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Floristic richness and reconstitution of alfa (*Stipa tenacissima* L.) steppe in Sidi-Djillali area (Tlemcen, Algeria)

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Abstract
The present work is devoted to the study of the floristic diversity and the reconstitution of Alfa "*Stipa tenacissima* L.", family of Poaceae, in the steppe rangelands of Sidi-Djillali; precisely at two sites 1: fenced and 2: non-fenced. The floristic richness and morphometric data analysis for Alfa tufts showed the existence of a significant difference between the two studied sites. In fact, the site1 shows both a much better growth of Alfa (height=87.32 cm and circumference of tufts=278 cm) and an important floristic richness (55 species, H'= 4.01). In contrast, the site 2 that contains only 23 species (H'=3.13); height and circumference of Alfa tuffs not exceeding 70 cm and 230 cm respectively.

Keywords: alfa (*Stippa tenacissima L.*), floristic richness, morphometric of alfa tufts, fencing, steppe, Sidi-Djillali

Introduction

The steppe regions of Algeria represent nine 9 percent (almost 200000 km²) of the territory which are real steppe rangelands (Nedjraoui *et al*, 2008) [12]. In these areas, the most important activity of the local population is sheep breeding which is mainly based on grazing. According to Hasnaoui *et al*, (2014) [9], most of the human population living in Algerian steppe is mainly composed of pastoralists.
In recent studies, several authors have pointed out the degradation of steppe rangelands especially those which are composed by the Alfa " *Stipa tenacissima L.*" (Kadi-Hanifi *et al*, 2005; Chaouch-khouane *et al*, 2018) [10, 4]. Rapid and intense changes have been noted in these areas under growing demand of the people, especially for the quest of herbs for their livestock.
The Alfa is a perennial poaceae which is part both of the steppe groups in the High Plateaux zone and the forest groups in the southern fringe of the Tellian Atlas. Bouazza (1995) [2], pointed out that Alfa can be found in matorrals and pre-forest plant communities as a dominant species, as well as, it can form groups of plants in the steppe either in a good condition, degraded or sandy. Its regression can have serious consequences on the ecosystem balance especially after soil degradation and the destruction of the typical plant communities growing next to the Alfa steppe.
The rangelands stretch over an area of almost 154000 ha (ie. 17 percent) in the Wilaya of Tlemcen. In this area, Alfa steppe represents a surface of almost 76000 ha (CFT 2020) [3].
The aim of our research is to carry out a floristic inventories and morphometric study of the Alfa in the region of Sidi-Djillali, Wilaya of Tlemcen in order to understand well the diversity of Alfa steppe and its reconstitution in this area of study. Furthermore, to find out the effect of fencing on the growth, reconstitution and biodiversity of these steppe rangelands, a comparative analysis was carried out both at the fenced and non-fenced areas.

Materials and Methods

The steppe rangeland of Sidi-Djillali area is located in the southern part of Tlemcen, at almost 75 km away from its center; with nearly 70000 ha (Fig.1). It rises at an altitudinal level of 1200 m, with a slope varying between 05 and 10%.
Rainfall in this area is an average of about 320 mm per year, and within an average temperature of 15.47°C. The rainfall quotient "Q_2= 30.98" of Emberger, classified Sidi-Djillali region at the bioclimatic arid stage with cool winter.
In this study, we used the linear transect method usually used by ecologist researcher (Daget *et al*, 1991) [6]. This type of sampling is considered to be the most suitable for conducting floristic inventories, especially in the steppe area rangelands (Haddouche 2009) [8].
The statistical sampling was carried out randomly during March-May 2019, at two sites: Site1 (fenced) and site 2 (non-fenced) using two transects (500 m) at each one.
This sampling technique makes it possible to carry out the various morphometric measurements of Alfa tufts, 25 tufts of Alfa were measured randomly at each transects, and determining the floristic richness in the area of study. Flora catalogues (Quezel *et al*, 1962; Dobignard *et al*, 2014) [7, 14] were used as references to identify the found species.
Species diversity, for each station, was calculated by using the Shannon-Wiener method (Magurran 2004) [11]:

$$H' = -\sum_{i=1}^{s} Pi \ Ln \ Pi$$

Where; H' is the Shannon-Wiener diversity index, *Pi* is the relative frequency of the *i* species, and s is the specific richness.
As for the morphometric measurements of Alfa tufts, height and circumference are the two main parameters taken into account in this survey. To carry out the statistical analyses, we used the "R" software to compare the morphometric data of Alfa for site1 and site 2.

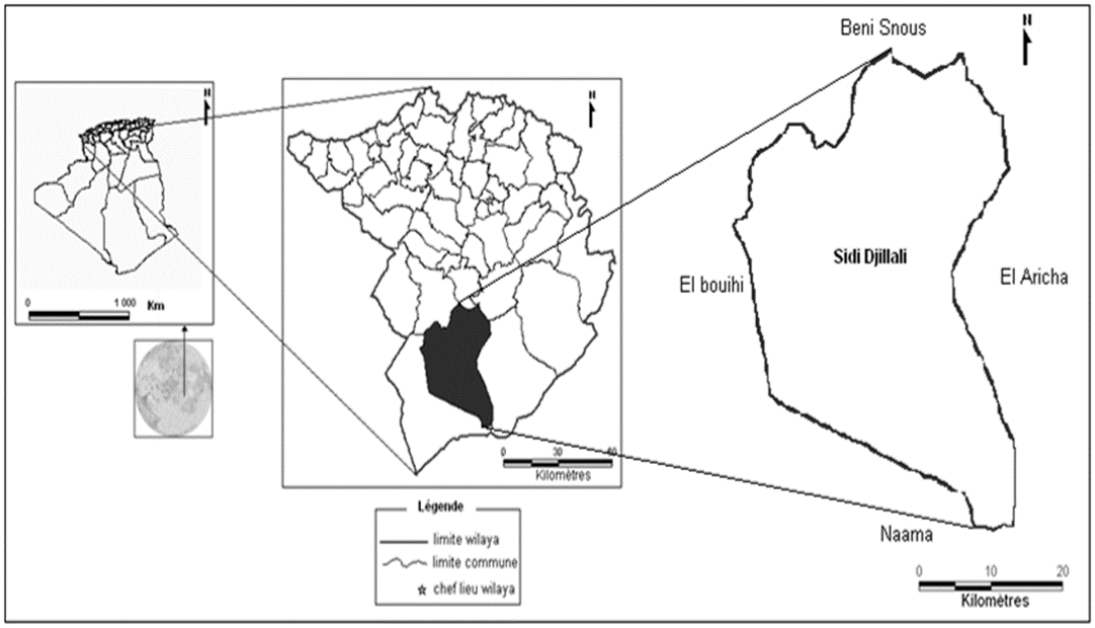

Fig 1: Geographical location of Sidi-Djillali region

Results and Discussion

The floristic composition of the study area (Sidi-Djillali region) includes 58 species belonging to 23 botanical families (Table 2). Thus, the observed species and family composition at the two sites are as follows:

- Sate 1 "fenced area" (Fig. 2): we have found 55 species and 21 families at this fenced site, the most important species are: *Stipa tenacissima L., Rosmarinus officinalis L., Aegilops geniculata Roth, Scabiosa stellata L., Bellis annua subsp. minuta (DC.) Q., Bromus rubens L., Genista tricuspidata Desf, Medicago laciniata (L.) Mill, Poa bulbosa L., Sedum sediforme (Jacq.) Pau., Achillea leptophylla M.B.,* Stipa tortilis Desf., *Stipa barbata Desf., Stipa parviflora Desf., Atractylis cancellata L., Minuartia montana L.,*

Fig 2: Photo of Alfa tuft at the site1

- Site 2 "Non-fenced area" (Fig. 3): we have found 23 species and 15 Families at this site; the main species are: *Stipa tenacissima L., Noaea mucronata (Forssk.) Asch. & Schweinf, Atractylis carduus (Forssk.) Christ, Asparagus horridus L., Artemisia herba-alba Asso, Atractylis humilis L. subsp. caespitosa (Desf.), Scorzonera undulate L., Astragalus armatus Willd.*

Fig 3: Photo of Alfa tuft at the site 2

Among the main biological types defined by Raunkiaer, we have identified the following categories in the study area: Chamephyte (10 %), Geophyte (7 %), Hemicryptophyte (28 %) Phanerophyte (5%) and Therophyte (50%). The biological types of plant species at each site are given in figure 4. The results of the calculation of the Shannon-Wiener index at the site 1 and site 2, show an H' value of 4.01 and 3.13 respectively.

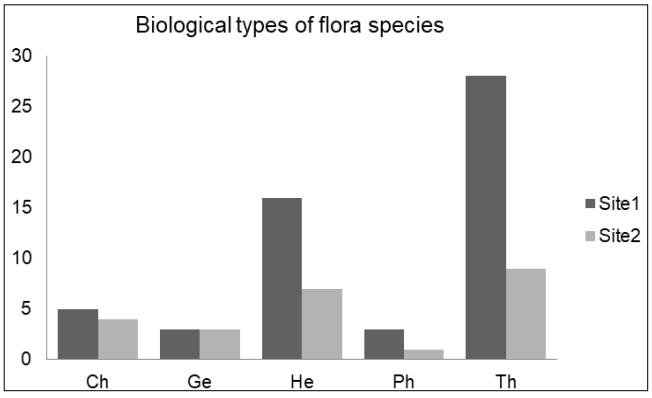

Fig 4: Biological types of flora species at the site1 and site2

The morphometric parameters measurements carried out on Alfa tufts at the two studied sites in Sidi-Djillali region, are given in table 1.

Table1: Values of morphometric measurements and floristic diversity of Alfa tufts at the two studied sites

	Site		Site1 (Fenced)	Site 2 (Non Fenced)
1	Morphometric measurements	H mean (Cm)	87,32	55,6
2		H min-max	50 - 123	40-70
3		C mean (Cm)	278	155.74
4		C min-max	190-520	97-230
5		Density of tufts/km	700	800
1	Florstic diversity	N species	55	23
2		H'	4,01	3,13

Table 2: List of floristic species recorded in the Sidi-Djillali region

	Species	Famillies	Biological types	Site1	Site2
1	*Atractylis humilis L.subsp. caespitosa (Desf.)*	Asteraceae	He	+	+
2	*Aegilops geniculata Roth*	Poaceae	Th	+	
3	*Alyssum parviflorum Fisch.*	Brassicaceae	Th	+	
4	*Artemisia herba-alba Asso*	Asteraceae	Ch		+
5	*Asparagus horridus L.*	Asparagaceae	Ge		+
6	*Asphodelus acaulis Desf.*	Asphodelaceae	Ge	+	+
7	*Astragalus armatus Willd.*	Fabaceae	Ch	+	+
8	*Atractylis carduus (Forssk.) Christ*	Asteraceae	Th		+
9	*Avena alba Vahl.*	Poaceae	Th	+	
10	*Bellis annua subsp. minuta (DC.) Q.*	Asteraceae	Th	+	
11	*Biscutella auriculata L.*	Brassicaceae	Th	+	
12	*Bombycilaena discolor (Pers.) M. Laínz*	Asteraceae	Th	+	+
13	*Bromus rubens L.*	Poaceae	Th	+	
14	*Centaurea involucrata Desf.*	Asteraceae	Th	+	
15	*Centaurea incana Desf.*	Asteraceae	He	+	
16	*Echinops spinosus L. subsp. Bovei (Boiss.) Maire*	Asteraceae	He	+	+
17	*Erodium guttatum (Desf.) Willd.*	Geraniaceae	Th	+	+
18	*Eryngium campestre L.*	Apiaceae	He	+	
19	*Euphorbia falcata L.*	Euphorbiaceae	Th	+	
20	*Genista tricuspidata Desf.*	Fabaceae	Ph	+	
21	*Hedypnois rhagadioloides subsp. cretica (L.) Willd.*	Asteraceae	Th	+	+
22	*Hordeum murinum subsp leporinum (Link) Asch.&Gr.*	Poaceae	Th	+	
23	*Juniperus oxycedrus L. subsp. rufescens (Link) Deb.*	Cupressaceae	Ph	+	
24	*Lobularia maritima (L.) Desv.*	Brassicaceae	Th	+	+
25	*Scabiosa stellata L.*	Dipsacaceae	Th	+	
26	*Stipa tenacissima L. (=Macrochloa tenacissima (L.) Kunth)*	Poaceae	He	+	+
27	*Marrubium vulgare L.*	Lamiaceae	Th	+	
28	*Noaea mucronata (Forssk.) Asch. & Schweinf.*	Amaranthaceae	Ch	+	+
29	*Paronychia argentea Lam.*	Illecebraceae	Th	+	
30	*Plantago albicans L.*	Plantaginaceae	He	+	+
31	*Plantago lagopus L.*	Plantaginaceae	Th	+	
32	*Poa bulbosa L.*	Poaceae	Th	+	
33	*Reseda Phyteuma subsp. collina (Gay) Batt.*	Resedaceae	He	+	+
34	*Rosmarinus officinalis L.*	Lamiaceae	Ch	+	
35	*Salvia verbenaca (L.) Briq.*	Lamiaceae	He	+	
36	*Schismus barbatus (L.) Thell.*	Poaceae	Th	+	+
37	*Scolymus hispanicus L.*	Asteraceae	He	+	
38	*Scorzonera laciniata L.*	Asteraceae	He	+	
39	*Scorzonera undulata L.*	Asteraceae	Th	+	+
40	*Thapsia garganica L.*	Apiaceae	He	+	+
41	*Thymus ciliatus (Desf.) subsp coloratus Boiss.*	Lamiaceae	Ch	+	+
42	*Urginea maritima (L.) Baker*	Hyacinthaceae	Ge	+	+
43	*Ziziphus lotus (L.) Desf.*	Rhamnaceae	Ph	+	+
44	*Achillea leptophylla M.B.*	Asteraceae	He	+	
45	*Anacyclus valentinus L.*	Asteraceae	Th	+	
46	*Atractylis cancellata L.*	Asteraceae	Th	+	
47	*Medicago laciniata (L.) Mill*	Fabaceae	Th	+	
48	*Sedum sediforme (Jacq.) Pau.*	Crassulaceae	He	+	
49	*Minuartia montana L.*	Illecebraceae	Th	+	
50	*Centaurea melitensis L.*	Asteraceae	He	+	
51	*Echium pycnanthum Pomel*	Boraginaceae	Th	+	+
52	*Stipa parviflora Desf.*	Poaceae	He	+	

53	*Stipa tortilis Desf.*	Poaceae	Th	+	
54	*Stipa barbata Desf.*	Poaceae	He	+	
55	*Teucrium pseudochamaepitys L.*	Lamiaceae	Th	+	
56	*Hippocrepis multisiliquosa L.*	Fabaceae	Th	+	
57	*Chamaerops humilis subsp. argentea André.*	Arecaceae	Ch	+	
58	*Allium roseum L.*	Alliaceae	Ge	+	

The two-sample z-test showed a significant difference between the studied morphometric parameter (site 1 and site 2) whether for the height (p.value= 7.577802e-21< 0.05) or for the circumference of the Alfa tufts (p= 3.344752e-40 < 0.05). The mustache boxplot (Fig. 5) also, illustrates the difference between the circumference of Alfa tufts inside and outside fencing (C2=155.74 cm < C1= 278 cm). It also shows a significant difference between the heights of Alfa tufts (H2=55.6 cm < H1=87.32 cm).

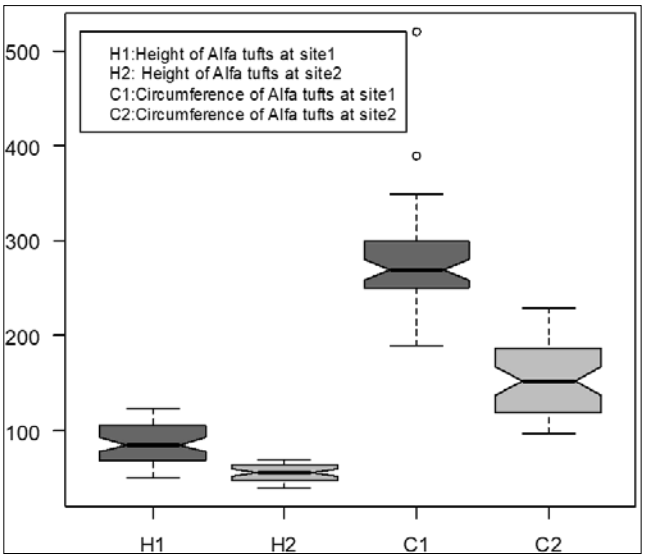

Fig 5: Moustache box of heights and circumferences of Alfa tufts at site 1 and site 2.

The overall results obtained from this study show that fencing, has a positive effect on species diversity, growth and reconstitution of Alfa tuffs; we have noticed that the site1 (fenced area) represent the lower value of growth of Alfa tuffs (H_{max}= 123 cm, C_{max} =520 cm) and floristic diversity. Where at the site2 (non-fenced area), the Alfa tuffs are very degraded (H_{max}= 70 cm, C_{max}= 230 cm) and more affected by grazing activity.

According to Cristofoli (2010) [5] the species richness is considered as a prominent factor of productivity and stability of the landscape. in the region of Sidi-Djillali, we have noted that the floristic richness at the fenced area (55 species at site1) is almost double than the non-fenced area (site 2), which is represented by only 23 species.

Indeed, the fencing allows the development of mixed vegetation based on Alfa and Rosmarin. On the other hand, the presence of several annual species such as: *Poa bulbosa L., Bellis annua subsp. minuta (DC.) Q., Medicago laciniata (L.) Mill, Sedum sediforme (Jacq.) Pau, Allium roseum L., Hippocrepis multisiliquosa L.*, are favoured by the existence of a microclimate, created by the Alfa tufts.

In terms of quality, we noticed the presence of many species as the Alfa degraded, especially in the non-fenced site such as: *Noaea mucronata, Astragalus armatus Willd, Asparagus horridus L., Atractylis carduus (Forssk.) Christ, Ziziphus lotus (L.) Desf.*

Several researchers have pointed out that the degradation of Alfa has resulted in a loss of species diversity, a reduction in floristic diversity and a drop in growth and production (Bouazza 1995; Kadi-Hanifi *et al*,2005; Hasnaoui *et al*, 2014; Chaouch-khouane *et al* 2018) [2, 4, 9, 10].

According to Aidoud (1994) [1] the overgrazing is the main anthropozoic factor that affects the steppe of Alfa. And it is the most devastating action on perennial vegetation and also a cause of desertification over the last two decades (Nedjraoui *et al*, 2016) [13].

Conclusion

Finally, looking at the current situation of the Alfa steppe in the Sidi-Djillali region, which is threatened by several degradation factors, in particular overgrazing and climatic drought, protection measures are required. Indeed, we have noted the beneficial effect of fencing not only on the floristic richness, but also on the reconstitution and growth of Alfa throughout Sidi-Djillali region.

The forest conservation of Tlemcen (CFT) and the High Commission for Development of Steppe (HCDS) must encourage the establishment of fencing and conducting development and restoration programs in the degraded Alfa tuffs, in order to fight desertification and to allow a sustainable development of these steppe rangelands areas. Further works are needed in order to better understand the dynamics of steppe vegetation and to determine the different degradation factors affecting growth and diversity of the steppes of Alfa.

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References

1. Aidoud A. Grazing and desertification of arid steppes in Algeria, case of the Alfa steppe (*Stipa tenacissima L.*). Paralelo,1994:37(16):33-42.
2. Bouazza M. Phyto-ecological study of the *Stipa tenacissima* L. steppe south of Sebdou (Oran region, Algeria). Ecologia Mediterranea,1991:17:173-174.
3. CFT. Report on the forest sector presentation for the Wilaya of Tlemcen. Conservation des forêts de Tlemcen (CFT), 2020, 17.
4. Chaouch-Khouane H, Belhamra M, Aidoud A. Evolution of the plant communities of alfa (*Stipa tenacissima L.*) steppes in Algeria. Courrier du Savoir,2018:26:107-118.
5. Cristofoli S, Monty A, Mahy G. Historical landscape structure affects plant species richness in wet heathlands with complex landscape dynamics. Landscape Urban Plann,2010:98:92-98.
6. Daget PH, Poissonet P. Prairies permanentes et pâturages: Méthodes d'étude (Permanent grasslands and

pastures: Study methods). Institut de Botanique, Montpellier, 1991, 331.
7. Dobignard A, Chatelain C. Synonymic and bibliographic index of North Africa plants. Conservatory and Botanical Garden of the City of Geneva, 2010-2013, 1-5.
8. Haddouche D. Teledetection and landscape dynamics in arid and semi-arid environments in Algeria: the case of the Naâma region. PhD thesis. University of Tlemcen, Algeria, 2009, 211.
9. Hasnaoui O, Meziane H, Borsali AH *et al*. Evaluation of Characteristics Floristico-Edaphic of the Steppes at Alfa (*Stipa tenacissima L*.) in the Saida Region (Western Algeria). Open Journal of Ecology,2014:4:883-891.
10. Kadi-Hanifi H, Sadji A, Amghar F. The impact of anthropic action and aridity on the pastoral production in the *Stipa tenacissima L*. steppes of Algeria. Options Méditerranéennes,2005:(67):61-66.
11. Magurran AE. Measuring Biological Diversity. Blackwell Publishing, Oxford, 2004, 256.
12. Nedjraoui D, Bedrani S. Desertification in the Algerian Steppes. Causes, Impacts and Actions to Fight. Review Electronic Environmental,2008:8:1-15.
13. Nedjraoui D, Hirche A, Boughani A *et al*. Surveillance à long terme des écosystèmes steppiques et suivi de la désertification. Cas de la steppe du SudOuest. Biocénose,2016:2:5-21.
14. Quezel P, Santa S. Nouvelle flore de l'Algérie et des régions méridionales (New flora of Algeria and the southern regions), CNRS, Tome,1962:1-2:1190.