

Abstract Isolated savannas enclosed by forest are especially abundant in the eastern part of the Congolese Mayombe. They are about 3000 years old, and were more extensive some centuries ago. The boundary between forest and savanna is very abrupt, as a consequence of the numerous savanna fires lit by hunters. Floristic composition and vegetation structure data, organic carbon ratios, $\Delta^{14}\text{C}$ and $\delta^{13}\text{C}$ measurements presented here show that forest is spreading over savanna at the present time and suggest that the rate of forest encroachment is currently between 14 and 75 m per century, and more probably about 20–50 m per century. As most savannas are less than 1 km across, such rates mean, assuming there are no changes in environmental conditions, that enclosed savannas could completely disappear in the Mayombe in about 1000–2000 years.

Key words Congo · Forest-savanna dynamics · ^{13}C natural abundance · Forest encroachment · Pioneer trees

Introduction

All over the African equatorial forest, but especially in the Congolese Mayombe, forest cover encloses some isolated savannas. It is widely held that the enclosed savannas of the Mayombe are recent anthropic savannas. This hypothesis has been supported only by the fact that these savannas were densely occupied by villages at the beginning of the twentieth century (Vennetier 1968; Cusset 1989; Gibert and Sénéchal 1989; Petit 1990). As demonstrated by Foresta (1990), savanna formation due to man's activities may be, in the Mayombe, unfounded.

D. Schwartz (✉)¹ · H. de Foresta² · J.P. Massimba
ORSTOM, B.P. 1286, Pointe Noire, Congo

A. Mariotti · J. Balesdent · C. Girardin
Université P. et M. Curie – INRA, Biogéochimie Isotopique,
Case n° 120, 4 Place Jussieu, F-75252 Paris 5, France

Present addresses:

¹ CEREG, 3 rue de l'Argonne, F-67083 Strasbourg, France
² ICRAF, P.O. Box 161, Bogor 16001, Indonesia

Despite the availability of efficient tools such as the chain saw, the development of commercial agriculture, and the fact that vegetation in the most inhabited areas testifies to an important forest degradation resulting from repeated agricultural clearing and that villages are located in the less humid areas of the Mayombe, savanna formation can never be observed. Data collected suggest that these savannas have a palaeoclimatic origin (Foresta 1990; Schwartz et al. 1990b), that they could be 3000 years old and were more extensive during past centuries. Moreover, archaeological data suggest that they were previously found as far as the Les Saras area, which is currently purely forested (Schwartz et al. 1990a). This evidence suggests that forest is at present encroaching onto savanna. Botanical observations, both floristic and structural, agree with this hypothesis (Massimba 1987; Foresta 1990), but this approach is only qualitative. To provide more conclusive evidence, other approaches have to be used, such as determination of the mean residence time (MRT) of soil organic matter (SOM) by ^{14}C dating combined with an isotopic (^{13}C) characterization of vegetation change recorded in SOM. This paper presents the results from a combined botanical and SOM approach along two forest-enclosed savanna sequences, as a means to understand the present dynamics of the vegetation in the Congolese Mayombe.

Materials and methods

Study sites

The location of the observations is shown in Figs. 1 and 2. The Mayombe is a mountain extending from Gabon to Zaïre parallel to the coastline. In the Congo, the highest crests culminate at about 900 m. The rainfall increases from the west (1200 mm/year) to the highest crests (1980 mm/year) and then decreases down to Loubomo (1160 mm/year). Rain falls from October until May. Mists and drizzles are abundant during the dry season, and contribute to the retention of some moisture in soils. The number of hours of sunshine is small, especially during the dry season: less than 1000 h/year at Dimonika (Clairac et al. 1989). This dry, fresh and cloudy weather explains the presence of rain-forest in the less humid areas. The soils of the Mayombe are ferralic cambisols (FAO