THE CURRENT ECOLOGICAL STATUS OF ALEPPO PINE OF EL HAMIMET FOREST (ALGERIA)

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ABSTRACT

The forest of El Hamimet, Oum el Bouaghi is a forestry and ecotourism site. Managed by the Oum El Bouaghi Forestry Department, this forest is made up of several silvicultural species (conifers) spread over an area of 1460 ha. The objective of this study is to characterize the current ecological status of Aleppo pine in El Hamimet forest (Algeria). The inventory of softwoods allowing a complete knowledge of quantitative data on the basis of dendrometric parameters collected on 4 plots. The results indicate that the floral diversity is low, characterized by 3 species. The highest abundance is marked in plot 1 with 389 individual/ha, while plot P3 has the highest volume with about 211.58 m^3/ha. The vertical structure shows that the 3-5m class is the most abundant. Indeed, this work will provide a solid reference for future follow-up studies for Aleppo Pine.

Keywords: *Aleppo pine, Ecological status, Inventory, structure*

INTRODUCTION

The richness of the national biodiversity is a reflection of the ecosystem diversity. Algeria's mountainous massifs harbor significant biological diversity. Among the flora species, Algeria has a large number of trees and shrubs. Of the 70 tree taxa of the spontaneous Algerian flora, 52 species are found in mountainous areas. The forest wealth of the El Hamimet forest (Oum El Bouaghi, Algeria) is made up of a heritage that consists of Aleppo pine, holm oak, juniper, cypress and other trees of different species [1]. However, this richness is subject to latent degradation that can in the long term lead to harmful consequences both ecologically and socio-economically [2].

The most important risk factors for the reduction of biodiversity are, on the one hand, natural factors (drought, fires, floods, etc.) and, on the other hand, various human activities: destruction and/or overexploitation of biological resources, overgrazing, extension of cultivated land, development of the urban framework, development of infrastructure works, pollution, tourism, hunting and poaching. Forest biodiversity is in decline in most of Algeria's forest regions. Indeed, in addition to the natural vulnerability that characterises Mediterranean forests and sub-forestry formations, Algerian forests continue to be subjected to various and repeated pressures that considerably reduce their vegetal, hydric and edaphic potential.

The estimation of resources, at the level of a region or a country, is the prerequisite for any forestry policy worthy of the name. From this point of view, the forest inventory is a fundamental tool for obtaining quantitative data on these resources. The objective of this work is to obtain information on the characteristics of the woody resources (height, diameter, basal area, volume, etc.) and on the quantitative relationships between them. This will help to take care of this forest formation by considering all the ecosystems connected to it and by studying various alternatives for the development and conservation of all the forest species found in the El Hamimet forest, which would contribute to its protection.

MATERIAL AND METHODS

Presentation of the study area

Forest of El Hamimet is located north of Oum EL Bouaghi (Algeria). The forest spreads over an area of 1460 ha (Fig. 1). Extreme altitudes of the forest are about 1039 m (maximum altitude) and 800 m (minimum altitude). Its bioclimatic is semi-arid to arid. The average annual rainfall is estimated at 378.75mm. It is generally a rugged relief with an average altitude of 848 m, with a slope of 12.5%. The geology of the forest is dominated by clay-limestone to limestone soils.

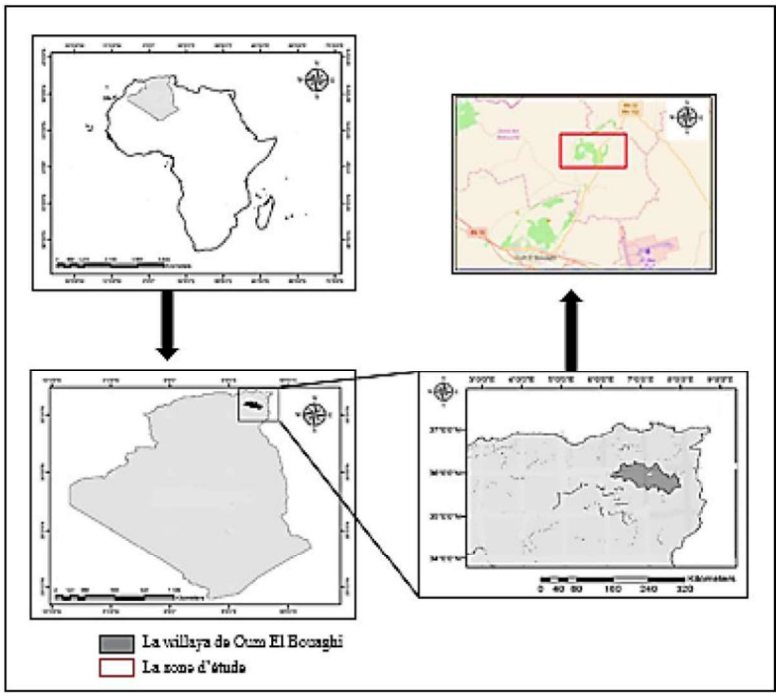

Fig. 1. *Study area (Forest of El Hamimet.*

Dendrometric parameters

Only individuals of *Pinus Halepensis Mill* present in the plots were measured. The dendrometric parameters measured were the circumference at chest height

DHP (1.30 m from the ground) and the total height. The diversity indices considered in this study are the most commonly used in the literature were selected in the (Table 1).

Table 1. *Diversity indices.*

Index	Formula	Measuring diversity
Abundance	$N = (n\ 10000)/(S)$	n: total number of individuals. S: the area (m^2) of the plot.
Dominance	$Gi = \Sigma\ g = \Sigma\ (\pi * Di^2/4)$	g: Basal surface of individual i Gi: Basal area of the plot Di: DHP
Shannon-Wiener (H')	$H' = \sum_{i-1}^{S} Pi \ln Pi$	Pi: ni/N. S: number of species ni: number of individuals of a species N: total number of individuals of all species in the plot.
Simpson (Ds)	$Ds = 1 - \sum \frac{[ni(ni-1)]}{[N(N-1)]}$	ni: number of individuals in species i. N: total number of individuals.
Mixing Coefficient (MC)	$CM = \frac{S}{N}$	S: number of species. N: total number of stems inventoried.

RESULTS AND DISCUSSION

In order to determine the structure of the stand studied, inventory work is considered the best means, but it is the appropriate methods that are different according to the environments and data searched. The inventory of ligneous trees carried out in the 4 plots identified 3 species (*Pinus halepensis, Cupressus sempervirens, Eucalyptus sp.*), grouped into 3 families (*Pinaceae, Cupressaceae and Myrtaceae).*

The results show that the mixing coefficient (MC) is used to determine the distribution of species among the individuals present in each plot [3], the plot (P4) has the highest floristic diversity with (MC=2/378). This MC value indicates that after each (378) trees, two species appear. This mixing coefficient shows that (P4) has a high number of species in relation to the total number of trees inventoried. The species in the plot (P3) are the least diversified, with (CM=1/389), this can be interpreted by the abundance of the *Pinus Halepensis*, which makes this formation more or less homogeneous (Table 2).

In plots 4 and 3 (H'=1.30; H'= 1.27) the index is highest when all individuals are equally distributed over all species, which means the Aleppo pine dominates all four forest plots [4]. The results of the Simpson index are identically comparable to those of the presiding indices, the index is maximum (Ds = 0.7) for the plots (P4 and P3) this means that the species dominance for these two plots is assimilated.

Table 2. *Diversity indices.*

Plots	CM	H'	Ds
P1	2/467	0.85	0.58
P2	1/334	0.67	0.48
P3	2/389	1.27	0.7
P4	2/378	1.30	0.70

Only individuals of *Pinus Halepensis Mill* present in the plots have been measured. The abundance, dominance and total volume are used to determine the horizontal structure of forest stands [5]. Abundance is high in plot 1; while dominance is higher in plot 4. Diameter, height and total volume are highest in plot 2 (Table 3).

Table 3. *Dendrometric characteristic of forest stands.*

Plots	N/ha	D (cm)	H (m)	H/D	G (m^2/ha)	V (m^3/ha)
P1	389	15.31	5.72	39.23	7.80	44.62
P2	344	29.88	6.41	25.89	33.01	211.58
P3	156	24.54	4.64	26.47	8.87	52.75
P4	378	29.84	5.95	30.60	37.68	209.13

The vertical structure of the forest stand is determined from the determination of height classes. The most dominant height structure of *P. halepensis* is between 3 and 5m. The height/diameter ratio (H/D) is used sometimes at the stand scale, sometimes referred to as a "stability factor", to quantify the risks of significant windthrow. The slenderness coefficient gives an idea of the ecological stability of the softwood layer. For best stability, the value of the coefficient should be close to 100 [6]. Considering the H/D ratio, softwoods have the most favourable values. Therefore they are subject to 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 is explained by their strong competitive power [7]. For the four plots with an average diameter between 15 and 30 cm, the slenderness coefficients are between 25 and 39% and therefore below 100, which means that these stands are stable and regular. *Pinus halepensis* with a slenderness coefficient of around 26% (P2) represents the most stable stand, the most resistant to wind, snow and windthrow with a strong competitive power [8].

CONCLUSION

The forest of El Hamimet (Algeria), is considered a very rich forest area in terms of biological diversity. This forest is composed mainly by Aleppo pine and cypress which are currently in a healthy and sometimes stressed state. The Aleppo pine and cypress are very interesting reforestation species in terms of wood production, soil protection and the development of tourist and leisure activities. This study allowed the dendroecological characterization of natural stands of *Pinus halepensis* in plots at different exposures of the El Hamimet forest. This forest is characterized by the dominance of large diameter individuals and small diameters

are rare in all plots. The results of this research constitute a descriptive and analytical diagnosis that deserves to be extended to other Aleppo pine forests in semi-arid zones in Algeria in order to obtain more information on the behavior of this species and to propose silvicultural treatments to ensure better protection of natural pine forests that have been threatened for several decades.

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