An-Najah National University
Faculty of Graduate Studies

The Impact of Grazing and Land Reclamation on Natural Plant Biodiversity in Al-Fara'a Area

By

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Dedication

This thesis is dedicated to my wonderful parents, who have raised me to be the person I am today and have supported me from the beginning of my studies. Thank you for everything.

This thesis is dedicated to my wife who has been with me every step of the way, through good and bad times. Thank you for all the unconditional love, guidance, and support that you have always given me.

Finally, this thesis is dedicated to all those who believe in the richness of learning.

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Table of content

List of tables

List of figures

List of Appendices

p

The Impact of Grazing and Land Reclamation on Natural Plant Biodiversity in Al-Fara'a Area

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Abstract

This study was carried out in Tallouza village which located in the Wadi El-Far'a area in West Bank in order to study the effect of grazing and land reclamation on natural vegetation diversity during two growing seasons (2005-2006 and 2006-2007). Four sites of grassland ecosystem of different type of land use (reclaimed grassland, recently no-grazing grassland, under-grazing grassland, natural reserved grassland) were selected. Vegetation and soil sampling were carried out in mid April for each growing season, data about amount and distribution of rainfall and temperature were collected for the area during the two growing season. Vegetation sampling and above ground biomasses were determined by using quadrate method. Braun-Blanquet scale was used to visually estimate the relative vegetation cover of each species. The study showed that vegetation composition and percent vegetation cover differ between the sites. Percent vegetation cover was significantly increased in recently no-grazing grassland when compared it with under-grazing grassland and the highest percent vegetation cover was in the natural reserved grassland, and this was indicator for the high potential of this grassland for the rehabilitation in few years when we exclude grazing. Species diversity, evenness, above ground biomass and density were significantly higher in the recently no-grazing grassland and natural reserved grassland than under-grazing grassland. Agricultural activities, especially ploughing were

justifying the low natural species diversity evenness, above ground biomass and density in reclaimed grassland. Species found in under-grazing grassland were mostly low palatable to grazing animals, mostly small, prostrate or rosette plants while in natural reserve grassland mostly palatable to grazing animals, mostly tall and erect plants. The vegetation cover observed in mid April 2007 was higher than mid April 2006 at natural reserve grassland and recently no-grazing grassland were due to the differences in distribution of precipitation in the two growing seasons and grazing exclusion.

There was no significant difference between the sites in the edaphic factors, so we didn't know the effect of these factors on natural vegetation diversity in the area.

Chapter one

General Introduction

1.1 Background.

1.2 Definitions.

1.3 Literature review.

1.4 The aims of the study.

1.1 Background:

Vegetation in the Mediterranean Basin was developed over thousands of years, depending on natural processes and human intervention (e.g. woodcutting, fire and grazing) (Kutiel et al., 2000). Many natural grasslands have been destroyed by cultivation or modified by grazing from livestock (Watkinson & Ormerod, 2001).

The natural grassland in Al-Fara'a area mainly composed of herbaceous vegetation association, it is 105,398 dunum, which constitute 31.8% of the total area of Al-Fara'a (Environment Quality Authority, EQA, 2004).

Al-Fara'a area has suffered from two factors that affect the natural vegetation diversity and lead to severe deterioration: grazing by domestic livestock and land reclamation (EQA, 2004).

Heavy grazing by domestic livestock and misuse of rangeland in the past 40 years have resulted in the depletion of many shrubs, grasses, and many palatable plants including *Retama raetam*, *Artemisia spp, Vicia spp, Trifolium spp* and *Hordeum spp* (Ministry Of Agriculture, MOA, 2004).

The dominant grazing system is known where shepherds move their animals to rich grazing lands as soon as the forages start their life cycle in February or March. The plants have no chance to grow and give high forage quantities due to early grazing (MOA, 2004). Under these conditions, grasslands were degraded and only provide forages for free grazing within 2 to 3 months during good rainy seasons (MOA, 2004).

Because of the increasing demand for food due to the rapid increase of the population, several land reclamation projects have been implemented in the Northern West Bank (NWB) by the MOA and other nongovernmental organizations (NGOs) since 1989. About 60,000 donums (donum= 1,000 square meters) have been reclaimed (MOA, 2006). Non-cultivated lands, and rangelands have been for example transformed into cultivated land. This has therefore increased the area of cultivated land, and thus agricultural activities, at the same time decreased the area of range land and finally grassland.

Some reclamation projects, however, have reclaimed part of the target land, and maintained the other part as natural or pasture lands. In the latter lands, agricultural practices including use of pesticides and tillage are not carried out.

Since land reclamation projects concern with changing or manipulating natural environment through changing land use, this factor is expected to have a significant effect on vegetation cover and natural plant biodiversity in the Al-Fara'a grassland.

The intensive grazing and land reclamation projects are continued, so that it is important to understand the effects of grazing on the dynamics of Mediterranean herbaceous communities and study the natural vegetation biodiversity in the area and assess the impacts of these interventions (grazing and reclamation) on the natural vegetation diversity.

1.2 Definitions:

Grassland: a natural biological community composed mainly of species of grasses. The many kinds of grassland communities may be classified on the basis of the climate, the geology of the area and the dominant grass species.

Diversity: the richness of a habitat or region in species, based on the absolute number of species present and the degree of equitability in their abunances.

Species richness: a count of the number of plant species in a quadrat, area or community it is often equated with the diversity (Alpha diversity), when ecologists talk of high diversity, they often mean a community containing a large number of different species.

Equitability (Evenness) index: the evenness of species in their abundances, the higher value of the index means that the species are more even in their distribution.

Shannon diversity index: it is a mathematical expression that used in ecology as a measure of diversity. It compines species richness and relative abundance (evenness or unevenness) in measuring diversity.

Density: the number of organisms per unit area or volume of habitat.

Frequency: in community description, the fraction of sampling units in which a particular species occurs.

Biomass: the total mass of organic matter per unit area or volume of habitat at one point in time.

1.3 Literature review:

The impact of grazing on plant community structure and ecosystem functioning is a key issue for range management as well as for nature conservation. On the other hand range manager emphasize the long-term sustainable maximization of livestock production and profitability of the operation, while conservationists seek to maintain high biodiversity (Tilman et al., 1996. Noy-Meir et al., 1989). Mediterranean ecosystems are distiguished by high seasonality in resource availability, great inter-annual rainfall variability, large component of annual plants in the flourestic composition and a long history of grazing and disturbance (Noy-Meir & Seligman, 1979). Domestic livestock have grazed Mediterratnian ecosystems, and particularly those of the Middle East, for more than 5,000 years (Edelstein & Milevsky, 1994). It is therefore not unusual to find many species well-adapted to grazing, expresing a high degree of resiliance following defoliation (Perevolotsky & Seligman, 1998).

Heavy grazing pressure has been reported to reduce the diversity of herbs and shrubs in the range land (Zhao et al., 2006). Due to overgrazing, the vegetation species composition, richness and productivity has changed over the past decades, some species have disappeared, while others have survived through the use of morphological or other adaptations (Wang et al., 2002).

A case study in Africa showed that plant community response to heavy grazing near stock posts was the reduction of palatable grass species sensitive to heavy grazing and replacement with species of lower palatablity, thereby lowering grazing pressure (Hendricks et al., 2005).

Grazing can influence the structure and organization of plant communities in different ways (Noy-Meir et al., 1989). The direct effect of herbivory occurs by the selective and differential removal of plant tissues or species. Indirect effects on botanical composition and species diversity can occur when selective grazing on dominant species reduces their vigour and presence, thus favouring the spread of less competitive but more grazing-tolerant plants. Previous research in these communities has suggested that the responses of vegetation to grazing are associated with plant growth form, mainly plant height, and to a lesser extent with palatability and spininess (Noy-Meir et al., 1989).

Some native population of the perennial grasses subjected to heavy grazing were typically shorter and more prostrate than ungrazed or lightly defoliated populations of the same species (Tomas et al., 2000).

In the middle of the twentieth century, the traditional and diverse management practices, which have been the main driving forces for the increase and preservation of biodiversity, were given up and were replaced by modern agriculture in some areas and mismanagement in others. Intensification of agriculture by use of high-yielding crop varieties, fertilization, irrigation, and pesticides has contributed substantially to tremendous increases in food production over the past 50 years (Matson et al., 1997).

As aresult, over the last few decades a severe decline in plant species diversity is reported from arable land (e.g., Moravec, 1993; Albrecht, 1995; Sutcliffe & Kay, 2000).

In the Southern part of the West Bank the rangeland was found to suffer from severe deterioration, due to overgrazing, improper grazing time, uses of trees and shrubs as sources for fuel, and the cultivation of marginal land (Mohammed, 2005). These factors are thought to have lead to the current poor condition of the rangeland, characterized by damaged vegetation cover, low productivity, increase of poisonous and unpalatable plant species, low vegetation cover, and presence of large percentage of weed like *Sarcopoterium sp*.

More than 36% of the world's inhabitable land is exposed to extensive human disturbance due to urbanization and agricultural activities (Hannah et al. 1994). These disturbances can be categorized as (i) modifications of natural disturbance regimes (e.g., altered fire and grazing frequency) and (ii) the introduction of novel mechanical disturbances such as building and highway construction, heavy-vehicle activity, tillage (including levelling, clearing and planting). The latter can be described as exotic disturbance resulting in destruction of plant biomass and removal or dramatic alteration of surface soil.

Exotic disturbance can alter successional processes due to the loss of soil nutrients, micro-flora, native seed banks and proximate seed sources and to the rapid invasion of exotic weedy species (Allen, 1988; D'Antonio & Vitousek, 1992). Such alterations can lead to the reduction of native species cover and richness (Hironaka & Tisdale, 1963; Lathrop, 1983; Waaland & Allen, 1987) and alteration of ecosystem processes (Vitousek & Walker, 1989).

In some cases native species can recover after severe anthropogenic disturbances, but typically only when such activities have occurred for many years or when they match natural disturbance regimes (Denslow, 1985; Hobbs & Huenneke, 1992). For example, Mediterranean Basin regions have a long history of urban and agricultural disturbance; thus annual herbaceous species endemic to these regions, such as *Erodium spp.*, *Avena spp*. and *Bromus spp.*, are well-adapted to human activities and readily invade mechanically disturbed sites in other areas of the world where such perturbations are relatively recent (Naveh, 1967; Groves, 1986).

The aims of the study:

The present study was aimed at:

1. Studying the effect of land reclamation practices, grazing and grazing exclusion on vegetation cover, vegetation biomass, species composition and diversity in Al-Fara'a area.

2. Evaluating the effects of the amount and seasonal distribution of rainfall on the structure of the herbaceous community under grazing and reclamation practices.

3. Evaluating the effects of the edaphic factors (organic matter, pH, texture, moisture content) on the structure of the herbaceous community under grazing and reclamation practices.

Chapter two

Materials and Methods

2.1 The study area.

2.2 Experimental design.

2.3 Vegetation sampling and measurement.

2.4 Soil sampling and chemical analysis.

2.5 Climatic data.

2.6 Statistical analysis of vegetation data.

2.1 The study area:

The field work was conducted in Tallouza village which located in the Wadi El-Far'a area, in the north-eastern part of Nablus district in the West Bank (latitude 32.27 N, longitude 35.31 E, altitude 360 m above sea level) (Figure 2.1). Wadi El-Far'a area extends about 30 km from Nablus in the West, to the Jordan River in the east, with an area of 331 sq. km (EQA, 2004). The stream Wadi El-Far'a is a tributary of the Jordan River, and is considered one of most important wetlands in the West Bank. Topography is a unique factor in Wadi El-Far'a which ranges from 900 m above sea level in Nablus Mountains in the west to about 250 m below sea level at the point where Wadi El-Far'a meets the Jordan River. These factors have contributed to the high and unique biodiversity, especially endemic plant species, of the regions ecosystems.

The topography at the study sites is hilly, with slopes generally less than 20%. Soil is light brown Rendzina with clay texture and variable depth, but rarely deeper than 60 cm, and with a rock cover of about 30 % (EQA, 2004).

The climate is semi-arid Mediterranean climate, characterized by wet and mild winters, dry and hot summers (about 5 months), with mean minimum and maximum temperatures approaching 13.3 Cº and 22.3 Cº, respectively (EQA, 2004). The annual average precipitation is 630 mm, falling mostly in winter. The rainy season begins in October – November and ends in April (EQA, 2004).

The growing season of the vegetation is closely associated with the distribution of rainfall. Germination of annuals and regrowth of most perennials happen soon after the first rains. Growth is rather slow during the winter months of December-January, but the vegetation is usually well-established by mid-end January (EQA, 2004). Growth is rapid in spring and peak growth, coincided with seed set, occurrs in March-April (EQA, 2004). By mid-May, most of the herbaceous vegetation is dry and most seeds would have shattered. The forage quality start to decrease at the beginning of the long dry summer.

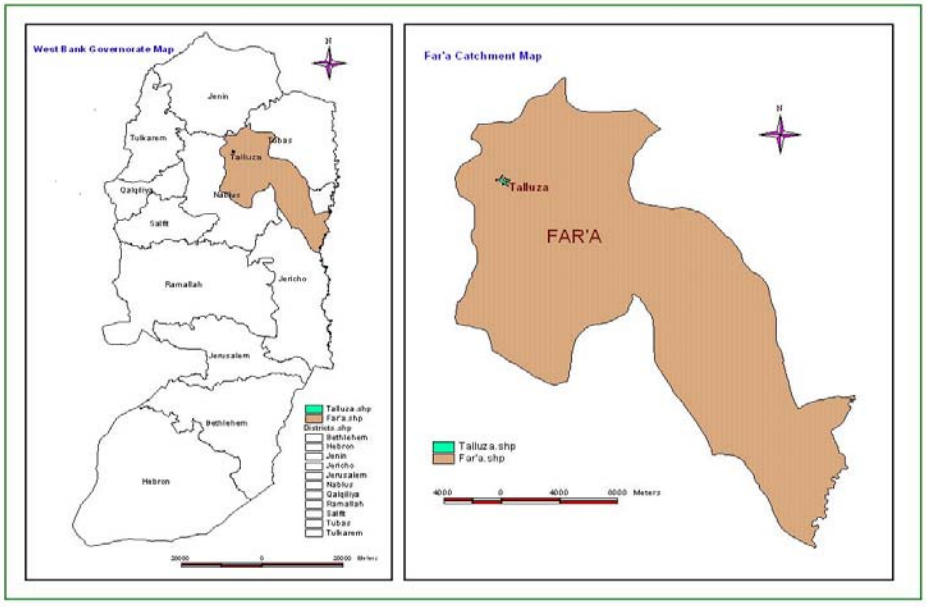

Figure (2.1): Map of West Bank showing the Study area.

2.2 Experimental design:

A complete randomized design (CRD) was used, four different sites (3000 square meter each site) in Tallouza village rangeland which mainly dominated with grasses, were selected to study the effect of land use mainly grazing and land reclamation on natural vegetation diversity.

Site1. Reclaimed grssland (R):

This site was previously a part of a grassland suffering from grazing mainly by sheep and goat herds. In mid Agust 2005 the site was converted into agricultural land through a reclamation scheme which involved the removal of above-ground rocks and vegetation cover, and leveling of soil using heavy balldozers. Reclamation activities also included the construction of stone walls and a water cistern, fencing, and planting the land with fruit trees. Since then, the land has been under normal practices.

Figure (2.2): Photo for reclaimed grassland site.

Site 2. Recently no-grazing grassland (P):

This sites was previously a part of a grassland suffering from grazing mainly by sheep and goat herds. In October 2005 the land was fenced and protected from any agricultural practices or grazing.

Figure (2.3): Photo for recently no-grazing grassland site.

Site 3. Under-grazing grassland (G):

The site was under grazing mainly by sheep and goats herds for the last 25 years.

Figure (2.4): Photo for under-grazing grassland site.

Site 4. Natural reserved grassland (C):

No human activities, agricultural practices or grazing had taken place on the site for the last 5 years. This site was considered as the control treatment.

Figure (2.5): Photo for the natural reserved grassland site.

Three 10x25 m permanent replicate sampling plots were randomly selected at each site.

Three 1x1 m permanent quadrats were randomly selected at each replicate sampling plot for vegetation description and analysis.

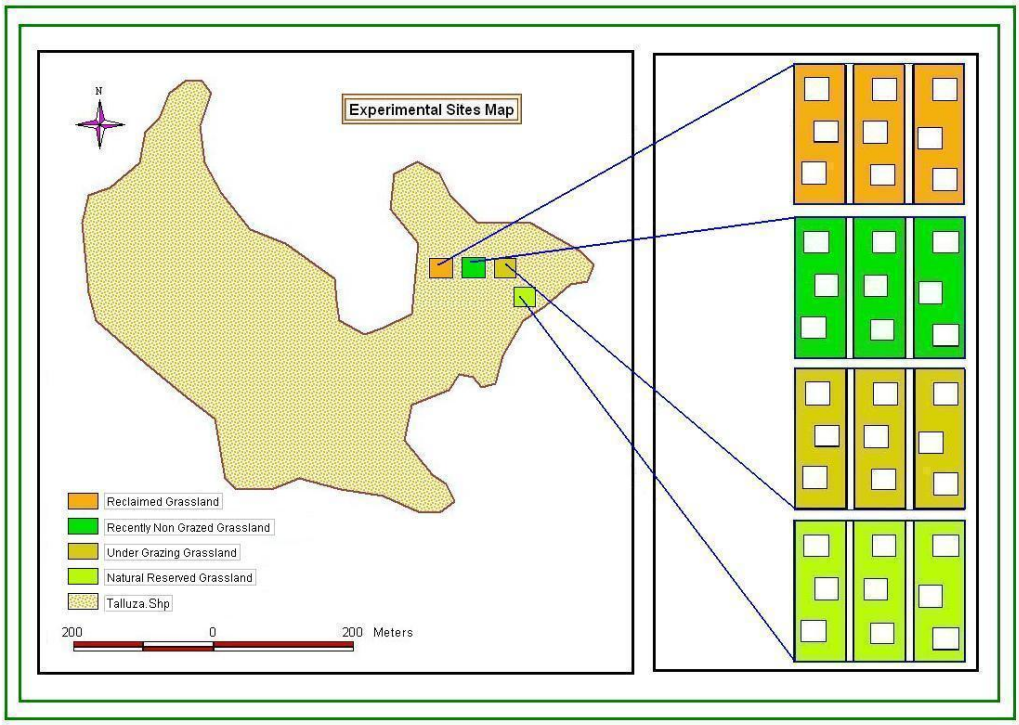

Figure (2.6): Map of Tallouza showing the experiment layout.

2.3 Vegetation sampling and measurement:

The vegetation sampling at the study sites were carried out at the peak of growing period (mid of April) (Sternberg et. al., 2000) during two growing seasons 2005-2006 and 2006-2007 to determine: total vegetation cover, species composition, relative vegetation cover, species richness, species diversity and evenness, plant density, and aboveground biomass.

2.3.1 Total vegetation cover (TVC):

This was estimated by eye (visually) at each permanent quadrat in the sampling plots at the study sites (Kent & Coker, 1992).

2.3.2 Species composition:

Vegetation cover in the permanent quadrats and its component plant species were studied and identified based on plant taxonomy references and pictorial floras (e.g., Zohary & Feinbrun-Dothan, 1966). Identification of plants (Appendix A) were authenticated by comparison with similar herbarium specimens at the Biodiversity & Environmental Research Center (BERC) Herbarium. Voucher specimens of the studies plants were collected and deposited at the BERC herbarium.

Plant species that identified in the sites were sorted according to their grazing palatability, based on local herds traditional knowledge and available literature (eg. Snkry, 1981, Sternberg et. al., 2000, Salem, et. al., 2007) see Appendix B.

2.3.3 Relative vegetation cover (RVC):

The Braun-Blanquet scale (Table 2.1), was used to visually estimate the relative vegetation cover of each species (Kent & Coker, 1992). It was measured for 3 permanent quadrats (one at each sampling plot at each of the study sites).

Table (2.1): Braun-Blanquet scale used for estimating percentage vegetation cover for each species.

Value	Braun-Blanquet
+	Less than 1 % cover
1	1-5% cover
2	6-25% cover
3	26-50% cover
4	51-75% cover
5	76-100% cover

2.3.4 Plant species richness:

Species richness was calculated as the total number of species per permenent quadrat (Kent & Coker, 1992). Numbers were measured for 1 permenent quadrat at each sampling plot at the study site.

2.3.5 Plant species density:

Species density was assessed as the number of individuals of each species per quadrat (Kent & Coker, 1992). It was measured in 1 permanent quadrat at each replicate sampling plot at each of the study site.

2.3.6 Species frequency:

Species frequency was calculated as the probability or chance of finding a species in a given quadrat. It was noted as presence or absence in each quadrat for each species. Therefore, a species with a fequency of 50 % would occur in half of the quadrats taken (Kent & Coker, 1992). Frequency was measured from 1 permanent quadrat at each sampling plot at the study sites.

2.3.7 Plant species diversity and evenness:

Species diversity was calculated based on the Shannon –Wiener Index according to the following formula:

$$H' = -\sum_{i=1}^{s} Pi(LnPi)$$

where:

s is the number of species.

Pi is the relative contribution of the species cover to the total plant cover.

This index takes into account the number of species and the relative contribution of each species cover to the overall plant cover. The higher value of H` indicates higher diversity (Kent & Coker, 1992).

Species evennesss, the equitability or the evenness of the treatments was calculated based on Shannon –Wiener Index according to the following formula: $J = \frac{H'}{Lns}$

Where:

J is the equitability or the evennesss index.

H`is the Shannon –Wiener Index.

s is the number of species.

The higher value of J, the more even the species are in their distribution within the treatment (Kent & Coker, 1992). Species diversity and evenness were measured from 1 permanent quadrat at each sampling plot at each of the study sites (see Apendix C).

2.3.8 Aboveground biomass:

Within each sampling plot, three 25 x 25 cm quadrats were randomly positioned and the above-ground vegetation were clipped by shears. The collected plants were dried in an oven at 75 Cº for 48 hours and then weighted. The dry weight in gm / unit area was used to indicate the above-ground biomass (Kent & Coker, 1992). It was measured in mid June 2006, end March 2007 and mid April 2007.

2.4 Soil sampling and chemical analysis:

Composite soil samples were collected at the four study sites in mid April 2006 and 2007. At each study site, 2–3 kg composite soil samples at 0–15 cm depth were collected randomly with an auger. Soil samples were air dried, grounded, sieved with 2 mm mesh sieves and stored in plastic bags at room tempreture for chemical analysis. Composite soil samples were analyzed for texture, soil moisture content, pH and soil organic matter.

Soil texture was determined for each soil sample using a hydrometeric method as described by (Day, 1965).

Soil moisture content was determined by gravimetric techniques (Hesse, 1971).

Soil pH was determined on a suspension of 10 g air dry soil and 10 mL 0.01 M CaCl2 by using a pH-meter (Mclean, 1982).

Soil organic matter was determined by reduction of potassium dichromate by organic carbon compounds and subsequent determination of unreduced dichromate by oxidation-reduction titration with ferrous ammonium sulfate method (FAO, 1974), and later converted to soil organic carbon using a factor of 0.58 (Wang & Zhou, 1999).

2.5 Climatic data:

Annual rainfall (in mm), annual means of temperatures (min, mean, max) during the two growing seasons were obtained from two meteorological stations located in Nablus (Askar and Albadan stations).

2.6 Statistical analysis of vegetation data:

The statistical analysis of the vegetation data was carried out with the SPSS for Windows package (SPSS, Version 13, 2005). Significantly different means ($p \leq 0.05$) were separated by the least significant difference (LSD) after the present of significant effects ($p \leq 0.05$) had been confirmed by one –way ANOVA, (see Appendix D).

Hierarchical cluster analysis was used to assess the similarity of sites in terms of species composition (see Appendix E), the correlation among them was represented by dendrogram graph, Jaccard coefficient was used as similarity coefficient and calculated according to following formula:

$$Sj = \frac{a}{(a + b + c)}$$

Where:

Sj is the Jaccard similarity coefficient

a is the number of species common to both quadrats/samples

b is the number of species in quadrat/sample1

c is the number of species in quadrat/sample2.

Chapter three

Results

3.1 Vegetation characteristics.

3.1.1 Total vegetation cover.

3.1.2 Biomass.

3.1.3 Species compositions.

3.1.4 Similarity and plant response.

3.1.5 Natural vegetation diversity.

3.1.5.1 Species richness.

3.1.5.2 Species evenness

3.1.5.3 Shannon – Wiener Index.

3.1.6.Plant density.

3.1.7 Vegetation characters in the reclaimed grassland.

3.2 Soil characteristics.

3.3 Climatic condition.

3.3.1 Rain fall distribution.

3.3.2 Temperature.

3.1 Vegetation characteristics:

3.1.1. Total vegetation cover (TVC):

Over two consecutive growing seasons (mid April 2006 and 2007), the total vegetation cover varied significantly ($p \leq 0.05$) between the different land use sites, the natural reserve grassland yielding the highest TVC it was (81.7 %, 86.9 % in mid April 2006 and 2007 respectively), followed by recently non-grazed grassland it was (46.7%, 71.7% in mid April 2006 and 2007 respectively) and the lowest in the under-grazing grassland (28.9%, 26.2% in mid April 2006 and 2007 respectively) (Table 3.1)

3.1.2. Biomass:

Above ground biomass data in mid April 2007 varied significantly ($p \leq 0.05$) between the different land use sites, with the natural reserve grassland yielding the highest above ground biomass it was 10858.7 Kg/ha, followed by recently non-grazed grassland 4688 kg/ha and the lowest above ground biomass was obtained in the under-grazing grassland it was 730.7 kg/ha (Table 3.1).

Table (3.1): Means and standard deviation of the total vegetation cover percentage and dry biomass at different land use practices at the two sampling dates (mid April 2006, 2007).

Characters	Date	C[1]	G[1]	P[1]	Sig.
Total vegetation cover %	Mid April 2006	a[2] 81.7±4.4	c 28.9±5.9	b 46.7±1.7	0.00
	Mid April 2007	a 86.9±4.8	c 26.2±5.6	b 71.7±4.4	0.00
Above ground total dry biomass (kg/hectar)	End March 2007	a 9104±712.5	c 1184.5±162.7	b 3946.7±1602.7	0.00
	Mid April 2007	a 10858.7±1402.3	c 730.7±295.2	b 4688±1792.2	0.00

[1] C = natural reserved grassland, G = Under-grazing grassland, p = Recently non-grazed grassland.

[2] means with the same letter per row are not significantly different at $p \leq 0.05$.

3.1.3. Species compositions:

A total of 32 different plant species were identified at the three land use practices sites. Number of species ranged between 18-23 in the different sites over the study period, slightly higher numbers of species were found at the peak of growing season in the recently non-grazed grassland, followed by the under-grazing grassland and the lowest number of species was obtained at the natural reserved grassland (Table 3:2).

Table (3:2): Means of relative vegetation cover and Braun-Blanquet scale of plant species at study sites at the two sampling date, mid April 2006, 2007

Species (scientific name)	Mid April 2006						Mid April 2007					
	C[1]		G[1]		P[1]		C[1]		G[1]		P[1]	
	Relative cover	Braun-Blanquet	Relative cover	Braun-Blanquet	Relative cover	Braun-Blanquet	Relative cover	Braun-Blanquet	Relative cover	Braun-Blanquet	Relative cover	Braun-Blanquet
Adonis palestina			0.33	+	1.83	1			0.17	+	1.83	1
Ainsworrthia trachycarpa Boiss	0.33	+			0.33	+	0.33	+			0.50	+
Anthemis nabataea	0.17	+	6.00	2	10.00	2	0.17	+	3.67	1	10.33	2
Artedia squamata.	0.17	+					0.17	+				
Avena eriantha	14.33	2	0.50	+	0.33	+	23.33	2	0.17	+	5.00	1
Bupleurum brevicaule Schlecht					1.83	1					1.83	1
Centaurea procurrens					0.17	+			1.33	1	0.33	+
Cichorium pumilum			0.50	+	0.33	+			0.83	+	0.33	+
Echinops polyceras Boiss	0.50	+	0.17	+	1.67	1	3.17	1	1.33	1	1.33	1

Eryngium barrelieri Boiss			5.00	1	1.83	1			5.67	2	2.00	1
Gastridium scabrum			2.00	1								
Geropogon hybridus	0.33	+					1.00	1				
Hordeum spontaneum	38.33	3					45.00	3			1.67	1
Lagoecia cuminoides			3.33	1	1.83	1			2.00	1	1.67	1
Linum pubescens	1.00	1			6.00	2	0.83	+			5.00	1
Medicago rotata	0.33	+	0.17	+			2.33	1	0.17	+		
Notobasis syriaca (L.) Cass.	1.67	1	0.17	+	0.33	+	1.00	1	2.67	1	1.00	1
Onobrychis caput- galli	1.83	1					2.00	1				
Pallenis spinosa (l.) Cass	0.17	+	0.17	+			0.33	+	1.00	1		
Plntago afra L.			3.50	1	13.00	2			3	1	11.83	2
Rhagadiolus edulis Gaetner	0.17	+	0.17	+	0.67	+	0.17	+	0.17	+	1.00	1
Salvia palaestina Bentham			0.33	+	0.33	+			0.33	+	0.33	+
Sarcopoterium spinosum(L.)	16.67	2			5.00	1	16.67	2	0.67	+	5.00	1
Scandix pecten-veneris	0.17	+	0.50	+	5.67	2	0.17	+	0.50	+	4.00	1
Sinapis alba			0.33	+					0.67	+		
Stipa capensis					4.50	1					10.00	2
Tetragonolobus palaestinus			0.17	+			0.33	+				
Tordylium aegyptiacum					0.33	+						
Torilis tenella			8.33	2	3.50	1			4.33	1	2.00	1
Trifolium clypeatum	2.00	1	0.17	+			2.17	1			1.00	1
Trifolium stellatum	4.33	1	0.17	+	0.17	+	3.50	1	0.17	+	0.33	+
Urospermum picroides	1.83	1	0.33	+	3.83	1	1.50	1	0.33	+	4.00	1
Total number of species	**18**		**21**		**22**		**19**		**20**		**23**	

[1]C = natural reserve grassland, G = Under-grazing grassland, P = Recently non-grazed grassland

Table 3.2 showed that the means of relative vegetation cover (Braun-Blanquet scale) of each identified plant species varied in the land use practices study sites and in the two consecutive growing seasons

Plant species with high cover, frequency and density were considered as dominant species. Dominant plant species were different between the three land use practices sites in the two sampling dates. At natural reserve grassland they were *Avena eriantha, Hordeum spontaneum*, at under-grazing grassland they were *Anthemis nabataea, Eryngium barrelieri Boiss, Torilis tenella*, and at recently non-grazed grassland they were *Anthemis nabataea, Plntago afra L.,*and *Stipa capensis*.

Species over the study period at the three land use practices sites, were classified into seven groups according to their present or absent in the treatments as shown in Figure 3:1.

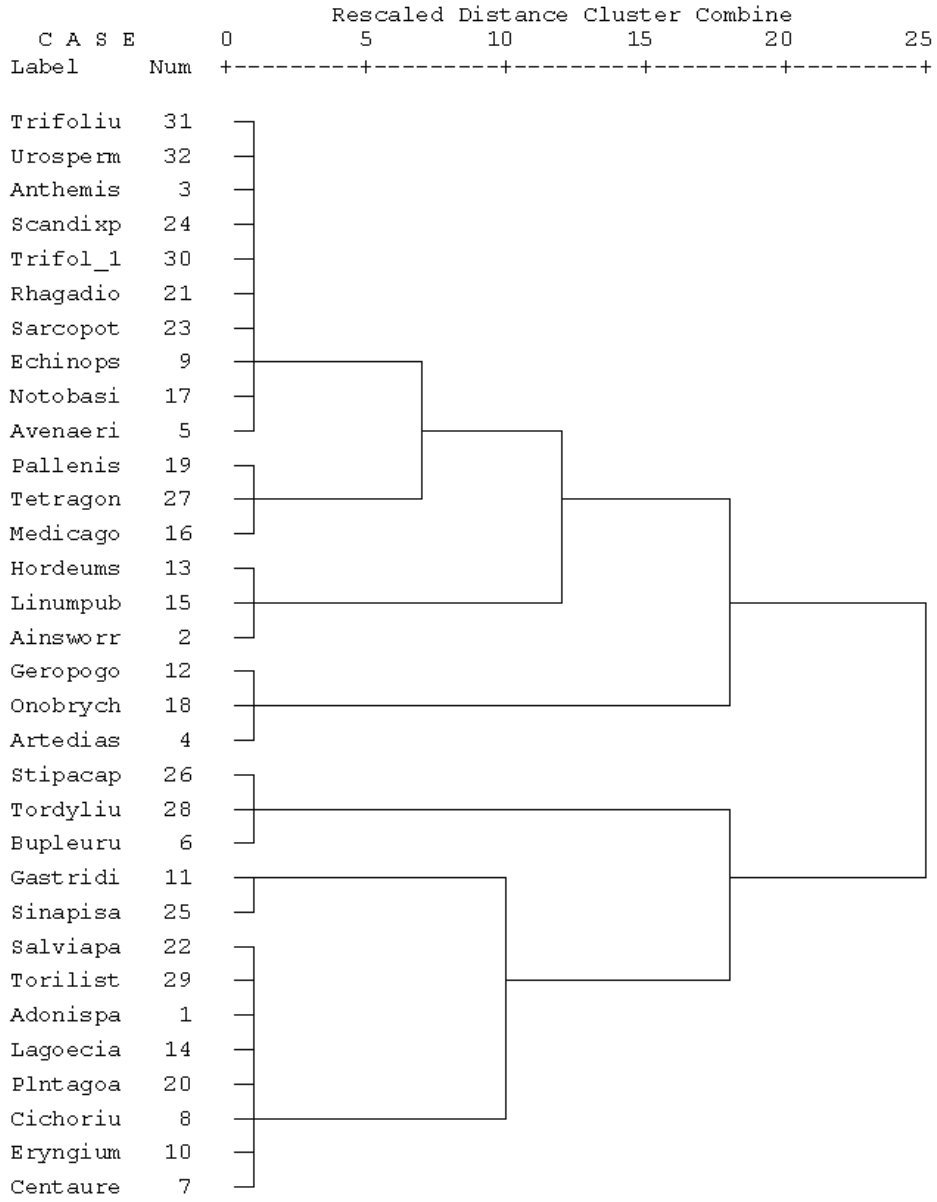

Figure (3.1): Dendrogram resulted from hierarchical cluster analysis using average linkage (within groups) method for the different vegetation composition of land use practices.

3.1.4 Similarity and plant response:

The similarity coefficient between the vegetation compositions at different land use practices study sites ranged between 37.9% and 65.4%, similarity between the under-grazing grassland quadrats and recently non-grazed grassland quadrats were the highest value in mid April 2006 (65.4%), and this similarity tented to decrease with time to reach 53.6% in mid April 2007 (Table 3.3).

Table (3.3): Jaccard similarity coefficients (%) between vegetation composition at different land use practices at study sites at the two sampling dates 2006 and 2007.

Land use practice	G[1]		P[1]	
	2006	2007	2006	2007
C[1]	39.3	39.3	44.8	37.9
G[1]	1.0	1.0	65.4	53.6

[1]C=natural reserve grassland, G=under-grazing grassland, P=recently non-grazed grassland

Figure 3.2 showed the similarity analysis for vegetation of the different land use practices treatments. Two clusters or groups were emerged. The first cluster was the under-grazing grassland and recently non-grazed grassland. The second cluster was the natural reserve grassland.

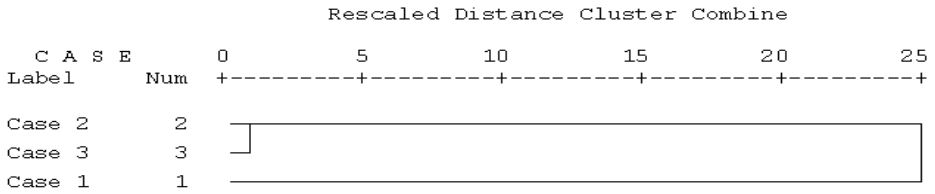

Figure (3.2): Dendrogram resulted from hierarchical cluster analysis using average linkage (between groups) method for the different vegetation composition of land use practices (case 1 = Natral reserved grassland, case 2 = Under-grazing grassland, case 3 = Recently non grazing grassland)

Natural reserve grassland over the two consecutive growing seasons (mid April 2006 and 2007) yielding the highest percent of highly palatable species and the lower percent of low palatable species, while the higher percent of low palatable species obtained in recently non-grazed grassland and under-grazing grassland (Table 3.4).

Table (3.4): Means of the percent of highly palatable and low palatable species at land use practices study sites at the two sampling date, mid April 2006, 2007

Site	Natural reserve grassland		Undr-grazing grassland		Recently non-grazing grassland	
Date	2006	2007	2006	2007	2006	2007
Total no. of species	18	19	21	20	22	23
% of highly palatable species	66.7	68.4	47.6	35	36.4	43.5
% of low palatable species	33.3	31.6	52.4	65	63.6	56.5

3.1.5 Natural vegetation diversity:

3.1.5.1 Species richness:

Over the two consecutive growing seasons, low variation was observed for means of species richness between the land uses treatments in the study sites, it was 11, 11.7, and 13.7 in C, G, and P respectively in mid April 2006 and it was 12.3, 13.3, and 14.3 in C, G, and P respectively in mid April 2007. The recently non-grazed grassland showed the highest species richness, followed by under-grazing grassland, while the lowest species richness was obtained at the natural reserve grassland (Table 3.5).

3.1.5.2 Species evenness:

Over the two consecutive growing seasons significant variation was observed for the means of plant species evenness between the study sites under the land use practices, it was 0.5, 0.4, and 0.6 in C, G, and P respectively in mid April 2006 and it was 0.5, 0.4, and 0.7 in C, G, and P respectively in mid April 2007. Under-grazing grassland showed the lowest evenness than other two treatments. There was slightly variation between the natural reserved grassland and recently non-grazed grassland (Table 3.5).

3.15.3 Shannon – Wiener Index:

Over the two consecutive growing seasons significant variation was observed for the means of Shannon – wiener index between the study sites under the land use practices, it was 1.1, 0.9, and 1.5 in C, G, and P respectively in mid April 2006 and it was 1.4, 0.9, and 1.8 in C, G, and P respectively in mid April 2007. Th recently non-grazed grassland and natural reserved grassland showed a significant higher Shannon – wiener index than under-grazing grassland treatment (Table 3.5).

Table (3.5): Means ± standard deviation of the natural vegetation diversity measures during the study period at the land use practices sites at the two sampling date, mid April 2006, 2007.

Measure	Date	C[1]	G[1]	P[1]	Sig.
Species diversity H`Index	2006	ab[2] 1.1±0.1	b 0.9±0.2	a 1.5±0.2	0.021
	2007	a 1.4±0.3	b 0.9±0.2	a 1.8±0.2	0.01
Species richness (no.of species)	2006	11.0±2.0	11.7±0.6	13.7±1.2	0.121
	2007	12.3±2.3	13.3±2.0	14.3±1.5	0.512
Equitability or evenness	2006	ab 0.5±0.0	b 0.4±0.1	a 0.6±0.1	0.02
	2007	a 0.5±0.1	b 0.4±0.1	a 0.7±0.0	0.003

[1] C = natural reserved grassland, G = Under-grazing grassland, p = Recently non-grazed grassland)

[2] means with the same letter per row are not significantly different at $p \leq 0.05$.

3.1.6. Plant density:

Non significant variation in plant density was observed in mid April 2006 between the land uses treatments in the study sites. In mid April 2007, the natural reserved grassland showed significantly the highest density, followed by recently non-grazed grassland and the lowest density was obtained at under-grazing grassland (Table 3.6) However, the later two treatments did not differ significantly in plant density over the two growing season.

Table (3.6): Means ± standard deviation of plant density during the study period at the land use practices sites at the two sampling date, mid April 2006, 2007.

	Date	C[1]	G[1]	P[1]	Sig.
Plant density (plant / m^2)	2006	233.3±108.9	69.7±31.0	136.3±5.2	0.081
		a[2]	b	ab	
	2007	248.3±78.8	56.33±22.5	152.7±54.0	0.017

[1] C = natural reserved grassland, G = Under-grazing grassland, p = Recently non-grazed grassland)

[2] means with the same letter per row are not significantly different at $p \leq 0.05$.

3.1.7 Results of vegetation characters in the reclaimed grassland:

It was observed that vegetation characteristics of the reclaimed grassland as a land use change were greatly different from others (natural reserved grassland, under-grazing grassland, recently non-grazed grassland). Table 3.7 showed that the mean relative vegetation cover, mean plant density, and total number of species were low when compered with the same attributes of the other sites in tables (3.2 and 3.6).

It was noted from the vegetation composition comparison that *Anagallis arvensis L., Catananche lutea L, Convolvulus pentapetaloides L., Helianthemus salicifolium (L) Miller and Malcolmia crenulata (DC.) Boiss.var.crenulata* were species present only in the reclaimed grassland.

Table 3.7 showed that the mean of Shannon–Wiener Index in the reclaimed grassland at the two sampling date mid April 2006 and mid April 2007 was 0.19, 0.22 respectively, these diversity values were low when compered with the other sites in table (3.5). It also showed that species evenness was 0.11, 0.20 in the mid April 2006 and mid April 2007 respectively and these values were low when compared whith the species evenness of other sites in table (3.5) .

Table (3.7): Vegetation composition, mean of relative vegetation cover, Braun-Blanquet scale, mean of species density, frequency at the reclaimed grassland at the two sampling dates.

	mid April 2006				mid April 2007			
Species (scientific name)	**Relative cover**	**Frequency**	**Braun-Blanquet**	**Density**	**Relative cover**	**Frequency**	**Braun-Blanquet**	**Density**
Adonis palestina Bois	0.33	0.66	+	0.67				
Anagallis arvensis L.	0.17	0.33	+	2.00	0.17	0.33	+	2.00
Avena eriantha Durieu					1.33	0.66	1	2.67
Bupleurum brevicaule Schlecht.	0.17	0.33	+	0.67				
Catananche lutea L.	0.17	0.33	+	0.33				
Convolvulus pentapetaloides L.	0.17	0.33	+	0.33				
Gastridium scabrum C.Presl	0.17	0.33	+	0.33				
Helianthemus salicifolium(L)	0.17	0.33	+	0.67				
Hordeum spontaneum C.Koch	0.17	0.33	+	0.33	1.33	0.66	1	3.33
Lagoecia cuminoides L.	0.17	0.33	+	0.33				
Malcolmia crenulata (DC.) Boiss.	0.17	0.33	+	0.67				
Notobasis syriaca (L.) Cass.	0.33	0.66	+	0.67	1.83	1	1	2.00
Plntago afra L.	0.33	0.66	+	2.33	0.33	0.33	+	1.00
Salvia palaestina Bentham	1.67	0.33	1	1.33	1.00	0.33	1	0.67
Tordylium aegyptiacum(L.)Lam.	0.17	0.33	+	1.00				
Trifolium stellatum L.	0.17	0.33	+	0.33				
Mean Relative cover	4.50				6.00			
Mean Density	12.00				11.67			
Mean of Shannon –	0.19				0.22			
Mean of species	0.11				0.20			
Total number of species	15				6			

Table 3.8 showed that mean of above ground biomass in the reclaimed grassland were reduced from the end March 2007 to mid April 2007 it was 3332.8 and 1008 kg/ha respectively, and these means were higher than the means of above ground biomass of the under-grazing grassland while it is lower than natural reserved grassland and recently non-grazed grassland.

Table (3.8): Above ground biomass means in Kg/ha at the study sites at three sampling dates.

Date of sampling	C[1]	G[1]	P[1]	R[1]	Sig.
	a[2]	ab	ab	b	
17/6/2006	6336.00	1719.11	2193.77	0.00	0.072
	a	c	b	bc	
31/3/2007	9104.00	1184.533	3946.66	3334.22	0.00
	a	c	b	c	
13/4/2007	10858.67	730.66	4688.00	1008.00	0.00

[1] C = natural reserved grassland, G = Under-grazing grassland, p = Recently non-grazed grassland, R = Reclaimed grassland)

[2] means with the same letter per row are not significantly different at $p \leq 0.05$.

3.2 Soil characteristics:

The soil of the four study sites has generally the same characteristics as shown in (Table 3.9). They have clay texture, neutral soil (pH 6.5-7.5), soil organic matter were relatively high in the four sites and there is nearly no differences in the four sites, soil moisture content were high in the four study sites in 2006 than 2007.

Table (3.9): Physical and chemical properties of soil at study sites in the two sampling date.

Treatments	Soil texture	Soil moisture content%		pH		Organic matter%	
		Apr-06	Apr-07	Apr-06	Apr-07	Apr-06	Apr-07
C[1]	clay	21.9	15.47	7.37	6.83	3.96	3.40
G[1]	clay	21.9	13.76	7.37	6.84	3.79	3.50
P[1]	clay	20.5	13.38	7.44	6.8	3.96	3.44
R[1]	clay	21.2	19.33	7.5	7.13	3.79	2.42

[1] C = natural reserved grassland, G = Under-grazing grassland, p = Recently non-grazed grassland, R = Reclaimed grassland)

3.3 Climatic condition:

3.3.1 Rain fall distribution:

The inter-annual and within-season rainfall during the research period are presented in Fig. 3.3. The data recorded showed a clear variation between the two rainfall seasons in the total amount and the distribution of the precepitation., although the onset of the rains in the two seasons were in October, the amount of rain that fall in October 2005 were 7 mm and this amount was very small when compared to 83 mm in October 2006 (Appendix G).

The total rainfall in the first and second season were amounted to 103% and 93% respectively of the long-term annual average for the site.

In the two season (2005-2006) and (2006-2007), 55% and 50% of the total annual rainfall occurring before the onset of grazing which occurs at the beginning of February in the two seasons.

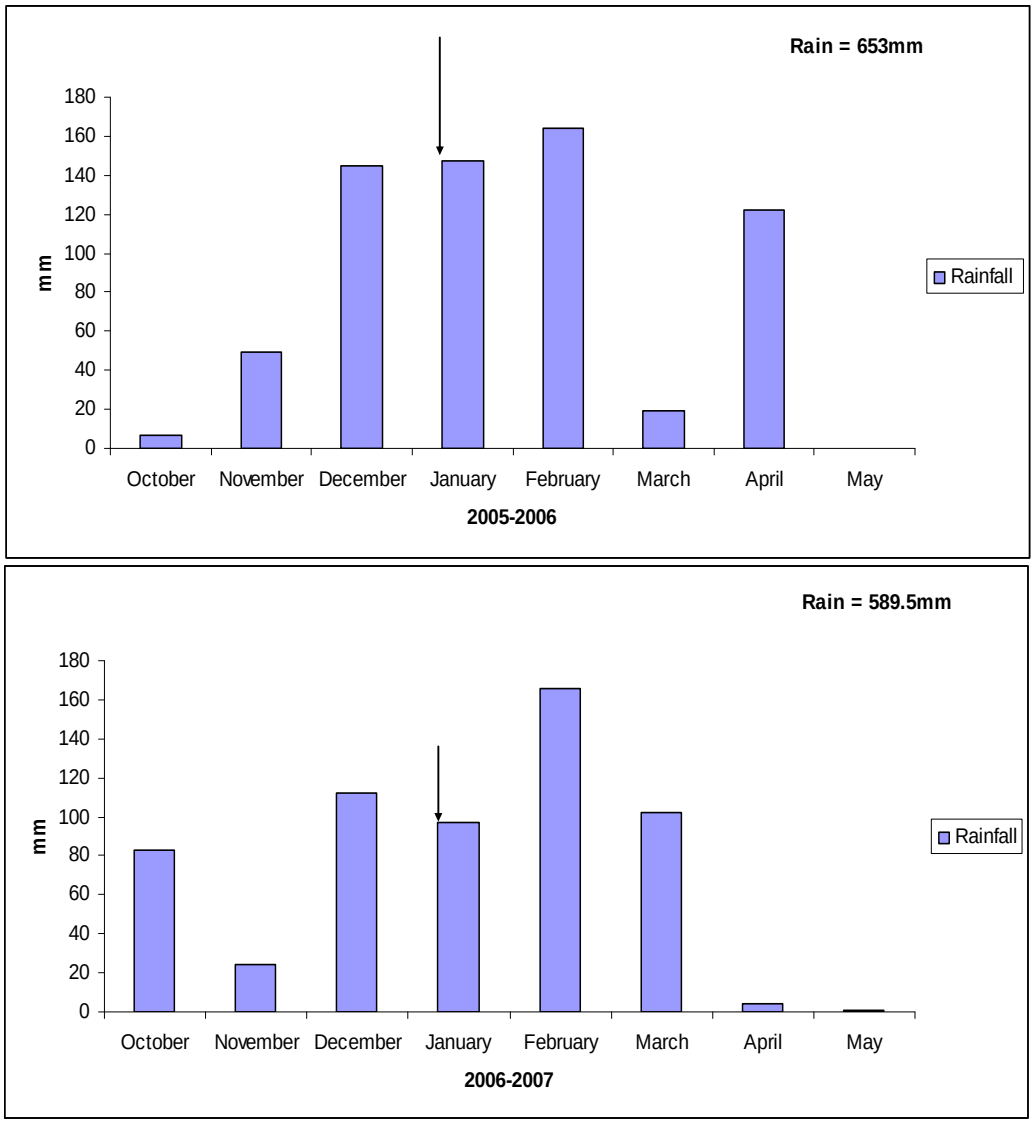

Figure.(3.3): Precipitation distribution at monthly intervals at Nablus station during the rainfall seasons2005-2006 and 2006-2007. Arrows indicate the start of grazing.

3.3.2 Temperature:

Temperature during the period of the experiment are shown in Table 3.9 and Figure 3.4, it was noted that there were no differences in the means of monthly, maximum, minimum temperature of the two seasons 2005-2006 and 2006-2007.

Table (3.10): Means of monthly, maximum, minimum temperature of the two season 2005-2006 and 2006-2007 at study area

Season	Temp.(C)	October	November	December	January	February	March	April
2005-2006	mean monthly temp.	21.50	17.40	15.20	11.63	13.93	16.33	18.93
	mean monthly Max temp.	27.30	21.80	20.10	15.41	18.78	22.44	25.19
	mean monthly Min temp.	18.30	13.70	12.30	8.55	10.17	11.71	14.59
2006-2007	mean monthly temp.	23.37	17.33	12.87	12.36	13.73	15.51	18.79
	mean monthly Max temp.	29.47	22.81	17.01	16.46	18.04	20.41	24.69
	mean monthly Min temp.	19.27	13.34	8.98	8.43	10.17	11.16	14.08

Source: Albadan agroclimatic station

Chapter four

Discussion

4.1 Vegetation cover

4.2 Species compositions, similarity and species response.

4.3 Natural vegetation diversity.

4.4 Plant density.

4.5 Vegetation characters in the reclaimed grassland.

4.6 Conclusion.

4.7 Recommendations.

4.1. Vegetation cover:

No one denies the fact that grazing has had a significant effect on ecosystems, or if grazing had been excluded, significant change in the community structure and floristic composition will occur. In this study, the low values in total vegetation cover and above ground biomass in under-grazing grassland (Table 3.1) can be attributed to grazing sheep's and goats that affected vegetation growth directly through consumption and trampling, or due to the nature of plant species that grow under grazing (prostrate species, dwarf species, species with medium specific leaf area, etc.) (Peco et al., 2005).

On the other hand, the higher values (total vegetation cover and above ground biomass) were obtained in natural reserved grassland and recently non-grazed grassland. This can be attributed to the exclusion of livestock grazing and subsequently vegetation accumulation for five years in natural reserved grassland and one year in the recently non-grazed grassland, or due to the nature of plant species that grow in natural reserved grassland (taller plants, heavy leaf dry weight, species with heavy seeds etc.).

Hence, the natural vegetation in our study area has showed a high potential to revegetate within few years by controlling grazing.

The present results are therefore in agreement with those of Marrs et al., (1989) who found that reductions in utilization of vegetation due to grazing exclusion will have important feedback effects on ecosystem

function, as a result of changes in above-ground biomass, species composition and vegetation quality.

The present results are also in agreement with those of other similar studies (McNaughton, 1979; Vickery, 1981; Floret, 1981; Noy-Meir, 1990; Ayyad et al., 1990; Huntly, 1991; Skarpe, 1991) who also found substantial changes in the vegetation of rangelands following the exclusion or control of grazing.

Both the total and relative vegetation cover in the natural reserved grassland and the recently non-grazed grassland were higher in mid April of 2007 than mid April of 2006. This seems to be due to the difference in distribution of precipitation.where it was 7 mm in October 2005 compared to 83 mm in October 2006. The vegetation therefore began new growth earlier in the season 2006 than 2005. Similar results were obtained by (Mohamad, 2000) in the Southern part of West Bank, where he concluded that the distribution of the precipitation in the growing season and soil characteristics determine rangeland productivity.

Hence, the present results are in consistence with observations from other studies that have attempted to relate changes in vegetation to rainfall and grazing intensity (Lauenroth & Sala, 1992; Biondini et al., 1998; Koukoura et al., 1998).

4.2 Species compositions, similarity and species response:

The emerged seven different groups of plant species resulted from hierarchical cluster analysis for the different vegetation composition of land use practices (Table 4.1), showed that there were differences in the floristic composition of the study sites.

The under-grazing, non-grazed and natural reserve grassland only share approximately 31% of the species (10 species), while the other 69% are exclusive to under-grazing or recently non-grazing or natural reserve grassland or share between any two land use practices (Table 4.1).

The similarity between the type of species present in the natural reserve grassland and the under-grazing grassland and recently non-grazed grassland for each vegetation type was very low.

Low similarities were observed when the natural reserve grassland quadrats were compared to under-grazing and recently non-grazed grassland quadrats, while the highest similarity was observed when the. recently non-grazed grassland quadrats were compared to under-grazing (Fig. 3.2).

The main factor explaining changes in the floristic composition of the study sites is grazing, which effects the competition potential for the palatable species. It often plays an important factor in Mediterranean environments, the exclusion of grazing of long-term grazing zone was also found to be associated with profound changes in floristic composition (Peco et al., 2006).

In the present study the floristic composition at the three study sites, not only differed in the type of species present or shared in these sites, but also differed in the relative vegetation cover of each species and the density of each one. Such differences may be attributed to because the fact that grazing affects the competition potential for the palatable species, and may also be due to the physiological and morphological adaptations of the different plant species present (Kemp, 1983), each being adapted for utilizing a particular phase of the seasonally and yearly variable water. The occurrence of suitable microsite for the establishment of certain species may also determine their presence and abundance within the community, and in the long term this may be modify the successional trajectory of the community (Sternberg et al., 1999). The present results are in agreement with those obtained by Mohammad (2000).

This result coincides with findings by other authors who recognize that livestock grazing has a considerable effect on community structure and floristic composition (Milchunas & Lauenroth, 1993; Bullock et al., 1995).

We also detected a local species indicators of the grazing level in the area of the study: *Sarcopoterium spinosum(L.), Echinops polyceras Boiss* and *Notobasis syriaca (L.) Cass* are thistle and low palatable species found under the three landuse practice sites. The presence of thistle species are indicator of grazing and plant response to grazing in the area by modifying thistles.

Species that found in the under-grazing grassland were mostly low palatable to grazing, mostly small, prostrate or rosette plants while in

natural reserve grassland the dominant species were mostly palatable to grazing, mostly tall and erect plants (eg., *Avena eriantha*, *Hordeum spontaneum*). By excluding grazing these plants have the chance to grow and reproduce.

The presence of *Hordeum spontaneum* and *Linum pubescens* which are highly palatable species in the recently non-grazing and natural reserve grassland quadrats and the absence of both species in under-grazing grassland was due to the absence or presence of grazing animals which justify the decrease in similarity with time between under-grazing grassland and recently non-grazing grassland, the appearance and speed of the regrowth and spread of these species in recently non-grazing grassland were indicative of the high potential of the ecosystem for rehabilitation in short time.

In this study plant species seemed to have responded to grazing by decreasing number of high palatable species and increasing low palatable species. The opposite trend were obtained when grazing were excluded by fencing. These results are in agreement with those of Hendricks et al., (2005) who showed that plant community responded to heavy grazing near stock posts by the reduction of palatable grass species sensitive to heavy grazing and the replacement of these species with species of lower palatability, thereby lowering grazing pressure.

Table (4.1): species palatability and groups resulted from hierarchical cluster analysis using average linkage (within groups) method for the different vegetation composition of land use practices**.**

Group description	Species present	Palatability
1. Species present in C,G&P[1]	*Avena eriantha*	H[2]
	Trifolium stellatum	H
	Trifolium clypeatum	H
	Urospermum picroides	H
	Anthemis nabataea	H
	Scandix pecten-veneris	L[2]
	Rhagadiolus edulis Gaetner	L
	Sarcopoterium spinosum(L.)	L
	Echinops polyceras Boiss	L
	Notobasis syriaca (L.) Cass	L
2. Species only present in P&G	*Plntago afra L.*	H
	Salvia palaestina Bentham	L
	Torilis enella	L
	Adonis palestina	L
	Lagoecia cuminoides	L
	Cichorium pumilum	L
	Eryngium barrelieri Boiss	L
	Centaurea procurrens	L
3. Species only present in C&G	*Pallenis spinosa (l.) Cass*	H
	Medicago rotata,	H
	Tetragonolobus palaestinus	H

4. Species present in P only	*Tordylium aegyptiacum*	L
	Bupleurum brevicaule Schlecht	H
	Stipa capensis	H
5 Species only present in P &C	*Ainsworrthia trachycarpa Boiss*	L
	Hordeum spontaneum	H
	Linum pubescens	H
6. Species present in G only	*Gastridium scabrum*	H
	Sinapis alba	L
7. Species present in C only	*Onobrychis caput- galli*	H
	Artedia squamata	H
	Geropogon hybridus	H

[1]C = natural reserved grassland, G = Under-grazing grassland, P= Recently non-grazed grassland., [2]H = highly palatable to grazing, L = low palatable to grazing.

4.3. Natural vegetation diversity:

Removal of the vegetation, whether anthropogenic or unintentional (pasturage), causes changes in the physical environment, so that the day light intensity, temperature and evaporation rate increase at the ground level. This normally leads to changes in vegetation composition, species richness and species diversity (Kutiel et al., 2000)

Continuous grazing with moderate grazing intensities allows the establishment and development of a more species-rich community compared to seasonal grazing (Sternberg et al., 2000). Grazing animals have been reported to play a unique role in maintaining and enhancement of grassland heterogeneity through selective defoliation between species that alters competitive advantage between species both by direct removal of biomass and by altering the competition for light and soil nutrient (Andrew &Tallowin, 2003)

The differences in species richness might be due to grazing animals that have a role in propagule dispersal in under-grazing grassland. This process can be achieved by seeds passing through the animals digestive system, or by seeds attaching to the animals coat. These diverse seeds germinate and grow and increase species richness, and this justified why species richness were slightly higher in. under-grazing grassland than in natural reserved grassland (Table 3.5).

When the under-grazing grassland becomes protected from grazing, there will no consumption for the palatable species by grazing animals and the appearance of this palatable species will increase the species richness, and this

justified why species richness were slightly higher in recently non-grazed grassland than in under-grazing grassland (Table 3.5).

The average of Shannon–Wiener Index and evenness found in under-grazing grassland was significantly the lowest when compared to the sites that excluded from grazing (natural reserved grassland and recently non-grazed grassland). This can be attributed to grazing animals that made patches through the selection of the palatable species for grazing, and thus decreased the relative vegetation cover of these species and decreased the evenness of speciess distribution and finally decreased the diversity (Shannon–Wiener Index). These differences might also be due to grazing animals that have a role in propagule dispersal in under-grazing grassland. This process can be achieved by seeds passing through the animals digestive system, or by seeds attaching to the animals coat. These diverse seeds germinate and grow and increase species richness. When the under-grazing grassland protected from grazing, there were no consumption for the palatable species which increased the species richness, density, biomass, and finally the diversity index more in the recently non-grazed grassland than before in the under-grazing grassland).

Species evenness was less in natural reserve grassland when compared to the recently non-grazing grassland and this is because the species richness was the lowest in the natural reserve grassland.

Species were less even in their distribution at quadrat scale in the natural reserve grassland due to the very high density of highly palatable species *Avena eriantha* and *Hordeum spontaneum* when compared to the density of other species present. The high density of the two species where due their fast

reproduction method (seeds), short life-cycle (annual species), high palatability for grazing animals, and exclusion of grazing in the site.

Species were more even in their distribution in the recently non-grazing grassland and this is because the density of each species present nearly the same. The lowest even in the species distribution that obtained in the under-grazing grassland attributed to lowest Shannon–Wiener Index in the site

4.4. Plant density:

The higher plant density obtained in natural reserve grassland is mainly due to the absence of grazing in the last five years which has provided the plants with the chance each year to grow, flower and produce seed which fall to ground in the same site and many of them germinate in the second year and so on.

The low plant density obtained in the under-grazing grassland was probably due to the consumption of plants by grazing animals at the beginning of their growing season, and therefore did not have chance to reach the flowering and reproductive stage. These results are in agreement with those of Zaady et al.(2001) who found that grazing had immediate effects on plant community and habitat structure and the densities of plant species (decrease).

The slightly higher plant density obtained in the recently non-grazing is because this site was previously a part of grassland suffering from grazing and had only been fenced and protected from grazing in October 2005. No plant consumption therefore had taken place through

grazing for the last two seasons (2005-2006, 2006-2007). This has also resulted in an increase in the number of individuals of plants more than in under-grazing grassland. This process was also the reason why the density differed in the two sampling dates.

The present study demonstrates that under similar environmental condition (semi-arid Mediterranean climate) there is a high potential for natural revegetation in the degraded grassland ecosystems in Al-Fara'a area within a short period of time.

4.5 Vegetation characters in the reclaimed grassland:

The lower values of the mean of Shannon –Wiener Index in reclaimed grassland that obtained can be attributed to extensive human disturbance due to urbanization and agricultural activities, which can alter succesional processes due to the loss of native seed banks and proximate seed sources and to the rapid invasion of exotic weedy species (Allen, 1988; D'Antonio & Vitousek, 1992). Such alterations can lead to reduction of native species cover and richness (Lathrop, 1983; Waaland & Allen, 1987).

The species that present only in the reclaimed grassland was probably due to their presence in the soil seed bank and when this grassland was ploughed again, the seeds reappeared from the seed bank. This result is in agreement with those of Amiaud & Touzard (2004) who showed that the seeds reserves hidden in the soil germinate when natural or human disturbances take place.

4.6. Conclusions:

- The area of our study suffered from heavy grazing and land reclamation projects that negatively affect the natural vegetation diversity.
- The present study demonstrates that under similar environmental condition (semi-arid Mediterranean climate) there is a high potential for natural revegetation in the degraded grassland ecosystems in Al-Fara'a area within a short period of time
- The distribution of the precipitation in the growing season, seem to determine range land productivity.
- Agricultural practices specially ploughing have a negative effects in natural vegetation diversity

4.7. Recommendations:

1. Long term studies in our study area are necessary to understand the effect environmental factors (e.g. rainfall, temperature.) and edaphic factors on natural vegetation diversity.

2. Short term grazing exclusion (two years) may have important consequences and a vital role to play in nature conservation in grassland ecosystem and managements.

3. Temporary conversion of grassland into cultivated land leads to drastic change in natural vegetation and therefore should be avoided.

4. Identification of range land in Palestine and confine their use to grazing. Such lands would not therefore be included in land reclamation projects.

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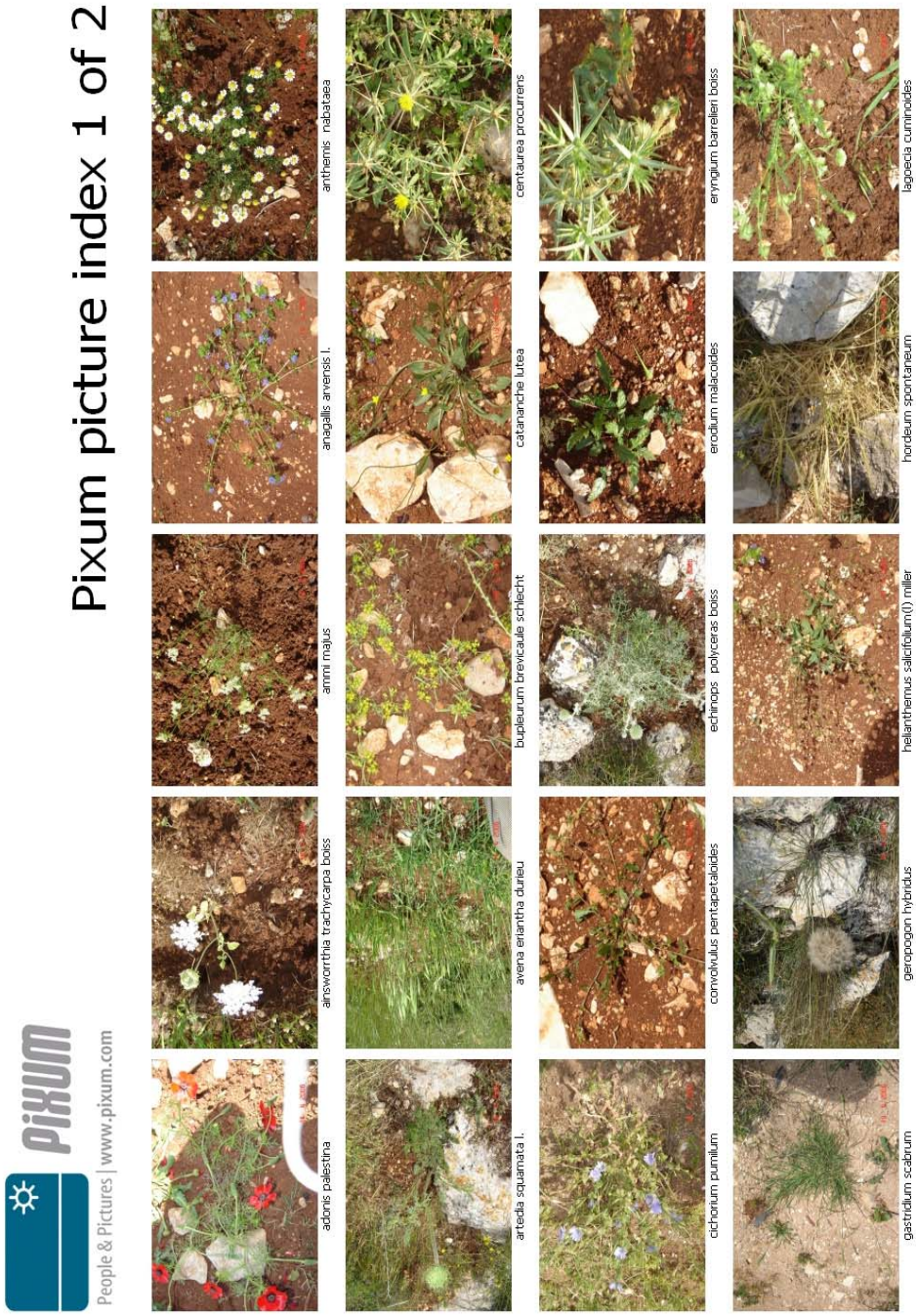
Appendices.

Appendix (A): Species presents in the Study sites.



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linum pubescens | malcolmia crenulata(dc.)boiss.var.crenulata | medicago rotata boiss | notobasis syriaca (l.) cass. | onobrychis caput- galli

pallenis spinosa (l.) cass | plntago afra l. | rhagadiolus edulis gaetner | salvia palaestina bentham | sarcopoterium spinosum(l.)

scandix pecten-veneris | sinapis alba | stipa capensis | tetragonolobus palaestinus | tordylium aegyptiacum

torilis tenella | trifolium clypeatum | trifolium stellatum | urospermum picroides

Appendix (B): Palatability of species in the study sites.

Family name	Scientific name	palatability	Reference
CISTACEAE	*Geropogon hybridus (L.) Schultz Bip.*	high	local herds traditional knowledge
COMPOSITAE	*Anthemis nabataea Eig*	high	Snkry,1981
COMPOSITAE	*Artedia squamata L.*	high	local herds traditional knowledge
COMPOSITAE	*Avena eriantha Durieu*	high	sternberg,2000,syria
COMPOSITAE	*Catananche Lutea L.*	high	local herds traditional knowledge
COMPOSITAE	*Gastridium scabrum C.Presl*	high	local herds traditional knowledge
COMPOSITAE	*Medicago rotata Boiss*	high	bragheith
COMPOSITAE	*Urospermum picroides (L.)F.W.Schmidt*	high	local herds traditional knowledge
COMPOSITAE	*Pallenis spinosa (L..) Cass*	high	local herds traditional knowledge
COMPOSITAE	*Notobasis syriaca (L.) Cass.*	low	syria ,but good for kamell
COMPOSITAE	*Rhagadiolus edulis Gaetner*	low	local herds traditional knowledge
CONVOLVULACEAE	*Bupleurum brevicaule Schlecht.*	high	local herds traditional knowledge
CRUCIFERAE	*Linum pubescens Banks et Solander*	high	local herds traditional knowledge
CRUCIFERAE	*Sinapis alba(L.)*	low	Sternberg et. al., 2000
GERANIACEAE	*Cichorium pumilum Jacq*	low	local herds traditional knowledge
GRAMINEAE	*Erodium malacoides (l.) L,Her.*	high	Snkry,1981
GRAMINEAE	*Helianthemus Salicifolium(L) Miller*	high	syria
GRAMINEAE	*Stipa capensis Thunb.*	high	local herds traditional knowledge
GRAMINEAE	*Ainsworrthia trachycarpa Boiss*	low	local herds traditional knowledge
LABIATAE	*Salvia palaestina Bentham*	low	Snkry,1981
LINACEAE	*Lagoecia cuminoides L.*	low	syria
PAPILIONACEAE	*Onobrychis caput- galli (L.) Lam.*	high	syria
PAPILIONACEAE	*Tetragonolobus palaestinus Boiss.et Blanche*	high	local herds traditional knowledge
PAPILIONACEAE	*Trifolium clypeatum L.*	high	bragheith
PAPILIONACEAE	*Trifolium stellatum L.*	high	bragheith
PAPILIONACEAE	*Malcolmia crenulata(DC.)Boiss.var.crenulata*	low	Sternberg et. al., 2000
PLANTAGINACEAE	*Plntago afra L.*	good	Snkry,1981
PRIMULACEAE	*Eryngium barrelieri Boiss*	low	Snkry,1981
RANUNCULACEAE	*Centaurea procurrens Sprengel*	low	Snkry,1981
Rosaceae	*Sarcopoterium spinosum(L.)*	low	Ayed Mohamad
UMBELLIFERAE	*Anagallis arvensis L.*	high	local herds traditional knowledge
UMBELLIFERAE	*Convolvulus pentapetaloides L.*	high	local herds traditional knowledge
UMBELLIFERAE	*Hordeum spontaneum C.Koch*	high	Sternberg et. al., 2000
UMBELLIFERAE	*Echinops polyceras Boiss*	low	Sternberg et. al., 2000
UMBELLIFERAE	*Adonis palestina Bois*	low	local herds traditional knowledge
UMBELLIFERAE	*Scandix pecten-veneris L.*	low	Snkry,1981
UMBELLIFERAE	*Tordylium aegyptiacum(L.)Lam.*	low	local herds traditional knowledge
UMBELLIFERAE	*Torilis tenella(Delile)Reichenb.*	low	local herds traditional knowledge

Appendix (C): Calculation of Shannon index and Evenness index.

(C.1): Calculation of Shannon index and Evenness index for the natural reserve grssland at 13-4-2007.

Date:13-4-2007	**Natural reserve grssland**											
Site :natural reserve grssland	**Quadrat1**				**Quadrat2**				**Quadrat3**			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois												
Ainsworrthia trachycarpa Boiss	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03				
Anagallis arvensis L.		0.00				0.00						
Anthemis nabataea Eig		0.00			0.5	0.00	-5.34	-0.03				
Artedia squamata L.		0.00			0.5	0.00	-5.34	-0.03				
Avena eriantha Durieu	20	0.19	-1.65	-0.32	40	0.38	-0.96	-0.37	10	0.10	-2.35	-0.22
Bupleurum brevicaule Schlecht.		0.00				0.00				0.00		
Catananche Lutea L.		0.00				0.00				0.00		
Centaurea procurrens Sprengel		0.00				0.00				0.00		**Cont.(C.1)**

Date:13-4-2007	**Natural reserve grssland**											
Site :natural reserve grssland	**Quadrat1**				**Quadrat2**				**Quadrat3**			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Cichorium pumilum Jacq		0.00				0.00				0.00		
Convolvulus pentapetaloides L.		0.00				0.00				0.00		
Echinops polyceras Boiss	0.5	0.00	-5.34	-0.03	4	0.04	-3.26	-0.12	5	0.05	-3.04	-0.15
Erodium malacoides (l.) L,Her.		0.00				0.00				0.00		
Eryngium barrelieri Boiss		0.00				0.00				0.00		
Gastridium scabrum C.Presl		0.00				0.00				0.00		
Geropogon hybridus (L.) Schultz Bip.		0.00			1	0.01	-4.65	-0.04	2	0.02	-3.96	-0.08
Helianthemus Salicifolium(L) Miller		0.00				0.00				0.00		
Hordeum spontaneum C.Koch	70	0.67	-0.40	-0.27	10	0.10	-2.35	-0.22	55	0.53	-0.64	-0.34
Lagoecia cuminoides L.		0.00				0.00				0.00		**Cont.(C.1)**

Date:13-4-2007	**Natural reserve grssland**											
Site :natural reserve grssland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Linum pubescens Banks et Solander		0.00			2	0.02	-3.96	-0.08	0.5	0.00	-5.34	-0.03
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00				0.00				0.00		
Medicago rotata Boiss	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04	5	0.05	-3.04	-0.15
Notobasis syriaca (L.) Cass.		0.00				0.00			3	0.03	-3.55	-0.10
Onobrychis caput- galli (L.) Lam.	1	0.01	-4.65	-0.04	5	0.05	-3.04	-0.15		0.00		
Pallenis spinosa (L..) Cass	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03		0.00		
Plntago afra L.		0.00				0.00				0.00		
Rhagadiolus edulis Gaetner	0.5	0.00	-5.34	-0.03		0.00				0.00		
Salvia palaestina Bentham		0.00				0.00				0.00		
Sarcopoterium spinosum(L.)		0.00			50	0.48	-0.74	-0.35		0.00		
Scandix pecten-veneris L.		0.00			0.5	0.00	-5.34	-0.03		0.00		**Cont.(C.1)**

Date:13-4-2007	**Natural reserve grssland**											
Site :natural reserve grssland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Sinapis alba(L.)		0.00				0.00				0.00		
Stipa capensis Thunb.		0.00				0.00				0.00		
Tetragonolobus palaestinus Boiss.et Blanche		0.00				0.00			1	0.01	-4.65	-0.04
Tordylium aegyptiacum(L.)Lam.		0.00				0.00				0.00		
Torilis tenella(Delile)Reichenb.		0.00				0.00				0.00		
Trifolium clypeatum L.	5	0.05	-3.04	-0.15	1	0.01	-4.65	-0.04	0.5	0.00	-5.34	-0.03
Trifolium stellatum L.	5	0.05	-3.04	-0.15	0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15
Urospermum picroides (L.)F.W.Schmidt	0.5	0.00	-5.34	-0.03		0.00			4	0.04	-3.26	-0.12
Total cover	104.5				117				91			
Number of species = s	11				15				11			
Shannon index, H` = -∑ Pi (Ln Pi)	1.09				1.58				1.40			
Evenness index, J = H` / Ln s	0.46				0.58				0.58			

(C.2): Calculation of Shannon index and Evenness index for the under-grazing grassland at 13-4-2007.

Date: 13-4-2007	**Under-grazing grassland**											
Site: under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois	0.5	0.00	-5.34	-0.03		0.00						
Ainsworrthia trachycarpa Boiss		0.00				0.00						
Anagallis arvensis L.		0.00				0.00						
Anthemis nabataea Eig	3	0.03	-3.55	-0.10		0.00			8	0.08	-2.57	-0.20
Artedia squamata L.		0.00				0.00				0.00		
Avena eriantha Durieu	0.5	0.00	-5.34	-0.03		0.00				0.00		
Bupleurum brevicaule Schlecht.		0.00				0.00				0.00		
Catananche Lutea L.		0.00				0.00				0.00		
Centaurea procurrens Sprengel	1	0.01	-4.65	-0.04	2	0.02	-3.96	-0.08	1	0.01	-4.65	-0.04
Cichorium pumilum Jacq	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04	0.5	0.00	-5.34	-0.03
Convolvulus pentapetaloides L.		0.00				0.00				0.00		**Comt. (C.2)**

Date: 13-4-2007	**Under-grazing grassland**											
Site: under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Echinops polyceras Boiss	2	0.02	-3.96	-0.08	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04
Erodium malacoides (l.) L,Her.		0.00				0.00				0.00		
Eryngium barrelieri Boiss	3	0.03	-3.55	-0.10	4	0.04	-3.26	-0.12	10	0.10	-2.35	-0.22
Gastridium scabrum C.Presl		0.00				0.00				0.00		
Geropogon hybridus (L.) Schultz Bip.		0.00				0.00				0.00		
Helianthemus Salicifolium(L) Miller		0.00				0.00				0.00		
Hordeum spontaneum C.Koch		0.00				0.00				0.00		
Lagoecia cuminoides L.	3	0.03	-3.55	-0.10	3	0.03	-3.55	-0.10		0.00		
Linum pubescens Banks et Solander		0.00				0.00				0.00		
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00				0.00				0.00		
Medicago rotata Boiss	0.5	0.00	-5.34	-0.03		0.00				0.00		**Comt. (C.2)**

Date: 13-4-2007	**Under-grazing grassland**											
Site: under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Notobasis syriaca (L.) Cass.	3	0.03	-3.55	-0.10	3	0.03	-3.55	-0.10	2	0.02	-3.96	-0.08
Onobrychis caput- galli (L.) Lam.		0.00				0.00				0.00		
Pallenis spinosa (L..) Cass	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04
Plntago afra L.	8	0.08	-2.57	-0.20		0.00			1	0.01	-4.65	-0.04
Rhagadiolus edulis Gaetner		0.00				0.00			0.5	0.00	-5.34	-0.03
Salvia palaestina Bentham	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03		0.00		
Sarcopoterium spinosum(L.)		0.00			2	0.02	-3.96	-0.08		0.00		
Scandix pecten-veneris L.	1	0.01	-4.65	-0.04	0.5	0.00	-5.34	-0.03		0.00		
Sinapis alba(L.)		0.00			2	0.02	-3.96	-0.08		0.00		
Stipa capensis Thunb.		0.00				0.00				0.00		
Tetragonolobus palaestinus Boiss.et Blanche		0.00				0.00				0.00		
Tordylium aegyptiacum(L.)Lam.		0.00				0.00				0.00		**Comt. (C.2)**

Date: 13-4-2007	**Under-grazing grassland**											
Site: under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Torilis tenella(Delile)Reichenb.	10	0.10	-2.35	-0.22		0.00			3	0.03	-3.55	-0.10
Trifolium clypeatum L.		0.00				0.00				0.00		
Trifolium stellatum L.		0.00			0.5	0.00	-5.34	-0.03		0.00		
Urospermum picroides (L.)F.W.Schmidt		0.00			0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03
Total cover	38				21				28.5			
Number of species = s	15				13				11			
Shannon index, H` = -∑ Pi (Ln Pi)	1.18				0.79				0.85			
Evenness index, J = H` / Ln s	0.44				0.31				0.36			

(C.3): Calculation of Shannon index and Evenness index for the recently no grazing grassland at 13-4-2007.

Date: 13-4-2007	**Recently no grazing grassland**											
Site:Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois					0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15
Ainsworrthia trachycarpa Boiss	1	0.01	-4.65	-0.04	0.5	0.00	-5.34	-0.03		0.00		
Anagallis arvensis L.		0.00				0.00				0.00		
Anthemis nabataea Eig	10	0.10	-2.35	-0.22	20	0.19	-1.65	-0.32	1	0.01	-4.65	-0.04
Artedia squamata L.		0.00				0.00				0.00		
Avena eriantha Durieu	5	0.05	-3.04	-0.15	5	0.05	-3.04	-0.15	5	0.05	-3.04	-0.15
Bupleurum brevicaule Schlecht.		0.00			0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15
Catananche Lutea L.		0.00				0.00				0.00		
Centaurea procurrens Sprengel	1	0.01	-4.65	-0.04		0.00				0.00		
Cichorium pumilum Jacq	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03		0.00		
Convolvulus pentapetaloides L.		0.00				0.00				0.00		**Cont.(C.3)**

Date: 13-4-2007	**Recently no grazing grassland**											
Site:Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Echinops polyceras Boiss		0.00				0.00			4	0.04	-3.26	-0.12
Erodium malacoides (l.) L,Her.		0.00				0.00				0.00		
Eryngium barrelieri Boiss	1	0.01	-4.65	-0.04		0.00			5	0.05	-3.04	-0.15
Gastridium scabrum C.Presl		0.00				0.00				0.00		
Geropogon hybridus (L.) Schultz Bip.		0.00				0.00				0.00		
Helianthemus Salicifolium(L) Miller		0.00				0.00				0.00		
Hordeum spontaneum C.Koch		0.00				0.00			5	0.05	-3.04	-0.15
Lagoecia cuminoides L.	1	0.01	-4.65	-0.04		0.00			4	0.04	-3.26	-0.12
Linum pubescens Banks et Solander		0.00				0.00			15	0.14	-1.94	-0.28
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00				0.00				0.00		
Medicago rotata Boiss		0.00				0.00				0.00		**Comt. (C.2)**

Date: 13-4-2007	**Recently no grazing grassland**											
Site:Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Notobasis syriaca (L.) Cass.	3	0.03	-3.55	-0.10		0.00				0.00		
Onobrychis caput- galli (L.) Lam.		0.00				0.00				0.00		
Pallenis spinosa (L..) Cass		0.00				0.00				0.00		
Plntago afra L.	15	0.14	-1.94	-0.28	20	0.19	-1.65	-0.32	0.5	0.00	-5.34	-0.03
Rhagadiolus edulis Gaetner	1	0.01	-4.65	-0.04	2	0.02	-3.96	-0.08		0.00		
Salvia palaestina Bentham		0.00				0.00			1	0.01	-4.65	-0.04
Sarcopoterium spinosum(L.)		0.00			15	0.14	-1.94	-0.28		0.00		
Scandix pecten-veneris L.	10	0.10	-2.35	-0.22		0.00			2	0.02	-3.96	-0.08
Sinapis alba(L.)		0.00				0.00				0.00		
Stipa capensis Thunb.	20	0.19	-1.65	-0.32	5	0.05	-3.04	-0.15	5	0.05	-3.04	-0.15
Tetragonolobus palaestinus Boiss.et Blanche		0.00				0.00				0.00		
Tordylium aegyptiacum(L.)Lam.		0.00				0.00				0.00		**Comt. (C.2)**

Date: 13-4-2007	**Recently no grazing grassland**											
Site:Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Torilis tenella(Delile)Reichenb.	1	0.01	-4.65	-0.04	3	0.03	-3.55	-0.10	2	0.02	-3.96	-0.08
Trifolium clypeatum L.		0.00				0.00			3	0.03	-3.55	-0.10
Trifolium stellatum L.		0.00			1	0.01	-4.65	-0.04		0.00		
Urospermum picroides (L.)F.W.Schmidt	5	0.05	-3.04	-0.15	2	0.02	-3.96	-0.08	5	0.05	-3.04	-0.15
Total cover	74.5				75				67.5			
Number of species = s	14				13				16			
Shannon index, H` = -∑ Pi (Ln Pi)	1.73				1.60				1.91			
Evenness index, J = H` / Ln s	0.66				0.62				0.69			

(C.4): Calculation of Shannon index and Evenness index for the reclaimed grassland at 13-4-2007.

Date: 13-4-2007	**Reclaimed grassland**											
Site reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois		0.00										
Ainsworrthia trachycarpa Boiss		0.00										
Anagallis arvensis L.	0.5	0.00	-5.34	-0.03								
Anthemis nabataea Eig		0.00										
Artedia squamata L.		0.00										
Avena eriantha Durieu	1	0.01	-4.65	-0.04	3	0.03	-3.55	-0.10				
Bupleurum brevicaule Schlecht.		0.00										
Catananche Lutea L.		0.00										
Centaurea procurrens Sprengel		0.00										
Cichorium pumilum Jacq		0.00										
Convolvulus pentapetaloides L.		0.00										

Cont.(C.4)

Date: 13-4-2007	**Reclaimed grassland**											
Site reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Echinops polyceras Boiss		0.00										
Erodium malacoides (l.) L,Her.		0.00										
Eryngium barrelieri Boiss		0.00										
Gastridium scabrum C.Presl		0.00										
Geropogon hybridus (L.) Schultz Bip.		0.00										
Helianthemus Salicifolium(L) Miller		0.00										
Hordeum spontaneum C.Koch	2	0.02	-3.96	-0.08	2	0.02	-3.96	-0.08				
Lagoecia cuminoides L.		0.00										
Linum pubescens Banks et Solander		0.00										
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00										
Medicago rotata Boiss		0.00										**Cont.(C.4)**

Date: 13-4-2007	**Reclaimed grassland**											
Site reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Notobasis syriaca (L.) Cass.	0.5	0.00	-5.34	-0.03	2	0.02	-3.96	-0.08	3	0.03	-3.55	-0.10
Onobrychis caput- galli (L.) Lam.		0.00										
Pallenis spinosa (L..) Cass		0.00										
Plntago afra L.		0.00							1	0.01	-4.65	-0.04
Rhagadiolus edulis Gaetner		0.00										
Salvia palaestina Bentham	3	0.03	-3.55	-0.10								
Sarcopoterium spinosum(L.)		0.00										
Scandix pecten-veneris L.		0.00										
Sinapis alba(L.)		0.00										
Stipa capensis Thunb.		0.00										
Tetragonolobus palaestinus Boiss.et Blanche		0.00										
Tordylium aegyptiacum(L.)Lam.		0.00										
Torilis tenella(Delile)Reichenb.		0.00										**Cont.(C.4)**

Date: 13-4-2007	**Reclaimed grassland**											
Site reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Trifolium clypeatum L.		0.00										
Trifolium stellatum L.		0.00										
Urospermum picroides (L.)F.W.Schmidt		0.00										
Total cover	7				7				4			
Number of species = s	5				3				2			
Shannon index, H` = -∑ Pi (Ln Pi)	0.27				0.25				0.15			
Evenness index, J = H` / Ln s	0.17				0.23				0.21			

(C.5): Calculation of Shannon index and Evenness index for the natural reserve grssland at 14-4-2006.

Date: 14-4-2006	**Natural reserve grssland**											
Site: Natural reserve grssland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois		0.00										
Ainsworrthia trachycarpa Boiss	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03				
Anagallis arvensis L.		0.00				0.00						
Anthemis nabataea Eig	0.5	0.00	-5.34	-0.03		0.00						
Artedia squamata L.		0.00			0.5	0.00	-5.34	-0.03				
Avena eriantha Durieu	8	0.08	-2.57	-0.20	30	0.29	-1.25	-0.36	5	0.05	-3.04	-0.15
Bupleurum brevicaule Schlecht.		0.00				0.00				0.00		
Catananche Lutea L.		0.00				0.00				0.00		
Centaurea procurrens Sprengel		0.00				0.00				0.00		
Cichorium pumilum Jacq		0.00				0.00				0.00		
Convolvulus pentapetaloides L.		0.00				0.00				0.00		**Cont.(C.5)**

Date: 14-4-2006	**Natural reserve grssland**											
Site: Natural reserve grssland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Echinops polyceras Boiss	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03
Erodium malacoides (l.) L,Her.		0.00				0.00				0.00		
Eryngium barrelieri Boiss		0.00				0.00				0.00		
Gastridium scabrum C.Presl		0.00				0.00				0.00		
Geropogon hybridus (L.) Schultz Bip.		0.00			0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03
Helianthemus Salicifolium(L) Miller		0.00				0.00				0.00		
Hordeum spontaneum C.Koch	50	0.48	-0.74	-0.35	5	0.05	-3.04	-0.15	60	0.57	-0.55	-0.32
Lagoecia cuminoides L.		0.00				0.00				0.00		
Linum pubescens Banks et Solander	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00				0.00				0.00		
Medicago rotata Boiss	0.5	0.00	-5.34	-0.03		0.00			0.5	0.00	-5.34	-0.03

Continue (C:5)

Date: 14-4-2006	**Natural reserve grssland**											
Site: Natural reserve grssland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Notobasis syriaca (L.) Cass.		0.00				0.00			5	0.05	-3.04	-0.15
Onobrychis caput- galli (L.) Lam.	0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15		0.00		
Pallenis spinosa (L..) Cass	0.5	0.00	-5.34	-0.03		0.00				0.00		
Plntago afra L.		0.00				0.00				0.00		
Rhagadiolus edulis Gaetner	0.5	0.00	-5.34	-0.03		0.00				0.00		
Salvia palaestina Bentham		0.00				0.00				0.00		
Sarcopoterium spinosum(L.)		0.00			50	0.48	-0.74	-0.35		0.00		
Scandix pecten-veneris L.		0.00			0.5	0.00	-5.34	-0.03		0.00		
Sinapis alba(L.)		0.00				0.00				0.00		
Stipa capensis Thunb.		0.00				0.00				0.00		
Tetragonolobus palaestinus Boiss.et Blanche		0.00				0.00				0.00		
Tordylium aegyptiacum(L.)Lam.		0.00				0.00				0.00		
Torilis tenella(Delile)Reichenb.		0.00				0.00				0.00		**Cont.(C.5)**

Date: 14-4-2006	**Natural reserve grssland**											
Site: Natural reserve grssland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Trifolium clypeatum L.	5	0.05	-3.04	-0.15	1	0.01	-4.65	-0.04		0.00		
Trifolium stellatum L.	8	0.08	-2.57	-0.20		0.00			5	0.05	-3.04	-0.15
Urospermum picroides (L.)F.W.Schmidt	0.5	0.00	-5.34	-0.03		0.00			5	0.05	-3.04	-0.15
Total cover	76				94.5				82.5			
Number of species = s	13				11				9			
Shannon index, H` = -∑ Pi (Ln Pi)	1.14				1.22				1.02			
Evenness index, J = H` / Ln s	0.44				0.51				0.46			

(C.6): Calculation of Shannon index and Evenness index for the under-grazing grassland at 14-4-2006.

Date: 14-4-2006	**Under-grazing grassland**											
Site:Under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03				
Ainsworrthia trachycarpa Boiss		0.00				0.00						
Anagallis arvensis L.		0.00				0.00						
Anthemis nabataea Eig	8	0.08	-2.57	-0.20		0.00			10	0.10	-2.35	-0.22
Artedia squamata L.		0.00				0.00				0.00		
Avena eriantha Durieu	0.5	0.00	-5.34	-0.03		0.00			1	0.01	-4.65	-0.04
Bupleurum brevicaule Schlecht.		0.00				0.00				0.00		
Catananche Lutea L.		0.00				0.00				0.00		
Centaurea procurrens Sprengel		0.00				0.00				0.00		
Cichorium pumilum Jacq	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03
Convolvulus pentapetaloides L.		0.00				0.00				0.00		
Echinops polyceras Boiss		0.00				0.00			0.5	0.00	-5.34	-0.03

Cont .of (C.6) **Date: 14-4-2006**	**Under-grazing grassland**											
Site:Under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Erodium malacoides (l.) L,Her.		0.00				0.00				0.00		
Eryngium barrelieri Boiss	1	0.01	-4.65	-0.04	6	0.06	-2.86	-0.16	8	0.08	-2.57	-0.20
Gastridium scabrum C.Presl	1	0.01	-4.65	-0.04	5	0.05	-3.04	-0.15		0.00		
Geropogon hybridus (L.) Schultz Bip.		0.00				0.00				0.00		
Helianthemus Salicifolium(L) Miller		0.00				0.00				0.00		
Hordeum spontaneum C.Koch		0.00				0.00				0.00		
Lagoecia cuminoides L.	5	0.05	-3.04	-0.15	5	0.05	-3.04	-0.15		0.00		
Linum pubescens Banks et Solander		0.00				0.00				0.00		
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00				0.00				0.00		
Medicago rotata Boiss	0.5	0.00	-5.34	-0.03		0.00				0.00		

Cont .of (C.6) **Date: 14-4-2006**	**Under-grazing grassland**											
Site:Under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Notobasis syriaca (L.) Cass.		0.00				0.00			0.5	0.00	-5.34	-0.03
Onobrychis caput- galli (L.) Lam.		0.00				0.00				0.00		
Pallenis spinosa (L..) Cass		0.00				0.00			0.5	0.00	-5.34	-0.03
Plntago afra L.	10	0.10	-2.35	-0.22		0.00			0.5	0.00	-5.34	-0.03
Rhagadiolus edulis Gaetner		0.00				0.00			0.5	0.00	-5.34	-0.03
Salvia palaestina Bentham	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03		0.00		
Sarcopoterium spinosum(L.)		0.00				0.00				0.00		
Scandix pecten-veneris L.	0.5	0.00	-5.34	-0.03	1	0.01	-4.65	-0.04		0.00		
Sinapis alba(L.)		0.00			1	0.01	-4.65	-0.04		0.00		
Stipa capensis Thunb.		0.00				0.00				0.00		
Tetragonolobus palaestinus Boiss.et Blanche		0.00			0.5	0.00	-5.34	-0.03		0.00		
Tordylium aegyptiacum(L.)Lam.		0.00				0.00				0.00		
Torilis tenella(Delile)Reichenb.	20	0.19	-1.65	-0.32		0.00			5	0.05	-3.04	-0.15

Cont .of (C.6) Date: 14-4-2006	**Under-grazing grassland**											
Site:Under-grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Trifolium clypeatum L.		0.00				0.00			0.5	0.00	-5.34	-0.03
Trifolium stellatum L.		0.00			0.5	0.00	-5.34	-0.03		0.00		
Urospermum picroides (L.)F.W.Schmidt		0.00			0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03
Total cover	48				21				28			
Number of species = s	12				11				12			
Shannon index, H` = -∑ Pi (Ln Pi)	1.13				0.70				0.82			
Evenness index, J = H` / Ln s	0.45				0.29				0.33			

(C.7): Calculation of Shannon index and Evenness index for the recently no grazing grassland at 14-4-2006.

Date: 14-4-2006	**Recently no grazing grassland**											
Site: Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois		0.00			0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15
Ainsworrthia trachycarpa Boiss	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03		0.00		
Anagallis arvensis L.		0.00				0.00				0.00		
Anthemis nabataea Eig	9	0.09	-2.45	-0.21	20	0.19	-1.65	-0.32	1	0.01	-4.65	-0.04
Artedia squamata L.		0.00				0.00				0.00		
Avena eriantha Durieu		0.00			0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03
Bupleurum brevicaule Schlecht.		0.00			0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15
Catananche Lutea L.		0.00				0.00				0.00		
Centaurea procurrens Sprengel	0.5	0.00	-5.34	-0.03		0.00				0.00		
Cichorium pumilum Jacq	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03		0.00		
Convolvulus pentapetaloides L.		0.00				0.00				0.00		
Echinops polyceras Boiss		0.00				0.00			5	0.05	-3.04	-0.15

Cont. of (C.7) Date: 14-4-2006	**Recently no grazing grassland**											
Site: Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Erodium malacoides (l.) L,Her.		0.00				0.00				0.00		
Eryngium barrelieri Boiss	0.5	0.00	-5.34	-0.03		0.00			5	0.05	-3.04	-0.15
Gastridium scabrum C.Presl		0.00				0.00				0.00		
Geropogon hybridus (L.) Schultz Bip.		0.00				0.00				0.00		
Helianthemus Salicifolium(L) Miller		0.00				0.00				0.00		
Hordeum spontaneum C.Koch		0.00				0.00				0.00		
Lagoecia cuminoides L.	0.5	0.00	-5.34	-0.03		0.00			5	0.05	-3.04	-0.15
Linum pubescens Banks et Solander		0.00				0.00			18	0.17	-1.76	-0.30
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00				0.00				0.00		
Medicago rotata Boiss		0.00				0.00				0.00		

Cont. of (C.7) Date: 14-4-2006	**Recently no grazing grassland**											
Site: Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Notobasis syriaca (L.) Cass.	1	0.01	-4.65	-0.04		0.00				0.00		
Onobrychis caput- galli (L.) Lam.		0.00				0.00				0.00		
Pallenis spinosa (L..) Cass		0.00				0.00				0.00		
Plntago afra L.	18	0.17	-1.76	-0.30	20	0.19	-1.65	-0.32	1	0.01	-4.65	-0.04
Rhagadiolus edulis Gaetner	1	0.01	-4.65	-0.04	1	0.01	-4.65	-0.04		0.00		
Salvia palaestina Bentham		0.00				0.00			1	0.01	-4.65	-0.04
Sarcopoterium spinosum(L.)		0.00			15	0.14	-1.94	-0.28		0.00		
Scandix pecten-veneris L.	12	0.11	-2.16	-0.25		0.00			5	0.05	-3.04	-0.15
Sinapis alba(L.)		0.00				0.00				0.00		
Stipa capensis Thunb.	12	0.11	-2.16	-0.25	0.5	0.00	-5.34	-0.03	1	0.01	-4.65	-0.04
Tetragonolobus palaestinus Boiss.et Blanche		0.00				0.00				0.00		
Tordylium aegyptiacum(L.)Lam.		0.00				0.00			1	0.01	-4.65	-0.04
Torilis tenella(Delile)Reichenb.	0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15	5	0.05	-3.04	-0.15

Cont. of (C.7) Date: 14-4-2006	**Recently no grazing grassland**											
Site: Recently no grazing grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Trifolium clypeatum L.		0.00				0.00				0.00		
Trifolium stellatum L.		0.00			0.5	0.00	-5.34	-0.03		0.00		
Urospermum picroides (L.)F.W.Schmidt	6	0.06	-2.86	-0.16	0.5	0.00	-5.34	-0.03	5	0.05	-3.04	-0.15
Total cover	62				65				63.5			
Number of species = s	13				13				15			
Shannon index, H` = -∑ Pi (Ln Pi)	1.42				1.31				1.71			
Evenness index, J = H` / Ln s	0.55				0.51				0.63			

(C.8): Calculation of Shannon index and Evenness index for the reclaimed grassland at 14-4-2006.

Date: 14-4-2006	**Reclaimed grassland**											
Site: Reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Adonis palestina Bois	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03				
Ainsworrthia trachycarpa Boiss		0.00				0.00						
Anagallis arvensis L.	0.5	0.00	-5.34	-0.03		0.00						
Anthemis nabataea Eig		0.00				0.00						
Artedia squamata L.		0.00				0.00						
Avena eriantha Durieu		0.00				0.00						
Bupleurum brevicaule Schlecht.	0.5	0.00	-5.34	-0.03		0.00						
Catananche Lutea L.		0.00			0.5	0.00	-5.34	-0.03				
Centaurea procurrens Sprengel		0.00				0.00						
Cichorium pumilum Jacq		0.00				0.00						
Convolvulus pentapetaloides L.		0.00			0.5	0.00	-5.34	-0.03				
Echinops polyceras Boiss		0.00				0.00						

Cont. of (C.8) Date: 14-4-2006	**Reclaimed grassland**											
Site: Reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Erodium malacoides (l.) L,Her.		0.00				0.00						
Eryngium barrelieri Boiss		0.00				0.00						
Gastridium scabrum C.Presl		0.00				0.00			0.5	0.00	-5.34	-0.03
Geropogon hybridus (L.) Schultz Bip.		0.00				0.00						
Helianthemus Salicifolium(L) Miller	0.5	0.00	-5.34	-0.03		0.00						
Hordeum spontaneum C.Koch		0.00			0.5	0.00	-5.34	-0.03				
Lagoecia cuminoides L.	0.5	0.00	-5.34	-0.03		0.00						
Linum pubescens Banks et Solander		0.00				0.00						
Malcolmia crenulata(DC.)Boiss.var.crenulata		0.00			0.5	0.00	-5.34	-0.03				
Medicago rotata Boiss		0.00				0.00						

Continue (C:8)

Cont. of (C.8)Date: 14-4-2006	**Reclaimed grassland**											
Site: Reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Notobasis syriaca (L.) Cass.		0.00			0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03
Onobrychis caput- galli (L.) Lam.		0.00				0.00						
Pallenis spinosa (L..) Cass		0.00				0.00						
Plntago afra L.	0.5	0.00	-5.34	-0.03	0.5	0.00	-5.34	-0.03				
Rhagadiolus edulis Gaetner		0.00				0.00						
Salvia palaestina Bentham	5	0.05	-3.04	-0.15		0.00						
Sarcopoterium spinosum(L.)		0.00				0.00						
Scandix pecten-veneris L.		0.00				0.00						
Sinapis alba(L.)		0.00				0.00						
Stipa capensis Thunb.		0.00				0.00						
Tetragonolobus palaestinus Boiss.et Blanche		0.00				0.00						
Tordylium aegyptiacum(L.)Lam.		0.00			0.5	0.00	-5.34	-0.03				
Torilis tenella(Delile)Reichenb.		0.00				0.00						

Cont. of (C.8) Date: 14-4-2006	**Reclaimed grassland**											
Site: Reclaimed grassland	Quadrat1				Quadrat2				Quadrat3			
species (scientific name)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)	cover	(Pi)	LN (Pi)	(Pi)*LN (Pi)
Trifolium clypeatum L.		0.00				0.00						
Trifolium stellatum L.		0.00			0.5	0.00	-5.34	-0.03				
Urospermum picroides (L.)F.W.Schmidt		0.00				0.00						
Total cover	8				4.5				1			
Number of species = s	7				9				2			
Shannon index, H` = -∑ Pi (Ln Pi)	0.30				0.23				0.05			
Evenness index, J = H` / Ln s	0.15				0.10				0.07			

Appendics (D) statistical analysis.

(D.1): Descriptives

Character	Sites	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
%total cover2006	recently no grazing grassland	3	46.6667	1.66667	.96225	42.5264	50.8069	45.00	48.33
	under grazing grassland	3	28.8889	5.85314	3.37931	14.3489	43.4289	23.33	35.00
	natural reserve grassland	3	81.6667	4.40959	2.54588	70.7126	92.6207	78.33	86.67
	Total	9	52.4074	23.55713	7.85238	34.2998	70.5150	23.33	86.67
% total cover2007	recently no grazing grassland	3	71.6667	4.40959	2.54588	60.7126	82.6207	66.67	75.00
	under grazing grassland	3	26.2222	5.64046	3.25652	12.2105	40.2339	20.00	31.00
	natural reserve grassland	3	86.8889	4.78810	2.76441	74.9946	98.7832	83.33	92.33
	Total	9	61.5926	27.67157	9.22386	40.3223	82.8628	20.00	92.33

Cont.of (D.1) Character	Sites	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Species density 2006	recently no grazing grassland	3	136.3333	51.61718	29.80119	8.1091	264.5575	92.00	193.00
	under grazing grassland	3	69.6667	31.00538	17.90096	-7.3550	146.6883	47.00	105.00
	natural reserve grassland	3	233.3333	108.91434	62.88172	-37.2249	503.8916	140.00	353.00
	Total	9	146.4444	94.61516	31.53839	73.7168	219.1721	47.00	353.00
Species density 2007	recently no grazing grassland	3	152.6667	54.04936	31.20541	18.4006	286.9327	112.00	214.00
	under grazing grassland	3	56.3333	22.50185	12.99145	.4356	112.2310	40.00	82.00
	natural reserve grassland	3	248.3333	78.83104	45.51312	52.5062	444.1605	196.00	339.00
	Total	9	152.4444	96.55324	32.18441	78.2271	226.6618	40.00	339.00
Species richness2006	recently no grazing grassland	3	13.6667	1.15470	.66667	10.7982	16.5351	13.00	15.00

Cont.of (D.1)	under grazing grassland	3	11.6667	.57735	.33333	10.2324	13.1009	11.00	12.00
	natural reserve grassland	3	11.0000	2.00000	1.15470	6.0317	15.9683	9.00	13.00
	Total	9	12.1111	1.69148	.56383	10.8109	13.4113	9.00	15.00
Species richness2007	recently no grazing grassland	3	14.3333	1.52753	.88192	10.5388	18.1279	13.00	16.00
	under grazing grassland	3	13.3333	2.08167	1.20185	8.1622	18.5045	11.00	15.00
	natural reserve grassland	3	12.3333	2.30940	1.33333	6.5965	18.0702	11.00	15.00
	Total	9	13.3333	1.93649	.64550	11.8448	14.8219	11.00	16.00
Shannon –Wiener Index2006	recently no grazing grassland	3	1.4800	.20664	.11930	.9667	1.9933	1.31	1.71
	under grazing grassland	3	.8833	.22189	.12811	.3321	1.4345	.70	1.13
	natural reserve grassland	3	1.1267	.10066	.05812	.8766	1.3767	1.02	1.22
	Total	9	1.1633	.30500	.10167	.9289	1.3978	.70	1.71

Cont.of (D.1)						95% Confidence Interval for Mean			
Character	Sites	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Shannon –Wiener Index2007	recently no grazing grassland	3	1.7467	.15567	.08988	1.3600	2.1334	1.60	1.91
	under grazing grassland	3	.9400	.21000	.12124	.4183	1.4617	.79	1.18
	natural reserve grassland	3	1.3567	.24786	.14310	.7410	1.9724	1.09	1.58
	Total	9	1.3478	.39306	.13102	1.0456	1.6499	.79	1.91
evennessss2006	recently no grazing grassland	3	.5633	.06110	.03528	.4116	.7151	.51	.63
	under grazing grassland	3	.3567	.08327	.04807	.1498	.5635	.29	.45
	natural reserve grassland	3	.4700	.03606	.02082	.3804	.5596	.44	.51
	Total	9	.4633	.10500	.03500	.3826	.5440	.29	.63
evennessss2007	recently no grazing grassland	3	.6567	.03512	.02028	.5694	.7439	.62	.69
	under grazing grassland	3	.3700	.06557	.03786	.2071	.5329	.31	.44
	natural reserve grassland	3	.5400	.06928	.04000	.3679	.7121	.46	.58
	Total	9	.5222	.13479	.04493	.4186	.6258	.31	.69

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Biomass mid June 2006 kg/hec	recently no grazing grassland	3	2193.78	1563.632	902.763	-1690.4991	6078.0546	1181.33	3994.67
	under grazing grassland	3	1719.11	401.42266	231.761	721.9220	2716.3003	1293.33	2090.67
	natural reserve grassland	3	6336.00	4749.414	2742.08	-5462.1989	18134.1989	3149.33	11794.67
	reclaimed grassland	3	.0000	.00000	.00000	.0000	.0000	.00	.00
	Total	12	2562.22	3237.352	934.543	505.3067	4619.1377	.00	11794.67
Biomass mid April 2007 kg/ hec	recently no grazing grassland	3	4688.00	1792.214	1034.74	235.8929	9140.1071	2880.00	6464.00
	under grazing grassland	3	730.667	295.17001	170.416	-2.5763	1463.9096	480.00	1056.00
	natural reserve grassland	3	10858.7	1402.291	809.613	7375.1816	14342.1518	9696.00	12416.00
	reclaimed grassland	3	1008.00	602.28897	347.732	-488.1687	2504.1687	320.00	1440.00
	Total	12	4321.33	4384.719	1265.76	1535.4158	7107.2509	320.00	12416.00
Biomass end March 2007 kg/hec	recently no grazing grassland	3	3946.67	1602.664	925.299	-34.5725	7927.9059	2400.00	5600.00
	under grazing grassland	3	1184.53	162.73922	93.9575	780.2667	1588.8000	1057.60	1368.00
	natural reserve grassland	3	9104.00	712.49421	411.359	7334.0663	10873.9337	8320.00	9712.00
	reclaimed grassland	3	3334.22	1616.802	933.461	-682.1347	7350.5814	1600.00	4800.00
	Total	12	4392.36	3203.087	924.652	2357.2115	6427.5002	1057.60	9712.00

Cont.of (D.1)

Cont.of (D.1)	Sites	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Number of non palatable species2007	recently no grazing	3	7.3333	1.52753	.88192	3.5388	11.1279	6.00	9.00
	under grazing grassland	3	9.0000	1.73205	1.00000	4.6973	13.3027	7.00	10.00
	natural reserve grassland	3	3.0000	1.00000	.57735	.5159	5.4841	2.00	4.00
	Total	9	6.4444	2.96273	.98758	4.1671	8.7218	2.00	10.00
Number of non palatable species2006	recently no grazing	3	7.6667	1.52753	.88192	3.8721	11.4612	6.00	9.00
	under grazing grassland	3	6.6667	.57735	.33333	5.2324	8.1009	6.00	7.00
	natural reserve grassland	3	3.0000	1.00000	.57735	.5159	5.4841	2.00	4.00

Cont.of (D.1)	Total	9	5.7778	2.33333	.77778	3.9842	7.5713	2.00	9.00
Number of palatable species2007	recently no grazing	3	7.0000	2.00000	1.15470	2.0317	11.9683	5.00	9.00
	under grazing grassland	3	4.3333	.57735	.33333	2.8991	5.7676	4.00	5.00
	natural reserve grassland	3	9.3333	1.52753	.88192	5.5388	13.1279	8.00	11.00
	Total	9	6.8889	2.52212	.84071	4.9502	8.8276	4.00	11.00
Number of palatable species2006	recently no grazing	3	6.0000	1.73205	1.00000	1.6973	10.3027	4.00	7.00
	under grazing grassland	3	5.0000	1.00000	.57735	2.5159	7.4841	4.00	6.00
	natural reserve grassland	3	8.0000	1.73205	1.00000	3.6973	12.3027	7.00	10.00
	Total	9	6.3333	1.87083	.62361	4.8953	7.7714	4.00	10.00

Cont.of (D.1)						95% Confidence Interval for Mean			
Character	Sites	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
% of non palatable species2006	recently no grazing grassland	3	56.2393	11.80973	6.81835	26.9023	85.5763	46.15	69.23
	under grazing grassland	3	57.3232	6.87407	3.96875	40.2471	74.3994	50.00	63.64
	natural reserve grassland	3	27.2209	7.92934	4.57801	7.5233	46.9185	22.22	36.36
	Total	9	46.9278	16.76523	5.58841	34.0409	59.8147	22.22	69.23
% of non palatable species2007	recently no grazing grassland	3	51.3965	11.22689	6.48185	23.5074	79.2857	43.75	64.29
	under grazing grassland	3	67.2439	3.92804	2.26785	57.4861	77.0017	63.64	71.43
	natural reserve grassland	3	24.0404	5.08273	2.93451	11.4142	36.6666	18.18	27.27
	Total	9	47.5603	20.00203	6.66734	32.1853	62.9352	18.18	71.43

Cont.of (D.1)									
% of palatable species2006	recently no grazing grassland	3	43.7607	11.80973	6.81835	14.4237	73.0977	30.77	53.85
	under grazing grassland	3	42.6768	6.87407	3.96875	25.6006	59.7529	36.36	50.00
	natural reserve grassland	3	72.7791	7.92934	4.57801	53.0815	92.4767	63.64	77.78
	Total	9	53.0722	16.76523	5.58841	40.1853	65.9591	30.77	77.78
% of palatable species2007	recently no grazing grassland	3	48.6035	11.22689	6.48185	20.7143	76.4926	35.71	56.25
	under grazing grassland	3	32.7561	3.92804	2.26785	22.9983	42.5139	28.57	36.36
	natural reserve grassland	3	75.9596	5.08273	2.93451	63.3334	88.5858	72.73	81.82
	Total	9	52.4397	20.00203	6.66734	37.0648	67.8147	28.57	81.82

(D.2): ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
%total cover2006	Between Groups	4326.543	2	2163.272	114.902	.000
	Within Groups	112.963	6	18.827		
	Total	4439.506	8			
% total cover2007	Between Groups	5977.358	2	2988.679	120.860	.000
	Within Groups	148.370	6	24.728		
	Total	6125.728	8			
%Relative cover2006	Between Groups	4109.389	2	2054.694	21.503	.002
	Within Groups	573.333	6	95.556		
	Total	4682.722	8			
%Relative cover2007	Between Groups	8423.167	2	4211.583	50.254	.000
	Within Groups	502.833	6	83.806		
	Total	8926.000	8			
Species density 2006	Between Groups	40640.222	2	20320.111	3.936	.081
	Within Groups	30976.000	6	5162.667		
	Total	71616.222	8			

Species density	Between Groups	55296.222	2	27648.111	8.602	.017
	Within Groups	19284.000	6	3214.000		
	Total	74580.222	8			
Species	Between Groups	11.556	2	5.778	3.059	.121
	Within Groups	11.333	6	1.889		
	Total	22.889	8			
Species	Between Groups	6.000	2	3.000	.750	.512
	Within Groups	24.000	6	4.000		
	Total	30.000	8			
Shannon –Wiener	Between Groups	.540	2	.270	7.937	0.021
	Within Groups	.204	6	.034		
	Total	.744	8			
Shannon –Wiener	Between Groups	.976	2	.488	11.287	0.009
	Within Groups	.260	6	.043		
	Total	1.236	8			
evennessss2006	Between Groups	.064	2	.032	8.056	0.020
	Within Groups	.024	6	.004		
	Total	.088	8			

evennessss2007	Between Groups	.125	2	.062	18.100	0.003
	Within Groups	.021	6	.003		
	Total	.145	8			
Number of non	Between Groups	57.556	2	28.778	13.632	.006
	Within Groups	12.667	6	2.111		
	Total	70.222	8			
Number of non	Between Groups	36.222	2	18.111	14.818	.005
	Within Groups	7.333	6	1.222		
	Total	43.556	8			
Number of palatable	Between Groups	37.556	2	18.778	8.450	.018
	Within Groups	13.333	6	2.222		
	Total	50.889	8			
Number of palatable	Between Groups	14.000	2	7.000	3.000	.125
	Within Groups	14.000	6	2.333		
	Total	28.000	8			
% of non palatable	Between Groups	1749.391	2	874.695	10.513	.011
	Within Groups	499.194	6	83.199		
	Total	2248.584	8			

% of non palatable	Between Groups	2866.035	2	1433.017	25.696	.001
	Within Groups	334.613	6	55.769		
	Total	3200.648	8			
% of palatable	Between Groups	1749.391	2	874.695	10.513	.011
	Within Groups	499.194	6	83.199		
	Total	2248.584	8			
% of palatable	Between Groups	2866.035	2	1433.017	25.696	.001
	Within Groups	334.613	6	55.769		
	Total	3200.648	8			

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Biomass mid June 2006 kg/hec	Between Groups	64958907.283	3	21652969.09	3.442	.072
	Within Groups	50326039.745	8	6290754.968		
	Total	115284947.028	11			
Biomass mid April 2007 kg/ hec	Between Groups	200226709.333	3	66742236.44	47.433	.000
	Within Groups	11256661.333	8	1407082.667		
	Total	211483370.667	11			
Biomass end March 2007 kg/hec	Between Groups	101423997.497	3	33807999.17	23.656	.000
	Within Groups	11433426.193	8	1429178.274		
	Total	112857423.690	11			

(D. 3): Multiple Comparisons LSD.

Dependent Variable	(I) treatments	(J) treatments	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Lower Bound
%total cover2006	recently no grazing	under grazing grassland	17.77778(*)	3.54280	.002	9.1089	26.4467
		natural reserve grassland	-35.00000(*)	3.54280	.000	-43.6689	-26.3311
	under grazing grassland	recently no grazing grassland	-17.77778(*)	3.54280	.002	-26.4467	-9.1089
		natural reserve grassland	-52.77778(*)	3.54280	.000	-61.4467	-44.1089
	natural reserve grassland	recently no grazing grassland	35.00000(*)	3.54280	.000	26.3311	43.6689
		under grazing grassland	52.77778(*)	3.54280	.000	44.1089	61.4467
% total cover2007	recently no grazing	under grazing grassland	45.44444(*)	4.06025	.000	35.5094	55.3795
		natural reserve grassland	-15.22222(*)	4.06025	.010	-25.1573	-5.2872
	under grazing grassland	recently no grazing grassland	-45.44444(*)	4.06025	.000	-55.3795	-35.5094
		natural reserve grassland	-60.66667(*)	4.06025	.000	-70.6017	-50.7316

Cont. of (D.3)	natural reserve grassland	recently no grazing grassland	15.22222(*)	4.06025	.010	5.2872	25.1573
		under grazing grassland	60.66667(*)	4.06025	.000	50.7316	70.6017
%Relative cover2006	recently no grazing	under grazing grassland	31.16667(*)	7.98146	.008	11.6367	50.6966
		natural reserve grassland	-20.83333(*)	7.98146	.040	-40.3633	-1.3034
	under grazing grassland	recently no grazing grassland	-31.16667(*)	7.98146	.008	-50.6966	-11.6367
		natural reserve grassland	-52.00000(*)	7.98146	.001	-71.5299	-32.4701
	natural reserve grassland	recently no grazing grassland	20.83333(*)	7.98146	.040	1.3034	40.3633
		under grazing grassland	52.00000(*)	7.98146	.001	32.4701	71.5299
%Relative cover2007	recently no grazing	under grazing grassland	42.83333(*)	7.47465	.001	24.5435	61.1231
		natural reserve grassland	-31.83333(*)	7.47465	.005	-50.1231	-13.5435
	under grazing grassland	recently no grazing grassland	-42.83333(*)	7.47465	.001	-61.1231	-24.5435
		natural reserve grassland	-74.66667(*)	7.47465	.000	-92.9565	-56.3769
	natural reserve grassland	recently no grazing grassland	31.83333(*)	7.47465	.005	13.5435	50.1231
		under grazing grassland	74.66667(*)	7.47465	.000	56.3769	92.9565
Species density 2006	recently no grazing	under grazing grassland	66.66667	58.66667	.299	-76.8855	210.2188
		natural reserve grassland	-97.00000	58.66667	.149	-240.5522	46.5522

Cont. of (D.3)	under grazing grassland	recently no grazing grassland	-66.66667	58.66667	.299	-210.2188	76.8855
		natural reserve grassland	-163.66667(*)	58.66667	.032	-307.2188	-20.1145
	natural reserve grassland	recently no grazing grassland	97.00000	58.66667	.149	-46.5522	240.5522
		under grazing grassland	163.66667(*)	58.66667	.032	20.1145	307.2188
Species density 2007	recently no grazing	under grazing grassland	96.33333	46.28895	.083	-16.9316	209.5983
		natural reserve grassland	-95.66667	46.28895	.084	-208.9316	17.5983
	under grazing grassland	recently no grazing grassland	-96.33333	46.28895	.083	-209.5983	16.9316
		natural reserve grassland	-192.00000(*)	46.28895	.006	-305.2650	-78.7350
	natural reserve grassland	recently no grazing grassland	95.66667	46.28895	.084	-17.5983	208.9316
		under grazing grassland	192.00000(*)	46.28895	.006	78.7350	305.2650
Species richness2006	recently no grazing	under grazing grassland	2.00000	1.12217	.125	-.7458	4.7458
		natural reserve grassland	2.66667	1.12217	.055	-.0792	5.4125
	under grazing grassland	recently no grazing grassland	-2.00000	1.12217	.125	-4.7458	.7458
		natural reserve grassland	.66667	1.12217	.574	-2.0792	3.4125
	natural reserve grassland	recently no grazing grassland	-2.66667	1.12217	.055	-5.4125	.0792
		under grazing grassland	-.66667	1.12217	.574	-3.4125	2.0792

Cont. of (D.3)							
Species richness2007	recently no grazing	under grazing grassland	1.00000	1.63299	.563	-2.9958	4.9958
		natural reserve grassland	2.00000	1.63299	.267	-1.9958	5.9958
	under grazing grassland	recently no grazing grassland	-1.00000	1.63299	.563	-4.9958	2.9958
		natural reserve grassland	1.00000	1.63299	.563	-2.9958	4.9958
	natural reserve grassland	recently no grazing grassland	-2.00000	1.63299	.267	-5.9958	1.9958
		under grazing grassland	-1.00000	1.63299	.563	-4.9958	2.9958
Shannon –Wiener	recently no grazing	under grazing grassland	.59667(*)	.15060	.007	.2282	.9652
		natural reserve grassland	.35333	.15060	.057	-.0152	.7218
	under grazing grassland	recently no grazing grassland	-.59667(*)	.15060	.007	-.9652	-.2282
		natural reserve grassland	-.24333	.15060	.157	-.6118	.1252
	natural reserve grassland	recently no grazing grassland	-.35333	.15060	.057	-.7218	.0152
		under grazing grassland	.24333	.15060	.157	-.1252	.6118
Shannon –Wiener	recently no grazing	under grazing grassland	.80667(*)	.16981	.003	.3911	1.2222
		natural reserve grassland	.39000	.16981	.061	-.0255	.8055
	under grazing grassland	recently no grazing grassland	-.80667(*)	.16981	.003	-1.2222	-.3911

Cont. of (D.3)		natural reserve grassland	-.41667(*)	.16981	.050	-.8322	-.0011
	natural reserve grassland	recently no grazing grassland	-.39000	.16981	.061	-.8055	.0255
		under grazing grassland	.41667(*)	.16981	.050	.0011	.8322
evennessss2006	recently no grazing	under grazing grassland	.20667(*)	.05157	.007	.0805	.3328
		natural reserve grassland	.09333	.05157	.120	-.0328	.2195
	under grazing grassland	recently no grazing grassland	-.20667(*)	.05157	.007	-.3328	-.0805
		natural reserve grassland	-.11333	.05157	.070	-.2395	.0128
	natural reserve grassland	recently no grazing grassland	-.09333	.05157	.120	-.2195	.0328
		under grazing grassland	.11333	.05157	.070	-.0128	.2395
evennessss2007	recently no grazing	under grazing grassland	.28667(*)	.04792	.001	.1694	.4039
		natural reserve grassland	.11667	.04792	.051	-.0006	.2339
	under grazing grassland	recently no grazing grassland	-.28667(*)	.04792	.001	-.4039	-.1694
		natural reserve grassland	-.17000(*)	.04792	.012	-.2873	-.0527
	natural reserve grassland	recently no grazing grassland	-.11667	.04792	.051	-.2339	.0006
		under grazing grassland	.17000(*)	.04792	.012	.0527	.2873
Number of non	recently no grazing	under grazing grassland	-1.66667	1.18634	.210	-4.5695	1.2362

Cont. of (D.3)		natural reserve grassland	4.33333(*)	1.18634	.011	1.4305	7.2362
	under grazing grassland	recently no grazing grassland	1.66667	1.18634	.210	-1.2362	4.5695
		natural reserve grassland	6.00000(*)	1.18634	.002	3.0971	8.9029
	natural reserve grassland	recently no grazing grassland	-4.33333(*)	1.18634	.011	-7.2362	-1.4305
		under grazing grassland	-6.00000(*)	1.18634	.002	-8.9029	-3.0971
Number of non	recently no grazing	under grazing grassland	1.00000	.90267	.310	-1.2088	3.2088
		natural reserve grassland	4.66667(*)	.90267	.002	2.4579	6.8754
	under grazing grassland	recently no grazing grassland	-1.00000	.90267	.310	-3.2088	1.2088
		natural reserve grassland	3.66667(*)	.90267	.007	1.4579	5.8754
	natural reserve grassland	recently no grazing grassland	-4.66667(*)	.90267	.002	-6.8754	-2.4579
		under grazing grassland	-3.66667(*)	.90267	.007	-5.8754	-1.4579
Number of palatable	recently no grazing	under grazing grassland	2.66667	1.21716	.071	-.3116	5.6450
		natural reserve grassland	-2.33333	1.21716	.104	-5.3116	.6450
	under grazing grassland	recently no grazing grassland	-2.66667	1.21716	.071	-5.6450	.3116
		natural reserve grassland	-5.00000(*)	1.21716	.006	-7.9783	-2.0217
	natural reserve grassland	recently no grazing grassland	2.33333	1.21716	.104	-.6450	5.3116

Cont. of (D.3)		under grazing grassland	5.00000(*)	1.21716	.006	2.0217	7.9783
Number of palatable	recently no grazing	under grazing grassland	1.00000	1.24722	.453	-2.0518	4.0518
		natural reserve grassland	-2.00000	1.24722	.160	-5.0518	1.0518
	under grazing grassland	recently no grazing grassland	-1.00000	1.24722	.453	-4.0518	2.0518
		natural reserve grassland	-3.00000	1.24722	.053	-6.0518	.0518
	natural reserve grassland	recently no grazing grassland	2.00000	1.24722	.160	-1.0518	5.0518
		under grazing grassland	3.00000	1.24722	.053	-.0518	6.0518
% of non palatable	recently no grazing	under grazing grassland	-1.08392	7.44755	.889	-19.3074	17.1396
		natural reserve grassland	29.01839(*)	7.44755	.008	10.7949	47.2419
	under grazing grassland	recently no grazing grassland	1.08392	7.44755	.889	-17.1396	19.3074
		natural reserve grassland	30.10231(*)	7.44755	.007	11.8788	48.3258
	natural reserve grassland	recently no grazing grassland	-29.01839(*)	7.44755	.008	-47.2419	-10.7949
		under grazing grassland	-30.10231(*)	7.44755	.007	-48.3258	-11.8788
% of non palatable	recently no grazing	under grazing grassland	-15.84735(*)	6.09748	.041	-30.7673	-.9273
		natural reserve grassland	27.35612(*)	6.09748	.004	12.4361	42.2761
	under grazing grassland	recently no grazing grassland	15.84735(*)	6.09748	.041	.9273	30.7673

Cont. of (D.3)		natural reserve grassland	43.20346(*)	6.09748	.000	28.2835	58.1235
	natural reserve grassland	recently no grazing grassland	-27.35612(*)	6.09748	.004	-42.2761	-12.4361
		under grazing grassland	-43.20346(*)	6.09748	.000	-58.1235	-28.2835
% of palatable	recently no grazing	under grazing grassland	1.08392	7.44755	.889	-17.1396	19.3074
		natural reserve grassland	-29.01839(*)	7.44755	.008	-47.2419	-10.7949
	under grazing grassland	recently no grazing grassland	-1.08392	7.44755	.889	-19.3074	17.1396
		natural reserve grassland	-30.10231(*)	7.44755	.007	-48.3258	-11.8788
	natural reserve grassland	recently no grazing grassland	29.01839(*)	7.44755	.008	10.7949	47.2419
		under grazing grassland	30.10231(*)	7.44755	.007	11.8788	48.3258
% of palatable	recently no grazing	under grazing grassland	15.84735(*)	6.09748	.041	.9273	30.7673
		natural reserve grassland	-27.35612(*)	6.09748	.004	-42.2761	-12.4361
	under grazing grassland	recently no grazing grassland	-15.84735(*)	6.09748	.041	-30.7673	-.9273
		natural reserve grassland	-43.20346(*)	6.09748	.000	-58.1235	-28.2835
	natural reserve grassland	recently no grazing grassland	27.35612(*)	6.09748	.004	12.4361	42.2761
		under grazing grassland	43.20346(*)	6.09748	.000	28.2835	58.1235

Multiple Comparisons

LSD

Dependent Variable	(I) treatments	(J) treatments	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Biomass mid June 2006 kg/hec	recently no grazing grassland	under grazing grassland	474.66667	2047.886	.823	-4247.7667	5197.1000
		natural reserve grassland	-4142.2222	2047.886	.078	-8864.6556	580.2111
		reclaimed grassland	2193.77778	2047.886	.315	-2528.6556	6916.2111
	under grazing grassland	recently no grazing grassland	-474.66667	2047.886	.823	-5197.1000	4247.7667
		natural reserve grassland	-4616.8889	2047.886	.054	-9339.3222	105.5445
		reclaimed grassland	1719.11111	2047.886	.426	-3003.3222	6441.5445
	natural reserve grassland	recently no grazing grassland	4142.22222	2047.886	.078	-580.2111	8864.6556
		under grazing grassland	4616.88889	2047.886	.054	-105.5445	9339.3222
		reclaimed grassland	6336.00000*	2047.886	.015	1613.5667	11058.4333
	reclaimed grassland	recently no grazing grassland	-2193.7778	2047.886	.315	-6916.2111	2528.6556
		under grazing grassland	-1719.1111	2047.886	.426	-6441.5445	3003.3222
		natural reserve grassland	-6336.0000*	2047.886	.015	-11058.4333	-1613.5667
Biomass mid April 2007 kg/ hec	recently no grazing grassland	under grazing grassland	3957.33333*	968.53245	.004	1723.8935	6190.7732
		natural reserve grassland	-6170.6667*	968.53245	.000	-8404.1065	-3937.2268
		reclaimed grassland	3680.00000*	968.53245	.005	1446.5602	5913.4398
	under grazing grassland	recently no grazing grassland	-3957.3333*	968.53245	.004	-6190.7732	-1723.8935
		natural reserve grassland	-10128.000*	968.53245	.000	-12361.4398	-7894.5602
		reclaimed grassland	-277.33333	968.53245	.782	-2510.7732	1956.1065
	natural reserve grassland	recently no grazing grassland	6170.66667*	968.53245	.000	3937.2268	8404.1065
		under grazing grassland	10128.000*	968.53245	.000	7894.5602	12361.4398
		reclaimed grassland	9850.66667*	968.53245	.000	7617.2268	12084.1065
	reclaimed grassland	recently no grazing grassland	-3680.0000*	968.53245	.005	-5913.4398	-1446.5602
		under grazing grassland	277.33333	968.53245	.782	-1956.1065	2510.7732
		natural reserve grassland	-9850.6667*	968.53245	.000	-12084.1065	-7617.2268

*. The mean difference is significant at the .05 level.

Multiple Comparisons

Dependent Variable: Biomass end March 2007 kg/hec

LSD

(I) treatments	(J) treatments	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
recently no grazing grassland	under grazing grassland	2762.13333*	976.10733	.022	511.2258	5013.0409
	natural reserve grassland	-5157.3333*	976.10733	.001	-7408.2409	-2906.4258
	reclaimed grassland	612.44333	976.10733	.548	-1638.4642	2863.3509
under grazing grassland	recently no grazing grassland	-2762.1333*	976.10733	.022	-5013.0409	-511.2258
	natural reserve grassland	-7919.4667*	976.10733	.000	-10170.3742	-5668.5591
	reclaimed grassland	-2149.6900	976.10733	.059	-4400.5975	101.2175
natural reserve grassland	recently no grazing grassland	5157.33333*	976.10733	.001	2906.4258	7408.2409
	under grazing grassland	7919.46667*	976.10733	.000	5668.5591	10170.3742
	reclaimed grassland	5769.77667*	976.10733	.000	3518.8691	8020.6842
reclaimed grassland	recently no grazing grassland	-612.44333	976.10733	.548	-2863.3509	1638.4642
	under grazing grassland	2149.69000	976.10733	.059	-101.2175	4400.5975
	natural reserve grassland	-5769.7767*	976.10733	.000	-8020.6842	-3518.8691

*. The mean difference is significant at the .05 level.

Appendix (E): Similarity analysis.

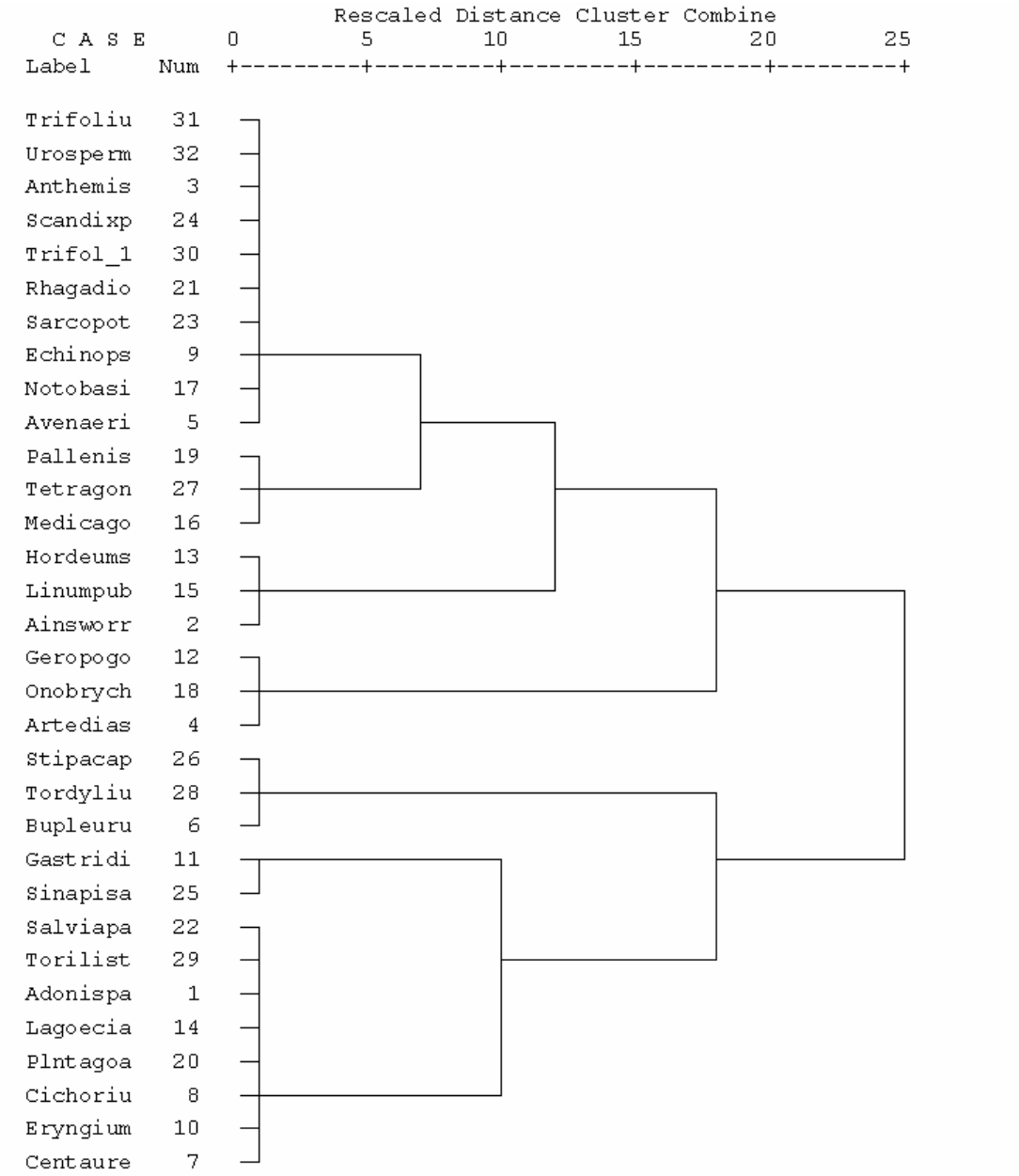
(E.1): Average Linkage (Within Groups).

Agglomeration Schedule

	Stage Cluster First Appears			Cluster Combined		
Next Stage	Cluster 2	Cluster 1	Coefficients	Cluster 2	Cluster 1	Stage
2	0	0	1.000	32	31	1
9	1	0	1.000	31	3	2
9	0	0	1.000	30	24	3
11	0	0	1.000	29	22	4
7	0	0	1.000	28	26	5
14	0	0	1.000	27	19	6
30	5	0	1.000	26	6	7
27	0	0	1.000	25	11	8
12	3	2	1.000	24	3	9
12	0	0	1.000	23	21	10
18	4	0	1.000	22	1	11
22	10	9	1.000	21	3	12
18	0	0	1.000	20	14	13
26	6	0	1.000	19	16	14
20	0	0	1.000	18	12	15
22	0	0	1.000	17	9	16
19	0	0	1.000	15	13	17
23	13	11	1.000	14	1	18

28	17	0	1.000	13	2	19
29	15	0	1.000	12	4	20
23	0	0	1.000	10	8	21
25	16	12	1.000	9	3	22
24	21	18	1.000	8	1	23
27	0	23	1.000	7	1	24
26	0	22	1.000	5	3	25
28	14	25	.872	16	3	26
30	8	24	.822	11	1	27
29	26	19	.783	3	2	28
31	20	28	.678	4	2	29
31	7	27	.667	6	1	30
0	29	30	.527	2	1	31

Dendrogram using Average Linkage (Within Group)



Abbreviated Name	Extended Name
Adonispa	*Adonis palestina Boiss*
Ainsworr	*Ainsworrthia trachycarpa Boiss*
Anthemis	*Anthemis nabataeaEig*
Artedias	*Artedia squamataL*
Avenaeri	*Avena eriantha Durieu*
Bupleuru	*Bupleurum brevicaule Schlecht*
Centaure	*Centaurea procurrens Sprengel*
Cichoriu	*Cichorium pumilum Jacq*
Echinops	*Echinops polyceras Boiss*
Eryngium	*Eryngium barrelieri Boiss*
Gastridi	*Gastridium scabrum CPresl*
Geropogo	*GeropogonhybridusLSchultzBip*
Hordeums	*Hordeum spontaneum CKoch*
Lagoecia	*Lagoecia cuminoides L*
Linumpub	*Linum pubescens Bankset Solander*
Medicago	*Medicago rotate Boiss*
Notobasi	*Notobasis syriaca (L.) Cass*
Onobrych	*Onobrychis caput-galli LLam*
Pallenis	*Pallenis spinosa L. Cass*
Plntagoa	*Plntago afraL*
Rhagadio	*Rhagadiolus edulis Gaetner*
Salviapa	*Salvia palaestina Bentham*
Sarcopot	*Sarcopoterium spinosum (L.)*
Scandixp	*Scandix pectin – veneris L*
Sinapisa	*Sinapis albaL*
Stipacap	*Stipa capensis Thunb*

Tetragon	*Tetragonolobus palaestinus Boisset Blanche*
Tordyliu	*Tordylium aegyptiacum LLam*
Torilist	*Torilis tenella Delile Reichenb*
Trifol_1	*Trifolium clypeatum L*
Trifoliu	*Trifolium stellatum L*
Urosperm	*Urospermum picroides LFW Schmidt*

(E.2): Average Linkage (Between Groups).

Agglomeration Schedule

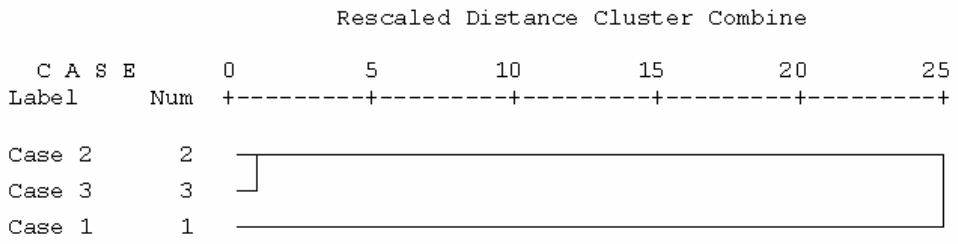
Next Stage	Stage Cluster First Appears		Coefficients	Cluster Combined		Stage
	Cluster 2	Cluster 1		Cluster 2	Cluster 1	
2	0	0	.621	3	2	1
0	1	0	.441	2	1	2

Proximity Matrix

Jaccard Measure			Case
3	2	1	
.433	.448	1.000	1
.621	1.000	.448	2
1.000	.621	.433	3

This is a similarity matrix

Dendrogram using Average Linkage (Between Groups



Appendix (F)

(F.1): Mean density of plant species at the land use practices study sitesat the two sampling dates, mid April 2006, 2007

Species Scientific name	Arabic name	C[1]		G[1]		P[1]	
		2006	2007	2006	2007	2006	2007
Adonis palestina	شقائق النعمان		0.00	1.33	0.33	2.67	2.00
Ainsworrthia trachycarpa		1.33	1.33	0.00	0.00	1.33	1.33
Anthemis nabataea	اقحوان ابيض	0.33	0.67	8.33	6.33	19.67	19.67
Artedia squamata.		0.67	0.33	0.00	0.00	0.00	0.00
Avena eriantha	شوفان	45.00	63.33	1.33	0.33	1.00	7.00
Bupleurum brevicaule		0.00	0.00	0.00	0.00	3.67	2.67
Centaurea procurrens	مرار	0.00	0.00	0.00	2.33	0.33	0.33
Cichorium pumilum	عللك	0.00	0.00	2.00	2.67	0.67	0.67
Echinops polyceras Boiss	أرث	1.67	1.67	0.33	1.67	1.00	1.00
Eryngium barrelieri Boiss	القرصعنه	0.00	0.00	4.33	5.67	2.00	2.00
Gastridium scabrum	سبيلة	0.00	0.00	6.67	0.00	0.00	0.00
Geropogon hybridus	رجل البطه(ذنبة	1.67	2.00	0.00	0.00	0.00	0.00
Hordeum spontaneum	شعير بري	90.33	96.67	0.00		0.00	5.00
Lagoecia cuminoides		0.00	0.00	6.67	4.00	4.67	4.00
Linum pubescens	كتان	6.00	5.67	0.00	0.00	4.33	5.00
Medicago rotata	نفل	5.67	11.33	0.33	0.33	0.00	0.00
Notobasis syriaca (L.)	خرفيش	3.33	1.67	0.67	5.00	0.67	1.33
Onobrychis caput- galli		7.67	9.67	0.00	0.00	0.00	0.00

Pallenis spinosa (l.) Cass		0.33	0.67	0.33	2.33	0.00	0.00
Plntago afra L.	قطونة	0.00	0.00	5.67	5.33	45.00	45.00
Rhagadiolus edulis		0.67	1.00	0.33	0.33	3.67	4.33
Salvia palaestina		0.00	0.00	1.00	1.00	1.33	1.33
Sarcopoterium	نتش	0.33	0.33	0.00	0.33	0.33	0.33
Scandix pecten-veneris		0.33	0.33	4.00	2.67	10.33	11.00
Sinapis alba	خردل	0.00	0.00	1.67	1.67	0.00	0.00
Stipa capensis	البهمه	0.00	0.00	0.00	0.00	14.33	18.67
Tetragonolobus	أصيبعه(جلائون)	0.00	1.00	0.33	0.00	0.00	0.00
Tordylium aegyptiacum		0.00	0.00	0.00	0.00	1.00	0.00
Torilis tenella	جزر الشيطان	0.00	0.00	21.00	12.33	10.00	9.67
Trifolium clypeatum	برسيم	25.00	21.67	0.67		0.00	1.67
Trifolium stellatum	برسيم	33.33	23.33	0.33	0.33	0.33	0.67
Urospermum picroides		9.67	5.67	2.33	1.33	8.00	8.00
Total number of		233.33	248.33	69.67	49.67	136.3	143.3

[1]C = natural reserve grassland, G = Under-grazing grassland, P = recently non-grazed grassland

(F.2): Frequency of plant species at the land use practices study sites at the two sampling dates.

Species (scientific name)	Mid April 2006			Mid April 2007		
	C[1]	G[1]	P[1]	C[1]	G[1]	P[1]
Adonis palestina Bois		0.66	0.66		0.33	0.66
Ainsworrthia trachycarpa Boiss	0.66		0.66	0.66		0.66
Anthemis nabataea Eig	0.33	0.66	1.00	0.33	0.66	1.00
Artedia squamata L.	0.33			0.33		
Avena eriantha Durieu	1.00	0.66	0.66	1.00	0.33	1.00
Bupleurum brevicaule Schlecht.			0.66			0.66
Centaurea procurrens Sprengel			0.33		1.00	0.33
Cichorium pumilum Jacq		1	0.66		1.00	0.66
Echinops polyceras Boiss	1.00	0.33	0.33	1.00	1.00	0.33
Eryngium barrelieri Boiss		1	0.66		1.00	0.66
Gastridium scabrum C.Presl		0.66				
Geropogon hybridus (L.) Schultz Bip.	0.66			0.66		
Hordeum spontaneum C.Koch	1.00			1.00		0.33
Lagoecia cuminoides L.		0.66	0.66		0.66	0.66
Linum pubescens Banks et Solander	1.00		0.33	0.66		0.33
Medicago rotata Boiss	0.66	0.33		1.00	0.33	
Notobasis syriaca (L.) Cass.	0.33	0.33	0.33	0.33	1.00	0.33
Onobrychis caput- galli (L.) Lam.	0.66			0.66		
Pallenis spinosa (L..) Cass	0.33	0.33		0.66	1.00	
Plntago afra L.		0.66	1.00		0.66	1.00
Rhagadiolus edulis Gaetner	0.33	0.33	0.66	0.33	0.33	0.66

Salvia palaestina Bentham		0.66	0.33		0.66	0.33
Sarcopoterium spinosum(L.)	0.33		0.33	0.33	0.33	0.33
Scandix pecten-veneris L.	0.33	0.66	0.66	0.33	0.66	0.66
Sinapis alba(L.)		0.33			0.33	
Stipa capensis Thunb.			1.00			1.00
Tetragonolobus palaestinus Boiss.et Blanche		0.33		0.33		
Tordylium aegyptiacum(L.)Lam.			0.33			
Torilis tenella(Delile)Reichenb.		0.66	1.00		0.66	1.00
Trifolium clypeatum L.	0.66	0.33		1.00		0.33
Trifolium stellatum L.	0.66	0.33	0.33	1.00	0.33	0.33
Urospermum picroides (L.)F.W.Schmidt	0.66	0.66	1.00	0.66	0.66	1.00

[1]C = natural reserve grassland, G = Under-grazing grassland, P = Recently non-grazed grassland

Appendix (H) Rainfall Data**.**

(H.1). Rainfall in mm for the 2005-2006 season.

مجموع الموسم الحالي		سجل الأمطار للموسم (2005 / 2006)																																		
ملم	أيام	31	30	29	28	27	26	25	24	23	22	21		20	19	18	17	16	15	14	13	12	11		10	9	8	7	6	5	4	3	2	1	الشهر / اليوم	
0	0																																		أيلول	9
7	4	1	1	2											3																				تشرين الأول	10
49	6													20	18				1									3	6			1			تشرين الثاني	11
145	7						5	25	50	13	1						16	35																	كانون الأول	12
147	18				3	8	12	12			1			2	10	15	9			2	3	7	29		10	5	4	14			1				كانون الثاني	1
164	7																	25	12	1						71	44					8	3		شباط	2
19	1																								19										آذار	3
122	7								26									3												10	3	1	57	22	نيسان	4
0	0																																		أيار	5
653	**50**																																		**المجموع**	

(H.2): Rainfall in mm for the 2006-2007 season.

مجموع الموسم الحالي		سجل الأمطار للموسم (2006 / 2007)																																		
ملم	أيام	31	30	29	28	27	26	25	24	23	22	21		20	19	18	17	16	15	14	13	12	11		10	9	8	7	6	5	4	3	2	1	الشهر / اليوم	
0	0																																		أيلول	9
83	4			3.0	45.0	16.0													19.0																تشرين الأول	10
25	5										1.0								8.5											7.0	7.0			1.0	تشرين الثاني	11
112	3	14.0				13.0	85.0																												كانون الأول	12
97	9		23.0	1.0	4.0							5.0		35.0								2.0						8.0	6.0	13.0					كانون الثاني	1
166	14					2.0	8.0	16.0								8.0			5.0	15.0	9.0				1.0	6.0			25.0	12.0	22.0	35.0	2.0		شباط	2
102	6	9.0															1.0	17.0	20.0	39.0	16.0														آذار	3
4	4															1.0								1.0	1.0									1.0	نيسان	4
1	1																	1.0																	أيار	5
590	**46**																																		**المجموع**	

Source :Askar/ Nablus metrological station

جامعةالنجاح الوطنية

كلية الدراسات العليا

أثر الرعي و إستصلاح الأراضي على تنوع الغطاء النباتي البري في منطقة الفارعة

إعداد

عمار غازي صلاحات

إشراف

الأستاذ الدكتور محمد سليم اشتية

قدمت هذه الأطروحة استكمالاً لمتطلبات درجة الماجستير في العلوم البيئية، بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.

2007

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الملخص

تم أجراء هذه الدراسة في قرية طلوزة الواقعة في منطقة وادي الفارعة في الضفة الغربية, و ذلك من أجل دراسة اثر الرعي و أستصلاح الأراضي على تنوع الغطاء النباتي البري, تمت هذه الدراسة خلال موسمين نمو (2006-2007, 2005-2006). تم تصميم التجربة في منطقة عشبية, حيث تم أختيار اربعة مواقع, وهذه المواقع هي: أرض عشبية تم أستصلاحها, أرض عشبية كانت معرضة للرعي لسنين مضت وفي عام 2005 تم حمايتها من الرعي و أي نشاط زراعي, أرض عشبية كانت و ما زالت تتعرض الرعي, و أرض عشبية تم حمايتها من الرعي وأي نشاط زراعي منذ خمس سنوات مضت.

تم أخذ عينات التربة و العينات النباتية في منتصف شهر نيسان لكل موسم نمو وتم جمع معلومات عن توزيع كميات الأمطار و درجات الحرارة خلال الموسمين, حيث تم أستخدام طريقة المربع في أخذ العينة النباتية, وتم اتباع مقياس Braun-Blanquet لتقدير نسبة الغطاء النباتي بالعين.

لوحظ أثناء الدراسة أختلاف مكونات الغطاء النباتي في مواقع الدراسة وكذلك لوحظ أختلاف نسبة الغطاء النباتي حيث أن نسبة الغطاء النباتي ارتفعت في الأرض التي تمت حمايتها عن نسبته في الأرض التي تتعرض للرعي وأعلى نسبة للغطاء النباتي كانت في الأرض المحمية منذ خمس سنوات و هذا مؤشر على قابلية هذه المراعي للتأهيل في فترة قليلة من الزمن عند منع الرعي. كذلك تنوع النباتات البرية و كثافتها و الكتلة الحيوية كانوا أعلى بشكل معنوي في الأرض المحمية من الرعي و أي نشاط زراعي منذ فترة خمس سنوات و الأرض المحمية حديثا عن الأرض التي تتعرض للرعي.

العمليات الزراعية و خصوصا الحراثة كانت هي السبب في أنخفاض نسبة الغطاء النباتي و انخفاض تنوع النباتات البرية في الأرض المستصلحة. لوحظ أن الأصناف النباتية التي تواجدت في الأرض المتعرضة للرعي كانت بغالبيتها تمتاز بأنها أصناف أستسصاغتها للرعي منخفضة و منهكة و

أصناف قصيرة وتحورت لتصبح بشكل وردي, بينما غالبية الأصناف التي وجدت في الأرض المحمية منذ فترة طويلة من الرعي و العمليات الزراعية كانت بغالبيتها تمتاز بأنها أصناف أستصاغتها للرعي عالية و هي أصناف قائمة و طويلة نسبيا. النسبة العالية للغطاء النباتي التي حصل عليهافي الأرض المحمية من الرعي و أي نشاط زراعي منذ فترة و الأرض المحمية من الرعي حديثا في منتصف نيسان لعام 2007 تعود الى الأختلاف في توزيع ألأمطار في الموسمين المطربين و الى أن عملية أستثناء الرعي أصبحت أطول في عام2007 . لا يوجد فروق معنوية بين مواقع الدراسة بالنسبة لعوامل التربة (المادة العضوية, درجة حموضة التربة, نسيج التربة, المحتوى الرطوبي) و بالتالي لم نستطع معرفة أثر هذه العوامل على على تنوع الغطاء النباتي البري.