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Floristic diversity of *Tamaricaceae* of the northern region of western Algeria: dynamic and biological aspects

N. Belkhodja[1]. A. Sari-Ali [2]. N. Benabadji [3].

Laboratory of Ecology and Management of Natural Ecosystems, SNV.STU Faculty
Abou-Bekr Belkaïd University, Tlemcen, Algeria

* Corresponding author: nesrine.benlaldj@yahoo.fr; Phone: +213 558188074;

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ABSTRACT / SUMMARY

Abstract: *This study focuses on the floristic procession of the Tamaricaceae in western Algeria. It's a dynamic and physionomic study of these taxa in order to compare the floristic diversity that prevailed in 2004 with that of 2017 and to note the changes recorded during this period, knowing that stationary conditions and ecological factors such as bioclimatic change, anthropogenic action and salinity , can play a major role in the distribution of different species and the establishment of plant groupings. Indeed, biological, morphological and biogeographic types are likely to provide us with valuable information on vegetation dynamics in this northern region of Western Algeria. An exhaustive inventory at two study stations, "Hammam Boughrara" and "Béni-Saf", was carried out, followed by the identification of the species surveyed and a comparison over time. The results obtained bear whitness to Mediterranean elements that represent the most important part of the flora of the Tlemcen region, the other elements are little and / or very little represented with a very low percentage. Analysis of the biological type shows the dominance of therophytes in the study area. This therophytization is due to the salinization of the soils, marked both by the dominance of the fields in this region and the climatic requirements. Analysis of the percentage distribution of families shows that Asteraceae and Poaceae predominate in this region in 2004 and 2017.*

I. Introduction

The Mediterranean basin is characterized by an exceptional concentration of plant species and a very high rate of endemism; today it is at the center of global concerns in terms of biological conservation. Algeria offers exceptional opportunities for the evaluation and an understanding of the mechanisms involved in diversification and adjustment of plants related to the evolution of their environment.

Some of this biodiversity and endemism correspond to plants in expert circles to a significant constraint such as salinity (Verlaque, Médail, Quézel and Babinot, 1997).

Tamarix are common on salty grounds; as plants, they have sparked interest in soil conservation against the various physical phenomena of erosion. Also, their hardiness, acquired by their resistance to drought, gives them a particular interest.

To these great adaptive capacities, is added a very great ecological plasticity as regards to the soil and humidity, where this kind adapts as well to flooded or to arid and drier environments. in addition to its very good resistance to salty soils and spray. All of those characteristics make *Tamarix* among the plants with the exception of a few species adapted to these very special conditions.

Our contribution consists of a spatio-temporal comparative study of the diversity and floristic heterogeneity of *Tamaricaceae* stands, from a coastal region near the "Béni-Saf" sea with a subcontinental region "Hammam Boughrara". Both

are located in western Algeria. The phytodynamic concerns precisely the years 2004 and 2017.
To better understand the qualitative and quantitative compositions of these plant formations, we carried out a study based essentially on the exhaustive inventory of species with an identification of their biological, morphological, biogeographic types.
Two main aims cover this study:
- update the floristic composition of this region of western Algeria in order to highlight the new floristic diversity of *Tamaricaceae* stands.
-To draw out the responsible factors for the distribution of this plant diversity in space and time.

II. Materials and methods

The study area is located in the western part of north-western Algeria and extends over part of "Oued Tafna" (figure. 1).

The choice of stations was guided by the presence of the *Tamaricaceae* that we focus on in this paper.

For our study we have chosen two sites: the stations of "Hammam Boughrara" (sub-continental) and of "Béni-Saf" (littoral) that take part of our studying area in order to have complete overview.

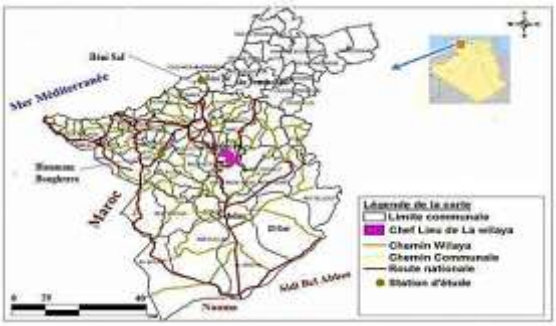

Figure 1. *Geographical location of the study area*

Figure 2. *Study station"Hammam Boughrara"*

Figure 3. *Study station "Béni-Saf"*

II.1. Description of study stations

II.1.1. Study station of "Hammam Boughrara" (figure. 2)

Located at an altitude of about 200 m and located on the eastern slope, this station sits on a slope of 10 to 15% with a longitude of 1 ° 38 'West and a latitude of 34 ° 55' North.

The rate of vegetation cover is low, from 30 to 35% in 2004 and from 20 to 25% in 2017.

The average height of the vegetation can reach from 1 to 2 meters.

II.1.2. Study station of "Beni-Saf" (figure. 3)

Situated in the North-West, this station located at an altitude of 40 m, it is characterized by a

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longitude of 1 ° 26 'West and a latitude of 35 ° 16' North.

The rate of vegetation is from 30% to 40% in 2004 and from 30 to 35% in 2017, with a fairly low slope of 5% which is based on a siliceous substrate. The vegetation rises at a height between 1.5 and 2 meters.

II.2. Floristic surveys and characterization

In order to follow the dynamism of vegetation over time in the studied area, we took into consideration the diachronic method of Dutoit (1996).This method consists on the oldest state as the starting point for the observation. This is the study of a site in its initial state, at the time called "To" and we can identify the modifications of the floristic composition which can occur at a specific time "To + n".

To determine the floristic composition of the vegetation, we followed a typically phytoecological approach of Braun Blanquet (1952), based on surface floristic surveys. In order to obtain a good overview of the diversity and heterogeneity of the *Tamaricaceae* plant formations, we carried out a significant number of readings (60 readings/ station). The surveys were carried out on floristically homogeneous surfaces in spring; season considered optimal for observations. Biological types were assigned according to the classification of Raunkiaer (1905).

Initially, for the year 2004, we used the floristic composition, existing in our database, of the two considered stations (Bemmoussat, 2004). Secondly, we went to the two sites in order to identify the physiognomic units for the year 2017.

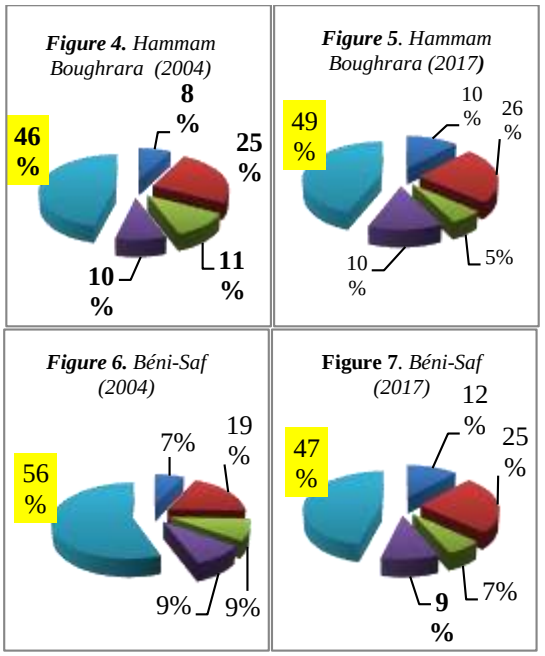
For the determination of the species we used the flora of Quézel and Santa (1962-1963), Gaston Bonnier (1990) and Ozenda (1977).

The analysis of biological and systematic diversity was facilitated by the realization of spectra. These allow a better approach for the analysis of plant formations.

III. Results and discussion

Comparing the data of Bemmoussat (2004) with those updated in 2017, we obtain a certain number of results.

III.1. Biological types and systematic composition



Figures 4 to 7. *Biological spectra of the "Hammam Boughrara" and "Béni-Saf" study stations*

Concerning the biological types, the therophytes dominate and represent approximately half of the inventoried species. An increase of 3% was noted in 2017, at the station of "Hammam Boughrara" as well as a decrease of 9% at "Béni-Saf". Nevertheless, the therophytes always occupy the first position in this station.

Among the species encountered we have:

- *Aegilops triuncialis* L.
- *Anagalis arvensis* L.
- *Asteriscus maritimus* (L.) Less.
- *Avena alba* Vahl.
- *Daucus carota* L.
- *Eryngium tricuspidatum* L.
- *Reseda alba* L.

The abundance of this type of vegetation is mainly due to their resistance to dry periods and to the strong influence of human action on these environments. It remains a characteristic of arid zones, according to Daget (1980); he expresses a strategy of adaptation to unfavorable conditions and a form of resistance to climatic rigors.

- **Chamaephytes**

The identified taxa seem to adapt to these environments, semi-arid in a cool winter for "Hammam Boughrara" and semi-arid in warm

winter for "Béni-Saf", that have a particularly important place at the level of the stations studied.
It should be noted that the chamaephytic subjects revealed a slight increase from 2004 to 2017 with an increase rate of 1% for "Hammam Boughrara" and 6% for "Béni-Saf".
Among the dominant species found, we cite:

- *Atriplex halimus* L.
- *Calycotome spinosa* (L.) Lamk.
- *Daphne gnidium* L.
- *Juncus maritimus*. Lamk.
- *Chamaerops humilis* L.

This chamaephytisation originates from the phenomenon of aridisation (Floret, Galan, Le Floch, Orshan and Romane, 1990). Danin and Orshman (1990) reported that chamaephites adapt better to summer drought and light. Grazing also generally favors chamaephytes, most of which are systematically refused by the herds (Kadi Hanifi, 1998).

- **Phanerophytes**

Phanerophytes occupy a significant place in the two study stations during the year 2017. In 2004, they were less representative, in particular for the "Béni-Saf" station (figures 4 to 7).
The development over time of the phanerophytes is not significant but remains non-negligible with an increase of 2% for the "Hammam Boughrara" station and of 5% for "Béni-Saf".
The most abundant and dense taxon is notably *Tamarix gallica*, a species find in rivers. The latter mainly occupies the shore of the "Oued Tafna" of the two study stations, during the years 2004 and 2017. Known to adapt to the different environmental conditions, *Tamarix gallica* is found in the forms: constant, accessory or accidental.
Among the species encountered we have:

- *Eucalyptus globulus* Labill.
- *Juniperus oxycedrus* L.
- *Olea europea* L.
- *Tamarix gallica* L.
- *Tetraclinis articulata* (Vahl.) Masters.

This increase can be partially explained by the increase in cultivated areas in this study area, which leads farmers to plant trees often used as fences and windbreaks (hedges).

- **Geophytes**

It can be noticed that geophytes are present in 2004 and 2017 in the two stations.
The rate of increase during the period (2004-2017) is almost zero.
The most representative species are:

- *Asparagus acutifolius* L.
- *Urginea maritima* (L.) Baker.
- *Asphodelus microcarpus* Salzm and Vivo.

- **Hemicryptophytes**

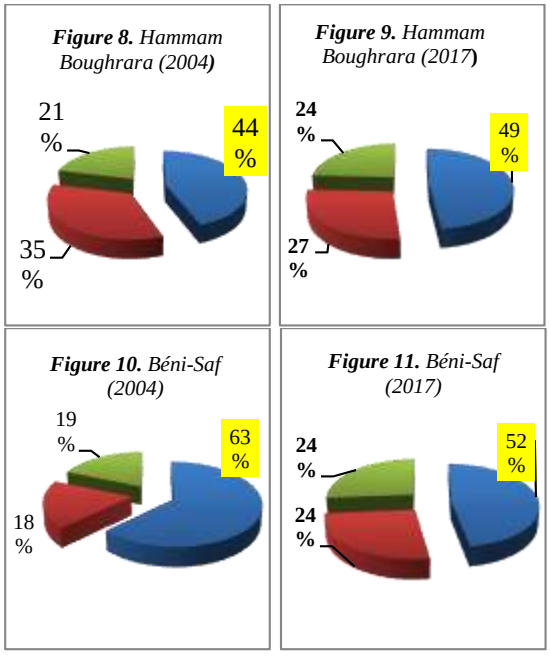
By comparing the two years, we notice that the hemicryptophytes are less representative and shown a decrease in 2017. More specifically, a decrease of 6% was recorded at the level of the station of "Hammam Boughrara" and of 2% at the level of the "Béni-Saf" station (figures 4 to 7).
According to Barbero, Bonin, Loisel and Quezel, (1989), the abundance of hemicryptophytes is explained by a richness in organic matter in the forest environment and by altitude. According to Belkhodja (2014), these study stations only have a low soil organic matter content, which seems to explain this drop in the occupancy rate of hemicryptophytes.

The sites are represented by the following species:

- *Atractylis humilis* L.
- *Calendula arvensis* L.

III.2. Morphological types

The plant formations present in the study area are marked by their heterogeneity between woody and herbaceous plants on the one hand, and perennials and annuals on the other hand.



Figures 8 to 11. *Morphological spectra of the "Hammam Boughrara" and "Béni-Saf"stydy stations*

The morphological spectrum illustrates a predominance of annual herbaceous plants during the two years. The drop in annual herbaceous plants at the "Béni-Saf "station between 2004 and 2017 is quite significant with a percentage of 11%, on the other hand the "Hammam Boughrara" station shows

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an increase of 2%. Despite this, this morphological type remains dominant. The other morphological types are also experiencing a dynamism, either regressive or more or less progressive, during the years 2004 and 2017. We note that the perennial herbs in the "Hammam Boughrara" station gain 8% of surface area during the new period. A decline of 6% was observed at the level of "Béni-Saf". As for the category of perennial woody plants, it gains more surface area, i.e 3% at "Hammam Boughrara" and 6% at "Béni-Saf", which is probably due to the non-palatability of these formations for the herds. In addition, this approach noted the emergence of new species such as *Nerium oleander* and *Acacia albida*.

In this studying area, perennial woody plants are composed mainly of halophilic stands composed mainly of: *Tamarix* and *Atriplex*.

In my opinion, the structural instability of the soil and the harsh climatic conditions seem to accentuate the degradation of the plant cover, thereby favoring the establishment and development of species with a short life cycle, thus resulting in the invasion of therophytic species, which are generally annual herbaceous plants at the expense of perennial woody plants which are generally more demanding in terms of water and trophic needs

III.3. Biogeographic types

By examining the biogeographic type of the identified species, we note that it is the Mediterranean which largely predominate these formations in the studied sites and this, during the two years, with percentages of 40 and 33% for "Hammam Boughrara" and 38 and 41 % for "Béni-Saf" (figures 12 to 15).

The remaining species are characterized by a variable biogeographic type and obviously contribute to the diversity of the plant.

Figure 12. *Hammam Boughrara (2004)*

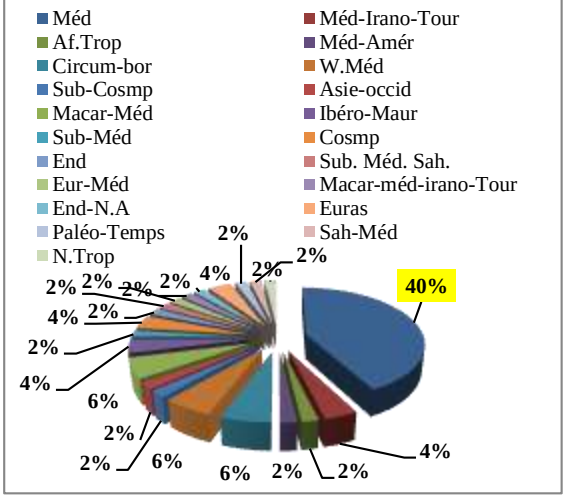


Figure 13. *Béni-Saf (2004)*

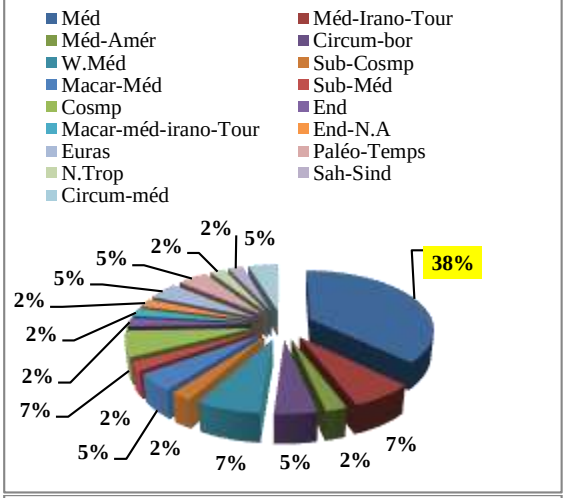
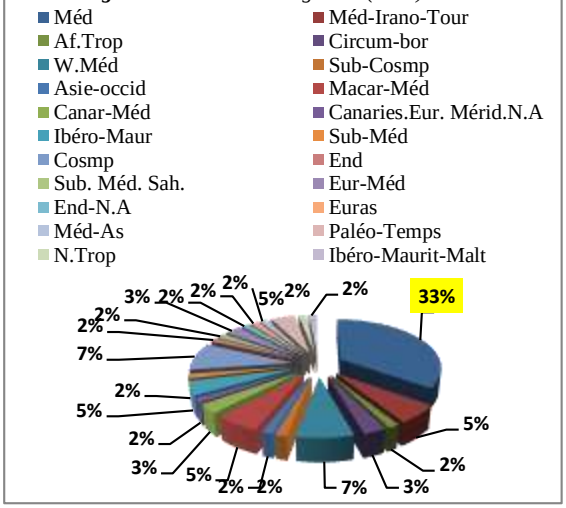
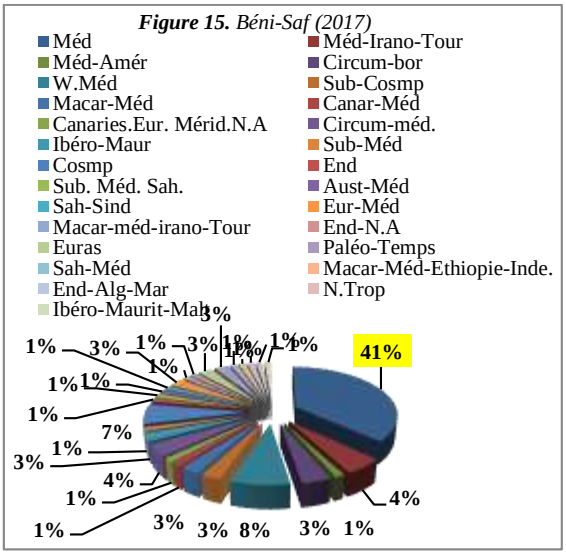


Figure 14. *Hammam Boughrara (2017)*





Figures 12 to 15. *Biogeographical spectra of the "Hammam Boughrara" and "Béni-Saf" study stations*

In addition, the reported indigenous Mediterranean element is represented mainly by therophytes and chamaephytes.

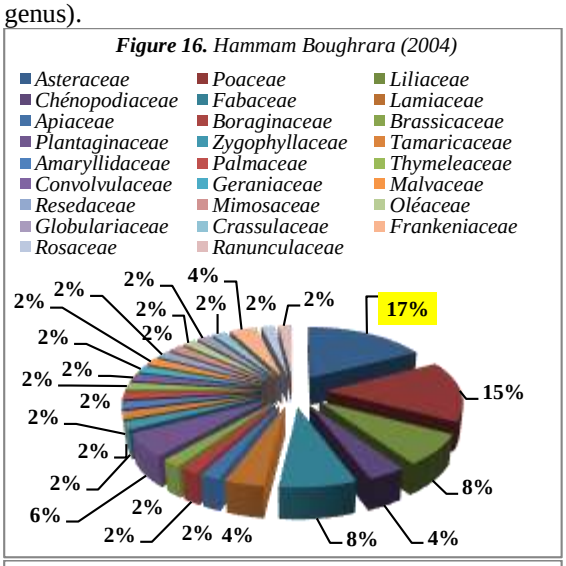
III.4. Systematic composition

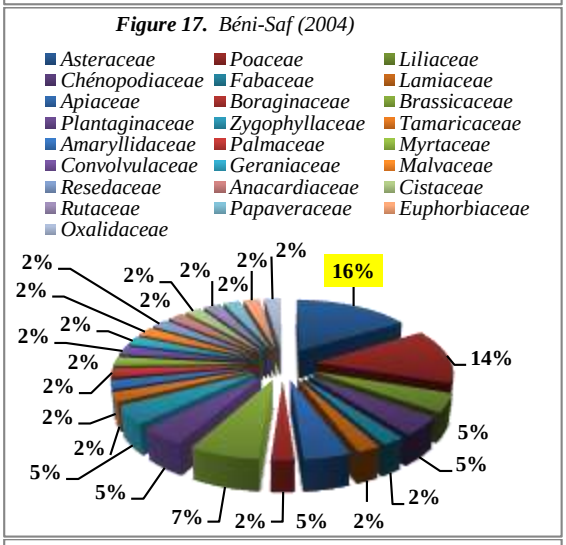
The distribution of families in the stations studied shows a certain heterogeneity (Figures 16 to 19).

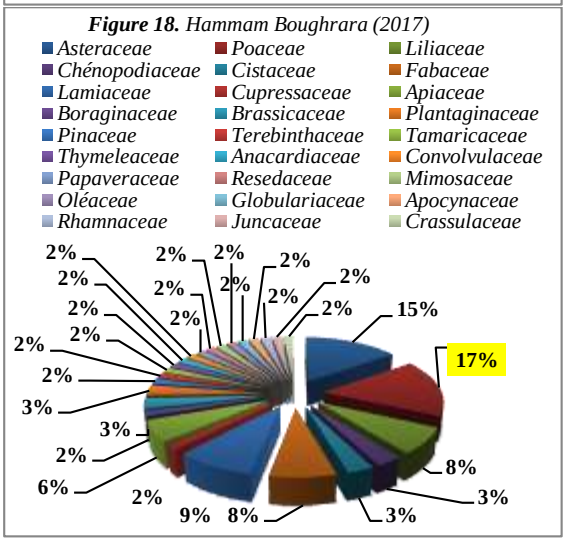
The floral procession is more or less stable in the station of "Hammam Boughrara" with 26 families in 2004 and 27 families in 2017, while that of "Béni-Saf" has increased from 25 to 35 families, i.e 10 more families. in 2017. This heterogeneity is linked on the one hand to climatic factors and on the other hand to human impact.

The most representative families during the period studied are essentially the *Asteraceae*, the *Poaceae* and the *Liliaceae*. The others represent only a small percentage, this is the case of families represented by a single genus called mono-generic or by a single species called monospecific:

- Hammam Boughrara (2004): *Asteraceae* (9 species / 9 genera), *Poaceae* (9 species / 8 genera), *Liliaceae* (4 species / 3 genera), *Tamaricaceae* (1 species / 1 genus).
- Hammam Boughrara (2017): *Asteraceae* (10 species / 9 genera), *Poaceae* (11 species / 8 genera), *Liliaceae* (5 species / 3 genera), *Tamaricaceae* (1 species / 1 genus).
- Béni-Saf (2004): *Asteraceae* (7 species / 6 genera), *Poaceae* (6 species / 5 genera), *Liliaceae* (2 species / 2 genera), *Tamaricaceae* (1 species / 1 genus).
- Béni-Saf (2017): *Asteraceae* (12 species / 10 genera), *Poaceae* (10 species / 8 genera), *Liliaceae* (5 species / 3 genera), *Tamaricaceae* (1 species / 1 genus).







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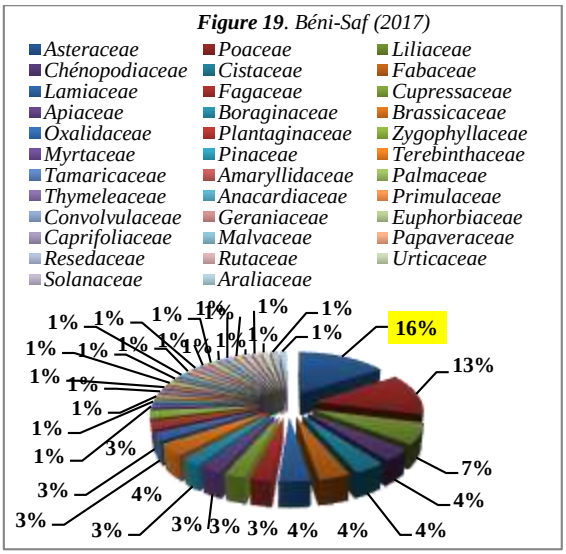

Figures 16 to19. *Distribution spectra of the families of the "Hammam Boughrara" and "Béni-Saf"study stations*

IV. Conclusion

The diachronic study from dated documents allowed us to analyze and assess the evolution of land use between 2004 and 2017 as well as to better understand the floristic composition of *Tamaricaceae* in the two stations "Hammam Boughrara "and" Béni-Saf ".

This method allows spatio-temporal monitoring of the dynamics of plant formations and highlights the profound transformations of our environment over time.

Indeed, the monitoring of vegetation and the comparison over time have provided us with very relevant results in this studied region, which can be summarized as follows:

- the plant cover is experiencing a certain dynamism: the therophytes seem to remain in first position even if the "Béni-Saf" station experienced a loss of 9% of surface for this biological type during the year 2017.
- the abundance of this biological type may justify the predominance of annual herbaceous plants which are all the more favored by the presence of crops.
- phanerophytes have gained more land by planting trees, often used as hedges for agricultural land.
- The biogeographic distribution shows a dominance of the Mediterranean element (chamaephytes and therophytes) in 2004 and 2017.
- *Asteraceae* and *Poaceae* are dominant throughout the study period.

As nature is in perpetual change and a research work can never be complete and definitive, we plan to expand this work by multiplying the study stations in order to better understand the floristic diversity of *Tamaricaceae* in this region of Western Algeria.

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