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Evolution of floristic diversity according to altitude in the localities of Bangolo and Logoualé west of Côte d'Ivoire

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ABSTRACT

This study relates to the evolution of floristic diversity in keeping with altitude in the localities of Bangolo and Lougoualé at west of Côte d'Ivoire. The objective was to measure and evaluate the variation and/or the evolution of floristic diversity according to altitude and to study the influence of altitude, the slope and the exposure to the wind on this floristic diversity; this in order to understand the distribution of the types of vegetation. It was based on floristic inventories inspired of the itinerant method and that of the small squares (grixels). The data obtained allowed to shown that the flora is diversified and more homogeneous to 500 m of altitude. It is diversified and less homogeneous with lower altitudes (350 m to 450 m) and with higher altitudes (550 m and 600 m) In addition, the floristic compositions of lower altitudes (350m to 400 m) approach the diversity of 500 m. The floristic diversity of higher altitudes differs deeply from that to 500 m. On the other hand, the flora at 450 m with a floristic composition completely different from those with other altitudes. In addition, some rare species colonize only the low altitudes and are absent at 500 m. On the other hand, others woody species were inventoried at all the levels.

KEYWORDS

Flora;
Altitude;
Diversity;
Variation;
Logoualé;
Bangolo.

INTRODUCTION

The natural resources available on planet evolve and become exhausted over the years. On the other hand, the populations of the countries in the process of development know increase demography. Whereas the biodiversity interests many actors of international development nowadays, in particular of the research teams and certain official authorities. All, direct their actions towards durable management of the ecosystems and by rebound of the biodiversity. Indeed, the biodiversity is one of the essential components of the environment which conditions the survival of planet. Also, she is represented on all the levels of integration of the biological systems. However, in many African countries, the problem: growth of the population and the availability of the natural resources is deeply posed. Also, the land pressure is felt it in a gradual way in these countries. In Côte d'Ivoire, the frequent problem of rural land and sometimes source of fatal conflicts is one of the direct cause of rural the land pressure. The reduction of phytogenetic natural spaces and exhaustion of resources, faunal are caused by: the fast urbanization of rural environments, increase demography, the anarchistic exploitation of these resources etc. In addition, the flora of Côte d'Ivoire knows an increasing degradation over the years. Many works were directed towards the characterization of the flora in forest area. They are inter alia, those of Alexandre[1], Kouamé[8] and Kouassi[9]. Mitja[13] and Yossi[18] have concentrated the essence of their work on the savanicole flora. Also the dynamic of the post-farming flora has been lengthily approached by Floret and al.[3], Baker and al., for finding techniques of fast floristic regeneration of the post-farming mediums and ranges. Despite everything these attempts, the degradation of the flora of the forest mediums does not cease growing. The human activities on all the components of the environment contributed to weaken reduce and sometimes destroy to a significant degree the flora of the ecosystems.

Face to these problems, more solutions of durable and integrated management of spaces and natural resources are recommended to prevent eco-climatic imbalances. The safeguard of the wealth and the floristic diversity of many countries with agricultural vocation must be based on the protection of flora and faunal ecosystems still rich. Lubini[11] and Reitsma[15] didn't say that the study of the vegetable groupings constitutes as well as the floristic inventories one of the most important sources of basic information in particular for research relating to biological diversity and the development of management systems, the installation and the nature conservation? And yet, one cannot make forest écophylaxie's, the conservation of the zoocenoses, the geomorphology, management of nature reserves,… without knowing the structure, the dynamics and the operation of the phytocoenoses. Mullenders[14] announces that the knowledge of the vegetable groupings takes on an essential range because these groupings are the resultant many factors of the habitat. Their analysis makes it possible to appreciate, to a certain extent, the relative importance which returns to each one of them according to the particular circumstances. In Côte d'Ivoire, the mountains and the inselbergs sometimes difficult to reach constitute privileged refuges of the plant species and animal. These ecosystems are very often diversified and include many endemic species, rare, threatened etc. Then the altitude can be select like criteria of the biodiversity. And yet, the biodiversity cannot be preserved in all its forms, because of the requirements of grounds for the various agriculture, and exploitations. This is why, it is imperative to identify and concentrate the efforts of conservation on certain priority areas[2], such as the mountains. The mountainous solid masses always interest many researchers and the scientist of other areas of the world as in Cameroon and in It Ivory. Studies relating to the variation of the specific wealth according to altitude in the tropical forests were conducted for example in Tanzania[10], in Costa Rica[7], in Argentina[12], in West Africa with the Mounts Aureoled, etc. These studies were carried out with an aim of knowing the impact of altitude on the species distribution and the various types of vegetable formations.

The present study aims to evaluate the impact height on the variation of the floristic diversity of the mountains.

MATERIALS AND METHODS

From the floristic point of view, the inventoried sites belong to the Guinean field. One meets the wet dense green forest (persistence of the sheets of the trees during all the year), of the marshy forests of the enclaves, of Raphiales, etc. This luxuriant forest is seriously started and given way today to fragments of fallow completely degraded. These waste lands comprise many plots of cultures of revenues such as: the cacao-tree (*Theobroma cacao*), the coffee-tree (*Coffea caenophora*), of many plots of food crops (rain rice, corn, yam), of the fallow and the marshy or hydromorphic zones (Raphiales).

Floristic inventory

Two methods were associated during the floristic inventory. They were: itinerant method, of enumeration of species on layouts and the method of the grixels[6], which consists in describing the vegetation on "quadrats" of 20 side m. The inventories were carried on three (3) mountains Figure 1. On each mountain of an average surface of approximately 400 ha, 40 small squares of one hectare (1ha) each one Figure 2 were delimited. The markers with indelible ink were used to indicate the already inventoried sectors. The small squares were left again of kind to cover all the sides of

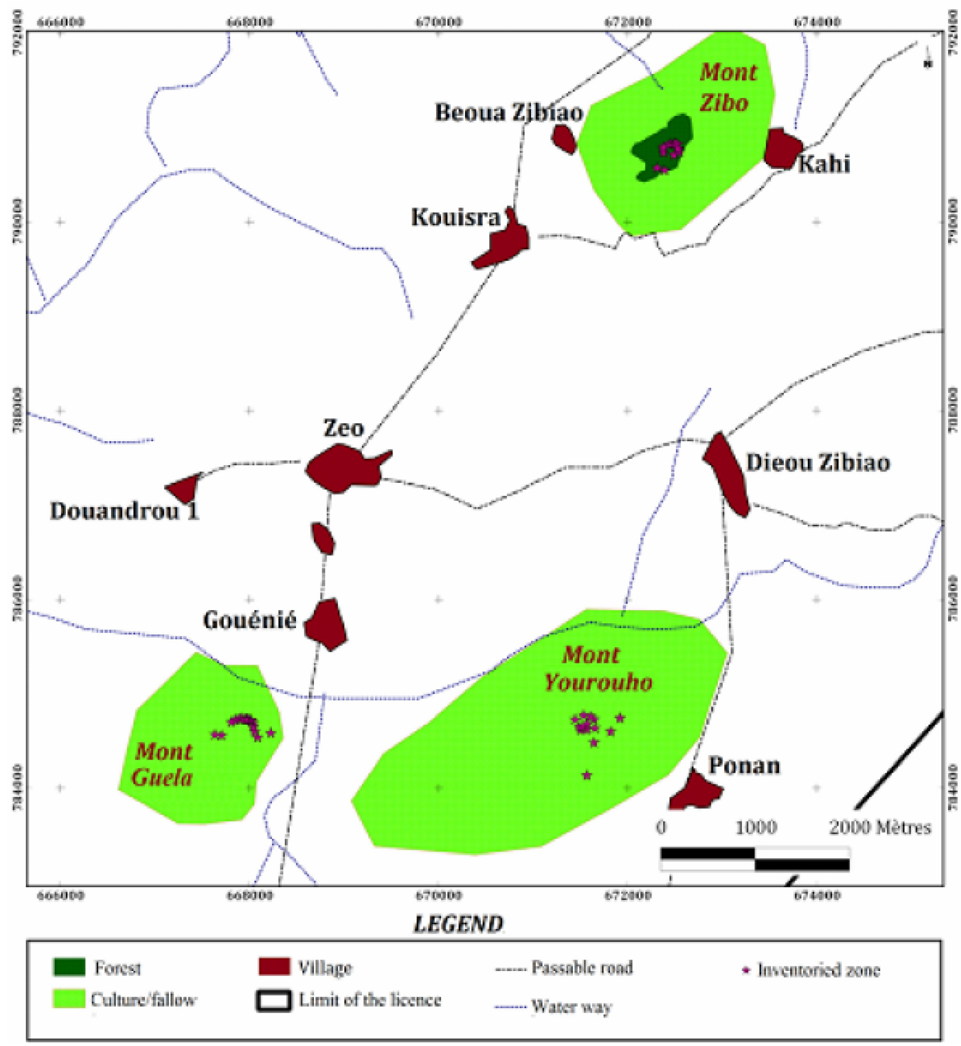

Figure 1 : Locality comprising the inventoried mountains

the mountains (top, sides and low of slope). Thus in each small square of inventories, all let us tax them were inventoried and classified according to their statute (endemic, threatened, with risk, vulnerable etc.). List UICN[17] was used as a basis of data for classification of species.

The small squares were left again of kind to cover all the sides of the mountains (top, sides and low of slope). Thus in each small square of inventory, all species were inventoried and classified according to their statute (endemic, threatened, with risk, vulnerable, etc.). The UICN[17] list was used as a basis of data for classification of species.

Analyzes of the flora

The floristic diversity was expressed starting from the index of Shannon-weaver[16] which is expressed in the following way:

H = - ΣPi*Log (pi)

With, pi = Fr/N, NR being the full number of inventoried species; Fr = F (a)/i, I = full number of inventory; F (a) = number of appearance of a species during the inventory. The values evolve of 0 with log (NR), NR being the full number of inventoried species. The Equitability was calculated starting from the index of Shannon. It is expressed as follows: E = H/log (NR). E evolves from 0 to 1. The distribution of the various vegetations was carried out starting from an Analysis in principal Component (AFC). The software Statistica version 8.1 was used for the analyses.

RESULTS

Wealth of the Mountains of 350 with 600m

Numerous species were inventoried on the mountains. The flora of each altitude is rich of more than 50 species TABLE 1. This flora is richer at 350 m of alti-

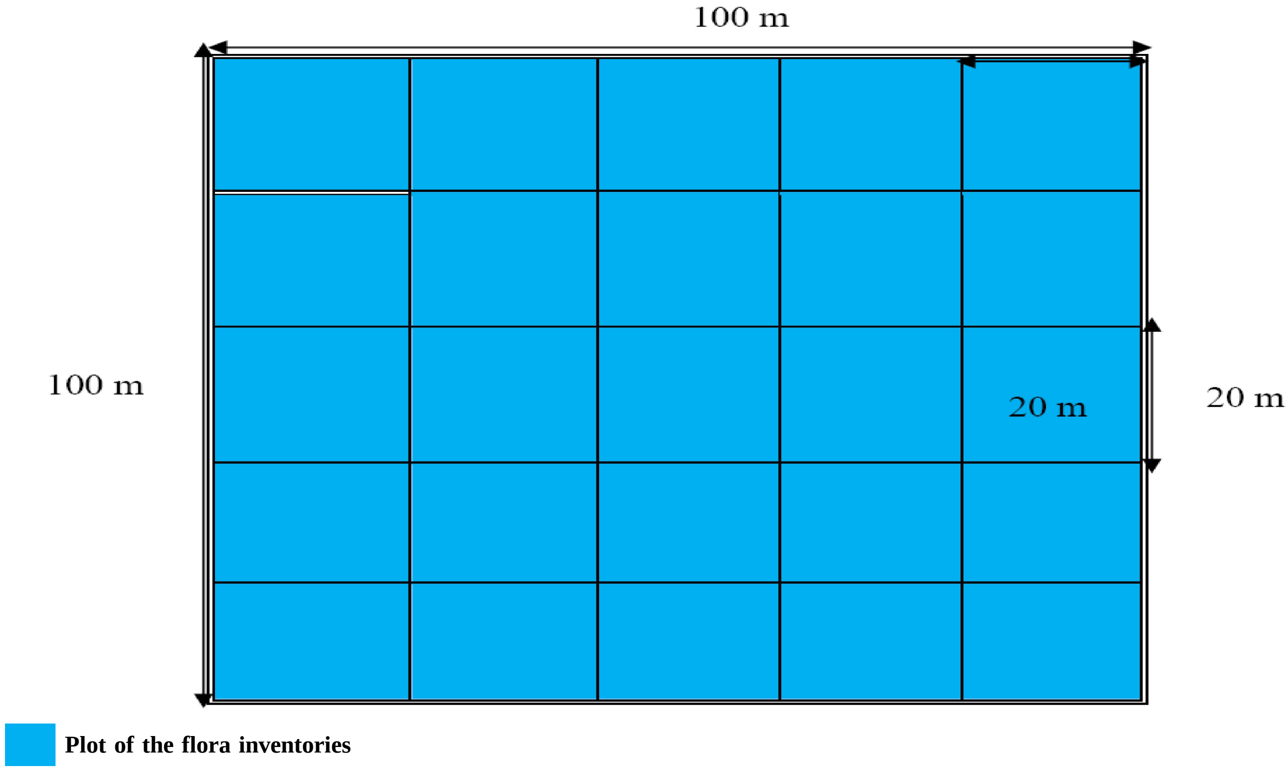

Figure 2 : Configuration of the plots of the flora inventories

tude with 167 species and to 550 m of altitude, with 143 species. It is fairly rich to 400.450 and 500 m of altitude, respectively, with 107.104 and 95 species. The lowest specific wealth was obtained to 600 m of altitude with 68 species.

TABLE 1 : Wealth specific of the mountains according to height

Elevation	Species richness (number of species)
350 m	167
400 m	107
450 m	104
500 m	95
550 m	143
600 m	68

Diversity of the species of the mountains of 350 m to 600 m of altitude

The analysis of the various parameters of this flora

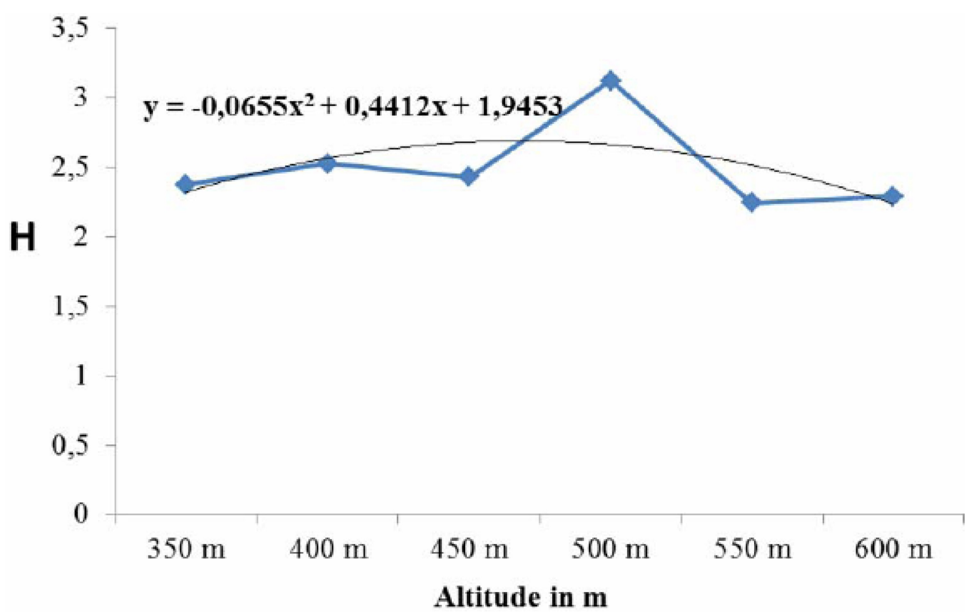

Figure 3 : Evolution of the index of diversity of Shannon of 350 m to 600 m on the mountains

shows that it is diversified (H = 3.12 bits) to 500 m of altitude Figure 3. But it is averagely diversified (H = 2.53 bits), (H = 2.43 bits) and (2.42 bits), respectively to 400 m, 450 m and at 550 m. In other hand, the flora is slightly diversified (2.37 bits), (2.29 bits) to 350 m and 600 m of altitude. The polynomial regression shows a relatively weak elution of diversity to lowest altitude (350 m) and to more high altitude (600 m). Whereas the highest values are obtained between 400 and 500 m of altitude.

The floristic homogeneity and the stability of the medium

The floristic homogeneity evolves gradually and

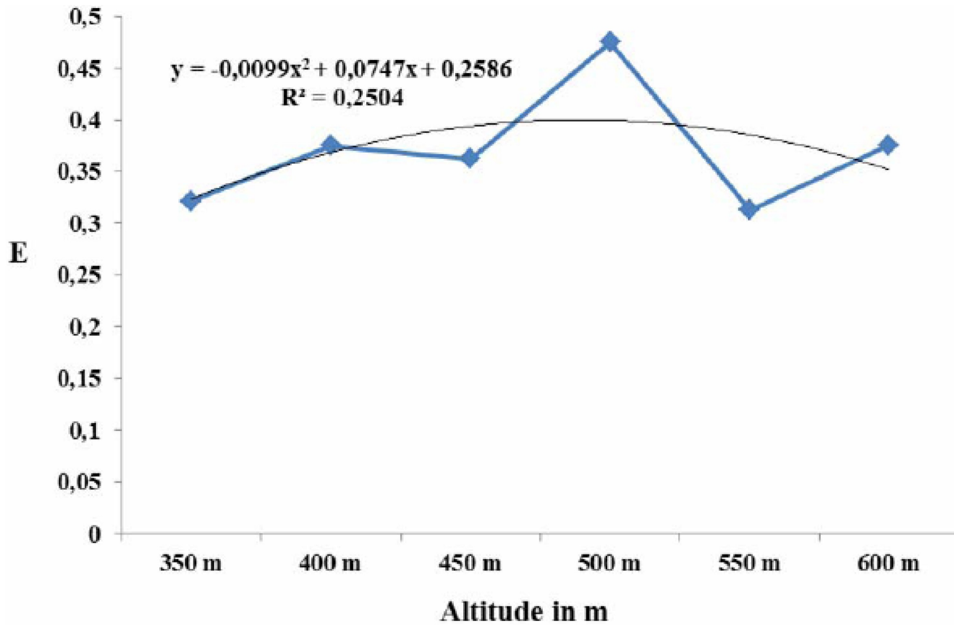

Figure 4 : Evolution of Equitabilité of 350 m to 600 m on the mountains

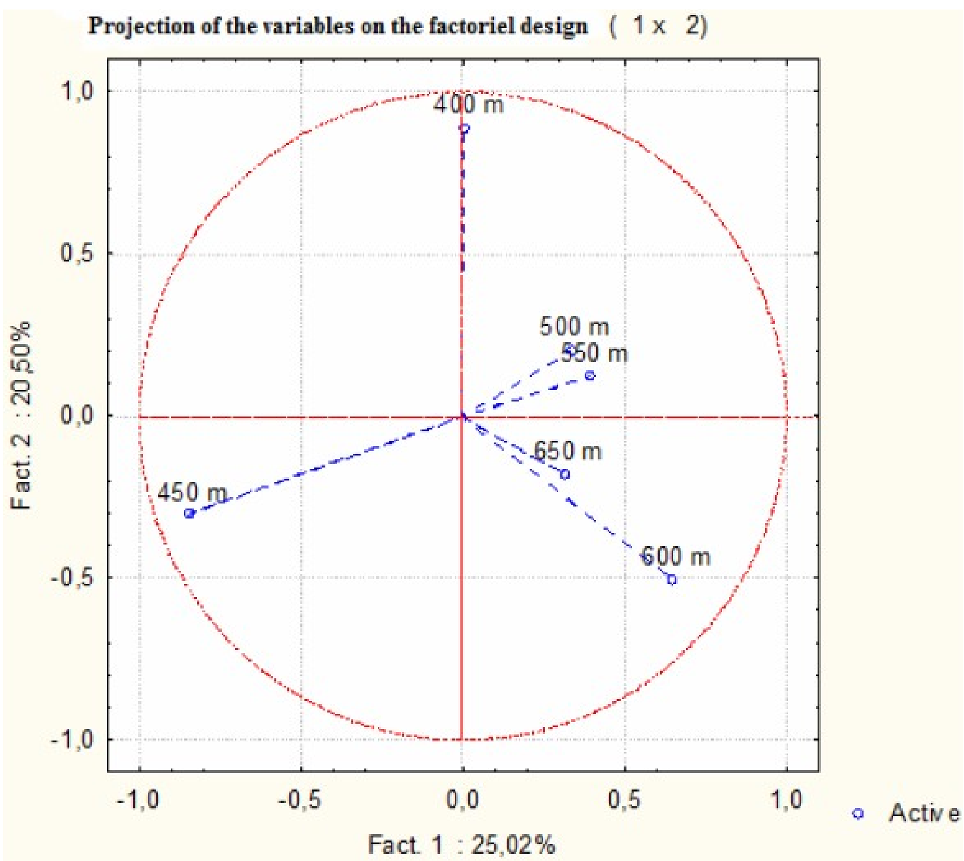

Figure 5 : Repair of the flora and similarity enters the vegetable communities of the mountains

reaches the maximum value m to 500 m of altitude, with (0.47; Figure 4). These values are followed of those obtained to 600 m (0.376), 400 m (0.375) and 450 m (0.363). The low values were obtained to 350 m, with E = 0.321 and to 550 m with E = 0.313.

Distribution, similarity or diversity of the flora from, 350 to 650 m

Figure 5, presents the repair of the floristic compositions of altitudes along the two main axes of the factorial analysis. The first two axes explain approximately 46% of the original variance. This median value makes it possible to discriminate the groups of species characteristic of altitudes represented. With the analysis, on axis 1 (factor 1) are concentrated the floristic composition with 400 m. The axis 2 (factor 2) watch the regrouping of the floristic composition to 500 m and that to 550 m. Of the same the floristic composition to 600 m and that to 650 approaches axis 2. On the other hand, the floristic composition to 450 m is isolated from the two axes.

DISCUSSION

Wealth and floristic diversity

Of all the inventoried flora those to 350 m and 550 m of altitude are richer in species. These flora are followed of those to 400 m and to 450 Mr. A these low altitudes more stable from the geomorphological point of view, one meets many species and the vegetation is provided. But as one rises in altitude, the flora especially becomes more selective because of climate and of the upheavals spontaneous which occur of time to others like shown Baker. The high number of taxon inventoried to 550 m is a specific case isolated like one meets some very often during investigations carried out in the natural environments. But, the results obtained from the estimates of indices of diversity of Shannon (H) show that at 500 m, the flora is diversified; what is attested by the high value of index at this altitude. This diversity is partly related to the particular status of the flora at this altitude. Indeed, the flora at this altitude neither too low nor too high profits from a natural protection, because difficult to reach and not subjected to the upheaval spontaneous of higher altitudes. On the other hand, the flora of lower altitudes (Altitude lower than 500 m) is constantly influenced by activities of anthropic origins such as agriculture and especially the taking away of specimens for needs (food, crafts, medicine etc.) the flora of these low altitudes following the example of those for the plateaus is the result of a stage of regeneration of the post-farming flora. The flora is diversified to 600 m of altitude than that at 500 m and that of lower altitudes (350 m, 400 m, 400 m, 450 m, 550 m) although this altitude is almost inaccessible. This weak diversification can be one of the consequences of many geomorphological and climatic phenomena (crumbling, landslide, low temperatures etc.). These phenomena are at the base of the dynamics of the flora. The flora of lower altitudes is exposed to many factors of destruction (upheavals geological and climatic).

Floristic homogeneity and stability of the medium

The indices of Equitabilité de Pielou calculated starting from the indices of diversity of Shannon showed that the flora to 500 m of altitude is more homogeneous and thus more stable from the ecological point of view. This Homogeneity is related to the diversity of the flora like it showed Kouassi[9] and Kouassi *et al*.. But the various activities undertaken in the zones at lower altitudes (350, 400.450 m) were sources of ecological disturbances and have contributed to a significant degree to the disturbances recorded in the flora. The flora of higher altitudes (550, 600m) was disturbed by the geomorphological and pedological upheavals like one shown Kouassi *et al*. on the inselbergs of Mafa-Mafou.

Similarity or diversity of the flora from 350 to 650 m

The projection of the correlated ecological parameters (altitude, composition of the flora) showed a bringing together of the flora of 500 m and that of lower altitudes (400, 350 m); that of high altitudes moving away a little more. Although flora 500 m is similar to that mentioned above, the similarity between the flora thus compared is not much significant. This significant difference is the consequence of the anthropic pressures which the flora undergo lower which without these pressures would present a flora similar to that met to 500 m. Naturaly, while rising, the climate, the geomorphology and other environmental factors become selection criteria of the flora who under these conditions becomes less and less diversified and less and less rich. It is what causes the difference in the compositions of the flora to 600 m and that at 550 m with that at 500 m. On the other hand the flora to 600 m and to 650 m which are the altitudes almost subjected to the same climatic conditions are those which are similar. The characteristic of the flora to 450 m is an except fact, for which the explanation could be as complex as that of the savannas included in the Guinean field. The composition of this flora could be dependent to sampling at this altitude.

CONCLUSION

The floristic diversity varies according to altitude. This variation is perceptible within diversity and the floristic homogeneity. The flora of the mountains of the two localities is diversified and more homogeneous to 500 m of altitude. It is less diversified and less homogeneous with the low altitudes subjected to the anthropic pressures and the high altitudes (550 m 600 m) subjected to eco-climatic imbalances. In its composition, the flora to 500 m of altitude approaches more those of low altitudes and differs to a significant degree of those from higher Altitudes (600m, 650 m). That to 450 m is entirely except and resembles neither the flora of low altitudes nor to the flora of high altitudes. The agriculture and much destruction carried out within the vegetable formations have considerably affected the diversity and the homogeneity of the flora of low altitudes. But all that the human being inflicts with the environment it inflicts it itself. The management of the environment must thus from now on integrate realities of the medium of kind to support the life of species in all its forms within nature to save the biodiversity durably.

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