STRUCTURE, COMPOSITION AND SPATIO TEMPORAL ECOSYSTEM DYNAMICS OF CORK-OAK FOREST IN BAB AZHAR (MOROCCO)

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Abstract: Most of the Moroccan decline is in a State of degradation and their natural regeneration by ways of planting became more and more difficult. The objective of this study is to describe the State of affairs and assess the spatio-temporal dynamics of the Oaks of Bab Azhar in order to develop effective interventionsThe aspects concern the types of settlement mapping using aerial photographs interpretation, which is supplemented by data collected on the ground, mapping, and analysis of the evolution of the stands during the past 26 years.The results show that Bab Azhar forest presents a significant floristic wealth (32 types of settlement) with a dominance of the Cork oak and green oak occupying almost three quarters of the total area of the forest.The study of the dynamics of stands to estimate important change (30.1%) that the forest has experienced between 1982 and 2008 with the regression of the formations to Oak Cork on an area of 87.1 ha is 0.96% of its area in 1982 and the dedensification of these formations over an area of 2638.9 ha is 32% of the total area of the Oaks.The counting of the data and the addition of the information collected on the ground helped to highlight that the main factor of degradation is the anthropic action.

Key words: Montado, Bab Azhar, dynamics, Types of stands, space-time.

INTRODUCTION

Bab Azhar forest, characterized by diverse vegetation significantly dominated by oak Cork (AEFCS, 1996), is among the most preserved decline in the Mediterranean region (Hammoudi, 2002). As to other Moroccan decline, the Oaks of Bab Azhar plays an undeniable role in ecological and socio-economic.By the production of Cork of excellent quality and first choice in Morocco (HCEFLCD, 2011), it ensures the activity of several companies harvest of Cork and the national and Mediterranean industries of transformation and development of this product. It provides employment to local residents and is recreation, grazing and recreational spaces.However, in recent decades, several Moroccan decline have been great as well natural that anthropogenic pressure leading to important changes. For example, it cites the case of the Maamora ((Belghazi, 2011, Aafi et al., 2005, Abourouh, 2005 etBenabid, 1989) montado, Ben Slimane (Saber et al., 2008) and the central RIF (Aafi, 2007) where the signs of their degradation are very apparent.)In this sense, the Oaks of Bab Azhar knows several environmental problems (deforestation, overgrazing, fires, systematic collection of acorns, cuts trees...) which result primarily from the human action that could lead to major changes and disruptions.So and to begin any rehabilitation of the Oaks, the quantification of changes in a montado known by his best State is necessary in order to develop effective interventions.It is in this context that fits

the present study aimed to evaluate and analyze the spatio-temporal dynamics of the Oaks of Bab Azhar by analysis of different missions (aerial photo).

STUDY AREA

Bab Azhar forest, an area of 39896 ha, is Eastern Middle Atlas. It extends between the Meridian 4 ° 09' and 4 ° 30' West, the parallel 33 ° 50' and 34 ° 12' North. The area covers the West and South of JbelTazekka flanks (1980 m) and the string that is extended to the South to the crest of Meurbat (AEFCS, 1996) (figure 1). The region of Bab Azhar has a mountain that offers a multitude of exhibitions and which gives the landscape more heterogeneity as a level landscape at the stand level. She is usually very terrains with very strong slopes is increasing the more towards the funds of the ravines (Morin, 1955).

On the soil level, five types of soil have been described by Mathieu (1962,1977) and the Danish Mission (1970) namely: Shales primary, on limestone soils, soils on red clay soil, soils on basalt of the permo-Triassic doleritique and soil on volcanic ash.Climate point of view, the montado develops on bioclimatic floors subhumid and humid to temperate and cold Variant; the seasonal regime is of the H.P.A.E type and the dry season takes an average of 120 days and starts from the month of June.

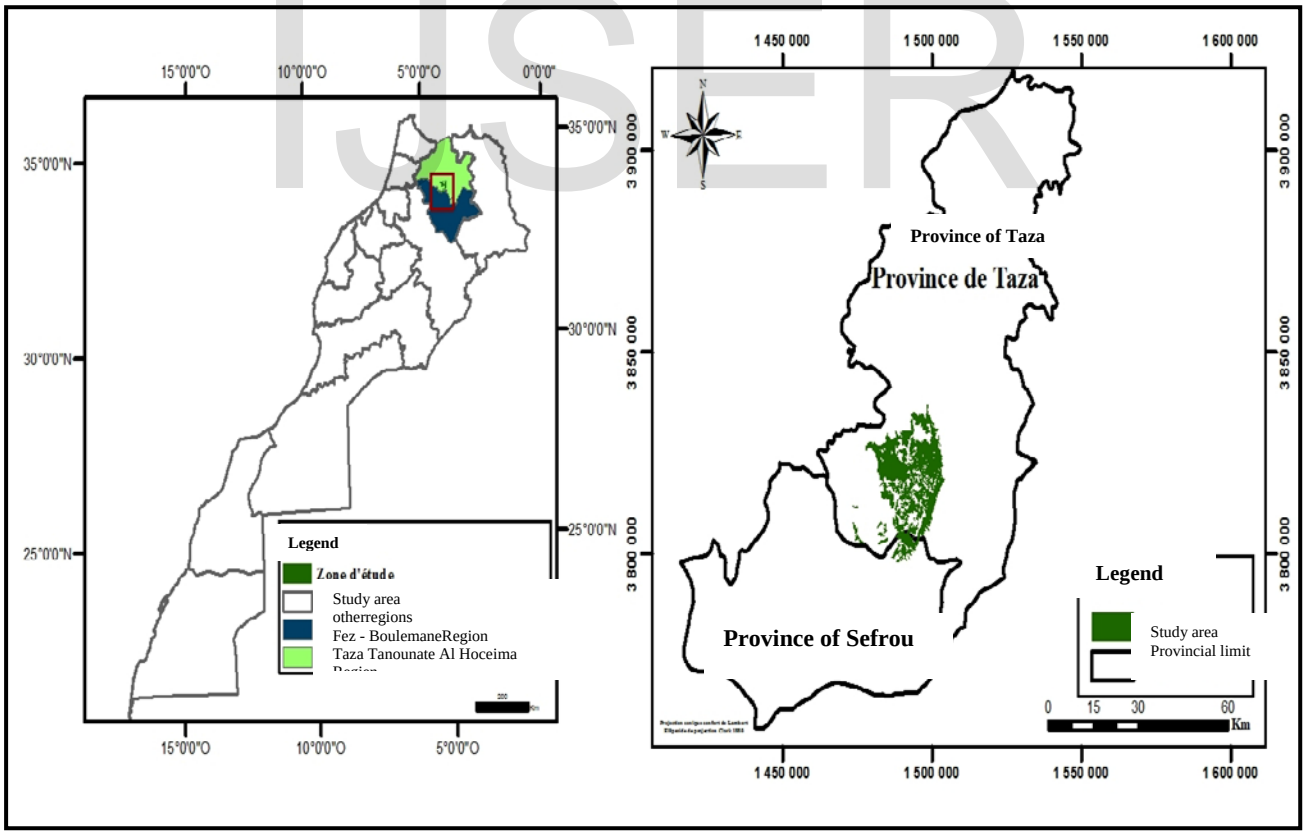

Figure 1: Location of the forest of Bab Azhar

MATERIAL AND METHODS

To assess the dynamics of the forest of cork oak of Bab Azhar, the diachronic method has been advocated. According

to Foundi et al. (2001), this method is to compare two maps or two photographic covers from various eras based on exploitation of the planimetric data (density),either systematically or by sampling (grids method) and statistical tools such as confusion matrices. These comparisons allow to express over the study period, an average pace of evolution which results in losses or gains of surfaces wooded to a certain density or some level of recovery.Two missions are available for our study area, (1982-2008) we have worked with.

1. Step of pictures interpretation

The interpretation of aerial photographs begins first by the reconstruction of the flight plan, establishing the Assembly table. Followed by the ranking of these photos by band and by chronological order of shots and thereafter for the placement of the corresponding key points on each aerial photograph.Generally, the scale of aerial photographs is not unique, it varies from one photo to another and even from one point to another in the same photo. Indeed, pictures show strong movement of objects and distortions of scale on the borders.So, to eliminate this defect, we worked on the useful surface of each photo while excluding half of lateral and longitudinal to share collections and other than this (HCEFLCD, 2007).The area is the area that gives a minimum of movement of relief and can avoid forgetfulness of details or map the same thing twice. This area is the place of the conduct of all operations of stratification and interpretation.After the delimitation of areas useful at the level of each photo, we did a preliminary interpretation that consists of a simple review to the naked photos in order to distinguish between large sets of easily recognizable areas. Then we did the delineation of the strata, homogeneous physiognomic units under stereoscope (Guellec, 1976).

2. Transfer of the stratification

Identified and delineated strata were postponed on topographic background same scale obtained from Taza and Ribat El khair to 1/50,000 topographical Fund. Which funds have been verified and supplemented by data from the field to get the final stratification using cartographic landmarks, such as dwellings, the hydrographic network, road network and the relief.

3. Development of evolution cards

From 1982 and 2008 photographic missions from cards, a superposition to detect the changes that occurred in the forest cover. The various statistics provided by the various cards will have a more detailed vision of the situation in the area.Confusion matrices generated by the confrontation of the data extracted from the two missions will thus give profile changes. These matrices are tables with double entry where the lines indicate surfaces of the training to the initial state, while the columns present training surfaces to the final State.The surfaces of the formations that have not undergone changes appear on the diagonal elements during the period of the study of evolution (Ouahid M. 1994).

4. Editions of the maps

The operation which puts an end to the mapping work is the edition of the final maps with the choice of the appropriate

symbols to represent different information to appear on the legend

RESULTS

1. Current state of the forest of Bab Azhar

Analysis of card type of settlement of 2008 has highlighted that the study area presents 32 types of stands. The main forest formations that characterize the forest massif of Bab Azhar are the Cork oak and green oak occupying almost three quarters of the total area in addition to Cedar,the cedar and zeen oak which essentially confined communities in cool, deep soils (table 1 and figure 2)

Table 1: Areas and percentages of forest formations of the forest of Bab Azhar

Strat	Area in ha	%
The Atlas Cedar	492,5	1.2
Cork oak	8 954,2	22,4
Green oak	17 004,6	42,6
Zeenoak	555,4	1,4
Otherhardwoods	215,6	0,5
Juniperoxy-Cedar	102,4	0,3
Matorral	2 231,5	5,6
Reforestation	2 783,1	7
Cedar	1 238,2	3,1
No woodland	6 319,2	15,8
Total area	**39896,8**	**100**

The current structure of the forest is dominated by the holm oak dense, medium dense, which occupies 65% of the area of the illiccaie. On the Oaks, Cork oak stands are made up of 5743,4 ha of pure montado (14.39%) and 3210,8 ha (08.05%) of mixed Cork oak.The dense montado covers 5104,81 ha, mode- rately dense 2358,14 ha and 1491,26 ha claire respectively 57%, 26.3% and 16.7% of the total area of the Cork oak. According to the plan, the Cork oak stands are State forest on an area of 7664,3 ha and the State of coppice on a surface of 1289,9 ha.

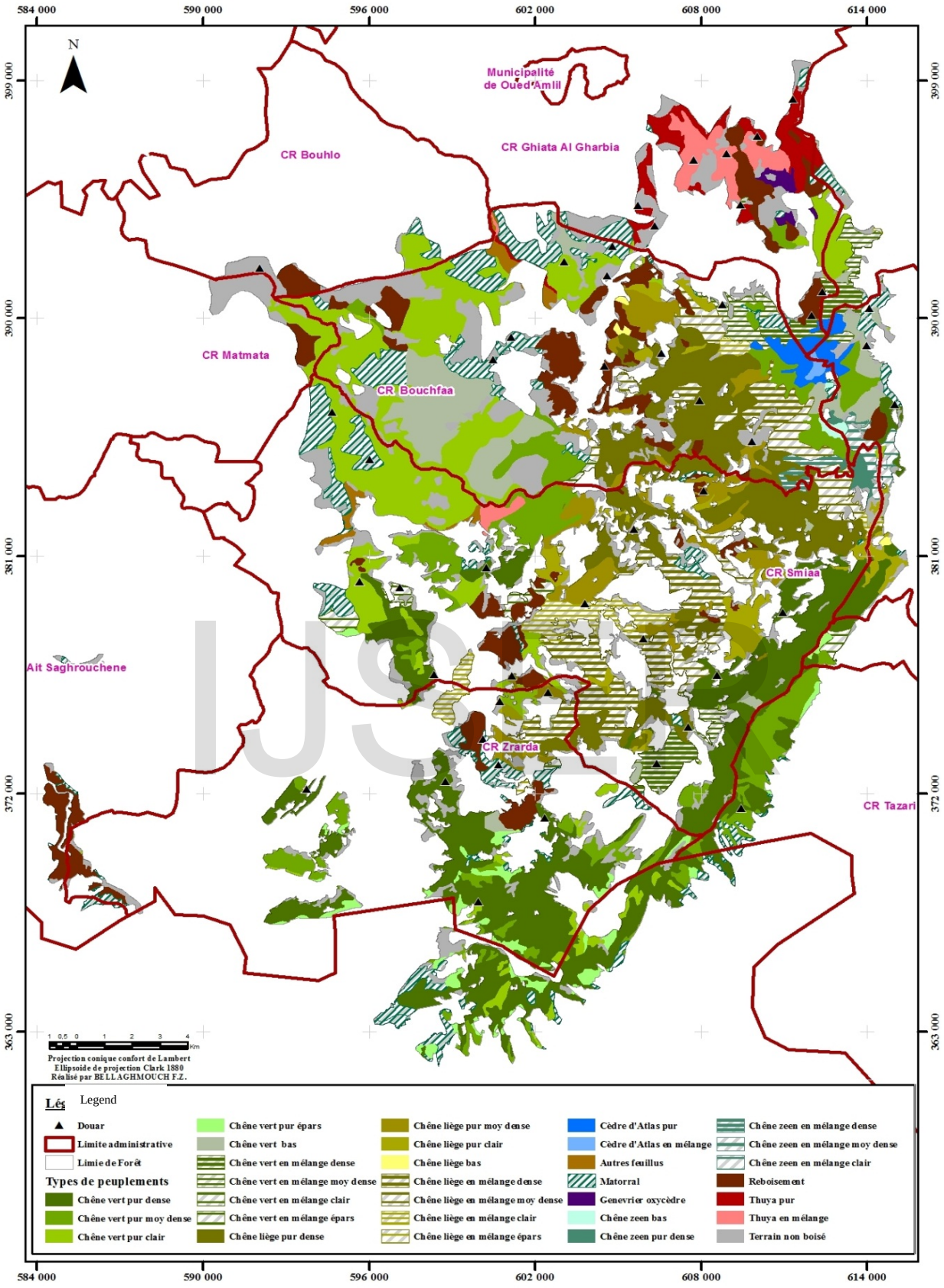

Figure 2: Card types of stands of forest of Bab Azhar from the aerial photos 2008

2. Assessment of the dynamics of forest stands

2.1.General changes from the Bab Azhar forest stands

Comparative study of the current situation with that of the year of 1982 showed that the forest has experienced major change in recent years with a rate that varies from one layer to another (figure 3).These changes in stands affected about 12 010,5 ha, or 30.1 per cent of the total area of the forest, against 27 886,3 ha of stands remaining unchanged over the last twenty-six years.

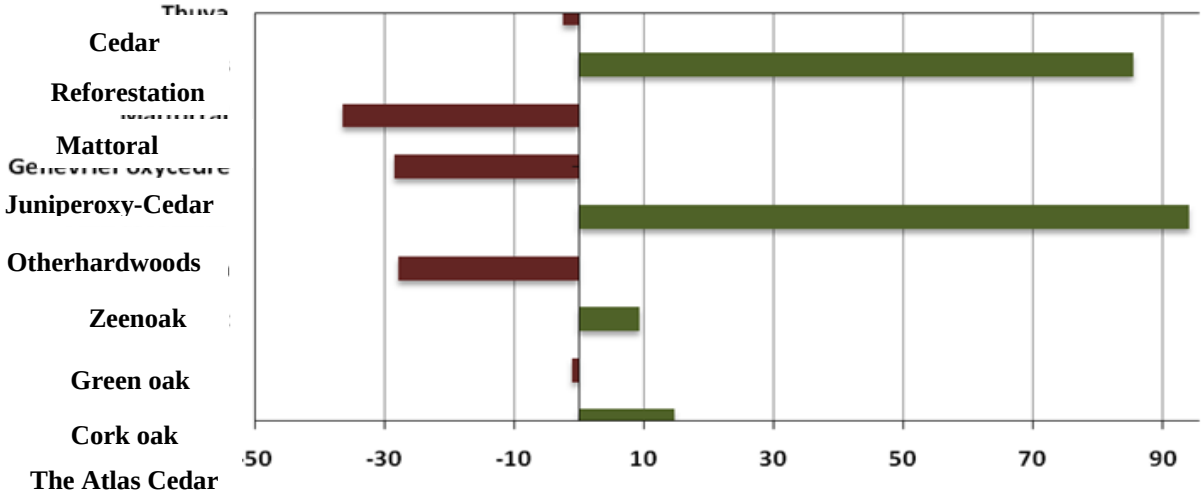

Figure 3: The dynamics of the forestry training pace between 1982 and 2008

Indeed, the forest has had a double, regressive and progressive evolution. Regressive evolution touched especially start at Oak Cork, Oak zeen, cedar and Juniper oxy-Cedar on a total area of 373.8 ha or 0.96% of the total area of the forest.La surface de la subéraie a perdu 87,1 ha soit 0.96% de sa superficie en 1982. La grande partie de cette superficie a été convertie en terrain non boisé, matorral ou en formations à chêne vert surtout aux alentours des agglomérations (douar de Beni essouaki, Sidi Boulhassen, Tighouname, Taridalt…..). Le rythme annuel moyen de cette régression est de l'ordre de 3,35 ha par an, soit un taux annuel moyen de 0,04%.Green oak is the training that has been the most important progressive evolution between the dates considered. Its area is passed in 1982 15543,2 HA to 17004,65 ha in 2008 with 11907,7 ha, which remained intact during this period. The gain which is 1461,4 ha which is a rate of 9.4% compared to its size in 1982, is obtained in the depends on the matorral and not wooded.

The average of this extension is of the order of 56,21 ha per year, or an annual average rate of 0.36 percent. This extension has been located in the areas adjacent to the perimeters of reforestation as well as in sites where anthropic pressure by the course has been diminished.It should be noted that rated conversions are not due in most cases to a replacement of gasoline by another. They are indeed, most often the result of a dedensification of one of the species of the mixture so that the respective shares of the percentages of apparent cutlery evolve and induce a change in the nomenclature of the type of settlement.

Table 2: Matrix confusion relative to the evolution of the forest formations of the forest of Bab Azhar between 1982 and 2008 in ha.

		2008										
		The Atlas Cedar	Cork oak	Green oak	Zeenoak	Otherhardwoods	Juniperoxy-Cedar	Matorral	Reforestation	Cedar	TNB	Total area
1982	The Atlas Cedar	299,9	7,39	107,4				4,6			10,1	**429,39**
	Cork oak	39,6	8206,2	145,1	41,6			49,5	173,3		386	**9041,3**
	Green oak	142,5	284,7	11907,7	120,9	166,5	5,7	744,9	805,8	151,1	1213,5	**15543,3**
	Zeenoak	9,6	56,3	204,9	378,6			98,5	15,8		5,6	**769,3**
	Otherhardwoods		6,8						5,2		0,9	**12,9**
	Juniperoxy-Cedar			8,2			85,3		19,3	0,4	30,1	**143,3**
	Matorral		1,6	1749		13,4		1077,3	181,6	4,5	486,1	**3513,5**
	Reforestation	0,9	102,2	90,6	5,5		0	72,5	1034,2	3,6	191,2	**1500,7**
	Cedar			16,3		3,1	1,2	20,1	130,4	1000,2	98,8	**1270,1**
	TNB		289	2775,5	8,8	32,5	10,2	164,1	417,5	78,5	3896,9	**7673**
	Total area	**492,5**	**8954,2**	**17004,7**	**555,4**	**215,5**	**102,4**	**2231,5**	**2783,1**	**1238,3**	**6319,2**	**39896,79**

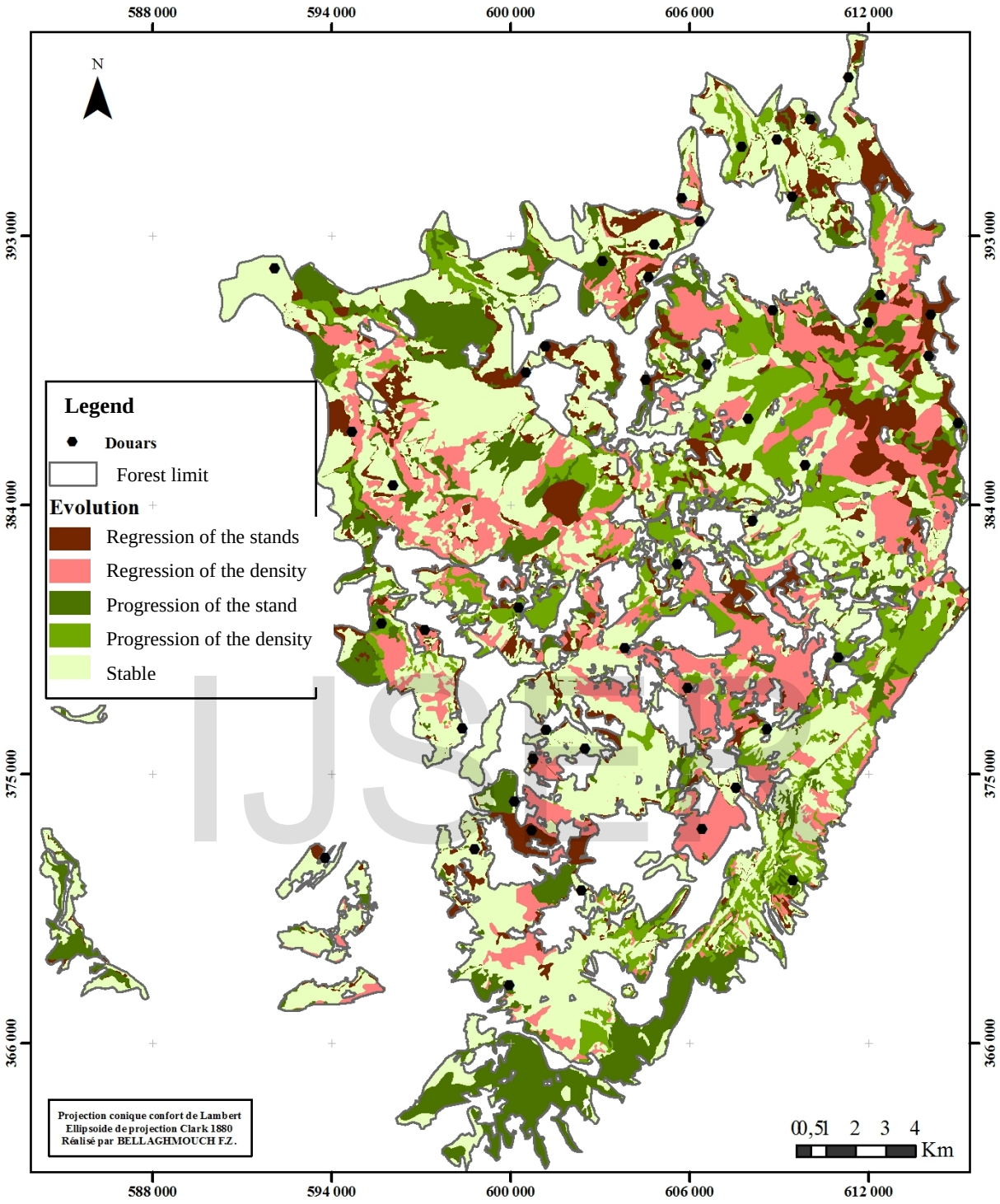

Figure 4: Map of evolution of the forest of Bab Azhar settlement patterns between 1982 and 2008.

2.1 the Oaks of Bab Azhar especially Dynamics

The matrix of confusion about the degree of cover of the Bab Azharmontado (table 3) is used to describe, in a more detailed manner, the transfer of the types of cork oak stands. The analysis of the matrix of confusion and figure 4, allows to identify a number of observations:

-Change layer by layer reported by the confusion matrix highlight the complexity of the dynamics of the Bab Azharmontado. These changes in stands affected, in the course of the past twenty six years, about 4780, 5ha, or 58.25 percent of the total area of the Oaks.

-The majority of the changes are located above the diagonal, reflecting a loss of density in stands. This dedensification has been described according to the matrix of confusion at 2638.9 ha or 32% of the total area of the Oaks.

-Pure dense Cork oak stands experienced significant changes. Indeed, they have evolved, double, regressive and progressive. Regressive evolution gave 1134,6 ha of its initial area for the benefit of the less dense decline with an annual average rate of decline of 43.6 ha/year and an annual average rate of 1.5%.

However, the biggest change is in the form of a gradual evolution. It manifests itself by a gain of density that has affected 1574,7 hectares of its original area, which corresponds to an annual average rate of progression of 60.57 ha/year, or one annual rate of increase of 2.08%. 75% of the dense pure montado gains were for the benefit of the moderately dense pure montado.

-Pure stands of oak medium dense Cork underwent important changes. The regression of this stratum is estimated at 1401 ha, or 52.5% of its original area, which corresponds to an annual average rate of decline of 53.88 ha/year.is an annual average rate of decline of 2.02 percent. They have transferred 1183,3 ha to the dense pure montado, 207.5 to clear Oaks and 786 ha to the Oaks in mixture. However, this stratum has been fuelled by progressive evolution of the other strata, but with a low importance (781 ha).

-The clear pure montado has experienced a reduction on 243.8 ha, which is 26.61% of the initial area. The annual average rate of regression is 9.38 ha/year is an average annual rate of decline of 1.02%.

-The Oaks in a mixture has been a progression over an initial area of 1119.7 ha. What corresponds to an annual average rate of progression 45.83 ha/year and an average annual growth rate of 2.7%.

Table 3: Matrix confusion relative to the density of the Oaks of Bab Azhar between 1982 and 2008 in ha

		2008								
		QsH1	QsH2	QsH3	QsMH1	QsMH2	QsMH3	QsMH4	QsB	Total général
1982	QsH1	1775,4	545,1	225,6	158,6	184,7	19,7		0,9	**2910,0**
	QsH2	1183,3	486,6	207,5	409,5	268,6	107,9		5,2	**2668,5**
	QsH3	229,2	215,4	202,0	120,3	60,1	79,0		10,1	**916,1**
	QsMH1	118,5	12,4	36,1	592,9	236,2				**996,1**
	QsMH2	27,5	2,7		56,7					**86,8**
	QsMH3	16,2	2,2	1,1	93,9	126,2	356,8	17,3		**613,7**
	QsB		3,2						11,8	**15,0**
	Total									

QsH1 : dense pure montado; **QsH2 :** pure dense medium-montado; **QsH3 :** clear pure montado ; **QsMH1** : Oaks in dense mix ; **QsMH2** : Oaks in moderately dense mix; **QsMH3** : Oaks in clear mix ; **QsMH4** : Oaks in a scattered mixture; **QsB**: low montado.

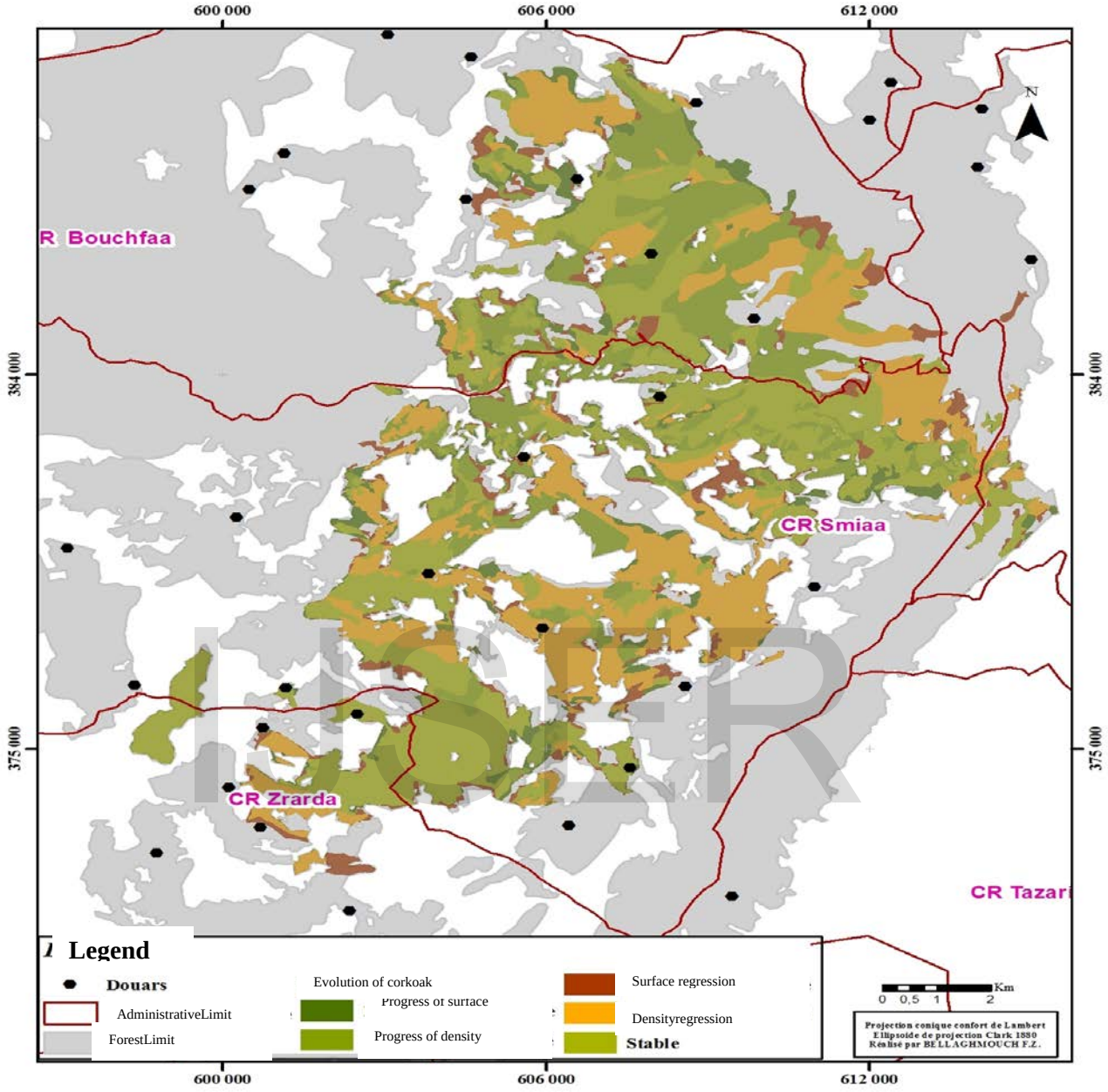

Figure 5: Evolution of the Bab Azharmontado card between 1982 and 2008.

Discussion

Comparison of current stand with that of 1982 showed that forest of Bab Azhar has undergone significant changes. These changes in stands affected 12.010,5 hectares, or 30.1% of the total area of the forest. The settlement of Cork declined 87.1 ha between 1982 and 2008, with an annual average rate of 3.35 ha per year, or an average annual rate of 0.04%. This average annual rate of evolution is very small if we compare, almost during the same period, with those of other subéraies. To Morocco, according to HCEFLCD (2014), the Oaks of Maamora underwent a regressive evolution of 16,600 ha during the past 39 years (1972-2011),with an annual average of regression of 425,64ha per year or an average annual rate of decline of 0.49%. At the level of the province of

Benslimane, the Oaks has been a regression of 235 ha, representing a rate of 0.17% of its original area (1987-2001) (Saber and al., 2008).

In Tunisia, El Hamrouni (1992)evaluated the spatial loss of the Tunisian montado to 0.17% between 1992 and 2003. For his part, El Afsa (1978) determined, from a test area of 8173 ha of oak Cork in Tabarka the annual loss is 1%.

In 1956, savage believed that the Bab Azharmontado covered an area of 15,000 ha which shows on the same term (26 years) the intensity of the changes have been greater between 1956 and 1982 (1.52%) between 1982 and 2008 (0.04%). However, the degree of cover of the Bab Azharmontado analysis showed that the latter had a dedensification on an area of 2638.9 ha is 32% of the total area of the Oaks. The use of the development plan of the forest of Bab Azhar of 1996 which estimated the area of pure stands of oak Cork to 6254,75 ha (AEFCS, 1996), we see that the rate of decline has accelerated in recent years which has increased from 0.14% between 1982 and 1996 to 0.31% between 1996 and 2008. This highlights the persistence of the degradation of the Bab Azhar Oaks by the dedensification.

Conclusion

The map of the forest populatingstypes in Bab Azhar of 2008 highlights 32 strata, following the standards proposed by HCEFLC (2011). The planimétrage of the map of the current populating types shows that the main forest trainings which characterize the massif forest of Bab Azhar are the cork oak and the holm oak which occupy almost three quarter of the total surface. These results suit to those found by the development plan of the forest in Bab Azhar at 1996.The current structure of the forest is dominated by the dense and averagely dense holm oak which occupies 65 % of the domain of the illiccaie. The subéraie is dominated by the dense cork oak with 57 %.The comparison of the current populatings with that of the 1982 showed that the forest in Bab Azhar underwent important changes. These changes of the populatings affected approximately 11 861,5 ha, that is 29,7 % of the total surface of the forest. Indeed, they knew a double evolution, regressive and progressive. The regressive evolution touched especially the trainings cork oak, oak zéen, in thuja and in Juniper oxycèdre on a total surface of 373.8 ha. On the other hand the progressive evolution affected the trainings holm oak, the cedar of the Atlas, the other broad-leaved trees and the reforestations.

The analysis concerning the degree of place setting of Bab Azhar'ssubéraie showed that the latter knew a dédensification on a surface of 2656,1 ha that is 32 % of the total surface of the subéraie. These trends establish a danger for the sustainability and the durability of the subéraie, as well as for the functions and the environmental services which it gets.

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