A REVIEW OF MIOMBO RESEARCH NOT PUBLISHED IN ENGLISH

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1. INTRODUCTION

In this contribution to bibliographical review of miombo research not published in English, 55 important references are pointed out. 45 of them were published in French, 10 others carried out in Angola and Mozambic were written in Portuguese.

Only French references constitue the basis of this presentation. A great number of them deal with the vegetation of the Shaba province in Zaïre. Researches on woodlands described in the Mosso-Malagasi (Burundi) were also red with interest.

Many of these studies were published in scientific journals; some were included in books of general interest, with rubrics on miombo knowledge. Up today, no one of them has entirely dealt with this subject. Various themes such as Floristical composition, physiognomy and phytosociology, phenology and ecological spectra, phytogeography, ethnoecology, Evolution of miombo were covered.

2. MIOMBO KNOWLEDGE THROUGH FRENCH LITERATURE

- Annual rainfall and miombo

According to the annual rainfall [SCHMITZ (1971), STREEL (1963), WHITE (1986)], 2 types of miombo have been recognized: - the wetter miombo usually need more than 1000 mm per year. - the drier are pored with less than 1000 mm.

As shown by the climatic map (fig. 1) and diagramme (fig. 2), a very large area of the province of Shaba, covered by miombo is classified in the Aw zone of KOPPEN (1936). The annual rainfall rises up to 1100-1300 mm even in the sites belonging to the Cw climate in Zaïre as well as in Burundi. Therefore, the occurence of wetter miombo is assumed to be the most obvious in these countries.

- Floristical composition, Physiognomy, Phytosociology

According to WHITE (1986), 19 species among the most dominant in miombo belong to genus *Brachystegia* Benth. Decription of those from central Africa was made by LEONARD (1953a) who localised the habitat of the following in miombo: *B. boehmii* Taubert, *B. floribunda* Benth., *B. gossweileri* Burtt Davy & Hutch., *B. longifolia* Benth., *B. manga* De Wild., *B. microphylla* Harms, *B. spiciformis* Benth., *B. stipulata* De Wild., *B. taxifolia* Harms, *B. utilis* Burtt Davy & Hutch., *B. wangermeeana* De Wild.

The other typical genera are *Isoberlinia* Craib et Stapf [*Isoberlinia angolensis* (Welw. ex Benth.) Hoyle et Brenan, *I. niembaensis* (De Wild.) Duvign., *I. tomentosa* (Harms) Craib et Stapf)] and *Julbernardia* Pellegr. [J. globuflora (Benth.) Troupin, *J. paniculata* (Benth.) Troupin].

This floristical composition is an important criterium allowing to differenciate miombo from the other types of woodlands (DEVRED 1958), such as the "mopane" which is characterized by *Colophospermum mopane* (Kirk. ex Benth.) J. Léonard.

The dominant elements in the physiognomical structure are generally 10 to 20 m high (Fig. 3: MALAISSE 1976), but scrub miombo can be as short as 3 m. Boles are slender and adscendent branches spread out in a flat-topped crown. Various hemiparasitic *Loranthaceae* are conspicious. Normally, lianas are only present on fire-protected stations, rocky sites and termites mounds. The herbaceous layer is generally sparse, with grasses up to 1.2 m high; it can disappear locally and replaced by patches of leaf-litter, especially during dry season.

From a phytosociological point of view, miombo vegetation is included in the order of *Julbernardio-Brachystegietalia spiciformis* Schmitz 1988. Alliances under which typical miombo associations described from central Africa were classified are:

- the *Berlinion-Marquesion* Lebrun and Gilbert 1954 [*Brachystegio-Marquesietum* Schmitz 1950, *Brachytegietum microphyllae* Schmitz (1954) 1963];

- the *Mesobrachystegion* Schmitz 1950 [*Combreto-Annonetum senegalensis Brachystegietosum wangermeeanae* Schmitz (1954) 1971, *Combreto-Annonetum senegalensis Brachystegietosum boehmii* Schmitz (1954) 1971];

- the *Xerobrachystegion* Schmitz 1950 [*Brachystegio-Monotetum katangensis* Schmitz 1954, *Brachystegio-Monotetum katangensis Brachystegietosum utilis* Schmitz 1954, *Uapaco-Brachystegietum boehmii* Schmitz (1954) 1963, *Bulbostylo-Brachystegietumstipulatae* Schmitz (1954) 1963, *Uapacio-Julbernardietum globiflorae* Reekmans 1981].

- Phenology and ecological spectra

The miombo are prevalent in freely drained stations, where the rooting environment is restricted. The most characteristic soils are leached and acid.

A phenological synthesis given by MALAISSE and MALAISSE-MOUSSET (1970) shows four defoliation phases corresponding to the rythm of seasons. The major defoliation occuring in dry weather (July-September) and the lowest in wet season (December-February) are separated by two transitional periods with medium values of litter-fall, 71% of which are constituted by leaves (fig.4). Strong attack by insects (*Elaphlorodes lactea* Gaede) in April can result in high consumption of leaves, i.e. 9.8g per m^2 (MALAISSE-MOUSSET et al. 1970). The annual total debris is about 3.7 t per ha. Similar results were obtained by REEKMANS (1982).

Ecological spectra established by MALAISSE and ANASTASSIOU-SOQUET (1983) confirm the results given by SCHMITZ (1971) and LEWALLE (1972), on the predominance of phanerophytes (fig. 5). Prickliness are the most evident mark of ecomorphoses (COLONVAL-ELENKOV et MALAISSE, F. 1975); most of species belong to microphyllus and mesophyllus classes of leaves dimensions, as far as RAUNKIAER's system is concerned. A great number of fruits are either fleshy or dry; their scattering is mainly due to Mammals and Birds, but autochory was also observed for many species.

- Phytogeography

Miombo are widespread in zambezian phytogeographical region [DUVIGNEAUD (1949), LEONARD (1953), SCHMITZ (1952, 1977)], but rather absent in Western Zambia, as well as in eastern Angola (WHITE 1986).

In Zaïre, this woodland type characterizes the Shabano-Zambezian sub-domain where it covered 84% of the Southern Shaba twenty years ago (MALAISSE 1973), with a species endemism rate of about 36.2% in the termitophilous flora (MALAISSE 1976). Therefore, termitalia distribution depending on their specific builders [ALONI (1975), ALONI and al. (1985, 1991)] is an important phytogeographical factor. The way the ground is turned over exercises tremendous influence on plants distribution. Miombo are also represented in the eastern Domain [GERMAIN 1952; LEBRUN and GILBERT (1954), LIBEN (1958), especially in the South-eastern Burundi: phytogeographycal District of Mosso-Malagasi [LEWALLE (1972), REEKMANS (1980, 1981)].

Ethnoecology

An interesting literature on the use of wild products by indigenous populations in the Shabano-zambezian region was written by LAMBRECHTS and BERNIER (1961), MALAISSE (1968,1991). About 500 different kinds of vascular plants, fungi, insects, fish and game were pointed out. Taxonomic study, nutritive value analyses and localization of wild eadible species were done. Woodland constitute the main source of a large part of these products, especially fungi which are abondant in miombo (Burundi, MALAISSE 1991). The capacity to supply food for people depending to a large extent on gathering and hunting in this ecosystem was estimated to less than one inhabitant/km^2.

Evolution

According to SCHMITZ (1974); SYMOENS and BINGEN-GATHY (1959), more or less intensive human action, for instance the use of firewood in copper metallurgy, was practiced in zambezian area as early as in the XVIth century. This exploitation opened 'savannisation' centers from which more and more population increased pression on forests [LOOTENS-DE MUYNCK et al. (1992), MALAISSE et al. (1980), MALAISSE et al. (1983)], not only by fire but also by clearing which was rising with recent systematic exploitation of mines, roads and railways impact as well as agriculture

and hardwood activities; dry period is said to be strengthened (MALAISSE 1974). The authors think that probably dry evergreen forests or deep soils transitional woodlands in highly wet areas resulted in miombo woodland, whose extension is seriously compromised by human impact particularly during these last decades.

Structure and floristical composition of nearly all the miombo on plateau have been modified and probably greatly simplified. Dry miombo growing on rocky sites with strong slopes have been preserved from cultivation. Secondary miombo can evolute towards evergreen forests or transitional woodlands.

3. DISCUSSION AND RECOMMENDATIONS

The content of English references on zaïrian miombo is not taken into account in this paper; it is the reason why some important aspects, for exemple trophic structure, basal area,..., are not outlined.

Systematic works available on miombo taxa have not been revised since their elaboration in the 40-50's. Thus, it would be necessary to bring regional flora up to date, as the basis of any investigations to be fulfil in projects concerning miombo.

The phytosociological synthesis of SCHMITZ (1988) attestes that botanical research has still much to do in synecology and syntaxonomy of woodlands in central Africa (Burundi, Rwanda and Zaïre).

Considering termitophilous flora, it has been emphasized that a great number of species have got so large ecological amplitude, that they are represented in miombo as well as in dense dry forests (Muhulu) or in hydromorphic sites (MALAISSE and ANASTASSIOU-SOQUET 1977). Such species are considered as transgressive indeed, although the same autors underlined that termitalia are certainly the most conspicious element in the miombo scenery. Therefore, why thermitophilous flora occuring in miombo is then constituted largely with widespread taxa, in spite of the high endemicity degree recognized for the Shabano-Zambezian Domain?

It is mentioned above that miombo is not well represented in the western part of zambezian regional center of endemism near the Karoo-Namib area. Similarly, the *Julbernadio-Brachystegietalia spiciformis* Schmitz 1988 is absent in the guineo-soudanian transitional zone, where the most dominant forests are those of the *Piptadenio-Celtidetalia* Lebrun and Gilbert 1954, borded by dry or sub-desertic vegetation of the sahelo-sahalian region. Maybe african deserts might excercise to some degree an influence on the miombo distribution, nevertheless the subject does not appear through the works mentioned in this paper. It seems that non-zonal factors, especially the difference of altitude between high zambezian plateaux and soudanian lands, with variability of ecological phenomena such as termitophily, mycorhizae, ..., relying upon them, would be worth examined in any tentative to explain such miombo distribution.

Performing Geographical Information System on miombo ecosystems in general and particularly in soudano-zambezian transitional zone (Burundi, Tanzania and Zaire), where woodlands typology and distribution were not quite clearly established, would be an important step towards the understanding of current dynamism of miombo and its importance in the mechanisms of climatic change in tropical Africa.

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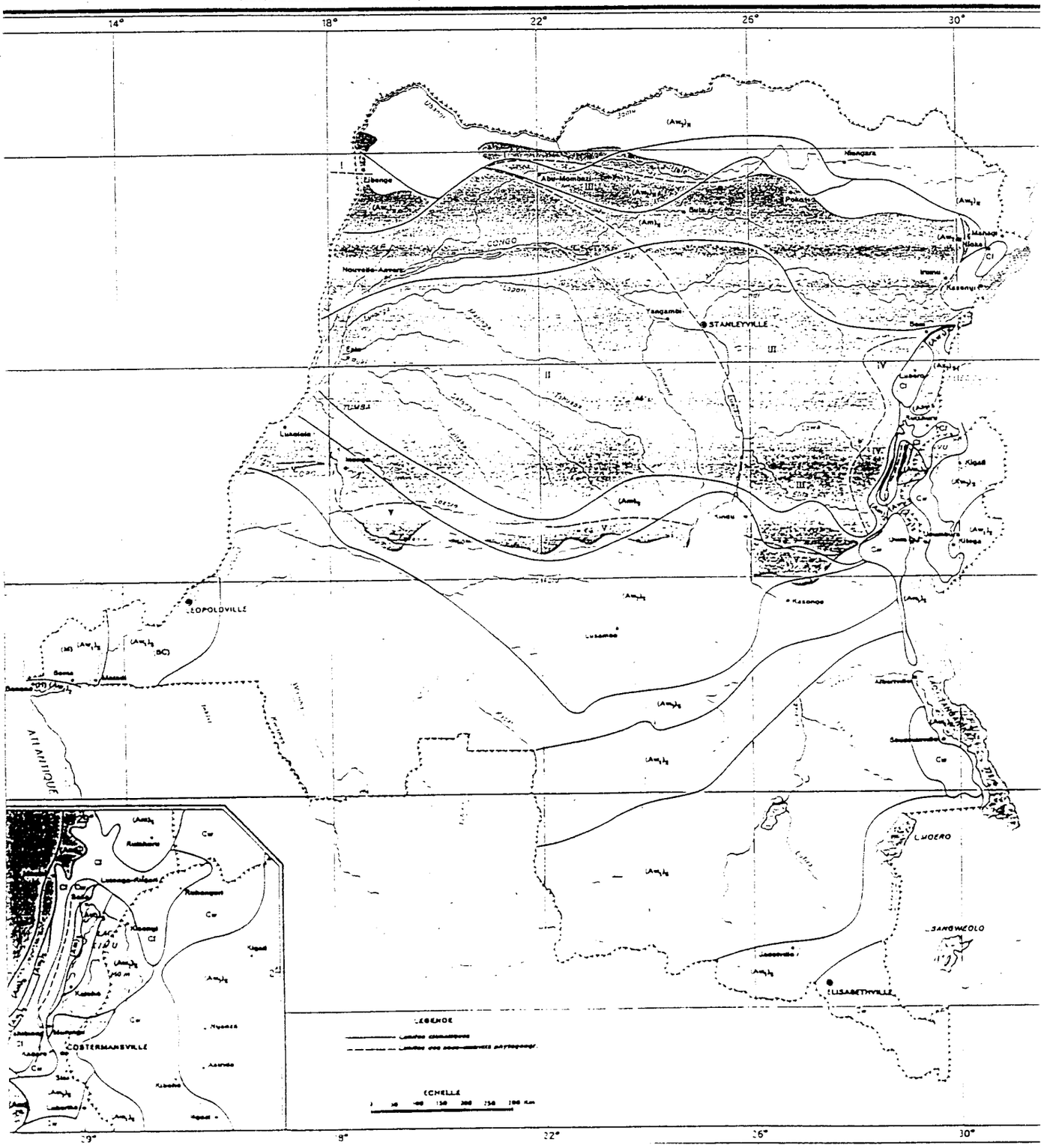
CARTE DES REGIONS CLIMATIQUES DU CONGO BELGE ETABLIE D'APRES LES CRITERES DE KÖPPEN.



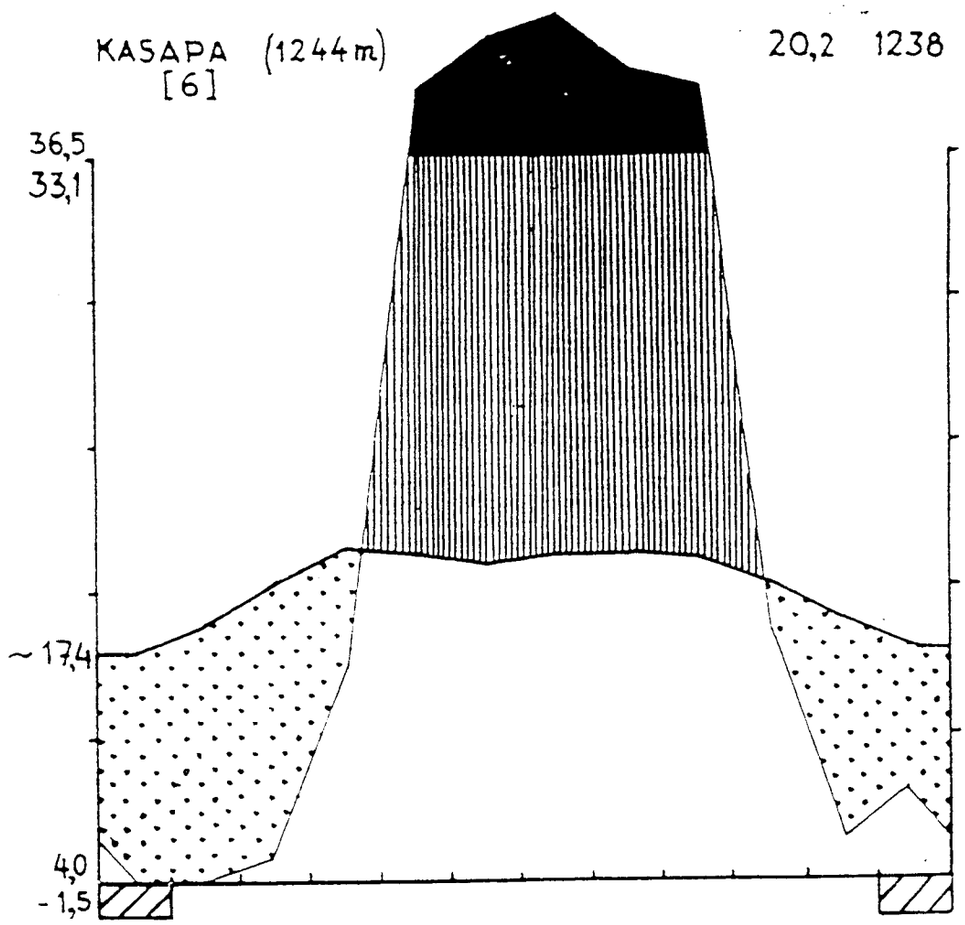


Fig. 2: Diagramme ombrothermique de la Kasapa, région à forêt claire (miombo)

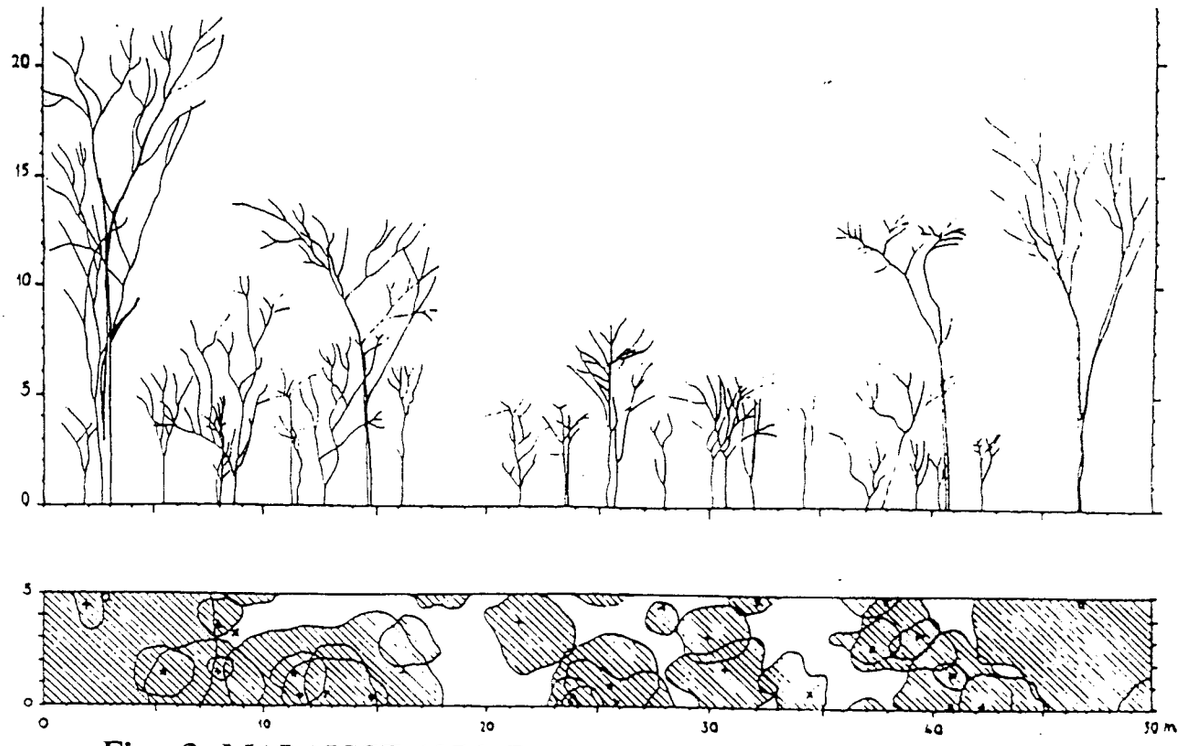


Fig. 3: MALAISSE 1976: Profil du "miombo" de la Kasapa

(o *Brachystegia boehmii*, + *Baphia bequaertii*, × *Diplorhynchus condylocarpon* subsp. *mossambicensis* var. *mossambicensis*, ᵀ *Swartzia madagascariensis*, ▲ *Afrormosia angolensis*, ► *Parinari curatellifolia* subsp. *mobola*, ● *Albizia antunesiana*, ▼ *A. adianthifolia*, ⊥ *Julbernardia paniculata*, ⊣ *Ochna schweinfurthiana*, ■ *Combretum molle*, ⊢ *Strychnos cocculoides*).

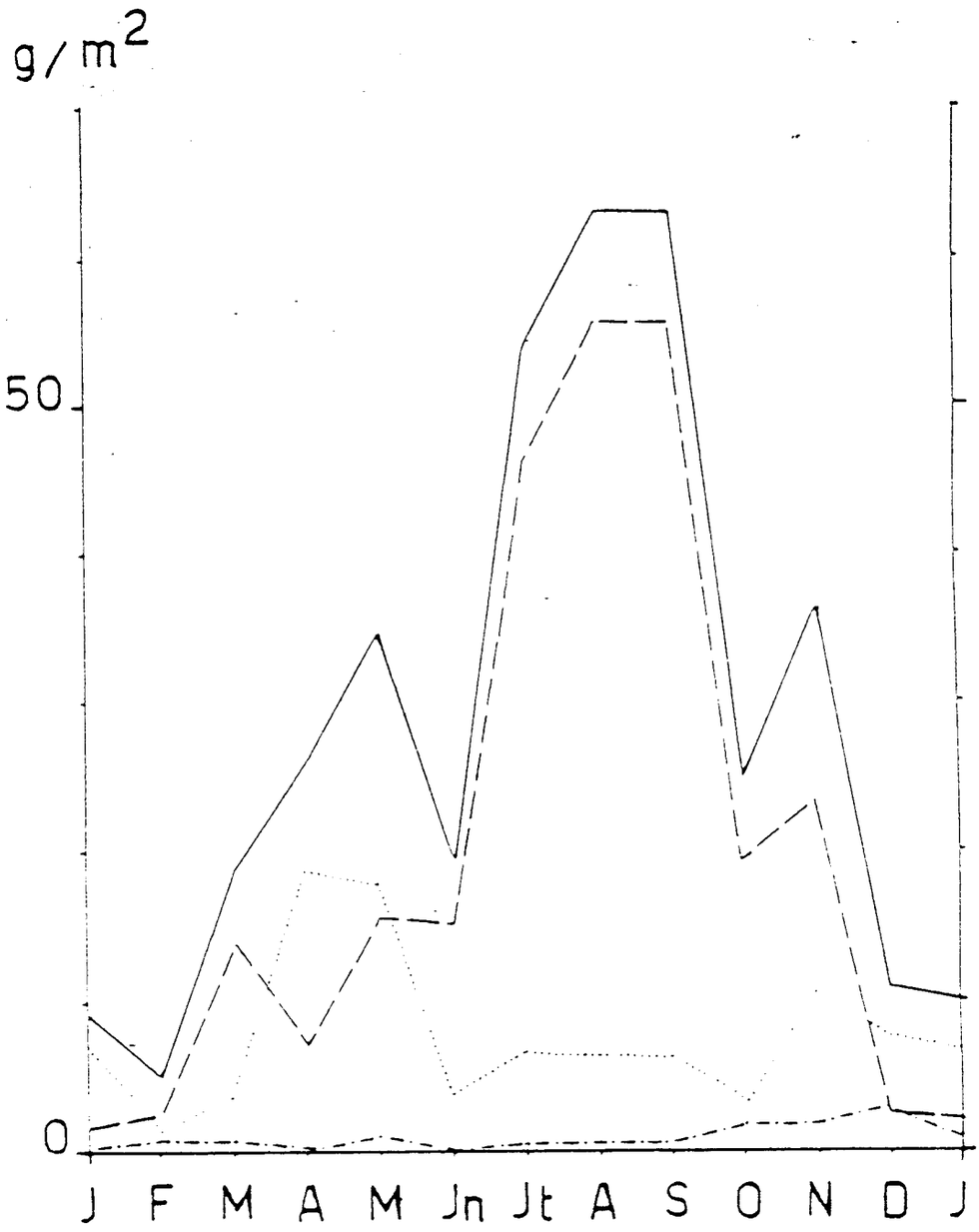


Fig. 4: MALAISSE et MALAISSE-MOUSSET (1970): Variations mensuelles du poids sec (g/m^2) de la litière dans le "miombo" de la Kasapa en 1968

(-------total, -- -- --feuilles, --.--.-- fleurs et fruits, ...rameaux)

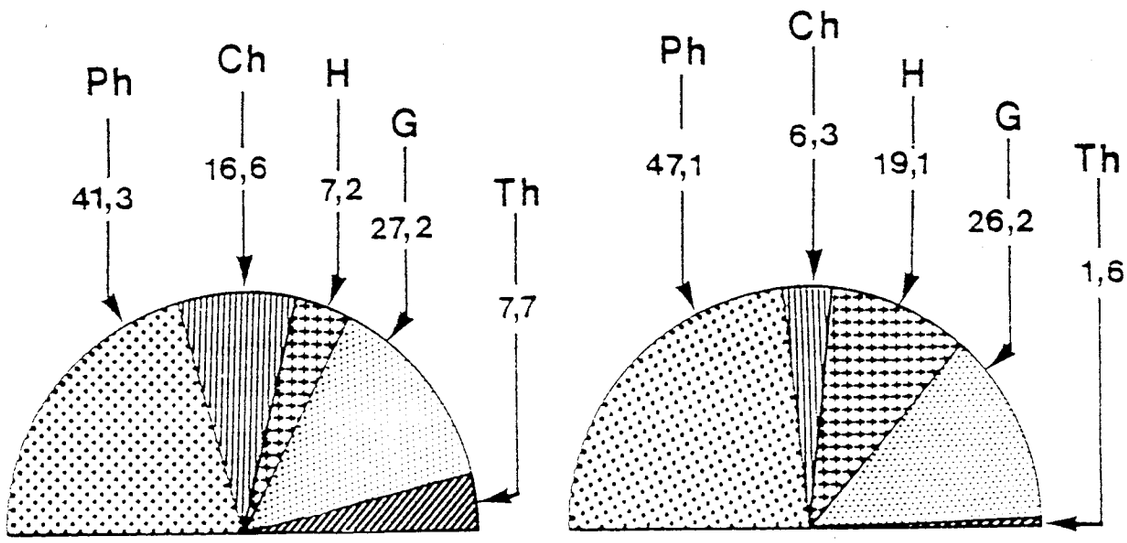


Fig. 5: SHMITZ (1971): Spectre biologique brut (gauche) et spectre pondéré (droite) du miombo