Impact of Overgrazing & Burning on Plant Diversity in the Ras Al-Hilal Region in the North East of Libya

Masoud.M.M.Zatout, and Ashraf.M.S.Soliman

***Abstract*—**Fires have decimated Mediterranean ecosystems in recent decades. Libya is most of its area is considered arid. Like other forests in the Mediterranean it has suffered extreme degradation. This is mainly due to overgrazing, fires or sometimes converting forested areas to agricultural uses. In general, fire in the drought climate of Libya is not a new phenomenon specially in the Jabal Akhdar regions. The aim of this study was to investigate the changes of vegetation and the effects of fires on the biological diversity have been investigated using the Shannon-Wiener diversity index in the Ras al- Hilal forest after 1996 fire. The study area is located in the Jabal Akhdar in North Eastern part of Libya. Based on data from extensive field surveys, were carried out in the study during 2013, included the burned area and nearby locations of unburned forest. This study showed that not different significant diversity between the burned and unburned sites.

***Keywords*—**Burned, Jabal Akhdar, plant diversity, unburned.

I. Introduction

FIRE undergone by Mediterranean ecosystems constitute a major recurring disturbance [18], where the incidence of fire is particulary high due to the long, historical human impact on ecosystems [11]- [18].

Although the different of the effects of fires on plant diversity, generally found that Mediterranean countries forests affected by fires show a pattern of direct regeneration, that is, a process in which the source of direct regeneration is the same species pool existing immediately prior to disturbance, and the same pre disturbance community is restored only several years after the disturbance.

Direct regeneration has been showed in vegetation communities affected by fires [17]- [19]. It is not possible to generalize that all Mediterranean vegetation survive fire in all cases.

In fact, various Mediterranean plant species do not have any efficient postfire regeneration mechanism [16], and even trees species that usually regenerate well after fire, such as *Pinus halepensis*, show irregular or low regeneration when postfire environmental conditions are not favourable for seed germination [13].

Hence, the direct regeneration model may not apply to all Mediterranean vegetation species, particularly those without resprouting mechanisms and irregular germination. The main consequence of a hypothetical failure of direct regeneration would be that some vegetation communities lose important vegetation species, and this might dramatically alter the relationships among vegetation and animal species and the functioning of the whole ecosystem. Moreover, the variation in the success of direct regeneration would have important consequences for the design of restoration vegetation of zones affected by fires, especially for the rehabilitation of burned zones and the conservation of species unable to cope with fire.

The aim of this study was to investigate the changes of vegetation and the effects of fires on the biological diversity have been investigated using the Shannon-Wiener diversity index in Ras al- Hilal forest after 1996 fire. The study area is located in the Jabal Akhdar in North Eastern part of Libya. Based on data from extensive field surveys, were carried out in the study during 2013, included the burned area and nearby locations of unburned forest.

This study showed that not different significant diversity between the burned and unburned sites. Libya is located in North Africa, and most of its area is considered arid (more than 90 % is desert) [1], except in a small region (less than 1 %) in the north east of Libya which is called the Jabal Akhdar [2].

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, the Jabal Akhdar contains about 50 % (59 species) of the total endemic species in Libya, which may be due to its unique physiographic and climatic conditions that isolate the region from the rest of the country [1]. It is worth mentioning that this region is rich in medicinal and aromatic plants as well [4]. These natural forests become threatened by degradation as a result of various reasons, thus leading to a serious disruption in the fragile ecosystem balance [4]. Major natural reasons affecting this degradation processes often are climate and aridity, which lead to reduction in the plant cover.

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Besides these, the human-induced reasons leading to this process are fires, felling and overgrazing [9]–[3].

Wild fires burn thousands of hectares all over the world each year. Fire in the drought climate of Libya is not a new phenomenon specially in the Jabal Akhdar regions. Fire events occurred in Ras al- Hilal in 1923, 1956, 1987, 2001 and most recently in 2013. Small holders clearing land for cultivation were primarily blamed for starting fires that rapidly spread out of control. The Great Fire of Ras al- Hilal in 1996 was one of the worst fire events in recent decade.

II. Study Area And Methods

A. Study Area

The Ras al-Hilal is a part of the Jabal Akhdar. It lies in the north east of Libya. It is about 30 km long and 20 km in width, and runs roughly parallel to the Mediterranean coast [21] (Figure 1). Climatically, the study area of the Ras al-Hilal is influenced by the Mediterranean Sea to the north.

The rainfall is erratic in quantity, frequency and distribution. It attracts considerably more reliable rainfall than other coastal regions of Libya between autumn to early spring, with the mean annual rainfall ranges between 450 and 650 mm, 24-30 % falling in January. The temperature is 8-13°C in winter and 22-27°C in summer Winds are northern in winter but southern and eastern southern in other seasons. The mean annual relative humidity ranges from 70 to 80% [2].

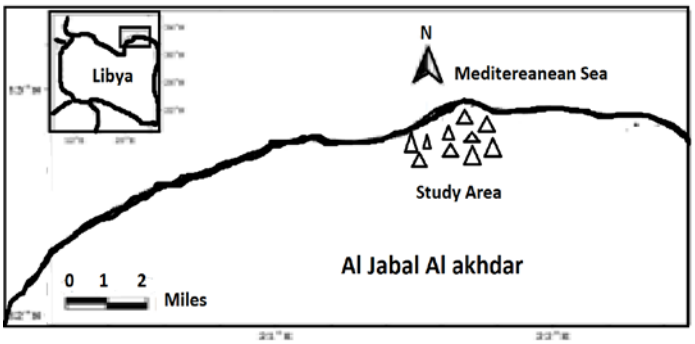

Fig. 1 Locations of the study area, which are located costal area of the Al Jabal Al akhdar.

B. Methods

In the spring of 2013, 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 [4].

Plant cover for all species was estimated using the modified line intercept method [4]. One of the most commonly used diversity indices is the Shannon-Wiener Index (H′) [15].

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 [20]:

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.

$\sum$ = 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 [10]- [15]. A high H′ indicates that the species are evenly distributed, that is they all have roughly the same abundance [10].

Therefore the H′ indicates not only the species richness but also the relative abundance of the species in the community (the evenness) [10]- [15].

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 [6].

III. Result And Discussion

Species diversity, as assessed by the Shannon-Wiener index, has been studied at the burned and unburned sites, partly to determine the effect of fire in terms of biodiversity, and also, by determine a Dominance and Evenness values, between seventeen species in the burned and unburned site; in other words, does an increase in the number of individuals mean an increase in biodiversity or not?.

The results of calculations of species diversity by the Shannon-Wiener index for all of the study plots are given in Table I, II.

Also, data were analyzed in order to compare of Shannon-Wiener index, Dominance and Evenness values, between burned and unburned area for the seventeen species Table III. It can be seen that the both locations burned and unburned are Similar in terms of number of species present, and this has been confirmed by the Shannon‟s index (H), as well as the Species Dominance and Evenness measures.

In study was carried out in the Mediterranean chaparral showed that the invasion of these forests by new plant species was limited once the initial first year populations was established and plant species composing mature postfire Mediterranean forests were found the first year after burn [7].

A possible interpretation of these results is that burned area did not experience elimination of all vegetation species under effect of fires. These authors found that the floristic

composition of these communities several years after fire did not differ markedly from more mature communities in the area [7].

TABLE I
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 BURNED AREA.

Plots	TAXA _S	Individuals	Dominance _D	Shannon_ H	Evenness_ e^H/S
P1	15	388	0.18	1.95	0.47
P2	15	641	0.10	2.33	0.68
P3	12	380	0.16	1.97	0.60
P4	11	417	0.18	1.86	0.58
P5	14	306	0.13	2.22	0.66
P6	13	384	0.26	1.68	0.41
P7	14	620	0.14	2.09	0.58
P8	13	437	0.13	2.15	0.66
P9	11	463	0.14	2.03	0.69
P10	13	249	0.20	1.85	0.49
P11	12	315	0.20	1.80	0.50
P12	14	375	0.15	2.08	0.57
P13	11	224	0.19	1.86	0.58
P14	10	228	0.21	1.75	0.57
P15	14	509	0.13	2.11	0.59

TABLE II
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 NO BURNED AREA.

Plots	TAXA _S	Individuals	Dominance _D	Shannon_ H	Evenness_ e^H/S
P1	12	223	0.24	1.76	0.43
P2	13	372	0.15	2.09	0.69
P3	12	174	0.15	2.05	0.69
P4	11	312	0.16	1.96	0.67
P5	14	393	0.11	1.98	0.50
P6	10	320	0.22	1.68	0.58
P7	11	192	0.19	1.91	0.61
P8	13	406	0.14	1.99	0.52
P9	14	239	0.29	1.87	0.42
P10	13	233	0.27	1.87	0.50
P11	13	259	0.29	1.83	0.49
P12	12	285	0.19	1.94	0.57
P13	13	324	0.14	2.16	0.66
P14	12	248	0.25	1.59	0.41
P15	14	398	0.18	2.03	0.54

The ecological implications of direct regeneration are twofold. First, it is assumed that plant species are highly adapted to disturbance, so the risk of losing plant species after fire is low, and second, conservation strategies and management plans may be relaxed because of the high resilience shown by the system.

The high resilience of Mediterranean plant communities after fire can be explained by the ability of plant species to recover from fire by means of resprouting from fire-resistant structures [8], and germination of fire-protected seeds stored in the soil or in the canopy bank [13]. These traits have been shown in many abundant or representative species, shrubs, and trees of the Mediterranean basin [13]- [14].

TABLE III
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 BURNED AND NON- BURNED AREA.

Diversity Index	Burned	Unburned
Taxa_S	17	14
Individuals	396	290
Dominance_D	0.09	0.09
Simpson_1-D	0.90	0.90
Shannon_H	2.5	2.4
Evenness_e^H/S	0.72	0.81
Diversity Index	Burned	Unburned

Generally, the present study confirms the mismanagement of these natural forests, reflected in the neglect of protection to forests, 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 tree growth and the elimination of most sapling regeneration.

When combined with fire 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 [12]- [5].

The Jabal Akhdar region has been exposed to continuing deterioration for many years due to accelerated erosion, which often can lead to desertification [4]. The problem of biodiversity was highlighted as one of the complex environmental problems facing the study area. There did not appear to be any link between biodiversity and whether the burned and unburned.

The present results show that the burned sites generally have a littel diversity than the unburned sites, presumably because the vegetation is still more open after fires. However, the difference might be because of greater competition for nutrients and light from the mature trees acting to prevent the growth of other species in the unburned sites.

Despite these possible alternative explanations, the most likely interpretation is the negative impact of the practices of clearance previously used in the past on the ecology, and the poor return of the original vegetation after such practices. Despite the randomized fires cause elimination of the types of natural vegetation, without distinction, but the juniper trees are considered the most affected by all of them and that, because they represent the type most prevalent in most parts of the Jabal Akhdar, including those exposed to fires, such as the Ras al- Hilal and others.

They are also more affected by their inability to natural regeneration in most cases, especially along the slopes of the

hills that characterize the Jabal Akhdar regions in general and a private of the Ras al- Hilal, where the trees cover more intense.The regeneration has enabled important species other than tree cover natural of natural regeneration in areas that came under fire after a few years of their occurrence, which has been documented in a number of areas such as the Ras al-Hilal and others that came under fire in 1996 was able important species of trees and shrubs of regeneration. On the other hand, the renewal of juniper trees in these areas in particular were very low or almost non-existent.

That among the factors that seem to cause disability or prevent the return of the natural vegetation is generally in these regions after its destruction by fire is exposed to overgrazing as is the case in the area of Ras Al Hilal, for example, based on the results of this study it was found that rapid action and constructive that would stimulate the growth of any vegetation, especially on the new hillsides that have become almost bare of any vegetation as a result of the devastating fires will help to keep the soil against erosion and provides a favorable environment for the return of other important species. The completely stop the practice of grazing in these areas in order to protect the new shoots within a comprehensive plan for the rehabilitation of these sites is very helpful.

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