Araucaria angustifolia (Bertol.) Kuntze	2p				

Table III.7: Alphabetic order of identified plants in anthropogenic affected areas (vegetation record according to Braun-Blanquet)

3. Tree section					
Altitude (in m)	5		5		
Angiosperms - Dicotyledons					
Asteraceae					
Dasyphyllum tomentosum (Spreng.) Cabr.			2p		
Vernonia sp.			2p		
Moraceae					
Sorocea bonplandii (Baill.) Burger			2p		
Myrtaceae					
Eucalyptus sp.	2a				
Myrtaceae (general)			2p		
Gymnosperms					
Araucariaceae					
Araucaria angustifolia (Bertol.) Kuntze	2p				
Podocarpaceae					
Podocarpus lambertii Klotzsch ex Endl.	2p				
Shrub section					
Altitude (in m)	3		3		
Moraceae					
Sorocea bonplandii (Baill.) WC Burger			1p		
Myrsinaceae					
Myrsine sp.			2p		
Myrtaceae					
Eucalyptus sp.	2p				
Angiosperms - Monocotyledons					
Poaceae					
Bambus sp.			4a		
Gymnosperms					
Araucariaceae					
Araucaria angustifolia (Bertol.) Kuntze	2p				
Podocarpaceae					
Podocarpus lambertii Klotzsch ex Endl.	2a		2p		

Table III.7: Alphabetic order of identified plants in anthropogenic affected areas (vegetation record according to Braun-Blanquet)

Herb section					
Angiosperms - Dicotyledons					
Asteraceae					
Hypochoeris sp.L.					1r
Solidago chilensis Meyen.					1r
Melastomataceae					
Leandra sp.	1p				
Miconia cinerascens Miq.	1p			1p	
Miconia hiemalis St. Hil.			1p	1p	
Myrsinaceae					
Myrsine sp.			1p		
Solanaceae					
Solanum variabile Mart.				1p	
Angiosperms - Monokotyledons					
Poaceae					
Poaceae (general)	r			4m	
Pteridophyta					
Dennstaedtiaceae					
Pteridium aquilinum (L.) Kuhn.	1p				
Angiosperms - Dicotyledons					
Cactaceae					
Rhipsalis sp.				r	
Angiosperms - Monokotyledons					
Bromeliaceae					
Bromelia sp.				p	
Tillandsia usneoides (L.) L.				p	
Oncidium concolor Hooker			p	p	
Pleurothallis hygrophila Barb.Rodr.			p		

Table III.7: Alphabetic order of identified plants in anthropogenic affected areas (vegetation record according to Braun-Blanquet)

Appendix IV

Table with data of the geographical position (GPS), altitude and vegetation types of the sample points

	Lat - South	Long - West	
specimen number	Deg Min Sec	Deg Min Sec	Altitude (in m) Space shuttle
1	29° 18' 59,40"	50° 50' 33,60"	770
2	29° 18' 50,04"	50° 54' 36,96"	528
3	29° 18' 55,74"	50° 51' 37,20"	752
4	29° 19' 14,70"	50° 53' 10,62"	612
5	29° 21' 52,68"	50° 47' 29,82"	832
6	29° 13' 34,50"	50° 44' 29,82"	847
7	29° 13' 34,74"	50° 44' 23,70"	846
8	29° 08' 42,54"	50° 48' 32,76"	901
9	29° 04' 48,48"	50° 37' 58,20"	852
10	29° 04' 46,68"	50° 38' 07,08"	848
11	29° 04' 38,40"	50° 38' 01,20"	826
12	29° 18' 29,70"	50° 29' 42,42"	934
13	29° 19' 48,12"	50° 30' 30,06"	892
14	29° 20' 19,86"	50° 40' 23,70"	877
15	29° 20' 24,66"	50° 40' 26,04"	882
16	29° 12' 18,54"	50° 14' 37,14"	937
17	29° 10' 43,44"	50° 16' 00,36"	961
18	29° 03' 24,72"	50° 07' 11,40"	1004
19	29° 07' 16,20"	50° 06' 07,62"	1006
20	29° 09' 38,64"	50° 04' 38,82"	922
21	29° 09' 38,10"	50° 05' 28,50"	935
22	29° 04' 07,68"	50° 01' 34,74"	1005
23	29° 11' 28,80"	50° 13' 37,14"	949
24	29° 20' 19,08"	51° 09' 20,94"	115
25	29° 19' 19,62"	51° 08' 30,30"	319
26	29° 15' 46,38"	51° 01' 59,94"	732
27	29° 12' 58,08"	51° 01' 24,36"	732
28	29° 12' 15,90"	51° 00' 28,50"	777
29	29° 12' 12,90"	51° 00' 28,80"	785
30	29° 10' 56,70"	51° 00' 26,70"	789
31	29° 12' 10,44"	51° 04' 09,42"	535
32	29° 13' 03,18"	51° 08' 49,44"	726
33	29° 23' 07,38"	50° 47' 01,62"	854
34	29° 19' 03,84"	50° 58' 23,64"	326
35	29° 19' 49,98"	50° 55' 16,44"	771
36	29° 15' 15,00"	50° 20' 10,50"	878
37	29° 15' 17,22"	50° 20' 13,74"	890

Table IV:Geographical position, altitude and vegetation type of sample points

38	29° 01' 12,30"	50° 33' 09,78"	942
39	28° 56' 34,86"	50° 28' 09,60"	841
40	29° 09' 13,26"	50° 39' 55,68"	920
41	29° 09' 14,64"	50° 39' 55,20"	920
42	29° 13' 18,36"	50° 28' 20,52"	949
43	29° 27' 19,50"	50° 20' 44,80"	925
44	29° 29' 50,20"	50° 21' 03,30"	882
45	29° 31' 10,70"	50° 19' 08,10"	307
46	29° 10' 56,50"	50° 12' 37,30"	1020
47	29° 15' 00,00"	50° 20' 55,26"	874
48	29° 15' 01,20"	50° 20' 59,28"	880
49	29° 09' 54,00"	50° 31' 24,42"	966
50	29° 06' 32,64"	50° 35' 28,20"	940
51	29° 07' 42,36"	50° 48' 03,90"	911
52	29° 07' 39,72"	50° 48' 11,04"	940
53	29° 09' 40,08"	50° 50' 08,40"	869
54	29° 25' 41,94"	51° 09' 53,94"	528
55	29° 24' 45,72"	51° 08' 05,70"	506
56	29° 26' 48,18"	51° 02' 50,28"	383
57	29° 22' 41,16"	51° 03' 27,84"	616
58	29° 22' 32,64"	50° 50' 06,78"	831
59	29° 21' 24,96"	51° 04' 22,50"	663
60	29° 06' 09,96"	51° 03' 36,18"	710
61	29° 06' 50,46"	51° 02' 48,18"	756
62	29° 09' 09,54"	50° 56' 52,98"	741
63	29° 10' 32,88"	50° 54' 57,00"	840
64	29° 13' 08,04"	50° 53' 32,88"	763
65	29° 13' 02,40"	50° 53' 36,24"	771
66	29° 13' 53,16"	50° 55' 33,18"	832
67	29° 26' 09,36"	50° 35' 55,92"	879
68	29° 23' 00,06"	50° 38' 22,20"	862
69	29° 17' 48,36"	50° 39' 52,74"	825
70	29° 16' 41,10"	50° 38' 12,90"	874
71	29° 14' 16,02"	50° 34' 36,72"	940
72	29° 09' 09,00"	50° 34' 17,16"	910
73	29° 05' 03,72"	50° 43' 57,78"	857
74	29° 04' 04,14"	50° 55' 12,72"	862
75	29° 06' 40,20"	50° 50' 36,30"	940
76	29° 08' 06,54"	50° 41' 46,92"	959
77	29° 09' 52,02"	50° 49' 33,48"	808
78	29° 10' 49,02"	50° 46' 51,54"	864

Table IV:Geographical position, altitude and vegetation type of sample points

79	29° 10' 14,70"	50° 31' 48,66"	918
80	29° 05' 11,28"	50° 26' 31,80"	941
81	29° 01' 43,26"	50° 25' 45,66"	959
82	29° 07' 47,04"	50° 26' 29,34"	941
83	29° 08' 45,70"	50° 18' 19,00"	872
84	29° 06' 10,70"	50° 19' 47,90"	899
85	29° 01' 53,70"	50° 07' 15,80"	1028

legend:

Araucaria forest
Semi-deciduous and deciduous forest
Capão
Gallery forest
Capoeira
Grassland (Campo)
Anthropogenic affected area

Table IV:Geographical position, altitude and vegetation type of sample points

Bildungsgang

Name:	Kerstin Kriegel	
Geburtstag:	12.Januar 1977	
Geburtsort:	Dresden	
Schulausbildung:	09/83 – 07/91	Polytechnische Oberschule „Alexander Puschkin“ in Dresden
	09/91 – 07/92	Mittelschule „Alexander Puschkin“ in Dresden
	09/92 – 06/95	Gymnasium Dresden - Großzschachwitz
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Studium:	10/95 – 04/01	Studium der Biologie an der Technischen Universität Dresden
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Thema der Dissertation:

”Recent palynological spectra from the Planalto region of the Serra Geral, Rio Grande do Sul/ Brazil: Reconstruction of contemporary vegetation – a case study”

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