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ORIGINAL ARTICLE

Understanding of the impact of the types of livestock on the steppe training systems

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The steppe route in Algeria know a significant degradation due to human and animal pressure. This degradation occurs at the level of the reduction of vegetation cover and the disappearance of pastoral species, which affects the productivity of pastoral systems and as a result, worsening the level of poverty of the rural populations. The results obtained show that the pastoral plantation has a positive impact through increased both quantitative than qualitative (floristic wealth, global recovery, phytomass and pastoral productivity) courses developed by report to others. The floristic study highlights the floristic diversity with 51 species combination The floral study underlines the floral diversity with 51 sorts species of long-lived 17 and short-lived 34) led inferred by the plantation of Atriplex canescens. From the biodiversity point of view, notes the rise of thorny species course undeveloped after the eradication of the palatable species. Quantitative when it showed a gradual change in the collection at the level of the courses laid out resulting in a significant biomass of the order of 720 kg MS/ha and 122 UF/ha of which to answer the food needs for the livestock and to decrease the overload on the vegetation.

Keywords: Step course; degradation; plantation; pastoral; productivity; M'Sila (Algeria)

Introduction and problematic

The Algerian steppes are located between the Tell Atlas to the north and the Sahara to the south and extend over an area of around 20 million hectares. They are bounded on the north by the 400 mm isohyet and on the south by the 100 mm isohyet which constitutes the southern limit of the extension of the alfa (*Stipa tenacissima*). This geographical area is predominantly pastoral and there is extensive breeding estimated at more than 15 million sheep. This set belongs to the arid bioclimatic stage with a cool variant with quite large thermal amplitudes reaching 34 °C for the amplitude of the extremes (the average minimum temperature of the coldest month is -4 °C, the average maximum temperature of the hottest month reaches 38°C).

For several decades, all the steppe vegetal formations in Algeria have been confronted with a problem of degradation induced by the combined effect of anthropogenic factors (rangeland and clearing) and natural factors (decrease of rainfall). Despite the human and financial resources mobilized to regenerate and protect this vegetation, which mainly serves as a forage resource, the results remain mixed and reveal the inefficacy of the approaches and methods (Benabdeli et al., 2008). This finding has been underlined by several authors (Le Houérou, 1985, 1996; CNTS, 1989; Nedjraoui, 2004; Aidoud, 1996; Kacimi, 1996 and Benabdeli, 2000, 2008), which confirm the qualitative and quantitative regression of the main plant formations. from the steppe zone.

These rangelands have been and are still very weakened by overgrazing and the severe climatic hazards that have led to a worrying degradation of the steppe ecosystem. Emergency measures are needed to implement the protection, conservation, regeneration and sustainable management of this area. The degradations are amplified by the inappropriate modes of exploitation of this space subjected to animal pressure with a pastoral load exceeding the 6 sheep equivalents instead of the theoretical 0.5 (Benabdeli, 2000). It is in this context that this study is inserted for an evaluation of the potentialities of the different routes in the M'sila region, a region that is fairly representative of the entire Algerian steppe.

Materials and methods

The purpose of this work is to compare the pastoral potentialities induced by the different techniques of development and development of rangelands and to facilitate the judicious choice of species and techniques.

Characterization of the study area

The area of M'sila is pastoral, it covers an area of 939 km^2 and is characterized by a relatively flat relief, an arid Mediterranean-type bioclimate cold variant, the rainfall regime is AHPE type with precipitation annual averages of the order of 289 mm.

Observation stations and techniques

The evaluation of the pastoral potential was made on 8 zones characterizedby the presence of different techniques of development. At the level of each zone, 3 observation plots of 16 m^2 each were installed in a random distribution. At the level of each plot, 5 vegetation surveys were carried out to evaluate the pastoral potential of the different study areas and which are:

- A plantation of Atriplex canescens put in defens (zone of Tamzlite) located in the commune of Bouti Sayeh in the North-West of the chief place of the Wilaya of M'Sila; this area covers an area of 334 ha and has benefited from a pastoral planting program.

-Another plantation of unprotected Atriplex canescens (area of Dayate El Besbès) located in the commune of Sidi Hadjres in the North-West of the chief town of the Wilaya of M'Sila. This area has also benefited from a pastoral planting program (*Atriplex canescens*) covering an area of 700 ha. The area was not set aside and remained open to grazing.

-The other stations characterized by natural pastoral formations based on *Thymelaea microphylla, Salsola vermiculata, Artemisia herba alba* and *Anabasis articulata*.

Evaluation of the different parameters

The phytomass: its evaluation was made through three squares of 1 m^2 randomly chosen in homogeneous plots and arranged in transects where all the present vegetation was harvested. When dried in a press in a neutral blotting paper until total desiccation when stabilizing the weight; this biomass is weighed with a precision balance of 10 g.

The floristic richness: it is the global number of the species that the stand takes into account in a given ecosystem (Ramade, 1984). The scale of Daget and Poissonet has been selected (Raréfiée: <of 5 species, Very poor: from 6 to 10 species, Poor: from 11 to 20 species, Medium: from 21 to 30 species, Quite rich: from 31 to 40 species: Rich: from 41 to 60 species and very rich: from 61 to 75 species).

Biological forms: are the five life forms or biological types of Raunkiaer: phanerophytes, chamaephytes, hemicryptophytes, geophytes and therophytes.

Quantitative study: the floristic surveys were carried out by noting for each species its abundance-dominance coefficient according to the mixed scale defined by Braun-Blanquet (1957).

The recovery rate (GR): within each station, the measurement of the recovery is done with the naked eye, by estimating the percentage of soil covered by the vegetation.

The phytomass: it is an important indicator of the state of the pastoral resources, it is the content of dry matter which is measured for each square. Immediately after harvest the samples are weighed and put in an oven at 105 °C for 24 hours. The sample is weighed again. The phytomass is expressed as the weight of MS by the unit area. Course states are valued through five classes.

The value of 900 kg MS/ha is used as the limit between good and bad runs (B.N.E.D.E.R., 2007; Djaballah, 2008).

Evaluation of the pastoral value: the pastoral value can be deduced easily thanks to the linear analysis of the vegetation and the specific indices. This is obtained by multiplying for each species, its specific contribution (CSi) to the vegetative layer by its specific quality index (ISi) and then adding the results obtained for all the species, it was calculated by the formula next:

Vpi=0.1* (Σ CSi*ISi)*RGV/100 where Vpi: Pastoral value of the station; CSi: Specific contribution (in%); 0.1: Coefficient used for steppe; ISi: Specific index; GVR: Overall vegetation cover (in%).

Specific frequency (FSi): This is the ratio in (%) of the number (Ni) of times that the species (i) is met by the total number (N) of reading point. FSi=Ni/N × 100

Specific contribution (Csi): relative expression of the biomass, it is equal to the ratio of the specific frequency (FSi) to the sum of the specific frequencies of all the listed species, reported at 100 (Bouabdallah, 1992). CSi=(FSi/Σ FSi) × 100

The specific index or coefficient of value: each species is characterized by a specific quality index. This index varies from a scale of 0 to 10 estimated empirically. The minimum value (0) indicates the refusal or the toxicity and maximum (10) very highly palatable.

Pastoral productivity: the calculation of pastoral values is qualitative and does not lead to the animal burden, hence the need to correlate phytomasses calculated with pastoral values. In southern Oran the following relationship was adopted: Pr=6.74 × Vp+14.77 where Pr: Pastoral productivity of facies in UF/ha/year; Vp: Pastoral value.

Quantitative study: To get an idea about the spatial floristic distribution of the different studied pathways, an evaluation of the annual average of the various parameters studied.

Results and discussion

To make a comparison between the different courses studied. Surveys are treated by floristic richness and diversity on the one hand and pastoral productivity on the other.

Floristic composition

In all the studied stations, we have inventoried 51 species belonging to 16 families (Table 1) divided into 17 perennials and 34 ephemera.

Table 1. Inventoried species classified according to their families.

Boraginacées	*Echium sp*	Tourn.
	Moltkia ciliata	(forsk.)
Caryophyllacées	*Herniaria mauritanica*	Murbeck

	Spergularia diandra	(Guss.) Heldr.et Sart.
Chénopodiacées	*Atriplex canescens*	
	Atriplex halimus	L.
	Salsola vermiculata	L.
	Anabasis articulata	Moq.
Composées	*Nolettia chrysocomoides*	Cassini
	Asteriscus pygmaeus	Coss. et Kral.
	Chrysanthemum macrocarpum	Coss. et Kral.
	Chrysanthemum fuscatum	Desf
	Artemisia herba-alba	Asso.
	Atractylis sp	L.
	Atractylis cancellata	L.
	Atractylis serratuloides	Sieber.
	Atractylis flava	Desf
	Picris sp	L.
	Picris albida	(Ball.) M
	Koelpinia linearis	Pallas.
	Launaea sp	Cassini.
	Launaea resedifolia	M.
	Launaea spinosa	(Lam.)Boiss.
Cynarées	*Centaurea sp*	L.
Frankeniacées	*Frankenia thymifolia*	Desf.
Gentianacées	*Centaurium pulchellum*	(Sw.) Hayek.
Graminées	*Pennisetum sp*	Rich.
	Lygeum spartum L.	L.
	Phalaris minor	Retz
	Stipa retorta	Cav.
	Schismus barbatus	(L.)Thell.
	Festuca sp	L.
	Bromus sp	L.
	Hordeum murinum	L.
Labiées=Lamiacées	*Ajuga iva*	(L.) Schreb.
	Marrubium vulgare	L.
Légumineuses	*Argyrolobium sp*	Eckl. et Zey.
	Medicago laciniata	Mill.
	Medicago litoralus	Rohde.
	Astragalus spL.	L.
	Astragalus gombo	Coss. et DR.
	Astragalus sinaicu	Boiss.
Malvacées	*Malva aegyptiaca*	L.
Ombellifères=Apiacées	*Eryngium sp*	L.
	Bupleurum semicompositum	L.
	Thapsia garganica	L.
Plantaginacées	*Plantago sp*	L.
	Plantago albicans	L.
Primulacées	*Anagallis arvensis*	L.
Thyméléacées	*Thymelea microphylla*	Coss. et DR.
Zygophyllacées	*Peganum harmala*	L.

The spectrum of distribution of the number of plant species by the different botanical families shows that out of the 16 families surveyed; 07 families are represented by only one species (Cynaraceae, Frankeniaceae, Gentianaceae, Malvaceae, Primulaceae, Thymeleaceae, Zygophyllaceae) and the compound family has the highest number with 15 species, followed by

Gramineae with 08 species, Leguminosae 06 species and Chenopodiaceae 04 species, Umbelliferae 03 species, other families are less represented such as Boraginaceae; Caryophyllaceae; the Labiés; Plantaginaceae by 02 species. However, the families of Compounds and Grasses are the most dominant in all the stations studied.

The floristic richness: The floristic biodiversity, can be measured by the floristic richness (Daget, 1982, Daget and Poissonet, 1997). The floristic richness in arid zones depends essentially on the annual species, the conditions of the environment and the correlation of all these variables (climate, soil and exploitation) (Aidoud, 1989; Benaredj et al., 2010).

The total richness characteristic of the 08 stations gives us an idea of their floristic diversity (Table 2).

Table 2. The total wealth at the different stations studied.

	Landscaped paths				**Undeveloped courses**			
Stations	1	2	3	4	5	6	7	8
Number of family	9	9	6	3	8	5	3	8
Number of perennial species	10	7	4	2	4	3	2	5
Number of ephemeral species	10	21	6	2	5	3	2	6
Total richness	20	28	10	4	9	6	4	11

The analysis of the results of the floristic richness shows that there is a variation between the different stations. Indeed, we note that station 02 and station 01 are the richest stations with respectively 28 and 20 species followed by station 08, station 03, station 05 and station 06 with respectively 11, 10, 9 and 6 species. Finally comes station 04 and station 07 with 04 species.

In addition, the results obtained show us that the difference in numbers of annual plants is still greater in the developed than free travel stations, which confirms that the introduction of Atriplex canesens in the managed routes has improved the environmental conditions by the fixation of the sand which allows an important development of the annual species and consequently the improvement of the floristic richness (Table 2).

Stationary wealth: The stationary wealth of the flora of the different stations according to the Daget and Poissonet scale (1997) is summarized as follows: Station 1: Poor; Station 2: Medium: Station 3: Very poor; Station 4: Rare; Station 5: Very poor; Station 6: Very poor; Station 7: Rare; Station 8: Poor.

Biological forms

To determine the biological type of species, we used: New Algerian Flora (Quezel and Santa, 1962-1963), Flora of the Sahara (Ozenda, 1977). The biological types or life forms of the species express the form presented by the plants in a medium without taking into account their systematic membership. Biological types and biological spectrum were determined for all listed species (Table 3).

Table 3. Distribution of species by biological type.

Biological type	**Absolute frequency (FA)**	**Relative frequency (FR) en %**
Thérophytes	22	43.13
Chamaephytes	9	17.64
Hémicryptophytes	7	13.72
Géophytes	2	3.92

The composition of the global spectrum shows a predominance of therophytes (22 taxa, 42.13%) on other forms of life. This predominance of therophytes is explained by the availability of seeds in the soil; with the help of the rains, these will germinate. This therophytisation is a characteristic of the arid zones. Chammephytes and hemicryptophytes occupy roughly the same position with respectively 17.64 and 13.72%. Geophytes are represented by two species which are: Lygeum spartum and Stipa retorta. Danin and Orshan (1990) in Aboura (2006) find greater proportions in geophytes.

Abundance-dominance of plant species

The results obtained are summarized in the following Table 4.

Table 4. Abundance-dominance of plant species.

Stations	**Species**	**Abundance**
1	*Atriplex canescen*	3
	Salsola vermiculata	2
	Atractylis cancellata.	2
	Atractylis serratuloides	2
	Ajuga iva	1
	Peganum harmala	3
2	*Echium sp*	+
	Spergularia diandra	3

	Anabasis articulata	2
	Atriplex canescens	1
	Salsola vermiculata	1
	Artemisia herba-alba	3
	Atractylis cancellata.	1
	Stipa retorta	2
	Hordeum murinum	1
	Plantago albicans	+
	Peganum harmala	+
3	*Chrysanthemum fuscatum*	1
	Chrysanthemum macrocarpum	+
	Atractylis sp	2
	Atractylis flava	2
	Launaea resedifolia	+
	Centaurium pulchellum	+
	Stipa retorta	+
	Eryngium sp	3
	Thymelaea microphylla	3
4	*Atractylis sp*	2
	Atractylis flava	2
	Thymelaea microphylla	4
5	*Atriplex halimus*	2
	Atractylis flava	2
	Marrubium vulgare	2
	Eryngium sp	2
	Plantago albicans	1
	Thymelaea microphylla	3
	Peganum harmala	2
6	*Artemisia herba-alba*	2
	Malva aegyptiaca	1
	Thymelaea microphylla	1
	Peganum harmala	5
7	*Anabasis articulata*	2
	Artemisia herba-alba	2
	Asteriscus pygmaeus	2
	Plantago albicans	1
8	*Spergularia diandra*	2
	Anabasis articulata	4
	Artemisia herba-alba	1
	Centaurea sp	2
	Frankenia thymifolia	1
	Stipa retorta	1
	Plantago albicans	1
	Peganum harmala	2

The study of diversity across the Braun-Blanquet scale shows floristic variations between the different stations, in fact the results obtained are processed by station:

The analysis of the results obtained indicates that the station 01 based on *Atriplex canescens* is represented by 06 plant species which are divided into 3 categories whose dominance of two species; *Atriplex canescens* (the introduced species), *Peganum harmala*, which are ranked at scale 3, whose abundance exceeds 27%.

Station 02 based on Atriplex canescens is characterized by the dominance of two species; Spergularia diandra and *Artemisia herbaalba* ranked at scale 3, the minimum is recorded for *Echium sp*, *Plantago albicans* and *Peganum harmala* are ranked at (+) scale. The rest they have notes of 1 and 2 of the abundance dominance scale.

Station 03, is dominated by the presence of *Salsola vermiculata* and *Thymelaea microphylla* with a dominance coefficient of abundance 3, are the most abundant and dominant species, thus constitute very large steppes homogeneous, then come the two plant species *Atractylis sp* and *Atractylis flava*, ranked at scale 2. The other species are ranked at scale 1 and (+) with very low recovery rate.

Station 4 shows that *Thymelaea microphylla* is the most abundant and dominant species that contributes more than 70% (Appendix 04), which allows it to record grade 4; *Atractylis sp* and *Atractylis flava*; they have a rating of 2 on the abundance ability scale with respectively 18.07% and 11.86% of the recovery rate.

Indeed we note that station 05 is characterized by a strong presence of scale 2 for 5 species (*Atriplex halimus, Atractylis flava, Marrubium vulgare, Eryngium sp* and *Peganum harmala*); followed by *Plantago albicans* with a score of 1 from the Abundance Abundance Ladder.

At station 06, *Peganum harmala* is the most dominant plant, which gives them a score of 5 which contributes more than 87%, the other species are ranked at scale 2 and 1 with very low recovery rates. . According to Nedjraoui et al. (1999) cited by Aboura (2006) "the appearance of units of *Peganum harmala*, indicates an overgrazing and shows the extent of the anthropozoic action".

Station 07, the minimum is recorded for *Plantago albicans* affected by note 1. The other species are classified at scale 2 with 18% recovery rate, which constitutes a homogeneous steppe.

In the unmanaged station 08, it appears very significantly that *Anabasis articulata* is the most dominant plant with a recovery rate of about 58.61%, which allows it to record the note 4 of the scale of abundance dominance. The other species are ranked at scale 2 and 1 with low recovery rates.

The recovery rate

The results obtained by the recovery analysis are presented in the following Table 5:

Table 5. Average overall recovery for surveyed stations.

	Landscaped paths				**Undeveloped courses**			
Stations	1	2	3	4	5	6	7	8
Recouvrement Global en (%)	45	43	33	75	15	5	5	10

The highest average overall recovery is observed in rangelands with an average of 49%; in station 3 *Bromus sp.* alone covers 75%. Vegetation in undeveloped areas averages only 9% at most. The plantations and the defenses make it possible to increase the global recovery and constitute means of improvement of the pastoral potentialities.

Evaluation of the phytomass

The average values of the phytomass of the different stations are summarized in Table 6.

Table 6. Average values of the phytomass of the different stations.

Stations	**Fraiche material phytomass (kg/ha)**	**phytomass MS kg/ha**
1	184.079	115.77
2	778.9	722.3
3	335	236.1
4	172.3	120
Average landscaped resorts	367.56	298.54
5	35.6	13.03
6	2	1.3
7	38.3	10.4
8	19	8.8
Average undeveloped resorts	23.72	8.38

The results of the phytomass obtained in the various stations also confirm the importance in the rangelands developed phytomass in this type of course fluctuates between 115.77 and 722.3 kg MS/ha. In undeveloped courses, however, the fluctuation remains very low, between 1.3 and 13.03. In this section, Bourbouze and Donadieu (1987) report that stands of Atripiex halimus have advantages in arid zones such as the recovery of heavy soils, the fixation of marly erosion barriers, cold resistance, energy richness and Protein, excellent complementary forage for late summer-early fall.

The pastoral value (VP)

It gives an overview of the quality of the pastures and the results obtained in the different stations studied and grouped in table 08 show once again that the rangelands offer the best pastoral values (Table 7).

Table 7. The pastoral value of the various stations studied.

	Landscaped paths	**Undeveloped courses**

Stations	1	2	3	4	5	6	7	8
Pastoral value	13.48	17.28	23.86	8.82	1.028	0.7	0.68	1.47

It is important to underline the great difference in the pastoral value recorded between the different stations, it is justified by the contribution of the species having a large forage input in the developed stations.

Pastoral productivity

The pastoral productivity of the various stations studied are grouped in the following Table 8.

Table 8. The pastoral productivity of the various stations studied.

	Landscaped paths				**Undeveloped courses**			
Stations	1	2	3	4	5	6	7	8
Productivité UF/ha/an)	105.68	131.26	175.63	74.23	21.7	19.49	19.4	24.7

The pastoral productivity of the improved stations is always higher than that of the unmanaged stations. where The maximum is recorded in station 2 with 131.26 UF/ha and the minimum for station 4 (74.23 UF/ha). On the other hand, at the level of undeveloped rangelands, productivity varies between 21.70 and 19.40 UF/ha.

Conclusion

The results obtained in the 8 stations make it possible to emphasize that there is a relationship between all the studied parameters and in particular the strong relation between the overall recovery rate of the rangelands and the floristic richness. It is the same for phytomass, hence the importance of planting forage species in arid zones in order to increase the rate of soil cover and therefore to fight against silting and erosion and to provide feeding to sheep flocks with an average load exceeding 2 sheep equivalents per hectare.

The results obtained also made it possible to quantify the main positive impacts of pastoral development projects on both the floristic composition, the vegetation cover and the pastoral characteristics of certain steppe plant formations in the M'sila wilaya. The floristic study emphasizes the floristic diversity with 51 species: (17 perennials and 34 ephemera) induced by the planting of Atriplex canescens.

The quantitative study showed a gradual evolution of recovery at the level of the managed courses resulting in an appreciable phytomass reaching in one case 720 kg MS/ha and 122 UF/ha, enough to meet the feed requirements of livestock and reduce overload on the vegetation.

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