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# EFFECT OF NEGATIVE HUMAN ACTIVITIES ON PLANT DIVERSITY IN THE JABAL AKHDAR PASTURES

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**Abstract:** The limited natural resources in several of pastures regions of the southern Mediterranean are threatened by rapid development and a growing human population. Inhabitants are faced with shrinking livestock grazing grounds and consequent overgrazing, depleting water supplies, loss of soil fertility, moving sand dunes, and salinisation of agricultural land. Libya is most of its area is considered arid and semi-arid. Like other zones in the North Africa it has suffered extreme degradation. This is mainly due to overgrazing, fires or sometimes converting pastures areas to agricultural uses. In general, the negative human activities like overgrazing in Libya is not a new phenomenon especially in the Jabal Akhdar regions. The aim of this study was to investigate the effects of negative human activities on the biological diversity have been investigated using the Shannon-Wiener diversity index in south of the Jabal Akhdar. The study area is located in North Eastern part of Libya. Based on data from extensive field surveys, were carried out in the study during 2014, included the grazed and protected by fencing. This study showed that different significant diversity between the grazed and protected by fencing sites.

**Key Words:** Diversity, Overgrazing, Grazed, Desertification, Jabal Akhdar, Libya.

## INTRODUCTION

A variety of factors have significantly altered the landscape and native vegetation of the southern Mediterranean countries over the last century, including: fires, livestock overgrazing, destruction of natural vegetation, agriculture, urbanisation, road and powerline construction, the limited renewable resource and recreation etc. (Batanouny, 2001).

All these activities deteriorate or destroy the native vegetation cover and increase blowing sand, as well as dust emission. Wind erosion is the principal mechanism of desertification in the southern Mediterranean regions. In addition, some inappropriate strategies of desertification control have delayed the process of desertification reversion and even stimulated the development of desertification in this zone.

Combating desertification requires assessment of the type and severity of land degradation in the dry and semi dry lands, a determination of the causes of the land degradation which has occurred, and the selection and application of appropriate actions to counter the problem. Desertification in the southern Mediterranean countries often results directly from Bedouin nomad land use, mostly livestock grazing (Tsoar, 1995; Batanouny, 2001). The destruction of natural habitats by animal overgrazing will lead to ecosystem degradation. Therefore, monitoring the negative human activities and protect desert plants along a grazing gradient is crucial to restore the herbaceous plant communities which are the sources of productivity and diversity in arid and semi-arid lands. Sand dune fixation and degraded land restoration in the southern Mediterranean have received much attention in the technical and popular media over the past decades (Aronson *et al*., 1993).

The reasons for this interest are multiple: wind erosion has severe financial and societal consequences including decreased agricultural productivity, and increased safety and health hazards; desertification is becoming more and more widespread throughout the southern and northern Mediterranean; and climatic and environmental conditions suitable for ecosystem recovery occur only irregularly and infrequently, and full recovery may take hundreds of years.

Like in many other parts of the world, an adaptive feature of the growth of psammophytes, halophytes and other in the Mediterranean coastal and desert environments is the capture and stabilisation of wind-borne sediments within or around their canopies (Danin, 1996; Batanouny, 2001). These phytogenic mounds represent natural biological barriers reducing wind velocity, capturing water, nutrients and propagules. Therefore, they are loci for productivity and biodiversity in the degraded lands. The efficiency of these patches for intercepting and accumulating soil, nutrients, seeds, and water depends on the landscape, on the growth and rooting habits of the host species, and on environmental factors (Batanouny 2001). So far, the feasibility to protect desert plants in degraded desert ecosystems to optimise biodiversity, has not been investigated.

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Libya like many Mediterranean regions, despite the small population, this country is experiencing a serious problem of desertification, due to the high temperatures and low precipitation resulted in low vegetation cover, increased soil erosion and land degradation, where the desert climate prevails in the wide areas of the country, with the exception of some the Northern highlands and the coastal plains, which called the Jabal Akhdar. This region is very important, due to it having distinct environmental characteristics associated with being the only evergreen forest of its kind in the region along the Mediterranean from the Atlas Mountains to the Levant (Al-Idrissi *et al*., 1996).

It is worth mentioning that this region is rich in medicinal and aromatic plants as well (Eldoumi *et al*., 2002). Rainfall in Libya is very infrequent, where most of the annual rainfall occurs during the months of January and February (El-Tantawi, 2005). Although the Al Jabal Al Akhdar lands is considered one of fragile ecosystems and affected by unfavourable natural factors in Libya, the rangeland in most of the southern of the Al Jabal Al Akhdar zones had not suffered severe desertification nor lost its capability of recovering from light disturbances. In Libya, as in most other African countries, rapid population growth and the expansion of economic activities has led to degradation of the environment. In many parts of the country, bush fires, agricultural cultivation, overgrazing, firewood collection, urbanization and village sprawl have seriously damaged the natural vegetation.

The main objective of this study understand reason the degradation of natural pastoral resources of the site by the implementation of pastoral rehabilitation actions able to create a dynamic allowing a biological recovery, and to investigate the effects of the negative human activities on the biological diversity in (grazed vs. protected by fencing), have been investigated using the Shannon-Wiener diversity index. The study area is located in the southern of Jabal Akhdar in North Eastern part of Libya. Based on data from extensive field surveys, were carried out in the study during 2014.

## MATERIALS AND METHODS

Little ecological work has been performed in the south of the Jabal Akhdar. Field surveys of desert plant species in the pasture along south of the Jabal Akhdar, screening for their potential to conserve or enhance plant diversity in (grazed vs. protected by fencing).

This implies determination of species numbers and abundances with the Shannon-Wiener Index (H′) (Magurran, 1988). In the summer of 2014, fifteen plots surveys (each of approximately 10m x 10m) were selected to represent the main habitats in the study area. Sites were selected to cover the whole of the geographic study area. In each stand, the annual and perennial species were listed. Plant nomenclature was according to Eldoumi *et al.* (2002).

Plant cover for all species was estimated using the modified line intercept method (Eldoumi *et al*., 2002). One of the most commonly used diversity indices is the Shannon-Wiener Index (H′) (Magurran, 1988). The Shannon-Wiener Index uses both the relative abundance and species richness of each of these species in a community to determine how likely it is that any individual picked at random will be of a given species. Using the data from the stand density, the richness and evenness measures of species diversity were calculated from each site as following (UNjobs, 2010); Species richness (R) was taken simply as the number of species found at each site.

$$R = s$$

Where: s = the number of species. Species evenness (E) was calculated based on the species richness and the Shannon-Wiener information measure (H′) using the equation; E= H′/ln(R). Where H′ = $\sum_{i=1}^{s}(pi \ln pi)$, pi = proportion of individuals in the sampled area which belong to species i., S = total number of species recorded.

∑ = sum the values for all species. ln = natural logarithm. High values of H′ indicate a more diverse community. A community with just one species in it would have an H′ value of 0 (Magurran, 1988; Lane, 2007). A high H′ indicates that the species are evenly distributed, that is they all have roughly the same abundance (Lane, 2007). Therefore the H′ indicates not only the species richness but also the relative abundance of the species in the community (the evenness) (Magurran, 1988; Lane, 2007). If all species have similar proportions then the evenness value is one, but when the abundances are very dissimilar (some of species rare or common) then the value increases (Gashaw, 2010).

## RESULTS AND DISCUSSION

Species diversity, as assessed by the Shannon-Wiener index, has been studied at the (grazed vs. protected by fencing) sites, partly to determine the effect of negative human activities like overgrazing, timber cutting. ect., on biodiversity, by determine a Dominance and Evenness values, between fourteen of plants species; in other words, does an increase in the number of individuals mean an increase in biodiversity or not?. Data on the species records for all recorded species of shrubs in each plot are given in Table 1 (protected by fencing) and 3 (grazed), and the results of calculations of species diversity by the Shannon-

Wiener index for all of the study plots are given in Table 2,4. Also, data were analyzed in order to compare of Shannon-Wiener index, Dominance and Evenness values, between (grazed vs. protected by fencing) area for the fourteen of plants species in Table 5.

**Table 1:** Summary of number of individuals for all species of shrubs in the protected by fencing site.

| Species name | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 | P14 | P15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hammada scoparia articulatum* | 43 | 98 | 65 | 8 | 56 | 235 | 22 | 17 | 54 | 32 | 87 | 154 | 176 | 45 | 3 |
| *Thymus capitatus* | 2 | 88 | 7 | 90 | 55 | 4 | 88 | 53 | 75 | 5 | 1 | 75 | 0 | 87 | 64 |
| *Phlomis floccosa* | 3 | 59 | 76 | 6 | 53 | 24 | 86 | 0 | 42 | 7 | 7 | 64 | 53 | 2 | 75 |
| *Zizyphus lotus* | 53 | 2 | 34 | 5 | 7 | 121 | 5 | 87 | 9 | 3 | 0 | 0 | 0 | 0 | 87 |
| *Rhamnus oleoides* | 4 | 6 | 8 | 22 | 8 | 5 | 6 | 3 | 21 | 5 | 6 | 8 | 5 | 3 | 2 |
| *Artemisia herba-alba* | 4 | 87 | 87 | 176 | 53 | 54 | 0 | 7 | 96 | 32 | 3 | 87 | 47 | 214 | 65 |
| *Anabasis artiwpata* | 55 | 66 | 0 | 0 | 2 | 16 | 65 | 0 | 4 | 2 | 9 | 11 | 7 | 54 | 2 |
| *Pitoranthos tortousus* | 43 | 67 | 2 | 46 | 7 | 66 | 3 | 7 | 0 | 42 | 98 | 6 | 134 | 75 | 7 |
| *Thymelea hirsuta* | 2 | 6 | 43 | 3 | 14 | 3 | 6 | 8 | 9 | 2 | 10 | 54 | 0 | 0 | 6 |
| *Atriplex halimus* | 5 | 67 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 1 |
| *Mesembryanthemum nodiflorum* | 76 | 54 | 74 | 98 | 8 | 22 | 90 | 57 | 91 | 5 | 2 | 6 | 86 | 35 | 4 |
| *Periploca laevigata* | 3 | 4 | 54 | 7 | 2 | 1 | 65 | 8 | 64 | 5 | 87 | 98 | 12 | 65 | 87 |
| *Viburnum tinus* | 0 | 63 | 5 | 2 | 4 | 5 | 2 | 45 | 2 | 3 | 0 | 0 | 4 | 6 | 3 |
| *Bromus madritensis Lioyd* | 0 | 4 | 6 | 74 | 7 | 1 | 0 | 0 | 0 | 0 | 75 | 6 | 8 | 3 | 5 |

*P=Plot

**Table 2:** The total number of taxa and individuals per plot, together with mean values for species diversity as measured by Shannon's (H), evenness, dominance measures at each of the plots for protected by fencing area.

| Diversity Index | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 | P14 | P15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Taxa_S | 12 | 14 | 12 | 12 | 13 | 13 | 12 | 10 | 11 | 13 | 12 | 11 | 10 | 11 | 14 |
| Individuals | 293 | 671 | 461 | 537 | 276 | 557 | 443 | 292 | 467 | 145 | 389 | 569 | 532 | 589 | 411 |
| Dominance_D | 0.18 | 0.11 | 0.14 | 0.20 | 0.16 | 0.25 | 0.16 | 0.19 | 0.15 | 0.19 | 0.20 | 0.17 | 0.22 | 0.20 | 0.17 |
| Shannon_H | 1.89 | 2.30 | 2.11 | 1.85 | 2.05 | 1.71 | 1.95 | 1.87 | 2.03 | 1.97 | 1.78 | 1.96 | 1.74 | 1.86 | 1.92 |
| Evenness_e^H/S | 0.55 | 0.71 | 0.69 | 0.53 | 0.60 | 0.43 | 0.59 | 0.65 | 0.69 | 0.55 | 0.49 | 0.65 | 0.57 | 0.58 | 0.49 |

*P=Plot

It can be seen that the both locations (grazed vs. protected by fencing) are not similar in terms of number and density of species present, and this has been confirmed by the Shannon"s index (H). The results showed Increase of the numbers of *Hammada scoparia articulatum* (important environmental medium) and *Artemisia herba-alba* which is considered unpalatable species (except to Camel) in protected by fencing sites. According to Benmansour and Bendiab (1998). *A. herba-alba* is also considered to be important as a fodder for livestock and sheep in the plateau regions of Algeria where it grows abundantly.

**Table 3:** Summary of number of individuals for all species of shrubs in the grazed site.

| Species name | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 | P14 | P15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Hammada scoparia articulatum* | 31 | 54 | 2 | 5 | 8 | 54 | 6 | 2 | 4 | 32 | 54 | 6 | 2 | 1 | 6 |
| *Thymus capitatus* | 4 | 6 | 5 | 87 | 2 | 3 | 5 | 1 | 0 | 0 | 0 | 6 | 4 | 5 | 3 |
| *Phlomis floccosa* | 4 | 55 | 64 | 7 | 1 | 7 | 7 | 7 | 2 | 4 | 6 | 1 | 3 | 0 | 0 |
| *Zizyphus lotus* | 3 | 44 | 5 | 38 | 6 | 15 | 3 | 122 | 5 | 9 | 3 | 0 | 5 | 4 | 4 |
| *Rhamnus oleoides* | 4 | 32 | 5 | 7 | 8 | 53 | 4 | 53 | 53 | 4 | 6 | 43 | 76 | 73 | 1 |
| *Artemisia herba-alba* | 2 | 5 | 74 | 6 | 2 | 8 | 5 | 1 | 1 | 4 | 0 | 0 | 0 | 86 | 5 |
| *Pitoranthos tortousus* | 2 | 4 | 1 | 75 | 1 | 7 | 0 | 0 | 0 | 0 | 0 | 6 | 7 | 65 | 8 |
| *Thymelea hirsuta* | 1 | 3 | 4 | 6 | 0 | 4 | 5 | 7 | 0 | 3 | 66 | 4 | 3 | 54 | 9 |
| *Atriplex halimus* | 6 | 5 | 4 | 54 | 74 | 5 | 86 | 6 | 3 | 5 | 54 | 54 | 3 | 65 | 59 |
| *Mesembryanthemum nodiflorum* | 99 | 32 | 4 | 65 | 87 | 3 | 7 | 2 | 2 | 76 | 5 | 4 | 45 | 65 | 8 |

*P=Plot

**Table 4:** The total number of taxa and individuals per site, together with mean values for species diversity as measured by Shannon's (H), evenness, dominance measures at each of the plots for grazed area.

| Diversity Index | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 | P14 | P15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Taxa_S | 10 | 10 | 10 | 10 | 9 | 10 | 9 | 9 | 7 | 8 | 7 | 8 | 9 | 9 | 9 |
| Individuals | 156 | 240 | 168 | 350 | 189 | 159 | 128 | 201 | 70 | 137 | 194 | 124 | 148 | 418 | 103 |
| Dominance_D | 0.45 | 0.17 | 0.34 | 0.18 | 0.37 | 0.24 | 0.47 | 0.44 | 0.59 | 0.37 | 0.27 | 0.32 | 0.36 | 0.16 | 0.36 |
| Shannon_H | 1.24 | 1.90 | 1.39 | 1.88 | 1.25 | 1.73 | 1.31 | 1.14 | 0.96 | 1.36 | 1.45 | 1.43 | 1.36 | 1.88 | 1.52 |
| Evenness_e^H/S | 0.34 | 0.67 | 0.40 | 0.65 | 0.39 | 0.57 | 0.41 | 0.35 | 0.37 | 0.5 | 0.61 | 0.52 | 0.43 | 0.72 | 0.51 |

*P=Plot

**Table 5:** The total number of taxa and individuals per plot, together with mean values for species diversity as measured by Shannon's (H), evenness, dominance measures at each of the plots for grazed and protected by fencing area.

| Diversity Index | Protected By Fencing | Grazed |
|---|---|---|
| Taxa_S | 14.0 | 10.0 |
| Individuals | 442.1 | 185.7 |
| Dominance_D | 0.1 | 0.1 |
| Shannon_H | 2.4 | 2.2 |
| Evenness_e^H/S | 0.8 | 0.9 |

Overgrazing leads to the degradation of plant and soil resources (Keya, 1998) and the loss of species richness, while favoring the abundance of unpalatable species (Mwendera & Saleem, 1997; Beguin *et al*, 2009).

The results showed decrease of the numbers of species which is considered palatable for livestock in grazed sites, like Thymus capitatus compared to other species like *Mesembryanthemum nodiflorum*. A possible interpretation of these results is that, with a pattern of uncontrolled grazing resulting in overgrazing and a decrease in palatable species, causing a reduction in perennial vegetation, as well as, watering points are not appropriately located or found at suitably frequent distances, with the result that livestock concentrate around water points causing the destruction of pasturelands, in addition, pastoralists have increased their herd sizes in many range areas without considering the carrying capacity of each range, resulting in overgrazing. Despite these possible alternative explanations, the most likely interpretation is the negative impact of the practices of human activities in the past on the ecology.

We found that the recovery is higher in the zone protected by fencing situation. Thus, we can say that the zone protected by fencing has improved the recovery rate of vegetation. According to Le Houérou (1995) "The biological recovery is the set of inverse biological processes to those of the steppe and desertification. The recovery is characterized by the organic growth rate of perennial biomass recovery, permeability, water balance, structural stability, biological activity and the rate of organic matter in soil."

The present study confirms the mismanagement of these natural pastures, reflected in the neglect of protection to pastures, particularly lack of protection from overgrazing, fires and negative human activities. In fact, from the present study, it becomes evident that overgrazing is a major problem in the process of desertification, represented in the stopping of shrubs growth and the elimination of most sapling regeneration. In this region, vegetation has been seriously degraded as a consequence of a long history of desertification, resulting from a combination of factors such as drought, overgrazing, overcutting for fuel, timber and other activities (di Lernia and Palombini, 2002; Brooks, 2004, 2006). When combined with overgrazing and its effects on the environment, predictions for the future of the Jabal Akhdar are pessimistically negative unless conditions can be altered. The degradation of land may result from climatic variability, and also negative human activities such as over cultivation, overgrazing, deforestation and wild land fire amongst others (Le Houérou, 1977; FAO, 2007). The Jabal Akhdar region has been exposed to continuing deterioration for many years due to accelerated erosion, which often can lead to desertification (Eldoumi *et al*., 2002). The problem of biodiversity was highlighted as one of the complex environmental problems facing the study area. The present results show that the grazed sites generally have low diversity Compared to the protected by fencing sites. This study suggests that reducing the pressure on rangelands, may be a solution to stem the degradation processes and desertification. In light of this, it is imperative to put in place a comprehensive program to preserve natural resources for future generations.

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