

Phytoecological characterization of groupings plants in the Bab Azhar's cork oak forest (Morocco)

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Abstract: The objective assigned to this research work is the description of the State of the place, through the joint study of the factors of the environment, of the parameters of the settlement and vegetation, to determine the responsible ecological descriptors of the distribution of the vegetation at the level of the Bab Azhar montado. The treated aspects concern, the study and mapping of vegetation based on numerical analysis (factorial correspondences analysis). 201releves has been made by a stratified sampling guided, according to three types of descriptors: topoclimatics, substrate, and stand types. The results show that the Bab Azhar montado presents a significant floristic wealth. Indeed, the analysis helped to identify six vegetation (containing 77 species) which are distinguished by their floristic composition. The spatial distribution of these units is based on the nature of soil (texture, depth and soil moisture), topography (exposure, altitude) and the degree of openness of the over story.

Key words: Phytoecology, vegetation, Montado, Bab Azhar Morocco.

I. Introduction

Located on the mountain massif of the tabular Middle Atlas on a total of 39 896,75 ha, Bab Azhar forest is characterized by diverse plant formations, clearly dominated by either pure or mixed Cork oak, green oak, cedar, zeen oak and cedar (A.E.F.C.S. 1996). The forest has been the subject of three studies of facilities whose main objective was to foster the production of Cork from reproduction, which is known by its excellent quality, something that makes it the first choice in Morocco (HCEFLCD, 2011). Ecologically, the ecosystem of oak Cork forest of Bab Azhar meets in Thermomediterranneen (700-1100 m) sub-humid to humid temperate; the Mesomediterraneen (1100-1500) wet charge, and the Supramediterraneen wet cold on North and West. The annual average rainfall varies from 571.40 mm/year to Tahla to 876.08mm/year at Tazekka. The Oaks is bounded by edaphic factors (calcifuge species). As soon as you go from primary field to the calcareous soil, the Cork oak disappears almost momentarily (Metro and wild, 1955). In order a valuation and sustainable management of the Bab Azhar montado through understanding its workings, we conducted this study for the characterization of the composition and diversity of vegetation

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II. Material and methods

1. Inventory of vegetation and environment

Map of settlement patterns developed by ourselves, using photos aerial mission 2008, served as basis for the distribution of our vegetation surveys in different plant formations for Cork. The distribution of the statements was made according to a stratified sampling guided by the change of the vegetation and three types of stratificators: Topoclimate (altitude(m), exposure, the topographic position and slope (%)), substrate and stand types. Statements have been made on a surface that may contain almost all of the species of the floristic uniform plant community, or area minimum (Guinochet, 1973). At the level of each floristic survey, there was information about its location using GPS, features ecological and morphometric for the station and all species by assigning to each species two indices including the first expresses the abundance-dominance and the second represents sociability (Braun-Blanquet, 1932).

2. The data processing

Data processing has been operated by the analysis factorial of matches (AFC), which is one of the most widely used methods for the digital study of vegetation. This method has been used in this area by many researchers, including Dagnelie (1960), M'Hirit (1982), Achhal (1986), Zine El Abidine (1988), Ezzahiri (1989), Amini (2008), Bellaghmouch (2008), Aafi (2011) et Dossou (2012). This analysis is often used to sum up the structure of a distribution of species data set and connect the ecological conditions of the stations with species that are characteristic (Ezzahiri, 1989). To identify the characteristic species of a group to which they belong, we appealed to the characterization of the species index which is defined by the following formula (October, 1982):

$$\text{Index of characterization} \\ (\text{IC}) = 2 f(x) / (F(x) + N)$$

Where

$f(x)$ = frequency of the species 'x' in the Group

$F(x)$ = General frequency of species 'x' in the AFC

N = number of statements of the Group

As a result, more this report tends to 1, more 'x' is 'characteristic' of the concerned group (Vedrenne, 1982).

3. Vegetation mapping

Map of vegetation reflects the results of the study of vegetation. As the locations of surveys have been spotted with their contact information, we merged all the surveys that are similar and which have affinities Commons and we have postponed on topographic background at the 1: 50,000 the limits of the strata identified from aerial photographs. In order to validate the identified strata and their

delimitation, a field verification was conducted through control points chosen so as to cover at least each of the individual units. This method has already been used successfully by Amini (2008) and Bellaghmouch (2008) on the ecosystems of the Oriental to the Morocco coast

III. RESULTS AND DISCUSSION

1. Floristic inventory

On the basis of floristic homogeneous areas identified on the ground, two hundred and one (201) identified vegetation has been made at the level of the Bab Azhar montado. The floristic analysis of these surveys could reveal the presence of a rich and diverse flora caused by 77 species including the most common of the Cork oak is:

Cistus salvifolius (134 statements),
Quercus rotundifolia (106 statements),
Pteridium aquilinum (59 statements),
Lavandula stoechas (56 statements), *Arbutus unedo* (48 statements), *Erica arborea* (43 statements), and *Cytisus triflorus* (34 statements).

2. Typology of vegetation

All of the vegetation surveys conducted during the field work underwent a comprehensive analysis. Partial analysis focused on statements that are grouped in the center of the factorial of the first two axes of the global analysis, where Visual discrimination was more delicate. The following table includes the digital settings of the AFC used to know the share of information expressed by each axis calculating participation relative to the total inertia of the cloud.

Table 2: Values and percentages of inertia of the global and partial analysis.

	Global analysis		Partial analysis	
	Eigenvalues	Rate of inertia	Eigenvalues	Rate of inertia
Axe 1	0,78	10,80	0,65	17,26
Axe 2	0,63	9,53	0,43	11,16

We distinguish between own values on the first two factorial axes which are respectively 78% and 63% for the overall analysis and 65% and 43% for partial analysis. This situation reflects the fact that there is a "dichotomy" (a grouping of individuals who oppose a whole (Vedrenne, 1982) very marked on factorial maps induced

by these two axes. Indeed, this "dichotomy" to discriminate against groups of statements points to study more in detail.

a. differentiation of statements sets

Review of factorial axes 1-2 and 1-3 maps to see a distribution of interesting statements in several batches, especially at the level of the

plan 1-2 which absorbs the maximum information (rate of inertia is 20,33% and 28.42% for the overall analysis and partial). On these plans, we identified six groupings, which are the following (figure 1 and 2):

*** Global analysis:**

-The group 'A', containing the following species: *Fraxinusangustifolia*, *Salix humilis*, *Prunusavium*, *Quercusfaginea*, *Nerium oleander*, *Taxusbaccata*, *Celtisaustralis* and *Pistaciaterebinthus*.

-The group 'B', containing the following species: *PistaciaAtlantica*, *Oleaeuropaea var. sylvestris*, *Ceratoniasiliqua*, *Calycotomespinosa*, *Centranthuscalcitrapa*, *Ceratoniasiliqua* and *Asperulahirta*.

*** Partial analysis:**

-The group 'C', containing the following species: *Pteridiumaquilinum*, *Cytisustrifloru* and *Chamaeropshumilis*.

-The group 'D', containing the following species: *Cistussalviifolius*, *Quercusrotundifolia*, *Erica arborea*, *Lavandulastoechas*, *Lavandulapedunculata*, *Phillyrealatifolia*, *Cytisustriflorus* and *UlexBoivinii*.

-The group 'E', containing the following species: *Arbutus unedo*, *Phillyrealatifolia*, *Quercuscanariensi*, and *Erica arborea*.

-The group 'F', containing the following species: *Lavandulastoechas*, *Cistussalviifolius*, *Cistuscrispus* and *Thymus riatarum*. *Lavandulastoechas*, *Cistussalviifolius*, *Cistuscrispus* et *Thymus riatarum*.

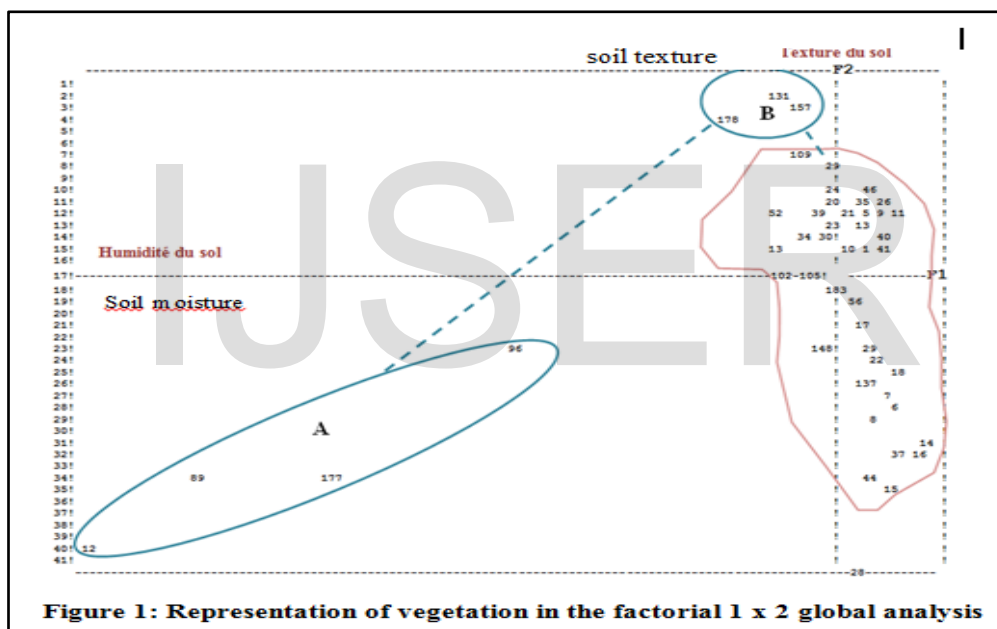
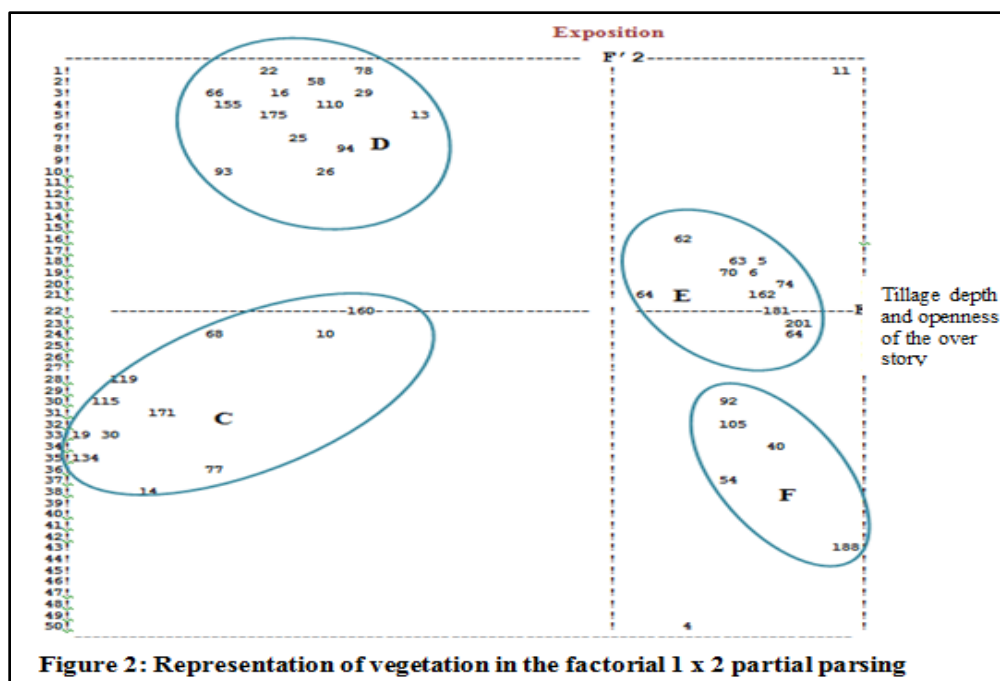


Figure 1: Representation of vegetation in the factorial 1 x 2 global analysis



(b) Interpretation of the axes

Interpretation were brought on the first two axes using the relative contributions of species, because all records and species are matched and the significance of the species is the same.

* Global analysis:

The observed sequence of natural groups along the first axis (F1) translated this axis may be interpreted as axis of soil moisture. From the negative side to the positive side of the axis, statements containing species riverine forest in the group 'A' that grow along streams where the soil moisture is high against surveys in areas of low humidity of the soil.

Axis 2 revealed two types of groups of species. The first group, on the negative side of the axis, corresponds to records located on clayey soils. Especially *Fraxinusangustifolia*, and *Prunusavium* species are indicators of this type of environment.

The second group, on the positive side, brings together records on rocky soils, which implies as well that this second axis translated the texture of the soil from the more clayey negative pole at the positive pole more Rocky.

* Partial analysis:

On the basis of the ecological value of species, the first axis can be interpreted in two ways. It shows the depth of the soil and the degree of

openness of the overstory, because on the negative side, meet species that thrive on shallow soils and under clear stands, while on the other side fall into order characteristic species of the deep soils and stands firm.

Along the second axis, the sequence found translated natural groups that this axis explains the exhibition, from the negative side to the positive side of the axis of North South exposures exposures.

1. description of vegetation

We recall first of all that our area belongs in phytosociological terms to the Querceteailicis class (. BR - BL. 1947) that is set for the whole of the Mediterranean region. This class groups in the forest of Bab Azhar all of forest and preforestiers groups. In fact, it brings together all the sclerophyllous formations (Benabid 2000). So, to characterize vegetation at the level of the Bab Azharmontado, we took into account the relative contributions of the species on the same poles of axes used to individualize these sets as well as the characterization of the species index.

-*Fraxinusangustifolia* (A) grouping: it is a group characterized by the following species: *Fraxinusangustifolia* (IC = 0, 93), *Salix humilis* (IC = 0, 73), *Prunusavium* (IC = 0, 57) and *Quercuscanariensis* (IC = 0, 45).

It corresponds to a group to ripiysilves that develop along the wadis (Dmnat, Azhar, Irhaleme...) and especially in the lower funds on intermediate to friable shale, clay-silty soils in loess, deep, little degraded and having a high humidity, strong enough slopes to strong rate, between 800 and 1200 m above sea level on an area of 159 ha or 2% of the total surface of the Oaks.

At the group level, we usually attend a high often clear and degraded oak Cork forest around the enclaves, where regeneration is almost non-existent to low.

PistaciaAtlantica (B) grouping: it is a group attached to the association *Rhuopentaphyllae - pistacietumatlantica* (Benabid, 2000) and the vicarious Association Algerian

Rhuopentaphyllae - Tetraclinetumarticulatae, which brings together side by side cedar and pistachio from the Atlas to 700 m in OuledMimoun and the mountains of Tlemcen (Hadjadj. 1991).

On a surface of 182 ha, this grouping corresponds to a group of the fauna. Among these species, we meet *PistaciaAtlantica*, *Oleauropea var. sylvestris*, *Ceratoniasiliqua*, *Calycotomespinosa* and *Centranthuscalcitraba* on superficial or almost absent degraded soils, strong enough to strong and slopes between 750 and 1100 m above sea level. The most dominant exhibits are dry exhibitions: South, East, and Southeast. This grouping shows drought conditions related especially to edaphic conditions (table 3).

Table3: Index of characterization of the species of the grouping to PistaciaAtlantica

Species	Index of characterization(IC)
<i>PistaciaAtlantica</i>	0,88
<i>Oleauropea var. sylvestris</i>	0,77
<i>Calycotomespinosa</i>	0,52
<i>Centranthuscalcitraba</i>	0,44
<i>Ceratoniasiliqua</i>	0,43

In general, at the level of this grouping, the Cork oak stand is clear to very clear and old adult with little seedlings and juveniles of cork oak and many seedlings totally stunted by place.

-Grouping in *Pteridiumaquilinum* (C): the main species characterizing floristic cortege are *Pteridiumaquilinum*, *Cytisustriflorus* and *Chamaeropshumilis*. This group occupies a surface of 2346 ha or 26% of the total surface of the Oaks (table 4).

Table 4: Characterization of the species of the Group Indices ofPteridiumaquilinum

Species	Index of characterization (IC)
<i>Pteridiumaquilinum</i>	0,78
<i>Cytisustriflorus</i>	0,61
<i>Chamaerops humilis</i>	0,44

This group evolves (shale and sandstone) siliceous terrain on soils generally clayey, silty clay and silty, superficial, on average slopes to

strong and between 800 and 1400 m altitude. The most dominant exhibits are fresh exhibitions: North, West, and Northwest.

It presents a progressive dynamics. Indeed, reflecting advanced degradation transparent species tend to occupy the sunniest circles (Benabid, 2000). So the mutilation of the Bab Azharmontado resulted in the almost continuous training in *Pteridium aquilinum* sometimes excluding the other species of the plant group, dotted with old and tortuous individuals of oak Cork with a generally low rate of regeneration by seedlings.

Of after Søndergaard (1969), training in *Pteridium aquilinum* on deep and well fed soil water protect seedlings against strong sunstroke in the summer. However on North slopes, and in the empty strongly invade by ground of bracken, the Cork oak regeneration is compromised

-Grouping (D): *Cistus salviifolius* it appears throughout the cantons of the Bab Azhar Oaks

on a surface of 3469 ha. This group evolves on substrates generally siliceous, clay-silty soil to silty, Sandy by place, superficial, little degraded to very degraded, on average slopes to strong, between 600 and 1500 m altitude and under training generally identified. The most dominating exhibitions are hot exhibitions (South, East, Southeast and Southwest).

This group is characterized by the following species: *Cistus salviifolius*, *Quercus rotundifolia*, *Erica arborea* and *Lavandulastoechas*. Of after Hissein (1994), this grouping reflects ecological conditions increasingly bad (shallow, Rocky soils and strong runoff) thing that explains the low seeding rate in this environment.

Table 5: Indices of characterization of the species of the *Cistus salviifolius* grouping

Species	Index of characterization (IC)
<i>Cistus salviifolius</i>	0,78
<i>Quercus rotundifolia</i>	0,53
<i>Lavandulastoechas</i>	0,46
<i>Erica arborea</i>	0.41

--Grouping(E) to *Arbutus unedo*: this group is limited especially on shale (shale intermediate and crumbly) substrates, stable little clay-silty, usually deep soils and humiferes, degraded and on strong enough slopes. He was essentially the mi-versants and the bottom of slopes on an area of 1105 ha or 12% of the total surface of the Oaks. It colonizes different exhibitions and is generally closed formations characterized

by undergrowth quite developed with plenty of litter.

This group is mainly characterized by the following species: *Arbutus unedo*, *Phillyrealatifolia* and *Quercus canariensis* which are among the best bioindicators of a great forest atmosphere, shaped by the stands of oak Cork (Benabid, 2000) (table 6).

Table 6: Index of characterization of the species of the group to the *Arbutus unedo*

Species	Index of characterization (IC)
<i>Arbutus unedo</i>	0,83
<i>Phillyrealatifolia</i>	0,60
<i>Quercus canariensis</i>	0,37

-Grouping (F) to *Lavandulastoechas*: Besides that *Lavandulastoechas*, we encounter the following species *Cistussalviifolius*, *Cistuscrispus* and

Thymus riatarum, which are the main species characterizing the floristic cortege of this group (table 7).

Table 7: Index of characterization of the species of the grouping to *Lavandulastoechas*

Species	Index of characterization (IC)
<i>Lavandulastoechas</i>	0,55
<i>Cistuscrispus</i>	0,33
<i>Cistussalviifolius</i>	0,23
<i>Thymus riatarum</i>	0,23

This group evolves ground shale (shale intermediate and crumbly), on soil clay-silty, clayey and silty, usually deep, strong enough slopes to strong, between 700 and 1300 m altitude and on a surface of 1693 ha is 19% of the total surface of the Oaks. The most dominant exhibits are fresh exhibitions: North, West, and Northwest.

At the level of certain parcels and especially next to the enclaves, the strong pressure exerted by the riparian population through illegal logging, overgrazing or by the topping of trees, the grouping is in the process of matorralisation where the rate of regeneration of cork oak is almost nil. Moreover, although scattered State, natural regeneration of Cork are.

As well, and according to the AFC, we have identified six plant communities that stand out for their floristic composition as well as their spatial distribution. Environmental factors involved significantly in the discrimination of vegetation (Ababou and al., 2009). This study reveals that the nature of soil (texture, depth and soil moisture), topography (exposure, altitude) and the degree of openness of the overstory are the determinants.

This look is relatively preserved. *Arbutus unedo*, *Cytisustriflorus*, *Viburnum tinus*, *Phillyrealatifolia*, *Quercuscanariensis*, grouped in the grouping to *Arbutus unedo*, are among the best bioindicators of a great forest atmosphere (Benabid, 2000) where the Cork oak stands in its ecological optimum.

Furthermore, based on the analysis of the areas occupied by each group, the *Cistussalviifolius*

(D) grouping is the most dominant, it occupies more than one-third of the total surface of the Oaks. This shows some degradation of the Oaks, which has brought about the occupation of the sunniest circles transpar species (Benabid 1976, Benabid, 2000, Aimé 1976, Arianoutsou & Margaris 1982, Meurer & al. 1986, Fennane 1987, Meurer 1988, Neff 1995, Bergmeir 1997 and Ferrandis & al. 1999). Such as *Cistussalviifolius*, *Genistatricuspidata*, *Calicotomespinosa* and *Ampelodesmos mauritanica*. These species are found in one group plant by Zeddami (2007) at the level of the Oaks of the Senhadja-Gherbes in Algeria in the fire circles as well as by Aafi (2007) at the level of the Oaks of Maamora in the Morocco where the found group is in the process of matorralisation due to the pressure exerted or under legal cuts undertaken by forest managers or illicit withdrawals by the riparian population. .

IV. CONCLUSION

The phytocologic by the digital method (AFC) of the Bab Azhar montado study to highlight the diversity of vegetation of this ecosystem, which gives one of the best qualities of Cork to the Morocco. Today, the Oaks is subject to certain pressures, especially on its periphery and around the enclaves, something which justifies the need for conservation. Subsequent studies are needed to understand the pressure that is exerted on it in order to develop strategies for conservation of this ecosystem.

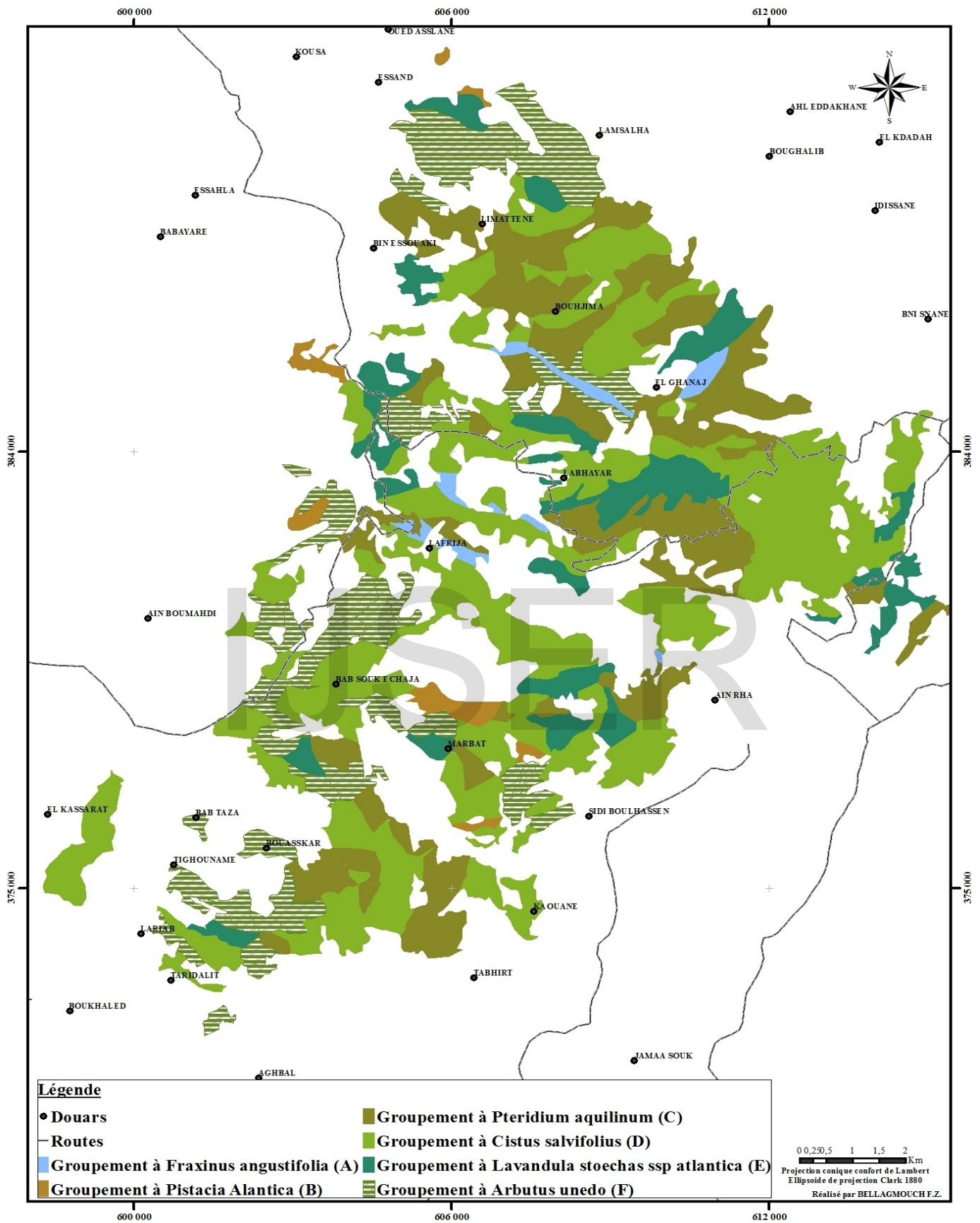


Figure 3: Map of vegetation of the Bab Azhar Oaks

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