ESJ Natural/Life/Medical Sciences

Floristic and Structural Study of the Dahliafleur Partial Nature Reserve Located in Bingerville (South Côte d'Ivoire)

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Doi:10.19044/esj.2022.v18n33p23

Submitted: 26 September 2022
Accepted: 19 June 2022
Published: 31 October 2022

Cite As:
Missa K., Soro K., Kanga A. L. & Koffi K.J. (2022). *Floristic and Structural Study of the Dahliafleur Partial Nature Reserve Located in Bingerville (South Côte d'Ivoire).* European Scientific Journal, ESJ, 18 (33), 23. https://doi.org/10.19044/esj.2022.v18n33p23

Abstract

The Dahliafleur Partial Nature Reserve, located in the town of Bingerville, is part of the great Ivorian protected area network. Unfortunately, very little is known about its floristic diversity, and even less about the structure of its vegetation. This work intends to characterize its floristic and structural aspects, through 13 surface surveys and an itinerant survey carried out in the northern, central, and southern zones of this area. The data analysis revealed that the Dahliafleur Partial Nature Reserve includes 135 species. These species are divided into 110 genera and 53 families. It has 26 special-status species and the highest diversity index of any urban forest. The diametric structure shows histograms in the shape of an "inverted J" for each of the areas. This pattern is typical of a forest in a good state of conservation

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

and with good regeneration capacity. This result shows the importance of this reserve for the conservation of floristic biodiversity.

Keywords: Urban Forest, Floristic diversity, Dahliafleur Partial Nature Reserve, Diametric Structure

Introduction

For its essential role in oxygen production and climate regulation, the forest is the ally par excellence and indispensable to all living organisms on earth. However, global forest area continues to decline, with global forest loss since 1990 amounting to 178 million hectares (Missa *et al*., 2018).

In Africa, forest cover degradation has reached alarming proportions. Indeed, Africa recorded the highest annual rate of forest loss over the period 2010-2020, with 3.9 million hectares (FAO, 2020).

In Côte d'Ivoire, the forest cover declined sharply from 1986 to 2015 (7,850,864 ha in 1986, 5,094,452 ha in 2000, and 3,401,146 ha in 2015). The annual deforestation rates are 3.04% in the first period and 2.66% in the second period. The forests of Côte d'Ivoire have almost disappeared outside protected areas. The situation was worsened by the various socio-political crises that the country experienced between 2002 and 2011. The tragic and continuous loss of this floral biodiversity is a worrying situation for mankind, as its survival depends on it. To address the threats to these biological resources, the Ivorian government's commitment has resulted in the implementation of a legislative framework, including the adoption of Law No. 2002-102 of February 11, 2002, on the conservation, management, and financing of national parks and nature reserves. Thus, Côte d'Ivoire has set up a network of 17 protected areas from the north to the south of the country. Among these protected areas are the urban protected areas, which are of great help to large cities such as Abidjan. Indeed, the urbanization of large cities is generally accompanied by an increase in air pollution that leads to mortality from cardiovascular and respiratory diseases (Konan *et al*., 2021). According to these authors, urban forests contribute to improving the quality of life of communities through the ecosystem services they provide. The Dahliafleur Partial Nature Reserve, which is located in the town of Bingerville, is part of the Ivorian protected areas network. Unfortunately, very little is known about its floristic diversity, even less about its vegetation. According to Asseh *et al*. (2019) since its establishment in 2001, only a few in-depth studies have focused on the biological diversity of the Reserve. The main role of protected areas being the conservation of biodiversity, the knowledge of these ecosystems becomes a fundamental concern for all actors involved in their management. This concern is what motivates this work. The general objective of the study is to characterize the plant biodiversity of the Dahliafleur Partial Nature Reserve.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Specifically, it aims to (i) evaluate the floristic diversity and (ii) analyze the structure of the vegetation.

Material and Methods

Study site

The Dahliafleur Partial Nature Reserve (DPNR) is located in the southern part of the town of Bingerville, in the eastern part of the Autonomous District of Abidjan, which is in the southern part of Côte d'Ivoire (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 Reserve with an area of 148 hectares, is bounded to the north, by the villages "Carrière I and II" and to the east by the Ebrié Lagoon (Monssou, 2018). To the south and west, it is bounded by various residential areas (Figure 1).

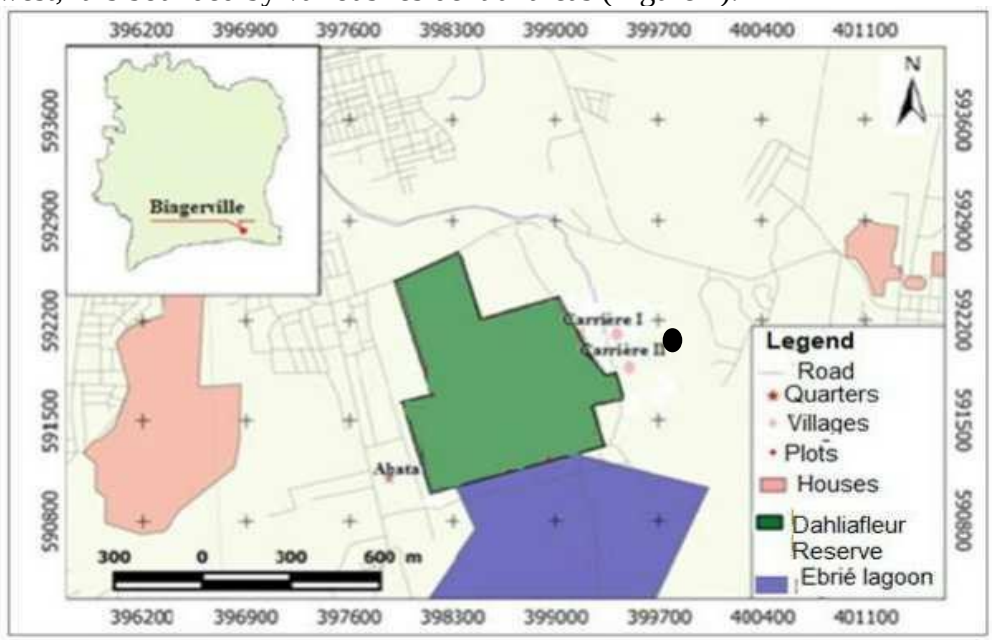

Figure 1. Location map of the Dahliafleur Partial Nature Reserve

Study Methodology

Collection of data

In this study, the surface survey consisted of delineating 400 m² (20 m x 20 m) square plots in three selected areas. They were arranged as follows: four (04) plots in the northern part of the Reserve, five (05) in the central part, and four (04) plots in the southern part of the Reserve. Within each plot, all species were inventoried and those that could not be identified on-site were collected to make herbariums. 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 recorded. A tree may consist of

multiple strands, these are counted separately if the separation is below 1.30 m from the ground (Gnangbo *et al*., 2015). To these surface surveys, the itinerant survey was associated which allowed noting all the species not met in the plots of inventories. The Species were identified according to the Angiosperm phylogenic classification Group (APG IV, 2016).

Data analysis

Specific richness: Species richness is the total or an average number of species per unit area or the number of species in a community or stand (Schnell, 1970).

The raw and weighted spectra of biological, and phytogeographical types were calculated per plant grouping in the Excel spreadsheet. Then, several ecological parameters were calculated. These are :

Relative density (R dens): The relative density of a species is the ratio of the number of individuals of that species to the total number of individuals of all species in the sample.

R dens = (Ni/ $\sum$ **Ni) x 100 Ni =** number of individuals of the species**,**

$\sum$ **Ni** =total number of individuals

Shannon's diversity index (H') is used to assess biological diversity. Its formula is:

H′ = $-(\sum ri/R)\ log_2\ ri/R$ where, **ri** = average individuals of a species I of the plant group;

R = Total number of individuals

Pielou's evenness (J') gives precision to the distribution of the species in a plant grouping. It is calculated by the following formula:

J′ = H′/$log_2 S$ where, **S** = total number of species

Structural paramètres

Basal Area

The basal area or basal cover of a plant formation is the sum of the cross-sectional circumferences of the trunks of all trees and shrubs in that formation at 1.30 m above the ground (Rondeux *et al*., 2010). This parameter better reflects the horizontal occupation of the soil by plant species.

Distribution of stems by diameter classes

The distribution of individuals by diameter class is often called "total structure" by foresters (Bouko *et al*., 2007). It makes it possible to account for the demographic structure of woody stands through histograms of the distribution of individuals by diameter class.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Data analysis methods

The data collected on the survey sheets were used as the basis for the description of the flora and stand structure. ANOVA comparison tests were used to compare DBH, density, and mean basal area.

Results

Floristic richness

The surface surveys supplemented by the roving survey yielded 135 species. These species are divided into 110 genera and 53 families. Among the species, 26 species of special status were recorded. Sixteen (16) species are endemic to the West African forest block (GCW). These are *Cercestis sagithatus, Cola caricifolia, Culcasia liberica, Dichapetalum filicaule, Diospyros heudelotii, Ehretia trachyphylla, Eugenia memecyloides, Landolphia membranacea, Landolphia micrantha, Maesobotrya barteri, Manotes expansa, Mussaenda linderi, Psychotria ivorensis, Trichilia heudelotii.* Three (03) of them are endemic to Côte d'Ivoire: *Albertisia cordifolia, Leptoderris miegei* and *Philodendron pertusum*. Four (04) species are listed on the IUCN red list, three (03) are vulnerable (*Anubias gracilis, Maesobotrya barteri,* and *Nesogordonia papaverifera*), and one endangered species: *Anthurium splendidum.* In the forest as a whole, the most abundant families are Fabaceae and Araceae (14 species each or 11%), Apocynaceae (11 species or 8%), Zingiberaceae and Rubiaceae (9 species or 7%), Connaraceae, Dioscoreaceae and Sapindaceae (6 species each or 4%). The families that are represented by one or two species are grouped under the term others and represent nearly 50% of the procession (Figure 2).

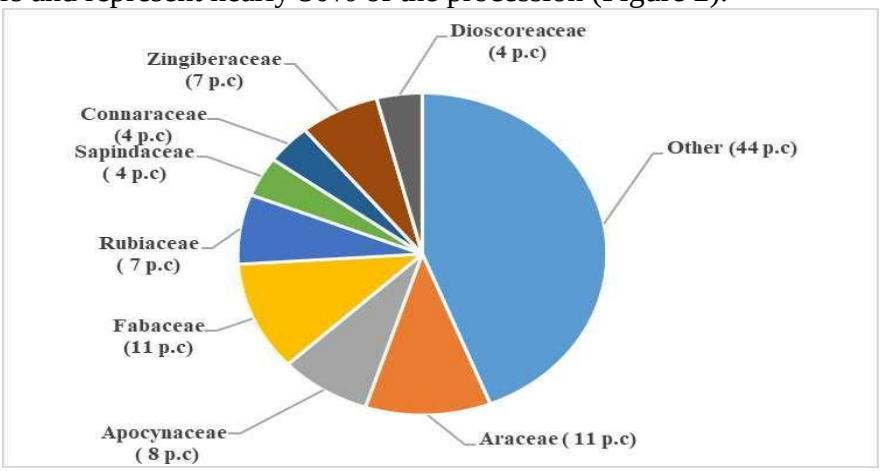

Figure 2. Spectrum of DNPR botanical families

The Shannon index value for the entire forest is 4.6. This value reflects a good diversity of species for the whole forest. The Piélou's evenness index

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

has a value of 0.75, 0.89 and 0.9 for the northern, central, and southern zones respectively. These values tend towards 1. This means that there is equidistribution of individuals within the different zones.

Structural diversity

In this study, 106 individuals with a diameter greater than or equal to 5 cm were counted on all plots. These individuals were counted on 0.52 ha or 203 individuals/ha. The mean values of the density of the different zones are statistically identical (p-value = 0.857), the same is true between the mean diameters per zone and the basal areas per zone (Table I).

The histogram of the distribution of trees in diameter classes shows an inverted 'J'shape in the three zones (Figure 3). For the three zones, the class of diameter between 5 and 15 cm, is the one that contains the most individuals. In all areas, there were 66 individuals in the 5-15 cm diameter class covering a basal area of 56.79 m^2. This class, which consists of regenerating individuals, is the most abundant.

Table I. Density, DBH, and Average basal area of the different zones of the DNPR

AREA	Density	DBH
	Basal area	
North	300±41.14[a]	18.28±1.26[a]
	214.09±34.42[a]	
Center	190±47.51[a]	12.12±0.73[a]
	99.33±14.47[a]	
South	218±54.68[a]	13.97±0.33[a]
	172.13±29.33[a]	
p	0.857	0.149 0.53

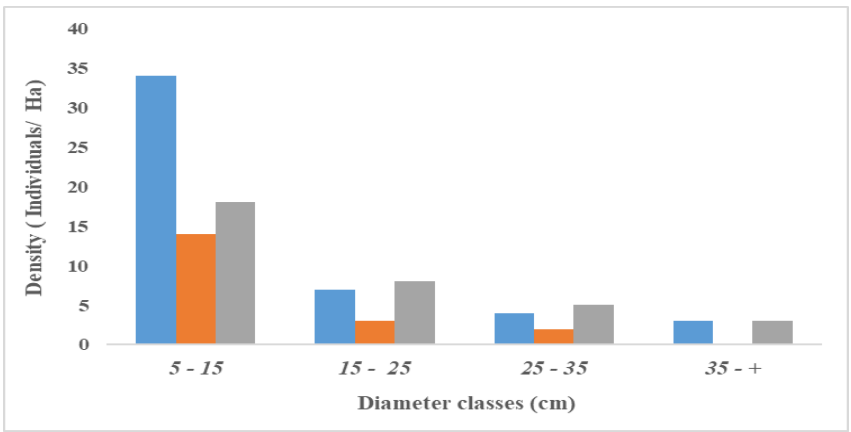

Figure 3. Distribution of individuals from the three DNPR areas by diameter

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Discussion

Floristic diversity

This study identified 135 species, divided into 110 genera and 53 families in the RNPD. Among these species, we note a strong endemicity and the presence of rare and endangered species that testify to the great floristic diversity contained in the reserve (Adou Yao and Roussel, 2007). This makes it of particular interest for biodiversity conservation, as suggested by Myers *et al*. (2000).

The Dahliafleur Partial Nature Reserve is dominated by families such as Fabaceae, Araceae, Apocynaceae, and Rubiaceae. The dominance of the Fabaceae Apocynaceae and Rubiaceae is a fairly general phenomenon for most dense tropical rainforests (Aubreville, 1959; Kouamé *et al*., 1998; Nusbaumer *et al*., 2005). The dominance of Fabaceae is often cited as the characteristic botanical feature of Ivorian forests (Guillaumet and Adjanohoun, 1971).

The Shannon index of a value of 4.82 is very high. This could be due to the recovery of vegetation, one could say that this forest is tending toward maturity. The low human activity in the partial nature reserve could also explain the high diversity (Missa *et al*., 2018). A study by Sharma and Kumar (2004) in India showed that species diversity is higher in moderately disturbed sites. Regarding the Piélou (1966) index, the high value indicates an equitable distribution of individuals or species throughout the forest.

Vegetation structure

In the Dahliafleur Nature Reserve, the diametric structure shows "inverted J" shaped histograms for each zone. This is typical of tropical forests (Adou Yao *et al*., 2007). This curve shows that in a stable natural environment the number of individuals in a forest stand decreases steadily as one moves from small-diameter trees to larger trees. Senterre (2005) showed that this pattern is evidence of strong regeneration in the forest. Adou Yao et al (2005) made the same observations in Taï National Park. According to these authors, this pattern shows that of all the species combined, the youngest trees with small diameters are the most numerous. This pattern is typical of a forest in a good state of conservation and with good regeneration capacity (Nusbaumer, 2003). This is due to the fact that it is located in a protected area.

Conclusion

The Dahliafleur Partial Nature Reserve includes 135 species divided into 110 genera and 53 families. The families most encountered in the whole forest are Fabaceae, Araceae, Apocynaceae, and Rubiaceae. This reserve has great ecological value with the presence of species of special status. It ranks among the most diverse forests of urban forests in particular and dense

evergreen forests in general. The diametric structure of each area shows that the Reserve is in a good state of conservation and has a good regeneration capacity.

Conflict of interest: The authors declare that they have no competing interests.

Author Contributions

Authors MK and KAL participated in data collection and interpretation of results. KKJ and SK contributed to the compilation and final proofreading of this article.

Acknowledgments

All the authors of this article would like to thank the members of the Office Ivoirienne des Parc et Réserves (OIPR) for their involvement in this work. Our thanks also go to the field guides for having accepted to accompany us in the field.

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