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Contributive to the floristic study of the Partial Natural Reserve of Dahliafleur located in the Department of Bingerville, in southern Côte d'Ivoire

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ABSTRACT: In Côte d'Ivoire, the problem of forest sustainability has led to studies on their dynamics being undertaken in recent years. The Dahliafleur Nature Reserve, located in the commune of Bingerville is part of the Ivorian urban forests. Unfortunately, it is very little known in its floristic diversity, let alone its vegetation. The surface surveys supplemented by the mobile survey made it possible to identify 135 species throughout the forest. These species are divided into 110 genera and 53 families. The most represented families in these three zones are respectively for the North, South and East zones, the Fabaceae, the Apocynaceae and the Araceae. The analysis of the chorological spectrum of all the species identified highlights five types of chorological affinities. The species with the strongest I.V.I. are (in descending order) Tabernaemontana crassa, Ceiba pentandra, Senna siamea, Acacia mangium, and Nesogordonia papaverifera. A comparison of the different plots in two by two reveals a rather weak similarity.

KEYWORDS: Côte d'Ivoire, Dahliafleur, Nature Reserve, floristic diversity, chorological.

1 INTRODUCTION

More than half of the world's population has been living in cities since 2007. These cities are nowadays home to a relatively high number of plant formations that are either planted or natural [1]. These formations known as urban forests [2,3] offer a multiplicity of services, in particular ecosystem services, thus promoting savings on health care [4,5]. Unfortunately, these spaces are subject to various pressures, namely the construction of buildings.

In Côte d'Ivoire, the high demand for land means that priority is given to housing and infrastructure to the detriment of urban forests [6], due to a lack of knowledge of the ecosystem services they offer, particularly carbon immobilization. The problem of the sustainability of these forests has led to conducting, for some years, studies on their dynamics. However, it is easy to see that their dynamics have been little followed [7]. The Dahliafleur Nature Reserve, located in the town of Bingerville, is part of the Ivorian urban forests. Unfortunately, it is very little known in its floristic diversity, even less for its vegetation. According to [8] since its creation in 2001, the Reserve has benefited from few in-depth studies of its biological diversity [9]. It is therefore necessary to know the potential of these urban forests in the context of climate change. The general objective of this study is to deepen our knowledge of forest conservation in the context of climate change. Specifically, it will be concerned with evaluating the plant diversity in this Nature Reserve.

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2 MATERIAL AND METHODS

2.1 STUDY SITE

The Dahliafleur Partial Nature Reserve (RNPDF) is located in the southern part of the municipality of Bingerville, itself located in the east of the Autonomous District of Abidjan, which is in the south of Côte d'Ivoire [10] (Konan et al., 2021). Approximately located between 3° 54' 25" and 3° 55' 24" West longitudes and 5° 21' 57" and 5° 22' 23" North latitudes, this 148-hectare Reserve is bounded to the North by the villages "Carrière I and II" and to the East by the Ebrié Lagoon [11] (Monssou, 2018). To the south and west, it is bordered by various residential districts (Figure).

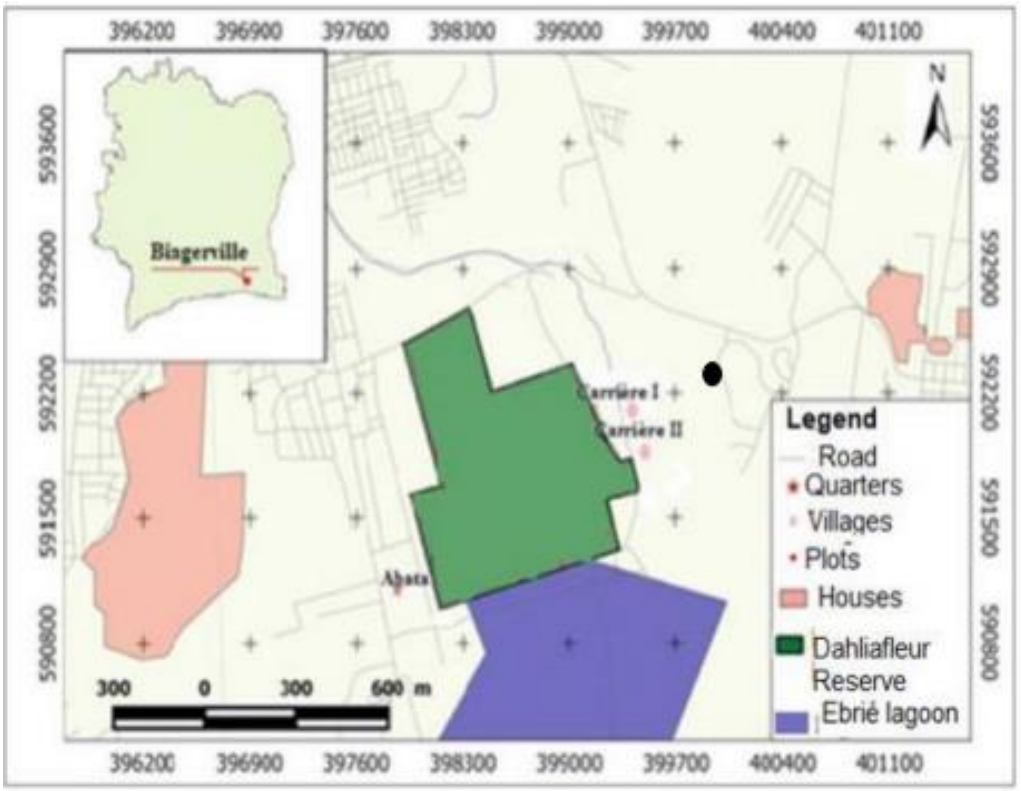

Fig. 1. Location map of the Dahliafleur Partial Nature Reserve

2.2 DATA COLLECTION

In this study, the surface survey consisted of delineating 400 m^2 (20 m x 20 m) square plots in three selected areas. The Dahliafleur Partial Nature Reserve (RNPDF) is located in the southern part of the municipality of Bingerville, itself located in the east of the Autonomous District of Abidjan, which is in the south of Côte d'Ivoire [10]. On each plot, the circumferences of all woody species (shrubs and trees) with a DBH (diameter at breast height) ≥ 5 cm were measured at 1.30 m above the ground and noted. A tree can be made up of several strands, these are counted separately if the separation is below 1.30 m from the ground [12]. To these surface surveys, was associated the itinerant survey which made it possible to note all the species not encountered in the inventory plots.

2.3 FLORISTIC ANALYSIS METHODS

2.3.1 SHANNON DIVERSITY INDEX

Shannon's (1949) diversity index [13] was used to assess species diversity. It is commonly used in studies of Ivorian forests to assess the heterogeneity and diversity of a biotope [14]. This index is calculated using the following formula:

$$H' = -\sum (Ni/N) \ln (Ni/N)$$

In this formula, H is the Shannon index; Ni is the number of individuals of species i and N is the total number of individuals of all species. The limiting values of this index are 0 and ln S, with ln S rarely exceeding [15].

2.3.2 PIÉLOU EQUITABILITY INDEX

The index of [16] highlights the level of equilibrium of the different zones studied. It is calculated as follows:

$$E = H' / \ln S$$

In this formula, E is the equitability index, H is the Shannon diversity index and S is the total number of species. This index, which varies from 0 to 1, is used to assess the distribution of individuals between species on the plots. Indeed, when it tends to 0, it describes a phenomenon of dominance of one species over the others. If E tends to 1, the distribution of individuals between species is regular.

2.3.3 INDEX OF SPECIES IMPORTANCE VALUES

The estimation of the tree plant species diversity was done using the Importance Value Index [17]. This index highlights the most important species. It is the sum of three factors (relative dominance, relative density and finally relative frequency). It is expressed as a percentage [18]. For each species, these factors are calculated as follows:

$$\textbf{Relative frequency (a)} = \frac{\text{Number of species occurrences (a)}}{\text{Sums of occurrences of all species}} \times 100$$

$$\textbf{Relative density (a)} = \frac{\text{Number of individuals of the species (a)}}{\text{Total number of individuals}} \times 100$$

$$\textbf{Relative dominance (a)} = \frac{\text{Basal area of the species (a)}}{\text{Sum of basal areas of all species}} \times 100$$

2.3.4 FAMILIES IMPORTANCE VALUES INDICES

The family importance value index (V.I.F.) enables us to assess the diversity of a family (f) and its importance in relation to other families [19]. It provides information on the floristic importance of each family in terms of the number of individuals in the family, the number of species representing the family, and the quantitative importance of families in terms of their basal areas (or land areas). Its formula is given by [20].

$$\textbf{Relative dominance (f)} = \frac{\text{Sums of the basal areas of the individuals in the family (f)}}{\text{Sums of basal areas of individuals in all families}} \times 100$$

$$\textbf{Relative diversity (f)} = \frac{\text{Number of species in the family (f)}}{\text{Total number of species in the family (f)}} \times 100$$

$$\textbf{Relative density (f)} = \frac{\text{Number of individuals in the family (f)}}{\text{Total number of individuals}} \times 100s$$

2.4 DATA ANALYSIS METHODS

Anova comparison tests were used to compare the average number of species.

3 RESULTS

3.1 FLORISTIC RICHNESS AND DIVERSITY

The surface surveys supplemented by the itinerant survey made it possible to identify 135 species throughout the forest. These species are divided into 110 genera and 53 families. The analysis of this table 1 indicates that the northern zone contains 61 species, 54 genera and 33 families. The central one has 68 species, 57 genera and 31 families. Finally, in the southern zone there are 63 species, 58 genera and 29 families. The comparison of the floristic richness shows that the differences between the average number of species are not significant. Considering the different zones, the value of the Shannon index does not vary considerably from one type of habitat to another. Indeed for the northern, central and southern zones the value of the Shannon index is respectively: 4.55, 4.01 and 4.04. The value of the Shannon index for all plots inventoried is 4.6. Regarding the Piélou equitability index, it has a value of 0.75, 0.89 and 0.9, respectively for the northern, central and southern zones.

The families most represented in these three zones are, respectively for the North, South and Center zones, the Fabaceae, with respective rates of 15%, 17% and of 14%, the Apocynaceae, with rates of 13%, 8% and 8%, and the Araceae, with rates of 6%, 12% and 8% (Figure 2).

Table 1. Comparison of the three RNDF zones

Zones	North	Center	South
Number of scpecies	61	68	63
Number of genera	54	57	58
Number of families	33	31	29
Shannon Index	4.55	4.01	4.04
Equitability Index	0.75	0.89	0.9
Specific richness	20.77 ± 5.5 a	20.44±3.36 a	21.25±5.8 a

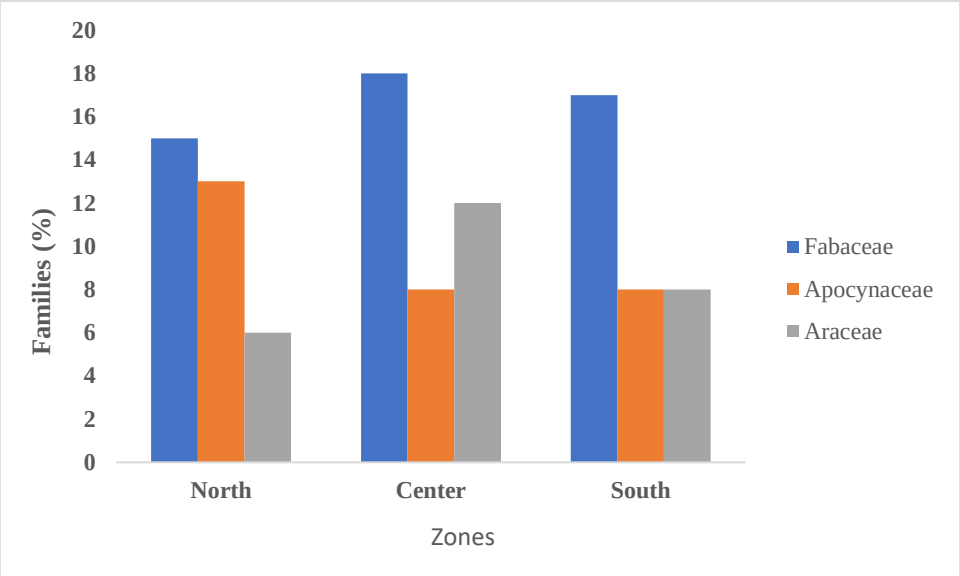

Fig. 2. Family spectrum of the three RBDF zones

The analysis of the chorological spectrum of all the species identified highlights five types of chorological affinities, namely the species GC, GC-SZ, GCW, GCi and i (Figure 4). The most representative are the species of the Guineo-Congolese region (GC) with 62%. They are followed by species from the savannah-forest transition zone (GC-SZ) with 16%. Endemic species of the forest block west of Togo, including Ghana, Ivory Coast, Liberia, Sierra Leone, Guinea Bissau, Gambia and Senegal (GCW) with 10%. Finally come the introduced species and the species endemic to Côte d'Ivoire which have respectively 8 and 2%.

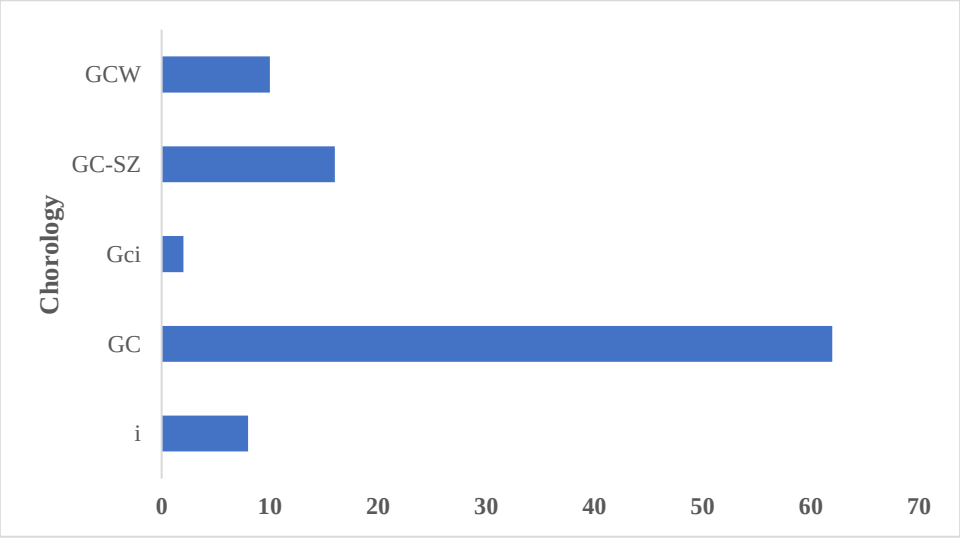

Fig. 3. Chorological Spectrum of Species

3.2 IMPORTANCE OF SPECIES AND FAMILIES

To appreciate the place of a species in relation to all the other species, we have calculated the I.V.I (Table 2). The species with the strongest I.V.Is are (in descending order) *Tabernaemontana crassa, Ceiba pentandra, Senna siamea, Acacia mangium, and Nesogordonia papaverifera*. These species, which are very abundant on our plots, constitute most of the large-diameter individuals.

Table 2. Importance values of the species of the three zones (North Center and South) of the RNDF

SPECIES	Relative frequency	Relative density	Relative dominance	IVI
Tabernaemontana crassa	10.27	14.29	11	35.56
Ceiba pentandra	6.09	2.17	22.2	30.46
Senna siamea	4.43	13.12	10.73	28.28
Acacia mangium	6.09	12.71	8.28	27.08
Nesogordonia papaverifera	4.43	1.86	13.98	20.27
Funtumia africana	4.43	9.62	4.01	18.06
Psychotria ivorensis	4.43	5.16	4.53	14.11
Spondias mombin	4.43	4.81	3.06	12.31
Ficus exasperata	4.43	5.43	2.4	12.26
Terminalia mantaly	4.43	2.86	4.7	11.99
Senna siamea	6.67	2.17	3.06	11.9
Eugenia jambos	6.67	3.62	0.46	10.75
Albizia adianthifolia	3.87	2.17	4.65	10.69
Allophylus africanus	6.67	3.62	0.16	10.44
Blighia sapida	4.43	3.26	2.62	10.31
Baphia nitida	4.43	2.43	1.87	8.72
Cola caricifolia	2.76	2.86	0.81	6.42
Rauvolfia vomitoria	2.76	2.63	0.69	6.08
Parkia bicolor	2.76	2.63	0.42	5.81
Anthonotha macrophylla	2.76	1.28	0.28	4.33
Newbouldia laevis	2.76	1.28	0.2	4.25
Total	100	100	100	300

Families who have a V.I.F. high in Table 3 are, in descending order, Fabaceae (59.99), Apocynaceae (49.66), Bombacaceae (36.14), Moraceae (30.23) and Rubiaceae (27.18). These are the most representative families of the plot.

Table 3. Importance values of RNDF families

FAMILIES	Relative dominance	Relative diversity	Relative density	VIF
Fabaceae	27.81	8.5	23.68	59.99
Apocynaceae	12.17	8.5	28.99	49.66
Bombacaceae	24.48	9.5	2.17	36.14
Moraceae	12.3	9.5	8.43	30.23
Rubiaceae	4.53	9.5	13.16	27.18
Combretaceae	13.53	8.5	2.86	24.89
Sapindaceae	1.4	9.5	6.52	17.41
Anacardiaceae	3.06	8.5	5.71	17.27
Myrtaceae	0.46	9.5	4.12	14.08
Bignoniaceae	0.2	9.5	2.17	11.87
Malvaceae	0.07	9.5	2.17	11.74
Total	100	100	100	300

3.3 FLORISTIC SIMILARITY OF THE ZONES

According to figure 5, the comparison of the different plots taken in twos, reveals a rather weak similarity. The species composition varies from one plot to another. By considering a similarity less than 0, two groups can be obtained with the isolation of the statement F. We have group 1 which is made up of the DF, DC, DA, FR, E and SAM. We distinguish group 2. This

group is made up of the PC1, PN1, DB, SUD and PC2. The F statement differs from all of the two groups. This survey, carried out in the center of the reserve, comes from a very degraded area.

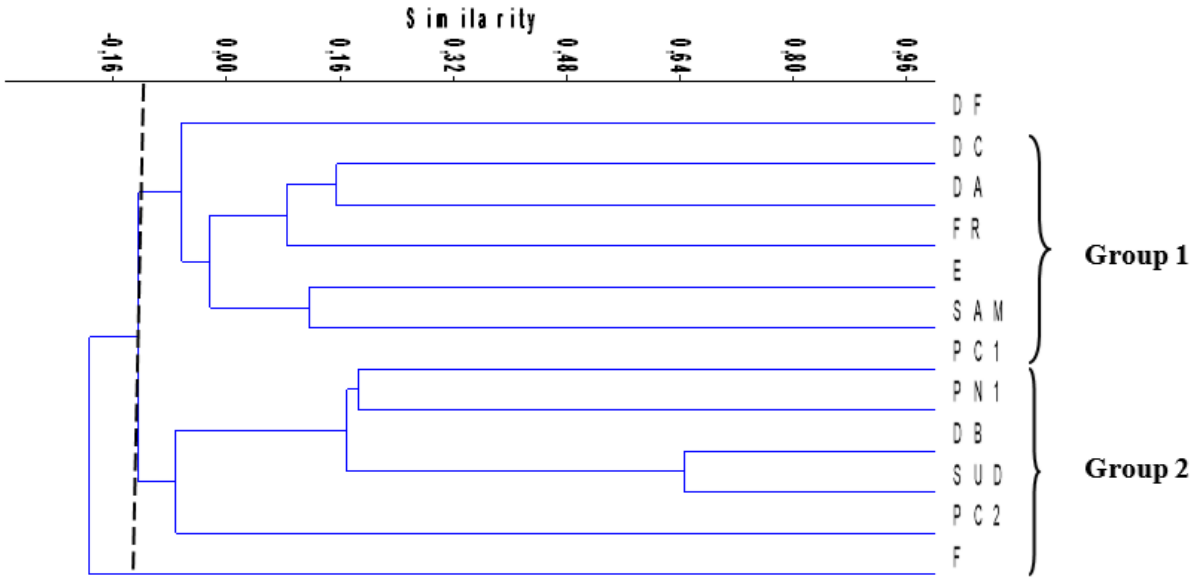

Fig. 4. Floristic similarity of the surveys

4 DISCUSSION

Generally speaking, and taking floristic composition into account, the three zones of the Dahliafleur Nature Reserve are comparable. We counted 61 species, 54 genera and 33 families in the north, and 68 species, 57 genera and 31 families in the center. In the south, we counted 63 species, 58 genera and 29 families. A comparison of floristic richness shows that the three zones are floristically similar. This could be explained by the fact that the zones do not differ edaphically [21].

The reserve is characterized by a high proportion of Guinean-Congolese species (62%). This proportion shows that the vegetation has recovered well. These results are in line with [22]. The relatively high proportion of species in the GC-SZ transition zone proves that the various sites are suffering from some form of disturbance [23]. The nature reserve is highly endemic, with a total of 16 endemic species, including thirteen (13) from West Africa and three (03) from Côte d'Ivoire, and four (04) on the IUCN red list. The number of these species of conservation value is higher than that established by [7]. This small list of special-status species gives Dahliafleur a particular conservation focus, as suggested by [24]. Of these conservation efforts for endemic, rare and endangered species should be a priority.

The study reveals that of the 22 species with DBH ≥ 5 cm, the species that contribute most to forest vegetation are *Tabernaemontana crassa, Ceiba pentandra, Senna siamea, Acacia mangium, Nesogordonia papaverifera*. The analysis of the Family Importance Index (VIF) reveals a strong representativeness of species belonging to the Fabaceae family. The abundance of species of this family in a forest indicates that it belongs to the Guinean-Congolese phytogeographical type.

The equitable distribution of individuals could be explained by the fact that these species group together in different areas according to their ecological affinity.

The dissimilarity between the plots could be explained by a variation in the floristic composition of the different plots due to the state of the vegetation from one plot to another [25, 26].

5 CONCLUSION

The Dahliafleur Partial Nature Reserve includes the northern zone contains 61 species, 54 genera and 33 families. The central one has 68 species, 57 genera and 31 families. Finally, in the southern zone there are 63 species, 58 genera and 29 families. The nature reserve is highly endemic, with a total of 16 endemic species, including thirteen (13) from West Africa and three (03) from Côte d'Ivoire, and four (04) on the IUCN red list. Considering the different zones, the value of the Shannon

index does not vary considerably from one type of habitat to another. The analysis of the Family Importance Index (VIF) reveals a strong representativeness of species belonging to the Fabaceae family. The comparison of the different plots taken in twos, reveals a rather weak similarity. These result shows that the Reserve is in a good state of conservation and has a good regeneration capacity.

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