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STUDY OF PLANT DIVERSITY IN THE RANGELANDS OF *STIPA TENACISSIMA* L.: CASE OF SFISSIFA AND EL BIODH REGION (SOUTH WEST ALGERIA)

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Abstract
The floristic diversity analysis made it possible to distinguish 42 species listed in 30 genera and 17 families in the Sfissifa station and 34 species classified in 23 genera and 15 botanical families in the El Biodh station. The most representative families in the Sifissifa station are: Asteraceae (14,28 %), Amaranthaceae (11,90 %), Brassicaceae (11,90 %), Poaceae (7,14 %), Lamiaceae (7,14 %) and Cistaceae (7,14 %). The dominant families in El Biodh station are Asteraceae (17,64 %), Poaceae (11,74 %), Amaranthaceae (8,82 %), Brassicaceae (8,82 %), Lamiaceae (8,82 %) and Cistaceae (8,82 %). The other remaining families have only one or two species with estimated rates ranging from 2,38 % to 4,76% in Sfissifa and 2,94 % to 5,88 % in El Biodh. The study of biological types shows the abundance of therophytes in the two stations with 42.86 % at Sfissifa and 50 % at El Biodh, which reflects the importance of the anthropologic action and the xericity of the climate. The analysis of the biogeographical spectrum shows the dominance of native species of the Mediterranean (19 species in Sfissifa and 15 species in El Biodh). The AHC analysis of the data revealed the main factors controlling the distribution of plant formations in the two studied stations including overgrazing, salinity and desertification. The combination of prolonged droughts and anthropogenic pressures exerted on the studied areas results in the extension of species of low pastoral value and the appearance of vast expanses of bare soil reaching the stage of desertification.

Keywords: Algeria, anthropologic action, biogeographical spectrum, biological types, floristic diversity

1. INTRODUCTION

The steppe zone occupies a central position in Algeria in the north-south direction. It plays both an economic role through the practice of sheep farming and the production of alfa and a role of linking zone between agricultural Tell in the north, and the Sahara Desert in the south. Steppe vegetation plays a fundamental role in the structure and functioning of the steppe ecosystem, of which it is an expression of biological potential (Bouchetata and Bouchetata, 2005; Benamara, 2017).

The diachronic studies carried out in the southern steppe of Oran region have shown that the natural vegetal cover is subjected to a double edapho-climatic stress (climatic and edaphic aridity) on the one hand and the abusive anthropogenic exploitation of steppe paths on the other hand (Bensaid, 2006;

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Hirche et al., 2010; Benguerai, 2011). Benabdeli et al. (2008) confirm that the impact of the grazing is at the origin of this degradation.
Despite the strong pressures that the Algerian steppe region has undergone in general, and the Naâma region (southwestern Algeria) in particular, this ecosystem presents a very appreciable floristic diversity (Matet, 2009). The rational management of natural resources begins with a good knowledge of the structure and the floristic composition of the ecosystems concerned. In this context, the research work has undertaken into two regions that differ from a geographical point of view.
The aim of this research is to study the current state of the plant cover in two steppic rangelands of *Stipa tenacissima* L., located in the Naâma province (western Algeria), as well as the factors responsible for its decrease.

2. MATERIALS AND METHODS

2.1. Study stations

Our study concerns two stations in the Naâma region namely Sfissifa and El Biodh (Fig.1), both of which are part of the western high steppe plains of Algeria.

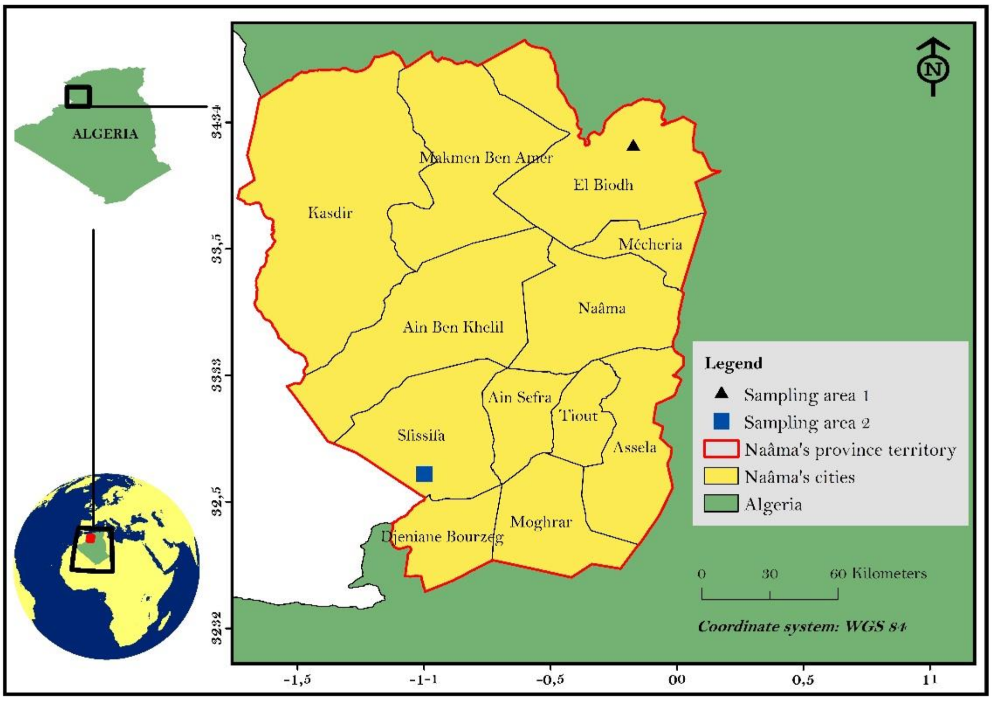

Figure 1. Location of study stations

The station Sfissifa is located in the Ksour Mountains, south-west of the Naâma region. Limited to the north by Ain Benkhelil region, to the east by Ain Sefra city, to the west by the Kingdom of Morocco and to the south by Djeniene Bourezg. It is inserted between the Tell Atlas to the north and the Saharan Atlas to the south over an area of 2347,5 km^2 with a population of 7592 inhabitants (Tabouch, 2012; DPSB, 2017). Geologically, the region belongs to the Upper Jurassic and Middle, limestone soils characterize the major features of the region (Guerine et al., 2020).
The zone of Biodh is limited to the north by Chott Ech Chergui, to the east by Djebel Ksel, to the west by Mekmene Ben Amar city and to the south by Djebel Kerrouch, it straddles two steppe regions:

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El Bayadh and Naâma on an area of 3663 km^2 with a population of 11965 inhabitants (DPSB, 2017). The region is characterized by the presence of an anticline of Jurassic formations, plains represented by continental formations, and recent deposits: alluvial and dune (Derdour et al., 2021).

2.2. Data collection

In total, 40 floristic surveys were carried out (20 surveys/zone) during the optimal period of vegetation following a subjective sampling which takes into account the variability of the plant formations encountered. According to the sigmatist method, the surveys were installed on ecologically homogeneous areas (Daget and Poissonet, 1971; Roselt/OSS, 2008; Richard et al., 2010). The area of 100 m^2 seems sufficiently representative of the minimal area of our region. This is practically the minimal area adopted for the entire Algerian steppe (URBT, 1978; Djebaili, 1984; Benabadji and Bouazza, 2002).

A list of species was established for each survey. The unidentified species on the field were collected in the form of a herbarium and deposited in the botany laboratory of the Naâma University Center for later identification.

The basic works used for the identification of species are Quezel and Santa (1962-1963), Maire (1952-1987), Ozenda (2004) and Fennane et al. (2007).

- **Biological types**

Biological types or biological forms that designate the adaptive behavior of the species, they provide information on the type of plant formation, and its transformations. The classification to which we have referred is that of Raunkiaer (1934). It is based on the position occupied by the dormant meristems in relation to the ground level during the difficult season and is thus subdivided into:

- Phanerophytes (Ph): Shrub and shrub trees, lianas
- Chamephytes (Ch): under shrubs
- Hemicryptophytes (He): perennial herbaceous plants
- Cryptophytes (Ge): tuberous plants, rhizomes or bulbs
- Therophytes (Th): annual plants

- **The disturbance index (PI)**

The perturbation index (PI = number of Chamaephytes + number of Therophytes / total number of species) calculated according to Loisel and Gamila (1993) was used to assess the state of degradation of the vegetation cover.

- **Phytogeographic spectrum**

Species recorded are indicated by their biogeographic type recomposed by Quezel and Santa (1962-1963) and Pignatti (1982).

- **The pastoral quality rangelands: specific quality index**

The specific quality index of a plant species is a synthetic expression, determined empirically and expressed in the form of a score or a note (Aidoud, 1983). It falls under many parameters of the species; its energy value, its palatability but also its speed of growth, its possible toxicity, etc. (Roselt/OSS, 2008). In practice, the procedure adopted is to classify the perennial and annual taxa according to the average assessments estimated by a certain number of breeders and pastoralists questioned on this subject through field surveys (Zoungrana, 1991; Kièma, 2007; Roselt/OSS, 2008). Thus, Dahlberg (2000), Akpo and Grouzis (2004), Rakotoarimanana and Grouzis (2006) considered four classes. For their part, Grouzis (1982), Daget and Godron (1995), Rakotoarimanana et al., (2008) and Ayad et al., (2010) define five classes ranging from 0 (without pastoral value), 1 (low pastoral value), 2 (moderately pastoral value), 3 (good pastoral value) and 4 (very good pastoral value). It is

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also this same number of classes that we defined and retained at the end of our interviews with the breeders exploiting the studied areas.

- **Statistical treatments**

Different statistical methods make it possible to analyze data tables (quantitative and qualitative), and to look for possible links between variables. Among the latter AHC (Agglomerative Hierarchical Clustering) and AFC (factorial component classification) were used more particularly. Many authors (Guinochet, 1973; Boraud, 2000, Bouxin, 2008; Touré, 2010; Meddour, 2011) recommend these techniques. Statistical analysis were conducted using the Minitab (Ver.16) software.

3. RESULTS AND DISCUSSIONS

3.1. Floristic richness and diversity

The inventory made it possible to count 42 species in the Sfissifa station belonging to 30 genera and 17 families while the taxa listed in the Biodh station were of the order of 34 species belonging to 23 genera and 15 botanical families (Table 1).

Table 1. Families and species inventoried in the two study stations

Station	Sfissifa		El Biodh	
Families	***Genera***	***Species***	***Genera***	***Species***
Amaranthaceae	5	5	3	3
Apiaceae	1	2	1	2
Asteraceae	3	6	3	6
Boraginaceae	1	1	1	1
Brassicaceae	3	5	2	3
Caryophyllaceae	1	2	1	2
Cistaceae	1	3	1	3
Cupressaceae	1	1	0	0
Euphorbiaceae	1	1	1	1
Fabaceae	2	2	1	1
Lamiaceae	2	3	2	3
Malvaceae	1	2	1	2
Poaceae	3	4	3	4
Ranunculaceae	1	1	1	1
Rhamnaceae	1	1	0	0
Thymelaeaceae	1	1	1	1
Zygophyllaceae	2	2	1	1

Asteraceae, Amaranthaceae, Brassicaceae and Poaceae are dominant in both stations (Fig. 2). These four families represent more than 47 % of the global flora inventoried. The other families (Apiaceae, Boraginaceae, Caryophyllaceae, Cistaceae, Cupressaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Malvaceae, Ranunculaceae, Rhamnaceae, Thymelaeaceae, Zygophyllaceae) are less represented.
This observation is reported by Ozenda (1991) which indicates the dominance of Asteraceae, Poacceae and Brassicacceae in arid and semi-arid Mediterranean areas. In Algeria, the dominance of these botanical families is underlined by several authors (Boughani et al., 2009; Benabadji et al., 2010, Kazi-Tani et al., 2010; Benkhettou et al., 2015; Benaissa et al., 2018; Guit and Nedjimi, 2019; Guerine and Hadjadj, 2019; Habib et al., 2020, Hadjadj et al., 2020).

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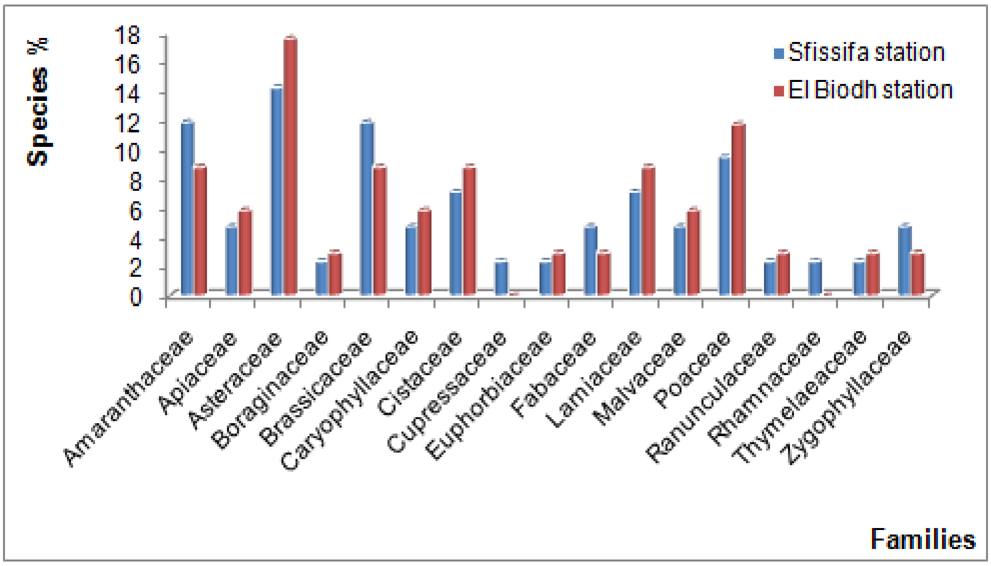
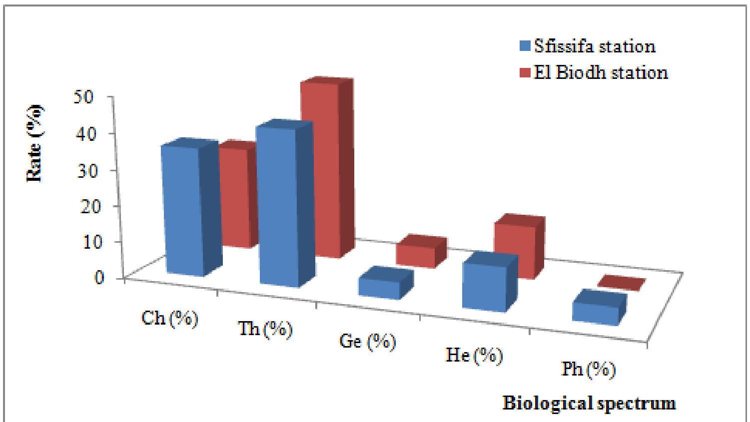


Figure 2. Floristic richness of families in the two study stations

3.2. Biological types

The analysis reveal that the biological spectrum is of type Th> Ch> He> Ge = Ph in the Sfissifa station and Th> Ch> He>Ge in the El Biodh station (Fig. 3). Therophytes are dominant in both resorts with 42,86% in Sfissifa and 50% in El Biodh. This observation tells us about the extent of the anthropogenic pressure (grazing) on the one hand and the climatic xericity on the other hand. Indeed, therophytes are particularly well adapted to disturbances thanks to their short cycle (Kazi Tani et al., 2010; Melom et al., 2015).



	Ch (%)	*Th (%)*	*Ge (%)*	*He (%)*	*Ph (%)*
Sfissifa station	*35,71*	*42,86*	*4,76*	*11,91*	*4,76*
El Biodh station	*29,41*	*50*	*5,88*	*14,71*	*0*

Figure 3. Biological spectrum of inventoried species in Sfissifa and El Biodh station

Several authors note a clear dominance of therophytes, chamephytes and hemicryptophytes in arid and semi-arid Mediterranean areas (Ozenda, 1991; Lacoste and Salanon, 2001; Aidoud, 2005; Amghar and Kadi-Hanifi, 2008; Ghafoul et al., 2019, Hadjadj et al., 2021). Therophyta is a strategy

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of adaptation to unfavorable conditions. This proliferation of annuals, whose ephemera constituting a large proportion of plant mats, appears suddenly after a small amount of rain. The dominance of chamephytes is above all a fact mainly linked to bioclimatic factors. This finding is similar to that of Kadi-Hanifi (1998).

3.3. Disturbance index

The disturbance index is respectively 78,5% and 79,4% in the Sfissifa and El Biodh stations. This clearly shows the degradation suffered by these plant formations and the importance of this index is proportional to the dominance of therophytes and chamaephytes which is the case for the study stations. For comparison, the perturbation index calculated by Mallem et al., (2017) in the Mokrane area (Laghouat, Algeria) and Habib et al., (2020) in the steppe region of Djelfa were respectively 66% and 59%. These results highlight the intensity of the disturbance in our study stations.

3.4. Morphological types

The categorization of the plant species encountered according to their morphological types shows that the annual herbaceous species are the dominant species, with a rate of 50% (21 species) in the Sfissifa station and 55,88% (19 species) in the El Biodh station. In addition, perennial grasses account for 35,71% in Sfissifa and 38,24% in El Biodh respectively. Lastly, the perennial ligneous are about 14,29% for the Sfissifa station and 5,88% in the El Biodh station (Fig. 4).The annual herbaceous growth is due to the invasion of therophytes. That of perennial herbaceous species is probably due to their asexual and sexual reproduction. The same plant species is more or less palatable by animals. The feeding behavior of the animal with respect to the choice of a plant, therefore, involves the palatability of the plant and the preference of the animal (Bourbouze and Donadieu, 1987). Goats, have no special predilection for ligneous, consume many species. Sheep and goats prefer different species classified by main morphological types (upright woody, perennial herbaceous, annual). Sheep appreciate the annual species and almost indifferently of the biological stage where they are on the other hand goats consume little annuals (Aboura, 2006; Benkhettou et al., 2015).

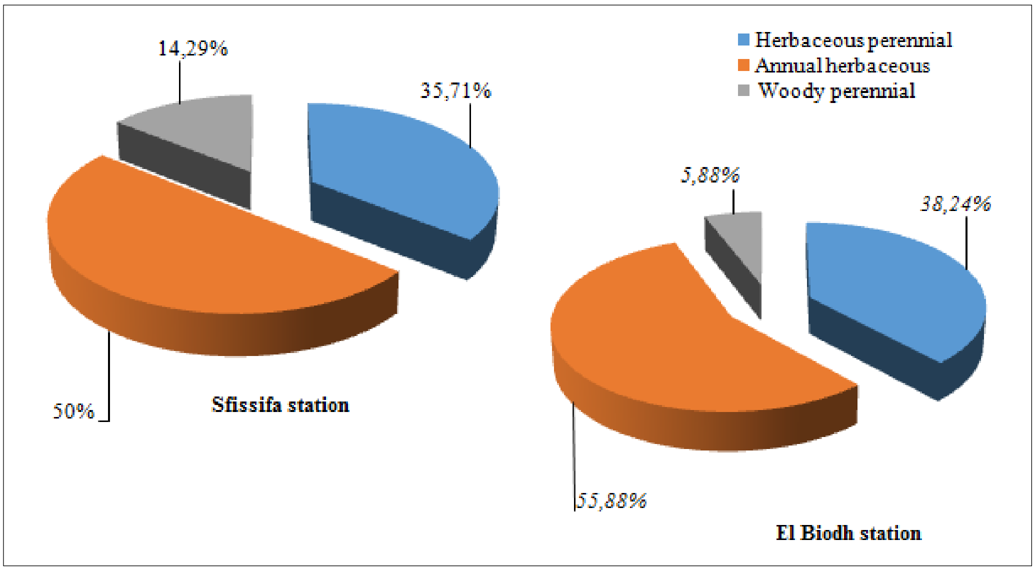

Figure 4. Morphological types of species in Sfissifa and El Biodh station

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3.5. Phytogeographic spectrum

The global phytogeographic spectrum (Table 2) show a diversity of phytogeographic elements with the dominance of the Mediterranean element in the two stations.

Table 2. Phytogeographic types determined in the study stations

Biogeographic types	**Sfissifa station**	**El Biodh Station**
Mediterranean-Saharo-Sindian	14,29 %	14,71 %
Mediterranean	45,24 %	44,12 %
Saharo-Mediterranean	2,38 %	0 %
Euro-Mediterranean	9,52 %	11,76 %
South-Mediterranean	2,38 %	2,94 %
Saharo-Sindian	9,52 %	8,82 %
Cosmopolitan	9,52 %	8,82 %
Endemic Algerian	4,76 %	5,88 %
Ibero-Mauritanian	2,39 %	2,95 %

For the Sfissifa station, the biogeographic types are as follows: Mediterranean 19 species (45,24%), Mediterranean-Saharo-Sindian 6 species (14,29%), Saharo-Mediterranean with a single species (2,38%), Euro-Mediterranean 4 species (9,52%), South-Mediterranean one species (2,38%), Saharo-Sindian 4 species (9,52%), Cosmopolitan 4 species (9,52%), Endemic-Algerian 2 species (4,76%), and finally, Ibero-Mauritanian one species (2,38%).

Concerning El Biodh station, the biogeographic types determined in this zone have the following percentages: Mediterranean 15 species (44,12%), Mediterranean-Saharo-Sindian 5 species (14,71%), Euro- Mediterranean 4 species (11,76%), Saharo-Sindian and Cosmopolitan 3 species (8,82%) for each type, Algerian Endemic 2 species (5,88%). The two Ibero-Mauritanian and Southern-Mediterranean phytogeographic types are characterized by the presence of a single species (2,94%).

Quezel and Barbero (1993) explain the importance of the biogeographical diversity of North Africa by the climatic changes undergone by this region since the Miocene and which led to migrations of tropical and extra-tropical flora, of which we still find some vestiges.

3.6. Pastoral value quality: specific quality indices

It is very interesting to mention that the surveys carried out among 71 breeders in the studied areas made it possible to classify the inventoried species into 4 categories according to their specific quality indices Is (Table 3).

We emphasize that our results indicate the dominance of low pastoral value species with a rate of (44,19%). Among these species, we cite: *Noaea mucronata*, *Anabasis articulata*, *Hammada scoparia*, *Launaea arborescens*, *Marrubium deserti*, *Adonis dentata*.

Average pastoral value species record a rate of 11,63%, such as: *Tribulus terrestris*, *Lygeum spartum*, *Myosotis scorpioides*, *Salsola vermiculata*, *Stipa tenacissima*. For the species *Peganum harmala*,

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Ferula vesceritensis, Ferula cossoniana, Euphorbia calyptrata, Chenopodium ambrosioides which are considered toxic (Is = 0), a rate similar to that of plants of average pastoral value (11,63%) is recorded.
In addition, the good pastoral value (Is = 4) group species is moderately represented (25,58%). We find in this group: *Artemisia campestris, Artemisia herba-alba, Helianthemum hirtum, Helianthemum lippii, Helianthemum virgatum, Herniaria fontanesii, Herniaria mauritanica, Stipa parviflora.* Finally, the very good pastoral value species category is represented by only three species: *Alyssum granatense, Alyssum linifolium*, which gives a relatively low rate (6,98%).
It should be noted that the palatability of the fodder that conditions the ingestion depends on the specific composition of the pastoral vegetation and the period of use. A plant, not palatable in the fresh state, can be so in the dry state, it is practically the case of *Peganum harmala*, *Euphorbia calyptrata*, *Chenopodium ambrosioides* that are considered as of no pastoral value or even toxic in the fresh state; however, a good forage when dry (Akpo et al., 2000; Akpo and Grouzis, 2004).

Table 3. Specific quality index (Is) of identified species

Specific quality index classes (Is)		Species number	Rate (%)
Very good pastoral value	4	3	6,98
Good pastoral value	3	12	25,58
Moderately pastoral value	2	6	11,63
Low pastoral value	1	19	41,86
Without pastoral value	0	5	11,63

Based on the obtained results, it appears that the studied area's paths have evolved into unfavorable situations to end up either in a degraded state or else in a well-advanced state of degradation. The potential of rangelands is manifested by the decline of good pastoral quality formations to the benefit of formations rather rich in species of low pastoral and/or toxic values.

3.7. Data processing (AHC)

The AHC allowed us to group individuals into classes according to the "distance" between them. Grime et al. (1988) point out that AHC is a statistical treatment that provides a typology of study sites interpreted on the basis of life traits or ecological requirements of species. This method is carried out from the floristic tables, in order to assimilate the main types of assemblages that characterize the species *Stipa tenacissima*, according to the different ecological and anthropic factors.

3.7.1. Differentiation and definition of plant groups

The AHC made it possible to distinguish 3 nuclei, which are well individualized (Fig. 5). The groupings thus defined are:

- ***Sfissifa Station***

A core **A** containing 8 taxa

- *Adonis dentata*
- *Artemisia herba-alba*
- *Euphorbia calyptrata*

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- *Hammada scoparia*
- *Retama retam*
- *Stipa parviflora*
- *Juniperus oxycedrus*
- *Scorzonera undulata*

This core is rich in purely steppe species such as: *Artemisia herba-alba; Stipa parviflora; Scorzonera undulata; Hammada scoparia* and psammophil species including *Retama retam* which adapts thanks to the reduction of its leaf area.

A core **B** with 27 taxa

This group is composed of palatable species that have a significant forage value.

- *Alyssum granatense*
- *Eruca vesicaria*
- *Peganum harmala*
- *Ziziphus lotus*
- *Anabasis articulata*
- *Malva aegyptiaca*
- *Alyssum linifolium*
- *Artemisia campestris*
- *Helianthemum hirtum*
- *Diplotaxis tenuifolia*
- *Launaea resedifolia*
- *Helianthemum virgatum*
- *Myosotis scorpioides*
- *Malva parviflora*
- *Launaea glomerata*
- *Tribulus terrestris*
- *Herniaria mauritanica*
- *Marrubium deserti*
- *Helianthemum lippii*
- *Eruca sativa*
- *Herniaria fontanesii*
- *Teucrium polium*
- *Launaea arborescens*
- *Marrubium alysson*
- *Medicago laciniata*

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A core **C** with 9 taxa

- *Aristida pungens*
- *Ferula cossoniana*
- *Ferula vesceritensis*
- *Noaea mucronata*
- *Salsola vermiculata*
- *Stipa tenacissima*
- *Thymelaea microphylla*
- *Lygeum spartum*
- *Suaeda fruticosa*

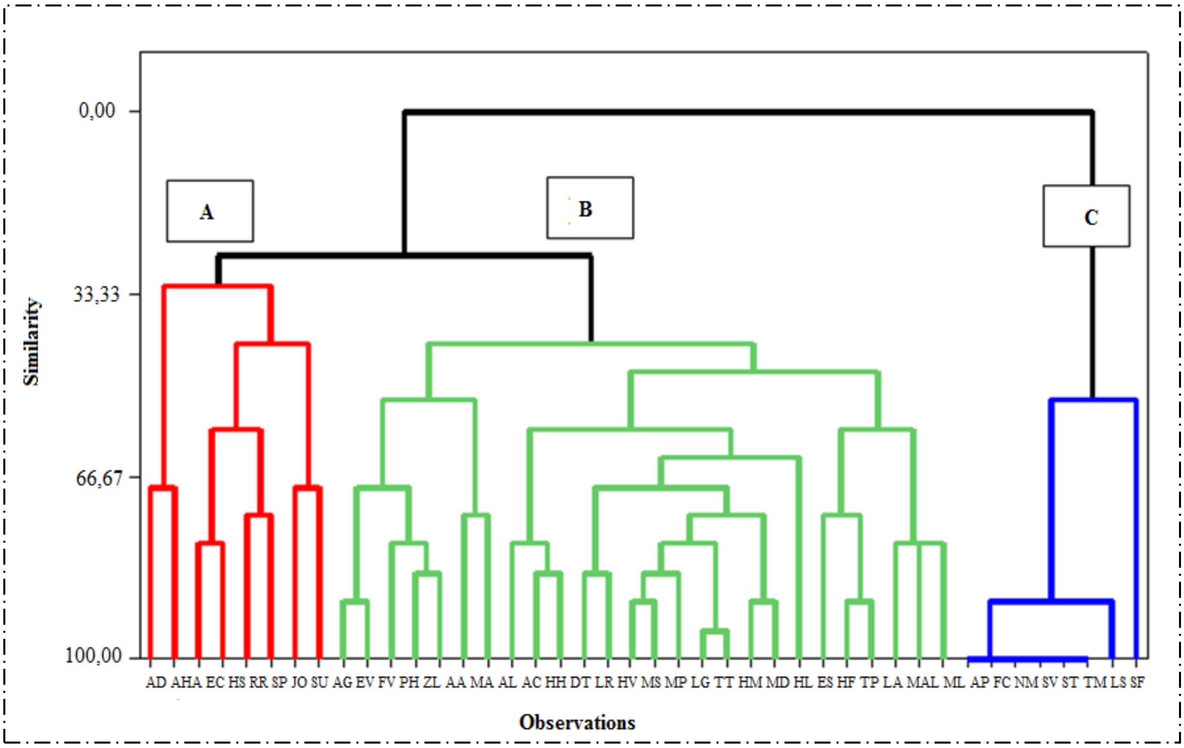

Figure 5. Agglomerative Hierarchical Clustering of Sfissifa station

The species in this group are characterized by their highly valued forage value and indicative of overgrazing. Among other things, this group has the particularity of being composed of halophytes such as *Salsola vermiculata, Noaea mucronata, Ferula cossoniana.*

Ecological significance of the axis

Factorial plan 2/1

Axis 01

Positive side

Stipa tenacissima; Ferula cossoniana; Thymelaea microphylla; Aristida pungens; Salsola vermiculata; Noaea mucronata; Ferula vesceritensis; Malva aegyptiaca; Peganum harmala; Eruca

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vesicaria; Alyssum granatense; Ziziphus lotus; Artemisia campestris; Eruca sativa; Adonis dentata; Scorzonera undulata; Helianthemum hirtum; Myosotis scorpioides; Helianthemum lippii; Launaea glomerata; Tribulus terrestris.

Negative side

Lygeum spartum; Suaeda fruticosa; Artemisia herba-alba; Hammada scoparia; Euphorbia calyptrata; Medicago laciniata; Stipa parviflora; Anabasis articulata; Retama retam; Herniaria mauritanica; Launaea arborescens; Marrubium alysson; Malva parviflora; Helianthemum virgatum; Chenopodium ambrosioides; Diplotaxis tenuifolia; Teucrium polium.

Axis 02

Positive side

Stipa tenacissima; Noaea mucronata; Salsola vermiculata; Thymelaea microphylla; Ferula cossoniana; Aristida pungens; Lygeum spartum; Suaeda fruticosa; Artemisia herba-alba; Hammada scoparia; Euphorbia calyptrata; Juniperus phoenicea.

Negative side

Ferula vesceritensis; Malva aegyptiaca; Adonis dentata; Scorzonera undulata; Medicago laciniata; Stipa parviflora; Anabasis articulata; Launaea resedifolia; Alyssum granatense; Ziziphus lotus; Artemisia campestris; Eruca sativa; Helianthemum hirtum; Myosotis scorpioides; Helianthemum virgatum; Launaea glomerata; Tribulus terrestris; Marrubium deserti; Malva parviflora; Herniaria mauritanica; Alyssum linifolium; Launaea arborescens; Diplotaxis tenuifolia; Teucrium polium; Marrubium alysson; Chenopodium ambrosioides.

The 2/1 axis reflects a therophytization gradient in the opposite direction of the axis, and opposes halophyte species: *Noaea mucronata; Salsola vermiculata* related to saline substrates (Fig. 6).

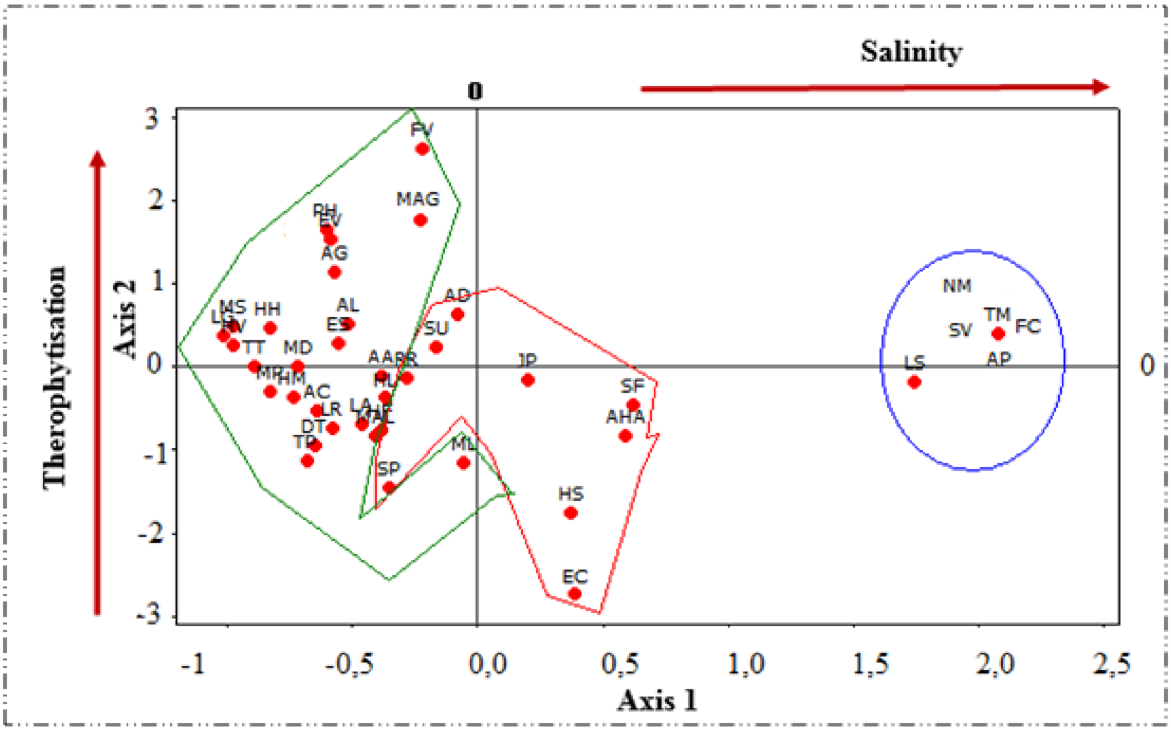

Figure 6. Factorial plan of the species of the Sfissifa station (axis 1 and axis 2)

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- ***El Biodh Station***

A core **A** includes **2** taxa

- *Peganum harmala*
- *Euphorbia calyptrata*

From the point of view of appetability, these two species are non-palatable because of their toxicity (Speroni et al., 1991; Bellakhdar, 1997), in particular *Euphorbia calyptrata* (Fig. 7).

A core **B** composed of **28** taxa

- *Anabasis articulata*
- *Aristida pungens*
- *Artemisia campestris*
- *Artemisia herba-alba*
- *Chenopodium ambrosioides*
- *Diplotaxis tenuifolia*
- *Eruca sativa*
- *Eruca vesicaria*
- *Ferula vesceritensis*
- *Helianthemum hirtum*
- *Helianthemum lippii*
- *Helianthemum virgatum*
- *Herniaria fontanesii*
- *Herniaria mauritanica*
- *Launaea arborescens*
- *Launaea glomerata*
- *Launaea resedifolia*
- *Malva aegyptiaca*
- *Malva parviflora*
- *Marrubium alysson*
- *Marrubium deserti*
- *Medicago laciniata*
- *Myosotis scorpioides*
- *Scorzonera undulata*
- *Stipa parviflora*
- *Teucrium polium*
- *Thymelaea microphylla*
- *Tribulus terrestris*

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On a bioclimatic level, these species are relatively more xerophilic, which reflects the aridity of the El Biodh region.

A core **C** includes **4** taxa

- *Ferula cossoniana*
- *Lygeum spartum*
- *Noaea mucronata*
- *Stipa tenacissima*

On the physiognomic aspect, this facies characterizes the order *Lygio-Stipetalia* (Rivas-Martinez, 1977) which presents a forage resource of great value. In addition, this station is a pre-Saharan zone of contact which is distinguished notably by the presence of *Noaea mucronata*.

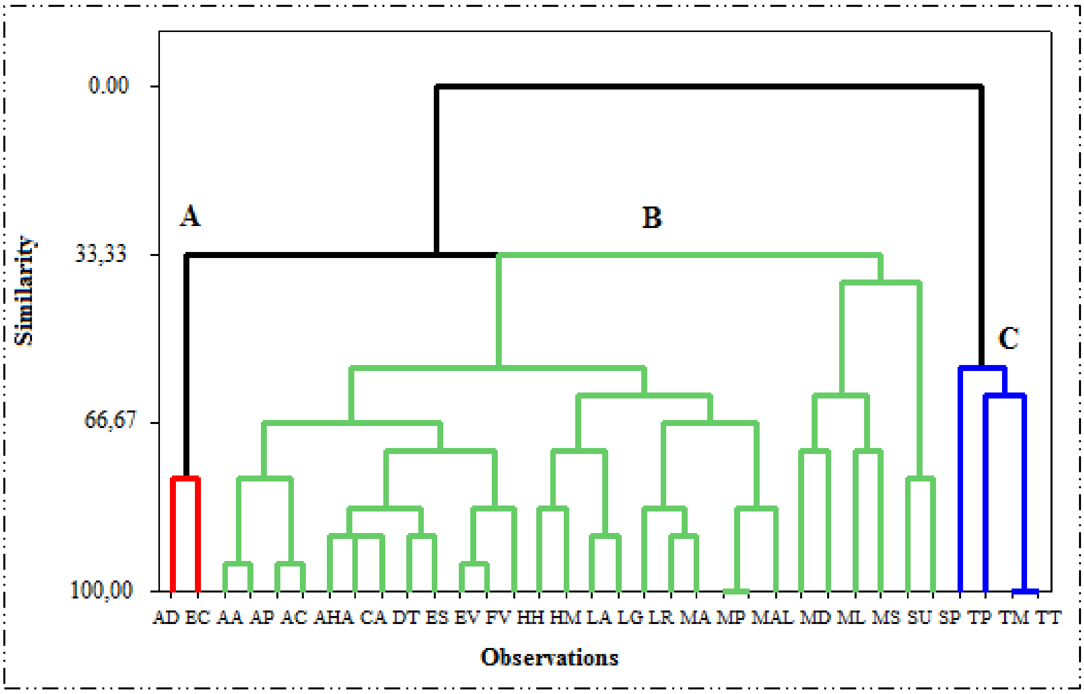

Figure 7. Agglomerative Hierarchical Clustering of El Biodh station

Ecological significance of the axis
Factorial plan 2/1
Axis 01
Positive side

Stipa tenacissima; *Adonis dentata*; *Euphorbia calyptrata*; *Stipa parviflora; Thymelaea microphylla; Artemisia herba-alba; Marrubium alysson; Malva aegyptiaca; Diplotaxis tenuifolia; Artemisia campestris; Aristida pungens; Chenopodium ambrosioides; Launaea glomerata; Myosotis scorpioides; Helianthemum hirtum; Helianthemum virgatum; Teucrium polium; Ferula vesceritensis.*

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Negative side

Noaea mucronata; Lygeum spartum; Ferula cossoniana; Launaea arborescens; Medicago laciniata; Launaea resedifolia; Malva parviflora; Scorzonera undulata; Eruca sativa; Eruca vesicaria; Tribulus terrestris; Marrubium deserti; Herniaria mauritanica.

Axis 02

Positive side

Adonis dentata; Euphorbia calyptrata; Stipa tenacissima; Noaea mucronata; Lygeum spartum; Launaea arborescens; Stipa parviflora; Thymelaea microphylla; Medicago laciniata.

Negative side

Medicago laciniata; Marrubium alysson; Malva aegyptiaca; Diplotaxis tenuifolia; Alyssum linifolium; Aristida pungens; Chenopodium ambrosioides; Artemisia campestris; Launaea glomerata; Myosotis scorpioides; Peganum harmala; Ferula vesceritensis; Helianthemum virgatum; Teucrium polium; Eruca sativa; Eruca vesicaria; Tribulus terrestris; Scorzonera undulata; Malva parviflora; Marrubium deserti; Launaea resedifolia; Herniaria mauritanica.

We are witnessing a regressive dynamic of vegetation. Indeed the duration of the period of famine and the human pressure exerted on this zone of study imposes on the vegetation a continual degradation, which can end up the stage of desertification (Fig. 8).

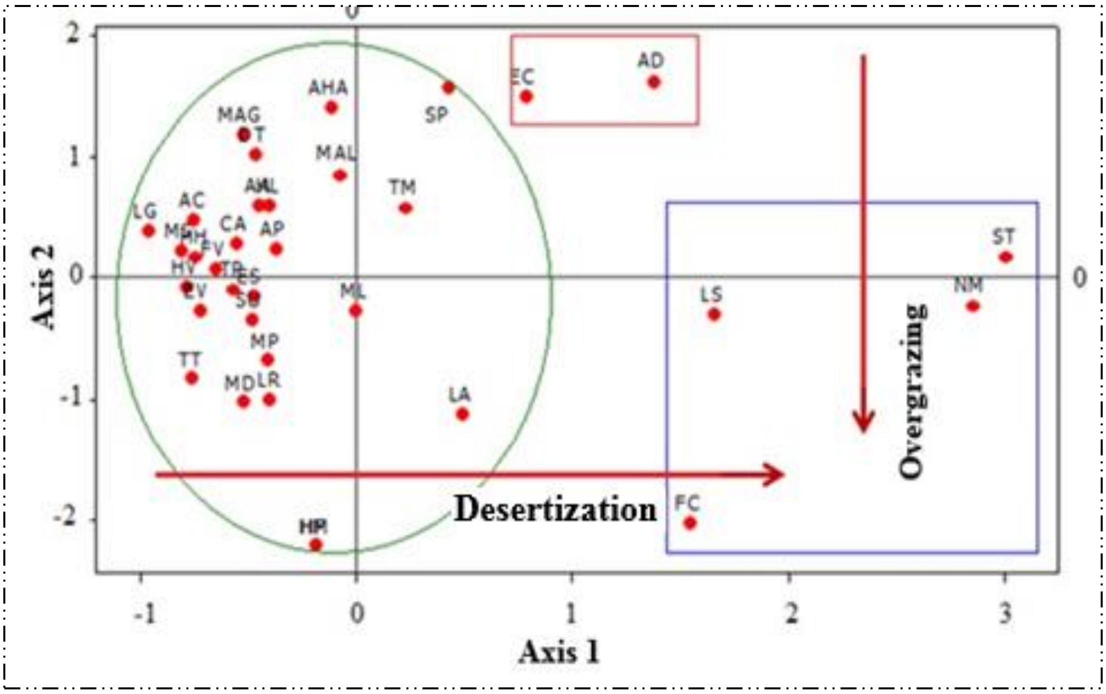

Figure 8. Factorial plan of the species of El Biodh station (axis 1 and axis 2)

4. CONCLUSIONS

This diagnosis enabled us to highlight the floristic and ecological potentialities of the study area, to understand the relationships that exist between the different identified groups and the ecological factors responsible for the spatial organization of the floristic diversity of the steppe rangelands, know: overgrazing, desertization, therophytisation, salinity.

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The combination of prolonged droughts and anthropogenic pressures exerted on the studied areas results in the extension of species of low pastoral value and the appearance of vast expanses of bare soil reaching the stage of desertification.

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