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FLORISTIC DIVERSITY OF THE GROUPING AT *PISTACIA ATLANTICA* IN THE REGION OF NAÂMA (ALGERIA)

Abdelkrim Benaradj [1*], Hafidha Boucherit [1], Okkacha Hasnaoui [2]

[1]Laboratory of Sustainable Management of Natural Resources in Arid and Semi-Arid Areas, Salhi Ahmed University Center of Naama, Algeria
[2]Laboratory of Plant Ecology and Management of Natural Ecosystems, Tlemcen. Dr Tahar Moulay University of Saida, Algeria

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Abstract
Floristic inventory carried out on grouping range at Pistacia atlantica in southern region of Naama makes it possible to identify 135 taxa, divided into 36 families and 105 genera. This large specific diversity, belong to 36 botanical families, best represented (48%) being Asteraceae, Poaceae, Fabaceae and Brassicaceae. The biological analysis shows predominance of Therophytes with 68 species, i.e. 50%. This predominance is characteristic of arid regions vegetation which adapt to saharan and steppe environment. The biogeographic analysis reveals a predominance of three biogeographical types (mediterranean, saharan and endemic) with a rate of 64% or 87 species. This biogeographic distribution reveals floristic heterogeneity and confirms mediterranean affinity of region flora, which combines three sets: high steppe plains, saharan atlas and Saharan border to South.

Keywords: floristic diversity, grouping, Pistacia atlantica, Saharan atlas

1. INTRODUCTION

The saharan atlas covers important plant resources spread over plains, mountains, chotts, dayas and saharan areas (Benaradj, 2017).

According to MICLE (1997), their potential for biological resources and their impressive diversity across the country imperatively require a preservation strategy is developed.

The ratification by Algeria, the Convention on Biological Diversity is an important step in the management of this valuable capital and an irrefutable proof which strengthens the position of our country in the conservation of biological diversity across planetary and in building sustainable development (Benaradj et al., 2015a)

The purpose of this study is to analyze ecological and floristic indicators of grouping at *Pistacia atlantica*. This woody and xero-thermophilic species of *Anacardiaceae* family is a tree par excellence of arid, semi-arid and saharan areas, although for Boudy (1952), pistachio trees are characteristic species of mediterranean region. Most of range is found in North Africa (Morocco, Algeria, Tunisia), but it is also found in Canary Islands, Libya (Cyrenaica), Cyprus and the Near East (Quézel and Médail, 2003).

*Corresponding author, E-mail address: kbenaradj@yahoo.fr

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We have focused our work on establishment of a descriptive inventory of grouping situation in *Pistacia atlantica*. It was carried out at an area of this taxon in Naama region. This work has not been undertaken in arid and saharan zones to date; Hence its interest.

2. MATERIALS AND METHODS

2.1. Geographic location

Trees of *Pistacia atlantica* are well distributed in study station of Hadjadj (South of Naama). This choice was imposed naturally by *Pistacia atlantica* dissemination in saharan atlas. This choice is to better understand the phytoecological aspects of its distribution in this part of the region of Naama.
On biogeographical level, study station is part of saharan atlas (sub-sector AS1) sector in sense of Quézel and Santa (1962); that is to say in most western part of Algeria.
Hadjadj station is located 20 km south of Ain Sefra and 30 km north of Moghrar (between Ain Sefra and Moghrar). It is spread over an area of more than 30.000 hectares and on altitudes oscillating between 930 m and 1.300 m. Trees of *Pistacia atlantica* are well dispersed in talwegs and outcrops of mountains or valley.
Geographically, study area is between 32°41'31.74" N and 32°38'12.15" N of north elevation and between meridians of longitude 0°26'29.83"W and 0°22 '20.82"W to the west (Fig.1).

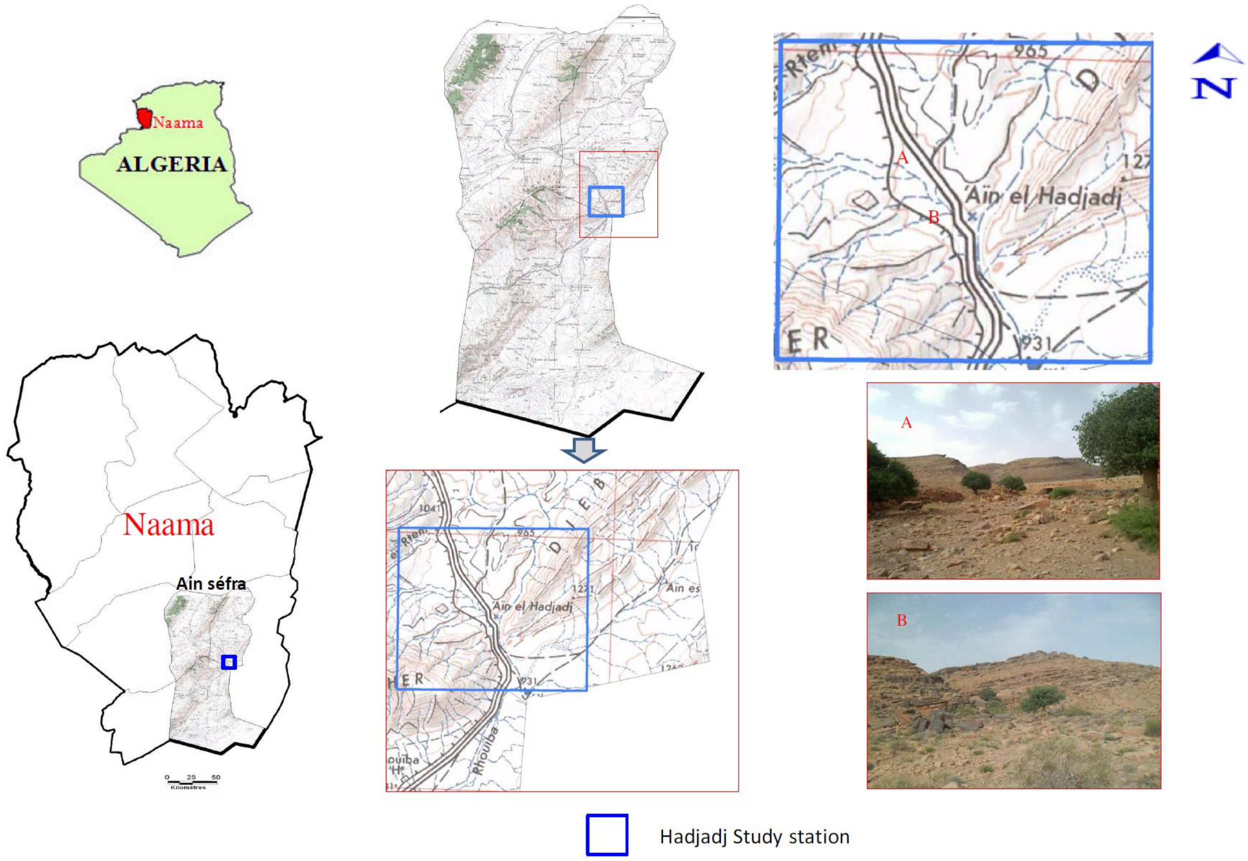

Figure 1. Geographical location of the study station at "Hadjadj" (South of Naama) (I.G.M, 1999)

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2.2. Methods of study

2.2.1. Structure of sampling

We have opted for systematic transect sampling. This approach, with help of 50 floristic surveys carried out, makes it possible to identify largest number of plant species on the one hand and is effective in the arid and semi-arid open ecosystems on the other.

2.2.2. Quantitative study

Technique of transect was described by several authors (Gounot, 1969; Godron, 1968; Daget and Poisson, 1971). It is well adapted to steppe ecosystems in analysis of vegetation and soil surface characteristics (Aïdoud, 1983; Nedjraoui, 1990; Slimani, 1998). It is considered as an efficient means of studying evolution of vegetation cover in case of a permanent line (Gounot, 1969; Aïdoud, 1983). The reading is done every 10 cm on a line marked with a graduated ribbon stretched over vegetation.

According to Kadi-Hanifi (2003), this quantitative method consists of enumeration within each stand or formation of species total number and population number of each species. It is specific wealth which is one of characteristic of a stand.

The measures of a quantitative nature are as follows:

- *Measurement of vegetation cover:* The recovery of a species is theoretically defined as soil surface percentage that would be covered if species individual's aerial organs were projected vertically on ground (Gounot, 1969).
- *Floristic richness:* This corresponds to the realization of a floristic inventory; this stage is based on a census of floristic procession species constituting of grouping in *Pistacia atlantica*.

2.2.3. Qualitative study

It consists of studying biological, systematic and phytogeographical composition of a plant in a given region (Kadi-Hanifi, 2003).

The qualitative measures are:

- Biological characterization: The 5 biological types, which were defined by Raunkiaer (1934) according to morphological nature and which are: Phanerophyte, Chamaephyte, Hemicryptophyte, Geophyte and Therophyte. Raw biological types production is oriented on taxa counting by biological type and carried out on all groups floristic cortege species at *Pistacia atlantica*.
- Phytogeographic characterization: According to Barry and Celles (1973), about the phytogeographical division, study area belongs to holarctic empire, mediterranean region, euromediterranean region, maghrebin-steppic domain and algerian-oranian highlands and saharan atlas.

2.2.4. Determination of floristic, biological and phytogeographical characteristics

Botanical, taxonomic, biological and phyto-geographical determinations of species recorded in field were made at Botanical Laboratory of Tlemcen University and using usual identification keys:

- The Flora of Maire (1952-1987);
- The flora of Algeria (Quézel and Santa, 1962-1963);
- The flora of the Sahara (Ozenda, 1977);
- The great flora in colors: France, Switzerland, Belgium and neighboring countries (Bonnier, 1990);
- The Flora and vegetation of southern Tunisia (Guittonneau et *al.*, 2011);
- Works of dissertations and theses of (Bouzenoune, 1984; Benaradj, 2010; Babali, 2014);
- Works of Le Houérou (1995) and Kaabèche (1990, 2003).

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3. RESULTS AND DISCUSSIONS

Our contribution concerns floristic diversity study as well as an analysis of flora within grouping at *Pistacia atlantica* on biological, taxonomic and phytogeographical of pre-Saharan ecosystems. This contribution makes it possible to highlight their floristic originality, their state of conservation.

3.1. Recovery and flora richness

The floristic study within group at *Pistacia atlantica*, allowed us to rise following points (Table 1):
• Coverage around 35%;
• A floristic richness represented by 135 tree, shrub and herbaceous plant species.

Table 1. Recovery rates and plant wealth in the the study station

Parameters	**Results**
Recovery from vegetation (%)	35%
Floristic wealth (number of species)	135 species

From these results, we find that recovery rate and floristic richness are generally influenced by several factors:
- ***Rainfall and water transfer***: these two factors play a very important role in vegetation reconstruction by seeds germination, because water is an important factor in triggering germination. Year 2012 is experiencing an exceptional rainfall (more 108 mm only in November months 2012) (Benaradj, 2017). According to Poilecot (1996), vegetation is dependent on moisture factor and moisture retention soil capacity. It is this high availability of water for plants that explains the specific richness of sandy soils despite their low retention capacity and which is high in sandy clay soils.
- ***Floristic migration***: according to Quézel (1995), our study area has been subjected to a floristic migration which can be caused by two major causes: climate change, which is a major floristic migration process and flora dissemination by long-distance transport by wind, birds and animals by their displacement.
- ***Proliferation and settlement of non-palatable (toxic and/ or spiny) species***: another finding was made, non-palatable species establishment in *Pistacia atlantica* (*Ziziphus lotus, Centaurea maroccana, Asparagus altissimus, Atractylis humilis, Atractylis serratuloides, Urginea maritima, Ferula cossoniana, Nerium oleander, Hammada scoparia*). Same observation was reported by Benabadji and *al*., 2007. This is explained by a regeneration *Pistacia atlantica* within *Rhus tripartita* tufts, *Launaea arborescens* and *Zilla macroptera* (Benaradj, 2010; Benaradj *et al*., 2015b).
- ***Adaptation and acclimatization***: Various morphological and physiological adaptations allow these plants to resist, adapt and maintain themselves in their arid (very dry) environments. Among these forms of adaptations are leaf area reductions (plants that may have very thick leaves or reduced to spines, which allows them to limit their water losses (*Fagonia glutinosa, Fagonia latifolia, Zilla spinosa, Launaea arborescens*). The formation of a cushion is also a form of adaptation to xeric medium with a morphological modification, for example species (*Anabasis aretioides*) may take on a ball or pincushion appearance and *spinous xerophyte*. Some plants may have considerably developed underground organs (Rhizomatous) (*Scorzonera undulata*). Leaves can also take needle or scales forms, as is case with following species: *Hammada scoparia, Hammada schmittiana, Thymelaea microphylla, Ephedra alata, Genista saharae, Retama retam*. In

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the end, the vegetative apparatus reduction constitutes a remarkable adaptation to conditions of very difficult environment. This is reflected in certain woody species tolerance of that opts for a morphological plasticity that reflects the resilience capacity in response to disturbances of biotic or abiotic origin. These species bury their woody structures below ground level or spread their root system on supports with higher water availability (*Pistacia atlantica*, *Ceratonia siliqua*, *Hammada scoparia*) (Birnbaum, 2012; Benaradj, 2017).

3.2. Biological, systematic and biogeographic analysis

3.2.1. Biological analysis

The table below shows floristic composition according to presence number and each biological type percentage in relation to total number of 135 species recorded in study station. These biological forms show biological spectrum seasonal variation.

Table 2. Distribution of species by biological types in the study station

Biological type	Absolute frequency	Relative frequency (%)
Chamephytes	25	18,52
Geophytes	06	04.44
Hemicryptophytes	27	20.00
Phanerophytes	09	06.67
Therophytes	68	50.37
Total	135	100%

From Table 2, it can be seen that biological spectrum is of following type: Th> He>Ch>Ph> Ge. There is a remarkable dominance of herbaceous stratum by therophytic species with 68 species, i.e. 50.37%, followed by hemicry ptophytic species with 27 species, i.e. 20%, chamaephytes having 18.52% (25 species), phanerophytes with 6.45% (9 species) and finally by geophytes with 4.44% (6 species). This dominance of therophytes is strictly related to seasonal rains (Belhacini, 2011). The percentage of phanerophytes, hemicryptophytes and geophytes decreases with aridity and aperture of medium, while those of therophytes and chamaephytes increase (Kadi-Hanifi, 2003). Among phanerophytic species: *Pistacia atlantica*, *Ceratonia siliqua*, *Nerium oleander*, *Retama retam*, *Retama sphaerocarpa*, *Rhus tripartita*, *Olea europaea*, *Genista saharae and Ziziphus lotus*. Using the different results, we can make the following observations:

- Biological analysis confirms regressive evolution of vegetal carpet as it was glimpsed by floristic composition group examination. Vegetation matrix regression results in progressive disappearance of phanerophytes, extension of geophytes (*Urginea maritima*, *Urginea noctiflora*, *Gymnarrhena micrantha*, *Gynandriris sisyrinchium*) and progressive appearance of hemicryptophytes (*Astragalus vogelii*, *Erodium garamantum*, *Paronychia chlorothyrsa*, *Plantago albicans*). It is also noted some chamaephytes (*Hammada schmittiana*, *Hammada scoparia*, *Atractylis serratuloides*) become dominant in contribution to vegetal mat, although they are few in number thus favoring their development. This observation was also pointed out by Kadi-Hanifi (2003).
- Biological spectrum is considered by phytogeographers as a strategy for flora adaptation to unfavorable environments conditions and more particularly to climatic conditions (Daget, 1980). Thus the various biological forms inform about growth forms and therefore the plants response to the environment local conditions (Aidoud, 1998).

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- In general, it can be seen that study area presents a floristic procession marked by heterogeneity between woody and herbaceous plants and between perennials and annuals. This landscape disparity may be linked to orographic, edaphic and hydrological environment conditions.

3.2.2. Systematic Analysis

Table 3 shows a variation in distribution and families, genera and species distribution encountered. This systematic evaluation took into account species number in each family in descending order. Floristic inventory made it possible to identify 135 species of spermaphytes belonging to 105 genera and 36 botanical families.

Table 3. List of botanical families of the study station

No.	Families	Number of Genera	Number of Species	Percentage (%)
1	Asteraceae	27	35	25.92
2	Poaceae	10	14	10.37
3	Brassicaceae	10	11	8.15
4	Fabaceae	6	9	6.67
5	Papaveraceae	4	5	3.70
6	Boraginaceae	4	4	2.96
7	Caryophylaceae	4	4	2.96
8	Resedaceae	1	4	2.96
9	Zygophyllaceae	2	3	2.22
10	Geraniaceae	1	3	2.22
11	Lamiaceae	2	3	2.22
12	Plantaginaceae	1	3	2.22
13	Plombaginaceae	2	3	2.22
14	Polygonaceae	3	3	2.22
15	Apiaceae	2	2	1.48
16	Amaranthaceae	2	2	1.48
17	Anacardiaceae	2	2	1,48
18	Asparagaceae	2	2	1.48
19	Convolvulaceae	2	2	1.48
20	Xanthorrhoeaceae	1	2	1.48
21	Euphorbiaceae	1	2	1.48
22	Malvaceae	1	2	1.48
23	Rosaceae	2	2	1.48
24	Apocynaceae	1	1	0.74
25	Capparidaceae	1	1	0.74
26	Cistaceae	1	1	0.74
27	Cucurbitaceae	1	1	0.74
28	Dipsacaceae	1	1	0.74
29	Iridaceae	1	1	0.74
30	Oleaceae	1	1	0.74
31	Onagaceae	1	1	0.74
32	Arecaceae	1	1	0.74
33	Rhamnaceae	1	1	0.74
34	Rubiaceae	1	1	0.74
35	Scrophulariaceae	1	1	0.74
36	Thymeleaceae	1	1	0.74
Total		**105**	**135**	**100%**

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The plant diversity analysis shows that specific richness represents 3.45% of Algeria flora estimated at 3139 by Quézel and Santa (1962-1963), indicating a specific, generic and systematic diversity of floristic procession within grouping in *Pistacia atlantica*. This result is broadly similar to those obtained by several authors (Quézel and Bounaga, 1975; Bouzenoune, 1984; Gherzouli and Djellouli, 2005; Yahi et al., 2008; Bouallala, 2006; Rebbas, 2014) in their vegetation studies.
An examination of different taxa list (Table 3) shows that most representative families in species number are Asteraceae (35 species and 27 genera), Poaceae (14 species and 10 genera), Brassicaceae 11 species and 10 genera) and Fabaceae (9 species and 6 genus). These four families alone represent 69 species, i.e. 51% of floristic group at *Pistacia atlantica* in study station. These species are divided into 53 botanical genera within 4 families already mentioned.
The other families that are less represented are variable; Papaveraceae with 5 species, 3 families with 4 species (Caryophyllaceae, Borraginaceae and Resedaceae), 7 families with 3 species (Lamiaceae, Geraniaceae, Plombaginaceae, Polygonaceae, Plantaginaceae and Zygophyllaceae), 9 families of bispecific with 2 species (Cistaceae, Apocynaceae, Cucurbitaceae, Iridaceae, Arecaceae, Capparidaceae, Onagaceae, Dipsacaceae, Oleaceae, Rhamnaceae, and the other two species (Amaranthaceae, Asparagaceae, Apiaceae, Euphorbiaceae, Anacardiaceae, Malvaceae, Convolvulaceae, Rosaceae and Xanthorrhoeaceae) and finally 12 families are monospecific (Cistaceae, Apocynaceae, Cucurbitaceae, Iridaceae, Arecaceae, Capparidaceae, Onagaceae, Dipsacaceae, Oleaceae, Rhamnaceae, Rubiaceae and Scrophulariaceae).
This diversity of families is due to several factors: climate, type of habitat, orography, anthropogenic action, biotopes ecological diversity within study station (valley, mountain, rocky outcrops). It is reported that these figures are in adequacy with those quoted by Ozenda (1991) for Sahara. This generic variation is explained by Boughani et al. (2009): in arid zone and Sahara, most families are represented by only one or two genera and most genera by only one or two species.
There families of Saharan-northern domain (Ozenda, 1977), such as Euphorbiaceae, Plantaginaceae, are represented but with a small percentage. These families are characterized by Saharan genera (*Fagonia*, *Astragalus*, *Arnebia*, *Ifloga*, *Zilla*, *Senecio*, *Pergularia*, *Neuroda*, *Morettia*, *Moltkia*).

3.2.3. Phytogeo graphic analysis

This analysis of flora within grouping at *Pistacia atlantica* reveals diversity in phytogeographical elements (Table 4).

Table 4. Biogeographical distribution of the procession floristic

No.	Phytogeographical types	Number of Species	Percentage (%)
1	Mediterranean	34	25.19
2	Saharo-Sindian	29	21.48
3	Endemic	24	17.78
4	Multi-regional	20	14.81
5	Saharan	12	8.89
6	Ibero-Mauritanian	7	5.18
7	Cosmopolitan	3	2.22
8	Tropical	3	2.22
9	Palaeo-temperate	3	2.22
	Total	**135**	**100%**

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The phytogeographical analysis shows that biogeographical type's distribution is as follows: Mediterranean> Saharo-Sindian> Endemic> Multi-regional> Saharan> Ibero-Mauritanian> Cosmopolitan = Tropical = Palaeo-temperate.
At the study station level located in western part of Saharan atlas, species majority belong to Mediterranean element (2519%) domains , element Saharan -Sindian (with 29 species, i.e. 21.48% of listed species (*Zilla spinosa*, *Zilla macroptera*, *Cleome arabica*, *Gymoncarpos decander*, *Polycarpaea repens*, *Rumex vesicarius*, *Calendula aegyptiaca*, *Morettia canescens*, *Fagonia glutinosa*, *Fagonia latifolia*), endemic element (24 species, i.e. 17.78% of flora), multi-regional element representing 20 species, i.e. 15% of floristic cortege, and presence of this multi-regional element with a considerable rate in this flora is caused by seeds dissemination by different modes (anemochory, zoochory, hydrochory). The Saharan element represents 9% (12 species), and for the other elements stories have less than 10 species to know (Iberian Mauritanian 7, Cosmopolitan 3, Tropical 3 and Paleo-temperate 3).
Study station has a very high rate of endemism, which explains why station is less anthropized, this protection is due to its location near border strip of Morocco and inaccessibility of these places by man and their flock.
Bouallala (2013) indicates that Hamadas biotope is characterized by dominance of Saharo-Arabic element and a weakness for Mediterranean element. There are also numerous Saharan taxa (*Retama retam*,*Randonia africana*, *Rhantherium suaveolens*...), these Saharan trees dominate very clearly.
In study station, a presence of steep slopes, certain exposure and altitude allow installation of typically hygrophyllous vegetation: *Nerium oleander*, *Phoenix dactylifera*.

4. CONCLUSIONS

Grouping at *Pistacia atlantica* has an important biological, systematic and biogeographical floristic diversity. This diversity makes it possible to appreciate different coping strategies of life and a wide geographical distribution.
Floristic procession within grouping at *Pistacia atlantica* conceals a large heterogeneous phytodiversity on a quantitative and qualitative level; it is linked to geographical position, edaphic structure, geological history, altitude, types of Mediterranean steppe and/ or Saharan vegetation, orography, climate, topography, the nature and depth of soils, and various degrees of anthropozoic pressure.
Its conservation and multiplication are therefore an essential necessity; forest managers and administrators must address valorization problem of this plant genetic resource and give it much more importance.

5. REFERENCES

Aïdoud, A. (1983). Contribution à l'étude des écosystèmes steppiques du sud oranais : phytomasse, productivité primaire et applications pastorales [Contribution to the study of steppe ecosystems in southern Oran: phytomass, primary productivity and pastoral applications]. Thèse Doctorat 3ème cycle USTHB. Alger. 245 p. + Annexes.
Aïdoud A. (1998). Fonctionnement des écosystèmes méditerranéens [Functioning of Mediterranean ecosystems]. Conférence du réseau MESOE (Méditerranée Enseignement Secondaire Observation et Environnement). 50p.
Babali, B. (2014). Contribution à une étude phytoécologique des monts de Moutas (Tlemcen- Algérie occidentale): Aspects syntaxonomique, biogéographique et dynamique [Contribution to a phytoecological study of the Moutas mountains (Tlemcen- Western Algeria): Syntaxonomic, biogeographic and dynamic aspects]. Thèse de Doctorat. Département d'Ecologie et Environnement. Faculté des Sciences de la Nature et de la Vie, des Sciences de la Terre et de l'Univers. Université Abou Bakr Belkaïd Tlemcen. 160p.

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Barry, J.P. & Celles, J.C. (1972-1973). Le problème des divisions bioclimatiques et floristiques au Sahara Algérien (entre 0° et 6° de longitude Est) [The problem of bioclimatic and floristic divisions in the Algerian Sahara (between 0 ° and 6 ° East longitude)]. Nat. Monsp. Sér. Bot, 5-48.

Belhacini, F. (2011). Contribution à une étude floristique et biogéographique des matorrals du versant sud de la région de Tlemcen. Département d'Ecologie et Environnement Faculté des Sciences de la Nature et de la Vie, des Sciences de la Terre et de l'Univers. Université Abou Bakr Belkaïd – Tlemcen. 125p.

Benabadji, N., Benmansour, D., Bouazza, M. (2007). La Flore Des Monts d'Ain Fezza dans l'Ouest Algérien, biodiversité et dynamique [The Flore Des Monts d'Ain Fezza in Western Algeria, biodiversity and dynamics]. *Sciences & Technologie* C – N°26, décembre, 47-59.

Benaradj, A. (2010). Contribution à l'étude phyto-écologique du *Pistacia atlantica* Desf. *atlantica* dans la région de Béchar (Sud-Ouest algérien) [Contribution to the phyto-ecological study of *Pistacia atlantica* Desf. atlantica in the region of Bechar (southwestern Algeria)]. Mémoire de Magistère, Faculté des Science de la Nature et de la Vie et Sciences de la Terre et de l'Univers, Université de Tlemcen. 147p.

Benaradj A., Bouazza M. & Boucherit H. (2015a). Phytodiversity the Group to *Pistacia atlantica* Desf. in the Saharan atlas (Bechar-Algeria). *Energy Procedia* 74, 258 – 264

Benaradj, A., Bouazza, M. & Boucherit, H. (2015b). Ecologie du groupement à *Pistacia atlantica* dans l'atlas saharien oranais (Béchar- Algérie) [Ecology of the *Pistacia atlantica* group in the Saharan Oranian atlas (Béchar-Algeria)]. *Fl. Medit*. 25, 87-94.

Benaradj, A. (2017). Étude phyto-écologique des groupements à *Pistacia atlantica* Desf.dans le sud Oranais (Sud-Ouest algérien) [Phyto-ecological study of groups with *Pistacia atlantica* (Desf.) in the south of Oran (south-west of Algeria)]. Thèse de Doctorat en Foresterie. Département des ressources Forestières, Faculté des Sciences de la Nature de la Vie et Sciences de la Terre et de l'Univers, Université Abou Bekr Belkaid Tlemcen. 266p.

Birnbaum, P. (2012). Biodiversité au Sahel. Les forêts du Mali [Biodiversity in the Sahel. The forests of Mali]. Edition Quae. 208p.

Bonnier, G. et Douin, R. (1990). La grande flore en couleurs. France, Suisse, Belgique et pays voisins [The great flora in color. France, Switzerland, Belgium and neighboring countries]. Editeur de Belin. Collection : Nouvelle Flores de Bonnier. 400p.

Bouallala, M. (2006). Contribution à l'étude phytoécologique des écosystèmes : cas du Djebel Aïssa (Monts des Ksours, Aïn Sefra, Nâama) [Contribution to the phytoecological study of ecosystems: case of djebel Aïssa (Monts des Ksours, Aïn Sefra, Nâama)]. Mémoire de magister, Faculté des Sciences, Département de Biologie. Université d'Oran Es-Sénia. 90 p.

Bouallala M. (2013). Etude floristique et nutritive spatio-temporelle des parcours camelins du Sahara Occidental Algérien. Cas des régions de Bechar et Tindouf [Spatio-temporal floristic and nutritive study of camel routes in Western Algerian Sahara. Case of the regions of Bechar and Tindouf]. Thèse Doctorat Es Sciences. Département Des Sciences Agronomiques. Faculté des Sciences de la Nature et de la Vie et des Sciences de La Terre et de l'Univers Université Kasdi Merbah Ouargla. 123p.

Boudy, P. (1952). Guide forestier en Afrique du Nord [Forest guide in North Africa]. Edition la Maison Rustique, Paris, 509p.

Bouzenoune A. (1984). Etude phytogéographique et phytosociologique des groupements végétaux du sud oranais (wilaya de Saida) [Phytogeographic and phytosociological study of plant groups in southern Oran (wilaya of Saida)]. Thèse Doct.3e cycle,Univ.Sci.Technol. Haouari Boumediene, Alger, 225p.

Daget, Ph. & Poissonet, J. (1971). Une méthode d'analyse phytoécologique des prairies, critères d'application [A method of phytoecological analysis of meadows, application criteria]. Ann. Agron, 22 (1), 5-41.

Daget, Ph. (1980). Sur les types biologiques en tant que stratégie adaptative. (Cas des thérophytes) [On biological types as an adaptive strategy. (Case of therophytes)]. in : Recherches d'écologie théorique, les stratégies adaptatives. Paris, 89-114.

Gharzouli R. & Djellouli Y. (2005). Diversité floristique de la Kabylie des Babors (Algérie) [Floristic diversity of Kabylia des Babors (Algeria)]. *Sécheresse*, 16, 217-223.

Godron, M. (1968). Quelques applications de la notion de fréquence en écologie végétale [Some applications of the concept of frequency in plant ecology]. *Oecol. Plant*. 3, 185-212.

Gounot, M. (1969). Méthodes d'étude quantitatives de la végétation [Quantitative vegetation study methods]. Edition : Masson et Cie, p. 314.

Guittonneau, G. G., Astie, M., Begel, P., Bismuth H., Chaffin C., Charpin A., Covillot J., Dakhlia G., Delaigue M., Dreger, F., Duclos, A., Dupont, J. M., Georges, C., Le Strat, F., Leveugle, A., Magnouloux, M., Thiebault, P.

*Corresponding author, E-mail address: kbenaradj@yahoo.fr

(2011). Flore et végétation de la Tunisie méridionale [Flora and vegetation of southern Tunisia]. Documents sur les activités de la Société botanique de France, 6, 281-359.

Kaabeche, M. (1990). Les Groupements Végétaux de la Région de Bou-Saada. Contribution à la Synsystématique des Groupements steppiques du Maghreb [The Plant Groups of the Bou-Saada Region. Contribution to the Synsystematics of the Steppe Groups of the Maghreb]. Thèse de Doctorat d'Université. 2 Vol., Université de Paris-Sud, Centre d'Orsay, France.

Kaabeche M. (2003). Conservation de la biodiversité et gestion durable des ressources naturelles : étude sur la réhabilitation de la flore locale au niveau de la réserve «El - Mergueb» (Wilaya De M'sila, Algérie) [Conservation of biodiversity and sustainable management of natural resources: study on the rehabilitation of local flora at the level of the "El - Mergueb" reserve (Wilaya De M'sila, Algeria)]. Projet DGF, ALG/00/G35/A/1G/99. 42p.

Kadi-Hanifi, H. (2003). Diversité biologique et phytogéographique des formations à Stipa tenacissima L. de l'Algérie [Biological and phytogeographic diversity of *Stipa tenacissima* L. formations from Algeria]. *Sécheresse* n° 3, vol. 14, 169-179.

I.G.M (Institut Géographique National), 1966. Carte du Sahara, Ain Séfra (Sud de Naâma) [Pap of Sahara, Ain Sefra]. Echelle 1/20000 (Projection UTM). Feuille NI-30-VI.

Le Houerou, H. N. (1995). Considérations biogéographiques sur les steppes arides du Nord de l'Afrique (A) [Biogeographical considerations on the arid steppes of North Africa (A)]. *Sécheresse*; 6, 167-182.

Maire, R. (1952-1987). Flore de l'Afrique de Nord [Flora of North Africa]. Vol. 1 à 16. Le chevalier, Paris.

M.I.C.L.E (Ministère de l'Intérieur, des Collectivités Locales et de l'Environnement). (1997). Elaboration de la stratégie nationale pour la conservation et l'utilisation durable de la diversité biologique [Development of the national strategy for the conservation and sustainable use of biological diversity]. Rapport intérimaire. Secrétariat d'Etat Chargé de l'Environnement., 27p.

Nedjraoui, D. (1990). Adaptation de l'Alfa (*Stipa tenacissima*) aux conditions stationnelles. Contribution à l'étude du fonctionnement de l'écosystème steppique [Adaptation of Alfa (*Stipa tenacissima*) to station conditions. Contribution to the study of the functioning of the steppe ecosystem]. Thèse Doct. U.S.T.H.B. Alger.166p.

Ozenda, P. (1977). Flore du Sahara [Sahara flora]. 2ème Ed. CNRS. Paris, 622 p.

Ozenda, P. (1991). Les relations biogéographiques des montagnes sahariennes avec la région méditerranéenne [The biogeographical relations of the Saharan mountains with the Mediterranean region]. *Revue de géographie alpine* LXXIX, 43-53.

Poilecot, P. (1996). La Reserve Naturelle Nationale de l'Aïr et du Ténéré (Niger) [The Aïr and Ténéré National Nature Reserve (Niger)]. MH/E / WWF/ IUCN; 228p.

Quézel, P. et Medail, F. (2003). Ecologie et biogéographie des forêts du bassin méditerranéen [Ecology and biogeography of the forests of the Mediterranean basin]. Ed. sci. Méd. Elsevier. SAS..

Quézel, P. et Santa, S. (1962-1963). Nouvelle flore de l'Algérie et des régions désertiques méridionales [New flora of Algeria and southern desert regions]. Paris: Ed. C.N.R.S. 2 Vol, 1170p.

Quézel, P. & Bounaga, D. (1975). Aperçu sur la connaissance actuelle de la flore d'Algérie et de Tunisie [Overview of the current knowledge of the flora of Algeria and Tunisia]. Colloque Internernational, CNRS. Flora Mediterranea, Paris, 235, 125-130.

Quézel, P. (1995). La flore du bassin méditerranéen: origine, mise en piace, endémisme [The flora of the Mediterranean basin: origin, enjoyment, endemism]. *Ecol. Medit*. 20(1/2), 19-39.

Raunkiaer, C. (1934). The Life forms of plants and Statistical Plant Geography. Oxford University Press, Oxford. 632p.

Rebbas Kh. (2014). Développement durable au sein des aires protégées algériennes, cas du Parc National de Gouraya et des sites d'intérêt biologique et écologique de la région de Béjaïa [Sustainable development within Algerian protected areas, the case of Gouraya National Park and sites of biological and ecological interest in the Béjaïa region]. Département de Biologie et Écologie Végétale. Faculté des Sciences de la Nature et de la Vie. Université Ferhat Abbas Sétif 1. 130p.

Slimani, H. (1998). Effet du pâturage sur la végétation et le sol et désertification. Cas de la steppe à alfa de Rogassa des Hautes Plaines Occidentales algériennes [Effect of grazing on vegetation and soil and desertification. Case of the alfa steppe of Rogassa of the Algerian Western High Plains]. Thèse magister, USTHB. Alger. 123p.

Yahi, N., Véla, E., Benhouhou, S., De Bélair, G. & Gharzouli, R. (2012). Identifying important plants areas (Key Biodiversity Areas for Plants) in northern Algeria. *J. Threat. Taxa*, 4, 2753-2765.

*Corresponding author, E-mail address: kbenaradj@yahoo.fr