Journal of Bioresource Management

Volume 8 | Issue 1 Article 4

1-27-2021

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Recommended Citation

Yassine, N., Ramzi, H., Hichem, K., Sakina, M., & Etayeb, B. (2021). Diversity, Ecology and Therapeutic Properties of the Medicinal Plants in Ziban Region (Algeria), *Journal of Bioresource Management, 8* (1). DOI: https://doi.org/10.35691/JBM.1202.0163

DIVERSITY, ECOLOGY AND THERAPEUTIC PROPERTIES OF THE MEDICINAL PLANTS IN ZIBAN REGION (ALGERIA)

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ABSTRACT

With the aim to assess the floristic population diversity, distribution and therapeutic properties in the Ziban region (Algeria), a survey was conducted along two successive study years in the main area. The objective of this study was to contribute to the knowledge and description of this plant groups with exhaustive inventory spontaneous vegetation. In order to study the dynamics of medicinal plants, we used a quantitative method based essentially on the classic technique of linear surveys and floristic inventory using the minimum area method. The results showed that the floristic procession of medicinal plants is represented by 21 species belonging to the 13 families, with a total of 31 species for the 08 study stations, which represents 68% of the total procession. The results obtained showed that the overall recovery is higher at the Ain Ben Noui station with 69%, even if the clumps of *Aristida pungens*, *Atractylis serratuloides* and *Atriplexhalimus* are isolated and scattered. The lowest overall coverage at the Oumache station is less than 21%, as it is an area with sandy soils. The species that contribute most to the recovery of mobile sand accumulations is *Astragalus armatus* with a rate of 76.19% at the Ain Ben Noui station. Frequency results allowed us to say that *Atriplex halimus* and *Zizyphus lotus* are the ubiquitous species (100% of the surveys). On the other hand, *Nitraria retusa*, *Teucrium polium*, *Shismus barbatus*, *Sueda mollis* and *Halocnemum strobilaceum* are the species present in only one survey.

Keywords: Medicinal plants, Ziban, *Atriplexhalimus,* Oumache, frequency.

INTRODUCTION

Medicinal plants still remain a source of medical care in the countries of Maghreb (Baba-Aissa, 2000) the composition of the Algerian Sahara vegetation carpet has been the subject of some works, such as those of (Quezel and Santa, 1962-1963; Ozenda., 1977-1982; Chehma, 2004; Chalabi, 2007). The exploration of the Saharan flora and more particularly that of the Northern Sahara dates back to the last century under French colonization (Salemkour et al., 2012). The majority of countries use medicinal plants for health purposes and medical treatment (Cunningham, 1993; Agisho et al., 2014).

In Africa, and particularly in Algeria, the practice and knowledge of traditional medicine have been passed on from older generations to future generations in recent years several research programs on traditional medicine have been strengthened in this context to increase their knowledge (WHO, 2013; Rebbas et al., 2012).

Within the framework of having a database on the genetic background of these medicinal plants and their biotechnological applications based on the values of their bioactive substances of which are little known, several authors have published books on phytotherapy and ethnobotany (Baba-Aissa, 1991; Beloued,

1998; Baba, 2000 and Ait, 2006) and ethnobotanical research (Rebbas et al., 2012; Miara et al., 2013; Meddour and Meddour-Sahar, 2015; Benarba et al., 2015; Chermat and Gharzouli, 2015; Lakhdari et al., 2016 Ouelbani et al., 2016 and Miara et al., 2019). The region of Ziban in the wilaya of Biskra very few studies have been devoted to the vegetation of sandy accumulations except those of Laadjal (2005) who studied the distribution of spontaneous vegetation in the region of Zibans and Merabeti (2006) on the degradation of spontaneous plant genetic resources in the region of Biskra. The work that will be exposed here aims to listing the medicinal plants of the Ziban region, to provide information on their ecology and to get an idea for their therapeutic properties.

MATERIAL AND METHOD

Study Area

The Ziban region is the transition between the atlas and the desert (Figure. 1).It is rich in various sandy accumulations which are characterized by typical vegetation that is dependent on the sand. Despite the harsh conditions to which these plants are subjected, they have developed strategies that allow them to survive. From the climatic point of view, the region also constitutes a transition between the semi-arid environment of the high plains and the hyper-arid domain of the Sahara Gouskov (1962). The Ziban oasis is located in the east of Algeria, south of the Aurès Mountains (5º 44' 00" N, 35º 51' 00" E). The region is characterized by the arid Mediterranean climate. The average maximum temperature is 41.38 ºC in August and the minimum temperature during January is 8.26 ºC. Precipitation averaged about 128 mm over the last ten years (2004–2014) as reported by Nouidjem et al., (2019).

To give an accurate view of the floristic composition in this region, 08 study stations were chosen, and at each station several surveys were necessary. All surveys are carried out during the spring period 2010/2011.

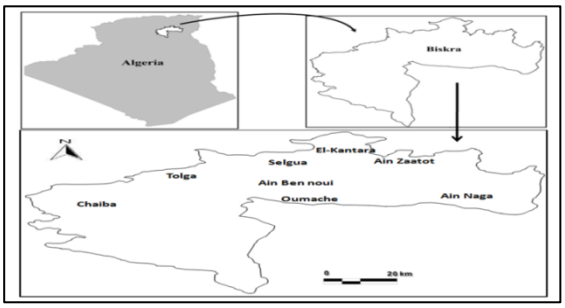

Figure 1: Study area's location.

Method of Sampling and Species Determination

The literature describes several sampling methods for carrying out phytosociological surveys. Two methods have been selected, the first is the linear survey method used for the study of the dynamics of medicinal plants, as it provides data on quantitative. The second is the minimum areas used for the study of floristic composition. To determine the species recorded in the 08 stations, the "flora and vegetation of the Sahara" of Ozenda (1977) and Quezel and Santa (1962-1963) were used.

i. Linear Reading

The linear survey method has only been carried out at a few stations. This technique seems to be the most effective in this type of training, as it is simple, quick, and relatively objective and can be used in all types of low vegetation. This method has been described by several authors (Gounot, 1969; Daget and Poissonet, 1969 and Long, 1970) and is adapted to lowland formations in general and steppe ecosystems in particular (Aidoud, 1983; Melzi, 1986; Nedjraoui, 1990). It consists of setting up a device consisting of a line made up of a graduated ribbon stretched over the vegetation. The reading was done by points marked by a needle at regular

intervals of 10 cm. The number of readings by this technique was 10 lines of 10 m for each transect, i.e. a total of 1000 sampling points per transect, the lines were 50 m apart from each other. The form for the linear survey was a record sheet represented by a 101-column table called the "vegetation matrix image". The first column was quite large and contains the soil features and the names of the species surveyed.

ii. Minimum Area

From a qualitative point of view, we compared the floristic composition of the different stations with different representative profiles of the different forms of sandy accumulations in the study area. The method chosen to give an accurate picture of the vegetation of the different stations was that of minimum areas. This was the smallest area necessary for most species to be represented (Kadik, 1990). The survey area was based on the concept of minimum area. This notion was linked to the increase in the number of species according to the area sampled (area/species relationship) with the formation of a plateau at a certain scale. For our experiment, measurements were taken over areas of 100 m².

iii. The Ecological Indexes

The study of the dynamics of medicinal plants and their floristic compositions was carried out using ecological indices and statistical methods. The ecological indices used in our study give us a picture of the composition and structure of medicinal plants.

iv. Total Richness (S)

The total richness S is equal to the total number of species present and obtained from the total number of surveys (Blondel, 1979; Ramade, 1984).

v. Overall Vegetation Cover (RG)

The study of land cover is a fundamental parameter in the evaluation of the dynamics of plant units. It is based on the measurement of vegetation cover, which constitutes one of the best bases for evaluating the evolutionary trends of vegetation, as well as on the measurement of the cover of elements on the soil surface that reflect the intensity of hydric and especially wind erosion (Melzi, 1986). The overall cover is the percentage ratio between the number of vegetation points (n) and the total number of contact points (N).

Coverage rates are estimated as a proportion of the area covered by all vegetation in the surveyed synusia (Sv), and not as a proportion of the total survey area (St).

$$\boldsymbol{RG}\% = \frac{\boldsymbol{n}}{\boldsymbol{N}} \times \mathbf{100}$$

n: number of points where vegetation was encountered.

N: total number of points of contact.

vi. Specific Frequency (Fsi)

Vegetation cover can also be expressed by the notion of specific frequency centesimal. It is the ratio expressed as a percentage of the number (ni) of times the species (i) was surveyed along the line to the total number of points sampled (N). The specific frequency expresses the probability of occurrence of a species in the sampled unit. The accuracy of the measurement will depend on the number of units sampled.

$$\boldsymbol{F_{si}}(\%) = \frac{\boldsymbol{ni}}{\boldsymbol{N}} \times \mathbf{100}$$

The overall recovery rate (RGV) is expressed as follows:

$$\boldsymbol{RGV} = \sum \boldsymbol{F_{si}}$$

This important parameter represents the sum of the specific cash frequencies. The total number of vegetation contact points is related to the total number of points.

RESULTS

Floristic List of Study Stations

The inventory of the flora of the 08 resorts allowed to count 31 species all belonging to the Magnoliophyta phylum and divided into two classes which are the Magnoliopsida and the Liliopsida. The most represented class was that of Magnoliopsida with 4 subclasses, 11 orders, 13 families and 28 species, while the Liliopsida class was represented by only one subclass, 1 order, 1 family and 3 species (Table1)

The 31 recorded species of the vegetation existing in the 08 study stations belong to the following 14 botanical families: Anacardiaceae, Asclepiadaceae, Asteraceae, Chenopodiaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Plumbaginaceae, Poaceae, Rhamnaceae, Tamaricaceae, Thymelaeaceae, and Zygophyllaceae.

Rate of Species Inventoried by Families

The majority of the families recorded are represented by a single species except for the families of: Chenopodiaceae (07 species), Asteraceae (04 species), Zygophyllaceae (04 species), Fabaceae (03 species), Poaceae (03 species).

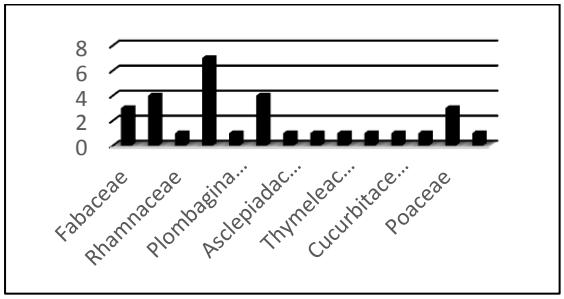

Figure 2: Rate of species inventoried by families.

Global Biological Spectrum

We have selected five biological types: Phanerophytes, Chamephytes, Geophytes, Hemicryptophytes and Therophytes. According to the global list of species, we obtain: Phanerophytes: 19%, Chamephytes: 54%, Hemicryptophytes: 10%, Geophytes: 4%, Therophytes: 13%. The composition of the overall spectrum shows a predominance of Therophytes and Chamephytes over the other forms (Figure.3).

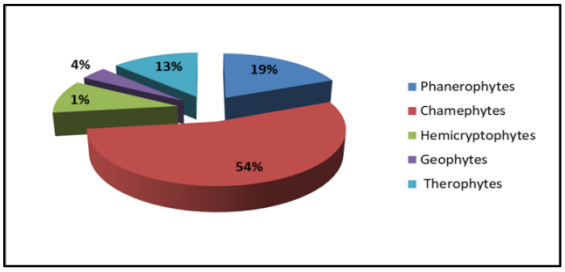

Figure 3: Global biological spectrum.

Overall Vegetation Cover RG (%)

The overall vegetation cover of the Ain Ben Noui station is higher than that of the other stations (Figure. 4), but it is lower than that of the Oumache station, where the overall vegetation cover is less than 21%.

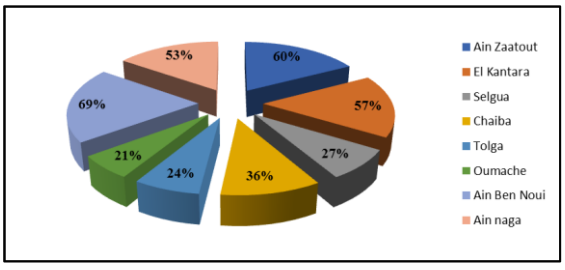

Figure 4: Overall RG vegetation cover per station.

Specific Frequency Fsi (%)

The results of the vegetation frequencies of the 08 study stations are shown respectively in Table 2.

Table 1: Inventory of plant species recorded in the Biskra region.

Family	Species	Biological type
Anacardaceae	Pistacia atlantica Desf.	Phanerophytes
Asclepiadaceae	Pergularia tomentosa L.	Chamephytes
Asteraceae	Artemisia herba-alba Asso	Chamephytes
	Atractylis serratuloides Sieber.	Chamephytes
	Cotula cineria L.	Therophytes
	Echinops spinosus L.	Hemicryptophytes
Chenopodiaceae	Anabasis articulata Forssk.	Chamephytes
	Atriplex halimus L.	
	Halocnemum strobilaceum Pall.	
	Hammada scoparia Pomel.	
	Salsola vermiculata L.	
	Suaeda fruticosa Forssk.	
	Suaeda mollis Forssk.	
Cucurbitaceae	Colocynthis vulgaris Schrad.	Hemicryptophytes
Euphorbiaceae	Euphorbia guyoniana Boiss.	Therophytes
Fabaceae	Astragalus armatus L.	Chamephytes
	Genista saharae Coss.	Phanerophytes
	Retama retam Forssk.	Phanerophytes
Lamiaceae	Rosmarinus officinalis L.	Chamephytes
	Teucrium polium L.	Chamephytes
Plombaginaceae	Limoniastrum guyonianum Boiss.	Chamephytes
Poaceae	Aristida pungens Desf.	Hemicryptophytes
	Schismus barbatus Loefl.	Therophytes
	Stipa tenacissima L.	Geophytes
Rhamnaceae	Ziziphus lotus L.	Phanerophytes
Tamaricaceae	Tamarix gallica L.	
Thymeliaceae	Thymelaea microphylla Coss.	Chamephytes
Zygophyllaceae	Fagonia glutinosa Delile.	Chamephytes
	Nitraria retusa Forssk.	Phanerophytes
	Peganum harmala L.	Therophytes
	Zygophyllum album L.	Chamephytes

Table 2: Specific frequencies of plant species in the study stations.

Statement / Species	S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	Moy
Astragalus armatus L.	3	48	5	9	0	16	1	4	**10.75**
Zygophyllum album L.	0	0	0	0	0	0	33	0	**4.12**
Peganum harmala L.	7	3	0	0	11	0	1	2	**3.45**
Zizyphus lotus L.	4	0	0	0	1	0	0	0	**0.62**
Salsola vermiculata L.	0	0	0	0	0	1	0	0	**0.12**
Atriplex halimus L.	0	0	9	6	6	2	33	6	**7.75**
Atractylis serratuloïdes Sieber	0	0	0	5	0	0	0	0	0.62
Artemisia herba-alba Asso	25	5	4	10	0	0	0	27	**8.87**
Echinops spinosus L.	0	0	1	0	0	0	0	1	**0.25**
Rosmarinus officinalis L.	19	1	0	0	0	0	0	0	2.5
Tamarix gallica L.	0	0	0	0	1	0	0	0	0.12
Colocynthys vulgaris Schrad.	0	0	0	0	0	2	1	0	0.37
Stipa tenacissima L.	2	0	8	0	0	0	0	0	1.25
Shismus barbatus Loefl	0	0	0	0	5	0	0	0	0.62

Table 3: Medicinal plants of the Ziban region and their therapeutic properties.

Family	Species	Therapeutical Properties
Fabaceae	*Retama retam*	Used as a powder, infusion or compress for the treatment of rheumatism, wounds, insect bites, as well as to treat diarrhea and feverish illnesses.
Zygophyllaceae	*Nitraria retusa*	It is used against diseases of the respiratory system. It has diuretic properties.
	Zygophyllum album	It is used as a decoction, powder or ointment for the treatment of diabetes, indigestion and dermatitis.
	Peganum harmala	In fumigation, it is used to dissipate disorders caused by the evil eye and treats children's convulsions, used as an ointment to treat fevers and in friction to treat rheumatism.
Rhamnaceae	*Zizyphus lotus*	Used in decoction as a sedative and diuretic pectoral sedative, in powder mixed with warm water or milk applied as a plaster on boils.
Anacardiaceae	*Pistacia atlantica*	By crushing the leaves, the liquid obtained is used as eye drops against conjunctivitis, chewing the leaves has a disinfectant action in the case of gingivitis.
Chenopodiaceae	*Anabasis articulata*	Used as a plaster to treat scabies.
	Salsola vermiculata	In cataplasm, the leaves are used on pimples and for the treatment of ringworm.
	Arthrophytum scoparium	Used for the treatment of indigestion, scorpion stings and dermatitis.
	Atriplex halimus	The leaves are crushed and used to dry the wounds, very effective for the treatment of cistus.
Plombaginaceae	*Limoniastrum guyonianum*	Herbal teas from leaves, branches and galls are anti-dysenteric while the root decoction is used as a depurative.
Asteracea	*Cotula cinerea*	Used as an infusion to aid digestion.
	Artemisia herba-alba	Its leaves, in infusion, maceration or boiled, are widely used for all digestive disorders and against colds, still used as a poultice to treat variola.
	Echinops spinosus	Used as an anti-hemorrhoid, these roots are used to improve the circulatory system.
Asclepiadaceae	*Pergularia tomentosa*	It is used for angina and dermatitis, in application the milk contained in the plant brings out the spines of the skin.
	Rosmarinus officinalis	Used as an antispasmodic, antiseptic, diuretic treats hepatic, digestive disorders and migraine depressions.
Tamaricaceae	*Retama retam*	Used against lice as a lotion, and the leaf decoction used against spleen oedema.
Cucurbitaceae	*Nitraria retusa*	It is used as an infusion, poultice, ointment and compress for the treatment of scorpion stings, indigestion, dermatitis and genital infections.
Euphorbiaceae	*Zygophyllum album*	Used against snake bites.
Poaceae	*Peganum harmala*	In washing, ashes are prescribed in the treatment of chronic scalp ulcers.

Distribution of Medicinal Plants in the Ziban Region

Based on the floristic inventory of the stations using the minimum area method, the floristic procession of medicinal plants is represented by 21 species belonging to the 13 families, which represents 68% of the total procession distributed according to the following map:

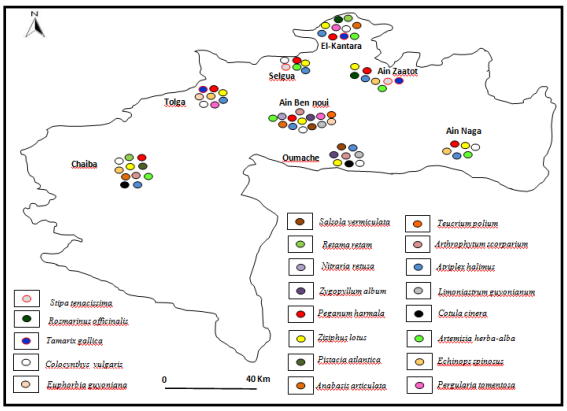

Figure 5: Map of the distribution of medicinal plants in the Ziban region.

Therapeutic Properties of Medicinal Plants in Ziban Region

The world of plants is full of resources and virtues where man not only takes his food, but also active substances that often provide a good to his body. The region of Ziban is characterized by multiple local uses of medicinal plants, drawn from ancestral heritage and multiple experiences over time. Herbalists have provided extensive and valuable information about medicinal plants and their uses for the daily treatment of diseases. It is essential that traditional herbalists and practitioners of phytotherapy continue to hand on their invaluable knowledge to future generations (Miara, 2019). These properties are outlined in Table 3.

DISCUSSION

All the species inventoried are listed in Table 01. The Quezel and Santa phytogeographical types and the biological types of Raunkiaer, 1934 are also mentioned. Compared with the 131 botanical families of the entire Algerian flora recorded by Quezel and Santa (1962-1963), the study region contains almost 10% of these families. Examination of the distribution of the 31 species in all 14 families led to the following observations: The most representative families in the number of species are the Chenopodiaceae (07 species), Asteraceae (04 species), Zygophyllaceae (04 species), Fabaceae (3 species), Poaceae (03 species). These 5 families alone represent 21 species, i.e. 67.74% of the floristic richness of the region.

The predominant place occupied by the Chenopodiaceae, Asteraceae, Zygophyllaceae, and Poaceae is justified since these are cosmopolitan families that are very well represented all over the world (Boughani, 1995).

The ratio of the number of families to the number of species is high 22%, it is 10% for the south of Oran (Bouzenoune, 1984) and 18% for southern Algeria (Melzi, 1986). This difference can be explained so that in arid areas and the Sahara.

The floristic surveys allowed us to successively identify 09 species belonging to the 07 families in the Ain Zaatot station, 12 species belonging to the 10 families in the El-Kantara station, 07 species belonging to the 07 families in the Selgua station, 14 species belonging to the 07 families in the Chaiba station, 12 species belonging to the 12 families in the Tolga station, 13 species belonging to the 07 families in the Oumache station, 17 species belonging to the 11 families in the Ain Ben Noui station, 08 species belonging to the 07 families in the Ain naga station.

From the floristic inventory of the 08 stations using the method of minimum areas, it appears that the floristic procession is represented by an average number of species; this is 31 species for

the 08 stations. The number of species per station varies between a maximum of 17 species at the Ain Ben Noui station and only 07 species at the Selgua station. The floristic richness of the Ziban region is average. Our results agree with those obtained by Laadjal (2005) who counted 18 species on dune accumulations in a study on the distribution of spontaneous vegetation in the Ziban region (Biskra). Similarly, for Merabeti (2006), who inventoried 10 species on dune accumulations in El-Hadjeb in a study on the degradation of spontaneous plant genetic resources in the Biskra region. In another study on silting and soil vulnerability to desertification in the region of Ain Ben Naoui (wilaya of Biskra) Bourezzane (2006) found 14 species cited among psammophytic groups. This finding is not specific to the Zibans region, but the entire Sahara. Chalabi (2007) found 18 families and 47 species in a floristic study of Saharan formations in the Taleb El Arbi region in the wilaya of El Oued.

In the Ain Ben noui station, the overall recovery is higher (69%). Even if the clumps of *Aristida pungens*, *Atractylis serratuloides* and *Atriplex halimus* are isolated and scattered, their sizes offer a greater overlap than other species such as (*Euphorbia guyoniana*, *Teucrium polium*, *Anabasis articulata*). And the lowest overall cover is that of Oumache station, which is less than 21%, as it is an area of sandy soils and generally the vegetation cover of sandy soils, is low. Our results agree with those obtained by Chalabi (2007), where she notes recovery rates of 24.9%. Chehma (2004) reports a sandy soil cover of 23.28%.

According to Table 2, *Astragalus armatus* is the most frequent species with an average rate of 10.75%, followed by *Artemisia herba-alba* (8.87%), *Atriplexhalimus* (7.75%), *Zygophyllum album* (4.12%) and *Peganum harmala* (3.45%), while the other species have frequencies that vary between 0.1% and 1%. If the frequencies of each survey are taken into account, it can be seen that they vary from one survey to another. In fact, *Astragalusarmatus* is present without interruption in all stations except Tolga with frequencies varying between 1 and 48%, while *Shismus barbatus* is only present in Tolga with a frequency of 5%.

The comparison between the 08 stations shows that there is a differentiation of vegetation between the surveys according to the type of soil. When the sand is mobile, the presence of *Aristida pungens* is noted, while the presence of the other species indicates that the sand is non-mobile. The study carried out by Bourezzane (2006) on the vulnerability of soils to desertification in the region of Ain Ben Naoui (Biskra) and more precisely on the dune accumulations of Djebel Boughzel, shows that the floristic procession is mainly composed of *Anabasis articulata; Atractylis flava; Sueda fruticosa; Aristida pungens; Zygophyllum cornitum; Tamarix africana; Salsola vermiculata* and *Limoniastrum guyonianum.*

CONCLUSION

As a result of this study, we were able to gain knowledge about the dynamics and floristic composition of medicinal plants. The work undertaken within the framework of this dissertation concerned 08 stations with diversified plant formations. This region is considered as a typical biotope representative of arid environments. It appears that these plants have a great ability to grow, despite all the unfavourable and constraining conditions to its productivity.

The 08 surveys carried out at the 08 stations allowed us to determine 31 species divided into 13 orders and 14 families. The species that most characterize these medicinal plants are *Peganum harmala, Atriplex halimus, Artemisia herba-alba, Teucrium polium,*

Rosmarinus officinalis, *Zygophyllum album.*

In order to study the dynamics of medicinal plants, we used a quantitative method which was essentially based on the classical technique of linear surveys. We carried out this technique at 08 stations. The results obtained show that the overall recovery is higher at the Ain Ben noui station with 69%, even if the clumps of *Aristida pungens*, *Atractylis serratuloides* and *Atriplex halimus* are isolated and scattered. And the lowest overall coverage is that of the Oumache station with less than 21%. This is an area of sandy soils and in general, the vegetation cover of the sandy soils is low. This difference may be due to the amount of rainfall and the significant overgrazing (Laachaba, i.e. the transhumance of sheep herds from north to south during winter) in each station of this region. The species that contribute most to the general recovery of mobile sand accumulations is *Astragalusarmatus* with a rate of 76.19% at the Ain Ben Noui station. Frequency results allowed us to say that *Atriplexhalimus* and *Zizyphus lotus* are the ubiquitous species (100% of the surveys). On the other hand, *Nitraria retusa*, *Teucrium polium*, *Shismus barbatus*, *Sueda mollis* and *Halocnemum strobilaceum* are species that are present in only one survey.

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