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Evaluation of floristic and structural diversities of the fallow of the National Centre of Floristic

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Abstract

The flora and the vegetation of the fallow of the National Centre of Floristic (NCF) were analyzed 14 years after first inventory was carried out in 1995. The objective of this study was to evaluate the evolution of the flora and the vegetation of the fallow of the NCF. Thus, the fallow was divided into 4 layers representing each one with homogeneous plot. The methodology of inventory adopted is the combination of the linear method described by Gautier et al. (1994) and the way-walking inventory. The study of the vegetation was carried out by vertical and horizontal profiles. The results indicated that this fallow is rich of 162 plant species gathered in 138 genera and 60 families. Among these species more than 80% are Phanerophytes. The structure of the vegetation differs according to the localization of the plot. The observations made it possible to affirm that the fallow of the NCF is still young in a state of regeneration with a regular distribution of species and a small proportion of individuals of the layer V. The comparison of these results, to those of Boraud (1995) showed that fallow in its undisturbed parts evolves to a secondary forest and the fallow is enriched with new species.

Keywords: Flora, vegetation, fallow, dynamic, National Centre of Floristic, Ivory Coast.

INTRODUCTION

The National Centre of Floristic is a structure of research of the University of Cocody-Abidjan located on the site of the former botanical garden created in 1964 for cultivation of decorative plants intended for the embellishment of the University. A role of an Institution of ex-situ conservation of the biodiversity and support to teaching and research were allotted at its creation in 1973 (Dibi et al., 2009). To enable it to achieve this mission, two complementary entities were set up according to the two principal modes of conservation of floristic diversity: dead conservation represented by the national herbarium of Ivory Coast and the live conservation which is done within an arboretum and a fallow. This fallow is an important scientific and teaching instrument which should be allowed among other things to understand at small scales, the evolution of flora and vegetation of the surroundings of dense forests from which it resulted to the various successions. Indeed, the vegetation of the fallow of the National Centre of Floristic was reconstituted after a complete destruction of the original vegetation cover with the construction of the University. The constant evaluation of its flora and its vegetation thus becomes necessary to help determine the mode of reconstitution of the forest vegetations. Therefore, Boraud (1995) reported it 30 years after creation. The results of this first study showed evidence of an evolution towards a forest. This present work was carried out 15 years after the aim to determine the characteristics of the flora and the vegetation

of this fallow after approximately half-century of installation and to determine its evolution dynamics. More precisely, we evaluated the floristic and structural diversities of the fallow of the National centre of Floristic after 45 years of existence.

MATERIALS AND METHODS

Study area

The NCF is located on the land field of the University of Cocody-Abidjan, between 5°20' 45" and 5°20' 58" of Northern latitude and 3°59' 6" and 3°58' 53" of Western longitude. The field of the National Centre of Floristic is under the influence of a subequatorial climate characterized by a great dry season from December to February, a great rainy season from March to July with a peak of precipitations in June, followed by small dry season from August to September and a small rainy season which extends from October to November (Brou, 2010). The temperatures revealed a hot long period going from January to May and a period of freshness going from June to September. This climatic variation is due to the influence of the Atlantic ocean (Belem, 1988). The soil is primarily ferralitic and desaturated with a content of organic matter which is rather poor (Perraud, 1971). The vegetation is ‹‹*Turraeantho-heisterietum*›› type covering all Abidjan regions (Mangenot, 1955).

Data collection

Characterization of the flora and the vegetation

This inventory was carried out using 2 methods: itinerant censuses for assessing species richness and the method of linear inventory (Gautier et al., 1994) for describing the vegetation structure.

Flora characterization

For a more efficient exploration, we divided the fallow into 4 sectors according to the various human activities and the topography. Sector 1 is a plot which currently shelters various tests; sector 2 is a plot which has received experiments 15 years ago; sector 3 is an undisturbed plot localized on top of a slope and finally sector 4 which is an undisturbed plot on the slope. In the succession, plot 1 is youngest successively followed by plots 2, 3 and 4. For the inventory, each plot was crossed while following internal tailboards or when missing small tracks traced in the underwood. Each species was given the biological and the morphological type. Thus, the flora was characterized by the determination of the floristic richness (species number, genera number, families' number, generic index of diversity) and averages of bio-morphologic types.

Vegetation characterization

The structural profile of the vegetation was made up with the linear method (Gautier et al., 1994) and has the advantage of presenting the distribution of the plant species in a plan (Kouamé, 1998). Therefore, in each piece (sector), we traced 1 transect of 4 in general. The method consists of tending horizontally with a short-nap cloth of the ground, a graduated ribbon of 200 m (Chatelain, 1996; Bakayoko, 1999). From this device, 100 measurements are made using an 8 m height stake vertically placed with intervals of two meters. Measurements consist of registering the names of the species in contact with the vertical stake and these contacts height. Beyond 8 m, measurements are made by simple estimations. For each plant, we took into account the names of the species as well as the lower and higher contact. A five level-scale of height was used (Layer I, from 0 to 5 m; layer II, from 5 to 10 m; layer III, from 10 to 15 m; layer IV, from 15 to 20 m; layer V, more than 20 m). For each sector, the average of contacts that represents the vegetation cover was calculated per layer and shown on histograms.

Data analyses

Each met species were given its biological and morphological type. Thus the flora was characterized by the determination of the floristic richness (number of species, genera, families, generic index of diversity) and biological types. The results are related to tables and histogram. Formulate calculation of generic diversity (Touré et al., 2008):

$$Dg = \frac{Nbs}{Nbg}$$

Dg is a generic index of diversity; Nbs is the number of species and Nbg the number of genera.

A profile of the vegetation was also presented in the results of the horizontal and vertical observations. Covering can be calculated separately for each interval height by the following formula (Menzies, 2000):

$$C = \frac{\text{Number of points on the line of transect on which a species is present}}{\text{Total number of points on the transect}}$$

C is a covering.

For the vertical profile, the heights measured on the ground along the linear sample allowed the visualization of the vegetation on a vertical plan. All the contact points with the vegetation are represented on a graph with the length of the line on the ground in X-coordinate, and the height of contact in coordinate with the EXCEL software. Thus, we obtain a visual representation of the distribution of the vegetation.

RESULTS

Characteristics of the flora

One hundred and sixty two (162) species were inventoried including 131 Dicotyledons, 29 Monocotyledons and 2 Pteridophytes. The results of flora characteristics are shown in the Tables 1 and 2. In Table 1, we have a taxonomic description and some ecological information (Pioneer species; Forest species), etc. Table 2 indicated for each biological type, the number of

Table 1. Floristic parameters.

Floristic parameter	Number
Species number	162
Genera number	138
Generic index	1,17
Families number	60
Monocotyledons species	29
Dicotyledons species	131
Fern species	2
Pioneer species	62
Forest species	86
Introduced species	1
Timber species	10

Table 2. Biologic types.

Biologic type	Number
Hemicryptophytes	5
Therophytes	3
Chamephytes	5
Epiphytes	2
Geophytes	10
Phanerophytes	140

species. In this flora we have 15 lianas species trees and shrubs. The pioneer species number is 61. The value of the generic index of the fallow is 1.18. The forecast is a good diversity of this forest.

Vegetation

Figure 1 gives the result of the observations on the vertical structure of the vegetation marked by coverings of the layers. This structure differs according to the sector. With the exception of very disturbed sector 1, five layers are met on the three others. However, there exist a difference in the proportion of the vegetation covering of the layers according to the sector. When one considers the three sectors in this moment of fallow, we notice that coverings of layer I are in decreasing proportion of the youngest fallow (sector 2) to oldest (sector 4). Contrary, coverings of the highest layers are larger to the pieces best preserved (sector 4). Layer V is even absent in sector 1 which is still very disturbed. The observation of profile vegetation (Figures 2, 3, 4 and 5) gives the same results. The underwood is denser on sector 2.

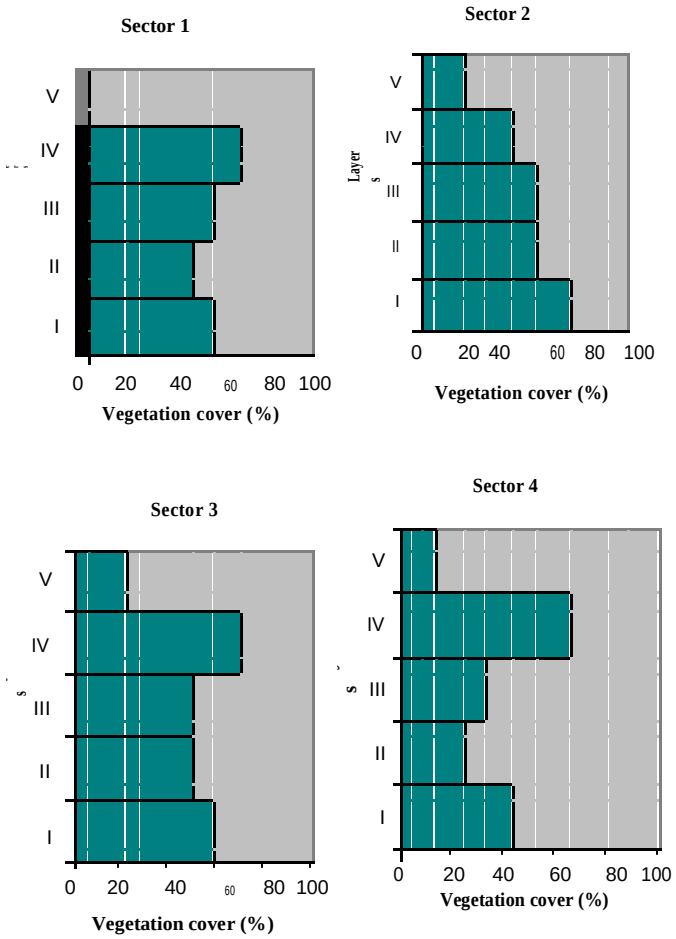

Figure 1. Histograms of the vegetation types cover in the fallow of the National Centre of Floristic.

DISCUSSION

A first study of the characterization of the flora (Table 3) was carried out by Boraud (1995) generally showed on all levels of comparison, less diversification compared with the results obtained during this current work. This increasing plant richness of the fallow of the National Centre of Floristic since 1995 was explained by the fact that some species existed in the form of potential flora (seeds) could germinate and develop vegetation. This phenomenon was observed in the forests constitution during the first year of fallow, the number of species grows generally (Huttel, 1977; Barima et al., 2010). It was also noticed that Dicotyledons (132 in 1995 compared with 147 in 2009) as at Monocotyledons whose number passed from 20 to 29. It should be observed that the numbers of Ferns did not vary, so what one can say for that? The pioneer species passed from 20 listed in 1995 to 61 species in 2009. They are abundant especially in sample 1 that shelters experimental tests currently in

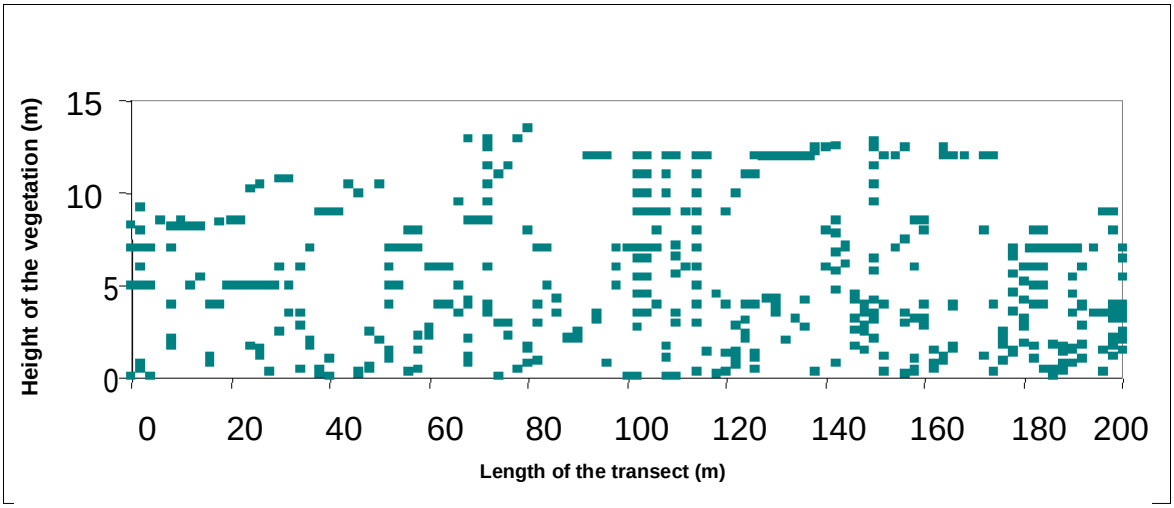

Figure 2. Structural profile of the vegetation of the sector 1 of the fallow of the National Centre of Floristic.

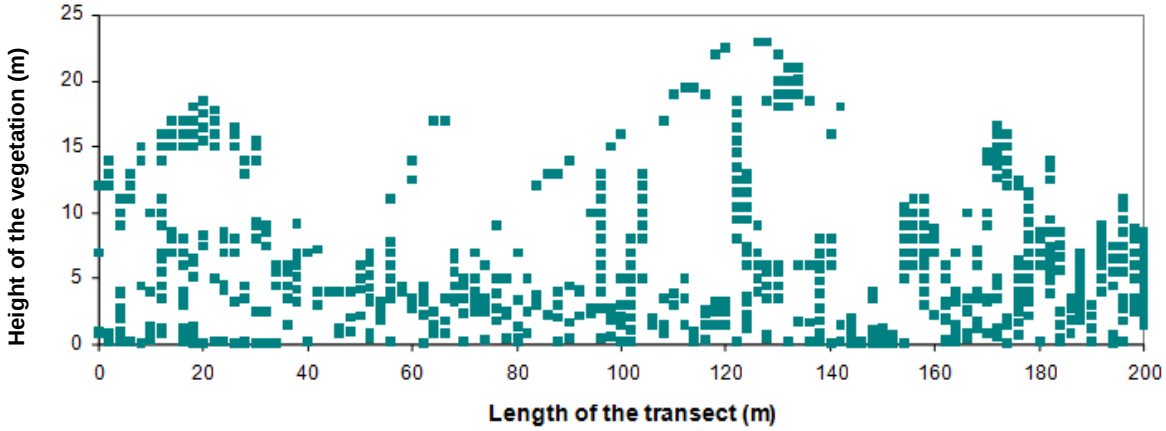

Figure 3. Structural profile of the vegetation of the sector 2 of the fallow of the National Centre of Floristic.

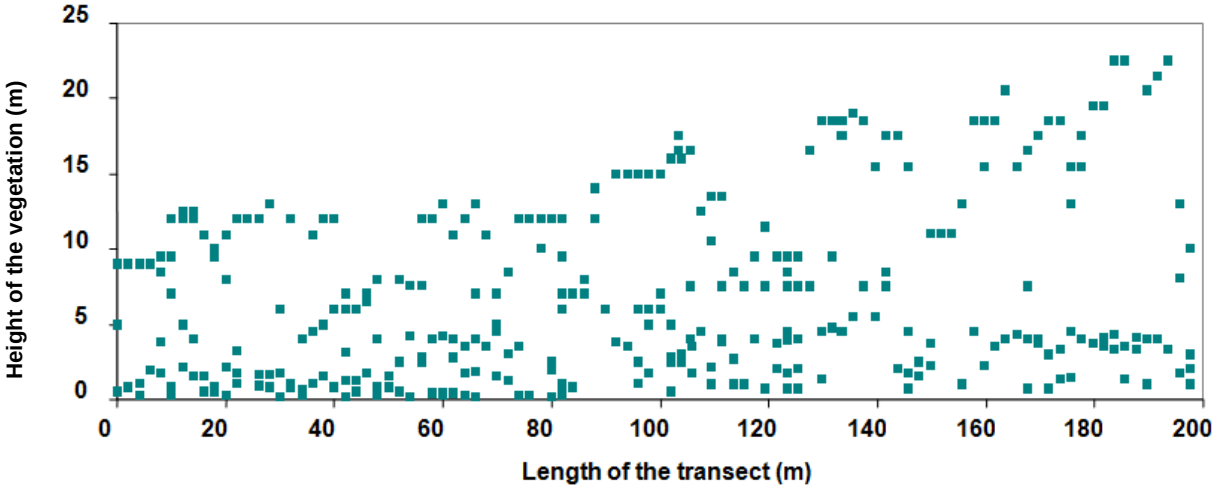

Figure 4. Structural profile of the vegetation of the sector 3 of the fallow of the National Centre of Floristic.

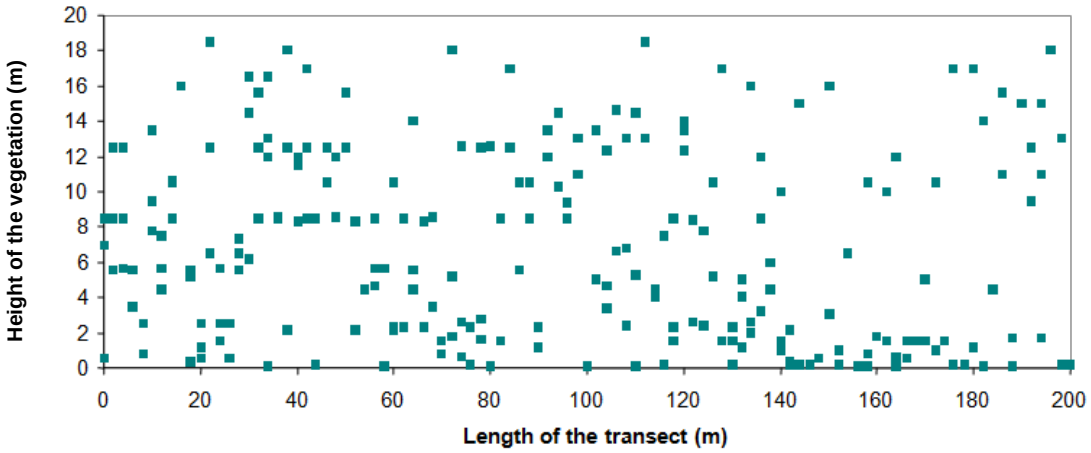

Figure 5. Structural profile of the vegetation of the sector 4 of the fallow of the National Centre of Floristic.

Table 3. Caractéristique de la flore de la jachère du CNF en 1995.

Floristic parameter	Number
Species number	147
Genera number	131
Generic index	1,12
Families number	35
Monocotyledons species	20
Dicotyledons species	125
Fern species	2
Pioneer species	20
Forest species	116
Introduced species	11
Timber species	10

hand. It is a sparse environment where several light-demanding species grow. Indeed, the solar rays that fully reach the ground maintain seminal potential and support their germination. The introduced species practically disappeared to make place for more competitive local species. The introduced species identified are in majority food plants [*Musa paradisiaca* L. (Musaceae), *Persea americana* Mill. (Lauraceae), *Colocasia esculenta* (L.) Schott. (Araceae), *Ananas comosus* (L.) Merr. (Bromeliaceae)] or medicinal plants in plot 2. It was a plot of cultivation of plants for various uses and to provide samples of plants for practical works. An example of medicinal plant is *Ocimum gratissimum* L.

Generally, from the youngest to the oldest plots, the variation of the vegetation structure indicated that we should be inclined towards a reconstitution of the forest. Specific characteristics to the forests of Côte d'Ivoire (Kouamé, 1998; Bakayoko et al., 2002) are observed on plots 3 and 4 which are best preserved. Euphorbiaceae, Rubiaceae and Apocynaceae families have the greatest number of species. Furthermore, we also notice the predominance of Phanerophytes, thus, the fallow continues its evolution towards a wet forest. The proportion of woody Phanerophytes which is obtained here (80 to 90% of the species) corresponds to the species of these forest types (Mangenot, 1955). The fallow counts more trees and shrubs than lianas and grass. The proportions of trees and shrubs than lianas and grass found that the fallow is very close to those of wet Equatorial forests (Mangenot, 1955). The reduction in the density of covering of layer I also indicates an evolution towards a secondary forest. Classically, when the age of the fallow increases, the number of woody species also increases (Walker, 1971; Walker and Noy-

Meir, 1982; Knoop and Walker, 1985). However, the layer V is still characterized by very low densities of covering even though a big number of Mega-phanerophytes were listed. However, even if the fallow tends towards the original forest, Mega-phanerophytes met have not yet reached their maximum size (Aweto, 1981).

Conclusion

The flora of the fallow of the National Centre of Floristic is rich of 162 species gathered in 138 genera and 60 families. It is primarily made up of Phanerophytes with a considerable proportion of lianas. Qualitatively, the fallow is richer in Euphorbiaceae, Rubiaceae and Apocynaceae families. The floristic diversification of this forest is mainly indicated by the low value of its index of generic diversity. This great diversification is supported by the wet climate of the NCF. The species met belong to all the biological forms. The various parts of this forest grow rich considerably in new species. The structure and the profile of the vegetation of sector 4 (The best preserve part of the fallow), compared to sector 1 for example, showed that the fallow evolves to a secondary forest. With the exception of sector 1, the five layers that mark the secondary and the primary forests are present in the other three. This conformation forecasts of a strong tendency to the reconstitution of the vegetation.

In general, the vegetation of the fallow of the National Centre of Floristic tends towards a forest and could be used as academic case in our country and elsewhere in the tropics where forests are in constant disappearance. For the full realization of this objective, this work deserves to be continued by taking into account other parameters such as; density of settlement, burrow surface and to evaluate the numbers of species with commercial value existing in the fallow.

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