Zeitschrift: Candollea : journal international de botanique systématique = international journal of systematic botany

Herausgeber: Conservatoire et Jardin botaniques de la Ville de Genève

Band: 39 (1984)

Heft: 1

Artikel: Monocotyledons and pteridophytes indicators of environmental constraints in the tropical vegetation

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DOI: https://doi.org/10.5169/seals-879905

Monocotyledons and pteridophytes indicators of environmental constraints in the tropical vegetation

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RÉSUMÉ

GRANVILLE, J.-J. DE (1984). Monocotylédones et ptéridophytes, indicateurs du niveau de contrainte dans la végétation tropicale. *Candollea* 39: 265-269. En anglais, résumé français.

La proportion de monocotylédones par rapport au total des angiospermes dans une végétation tropicale homogène est faible lorsque les conditions écologiques sont optimales. Elles augmentent lorsqu'apparaissent de puissants facteurs limitants. La répartition des monocotylédones dans la forêt montre qu'elles occupent des biotopes marginaux: épiphytes et herbes du sous-bois. L'étude de la dynamique de la végétation permet de mettre en évidence les échanges qui existent entre ces deux ensembles. La proportion de monocotylédones exprime donc le niveau de contrainte du milieu et leur répartition dans les différents ensembles structuraux d'un site forestier indique son âge approximatif.

ABSTRACT

GRANVILLE, J.-J. DE (1984). Monocotyledons and pteridophytes indicators of environmental constraints in the tropical vegetation. *Candollea* 39: 265-269. In English, French abstract.

The proportion of monocotyledons in relation to the total angiosperms in a homogenous tropical vegetation is small when the ecological conditions are optimal. It increases when there appears strong ecological limiting factors. The distribution of monocotyledons in the forest reflects its occupation of marginal biotopes: epiphytes and understory herbs. The study of the dynamics of the vegetation allows to put in evidence the exchanges which exist between these two layers. The proportion of monocotyledons hence expresses the level of environmental constraints and their distribution in different structural entities of a forest-site reflects its approximative age.

The simple qualitative and quantitative analysis of the tropical lowlands vegetal cover plainly proves that the repartition of the monocotyledons is not hazardous: on one hand it varies steadily from one formation to another and, on the other hand, inside the very forest formations, monocotyledons are not uniformly distributed.

Monocotyledon repartition among the big vegetal formations

1. A neotropical example: French Guiana

The percentage of monocotyledons figured with reference to the total amount of terrestrial angiosperms in the various plant formations has been obtained from data established in French Guiana (GRANVILLE, 1976, 1978; HOOCK, 1971) and completed by the ones established by LINDEMAN (1953) in Suriname (Fig. 1A).

On solid ground forest, according to cases, the proportion of monocotyledons is quite small and varies between the 0% to 13% brackets, while on marshes, it varies from 12% ("marsh forest") to 31% ("swamp wood"). These low lying boggy grounds, called "pinotières" in French Guiana, are striking by their abundance of large leaves monocotyledons: Cyclanthaceae, Marantaceae, Musaceae, Rapateaceae, Zingiberaceae. The most characteristic palms are *Euterpe oleracea* and, on the coastal zone, *Mauritia flexuosa*. The proportion of monocotyledons increases with the increase of water content in the soil together with the degradation of ecological conditions: on subcoastal herbaceous swamps, it varies from 25% ("*Eleocharis mutata* swamps") to 63%

CODEN: CNDLAR
ISSN: 0373-2967
39(1) 265 (1984)

("Lagenocarpus guianensis swamps"). Alismataceae, Araceae *(Montrichardia arborescens),* Cyperaceae, Gramineae, Lemnaceae, Pontederiaceae, Typhaceae, Xyridaceae are, here, predominant.

On the contrary, when one leaves the optimal ecological conditions that prevail in the hard ground forest on deep soil, to reach progressively dryer formations, by lack of water or ground, the percentage of monocotyledons also progress: the "savanna forest", on more or less podzolised soil, counts 16% of terrestrial monocotyledons and the outcrop scrub forest, on thin soil, 32% (Bromeliaceae, Cyperaceae, Gramineae, Marantaceae). On the coastal dry savannas, where Cyperaceae, Eriocaulaceae, Gramineae, Xyridaceae predominate, monocotyledons are abundant: 35 to 40% ("savanes hautes" on ferrallitic soils) and 45 to 60% ("savanes basses" on podzolised soils). On the "savanes-roches" of rocky outcrops, the average ratio of monocotyledons is 57% but a keener analysis made in Tumuc-Humac area, shows that it may reach 100% on the succulent facet (orchid tufs on bare rock) while it is only of 41% on the *Ischaemum guianense* facet (continuous grass cover on thin soil).

To come last, the epiphytic communities of the forest canopy are in strong majority composed of monocotyledons (Araceae, Bromeliaceae, Orchidaceae): 86% for tropical America in its whole, according to MADISON (1977).

2. A paleotropical example: Ivory Coast

A similar calculation carried out for Ivory Coast from ADJANOHOUN (1964) as well as GUILLAUMET's data (1967) give very comparable results to these of French Guiana (Fig. 1B).

In the dense rain forest on solid ground, the proportion of monocotyledons varies from 12% (deep and rich soil on metamorphic rocks) to 18% (thin soil on granite). In the marsh or swamp forests where palms genus *Raphia* dominate with Commelinaceae and Marantaceae, it varies from 27% (low lying raphia and *Gilbertiodendron splendidum* lands) to 44% (raphia low lands). Herbaceous swamps count more than 40% monocotyledons, mainly Cyperaceae, Gramineae, Marantaceae *(Thalia geniculata): Thalia geniculata* ponds (41%), *Loudetia phragmitoides* association (48%), *Vetiveria nigritana* association (50%), *Isoetes nigritana* and *Ophioglossum gomezianum* association (53%).

As well as in French Guiana, formations showing a more or less xeric facies, present a more important score of monocotyledons than the solid ground forest on deep soil: 21% in the subcoastal forest on pseudopodzols, 29% on the dry savannas with predominance of Cyperaceae and Gramineae *(Brachiaria brachylopha* association), 42 to 50% in the herbaceous outcrop formations (*Afrotrilepis pilosa* association).

Lastly, according to MADISON (1977), for the whole tropical Africa, the canopy counts 94% of epiphytic monocotyledons (mainly orchids).

Repartition of monocotyledons in the Guianese forest

Figure 2 schematizes the monocotyledon repartition in the principal formations in French Guiana and emphasizes their relative ecology with the forest dynamics.

The sole layer, rich in herbaceous monocotyledons, of the low formations (savannas, marshes, outcrops) divides itself at the forest level (Fig. 2B) to give an upper set with heliophile herbs (epiphytes) in the canopy and a lower set constituted by heliophile terrestrial species (shade tolerant seedlings) or subsciaphile ones (understory plants). The richness in monocotyledons of each of these sets is not constant and varies with the dynamics of the forest. As a matter of fact, we know that the forest is not uniform in space but is constituted of a mosaic of sylvigenetic phases of different ages (HALLE, OLDEMAN & TOMLINSON, 1978). During a young sylvigenetic phase, the understory is rich in terrestrial monocotyledons and the canopy poor in epiphytes (Fig. $2C_1$). In an old phase, the contrary happens: canopy is rich in monocotyledons (Bromeliaceae, Cyclanthaceae, Orchidaceae) and the understory quite impoverished in monocotyledons, only counts seedlings checked in their growth and awaiting a casual clearing (Fig. $2C_3$).

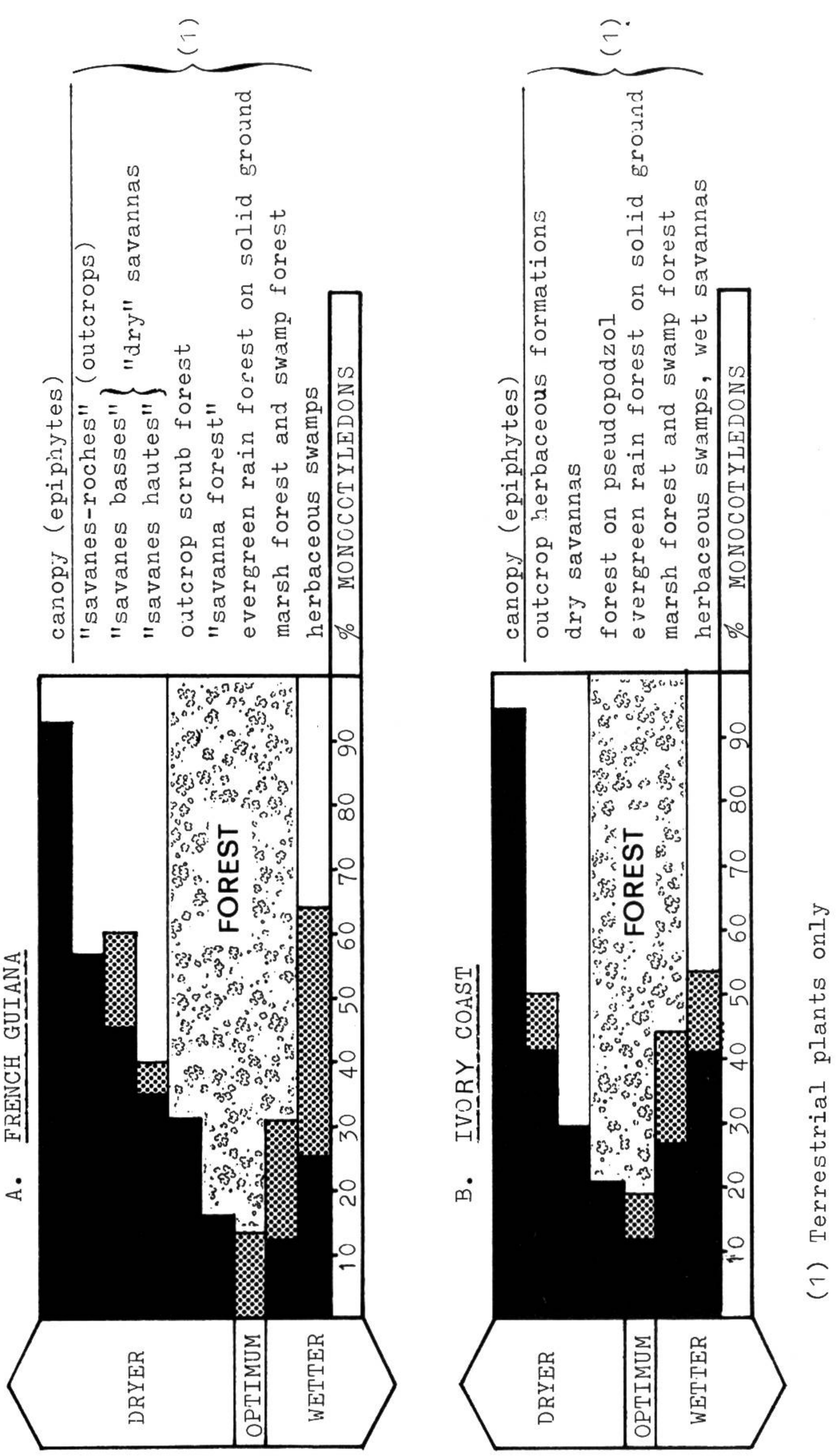

Fig. 1. — Proportion of monocotyledons among the main plant formations in French Guiana (tropical America) and Ivory Coast (tropical Africa).

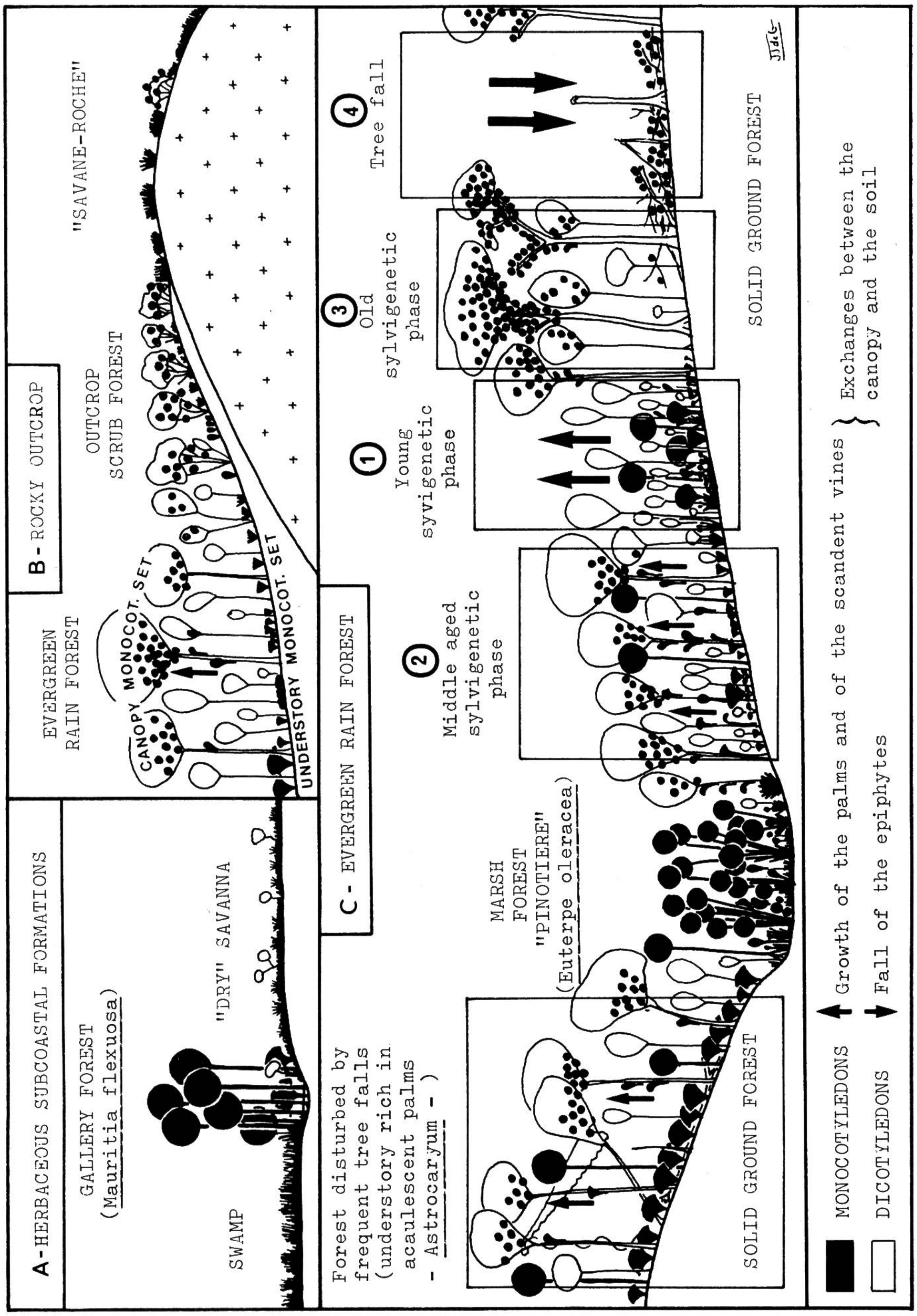

Fig. 2. — Distribution and dynamics of the monocotyledons in the guianese vegetation.

As the sylvigenetic phase goes, the interchanges of monocotyledons between the ground level and the canopy are shown by the growing of the big palms and the scandent vines (Fig. $2C_2$), mainly Araceae and Cyclanthaceae, and, in the other way, by the fall of epiphytes out of the open places ("chablis", Fig. $2C_4$).

Conclusion

In French Guiana as well as in Ivory Coast, monocotyledons prefer marginal biotopes. From what we have observed, it is the same for pteridophytes. The proportion of monocotyledons, compared to the total of angiosperms (or monocotyledons + pteridophytes compared to the total of vascular plants) increases proportionaly with the hostile character of the environment. A high proportion of monocotyledons, therefore, reveals reality of important limitative factors or a recent perturbation of the station (human intervention, pasturage, fires, casual clearing in forest, to give examples). On one side, monocotyledons are colonizing plants in the open formations, and on the other side they have an important impact on the sylvigenesis.

The reasons of this peculiar ecology, implying a great adaptative facility, seem to be due to the lack of cambium and secundary growing that constitute their essential characteristics. These striking histological features of both monocotyledons and pteridophytes involve the impossibility of reiteration and important ramification, hence a display of growing ways and different architectural models than these of dicotyledons. The adaptability of monocotyledons is a definite advantage for the exploration and the colonization of the medium, either horizontal (creeping herbs) or vertical (scandent vines, growth in height without increase of the crown among the tall palms, well adapted to fill up gaps in the canopy after a tree fall). The highly specialized structures (epiphytes, hydrophytes) are also striking advantages for the exploitation of special biotopes.

Applications of this type of researches, in order to enhance the value of natural ecosystems are possible: appreciation of the ecological bondage of the environment, roughly figured after the monocotyledon ratio, planification of monocotyledon agro-ecosystems in the best conditions.

In fact, the geographic limits for the application of the above theory, valid for French Guiana and Ivory Coast, are not known yet. It remains, very likely, true for the lowland tropical vegetation in general, but its extension to the mountains, as well as to temperate or cold countries, has to be studied.

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