

CHARACTERISATION AND ASSESSMENT OF THE DECLINE OF THE OULED BECHIH FOREST (ALGERIA)

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ABSTRACT

The establishment of the state of the massif by a diagnosis on different forest plots is part of a project of monitoring and silvicultural management. The purpose of this study is to assess the health status of the Ouled Bechih forest. The methodology used was the visual assessment of the tree crown of the dominant species (i.e. *Quercus suber* and *Quercus canariensis*) according to the protocols DEPEFEU, DEPERIS and ICP Forests. These protocols were selected for adoption based on field observations and their applicability in record time. The results obtained indicate that the health status of the trees within the studied plots is declining. The DEPEFEU value index shows an average of 1.75 for *Quercus suber* and 2.6 for *Quercus canariensis* while the DEPERIS has an average level of 2.36 *Q. suber* in and 3.37 in *Q. canariensis*. ICP Forests has also contributed to providing clearer information on the consequences of this health situation by deducting an average visibility rate of 1.20 and 2.63; social status of 1.17 and 3.11 and competition of 1.11 and 2.49 for *Q. suber* and *Q. canariensis* respectively. In general, the health status of the tree crown is average and almost adapted to the environmental conditions. In contrast, the carrying capacity of biodiversity is low and needs to be improved.

Keywords: *Q. suber*, *Q. canariensis*, DEPEFEU, DEPERIS, ICP

INTRODUCTION

The importance of forests no longer needs to be demonstrated from an economic, ecological, aesthetic or cultural point of view, but great attention must be paid to preserving them. In the alarming context of climate change and drastic erosion of biodiversity, the need to sustain the ecosystem services offered by forest ecosystems is indispensable. It is therefore important to monitor forest areas in order to assess their state of health and try to identify the precise causes of any decline.

At present, many natural Mediterranean forests and reforestation areas are out of balance. Many outbreaks of dieback have been reported in recent years. Among the main forest species affected by the phenomenon are the Atlas cedar in Morocco and Algeria [1], several pine species in Morocco and France, some oak species



(especially cork oak) in France, Spain, Portugal, Morocco and Algeria [2], beech and fir in France.

The estimation of these symptoms is standardized by using the DEPEFEU protocol, developed by the Forest Health Department [3]. This protocol allows the assessment of the condition of deciduous tree crowns on several criteria. The main ones are crown transparency, mortality of perennial organs (branches) and leaf mass distribution [4]. The primary objective is to estimate the health status of the Ouled Bechih forest through the health assessment of a set of plots considered as representative of the forest's condition.

MATERIALS AND METHODS

Presentation of the study area

Forest of Ouled Bechih is located north of Souk Ahras (Algeria). The study area is located between the coordinates 36°21'26" north latitude and 7°50'08" East longitude. It covers an area of 6582 ha, mainly composed of *Quercus suber* and *Quercus canariensis*. This region is characterised by a sub-humid climate. The average annual temperature is 16°C and the average annual rainfall is 625 mm, with an atmospheric humidity of 68%. The altitude of the Ouled Bechih forest varies from 790 m to 1050 m, with slopes of over 15%.

Assessment of the health of forest plots

The assessment of the crown condition by specific protocols makes it possible to characterize the stages of decline of each individual observed [5]. In order to characterize the health status of Ouled Bechih stands, the DEPEFEU, DEPERIS and ICP forests protocols were used to assess the condition of *Q. suber* and *Q. canariensis* crown trees. As the season does not allow the use of all the criteria proposed by Nageleisen [6], the criteria represented in Table 1 were used.

The hardwood dieback protocol (DEPEFEU) is used to assess the dieback of hardwood forests based on a multi-criteria description of the crown. It is based on the observation from the soil of symptoms giving information on the crown health status. Three symptomatological criteria can be distinguished: crown transparency, mortality of perennial organs (branches, twigs) and leaf mass distribution. Each of these symptom categories is divided into sub-categories (Table 1), symptomatological criteria to be observed in the upper crown of trees (adult trees of the dominant stage) in order to make a dieback rating.

Table 1. Notations used for the DEPEFEU method [6].

Note	Frequency	Number	Number	Indicative (%)
0	Absence or trace	None to very low	0 to a few rare	0-5
1	Low	Low	A few to a small number	6-25
2	Somewhat strong	Moderate	Somewhat numerous	26-50
3	Strong	Important	Many	51-75
4	Very strong	Very important	Very numero	76-95
5	Total	The entire rated party concerned	Total	96-100

To conclude, the sustainability of a forest ecosystem is closely linked to its health. The diagnosis of the health status of *Q. suber* and *Q. canariensis* stands in the Ouled Bechih forest is based on field observation of individuals of each species and on three methods: DEPEFEU, DEPERIS and ICP Forests. The interest of this study is the characterization of the forest stands of this forest. However, the comparison remains difficult because the dominant species on the plots studied is not the same.

This method allows the assessment of forest dieback based on a multi-criteria description of the tree crown [7]. The results show that the majority of cork oak trees are classified in class 2 with a percentage of 49.12%. A significant proportion of trees are in class 3 (29.82%) and the percentage of trees in class 1 is the lowest (21.05%). Trees in classes 0 and 4 are non-existent; this is explained by the absence of dead crowns and trees with no symptoms. The health status of this species is therefore good as the presence of dying trees is quite low.

In the plots, it can be seen that the majority of the trees of the *Quercus canariensis* are classified in category 2 with a percentage of 70% where the symptoms are totally absent (Table 2); whereas the crowns of the trees in plot 3 are dying and show 30%. The health status of this species is therefore good. The health status of this species is therefore good.

Table 2. Number of trees in DEPEFEU classes for both species.

Plots	Species	Fully visible	Partially visible	Against the light	Not visible
P1	<i>Quercus suber</i>	17	11	18	0
P2		17	22	59	0
P3		58	32	0	0
P4		8	36	24	0
P1	<i>Quercus canariensis</i>	0	0	0	0
P2		0	0	20	66
P3		0	0	20	22
P4		0	0	60	12

According to the above results, the overall tree crown condition is good for the *Q. suber* and *Q. canariensis* in the Ouled Bechih forest. Visibility refers to the possibility to observe the crown optimally, i.e. in a side view at an angle of about 45° [8]. Figure 1 shows that 21.05% of the trees have a fully visible crown. The crowns are partially visible for 49.12% of the oaks. The remaining part of the oaks has backlit crowns (29.82%). The closer a tree is to its neighbours, the lower the visibility. In dense stands, it becomes very difficult to see the upper part of the crown. Therefore the trees in the plots are in a form of thinning.

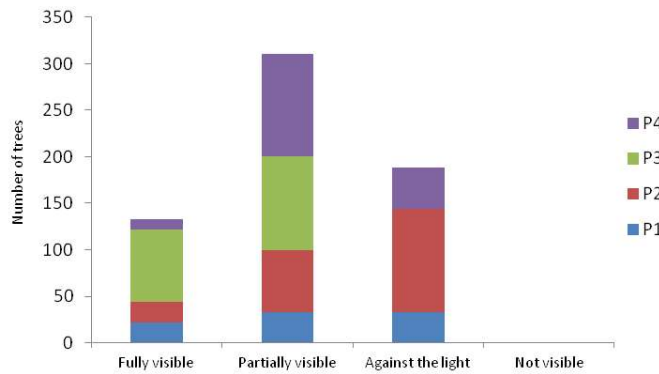


Fig. 1. Distribution of trees by visibility level.

The situation of trees in relation to the neighbouring. This information is used to interpret the condition of the crown and its sensitivity to stress [9]; [10]. Figure 2 shows that the majority of the trees are under-dominant or dominant with 31.58% and 29.82% of the trees observed respectively. About 29.82% of the oaks are subdominant and 8.77% are codominant. According to [11]; [12], dominant trees are supposed to be more sensitive to stresses than codominant trees, which are better inserted in the canopy mass. From the results obtained in our experiment, we can say that most of the trees are less sensitive.

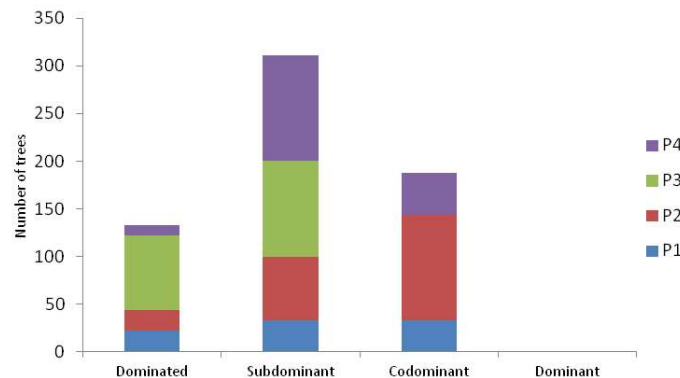


Fig. 2. Distribution of trees by social status.

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Competition is defined as the space available for crown development [9], [13]. The majority of oaks have two or three sides of their crown in contact with other crowns, respectively 37.77% of the trees (Figure 3), and the crowns that are more competitive (four sides) represent 10.53% of the cases.

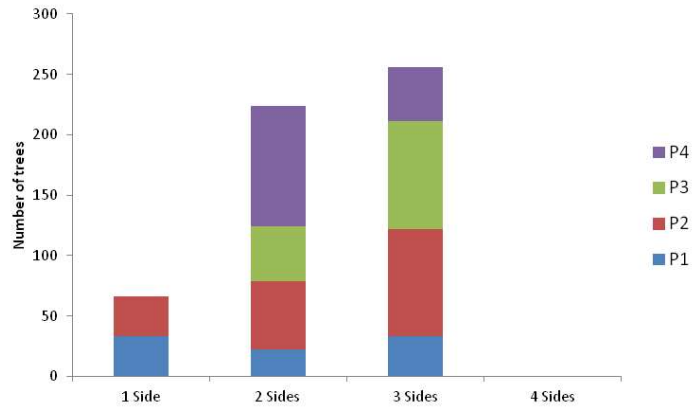


Fig. 3. Distribution of sampled trees according to shade levels.

The discoloration is defined as any alteration in the normal colour of the foliage of the species observed, either in hue or in the distribution of that colour. Trees with normal discoloration make up 33.33% of the observed trees, 49.12% have a light discoloration, 12.28% are trees with Moderate discoloration and 5.26% of the trees are subject to strong discoloration (Figure 4).

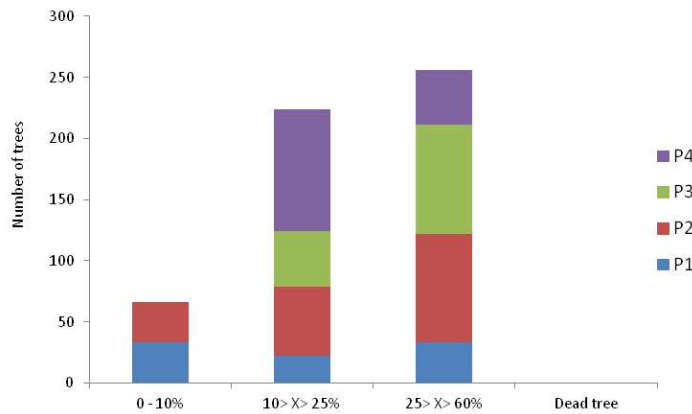


Fig. 4. Distribution of sampled trees according to the level of discoloration.

CONCLUSION

The results obtained from the different indicators and criteria used to determine the health status of the Ouled Bechih forest indicate the possibility of a health crisis in the study plots, which worsens over time. This health plan calls for further analysis of the contribution of the various potential decline factors - be they soil, global changes, silvicultural treatments and/or logging. And to take the necessary management measures. It would be interesting to develop more comprehensive method of characterising the health of hardwoods and trees in general, taking into account, for example, the condition of the crown and trunk, productivity, local causes of dieback through physical and chemical soil analyses and together with analysis of starch reserves and the impact of game, will be considered.

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