

# The Importance of the Soil's Occupation, of the Recovery and the Living Space of the Main Forest Species in the Sustainability of the Forest Areas of the Mountains of Dhaya and Mountains of Saïda (West Algeria)

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**Abstract:** The study of the forests structure in the arid Mediterranean zone informs on their resilience and durability. The assessment of three parameters identified as critical in the understanding of this resilience, and these the overall occupancy rate of the soil by perennial vegetation, the recovery rate by stratum and living space of the defining species, is useful for understanding the dynamics of these plant formations.

This evaluation was conducted in two bioclimatics most dominant in Algeria and throughout the Mediterranean basin and allowed to have results to classify the strata according to their importance with respect to these three criteria.

It follows from the appreciation of the parameter recovery by stratum that the tree layer and shrub play a determining role in the semi-arid and sub-humid floors. In the estimation of the occupied soil it is shrub strata for the semiarid and tree layer for the sub-humid.

The vital space per species depends on its density and its regenerative capacity, for the eight dominant species and main characteristics of the forests formations it ranges between 28 and 222 square meters depending on the species inducing misconduct densities and silviculturals.

It is necessary to undertake work planting or silvicultural intervention to preserve these strata with the component species to be sure to provide stability to the formations under study.

**Keywords:** Recovery, vital space, forest species, perennial vegetation, mountains of Saïda, mountains of Dhaya (western Algeria).

## INTRODUCTION

Being threatened by fire, herds and drought, the sustainability of forest formation in Algeria remains a challenging concern. In addition to such degrading factors, there are also the unfavourable physicochemical characteristics of soil (which consists in a low water holding capacity, a poor organic matter as well as a structural instability). The survival of these forest formations is conditioned by the rate of covering, the land use and the living spaces that are necessary for key species. These latter three elements are significant indicators that call for an appreciation of the features that reveal the importance of both ecological and economic forest formations [1].

The covering rate resulting in the species' occupation of living space determines the habitat so vital for each individual timber plant living. Also, it is a reference parameter that assesses both the vitality and the resilience of species to environmental conditions.

These data are important for the Mediterranean region because they directly depend on constraints and anthropogenic climate change. Moreover, it is possible to identify plant species that may play a role in the sustainability of forest formations.

In Algeria, the concentration of more than 80% of forest cover in the semi-arid bioclimatic justifies the study of the species average distribution in living space besides strengthening the role of density in ensuring the survival of these plants. In this regard, Benabdeli [2] notes that, "Recovery rate and actual occupation of land in forest formations help identify the best planting densities and stands education.

## EXPERIMENTAL DESIGN

In each bioclimatic stage and according to the plant grouping type being identified, ten plots of 10 square meter each were delineated and were used for assessing the rate of land by woody plant species contributing to the sustainability of forestry groups. The parameters evaluated were the occupation of space by persistent plants, the recovery per stratum and the living space reserved for each species. This would

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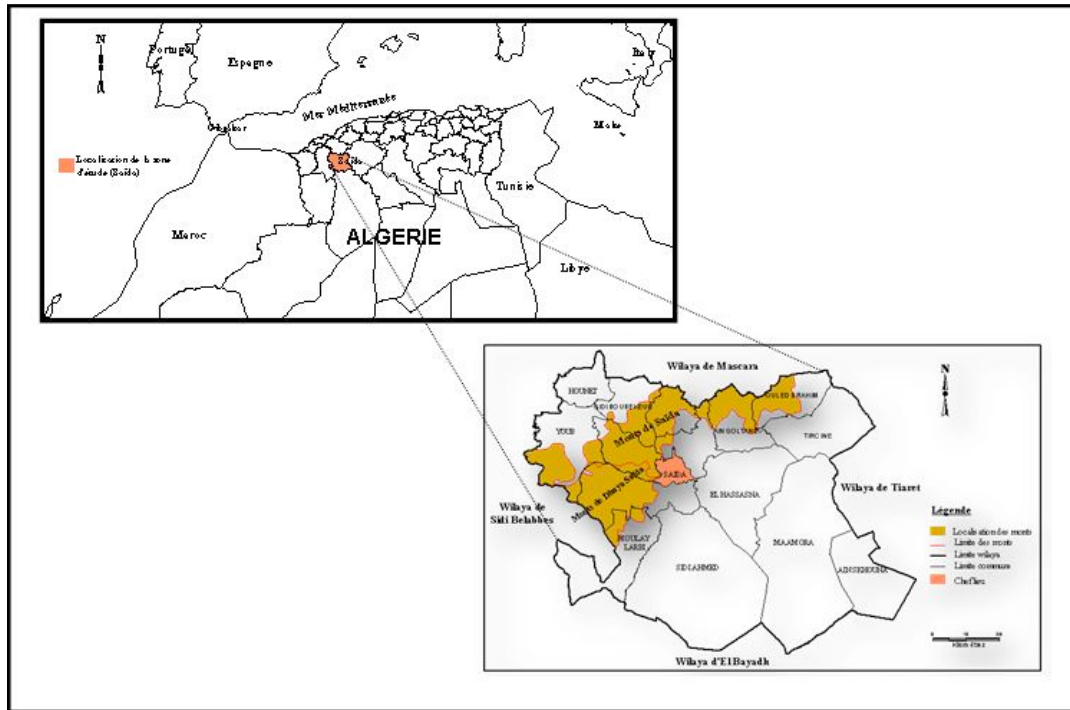


Figure 1: Delimitation of the Study Area (the Mountains of Dhaya and Saïda).

Table 1: Occupancy Rate of the Soil by Stratum and Bioclimatic Stage

Strata	Semi-arid Stage			Sub-humid Stage		
	minimal soil occupation rate			maximal soil occupation rate		
Arborescent	17%	to	7%	28%	to	13%
Shrub	23%	to	8%	31%	to	23%
Under shrub	25%	to	10%	26%	to	9%
Total	65%	to	25%	85%	to	45%

allow for a better understanding of the behaviour and dynamics of the major forest formations.

Evaluating these three parameters is crucial to assess the forest formations' potential for resistance to various attacks such as by the anthropogenic climate change. This evaluation was done to calculate the land occupation considering all ground species. The space occupation is found by subtracting the remaining part of the bare ground. Evaluating the living space is achieved by dividing the area according to the number of dominant species that represent the backbone of the vegetal formation.

The plant communities where the three parameters have been described are for the bioclimatic semi-arid stage for a forest of Aleppo pine and cedar and a forest of Aleppo pine and oak. For the sub-humid bioclimatic stage, there are coppices of oak and juniper and oak

coppice with standards of Aleppo pine and holm oak. These are the most dominant forest formations in the forest area of the Dhaya Mountains and Saïda mountains.

## RESULTS

The main results obtained concerning the occupancy of space, the rate of land by strata as well as the living space reserved for the main species inform of some techniques to apply including restocking, replanting and cutting.

### 1. Space Occupancy Rate

This is a critical parameter in determining the aspect, the increase, the structure and dynamics of forest formations. It results in an assessment of the recovery rate of each species and each stratum by the

projection of the total biomass of the species on the ground. It will confirm the impact of other parameters on the identification and determination of physiognomy [3].

The rates occupied by each woody species helps understand with some precision the concepts of presence and especially the stability of species.

As shown in Table 1, whatever the plant grouping and the bioclimatic stage to which it belongs, the rate of land through all strata combined varies between 45 and 65% but with a minimum of 25% and a maximum of 85% the results that confirm studies by Benabdeli [4]. These rates are relatively interesting taking into consideration the harsh climatic and anthropogenic conditions. The study of the distribution of occupancy of the soil by stratum and bioclimatic stage will help identify the role of stratification.

The average percentage of land in each stratum is summarized in Table 1.

Whatever the type of plant formation and its dynamics - that arise from work or other kind of pressures exerted on it – it seems that only the forestry groupings of the sub-humid bioclimatic stage offer the best rate of space occupation in all the strata. This is due to the importance of the slice average annual rainfall received and soil quality (soil depth, organic matter content, species composition).

The values obtained confirm the important role of the shrub layers and under shrubs [5] in the fight against erosion, the stability of the vegetation cover, the sustainability and the protection of phytocenosis despite the attacks experienced besides constantly unfavourable environmental conditions affecting 80% of the area for almost nine months out of 12.

The above findings are used to classify the strata according to their importance for the recovery of the global ground. This classification highlights the interest

of the physiognomic aspect of forestry groups imposed by the role of each stratum:

<b>Semi-arid Floor</b>	<b>Subhumid Floor</b>
1 – Under shrub Stratum	1 - Shrubs Stratum
2 - Shrubs Stratum	2 - Arborescent Stratum
3 – Arborescent Stratum	3 - Under shrub Stratum

The importance of the shrub layer in the semi-arid should be stressed out, which is due to the low covering of the tree layer induced by a low density. The resistance and the power to reject a high percentage (60%) of species in the under shrub stratum makes it possible for the semi-arid to have an occupancy rate of the high space. In the sub-humid bioclimatic stage, the under shrub stratum is almost completely eliminated by the remarkable high rate of soil occupancy of the two other strata. The shrub stratum dominates because individuals composing it are much covering and rapidly growing.

**2. Overall Recovery Rate per Stratum**

The following indicator does not overlap with the previous one as it represents the projection of the biomass of all species on the ground and can exceed 100% because there is an overlap between species belonging to different strata. On the other hand, the rate of space occupancy is limited to the land and shall in no event exceed 100%. By stratum or all strata combined, this rate expresses the dominance of a stratum or component species over others. This helps impose a special character in a plant formation based on their fluctuation [6].

The results reveal the dominance of the arborescent stratum in the semi-arid and the shrub stratum in the sub-humid. This is summarised in Table 2:

Following the importance of the recovering rate, the classification of strata by bioclimatic stage is different as compared to the level of soil occupation. This is summarised below:

**Table 2: Recovering Rate Per Stratum**

Strata	Semi-arid Stage		Subhumid Stage		Mean	
Arborescent	42	to 94%	33	to 97%	65	to 68%
Shrubby	11	to 43%	51	to 127%	45	to 89%
Under Shrub	22	to 67%	7	to 15%	11	to 27%
Total	76	to 204%	91	to 239%	140	to 165%

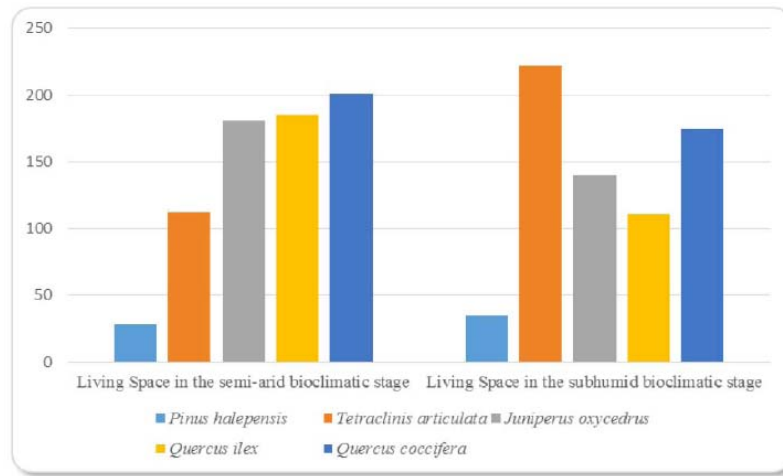


Figure 2: The vital space according to species.

**Semi-arid Stage**

- 1 - Arborescent Stratum
- 2 - under shrub Stratum
- 3 - shrubby stratum

**Sub-humid Stage**

- 1 - layer of shrubs
- 2 - Arborescent Stratum
- 3 - Under shrub Stratum

In every bioclimatic stage, some strata are dominating and are linked to the role that the level of soil occupation in each stratum plays. Likewise, the floristic composition and its distribution per stratum have an impact on the importance of species with a high recovery rate. The arborescent stratum is important in semi-arid bioclimatic stage whereas in sub-humid stage the shrubby stratum dominates.

The success of restocking and reforestation of degraded forest areas must comply with a choice of species as belonging to a given stratum.

**3. Living Space of the Main Species**

The structuring of forest formations usually abides by a ranking of species according to their distribution and to the surface already reserved, or being reserved by man in their silviculture, for each species [7]. The results help explain the structure and physiognomy of vegetation. In the semi-arid the average area available to each tree is 16 m while it is only 7 m in the sub-humid, this notion of living space varies in the semi-arid from 7 to 25 m<sup>2</sup> and from 3 to 11 m<sup>2</sup> in sub-humid as well as by individual tree planting stage.

This is an important parameter, all individual young plants have equal opportunities to grow quickly but they compete for space (soil, water and light). The struggle for life will be decisive on any surface. A population grows to the maximum as allowed by the density and by the space left by people who may vacate it.

The average weight of a population of plants would be bound, through a precise mathematical relationship, to their density on a given area. This is reflected in the work of Harder [8] where a line called "thinning right":  $\log W = -1.5 \log d + \log k$  is  $W = kd^{-1.5}$ . With W: average weight of dry matter of an individual occupying one square meter (virtual weight of an individual, often those with a circumference of a meter), d: the density per square meter. Only the intensity of light is able to change the position of the right, any change in other factors implies a change of speed in the progression of the right. Thus the living space is a fundamental that must be mastered to understand the development of individuals of each plant community.

The management of the living space can help control the thinning that enhances the well-planned harvest leading to the development of vegetation formations while increasing the increment of individual plants in diameter and so in volume. The number of subjects to be removed depends on the local ecological potential of gasoline, population age, density in site, and of the targeted objective. Devaux's [9] definition of the thinning is to make less tight a forest population by removing the subjects from the main species, leaving the trees tight enough to fill the timber and spaced enough for tree to grow well.

The management of this vital space follows some basic parameters which are: the nature, type, the weight, the character, the rotation and the woody material in site. Nature can be quantitative or qualitative. The type consists in the ratio between the volume of the average tree harvested and the volume of the average tree before cutting. The weight is the volume taken from the unit area during a single

intervention, that is, the ratio of the volume removed at once and the volume up before intervention. The character includes the nature, weight and type. The cut represents the expression of the treatment. The rotation is the frequency of cuts. The growing stock is the number of bolt according to the dominant height and intensity is the ratio between the average annual volume taken during the cuts and the total annual increase that has maximum volume.

The living space available here is an instrumental value because it allows us to appreciate the potential of the station and provide information on the structure of plant species [10]. All the economic and even ecological aspect of the main plant species is determined by the density which is a reflection of the living space available naturally or artificially each from individual plant.

It provides information on the density, structure and even the physiognomy. The more species have at their disposal a large living space the more a plant shows interesting biometric parameters (height and diameter mostly). Devaux *et al.* [6] who studied the compared structure of Aleppo pine population notes that the living space available to the Aleppo pine averages between 19.7 and 8.2 square meters. Parde [7] states that for an optimal timber production, thinning is necessary in increasing the living space and evaluating the density at 200 subjects per hectare to an age of 70 which is equivalent to 50 square feet per tree. By studying the thinning to be applied in a stand of Aleppo pine in the forest of Nesmoth (Mascara), Maachou [11] recommended for ages 50, 60, 70 and 80 years respectively the densities of 420, 350, 275 and 120 individuals per hectare.

In the area under study, the species of the arborescent stratum have in the semi-arid and sub-humid stage a living space o fluctuating between 28 and 201 m<sup>2</sup> as confirmed by Table 3, Figures 2 and 3.



Figure 3: The vital space for *Pinus halepensis* in the subhumid bioclimatic stage in the forest of Nesmoth (Mascara), (January 2010, Photo KEFIFA).



Figure 4: The vital space for *Pinus halepensis* in the semi-arid bioclimatic stage in the forest of Balloul (Saïda), (April 2011, Photo KEFIFA).

The exploitation of these results confirms the role of recovery rate for each stratum in the choice of living space allowing species to develop and adapt to environmental conditions. The living space of the few species studied remains high in the semi-arid bioclimatic stage, i.e., over 20% in average in relation to the sub-humid floor. These figures may be a reference to justify the choice of density in relation to environmental conditions in the study area for all development operations (planting, restocking and

Table 3: The Vital Space According to Species

Species	Living Space in the semi-arid bioclimatic stage	Living Space in the subhumid bioclimatic stage
<i>Pinus halepensis</i>	28	35
<i>Tetraclinis articulate</i>	112	222
<i>Juniperus oxycedrus</i>	181	140
<i>Quercus ilex</i>	185	111
<i>Quercus coccifera</i>	201	175

thinning). The optimum densities observed in the different plant formations of the mountains of Dhaya and the mountains of Saida (western Algeria) fluctuate between 160 and 446. This is compared to planting densities in the reforestation and restocking which are currently 2,600 plants per hectare. Lessons are to be drawn as to the high rate of failure of these actions. In 1996, Benabdeli [5] declared in this context that the high densities are the source of competition for pure water resulting in major failures.

These results support the choice of a density linked to the rainfall range in order to ensure sustainability in forestry groupings and in reducing competition.

## CONCLUSION

The importance of controlling the three parameters; land rate, recovery rate and living space (by stratum and by woody species), so often neglected in the description of forest stands, should not be neglected in the management of forest formations as they play a major role in the dynamics and evolution of forest vegetation.

The study shows also that it is possible through the assessment of these parameters to correct technical errors often made in the choice of species (stratum), planting density and silviculture.

Both the ecological and economic impacts of these guidelines are significant in more than one way and will ensure continuity in forest formations by the application of techniques specific to each type of group.

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