FLORISTIC DIVERSITY AND STRUCTURAL CHARACTERIZATION OF THE FOREST OF CHETTABA (ALGERIA)

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ABSTRACT

The structure of various stands, defined as the diversity of trees in the stands, can be an indication of overall biodiversity and habitat suitability, be useful in predicting stand growth and provide stand details for forest inventories.

In an effort to find sustainable resource management strategies, a study was conducted on the structural and ecological characteristics of stands in Chettaba forest (Algeria). In this study, six diversity indices were used to characterize the horizontal and spatial distribution of individuals in multi-species stands, using four plots, located in the Chettaba forest (East-North Algeria). The results obtained allowed us to note that P2 and P3 present similar average densities (600 feet/ha), the plots P1 and P4 present low average densities (250 feet/ha and 350 feet/ha). The average DBH values vary from 25.65 cm for the P2 stand to 30.61 cm for the P1 stand. The average basal area varied between 33.73 m²/ha (P3) and 18.92 m²/ha (P1). The Shannon and Weaver index reached its maximum in plot 4 with 8 species. The study allowed us to evaluate the floristic diversity of the forest. Moreover, it indicated the need for its integral protection for its dynamics towards a dense forest vegetation.

Keywords: *Chettaba, floristic diversity, spatial distribution, horizontal distribution*

INTRODUCTION

The forest is a complex ecosystem and remains a universal common good [1], [2]. It provides vital goods and services that contribute to human well-being [3]. Pressures on forest lands and unsustainable exploitation of forest resources cause negative impacts on forest genetic resources. It is therefore important to find mechanisms for sustainable management of forest ecosystems [4]. It is therefore important to find mechanisms for sustainable management of forest ecosystems. Sustainable forest management requires a better understanding of the ecological and

physiognomic aspects of the vegetation [5]. The reconstitution of forest cover is one of the many challenges facing sustainable natural resource management policies.

The plant formations of the forest of Chettaba are poorly known, no study has been made to know its floristic richness although it presents the most important ecosystem of the region of Constantine. One meets at the level of this massif a formation of matorral type resulting from the degradation of the forest under the combined action of various factors in particular the repeated fires and the not controlled grazing.

To better understand the degradation of ecosystems, which is of natural and anthropic orders, the study of vegetation seems very appropriate. Indeed, the flora and vegetation of a region are the result of a long process of natural selection under the action of climate, edaphic and topographic conditions, without forgetting anthropic activities [6], [7], [8].

A precise knowledge of the existing forest resources, as well as their evolution should focus on the floristic composition, structure and regeneration of valuable species, hence the need to conduct a forest inventory, which is the subject of this work.

The objective of this work is to obtain information on the characteristics of woody resources (height, diameter, basal area, volume,...) and on the quantitative relationships between them. This will help to take care of this forest formation considering all the ecosystems that are connected to it and studying various alternatives of development and conservation of all the forest species that are in the Chettaba forest, which would contribute to the protection of the latter.

MATERIAL AND METHODS

Situation of the forest of Chettaba

The state forest of Chettaba belongs to the watershed Kebir Rhumel, it is located south-west of Constantine, south of Ibn Ziad, north of Ain Smara and east of Oued Athmania. The study area is located on the topographic map of Constantine Scale 1/200.000 sheet N° 17 and more or less located between the coordinates 36 ° 18', 36 ° 21' north latitude and 6 ° 26', 6 ° 30' east longitude (Figure 1).
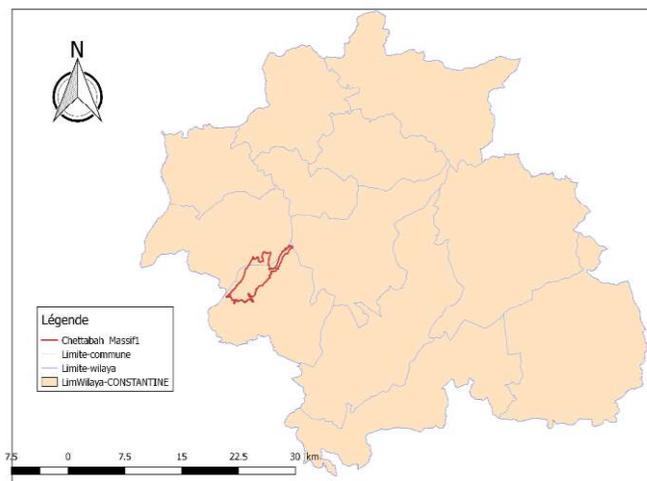
Fig. 1. *Geographical location of the Chettaba forest.*

Method of study

The dendrometric characterization was done by means of a forest inventory. Within the Chettaba forest, 4 plots were installed. Within each of the plots all individuals of the species were inventoried. For each individual, the average diameter and total height were measured.

The following formulas were used to calculate the dendrometric parameters.

- Stand density (N) is the number of stems per hectare.
- The basal area of the stand is the sum of the basal areas of all trees and shrubs. It was obtained by the formula:

$$G = \Sigma \pi \ D2/4, \text{ with:}$$

G = basal area expressed in m2/ha.

D = diameter at breast height of trees.

- Floristic diversity covers floristic richness and equitability, which is the way individuals of the species encountered are distributed.
- Shannon's index (H), Simpson's diversity index (D) and Piélou's equitability index (E) expressed by the following equations [9]:

$$H = -\Sigma(Ni/N)\log2(Ni/N).$$

$$D = 1-\Sigma(Ni/N)2.$$

$$E = H/\log2(S) \text{ with:}$$

ni = the number of individuals of a species i.

N = the total number of individuals of all species.

S = the total number of species.

RESULTS AND DISCUSSION

The management objective of modern forestry is to reconstruct the structure of artificial forests by simulating the structure of forests. For this purpose, the first question is how to express the characteristics of forest structure. But it seems impossible to describe the structure of forests well by using only one parameter because of their complexity. Therefore, a system used to assess different aspects of spatial stand structure was created by combining four indices: species richness, Simpson's index, Shannon and Weaver's index, relative density, relative basal area, diameter differentiation index and Pielou's segregation index in this study. A number of studies have indicated that they are available and can effectively interpret the spatial characteristics of different forest types.

The basal area, density, Shannon's diversity index, Simpson's index and Pielou's index of the different woody groups are shown in Tables 1 and 2. The results obtained show that two of the four stands analyzed (P2, P3) had similar basal areas (32.50-33.73 m2/ha, N = 600/ha). The stands in the forest (plot 4) had a greater extent of DBH, but the height extent was in plot 1. The lowest average DBH of all live trees was in plot 2 (d1.3 = 25.65 cm) and the highest in plot 1 (d1.3 = 30.61 cm). The highest average height was obtained in plot 3 (10.02 m) and the lowest in plots 1 and 2. Density is the stand variable most closely associated with stability, although its effect depends on other factors such as the type of abiotic factor or wind exposure. In general, the higher the density, the greater the snow damage, as it is easier for snow layers to pile up on the crowns (Table 1).

Table 1. *Characteristics of the plots studied.*

Plots	N/ha	D (cm)	G (m²/ha)	H (m)
P1	250	30.61	18.92	9.03
P2	600	25.65	32.50	9.29
P3	600	26.42	33.73	10.02
P4	350	28.18	23.03	8.35

The proportion of species implies the importance value per species, which may result in the need to manage a large number of values in very diverse stands. Therefore, when mixtures include more than two or three species, indices that summarize species composition are often preferred. In forest stands (Table 2), species richness (SR) ranges from 4 in plot 3 to 8 in P4, the latter being, by definition, richer. The Shannon-Weaver index (H) increased with increasing species number and uniformity of individuals per species. In the tree plots (1, 2 and 3) with 6 and 4 species respectively, the index is 0.53. Simpson's index ranged from 0.83 in plot 3 to 0.92 in plot 4. Pielou's segregation index (E) shows that Aleppo pine has a tendency to independent distribution in 4 plots.

Table 2. *Diversity indices.*

Parcelles	SR	H	D	E
P1	6	0.53	0.89	0.20
P2	6	0.53	0.87	0.21
P3	4	0.43	0.83	0.26
P4	8	0.51	0.92	0.17

CONCLUSION

The state forest of Chettaba presents the most important ecosystem of the region of Constantine with a surface of 2400 ha.

The spatial structure of an ecosystem, that is to say the way in which the individuals which compose it are organized in space, often plays an essential role in its functioning. This spatial structure of an ecosystem contributes to improve the knowledge of the natural resources present in the Chettaba forest and serves as a data base for forest management. For all the results concerning the dendrometric parameters, plots 3 and 4 are the most abundant and dominant; it can be deduced that some plots are well adapted to the climatic and soil conditions of the environment. Each of the three stand structure indices used quantifies spatial relationships in a specific way. Floristic diversity is low within the forest, which therefore tends to be very homogeneous.

The floristic composition and structure of the site indicate the need for its integral protection for its dynamics towards a climatic vegetation. Consequently, any development aiming at wood production will be detrimental to it. The objective of possible developments on the site should be to safeguard biodiversity by protecting and restoring the natural vegetation. However, this can only be achieved if the riparian populations are associated for a participatory management.

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