VALORIZATION AND CHARACTERIZATION OF THE FOREST OF EL HAMIMET (ALGERIA)

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ABSTRACT

This study focuses on the El Hamimet forest (eastern Algeria). Its ecological status is unknown until now and no system has been established to measure and monitor its viability. The objectives were to collect data on the current ecological state of this forest and to analyze the structure of the stands; for this purpose, we carried out an inventory in the field allowing the knowledge of quantitative data relating to these resources from dendrometric parameters collected on 4 plots of softwoods. The results obtained show that the species *Pinus halepensis* is the most abundant with 425 tree/ha or 95.41%; the average basal area is 23.41 m^2/ha and offers a significant quantity of wood 132.95 m^3/ha, and therefore it is the main species among all the species studied.

Keywords: *Pinus halepensis, structure, sustainability*

INTRODUCTION

The strong degradation of environments linked to human activities has prompted restoration initiatives for several decades [1]. The ecology of restoration addresses all-natural processes and is assisted by interventions that initiate or promote the recovery of degraded, damaged, or destroyed ecosystems [2]. A need to restore these forests is imposed because apart from their role as a reservoir of biodiversity, they ensure above all a regulatory function that is a determinant of the water regime of the area and the stabilization of soil degradation [3]. So far, human activities have destroyed the Earth's biological diversity. Changes in the existing politics, economy, technology, and ideological structures must then be made to encourage the increase of the population's quality of life, the quality of the environment, aesthetics, and culture. The standard economic approach has tended to ignore the costs of environmental damage and the degradation of natural resources [4]. Currently, the new field of environmental economics is developing methods to value biological diversity, and in the process is making the case for its conservation. The development of a forest ecosystem requires the design of a system of economic, ecological, human, and social interventions that will allow it to make regular profits while maintaining or increasing the potential of its property and ensuring the sustainability of its human and social benefits [5]. The general objective of the study is to collect the necessary information on the forest of El Hamimet for a proposal of restoration strategies.

MATERIAL AND METHODS

Presentation of the study area

The Forest of El Hamimet is located north of Oum EL Bouaghi (Algeria). The forest spreads over an area of 1460 ha. 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.

Dendrometric parameters

The horizontal analysis consists of studying the spatial structure of the stand in terms of abundance and dominance.

- Abundance gives the number of stems of a species (here Pinus halepensis) in the stand. It is expressed in the number of N per hectare (N/ha).
- Dominance evaluates the basal area G.

It is formulated by $G = \Sigma g = \Sigma\ (\Pi d^2/ 4)$ and is expressed in m^2/ ha. D is the diameter of the tree at 1.30 m from the ground. The dominance gives an idea of the degree of filling of the forest, i.e. the part of the surface occupied by stems. It is then an index for the production of the stand. As for the number N, the basal area G is also established by the diameter class.

- The basal area of the average diameter tree is the area calculated from the average diameter of the population: $gh = \Pi^* Dg^2 /4$, where Dg is the average diameter of the stand [6].
- The comparison between the average basal area and the basal area of the average diameter tree allows us to qualify the productivity of the stand. A new parameter that we will note by (g - gh) where g is the average basal area of the population will be introduced in the horizontal analysis of the stands. The distribution of stems across the different diameters and the fact that the area is a function of the square of the diameter are at the origin of the difference between the average basal area and the basal area of the average diameter tree [7]. This parameter then characterizes the distribution of the number of stems per diameter. A positive (g - gh) means that the trees in the population occupy on average a larger basal area than the average tree. This can be translated to a gain in the basal area of each tree relative to the average diameter tree. In other words, the total area is relatively large compared to the average tree diameter and stand density.

The positive (g - gh) then characterizes the good productivity of the stand.

- The ratio of the height to the diameter qualifies the slenderness of the tree. It is called the "slenderness coefficient" and is noted: H/D = Htot* 100/D1.3 where Htot is the total height and D1.3 the diameter at man's height of the tree. The stability of the stand depends on both the density and the slenderness of the trees. The study of tree taper aims to determine the factors of variation of its value and its relationship with the stability of the stand. Generally, the slenderness coefficient of 100 corresponds to the stability threshold of a stand, but for a species sensitive to disturbances, this threshold goes down to 80 [8].

RESULTS AND DISCUSSION

The horizontal structure of a species combines the distribution of stems and the distribution of basal area by diameter class. Since density, basal area, and stand development are strongly linked, the study of one cannot be done without the introduction of another [9]. This study will be done by taking into account at least two of these factors. Table 1 summarizes the main characteristics of *Pinus halepensis* stands in each plot, concerning trees with the measurable basal area.

With an average diameter between 5.41 and 67.02 cm, these stands are in the young growth stage. The total density of Aleppo pine trees with a diameter at man's height greater than 5 cm varies from 344 to 489 individuals per hectare. The youngest of all is that of plot 1 with a diameter at a man's height of 15.31 cm on average. This stand contains a large number of young trees (389 trees/ha).

Table 1. *Quantitative characteristics of the stands.*

Plots	D (cm)	H (m)	H/D	g (m^2)	gh (m^2)	g-gh (cm^2)	N/ha	G (m^2/ha)
P1	15.31	5.72	39.23	0.02	0.01	1.13	389	7.78
P2	29.88	6.41	26.47	0.10	0.01	8.71	344	33.01
P3	29.44	5.95	30.60	0.10	0.01	9.10	378	37.68
P4	17.22	4.32	27.81	0.03	0.01	2.04	489	14.67

The (g - gh) value of these *Pinus halepensis* stands varies from 1.13 cm² for plot 1 to 9.10 cm² for plot 3. The stands all have a positive (g - gh). This means that in these stands the trees are on average larger than the average tree. These developmental states then correspond to a stage where the trees reinforce their stability by growing widthwise. The total density and the average diameter of the stand no longer explain the parameter (g - gh). We can say that the other development factors such as spacing texture and canopy influence the productivity of the stand largely. The average slenderness coefficients vary between 26.47 and 39.23 in the 4 plots. The variation in H/D is irregular; this finding suggests that the slenderness coefficient is a function of the average diameter and therefore the age of the stand. Figure 1 shows the slenderness coefficient as a function of the average diameter of the stand, as well as the polynomial trend line of the function.

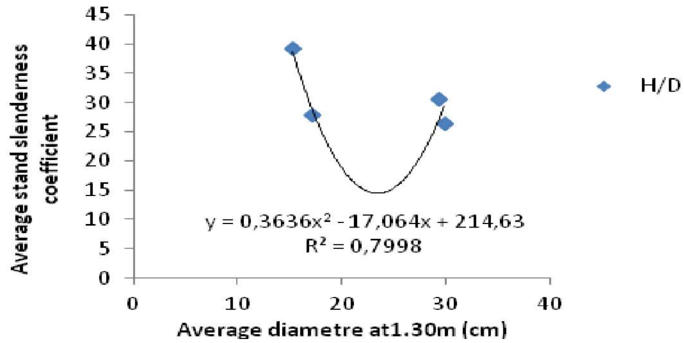

Fig. 1. *Slenderness coefficient as a function of average stand diameter.*

According to the previous results, the slenderness coefficient is a negative function of the mean diameter. The coefficient of determination $r^2 = 0.7998$ of the trend curve means that only 21% of the observed values are not explained by the trend curve. There is therefore a relationship between the average diameter and the average height of the natural regeneration stand, which we will try to formalize with the graph in figure 2.

According to the coefficient of determination, 99% of the observed height values are explained by the trend curve. We can then use this curve to predict the average height of a stand of natural regeneration left to itself if the average diameter is known.

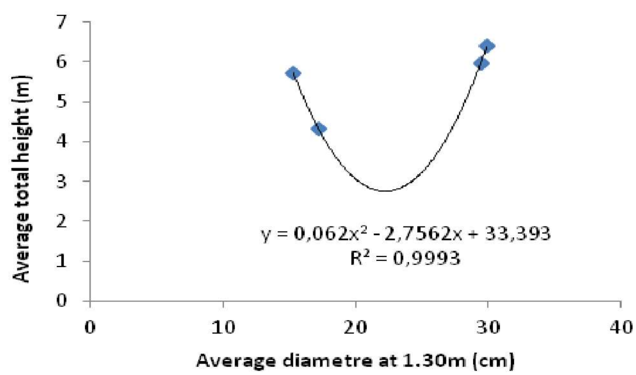

Fig. 2. *Average total height versus diameter at 1.3 m in the stand.*

The natural regeneration is presented by the young wood of less than 5 cm of diameter at man's height, thus of not yet measurable basal surface. It corresponds precisely to the state of the thicket. As in the previous studies, the study of natural regeneration of Pinus halepensis will be done in increasing order of average stand diameter. The study of natural regeneration consists of analyzing the abundance and spatial distribution of these young woods in the different *Pinus halepensis* stands inventoried. The natural regeneration of two stands with an average diameter at 1.3 m lower than 17cm, namely those of plots 1 and 4, is low. We can say that the abundance of regeneration decreases when the average diameter increases in these two stands. This may mean that these shrubs in the thicket state are not from the regeneration of the stand in which they are found. The diameter class at 1.3 m less than 5 cm is empty in the stands of plot 2. However, it should be noted that plot 4 contains too little regeneration (Table 2). This can be explained by the fact that in a naturally regenerating stand without any intervention, the trees all reach the measurable diameter at 1.3 m from 12 cm.

Table 2. *Regeneration and mortality rates.*

Plots	Mortality rate	Regeneration rate
P1	0	14.29
P2	3.23	0
P3	11.11	5.56
P4	0	15.9

CONCLUSION

The use of Aleppo pine in reforestation for timber production will not only be a way to value the various qualities of its wood, but also a way to diversify the products on the timber market and a way to protect the bare soil of the highlands. Due to its interesting physical-mechanical properties, the wood of *Pinus halepensis* has a multitude of possible uses that classify it in the category of quality woods. This species is particularly successful in the study site, with rapid growth and successful natural regeneration.

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