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Floristic Inventory and Microbiological Soil Analysis for the Restoration of the Soumba River in the Prefecture of Dubréka, Republic of Guinea

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Abstract: The widespread destruction of ecosystems contributes to biodiversity loss and climate change. In the Republic of Guinea, the study of the factors influencing this degradation remains the essential tool for identifying the different methods adopted for the restoration and assessment of floristic diversity. The objectives of this study are to inventory all plant species along the Soumba River and characterize the microbiological nature of the soil. The so-called quadrat method was used. A total of 32 species were recorded, distributed across 26 families, with a cover of 64% for tall woody plants and 20% for low woody plants, and 60% for herbaceous plants. The soil is clay-sandy in nature and has a gentle slope. These exploitable results can serve as a database for better preservation of the flora of the Soumba Gallery Forest Partial Wildlife Reserve.

Key words: Microorganisms, floor, plant diversity, Soumba River, Guinea.

1. Introduction

The deterioration of riparian ecosystems constitutes one of the most worrying factors of environmental problems linked to anthropogenic activities and climate change. Sustainably managed forests have many particularly important socio-economic and environmental functions at global, national and local scales; they also play a crucial role in sustainable development.

Ecosystems are complex entities characterized by the exchange of materials, energy and multiple interactions between living and non-living components. In an ecosystem, the soil and the plant are influenced by abiotic parameters, such as climate, parent rock and topography, and those of living organisms [1]. Healthy soils are necessary to ensure the steady evolution of natural or managed vegetation that provides food, fiber, fuel and medicinal products and provides ecosystem services such as climate regulation and oxygen production [2]. Soil and vegetation are intimately linked. Nutrients are provided to plants by fertile soil promoting their growth; constituting the water tank, and their support. In turn, vegetation, tree cover and forests prevent soil destruction and desertification by stabilizing it, ensuring water retention and nutrient cycling while reducing erosion caused by water and wind [2].

Indeed, soil microorganisms play a fundamental role in biogeochemical cycles, nutrient availability, organic matter decomposition, and plant regeneration mechanisms. Their analysis is therefore essential for understanding the resilience of degraded environments and guiding ecological restoration programs.

In the Republic of Guinea, river ecosystems have

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been under increasing pressure for several decades linked to agricultural expansion, logging, urbanization, mining activities as well as anarchic land occupation practices. The Soumba River, located in the Dubréka prefecture, is not immune to this dynamic of environmental degradation. The regression of the gallery forest, the erosion of the banks, the biological impoverishment of the soils and the disturbances of the microbial communities materialize in an advanced weakening of this ecosystem, the negative ecological and socio-economic impacts of which are becoming more and more perceptible.

This study mainly aims to identify the structure and dynamics of riparian vegetation, to evaluate the microbiological properties of associated soils, as well as to analyze the interactions between floristic and microbial components with a view to establishing scientifically based strategies for ecological restoration.

2. Materials and Working Methods

2.1 Study Area

The Soumba River is located in the sub-prefecture of Khorira, Dubréka Prefecture. It is 39 km long and has a drainage basin of 392 km². Dubréka Prefecture is situated in Maritime Guinea (Lower Guinea), near the capital. The southwestern part, bordering the Atlantic Ocean, is low-lying and covered in mangroves. Inland, the terrain rises sharply. It is an administrative subdivision of Guinea; its capital is the city of Dubréka. Its population is estimated at 330,548 inhabitants [3]. With a density of 62 inhabitants/km², it is located 48 km from Conakry on National Route N3.

This prefecture has a savanna climate and an area with significant rainfall. The main activities carried out by the populations surveyed are rice cultivation, fishing, salt extraction and wood cutting.

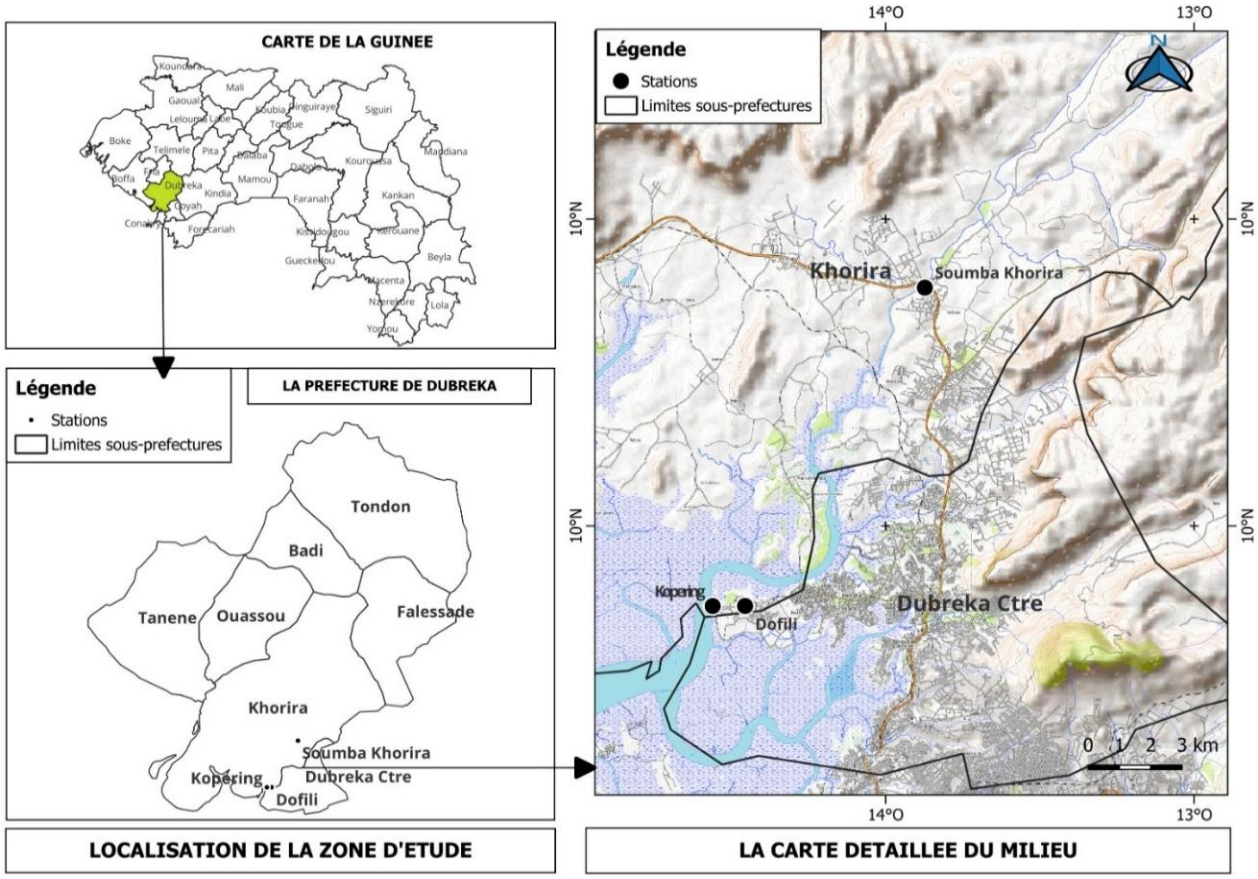

Fig. 1 Map of the Soumba River with sampling sites.

2.2 Methodology

The method used is quadrats for vegetation and random sampling for soil analysis.

The bacteriology analysis was carried out in the microbiological laboratory of the CERE (Center for Environmental Study and Research).

2.3 Data Processing

Word, Excel, and R software will be used for data processing.

3. Results

To diversify flora and microorganisms, we chose two sampling sites: Kopering and Khorira, two villages crossed by the Soumba River, due to their proximity and accessibility.

3.1 General Characteristics of the Vegetation

The results obtained are recorded in the following tables and figures:

A total of 32 species were recorded, distributed among 26 families and 29 genera. The most represented families are the Connacrea (3 species), followed by the Moracea (2 species), the Malvaceae (2 species) and the Poacea (2 species).

Overall, we observed a cover of 84%, with 64% for tall woody plants and 20% for low woody plants, 60% for herbaceous plants on a gentle slope.

Table 1 List of species recorded in Khorira and Kopering.

ID	Families	*Genus*	*Species*
1	Verbenaceae	*Gmelina*	*Gmelina arborea*
2	Arecacées	*Elacis*	*Elacis guineensis*
3	Asteracées ou composées	*Siegesbeekia*	*Siegesbeekia orientalis*
4	Poaceae	*Peunisetum*	*Peunisetum purpureum*
		Andropogou	*Andropogou tectorum*
5	Annonaceae	*Uvaria*	*Uvaria chamae*
6	Fabaceae	*Cassia*	*Cassia pedocarpa*
7	Anacardiaceae	*Sorindea*	*Sorindea juglandifolia*
8	Fabaceae	*Dialium*	*Dialium guineensis*
9	Combretaceae	*Combretum*	*Combretum tomensum*
10	Rubiaceae	*Nauclea*	*Nauclea latifolia (sarcocephalus latifolia)*
11	Celastraceae	*Solacia*	*Solacia senégalensis*
12	Aracées	*Amorphophallus*	*Amorphophallus aphyllus*
13	Ochnaceae	*Kisaré*	*Kisaré ochnacee*
14	Snilacaceae	*Surilax*	*Surilax anceps*
15	Commelinaceae	*Commelis*	*Commelis bengalensis*
16	Diascoreceae	*Diascorca*	*Diascorca dumetoum*
17	Asteraceae	*Chromolaena*	*Chromolaena odorata*
18	Anisophylleacées	*Anisophyllea*	*Anisophyllea laurina*
19	Colchicaceae	*Gloriosa*	*Gloriosa superba*
20	Connaraceae	*Cnestis*	*Cnestis feriginea*
			-Cnestis cornuculata
		Byrsocarpus	*Byrsocarpus coccineus*
21	Clusiaceae	*Laami*	*Laami laami (pentadesma butyracea)*
22	Moracea	*Ficus*	*Ficus vogelii*
			Ficus ottonifolia
23	Apocynacées	*Holarrhena*	*Holarrhena floribunda*
24	Myrtaceae	*Eugenia*	*Eugenia uniflora*
25	Rubiacées	*Canthium*	*Canthium horizontale*
26	Malvacées	*Hibiscus*	*Hibiscus asper*
		Urena	*Urena lobata*
			Urena procambeus

Table 2 Vertical structure of the station according to population size and their frequencies in Khorira.

ID	Strates	NI	NI ‰	P	P ‰	Densité
1	LH3	6	0.023	5	1.488	0.06
2	LH2	5	0.019	5	1.488	0.05
3	LH1	6	0.023	6	1.785	0.06
4	LB3	4	0.015	3	0.892	0.04
5	LB2	75	0,294	42	12.5	0.75
6	LB1	58	0.228	55	16.369	0.58
7	H3	2,150	8.453	75	22.321	21.5
8	H2	8,130	31.969	80	23.809	81.3
9	H1	15,000	58.976	65	19.345	150
Total		25,434	100	336	100	25.434

Notes: LH, tall woody; LB, low woody; H, herbaceous.

Table 3 Vertical structure of the station according to population size and their Kopering frequencies.

ID	Strates	NI	NI ‰	P	P ‰	Densité
1	LH3	8	0.026	4	2.409	0.08
2	LH2	5	0.016	2	1.204	0.05
3	LH1	6	0.02	4	2.409	0.6
4	LB3	36	0.12	14	8.433	0.36
5	LB2	58	0.193	35	21.084	0.58
6	LB1	55	0.183	40	24.096	0.55
7	H3	2,139	7.142	25	15.06	21.39
8	H2	8,140	27.181	22	13.253	81.4
9	H1	19,500	65.115	20	12.048	195
Total		29,947	100	166	100	299.470

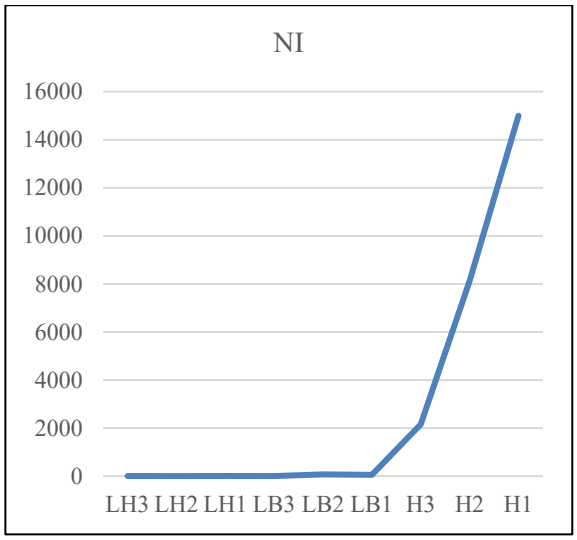

Fig. 2 Forest evolution between strata and the number of individuals Khorira.

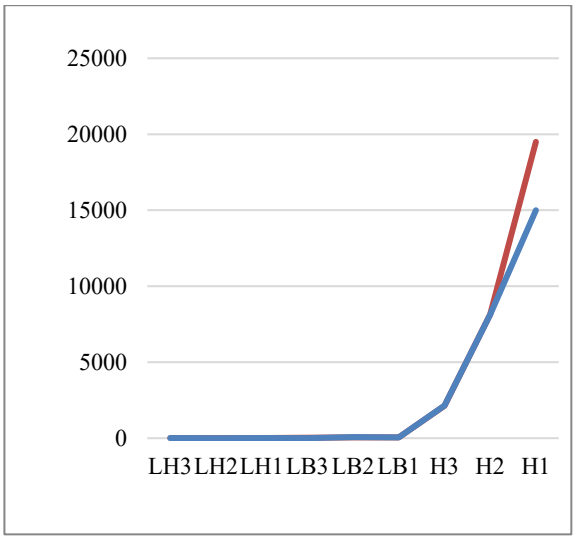

Fig. 3 Forest evolution between strata and the number of individuals Kopering.

Table 4 Results of the microbiological analysis of the soil.

Parameters / Station	FMAT (UFC/g)	Yeast-mold (CFU/g)	Total colony-forming	Fecal colony-forming
Khorira	1.0 10^3	6.5 10^3	40	30
Kopering	3.4 10^6	3.2 10^6	46	25
Normes	10^6 à 10^9	10^3 à 10^6	-	-

We observe a strong dominance of herbaceous plants due to the abundant rainfall in Guinea during this period.

Below these strata, there are both low-growing woody plants and herbaceous plants.

The table above presents the results of the soil analysis.

There are no standard reference values in soil microbiological analysis; they depend on the soil type and use, the climate, and the analytical method employed.

The results obtained reveal a significant difference in microbiological activity between the studied sites. The Kopering station exhibits the highest densities of TATF (Total aerobic and anaerobic mesophilic flora) and yeast-molds.

Conversely, the low bacterial density observed at Khorira (1.0×10^3 CFU/g) suggests reduced biological activity. This situation may be associated with low nutrient availability, unfavorable soil conditions, or environmental disturbances limitant microbial growth.

The presence of total and fecal coliforms at all stations indicates organic soil contamination. However, the small differences observed between sites suggest that this contamination is relatively homogeneous. These microorganisms may originate from animal waste, human activities, or surface water runoff.

Overall, the Kopering station appears to have the highest microbiological activity, while Khorira is characterized by lower activity. These differences highlight the likely influence of soil physicochemical and environmental characteristics on microbial population dynamics.

4. Discussions

These results corroborate with those found by Braun-Blanquet [4] where Moracea and Malvacea are among the best represented families with respectively 5 and 7 species in terms of the organization of vegetation in the forests of Kongolo Island in the Democratic Republic of Congo where in the floodable forests, 542 tree individuals divided into 66 species and 26 families were recorded including 62 grouped species into 26 families for the lower strata and 13 species divided into 8 families for the upper strata.

• In the same wake, Connaracea were found in abundance with 9.38% followed by Malvaceae, Poacea and Moracea with 6.26% each, as reported by Douma et al. [5] in the Tamou Total Wildlife Reserve in Niger where 42 woody species distributed in 29 genera and 20 families were recorded in the 96 floristic surveys.

• Of the 32 species listed there is a strong dominance of herbaceous species. This agrees with Jazy et al. [6] which, out of 40 surveys, 126 species were recorded including 98 herbaceous and 28 woody, belonging to 89 genera and 32 families. Group I has a systematic diversity of 33 species including 6 woody and 24 herbaceous.

• Microbiological analyzes show that the soils studied present variable levels of microbial colonization. The Kopering station is distinguished by a microbial richness significantly greater than that of Khorira.

• The presence of coliforms in the three stations indicates organic contamination of the environment. These results corroborate with those obtained by Razika [7] who obtained 64.90x106 CFU/g of bacteria and 90.08x102 g/g for fungi.

5. Conclusion

In the riparian zone of the Soumba River, we identified 32 species belonging to 26 families. The

Connaceae family was particularly abundant, representing 9.38% of the total, followed by Malvaceae, Poaceae, and Moraaceae, each accounting for 6.26%. We observed a vegetation cover of 84%, with tall woody plants accounting for 64% and low-lying woody plants for 20%. Herbaceous plants covered 60% of the area on a gentle slope. Further analysis of the soil's physicochemical parameters (pH, organic matter, moisture, nitrogen, phosphorus, etc.) would help to better explain the differences observed between the sites.

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