TREE SPECIES DIVERSITY AND SPATIAL DISTRIBUTION OF HOLM OAK STANDS IN CHETTABA FOREST (ALGERIA)

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ABSTRACT

The forest of Chettaba is for ecotourism. Managed by the Forest Conservation of Constantine, this site is formed of several forestry species (hardwood and softwood) spread over an area of 3010 ha. The objective of this study is to estimate the viability of this site through the permanent monitoring of the current state of the forest including biodiversity and pressures. The collection of data related to it had recourse to a forest inventory and an inventory of pressures. The condition was assessed by analyzing these components. The various analyses conducted during this study revealed that the forest is subject to biotic and abiotic pressures and average viability. This is induced by a fairly good stand quality (PHF= 333), medium stability (S= 44.45), low mortality (MR = 4.16%) and good future potential (high regeneration rate (RR =231.25%). Grazing, fire and illegal logging are the most important pressures. Despite these pressures, the forest is classified as a viable ecosystem. However, these potentials are insufficient: it is necessary to reduce the pressures and reforest the degraded plots for better conservation of the ecosystem. To this end, the present study suggests management primarily through silvicultural interventions that promote the regeneration of the various species and to include a permanent ecological monitoring system.

Keywords: *Quercus ilex, Viability, PHF, Pressions*

INTRODUCTION

Forests play a crucial role in sustaining life on the planet [1]. They play a role in the regulation of global and regional climate systems [2]. They constitute carbon sinks [3], are very rich in biodiversity and provide vital resources to human populations. Despite these multiple functions, the management of natural forests, particularly in arid and semi-arid areas in Algeria, is faced with a lack of data to understand the functioning of these ecosystems in terms of floristic composition, structure and regeneration. Consequently, developing sustainable management strategies and approaches based on reliable scientific foundations remains very difficult [4]. However, data concerning the structural characteristics and dynamics

of plant species are unfortunately not documented. The study of the structure of a forest formation serves as a basis for its silviculture, guides forest economics, allows the assessment of the state of degradation of ecosystems, helps to understand the past management history of stands and forest dynamics [5].

The holm oak is the main species of the state forest of Chettaba which covers an area of 2398ha where it occupies 1127ha. However, during the last decade, particular attention and scientific and forestry interest have been expressed for this species.

The objectives of this paper are to collect data on the current ecological status of the Chettaba forest and identify its level of viability. This database will be a reference tool to assist in decision-making for forest service managers, because good management of forest stands, first of all, requires a good knowledge of their structures.

MATERIAL AND METHODS

Presentation of the study area

The forest of Chettabah is located southwest of Constantine (Algeria). The estimated terrain elevation above sea level is 865 meters. The study area is located on the map topographic Constantine Scale 1/200 000 sheet N° 17 and located between the coordinates 36°19'4" north latitude and 6°28'36" East longitude. The forest of Chettaba spreads over an area of 2398 ha and 94a, and is perfectly limited and divided into six districts. Extreme altitudes of the forest is about 1104 m (maximum altitude) and 652 m (minimum altitude), corresponding to each of them respectively following map coordinates: (x = 839, y = 344), (x '= 839.9, y' = 340.3). Its bioclimatic is semi-arid to sub-humid. The average annual rainfall is estimated between 670 and 800 mm and the mean annual temperature of the region is 18°C, with an average of the warmest month above 35°C and the coldest month varies between 1.25 and 3.05°C. A large plant grouping as the forest of Chettaba can be studied in its entirety, especially when it concerns hundreds of acres to be treated in the detail.

Dendrometric parameters

Dendrometric data collection inventory and description of the stands are a prerequisite for any successful forest management and silvicultural planning. We are interested in achieving this inventory to highlight the structure, stand density and the difference of perspective development for each station. The structure of the stand is defined as the manner in which these are arranged dendrometric variables. The tree inventory was conducted in each plot. Dendrometric measurements are:

- The diameter (D) at 1.30 m is estimated using calipers;
- The circumference (C) at 1.30 m is estimated with a tape measure;
- The total tree height (H) measured with the "Smartphone". The Swedish unit is, recommended in this type of study requiring maximum precision; the permissible error is negligible with direct readings that require no calculation. The measurement accuracy

depends on the quality of the inclinometer of Apps and stability with which the device is held.

- The basal area of a stand is the area of all cross-sections of trunks, 1.30 m tall, and the trees on one hectare of forest. It is expressed in m^2/ha. It should be noted that all dendrometric characteristics were measured on three stations of Holm oak.

Data processing and analysis

The data obtained were entered into the Excel spreadsheet, which allowed us to determine the ecological characteristics and structure of the natural holm oak population.

- The density (N) or number of individuals per hectare.
- Basal area (G in m^2/ha) is the sum of the cross-sectional area at 130 cm above the ground of all individuals.
- The total volume (V) depends on the basal area and the height of the individuals.

A multitude of indices are developed and those used in this article are the Shannon, Pielou and Simpson indices.

RESULTS AND DISCUSSION

The floristic composition allows us to highlight the list of species present in the study area. The surveys carried out at the level of the forest of Chettaba (Algeria) allowed to determine 5 woody species (*Quercus ilex, Juniperus oxycedrus, Phillyrea latifolia, Crataegus monogyna, Pinus halepensis*) distributed in 5 families (*Fagaceae, Cupressaceae, Oleaceae, Rosaceae, Pinaceae*). The majority species in terms of number of individuals is *Quercus ilex* (holm oak), which constitutes 84% of all trees observed (Figure 1).

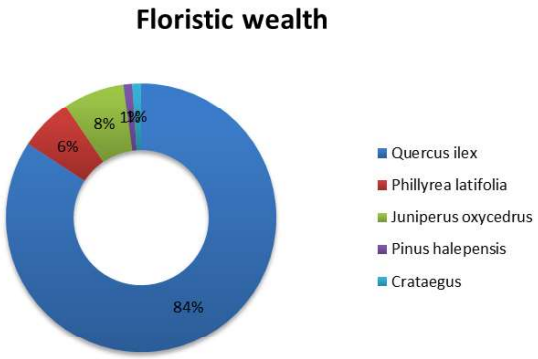

Fig. 1. *Species distribution in the Chettaba forest.*

The mixing coefficient is 0.05; this coefficient reflects the tendency towards homogeneity of the different stands. The values of the Shannon, Simpson and Pielou indices are not very significant and indicate a low floristic diversity; they are

respectively (0.88, 0.40 and 0.38). The Shannon index is often accompanied by the Pielou equitability index. The equitability index measures the distribution of individuals within species, independently of the specific richness. Its value varies from 0 (dominance of one of the species) to 1. These two indices remain dependent on the size of the samples and on the type of habitat. It is therefore difficult to use them as a descriptor of the state of an environment unless threshold values are determined beforehand for each type of habitat and for a given sampled area, as proposed by Ramalanjoana, 2013 [6].

The average density of woody plants at Chettaba is 211 individuals/ha with an average basal area of 2.02m²/ha and an average volume of 3.30m3/ha (Table 1). The average diameter is 8.10cm; these stands present characteristics with high regeneration potential (RR = 231.25%) but with a survival problem during the transition between developmental stages [7] and the mortality rate is very low (4.16%).

The slenderness coefficient gives an idea about the ecological stability of the tree stratum [8]. Considering the H/D ratio, this factor is of the order of 41.50. Therefore, the trees are under too much competition and should not be able to withstand the wind well. They have a height that is far too high in relation to their diameter. This growth rate can be explained by their strong competitive power [9]. This observation allows us to assume that the slenderness coefficient is a function of the average diameter and therefore of the age of the stand. Therefore, the slenderness coefficient is less than 100, which means that these stands are stable and regular.

Table 1. *Characteristics of the species studied.*

Species	D (cm)	H (m)	H/D	g	gh	(g-gh)	N/ha	G (m^2/ha)	V (m^3/ha)
Crataegus	9.55	3.50	36.63	0.01	0.01	0.00	11	0.08	0.013
Quercus ilex	10.29	4.17	43.85	0.01	0.01	12.88	889	8.53	3.82
Phillyrea latifolia	4.56	2.30	53.45	0.00	0.00	3.52	67	0.13	0.04
Juniperus oxycedrus	8.44	3.46	47.38	0.01	0.01	9.50	78	0.51	0.17
Pinus halepensis	7.64	2.00	26.17	0.00	0.01	-6.14	11	0.85	0.00
Average	8.10	3.09	41.50	0.01	0.01	3.95	211	2.02	3.30

The graph in Figure 2 shows the wood productivity of each species. *Quercus ilex* is the richest with a volume of 3.82 m³ /ha.

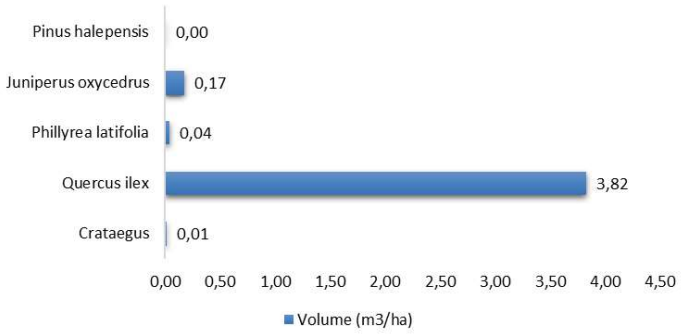

Fig. 2. *Wood Volume of each species.*

The number of stems in the plot is at the pole stage (their diameters do not exceed 17.5cm. This means that these species have not yet had time to reach large diameters. The *Quercus ilex* contains all three diameter classes' perches and small woods, the *Phillyrea latifolia, Juniperus oxycedrus, Pinus halepensis* and *Crataegus* are only found in the form of perches.

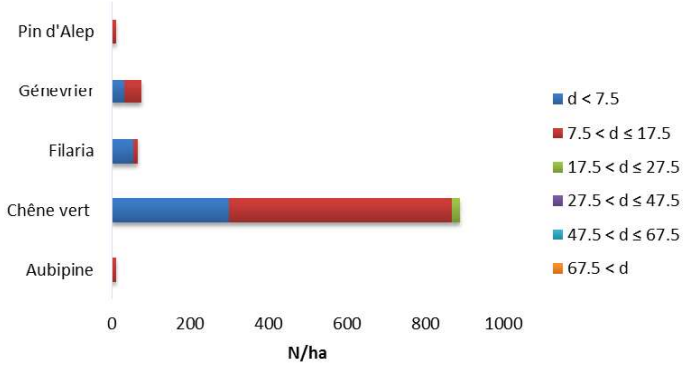

Fig. 3. *Tree density by diameter class.*

The quality of the stands can be given by the PHF index, a three-digit index that gives a judgment of the position of the tree (in relation to the others and thus indicating the dominance and the stage of competition or exposure to the dominant stage), the general shape of the crowns, and the shape of the shafts, It allows more detailed silvicultural interpretation to predict the future of the stand [7] and to deduce in the end the viability of the stands [8]. The average of the results of the PHF index is 333 for the whole of the studied species since which we deduced a rather good quality of our studied stands.

CONCLUSION

The structural study and the floristic composition of the forest allowed knowing the diversity of the plant groups of this ecosystem. The forest of Chettaba functions today as an isolated ecosystem under pressure at its periphery and justifies the need to conserve this ecosystem. The evaluation of the specific diversity by the index of Shannon and the equitability shows a certain relation with the disturbance of the environment. The analysis of viability suggests that, in general, the forest as an ecosystem is viable even if pressures have reduced floristic diversity. Therefore, if the degree of pressure increases and reduces the forest area, the sustainability of the forest will be threatened.

REFERENCES

[1] Larrere C., Larrere R., Du bon usage de la nature. Pour une philosophie de l'environnement. Aubier, Paris, pp 355, 1997

[2] Sinsin B., Kampmann D., Atlas de la biodiversité de l'Afrique de l'ouest, Tome I : Bénin. Cotonou et Frankfurt/Main. BIOTA, pp 676, 2010.

[3] Picard N., Gourlet-F S., Analyse des données de pré inventaire de Yoko. « Dynamique des forêts naturelles », Libreville, Gabon, pp 2, 2008.

[4] Quezel P., Les forêts du pourtour méditerranéen. Forêts et maquis méditerranéens: écologie, conservation et aménagement. Note technique MAB, 2, pp 9-33, 1976.

[5] Adedire M.O., Sustain J. Environmental implications of tropical deforestation. *Dev. World Ecol*, 9, pp 33-40, 2002.

[6] Ramalanjoana M., Etude de la régénération de la sénescence de *Tamarin dusindica* et ses impacts et implications écologiques dans la réserve de BezàMahafaly. Mémoire d'ingénieur en sciences agronomique. Université d'Antananarovi, 2013, pp 33-46.

[7] Nshimba M., Étude floristique, écologique et phytosociologique des forêts de l'île Mbiye à Kisangani (R.D.C) Thèse de doctorat, Université Libre de Bruxelles, 2008, pp 271.

[8] Rajoelison G., Rabenilalana F., Rakoto H., Rapport final. Suivi écologique et analyse socio-économique d'un aménagement participatif de bassin versant dans la zone de Mandraka – Madagascar, pp 70, 2008,

[9] Massenet J., Hauteur des arbres. Lycée forestier – Château de Mesnières, 25 p, 2011.