Investigation on Soil and Vegetation Characteristics in relation to Distance from Critical Areas in the Central Alborz's Grasslands (Iran)

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Abstract

The continuous heavy livestock grazing may cause excessive destruction of rangeland ecosystems. Thus, monitoring of qualitative and quantitative changes on the soil and vegetation characteristics is essential in these sites in order to to improve rangeland management practices. The objective of this study was to investigate the effects of high livestock density on vegetation cover and soil properties in central Alborz's grasslands in Iran. Grazing gradient method (systematic changes in vegetation cover with distance from stock ponds and around villages as two of critical areas) has been used to determine the characteristics of soil and vegetation.. Factors such as vegetation cover, litter, plant diversity, bare soil, rock and gravel were measured. The results showed that vegetation cover was significantly correlated with distance from the village but not with the distance from the watering pointss. Litter and plant diversity was significantly correlated with the distance from critical points noticeably so that these factors had higher values at longer distances. Although, the grit was not significantly correlated with any critical area, it increased at longer distances from villages. Regarding that, in order to improve ranges condition (with emphasis on critical areas) proper management should be practiced including change of grazing pattern and bed ground livestock in Iran's grasslands.

Keywords: Critical Areas, Grazing Gradient, Iran's Grasslands

Introduction

Non- uniform and continuous livestock grazing in rangelands is one of the problems that range managers have always faced. This is due to various factors including distance from water resources, topography, vegetation diversity, disproportion of livestock with range, pests and climate (Holechek et al, 1995). Evidently, the highergrazing pressure,the more degradation usually occur in these critical areas (Badripour, 1997). Changes in vegetation due to distance from critical areas is called Grazing Gradient (Bastin et al, 1993). Regarding that, continuous grazing and daily traffic of livestock caused excessive destruction of these areas (critical area) more than in other rangeland sites. Hence, frequent monitoring of quantitative

and qualitative changes on the soil and vegetation is essential in these areasIn order to improve rangeland management practices. The aim of this study was to estimate the effects of high livestock density on vegetation cover and soil properties of critical areas and on their surroundings in central Alborz's grasslands in Iran.

Material & Methods

This study was conducted in central part of Alborz called Polour in Mazandaran province (85 km northeast of Tehran). This site is at an altitude of 1800 to 2600m asl. Climate is cool- dry with average annual precipitation of 204 mm. The dominant species include Dactylis glomerata L, Bromus tomentellus Boiss, Festuca ovina L, *Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey, Stipa barbat Desf and number of invaders such as Sophora alopecuroides (L) Bong ex Boiss, Cousinia commutate Bung, Euphorbia aucheri Boiss. Critical areas determined in two places, around the village and stock pond. Data were collected by using 100m transect and $1m^2$ quadrates. Condition of biophysics indicators including vegetation cover, litter, plant diversity, rock and garavel and bare soil was determined into each quadrat. Regression analysis and Pearson correlation were used in order to study the correlation between the distance of critical area in grazing gradient and the measured vegetation and soil characteristics at SPSS 17.0 software.

Results & Discussion

The results showed that the condition of soil cover was reduced around the village because of high stocking rate and continuous livestock grazing. Thus, with increasing distance from village, vegetation cover, plant diversity and litter increased, while palatable and desirable species that were replaced increased in number and cover. Although, vegetation cover, density and bare soil were not correlated with distance from stock pond, desirable species and litter were. This result is probably related to the large number of stock pond in the area. Rock and gravel were not affected by the distance in the critical areas. Bastin et al (1993); Pichup and Chewing (1994) and Badripour (1997) produced similar results.

Table 1. The relationship of study factors with distance from critical areas

Critical Areas	Vegetation	Bare Soil	Rocks & Gravels	Litter	Plant Diversity	Correlation
Around village	<0.01**	<0.01**	<0.05*	<0.01**	<0.01**	P
	0.095	0.097	0.075	0.096	0.097	R
Stock pond	>0.05	>0.05	>0.05	<0.01**	<0.01**	P
	0.065	0.042	0.047	0.099	0.096	R

Note: ** is significant in 99% level and * is significant in 95% level

Conclusion

Condition of vegetation and soil around villages was very poor in comparison to areas around stock ponds due to overgrazing and overstocking. The model of grazing gradient is simple- regular around villages and it is simple- combination around stock ponds. This means that vegetation increases gradually with distance from critical areas and the destruction intensity is limited. However, around stock ponds, vegetation, and especially desirable species decreased to a certain distance from stock ponds and then increases. This type of grazing gradient remains in times of annual dryness and wetness that causes increase of shrubs and unpalatable species near to the stock ponds. Regarding that, in order to improve ranges condition (with emphasis on critical areas) proper management should be practiced including changes of livestock traffic, grazing pattern and bed ground livestock in Iran's grasslands.

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Soil properties along grazing gradients in an open canopy oak forest

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Abstract

There is a great interest in understanding how management practices of silvopastoral systems affect the long-term sustainability of oak ecosystems and mainly their influence on nutrient cycling. The aim of this study was to examine the effects of relative grazing intensity on soil properties in an open canopy oak forest dominated by *Quercus frainetto*. The research was conducted in the area of Pentalofos, which is located in Evros region, northeastern Greece and is grazed mainly by goats. The distance (meters) from a goat corral was used to represent relative grazing intensity. In June 2011, soil samples were collected within each of three quadrats along transects running perpendicular to three replicates. The transects were placed at 50, 150, 300, 600 and 1200 m from the goat corral. Soil pH, phosphorous (P) and nitrogen (N) concentrations were measured. Heavy grazing reduced soil organic matter while it increased total nitrogen. Grazing intensity did not affect available P and soil pH.

Keywords: Grazing intensity – Nitrogen - Organic matter - Silvopastoral system

Introduction

It is well substantiated that Mediterranean forests maintain an extensive area with significant social benefits and services. These forests are rich in plant species and are of great ecological and economic interest. Most of them have relatively open canopy because they have suffered from mismanagement during the last decades (Ainalis et al. 2009). Oak forests are the dominant forest type in Greece occupying 1,471,839 ha (Ministry of Agriculture 1992). Deciduous oak forests, especially the open coppice, have been affected more than other forest types by livestock grazing as silvopastoralism is well adapted to the Mediterranean environment (Papanastasis et al., 2009). Thus, there is evidence that coexistence of livestock and forest production can be achieved under certain conditions.

Grazing animals primarily affect soil properties by direct impacts through trampling and lunging and indirectly by altering plant community structure (Beukes and Cowling 2003). Soil chemical characteristics as well as soil moisture are the most important soil properties that may be altered by livestock grazing (Al-Seekh et al. 2009). Grazing can cause altering to the

natural chemical processes of the soil, while it could cause soil erosion (Azarnivand et al. 2010).

Numerous studies have shown that overgrazing causes dramatic changes in plant community, leads to reduction in canopy cover and productivity and causes heavy destruction in soil structure and compaction, fact that leads to decrease in soil organic C and N contents (Shi et al. 2010).

It has been reported by Zhou et al (2010) that high grazing intensity increases soil compaction and soil density, reduces soil aggregate stability and fertility. Some of these effects are acting in combination and it is believed that they resulted in an increase of topsoil erosion (Zhou et al. 2010). Sustainable management of grazing lands is of great importance. Sustainable grazing management increases herbage production and ameliorates litter accumulation. Therefore, it results in reduction of soil erosion and evaporation, it increases permeability and water holding capacity of the soil and it also adjust soil surface temperature (Fakhimi et al. 2011). Consequently, one of the main objectives of silvopastoral management is to identify which grazing intensity optimizes the soil properties.

The main objective of the present study was to examine the effects of relative grazing intensity on some soil properties in an open canopy oak forest dominated by *Quercus frainetto*.

Materials and methods

The research was conducted in the area of Pentalofos, which is located in Evros region, NE Greece. The oak forest of Pentalofos occupies a total area of 10199.56 ha. It is mainly used for firewood and livestock grazing by the local population. The common oak species are *Quercus frainetto, Quercus petraea*, *Quercus pubescens* and *Quercus cerris*. The spread of oak covers almost the entire area of the forest. Other common woody species are *Carpinus orientalis, Fraxinus ornus*, *Juniperus oxycedrus*, *Cornus mas*, *Tilia tomentosa*, *Phyllirea latifolia* and *Acer monspessulanum*. The climate of the area is classified as sub-Mediterranean, with cold, moist winters and warm, dry summers. The average maximum temperature is 30.5 ˚C in July and the average minimum temperature is -7.0 ˚C in January. The annual precipitation is 539.5 mm. The study area is grazed by goats.

A grazing gradient approach (Andrew 1988) was used. The distance (in meters) from a goat corral was used to represent relative grazing intensity, according to previous studies where this approach was applied (Sasaki et al. 2012). In June 2011, soil samples were selected within each of three quadrats along transects of 20 m long running perpendicular to three

replicates. A 10 cm diameter ring was used for the collection of soil samples at a depth of 0-10 cm. The transects were placed at 50, 150, 300, 600 and 1200 m from the goat corral. These distances are stand for very heavy, heavy, moderate, light and very light grazing respectively. Soil samples were air dried and sieved through 2 mm mesh screens. Soil organic matter was determined by means of wet oxidation (Nelson and Sommers 1982). Total N was determined by the Kjeldahl method (Stevenson 1982). Available P was extracted with 0.5N $NaHCO_3$ at pH 8.5 and was measured spectophotometrically by a modified phospomolybdenum blue method (Alifragis 2010). Soil pH was determined by using a glass electrode.

The obtained data were analysed with SPSS 17 for Windows. One-way ANOVA was used to analyse the effect of grazing intensity on the soil properties. The LSD at the 0.05 probability level was used to detect the differences among means (Steel and Torrie 1980).

Results and Discussion

Significant lower organic matter content was obtained at the distances close to the goat corral indicating that organic matter decreased gradually as grazing intensity increased (Table 1). This decrease can be attributed to a significant reduction in litter due to intensive grazing that reduces vegetation cover and consequently it leads to litter being blown away by wind or washed away by heavy rainfalls (Liu et al. 1997). Similar results have been reported by Xie and Witting (2004).

Soil organic matter provide nutrient for plant growth and it was the most cited as one of the most effective predictor of soil quality (Al-Seekh et al. 2009). Fakhimi et al. (2011) reported that increased soil organic matter is strongly related to higher biomass production. Zhao et al. (2007) found that the increase of the degree of soil compaction by trampling will possibly increase the risk of soil degradation and erosion. Trampling breaks up soil aggregates, exposing organic matter to decomposition and loss through erosion (USDA 2001). However, it is has to be noticed that moderate and light grazing did not affect significantly soil organic matter.

On the contrary, total nitrogen was significantly higher at the closest distance to the goat corral (Table 1). This result implies that heavy grazing results in an increase of total soil nitrogen. The higher amount of nitrogen in soil under heavy grazing is probably caused by animal excrement and urine (Tamartash et al. 2007). This result is in agreement with this that has reported by Liu et al. (2011).

Table 1. Soil properties at the different distances from the goat corral

Distance (m)	Organic matter (%)		N (%)	P (mg*100g^{-1})	pH
50	0.511	c*	0.143 a	2.063	6.206
150	0.704	bc	0.109 b	2.203	6.268
300	0.874	ab	0.065 c	2.435	6.207
600	1.070	a	0.068 c	2.229	6.468
1200	1.126	a	0.091 bc	2.149	6.429
Significance	0.005		0.005	NS	NS

*Means in the same column followed by the same letter are not significantly different (P≤0.05)

Grazing intensity did not significantly affect available P and soil pH (Table 1). Milchunas and Lauenroth (1993) analysed a set of worldwide data from 236 sites and found no relationship between grazing and soil phosphorus and pH. Controversially, while Xie and Witting (2004) reported a significant reduction of available P under heavy grazing in a steppe rangeland, Dahlgren et al. (1997) found higher available P in an oak woodland under grazing. Probably, available P in soil is related to grazing and also to vegetation type.

Conclusions

Heavy grazing reduced soil organic matter while it increased total nitrogen. Grazing intensity did not affect available P and soil pH. Moderate grazing had a minimal effect upon the analyzed soil properties. Thus, extensive moderate grazing can be a viable way of managing ecosystem sustainability (Arevalo et al. 2011).

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