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The Impact of Exclosure on the Rehabilitation of Steppe Vegetation at Naâma Rangelands in Algeria

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Abstract. The Naâma steppe rangelands in Algeria are undergoing continuous degradation due to overgrazing, land clearing, silting up and desertification. Given the seriousness of this situation and the ecological deterioration of these steppe rangelands, the need for an action plan to preserve and rehabilitate the degraded rangelands is becoming more and more urgent. Among the solutions proposed for the degraded rangeland rehabilitation, the exclosure has proven to be an effective and inexpensive fight against the degradation factors. This study aimed to quantifying the effectiveness and impact of the exclosure rehabilitation technique after a protection period (2009-2015) in the esparto grasslands (*Stipa tenacissima* L.) ranges located at Djedida in the Naâma region (Western Algeria). The adopted methodological approach is that of the comparative analysis of vegetation descriptors based on a quantitative (recoveries, floristic richness) and qualitative assessment, evaluation of the plant cover (biological, systematic, biogeographic phytodiversity) between the exclosure rangeland and the nearby located grazing rangeland having about the same climato-edaphic station conditions. Thirty phytoecological surveys were carried out for the exclosure rangeland as well as on an unprotected control range (outside the exclosure area). The comparative analysis of the obtained results shows that, in general, the exclosure rangeland is relatively much richer in terms of quantity and quality than the grazing range. In the exclosure areas, the vegetation was more productive and more diversified, the average vegetation cover was 25% vs 5%, Number of species was 41 vs. 14 and density was 19.3 vs, 4.6 plants/100m² for exclosure and open grazing range, respectively. On the other hand, in the grazing range, the vegetation was much diversified in terms of biological, systematics and biogeographic aspects in terms of floristic diversity. The impact of exclosure of pastoral improvement was interesting after a period of more than 6 years. It has a remarkable effect on the vegetation cover improvement, the floristic composition and the floristic richness increase. It stimulates the reconstitution, regeneration and development of the grass species of esparto grass (*Stipa tenacissima* L.) in the steppe ranges of perennial species.

Key words: *Stipa tenacissima* L., Vegetation, Exclosure, Steppe, Naama

Introduction

The Naâma steppe region, which is part of the Oranian High Steppe Plains (Western Algeria), has a total area of three million hectares, largely occupied by the largest potential of land with steppe rangelands, including an inheritance of 436,250 ha of esparto grasslands (20%). It is a region of agropastoral vocation par excellence, where the sheep farming is estimated at more than 1.5 million heads (Benaradj, 2009 and Boucherit, 2018).

Over the last four decades, the South-Oranian steppe area (Algeria) has experienced an increasingly accentuated degradation of all ecosystem components. Among the steppe environment degradation causes often highlighted (both natural and anthropogenic, one can notice: clearing, intensive overgrazing and abusive and irrational exploitation of rangelands, combined with drought, silting up and wind erosion). This is shown in the reduction of the biological potential by decreasing the recovery rate and the floristic group change by the reduction of productive perennial species and by the disruption of ecological and socio-economic balances (Le Houérou, 1995; Benaradj *et al*., 2014).

To face this alarming situation, the Algerian State has implemented several actions and pastoral development programs, aimed at reducing the fodder deficit, in order to remedy this degradation by rehabilitating and restoring the strongly degraded steppe rangelands. Among the actions carried out, there have been the important Green Dam project, land development, pastoral plantations, fixing of mobile dunes, reforestation, fruit tree plantations, prohibition of ploughing on pastoral areas, mobilization of surface waters, as well as actions to fight desertification and exploitation of steppe resources, particularly through the setting up of exclosure and protected areas of hundreds of thousands of hectares of steppe rangelands (Amghar *et al*., 2016; Huguenin *et al*., 2017, Benaradj *et al*., 2017; Boucherit *et al*., 2017).

The choice of such an action and/or a rehabilitation technique is to be applied according to the station context and the rangelands degradation state.

According to Diatta (1994), the control of this phenomenon requires facilities that promote biological recovery and the restoration of soil cover. Among these, exclosure measures are a technique that consists of restoring degraded areas through periodic rotations in order to favor the ecosystem restoration.

In the Naâma region, the High Commission for the Development of the Steppe (HCDS[1]) has undertaken a series of restoration or rehabilitation measures by recommending exclosure of 515,000 ha of rangelands, in terms of development and preservation of natural resources in the Algerian-Moroccan border area (HCDS, 2012).

Many studies have already proven the ecological effectiveness on pasture rehabilitation (exclosure) in the quantitative and qualitative improvement of pastures by the remarkable increase in plant cover, the regeneration of plant cover. The effect of protection by exclosure has been done in the steppes of North Africa. Many authors have approved that exclosure range are relatively much richer than grazing range (Table.1).

The present work aims at evaluating the effect of exclosure on phytodiversity and on the quantitative (vegetation cover and floristic richness, floristic composition) and of the esparto grass steppe formation (*Stipa tenacissima* L. Syn. *Macrochloa tenacissima* L.) after a 6-year period of protection in the Naâma region (South-West of Algeria).

1- High Commission for the Development of the Steppe

Table 1. Effect of the protection by exclosure on improving vegetation recovery rate and the flora richness in North Africa

Country / Locality	Vegetation Cover (%)		Number of species		Type of plant Formation	Authors
	OG	EX	OG	EX		
Algeria						
Ain El Mahdi (Laghouat)			25	50	*Stipa tenacissima* L.	Amghar et Kadi-Hanifi, 2004
Ksar El Hirane (Laghouat)			12	15	*Stipa tenacissima* L.	Amghar et Kadi-Hanifi, 2004
Messaad (Djelfa)			15	31	*Hammada scoparia* (Pomel)	Amghar et Kadi-Hanifi, 2004
Taadmit (Djelfa)			62	40	*Stipa tenacissima* L.	Amghar et Kadi-Hanifi, 2004
Ben Hamed (Djelfa)	21.5	44.6	16	25	*Stipa tenacissima* L.	Djaballah, 2008
Atf Albgar (Djelfa)	19.6	21.4	10	14	*Hammada scoparia* (Pomel)	Djaballah, 2008
Lazbar Brézina (El-Bayadh)	35	10	29	11	*Hammada scoparia* (Pomel)	Mansour, 2010
Dhayat-Cheih Roggassa (El- Bayadh)	40	15	29	12	*Lygeum spartum* L.	Mansour, 2010
Megouchech Stiten (El- Bayadh)	20	75	38	22	*Stipa tenacissima* L.	Mansour, 2010
Touadjeur- Mécheria (Naâma)	5	25	27	71	*Lygeum spartum* L.	Benaradj *et al*., 2010
Sidi Bouzid- (Laghouat)	13.9	33.5	38	18	*Hammada scoparia* (Pomel)	Salemkour *et al*., 2013
El- Houaita- (Laghouat)	22.5	45.6	28	17	*Stipa tenacissima* L.	Salemkour *et al*., 2013
Noufikha- Sfissifa (Naâma)	15	30	41	95	*Stipa tenacissima* L.	Benaradj *et al*., 2013a
Abedelmoulah- Kasdir (Naâma)	8	45	21	56	*Lygeum spartum* L.	Benaradj *et al*., 2013b
Marnouna (Msila)	58	35.6	34	30	*Artemisia herba alba* Asso.	Kherief *et al*., 2013
Roumena El-Gueblia (M'sila)	49	30.6	42	30	*Stipa tenacissima* L.	Kherief *et al*., 2013
Maâmora (Saida)	30	9			*Lygeum spartum* L.	Guendouzi, 2014
Litima (Naâma)	20	57	4	20	*Lygeum spartum* L.	Khalid *et al*., 2015
Hadjra kahla (Naama)	9	30	3	17	*Artemisia herba alba* Asso.	Khalid *et al*., 2015
Zaboudja – Tiout (Naâma)	20	40	108	44	*Hammada scoparia* (Pomel)	Boucherit *et, al*., 2017
Bouarfa (Ain Sefra)	25	9	71	28	*Hammada scoparia* (Pomel)	Benaradj *et al*., 2017
Haj Mécheri- Brida (Laghouat)	56	35	28	23	*Lygeum spartum* L.	Bouchareb *et al*., 2019
Tunisia						
Oued Zayed (Menzel Habib)	38	41	9	35	*Rhanterieum suaveolens* Desf.	Tbib and Chaieb, 2004
Garât Snouci (Menzel Habib)	20	39	22	6	*Rhanterieum suaveolens* Desf.	Tbib and Chaieb, 2004
Sèfiya (Menzel Habib)	10	53	39	20	*Rhanterieum suaveolens* Desf.	Tbib and Chaieb, 2004
Souiouina (Oujda)	17.5	34.5			*Artemisia herba alba* Asso.	Acherkouk *et al*., 2012
Bou Hedma (Sidi Bouzid)			50	31	*Juniperus phoenicea* L.	Ouled Belgacem *et al*., 2013
Morocco						
Khoui Lamchach (Oujda)	4.5	44.5	31	11	*Stipa tenacissima* L.	Hachmi *et al*., 2015
Mesguin (Agadir)	22	64	88	22	*Argania spinosa* L.	Achour *et al*..,2011
Ras Benzayed-(Tendrara)	56	52			*Artemisia herba alba* Asso.	Maatougui *et al*., 2013

* EX : Exclosure, OG: Open Grazing

Materials and Methods

Study area

The exclosure area of Djedida (Naâma) is spread over an area of 2500 ha; it is located in the south-eastern part of the department of Naâma (western Algeria). Geographically stretches between 33°12'47.78 "to 33°11'33.46" North latitude and 0°20'46.13 "to 0°21'18.83" West longitude, with an altitude of 1175m (Fig. 1). It constitutes a homogeneous topographic unit without a major accident. It is characterized by an arid Mediterranean bioclimate, with an average annual rainfall of 220mm.

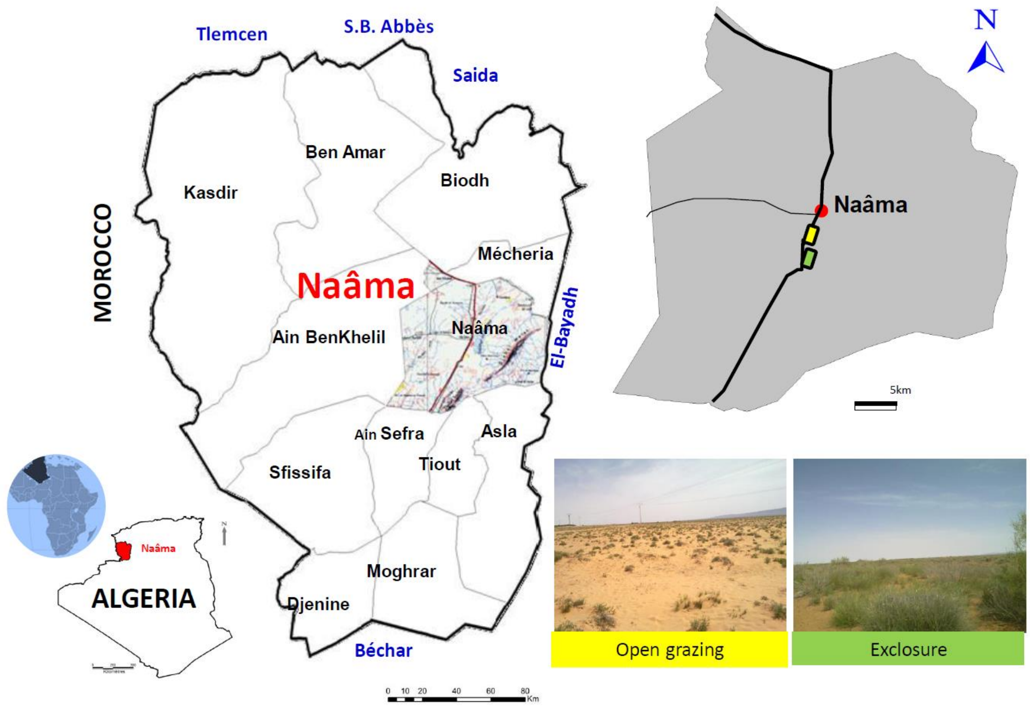

Fig. 1. The location the study area of Djedida in Naama (Southwest of Algeria)

Methodological Approach

a) Making statements phytoecological

We launched a sampling campaign during spring 2015 to determine the effect of this experimental practice on plant diversity and on the condition of the soil surface in the Djedida (Naâma) study station.

To meet the objectives of this study, we adopted a methodological approach based on the comparison of phytoecological records between the exclosure and the neighboring grazing ranges.

The method consists of regularly arranging a certain number of square plots with 100m² of surface area along the line transects carried out in the study area. Such measurements can be carried out along transects (Fig. 2). It is used to measure various parameters, at the plant scale, at the spatial scale and at the temporal scale (seasons, few years). It has often been used to assess the total plant cover, list the species present in each surface (floristic inventory) and estimate the density of the species in question of *Stipa tenacissima* (number of tufts per plot).

According to Roselt/OSS (2007), the method provides an interesting indication of the state of development, or, on the opposite, of degradation of a given group. These measurements were carried out inside and outside the exclosure area during the period between April and May 2015; period of most plant species active growth. Three transects (T1, T2 and T3) of more than 1 km in length were installed on the exclosure site and the grazed site (not protected) in the direction of the gradient of variation of the field according to the methods of Braun-Blanquet *et al.*, (1951), Le Houérou (1969) and Djebaili (1978). For this, it is necessary that these linear transects are set (with the greatest care with the GPS) perpendicular to the lines in the field. These transects are materialized on the ground by two hollow stakes driven into the ground between which a wire is stretched. Readings are taken every 200m over a length. The same number of surveys and transects have been developed to ensure good representativeness.

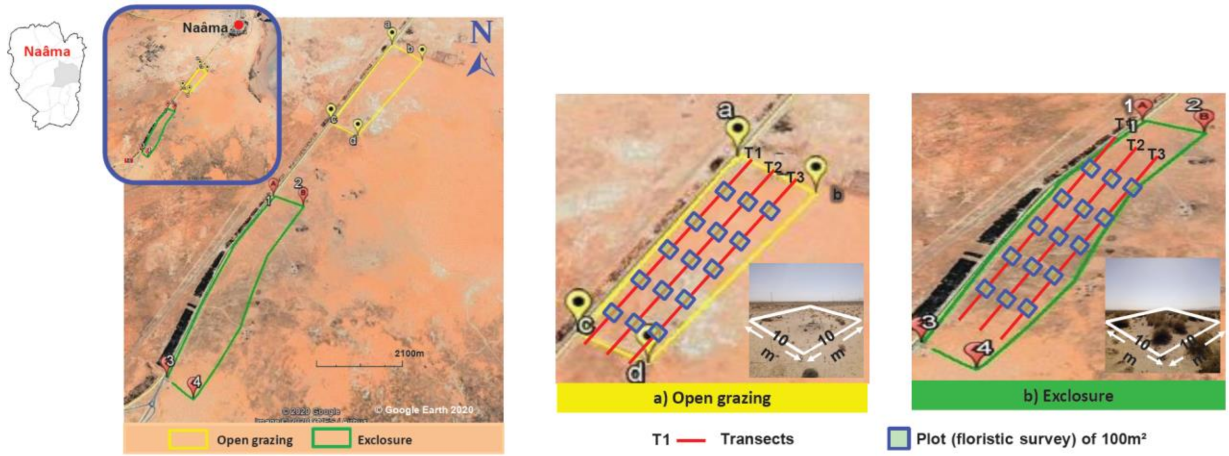

Fig. 2. Location of plots along the transects in the study sites (Exclosure and Open grazing)

b) Analysis of floristic composition

b.1) Quantitative characterization

- **Recovery:** The cover of a taxon is defined as the percentage of the area of the station covered by the vertical projection, on the ground, of the aerial parts of this taxon. Evaluating the recovery of taxa, but also of vegetation, provides access to an assessment of the state of the vegetation, its evolution (reconstitution, stability or degradation) (Roselt/OSS, 2008).

- **Floristic richness**: The floristic richness of a territory is the total number of species it contains, this floristic richness is generally all the higher as the surface of the territory is larger, but naturally grows less quickly than the considered area (Ozenda 1991, Djebaili 1978; Benaradj *et al*., 2017).

- Estimation of the density

The measurement of the density of the alpha is carried out by:

1) Delimitation of 30 plots 200 m apart with an area of 100 m² in each study site (15 plots in the exclosure and 15 plots in the Open Grazing).

2) Count of existing esparto grass individuals to have the average density of esparto grass in the plots installed in the field

b.2) Qualitative characterization

The species recorded inside and outside the enclosure were indicated (Daget, 1980), Systematics (Angiosperm Phylogeny Group III, 2009) and biogeographical (Le Houérou, 1995). This study consists of a comparative analysis of the impact of the exclosure by a characterization inside exclosure and outside (free range), allowed us to obtain the results on the quantitative level (floristic richness, rate of recovery, density) and qualitatively (biological, biogeographical and systematic).

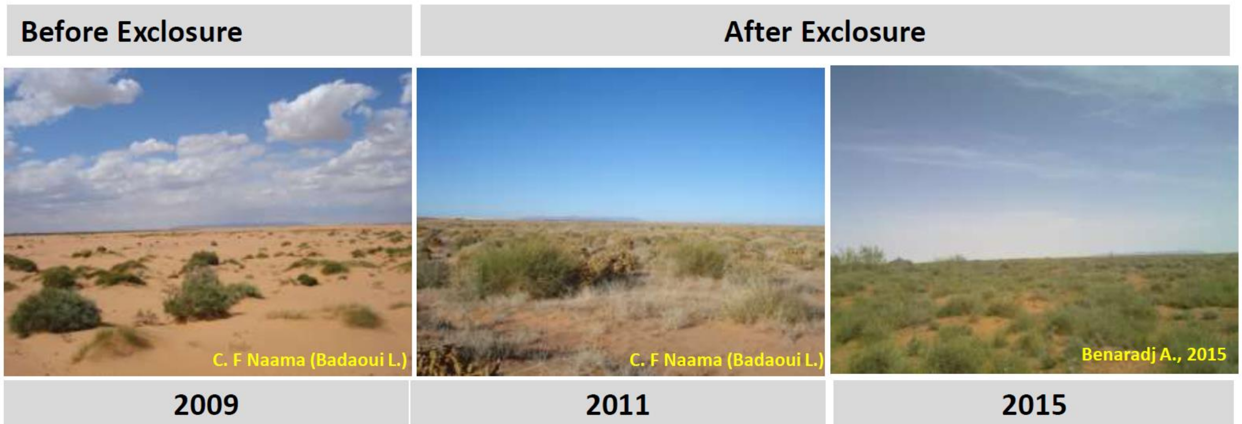

Fig. 3. Condition grazing initiation area of Djedida (Naama) between 2009 and 2015

Effect of exclosure on Vegetation cover, Floristic richness and Density

Regarding the vegetation cover, we notice that there is a large difference between the exclosure and the grazing range. In exclosure, the esparto grass tufts (*Stipa tenacissima* L.) are well developed, the overlap is between 15 and 30%, but it is very variable in space. On the other hand, it is different in the grazing range, where the *Stipa tenacissima* (L.) is degraded so the recovery rate hardly exceeds.

We note that the recovery is higher in the exclosure, it is three times higher than that of grazing range in the study station. It is noted that the exclosure allowed a marked improvement in the covering of the vegetation. The variation in floristic richness in the study station illustrated in Table 2 from the floristic surveys carried out inside and outside the exclosure. Indeed, the species inventoried inside the enclosure are more important than outside. In the protected zone, the recovery is mainly made up of palatable perennial species (*Lygeum spartum*, *Stipagrostis pungens*, *Avena sterelis*, *Medicago laciniata*, *and Astragalus mareoticus*), while in the unprotected zone there are mainly annuals and non-palatable perennials.

The effect of exclosure on plant density values was estimated by the presence of number of esparto grass individuals in a plot and under the different modes of exclosure and grazing range. The analysis of the density of *Stipa tenacissima* (L.) present in exclosure is of 19.3 individuals / 100m², while, in the grazing range, it was 0.23 individuals /100m². It can be seen that average total density is higher inside the exclosure compared to grazing range. However, the protection has favored the regeneration of this grassy species, which results in a high density as well as the vegetation are in good condition in exclosure On the other hand, in the unprotected area where the degradation is much accentuated, the esparto grass (*Stipa tenacissima* L.) has completely disappeared.

Table 2. Vegetation cover, Floristic richness and esparto grass density in the two study sites (Exclosure and Open Grazing

Rangeland	Vegetation cover %	Number of species	Plant Density per 100m²
Exclosure	15-30%	41 species	19.3
Open Grazing	0-10%	14 species	4.6
Rate of increases in Exclosure	3 times	2.9 times	4.2 times

Effect of exclosure on floristic composition

The results of the floristic composition are characterized on the biological, systematic and biogeographical plan.

a) Biological plan

From Fig 4, we see a considerable difference between the exclosure and the grazing range. This explains the state of degradation of these Grazing range. In the exclosure we find the following biological life-form (Th> Ch> He> Ph> Ge) on the other hand, in the grazing range the life-form was (Ch> Th> He).

In the exclosure, the biological type is characterized by a strong presence of the predominant herbaceous layer. The therophytes occupy 41.46%, the chamaephytes (34.14%). hemicrvptophytes (17.07%), phanerophytes (4.87%) and geophytes (02.43%).

On the other hand, in grazing range where the degradation is very important, the analysis of the illustrated results reveals that the dominant biological type is represented by the chamaephytes (50%), therophytes (28.57%), hemicryptophytes (21.42%), respectively. So the life-form is present a resemblance but its floristic composition is very poor.

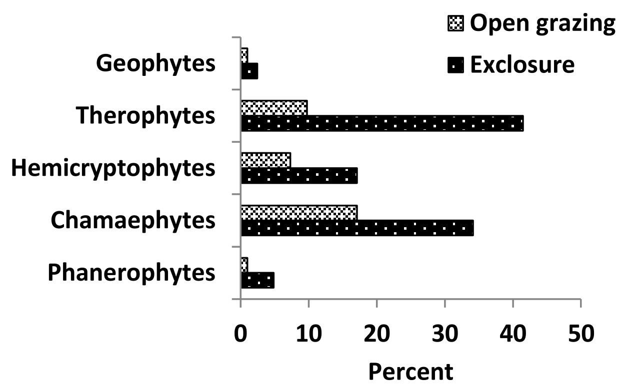

Fig. 4. Effect of exclosure on biological characterization

c) Systematic plan

The study station shows a significant difference in systematic point of view between the exclosure and that of the grazing range.

There is a great systematic point of view differences between the exclosure and the grazing range (Fig.5). Table 3 shows the variation in flora systematically at the study station, as follows.

Table 3. Systematic plan in the two study sites (Exclosure and open grazing)

Taxonomy	Exclosure	Open Grazing
Familiy	18	11
Genera	38	14
Species	41	14

We find that exclosure is represented by 18 families, 38 genera and 41 species; on the other hand, in the open grazing, we find only 11 families, 14 genera and 14 species.

In exclosure, the Poaceae family is the most dominant represented by 9 species and 9 genera, in the open grazing, it is the Asteraceae family (7 species and 7 genera) followed by the Fabaceae families (5 species and 3 genera), followed by the Amaranthaceae family (3 genera and 3 species) and Caryophyllaceae (2 genera and 2 species), the Lamiaceae family (2 genera and 2 species). On the other hand, there are families mono-specific which are present by a single species namely; Borraginaceae, Brassicaceae, Malvaceae, Cistaceae, Dipsacaceae, Euphorbiaceae, Geraniaceae, Iridaceae, Onagaceae, Plantaginaceae, Tamaricaceae and Thymeleeae.

In the open grazing, is dominated mainly by the Asteraceae Poaceae and Lamiaceae (with 2 genera and 2 species). As well as other cases by the presence with a single genus and a single species such as the mono-specific families: Borraginaceae, Caryophyllaceae, Amaranthaceae, Fabaceae, Plantaginaceae, Malvaceae, Thymeleaceae, Zygophyllaceae.

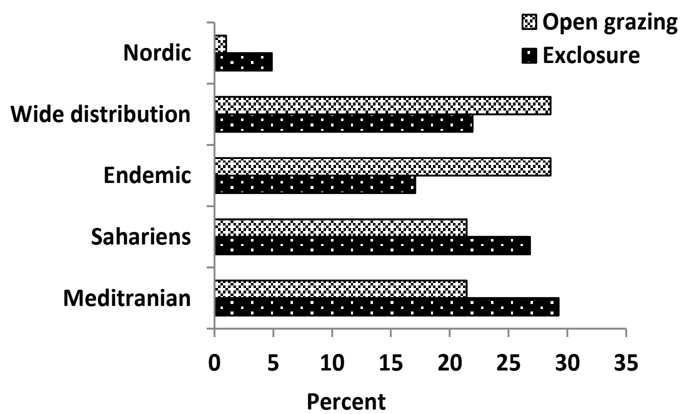

Fig. 5. Effect of exclosure on biogeographic characterization

d) Biogeographic plan

The flora is very rich and diversified in biogeographical elements, with nearly 56% being representative of a great Mediterranean and Saharan affinity on the global list of the floristic procession (Fig6).

In the exclosure the biologeographic type showed the superiority of Mediterranean origins with 12 taxa or 29.27%. The Mediterranean type is origins in the area of the Saharan Atlas. For the other biologeographic type, we record the Saharan element (11 species or 26.83%), Wide distribution (9 species or 21.95%), Endemic with 7 species (17.07%), and finally the Nordic element (2 species or 4.88%).

On the other hand, in the open grazing, we also observe the dominance of the same elements but of low rate in species: the Mediterranean biologeographic with either 3 species, Saharans (3 species), Endemic (28.57%), Wide distribution (28, 57%). To this end, with anthropogenic pressure we note the decrease in Mediterranean affinity species and endemics and the increase in Saharo-Arabians.

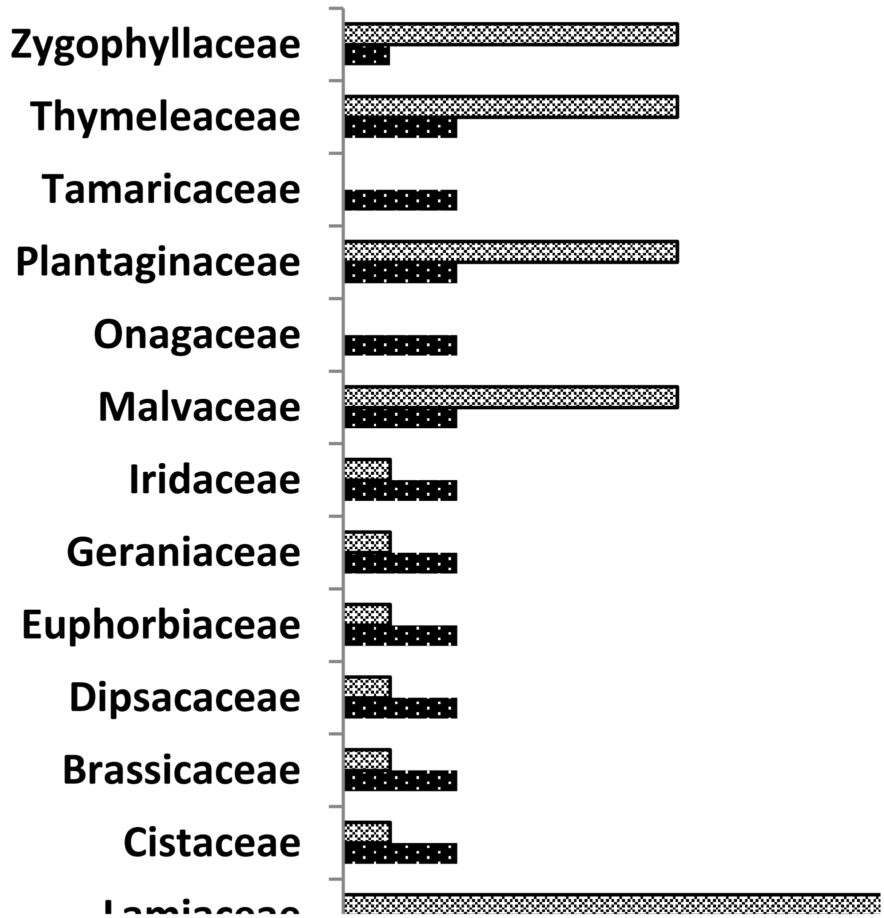

Fig. 6 Effect of exclosure on systematic characterization

Discussion

Many studies have already proven the ecological effectiveness of this practice of pasture rehabilitation (exclosure) in the quantitative and qualitative improvement of pastures by the remarkable increase in plant cover, the regeneration of plant cover after a period of three years and more (Amghar *et al*., 2016, Bouchertit *et al*., 2017; Moukrim *et al.*, 2019; Asmare and Gure, 2019).

Effect of exclosure on recovery rate

The improvement in the recovery rate in the exclosure is due to the process of biological recovery induced by the exclosure. According to Le Houérou (1995), biological recovery is the set of reverse processes to those of steppization and desertification. The biological recovery process is manifested first by the development and multiplication of species and an increase in the rate of soil cover.

The dynamics of the vegetation in the steppe or the evolution of the steppes in the long term show that the essential processes which play a very important role in the landscapes transformation in a regressive way by the following two processes: steppization and desertification.

These two processes (steppization and desertisation) are linked, on the one hand with intense climatic variability (drought and fairly long aridity), on the other hand, with particular natural conditions as well as some unfavorable anthropogenic conditions such as overgrazing, clearing, mismanagement and natural resources exploitation (Aimé and Remaoun, 1988). The steppization process is characterized by the replacement of forest-type vegetation by typically steppe formations (esparto grass, esparto and sagebrush steppes) (Le Houérou, 1995). The irrational exploitation by man of these environments, weakened by climatic constraints, locally promotes the often irreversible degradation of the steppe ecosystem. The impact of these constraints results in different types of responses of *Stipa tenacissima* (L.) by the reduction of the vegetative apparatus in the steppe environment (Bouazza, 1991). For desertisation, it is a process of transformation of steppe spaces towards desert spaces in the arid regions of North Africa, either physically by the disappearance of vegetation, or demographically by the disappearance of the population (Le Houérou, 1995).

In the case of open grazing, the poor vegetation coverings observed can be explained by grazing (grazing and defoliation) and animal load (trampling) by the herds (Daget et Godron, 1995; Le Floc'h, 2001). Herds of sheep and goats crush the plant cover while trampling it, which prevents any natural regeneration of plants and causes a gradual disappearance of vegetation (Le Houérou, 1995).

Effect of exclosure on flora richness

The difference observed in the number of species between the interior and the exterior of the exclosure shows the beneficial effect of the setting on the flora richness. In the exclosure range, it appears that the protection has allowed floristic enrichment.

This duration of protection aims to reactivate biological recovery in species. Thus, protected rangelands with the ability to regenerate and return species of pastures interest (*Stipa tenacissima* L., *Lygeum spartum* L., *Stipa parvriflora* Desf., *Saccocalyx satureioides* Coss., etc.).

The open grazing was marked by a low floristic richness and the presence of species of no pastoral utility (*Cleome arabica* L., *Peganum harmala* L., *Thymelaea microphylla* Coss. & Durieu, *Salsola vermiculata* L., *Echinops spinosus* L., etc.). The latter, unpalatable species are said to be indicators of degradation. This finding explains why unprotected rangelands show a very advanced stage of degradation. Indeed, these rangelands are subject to strong human and animal pressure (clearing, over exploitation, overgrazing). According to Visser (2001), overgrazing prevents flowering and fruiting of palatable annuals. Overgrazing has led to the disappearance and elimination of species of good pasture value, giving way to other invasive species little appreciated by the livestock (little or no palatable, toxic and thorny).

The reduction in plant cover, through grazing, almost inevitably leads to the modification of the relationships of dominance between species (Le Floc'h, 2001). According to Neffati *et al.*, 1993, the eradication of vegetation from steppe plant formations leads to the denudation of vast areas. Several authors have approved that exclosure range are relatively much richer than open grazing, which is in agreement with our results.

Effect of exclosure on plant density

Density assessment is another interesting indicator to assess the impact of protection on steppe vegetation (Yerou and Benabdeli, 2013). Density makes it possible to assess the trend in the evolution of the floristic composition of a plant community (Maatougui *et al*., 2013).

The effect of exclosure on plant density values was estimated by the presence of number of in a plot and under the different modes of exclosure and open grazing.

The density of esparto grass (*Stipa tenacissima* L.) present in exclosure is of 19.3 individuals / 100m², while, in the open grazing, it was 0.23 individuals /100m². Indeed, the protection has favored the regeneration of this grassy species, which results in a high density as well as the vegetation are in good condition in exclosure.

Our results obtained are quite similar to those of studies carried out by other authors: in the Algerian South-Oranian: Slimani, 1998, Slimani and Aidoud, 2004 showed a progressive and significant decrease in the quantitative parameters of perennial vegetation (density) and in particular esparto grass, of exclosure towards the open grazing area.

Maatougui *et al*. (2013), found that the density of *Artemisia herba-alba* Asso. is 18.67 individuals / m² in the protected zone while in the control it was 0.33 individuals / m² in the region of Ras Benzayed (Tendrara, Morocco Oriental);

Joffre (1978), has indicates that the open grazing is characterized by a low rate of recovery, and therefore a large dispersion of individuals on the surface, on the one hand; high variability in the sizes and shapes of the esparto grass tufts on the other hand in the Bir Lahmar station in Medenine (Tunisia).

This difference can be explained mainly by the intensity of grazing which acts on intra-specific competition, but also by inter-specific competition with respect to perennial grasses which have a high density within the setting. Indeed, this forage grass (*Stipa tenacissima* L.) is very grazed by animals. This alters their regeneration capacity by preventing the establishment of seedlings, especially where this grass reproduces only by seeds.

Thus, in the open grazing, the intense grazing causes the decrease in density, and reduces them to tufts at ground level (Joffre, 1978; Maatougui *et al*., 2013; Moulay *et al*., 2011).

Therefore, the high pasture load in the open grazing is the main source of degradation of the formations at *Stipa tenacissima* L., resulting in a marked decrease in the density of the esparto grass. Thus, the eradication of *Stipa tenacissima* (L.) will have very serious consequences on the balance of the entire ecosystem and will result in the establishment of an ecosystem conducive to desertification (Moulay and Benabdeli, 2012).

Reasoned exclosure can have a beneficial effect on the length of the vegetative period of certain species. Furthermore, these vegetative rest periods are generally more favorable, allow the installation of young perennial plants and thus promote the germination of annual species.

Effect of exclosure on floristic composition

The floristic composition has also evolved from 14 to 41 species with a marked increase in therophytes and chamaephytes. This improvement has also been demonstrated by several authors who recognize that grazing and pasture overload have a considerable effect on the structure of the community and the floristic composition (Amghar *et al*., 2012; Gamoun *et al*., 2012). According to Nedjraoui (2004), the decrease in plant cover and the change in the floristic composition are the elements that characterize the regressive evolution of the steppe.

a) Biological plan

In the first situation of exclosure, the life-form presents a heterogeneity which is due to the exclosure and on the other hand its vegetation cover requires a period of rest or protection to allow the process of the « biological rise » of the reconstitution, regeneration and reappearance of species threatened with destruction by degradation factors. On the other hand, in the open grazing, the floristic composition is very poor with a very low number floristically, the latter is due to the anthropic action exerted on the courses which results in a strong degradation.

The dominance of therophytes in the study station is considered to be an indicator of vegetation degradation due to anthropogenic and climatic disturbances.

Disturbance is the mechanism that limits the development of vegetation causing its partial or total destruction, while stress is a factor that limits the rate of biomass production. Disturbances play a fundamental role in the variation in floristic composition and their dynamics depending on the pressure exerted on the rangelands (overgrazing, drought). Stress could indeed be considered both as a disturbance and a stress on plants (Grime, 1977).

These climatic disturbances will largely contribute to a blockage of germination of annual species, to the regression of the plant cover, and to the degradation of the edaphic environment, already very sensitive (Floret *et al.*, 1978). The disturbances lead to a considerable drop in pasture potential and thus worsen the deterioration of the environment, until the desertification of the environment (Floret and Pontanier 1982; Khatteli 1996).

According to Ouled Belgacem *et al.* (2006) in the event that these disturbances have not yet led to irreversible degradation of the natural environment, a simple rest (short-term protection) could allow the spontaneous reconstitution of the original vegetation.

b) Systematic plan

This systematic analyzes show a more nuanced diversity in plant families and genera in the situation after exclosure compared to the situation before exclosure.

Asteraceae, Poaceae and Fabaceae are three families common to both situations with predominance in the two floristic lists. This predominance is justified since they are cosmopolitan families which are very well answered all over the globe (Benaradj *et al*., 2013a).

The application of protection after a period of exclosure allows the subtraction and elimination of all forms of exploitation on steppe ranges. Therefore, the temporary stop of grazing allowed the stimulation of the regeneration of the vegetation towards a greater plant phytodiversity.

c) Biogeographic plan

There is a disproportion between the dominant biogeographical types (Mediterranean, Endemic and Saharan) and the other biogeographical elements. The examination of the main biogeographical types confirms the abundance of the Mediterranean element, which was emphasized by Quézel (2000). Thus, the infiltration of the Saharan element is explained by the fact that the study area is a transition zone between the Saharan atlas and the Tellian atlas.

The comparative analysis at the biogeographical level shows the importance of the phytodynamics of the steppe ranges; either progressive in the course put in exclosure (much diversified of floristic composition) or regressive in the grazing range. This regression is due to the impact of climatic and anthropogenic changes.

Conclusion

From this evaluation, the favorable effect of exclosure on the preservation of the esparto grass steppe (*Stipa tenacessina* L.) in the steppe region of Naâma (Algeria) emerges. Indeed, the comparison between the results obtained in the exclosure situation, and that of the open-access course, highlights the beneficial effect of the protection appears by:

- The increase of the plant cover and consequently the increase of the phytomass; this makes it possible to fight against desertification and silting up;

- The quantitative and qualitative increase of the floristic richness, which automatically induces an increase in the value and pasture productivity of the rangelands and a decrease in the pasture load;
- The resettlement and reappearance of endangered species.

However, in order to achieve the hoped-for objectives, this technique of pasture management requires the support of the populations, in particular the stockbreeders, and the reinforcement of the surveillance means with a rational management of these rangelands which are exclosure after their opening by respecting the load pitch capacity.

The exclosure positive impacts, at least over 6 years, are very interesting for the rehabilitation, preservation and restoration of steppe rangelands against any form of degradation.

The success of such a type of pasture management applied (exclosure, plantations...) requires the involvement and support of the local pasture population (pastoralists and agro-pastoralists) in the management and safeguarding of these rangelands ecological potential.

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