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Evaluation of Characteristics Floristico-Edaphic of the Steppes at Alfa (*Stipa tenacissima* L.) in the Saida Region (Western Algeria)

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Abstract

To establish an assessment of floristic and edaphic characteristics of steppe formations we conducted a phytoecological study on a local scale by comparing the current plant diversity and soil in three (3) stations representative of the vegetation to alfa (*Stipa tenacissima* L.) located south of Saida (western Algeria). The relations between the station, the vegetation and the characteristics of soils in the steppe are very imperfectly known. This study intends to analyze the relationship between floristic composition and edaphic parameters of the steppe at alfa. Anthropogenic pressures on plant structure are different imbalance resulting in one ecological. The floristic and edaphic data have been the subject of a factorial correspondence analysis (A.F.C). The floristic inventory denotes a regressive dynamics of the formations at alfa passing from one site to another. Thus 39 plant species have been inventoried in the site in good condition, against 26 species for the moderately degraded site and 16 species only for the damaged site. The coupled results between species and edaphic parameters show the relations between the plant diversity and the physico-chemical characteristics of the soils. The statistical analyses do appear a strong correlation between floristic composition, the state of vegetation and the edaphic parameters.

Keywords

Evaluation, Steppe, *Stipa tenacissima* L., Soil Analysis, Plant Diversity

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1. Introduction

Steppe plant formations of North Africa are the result of the combined action of climatic factors and old and moderate anthropogenic pressures. The agro-sylvo-pastoral balance observed during the latter centuries has been broken in recent years by growing demographic pressure and changes in production systems (extensive sheep rearing and mechanized agriculture).

Abdelguerfi and Laouer [1] found that, for several years, in the countries of the Maghreb an agro-sylvo-pastoral imbalance settled and manifested itself by a degradation of the pastoral and forest potential.

In Algeria the steppe regions represent 9% of the territory and are real areas of steppe rangelands. Their population is composed mainly of pastoralists [2]. In 1971, the works of Le Houérou [3] showed that the steppe of Algeria was satisfactory and their perennial aboveground phytomass was of the order of 800 to 1500 kg MS/ha (dry mass per hectare) between 1950 and 1970. The same author noted in 1985 that perennial biomass was less than 200 kg MS/ha and the islets of degradation had became jointifs and covered considerable expanses.

The phenomenon of degradation of the steppe formations, found that there was a 40-year, trained more and more alarming desertification and translated on the ground by a modification of the component of the ecosystem (flora, fauna, soil and its elements, habitats) [3]-[5].

The further restructuring of the Algerian steppe area in recent years was characterized by the development of agglomerations and the sedentarization of nomads in a fragile space. The highlands territories have been occupied by tens of thousands of people; there is barely more than a century and currently this is occupied by several million people. These changes have the most disturbing ecological consequences [6] [7]. The former pastoralists and occasional farmers have become one of the workings of the economy of the country [8] [9]. The degradation of the steppe spaces is mainly due to the increase of livestock and overgrazing. The increase of the population and extensive farming has harmful consequences on the future of natural resources already weakened by climate pejorations.

These socio-cultural changes are accompanied by important qualitative and quantitative changes aboveground phytomass following a decrease and/or disappearance of species with good pastoral values [10], leaving room for species not palatable (spiny or toxic species) [11] [12]. It appears that overall pastoral production in these rangelands is marked by a very significant decline. Rapid and intense changes have been remarked in these areas under the growing demand of the people.

Given the degradation of these natural ecosystems, phytomass distribution seems to be linked to certain soil parameters (particle size, organic matter, pH, electrical conductivity, depth). These parameters have been studied, particularly for soil-vegetation relationships in the steppe [13]-[17]. In the wilaya of Saïda the rangelands extend over an area of 163,063 ha and are representing a total area of 24.1% and are located in the municipalities of Moulay Larbi, Sidi Ahmed, Maamoura and Skhouna. There are four types of steppe rangelands: *Stipa*, *Artemisia*, *Atriplex* and salsolaceae [18].

To identify the dynamics of vegetation and edapho-resources we have inventoried the flora and evaluated the characteristics edaphic relating to perimeters of alfa (*Stipa tenacissima* L.) located in the municipality of Mâamoura (south of Saïda). This work fits in tracking the physiognomy change of natural ecosystems exposed to anthropogenic stress on one hand and the relationship between the degradation of the site to *Stipa* on the other hand.

2. Materials and Methods

2.1. Physical Layout and Choice of Stations

The study area is located in the southern part of the wilaya of Saïda (western Algeria). It is naturally limited by a series of Djebel oriented north to northeast with Djebel Sidi Youssef (1338 m) and Djebel Harchoune (1259 m). These mountains are arranged in a southwest and north and are bowing to the south in the direction of high steppe plains (**Figure 1**).

The human impact on ecosystems in the study area is quite contrasting. Thus the choice of stations was motivated by the persistence at alfa locally little or not damaged. This physiognomic descriptor has allowed us to identify tree stations (**Table 1**):

1) Perimeter at alfa in good condition (Site 1) = A.B.V;
2) Perimeter to moderately degraded at alfa (Site 2) = A.M.D;
3) Perimeter at alfa damaged (Site 3) = A.D.

Table 1. Characteristics of the study sites.

		A.B.V	A.M.D	A.D
Geographic coordinates		0˚35'28"W, 34˚41'11"N	0˚36'19"W, 34˚40'9"N	0˚36'15"W, 34˚59'1"N
Description of the stations	Average recovery rate	50% - 70%	30% - 50%	Less than 30%
	Average height of the tufts at alfa	60 cm	30 cm - 60 cm	Less than 30 cm
Average altitude			1100 metres slope: 2% to 5%	
Climate		• Mediterranean climate dry and hot summer season and winter rainy, cool and cold; • Rainfall accumulation of last two decades is between 81.5 mm and 356 mm/yr [12]; • Seasonal pattern: HAPE; • Frost days: 37 (from December to March); • Sirocco days: 11 (from May to August); • Bioclimate: arid than cold variant.		

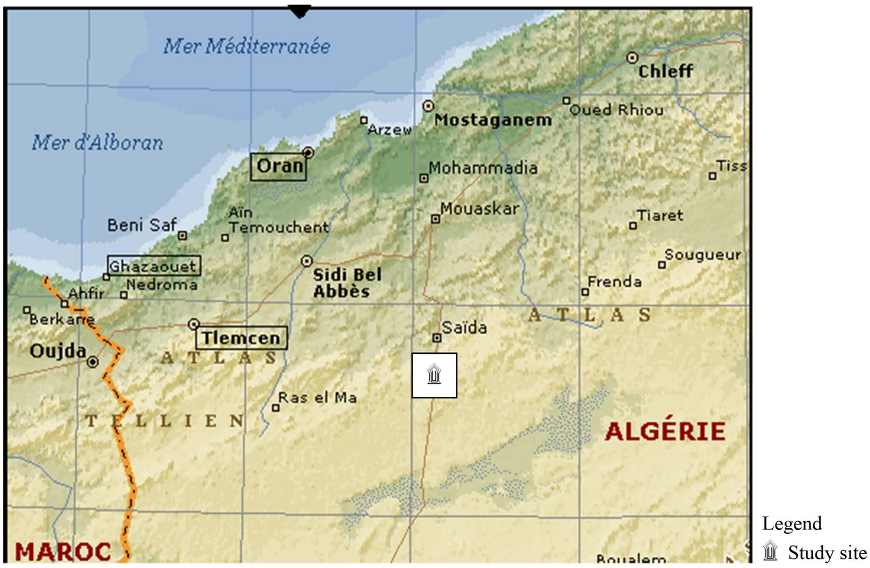

Figure 1. Location of the study area.

These three stations are representative of steppe rangelands. In each of these formations ten floristic surveys related to ten soils were made.

2.2. Study Methods

2.2.1. Study of the Vegetation and Soil

The approach used to study vegetation has adapted to the characteristics of the steppe formations whose stands are discontinuous. We've made 10 floras by station surveys during the good phenological time. The surface of records must be sufficient to understand the maximum of plant and floristically homogeneous species [19] [20]. An area of 400 m^2 was chosen deliberately to our sampling. Inventory of vegetation was made based on the stigmatic abundance-dominance of Braun-Blanquet method [21].

The soil survey approach is based on 10 samples of soil by site. Each sample of soil was associated with a floristic survey and the vegetation (A.B.V; A.M.D and A.D). Soil samples have been made at the level of the rhizosphere of subjects to alfa.

The edaphic variables are measured on fine soil (less than 2 mm) and are as follows: granulometric analyses; pH, conductivity electrical (CE), total limestone (Ct, %), active limestone (Ca, %) and the organic matter (Mo) of a hand and the depth (Pr) of the profile to the limestone crust on the other.

2.2.2. Data Processing

To explain the links between vegetation and edaphic parameters we confronted the different results using at A.F.C. This approach allows highlighting the correlations between plant data and the parameters of the studied soil [22] [23]. Plant species have been treated in presence-absence.

Digital processing was performed using the Minitab Version 15 Software.

3. Results and Discussion

3.1. Analytical Results of Soil

3.1.1. Grading Results

The granulometric results obtain in laboratory are transferred on the diagram of textures, this allowed us to classify sites sampled. **Table 2** reflects the most significant results.

The results obtained show a fairly divided composition. On site A.D the amount of clay is reduced, it is between 5.2% and 10.3% and for the other sites it oscillates between 10.3% and 20.6%. As silt, measurements vary between 08.2% and 29.5% for A.M.D; 25.8 to 29.3% for the A.D and 28.1% to 42.8% for A.B.V. The percentage of the sands is important in three sites. The measures range from 60.3 and 71.3% for A.D and A.M.D sites however the A.B.V site presents a moderate percentage (values between 46.9 and 51.3%). Our results from the fraction of clay from the site 3 confirm the results of Trabut [24]. However we note that in degraded and/or degraded places the percentage of clay is low. The role of the latter is to establish links between the elementary particles of the soil or with many substances (ions, organic molecules, water).

3.1.2. Physico-Chemicaly Results of the Soils Studied

The results are grouped in **Table 3**.

The Analyses show a clear difference of Mo content from one site to another (A.B.V; A.M.D and A.D). Despite a grade of 0.91 per cent on average of Mo for A.B.V; it remains too low. According to estimates by Pouget [13] and Djebaili [15] the Mo average is 1% - 2% for steppe soils. As for the other sites (A.M.D; A.D) the values in Mo are respectively 0.5% and 0.3%.

Also we note a clear difference between the Pr of sites profiles. The global average of Pr of soil is 16 cm for A.B.V; 9.7 cm for A.M.D and 5.4 cm for the A.D. These values show a regression of Pr of soils and their truncation are net.

The rate of Ca is roughly equal in the three sites; it is 2.33% to 2.58% for A.B.V; 2.30% to 2. 83% for A.M.D and 2.05% to 2.73% for A.D.

The CE is close in the three sites, it oscillates respectively: 0.3 to 0.7 mmhos for A.B.V; 0.2 to 0.9 mmhos for A.M.D and 0.1 to 0.6 mmhos for A.D.

3.2. Analysis of Vegetation

The species inventoried using the keys Quézel and Santa [25] are grouped in **Table 4**. Species were coded and their calculated frequencies of occurrence. 39 species have been recorded in A.B.V, against 26 sp. for A.M.D and only 16 sp. for A.D.

Table 2. Results of granulometric analyses of the studied soils.

	Clays **(%)**	***Silt*** **(%)**	***Sands*** **(%)**	**Texture**
	15.5	35.1	49.4	Silty
A.B.V	20.6	28.1	51.3	Silty
	10.3	42.8	46.9	Silty
	10.3	29.5	60.3	Silty-sandy
A.M.D	15.5	20.6	63.9	Silty-sandy
	20.6	08.2	71.3	Silty-clayey-sandy
	10.3	29.3	60.4	Silty-sandy
A.D	10.3	27.3	62.4	Silty-sandy
	5.2	25.8	69.1	Silty-sandy

Table 3. Analytical results of the studied soils.

Site of vegetation	N survey	pH	pH KCl	CE mmhos	Ct%	Ca%	Mo%	Pr cm
A.B.V	R 1	8.2	8.4	0.6	4.9	/	1.1	20
	R 2	7.9	7.7	0.3	6.5	2.53	0.9	14
	R 3	8.4	8.1	0.3	2.4	/	1.3	14
	R 4	8.2	7.9	0.4	7.9	2.48	0.7	15
	R 5	8.7	7.9	0.5	6	2.45	0.8	15
	R 6	8.4	7.5	0.7	7.1	2.36	1	14
	R 7	8.7	7.9	0.4	8.1	2.58	0.6	15
	R 8	8.5	8.4	0.3	5.6	2.33	0.7	14
	R 9	8.4	7.8	0.4	5.8	2.45	0.5	15
	R 10	8.1	7.9	0.4	8.4	2.38	1.1	19
A.M.D	R 1	8.5	7.9	0.4	9.7	2.41	0.9	10
	R 2	8.2	7.8	0.8	7.9	2.30	0.4	11
	R 3	8.4	8.1	0.8	8.1	2.83	0.6	9
	R 4	8.4	8.2	0.3	7.6	2.64	0.8	10
	R 5	8.3	7.8	0.8	7.6	2.31	1.1	11
	R 6	7.9	7.9	0.3	8.1	2.61	0.3	9
	R 7	8.4	7.9	0.2	7.1	2.63	0.4	8
	R 8	8.3	7.8	0.9	8.4	2.65	0.4	11
	R 9	8.4	8.0	0.7	8.4	2.63	0.2	11
	R 10	8.6	8.3	0.4	9.2	2.38	0.5	9
A.D	R 1	8.5	8.3	0.3	8.3	2.58	0.4	5
	R 2	8.7	8.3	0.1	11.6	2.71	0.3	7
	R 3	8.6	7.9	0.3	8.4	2.65	0.5	5
	R 4	8.7	8.7	0.4	8.6	2.72	0.2	6
	R 5	8.6	8.3	0.6	10.1	2.05	0.5	7
	R 6	8.6	8.4	0.4	7.1	2.65	0.2	7
	R 7	8.7	8.0	0.5	9.9	2.73	0.4	6
	R 8	8.8	8.2	0.4	7.1	2.35	0.1	3
	R 9	8.7	8.2	0.5	9.1	2.58	0.3	6
	R 10	8.4	8.1	0.4	7.1	2.61	0.2	5

The comparative analysis of the frequencies and taxa shows the disappearance of many species along an anthropogenic gradient. Some species have adapted to the pressures and their frequencies have practically not changed (*Poa bulbosa*, *Noaea mucronata*, *Astragalus incanus*, *Bromus rubens*, *Hordeum murinum*); others have seen their increased frequency (*Avena sterilis*, *Muscari comosum*, *Paronychia argentea*, *Peganum harmala*, *Senecio flavus*, *Artemisia herba alba*) and others have disappeared (**Table 4**). We have noted the appearance of a species in A.D (*Helianthemum virgatum*).

Table 4. List of species and their frequencies in the study sites.

Plant species	Code	A.B.V frequency	A.M.D frequency	A.D frequency	Trend
Stipa tenacissima	stte	0.8	0.5	0.4	↘
Poa bulbosa	pobu	0.7	0.7	0.6	→
Stipa parviflora	stpa	0.7	-	-	Disappearance
Alkanna tinctoria	alti	0.6	0.5	-	Disappearance
Astragalus sesameus	asse	0.6	0.5	-	Disappearance
Bassia muricata	bamu	0.6	0.4	0.3	↘
Diplotaxis virgata	divi	0.6	0.6	-	→
Erucaria uncata	erun	0.6	-	-	Disappearance
Muricaria prostrata	mupr	0.6	-	-	Disappearance
Noaea mucronata	nomu	0.6	-	0.5	→
Schismus barbatus	scba	0.6	0.6	0.3	↘
Scorzonera undulata	scun	0.6	0.5	-	↘
Senecio vulgaris	sevu	0.6	-	-	Disappearance
Astragalus incanus	asin	0.5	0.5	0.6	→
Avena sterilis	aval	0.5	0.5	0.8	↗
Bromus rubens	brru	0.5	0.6	0.6	→
Centaurea pungens	cepu	0.5	0.4	-	Disappearance
Eruca vesicaria	erve	0.5	0.4	0.6	↗
Hordeum murimum	homu	0.5	0.6	0.5	→
Astragalus armatus	asar	0.4	0.7	-	Disappearance
Helianthemum lippii	heli	0.4	-	-	Disappearance
Helianthemum pilosum	hepi	0.4	0.4	-	Disappearance
Iris sisyrinchium	irsi	0.4	-	-	Disappearance
Ornithogalum pyramidale	orpy	0.4	-	-	Disappearance
Reseda lutea	relu	0.4	-	-	Disappearance
Salvia verbenaca	save	0.4	-	-	Disappearance
Saponaria glutinosa	sagl	0.4	0.4	-	Disappearance
Chrysanthemum coronarium	chco	0.3	-	-	Disappearance
Erucastrum leucanthum	erle	0.3	0.3	-	Disappearance
Marrubium vulgare	mavu	0.3	-	-	Disappearance
Matthiola livida	mali	0.3	0.3	-	Disappearance
Muscari comosum	muco	0.3	-	-	Disappearance
Paronychia argentea	para	0.3	0.6	0.5	↗
Peganum harmala	peha	0.3	0.5	0.7	↗
Senecio flavus	sefl	0.3	0.3	0.7	↗
Artemisia herba alba	arhe	0.2	0.3	0.3	↗
Ferula communis	feco	0.2	0.5	-	Disappearance
Herniaria hirsuta	hehi	0.2	0.4	-	Disappearance
Micropus bombicinus	mybo	0.2	0.5	0.5	↗
Helianthemum virgatum	hevi	-	-	0.4	Appearance

The arrow refers to the tendency of the plant (evolution or regression).

This analysis shows a decline of plant biodiversity and the physiognomy of the route to alfa is changing. Taxas them toxic and/or thorny replace taxas them appetables and aboveground biomass is in clear regression.

3.3. Relationships Factors Soil-Vegetation

The interdependence of the parameters studied (floristic surveys and their edaphic values) is represented in Figure 2 and Figure 3. Floristic surveys, edaphic factors and plant species are represented by symbols accompanied by their coding (Table 4).

Analysis of factorial:

The study of factorial 1-2, 1-3 and 2-3 shows significant variations, including those of edaphic factors, are organized according to axis 1 that represents the highest contribution (0.344 for axis 1; 0.222 for axis 2 and 0.155 for axis 3).

1-2 and 1-3 plans that will be represented and discussed contain most of the statistical information.

Plan 1-2 (Figure 2):

Records are ordered according to axis 1, which corresponds to a gradient of degradation, from A.B.V in the positive part to A.D in contrast, with A.M.D intermediate position. The edaphic point of view, the point cloud is highly structured for the Ct, the Pr and the Mo. High Ct (Ct3) levels correspond to A.D site which is also characterized by a low Pr (Pr1) and the lowest rate in Mo (Mo1).

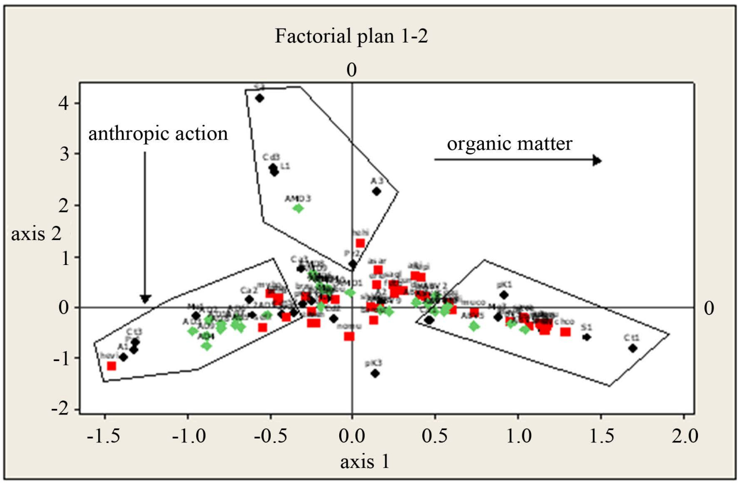

Figure 2. Factorial plan 1-2.

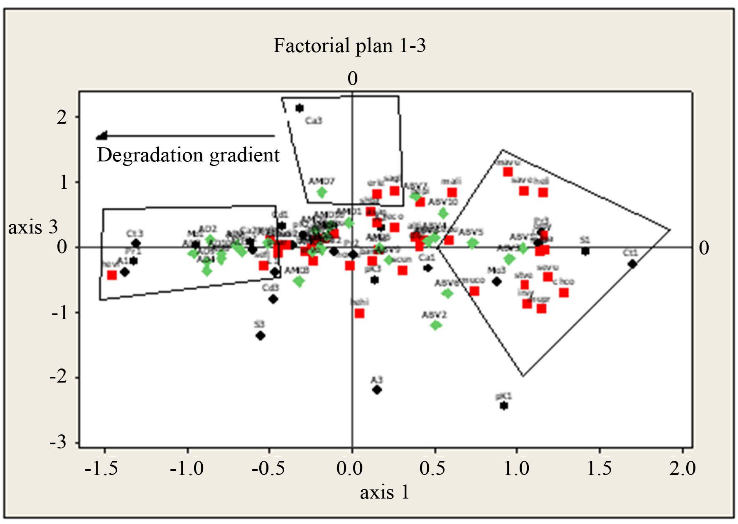

Figure 3. Factorial plan 1-3.

Interpretation of the axes:

Axis 1: Parameters edaphic Ct1, S1, Mo 3, Pk1, Pr 3 and L3 are well correlated and lie side axis 1 positive. The negative are: A1, Ct3, Pr1, Mo1, A2 and L2. Axis 1 is characterized by Mo and the negative Pr gradients toward the positive pole.

On the floristic map the species that are found side positive and are associated with edaphic (Ct1, S1, Mo 3, Pk1, Pr 3 and L3) parameters are as follows: *Helianthemum lippii*, *Chrysanthemum coronarium*, *Stipa parviflora*, *Muricaria prostrata*, *Senecio vulgaris*, *Marrubium vulgare*, *Salvia verbenaca*, *Ornithogalum pyramidale*, *Matthiola livida*, *Centaurea pungens*, *Muscari comosum*, *Iris sisyrinchium*, *Eruca vesicaria* et *Reseda lutea*. These taxa represent a facies at alfa in good condition (A.B.V).

The side negative of the axis is marked by the presence of the following species: *Helianthemum virgatum*, *Senecio flavus*, *Micropus bombicinus*, *Avena alba*, *Peganum harmala* and *Paronychia argentea*. These species are associated with the following soil parameters: A3, Ct3, Pr1, L2 and Mo1 (**Figure 2**). These indicators both floristic and edaphic indicate us a regression of vegetation and the physiognomy of the alfa facies is A.D.

Axis 2: On the positive side we find the following soil parameters: S3, L1, A3, Pr2 and Cd3. These parameters have a great affinity with A.M.D. A single species seems marked this facies is *Herniaria hirsuta*. The edaphic parameters: A1, Pr1 and Ct 3 strong and are in opposition with S3, Cd 3 and L1.

Plan 1-3 (Figure 3):

It completes one given by the 1-2 plan. It may be noted, in addition to information from plan 1-2 (axis 1), that *Erucaria uncata* and *Astragalus sesameus* A.B.V-related and occur side axis 1 positive. The negative axis 1 *Helianthemum virgatum*, *Senecio flavus* and *Paronychia argentea* have an affinity with A1, Pr1, and Ct3 characterize A.D.

Axis 3: *Saponaria glutinosa*, *Erucastrum leucanthum* and *Schismus barbatus* species show some affinity characterized by a spatial proximity on the factorial and A3 side positive and negative axis 3 *Herniaria hirsuta* with A3 side.

Analysis of plan 1-3 confirmed evolutionary gradient of the vegetation and the soil depth. The edapho-flora combinations show the existing affinities between different parameters considered in the studied facies types (**Figure 3**).

4. Conclusions and Recommendations

The strong climate-anthropogenic impact causes the disruption of ecosystems at alfa in the Algerian highlands. The residuals pockets at alfa observed in the region of Saida are threatened with extinction. One of these, used as control, allows studying the influence of damage anthropozoogenes on the floristic composition and some soil parameters of the two neighbouring sites, respectively moderately degraded and seriously affected.

The combination of floristic and edaphic data by the A.F.C highlights a degradation gradient associated with the floristic composition and three major soil variables: the depth of the soil, organic matter and the rate of total limestone.

The vegetation is mainly affected by a regression of the floristic richness that passes of 36 species for the control (A.B.V), 26 species for A.M.D and only 16 species for A.D (the more degraded stage). This regressive evolution translates into a decrease in the aboveground phytomass, a regression and an endangered species. We noticed the individualisation of a species (*Helianthemum virgatum*) in the more altered site. This dynamic causes a change in the appearance of the steppes with mainly the installation of a poor ecosystem herbal thorny and/or toxic (*Peganum harmala*, *Ferula communis*, *Paronychia argentea*, *Senecio flavus*, *Micropus bombicinus*).

Degraded stage is marked by a truncation of the soil, intense erosion which translates into a low depth, a small amount of organic matter and a high total limestone rate.

Edaphic and floristic data indicate unambiguously and convergently double erosion of natural resources (soil and biological). The trampling of livestock, the low recovery of the vegetation, the reduced structural stability of soils in an arid climate can causing a significant erosion by rain water or wind. Physico-chemical changes in soils and plant physiognomy induce a scarcity of biological potential. The dunes that are observed on the highlands are witnesses on these phenomena, and the situation calls for immediate measures of protection and restoration of the steppe ecosystems. This must involve the creation of a seed bank on one hand and a biological study of the species that structuring the steppes on the other hand.

References

[1] Abdelguerfi, A. and Laouer, M. (2000) Impact of Changes on the Genetic Resources of the Maghreb. *Review Option Mediterranean*, **39**, 77-87.

[2] Nedjraoui, D. and Bedrani, S. (2008) Desertification in the Algerian Steppes. Causes, Impacts and Actions to Fight. *Review Electronic Environmental*, **8**, 1-15.

[3] Le Houerou, H.N. (1985) Regeneration Algerian Steppe. Mission Report of Consultation and Evaluation. Ministry of Agriculture Algiers, 37 p.

[4] Aidoud, A. and Touffet, J. (1996) Regression of Alfa (*Stipa tenacissima* L.), Perennial Grass, an Indicator of Desertification the Algerian Steppe. *Sécheresse*, **7**, 187-193.

[5] El Zerey, W., Bouiadjra, S.E.B., Benslimane, M. and Mederbal, K. (2009) The Steppe Ecosystem to Desertification: The Case of El Baydh Region—Algeria. *Vertigo*, **9**. http://vertigo.revues.org/8821

[6] Boucheta, T. and Boucheta, A. (2005) Degradation of Steppe Ecosystems and Sustainable Development Strategy. Development of a Methodology Applied to the Province of Nâama (Algeria). *Sustainability and Territories Journal*. http://developpementdurable.revues.org/1339

[7] Hadeid, M. (2006) The Spatial Changes and Social Space in Steppe. For Upper Southeastern Plains of Oran (Algeria). Thesis, University Franche-Comte, France.

[8] Boukhobza, M. (1976) Nomadism and Colonization Analysis of the Mechanisms of Disintegration and Dispersion of Traditional Pastoral Society in Algeria. Thesis, Paris.

[9] Couderc, R. (1979) Geography and Development: The High Steppes South of Oran. Ph.D. Montpellier III, France.

[10] Floret, C., Le Floc'h, E., Pontannier, R. and Romane, F. (1981) Dynamics of Ecological Systems of the Arid Zone. Application Development on Ecological Foundations of an Area of the Pre-Saharan Tunisia. *Acta Oecologica. Oecologia Applicata*, **2**, 195-214.

[11] Kadi-Hanifi, H. (1998) Alfa in Algeria: Syntaxonomie, Vegetation-Environment Relationship, Dynamic and Forward-Looking. Ph.D. Thesis, USTHB.

[12] Hasnaoui, O., Borsali, A.H. and Benaredj, A. (2014) Some Aspects of the Dynamics of Steppe Formations of South Oran (Western Algeria). *Proceedings of the* 2nd *International Conference of Plant Biodiversity*, 27-29 March 2014.

[13] Pouget, M. (1980) The Relation Soil-Vegetation in South Algiers Steppes. Ph.D. Thesis, Aix-Marseille III University, Marseille.

[14] Aidoud, A. (1983) Contribution to the Study of Steppe Ecosystems of South Oran: Plant Biomass, Primary Productivity and Pastoral Application. Thesis, University of Sciences and Technology Houari Boumediene, Algiers.

[15] Djebaili, S. (1984) Algerian Steppe: Phytosociology and Ecology. Odessa Polytechnic National State University, Algiers.

[16] Benabadji, N. (1995) Phytoecological Study of the Steppes at *Artemisia herba alba* Asso and *Salsola vermiculata* L. in South Sebdou (Oran, Algeria). Ph.D. Thesis, University of Tlemcen, Tlemcen.

[17] Bouazza, M. (1995) Phytoecological Study of the Steppes at *Stipa tenacissima* L. and *Lygeum spartum* L. in South Sebdou (Oran, Algeria). Ph.D. Thesis, University of Tlemcen, Tlemcen.

[18] Henni, M. (2014) Spatio-Temporal Evolution of Vegetation and Soil in *Atriplex canescens* and Role of the Species in Improving Feed Provides Degraded Steppe Rangelands of the Wilaya of Saida (Western Algeria). Ph.D. Thesis, Djillali Liabes University of Sidi Bel-Abbes, Algeria.

[19] Guinochet, M. (1973) Phytosociology. Masson et Cie Edit., Paris.

[20] Long, G. (1974) Phytoecological Diagnostic and Planning. I. General Principles and Methods. Masson and Cie, Paris.

[21] Braun-Blanquet, J. (1951) Pflanzensoziologie. 2nd Edition, Springer, Vienne, 631 p.

[22] Cordier, B. (1965) The Correspondence Analysis. Thesis, Université de Rennes, Rennes, 66 p.

[23] Godron, M. (1984) Ecology of Terrestrial Vegetation. Masson and Cie, Paris.

[24] Trabut, C.L. (1887) D'Oran at Méchéria. Botanical Notes and Catalog Remarkable Plants. Algiers, 36 p.

[25] Quézel, P. and Santa, S. (1962) New Flora of Algeria and the Southern Desert Regions. CNRS, Paris.