Regeneration of Quercus Forest after Fire Under the Influence of Ecological and Environmental Parameters

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Abstracts: Fires are one of the major disruptive factors for all forest biomass. The study was carried out at the level of the Algerian Northeast region, where forest sites of Souk-Ahras are remarkably materialized by the species: Quercus suber and Quercus canariensis. The regeneration problem analysed after fire took into account the effects of natural environmental parameters, namely temporality, frequency of individuals and topographical parameters such as exposure, slope and altitude. The results show a very small and relative change. However, the cumulative actions of these latter must be checked by the intensity of the fires, by the energy and the kinetics of combustion in order to be able to pronounce on the possible temporality to the regeneration. Thus, it turns out that the frequency parameter depends closely on the storage and the arrangement of individuals, as this, could give the necessary time for cells to no longer have the ability to function for regeneration. For the topography parameter, regeneration is observed from the altitude 800 m. And, by combining the exposure sub parameter, we concluded that the regenerated parts benefited from better radiation.

Keywords: Fires, Regeneration, Quercus Suber, Quercus Canariensis, Ecological And Environmental Parameters.

1. INTRODUCTION

Events as they affect forests remain a complex concern. Their severity, in consequence, including fires, has made the management of natural resources very difficult and fruitless, even too costly. Work in the world has been developed without demonstrating the effectiveness of certain parameters offering a favour of dynamics, regeneration, for forest recovery after fires. Trabaud, in the Mediterranean region, during the years 83 and 92, specified certain types of calcareous forests (garrigues) where regeneration is generally less dynamic than on siliceous soils, the same results are found by (Cherifi, 2017; Ouadah et al., 2016; Melouani, 2014; Bekdouche, 2010; Jacquet and Cheylan, 2008) in Algeria, (Jaziri and Baccouche, 2020; Abaza, 2015) in Tunisia, (Cherki and Gmira, 2013) in Morocco.

The idea is aimed at observing in synchronicity whether certain parameters are linked in a direct or indirect way to promote the recovery of the forest burned. This refers to combining a multitude of parameters such as the frequency of individuals, the topography of forest places quite related to ecological conditions such as altitude, exposure and slope. It turns out that regeneration is very poorly recognizable depending on temporality and some other environmental factors. Notwithstanding this, some tree species such as Quercus suber and Quercus canariensis have shown a pilot ability in relation to other species as being partial information on the onset of change.

The reflection is then clarified through the reading of a number of stations and a simple method of counting the regenerated individuals according to the temporal classes, the frequencies of the species, while checking their links to the topography and its hazards (Exposure, Altitude and Slope).

1.1. Issue

The management of the forest requires not only adequate means but also a state-of-the-art technicality for its maintenance and restoration especially after fires. The absence of fire forecasts and preparations only increases the risk of losing the forest heritage. Faced with this, many questions are crowded in order to inform us about the possibility of recovering the forest material through one of the parameters engaged as ecological or environmental order through regeneration?

1.2. Objective

The main objective is to highlight the report: the regeneration of species and the effect of some ecological parameters specific to the forest in the face of constraints in order to be able to decide on their relevance as regards the recoverability of forest cover, adopting the following expression:

Recovery rate = N.Population / (T x Fr x To / Alt x Exp x P) :

Which :

T = variable expressing temporality by year class;

Fr = variable expressing the frequency of regenerated individuals either by time class, by altitude and slope class;

To = is the topography which is a constant within the combination=1;

Alt = variable expressing the altitude class taken into account in (m);

Exp = is the exposure constant within the combination=1;

P = variable expressing the grade of the slope taken into account as a percentage (%)

This is the denominator of the expression expressing the product of the environmental parameters involved in relation to the number of regenerated population (PND) as a numerator denoting the level of recoverability of the estimated forest canopy.

1.3. Description Of Study Area

The study area is located in the extreme north-east of Algeria on an area of 4359.65 km2. It is bounded in the North by the wilayas of El-Tarf and Guelma; in the West by the wilaya of Oum Bouaghi; in the South by the region of Tebessa and, in the East, by the Tunisian border on a band of 88km (Figure 1; SRAT "Regional Strategic Planning Document" 2021).

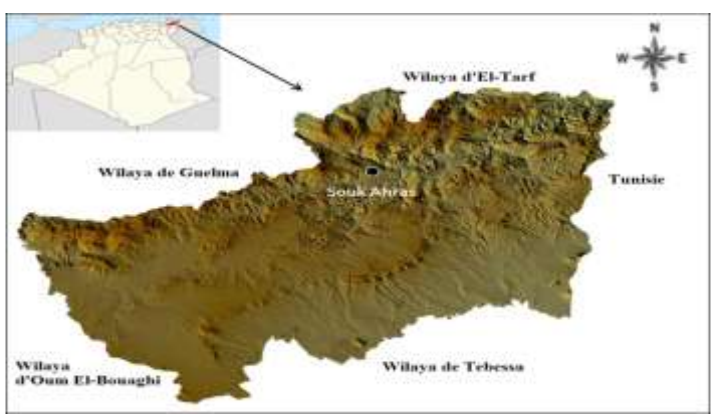

Figure 1: Location map of the Souk Ahras region.

To the north, it is characterized by irregular precipitation averaging 700 mm per year and average temperatures of 3.7°C and maximum 33°C (Souk Ahras Weather Station 2021). The accompanying level of freshness marks a great impact on the functioning of all plant cover. The rugged terrain (0 to 30% slope) consists of many micro-slopes of varying exposures. The maximum altitude is 900m. The reading area is characterized by a subhumide winter temperate bioclimate. Finally the suberasy is represented by the dominance of Quercus suber and Quercus canariensis to the forest of Mazraa, Ain Seynour, Mechrouha and Ain Zana.

2. EQUIPMENT AND METHODS

2.1. Material

The nature of the investigation is based on a direct field reading operation for which we judged the use:

-Field sheets divided into two parts, one of which is for the data relating to the survey station (Exposure, Slope, Altitude, Geographical coordinates, Nature of the mother rock-(RM)- and other factors such as presence-absence of anthropogenic factors, Litter thickness, presence-absence of mosses and lichens, and the date of the surveys).

The other is specified for the phytosociological inventory of species with abundance notation – relative dominance of each plant species on the scale of (Braun-Blanquet 1959).

2.2. Methodology

The analysis and estimation of vegetation was carried out using the principle proposed by Braun-Blanquet (1959). This is the most accurate of the vegetation classification systems (Gounot, 1969).

The surveys themselves include a list of all the species present, with for each species a notation of abundance – dominance, as well as geographical and ecological indications of the station studied. In El Mazraa and Aïn Zana, we delimited 100 m2 quadras during the growing season and counted the number of regenerated individuals of the two main species that make up the forest.

The data collected was processed using the MINITAB.17 software.

3. RESULTS AND DISCUSSIONS

3.1. Regeneration As A Function Of Temporality

The analysis of the variance, “P = 0.36”, (Table 1), as well as the Fisher test (Table 2), show that the temporality as a whole is classified in group A “the same group of means” of which - there is no significant difference. This proves that temporality, taken into account in different classes, does not sufficiently explain the regenerative capacity. In addition, a number of regenerated Quercus suber individuals, ranging from 0 to 13 wood individuals per 7 regenerated individuals. The fact is read as a particular or stereotyped case. However, this beginning of regeneration allows us to raise the question that is not referred to: «how long could the vegetation regenerate after the fire?». These results can largely corroborate the findings of (Noël, 2001).

Table 1 : Analysis of variance according to temporality.

Source	DF	Adj SS	Adj MS	F – Value	P – Value
C1	2	4,176	2,088	1,04	0,369
Error	22	44,064	2,003		
Total	24	48,240			

Table 2 : Fisher's test (comparison of variances).

C1	N	Mean	Grouping
20 ans	6	1,17	A
9 – 12 ans	13	0,462	A
1 – 5 ans	6	0,000000	A

The regenerated individuals of Quercus canariensis, inform that after 20 years, very few individuals have resumed their vegetation in the same way 5 years and 9-12 years. Exceptional cases are visible in two temporalities: 9-12 years and 20 years (Figure 2).

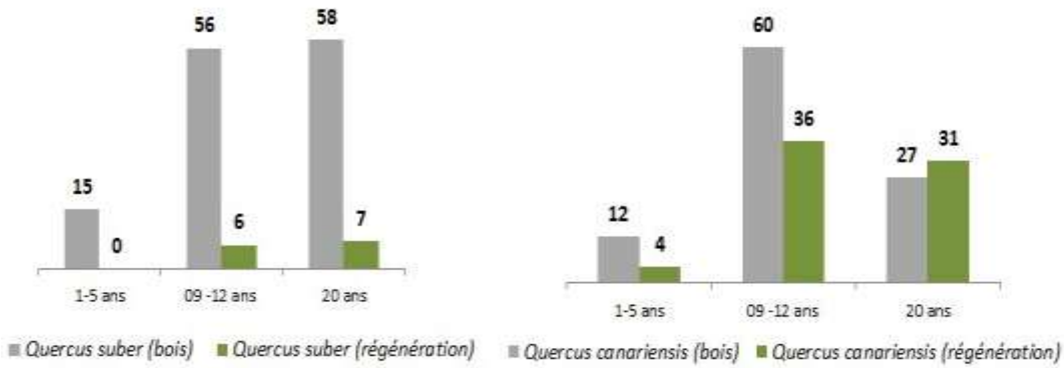

Figure 2: The regeneration of *Quercus suber* and *Quercus canariensis* according to temporality.

Some researchers have described that tree regeneration is observed variability after months or years after fires. For some trees, the regeneration time is significantly longer. The estimation of the resilience of the forest species using the functional triangle of fire, it is highlighted the three forces of the challenge fire: the combustible substances of the plants, heat and oxygen (Jacquet and Prodon, 2007; Bergeron and Le Goff, 2005; Bergeron et al., 1998; Meddour, 1992; Trabaud, 1983; Van Wagner, 1972).

The onset of very slow change (for 20 years) is due to other important ecological forces factors such as: Slope, altitude and exposure. (Fisher Individual 95% Cis test; Figure 3).

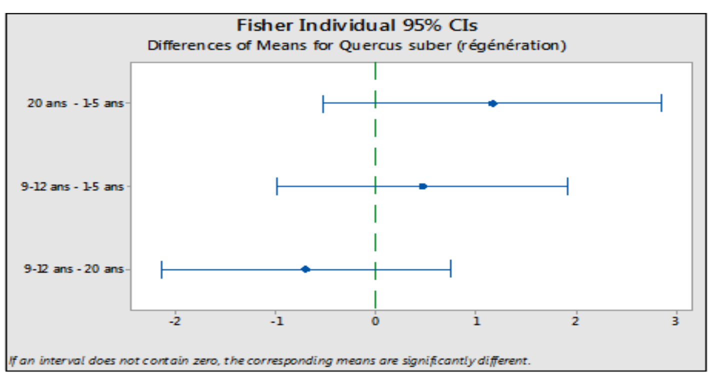

Figure 3: Linear interval graph according to the Fisher method.

3.2. Regeneration as a function of frequency

The relative frequency of Quercus suber and Quercus canariensis

Following the analysis of the variance for regenerated Quercus suber and Quercus canariensis, the difference is not significant “P = 0.8” (Table 3), which does not explain the relationship between the distribution of species - the intensity of fire influencing the number of species and - the regeneration occurred.

Table 3 : Analysis of the variance of the relative frequency of the two regenerating forest species.

Source	DF	Adj SS	Adj MS	F - Value	P – Value
Regression	1	0,0247	0,024748	0,03	0,864
Quercus canariensis (régénération)	1	0,0247	0,024748	0,03	0,864
Error	53	44,2753	0,835382		
Lack-of-Fit	52	44,2753	0,851447	*	*
Pure Error	1	0,0000	0,000000		
Total			54	44,30 00	

However, the regeneration of Quercus suber and Quercus canariensis is observed for some stations where the conditions for plant recovery may be more favourable (Figure 4). This may corroborate the results of (Bond and van Wilgen, 1996 ; Zasada et al., 1992 Ahlgren, 1960) where the soil surface would be a good indicator for the distribution of burned individuals as well as for regenerated individuals. In addition, the houppier of individuals who increase or reduce space and their volume facilitates the transfer of the flame from one point to another (Curt, 2010).

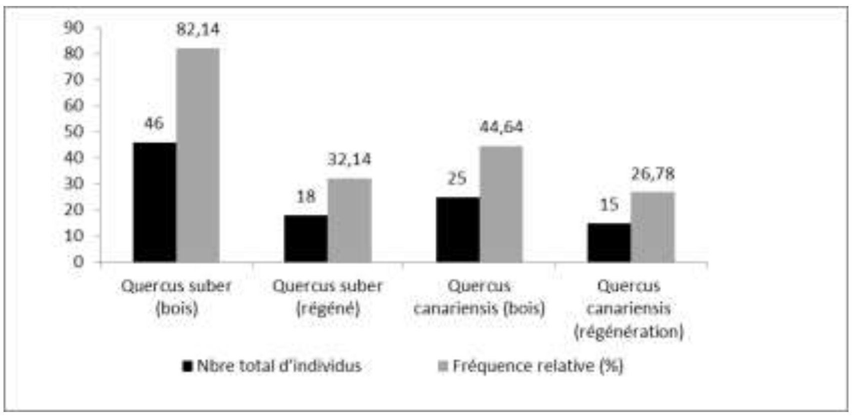

Figure 4 : Regeneration as a function of the frequency of the two pilot species.

Cork oak, considered a passive pyrophyte, burns because of its dense undergrowth, which is abundant and consists mainly of pyrophilic species of the family Cistaceae or Ericaceae) prolonging the duration of fires under cork oak (Photo 1).

Photo 1: Dense undergrowth under the *Quercus suber.* Photo Z. SOBEHI.

Indeed, (Quézel, 1974) points out that cork oak forests are most often open stands, invaded by a dense scrub promoting the spread of fire and presenting a particularly high fire risk. The continuity of the stratification of the vegetation in tree, shrub and especially herbaceous stratum in these stands, is at the origin of the great spread of fire. This tells us enough about the severity of the fire duration sustained by the canopy. It has the same similarity as subéraie in the study area.

The observed heterogeneity, distribution and shape of the houppiers of the two species Quercus suber and Quercus canariensis regenerated also remain related to other factors within the same ecological conditions.

The explanation of regeneration as a function of frequency is naturally due first to the storage of the procession of individuals on the right path of fire and second to the density of plant biomass. This imposes the duration of heat and combustion at a level such that individuals could not regenerate whatever the temporality or even the edaphic conditions of the places, because the reserves charged with the mechanisms of regeneration are completely destroyed.

3.3. Regeneration According To Topographic Sub-Parameters

Structural parameters were targeted; the topography of the burned area; exposure; slope and altitude.

3.4. Exposure

Nine (09) classes characterized the exhibition vision: East, North, Northeast, Northwest, West, South, Southeast, Southwest and Flat.

Observations on the two species Quercus suber and Quercus canariensis suggest that exposure plays a role not only complementary to slope and altitude but also a pilot role favouring a better gain of interest in radiation.

Analysis of variance indicates very low and non-significant variability (Table 4).

Table 4 : Analysis of variance for the exposure factor.

Source	DF	Adj SS	Adj MS	F – Value	P - Value
Regression	8	253,51	29,44	1,99	0,069
Quercus suber (bois)	1	11,18	11,18	0,75	0,390
Quercus canariensis (bois)	7	196,51	28,07	1,89	0,092
Error	47	696,49	14,82		
Lack-of-Fit	20	365,24	18,26	1,49	0,166
Pure Error	27	331,25	12,27		
Total	55	932,00			

Moreover, at several observed sites, we do not find regenerated individuals for both Quercus suber and Quercus canariensis. This corroborates the results obtained by (Jdaidi et al., 2017; Bekdouche, 2010).

3.5. Slope

Depending on the verticality, that is, theoretically the longer and flatter the slope the higher the percentage of regeneration. Indeed, more than 50% of individuals of Quercus suber and Quercus canariensis were observed in 0-5% slope regeneration.

The regeneration percentage of Quercus canariensis is very important for the slope 0%; case of station R32 where it reaches 86%. These results are consistent with those of (Jdaidi et al., 2017) in North-West Tunisia. However, regeneration characteristics are observed at the 10-15% slope scale where recovery is very slow.

In the sense of a better understanding, the action of forest fire could probably be explained by theoretical parameters relating to conduction, kinetic energy and convection of hot air.

3.6. Altitude

A percentage of 0.33% to 16% of individuals can be found in regeneration after fire. We observe that the reaction of Quercus suber and Quercus canariensis is cumulative at altitudes. It turns out that certain altitudes (800 m for example) can inform us about a change beginning (Figure 5). The contribution of freshness to altitudes acts positively for regeneration. Some work indicates that Quercus suber prefers wetlands (Jdaidi et al., 2017).

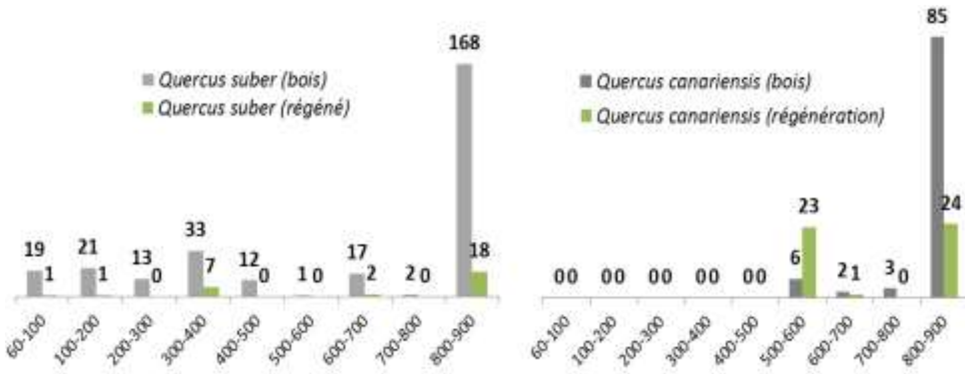

Figure 5 : Regeneration of *Quercus suber* and *Quercus canariensis* according to altitude.

3.7. Functional Combination Of Parameters For Regeneration

It is believed that regeneration is a combined phenomenon between the parameters of the following scheme and the environmental conditions of the environment concerned. In such an explanatory way, regeneration is a response of some plant species that have benefited from certain ecological favors such as altitude, exposure, as well as temporality which is not determined in number of years. The system combination oscillates between the parameters of the block diagram (Figure 6), the contribution of which is specific:

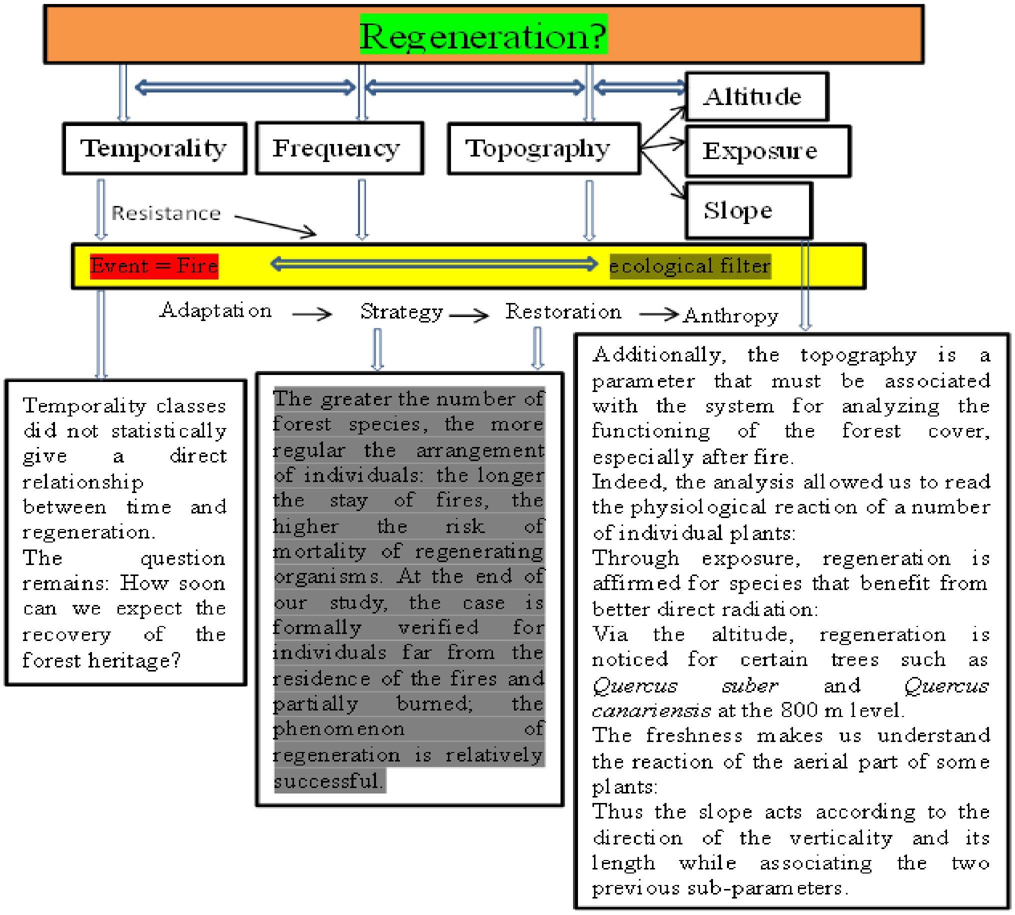

Figure 6: Block diagram of parameters in combination for regeneration.

-Temporality is a cumulation of years linked to the favor of a number of ecological conditions ;

-Frequency imposes its action through the storage of individuals, the density of the biomass, as well as the intensity of the fire that presses the cells generating the plants, from which regeneration is possible or not for the forest canopy;

-The topography through the exposure, slope and altitude sub-parameters acts in the system through radiation, the distribution of energies and the circulation of nutrients so that we can see in certain floors and altitudes the recovery of trees.

It remains certain that the recovery of the forest is very possible after fire, but very slowly because of the complex actions between the parameters taken into account.

CONCLUSIONS

It should be remembered that differences do not give meaning, is partly explained by the temporality which represents an element of the complex system, expresses the recoverability of forest equipment after fire. Also, the interactive operation of the system is cumulative.

Frequency regeneration prediction is closely related to the distribution and storage of individuals. In fact, the fire acts by other parameters such as conduction, thermal radiation, convection and duration of combustion.

The results obtained reflect the dynamics and natural organization of forest ecosystems: the number of regenerated individuals is very low and the recoverability is very slow.

The action of the topography is very relative and tends towards the specificities of the exposure, the altitude and the slope. Example: percentage greater than 51% at an altitude of 800m.

As with the exposure, we believe that the parts that have regenerated have received sufficient radiation. Also in altitude, the important freshness, would be favorable for the strategy of functioning of aerial vegetative traits. We can deduce that the regeneration of Quercus suber and Quercus canariensis is a prediction to be retained for the recoverability of the burned forest.

It would rather be very beneficial to think about setting up nurseries in each layer of vegetation so that the plants grow in adaptation with the conditions of the environment on site, This can increase the chances of survival of these plants during transplant to burned places and help the forest in regeneration.

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